RECOVERY PLAN

FOR THE EVOLUTIONARILY SIGNIFICANT UNIT OF CENTRAL CALIFORNIA COAST COHO SALMON

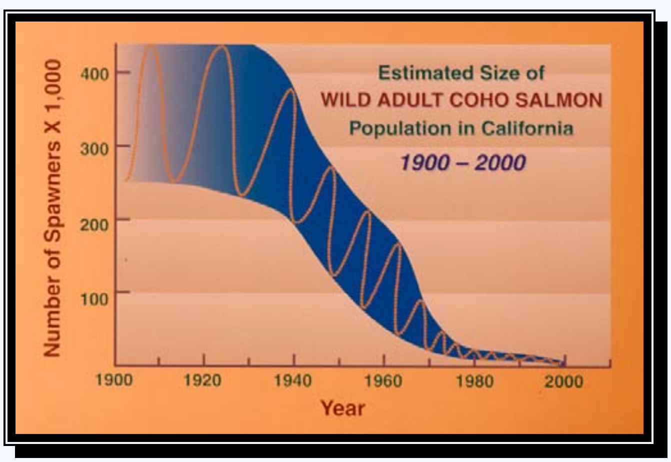


Photo Courtesy: CCC coho salmon, Morgan Bond, SWFSC
Conceptual Model of the Extinction Vortex for California's Coho Salmon, Peter Moyle 2009

PUBLIC DRAFT

Version: March 2010
Southwest Regional Office
National Marine Fisheries Service
Santa Rosa, CA

DISCLAIMER

Recovery plans delineate such reasonable actions as may be necessary, based upon the best scientific and commercial data available, for the conservation and survival of listed species. Plans are published by the National Marine Fisheries Service (NMFS), sometimes prepared with the assistance of recovery teams, contractors, State agencies and others. Recovery plans do not necessarily represent the views, official positions or approval of any individuals or agencies involved in the plan formulation, other than NMFS. They represent the official position of NMFS only after they have been signed by the Assistant or Regional Administrator. Recovery plans are guidance and planning documents only; identification of an action to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. Nothing in this plan should be construed as a commitment or requirement that any General agency obligate or pay funds in any one fiscal year in excess of appropriations made by Congress for that fiscal year in contravention of the Anti-Deficiency Act, 31 U.S.C 1341, or any other law or regulation. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

LITERATURE CITATION SHOULD READ AS FOLLOWS:

National Marine Fisheries Service. 2010. Public Draft Recovery Plan for Central California Coast coho salmon (*Oncorhynchus kisutch)* Evolutionarily Significant Unit. National Marine Fisheries Service, Southwest Region, Santa Rosa, California.

ADDITIONAL COPIES MAY BE OBTAINED FROM:

National Marine Fisheries Service

Protected Resources Division

777 Sonoma Avenue, Room 325

Santa Rosa, CA 95467

Or on the web at:

http://www.nmfs.noaa.gov/pr/recovery/plans.htm

or

http://www.nmfs.noaa.gov/pr/recovery/plans.htm

ACKNOWLEDGEMENTS

The authors wish to acknowledge the many individuals and organizations who have been vital partners during the development of the CCC coho salmon recovery plan. First, we appreciate the collaboration with our co-managers, the California Department of Fish and Game. They provided assistance in the development of this recovery plan, reviewed earlier drafts, provided data, and developed and refined recovery actions. In particular, we thank John McCamman, Kevin Shaffer, Stephen Swales, Scott Downie, Doug Albin, Scott Harris, Gail Seymour, Jennifer Nelson, Krissy Atkinson, Michelle Leicester, and Rick Macedo. A special mention goes to Derek Acomb for his dedication in compiling Fish and Game Habitat Typing Data, and to Sean Gallagher for his significant contributions to our monitoring chapter.

We gratefully acknowledge Wendy Millet, Greg Low, Jeanette Howard (Ph.D.) and Warren Lockwood from The Nature Conservancy for their training and support in our use of their Conservation Action Planning method. This analysis method and organizational tool is foundational to the recovery plan. We thank Deanne DiPietro, Alex Young, Zhahai Stewart, Arthur Dawson, Caitlin Cornwall and Lisa Michelli (Ph.D.), of the Sonoma Ecology Center, for their enduring patience and dedication to the extensive and detailed data compilation and analysis, assistance with website development, the historical prologue, and reference management. We extend a sincere appreciation to UC Berkeley (James Hunt, Ph.D.; Norman Miller, Ph.D.), Lawrence Livermore National Laboratory (Deborah Agarwal, Ph.D.), Berkeley Water Center (Carolyn Remick) and Microsoft eScience (Catherine Van Ingen, Ph.D.) for their collaboration with us to advance our data analysis capabilities into the future through the watershed analysis tool called the "datacube".

We are very appreciative of the many public and private entities who have collected watershed and population data, and worked tirelessly to conserve and protect anadromous salmonids and their habitats. While many have contributed, we offer special mention to: Mike Podlech; Don and Rosalind Alley; Jerry Smith Ph.D.; Chris Berry; Jim Robins; Kristen Kittleson; Betsy Herbert Ph.D.; Jeff Hagar; Kate Goodnight; SPAWN; Craig Bell; Campbell Timberland Management (in particular David Wright); Big Creek Timber Company; Coastal Watershed Council; Jackson Demonstration State Forest; Mendocino Redwood Company; Marin Municipal Water District; Gualala Watershed Council; county Resource Conservation Districts; National Park Service (Brannon Ketchum and Michael Reichmuth and Ettlinger); FishNet 4C (Steve Kinsey; Kallie Kull; Darcy Ashton); and a very warm thank you to all of you who contributed stories and pictures to the historical prologue.

We thank the North Central California Coast Domain Technical Recovery Team (TRT) and NMFS Science Center, especially TRT Chair, Brian Spence, Ph.D., who provided the biological framework for this recovery plan and supported us with technical assistance throughout this process. NMFS Southwest Region Santa Rosa Office dedicated their efforts and contributed in critical capacities to support shifting workloads, data analysis, document preparation, developing and cataloging watershed information and recovery actions, GIS analysis and mapping, and many other aspects of recovery planning. To all from the NMFS Southwest Region Santa Rosa Office Protected Resources Division, Charleen Gavette and Bill Winner from the Habitat Conservation Division, and Kit Crump from the NOAA Restoration Center; thank you.

Finally, critical financial support from Sonoma County Water Agency facilitated compilation of the best available information at a scale and depth unprecedented for the central coast of California; data that significantly informed our analyses. Our relationship with the Water Agency has fostered partnerships at local, State and Federal levels; partners with a common goal of finding common ground on complex issues while ensuring a future for California's iconic salmon. In one example, the Water Agency funds supported UC Davis Hopland Research (Shane Feirer and Scott Webb) in compiling DFG habitat typing data across the NCCC Domain, creating a database that is spatially linked and queriable. It has been a pleasure working with the staff of the Water Agency and we wish to extend our thanks to Paul Kelley, Grant Davis, Keenan Foster, Renee Webber, David Manning, Connie Barton and Jane Guteirrez. Above all, we are thankful for Randy Poole, retired General Manager and Chief Engineer. It was his vision of stewardship and leadership in action that is embodied in this plan. We wish Randy the very best as he retires from the Water Agency and embarks on new adventures; Godspeed.

EXECUTIVE SUMMARY

CURRENT STATUS AND DISTRIBUTION: The known historical range of the Central California Coast (CCC) coho salmon Evolutionarily Significant Unit (ESU) extends from Punta Gorda in northern California south to Elkhorn Slough in Monterey County, California. The listed range extends from Punta Gorda south to the San Lorenzo River in Santa Cruz County, California. This species was listed as threatened with extinction on October 31, 1996 (61 FR 56138). Due to severe population declines its listing status was reclassified to endangered on June 28, 2005 (70 FR 37160). More recent studies are indicating a probable population collapse (McFarlane and Hayes 2008, in draft) across the species' range; increasing the likelihood of extinction. Only a few watersheds currently support more than remnant populations (e.g., Pudding Creek, Albion River, and Lagunitas Creek).

LIFE HISTORY AND HABITAT REQUIREMENTS: Coho salmon are anadromous fish and live in both the ocean and freshwater ecosystems where they exhibit distinctly different life stages (e.g., spawning, egg, alevin, summer rearing, winter rearing, smolt and ocean adult) with unique habitat requirements. Coho salmon spend approximately one year in freshwater and two years in the marine environment. They live approximately three years, and adults return to the streams where they were born, spawn, and then die after spawning. This species has a fairly rigid three year life history and fish of one year class rarely interbreed with fish from another year class. In the freshwater environment coho salmon require: (1) clean gravels for successful spawning and incubation; (2) adequate quantities of cool and well oxygenated water with complex deep pools for juvenile summer rearing; and (3) side-channels and alcoves and/or sufficient quantities of large woody debris for over-wintering habitat.

THREATS TO COHO SALMON: The factors adversely affecting this species are numerous and include both natural and human-made threats. Natural threats include disease, predation, droughts, and fluctuating ocean marine conditions. Human-made threats include habitat alterations such as water diversion, road building and maintenance, timber harvest, urbanization, flood control structures and practices and climate change. Generally, the greatest threats for coho salmon across the ESU come from three threat categories: (1) Roads and Railroads, and, particularly from the Russian River south, (2) Droughts, and (3) Residential and Commercial development. Logging and Wood Harvesting is a significant threat from the Russian River north. In certain watersheds, Channel Modification or Livestock Farming and Ranching posed significant threats to the species.

RECOVERY PLAN: When a species is listed as federally threatened or endangered under the Endangered Species Act (ESA), the listing agency must develop and implement a plan for the species' recovery. The final recovery plan was developed by the National Marine Fisheries Service (NMFS) Santa Rosa recovery team with assistance and input from scientists, co-managers, stakeholders, and others. The foundation of this recovery plan rests upon two NOAA Technical Memoranda prepared by a Technical Recovery Team (TRT) which was comprised of fishery scientists. The NOAA Memoranda described historical population structure and biological viability (Bjorkstedt *et al.* 2005, Spence *et al*. 2008) provided a rigorous scientific framework and numeric population viability goals and scenarios, which formed the basis for the recovery strategy.

The recovery team assessed current conditions and conducted a threats assessment for future threats for the freshwater and marine environments, including an analysis of the potential effects of climate change. Conditions and threats were assessed using The Nature Conservancy's Conservation Action Planning (CAP) protocol, one of several methods recommended in NMFS' (2007) Interim Recovery Planning Guidance for Threatened and Endangered Species. The recovery team endeavored to use the best available information to inform the assessments including information from California Department of Fish and Game habitat typing data, watershed assessments, public/private datasets, and many other sources of information and data.

RECOVERY STRATEGY: To focus recovery efforts and ensure proper prioritization, threat abatement and restoration and enhancement actions were developed for 28 of the 76 watersheds that historically maintained coho salmon. Within these 28 watersheds, subwatersheds were hierarchically prioritized. Subwatersheds with persisting populations were designated as Core areas. Protecting and restoring Core areas is essential for preventing the extinction of CCC coho salmon and Core areas are targeted for immediate threat abatement and enhancement and restoration actions. Areas outside of Core subwatersheds were designated Phase I or Phase II areas. Phase I areas are designated for necessary recovery actions to expand current populations. Phase II areas are designated for long-term recovery actions.

RECOVERY GOALS & OBJECTIVES: The overarching goal of this Recovery Plan is to prevent the extinction of wild CCC coho salmon and ensure their long term persistence in a viable, self sustaining, and eventually harvestable status across the ESU. Before NMFS considers downlisting or delisting CCC coho salmon, substantially higher numbers of returning adults and, successful spawning and rearing conditions in freshwater environments, are needed. To achieve these goals, it is critically important to preserve, enhance, and restore the species' existing habitats. Individual watersheds must have the capacity to support self-sustaining populations in the face of natural variation and conditions such as droughts, floods, variable ocean-rearing conditions, wildfires, and long-term climate change. Taken together, each watershed achieving a self-sustaining population contributes to a viable Diversity Stratum (groups of watersheds in ecologically similar environments), which in turn contributes to a viable ESU. NMFS has identified three objectives for the ultimate recovery of CCC coho salmon:

> **Objective 1:** Prevent extinction by protecting habitats in Core Areas within identified focus populations. This will be accomplished by improving current conditions, and ameliorating existing and future threats;
>
> **Objective 2:** Re-establish viable populations in the 28 prioritized watersheds (at a minimum) and within four of the five Diversity Strata by protecting, enhancing, and restoring habitats to properly functioning conditions, and by controlling and abating existing and future threats in all Core, Phase I and Phase II areas;
>
> **Objective 3:** Implement standardized monitoring of coho salmon populations and their habitat across the CCC ESU. Standardization reduces uncertainty associated with habitat assessment methods and increases confidence in population estimates when evaluating effectiveness of recovery actions. Standardization will also improve accuracy when measuring progress towards downlisting and delisting criteria.

It is our hope that the information in this plan will facilitate further discussion on data resources and analysis, future threats and beneficial recovery actions, and will facilitate funding for high priority actions needed for CCC coho salmon. Working collaboratively with communities, organizations, and agencies to preserve our salmon heritage is our highest priority.

RECOVERY CRITERIA: Recovery criteria were developed to measure progress toward achieving recovery objectives. Recovery criteria measure progress toward achieving recovery objectives. Criteria must be "SMART": specific, measureable, achievable, realistic and time-referenced. NMFS is proposing downlisting criteria for the transition between the endangered and threatened status, as well as delisting criteria, for the ESU. The specific criteria related to the status of populations, improvements in watershed conditions and the abatement of threats across the ESU must be met prior to downlisting or delisting. In addition, an analysis of threats pursuant to the five statutory listing factors in section 4 of the ESA will be necessary. Criteria are outlined in the following format in the recovery plan:

1. ***Downlisting and Delisting Recovery Criteria for Populations and ESU***
   - ❑ Population Level Criteria for Independent and Dependent Populations
   - ❑ ESU Recovery Criteria for Delisting
2. ***Downlisting and Delisting Criteria for Watershed Health***
3. ***Downlisting and Delisting Criteria for Threats (including an analysis of the listing factors)***

Five Listing Factors

- ❑ Present or threatened destruction, modification, or curtailment of habitat or range
- ❑ Overutilization for commercial, recreational, scientific, or educational purposes
- ❑ Disease or predation
- ❑ Inadequacy of existing regulatory mechanisms
- ❑ Other natural and manmade factors affecting the species continued existence

A decision to delist a species must consider the biological performance of the populations (viability criteria), the threats that contributed to the species' decline and listing under the ESA, and the future threats limiting their recovery.

RECOVERY ACTIONS: Recovery actions were developed for the ESU, Diversity Strata, and specific watersheds. The highest priority actions advocated to increase survival and improve the likelihood of recovery are:

- ❑ Finalize and implement the State Coastal Monitoring Plan. Implementation of the State Coastal Monitoring Plan (including development of an adaptive management and comprehensive database) is essential for evaluating the long-term viability of CCC coho salmon and their habitats as well as other species of listed salmonids in California;
- ❑ Focus restoration funds, notably the Pacific Coast Salmon Restoration Fund and California's Fisheries Grant Restoration Program, to prioritize funding in Core areas and on activities that will increase the probability of freshwater survival;

- Promote restoration projects in over-wintering habitats such as alcoves, backchannels, off channel areas, and estuaries;
- Encourage appropriate agencies to secure funding for, and engage in, full enforcement of relevant laws, codes, regulations and ordinances protective of coho salmon and their habitats;
- Work with DFG to improve freshwater sport fishing regulations to minimize unintentional and unauthorized take, and incidental mortality, of CCC coho salmon by anglers during the CCC coho salmon migration period. This effort should include the development of appropriate low-flow closure thresholds (including consideration of emergency closure during adult migration beginning 2010), seasonal fishing closures, and angler outreach programs;
- Urge the California Board of Forestry to develop no-take rules and/or apply for a statewide Forestry Habitat Conservation Plan (HCP) and seek funding opportunities to support the effort;
- Assess and address the mechanisms driving forest conversions and provide incentives for sustainable forestry;
- Encourage forestry landowners to develop HCPs protective of coho salmon and their habitat;
- Improve coordination between the agencies, particularly the SWRCB, to effectively address seasons of diversion, off-stream reservoirs, and bypass flows fully protective of CCC coho salmon;
- Encourage counties to control forest conversions and prioritize development of rezoning and grading ordinances that are protective of CCC coho salmon and their habitats; and
- Finalize the Mendocino Redwood Company HCP.

ESTIMATED COSTS: Section 4(f) of the ESA requires recovery plans to include "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal" (16 U.S.C. 1533(f)(1)(B)(iii)). NMFS estimates recovery for CCC coho salmon could take 50 to 100 years. The California Department of Fish and Game developed a State Coho Recovery Plan in 2004 and this Federal plan builds from the State Plan and contains many of the same recovery actions. The State of California conducted a comprehensive cost analysis for coho salmon recovery and estimated the total cost to achieve recovery for CCC coho salmon at between 3 billion dollars and 5 billion dollars (depending on Alternatives implemented) {DFG, 2004}. This estimate may under or over estimate the full cost of implementation, because not all costs could be quantified, and some costs may be incurred even without implementation of the plan. The State Coho Recovery Plan offered some recommendations that differ from those presented in this plan. The State Coho Recovery Plan presented costs in the simplest possible terms: the current cost of completing the action in 2004. It did not consider inflation or financing costs. Although there are differences between the State Coho Recovery Plan and the Federal CCC coho salmon recovery plan, NMFS will use the State cost estimates as they currently represent the best available information most relevant to the CCC coho salmon ESU. During the public comment period, we will further evaluate the cost analysis with assistance from the NMFS Science Center, NOAA Restoration Center and others including additional requests to the public for more precise cost estimates associated with restoration, monitoring and threat abatement.

Recovery of coho salmon will have significant costs, but will also provide economic benefits. Recovery actions undertaken for coho salmon will likely improve conditions for other listed salmon and steelhead, and also for a variety of aquatic and riparian species. Because of their direct and indirect economic value as a resource for fishing, recreation and tourism related activities, each dollar spent on salmon recovery may generate significantly more dollars for local, state, Federal, and tribal economies. In other words, salmon recovery is best viewed not as a cost, but as an investment and opportunity to derive, diversify, and strengthen the economy.

TABLE OF CONTENTS PAGE

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS

The following is a list of selected acronyms and abbreviations used throughout the plan.

ABAG	Association of Bay Area Governments
a.k.a.	also known as
BACI	before after control impact
BKD	bacterial kidney disease
BLM	Bureau of Land Management
BMPs	best management practices
BOF	California Board of Forestry
CalFire	California Department of Forestry and Fire Protection
Caltrans	California Department of Transportation
C	Celsius
CAP	Conservation Action Planning
CCC	Central California Coast
CCR	California Code of Regulations
CDF	California Department of Forestry and Fire Protection
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFPA	California Forest Practices Act
CFIP	California Forest Improvement Program
cfs	cubic feet per second
CGS	California Geological Survey
CHERT	County of Humboldt Extraction Review Team
Commission	California Fish and Game Commission
CPS	coastal pelagic species
CRMP	coordinated resources management planning
CRT	California Statewide Coho Salmon Recovery Team
CV	coefficient of variation
CWA	Clean Water Act
CWT	coded wire tag
DBH	diameter (of a Tree) at breast height
DFG	California Department of Fish and Game
DOC	Department of Conservation
DP	dependent population

DPR	California Department of Parks and Recreation
DPS	distinct population segment
DWR	California Department of Water Resources
ECS	egg collection station
EEZ	U.S. Exclusive Economic Zone
EIS	Environmental Impact Statement
ENSO	El Niño/Southern Oscillation
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
ESU	evolutionarily significant unit
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FEMAT	Forest Ecosystem Management Assessment
FERC	Federal Energy Regulatory Commission
FGC	California Fish and Game Code
FIP	Functionally Independent Population
FLPMA	Federal Land Policy and Management Act
FMP	Fishery Management Plan
FPA	Forest Practice Act
FPR	Forest Practice Rules
FRGP	Fisheries Restoration Grant Program
GIS	geographic information system
GRTS	generalized random tessellation sampling
HCD	Habitat Conservation Division
HCP	habitat conservation plan
HGMP	hatchery genetic management plan
IP	intrinsic potential
IPHC	International Pacific Halibut Commission
IP-km	intrinsic potential per kilometer
IUCN	International Union for Conservation of Nature
JDSF	Jackson Demonstration State Forest
LWD	large woody debris

mg	milligrams
mm	millimeter
MMWD	Marin Municipal Water District
MOU	memorandum of understanding
MRC	Mendocino Redwood Company
MBSTP	Monterey Bay Salmon and Trout Project
MWAT	maximum weekly average temperature
MWMT	maximum weekly maximum temperature
OLE	Office of Law Enforcement
NCCC Domain	North Central California Coast Recovery Domain
NCRWQCB	North Coast Regional Water Quality Control Board
NCWAP	North Coast Watershed Assessment Program
NFWF	National Fish and Wildlife Foundation
NFP	National Forest Plan
NGO	non governmental organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NTP	non-industrial timber plan
NTU	nephelometric turbidity unit
PAH	polycylcic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCSRF	Pacific Coast Salmon Restoration Fund
PDO	Pacific (inter)decadal oscillation
PFMC	Pacific Fishery Management Council
PIP	potentially independent population
PIT	passive integrated transponder
ppm	parts per million
PRD	Protected Resources Division
PSMFC	Pacific States Marine Fisheries Council
RC	Restoration Center

RCD	Resource Conservation District
R/K	Rogue/Klamath
RM	river mile
ROD	record of decision
RPA	reasonable and prudent alternative
RPF	registered professional foresters
RWQCB	California Regional Water Quality Control Board
SEC	Sonoma Ecology Center
SLC	State Lands Commission
SMARA	Surface Mine and Reclamation Act
SONCC	Southern Oregon/Northern California Coasts
SPAWN	Salmon Protection and Watershed Network
SWRCB	State Water Resources Control Board
SWFSC	Southwest Fisheries Science Center
SYP	sustained yield plans
T & I	threatened and impaired water body
THP	timber harvest plan
TMDL	total maximum daily load
TNC	The Nature Conservancy
TRT	Technical Review Team
TU	Trout Unlimited
UC	University of California
UCCE	University of California Cooperative Extension
UPGMA	unweighted pair group method with arithmetic averages
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UILT	upper incipient lethal temperature
UUILT	upper ultimate incipient lethal temperature

VSP	viable salmonid populations
WRP	Wetlands Reserve Program
WOC	Washington, Oregon, and California
WSH	Warm Springs Hatchery

APPROACH TO RECOVERY & DOCUMENT STRUCTURE

The Federal Endangered Species Act (ESA) was signed into law in 1973 for the purposes of conserving species in danger of extinction. The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) is responsible for ESA implementation for listed marine and anadromous species, including the Central California Coast (CCC) Evolutionarily Significant Unit (ESU) coho salmon (*Oncorhynchus kisutch*). CCC coho salmon are listed as an endangered species and as such, the ESA requires NMFS to develop and implement a recovery plan to ensure the survival and recovery of this species. The plight of CCC coho salmon is severe and unless the causes of their decline are addressed immediately, they will likely go extinct in our children's lifetime.

Recovery is defined as the process of restoring listed species and their ecosystems to the point that they no longer require the protections of the ESA. A recovery plan serves as a road map for species recovery—it lays out where we need to go and how best to get there. Without a plan to organize, coordinate and prioritize the many possible recovery actions on the part of Federal, state, local, and tribal agencies, local watershed councils and districts, and private citizens, our efforts may be inefficient, ineffective, or even misdirected. Prompt development and implementation of a recovery plan will target limited resources effectively. Although recovery plans are guidance documents, not regulatory documents, the ESA clearly envisions recovery plans as the central organizing tool for guiding each species' progress toward recovery.

This recovery plan was constructed to be consistent with the conceptual approach used to establish the scientific biological foundations for this recovery plan developed by NMFS and other scientists (e.g., Technical Recovery Team) for CCC coho salmon viability (see McElhany *et al.* 2000; Bjorkstedt *et al*. 2005; Spence *et al.* 2008). The Technical Recovery Team (TRT) was appointed in 2000 and operated under the guidance of NMFS' Southwest Fisheries Science Center to assist with the development of biological criteria for the recovery plan. The TRT accounted for life history constraints, the physical setting of the ESU, and other aspects of coho historical population structure in establishing a viability framework. Their work sets the stage for coho salmon recovery by establishing minimum population viability targets, as well as the conceptual approach regarding overall ecosystem processes to support these minimum populations.

The TRT framework recommends that recovery planners evaluate the full context of the historical and current population structure. Their framework also recommends implementation of strategies that restore the rates of watershed processes towards their historical range of values. The premise: increasing divergence from the historical conditions under which the species evolved substantially increases the uncertainty regarding the ability of the ESU to persist over long time scales (Bjorkstedt *et al.* 2005).

NMFS recovery planners recognize that restoring all conditions under which CCC coho salmon have evolved, persisted, and thrived for tens of thousands of years across their historical range is unlikely. The challenge then is to establish a balance of providing for conditions that allow the species to thrive in a changing environment. The most immediate goal is to implement restoration, planning and policy actions in time to prevent extinction of CCC coho salmon.

The recovery plan is structured to provide the reader with (1) an overview of CCC coho salmon, Federal Endangered Species Act mandates and the listing factors/protective efforts identified in the *Federal Register*, (2) methods of analysis for populations, assessing current conditions and establishing threats and (3) the overall recovery strategy to include ESU, Diversity Strata and Population (*e.g.*, watershed) priorities for recovery actions.

We believe, if the strategies in this plan are implemented within recommended timescales, coho salmon can survive and will eventually recover. It is our fervent hope that through good stewardship, our children and their children will enjoy the benefits of experiencing abundant and healthy populations of coho salmon.

PROLOGUE

"Dan Jansen looked down from a bluff… "the water was like glass…the [coho] salmon were in rows…they lay there still…every now and then one would wiggle it's tail to keep his place in line. They lay there by the thousands as far as the eye could see…"

Thanksgiving on the Garcia River 1930's (Levene 1976)

LET THE FISH TELL THE STORY

Nearly everyone has a fish story to tell. Some of them include tales of a time when "…salmon and steelhead spawning runs were so thick that a person could walk across the stream on their backs" or when the "big one got away". These tales remind us of a time when coho salmon were so abundant and so prolific across all the coastal streams between Mendocino and Santa Cruz counties they were believed "inexhaustible". Today CCC coho salmon exist in such low numbers there are no longer fish stories to tell. The ones that are told chronicle a species demise.

Photo Courtesy: Kelley House Museum, Fort Bragg, California, 1920's

CCC coho salmon populations persisted for thousands of years in staggering abundance. Now gone from most streams, their precipitous decline is intimately tied to the human story of the region and the expanding human configured landscape and harvest pressure of the last 200 years. While the fate of salmon will depend on us, humans have depended on salmon for hundreds of years. With the paradigm that salmon were inexhaustible there were little controls on harvest and channel/riparian modificatins. Now commercial fishing boats lie idle at the docks, sports fishermen travel north to fish, our young don't fish with grandpa and the social safety net that has preserved this iconic species in the hearts and minds of California is unraveling. Today, when a few dozen wild coho arrive each winter to spawn in Marin's Lagunitas Creek or Mendocino's Pudding Creek, it is reason to celebrate, and to grieve. These few fish represent the struggling remnants of a once abundant species and a thread back in time, not so very long ago, when our creeks were clean, cool, and flowed unimpaired from their headwaters to the sea.

CCC coho salmon are nearly extinct and some argue that nothing can be done to save them; we disagree.

"It is difficult to break old concepts and to think along new lines. But when the evidence points strongly in favor of a change of thought, then it is fair and necessary to do so…"

Shapovalov and Taft 1954

"The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew, and act anew."

Abraham Lincoln, Message to Congress, December 1, 1862

Thousands as Far as the Eye Could See

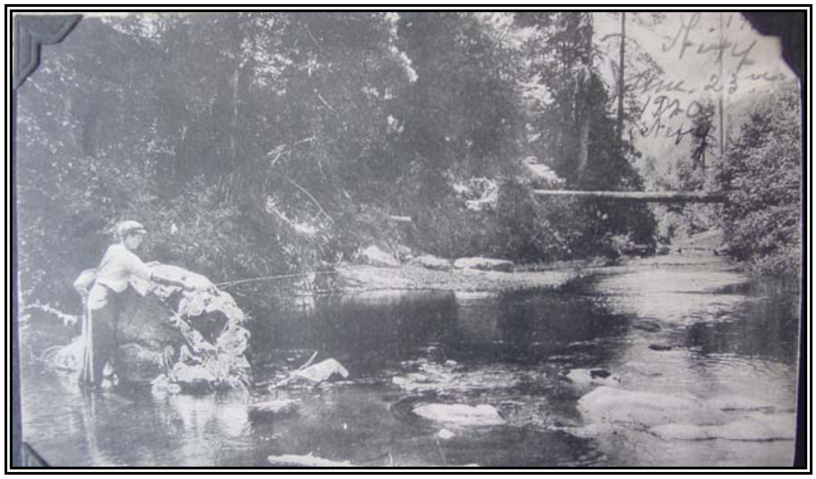


Photo Courtesy: Kelley House, Sheppard Album, Post Cards, Noyo River (1920)

Within the living memories of California's elders are visions of coho salmon in staggering abundance. It was late November in the 1930's when Dan Jansen looked down from a bluff above the Garcia River in Mendocino County. He said the water was "like glass," he could see huge numbers of salmon lined up in rows and "(n)ot a move out of them. Every once in awhile one would wiggle his tail to keep his place in line. They lay there by the thousands as far as my eye could see" (Levene *et al.*, 1976). These were adults returning from the ocean to their natal river, the Garcia, to prepare for their upstream migration to spawn and die. Other rivers are remembered for their size of coho salmon runs such as the Navarro, the Noyo, the Big, the Russian, and the San Lorenzo. These runs "were once a mainstay of California's sport and commercial fisheries" (Moyle *et al.*, 2008). This species, which had survived millennia of predators, droughts, fluctuating ocean conditions, and other natural hazards, was considered "inexhaustible" just fifty years ago (Janssen 2008). But it would barely survive the 20th century. By 1991 another lifelong resident of the Garcia River, Lando Franci, reported that "the (c)oho are gone" (Monschke *et al.*, 1992).

Cool, Moist, and Coastal

The distribution of CCC coho salmon at the time of European settlement included most coastal streams from the Santa Cruz County portion of the Pajaro River north to Usal Creek in Mendocino County. Watersheds draining into San Francisco Bay with similar conditions (*e.g.* ample cool water and conifer forests), also supported them. The first scientific specimens of CCC coho salmon in California were collected from a San Francisco Bay stream, San Mateo Creek in San Mateo County, by Alexander Agassiz in 1860. Historical presence of coho is confirmed for Corte Madera Creek and Arroyo Corte Madera del Presidio in Marin County. Less definitive evidence suggests coho presence in streams further east to include the Napa River, Walnut Creek, San Leandro Creek, Coyote Creek, and the Guadalupe River. A longtime Berkeley resident reported in 1939 that Strawberry Creek, "the one which runs through the University of California Campus . . . [once] supported a run of silver salmon" (Leidy 2007). This observation is supported by archeological evidence predating Spanish settlement (Gobalet *et al.*, 2004). While up to a quarter of Bay watersheds may have supported coho, conditions may not have been ideal. The persistence of coho in the Bay probably depended on "immigration from coastal populations" (Bjorkstedt *et al.*, 2005). Drier and hotter inland areas probably saw them intermittently, with coho runs possibly not surviving drought years. In the Russian River, in Sonoma and Mendocino Counties, there was a similar pattern; coho were abundant in the lower watershed, in the cool fog belt near the ocean. Its middle section, which, historically experienced dry reaches in the summer (Levene *et al.*, 1976), does not appear to have had coho. In the upper Russian River, where it was wetter and cooler, "occasional migrants were likely present for short periods of time." But in the long run it was "too warm or dry to allow coho to complete their life cycles" (Bjorkstedt *et al*., 2005). A similar situation existed along the coast south of the Pajaro River, where the presence of coho to at least the Big Sur River (Monterey County) has been hypothesized, but not documented (Anderson 1995). Recently uncovered archeological evidence confirmed coho at least as far south as Elkhorn Slough in Monterey County (Gobalet 2008). Evidence suggests that the CCC coho population was likely concentrated near the coast where habitat conditions were ideal. At the edges and interiors of their range, coho were probably found occasionally, and likely disappeared as conditions became too warm and dry.

Photo Courtesy: Juvenile coho salmon, *Oncorhynchus kisutch*, collected in San Mateo Creek, a tributary of San Francisco Bay, in 1860. Image provided by the Harvard Museum of Comparative Zoology. Specimen 68471.

"En Especial Salmon"

Salmon, because they represented a significant seasonal food source, have always attracted humans. This was reflected in the placement of many native villages, and held true when the Spanish began to arrive in California in the late 18th century. Place names like *Pescadero* ("fishing place") illustrate the importance of fish as a food source. At the Carmel Mission, "Father Serra had a lagoon created . . . and they diverted the Rio Carmelo and raised salmon/steelhead in it" (Lydon 2008). Decades later, during the founding of the last California mission, Father Altimira recorded the observation of a native guide, who told him that Sonoma Creek had plenty of fish, "*en especial salmon*" (Altimira 1823). While Spanish and Mexican settlers caught, ate and even raised salmon, it seems unlikely they had much effect on coho salmon populations. The number of settlers was small, the fish abundant, and their habitats relatively unimpaired.

A Changing Landscape

As the Mission era drew to a close in the 1830s, ownership of land shifted from the church to private individuals. Land grants of thousands of acres were given out. The mature forests and ample water that coho salmon require attracted the attention of the new landowners, and the relationship between people and salmon began to change. The population of American settlers in Mexican California was slowly increasing, and so was the

Photo Courtesy: Early logging operation, Sonoma County c. 1880. Sonoma County Museum Collection demand for lumber. From the earliest mission days, redwoods and other trees had been cut and milled by hand. Two men working a sawpit could produce about 100 board feet of lumber a day (Carranco and Labbe 1975). It could take a year or more to reduce a medium-sized redwood to boards. Several coho streams still bear Spanish names which point to early timber harvesting in these watersheds, including Corte Madera Creek, and Arroyo Corte Madera del Presidio. A "*Corte Madera*" is a place to "cut lumber."

California's first water-powered sawmill was built in 1834 on a coho stream—Mark West Creek, a tributary of the Russian River. It could process about 500 board feet a day (Carranco and Labbe 1975). A flood washed the mill away before the decade was out, but others were soon in operation. General Vallejo built a mill on Sonoma Valley's Asbury Creek in 1839 (Dawson 1998). The Santa Cruz area developed its first mill in 1841, with another built in 1845. By 1857, there were ten sawmills in the county and by 1864 the number had increased to twenty-eight. This exponential growth of sawmills was not driven by local need, but paralleled the exponential population growth associated with the Gold Rush and developing San Francisco (Figure 1). Santa Cruz became "one of the major suppliers for the builders" of San Francisco (Lehmann 2000). North of the Golden Gate, mills appeared along the Sonoma coast in the 1840s, and by 1852 on the Big River in Mendocino County (Downie *et al*., 2006). Again, demand from San Francisco drove these mill operations; Mendocino County's population was so small that its affairs were administered by Sonoma County until 1859.

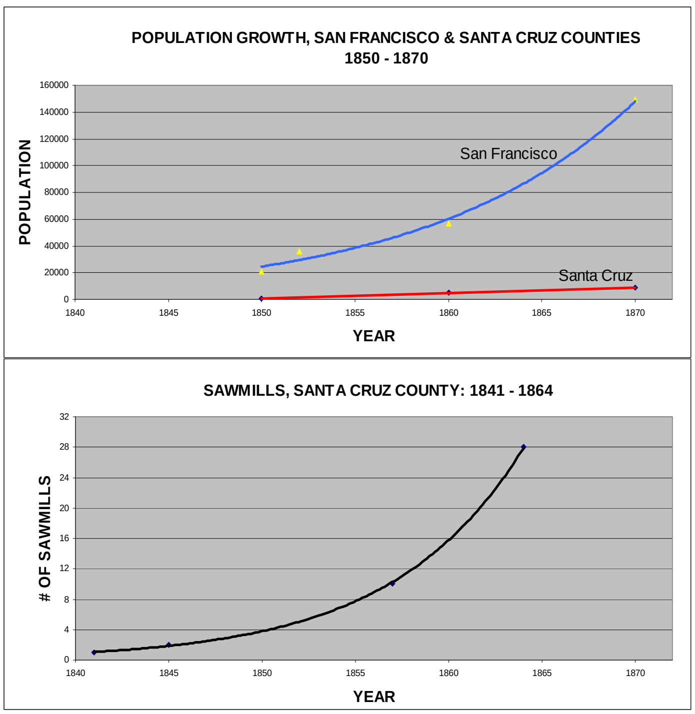


Figure 1: Exponential growth of sawmills and human population

Coho habitat was at the center of this logging boom. Many coho streams were named after their mills or mill owners: Mill Creek in Marin County; Mark West in Sonoma County; and Waddell in Santa Cruz. Usal Creek in Mendocino, is said to be named for the initials of the "United States of America Lumber" Company. Likewise, Duncan's Mill gave its name to the small town on the Russian River where it once stood. How did this first wave of logging affect the coho? On Mendocino's Big River, and probably elsewhere, early logging was done next to the river, so that the logs could be floated downstream to the mill (Downie *et al*., 2006). As trees shading the pools where coho reared during summer were cut, water temperatures increased, making the habitat less suitable. Debris in the water created barriers for coho migration to and from the sea. South of the Golden Gate, streams did not have the volume of water to carry logs, so they "had to be skidded down using oxen, or processed where they fell. The best the lumbermen could do was fell the redwoods . . . and split them on site, carrying the posts, pickets, or shakes out . . . on mules or wagons." Coho spawning beds and rearing pools were directly and indirectly altered, as "roads were laid out in stream bottoms or drainage swales, and no attempts were made to control the resulting erosion. Gullies from these early operations are still visible… Landslides and slumps were often precipitated by these logging practices… Many of today's mapped landslide deposits probably date from this period" (County of Santa Cruz 1976).

A host of products were produced from forests of California's central coast—lumber, shingles, fencing, as well as tan oak bark for tanning leather, a major industry at the time. Redwood was, "the best wood known for railroad ties . . . Sonoma and Mendocino Counties provided ties for the Central Pacific Railroad [the first trans-continental railway]. Every eastern train that crosses the Sierra rolls over the product of the forests of Sonoma . . . ties from this county synchronized to "maximize the flow." To avoid jams, men cleared the channels in the drier months of "all obstructions and debris." Log drives had severe consequences for coho salmon: they flushed away gravel spawning beds; deposited huge amounts of fine sediment in the estuary; destroyed rearing pools by eroding streambeds, in some cases to bedrock; and created jams which may have acted as migration barriers. Splash damming continued into the early 1930s and more than 70 years later, the devastating effects of these log drives are still apparent. The Big River watershed was recently described as being "beat up the worst" of any river on the central coast, due to this practice (Downie *et al*., 2006). Splash dams were also used on the Garcia and Navarro Rivers and perhaps other parts of the Mendocino Coast.

"A Moving Mass of Turgid Filth"

By twentieth century standards, the pace of early logging was modest. About a thousand acres a year were being harvested in Sonoma County during the 1870s (Thompson 1877), a rate that may have been nearly sustainable for both trees and salmon. However, downstream the operations of the mills themselves caused other problems. Sawmills produced tremendous quantities of sawdust. A common practice in the 19th century was to dump the waste into the same stream that powered the mill. As early as 1867, the *Santa Cruz Sentinel* reported that, "the sawmills on the Pescadero have . . . injured the fishing, from the sawdust running down the creek." Four years later, an article in the same newspaper described how the "impact of sawmills on trout fishing was always a matter of contention in the communities along the streams flowing out of the redwood-covered canyons of the Santa Cruz Mountains". For years it had been the practice of lumber companies to remove sawdust from the various mills by sluicing it into the running streams. This system had become universal . . . "until our pure limpid streams were discolored, and the water became, in some instances, as black as tar,--a moving mass of turgid filth" (Sentinel 1871).

The problem was not limited to sawmills. Creeks were seen as handy disposal systems. In Santa Cruz, "Bausch Beer Gardens lost business on days a nearby winery dumped pungent tailings in the creek and the [San Lorenzo] river ran red when Kron's tannery emptied a tanbark vat" (Gibson 1994). Some of the earliest environmental protection laws in California were passed during this era. In Santa Cruz "local laws curbed mill dumping of sawdust." North of the Golden Gate, the Big River Mill, near the town of Mendocino, was temporarily shut down in 1889 to instigate a new sawdust disposal system required by the County Fish Commissioner (Downie *et al.*, 2006), and the following year, the *Point Arena Record* reported the mill at Gualala was "constructing a large furnace . . . to burn their sawdust instead of dumping it into the river" (Mendocino-Beacon 1890).

Creeks were also used for other purposes besides log transport and waste disposal. In 1873 it was reported that "every dairyman along the many streams which drain the western slope of the Santa Cruz range," was preparing to tap these creeks for irrigation and domestic use. These included waterways like San Vicente Creek (where coho are still found), and most "…streams along the coast south of Waddell's creek, to the Pajaro." Water which flowed into the ocean rather than put to human uses was considered "waste water" (Sentinel 1873).

Hooks, Nets, Pitchforks, and Dynamite

It was only a few years before these impacts began to have a noticeable effect on the numbers of trout and salmon. In 1878, A.J. LaMotte, who arrived in Sonoma Valley in the early 1860s, lamented, "(s)ome years back great numbers of trout could be taken, but as fishermen increased, the fish rapidly decreased in number" (Munro-Fraser 1880). The same story was true in at least one tributary of the Russian River. In the 1870s the local newspaper reported that Santa Rosa Creek, "once a splendid stream for trout" had gotten so bad that "now no one thinks of trying to fish there" (The-Sonoma-Democrat 1876). Besides steelhead, Santa Rosa Creek also supported coho (Merritt-Smith-Consulting 1996). In addition to sport fishing, coho were being commercially harvested in at least a few places during the 1860s, including Pescadero and San Gregorio Creeks, Santa Cruz County (Gobalet *et al*., 2004). Two decades later, over 183,000 pounds of salmon were canned near Duncan's Mills on the Russian River in 1888. The size of the fish, 8-20 pounds, makes it appear that many were coho salmon. Coincidentally or not, declining numbers of salmon were first noted in the Russian River that same year (Steiner Environmental Consulting 1996).

Photo Courtesy: Kelley House, Post Cards, Noyo River 1930's

Salmon Spear, Kelley House Museum

It is impossible to know exactly how much effect commercial and recreational fishing by itself had on salmon populations in that era. The popularity of fishing is evidenced by this account: "(w)hen the railroad reached Santa Cruz in 1876, it was the river as much as the beach that drew tourists. Santa Cruz promoted itself as a 'sportsmen's paradise,' with most hotels only two blocks from the river. Hotels and downtown campgrounds saw a business boom each year at the start of fishing season" (Gibson 1994).

There were no limits or fishing regulations in those days. Fish were caught with hooks, nets, pitchforks, fish wheels, even dynamite: In the San Lorenzo River, "railroad workers . . . while building the South Pacific Coast Railroad in the late 1870s, often used explosives to 'fish.'" (Lydon 2008). Though no longer legal, the same technique was used by at least one individual in Sonoma Valley as late as the 1930s (Dawson 1998). Most historical sources lump several species under the term "salmon," so one can only guess at what impact 19th century fishing had on the coho population. Hard to catch with hook and line (Janssen 2008), spawning runs would have been vulnerable to nets, pitchforks, fish wheels, and dynamite. Coho's life cycle makes them especially sensitive to human impact, suggesting that their population followed the general decline of California "salmon" and "trout" recorded during the mid-19th century, perhaps more steeply than other species.

Photo Courtesy: "Fishing Fleet at Noyo, Mendocino County, California, circa 1930. H. H. Wonacott, photographer. Collection of the Mendocino County Museum

Declining numbers of salmon and trout prompted action. As mentioned, the dumping of waste into streams was prohibited. The California Fish Commission was created in the 1870s, and established early fishing regulations. The state's first fish hatchery was built on a tributary of the Sacramento in 1872. Hatcheries soon proliferated, built with both public and private funding (including railroads hoping to attract tourists). While early hatcheries raised steelhead and Chinook, "propagation of coho dates back to at least the 1890s" (DFG 2002). Beginning around 1906, the San Lorenzo River was stocked with coho and steelhead (Becker and Reining 2007). It was common practice in those days to plant fry (fish a few months old or less), which have a much lower rate of survival than larger, year-old smolts. Hatcheries also used eggs from watersheds as far away as Oregon and Washington, so the young fish were not genetically adapted to the waters into which they were released (Bjorkstedt *et al.*, 2005). Over 100,000 fry were planted in Waddell Creek between 1913 and 1933. Scott Creek was also heavily stocked during this time (Anderson 1995). However, in general, coho planting was "infrequent before 1929" (Bjorkstedt *et al.*, 2005). For many reasons, planting hatchery fish probably had little to no effect on wild coho before the mid-twentieth century.

Bales of Smoked Coho

Initially, the center of California's salmon industry was the Sacramento River, with its abundant runs of Chinook salmon. As that fishery declined, "commercial trollers began harvesting salmon offshore. By 1904, some 175 sail-powered fishing boats were operating out of Monterey Bay" (Lufkin 1991). Coho that had survived more than a year in freshwater *and* migration out to sea, faced a new challenge. Human activity was now affecting coho at every life stage. In Mendocino County, commercial fishing began near Fort Bragg, on the Noyo River in the 1890s with "a few men using dories or rowboats on the river," who "netted or seined silver salmon in the winter" (Stebbins 1986). Elmer Walker, who was born on the Garcia River in 1889, recalled how his father sent fish to San Francisco:

> "They had what they called a card. [It] had timbers that would float, with slots in there so that the fish couldn't get out. But they'd put them right in there and keep them alive . . . everything was shipped by boat at that time. They towed the cards. From where it was located it wasn't too far down to the mouth of the river . . . and then they had a dip net that they dipped them out with when they got ready to ship them. They were shipped in wooden crates and nailed up and sent to San Francisco. They knocked 'em in the head. Salmon and steelhead: there was no designation as far as marketable fish"

Roy Bishop, who also grew up on the Garcia River, remembered seeing "bales of smoked coho" that his grandfather sold. This was around 1925 (Levene *et al.*, 1976).

By the 1920s, California's salmon and steelhead streams had earned worldwide acclaim, and the "economic value of the sport fishery exceeded commercial fishing by two-to-one" (Lufkin 1991). Special trains brought anglers from the Bay Area to fish for adult coho in Lagunitas Creek (Brown and Moyle 1991). By one account, "the San Lorenzo River became the number 1 fishing river in northern California, and remained so for half a century." At the same time, the advent of the automobile granted fishermen ready access to once remote streams. Soon after, the Great Depression saw a resurgence of subsistence fishing as people fell on hard times. Vernon Piver recalled:

> "Times were really tough. My mother told me, to this day, she don't have a taste for smoked salmon, because they netted fish on the Garcia River and my grandfather smoked salmon and sold them for revenue, to pick up a few nickels and dimes. One of their main staples was that smoked fish" (Russell and Levene 1991).

Coho salmon. "Mouth of Garcia, Oct. 1932. This is what we caught." Sheppard Album, Kelley House Museum, Mendocino, California

While diminished to some degree from their numbers a century before, CCC coho salmon continued to occupy most of their original range. To some extent the land was recovering from the 19th century logging. By 1942, the Big River basin, whose channels had been so badly "beaten up" by the use of splash dams, had "some of the finest redwood second growth in the state"(Downie *et al.*, 2006). World War II may have granted coho a temporary reprieve from fishing and planting, because industry focused on building weapons to fight the war. But ultimately, the war had repercussions that reached to the heart of the coho's domain.

From War Tanks to Bulldozers: Building A Moonscape

In the late 1940s, "the technologies of World War II . . . spun off the highly mobile track-driven bulldozer," which delivered the large trees of the central coast "for conversion to two-by-fours for a national building boom driven by the affluence of the returning soldiers" (House 1998). In essence, the industrial capacity used to build tanks was retooled into building bulldozers. Transient "gypsy loggers and sawmillers invaded the region with Gold Rush zeal"(Lufkin 1991). The combination of heavy equipment and the way it was used caused significant erosion and sediment delivery to streams. The equipment's size required the use of wide skid roads. Water breaks to curb erosion were rarely installed. To brake going downhill, tractor drivers scraped the ground with their blades. The construction of logging roads on unstable ground was common practice. Even worse, a 1962 Fish and Game survey of the Garcia River noted that "numerous roads were constructed in the stream channels," themselves, "oftentimes moving the stream out of its natural channel" (Monschke *et al.,* 1992). Trees were harvested "practically to the bottom of small gullies"(Downie *et al.,* 2006). Individual "layouts" were created, up to 300 feet long and 20 feet wide, to prevent falling trees from shattering on impact. By the end of 1956 it was estimated over 1000 miles of California streams had been damaged. The 1962 survey of the Garcia found more than 85 percent, of the channels had suffered some damage, and more than a third was "severely damaged" (measured by length). A person who saw it from the air in the late 1960s described the upper Garcia as "…a moonscape. Blue-line creeks were skid roads" (Monschke *et al.,* 1992). The intensity of the timber harvest was summed up by a resident of the Butano/Pescadero watershed: "They built a road to every tree they cut down" (Environmental Science Associates, Pacific Watershed Associates *et al*., 2004). By the 1970s, "more than 80 percent of the virgin forests had been cut, milled, and shipped," in most watersheds along the central coast (Lufkin 1991).

Even in an average year, such conditions caused serious problems for coho: "These hills are prone to erosion in the first place, so if you build roads and take out the trees, it's going to cause sedimentation" (Craig Bell quoted in (Monschke *et al.,* 1992) . In an unfortunate coincidence, two of the region's biggest floods on record happened in 1955 and 1964. Several residents of the Butano Creek basin reported that "the cause of the first damaging flood in the watershed . . . was due to logging undertaken by the Santa Cruz Lumber Company . . . beginning in 1955." Trout fishermen saw fishing decline rapidly: "(t)he creek silted up so bad . . . that the pool at the bottom of the 'Falls' was completely silted in." A resident who flew over the area at the time reported "hundreds and possibly thousands of landslides in the upper Butano" (Environmental Science Associates, Pacific Watershed Associates et al., 2004). Silt from landslides clogged spawning gravel and filled rearing pools, and landslides themselves directly blocked streams, creating migration barriers for coho.

Attempts at flood control were made in response to these events. On the lower San Lorenzo River in the City of Santa Cruz, "all riverside forests were stripped and the river was straightened by the Army Corps of Engineers," which also built flood control levees. These "transformed the river from a tree-lined and very scenic part of town, to a sterile drainage ditch. The siltation of the channel and the lack of deep water pools of water, coupled with low summer flows and a lack of shade . . . decimated fish populations." Where before, "trout and salmon had been routinely caught in the city," now "the river was barren of most wildlife," and "the fish populations declined" (McMahon 1997).

The Baby Boom

The postwar building boom increased the demand for other building materials besides lumber. In the early part of the twentieth century, gravel mining was done by hand in local streams. Elders in Sonoma Valley remember people driving small trucks down to the creek. "A number three scoop [shovel] and a strong back, that was how you did it" (Dawson 2002). Local gravel went to construct nearby buildings, bridges, and roads. The Garcia River saw its first commercial gravel operation in the 1930s *(Monschke, et al.,* 1992), but it was not until after the war that such operations increased to the point where they were making a significant impact to rivers and streams (Dawson 2002).

Population growth was the engine that drove the postwar boom. The number of people living in the Russian River basin increased 400 percent in the second half of the 20th century. More people brought a corresponding increase in demand for water. Dams of every size were constructed on coho streams throughout the region. Two large dams were built on the Russian River; Coyote Dam was completed in 1959, and Warm Springs Dam in 1982. While these dams pose a barrier to other salmonids this was probably not significant for coho, which never spawned in large numbers in the middle or upper Russian. Downstream, however, these dams altered the dynamics of the river, reducing peak flows, prolonging high winter flows, reducing replenishment of spawning gravel, and increasing summer flows to 15 to 20 times above historical levels (Steiner Environmental Consulting 1996). This last effect may be the most significant. During the warm months, coho rely on the cooler water at the bottom of deep pools. Higher summer flows raise the temperature of this cooler layer by mixing it with warmer surface waters. Medium-sized dams were built in smaller coho watersheds, such as Lagunitas and Nicasio Creeks in Marin County. Nevertheless, the small dams may have had the greatest cumulative effect. Five hundred small dams were counted on tributaries of the Russian River in 1996 (Steiner Environmental Consulting 1996). Besides acting as migration barriers on the lower Russian's coho streams, these dams also reduce spawning gravel and summer water supply downstream.

Photo Courtesy: Hal Janssen with two coho salmon caught in the San Lorenzo River, 1964. Alameda Creek Alliance

An Amazing Time to Live

As the second half of the twentieth century progressed, coho faced ever-increasing pressures at every stage of their life history: they were cut off from much of their prime habitat, they laid their eggs in clogged spawning beds, they had lost cool summer refuges at the bottom of deep pools, and they faced increasing commercial fishing at sea. It is really no surprise their numbers declined; however, it did not happen all at once. During the 1960s and 1970s, commercial and sport fishermen were still seeing and catching them. In places, coho were still abundant.

Photo Courtesy: Central California Coast Coho. Hal Janssen collection.

Hal Janssen, who grew up on Alameda Creek on San Francisco Bay in the 1950s, has spent a lifetime on the central coast, fishing "300 days a year . . . for thirty-five, forty years." Hal called the 'fifties "an amazing time to live." Speaking of coho, he recalls, "We would have huge schools and schools of them in California in the 'fifties and 'sixties in the San Lorenzo River and Pescadero." As fishing declined on the San Lorenzo in the early 1960s, he moved north, to the Russian and then up into Mendocino. One September a friend called him up and said, "Come to the Garcia; you can't believe it. It's loaded with silvers (coho); they're jumping everywhere!" Sure enough, when he arrived on the Garcia, coho salmon "were everywhere." Speaking of the Navarro, he said, "(t)he tidewater used to be absolutely packed with salmon. Packed! You'd go down there in September, it was more packed than the Garcia was." He also mentioned the Big River and Ten Mile River.

Being out so much of the time, Hal witnessed first-hand the decline of coho and other salmonids. Of the Navarro, he said, "Now there is none! They're gone!" He attributes the decline to a number of things, including: poachers, who take advantage of the lack of game wardens in the field; the flood of 1955, and predation by marine mammals (Janssen 2008) .

Computers, Accidental Anglers and Millions of Fry

Coho numbers are estimated to have plummeted statewide from as many as 500,000 in the 1940s, to as few as 13,000 by 2002 (DFG 2002) (CCC coho would have represented a fraction of this number). Moreover, while most coho in the 1940s were native to their streams, as few as 500 purely native fish remained. The gene pool of the rest has been diluted by out-of-basin plantings. A troubling development is the disappearance of coho from many parts of their range, the general pattern being from south to north. In Santa Cruz County, the Pajaro River and Soquel Creek lost their native runs around 1968, followed by Aptos Creek in 1973. In 1957, the San Lorenzo River was called "the most important steelhead and salmon fishery " south of the Bay area (Becker and Reining 2007). Just twenty-seven years later, its coho run was gone. Many San Mateo County streams lost their runs in the late 1970s and early 1980s, due to the drought of 1976 -1977 coupled with land and water development. By 1995, only Waddell and Scott Creeks were believed to maintain sustained natural runs of coho south of San Francisco (Anderson 1995).

Urbanization is a prominent factor in the decline of coho, particularly in San Francisco Bay. As late as 1965, runs of coho salmon were reported in Marin's Corte Madera Creek. The following year, California Fish and Game reported that coho in the Napa River (Napa County) "had been eliminated." Coho and other salmonids became rare in the Walnut Creek watershed in the late 1960s, and were last reported in the south Bay's Guadalupe River (Santa Clara County) in the 1970s (Leidy 2007). Similar urban pressures were occurring in the San Lorenzo River watershed. The growth of Silicon Valley fueled a sharp rise in development in the upper watershed that peaked in the 1970s (County of Santa Cruz 2001). One likely effect of all this building boom was a huge increase in siltation first noted in the 1960s (Becker and Reining 2007). Unlike logging impacts, where the impacts from past practices are slowly healing over time, the impact of urbanization is profound and permanent. Of all 78 watersheds that historically had a coho population, all of those with significant amounts of urban development, have lost their coho run save one, Lagunitas Creek[1].

In Lagunitas Creek, the 2007/2008 coho run was probably the smallest run observed since annual surveys began in 1995. There was a 70 percent decline in the number of redds (gravel "nests" where eggs are laid) compared the parent generation, which hatched three years earlier. Similar or greater declines were seen in other coastal watersheds in Marin. This is consistent with a 73 percent decline in counts for returning CCC coho throughout their range. The decline has been attributed to reduced populations and influences of "poor ocean conditions and food supply when these coho migrated to the ocean as smolts in 2006" (Ettlinger, Childress *et al*., 2008). Remarkably, as bad as the 2007/2008 spawning run was the 2008/2009 spawning run was worse, with only 40 fish returning from the ocean.

On the Russian River, the number of coho smolts entering to the ocean is estimated to have declined 85 percent in just the sixteen years between 1975 and 1991. By the winter of 2007/2008, Joe Pecharich, a coho researcher who worked at the Warm Springs Dam Fish Hatchery and now works for NMFS, said, "…we know of only two coho that came back. The year before that we know of only two. The year before that were five." And in the current winter of 2008/2009, the only known coho female to return was caught and, inadvertently, killed by an angler (Norberg 2009).

Along the Mendocino coast, the pattern was more varied, in some cases being the opposite of that seen in the southern portion of the species coastal range. On the Big River, which had seen intensive logging, only two coho were reported in 1955. Yet by 1978 its coho run was estimated at 2000. Stocking of coho began there in 1956, and a hatchery was built in the early 1960s (Stebbins 1986). A half million eggs and fry were planted in the Big River between 1956 and 1978 (Downie *et al*., 2006). As with past stocking efforts using fry, the effectiveness of the plants was probably minimal. Current run size is unknown, but juveniles have been consistently found in many tributaries, showing that some adults are still spawning on the Big River. On the Garcia, Lando Franci recalled that "(s)almon were already starting to dwindle" by the 1940s. Craig Bell remembers seeing "(s)ilvers and Kings . . . rolling in the tidewater" in October 1979. But "by about '(19)85 it was history" (Monschke *et al*., 1992). The fish were gone.

As on the Big River, declining numbers of coho inspired vigorous hatchery and planting programs. Unfortunately there was still no effort to plant native streams with native stock. In all, over 11.5 million out-of-basin fry and fingerlings were released in central coast streams, mostly from the 1950s through the mid-1990s (Bjorkstedt *et al.,* 2005). Despite all the planting, commercial catch of coho declined sharply in the late 1970s, believed to be the result of poor conditions in both the ocean and the coho's freshwater

[1] Lagunitas Creek coho are persisting due in large part the dedication and organization of local citizens and the common vision of local agencies and political bodies to implement restoration actions and policies necessary to save this fish.

habitat. By the early 1990s, ocean stocks of coho were so low that commercial and sport fishing were closed (DFG 2002) and have remained closed ever since.

Rays of Hope

By the winter 2006/2007, native coho were estimated to have declined more than 99 percent in less than seventy years. Most spawning populations are reduced to less than fifty fish (Moyle *et al.*, 2008). California's once abundant central coast coho are now nearly extinct. Only a sustained and vigorous effort by the public, landowners, and decision-makers at every level, will bring them back. While their survival hangs in the balance, a handful of places have seen modest increases in coho in recent years. On a tributary of the Garcia River where coho had not been seen for at least twenty years, schools of juveniles were discovered at ten locations in 2008. One researcher believes that the sustainable forestry now being practiced there, "might be the best way left to preserve woodland ecosystems, watersheds and fish" (Fimrite 2008). Additionally, gravel mines have closed or improved their activities to be more compatible with habitat needs, such as Homer and Steve Canelis from Austin Creek Aggregates, and extensive restoration efforts on agricultural and forested landscapes have been ongoing for 15 years and are resulting in substantial improvements in habitat quality.

Large wood is being placed into streams to promote gravel sorting and pool development for improved spawning and rearing habitats. One such project on the South Fork Ten Mile River facilitated the restoration of 9.4 miles with 245 logs and 65 rootwads placed across 138 sites. Coho salmon were observed in the South Fork Ten Mile for the first time in a decade. Similar projects are being proposed for the North Fork Ten Mile; projects that are a very high priority for preventing extinction and ensuring survival of coho salmon.

In Santa Cruz County, San Vicente Creek had apparently lost its coho run by the early 1980s. Yet, in the fall of 2002, several hundred coho were discovered in an agricultural off-channel pond on the Coast Dairies Property by NOAA's Office of Law Enforcement (The Trust for Public Land 2004). Researchers believe the cool, deep water in this pond, which is connected to the creek by an inlet and outlet channel, mimics natural "off channel" conditions preferred by coho for rearing. Recently, when water flow into this pond became disconnected, numerous agencies and concerned citizens joined together and completed a complex restoration effort in record time, solely for the purpose of saving this important southern coho salmon population.

California's redwood forests are now the last areas where coho salmon persist in some abundance. Unlike other landuses such as agriculture or urbanization, timberland management in California is regulated by Forest Practice Rules. These Rules have standards for road construction and maintenance to reduce sediment to streams, riparian canopy retention along fish-bearing and non-fishbearing watercourses and mechanisms for forest growth and regeneration. Watershed processes that provide for salmon spawning, rearing and sheltering are relatively intact in forestlands. The future and fate of salmon is inextricable to the future and fate of California's redwood forests.

If people can come together to prevent the extinction of the condor or raise and fly whooping cranes across country in an ultralight to teach them migration; we can bring salmon back in California. The news of preventing extinctions of species is growing and offers a ray of hope that the story of CCC coho salmon will continue. The purpose of this plan is to build upon these successes and educate our children so that the spawning runs witnessed on the Garcia River in the 1930's as well as healthy spawning runs throughout the Central Coast, will be a part of our future.

Photo Courtesy: Bob Coey, NMFS

CHAPTER 1: OVERVIEW OF THE CCC COHO SALMON ESU

"Pacific salmon matter not only as a delicacy and an economic resource but also as an indicator of the state's environmental health. Wild salmon are to the rivers and the watershed and the ocean what the canary is to the miners in the coal mine."

Congressman Mike Thompson 2008

A SPECIES AT THE BRINK OF EXTINCTION

Central California Coast coho salmon are gravely close to extinction. Despite being listed under both the Federal and California Endangered Species Acts, the populations of the CCC coho salmon have continued to decline precipitously. The dire status of this salmon requires immediate and focused action to increase survival of, and provide the highest protection for, each individual and all remaining populations.

Photo Courtesy: A juvenile CCCC coho salmon from Scott Creek, Santa Cruz County, California. Morgan Bond, SWFSC.

Regrettably, many of our streams are inhospitable to our salmon. For millennia salmon have successfully persisted in abundance under catastrophic and shifting environments. The human altered landscape over the last two centuries, and human harvesting, has placed additional pressures on these populations. This altered landscape with competing demands for water, stream channel modifications (*e.g.*, bank stabilization, levee development, etc.), water pollution, land use practices, and many other unsustainable uses of our land and water are resulting in significant detrimental changes to our streams and rivers. As rivers become more inhospitable to salmon, fewer salmon survive and populations decline. As fewer and fewer individuals survive, the population as a whole becomes more vulnerable to shifting ocean environments and natural catastrophic events. This condition, when low populations cannot overcome ongoing declines, when genetic diversity is compromised, when habitats become degraded and fragmented, and when spawners are at such low numbers they cannot find one another to reproduce is often referred to as an extinction vortex (Gilpin and Soule 1986). "Extinction vortex" is the term used to describe the process that declining populations undergo when "*a mutual reinforcement occurs among biotic and abiotic processes that drives population size downward to extinction*" (Brook, Sodhi & Bradshaw 2008). Current information on adult escapement in the ESU is very limited; however, information from current monitoring on Scott, Lagunitas, Noyo, Caspar and Pudding Creeks indicate a significant CCC coho salmon decline and that coho salmon are in this vortex.

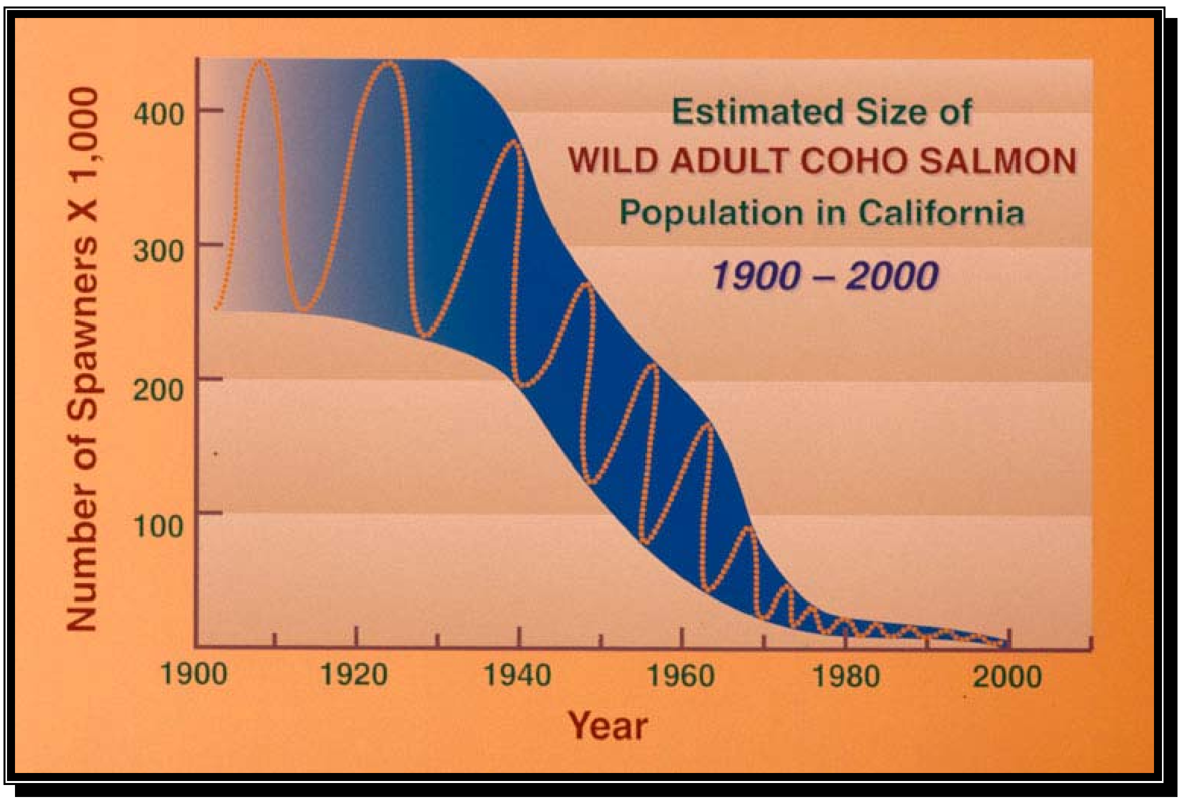


Figure 2: Visual Representation of Extinction Vortex of Coho Salmon (Peter Moyle, pers. comm.)

The dire status of CCC coho salmon is a call for immediate action to prevent their extinction by:

1. Implementing actions that increase survival of all current individuals and populations;
2. Expanding their distribution through focused restoration actions in critical areas;
3. Preventing degradation of existing high quality habitats across the historical range (especially areas that have supported populations within the last four generations);
4. Restoring habitat conditions and watershed processes across their historical range; and
5. Controlling and abating threats and providing for their long-term survival and recovery.

The situation is daunting, but it is not hopeless. Coho salmon persist in many watersheds, particularly in Mendocino County, and, in some years, these areas witness good numbers of adults returning from the ocean to their natal streams. Lagunitas Creek, in Marin County, also maintains a consistent run of coho salmon. It is imperative to protect and maintain the remaining populations to ensure survival of the species across the ESU.

Photo Courtesy: A very rare sighting; three wild juvenile coho salmon (and one juvenile steelhead – bottom left) in the Russian River in 2008. Joe Pecharich, Russian River coho monitoring project, UC Cooperative Extension – Sonoma County.

Innovative approaches and partnerships will be necessary to save our salmon. The persistence and recovery of salmon will require re-thinking our land and water resource conservation values to work towards mutually beneficial solutions to both mankind and our environment. Any one effort will not act alone, but will work in synchrony with the many others who are working to save this species. Since the Federal listing in 1996 much has been done. The Monterey Bay Salmon and Trout Project (MBSTP) and Corps of Engineers (USACE) are working with NMFS' Science Center and the California Department of Fish and Game (DFG) to ensure the King Fisher Flat facility on Scott Creek are managed appropriately. The Sonoma County Water Agency, USACE, NMFS, CDFG and others are collaborating on operations for the Congressman Don Clausen facility (Warm Springs) in the Russian River to maximize genetic diversity and improve distribution and abundance of coho salmon. DFG, NOAA Restoration Center, Trout Unlimited, The Nature Conservancy, Resource Conservation Districts and many others have dedicated substantial sums of money to restore passage, install woody debris, and reduce sediment inputs from problem roads in many watersheds. The Marin Municipal Water District operates their reservoirs and the non-profit group, SPAWN, work in such a way to ensure Lagunitas Creek maintains a strong population. The National Park Service is conducting extensive monitoring for Lagunitas and Olema Creeks and water agencies have provided funding to the recovery efforts. The Counties have joined together under the FishNet 4C and meet regularly to pool resources in an effort to streamline permitting, train their staffs, and obtain addition grant monies for the benefit of coho salmon. Timber companies and conservation organizations have dedicated numerous resources, including staff and equipment, to monitor coho populations and their habitat, fix problem roads and stream crossings, and restore instream habitat.

Recovery actions have been developed for each watershed, and across the ESU, with the intent of preventing extinction and reversing the coho salmon trajectory back towards persistence and recovery. These recovery actions are in draft and NMFS is requesting the public, stakeholders and agencies work with us to find mutually beneficial solutions to salmon recovery. Working together, we believe it is possible to restore coho salmon populations to the large numbers witnessed by our parents and grandparents, just fifty years ago.

THE TAXONOMY, RANGE AND ESA LISTING OF COHO SALMON

Taxonomy

There are six species of Pacific salmon within the *Oncorhynchus* genus: *O. kitsutch, keta, gorbuscha, tshawytscha, nerka,* and *masou*. Within this group, coho and Chinook salmon are the most closely related. The English translation of the genus name, *Oncorhynchus*, is hooked snout. Coho salmon, the common name accepted by the American Fisheries Society for *O. kisutch*, comes from a Native American name for the species. Silver salmon is another commonly used name. Other common names include sea trout, blueback, jack salmon, hooknose, and silversides (Hassler 1987).

Range

The current North American range of *O. kitsutch* extends from Point Hope, Alaska, south to the East Branch Soquel Creek in Santa Cruz County, California. NMFS has designated seven evolutionarily significant populations of coho salmon in Washington, Oregon, and California. The CCC coho salmon ESU is the southern-most extant population. CCC coho salmon occupy an area from Punta Gorda in northern California south to Soquel Creek in Santa Cruz County, California; their historical range includes the San Francisco Bay and many of its tributaries). Two artificial propagation programs are considered part of this ESU: the Don Clausen Fish Hatchery Captive Broodstock Program and the Scott Creek/King Fisher Flats Conservation Program (MBSTP). Both of these coho salmon programs are managed as conservation facilities and not for fishing supplementation.

Coho salmon may have persisted as far south as the Big Sur River in Monterey County and east into streams of the Sierras in the Central Valley (Gustafson *et al*., 2007). According to recently discovered archeological data from Elkhorn Slough, this species once ranged as far south as the Pajaro River in Santa Cruz and Santa Clara counties and/or possibly the Salinas River in Monterey and San Luis Obispo counties (Gobalet, in press). The first known collection of CCC coho salmon for scientific purposes occurred in 1860 when Alexander Agassiz collected the species in San Mateo Creek in San Mateo County. Today, not only are coho extirpated from San Mateo Creek, they have been extirpated from every tributary stream and river flowing into San Francisco Bay.

On November 12, 2003, NMFS received a petition to redefine the southern extent of the CCC coho salmon ESU by excluding coho salmon populations occupying watersheds in Santa Cruz and coastal San Mateo counties, California, from the CCC ESU designation. NMFS rejected the petition. The petitioner's assertions were based on the following: (1) early scientific species range descriptions and newspaper accounts failing to document coho south of San Francisco prior to artificial introductions in 1906; (2) absence of coho salmon remains in the refuse sites (middens) of the native people; (3) various physical characteristics (climate, geology, and hydrology) render the streams of the Santa Cruz mountains inhospitable to coho salmon; and 4) incorrect application of the ESU/DPS policies.

NMFS rejected the petition on all points (71 FR 14683). NMFS found that, not only did the best available evidence contradict the thesis of Plaintiff's petition, but the purported evidence submitted by Plaintiff in support of his petition was flawed to the point of not being reliable. The evidence was refuted based on the following:

1) Juvenile coho salmon were collected from four streams in San Mateo and Santa Cruz county streams in 1895, eleven years before a hatchery program was initiated in Santa Cruz County. These specimens are housed at the California Academy of Sciences in San Francisco;
2) The midden sampling effort was too small to determine absence, a point made by the investigator who conducted the sampling (Gobalet *et al*., 2004)[2];
3) Information suggesting physical conditions are too extreme for coho salmon in Santa Cruz and San Mateo (in comparison to areas north of San Francisco Bay) was not compelling to suggest these conditions were significant enough to preclude species presence – particularly since these same conditions are present throughout other watersheds in the CCC ESU that remain occupied by coho salmon; and
4) NMFS' ESU policy was properly applied to these populations.

Additional information regarding coho salmon south of San Francisco Bay was summarized in Fisheries (Adams *et al*., 2007).

[2] Soon after NMFS issued its finding, Dr. Gobalet examined fish remains of two salmonids recovered during excavations from archaeological site CA-SMA-18 in Año Nuevo State Park, Santa Cruz County. Those remains, which predate European arrival in North America, also were independently evaluated by two other fish osteological (bone) identification experts, with the following result: "[o]ne vertebra was determined to be from a coho salmon by all three experts and the second was identified as coho salmon by two of the three" (Adams *et al*., 2007).

State and Federal Listings of CCC Coho Salmon

NMFS listed the CCC coho salmon ESU on October 31, 1996, as Federally threatened (61 FR 56138) under the Federal Endangered Species Act (ESA) of 1973, as amended. The State of California listed coho salmon south of San Francisco Bay as a state endangered species in 1995. In 2002, the State listed the CCC coho salmon ESU as State endangered and the California portion of the Southern Oregon Northern California coho salmon ESU as threatened. A recovery strategy for the California ESUs was developed by the State and finalized in 2004 (DFG 2004). Due to severe population declines between 1996 and 2004, NMFS relisted CCC coho salmon and changed its status from threatened to endangered (*i.e.*, in danger of extinction throughout all or a significant portion of its range) on June 28, 2005 (70 FR 37160). In spite of the protections afforded by these listings, the development of a State Recovery Plan and ongoing implementation of many recovery actions recommended in the plan, the population has not stabilized and continues to decline.

THE IMPERILED CCC COHO SALMON

Only rough estimates exist of the historical CCC coho salmon adult abundance. There are still no long term data sets for wild coho salmon abundances across individual river systems in the ESU. Despite these limitations, the pronounced decline of CCC coho has been documented over the course of 70 years by various researchers and agencies with estimates of (Figure 3): 200,000 to 500,000 coho salmon statewide in the 1940's (Brown, 1994); 99,000 statewide with approximately 56,100 (56%) in CCC coho salmon ESU streams in the 1963 (DFG 1965); 18,000 wild CCC coho salmon adults in the 1984/1985 spawning season (Wahle and Pearson 1987); 6,000 wild CCC coho salmon adults in the 1990's (61 FR 56138) and the most recent estimate of less than 500 wild adults in 2009 (Spence pers. comm. 2009). In fact, more recent studies are indicating a probable population collapse (MacFarlane *et al.* 2009, in draft) and impending extinction. Coho salmon, as of this writing in 2009, are extirpated or severely reduced in most of the watersheds they historically occupied. All early estimates (including both wild and hatchery fish) from within the CCC ESU (Table 1) are considered "best professional guesses" based on a limited catch statistics, hatchery records, and personal observations of local biologists (Brown *et al*., 1994).

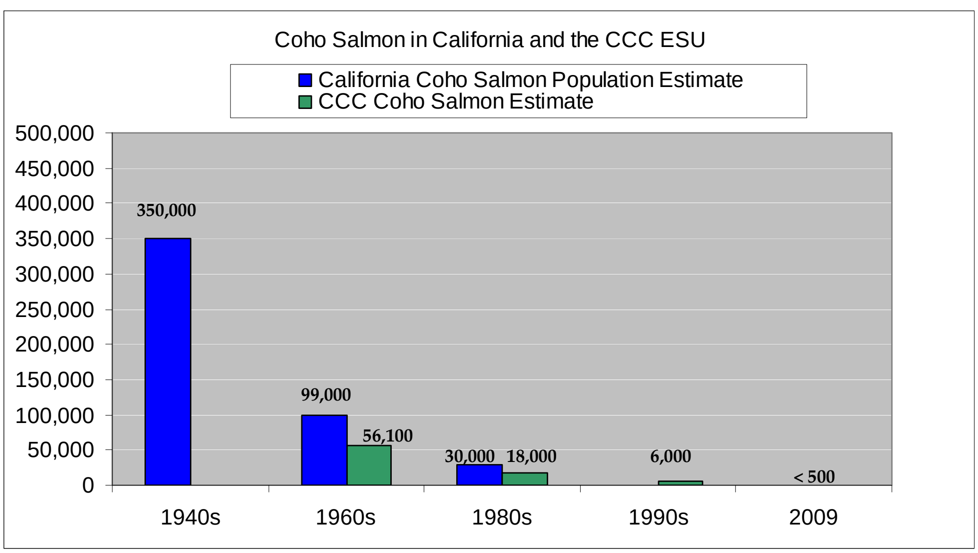


Figure 3: Historical and Current Estimate of Coho Salmon Abundance

Table 5: Historical Estimates of coho salmon spawner abundance across the CCC coho salmon ESU

	Estimated Escapement			
River/Region	DFG (1965)[3] 1963		Wahle & Pearson (1987)[4] 1984-1985	Brown et al. (1994)[5] 1987-1991
Ten Mile River		6,000	2,000	160[6]
Noyo River		6,000	2,000	3,740
Big River		6,000	2,000	280
Navarro River		7,000	2,000	300
Garcia River		2,000	500	
Other Mendocino County		10,000	7,000[7]	470[8]
Gualala River		4,000	1,000	200
Russian River		5,000	1,000	255
Other Sonoma County		1,000		180
Marin County		5,000		435
San Mateo and Santa Cruz Counties		4,100	550	140
San Mateo County	1,000			
Santa Cruz Co (excl. SLRiver)	1,500		50	
San Lorenzo River	1,600		500	
ESU Total	**56,100**		**18,050**	**6,160**

[3] Values excludes ocean catch

[4] Estimates are for wild or naturalized fish; hatchery returns excluded.

[5] Estimates are for wild or naturalized fish; hatchery returns excluded. For streams without recent spawner estimates (or estimates lower than 20 fish), assumes 20 spawners.

[6] Indicates high probability that natural production is by wild fish rather than naturalized hatchery stocks.

[7] Value may include Marin and Sonoma County fish.

[8] Appears to include Garcia River fish.

No time series of adult abundance free of hatchery influence and spanning eight or more years are available for the CCC ESU. Adult counts from the Noyo egg collecting station (ECS) represent a mixture of naturally produced and hatchery fish, and counts are incomplete for most years because trap operation was sporadic during the winter season and typically ceased after quotas were met (Figure 4). These data, at best, represent an index of abundance. Assuming these counts reflect general population trends, there appears to have been a significant decline in abundance of coho salmon in the South Fork Noyo beginning in 1977. That year was one of the driest rainfall years on record for California and also marked a dramatic shift in the prevailing polarity in the oscillation ocean-atmosphere climatic variability centered over the mid-latitude of the North Pacific basin. This shift corresponded with dramatic shifts in salmon production regimes in the North Pacific Ocean (Mantua *et al*., 1997). Since 2000 the ECS has stopped collecting fish and recent estimates (see Noyo River strategies for graph of recent adult escapement in the South Fork Noyo River) reflect the actual run size at the ECS. Despite the caveats described above, the trend for coho salmon in the South Fork Noyo is clear, they have declined and continue to decline in abundance.

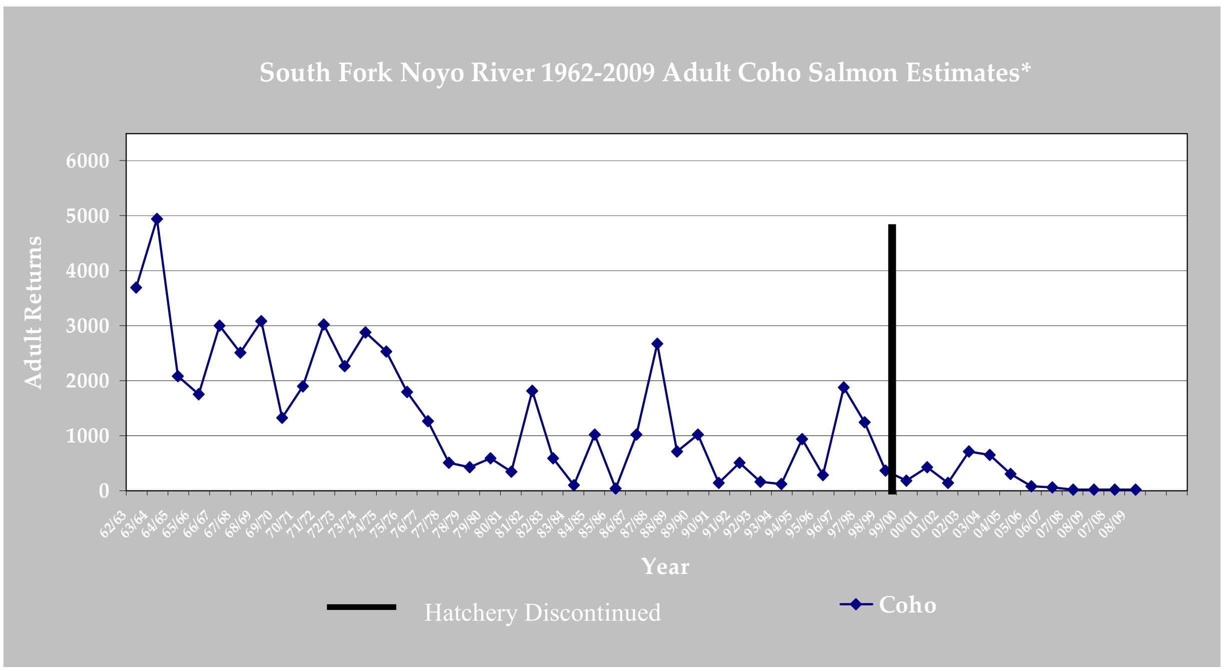


Figure 4: Adult coho salmon returns to Noyo Egg Collecting Station (1965 – 2009)

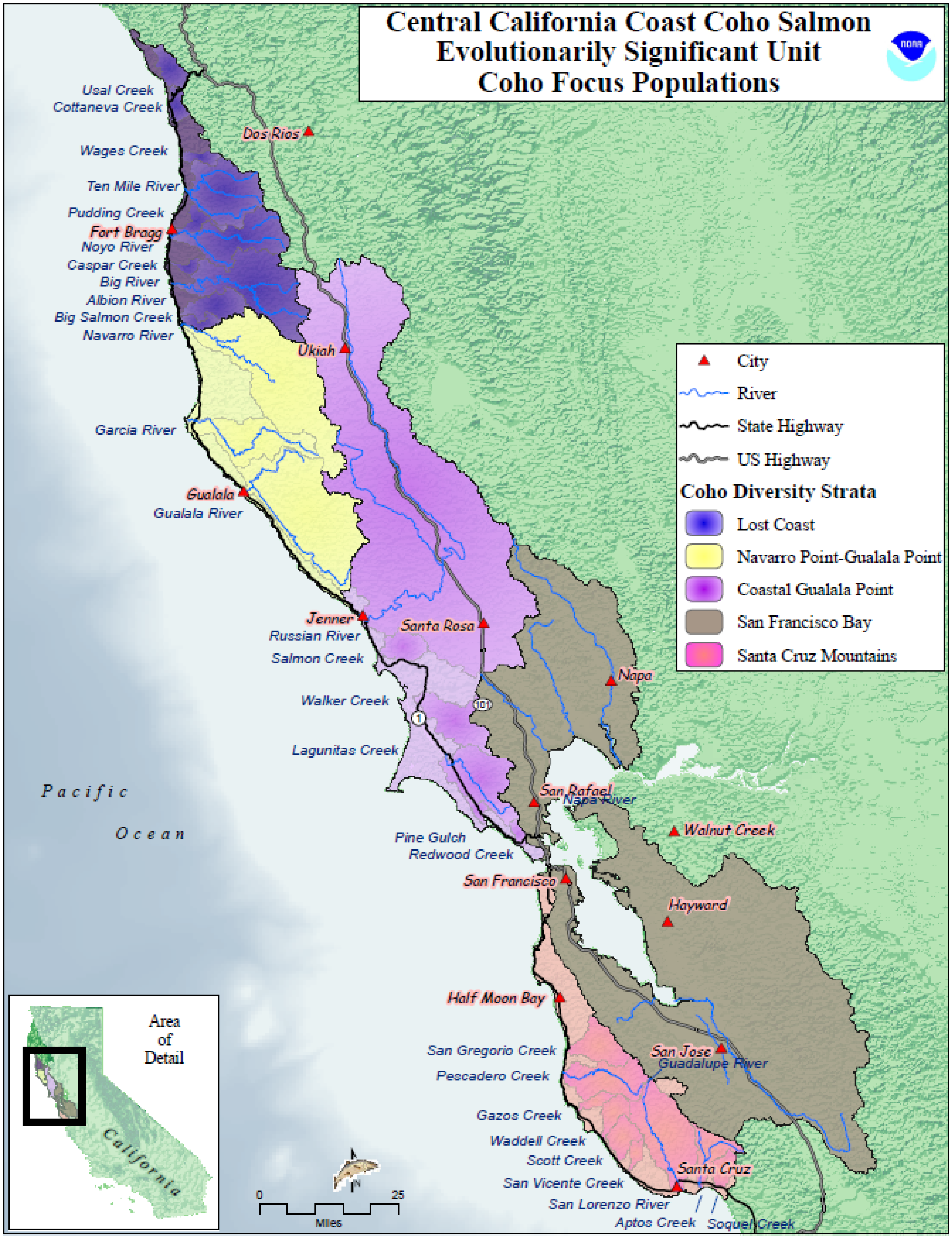


Figure 5: Historical Range of CCC coho salmon and Focus Populations for Recovery

COHO SALMON LIFE HISTORY

Juveniles: Juvenile salmon are blue-green on the back with silver sides and 8-12 parr marks (Hassler 1987). The parr marks are centered along the lateral line and are narrower than the spaces between marks. The adipose fin is finely speckled with uniform pigmentation making it appear dark grey (Moyle 2002). The anal, pectoral, and pelvic fins lack spots and are tinted orange with varying intensity. The anal fin is pigmented between the rays which can produce a black banding effect (Hassler 1987).

Characteristics commonly used to identify juvenile coho salmon from other salmonid species are their sickle shaped anal and dorsal fins and their large eyes (Pollard *et al.* 1997).

Freshwater Adult: Adult coho salmon have a fusiform body shape that is laterally compressed (Hassler 1987). Considered a medium to large salmon, coho salmon typically reach fork lengths of 4–70 cm and weights of 3–6 kg (Shapovalov & Taft 1954; Moyle 2002). Dorsal, anal, pectoral, and pelvic fins range from 9–12, 12–17, 13–16, and 9-11 rays respectively (Moyle 2002). The lateral line is straight with 121–148 single pored scales. The white gum line of coho salmon can be used to distinguish this species from Chinook salmon, which have black gums. Coho salmon can be distinguished from chum and sockeye salmon by the dark spots on the back, dorsal fin, and upper lobe of the tail (Hassler 1987).

Ocean Adult: In the ocean, the coloration of adult coho salmon is steel blue to greenish on the back, silvery on the sides, and white on the belly (Hassler 1987). The coloration of spawning males is dark green on the back, bright red on the sides, and gray to black on the belly (Scott & Crossman 1973). In addition to the red lateral line, spawning males are also characterized by a hooked jaw, enlarged and exposed teeth, and slightly humped backs. Females have duller coloration than males with a pale pink hue on the sides (Moyle 2002). Males and females both have small black spots on the back, upper sides, base of the dorsal fin, and upper lobe of the caudal fin.

Life History Strategy

Coho salmon are anadromous fish, meaning they migrate between the ocean and freshwater environments at different stages of their three-year life; many return to the stream they were born. These life stages are egg, alevin, summer rearing/winter rearing juvenile, outmigrant or smolt and ocean adult. Coho salmon are also semelparous; they die shortly after spawning.

The life history of coho salmon is similar to most Pacific salmonids in that they hatch and rear in freshwater, migrate downstream, grow to adults in the ocean, and return to natal freshwater to spawn and die (Figure 6). Within this cycle coho salmon exhibit less flexibility than other salmonid species, predominantly adhering to a three year life cycle. The exceptions to the three year life cycle are jack males which return to freshwater at two years of age and a small percentage of smolts which remain in freshwater for two years rather than one year. These exceptions prevent genetic isolation between temporal runs (Moyle 2002). The life history and habitat requirements of CCC coho salmon have been well documented by Shapovalov & Taft (1954); Hassler (1987); Emmett *et al.*, (1991); Sandercock (1991); Pearcy (1992); and Moyle (2002).

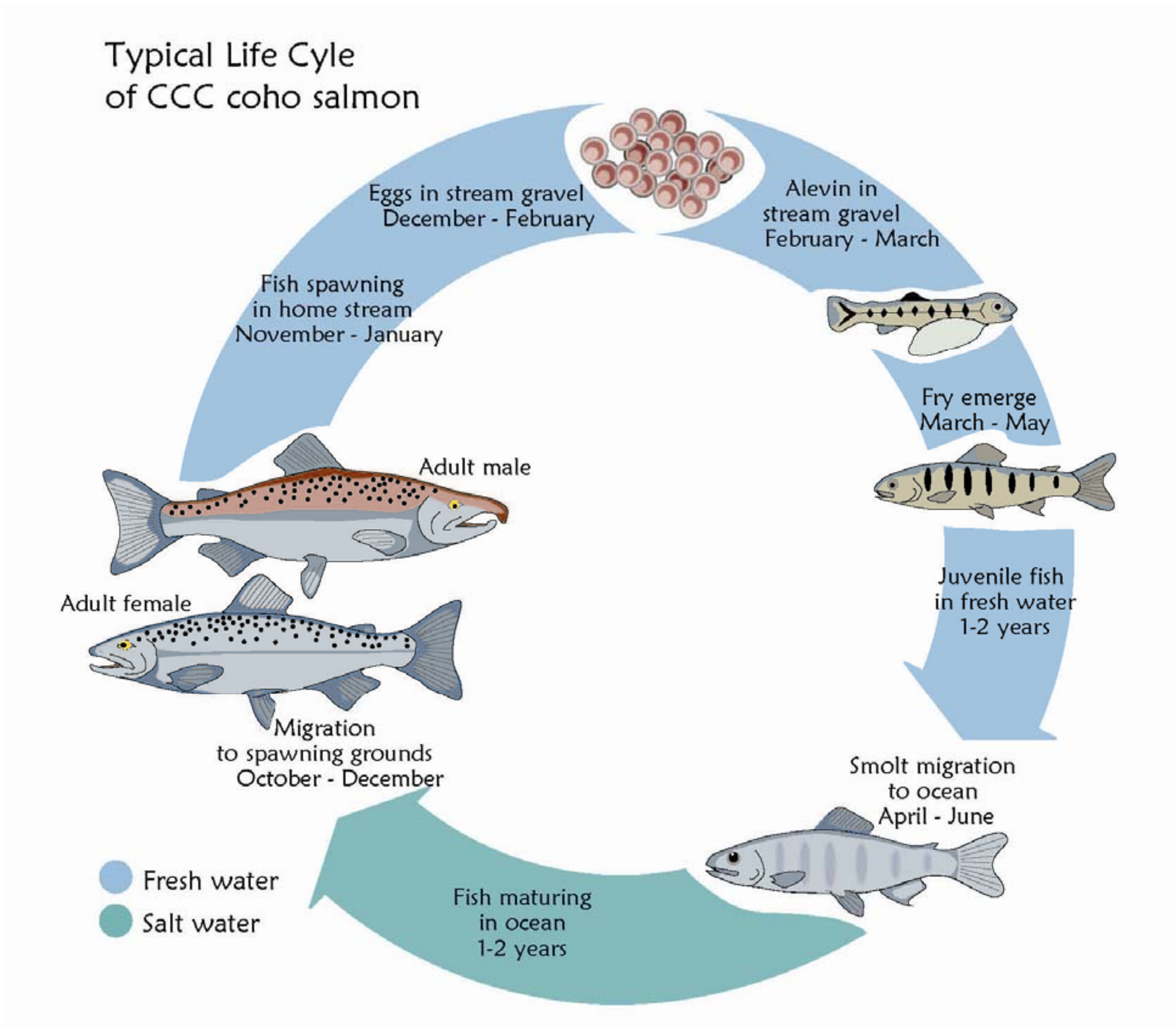


Figure 6: General overview of life stages (modified from Reeves 2009).

Coho salmon exhibit distinct life stages that occur during defined seasons (Table 2). Adult coho salmon migrate from the ocean to natal streams in the fall, generally entering freshwater from September through January and spawning primarily from November to January (DFG 2004). Moving south, the timing of migration occurs later, with fish entering freshwater in the southern portion of the range in November through January and spawning into February or early March (Moyle 2002). The upstream migration typically coincides with large increases in streamflow (Hassler 1987). Coho salmon are often not able to enter freshwater until heavy rains have caused the breaching of sand bars that form at the mouths of many coastal California streams. Spawning occurs primarily in streams with direct flow to the ocean or large river tributaries (Moyle 2002).

Female coho salmon pick a site to spawn at the head of a riffle, just below a pool where water flow changes from slow to turbulent and medium to small size gravel is abundant. Once suitable habitat is located, females fan the gravels with their tails to create nests in the gravel, known as "redds", where they lay their eggs which are fertilized by accompanying males. The number of eggs a female produces is positively correlated with her size (the larger the female, the more eggs), but in general ranges from 1,400–3000 eggs. The number of eggs deposited per redd is approximately 100 or more. Redd location is chosen to allow good aeration and removal of metabolic waste from the nest. Eggs incubate in redds during November through April, hatching into "alevins" after a period of 35-50 days (Shapovalov & Taft 1954). The period of incubation is inversely related to water temperature (Moyle 2002, DFG 2004). Alevins remain in the gravel for two to ten weeks then emerge into the water column as young juveniles, known as "fry".

Table 6: Seasonal calendar of coho salmon presence in California's coastal watersheds. Dark shading indicates months of peak activity for a particular life stage; the lighter shading indicates months of lower activity.

LIFE STAGE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult migration												
Spawning												
Egg Incubation												
Emergence/ Fry												
Juvenile rearing												
Emigration												

Juveniles, or fry, form schools in shallow water along stream margins. Fish feed heavily during this time and as they grow, fish separate and set up individual territories in deep pools with good cover. Juveniles rear in freshwater for about one year with distinct habitat use during summer and winter rearing. In the summer, when flows are low, juvenile coho salmon concentrate in deep pools. In the winter, when stream flows are high, juvenile coho salmon require refuge in habitat such as off channel or backwater pools formed by large woody debris (LWD). After about one year in freshwater juvenile coho salmon undergo transformation into "smolts" in preparation for outmigration to the ocean.

Smoltification is associated with fish age, size, and environmental conditions (Hassler 1987). Smolt outmigration begins in late March or early April, and peaks in California from April to early July (Weitkamp *et al.*, 1995). A period of estuarine residency may occur prior to ocean entry to allow fish to transition to the saline environment. Estuarine use in the CCC coho salmon ESU is quite variable, ranging from substantial juvenile rearing to use only as a migratory corridor.

Ocean adult distribution and behavior are not well studied. After initial entrance to the ocean, smolts concentrate in schools inshore, gradually moving north along the continental shelf (DFG 2004). Ocean residence lasts for two years (except for jacks) until adult fish return to freshwater to spawn and begin the cycle again.

Three-Year Female Life Span

Coho exhibit an almost completely distinct maternal brood year lineage that is a life history trait of significant influence on overall population viability, management, and recovery (DFG 1995). Essentially all wild female CCC coho salmon spawn as three-year olds[9] (Shapovalov and Taft 1954). As a consequence of all wild female coho being three-years old at time of spawning, there are three distinct, separate maternal brood year lineages for the each stream in the ESU (Shapovalov and Taft 1954; DFG 1995). For example, nearly all coho salmon males and females produced in 2008 were the progeny of females produced three years earlier in 2005, which in turn were the progeny of females produced three years earlier in 2001, *etc*. The three maternal brood year lineages are shown in Table 3.

Table 7: Maternal brood year lineage

Lineage: I	2000	2003	2006	2009	2012	2015
Lineage: II	2001	2004	2007	2010	2013	2016
Lineage: III	2002	2005	2008	2011	2014	2017

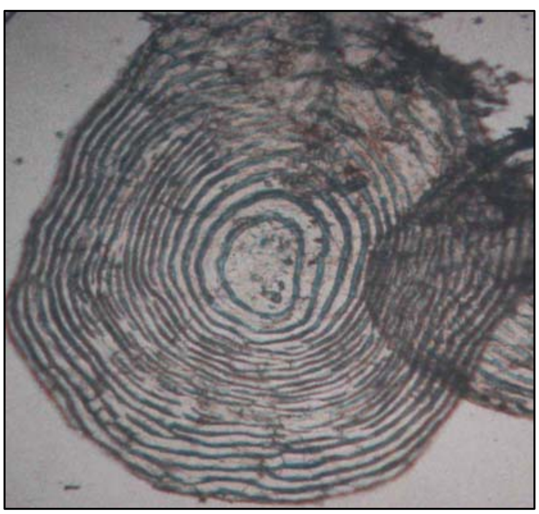


Photo Courtesy: Image of CCC coho salmon scale from 2006, Scott Creek, Santa Cruz, CA. This fish hatched in Spring 2005 and instead of outmigrating in Spring in 2006, it remained in Scott Creek. It would have migrated in 2007. Jerry Smith, San Jose State University.

[9] There is genetic exchange between year classes of a particular stream when two year old precocious males (jacks) of one year class spawns with three year old females of the prior year class. Recent information from California has documented juveniles rearing in freshwater for two years (Bell 2001; Smith pers comm. 2009; Hayes pers. comm. 2009; Wright pers. comm. 2009), and based on documentation of precocious females at the Noyo ECS (DFG 2008 – comments) it appears as though some genetic exchange in maternal brood years is possible.

The overall lack of overlapping maternal generations places brood year lineages (*i.e.*, year classes) at high long-term risk from the adverse effects of stochastic events (such as floods, droughts, *etc*.) This risk is especially high for small, remnant populations. For example, a chemical spill or catastrophic wildfire may eliminate all juveniles in a stream resulting in a complete loss of a year class and, thus, loss of adult spawners three years later. As continuous losses of each year class occurs across generations, extinction becomes imminent. Repopulation is possible by improving freshwater conditions that allow the remnant population to gradually rebound or from pairs straying into neighboring streams to spawn.

Low freshwater survival and reduced population size coupled with poor ocean conditions places further pressure on survival and persistence. This appears to have happened to the lineages of populations in the coho streams south of San Francisco Bay. Lineage I and II have been virtually eliminated but Lineage III persisted in many streams, albeit at a greatly reduced population size. This lineage was generally considered the last strong remaining year class. Unfortunately, poor ocean conditions during 2006/2007 resulted in a catastrophically low rate of adult returns during the winter of 2007/2008 and now, this one strong year class is almost gone (Spence pers. comm. 2009). Further compounding of the risk to coho south of San Francisco Bay occurred with the Lockheed fire in August of 2009. That wildfire burned most of the headwaters of Scott Creek and places this small population at exceptional risk of extirpation due to high rates of sedimentation when the 2009 winter rains begin.

LIFE HISTORY HABITAT REQUIREMENTS

Coho salmon must survive conditions across many different environments between and within freshwater and the ocean. Coho salmon spend the majority of their lives in the ocean, an environment that is difficult to manage and largely subject to environmental events affecting fish outside the control of humans. When environmental conditions are favorable the sub-adult and adult survival rates appear relatively high. Most coho mortality occurs in freshwater and during the rearing stage where the juveniles may be exposed to winter and spring flooding, summer droughts, or lack of rearing or winter refugia space (Sandercock 1991).

In freshwater, coho salmon must have enough energy to migrate (in some cases) long distances, find and fight for mates (males), build redds, survive through winter flows, avoid predators, obtain food, find pools and cool water for summer rearing, access offchannel habitats during outmigration and high winter/spring flows and find refuge in lagoon/estuary habitats for successful saltwater transition to the ocean environment. Environmental conditions influence how much energy coho salmon will need to survive, and whether or not they can survive within the range of available conditions. For example, turbid water beyond a coho salmon's preferred range can increase the energy needed to find food (as prey becomes more difficult to locate). This reduces the energy available to escape predators, and as food input declines, energy for all necessary life functions is further reduced. As environmental conditions become less favorable for coho salmon, fewer will be able to survive (Gregory and Bisson 1997, Lichatowich (1989), Beechie *et al*., 1994). Table 4 summarizes habitat requirements for each life stage.

Table 8: Habitat requirements for each life stage of CCC coho salmon

Freshwater Streams	Eggs: Incubation requires clean water, free of contamination and siltation. Disturbance of a single "redd" (nest of eggs) will result in the death of thousands of salmon embryos.
Freshwater Streams	Alevins: After hatching, alevins remain nestled in the small spaces between the gravels and feed from their attached yolk sacs. They are highly vulnerable to siltation and scour. Once the yolk is absorbed, the young salmon emerge from the gravels.
Freshwater Streams	Juveniles: Deep cool pools for summer rearing juveniles are critical for survival. Riparian vegetation helps support some of the insects consumed by juveniles, provides cover from predators, (when recruited to streams can create wood formed pools) and limits solar radiation to streams keeping water temperatures cool. Tree roots stabilize streambanks and create habitat structure. Downed wood creates cover and refugia for the tiny salmon to reside during high velocity flows. Pools and wetlands provide shelter from high flows and predators.
Freshwater Streams, Estuaries, Ocean	Smolts: Juvenile salmon undergo a physiological change known as "smoltification" that enables them to transition from freshwater to saltwater in the estuaries or lagoons. Smoltification can occur primarily within the freshwater areas, or in the nearshore environment. Smolts need adequate flow from upstream rearing areas to reach these estuaries. Estuaries should provide cover and adequate feeding habitats to facilitate the transition into the ocean. The quality of these areas has implications to survival of smolts as they enter the marine environment.
Ocean	Sub-Adults/Adults: Maturation occurs during ocean residency over a two year period, leading up to the adult salmon's return to streams of their birth. The patterns of migration in the ocean vary and shifts in ocean conditions affect food, migration patterns and survival. Fish in the ocean need adequate supplies of food to facilitate rapid growth. As the salmon return to their natal stream to reproduce, they once again undergo change from saltwater to freshwater; they depend on the nearshore and estuarine environments for this transition.
Ocean, Estuaries, Freshwater Streams	Spawners: Once the adult spawners arrive at their home river they need adequate flows, cool water temperatures, deep pools and cover to rest and hide as they migrate upstream. Females seek clean, loose gravel of a certain size in highly oxygenated water for laying their eggs. The site must remain stable throughout egg incubation and emergence, and allow water to percolate through the gravel to supply oxygen to the developing embryo.

The key to preventing the decline of coho salmon is to protect their spawning and rearing streams and to restore damaged habitat (Moyle 2002). While the ocean environment is where the species spends the majority of its life (and productivity fluctuations in this environment result in changes to coho salmon populations), low ocean returns of adults (escapement) combined with impaired freshwater habitats have a greater negative impact on successful spawning, rearing and outmigration. These factors act synergistically and make it difficult for the population to recover from adverse effects resulting from natural or anthropogenic impacts to ocean cycles. While ocean conditions have fluctuated in the past from poor to excellent for coho salmon, the general trend of freshwater habitat conditions during the 20th and 21st Centuries has been of increasing degradation. Continuing degradation of freshwater habitat impairs the ability of coho to rebound from poor ocean conditions when ocean conditions improve. It is therefore important to restore and protect essential freshwater habitat features.

Conditions in the freshwater environment that ensure the highest likelihood of coho salmon survival through spawning, rearing, and outmigration are varied. Coho salmon are found in a broader diversity of habitats than any of the other anadromous salmonids, from small tributaries of coastal streams to lakes to inland tributaries of major rivers (Meehan & Bjornn 1991). Based on the current status of the population this may seem implausible. However, coho salmon were found throughout their range in California into the mid 1900s. Shapovalov and Taft (1954) reported that coho salmon ascend practically all accessible streams within their range flowing into the Pacific Ocean, from the largest to the very smallest. To emphasize the point they cited Chamberlain (1907) who reported that in southeastern Alaska "(t)he coho is probably less particular (in comparison with the other Pacific salmons) in its requirements. The fry were found, without exception, in every stream and brook examined; even a tiny seepage … which would become dry with the first week of fair summer weather contained its little school of coho fry." Historically, CCC coho salmon inhabited the largest river basins, such as the Russian River, and very small coastal tributaries such as Laguna Creek (Santa Cruz County).

Unfortunately, the habitat requirements for coho salmon in most streams in the CCC ESU are not at properly functioning condition because the natural rates of critical watershed processes (*e.g.,* sediment delivery, hydrology, wood recruitment, temperature regulation, *et cetera*) have been substantially altered by human activities. This is remarkable considering the historically ubiquitous occurrence of coho salmon in the northern coastal streams of North America. The absence of coho salmon in these freshwater habitats is a strong indication that the majority of the watersheds in the CCC ESU are substantially disrupted and degraded. Until these habitats operate at their potential, and the natural processes that form them are restored, streams are unlikely to support viable salmon populations. If ecosystems are allowed to function in a more natural manner, habitat characteristics favorable to salmonids will result, and fish will be able to recolonize and populate historical habitats, recover from earlier stressors, and persist under natural disturbance regimes (Spence 1996). This plan provides strategies to enable the ecosystems where CCC coho salmon once thrived to begin their recovery and ultimately allow the population to reach a recovered status in the same watersheds inhabited by the human population.

Optimal Coho Freshwater Habitat and Current Conditions

When in freshwater, optimal habitats for successful rearing include adequate quantities of: (1) deep complex pools formed by large woody debris, (2) adequate quantities of water, (3) cool water temperatures, (4) unimpeded passage to spawning grounds (adults) and back to the ocean (smolts), (5) adequate quantities of clean spawning gravel, and (6) access to floodplains, side channels and low velocity habitat during high flow events. Numerous other requirements exist (*i.e.*, adequate quantities of food, dissolved oxygen, low turbidity, *etc.*) but in many respects these other needs are generally met when the six freshwater habitat requirements listed above are at a properly functioning condition.

Deep complex pools formed by wood. Large woody debris originating from riparian trees is a form of cover in many streams and its importance is widely recognized (Bisson *et al.* 1987; Holtby 1988). When riparian trees fall into water courses they create conditions which scour the gravel bottoms of streambeds and create deep pools. These pools are the preferred habitat of coho salmon. Coho prefer the slower moving areas of a stream, provided by pools, as feeding habitat and cover from predators. Slow moving water allows coho to capture food with the minimum expenditure of energy. Pools also provide an increase in the volume of rearing habitat which allows a greater density of juveniles than an equivalent length of stream without pool habitats. For example, in British Columbia, juvenile coho salmon abundance was five times higher in streams with large amounts of LWD (Fausch and Northcote 1992 in Bilby and Bisson 1998).

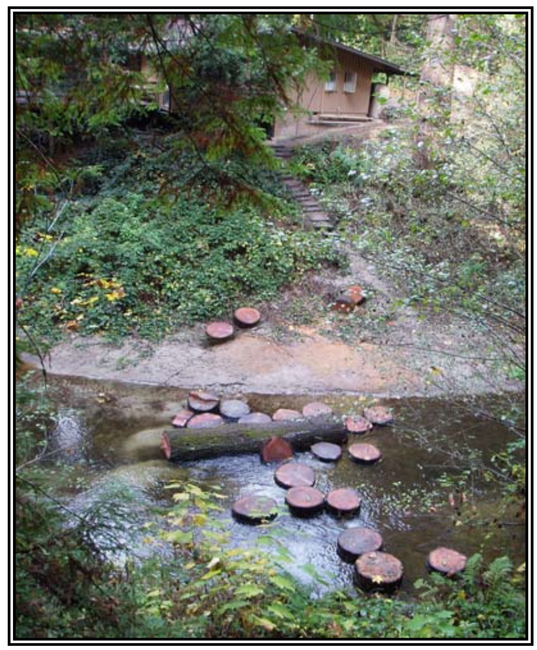


Photo Courtesy: These recent photographs (and the one on the following page) illustrate the practice of removing one of the most essential structural components of coho salmon habitat, large woody debris. These trees were cut up into small pieces on the San Lorenzo River in Santa Cruz County. Cutting these trees rendered them useless in future pool formation due to the wide width of the river. Large trees are needed because they tend to remain stable during high flows and help create deep scour holes that provide summer rearing habitat as well as high flow refugia during winter floods. Photographs courtesy of Chris Berry, Santa Cruz Water Department.

In many streams, these essential pool and complex habitats have been altered or lost due to reduced water flows, large woody debris removal activities, increased rates of sedimentation, and loss, alteration and simplification of riparian forests which leads to a lack of significant large wood recruitment. Lack of recruitment is due in large part to the much younger age of current riparian forests which generally lack older trees that fall into the stream as they age and die. The absence of large wood in the stream, in particular, has had major impacts to coho salmon because of its role in physical habitat formation, in sediment and organic-matter storage, and in maintaining a high degree of spatial heterogeneity (habitat complexity) in stream channels {NAP, 1996}. Decreases in coho abundances following LWD removal or loss have been documented in streams in the Pacific North West and Alaska (Bryant 1983; Dollof 1986; Reeves et al 1993). The loss of pools formed by large woody debris is indicative of past and present management practices as well as altered natural processes. Maintaining pool habitats, reversing the mechanisms leading to their loss, and adding wood will be necessary to ensure adequate summer and winter rearing habitat in every stream designated for recovery.

Photo Courtesy: Caspar Creek, Mendocino County, CA. Prime CCC coho salmon summer rearing habitat. Photo courtesy of Rick Macedo, DFG.

Water.

Fish need water and adequate water quantity and quality are essential for CCC coho salmon survival and persistence. Coho salmon populations need enough aquatic space for large numbers of juveniles to find food and escape from predators. Appropriate flows are needed for migration to and from the ocean, for habitat connectivity during the low flow summer season, for spawning, and for egg and alevin survival.

Lack of water is a severe limiting factor for coho salmon in many watersheds in the CCC ESU. Impacts from ongoing water diversions are most severe in the more urbanized watersheds and watersheds with significant agriculture diversions. California's Mediterranean climate results in low flow conditions during the summer and late fall rearing periods. Water diversions during the summer rearing period magnify the impact of natural low flows with pronounced impacts to juvenile survival. Frost protection for vineyards can create instantaneous flow reductions that leave salmon stranded on a drying stream bed. Additionally, in urbanized areas water runs off more quickly due to increased impervious surfaces resulting in higher winter flows and lower summer baseflow. DFG has noted that undocumented and illegal summer and fall water diversions are a serious concern and many previously perennial streams are now dry in late summer (Harris, S. pers. comm. 2009). Strategies to address this limiting factor are often difficult to implement but will be necessary to begin coho salmon recovery in many of the targeted watersheds in the ESU.

Instream temperature. Summer rearing coho salmon are sensitive to warm water temperatures. Optimal growth occurs when instream temperatures average 12-14° C. When maximum weekly average temperatures exceed 18° C coho salmon are absent from otherwise suitable rearing habitat (Welsh *et al.*, 2001). Temperatures exceeding 25-26° C are lethal. Altered thermal regimes change many characteristics of stream habitat through altering the structure of plant and invertebrate communities (Bisson & Davis 1976) and adverse interspecfic interactions between salmon and non-salmon fishes through increased competition and predation (Reeves *et al.*, 1987).

One of the more important factors contributing to optimal stream temperature is intact riparian buffers. Retention of wide riparian buffers with adequate riparian canopy, formed by mature native trees, moderates water temperature. Riparian canopy intercepts solar radiation, particularly in the smaller tributary streams where coho juveniles rear, and moderates the effects of warm summer temperatures.

Photo Courtesy: Coho smolt with parr marks fading and fish turning silver. San Vicente Creek, Santa Cruz, CA. Chris Berry, City of Santa Cruz Water Department.

Passage. Coho salmon require adequate passage conditions from the ocean to spawning areas for adults and from rearing areas to the ocean for smolts. Reduced flows, debris jams, plugged or improperly placed/sized culverts, excessive water velocities, closed sandbars and other conditions impede migrating adults. Unscreened diversions can impede smolt outmigration, particularly during low flow conditions. Typically, adult coho salmon do not migrate to the higher gradient stream reaches that steelhead are able to access. Many of the more significant barriers to adult migration in the CCC ESU have been addressed because a large proportion of past restoration projects have been directed at fixing passage problems. Barriers formed by large wood were removed at considerable effort by DFG in the past[10].

Spawning gravel. Adult coho females typically choose a spawning site near the head of a riffle, just below a pool, where water changes from smooth to turbulent flow and where there is abundant medium to small gravel. Most females dig at least three to four nests (redds) and deposit eggs in each {Godfrey, 1965}. The eggs will incubate an average of 38 days at 10.7° C (Shapovalov & Taft 1954) or longer at cooler water temperatures. Depth of egg burial varies substantially within and between salmon populations (Burner, 1951; van den Berghe and Gross, 1984; Tripp and Poulin, 1986). In some cases, larger females deposit eggs at greater depth than their smaller counterparts (van den Berghe and Gross, 1984), reducing the probability egg loss due to streambed scour during high flow conditions. Physical factors such as water velocity, the size of substrate and compaction of the stream bed also influence the depth of egg burial (Burner, 1951). Upon hatching the sac fry (alevins) remain in the gravel from one to five months. To ensure survival from spawning to emergence the gravels must be clean of fine sediment in order to supply, via intragravel flow, the eggs and newly hatched sac fry with oxygen rich water and to remove metabolic waste.

Photo Courtesy: A coho salmon redd and spawning gravel on the South Fork Noyo River, Jackson Demonstration State Forest, Mendocino County, CA. Rick Macedo, DFG.

Gravels with high concentrations of fine sediment can substantially reduce egg survival. Phillips *et al.*, (1975) found survival to emergence was only eight percent where gravel/sand mixtures were 70 percent (particle size < 3.3 mm). Fine sediment originates from many anthropogenic activities including agriculture, livestock grazing, urbanization, roads, forestry, mining as well as natural processes such as landslides, streambank erosion, and fire. Minimizing anthropogenic sources of fine sediment is readily achievable when riparian buffers of sufficient size persist along stream channels, culverts are adequately sized and properly located, development or extractive land management practices are avoided on unstable areas, cover crops are left during the winter, roads are properly maintained, *etc.*

[10] Today a lack of wood exists in many streams due to some of the large wood removal activities that were conducted for the purpose of passage improvement and channel improvement. Reduced large wood frequencies in most streams is now recognized as a key habitat limiting factor of for coho habitat across the CCC ESU.

Photo courtesy: This series of photographs illustrates the consequences of a massive land slide at the headwaters of Soldier Creek, tributary to Usal Creek in Mendocino County, California. The slide may have delivered up to one million cubic yards of sediment into the watershed. Sediment from this slide buried the coho salmon spawning and rearing habitat in Soldier Creek rendering it unsuitable for coho salmon for many years afterwards. Picture at bottom left illustrates the lower portion of Soldier Creek that changed from a system with abundant diversity of instream habitat to a greatly simplified stream that was essentially one long continuous riffle, unsuitable for juvenile rearing. Picture at bottom right illustrates the sediment plume from Soldier Creek as it enters North Fork Usal Creek. Twelve years after the slide stream conditions are improving. Photos courtesy of David Hines and Jonathan Ambrose, NMFS.

Floodplains. Survival and distribution of juvenile coho salmon are associated with available winter habitat (Bustard & Narver 1975; Peterson 1982; Tschaplinski & Hartman 1983; Nickelson *et al.* 1992; Quinn & Peterson 1996, Bell 2001). During winter, juvenile coho salmon select habitats with low velocity water such as alcoves, side-channels, backwaters, riverine ponds, and deep pools formed by rootwads (Bustard & Narver 1975; Tschaplinski & Hartman 1983; Nickelson *et al.* 1992). These habitat features provide cover from predators and protection from high discharge, factors that cause premature emigration and/or mortality of over-wintering salmonids (Bustard & Narver 1975; McMahon & Hartman 1989; Sandercock 1991; Erman *et al.*, 1988). These habitat features often occur at the greatest frequency on floodplains.

Cottaneva Creek, Mendocino County, CA. Photo courtesy of Matt Goldsworthy, MRC

Because survival and growth are often better in floodplain habitats, maintenance and restoration of these areas may be of exceptional importance for coho salmon recovery. However, floodplains are frequently locations of human development and as the name implies, are areas prone to flooding. Many floodplain habitats in the CCC ESU are heavy altered and channelized (for flood control and as a matter or routine maintenance practices) and no longer maintain alcoves, side-channels, backwaters, *etc.* Restoring floodplain habitats, wherever feasible and beneficial, would have a significant benefit to over-winter survival of juvenile coho salmon.

For more extensive discussion of and data supporting the relationship between changes in habitat variables and the status and trends of fish and wildlife populations, readers should refer to the work of Fiedler and Jain (1992), Gentry (1986), Gilpin and Soule (1986), Nicholson (1954), Odum (1971, 1989), and Soulè (1986). For detailed discussions of the relationship between habitat variables and the status and trends of salmon populations, readers should refer to the work of FEMAT (1993), Gregory and Bisson (1997), Hicks *et al*., (1991), Murphy (1995), National Research Council (1996), Nehlsen *et al*., (1991), Spence *et al*., (1996), Thomas *et al*., (1993), and The Wilderness Society (1993).

Photo courtesy: Branciforte Creek on the San Lorenzo River, Santa Cruz County, CA. This picture illustrates permanent impacts to a riparian zone on a floodplain due to bank hardening and stabilization actions. This urbanized stream bank no longer provides shade or any potential for future wood recruitment. The rip rap on the streambank will act to increase water velocity rending the habitat much less suitable for rearing and migration. Jon Ambrose, NMFS.

<u>Marine Environment</u>

The marine life stage of CCC coho salmon is not well studied. After initial entrance to the ocean, smolts concentrate in schools inshore, gradually moving north along the continental shelf (DFG 2004). As described above, ocean residence typically lasts for two years, when adult fish return to freshwater to spawn and begin the cycle again. Some precocious males (jacks) return after only six months of ocean residence.

Long-term trends in marine productivity associated with atmospheric conditions in the North Pacific Ocean have a major influence on coho salmon production. Natural climatic conditions may have exacerbated or mitigated the problems associated with degraded and altered riverine and estuarine habitats (69 FR 33102). Coho salmon have evolved behaviors and life history traits allowing them to survive a variety of environmental conditions. When populations are fragmented or reduced in size and range, however, they are more vulnerable to extinction by natural events.

Poor ocean conditions are believed to have a prominent role in the recent decline of coho salmon populations in California. Unusually warm ocean surface temperatures and associated changes in coastal currents and upwelling, known as El Niño conditions result in ecosystem alterations such as reductions in primary and secondary productivity and changes in prey and predator species distributions. More significantly, poor ocean conditions that affect the biological productivity are the result of interdecadal climate variability in the northeast Pacific (Beamish and Boullion 1993, Hollowed and Wooster 1994). Regimes shifts in the ocean have likely significantly adversely affected overall CCC coho salmon production.

El Niño is often cited as a cause for the decline of West Coast salmonids. Near-shore conditions during the spring and summer months along the California coast may have dramatically affected year-class strength of salmonids (Kruzic *et al.,* 2001). Coho salmon along the California coast may be especially sensitive to upwelling patterns because of the lack of other coastal habitat types that normally buffer adverse oceanographic effects (*i.e.* extensive bays, straits, and estuaries). The paucity of high quality near-shore habitat, coupled with variable ocean conditions, makes freshwater rearing habitat more crucial for the survival and persistence of many coho salmon populations. Of greatest importance is not how salmonids perform during periods of high marine survival, but how prolonged periods of poor marine survival affect population viability. Salmonid populations have persisted through many such cycles. It is less certain how they will fare in periods of poor ocean survival when freshwater, estuary, and nearshore marine habitats are degraded (Good *et al.,* 2005). Recovery of coho salmon in the NCCC Domain will depend on populations robust and resilient enough to withstand natural changes in ocean productivity.

El Nino events are interannual variations in ocean conditions that decrease the abundance of salmonid prey items in the ocean, and while they tend to occur more frequently in particular longer term ocean environmental regimes they are not necessary for poor marine survival. The changes to Pacific Decadal Oscillation (PDO) are more long lasting and more profound. Synthesis of climate and fishery data from the North Pacific sector highlights the existence of this very large scale, interdecadal, coherent pattern of environmental and biotic changes. The marine ecological response to the PDO-related environmental changes starts with phytoplankton and zooplankton at the base of the food chain and works its way up to higher level predators like salmon (Venrick *et al.,* 1992, Roemmich and McGowan 1995, Hare 1996, Brodeur *et al.,* 1996, Francis *et al.,* 1997). This "bottom-up" enhancement of overall productivity appears to be closely related to upper ocean changes that are characteristic of the positive polarity of the PDO. PDO reversals occurred in 1925, 1947, and 1977 (Mantua *et al*., 1997, Mantua and Hare 2002). The results of these reversals were significantly changed harvest patterns between Alaskan fisheries and fisheries in Washington, Oregon, and California (WOC). Of note however, Mantua *et al*., (1997) observed a weaker connection between harvest records for the WOC salmonids than the Alaskan fisheries. They indicated that climatic influences on salmon in their southern ranges may also be masked or overwhelmed by anthropogenic impacts: Alaskan stocks are predominantly wild spawners in pristine watersheds, while the WOC coho and Columbia River spring Chinook salmon are mostly of hatchery origin and originate in watersheds that have been significantly altered by human activities.

For more information on marine conditions please see Appendix A.

Photo Courtesy: Hatchery adult (from the Broodstock Program) CCC coho salmon, Scott Creek, Santa Cruz County, CA. Morgan Bond, SWFSC

Chapter 2: The ESA & NMFS Recovery Planning

"From the most narrow possible point of view, it is in the best interest of mankind to minimize the losses of genetic variations. The reason is simple: they are potential resources. They are the keys to puzzles which we cannot solve, and may provide answers to questions which we have not yet learned to ask."

U.S. House of Representatives when enacting the Endangered Species Act

THE FEDERAL ENDANGERED SPECIES ACT

The federal ESA (16 U.S.C. 1531 *et seq*.) was enacted by Congress and signed into law December 28, 1973, by President Richard Nixon, and amended several times subsequently (16 U.S.C. 1531 et seq.). The ESA was established to conserve the Nation's natural heritage for the enjoyment and benefit of current and future generations by conserving species in danger of extinction. The intent of Congress, interpreted by the United States Supreme Court, in enacting the ESA was "to halt and reverse the trend toward species extinction," "require agencies to afford first priority to the declared national policy of saving endangered species," and "give endangered species priority over the 'primary missions' of Federal agencies" (Tennessee Valley Authority v. Hill, 437 U.S. 153 1978).

NMFS and the U.S. Fish and Wildlife Service (USFWS) share responsibility for ESA implementation. Generally, USFWS manages land and freshwater species, while NMFS manages marine and anadromous species (*e.g.*, species that live their adult lives in the ocean but move into freshwater streams to reproduce or spawn; such as salmon). When a marine or anadromous species is listed as Federally threatened or endangered, section 4 of the ESA requires NMFS to develop a plan for the species conservation and survival (*i.e.*, recovery plan). The plan of recovery should outline the processes needed to stop or reverse the decline, neutralize threats, and bring the species back from possible extinction to a point at which the protections of the ESA are no longer necessary.

NMFS (2006a) defines recovery as:

"…the process by which listed species and their ecosystems are restored and their future safeguarded to the point that protections under the ESA are no longer needed."

Section 4(f)(1)(B) of the ESA outlines that the agency shall to the maximum extent practicable:

> *Incorporate in each plan -*
>
> *i. Description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;*
>
> *ii. Objective, measurable criteria which, when met, would result in the determination that the species be removed from the list; and*
>
> *iii. Estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and the intermediate steps toward that goal.*

Case law has underscored the requirement that actions must be site-specific and that criteria must link to the factors that led to the species decline. The 1994 Interagency Policy on Information Standards directs NMFS to "verify and assure the quality of the science used to establish official positions, decisions and actions" (59 FR 24271). Furthermore, the Data Quality Act of 2002 requires NMFS to use the best available information and process all information sources and analyses through a formal system of review (69 FR 49718).

Section 4(f) additionally provides guidance for agencies to "procure services of appropriate public and private agencies and institutions, and other qualified persons" and appoint recovery teams. Section 4 (f)(3) outlines that agencies "shall report every two years to the Committee on Environment and Public Works of the Senate and the Committee on Merchant Marine and Fisheries of the House of Representatives on the status of efforts to develop and implement recovery plans for all species listed…and on the status of all species for which such plans have been developed." NMFS' recovery planning process is additionally guided by the Interim Endangered and Threatened Species Recovery Planning Guidance (NMFS 2006a).

RECOVERING SALMONIDS UNDER THE FEDERAL ESA

There are 27 populations of salmon and steelhead across the Pacific Northwest designated as threatened with extinction or in danger of extinction under the ESA. A recent NMFS status review (Good *et al.* 2005) determined that, while significant efforts to improve habitats are underway and improvements in the abundance of several populations were observed, all populations continue to warrant ESA protections.

NMFS Southwest Region recovery planning for these salmon and steelhead is organized into Recovery Domains. Each Domain includes: (1) one or more populations of salmon and steelhead; (2) a recovery coordinator responsible for facilitating development of the recovery plan; and (3) a Technical Recovery Team (TRT) led by the NMFS Science Center. While each recovery plan will meet ESA requirements, the process of recovery plan development across the Pacific Northwest varies based on the unique circumstances of the Domain such as species life history, local planning efforts, public interest and coordination, and data availability.

California's Recovery Domains

Of the 27 salmon and steelhead populations listed under the ESA, ten are entirely within, or partly occur in, California. These 10 populations are organized into four Recovery Domains (Figure 7): (1) Southern Oregon/Northern California Coast; (2) North-Central California Coast; (3) California Central Valley; (4) South-Central/Southern California Coast. Responsible NMFS offices for each Domain are located in: (1) Arcata; (2) Santa Rosa; (3) Sacramento; and (4) Long Beach, respectively.

The Southwest Fisheries Science Center (SWFSC) in Santa Cruz, California, chairs the TRT of each Domain. The TRTs are comprised of technical experts appointed as an official recovery team charged with identifying the historical population structure and developing biological viability criteria for each listed salmon ESU and steelhead Distinct Population Segment (DPS) in their respective domains. Plan development and finalization—including processes for public outreach, stakeholder input, and internal coordination– are the responsibility of the Protected Resources Division (PRD) of NMFS and of the recovery coordinator.

Goals of This Draft Recovery Plan

While the ultimate goals of a recovery plan are to provide a basis for delisting, it is also our intent to provide the public an opportunity to learn more about salmon and how they can contribute to salmon recovery in California. This draft is intended to foster discussions and information/data exchange regarding watershed conditions, status coho salmon, priority recovery actions that can be mutually beneficial in establishing restoration opportunities.

Overarching goals of the recovery plan are to:

- ❑ Provide information on the life history of CCC coho salmon related to their endangerment and recovery;
- ❑ Outline a transparent and adaptable strategy to achieve recovery;
- ❑ Identify highest priorities, and recovery actions targeting those priorities;
- ❑ Establish criteria to measure the achievement of recovery; and
- ❑ Provide a framework for outreach, funding, and collaboration for recovery.

Furthermore, it is the intent of the ESA that recovery plans guide Federal agencies in fulfilling their obligations under section 7(a)(1) of the ESA, which calls on all Federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species…" In addition to outlining strictly proactive measures to achieve the species' recovery, the plans provide context and a framework for implementation of other provisions of the ESA with respect to a particular species, such as section 7(a)(2) consultations on Federal agency activities or development of section 10(a)(1)(B) Habitat Conservation Plans (HCPs).

Recovery: A Collaborative Effort

NMFS believes it is critically important to base ESA recovery plans for Pacific salmon on the many Federal, State, regional, local, and private conservation efforts already underway throughout the region. It is essential that those whose activities directly affect the listed species, and whose actions will be most affected by recovery requirements, support ESA recovery plans. NMFS will encourage locally-led collaborative efforts to finalize this and other recovery plans, involving local communities, State and Federal entities, and other stakeholders.

North Central California Coast Recovery Domain

The NCCC recovery domain is located along approximately 250 miles of California coast, extending from the Redwood Creek watershed in Humboldt County to the Aptos Creek watershed in Santa Cruz County. This domain encompasses approximately 8 million acres and includes the San Francisco Bay Estuary and its tributaries (except for the Sacramento-San Joaquin rivers), as well as Humboldt Bay and its tributaries. The geographic setting of the domain includes forested mountains, the adjacent Pacific Ocean, and the highly urbanized areas of San Francisco Bay and the north-south U.S. Highway 101 corridor (Figure 7). The NCCC Domain includes the following ESUs and DPSs: Central California Coast steelhead; Northern California steelhead; California Coastal Chinook and CCC coho salmon. This recovery plan was developed specifically for the CCC coho salmon ESU first due to its critical status, to be followed by a multispecies plan for the remaining populations in the Domain.

Figure 7: California's Four Salmon and Steelhead Recovery Domains (with overlapping Domain areas shown with cross-hatching).

CHAPTER 3: FACTORS LEADING TO FEDERAL LISTING

"Man in his misguidance has powerfully interfered with Nature. He has devastated the forests, and thereby even changed the atmospheric conditions and the climate. Some species of plants and animals have become entirely extinct through man, and the purity of the air is affected by smoke and the like, and the rivers are defiled. These and other things are serious encroachments upon Nature, which men nowadays entirely overlook but which are of the greatest importance, and at once show their evil effect not only upon plants but upon animals as well, the latter not having the endurance and power of resistance of man."

Goethe, 1832

PURPOSE

To comply with ESA, case law and recovery planning policies, an analysis of threats (*e.g.*, listing factors) identified at the time of and since listing was conducted according to the following guidelines:

1. Directives by the U. S. Government Accountability Office (GAO 2006), from an audit of all recovery plans, to ensure all new recovery plans have criteria evidencing consideration of all factors considered to affect the species at time of listing; and
2. Case law outlining plans must recognize identified threats and recommend appropriate actions to address threats. The administrative record should reflect the agency considered new ESA section 4(a) threats that have arisen since listing, document the existence of new threats or the elimination of a threat since listing, and develop criteria that address these threats Fund for Animals at 111; Defenders of Wildlife v. Babbitt, 130 F. Supp. 2d. 121 {D.D.C. 2001}. The *Federal Register* notices analyses should facilitate the development of criteria that address the factors that affect the species and provide a benchmark to measure whether threats have been reduced or removed.

All pertinent *Federal Register* notices, including both proposed and final listing determinations for the CCC coho salmon were reviewed (Table 5). The listing factors described in this Chapter are those specified at the time of listing and explicitly described in the listing determination notices for which the notice pertained, or those incorporated by reference. The current status of all listing factors were assessed in context to the recovery plan threats analysis and through consultation with staff/personnel from NMFS, DFG, and other entities. All data were catalogued to facilitate tracking of threats at the time of listing, those changed since listing and newly identified threats. Each table records the date and page number of publication in the *Federal Register*, and describes each as it was presented in the *Federal Register* at the time of publication. New and forecasted threats are compared against the listing factors and linked to associated strategies by threat category. These tables can be provided upon request, are part of the administrative record and will be included in the final recovery plan. These analyses allow tracking during reclassification to a possible downlisted or delisted status, and provide the framework to assessing how implementation will ensure underlying causes of decline are being addressed or mitigated. The status of listing factors and associated recovery criteria to improve conditions and abate threats is outlined in Table 6. The analysis results indicate little to no change in threats since listing; a short summary is provided.

Table 9: Federal Register Notices analyzed to assess threats and protective measures

Date	Citation	Title	Content Description
July 25, 1995	60 FR 38011	Endangered and Threatened Species; Proposed Threatened Status for Three Contiguous ESUs of Coho Salmon Ranging From Oregon Through Central California	Proposed rule: threatened status for CCC coho salmon.
October 31, 1996	61 FR 56138	Endangered and Threatened Species; Threatened Status for CCC Coho Salmon ESU	Final rule: threatened status for CCC coho.
June 14, 2004	69 FR 33102	Endangered and Threatened Species: Proposed Listing Determinations for 27 ESUs of West Coast Salmonids	Proposed rule: endangered status for CCC coho salmon, threatened status update for CC Chinook, threatened status update for CCC steelhead, threatened status update for NC steelhead.
June 28, 2005	70 FR 37160	Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs	Final rule, endangered status for CCC coho salmon, threatened status update for CC Chinook salmon. Extend final listing for *O. mykiss* DPSs.

FACTORS AFFECTING CCC COHO SALMON AT THE TIME, AND SINCE, LISTING

Section 4(a)(1) of the ESA and NMFS implementing regulations (50 CFR Part 424) direct NMFS to determine if a species is threatened or endangered through one or a combination of the following factors:

Federal Register Listing Factors:

(A) The present or threatened destruction, modification or curtailment of habitat or range;

(B) Overutilization for commercial, recreational, scientific, or educational purposes;

(C) Disease or predation;

(D) Inadequacy of existing regulatory mechanisms; or

(E) Other natural or man-made factors affecting its continued existence.

Through the regulatory process, the Secretary of Commerce has determined that the CCC coho salmon ESU is an endangered species based on the combination of the five factors as summarized below. The factors threatening naturally reproducing coho salmon throughout its range are numerous and varied. For the CCC coho salmon ESU the present depressed condition is the result of several long-standing human-induced factors (*e.g.*, habitat degradation, harvest, water diversions, and artificial propagation) that serve to exacerbate the adverse effects of natural environmental variability from such factors as drought and poor ocean conditions (61 FR 56138).

Factor A (At Time of Listing): Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Logging, agriculture and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals and unscreened diversions for irrigation contributed to the decline of the CCC coho salmon ESU. Land use activities associated with logging, road construction, urban development, mining, agriculture, and recreation have significantly altered coho salmon habitat quantity and quality (61 FR 56138). Impacts of concern associated with these activities include the following: alteration of streambank and channel morphology, alteration of ambient stream water temperatures, elimination of spawning and rearing habitat, fragmentation of available habitats, elimination of downstream recruitment of spawning gravels and LWD, removal of riparian vegetation resulting in increased stream bank erosion, and degradation of water quality (61 FR 56138). Of particular concern was the increased sediment input into spawning and rearing areas resulting from the loss of channel complexity, pool habitat, suitable gravel substrate, and LWD (61 FR 56138). Decreased large woody material in streams also reduced habitat complexity and contributed to the loss of cover, shade, and pools which are required by juvenile coho salmon (60 FR 38011). Logging activities altered the natural hydrograph.

Agricultural practices contributed to the degradation of salmonid habitat in the ESU through irrigation diversions, overgrazing in riparian areas, and compaction of soils in upland areas from livestock. Habitat degradation resulting from the negative impacts of livestock grazing on riparian vegetation are described in 61 FR 56138. Urbanization has degraded coho salmon habitat through stream channelization, changes to the hydrologic regime (including floodplain drainage), riparian damage, and point source and non-point pollution (including sediments with trace metals, pesticides, herbicides, fertilizers, gasoline, and other petroleum products).

Depletion and storage of natural flows have drastically altered natural hydrological cycles in many central California rivers and streams. Alteration of stream flows has increased juvenile salmonid mortality for a variety of reasons described in 61 FR 56138. Reduced flows degrade or diminish fish habitats via increased deposition of fine sediments in spawning gravels, decreased recruitment of new spawning gravels, encroachment of riparian and non native vegetation into spawning and rearing areas, and increased water temperatures (60 FR 38011; 61 FR 56138).

The destruction or modification of estuarine areas has resulted in the loss of important rearing and migration habitats. California has experienced a 91 percent loss of its wetland habitat.

Factor A (Since Listing): Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

No significant changes to this factor have occurred since listing and the threats remain. Land use activities associated with logging, road construction, urban development, mining, agriculture, ranching, and recreation, and their associated impacts continue to result in the loss, degradation, simplification, and fragmentation of CCC coho salmon habitat, and cause resulting declines in CCC coho salmon populations. Depletion and storage of natural flows have drastically altered natural hydrological cycles in many central California rivers and streams. Many habitat blockages, including major dams such as Coyote and Warm Springs Dams located in the Russian River Basin, exist within the ESU.

Factor B (At Time of Listing): Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Coho salmon were historically a part of tribal fisheries, and were targeted in recreational and commercial fisheries since the early 1800s. Overfishing in the early days of European settlement led to the depletion of many stocks of salmonids, prior to extensive modifications and degradation of natural habitats (69 FR 33102). Marine harvest of coho salmon occurs primarily in nearshore waters off British Columbia, Washington, Oregon, and California. Recreational fishing for coho salmon was pursued in numerous streams throughout the central California coast when adults return on the fall spawning migration. Coho salmon stocks were managed by NMFS in conjunction with the Pacific Fisheries Management Council, the States, and certain tribes. The central California coast falls within the Federal salmon fishery management zone stretching from Horse Mountain, just north of Fort Bragg, California, to the Mexico border. Coho salmon ocean harvests were managed by setting escapement goals for Oregon Coastal Natural coho salmon. This stock aggregate constituted the largest portion of naturally produced coho salmon caught in ocean salmon fisheries off California and Oregon. Using this index may have resulted in pre-1994 exploitation rates higher than central California populations could sustain. The confounding effects of habitat deterioration, drought, and poor ocean conditions on coho salmon survival make it difficult to assess the degree to which recreational and commercial harvest have contributed to the overall decline of coho salmon in West Coast rivers (61 FR 56138). However, during periods of decreased habitat availability (*e.g.*, drought conditions) the impacts of incidental capture from recreational fishing may be heightened.

Collection for scientific research and educational programs had little or no impact on California coho salmon populations. In California, most of the scientific collection permits are issued to environmental consultants, Federal resource agencies, and educational institutions by DFG and NMFS. Regulation of take is controlled by conditioning individual permits. DFG and NMFS require reporting of any coho salmon taken incidental to other monitoring activities; however, no comprehensive total or estimate of coho salmon mortalities related to scientific sampling are kept for any watershed in California. DFG does not believe that indirect mortalities associated with scientific use are detrimental to coho salmon in California (61 FR 56138).

Factor B (Since Listing): Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

No significant changes to this factor have occurred since listing and the threats remain. State sport fishing regulations no longer allow retention of CCC coho salmon in inland or nearshore waters. Commercial harvest of coho salmon is not permitted in California. A global moratorium on high seas driftnet fishing (via a United Nations resolution implemented by the US in 1992) has reduced the impact of this threat to salmonids. Collection for scientific research and education programs is currently not being tracked; therefore, it is unknown how collecting may be affecting CCC coho salmon populations. Given the extremely low population, any collection may have a significant adverse effect and should be monitored.

Factor C (At Time of Listing): Disease or Predation

Relative to the effects of fishing, habitat degradation, and hatchery practices, disease and predation were not believed to be major factors contributing to the decline of West Coast coho salmon populations. However, disease and predation may have substantial adverse impacts in local areas.

Coho salmon are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. Specific diseases known to be present in and affect salmonids are listed in 69 FR 33102. Very little current or historical information existed to quantify changes in infection levels and mortality rates attributable to these diseases for coho salmon. However, studies have shown native fish tend to be less susceptible to these pathogens than hatchery-reared fish (Buchanan *et al*., 1983; Sanders *et al.,* 1992). In California, many natural and hatchery coho salmon populations were tested positive for the bacterium *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease (BKD). Within the CCC coho salmon ESU, the overall incidence of BKD infection in fish at Scott and Waddell Creeks was believed to be 100 percent (61 FR 56138). Stress, caused by migration or poor water quality or quantity, may trigger the onset of the disease. DFG initiated a treatment protocol to attempt to control BKD outbreaks in hatchery fish released into the Russian River and Scott Creek (61 FR 56138).

Introductions of non-native species and habitat modifications resulted in increased predator populations in numerous rivers and lakes. Predation by marine mammals (primarily harbor seals and California sea lions) was also of concern in areas experiencing dwindling run sizes of salmon. Predation by seabirds can decrease the survival of juvenile coho salmon. Known avian predators include ring-billed gulls, common merganser, herons, cormorants, and alcids. Piscivorous predators may also affect the abundance and survival of salmonids. Although predation does occur, it is believed to be a minor factor in the overall decline of coastwide salmonid populations. The increased impact of certain predators was largely the result of ecosystem modification related to habitat changes and a decrease in water quantity and quality. For example, decreases in cover habitat and adequate migration and rearing flows make fish more vulnerable to predation.

Factor C (Since Listing): Disease or Predation Since Time of Listing

The threats identified at the time of listing remain. Relative to other effects (*i.e.*, habitat degradation and hatchery practices), disease and predation are not believed to be major factors contributing to the decline of West Coast coho salmon populations (61 FR 56138). Predation by marine mammals (principally seals and sea lions) is of concern in areas experiencing dwindling run sizes of salmon (69 FR 33102) and has been found to be watershed specific. Predation by marine mammals coincidental with salmonid migrations may, in some cases, kill a significant fraction of a run and local depletion might occur (NMFS 1997; Quinn 2005). Habitat conditions such as low water flows and high temperatures can exacerbate susceptibility to infectious diseases (69 FR 33102).

Factor D (At Time of Listing): Inadequacy of Existing Regulatory Mechanisms

Despite the Federal and non-federal efforts, due to funding and implementation uncertainties, and the voluntary nature of many programs, the regulatory mechanisms that existed at the time of listing were determined as not providing sufficient certainty that combined Federal and non-federal efforts are reducing threats to CCC coho salmon. The information below outlines what the FRN articulated on each topic at the time of listing.

Federal Efforts

The U.S. Army Corps of Engineers (USACE) regulates dredging and filling in the waters of the United States through the Clean Water Act (CWA) Section 404 Program. The USACE program is implemented through the issuance of a variety of Individual, Nation-Wide and Emergency permits. USACE does not permit a discharge that would "cause or contribute to significant degradation of the waters of the United States." One of the factors that must be considered in this determination is cumulative effects. However, COE guidelines do not specify a methodology for assessing cumulative impacts or how much weight to assign them in decision-making. Furthermore, COE does not have in place any process to address the cumulative effects of the continued development of water front, riverine, coastal, and wetland properties. A variety of factors, including inadequate staffing, training, and in some cases policy direction, results in ineffective protection of aquatic habitats important to migrating, spawning, or rearing coho salmon. The deficiencies of the current program are particularly acute during large-scale flooding events, such as those associated with EI Nino conditions, which can put additional strain on the administration of the CWA Section 404 program.

The Federal Emergency Management Agency (FEMA) administers a Flood Insurance Program which strongly influences the development in waterways and floodplains. Regulations allow for development in the margins of active waterways if they are protected against 100-year flood events, and do not raise the water elevations within the active channel (floodway) more than one foot during such flood events. This standard did not adequately reflect the dynamic, mobile nature of watercourses in the CCC coho salmon ESU, and the critical role that margins of active waterways (riparian areas) play in the maintenance of aquatic habitats. FEMA conducts technical and financial assistance to public and private property owners who incur damages from flooding resulting from natural disasters. FEMA programs for repairing flood related damages (Public Assistance Program, Individual and Households Program, and Hazard Mitigation Grant Program) promote the replacement of damaged facilities and structures in their original locations, which are prone to repeated damage from future flooding, and thus lead to repeated disturbance of riparian and aquatic habitats important to migrating, spawning, or rearing steelhead.

The CWA intent to protect beneficial uses associated with aquatic habitats, including fishery resources had not been found fully effective in adequately protecting fishery resources, particularly with respect to non-point sources of pollution (including increased sedimentation from routine maintenance and emergency flood control activities within the active channel and floodplain).

Section 303(d)(1)(C) and(D) of the CWA requires states to prepare Total Maximum Daily Loads (TMDLs) for all water bodies that do not meet State water quality standards. TMDLs are a method for quantitative assessment of environmental problems in a watershed and identifying pollution reductions needed to protect drinking water, aquatic life, recreation, and other use of rivers, lakes, and streams. TMDLs may address all pollution sources including point sources such as sewage or industrial plant discharges, and non-point discharges such as runoff from roads, farm fields, and forests.

The CWA gives state governments the primary responsibility for establishing TMDLs. However, the Environmental Protection Agency (EPA) is required to do so if a state does not meet this responsibility. EPA made a commitment guaranteeing that either EPA or the State of California will establish TMDLs that identify pollution reduction targets for 18 impaired river basins in California by the year 2007. The State of California made a commitment to establish TMDLs for approximately half the 18 river basins by 2007. EPA outlined they would develop TMDLs for the remaining impaired basins in the State and agreed to complete all TMDLs if the State failed to meet its commitment by 2007. The ability of these TMDLs to protect salmon and steelhead should be significant in the long term. However, implementation of this statute was not determined as adequate to protect coho salmon habitat at the time of listing with their efficacy in protecting salmonid habitat uncertain.

The North Coast Regional Water Quality Control Board was in the process of updating its north coast basin plan, which would establish water quality standards for all of the northern California rivers and streams (including the Ten Mile, Noyo, Navarro, Garcia, Gualala and Russian Rivers). These plans would also incorporate TMDL standards developed for water bodies that are listed as 303(d) impaired under section 303(d) of the CWA. These plans were anticipated to help reduce human impacts to aquatic environments and thus protect ESA listed salmonids.

NMFS staff conduct ESA section 7 consultations with Federal action agencies that fund, conduct or authorize projects in the range of CCC coho salmon. NMFS evaluates mpacts to CCC coho salmon from a wide variety of projects including: irrigation and water diversion, timber harvest, watershed restoration, fish passage, gravel mining, grazing, and transportation projects. One important consultation was the Potter Valley Project (which included the Russian River). Other important consultations were ongoing with the USACE and the Sonoma County Water Agency (for the Russian River). These consultations were expected to improve, or minimize adverse impacts to, the CCC coho salmon ESU and associated habitat. NMFS was engaged in an ongoing effort to assist in the development of HCPs for State and private lands under section 10 of the ESA.

The National Forest Plan (NFP) is a Federal management policy with potential benefits for CCC coho salmon. Under the NFP the US Forest Service (USFS) and the Bureau of Land Management (BLM) made efforts to reduce adverse effects to aquatic and riparian dependent species including salmon in the range of the Northern spotted owl. The most significant element of the NFP for anadromous fish is its Aquatic Conservation Strategy, which includes an objective for salmon habitat conservation. However, Federal lands comprise only about five percent of the CCC coho salmon ESU, a proportion too small to secure recovery even with the strictest of Federal forest management practices.

The PFMC manages ocean fisheries consistent with NMFS' requirements for listed salmonids. This management reduced the impact of ocean harvest to listed salmon such as the coho salmon. While ocean fishing is regulated to reduce impact on coho salmon, State sport fishing regulations continue to allow fishing for coho salmon in inland waters.

The Pacific Coastal Salmon Recovery Fund allowed NMFS to provide annual grants to the State to assist salmon recovery efforts in coho watersheds from the Oregon border to southern California – the program as implemented by the state was competitive in nature, and did not adequately prioritize funding based on listing status and ESU.

Non-Federal Efforts

Several management efforts were implemented to protect listed salmonid ESUs in California. These included restricted exploitation rates on Rogue River/Klamath River hatchery stocks to protect CCC coho salmon and no retention take prohibitions for coho salmon in the marine environment off the coast of California.

Due to the lack of comprehensive abundance and trend data for coastal salmonids, the DFG funded a development effort for a Statewide coastal salmonid monitoring plan, and monitoring program. DFG and NMFS identified the need for a programmatic coordinated effort which would utilize peer-reviewed and standardized methodologies as a critical need in assessing the viability of listed ESU's.

Resource Conservation Districts (RCDs) along the California coast allow the agricultural community to voluntarily address and correct management practices impacting ESA listed salmonids and their habitats. The RCDs assist landowners in developing and implementing best management practices protective of salmonids.

The Rangeland Management Advisory Committee developed a management plan for inclusion in the State's Non-point Source Management Plan. The purpose of the plan was to maintain and improve the quality and associated beneficial uses of surface water that passes through rangeland resources.

Long-term sustained gravel mining plans were being developed by Mendocino County, which comprises a significant portion of the range of the CCC coho salmon with extant independent populations.

A Memorandum of Understanding between NMFS and five northern California counties (including Mendocino) was developed to create standardized county routine road maintenance manual to assist in the protection of ESA listed species and their habitat. This manual includes best management practices (BMPs) for reducing impacts to listed species and the aquatic environment, a five-county inventorying and prioritization of all fish passage barriers associated with county roads, annual training of road crews and county planners, and a monitoring framework for adaptive management.

The Sotoyome RCD developed a voluntary certification program (Fish Friendly Farming) for grape growers in Sonoma and Mendocino Counties who implemented land management practices that decrease soil erosion and sediment delivery to streams.

FishNet 4C is a multi-county group comprised of representatives from Mendocino, Sonoma, Marin, San Mateo, and Santa Cruz Counties. The program coordinated county efforts such as road maintenance, fish barrier assessment and removal, riparian and grading ordinances, erosion control, implementation of bioengineering projects and the development of guidelines for public works departments that enhance or protect salmonid habitat.

Local watershed councils and other groups throughout California successfully developed restoration plans and worked to implement habitat restoration projects expected to contribute to the conservation of listed salmonid ESUs. In the range of the CCC coho salmon ESU watershed, groups are addressing: Tomales Bay, Lagunitas Creek, and the Russian River.

Many other sub-watershed groups, landowners, environmental groups, and non-profit organizations throughout the range of CCC coho salmon conducted habitat restoration and planning efforts that may contribute to species conservation.

The California State Water Resources Control Board (SWRCB) administers a water rights permitting system which controls utilization of waters for beneficial uses throughout the State. This system, while it contains provisions (including public trust provisions) for the protection of instream aquatic resources, does not provide an explicit regulatory mechanism to implement DFG Code Section 5937 requirements to protect fish populations below impoundments. Additionally, SWRCB generally lacks the oversight and regulatory authority over groundwater development comparable to surface water developments for out-of-stream beneficial uses.

Local governments have the most direct responsibility for permitting land uses on non-Federal and non-State owned lands. Local efforts to control development within the floodplains and active channels is in many cases limited to the protection of public properties such as county or city roads, bridges, and other infrastructure. Local government regulation of floodplain development depends to a large extent on the standards provided by FEMA's Flood Insurance Program which does not explicitly provide for the protection of natural fluvial processes essential for the maintenance of naturally functioning riverine and riparian habitats important for coho salmon migration, spawning, and rearing.

The State of California's forest practice rules (FPRs) contain provisions that can be protective of coho salmon if fully implemented. However, the Board of Forestry did not adopt DFG's proposal to designate coho salmon as a sensitive species, preventing adoption of special management practices for sensitive species and their habitat.

Factor D (Since Listing): Inadequacy of Existing Regulatory Mechanisms

Other than those listed below, no significant changes to this factor have occurred since listing and the threats remain. A variety of State and Federal regulatory mechanisms exist to protect coho salmon habitat and address the decline in the ESU, but they have not been adequately implemented (61 FR 56138 at 56143). Collectively protective efforts do not provide sufficient certainty of implementation and effectiveness to substantially ameliorate the level of assessed extinction risk for the CCC coho salmon ESU (70 FR 37160 at 37190).

Changes in Federal and non-federal efforts include: (1) the issuance of California's Recovery Strategy for California Coho Salmon and (2) the issuance of a final biological opinion for the Sonoma County Water Agency's activities in the Russian River and (3) under a court order, the State of California with assistance from EPA have developed TMDLs for nearly all of the 18 impaired rivers. The Statewide coastal monitoring program, funded by the DFG, California's Watershed Protection Program and the PACFISH or Infish, the sister plan for non-Columbia River Basin, have not been funded, developed and/or implemented as anticipated. While the Statewide Coastal Monitoring Plan is in final draft, the delay in funding and implementing the Statewide Coastal Monitoring Program is a concern, and remains a top priority within the CCC coho salmon recovery plan.

Factor E (At Time of Listing): Other Natural and Man-made Factors Affecting the Species' Continued Existence

Long-term trends in rainfall and marine productivity associated with atmospheric conditions in the North Pacific Ocean had a major influence on coho salmon production. Natural climatic conditions may have exacerbated or mitigated the problems associated with degraded and altered riverine and estuarine habitats (69 FR 33102 2004). Coho salmon have evolved behaviors and life history traits allowing them to survive a variety of environmental conditions. When populations are fragmented or reduced in size and range, however, they are more vulnerable to extinction by natural events.

The effects of extended drought on water supplies and water temperatures were a major concern for California populations of coho salmon. Drought conditions reduced the amount of water available, resulting in reductions (or elimination) of flows needed for adult coho salmon passage, egg incubation, and juvenile rearing and migration. The decline of many coho salmon populations began prior to numerous years of drought conditions in California.

Flood events increased sedimentation to streams, particularly in areas with inherent erosion risk, urban encroachment, intensive timber management, and land disturbances resulting from logging, road construction, mining, urbanization, livestock grazing, agriculture, and fire. Sedimentation of stream beds was implicated as a principal cause of declining salmonid populations throughout their range. Central coastal California has some of the most erodible terrain in the world. In this region, catastrophic erosion and subsequent stream sedimentation (such as during the 1955 and 1964 floods) resulted from areas which had been clearcut or had roads constructed on unstable soils (61 FR 56138).

Poor ocean conditions were believed to have a prominent role in the decline of coho salmon populations in California. Unusually warm ocean surface temperatures and associated changes in coastal currents and upwelling, known as El Niño conditions, resulted in ecosystem alterations such as reductions in primary and secondary productivity and changes in prey and predator species distributions. El Niño was often cited as a cause for the decline of West Coast salmonids. Near-shore conditions during the spring and summer months along the California coast may have dramatically affected year-class strength of salmonids (Kruzic *et al.* 2001). Coho salmon along the California coast may be especially sensitive to upwelling patterns because of the lack of other coastal habitat types that normally buffer adverse oceanographic effects (*i.e.*, extensive bays, straits, and estuaries). The paucity of high quality near-shore habitat, coupled with variable ocean conditions, makes freshwater rearing habitat more crucial for the survival and persistence of many coho salmon populations.

The use of artificial propagation had a significant impact on the production of West Coast coho salmon. Non-native coho salmon stocks were introduced as broodstock in hatcheries and widely transplanted in many coastal rivers and streams in central California (Bryant 1994; Weitkamp et al. 1995). Potential problems associated with hatchery programs include genetic impacts on indigenous, naturally-reproducing populations (Waples 1991), disease transmission, predation of wild fish, difficulty in determining wild stock status due to incomplete marking of hatchery fish, depletions of wild stock to increase brood stock, and replacement rather than supplementation of wild stocks through competition and continued annual introduction of hatchery fish (61 FR 56138).

While non-native fish were introduced in the CCC coho salmon ESU, most hatchery programs were currently conducted without inter-ESU import of broodstock. Hatchery fish releases were conducted based on a determination that the hatchery stocks are considered similar to the native run. Efforts were made to return hatchery fish to their natal streams, and they are held for an acclimation period to increase the probability of imprinting. However, there were inadequate resources to tag enough hatchery coho salmon to monitor return rates and rates of straying (61 FR 56138).

Factor E (Since Listing): Other Natural and Man-made Factors Affecting the Species' Continued Existence

No significant changes to this factor have occurred since listing and the threats remain. The best available scientific information indicates that the Earth's climate is warming, driven by the accumulation of greenhouse gasses in the atmosphere (Oreskes 2004; Battin *et al.* 2007; Lindley *et al*. 2007). Because CCC coho salmon depend upon freshwater streams and the ocean during different stages of their life history cycle, the population is likely to be significantly impacted by climate change.

Table 10: Listing Factors, Status and Associated Recovery Criteria References

Listing Factor A: Habitats	Status of Listing Factor	See Restoration, ESU or Threat Abatement Actions/Criteria
Agriculture	Persisting; Expected to worsen	Threats (Agriculture; Logging)
Estuarine modification	Persisting; Expected to worsen	Threats (Channel Modification)
Forestry	Persisting; Expected to worsen	Threats (Logging)
Freshwater Conditions	Persisting; Expected to worsen	All Restoration
Habitat Degradation	Persisting; Expected to worsen	All Restoration
Mining	Persisting; Watershed specific	Threat (Mining)
Removal of Riparian Habitat	Persisting; Expected to worsen	Restoration (Riparian)
Removal of Wetland Habitat	Persisting; Expected to worsen	Restoration (Off channel)
Urbanization	Persisting; Expected to worsen	Threat (Development)
Water Diversions	Persisting; Expected to worsen	Threat (Water Diversion)
Wildfires	Currently Low; Expected to worsen	Threats (Fire) (Climate Change)

Listing Factor B: Overutilization	Status of Listing Factor	See Restoration, ESU or Threat Abatement Actions/Criteria
Collection	Persisting; Magnitude unknown; Information needed	Criteria Needed
Freshwater Harvest	Persisting; Expected to worsen	Threat (Fishing)
Illegal Harvest	Persisting; Expected to worsen	Threat (Fishing)
Overfishing	Improved; Bycatch and freshwater interception persisting; Magnitude unknown	Threat (Ocean Harvest & Fishing)

Listing Factor C Disease & Predation	Status of Listing Factor	See Restoration, ESU or Threat Abatement Actions/Criteria
Avian Freshwater Predation	Persisting; Magnitude unknown	Threat (Disease, Predation, Competition)
Predation	Persisting; Magnitude watershed specific	Threat (Disease, Predation, Competition)
Disease and Predation	Disease Improved; Predation Persisting; Watershed specific	Threat (Disease, Predation, Competition)
Infectious Disease	Threat Unknown; Magnitude unknown	Threat (Disease, Predation, Competition)
Marine Mammal Predation	Persisting; Magnitude watershed specific	Threat (Disease, Predation, Competition)
Marine Predation	Threat Unknown; Magnitude unknown	Threat (Disease, Predation, Competition)
Piscivorous Predators	Threat Unknown; Magnitude unknown	Threat (Disease, Predation, Competition)
Predation	Persisting; Magnitude unknown	Threat (Disease, Predation, Competition)
Predation by non-native species	Persisting; Magnitude unknown	Threat (Disease, Predation, Competition)
Predation by seabirds	Persisting; Magnitude unknown	Threat (Disease, Predation, Competition)

Table 6 (cont.): Listing Factors, Status and Associated Recovery Actions and Criteria

Listing Factor D Inadequate Regulatory Mechanisms	Status of Listing Factor	Criteria
All Federal, State, local governments, municipalities and others	Threat Persisting; Expected to worsen	

Listing Factor E Other Factors	Status of Listing Factor	See Restoration, ESU or Threat Abatement Actions/Criteria
Artificial Propagation	Improved; Conservation practices implemented	Hatchery Criteria (Spence *et al.* 2008)
Drought	Persisting; Expected to worsen	Threat (Drought)
El Nino conditions	Persisting; Expected to worsen	Threat (Marine)
Floods	Persisting; Expected to worsen	Threat (Storms & Flooding)
Floods – scour	Persisting; Expected to worsen	Threat (Storms & Flooding)
Floods – sediment	Persisting; Expected to worsen	Threat (Storms & Flooding)
Floods – sedimentation	Persisting; Expected to worsen	Threat (Storms & Flooding)
Floods – erosion	Persisting; Expected to worsen	Threat (Storms & Flooding)
Forest Fires	Persisting; Expected to worsen	Threat (Fire)
Hatchery Programs	Improved; Conservation practices implemented	HGMP and Hatchery Criteria (Spence *et al.* 2008)
Natural Climatic Conditions	Persisting; Expected to worsen	Threat (Climate Change)
Natural Events	Threat Persisting; Expected to worsen	Threats (Storms & Flooding; Drought; Climate Change)
Ocean Conditions	Threat Persisting; Expected to worsen	Threat (Marine)
Ocean Conditions - El Nino	Threat Persisting; Expected to worsen	Threat (Marine)

CHAPTER 4: ASSESSMENT OF PROTECTIVE EFFORTS

"Conservation is a state of harmony between men and land."

Aldo Leopold

FEDERAL REGISTER ASSESSMENT OF PROTECTIVE EFFORTS

Two types of assessments are conducted to assess protective efforts in context to listing and recovery:

1. Protective efforts, as evaluated pursuant to the "Policy for Evaluation of Conservation Efforts When Making Listing Decisions" (68 FR 15100), and
2. Conservation Assessment pursuant to the Interim Recovery Planning Guidance (NMFS 2006a).

Protective efforts assessed during listing decisions are required under section 4(b)(1)(A) of the ESA. Federal agencies are required to review the status of the species using the best scientific and commercial data available after taking into account efforts being made to protect the species. The efficacy of existing efforts must consider the following: (1) substantive, protective and conservation elements; (2) degree of certainty efforts will be implemented; and (3) presence of monitoring provisions that determine effectiveness and permit adaptive management.

All pertinent *Federal Register* notices, including both proposed and final listing determinations for the CCC coho salmon were reviewed (Table 5). Documented protective efforts (e.g., conservation efforts) at the time of listing were only those specifically described in the listing determination notices for which the notice pertained, or those incorporated by reference. Assessed and documented are the major conservation efforts that were ongoing at the time of CCC coho salmon listing, including efforts which are currently inactive or still pending implementation and a detailed discussion of efforts since listing (see appendices). An assessment was additionally conducted to define current status of the protective effort, or conservation action, through consultation with staff/personnel from NMFS, DFG, and other entities. All data were catalogued to facilitate tracking of conservation actions identified at the time of listing those changed since listing and newly identified actions (see appendices). Each table within the Appendix records the date and page number of publication in the *Federal Register*, and describes each as it was presented in the Federal Register at the time of publication. A discussion of the current status, current benefits to CCC coho salmon, effectiveness, and duration of each conservation effort is also included below.

Conservation Efforts at, and Since, the Listing of CCC Coho Salmon

Conservation efforts for CCC coho salmon have been ongoing for many years. These efforts are being conducted by individuals, private organizations, state and local agencies, or Federal agencies and others. While much has been accomplished through the California Department of Fish and Game Fisheries Restoration Grant Program (FRGP) and other programs, a comprehensive analysis of the overall benefit and effectiveness has not been conducted since listing. Protective efforts were evaluated, pursuant to the "Policy for Evaluation of Conservation Efforts When Making Listing Decisions" (68 FR 15100), across the geographic area of the CCC coho salmon ESU when the ESU was listed as threatened in 1996 (61 FR 56138) and most recently when the ESU was relisted to endangered in 2006 (69 FR 33116; 70 FR 37160 2005). Efforts ranging in scope from regional conservation strategies to local watershed initiatives were evaluated. Such efforts include completion of the California Recovery Strategy for Coho Salmon and subsequent State listing of coho salmon, the California Fisheries Restoration Grant Program, Warm Springs Hatchery and Scott Creek Hatchery Captive Broodstock Programs, Fish Friendly Farming Program, county programs such as the FishNet 4C, development of Habitat Conservation Plans and others.

While these and other efforts are underway, and collectively enhance the potential that populations and habitats of the CCC coho salmon ESU can be protected, it was determined that they did not provide sufficient certainty of implementation and effectiveness to substantially ameliorate the level of assessed extinction risk for CCC coho salmon. The fact that CCC coho salmon continue to decline is an indication conservation efforts may need refocusing and restructuring to align with the highest priorities to, first, prevent this species' extinction and, second, provide for its long-term survival.

A discussion of the current status, current benefits to CCC coho salmon, effectiveness, and duration of each conservation effort is also included below. Conservation efforts are organized as Federal, State, local or non-government efforts according to the primary entity leading the effort. Although salmon and steelhead conservation efforts have become more effective and widespread since listing, when considered cumulatively, the following described conservation efforts do not sufficiently address the threats to warrant consideration of downlisting or de-listing of CCC coho salmon at this time.

Federal Efforts at Time of Listing

NMFS identified several potential conservation efforts for CCC coho salmon in the proposed threatened listing in 1995 (60 FR 38011). These efforts included: regulations to ensure fish passage at dams, improved water diversion monitoring and water rights enforcement, and water diversion screening. NMFS also determined inter-agency and public watershed partnerships could play an important role in coho salmon conservation by: encouraging and informing the public on best land management practices; providing guidance and training to other agency personnel; and involving multiple stakeholders in the coho salmon recovery planning process.

The FRN analysis during the relisting of CCC coho salmon from threatened to endangered outlined the following in regarding to federal efforts:

- ❑ With the ESA listing of CCC coho salmon in 1996, Federal agencies were required to receive technical assistance from and/or initiate section 7 consultations with NMFS, which enabled

NMFS to evaluate the effects of Federal actions on ESA-listed salmonids. In general, section 7 consultations allowed NMFS to promote practices either minimizing adverse effects to salmon and steelhead or improving salmon and steelhead populations and/or habitat. The NMFS section 7 consultation for the USACE and Sonoma County Water Agency Reservoir Operations project (Russian River) was specifically noted (69 FR 33102).

- Additional Federal conservation efforts at the time of listing of CCC coho salmon included: the Federal CWA, ocean fishing regulations, Federal land management plans, ESA section 7 consultations, ESA section 10 incidental take permits/HCPs, ESA section 4(d) protective regulations and critical habitat designations, Federal funded grant programs for restoration activities, a procedural review process for authorizing salmon and steelhead protective activities on private lands, and the NMFS and DFG Coastal Salmonid Monitoring Program.

- The Federal CWA established a framework to identify and address water quality impairments in streams throughout the CCC coho salmon ESU.

- The implementation of more stringent ocean fishing regulations was intended to reduce the harvest of salmon and steelhead and reduce the adverse impacts of ocean fishing practices on salmon and steelhead populations. However, the closure or severe curtailment of ocean and river fishery harvest of coho salmon was noted to have no noticeable benefits to CCC coho salmon (60 FR 38011). Later, the retention of coho salmon in Federal waters was prohibited.

- NMFS, often in coordination with the USFWS, developed and implemented section 10 incidental take permits/HCPs which contributed to the conservation of ESA-listed salmonids and restored aquatic habitat on private land. In particular, the development and implementation of HCPs were expected to reduce harm and take of CCC coho salmon, address the problems contributing to the decline of CCC coho salmon, and increase the distribution of coho salmon throughout the ESU. The HCP for Mendocino Redwood Company was specifically noted to improve CCC coho salmon populations and habitat.

- NMFS issued protective regulations for CCC coho salmon under section 4(d) of the ESA on July 10, 2000 (65 FR 42422) and January 9, 2002 (67 FR 1116), to halt the decline and begin the recovery of CCC coho salmon. NMFS simplified and re-issued ESA section 4(d) protective regulations for CCC coho salmon and multiple ESUs on June 28, 2005 (70 FR 37160), in an effort to improve regulatory compliance and protect numerous ESA-listed salmon and steelhead ESUs. NMFS designated critical habitat for CCC coho salmon on May 5, 1999 (64 FR 24049), and again on September 2, 2005 (70 FR 52488).

- The NMFS Pacific Coastal Salmon Recovery Fund has provided grant funding to the state of California's FRGP for salmon and steelhead habitat restoration, watershed planning, enhancement, research and monitoring, and outreach and education efforts.

- NMFS' gravel removal guidelines evaluated the impacts of gravel mining projects to ESA-listed salmonids in Mendocino and Sonoma counties.

- The NMFS/Natural Resource Conservation Service (NRCS) Memorandum of Understanding (MOU) was a joint effort between NMFS, NRCS, USFWS, USEPA, the State of California, and numerous local watershed resource conservation districts to provide technical guidance to private landowners on land-use activities that had already undergone section 7 consultation with NMFS or USFWS. The program would facilitate the voluntary implementation of land-use activities that would conserve and protect CCC coho salmon and their habitat. The program would ultimately address the problems contributing to the decline of CCC coho salmon.

- The NMFS and DFG Coastal Salmonid Monitoring Program would monitor the abundance and distribution of CCC coho salmon ESU-wide, and would improve long-term population viability assessments. Improved research and monitoring would aid in the response of NMFS and other agencies to the conservation needs of CCC coho salmon.

- NMFS identified several potential conservation efforts for CCC coho salmon at the proposed threatened listing in 1995 (60 FR 38011). These efforts included: regulations to ensure fish passage at dams, improved water diversion monitoring and water rights enforcement, and water diversion screening. NMFS also determined inter-agency and public watershed partnerships could play an important role in coho salmon conservation by: encouraging and informing the public on best land management practices; providing guidance and training to other agency personnel; and involving multiple stakeholders in the coho salmon recovery planning process.

- NMFS recognized several efforts as potential future conservation efforts for CCC coho salmon (61 FR 56138). NMFS planned to evaluate the effects of freshwater fishing regulations and hatchery activities on CCC coho salmon and develop new regulations to reduce the adverse effects of the freshwater fishery and hatcheries. NMFS planned to evaluate the effect/success of the State coho salmon ESA-listing and State coho salmon recovery plan. The future development and implementation of a Federal CCC coho salmon recovery plan was also detailed as a potential future conservation effort.

Federal Efforts Since Listing

Federal conservation efforts since the listing of CCC coho salmon include: the Federal CWA; ocean fishing regulations; Federal land management plans (National Park general management); ESA section 7 consultations; ESA section 10 incidental take permits/habitat conservation plans; ESA Section 4(d) protective regulations and critical habitat designations; NMFS CCC coho salmon recovery and conservation strategy; Federal funded grant programs for restoration activities; fish passage guidelines; water diversion screening and monitoring; a procedural review process for authorizing salmon and steelhead protective activities on private lands (NMFS/NRCS MOU); and the NMFS and DFG Coastal Salmonid Monitoring Program.

The current status of specific efforts mentioned in the FRNs:

- The NMFS section 7 consultation for the USACE and Sonoma County Water Agency Reservoir Operations project (Russian River) specifically noted in 69 FR 33102 has been finalized;
- The HCP for Mendocino Redwoods Company was specifically noted to improve CCC coho salmon populations and habitat. The HCP is currently in draft. The finalization of this HCP and the development of either a statewide forestry HCP or other forestry landowner HCPs is a very high priority for the recovery of the CCC coho salmon. Fifteen of the 28 key recovery watersheds are located in areas of large tracts of forestlands owned either by private small landowners or large timber companies;
- Projects within the CCC coho salmon ESU under the Pacific Coastal Salmon Recovery Fund compete against funding for other salmonid projects within all other coastal ESUs in the state. The plight of CCC coho salmon within California, and the directives from Congress regarding allocation of funds, would suggest consideration of prioritizing funds towards preventing the extinction of CCC coho salmon;
- NMFS' gravel removal guidelines continue to be a utilized and useful tool when evaluating and reducing the impacts of gravel mining projects to ESA-listed salmonids in Mendocino and Sonoma counties;
- The NMFS/NRCS MOU was not completed;
- The NMFS and DFG Coastal Salmonid Monitoring Program is one of the highest priorities designated in this recovery plan. While the draft plan is nearly finalized, the "Program" itself has yet to be funded or implemented on a programmatic level. Various monitoring efforts are occurring throughout California in many of the key watersheds identified in the final draft monitoring plan, by various public and private entities and funding sources (non-dedicated grants and private sources). However, the efforts are not coordinated on a programmatic level to where statewide or even ESU level abundance/trends can be evaluated. The TRT outlined in their report, "It is imperative that California, which is well behind other states in the Pacific Northwest, begin conducting monitoring at spatial scales relevant to recovery planning if we are to have any hope of accurately evaluating status and progress toward recovery" (Spence *et al.* 2008);
- Little has developed in regards to NMFS participation in inter-agency and public watershed partnerships due to staff limitations and section 7 workloads. For CCC coho salmon recovery, it will be imperative to begin developing and supporting these partnerships. With a few exceptions (*e.g.*, Lagunitas Creek and Russian River), the key CCC coho salmon watersheds occur on private lands and in areas not triggered by section 7 consultations. Use of section 7 towards recovery of CCC coho salmon will have limited benefit except where specific to federal lands, specific actions requiring federal consultation, providing streamlining of restoration projects, or voluntary support for high priority conservation actions; and
- NMFS evaluations on the effects of freshwater fishing regulations and hatchery activities on CCC coho salmon and the development of new regulations to reduce the adverse effects of the freshwater fishery and hatcheries are ongoing.

State Efforts at Time of Listing

State conservation efforts at the time of listing of CCC coho salmon include: freshwater fishing regulations; the California Forest Practices Act (CFPA); State funded restoration grant programs; and the operation and management of salmon and steelhead fish hatcheries and/or rearing facilities. Also, coho salmon were subject to State conservation efforts and additional initiatives as a listed species under the California Endangered Species Act (CESA). The California Natural Communities Conservation Planning Program and the Coastal Salmon Initiative were examples of conservation efforts by the State of California in response to the species' listing under CESA.

California State freshwater fishing regulations were acknowledged at the time of CCC coho salmon listing. In particular, the closure or severe curtailment of ocean and river fishery harvest of coho salmon was noted to have no noticeable benefits to CCC coho salmon (60 FR 38011).

The CFPA provided a set of guidelines to establish habitat protection zones and reduce the degradation of aquatic habitat associated with timber harvest operations on non-federal land. In the original threatened listing determination for CCC coho salmon (61 FR 56138), NMFS acknowledged several cooperative efforts with CalFire and/or DFG to: further reduce take of coho salmon during logging operations; increase protective measures for CCC coho salmon and habitat, especially south of San Francisco; and generally improve implementation of the CFPA.

The California FRGP has provided funding to numerous organizations to perform salmonid habitat restoration projects throughout the range of CCC coho salmon.

The operation and management of coho salmon hatcheries and rearing facilities was frequently acknowledged throughout the listing history of CCC coho salmon. Several hatcheries, including private and State run facilities, were recognized as increasing coho salmon population abundance, distribution, spatial structure, and genetic diversity in the watersheds in which they operated. DFG implemented improved hatchery management regulations to ensure the genetic integrity of hatchery produced fish and minimize interaction and adverse effects to wild salmonid populations. In general, hatchery management regulations were designed to ensure that artificial propagation was used for the conservation and recovery of natural, native populations. Several hatchery management regulations include: the incorporation of wild coho salmon into hatchery broodstock, the discontinuation of out-of-ESU artificial propagation and stocking practices, and treatment protocols to control disease outbreaks (*i.e.*, BKD).

Coho salmon were first listed under the CESA in 1995 south of San Francisco only, however, coho salmon throughout the CCC ESU were later included in the CESA listing in 2005. As a listed species under the CESA, CCC coho salmon were the target of numerous State initiated conservation efforts intended to address the problems contributing to the decline of CCC coho salmon. CDF and DFG implemented improved regulations to protect CCC coho salmon under the CFPA. In response to the listing of CCC coho salmon under the CESA, the California Fish and Game Commission initiated recovery planning to identify and address the recovery needs of coho salmon populations and habitat. The recovery plan would provide recommendations addressing stream flow, water rights, fish passage, water temperature, pool habitat structure, riparian habitat, watershed planning, and gravel mining activities. Hatchery programs and the California FRGP would also be integrated into CCC coho salmon recovery planning. In addition, the California coho salmon recovery implementation plan would provide additional guidance and prioritization of recovery actions.

The California Resources Agency initiated the California Natural Communities Conservation Planning Program and the Coastal Salmon Initiative. Both programs utilized input from the public to develop voluntary coho salmon conservation programs/plans which would address the problems contributing to the decline of CCC coho salmon Statewide. The California Natural Communities Conservation Planning Program was intended to form the basis of protective regulations by NMFS under section 4(d) of the ESA.

State Efforts Since Listing

Significant State conservation efforts since the listing of CCC coho salmon include: California ESA listings and recovery planning; freshwater fishing regulations; the CFPA; water-use regulations; various State funded management and conservation programs which conserve or rehabilitate salmonid habitat through watershed planning, improved regulatory oversight, land acquisition, and habitat restoration or enhancement activities; numerous State funded restoration grant programs; State land-use management plans; the operation and management of salmon and steelhead fish hatcheries or rearing facilities; California Rangeland Water Quality Management Program; California Natural Communities Conservation Planning Program; and the California Department of Transportation's (CalTrans) Environmental Enhancement and Mitigation Program.

- California Recovery Strategy for Coho Salmon: The State recovery strategy does provide recommendations to address stream flow, water rights, fish passage, water temperature, pool habitat structure, riparian habitat, watershed planning, and gravel mining activities. Recovery priorities have been included into the operations of both conservation hatchery programs (Warm Springs and Kingfisher Flat in Scott Creek) and the DFG FRGP, though currently the plan has not been evaluated for its effectiveness due to lack of funding for State monitoring programs.
- California State freshwater fishing regulations: Considerations should be made to revise the current fishing regulations to minimize the interception of CCC coho salmon during sport fishing for steelhead and to provide clarity regarding which streams do not have hatchery steelhead or hatchery trout.
- Forestry: NMFS has participated in Board of Forestry meetings since 1998 and has encouraged the State of California to adopt State Forest Practice Rules protective of salmonids and pursue development of a section 10(a)(1)(B) permit (e.g., HPC) that authorizes incidental take of listed salmonids under the ESA modeled from the Washington State Forest Practice HCP (including their monitoring and adaptive management process). Currently the Rules allow operations to occur in salmonid watersheds that are less protective than standards under west coast forestry HCP's that authorize incidental take. NMFS is considering re-initiating reviews of timber harvest plans and will continue encouragement of either no-take guidelines (similar for the Northern Spotted Owl) or a Statewide HCP. Nearly 85 percent of remaining CCC coho salmon populations co-occur on forestlands and the Board of Forestry has an opportunity to make a significant difference in the future of California's salmon and steelhead, especially CCC coho salmon.
- Many projects have been implemented within the CCC coho salmon ESU under the DFG FRGP, and DFG conducts implementation and effectiveness monitoring to track the success and benefits of these

efforts. However, these projects compete against funding for other salmonid projects within all other coastal ESUs in the state. The plight of CCC coho salmon within the CCC coho ESU, and the directives from Congress regarding allocation of funds, would suggest that DFG consider the prioritization of funds towards preventing the extinction of CCC coho salmon.

- Hatchery Practices: Conservation hatchery practices that have been put in place are anticipated to be beneficial to the species. Monitoring is currently being conducted on these populations, though the numbers of fish released are only recently approaching the level at which significant adult returns could be expected. Utilization of excess broodstock within the Warm Springs Captive Broodstock Program has resulted in additional recovery efforts in watersheds where coho were extirpated within the ESU. Specifically adult releases to Walker and Salmon Creeks have been somewhat successful and will continue. These activities should continue, with appropriate monitoring. Additional funding is necessary to evaluate the effectiveness of the Kingfisher Flat Broodstock program.
- The California Natural Communities Conservation Planning Program was intended to form the basis of protective regulations by NMFS under section 4(d) of the ESA, which is no longer available due to the CCC coho salmon listing of endangered. This program was never realized.

Local Government Efforts At Listing

Local Government efforts at the time of listing of CCC coho salmon include: Mendocino County's efforts to evaluate the impacts to ESA-listed salmonids from gravel mining projects, Fishnet4C's efforts to provide guidance to public works departments to enhance or protect salmonid habitat and Sonoma County Water Agency efforts to assist local agriculture and conservation groups to use Federal Grants for restoration planning.

Local Government Efforts Since Listing

Local government agencies, particularly at the county level, have implemented conservation efforts since the listing of CCC coho salmon. The primary local government conservation efforts targeting CCC coho salmon since the species' listing are the Five County Salmonid Conservation Program, the FishNet 4C program, and cooperative efforts by Santa Cruz County to address forestry practices.

- FishNet 4C: The FishNet 4C continues to provide coordination and technical guidance for public works departments in Mendocino, Sonoma, Marin, San Mateo, and Santa Cruz counties. A Road Maintenance Manual was developed, and associated training provided for county roads and maintenance staff (and others). The group meets regularly with County and State/Federal fisheries agency staff to discuss progress towards changing County policy to be in line with ESA and Recovery guidelines, and the implementation of fish-friendly projects. More recently the American Fisheries Society distributed a letter to Marin County that outlined recommended improvements to county practices due to the status of CCC coho salmon and their importance in Marin. FishNet 4C provides the forum needed for NMFS and DFG to engage the counties regarding recovery priorities. While a 4(d) Exemption is no longer available, the opportunity to explore other mechanisms for no-take or take authorization for some County activities (through programmatic permits) should be explored.

Non-Governmental Efforts At Listing

Non-Governmental Efforts at the time of listing of CCC coho included activities from the following groups: Coastal Watershed Council, Committee for Green Foothills in San Mateo County, Friends of

Corte Madera creek, Garcia River Watershed Advisory Group, Hawthorne Campbell Timberlands, Mendocino Redwood Company, Mill Valley Streamkeepers, Monterey Salmon and Trout, Noyo Watershed Alliance, Occidental Arts and Ecology Center, Peninsula Open Space District, Pescadero Conservation Alliance, Rangeland Management Advisory Committee, Redwood Creek Landowners Association, Santa Cruz County unspecified watershed groups, Sonoma Ecology Center, Sotoyome Resource Conservation District, Ten Mile Forest Landowners Association, Trout Unlimited and various unspecified local watershed councils and groups. Efforts by these various groups were identified as contributing to the improvement in CCC coho salmon habitats and population abundance.

Non-Governmental Efforts Since Listing

In addition to government agencies, the conservation efforts of numerous local non-governmental groups including RCDs, private conservation entities/watershed councils, timber companies, and water agencies have persisted since the listing of CCC coho salmon. Non-governmental organizations have also been highly effective at utilizing various Federal, State, local, and private funding sources to perform voluntary and proactive fisheries habitat restoration projects and other efforts.

- ❑ The effectiveness of conservation efforts of numerous local non-governmental organizations, while likely benefiting CCC coho salmon, is unknown in terms of increasing coho populations. While DFG conducts project monitoring associated with all PCSRF funded projects, there is no larger oversight body that conducts implementation and effectiveness monitoring for all local, state and federal funding sources to determine whether these actions are successful, or are benefiting the populations of CCC coho salmon as a whole – this is partially related to the lack of a statewide coordinated trend and abundance monitoring program.
- ❑ The Fish Friendly Farming Program provides guidance to grape growers to manage agricultural land to decrease soil erosion and sediment delivery to streams and improve riparian conditions. This effort has resulted in needed education, outreach and improvements in agricultural practices. While the program addresses water infrastructure concerns (passage barriers, screening criteria, *etc.*) it has not addressed streamflow impacts to salmon from diversions on participating ownerships and does not necessarily provide standards that achieve a “no take” standard.
- ❑ The California Rangeland Management Plan has not been evaluated.

Numerous Federal, State and local conservation programs that have been ongoing include:

- ❑ Development and implementation of EPA Total Maximum Daily Load Programs;
- ❑ CalFish and California Fish Passage Forum; and
- ❑ Salmonid Coalition of the Russian River.

Priority Conservation Efforts

While the Federal, State, County and non-governmental efforts are underway, and collectively enhance the potential that populations and habitats of the CCC coho salmon ESU can be protected, they do not provide sufficient certainty of implementation and effectiveness to substantially ameliorate the level of assessed extinction risk for CCC coho salmon. The fact that CCC coho salmon continue to decline is an indication that conservation efforts may need refocusing and restructuring to align with the highest priorities to, first, prevent this species’ extinction and, second, provide for its long-term survival.

Given all of the ongoing conservation efforts, the following efforts are considered the highest priority for future continuation:

- Russian River and Scott Creek Captive Broodstock Programs: a permanent source of funding is needed for the Scott Creek Program; monitoring for both programs should continue.
- Pacific Coastal Salmon Recovery Fund provides funds to the State for use in their Fisheries Restoration Grant Program: Geographically, funding for projects has had a larger than anticipated focus on restoration actions for coho salmon in the South Oregon Northern California (SONCC) ESU (*e.g.* efforts on the Scott and Shasta rivers). Funding for projects specifically directed for the benefit of CCC ESU coho recovery has been diluted by the SONCC focus and competing priorities for other salmonid species. Where funding for restoration projects does occur within the CCC ESU, many projects, particularly those south of San Francisco Bay are directed at steelhead restoration with secondary consideration to coho salmon. Funding should be appropriately allocated to prevent the extinction of CCC coho salmon; and
- California Coastal Salmonid Monitoring Program: The combined DFG and NMFS efforts towards a completion of a final plan should continue. Funding and implementation of a coordinated Program are the required next steps to enable ESU and statewide tracking of population trends for listed species and tracking of efforts towards recovery.

Conservation efforts of very high priority that were anticipated at the time of listing for implementation but currently remain unrealized, or not fully realized, include:

- Mendocino Redwood Company HCP: The company owns portions of six high priority recovery watersheds in Mendocino and Sonoma counties; watersheds currently supporting extant Coho populations. Finalization of the HCP is strongly recommended and is expected to have significant benefits to preventing the extinction and facilitating recovery of CCC coho salmon.
- Other HCPs: HCPs in development at time of listing (i.e., Jackson Demonstration State Forest and Georgia-Pacific Corporation now Hawthorne Timberlands Inc. managed by Campbell Timberland Management) have been discontinued and are not anticipated to recommence in the foreseeable future. These should be investigated for possible continuation and to focus on securing these forestlands for the long term due to the high number of watersheds where current populations of CCC coho salmon persist.
- The California Recovery Strategy for Coho Salmon has been finalized and was largely relied upon in the development of this recovery plan. The priorities described in the Strategy, and this recovery plan should guide implementation of the PCSRF/FRGP funds as discussed above.

CHAPTER 5: POPULATION STRUCTURE & VIABILITY

"In summary, the lack of demonstrably viable populations...and substantial gaps in the distribution of coho salmon throughout the CCC ESU strongly indicate that this ESU is currently in danger of extinction."

Spence et al., 2008

HISTORICAL POPULATION STRUCTURE & BIOLOGICAL VIABILITY CRITERIA

Salmon and have a high fidelity to return to the rivers where they reared as young to spawn, with some occasional straying between neighboring rivers. Thus, multiple populations across river systems are connected by a small degree of genetic exchange which ensures genetic diversity and distribution that provides resilience for the species to persist overtime. Populations within and between neighboring streams will share more genetic characteristics than those separated by hundreds of miles. The biological framework for recovery builds from this hierarchical structure Figure 8 (*e.g.*, an individual, a group of individuals called a population and a group of populations designated into an ESU).

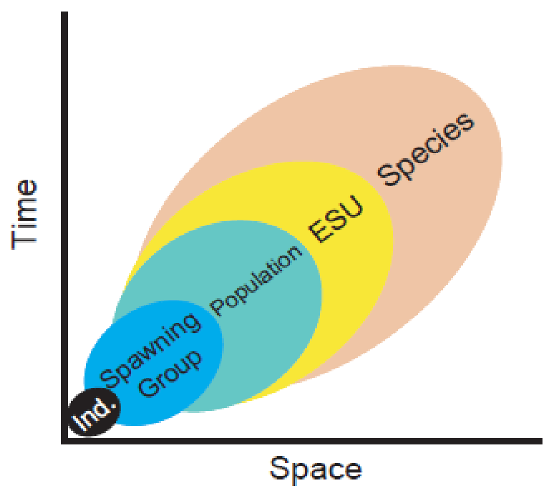


Figure 8: Hierarchical Structure of Populations

For the CCC coho salmon ESU to be removed from the Federal Endangered Species list, criteria related to the number, size, trends, structure, *etc.* and the timeframes (*e.g.*, 100 years) to sustain these biological conditions must be met. To inform the recovery or "delisting" criteria, the TRT prepared two NOAA Technical Memoranda characterizing the historical population structure and biological viability criteria for the NCCC Domain salmon and steelhead ESUs/DPSs (Bjorkstedt *et al*., 2005, Spence *et al*., 2008). These memoranda describe this hierarchy and provide criteria to assess the biological status of populations and their risk of extinction.

This Chapter provides a summary of these memoranda including theoretical basis, methods, recovery team application of the TRT materials and final recommended criteria.

Viable Salmonid Populations

Recovery and long-term sustainability of these populations depend on:

- Ensuring adequate reproduction for replacement of losses due to natural mortality factors (including disease and stochastic events);
- Maintaining sufficient genetic diversity to avoid inbreeding depression and to allow adaptation;
- Providing sufficient habitat (type, amount and quality) for long-term population maintenance; and
- Elimination or control of threats that are affecting their conservation, survival and recovery.

The TRT approach to defining population viability and determining risk of extinction builds from the document "*Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units*" and the viable salmonid population (VSP) concept developed by McElhany *et al*. (2000). McElhany *et al.* (2000) formally outlines evaluation of abundance, productivity, spatial structure, and diversity through two VSP levels: the ESU and the independent population.

An ESU is a Pacific salmon population or group of populations that is substantially reproductively isolated from other conspecific populations and that represents an important component of the evolutionary legacy of the species.

An Independent Population is defined by McElhany et al. (2000) as:

"…a group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place at a different season. For our purposes, not interbreeding to a 'substantial degree' means that two groups are considered to be independent populations if they are isolated to such an extent that exchanges of individuals among the populations do not substantially affect the population dynamics or extinction risk of the independent populations over a 100-year time frame."

The TRT extended the VSP concept by considering two population characteristics independently: "*viability, defined in terms of probability of extinction over a specified time frame and independence, defined in terms of the influence of immigration on a population's extinction probability*" {Bjorkstedt, 2005}. The final TRT criteria are "*intended to provide a framework for planners both to set general biological based targets for recovery and to guide future evaluations of the status of the ESA-listed salmonids…*" {Spence, 2008}.

Historical Population Structure

Development of viability criteria and recovery goals requires some knowledge of and accounting for "*characteristics that contribute to a populations' viability and thus their contribution to the persistence of the ESU*" {Bjorkstedt, 2005}. Essentially, how the overall hierarchical structure of individuals, populations and aggregate populations contribute to overall ESU dynamics, viability and extinction risk. This analysis of historical structure by the TRT was framed by the premise: "*…historical patterns of population abundance, productivity, spatial structure and diversity form the reference conditions about which we have a high confidence that the ESUs and their constituent independent populations had a high probability of persisting over long periods of time. As populations depart from these historical conditions, their probability of persistence declines and their functional role with respect to ESU viability may be diminished*" {Spence, 2008}.

The development of the historical structure included:

- Modeling of the historical intrinsic potential of streams to support spawning and rearing coho salmon;
- Compilation and review of historical records on population size and distribution;
- Defining populations and their viability in context to the ESU;
- Grouping populations into geographical units within an ESU and
- Analyses to inform historical structure that included genetic structure and an assessment of the historical artificial propagation (See Bjorkstedt *et al.* 2005 for more information).

Intrinsic Habitat Potential

Spawning and rearing habitats for juvenile coho salmon are largely determined by landform, lithology, and hydrology that interact to govern movement and deposition of sediment, large wood and other structural elements along a river network (Agrawal *et al.* 2005). Three primary indicators of landform and hydrology, channel gradient, and index of valley width and mean annual discharge serve as a reasonable predictor of channel morphology and this determined the potential for a particular reach to provide suitable habitat under historical conditions. To account for differences in habitat suitability (and thus population size), the TRT used a GIS habitat model developed by Burnett (2003). This GIS model characterized channel gradient, valley width and mean annual discharge to predict the intrinsic (historical) potential (IP-km) for a particular reach of stream to exhibit habitat for coho salmon. Suitability curves for each of the three IP-km components were used to develop a reach specific value for a particular lifestage and species. These reach specific values, or "suitability scores" were based on a scale of 0-1 (Agrawal *et al.* 2005). IP-km for each reach is calculated as the geometric mean of the suitability scores and describes the likelihood a stream reach will provide habitat with respect to the three variables used. As a proxy for population carrying capacity the TRT used the IP score for each reach in the watershed multiplied by its respective reach length, and summed these values which resulted in a "weighted IP" value. The weighted IP kilometers (IP-km) value estimated the intrinsic potential, or carrying capacity, of the watershed for coho salmon. The IP model seeks to account for the fact that not all stream miles were created equal when it comes to producing salmon. These IP layers are output spatially for each population and all streams reaches. Depending on watershed size between 20 to 40 spawners per IP-km were calculated to determine the low extinction risk criteria for each population

Discrepancies were observed between the predicted IP for CCC coho salmon and historical record accounts. A summer water temperature component was included to address discrepancies in the model for coho salmon because water temperature is a strong indicator of presence and high survival of summer rearing juveniles. Historical records for distribution of CCC coho salmon were reviewed {Spence, 2005} and a mean August air temperature that exceeds 21.5° C (following isolines) was applied to the model (*i.e.,* temperature mask) to exclude areas where streams were likely too consistently warm for coho salmon (Figure 9). The resulting outputs were more consistent with historical records.

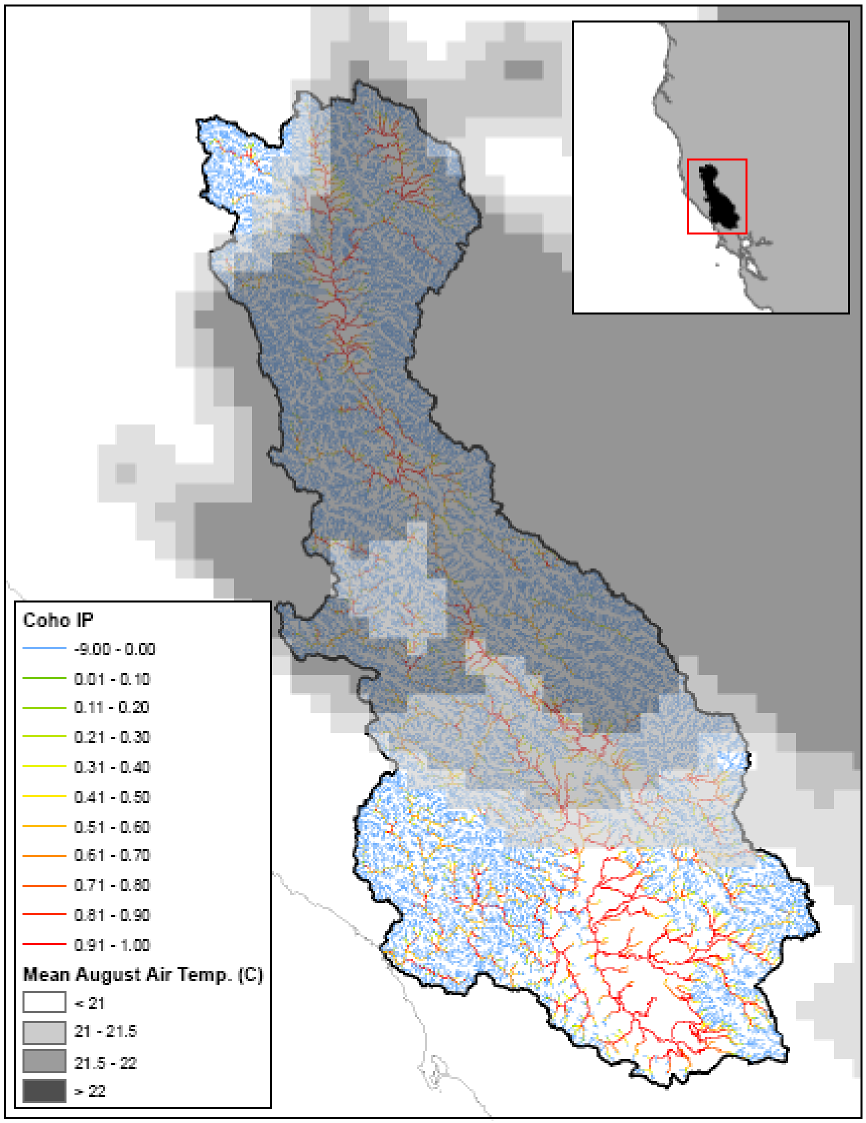


Plate 4: Intrinsic potential for coho salmon rearing habitat in the Russian River with areas from which coho salmon are likely to be excluded by high summer temperatures.

Figure 9: Temperature Mask Example

The TRT acknowledged the uncertainty and potential model bias to over or underestimate IP and historical habitat potential. Nonetheless, a benefit of the IP model is that it takes into account differences in intrinsic habitat potential in an objective and transparent manner. This objectivity precluded subjective judgments regarding whether or not habitat historically supported spawning and rearing salmon, which is often very difficult to determine in light of currently degraded habitat conditions. Comparisons of modeled IP-based results of spawner abundance to the few historical records of abundance was conducted by Spence (pers. comm. 2008) which indicated, in the majority of cases, adult abundances projected by the TRT are <u>lower</u> than those observed during the 1930s into the 1950s. Therefore, the TRT concluded projected spawner abundance targets did not overestimate natural carrying capacity of the majority of populations within the ESU.

Defining Populations for the CCC coho salmon ESU

Spawner abundance across potential IP is the underlying factor determining a population's extinction risk. The TRT defined a population as "*a group of fish of the same species that spawns in a particular locality at a particular season and does not interbreed substantially with fish from any other group*." (Bjorkstedt 2005). A "viable" population is "*a population having a low (<5%) probability of going extinct over a 100-year time frame*" and an "Independent" population "*as one for which exchanges with other populations have negligible influence on its extinction risk"* (Bjorkstedt 2005) or otherwise termed "viable-in-isolation". To distinguish between "viable" and "non-viable" populations the TRT evaluated each populations potential to be "viable-in-isolation" and their measure of "self-recruitment" (Figure 10). Self-recruitment "is the proportion of a populations' spawning run that is of native origin" (Bjorkstedt, 2005).

Population size directly affects an ESU viability and extinction risk; thus, the TRT used the likely historical population carrying capacity as a proxy for assessing viability-in-isolation. The self-recruitment analysis was framed by (1) the understanding that an individual will attempt to return to its natal watershed and (2) whether population dynamics are dominated by internal processes from those strongly influenced by external dynamics (*e.g.*, straying). This analysis assisted the TRT "*in identifying the functional role different populations historically played in ESU persistence*" (Bjorkstedt 2005 *in* Spence 2008).

The TRT determined that at least 32 IP-km were required for a population of coho salmon to be viable-in-isolation. This value was selected for consistency with other TRTs in California and Oregon and was based on a simulation analysis of Nickelson and Lawson (1998).

Three types of populations have been defined:

- "Functionally Independent Populations" (FIPs): Populations with a high likelihood of persisting over 100-year time scales due to their population size and relatively independent dynamics (*i.e.*, negligible influence of migrants from neighboring populations on extinction risk);
- "Potentially Independent Populations" (PIPs): Populations with a high likelihood of persisting in isolation over 100-year time scales due to large population size, but were likely too strongly influenced by immigration from other populations to exhibit independent dynamics; and
- "Dependent Populations" (DPs): Populations with a substantial likelihood of going extinct within a 100-year time period in isolation due to smaller population size, but receive sufficient immigration to alter their dynamics and reduce extinction risk.

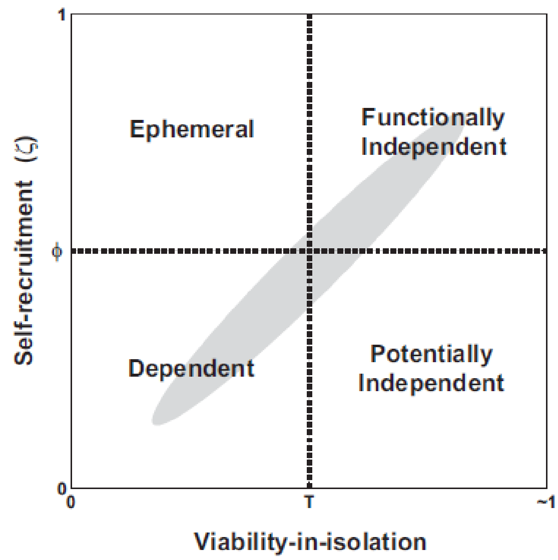


Figure 10: Viability and Self-Recruitment

Classification of populations provided the necessary rationale to prioritize each population's importance to viability and recovery based on their relative function and role in the ESU. For example, a large population (*e.g.*, Independent Population) likely functioned as a regular source of surplus individuals (through straying) to smaller populations (*e.g.*, Dependent Populations). Straying added resilience to the ESU when smaller populations may have suffered from the impacts of adverse environmental conditions (*e.g.*, catastrophic wildfire, *etc.*). Surplus individuals from large populations could re-colonize watersheds after those events leading to the extirpation of small populations. This resilience confers more importance onto large populations for their role in the viability and recovery of the ESU.

Grouping Populations: ESU Diversity Strata

Diversity strata, or boundaries that group populations, were delineated for the ESU and are "*geographically proximate populations that reflect the diversity of selective environments, phenotypes and genetic variation across the ESU*" and are "*described in terms of geography and a generally similar set of environmental and ecological conditions*" {Bjorkstedt, 2005}.

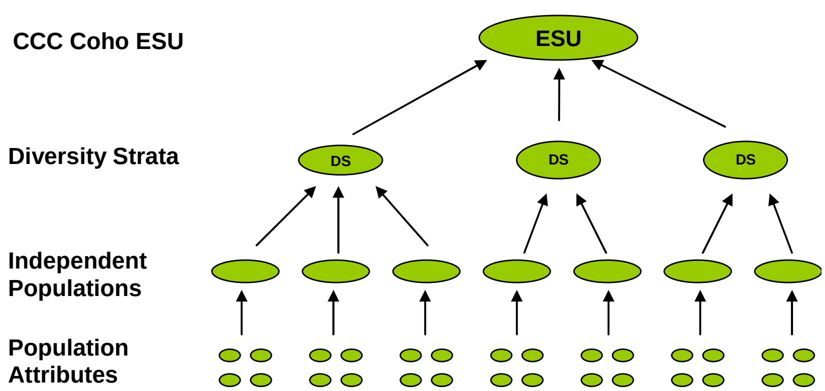


Figure 11: Populations, Diversity Strata and ESU Levels

Results from Historical Structure Analysis

The TRT identified 11 "functionally independent", one "potentially independent" (Figure 12) and 64 "dependent" populations in the CCC coho salmon ESU (Bjorkstedt *et al*. 2005 with modifications described in Spence *et al*. 2008). The 75 populations were grouped into five Diversity Strata. Five thousand one hundred and ninety four (5,194) IP-km were identified across the historical CCC coho salmon ESU[11]. Watershed boundaries delineate each population for CCC coho salmon.

The advised application of the TRT historical structure is outlined in Bjorkstedt *et al*., (2005):

*"Increasing divergence from this baseline almost certainly decreases the ability of the ESU to persist. The functional relationship between departure from historical conditions and extinction risk for the ESU is probably non-linear, such that the loss of a few populations–particularly small populations–from an otherwise intact ESU may not greatly reduce ESU viability, whereas the loss of key populations or the loss of populations from an already diminished ESU will have more profound implications for the persistence of the ESU. Uncertainty associated with the form of this relationship must be accounted for in assessing the viability of any proposed ESU configurations that departs from historical conditions. Understanding the historical population structure of an ESU is essential to reducing the consequences of this uncertainty, as information on the historical role of specific populations in the ESU supports a biologically relevant context for recovery planning. **Simply put, populations that were important to ESU persistence in the past, if restored or preserved, are likely to be important to ESU persistence in the future"***(emphasis added).

A more detailed description of the methods and rationale underlying the historical population structure analysis and results are provided in Bjorkstedt *et al*. (2005).

[11] The recovery scenario for CCC coho designated 28 focus watersheds. The total historical IP km of these 28 watersheds is 1736 km or 33 percent of the historical total.

Page Left Intentionally Blank

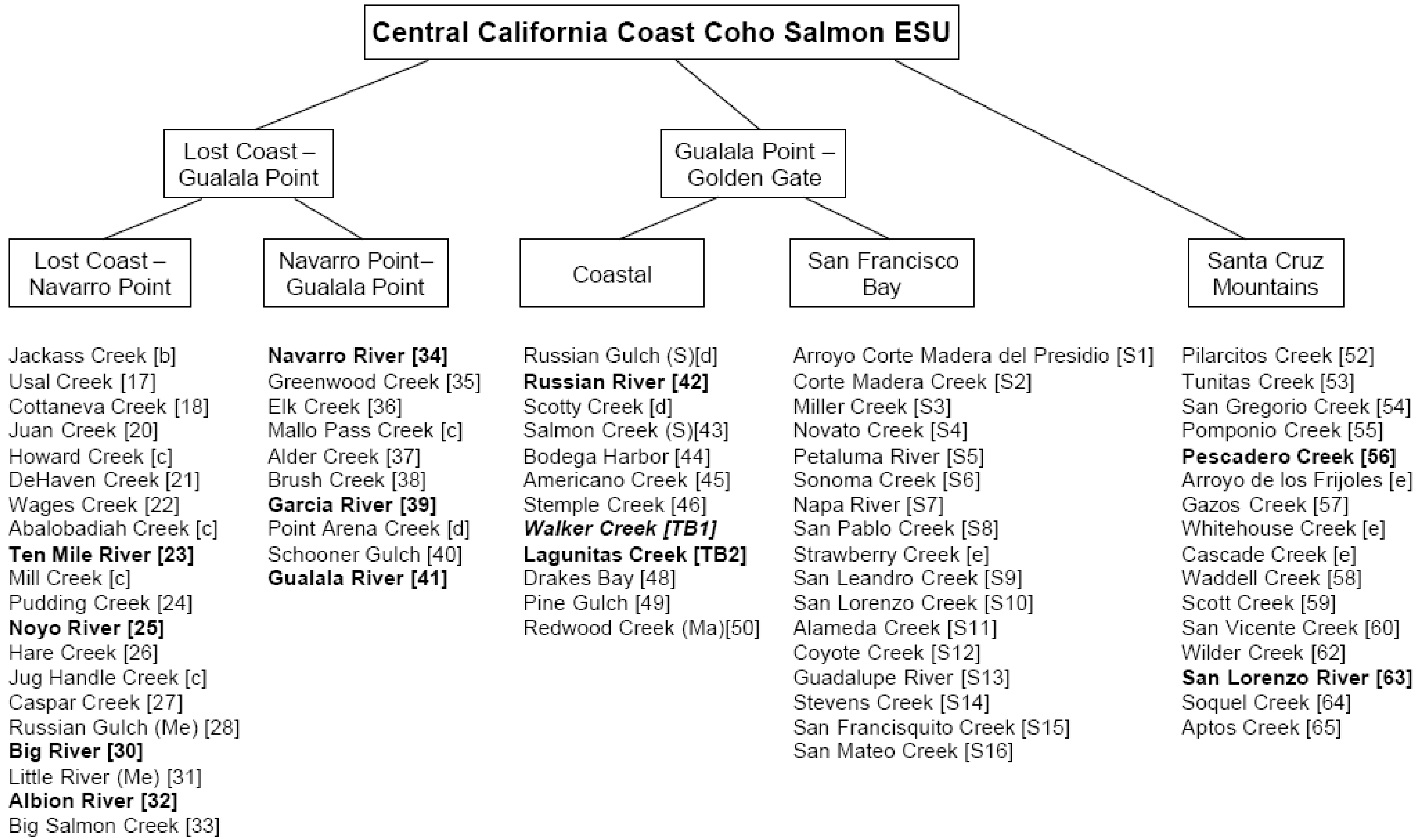


Figure 12: Historical population structure of the CCC coho salmon ESU, arranged by Diversity Strata. Functionally Independent populations are listed in bold font. Potentially Independent populations are listed in bold italic font. Dependent populations are listed in regular font. All dependent populations are not displayed. From Spence et al., 2008.

Biological Viability Criteria

Spence *et al.* (2008) developed biological viability criteria at the three levels of biological organization outlined by Bjorkstedt *et al*. (2005) important for the long term persistence of CCC coho salmon (*i.e.*, populations, Diversity Strata and ESU). These criteria are described in the two categories of: "Population Viability Criteria" and "ESU Viability Criteria". The biological viability criteria "*defines sets of conditions or rules that, if satisfied, would suggest that the ESU is at low risk of extinction*" (Spence *et al*. 2008). These general conditions require: (1) achieving population viability across selected populations and (2) attaining the necessary number and configuration of these viable populations across the landscape. These criteria do not include abundance of dependent populations nor do they provide context on recovering populations under the influence of climate change or ocean conditions.

The biological criteria "…*do not explicitly specify which populations must be viable for the ESU to be viable…but rather they establish a framework within which there may be several ways by which ESU viability can be achieved*" and are "…*intended to provide a framework for planners both to set general biological based targets for recovery and to guide future evaluations of the status of the ESA-listed salmonids…*" {Spence, 2008}. While criteria should be tailored to populations, their biological characteristics and the ability of habitats to support these populations, these data are not available and will likely not be available in the foreseeable future. Thus, in the absence of quantitative data, general objective criteria were recommended by a Recovery Science Review Panel and Shaffer *et al.* (2002) such as those used by the International Union for Conservation of Nature (IUCN 2001). These were applied for these criteria. These criteria inform the final delisting criteria (but are not synonymous with recovery criteria), for CCC coho salmon. They provide the bases to select populations for the recovery scenario relative to the number, size, trends, structure, recruitment and distribution of spawning adults over a 10-12 year moving average.

ESU and population viability was considered by {Spence, 2008} using "*two distinct but equally important perspectives*": (1) population viability in relation to its historical function and (2) minimum population size.

Population Viability Criteria

Criteria were developed that, combined, constitute a viable population (Tables 8 and 9). To define the key characteristics of what makes a population viable, the TRT classified populations "*into various extinction risk categories based on a set of quantitative and qualitative criteria related*" to the VSP parameters of abundance, population growth rate, population spatial structure and population diversity (McElhany *et al.* 2000). Abundance typically refers to the number of adult spawners measured over a time series relevant to life history. Population growth rate (*i.e.*, productivity) is a measure of a populations' ability to sustain itself overtime (*e.g.*, returns per spawner). Population spatial structure describes how populations are arranged geographically based on dispersal factors and quality of habitats. Population diversity is the underlying genetic and life history characteristics that provide for population resilience and, thus, persistence across space and time. For a population to be viable it must be large enough to: (1) have a high probability of surviving environmental variation, (2) compensate for disturbances, (3) maintain genetic diversity, and (4) functionally contribute to associated ecosystems.

The population viability criteria (also termed extinction risk criteria), when met, are expected to result in populations with a low risk of extinction (*i.e.,* viable). These criteria are: (1) likelihood of extinction; (2) effective population size or total population size; (3) population decline; (4) catastrophic decline; (5) spawner density, and; (6) hatchery influence (Table 7). To inform these criteria it is necessary that monitoring include a lengthy time series of adult abundance at appropriate spatial scales. Life cycle monitoring will be necessary to inform these criteria. Few datasets exist and "*there is an urgent need to initiate monitoring programs that will generate data of sufficient quality to rigorously assess progress toward population and ESU recovery. Development of a comprehensive coastal monitoring plan for salmonids has been underway for several years by the California Department of Fish and Game, with input from NMFS; however, dataset that will allow assessment of status using the criteria described herein are likely more than a decade away. Consequently, the present values of these criteria…are to inform the development of such a monitoring plan and to provide preliminary targets for recovery planners*" (Spence *et al*. 2008). Refer to Spence *et al.* (2008) for additional information regarding methods and criteria that provides an outline of monitoring recommendations.

Table 11: Population Extinction Risk Criteria

Population Characteristic	Extinction Risk		
	High	**Moderate**	**Low**
Extinction risk from population viability analysis (PVA)	$\geq$ 20% within 20 yrs	$\geq$ 5% within 100 yrs but < 20% within 20 yrs	< 5% within 100 yrs
	- or any ONE of the following -	- or any ONE of the following -	- or ALL of the following -
Effective population size per generation *-or-* Total population size per generation	$N_e \leq 50$ *-or-* $N_g \leq 250$	$50 < N_e < 500$ *-or-* $250 < N_g < 2500$	$N_e \geq 500$ *-or-* $N_g \geq 2500$
Population decline	Precipitous decline[a]	Chronic decline or depression[b]	No decline apparent or probable
Catastrophic decline	Order of magnitude decline within one generation	Smaller but significant decline[c]	Not apparent
Spawner density	$N_a/IPkm^d \leq 1$	$1 < N_a/IPkm <$ MRD[e]	$N_a/IPkm \geq$ MRD[e]
Hatchery influence[f]	Evidence of adverse genetic, demographic, or ecological effects of hatcheries on wild population		No evidence of adverse genetic, demographic, or ecological effects of hatchery fish on wild population

[a] Population has declined within the last two generations or is projected to decline within the next two generations (if current trends continue) to annual run size $N_a \leq 500$ spawners (historically small but stable populations not included) or $N_a > 500$ but declining at a rate of $\geq$10% per year over the last two-to-four generations.
[b] Annual run size N_a has declined to $\leq$ 500 spawners, but is now stable *or* run size $N_a > 500$ but continued downward trend is evident.
[c] Annual run size decline in one generation < 90% but biologically significant (e.g., loss of year class).
[d] *IPkm* = the estimated aggregate intrinsic habitat potential for a population inhabiting a particular watershed (i.e., total accessible km weighted by reach-level estimates of intrinsic potential; see Bjorkstedt et al. [2005] for greater elaboration).
[e] MRD = minimum required spawner density and is dependent on species and the amount of potential habitat available. Figure 5 summarizes the relationship between spawner density and risk for each species.
[f] Risk from hatchery interactions depends on multiple factors related to the level of hatchery influence, the origin of hatchery fish, and the specific hatchery practices employed.

ESU Viability Criteria

Four criteria were developed that, collectively, constitute a configuration in the number and distribution of viable and non-viable populations that would likely provide for ESU persistence over 100 year time frame (i.e., viable). Thus, there may be "several plausible scenarios of population viability that could satisfy ESU-level criteria" {Spence, 2008}. The goals of the ESU criteria are to reduce the risk of extinction by ensuring (1) connectivity between populations, (2) representation of ecological, morphological, and genetic diversity, and (3) redundancy in populations to minimize risks associated with catastrophic events.

In characterizing a viable ESU the TRT applied the hypothesis that populations, as they functioned in their historical context, were highly likely of persisting and that "…*increasing departure from historical characteristics logically requires a greater degree of proof that a population is indeed viable*" (Spence *et al*. 2008). Due to the likely historical roles of functionally independent or potentially independent populations these form the foundation of the ESU viability criteria. The "non-viable" or dependent population criteria were designed to ensure reservoirs of genetic diversity, contribute to connectivity, reduce risk of ESU extinction, and provide a source of colonizers to extirpated watersheds and buffer ocean conditions and disturbances to independent populations.

The four ESU viability criteria are:

(1) Representation Criteria;

1.a. All indentified diversity strata that include historical FIPs or PIPs within an ESU should be represented by viable population for the ESU to be considered viable.

-AND-

1. b. Within each diversity stratum, all extant phenotypic diversity (i.e., major life-history types) should be represented by viable populations.

(2) Redundancy and Connectivity;

2.a. At least fifty percent of historically independent populations (FIPs or PIPs) in each diversity stratum must be demonstrated to be at low risk of extinction according to the population viability criteria. For strata with three or fewer independent populations, at least two populations must be viable.

-AND-

2.b. Within each diversity stratum, the total aggregate abundance of independent populations selected to satisfy this criterion must meet or exceed 50% of the aggregate viable population abundance (*i.e*., meeting density-based criteria for low risk) for all FIPs and PIPs.

(3) Remaining populations, including historically dependent populations or any historical FIPs or PIPs that are not expected to attain a viable status, must exhibit occupancy patterns consistent with those expected under sufficient immigration subsidy arising from the 'focus' Independent populations selected to satisfy the preceding criterion.

(4) The distribution of extant populations, regardless of historical status, must maintain connectivity within the diversity stratum, as well as connectivity to neighboring diversity strata.

APPLYING TRT FRAMEWORK TO COHO SALMON ESU RECOVERY CRITERIA

A total of 75 watersheds, between Mendocino County and Santa Cruz County (including San Francisco Bay tributaries) were identified by Bjorkstedt *et al*. (2005) as historically supporting CCC coho salmon populations. All 12 independent populations and 16 dependent populations (DPs) were chosen across four diversity strata for the CCC coho salmon ESU recovery scenario; no populations were chosen for the San Francisco Bay Diversity Stratum. Recovery targets for spawner abundance for each FIP or PIP within the ESU coincide with the low extinction risk targets identified in Spence *et al.* 2008, except for the Russian River. Occupancy targets for DPs were derived from abundance estimates from Waddell Creek data from the 1930's (Shapavolov and Taft 1954).

The combined abundance targets and recovery criteria for the CCC coho salmon ESU we believe represent the recovery of the species. The reasons for this are threefold: 1) The approach provides redundancy, resiliency and representation in the ESU; 2) We recognize that the salmon provide additional ecological benefits such as maintenance of ecosystem productivity; and 3) Salmon may ultimately be harvested, as they near recovery, for recreational, commercial and tribal uses. It would be unwise not to consider this as part of the broader ecological picture when developing recovery criteria.

The current recovery scenario expects 37 percent of historical populations (28 individual watersheds) to achieve and maintain viability across all potential habitats for CCC coho salmon to meet ESU-level criteria. These 28 watersheds occupy **43 percent** of the total land area in the ESU, and represent **33 percent** of all the stream kilometers with the potential to have provided habitat historically (*i.e*. IP km). Though these 28 populations are the focus of this analysis and subsequent strategy development, recovery and threat abatement actions should not be limited exclusively to these watersheds. In particular, efforts to prevent coho salmon extirpation and facilitate their recovery should be initiated where this species is present. In addition, all coho salmon populations and individuals and their designated critical habitat remain fully protected under the ESA wherever they occur and are therefore still subject to all the protections therein; including prohibitions on take and habitat modifications (unless legally exempted by permit).

IP habitats for coho salmon were output for each population and are displayed on maps that include a range of IP values across three scales: 0.0 to 0.35; 0.35 to 0.7 and > 0.7. These scales represent: (1) relative likelihood for historic channel and flow conditions to provide higher quality rearing habitats for coho salmon; and (2) likelihood of areas within a watershed to historically provide higher or lower abundance per length of stream reach to meet overall abundance target for the population. The IP values across these scales represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon with > 0.7 having a high likelihood, 0.35 to 0.7 having a moderate likelihood and 0.0 to 0.35 having a lower likelihood.

For recovery planning purposes, NMFS is evaluating those areas identified as > 0.7 as having a higher potential for responding to instream restoration actions (e.g., input of large wood and pool formation).

With the current goal to prevent extinction, these areas will be evaluated for their potential to respond quickly to restoration activities and provide immediate or very near term benefits to improve CCC coho salmon survival. These areas are also those most likely to respond negatively as well as upstream conditions degrade. Nevertheless, the overall persistence of this species relies on restoration and maintenance of watershed processes across IP and non-IP areas.

Recovery Goals for Independent Populations

Table 8 summarizes the Independent Population recovery criteria for CCC coho salmon, including both biological criteria for population viability and recovery and the total IP-km expected to function towards meeting these recovery goals. Viable population abundance is calculated as the product of all stream reaches with intrinsic potential (IP-km) in a watershed and recovery target densities for spawning adults based on Spence *et. al.* (2008).

Table 12: Independent Population Adult Spawner Abundance Targets for Recovery

Diversity Strata	Population	IP-km	Density Targets	Spawning Adult Target	
Lost Coast	**Ten Mile**	**105.1**	**34.93**	3700	
Lost Coast	**Noyo**	**118**	**34.03**	4000	
Lost Coast	**Big**	**191.8**	**28.91**	5500	
Lost Coast	**Albion**	**59.2**	**38.11**	2300	
			Total:	**15,500**	
Navarro Pt.	**Navarro**	**201**	**28.27**	5700	
Navarro Pt.	**Garcia**	**76**	**36.95**	2800	
Navarro Pt.	**Gualala**	**251.6**	**24.76**	6200	
			Total:	**14,700**	
Coastal	**Russian**	**506**	**20.00**	**10,100**	
Coastal	**Walker***	**76.2**	**36.93**	2800	
Coastal	**Lagunitas**	**70.4**	**37.34**	2600	
			Total:	**15,500**	
Santa Cruz	**Pescadero**	**60.6**	**38.02**	2300	
Santa Cruz	**San Lorenzo**	**126.42**	**33.45**	4200	
			Total:	**6500**	
				ESU Total:	**52,200**

*Potentially Independent Population

Unfortunately, data are insufficient to assess current viability for the 12 independent populations based on the defined criteria. Ancillary data compiled and assessed by the TRT indicate that over half of the independent populations (and many dependent populations) are extirpated, or nearly so (Spence *et al.*

2008). Despite the data limitations, all evidence suggests that the CCC coho salmon ESU is at a high risk of extinction (Spence *et al.* 2008).

Recovery Goals for Dependent Populations

In order to meet viability criteria and address the extreme decline in the coho salmon population, specific Dependent Populations were included to minimize extinction risk. The inclusion of these Dependent Populations are anticipated to (1) maintain connectivity within and across diversity strata; (2) provide potential sources of colonizers if adjacent populations are eliminated or experience severe declines; and, (3) ensure continued genetic reservoirs in strata where Independent Populations are extirpated. The 16 selected Dependent Populations must exhibit occupancy patterns within targeted ranges (Table 9) consistent with those expected under sufficient immigration subsidy arising from the Independent Populations; and the distribution of extant populations, regardless of historical status, must maintain connectivity within the diversity stratum, as well as connectivity to neighboring Diversity Strata.

Table 13: Dependent Population

Adult Spawner Abundance for Recovery

Dependent Populations	Current IP-km	Spawer/km	Target Na
Usal Creek	10.6	34	360
Cottaneva Creek	13.8	34	469
Wages Creek	10	34	340
Pudding Creek	28.9	34	983
Casper Creek	12.8	34	435
Big Salmon Creek	17	34	578
Salmon Creek	47.6	34	1618
Pine Gulch	7.4	34	252
Redwood Creek	8	34	272
San Gregorio	40.1	34	1363
Gazos Creek	8.2	34	279
Waddel Creek	9.2	34	313
Scott Creek	15	34	510
San Vicente Creek	3.1	34	105
Soquel Creek	33	34	1122
Aptos Creek	27.4	34	932
Lost Coast-Navarro Point	6 populations		3165
Navarro Point-Gualala Point	no populations		0
Coastal	3 populations		2142
Santa Cruz Mountains	7 populations		4624
		ESU Total	**9931**

Available data were used to develop a target range for spawner densities in dependent watersheds. Data from 1933-1942 in Waddell Creek, Santa Cruz County, (Shapovalov and Taft 1954) were used as a reference for the spawner target density target[12]. The average

[12] It is important to note that virtually all portions of the Waddell Creek watershed, at the time of the Shapovalov and Taft study in the 1930's, had been were not at a pristine or condition. Shapovalov and Taft (1954) describe Waddell Creek in the following terms: *"Some changes from the primitive condition of the area have taken place as a result of human usage. The redwood forest of the watershed below Big Basin was logged off by 1870 and is now covered by a second growth. The early lumbering operations have resulted in the creation of several semipermanent log jams and temporary accumulations of logs, which have hastened erosion of stream banks, with consequent increase in silting during flood stage."*

spawner population was 312 fish (which ranged from111-748) resulting in a spawner density target of 34 per IP-km (312/9.2 IP-km).

The statements of Shapovalov and Taft (1954) likely understate the degree Waddell Creek had been affected by the removal of the redwood forest. Virtually all portions of the watershed accessible to coho salmon were extensively disturbed prior to the onset of the Shapovalov and Taft (1954) study. Early logging practices were particularly destructive and this level of disturbance likely resulted in a significant reduction in the productive capacity for coho salmon in the watershed.

Considering the SF Bay Stratum

All CCC coho salmon populations that historically existed in the San Francisco Bay region have been extirpated. The most plausible explanation for the extirpation is the intense urbanization and associated developments in the region. Historical evidence confirms that watersheds that are tributaries to the San Francisco Bay, which collectively comprise the San Francisco Bay Diversity Stratum, supported populations of coho salmon (Spence *et al*. 2005). The first known scientific specimen of a coho salmon from California was collected in the 1860's from San Mateo Creek in San Mateo County. An investigation of the Indian middens in the Emeryville shellmounds revealed remains of coho salmon prior to European contact (Gobalet *et al*. 2004), and adult coho salmon were also observed in Alameda Creek as recently as the 1960s (Leidy *et al*. 2005).

While the historical presence of coho salmon in the San Francisco Bay stratum is established, the degree to which these tributaries were historically capable of supporting coho salmon populations is uncertain. Bjorkstedt *et al.* (2005) identified many watersheds exceeding the minimum 32 IP-km for Independent Population status. According to the model predictions, San Francisco Bay populations represented 16 of 75 watersheds in the ESU with historic potential to support coho salmon. San Francisco Bay watersheds contain 38 percent of all the historic IP mileage in the ESU. Bjorkstedt *et al.* (2005), however, described considerable uncertainty in the IP model prediction results due to the highly altered current condition and the lack of historical evidence of viable populations. The general conclusion reached by Bjorkstedt *et al*. (2005) is the San Francisco Bay watersheds supported only small and/or ephemeral populations, particularly in the drier and warmer interior watersheds. The TRT concluded (Bjorkstedt *et al.* 2005) that no independent populations historically existed and, thus, no viability abundance criteria were developed for populations of the San Francisco Bay Diversity Stratum.

Reasons for the extirpation of CCC coho salmon in the San Francisco Bay region are likely due to multiple factors such as inherently marginal habitats, currently highly degraded watersheds and occupancy by populations that were ephemeral or occasional in nature. The extirpation of CCC coho salmon in this Stratum and the high costs of restoration and/or infeasibility of restoration suggested may be little value in including this Stratum into the recovery scenario. Nonetheless, while the San Francisco Bay Diversity Stratum was not included in the recovery scenario it is recommended that evaluation be done on the feasibility and likelihood of restoring CCC coho salmon populations some San Francisco Bay tributaries (such as Corte Madera Creek) due to some uncertainty regarding the role these populations may have had in the ESU.

CHAPTER 6: ASSESSMENT OF HABITATS & THREATS

"There is one thing more vital to science than intelligent methods; and that is, the sincere desire to find out the truth, whatever it may be."

Charles Sanders Pierce

METHODS TO ASSESS HABITAT CONDITIONS AND THREATS

Statute, case law, and agency policy guide the process NMFS uses to assess habitat conditions and threats to Federally listed species. The ESA mandates each recovery plan shall incorporate, to the maximum extent practicable, objective, measurable criteria which, when met, would result in a determination that the species has reached long term viability to the point that the protections of the ESA are no longer necessary (NMFS 2006a). Legal challenges underscore this statute and the intent of Congress. The law requires that objective, measurable criteria must link to threats identified at listing, as well as those identified since listing, and must measure whether threats have been abated. The U.S. Government Accountability Office in 2006, in an audit of Federal recovery plans, directed Federal agencies to incorporate, in all new or revised recovery plans, appropriate criteria evidencing consideration of listing factors. Thus, NMFS Interim Guidance (NMFS 2007) recommends "a structured approach to assessing threats, sources of threats, and their relative importance to the species' status…". The Interim Guidance (2007) additionally recommends recovery plans conduct an assessment explicitly identifying all threats to a species and track, through objective and measurable criteria, how each threat will be reduced or eliminated through site-specific management actions. This process includes: (1) identifying threats to the species at time of listing (Chapter 3); (2) identify changes in those threats; (3) identify any new threats; and (4) cross-referencing threats at time of listing and new threats.

Achieving population abundance necessary for viability and recovery will not be possible unless degraded habitats are restored to functioning conditions, and the threats that compromise these habitats are adequately controlled. The purpose of a threats assessment in recovery planning is to determine why, to the extent possible, the species is declining (NMFS 2007). The causes for this decline may be related to past, ongoing, and/or future stressors in the species' environment, or from direct mortality to individuals. Understanding current habitat conditions, stresses, and the sources of stress (*e.g.*, threats) to the species is essential in developing effective recovery actions. Coho salmon utilize a wide range of habitats and the condition of these habitats has different effects according to life stage. This chapter describes the methods used to: (1) assess current habitat conditions and future threats for the 28 focus populations in the CCC coho salmon ESU, and (2) develop recovery actions designed to restore functional habitat conditions, and control identified threats.

Conservation Action Planning

The Interim Recovery Planning Guidance for Threatened and Endangered Species (NMFS 2007) recommends the Conservation Action Planning (CAP) process as a method to assess current habitat conditions and future threats that affect species viability and to develop recovery strategies that address those conditions and threats. The CAP process was thus applied to CCC coho salmon recovery planning. It was developed by The Nature Conservancy (TNC) in collaboration with the World Wildlife Fund, Conservation International, Wildlife Conservation Society and others. Standards were developed by the Conservation Measures Partnership; a partnership of ten different biodiversity non-governmental organizations (www.conservationmeasures.org). CAP has been applied to more than 400 landscapes and 25 countries; TNC has officially adopted CAP as its standard conservation planning tool. CAP workbook information is available at: http://conserveonline.org/workspaces/cbdgateway/cap/index_html.

The CAP protocol was followed explicitly for CCC coho salmon recovery planning. The process involved assembling both qualitative and quantitative data on freshwater and marine conditions. All decisions, data, and references are catalogued in customized Excel tables, the CAP Workbook. This specialized CAP Workbook was designed to organize, track, and summarize large amounts of information in an easily updatable and user-friendly manner. The comprehensive documentation, transparency, and adaptability serves as the foundation for successive iterations as additional data are learned and gathered. The recovery plan only outputs the CAP workbook results for each watershed and summarized across watersheds. The metadata is extensive and was not included in the plan at this time, but can be requested.

The NMFS application of the CAP protocol included: (1) defining current conditions for habitat attributes essential for the long term survival of CCC coho salmon; (2) identifying activities reasonably expected to continue, or occur, into the future that will have a direct, or indirect, negative effect on the species; and (3) strategy development to improve current conditions (restoration strategies) and abate future threats (threats strategies). Each step culminates into a testable hypothesis of species viability across the dimensions of life stage/population viability, habitat conditions and continuing/future threats. From the hypothesis, success is measured from clearly defined objectives and strategies actions secured in CAPs adaptive and iterative framework.

In 2006, NMFS partnered with TNC for their assistance and support in applying the CAP process for the CCC coho salmon recovery plan. The hands-on training and interactions with TNC staff facilitated the custom application of the CAP workbook to CCC coho salmon. Several other NMFS recovery domains in California are also using the TNC CAP protocol, or a modified version of the process, to develop their recovery plans.

CAP Workbook Structure

Twenty-eight CAP workbooks were developed representing each of the focus freshwater populations (populations coincide with watersheds for the CCC coho salmon ESU). Each workbook was organized to assess site-specific and watershed conditions and threats, across freshwater lifestages (*e.g.*, adult spawning, egg survival, juvenile/winter survival, and smolt outmigration). This directed attention to a limiting lifestage, and the possible causes of the limitations. The conditions of all life stages collectively provide the landscape view of what may be limiting the overall population. Each CAP workbook has three structural components: the Viability Table, the Threats Tables, and a section on Strategic Actions.

The Viability Table

The Viability Table was developed to assess site-specific and watershed conditions. It was organized by a defined set of values supported by the best available scientific literature and provided a reference to assess current aquatic and upland conditions relevant to specific CCC coho salmon life stages. The Viability Table defines specific life stages as conservation targets, and assesses key habitat or population elements required for each life stage. The assessment depends on specific parameters or indicators, and reference values for each indicator.

Conservation Targets

The Conservation Targets have been defined as the following freshwater life-stages (Table 10):

- Spawning Adults – Includes adult fish from the time they enter freshwater, hold or migrate to spawning areas, and complete spawning (November 1 to March 1)[13];
- Egg – Includes fertilized eggs deposited into redds and the incubation of these eggs through the time of emergence from the gravel (December 1 to April 1);
- Summer Rearing – Includes juvenile rearing in streams and estuaries (when applicable) during summer and fall (June-October) prior to the onset of winter rains;
- Winter Rearing – Includes rearing of juveniles from the onset of winter rains through the winter months up to the initiation of smolt outmigration (November 1 to March 1);
- Smolt – Includes juvenile migration from natal rearing areas until they enter the ocean (March 1 to June 1); and
- Multiple Life Stages – Includes one or more freshwater life stages potentially affected by upslope or landscape processes. These processes have wide-ranging effects and occur at the watershed scale.

[13] The purpose in defining discrete life-stage periods is to assess habitat attributes during a representative time frame, not to encapsulate the full range of timing possibilities.

Table 14: CAP Example Workbook Page and Life Stage Targets

Conservation Action Planning Workbook
A tool for developing strategies, taking action, and measuring success
© 2008 The Nature Conservancy Version: CAP_v5a March 7, 2008

ConserveOnline Help
Online Tutorial
Full Version

To enter, edit or delete data in protected cells (which are shaded or contain entries in black font), double-click on the cell. An entry form will appear.
To change the table format, double-click on the table header. A table format form will appear.

	Project and Conservation Targets	
	Project	**Central California Coast Coho Salmon ~ Lagunitas Creek Population**
1	**Target #1**	**Spawning Adults**
2	**Target #2**	**Eggs**
3	**Target #3**	**Summer Rearing Juveniles**
4	**Target #4**	**Winter Rearing Juveniles**
5	**Target #5**	**Smolts**
6	**Target #6**	**Multiple Life Stages**
7	**Target #7**	
8	**Target #8**	

Key Attributes

Key Habitat Attributes are the freshwater elements required for the species survival and recovery. These attributes are essential to the immediate and long-term success of the species at each life stage and are presumed to limit the population if missing or degraded.

Indicators and Indicator Ratings

Indicators are the specific habitat or population parameters that define a Key Attribute. Indicator Ratings are the reference values for each Indicator. Depending on the complexity of the key attribute or the nature of available data, one or more Indicators have been identified for each Key Attribute. For example, because two types of data were available for the Egg life stage, Key Attribute of Sediment for Incubation and Emergence, two indicators were identified: bulk samples and embeddedness (Table 11).

Photo Courtesy: Inman Creek, Mendocino County, CA, Samantha Kannry and Rob Cimitile, TNC

Table 15: Example CAP Workbook Table of Key Attributes, Indicators and Ratings

Assessment of Target Viability								
Central California Coast Coho Salmon ~ Lagunitas Creek Population					Indicator Ratings			
				Double-click opens entry form	Bold = Current		Italics = Desired	
Conservation Target		Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good
2	Eggs	Condition	Sediment: Incubation & Emergence	Gravel Quality: Percent of fines in bulk samples of potential spawning sites	>14% 0.85mm and/or >30% 6.4mm	Between Poor and Good	**<14% 0.85mm and/or <30% 6.4mm**	
2	Eggs	Condition	Sediment: Incubation & Emergence	Gravel Quality: Percent of pool-tailouts sampled with embeddedness values of 1 and 2	<25% 1 & 2	25-50% 1 & 2	**>50% 1 & 2**	Not Defined

Indicators allow each Key Attribute to be objectively assessed by providing a means to measure a specific habitat condition with existing data. Ratings are classes bound by generally quantitative thresholds that define whether the condition of a given indicator is "Very Good, "Good", "Fair", or "Poor". To the extent possible, these thresholds were defined using values in published scientific literature. Measurable indicators were used for as many of the analyses as possible; however, data limitations demanded the formulation of other decision-making structures for qualitative information when quantification was not possible. A total of 12 indicators relied on this approach to include instream flow conditions, estuary condition (to some degree), and toxicity. A complete list is provided in Table 12 and a description of the attributes is available in Appendix D (Viability Table Report).

Geographic Limits of Analysis

To adequately rate Indicators, an analysis of data at the watershed scale was necessary. The NCCC Domain Recovery Team considered all stream reaches that historically supported the target life stages. For example, to characterize water temperature for summer rearing juveniles, all stream reaches that likely supported summer rearing were evaluated across the extent and distribution of historic habitat as defined by the TRT (IP). The IP model provided an estimate of the linear extent of potential habitat in each watershed in kilometers (km), thus providing a spatially discrete estimate of potential spawning and rearing habitat at the reach scale (Agrawal *et al*. 2005). Using this model facilitated the definition of all stream reaches within a watershed potentially suitable habitat for each life stage target and avoided biases in the assessments.

Table 16: Targeted Life Stage, Habitat Attributes and Indicators

Target Life Stage	Habitat Attribute	Indicator
Spawning Adults	Viability (Incidental Mortality)	Freshwater Harvest
Spawning Adults	Hydrology, Adult passage to spawning grounds	Passage Flows
Spawning Adults	Passage	Physical Barriers
Spawning Adults	Passage at Stream Mouth	Entry Period
Spawning Adults	Sediment, Spawning Substrate	Spawning gravel quantity/distribution
Spawning Adults	Viability, Pop. Density	Density Target
Egg	Hydrology	Redd Scour
Egg	Hydrology	Instantaneous Condition
Egg	Sediment	Gravel Quality (Bulk)
Egg	Sediment	Gravel Quality (Embed.)
Summer Rearing	Hydrology	Baseflow
Summer Rearing	Water Quality	Temperature (MWAT or MWMT)
Summer Rearing	Pool Habitat	Shelter Rating
Summer Rearing	Pool Habitat	Frequency of Primary Pools
Summer Rearing	Viability	Density (Juveniles)
Summer Rearing	Viability	Distribution
Winter Rearing	Velocity Refuge	Complex Habitat Types
Smolt	Estuary	Estuary
Smolt	Passage	# of Diversions
Smolt	Hydrology	Flow Conditions
Multiple Life Stages	Pool Habitat	Shelter Rating
Multiple Life Stages	Hydrology	Impervious Surfaces
Multiple Life Stages	Hydrology	Stand Age
Multiple Life Stages	Land disturbance	Agriculture
Multiple Life Stages	Land disturbance	Timber Harvest
Multiple Life Stages	Riparian Veg., Stream Shading	Canopy Cover
Multiple Life Stages	Riparian Veg.	DBH (North) DBH (South)
Multiple Life Stages	Riparian Veg.	Species Composition
Multiple Life Stages	Sediment Transport	Road Density
Multiple Life Stages	Sediment Transport	Road density (Riparian)
Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)
Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)
Multiple Life Stages	Velocity Refuge	Floodplain Connectivity
Multiple Life Stages	Water Quality, Toxins	Toxicity

Viability Table Data Sources

The data that informed the viability tables came from a wide variety of sources. Sources included the DFG, SWRCB, U.S. EPA, RCDs, private timber companies, conservation organizations, consultants, local watershed groups and other contributors. Each of the 34 indicators required its own method of integrating data. A detailed description of these methods is provided in Appendix C. The methods are briefly summarized into the following seven categories:

1. Hab-8 Data: Eight indicators were informed by the DFG stream habitat-typing dataset. These data provided wide coverage across 14 of 28 focus watersheds using a standardized data collection protocol (Flosi and Reynolds 1998).
2. Instream Flow: Lack of sufficient gage data in rearing and migration habitats led us to derive ratings for instream flow indicators from a structured decision-making model informed by a panel of local experts (appendices). Five indicators were developed with this method.
3. Instream Temperature Data: A single indicator was used to inform this habitat attribute, but it required extensive compilation of disparate datasets. In order to extrapolate temperature data taken at a specific point to inform a watershed-wide rating, point data were grouped into condition classes. Final ratings were made by estimating the proportion of a watershed's IP network that fell within each temperature class.
4. Estuary Conditions and Toxicity: The indicators for these attributes were difficult to quantify, so structured decision-making models were developed and were informed by literature review and expert opinion (appendices).
5. Land Use Assessments: Nine indicators were informed by GIS queries of available spatial datasets.
6. Population Viability: Three viability indicators were informed by review and synthesis of all available fisheries monitoring data in the ESU.
7. Other Indicators: The six remaining indicators were informed by various methods ranging from queries of existing databases (*e.g*. physical barriers) to best professional judgment.

Contributions from the Sonoma Ecology Center

To provide focused support for data acquisition, NMFS contracted with the Sonoma Ecology Center (SEC) to search for, compile, manage, and apply the disparate data necessary to inform many of the indicators and ratings previously discussed. The following is a summary of their efforts. A final report detailing these efforts is available in the appendices.

Much of SEC's effort involved the application of DFG's Hab-8 data to the 14 of 28 focus watersheds to which these data were available. SEC managed data acquisition (from DFG), spatially referenced the data, conducted bias analyses and quality control, as well as developed the necessary queries to match the data to 8 of the 34 indicators.

SEC supported assessments of passage issues using the Pacific States Marine Fisheries Council Passage Assessment Database (PSMFC 2006). They also used the National Landcover Database (2001) to calculate the percent of impervious surface and percent of land in agriculture for 28 watersheds.

Finally, SEC conducted exploratory data searches for several indicators to investigate the feasibility of using data-driven ratings for a number of indicators related to instream flows, estuaries, and toxicity. In most of these cases we reverted to using structured decision-making models due to lack of appropriate data. However, SEC supported these models with the best available data.

Spatial Analysis

NMFS Habitat Conservation Division GIS unit provided extensive information and analysis, particularly for land use attributes. For each focus watershed, an individual report was developed with detailed information on a variety of indicators. Watershed Characterizations detailed acreage and percentage of urbanization, land ownership, land cover, current and projected development, road densities, erosion potential, amount of farmland, timber harvesting history, location and types of barriers, diversions, and industrial influences (mines, discharge sites, toxic release sites) and stream temperature. These data were utilized either to directly inform the CAP workbooks viability indicator rankings or to inform the Recovery Team's general watershed knowledge (See Appendix F).

CDFG Habitat Typing Survey Data and UC Hopland Research

The NMFS Santa Rosa office has secured all CDFG habitat typing data for the NCCC Domain. These datasets are currently being standardized into an Access database under funds provided by Sonoma County Water Agency. This "*Stream Summary Application*" is in development by UC Davis Hopland Research and DFG. UC Hopland is conducting the following: (1) entering field data from datasheets and importing databases from individual surveys into the stream habitat application; (2) performing quality control and assurance on spatial datasets; and (3) creating spatial representations of stream surveys; and (4) using the stream habitat application to summarize the data for use by NMFS, DFG, SCWA, stakeholders and the general public. This database will provide summarized reach level data of all DFG surveys across all habitat parameters. The spatial application represents the upstream areas above and around each reach (e.g., reachsheds). The final product is scheduled for late October and will be used for the Domain Multispecies Plan analysis as well as finalization of the CCC coho salmon plan.

NMFS, NMFS contractors, UC Hopland and DFG will work together to develop queries for the final recovery plans, output tables and provide instructions on use of the database and its spatial output capabilities. In addition, as part of this contract these datasets will be uploaded into a Water Cyber infrastructure prototype (detailed below) for higher resolution analysis across dimensions of habitats (e.g., flow, temperature, shelter ratings, pools, etc.) and populations. The Stream Survey Application is forthcoming in October and will be used for our analyses in the final recovery plan. Below are two draft example spatial outputs of queries for the Russian River based on our habitat criteria for Percent Canopy and Pool Depth. The scales are based on poor, fair, good and very good ratings.

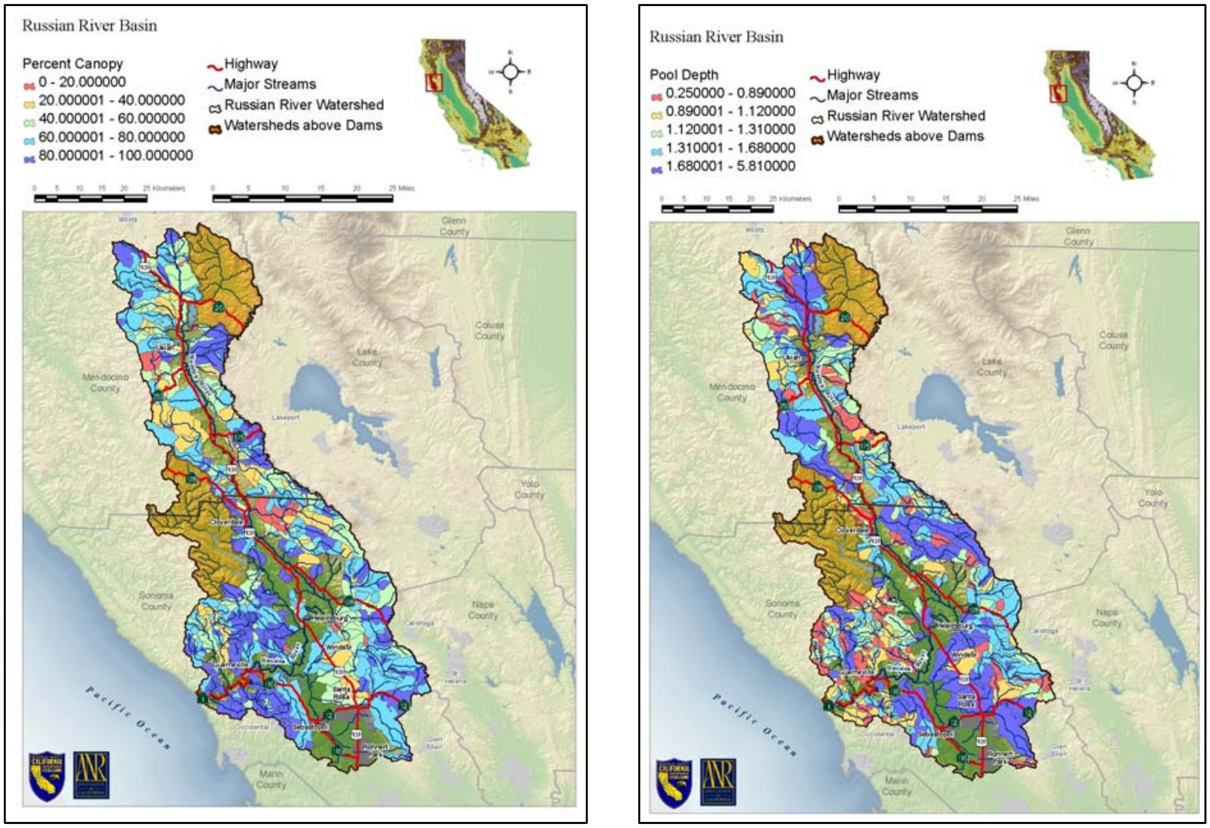


Figure 13: Example DFG data outputs by subwatershed for percent canopy and pool depth (working draft maps)

UC Berkeley, Lawrence Berkeley Laboratory and Microsoft Research

A centralized database of habitat and biological information has been an existing need in California for many years. While a number of worthwhile and important efforts and products exist that advance the goal of a centralized database (e.g., CalFish, KRIS, NCWAP, etc.), the information remains in a relatively unusable and unqueriable form. When recovery planning was fully initiated for the Santa Rosa office, the awkward nature of compiling data and conducting analyses from these various datasets became apparent. Thus, through funding provided to NMFS for recovery planning and data analysis a collaborative effort is underway to develop a centralized database of habitat and population data for the CCC coho salmon. In collaboration with California Department of Fish and Game, UC Davis Hopland Research Center, University of California Berkeley Water Center (BWC), Lawrence Berkeley National Laboratory (LBNL) and Microsoft Research eScience Group a new database prototype is being developed for CCC coho salmon that incorporates hydrological, meteorological, biological and other relevant data. This Water Cyber infrastructure prototype is being developed to provide dimensional evaluations of habitat relationships within and across watersheds to more accurately characterize the functionality of streams for salmon. The ability to perform high level analysis in California as described has not previously been feasible; this prototype will be expanded to include additional datasets for other salmon and steelhead populations in the Recovery Domain. This database is termed the "datacube". Currently a data cube prototype is being developed under a coordination agreement and pending contract between NMFS Santa Rosa, BWC, LBNL and Microsoft that includes hydrologic and meteorologic data. This datacube requires expansion to include water temperature, spatial data on stream habitat and population parameters to be of greater utility to NMFS. Following expansion, NMFS staff will have a broader range of analysis opportunities of salmon habitats. Using demonstrations of datacube application to the CCC coho salmon ESU and with training, NMFS will be positioned to use and update the datacube for broader application to other salmon and steelhead recovery planning efforts. NMFS will produce the final datasets prior to the final release of the recovery plan and work to make the data available and usable to the public.

The Threats Table

Threats are distinct from the key attributes developed to define current conditions in each watershed. Instead of conditions that currently exist, they attempt to define future conditions likely to limit recovery resulting from currently active issues such as ongoing logging practices, or from issues likely to occur in the future (usually within 10 years), such as residential development. Each threat is compared against a series of altered or impaired key attributes for each population, and ranked using the following metrics:

The Threats Table is organized into Stresses and Source of Stresses, which, when combined, constitute a threat to the species.

Stresses

Stresses represent altered or impaired Key Attributes for each population. They are essentially the inverse of the Key Attributes, so the attribute for "passage" would be "impaired passage" as a stress. Stresses were ranked using two metrics:

1. Stresses (Severity of Damage): The level of damage to the conservation target that can reasonably be expected to occur into the future under current circumstances (*i.e.*, given the continuation of the existing situation).
2. Stresses (Scope of Damage): The geographic scope of impact on the conservation target at the site that can reasonably be expected into the future under current circumstances (*i.e.*, given the continuation of the existing situation).

Sources of Stresses

Source of Stresses are defined as the proximate cause of the stress and are ranked using the following metrics:

1. Source of Stress (Irreversibility): Reversibility of the stress; and
2. Source of Stress (Contribution): Expected contribution of the source, acting along, to the full expression of a stress under current circumstances (*i.e.*, given the continuation of the existing management/conservation situation).

Many sources of stress are driven by social, economic, or political causes that then become the focus of conservation strategies. NMFS evaluated stresses and threats according to the CAP workbook protocols. Sixteen threats were identified and evaluated in the freshwater workbooks, and nine in the marine workbook. This list, or Threat Taxonomy, (Appendix D), provided a useful categorization of all the major threats to CCC coho salmon NMFS used for this evaluation.

Threats Data Sources

NMFS Habitat Conservation Division GIS unit provided extensive information and analysis, particularly for land use attributes. For each focus watershed, an individual report was developed with detailed information on a variety of indicators. Watershed Characterizations detailed acreage and percentage of urbanization, land ownership, land cover, current and projected development, road densities, erosion potential, amount of farmland, timber harvesting history, location and types of barriers, diversions, and industrial influences (mines, discharge sites, toxic release sites) and stream temperature. These data were utilized to directly inform the CAP threats rankings (See Appendix F). Additional information was gathered by reviewing watershed assessment documents and strategic planning materials for local/state/federal agencies, contacting knowledgeable individuals, utilizing staff expertise, and consulting a number of other references.

Recovery Actions

The ESA mandates recovery actions must be site specific and include objective and measurable (though not exclusively numeric) criteria. Recovery actions and criteria are analogous to the CAP terminology of strategies and measures. The strategies and measures application included in the CAP workbook identifies specific desirable outcomes or objectives and links them to improving current viability (*e.g*. current conditions), and abating identified threats. The workbook facilitates identifying and tracking the suite of strategic recovery actions to accomplish those objectives. Strategies and actions address specific key attributes and abate or reduce anticipated future threats found to be limiting population viability. The combined set of recovery actions and criteria comprise the standards on which decisions to reclassify or delist these species will be based.

The overall objective was to shift the poor current conditions ratings to Good or Very Good, the High or Very High ranked threats to Medium or Low, and to maintain generally good habitats where they exist. Recovery actions are presented on three hierarchical levels: Objectives, Actions and Action Steps.

Recovery actions were designed to achieve specific objectives to restore functional habitat conditions, or to abate future threats to the species. Strategic actions and action steps were developed to address all habitat attributes ranked as Poor. For attributes determined to be limiting in some watersheds, strategies were also developed for those ranked as Fair. In some cases, specific strategies were developed to address attributes which ranked as good or very good over an entire watershed, but were limiting in specific sub-watersheds. However, strategies were not developed for most attributes ranked as Fair, Good or Very Good. Since multiple attributes are sometimes involved, strategies were developed if any one of the related attributes were rated as poor. Similarly, strategic actions and actions steps were developed to address future threats ranked as High or Very High, but except in certain cases, were not developed for threats ranked as Medium or Low.

A priority structure for strategy implementation has been developed. Priority 1 actions are actions that must be taken in the near future to help prevent extinction or extirpation. These actions are focused on Core areas where CCC coho currently persist, and areas where functional habitat conditions are present for coho salmon. The approach of protecting existing high quality habitat over restoration of degraded or compromised habitat follows NMFS guidance in Ecosystem Recovery Planning for Listed Salmon (NMFS 2003). However, CCC coho populations will not persist simply by protecting extant populations and habitat within Core areas. Priority 2 actions must be taken as well to stop further decline and prevent further impairment to habitats. Priority 2 actions are focused primarily at Core or Phase I areas where efforts are directed to expand the current range to more closely resemble the historic range of CCC Coho. Priority 3 actions are directed primarily at Phase I and II areas, and are expected to improve habitat conditions for expanding populations. Priority 3 actions focus on preventing further degradation and reestablishing long-term recovery for expanding populations in all identified IP km. Priority 3 actions also include all other actions necessary to achieve full recovery of the species. Priority actions in Phase I and II areas are based on finding areas where there are feasible opportunities to significantly expand the current range of CCC Coho so these watersheds can reach their viability and recovery targets. Phase I and II areas are considered high priorities if the current populations in Core areas are secured, and opportunities to expand the overall population in the watershed are available.

NMFS did not use the TNC CAP workbook for strategy development. NMFS GIS department developed a recovery action database due to the magnitude of recovery actions and the need to include specific details associated with the required recovery action implementation schedule (*e.g.* costs, recovery partners, duration, priority number, etc.). These implementation schedules have been developed for each focus watershed (Chapter 10).

Strategies (a.k.a. Recovery Action) Data Sources

The NCCC Domain Recovery Team capitalized on a full range of resources to develop and prioritize recovery actions. The California Recovery Strategy for California Coho Salmon was used extensively for ESU and watershed specific strategies and is often identified as (DFG 2004) at the end of each strategic action or action step. Relevant actions were also developed from watershed assessment reports, TMDLs, EIR documents, strategic plans from cities/counties, coordination with other divisions of NOAA, outreach to knowledgeable individuals, staff expertise, and many other sources. A strategy database was developed for each watershed and individual actions from these sources input into each database. These databases were queried for specific strategies (*e.g.*, large wood input or barrier removal). If an action was found pertinent it was incorporated into the recovery action implementation schedule for the watershed. A partial list of the resources used to inform the recovery actions is provided in Appendix E. It is our intent to utilize as much currently existing information as possible to inform recovery actions. To that end, NMFS extends an invitation to the public, during the public comment period, to provide us with your information to more fully inform and refine these recovery actions.

Revisions to the CAP Workbook

NMFS Interim Guidance describes a threats assessment as an iterative process that should provide feedback to management actions (NMFS 2007). To ensure the effectiveness of our strategic actions, we will, in the public draft and implementation phase, work with the public to refine and update datasets and data informing our CAP workbook analysis. Furthermore, it is the intent of NMFS to make these CAP workbooks available to the public, conduct trainings in collaboration with TNC staff and provide the public an opportunity to work with and use these CAP workbooks moving forward.

CHAPTER 7: POPULATION, HABITAT & THREATS RESULTS

"There is presently no other way for humans to educate themselves for survival and fulfillment than through the instruction available from the natural world."

Freeman House

INTRODUCTION

Appropriate actions to recover CCC coho salmon will not be possible until there is (1) a clear understanding of coho salmon environmental requirements, (2) which requirements may be lacking or degraded, and (3) what threatens to further degrade habitats and limit the recovery. Results from the assessments of population viability, habitat conditions, and ongoing and future threats are therefore an essential foundation to the recovery plan. This chapter provides an overview of those results. Descriptions of the methods used to arrive at these conclusions are provided in Chapter 6.

Results include patterns and trends of watershed conditions currently impairing CCC coho salmon habitats and are presented by life stage and watershed to help prioritize recovery actions based on attributes most limiting to existing populations. This summary is based on assessments of current conditions and future threats conducted using the CAP protocol and workbook. Twenty eight focus watersheds were assessed across the ESU using data collected and generously provided by local and State agencies, public entities, landowners and others.

POPULATIONS SELECTED FOR RECOVERY

A total of 75 watersheds, between Mendocino County and Santa Cruz County (including San Francisco Bay tributaries) were identified by Bjorkstedt *et al*. (2005) as historically supporting CCC coho salmon populations. All 12 independent populations and 16 dependent populations (DPs) were chosen across four diversity strata for the CCC coho salmon ESU recovery scenario; no populations were chosen for the San Francisco Bay Diversity Stratum. Recovery targets for spawner abundance for each FIP or PIP within the ESU coincide with the low extinction risk targets identified in Spence *et al.* 2008, except for the Russian River. Occupancy targets for DPs were derived from abundance estimates from Waddell Creek data from the 1930's (Shapavolov and Taft 1954). The combined abundance targets for the CCC coho salmon ESU recovery scenario we believe represent broad sense recovery goals which are designed to provide for commercial, recreational, or tribal harvest as well as providing for additional ecological benefits (such as maintenance of ecosystem productivity). These targets have the added benefit of improving the redundancy, resiliency and representation of coho salmon in the ESU.

The current recovery scenario expects 37 percent of historical populations (28 individual watersheds) to achieve and maintain viability across all potential habitats for CCC coho salmon to meet ESU-level criteria. These 28 watersheds occupy **43 percent** of the total land area in the ESU, and represent **33 percent** of all the stream kilometers with the potential to have provided habitat historically (*i.e*. IP km). Though these 28 populations are the focus of this analysis and subsequent strategy development, recovery and threat abatement actions should not be limited exclusively to these watersheds. In particular, efforts to prevent coho salmon extirpation and facilitate their recovery should be initiated where this species is present. In addition, all coho salmon populations and individuals and their designated critical habitat remain fully protected under the ESA wherever they occur and are therefore still subject to all the protections therein; including prohibitions on take and habitat modifications (unless legally exempted by permit).

IP habitat for coho salmon were output for each population and are displayed on maps that include a range of IP values across three scales: 0.0 to 0.35; 0.35 to 0.7 and > 0.7. These scales represent: (1) relative likelihood for historic channel and flow conditions to provide higher quality rearing habitats for coho salmon; and (2) likelihood of areas within a watershed to historically provide higher or lower abundance per length of stream reach to meet overall abundance target for the population. The IP values across these scales represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon with > 0.7 having a high likelihood, 0.35 to 0.7 having a moderate likelihood and 0.0 to 0.35 having a lower likelihood.

For recovery planning purposes, NMFS is evaluating those areas identified as > 0.7 as having a higher potential for responding to instream restoration actions (e.g., input of large wood and pool formation). With the current goal to prevent extinction, these areas will be evaluated for their potential to respond quickly to restoration activities and provide immediate or very near term benefits to improve CCC coho salmon survival. These areas are also those most likely to respond negatively as upstream conditions degrade. Nevertheless, the overall persistence of this species relies on restoration and maintenance of watershed processes across IP and non-IP areas.

Revisiting IP in the Coastal Diversity Stratum

The Coastal Diversity Stratum contains three historically independent populations of CCC coho salmon. The TRT concluded the Russian River, the largest watershed in the ESU, historically supported two coho salmon populations: a major functionally independent population that spawned in tributary watersheds in the lower basin where coastal climates moderated summer temperatures and a dependent, possibly "ephemeral" population that occupied tributaries in the northwest corner of the basin (Bjorkstedt *et al*. 2005). Lagunitas Creek is believed to have also supported a functionally independent population, while Walker Creek historically supported a potentially independent population (Spence *et al*. 2008).

The estimate of historical IP-km in the Russian River basin was estimated at 779 IP-km. A density of 20 spawners/IP-km results in a population target of 15,600 adult fish in the Russian River. However, approximately 22 IP-km lie upstream of Warm Springs and Coyote Valley dams, and approximately 251 IP-km has limited potential for coho production in the basin due to a combination of urban development and extensive channelization for flood control. The degraded, channelized condition of heavily urbanized portions of the Russian River watershed makes attainment of the TRT's population viability target, (is based on historical habitat availability), highly unlikely. Thus, numeric spawner targets for recovery criteria were calculated from a revised estimate of IP km, to account for habitat loss associated with urban development and cold water habitat gains in the Russian River basin as discussed below.

The Russian River is both the largest watershed and a major center of human population within the CCC coho salmon ESU, where large portions of this watershed are urbanized and a large proportion of historical coho salmon habitat has been lost. The Santa Rosa Creek watershed and the Laguna de Santa Rosa watershed (upstream from the confluence with Santa Rosa Creek) collectively have 98 km of trapezoidal flood control channels[14]. These straightened channels run through urban and other highly developed areas that may preclude channel restoration capable of supporting rearing habitats for coho salmon. The hydrology of urban flood control channels are highly altered and may not be conducive to providing quality coho salmon habitat. Much of the remaining habitat in the Laguna de Santa Rosa (upstream of Santa Rosa Creek) is low gradient sloughs without significant spawning habitat. However, the Laguna de Santa Rosa does continue to provide abundant potential winter refugia for coho salmon. Appreciable amounts of the Laguna channel remains well connected to its flood plain, so that during winter the Laguna forms a network of large shallow ponds. Unfortunately, potential production of juveniles in these sloughs is likely prevented by the paucity of spawning habitat due to the network of numerous flood control channels and extensive low gradient, silt bottomed sloughs that make up most of the habitat in these two subwatersheds.

Attempts to restore natural stream meanders with backwater or scour pool habitats in these reaches, or to reconnect the channels with floodplains for the development of offchannel pools, is precluded by the adjacent extensive urban development. Similarly, placement (and retention) of large woody debris in heavily maintained flood control channels, may impair conveyance or provide marginal habitat improvements (when considering the accelerated runoff from impervious surfaces in the adjacent highly residential floodplain).

This evaluation is supported by DFG which has regarded the Laguna de Santa Rosa as a subwatershed with inconsequential potential coho salmon rearing and spawning habitat as the result of both habitat loss and extreme habitat degradation (R. Coey, former DFG Supervisory Fishery Biologist, personnel communication). Nevertheless, given the value of the Laguna as potential winter habitat for coho salmon, we have retained the lowermost portion of the Laguna (downstream of the mouth of Santa Rosa Creek) as current IP km which could potentially serve as winter habitat for coho salmon spawned in Mark West Creek.

Another revision to the TRT estimate of IP km in the Russian River watershed includes the subtraction of IP km for a small number of streams in the Northwest corner of the Russian River watershed (*e.g.*, Forsythe Creek and others). These few small streams were considered a small Dependent Population that relied on immigration from the much larger independent population in the southern end of the watershed. However, based on flow, temperature conditions, and natural barriers to migration in this northern area, it was unlikely that coho salmon consistently occupied these streams. Considering the distance from the Core Areas in the lower basin, and the conditions for migration to the upper basin

[14] Tables 28 and 29 in NMFS (2008) from Russian River Biological Opinion

tributaries through the mainstem, much of what is effectively channelized, the IP km for this ephemeral population was removed from analysis of current conditions. It is unlikely that these few streams in the upper northwest corner of the Russian River watershed could be restored to a state where they would contribute significantly to the recovery of the independent coho population (R. Coey, former DFG Supervisory Fishery Biologist, personnel communication).

Finally, while subtracting Santa Rosa Creek, the Laguna de Santa Rosa (upstream from the mouth of Santa Rosa Creek), and the few streams in the northwest corner of the watershed from the estimate of current IP km, we added 14 miles of Dry Creek as current IP km. Dry Creek had been excluded from the TRT estimate of IP km due to high summer air temperatures predicted by the model - it is possible that, prior to the construction and operations of Warm Springs Dam, the high air temperatures elevated water temperatures in lower Dry Creek above the tolerance levels for rearing coho salmon. However, with current high summer flow releases of cold water from Warm Springs Dam, water temperatures in Dry Creek are now highly favorable for rearing juvenile coho salmon and coho presences has been documented routinely in recent history in Dry Creek and it's various tributaries.

Walker Creek is heavily impacted by livestock ranching practices and wild CCC coho salmon have not been observed in several decades (the stream was planted with Russian River captive broodstock in 2004). The Walker Creek coho salmon population was categorized by the TRT as "extinct." Similar to the Russian River, Walker Creek does not currently maintain conditions to support the number of spawners needed to achieve the TRT (low extinction) viability target of 2,800. However, Walker Creek is impacted by land uses practices that are potentially easier to reverse than land-use practices in the Russian River.

Unlike the Russian River and Walker Creek, Lagunitas Creek maintains a consistent run of CCC coho salmon. Data from this watershed is the most reliable set for any Independent Population in the CCC coho salmon ESU. Thought the TRT categorized this population at "moderate risk" of extinction, Lagunitas Creek currently does not have suitable habitat conditions, to achieve the viability target of 2,600. Trends do indicate, though, that this may be the only watershed that could potentially satisfy low risk extinction criteria in the near future, if significant restoration were to occur.

To identify recovery targets for these three populations which would reflect a realistic recovery scenario for a viable Russian, Walker and Lagunitas Creek salmon populations, while still achieving Diversity Strata targets and ESU level viability criteria, we revised the current IP-km for the Russian River watershed, excluding areas that because of substantial and irreversible degradation are unlikely to contribute to a viable Russian River population. We then calculated a recovery target abundance based on currently accessible habitat using density criteria proposed by the TRT – also calculating low-risk targets based on currently accessible habitat (*i.e.*, excluding area upstream of impassible dams) for Lagunitas and Walker creeks.

To ensure that ESU-level criteria were met, the total projected cumulative abundance for the three independent populations in the Coastal diversity strata (Russian, Lagunitas, Walker) was determined *a priori* to be not less than 50% of the total historical aggregate abundance of these populations.

Results indicate the recovery target for the Coastal Diversity Stratum is adequate to achieve the conditions necessary for viability (Table 13), and that those conditions can be met from the Russian River and Lagunitas Creek populations alone, or with contribution from Walker Creek (which could also be restored to a viable population of at least 2,800 individuals). Given the uncertainty regarding the large recovery target for the Russian River, and the significant extent of urbanization of this watershed, pursing restoration actions in Walker Creek to approach a level of several thousand spawners (which could contribute to reaching the stratum total of 11, 850) would seem a reasonable and prudent target to pursue.

Table 17: Proposed Abundance Targets for the Russian River and Coastal Diversity Stratum

Population	Historic IP Km	Historical viability	Current IP km	Stratum target
Russian River	779	15,600	506	10,100
Walker Creek	103	3,600	76	2,800
Lagunitas Creek	137	4,500	70	2,600
Aggregate Target		50% of 23,700 = 11,850	—	15,500

CAP WORKBOOK: ESU POPULATION RESULTS

Coho salmon viability, as characterized by the four population viability indicators (adult density, juvenile density, juvenile distribution, and smolt productivity) rated in the CAP workbooks, is generally poor throughout the ESU (Table 15). This condition is especially apparent south of the Lost Coast Diversity Stratum, where few ratings for viability rise above poor condition. With the exception of Lagunitas Creek, every population from the Navarro River (inclusive) south appear at a critically high risk of extinction. While the Lost Coast Diversity Stratum is less so, the abundance of poor and fair ratings still suggest endangered populations.

The number of watersheds in the ESU with "Poor" ratings for population viability indicators illustrates the extent of depressed populations:

- 24 of 28 watersheds had poor juvenile densities (defined as having a watershed average of <0.2 fish per square meter);
- 24 of 28 watersheds had poor adult spawning densities (defined as having a watershed average of <1 spawning per IP km); and
- 14 of 28 watersheds had poor juvenile distributions (defined as having a watershed average of <20 percent of its historic distribution).

These results are consistent with the legal designation of Endangered for this species, the latest status reviews, and other sources (Good et al. 2005, Spence *et al*., 2008). The collapse of the 2006/2007 adult cohort in response to poor ocean conditions (Hayes and McFarlane 2008) is a testament to the vulnerability of a species on the brink of extinction.

Photo Courtesy: Noyo River, Mendocino County, CA. Rick Macedo, DFG

CAP WORKBOOK: CURRENT HABITAT CONDITION RESULTS

Using results generated from the TNC CAP workbooks, NMFS calculated the current "percent poor" values across habitat and population attributes for all ESU populations (Figure 13). Percent poor values represent habitat conditions that are currently outside the range of natural variability and therefore limit populations. Percentages in the proceeding figures should be viewed as provisional, as they were based on assessments that were in some instances uncertain, however they provide a picture of the relative status of different habitat and population attributes for CCC coho salmon.

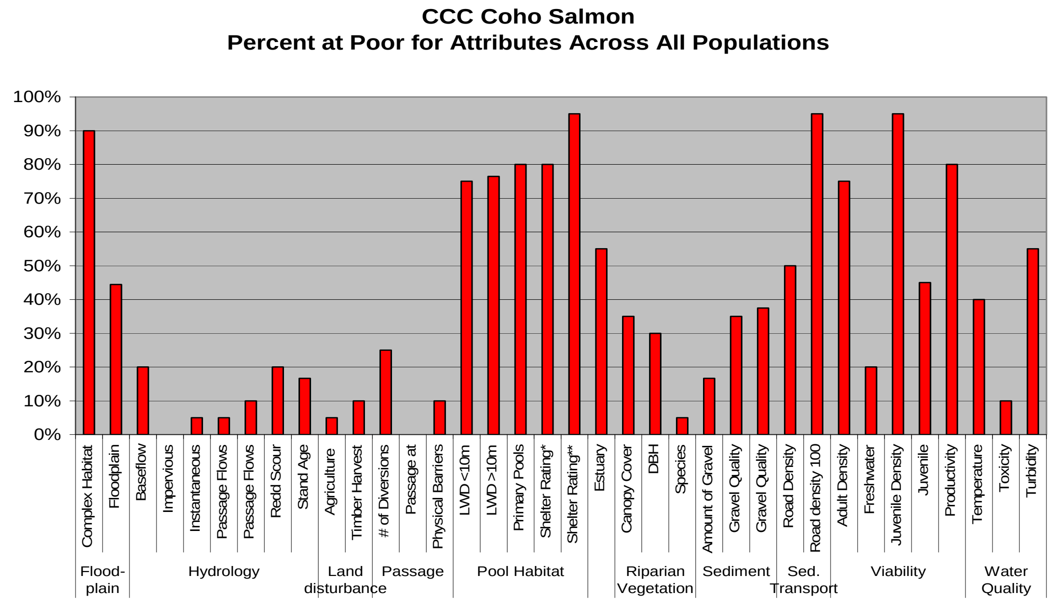


Figure 14: Current "Percent Poor" values for habitat and population attributes across all populations

*** Pool habitat shelter rating for summer rearing life stage **Pool habitat shelter rating for multiple life stage**

NMFS made the following generalizations from the information provided:

- *Attributes are considerably variable across populations.* Habitat and population attributes tend to occur at discrete spatial and temporal scales. In particular, the distribution of both spawning and rearing habitat, under natural conditions is largely determined by physical processes controlled by watershed characteristics (e.g., topography, hydrology, vegetation, etc) that are effectively constant over millennial timescales (Frissell *et al*. 1986; Montgomery and Buffington, 1998);
- *Pool habitats represent the highest "percent poor" ratings across all populations.* For example, poor shelter ratings for summer and multiple life stages occur in 80-95% of the population, respectively. A larger number of ESU populations are lacking in primary pools and adequate LWD. NMFS assumes that the increased landuse practices, which increase rates of sedimentation and reduce wood recruitment to streams is the likely cause of such high percentage values; and
- *As a whole, hydrology attributes represent the lowest "percent poor" values across all ESU populations, ranging from 0-25%.* Among these attributes redd scour represents 20% the highest "percent poor" values for this category.

Using reports generated by the TNC CAP workbooks, NMFS also calculated the current "percent poor" value across all populations and attributes for each life stage of the CCC coho. These values represent the percentage of populations with poor conditions for eggs, multiple life stage, smolts, spawning adults, summer rearing, and winter rearing per total IP-km. NMFS made the following generalization from the information:

- *Eggs and spawning adults have the lowest "percent poor" values across all populations per watershed.* Approximately 20% of the streams rated poor for spawning adults. As shown above in Figure 13, approximately 25-35% of the populations were rated as poor for sediment attributes that affect spawning adults (amount of gravel, gravel quality bulk and embeddedness). In general, streams in the ESU for spawning adults are not gravel limited;
- *Summer rearing and multiple life stages were estimated to have percent poor values of 57 and 46% respectively*; and
- *Winter rearing and smolt CCC coho have the highest "percent poor" values across all populations and attribute indicators, 95 and 73% respectively.* These estimates are consistent with estimates of high percent poor ratings for pool habitats attributes: shelter, primary pools, and LWD (Figure 14) and high percent poor values for complex habitat and shelter rating known to affect summer and winter rearing coho (Figure 14).

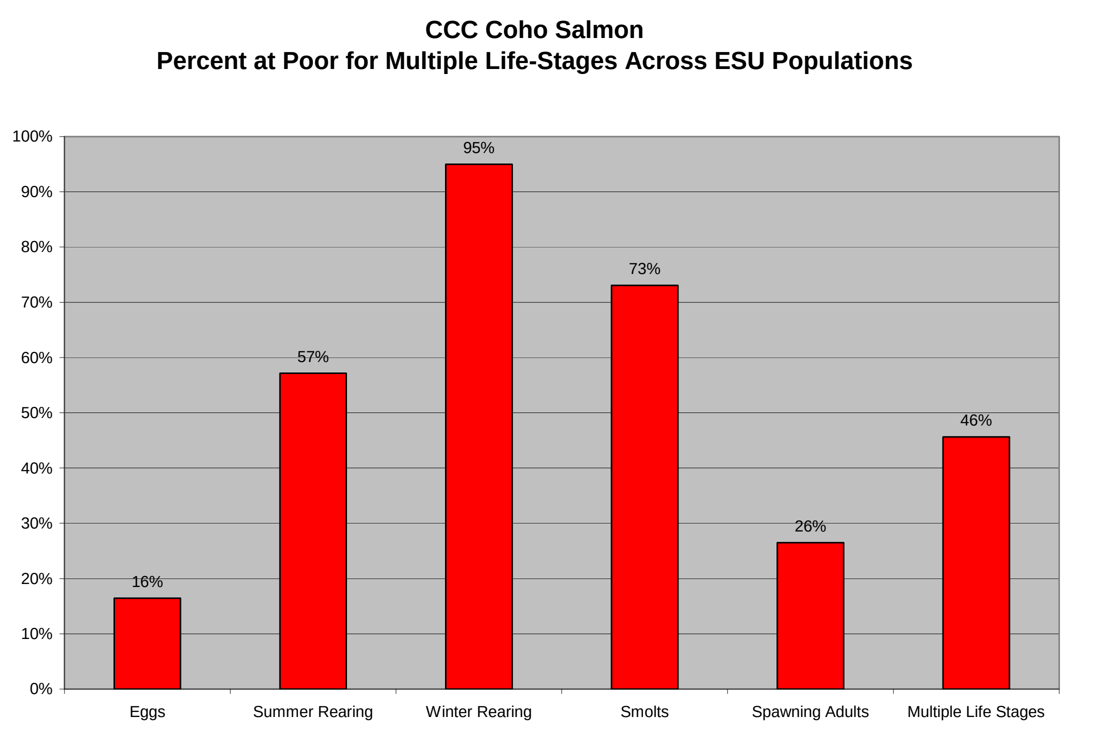


Figure 15: Current "Percent Poor" values across all populations and attributes for each life stage

(Note: Winter Rearing has 1 indicator)

Using the results from the TNC CAP workbooks, NMFS rated the current key habitat attributes for summer and winter rearing CCC coho for each focus population. NMFS made the following generalizations from the information provided:

- *Across all CCC coho populations for summer rearing, baseflow was indicated as the attribute with the lowest percent poor value*. This indicates that 20% of the populations do not meet flow requirements for summer rearing coho;
- *Pool habitat indicators, primary pools and shelter rating, show similar high "percent poor" values for summer rearing habitat.* Results show that 70% of the watersheds lack primary pools and adequate stream shelter within the ESU. In addition, complex habitat for winter rearing is also lacking across the ESU with a high percent poor value of 95%;
- *Water quality attributes for temperature show that 40% of the populations do not meet temperature requirements for summer rearing*; and
- *NMFS, population viability attributes show that 95% of the populations have extremely low juvenile densities during the summer. Less than half, 45% of the population, have adequate juvenile distributed throughout the potential rearing habitat.*

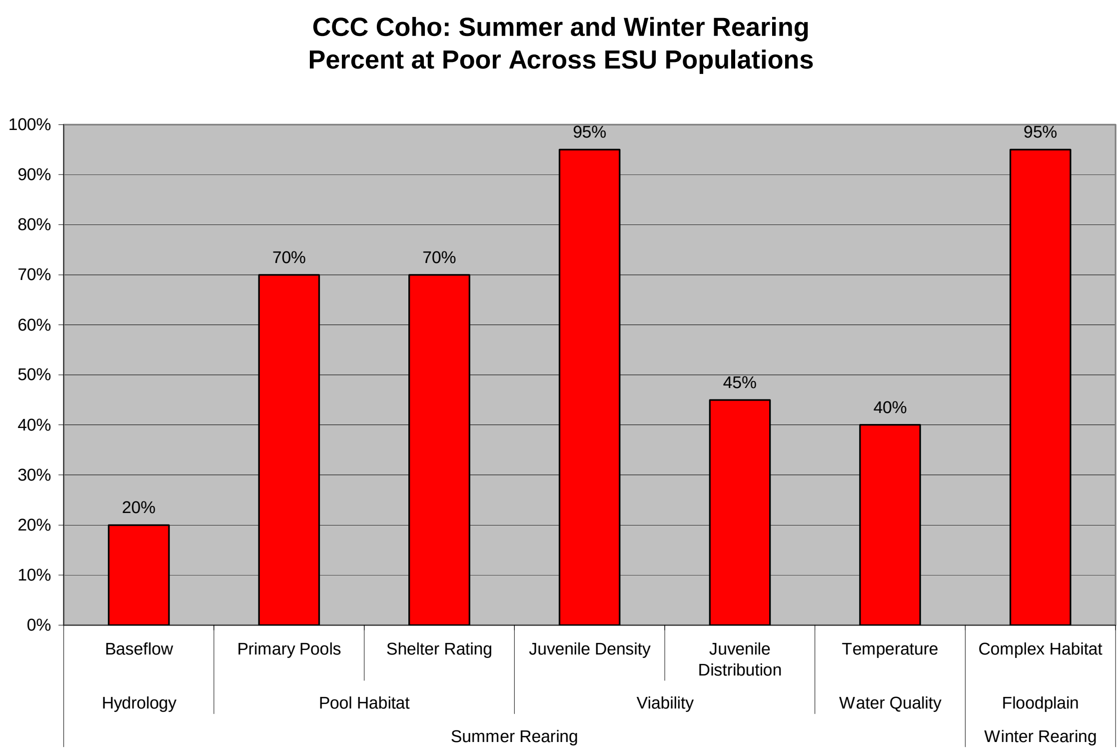


Figure 16: Current "Percent Poor" habitat and population attributes for CCC coho salmon summer and winter rearing across all populations

Habitat Results by Freshwater Attribute

The overall pattern of results for habitat indicators suggests watershed processes throughout the ESU are substantially degraded. This condition is illustrated most prominently in the degradation of summer rearing habitat. Interestingly, the pattern for summer rearing condition is largely mirrored by the pattern of poor population indicators, and suggests summer rearing life stage is limiting population viability. Winter rearing also appears to be a limiting life stage, but the lack of multiple indicators makes this discernment less obvious than the summer rearing indicator. What follows is a broad discussion of some of the critical habitat limitations affecting the ESU. Note that data was limited for certain habitat attributes within several watersheds, and not all attribute summaries encompass each focus watershed.

Road density (i.e., indicator Road density 100, or miles of road within 100 meters of the stream channel) was rated as poor in 27 of 28 watersheds. This suggests high road density is the most widespread indicator of poor habitat condition within the ESU. Riparian roads are often associated with problems such as sedimentation, migration barriers, lack of large wood recruitment, and channel encroachment. The San Lorenzo River had the most habitat attributes rated in poor condition (21 of 35 attributes), followed by the Russian River (19 of 36), and Walker Creek, (19 of 35). Cottaneva, Pudding, Caspar, Pine Gulch, and Gazos creeks all had ten or fewer poor indicators (Usal, Wages, San Gregorio, and Soquel creeks also had ten or fewer poor indicators but there were several indicators). While these results are important in determining priorities for restoration, recovery actions are also contingent upon the interaction of current conditions with future threats and population based viability criteria.

Table 14 demonstrates the pervasiveness of poor conditions across the ESU and highlights watersheds with the poorest conditions. The San Lorenzo River, Russian River, and Walker Creek are, by this measure, in the worst condition. While this may imply that they become top priorities for recovery actions, there are additional considerations, such as the potential role of each population in the ESU, which must be considered. Other pertinent details generated through the CAP process include:

1. Pool habitat shelter rating was rated as being in Poor condition in 26 of 28 focus watersheds for smolts and 22 of 24 watersheds for summer rearing juveniles. Habitat complexity is lacking in all watersheds across the ESU;
2. Primary pool abundance was rated as Poor in 21 of 24 focus watersheds. Primary pools are formed by habitat complexity elements, which are lacking across the ESU;
3. LWD volume for both large (width > 10 meters) and small (width < 10 meters) streams was rated as poor in 18 of 28 and 20 of 28 focus watersheds, respectively. LWD is an important constituent of habitat complexity and is lacking across much of the ESU;
4. The complexity of flood plain habitat was rated as Poor in 26 of 28 focus watersheds. Many streams across the ESU are incised or modified and disconnected from historic floodplain habitat;
5. Road density was rated as Poor in 19 of 28 focus watersheds, suggesting roads represent a significant disturbance across the ESU;
6. Temperature (*i.e.*, water temperature during summer rearing) was rated as Poor in 11 of 28 focus watersheds;
7. Gravel quality, as represented by both fine sediment percentage (*i.e.*, Gravel Quality (bulk)) and substrate embeddedness, was rated as Poor in 10 of 27 and 7 of 15 focus watersheds, respectively. These results reflect the unnaturally high sediment loads common to many watersheds within the ESU;
8. Riparian DBH was rated as Poor in 9 of 28 focus watersheds. A high proportion of small diameter trees within a riparian corridor suggests future LWD quality will be lacking, since

smaller trees are limited in their ability to influence channel morphology. Also, larger diameter trees typically last longer within the stream environment (*i.e.*, are slower to rot and flush downstream);

9. Estuary conditions were rated as Poor in 8 of 28 focus watersheds. This was most severe in the Santa Cruz Mountains diversity strata, where six of the nine estuaries have been highly modified by encroaching transportation corridors or other developments;
10. Floodplain connectivity was rated as poor in 7 of 24 focus watersheds. Many streams across the ESU are incised or modified and disconnected from historic floodplain habitat;
11. Freshwater harvest was rated as Poor in only 4 of 28 focus watersheds. Typically, freshwater harvest occurs where coho presence overlaps with a steelhead sport fishery, or where poaching is known to be a problem.
12. Redd scour was not a limiting factor within many of the CCC coho salmon watersheds, having been rated as Poor in only 4 of 28 focus watersheds. Redd scour occurs in simplified instream habitats with friable parent geology;
13. Passage flows for smolts were rated as Poor in the Russian and San Lorenzo Rivers, where agricultural diversions (Russian River) and a major municipal diversion by the City of Santa Cruz (San Lorenzo) are likely impairing smolt migration through critical reaches.
14. Land disturbance due to timber harvest was rated as Poor in the Ten Mile and Albion Rivers and Big Salmon Creek. All three watersheds have had extensive logging operations in the recent past;
15. Passage flows for spawning adults was rated as Poor in the San Lorenzo River. Major diversions operated by the City of Santa Cruz and San Lorenzo Valley Water District and other private and public diversions in the San Lorenzo watershed likely impair migration through critical reaches in the lower watershed under some flow regimes.
16. Physical barriers were rated as poor in Lagunitas Creek. Much of the historical coho salmon habitat within the Lagunitas Creek watershed lies upstream of impassable dams forming Kent and Nicasio Lakes.
17. Amount of gravel was rated as Poor in Pescadero Creek. The native bedrock geology in that watershed is highly friable sandstone and does not currently provide high quality spawning substrate.
18. Instantaneous flow conditions were rated as Poor in the Russian River where water withdrawals for frost protection can lower the water surface and desiccate redds or strand juvenile fish during late Winter/early Spring.
19. Passage conditions into and through estuaries for spawning adults was rated as Fair, Good, or Very Good across all focus watersheds, indicating the factor is not likely limiting the populations. However, during drought conditions it could potentially result in severe adverse effects to the population (*e.g.*, the 2007/2008 cohort in Scott Creek).

Habitat Results by Freshwater Life Stage

Spawning Adults: Instream habitat and watershed conditions appear to be generally supporting the adult life stage, as few habitat indicators were determined as Poor. Incidental capture from freshwater harvest, however, may be a limiting factor for adults in five watersheds (Russian River, Garcia River, Gualala River, Pescadero Creek, and San Lorenzo River).

Photo Courtesy: Adult CCC coho salmon, Albion River, Mendocino Co.,CA Tom Daugherty, NMFS

Eggs within redds: Gravel quality for egg incubation and fry emergence was commonly rated Poor to Fair across the ESU, with some exceptions. Poor conditions south of San Francisco Bay reflect an increased susceptibility to fine sediment intrusion and lower egg survival due, in part, to an abundance of unconsolidated geologic land forms in this area. Though other life stages may be in more immediate need of attention, reducing fine sediment concentrations should be considered a high priority for restoration throughout the ESU because of the pervasive nature by which sediment affects multiple life-stages and habitat types (e.g., infilling of summer pool habitat, degrading winter water quality via elevated turbidity, etc.).

Summer Rearing: Summer rearing habitat is consistently in poor condition across the ESU, with a few notable exceptions. All six summer rearing habitat indicators were poor in the Russian and San Lorenzo Rivers and Walker Creek, suggesting this life stage is limiting salmon productivity for those populations. Several watersheds have Poor ratings for at least four of the six indicators. High summer water temperatures limit juvenile survival in 11 of 28 populations; only four watersheds are rated as good. Pool habitat (frequency and complexity) was deficient in most watersheds. Given the preponderance of indicators in poor condition, restoration actions aimed at supporting the summer rearing life stage should be considered a top priority during recovery planning and implementation.

Photo Courtesy: Juvenile CCC coho salmon, Scott Creek, Santa Cruz Co., Morgan Bond, SWFSC

Winter Rearing: Habitat conditions influencing winter rearing success (*i.e.*, complex habitat types, such as off-channel and floodplain refugia for smolts from high flows) were consistently rated as Poor across much of the ESU, with the notable exception of Caspar Creek and Pine Gulch[15]. Given the preponderance of Poor ratings, habitats supporting

[15] Our confidence in the off-channel habitat assessment was low due to problems with assessment methods and lack of quantifiable data.

this life stage should be considered a top priority for recovery actions.

Smolts: For the smolt life stage, estuary condition is likely limiting coho salmon production within many watersheds south of Lagunitas Creek, due primarily to habitat degradation and impeded migration within the estuary environment. Pool habitat complexity, as represented by shelter rating, was also consistently poor for smolts, the lone exception being Pine Gulch Creek. Issues of channel complexity have already been identified as a priority for winter rearing. The frequency of water diversion structures was rated as poor in 5 of the 28 watersheds, suggesting smolt entrainment is not currently a major limiting factor in the ESU.

Multiple Life Stages: Analyses of instream habitat conditions can provide insight regarding how a particular stream reach may function at a specific site for a specific life stage. While these site-based and life stage specific analyses are informative, conducting a higher level review oriented to major watershed processes (*e.g.* dynamic interactions of wood, water and sediment through the stream system) that support all life stages provides a more comprehensive overview of watershed scale processes.

Results indicate current watershed process conditions (*e.g.,* multiple life stage categories) are variable, but tended toward a Poor condition rating. Impervious surfaces had no poor ratings, suggesting it is not a factor impairing the recovery of the ESU as represented by the 28 focus watersheds. The Russian River was the only watershed where agriculture rated as poor. Attributes for large woody debris and road density were more consistently rated as poor. These findings were consistent with the life stage specific findings of low pool complexity and degraded spawning gravel condition. Because LWD and sediment condition tend to affect multiple coho salmon life stages, projects addressing these factors should be considered a high priority for restoration actions.

CAP WORKBOOK: THREATS AND DIVERSITY STRATA RESULTS

ESU Threat Results

Results from the CAP threats analysis for the 28 populations are provided in Table 15. Generally, the greatest threats for CCC coho salmon across the ESU come from the three threat categories of (1) Roads and Railroads, (2) Droughts, and (3) Residential and Commercial Development. Threats are presented below based on their rank and prevalence across the ESU:

1. Roads and Railroads were ranked as a High or Very High threat in 24 of 28 focus watersheds. The amount of Very High or High ranks suggests that the threat of roads has a significant effect to coho salmon, and a high priority should be placed on actions to reduce this threat. Roads are clearly a significant factor contributing to habitat degradation across all ESU watersheds and populations;
2. Droughts were also ranked as a High or Very High threat in 19 of 28 focus watersheds. This threat was ranked Very High in five watersheds suggesting that a high priority should be placed on actions to reduce this threat. While NMFS cannot address naturally occurring droughts directly, we can facilitate planning, water storage, and other actions that will reduce the adverse effects of drought on coho salmon populations. This threat was most severe in watersheds from the Russian River south;

3. Logging and Wood Harvesting ranked as a High or Very High threat in 16 of 28 focus watersheds. Eleven of these watersheds are located in Mendocino County. Because approximately 75-80 percent of watersheds where coho salmon are currently persisting are in privately held timber lands, abating this threat is a high priority that will require extensive partnering with private landowners, CalFire and the State Board of Forestry;
4. Channel Modification ranked as a High or Very High threat in 8 of 28 focus watersheds. Channel modification occurs in all watersheds where coho salmon are currently extirpated and is a significant threat for the Russian River and watersheds south of the Russian River. Achieving properly functioning riparian conditions is difficult in modified channels, due to the permanent nature of bank stabilization, maintenance, and channelization activities;
5. Climate Change was ranked as a High or Very High threat in nine watersheds, from Salmon Creek south. Climate change is likely to have effects across the ESU; however, expected variation in watershed conditions will affect species response to climate change and thus their resiliency to such change. Watersheds at the southernmost extent of the range are likely to suffer the most severe effects;
6. Water Diversion and Impoundment ranked as a High threat in the Russian River and for six watersheds south of the Russian River. This threat occurs across nearly all CCC coho salmon watersheds and, due to potentially complex political and societal ramifications, is expected to be one of the most difficult threats to abate in the CCC ESU;
7. Agricultural Practices ranked as a Very High threat in the Russian River, and as High threats in four other focus watersheds. The conversion of forestlands to agriculture (particularly grape vineyards) is of particular concern;
8. Storms and Flooding ranked as a High threat in 11 watersheds. Reduced instream habitat complexity, a common issue across the ESU, reduces the resiliency of coho salmon to large storm events;
9. Residential and Commercial Development ranked as a very high threat in San Gregorio, San Vicente, and Aptos Creeks, and in the San Lorenzo River. It was ranked as a High threat in the Russian River, Lagunitas and Pescadero Creeks;
10. Disease, Predation and Competition ranked as a High threat in four watersheds south of the San Francisco Bay;
11. Fishing and Collecting ranked a Low or Medium threat to coho populations across the ESU, indicating that this activity is not likely to impede recovery;
12. Livestock Farming and Ranching ranked as a High threat in Salmon Creek, and as a Very High threat in Walker Creek;
13. Fire and Fuels Management ranked as a High threat in eight focus watersheds; all watersheds from Redwood Creek south excluding Gazos and Waddell Creeks;
14. Recreational Areas and Activities ranked as a High threat in the San Lorenzo River and in Aptos Creek;
15. Mining ranked as a Very High threat in San Vicente Creek. All other focus watersheds were ranked as Medium or Low for this threat, indicating that this activity is not likely to impede recovery; and
16. Hatcheries and Aquaculture ranked as a Medium or Low-ranked threat, indicating that these activities are not likely to impede recovery.

Diversity Strata Threat Results

Across Diversity Strata, threats increase in each category, with the exception of logging and wood harvesting, from north to south with the Santa Cruz Mountain Diversity Strata having the greatest number of threats ranked as High or Very High. The most significant threats are listed below.

Lost Coast

Roads and logging were ranked as high or very high in every watershed in the Lost Coast stratum, with the exclusion of logging in Usal Creek, which is a medium. Three watersheds each received a High rank in Channel Modification, Disease, and Residential and Commercial Development; Storms and Flooding received two High ranks; and Droughts received four. All other threats in the individual watershed comprising the stratum were ranked as Medium or Low. This stratum supports some of the most robust coho salmon populations in the ESU, and will be a critical component for preventing extinction and promoting recovery.

Navarro Point-Gualala Point

Roads, Logging and Wood Harvesting, Storms and Flooding, and Droughts are the greatest threats to coho salmon within the Navarro Point-Gualala Point stratum. Agricultural Practices ranked as a High threat in the Gualala River.

Coastal-Gualala Point

Channel Modification, Droughts, and Water Diversion and Impoundment are the greatest threats across the stratum. Climate Change ranked as a high threat in Salmon, Lagunitas and Redwood Creeks. Roads were ranked as High in the Russian River, and Salmon and Redwood Creeks. Residential and Commercial Development ranked a High threat in the Russian River and Lagunitas Creek. And Livestock Farming and Ranching was ranked as Very High in Walker Creek and High in Salmon Creek.

San Francisco Bay

This diversity stratum was not assessed since Independent Populations were not identified within the stratum and are believed extirpated from all watersheds in this stratum.

Santa Cruz Mountains

The high numbers and rankings of so many threats in the Santa Cruz Mountain stratum suggest focused and immediate threat abatement actions are necessary to prevent extinction of coho in this area. Roads and Droughts are the greatest threats across this stratum, ranking as High or Very High threats in every watershed. Climate Change was also a serious threat, ranking as High in every watershed except Pescadero, Gazos, and Waddell Creeks. Fire and Fuel Management ranked as High in every watershed except Gazos and Waddell Creeks. The Storms and Flooding threat ranked as High or Very High in every watershed except Gazos, Waddell, and San Vicente Creeks. Logging and Wood Harvesting ranked as a high threat in five of the nine watersheds. Residential and Commercial Development were Very

High in San Gregorio, Soquel, and Aptos creeks and the San Lorenzo River. Water Diversions and Impoundments ranked as high in Pescadero and San Vicente Creeks, and in the San Lorenzo River.

Table 18: CAP data analysis results for current conditions across life stages and populations. VG=Very Good; G=Good; F=Fair; P=Poor; Blank=N/A or data forthcoming

Target	Habitat Attribute	Indicator	Usal	Cottaneva	Wages	Ten Mile	Pudding	Noyo	Caspar	Big	Albion	Big Salmon	Navarro	Garcia	Gualala	Russian	Salmon	Pine Gulch	Walker	Lagunitas	Redwood	San Gregorio	Pescadero	Gazos	Waddell	Scott	San Vicente	San Lorenzo	Soquel	Aptos
Spawning Adults	Hydrology	Passage Flows		VG		G	G	G	VG	G	G	VG	F	G	F	F		G	G	VG	G		F	G	VG	G	G	P		VG
Spawning Adults	Passage	Passage at Mouth	G	G	G	F	G	VG	G	VG	VG	VG	G	G	G	G	G	VG	VG	VG	G	G	G	G	F	F	G	G	G	G
Spawning Adults	Passage	Physical Barriers	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	F	P	VG	G	G	VG	VG	VG	VG	G	G	P
Spawning Adults	Sediment	Amount of Gravel*		VG		G	G	VG	VG	VG	VG	F	VG	F	F	F	F	G	F	P	G		P	F	VG	VG	P	VG		G
Spawning Adults	Viability	Adult Density	P	P	P	P	P	P	P	P	P	P	P	P	P	F	G	P	VG	P	P	G	P	G	P	F	F	F	P	VG
Spawning Adults	Viability	Freshwater Harvest	G	F	G	F	G	G	G	G	G	G	F	P	P	F	G	G	G	G	G	G	P	G	G	F	G	P	G	G
Eggs	Hydrology	Instantaneous Condition		VG		G	G	G	VG	G	F	VG	F	G	F	P		G	F	G	G		G	VG	VG	VG	G	F		G
Eggs	Hydrology	Redd Scour		VG		G	G	F	VG	F	F	G	P	F	F	P		VG	F	G	G		F	F	F	P	F	P		F
Eggs	Sediment	Gravel Quality (Bulk)		F	F	P	P	G	P	F	P	P	F	F	F	G	F	G	P	G	VG	F	P	F	G	P	F	P	F	P
Eggs	Sediment	Gravel Quality (Embeddedness)	G	G		P	P	P	P	F	P	G	G	G	P	G									F		P			
Summer Rearing	Hydrology	Baseflow		G		G	F	F	G	F	F	G	P	F	F	P		F	P	G	F		F	G	G	F	F	P		G
Summer Rearing	Pool Habitat	Primary Pools		P		P	F	P	P	P	P	P	P	P	P	P	P	P	P	G	P		P	F	P	P	P	P		P
Summer Rearing	Pool Habitat	Shelter Rating		P		P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P		P	F	P	P	P	P		P
Summer Rearing	Viability	Juvenile Density	P	F	P	P	F	P	F	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P
Summer Rearing	Viability	Juvenile Distribution	P	F	P	F	G	F	VG	F	G	G	F	P	P	P	P	P	P	G	F	P	P	F	P	G	G	P	P	P
Summer Rearing	Water Quality	Temperature		F	F	P	F	P	G	P	F	F	P	P	P	P	F	G	P	P	G	F	P	F	F	F	G	P	F	F
Winter Rearing	Floodplain	Complex Habitat**	P	P	P	P	P	P	F	P	P	P	P	P	P	P	P	F	P	P	P	P	P	P	P	P	P	P	P	P
Smolts	Estuary	Estuary	F	G	F	G	VG	F	G	F	F	G	F	F	G	F	F	P	F	F	P	G	P	P	F	P	P	P	F	P
Smolts	Hydrology	Passage Flows		VG		G	G	G	VG	G	G	VG	F	G	F	P	F	G	G	VG	G		F	F	G	G	G	P		G
Smolts	Passage	# of Diversions**	VG	VG	F	G	G	G	VG	G	F	G	F	F	G	F	F	F	G	F	P	P	P	P	F	F	VG	P	F	G
Multiple Life Stages	Floodplain	Floodplain Connectivity	G		G		F	F	G	F	F	F	F			P	F	F	F	P	P	P	P	P	F	G	G	F	P	G
Multiple Life Stages	Hydrology	Impervious Surfaces ***	VG	VG	VG			G	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG		VG	VG	VG	VG	VG	VG	VG	G	VG	VG
Multiple Life Stages	Hydrology	Stand Age	G		F			G	G		F		G		P	P	F	G	P	G	G	G	G	G	G	G	G	G	G	G
Multiple Life Stages	Land disturbance	Agriculture ***	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG	G	VG	G	G	G	F	P	F	G	G	G	G	G	G	G	G	G	G
Multiple Life Stages	Land disturbance	Timber Harvest ***	G	F	F	P	F	G	VG	G	P	P	G	G	G	VG	VG	VG	G	G	G	VG	G	VG	VG	VG	G	VG		VG
Multiple Life Stages	Pool Habitat	LWD <10m	P	P	P	F	P	P	VG	P	P	F	P	F	P	P	P	F	P	P	VG	P	P	G	P	P	P	P	VG	P
Multiple Life Stages	Pool Habitat	LWD >10m	P		P	P	F	P		P	F		P	P	P	F	P	P	P	F	F	P	P	P	P	P		P	P	
Multiple Life Stages	Pool Habitat	Shelter Rating		P		P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P		P	P	P	P	P	P		P
Multiple Life Stages	Riparian Veg.	Canopy Cover	F	G	F	F	G		G	F	G	P	F	P	F	P	F	P	P	F	P	F	P	G	G	G	F	G	G	G
Multiple Life Stages	Riparian Veg.	DBH	G	G	F	P	P	F	G	P	F	P	P	F	P	P	F	P	P	F	F	G	G	G	G	G	G	G	G	F
Multiple Life Stages	Riparian Veg.	Species Composition	P	G	G	G	G	G	F	F	G	G	F	F	F	F	F	G	P	G	F	G	F	G	VG	G	G	G	G	G
Multiple Life Stages	Sediment Transport	Road Density ***	P	P	P	P	P	P	P	P	P	P	P	P	P	P	F	VG	VG	G	P	F	F	G	G	F	P	P	P	P
Multiple Life Stages	Sediment Transport	Road density 100 ***	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	F	P	P	P	P	P	P	P	P	P	P	P	P
Multiple Life Stages	Water Quality	Toxicity	G	G	G	G	G	F	G	F	G	G	F	G	F	F	G	F	P	G	F	F	G	F	F	F	F	P	F	G

Table 19: CAP threat rank results across populations. VH=Very High; H=High; M=Moderate; L=Low; /= N/A

Threat	Usal	Cottaneva	Wages	Ten Mile	Pudding	Noyo	Caspar	Big	Albion	Big Salmon	Navarro	Garcia	Gualala	Russian	Salmon	Pine Gulch	Walker	Lagunitas	Redwood	San Gregorio	Pescadero	Gazos	Waddell	Scott	San Vicente	San Lorenzo	Soquel	Aptos
Agricultural Practices	L	M	M	M	M	L	L	L	M	M	M	M	H	H	M	M	M	M	M	H	H	M	M	H	M	M	M	M
Channel Modification	M	M	M	M	H	M	M	M	M	M	M	M	M	M	H	H	M	H	VH	M	M	M	H	H	M	H	M	M
Climate Change	M	M	M	M	M	M	M	M	M	M	M	M	M	M	H	M	M	H	H	H	M	M	M	H	H	H	H	H
Disease, Predation, and Competition	M	M	M	M	M	L	L	L	L	M	L	L	L	M	L	L	M	L	L	L	H	H	M	L	M	H	M	H
Droughts	H	M	M	H	H	M	M	M	M	H	H	M	H	H	VH	VH	M	H	VH	VH	VH	M	H	H	H	H	H	H
Fire and Fuel Management	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	H	H	H	M	M	H	H	H	H	H
Fishing and Collecting	M	L	M	L	L	L	L	L	L	L	L	M	M	M	L	L	L	L	L	M	M	L	L	L	L	M	M	M
Hatcheries and Aquaculture	L	L	L	L	L	L	L	L	L	L	L	L	L	M	L	L	L	L	L	L	M	L	L	L	L	L	L	L
Livestock Farming and Ranching	L	M	M	M	M	L	L	L	M	L	M	M	M	M	H	M	VH	M	M	M	M	M	L	M	M	M	M	M
Logging and Wood Harvesting	M	H	H	H	H	VH	H	H	H	H	M	H	H	M	M	M	L	M	M	M	H	M	M	H	M	H	H	H
Mining	M	M	L	M	M	L	L	L	M	M	L	M	M	M	M	M	M	L	L	L	M	L	M	M	VH	M	M	L
Recreational Areas and Activities	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	H	M	H
Residential and Commercial Development	M	M	M	M	M	M	M	M	M	M	M	M	M	H	M	M	M	H	M	VH	H	M	M	M	M	VH	VH	VH
Roads and Railroads	H	H	H	VH	H	H	H	H	H	H	H	M	H	H	M	M	M	H	H	H	H	H	H	H	H	VH	H	VH
Storms and Flooding	M	M	H	M	M	M	M	H	M	M	H	H	M	M	VH	M	M	M	M	H	H	M	M	H	M	VH	H	H
Water Diversion and Impoundment	M	M	M	M	M	M	M	M	M	M	M	M	M	H	H	H	M	H	M	VH	M	M	M	M	M	H	H	M

Table 20: CCC Coho Salmon ESU Focus Populations, Spawner Targets and Threats

Stream Name	County	Diversity Stratum	# Spawners	Threats
Albion River	Mendocino	Lost Coast	2,300	Roads; Logging
Aptos Creek	Santa Cruz	Santa Cruz Mnts	932	Roads; Urbanization
Big River	Mendocino	Lost Coast	5,500	Roads; Logging
Big Salmon Creek	Mendocino	Lost Coast	578	Roads; Logging
Caspar Creek	Mendocino	Lost Coast	435	Roads; Logging
Cottaneva Creek	Mendocino	Lost Coast	469	Roads; Logging
Garcia River	Mendocino	Navarro Point	2,800	Logging; Flooding
Gazos Creek	San Mateo	Santa Cruz Mnts	279	Roads; Droughts
Gualala River	Mendocino/Sonoma	Navarro Point	6,200	Roads; Logging
Lagunitas	Marin	Coastal	2,600	Urbanization; Droughts
Navarro River	Mendocino	Navarro Point	5,700	Roads; Droughts
Noyo River	Mendocino	Lost Coast	4,000	Logging; Roads
Pescadero Creek	San Mateo	Santa Cruz Mnts	2,300	Droughts; Agriculture
Pine Gulch Creek	Marin	Coastal	252	Droughts; Water Diversion
Pudding Creek	Mendocino	Lost Coast	983	Roads; Logging
Redwood Creek	Marin	Coastal	272	Droughts; Channel Mod.
Russian River	Sonoma	Coastal	10,100	Agriculture; Urbanization
Salmon Creek	Sonoma	Coastal	1618	Droughts, Flooding
San Gregorio	Santa Cruz	Santa Cruz Mnts	1,363	Water Diversion; Urbanization
San Lorenzo River	Santa Cruz	Santa Cruz Mnts	4,200	Urbanization; Roads
San Vicente	Santa Cruz	Santa Cruz Mnts	105	Mining; Roads
Scott Creek	Santa Cruz	Santa Cruz Mtns	510	Roads; Logging
Soquel	Santa Cruz	Santa Cruz Mtns	1,122	Urbanization,; Logging
Ten Mile River	Mendocino	Lost Coast	3,700	Roads; Logging
Usal Creek	Mendocino	Lost Coast	360	Droughts, Roads
Waddell Creek	Santa Cruz	Santa Cruz Mnts	313	Climate; Roads
Wages Creek	Mendocino	Lost Coast	340	Logging; Roads
Walker Creek	Marin	Coastal	2,800	Grazing; Droughts

CHAPTER 8: STRATEGY FOR RECOVERY

"In the end, we will conserve only what we love. We will love only what we understand. We will understand only what we are taught."

Baba Dioum, Senegal

PREVENTING THE EXTINCTION OF CCC COHO SALMON

California may soon lose their coho salmon. The salmon decline is intimately tied to the human story of the region. For millennia CCC coho salmon thrived in abundance despite challenging and shifting natural marine and freshwater environmental conditions including predation. The human configured landscapes are leaving salmon without a home. Without cool clean water that flows relatively unimpaired from the headwaters to the ocean, CCC coho salmon are not expected to persist.

The underlying strategy for recovery is to rebuild what was once a social fabric and safety net for salmon: awareness. The stories of extinctions are not new, many have been told by our world's historians. Worldwide biologists have long monitored and chronicled a species decline and extinction. Biologists and historians cannot save salmon alone; only communities can. The strategy for recovery is to engage our communities on the issues and discuss solutions to the complex problems that face our salmon, our water and our watershed processes (e.g., landscapes). The collapse of our salmon populations and their well-being has bearing on our own. Salmon are not only an integral member in the processes of our natural world but salmon are our jobs, food, cultural heritage and recreation.

Others have fought and won similar situations of extinction and send a message of hope that California can bring back salmon as a resource for this State. In Washington State, whole communities including interest groups, businesses, local/State governments, scientists, etc. have formed alliances for the single purpose of ensuring a future for their iconic species: salmon. If Washington can do it; so can California.

Thus, the strategy for recovery is three fold:

1. Increase awareness and build solution-oriented collaborations and partnerships;
2. Provide an outline of immediate actions needed to prevent extinction and shift the trajectory of these populations back towards recovery;
3. Institute a process that provides a rapid feedback and response to successes and necessary shifts in priorities.

To accomplish these three strategic goals NMFS has included in the recovery plan:

(A) Implementation by NMFS Chapter that outlines how NMFS will proactively engage with the public;

(B) Restoration Chapter designed to provide more information on funding sources and processes should the public wish to engage in restoration actions;

(C) Instituted a process in this recovery plan whereby populations are prioritized, priority areas within populations are identified for immediate restoration and expectations of response time of populations for recovery actions are outlined (Provided in this Chapter).

(D) Monitoring Chapter outlining recommendations to establish a mechanism for understanding salmon and salmon habitats and their responses to restoration actions.

The dire status of CCC coho salmon is a call for immediate action to:

1. Prevent CCC coho salmon extinction by protecting, and conducting actions to increase survival of, all current individuals and populations;
2. Facilitate expanded distribution through focused and prioritized restoration actions in critical areas;
3. Prevent degradation of existing high quality habitats across the historical range (especially areas that have supported populations within the last four generations);
4. Restore habitat conditions and watershed processes across the CCC coho salmon historical range; and
5. Control and abate future threats to the species, and provide for their long-term survival and recovery.

Prioritizing Populations

Currently 28 CCC coho salmon populations are identified as the focus of this recovery plan (the geographic range of each CCC coho salmon population coincides with watershed boundaries). However, due to their status, and the great uncertainty of the various populations' response to recovery efforts, it is highly unwise to allow any CCC coho population (watershed) to further degrade and be precluded from the recovery scenario. NMFS encourages all watershed groups, agencies, NGOs, and planners to continue protection, enhancement and restoration activities and monitoring in all historical CCC coho salmon watersheds, particularly those with persisting populations. NMFS will review new data regarding populations, threats and implementation success of recovery actions to adapt the recovery plan (as appropriate) during the next iteration of the recovery plan.

Priority Areas within Populations

Within the focus watershed "Core Areas", "Phase I Expansion Areas" and "Phase II Expansion Areas" were identified to further prioritize recovery actions.

Core Areas are:

1. Areas within each watershed identified for immediate focus of restoration and threat abatement actions. Not all focus watersheds have identified Core Areas.

2. Locations known to have current or recent occupancy of CCC coho salmon according to (a) status reviews conducted prior to the initial listing on October 31, 1996 (61 FR 56138) and (b) data

provided by numerous agencies, individuals, and others including the presence/absence database developed by DFG.

Core areas should be prioritized, without delay, for restoration and threat abatement actions with the goal of increasing the likelihood of freshwater survival. Highest priorities are to: (1) prevent harm or death of any individual at any life stage; (2) halt all further habitat degradation; (3) implement specific restoration and enhancement activities immediately benefiting freshwater survival; and (4) abate future threats to secure existing populations. This approach front-loads recovery actions into areas critical for species survival, and further emphasizes protection of remaining habitats and their populations. These existing habitats and populations function as the foundation for expanding and recovering wild populations. Restoration in these areas must evaluate possible short term negative impacts against long term benefits. Large scale restoration projects, for example, may have significant inputs of sediment and short term habitat degradation, but will result in large long term benefits. In some special cases, short term impacts cannot be tolerated if the species is to persist in a particular watershed. All possible impacts to remaining CCC coho salmon populations should be carefully considered. Recovery actions in Core Areas are extremely high priorities for the next six years.

Phase I Areas are:

1. Areas within each watershed identified for near term expansion of CCC coho salmon populations and for near term focus of restoration and threat abatement actions; and

2. Locations adjacent or near to currently identified Core Areas with a reasonable chance of re-colonization by straying fish from Core Areas and, where habitat restoration is feasible.

Recovery actions in Phase I areas are designed to improve habitat conditions for expanding populations to allow distribution and abundance to shift towards patterns resembling historical patterns. Further work is necessary to assess the relevance of upstream and upslope processes that contribute significantly to the overall health of the watershed. In general, recovery actions in Phase I areas are high priorities for the next nine years (three coho salmon generations).

Phase II Areas are:

1. All remaining potential habitats needed by CCC coho salmon to achieve full recovery; and

2. While not the focus of immediate restoration, these areas are critical upstream sources of wood water and sediment. Further work is needed to provide priorities on these highly relevant upstream and upslope areas that contribute significantly to the overall health of the watershed. Consideration for Phase II areas should focus primarily on preventing further degradation and re-establishing or maintaining watershed processes functions.

Recovery actions in Phase II areas should enhance, and prevent degradation of, habitat conditions for expanding populations such that distribution and abundance begin to shift towards patterns resembling historical patterns; the long-term survival of the species depends on this shift. In general, recovery actions in Phase II areas are high priorities for the next 9 to 12 years.

Timing for Recovery

CCC coho salmon populations have been in steep decline for at least 40 years. Operating on the premise recovery actions will shift the ESU population trajectory from extinction to recovery; NMFS predicts recovery will take as much time as it did for the species to become imperiled. Existing populations of CCC coho salmon are very low, and recovery will require appropriate recovery actions over an extended period of time. Recovery is likely to be a challenging and slow process (Lindley *et al.*, 2007). Recovery actions, even those implemented now, will take time to result in improved habitat conditions and/or increased population abundance. In addition, because the species has a three year life cycle with distinct lineages with relatively little interbreeding (compared to some other salmonids), the response of a given population (and cohort) may not be observable for many years.

NMFS estimates that in general, habitats will respond to restoration actions (depending on physical processes) between one to five years. Some recovery actions, such as inputting large woody material where CCC coho salmon are present, may have more immediate results. Other recovery actions such as growing large diameter trees in the riparian corridor, or reducing stream temperatures may take considerably longer. NMFS estimates measurable increases in population abundance as a result of recovery actions can be expected between three to four generations. Each three year cycle represents a single generation; therefore a sustained generational response is not like to be observable for 12 to 15 years. Populations are expected to respond positively to incremental improvements in habitat conditions, even though increased abundances may not be readily observable. Population response will be measured as the annual average number of wild spawning adults in a watershed over the most recent 12 years of record.

The dire status of CCC coho salmon is a call for immediate action. However, the conditions required and the long timeframe (100 years) required achieving a fully recovered CCC coho salmon ESU may seem unreachable. These interim timelines were developed to provide more achievable and realistic steps on the long road to recovery.

Photo Courtesy: Steelhead (right) and coho (left) from Bean Creek (2005), San Lorenzo River tributary, Santa Cruz County, CA. First juvenile coho documented in the San Lorenzo watershed in 23 years and represents significant hope for recovering this species. Don Alley - Alley and Associates.

CHAPTER 9: RECOVERY CRITERIA

"Recovery is the process by which listed species and their ecosystems are restored and their future safeguarded to the point that protections under the ESA are no longer needed"

Interim Recovery Planning Guidelines July, 2006

FRAMEWORK FOR DOWNLISTING & DELISTING

The ESA requires recovery plans to incorporate (to the maximum extent practicable) objective, measurable criteria which, when met, would result in a determination in accordance with the provisions of the ESA that the species be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). The recovery criteria herein, or formal downlisting and delisting criteria, for the CCC coho salmon ESU include: (1) population based biological criteria that considers future commercial, recreational and tribal harvest; (2) criteria to measure watershed health and (3) criteria for the abatement and amelioration of threats . These criteria require clear evidence that the populations' status has improved in response to the reduction of threats and that they are tracking the reduction or abatement of threats (new and those identified at the time of listing). The analysis includes an assessment that threats, leading to the species decline and listing, have been reasonably controlled.

RECOVERY GOALS AND OBJECTIVES

The overarching goals of this recovery plan are to prevent the extinction of wild CCC coho salmon and ensure their long term persistence in a viable, self sustaining, and eventually harvestable status across the ESU. Before NMFS considers downlisting or delisting CCC coho salmon, substantially higher numbers of returning adults and, successful spawning and rearing conditions in freshwater environments, are needed. To that end it is critically important to preserve, enhance, and restore the species' existing habitats. Individual watersheds must have the capacity to support self-sustaining populations in the face of natural variation and conditions such as predation, droughts, floods, variable ocean conditions, wildfires, and long-term climate change. Viable populations across ensures a viable ESU. NMFS has identified three objectives for the ultimate recovery of CCC coho salmon:

> **Objective 1:** Prevent extinction by protecting habitats in Core Areas within identified focus populations. This will be accomplished by improving current conditions, and ameliorating existing and future threats;
>
> **Objective 2:** Re-establish viable populations in the 28 prioritized watersheds (at a minimum) and within four of the five Diversity Strata by protecting, enhancing, and

restoring habitats to properly functioning conditions, and by controlling and abating existing and future threats in all Core, Phase I and Phase II areas;

Objective 3: Implement standardized monitoring of coho salmon populations and their habitat across the CCC ESU. Standardization reduces uncertainty associated with habitat assessment methods and increases confidence in population estimates when evaluating effectiveness of recovery actions. Standardization will also improve accuracy when measuring progress towards downlisting and delisting criteria.

RECOVERY CRITERIA

Recovery criteria measure progress toward achieving recovery objectives. Criteria must be "SMART": specific, measureable, achievable, realistic and time-referenced. NMFS is proposing downlisting criteria for the transition between the endangered and threatened status, as well as delisting criteria, for the ESU. The specific criteria related to the status of populations, improvements in watershed conditions and the abatement of threats across the ESU must be met prior to downlisting or delisting. In addition, an analysis of threats pursuant to the five statutory listing factors in section 4 of the ESA will be necessary. An outline of the population, watershed and threat abatement criteria is provided in Table 17 followed by Table 18 which provides a summary of all recovery criteria.

Table 21: Outline and Hierarchy of Recovery Criteria for CCC coho salmon ESU

Downlisting and Delisting Recovery Criteria for Populations and ESU ❑ Population Level Criteria for Independent and Dependent Populations ❑ ESU Recovery Criteria for Delisting
Downlisting and Delisting Criteria for Watershed Health
Downlisting and Delisting Criteria for Threats (including an analysis of the five listing factors) Five Listing Factors ❑ Present or threatened destruction, modification, or curtailment of habitat or range ❑ Overutilization for commercial, recreational, scientific, or educational purposes ❑ Disease or predation ❑ Inadequacy of existing regulatory mechanisms ❑ Other natural and manmade factors affecting the species continued existence

Table 22: Population, Watershed Condition and Threat Criteria

	Population	ESU	Improving Watershed Condition	Abating Threats
Downlist	- All focus Independent Populations meet **moderate** extinction risk criteria of annual abundance >15 spawners/IP-km, over a 12 year period (four generations)[16]. - The sum of annual spawner abundance for Dependent populations in each focus Diversity Stratum is 50% of the total stratum abundance target over a 12 year period.	-All focus Independent and Dependent populations meet Population, Habitat, and Threats criteria for downlisting.	For each focus Diversity Stratum (Lost Coast, Navarro – Gualala Point, Coastal, and Santa Cruz) three criteria must be achieved for focus Independent and Dependent populations: **(1)** Key habitat attributes rated as poor or fair shift one level higher to an improved indicator rating in 50% of Core and 50% of Phase I areas; **(2)** Key habitat attributes rated as poor or fair shift one level higher to an improved rating in 25% of Phase II areas; and **(3)** **>** 32 IP-km of good quality habitat (based on good ratings of key habitat attributes) exists in each focus Independent basin.	For each focus Diversity Stratum (Lost Coast, Navarro –Gualala Point, Coastal, and Santa Cruz) two criteria must be achieved for focus Independent and Dependent populations: **(1)** All Core and 75% of Phase I areas improve one level in threat rank ***and/or*** all Core and 75% of Phase I areas rank as Low or Medium; and **(2)** 25% of Phase II areas improve one level in threat rank ***and/or*** 25% of Phase II areas rank as Low or Medium.
Delist	- All Independent Populations meet **low** extinction risk criteria (e.g. spawner density recovery targets) over a 12 year period (four generations). - All Dependent populations meet recovery abundance targets.	- All focus Independent and Dependent populations meet population, Habitat and Threats criteria for delisting.	For each focus Diversity Stratum (Lost Coast, Navarro – Gualala Point, Coastal, and Santa Cruz) three criteria must be achieved for all Independent and Dependent Populations: **(1)** Key habitat attributes rated as poor or fair shift one level higher to an improved rating in 75% of Core and 75% of Phase I areas ***and/or*** 75% of Core and 75% of Phase I areas rank Good or Very Good for these conditions; and **(2)** Key habitat attributes rated as poor or fair shift one level higher to an improved rating in 50% of Phase II areas ***and/or*** 50% of Phase II areas rank as Good or Very Good; and **(3)** > 75% of IP-km habitat contributing to spawning targets is rated as high quality.	For each focus Diversity Stratum (Lost Coast, Navarro –Gualala Point, Coastal, and Santa Cruz) two criteria must be achieved for all focus populations: **(1)** All Core and 75% of Phase I areas improve one level in threat rank ***and/or*** all Core and 75% of Phase I areas rank as Low or Medium and **(2)** 50% of Phase II areas improve one level in threat rank ***and/or*** 50% of Phase II areas rank as Low or Medium.

[16] At >15 adult coho salmon spawners per IP-km will allow all Independent populations to meet the threshold for low extinction risk for the population characteristic Ng, or total population size per generation (Ng ≥ 2500).

Biological Viability Criteria versus Delisting Recovery Criteria

The biological viability criteria developed by Spence *et al*. (2008) (Appendix B) set the foundation for understanding the long term biological viability of CCC coho salmon populations and ESU. These viability criteria, however, are not synonymous with recovery criteria. The viability criteria define "sets of conditions or rules for viable populations that, if satisfied, would suggest that the ESU is at low risk of extinction" (Spence *et al*. 2008). These general conditions include: (1) achieving population viability across selected populations; and (2) attaining a number and configuration of viable populations across the landscape to ensure long-term viability of the ESU as a whole. The criteria, however, "…do not explicitly specify which populations must be viable for the ESU to be viable… but rather they establish a framework within which there may be several ways by which ESU viability can be achieved" (Spence *et al.* 2008). Furthermore, the biological viability criteria do not include specific numeric targets for the abundances of populations identified as "dependent".

The viability criteria provide a theoretical foundation and practical basis for recovery planners to select populations for the inclusion into the recovery scenario, and to develop criteria for measuring population response to recovery actions. The viability criteria include metrics for population abundance, productivity, spatial structure, and diversity. Populations that are abundant at each life stage, highly productive, widely distributed, and exhibit the full variety of life history traits available are considered at low risk of extinction.

Downlisting and delisting recovery criteria includes: (1) biological viability criteria for Independent populations; (2) numeric criteria for Dependent populations; (3) criteria to track improvement of watershed conditions (e.g., health); and (4) criteria tracking the amelioration of threats including a specific analysis of threats outlined under the five listing factors. These criteria take into consideration the landscape context influencing our watersheds and salmon and the expectation that as these ecological processes are rebuilt to support ecosystem health and productivity, a surplus of salmon can develop for tribal, recreational or commercial harvests (numeric criteria not included in Spence *et al.* 2008).

Downlisting and Delisting Recovery Criteria for Populations and ESU

Downlisting and delisting recovery criteria have been developed for Independent and Dependent populations as well as targets for their associated Diversity Strata. Since the viability criteria developed by Spence *et. al.* 2008 focused on Independent populations, and did not include explicit numeric targets for abundances of Dependent populations. Criteria were thus developed for Dependent Populations to: (1) maintain connectivity within and across diversity strata; (2) provide potential sources of colonizers if adjacent populations are extirpated or experience severe declines; and, (3) ensure continued genetic reservoirs in strata where Independent populations are extirpated. The 16 selected Dependent populations must exhibit occupancy patterns consistent with patterns expected under sufficient immigration arising from the Independent populations. Thus, different metrics are involved in the development and evaluation of criteria between Independent and Dependent populations.

Population Level Recovery Criteria for Independent Populations

The population viability criteria (also termed extinction risk criteria), when met, are expected to result in Independent populations with a low risk of extinction (*i.e.,* viable). These criteria are: (1) likelihood of extinction; (2) effective population size or total population size; (3) population decline; (4) catastrophic decline; (5) spawner density, and; (6) hatchery influence (Table 19). In addition, spawner abundance criteria have been assigned to each Independent population. The population criteria have been aggregated at the Diversity Strata level to ensure the criteria meets ESU viability criteria outlined in Spence *et al.* 2008 (Table 20) which includes all criteria associated with Independent populations must be met to be considered for downlisting and delisting.

Table 23: Population Extinction Risk Criteria

Population Characteristic	Extinction Risk		
	High	**Moderate**	**Low**
Extinction risk from population viability analysis (PVA)	$\geq$ 20% within 20 yrs	$\geq$ 5% within 100 yrs but < 20% within 20 yrs	< 5% within 100 yrs
	- or any ONE of the following -	- or any ONE of the following -	- or ALL of the following -
Effective population size per generation *-or-* Total population size per generation	$N_e \leq 50$ *-or-* $N_g \leq 250$	$50 < N_e < 500$ *-or-* $250 < N_g < 2500$	$N_e \geq 500$ *-or-* $N_g \geq 2500$
Population decline	Precipitous decline[a]	Chronic decline or depression[b]	No decline apparent or probable
Catastrophic decline	Order of magnitude decline within one generation	Smaller but significant decline[c]	Not apparent
Spawner density	$N_a/IPkm^d \leq 1$	$1 < N_a/IPkm < \mathrm{MRD}^e$	$N_a/IPkm \geq \mathrm{MRD}^e$
Hatchery influence[f]	Evidence of adverse genetic, demographic, or ecological effects of hatcheries on wild population		No evidence of adverse genetic, demographic, or ecological effects of hatchery fish on wild population

[a] Population has declined within the last two generations or is projected to decline within the next two generations (if current trends continue) to annual run size $N_a \leq 500$ spawners (historically small but stable populations not included) *or* $N_a > 500$ but declining at a rate of $\geq$10% per year over the last two-to-four generations.
[b] Annual run size N_a has declined to $\leq$ 500 spawners, but is now stable *or* run size $N_a > 500$ but continued downward trend is evident.
[c] Annual run size decline in one generation < 90% but biologically significant (e.g., loss of year class).
[d] *IPkm* = the estimated aggregate intrinsic habitat potential for a population inhabiting a particular watershed (i.e., total accessible km weighted by reach-level estimates of intrinsic potential; see Bjorkstedt et al. [2005] for greater elaboration).
[e] MRD = minimum required spawner density and is dependent on species and the amount of potential habitat available. Figure 5 summarizes the relationship between spawner density and risk for each species.
[f] Risk from hatchery interactions depends on multiple factors related to the level of hatchery influence, the origin of hatchery fish, and the specific hatchery practices employed.

Table 24: Delisting and Downlisting Spawner Abundance Criteria for Independent Populations

Diversity Strata	Population	IP-km	Density Target	Delisting Target	Downlisting Target
Lost Coast	**Ten Mile**	**105**	**34.9**	3700	1575
Lost Coast	**Noyo**	**118**	**34.0**	4000	1770
Lost Coast	**Big**	**192**	**28.9**	5500	2880
Lost Coast	**Albion**	**59**	**38.1**	2300	885
				Total: 15,500	**7110**
Navarro Pt.	**Navarro**	**201**	**28.3**	5700	3015
Navarro Pt.	**Garcia**	**76**	**36.9**	2800	1140
Navarro Pt.	**Gualala**	**252**	**24.8**	6200	3780
				Total: 14,700	**7935**
Coastal	**Russian**	**506**	**20.0**	10,100	7590
Coastal	**Walker**	**76**	**36.9**	2800	1140
Coastal	**Lagunitas**	**70**	**37.3**	2600	1050
				Total: 15,500	**9780**
Santa Cruz	**Pescadero**	**61**	**38.0**	2300	915
Santa Cruz	**San Lorenzo**	**126**	**33.4**	4200	1890
				Total: 6500	**2805**
			ESU Total:	**52,200**	**27,630**

Downlisting targets in Table 20 are based on meeting the threshold for the low extinction risk population characteristic Ng, or total population size per generation (Ng ≥ 2500) for the smallest independent population (Albion River 59 IP-km). At the adult spawner density of 15 fish per IP-km all independent populations exceed the per generation target of 2500 adult fish.

For delisting, Table 20 displays spawner abundances are scaled between 20 and 40 spawners per IP-km depending on watershed size; abundance criteria is the product of the density times the total number of IP-km in that watershed. Criteria are evaluated per generation (e.g. 3 years) across 4 consecutive generations (e.g., 12 years). See Spence *et al.* 2008 for detailed equations.

Population Level Recovery Criteria for Dependent Populations

Adult spawner numeric criteria were developed for each Dependent population and their associated Diversity Strata. These numeric targets were developed using best available historical data and information associated with adult spawner densities within Dependent population watersheds. Data from 1933-1942 in Waddell Creek, Santa Cruz County (Shapovalov and Taft 1954), were used as a reference for the spawner target density target[17]. The average spawner population during the period between 1932 and 1954 was 312 fish (range 111-748) resulting in a spawner density target of 34 per IP-km (312/9.2 IP-km). The statements of Shapovalov and Taft likely understate the degree Waddell Creek had been affected by the removal of the redwood forest. Virtually all portions of the watershed accessible to coho salmon were extensively disturbed prior to the onset of the Shapovalov and Taft study. Early logging practices were particularly destructive and this level of disturbance likely resulted in a significant reduction in the productive capacity for coho salmon in the watershed. Nonetheless, we believe these numeric criteria represent best available information regarding average spawner populations to be expected in Dependent watersheds. The 34 spawner adults per IP-km were calculated against the current IP-km in each population to yield the recovery delisting targets in the table. Downlisting criteria for Dependent populations is to meet a 50% stratum target evaluated per generation (e.g., 3 years) across 4 consecutive generations (e.g., 12 years) with at least two populations in that stratum contributing to the 50% stratum target. Downlisting and delisting criteria are outlined in Table 21.

[17] It is important to note that virtually all portions of the Waddell Creek watershed, at the time of the Shapovalov and Taft study in the 1930's, were far from pristine conditions. Shapovalov and Taft describe Waddell Creek in the following terms: *"Some changes from the primitive condition of the area have taken place as a result of human usage. The redwood forest of the watershed below Big Basin was logged off by 1870 and is now covered by a second growth. The early lumbering operations have resulted in the creation of several semi permanent log jams and temporary accumulations of logs, which have hastened erosion of stream banks, with consequent increase in silting during flood stage."*

Table 25: Delisting and Downlisting Spawner Abundance Criteria for Dependent Populations

Dependent Population	Current IP-km	Spawner/km	Delisting Target Na
Usal Creek	10.6	34	**360**
Cottaneva Creek	13.8	34	**469**
Wages Creek	10	34	**340**
Pudding Creek	28.9	34	**983**
Casper Creek	12.8	34	**435**
Big Salmon Creek	17	34	**578**
Salmon Creek	47.6	34	**1618**
Pine Gulch	7.4	34	**252**
Redwood Creek	8	34	**272**
San Gregorio	40.1	34	**1363**
Gazos Creek	8.2	34	**279**
Waddel Creek	9.2	34	**313**
Scott Creek	15	34	**510**
San Vicente Creek	3.1	34	**105**
Soquel Creek	33	34	**1122**
Aptos Creek	27.4	34	**932**

Lost Coast-Navarro Point	6 Populations	Stratum Total (Delisting)	**3165**
		50% Aggregate (Downlisting)	***1583***
Navarro Point-Gualala Point	No Populations Selected		**0**
Coastal	3 Populations	Stratum Total (Delisting)	**2142**
		50% Aggregate (Downlisting)	***1071***
Santa Cruz Mountains	7 Populations	Stratum Total (Delisting)	**4624**
		50% Aggregate (Downlisting)	***2312***
		ESU Total (Delisting)	**9931**
		50% Total (Downlisting)	***4966***

ESU Recovery Criteria for Delisting

Four criteria were developed that, collectively, constitute a configuration in the number and distribution of viable and non-viable populations that would likely provide for ESU persistence over 100 year time frame (i.e., viable). Thus, there may be "several plausible scenarios of population viability that could satisfy ESU-level criteria" {Spence, 2008}. The goals of the ESU criteria are to reduce the risk of extinction by ensuring (1) connectivity between populations, (2) representation of ecological, morphological, and genetic diversity, and (3) redundancy in populations to minimize risks associated with catastrophic events.

In characterizing a viable ESU the TRT applied the hypothesis that populations, as they functioned in their historical context, were highly likely of persisting and that "…*increasing departure from historical characteristics logically requires a greater degree of proof that a population is indeed viable*" (Spence *et al*. 2008). Due to the likely historical roles of functionally independent or potentially independent populations these form the foundation of the ESU viability criteria. The "non-viable" or dependent population criteria were designed to ensure reservoirs of genetic diversity, contribute to connectivity, reduce risk of ESU extinction, and provide a source of colonizers to extirpated watersheds and buffer ocean conditions and disturbances to independent populations.

To ensure the ESU goals of reducing the risk of extinction are realized, the following viability criteria must be met for delisting (See Spence *et. al.* 2008 for more information):

(1) Representation Criteria;

1.a. All indentified diversity strata that include historical FIPs or PIPs within an ESU should be represented by viable population for the ESU to be considered viable.

-AND-

1. b. Within each diversity stratum, all extant phenotypic diversity (i.e., major life-history types) should be represented by viable populations.

(2) Redundancy and Connectivity;

2.a. At least fifty percent of historically independent populations (FIPs or PIPs) in each diversity stratum must be demonstrated to be at low risk of extinction according to the population viability criteria. For strata with three or fewer independent populations, at least two populations must be viable.

-AND-

2.b. Within each diversity stratum, the total aggregate abundance of independent populations selected to satisfy this criterion must meet or exceed 50% of the aggregate viable population abundance (*i.e*., meeting density-based criteria for low risk) for all FIPs and PIPs.

(3) ESU Occupancy;

3.a. Remaining populations, including historically dependent populations or any historical FIPs or PIPs that are not expected to attain a viable status, must exhibit occupancy patterns consistent with those expected under sufficient immigration subsidy arising from the Independent populations selected to satisfy the preceding criterion.

(4) Distribution Across ESU;

4.a. The distribution of extant populations, regardless of historical status, must maintain connectivity within the diversity stratum, as well as connectivity to neighboring diversity strata.

Downlisting Recovery Criteria for Watershed Health and Threats

To consider downlisting, the following criteria (in addition to the population and ESU level criteria) must be met for each focus Diversity Stratum (Lost Coast, Navarro –Gualala Point, Coastal, and Santa Cruz) and each identified Independent and Dependent population. These criteria are based on the TNC CAP workbook analysis and the associated ranking outputs of very good/good/fair/poor habitat and landscape attributes and the very high/high/medium/low threats. The identified shifts in levels will be accomplished by conducting the CAP workbook analysis process as described in this recovery plan. Table 18 provides a summary of these criteria.

(1) Key Habitat Attributes Criteria for Improving Watershed Health:

1.a. Key habitat attributes rated as poor or fair shift one level to an improved indicator rating in 50% of Core and 50% of Phase I areas;

-AND-

1.b. Key habitat attributes rated as poor or fair shift one level higher to an improved rating in 25% of Phase II areas;

-AND-

1.c. > 32 IP-km of good quality habitat (based on good ratings of key habitat attributes) exists in each focus Independent basin.

(2) Threats Criteria:

2. a. All Core and 75% of Phase I areas improve one level in threat rank ***and/or*** all Core and 75% of Phase I areas rank as Low or Medium;

-AND-

2.b. 25% of Phase II areas improve one level in threat rank ***and/or*** 25% of Phase II areas rank as Low or Medium.

Delisting Recovery Criteria for Watershed Health and Threats

To consider delisting, the following criteria (in addition to the population and ESU level criteria) must be met for each focus Diversity Stratum (Lost Coast, Navarro –Gualala Point, Coastal, and Santa Cruz) and each identified Independent and Dependent population. These criteria are based on the TNC CAP workbook analysis and the associated ranking outputs of very good/good/fair/poor habitat and landscape attributes and the very high/high/medium/low threats. The identified shifts in levels will be accomplished by conducting the CAP workbook analysis process as described in this recovery plan. Table 18 provides a summary of these criteria.

(1) Key Habitat Attributes Criteria for Improving Watershed Health:

1.a. Key habitat attributes rated as poor or fair shift one level higher to an improved rating in 75% of Core and 75% of Phase I areas ***and/or*** 75% of Core and 75% of Phase I areas rank Good or Very Good for these conditions;

-AND-

1.b. Key habitat attributes rated as poor or fair shift one level higher to an improved rating in 50% of Phase II areas ***and/or*** 50% of Phase II areas rank as Good or Very Good;

-AND-

1.c. > 75% of IP-km habitat contributing to spawning targets is rated as high quality.

(2) Threats Criteria:

2. a. All Core and 75% of Phase I areas improve one level in threat rank ***and/or*** all Core and 75% of Phase I areas rank as Low or Medium;

-AND-

2.b. 50% of Phase II areas improve one level in threat rank ***and/or*** 50% of Phase II areas rank as Low or Medium.

-AND-

2.c. Meet all listing factor criteria.

To inform these criteria it is necessary that monitoring include a lengthy time series of adult abundance at appropriate spatial scales. Life cycle monitoring will be necessary to inform these criteria. Few datasets exist and "*there is an urgent need to initiate monitoring programs that will generate data of sufficient quality to rigorously assess progress toward population and ESU recovery. Development of a comprehensive coastal monitoring plan for salmonids has been underway for several years by the California Department of Fish and Game, with input from NMFS; however, dataset that will allow assessment of status using the criteria described herein are likely more than a decade away. Consequently, the present values of these criteria…are to inform the development of such a monitoring plan and to provide preliminary targets for recovery planners*" (Spence *et al*. 2008). Refer to Spence *et al.* (2008) for additional information.

Listing Factor Criteria

Listing factor criteria address large scale issues limiting the species recovery across the ESU. As recommended in the NMFS Interim Guidance (2007), criteria were developed to assess these broad scale factors that originally led to the listing of the species.

Listing Factor A: Present or threatened destruction, modification, or curtailment of habitat or Range

The destruction, modification and curtailment of the habitat and range of the Domain salmonids are primary driving factors that led to their declines. Factors expected to continue into the future and, if not abated or removed, will significantly affect the recovery of this species.

Objective: Ensure adequate quantities of good quality habitat are available across the range of CCC coho salmon to support viable and recovered populations over the long term.

Criterion A 1: The watershed conditions and threat abatement criteria identified in Table 20 must be achieved for downlisting and delisting.

Listing Factor B: Overutilization for commercial, recreational, scientific, or educational purposes

The impacts of freshwater and marine harvest have been reduced since listing; however the magnitude of collection, illegal harvest, and fishing interception remain unknown.

Objective: Ensure commercial, recreational or educational activities are not adversely affecting the survival and recovery of CCC coho salmon.

Downlisting criterion B 1: Collection, illegal harvest, and bycatch (fishing interception including interception from the recreational steelhead fishery) are evidenced as not adversely impacting each life stage of CCC coho salmon by more than five percent across the ESU.

Delisting criterion B 2: Collection, illegal harvest and bycatch (fishing interception including interception from the recreational steelhead fishery) are evidenced as not adversely impacting each life stage of CCC coho salmon by more than one percent across the ESU.

> **Recovery action:** Section 10 Scientific Collection Permits will prioritize consistent methods, inform the recovery criteria, and expand to include monitoring of adults and smolts.
>
> **Recovery action:** DFG Steelhead Fishing Report-Restoration Card will require anglers to report incidental coho salmon capture.
>
> **Recovery action:** Conduct outreach and education for commercial and recreational anglers to reduce injury or mortality associated with incidental bycatch.
>
> **Recovery action:** Coordinate enforcement to minimize illegal harvest, identify areas where illegal harvest may be a problem, and coordinate NOAA and DFG enforcement actions in those areas.

Listing Factor C: Disease or predation

The impacts of disease and predation outlined at the time of listing either continue to persist or the magnitude of the impacts are unknown.

Objective: Disease and predation should not limit CCC coho salmon survival and recovery.

Downlisting criterion C 1: Sufficient information is available to reasonably conclude that disease and predation would not compromise the recovered status of CCC coho salmon.

Delisting criterion C 2: Disease and predation do not compromise long-term persistence of CCC coho salmon.

> **Recovery action:** Develop and implement programs informing the specific threats of freshwater versus disease and marine predation.
>
> **Recovery action:** Develop and implement targeted programs that successfully remove or substantially reduce non-native predators limiting coho salmon abundance in key environments.
>
> **Recovery action:** Evaluate the effects of native predators (*e.g.* marine mammals) and develop programs of control if warranted. Comply with the Marine Mammal Protection Act.

Listing Factor D: The inadequacy of existing regulatory mechanisms

Despite the Federal and non-Federal efforts, due to funding and implementation uncertainties and the voluntary nature of many programs, the existing regulatory mechanisms do not provide sufficient certainty that combined Federal and non-Federal efforts are reducing threats to all salmonids in the NCCC Domain.

Objective: Ensure Federal, State, local, and other agencies' regulatory mechanisms are adequate to ensure threats to the recovery of the CCC coho salmon do not persist or reappear.

Downlisting criterion D 1: High priority ESU and Diversity Strata strategies are underway and are implemented through appropriate regulatory processes.

Downlisting Criterion D 2: State and local management mechanisms to ensure sustainability of CCC coho populations in the future are underway.

Delisting criterion D 3: High priority ESU and Diversity Strata strategies are implemented or the relevant issues are addressed through an appropriate regulatory process.

> **Recovery action:** Appropriate agencies should secure funding for, and engage in, full enforcement of relevant laws, codes, regulations, policies and ordinances protective of CCC coho salmon and their habitats.
>
> **Recovery action:** Federal, state, local governments and other pertinent parties should cooperate to seek regulatory streamlining opportunities together to more efficiently work towards CCC coho recovery and provide regulatory assurance mechanisms for landowners and others.
>
> **Recovery action:** Conduct outreach and education to other Federal agencies to encourage implementation of their ESA section 7(a)(1) responsibilities for CCC coho salmon recovery.
>
> **Recovery action:** Prioritize ESA section 7 consultations which include important recovery actions, and include recovery actions in section 7 Reasonable and Prudent Alternatives and Conservation Recommendations.
>
> **Recovery action:** Encourage amendment of the Army Corps 404 Clean Water Act exemptions for farming, logging, and ranching activities by terminating Section 404(f) exemptions for discharges of dredged or fill material into US waters associated with agriculture, logging, ranching and farming.

Recovery action: Encourage amendments to the FEMA mandates to include funding for upgrades beneficial to CCC coho salmon to flood damaged infrastructure.

Recovery action: Petition SWRCB to declare all CCC coho salmon watersheds fully appropriated.

Recovery action: Work with the SWRCB to bring unauthorized diversions into compliance with State law.

Delisting Criterion D 4: State and local management mechanisms are in place to ensure sustainability of CCC coho populations in the future without the protections of the ESA.

Listing factor E: Other natural and manmade factors affecting the species' continued existence

Other than the hatchery programs, all threats are expected to persist into the future with the effects of climate change predicted to negatively impact salmonid habitats, and thus their likelihood of survival and recovery.

Objective: Improve other manmade factors and lessen or offset the effects of natural factors to salmonids and their habitats.

Downlisting criterion E1: Ensure the threat of hatcheries remains low for the CCC coho salmon and all future hatchery programs. Develop an HGMP under section 10 (a) (1) and comport to the hatchery criteria identified in Spence *et al.* (2008).

Delisting criterion E2: All recovery actions for Climate Change, Droughts, and Storms and Flooding are implemented or the issues addressed sufficiently to ensure population and habitat resiliency to these perturbations.

CHAPTER 10: RECOVERY ACTIONS

"When I first came in – 1906 there was plenty of fish and game; Anderson Valley and its hills were a boy hunter's paradise. When we lived in Mendocino I fished in Russian Gulch many times. The fish were small but it was not trouble to catch fifty which was the limit.

The Navarro River was a fine stream for its entire length even to its smallest tributaries. Hookbills (coho) and steelhead both ran in great numbers, although it was harshly treated by the lumber industry, not as bad however as the Garcia.

Fifty years, looking back is quite awhile but we well remember when the fish houses in Noyo were piled with big king salmon every day and everyone was busy. We bought them for awhile for 10 cents a pound.

Throughout the years, the supply of fish and game has risen and fallen, nature took care of things. Now with smaller limits and "managing" plus civilization; fish and game as we knew it is about gone; soon we hang up the rifle and put aside the rod. We few old ones left had it; we too are also about gone."

Judge Tindall 1966-1977 Mendocino County Remembered

TAKING ACTION FOR SALMON

The decline of CCC coho salmon and their path to recovery parallels our human story. In fact, the plight of salmon worldwide is intimately tied to the story of the evolving human configured landscape. Naturalists and biologists across Europe and North America have monitored salmon and chronicled their decline and extinctions. Biologists alone cannot shift a species trajectory from extinction to recovery; it requires a united community of experts and lay people forming alliances to this single purpose. While salmon now need us to innovate sustainable uses for our land and water, we also need salmon; perhaps more so. Salmon can support whole communities and businesses; they are our recreation, our food, and a part of our natural heritage. To achieve this end, we can do something uniquely human, contemplate our future and shift our thinking and our actions. Nothing else can do this. Improving the human well-being while innovating sustainable use of our natural resources (including securing a future for our salmon) are a one-in-the-same challenge.

This story of the salmon crisis is nothing new. Europe once had mesmerizing salmon runs, in fact salmon helped feed the Roman legions and formed the basis of large commercial fishing operations. However, gradual changes to natural freshwater systems through a long history of human induced impacts left the fish homeless; despite repeated warnings of salmon demise. Charles Dickens in 1861 spoke of the need for salmon protections in his weekly magazine All Year Round; a Salmon Fisheries Act of 1861 was established for England and Wales and later a Rivers Pollution Act of 1876.

However, the lack of enforcement and the "old plea of ruin… to undertake such work [salmon protections]" (Montgomery 2003) and the human predisposition to place blame on each other for the decline prevailed. A similar story can be told for other countries including our own and the decline of the Maine salmon populations. For over a century salmon haven't been seen in England; until recently. Actions to reduce pollution and improve stream conditions are working and salmon have been seen in recent years returning to cleaner and more habitable rivers such as the Thames and Seine. If we fail to learn the lessons of these other countries or the stories of salmon extinction due to changes to watershed processes it tells us more about ourselves and societal priorities as it does about the salmon.

PRIORITY RECOVERY ACTIONS FOR CCC COHO SALMON

An array of conditions has reduced the population size and historical distribution of coho salmon across the ESU. Many of the causes of decline are systemic and persistent, and cross numerous environmental and political boundaries. The sources and reasons for decline are identified in Federal Register Notices, the Recovery Strategy for California Coho Salmon (DFG 2004), and this recovery plan. Effectively addressing these causes involves multiple challenges and opportunities including: (1) development of new and effective implementation of current laws, policies and regulations; (2) securing adequate funding for recovery implementation; (3) developing strategic partnerships; (4) assuring prioritization and implementation of restoration, threat abatement, and monitoring actions; and (5) conducting education and outreach. The status of CCC coho salmon requires addressing the highest priority issues at all appropriate levels described above (*e.g*., policy, funding, partnerships, restoration and outreach) which in turn, dictates that a substantial and targeted investment in resources is needed for recovery.

The Chapter outlines priority recovery actions that apply within and across the overall ESU, or within and across Diversity Strata, and across spatial scales. At the ESU level, these priorities are organized by actions that need to be undertaken in the next few years to prevent extinction. Underpinning these larger scale actions are watershed-specific objectives, recovery actions, and action steps. These were developed for each of the 28 focus watersheds. These actions provide watershed specific recommendations for improving the most limiting current conditions, and minimize and abate the highest future threats. They focus and prioritize recovery actions and key areas for immediate restoration and threat abatement. The entire data set of conditions, threats and strategic actions for each watershed are provided below with populations listed alphabetically. Recovery implementation schedules have been developed for watersheds listed below:

- ❑ **Lost Coast Diversity Strata:** Albion River; Big River; Big Salmon Creek; Caspar Creek; Cottaneva Creek; Noyo River; Pudding Creek; Ten Mile River; Usal Creek; and Wages Creek;
- ❑ **Navarro Point Diversity Strata:** Garcia River; Gualala River; Navarro River;
- ❑ **Coastal Diversity Strata:** Lagunitas Creek; Pine Gulch Creek; Redwood Creek; Russian River; Salmon Creek; and Walker Creek; and

- **Santa Cruz Mountain:** Aptos Creek, Gazos Creek; Pescadero Creek; San Lorenzo River; San Gregorio Creek; San Vicente Creek; Scott Creek; Soquel Creek; and Waddell Creek.

ESU LEVEL RECOVERY ACTIONS

Overarching recovery actions address major threats across the ESU and implementation will affect a large geographic area, and will benefit multiple populations. Successful implementation will have positive long term effects and move the species toward recovery. As such, these actions are the highest priority across the ESU and within individual populations.

ESU level recovery actions to be implemented within the next one to five years include:

- Ensuring current populations of CCC coho salmon are protected from harm or take and protecting all historical habitats from further habitat degradation:
    - All work adjacent to, or within, waterways occupied by coho salmon should be conducted during the summer low flow period (June 15th - October 15th);
    - NMFS should provide information to the appropriate regulatory bodies regarding the current status of CCC coho salmon, priority watershed processes needing consideration, and recommendations that provide no take or incidental take assurances;
    - All relevant parties are recommended to conduct extensive outreach to improve education and awareness for agencies, professional organizations, landowners, and the public regarding the importance and imperative need for immediate and direct actions to prevent extinction and/or increase regulatory oversight on projects that may impair habitats or result in direct harm to coho salmon;
    - No-Take guidance should be considered to assist NMFS staff and stakeholders in avoiding and minimizing potential take or harm to CCC coho salmon or their habitats when evaluating or planning land use practices (*e.g*., livestock grazing, agriculture, road construction and maintenance, channel modification, *etc*.);
    - All relevant parties are recommended to strongly encouraging appropriate agencies to secure funding for, and engage in, full enforcement of relevant laws, codes, regulations and ordinances protective of coho salmon and their habitats;
- Conducting actions that significantly increase the probability of survival of each individual in both the marine and freshwater environments;
    - Implementing and enforcing the most conservative version of AB 2121, which codified (in sections 1259.2 and 1259.4 of the California Water Code) DFG and NMFS' Water Diversion Guidelines to ensure protective flows for all life stages of coho salmon;
    - Work with DFG to develop protective regulations to minimize impacts from offshore fishing during migratory periods (*e.g*. until sandbars open naturally) within one mile of the river mouths of the focus watersheds;
    - Work with DFG to improve freshwater sport fishing regulations to minimize unintentional and unauthorized take, and incidental mortality, of CCC coho salmon by anglers during the CCC coho salmon migration period. Considerations may include

low-flow closure thresholds (including emergency closure during adult migration beginning 2010), seasonal fishing closures, and angler outreach programs;

- Improving coordination between the agencies, particularly the SWRCB, to effectively address illegal water diverters and out-of-compliance diverters, seasons of diversion, off-stream reservoirs, and bypass flows fully protective of CCC coho salmon;
- Petitioning SWRCB to have all CCC coho salmon watersheds with existing populations and ongoing diversions declared as fully appropriated;
- Encouraging amendments to Army Corps 404 Clean Water Act exemptions for farming, logging, and ranching activities to terminate Section 404(f) exemptions for discharges of dredged or fill material into US waters (channelization) associated with agriculture, logging, ranching and farming;
- Develop water conservation measures at local and State levels to include a drought management plan for each watershed that is triggered by minimum flow requirements.
    - Work with the agricultural community to develop water conservation strategies protective of salmonids while allowing ongoing agricultural land uses (*i.e.*, off-channel storage ponds).
- Projects involving high underwater sound pressure levels should implement sound attenuation methods to assure that (1) no physical injury to coho salmon results, (2) adverse modification to behavior is avoided and (3) extent of area impacted is reduced. Where sound attenuation cannot meet the three criteria above then work should be conducted during established seasonal work windows (summer low flow period only) to avoid harm to CCC coho salmon.
- Immediately implement or initiate the following rangewide recommendations outlined in the 2004 Recovery Strategy for California Coho Salmon: stream flow, water rights, water temperature, ecological refugia, large woody debris, riparian vegetation, land uses and outreach.
- Initiate discussions on the following rangewide recommendations outlined in the 2004 Recovery Strategy for Coho Salmon: integration with other plans and programs, permitting, enforcement of existing laws and assessment, monitoring and research.
- Collaborate and support the SWRCB to increase oversight and responsibility for regulating groundwater hydrologically connected to surface flows; and
- Collaborate with CalFire to coordinate fire fighting and post fire response with the resource agencies;

- [ ] Collaborate with DFG to finalize and implement the Statewide Coastal Monitoring Plan. Implementation of the Statewide Coastal Monitoring Plan is essential for evaluating the long-term viability of CCC coho salmon as well as other species of listed salmonids in California;
    - Conduct population research and monitoring focusing on life stage survival (e.g., life cycle stations) within each Diversity Stratum including survival and fitness in wetland, estuaries and lagoons;

- Conduct research and monitoring of freshwater habitats and their suitability to support each life stage (adult, egg, summer/winter rearing, smolt outmigration including adult/juvenile/smolt survival in wetlands and estuarine/lagoon habitats);

- ❑ Establish mechanisms to maintain existing genetic diversity through intervention and augmentation. This may include (1) juvenile capture from the wild and rearing in an established conservation hatchery for release as adults and (2) developing comprehensive broodstock programs similar to the Russian River Coho Salmon Captive Broodstock program.
  - Utilize existing population models and genetic information for each watershed and associated Diversity Stratum to identify minimum redd or adult counts that would trigger the need for augmentation or intervention;
  - Appropriate augmentation or intervention strategies may vary based upon knowledge of population genetics, ability of the watershed to support and maintain coho salmon through the freshwater lifestage, and long-term recovery objectives;
    - Evaluate and test success of adult releases to watersheds to augment existing coho salmon genetic diversity;
  - Re-assess marking protocol of broodstock versus hatchery fish to minimize possible mis-identification by recreational fishermen;

- ❑ Prioritizing restoration funding (*e.g*., Pacific Coast Salmon Restoration Fund (PCSRF) and California's Fisheries Grant Restoration Program) on those actions that increases the probability of freshwater survival in Core areas in the next four years and improvements to nearby expansion habitats (e.g. Phase I) followed by habitat improvements to Phase II areas thereafter;
  - Aggressively promoting installation of instream large woody debris and improving off-channel/floodplain habitats to immediately benefit freshwater survival in areas with extant population;
    - Fully implementing the Programmatic Section 7 consultation for restoration projects administered by the NOAA Restoration Center that permits placement of instream large woody debris;
  - Promote restoration projects in habitats most limiting for CCC coho salmon - critical over-wintering habitats (such as alcoves, backchannels, off channel areas, and estuaries), and critical summer rearing habitat (such as complex pool habitat and unimpeded summer flows).

- ❑ Developing a multi-agency CCC coho strike team to address critical and immediate threats;
  - Evaluating establishment of an Emergency Drought Operations Center (similar to the Emergency Drought Operations Center developed in Washington State), comprised of the SWRCB, DFG, NMFS, and others to develop emergency rules for augmenting water supplies and mitigating the effects of drought and extreme climate (due to climate change) on CCC coho salmon and their habitats;

- ❑ Working with the California Board of Forestry, CalFire, DFG, professional organizations and landowners to secure forest lands from conversion, promote sustainable forestry practices and provide incentives for growing large trees and conducting restoration actions. For example:

- o Modify the timber harvest permitting process to provide opportunities and incentives for LWD recruitment during timber harvest operations;
- o Urge the California Board of Forestry to apply for a statewide Forestry Habitat Conservation Plan (similar to that developed in Washington State) and seek funding opportunities to support the effort or approve Rules that ensure no-take or harm;
- o Evaluate the timber harvest review processes to ensure CalFire, DFG, Water Quality, foresters and landowners are familiar with the specific areas and issues of concern;

- ❑ Establishing recovery plan implementation groups across each Recovery Unit (*e.g*., diversity strata) and securing funding (*e.g*., Pacific Coast Salmon Restoration Fund) for four designated representatives to act as liaisons and coordinator for each implementation group. These liaisons will also work with grassroots watershed groups to implement recovery efforts;
- ❑ Evaluating geological patterns in the CCC ESU to identify sources of karst and similar geology. These sites may provide sources of cool water refugia and serve as locations that can buffer populations in the advent of climate change;
- ❑ Participating in land and water use planning with local, county, and State agencies that have direct control and responsibilities over non-Federal practices;
  - o Encourage counties in revising their General Plans to consider building their planning along watershed boundaries to include Area Planning and associated analyses;
  - o Evaluate other State programs that monitor and regulate land and water uses and initiate new sustainable innovations on uses regarding, and policies for, these natural resources.
  - o Conduct an assessment of the mechanisms motivating conversion (from forest to agricultural or rural residential land uses) and develop policies aimed at protecting forestlands;
  - o Promote programs that purchase land or develop conservation easements encouraging the protection, re-establishment and/or enhancement of natural riparian communities;
- ❑ Implementing monitoring programs to assess spawner abundance and population viability and key habitat attributes. These programs will require consistent methods, reporting, databasing and adaptive management across the ESU to evaluate population and habitat responses to recovery actions;
  - o Developing standardized watershed assessment protocols (*e.g.* DFG habitat assessment protocols) within sub-watersheds to define limiting factors specific to those areas;
  - o Development of a centralized database and analysis tool for population and habitat data collected under standardized monitoring protocols;
- ❑ Support and engage CalTrans, FishNet 4C, counties and others with oversight on road practices to reduce sediment delivery to streams from road networks and channelization from poorly situated roads. This should be accomplished through education, laws and policies designed to educate staff and road engineers and improve construction, maintenance, and decommissioning practices;
- ❑ Working with Federal and State agencies to coordinate and develop programmatic permits for incidental take authorization for actions that contribute to the recovery of CCC coho salmon and their habitats;

- Coordinating with DFG and RWQCB to develop streamlined permitting for non-PCSRF funded restoration projects;

DIVERSITY STRATA RECOVERY ACTIONS

Diversity Strata recovery actions are more general than the watershed specific actions that follow, but they also affect large geographic areas, and benefit multiple populations. Strata are organized from North to South.

Lost Coast

- Establish mechanisms to promote sustainable forestry practices and reduce forest conversions;
- Continue to participate and promote the collaborative effort between agencies and landowners on the pilot large woody debris enhancement project;
- Establish HCPs protective of coho salmon and their habitat for industrial and non-industrial timber harvest;
  - Finalize Mendocino Redwood Company HCP;
  - Encourage development of a HCP/NCCP with industrial and non-industrial forestland owners including Jackson Demonstration State Forest, State Parks, The Conservation Fund, Coastal Ridges, Redwood Forest Foundation, Campbell Timberland and Hawthorne Timber Company;
- Implement other Logging and Wood Harvesting strategies outlined in this recovery plan;
- Strongly encourage Mendocino County (including cities and local jurisdictions) to take a greater leadership role and work with their various departments on permitting, road maintenance, ordinances, etc. to reduce the ongoing impacts of urbanization, agriculture, road building, grading activities, timber conversions, etc. to salmon and their habitats. Mendocino County currently supports over 85% of remaining populations of CCC coho salmon.

Navarro-Gualala Point

- Establish mechanisms to promote sustainable forestry practices and reduce forest conversions;
- Promote a collaborative effort between agencies and landowners on the pilot large woody debris enhancement project and floodplain/offchannel restoration;
- Establish HCPs protective of coho salmon and their habitat for industrial and non-industrial timber harvest;
- Implement other Logging and Wood Harvesting strategies outlined in this recovery plan;
- Evaluate the need and feasibility of developing a Captive Broodstock Program; and
- Strongly encourage Mendocino County (including cities and local jurisdictions) to take a more leadership role and work with their various departments on permitting, road maintenance, ordinances, etc. to reduce the ongoing impacts of urbanization, agriculture, road building,

grading activities, timber conversions, etc. to salmon and their habitats. Mendocino County currently supports over 85% of remaining populations of CCC coho salmon.

Coastal

- Explore strategies to augment or intervene to assure continuation of existing genetic diversity.
    - o Augmentation and intervention such as juvenile collection and retention at established rearing facilities for release as adults (or other intervention methods) may be necessary at this time due to the extremely low populations to ensure long-term genetic diversity is preserved. Watersheds of particular interest are Lagunitas/Olema, Redwood Creek and Pine Gulch and Walker.
- Work with Sonoma and Marin counties to develop more protective regulations in regard to vineyard, rural residential, and urban development;
- Implement water diversion and agricultural strategies outlined in this recovery plan;
- Establish HCPs protective of coho salmon and their habitat;
    - o Encourage development of a Sonoma County-wide HCP that includes State Parks, major water diverters in the Russian River Watershed, the County of Sonoma, municipalities, timberland, and vineyard owners;
    - o Encourage development of a Marin County-wide Habitat Conservation Plan that includes State Parks, major water diverters in the coastal watersheds, the County of Marin, and municipalities;
- As the largest freshwater wetland in the CCC coho salmon ESU a historical ecology study of the Laguna de Santa Rosa is recommended to identify physical processes that have been diminished. The study would provide the foundation for a conceptual plan to prevent wetland loss and improve wetland habitats and functions for CCC coho salmon.
    - o Conduct a feasibility study regarding the potential contribution the Laguna de Santa Rosa to Russian River viability targets. If determined to be feasible, a resource management plan should be developed to coordinate land use to protect, restore and enhance the Laguna de Santa Rosa.
- Strongly encourage the counties (including cities and local jurisdictions) to take a greater leadership role to work with their various departments on permitting, road maintenance, ordinances, etc. to reduce the ongoing impacts of urbanization, agriculture, road building, grading activities, timber conversions, etc. to salmon and their habitats. Marin County is leading this type of effort for San Geronimo in Lagunitas.

San Francisco Bay

- Evaluate the feasibility and likelihood of success of re-establishing coho salmon populations into Corte Madera Creek, Sonoma Creek, the Napa River, and other local watersheds with the potential to support coho salmon populations.

Santa Cruz Mountains:

- Establish HCPs protective of coho salmon and their habitat;
    - Finalize the City of Santa Cruz HCP, and
    - Work with forest landowners in this stratum to investigate opportunities to develop a multi-landowner forestry HCP.
- Conduct outreach and education to private landowner regarding the importance of instream large wood and it's role in providing critical habitats for coho salmon survival;
- Secure long term funding of captive broodstock program for the Kingfisher Flat facility (Scott Creek);
- Continue working with the Santa Cruz Resource Conservation District and Coastal Conservancy to identify willing landowners to implement restoration projects in Core and Phase 1 areas;
- Work with DFG to improve freshwater sport fishing regulations to minimize unintentional and unauthorized take, and incidental mortality, of CCC coho salmon by anglers during the CCC coho salmon migration period. This effort should include the development of appropriate low-flow closure thresholds (including consideration of emergency closure during adult migration beginning 2010), seasonal fishing closures, and angler outreach programs.
- Strongly encourage Santa Cruz County (including cities and local jurisdictions) to take a greater leadership role to work with their various departments on permitting, road maintenance, ordinances, etc. to reduce the ongoing impacts of urbanization, agriculture, road building, grading activities, timber conversions, etc. to salmon and their habitats. Santa Cruz county currently supports over a few remaining populations of CCC coho salmon.
- Conduct a thorough historical analysis (including archeological analysis of Indian middens) and determine whether coho salmon occupied streams south of Elkhorn Slough in Monterey County. If positive data are discovered, evaluate the feasibility and likelihood of success of re-establishing coho salmon populations into the Big Sur and Little Sur Rivers.

IMPLEMENTATION SCHEDULE

The watershed specific implementation schedules that follow outline the recommended recovery actions and estimated costs for the recovery of CCC coho salmon over a 60-year period. The first five years are itemized. The implementation schedules are specific guides for carrying out recovery actions, and meeting the long term recovery goals outlined in this plan. Actions are organized to build on each other, with overarching objectives supported by recovery actions, and these, in turn, are supported and implemented by a series of action steps. Each action links back to key habitat features that are currently in poor condition and will be improved by the action, or to threats the action is expected to abate. Each action has a unique identifying recovery strategy number which facilitates implementation tracking, and a succinct description of the recommended action.

Each action step was assigned a priority, which was defined as follows:

Priority 1

An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future;

Priority 2

An action that must be taken to prevent significant decline in species population/habitat quality or some other significant negative impact short of extinction; and

Priority 3

All other actions necessary to provide for full recovery of the species.

An estimated duration required to complete the actions, the recovery partners responsible for actions (either funding, permitting, reviewing, or carrying out), and estimated costs to complete the action are also outlined. Parties with authority, responsibility, or expressed interest to implement a specific recovery action are identified in the implementation schedules. Listing a party in the implementation schedule does not require the identified party to implement the action(s) or to secure funding for implementing the action(s). Agencies and cooperating entities may voluntarily participate in any aspect of implementation of particular tasks listed with this recovery plan. Recovery partners may willingly participate in project planning, funding, provide technical assistance, staff time, or any other contributions to recovery goals.

Costs of many recovery tasks cannot be estimated at this time due in part to difficulties obtaining cost estimates from other identified parties and because estimating costs becomes increasingly imprecise the further into the future they are projected. In addition, many actions build on previous actions, which have not yet been implemented. Costs will vary depending on landowner and agency participation, available information, site specific and social constraints, and expertise of agency staff. Costs of developing and implementing some management and protection plans will vary with local circumstances and details of individual plans. As a result of these uncertainties, the total costs shown in the implementation schedules likely substantially underestimate the real cost of recovering the species. Many actions also contain comments that provide additional specificity or information on cost estimates.

INTRODUCTION TO POPULATION LEVEL ACTIONS

An analysis was conducted for each population using the TNC CAP tool and protocols which include (1) evaluation of current watershed conditions using readily available information from DFG and others, (2) anticipated threats to watershed processes and marine environments which are likely to worsen conditions into the future and (3) development of recovery actions that are intended to improve current conditions and abate future threats. Each watershed or population profile in the following Chapters display (1) Viability and Threats Tables from the CAP analysis process which provide a summary of our understanding of current watershed conditions and threats, and (2) recovery action implementation schedules outlining all recovery actions and their priority for that watershed/population. Many of these actions are those in the State of California Recovery Strategy for Coho Salmon (DFG 2004) and others identified in watershed assessment and monitoring documents.

We stress that these results are only preliminary and should not be viewed as static. The information herein is a platform for discussion regarding additional data and information to improve this draft during the public comment period. The information following displays only the outputs of the CAP workbook analysis. Due to the volume of information behind our analysis, all available data were not included. If more information is desired please email or phone the Santa Rosa office and we will be happy to provide the additional datasets.

ALBION RIVER

Photo Courtesy: Albion River, Marilyn Stubbs

Albion River

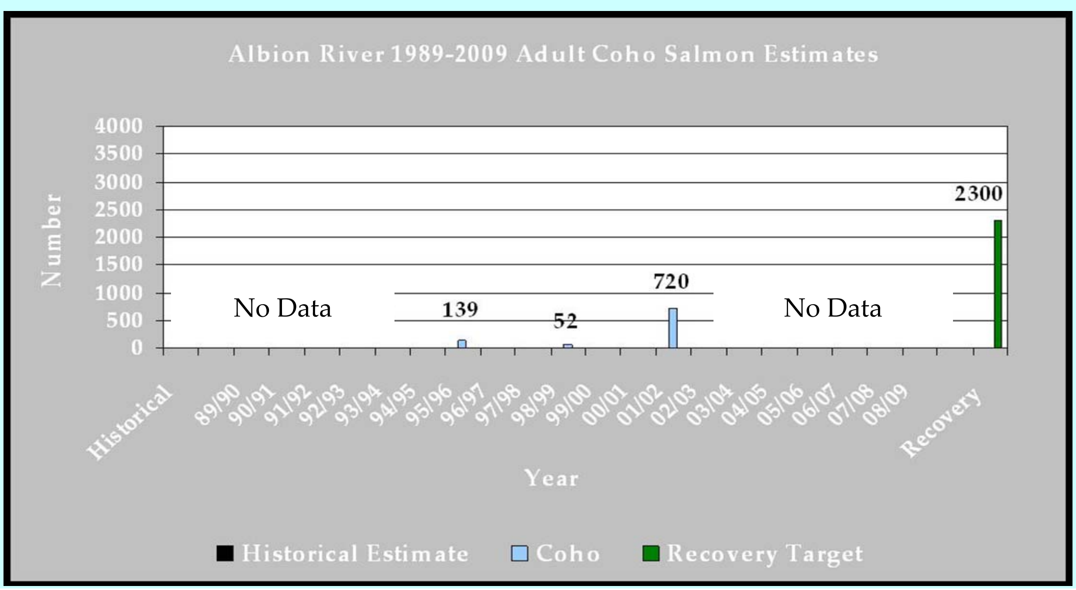
Independent Population
59.2 IP-Km of potential coho salmon habitat
Coho salmon, Chinook salmon, and steelhead present

The Albion River watershed is located in the California Coast Range and drains an area of about 43 square miles, in western Mendocino County. The Albion River enters the Pacific Ocean at the town of Albion. This watershed has a large estuary with a tidal influence extending upstream as much as five miles (Albion NCWAP 2004). The mouth is aligned so that longshore sediment transport is minimized which allows the estuary to remain open to the ocean all year. About 74 percent of the Albion River watershed is redwood coniferous forest and about eight percent of the watershed area is either montane or riparian hardwood forest. The entire Albion River watershed has moderate erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. Nearly the entire Albion River watershed is in private ownership; the only public land (< 1 percent of the watershed) is found in Van Damme State Park. The dominant land use within the Albion River watershed is forestry. Currently the largest forest landowner is Mendocino Redwood Company (MRC), which purchased the land in 1998. Within the past ten years, about 41 percent of the Albion River watershed has been under a timber harvest plan. Housing development within the Albion River watershed is moderately low – about 500 housing units are present in the watershed.

Albion River estuary
Photo provided by Friends of the Gualala River, photographer Rixanne Wehren, and is used with permission.

The Watershed at a Glance

Spawning Quantity & Quality:	**VERY GOOD**
Summer Water Temperatures:	**FAIR**
Depth & Shelter of Pools:	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**FAIR to GOOD**
off channel/Floodplain Quality:	**POOR to FAIR**
Estuary Function:	**FAIR**



Albion River

Recovery Target: 2,300 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvesting
- Roads and Railroads

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Albion River watershed that are in poor condition. The highest priorities for restoration are to:

- Improve pool complexity
- Increase large wood in streams
- Increase riparian tree size
- Increase the frequency of off channel habitat
- Reduce the amount of roads in and near the riparian zone
- Reduce the rate of timber harvest
- Reduce sources of sediment
- Improve gravel quality by reducing sediment inputs

We Need Your Photo Here

Albion River
Photo © Your Name Here, AFFIL

Advancing recovery of coho

salmon in Albion River requires these priority **recovery actions:**

- Address high priority roads, culverts, slides, and landings that are contributing sediment to streams as identified in the MRC Albion River Watershed Analysis, or other credible assessments.
- Install or enhance existing LWD and other features to increase stream complexity and improve pool frequency and depth. Implement projects that improve habitat complexity.
- Identify and eliminate depletion of summer base flows from unauthorized water uses. Promote off channel storage to reduce impacts of water diversion.
- Provide for watershed processes by promoting long term sustainable forestry practices that support coho salmon.
- Discourage rezoning forestlands to rural residential or other land uses (e.g., vineyards).

. . . in these **core areas:** Middle and South Fork Albion River planning watershed, and the Railroad Gulch area of the Lower Albion planning watershed.

Conservation Highlights

- The County of Mendocino has recently improved passage on the mainstem Albion by replacing a problematic culvert.
- The Mendocino Redwood Company has made road upgrades and improved passage by replacing old culverts with bridges that allow for improved passage for salmonids.

We Need Your Photo Here

Albion River
Photo © Your Name Here, AFFIL

Immediate Needs

√ Support MRC efforts to conduct road decommissioning and upgrade projects.

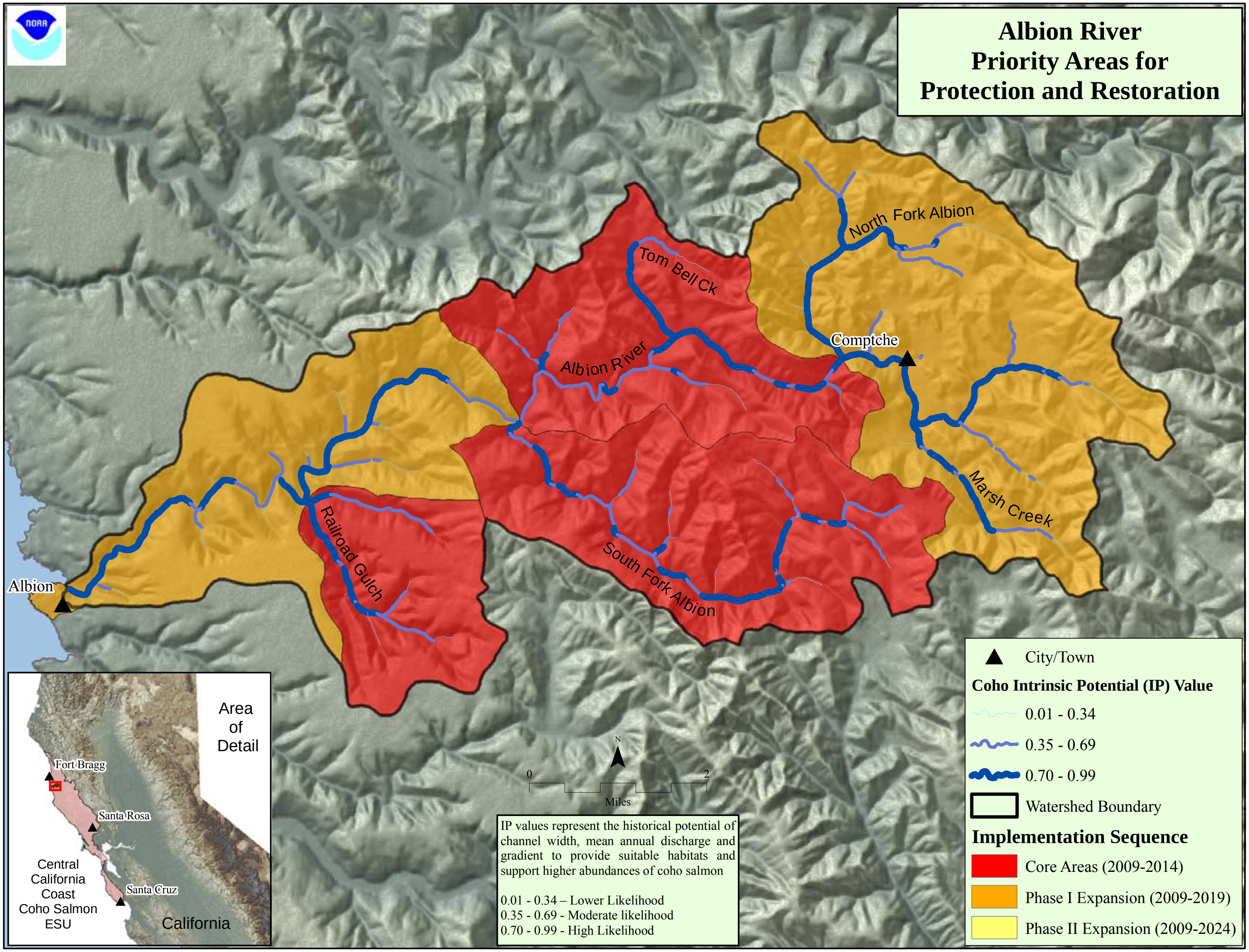
√ Emphasize introduction of entire trees along the mainstem Albion River to improve gravel retention and overwintering habitat.

√ Identify and ameliorate riparian roads and small water diversions and other rural residential impacts to reduce cumulative impacts to coho salmon.

√ Finalize MRC Habitat Conservation Plan.

Recovery Partners

NMFS
DFG
Mendocino Redwood Company
County of Mendocino
Trout Unlimited



Albion River
Priority Areas for
Protection and Restoration
North Fork Albion
Tom Bell Ck
Comptche
Albion River
Marsh Creek
Railroad Gulch
South Fork Albion
Albion
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
0
2
Miles
N
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Albion River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	35-50	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	91%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	>90 days	Very Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	8832 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<300 m^2	300-3100 m^2	3100-6000 m^2	>6000 m^2
NMFS	Best Prof. Judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	58	Fair	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	51-75	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality (Bulk)	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	19%	Poor	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	67	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	25.2	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	8%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	25.2	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% Connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	3.89/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	25.2	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. Judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	43%	Fair	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.14%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.06	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	41%	Poor	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	2.1/100m	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
NMFS	Best Prof. Judgment	1-1.3/100m	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	43%	Fair	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	93%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	7.7 mi/sq mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	6.4 mi/sq mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. Judgment	1-20 per IP-km	Fair	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. Judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. Judgment	35-50%	Good	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Albion River Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	Medium	High			High
2	Roads and Railroads	Medium	Medium	Medium	Medium	Medium	High			High
3	Droughts	Medium	Low	High	Medium	Medium	Medium			Medium
4	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
5	Climate Change	Medium	Low	Medium	Medium	Medium	Medium			Medium
6	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Storms and Flooding	Medium	Medium	Medium	Medium	Low	Medium			Medium
9	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Channel Modification	Medium	Low	Medium	Medium	Low	Medium			Medium
11	Livestock Farming and Ranching	Medium	Low	Low	Medium	Medium	Medium			Medium
12	Recreational Areas and Activities	Medium	Low	Low	Medium	Medium	Medium			Medium
13	Mining	Medium	Low	Low	Medium	Low	Low			Medium
14	Disease, Predation, and Competition	-	-	Medium	-	Low	-			Low
15	Fishing and Collecting	Low	-	Low	Low	Low	-			Low
16	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
Threat Status for Targets and Project		High	Medium	High	High	High	High	-	-	High

Albion River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
								FY1	FY3	FY4	FY5	Entire Duration	
AIR-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
AIR-A-2.1.1	Recovery Action	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	1	2	CDFG, Private Landowners	5.00	5.00				10	Cost estimate based on review of existing data and validation of habitat in the field.
AIR-A-2.1.2	Recovery Action	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	10	CDFG, Private Landowners							Cost cannot be determined without additional site specific analysis.
AIR-A-2.1.3	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.										
AIR-A-2.1.3.1	Action Step	Floodplain	Remove riprap and gabion rock at lowest end of watershed.	3	2	CDFG, Private Landowners	50.00	50.00				100	CDFG recommends improvement of estuary in lower areas of Albion.
AIR-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical, spatial, and temporal pattern of surface flows.										
AIR-A-3.1.1	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
AIR-A-3.1.1.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (storage tanks for rural residential users). Focus efforts in the Comptche area to minimize effects to the North Fork Albion and mainstem Albion.	2	5	NOAA RC, NRCS, Private Landowners, SWRCB	10.00	10.00	10.00	10.00	10.00	50	Cost based on small number of landowners participating in program during the first five years.
AIR-A-3.1.2	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
AIR-A-3.1.2.1	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	1	60	CDFG, SWRCB							Continued enforcement will likely be required.
AIR-A-3.1.2.2	Action Step	Hydrology	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	2	5	CDFG, NMFS, RWQCB	1.00	1.00	1.00	1.00	1.00	5	Cost estimate for various agency coordination and associated tasks to improve flow for coho salmon.
AIR-A-3.1.2.3	Action Step	Hydrology	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	3	3	RWQCB	50.00	50.00	50.00			150	Cost estimate for additional SWRCB staff.
AIR-A-3.1.3	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
AIR-A-3.1.3.1	Action Step	Hydrology	Assess and map water diversions (DFG 2004).	2	5	SWRCB	20.00	20.00	20.00	20.00	20.00	100	Cost estimate is for additional SWRCB staff to conduct work.
AIR-A-3.1.3.2	Action Step	Hydrology	Support SWRCB in regulating the use of streamside wells and groundwater.	3	3	CDFG	33.33	33.33	33.33			100	Cost based on additional staff time for CDFG.
AIR-A-3.1.3.3	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	2	5	SWRCB							Cost estimate needed from SWRCB.
AIR-A-3.1.3.4	Action Step	Hydrology	Require streamflow gauging devices to determine the level of impairment to natural flow.	2	10	SWRCB	50.00	50.00	50.00	50.00	50.00	500	Provide funding to USGS for additional staff and equipment.
AIR-A-3.2	Objective	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	1	10	CDFG, Private Landowners, SWRCB							Need additional analysis to develop cost estimate.
AIR-A-4.1	Objective	Land Disturbance	Reduce the percent acres of the watershed harvested to less than 25 percent in a ten year period.										
AIR-A-4.1.1	Recovery Action	Land Disturbance	Work with private landowners to achieve reductions in area harvested.	3	5	CalFire, CDFG, Private Landowners	2.00	2.00	2.00	2.00	2.00	10	Additional regulatory agency staff time with landowners.
AIR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										

Albion River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
								FY1	FY3	FY4	FY5	Entire Duration	
AIR-A-6.1.1	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
AIR-A-6.1.1.1	Action Step	Pool Habitat	Utilize information developed on LWD demand and recruitment potential in the MRC Albion Watershed Analysis.	1	1	CDFG, Mendocino Redwood Company, Private Landowners	5.00					5	Review current information and validate in field.
AIR-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.										
AIR-A-6.1.2.1	Action Step	Pool Habitat	Improvement of in-channel LWD densities, and associated habitat benefits, could be most easily accomplished by the addition of large key pieces) conifer trees and root wads. It is recommended that this be achieved by cutting large trees and dropping them into the channel, or preferably by pulling them partially into the channel complete with rootwad, at appropriate upstream locations. Downed logs may be transported to proper location to be placed in the stream.	2	5	CalFire, CDFG, Private Landowners	40.00	40.00	40.00	40.00	40.00	200	Based on $50K at a minimum of five areas.
AIR-A-6.1.3	Recovery Action	Pool Habitat	Investigate the feasibility of removing the earthen dam on Marsh Creek to increase habitat availability for coho salmon.	1	2	CDFG, Private Landowners, RCD	10.00	10.00				20	Cost estimate for removal of small dams (CDFG 2004).
AIR-A-6.1.4	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams.										
AIR-A-6.1.4.1	Action Step	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	CDFG, Private Landowners						0	Costs expected to be minimal to maintain current conditions.
AIR-A-6.1.5	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	1	20	CDFG, NRCS, Private Landowners, RCD, RWQCB	5.00	5.00	5.00	5.00	5.00	100	Cost estimate for additional staff to coordinate with landowners.
AIR-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
AIR-A-7.1.1	Recovery Action	Riparian Vegetation	Restore and protect riparian vegetation to improve migration and summer/overwintering habitat for coho salmon (DFG 2004).										
AIR-A-7.1.1.1	Action Step	Riparian Vegetation	Focus efforts on the Albion River and tributaries in the eastern part of the watershed.	2	20	CDFG, Private Landowners							Cost estimate is expected to average $30k per acre.
AIR-A-7.1.1.2	Action Step	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004). Investigate additional conservation easements with MRC along tributaries in Core and Phase I stream reaches.	3	20	CDFG, Private Landowners							Cost will depend on size and scope of easements.
AIR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
AIR-A-8.1.1	Recovery Action	Sediment	Conduct road and sediment assessments to identify and prioritize sites for sediment reduction.										
AIR-A-8.1.1.1	Action Step	Sediment	Conduct road and sediment assessment on the Comptche Ukiah Road segment that drains to the Albion Watershed.	3	1	Mendocino County	30.00					30	Cost based on additional time for County staff/consultant to conduct assessment.
AIR-A-8.1.1.2	Action Step	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	5	Mendocino County, Mendocino Redwood Company, Private Landowners, RWQCB	10.00	10.00	10.00	10.00	10.00	50	Cost based on a subset of roads that represent watershed conditions.
AIR-A-8.1.2	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										

Albion River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)	FY1	FY3	FY4	FY5	Entire Duration	Comments
AIR-A-8.1.2.1	Action Step	Sediment	Treat high priority roads, culverts, road slides and landings that are identified in the MRC Albion River Watershed Analysis or other credible assessments.	1	10	CDFG, Mendocino County, NOAA RC, Private Landowners							Need additional analysis to estimate.
AIR-A-8.1.2.2	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1	10	CDFG, NOAA RC, NRCS, Private Landowners	10.00	10.00	10.00	10.00	10.00	100	Costs based on decommissioning a minimum of one mile per year ($10k/mile) for a ten year period.
AIR-A-8.1.2.3	Action Step	Sediment	Provide incentives to restore high priority sites as determined by watershed analysis, DFG, or CalFire.	2	20	CDFG, FishNet 4C, NOAA RC, NRCS							Additional information needed.
AIR-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
AIR-A-9.1.1	Recovery Action	Viability	Measure or estimate response of key habitat attributes to recovery efforts across the watershed.										
AIR-A-9.1.1.1	Action Step	Viability	Conduct surveys in areas of the mainstem Albion, South Fork Albion, and the North Fork Albion, and selected tributaries.	2	20	CDFG, Mendocino Redwood Company, NMFS PRD							Additional information needed.
AIR-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
AIR-A-9.1.2.1	Action Step	Viability	The Albion watershed should be considered for a coho salmon life-cycle monitoring station.	1	20	CDFG, NMFS, Private Landowners	100	100	100	100	100	2,000	Cost based on $100k per year for 20 years.
AIR-A-9.1.3	Recovery Action	Viability	Support local efforts to monitor water quality, instream flow, and instream habitat conditions in the estuary and streams.										
AIR-A-9.1.3.1	Action Step	Viability	Support a community based water monitoring program in the Albion watershed.	3	10	CDFG, NOAA RC, Private Landowners, Public	5.00	5.00	5.00	5.00	5.00	50	Cost based on need to have data and results prepared each year.
AIR-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches.										
AIR-A-10.1.1	Recovery Action	Water Quality	Determine site-specific recommendations, including incentives, to remedy high temperatures and implement accordingly (DFG 2004) .	2	10	CDFG, NOAA RC, NRCS, Private Landowners							Need additional analysis of site specific recommendations.
AIR-A-10.1.2	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
AIR-A-10.1.2.1	Action Step	Water Quality	Provide funding and expertise to private landowners to plant native vegetation to improve stream reaches with poor streamside shade.	2	10	CDFG, FishNet 4C, NOAA RC, Private Landowners	20.00	20.00	20.00	20.00	20.00	200	Cost based estimate to improve riparian in eastern area of watershed.
AIR-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
AIR-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	3	60	CDFG, NOAA RC, NRCS, Private Landowners							Cost is unknown. The main benefit of this action is to improve flow conditions in the lower portion of the watershed where the majority of home owners and agricultural use occurs.
AIR-A-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
AIR-A-15.2.1	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	2	60	CalFire, CalTrans, CDFG, NMFS, NOAA RC, NRCS, Private Landowners							Cost is expected to be minimal. This action specific to dust control related to timber management actions. Most of these diversion have a 1600 agreement with the Department of Fish and Game and are likely incorporated into existing operations.
AIR-A-15.2.2	Recovery Action	Droughts	Support the development of new regulations to minimize impacts on summer baseflow from riparian water rights users.	3	20	CDFG, NMFS, SWRCB							Costs are unknown. Precise impact of costs to develop new regulations applied to the Albion watershed will likely be minimal due to the relatively small number of diverters.

Albion River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
								FY1	FY3	FY4	FY5	Entire Duration	
AIR-A-15.3	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
AIR-A-15.3.1	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows.	2	20	CDFG, CDFG Law Enforcement, NMFS HCD, NMFS OLE, NMFS PRD, NOAA RC, NRCS, Private Landowners							Cost may be minimal if conducted through existing programs.
AIR-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
AIR-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	20	CalFire, CDFG, Mendocino County, NMFS, Private Landowners, Public, USFWS							Cost is expected to be the result of focused staff time directed at Mendocino BOS and various land use organizations.
AIR-A-20.1.2	Recovery Action	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	3	60	CA Coastal Commission, CalFire, CDFG, Mendocino County, NMFS PRD, Private Landowners, Public							Cost may be minimal if action is conducted within current regulatory framework.
AIR-A-20.1.3	Recovery Action	Logging and Wood Harvesting	Should large tracts of forestlands within any watershed identified as a priority in this recovery plan become available for purchase, the State of California should consider purchasing the area as a Demonstration Forest or State Park.	2	60	California Coastal Conservancy, CDFG, Private Landowners, Public, Redwood Forest Foundation, State Parks							Cost will vary with size of and quality of land available.
AIR-A-20.2	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
AIR-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.	2	60	Mendocino Redwood Company, Private Landowners							Additional information needed to determine the cost of implementation.
AIR-A-20.3	Objective	Logging and Wood Harvesting	Improve existing coordination and oversight of timber operations by regulatory agencies.										
AIR-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the regulatory agencies for proposed harvest operations within the Albion watershed.										
AIR-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	20	CalFire, CDFG, NMFS PRD							Cost dependent on number of proposed harvest operation that need NMFS review.
AIR-A-20.4	Objective	Logging and Wood Harvesting	The priorities in this recovery plan should serve as a guide for independent Forest Certification.										
AIR-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Investigate opportunities to programmatically permit the forest certification program to authorize incidental take for landowners through Section 10(a)(1)(B).	3	5	CalFire, CDFG, NMFS, Private Consultants, Private Landowners							Cost for staff time and consulting to certification program.
AIR-A-20.5	Objective	Logging and Wood Harvesting	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of CCC coho salmon.										

Albion River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
								FY1	FY3	FY4	FY5	Entire Duration	
AIR-A-20.5.1	Recovery Action	Logging and Wood Harvesting	Implement the recommendations of the North Coast Watershed Assessment /Coastal Watershed Program.	1	10	CDFG, NOAA RC, NRCS, Private Landowners, RCD							Additional analysis required to develop cost.
AIR-A-20.5.2	Recovery Action	Logging and Wood Harvesting	Develop a framework similar to Washington State that establishes a scientific framework for monitoring the effectiveness of practices in meeting watershed process goals and a decision-making process that is adaptive to the new information.	3	5	CalFire, CDFG, NMFS, Private Landowners							Cost of additional staff time is unknown at this time, but could be considerable.
AIR-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
AIR-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	5	CalFire, CDFG, NMFS, Private Landowners							Cost of additional staff time is unknown at this time, but could be considerable.
AIR-A-24.1.2	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	5	CDFG, Mendocino County, NOAA RC, NRCS, Private Landowners	10.00	10.00	10.00	10.00	10.00	50	Cost based on annual training for certification of entities in Albion watershed.
AIR-A-24.1.3	Recovery Action	Roads and Railroads	Encourage development and implementation of a program similar to the County of Santa Cruz's Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	2	10	Mendocino County							Additional analysis is required to determine costs to county.
AIR-A-24.1.4	Recovery Action	Roads and Railroads	Expand the NRCS/RCD coordinated permit program to a statewide programmatic ESA consultation that allows funding and technical expertise to small land owners and rural residential property owners.	2	20	CDFG, NMFS PRD, NRCS, Private Consultants, Private Landowners, SWRCB, USACE							Cost associated with additional staff time and consulting to expand program at this time unknown.
AIR-A-24.2	Objective	Roads and Railroads	Design new roads that are hydrologically disconnected from the stream network.										
AIR-A-24.2.1	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	10	CalFire, Mendocino County, NMFS PRD, NOAA RC, Private Landowners	250	250	250	250	250	2,500	Many roads are upgraded in watershed. Cost based on upgrading
AIR-A-24.2.2	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	2	10	CalTrans, Mendocino County, NOAA RC, Private Landowners							Cost not expected to be high. Most passage barriers have been addressed in this basin.
AIR-A-24.3	Objective	Roads and Railroads	Reduce sediment sources from road networks and other actions that deliver sediment to stream channels through improved or new laws and policy.										
AIR-A-24.3.1	Recovery Action	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, Phase I within 10 years, and Phase II areas within 15 years (from 2010).	1	15	CDFG, Mendocino Redwood Company, Private Landowners, RWQCB							Many road upgrades have been done in this watershed. Additional information needed on the remaining road segments that need work to estimate cost.
AIR-A-24.3.2	Recovery Action	Roads and Railroads	Minimize new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	1	20	CDFG, Mendocino Redwood Company, Private Landowners, RWQCB							Cost associated with increased costs for land managers is unknown at this time, additional analysis needed to determine.
AIR-A-24.3.3	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	20	Mendocino County, NOAA RC, NRCS, Private Landowners, RCD							Number of rural roads and associated costs are unknown at this time.

Albion River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
								FY1	FY3	FY4	FY5	Entire Duration	
AIR-A-24.3.4	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails to decrease fine sediment loads.	2	5	CDFG, NOAA RC, NRCS, Private Landowners, RCD	10.00	10.00	10.00	10.00	10.00	50	Estimated cost for materials to block roads and trails, large rock and gates.
AIR-A-24.4	Objective	Roads and Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.										
AIR-A-24.4.1	Recovery Action	Roads and Railroads	Continue to refine, update, and maintain the Coastal Conservancy database of barriers to fish passage (DFG 2004).	3	5	CDFG, NOAA RC, Private Consultants, Private Landowners	10.00	10.00	10.00	10.00	10.00	50	Cost for just updating the Albion watershed for 5 years.

APTOS CREEK

Aptos Creek

Dependent Population
27.35 IP-km of potential coho salmon habitat
Steelhead present and coho salmon extirpated

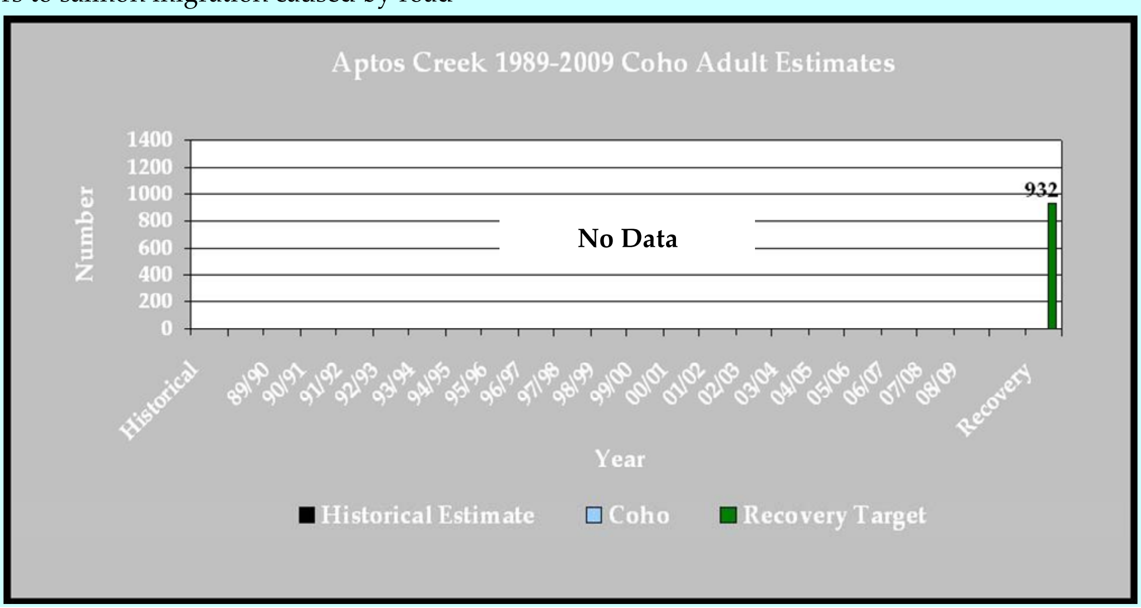
Aptos Creek in Santa Cruz County drains about 24.5 square miles of steep mountainous terrain. Approximately 68 percent of the Aptos Creek watershed is redwood coniferous forest and about 11 percent of the watershed area is coastal oak woodland. The Aptos Creek watershed has low to moderate erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. In 2003, the SWRCB listed the Aptos Creek watershed as having water quality impaired by pathogens and sediment. The water quality impairment listing determined that sediment and pathogens were impairing habitats beneficial to coho salmon including migration, spawning and rearing habitats, and identified urban runoff during storm events, channel erosion, and disturbed sites from development as probable causes. Fifty-two percent of the Aptos Creek watershed is privately owned land and includes rural residential development, timber and agricultural lands. Nisene Marks State Park encompasses the remaining 48 percent of the watershed. The lower portions of the Aptos Creek watershed are predominantly suburban/urban residential and commercial development. Within the past ten years, about eight percent of the Aptos Creek watershed has been under a timber harvest plan. Housing development within the Aptos Creek watershed is moderate to high in areas outside of state parks; approximately 3,000 housing units are present in the watershed. There are numerous barriers to salmon migration caused by road crossings, diversions, and natural structures. Aptos Creek is outside the ESU for CCC coho salmon, although they were present in the watershed historically and returning coho to Aptos is necessary for the long term viability of this species.

We Need Your Photo Here

Aptos Creek
Photo © Your Name Here, AFFIL

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD to VERY GOOD**
Summer Water Temperatures:	**FAIR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**FAIR to GOOD**
Off channel/Floodplain Quality:	**POOR**
Estuary Function:	**POOR**



Aptos Creek

Recovery Target: 932 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Roads and Railroads
- Residential and Commercial Development
- Storms and Flooding
- Droughts
- Fire and Fuel Management
- Disease, Predation, and Competition
- Climate Change
- Logging and Wood Harvesting
- Recreational Areas and Activities

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Aptos Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve spawning habitat
- Enhance and increase pool habitat
- Enhance and increase the shelter provided within pools
- Increase and improve off channel habitat
- Improve the condition and extent of the estuary
- Augment the amount of large wood in the stream
- Decrease the miles of roads within the watershed and lessen the affects of remaining roads

We Need Your Photo Here

Aptos Creek
Photo © Your Name Here, AFFIL

Advancing recovery of coho

salmon in Aptos Creek requires these priority **recovery actions:**

- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.
- Identify habitats lacking in channel complexity and implement restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.
- Manage riparian areas for their site potential composition and structure when initiating logging actions.
- Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.

. . . **throughout** the Aptos Creek Planning watershed.

Conservation Highlights

- The Coastal Watershed Council monitors the Aptos Creek watershed and has conducted several watershed assessments
- Fish passage improvement at Valencia Creek culvert has been completed as well as improvements to the pipeline crossing the creek, thereby allowing better fish passage. Improvements were partially funded by fine monies from a NOAA enforcement case.

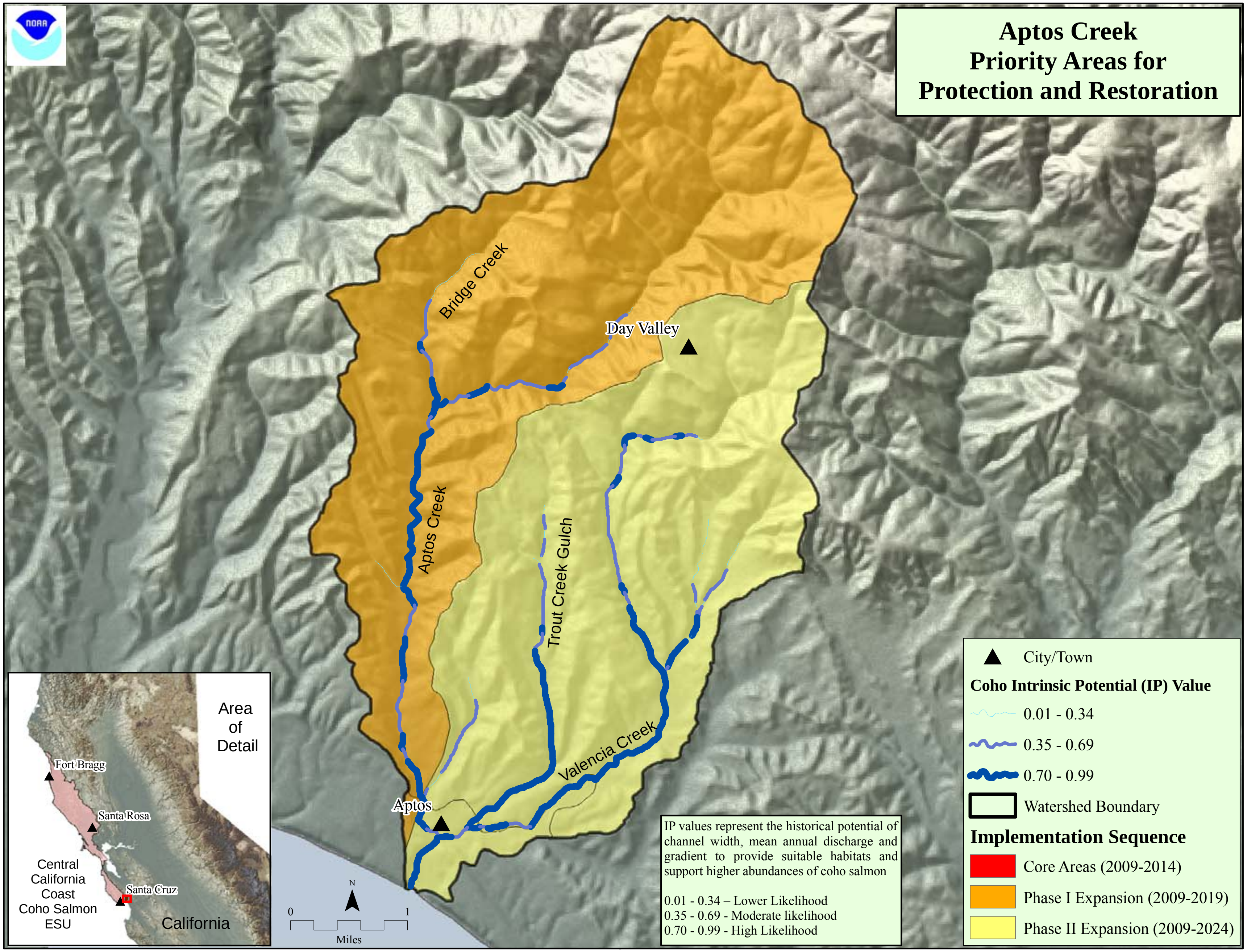
Culvert in Valencia Creek retrofitted with a new fish ladder in 2007.
Photo by Ross Taylor and Associates

Recovery Partners

Coastal Watershed Council
County of Santa Cruz
Santa Cruz RCD
NMFS
State Parks

Immediate Needs

Concentrate in the mainstem initially √
Improve roads √
Add structural complexity to the streams √



Aptos Creek
Priority Areas for
Protection and Restoration
Bridge Creek
Day Valley
Aptos Creek
Trout Creek Gulch
Valencia Creek
Aptos
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
0
1
Miles
N
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Aptos Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	<35	Very Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	33%	Poor	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	1820 m^2	Good	Spawning Adults	Sediment	Amount of Gravel*	<200 m^2	200-1300 m^2	1300-2500 m^2	> 2500 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	42	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	75	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	42	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	38.2	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	2%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	38.2	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Poor	Poor	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0.37/10 IP-km	Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	38.2	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	68%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	2.03%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	1.72%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	6%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	7.4 / 100m	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	NA	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	69%	Fair	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	87%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	≤ 69% density "D" across IP-km	70 -79%	> 80%	
NMFS	CDF THP Dataset	6 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	5.9 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Aptos Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Roads and Railroads	Medium	High	High	High	Very High	High			Very High
2	Residential and Commercial Development	Medium	High	High	High	Very High	Medium			Very High
3	Storms and Flooding	Medium	High	Medium	High	High	High			High
4	Droughts	Medium	Medium	Very High	Medium	Medium	Medium			High
5	Fire and Fuel Management	Medium	High	High	Medium	High	Medium			High
6	Disease, Predation, and Competition	High	-	High	-	High	-			High
7	Climate Change	Medium	Medium	High	Medium	High	Medium			High
8	Logging and Wood Harvesting	Medium	Medium	High	High	Medium	Medium			High
9	Recreational Areas and Activities	Medium	Medium	Medium	Medium	High	Medium			High
10	Agricultural Practices	Medium	Low	High	Medium	Medium	Medium			Medium
11	Channel Modification	Medium	Low	High	Medium	Low	Medium			Medium
12	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium			Medium
13	Water Diversion and Impoundment	Medium	Medium	Medium	Medium	Medium	Low			Medium
14	Fishing and Collecting	Medium	-	Medium	Low	Medium	-			Medium
15	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
16	Mining	-	-	-	-	-	Low			Low
Threat Status for Targets and Project		High	High	Very High	High	Very High	High	-	-	Very High

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
ApC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.										
ApC-A-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	3	20	CDFG, NMFS, Santa Cruz County						TBD	Lower priority for coho but will facilitate smolt transition into the marine environment and adult upmigration. This will directly benefit federally listed CCC steelhead which rear in the estuary.
ApC-A-1.1.2	Recovery Action	Estuary	Where appropriate, remove structures and/or modify practices which impair or reduce the historical Spring feeding and transition habitat where feasible and where benefits to coho salmon and/or the estuarine environment are predicted.										
ApC-A-1.1.2.1	Action Step	Estuary	Encourage State Parks and County of Santa Cruz to fence off lagoon with temporary fencing rather than breach lagoon as a precaution to protect public health and safety.	2	3	CDFG, State Parks						TBD	Costs associated with development and implementation of ordinances are difficult to determine.
ApC-A-1.1.2.2	Action Step	Estuary	Develop and implement programs to address ongoing poor water quality in Aptos Lagoon.	3	15	California Coastal Conservancy, CDFG, NMFS, NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD, USEPA						TBD	Available information suggests the water quality in the lagoon is compromised due to sewage water input etc.
ApC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
ApC-A-2.1.1	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	60	California Coastal Conservancy, CDFG, NMFS PRD, NOAA RC, NRCS, Private Landowners, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, USACE						TBD	Costs will vary significantly depending on site specific constraints and type of structure constructed. Many of the historical floodplain areas have been built upon. Remaining floodplains should be considered a high priority for preservation and enhancement actions.
ApC-A-2.1.2	Recovery Action	Floodplain	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.										
ApC-A-2.1.2.1	Action Step	Floodplain	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment of natural riparian communities. Prioritize Phase I areas (mainstem Aptos Creek) as well as the lagoon.	2	60	CDFG, Santa Cruz County, Santa Cruz County Land Trust						TBD	Costs associated with development and implementation of this program are currently difficult to determine. Costs will vary significantly depending on market conditions, landowner participation, and programs actually used.
ApC-A-2.1.2.2	Action Step	Floodplain	Reclaim the access road on the north side of the Aptos lagoon.	3	10	State Parks	15.00	15.00	15.00	15.00	15.00	150	
ApC-A-2.1.2.3	Action Step	Floodplain	Evaluate feasibility of modifying lower Aptos Creek floodwall and parking lot as a strategy to restore tidal prism in Aptos lagoon.	3	30	CA Coastal Commission, California Coastal Conservancy, CDFG, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board						TBD	Lower priority for coho but will facilitate smolt transition into the marine environment and adult upmigration. This will directly benefit Federally listed CCC steelhead which rearing in the estuary.
ApC-A-2.1.3	Recovery Action	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	30	CalFire, CDFG, NOAA RC, Private Landowners, Santa Cruz RCD, State Parks, USACE						TBD	An evaluation of these habitat features is needed in order to develop a reasonable cost estimate. Costs of an evaluation could be partially offset by leveraging past survey information and the Aptos Creek watershed assessment.

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-5.1	Objective	Passage	Identify and remove existing passage barriers.										
ApC-A-5.1.1	Recovery Action	Passage	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	60	CalFire, CalTrans, Farm Bureau, FEMA, FishNet 4C, Mines and Geology, NMFS PRD, NOAA RC, NRCS, Private Landowners, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD, State Parks, USACE						TBD	Adoption of NMFS guidelines should be considered a baseline standard for all new or retrofitted crossings.
ApC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
ApC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
ApC-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity and implement restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.	1	15	Alnus Ecological, California Coastal Conservancy, CDFG, NMFS, NOAA RC, Private Consultants, Santa Cruz County, Santa Cruz RCD	43.33	43.33	43.33	43.33	43.33	650	Existing documents (DFG stream survey records and Aptos Creek Watershed Assessment) could be used to identify key areas lacking in LWD. If additional information is needed and site specific surveys required, the costs will likely increase significantly. LWD should be properly sized and installed to viability table targets.
ApC-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	2	60	CalTrans, NMFS PRD, NRCS, Private Consultants, Private Landowners, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD, USACE	8.33	8.33	8.33	8.33	8.33	500	Costs will vary depending on site specific conditions, wood availability, and frequency of instream bank hardening projects.
ApC-A-6.1.1.3	Action Step	Pool Habitat	Educate landowners, land managers, and County and municipal staffs on the importance of LWD to coho survival and recovery, and watershed processes.	1	5	CalFire, CDFG, FishNet 4C, NMFS, NRCS, Private Consultants, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, USACE	2.00	2.00	2.00	2.00	2.00	10	Costs would likely be minimal, consisting of staff time for public outreach and outreach materials.

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CalFire, CDFG, Farm Bureau, FishNet 4C, Monterey Bay Salmon and Trout Project, NMFS PRD, NOAA RC, NRCS, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, State Parks, USACE						0	
ApC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
ApC-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	60	FishNet 4C, NMFS, Santa Cruz County, Santa Cruz County Land Trust, State Parks						TBD	
ApC-A-7.1.2	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	60	NRCS, Private Landowners, Santa Cruz RCD, State Parks						TBD	
ApC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
ApC-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
ApC-A-8.1.1.1	Action Step	Sediment	Prioritize and treat erosion sources in Table 11 of the Aptos Geomorphic and Erosion Source Technical Report.	2	15	California Coastal Conservancy, California Department of Mines and Geology, CDFG, NMFS, NRCS, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD						TBD	
ApC-A-8.1.1.2	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	2	60	CalFire, CDFG, Mines and Geology, NMFS, RWQCB, Santa Cruz County, USACE						0	This should be considered a standard practice by all regulatory agencies.
ApC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
ApC-A-9.1.1	Recovery Action	Viability	Conduct periodic, standardized smolt outmigration surveys to estimate smolt abundance in the watershed.	3	9	CDFG, NMFS PRD, NOAA SWFSC, Private Consultants	33.33	33.33	33.33	33.33	33.33	300	Monitoring smolt abundance in Aptos Creek is not as high a priority as in other watersheds in the Santa Cruz Mountains Diversity Stratum due to the watersheds designation as "Dependent" and the existing monitoring currently occurring in the Stratum. Periodic monitoring should have sufficient funding to document size of all three cohorts and should occur concurrently with adult monitoring to the maximum extent possible.

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-9.1.2	Recovery Action	Viability	Conduct periodic, standardized spawning surveys to estimate adult abundance in the watershed. Surveys should include all three cohorts.	3	9	CDFG, NMFS PRD, NOAA SWFSC, Private Consultants, Santa Cruz County Fish and Wildlife Advisory Board	40.00	40.00	40.00	40.00	40.00	360	Monitoring adult abundance in Aptos Creek is not as high a priority as in other watersheds in the Santa Cruz Mountains Diversity Stratum due to the watersheds designation as "Dependent" and the existing monitoring currently occurring in the Stratum. Periodic monitoring should have sufficient funding to document size of all three cohorts and should occur concurrently with smolt monitoring to the maximum extent possible. Monitoring in Aptos should not begin until other watersheds in the Santa Cruz Mountains Diversity Stratum start recovering.
ApC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
ApC-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
ApC-A-10.1.1.1	Action Step	Water Quality	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	2	60	CDFG, FishNet 4C, NMFS PRD, NOAA RC, RWQCB, Santa Cruz County, USEPA						TBD	Implementation of this recommendation will take a multi-faceted approach. Costs of implementation will likely vary depending on willingness of County and RWQCB to adopt new policies and procedures to improve water quality.
ApC-A-10.1.1.2	Action Step	Water Quality	Encourage County of Santa Cruz to establish wider riparian buffers in residential and urban areas.	2	60	CDFG, FishNet 4C, NMFS, RWQCB, USEPA							Successful implementation of this recommendation will likely require extensive local landowner outreach. See Soquel implementation table for a estimate of costs. This cost will apply to all focus streams in Santa Cruz County.
ApC-A-10.1.1.3	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	2	60	NRCS, Private Landowners, Santa Cruz RCD	3.33	3.33	3.33	3.33	3.33	200	Costs will vary depending on landowner participation and acreage that would benefit from this recommendation. This is a very rough cost estimate.
ApC-A-10.1.1.4	Action Step	Water Quality	Remove invasive exotic vegetation at problematic sites, such as the Old Mill site, and revegetate with native plants.	3	60	CalFire, CDFG, NRCS, RWQCB, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, State Parks						TBD	Costs will vary depending on degree of infestation and landowner participation.
ApC-A-10.1.1.5	Action Step	Water Quality	Install continuous water quality samplers in and adjacent to Mangels Gulch.	2	6	RWQCB, Santa Cruz RCD	1.67	1.67	1.67	1.67	1.67	10	This is a high priority action in the Aptos Creek Watershed Assessment (2003), due to known water quality issues.
ApC-A-11.1	Objective	Agricultural Practices	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage and support landowners who conduct operations in a manner compatible with CCC coho salmon recovery priorities.										
ApC-A-11.1.1	Recovery Action	Agricultural Practices	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	60	California Coastal Conservancy, CDFG, Santa Cruz County, Santa Cruz County Land Trust							
ApC-A-11.1.1.1	Action Step	Agricultural Practices	Promote adequate monitoring and enforcement of existing conservation easements in the watershed to ensure compliance with stated easement goals and habitat targets.	3	60	Farm Bureau, NRCS, Private Landowners, Santa Cruz County Land Trust						0	This is a standard requirement for conservation easements.
ApC-A-11.2	Objective	Agricultural Practices	Promote agricultural practices that protect and restore habitats for CCC coho salmon.										
ApC-A-11.2.1	Recovery Action	Agricultural Practices	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	60	CDFG, NMFS, Santa Cruz RCD, SWRCB, Trout Unlimited						TBD	Costs cannot be determined until a water budget for the watershed is completed.

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-11.2.2	Recovery Action	Agricultural Practices	Aid landowners willing to fence off riparian areas in choosing alternatives water source sites (preferably ones that are hydrologically disconnected from stream flows).	3	60	CDFG, NMFS, NRCS, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD						TBD	DFG 2004 estimated costs for fencing in the coho salmon ESUs averaged $8 per lineal foot. Costs will vary depending on the sort of materials used and will also vary according to local average construction wage.
ApC-A-11.2.3	Recovery Action	Agricultural Practices	Promote dry-land farming instead of irrigated crops to reduce impacts of water diversions.	3	60	Farm Bureau, NRCS, UC Extension						TBD	Costs will vary and will likely result in farming of less economically lucrative crops.
ApC-A-11.2.4	Recovery Action	Agricultural Practices	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
ApC-A-11.2.4.1	Action Step	Agricultural Practices	Continue the use of cover crops in agriculture fields.	2	60	Farm Bureau, FishNet 4C, NRCS, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, UC Extension						0	This should not result in additional expense to landowners.
ApC-A-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
ApC-A-12.1.1	Recovery Action	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.										
ApC-A-12.1.1.1	Action Step	Channel Modification	Evaluate whether proposed stabilization projects will lead to additional instability either up- or downstream.	2	60	CalFire, CalTrans, CDFG, FEMA, Mines and Geology, NMFS, NRCS, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD, USACE						0	
ApC-A-12.1.1.2	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	60	CalTrans, CDFG, NMFS, NRCS, Santa Cruz County Department of Public Works, Santa Cruz RCD, USACE						TBD	Costs will vary depending on extent and location of streambank work. Gabions and undersized rock are often used because they are cheaper than larger and more stable rock features. USDA estimated stream bank protection projects in general coast about 125 dollars per square foot in California.
ApC-A-12.1.1.3	Action Step	Channel Modification	For riparian roads, promote road relocation as a preferred alternative to bank stabilization.	1	60	CalFire, CalTrans, NRCS, Private Landowners, Santa Cruz County Department of Public Works, Santa Cruz County Land Trust, Santa Cruz RCD, USACE						TBD	Costs will vary significantly depending on road type and road location. Costs can be significant if roads are a major public road or may be minor if road is used primarily by rural residential landowners and is relocated to a more stable location.
ApC-A-14.1	Objective	Disease, Predation, and Competition	Implement regulatory, abatement, and education measures to prevent the invasion of exotic species, (including exotic plants).	2	60	CDFG, Farm Bureau, FishNet 4C, NMFS PRD, NOAA RC, NRCS, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, UC Extension						TBD	

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-15.1	Objective	Droughts	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts while also providing for CCC coho salmon recovery needs.										
ApC-A-15.1.1	Recovery Action	Droughts	Identify and eliminate depletion of summer base flows from unauthorized water uses.										
ApC-A-15.1.1.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	1	5	SWRCB						TBD	Cost will likely vary depending on diverter cooperation and available staffing at SWRCB.
ApC-A-15.1.2	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
ApC-A-15.1.2.1	Action Step	Droughts	Develop and implement critical flow levels for stream reaches impacted by water diversions.	1	4	CDFG, NMFS HCD, Private Consultants, SWRCB	25.00	25.00	25.00	25.00		100	
ApC-A-15.1.2.2	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	1	4	CDFG, NMFS HCD, SWRCB						TBD	
ApC-A-15.1.2.3	Action Step	Droughts	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by municipal water suppliers and other users in the watershed through conservation programs.	1	60	CDFG, FishNet 4C, NMFS, SWRCB						TBD	Costs could be significant depending on availability of other water sources and magnitude of impacts.
ApC-A-15.1.3	Recovery Action	Droughts	Investigate feasibility of desalination to prevent stream dewatering and ensure a more stable source of water overtime.	2	20	Santa Cruz County						TBD	The City of Santa Cruz and Soquel Water District are currently evaluating desalination opportunities. A combined regional approach would allow an economy of scale.
ApC-A-16.1	Objective	Fire and Fuels Management	Develop measures protective of salmonids during fire control.										
ApC-A-16.1.1	Recovery Action	Fire and Fuels Management	Establish fire contingency plan developed by experts from CalFire, local fire districts, Santa Cruz RCD, and regulatory agencies with expertise in fisheries issues.										
ApC-A-16.1.1.1	Action Step	Fire and Fuels Management	Encourage CalFire to provide plan to all non-County fire fighters when providing fire fighting assistance in the Aptos Creek watershed (and all other watersheds in the County).	1	5	CalFire, Santa Cruz County						0	
ApC-A-16.1.1.2	Action Step	Fire and Fuels Management	In the event of a wildfire, we recommend CalFire Resource Advisors inform the resource agencies for ESA consultation (or technical assistance) about the incident. The resource agencies can provide guidance regarding critical resources in the area that may be affected by fire fighting actions.	2	60	CalFire, CDFG, NMFS, USFWS						TBD	
ApC-A-16.1.1.3	Action Step	Fire and Fuels Management	Implement sediment reduction techniques in concert with prescribed fire techniques to minimize sediment impacts to various coho salmon life stages.	1	60	CalFire						TBD	
ApC-A-16.1.1.4	Action Step	Fire and Fuels Management	Immediately implement appropriate sediment control measures following completion of fire suppression while fire fighters and fire fighting equipment are on site.	1	60	CalFire						0	
ApC-A-16.1.2	Recovery Action	Fire and Fuels Management	Disseminate NMFS' October 9, 2007, jeopardy biological opinion on the use of fire retardants to local fire fighting agencies and CalFire.										
ApC-A-16.1.2.1	Action Step	Fire and Fuels Management	Avoid use of aerial fire retardants and foams within 300 feet of riparian areas throughout the current range of CCC coho salmon.	2	60	CalFire						0	
ApC-A-16.1.2.2	Action Step	Fire and Fuels Management	Develop guidance that directs CalFire and other agencies and organizations using fire retardants to conduct an assessment of site conditions following wildfire where fire retardants have entered waterways, to evaluate the changes to on site water quality and the structure of the biological community.	2	5	CalFire, CDFG	6.00	6.00	6.00	6.00	6.00	30	

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-16.2	Objective	Fire and Fuels Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.										
ApC-A-16.2.1	Recovery Action	Fire and Fuels Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.										
ApC-A-16.2.1.1	Action Step	Fire and Fuels Management	Use managed fire to promote revegetation of species that filter out fine sediment.	2	60	CalFire						TBD	
ApC-A-16.2.1.2	Action Step	Fire and Fuels Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	2	5	CalFire, CDFG, Santa Cruz County, USFWS	3.00	3.00	3.00	3.00	3.00	15	
ApC-A-16.2.1.3	Action Step	Fire and Fuels Management	Reassess fire risk every ten years.	3	10	CalFire						TBD	
ApC-A-16.2.1.4	Action Step	Fire and Fuels Management	Work with County planners to define future impacts of proposed urban and infrastructure development on fire suppression and fuel load buildup.	2	5	CalFire, Santa Cruz County	6.00	6.00	6.00	6.00	6.00	30	
ApC-A-20.1	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
ApC-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
ApC-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	3	60	CalFire, Santa Cruz County						TBD	
ApC-A-20.1.1.2	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.		60	CalFire, California Department of Mines and Geology						TBD	Costs should generally be minimal in circumstances where trees are retained. Cost may be incurred when a private licensed engineering geologist is used. The total costs cannot be determined because the frequency of the action cannot be determined at this time.
ApC-A-20.1.2	Recovery Action	Logging and Wood Harvesting	Allow trees in riparian areas to age, die, and recruit into the stream naturally.										
ApC-A-20.1.2.1	Action Step	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.	1	60	CalFire, CDFG, RPFs, RWQCB, Santa Cruz County						0	
ApC-A-20.1.3	Recovery Action	Logging and Wood Harvesting	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	60	CalFire, CDFG, RPFs, RWQCB						TBD	Costs should be minimal.
ApC-A-20.2	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
ApC-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
ApC-A-20.2.1.1	Action Step	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	60	Santa Cruz County						0	
ApC-A-20.2.1.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	1	60	CalFire, CDFG, NMFS, Santa Cruz County, USFWS						0	
ApC-A-22.1	Objective	Recreational Areas and Activities	Reduce sediment input from parks and other recreation areas.										
ApC-A-22.1.1	Recovery Action	Recreational Areas and Activities	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-22.1.1.1	Action Step	Recreational Areas and Activities	Ensure roads, hiking trails, and biking paths are properly winterized prior to winter rains according to California Forest Practice Rules standards under section 916.5.	2	60	CalFire, Farm Bureau, NRCS, Private Landowners, RWQCB, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, State Parks						TBD	Costs will vary depending on access, prior weatherization practices, and severity of the problem. These data are currently unavailable.
ApC-A-22.1.1.2	Action Step	Recreational Areas and Activities	Encourage development of a trail management plan/maintenance guidelines for Forest of Nisene Marks State Park. Use plan to develop a program to reduce erosion, decommission illegal or duplicate trials, and keep users on designated trails.	2	4	Santa Cruz RCD, State Parks	6.25	6.25	6.25	6.25		25	Development of a management plan should be relatively inexpensive if it draws from existing guidelines and sediment reduction protocols.
ApC-A-22.1.2	Recovery Action	Recreational Areas and Activities	Close unauthorized trails and conduct appropriate decommissioning practices. Hydrologically disconnect trails from associated waterways.	2	20	CalFire, RWQCB, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, State Parks						TBD	Cost will vary depending on trail location and accessibility. Costs may range from $3,000 per mile to $23,000 per mile according to estimates in the State Coho Recovery Plan.
ApC-A-22.1.3	Recovery Action	Recreational Areas and Activities	Educate users (including mountain bikers, hikers, ORV users, etc) to help prevent or control erosion and sediment problems along the stream.										
ApC-A-22.1.3.1	Action Step	Recreational Areas and Activities	Place educational materials/signage at stream crossings and interpretive centers about salmon and how to minimize impacts.	2	5	NRCS, Private Landowners, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, State Parks	2.00	2.00	2.00	2.00	2.00	10	
ApC-A-23.1	Objective	Residential and Commercial Development	Improve stream maintenance practices to protect instream complexity, hydrologic processes and riparian functions.										
ApC-A-23.1.1	Recovery Action	Residential and Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating CCC coho salmon.	2	5	Santa Cruz County	8.00	8.00	8.00	8.00	8.00	40	Costs will vary depending on concerns raised over vegetation growth along stream banks, LWD input, and a variety of social issues that are difficult to quantify. Assessment may take the form of detailed hydraulic analysis or periodic site visits by resource professionals.
ApC-A-23.1.2	Recovery Action	Residential and Commercial Development	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004). Removal should only occur after careful review and consideration.										
ApC-A-23.1.2.1	Action Step	Residential and Commercial Development	Educate county and city public works departments, flood control districts, and planning departments, etc., on the critical importance of maintaining riparian vegetation, instream LWD, and LWD recruitment.	2	10	FishNet 4C, Santa Cruz County Department of Public Works, Santa Cruz County Fish and Wildlife Advisory Board	2.00	2.00	2.00	2.00	2.00	20	

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-23.1.2.2	Action Step	Residential and Commercial Development	Remove logs and debris from streams only as a "last resort" (i.e., failure to remove them will certainly cause the loss of an essential facility) after consultation with a hydrologist and/or qualified fisheries biologist.	1	60	CDFG, NMFS, Santa Cruz County, Santa Cruz County Department of Public Works, USFWS						0	
ApC-A-23.2	Objective	Residential and Commercial Development	Maintain and restore hydrologic function, protect riparian and floodplain areas, and minimize adverse effects to water quality and instream rearing habitats resulting from commercial and urban development.										
ApC-A-23.2.1	Recovery Action	Residential and Commercial Development	Encourage the State Division of Water Rights to evaluate water rights compliance in all sub-watersheds where new development is proposed.	1	60	Santa Cruz County, SWRCB							
ApC-A-23.2.2	Recovery Action	Residential and Commercial Development	As mitigation for hydrograph consequences, municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.										
ApC-A-23.2.2.1	Action Step	Residential and Commercial Development	Develop an incentive program for a roof runoff collection system for detaining runoff and providing for landscape irrigation.	3	20	Santa Cruz County, Santa Cruz RCD						TBD	
ApC-A-23.2.3	Recovery Action	Residential and Commercial Development	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.										
ApC-A-23.2.3.1	Action Step	Residential and Commercial Development	Encourage Santa Cruz County to develop property easement acquisition funds and acquire grant monies to purchase eroding private properties in riparian corridors or properties subject to frequent flooding though a buyout program.	3	60	Santa Cruz County, Santa Cruz County Land Trust						TBD	
ApC-A-23.2.3.2	Action Step	Residential and Commercial Development	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	1	60	Santa Cruz County, USACE						0	Costs would be minimal if this concept is adopted early in the planning process.
ApC-A-23.2.3.3	Action Step	Residential and Commercial Development	Modify all County General Plans to eliminate provisions allowing new construction in undeveloped areas within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	1	10	Santa Cruz County						0	Cost of implementing this recommendation should be minimal if adopted into County Plan updates. Implementation of this recommendation will likely be controversial and costs to County regarding implementation are unknown.
ApC-A-23.2.4	Recovery Action	Residential and Commercial Development	Sediment from existing and future commercial and urban development should be reduced to magnitudes appropriate to the geological setting of the watershed, resulting in no net increase in sedimentation over natural limits.										
ApC-A-23.2.4.1	Action Step	Residential and Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	1	60	RWQCB, Santa Cruz County						0	
ApC-A-23.2.4.2	Action Step	Residential and Commercial Development	Encourage counties and local municipalities to expand riparian buffer widths for new development (including redevelopment).	1	60	Santa Cruz County						0	
ApC-A-23.2.4.3	Action Step	Residential and Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.	2	60	Private Consultants, Private Landowners, Santa Cruz County						0	
ApC-A-23.2.4.4	Action Step	Residential and Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	3	60	RWQCB, Santa Cruz County						TBD	

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-23.2.5	Recovery Action	Residential and Commercial Development	Avoid, or at a minimum regulate, the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	2	60	RWQCB, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, USEPA						0	
ApC-A-23.2.6	Recovery Action	Residential and Commercial Development	Toxic waste products from urban activities should receive the appropriate treatment before being discharged into any body of water that may enter any historic CCC coho salmon waters.										
ApC-A-23.2.6.1	Action Step	Residential and Commercial Development	Determine and eliminate sewage sources into lagoon.	2	10	RWQCB, Santa Cruz County						TBD	
ApC-A-23.3	Objective	Residential and Commercial Development	Standards and recommendations regarding development should apply to all jurisdictions, including school districts and other special districts not subject to county and/or state related ordinances or policies.	2	60	CDFG, NMFS, Santa Cruz County, Santa Cruz County Department of Public Works, USACE, USFWS						TBD	
ApC-A-23.4	Objective	Residential and Commercial Development	Encourage Santa Cruz County to assess the effectiveness of Sensitive Habitat Ordinance and implement improved performance measures as necessary.	2	5	Santa Cruz County	8.00	8.00	8.00	8.00	8.00	40	
ApC-A-24.1	Objective	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources.										
ApC-A-24.1.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
ApC-A-24.1.1.1	Action Step	Roads and Railroads	Implement a sediment reduction program for private roads.	1	10	CalFire, California Coastal Conservancy, FishNet 4C, NRCS, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD						TBD	
ApC-A-24.1.1.2	Action Step	Roads and Railroads	Develop a private road improvement fund to share costs and encourage private road associations to upgrade poorly constructed or improperly located roads.	3	60	California Coastal Conservancy, CDFG, Private Landowners, Santa Cruz County, Santa Cruz RCD						TBD	Costs will vary depending on landowner cooperation and the severity of problems identified.
ApC-A-24.1.2	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.										
ApC-A-24.1.2.1	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, Private Landowners, Santa Cruz County, Santa Cruz County Department of Public Works						TBD	Costs will vary depending on frequency of grading.
ApC-A-24.1.2.2	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	2	5	CalFire, CalTrans, CDFG, NRCS, RWQCB, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Berms are a common road drainage feature on Santa Cruz County Roads. These berms increase water velocity and sediment input into anadromous fish streams. These berms are often installed as a quasi safety device in lieu of crash barriers or guardrails.

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-24.1.2.3	Action Step	Roads and Railroads	Install sediment traps for pretreatment, and a modified culvert system that can act as an efficient detention system.	3	60	RWQCB, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	
ApC-A-24.1.3	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.										
ApC-A-24.1.3.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	60	CalFire, CalTrans, Farm Bureau, FishNet 4C, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	
ApC-A-24.1.4	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, CalTrans, CDFG, FishNet 4C, NMFS, NRCS, Private Consultants, Private Landowners, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD, State Parks						TBD	Costs of upgrading practices to new and improved practices are difficult to determine at this time. However, if these road standards are adopted for all future road construction/reconstruction projects costs will be minimal. Where these standard are implemented solely for the purpose of stream protection, costs can be significant.
ApC-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
ApC-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	20	CalFire, NRCS, Santa Cruz County, Santa Cruz RCD, State Parks						TBD	Costs will vary depending on scale of work identified. Costs can range between $3,000 per mile to $10,000 per mile. Estimates in State Coho Recovery Plan indicate costs in nearby San Mateo County, in 2003 dollars, may reach $15,000 per mile.
ApC-A-24.2.2	Recovery Action	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	60	CalFire, CalTrans, Santa Cruz County Department of Public Works, State Parks						TBD	Costs will likely be significant, particularly in circumstances where major infrastructure changes are required. Costs could be reduced if infrequently used and non-essential roads are targeted (e.g., roads on State Parks and forestlands).
ApC-A-24.3	Objective	Roads and Railroads	Identify and remove existing passage barriers.										
ApC-A-24.3.1	Recovery Action	Roads and Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	60	CalFire, CalTrans, CDFG, FEMA, NMFS, NRCS, Private Landowners, Santa Cruz County Department of Public Works, Santa Cruz RCD, USACE						TBD	Costs will vary depending on number of upgraded crossings and unknown site specific constraints and County building codes.
ApC-A-24.3.2	Recovery Action	Roads and Railroads	Amend County ordinances that discourage the use of inexpensive railcar bridges in favor of culverts.										
ApC-A-24.3.2.1	Action Step	Roads and Railroads	Educate county policy staff and Board of Supervisors on the benefits of railcar bridges and provide information from other counties where they are commonly used.	2	10	CalFire, FEMA, FishNet 4C, Santa Cruz County Department of Public Works, Santa Cruz RCD	1.50	1.50	1.50	1.50	1.50	15	

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-24.3.3	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	2	60	CalFire, CDFG, NMFS, RWQCB, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD, USACE						TBD	
ApC-A-24.3.3.1	Action Step	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	2	60	CalFire, Private Landowners						TBD	Costs will vary depending on number of existing crossings requiring replacement. Identification and mapping should result in minor costs to THP process.
ApC-A-24.4	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
ApC-A-24.4.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.										
ApC-A-24.4.1.1	Action Step	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	20	CDFG, FishNet 4C	2.50	2.50	2.50	2.50	2.50	50	Annual training could be combined on a County-wide basis. Cost estimate represents relative Aptos contribution.
ApC-A-24.5	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
ApC-A-24.5.1	Recovery Action	Roads and Railroads	Improve enforcement of Erosion Control Ordinance for private roads. The current Santa Cruz Erosion Control Ordinance has provisions requiring the responsible parties to repair and alleviate erosion problems that are deemed severe. Santa Cruz Planning should create new erosion control staff positions to help coordinate the County's cooperative efforts, but also to conduct inspections and enforcement actions as necessary.	1	10	Santa Cruz County						0	See Soquel Creek implementation table for a County-wide cost estimate.
ApC-A-24.5.2	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	1	60	RWQCB, Santa Cruz County						TBD	
ApC-A-24.5.3	Recovery Action	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	3	60	CalTrans, RWQCB, Santa Cruz County Department of Public Works						TBD	
ApC-A-24.5.4	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	5	CalTrans, NMFS, Private Landowners, RWQCB, Santa Cruz County						TBD	
ApC-A-25.1	Objective	Storms and Flooding	Conduct outreach and education regarding how local, city, county, State and Federal planning can put in place mechanisms that provide community resiliency to storms and flooding.										
ApC-A-25.1.1	Recovery Action	Storms and Flooding	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.	2	60	CalFire, CDFG, FEMA, FishNet 4C, NMFS HCD, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz RCD, State Parks, USACE						TBD	Determining appropriate locations for this action and implementing recommendations will likely require significant effort. We cannot currently determine cost until requisite site specific studies are conducted.

Aptos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ApC-A-25.1.2	Recovery Action	Storms and Flooding	Implement performance standards in Stormwater Management Plans.	2	10	RWQCB, USEPA						TBD	
ApC-A-25.1.3	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).										
ApC-A-25.1.3.1	Action Step	Storms and Flooding	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.	1	60	Santa Cruz County, USACE						0	Not building in floodplains should result in a long term cost savings.
ApC-A-25.1.4	Recovery Action	Storms and Flooding	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	5	FishNet 4C, Santa Cruz County, Santa Cruz RCD, USACE	6.00	6.00	6.00	6.00	6.00	30	Existing protocols could likely provide most of the templates necessary for this recommendation. Site specific considerations could be incorporated into the final product which could be shared by all municipalities within the CCC ESU.
ApC-A-25.1.5	Recovery Action	Storms and Flooding	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	1	60	CalFire, RWQCB, Santa Cruz County, USACE, USEPA						TBD	Costs cannot be estimated because rates of development and site specific conditions in the Aptos watershed are unknown,
ApC-A-25.2	Objective	Storms and Flooding	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.										
ApC-A-25.2.1	Recovery Action	Storms and Flooding	Establish targeted polices, requirements and assistance for sandy soils areas.	3	10	RWQCB, Santa Cruz County						TBD	

Big River

Big River

Independent Population
191.8 IP-Km of potential coho salmon habitat
Coho salmon, Chinook salmon, and steelhead present

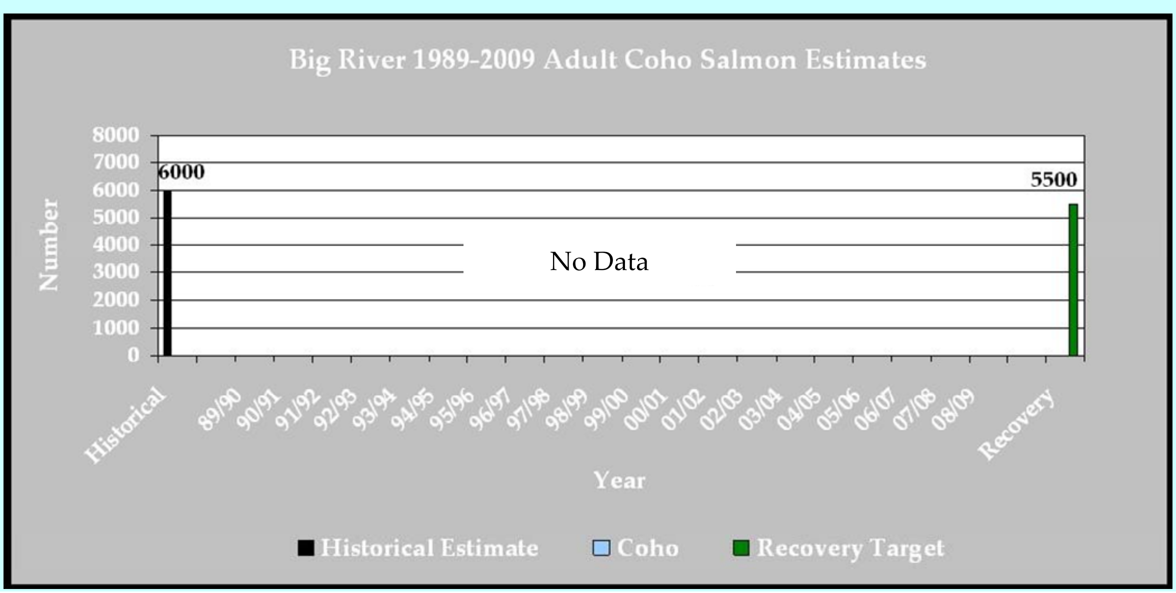
Big River drains approximately 181 square miles of the California Coast Range in western Mendocino County. Big River enters the Pacific Ocean at the town of Mendocino. An eight mile long estuary is located in the western edge of the basin. About 64 percent of the Big River watershed is redwood coniferous forest and about 14 percent of the watershed area is montane hardwood forest. About 72 percent of the Big River watershed has moderately-high to high erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. About 77 percent of the Big River watershed is in private ownership. Most of the public land within the watershed is state forest lands and both state parks land. The dominant land use within the Big River watershed is forestry. Within the past 10 years, about 14 percent of the Big River watershed has been under a timber harvest plan. The EPA listed Big River as having water quality impaired for sediment and high water temperature in 2001. The water quality impairment listing determined that sediment was impairing the migration, spawning, reproduction and early development of coho salmon and other salmonids, and identified non-point source forestry as the probable cause. Since then, the EPA has established a TMDL for the watershed. Housing development within the Big River watershed is moderate – about 290 housing units are present in the watershed.

We Want Your Photo Here

Big River
Photo © Your Name Here, AFFIL

The Watershed at a Glance

Spawning Quantity & Quality:	**VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**POOR to FAIR**
off channel/Floodplain Quality:	**POOR to FAIR**
Estuary Function:	**FAIR**



Big River

Recovery Target: **5,500 Adult Coho Salmon**

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and wood harvesting
- Roads throughout the watershed
- Storms and Flooding

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Big River watershed that are in poor condition. The highest priorities for restoration are to:

- Improve pool habitat
- Increase pool frequency
- Improve complex off channel habitats
- Reduce sources of sediment
- Increase large woody debris frequency
- Increase riparian shade to cool streams
- Reduce the amount of roads near the riparian area

Failed road in Big River watershed
Photo courtesy of the KRIS Information System, Big River project.

Advancing recovery of coho

salmon in Big River requires these priority **recovery actions:**

- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.
- Install properly sized large woody debris to appropriate locations.
- Decommission riparian roads and/or upgrade roads (and skid trails on forestlands) that deliver sediment to adjacent watercourses.
- Provide for watershed processes by promoting long term sustainable forestry practices that support coho salmon.
- Undertake a focused effort to improve roads and legacy sediment sources to improve future instream conditions.

. . . in these **core areas:** Russell Brook Creek area of the Russell Brook planning watershed; Dark Gulch, James Creek, East Branch North Fork Big River, and Berry Gulch planning watersheds; Two Log Creek area of the Two Log Creek planning watershed

Conservation Highlights

- California State Parks, Blencowe Forestry, Trout Unlimited (TU), and the NOAA Restoration Center collaborated on placement of large woody debris in the watershed.
- Mendocino Redwood Company, the Conservation Fund, California State Parks, and Coastal Ridges have upgraded roads, and improved passage at undersized or poorly designed crossings.

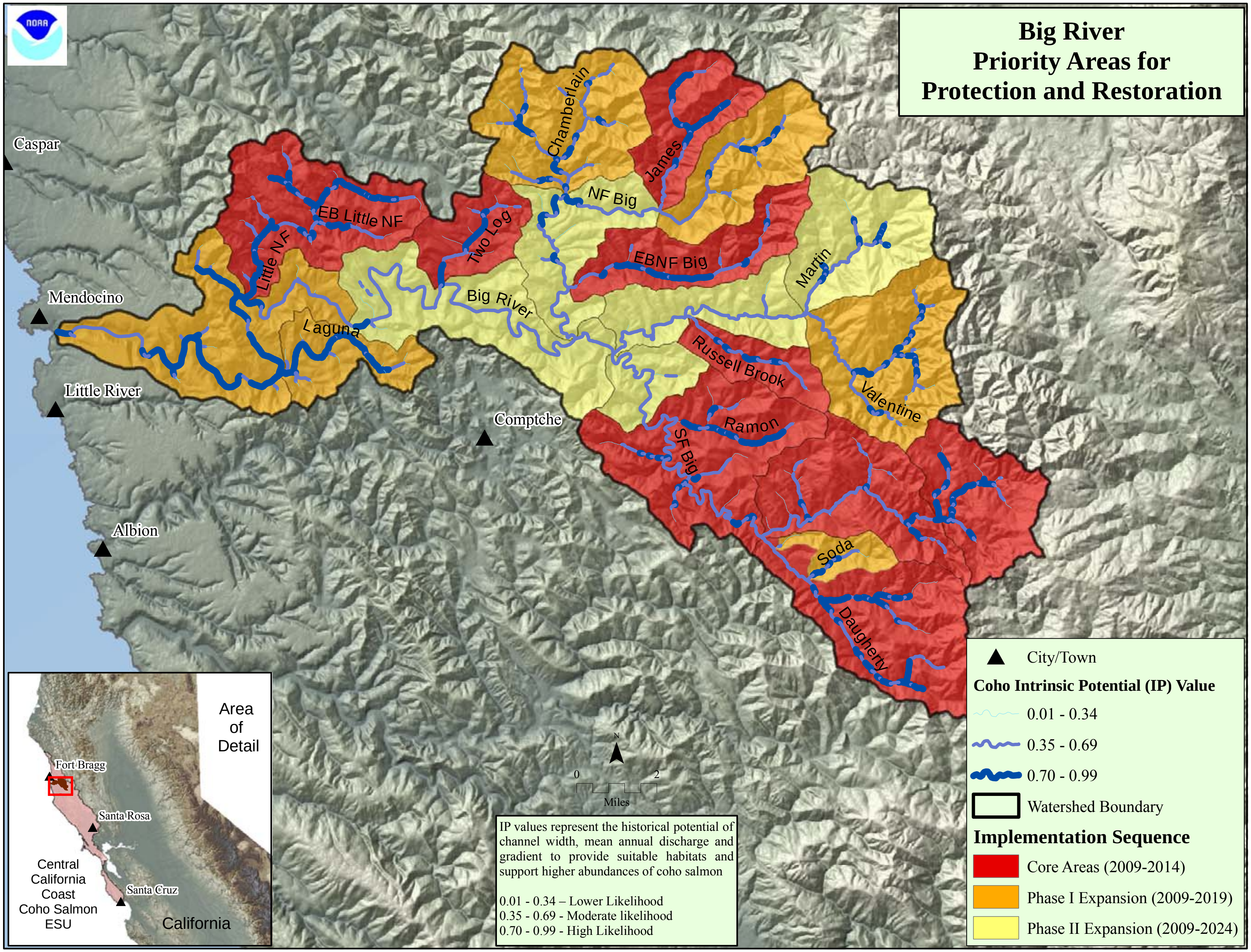
Improved culvert crossing of James Creek.
Photo courtesy of Mendocino County.

Immediate Needs

√ Continuing collaborative restoration efforts
√ Identify a watershed coordinator for this basin
√ Address road sediment input
√ Finalize MRC Habitat Conservation Plan.

Recovery Partners:

DFG
NOAA Restoration Center
California State Parks
Blencowe Forestry
Trout Unlimited
Mendocino Land Trust



Big River
Priority Areas for
Protection and Restoration
Caspar
Mendocino
Little River
Albion
Comptche
Chamberlain
James
NF Big
EB Little NF
Two Log
Little NF
EBNF Big
Martin
Big River
Laguna
Russell Brook
Valentine
Ramon
SF Big
Soda
Daugherty
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
2
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Big River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	33	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	99%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	>90 days	Very Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	78787 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<900 m^2	900-7700 m^2	7700-14500 m^2	>14500 m^2
NMFS	Best Prof. Judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	Good	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	58	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality (Bulk)	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	43%	Fair	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	Fair	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	36.9	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	4%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	36.9	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% Connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	35-50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0.03/10Ip-km	Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	36.9	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. Judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	59%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.07%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	16%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	3/100m	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. Judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	34%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	83%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	6.4 mi/sq mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	6.9 mi/sq mi	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. Judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. Judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. Judgment	20-34%	Fair	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Big River Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Logging and Wood Harvesting	Medium	Medium	High	High	High	High			High
2	Roads and Railroads	High	Medium	High	Medium	Medium	High			High
3	Storms and Flooding	Medium	Medium	Medium	Medium	High	Medium			High
4	Droughts	Medium	Low	High	Medium	Medium	Medium			Medium
5	Channel Modification	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Climate Change	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Recreational Areas and Activities	Medium	Low	Low	Medium	Medium	Medium			Medium
9	Residential and Commercial Development	Medium	Low	Low	Medium	Medium	Medium			Medium
10	Water Diversion and Impoundment	Low	Low	Medium	Medium	Medium	-			Medium
11	Mining	Low	Low	Low	Medium	Low	Low			Low
12	Agricultural Practices	Low	Low	Low	Medium	Low	-			Low
13	Livestock Farming and Ranching	Low	Low	Low	Medium	Low	-			Low
14	Disease, Predation, and Competition	Medium	-	-	-	-	-			Low
15	Fishing and Collecting	Low	-	-	Low	Low	-			Low
16	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
Threat Status for Targets and Project		High	Medium	High	High	High	High	-	-	Very High *

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BR-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
BR-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, and use streamway concept where appropriate.										
BR-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2c	10	CDFG, MMWD, SPAWN	10.00	10.00	10.00	10.00	10.00	100	Existing program (e.g. SPAWN) could be expanded at minimal cost. Estimate additional monitoring costs at $10K/year.
BR-A-2.1.1.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	3	10	California Coastal Conservancy, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB, State Parks						TBD	Costs depend on level of technical assistance required and types of projects proposed. Many salmon recovery efforts and management programs are currently ongoing. It is possible that there could be additional salmon restoration costs identified based on recovery needs of the species; however, at this time we do no have sufficient information to estimate those potential costs or identify the actions under which they might fall.
BR-A-2.1.1.3	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	20	California Coastal Conservancy, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, NOAA RC, Private Landowners, State Parks, Trout Unlimited						TBD	Initiate projects should target stream reaches with high IP-km values, however, consideration should be also given to mainstem Big River, particularly mainstem reaches above the estuary.
BR-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical, spatial, and temporal pattern of surface flows.										
BR-A-3.1.1	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
BR-A-3.1.1.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	3	60	California Coastal Conservancy, CDFG, NMFS, NOAA RC, Private Consultants, Private Landowners, SWRCB						TBD	Costs may be significant due to large amount of infrastructure often required to implement this action. However, the benefits to public trust resources in the watershed would likely be significant, particularly if this action prioritizes key tributaries where diversions are concentrated (e.g., South Fork Big River).
BR-A-3.1.1.2	Action Step	Hydrology	Promote diversion devices designed per NMFS Guidelines.	2	60	CDFG, NMFS, Private Landowners, SWRCB, USACE						0	These guidelines should be adopted by the SWRCB and DFG when permitting any diversion. Outreach to existing diverters is also recommended.
BR-A-3.1.2	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
BR-A-3.1.2.1	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	1	20	CDFG, CDFG Law Enforcement, NMFS OLE, Private Landowners, SWRCB						TBD	
BR-A-3.1.2.2	Action Step	Hydrology	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	2	10	CDFG, NMFS, Private Landowners, SWRCB, USFWS						0	Cost of additional coordination is expected to be minimal.
BR-A-3.1.2.3	Action Step	Hydrology	Require compliance with the most recent update of NMFS' Water Diversion Guidelines.	2	60	NMFS, NMFS OLE, Private Landowners, SWRCB						TBD	Further analysis is needed to determine cost to landowners to comply with guidelines for new diversions.

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BR-A-3.1.3	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
BR-A-3.1.3.1	Action Step	Hydrology	Assess and map water diversions (DFG 2004).	2	2	CDFG, NMFS, SWRCB	10.00	10.00				20	Rough cost estimate for Big River watershed only. This exercise should include Riparian and Appropriative diversions. The majority of the estimated cost would result from attempting to identify unreported Riparian diversions.
BR-A-3.1.3.2	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	2	10	SWRCB						TBD	Additional analysis needed.
BR-A-3.1.3.3	Action Step	Hydrology	Require streamflow gauging devices to determine the current streamflow condition.	2	10	NMFS, SWRCB, USGS	30.00	30.00	30.00	30.00	30.00	300	Cost based on 30k per year for two stations. This information could provide baseline information that would be useful in evaluating changes to baseflow over time.
BR-A-3.1.4	Recovery Action	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	3	60	CDFG, NOAA RC, Private Landowners, SWRCB						TBD	Number of landowners willing to participate is unknown.
BR-A-3.1.5	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches currently impacted by water diversion.										
BR-A-3.1.5.1	Action Step	Hydrology	Protect instream flows in all Core areas including the Little North Fork, Two Log Creek, James Creek, East Branch North Fork Big River, Russell Brook, and the upper South Fork Big River.	1	60	CalFire, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS, NMFS OLE, Private Landowners, SWRCB						TBD	
BR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
BR-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
BR-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.	1	5	California Coastal Conservancy, CDFG, Mendocino Land Trust, Mendocino Redwood Company, NOAA RC, Private Landowners, State Parks						TBD	These data would be most effective if combined into a central repository and restoration projects were prioritized according to highest restoration priority.

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BR-A-6.1.1.2	Action Step	Pool Habitat	Fund a watershed coordinator.	2	5	California Coastal Conservancy, CDFG, Jackson Demonstration State Forest, Mendocino County, Mendocino County Fish and Wildlife Advisory Board, RCD, RWQCB, State Parks, Trout Unlimited	50.00	50.00	50.00	50.00	50.00	250	Currently, Big River is managed by five or six larger landowners - including State, private, and non-profit. A coordinator is likely necessary to focus actions and resources in key areas and to apply for grants that will span multiple landowners.
BR-A-6.1.1.3	Action Step	Pool Habitat	Install properly sized large woody debris to appropriate viability table targets.	1	20	California Coastal Conservancy, CDFG, Jackson Demonstration State Forest, Mendocino Land Trust, Mendocino Redwood Company, NOAA RC, Private Landowners, State Parks, UC Extension	100	100	100	100	100	2,000	Costs may vary significantly due to access, varying paucity of large wood between sub-watersheds, and installation techniques. Much of Big River has been habitat typed and thus the stream reaches lacking wood can be readily identified. Permitting should be streamlined because of programmatic biological opinions for these types of actions. Many key areas in Big River have been targeted for LWD enhancement through the MRC HCP and on JDSF and total costs may be significantly less than projected.
BR-A-6.1.1.4	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CalFire, CDFG, Mendocino County, Mendocino County Department of Public Works, Mendocino Land Trust, Mendocino Redwood Company, NOAA RC, NRCS, Private Landowners, RWQCB, State Parks						TBD	Costs will vary with site specific conditions (such as access and availability of materials). However, significant cost saving could result if projects are implemented when other land management action are planned.
BR-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
BR-A-7.1.1	Recovery Action	Riparian Vegetation	Conserve and manage forestlands for older forest stages.										
BR-A-7.1.1.1	Action Step	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	3	20	CDFG, Coastal Ridges, Conservation Fund, Mendocino Redwood Company, Private Landowners, Redwood Forest Foundation, State Parks, The Nature Conservancy						TBD	Cost cannot be estimated because overall amount of landowner participation is unknown (particularly for conservation easements).

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BR-A-7.1.1.2	Action Step	Riparian Vegetation	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	60	CalFire, CalTrans, Conservation Fund, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, NMFS, NRCS, Private Landowners, RWQCB, State Parks						TBD	Particular attention should be directed at implementing this action along mainstem Big River. Mainstem temperatures are very warm, particularly in the lower reaches, and it will take a considerable time to grow the riparian canopy to sufficient size to add in overall stream shading.
BR-A-7.1.1.3	Action Step	Riparian Vegetation	Encourage development and implementation of a program similar to the County of Santa Cruz's Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	60	Conservation Fund, Mendocino County Department of Public Works, Mendocino Land Trust, Mendocino Redwood Company, Mid Penninsula Open Space District, State Parks, SWRCB	0.00	0.00	0.00	0.00	0.00	0	Adoption of the existing plan should minimize costs. Majority of the cost likely the result of tailoring the document to Mendocino County issues.
BR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment input to the stream channel network.										
BR-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
BR-A-8.1.1.1	Action Step	Sediment	Develop a Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with survey focused on slides and other non-road related sediment sources in the watershed.	1	5	CalFire, Coastal Ridges, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB, USEPA						TBD	Sediment reduction plan could be part of a larger road and sediment reduction plan. This plan should tier off recommendations in the Big River TMDL.
BR-A-8.1.1.2	Action Step	Sediment	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas (DFG 2004).	2	5	CalFire, California Department of Mines and Geology, Conservation Fund, Mendocino County, Mendocino County Department of Public Works, Mendocino Land Trust, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB						0	Cost is likely minimal because most of these sites have likely already been identified and cataloged by CalFire and Mines and Geology through the THP process.

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
BR-A-8.1.1.3	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	2	60	CDFG, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino County Department of Public Works, RWQCB, State Parks	50.00	50.00	50.00	50.00	50.00	3,000	This infrastructure is likely present in many of the Big River subwatersheds. Additional sites may be installed as part of the timber harvest plan process and the cost for construction will likely be absorbed on a harvest plan by harvest plan basis. Ongoing maintenance will likely occur as part of yearly evaluation prior to the winter period. Maintenance costs are estimated at $50,000/yr. Most of these costs are not anticipated to be additional costs to landowners but should be viewed as expenses incurred for maintenance of existing infrastructure.
BR-A-9.1	Objective	Viability	Implement a monitoring program to evaluate the performance of recovery efforts. Core areas should have the highest priority for a site-based assessment; adapt the strategies for restoration and threat abatement to address site-based issues identified by the watershed assessments.										
BR-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key habitat attributes across the watershed. Prioritize Core tributaries first, followed by Phase I and Phase II areas as appropriate.										
BR-A-9.1.1.1	Action Step	Viability	Implement standardized assessment protocols (i.e., DFG habitat assessment protocols) to ensure ESU-wide consistency.	3	60	CalFire, California Department of Mines and Geology, CDFG, Conservation Fund, Jackson Demonstration State Forest, Mendocino Land Trust, Mendocino Redwood Company, NMFS, NRCS, Private Consultants, Private Landowners, RPFs, RWQCB, SWRCB, UC Extension						TBD	Most of the watershed has been habitat typed according to DFG stream protocols. New habitat assessment methods may result in additional (but unknown) costs for Big River.
BR-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
BR-A-9.1.2.1	Action Step	Viability	Conduct monitoring activities to determine the population status of adult and salmonid smolts in Core and Phase 1 areas.	2	12	CDFG, Conservation Fund, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS, Private Landowners, State Parks	100	100	100	100	100	1,200	Cost may total on 100k per year for both adult and smolt surveys. However, due to other monitoring efforts in adjacent diversity stratum watersheds - Noyo in particular - monitoring in Big River may be of a lesser intensity. Monitoring in the Big River watershed should be closely coordinated and complementary with other ongoing monitoring efforts in the Lost Coast Diversity Stratum. Cost estimates based on presumed redd survey methods in three key tributaries (rough estimate of necessary sampling intensity).
BR-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. Also follow strategies for restoring and enhancing riparian vegetation.										
BR-A-10.1.1	Recovery Action	Water Quality	Encourage riparian restoration and establishment of wider riparian buffers in rural residential and forest management areas.	2	60	CalFire, CDFG, Mendocino County, Mendocino Redwood Company, NOAA RC, NRCS, Private Landowners, RCD						TBD	

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
BR-A-15.1	Objective	Droughts	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts while also providing for CCC coho salmon recovery needs.										
BR-A-15.1.1	Recovery Action	Droughts	Enforce existing, and support development of new, regulations to minimize impacts on summer baseflow from water rights users.										
BR-A-15.1.1.1	Action Step	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	3	10	CDFG, NMFS, Private Landowners						TBD	Cost to landowners may be low due to past over harvesting in riparian zones.
BR-A-15.1.2	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
BR-A-15.1.2.1	Action Step	Droughts	Develop critical flow values that are the basis for minimum bypass flow requirements to support juvenile rearing habitat conditions in the summer and fall months.	2	10	CDFG, NMFS, SWRCB	10.00	10.00	10.00	10.00	10.00	100	Initial efforts should be focused in upper South Fork Big River where numerous small landowners are believed to divert from Big River for domestic purposes.
BR-A-15.1.2.2	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	2	10	CDFG, NMFS, SWRCB						0	
BR-A-15.1.2.3	Action Step	Droughts	If predicted flows are below a level considered critical to maintain habitat conditions for coho salmon, measures to reduce water consumption should be initiated by users in the watershed through conservation programs.	2	60	CDFG, NMFS, Private Landowners, SWRCB						TBD	
BR-A-20.1	Objective	Logging and Wood Harvesting	Establish greater oversight for pre and post-harvest monitoring by the permitting agency for operations within Core, Phase I and Phase II CCC coho salmon areas.										
BR-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	CalFire, NMFS						0	Financial estimate is present in the Ten Mile River recovery strategy. It is assumed that this recommendation will require one full time NMFS position dedicated to the Lost Coast Diversity stratum.
BR-A-20.1.2	Recovery Action	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	60	CalFire, CDFG, Private Landowners, RWQCB						0	
BR-A-20.2	Objective	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.										
BR-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	3	10	Board of Forestry, CalFire, CDFG, Mendocino County, NMFS PRD, RWQCB						0	Cost expected to be minimal if current agency staff can conduct work to improve regulations.
BR-A-20.2.2	Recovery Action	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	20	CDFG, Mendocino County, NMFS						0	Cost expected to be minimal if current agency staff can work with County of Mendocino.
BR-A-20.2.3	Recovery Action	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	60	CDFG, Mendocino County, NMFS, RWQCB						0	Minimal cost if conducted with agency staff.
BR-A-20.2.4	Recovery Action	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.	2	60	CalFire, Mendocino Redwood Company, Private Landowners						TBD	Some cost to timber landowners. Need additional cost analysis for estimate to implement this management. Cost difficult to estimate and will depend on harvest strategies of the various landowners in the watershed.

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BR-A-20.2.4.1	Action Step	Logging and Wood Harvesting	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	20	CalFire, CDFG, Conservation Fund, Jackson Demonstration State Forest, Mendocino Redwood Company, NRCS, Private Landowners, RWQCB, State Parks	5.00	5.00	5.00	5.00	5.00	100	Costs are difficult to predict because a significant proportion of the watershed is under active timber management. In those areas where timber management is not ongoing (State Parks) additional costs will be incurred in order to implement this recommendation. Conifer release should only occur in those areas where adverse affects to instream temperature are anticipated to be minimal.
BR-A-20.3	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
BR-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Require tree retention on the axis of headwall swales Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	60	Board of Forestry, CalFire, CDFG, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB						0	
BR-A-20.4	Objective	Logging and Wood Harvesting	Encourage a watershed-wide HCP for all or multiple landowners within a watershed to pool resources as a means to facilitate long-term survival and recovery for coho salmon and their habitat.	3	30	CalTrans, CDFG, Coastal Ridges, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, NMFS, Private Landowners, State Parks, USFWS	33.33	33.33	33.33	33.33	33.33	1,000	Cost is a rough estimate and may vary considerably depending on the number of species and activities covered. A multiple landowner HCP is preferable due to economy of scale and overall, similar land management actions across the watershed. Although MRC is developing its own HCP for its lands in the Big River watershed, other landowners may be able to leverage off this effort as a means of reducing development cost.
BR-A-24.1	Objective	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, Phase I within 10 years, and Phase II areas within 15 years (from 2010).										
BR-A-24.1.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
BR-A-24.1.1.1	Action Step	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.	2	10	CalFire, California Department of Mines and Geology, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino Land Trust, Mendocino Redwood Company, RWQCB, State Parks	15.00	15.00	15.00	15.00	15.00	150	This plan should leverage the Big River TMDL. If most of the TMDL recommendations are adopted the total cost of this plan would likely be significantly less than that estimated here.
BR-A-24.1.2	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized users to decrease fine sediment loads.										

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BR-A-24.1.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	2	60	CalFire, CalTrans, Conservation Fund, Jackson Demonstration State Forest, Mendocino County Department of Public Works, Mendocino Redwood Company, NRCS, Private Landowners, RWQCB, State Parks						0	The recommendation should be considered a part of ongoing road maintenance and should occur for the entire road network for each respective land owner in the watershed.
BR-A-24.1.3	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).										
BR-A-24.1.3.1	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	3	60	CalFire, CalTrans, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, Mendocino County Department of Public Works, RWQCB, State Parks						0	These areas are likely already established in the watershed. Efforts should be made to coordinate storage with all landowners in the basin to minimize cost and impacts to water quality.
BR-A-24.1.3.2	Action Step	Roads and Railroads	Maintain all roads with inside ditches unless these roads have been properly decommissioned. All roads with inside ditches should be evaluated, and problems addressed, prior to the winter season.	1	60	CalFire, CalTrans, Conservation Fund, Jackson Demonstration State Forest, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners, RPFs, State Parks						0	Many roads in the watershed have inside ditches. Cost should be considered part of ongoing road maintenance costs.
BR-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
BR-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1	5	CalFire, California Department of Mines and Geology, Conservation Fund, Jackson Demonstration State Forest, Mendocino County Department of Public Works, Mendocino Redwood Company, NMFS, NOAA RC, NRCS, Private Landowners, RCD, State Parks	80.00	80.00	80.00	80.00	80.00	400	Implementation of this recommendation may be more achievable in the Big River watershed than most other watersheds in the ESU due to the large percentage of private and public ownership. Recent purchase of the lower Big River watershed by State Parks could result in significant opportunities to decommission problematic riparian roads.

Big River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BR-A-24.2.2	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	5	Board of Forestry, CalFire, CDFG, Conservation Fund, Jackson Demonstration State Forest, Mendocino County, NMFS, Private Landowners, State Parks, SWRCB						TBD	Cost may be low due to extensive road system already present in this watershed.
BR-A-24.3	Objective	Roads and Railroads	Identify and remove existing passage barriers.										
BR-A-24.3.1	Recovery Action	Roads and Railroads	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	3	5	California Coastal Conservancy, CDFG, NOAA RC, NRCS, Private Landowners, RCD	10.00	10.00	10.00	10.00	10.00	50	Barriers on public roads and industrial timberlands are generally already known. Focus of this recommendation should be directed towards small private landowner roads.
BR-A-24.3.2	Recovery Action	Roads and Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	60	CalFire, CalTrans, CDFG, Coastal Ridges, Conservation Fund, Jackson Demonstration State Forest, Mendocino County Department of Public Works, Mendocino Redwood Company, NMFS, NRCS, Private Landowners, State Parks, USACE						TBD	Additional cost of meeting NMFS guidelines is will vary by project. However, these guidelines are standard requirements that are applied by most landowners and regulatory agencies working in the watershed.
BR-A-25.1	Objective	Storms and Flooding	Conduct outreach and education regarding how local, city, county, State and Federal planning can put in place mechanisms that provide community resiliency to storms and flooding.										
BR-A-25.1.1	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	3	60	Mendocino County, Private Landowners						TBD	Some additional cost to the County and private landowners.
BR-A-25.1.2	Recovery Action	Storms and Flooding	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	3	60	CDFG, NMFS						TBD	Cost should be one time for ESU wide use.
BR-A-25.2	Objective	Storms and Flooding	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.	2	20	CalFire, California Department of Mines and Geology, CDFG, Jackson Demonstration State Forest, NOAA RC, Private Landowners						TBD	Number and site specific information needed to develop cost estimate.

BIG SALMON CREEK

Big Salmon Creek

Dependent Population
17.0 Km of Potential Habitat
Coho salmon and steelhead present

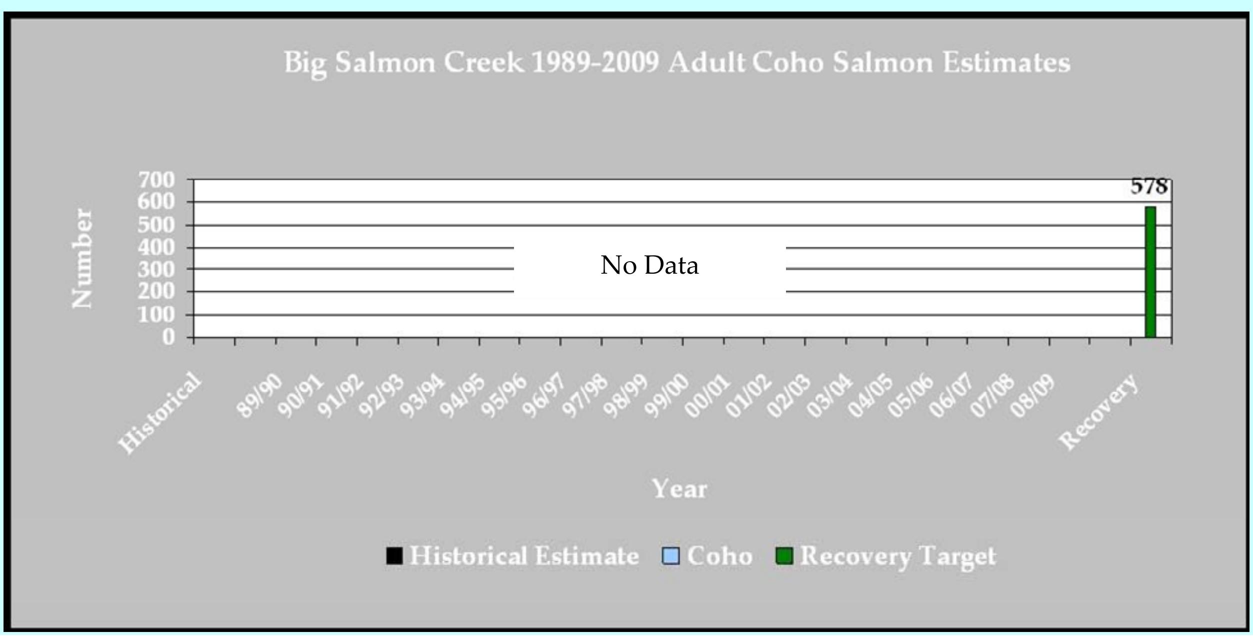
We Need Your Photo Here

Big Salmon Creek
Photo © Your Name Here, AFFIL

Big Salmon Creek drains approximately 13 square miles of the California Coast Range in western Mendocino County. Big Salmon Creek enters the Pacific Ocean about 1 mile south of the community of Albion. About 71 percent of the Big Salmon Creek watershed is redwood coniferous forest and about 16 percent of the watershed area is grassland or shrub land. The upper portions of the watershed consist of an uplifted marine terrace supporting a pygmy forest. The entire Big Salmon Creek watershed has intermediate susceptibility to erosion, after considering slope, precipitation, and the susceptibility of failure of underlying geology. The entire watershed is in private ownership. The dominant land use within the Big Salmon Creek watershed is forestry. The watershed was originally logged in late 1800s, and more or less continually since, with heavy clear cutting in the 1970s and 1980s. Within the past 10 years, about 20 percent of the Big Salmon Creek watershed has been under a timber harvest plan. Housing development within the Big Salmon Creek watershed is moderate – about 270 housing units are present in the watershed.

The Watershed at a Glance

Spawning Quantity & Quality:	**FAIR to VERY GOOD**
Summer Water Temperatures:	**FAIR**
Depth & Shelter of Pools	**POOR to FAIR**
Large Wood Frequency:	**FAIR**
Riparian Canopy:	**POOR**
off channel/Floodplain Quality:	**FAIR**
Estuary Function:	**GOOD**



Big Salmon Creek

Recovery Target: **578 Adult Coho Salmon**

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvest
- Roads and Railroads

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Big Salmon Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve gravel quality by reducing sediment inputs
- Decrease rate of timber harvest
- Increase pool habitat complexity
- Increase size of riparian trees
- Increase riparian shading to cool streams
- Reduce riparian and watershed road density
- Decrease sources of sediment

We Need Your Photo Here

Big Salmon Creek
Photo © Your Name Here , AFFIL

Advancing recovery of coho

salmon in Big Salmon Creek requires these priority **recovery actions:**

- Construct/create alcoves, backwaters in areas where these habitat features are limiting carrying capacity.
- Develop and implement large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth.
- Discourage home building or other incompatible land use in areas identified as timber production zones.
- Limit winter use of unsurfaced roads and recreational trails by unauthorized individuals and impacting uses to decrease fine sediment loads.

. . . **throughout** the Big Salmon Creek watershed.

Conservation Highlights

- The Conservation Fund recently purchased from Hawthorne Timber Company, 4,350 acre tract of timber and plans on implementing practices to decrease the intensity of harvests, increase the time between harvests and widen riparian buffers.
- Hawthorne Timber Company has undertaken placement of large woody debris structures and sediment remediation projects.

We Need Your Photo Here

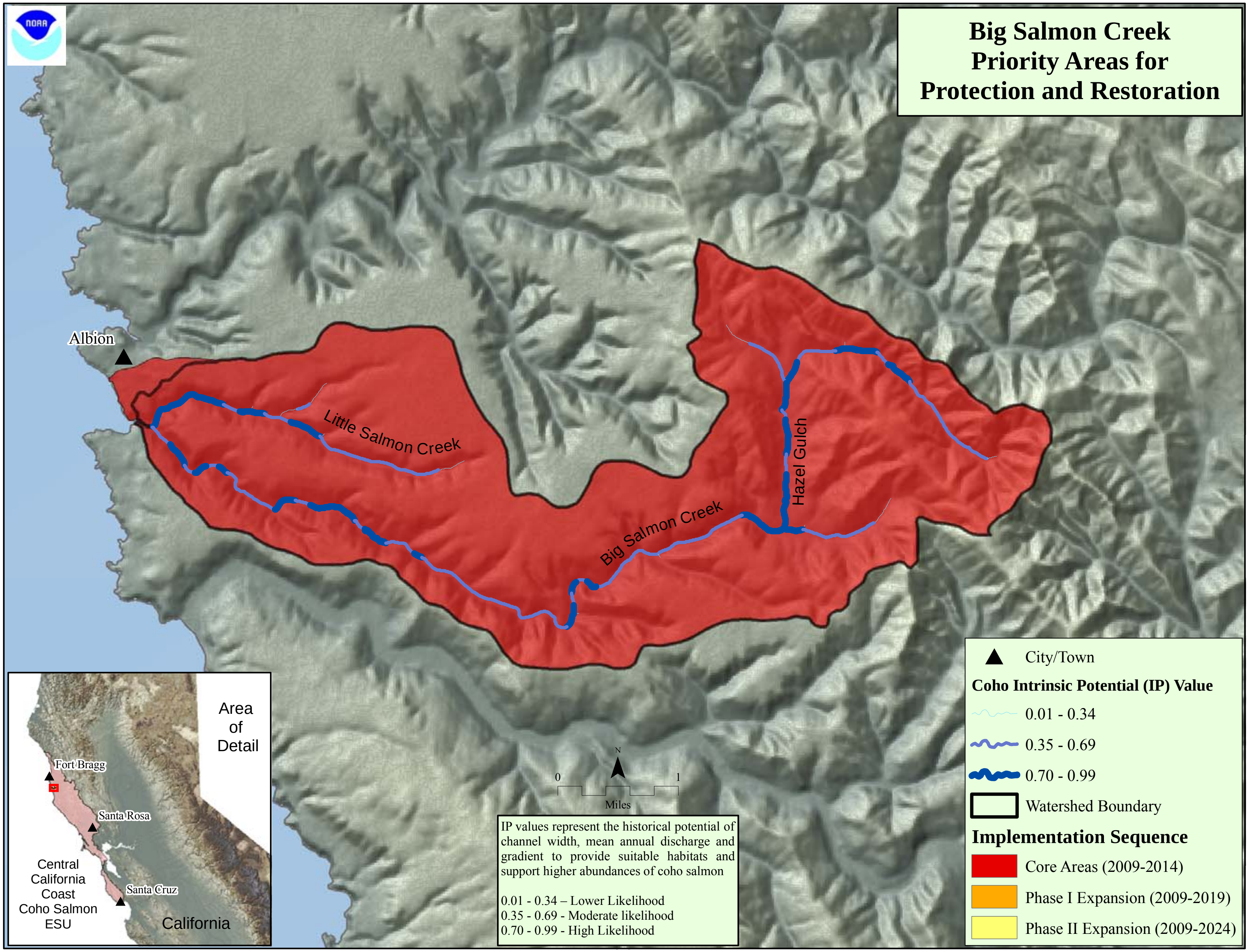
Big Salmon Creek
Photo © Your Name Here, AFFIL

Immediate Needs

√ Identify and address sources of sediment input to streams from roads.
√ Protect existing stream flows.

Recovery Partners

DFG
The Conservation Fund
Hawthorne Timber Company


Big Salmon Creek
Priority Areas for
Protection and Restoration
Albion
Little Salmon Creek
Big Salmon Creek
Hazel Gulch
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Big Salmon Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	<35	Very Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	>90 days	Very Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	100-900 m^2	Fair	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-900 m^2	900-1900 m^2	>1900 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	<35	Very Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	50	Good	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	77%	Good	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	35-50	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	34	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	16%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	34	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Good	Good	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	<35	Very Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0.59/10 IP-km	Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	34	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	38%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.26%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	20.0%	Poor	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	NA	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	33%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	33%	Poor	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	7.5 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	6.1 mi/sq.mi	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	1-20 per IP-km	Fair	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	35-50%	Good	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Big Salmon Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Roads and Railroads	Medium	High	Medium	Medium	Medium	Very High			High
2	Droughts	Medium	Medium	High	Medium	Medium	Medium			High
3	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	Medium	High			High
4	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium			Medium
5	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Recreational Areas and Activities	Medium	Medium	Medium	Medium	Medium	Medium			Medium
7	Storms and Flooding	Medium	Medium	Medium	Medium	Medium	Medium			Medium
8	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Channel Modification	Low	Low	Medium	Medium	Medium	Medium			Medium
11	Mining	Medium	Low	Medium	Low	Low	Medium			Medium
12	Agricultural Practices	Low	-	Medium	Low	Medium	Medium			Medium
13	Disease, Predation, and Competition	Medium	-	Medium	-	Low	-			Medium
14	Livestock Farming and Ranching	-	Low	Low	Low	Low	-			Low
15	Fishing and Collecting	-	-	Low	Low	Low	-			Low
16	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
Threat Status for Targets and Project		High	High	High	High	High	Very High	-	-	Very High

Big Salmon Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
BSC-A-6.1.1.1	Action Step	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).	1	60	CDFG, Conservation Fund, NMFS, Private Landowners	2.50	2.50	2.50	2.50	2.50	150	Cost is a rough estimate to improve instream LWD complexity to viability table targets. Due to the lack of downstream infrastructure in Big Salmon Creek, it is assumed that most of the instream structure will consist of LWD and that most of this structure will be left unanchored. LWD should consist of logs 1.5 to 2 times the bankfull channel width.
BSC-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	3	60	CDFG, Conservation Fund, NMFS PRD						0	Cost will likely be captured within the costs of future restoration designs. Due to the lack of infrastructure in Salmon Creek it is assumed that this recommendation will be used primarily for the purpose of road stabilization. Road stabilization should only occur if the road is an essential transportation corridor and cannot be relocated.
BSC-A-6.2	Objective	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	CDFG, Conservation Fund, Private Landowners						0	Cost expected to be minimal to maintain current conditions.
BSC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
BSC-A-7.1.1	Recovery Action	Riparian Vegetation	Restore and protect riparian vegetation to improve migration and summer/overwintering habitat for coho salmon (DFG 2004).	3	60	CDFG, Conservation Fund, NMFS, Private Landowners						TBD	Cost is likely minimal.
BSC-A-7.1.2	Recovery Action	Riparian Vegetation	Conduct conifer release to promote rapid shade-tree development.	2	60	CalFire, CDFG, Conservation Fund, NMFS, NOAA RC, Private Landowners						TBD	Cost is dependent on area treated and treatment used. Costs may be minimal if this recommendation is incorporated into future timber harvest plans. Cost would likely increase if this recommendation is implemented as a stand-alone project. However, a stand-alone project could more effectively target areas that could directly benefit riparian processes.
BSC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
BSC-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
BSC-A-8.1.1.1	Action Step	Sediment	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	2	2	CDFG, NOAA RC, Private Landowners, Trout Unlimited	25.00	25.00				50	Cost based on consultant development and onsite review of the watershed and development of the plan.
BSC-A-8.1.2	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	3	10	CDFG, Conservation Fund, Mendocino Redwood Company, Private Landowners, RWQCB	1.00	1.00	1.00	1.00	1.00	10	
BSC-A-8.1.2.1	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	3	60	CalFire, California Department of Mines and Geology, CDFG, Conservation Fund, Private Landowners, RWQCB						TBD	Cost for construction is likely low since action will likely be captured in future timber harvest costs. However, costs of ongoing maintenance may be significant depending on magnitude of sediment input, types of structures developed, difficulty of access, etc. The expense of maintenance should be considered an ongoing requirement for all landowners with roads.
BSC-A-8.1.2.2	Action Step	Sediment	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF).	2	60	CDFG, Conservation Fund, NMFS, NOAA RC, Private Landowners						0	Cost of prioritizing restoration actions is expected to be low.

Big Salmon Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BSC-A-8.1.2.3	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	10	California Department of Mines and Geology, CDFG, Conservation Fund, NOAA RC, NRCS, Private Landowners, Trout Unlimited	5.00	5.00	5.00	5.00	5.00	50	Costs based on decommissioning a minimum of 0.5 mile per year ($10k/mile) for a ten year period.
BSC-A-8.1.3	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	5	Conservation Fund, Mendocino Redwood Company, Private Landowners, RWQCB	10.00	10.00	10.00	10.00	10.00	50	Cost based on a subset of roads that represent watershed conditions.
BSC-A-9.1	Objective	Viability	Conduct periodic, standardized spawning surveys to estimate adult abundance in the watershed. Surveys should include all three cohorts.	3	9	CDFG, Conservation Fund, NMFS, Private Landowners	8.89	8.89	8.89	8.89	8.89	80	Cost is difficult to estimate and are dependent on frequency and number of sampling events. It is assumed that only sporadic sampling will occur in the Salmon Creek watershed due to its status as a Dependent watershed, and the overall magnitude of ongoing sampling occurring elsewhere in the Lost Coast Diversity stratum. Cost are estimated from survey methods developed by Gallagher and Gallagher (2005).
BSC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
BSC-A-10.1.1	Recovery Action	Water Quality	Initiate thinning of ceanothus fields adjacent to stream with perennial flow to help release conifers for streamside shade.	3	10	Conservation Fund, Private Landowners						TBD	
BSC-A-10.1.2	Recovery Action	Water Quality	Plant native vegetation to promote streamside shade.	3	60	CDFG, NMFS, Private Landowners, SWRCB						TBD	
BSC-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
BSC-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	2	60	CDFG, NMFS, Private Landowners, SWRCB						TBD	Costs can be highly variable and dependent on location and quantity of water right.
BSC-A-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
BSC-A-15.2.1	Recovery Action	Droughts	DFG, SWRCB, and Conservation Fund, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	3	60	CalFire, CalTrans, CDFG, Conservation Fund, NMFS, NOAA RC, NRCS, Private Landowners						TBD	Cost is expected to be minimal. Most diversions in the Big Salmon watershed for dust control are for timber management actions. Most of these diversion have a 1600 agreement with the Department of Fish and Game and are likely incorporated into existing operations.
BSC-A-15.3	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
BSC-A-15.3.1	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.										
BSC-A-15.3.1.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	1	20	CDFG, NMFS HCD, NMFS OLE						0	Cost of encouraging SWRCB is expected to be low and likely captured through agency staff time.
BSC-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and prevent future conversion of forestlands to agriculture or other land uses.										

Big Salmon Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BSC-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
BSC-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	60	CalFire, CDFG, Mendocino County, NMFS, RWQCB, Trout Unlimited						0	
BSC-A-20.1.1.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	1	60	CalFire, CDFG, Mendocino County, NMFS PRD, Private Landowners, Public						TBD	Cost may be minimal if action is conducted within current regulatory framework.
BSC-A-20.2	Objective	Logging and Wood Harvesting	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches, particularly where large woody debris is found lacking.										
BSC-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Particular focus should be directed to stream reaches in Hazel and Ketty Gulch.	2	10	CDFG, Conservation Fund, RWQCB, Trout Unlimited	4.00	4.00	4.00	4.00	4.00	40	Overall Salmon Creek costs captured in Pool Habitat estimate. However, additional costs may be incurred if the recommendation moves forward as a stand alone project.
BSC-A-20.3	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
BSC-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Minimize sediment-related effects to coho salmon habitat from road building and other soil-disturbing activities.										
BSC-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	60	CDFG, Conservation Fund, Mendocino County, NMFS, NMFS OLE, Private Landowners, Public						TBD	Cost is difficult to determine at this time.
BSC-A-20.3.1.2	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	2	30	CalFire, CDFG, Mendocino County, NMFS						0	Action duration extended due to unknown rate of harvest. Assumed most of watershed will be entered within 30 years. Costs equal 0 because this should be considered a mitigation measure for future harvest activities.
BSC-A-20.3.1.3	Action Step	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	3	60	CalFire, California Department of Mines and Geology, CDFG, Conservation Fund, Mendocino County, Private Landowners, Public, RPFs						0	Cost may be minimal if the action is conducted within the current regulatory framework and the task should be considered a standard business practice.
BSC-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Promote logging practices that minimize erosion and maximize forest diversity and health.										
BSC-A-20.3.2.1	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	3	60	CalFire, California Department of Mines and Geology, CDFG, Mendocino County, NMFS PRD, RPFs, RWQCB						0	Cost may be minimal if action is conducted the within current regulatory framework.
BSC-A-20.3.2.2	Action Step	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.	3	60	CalFire, CDFG, Conservation Fund, Private Landowners, RPFs, RWQCB						0	Cost may be minimal if the action is conducted within the current regulatory framework.
BSC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										

Big Salmon Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
BSC-A-24.1.1	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	3	5	Conservation Fund, Mendocino County Department of Public Works, Private Landowners						TBD	Adoption of existing programs should result in reduced costs.
BSC-A-24.1.2	Recovery Action	Roads and Railroads	Conduct collaborative evaluations of priorities for treatment of CCC coho salmon passage barriers, such as the Fish Passage Forum (DFG 2004).	3	60	CalFire, California Coastal Conservancy, CalTrans, CDFG, Conservation Fund, Mendocino County Department of Public Works, NOAA RC, Private Landowners, RCD						TBD	Similar existing programs could be modified and implemented at minimal cost. Few barriers to passage exist in the Big Salmon Creek watershed, and it is anticipated that they have already been identified.
BSC-A-24.2	Objective	Roads and Railroads	Minimize sediment input from existing road networks into the aquatic environment.										
BSC-A-24.2.1	Recovery Action	Roads and Railroads	Conduct actions that hydrologically disconnect roads.										
BSC-A-24.2.1.1	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	2	30	CalFire, CalTrans, Conservation Fund, Mendocino County Department of Public Works, Private Landowners						0	Cost is expected to be minimal and should be incorporated into ongoing road maintenance activities. Initial focus should be directed toward riparian roads.
BSC-A-24.2.2	Recovery Action	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.	2	10	CalFire, CDFG, Conservation Fund, Mendocino County Department of Public Works, NMFS, Private Landowners	20.00	20.00	20.00	20.00	20.00	200	Cost is dependent on measures taken to reduce road density.
BSC-A-24.2.3	Recovery Action	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, Conservation Fund, Private Landowners						TBD	
BSC-A-24.2.4	Recovery Action	Roads and Railroads	Minimize sediment delivery from roads during the winter period.										
BSC-A-24.2.4.1	Action Step	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized individuals and impacting uses to decrease fine sediment loads.	2	60	CalFire, CDFG, Conservation Fund, Mendocino County Department of Public Works, NMFS OLE, Private Landowners						0	Costs are not estimated because this action should be considered an obligation of the landowner.
BSC-A-24.2.5	Recovery Action	Roads and Railroads	Use best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, California Department of Mines and Geology, Conservation Fund, Mendocino County Department of Public Works, Private Landowners, RPFs, RWQCB, Trout Unlimited						0	

CASPAR CREEK

Caspar Creek

Recovery Target: 435 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvesting
- Roads and Railroads

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Caspar Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve gravel quality by reducing sediment inputs
- Reduce sources of sediment
- Improve pool complexity and increase number of pools
- Increase the frequency of off channel habitat and floodplain connectivity
- Reduce the amount of roads in and near the riparian zone and throughout the watershed

We Need Your Photo Here

Caspar Creek
Photo © Your Name Here, AFFIL

Advancing recovery of coho

salmon in Caspar Creek requires these priority **recovery actions:**

- Restoration projects that upgrade or decommission high risk roads in Core Area.
- Install or enhance existing woody debris, boulders, and other features to increase stream complexity and improve pool frequency and depth.
- Implement projects that improve habitat complexity.
- Implement the Jackson Demonstration State Forest Road Management Plan.
- Establish a moratorium on new road construction in sensitive areas until a watershed road management plan is created and implemented.
- Identify incentives to restore high priority sites as determined by watershed analysis, DFG, or the Jackson Demonstration State Forest EIR.

. . . **throughout** the Caspar Creek watershed.

Conservation Highlights

- Watershed restoration and research actions by the California State Parks, Mendocino Land Trust, JDSF, and US Forest Service Pacific Southwest Research Station.
- Coho salmon life cycle station operated by DFG.

We Need Your Photo Here

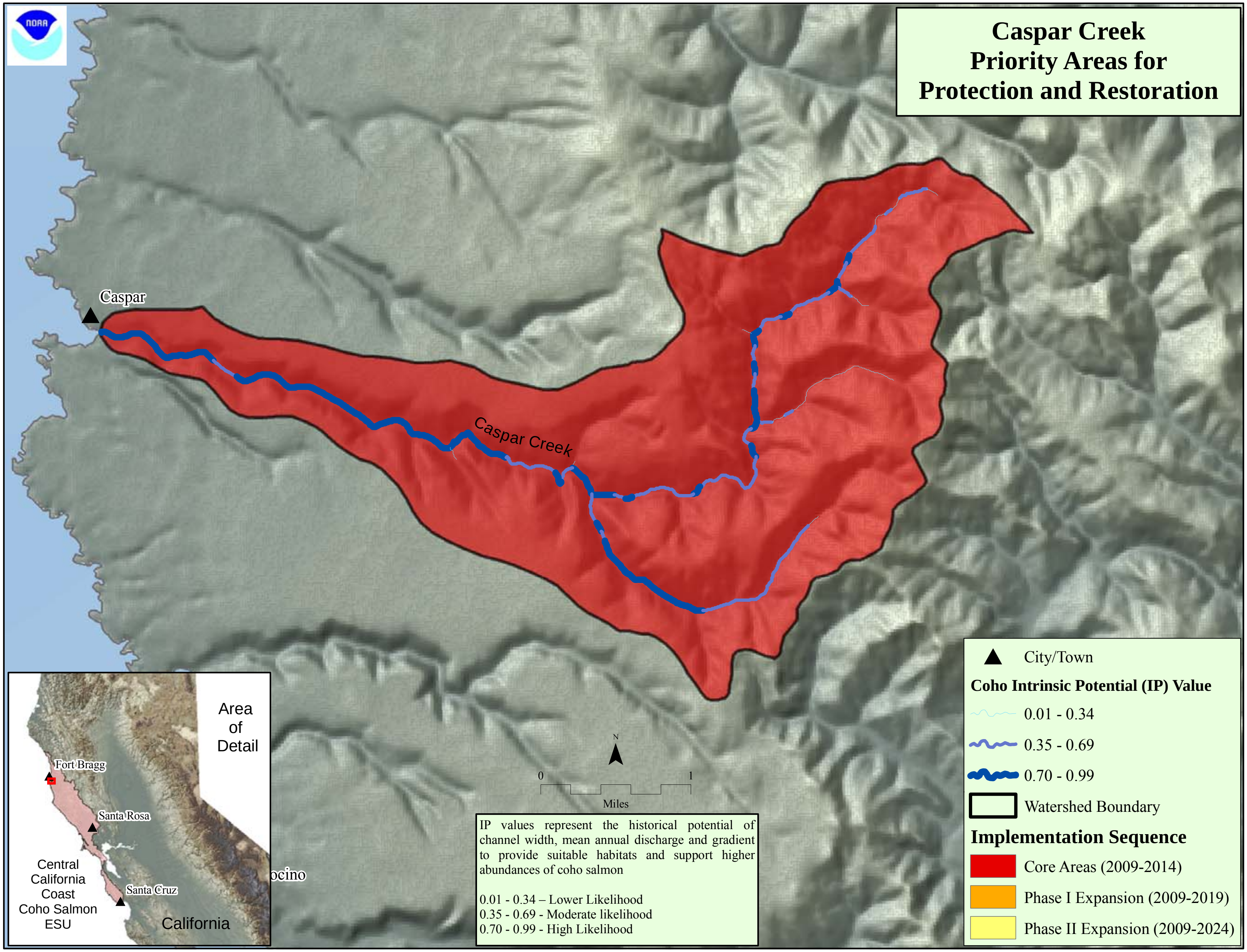
Caspar Creek
Photo © Your Name Here, AFFIL

Immediate Needs

√ Continue collaborative watershed restoration and research actions
√ Implement the JDSF Road Management Plan
√ Continue efforts to place large woody debris structures in streams throughout the watershed
√ Control invasive plant species
√ Protect the Sitka spruce as source of LWD
√ Continue ongoing fish sampling efforts

Recovery Partners:

NMFS
DFG
California State Parks
Mendocino Land Trust
Jackson Demonstration State Forest
USFS Pacific Southwest Research Station


Caspar Creek
Priority Areas for
Protection and Restoration
Caspar
Caspar Creek
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
ocino
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Caspar Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	33	Very Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	5687 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-600 m^2	600-1300 m^2	>1300 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	<35	Very Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	<36	Very Good	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	39%	Poor	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	35-50	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	52.3	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	8%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Good	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	52.3	Fair	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Good	Good	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	Very Good	Very Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0/10 IP-km	Very Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	52.3	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	55%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.22%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	2%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	13.3/ 100 m	Very Good	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	NA	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	56%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	96%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	5.1mi./sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	5.8me./sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	1-20 per IP-km	Fair	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	0.2-0.5 fish/m^2	Fair	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	>50%	Very Good	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Caspar Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Roads and Railroads	Medium	High	Medium	Medium	Medium	Very High			High
2	Logging and Wood Harvesting	Medium	High	Medium	Medium	Medium	High			High
3	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
4	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
5	Climate Change	Medium	Medium	Medium	Medium	Medium	Low			Medium
6	Droughts	Medium	Medium	Medium	Medium	Medium	Low			Medium
7	Storms and Flooding	Low	Low	Medium	Medium	Medium	Medium			Medium
8	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium				Medium
9	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	-			Medium
10	Channel Modification	Medium	Low	Low	Medium	Low	Low			Medium
11	Agricultural Practices	Low	Low	Low	Medium	Low	-			Low
12	Livestock Farming and Ranching	Low	Low	Low	Medium	Low	-			Low
13	Mining	Low	Low	Low	Medium	Low	-			Low
14	Hatcheries and Aquaculture	Low	-	-	Low	Low	Low			Low
15	Disease, Predation, and Competition	Low	-	Low	-	Low	-			Low
16	Fishing and Collecting	-	-	Low	Low	Low	-			Low
Threat Status for Targets and Project		Medium	High	Medium	High	High	High	-	-	High

Caspar Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
CaC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
CaC-A-2.1.1	Recovery Action	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	3	5	California Coastal Conservancy, Campbell Timberland Management	8.00	8.00	8.00	8.00	8.00	40	This may be a GIS exercise with ground truthing. Available information exists from past habitat typing that may streamline this analysis and further reduce the overall cost.
CaC-A-2.1.2	Recovery Action	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	3	30	California Coastal Conservancy, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NOAA RC, Private Landowners						TBD	Increased LWD frequencies may provide the winter habitat targeted by this action.
CaC-A-2.1.3	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2									
CaC-A-2.1.3.1	Action Step	Floodplain	Enhance and restore estuary function by improving complex habitat features.	2	20	California Coastal Conservancy, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Private Landowners						TBD	Cost will depend on number and type of project implemented.
CaC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
CaC-A-6.1.1	Recovery Action	Pool Habitat	Install or enhance existing LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004). Work with Jackson Demonstration State Forest and USFS staff to implement projects that improve habitat complexity.										
CaC-A-6.1.1.1	Action Step	Pool Habitat	Install properly sized large woody debris to appropriate viability table targets.	2	60	CDFG, NMFS						TBD	promoting restoration actions is not expected to entail high costs.
CaC-A-6.1.1.2	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	30	Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NOAA RC, Private Landowners						TBD	Cost is dependent on the number, location and type of restoration action.
CaC-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.	2	10	CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners	20.00	20.00	20.00	20.00	20.00	200	Estimate of 20k per year to assess coho habitat.
CaC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
CaC-A-8.1.1	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels. Restoration projects that upgrade or decommission high risk roads in Core CCC coho salmon areas should be considered an extremely high priority for funding (e.g., PCSRF).										

Caspar Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
CaC-A-8.1.1.1	Action Step	Sediment	Implement the Jackson Demonstration State Forest Road Management Plan.	1	5	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest						0	The cost of implementing the plan will likely be low, since the plan already exists and costs will be absorbed into existing management activities.
CaC-A-8.1.1.2	Action Step	Sediment	Provide incentives to restore high priority sites as determined by watershed analysis, DFG, or the Jackson Demonstration State Forest EIR.	1	2	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Cost is difficult to estimate at this time.
CaC-A-8.1.1.3	Action Step	Sediment	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF).	1	5	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						TBD	TBD- difficult to estimate cost because assessments for the magnitude of the problem were not available.
CaC-A-8.1.2	Recovery Action	Sediment	Implement actions that minimize sediment delivery from road surfaces during the winter period.										
CaC-A-8.1.2.1	Action Step	Sediment	Close unauthorized trails and conduct appropriate decommissioning practices. Hydrologically disconnect trails from associated waterways.	2	5	CalFire, CDFG, Mendocino County, NMFS, RWQCB						TBD	Cost will likely be low since work will likely be absorbed by agency personnel.
CaC-A-8.1.2.2	Action Step	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	10	Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Cost is difficult to estimate at this time.
CaC-A-8.1.2.3	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	3	60	Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Much of the watershed has been habitat typed. New habitat assessment methods may have future (unknown) costs.
CaC-A-9.1	Objective	Viability	Monitor population status for response to recovery actions.										
CaC-A-9.1.1	Recovery Action	Viability	Continue ongoing juvenile sampling efforts in the watershed. Establish consistent reporting methods to ensure ESU-wide consistency.	1	60	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						TBD	
CaC-A-9.1.2	Recovery Action	Viability	Continue funding of lifecycle station operated by DFG.	1	60	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						TBD	
CaC-A-20.1	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										

Caspar Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
CaC-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Minimize sediment-related effects to coho salmon habitat arising from road building and other land-disturbing activities.										
CaC-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	3	60	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Cost of future sampling efforts is dependent on the number, location and frequency of sampling efforts.
CaC-A-20.1.1.2	Action Step	Logging and Wood Harvesting	Implement the Jackson Demonstration State Forest Road Management Plan.	3	60	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Cost of future sampling efforts is dependent on the number, location and frequency of sampling efforts.
CaC-A-20.1.1.3	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	20	Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Costs will vary with THP activity and additional maintenance needed.
CaC-A-20.1.1.4	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	1	20	Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners	100	100	100	100	100	2,000	Estimate to decommission riparian roads.
CaC-A-20.1.1.5	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	3	60	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Cost of additional review and loss of merchantable trees is unknown.
CaC-A-20.2	Objective	Logging and Wood Harvesting	Manage timberlands to establish a diverse forest environment exhibiting properly functioning instream habitat, and implement restoration actions where degraded habitat is limiting coho salmon production.										
CaC-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.	2	60	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						tbd	the cost of this action may be minimal depending on the land-use philosophy of landowner.
CaC-A-20.2.2	Recovery Action	Logging and Wood Harvesting	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	60	Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						tbd	minimal costs
CaC-A-20.2.3	Recovery Action	Logging and Wood Harvesting	Encourage Jackson Demonstration State Forest and USFS to implement restoration projects as part of their ongoing practices in priority stream reaches and where LWD is found lacking.	2	10	CDFG, Jackson Demonstration State Forest, NMFS	20.00	20.00	20.00	20.00	20.00	200	Cost based on 4 projects of 50k.

Caspar Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
CaC-A-20.3	Objective	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency for operations within Core, Phase I and Phase II CCC coho salmon areas.										
CaC-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	NMFS	70.00	70.00	70.00	70.00	70.00	700	
CaC-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Provide information to BOF regarding CCC coho salmon priorities and recommend upgrading relevant forest practices.	2	4	CalFire, NMFS	7.50	7.50	7.50	7.50		30	cost is expected to be minimal.
CaC-A-20.4	Objective	Logging and Wood Harvesting	The priorities in this recovery plan should serve as a guide for independent Forest Certification.										
CaC-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Investigate opportunities to programmatically permit the forest certification program to authorize incidental take for landowners through Section 10(a)(1)(B).	2	4	CalFire, NMFS	7.50	7.50	7.50	7.50		30	cost is expected to be minimal.
CaC-A-20.5	Objective	Logging and Wood Harvesting	Monitor coho salmon population and habitat status to determine if restoration actions and timber management modifications are having the desired effect.	2									
CaC-A-20.5.1	Recovery Action	Logging and Wood Harvesting	Continue the activities of the North Coast Watershed Assessment /Coastal Watershed Program.	2	4	CalFire, NMFS	7.50	7.50	7.50	7.50		30	cost is expected to be minimal.
CaC-A-20.5.2	Recovery Action	Logging and Wood Harvesting	Develop a framework similar to Washington State that establishes a scientific framework for monitoring the effectiveness of practices in meeting watershed process goals and a decision-making process that is adaptive to the new information.	2	60	CalFire, CDFG, Jackson Demonstration State Forest, Private Landowners						TBD	The cost of continued education for Jackson State Forest staff is expected to be minimal.
CaC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
CaC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Jackson Demonstration State Forest staff and private logging contractors regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	60	CalFire, CDFG, Jackson Demonstration State Forest, Private Landowners						TBD	The cost of continued education for Jackson State Forest staff is expected to be minimal.
CaC-A-24.1.2	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	3	5	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Mendocino County Department of Public Works, NMFS, Private Landowners						tbd	cost is unknown, but should be <$50k.
CaC-A-24.2	Objective	Roads and Railroads	Minimize sediment input from existing road networks into the aquatic environment.										
CaC-A-24.2.1	Recovery Action	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
CaC-A-24.2.1.1	Action Step	Roads and Railroads	Install sediment traps for pretreatment, and a modified culvert system that can act as an efficient detention system.	2	60	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						tbd	

Caspar Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
CaC-A-24.2.1.2	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	3	60	Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Most of the watershed has been habitat typed. New habitat assessment methods may have future (unknown) costs.
CaC-A-24.2.1.3	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	2	60	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Mendocino County Department of Public Works, Private Landowners						0	These areas are likely already established. Efforts should be made to coordinate storage with all landowners in the basin to minimize costs and impacts.
CaC-A-24.2.2	Recovery Action	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
CaC-A-24.2.3	Recovery Action	Roads and Railroads	Design and implement a program of BMPs for road maintenance on private roads similar to the proposed program for public roads.	3	5	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	The cost of developing the plan is difficult to precisely estimate, but may be less than $100k.
CaC-A-24.2.4	Recovery Action	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, California Coastal Conservancy, CalTrans, Campbell Timberland Management, CDFG, FishNet 4C, Jackson Demonstration State Forest, Mendocino County Department of Public Works, NOAA RC, Private Landowners, RCD						TBD	Similar existing programs could be modified and implemented at minimal cost.
CaC-A-24.2.5	Recovery Action	Roads and Railroads	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF). Where no Core areas are designated, apply this action to Phase I areas.	2	5	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners	600	600	600	600	600	3,000	TBD- difficult to estimate cost because assessments for the magnitude of the problem were not available. Additionally, many roads in Core watersheds have been addressed - often through the timber harvest process - and these costs should be considered an ongoing operation expense.
CaC-A-24.2.6	Recovery Action	Roads and Railroads	Minimize sediment delivery from roads during the winter period.										
CaC-A-24.2.6.1	Action Step	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized individuals and impacting uses to decrease fine sediment loads.	1	60	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners, Public						0	

Caspar Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
CaC-A-24.2.6.2	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	3	60	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, NMFS, Private Landowners						TBD	Cost is difficult to estimate due to the uncertainty in developing and implementing the program.
CaC-A-24.2.7	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						TBD	
CaC-A-24.2.8	Recovery Action	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	1	20	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						TBD	Additional information is required to estimate cost of culvert upgrades.
CaC-A-24.2.9	Recovery Action	Roads and Railroads	Reduce sediment sources from road networks and other actions that deliver sediment to stream channels through improved or new laws and policy.	2	20	California Department of Mines and Geology, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Private Landowners						TBD	Need additional analysis to make accurate estimate of remediating sediment from road network.
CaC-A-24.2.9.1	Action Step	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	1	60	CalFire, California Department of Mines and Geology, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						TBD	Costs likely to be incurred as part of timber harvest operations. However, in some circumstances this may be a stand alone cost.
CaC-A-24.3	Objective	Roads and Railroads	Ensure all existing and new road crossings allow upstream and downstream passage for coho salmon.										
CaC-A-24.3.1	Recovery Action	Roads and Railroads	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	2	20	Mendocino County, NMFS						0	Existing authorities of permitting agencies facilitate implementation at minimal costs.
CaC-A-24.3.2	Recovery Action	Roads and Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	60	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Mendocino County Department of Public Works, Private Landowners						0	

Cottaneva Creek

Cottaneva Creek

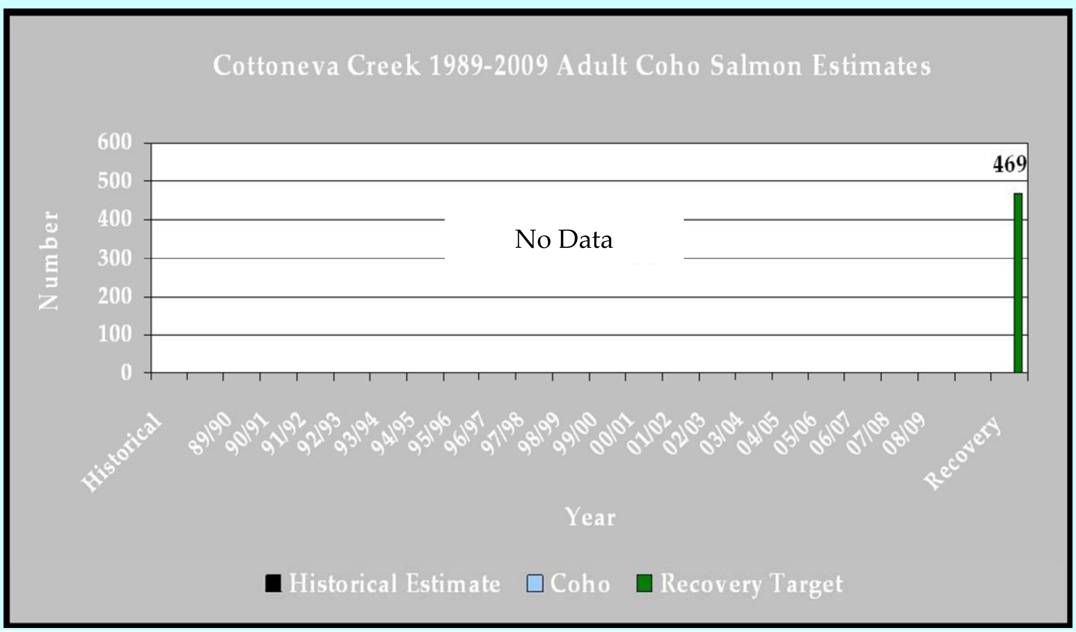
Dependent Population
13.8 IP-Km of potential coho salmon habitat
Coho salmon and steelhead present

Cottaneva Creek drains about 17 square miles of western Mendocino County and enters the Pacific Ocean about 25 miles north of the town of Fort Bragg. About 73 percent of the Cottaneva Creek watershed is redwood forest and about 21 percent is either montane or riparian hardwood forest. The entire Cottaneva Creek watershed has highly erodible soils. The entire watershed is in private ownership. The dominant land use within the watershed is forestry. The first sawmill at Cottaneva Creek started in 1877. Various timber harvesting operations occurred in Cottaneva Creek over subsequent years. The Mendocino Redwood Company (MRC), purchased approximately 75 percent of the watershed in 1998. MRC currently manages the land for sustained timber harvest. Recreational use of the watershed includes fishing, hunting, and mushroom gathering. Housing development within the watershed is uncommon – only 15 houses are present.

Cottaneva Creek estuary and lower watershed.
Copyright (C) 2002-2009 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org.

The Watershed at a Glance

Spawning Quantity & Quality:	**FAIR to GOOD**
Summer Water Temperatures:	**FAIR**
Depth & Shelter of Pools:	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**GOOD**
Off channel/Floodplain Quality:	**POOR**
Estuary Function:	**GOOD**



Cottaneva Creek

Recovery Target: **469 Adult Coho Salmon**

Increasing the survival of coho salmon requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvesting
- Roads and Railroads

Preventing the extinction of coho salmon means **restoring** many key habitat attributes within the Cottaneva Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Reduce sources of sediment
- Improve pool complexity and increase number of pools
- Increase large wood in streams
- Increase the frequency of off channel habitat and floodplain connectivity
- Reduce the amount of roads in and near the riparian zone and throughout the watershed

Cottaneva Creek

Photo © Mendocino Redwood Company

Advancing recovery of coho salmon in Cottaneva Creek requires these priority **recovery actions:**

- Install large wood, boulders, and other structures to increase stream complexity and improve pool frequency and depth.
- Promote restoration projects designed to create or restore alcove and backchannel habitats, including projects that will provide functioning habitat at flows intermediate between winter base flow and flood stage.
- Decommission riparian road systems and/or upgrade roads and skid trails that deliver sediment to streams.
- Provide for watershed processes by promoting long term sustainable forestry practices that support coho salmon
- Treat high priority roads, culverts, road slides and landings to reduce sediment input to streams.

. . . **throughout** the Cottaneva Creek watershed.

Conservation Highlights

We Need Your Photo Here

Cottaneva Creek

Photo © Your Name Here, AFFIL

Immediate Needs

√ Implement restoration actions described in the Mendocino Redwood Company watershed analysis.

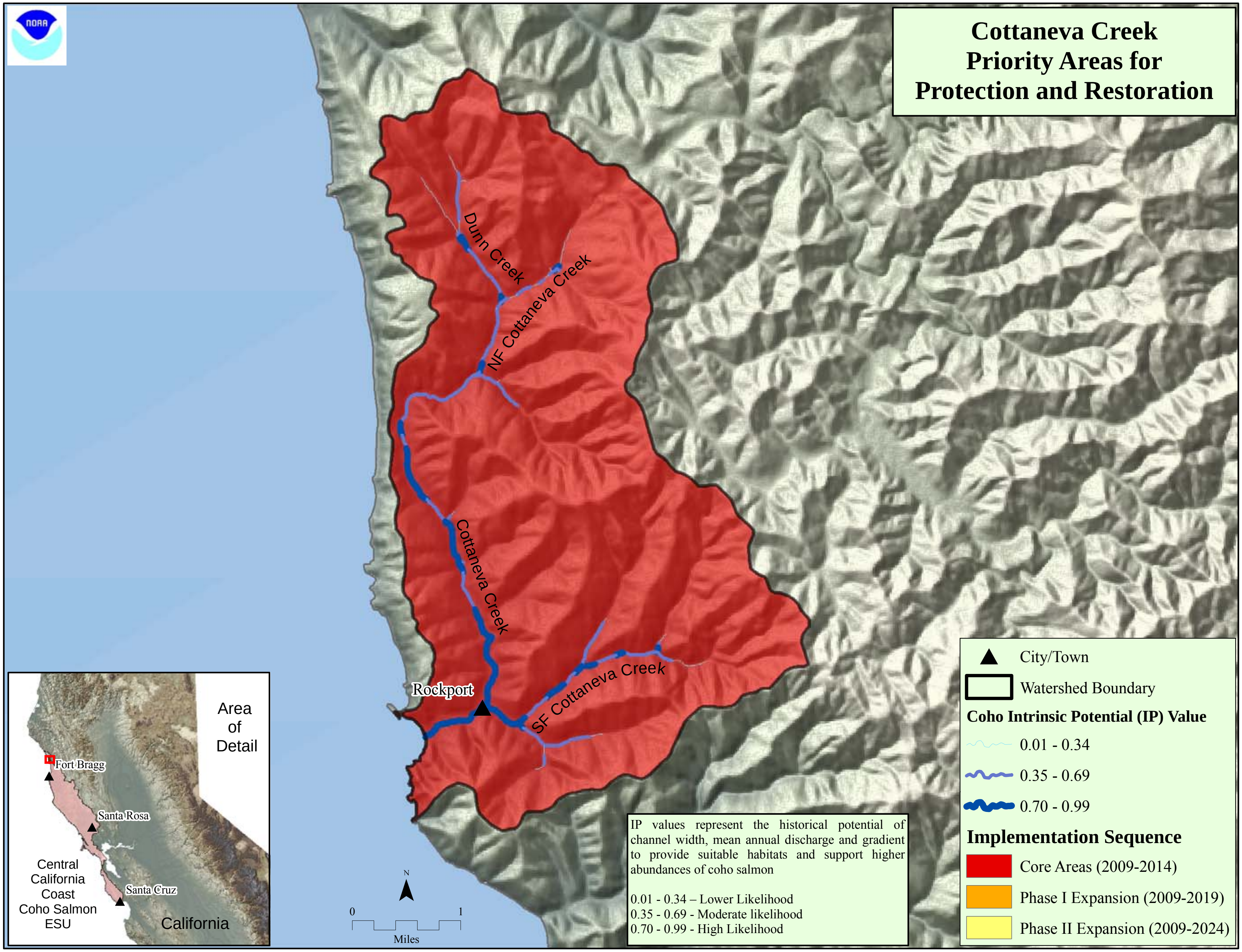
√ Incorporate fish sensitive methods into maintenance of Highway 1, including improvements to the Dunn Creek culvert under Highway 1.

√ Describe the current condition of the estuary and identify restoration actions.

√ Finalize MRC Habitat Conservation Plan.

Recovery Partners

NMFS
DFG
Trout Unlimited
Mendocino Redwood Company
CalTrans



Cottaneva Creek
Priority Areas for
Protection and Restoration
Dunn Creek
NF Cottaneva Creek
Cottaneva Creek
SF Cottaneva Creek
Rockport
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Watershed Boundary
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Cottaneva Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	33	Very Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	92%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	17055 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-800 m^2	800-1600 m^2	>1600 m^2
NMFS	Best Prof. judgment	5-10%	Fair	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	Very Good	Very Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	33	Very Good	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	63%	Good	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	Good	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	44.2	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	4%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	43	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Good	Good	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	Very Good	Very Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0/10 IP-km	Very Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	44.2	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	58%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.18%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	28%	Fair	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	0.7/100m%	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	NA	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	57%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	94%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	6.9mi/sq. mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	6.8.i/sq/mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	0.2-0.5 fish/m^2	Fair	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	20-34%	Fair	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Cottaneva Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Roads and Railroads	Medium	Medium	Medium	Medium	Medium	Very High			High
2	Logging and Wood Harvesting	Medium	Low	High	Medium	Medium	High			High
3	Droughts	Medium	Low	Medium	Medium	High	Medium			Medium
4	Storms and Flooding	Medium	Low	Medium	Medium	Medium	High			Medium
5	Channel Modification	Medium	Low	Medium	Medium	Medium	Medium			Medium
6	Climate Change	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Mining	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
12	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Low			Medium
13	Agricultural Practices	Medium	Low	Medium	Medium	Medium	-			Medium
14	Disease, Predation, and Competition	Medium	-	Low	-	Medium	-			Medium
15	Fishing and Collecting	Medium	-	Low	Low	Low	-			Low
16	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
Threat Status for Targets and Project		High	Medium	High	High	High	Very High	-	-	Very High

Cottaneva Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
CoC-A-6.1.3	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	1	60	CDFG, Mendocino Redwood Company, NMFS PRD, NOAA RC, Private Landowners						TBD	Can not determine cost at this time.
CoC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
CoC-A-8.1.1	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels. Restoration projects that upgrade or decommission high risk roads in Core CCC coho salmon areas should be considered an extremely high priority for funding (e.g., PCSRF).										
CoC-A-8.1.1.1	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1	60	CalFire, CDFG, Mendocino Redwood Company, NOAA RC, Private Landowners, RWQCB						TBD	Costs may vary widely depending on number of riparian roads and the magnitude of the problem associated with the roads.
CoC-A-8.1.1.2	Action Step	Sediment	Treat high priority roads, culverts, road slides and landings that are identified in the 2005 MRC Cottaneva Creek Watershed Analysis. Focus on 88 culverts determined to be high priority by MRC.	1	5	CDFG, Mendocino Redwood Company, NOAA RC	60.00	60.00	60.00	60.00	60.00	300	Cost is based on a rough estimate of $3000 per culvert.
CoC-A-8.1.1.3	Action Step	Sediment	Provide incentives to restore high priority sites as determined by watershed analysis, DFG, or CalFire.	2	30	CalFire, CDFG, Mendocino Redwood Company, NOAA RC, Private Landowners						TBD	Costs are difficult to estimate at this time.
CoC-A-8.1.1.4	Action Step	Sediment	Acquire funding for assessment and implementation of sediment reduction measures associated with the 2008 Middle Fire in the Cottaneva Creek watershed.	2	20	CalFire, CDFG, Mendocino Redwood Company, NOAA RC, Private Landowners						TBD	Costs are difficult to estimate at this time.
CoC-A-8.1.1.5	Action Step	Sediment	Roads or landings shall be maintained at the design standards that lower risk of mass wasting sediment delivery.	2	60	CalFire, CDFG, Mendocino Redwood Company, Private Landowners						0	The cost associated with this strategy is likely low.
CoC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
CoC-A-9.1.1	Recovery Action	Viability	Measure or estimate response of key habitat attributes to recovery efforts across the watershed.										
CoC-A-9.1.1.1	Action Step	Viability	Use standardized watershed assessments (Coastal Monitoring Plan) within sub-watersheds not previously evaluated in MRC's 2005 effort.	3	12	CDFG, Mendocino Redwood Company, NMFS, Private Consultants, Private Landowners						TBD	12 years based on frequency of conducting assessments every 5 years during a 60 year plan period.
CoC-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
CoC-A-9.1.2.1	Action Step	Viability	Use Coastal Monitoring Plan methods to determine the population status of adult and smolt salmonids in the watershed and its tributaries.	3	60	CDFG, Mendocino Redwood Company, NMFS, NOAA SWFSC, Private Landowners						TBD	60 years or until population targets have been met.
CoC-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
CoC-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	3	60	CalFire, CDFG, NMFS						0	Cost expected to be minimal. Action should take place at state level.

Cottaneva Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
CoC-A-20.2	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
CoC-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Address sources from timber harvesting operations.										
CoC-A-20.2.1.1	Action Step	Logging and Wood Harvesting	Ensure that post harvest THP road maintenance and BMPs are implemented.	2	60	CalFire, CDFG, Private Landowners						TBD	Need additional information for monitoring and upgrade costs to estimate total cost of implementing this action.
CoC-A-20.2.2	Recovery Action	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.	3	60	CalFire, CDFG, Mendocino Redwood Company, NMFS PRD						TBD	Costs to implement this action may be minimal if MRC HCP is completed.
CoC-A-20.2.3	Recovery Action	Logging and Wood Harvesting	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches, particularly where large woody debris is found lacking.	2	60	CDFG, Mendocino Redwood Company, NOAA RC, Private Landowners						TBD	Cost can not be determined at this time.
CoC-A-20.3	Objective	Logging and Wood Harvesting	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of CCC coho salmon.										
CoC-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Consider the development of a Watershed Database (similar to the DFG Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.	3	10	CalFire, CDFG, NMFS						0	Cost is estimated for all watersheds in Ten Mile strategies. $300K for ten years.
CoC-A-20.4	Objective	Logging and Wood Harvesting	Provide information to BOF regarding CCC coho salmon priorities and recommend upgrading relevant forest practices.	2	2	NMFS HCD, NMFS PRD	25.00	25.00				50	Cost based on NMFS staff time over a two year period. This cost would cover all CCC focus watersheds.
CoC-A-20.5	Objective	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within Core, Phase I and Phase II CCC coho salmon areas.	2	60	CDFG, Mendocino Redwood Company, NOAA RC, Private Landowners						TBD	Cost can not be determined at this time.
CoC-A-20.5.1	Recovery Action	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	CalFire, NMFS, NMFS OLE	50.00	50.00	50.00	50.00	50.00	500	Cost estimate only considers NMFS staff time.
CoC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
CoC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County, and MRC road engineers and maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	60	CalFire, CalTrans, CDFG, Jackson Demonstration State Forest, NMFS, Private Consultants, Private Landowners						TBD	Cost is included in other watersheds.
CoC-A-24.1.2	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	10	CalFire, FishNet 4C, NOAA RC, Private Landowners, RWQCB	5.00	5.00	5.00	5.00	5.00	50	Cost includes only estimated portion that would cover Cottaneva Creek watershed.
CoC-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas.										
CoC-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004). See MRC watershed analysis for segments identified for decommissioning.										

Cottaneva Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
CoC-A-24.2.1.1	Action Step	Roads and Railroads	Three road segments in Cottaneva Creek have been identified as potential candidates for decommissioning. These segments include roads 47-CC (South Fork Cottaneva near Kimball Creek), 47- PH 005 (south of Honky Tonk picnic area) and 47-G4 (Middle Fork Cottaneva). A detailed field evaluation of these segments will be required in order to determine if decommissioning is appropriate.	3	12	CDFG, Mendocino Redwood Company, NMFS, Private Consultants, Private Landowners						TBD	12 years based on frequency of conducting assessments every 5 years during a 60 year plan period.
CoC-A-24.3	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
CoC-A-24.3.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
CoC-A-24.3.1.1	Action Step	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	3	10	Private Landowners						0	Lower priority and cost has been assigned because MRC is the major landowner and has conducted watershed analysis.
CoC-A-24.3.2	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	2	10	CalFire, FishNet 4C, NOAA RC, Private Landowners, RWQCB	5.00	5.00	5.00	5.00	5.00	50	Cost includes only estimated portion that would cover Cottaneva Creek watershed.
CoC-A-24.3.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	2	60	Private Landowners, RWQCB						TBD	This action is part of ongoing road maintenance. Some additional cost may be expected from increased inspections and resulting maintenance costs.
CoC-A-24.4	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels.										
CoC-A-24.4.1	Recovery Action	Roads and Railroads	Minimize new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	60	CalFire, CalTrans, CDFG, Mendocino County Department of Public Works, NOAA RC, Private Landowners, RWQCB						TBD	Cost of avoiding these sensitive areas will require further analysis.
CoC-A-24.4.2	Recovery Action	Roads and Railroads	Implement high and medium priority sediment reduction actions identified in the Mendocino Redwood Company's 2005 watershed analysis. Conduct a similar sediment reduction plan in the Dunn Creek subbasin.	1	10	Mendocino Redwood Company, NOAA RC, Trout Unlimited						TBD	Much of the cost is accounted for in other actions or is yet to be determined.
CoC-A-24.4.3	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	2	60	Mendocino Redwood Company, NOAA RC, Private Landowners						TBD	Need estimates from landowners within this basin.

GARCIA RIVER

Garcia River

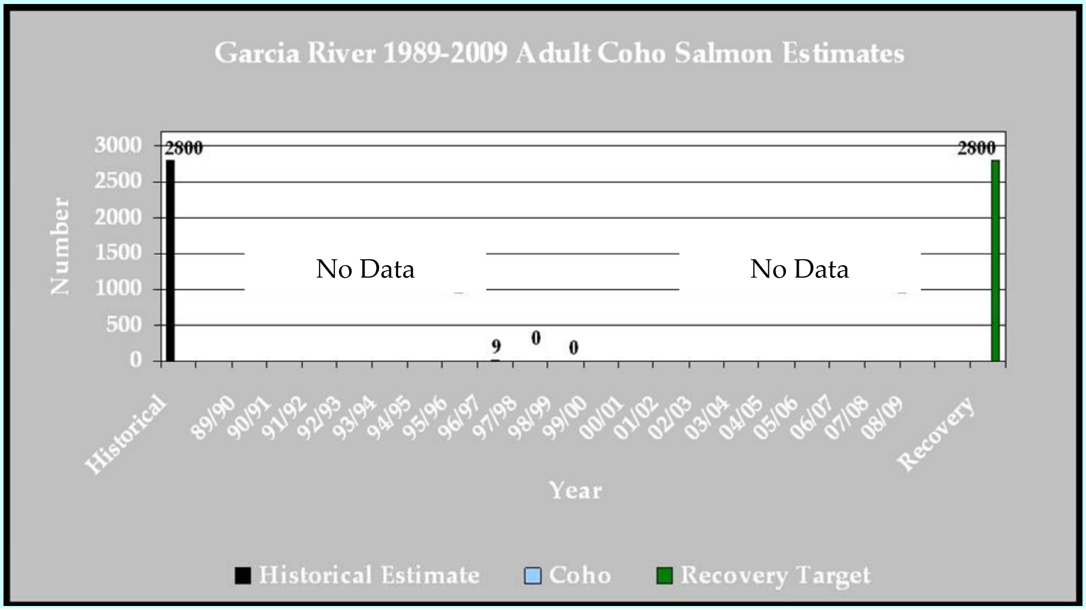
Independent Population
76.0 IP-Km of potential coho salmon habitat
Coho salmon, Chinook salmon, and steelhead present

Garcia River drains about 114 square miles of western Mendocino County, and enters the Pacific Ocean about five miles north of Point Arena. About 51 percent of the Garcia River watershed is redwood coniferous forest, about 15 percent is Douglas-fir forest, and about 18 percent of the watershed area is montane hardwood forest. Approximately 57 percent of the watershed has intermediate susceptibility to soil erosion and the remaining 43 percent has high susceptibility to erosion. The EPA determined the Garcia River as having impaired water quality, and that sedimentation was impairing salmonids and their habitat. The EPA established a TMDL for the watershed in 2002. Most of the Garcia River watershed is privately owned; less than one percent of the watershed is either state park land or federal forest. The dominant land use within the Garcia River watershed is forestry, though some lands are used for agriculture and gravel mining. Logging in the Garcia River watershed began in the late 1800s; several rounds of harvest of second growth timber have occurred; approximately 52 percent of the basin was harvested between 1987 and 1997. Within the past 10 years, about 20 percent of the Garcia River watershed has been under a timber harvest plan. Housing development within the Garcia River watershed is moderate; approximately 380 housing units are present in the watershed. There are no dams within the watershed that impede or block salmon migration, though there are at least 34 partial barriers to salmon migration caused by diversions, road crossings, and natural barriers. Impassable barriers block salmonids from less than 10 percent of the watershed.

Garcia River.
Photo provided by KRIS Information System, and is used with permission

The Watershed at a Glance

Spawning Quantity & Quality:	**FAIR to VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools:	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**FAIR**
Off channel/Floodplain Quality:	**POOR**
Estuary Function:	**FAIR**



Garcia River

Recovery Target: 2,800 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvesting
- Roads and Railroads
- Agriculture
- Droughts

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Garcia River watershed that are in poor condition. The highest priorities for restoration are to:

- Increase pool habitat complexity and frequency of pools
- Increase the frequency of off channel habitat
- Increase the frequency of large woody debris in streams
- Increase riparian shade to cool streams
- Reduce road density in riparian areas and across the watershed.

We need your photo here.

Garcia River
Photo © Your Name Here, AFFIL

Advancing recovery of coho

salmon in Garcia River requires these priority **recovery actions:**

- Reestablish connectivity of lower North Fork Garcia River to the main stem.
- Install or enhance existing LWD, boulders, and other features to increase stream complexity and improve pool frequency and depth. Implement projects that improve habitat complexity.
- Undertake restoration projects that upgrade or decommission high risk roads throughout the core areas.
- Maintain the following tributaries to provide coldwater input to the Garcia River mainstem: Hathaway, North Fork, Rolling Brook, Mill Creek (lower Garcia River), South Fork, Signal, Mill Creek (upper Garcia River).
- . . . in these **core areas:** North Fork Garcia River, South Fork Garcia River, Signal Creek, and Inman Creek planning watersheds.

Conservation Highlights

- The Conservation Fund (TCF) and The Nature Conservancy (TNC) purchased ~ 24,000 acres of the Garcia River watershed, and will manage the property for sustainable forestry.
- Trout Unlimited (TU), MRC, TCF, Mendocino County Fish and Wildlife Advisory Board, and TNC have undertaken various stream restoration actions.
- Established Salmonid Restoration Federation Field School

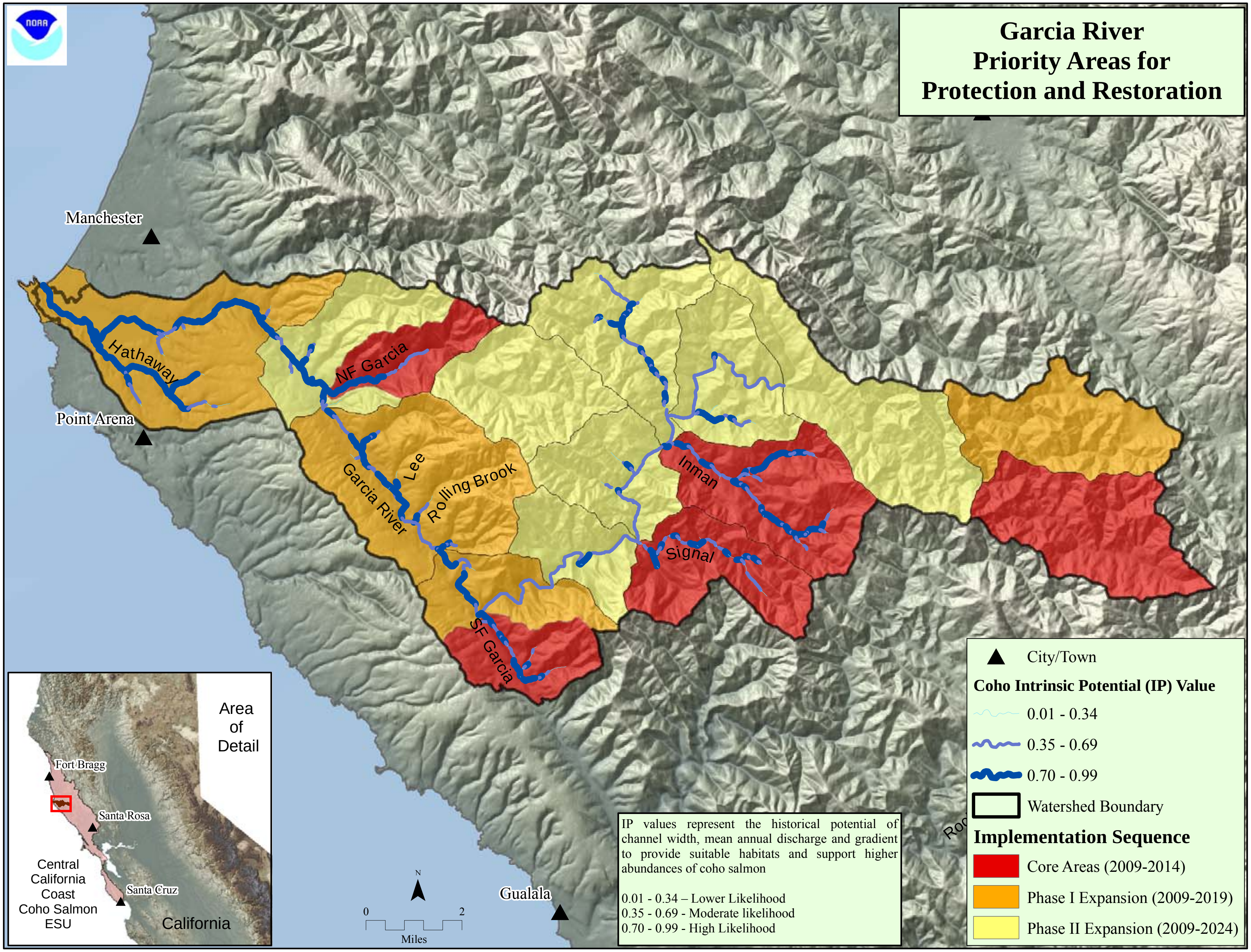
Installing LWD in Garcia River
Photo provided by KRIS Information System, and is used with permission

Immediate Needs

√ Continue effective collaborative restoration efforts.
√ Develop and implement life cycle and abundance studies.
√ Identify floodplain actions needed to improve habitat.
√ Finalize MRC Habitat Conservation Plan.

Recovery Partners

AmeriCorps
California Conservation Corps
Mendocino County Fish and Wildlife Advisory Board
TCF
TNC
TU
MRC
Salmonid Restoration Federation Field School
RWQCB



Garcia River
Priority Areas for
Protection and Restoration
Manchester
Point Arena
Gualala
Hathaway
NF Garcia
Garcia River
Lee
Rolling Brook
Inman
Signal
SF Garcia
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
2
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Garcia River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	50	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	400-3800 m^2	Fair	Spawning Adults	Sediment	Amount of Gravel*	<400 m^2	400-3800 m^2	3800-7300 m^2	>7300 m^2
NMFS	Best Prof. judgment	>10% of pop.	Poor	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	50	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	75	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	77%	Good	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	58	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	50	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	10%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	50	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	1.58/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	50	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	41%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.14%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.88%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	15%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	3.7/100	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	40%	Fair	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	40%	Poor	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	5.9 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	6.2 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Garcia River Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Logging and Wood Harvesting	Medium	Medium	High	High	Medium	Medium			High
2	Storms and Flooding	Medium	Medium	Medium	Medium	High	High			High
3	Droughts	Medium	Low	High	Medium	Medium	Medium			Medium
4	Mining	Medium	Low	Low	Medium	Medium	High			Medium
5	Roads and Railroads	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Climate Change	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Channel Modification	Low	Low	Medium	Medium	Medium	Medium			Medium
10	Livestock Farming and Ranching	Low	Low	Medium	Medium	Medium	Medium			Medium
11	Agricultural Practices	Low	Low	Low	Medium	Medium	Medium			Medium
12	Water Diversion and Impoundment	Low	Low	Low	Medium	Medium	Medium			Medium
13	Recreational Areas and Activities	Medium	Low	Low	Medium	Medium				Medium
14	Fishing and Collecting	Medium	-	-	Low	Medium	Medium			Medium
15	Disease, Predation, and Competition	Medium	-	-	-	-	Low			Low
16	Hatcheries and Aquaculture	-	-	-	Low	Low	-			Low
Threat Status for Targets and Project		High	Medium	High	High	High	High	-	-	Very High *

Garcia River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaR-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
GaR-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
GaR-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	1	2	CDFG, Mendocino Redwood Company, The Nature Conservancy	5.00	5.00				10	Cost estimate based on review of existing data and validation of habitat in the field.
GaR-A-2.1.1.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	10	CDFG, Mendocino Redwood Company, Private Consultants, Private Landowners, The Nature Conservancy						TBD	Cost can not be determined with out additional site specific analysis.
GaR-A-2.1.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.										
GaR-A-2.1.2.1	Action Step	Floodplain	Support programs to purchase land/conservation easements to re-establish and/or enhance natural riparian communities.	3	5	CDFG, Mendocino Redwood Company, NMFS, Private Landowners, Public, Redwood Forest Foundation	2.00	2.00	2.00	2.00	2.00	10	Cost based on additional agency staff time to promote these programs.
GaR-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
GaR-A-3.1.1	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
GaR-A-3.1.1.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	5	CDFG, NMFS, NRCS, Private Landowners, RCD, SWRCB	10.00	10.00	10.00	10.00	10.00	50	Cost based on small number of landowner participation in program during the first five years.
GaR-A-3.1.2	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
GaR-A-3.1.2.1	Action Step	Hydrology	Identify and work with the SWRCB to eliminate depletion of summer base flows from unauthorized water uses.	1	60	CDFG, NMFS OLE, SWRCB						TBD	Continued enforcement will likely be required.
GaR-A-3.1.2.2	Action Step	Hydrology	Implement AB2121 to maintain instream flows for coho salmon.	1	20	SWRCB						TBD	20 year time frame was used because some improvements may be needed.
GaR-A-3.1.2.3	Action Step	Hydrology	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	3	3	SWRCB	3.33	3.33	3.33			10	Cost estimate for the Garcia watershed.
GaR-A-3.1.3	Recovery Action	Hydrology	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	2	10	CDFG, NMFS, NRCS, SWRCB	2.00	2.00	2.00	2.00	2.00	20	Cost based on minimal regulatory staff time to encourage compliance.
GaR-A-3.1.4	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
GaR-A-3.1.4.1	Action Step	Hydrology	Assess and map water diversions (DFG 2004).	2	5	SWRCB						0	Accounted for in other watersheds (approximately $150k over 5 years).
GaR-A-3.1.4.2	Action Step	Hydrology	Support the SWRCB in regulating groundwater.	3	5	CDFG, NMFS, RWQCB						TBD	Cost to support SWRCB for the Garcia watershed is expected to be minimal.
GaR-A-3.1.4.3	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	2	5	CDFG, NMFS, SWRCB						TBD	Cost estimate needed from SWRCB.

Garcia River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaR-A-3.1.5	Recovery Action	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	2	20	CDFG, NOAA RC, Private Landowners, SWRCB						TBD	Cost will vary with the number of water rights holders willing to participate.
GaR-A-3.1.6	Recovery Action	Hydrology	Maintain natural flow regime to improve juvenile rearing habitats.										
GaR-A-3.1.6.1	Action Step	Hydrology	Maintain the following tributaries to provide coldwater input to the Garcia River mainstem: Hathaway, North Fork, Rolling Brook, Mill Creek (lower Garcia River), South Fork, Signal, Mill Creek (upper Garcia River) (DFG 2004).	1	60	CDFG, NMFS, Private Landowners, SWRCB, The Nature Conservancy						TBD	Additional analysis of existing and potential water diversions must be conducted to estimate cost.
GaR-A-5.1	Objective	Passage	Identify and remove existing passage barriers.										
GaR-A-5.1.1	Recovery Action	Passage	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).										
GaR-A-5.1.1.1	Action Step	Passage	Reestablish connectivity of lower North Fork Garcia River to the mainstem (DFG 2004).	1	10	CDFG, NRCS, Private Consultants, Private Landowners						TBD	Specific projects must be developed to determine cost.
GaR-A-5.1.1.2	Action Step	Passage	Evaluate the feasibility of relocating juvenile coho in the North Fork Garcia until geomorphic and low flow stresses are rectified (DFG 2004).	1	5	CDFG, NMFS PRD, NOAA RC, Private Consultants, Private Landowners, The Nature Conservancy	20.00	20.00	20.00	20.00	20.00	100	Cost estimate to relocate juvenile coho to suitable habitat.
GaR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
GaR-A-6.1.1	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.										
GaR-A-6.1.1.1	Action Step	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	Private Landowners						0	Cost to maintain current structure is expected to be minimal.
GaR-A-6.1.2	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
GaR-A-6.1.2.1	Action Step	Pool Habitat	Install or enhance existing LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004). Use information from MRC Garcia Watershed Analysis to determine stream locations with high instream LWD demand, and utilize DFG stream habitat data and The Nature Conservancy data to help determine reaches for LWD placement. Install properly sized LWD to appropriate viability table targets.	1	10	CDFG, NOAA RC, NRCS, Private Landowners, RCD	320	320	320	320	320	3,200	Cost estimate for 10 LWD loading projects at 80k in four core area subbasins.
GaR-A-6.1.2.2	Action Step	Pool Habitat	Encourage coordination of LWD placement in streams as part of logging operations and road upgrades to maximize size, quality, and efficiency of effort (DFG 2004).	2	20	CalFire, CDFG, Private Landowners						TBD	Cost will vary depending on number of projects.
GaR-A-6.1.2.3	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	20	CDFG, NOAA RC, NRCS, RCD	5.00	5.00	5.00	5.00	5.00	100	Based on a minimal expenditure to work with landowners. 5k for 20 years.
GaR-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										

Garcia River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
GaR-A-7.1.1	Recovery Action	Riparian Vegetation	Conserve and manage forestlands for older forest stages.										
GaR-A-7.1.1.1	Action Step	Riparian Vegetation	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.	3	2		40.00	40.00				80	Cost based on $20K in each Core area subbasin over a two year period.
GaR-A-7.1.2	Recovery Action	Riparian Vegetation	Restore and protect riparian vegetation to improve migration and summer/overwintering habitat for coho salmon (DFG 2004).										
GaR-A-7.1.2.1	Action Step	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004). Focus on partnerships with railroad and timber industry, as well as large private landowners.	3	20	CA Coastal Commission, California Coastal Conservancy, CDFG, Mendocino County, NMFS, NRCS, Private Landowners, RCD, Redwood Forest Foundation						TBD	Costs can not be determined without additional information on the potential projects within this basin.
GaR-A-7.1.2.2	Action Step	Riparian Vegetation	Work with landowners to plant conifers in the lower mainstem Garcia River from Eureka Hill Road Bridge to Windy Hollow road with the goal of reducing stream temperature, providing bank stability and long-term LWD recruitment (DFG 2004).	2	10	CDFG, NRCS, Private Landowners, RCD						TBD	Additional info required to estimate total cost.
GaR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
GaR-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
GaR-A-8.1.1.1	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1									See roads section.
GaR-A-8.1.1.2	Action Step	Sediment	Complete the remaining 25% of erosion control sites identified in the South Fork Garcia River by the Trout Unlimited North Coast Coho Project.	1	5	Mendocino Redwood Company, Trout Unlimited						TBD	Need cost estimates from project proponents.
GaR-A-8.1.1.3	Action Step	Sediment	Treat high and medium priority sites that are identified in the MRC Garcia River Watershed Analysis, Garcia River Forest Integrated Resource Management Plan and other credible landowner assessments.	1	10	CDFG, NOAA RC, Private Consultants, Private Landowners, SWRCB	200	200	200	200	200	2,000	Based on $1 million estimate for just Garcia river forest sites.
GaR-A-8.1.1.4	Action Step	Sediment	Acquire funding for assessment and implementation of sediment reduction measures associated with the 2008 Jacks Fire which occurred in the North Fork Garcia River subbasin.	2	2	CalFire, NRCS, Private Landowners, RCD	100	100				200	Rough estimate for erosion control in affected area.
GaR-A-8.1.2	Recovery Action	Sediment	Reduce the density of roads and trails and their crossings across watercourses.										See Roads section.
GaR-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
GaR-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key attributes across the watershed.										
GaR-A-9.1.1.1	Action Step	Viability	Use standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas.	2	10	CDFG, NMFS, Private Consultants, Private Landowners	100	100	100	100	100	1,000	Estimate of $100K per year to conduct monitoring.
GaR-A-9.1.1.2	Action Step	Viability	Conduct a comprehensive assessment of watershed processes (e.g., hydrology, geology, fluvial-geomorphology, water quality, and vegetation), instream habitat, and factors limiting coho salmon production (DFG 2004). Use the watershed assessment template developed in portions of the watershed in Mendocino Redwood Company ownership, and apply to the rest of the Garcia River watershed.										Monitoring costs included in "standardized watershed assessment" action step.

Garcia River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaR-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
GaR-A-9.1.2.1	Action Step	Viability	Continue and improve upon monitoring activities to determine the population status of adult and smolt salmonids in the watershed and its tributaries.	1	10	CDFG, NMFS	100	100	100	100	100	1,000	Cost estimate for adult and smolt monitoring each year.
GaR-A-9.2	Objective	Viability	Core areas should have the highest priority for a site-based assessment; adapt the strategies for restoration and threat abatement to address site-based issues identified by the watershed assessments.	1	20	CDFG, NMFS, Private Landowners						0	Cost to prioritize expected to be minimal.
GaR-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
GaR-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										See Riparian section above.
GaR-A-10.1.1.1	Action Step	Water Quality	Work with landowners to plant riparian zones of Blue Waterhole, Inman Creek, and Pardaloe Creek with the goal of reducing instream temperatures and sediment input into the Garcia River mainstem, and providing a long-term source of conifer LWD (DFG 2004).	1	10	CDFG, NOAA RC, Private Landowners						TBD	Cost will depend on the length of reaches identified for planting.
GaR-A-10.1.1.2	Action Step	Water Quality	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	60	BLM, CDFG, Conservation Fund, FishNet 4C, Mendocino County, Mendocino Redwood Company, NMFS, NRCS						TBD	Cost expected to be minimal to promote conservation measures.
GaR-A-10.1.2	Recovery Action	Water Quality	Institutionalize programs to purchase easements on water rights to encourage the maintenance of surface flows.	2	10	CDFG, Private Landowners, SWRCB						TBD	Number of water rights available will need to be determined for cost estimate.
GaR-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
GaR-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	2	20	CDFG, NMFS, Private Landowners, SWRCB						TBD	Cost will vary with the number of water rights holders willing to participate. Same recommendation in Hydrology section.
GaR-A-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
GaR-A-15.2.1	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	2	60	CalFire, CalTrans, CDFG, Mendocino County Department of Public Works, Private Landowners, RWQCB						0	Cost is expected to be minimal. Most diversions in the Garcia for dust control are for timber management actions. Most of these diversion have a 1600 agreement with the Department of Fish and Game and are likely incorporated into existing operations.
GaR-A-15.3	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
GaR-A-15.3.1	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.										Costs addressed in Hydrology section.
GaR-A-15.3.1.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.				SWRCB							Costs addressed in Hydrology section.

Garcia River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaR-A-15.3.2	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										Costs addressed in Hydrology section.
GaR-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
GaR-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Areas adjacent to currently owned State parks or forestlands supporting Core, Phase I and Phase II priority areas should be considered for purchase (if feasible within the next 5 years).										
GaR-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Should large tracts of forestlands within any watershed identified as a priority in this recovery plan become available for purchase, the State of California should consider purchasing the area as a Demonstration Forest or State Park.	2	60	BLM, CDFG, Redwood Forest Foundation, State Parks, The Nature Conservancy						TBD	Cost based on parcel to be purchased.
GaR-A-20.1.2	Recovery Action	Logging and Wood Harvesting	Conduct an assessment of the mechanisms driving forestland conversion and develop strategies to protect forestlands.	3	10	Board of Forestry, Mendocino County, NMFS PRD						TBD	
GaR-A-20.1.3	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
GaR-A-20.1.3.1	Action Step	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	20	Board of Forestry, CA Coastal Commission, CDFG, NMFS						minimal	Cost expected to be minimal to improve coordination with Mendocino County.
GaR-A-20.1.3.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	1	60	CA Coastal Commission, CDFG, Mendocino County, NMFS						TBD	Need to determine the number of regulatory staff to control rural development in Mendocino County.
GaR-A-20.2	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
GaR-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
GaR-A-20.2.1.1	Action Step	Logging and Wood Harvesting	Design and implement a program of BMPs for road maintenance on private roads similar to the proposed program for public roads.	1	60	Mendocino County, Private Landowners, Public						TBD	
GaR-A-20.2.1.2	Action Step	Logging and Wood Harvesting	Minimize sediment-related effects to coho salmon habitat from road building and other soil-disturbing activities.	1	60	Board of Forestry, CalFire, California Department of Mines and Geology, CDFG, NMFS, Private Landowners						TBD	Cost will vary with logging activity in the basin.
GaR-A-20.2.1.3	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	1	60	CalFire						TBD	Cost will vary with logging activity in the basin.
GaR-A-20.2.1.4	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	1	20	CalFire, Mendocino Redwood Company, NOAA RC, Private Landowners						TBD	Cost will vary with THP development near streams with legacy roads.
GaR-A-20.3	Objective	Logging and Wood Harvesting	Prevent future conversion of non-agricultural land to agriculture.										
GaR-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	2	60	CalFire, California Department of Mines and Geology, CDFG, NMFS						TBD	This action may require funding for additional regulatory agency staff to work with CalFire to minimize conversion projects.

Garcia River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaR-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Provide information to BOF regarding CCC coho salmon priorities and recommend upgrading relevant forest practices.	1	2	CDFG, NMFS						minimal	This is underway.
GaR-A-20.4	Objective	Logging and Wood Harvesting	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of CCC coho salmon.										
GaR-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Continue the activities of the North Coast Watershed Assessment /Coastal Watershed Program.	1	20	CDFG, NMFS, Private Landowners						TBD	NCWP/Coastal Watershed Program needs to implement assessment in the Garcia River basin.
GaR-A-20.4.2	Recovery Action	Logging and Wood Harvesting	Consider the development of a Watershed Database (similar to the DFG Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.	2	20	Board of Forestry, CDFG, NMFS	5.00	5.00	5.00	5.00	5.00	100	Assumes data for the Garcia River portion of the database can be maintained for $5k per year.
GaR-A-20.4.3	Recovery Action	Logging and Wood Harvesting	Develop a framework similar to Washington State that establishes a scientific framework for monitoring the effectiveness of practices in meeting watershed process goals and a decision-making process that is adaptive to the new information.	1	10	Board of Forestry, CalFire, CDFG, Conservation Fund, Mendocino Redwood Company, NMFS, Private Landowners	25.00	25.00	25.00	25.00	25.00	250	Assumes $50k to be spent on THP effectiveness monitoring for a minimum of five years.
GaR-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
GaR-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	10	CalTrans, CDFG, Mendocino County Department of Public Works, NRCS, Private Consultants						TBD	Cost may be minimal for education of staff working in the Garcia River.
GaR-A-24.1.2	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	10	CDFG, Mendocino County, NOAA RC, NRCS, Private Landowners	5.00	5.00	5.00	5.00	5.00	50	Cost estimate for Garcia watershed only.
GaR-A-24.1.3	Recovery Action	Roads and Railroads	Conduct collaborative evaluations of priorities for treatment of CCC coho salmon passage barriers, such as the Fish Passage Forum (DFG 2004).	3	60	CalFire, FishNet 4C, Mendocino County Department of Public Works, NOAA RC, NRCS, Private Landowners						0	Cost expected to be minimal.
GaR-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
GaR-A-24.2.1	Recovery Action	Roads and Railroads	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF). Where no Core areas are designated, apply this action to Phase I areas.	1	20	CDFG, NOAA RC, NRCS						0	Costs minimal to prioritize projects.
GaR-A-24.2.2	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1	20	CalFire, CDFG, NOAA RC, NRCS, Private Landowners, RCD						TBD	Cost may be less than other basins due to TMDLs in place since 1997.
GaR-A-24.3	Objective	Roads and Railroads	Design new roads that are hydrologically disconnected from the stream network.										
GaR-A-24.3.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	1	20	CalFire, CDFG, NOAA RC, NRCS, Private Landowners, RCD						TBD	Cost may be less than other basins due to TMDLs in place since 1997.
GaR-A-24.3.1.1	Action Step	Roads and Railroads	Implement a sediment reduction program for private roads.	1	20	CalFire, CDFG, Private Landowners						TBD	Cost beyond TMDL work needs to be developed.

Garcia River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaR-A-24.3.1.2	Action Step	Roads and Railroads	Develop a private road database using standardized methods. The methods should document all road features, apply erosion rates, and compile information into a GIS database.	3	5	CalFire, Mendocino County Department of Public Works, NMFS, Private Consultants, Private Landowners	10.00	10.00	10.00	10.00	10.00	50	Cost estimate for entire basin.
GaR-A-24.3.1.3	Action Step	Roads and Railroads	Design and implement a program of BMPs for road maintenance on private roads similar to the proposed program for public roads.	2	40	Mendocino County, NOAA RC, NRCS, RCD						TBD	Need to determine number of miles that would be maintained for cost estimate.
GaR-A-24.3.2	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	1	20	CalFire, CDFG, NOAA RC, NRCS, Private Landowners, RCD						TBD	Costs are related to maintenance and enforcement of gates and other closure techniques.
GaR-A-24.3.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	2	5	CalFire, CalTrans, CDFG, NMFS, NRCS, Private Landowners	50.00	50.00	50.00	50.00	50.00	250	Based on approximately $50k to do inspections for a five year period.
GaR-A-24.3.3	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	10	CalFire, CDFG, Mendocino County Department of Public Works, NRCS, Private Landowners						TBD	Cost for BMP unknown at this time. Ten year duration to accommodate changes in BMPs.
GaR-A-24.3.4	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	1		CalTrans, Mendocino County Department of Public Works							
GaR-A-24.3.4.1	Action Step	Roads and Railroads	Stream crossings should be identified and mapped with the intention of replacement or removal if they cannot pass the 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	2	20	CDFG, Mendocino County Department of Public Works, NOAA RC, NRCS, Private Landowners, RCD						TBD	Number of culverts and specific details to upgrade are needed to estimate cost.
GaR-A-24.4	Objective	Roads and Railroads	Reduce sediment sources from road networks and other actions that deliver sediment to stream channels through improved or new laws and policy.										
GaR-A-24.4.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	CalFire, CDFG, Private Landowners						TBD	Cost may be minimal since roads are in place throughout the Garcia watershed.
GaR-A-24.4.2	Recovery Action	Roads and Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. The Counties should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with endangered salmonid habitat.	2	10	FEMA, Mendocino County Department of Public Works, Private Landowners	50.00	50.00	50.00	50.00	50.00	500	Based on an estimate of $50k funding for the Garcia watershed emergency funding per year.
GaR-A-24.4.3	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails to decrease fine sediment loads.	2	10	FEMA, Mendocino County Department of Public Works, Private Landowners	50.00	50.00	50.00	50.00	50.00	500	Based on an estimate of 50k funding for the Garcia watershed emergency funding per year.

Gazos Creek

Gazos Creek

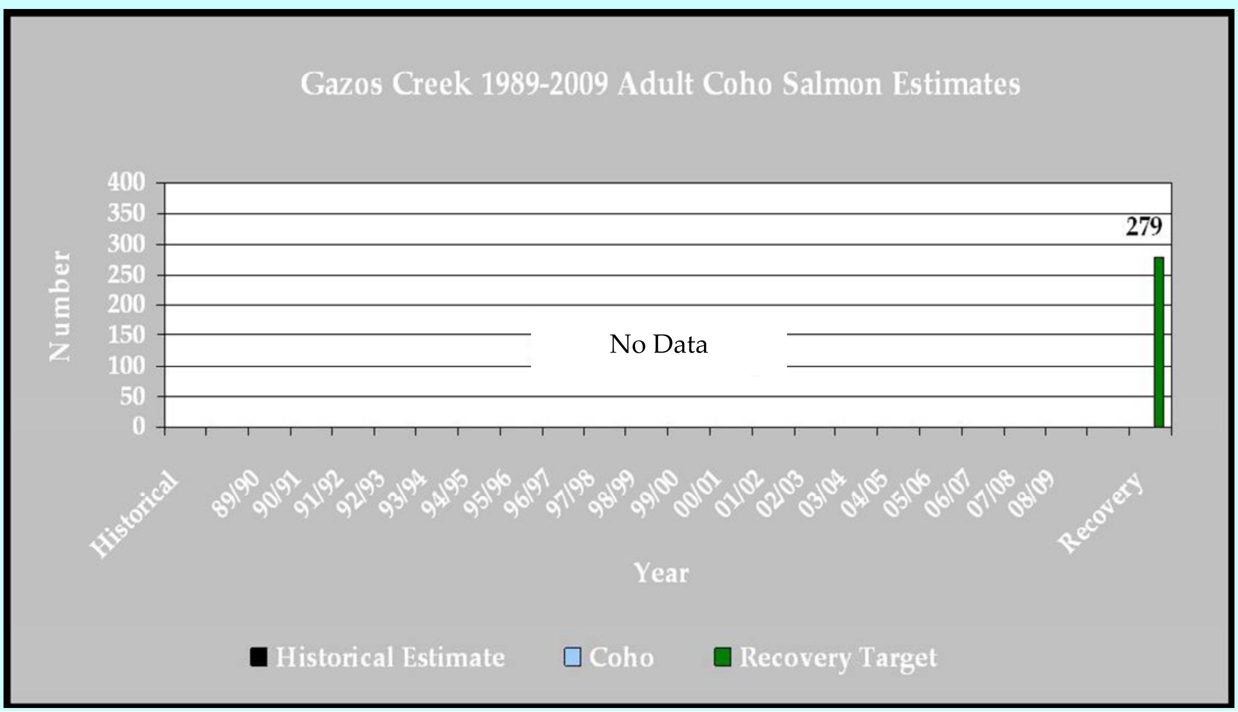
Dependent Population
8.2 IP-km of potential coho salmon habitat
Coho salmon extirpated and steelhead present

Gazos Creek drains approximately 12 square miles of the Santa Cruz Mountains in western San Mateo and Santa Cruz Counties. Gazos Creek enters the Pacific Ocean about 25 miles north of Santa Cruz. About 65 percent of the Gazos Creek watershed is redwood coniferous forest and about 24 percent of the watershed is shrubland. Gazos Creek flows through deep canyons developed in "chalk rock" – fractured mudstones of the Santa Cruz formation. Streams draining the chalk rock are sustained by seepage of cool, low-salinity, slightly alkaline waters, rich in naturally occurring phosphates and other nutrients. Sustained seepage continues to emanate from the deep fractures through multi-year droughts. The unusual setting of the "chalks" offers a more resilient environment for salmonids than do the sandy or decomposed granite watersheds elsewhere in the Santa Cruz Mountains. In the lower watershed, the landscape includes rolling grassland hills, coastal shrub and agricultural lands. A coastal lagoon with public access is present at the mouth of the creek. (CWC 2003).

Gazos Creek
Photo © USGS

The Watershed at a Glance

Spawning Quantity & Quality	**FAIR to GOOD**
Summer Water Temperatures	**FAIR**
Depth & Shelter of Pools	**FAIR**
Large Wood Frequency	**POOR to GOOD**
Riparian Canopy	**GOOD**
Off channel/Floodplain Quality	**POOR**
Estuary Function	**POOR**



Gazos Creek

Recovery Target: 279 Adult Coho Salmon

Increasing the survival of coho salmon requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Roads and Railroads
- Disease, Predation, Competition

Preventing the extinction of coho salmon means **restoring** many key habitat attributes within the Gazos Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Increase spawning habitat
- Improve and increase frequency of pools
- Increase the amount of large wood in streams
- Increase the number of off channel habitats
- Enhance hydrologic connectivity
- Decrease the number of roads near the stream and reduce impacts from remaining roads

Road failure adjacent to Gazos Creek
Photo by Jerry Smith, SJSU

Advancing recovery of coho salmon in Gazos Creek requires these priority **recovery actions:**

- Maintain instream structures to preserve woody debris material
- Promote and continue implementation, via technical assistance and/or regulatory actions for the reduction of roads and railroads near streams

. . . **throughout** the Gazos Creek watershed.

Conservation Highlights

- Annual juvenile abundance surveys conducted by San Jose State University faculty and students provides important population data on coho salmon in the Waddell Creek watershed.

We Need Your Photo Here

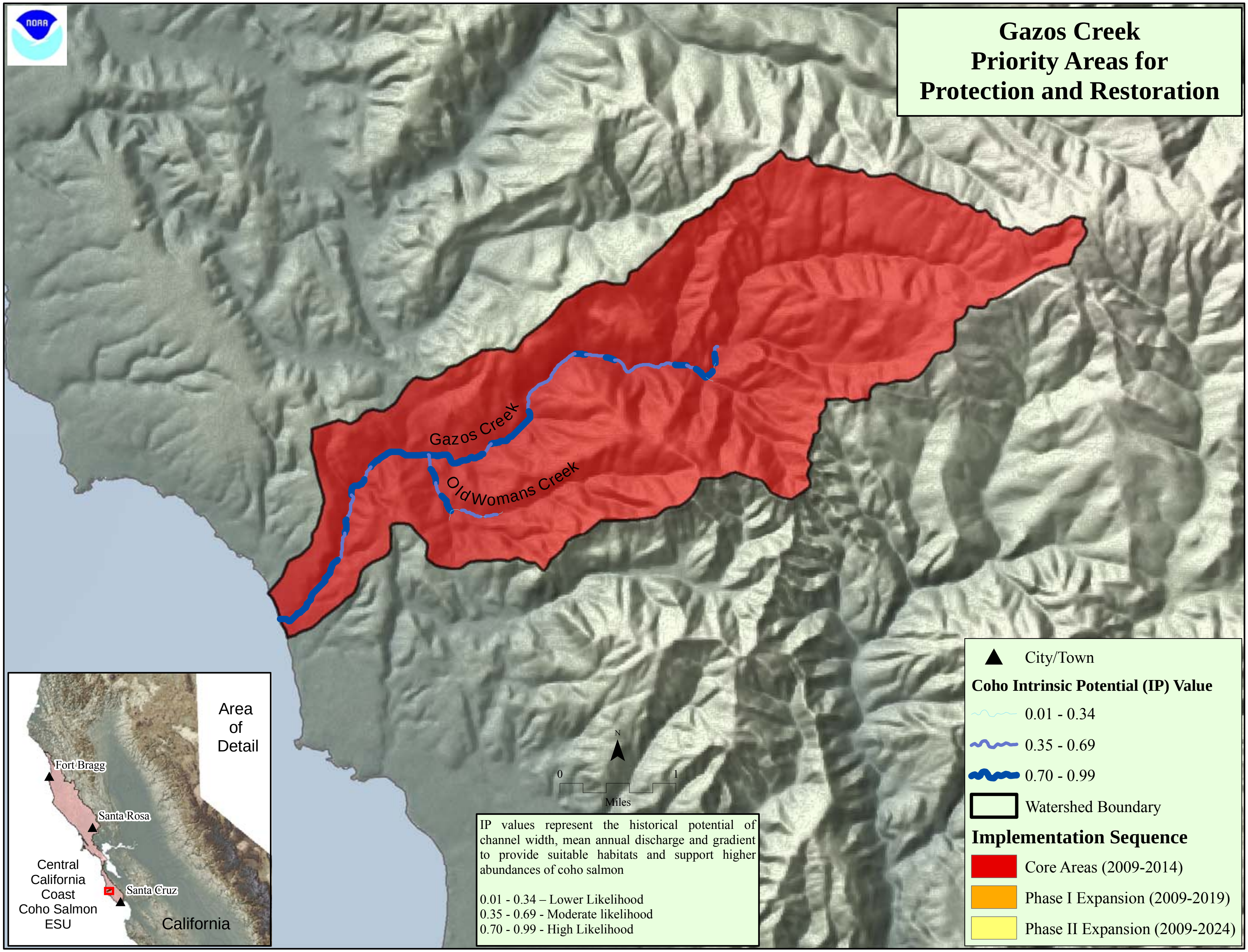
Gazos Creek
Photo © your name, AFFIL

Recovery Partners

NPS
San Mateo RCD
San Jose State Univ.
DFG
San Mateo County

Immediate Needs

Maintain current instream LWD √
Repair roads in Old Woman's Creek √



Gazos Creek
Priority Areas for
Protection and Restoration
Gazos Creek
Old Womans Creek
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Gazos Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	50	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	91%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	100-400 m^2	Fair	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-400 m^2	400-800 m^2	>800 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	<35	Very Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	67	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	42	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	60-80	Fair	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	<60 avg. rating	Fair	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	Poor	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Poor	Poor	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	58	Fair	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	17.16/10 IP-km	Poor	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	<60 avg. rating	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	<50%	Poor	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	68%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.18%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	1.59%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	3%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Good	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	8.8	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	73%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	70-80%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	≤ 69% density "D" across IP-km	70 -79%	> 80%	
NMFS	CDF THP Dataset	2 mi/sq.mi.	Good	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	3.7 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Fair	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Gazos Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Roads and Railroads	Medium	High	Medium	High	High	High			High
2	Disease, Predation, and Competition	High	-	Medium	-	High	-			High
3	Droughts	Medium	Low	Medium	Medium	High	Medium			Medium
4	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
5	Residential and Commercial Development	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Channel Modification	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Climate Change	Medium	Medium	Medium	Medium	Medium	Low			Medium
9	Logging and Wood Harvesting	Low	Medium	Medium	Medium	Medium	Medium			Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Storms and Flooding	Low	Medium	Medium	Medium	Medium	Medium			Medium
12	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium			Medium
13	Livestock Farming and Ranching	Low	Low	Medium	Medium	Medium	Medium			Medium
14	Fishing and Collecting	-	-	-	Low	Medium	-			Low
15	Hatcheries and Aquaculture	-	-	-	Low	Low	-			Low
16	Mining	-	Low	-	-	-	-			Low
Threat Status for Targets and Project		High	High	High	High	High	High	-	-	Very High

Gazos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
GaC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
GaC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.										
GaC-A-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	3	20	California Coastal Conservancy, CalTrans, County of San Mateo, NOAA RC, State Parks						TBD	Lower priority for coho, but will benefit smolt transition and adult upmigration.
GaC-A-1.1.1.2	Action Step	Estuary	Post durable and attractive signs to discourage lagoon breaching.	3	5	State Parks	0.08	0.08	0.08	0.08	0.08	0	This action will directly benefit listed steelhead rearing in the lagoon.
GaC-A-1.1.1.3	Action Step	Estuary	Address water quality problems in the estuary.	3	10	CDFG, County of San Mateo						TBD	This action will directly benefit listed steelhead rearing conditions. Benefits to coho are likely to be indirect. When the sandbar is in place the raised lagoon levels are believed to inundate a local septic system.
GaC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
GaC-A-2.1.1	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	15	California Coastal Conservancy, CDFG, County of San Mateo, NOAA RC, Private Landowners, San Mateo RCD						TBD	Gazos has more instream wood than many streams south of San Francisco Bay that could be readily manipulated to create refuge habitats. Costs will vary depending on access and site specific conditions. Actual floodplain habitat is limited due to slope confinement and the presence of the County road. Better floodplain habitat is generally restricted to the channel downstream of road mile 2.3 above Highway 1 (downstream of Old Woman's Creek).
GaC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
GaC-A-3.1.1	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.										
GaC-A-3.1.1.1	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	2	20	CDFG, County of San Mateo, NMFS, Private Landowners, SWRCB						TBD	Costs cannot be estimated until an overall strategy to address diversions and their relative impact to salmonids is developed. This effort should focus on lower reaches in the watershed where the majority of problematic diversions are located.
GaC-A-3.1.1.2	Action Step	Hydrology	Promote conjunctive use of water through strategies that include off-channel storage as a method to reduce impacts of legal water diversion (e.g. storage tanks for rural residential users).	2	20	CDFG, Farm Bureau, Private Landowners, SWRCB, Trout Unlimited							Costs cannot be estimated at this time. A water budget for the watershed will need to be developed. Costs will vary depending on diversion strategy, infrastructure constraints, and landowner participation.
GaC-A-3.1.2	Recovery Action	Hydrology	Reduce water use affecting the natural hydrograph and support development of alternative water sources protective of the natural hydrograph.	2	10							TBD	Development of alternative sources may be costly, but depend on numbers and types of alternatives implemented.
GaC-A-3.1.3	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
GaC-A-3.1.3.1	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	1	3	Alnus Ecological, CDFG, CDFG Law Enforcement, NMFS OLE, Private Landowners, SWRCB	33.33	33.33	33.33			100	Costs are estimated to include staff time from DFG 1600 staff, DFG Law Enforcement, and/or NMFS OLE.
GaC-A-3.1.3.2	Action Step	Hydrology	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	1	60	CDFG, NMFS HCD, Private Landowners, SWRCB						0	This is a general recommendation and costs of providing these updates to the SWRCB is expected to be minimal.

Gazos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaC-A-3.1.4	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
GaC-A-3.1.4.1	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	2	2	CDFG, NMFS HCD, Private Consultants	25.00	25.00				50	Cost may be less if existing information from Gazos is leveraged and is incorporated into the flow evaluation program.
GaC-A-3.1.4.2	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	2	60	CDFG, NMFS HCD, SWRCB						TBD	Costs cannot be determined until a watershed specific evaluation is completed. Until such a time, the expense and financial impact of potential restrictions is speculative.
GaC-A-3.1.4.3	Action Step	Hydrology	Continue streamflow gauging to determine the level of impairment to natural flow.	2	5	Private Consultants, USACE, USGS	15.00	15.00	15.00	15.00	15.00	75	The gage in Gazos was installed and is currently maintained by Balance Hydrologics. Gauging should continue into the foreseeable future and funding should continue until a range of natural flow conditions are obtained for the watershed.
GaC-A-3.1.5	Recovery Action	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	3	60	California Coastal Conservancy, CDFG, NOAA RC, SWRCB						TBD	The aggregate fiscal cost of water acquisition will depend on the quantity of want and whether water rights will be permanently transferred or purchased for single periods. This information is currently unavailable for the Gazos Creek watershed.
GaC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
GaC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
GaC-A-6.1.1.1	Action Step	Pool Habitat	Improvement of in-channel LWD densities, and associated habitat benefits, could be most easily accomplished by the addition of large (>2 diameter and or 20' length) conifer tree trunks and root wads. It is recommended that this be achieved by cutting large trees and dropping them into the channel, or preferably by pulling them partially into the channel complete with rootwad, at appropriate upstream locations. Downed logs may be transported to proper location to be placed in the stream.	1	10	California Coastal Conservancy, CDFG, County of San Mateo, NOAA RC, Private Landowners, RWQCB, San Mateo RCD						TBD	Costs will vary depending on whether the LWD is secured and anchored, or whether the material is simply felled and placed into the creek. Due to infrastructure, most streams in the Santa Cruz Mountains Diversity Stratum will likely require cabling which increases overall project costs. However, it is conceivable that at least a portion of the structures in Gazos could simply be placed into the stream without cabling or anchoring, which would reduce costs. Gazos has relatively little infrastructure that would be potentially impacted by a potential LWD jam.
GaC-A-6.1.1.2	Action Step	Pool Habitat	Do not remove woody material from the stream channel without consultation and approval from a fishery biologist with experience working in small, Central California Coastal streams.	1	60	CDFG, NMFS PRD, Private Consultants	0.83	0.83	0.83	0.83	0.83	50	This recommendation estimates the expense of periodically having an experienced fisheries biologist evaluate LWD removal projects from Gazos. It is anticipated that these requests will occur infrequently.
GaC-A-6.1.1.3	Action Step	Pool Habitat	Leave wood clusters as beneficial sediment traps, even if they pose passage difficulties for migrating salmonids.	2	60	California Coastal Conservancy, CDFG, County of San Mateo, NMFS PRD, NOAA RC, POST, Private Consultants, Private Landowners, San Mateo RCD, USACE, USFWS						0	
GaC-A-6.1.1.4	Action Step	Pool Habitat	After large floods, tree seedlings should be allowed to regenerate on exposed bars.	3	60	County of San Mateo, Private Landowners						0	

Gazos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaC-A-6.1.1.5	Action Step	Pool Habitat	Conduct annual surveys in Gazos to ensure wood clusters do not create a complete barrier to adult passage.	2	15	CDFG, San Mateo County, San Mateo RCD	3.33	3.33	3.33	3.33	3.33	50	
GaC-A-6.1.1.6	Action Step	Pool Habitat	Educate landowners, land managers, and County and municipal staffs on the importance of LWD to coho survival and recovery, and watershed processes.	1	10	CDFG, Coastside Land Trust, Farm Bureau, FEMA, FishNet 4C, NMFS, NRCS, San Mateo RCD, State Parks	1.00	1.00	1.00	1.00	1.00	10	
GaC-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	3	60	CDFG, County of San Mateo, NRCS, POST, State Parks, USFWS, USGS						0	Costs to landowners will vary by project. This recommendation is directed at project proponents and regulatory agencies to opportunistically consider and recommend restoration opportunities to landowners.
GaC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
GaC-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	3	60	California Coastal Conservancy, CDFG, Coastside Land Trust, County of San Mateo, Mid Penninsula Open Space District, POST, Private Landowners, San Mateo RCD						TBD	Costs will vary depending on the conservation measure. Land owner participation is critical to implementation of this measure. Land owner willingness to participate is unknown.
GaC-A-7.1.2	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).										
GaC-A-7.1.2.1	Action Step	Riparian Vegetation	Encourage development and implementation of a program similar to the County of Santa Cruz's Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	10	CDFG, County of San Mateo, NMFS	1.00	1.00	1.00	1.00	1.00	10	This recommendation would likely be most effective if undertaken by the County of San Mateo. In that case, the total cost regarding contribution of the Gazos Creek population is difficult to reasonably quantify. The cost estimate is an estimate related only to Gazos and the total cost may be reduced significantly if the standards from the Santa Cruz Plan are adopted for San Mateo County.
GaC-A-7.1.2.2	Action Step	Riparian Vegetation	Target Cape Ivy in the lower portion of the watershed for removal.	3	2	California Coastal Conservancy, CDFG, NRCS, San Mateo RCD, State Parks	5.00	5.00				10	
GaC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
GaC-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
GaC-A-8.1.1.1	Action Step	Sediment	Repair manageable bank failures or landslide toes that are significant sources of chronic fine sediment in Gazos, Old Woman's and Bear Gulch.	1	10	CDFG, County of San Mateo, NMFS, NRCS, Private Landowners, RWQCB, USACE						TBD	Costs are unknown. DFG 2004 estimated stream bank projects cost about $125 per square foot - these costs do not include the cost of maintenance or permitting. Other estimates range between $30 and $1,000 per foot. Repairs should be completed using bioengineering techniques and material, where appropriate. Changes in water flow patterns should be made if existing flow patterns exacerbate slope failure. Habitat enhancement should be incorporated into the engineering design, where feasible. Rocks placed at the toe of the bank should be large enough to provide escape cover and scour objects.

Gazos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaC-A-8.1.2	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										
GaC-A-8.1.2.1	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	2	60	CalFire, CDFG, County of San Mateo, NMFS, NRCS, RWQCB, USACE, USEPA, USFWS						0	This should be considered a standard business practice for all regulatory and oversight agencies.
GaC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
GaC-A-9.1.1	Recovery Action	Viability	Measure or estimate response of key habitat attributes to recovery efforts across the watershed.										
GaC-A-9.1.1.1	Action Step	Viability	Implement standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	3	60	CDFG, County of San Mateo, NOAA RC, NOAA SWFSC, NRCS, Private Consultants, RWQCB, San Mateo RCD						0	
GaC-A-9.1.2	Recovery Action	Viability	Evaluate feasibility of initiating adult surveys and replicating DFG's past smolt outmigration surveys.	3	9	CDFG, NMFS, Private Consultants, Private Landowners	33.33	33.33	33.33	33.33	33.33	300	Gazos is a lesser priority for adult monitoring because of its status as a Dependent Population and the existing monitoring efforts in other Dependent populations in the Santa Cruz Mountains Diversity Stratum.
GaC-A-9.1.3	Recovery Action	Viability	Continue ongoing juvenile sampling efforts in the watershed. Establish consistent reporting methods to ensure ESU-wide consistency.	2	10	CDFG, NOAA SWFSC, Private Consultants, State Parks	5.00	5.00	5.00	5.00	5.00	50	
GaC-A-14.1	Objective	Disease, Predation, and Competition	Implement regulatory, abatement, and education measures to prevent the invasion of exotic species, (including exotic plants).	3	60	California Coastal Conservancy, CDFG, County of San Mateo, Farm Bureau, FishNet 4C, NMFS PRD, NOAA RC, NRCS, Private Landowners, San Mateo RCD, USEPA						TBD	
GaC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
GaC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.										
GaC-A-24.1.1.1	Action Step	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	20	CalFire, CalTrans, FishNet 4C, NRCS, POST, Private Consultants, Private Landowners, RWQCB, San Mateo County, San Mateo RCD, USACE	2.00	2.00	2.00	2.00	2.00	40	Annual training could be combined on a County-wide basis. Cost estimate represents relative Gazos contribution. Program should leverage off the FishNet4C program and training manual.
GaC-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										

Gazos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaC-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	20	California Department of Mines and Geology, CDFG, County of San Mateo, Private Landowners, RWQCB, San Mateo County, San Mateo RCD, USACE						TBD	Costs will vary depending on scale of work identified. Costs can range between $3,000 per mile to $10,000 per mile. Estimates in the State Coho Recovery Plan indicate costs in nearby San Mateo County, in 2003 dollars, may reach $15,000 per mile. Rerouting of mainline roads will result in significantly higher costs.
GaC-A-24.3	Objective	Roads and Railroads	Conduct actions to hydrologically disconnect roads.										
GaC-A-24.3.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
GaC-A-24.3.1.1	Action Step	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	2	60	CDFG, FishNet 4C, Mid Penninsula Open Space District, Mines and Geology, NMFS, POST, RWQCB, San Mateo RCD, USACE, USEPA	1.00	1.00	1.00	1.00	1.00	60	Cost will vary depending on landowner participation and site specific conditions. The program should be running within ten years and continue in perpetuity.
GaC-A-24.3.1.2	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, CalTrans, County of San Mateo, Private Landowners, RWQCB						TBD	This is a cost that is frequently absorbed into road projects. Costs will vary depending on actual amount of grading in the watershed.
GaC-A-24.3.1.3	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	2	10	CalFire, California Department of Mines and Geology, County of San Mateo, Farm Bureau, NRCS, Private Landowners, RWQCB						TBD	Cost of removal cannot be estimated until an evaluation of the magnitude of the problem in conducted. Cost associated with berm evaluation should be coupled with ongoing and future public and private road evaluations as a means to reduce overall expenses.
GaC-A-24.3.1.4	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	2	5	CalFire, CalTrans, CDFG, County of San Mateo, RWQCB	6.00	6.00	6.00	6.00	6.00	30	Inadequate storage sites in Gazos is a concern in the watershed. The paucity of locations for temporary storage of landslide material is a significant constraint. Sites should be identified within the duration specified and this action should be continued in perpetuity.
GaC-A-24.3.2	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.										
GaC-A-24.3.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	60	CalFire, County of San Mateo, NRCS, POST, Private Landowners, Public, RWQCB, San Mateo RCD						TBD	

Gazos Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GaC-A-24.3.3	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, CalTrans, CDFG, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, Mid Penninsula Open Space District, Mines and Geology, NMFS, NRCS, POST, RWQCB, USACE, USFWS						TBD	Costs cannot be determined at this time. These standards should be adopted for all future road projects in the Gazos watershed.
GaC-A-24.3.4	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	3	60	CalFire, California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, Mid Penninsula Open Space District, Mines and Geology, NMFS, NRCS, Private Consultants, Private Landowners, RPFs, RWQCB, San Mateo RCD, USACE						TBD	Replacement of culverts/bridges to NMFS standards will result in increased cost for materials and construction, but will likely result in structures that can withstand large storm events better than existing structures. Long term durability and stability will result in long-term cost savings in many circumstances.
GaC-A-24.4	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
GaC-A-24.4.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	3	20	CalFire, County of San Mateo, RWQCB						TBD	Costs may vary significantly depending on societal pressures to build in these areas. A well designed road management plan should result in long term cost savings. However, this may be difficult to fully implement due to the multiple landowners in the watershed, the relatively small size of the watershed, and its diverse geology, which ultimately may limit the feasibility of this recommendation.
GaC-A-24.4.2	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	2	60	California Coastal Conservancy, CDFG, County of San Mateo, Farm Bureau, FishNet 4C, NOAA RC, Private Landowners, Public, RWQCB, San Mateo RCD						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have their roads addressed and sediment sources remediated.
GaC-A-24.4.3	Recovery Action	Roads and Railroads	Continue implementation of San Mateo County's Road Maintenance Manual.	1	60	San Mateo County						0	

GUALALA RIVER

Gualala River

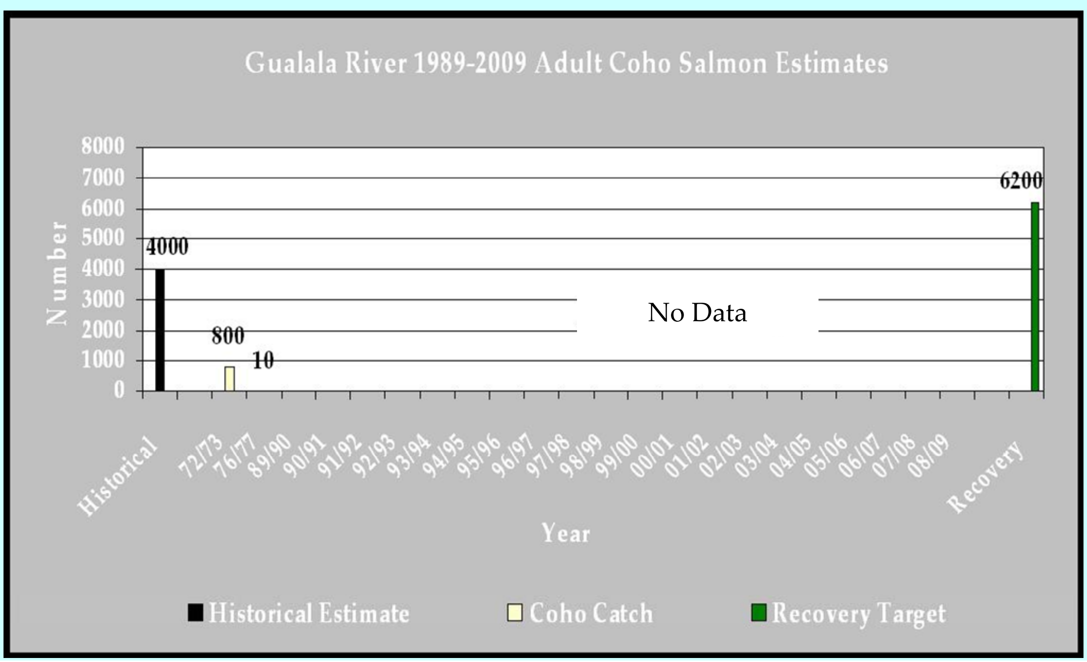
Independent Population
251.6 IP-Km of potential coho salmon habitat
Coho salmon and steelhead present

Gualala River drains approximately 298 square miles of western Mendocino and Sonoma counties, and enters the Pacific Ocean at Gualala. During summer months, a sand bar typically forms across the mouth of the estuary which blocks the flow of tidewater creating a coastal lagoon. Approximately 52 percent of the Gualala River watershed is coniferous forest (redwood, 36 percent, and Douglas-fir, 11 percent), ~ 31 percent is montane hardwood, and 16 percent is annual grassland. Twenty-nine percent of the watershed has very low to intermediate susceptibility to soil erosion, while the remaining 71 percent has moderately-high to high susceptibility to erosion. The EPA listed the Gualala as having water quality impaired for sediment, and identified from timber harvest as the main contributor. The EPA established a TMDL for the watershed. Most of the Gualala River watershed is privately owned; less than one percent is state park land or owned by the U.S. Bureau of Indian Affairs. Land use in the watershed is dominated by timber production, which began in 1862. Within the past ten years, about 13 percent of the watershed has been under a timber harvest plan. Agriculture is a significant land use in the Gualala, with vineyards becoming increasingly widespread as well as in-stream gravel mining Housing development within the watershed is moderately low; approximately 890 housing units are present in the watershed. There are 46 barriers within the watershed that impede or block salmon migration caused by dams, diversions, road crossings, and natural barriers. Impassable barriers block salmonids for less than ten percent of the watershed.

Gualala River.
Photo by Bob Coey, NMFS.

The Watershed at a Glance

Spawning Quantity & Quality:	**FAIR to VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools:	**POOR to GOOD**
Large Wood Frequency:	**GOOD**
Riparian Canopy:	**POOR to FAIR**
off channel/Floodplain Quality:	**POOR to GOOD**
Estuary Function:	**GOOD**



Gualala River

Recovery Target: 6,200 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvesting
- Roads and Railroads
- Agriculture
- Droughts

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Gualala River watershed that are in poor condition. The highest priorities for restoration are to:

- Increase pool habitat complexity and frequency of pools
- Increase frequency of off channel habitat
- Increase the amount of large woody debris in streams
- Increase riparian shade to cool streams
- Reduce road density in riparian areas and across the watershed.
- Improve gravel quality (high loads of fine sediment)
- Increase size of riparian trees
- Reduce turbidity

Wide and shallow riffle in the Gualala River
Photo provided by KRIS Information System, and is used with permission

Advancing recovery of coho

salmon in Gualala River requires these priority **recovery actions:**

- Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment to adjacent watercourses to decrease fine sediment.
- Identify high priority barriers and restore passage per NMFS' fish passage guidelines.
- Work with SWRCB and landowners to re-establishing base flows throughout the year. Identify unauthorized water uses and non-compliant bypass flows to protect coldwater input to the main stem and estuaries.
- Conduct programs to purchase water rights to improve surface stream flows.
- . . . in these **core areas:** Robinson Creek and Doty Creek planning watersheds.

Conservation Highlights

- The Gualala River Watershed Council (GRWC) has worked with landowners to conduct sediment reduction projects that have prevented more than 15,000 dump truck loads of sediment from polluting streams.
- GRWC has installed 70 stream temperature monitoring stations throughout the watershed.
- GRWC conducts annual surveys of fish and aquatic and riparian habitat. GRWC completed the first scientific study of the Gualala River Estuary.
- Gualala Redwood Company has installed many instream LWD structures on the North Fork Gualala River

We Need Your Photo Here

Gualala River
Photo © Your Name Here, AFFIL

Immediate Needs

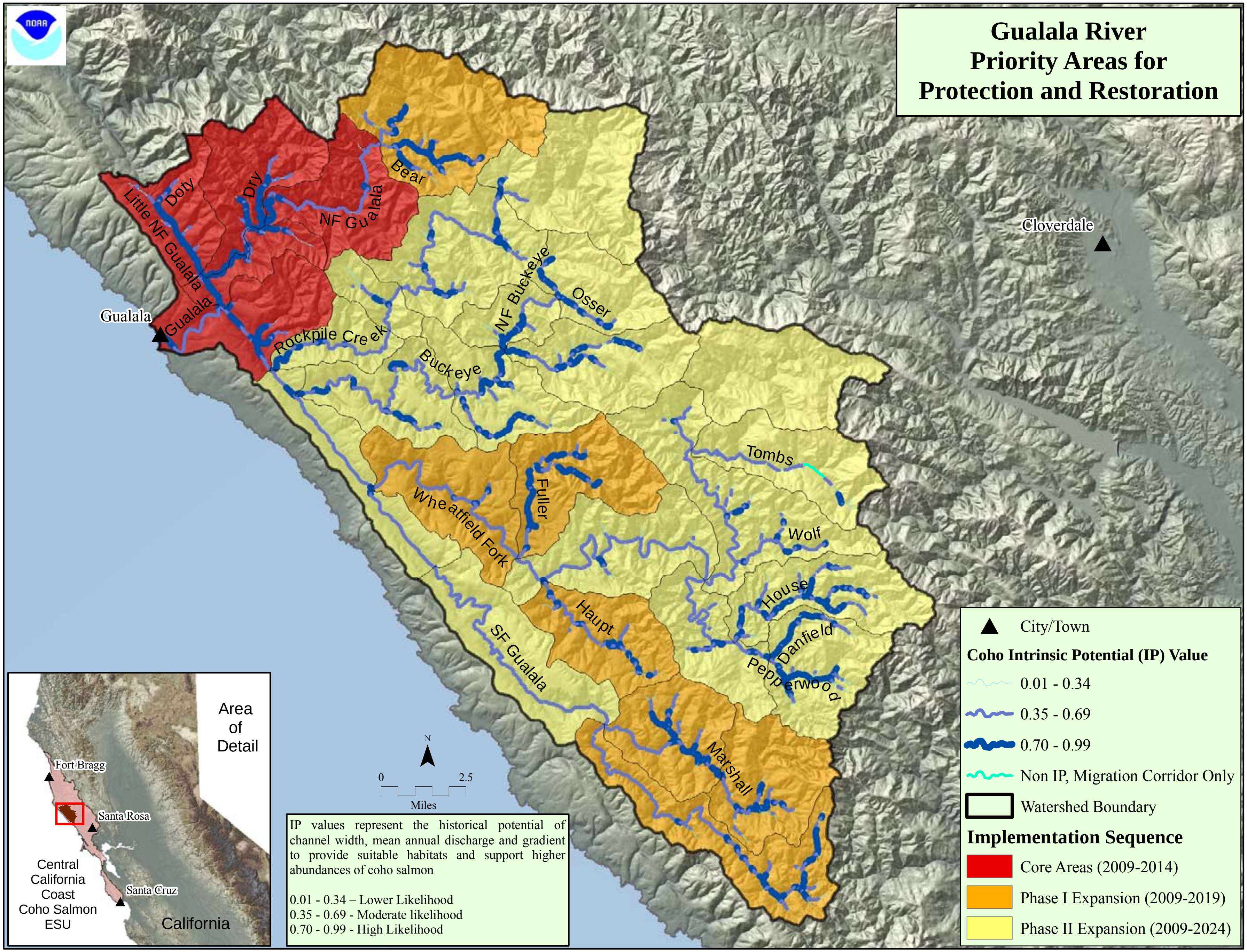
√ Continue effective GRWC collaborative restoration efforts to reduce sediment inputs to streams.

√ Watershed stakeholders need to convene a group to address water diversion issues and develop alternatives to reduce impacts to stream base flow, including alternative frost protection actions, and programs to purchase water rights.

√ Support the ongoing efforts of the Gualala Redwoods Company to increase LWD abundance, and to upgrade or decommission roads.

Recovery Partners

NMFS
DFG
Gualala River Watershed Council
Gualala Redwood Company



Gualala River
Priority Areas for
Protection and Restoration
Cloverdale
Gualala
Bear
Doty
Dry
NF Gualala
Little NF Gualala
Gualala
Rockpile Creek
NF Buckeye
Osser
Buckeye
Tombs
Fuller
Wheatfield Fork
Wolf
House
Danfield
Pepperwood
Haupt
SF Gualala
Marshall
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Non IP, Migration Corridor Only
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)
N
0
2.5
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California

CCC Coho Salmon
Gualala River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	58	Fair	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	7,817 m^2	Fair	Spawning Adults	Sediment	Amount of Gravel*	<1100 m^2	1100-8600 m^2	8600-16100 m^2	>16100 m^2
NMFS	Best Prof. judgment	>10% of pop.	Poor	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	67	Fair	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	75	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	59%	Poor	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	75	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	32.9	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	6%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	19.8	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Good	Good	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	51-75	Fair	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0.24/10 IP-km	Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	32.9	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	35%	Poor	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.12%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	1.01%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	12%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	6.4	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	3.0	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	37%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	65%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	4.8 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	4.1 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Gualala River Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Roads and Railroads	Medium	High	High	Medium	Medium	Very High			High
2	Agricultural Practices	Medium	High	Medium	Medium	Medium	High			High
3	Logging and Wood Harvesting	Medium	Medium	High	Medium	Medium	High			High
4	Droughts	Medium	Medium	High	Medium	Medium	Medium			High
5	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
7	Livestock Farming and Ranching	Medium	Medium	Medium	Medium	Medium	Medium			Medium
8	Channel Modification	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Mining	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
12	Storms and Flooding	Low	Medium	Medium	Medium	Medium	Medium			Medium
13	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Low			Medium
14	Fishing and Collecting	Medium	-	Medium	Low	Low	-			Medium
15	Hatcheries and Aquaculture	-	-	Medium	Low	Low	Low			Low
16	Disease, Predation, and Competition	Low	-	Medium	-	-	-			Low
Threat Status for Targets and Project		High	High	High	High	High	Very High	-	-	Very High

Gualala River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GuR-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
GuR-A-3.1.1	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.										
GuR-A-3.1.1.1	Action Step	Hydrology	Identify and work with the SWRCB to eliminate depletion of summer base flows from unauthorized water uses.	1	5	CDFG, NMFS, Private Landowners, SWRCB	50.00	50.00	50.00	50.00	50.00	250	Cost estimate of 50K per year for agency staff.
GuR-A-3.1.1.2	Action Step	Hydrology	Monitor, identify problems, and prioritize needed changes to permitted water diversions on current or potential coho streams.	2	10	BLM, CDFG, NMFS, North Gualala Water Company, Private Landowners, Sea Ranch, SWRCB	25.00	25.00	25.00	25.00	25.00	250	Cost assumes a partial person year from SWRCB or other agency.
GuR-A-3.1.1.3	Action Step	Hydrology	Require streamflow gauging devices to determine the level of impairment to natural flow.	3	60	CDFG, NMFS, USGS						TBD	Provide consistent funding for the North Fork Gualala River and possible funding for the Wheatfield Forks of the Gualala River.
GuR-A-3.1.2	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
GuR-A-3.1.2.1	Action Step	Hydrology	Enforce existing by-pass flow permit conditions of water diversions to protect coldwater input to the mainstem and estuary.	1	20	CDFG, NMFS, North Gualala Water Company, Private Landowners, Sea Ranch, SWRCB	25.00	25.00	25.00	25.00	25.00	500	Estimates 25K per year to enforce water rights conditions.
GuR-A-3.1.2.2	Action Step	Hydrology	Require compliance with the most recent update of NMFS' Water Diversion Guidelines.	2	60	Private Landowners, Water Agencies						TBD	Additional analysis needed to determine cost of meeting NMFS guidelines.`
GuR-A-3.1.2.3	Action Step	Hydrology	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	2	60	CDFG, NMFS, North Gualala Water Company, Sea Ranch, SWRCB						0	Improved coordination is expected to be a minimal cost.
GuR-A-3.1.2.4	Action Step	Hydrology	Map all water diversions and upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	2	60	CDFG, NMFS, North Gualala Water Company, Private Landowners, Sea Ranch, SWRCB						TBD	Costs may be minimal due to the low number of diverters in this basin.
GuR-A-3.1.3	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
GuR-A-3.1.3.1	Action Step	Hydrology	Regulate the use of streamside wells.	2	60	SWRCB						TBD	Estimate of a partial person year to accomplish this task.
GuR-A-3.1.3.2	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	20	CDFG, North Gualala Water Company, Private Landowners, Sea Ranch, SWRCB	10.00	10.00	10.00	10.00	10.00	200	Promoting these type of projects will require a sustained effort to target willing landowners in critical stream reaches.
GuR-A-3.1.3.3	Action Step	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	2	60	CDFG, NOAA RC, SWRCB						0	Costs are expected to be minimal as some of these efforts will be part of existing programs, however some technical assistance may be necessary from a variety of agencies.
GuR-A-3.1.3.4	Action Step	Hydrology	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	3	5	CDFG, NMFS PRD, NOAA RC, Private Landowners						0	Evaluation costs are expected to be minimal.

Gualala River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GuR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
GuR-A-6.1.1	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
GuR-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.	2	20	CDFG, NOAA RC, Private Landowners						TBD	Continue current restoration projects in progress.
GuR-A-6.1.1.2	Action Step	Pool Habitat	Encourage coordination of LWD placement in streams as part of logging operations and road upgrades to maximize size, quality, and efficiency of effort (DFG 2004).	2	20	CalFire, CDFG, NOAA RC, Private Landowners						0	Cost to coordinate projects is expected to be low.
GuR-A-6.1.1.3	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CDFG, NOAA RC, Private Landowners						0	Minimal cost expected.
GuR-A-6.1.2	Recovery Action	Pool Habitat	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.										
GuR-A-6.1.2.1	Action Step	Pool Habitat	Place instream structures to improve pool depth and habitat complexity.	1	20	CDFG, NOAA RC, Private Landowners						TBD	Need to determine current restoration status and develop cost estimate for remaining work.
GuR-A-6.1.2.2	Action Step	Pool Habitat	Promote bio-engineering solutions as appropriate for bank protection projects.	2	60	CDFG, NRCS, Private Landowners, RCD, Sonoma County						TBD	Cost will vary over time. Cost to support bioengineering low.
GuR-A-6.1.3	Recovery Action	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	CDFG, NMFS, NRCS, Private Landowners						0	Cost to maintain LWD is expected to be minimal.
GuR-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
GuR-A-7.1.1	Recovery Action	Riparian Vegetation	Conserve and manage forestlands for older forest stages.										
GuR-A-7.1.1.1	Action Step	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	3	25	CDFG, NOAA RC, Private Landowners, Sonoma County						TBD	Associated costs per acre can be highly variable. Costs for timberlands ranged from $54 to $279 per acre (DFG 2004), and costs in Sonoma County are likely much higher and cannot be accurately determined at this time.
GuR-A-7.1.2	Recovery Action	Riparian Vegetation	Restore and expand riparian buffers to increase riparian canopy cover.										
GuR-A-7.1.2.1	Action Step	Riparian Vegetation	Locate and utilize sources of native seed and cuttings for planting stock.	3	60	NRCS, Private Consultants, Private Landowners, Sonoma County						TBD	Need additional information to develop cost estimate.
GuR-A-7.1.2.2	Action Step	Riparian Vegetation	Plant native vegetation to promote streamside shade.	2	30	CDFG, NOAA RC, Private Landowners						TBD	Project specific information for specific riparian restoration is needed for cost estimate.
GuR-A-7.1.2.3	Action Step	Riparian Vegetation	Prioritize and fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).	2	20	NOAA RC, Private Landowners						TBD	More site specific project information is needed.
GuR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
GuR-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										

Gualala River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GuR-A-8.1.1.1	Action Step	Sediment	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Can be implemented as part of a program that reduces sediment sources from roads.	1		CDFG, NOAA RC, Private Landowners, RWQCB							Prioritize funding for North Fork Core area with areas along the South Fork Phase 1 areas having the next highest priority.
GuR-A-8.1.1.2	Action Step	Sediment	Treat high priority slides and landings identified in credible landowner assessments.	1	20	CDFG, NOAA RC, Private Landowners						TBD	Cost estimated at 2-3 million for priority sediment sites. Site specific information needed for a accurate cost estimate.
GuR-A-8.1.1.3	Action Step	Sediment	Permitting agencies (State, Federal, and local landowners) should evaluate all authorized erosion control measures during the winter period.	2	5	CDFG, NMFS, Private Landowners, RWQCB	20.00	20.00	20.00	20.00	20.00	100	Rough cost estimate to conduct field assessments.
GuR-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
GuR-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key attributes across the watershed.										
GuR-A-9.1.1.1	Action Step	Viability	Use standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to use similar assessment methods.	2	60	CDFG, NMFS, Private Landowners, RCD						TBD	Use Coastal Monitoring Plan methods.
GuR-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
GuR-A-9.1.2.1	Action Step	Viability	Continue and improve upon monitoring activities to determine the population status of adult and smolt salmonids in the watershed and its tributaries.	2	60	CDFG, NMFS, Private Landowners, RCD						TBD	Use Costal Monitoring Plan methods.
GuR-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. Also see strategies for restoring and enhancing riparian vegetation.										
GuR-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
GuR-A-10.1.1.1	Action Step	Water Quality	Modify policies and regulations to protect riparian corridors, and maintain channel integrity.	1	60	Board of Forestry, CalFire, CDFG, NMFS						TBD	To estimate cost of additional regulations and loss of timber resources in corridors additional analysis is required.
GuR-A-10.1.1.2	Action Step	Water Quality	Improve riparian and instream conditions in rearing habitats by establishing riparian protection zones that extend the distance of a site potential tree height from the outer edge of a channel.	2	60	Board of Forestry, CalFire, CDFG, NMFS						TBD	Loss of timber resources as a result of riparian protection zones can not estimated at this time.
GuR-A-10.1.2	Recovery Action	Water Quality	Conduct programs to purchase water rights to improve surface flows during the summer period.	1	10	CDFG, NMFS, Private Landowners, SWRCB						TBD	Cost is likely greater than 500 dollars per acre foot.
GuR-A-11.1	Objective	Agricultural Practices	Control or abate the development of vineyards or other agricultural activities that impact coho salmon in the next ten years.	1	10	Board of Forestry, CalFire, CDFG, NMFS, Sonoma County						TBD	Regulatory costs and socioeconomic costs associated with this action cannot be estimated at this time.
GuR-A-11.2	Objective	Agricultural Practices	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.										
GuR-A-11.2.1	Recovery Action	Agricultural Practices	Work within the agricultural community to educate landowners and enhance practices that provide for functional watershed processes.	3	20	Farm Bureau, FishNet 4C, Private Landowners, Sonoma County						0	Relatively low cost is expected to work with agricultural community.
GuR-A-11.3	Objective	Agricultural Practices	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches and where habitat is in poor or fair condition.										
GuR-A-11.3.1	Recovery Action	Agricultural Practices	Implement the NRCS/RCD coordinated program for fishery restoration practices.	2	60	CDFG, NMFS, NRCS, Private Landowners, RCD, USACE						0	Low cost expected because these programs are currently in place.
GuR-A-11.4	Objective	Agricultural Practices	Promote agricultural practices that protect and restore habitats for CCC coho salmon.										

Gualala River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GuR-A-11.4.1	Recovery Action	Agricultural Practices	Address sources from agricultural actions that deliver sediment and runoff to stream channels.										
GuR-A-11.4.1.1	Action Step	Agricultural Practices	Investigate effects to coho salmon of conversion of timberland and oak woodlands in the Gualala River (DFG 2004).	2	2	CalFire, CDFG, Private Consultants, Private Landowners	25.00	25.00				50	Rough estimate to conduct pilot study.
GuR-A-11.4.1.2	Action Step	Agricultural Practices	Work with vineyard owners to assess the effectiveness of erosion control measures throughout the winter period.	3	5	CalFire, CDFG, NMFS, RWQCB, Sonoma County	10.00	10.00	10.00	10.00	10.00	50	Cost estimate for field work by agency or other staff.
GuR-A-11.4.2	Recovery Action	Agricultural Practices	Maintain and enhance riparian stream buffer areas near agricultural activities that allow functional riparian areas to develop.	2	20	FishNet 4C, NOAA RC, Private Landowners, Sonoma County						TBD	Additional information needed on the size and scope of projects in order to estimate cost.
GuR-A-11.4.3	Recovery Action	Agricultural Practices	Promote off-channel storage to reduce impacts of water diversion (e.g. winter diversion to ponds).	1	10	CalFire, CDFG, NMFS, NMFS OLE, Private Landowners, Sonoma County, SWRCB						TBD	Low cost to promote. Implementation likely 1-2 million based on recent Russian River costs to develop off-channel storage.
GuR-A-15.1	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
GuR-A-15.1.1	Recovery Action	Droughts	Establish an emergency drought operations center (EDOC), (e.g., Washington Department of Fish and Wildlife, 2001), comprised of the SWRCB, DFG, NMFS, and others to develop emergency rules for augmenting water supplies and mitigating the effects of drought on fish.										
GuR-A-15.1.1.1	Action Step	Droughts	Use the emergency drought operations center (EDOC) or other similar group to oversee implementation of water conservation measures and alternatives; coordinate law enforcement actions to minimize water use and promote CalTIP help discourage poaching.	2	60	CDFG, CDFG Law Enforcement, NMFS OLE, North Gualala Water Company, Private Landowners, Public, Sea Ranch, Sonoma County						TBD	Need additional analysis to estimate cost which will vary with drought frequency.
GuR-A-15.1.1.2	Action Step	Droughts	Work with DFG, Counties, other agencies, and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	2	10	CDFG, NMFS HCD, North Gualala Water Company, Sea Ranch, Sonoma County Water Agency, SWRCB						0	Cost expected to be low if conducted by existing agency staff.
GuR-A-15.1.1.3	Action Step	Droughts	Increase enforcement patrols by DFG and NMFS OLE in sensitive spawning and rearing areas.	1	10	CDFG Law Enforcement, NMFS OLE	4.00	4.00	4.00	4.00	4.00	40	Cost assumes 2 person team making weekly site investigations throughout the summer.
GuR-A-15.1.2	Recovery Action	Droughts	Minimize water use and seek alternatives during droughts to maintain survival of CCC coho salmon.										
GuR-A-15.1.2.1	Action Step	Droughts	Impose mandatory conservation measures to maintain instream flow needs of CCC coho salmon.	3	10	CDFG, NMFS						0	Prioritizing existing funding mechanisms is not expected to add additional cost to the process.
GuR-A-15.1.2.2	Action Step	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	1	60	CalFire, CalTrans, Mendocino County, NMFS, NRCS, Private Landowners, Public, RCD, Sonoma County						TBD	Cost cannot be determined at this time but should be adopted as part of future road actions.
GuR-A-15.1.2.3	Action Step	Droughts	Develop critical flow values that are the basis for minimum bypass flow requirements to support juvenile rearing habitat conditions in the summer and fall months.	2	60	Mendocino County, Sonoma County						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have roads addressed.
GuR-A-15.2	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										

Gualala River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GuR-A-15.2.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004) (Water Code § 1707).	2	20	CDFG, NMFS HCD, North Gualala Water Company, Private Landowners, Sonoma County Water Agency, SWRCB						TBD	Water rights sellers need to be identified and amount of flow/acre-feet to be purchased for a cost estimate.
GuR-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
GuR-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Forestlands supporting Core, Phase I and Phase II priority areas should be considered for purchase (if feasible within the next 5 years).										
GuR-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Should large tracts of forestlands within the Gualala River watershed identified as a Core or Phase I in this recovery plan become available for purchase, the State of California or other entities should consider purchasing the area as a Demonstration Forest or State Park.	2	20	BLM, CalFire, California Coastal Conservancy, CDFG, Conservation Fund, NMFS, Private Landowners, Sonoma County, State Parks, The Nature Conservancy						TBD	Not able to estimate cost at this time.
GuR-A-20.1.2	Recovery Action	Logging and Wood Harvesting	Coordinate with regulatory agencies to minimize conversions in key watersheds and discourage forestland conversions.										
GuR-A-20.1.2.1	Action Step	Logging and Wood Harvesting	Work with Sonoma county planning staff to minimize rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	60	CalFire, NMFS HCD, Sonoma County						0	Cost low if conducted with current regulatory and County staff.
GuR-A-20.1.2.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	3	60	CalFire, CDFG, NMFS, Private Landowners, Sonoma County						TBD	Costs may be low if conducted with existing federal, state and county staff.
GuR-A-20.2	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
GuR-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Address sources from timber harvesting operations.										
GuR-A-20.2.1.1	Action Step	Logging and Wood Harvesting	Encourage all permanent and year-round access roads beyond the THP parcel be surfaced after harvest completion with base rock and road gravel, asphalt, or chipseal, as appropriate.	1	60	CalFire, Private Landowners						TBD	See Roads section.
GuR-A-20.2.1.2	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	10	CalFire, CDFG, NMFS PRD, Private Landowners, RWQCB	20.00	20.00	20.00	20.00	20.00	200	Assumes additional monitoring on at least four THPs at 5k per plan.
GuR-A-20.2.1.3	Action Step	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	3	20	CalFire, California Department of Mines and Geology, Private Consultants, Private Landowners, RWQCB						TBD	Cost expected to be low because much of this mapping has been completed.

Gualala River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
GuR-A-20.2.1.4	Action Step	Logging and Wood Harvesting	Require tree retention on the axis of headwall swales Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	60	CalFire, California Department of Mines and Geology, CDFG, NMFS PRD, Private Consultants, Private Landowners, RWQCB						TBD	Cost can not be determined without information on the number of acres and cost of merchantable timber retention.
GuR-A-20.2.2	Recovery Action	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.										
GuR-A-20.2.2.1	Action Step	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.	2	60	Board of Forestry, CalFire, CDFG, NMFS						TBD	Cost of reducing timber available in riparian areas needs to be calculated for estimating cost of this action.
GuR-A-20.3	Objective	Logging and Wood Harvesting	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of CCC coho salmon.										
GuR-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency for operations within Core, Phase I and Phase II CCC coho salmon areas.										
GuR-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	1	10	CalFire, NMFS	10.00	10.00	10.00	10.00	10.00	100	Assumes NMFS would expend approximately 10K in staff time each year to review, conduct site visits, and comment on Gualala River watershed THPs.
GuR-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Consider the development of a Watershed Database (similar to the DFG Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.										
GuR-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
GuR-A-24.1.1	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	10		5.00	5.00	5.00	5.00	5.00	50	Estimates 5K in cost to certify various staff in the Gualala River watershed.
GuR-A-24.2	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels.										
GuR-A-24.2.1	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.										
GuR-A-24.2.1.1	Action Step	Roads and Railroads	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.	2	5	NRCS, Private Consultants, Private Landowners, RCD						TBD	Cost expected to be low because most areas have been surveyed.
GuR-A-24.2.1.2	Action Step	Roads and Railroads	Design new roads that avoid riparian areas and are hydrologically disconnected from the stream network.	2	60	Private Consultants, Private Landowners, Sonoma County						0	Cost can not be determined at this time.
GuR-A-24.2.2	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
GuR-A-24.2.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	2	5	CDFG, Private Consultants, Private Landowners, RWQCB						TBD	Five years may be sufficient to determine problem segments that would be strormproofed.
GuR-A-24.2.2.2	Action Step	Roads and Railroads	Encourage, when necessary and appropriate, restricted access to unpaved roads in winter to reduce road degradation and sediment release. Where restricted access is not feasible, encourage measures such as rocking to prevent sediment from reaching streams with coho salmon (DFG 2004).	2	20	Private Landowners						TBD	Twenty years is suggested to institutionalize these practices.

Gualala River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
GuR-A-24.2.2.3	Action Step	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	Private Landowners, RCD, Sonoma County						TBD	Cost of maintaining upgraded roads will depend on severity of previous winter.
GuR-A-24.2.2.4	Action Step	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.	1	10	FishNet 4C, Private Landowners, RCD						TBD	
GuR-A-24.2.2.5	Action Step	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1	10	CDFG, NOAA RC, Private Landowners, RCD, Sonoma County	500	500	500	500	500	5,000	Based on remaining number of miles of roads that have not been upgraded (500 miles) in Core and Phase I recovery areas. Cost per mile estimated at an average of 10K per mile to upgrade or decommission..

LAGUNITAS RIVER

Lagunitas Creek

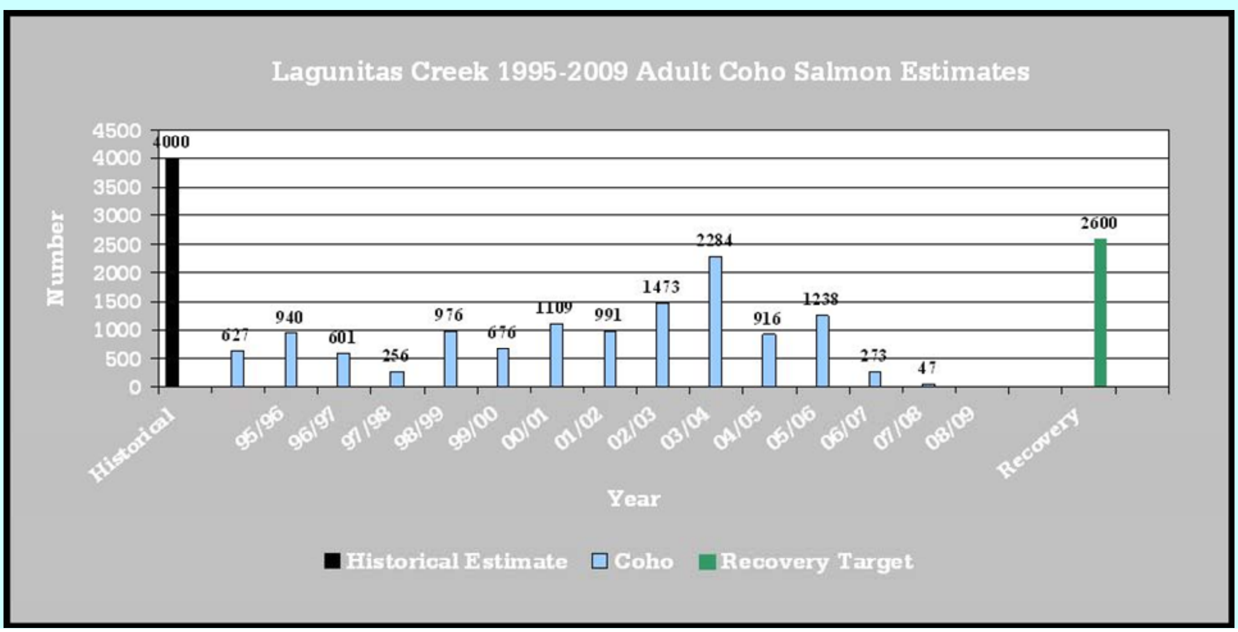
Independent Population
70.3 Km of Potential Habitat
Coho salmon, steelhead, and Chinook salmon present

Lagunitas Creek drains approximately 109 square miles of western Marin County, and empties into Tomales Bay. The Lagunitas Creek watershed is about 35 percent grasslands, 28 percent montane or riparian hardwood forest, and about 22 percent is redwood coniferous forest. The upper portions of the Nicasio Creek subwatershed are dominated by grassland habitats while the main stem of Lagunitas Creek, San Geronimo Creek, and Olema Creek, are dominated by forested habitats. The Lagunitas Creek watershed has moderate erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. Forty-eight percent of the Lagunitas Creek watershed is in private ownership. Local water district lands, national parks and open space make up the remaining area of the watershed. Land uses within the watershed include municipal water supply reservoirs, agriculture, rural residential development, and recreation. Housing development within the Lagunitas Creek watershed is low to moderate, approximately 2600 housing units are present in the watershed. There are 21 dams within the watershed that impede or block salmon migration, and numerous partial barriers to salmon migration caused by road crossings, and diversions. Impassable barriers block salmonids from more than 50 percent of the watershed, more than any other of the 28 focus watersheds identified in this recovery plan.

Lagunitas Creek
Photo provided by KRIS Information System, and is used with permission

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD to VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools	**POOR to GOOD**
Large Wood Frequency:	**POOR to FAIR**
Riparian Canopy:	**POOR to FAIR**
off channel/Floodplain Quality:	**POOR**
Estuary Function:	**FAIR**



Lagunitas Creek

Recovery Target: 2,600 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Droughts
- Residential and Commercial Development
- Climate Change
- Roads and Railroads
- Agricultural Practices
- Water Diversion and Impoundments
- Channel Modification

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Lagunitas Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Increase spawning habitat
- Remove barriers
- Improve pool habitat
- Increase and improve off channel
  habitat types
- Increase the amount of large wood in streams
- Improve riparian shading to cool streams
- Decrease the number of roads near the stream and reduce impacts from remaining roads

Peters Dam located on Lagunitas Creek
Photo provided by KRIS Information System, and is used with permission

Advancing recovery of coho

salmon in Lagunitas Creek requires these priority **recovery actions:**

- Increase the frequency and functionality of off channel habitats.
- Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.
- Maintain and restore hydrologic function, protect riparian and floodplain areas, and minimize adverse effects to water quality and instream rearing habitats resulting from commercial and urban development.
- Create passage to currently inaccessible spawning and rearing habitats above major dams.

. . . in these **core areas:** San Geronimo Creek, Olema Creek, Cheda Creek and lower Lagunitas Creek floodplain and estuarine areas.

Conservation Highlights

- Extensive monitoring activities are conducted in Lagunitas by Marin Municipal Water District, SPAWN, and the National Park Service. Lagunitas has one of the most robust data sets for CCC coho salmon.
- The County of Marin and the NPS have remediated several passage barriers in the Lagunitas Creek watershed.
- SPAWN is also involved in sediment remediation activities.

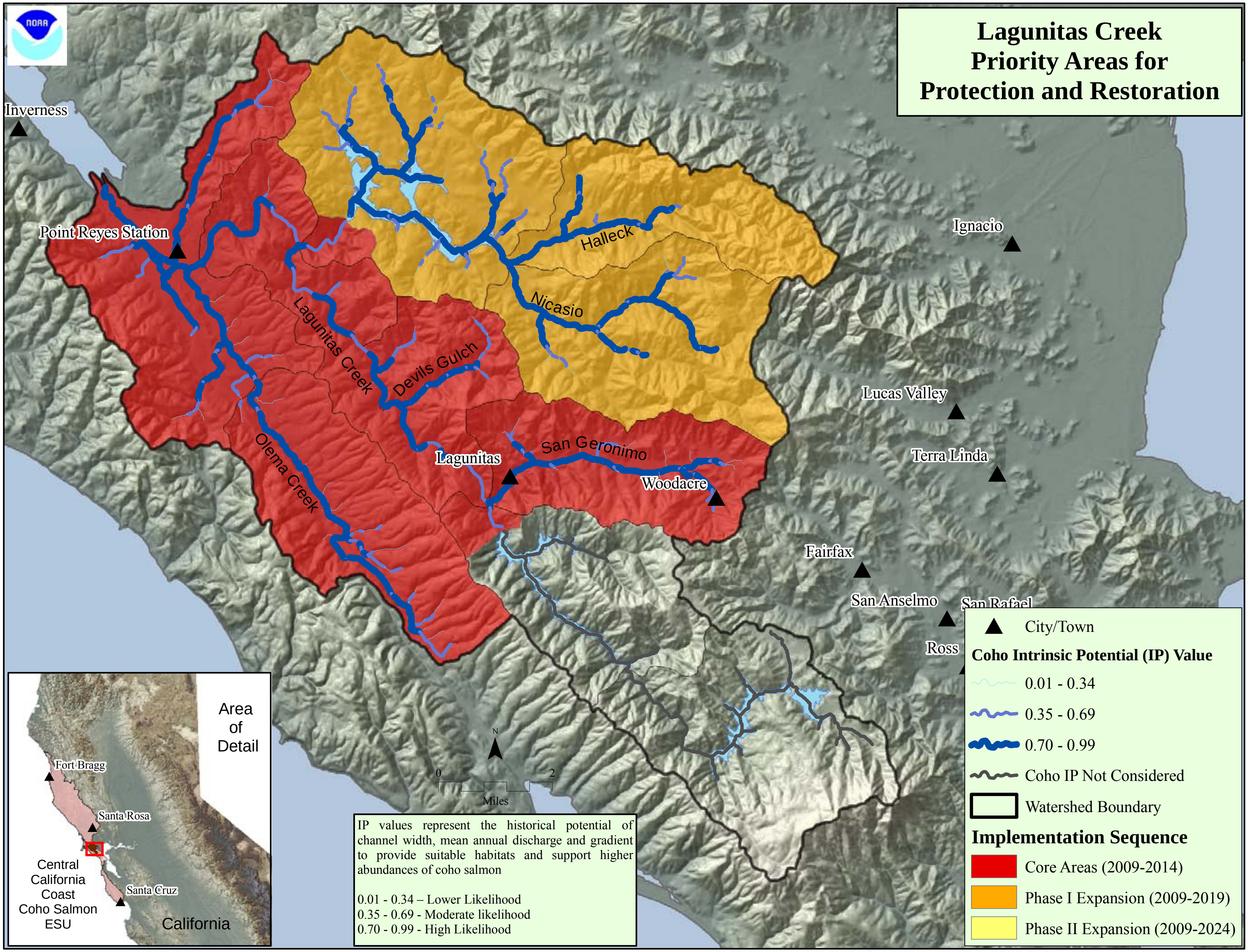
Monitoring in Lagunitas Creek
Photo provided by KRIS Information System, and is used with permission

Immediate Needs

√ Continue monitoring
√ Life cycle monitoring: Lagunitas/Olema
√ Expand monitoring to estuary and Tomales Bay

Recovery Partners

Tomales Bay Watershed Council
MMWD
SPAWN
NPS
County of Marin
California State Parks


Lagunitas Creek
Priority Areas for
Protection and Restoration
Inverness
Point Reyes Station
Halleck
Nicasio
Lagunitas Creek
Devils Gulch
Olema Creek
Lagunitas
San Geronimo
Woodacre
Ignacio
Lucas Valley
Terra Linda
Fairfax
San Anselmo
San Rafael
Ross
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
0
2
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Coho IP Not Considered
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Lagunitas Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	33	Very Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	32%	Poor	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	>90 days	Very Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	303 m^2	Poor	Spawning Adults	Sediment	Amount of Gravel*	<600 m^2	600-6100 m^2	6100-11700 m^2	>11700 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	50	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	50	Good	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Good	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8		NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	50	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	17.05	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	4%	Good	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	0.03%	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	33	Very Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	2.7/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	17.05	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	<50%	Poor	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR		Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.42%	Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	12.48%	Fair	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	10 - 25%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	2.6	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	51%	Fair	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	83%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	2.2 mi/sq.mi.	Good	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	2.9 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	20-40 per IP-km	Good	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	35-50%	Good	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Lagunitas Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Residential and Commercial Development	Medium	Low	High	High	Medium	Very High			High
2	Droughts	Medium	Low	High	Medium	Medium	Very High			High
3	Channel Modification	Medium	Low	Medium	High	Medium	High			High
4	Climate Change	Medium	Low	High	Medium	Medium	High			High
5	Roads and Railroads	Medium	Low	Medium	High	Medium	High			High
6	Water Diversion and Impoundment	Medium	Low	High	Medium	Medium	High			High
7	Livestock Farming and Ranching	Medium	Low	High	Medium	Medium	Medium			Medium
8	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Logging and Wood Harvesting	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
12	Storms and Flooding	Medium	Low	Medium	Medium	Medium	Medium			Medium
13	Mining	Low	Low	Low	Medium	Low	-			Low
14	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
15	Disease, Predation, and Competition	Low	-	-	-	Low	-			Low
16	Fishing and Collecting	-	-	-	Low	Low	-			Low
Threat Status for Targets and Project		High	Low	Very High	High	High	Very High	-	-	Very High

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-2.1	Objective	Floodplain	Permanently protect riparian and floodplain habitat.										
LaC-A-2.1.1	Recovery Action	Floodplain	Support the acquisition of the San Geronimo Golf Course to support fish passage and increase channel complexity and access to off channel habitat in the San Geronimo Corps area.	1	10	CDFG, NMFS, NOAA RC, SPAWN, USFWS	800	800	800	800	800	8,000	There is local support for the acquisition, and the property is currently on the market. Acquisition and restoration may be the single most important action to be taken in this watershed for recovery of the coho salmon population.
LaC-A-2.1.2	Recovery Action	Floodplain	Evaluate undeveloped and developed floodplain property for potential function and acquisition potential.	2	3	MMWD, NPS, SPAWN	1.67	1.67	1.67			5	Costs of evaluation coincide with other proposed evaluation actions, and are expected to be minimal.
LaC-A-2.1.2.1	Action Step	Floodplain	Work with the San Geronimo Golf Course to restore the floodplain, riparian, and in stream habitats.	2	2	CA Coastal Commission, California Coastal Conservancy, CDFG, NMFS, NOAA RC, Private Landowners, SPAWN						TBD	
LaC-A-2.1.3	Recovery Action	Floodplain	Evaluate potential of modification to the Olema Ranch Campground to accommodate improved floodplain function on Olema Creek.	2	3	NPS, Private Landowners, State Parks	0.67	0.67	0.67			2	Most costs would be associated with implementation, and costs of evaluation are expected to be minimal.
LaC-A-2.1.4	Recovery Action	Floodplain	Evaluate potential acquisition of easements to protect floodplain function on lower Lagunitas Creek.	2	5	NPS, Private Landowners	0.40	0.40	0.40	0.40	0.40	2	Costs of evaluation coincide with other proposed evaluation actions, and are expected to be minimal.
LaC-A-2.2	Objective	Floodplain	Allow and support the formation of inset floodplains in the Lower Lagunitas watershed.										
LaC-A-2.2.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.	1	60	Marin County, Marin RCD, MMWD, NPS, State Parks	1,667	1,667	1,667	1,667	1,667	100,000	Addresses multiple poor habitat attributes and results in long term benefits by addressing the underlying threats.
LaC-A-2.2.1.1	Action Step	Floodplain	Implement Marin County Flood Zone activities for the improvement of coho salmon habitat	2	-1	Marin County, MMWD						0	Implementation of existing program activities are unlikely to increase costs associated with recovery.
LaC-A-2.3	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
LaC-A-2.3.1	Recovery Action	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	3	5	Marin County, MMWD, NPS, State Parks	8.00	8.00	8.00	8.00	8.00	40	This is a GIS exercise with ground truthing, and costs are expected to be fairly low.
LaC-A-2.3.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	60	CDFG, Marin County, MMWD, NMFS, NPS, State Parks						TBD	Costs to promote and support restoration efforts (e.g. technical assistance) depend on level of technical assistance provided and the types of projects proposed.
LaC-A-2.3.2.1	Action Step	Floodplain	Where existing infrastructure exists within historical floodplains or offchannel habitats, and where restoration is found feasible, encourage willing landowners to restore these areas through conservation easements, etc.	3	25							TBD	Conservation easements can be a powerful tool for conservation. Associated costs per acre can be highly variable. Costs for timberlands ranged from $54 to $279 per acre (DFG 2004). Costs in Marin County are likely much higher and cannot be accurately determined at this time.
LaC-A-2.3.3	Recovery Action	Floodplain	Target habitat restoration and enhancement projects that will function between winter base flow and flood stage.	2	60	Marin County, MMWD, NMFS, NPS, State Parks						TBD	Costs depend on level of technical assistance required and types of projects proposed. Many salmon recovery efforts and management programs are currently ongoing by a variety of agencies and stakeholders. It is possible that there could be additional salmon restoration costs identified; however, at this time we do not have sufficient information to estimate those potential costs.
LaC-A-2.4	Objective	Floodplain	Improve connectivity of floodplain habitat on tributaries, mainstem and estuarine habitat.										
LaC-A-2.4.1	Recovery Action	Floodplain	Evaluate existing road and transportation networks and identify measures to reduce interaction of transportation infrastructure on tributary, mainstem and estuarine floodplain process.	3	5	Marin County, MMWD, NPS, State Parks	4.00	4.00	4.00	4.00	4.00	20	Costs to evaluate and identify measures are expected to be minimal. Most costs would be associated with implementation rather than with preliminary analysis.
LaC-A-2.4.2	Recovery Action	Floodplain	Evaluate potential habitat benefitting multiple species and lifestages	2	5	CDFG, MMWD, NPS, SPAWN, State Parks	2.00	2.00	2.00	2.00	2.00	10	Extensive work on habitat evaluation has been conducted. Additional costs to evaluate remaining habitat expected to be minimal.

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
LaC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
LaC-A-3.1.1	Recovery Action	Hydrology	Manage reservoirs and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	2	60	CDFG, MMWD, NMFS						TBD	
LaC-A-3.1.1.1	Action Step	Hydrology	Continue to assess the release of water from Soulejule Reservoir to develop the optimum flow release for coho salmon (DFG 2004).	2	20	Marin County, Marin RCD, MMWD, NMFS PRD, SWRCB						0	Assessment is ongoing, additional costs are expected to be minimal.
LaC-A-3.1.2	Recovery Action	Hydrology	Manage riparian areas for their site potential composition and structure.	3	60	Marin County, MMWD, Tomalis Bay Watershed Council						TBD	
LaC-A-3.1.3	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
LaC-A-3.1.3.1	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	2	60	CDFG, Gold Ridge RCD, Marin County, Marin RCD, MMWD, NMFS						TBD	Technical assistance is ongoing.
LaC-A-3.1.3.2	Action Step	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	2	10	DWR, Marin County, NMFS, SWRCB						TBD	
LaC-A-5.1	Objective	Passage	Improve access of spawning adults and juveniles to blocked IP kilometers.										
LaC-A-5.1.1	Recovery Action	Passage	Remove all barriers remaining in the Lagunitas Watershed.										
LaC-A-5.1.1.1	Action Step	Passage	Restore fish passage at Roy's Pools to facilitate unimpeded passage for all life stages into the San Geronimo Core Area.	1	3	SPAWN	267	267	267			800	This action would provide access to the San Geronimo Valley Core area for all lifestages.
LaC-A-5.1.1.2	Action Step	Passage	Remove all barriers in the Woodacre, Arroyo, Larsen and Montezuma subwatersheds, tributaries in the San Geronimo core area and remove all barriers in the remaining San Geronimo tributaries and the San Geronimo mainstem portion of the core area.	1	5	Marin County, SPAWN, Trout Unlimited	200	200	200	200	200	1,000	This action would provide access to the most productive subwatershed in this system. Many barriers have been addressed, however some continue to limit access to habitat.
LaC-A-5.1.1.3	Action Step	Passage	Removal all remaining Core area barriers in the Cheda, Devil's Gulch and Olema subwatersheds.	1	10	Marin County, MMWD, NPS, State Parks	500	500	500	500	500	5,000	This is an important Core area that supports extant populations.
LaC-A-5.1.1.4	Action Step	Passage	Remove all barriers remaining in the Lagunitas Watershed.	1	20	Marin County, Marin RCD, MMWD, NPS, State Parks	500	500	500	500	500	10,000	This action addresses access to Phase I&II expansion areas.
LaC-A-5.1.2	Recovery Action	Passage	Evaluate feasibility, develop solutions, and implement fish passage over Seeger Dan (Nicasio).										
LaC-A-5.1.2.1	Action Step	Passage	Provide passage over Seeger Dam (Nicasio).	3	30	CDFG, Marin County, NMFS OLE						TBD	Cannot determine at this time. Cost will depend on method of passage.
LaC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
LaC-A-6.1.1	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-6.1.1.1	Action Step	Pool Habitat	Expand on the efforts of the Regional Water Quality Control Board and Marin Municipal Water District efforts retain LWD.	2	10	MMWD, RWQCB, SPAWN, Trout Unlimited						0	Cost to maintain LWD is expected to be minimal.
LaC-A-6.1.2	Recovery Action	Pool Habitat	Evaluate, develop solutions and implement immediate needs to address problems resulting from channelization.										
LaC-A-6.1.2.1	Action Step	Pool Habitat	Hold restoration workshops to specifically focus on restoration techniques that promote winter rearing juvenile habitat complexity in the Tocaloma reach of the lower Lagunitas mainstem. In addition, focus on restoration techniques that specifically address declining pool frequency and shelter ratings for summer rearing juveniles.	3	9	Marin County, Marin RCD, NOAA RC, SPAWN	10.00	10.00	10.00	10.00	10.00	90	Plan for three workshops over 9 years, each costing approximately 30k.
LaC-A-6.1.3	Recovery Action	Pool Habitat	Identify areas with low large wood recruitment potential and prioritize for restoration.	2	5	MMWD, NPS, SPAWN	4.00	4.00	4.00	4.00	4.00	20	Expect four surveys (one per sub basin) to identify areas with low LWD at approximately $5,000 each.
LaC-A-6.1.4	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.										
LaC-A-6.1.4.1	Action Step	Pool Habitat	Analyze whether summertime low-flow pools (perceived to be a limiting factor) are filling up with fine sediment from San Geronimo Creek between flow events that have enough power to scour the pools. This could be examined by surveying selected pools in detail several times a year (long enough to cover several potential scour and fill events), as was conducted in 1981.	2	5	MMWD, NPS, SPAWN	5.00	5.00	5.00	5.00	5.00	25	Five years of data is expected to be adequate to determine rates of sedimentation.
LaC-A-6.1.4.2	Action Step	Pool Habitat	In the San Geronimo Creek sub-watershed, continue public outreach and education for private landowners, residents, commercial, public utility and county workers regarding best management practices to control erosion, protect riparian vegetation, retain LWD, and minimize disturbance to coho salmon from domestic animals.	3	5	Marin County, SPAWN	1.00	1.00	1.00	1.00	1.00	5	Continue ongoing efforts.
LaC-A-6.1.5	Recovery Action	Pool Habitat	Install LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004).										
LaC-A-6.1.5.1	Action Step	Pool Habitat	Implement LWD projects to address concerns in the 2003 assessment of LWD. The data collected in 2003 provide some insights into the habitat improvements that still need to be made. Resurvey these reaches to compare current conditions to those in 2003.	1	5	CDFG, Marin County, Marin RCD, MMWD, NOAA RC, SPAWN, Trout Unlimited	2,240	2,240	2,240	2,240	2,240	11,200	Cost estimate based on DFG 2004, at approximately 20k per mile.
LaC-A-6.1.5.2	Action Step	Pool Habitat	Install structures with multiple logs and root balls because they are more effective than structures with only one log. The eight top-ranked structures each had between two and four logs.	1	10	CDFG, Marin County, MMWD, NPS, SPAWN	70.00	70.00	70.00	70.00	70.00	700	Estimate 35 structures (1 per 2km), at 20k per structure. Structures already been place in some subwatersheds.
LaC-A-6.1.5.3	Action Step	Pool Habitat	Implement LWD projects with the following four goals or targeted woody debris functions: 1. Retard downstream migration of medium to large gravel and cobble: at incipient riffles and at existing riffles that are too coarse or are lacking sufficient quantities of desirable gravel; 2. Increase pool volume via local scour from flow obstruction; 3. Increase high flow refuge habitat by creating eddies and slower moving water behind obstructions; and 4. Increase summer escape cover habitat by increasing the complexity of the underwater environment and increasing the percentage of the pool that is shaded by cover on or just above the surface of the water.	2	10	Marin RCD, MMWD, NPS, RWQCB, SPAWN, Trout Unlimited						0	Costs covered in LWD structures action (35 structures at 20k each).

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-6.1.5.4	Action Step	Pool Habitat	Conduct outreach and education efforts. Prepare and distribute LWD Brochure to visitors at Samuel P. Taylor State Park. Develop Public displays. Set up Press coverage. Conduct annual outreach to local community groups. Integrate descriptions of the plan into information disseminated by MMWD, including an annual flyer to MMWD customers. Support community-based watershed restoration efforts. Make copies of reports available to the public.	3	10	MMWD, SPAWN, State Parks	5.00	5.00	5.00	5.00	5.00	50	Expect cost to be approximately 5K per year.
LaC-A-6.1.6	Recovery Action	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	2	5	Marin County, MMWD						0	Action is to stop removal of LWD and other habitat elements, so costs are expected to be minimal, and cost savings may occur.
LaC-A-6.1.7	Recovery Action	Pool Habitat	Remove logs and debris from streams only as a "last resort" (i.e., failure to remove them will certainly cause the loss of an essential facility) after consultation with a hydrologist and/or qualified fisheries biologist.	3	60	Marin County, Marin RCD, MMWD, NPS, SPAWN, State Parks						TBD	Costs depend on level of technical assistance provided and the types of projects proposed.
LaC-A-6.1.8	Recovery Action	Pool Habitat	Focus efforts to restore channel complexity in the Tocaloma reach of the Lagunitas mainstem to improve smolt survival.	1	10	MMWD, NPS						0	Costs are expected to be included in implementation of LWD placements actions.
LaC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
LaC-A-7.1.1	Recovery Action	Riparian Vegetation	Prioritize and fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).										
LaC-A-7.1.1.1	Action Step	Riparian Vegetation	Continue riparian protection and sediment control projects with a focus on working with landowners to manage livestock to protect riparian areas, and to implement erosion control projects on State and Federal park and private lands (e.g., Devil's Gulch).	1	10	Marin County, Marin RCD, MMWD, NPS, SPAWN, State Parks						TBD	Livestock damage has severe effects in the Olema Core area, but is less of an issue in the other areas of the watershed.
LaC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
LaC-A-8.1.1	Recovery Action	Sediment	Identify and modify road maintenance activities that generate fine sediment to decrease fine sediment loads (DFG 2004).	3	10	Marin County, NPS, State Parks	15.00	15.00	15.00	15.00	15.00	150	Some work has already been done to reduce sediments from roads. Estimate 25 miles or roads may require treatment, at approximately $6,000 per mile (DFG 2004).
LaC-A-8.1.2	Recovery Action	Sediment	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas (DFG 2004).	3	5	Marin County, Marin RCD, MMWD, NPS, SPAWN, State Parks	4.00	4.00	4.00	4.00	4.00	20	Implementation requires mainly staff time, technical assistance by GIS analysis, so costs expected to be minimal.
LaC-A-8.1.3	Recovery Action	Sediment	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	3	60	CDFG, Marin County, NPS, State Parks						0	NMFS recommends the Fishnet 4C Best Management Practices. Costs are expected to be minimal if BMPs are followed.
LaC-A-8.1.4	Recovery Action	Sediment	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	2	5	Marin County, NPS, State Parks						0	Costs are expected to be minimal due to existing management plans.
LaC-A-8.1.5	Recovery Action	Sediment	Fully implement practices consistent with the SFRWQCB sediment TMDL.	2	10	Marin County, NPS, RWQCB, State Parks						0	Implementation of the TMDL is mandated by the Clean Water Act, and additional costs associated with recovery are not expected.
LaC-A-8.1.6	Recovery Action	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	3	10	Marin County, NPS, State Parks						TBD	Decommissioning and rerouting road and trails can be expensive, however, costs cannot be determined due to an unknown number of miles of roads that may be targeted.
LaC-A-8.1.7	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-CCC-8.1.7.3	Action Step	Sediment	Examine whether fine sediment from San Geronimo Creek is negatively impacting the overall habitat by collecting data that serves as an "indicator" of overall habitat health. Indictors include physical indicators such as the amount of fine material in riffles or biological indicators such as the collection of aquatic insects (which live in the streambed).	3	5	SPAWN, USEPA	10.00	10.00	10.00	10.00	10.00	50	Estimate monitoring costs of approximately 10K per year.
LaC-CCC-8.1.7.4	Action Step	Sediment	Analyze whether the amount of fine sediment in the riffles is high enough to jeopardize juvenile salmonid survival. Subsurface samples in the riffles should be collected, analyzed, and compared to a large body of research that has quantified how much fine sediment is detrimental to salmonid survival. Alternatively, inexpensive monitors that directly sample inter-gravel dissolved oxygen should be installed.	3	5	MMWD, NPS, SPAWN, State Parks, USEPA	15.00	15.00	15.00	15.00	15.00	75	Cost estimate is 15K/year in addition to monitoring in San Geronimo Creek.
LaC-CCC-8.1.7.5	Action Step	Sediment	Assess and implement private road upgrades to reduce excessive fine sediment loading to San Geronimo Creek.	1	5	CDFG, NOAA RC, RWQCB, SPAWN						TBD	Spawn is currently organizing landowner groups in subwatersheds of San Geronimo Creek to develop road upgrade strategies. Roads are currently in poor condition and a significant source of sediment.
LaC-CCC-8.1.8	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	3	30	Marin RCD, Private Landowners, RWQCB						TBD	Costs cannot be determined due to an unknown number of landowners, and undetermined assessment methods.
LaC-CCC-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
LaC-CCC-9.1.1	Recovery Action	Viability	Measure or estimate response of key habitat attributes to recovery efforts across the watershed.										
LaC-CCC-9.1.1.1	Action Step	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	1	20	CDFG, Marin RCD, MMWD, NMFS, RWQCB, SPAWN, State Parks						TBD	Need additional info for methods to be used and landowners participating to develop cost estimate.
LaC-CCC-9.1.1.2	Action Step	Viability	To better understand changes in sedimentation, monitoring in the basin should include: longitudinal profiles, cross-sections, V*, LWD volume and distribution, and embeddedness.	2	30	CDFG, Marin County, MMWD, NPS, SPAWN, State Parks						TBD	Cost cannot be determined at this time. Specific information on the number of sample reaches and methods will determine cost.
LaC-CCC-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
LaC-CCC-9.1.2.1	Action Step	Viability	Monitor population response in off-channel habitats compared to instream habitat, similar to work conducted by Environmental Science Associates et al. (2004).	1	60	CDFG, MMWD, NMFS, NPS, Private Consultants, State Parks						TBD	Cost for monitoring program are estimated at 160K (DFG 2004). This monitoring would follow off-channel habitat improvements and cannot be estimated at this time.
LaC-CCC-9.2	Objective	Viability	Develop the watershed as a lifecycle monitoring location. Standardize monitoring efforts to assess population level response in this area of the Coastal Diversity Stratum.										
LaC-CCC-9.2.1	Recovery Action	Viability	Operation of the Lagunitas life cycle station should continue (Gallagher and Gallagher 2005).		10	CDFG, Marin County, MMWD, NMFS, NPS, SPAWN, State Parks	75.00	75.00	75.00	75.00	75.00	750	Includes juvenile surveys, smolt outmigration, and adult carcass surveys at 75k per year for 10 years.
LaC-CCC-9.2.2	Recovery Action	Viability	Annually monitor juvenile and adult coho salmon to assess success of the implemented augmentation/intervention strategy (eg. number of adult returns, spawning success, juvenile survival etc.) to determine if there is an increase in abundance of natural production of coho salmon in this population.	1	12	CDFG, MMWD, NMFS, SPAWN	0.83	0.83	0.83	0.83	0.83	10	
LaC-CCC-9.3	Objective	Viability	Recover a naturally reproducing run of coho salmon in appropriate subwatersheds.										
LaC-CCC-9.3.1	Recovery Action	Viability	Supplement the existing population, while minimizing departure from the genetic profile that historically existed in the population.										
LaC-CCC-9.3.1.1	Action Step	Viability	Annually capture or retain (during rescue efforts) - adequate numbers of fish from streams in Marin Countiy for purposes of broodstock	1	10	CDFG, MMWD, NMFS, NPS, SPAWN							existing operations

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-CCC-9.3.1.2	Action Step	Viability	Utilize captured fish in a within-basin program for an immediate short term augmentation strategy at established facility(s), for release as adults, to avoid near term extinction (within 6 years).	1	6	CDFG, MMWD, NMFS, NPS, USACE						TBD	Costs estimated for these activities are not high and are being absorbed through the implementation of other programs and existing staff resources.
LaC-CCC-9.3.1.3	Action Step	Viability	Pursue longer term intervention strategies through establishing a river specific facility if populations do not rebound within six years, to avoid extinction and ensure long-term genetic diversity within the population.	2	12	CDFG, MMWD, NMFS, NPS, USACE						TBD	Cost cannot be determined at this time. More specific methods in development will determine cost.
LaC-CCC-9.3.2	Recovery Action	Viability	Re-establish extinct populations within the ESU, while minimizing departure from the genetic profile that historically existed in the population.										
LaC-CCC-9.3.2.1	Action Step	Viability	Annually capture or retain (during rescue efforts) - adequate numbers of fish from streams in Marin Countiy for purposes of broodstock	1	10	CDFG, MMWD, NMFS, NPS							existing operations
LaC-CCC-9.3.2.2	Action Step	Viability	Utilize these surplus fish in out-of-basin programs to increase genetic variability in the Russian River Program as well as for adult re-introduction efforts in barren Marin and Sonoma County streams (eg.Walker and Salmon Creeks)	1	10	CDFG, MMWD, NMFS, NPS, USACE						TBD	Costs estimated for these activities are not high and are being absorbed through the implementation of other programs and existing staff resources.
LaC-CCC-9.3.3	Recovery Action	Viability	Continue to work with existing permitees to rescue juvenile coho salmon that are under an imminent risk of stranding and mortality and relocate to suitable habitat when deemed appropriate by NMFS and CDFG	1	10	CDFG, MMWD, NMFS, NPS, SPAWN, State Parks							Existing operations
LaC-CCC-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
LaC-CCC-10.1.1	Recovery Action	Water Quality	Determine site-specific recommendations, including incentives, to remedy high temperatures and implement accordingly (DFG 2004) .	3	5	Marin County, MMWD, NPS, State Parks							Existing programs could be copied for implementation, so costs are expected to be minimal.
LaC-CCC-10.1.1.1	Action Step	Water Quality	Focus on restoration efforts that deal with riparian canopy, shelter ratings and any other impaired key habitat attribute indicator that relates specifically to instream temperature.	3	5	Marin County, MMWD, NPS, State Parks							Existing programs could be copied for implementation, so costs are expected to be minimal.
LaC-CCC-10.2	Objective	Water Quality	Fully implement practices consistent with the SFRWQCB pathogen and sediment TMDLs.	2	10	Marin County, MMWD, NPS, RWQCB, State Parks						0	Implementation of the TMDL is mandated by the Clean Water Act, and additional costs associated with recovery are not expected.
LaC-CCC-11.1	Objective	Agricultural Practices	Address sources from agricultural actions that deliver sediment and runoff to stream channels.										
LaC-CCC-11.1.1	Recovery Action	Agricultural Practices	Assist in the development and support implementation of sediment TMDL to assure water quality conditions for coho salmon are improved and fine sediment loads are decreased to baseline conditions.		5							0	Costs are expected to be minimal, however technical assistance from several agencies will be needed.
LaC-CCC-12.1	Objective	Channel Modification	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.										
LaC-CCC-12.1.1	Recovery Action	Channel Modification	Develop a Salmon Certification Program for road maintenance staff.	3	5	Marin County, MMWD, NPS, State Parks						0	Existing programs could be copied for implementation, so costs are expected to be minimal.
LaC-CCC-12.2	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
LaC-CCC-12.2.1	Recovery Action	Channel Modification	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow “emergencies”.	2	5	Marin County, Marin RCD, MMWD, NPS, SPAWN, State Parks						0	Costs are expected to be minimal and leaving LWD in place may actually save costs.
LaC-CCC-12.2.2	Recovery Action	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	60	Marin County, MMWD, NPS, State Parks, USACE						0	Gabion baskets are more expensive than most bioengineered solutions, so implementation may actually save costs.
LaC-CCC-12.2.3	Recovery Action	Channel Modification	Conduct restoration activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.	2	30	CDFG, Marin County, Marin RCD, MMWD, NPS, SPAWN, State Parks							Costs cannot be determined due to unknown types and sizes of restoration activities.

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-12.3.1.1	Action Step	Channel Modification	Encourage counties to develop a Sensitive Habitat Ordinance similar to that in place for the County of Santa Cruz.	3	60	Marin County, MMWD, NPS, State Parks						TBD	Costs cannot be determined at this time, however since the Santa Cruz ordinance could serve as a template, and costs are expected to be minimal.
LaC-A-12.3.2	Recovery Action	Channel Modification	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.										
LaC-A-12.3.2.1	Action Step	Channel Modification	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	1	40	CDFG, Marin County, Marin RCD, MMWD, NMFS, NPS, RWQCB, SPAWN, State Parks, USACE, USEPA							Costs cannot be determined at this time, however the net result is expected to be that project proponents leave woody debris in place, which could save costs.
LaC-A-12.3.3	Recovery Action	Channel Modification	Counties and municipalities should adopt a policy of “managed retreat” (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	3	60	Marin County, MMWD, NPS, State Parks						0	Costs associated with policy development are expected to be minimal.
LaC-A-12.3.4	Recovery Action	Channel Modification	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).										
LaC-A-12.3.4.1	Action Step	Channel Modification	Flood control projects or other modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	3	60	Marin County, USACE						0	Implementation is expected to save costs for developers and land owners in the long run.
LaC-A-12.4	Objective	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	2	30	Marin County, Marin RCD, MMWD, SPAWN						TBD	Many design alternatives exist, however they may depend on available resources (e.g. root wads or other bioengineered solutions), and costs cannot be determined at this time.
LaC-A-12.5	Objective	Channel Modification	Evaluate channel crossings, culverts and headcuts to determine effective measures to ensure stable conditions and improved habitat features.	2	5	Marin County, MMWD, NOAA RC, SPAWN						0	This should be a standard business practice, and additional costs are not expected.
LaC-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
LaC-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	2	10	CDFG, MMWD, NPS, RWQCB, State Parks						0	Costs are expected to be minimal as some of these efforts will be part of existing programs, however some technical assistance may be necessary from a variety of agencies.
LaC-A-15.1.2	Recovery Action	Droughts	Dedicate appropriative water rights to instream flow in Olema Creek watershed (NPS is currently evaluating opportunities in this watershed).	2	7	NPS, RWQCB						0	No costs specific to recovery are associated with this effort.
LaC-A-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
LaC-A-15.2.1	Recovery Action	Droughts	Evaluate and assess impacts of local groundwater withdrawals in San Geronimo Creek watershed.	3	20	Marin RCD, MMWD, Private Landowners, RWQCB, SPAWN						TBD	Assessment costs depend on participation and methods utilized, and cannot be determined at this time.
LaC-A-15.3	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
LaC-A-15.3.1	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
LaC-A-15.3.1.1	Action Step	Droughts	Manage reservoirs and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	3	20	CDFG, Marin County, NMFS, Private Landowners, SPAWN						TBD	Costs associated with operations are expected to be minimal, however structural modifications to facilitate appropriate operations may be costly. Costs cannot be determined until specific structural modifications are developed.
LaC-A-15.3.1.2	Action Step	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	3	20	Marin County, Marin RCD, NPS, Private Landowners, SPAWN, State Parks						TBD	Costs cannot be determined due to an unknown number of unauthorized users, and unknown level of enforcement that would be required.

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-15.3.1.3	Action Step	Droughts	Evaluate and implement rainfall capture from impervious surfaces for irrigation use to protect water quality and reduce water demand in summer.	3	10	CDFG, Marin County, Marin RCD, MMWD, NPS, SPAWN, State Parks						TBD	Costs cannot be determined due to an unknown number of participants and types of modifications required for implementation.
LaC-A-19.1	Objective	Livestock Farming and Ranching	Promote grazing and ranching practices that protect and restore CCC coho salmon habitats.										
LaC-A-19.1.1	Recovery Action	Livestock Farming and Ranching	Support grazing practices that minimize impacts to riparian and instream habitat: livestock exclusion, rotational grazing, etc.										
LaC-A-19.1.1.1	Action Step	Livestock Farming and Ranching	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take priority for riparian fencing programs over steer operations.	2	20	CDFG, Marin RCD, NOAA RC						TBD	Costs depend on methods and extent of fencing installed.
LaC-A-19.1.1.2	Action Step	Livestock Farming and Ranching	Increase the use of water storage and catchment systems that collect rainwater in the winter for use during the dry summer and fall seasons.	2	10	Marin RCD, NPS, Private Landowners, State Parks						TBD	Costs for required infrastructure (e.g. mobile water trailers, tanks, etc.) will be the responsibility of individual landowners or supporting agencies, but cannot be determined at this time.
LaC-A-23.1	Objective	Residential and Commercial Development	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.										
LaC-A-23.1.1	Recovery Action	Residential and Commercial Development	Educate county and city public works departments, flood control districts, and planning departments, etc., on the critical importance of maintaining riparian vegetation, instream LWD, and LWD recruitment.										
LaC-A-23.1.1.1	Action Step	Residential and Commercial Development	Encourage FishNet 4C to facilitate instream and riparian restoration and management workshops with a specific focus on problems and opportunities in the Lagunitas Watershed.	2c	5	CDFG, FishNet 4C, Marin County, MMWD, NMFS, NPS, SPAWN, State Parks	30.00	30.00	30.00	30.00	30.00	150	Estimate costs of conducting workshops at approximately $30K per workshop, and annual workshops over 5 years would be ideal.
LaC-A-23.2	Objective	Residential and Commercial Development	Improve stream maintenance practices to protect instream complexity, hydrologic processes and riparian functions.										
LaC-A-23.2.1	Recovery Action	Residential and Commercial Development	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	10	Marin County, NPS, State Parks						0	Costs associated with development of a policy is expected to be minimal.
LaC-A-23.2.2	Recovery Action	Residential and Commercial Development	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	2	5	CDFG, Marin County, Marin RCD, MMWD, NPS, State Parks						0	Action is to stop removal of LWD and other habitat elements, so costs are expected to be minimal, and cost savings may occur.
LaC-A-23.2.3	Recovery Action	Residential and Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	2	60	Marin RCD, MMWD, NPS, Private Landowners, State Parks						TBD	It is possible that there could be additional salmon restoration costs identified based on recovery needs of the species; however, at this time NMFS does not have sufficient information to estimate those potential costs.
LaC-A-23.2.4	Recovery Action	Residential and Commercial Development	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	3	60	CDFG, Marin RCD, NPS, Private Landowners, State Parks						TBD	Costs depend on level of technical assistance provided and the types of projects proposed.
LaC-A-23.2.5	Recovery Action	Residential and Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating CCC coho salmon.	3	10	Marin County, MMWD, NPS, State Parks						TBD	Costs may vary with methods and extent of assessments and actions taken to address impacts, and cannot be determined at this time.
LaC-A-23.3	Objective	Residential and Commercial Development	Maintain and restore hydrologic function, protect riparian and floodplain areas, and minimize adverse effects to water quality and instream rearing habitats resulting from commercial and urban development.										
LaC-A-23.3.1	Recovery Action	Residential and Commercial Development	Avoid new development within riparian zones and the 100 year floodprone zones.										

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-23.3.1.1	Action Step	Residential and Commercial Development	Support the Marin County Streamside Conservation Area Ordinance. Evaluate current moratorium in San Geronimo Valley for pertinent action items.	2a	10	CDFG, Marin County, NPS, SPAWN, State Parks						0	Costs associated with support and evaluation are expected to be minimal.
LaC-A-23.3.2	Recovery Action	Residential and Commercial Development	Avoid, or at a minimum regulate, the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	2	10	Marin County, Marin RCD, MMWD, NPS, State Parks, USACE, USEPA						TBD	Cost savings may occur with limiting use of pesticides, however other types of management may cost more or less, and cannot be determined at this time.
LaC-A-23.3.3	Recovery Action	Residential and Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.	2	60	Marin County, Private Landowners, USACE						0	Stringent review by permitting agencies is expected to reduce costs associated with poorly planned and poorly located developments.
LaC-A-23.3.4	Recovery Action	Residential and Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	1	60	Marin County, Marin RCD, MMWD, NPS, Private Landowners, State Parks						0	Maintenance of existing buffers is not expected to increase costs of recovery.
LaC-A-23.3.5	Recovery Action	Residential and Commercial Development	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
LaC-A-23.3.5.1	Action Step	Residential and Commercial Development	As mitigation for hydrograph consequences, municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	3a	25	Marin County, MMWD, NPS, State Parks						TBD	Costs depend on extent and types of mitigation and/or detention proposed, and cannot be determined at this time.
LaC-A-23.3.5.2	Action Step	Residential and Commercial Development	New development in all historic CCC coho salmon watersheds should meet a zero net increase in storm-water runoff, changes in duration, or magnitude of peak flow.	3a	20	Marin County, Private Landowners						0	County planning, policies, and permits should be modified to implement this action and costs are expected to be minimal.
LaC-A-23.3.5.3	Action Step	Residential and Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	3b	30	Marin County, Marin RCD, MMWD, NPS, RWQCB, State Parks						TBD	Costs to upgrade stormwater discharge points cannot be determined at this time, but may be substantial.
LaC-A-23.3.6	Recovery Action	Residential and Commercial Development	Provide technical and staff support to counties to encourage general plan updates that include measures to protect coho salmon (DFG 2004).	2	20	CDFG, NMFS						TBD	Costs associated with appropriate general plan updates include staff time and technical assistance, but are likely not prohibitive.
LaC-A-23.3.7	Recovery Action	Residential and Commercial Development	Sediment from existing and future commercial and urban development should be reduced to magnitudes appropriate to the geological setting of the watershed, resulting in no net increase in sedimentation over natural limits.										
LaC-A-23.3.7.1	Action Step	Residential and Commercial Development	Toxic waste products from urban activities should receive the appropriate treatment before being discharged into any body of water that may enter any historic CCC coho salmon waters.	2c	60	Marin County, MMWD, RWQCB, USEPA						TBD	Current discharge permits address part of this action, however, additional regulation may be required to address toxic urban runoff. Costs cannot be determined at this time.
LaC-A-23.4	Objective	Residential and Commercial Development	Minimize rate, and subsequent adverse affects, of land conversion to residential and commercial development.										
LaC-A-23.4.1	Recovery Action	Residential and Commercial Development	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).										
LaC-A-23.4.1.1	Action Step	Residential and Commercial Development	Modify Federal, State, city and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	3b	20	Marin County, USACE						0	This is essentially a policy issue that could be addressed at minimal cost.

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
LaC-A-23.4.1.2	Action Step	Residential and Commercial Development	Purchase conservation easements from landowners that currently have grazing or agricultural operations along the estuary.	3a	20	Marin County, Marin RCD, Private Landowners						TBD	Conservation easements can provide a powerful tool for conservation. Associated costs per acre can be highly variable. Costs for timberlands ranged from $54 to $279 per acre (DFG 2004), and costs in Marin County are likely much higher and cannot be accurately determined at this time.
LaC-A-23.4.1.3	Action Step	Residential and Commercial Development	Counties and municipalities should adopt a policy of “managed retreat” (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	3a	25	Marin County						0	Costs associated with policy development are expected to be minimal.
LaC-A-23.4.2	Recovery Action	Residential and Commercial Development	Develop legislation that will fund county planning for environmentally sound growth and water supply and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (DFG 2004).										
LaC-A-23.4.2.1	Action Step	Residential and Commercial Development	Encourage counties to develop a Sensitive Habitat Ordinance similar to that in place for the County of Santa Cruz.	3a	5	Marin County, Marin RCD						0	Costs associated with policy development are expected to be minimal.
LaC-A-23.4.3	Recovery Action	Residential and Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	3	20	Marin County, USACE						0	Additional costs associated with recovery are not expected.
LaC-A-23.4.4	Recovery Action	Residential and Commercial Development	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	30	Marin County, Marin RCD, Private Landowners						0	Costs associated with program development are expected to be minimal.
LaC-A-23.4.5	Recovery Action	Residential and Commercial Development	Work with counties to develop and implement ordinances (e.g. Santa Cruz County Code 2008) to restrict subdivisions by requiring a minimum acreage limit for parcelization in concert with limits on water supply and groundwater recharge areas.	3	15	Marin County, Marin RCD						TBD	Costs associated with development and implementation of ordinances is difficult to determine.
LaC-A-23.4.6	Recovery Action	Residential and Commercial Development	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	2	5	CDFG, Marin County, Marin RCD, MMWD, USACE						0	Costs involved in developing policy are expected to be minimal.
LaC-A-23.4.7	Recovery Action	Residential and Commercial Development	Standards and recommendations regarding development should apply to all jurisdictions, including school districts and other special districts not subject to county and/or state related ordinances or policies.	3	10	Marin County						TBD	This action is basically a policy issue, however additional authorities may be developed to implement the action fully.
LaC-A-23.4.8	Recovery Action	Residential and Commercial Development	Support the development and implementation of regulations for activities that intercept groundwater recharge (e.g., use of subsurface tiles in vineyards, impervious surfaces, etc.).	3	15	CDFG, RWQCB						TBD	This action is basically a policy issue, however additional authorities may be developed to implement the action fully.
LaC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
LaC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.										
LaC-A-24.1.1.1	Action Step	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	3	10	CalTrans, CDFG, Marin County, MMWD						0	Similar existing programs could be modified and implemented at minimal cost.
LaC-A-24.1.1.2	Action Step	Roads and Railroads	Encourage development and implementation of a program similar to the County of Santa Cruz’s Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	10	Marin County, Marin RCD, MMWD, NPS, State Parks						0	Similar existing programs could be modified and implemented at minimal cost.

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-24.1.2	Recovery Action	Roads and Railroads	Expand the NRCS/RCD coordinated permit program to a statewide programmatic ESA consultation that allows funding and technical expertise to small land owners and rural residential property owners.	3	5	CDFG, Marin RCD						0	Cost to expand an existing program are expected to be minimal.
LaC-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
LaC-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).										
LaC-A-24.2.1.1	Action Step	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	10	CalTrans, Marin County						TBD	Costs associated with assessment and redesign cannot be determined at this time, however some assessment has already been conducted.
LaC-A-24.2.1.2	Action Step	Roads and Railroads	Decommission or treat the road sites on the priority list of 20 road sites within the San Geronimo subwatershed based on amount of sediment discharge.	2b	30	Marin County, Marin RCD, SPAWN	17.39	17.39	17.39	17.39	17.39	522	Costs cannot be accurately determined due to an unknown extent and types of treatments required, however, road treatment or decommissioning in coastal Marin has been estimated at approximately $13124276.00 (DFG 2004). Costs associate with this action were estimated by multiplying the approximate stream miles by the per mile cost provided in DFG 2004.
LaC-A-24.2.1.3	Action Step	Roads and Railroads	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF). Where no Core areas are designated, apply this action to Phase I areas.	2a	2	CDFG, NMFS						0	Reviewing agencies can implement this action immediately at minimal cost.
LaC-A-24.2.2	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	Marin County, USACE						0	Existing authorities of permitting agencies facilitate implementation at minimal costs.
LaC-A-24.3	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
LaC-A-24.3.1	Recovery Action	Roads and Railroads	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.										
LaC-A-24.3.1.1	Action Step	Roads and Railroads	NMFS and other stakeholders will work with RCD or NRCS to encourage hiring of consultants to conduct road assessments (first for subwatersheds in Core areas, then for Phase I areas).	3a	10	Marin RCD, MMWD, SPAWN						TBD	Some assessments have already been conducted, but additional costs cannot be determined at this time.
LaC-A-24.3.2	Recovery Action	Roads and Railroads	Implement the most effective best management practices to conduct sediment reduction actions.	3	5	CalTrans, Marin County, Marin RCD, MMWD, NPS, SPAWN						0	NMFS recommends the FishNet 4C best management practices manual, and this resource is readily available.
LaC-A-24.3.3	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.										
LaC-A-24.3.3.1	Action Step	Roads and Railroads	Support the MMWD in their efforts to reduce sedimentation from lands in the Lagunitas Creek watershed. MMWD will also coordinate with the Marin County Stormwater Pollution Prevention Program (MCSTOPPP) to make sure that educational materials about non-point source pollution are available to homeowners in the San Geronimo Valley.	2b	10	Marin RCD, MMWD, RWQCB						0	Outreach and education are ongoing, and additional costs are expected to be minimal.
LaC-A-24.3.3.2	Action Step	Roads and Railroads	Develop MOUs with local agencies. MMWD will seek to enter into a MOU with DPR, MCOSD NPS, and MCFD to foster the working relationship between these agencies in terms of road maintenance and sediment control.	3c	5	Marin County, MMWD, RWQCB						0	Increased coordination between county agencies and other stakeholders is expected to result in cost savings.

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-24.3.4	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.										
LaC-A-24.3.4.1	Action Step	Roads and Railroads	Continue to work to restore coho salmon passage at county facilities.	1b	30	CDFG, Marin County, Marin RCD, MMWD						TBD	Costs depend on types of passage improvements proposed, and cannot be accurately determined.
LaC-A-24.4	Objective	Roads and Railroads	Determine extent of roads and railroad networks that directly impede fish passage and take steps to address this threat.										
LaC-A-24.4.1	Recovery Action	Roads and Railroads	Using the most recent established protocols, conduct passage assessments where they do not currently exist.	2	15	Marin RCD, MMWD, NPS, SPAWN, State Parks						TBD	Some assessments have already been conducted, however remaining needs have not been quantified, and costs cannot be determined.
LaC-A-24.4.2	Recovery Action	Roads and Railroads	Conduct collaborative evaluations of priorities for treatment of CCC coho salmon passage barriers, such as the Fish Passage Forum (DFG 2004).	2	15	CDFG, MMWD, NMFS, NPS, SPAWN, State Parks						0	Collaborative approaches are expected to result in cost savings.
LaC-A-26.1	Objective	Water Diversion and Impoundment	Provide incentives to improve instream flows for coho salmon:.										
LaC-A-26.1.1	Recovery Action	Water Diversion and Impoundment	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).										
LaC-A-26.1.1.1	Action Step	Water Diversion and Impoundment	Organize and stakeholder group with members of the SWRCB and DWR as well as other interested parties to create the incentive program.	2	60	Marin RCD, MMWD, NPS, Private Landowners, RWQCB, State Parks						TBD	Costs to develop and maintain a functioning group cannot be determined at this time, but would likely not be prohibitive.
LaC-A-26.2	Objective	Water Diversion and Impoundment	Promote water conservation by the public, water agencies, agriculture, private industry, and the citizenry.										
LaC-A-26.2.1	Recovery Action	Water Diversion and Impoundment	Collaborate with landowners to minimize impacts on summer base flow from riparian water diversion activities.										
LaC-A-26.2.1.1	Action Step	Water Diversion and Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFG, Marin RCD, MMWD, NPS, SPAWN, State Parks						0	Costs associated with promoting use of reclaimed water is expected to be minimal.
LaC-A-26.3	Objective	Water Diversion and Impoundment	Improve current laws and policies to control diversions and water use in order to maintain and restore surface flows.										
LaC-A-26.3.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon by establishing a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage (DFG 2004).										
LaC-A-26.3.1.1	Action Step	Water Diversion and Impoundment	Promote conjunctive use of water with water projects whenever possible to maintain or restore coho salmon habitat.	3	60	CDFG, Marin County, Marin RCD, MMWD, RWQCB, SPAWN						0	Costs associated with promoting conjunctive use of water is expected to be minimal.
LaC-A-26.3.1.2	Action Step	Water Diversion and Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	3	30	Marin RCD, MMWD, NMFS, RWQCB						0	Costs to remote this action are expected to be minimal.
LaC-A-26.4	Objective	Water Diversion and Impoundment	Explore passage alternatives to regain access to historic habitat blocked by water diversions.										
LaC-A-26.4.1	Recovery Action	Water Diversion and Impoundment	Examine the feasibility of creating passage over Seeger Dam for both adults and smolts to restore access to Nicassio Creek.										
LaC-A-26.4.1.1	Action Step	Water Diversion and Impoundment	Enter into a dialog with MMWD about establishing passage over Seeger Dam.	2									Costs related to discussion and planning are expected to be minimal, however, costs of implementing passage may be substantial.
LaC-A-26.4.1.2	Action Step	Water Diversion and Impoundment	Determine physical and biological constraints of passage and survival in the reservoir and watershed.	2	5	CDFG, MMWD, NMFS						TBD	Costs for a limiting factors analysis are unknown at this time but a likely not prohibitive.
LaC-A-26.4.1.3	Action Step	Water Diversion and Impoundment	Evaluate feasibility of establishing passage to and from Nicassio Creek based on the constraints and implement if feasible.	2	10	CDFG, Marin County, MMWD, NMFS						TBD	Costs associated with implementation depend on type of passage determined to be feasible, and cannot be determined.
LaC-A-26.5	Objective	Water Diversion and Impoundment	Improve current laws and policies to control diversions and water use in order to maintain and restore surface flows.										

Lagunitas Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
LaC-A-26.5.1	Recovery Action	Water Diversion and Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.										
LaC-A-26.5.1.1	Action Step	Water Diversion and Impoundment	Encourage the SWRCB to adjudicate watersheds with CCC coho salmon populations to resolve over-allocation of water resources and provide adequate funding to water masters to enforce allocations.	3	10	RWQCB						TBD	Costs to adjudicate and enforce water allocations cannot be determined at this time.
LaC-A-26.5.1.2	Action Step	Water Diversion and Impoundment	Require the SWRCB to conduct interagency consultation with the California Department of Fish and Game and technical assistance with NMFS on the issuance of water rights permits.	3	15	NMFS, RWQCB						TBD	Additional regulatory authorities may be needed to fully implement this action, and associated costs cannot be determined. However technical assistance may be readily provided, and associated costs are expected to be minimal.
LaC-A-26.5.1.3	Action Step	Water Diversion and Impoundment	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	3	10	CDFG, NMFS, RWQCB						TBD	Costs associated with review and modification of use may be substantial, but cannot be determined due to an unknown number of water users.
LaC-A-26.5.1.4	Action Step	Water Diversion and Impoundment	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	3	3	RWQCB						0	This effort is ongoing, and no additional costs are expected.
LaC-A-26.5.1.5	Action Step	Water Diversion and Impoundment	Petition SWRCB to have all CCC coho salmon watersheds declared as fully appropriated.	3	3	CDFG, NMFS, NPS, RWQCB						0	Costs are expected to be minimal.
LaC-A-26.6	Objective	Water Diversion and Impoundment	Develop new policies and regulations to provide suitable flow conditions for CCC coho salmon.										
LaC-A-26.6.1	Recovery Action	Water Diversion and Impoundment	Implement guidelines (e.g. DFG & NMFS 2002) or protective measures anticipated as a result of California's AB2121 stream flow policy.	1	2	RWQCB						0	Implementation of existing guidelines and protective measures is not expected to have additional costs.
LaC-A-26.6.2	Recovery Action	Water Diversion and Impoundment	Encourage the SWRCB to adjudicate watersheds with CCC coho salmon populations to resolve over-allocation of water resources and provide adequate funding to water masters to enforce allocations.										
LaC-A-26.6.2.1	Action Step	Water Diversion and Impoundment	Work with the SWRCB to place a moratorium on summer water diversions in all priority CCC coho salmon watersheds. Focus first on Core Areas, then on Phase I and Phase II areas.	2	5	CDFG, RWQCB						TBD	Costs to water users may be substantial, but cannot be determined.
LaC-A-26.6.2.2	Action Step	Water Diversion and Impoundment	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	3	5	CDFG, USACE						0	Evaluation costs are expected to be minimal.
LaC-A-26.6.3	Recovery Action	Water Diversion and Impoundment	Support the development and implementation of regulations for activities that intercept groundwater recharge (e.g., use of subsurface tiles in vineyards, impervious surfaces, etc.).	3	20	CDFG, Marin County, MMWD, RWQCB						TBD	Implementation may require additional regulatory authorities and extensive modifications to existing groundwater uses, however, NMFS is not able to estimate costs at this time due to an unknown number of extractors and uses in the watershed.
LaC-A-26.6.4	Recovery Action	Water Diversion and Impoundment	Institutionalize programs to purchase easements on water rights to encourage the maintenance of surface flows.	3	10	CDFG, Marin County, Marin RCD, RWQCB						TBD	Costs associated with development and implementation of easement programs cannot be determined at this time.
LaC-A-26.7	Objective	Water Diversion and Impoundment	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
LaC-A-26.7.1	Recovery Action	Water Diversion and Impoundment	Minimize take attributable to diversion of stream flow through alternatives such as: the operation of off-stream reservoirs, development of infrastructure necessary for conjunctive use of stream flow, and use of reclaimed water.	2	30	CDFG, Marin RCD, MMWD, Private Landowners						TBD	Costs associated with development of alternatives cannot be determined due to the unknown number and types of alternatives that might be proposed.
LaC-A-26.7.2	Recovery Action	Water Diversion and Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	2	5	CDFG, Marin County, Marin RCD, MMWD, RWQCB						0	Coordination costs are expected to be minimal, depending on what specific actions are proposed.

NAVARRO RIVER

Navarro River

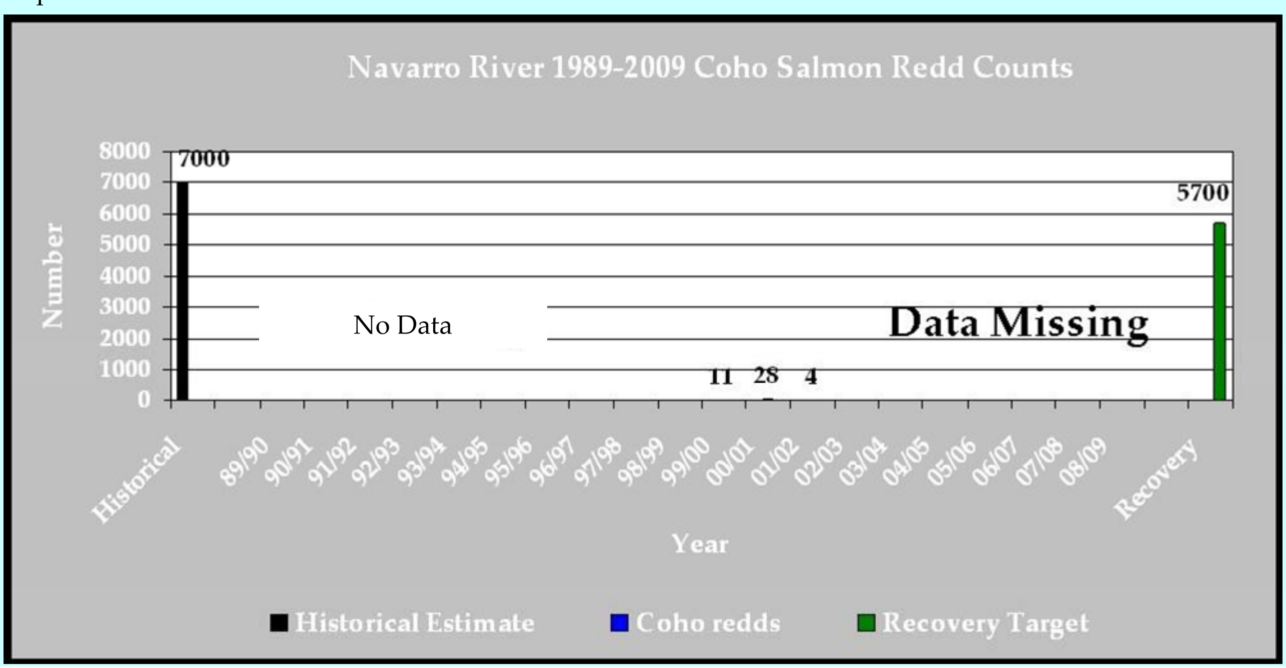
Dependent Population
17.0 Km of potential coho salmon habitat
Coho salmon, Chinook salmon, and steelhead present

Navarro River drains approximately 315 square miles of western Mendocino County. Navarro River enters the Pacific Ocean about fifteen miles south of the town of Mendocino. Approximately 41 percent of the Navarro River watershed is redwood, nine percent is Douglas-fir forest, 26 percent is montane hardwood, and 15 percent is annual grassland. The entire Navarro River watershed has moderate to high erodibility. In 2000 the EPA established a TMDL for the Navarro as water quality was impaired for sediment and temperature. About 98 percent of the watershed is in private ownership; about two percent of the watershed is state park land, state wildlife lands, or federal forest and grazing lands. Land use in the watershed is dominated by timber production, though agriculture is also prominent. Timber harvesting began in the Navarro watershed during the mid-1800s, and a second logging boom occurred from the 1930s to the early 1950s. Within the past 10 years, about 15 percent of the Navarro River watershed has been under a timber harvest plan. Housing development within the Navarro River watershed is moderately low; approximately 1280 housing units are present in the watershed. There are six dams within the watershed that impede or block salmon migration, in addition, there are numerous partial barriers to salmon migration caused by diversions, road crossings, and natural barriers. Impassable barriers block salmonids for less than ten percent of the watershed.

Navarro River estuary
Photo provided by KRIS Information System, and is used with permission

The Watershed at a Glance

Spawning Quantity & Quality:	**FAIR to VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools	**POOR to GOOD**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**POOR to FAIR**
off channel/Floodplain Quality:	**POOR to FAIR**
Estuary Function:	**FAIR**



Navarro River

Recovery Target: 5,700 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Storms and Flooding
- Drought
- Roads and Railroads

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Navarro River watershed that are in poor condition. The highest priorities for restoration are to:

- Increase pool habitat complexity
- Increase riparian shade to cool streams
- Increase frequency of off channel habitat
- Manage stream flow to reduce redd scour
- Increase stream base flow
- Increase frequency of LWD
- Increase size of riparian trees
- Reduce road density in riparian areas and across the watershed
- Decrease sources of sediment

Photo showing poor conditions in Anderson Creek
Photo by Tom Daugherty, NMFS

Advancing recovery of coho

salmon in Navarro River requires these priority **recovery actions:**

- Install large woody debris structures and other features to increase stream complexity and improve pool frequency and depth.
- Identify and implement water conservation measures. Identify and eliminate unauthorized water uses.
- Work with SWRCB and landowners to improve base stream flow. Develop and implement alternative frost protection strategies that are protective of salmonids.
- For all rural roads apply tested and approved best management practices for road maintenance and decommissioning.

. . . in these **core areas:** Flynn Creek, John Smith Creek, Lower South Branch Navarro River, and the North Fork Navarro River planning watersheds.

Conservation Highlights

- MRC has worked with TU and NMFS to improve coho salmon habitat, by replacing large culverts at John Smith Creek and conducting road upgrades.
- Mendocino County RCD and NRCS continue to work with private landowners to conduct road upgrade and sediment reduction projects throughout the watershed. Also, these agencies work with landowners to conduct stream improvement projects, such as riparian planting, and bank protection projects.

Culvert that was removed on John Smith Creek
Photo provided by KRIS Information System, and is used with permission

Immediate Needs

√ Cooperate with the Mendocino RCD and NRCS to minimize impacts of private roads and agricultural activities.

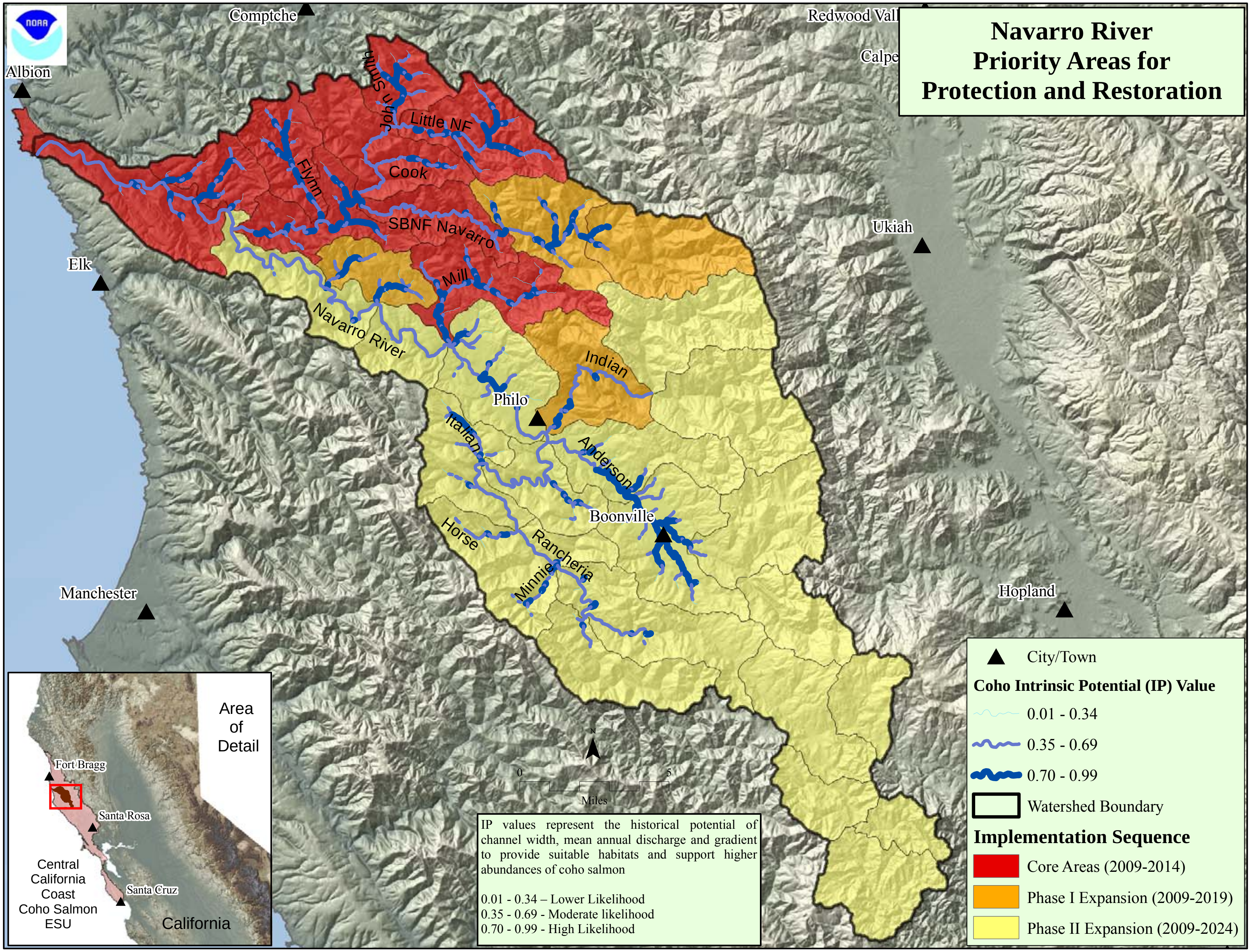
√ MRC finalize its proposed Habitat Conservation Plan and continue restoration efforts on their lands that provide current and potential habitat for coho salmon.

√ Work with water diverters along tributaries such as Floodgate Creek, Indian Creek and Mill Creek to maintain a population of coho salmon in the watershed area above the North Fork confluence.

√ Conduct an assessment of floodplain and coho salmon over-wintering potential of the Highway 128 corridor and implement actions to improve overwintering habitat impacted by the highway.

Recovery Partners

NMFS
DFG
Mendocino County RCD
NRCS
MRC
TU



Navarro River
Priority Areas for
Protection and Restoration
Comptche
Redwood Vall
Calpe
Albion
Ukiah
Elk
Manchester
Hopland
Philo
Boonville
John Smith
Little NF
Flynn
Cook
SBNF Navarro
Mill
Navarro River
Indian
Italian
Anderson
Horse
Rancheria
Minnie
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California

CCC Coho Salmon
Navarro River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	58	Fair	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	91%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	126,528 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<900 m^2	900-7800 m^2	7800-14800 m^2	>14800 m^2
NMFS	Best Prof. judgment	5-10%	Fair	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	67	Fair	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	76.5	Poor	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	54%	Good	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	92	Poor	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	50.2	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	4%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	53.5	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	67	Fair	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	3.1/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	50.2	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	33%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.14%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	1.26%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	15%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	3.6	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	31%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	79%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	5.5 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	5.4 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	20-34%	Fair	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Navarro River Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Roads and Railroads	Medium	Low	Medium	Medium	Medium	Very High			High
2	Storms and Flooding	Medium	Medium	Medium	Medium	High	High			High
3	Droughts	Medium	Medium	High	Medium	Medium	Medium			High
4	Agricultural Practices	Medium	Low	Medium	Medium	Medium	High			Medium
5	Logging and Wood Harvesting	Medium	Low	Medium	Medium	Medium	High			Medium
6	Climate Change	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Water Diversion and Impoundment	Medium	Medium	Medium	Medium	Medium	Low			Medium
11	Channel Modification	Medium	Low	Medium	Medium	Medium	Low			Medium
12	Recreational Areas and Activities	Medium	Low	Low	Medium	Medium	Medium			Medium
13	Mining	Low	Low	Low	Medium	Low	Low			Low
14	Fishing and Collecting	Medium	-	-	Low	Low	-			Low
15	Disease, Predation, and Competition	Medium	-	-	-	-	-			Low
16	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
Threat Status for Targets and Project		High	Medium	High	High	High	Very High	-	-	Very High

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
NaR-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
NaR-A-2.1.1	Recovery Action	Floodplain	Target habitat restoration and enhancement that will provide functioning winter refuge habitat.										
NaR-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	3	2	CDFG, Private Consultants, Private Landowners	12.50	12.50				25	Cost based on use of existing data and to validate in field.
NaR-A-2.1.1.2	Action Step	Floodplain	Evaluate Highway 128 and associated crossings with focus on the segment from the North Fork Navarro Bridge to Barton Gulch. Many crossing may need to be modified to provide access to historical floodplain habitats.	1	1	CalTrans, CDFG, NOAA RC	10.00					10	Cost to evaluate existing passage database and plan restoration of culvert crossings on Hwy128.
NaR-A-2.1.1.3	Action Step	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or removal barriers or levees that inhibit access to winter habitat.	2	20	CalTrans, CDFG, Mendocino County Department of Public Works, NOAA RC, NRCS, Private Landowners, RCD						TBD	Reaches for this action need to be identified and cost estimates developed. Stream segments in Anderson Valley have most potential for this action.
NaR-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
NaR-A-3.1.1	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
NaR-A-3.1.1.1	Action Step	Hydrology	Assess and map water diversions (DFG 2004). Focus initial efforts in Core and Phase I watersheds. Expand efforts to Phase II watersheds upon completion of Core and Phase I evaluation.	2	2	Private Consultants, Private Landowners, SWRCB	15.00	15.00				30	Estimate based on landowner cooperation to assess diversion sites.
NaR-A-3.1.1.2	Action Step	Hydrology	Support SWRCB in regulating the use of streamside wells and groundwater.	2	5	CDFG, FishNet 4C, NOAA RC, Private Landowners, RCD, SWRCB	40.00	40.00	40.00	40.00	40.00	200	Additional regulatory staff to support improved regulation of groundwater.
NaR-A-3.1.1.3	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	2	5	SWRCB						TBD	Need additional info from SWRCB to develop cost estimate for this action.
NaR-A-3.1.1.4	Action Step	Hydrology	Require streamflow gauging devices to determine the level of impairment to natural flow. Focus initial efforts on Mill Creek, Flynn Creek, and North Fork Navarro.	3	10	Private Landowners, SWRCB, USGS	40.00	40.00	40.00	40.00	40.00	400	Need information from USGS to develop more precise cost estimate. Estimate provided is based on two gauges at 20k per year for 10 years.
NaR-A-3.1.2	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
NaR-A-3.1.2.1	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses. Focus efforts along Mill Creek, and other tributaries along the mainstem Navarro River above the North Fork. Tributaries such as Floodgate Creek and Perry Gulch and other small tributaries need water use evaluated.	1	5	CDFG, CDFG Law Enforcement, NMFS OLE, SWRCB	40.00	40.00	40.00	40.00	40.00	200	Estimated cost for additional regulatory staff to conduct work.
NaR-A-3.1.2.2	Action Step	Hydrology	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	3	60	CDFG, NMFS, SWRCB						TBD	Need additional analysis to determine costs of upgrading and maintaining system.
NaR-A-3.1.3	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
NaR-A-3.1.3.1	Action Step	Hydrology	Work with SWRCB and landowners to re-establish natural flow regimes to improve adult migration to spawning habitats and smolt outmigration.	2	10	CDFG, NMFS HCD, Private Consultants, Private Landowners, SWRCB						TBD	Additional information needed to determine cost of providing appropriate bypass flows.

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NaR-A-3.1.3.2	Action Step	Hydrology	Work with SWRCB and landowners to improve and protect over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently or have potential to be impacted by water use.	1	20	CDFG, FishNet 4C, NOAA RC, Private Landowners, RCD, SWRCB						TBD	Costs for acquisition of water rights and developing alternatives will need to be developed. Cost of water is reported to be 500 dollars or more per acre foot (Sunding and Zwane 2004).
NaR-A-3.1.3.3	Action Step	Hydrology	Work with SWRCB and landowners to restore and maintain the natural hydrograph between March 1 and May 15 to minimize impacts to coho fry due to stranding by implementing alternative frost protection strategies.	1	5	Farm Bureau, NMFS HCD, NMFS OLE, Private Landowners, SWRCB						TBD	5 year period to get methods and actions in place to minimize stranding. Costs may be high in a few areas of Anderson Valley that maintain coho populations.
NaR-A-3.1.4	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
NaR-A-3.1.4.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	5	CDFG, Mendocino County, NMFS, NOAA RC, Private Consultants, Private Landowners, SWRCB	20.00	20.00	20.00	20.00	20.00	100	Cost based on initial startup of program and some implementation (water tanks etc.). Cost of purchasing tanks and infrastructure beyond 5 years will likely require additional funding.
NaR-A-3.1.4.2	Action Step	Hydrology	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	1	20	CDFG, Mendocino County, NMFS, NOAA RC, NRCS, RCD, SWRCB						TBD	Cost will depend on specifics of project implementation.
NaR-A-3.1.4.3	Action Step	Hydrology	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	2	10	CDFG, NMFS HCD, NOAA RC, NRCS, Private Consultants, Private Landowners	25.00	25.00	25.00	25.00	25.00	250	Assumes 5 evaluations per year at 5k for 10 years.
NaR-A-3.1.4.4	Action Step	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	1	10	CDFG, NMFS, Private Landowners, SWRCB						TBD	Number of water rights holders willing to participate is unknown at this time. Cost 500 dollars or more per acre foot.
NaR-A-3.1.5	Recovery Action	Hydrology	Implement Best Management Practices (BMP's) for agriculture land use within Mendocino County (DFG 2004).										
NaR-A-3.1.5.1	Action Step	Hydrology	Develop BMP's (such as off-channel storage) for landowners conducting water diversion actions.	1	20	NMFS HCD, NRCS, Private Landowners, SWRCB						TBD	Total cost for basin will need additional analysis. Cost per landowner is estimated to be 10-50k.
NaR-A-3.1.5.2	Action Step	Hydrology	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	2	10	CDFG, NMFS, Private Landowners, SWRCB	2.00	2.00	2.00	2.00	2.00	20	Cost based on minimal regulatory staff time to work with landowners on compliance.
NaR-A-5.1	Objective	Passage	Identify and remove existing passage barriers.										
NaR-A-5.1.1	Recovery Action	Passage	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).										
NaR-A-5.1.1.1	Action Step	Passage	Restore passage in high priority areas of the Navarro watershed as identified by the Mendocino RCD, MRC, the County of Mendocino, Caltrans (HWY 128), and existing fish passage databases.	1	10	CalTrans, CDFG, NOAA RC, Private Landowners						TBD	Review of existing passage database must be conducted to develop cost estimate. Projects along HWY 128 are likely to be very costly but key to improved lower tributary production.
NaR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
NaR-A-6.1.1	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.	1	10	CDFG, NOAA RC, Private Landowners, RWQCB, SWRCB						TBD	Number of water rights holders willing to participate is unknown at this time. Cost could approach 500 dollars per acre foot.

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NaR-A-6.1.1.1	Action Step	Pool Habitat	Maintain current LWD, boulders, and other structure providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004). Maintain large debris accumulations along Highway 128 on the North Fork Navarro.	1	60	CalTrans, CDFG, NMFS PRD, State Parks						TBD	Minimal cost to allow wood to accumulate. Cost of providing alternative route via Flynn Creek road.
NaR-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.										
NaR-A-6.1.2.1	Action Step	Pool Habitat	Install or enhance existing LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004). Focus on tributaries of Flynn Creek, North Fork Navarro, South Branch Navarro, and Mill Creek.	1	10	CDFG, NOAA RC, NRCS, Private Landowners	100	100	100	100	100	1,000	Based on an estimate of 50 miles in the nest 10 years at 20k for Core and Phase 1 areas. 20k per mile based on Sundig and Zwane (2004).
NaR-A-6.1.2.2	Action Step	Pool Habitat	Target habitat restoration and enhancement that will provide functioning winter refuge habitat at flows between winter base flow and flood stage.	1	20	Private Landowners						TBD	Cost is part of estimate for LWD enhancement above.
NaR-A-6.1.2.3	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CDFG, NOAA RC, NRCS, Private Landowners, RCD, Trout Unlimited						TBD	Minimum cost for LWD per mile 20k.
NaR-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
NaR-A-7.1.1	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).										
NaR-A-7.1.1.1	Action Step	Riparian Vegetation	Focus on existing areas of Arundo located in the upper reaches of Rancheria Creek to stop infestation of downstream areas.	2	2	CDFG, NOAA RC, NRCS, Private Landowners, RCD	25.00	25.00				50	Cost based on estimate of 5 projects at 10k per project.
NaR-A-7.1.2	Recovery Action	Riparian Vegetation	Restore and protect riparian vegetation to improve migration and summer/overwintering habitat for coho salmon (DFG 2004).										
NaR-A-7.1.2.1	Action Step	Riparian Vegetation	Fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream). Focus efforts along tributaries in Anderson Valley reach of the mainstem Navarro River.	2	10	CDFG, NOAA RC, NRCS, Private Landowners, RCD	90.00	90.00	90.00	90.00	90.00	900	Based on cost of 30k per acre and a minimum of 5 miles 50 feet wide fenced.
NaR-A-7.1.2.2	Action Step	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004). Work cooperatively with land trusts, and Mendocino RCD to establish conservation easements, setbacks, and riparian buffers on industrial timberland, agricultural, and rangeland within Core and Phase 1 subbasins.	3	20	CA Coastal Commission, California Coastal Conservancy, CDFG, NOAA RC, NRCS, Private Landowners, State Parks						TBD	Costs can not be determined without additional information on the potential projects within this basin.
NaR-A-7.1.2.3	Action Step	Riparian Vegetation	Improve riparian and instream conditions in rearing habitats by establishing riparian protection zones that extend the distance of a site potential tree height from the outer edge of a channel.	2	60	CalFire, Mendocino County, Mendocino Redwood Company, NRCS, Private Landowners, RCD						TBD	Some cost to landowners due to increased protection zones.
NaR-A-7.1.3	Recovery Action	Riparian Vegetation	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	40	CDFG, FishNet 4C, Mendocino County, NMFS, NOAA RC, Private Landowners, SWRCB, USACE, USEPA, USFWS						0	Cost will be minimal to promote planting riparian vegetation.
NaR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NaR-A-8.1.1	Recovery Action	Sediment	Address sources from slides and gullies that deliver sediment and runoff to stream channels.										
NaR-A-8.1.1.1	Action Step	Sediment	Address high and medium priority sediment delivery sites as identified by the Mendocino RCD, Mendocino Redwoods Company, or other credible assessments.	1	20	CDFG, Mendocino Redwood Company, NOAA RC, NRCS, Private Landowners, RCD						TBD	More information is needed for large projects such as large slides and landings.
NaR-A-8.1.1.2	Action Step	Sediment	Acquire emergency funding for sediment reduction measures associated with the Navarro Fire that occurred in the Flynn Creek subbasin in 2008.	1	2	CalFire, CDFG, NOAA RC, Private Landowners, RCD, RWQCB						TBD	Need to conduct restoration during 2009 or 2010 to minimize sediment delivery to Flynn creek and its tributaries.
NaR-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
NaR-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key habitat attributes across the watershed. Prioritize Core tributaries first, followed by Phase I and Phase II areas as appropriate.	2	60	CDFG, Mendocino Redwood Company, NMFS, Private Landowners						TBD	Frequency and survey method will determine costs.
NaR-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
NaR-A-9.1.2.1	Action Step	Viability	Conduct monitoring activities to determine the population status of adult and smolt salmonids in Core and Phase 1 areas.	2	60	CDFG, Mendocino Redwood Company, NMFS						TBD	Type and effort of future population monitoring is not known.
NaR-A-9.1.2.2	Action Step	Viability	Evaluate feasibility of installing a lifecycle station in an appropriate location within the watershed.	3	2	CDFG, Mendocino Redwood Company, NOAA SWFSC, Private Landowners						0	Minimal cost to determine feasibility of a lifecycle station.
NaR-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
NaR-A-10.1.1	Recovery Action	Water Quality	Determine site-specific recommendations for improving riparian habitat to remedy high stream temperatures and implement accordingly (DFG 2004).	2	2	CDFG, NMFS, NRCS, Private Consultants, RCD	10.00	10.00				20	Cost is only to determine site specific recommendations using existing data.
NaR-A-10.1.1.1	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	1	20	CDFG, NOAA RC, NRCS, Private Landowners, RCD						TBD	Specific areas for planting need to be identified for cost estimate to be estimated.
NaR-A-11.1	Objective	Agricultural Practices	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.										
NaR-A-11.1.1	Recovery Action	Agricultural Practices	Work within the agricultural community to educate landowners and enhance practices that provide for functional watershed processes.	3	3	Farm Bureau, NRCS, RCD	20.00	20.00	20.00			60	Additional staff time for RCDs and NRCS to conduct education programs for landowners.
NaR-A-11.1.2	Recovery Action	Agricultural Practices	Provide technical and staff support to counties to encourage general plan updates that include measures to protect coho salmon (DFG 2004).										
NaR-A-11.1.2.1	Action Step	Agricultural Practices	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	2	10	Board of Forestry, CDFG, Mendocino County, NMFS, Private Landowners, SWRCB	10.00	10.00	10.00	10.00	10.00	100	Additional staff time to improve regulations.
NaR-A-11.2	Objective	Agricultural Practices	Minimize future agricultural development and promote agricultural practices on existing activities that protect and restore habitats for CCC coho salmon.										

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NaR-A-11.2.1	Recovery Action	Agricultural Practices	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	3	20	CDFG, FishNet 4C, Mendocino County, NMFS PRD, NOAA RC, NRCS, Private Consultants, RCD						0	Cost is expected to minimal for agency staff to encourage restoration projects.
NaR-A-11.2.2	Recovery Action	Agricultural Practices	Promote off-channel storage to reduce impacts of water diversion during the spring and summer (e.g. diversion during winter high flow).	1	10	CDFG, NMFS HCD, Private Landowners, SWRCB						TBD	Cost of implementing is unknown at this time.
NaR-A-11.2.3	Recovery Action	Agricultural Practices	Implement the NRCS/RCD coordinated permit program for fishery restoration practices.	2	40	CDFG, Farm Bureau, NMFS HCD, Private Landowners						TBD	Cost of implementing BMPs to agriculture producers is not known at this time. The cost BMPs for reducing sediment production, riparian protection, and water use will need to be determined.
NaR-A-11.2.3.1	Action Step	Agricultural Practices	Develop a Road Sediment Reduction Plan for agricultural lands that prioritizes problem sites and outlines implementation and a timeline of necessary actions.	2	2	Private Consultants, Private Landowners	25.00	25.00				50	Cost estimate for current activities in the Anderson Valley.
NaR-A-11.2.3.2	Action Step	Agricultural Practices	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	3	5	Board of Forestry, CDFG, Farm Bureau, NMFS, Private Landowners	20.00	20.00	20.00	20.00	20.00	100	Additional staff time to improve regulations.
NaR-A-11.2.3.3	Action Step	Agricultural Practices	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	3	2	Farm Bureau, NMFS, Private Consultants, Private Landowners	10.00	10.00				20	Cost based on consultant working with landowners to carry out effectiveness monitoring.
NaR-A-11.2.4	Recovery Action	Agricultural Practices	Maintain and enhance existing natural vegetation types within the Navarro watershed.										
NaR-A-11.2.4.1	Action Step	Agricultural Practices	The State and Mendocino County should impose a moratorium on conversion of open space, rangeland, or TPZ to vineyards or other agricultural uses that impact salmonids until a grading ordinance and land conversion ordinance are in place.	1	60	Farm Bureau, Private Consultants, Private Landowners						TBD	Cost to minimize or halt future agricultural development can not be determined at this time.
NaR-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
NaR-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	3	40	CDFG, NMFS, SWRCB						TBD	Cost is unknown. The main benefit of this action is to improve flow conditions in stream reaches where the majority of home owners and agricultural use occurs.
NaR-A-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
NaR-A-15.2.1	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	2	60	CDFG, NOAA RC, NRCS, Private Landowners, RCD						0	Cost is expected to be minimal. Most diversions in Navarro River watershed for dust control are for timber management actions. Most of these diversion have a 1600 agreement with the Department of Fish and Game and are likely incorporated into existing operations.
NaR-A-15.3	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
NaR-A-15.3.1	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.										
NaR-A-15.3.1.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	2	20	NOAA RC, Private Landowners, USACE						0	Minimal cost to implement.
NaR-A-15.3.2	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NaR-A-15.3.2.1	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	2	60	CDFG, NMFS, NMFS OLE, Private Landowners, SWRCB						TBD	Cost of providing bypass flow can not be estimated without further analysis.
NaR-A-15.3.2.2	Action Step	Droughts	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by municipal water suppliers and other users in the watershed through conservation programs.	2	60	Mendocino County, NOAA RC, Private Landowners, Public, SWRCB						TBD	Additional analysis needed to estimate total cost.
NaR-A-15.3.3	Recovery Action	Droughts	Establish an emergency drought operations center (EDOC), (e.g., Washington Department of Fish and Wildlife, 2001), comprised of the SWRCB, DFG, NMFS, and others to develop emergency rules for augmenting water supplies and mitigating the effects of drought on fish.										
NaR-A-15.3.3.1	Action Step	Droughts	Work with DFG, County of Mendocino, MRC, municipalities, and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	3	5	CDFG, Mendocino County, NMFS, Private Landowners, Public, SWRCB	6.00	6.00	6.00	6.00	6.00	30	Cost based on estimate for additional staff time to develop rules.
NaR-A-15.3.3.2	Action Step	Droughts	Increase enforcement patrols by DFG and NMFS OLE in sensitive spawning and rearing areas.	2	20	CDFG, NMFS OLE	30.00	30.00	30.00	30.00	30.00	600	Based on 4 additional staff estimated for 3 drought years in a 20 year period.
NaR-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.	3	60	California Coastal Conservancy, Private Landowners, State Parks						TBD	Cost would be millions for purchase and operation of additional land held by the State or other entity.
NaR-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Areas adjacent to currently owned State parks or forestlands supporting Core, Phase I and Phase II priority areas should be considered for purchase (if feasible within the next 5 years).										
NaR-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Should large tracts of forestlands within any watershed identified as a priority in this recovery plan become available for purchase, the Federal Government, State of California, or other entities should consider purchasing the area as a conservation area.	3		BLM, CDFG, Redwood Forest Foundation						TBD	Will vary with specific tract.
NaR-A-20.1.1.2	Action Step	Logging and Wood Harvesting	Increase size of Navarro River Redwoods State Park if opportunities arise. At the minimum purchase or develop conservation easement on lower tributaries and associated riparian areas, including important coho salmon tributaries such as Flynn Creek.	1	20	Mendocino Redwood Company, Private Landowners, State Parks						TBD	Cost will vary with size of parcel purchased or placed in a conservation easement.
NaR-A-20.1.2	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
NaR-A-20.1.2.1	Action Step	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	20	CDFG, Mendocino County, NMFS PRD, RWQCB, State Parks						TBD	Some increase in cost to regulatory agencies.
NaR-A-20.1.2.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	1	60	CalFire, Mendocino County, NMFS, Private Landowners						TBD	Additional regulatory agency cost. Undetermined at this time.
NaR-A-20.2	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
NaR-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Address sources from logging areas that deliver sediment and runoff to stream channels.										
NaR-A-20.2.1.1	Action Step	Logging and Wood Harvesting	Work with the California Board of Forestry to design and implement a program of BMPs for logging areas that meets the approval of NMFS and DFG.	1	3	CalFire, NMFS, NMFS OLE, Private Landowners, RWQCB						TBD	Cost of additional BMPs to timber operators can not be determined at this time.

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NaR-A-20.2.1.2	Action Step	Logging and Wood Harvesting	Encourage all permanent and year-round access roads beyond the THP parcel be surfaced after harvest completion with base rock and road gravel, asphalt, or chipseal, as appropriate.	1	60	CalFire, CDFG, NMFS, Private Landowners, RWQCB						TBD	See roads and sediment actions.
NaR-A-20.2.1.3	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	1	40	CalFire, CDFG, NRCS, Private Landowners						TBD	Cost will be estimated in sediment reduction actions and roads actions.
NaR-A-20.2.1.4	Action Step	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	2	60	CalFire, CDFG, Private Consultants, Private Landowners, RWQCB						0	These action occur now in CA THP process, therefore cost is expected to be minimal.
NaR-A-20.2.1.5	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	3	60	Private Landowners						TBD	Additional cost of retaining trees is not know at this time. Landowners need to estimate timber volumes that would be lost.
NaR-A-20.2.2	Recovery Action	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.										
NaR-A-20.2.2.1	Action Step	Logging and Wood Harvesting	Explore acquisition or conservation easements from willing land-owners.	3	2	Private Consultants, Private Landowners	15.00	15.00				30	Cost based on private consultant to contact landowners and determine interest in conservation easements.
NaR-A-20.2.2.2	Action Step	Logging and Wood Harvesting	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	2	60	Board of Forestry, CalFire, Mendocino County, Mendocino Redwood Company, Private Landowners						TBD	Need additional info to determine cost for landowners to implement riparian management.
NaR-A-20.3	Objective	Logging and Wood Harvesting	The priorities in this recovery plan should serve as a guide for independent Forest Certification.	3	60	California Coastal Conservancy, Private Landowners, State Parks						TBD	Cost would be millions for purchase and operation of additional land held by the State or other entity.
NaR-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Investigate opportunities to programmatically permit the forest certification program to authorize incidental take for landowners through Section 10(a)(1)(B).	3	5	CalFire, CDFG, NMFS PRD, Private Consultants, Private Landowners						TBD	Need further analysis to costs to develop take permit.
NaR-A-20.4	Objective	Logging and Wood Harvesting	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of CCC coho salmon.										
NaR-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	CalFire, NMFS	25.00	25.00	25.00	25.00	25.00	250	Based on 25k of NMFS staff time for the Navarro watershed per year..
NaR-A-20.4.2	Recovery Action	Logging and Wood Harvesting	Consider the development of a Watershed Database (similar to the DFG Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.	3	3	CalFire, Private Consultants, Private Landowners	16.67	16.67	16.67			50	Cost is rough estimate for database development.
NaR-A-20.4.3	Recovery Action	Logging and Wood Harvesting	Develop a framework similar to Washington State that establishes a scientific framework for monitoring the effectiveness of practices in meeting watershed process goals and a decision-making process that is adaptive to the new information.	3	20	CalFire, CDFG, NMFS, Private Consultants, Private Landowners, RWQCB						TBD	Additional analysis need to develop cost estimate monitoring practices.
NaR-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
NaR-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	60	CalFire, CDFG, Mendocino County, Private Landowners						TBD	Cost of additional staff time is unknown at this time, could be considerable.

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
NaR-A-24.1.2	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	5	CDFG, FishNet 4C, Mendocino County, Mendocino Redwood Company, NOAA RC, Private Consultants, Private Landowners	10.00	10.00	10.00	10.00	10.00	50	Cost based on annual training for certification of entities in Navarro watershed.
NaR-A-24.1.3	Recovery Action	Roads and Railroads	Expand the NRCS/RCD coordinated permit program to a statewide programmatic ESA consultation that allows funding and technical expertise to small land owners and rural residential property owners.	2	20	CDFG, NMFS PRD, NOAA RC, NRCS, Private Landowners, RCD, USACE						TBD	Cost associated with additional staff time and consulting to expand program at this time unknown.
NaR-A-24.1.4	Recovery Action	Roads and Railroads	Conduct collaborative evaluations of priorities for treatment of CCC coho salmon passage barriers, such as the Fish Passage Forum (DFG 2004).	3	60	CalFire, CalTrans, CDFG, FishNet 4C, NMFS, NRCS, Private Landowners						0	Cost expected to be minimal.
NaR-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
NaR-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).										
NaR-A-24.2.1.1	Action Step	Roads and Railroads	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF). Where no Core areas are designated, apply this action to Phase I areas.	1	20	CDFG, Mendocino County, Mendocino Redwood Company, NOAA RC, Private Landowners						TBD	estimates for roads not yet been upgraded are not available.
NaR-A-24.2.2	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	1	10	Mendocino County, Mendocino Redwood Company, Private Landowners	50.00	50.00	50.00	50.00	50.00	500	A cost estimate to avoid sensitive areas over the next ten years.
NaR-A-24.3	Objective	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, Phase I within 10 years, and Phase II areas within 15 years (from 2010).										
NaR-A-24.3.1	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.	2	3	Mendocino Redwood Company, NRCS, Private Consultants, Private Landowners, RCD	33.33	33.33	33.33			100	Estimate based on using existing data from various sources to develop road plan for the watershed.
NaR-A-24.3.1.1	Action Step	Roads and Railroads	Develop a road database using standardized methods. The methods should document all roads features, apply erosion rates, and compile information into a GIS database.	3	5	NRCS, Private Landowners, Public, RCD	10.00	10.00	10.00	10.00	10.00	50	Rough estimate to develop database for Navarro watershed.
NaR-A-24.3.2	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	3	60	CalFire, CDFG, Mendocino County, Private Landowners						TBD	Cost of additional staff time is unknown at this time, could be considerable.
NaR-A-24.3.2.1	Action Step	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply best management practices for road construction maintenance management and decommissioning (e.g. Hagans & Weaver 1994 Sommarstrom 2002 Oregon Department of Transportation 1999).	1	10	CDFG, Mendocino County Department of Public Works, Mendocino Redwood Company, NOAA RC, NRCS, Private Landowners, Public, RCD	312	312	312	312	312	3,120	Estimate for treating 200 miles of dirt roads over ten years at 15.6k per mile.
NaR-A-24.3.3	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.										

Navarro River (Navarro Point-Gualala Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NaR-A-24.3.3.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	5	CDFG, NOAA RC, Private Landowners, RCD	50.00	50.00	50.00	50.00	50.00	250	Based on 50K estimate for highest priority work that needs to be done prior to each winter.
NaR-A-24.3.4	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	20	Mendocino County, Mendocino Redwood Company, Private Landowners						TBD	Cost not available for conducting improved practices.
NaR-A-24.4	Objective	Roads and Railroads	Improver salmonid passage conditions at road crossings.										
NaR-A-24.4.1	Recovery Action	Roads and Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	10	CalTrans, Mendocino County Department of Public Works, NOAA RC, NRCS, Private Landowners	30.00	30.00	30.00	30.00	30.00	300	Based on estimate for 3 projects per year and each would have an additional 10k in cost.
NaR-A-24.4.2	Recovery Action	Roads and Railroads	Continue to refine, update, and maintain the California Fish Passage Assessment Database of barriers to fish passage.	2	10	California Coastal Conservancy, CDFG, Pacific States Marine Fisheries Commission, USFWS	5.00	5.00	5.00	5.00	5.00	50	Cost estimate for maintaining database for the Navarro watershed for 10 years.
NaR-A-25.1	Objective	Storms and Flooding	Support economic incentives to reduce the impacts of storms and flooding from current and future planned urban infrastructure.										
NaR-A-25.1.1	Recovery Action	Storms and Flooding	Where existing infrastructure exists within historical floodplains or offchannel habitats in any historical coho watersheds, and restoration is found feasible, encourage willing landowners to restore these areas through conservation easements, etc.	3	40	CDFG, NMFS, Private Landowners						TBD	Potential sites need to be identified and cost estimate developed.
NaR-A-25.2	Objective	Storms and Flooding	Develop policies in urban planning that reduce the impacts of storms and flooding on watersheds occupied by CCC Coho.	1	40	CalFire, California Department of Mines and Geology, CalTrans, CDFG, Mendocino Redwood Company, NRCS, Private Landowners, Public, RCD, RWQCB						TBD	Can be very costly, need to determine number of high risk sites and develop cost estimate.
NaR-A-25.2.1	Recovery Action	Storms and Flooding	Modify Federal, State, city and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	3	20	CDFG, Mendocino County, NMFS, RWQCB						TBD	Additional analysis needed to determine cost of modifying regulations at various levels.
NaR-A-25.2.1.1	Action Step	Storms and Flooding	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.	2	60	Board of Forestry, CalFire, CDFG, Mendocino County, Private Landowners						TBD	Cost of protecting high risk areas is unknown at this time.
NaR-A-25.2.2	Recovery Action	Storms and Flooding	New development in all historic CCC coho salmon watersheds should meet a zero net increase in storm-water runoff, changes in duration, or magnitude of peak flow.	3	60	Mendocino County						TBD	Cost dependent on number of projects.
NaR-A-25.2.3	Recovery Action	Storms and Flooding	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	3	2	CDFG, NMFS, NRCS, Private Consultants	25.00	25.00				50	A rough estimate for an agency or consultant using existing information to develop guidelines.

Noyo River

Noyo River

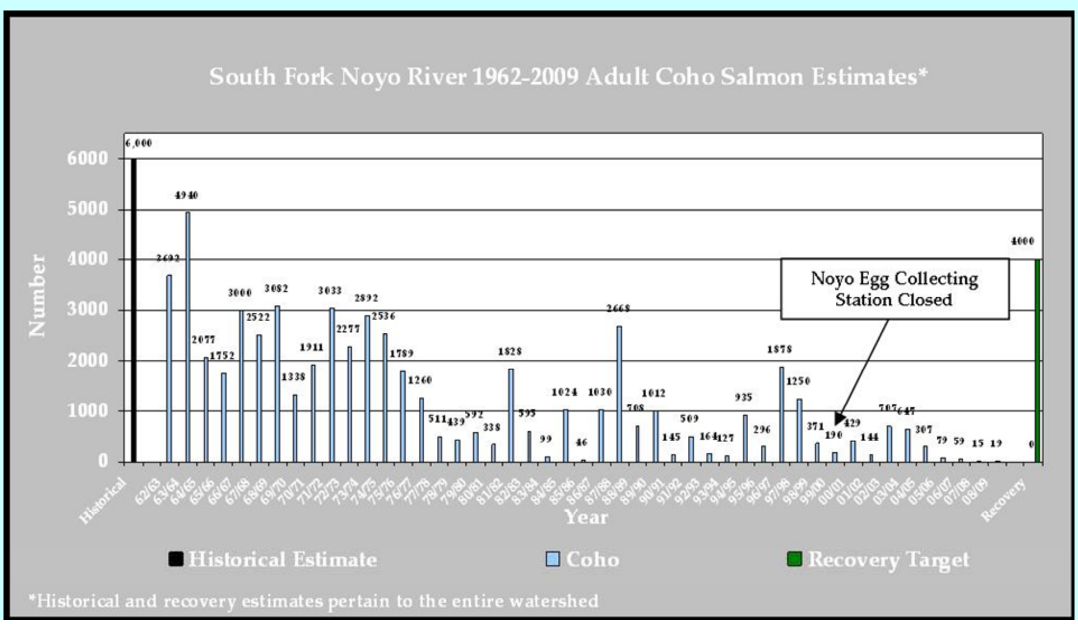
Independent Population
118.0 IP-Km of potential coho salmon habitat
Coho salmon, Chinook salmon, and steelhead present

The Noyo River drains approximately 113 square miles of western Mendocino County, and enters the Pacific Ocean at the town of Fort Bragg. The Noyo River estuary is tidal and controlled by concrete breakwaters on both sides of the harbor entrance. The harbor supports the only major fishing fleet between Bodega Bay and Eureka. About 71 percent of the Noyo River watershed is characterized as redwood coniferous forest. At least 49 percent of the Noyo River watershed has moderate to high erodibility. The EPA listed the Noyo River as water quality impaired for sediment in 2001, and determined that sediment was impairing salmonids and identified non-point source silviculture as the probable cause. The EPA has established a TMDL for the watershed. Eighty-one percent of the Noyo River watershed privately owned; the remaining 19 percent is state-owned forest lands. The dominant land use within the Noyo River watershed is forestry. Within the past ten years, about 21 percent of the Noyo River watershed has been under a timber harvest plan. Housing development within the Noyo River watershed is moderate – about 1200 housing units are present in the watershed. The town of Fort Bragg's water supply originates from the Noyo River (NCRWQCB 2005).

Noyo River harbor

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD to VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools:	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**FAIR**
off channel/Floodplain Quality:	**POOR to FAIR**
Estuary Function:	**FAIR**



Noyo River

Recovery Target: 4,000 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and wood harvesting
- Roads and railroads

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Noyo River watershed that are in poor condition. The highest priorities for restoration are to:

- Reduce summer stream temperatures
- Improve pool complexity and increase number of pools
- Increase large wood in streams
- Increase the frequency of off channel habitat
- Reduce the amount of roads in and near the riparian zone and throughout the watershed
- Reduce sources of sediment
- Improve gravel quality by reducing sediment inputs

Passage impediment associated with a railroad crossing.
Photo courtesy of NMFS.

Advancing recovery of coho

salmon in Noyo River requires these priority **recovery actions:**

- Address high priority slides and landings identified in the MRC Noyo River Watershed Analysis.
- Install or enhance existing large woody debris, boulders, and other features to increase stream complexity and improve pool frequency and depth.
- Provide for watershed processes by promoting long term sustainable forestry practices that support coho salmon
- Work with the California Western Railroad to stop removal of LWD from stream channels.
- Design and implement a best management practices for road maintenance on private roads similar to the program for public roads (Five County Road Program).

. . . in these **core areas:** Parlin and Redwood Creek planning watersheds, and the Little North Fork area of the Little North Fork planning watershed.

Conservation Highlights

- CalFire has placed large woody debris structures within the Jackson Demonstration State Forest.
- MRC has undertaken sediment remediation projects
- DFG is conducting coho salmon spawner surveys.

We Need Your Photo Here

Noyo River
Photo © Your Name Here, AFFIL

Immediate Needs

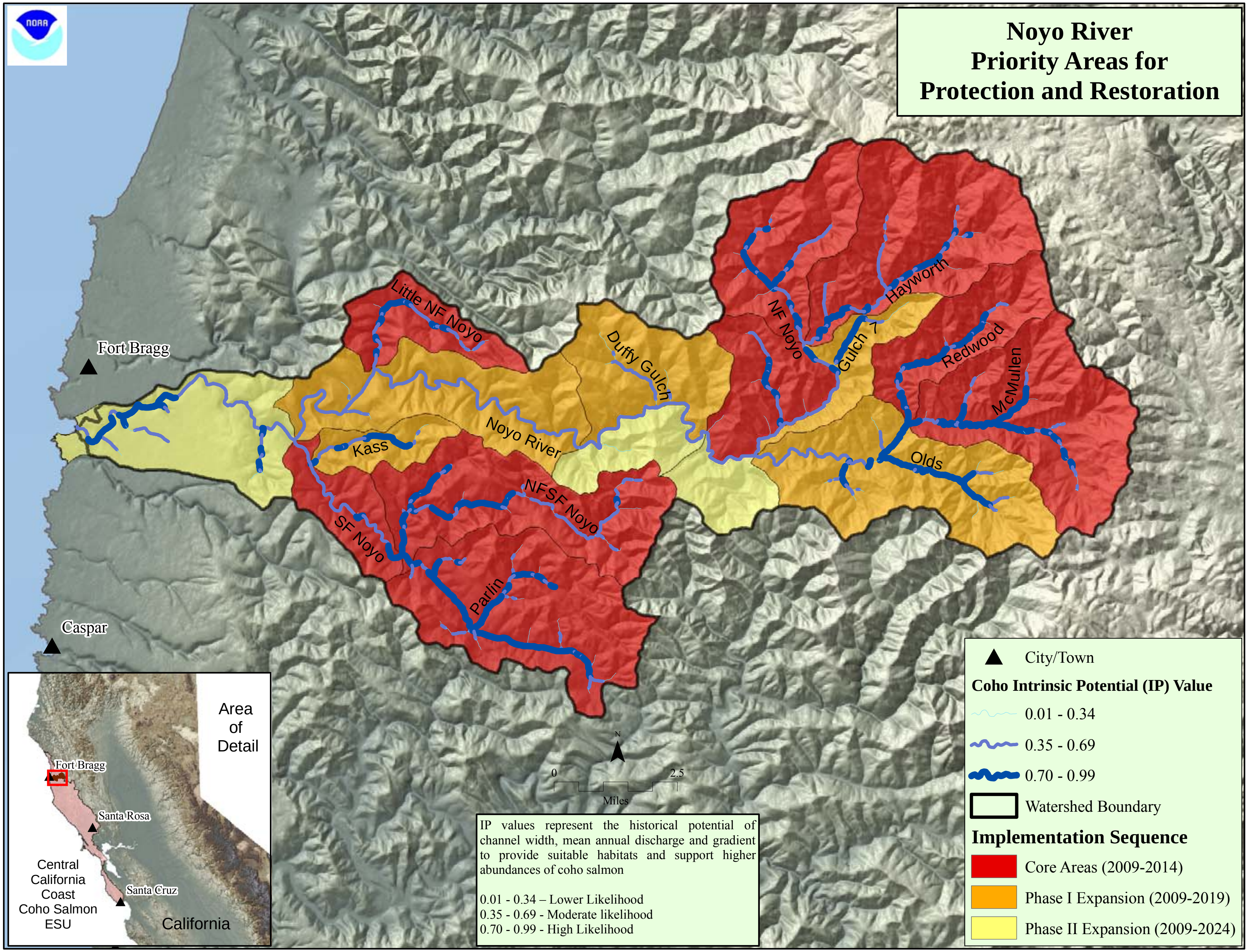
√ Continue collaborative stream habitat efforts undertaken by the Mendocino Redwood Company, Campbell Timberlands Management, and staff at the Jackson Demonstration State Forest.

√ Encourage the Noyo Watershed Alliance to continue and expand its successful watershed actions such as limiting use of the Sherwood Road during the winter months.

√ Finalize MRC Habitat Conservation Plan.

Recovery Partners

National Marine Fisheries Service
California Department of Fish and Game
CalFire, Jackson Demonstration State Forest
Noyo Watershed Alliance
Mendocino Redwood Company
Campbell Timberlands Management


Noyo River
Priority Areas for
Protection and Restoration
Fort Bragg
Caspar
Little NF Noyo
Duffy Gulch
NF Noyo
Gulch 7
Hayworth
Redwood
McMullen
Kass
Noyo River
Olds
NFSF Noyo
SF Noyo
Parlin
0
2.5
Miles
N
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Noyo River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	42	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	99%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	>90 days	Very Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	77,894 sq. mi	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<600 m^2	600-5400 m^2	5400-10400 m^2	>10400 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	Good	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	58	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Good	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	38%	Poor	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	Fair	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	31.2	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	4%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	22.2	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	Good	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0.59/10 IP-km	Good	Multiple Life Stages	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	31.2	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	41%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.35%	Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.02	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	21%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	2.6	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	47%	Fair	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	92%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	7.4mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	7.0mi/sq.mi	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	1-20 per IP-km	Fair	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	20-34%	Fair	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Noyo River Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Logging and Wood Harvesting	Medium	Medium	Very High	High	High	High			Very High
2	Roads and Railroads	Medium	Medium	Medium	Medium	Medium	High			High
3	Droughts	Medium	Low	High	Medium	Medium	Medium			Medium
4	Channel Modification	Medium	Medium	Medium	Medium	Medium	Medium			Medium
5	Storms and Flooding	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Climate Change	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Recreational Areas and Activities	Medium	Low	Low	Medium	Medium	Medium			Medium
9	Residential and Commercial Development	Medium	Low	Low	Medium	Medium	Low			Medium
10	Water Diversion and Impoundment	Low	Low	Medium	Medium	Low	Low			Medium
11	Livestock Farming and Ranching	Low	Low	Low	Medium	Low	Low			Low
12	Agricultural Practices	Low	Low	Low	Medium	Low	-			Low
13	Mining	Low	Low	Low	Medium	Low	-			Low
14	Hatcheries and Aquaculture	Low	-	-	Low	Low	Low			Low
15	Disease, Predation, and Competition	Low	-	Low	-	Low	-			Low
16	Fishing and Collecting	Low	-	-	Low	Low	-			Low
hreat Status for Targets and Project		High	Medium	High	High	High	High	-	-	High

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
NoR-A-2.1.1	Recovery Action	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	3	5	California Coastal Conservancy, Campbell Timberland Management, Mendocino Redwood Company, Private Landowners	8.00	8.00	8.00	8.00	8.00	40	This may be a GIS exercise with ground truthing. Available information exists from past habitat typing that may streamline this analysis and further reduce the overall cost.
NoR-A-2.1.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, Mendocino Redwood Company, Private Landowners						TBD	Costs to promote and support restoration efforts depend on level of technical assistance provided and the types of projects proposed.
NoR-A-2.1.3	Recovery Action	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.										
NoR-A-2.1.3.1	Action Step	Floodplain	Focus restoration actions in the lower mainstem Noyo River and Core areas and areas with high IP-km values (> 0.7).	1	20	CalFire, CalTrans, Campbell Timberland Management, Jackson Demonstration State Forest, Mendocino County Department of Public Works, Private Landowners						TBD	Actions should be coordinated with road and timber harvest activities in lower Noyo River mainstem.
NoR-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
NoR-A-3.1.1	Recovery Action	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	3	20	CDFG, NMFS, SWRCB						TBD	The exact incentives are unknown at this time, as well as the cost of those incentives.
NoR-A-3.1.2	Recovery Action	Hydrology	Encourage water conservation and the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers. Focus a program with the City of Fort Bragg to reduce diversion from the Noyo River.	3	10	City of Fort Bragg, Mendocino County, Private Landowners, SWRCB						TBD	The cost of developing a water conservation program is dependent upon the size and scope of the program, which are unknown factors at this time.
NoR-A-3.1.3	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
NoR-A-3.1.3.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (storage tanks for rural residential users) in the upper watershed.	2	60	CalFire, Campbell Timberland Management, Jackson Demonstration State Forest, Private Landowners						TBD	Cost is difficult to estimate due to the uncertainty in developing and implementing the program.
NoR-A-3.1.3.2	Action Step	Hydrology	Promote conjunctive use of water with water projects whenever possible to maintain or restore coho salmon habitat.	2	60	CDFG, City of Fort Bragg, Jackson Demonstration State Forest, Private Landowners, SWRCB, USFWS						0	Efforts should be made to coordinate storage with all landowners in the basin to minimize costs and impacts.

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-3.1.3.3	Action Step	Hydrology	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	1	60	Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Private Landowners, SWRCB						0	Need to work with private and large industrial timberland owners to develop water storage for summer needs.
NoR-A-3.1.3.4	Action Step	Hydrology	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	3	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, FishNet 4C, Mendocino Redwood Company, NMFS, Private Landowners, RCD						0	Cost is expected to be covered through normal section 7/section 10 NMFS work.
NoR-A-3.1.4	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
NoR-A-3.1.4.1	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	3	5	CDFG, NMFS, NMFS OLE, SWRCB						TBD	The cost of this strategy is difficult to estimate at this time. Investigation will likely include DFG/NMFS biologists and enforcement officers, as well as SWRCB.
NoR-A-3.1.4.2	Action Step	Hydrology	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	3	60	Campbell Timberland Management, CDFG, Mendocino County, Mendocino Redwood Company, NMFS, Private Landowners						TBD	Estimating cost for this strategy is difficult at this time.
NoR-A-3.1.5	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
NoR-A-3.1.5.1	Action Step	Hydrology	Assess and map water diversions (DFG 2004).	3	10	SWRCB						TBD	Estimating cost is difficult at this time.
NoR-A-3.1.5.2	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	3	5	Campbell Timberland Management, CDFG, Mendocino Redwood Company, NMFS, Private Landowners						TBD	Costs will be dependant on the extent, methods, and frequency of monitoring and cannot be determined at this time.
NoR-A-3.1.5.3	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004). Encourage SWRCB to not authorize additional water diversions from the Noyo River watershed.	3	10	CDFG, NMFS, RWQCB, SWRCB						0	Resources to promote this strategy will likely be addressed by NMFS/DFG/RWQCB staff. Difficult to estimate the amount of time required by water rights staff at these agencies at this time.
NoR-A-5.1	Objective	Passage	Identify and remove existing passage barriers.										
NoR-A-5.1.1	Recovery Action	Passage	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	3	10	Cal Western Railroad, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, NOAA RC, Private Landowners, Railroad							Most barriers in the Noyo have been identified and total cost for this assessment is likely very low.
NoR-A-5.1.2	Recovery Action	Passage	Restore passage in high priority areas of the Noyo River Watershed as identified in existing fish passage databases.										

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-5.1.2.1	Action Step	Passage	Assess and restore passage at barriers associated with the California Western Railroad.	3	20	Campbell Timberland Management, CDFG, Mendocino County, Mendocino Redwood Company, NMFS, Private Landowners						TBD	Passage conditions were ranked good to very good within the CAP workbook, so cost of this strategy may be low.
NoR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
NoR-A-6.1.1	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.										
NoR-A-6.1.1.1	Action Step	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	Cal Western Railroad, CalFire, California Coastal Conservancy, California Department of Mines and Geology, Campbell Timberland Management, CDFG, City of Fort Bragg, Mendocino Redwood Company, NMFS, Private Landowners, RWQCB, USACE						0	There will be no cost when leaving remaining instream structures in place.
NoR-A-6.1.1.2	Action Step	Pool Habitat	Work with the railroad (California Western Railroad) to stop removal of LWD from stream channels.	2	10	Cal Western Railroad, CDFG, NMFS						TBD	Cost of educating the railroad regarding the importance of large woody debris and their obligation pursuant to ESA and 1600 is expected to be small.
NoR-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.										
NoR-A-6.1.2.1	Action Step	Pool Habitat	Install or enhance existing LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004). Use information, where germane, from MRC Noyo Watershed Analysis to determine stream locations with high instream LWD demand, and utilize DFG stream habitat data to help determine reaches for LWD placement. Core areas of the South Fork Noyo, Little North Fork Noyo and Redwood Creek are priorities for restoration of LWD.	1	20	Cal Western Railroad, CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, City of Fort Bragg, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS, NOAA RC, Pacific States Marine Fisheries Commission, Private Landowners, RWQCB, Trout Unlimited						TBD	Cost is difficult to estimate at this time, and will likely be influenced by the number, scale and spatial distribution of future projects. Projects such as this are directly aimed at improving long-term survival for all freshwater lifestages of CCC coho salmon.

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-6.1.3	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	20	CDFG, NOAA RC, Private Landowners, Railroad, Trout Unlimited						TBD	Cost cannot be determined at this time, but should be covered in part by existing grant funding.
NoR-A-6.1.4	Recovery Action	Pool Habitat	Implement the most recent NMFS' Guidelines for Summer Dams for all existing and new summer dams seeking 1600 permits.	3	60	CDFG, CDFG Law Enforcement, NMFS, NMFS OLE, Private Landowners, RWQCB, USACE						0	The cost is expected to be covered through NMFS staff time.
NoR-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
NoR-A-7.1.1	Recovery Action	Riparian Vegetation	Conserve and manage forestlands for older forest stages.	2	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, Mendocino Redwood Company, NMFS, NOAA RC, Private Landowners						TBD	As most of the land is used for forest management, most of this cost will be absorbed as part of on going forestry practices. Additional cost may be incurred across the areas of the watershed where industrial land management actions occur.
NoR-A-7.1.2	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, Mendocino Redwood Company, NMFS, NOAA RC, Private Landowners, Trout Unlimited						TBD	As most of the land is used for forest management, most of this cost will be absorbed as part of on going forestry practices. Cost of easements cannot be made without specific information.
NoR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
NoR-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
NoR-A-8.1.1.1	Action Step	Sediment	NMFS and other landowners will work with RCD or NRCS to encourage sediment reduction assessments (first for subwatersheds in Core areas, then for Phase I areas).	3	10	CalFire, Campbell Timberland Management, CDFG, Mendocino Redwood Company, NOAA RC, Private Landowners						TBD	Since majority of watershed is owned by private timber companies, much of the road network has likely been assessed.
NoR-A-8.1.2	Recovery Action	Sediment	Address sources that deliver sediment and runoff to stream channels.										
NoR-A-8.1.2.1	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	2	60	CalFire, Campbell Timberland Management, Mendocino Redwood Company, Private Landowners	50.00	50.00	50.00	50.00	50.00	3,000	This infrastructure is likely present in many of the Noyo subwatersheds. Additional sites may be installed as part of the timber harvest plan process and the cost for construction will likely be absorbed on a harvest plan by harvest plan basis. Ongoing maintenance will likely occur as part of yearly evaluation prior to the winter period. Maintenance costs are estimated at $50,000/yr.

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-8.1.2.2	Action Step	Sediment	Treat high priority slides and landings identified in the MRC Noyo River Watershed Analysis or the Jackson Demonstration State Forest Road Management Plan.	1	5	CalFire, Campbell Timberland Management, Mendocino Redwood Company, Private Landowners						TBD	TBD- difficult to estimate cost because assessments for the magnitude of the problem were not available. Additionally, many sediment sources in Core watersheds have been addressed - often through the timber harvest process - and these costs should be considered an ongoing operation expense.
NoR-A-8.1.2.3	Action Step	Sediment	Acquire funding for assessment and implementation of sediment reduction measures associated with the 2008 Indian Fire in the South Fork Noyo subbasin.	2	10	CalFire, Jackson Demonstration State Forest						TBD	Cost is difficult to estimate at this time.
NoR-A-8.1.3	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										
NoR-A-8.1.3.1	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	2	2	CalFire, CDFG, Mendocino County Department of Public Works, NMFS						TBD	Cost is likely to be low, since agency staff time will likely cover much of the work.
NoR-A-9.1	Objective	Viability	Monitor key habitat attribute indicators to ensure they move from poor condition towards very good condition.										
NoR-A-9.1.1	Recovery Action	Viability	Conduct a comprehensive assessment of watershed processes (e.g., hydrology, geology, fluvial-geomorphology, water quality, and vegetation), instream habitat, and factors limiting coho salmon production (DFG 2004). Use the watershed assessment template developed in portions of the watershed in Mendocino Redwood Company ownership, and apply to the rest of the Noyo River watershed.										
NoR-A-9.1.1.1	Action Step	Viability	Core areas should have the highest priority for a site-based assessment; adapt the strategies for restoration and threat abatement to address site-based issues identified by the watershed assessments.	3	10	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, Private Landowners						TBD	Estimating cost is difficult since the number and scope of the assessments is unknown at this time.
NoR-A-9.1.2	Recovery Action	Viability	Continue and improve upon monitoring activities to determine the population status of adult and smolt salmonids in the watershed and its tributaries.										
NoR-A-9.1.2.1	Action Step	Viability	Promote development of a life cycle station (Gallagher and Gallagher 2005). A likely location would be at the former egg taking station located on the South Fork Noyo River in the Jackson Demonstration State Forest.	2	5	Campbell Timberland Management, Jackson Demonstration State Forest, Mendocino Redwood Company, Private Landowners						TBD	Cost is difficult to estimate at this time.
NoR-A-9.1.2.2	Action Step	Viability	Continue juvenile monitoring efforts initiated by Burns (1972) and continued by Valentine and Jamison (CDF 1992) and Georgia-Pacific Corp. and Campbell Timberland Management (1994-1998) in Little North Fork Noyo River.	2	60	Campbell Timberland Management, CDFG, Mendocino Redwood Company, Private Landowners	50.00	50.00	50.00	50.00	50.00	3,000	Estimate of $50,000 over 60 years. Cost would be lower if much of the area is monitored by local timber companies.
NoR-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
NoR-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-10.1.1.1	Action Step	Water Quality	Improve riparian and instream conditions in rearing habitats by establishing riparian protection zones that extend the distance of a site potential tree height from the outer edge of a channel, and by adding LWD.	3	30	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS, Private Landowners						TBD	Cost of this action step is likely covered through future THPs in the watershed.
NoR-A-10.1.2	Recovery Action	Water Quality	Work with landowners to purchase easements on water rights to encourage the maintenance of surface flows.	3	20	CDFG, NMFS HCD, Private Landowners, SWRCB						TBD	The cost of purchasing water rights is expected to be high if combined with socioeconomic costs. Likely greater than $500 per acre foot.
NoR-A-15.1	Objective	Droughts	Minimize water use and diversion and seek alternatives during droughts.										
NoR-A-15.1.1	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	2	60	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS, Private Landowners						TBD	Cost is expected to be minimal. Most diversions in the Noyo watershed for dust control are for timber management actions. Most of these diversions have a 1600 agreement with the Department of Fish and Game and are likely incorporated into existing operations.
NoR-A-15.2	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
NoR-A-15.2.1	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	3									
NoR-A-15.2.1.1	Action Step	Droughts	Develop and implement critical flow levels for stream reaches impacted by water diversions.	3	60	CDFG, NMFS, Private Landowners, SWRCB	1.67	1.67	1.67	1.67	1.67	100	Cost is expected to be minimal because relatively few diversions occur in the watershed.
NoR-A-15.2.1.2	Action Step	Droughts	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by municipal water suppliers and other users in the watershed through conservation programs.	3	60	CDFG, NMFS, Private Landowners, SWRCB						TBD	This action is predicated on above actions. Cost is expected to be minimal due to relatively few diversions in the watershed.
NoR-A-15.2.1.3	Action Step	Droughts	Prohibit filling of all recreational instream summer dams during drought periods.	3	5	CDFG, NMFS, Private Landowners, SWRCB						0	Establishing a prohibition through the SWRCB is not expected to have a high cost.
NoR-A-15.2.2	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	3									
NoR-A-15.2.2.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	3	10	CDFG, NMFS HCD, SWRCB						0	The cost of encouraging the state of California to enforce state water law is expected to be minimal. The work will be performed as part of NMFS staff time.
NoR-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
NoR-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Areas adjacent to currently owned State parks or forestlands supporting Core, Phase I and Phase II priority areas should be considered for purchase (if feasible within the next 5 years).	3	5	CDFG, Mendocino County, NMFS, Private Consultants	36.00	36.00	36.00	36.00	36.00	180	Assessment estimate from DFG (2004).
NoR-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Should large tracts of forestlands within any watershed identified as a priority in this recovery plan become available for purchase, the State of California should consider purchasing the area as a Demonstration Forest or State Park.	3	60	CDFG, Mendocino County, NMFS						TBD	Cost is difficult to estimate at this time, but could be substantial.

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-20.1.2	Recovery Action	Logging and Wood Harvesting	Conduct an assessment of the mechanisms driving forestland conversion and develop strategies to protect forestlands.	3	5	CDFG, Mendocino County, NMFS, Private Consultants	36.00	36.00	36.00	36.00	36.00	180	Assessment estimate from DFG (2004).
NoR-A-20.1.3	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	2									
NoR-A-20.1.3.1	Action Step	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	60	CDFG, Mendocino County, NMFS, RWQCB, SWRCB						0	Discouraging counties can likely be done through existing regulatory channels utilizing staff time.
NoR-A-20.1.3.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	60	CDFG, Mendocino County, NMFS, RWQCB, SWRCB						0	Discouraging incompatible land uses can likely be done through existing regulatory channels utilizing staff time.
NoR-A-20.2	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.	2	10	CDFG, Farm Bureau, NMFS, NRCS, RCD						TBD	soliciting cooperation is not expected to entail high costs.
NoR-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Complete comprehensive assessment/implementation of erosion control measures in the entire North Fork River basin (DFG 2004).	3	5	NMFS						TBD	Cost is expected to be minimal.
NoR-A-20.2.2	Recovery Action	Logging and Wood Harvesting	Document and improve THP access roads. The use of existing multiple-use roads to access THP parcels is common. This presents an opportunity to document existing conditions on private roads to improve the road database and for upgrading deficient roads.	3	5	NMFS	6.00	6.00	6.00	6.00	6.00	30	
NoR-A-20.2.3	Recovery Action	Logging and Wood Harvesting	Encourage all permanent and year-round access roads beyond the THP parcel be surfaced after harvest completion with base rock and road gravel, asphalt, or chipseal, as appropriate.	3	2	NMFS						0	Cost is expected to be minimal.
NoR-A-20.2.4	Recovery Action	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	3	5	NMFS	6.00	6.00	6.00	6.00	6.00	30	The cost in considering development of the above mentioned plan is unlikely to cost much.
NoR-A-20.2.5	Recovery Action	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	3	20	CDFG						0	The cost of this recovery action is difficult to estimate at this time.
NoR-A-20.2.6	Recovery Action	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	3	5	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS						TBD	The cost in considering development of the above mentioned plan is unlikely to cost much.
NoR-A-20.2.7	Recovery Action	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	3	10	CalFire, CDFG, NMFS						TBD	The cost of this recovery action is difficult to estimate at this time.
NoR-A-20.3	Objective	Logging and Wood Harvesting	Work through existing regulatory frameworks, or enact new regulations, to minimize take of coho salmon from logging operations.										
NoR-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within Core, Phase I and Phase II CCC coho salmon areas.										
NoR-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	60	CDFG, Mendocino County, NMFS, RWQCB, SWRCB						0	Discouraging incompatible land uses can likely be done through existing regulatory channels utilizing staff time.

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Provide information to BOF regarding CCC coho salmon priorities and recommend upgrading relevant forest practices.	2	60	CalFire, Campbell Timberland Management, FishNet 4C, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	33.33	33.33	33.33	33.33	33.33	2,000	Similar existing programs could be modified and implemented at minimal cost.
NoR-A-20.4	Objective	Logging and Wood Harvesting	The priorities in this recovery plan should serve as a guide for independent Forest Certification.										
NoR-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Investigate opportunities to programmatically permit the forest certification program to authorize incidental take for landowners through Section 10(a)(1)(B).	3	5	NMFS	6.00	6.00	6.00	6.00	6.00	30	The cost in considering development of the above mentioned plan is unlikely to cost much.
NoR-A-20.5	Objective	Logging and Wood Harvesting	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of CCC coho salmon.										
NoR-A-20.5.1	Recovery Action	Logging and Wood Harvesting	Continue the activities of the North Coast Watershed Assessment /Coastal Watershed Program.	3	20	CDFG						0	Similar existing programs could be modified and implemented at minimal cost.
NoR-A-20.5.2	Recovery Action	Logging and Wood Harvesting	Consider the development of a Watershed Database (similar to the DFG Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.	3	5	CalFire, Campbell Timberland Management, CDFG, Jackson Demonstration State Forest, Mendocino Redwood Company, NMFS						TBD	The cost in considering development of the above mentioned plan is unlikely to cost much.
NoR-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
NoR-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of County road engineers, timber company, and railroad maintenance staff regarding watershed processes and the adverse effects of improper road/railroad construction and maintenance to salmonids and their habitats.	2	60	CalFire, Campbell Timberland Management, FishNet 4C, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners	33.33	33.33	33.33	33.33	33.33	2,000	Cost accounted for within other watershed strategies.
NoR-A-24.1.2	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	3	10	CalTrans, Campbell Timberland Management, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners						0	Cost is included in previous action.
NoR-A-24.2	Objective	Roads and Railroads	Minimize sediment input into the aquatic environment from existing road and railway networks.										

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
NoR-A-24.2.1	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	1	10	CalFire, Campbell Timberland Management, Mendocino County Department of Public Works, Mendocino Redwood Company, NOAA RC, Private Landowners, RWQCB						TBD	Similar existing programs could be modified and implemented at minimal cost.
NoR-A-24.2.2	Recovery Action	Roads and Railroads	Conduct actions that hydrologically disconnect roads and railroads in Core and Phase 1 CCC coho salmon watersheds in a compressed timeframe.										
NoR-A-24.2.2.1	Action Step	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.	2	10	CDFG, Mendocino County, NOAA RC, RWQCB, Trout Unlimited						TBD	Cost estimates should be developed from credible watershed assessments.
NoR-A-24.2.2.2	Action Step	Roads and Railroads	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF).	1	10	CDFG, Mendocino Redwood Company, NOAA RC, Private Landowners, RWQCB, Trout Unlimited						TBD	Need additional information on miles of roads to be treated and associated cost of treatments.
NoR-A-24.2.3	Recovery Action	Roads and Railroads	Minimize sediment delivery from roads during the winter period.										
NoR-A-24.2.3.1	Action Step	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	2	20	CalFire, Campbell Timberland Management, CDFG, Mendocino Redwood Company, Private Landowners						TBD	Cost is difficult to estimate at this time.
NoR-A-24.2.3.2	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	3	60	Campbell Timberland Management, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners						TBD	The cost of implementing a road sediment reduction program is difficult to estimate at this time.
NoR-A-24.2.3.3	Action Step	Roads and Railroads	Encourage County of Mendocino to address and adequately maintain the Sherwood Ridge Road. Encourage County of Mendocino to completely close and monitor gates and barriers during the winter period.	3	10	Campbell Timberland Management, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners						TBD	This likely already exists for large timberland owners in the basin. Most costs are likely to involve ongoing updates. Cost is expected to be minimal.
NoR-A-24.2.3.4	Action Step	Roads and Railroads	Design and implement a program of BMPs for road maintenance on private roads similar to the program for public roads (Sommarstrom, 2002).	1	20	Mendocino County Department of Public Works, NOAA RC, Private Landowners						TBD	Work with Mendocino County DOT to develop cost estimate for BMP cost in Noyo River watershed.
NoR-A-24.2.4	Recovery Action	Roads and Railroads	Fully implement the Noyo River TMDL.	1	30	CalFire, Campbell Timberland Management, Mendocino Redwood Company, Private Landowners						TBD	Cost is difficult to estimate at this time. Much of cost should be covered under sediment and road actions.

Noyo River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
NoR-A-24.2.5	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	2	20	CalTrans, Campbell Timberland Management, CDFG, Mendocino County Department of Public Works, Mendocino Redwood Company, Private Landowners						0	Costs will vary with specific road segments.
NoR-A-24.2.6	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	1	20	Cal Western Railroad, CDFG, Mendocino Redwood Company, NMFS, Private Landowners						TBD	Can not be determined at this time.
NoR-A-24.3	Objective	Roads and Railroads	Ensure all existing and new road and railway crossings minimize potential sediment delivery to the stream environment and allow upstream and downstream passage of adult and juvenile coho salmon.										
NoR-A-24.3.1	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	1	5	CalFire, Campbell Timberland Management, Mendocino Redwood Company, Private Landowners						tbd	Difficult to assess without further information.
NoR-A-24.3.2	Recovery Action	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	3	60	Cal Western Railroad, California Department of Mines and Geology, Campbell Timberland Management, Mendocino Redwood Company, Private Landowners						tbd	Costs may vary depending on number of road crossings.

PESCADERO CREEK

Pescadero Creek

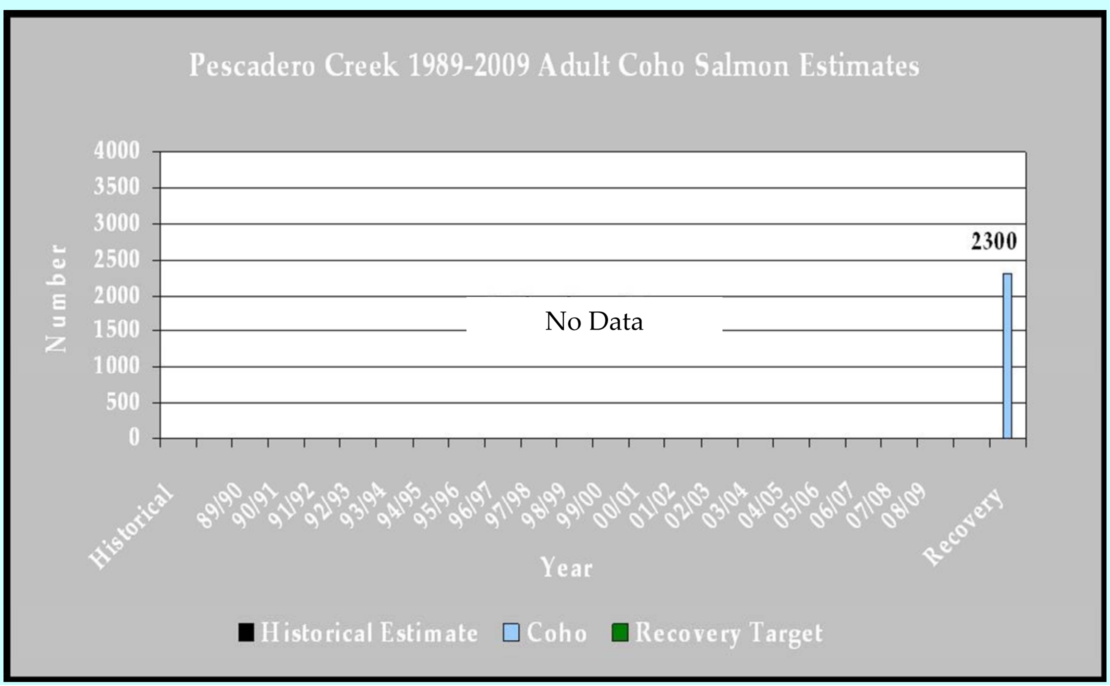
Independent Population
60.6 IP-km of potential coho salmon habitat
Coho salmon extirpated and steelhead present

Pescadero Creek drains approximately 81 square miles of the Santa Cruz Mountains in western San Mateo and Santa Cruz Counties. Pescadero Creek enters the Pacific Ocean near the town of Pescadero. The watershed contains steep forested slopes, deep canyons with steep inner gorges, a fertile coastal valley, and grasslands near the coast. The Pescadero Creek watershed has moderate to high erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. The SWRCB listed the Pescadero Creek as having water quality impaired for sediment in 2003. The water quality impairment listing determined that sediment was impairing habitats beneficial to coho salmon including migration, spawning and rearing habitats, and identified non-point sources as the probable cause. Pescadero has a large amount of rural residential housing adjacent to Pescadero Creek and its tributaries, likely contributing to degraded water quality. Coho salmon are believed to be extirpated from the watershed, although some smolts have been outplanted from the NMFS SWFSC and Monterey Bay Salmon and Trout Project captive broodstock program in recent years in an attempt to reestablish the population.

Pescadero Creek
Photo by Joel Casagrande

The Watershed at a Glance

Spawning Quantity & Quality	**POOR to GOOD**
Summer Water Temperatures	**POOR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency	**POOR**
Riparian Canopy	**POOR to GOOD**
Off channel/Floodplain Quality	**POOR**
Estuary Function	**POOR**



Pescadero Creek

Recovery Target: 2,300 Adult Coho Salmon

Increasing the survival of coho salmon

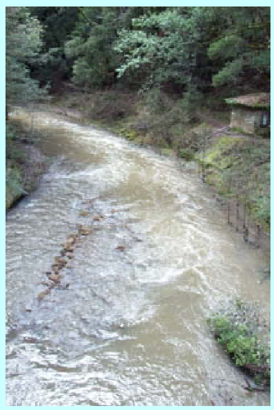
requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Droughts
- Storms and Flooding
- Agricultural practices
- Roads and Railroads
- Disease, Predation, Competition
- Fire and Fuel Management
- Logging and Wood Harvest
- Water Diversion and Impoundments

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Pescadero Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Increase spawning habitat
- Improve and increase the frequency of pools
- Increase the amount of large wood in streams
- Increase the number of off channel habitats
- Improve hydrologic connectivity
- Increase riparian shading to cool streams
- Decrease the number of roads near the stream and reduce impacts from remaining roads



Pescadero Creek
Photo by San Mateo County PW Dept

Advancing recovery of coho

salmon in Pescadero Creek requires these priority **recovery actions:**

- Increase the frequency and functionality of off channel and pool habitats.
- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.
- Promote, via technical assistance and/or regulatory action the development of discharge bypass requirements for water diversions, impoundments, and protection of riparian and floodplain areas.
- Maintain and restore hydrologic function to improve and minimize adverse affects to water quality and protect riparian and floodplain areas
- Conduct erosion site assessments to identify chronic sediment sources.

. . . **throughout:** the Teawater and Peters Creek planning watersheds.

Conservation Highlights

- There are actions underway to include a multidisciplinary task force to address yearly fish kills that appear to result in significant mortality rates of federally listed CCC steelhead.

We Need Your Photo Here

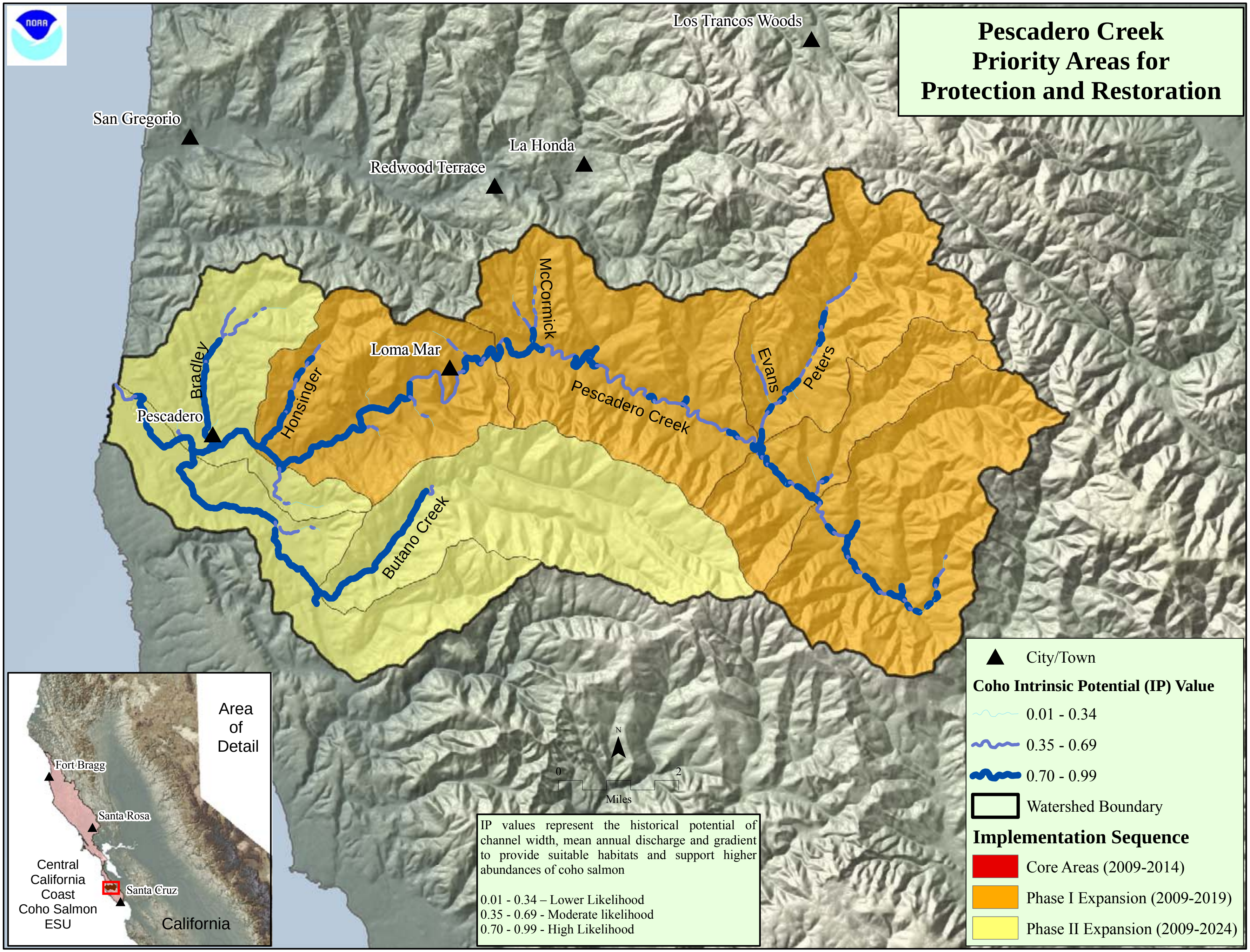
Pescadero Creek
Photo © Your Name Here, AFFIL

Recovery Partners

San Mateo County
State Parks
Big Creek Lumber Company
San Mateo RCD
San Jose State University
DFG
Farm Bureau

Immediate Needs

Install instream structures √
Protect the core sub-watersheds √
Develop water conservation practices √
Continue task force to address fish kills in the lagoon √



Pescadero Creek
Priority Areas for
Protection and Restoration
Los Trancos Woods
San Gregorio
La Honda
Redwood Terrace
Loma Mar
Pescadero
Bradley
Honsinger
McCormick
Pescadero Creek
Evans
Peters
Butano Creek
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
2
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Pescadero Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	67	Fair	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	89%	Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	<300 m^2	Poor	Spawning Adults	Sediment	Amount of Gravel*	<300 m^2	300-3100 m^2	3100-6000 m^2	>6000 m^2
NMFS	Best Prof. judgment	>10% of pop.	Poor	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	42	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	75	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	75	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	<60 avg. rating	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	<30% pools by length	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	Poor	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Poor	Poor	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	75	Fair	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	9.07/10 IP-km	Poor	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	<60 avg. rating	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	<50%	Poor	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	59%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.28%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	3.11%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	11%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	6.8	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	69%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	60-70%	Poor	Multiple Life Stages	Riparian Veg.	Canopy Cover	≤ 69% density "D" across IP-km	70 -79%	> 80%	
NMFS	CDF THP Dataset	3 mi/sq.mi.	Fair	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	3.3 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Pescadero Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Droughts	Medium	Medium	Very High	Medium	Very High	High			Very High
2	Storms and Flooding	High	High	Medium	High	High	Medium			High
3	Agricultural Practices	High	High	High	Medium	Medium	Medium			High
4	Roads and Railroads	High	High	Medium	Medium	Medium	High			High
5	Disease, Predation, and Competition	High	-	High	-	High	-			High
6	Fire and Fuel Management	High	High	Medium	Medium	Medium	Medium			High
7	Logging and Wood Harvesting	High	High	Medium	Medium	Medium	Medium			High
8	Residential and Commercial Development	Medium	Medium	Medium	Medium	Medium	High			High
9	Channel Modification	Medium	Low	Medium	Medium	Medium	High			Medium
10	Water Diversion and Impoundment	Medium	Low	High	Medium	Medium	Medium			Medium
11	Fishing and Collecting	High	-	Medium	Low	Medium	-			Medium
12	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium			Medium
13	Livestock Farming and Ranching	Medium	Medium	Medium	Medium	Medium	Medium			Medium
14	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
15	Mining	Medium	Low	Medium	Medium	Medium	Low			Medium
16	Hatcheries and Aquaculture	Medium	-	Medium	Low	Medium	Low			Medium
Threat Status for Targets and Project		Very High	High	Very High	High	Very High	High	-	-	Very High

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
PeC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to restore estuarine function.	2	20	California Department of Mines and Geology, Campbell Timberland Management, CDFG, Private Landowners						TBD	
PeC-A-1.1.2	Recovery Action	Estuary	Encourage State Parks/DFG/NOAA Fisheries to take a proactive role in resolving the yearly fish kills in Pescadero lagoon. Fish kills in the lagoon are currently affecting steelhead, however – until this issue is resolved – the lagoon is also considered unsuitable for coho salmon.	2	3	CDFG, County of San Mateo, NMFS, State Parks, USFWS	33.33	33.33	33.33			100	Staffing is considered the main cost. Close coordination among stakeholders and regulatory agencies is essential to resolving this issue.
PeC-A-1.1.2.1	Action Step	Estuary	Encourage State Parks to fund and implement restoration actions that benefit CCC coho and CCC steelhead and other special status species in the lagoon. Requirements and goals will vary by species.	3	5	CA Coastal Commission, California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, NMFS, Private Landowners, State Parks, USACE, USFWS	200	200	200	200	200	1,000	Primary life stages targeted for this action are over-wintering and smolt out migration for CCC coho. This cost estimate includes necessary maintenance actions such as culvert gate operations.
PeC-A-1.1.2.2	Action Step	Estuary	Restore the timing of sandbar closure so that it closes in June / July (as it did prior to reconstruction of the Highway 1 bridge) so as to provide adequate time for de-stratification and conversion to freshwater. Early closure is believed necessary to prevent fish kills and maximize lagoon productivity.	2	3	CA Coastal Commission, California Coastal Conservancy, CDFG, County of San Mateo, NMFS, State Parks, USACE, USFWS	23.33	23.33	23.33			70	Three years of experimentation should be adequate to ascertain whether this action produces favorable results in regard to yearly fish kills. If this experiment results in desired results it should be incorporated into ongoing Pescadero operations by State Parks during most water years. This action has a potential to produce significant benefits to rearing steelhead (listed as threatened under the ESA).
PeC-A-1.1.2.3	Action Step	Estuary	Evaluate benefits of temporarily plugging large culverts in spring to determine if blocking tidal flow would reduce the tidal prism and/or alter tidal velocity and timing to a condition resulting in early sandbar formation. If experiments prove successful replace failing culverts in the estuary with fewer, smaller, and/or closable culverts to allow State Parks to maintain functional rearing habitat.	2	5	CDFG, NMFS, RWQCB, State Parks	5.00	5.00	5.00	5.00	5.00	25	Cost are an estimate of the amount of agency personnel time necessary to initiate this project and producing the necessary report. The actual work would likely be very inexpensive.
PeC-A-1.1.2.4	Action Step	Estuary	Evaluate replacement of rusted culverts from North Marsh to facilitate water level and salinity management of the North Marsh.	3	5	CDFG, State Parks, USACE	6.00	6.00	6.00	6.00	6.00	30	
PeC-A-1.1.2.5	Action Step	Estuary	Evaluate existing conservation easements in the Estuary to ensure they are in conformance with original terms and conditions of the easement.	1	5	County of San Mateo, Private Landowners, State Parks						0	This cost should be minimal and should be considered a standard business practice by the entity that has granted conservation easements for private properties in the estuary.
PeC-A-1.1.3	Recovery Action	Estuary	Evaluate reconnection of hydraulic connectivity under Highway 1 at northern end of Pescadero Marsh.										
PeC-A-1.1.3.1	Action Step	Estuary	Encourage State Parks to remove parking lot at north end of Pescadero Marsh if hydraulic connectivity is determined to be a biologically beneficial and viable option for restoring lagoon function.	3	10	CA Coastal Commission, NMFS, State Parks, USFWS	20.00	20.00	20.00	20.00	20.00	200	Parking lot removal should be relatively inexpensive. The total parking lot holds parking spaces for less than 30 cars. Costs can be reduced if nearby disposal areas for asphalt are available.
PeC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
PeC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	5	California Coastal Conservancy, CDFG, County of San Mateo, NMFS, Private Landowners, State Parks	8.00	8.00	8.00	8.00	8.00	40	Standardized assessment methods should be used for this evaluation. Cost may vary depending on landowner access issues and existing data.
PeC-A-2.1.1.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	10	California Coastal Conservancy, CDFG, County of San Mateo, NMFS HCD, NOAA RC, State Parks, USACE						TBD	An evaluation of feasibility is needed to determine where these areas may exist. This action could have direct benefits to coho during the winter period.
PeC-A-2.1.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	60	California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, FEMA, FishNet 4C, NMFS, NRCS, San Mateo RCD, State Parks, USACE, USFWS						TBD	Costs cannot be determined at this time. Costs may be significant and will depend on number of projects constructed. The number of projects will vary depending on landowner participation and acceptance.
PeC-A-2.1.3	Recovery Action	Floodplain	San Mateo County should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.										
PeC-A-2.1.3.1	Action Step	Floodplain	Evaluate watershed for infrastructure at high risk of flooding.	2	5	CalTrans, County of San Mateo, FEMA, Private Landowners	15.00	15.00	15.00	15.00	15.00	75	Many of these structures have been identified. FEMA maps of the area should facilitate review.
PeC-A-2.1.3.2	Action Step	Floodplain	Encourage San Mateo County to develop a property easement acquisition funds and acquire grant monies to purchase, through a buyout program, eroding private properties in riparian corridors or properties subject to frequent flooding.	2	60	County of San Mateo, FEMA, Private Landowners, San Mateo RCD, State Parks						TBD	
PeC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
PeC-A-3.1.1	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.										
PeC-A-3.1.1.1	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	1	60	CDFG, NMFS, San Mateo RCD, SWRCB, Trout Unlimited						TBD	Cost will vary depending on land owner participation and types of projects identified.
PeC-A-3.1.1.2	Action Step	Hydrology	Develop more efficient and coordinated use of water resources to provide increased supply, restore groundwater levels, and increase dry weather baseflows through conjunctive management, use of reclaimed wastewater, and increased storage or utilization of excess winter stream flows.	1	60	CDFG, NMFS, San Mateo RCD, SWRCB						TBD	Costs will vary depending on landowner participation.
PeC-A-3.1.2	Recovery Action	Hydrology	Re-establish natural flow regime to improve adult migration to spawning habitats.										
PeC-A-3.1.2.1	Action Step	Hydrology	Conduct water supply pumping overnight to the extent feasible, particularly for upstream diversions.	2	60	CDFG, County of San Mateo, NMFS						0	Cost should be minimal once legal diversions and their impacts are determined.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-3.1.2.2	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	60	CDFG, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, NMFS HCD, NOAA RC, NRCS, POST, Private Landowners, San Mateo RCD, State Parks, SWRCB, Trout Unlimited						TBD	Water augmentation costs were estimated in regards to the Shasta-Scott Pilot Program (DFG 2004). These results indicated potentially significant costs. Off channel storage cost will vary depending on landowner participation, regulatory agency participation, and permitting requirements. Costs cannot be estimated for Pescadero at this time.
PeC-A-3.1.3	Recovery Action	Hydrology	Institutionalize programs to purchase easements on water rights to encourage the maintenance of surface flows.										
PeC-A-3.1.3.1	Action Step	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	1	20	CDFG, NMFS, Private Landowners, SWRCB						TBD	The price at which water is sold on environmental water markets is determined by negotiations between landowners and purchasing entities. The aggregate fiscal cost of water acquisition will depend on the quantity of water acquired and whether water rights will be permanently transferred or purchased for single periods of time.
PeC-A-3.1.4	Recovery Action	Hydrology	To improve connectivity of surface flows with groundwater reduce aggradation and overall sediment load at the watershed scale by treating roads and sources of mass wasting.	2	60	CalFire, CalTrans, County of San Mateo, Mid Penninsula Open Space District, San Mateo RCD, State Parks						TBD	Costs are estimated under Roads
PeC-A-5.1	Objective	Passage	Identify and remove existing passage barriers.										
PeC-A-5.1.1	Recovery Action	Passage	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	3	60	CalFire, California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, FEMA, FishNet 4C, Mid Penninsula Open Space District, NMFS, NRCS, RWQCB, San Mateo RCD, State Parks						TBD	Replacement of culverts/bridges and upgrading to NMFS standards will result in increased cost for materials and construction but will likely result in structures that can withstand large storm events better than many existing structures.
PeC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
PeC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Phase 1 areas and lower mainstem reaches of Pescadero Creek.	1	10	California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, FEMA, Mid Penninsula Open Space District, NMFS, NRCS, Private Landowners, RWQCB, San Mateo RCD, State Parks, USACE, USFWS	4.00	4.00	4.00	4.00	4.00	40	
PeC-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	2	60	CDFG, County of San Mateo, FEMA, NMFS, Private Consultants, Private Landowners, San Mateo RCD, USACE						0	Costs should be minimal. This recommendation would be implemented only when an existing problem has been identified and is in needed of protection.
PeC-A-6.1.1.3	Action Step	Pool Habitat	Educate landowners, land managers, and County and municipal staffs on the importance of LWD to coho survival and recovery, and watershed processes.	1	2	CalTrans, CDFG, County of San Mateo, FEMA, FishNet 4C, NMFS, San Mateo RCD, State Parks	7.50	7.50				15	Information in this recovery plan may serve as a source of information regarding the importance of LWD
PeC-A-6.1.1.4	Action Step	Pool Habitat	Install properly sized large woody debris to appropriate viability table targets.	1	20	CalFire, California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, FEMA, FishNet 4C, Mid Penninsula Open Space District, NOAA RC, NRCS, Private Landowners, San Mateo RCD, USACE	85.00	85.00	85.00	85.00	85.00	1,700	Estimates in the State Coho Plan indicate that LWD placement costs about $20,000 per stream mile; costs rise as the width of the water bodies increase and as the size of the material to be placed in channels grows. Currently, the Pescadero watershed lacks a LWD inventory but available information indicates LWD is lacking. Assuming universal landowner approval and permission, the cost to install LWD in the 61 IP-km (38mi) = $760,000. We believe this cost would be significantly more in the Pescadero watershed due to concerns regarding LWD stability and flooding that would require more engineering. Additionally, the LWD targets proposed in this plan likely exceed those estimated in the State Plan resulting in increased costs.
PeC-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	1	60	CalFire, California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, FEMA, FishNet 4C, Mid Penninsula Open Space District, NMFS, NRCS, Private Landowners, RWQCB, San Mateo RCD, USACE						TBD	Cost should be minimal. This recommendation should be adopted as a reoccurring recommendation for all restoration projects by individuals, agencies, and organizations that fund restoration projects.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-6.1.3	Recovery Action	Pool Habitat	Encourage retention and natural rates of recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.	1	60	CalFire, California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, FEMA, FishNet 4C, Mid Penninsula Open Space District, NMFS, NRCS, Private Consultants, RWQCB, San Mateo RCD, USACE						0	Cost should be minimal. This recommendation should be adopted as a reoccurring recommendation for all restoration projects by individuals, agencies, and organizations that fund restoration projects.
PeC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
PeC-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	60	CalFire, CalTrans, CDFG, County of San Mateo, FEMA, FishNet 4C, Mid Penninsula Open Space District, NMFS, San Mateo RCD						TBD	Cost will vary depending on landowner participation and market conditions. Conservation easements should be easements should be acquired opportunistically in high priority subbasins within the Pescadero Creek watershed.
PeC-A-7.1.2	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	20	CalFire, County of San Mateo, Mid Penninsula Open Space District, NRCS, Private Landowners, San Mateo RCD, State Parks						TBD	Estimated cost of watershed wide inventory. Reports should assess risk, impacts, and removal priorities.
PeC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
PeC-A-8.1.1	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	10	CalFire, County of San Mateo, Mid Penninsula Open Space District, NRCS, Private Landowners, San Mateo RCD, State Parks	4.00	4.00	4.00	4.00	4.00	40	Rough estimate for outreach efforts. These efforts should be directed towards landowners in high risk areas. This does not include the cost for a similar effort directed specifically to the Agricultural community.
PeC-A-8.1.1.1	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	2	60	CalFire, California Department of Mines and Geology, CalTrans, CDFG, County of San Mateo, FEMA, NMFS PRD, NRCS, San Mateo RCD						0	This should be considered a standard business practice.
PeC-A-8.1.2	Recovery Action	Sediment	Restore the number and function of log jams to store fine sediment to improve the quality of substrate for salmonids.	1	20	CalFire, CalTrans, CDFG, County of San Mateo, NMFS, Private Landowners, RWQCB, San Mateo RCD						TBD	The recommendation will facilitate the sorting and routing of gravels and improve instream rearing conditions. Costs are estimated under Pool Habitat.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
PeC-A-9.1.1	Recovery Action	Viability	Measure or estimate response of key habitat attributes to recovery efforts across the watershed.	2	12								Other monitoring efforts are occurring in the Santa Cruz Mtns Diversity Stratum and therefore, Pescadero ranks lower in overall priority in the immediate future. However, it will ultimately be important to begin assessing the overall run size in Pescadero. Redd monitoring may be less expensive than establishing a site to count migrating adults and smolts.
PeC-A-9.1.1.1	Action Step	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	2	10	CalFire, CDFG, NMFS, RWQCB, USFWS						TBD	All assessments should use standardized methods. Methods should be consistent across the ESU or at a minimum the Santa Cruz Mtns Diversity Stratum. Results from past assessments can be used in some circumstances to jump start restoration actions and need not necessarily wait upon completion of a standardized assessment protocol.
PeC-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
PeC-A-9.1.2.1	Action Step	Viability	Establish a life cycle station in Pescadero Creek or utilize assessment methods that comport to those of Gallagher and Gallagher (2005) or the Coastwide Monitoring Plan.	2	12	CDFG, NOAA SWFSC, Private Consultants, Private Landowners, State Parks	50.00	50.00	50.00	50.00	50.00	600	Costs may vary significantly. This estimate assumes redd/carcass counts on a subset of streams within the watershed.
PeC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
PeC-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
PeC-A-10.1.1.1	Action Step	Water Quality	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	2	10	CalFire, CalTrans, County of San Mateo, Mid Penninsula Open Space District, San Mateo RCD	2.00	2.00	2.00	2.00	2.00	20	
PeC-A-10.1.1.2	Action Step	Water Quality	Encourage County of San Mateo to establish wider riparian buffers in residential and urban areas for Pescadero Creek (and other historic CCC coho salmon coastal drainages.	2	10	County of San Mateo						TBD	Other monitoring efforts are occurring in the Santa Cruz Mtns Diversity Stratum and therefore, Pescadero ranks lower in overall priority in the immediate future. However, it will ultimately be important to begin assessing the overall run size in Pescadero. Redd monitoring may be less expensive than establishing a site to count migrating adults and smolts.
PeC-A-10.1.1.3	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	3	60	CalFire, County of San Mateo, Farm Bureau, FishNet 4C, Mid Penninsula Open Space District, NOAA RC, NRCS, Private Landowners, San Mateo RCD	2.50	2.50	2.50	2.50	2.50	150	Costs are difficult to estimate until and evaluation of candidate areas is conducted. Initial focus should be in lower reaches lacking streamside shade. Costs will vary depending on landowner participation and cost sharing.
PeC-A-11.1	Objective	Agricultural Practices	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
PeC-A-11.1.1	Recovery Action	Agricultural Practices	Reduce impacts of sediment inputs related to agricultural practices.										

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-11.1.1.1	Action Step	Agricultural Practices	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	60	County of San Mateo, Farm Bureau, NRCS, San Mateo RCD							This is a focused strategy to control sediment. Additional sediment control recommendations are presented under Sediment. Cost estimate would only apply to outreach to the agricultural community.
PeC-A-11.1.1.2	Action Step	Agricultural Practices	Encourage Regional Water Quality Control Board to extend greater oversight regarding effectiveness of erosion control measures.	2	60	RWQCB						0	This should be a standard business practice of the RWQCB.
PeC-A-11.1.1.3	Action Step	Agricultural Practices	Implement programs similar to the Sotoyome Resource Conservation District's Fish Friendly Farming practices (DFG 2004).	2	10	County of San Mateo, Farm Bureau, FishNet 4C, Private Landowners, San Mateo RCD	10.00	10.00	10.00	10.00	10.00	100	Cost is a rough estimate and could be significantly reduced if Sotoyome recommendations are directly adopted with minimal site specific adaptations. More site specific issues will likely increase costs. A large portion of the estimated cost would likely be incurred from outreach activities. These cost estimates do not include matching funding or land owner expenses. Note that these programs and take minimization measures and are not a no take standard.
PeC-A-11.1.1.4	Action Step	Agricultural Practices	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors.	2	60	County of San Mateo, Farm Bureau, FishNet 4C, Mid Penninsula Open Space District, Private Landowners, San Mateo RCD						TBD	Re-vegetation would also facilitate amelioration of instream temperatures and would provide a source for future LWD recruitment. This recommendation will likely be received with some resistance by some landowners. Costs will vary depending on landowner participation and existing landuse.
PeC-A-11.1.1.5	Action Step	Agricultural Practices	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	1	60	CDFG, County of San Mateo, FishNet 4C, Mid Penninsula Open Space District, Private Landowners, San Mateo RCD						0	Maintaining intact buffers will incur no additional costs.
PeC-A-11.1.1.6	Action Step	Agricultural Practices	Purchase conservation easements from landowners that currently have ongoing grazing or agricultural operations along the estuary.	3	60	CDFG, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, NMFS, POST, Private Landowners, San Mateo RCD, State Parks						TBD	Costs will vary depending on the amount of willing landowners participating in the program.
PeC-A-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
PeC-A-12.1.1	Recovery Action	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.										
PeC-A-12.1.1.1	Action Step	Channel Modification	Evaluate whether proposed stabilization projects will lead to additional instability either up- or downstream.	1	60	California Department of Mines and Geology, CalTrans, CDFG, County of San Mateo, FEMA, Mid Penninsula Open Space District, NMFS, NRCS, POST, Private Consultants, RWQCB, San Mateo RCD, USACE						0	This should be considered a standard business practice for all practitioners of instream bank stabilization.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-12.1.1.2	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	1	60	CalFire, CDFG, County of San Mateo, FEMA, FishNet 4C, Mid Penninsula Open Space District, NOAA RC, POST, Private Landowners, RWQCB, San Mateo RCD, USACE						0	
PeC-A-12.1.1.3	Action Step	Channel Modification	Where feasible, remove obsolete bank stabilization structures from the channel which contribute to channel incision and reduced habitat complexity.	2	60	CalFire, CalTrans, County of San Mateo, FishNet 4C, Mid Penninsula Open Space District, NOAA RC, POST, Private Landowners, San Mateo RCD						TBD	Costs cannot be determined at this time. An evaluation of the number of structures is needed and costs will vary depending on site specific conditions.
PeC-A-12.1.2	Recovery Action	Channel Modification	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	2	5	CDFG, NMFS, San Mateo County	8.00	8.00	8.00	8.00	8.00	40	Policy could be applied to all targeted San Mateo County streams. Estimated cost of developing a new policy and staff time.
PeC-A-14.1	Objective	Disease, Predation, and Competition	Evaluate suitable methods and levels of marine mammal control when predation is identified as a significant limiting factor to recovery on an individual watershed basis.	3	20	CDFG, NMFS, NMFS OLE, NOAA SWFSC, Public						TBD	Marine mammal control likely to be a very expensive action depending on method of control and due to significant permitting requirements. Costs cannot be determined at this time. This action should only be considered as an option of last resort and where a problematic situation is clearly documented.
PeC-A-14.2	Objective	Disease, Predation, and Competition	Implement regulatory, abatement, and education measures to prevent the invasion of exotic species, (including exotic plants and potentially striped bass).	2	10	CA Coastal Commission, California Coastal Conservancy, CDFG, County of San Mateo, NRCS, Private Landowners, San Mateo RCD						TBD	Costs will vary depending on abatement methods used which will vary depending on problems identified.
PeC-A-15.1	Objective	Droughts	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts while also providing for CCC coho salmon recovery needs.										
PeC-A-15.1.1	Recovery Action	Droughts	Identify and eliminate depletion of base flows from unauthorized water uses.										
PeC-A-15.1.1.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	1	5	CDFG, County of San Mateo, NMFS, SWRCB	60.00	60.00	60.00	60.00	60.00	300	Cost will likely be staff time expense.
PeC-A-15.1.1.2	Action Step	Droughts	Work with water diverters streams to assure adequate and proper consideration is given to fish needs. Develop agreements that will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	2	20	CDFG, County of San Mateo, NMFS, SWRCB						TBD	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and rearing habitat conditions in summer and fall months.
PeC-A-15.1.2	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
PeC-A-15.1.2.1	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	1	5	CDFG, NMFS HCD, SWRCB						TBD	This cost may be significant and will require development of a water budget for Pescadero Creek.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-CCC-15.1.3	Recovery Action	Droughts	Increase enforcement patrols by DFG and NMFS OLE in sensitive spawning and rearing areas.	2	60	CDFG Law Enforcement, NMFS OLE							
PeC-CCC-16.1	Objective	Fire and Fuels Management	Develop measures protective of salmonids during fire suppression activities.										
PeC-CCC-16.1.1	Recovery Action	Fire and Fuels Management	Establish fire contingency plan developed by experts from CalFire, local fire districts, San Mateo RCD, and regulatory agencies with expertise in fisheries issues.										
PeC-CCC-16.1.1.1	Action Step	Fire and Fuels Management	Encourage CalFire to provide plan to all non-County fire fighters when providing fire fighting assistance in the Pescadero Creek watershed (and all other watersheds in the County).	1	5	CalFire						0	Cost of providing the plan is minimal.
PeC-CCC-16.1.1.2	Action Step	Fire and Fuels Management	In the event of a wildfire, we recommend CalFire Resource Advisors contact the resource agencies for ESA consultation (or technical assistance) regarding the incident. The resource agencies can provide guidance regarding critical resources in the area that may be affected by fire fighting actions.	2	60	CalFire						0	Guidance could include informing CalFire of sensitive biological resources in the watershed as well as recommendations regarding watersource locations (e.g., picking up water from areas other than (Pescadero lagoon when using helicopters). Protocols, similar to those developed between USFWS/USFS/BLM/NMFS could serve as a template.
PeC-CCC-16.1.1.3	Action Step	Fire and Fuels Management	Implement sedimentation reduction techniques in concert with prescribed fire techniques to minimize sediment impacts to various coho salmon life stages.	1	60	CalFire						0	This recommendation should be considered a standard practice.
PeC-CCC-16.1.1.4	Action Step	Fire and Fuels Management	Immediately implement appropriate sediment control measures following completion of fire suppression while fire fighters and fire fighting equipment are on site.	1	60	CalFire						0	This recommendation will result in a net cost savings. Reduce erosion from building fire lines by: out sloping, installing waterbars at appropriate intervals, breaks in fire lines (pick up blades on dozers occasionally, especially where fuels are sparse0, minimize gradient of fire lines, change fire-line alignment onto occasional flats as often as possible. To maximum extent possible maintain the ground topography.
PeC-CCC-16.1.1.5	Action Step	Fire and Fuels Management	Re-contour any new facility sites as soon as possible after site clean up and fire.	3	60	CalFire						0	Standard business practice.
PeC-CCC-16.2	Objective	Fire and Fuels Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.										
PeC-CCC-16.2.1	Recovery Action	Fire and Fuels Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.										
PeC-CCC-16.2.1.1	Action Step	Fire and Fuels Management	Use managed fire to promote revegetation of species that filter out fine sediment.	3	60	CalFire						TBD	
PeC-CCC-16.2.1.2	Action Step	Fire and Fuels Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	2	5	CalFire	4.00	4.00	4.00	4.00	4.00	20	
PeC-CCC-16.2.1.3	Action Step	Fire and Fuels Management	Reassess fire risk every ten years.	3	60	CalFire, County of San Mateo						TBD	
PeC-CCC-16.2.1.4	Action Step	Fire and Fuels Management	Work with County planners to define future impacts of proposed urban and infrastructure development on fire suppression and fuel load buildup.	3	60	CalFire, County of San Mateo						TBD	
PeC-CCC-17.1	Objective	Fishing and Collecting	Minimize bycatch of CCC coho salmon from offshore commercial and sport fishing.										
PeC-CCC-17.1.1	Recovery Action	Fishing and Collecting	Conduct outreach and education to anglers to reduce hook-and-release injury and mortality, and on methods to reduce salmonid gut hooking.	2	3	CDFG, NMFS						TBD	
PeC-CCC-17.1.2	Recovery Action	Fishing and Collecting	Prohibit offshore fishing until January 15 (or until sandbar opens naturally) within one mile of the river mouth.	2	3	CDFG, NMFS						TBD	If sandbar breeches due to unauthorized human actions and drought conditions do not provide adequate flows in Pescadero for upmigration, consider waiting until the first significant rainfall event and/or January 15.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-CCC-17.1.2.1	Action Step	Fishing and Collecting	Work with DFG to monitor the river mouth until river flows naturally breach the sandbar.	2	60	CDFG, NMFS						0	Some fishing has been documented in waterways prior to breaching. Cost should be minimal and this should be considered a standard DFG business practice.
PeC-CCC-17.2	Objective	Fishing and Collecting	Minimize interception of CCC coho salmon during the trout and steelhead freshwater sport fishing season.										
PeC-CCC-17.2.1	Recovery Action	Fishing and Collecting	Work with DFG to improve the Fishing Regulation manual to clearly identify differences in body morphology of all potentially present adult salmonids with color photos of diagnostic features (e.g., caudal fin spotting, caudal fin shape, coloration of lower jaw, peduncle width, etc.).	2	3	CDFG, NMFS						TBD	Cost should be minimal.
PeC-CCC-17.2.2	Recovery Action	Fishing and Collecting	Work with DFG to conduct correlative flow studies that assess critical riffles or other passage impediments in the watershed.	2	3	CDFG, NMFS	16.67	16.67	16.67			50	This cost may be less than projected depending on the quality of existing habitat typing information for the watershed
PeC-CCC-17.2.3	Recovery Action	Fishing and Collecting	Promote CalTip to discourage poaching (DFG 2004).	2	3	CDFG, NMFS						TBD	
PeC-CCC-19.1	Objective	Livestock Farming and Ranching	Promote grazing and ranching practices that protect and restore CCC coho salmon habitats.										
PeC-CCC-19.1.1	Recovery Action	Livestock Farming and Ranching	Aid landowners willing to fence off riparian areas in choosing alternatives water source sites (preferably ones that are hydrologically disconnected from stream flows).	3	60	Farm Bureau, NOAA RC, Private Landowners, RWQCB, San Mateo RCD						TBD	DFG 2004 estimates fencing costs in 2002 dollars at $4 per LF. Costs may be higher in the Pescadero watershed. Total costs are unknown and may vary depending on landowner participation and total amount of habitat fenced.
PeC-CCC-19.1.2	Recovery Action	Livestock Farming and Ranching	To minimize gully initiation, grazing should be kept at relatively low intensities on the steeper slopes in this area.	3	60	Farm Bureau, FishNet 4C, RWQCB, San Mateo RCD, State Parks						0	The lower Pescadero is vulnerable to gully initiation. Establishing conservative targets would reduce the total number of AUM but would also reduce restoration costs to address gullies.
PeC-CCC-19.1.2.1	Action Step	Livestock Farming and Ranching	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3	5	CDFG, NMFS HCD, SWRCB						TBD	
PeC-CCC-19.1.3	Recovery Action	Livestock Farming and Ranching	Locate water sources away from riparian areas.	3	60	Farm Bureau, FishNet 4C, NRCS, Private Landowners, San Mateo RCD						TBD	DFG estimated water control structures at $15,000 each. The cost of moving a water source for grazing cattle is likely much lower. However, costs cannot be estimated because landowner participation is unknown and site specific conditions are currently unknown.
PeC-CCC-19.1.4	Recovery Action	Livestock Farming and Ranching	Reduce the adverse effects of grazing and ranching to water quality in the Bradley Creek subwatershed.	3	30	Farm Bureau, FishNet 4C, Private Landowners, San Mateo RCD						TBD	
PeC-CCC-20.1	Objective	Logging and Wood Harvesting	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
PeC-CCC-20.1.1	Recovery Action	Logging and Wood Harvesting	Provide information to the appropriate regulatory bodies regarding the status of CCC coho salmon, priority watershed processes needing consideration, and recommendations that provide no take or incidental take assurances.	2	60	Board of Forestry, CalFire, CDFG, County of San Mateo, NMFS, SWRCB, USACE, USEPA, USFWS						0	This recovery plan could serve as a source of information for outreach.
PeC-CCC-20.1.2	Recovery Action	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within Core, Phase I and Phase II CCC coho salmon areas.										
PeC-CCC-20.1.2.1	Action Step	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	NMFS						0	See San Lorenzo River for an estimate of costs for the Santa Cruz Mountains Diversity Stratum.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
PeC-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
PeC-A-20.2.1.1	Action Step	Logging and Wood Harvesting	Discourage San Mateo County from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	3	CDFG, NMFS						0	
PeC-A-20.2.1.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	3	CDFG, NMFS						TBD	Cost should be minimal and long-term savings due to reduced watershed impacts should be significant.
PeC-A-20.3	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
PeC-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	60	Board of Forestry, CalFire, CDFG, County of San Mateo, NMFS, SWRCB, USACE, USEPA, USFWS						0	This recovery plan could serve as a source of information for outreach. See Roads and Railroads strategies for more detail on sediment control recommendations.
PeC-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	60	Board of Forestry, CalFire, Private Landowners						TBD	Cost is contingent on future rate of harvest and road network.
PeC-A-20.3.1.2	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	2	60	CalFire, CDFG, Private Landowners, SWRCB						TBD	Most of these costs will likely be associated with planned ongoing harvest plans.
PeC-A-20.3.1.3	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	60	CalFire, CDFG, Private Landowners						TBD	Cost should be minimal.
PeC-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Allow trees in riparian areas to age, die, and recruit into the stream naturally.										
PeC-A-20.3.2.1	Action Step	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.	3	60	CalFire, Private Landowners						TBD	Cost of managing riparian areas is anticipated to be minimal.
PeC-A-20.3.3	Recovery Action	Logging and Wood Harvesting	Conduct conifer release to promote growth of larger diameter trees where appropriate.	3	30	CalFire, Private Landowners						TBD	
PeC-A-23.1	Objective	Residential and Commercial Development	Improve stream maintenance practices to protect instream complexity, hydrologic processes and riparian functions.										
PeC-A-23.1.1	Recovery Action	Residential and Commercial Development	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004). Removal should only occur after careful review and consideration.										
PeC-A-23.1.1.1	Action Step	Residential and Commercial Development	Educate county and city public works departments, flood control districts, and planning departments, etc., on the critical importance of maintaining riparian vegetation, instream LWD, and LWD recruitment.	1	60	CDFG, County of San Mateo, FishNet 4C, NMFS, USACE						TBD	
PeC-A-23.1.1.2	Action Step	Residential and Commercial Development	Remove logs and debris from streams only as a "last resort" (i.e., failure to remove them will certainly cause the loss of an essential facility) after consultation with a hydrologist and/or qualified fisheries biologist.	1	60	CalTrans, CDFG, County of San Mateo, FEMA, NMFS PRD, Private Landowners, USACE						TBD	Costs may be highly variable depending on water year and flooding. Years of lower rainfall will likely have less need for site by site evaluation and costs will be less in those years. Cost will be significantly greater in wet years.
PeC-A-23.2	Objective	Residential and Commercial Development	Maintain and restore hydrologic function, protect riparian and floodplain areas, and minimize adverse effects to water quality and instream rearing habitats resulting from commercial and urban development.										
PeC-A-23.2.1	Recovery Action	Residential and Commercial Development	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.										See recommended strategies for Floodplains and Riparian areas.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
PeC-A-23.2.1.1	Action Step	Residential and Commercial Development	Encourage San Mateo to develop property easement acquisition funds and acquire grant monies to purchase eroding private properties in riparian corridors or properties subject to frequent flooding though a buyout program.	2	60	County of San Mateo						TBD	
PeC-A-23.2.1.2	Action Step	Residential and Commercial Development	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	1	60	CalTrans, County of San Mateo, FEMA, Private Landowners, USACE						0	Costs should be minimal if this concept is adopted early in the planning process for all new development.
PeC-A-23.2.1.3	Action Step	Residential and Commercial Development	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	1	60	County of San Mateo, FEMA, Private Landowners, Public, USACE						0	
PeC-A-23.2.2	Recovery Action	Residential and Commercial Development	Support the development and implementation of regulations for activities that intercept groundwater recharge (e.g., use of subsurface tiles in vineyards, impervious surfaces, etc.).	2	5	CDFG, County of San Mateo, Public, SWRCB						0	Costs of changing existing regulations should be minimal. Many existing templates for this type of action already exist and could be incorporated into new regulations.
PeC-A-23.2.3	Recovery Action	Residential and Commercial Development	Avoid, or at a minimum regulate, the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.										
PeC-A-23.2.3.1	Action Step	Residential and Commercial Development	Work with jurisdictional agencies to prohibit and or restrict transport of toxic chemicals on the Pescadero road corridor through the Pescadero Creek watershed.	2	60	CalTrans, CDFG, County of San Mateo, NMFS						TBD	
PeC-A-23.2.3.2	Action Step	Residential and Commercial Development	Encourage increased oversight by appropriate regulatory agencies of activities that use hazardous commercial and industrial products in the watershed.	2	60	CalTrans, CDFG, County of San Mateo, RWQCB, USEPA						TBD	
PeC-A-23.2.4	Recovery Action	Residential and Commercial Development	Sediment from existing and future commercial and urban development should be reduced to magnitudes appropriate to the geological setting of the watershed, resulting in no net increase in sedimentation over natural limits.										
PeC-A-23.2.4.1	Action Step	Residential and Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	1	60	CalFire, CalTrans, County of San Mateo, Mid Penninsula Open Space District, POST, RWQCB, USACE						0	Costs should be minimal if this concept is adopted early in the planning process for all new development.
PeC-A-23.2.4.2	Action Step	Residential and Commercial Development	Encourage counties and local municipalities to expand riparian buffer widths for new development (including redevelopment).	2	60	County of San Mateo						TBD	Costs cannot be determined at this time
PeC-A-23.2.4.3	Action Step	Residential and Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.	2	60	CalTrans, CDFG, County of San Mateo, FEMA, Private Landowners, Public, RWQCB, USACE						TBD	Stringent review by permitting agencies is expected to reduce costs associated with poorly planned and poorly located developments.
PeC-A-23.2.4.4	Action Step	Residential and Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	2	60	BLM, County of San Mateo, Private Landowners, USACE						TBD	Cost to upgrade stormwater discharge points cannot be determined at this time, but it may be significant.
PeC-A-23.3	Objective	Residential and Commercial Development	Minimize rate, and subsequent adverse affects, of land conversion to residential and commercial development.										
PeC-A-23.3.1	Recovery Action	Residential and Commercial Development	Encourage the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	2	60	County of San Mateo, FishNet 4C						0	

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-23.3.2	Recovery Action	Residential and Commercial Development	Encourage all permitting agencies to evaluate projects during construction, including erosion controls during the winter period for permitted projects in Core, Phase 1, and Phase 2 areas, emphasizing areas with sandy soils.	1	60	CDFG, County of San Mateo, FEMA, NMFS, RWQCB, SWRCB, USACE, USEPA, USFWS						0	This should be considered a standard business practice for all agencies that act in a regulatory role.
PeC-A-23.3.3	Recovery Action	Residential and Commercial Development	Flood control projects or other modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	1	60	CalTrans, County of San Mateo, FEMA, NRCS, RWQCB, USACE						0	Cost of avoiding development within the floodplain should result in a long term cost savings.
PeC-A-23.3.4	Recovery Action	Residential and Commercial Development	New development in all historic CCC coho salmon watersheds should meet a zero net increase in storm-water runoff, changes in duration, or magnitude of peak flow.	3	60	County of San Mateo, USACE						TBD	These costs are likely minimal because of the relatively low rate of development in the watershed likely precludes the necessity of significant flood detention basins, etc.
PeC-A-23.3.5	Recovery Action	Residential and Commercial Development	Work with counties to develop and implement ordinances (e.g. Santa Cruz County Code 2008) to restrict subdivisions by requiring a minimum acreage limit for parcelization in concert with limits on water supply and groundwater recharge areas.	3	3	County of San Mateo	50.00	50.00	50.00			150	Cost is a rough estimate of time and effort, including staff outreach, to develop new ordinances.
PeC-A-23.4	Objective	Residential and Commercial Development	Standards and recommendations regarding development should apply to all jurisdictions, including school districts and other special districts not subject to county and/or state related ordinances or policies.	1	60	County of San Mateo, USACE						TBD	
PeC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
PeC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	20	CalFire, CalTrans, County of San Mateo	1.00	1.00	1.00	1.00	1.00	20	Similar existing programs could be modified and implemented at minimal cost.
PeC-A-24.2	Objective	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, Phase I within 10 years, and Phase II areas within 15 years (from 2010).										
PeC-A-24.2.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
PeC-A-24.2.1.1	Action Step	Roads and Railroads	Implement a sediment reduction program for private roads.	1	10	CalFire, CDFG, Coastside Land Trust, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, POST, San Mateo RCD						TBD	Cost will vary depending on landowner participation and site specific conditions.
PeC-A-24.2.1.2	Action Step	Roads and Railroads	Design and implement a program of BMPs for road maintenance on private roads similar to the proposed program for public roads.	3	10	CalFire, Coastside Land Trust, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, NRCS, POST, San Mateo RCD						TBD	Implementation costs cannot be determined at this time but are likely significant.
PeC-A-24.2.2	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.										

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-24.2.2.1	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, California Department of Mines and Geology, CalTrans, County of San Mateo						TBD	This is a cost that is frequently absorbed into new road projects and should be considered a standard business practice.
PeC-A-24.2.2.2	Action Step	Roads and Railroads	Conduct a road survey beginning with inner gorge roads in sandy soils followed by roads in other settings.	2	20	CalFire, CalTrans, County of San Mateo, Farm Bureau, FishNet 4C, NRCS, San Mateo RCD	25.00	25.00	25.00	25.00	25.00	500	Costs are based on the fact that this work has been conducted in many subbasins in the watershed and additional assessments for these areas are not needed.
PeC-A-24.2.2.3	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	2	20	CalTrans, County of San Mateo, FishNet 4C, RWQCB, San Mateo RCD	25.00	25.00	25.00	25.00	25.00	500	Roadside berms are common on many private and county roads in San Mateo County.
PeC-A-24.2.2.4	Action Step	Roads and Railroads	Install sediment traps for pretreatment, and a modified culvert system that can act as an efficient detention system.	3	60	CalFire, CalTrans, County of San Mateo, Farm Bureau, FEMA, Mid Penninsula Open Space District, NRCS, POST, Private Landowners, San Mateo RCD						TBD	Costs will vary depending on number of culvert upgrades occur on a road network and the inefficiency of the current drainage system.
PeC-A-24.2.2.5	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	1	60	CalFire, CalTrans, County of San Mateo, FEMA, NRCS						0	Cost should be minimal as most of these sites are likely identified.
PeC-A-24.2.3	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.										
PeC-A-24.2.3.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	60	CalFire, CalTrans, CDFG, County of San Mateo, FishNet 4C, Mid Penninsula Open Space District, POST, Private Landowners, San Mateo RCD						TBD	This should be a standard business practice for landowners with roads and/or road managers. Costs of annual inspections should be minimal but costs of repairs can be significant depending on timing and site specific conditions.
PeC-A-24.2.4	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, CalTrans, CDFG, Coastside Land Trust, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, NRCS, POST, Private Consultants, RWQCB, San Mateo RCD, State Parks, USACE						TBD	Cost cannot be determined at this time but should be adopted as part of future road actions.
PeC-A-24.3	Objective	Roads and Railroads	Substantially reduce road densities over the next ten years prioritizing high risk areas in Phase 1 watersheds.										
PeC-A-24.3.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).										

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-24.3.1.1	Action Step	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	20	CalFire, CalTrans, County of San Mateo, FishNet 4C, Private Landowners, RWQCB, San Mateo RCD						TBD	Cost associated with assessment and redesign cannot be determined at this time. Costs would likely be significant due to large amount of infrastructure already in place.
PeC-A-24.3.1.2	Action Step	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	CalFire, CalTrans, County of San Mateo, USACE						TBD	Cost may vary significantly. However, a well designed road management plan should result in overall cost savings.
PeC-A-25.1	Objective	Storms and Flooding	Conduct outreach and education regarding how local, city, county, State and Federal planning can put in place mechanisms that provide community resiliency to storms and flooding.										
PeC-A-25.1.1	Recovery Action	Storms and Flooding	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	1	5	County of San Mateo, FEMA						TBD	
PeC-A-25.1.2	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	2	60	County of San Mateo, FEMA, FishNet 4C, NRCS, POST, RWQCB						TBD	
PeC-A-25.1.3	Recovery Action	Storms and Flooding	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	5	CDFG, FEMA, FishNet 4C, NMFS, NRCS, San Mateo County, San Mateo RCD, USACE, USFWS	4.00	4.00	4.00	4.00	4.00	20	Existing documents and policies can be used for this recommendation. Costs would increase if a number of site specific conditions and criteria are developed.
PeC-A-25.1.4	Recovery Action	Storms and Flooding	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	1	60	CalFire, CalTrans, County of San Mateo, FEMA, RWQCB, San Mateo RCD, USACE						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have roads and other infrastructure addressed to improve hydrologic function. As a general recommendation for future development cost may vary depending on existing infrastructure and site specific conditions.
PeC-A-25.1.5	Recovery Action	Storms and Flooding	Work with local governments to incorporate protection of CCC coho salmon in any flood management activity (DFG 2004).	2	10	CDFG, County of San Mateo, FEMA, NMFS, USACE						0	Outreach and education are ongoing, and additional costs are expected to be minimal.
PeC-A-26.1	Objective	Water Diversion and Impoundment	Improve current laws and policies to control diversions and water use in order to maintain and restore surface flows.										
PeC-A-26.1.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon by establishing a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage (DFG 2004).										
PeC-A-26.1.1.1	Action Step	Water Diversion and Impoundment	Develop and enforce stream flow bypass requirements for diversions in Pescadero Creek and its tributaries.	1	10	CDFG, NMFS HCD, RWQCB, SWRCB, USFWS						TBD	Cost may vary considerably depending on existing baseflow and existing uses of water being diverted.
PeC-A-26.1.2	Recovery Action	Water Diversion and Impoundment	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	2	60	CDFG, NMFS, SWRCB, USFWS						0	This should be considered a standard business practice for all reviewing agencies.
PeC-A-26.1.3	Recovery Action	Water Diversion and Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	1	60	CDFG, County of San Mateo, Farm Bureau, FishNet 4C, NMFS, NRCS, Private Landowners, RWQCB, SWRCB, USFWS						TBD	Costs will vary depending on degree of flow impairment, landowner participation, and quality of available data. This information is unknown at this time and cost cannot be estimated.

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-26.1.4	Recovery Action	Water Diversion and Impoundment	Monitor, identify problems, and prioritize needed changes to water diversion on current or potential coho streams that go dry in some years (DFG 2004).										
PeC-A-26.1.4.1	Action Step	Water Diversion and Impoundment	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	1	5	California Coastal Conservancy, CDFG, Coastside Land Trust, County of San Mateo, Mid Penninsula Open Space District, NMFS, NRCS, POST, Private Landowners, Public, San Mateo RCD, SWRCB, USFWS	60.00	60.00	60.00	60.00	60.00	300	Costs are a rough estimate and may be reduced depending on the availability of previous data and analysis.
PeC-A-26.1.4.2	Action Step	Water Diversion and Impoundment	Use developed exceedence probability curves to predict late summer flow conditions.	1	5	CDFG, NMFS HCD, SWRCB	20.00	20.00	20.00	20.00	20.00	100	Cost should be minimal as most of these sites are likely identified.
PeC-A-26.1.4.3	Action Step	Water Diversion and Impoundment	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by users in the watershed through conservation programs.	1	60	CDFG, County of San Mateo, NMFS, San Mateo RCD, SWRCB						TBD	Costs can be determined pending completion of evaluation of summer flows and impacts to historical hydrology from existing diversions.
PeC-A-26.1.5	Recovery Action	Water Diversion and Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	2	30	California Coastal Conservancy, CDFG, Coastside Land Trust, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, NMFS HCD, NOAA RC, NRCS, POST, RWQCB, San Mateo RCD, SWRCB, USFWS						TBD	Costs may be significant depending on site conditions and number of devices installed
PeC-A-26.1.6	Recovery Action	Water Diversion and Impoundment	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).										
PeC-A-26.1.6.1	Action Step	Water Diversion and Impoundment	Require the SWRCB to conduct interagency consultation with the California Department of Fish and Game and technical assistance with NMFS on the issuance of water rights permits.	1	60	CDFG, NMFS HCD, SWRCB						0	
PeC-A-26.2	Objective	Water Diversion and Impoundment	Promote water conservation by the public, water agencies, agriculture, private industry, and the citizenry.										
PeC-A-26.2.1	Recovery Action	Water Diversion and Impoundment	Promote conjunctive use of water with water projects whenever possible to maintain or restore coho salmon habitat.	2	30	CDFG, Coastside Land Trust, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, Mid Penninsula Open Space District, NMFS HCD, Private Landowners, RWQCB, San Mateo RCD, SWRCB, USFWS						TBD	
PeC-A-26.3	Objective	Water Diversion and Impoundment	Develop new policies and regulations to provide suitable flow conditions for CCC coho salmon.										

Pescadero Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PeC-A-26.3.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon.										
PeC-A-26.3.1.1	Action Step	Water Diversion and Impoundment	Assess and map water diversions (DFG 2004).	2	60	CDFG, County of San Mateo, NMFS HCD, NMFS OLE, RWQCB, SWRCB						0	This data base should already exist for the Pescadero Creek and costs to maintain it are likely minimal.
PeC-A-26.3.1.2	Action Step	Water Diversion and Impoundment	Determine and monitor 1600 program compliance related to water diversions (DFG 2004).	1	60	CDFG, SWRCB						TBD	This should be adopted as a standard practice by DFG.

PINE GULCH CREEK

Pine Gulch Creek

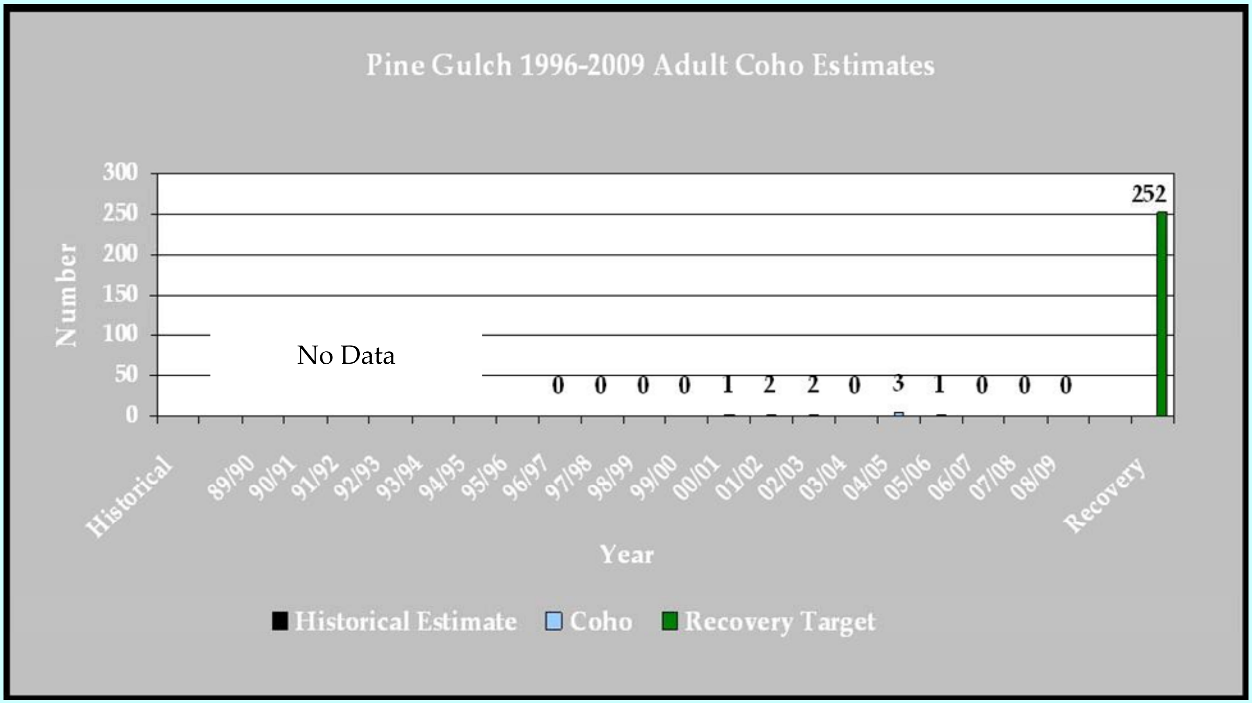
Dependent Population
7.4 Km of potential coho salmon habitat
Coho salmon and steelhead present

Pine Gulch Creek drains approximately 17 square miles of northern Marin County, and drains into Bolinas Lagoon. Approximately 50 percent of the Pine Gulch Creek watershed is coniferous forest, about 22 percent is riparian hardwood forest, and about 13 percent is grassland. Seventy-eight percent of the Pine Gulch Creek watershed is in state, local, or federally owned lands; the remaining 22 percent is in private ownership. The dominant land use within the Pine Gulch Creek watershed is recreational activities. Housing development within the Pine Gulch Creek watershed is low to moderate; approximately 50 housing units are present in the watershed. There are 12 barriers to salmon migration caused by road crossings and water diversions. Impassable barriers block salmonids from less than 10 percent of the watershed.

Pine Gulch Creek
Photo National Park Service, Point Reyes

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD to VERY GOOD**
Summer Water Temperatures:	**GOOD**
Depth & Shelter of Pools	**POOR to FAIR**
Large Wood Frequency:	**POOR to FAIR**
Riparian Canopy:	**POOR**
off channel/Floodplain Quality:	**FAIR**
Estuary Function:	**POOR**



Pine Gulch Creek Recovery Target: 252 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Droughts
- Water Diversion and Impoundment
- Channel Modification

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Lagunitas Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Increase pool frequency for summer rearing
- Improve the quality and extent of the estuary
- Increase riparian shading
- Increase the frequency of large wood in streams

Landslide near Pine Gulch Creek
Photo by National Park service, Point Reyes

Advancing recovery of **coho** salmon in Pine Gulch Creek requires these priority **recovery actions:**

- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.
- Improve summer rearing survival by reducing in-stream temperatures in potential rearing reaches.
- Develop off channel water storage for farming operation within the watershed to increase summer pool habitat in the lower portion of the watershed
- Conduct restoration activities that extend the duration of summer flow and provide refuge from high winter flows by restoring channels, floodplains, and meadows.

. . . in these **core areas:** the entire Pine Gulch planning watershed.

Conservation Highlights

•Private landowners are augmenting flow in Pine Gulch Creek to improve hydrology for coho salmon

We Need Your Photo Here

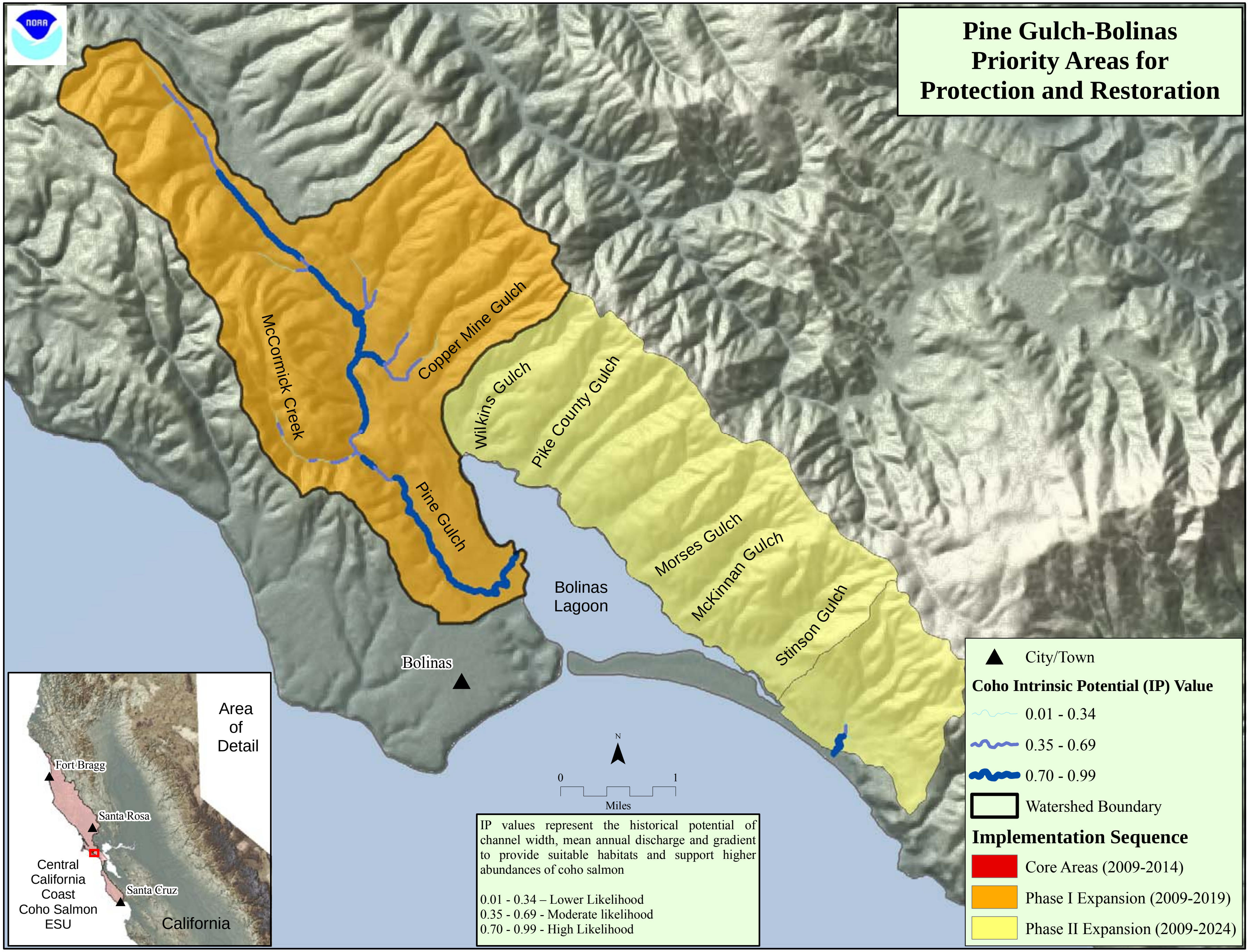
Pine Gulch Creek
Photo © Your Name Here, AFFIL

Immediate Needs

√ Implement the Pine Gulch Creek Watershed Enhancement project
√ Conduct presence/absence monitoring and genetic identification of coho year classes
√ Increase capacity of estuarine habitat in Bolinas Lagoon

Recovery Partners

Tomales Bay Watershed Council
MMWD
SPAWN
NPS
County of Marin
California State Parks



Pine Gulch-Bolinas
Priority Areas for
Protection and Restoration
McCormick Creek
Copper Mine Gulch
Pine Gulch
Wilkins Gulch
Pike County Gulch
Morses Gulch
McKinnan Gulch
Stinson Gulch
Bolinas Lagoon
Bolinas
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Pine Gulch-Bolinas
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	42	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	96%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	>90 days	Very Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	400-800 m^2	Good	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-400 m^2	400-800 m^2	>800 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	42	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	<35	Very Good	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Good	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	58	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	60-80	Fair	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	<30% pools by length	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Good	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	Fair	Fair	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Poor	Poor	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	2.58/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	60-80	Fair	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR		Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	1.65%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	19.31%	Fair	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	<10%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	3%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	60-70%	Poor	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	1.4 mi/sq.mi.	Very Good	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	0.9 mi/sq.mi.	Fair	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Pine Gulch Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Droughts	Very High	Low	Very High	Medium	Medium	Very High			Very High
2	Water Diversion and Impoundment	Low	Low	Very High	Medium	Low	Medium			High
3	Channel Modification	High	Low	High	Medium	Low	High			High
4	Climate Change	Medium	Low	Medium	Medium	Medium	Medium			Medium
5	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
6	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Agricultural Practices	Medium	Low	Medium	Medium	Low	Medium			Medium
8	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Low	Medium			Medium
9	Logging and Wood Harvesting	Medium	Low	Medium	Medium	Low	Medium			Medium
10	Storms and Flooding	Low	Medium	Medium	Medium	Low	Medium			Medium
11	Mining	Medium	Low	Medium	Medium	Low	Low			Medium
12	Residential and Commercial Development	Low	Low	Medium	Medium	Low	Medium			Medium
13	Roads and Railroads	Low	Low	Medium	Medium	Low	Medium			Medium
14	Disease, Predation, and Competition	-	-	Medium	-	-	-			Low
15	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
16	Fishing and Collecting	-	-	-	Low	Low	-			Low
Threat Status for Targets and Project		High	Medium	Very High	High	Medium	Very High	-	-	Very High

Pine Gulch Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PGC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
PGC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.										
PGC-A-1.1.1.1	Action Step	Estuary	Increase capacity of estuarine habitat in Bolinas Lagoon according to the recommendations in the Gulf of the Farallones National Marine Sanctuary preferred alternative.	2	40	NPS						TBD	
PGC-A-1.1.1.2	Action Step	Estuary	Continue restoration efforts on Bolinas lagoon to benefit coho salmon during all life phases and seasons.	2	10	NPS	800	800	800	800	800	8,000	
PGC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
PGC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
PGC-A-2.1.1.1	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	20	NPS, State Parks	500	500	500	500	500	10,000	
PGC-A-2.1.2	Recovery Action	Floodplain	Counties and municipalities should adopt a policy of “managed retreat” (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	20	Marin County						TBD	
PGC-A-2.1.3	Recovery Action	Floodplain	Rehabilitate stream channel to increase the frequency of instream and off channel pools.										
PGC-A-2.1.3.1	Action Step	Floodplain	Restore channel function in the lower watershed to create off channel habitat.	2	20	NPS, State Parks						TBD	
PGC-A-2.1.3.2	Action Step	Floodplain	Identify potential sites for construction/restoration of alcoves, backwaters, etc. based on land use and geomorphic constraints.	2	20	NPS, State Parks						TBD	
PGC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
PGC-A-3.1.1	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
PGC-A-3.1.1.1	Action Step	Hydrology	Implement the Pine Gulch Creek Watershed Enhancement Project. The proposed project includes appropriation of water to storage during the winter season, controlled riparian diversion between April and July 1, and no diversion between July 1 and December 15 of each year.	1	40	Marin RCD, Private Landowners						TBD	
PGC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
PGC-A-6.1.1	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
PGC-A-6.1.1.1	Action Step	Pool Habitat	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	2	40	Marin County, Marin RCD, NPS, State Parks						TBD	
PGC-A-6.1.1.2	Action Step	Pool Habitat	Install LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004).	3	10	Marin RCD, NPS, State Parks	800	800	800	800	800	8,000	100 projects at 80K per project

Pine Gulch Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PGC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
PGC-A-7.1.1	Recovery Action	Riparian Vegetation	Restore and protect riparian vegetation to improve migration and summer/overwintering habitat for coho salmon (DFG 2004).	2	30	Marin County, Marin RCD, NPS, Private Landowners, State Parks						TBD	
PGC-A-9.1	Objective	Viability	Monitor population status for response to recovery actions.	2	40	NPS						TBD	Continue to support ongoing monitoring efforts by NPS
PGC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
PGC-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
PGC-A-10.1.1.1	Action Step	Water Quality	Assess the water temperature regime during the summer season for three to five years to determine the role of water temperature as a limiting factor in coho salmon production (DFG 2004).	3	5	NPS, State Parks						TBD	
PGC-A-10.1.1.2	Action Step	Water Quality	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	20	NPS, State Parks						TBD	
PGC-A-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
PGC-A-12.1.1	Recovery Action	Channel Modification	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	2	10	NPS						TBD	
PGC-A-12.1.2	Recovery Action	Channel Modification	Conduct restoration activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.	2	30	Marin County, Marin RCD, NPS, State Parks						TBD	
PGC-A-12.2	Objective	Channel Modification	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
PGC-A-12.2.1	Recovery Action	Channel Modification	Modify Federal, State, city and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC coho salmon watersheds.										
PGC-A-12.2.1.1	Action Step	Channel Modification	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	20	Marin County						TBD	
PGC-A-12.2.1.2	Action Step	Channel Modification	Encourage counties to develop a Sensitive Habitat Ordinance similar to that in place for the County of Santa Cruz.	2	10	Marin County						TBD	
PGC-A-12.3	Objective	Channel Modification	All proposed development projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.		10	Marin County, NPS, State Parks						TBD	
PGC-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.	1	10	Marin RCD						TBD	
PGC-A-15.2	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.	1	20	Marin County, NPS, State Parks						TBD	
PGC-A-26.1	Objective	Water Diversion and Impoundment	Provide incentives to improve instream flows for coho salmon:.										
PGC-A-26.1.1	Recovery Action	Water Diversion and Impoundment	Develop off channel water storage for farming operation within the watershed to increase summer pool habitat in the lower portion of the watershed.	1	30	Marin RCD, Private Landowners						TBD	

Pine Gulch Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PGC-A-26.2	Objective	Water Diversion and Impoundment	Improve the education and awareness of agencies, landowners, and the public regarding water conservation and use.										
PGC-A-26.2.1	Recovery Action	Water Diversion and Impoundment	Promote the use of reclaimed water for agricultural or other uses.	1	20	Marin RCD, NRCS						TBD	

PUDDING CREEK

Pudding Creek

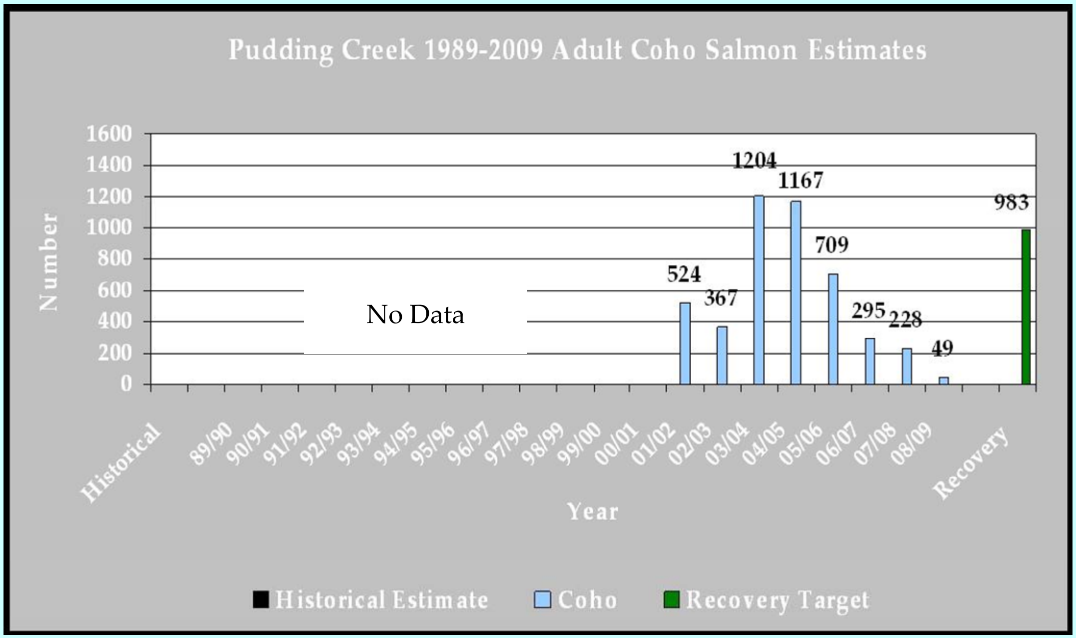
Dependent Population
28.9 IP-Km of potential coho salmon habitat
Coho salmon and steelhead present

Pudding Creek drains approximately 18 square miles of western Mendocino County, and enters the Pacific Ocean at the north edge of the town of Fort Bragg. There is a small dam across the lower Pudding Creek about 200 meters upstream of the Hwy 1 crossing. The dam was built in 1953 to impound water for the Union Lumber/Georgia-Pacific mill in the town of Fort Bragg. Although the mill has been dismantled, the dam is still in place. The impacts of the dam on water quality and estuarine dynamics are unknown at this time. About 74 percent of the Pudding Creek watershed is redwood coniferous forest and about four percent of the watershed area is either montane or riparian hardwood forest. The Pudding Creek watershed has moderately-low soil erodibility. The entire Pudding Creek watershed is privately owned. The dominant land use within the Pudding Creek watershed is forestry. A large portion of the forest within the watershed is in its third rotation and is managed for maximum sustained production. Within the past ten years, about 37 percent of the Pudding Creek watershed has been under a timber harvest plan. About four percent of the Pudding Creek watershed developed for urban uses – about 900 housing units are present in the watershed.

Pudding Creek estuary

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD**
Summer Water Temperatures:	**FAIR**
Depth & Shelter of Pools:	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**POOR**
off channel/Floodplain Quality:	**FAIR**
Estuary Function:	**GOOD**



Pudding Creek

Recovery Target: 983 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvesting
- Roads and Railroads
- Channel Modification
- Droughts

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Pudding Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Increase riparian tree size
- Improve pool complexity and increase number of pools
- Increase large wood in streams
- Increase the frequency of off channel habitat
- Reduce the amount of roads in and near the riparian zone and throughout the watershed
- Reduce sources of sediment
- Improve gravel quality by reducing sediment inputs

We Need Your Photo Here

Pudding Creek
Photo © Your Name Here, AFFIL

Advancing recovery of coho

salmon in Pudding Creek requires these priority **recovery actions:**

- Evaluate lower Pudding Creek impoundment and its effect on coho salmon survival.
- Promote restoration projects to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.
- Evaluate channel morphology and identify opportunities improve juvenile salmonid rearing habitat.
- Provide for watershed processes by promoting long term sustainable forestry practices that support coho salmon
- Discourage home building or other incompatible land use in areas identified as timber production zones.

. . . **throughout** the Pudding Creek watershed.

Conservation Highlights

- Campbell Timberland Management and the California Department of Fish and Game have collaborated on adult and smolt coho salmon surveys.

We Need Your Photo Here

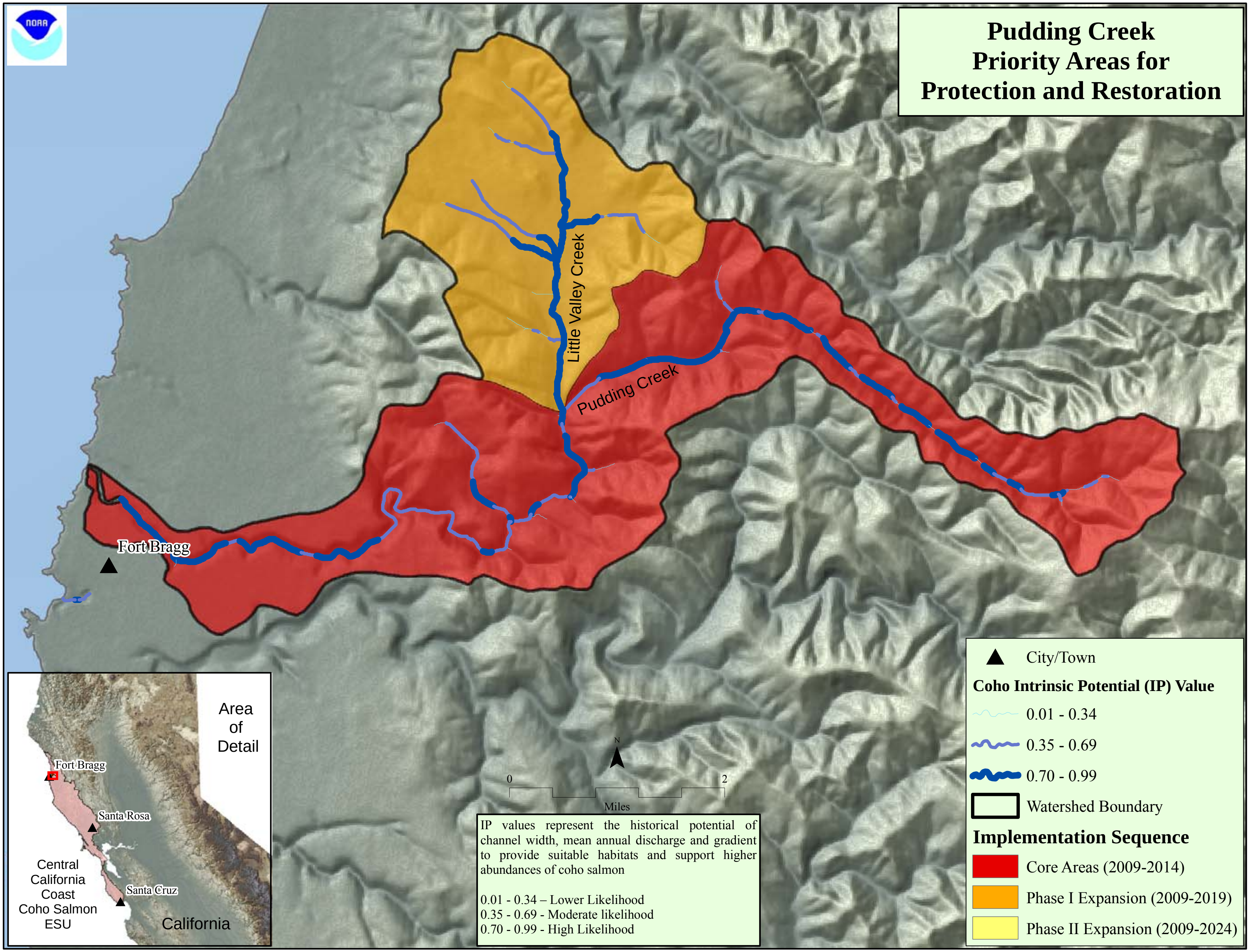
Pudding Creek
Photo © Your Name Here, AFFIL

Immediate Needs

√ Identify restoration actions to improve overwintering habitats.

Recovery Partners

NMFS
DFG
Campbell Timberland Management



Pudding Creek
Priority Areas for
Protection and Restoration
Little Valley Creek
Pudding Creek
Fort Bragg
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
N
0
2
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Pudding Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	42	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	1600-3200 m^2	Good	Spawning Adults	Sediment	Amount of Gravel*	<200 m^2	200-1600 m^2	1600-3200 m^2	>3200 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	50	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	35-50	Good	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	2%	Poor	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	58	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	43	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	<30% pools by length	Fair	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	43	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Very Good	Very Good	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0.69/10 IP-km	Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	43	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	30%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	3.28%	Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	35%	Fair	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	1.7	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	37%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	70-80%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	9.4 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	9.7 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	1-20 per IP-km	Fair	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	0.2-0.5 fish/m^2	Fair	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	35-50%	Good	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Pudding Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Logging and Wood Harvesting	Medium	High	High	Medium	Medium	High			High
2	Roads and Railroads	Medium	High	High	Medium	Medium	High			High
3	Channel Modification	Medium	Medium	High	Medium	Medium	Medium			High
4	Droughts	Medium	Medium	High	Medium	Medium	Medium			High
5	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
7	Mining	Medium	Medium	Medium	Medium	Medium	Medium			Medium
8	Recreational Areas and Activities	Medium	Medium	Medium	Medium	Medium	Medium			Medium
9	Storms and Flooding	Medium	Medium	Medium	Medium	Medium	Medium			Medium
10	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium			Medium
12	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
13	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium			Medium
14	Disease, Predation, and Competition	Low	-	Medium	-	Medium	-			Medium
15	Fishing and Collecting	Low	-	Low	Low	Low	-			Low
16	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
Threat Status for Targets and Project		High	High	Very High	High	High	High	-	-	Very High

Pudding Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
PC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.										
PC-A-1.1.1.1	Action Step	Estuary	Maintain impoundment on lower Pudding Creek pending further study regarding its overall influence to CCC coho salmon in the watershed.	2a	60	CDFG						0	Implementation is proposed by DFG, and additional costs are not expected.
PC-A-1.1.1.2	Action Step	Estuary	Evaluate lower Pudding Creek impoundment and its contribution/effect to coho salmon survival (DFG 2004).	1	2	Campbell Timberland Management, CDFG, NMFS, Private Consultants	50.00	50.00				100	The impoundment at Pudding Creek appears to function as superior winter habitat for coho salmon and possibly as summer rearing habitat at the upper end of the pond. This evaluation should include a component to evaluate exotic predators and determine if levels of predation are detrimental to viability targets.
PC-A-1.1.1.3	Action Step	Estuary	Repair dam as appropriate to maintain over wintering habitat in the estuary (DFG 2004).	2	60							TBD	Cost is difficult to estimate at this time and will likely vary depending on water year.
PC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
PC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.	2		CDFG, Private Landowners, RCD							Efforts should be focused in the Little Valley area in an effort to improve rearing habitat conditions.
PC-A-2.1.1.1	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	60	CalFire, Campbell Timberland Management, CDFG, RWQCB						TBD	Costs depend on level of technical assistance required and types of projects proposed. Many salmon recovery efforts and management programs are currently ongoing. It is possible there could be additional salmon restoration costs identified based on recovery needs of the species; however, at this time we do no have sufficient information to estimate those potential costs or identify the actions under which they might fall.
PC-A-2.1.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	60	California Coastal Conservancy, Campbell Timberland Management, CDFG, NOAA RC, Private Landowners						TBD	Costs to promote and support restoration efforts depend on level of technical assistance provided and the types of projects proposed.
PC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
PC-A-3.1.1	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.										
PC-A-3.1.1.1	Action Step	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	3	20	CDFG, NMFS, Private Landowners, RWQCB, SWRCB						TBD	Cost will vary depending on landowner interest.
PC-A-3.1.2	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
PC-A-3.1.2.1	Action Step	Hydrology	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	2	60	NMFS, Private Landowners, SWRCB						0	Cost is expected to be minimal.
PC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										

Pudding Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PC-A-6.1.1	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.	1	5	Campbell Timberland Management, CDFG, Mendocino County, NMFS, Private Landowners	1.00	1.00	1.00	1.00	1.00	5	Most of these areas have been identified by DFG and Campbell biologists. Since most of Pudding Creek has access to its floodplain, and because most of the watershed has been habitat-typed, the major effort in implementing this recommendation would likely involve mapping.
PC-A-6.1.1.1	Action Step	Pool Habitat	Implement a large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).	1	5	Campbell Timberland Management, CDFG, NMFS, NOAA RC, Private Landowners, RWQCB	20.00	20.00	20.00	20.00	20.00	100	Cost is influenced by the size, number and location of future restoration projects. Some large woody debris supplementation has already occurred in the watershed. Supplementation programs that are a part of future timber harvest plans may result in significantly reduced costs. Wood should be installed according to viability targets.
PC-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	3	60	Campbell Timberland Management, CDFG, NMFS, Private Landowners, RWQCB						TBD	Cost is dependent on the number, type, and location of future projects. It is anticipated that the majority of these projects will be directed at protecting the existing mainline riparian road. We recommend evaluating road relocation prior to initiating stream bank stabilization in the Pudding Creek watershed.
PC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
PC-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).										
PC-A-7.1.1.1	Action Step	Riparian Vegetation	Prioritize large tree retention.	2	60	Campbell Timberland Management, CDFG, Private Landowners, RPFs, RWQCB						0	Maintaining large trees, particularly within the riparian zones, will provide a source for future large woody debris recruitment.
PC-A-7.1.1.2	Action Step	Riparian Vegetation	Manage riparian areas for their site potential composition and structure.	3	5	Campbell Timberland Management, CDFG, NMFS						TBD	
PC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
PC-A-8.1.1	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
PC-A-8.1.1.1	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	20	CalFire, Campbell Timberland Management, CDFG, Private Landowners						TBD	Cost of action step will be driven largely by the number of miles and techniques used in decommissioning.
PC-A-8.1.1.2	Action Step	Sediment	Evaluate decommissioning of Slaughterhouse Gulch riparian road.	2	5	CalFire, California Department of Mines and Geology, Campbell Timberland Management, CDFG, NOAA RC, RWQCB						TBD	Evaluating whether to decommission Slaughterhouse Gulch road is not expected to cost more than $10K. Cost of implementation cannot be determined until an evaluation takes place. Total cost is not expected to exceed $50K. Slaughterhouse Gulch was identified as IP-km and it is currently a subwatershed where spawning occurs.
PC-A-8.1.1.3	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	2	60	CalFire, Campbell Timberland Management, CDFG, NMFS, Private Landowners, RPFs, RWQCB						0	Maintenance will likely be in perpetuity; however, these costs should be considered part of landowner obligations regarding their existing road networks.
PC-A-8.1.2	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										
PC-A-8.1.2.1	Action Step	Sediment	Encourage Campbell to evaluate all roads and skid trails throughout the winter period on their lands.	2	60	CDFG, NMFS, RWQCB						TBD	This should be considered a standard business practice.

Pudding Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PC-A-8.1.2.2	Action Step	Sediment	Permitting agencies should evaluate all authorized erosion control measures during the winter period.	2	60	CalFire, CDFG, RWQCB						0	
PC-A-9.1	Objective	Viability	Continue ongoing life cycle monitoring station at the Pudding Creek dam (DFG 2004). Establish consistent reporting methods to ensure ESU-wide consistency.	2	10	Campbell Timberland Management, CDFG, NMFS, Trout Unlimited	265	265	265	265	265	2,650	Cost based upon estimate of $265k per year to operate Freshwater Creek (Humboldt County) life-cycle station.
PC-A-9.2	Objective	Viability	Continue juvenile monitoring originally initiated by DFG in 1980's near the Slaughterhouse Gulch confluence.	2	10	Campbell Timberland Management, CDFG	1.00	1.00	1.00	1.00	1.00	10	This location is a long-term monitoring site and should be continued.
PC-A-9.3	Objective	Viability	Re-evaluate spawner density targets pending completion of Little Valley habitat suitability report.	3	10	NMFS						0	Overall quantity of IP-km in Pudding Creek may need adjustment if it is determined that Little Valley did not provide adequate summer rearing habitat historically.
PC-A-10.1	Objective	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
PC-A-10.1.1	Recovery Action	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
PC-A-10.1.1.1	Action Step	Water Quality	The City of Fort Bragg and/or the owner of the old Georgia-Pacific water right should avoid or minimize water extraction from the Pudding Creek impoundment to protect juvenile coho rearing in the lower portion of the watershed.	3	60	CDFG, Private Landowners						TBD	Cost is difficult to estimate at this time.
PC-A-10.1.1.2	Action Step	Water Quality	Evaluate potential benefits to dissolved oxygen concentrations in the Pudding Creek impoundment from installation of aeration devices (such as SolarBees)	2	5	Campbell Timberland Management, CDFG, Georgia-Pacific Corp, NOAA RC, RWQCB, UC Extension	6.00	6.00	6.00	6.00	6.00	30	DO levels may limit salmonid use of the Pudding Creek impoundment - increasing dissolved oxygen concentration may increase the total amount of rearing area for juvenile salmonids in the watershed. This evaluation should be considered part of a comprehensive evaluation of the impoundment.
PC-A-12.1	Objective	Channel Modification	Conduct restoration activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.										
PC-A-12.1.1	Recovery Action	Channel Modification	Evaluate past channelization actions in the Pudding Creek watershed.										
PC-A-12.1.1.1	Action Step	Channel Modification	Conduct an evaluation of channelization in the Little Valley subwatershed and evaluate impacts to juvenile rearing habitats.	1	7	California Department of Mines and Geology, Campbell Timberland Management, CDFG, NOAA RC, RWQCB, Trout Unlimited	14.29	14.29	14.29	14.29	14.29	100	The evaluation should consider all available historical documentation and include input from geomorphologists and restoration experts. The evaluation should include a series of recommendation to restore channel complexity in Little Valley if restoration is determined to have a net benefit to juvenile rearing condition and quantity.
PC-A-12.1.1.2	Action Step	Channel Modification	If Little Valley is determined to possess potential for juvenile rearing, implement actions to restore channel meander and instream complexity.	1	10	California Coastal Conservancy, California Department of Mines and Geology, Campbell Timberland Management, CDFG, NOAA RC, RWQCB, Trout Unlimited, USACE						TBD	Costs cannot be determined until completion of an assessment.
PC-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
PC-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004) (Water Code § 1707). Focus efforts in Little Valley.	2	20	CDFG, NMFS, SWRCB						TBD	TBD - the cost of acquiring or leasing water rights has been expensive in past efforts.

Pudding Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PC-A-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
PC-A-15.2.1	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	3	60	CalFire, CalTrans, Campbell Timberland Management, CDFG, NMFS, Private Landowners, RWQCB, SWRCB						TBD	Cost is expected to be minimal. Most diversions in Pudding Creek for dust control are for timber management actions. Most of these diversion have a 1600 agreement with the Department of Fish and Game and are likely incorporated into existing operations.
PC-A-15.3	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
PC-A-15.3.1	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	3	60	CalFire, CalTrans, Campbell Timberland Management, CDFG, NMFS, Private Landowners, RWQCB, SWRCB						TBD	Cost is expected to be minimal. Most diversions in Pudding Creek for dust control are for timber management actions. Most of these diversion have a 1600 agreement with the Department of Fish and Game and are likely incorporated into existing operations.
PC-A-20.1	Objective	Logging and Wood Harvesting	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage and support landowners who conduct operations in a manner compatible with CCC coho salmon recovery priorities.										
PC-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Encourage a watershed-wide HCP for all or multiple landowners within a watershed to pool resources as a means to facilitate long-term survival and recovery for coho salmon and their habitat.	2	30	Campbell Timberland Management, CDFG, NMFS, Private Landowners, USFWS	13.33	13.33	13.33	13.33	13.33	400	Cost is a rough estimate and may vary considerably depending on the number of species and activities covered and motivation of land owners. A multiple landowner HCP is preferable due to economy of scale and similar land management actions across the watershed. Costs could be significantly reduced if the Pudding Creek watershed was combined into a larger regional HCP effort.
PC-A-20.2	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands to prevent future conversion of forestlands to agriculture or other land uses.										
PC-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
PC-A-20.2.1.1	Action Step	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	2	60	CDFG, Mendocino County, NMFS, Private Landowners, RWQCB, UC Extension						0	Low cost, mainly staff time of resource agencies.
PC-A-20.2.1.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	1	60	CDFG, Mendocino County, NMFS						0	
PC-A-20.3	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
PC-A-20.3.1	Recovery Action	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	2	60	CalFire, Campbell Timberland Management, Private Landowners						tbd	Most of these costs will likely be associated with planned ongoing harvest plans.
PC-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	2	60	CalFire, Campbell Timberland Management, Private Landowners						tbd	This cost is expected to be minimal because the main land management action is timber harvest and the mapping will occur as part of the THP process.

Pudding Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PC-A-20.3.3	Recovery Action	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	60	CalFire, Campbell Timberland Management, CDFG, Private Landowners						0	This cost is expected to be minimal because the main land management action is timber harvest and the above action is likely a part of future timber harvest permitting.
PC-A-20.3.4	Recovery Action	Logging and Wood Harvesting	Conduct conifer release to promote growth of larger diameter trees where appropriate.	3	60	Campbell Timberland Management, Private Landowners						tbd	Cost is expected to be minimal and likely included as part of the THP process. However, additional costs would be incurred if action is implemented solely as a restoration action.
PC-A-20.3.5	Recovery Action	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.	2	60	CalFire, Campbell Timberland Management, Private Landowners						tbd	TBD- the cost of this action may be minimal depending on the harvest philosophy of the landowner.
PC-A-20.4	Objective	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within Core, Phase I and Phase II CCC coho salmon areas.										
PC-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	NMFS PRD						0	This action will likely require funding for at least one full time NMFS position. The need for this action may change if Forest Practices Rules change and achieve a no-take standard. The Cost is pro-rated in the Ten Mile River strategies. It is anticipated that one full time position would be dedicated to the Lost Coast Diversity stratum.
PC-A-20.4.2	Recovery Action	Logging and Wood Harvesting	Provide information to BOF regarding CCC coho salmon priorities and recommend upgrading relevant forest practices.	2	5	NMFS HCD, NMFS OLE, NMFS PRD						0	Task will likely be accomplished through NMFS staff time.
PC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
PC-A-24.1.1	Recovery Action	Roads and Railroads	Continue educating County road engineers, RPFs, and maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	10	CalFire, Campbell Timberland Management, FishNet 4C, Mendocino County Department of Public Works, Private Landowners						0	These types of programs are currently being implemented by the major landowner in the watershed. However, these practices should also be adopted by the County of Mendocino.
PC-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
PC-A-24.2.1	Recovery Action	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	10	CalFire, Campbell Timberland Management, Mendocino County Department of Public Works, NOAA RC, Private Landowners, RWQCB						TBD	Costs associated with assessment and redesign cannot be determined at this time. Costs may be significant and should be weighed against additional upland disturbance and overall costs. This recommendation is more feasible within the Pudding Creek watershed because a large portion of the watershed in owned by one landowner.
PC-A-24.2.2	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	3	20	CalFire, California Department of Mines and Geology, Campbell Timberland Management, CDFG, RWQCB	10.00	10.00	10.00	10.00	10.00	200	Costs associated with assessment and redesign is difficult to determine. Costs may be significant and should be weighed against additional upland disturbance and overall costs. This recommendation is more feasible within the Pudding Creek watershed because a large portion of the watershed is owned by one landowner. This action is a lower priority in Pudding Creek than in some other watersheds with high road densities due to low erosion hazard ratings.

Pudding Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
PC-A-24.2.3	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	60	California Department of Mines and Geology, Campbell Timberland Management, CDFG, Mendocino County Department of Public Works						0	Costs should be minimal. It is anticipated that no new additional road construction will take place within the watershed because most of the existing road infrastructure has already been constructed. However, this recommendation should be considered somewhat flexible when the purpose of new road construction is necessary as a result of road decommissioning in riparian or unstable areas.
PC-A-24.3	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
PC-A-24.3.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	3									
PC-A-24.3.1.1	Action Step	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Include County of Mendocino in regards to inclusion of Sherwood Ridge Road.	2	5	CalFire, CalTrans, Campbell Timberland Management, CDFG, Mendocino County Department of Public Works, NMFS, Private Landowners						TBD	
PC-A-24.3.1.2	Action Step	Roads and Railroads	Provide and maintain adequate energy dissipaters for culverts and other drainage pipe outlets where needed.	3	30	CalTrans, Campbell Timberland Management, Mendocino County Department of Public Works, Private Landowners	1.00	1.00	1.00	1.00	1.00	30	Cost is dependent on number, type, and location of dissipaters needed. Most of this infrastructure is already in place in the watershed.
PC-A-24.3.1.3	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, California Department of Mines and Geology, Campbell Timberland Management, Private Landowners						TBD	Costs likely to be incurred as part of timber harvest operations. However, in some circumstances this may be a stand alone cost.
PC-A-24.3.1.4	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed and Mendocino County road maintenance staff as appropriate.	3	60	CalFire, Campbell Timberland Management, CDFG, Mendocino County Department of Public Works, Private Landowners						0	These areas are likely already established. Efforts should be made to coordinate storage with all landowners in the basin to minimize costs and impacts.
PC-A-24.3.2	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.										
PC-A-24.3.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	60	Campbell Timberland Management, Private Landowners						0	This is action is part of ongoing road maintenance.
PC-A-24.3.2.2	Action Step	Roads and Railroads	Continue to minimize wet weather vehicle traffic through or across hillside areas, and promote winter road closures. Evaluate and implement measures to ensure Sherwood Ridge Road remains closed during the winter period.	3	60	CalFire, Campbell Timberland Management, Private Landowners						0	Noyo Watershed Alliance has worked to maintain winter closures. Ongoing management practices in the watershed include maintenance of existing gate and other forms of road closure.
PC-A-24.3.3	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, Campbell Timberland Management, Private Landowners						TBD	Costs associated with assessment and redesign cannot be determined at this time, however, some assessment has already been conducted.

Pudding Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
PC-A-24.3.4	Recovery Action	Roads and Railroads	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).										
PC-A-24.3.4.1	Action Step	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	1	60	Campbell Timberland Management, Private Landowners						0	This is action is part of ongoing road maintenance.
PC-A-24.3.4.2	Action Step	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	3	60	CalFire, Campbell Timberland Management, Private Landowners						0	cost will likely be absorbed through ongoing timber harvest planning and operations.

REDWOOD CREEK

Redwood Creek

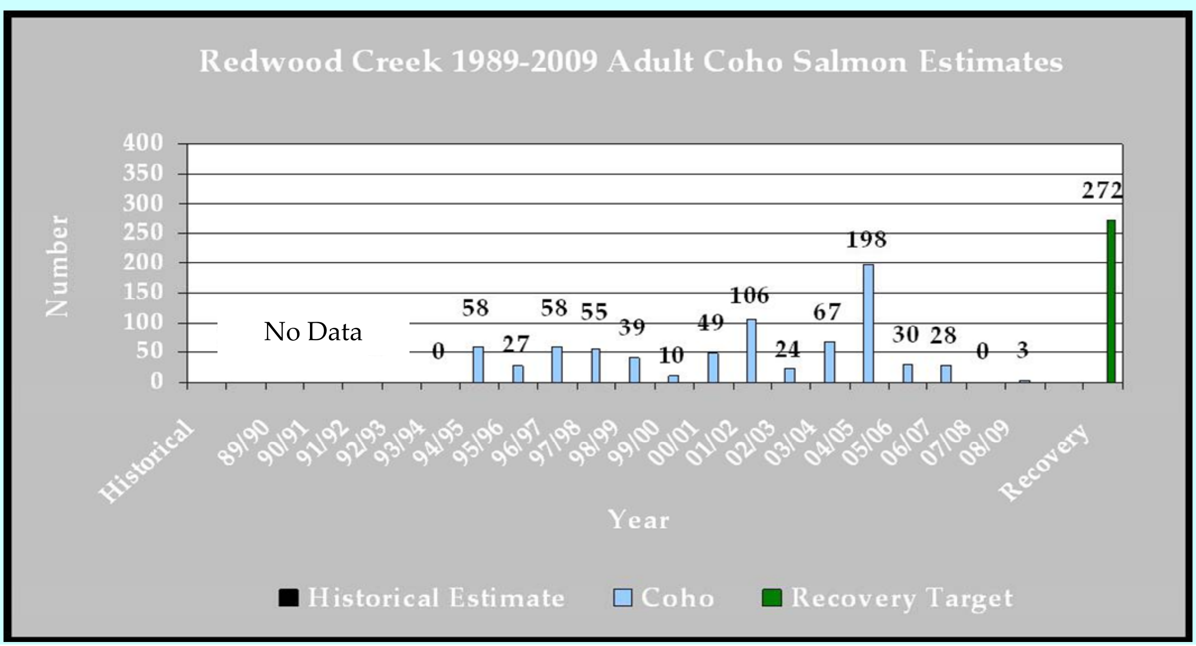
Dependent Population
8.0 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

Redwood Creek drains approximately nine square miles of Mount Tamalpais in western Marin County. Redwood Creek enters the Pacific Ocean at Muir Beach, about 13 miles north of San Francisco. Vegetation in the Redwood Creek watershed consists of about 32 percent shrub, 31 percent coniferous forest, 18 percent montane or riparian hardwood forest, and 12 percent grassland. Only five percent of the Redwood Creek watershed is in private ownership. State- and federally owned forest lands, local water district lands, and military lands make up the rest of the watershed area which includes the Muir Woods National Monument. Redwood Creek provides a critical spawning and rearing habitat for endangered coho salmon. Decades of agricultural activity, channel straightening and levee construction resulted in the loss or degradation of large areas of floodplain woodland, riparian vegetation and in-channel complexity. Today the dominant land use within the Redwood Creek watershed is recreational activities. Housing development within the Redwood Creek watershed is low; approximately 150 housing units are present in the watershed. There are 18 barriers to salmon migration caused by road crossings, diversions, and natural structures. Impassable barriers block salmonids from less than ten percent of the watershed.

Redwood Creek
Photo provided by KRIS Information System, and is used with permission

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD**
Summer Water Temperatures:	**GOOD**
Depth & Shelter of Pools:	**POOR**
Large Wood Frequency:	**FAIR to VERY GOOD**
Riparian Canopy:	**POOR to Fair**
off channel/Floodplain Quality:	**POOR**
Estuary Function:	**POOR**



Redwood Creek

Recovery Target: 272 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Droughts
- Channel Modification
- Roads and Railroads
- Climate Change
- Fire and Fuel Management

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Redwood Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve and increase pool habitat
- Increase and improve off channel
habitat types
- Enhance the estuary habitat
- Improve riparian shading to cool streams
- Decrease the number of roads near the stream and reduce impacts from remaining roads
- Eliminate sources of sediment

Redwood Creek estuary
Photo provided by KRIS Information System, and is used with permission

Advancing recovery of coho

salmon in Redwood Creek requires these priority **recovery actions:**

- Support efforts of NPS to restore functional floodplain and lagoon habitat in the lower portion of the watershed.
- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.
- Address sediment sources from road networks and other actions that deliver sediment to stream channels.
- Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon.

. . . in these **core areas:** entire Redwood Creek planning watershed

Conservation Highlights

- Estuary and floodplain restoration activities
- Agricultural Best Management Practices have been developed and implemented in the watershed
- Acquisition of key areas for the conservation of habitat
- Annual juvenile abundance surveys conducted by National Park Service provides important population data on coho salmon in the Redwood Creek watershed.

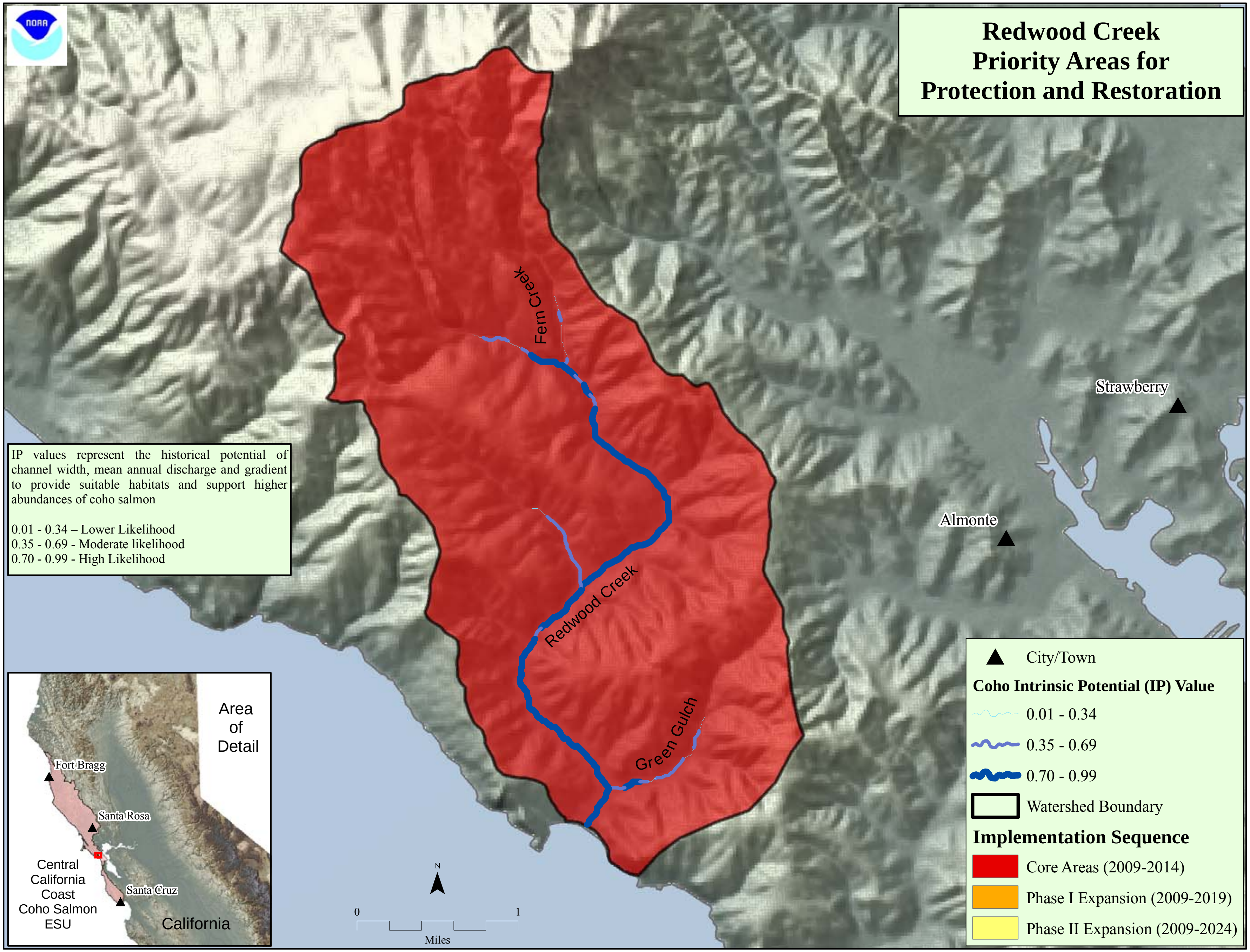
A volunteer planting riparian vegetation along Redwood Creek
Photo provided by KRIS Information System, and is used with permission

Recovery Partners

NPS
State Parks
DFG
NMFS
Marin RCD

Immediate Needs

Assess and prioritize sediment sources from road networks √
Assess and map water diversions √



Redwood Creek
Priority Areas for
Protection and Restoration
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
Fern Creek
Redwood Creek
Green Gulch
Strawberry
Almonte
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
N
0
1
Miles
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Redwood Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	50	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	400-800 m^2	Good	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-400 m^2	400-800 m^2	>800 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	42	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	50	Good	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Very Good	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	51-75	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	<60 avg. rating	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	<30% pools by length	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Good	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	Poor	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Poor	Poor	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	8.76/10 IP-km	Poor	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	<60 avg. rating	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	<50%	Poor	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	0%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	1.73%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	1.26%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	10 - 25%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	14.6 / 100m	Very Good	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	0%	Fair	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	<60%	Poor	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	4.1 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	4.9 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	1-20 per IP-km	Fair	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	20-34%	Fair	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Redwood Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Droughts	Medium	Low	Very High	Medium	High	Very High			Very High
2	Channel Modification	Medium	Low	High	High	High	Very High			Very High
3	Roads and Railroads	Medium	Low	Medium	Medium	High	Very High			High
4	Climate Change	Medium	Low	High	Medium	High	High			High
5	Fire and Fuel Management	Medium	Low	High	Medium	High	Medium			High
6	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	High			Medium
7	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Logging and Wood Harvesting	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Storms and Flooding	Medium	Low	Medium	Medium	Medium	Medium			Medium
12	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium			Medium
13	Mining	Low	Low	Low	Medium	Low	-			Low
14	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
15	Fishing and Collecting	-	-	-	Low	Low	-			Low
16	Disease, Predation, and Competition	-	-	-	-	-	Low			Low
Threat Status for Targets and Project		High	Low	Very High	High	Very High	Very High	-	-	Very High

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
ReC-A-1.1.1	Recovery Action	Estuary	Enhance and restore estuary function by improving complex habitat features.	1	30	Marin County, NPS						TBD	
ReC-A-1.1.2	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration. Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).										
ReC-A-1.1.2.1	Action Step	Estuary	Continue restoration efforts on Big Lagoon to benefit coho salmon during all life stages and seasons.	1	30	NPS	167	167	167	167	167	5,000	
ReC-A-1.1.2.2	Action Step	Estuary	Where appropriate, remove structures and/or modify practices which impair or reduce the historical tidal prism and/or estuarine function where feasible and where benefits to coho salmon and/or the estuarine environment are predicted.	1	60	NPS						TBD	
ReC-A-1.1.2.3	Action Step	Estuary	Support efforts of NPS to restore functional floodplain and lagoon habitat in the lower portion of the watershed.	1	60	Marin County, Marin RCD, NPS						TBD	
ReC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
ReC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
ReC-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	5	NPS	20.00	20.00	20.00	20.00	20.00	100	
ReC-A-2.1.1.2	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	60	Marin County, Marin RCD, NPS						TBD	
ReC-A-2.1.1.3	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	60	CDFG, Marin County, Marin RCD, NMFS, NPS						TBD	
ReC-A-2.1.1.4	Action Step	Floodplain	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	2	60	CDFG, NMFS, NPS, USFWS						TBD	
ReC-A-2.1.2	Recovery Action	Floodplain	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.										
ReC-A-2.1.2.1	Action Step	Floodplain	Encourage willing landowners to restore historical floodplains or offchannel habitats through conservation easements, etc.	1	60	Marin County, NPS						TBD	
ReC-A-2.1.3	Recovery Action	Floodplain	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.	1	60	Marin County, NPS						TBD	
ReC-A-2.1.4	Recovery Action	Floodplain	Restore channel function in the lower watershed to create off channel habitat.										
ReC-A-2.1.4.1	Action Step	Floodplain	Identify potential sites for construction/restoration of alcoves, backwaters, etc. based on land use and geomorphic constraints.	1	60	Marin County, Marin RCD, NPS						TBD	
ReC-A-2.1.4.2	Action Step	Floodplain	Evaluate, develop solutions and implement immediate needs to address problems resulting from channelization.	2	10	Marin County, Marin RCD, NPS						TBD	
ReC-A-2.1.4.3	Action Step	Floodplain	Support efforts to remove levees on the Banducci property to create backwater and alcove habitat by having the county raise the lower section of Muir Woods road where it meets Highway One. Raising the road will address flooding and create vital off channel habitat in this section of creek. Coordinate with the NMFS and/or DFG geomorphologist on design features and implementation techniques.	1	10	Marin County, NPS	1,000	1,000	1,000	1,000	1,000	10,000	

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-2.1.4.4	Action Step	Floodplain	Continue to monitor restored reaches in the "Bowling Alley" and "Upper Alley" sections to promote off channel habitat formation. Consult with NMFS and or DFG geomorphologist before and during the design and implementation phase.	1	20	NPS	25.00	25.00	25.00	25.00	25.00	500	
ReC-A-2.1.4.5	Action Step	Floodplain	Remove riprap and gabion rock at lowest end of watershed.	2	20	Marin County, Marin RCD, NPS						TBD	
ReC-A-2.1.5	Recovery Action	Floodplain	Restore connectivity and enhance habitat in Green Gulch.	1	10	CDFG, NOAA RC, Private Landowners	40.00	40.00	40.00	40.00	40.00	400	
ReC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
ReC-A-3.1.1	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
ReC-A-3.1.1.1	Action Step	Hydrology	Maintain water operations agreements between NPS, DFG, and MBCSD to operate in a manner that does not alter summer surface flow	2	60	CDFG, MBCSD, NPS, State Parks						TBD	
ReC-A-3.1.2	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
ReC-A-3.1.2.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	1	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-3.1.2.2	Action Step	Hydrology	Promote conjunctive use of water with water projects whenever possible to maintain or restore coho salmon habitat.	2	60	Marin County, Marin RCD, NPS, NRCS, State Parks						TBD	
ReC-A-3.1.2.3	Action Step	Hydrology	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-3.1.2.4	Action Step	Hydrology	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	3	60	CDFG, DWR, NMFS PRD, RWQCB, SWRCB						TBD	
ReC-A-3.1.3	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
ReC-A-3.1.3.1	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	2	30	CDFG, DWR, Marin County, Marin RCD, NMFS, RWQCB, SWRCB						TBD	
ReC-A-3.1.3.2	Action Step	Hydrology	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	1	60	CA Coastal Commission, CDFG, DWR, Farm Bureau, Marin County, Marin RCD, NPS, RWQCB, State Parks, SWRCB						TBD	
ReC-A-3.1.3.3	Action Step	Hydrology	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-3.1.4	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
ReC-A-3.1.4.1	Action Step	Hydrology	Assess and map water diversions (DFG 2004).	1	5	Marin County, Marin RCD, NPS, State Parks	40.00	40.00	40.00	40.00	40.00	200	

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-3.1.4.2	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	2	10	CDFG, DWR, Marin County, Marin RCD, NMFS, NPS, RWQCB, State Parks, SWRCB	25.00	25.00	25.00	25.00	25.00	250	
ReC-A-3.1.5	Recovery Action	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	1	60	CDFG, DWR, RWQCB, State Parks, SWRCB						TBD	
ReC-A-3.2	Objective	Hydrology	Evaluate existing and future stream crossings and support full replacement and bridges over retrofits to achieve more natural function without maintenance.										
ReC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
ReC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
ReC-A-6.1.1.1	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-6.1.1.2	Action Step	Pool Habitat	Educate landowners, land managers, and County and municipal staffs on the importance of LWD to coho survival and recovery, and watershed processes.	2	5	Marin County, Marin RCD, NPS, Private Landowners, State Parks	60.00	60.00	60.00	60.00	60.00	300	
ReC-A-6.1.1.3	Action Step	Pool Habitat	Install properly sized large woody debris to appropriate viability table targets.	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-6.1.1.4	Action Step	Pool Habitat	Fully implement the Programmatic Section 7 consultation for restoration projects administered by the NOAA Restoration Center that permits placement of instream large woody debris.	2	60	Marin County, Marin RCD, NMFS PRD, NOAA RC, NPS, State Parks						TBD	
ReC-A-6.1.1.5	Action Step	Pool Habitat	Cable in large logs with root wads to trap additional debris to create fixed pool locations.	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-6.1.1.6	Action Step	Pool Habitat	Place unsecured LWD in the stream and monitor how it is distributed in the watershed.	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-6.1.1.7	Action Step	Pool Habitat	Engage in riprap removal and LWD placement to restore channel processes within the Muir Woods National Monument as per Kimbell and Kondolf, 2002.	2	10	NPS, State Parks						TBD	
ReC-A-6.1.2	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.										
ReC-A-6.1.2.1	Action Step	Pool Habitat	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	3	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-6.1.3	Recovery Action	Pool Habitat	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
ReC-A-6.2	Objective	Pool Habitat	Assess and prioritize restoration of channelized sections to enhance pool depths in Redwood Creek through Muir Woods while maintaining the historic resource to the greatest degree possible.										
ReC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
ReC-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-7.1.2	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	5	State Parks	60.00	60.00	60.00	60.00	60.00	300	
ReC-A-7.1.3	Recovery Action	Riparian Vegetation	Maintain and enhance riparian vegetation related to agricultural activities.										
ReC-A-7.1.3.1	Action Step	Riparian Vegetation	Fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream).	3	20	Marin County, Marin RCD, NPS, State Parks	50.00	50.00	50.00	50.00	50.00	1,000	
ReC-A-7.1.3.2	Action Step	Riparian Vegetation	Locate water sources away from riparian areas.	2	60	Marin County, NPS, State Parks						TBD	
ReC-A-7.1.3.3	Action Step	Riparian Vegetation	Plant native vegetation to promote streamside shade.	3	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-7.1.3.4	Action Step	Riparian Vegetation	Promote bio-engineering solutions as appropriate (e.g. where critical infrastructure is located) for bank hardening projects.	3	60	CDFG, Marin County, Marin RCD, NMFS, NPS, State Parks						TBD	
ReC-A-7.1.4	Recovery Action	Riparian Vegetation	Review and develop preferred protocols for Pierce's Disease Control that would maintain a native riparian corridor and develop an outreach program (DFG 2004).	3	60	Marin County, NPS, State Parks						TBD	
ReC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
ReC-A-8.1.1	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
ReC-A-8.1.1.1	Action Step	Sediment	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.	3	5	Marin County, Marin RCD, NPS, State Parks	100	100	100	100	100	500	
ReC-A-8.1.1.2	Action Step	Sediment	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	3	5	Marin County, Marin RCD, NPS, State Parks	80.00	80.00	80.00	80.00	80.00	400	
ReC-A-8.1.1.3	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	30	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-8.1.1.4	Action Step	Sediment	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	2	60	Marin County, NPS, State Parks						TBD	
ReC-A-8.1.2	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
ReC-A-8.1.2.1	Action Step	Sediment	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas (DFG 2004).	2	10	Marin County, Marin RCD, NPS, State Parks	80.00	80.00	80.00	80.00	80.00	800	

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
ReC-A-8.1.2.2	Action Step	Sediment	Fence riparian areas and upslope areas prone to erosion.	3	30	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-8.1.3	Recovery Action	Sediment	Evaluate whether proposed stabilization projects will lead to additional instability either up- or downstream.	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-8.1.4	Recovery Action	Sediment	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
ReC-A-9.1.1	Recovery Action	Viability	Measure or estimate key habitat attributes across the watershed.										
ReC-A-9.1.1.1	Action Step	Viability	Refine assessment methods to more accurately identify and measure key habitat attributes.	2	2	NPS	5.00	5.00				10	
ReC-A-9.1.1.2	Action Step	Viability	Utilize standardized assessment protocols (i.e., DFG habitat assessment protocols) to ensure ESU-wide consistency.	2	60	NPS						TBD	
ReC-A-9.1.1.3	Action Step	Viability	Conduct standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to participate	2	2	CDFG, NPS	10.00	10.00				20	
ReC-A-9.1.2	Recovery Action	Viability	Conduct a comprehensive assessment of watershed processes (e.g., hydrology, geology, fluvial-geomorphology, water quality, and vegetation), instream habitat, and factors limiting coho salmon production (DFG 2004).	2	5	Marin County, Marin RCD, NPS, State Parks	50.00	50.00	50.00	50.00	50.00	250	
ReC-A-9.1.3	Recovery Action	Viability	Monitor population status.										
ReC-A-9.1.3.1	Action Step	Viability	Conduct periodic, standardized spawning surveys to estimate adult abundance in the watershed. Surveys should include all three cohorts.	1	60	NPS						TBD	
ReC-A-9.1.3.2	Action Step	Viability	Conduct periodic, standardized smolt outmigration surveys to estimate smolt abundance in the watershed. Surveys should occur during the same period as adult spawning surveys.	1	60	NPS						TBD	
ReC-A-9.1.3.3	Action Step	Viability	Evaluate feasibility of installing a lifecycle station in an appropriate location within the watershed.	1	10	NPS						TBD	
ReC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
ReC-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
ReC-A-10.1.1.1	Action Step	Water Quality	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	60	NPS, State Parks						TBD	
ReC-A-10.1.1.2	Action Step	Water Quality	Improve riparian and instream conditions in rearing habitats by establishing riparian protection zones that extend the distance of a site potential tree height from the outer edge of a channel, and by adding LWD.	3	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-10.1.1.3	Action Step	Water Quality	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	60	Marin County, NPS, State Parks						TBD	
ReC-A-10.2	Objective	Water Quality	Evaluate and reduce nutrient and pathogen loading from upstream areas to minimize oxygen demand in lower Redwood Creek.	2	2	NPS						TBD	
ReC-A-12.1	Objective	Channel Modification	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.										

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-12.1.1	Recovery Action	Channel Modification	Develop a Salmon Certification Program for road maintenance staff.	2	5	FishNet 4C						TBD	
ReC-A-12.2	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
ReC-A-12.2.1	Recovery Action	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-12.2.2	Recovery Action	Channel Modification	Encourage development and implementation of a program similar to the County of Santa Cruz's Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	2	20	Marin County						TBD	
ReC-A-12.2.3	Recovery Action	Channel Modification	Evaluate existing and future stream crossings to identify threats to natural hydrologic processes and support efforts to replace or retrofit bridges to achieve more natural conditions without maintenance.	2	15	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-12.3	Objective	Channel Modification	All proposed development projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.										
ReC-A-12.3.1	Recovery Action	Channel Modification	Flood control projects or other modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	3	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-12.3.2	Recovery Action	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.	2	20	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-15.1	Objective	Droughts	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts while also providing for CCC coho salmon recovery needs.										
ReC-A-15.1.1	Recovery Action	Droughts	Establish an emergency drought operations center (EDOC), (e.g., Washington Department of Fish and Wildlife, 2001), comprised of the SWRCB, DFG, NMFS, and others to develop emergency rules for augmenting water supplies and mitigating the effects of drought on fish.										
ReC-A-15.1.1.1	Action Step	Droughts	Work with DFG, Counties, other agencies, and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	3	10	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-15.1.1.2	Action Step	Droughts	Work with water managers on regulated streams to assure adequate and proper consideration is given to fish needs. Develop agreements, which will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	2	60	CDFG, DWR, Marin County, Marin RCD, NPS, RWQCB, State Parks, SWRCB						TBD	
ReC-A-15.1.1.3	Action Step	Droughts	Use the emergency drought operations center (EDOC) or other similar group to help discourage poaching of coho salmon by measures to: Cooperate with and provide incentives to landowners to maintain road and trail closures to be effective against trespass; Encourage monitoring of road closures and timely repair of defective or damaged road closure systems; Promote CalTIP, especially how it might apply to spawning coho salmon; and report un-permitted road use to local, State, and federal enforcement personnel during periods when coho salmon are migrating (DFG 2004).	2	60	Marin County, Marin RCD, NPS, State Parks						TBD	
ReC-A-15.1.2	Recovery Action	Droughts	Support the development of new regulations to minimize impacts on summer baseflow from riparian water rights users.										

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-15.1.2.1	Action Step	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	2	15	CalFire, CalTrans, CDFG, RWQCB, SWRCB						TBD	
ReC-A-15.1.3	Recovery Action	Droughts	Identify and eliminate depletion of summer base flows from unauthorized water uses.										
ReC-A-15.1.3.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	2	60	Marin County, Marin RCD, NPS, State Parks, SWRCB						TBD	
ReC-A-16.1	Objective	Fire and Fuels Management	Implement sediment reduction techniques in concert with prescribed fire techniques to minimize sediment impacts to various coho salmon life stages.										
ReC-A-16.1.1	Recovery Action	Fire and Fuels Management	Maintain and expand existing riparian areas to buffer excess fine sediment delivery from both naturally occurring and managed fires.										
ReC-A-16.1.1.1	Action Step	Fire and Fuels Management	Use managed fire to promote revegetation of species that filter out fine sediment.	3	60	NPS, State Parks						TBD	
ReC-A-16.1.1.2	Action Step	Fire and Fuels Management	Immediately implement appropriate sediment control measures following completion of fire suppression while fire fighters and fire fighting equipment are on site.	3	1	NPS, State Parks						TBD	
ReC-A-16.2	Objective	Fire and Fuels Management	Follow accepted procedures for protecting fish populations and critical habitat during pre-planning, initial attack, prolonged attack and rehabilitation phases of fire control efforts.										
ReC-A-16.2.1	Recovery Action	Fire and Fuels Management	Prevent adverse impacts by advance knowledge & avoidance: know natural resources at risks, know infrastructure (roads, developed water sites, potential facility locations), and plan.										
ReC-A-16.2.1.1	Action Step	Fire and Fuels Management	Maximize use of existing crossings. Funnel equipment through as few crossings as feasible. Cross where substrate is cobble dominated. Cross where stream banks are naturally low angled and where not subject to direct flow. Cross at flow “crossover points” (avoiding valuable pools, and minimizing bank disturbance at locations where high flow velocity will impinge). Rehabilitate temporary stream crossings as soon as possible, prior to the onset of winter rains if all possible.	3	60	NPS, State Parks						TBD	
ReC-A-16.2.2	Recovery Action	Fire and Fuels Management	Adopt the following guidelines for fire lines and back fires to protect streams.										
ReC-A-16.2.2.1	Action Step	Fire and Fuels Management	Avoid initiating backfires in streamside zones unless backfire will help protect streams and streamside zone from approaching wildfires – use backfires as a tool to protect streams and streamside zones from approaching wildfire.	2	60	NPS, State Parks						TBD	
ReC-A-16.2.2.2	Action Step	Fire and Fuels Management	If construction of fire lines involves falling trees near streams, dropping some into streams and/or stream-side zones is appropriate for short term LWD recruitment and erosion control.	3	60	NPS, State Parks						TBD	
ReC-A-16.2.2.3	Action Step	Fire and Fuels Management	Do not remove or fell standing dead or apparently dying trees in stream-side zone. Upslope, felling and leaving these along the contour may intercept sediment and runoff.	2	60	NPS, State Parks						TBD	
ReC-A-16.2.2.4	Action Step	Fire and Fuels Management	Reduce erosion from fire prevention or suppression activities by maintaining existing natural topography to the extent possible.	3	60	NPS, State Parks						TBD	
ReC-A-16.2.3	Recovery Action	Fire and Fuels Management	Adopt the following guidelines for facilities associated with fire control and suppression.										

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-16.2.3.1	Action Step	Fire and Fuels Management	Locate chemicals, petroleum products, latrines, camp sites, etc., as far from fish bearing streams and tributary watercourses as possible. Place on naturally flat ground.	2	60	NPS, State Parks						TBD	
ReC-A-16.2.3.2	Action Step	Fire and Fuels Management	Consult local DFG biologists or other experts to determine: presence of sensitive species and habitats, recommendations for avoiding or minimizing impacts associated with wildfire suppression, etc.	1	60	NPS, State Parks						TBD	
ReC-A-16.2.3.3	Action Step	Fire and Fuels Management	Re-contour any new facility sites as soon as possible after site clean up and fire.	3	60	NPS, State Parks						TBD	
ReC-A-16.2.4	Recovery Action	Fire and Fuels Management	Adopt the following guidelines for fire suppression activities.										
ReC-A-16.2.4.1	Action Step	Fire and Fuels Management	Obtain water from non-fish bearing waters if at all possible. In larger fish-bearing streams, excavate active channel areas outside of wetted width to create off-stream pools for water source. Mandate in equipment contract specs that water trucks/tenders be fitted with DFG and NMFS approved fish screens when water is acquired at fish bearing streams. Put up a silt fence or other erosion controls around the water extraction locations. Avoid significantly lower stream flows during water drafting.	2	60	NPS, State Parks						TBD	
ReC-A-16.2.5	Recovery Action	Fire and Fuels Management	Adopt the following guidelines for rehabilitation of watersheds after fire suppression activities have been implemented.										
ReC-A-16.2.5.1	Action Step	Fire and Fuels Management	Ensure DFG and NMFS participate on rehabilitation planning teams. During rehabilitation, consider leaving felled trees in streams as LWD source. Re-contour any massively modified areas. Storm-proof roads immediately after use. Where organic materials need disposal, windrow on disturbed soils on contour. Where larger organic material is available, place in severely burned-out class II and III watercourses (assure DFG/NMFS is a part of this design and decision). Seeding, preferably with local seed-stock, at high hazard/risk areas should be done whenever feasible.	2	60	CDFG, NPS, State Parks						TBD	
ReC-A-16.3	Objective	Fire and Fuels Management	Work with County planners to define future impacts of proposed urban and infrastructure development on fire suppression and fuel load buildup.	2	60	Marin County, NPS, State Parks						TBD	
ReC-A-16.4	Objective	Fire and Fuels Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	2	60	NPS, State Parks						TBD	
ReC-A-16.5	Objective	Fire and Fuels Management	Avoid use of aerial fire retardants and foams within 300 feet of riparian areas throughout the current range of CCC coho salmon.										
ReC-A-16.5.1	Recovery Action	Fire and Fuels Management	Analyze the cumulative impacts of fire retardants on fish populations exposed to fire stress conditions (Low DO, high temperatures, high ammonia and ash) so that the impacts of fire retardants can be assessed in the context of fire impacts.										
ReC-A-16.5.1.1	Action Step	Fire and Fuels Management	Use non-toxic retardants. Avoid dropping fire retardant into streams. To the maximum extent feasible, orient air drops so that the drop goes perpendicular to streams as opposed to parallel.	1	60	CalFire, NPS, State Parks						TBD	
ReC-A-16.6	Objective	Fire and Fuels Management	Increase coordination between NMFS and NPS on National Park lands in the Redwood Creek watershed.										
ReC-A-16.6.1	Recovery Action	Fire and Fuels Management	Reconcile differences between USFS fire retardant and suppression guidelines with recommendations in the NPS EIR for fire management on National Park lands within the Lagunitas, Pine Gulch, and Redwood Creek watersheds.										

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-16.6.1.1	Action Step	Fire and Fuels Management	Encourage the NPS to adopt the ESA emergency consultation guidelines and biological resource protection so that ESA consultations are initiated whenever coho salmon resources are at risk from fires and/or fire suppression activities.	1	60	NPS						TBD	
ReC-A-16.7	Objective	Fire and Fuels Management	Set up a comprehensive fire monitoring program that follows the guidelines in the Fire Monitoring Handbook.	3	60	NPS, State Parks						TBD	
ReC-A-16.8	Objective	Fire and Fuels Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.	2	60	NPS, State Parks						TBD	
ReC-A-16.9	Objective	Fire and Fuels Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.	2	60	NPS, State Parks						TBD	
ReC-A-17.1	Objective	Fishing and Collecting	Require maintenance of the existing recreational fishing closures within the Redwood Creek watershed.										
ReC-A-22.1	Objective	Recreational Areas and Activities	Evaluate trail crossings to ensure bridges are constructed to support horses.										
ReC-A-22.2	Objective	Recreational Areas and Activities	Eliminate horse access to creeks for watering or as fords.										
ReC-A-22.3	Objective	Recreational Areas and Activities	Increase education to the equestrian community regarding impacts to riparian and instream habitat from horse manure and hooves.										
ReC-A-22.4	Objective	Recreational Areas and Activities	Recreational trails should be set back from the creek and built to reduce erosion and minimize stream crossings.										
ReC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
ReC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.										
ReC-A-24.1.1.1	Action Step	Roads and Railroads	Support efforts to remove levees on the Banducci property to create backwater and alcove habitat by having the county raise the lower section of Muir Woods road where it meets Highway One. Raising the road will address flooding and create vital off channel habitat in this section of creek. Coordinate with the NMFS and/or DFG geomorphologist on design features and implementation techniques.										
ReC-A-24.1.1.2	Action Step	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.										
ReC-A-24.1.2	Recovery Action	Roads and Railroads	Encourage development and implementation of a program similar to the County of Santa Cruz's Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.										
ReC-A-24.1.3	Recovery Action	Roads and Railroads	Expand the NRCS/RCD coordinated permit program to a statewide programmatic ESA consultation that allows funding and technical expertise to small land owners and rural residential property owners.										
ReC-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
ReC-A-24.2.1	Recovery Action	Roads and Railroads	Address sediment sources from road networks and other actions that deliver sediment to stream channels.										

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-24.2.1.1	Action Step	Roads and Railroads	Revaluate the high priority treatment recommendations for unpaved roads from the PWA assessment, and implement recommended treatments if they are still relevant. If not, reassess and make new recommendations for treatment. Push for decommissioning when feasible.										
ReC-A-24.3	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
ReC-A-24.3.1	Recovery Action	Roads and Railroads	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.										
ReC-A-24.3.1.1	Action Step	Roads and Railroads	NMFS and other stakeholders will work with RCD or NRCS to encourage hiring of consultants to conduct road assessments (first for subwatersheds in Core areas, then for Phase I areas).										
ReC-A-24.3.2	Recovery Action	Roads and Railroads	Implement the most effective best management practices to conduct sediment reduction actions.										
ReC-A-24.3.3	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.										
ReC-A-24.3.3.1	Action Step	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).										
ReC-A-24.3.4	Recovery Action	Roads and Railroads	Remove levees along Big Lagoon and Pacific Way. Address issues with culverts, road network, and development within the Big Lagoon Area.										
ReC-A-24.4	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
ReC-A-24.4.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.										
ReC-A-24.4.2	Recovery Action	Roads and Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. The Counties should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with endangered salmonid habitat.										
ReC-A-24.4.3	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.										
ReC-A-24.4.4	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.										
ReC-A-24.5	Objective	Roads and Railroads	Evaluate existing and future stream crossings to identify threats to natural hydrologic processes and support efforts to replace or retrofit bridges to achieve more natural conditions without maintenance.										
ReC-A-24.6	Objective	Roads and Railroads	Evaluate existing and future stream crossings to identify threats to natural hydrologic processes and support efforts to replace or retrofit bridges to achieve more natural conditions without maintenance.										

Redwoord Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ReC-A-26.1	Objective	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon.										
ReC-A-26.1.1	Recovery Action	Water Diversion and Impoundment	Work with the Muir Beach CSD and Green Gulch farm to eliminate water diversions that affect flow within Redwood Creek.										

RUSSIAN RIVER

Russian River

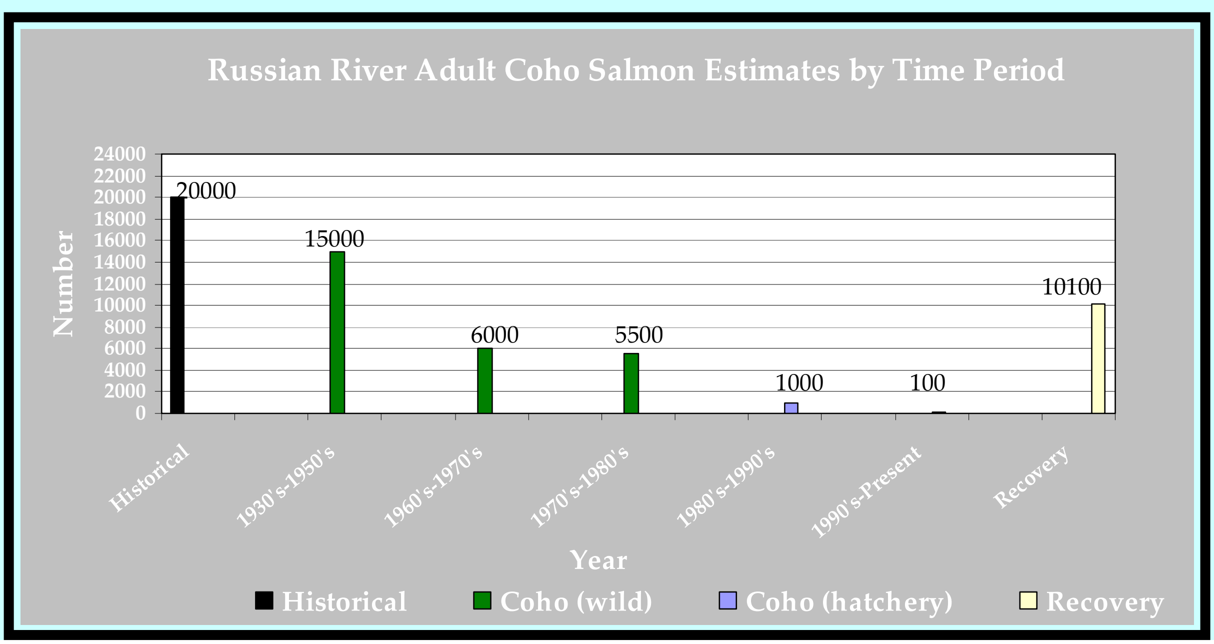
Independent Population
757.4 IP-km of potential coho salmon habitat
Coho salmon , steelhead, and Chinook salmon present

Russian River drains approximately 1,483 square miles of Sonoma and Mendocino County. The Russian River enters the Pacific Ocean near the town of Jenner. Approximately 40 percent of the Russian River watershed is montane or riparian hardwood forest, 18 percent is grassland, 13 percent is agricultural grazing and farm land, and 12 percent is coniferous forest. To date, only 75 percent of the Russian River watershed has been evaluated for erodibility. Even so, 58 percent of the Russian River watershed has moderate to high erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. The SWRCB listed the Russian River as having water quality impaired for sediment and temperature in 2003. The water quality impairment listing determined that sediment was impairing habitats beneficial to coho salmon including migration, spawning and rearing habitats, and identified areas disturbed from construction, dams, erosion/siltation, flow habitat modification, silviculture, and removal of riparian vegetation as the probable causes. The majority of the watershed is in private ownership; the remaining 8 percent is state owned park, university land, and federally owned land. Housing development within the Russian River watershed is moderate to high; approximately 148,500 housing units are present in the watershed. There are over 500 small dams on the Russian River and its tributaries (SEC 1996). An additional 2314 other barriers to salmon migration caused by road crossings, diversions, and natural structures. Impassable barriers block salmonids for less than 10 percent of the watershed.

Russian River
Photo by Joe Pecharich

The Watershed at a Glance

Spawning Quantity & Quality:	**FAIR to GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency:	**FAIR to POOR**
Riparian Canopy:	**POOR to FAIR**
off channel/Floodplain Quality:	**POOR**
Estuary Function:	**FAIR**



Russian River

Recovery Target: 10,100 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Agricultural Practices
- Droughts
- Roads and Railroads
- Residential and Commercial Development
- Water Diversion and Impoundment

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Russian River watershed that are in poor condition. The highest priorities for restoration are to:

- Improve hydrology to support redds, juveniles, and smolts
- Improve spawning habitat
- Increase and improve pool habitat
- Increase and improve off channel habitat
- Increase the amount of large wood in and near the stream
- Improve riparian shading to cool streams
- Decrease the number of roads near the stream and reduce impacts from remaining roads

Low flow conditions in a tributary to the Russian River
Photo by Joe Pecharich

Conservation Highlights

- Conservation Hatchery
- Fish Friendly Farming Program
- Citizen Monitoring
- Agricultural BMP's

Monitoring on Mill Creek
Photo by Joe Pecharich

Immediate Needs

√ Develop streamflow monitoring and evaluation programs
√ Expand broodstock releases to other streams
√ Develop tributary acclimation sites/facilities
√ Monitor salmonid trend and abundance

Advancing recovery of coho salmon in the Russian River

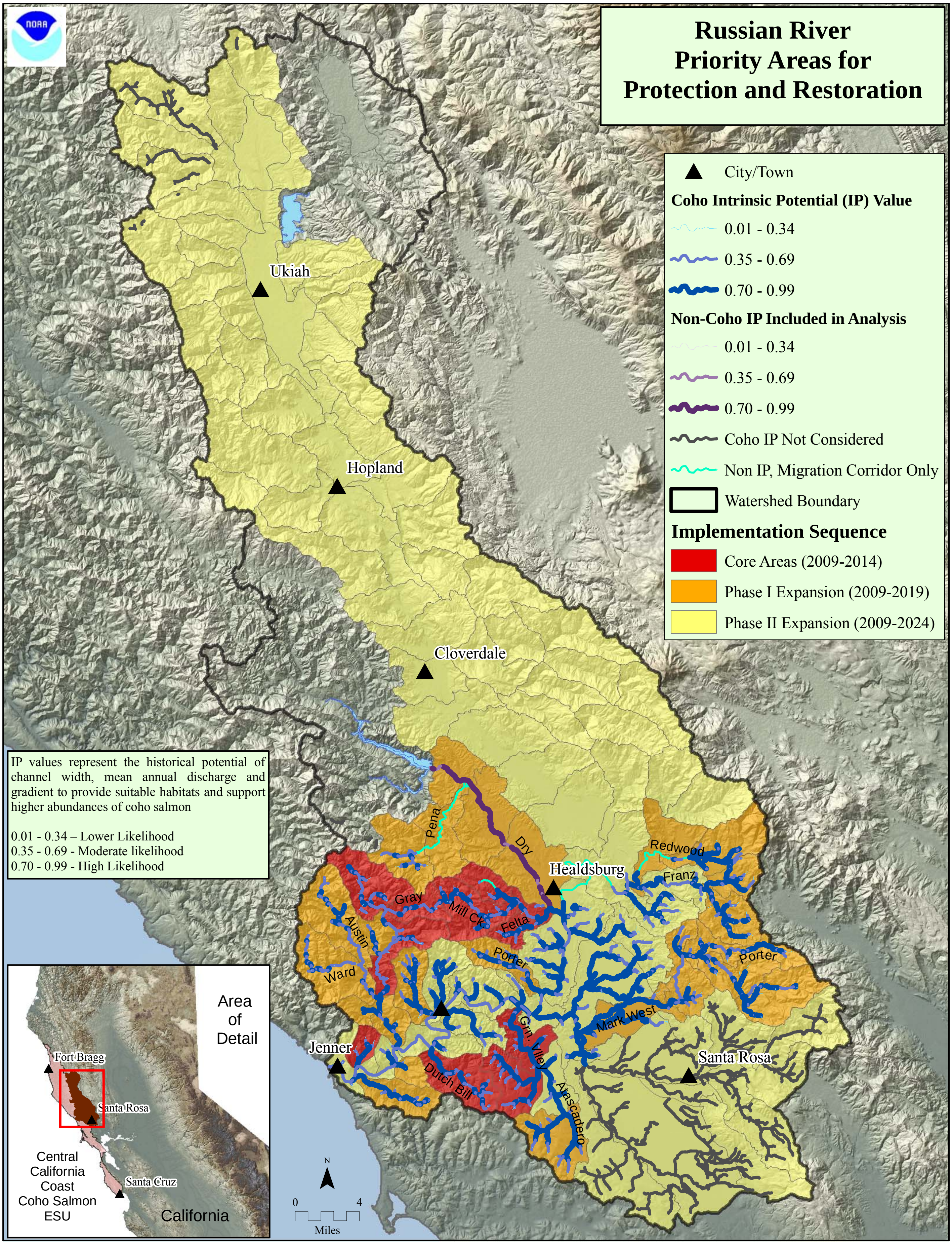
requires these priority **recovery actions:**

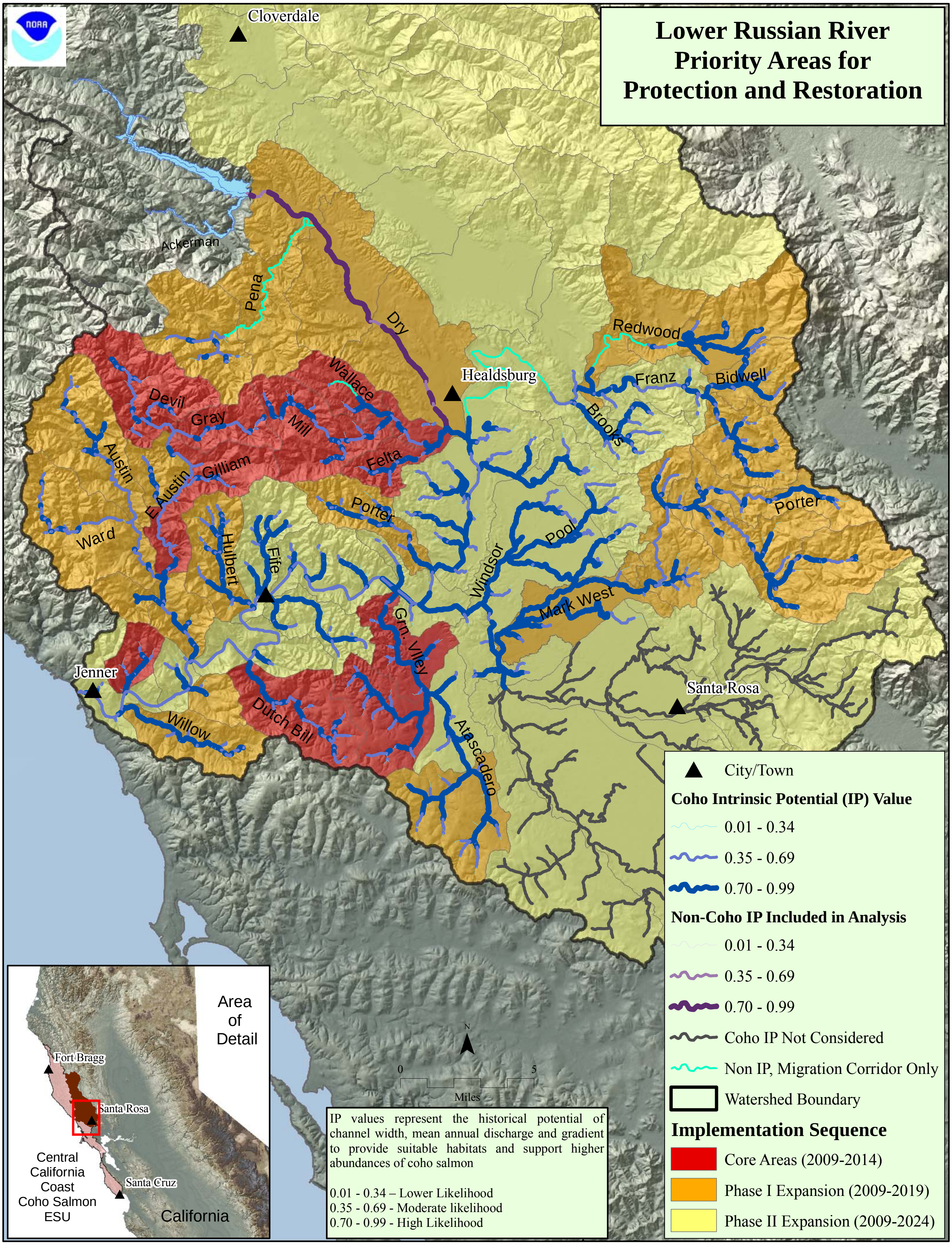
- Improve over winter survival by increasing the frequency and functionality of off channel habitats on tributaries
- Install or enhance existing LWD, boulders, and other features to increase stream complexity and improve pool frequency in historic coho streams
- Support the development of new regulations to minimize impacts on spring and summer baseflow from frost protection and other water diversions.
- Use available best management practices for road construction, maintenance, management and decommissioning

. . . in these **core areas:** Sheephouse Creek area of the Willow Creek planning watershed; Freezeout Creek area of the Freezeout Creek Planning watershed; Dutch Bill, Felta, Wallace, Palmer, and Upper East Gray Creek planning watersheds; Purrington Creek area of the Purrington Creek planning watershed

Recovery Partners

US Army Corps of Engineers
NRCS
UCCE
SCWA
MCRRFCD
RWQCB
NFWF
Trout Unlimited
DFG
Regional RCD's
Sonoma Grapegrowers
Russian River Property Association
Sonoma and Mendocino County and City Agencies
Sotoyome, Goldridge, and Mendocino United Winegrowers


Russian River
Priority Areas for
Protection and Restoration
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Non-Coho IP Included in Analysis
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Coho IP Not Considered
Non IP, Migration Corridor Only
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
Ukiah
Hopland
Cloverdale
Healdsburg
Jenner
Santa Rosa
Pena
Dry
Redwood
Franz
Gray
Mill Ck
Felta
Austin
Porter
Ward
Porter
Grn. Vlley
Mark West
Dutch Bill
Atascadero
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
N
0
4
Miles



Lower Russian River
Priority Areas for
Protection and Restoration
Cloverdale
Ackerman
Pena
Dry
Healdsburg
Redwood
Franz
Bidwell
Brooks
Wallace
Devil
Gray
Mill
Felta
Austin
E. Austin
Gilliam
Porter
Ward
Hulbert
Fife
Pool
Porter
Windsor
Mark West
Grn. Valley
Jenner
Santa Rosa
Willow
Dutch Bill
Atascadero
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Non-Coho IP Included in Analysis
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Coho IP Not Considered
Non IP, Migration Corridor Only
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)
N
0
5
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California

CCC Coho Salmon
Russian River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	75	Fair	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	96%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	8184.6 m²	Fair	Spawning Adults	Sediment	Amount of Gravel*	<3400 m²	3400-21800 m²	21800-40400 m²	>40400 m²
NMFS	Best Prof. judgment	5-10%	Fair	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	83	Poor	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	83	Poor	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Good	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	Good	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	92	Poor	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	31	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	6%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	44.2	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	83	Poor	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	3.99/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	31	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	<50%	Poor	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	11%	Poor	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	2.81%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	9.00%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	2%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	2 / 100m	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	1.2	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	13%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	73%	Poor	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	4.4 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	4.2 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m²	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m²	0.2-0.5 fish/m²	0.5-1.0 fish/m²	>1.0 fish/m²
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

: **Russian River Threats Across Targets**		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Very High			High
2	Droughts	Medium	Medium	Very High	Medium	Medium	Medium			High
3	Roads and Railroads	Medium	Medium	Medium	Medium	Medium	Very High			High
4	Residential and Commercial Development	Medium	Low	High	Medium	Medium	High			High
5	Water Diversion and Impoundment	Medium	Medium	High	Medium	Medium	Medium			High
6	Channel Modification	Medium	Low	Medium	Medium	Medium	High			Medium
7	Logging and Wood Harvesting	Medium	Low	Medium	Medium	Medium	High			Medium
8	Fishing and Collecting	High	-	Medium	Low	Medium	-			Medium
9	Climate Change	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium			Medium
12	Mining	Medium	Low	Medium	Medium	Medium	Medium			Medium
13	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
14	Storms and Flooding	Low	Medium	Medium	Medium	Low	Medium			Medium
15	Hatcheries and Aquaculture	Medium	-	Medium	Low	Medium	Low			Medium
16	Disease, Predation, and Competition	Medium	-	Medium	-	Medium	-			Medium
Threat Status for Targets and Project		High	Medium	Very High	High	High	Very High	-	-	Very High

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.	1	40	CalFire, California Department of Mines and Geology, CalTrans, CDFG, Mendocino Redwood Company, NRCS, Private Landowners, Public, RCD, RWQCB						TBD	Can be very costly, need to determine number of high risk sites and develop cost estimate.
RuR-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.	3	2	CDFG, NMFS, NRCS, Private Consultants	25.00	25.00				50	A rough estimate for an agency or consultant using existing information to develop guidelines.
RuR-A-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	2	10	CA Coastal Commission, California Coastal Conservancy, CDFG, Private Landowners						TBD	Costs include staff time to develop estuarine policy, and implementation of restoration actions. Due to an unknown number and type of restoration actions that may be implemented, costs cannot be determined at this time.
RuR-A-1.1.1.2	Action Step	Estuary	Where appropriate, remove structures and/or modify practices which impair or reduce the historical tidal prism and/or estuarine function where feasible and where benefits to coho salmon and/or the estuarine environment are predicted.	3	10	CA Coastal Commission, California Coastal Conservancy, CDFG						TBD	Costs associated with removal of structures will depend on the number and type of structures identified and cannot be accurately determined at this time.
RuR-A-1.1.1.3	Action Step	Estuary	Per the Russian River Biological Opinion, utilize adaptive management to guide future management and development of above guidelines	2	15	NMFS, Sonoma County Water Agency						TBD	Sonoma County Water Agency will incur most of this cost.
RuR-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.	1	40	CalFire, California Department of Mines and Geology, CalTrans, CDFG, Mendocino Redwood Company, NRCS, Private Landowners, Public, RCD, RWQCB						TBD	Can be very costly, need to determine number of high risk sites and develop cost estimate.
RuR-A-2.1.1	Recovery Action	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	2	CDFG, NMFS, Private Landowners, Sonoma County Water Agency						TBD	Cost will include GIS and validation in the field.
RuR-A-2.1.2	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
RuR-A-2.1.2.1	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	60	CDFG, NMFS, NRCS, Sonoma County Water Agency						TBD	Costs to promote and support restoration efforts (e.g. technical assistance) depend on the level of technical assistance provided and the types of projects proposed.
RuR-A-2.1.2.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	60	CDFG, NMFS, NRCS, Sonoma County Water Agency						TBD	Costs depend on level of technical assistance required and types of projects proposed. Many salmon recovery efforts and management programs are currently ongoing by a variety of agencies and stakeholders. It is possible that there could be additional salmon restoration costs identified based on recovery needs of the species; however, at this time we do not have sufficient information to estimate those potential costs or identify the actions under which they would fall.
RuR-A-2.1.2.3	Action Step	Floodplain	Implement managed retreat of current development and infrastructure from stream channels and floodplains.	3	30	CDFG, Sonoma County, Sonoma County Water Agency						TBD	Costs depend on the number and types of projects proposed, and cannot be accurately determined at this time.
RuR-A-2.1.3	Recovery Action	Floodplain	Investigate the potential role of the Laguna de Santa Rosa in supporting floodplain and off-channel habitat.										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-A-2.1.3.1	Action Step	Floodplain	Fund a hydrological and ecological study to determine the historic role of seasonal lakes and wetland areas of the laguna as over-winter and summer rearing habitat.	3	5	CDFG, Sonoma County Water Agency, SWRCB	36.00	36.00	36.00	36.00	36.00	180	DFG (2004) estimates that include surveying and research efforts have cost about $176,000 on average.
RuR-A-2.1.3.2	Action Step	Floodplain	Fund an investigation of the feasibility of laguna restoration.	3	5	CDFG, Sonoma County Water Agency	36.00	36.00	36.00	36.00	36.00	180	According to DFG (2004), average costs for projects that include surveying and other research efforts that DFG has funded average approximately $180,000.
RuR-A-3.1	Objective	Hydrology	Improve survival at all life stages by improving the spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
RuR-A-3.1.1	Recovery Action	Hydrology	Reduce water that effects the natural hydrograph, develop alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	3	2	CDFG, NMFS, NRCS, Private Consultants	25.00	25.00				50	A rough estimate for an agency or consultant using existing information to develop guidelines.
RuR-A-3.1.2	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
RuR-A-3.1.2.1	Action Step	Hydrology	Work with SWRCB and landowners to improve flow regimes for adult migration to spawning habitats and smolt outmigration.	2	10	Private Landowners, Sonoma County Water Agency						TBD	Costs to water users may be substantial, but cannot be determined.
RuR-A-3.1.2.2	Action Step	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.	3	10	RWQCB						TBD	Costs to adjudicate and enforce water allocations cannot be determined at this time.
RuR-A-3.1.3	Recovery Action	Hydrology	Work with water managers on regulated streams to assure adequate and proper consideration is given to fish needs. Develop agreements that will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.										
RuR-A-3.1.3.1	Action Step	Hydrology	Manage reservoirs and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	1	5	Sonoma County Water Agency, USACE						TBD	Changes in flow management may incur costs to diverters and water delivery systems, but costs are unknown.
RuR-A-3.1.4	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
RuR-A-3.1.4.1	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	1	5	CDFG, NMFS, Private Landowners, SWRCB	100	100	100	100	100	500	Costs to agencies engaged in the identification and elimination will vary depending on degree of cooperation from the diverter.
RuR-A-3.1.4.2	Action Step	Hydrology	Require streamflow gauging devices to determine the current streamflow condition.	2	40	California Coastal Conservancy, CDFG, Private Landowners, RCD, Sonoma County, Sonoma County Water Agency	2.50	2.50	2.50	2.50	2.50	100	Highlighting these issues will likely require MOAs between water users.
RuR-A-3.1.4.3	Action Step	Hydrology	Assess and map water diversions (DFG 2004).	2	20	California Coastal Conservancy, CDFG, NMFS, NOAA RC, Private Landowners, Sonoma County, Sonoma County Water Agency	10.00	10.00	10.00	10.00	10.00	200	Cost estimate for education and technical guidance.

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-A-3.1.4.4	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	2	20	CDFG, NMFS, NOAA RC, Private Landowners, RCD, Sonoma County, Sonoma County Water Agency, SWRCB	250	250	250	250	250	5,000	Promoting these alternatives will take a sustained effort to target willing landowners, and may require substantial investment in infrastructure, and changes to crop management.
RuR-A-3.1.5	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
RuR-A-3.1.5.1	Action Step	Hydrology	Promote alternative frost protection strategies.	2	60	CDFG, Private Landowners, Sonoma County, SWRCB						0	These costs will likely be included as part of the ongoing 1600 agreement requirements per DFG.
RuR-A-3.1.5.2	Action Step	Hydrology	Support SWRCB in regulating the use of streamside wells and groundwater.	2	60	CDFG, NMFS, NMFS OLE, SWRCB						0	Development of supporting infrastructure (e.g. purple pipe systems) will require substantial investment, but costs may also be recovered by savings in water generation.
RuR-A-3.1.6	Recovery Action	Hydrology	To improve connectivity of surface flows with groundwater reduce aggradation and overall sediment load at the watershed scale by treating roads and sources of mass wasting.	2	60	CDFG, NOAA RC, Private Landowners, Sonoma County, Sonoma County Water Agency						TBD	Costs depend on extent of treatments.
RuR-A-3.1.7	Recovery Action	Hydrology	Encourage the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	2	5	CDFG, NOAA RC, Sonoma County, Sonoma County Water Agency	4.00	4.00	4.00	4.00	4.00	20	Costs should be minimal for outreach and education. Many existing documents are available, and are part of ongoing programs.
RuR-A-5.1	Objective	Passage	Identify and remove existing passage barriers.										
RuR-A-5.1.1	Recovery Action	Passage	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).										
RuR-A-5.1.1.1	Action Step	Passage	Restore passage in high priority areas of the Russian River Watershed as identified by the DFG, NMFS, RCD, the County of Sonoma, Caltrans, and existing fish passage databases. High priority sites identified through DFG watershed surveys (DFG 2009) include: Dry Creek sub-basin: Mill Creek - private dam, Wallace Creek - county culvert, Crane Creek - bedrock sill, Grape Creek - County culvert. Lower River Tributaries: Purrington Creek - county culvert and possible private barriers, Dutch Bill, Duvoul and Grub Creek tributaries - County culverts, Willig Gulch - private culvert. Mark West sub-basin: Porter Creek - crossing at Calistoga Road. Maacama sub-basin: Redwood Creek - private crossing.	1	5	CDFG, NMFS, NOAA RC, Private Landowners, RCD, Sonoma County, Sonoma County Water Agency	400	400	400	400	400	1,998	DFG identified 386 barriers in the Russian River, and estimated the total cost of treatments at $64,255,622 (2004). Cost estimates for these projects were made by simple division, with a per project cost of $166,465.
RuR-A-5.1.1.2	Action Step	Passage	Barriers to upstream and downstream migration in Willow Creek should be corrected by removing or altering the design of the second bridge to allow channel forming processes to occur. The primary factors contributing to obstruction of upstream adult and downstream juvenile migration are the rapid sediment aggradation, widespread flow distribution, and channel disconnection at lower flows. These problems will continue without substantial changes to the bermed roadway at the second bridge.	1	5	CDFG, Sonoma County	33.29	33.29	33.29	33.29	33.29	166	DFG identified 386 barriers in the Russian River, and estimated the total cost of treatments at $64,255,622 (2004). Cost estimates for these projects were made by simple division, with a per project cost of $166,465.
RuR-A-5.1.2	Recovery Action	Passage	Evaluate the feasibility of providing adult passage over Coyote Valley Dam, and Warm Springs Dam (DFG 2004) .	2	3	NMFS HCD, Private Consultants, Sonoma County Water Agency, USACE	16.67	16.67	16.67			50	Cost estimated for feasibility study.

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
RuR-A-6.1.1	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.	3	60	Board of Forestry, CDFG, Mendocino County Department of Public Works, NMFS, Private Landowners, RCD, Sonoma County, Sonoma County Water Agency						0	Cost is expected to be minimal.
RuR-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.										
RuR-A-6.1.2.1	Action Step	Pool Habitat	Install or enhance existing LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004). Focus on the following areas: tributaries of Austin Creek, Crane Creek, Green Valley Creek, Dry Creek, Forsythe Creek, Grape Creek, Willow Creek, Sheephouse Creek, Porter Creek, Dutch Bill Creek, Redwood Creek, Foote Creek, Kellog Creek, Wine Creek and Yellowjacket Creek.	1	5	CDFG, NOAA RC, Sonoma County, Sonoma County Water Agency	140	140	140	140	140	700	Estimate 35 structures at ~20K per structure. Structures have already been placed in some areas.
RuR-A-6.1.2.2	Action Step	Pool Habitat	Spawning gravels on Green Valley Creek are limited due to channel incision. Structures to decrease channel incision and recruit spawning gravel (using gravel retention structures), should be installed to trap, sort and expand redd distribution in the stream where appropriate.	1	5	CDFG, NOAA RC, Sonoma County, Sonoma County Water Agency	40.00	40.00	40.00	40.00	40.00	200	Estimate 10 structures in these reaches would add complexity at $20K per structure.
RuR-A-6.1.2.3	Action Step	Pool Habitat	In Willow Creek there is a limited supply of large diameter, riparian redwood and Douglas-fir in the watershed. Promote growth of conifers in the riparian zone for later in-channel recruitment.	2	5	CDFG, NOAA RC, Sonoma County, Sonoma County Water Agency	17.50	17.50	17.50	17.50	17.50	88	Cost estimates for placement of LWD range from $20K to $30K per mile. Assuming proximally half the ~7stream miles require treatment, costs would be approximately $25K per mile.
RuR-A-6.1.3	Recovery Action	Pool Habitat	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	5	CDFG, NOAA RC, RCD, Sonoma County, Sonoma County Water Agency, USACE						TBD	Costs will depend on what extent and type of solutions are developed.
RuR-A-6.1.4	Recovery Action	Pool Habitat	Evaluate, develop solutions and implement immediate needs to address problems resulting from channelization.	2	5	CDFG, NOAA RC, RCD, Sonoma County, Sonoma County Water Agency, USACE						TBD	Costs will depend on what extent and type of solutions are developed.
RuR-A-6.1.5	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	20	CDFG, NOAA RC, Private Landowners, RCD, Sonoma County, Sonoma County Water Agency, USACE	60.00	60.00	60.00	60.00	60.00	1,200	DFG estimated the average cost of outreach and education programs at about $60 K per year (2004)
RuR-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-A-7.1.1	Recovery Action	Riparian Vegetation	Assess impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	10	CDFG, RCD, Sonoma County, Sonoma County Water Agency						TBD	Costs depend on assessment methods and extent and types of programs implemented.
RuR-A-7.1.2	Recovery Action	Riparian Vegetation	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.	2	5	CDFG, RCD, Sonoma County, Sonoma County Water Agency						TBD	Costs associated with development of a LWD plan are expected to be minimal, however additional costs may occur.
RuR-A-7.1.3	Recovery Action	Riparian Vegetation	Restore and protect riparian vegetation to improve migration and summer/overwintering habitat for coho salmon (DFG 2004). Watersheds identified by DFG as having poor shelter habitat and riparian condition include Turtle Creek, Fife Creek, Porter Creek, Bluejay Creek, Fisher Creek, Grub Creek, and Corral Creek (DFG 2009).										
RuR-A-7.1.3.1	Action Step	Riparian Vegetation	In the Ward Creek sub-basin reforestation to a conifer forest should be a long term strategy to return the area to fully functioning condition. Implementing this type of strategy will need to employ incentives and assistance to landowners. In conjunction with Sudden Oak death programs.	2	20	CDFG, NOAA RC, Private Landowners, RCD, Sonoma County, Sonoma County Water Agency	27.00	27.00	27.00	27.00	27.00	540	DFG estimated the cost of riparian planting at about $180 K per mile (2004), and assumption was that as much as 3 miles will require treatment. Implementation will take advantage of existing programs and will reduce costs somewhat.
RuR-A-7.1.4	Recovery Action	Riparian Vegetation	Fence riparian areas from grazing (using fencing standards that allow other wildlife to access the stream). Watersheds identified by DFG include Porter, Foote, Grub, Franz, and Franchi.	2	10	CDFG, NMFS, NOAA RC, Private Landowners, RCD, Sonoma County, Sonoma County Water Agency, USACE	10.00	10.00	10.00	10.00	10.00	100	Cost based on 10K for 10 years.
RuR-A-7.1.5	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	60	CDFG, Farm Bureau, Mendocino County, NMFS, NRCS, Private Landowners, RCD, Sonoma County						tbd	cost is dependent on the specific conservation measures implemented.
RuR-A-7.1.6	Recovery Action	Riparian Vegetation	Promote alternatives to conventional bank stabilization for public and private projects, including bioengineering techniques (DFG 2004).	2	30	Mendocino County, Private Landowners, RCD, Sonoma County	6.00	6.00	6.00	6.00	6.00	180	Cost is a rough estimate.
RuR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
RuR-A-8.1.1	Recovery Action	Sediment	Address sediment sources from road networks and other actions that deliver sediment and runoff to stream channels, in each sub-basin.										
RuR-A-8.1.1.1	Action Step	Sediment	Maintenance of ditches, culverts, and inboard cutbank slides should be improved to decrease the potential of sediment delivery to Dutchbill and Grub Creeks.	2	10	CDFG, Sonoma County	11.98	11.98	11.98	11.98	11.98	120	Costs cannot be accurately determined due to an unknown extent and type of treatment required, however, road treatment in the Russian River has been estimated at approximately $78,933,524.00 (DFG 2004). Costs associated with this action were estimated by multiplying the approximately 10 stream miles by the per mile cost ($11,982) provided in DFG 2004.
RuR-A-8.1.1.2	Action Step	Sediment	In Purrington Creek several stream crossings exist in Reach 1. These crossings should be improved to eliminate active soil erosion and runoff.	3	10	CDFG, RCD, Sonoma County	38.77	38.77	38.77	38.77	38.77	388	Cost estimate for remediation of three crossing follows DFG (2004).

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-8.1.1.1	Action Step	Sediment	Maintenance of ditches, culverts, and inboard cutbank slides should be improved to decrease the potential of sediment delivery to Dutchbill and Grub Creeks.	2	10	CDFG, Sonoma County	11.98	11.98	11.98	11.98	11.98	120	Costs cannot be accurately determined due to an unknown extent and type of treatment required, however, road treatment in the Russian River has been estimated at approximately $78,933,524.00 (DFG 2004). Costs associated with this action were estimated by multiplying the approximately 10 stream miles by the per mile cost ($11,982) provided in DFG 2004.
RuR-CCC-8.1.1.2	Action Step	Sediment	In Purrington Creek several stream crossings exist in Reach 1. These crossings should be improved to eliminate active soil erosion and runoff.	3	10	CDFG, RCD, Sonoma County	38.77	38.77	38.77	38.77	38.77	388	Cost estimate for remediation of three crossing follows DFG (2004).
RuR-CCC-8.1.1.3	Action Step	Sediment	In the East Austin Creek watershed, implement results of existing sediment source surveys, and assess remaining watershed road networks to eliminate high priority and high sediment yield sources. Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	2	10	CDFG, NOAA RC, Private Landowners, RCD, Sonoma County	11.98	11.98	11.98	11.98	11.98	120	Road treatment in the Russian River has been estimated at approximately $78,933,524.00 (DFG 2004). Costs associated with this action were estimated by multiplying the approximately 10 stream miles by the per mile cost ($11,982) provided in DFG 2004.
RuR-CCC-8.1.1.4	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004). High priority streams identified by DFG habitat reports include Sheephouse Creek, Austin and East Austin Creeks, Pena Creek, Porter Creek, Kidd Creek, Sexton Creek, Gilliam Creek, Hobson Creek, Conshea Creek, Crane Creek, and Schoolhouse Creek (DFG 2009).	2	25	CDFG, Private Landowners, RCD, Sonoma County, Sonoma County Water Agency, State Parks	16.93	16.93	16.93	16.93	16.93	423	Costs cannot be accurately determined due to an unknown extent and types of treatments required, however, road treatment or decommissioning in the Russian River has been estimated at approximately $7,027,012.00 (DFG 2004). Costs associated with this action were estimated by multiplying the approximately 70 stream miles by the per mile cost ($6,045) provided in DFG 2004.
RuR-CCC-8.1.2	Recovery Action	Sediment	Provide incentives to restore high priority sites as determined by watershed analysis, DFG, or CalFire.	1	20	CalFire, CDFG, NMFS						tbd	The cost of incentives is difficult to determine at this time.
RuR-CCC-8.1.3	Recovery Action	Sediment	Close unauthorized trails and conduct appropriate decommissioning practices. Hydrologically disconnect trails from associated waterways.	2	30	California Coastal Conservancy, California Department of Mines and Geology, Mendocino County, NMFS, NOAA RC, Private Landowners, Public, RCD, Sonoma County, State Parks						TBD	Costs cannot be determined until appropriate assessments have been conducted. Costs may vary significantly depending on type of road related problems and whether roads are closed or decommissioned.
RuR-CCC-9.1	Objective	Viability	Re-establish a naturally reproducing run of coho salmon in appropriate subwatersheds.										
RuR-CCC-9.1.1	Recovery Action	Viability	Continue the operation of the Captive Broodstock Program in the Russian River.										
RuR-CCC-9.1.1.1	Action Step	Viability	Annually capture or retain (during rescue efforts) - small numbers of surplus fish from drying streams/habitats in Marin and Sonoma Counties for purposes of broodstock in Russian River, Walker and Salmon Creeks	1	10	CDFG, NMFS, Private Landowners, Sonoma County Water Agency, Trout Unlimited, USACE							Existing operations
RuR-CCC-9.1.1.2	Action Step	Viability	Continue efforts to find long term funding for monitoring of the Russian River Coho Salmon Captive Broodstock Program.	1	10	CDFG, USACE						300,000/year	This action is funded through the ACOE Russian River Biological Opinion.
RuR-CCC-9.1.1.3	Action Step	Viability	Increase coho salmon smolt production at the Russian River Coho Salmon Broodstock facility to a level where consistent returns can be incorporated reliably into the spawning matrix	1	30	CDFG, USACE						0	The action is already funded by the USACE as a result of the Russian River Biological Opinion.
RuR-CCC-9.1.1.4	Action Step	Viability	Improve and expand rearing capacity of the Coho Salmon Captive Broodstock facility.	1	30	CDFG, USACE						TBD	This action is partially funded through the USACE Biological Opinion.
RuR-CCC-9.1.1.5	Action Step	Viability	Increase size at release to attain 160 mm at emigration, to enhance marine survival and increasing adult returns	1	30	USACE	1.33	1.33	1.33	1.33	1.33	40	

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-9.1.1.6	Action Step	Viability	Continue to utilize surplus fish in additional recovery opportunities (adult releases, releases to extirpated watersheds) and evaluate such actions in the context of recovering coho in the Russian River, extirpated watersheds, and the contribution to the diversity stratum	2	30	CDFG, NMFS						existing operations	
RuR-CCC-9.1.1.7	Action Step	Viability	Establish a release imprinting station on Mill Creek and Green Valley Creeks, and other smolt release streams, so that smolts can be held for a minimum two week period prior to release. The holding period should allow for imprinting to occur on the parent release stream, increasing the potential for returns as adults which spawn naturally.	1		CDFG, Private Landowners, Trout Unlimited, UC Extension, USACE						TBD	Cost cannot be determined at this time. More specific methods in development will determine cost.
RuR-CCC-9.1.2	Recovery Action	Viability	Minimize departure from the genetic profile that historically existed in the population.										
RuR-CCC-9.1.2.1	Action Step	Viability	Utilize the hatchery criteria and assessment guidance provided in Spence et al. 2008 when evaluating the risks and benefits of proposed and ongoing hatchery operations	1	30	CDFG, USACE						0	Action not expected to result in significant additional cost.
RuR-CCC-9.1.2.2	Action Step	Viability	Use surplus broodstock to repopulate nearby watersheds (within diversity strata) where populations have extirpated.	1	30	CDFG, NMFS, Sonoma County Water Agency, USACE						TBD	Specific plan needed to estimate cost.
RuR-CCC-9.1.2.3	Action Step	Viability	Continue tointegrate coho salmon from outside of the Russian River, but within the diversity strata, into the spawning programmatically to decrease inbreeding depression and the genetic bottleneck.		10	CDFG, NMFS, USACE							Existing operations
RuR-CCC-9.1.3	Recovery Action	Viability	Continue to work with existing permittees to rescue juvenile coho salmon that are under an imminent risk of stranding and mortality and relocate to suitable habitat when deemed appropriate by NMFS and CDFG		10	CDFG, NMFS, Private Landowners, Sonoma County Water Agency, Trout Unlimited							Existing operations
RuR-CCC-9.2	Objective	Viability	Conduct a comprehensive assessment of watershed processes (e.g., hydrology, geology, fluvial-geomorphology, water quality, and vegetation), instream habitat, and factors limiting coho salmon production (DFG 2004).	1	30	NMFS						tbd	Difficult to quantify at this time due to uncertain scope and extent.
RuR-CCC-9.3	Objective	Viability	Continue and expand the existing coho salmon life-cycle monitoring efforts.	2	25	CDFG, NMFS, Sonoma County Water Agency, USACE	265	265	265	265	265	6,625	The cost can vary depending on the number of stations within the watershed. Recent funding for the Freshwater Creek (Humboldt County) life-cycle monitoring station was $265,000 per season.
RuR-CCC-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See strategies for restoring and enhancing riparian vegetation.										
RuR-CCC-10.1.1	Recovery Action	Water Quality	Develop site-specific recommendations, including incentives, to remedy high temperatures and implement (DFG 2004) initially in core areas, following with phase 1 and 2 areas.		5	CDFG, NMFS, Private Landowners						TBD	Cannot estimate at this time.
RuR-CCC-10.1.2	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in assessed streams (DFG 2004).										
RuR-CCC-10.1.2.1	Action Step	Water Quality	Plant native vegetation to promote streamside shade: increase the canopy by planting native species where shade canopy is not at acceptable levels.	2	10	Mendocino County, Private Landowners, RCD, Sonoma County						TBD	Costs vary with amount and type of planting, labor, and post planting monitoring. DFG (2004) estimated riparian planting projects near roads cost between $30,000 and $35,000 per acre.
RuR-CCC-10.1.2.2	Action Step	Water Quality	Improve riparian and instream conditions in rearing habitats by establishing riparian protection zones that extends from the outer edge of the channel out to the site potential of tree height to allow LWD recruitment.	2	60	Board of Forestry, CalFire, CDFG, Private Landowners						TBD	Costs depend on the size of the buffer area, the level of technical assistance provided and the types of projects proposed.
RuR-CCC-10.2	Objective	Water Quality	Assess and remove sources of toxics from watershed areas or streams.										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-10.2.1	Recovery Action	Water Quality	Assess the number of septic systems or other wastewater producers that deliver toxics to the lower mainstem Russian River and tributaries (such as Dutchbill Creek and others). Work with cities and Sonoma County to eliminate these sources of toxic input.	3	5	NMFS, Private Landowners, RWQCB, Sonoma County						tbd	cost is difficult to estimate.
RuR-CCC-10.2.2	Recovery Action	Water Quality	Domestic garbage along Purrington Creek should be cleaned up and existing illegal dump sites along the road should be posted to reduce the possibility of toxic substances entering the creek. These dump sites appear to be routinely visited and periodic patrols by local law enforcement should be encouraged.	3	10	CDFG Law Enforcement, NMFS, NMFS OLE, Private Landowners, Sonoma County						tbd	cost is difficult to estimate at this time.
RuR-CCC-11.1	Objective	Agricultural Practices	Promote agricultural practices that protect and restore CCC coho salmon habitat by working with the agricultural community.										
RuR-CCC-11.1.1	Recovery Action	Agricultural Practices	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage increased involvement and support existing landowners who conduct operations in a manner compatible with CCC coho salmon recovery priorities.	3	60	CDFG, Farm Bureau, NMFS, NRCS, RCD						0	Soliciting cooperation with other agencies and groups is not expected to cost much.
RuR-CCC-11.1.2	Recovery Action	Agricultural Practices	Encourage the NRCS and RCDs to increase the number of landowners participating in sediment reduction planning and implementation.	3	60	CDFG, Farm Bureau, NMFS, NRCS, RCD						0	Soliciting cooperation with other agencies and groups is not expected to cost much.
RuR-CCC-11.1.3	Recovery Action	Agricultural Practices	Completion of Farm Conservation Plans that address sediment source reduction, riparian habitat, forest health, and restoration.	2	10							TBD	Cost will depend on the number of participants. A Farm Conservation Plan is estimated to cost 5k-10k.
RuR-CCC-11.1.4	Recovery Action	Agricultural Practices	Streamline permit processing where agricultural landowners are conducting actions aligned with recovery priorities.	2	5	FishNet 4C, NMFS, Private Landowners, Sonoma County						TBD	Cost are expected to be minimal to streamline permits. Cost to landowners may be high to meet recovery priorities.
RuR-CCC-11.2	Objective	Agricultural Practices	Discourage Mendocino and Sonoma Counties from rezoning forestlands to rural residential or other land uses.										
RuR-CCC-11.2.1	Recovery Action	Agricultural Practices	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	2	5	CalFire, CDFG, NMFS, RWQCB, Sonoma County, Sonoma County Water Agency, State Parks						0	Costs are expected to be minimal.
RuR-CCC-11.2.2	Recovery Action	Agricultural Practices	Continue to educate and encourage the County of Mendocino to adopt a grading ordinance that meets NMFS, RWQCB, and DFG approval.	2	5	CDFG, MCRRFCD, Mendocino County, Sonoma County, Sonoma County Water Agency, State Parks						0	Costs are expected to be minimal to work with the County of Mendocino. Cost to implement and carryout grading ordinance is likely high. Cost estimates should be determined from counties that have grading ordinance such as Sonoma and Napa.
RuR-CCC-11.3	Objective	Agricultural Practices	Implement the NRCS/RCD coordinated program for fishery restoration practices.										
RuR-CCC-11.3.1	Recovery Action	Agricultural Practices	Maintain and enhance riparian vegetation near agricultural activities and allow trees in riparian areas to age, die and recruit into the stream naturally.	2	5	MCRRFCD, Mendocino County, Sonoma County, Sonoma County Water Agency, State Parks						0	Costs are expected to be minimal and leaving LWD in place may actually save costs.
RuR-CCC-11.3.2	Recovery Action	Agricultural Practices	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	10	Farm Bureau, NRCS, Private Landowners						TBD	May be possible to carry out this action under the monitoring component of Farm Conservation Plans that are administered by NRCS.
RuR-CCC-11.4	Objective	Agricultural Practices	Support the development of new regulations to minimize impacts on spring and summer baseflow from frost protection and other water diversions.	1	5	CDFG, NMFS HCD, Private Landowners, SWRCB						TBD	Cost to support development of regulations is low. Cost of implementing, and enforcing is expected to be high.
RuR-CCC-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-12.1.1	Recovery Action	Channel Modification	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	2	5	MCRRFCD, Mendocino County, Sonoma County, Sonoma County Water Agency, State Parks						0	Costs are expected to be minimal and leaving LWD in place may actually save costs.
RuR-CCC-12.1.2	Recovery Action	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	60	MCRRFCD, Mendocino County, Sonoma County, Sonoma County Water Agency, USACE						0	Gabion baskets are more expensive than most bioengineered solutions, so implementation may actually save costs.
RuR-CCC-12.1.3	Recovery Action	Channel Modification	Conduct restoration activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.										
RuR-CCC-12.1.3.1	Action Step	Channel Modification	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	2	60	USACE						TBD	Estimating cost is difficult at this time since the extent of work is unknown.
RuR-CCC-12.2	Objective	Channel Modification	All proposed development projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.										
RuR-CCC-12.2.1	Recovery Action	Channel Modification	All proposed levees should be designed to account for minimal maintenance associated with an intact and functioning riparian zone.										
RuR-CCC-12.2.1.1	Action Step	Channel Modification	Where new levees or similar flood control projects are planned develop setbacks to allow the river to respond to natural hydrologic process and remain in equilibrium. At a minimum, setbacks should accommodate a 100 year event.	2	60	USACE						TBD	Encouraging agencies to incorporate the above mentioned concepts into their levee planning is not expected to result in a significant expense.
RuR-CCC-12.2.1.2	Action Step	Channel Modification	Flood control projects or other channel modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	3	60	Mendocino County, Sonoma County, USACE						0	Implementation is expected to save costs for developers and land owners in the long run.
RuR-CCC-12.2.2	Recovery Action	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. except where critical infrastructure is located) for bank hardening projects.										
RuR-CCC-12.2.2.1	Action Step	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.	1	60	CA Coastal Commission, California Coastal Conservancy, California Department of Mines and Geology, CalTrans, FEMA, Mendocino County, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD, Sonoma County, State Parks						TBD	This should become a standard business practice for all agencies and consulting firms engaged in constructing and designing solutions to address channel stability.
RuR-CCC-12.2.2.2	Action Step	Channel Modification	Discourage stabilization projects which will lead to additional instability either up- or downstream.	2	60	CA Coastal Commission, California Department of Mines and Geology, CalTrans, CDFG						TBD	This recommendation should be adopted as a standard business practice for all agencies and consulting firms involved in actions that address stream stability.
RuR-CCC-12.3	Objective	Channel Modification	Improve regulatory oversight of channel modifying projects to ensure potential effects to coho salmon habitat are fully minimized or mitigated.										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-12.3.1	Recovery Action	Channel Modification	Modify Federal, State, city and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	2	10	CDFG, MCRRFCD, RWQCB, Sonoma County Water Agency, State Parks						0	Costs are expected to be minimal as some of these efforts will be part of existing programs, however some technical assistance may be necessary from a variety of agencies.
RuR-CCC-12.3.2	Recovery Action	Channel Modification	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	10	CDFG, MCRRFCD, RWQCB, Sonoma County Water Agency, State Parks						0	Costs are expected to be minimal as some of these efforts will be part of existing programs, however some technical assistance may be necessary from a variety of agencies.
RuR-CCC-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
RuR-CCC-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	2	10	CDFG, MCRRFCD, RWQCB, Sonoma County Water Agency, State Parks						0	Costs are expected to be minimal as some of these efforts will be part of existing programs, however some technical assistance may be necessary from a variety of agencies.
RuR-CCC-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
RuR-CCC-15.2.1	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	3	5	Sonoma County Water Agency, USACE	4.00	4.00	4.00	4.00	4.00	20	This activity has already been addressed within the USACE Russian River Biological Opinion.
RuR-CCC-15.3	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
RuR-CCC-15.3.1	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	2	10	CDFG, MCRRFCD, RWQCB, Sonoma County Water Agency, State Parks						0	Costs are expected to be minimal as some of these efforts will be part of existing programs, however some technical assistance may be necessary from a variety of agencies.
RuR-CCC-15.3.2	Recovery Action	Droughts	Evaluate and prepare contingency plans to breach estuary sandbars to facilitate adult upmigration when instream flows are adequate for passage and spawning if sandbar remains closed by mid-January.	2	15	Sonoma County Water Agency, USACE						0	This activity has already been addressed within the USACE Russian River Biological Opinion.
RuR-CCC-15.3.3	Recovery Action	Droughts	Establish an emergency drought operations center (EDOC), (e.g., Washington Department of Fish and Wildlife, 2001), comprised of the SWRCB, DFG, NMFS, and others to develop emergency rules for augmenting water supplies and mitigating the effects of drought on fish.	2	15	Sonoma County Water Agency, USACE						0	This activity has already been addressed within the USACE Russian River Biological Opinion.
RuR-CCC-15.3.3.1	Action Step	Droughts	Use the emergency drought operations center (EDOC) or other similar group to help discourage poaching of coho salmon by measures to: Cooperate with and provide incentives to landowners to maintain road and trail closures to be effective against trespass; Encourage monitoring of road closures and timely repair of defective or damaged road closure systems; Promote CalTIP, especially how it might apply to spawning coho salmon; and report un-permitted road use to local, State, and federal enforcement personnel during periods when coho salmon are migrating (DFG 2004).	3	60	CalFire, CDFG, FishNet 4C, Mendocino County, MMWD, Private Landowners, Public, RCD, Sonoma County, State Parks						TBD	Costs depend on participation.
RuR-CCC-15.3.4	Recovery Action	Droughts	Work with DFG, Counties, other agencies, and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	2	15	Sonoma County Water Agency, USACE						0	This activity has already been addressed within the USACE Russian River Biological Opinion.

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-15.4	Objective	Droughts	Increase enforcement patrols by DFG, State Parks, and NMFS OLE in sensitive spawning and rearing areas.	2	60	CDFG Law Enforcement, NMFS OLE						0	costs are expected to be absorbed into ongoing activity budget.
RuR-CCC-15.5	Objective	Droughts	Work with water managers on regulated streams to assure adequate and proper consideration is given to fish needs. Develop agreements, which will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.										
RuR-CCC-15.5.1	Recovery Action	Droughts	Manage reservoirs and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	2	60	Sonoma County Water Agency, USACE						0	Flow changes have already been specified for Dry Creek and Russian River mainstem through the USACE Russian River BO.
RuR-CCC-15.5.2	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	3	20	Mendocino County, Private Landowners, RCD, Sonoma County, State Parks						TBD	Costs cannot be determined at this time due to an unknown number of unauthorized users, and the level of enforcement necessary.
RuR-CCC-17.1	Objective	Fishing and Collecting	Minimize interception of CCC coho salmon during the trout and steelhead freshwater sport fishing season.	1	60	CDFG, NMFS						TBD	Minimal cost to recreational fishery is expected.
RuR-CCC-17.1.1	Recovery Action	Fishing and Collecting	NMFS and DFG will work to improve the California Freshwater Sport Fishing Regulations to minimize interception of adult salmonids.	1	2	CDFG, NMFS PRD, Public						0	Cost expected to be minimal.
RuR-CCC-17.1.2	Recovery Action	Fishing and Collecting	NMFS will work with DFG to modify low flow restrictions under Article 4. Supplemental Regulations, Section 8.00 (a).	3	20	CDFG, Counties, FishNet 4C, NMFS, Private Landowners, Sonoma County Water Agency						TBD	Level of promotion that would be effective needs to be determined for accurate cost estimates.
RuR-CCC-17.1.3	Recovery Action	Fishing and Collecting	NMFS and DFG will work to improve the marking strategy of the coho captive broodstock recovery program to decrease confusion with allowable harvested hatchery steelhead.	1	1	CDFG, NMFS						TBD	Cost not determined.
RuR-CCC-17.2	Objective	Fishing and Collecting	Work with landowners and other agencies to conduct actions (e.g., maintain road and trail closures, increase enforcement patrols) that prevent trespassing and poaching activities.										
RuR-CCC-17.2.1	Recovery Action	Fishing and Collecting	Promote CalTip to discourage poaching (DFG 2004).	3	10	CDFG, FishNet 4C, NOAA RC, NRCS, Private Landowners, RCD	10.00	10.00	10.00	10.00	10.00	100	Cost based on 10k for 10 years to fund barriers such as K-rail, gates, or large rocks to block access.
RuR-CCC-17.3	Objective	Fishing and Collecting	Promote public outreach to the fishing community to ensure that coho salmon are properly identified and immediately released if incidentally caught during steelhead fishing.										
RuR-CCC-17.3.1	Recovery Action	Fishing and Collecting	Work with DFG to improve the Fishing Regulation manual to clearly identify differences in body morphology of all potentially present adult salmonids with color photos of diagnostic features (e.g., caudal fin spotting, caudal fin shape, coloration of lower jaw, peduncle width, etc.).	3	20	CDFG, Counties, FishNet 4C, NMFS, Private Landowners, Sonoma County Water Agency						TBD	Level of promotion that would be effective needs to be determined for accurate cost estimates.
RuR-CCC-17.3.2	Recovery Action	Fishing and Collecting	Install/construct permanent signs at all major public access points along the Russian River (below Dry Creek) that clearly identify differences in body morphology of all potentially present adult salmonids with color photos (e.g., caudal fin spotting, caudal fork shape, coloration of lower jaw, peduncle width, etc.).	3	2	CalFire, CDFG, NMFS						0	Cost is currently being covered by Sonoma County Fish and Wildlife Commission and other agencies.
RuR-CCC-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
RuR-CCC-20.1.1	Recovery Action	Logging and Wood Harvesting	Areas adjacent to currently owned State parks or forestlands supporting Core, Phase I and Phase II priority areas should be considered for purchase (if feasible within the next 5 years).										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
RuR-CCC-15.4	Objective	Droughts	Increase enforcement patrols by DFG, State Parks, and NMFS OLE in sensitive spawning and rearing areas.	2	60	CDFG Law Enforcement, NMFS OLE						0	costs are expected to be absorbed into ongoing activity budget.
RuR-CCC-15.5	Objective	Droughts	Work with water managers on regulated streams to assure adequate and proper consideration is given to fish needs. Develop agreements, which will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.										
RuR-CCC-15.5.1	Recovery Action	Droughts	Manage reservoirs and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	2	60	Sonoma County Water Agency, USACE						0	Flow changes have already been specified for Dry Creek and Russian River mainstem through the USACE Russian River BO.
RuR-CCC-15.5.2	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	3	20	Mendocino County, Private Landowners, RCD, Sonoma County, State Parks						TBD	Costs cannot be determined at this time due to an unknown number of unauthorized users, and the level of enforcement necessary.
RuR-CCC-17.1	Objective	Fishing and Collecting	Minimize interception of CCC coho salmon during the trout and steelhead freshwater sport fishing season.	1	60	CDFG, NMFS						TBD	Minimal cost to recreational fishery is expected.
RuR-CCC-17.1.1	Recovery Action	Fishing and Collecting	NMFS and DFG will work to improve the California Freshwater Sport Fishing Regulations to minimize interception of adult salmonids.	1	2	CDFG, NMFS PRD, Public						0	Cost expected to be minimal.
RuR-CCC-17.1.2	Recovery Action	Fishing and Collecting	NMFS will work with DFG to modify low flow restrictions under Article 4. Supplemental Regulations, Section 8.00 (a).	3	20	CDFG, Counties, FishNet 4C, NMFS, Private Landowners, Sonoma County Water Agency						TBD	Level of promotion that would be effective needs to be determined for accurate cost estimates.
RuR-CCC-17.1.3	Recovery Action	Fishing and Collecting	NMFS and DFG will work to improve the marking strategy of the coho captive broodstock recovery program to decrease confusion with allowable harvested hatchery steelhead.	1	1	CDFG, NMFS						TBD	Cost not determined.
RuR-CCC-17.2	Objective	Fishing and Collecting	Work with landowners and other agencies to conduct actions (e.g., maintain road and trail closures, increase enforcement patrols) that prevent trespassing and poaching activities.										
RuR-CCC-17.2.1	Recovery Action	Fishing and Collecting	Promote CalTip to discourage poaching (DFG 2004).	3	10	CDFG, FishNet 4C, NOAA RC, NRCS, Private Landowners, RCD	10.00	10.00	10.00	10.00	10.00	100	Cost based on 10k for 10 years to fund barriers such as K-rail, gates, or large rocks to block access.
RuR-CCC-17.3	Objective	Fishing and Collecting	Promote public outreach to the fishing community to ensure that coho salmon are properly identified and immediately released if incidentally caught during steelhead fishing.										
RuR-CCC-17.3.1	Recovery Action	Fishing and Collecting	Work with DFG to improve the Fishing Regulation manual to clearly identify differences in body morphology of all potentially present adult salmonids with color photos of diagnostic features (e.g., caudal fin spotting, caudal fin shape, coloration of lower jaw, peduncle width, etc.).	3	20	CDFG, Counties, FishNet 4C, NMFS, Private Landowners, Sonoma County Water Agency						TBD	Level of promotion that would be effective needs to be determined for accurate cost estimates.
RuR-CCC-17.3.2	Recovery Action	Fishing and Collecting	Install/construct permanent signs at all major public access points along the Russian River (below Dry Creek) that clearly identify differences in body morphology of all potentially present adult salmonids with color photos (e.g., caudal fin spotting, caudal fork shape, coloration of lower jaw, peduncle width, etc.).	3	2	CalFire, CDFG, NMFS						0	Cost is currently being covered by Sonoma County Fish and Wildlife Commission and other agencies.
RuR-CCC-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
RuR-CCC-20.1.1	Recovery Action	Logging and Wood Harvesting	Areas adjacent to currently owned State parks or forestlands supporting Core, Phase I and Phase II priority areas should be considered for purchase (if feasible within the next 5 years).										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-20.1.1.1	Action Step	Logging and Wood Harvesting	Should large tracts of forestlands within any watershed identified as a priority in this recovery plan become available for purchase, Federal, State, local government, and non-governmental organizations should consider purchasing the area as a Demonstration Forest or State Park.	3	60	CDFG, Mendocino County, NMFS, RCD, Sonoma County, State Parks						TBD	Impossible to anticipate where and how much land will come available for purchase in the future.
RuR-CCC-20.2	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
RuR-CCC-20.2.1	Recovery Action	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.										
RuR-CCC-20.2.1.1	Action Step	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.	2	60	CDFG, Mendocino County, NMFS, Sonoma County, State Parks, USEPA						TBD	Costs cannot be determined at this time, due to an unknown number of variables and research priorities.
RuR-CCC-20.2.1.2	Action Step	Logging and Wood Harvesting	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	2	60	Mendocino County, Sonoma County, State Parks						o	Recruitment of LWD to the stream is critical. This action is mainly a policy issue, with little or no direct costs.
RuR-CCC-20.3	Objective	Logging and Wood Harvesting	Work with state and local agencies reviewing and authorizing timber operations to ensure take of coho salmon is fully minimized.										
RuR-CCC-20.3.1	Recovery Action	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	3	2	CalFire, CDFG, NMFS						0	Cost is minimal because NMFS/DFG already participate in meetings the Board of Forestry.
RuR-CCC-20.3.2	Recovery Action	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency for operations within Core, Phase I and Phase II CCC coho salmon areas.	3	10	NMFS	20.00	20.00	20.00	20.00	20.00	200	This action would require funding of a 1/4 time NMFS position. The need for this action may change if the California Forest Practice Rules change and reach a no-take standard.
RuR-CCC-20.3.3	Recovery Action	Logging and Wood Harvesting	Provide information to BOF regarding CCC coho salmon priorities and recommend upgrading relevant forest practices.	3	2	CalFire, CDFG, NMFS						0	Cost is difficult to estimate at this time.
RuR-CCC-20.4	Objective	Logging and Wood Harvesting	The priorities in this recovery plan should serve as a guide for independent Forest Certification.										
RuR-CCC-20.4.1	Recovery Action	Logging and Wood Harvesting	Investigate opportunities to programmatically permit the forest certification program to authorize incidental take for landowners through Section 10(a)(1)(B).	3	60	CalFire, NMFS, Private Landowners						TBD	Cost is difficult to estimate at this time.
RuR-CCC-20.5	Objective	Logging and Wood Harvesting	Develop a California Forest Practice monitoring protocol to determine whether specific practices are effectively meeting intended objectives and are providing for the protection of CCC coho salmon.										
RuR-CCC-20.5.1	Recovery Action	Logging and Wood Harvesting	Consider the development of a Watershed Database (similar to the DFG Northern Spotted Owl database) for salmonids that provides watershed data and information in a consistent fashion to all foresters for consideration in their harvest plans.	3	10	Board of Forestry, CDFG, NMFS	20.00	20.00	20.00	20.00	20.00	200	Developing a database is likely to cost at least $200,000 according to estimates in DFG (2004).
RuR-CCC-20.5.2	Recovery Action	Logging and Wood Harvesting	Consider use of the Monitoring Study Group to create a platform for more large-scale assessments of Rule implementation and effectiveness.	3	20	Board of Forestry, CDFG, NMFS						TBD	Cost is difficult to estimate at this time.
RuR-CCC-20.5.3	Recovery Action	Logging and Wood Harvesting	Develop a framework similar to Washington State that establishes a scientific framework for monitoring the effectiveness of practices in meeting watershed process goals and a decision-making process that is adaptive to the new information.	3	10	Board of Forestry, CDFG, NMFS	20.00	20.00	20.00	20.00	20.00	200	The cost of developing a framework is difficult to estimate, but will likely exceed $200,000 (DFG 2004).
RuR-CCC-23.1	Objective	Residential and Commercial Development	Improve stream maintenance practices to protect instream complexity, hydrologic processes and riparian functions.										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-23.1.1	Recovery Action	Residential and Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating CCC coho salmon.	3	10	CalTrans, CDFG, MCRRFCD, Mendocino County, Sonoma County, Sonoma County Water Agency, State Parks						TBD	Costs may vary with methods and extent of assessments and actions taken to address impacts, and cannot be determined at this time.
RuR-CCC-23.1.2	Recovery Action	Residential and Commercial Development	Implement performance standards in Stormwater Management Plans.	2	30	CalTrans, City of Healdsburg, City of Santa Rosa, City of Ukiah, Mendocino County, RWQCB, Sonoma County						TBD	Cost cannot be determined.
RuR-CCC-23.1.3	Recovery Action	Residential and Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	2	30	CalTrans, City of Healdsburg, City of Santa Rosa, City of Ukiah, Mendocino County, RWQCB, Sonoma County						TBD	Cost cannot be determined.
RuR-CCC-23.2	Objective	Residential and Commercial Development	Maintain and restore hydrologic function, protect riparian and floodplain areas, and minimize adverse effects to water quality and instream rearing habitats resulting from commercial and urban development.										
RuR-CCC-23.2.1	Recovery Action	Residential and Commercial Development	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
RuR-CCC-23.2.1.1	Action Step	Residential and Commercial Development	As mitigation for hydrograph consequences, municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	3	25	MCRRFCD, Mendocino County, Sonoma County, Sonoma County Water Agency, State Parks						tbd	costs depend on extents and type of mitigation and/or detention proposed, and cannot be determined at this time.
RuR-CCC-23.2.2	Recovery Action	Residential and Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	3	30	MCRRFCD, Mendocino County, RCD, RWQCB, Sonoma County, Sonoma County Water Agency, State Parks						tbd	costs to upgrade stormwater discharge points cannot be determined at this time, but may be substantial.
RuR-CCC-23.2.3	Recovery Action	Residential and Commercial Development	New development in all historic CCC coho salmon watersheds should meet a zero net increase in storm-water runoff, changes in duration, or magnitude of peak flow.	3	20	Mendocino County, Private Landowners, Sonoma County						0	county planning, policies, and permits should be modified to implement this action, and costs are expected to be minimal.
RuR-CCC-23.3	Objective	Residential and Commercial Development	Improve coho salmon survival by minimizing the introduction into the stream environment of sediment or toxic compounds originating from commercial or residential development.										
RuR-CCC-23.3.1	Recovery Action	Residential and Commercial Development	Avoid, or at a minimum regulate, the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	2	10	MCRRFCD, Mendocino County, RCD, Sonoma County, Sonoma County Water Agency, State Parks, SWRCB, USACE, USEPA						tbd	cost savings may occur with limiting use of pesticides, however, other types of management costs may be more or less, and cannot be accurately determined at this time.

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-23.3.2	Recovery Action	Residential and Commercial Development	Toxic waste products from urban activities should receive the appropriate treatment before being discharged into any body of water that may enter any historic CCC coho salmon waters.	2	60	MCRRFCD, Mendocino County, RWQCB, Sonoma County, Sonoma County Water Agency, USEPA						tbd	current discharge permits address part of this action, however, additional regulation may be required to address toxic urban runoff. Costs cannot be determined at this time.
RuR-CCC-23.3.3	Recovery Action	Residential and Commercial Development	Sediment from existing and future commercial and urban development should be reduced to magnitudes appropriate to the geological setting of the watershed, resulting in no net increase in sedimentation over natural limits.	2	60	CDFG, Mendocino County, Private Landowners, Sonoma County						tbd	costs are unknown at this time, and will depend on the number and scope of actions implemented to control erosion.
RuR-CCC-23.4	Objective	Residential and Commercial Development	Minimize potential impacts to coho salmon habitat when planning and developing residential and commercial property.										
RuR-CCC-23.4.1	Recovery Action	Residential and Commercial Development	Develop legislation that will fund county planning for environmentally sound growth and water supply and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (DFG 2004).	2	8	Mendocino County, Sonoma County						tbd	Costs cannot be determined at this time.
RuR-CCC-23.4.2	Recovery Action	Residential and Commercial Development	Encourage counties to develop a Sensitive Habitat Ordinance similar to that in place for the County of Santa Cruz.	3	5	Mendocino County, RCD, Sonoma County						0	Cost to county is unknown.
RuR-CCC-23.4.3	Recovery Action	Residential and Commercial Development	Land use zoning should be appropriate to the site and consider the floodplain and riparian functions of stream channels.										
RuR-CCC-23.4.3.1	Action Step	Residential and Commercial Development	Modify Federal, State, local processes, and County General Plans, to eliminate provisions allowing new construction in undeveloped areas within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	2	60	California Department of Mines and Geology, CalTrans, City of Healdsburg, City of Santa Rosa, City of Ukiah, Mendocino County, NMFS, Private Landowners, Public, Sonoma County						tbd	Effective and consistent implementation of these policies are anticipated to have little cost. Modification of policies may be controversial and costs may be high.
RuR-CCC-23.4.3.2	Action Step	Residential and Commercial Development	Work with Sonoma County to develop more protective regulations in regard to exurban development (vineyard and rural residential).	2	20	CDFG, Mendocino County, NMFS, Private Landowners, Sonoma County						tbd	cost is difficult to estimate at this time.
RuR-CCC-23.4.3.3	Action Step	Residential and Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	1	60	City of Healdsburg, City of Santa Rosa, City of Ukiah, Mendocino County, Sonoma County						0	This action encourages implementation of many existing policies.
RuR-CCC-23.4.3.4	Action Step	Residential and Commercial Development	Work with counties to develop and implement ordinances (e.g. Santa Cruz County Code 2008) to restrict subdivisions by requiring a minimum acreage limit for parcelization in concert with limits on water supply and groundwater recharge areas.	3	15	Mendocino County, RCD, Sonoma County						tbd	Costs associated with development and implementation of ordinances is difficult to determine.
RuR-CCC-23.4.3.5	Action Step	Residential and Commercial Development	Standards and recommendations regarding development should apply to all jurisdictions, including school districts and other special districts not subject to county and/or state related ordinances or policies.	3	10	Mendocino County, Sonoma County						TBD	This action is basically a policy issue, however additional authorities may be developed to implement the action fully.
RuR-CCC-23.4.3.6	Action Step	Residential and Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.	2	60	Mendocino County, Private Landowners, Sonoma County, USACE						0	Stringent review by permitting agencies is expected to reduce costs associated with poorly planned and poorly located developments.

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-23.4.4	Recovery Action	Residential and Commercial Development	Where existing infrastructure exists within historical floodplains or offchannel habitats in any historical coho watersheds, and restoration is found feasible, encourage willing landowners to restore these areas through conservation easements, etc.	3	15	CDFG, RWQCB						tbd	This action is basically a policy issue, however additional authorities may be developed to implement the action fully.
RuR-CCC-23.4.4.1	Action Step	Residential and Commercial Development	Counties and municipalities should adopt a policy of “managed retreat” (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	3	25	Mendocino County, Sonoma County						0	Costs associated with policy development are expected to be minimal.
RuR-CCC-23.4.5	Recovery Action	Residential and Commercial Development	Support the development and implementation of regulations for activities that intercept groundwater recharge (e.g., use of subsurface tiles in vineyards, impervious surfaces, etc.).	3	15	CDFG, RWQCB						tbd	This action is basically a policy issue, however additional authorities may be developed to implement the action fully.
RuR-CCC-23.5	Objective	Residential and Commercial Development	Minimize rate, and subsequent adverse affects, of land conversion to residential and commercial development.										
RuR-CCC-23.5.1	Recovery Action	Residential and Commercial Development	Identify areas at high risk of conversion, and develop incentives and alternatives for landowners that discourage conversion.	2	60	Mendocino County, NMFS, Sonoma County						tbd	cost cannot be estimated without specific information.
RuR-CCC-23.5.1.1	Action Step	Residential and Commercial Development	Purchase conservation easements from landowners that currently have grazing or agricultural operations along the estuary.	3	20	Mendocino County, Private Landowners, RCD, Sonoma County						tbd	Conservation easements can provide a powerful tool for conservation. Associated costs per acre can be highly variable. Costs for timberlands ranged from $54 to $279 per acre (DFG 2004), and costs in Sonoma and Mendocino Counties are likely much higher and cannot be accurately determined at this time.
RuR-CCC-23.5.2	Recovery Action	Residential and Commercial Development	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	60	Mendocino County, NMFS, Private Landowners, Sonoma County						0	cost to landowners cannot be determined at this time.
RuR-CCC-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
RuR-CCC-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	5	CDFG, RCD						0	cost to expand an existing program are expected to be minimal.
RuR-CCC-24.1.1.1	Action Step	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	3	10	CalTrans, CDFG, MCRRFCD, Mendocino County, Sonoma County, Sonoma County Water Agency						0	Similar existing programs could be modified and implemented at minimal cost.
RuR-CCC-24.1.1.2	Action Step	Roads and Railroads	Encourage development and implementation of a program similar to the County of Santa Cruz’s Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	10	MCRRFCD, Mendocino County, RCD, Sonoma County, Sonoma County Water Agency, State Parks						0	Similar existing programs could be modified and implemented at minimal cost.
RuR-CCC-24.1.2	Recovery Action	Roads and Railroads	Expand the NRCS/RCD coordinated permit program to a statewide programmatic ESA consultation that allows funding and technical expertise to small land owners and rural residential property owners.	3	5	CDFG, RCD						0	cost to expand an existing program are expected to be minimal.
RuR-CCC-24.2	Objective	Roads and Railroads	Minimize sediment input from existing road networks into the aquatic environment.										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-24.2.1	Recovery Action	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, Phase I within 10 years, and Phase II areas within 15 years (from 2010).	2	30	Board of Forestry, CalFire, CDFG, Mendocino County, NOAA RC, Private Landowners, RCD, Sonoma County						TBD	costs are dependent on actions chosen.
RuR-CCC-24.2.2	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	2	5	CDFG, Mendocino County, Sonoma County						0	Cost of coordination should be minimal. Coordination should include County fisheries experts.
RuR-CCC-24.2.2.1	Action Step	Roads and Railroads	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF). Where no Core areas are designated, apply this action to Phase I areas.	3	10	CDFG, NMFS						0	Prioritizing existing funding mechanisms is not expected to add additional cost to the process.
RuR-CCC-24.2.3	Recovery Action	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	2	5	CDFG, Mendocino County, Sonoma County						0	Cost of coordination should be minimal. Coordination should include County fisheries experts.
RuR-CCC-24.2.4	Recovery Action	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.	2	10	CalFire, CDFG, NMFS, Private Landowners						tbd	Cost is difficult to estimate at this time, and ultimately depends on the roads chosen for decommissioning.
RuR-CCC-24.2.5	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, CalTrans, Mendocino County, NMFS, NRCS, Private Landowners, Public, RCD, Sonoma County						tbd	Cost cannot be determined at this time but should be adopted as part of future road actions.
RuR-CCC-24.2.6	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	5	CDFG, Mendocino County, NMFS, Sonoma County						0	Cost is expected to be minimal and will likely be absorbed through agency staff time.
RuR-CCC-24.2.7	Recovery Action	Roads and Railroads	Minimize sediment delivery from roads during the winter period.	2	15	CDFG, MCRRFCD, Sonoma County Water Agency, State Parks						0	Collaborative approaches are expected to result in cost savings.
RuR-CCC-24.2.7.1	Action Step	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails to decrease fine sediment loads.	1	60	CalFire, Mendocino County, Private Landowners, Sonoma County						0	Cost should be considered part of land owner road management plans.
RuR-CCC-24.2.7.2	Action Step	Roads and Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. The Counties should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with endangered salmonid habitat.	2	20	CalFire, City of Healdsburg, City of Santa Rosa, City of Ukiah, FEMA, Mendocino County, Private Landowners, Sonoma County, State Parks						tbd	Cost difficult to determine but may result in a long term cost savings.
RuR-CCC-24.3	Objective	Roads and Railroads	Ensure all existing and new road crossings allow upstream and downstream passage for coho salmon.										
RuR-CCC-24.3.1	Recovery Action	Roads and Railroads	Conduct collaborative evaluations of priorities for treatment of CCC coho salmon passage barriers, such as the Fish Passage Forum (DFG 2004).	2	15	CDFG, MCRRFCD, Sonoma County Water Agency, State Parks						0	Collaborative approaches are expected to result in cost savings.

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-24.3.2	Recovery Action	Roads and Railroads	Continue to refine, update, and maintain the Coastal Conservancy database of barriers to fish passage (DFG 2004).	3	10	California Coastal Conservancy, CDFG, NMFS						tbd	The cost of this action is difficult to determine at this time.
RuR-CCC-24.3.3	Recovery Action	Roads and Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	3	20	Mendocino County, RCD, Sonoma County, State Parks	25.00	25.00	25.00	25.00	25.00	500	Cost could be combined with other road assessment priorities in the watershed.
RuR-CCC-24.3.3.1	Action Step	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	3	60	Board of Forestry, CalTrans, CDFG, City of Healdsburg, City of Santa Rosa, City of Ukiah, Mendocino County, Private Landowners, RCD, Sonoma County						tbd	Incorporating free span bridges into replacement and new construction plans is unlikely to increase costs. Construction of the bridges will likely be much higher.
RuR-CCC-24.3.3.2	Action Step	Roads and Railroads	All new crossings and upgrades to existing crossings (bridges, culverts, fills, and other crossings) must accommodate 100-year flood flows and associated bedload and debris.	3	60	CalTrans, CDFG, Mendocino County, Sonoma County, State Parks						0	Incorporating 100-year flood flow design specifications into projects is not expected to result in more cost. Implementing the projects may prove more costly than less protective designs.
RuR-CCC-24.4	Objective	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, Phase I within 10 years, and Phase II areas within 15 years (from 2010).										
RuR-CCC-24.4.1	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	3	20	Mendocino County, RCD, Sonoma County, State Parks	25.00	25.00	25.00	25.00	25.00	500	Cost could be combined with other road assessment priorities in the watershed.
RuR-CCC-24.4.2	Recovery Action	Roads and Railroads	Implement actions that reduce sediment and runoff impacts from road networks to stream channel.	2	60	CalFire, CalTrans, CDFG, FEMA, Mendocino County, RCD, Sonoma County, State Parks, USACE						TBD	Replacement of culverts/bridges and upgrading to NMFS standards will result in increased cost for materials and construction but will likely result in structures that can withstand large storm events better than many existing structures.
RuR-CCC-24.4.2.1	Action Step	Roads and Railroads	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF). Where no Core areas are designated, apply this action to Phase I areas.	3	10	CDFG, NMFS						0	Prioritizing existing funding mechanisms is not expected to add additional cost to the process.
RuR-CCC-24.4.2.2	Action Step	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, CalTrans, Mendocino County, NMFS, NRCS, Private Landowners, Public, RCD, Sonoma County						TBD	Cost cannot be determined at this time but should be adopted as part of future road actions.
RuR-CCC-24.4.2.3	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	2	5	CDFG, Mendocino County, Sonoma County						0	Cost of coordination should be minimal. Coordination should include County fisheries experts.
RuR-CCC-24.4.2.4	Action Step	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails to decrease fine sediment loads.	1	60	CalFire, City of Healdsburg, City of Santa Rosa, City of Ukiah, Mendocino County, Private Landowners, Sonoma County, State Parks						0	Cost should be considered part of land owner road management plans.

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-24.4.2.5	Action Step	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.	1	60	CalFire, City of Healdsburg, City of Santa Rosa, City of Ukiah, Mendocino County, Private Landowners, Sonoma County, State Parks						0	Cost should be considered part of land owner road management plans.
RuR-CCC-24.4.2.6	Action Step	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	3	25	Mendocino County, Sonoma County						0	Costs associated with policy development are expected to be minimal.
RuR-CCC-24.4.2.7	Action Step	Roads and Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. The Counties should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with endangered salmonid habitat.	3	10	Mendocino County, Sonoma County						TBD	This action is basically a policy issue, however additional authorities may be developed to implement the action fully.
RuR-CCC-24.5	Objective	Roads and Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.										
RuR-CCC-24.5.1	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	3	60	Board of Forestry, CalTrans, CDFG, City of Healdsburg, City of Santa Rosa, City of Ukiah, Mendocino County, Private Landowners, RCD, Sonoma County						TBD	Incorporating free span bridges into replacement and new construction plans is unlikely to increase costs. Construction of the bridges will likely be much higher.
RuR-CCC-24.5.2	Recovery Action	Roads and Railroads	All new crossings and upgrades to existing crossings (bridges, culverts, fills, and other crossings) must accommodate 100-year flood flows and associated bedload and debris.	2	60	CalFire, CalTrans, CDFG, FEMA, Mendocino County, RCD, Sonoma County, State Parks, USACE						TBD	Replacement of culverts/bridges and upgrading to NMFS standards will result in increased cost for materials and construction but will likely result in structures that can withstand large storm events better than many existing structures.
RuR-CCC-24.5.3	Recovery Action	Roads and Railroads	Continue to refine, update, and maintain the Coastal Conservancy database of barriers to fish passage (DFG 2004).	3	10	California Coastal Conservancy, CDFG, NMFS						TBD	The cost of this action is difficult to determine at this time.
RuR-CCC-26.1	Objective	Water Diversion and Impoundment	Provide incentives to improve instream flows for coho salmon:.										
RuR-CCC-26.1.1	Recovery Action	Water Diversion and Impoundment	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	2	10	CDFG, MCRRFCD, RWQCB, Sonoma County Water Agency						0	Costs are expected to be minimal as some of these efforts will be part of existing programs, however some technical assistance may be necessary from a variety of agencies.
RuR-CCC-26.2	Objective	Water Diversion and Impoundment	Collaborate with landowners to minimize impacts on summer base flow from riparian water diversion activities.										
RuR-CCC-26.2.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon by establishing a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage (DFG 2004).										
RuR-CCC-26.2.1.1	Action Step	Water Diversion and Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	2	20	CDFG, Farm Bureau, MCRRFCD, NRCS, Sonoma County Water Agency						0	Promoting water conservation best practices is not expected to result in additional costs.

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-26.2.1.2	Action Step	Water Diversion and Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFG, MCRRFCD, RCD, Sonoma County Water Agency, State Parks						0	Costs associated with promoting use of reclaimed water is expected to be minimal.
RuR-CCC-26.2.1.3	Action Step	Water Diversion and Impoundment	Promote conjunctive use of water with water projects whenever possible to maintain or restore coho salmon habitat.	3	60	CDFG, MCRRFCD, Mendocino County, RCD, RWQCB, Sonoma County, Sonoma County Water Agency						0	Costs associated with promoting conjunctive use of water is expected to be minimal.
RuR-CCC-26.2.2	Recovery Action	Water Diversion and Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	3	20	CDFG, MCRRFCD, Mendocino County, Private Landowners, RCD, RWQCB, Sonoma County, Sonoma County Water Agency						TBD	Costs are minimal to promote. Costs for implementation will depend on the number of participants.
RuR-CCC-26.2.3	Recovery Action	Water Diversion and Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	3	60	CDFG, MCRRFCD, RCD, Sonoma County Water Agency, State Parks						0	Costs associated with promoting use of reclaimed water is expected to be minimal.
RuR-CCC-26.2.4	Recovery Action	Water Diversion and Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	3	30	MCRRFCD, NMFS, RCD, RWQCB, Sonoma County Water Agency						0	Costs to promote this action are expected to be minimal.
RuR-CCC-26.3	Objective	Water Diversion and Impoundment	Work within existing federal, state and local regulations to minimize coho salmon take from water diversion activities.										
RuR-CCC-26.3.1	Recovery Action	Water Diversion and Impoundment	Encourage the SWRCB to adjudicate watersheds with CCC coho salmon populations to resolve over-allocation of water resources and provide adequate funding to water masters to enforce allocations.	2	5	CDFG, MCRRFCD, Mendocino County, RCD, RWQCB, Sonoma County, Sonoma County Water Agency						0	Coordination costs are expected to be minimal, depending on what specific actions are proposed.
RuR-CCC-26.3.1.1	Action Step	Water Diversion and Impoundment	Petition SWRCB to declare the Russian River watershed fully appropriated.	3	15	Mendocino County, RCD, Sonoma County						TBD	Costs associated with development and implementation of ordinances is difficult to determine.
RuR-CCC-26.3.2	Recovery Action	Water Diversion and Impoundment	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	2	5	CDFG, MCRRFCD, Mendocino County, RCD, RWQCB, Sonoma County, Sonoma County Water Agency						0	Coordination costs are expected to be minimal, depending on what specific actions are proposed.
RuR-CCC-26.3.3	Recovery Action	Water Diversion and Impoundment	Require the SWRCB to conduct interagency consultation with the California Department of Fish and Game, and seek technical assistance from NMFS on the issuance of water rights permits.	3	15	NMFS, RWQCB						TBD	Additional regulatory authorities may be needed to fully implement this action, and associated costs cannot be determined. However technical assistance may be provided, and associated costs are expected to be minimal.
RuR-CCC-26.3.4	Recovery Action	Water Diversion and Impoundment	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	3	10	CDFG, NMFS, RWQCB						TBD	Costs associated with review and modification of use may be substantial, but cannot be determined due to an unknown number of water users.
RuR-CCC-26.3.5	Recovery Action	Water Diversion and Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	NMFS, RWQCB						TBD	Additional regulatory authorities may be needed to fully implement this action, and associated costs cannot be determined. However technical assistance may be provided, and associated costs are expected to be minimal.
RuR-CCC-26.4	Objective	Water Diversion and Impoundment	Develop new policies, regulations and programs to provide suitable flow conditions for CCC coho salmon.										

Russian River (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
RuR-CCC-26.4.1	Recovery Action	Water Diversion and Impoundment	Work with the SWRCB to place a moratorium on summer water diversions in all priority CCC coho salmon watersheds. Focus first on Core Areas, then on Phase I and Phase II areas.	2	5	CDFG, RWQCB						tbd	Costs to water users may be substantial, but cannot be determined.
RuR-CCC-26.4.2	Recovery Action	Water Diversion and Impoundment	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	3	5	CDFG, USACE						0	Evaluation costs are expected to be minimal.
RuR-CCC-26.4.3	Recovery Action	Water Diversion and Impoundment	Institutionalize programs to purchase easements on water rights to encourage the maintenance of surface flows.	3	10	CDFG, Mendocino County, RCD, RWQCB, Sonoma County						tbd	Costs associated with development and implementation of easement programs cannot be determined at this time.
RuR-CCC-26.4.4	Recovery Action	Water Diversion and Impoundment	Support the Development and implementation of groundwater use regulations.	3	10	CDFG, NMFS, RWQCB						tbd	This action is not expected to result in appreciable cost increase over the efforts currently underway.
RuR-CCC-26.5	Objective	Water Diversion and Impoundment	Investigate and monitor the relationship between instream flow levels and adverse effects to coho salmon habitat.										
RuR-CCC-26.5.1	Recovery Action	Water Diversion and Impoundment	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	2	10	CDFG, MCRRFCD, Sonoma County Water Agency	20.00	20.00	20.00	20.00	20.00	200	Estimated average cost for non-biological studies is approximately $200,000 (DFG 2004).
RuR-CCC-26.5.2	Recovery Action	Water Diversion and Impoundment	Determine and monitor 1600 program compliance related to water diversions (DFG 2004).	2	60	CDFG						0	Implementation is proposed by DFG, and additional costs are not expected.

SALMON CREEK

Salmon Creek

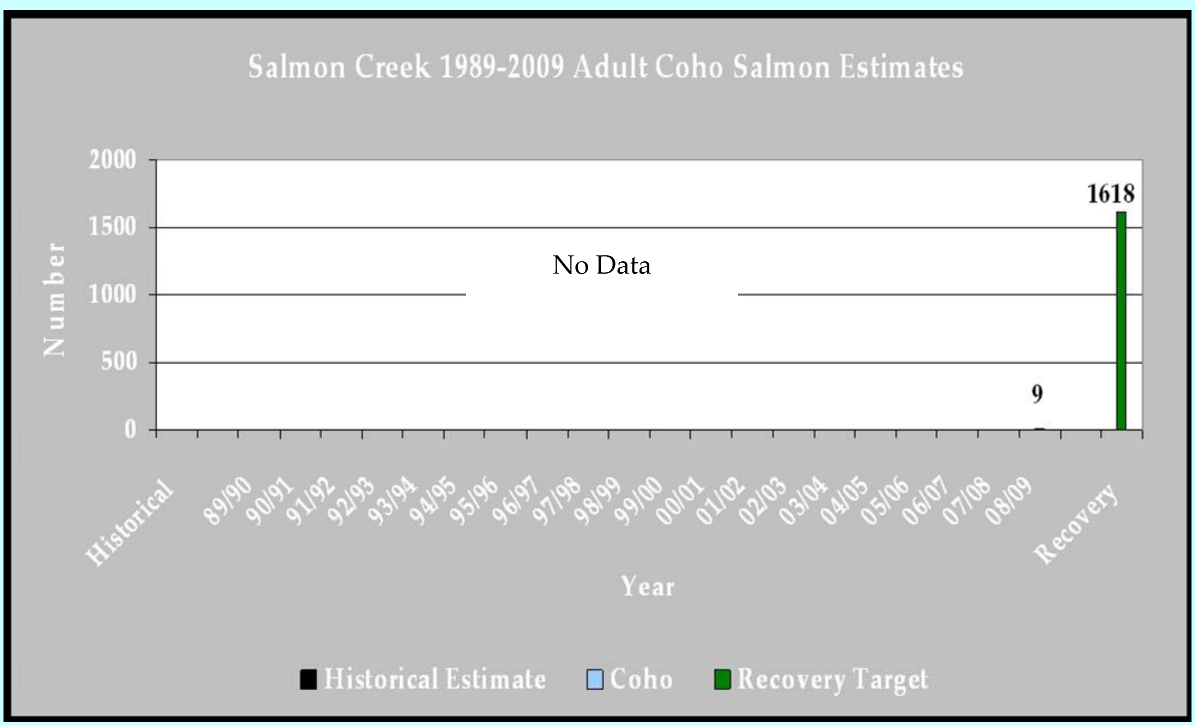
Dependent Population
47.6 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

Salmon Creek drains about 35 square miles in western Sonoma County. Salmon Creek enters the Pacific Ocean about two miles north of the town of Bodega Bay. Approximately 42 percent of the Salmon Creek watershed is annual grassland and about 42 percent of the watershed area is either redwood forest or montane hardwood forest. The entire Salmon Creek watershed has moderately to low erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. Nearly the entire Salmon Creek watershed is in private ownership; only 98 acres of the watershed is state park land. The dominant land use within the Salmon Creek watershed is agriculture, primarily livestock and dairy production. Housing development within the watershed is moderately to low: approximate about 90 homes are present in the watershed. There are no dams within the Salmon Creek watershed that impede or block salmon migration, though there are at least 42 diversions and natural barriers that are partially or totally impassable to migrating salmon. Impassable barriers block salmonids from less than ten percent of the watershed.

Salmon Creek
Photo by Dan Logan, NMFS

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD to VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools	**POOR to GOOD**
Large Wood Frequency:	**POOR to FAIR**
Riparian Canopy:	**POOR to FAIR**
off channel/Floodplain Quality:	**POOR**
Estuary Function:	**FAIR**



Salmon Creek

Recovery Target: 1,618 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Droughts
- Storms and Flooding
- Livestock Farming and Ranch
- Channel Modification
- Climate Change
- Water Diversion and Impoundment

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Salmon Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve pool complexity and frequency
- Improve floodplain connectivity
- Reduce roads in riparian areas
- Increase the amount of large wood in streams

We Need Your Photo Here

Salmon Creek
Photo © Your Name Here, AFFIL

Advancing recovery of coho

salmon in Salmon Creek requires these priority **recovery actions:**

- Continue restoration efforts on Salmon Creek Estuary to benefit coho salmon during all life phases and seasons.
- Install large wood, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth.
- Develop a large wood recruitment plan to ensure long-term natural recruitment of wood via large tree retention.
- Promote water conservation by the public, water agencies, agriculture, private industry, and the citizenry.

. . . **throughout:** the Salmon Creek watershed.

Conservation Highlights

- Salmon Creek was selected as a location for planting of progeny from a conservation hatchery.

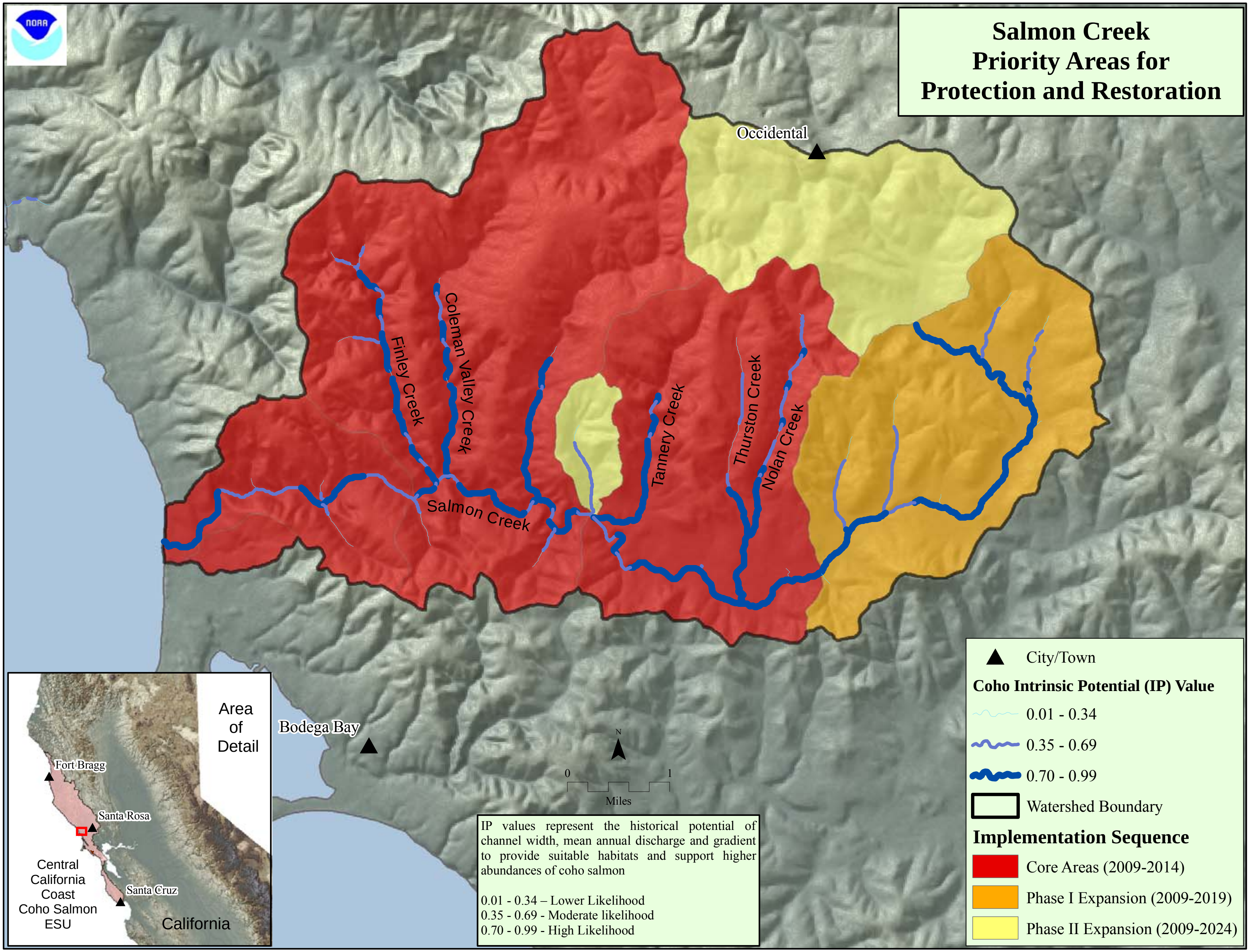
Michael Fawcett and Jennifer Michaud monitoring Salmon Creek
Photo by Dan Logan, NMFS

Immediate Need

√ Conduct landowner outreach to expand broodstock releases/monitoring.

Recovery Partners

NMFS
DFG
Goldridge RCD
UCCE
NOAA Restoration Center



Salmon Creek
Priority Areas for
Protection and Restoration
Occidental
Finley Creek
Coleman Valley Creek
Tannery Creek
Thurston Creek
Nolan Creek
Salmon Creek
Bodega Bay
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Salmon Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	NA	NA	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	642 m^2	Fair	Spawning Adults	Sediment	Amount of Gravel*	<300 m^2	300-2200 m^2	2200-4200 m^2	>4200 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	NA	NA	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	21	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	14%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	0.06%	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	58	Fair	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	2.4/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	21	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	NA	Fair	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.20%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	7.44%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	0%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	25-50%	Fair	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	40-54%	Fair	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	75%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	2.9 mi/sq.mi.	Fair	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	4 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Salmon Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Droughts	High	High	High	High	High	High			Very High
2	Storms and Flooding	High	High	High	High	High	High			Very High
3	Channel Modification	High	Medium	High	High	High	High			High
4	Climate Change	High	Medium	High	High	High	High			High
5	Livestock Farming and Ranching	Medium	Low	High	High	High	High			High
6	Water Diversion and Impoundment	Medium	High	High	Medium	High	Medium			High
7	Roads and Railroads	Medium	Low	Medium	Medium	High	Medium			Medium
8	Agricultural Practices	Medium	Medium	Medium	Medium	Medium	Medium			Medium
9	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
10	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	Medium	Medium			Medium
11	Residential and Commercial Development	Medium	Medium	Medium	Medium	Medium	Medium			Medium
12	Mining	Medium	Low	Medium	Medium	Medium	Medium			Medium
13	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
14	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
15	Fishing and Collecting	-	-	-	Low	Low	-			Low
16	Disease, Predation, and Competition	-	-	-	-	-	Low			Low
Threat Status for Targets and Project		High	High	Very High	Very High	Very High	Very High	-	-	Very High

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-A-1.1	Objective	Estuary	Continue restoration efforts on Salmon Creek Estuary to benefit coho salmon during all life phases and seasons.										
SaC-A-1.1.1	Recovery Action	Estuary	Restore and enhance estuary habitat in the watershed.										
SaC-A-1.1.1.1	Action Step	Estuary	Regain as much of the historical capacity and area of the Salmon Creek Estuary as possible.	1	30	California Coastal Conservancy, CDFG, FishNet 4C, NMFS HCD, Private Landowners, RWQCB, Sonoma County, State Parks, USFWS						TBD	Costs and duration are dependent on the specific mechanisms chosen to accomplish the task.
SaC-A-1.1.1.2	Action Step	Estuary	Assess the need to dredge Salmon Creek Estuary to increase capacity of estuarine habitat.	2	10	California Coastal Conservancy, CDFG, NMFS HCD, USACE						TBD	Cost is difficult to ascertain at this time.
SaC-A-1.1.2	Recovery Action	Estuary	Restore and enhance estuary function within the watershed.										
SaC-A-1.1.2.1	Action Step	Estuary	Restore estuary function by reducing fine sediment input from the upper watershed.	1	30	CDFG, Gold Ridge RCD, NMFS, Private Landowners, Sonoma County Water Agency						TBD	
SaC-A-1.1.2.2	Action Step	Estuary	Restore estuary function by increasing in-stream flow in Salmon Creek and tributaries that will provide greater freshwater input into the estuary.	2	30	CDFG, Gold Ridge RCD, NMFS, Private Landowners						tbd	Increasing flow within Salmon Creek will likely entail purchasing water rights upstream. The cost of purchasing water rights is unknown at this time.
SaC-A-1.1.2.3	Action Step	Estuary	Restore estuary function in Salmon Creek Estuary by improving complex habitat features and restoring historical flooding patterns where possible.	2	30	California Coastal Conservancy, CDFG, NMFS HCD, NOAA RC, Sonoma County, USACE, USFWS						TBD	Costs may be significant depending on site conditions and number of devices installed
SaC-A-1.1.3	Recovery Action	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	2	60	Gold Ridge RCD, Sonoma County						TBD	Costs cannot be calculated at this time
SaC-A-1.2	Objective	Estuary	Monitor the habitat use of various life stages of coho salmon in the Salmon Creek estuary and associated wetlands.	2	30	CDFG, Gold Ridge RCD, NMFS						TBD	
SaC-A-1.3	Objective	Estuary	Monitor the effectiveness of LWD structures and other restoration projects in the estuary	2	30	CDFG, Gold Ridge RCD						TBD	
SaC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
SaC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest.										
SaC-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	30	California Coastal Conservancy, CDFG, Coastside Land Trust, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, NMFS HCD, NOAA RC, NRCS, POST, RWQCB, San Mateo RCD, SWRCB, USFWS						TBD	Costs may be significant depending on site conditions and number of devices installed
SaC-A-2.1.1.2	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats. Focus efforts on lower gradient areas of the mainstem	2	5	CDFG, RWQCB						tbd	

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-A-2.1.1.3	Action Step	Floodplain	Identify and provide technical support to project applicants.	2	10	CDFG, Gold Ridge RCD, RWQCB						TBD	Costs may be significant depending on site conditions and number of devices installed
SaC-A-2.1.1.4	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	60	CDFG, Gold Ridge RCD						tbd	
SaC-A-2.1.1.5	Action Step	Floodplain	Support landowners and the Gold Ridge RCD in developing projects to improve channel conditions and restore natural channel geomorphology, including side channels and dense contiguous riparian vegetation (DFG 2004).	3	60	Gold Ridge RCD, Private Landowners						tbd	
SaC-A-2.1.1.6	Action Step	Floodplain	Restore channel function in the lower gradient reaches of the watershed to create off channel habitat.	3	60	CDFG, Gold Ridge RCD, NOAA RC, Private Landowners						tbd	
SaC-A-2.1.2	Recovery Action	Floodplain	Minimize the effect of new development on floodplain function and habitat value.										
SaC-A-2.1.2.1	Action Step	Floodplain	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	2	5	CDFG, Gold Ridge RCD, NOAA RC						tbd	
SaC-A-2.1.2.2	Action Step	Floodplain	Avoid new development within riparian zones and the 100 year floodprone zones.	2	30	CDFG, NMFS, Sonoma County						tbd	
SaC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical, spatial, and temporal pattern of surface flows.										
SaC-A-3.1.1	Recovery Action	Hydrology	Low in-stream flow should be addressed by increasing summer baseflows during the low rainfall seasons especially in reaches impacted by water diversions and by increasing riparian protection and restoration, erosion control, and employing best management practices that encourage permeability and infiltration. (Gold Ridge Resource Conservation District & Prunuske Chatham, Inc., 2007; DFG 2004).										
SaC-A-3.1.1.1	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	2	60	Gold Ridge RCD, Private Landowners						tbd	
SaC-A-3.1.2	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	2	60	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-A-3.1.3	Recovery Action	Hydrology	Avoid and/or minimize the adverse effects of water diversion on coho salmon by establishing: a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage (BM-HU-04 in DFG 2004).	1	20	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County	25.00	25.00	25.00	25.00	25.00	500	
SaC-A-3.1.4	Recovery Action	Hydrology	Support the water conservation training conducted by the Occidental Arts and Ecology Center Water Institute, Gold Ridge RCD, and Salmon Creek Watershed Council.	2	20	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County	15.00	15.00	15.00	15.00	15.00	300	
SaC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
SaC-A-6.1.1	Recovery Action	Pool Habitat	Conserve and manage forestlands and riparian corridors to retain shade and provide sources of LWD.										
SaC-A-6.1.1.1	Action Step	Pool Habitat	Promote growth of larger diameter trees where appropriate.	2a	2	CDFG, MMWD, NMFS						0	Cost of initial dialog is expected to be minimal.
SaC-A-6.1.1.2	Action Step	Pool Habitat	Protect existing riparian areas to maintain LWD supply and canopy.	2	20	CDFG, Gold Ridge RCD						tbd	

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-A-6.1.2	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
SaC-A-6.1.2.1	Action Step	Pool Habitat	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	3	60	CDFG, Gold Ridge RCD						tbd	
SaC-A-6.1.2.2	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CDFG, Gold Ridge RCD						tbd	
SaC-A-6.1.2.3	Action Step	Pool Habitat	Continue to study the effects of LWD placement and subsequent sheltered pool formation and monitor response of summer and winter rearing juvenile use.	3	5	CDFG						tbd	
SaC-A-6.1.3	Recovery Action	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	2	60	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-A-6.1.4	Recovery Action	Pool Habitat	Install LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004).										
SaC-A-6.1.4.1	Action Step	Pool Habitat	Where feasible, design and engineer pool enhancement structures to increase the number of pools (Gold Ridge Resource Conservation District & Prunuske Chatham, Inc., 2007; DFG 2004).	3	60	CDFG, Gold Ridge RCD, NOAA RC						tbd	
SaC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
SaC-A-7.1.1	Recovery Action	Riparian Vegetation	Increase the canopy along Salmon Creek by planting a succession of native riparian vegetation where shade canopy is not at acceptable levels. Non-anadromous reaches should also be assessed for revegetation as water temperatures throughout are affected from upstream (Gold Ridge Resource Conservation District & Prunuske Chatham, Inc., 2007; DFG 2004).										
SaC-A-7.1.1.1	Action Step	Riparian Vegetation	Encourage the cultivation and availability of locally indigenous riparian plants for use in restoration and bank stabilization (DFG 2004)	2	60	CDFG, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners						tbd	
SaC-A-7.1.2	Recovery Action	Riparian Vegetation	Support landowners and the RCD to restore riparian zones and manage livestock to increase stream protection and soil retention (Gold Ridge Resource Conservation District & Prunuske Chatham, Inc., 2007; DFG 2004).	3	20	Gold Ridge RCD, Private Consultants, Private Landowners						TBD	
SaC-A-7.1.3	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	5	Gold Ridge RCD, Private Consultants, Private Landowners	40.00	40.00	40.00	40.00	40.00	200	
SaC-A-7.1.4	Recovery Action	Riparian Vegetation	Promote bio-engineering solutions as appropriate (e.g. where critical infrastructure is located) for bank hardening projects.	3	20	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-A-7.1.5	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	20	CDFG, Gold Ridge RCD, NMFS, NRCS, Private Consultants, Private Landowners, USFWS						TBD	

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-7.1.6	Recovery Action	Riparian Vegetation	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	20	California Coastal Conservancy, CDFG, Sonoma County						tbd	
SaC-CCC-7.1.7	Recovery Action	Riparian Vegetation	Manage riparian areas for their site potential composition and structure.	2	30	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners, Sonoma County						TBD	
SaC-CCC-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
SaC-CCC-8.1.1	Recovery Action	Sediment	Continue to implement erosion control projects that were assessed and inventoried in sediment assessment plans (DFG 2004).	3	60	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-8.1.2	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.	3	60	Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-8.1.3	Recovery Action	Sediment	Address sources from slides and gullies that deliver sediment and runoff to stream channels.	3	20	Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-9.1	Objective	Viability	Re-establish a naturally reproducing run of coho salmon in appropriate subwatersheds.										
SaC-CCC-9.1.1	Recovery Action	Viability	Continue the operation of the Captive Broodstock Program in Salmon Creek.										
SaC-CCC-9.1.1.1	Action Step	Viability	Fund monitoring actions in Salmon Creek to evaluate success of adult reintroductions towards salmon recovery.	1	10	CDFG						TBD	
SaC-CCC-9.1.1.2	Action Step	Viability	Conduct outreach with landowners to expand broodstock releases within core areas, and remaining extirpated streams within the watershed.	1	2	Gold Ridge RCD						TBD	
SaC-CCC-9.1.2	Recovery Action	Viability	Minimize departure from the genetic profile that historically existed in the population.										
SaC-CCC-9.1.2.1	Action Step	Viability	Evaluate recent adult stocking efforts to guide adult spawner release sources.	2	5	NOAA SWFSC						TBD	
SaC-CCC-9.1.2.2	Action Step	Viability	Annually capture or retain (during rescue efforts) - small numbers of surplus fish from drying streams/habitats in Marin and Sonoma Counties for purposes of broodstock in Russian River, Walker and Salmon Creeks.	1	10	CDFG						tbd	
SaC-CCC-9.1.2.3	Action Step	Viability	Use surplus broodstock to repopulate remaining extirpated streams within the watershed.	1	10	CDFG, NMFS						tbd	
SaC-CCC-9.1.3	Recovery Action	Viability	Continue to rescue juvenile coho salmon with existing permittees that are under an imminent risk of stranding and mortality and relocate to suitable habitat when deemed appropriate by NMFS and CDFG	1	10	CDFG, Gold Ridge RCD, NMFS, Trout Unlimited							Existing operations
SaC-CCC-9.2	Objective	Viability	Conduct periodic, standardized spawning surveys to estimate adult abundance in the watershed. Surveys should include all three cohorts.	1	20	CDFG, Gold Ridge RCD, NMFS	200	200	200	200	200	4,000	
SaC-CCC-9.3	Objective	Viability	Conduct periodic, standardized smolt outmigration surveys to estimate smolt abundance in the watershed. Surveys should occur during the same period as adult spawning surveys.	2	20	CDFG, Gold Ridge RCD, NMFS	400	400	400	400	400	8,000	
SaC-CCC-9.4	Objective	Viability	Monitor the effectiveness and maintenance of watershed restoration projects and augment inventories as needed (DFG 2004).	2	20	CDFG, Gold Ridge RCD, NMFS	50.00	50.00	50.00	50.00	50.00	1,000	

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-10.1	Objective	Water Quality	Assess the water temperature regime during the summer season for three to five years to determine the role of water temperature as a limiting factor in coho salmon production (DFG 2004).	2	5	Gold Ridge RCD, Private Consultants, Private Landowners	60.00	60.00	60.00	60.00	60.00	300	
SaC-CCC-10.2	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
SaC-CCC-10.2.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
SaC-CCC-10.2.1.1	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	3	20	Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
SaC-CCC-12.1.1	Recovery Action	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.										
SaC-CCC-12.1.1.1	Action Step	Channel Modification	Evaluate whether proposed stabilization projects will lead to additional instability either up- or downstream.	2	10	CalTrans, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Public, Sonoma County						TBD	Costs may vary significantly depending on level of commitment from local government and private landowners. The majority of the costs would likely include local government and consultant staff time.
SaC-CCC-12.1.1.2	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	10	CalTrans, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Public, Sonoma County						TBD	Costs may vary significantly depending on level of commitment from local government and private landowners. The majority of the costs would likely include local government and consultant staff time.
SaC-CCC-12.1.1.3	Action Step	Channel Modification	Where feasible, remove obsolete bank stabilization structures from the channel which contribute to channel incision and reduced habitat complexity.	2	10	CalTrans, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Public, Sonoma County						TBD	Costs may vary significantly depending on level of commitment from local government and private landowners. The majority of the costs would likely include local government and consultant staff time.
SaC-CCC-12.1.2	Recovery Action	Channel Modification	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	2	10	CalTrans, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Public, Sonoma County						TBD	Costs may vary significantly depending on level of commitment from local government and private landowners. The majority of the costs would likely include local government and consultant staff time.
SaC-CCC-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-15.1.1	Recovery Action	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.	2	20	, Gold Ridge RCD, Private Landowners, Sonoma County						TBD	
SaC-CCC-15.1.2	Recovery Action	Droughts	Work with DFG, County of Sonoma, State Parks, municipalities, and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	1	20	, Cities, Sonoma County, State Parks						TBD	
SaC-CCC-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.	1	20	, Cities, Private Landowners, Sonoma County						TBD	
SaC-CCC-19.1	Objective	Livestock Farming and Ranching	Reduce the adverse effects of grazing and ranching to water quality.										
SaC-CCC-19.1.1	Recovery Action	Livestock Farming and Ranching	Support grazing practices that minimize impacts to riparian and instream habitat: livestock exclusion, rotational grazing, etc.										
SaC-CCC-19.1.1.1	Action Step	Livestock Farming and Ranching	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take priority for riparian fencing programs over steer operations.	2	20	Farm Bureau, Gold Ridge RCD, NRCS						TBD	
SaC-CCC-19.1.1.2	Action Step	Livestock Farming and Ranching	To minimize gully initiation, grazing should be kept at relatively low intensities on the steeper slopes in this area.	2	60	Farm Bureau, Gold Ridge RCD, Private Landowners, Sonoma County						TBD	
SaC-CCC-19.1.1.3	Action Step	Livestock Farming and Ranching	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	20	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners						TBD	
SaC-CCC-19.1.2	Recovery Action	Livestock Farming and Ranching	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	20	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners						TBD	
SaC-CCC-19.2	Objective	Livestock Farming and Ranching	Locate water sources away from riparian areas.										
SaC-CCC-19.2.1	Recovery Action	Livestock Farming and Ranching	Encourage riparian restoration to regain riparian corridors damaged from livestock and other causes.	2	30	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners						TBD	
SaC-CCC-19.2.2	Recovery Action	Livestock Farming and Ranching	Increase the use of water storage and catchment systems that collect rainwater in the winter for use during the dry summer and fall seasons.	2	30	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners						TBD	
SaC-CCC-24.1	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.	2	20	, Private Landowners, Sonoma County						TBD	This is the only road parameter that received a high or very high threat (density of roads in riparian zone)
SaC-CCC-25.1	Objective	Storms and Flooding	Conduct outreach and education regarding how local, city, county, State and Federal planning can put in place mechanisms that provide community resiliency to storms and flooding.										
SaC-CCC-25.1.1	Recovery Action	Storms and Flooding	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow “emergencies”.	1	20	Cities, FEMA, Sonoma County, Water Agencies						TBD	
SaC-CCC-25.1.2	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	2	60	Bodega Land Trust, CalFire, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Landowners, RWQCB						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have roads addressed.

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-25.1.3	Recovery Action	Storms and Flooding	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	5	CDFG, FEMA, FishNet 4C, Gold Ridge RCD, NMFS, NRCS, Sonoma County, USACE, USFWS	4.00	4.00	4.00	4.00	4.00	20	Existing documents and policies can be used for this recommendation. Costs would increase if a number of site specific conditions and criteria are developed.
SaC-CCC-25.1.4	Recovery Action	Storms and Flooding	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	1	60	CalFire, CalTrans, FEMA, Gold Ridge RCD, RWQCB, San Mateo RCD, Sonoma County, USACE						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have roads and other infrastructure addressed to improve hydrologic function. As a general recommendation for future development cost may vary depending on existing infrastructure and site specific conditions.
SaC-CCC-25.1.5	Recovery Action	Storms and Flooding	Work with local governments to incorporate protection of CCC coho salmon in any flood management activity (DFG 2004).	2	10	CDFG, Cities, FEMA, Gold Ridge RCD, NMFS, Sonoma County, USACE						0	Outreach and education are ongoing, and additional costs are expected to be minimal.
SaC-CCC-26.1	Objective	Water Diversion and Impoundment	Improve current laws and policies to control diversions and water use in order to maintain and restore surface flows.	1	Ongoing	CDFG, NMFS, RWQCB, SWRCB						TBD	
SaC-CCC-26.2	Objective	Water Diversion and Impoundment	Promote water conservation by the public, water agencies, agriculture, private industry, and the citizenry.										
SaC-CCC-26.2.1	Recovery Action	Water Diversion and Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	2	5	CDFG, Gold Ridge RCD, Private Landowners, RWQCB, Sonoma County						TBD	
SaC-CCC-26.2.2	Recovery Action	Water Diversion and Impoundment	Promote the use of reclaimed water for agricultural or other uses.	2	10	Gold Ridge RCD, Private Landowners, RWQCB, Sonoma County, Sonoma County Water Agency						TBD	
SaC-CCC-26.3	Objective	Water Diversion and Impoundment	Develop new policies and regulations and or enforce existing policies and regulations to provide suitable flow conditions for CCC coho salmon.										
SaC-CCC-26.3.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon.										
SaC-CCC-26.3.1.1	Action Step	Water Diversion and Impoundment	Determine and monitor 1600 program compliance related to water diversions (DFG 2004).	2	5	CDFG Law Enforcement, NMFS OLE, SWRCB						TBD	
SaC-CCC-26.3.1.2	Action Step	Water Diversion and Impoundment	Develop and implement regulations for groundwater use.	2	5	RWQCB, Sonoma County, SWRCB						TBD	

SAN GREGORIO CREEK

San Gregorio Creek

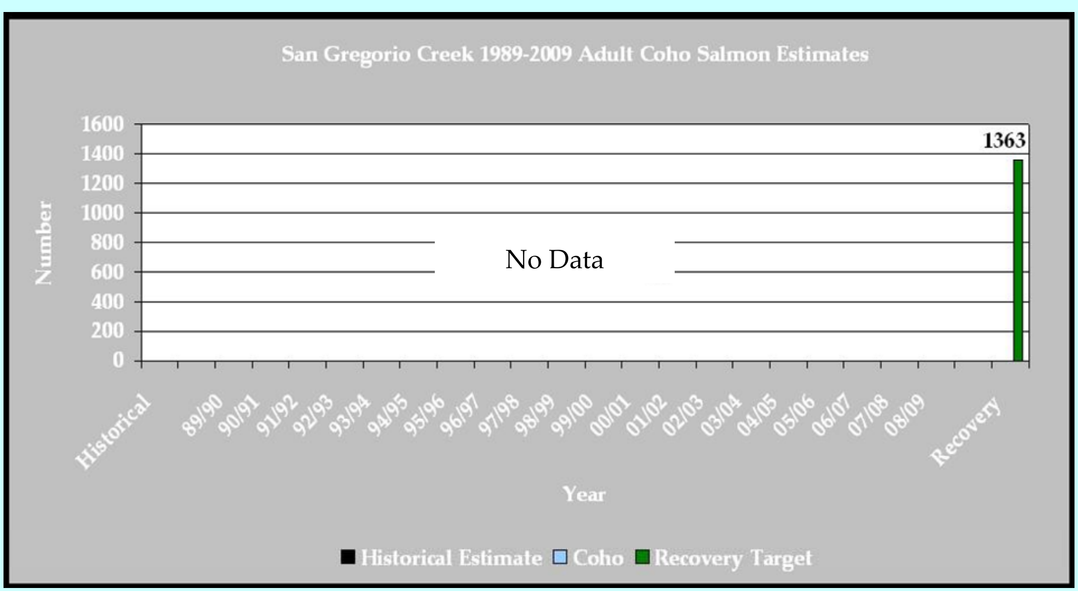
Dependant Population
40.1 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

San Gregorio Creek drains approximately 52 square miles of the Santa Cruz Mountains in western San Mateo and Santa Cruz Counties. San Gregorio Creek enters the Pacific Ocean downstream of the small town of San Gregorio. About 39 percent of the San Gregorio Creek watershed is shrubland, about 32 percent coniferous forest, and about 23 percent of the watershed area is annual grassland. The San Gregorio Creek watershed has moderate erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. The SWRCB listed the San Gregorio Creek as having water quality impaired for coliform and sediment in 2003. The water quality impairment listing determined that sediment and coliform was impairing habitats beneficial to coho salmon including migration, spawning and rearing habitats, and identified non-point sources as the probable cause. Ninety-eight percent of the San Gregorio Creek watershed is in private ownership; the remaining two percent is local-owned park lands. Housing development within the San Gregorio Creek watershed is low to moderate; approximately 1,007 housing units are present in the watershed. Of the 28 focus watersheds in the recovery plan, San Gregorio may have the most serious water diversion issues. NMFS has estimated that over 50 percent of the annual baseflow is diverted from the stream.

San Gregorio lagoon
Photo by Kristine Atkinson

The Watershed at a Glance

Spawning Quantity & Quality	**GOOD**
Summer Water Temperatures	**FAIR**
Depth & Shelter of Pools	**FAIR**
Large Wood Frequency	**POOR**
Riparian Canopy	**FAIR to GOOD**
Off channel/Floodplain Quality	**POOR**
Estuary Function	**POOR**



San Gregorio

Recovery Target: 1,363 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Droughts
- Water Diversions and Impoundments
- Residential and Commercial Development
- Roads and railroads
- Storms and Flooding
- Climate Change
- Agricultural Practices
- Fire and Fuel Management

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the San Gregorio Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve baseflow
- Increase and improve the number off channel habitats
- Increase the amount of large wood in streams
- Decrease the number of roads near the stream and reduce impacts from remaining roads
- Improve pool habitat

Streambank erosion in San Gregorio Creek
Photo by Kristine Atkinson

Advancing recovery of coho

salmon in San Gregorio requires these priority **recovery actions:**

- Increase the frequency and functionality of off channel habitats.
- Implement, via technical assistance and/or regulatory action the flow bypass requirements sufficiently protective of all freshwater life stages.
- Promote efforts to protect riparian and floodplain areas.
- Promote supplemental programs to increase LWD recruitment to improve stream complexity, gravel retention, and pool frequency and depth.
- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.

. . . in this **core area:** Alpine Creek

Conservation Highlights

- Mid Peninsula Open Space District is performing sediment abatement programs
- Army US Army Corps of Engineers of Engineers is funding operation of a USGS installed flow gage.
- The County of San Mateo is developing water conservation development

We Need Your Photo Here

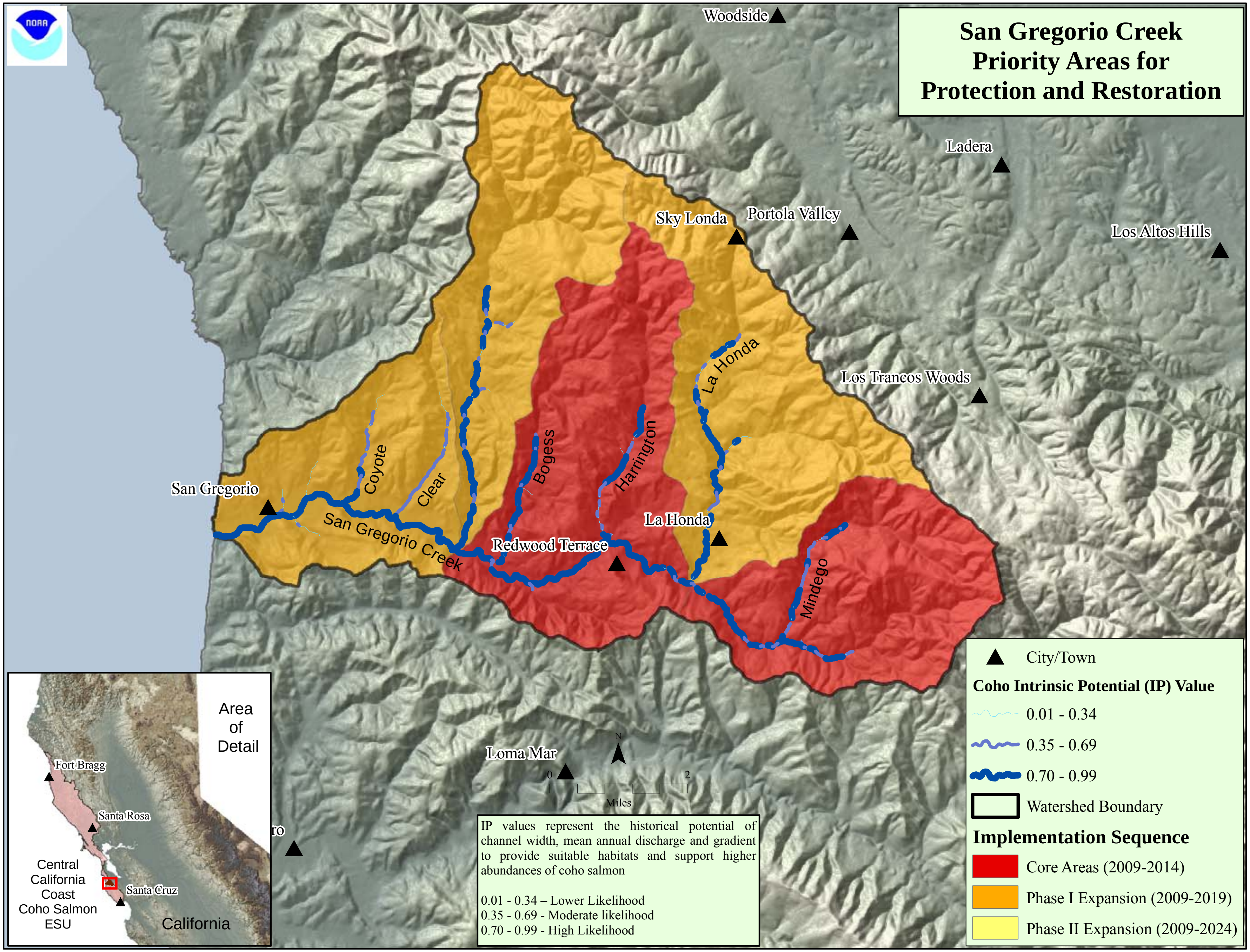
San Gregorio
Photo © Your Name Here, AFFIL

Recovery Partners

Mid-Peninsula Regional Open Space District
Coastal Watershed Council
US Army Corps of Engineers
Monterey Bay Sanctuary Citizen Watershed Monitoring Network
Stillwater Sciences
Natural Heritage Institute
San Gregorio Environmental Resource Center
San Mateo RCD

Immediate Needs

Address allocation of instream flow √
Reduce sediment input √
Address lack of instream structures √


San Gregorio Creek
Priority Areas for
Protection and Restoration
Woodside
Ladera
Sky Londa
Portola Valley
Los Altos Hills
Los Trancos Woods
La Honda
Coyote
Clear
Bogess
Harrington
San Gregorio
San Gregorio Creek
Redwood Terrace
La Honda
Mindego
Loma Mar
N
0
2
Miles
Area
of
Detail
Fort Bragg
Santa Rosa
Central
California
Coast
Coho Salmon
ESU
Santa Cruz
California
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
San Gregorio Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	NA	NA	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	79%	Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	NA	NA	Spawning Adults	Sediment	Amount of Gravel*	<200m²	200-1800	1800-3600	>3600
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	NA	NA	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	NA	NA	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	NA	NA	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	Poor	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Good	Good	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	NA	NA	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	10.4 / 10 IP-km	Poor	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	NA	NA	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	<50%	Poor	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	NA	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.29%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	2.57%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	0%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	1.2	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	55-69%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	70-80%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	≤ 69% density "D" across IP-km	70 -79%	> 80%	
NMFS	CDF THP Dataset	3 mi/sq.mi.	Fair	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	3.2 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m2	0.2-0.5 fish/m2	0.5-1.0 fish/m2	>1.0 fish/m2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

San Gregorio Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages	Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	
1	Droughts	Very High	Medium	Very High	Medium	Very High	Medium	Very High
2	Water Diversion and Impoundment	High	High	Very High	Medium	Very High	Medium	Very High
3	Residential and Commercial Development	Very High	High	High	High	High	High	Very High
4	Roads and Railroads	Medium	High	Very High	Medium	High	Medium	High
5	Storms and Flooding	Medium	High	Medium	High	High	High	High
6	Climate Change	High	Medium	High	Medium	High	Medium	High
7	Agricultural Practices	High	Medium	Medium	Medium	High	Medium	High
8	Fire and Fuel Management	High	Medium	High	Medium	Medium	Medium	High
9	Fishing and Collecting	High	-	Medium	Low	Low	-	Medium
10	Recreational Areas and Activities	Medium	Medium	Medium	Medium	Medium	Medium	Medium
11	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium	Medium
12	Channel Modification	Medium	Low	Medium	Medium	Low	Medium	Medium
13	Logging and Wood Harvesting	Medium	Low	Medium	Medium	Low	Medium	Medium
14	Hatcheries and Aquaculture	Medium	-	-	Low	Low	Low	Low
15	Disease, Predation, and Competition	-	-	-	-	Medium	-	Low
16	Mining	-	-	-	Low	-	-	Low
	Threat Status for Targets and Project	Very High	High	Very High	High	Very High	High	Very High

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
SGC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest.										
SGC-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	5	CDFG, NMFS, Private Consultants, San Mateo County	10.00	10.00	10.00	10.00	10.00	50	Significant work has occurred in recent years in San Gregorio Creek and total costs could be reduced by leveraging existing information.
SGC-A-2.1.1.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	60	California Coastal Conservancy, NMFS, Private Consultants, Private Landowners						TBD	Costs cannot be determined at this time. Implementation will depend on landowner participation.
SGC-A-2.1.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	60	CDFG, NMFS, NOAA RC, San Mateo County, San Mateo RCD, USACE						TBD	Costs cannot be estimated at this time. Costs will vary depending on restoration action and total number of projects implemented.
SGC-A-2.1.3	Recovery Action	Floodplain	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.	1	60	County of San Mateo, FEMA, Private Landowners, Public, USACE						0	
SGC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
SGC-A-3.1.1	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
SGC-A-3.1.1.1	Action Step	Hydrology	Work with SWRCB and landowners to re-establish natural flow regimes to improve adult migration to spawning habitats and smolt outmigration.	2	10	CDFG, NMFS, SWRCB						TBD	
SGC-A-3.1.1.2	Action Step	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.	1	20	CDFG, County of San Mateo, Farm Bureau, FishNet 4C, NMFS, NRCS, San Mateo RCD, SWRCB, Trout Unlimited						TBD	Costs cannot be determined at this time but may be significant and will require close coordination with NGOs, private landowners, regulatory and non regulatory agencies.
SGC-A-3.1.1.3	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	1	10	California Coastal Conservancy, CDFG, NMFS, SWRCB						TBD	Significant monitoring efforts are currently occurring in the San Gregorio watershed. Data from this monitoring effort should be evaluated and incorporated into the stream flow evaluation program as a means to reduce overall costs.
SGC-A-3.1.2	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
SGC-A-3.1.2.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	20	Farm Bureau, Gold Ridge RCD, NRCS, Trout Unlimited						TBD	This recommendation should be incorporated into all future regulatory reviews of water rights applications and 1600 Agreements in the San Gregorio watershed.
SGC-A-3.1.2.2	Action Step	Hydrology	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	3	60	CDFG, County of San Mateo, NMFS, SWRCB						0	This recommendation should be incorporated into all future regulatory reviews of water rights applications and 1600 Agreements in the San Gregorio watershed.

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SGC-A-3.1.2.3	Action Step	Hydrology	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	1	60	Coastside Land Trust, County of San Mateo, Farm Bureau, FishNet 4C, Mid Penninsula Open Space District, NMFS, NRCS, POST, Private Landowners, San Mateo RCD, SWRCB, Water Agencies						0	Cost associated with disseminating guidelines is minimal. Costs associated with compliance was not estimated.
SGC-A-3.1.2.4	Action Step	Hydrology	Support SWRCB in regulating the use of streamside wells and groundwater.	2	60	CDFG, County of San Mateo, Private Landowners, SWRCB, USFWS						0	
SGC-A-3.1.3	Recovery Action	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	1	60	California Coastal Conservancy, CDFG, County of San Mateo, Farm Bureau, NOAA RC, NRCS, POST, Private Landowners, SWRCB, USFWS						TBD	The price at which water is sold on environmental water markets is determined by negotiations between landowners and purchasing entities. The aggregate fiscal cost of water acquisition will depend on the quantity of water acquired and whether water rights will be permanently transferred or purchased for single periods.
SGC-A-3.1.4	Recovery Action	Hydrology	Encourage the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	3	60	County of San Mateo, Farm Bureau, NOAA RC, NRCS, POST, Private Landowners, San Mateo RCD, USACE, USEPA, USFWS						0	
SGC-A-3.2	Objective	Hydrology	Require streamflow gauging devices to determine the level of impairment to natural flow.										
SGC-A-3.2.1	Recovery Action	Hydrology	Continue to fund the maintenance and operation of the San Gregorio gauge.	2	5	SWRCB, USACE, USGS	20.00	20.00	20.00	20.00	20.00	100	
SGC-A-5.1	Objective	Passage	Identify and remove existing passage barriers.										
SGC-A-5.1.1	Recovery Action	Passage	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	3	20	California Coastal Conservancy, CDFG, County of San Mateo						0	Existing passage assessments should prove adequate for this recommendation.
SGC-A-5.1.2	Recovery Action	Passage	Systematically work to restore coho salmon passage at county facilities (DFG 2004) and other facilities and infrastructure that create impediments to passage.	3	30	California Coastal Conservancy, CalTrans, CDFG, County of San Mateo, NRCS, POST, Private Landowners, San Mateo RCD, USACE, USFWS						TBD	Most of the existing blockages and impediments have been identified in the San Gregorio watershed. Costs will vary depending on proposed passage solutions. Caltrans (DFG 2004) estimated culvert replacement cost, with an upgrade in flow capacity, would range from $30,000 to $2 million.
SGC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
SGC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).	1	60								

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.	1	30	California Coastal Conservancy, CDFG, County of San Mateo, FEMA, FishNet 4C, NOAA RC, NRCS, Private Consultants, San Mateo County, San Mateo RCD, USACE, USEPA, USFWS						TBD	Costs cannot be determined at this time.
SGC-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	2	60	CDFG, FEMA, NMFS PRD, NRCS, POST, Private Consultants, Private Landowners, RWQCB, San Mateo County, San Mateo RCD, USACE						TBD	Project costs cannot be estimated at this time because the number of future stream bank protection projects is unknown and cannot be reasonably predicted. Costs can vary significantly depending on access and type of project.
SGC-A-6.1.1.3	Action Step	Pool Habitat	Educate landowners, land managers, and County and municipal staffs on the importance of LWD to coho survival and recovery, and watershed processes.	1	5	CalFire, CalTrans, CDFG, Coastside Land Trust, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, NMFS, NRCS, POST, Private Consultants, Private Landowners, RWQCB, San Mateo County, San Mateo RCD, State Parks, Trout Unlimited, USACE, USFWS	3.00	3.00	3.00	3.00	3.00	15	Information and priorities in the recovery plan can serve as a source of information and future guidance.
SGC-A-6.1.1.4	Action Step	Pool Habitat	Implement a large woody debris supplementation program.	1	20	California Coastal Conservancy, CalTrans, CDFG, Coastside Land Trust, County of San Mateo, NMFS, NRCS, San Mateo RCD, Trout Unlimited, USACE	100	100	100	100	100	2,000	This is a high priority for the San Gregorio watershed. Overall costs may be reduced by assessing and leveraging past surveys and ongoing assessment in the watershed to prioritize key areas. However, due to the urbanized nature of the watershed and flooding concerns, it is anticipated that most LWD structures will require engineering.
SGC-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement woody debris restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	1	60	CalFire, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, Mid Penninsula Open Space District, NMFS, NRCS, POST, San Mateo County, San Mateo RCD, USACE, USFWS						0	Costs should be minimal. This recommendation should be adopted as a recurring recommendation for all restoration projects by individuals, agencies, and organizations that permit and fund restoration and enhancement projects.
SGC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
SGC-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-8.1.1.1	Action Step	Sediment	NMFS and other stakeholders will work with RCD or NRCS to encourage hiring of consultants to conduct road assessments (first for subwatersheds in Core areas, then for Phase I areas).	2	5	CalFire, California Coastal Conservancy, CalTrans, CDFG, NOAA RC, NRCS, POST, Private Consultants, RWQCB, San Mateo RCD, USACE	100	100	100	100	100	500	Some road assessments have already been conducted for San Gregorio Creek and the overall cost estimate may be less than predicted.
SGC-A-8.1.2	Recovery Action	Sediment	Address sources from trails, road networks, agricultural fields, and other sources that deliver sediment and runoff to stream channels.										
SGC-A-8.1.2.1	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	3	60	CalFire, CalTrans, County of San Mateo, Farm Bureau, FishNet 4C, Mid Penninsula Open Space District, NRCS, POST, Private Landowners, RWQCB, San Mateo RCD						TBD	Cost cannot be estimated at this time. Ongoing maintenance is critical to the success of this recovery action.
SGC-A-8.1.2.2	Action Step	Sediment	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF). Where no Core areas are designated, apply this action to Phase I areas.	2	30	CalFire, CalTrans, CDFG, NMFS, NRCS, San Mateo County, San Mateo RCD						TBD	Cost could not be estimated at this time.
SGC-A-8.1.3	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	3	60	California Coastal Conservancy, CDFG, Farm Bureau, NMFS, NRCS, Private Landowners, San Mateo RCD						TBD	This program should be implemented with the close coordination of local watershed groups.
SGC-A-8.1.3.1	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	2	60	CalFire, Campbell Timberland Management, FEMA, NMFS PRD, NRCS, RWQCB, USACE, USEPA, USFWS						0	While costs are involved in this recommendation, inspections should be considered a standard business practice by all regulatory agencies and this action should not be considered as an additional cost.
SGC-A-8.1.4	Recovery Action	Sediment	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage and support landowners who conduct operations in a manner compatible with CCC coho salmon recovery priorities.	3	60	California Coastal Conservancy, CDFG, Farm Bureau, NMFS, NRCS, Private Landowners, San Mateo RCD						TBD	
SGC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
SGC-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key attributes across the watershed.										
SGC-A-9.1.1.1	Action Step	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	2	15	California Coastal Conservancy, CDFG, FishNet 4C, NMFS, NRCS, Private Consultants, San Mateo County, San Mateo RCD, Trout Unlimited, USFWS						TBD	All assessments should use standardized methods. Methods should be consistent across the CCC ESU or at a minimum the Santa Cruz Mountains Diversity Stratum. Results from past assessments can be used in some circumstances to jump start restoration actions and need not necessarily wait upon completion of a standardized assessment protocol.

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.	3	12	California Coastal Conservancy, CDFG, NMFS						TBD	Primary emphasis for monitoring should be placed on adult assessments.
SGC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
SGC-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
SGC-A-10.1.1.1	Action Step	Water Quality	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	2	10	CalFire, California Coastal Conservancy, County of San Mateo, Farm Bureau, FishNet 4C, NMFS PRD, NOAA RC, NRCS, Private Landowners, RWQCB, San Mateo RCD	25.00	25.00	25.00	25.00	25.00	250	
SGC-A-10.1.1.2	Action Step	Water Quality	Encourage County of San Mateo to establish wider riparian buffers in residential and urban areas.	2	10	CDFG, FishNet 4C, NMFS, Private Landowners, RWQCB, USEPA, USFWS	5.00	5.00	5.00	5.00	5.00	50	Costs are a rough estimate and may vary depending on County approach to adopting the recommendation. This will likely be a sensitive issue for many landowners with property located next to riparian areas.
SGC-A-10.1.1.3	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	3	60	CalFire, California Coastal Conservancy, CDFG, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, NMFS, NRCS, POST, Private Consultants, Private Landowners, San Mateo RCD, USACE, USEPA, USFWS						TBD	The fiscal costs of riparian revegetation or planting depend on the complexity of the project undertaken, the remoteness of the parcel of land to be treated, and the degree of site preparation needed. According to DFG 2004, Evergreen Funding Consultants suggest a budget of between 5,000 dollars and 135,000 dollars per acre.
SGC-A-11.1	Objective	Agricultural Practices	Promote agricultural practices that protect and restore habitats for CCC coho salmon.										
SGC-A-11.1.1	Recovery Action	Agricultural Practices	Promote dry-land farming instead of irrigated crops to reduce impacts of water diversions.	3	60	CDFG, Farm Bureau, NMFS, NRCS, SWRCB						TBD	
SGC-A-11.1.2	Recovery Action	Agricultural Practices	Work within the agricultural community to educate landowners to enhance practices that provide for properly functioning watershed processes.	2	20	California Coastal Conservancy, CDFG, County of San Mateo, Farm Bureau, FishNet 4C, San Mateo RCD, Trout Unlimited, UC Extension	2.00	2.00	2.00	2.00	2.00	40	Existing templates could be used in San Mateo County, which would significantly minimize costs. Costs are a rough estimate of ongoing education and outreach to landowners.
SGC-A-11.1.3	Recovery Action	Agricultural Practices	Implement programs similar to the Sotoyome Resource Conservation District's Fish Friendly Farming practices (DFG 2004).	2	60	County of San Mateo, Farm Bureau, FishNet 4C, NRCS, San Mateo RCD, UC Extension, USFWS						TBD	Existing templates could be used in San Mateo County, which would significantly minimize costs. Sotoyome program provides a number of minimization measures to reduce impacts to listed salmonids and their habitats. However, these measures are not the equivalent of no-take standards.

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SGC-A-11.1.4	Recovery Action	Agricultural Practices	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.										
SGC-A-11.1.4.1	Action Step	Agricultural Practices	Maintain and enhance riparian stream buffer areas near agricultural activities that allow functional riparian areas to develop.	2	10	CDFG, Coastside Land Trust, Conservation Fund, County of San Mateo, Farm Bureau, FishNet 4C, Mid Penninsula Open Space District, NMFS, NRCS, POST, RWQCB, San Mateo RCD						TBD	Costs of maintaining existing buffers would result in minimal expenditures. However, taking agricultural land adjacent to streams in order to establish a buffer would result in a financial constraint to the landowner. Lands that are in organizations such as land trusts or other entities should be able to implement this recommendation more readily.
SGC-A-11.1.4.2	Action Step	Agricultural Practices	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	3	Farm Bureau, NRCS, POST, RWQCB, San Mateo RCD	16.67	16.67	16.67			50	
SGC-A-15.1	Objective	Droughts	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts while also providing for CCC coho salmon recovery needs.										
SGC-A-15.1.1	Recovery Action	Droughts	Identify and eliminate depletion of summer base flows from unauthorized water uses.										
SGC-A-15.1.1.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	1	60	SWRCB						TBD	This should be considered an ongoing business practice but due to the constraints of the SWRCB from lack of staffing an indeterminate cost is associated with this recommendation.
SGC-A-15.1.2	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.	3	20	California Coastal Conservancy, RWQCB, San Mateo County, SWRCB						TBD	Costs associated with this alternative are significant and may be infeasible in a small watershed like San Gregorio.
SGC-A-15.1.2.1	Action Step	Droughts	Develop and implement critical flow levels for stream reaches impacted by water diversions.	1	10	CDFG, NMFS HCD, NMFS PRD, RWQCB, San Mateo County, SWRCB, USACE						TBD	Significant monitoring efforts are currently occurring in the San Gregorio watershed. Data from this monitoring effort should be evaluated and incorporated into the stream flow evaluation program as a means to reduce overall costs. Particular focus of this effort should be directed at stream reaches with high IP values and significant diversions. Of all the watersheds targeted in this recovery plan, San Gregorio is most heavily over allocated.
SGC-A-15.1.2.2	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	1	10	CDFG, NMFS HCD, NMFS PRD, SWRCB, Trout Unlimited, USACE						0	
SGC-A-15.1.2.3	Action Step	Droughts	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by municipal water suppliers and other users in the watershed through conservation programs.	1	60	San Mateo County, SWRCB						TBD	Costs can be estimated when critical flow values are established.
SGC-A-15.1.3	Recovery Action	Droughts	Investigate feasibility of desalination to prevent stream dewatering and ensure a more stable source of water overtime.	3	20	California Coastal Conservancy, RWQCB, San Mateo County, SWRCB						TBD	Costs associated with this alternative are significant and may be infeasible in a small watershed such as San Gregorio Creek.
SGC-A-15.1.4	Recovery Action	Droughts	Increase enforcement patrols by DFG and NMFS OLE in sensitive spawning and rearing areas.	2	60	CDFG, NMFS OLE	1.67	1.67	1.67	1.67	1.67	100	Cost is a rough estimate of increased enforcement efforts in the San Gregorio watershed.
SGC-A-16.1	Objective	Fire and Fuels Management	Develop measures protective of salmonids during fire fight actions.										

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SGC-A-16.1.1	Recovery Action	Fire and Fuels Management	Establish fire contingency plan developed by experts from CalFire, local fire districts, San Mateo RCD, and regulatory agencies with expertise in fisheries issues.	2	3	CalFire, County of San Mateo, FishNet 4C, NMFS, San Mateo RCD, USFWS	33.33	33.33	33.33			100	Cost may be significantly reduced if existing plans and protocols are adopted (e.g. USFS protocols). Costs may be higher if site specific constraints and agency and community reluctance to adopt existing NMFS and USFWS approved protocols exists.
SGC-A-16.1.1.1	Action Step	Fire and Fuels Management	Disseminate plan to all local fire fighting agencies.	2									
SGC-A-16.1.1.2	Action Step	Fire and Fuels Management	Encourage CalFire to provide plan to all non-County fire fighters when providing fire fighting assistance in the San Gregorio Creek watershed (and all other watersheds in the County).	2	3	CalFire, San Mateo County, San Mateo RCD	0.17	0.17	0.17			1	
SGC-A-16.1.1.3	Action Step	Fire and Fuels Management	In the event of a wildfire, we recommend CalFire Resource Advisors request ESA consultation (or technical assistance) from the resource agencies regarding the incident. The resource agencies can provide guidance regarding critical resources in the area that may be affected by fire fighting actions.	2	60	CalFire, CDFG, NMFS PRD, USFWS						0	Some minor costs will be associated with requesting staff time, but the costs should be offset by savings from post fire remediation requirements.
SGC-A-16.1.1.4	Action Step	Fire and Fuels Management	Immediately implement appropriate sediment control measures following completion of fire suppression while fire fighters and fire fighting equipment are on site.	1	60	CalFire						0	This should be considered a standard business practice for all fire fighting agencies and will result in a long term cost savings.
SGC-A-16.1.1.5	Action Step	Fire and Fuels Management	Implement sedimentation reduction techniques in concert with prescribed fire techniques to minimize sediment impacts to various coho salmon life stages.	2	60	CalFire, NRCS						0	This should be considered a standard business practice.
SGC-A-16.1.2	Recovery Action	Fire and Fuels Management	Disseminate NMFS' October 9, 2007, jeopardy biological opinion on the use of fire retardants to local fire fighting agencies and CalFire.										
SGC-A-16.1.2.1	Action Step	Fire and Fuels Management	Avoid use of aerial fire retardants and foams within 300 feet of riparian areas throughout the current range of CCC coho salmon.	2	60	CalFire							This recommendation should be adopted in areas where life and infrastructure and not endangered by fire.
SGC-A-16.1.2.2	Action Step	Fire and Fuels Management	Develop guidance that directs CalFire and other agencies and organizations using fire retardants to conduct an assessment of site conditions following wildfire where fire retardants have entered waterways, to evaluate the changes to on site water quality and the structure of the biological community.	2	60							TBD	Guidance could include informing CalFire of sensitive biological resources in the watershed as well as recommendations regarding sensitive watersource location (e.g., San Gregorio lagoon).
SGC-A-16.2	Objective	Fire and Fuels Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.										
SGC-A-16.2.1	Recovery Action	Fire and Fuels Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.										
SGC-A-16.2.1.1	Action Step	Fire and Fuels Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	2	5	CalFire, CDFG, NMFS, USFWS	2.00	2.00	2.00	2.00	2.00	10	
SGC-A-16.2.1.2	Action Step	Fire and Fuels Management	Work with County planners to define future impacts of proposed urban and infrastructure development on fire suppression and fuel load buildup.	3	60	CalFire, County of San Mateo						TBD	
SGC-A-23.1	Objective	Residential and Commercial Development	Improve stream maintenance practices to protect instream complexity, hydrologic processes and riparian functions.										
SGC-A-23.1.1	Recovery Action	Residential and Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating CCC coho salmon.	3	10	County of San Mateo, Private Landowners, Public, San Mateo RCD						TBD	Little organized and systematic stream maintenance is believed to occur in San Gregorio. However, periodic maintenance (often unpermitted) likely occurs in the watershed and its impact should be evaluated.

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SGC-A-23.1.2	Recovery Action	Residential and Commercial Development	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	California Coastal Conservancy, CalTrans, CDFG, FEMA, NMFS PRD, NRCS, POST, Private Consultants, Private Landowners, RWQCB, San Mateo County, San Mateo RCD, State Parks, USACE						0	This should be considered a standard business practice for all organizations involved in bank stabilization activities.
SGC-A-23.1.2.1	Action Step	Residential and Commercial Development	Remove logs and debris from streams only as a "last resort" (i.e., failure to remove them will certainly cause the loss of an essential facility) after consultation with a hydrologist and/or qualified fisheries biologist.	1	60	CalTrans, CDFG, County of San Mateo, NMFS PRD, NRCS, POST, Private Consultants, Private Landowners, Public, RWQCB, San Mateo RCD, USACE						TBD	Costs may be highly variable depending on water year and flooding. Years of lower rainfall will likely have less need for site by site evaluations and costs will be less (or even non existent) in those years. Costs will be significantly greater in wet years.
SGC-A-23.1.2.2	Action Step	Residential and Commercial Development	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	2	5	CalTrans, County of San Mateo, Public, RWQCB						0	Costs for this recommendation were assessed for the Pescadero watershed. These same costs could be applied on a County-wide basis.
SGC-A-23.1.3	Recovery Action	Residential and Commercial Development	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.	1	60	California Coastal Conservancy, CalTrans, CDFG, FEMA, NMFS PRD, NRCS, POST, Private Consultants, Private Landowners, RWQCB, San Mateo County, San Mateo RCD, State Parks, USACE						0	This should be considered a standard business practice for all organizations involved in bank stabilization activities.
SGC-A-23.2	Objective	Residential and Commercial Development	Maintain and restore hydrologic function, protect riparian and floodplain areas, and minimize adverse effects to water quality and instream rearing habitats resulting from commercial and urban development.										
SGC-A-23.2.1	Recovery Action	Residential and Commercial Development	Encourage the State Water Resources Control Board to evaluate water rights compliance in all sub-watersheds where new development is proposed.	1	60	SWRCB						0	
SGC-A-23.2.2	Recovery Action	Residential and Commercial Development	As mitigation for hydrograph consequences, municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	2	60	RWQCB, San Mateo County, USEPA						TBD	
SGC-A-23.2.3	Recovery Action	Residential and Commercial Development	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.										Floodplains provide essential over-wintering habitat. Costs of implementing many of the following recommendations will be significant. However, benefits to this critical lifestage will likely we very significant.
SGC-A-23.2.3.1	Action Step	Residential and Commercial Development	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	1	60	County of San Mateo, FEMA, Private Landowners, Public, USACE						0	
SGC-A-23.2.3.2	Action Step	Residential and Commercial Development	Encourage San Mateo County to develop a property easement acquisition funds and acquire grant monies to purchase, through a buyout program, eroding private properties in riparian corridors or properties subject to frequent flooding.	3	60	County of San Mateo, FEMA						TBD	

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-23.2.3.3	Action Step	Residential and Commercial Development	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	1	60	CalTrans, County of San Mateo, FEMA, Private Landowners, USACE						0	Costs should be minimal if this concept is adopted early in the planning process for all new development.
SGC-A-23.2.3.4	Action Step	Residential and Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	1	60	CalFire, CalTrans, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, POST, Private Landowners, RWQCB, USACE						0	
SGC-A-23.2.4	Recovery Action	Residential and Commercial Development	Avoid, or at a minimum regulate, the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.										
SGC-A-23.2.4.1	Action Step	Residential and Commercial Development	Encourage increased oversight by appropriate regulatory agencies of activities that use hazardous commercial and industrial products in the watershed.	3	60	County of San Mateo, RWQCB, USEPA						TBD	
SGC-A-23.2.5	Recovery Action	Residential and Commercial Development	Sediment from existing and future commercial and urban development should be reduced to magnitudes appropriate to the geological setting of the watershed, resulting in no net increase in sedimentation over natural limits.										
SGC-A-23.2.5.1	Action Step	Residential and Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.	1	60	CalFire, County of San Mateo, FEMA, Mines and Geology, NRCS, POST, Private Landowners, San Mateo RCD, USACE						0	Stringent review by permitting and oversight agencies is anticipated to reduce cost associated with poorly planned and improperly located developments.
SGC-A-23.2.5.2	Action Step	Residential and Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	2	60	CalFire, County of San Mateo, FEMA, HUD, NRCS, Private Landowners, USACE							
SGC-A-23.3	Objective	Residential and Commercial Development	Minimize rate, and subsequent adverse affects, of land conversion to residential and commercial development.										
SGC-A-23.3.1	Recovery Action	Residential and Commercial Development	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	2	60	CalFire, CDFG, County of San Mateo							
SGC-A-23.3.2	Recovery Action	Residential and Commercial Development	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).										
SGC-A-23.3.2.1	Action Step	Residential and Commercial Development	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	60	CalFire, CDFG, County of San Mateo, NMFS, San Mateo County						0	
SGC-A-23.3.2.2	Action Step	Residential and Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	3	60	County of San Mateo, Public						0	
SGC-A-23.3.3	Recovery Action	Residential and Commercial Development	Encourage the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	3	60	County of San Mateo, FishNet 4C, NRCS, POST, San Mateo RCD, USACE, USFWS						0	Incentives and alternative could vary depending on receptiveness of local landowners and the availability of financial resources and local expertise.

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-23.3.4	Recovery Action	Residential and Commercial Development	Identify areas at high risk of conversion, and develop incentives and alternatives for landowners that discourage conversion.	3	60	California Coastal Conservancy, Coastside Land Trust, Conservation Fund, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, POST, San Mateo RCD						TBD	Incentives and alternative could vary depending on receptiveness of local landowners and the availability of financial resources and local expertise.
SGC-A-23.3.5	Recovery Action	Residential and Commercial Development	Encourage all permitting agencies to evaluate projects during construction, including erosion controls during the winter period for permitted projects in Core areas, emphasizing areas with friable/sandy soils.	2	60	CDFG, County of San Mateo, FEMA, NMFS, RWQCB, SWRCB, USACE, USEPA, USFWS						0	This recommendation should be considered a standard business practice for all agencies involved in regulatory oversight.
SGC-A-23.3.6	Recovery Action	Residential and Commercial Development	New development in all historic CCC coho salmon watersheds should meet a zero net increase in storm-water runoff, changes in duration, or magnitude of peak flow.	1	60	County of San Mateo, NRCS, RWQCB, USEPA						TBD	Cost could be relatively inexpensive or add significant expenses to a project depending on project size, location, site specific constraints, and detention techniques.
SGC-A-23.3.7	Recovery Action	Residential and Commercial Development	Standards and recommendations regarding development should apply to all jurisdictions, including school districts and other special districts not subject to county and/or state related ordinances or policies.	1	60	County of San Mateo, FEMA, RWQCB, USACE, USEPA						TBD	
SGC-A-24.1	Objective	Roads and Railroads	Identify and remove existing passage barriers.										
SGC-A-24.1.1	Recovery Action	Roads and Railroads	Adopt NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	60	CalFire, California Coastal Conservancy, California Department of Mines and Geology, CalTrans, CDFG, County of San Mateo, FEMA, FishNet 4C, Mid Penninsula Open Space District, NMFS HCD, NOAA RC, NRCS, POST, RWQCB, San Mateo RCD, USACE						TBD	Replacement of culverts/bridges to NMFS standards will result in increased cost for materials and construction but will likely result in structures that can withstand large storm events better than existing structures. Long term durability and stability will result in long-term cost savings in many circumstances.
SGC-A-24.1.1.1	Action Step	Roads and Railroads	Educate county policy staff and Board of Supervisors on the benefits of railcar bridges and provide information from other counties where they are commonly used.	3	60	CalFire, Farm Bureau, FEMA, Private Landowners, RWQCB, San Mateo County, San Mateo RCD						0	Adoption of policies regarding railcar bridges will result in a major cost savings to County Government and private landowners. Initial cost of outreach should be minor. These structures may be most appropriate for rural residential applications and could result in significant cost savings for landowners.
SGC-A-24.2	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
SGC-A-24.2.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.										

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-24.2.1.1	Action Step	Roads and Railroads	Continue training County Road Maintenance staff through the FishNet 4C program.	2	20	CalFire, CalTrans, County of San Mateo, FishNet 4C, Private Consultants, RWQCB, San Mateo RCD	2.50	2.50	2.50	2.50	2.50	50	
SGC-A-24.3	Objective	Roads and Railroads	Reduce sediment sources from road networks and other actions that deliver sediment to stream channels through improved or new laws and policy.										
SGC-A-24.3.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific road management plan is created and implemented.	3	20	CalFire, CalTrans, County of San Mateo, FEMA						TBD	Costs may vary significantly depending on societal pressures to build in these areas. A well designed road management plan should result in long term cost savings.
SGC-A-24.3.2	Recovery Action	Roads and Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. The Counties should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with endangered salmonid habitat.	3	20	County of San Mateo, FEMA, State Parks						TBD	Costs are difficult to accurately determine but it may result in a long term cost savings.
SGC-A-24.3.3	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	2	60	County of San Mateo, Mid Penninsula Open Space District, POST, Private Landowners						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have their roads addressed and sediment sources remediated. This should be considered the minimum standard for dirt roads in the watershed.
SGC-A-24.4	Objective	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, Phase I within 10 years, and Phase II areas within 15 years (from 2010).										
SGC-A-24.4.1	Recovery Action	Roads and Railroads	Conduct a public road survey.	2	5	CalFire, CalTrans, County of San Mateo, San Mateo RCD						TBD	Some road assessments have already occurred in the San Gregorio watershed. These assessments should form the basis of any future assessment work in the watershed.
SGC-A-24.4.2	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.										
SGC-A-24.4.2.1	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, CalTrans, County of San Mateo						TBD	This is a cost that is frequently absorbed into road projects.
SGC-A-24.4.2.2	Action Step	Roads and Railroads	Install sediment traps for pretreatment, and a modified culvert system that can act as an efficient detention system.	3	60	CalFire, CalTrans, County of San Mateo, Farm Bureau						TBD	Estimates of cost will require estimates on long term maintenance commitments. Maintenance costs may be highly variable depending on location and rainfall year. Years of high rainfall will require more frequent maintenance.
SGC-A-24.4.2.3	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	1	5	CalFire, CalTrans, Private Landowners, Public, RWQCB, San Mateo RCD	20.00	20.00	20.00	20.00	20.00	100	Inadequate storage of sediment has been an ongoing issue in San Gregorio watershed. The paucity of locations for temporary storage of landslide material is a significant constraint. Sites should be identified within the duration specified and this action should be continued in perpetuity.

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-24.4.2.4	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	2	5	CalFire, California Coastal Conservancy, CalTrans, Farm Bureau, FishNet 4C, Mid Penninsula Open Space District, NRCS, POST, RWQCB, San Mateo RCD						TBD	Cost of removal cannot be conducted until an evaluation of the magnitude of the problem in conducted. Cost associated with berm evaluation should be coupled with ongoing and future public and private road evaluations as a means to reduce overall expenses.
SGC-A-24.4.3	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	2	60	Cal Western Railroad, CalTrans, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, Mid Penninsula Open Space District, Mines and Geology, NRCS, POST, RWQCB, San Mateo RCD						TBD	Costs cannot be determined at this time. These standards should be adopted for all unsurfaced roads and trails in the San Gregorio watershed.
SGC-A-24.4.3.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	2	60	CalFire, CalTrans, Coastside Land Trust, County of San Mateo, Farm Bureau, Mid Penninsula Open Space District, NRCS, POST, Public, San Mateo RCD						TBD	Standard business practice; however, implementation may be difficult in the watershed due to the large number of small landowners and varying degree of financial resources.
SGC-A-24.4.4	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, CalTrans, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, Mid Penninsula Open Space District, Mines and Geology, NRCS, POST, RWQCB, San Mateo RCD						TBD	Costs cannot be determined at this time. These standards should be adopted for all future road projects in the San Gregorio watershed.
SGC-A-24.5	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas.										
SGC-A-24.5.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	3	20	CalFire, CalTrans, Farm Bureau, Mid Penninsula Open Space District, NRCS, POST, Private Landowners, RWQCB, San Mateo County, San Mateo RCD						TBD	DFG 2004 estimated costs of storm proofing roads at $15,900 per mile. However, costs may be significantly depending on infrastructure impacts and site specific conditions. Costs will vary depending on landowner participation and cooperation and feasibility of decommissioning roads in a relatively urbanized watershed like San Gregorio.
SGC-A-25.1	Objective	Storms and Flooding	Conduct outreach and education regarding how local, city, county, State and Federal planning can put in place mechanisms that provide community resiliency to storms and flooding.										

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-25.1.1	Recovery Action	Storms and Flooding	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	1	5	CalFire, CalTrans, CDFG, County of San Mateo, NMFS, NRCS, USACE	20.00	20.00	20.00	20.00	20.00	100	These monies could be used to develop a site specific program expressly for conditions in San Gregorio Creek. Monies could be saved if a Santa Cruz Mountain Diversity Stratum program or a San Mateo County program is developed to address this recommendation on a programmatic basis.
SGC-A-25.1.2	Recovery Action	Storms and Flooding	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, and use streamway concept where appropriate.	1	60	CalFire, California Coastal Conservancy, CalTrans, CDFG, Coastside Land Trust, Conservation Fund, County of San Mateo, Farm Bureau, FEMA, FishNet 4C, Mid Penninsula Open Space District, NRCS, POST, Private Landowners, RWQCB, San Mateo RCD, State Parks, USACE, USFWS						TBD	This is a very high priority. This will likely be an opportunistic restoration action and costs will be based on landowner willingness to participate and site specific conditions in regards to potential habitat suitability. Currently, these types of habitats have not been identified in the San Gregorio watershed.
SGC-A-25.1.3	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).										
SGC-A-25.1.3.1	Action Step	Storms and Flooding	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	60	County of San Mateo, FEMA						TBD	Adoption of these policies will result in significant short term expense but a long term cost savings as a result of minimizing future flood fighting actions and post flood infrastructure repair.
SGC-A-25.1.3.2	Action Step	Storms and Flooding	Flood control projects or other modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	2	60	County of San Mateo, FEMA, NMFS, RWQCB, USACE						0	Not building flood control projects will not incur expenses.
SGC-A-25.1.3.3	Action Step	Storms and Flooding	Modify Federal, State, city and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	2	10	FEMA, San Mateo County						TBD	
SGC-A-26.1	Objective	Water Diversion and Impoundment	Improve current laws and policies to control diversions and water use in order to maintain and restore surface flows.										
SGC-A-26.1.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon by establishing a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage (DFG 2004).										
SGC-A-26.1.1.1	Action Step	Water Diversion and Impoundment	Develop and enforce stream flow bypass requirements for diversions in San Gregorio Creek and its tributaries.	1	6	CDFG, NMFS, Private Consultants, SWRCB	33.33	33.33	33.33	33.33	33.33	200	Significant work regarding flow is currently occurring in San Gregorio Creek. These data should be leveraged, and it is anticipated that there will be a significant cost savings regarding the recommendation to develop bypass requirements. Most of the costs will involve enforcement of these conditions through the existing water master.
SGC-A-26.1.2	Recovery Action	Water Diversion and Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.										
SGC-A-26.1.2.1	Action Step	Water Diversion and Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	2	5	CDFG, NMFS, RWQCB, San Mateo County, SWRCB, USFWS						TBD	

San Gregorio Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SGC-A-26.1.3	Recovery Action	Water Diversion and Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	2	20	Farm Bureau, NMFS, San Mateo RCD, SWRCB, USACE						TBD	
SGC-A-26.1.4	Recovery Action	Water Diversion and Impoundment	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	1	60	SWRCB						TBD	
SGC-A-26.1.5	Recovery Action	Water Diversion and Impoundment	Ensure water supply demands can be met without impacting flow either directly or indirectly through groundwater withdrawals and aquifer depletion.										
SGC-A-26.1.5.1	Action Step	Water Diversion and Impoundment	Continue to prohibit new or increased summer diversions.	1	60	SWRCB						0	
SGC-A-26.2	Objective	Water Diversion and Impoundment	Promote water conservation by the public, water agencies, agriculture, private industry, and the citizenry.										
SGC-A-26.2.1	Recovery Action	Water Diversion and Impoundment	Promote conjunctive use of water with water projects whenever possible to maintain or restore coho salmon habitat.	1	60	California Coastal Conservancy, CDFG, County of San Mateo, Farm Bureau, FishNet 4C, NMFS HCD, NOAA RC, NRCS, POST, Private Consultants, Private Landowners, San Mateo RCD, Trout Unlimited						TBD	Costs will vary significantly depending on landowner cooperation, infrastructure constraints, and types of infrastructure necessary to meet landowner needs. Due to the high degree of flow impairment in the watershed it is likely that significant infrastructure and coordination will be required to meet minimum flow requirements for coho salmon viability and therefore, costs will be significant.
SGC-A-26.3	Objective	Water Diversion and Impoundment	Develop new policies and regulations and or enforce existing policies and regulations to provide suitable flow conditions for CCC coho salmon.										
SGC-A-26.3.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon.										
SGC-A-26.3.1.1	Action Step	Water Diversion and Impoundment	Determine and monitor 1600 program compliance related to water diversions (DFG 2004).	1	1	CDFG	100					100	This estimate is for a DFG warden and biologist to work half time for one year in the watershed to review current levels of compliance.
SGC-A-26.3.1.2	Action Step	Water Diversion and Impoundment	Develop and implement regulations for groundwater use.	3	10	County of San Mateo, SWRCB	30.00	30.00	30.00	30.00	30.00	300	New County regulations should be adopted within five years for areas where overdraft and direct connectivity is identified.
SGC-A-26.4	Objective	Water Diversion and Impoundment	Petition the SWRCB to declare San Gregorio Creek fully appropriated during summer and fall months (DFG 2004).	1	60	SWRCB						0	
SGC-A-26.4.1	Recovery Action	Water Diversion and Impoundment	Continue funding of a water master to enforce allocations.	1	60	Private Landowners, San Mateo County, SWRCB						0	This is an ongoing requirement per the adjudication in San Gregorio and should not be considered an additional expense.

SAN LORENZO RIVER

San Lorenzo River

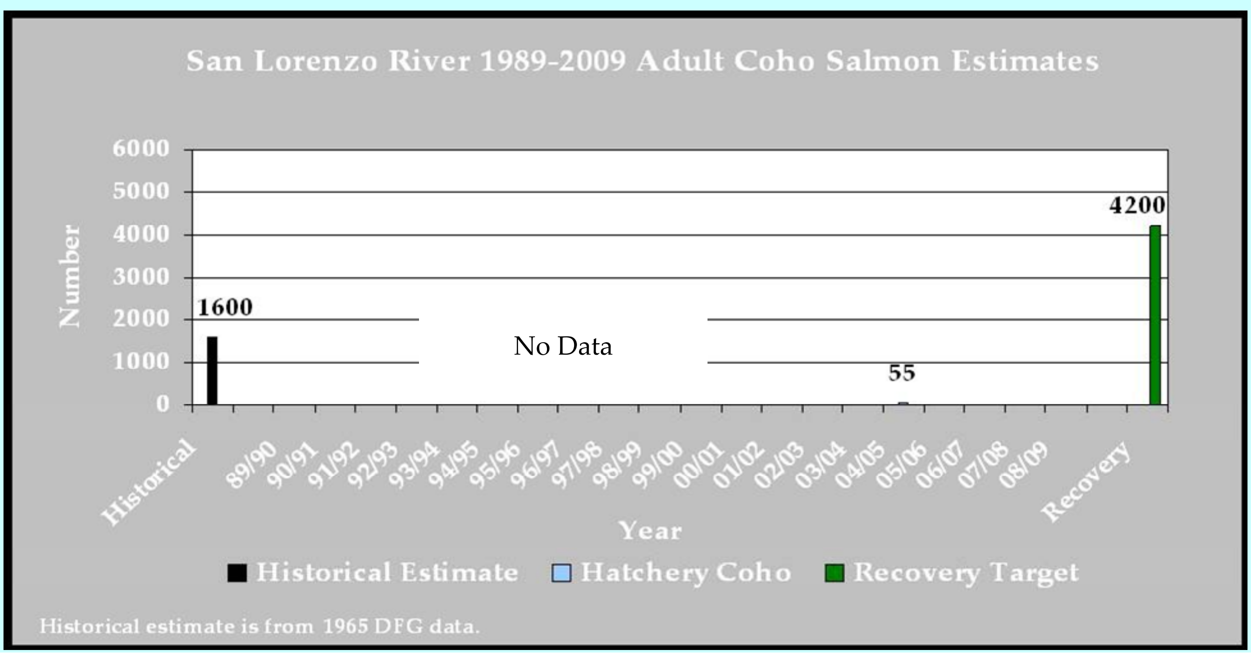
Independent Population
126.4 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

San Lorenzo River drains approximately 139 square miles of the Santa Cruz Mountains in western Santa Cruz County. The San Lorenzo River enters the Pacific Ocean at the city of Santa Cruz. About 62 percent of the San Lorenzo River watershed is coniferous forest and about 22 percent of the watershed area is either shrub or grasslands, the reaming 16 percent is urban development. To date, 83 percent of the San Lorenzo River watershed has been evaluated for erodibility. Eighty-nine percent of the San Lorenzo River watershed that has been evaluated has moderate to high erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. The EPA listed the San Lorenzo River as having water quality impaired for sediment and pathogens in 2006. The water quality impairment listing determined that sediment and pathogens were impairing habitats beneficial to coho salmon including migration, spawning, and rearing habitats, and identified urban runoff during storm events, septic seepage and discharge, and natural sources as the probable causes. Ninety percent of the San Lorenzo River watershed is in private ownership; the remaining ten percent is state owned parks and university lands. Within the past ten years, about nine percent of the San Lorenzo River watershed has been under timber harvest plans. Housing development within the San Lorenzo River watershed is high; approximately 34,000 housing units are present in the watershed. There are numerous partial barriers in the San Lorenzo, many of these are formed by road crossings and abutments for recreational summer dams. The current southern extent of the CCC-Coho ESU is the San Lorenzo River; however, coho salmon are extirpated in the San Lorenzo River. A major cause of the numerous limiting factor in the San Lorenzo results from the high amount of urban interface adjacent to the river and its tributaries. The high density of housing close to the river promotes detrimental practices such as bank stabilization, loss of riparian buffers, and removal of critical large woody debris by landowners.

San Lorenzo River
Photo © USGS

The Watershed at a Glance

Spawning Quantity & Quality:	**POOR to VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**GOOD**
Off channel/Floodplain Quality:	**POOR to FAIR**
Estuary Function:	**POOR**



San Lorenzo River

Recovery Target: 4,200 Adult Coho Salmon

Increasing the survival of coho salmon

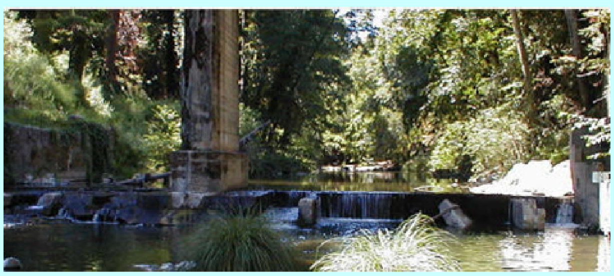
requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Residential and Commercial Development
- Roads and Railroads
- Storms and Flooding
- Droughts
- Fire and Fuel Management
- Channel Modification
- Climate Change
- Water Diversion and Impoundment
- Disease, Predation, and Competition
- Logging and Wood Harvesting
- Fishing and Collecting

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the San Lorenzo River watershed that are in poor condition. The highest priorities for restoration are to:

- Increase and protect the spawning habitat
- Ensure adequate flows year round
- Increase and improve pool habitat
- Decrease in-stream temperatures
- Increase and improve off channel habitat
- Increase the amount of large wood in all streams
- Decrease and reduce the impacts from roads
- Minimize sediment
- Improve water quality



Passage impediment on San Lorenzo River
Photo by D.W. ALLEY & Associates

Advancing recovery of coho

salmon in San Lorenzo River requires these priority **recovery actions:**

- Create flood refuge habitat such as hydrologically connected floodplains with riparian forest, or removal or setback of levees, and use streamway concept where appropriate.
- Identify historical habitats lacking in channel complexity and promote restoration projects designed to create pool scour, velocity refuge, and cover.
- Implement a private roads sediment reduction program to improve gravel quality and flow augmentation.
- Evaluate and monitor all water diversions for compliance with state regulations.
- Minimize potential impacts from commercial and residential development such as faulty septic systems and the ongoing LWD removal activities to protect infrastructure from potential erosion.

. . . in this **core area:** Bean Creek; **and**
Phase I areas: Zayante Creek, Bean Creek, Branciforte Creek, Bear Creek, and Boulder Creek planning watersheds

Conservation Highlights

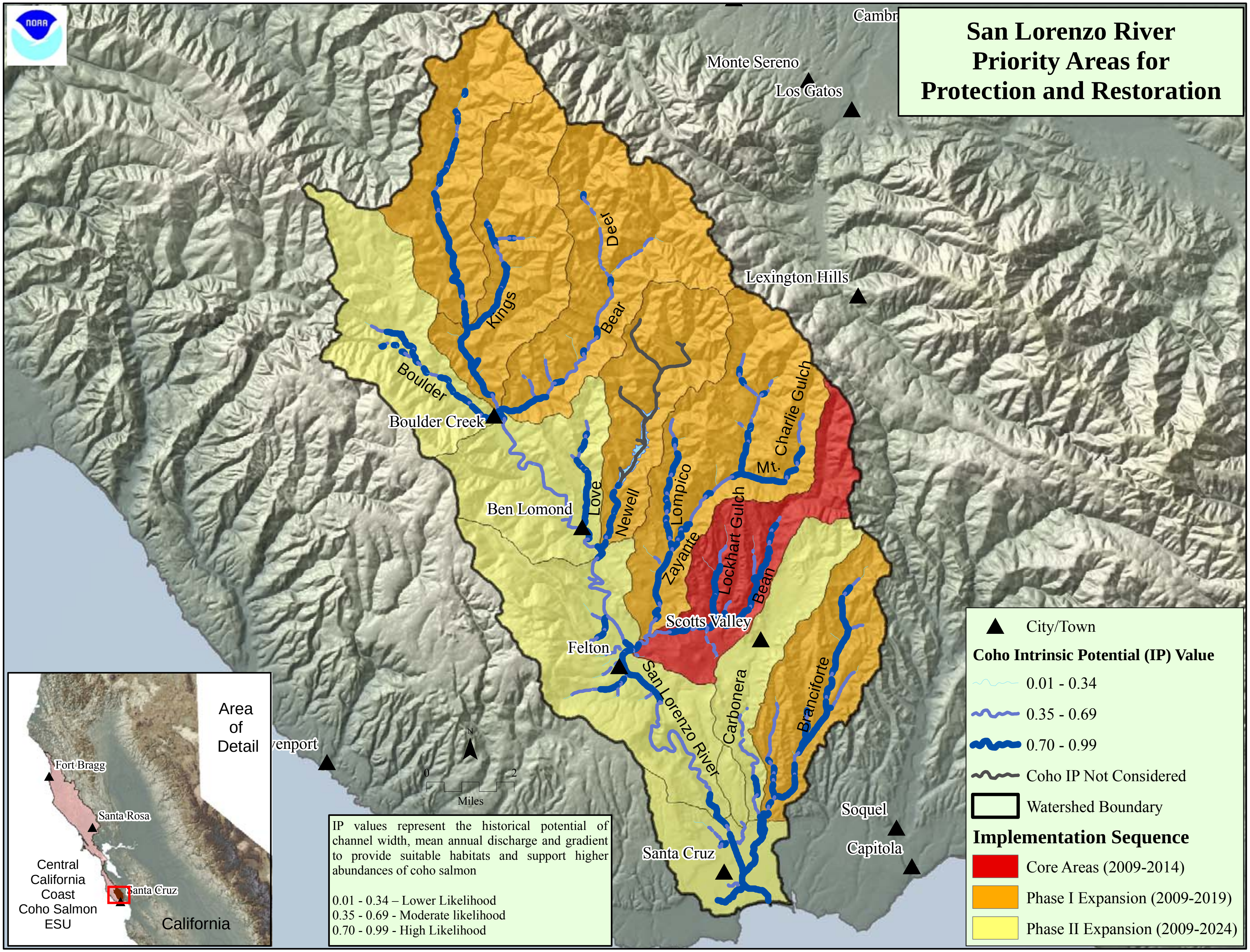
- The San Lorenzo Valley Water Agency and the County of Santa Cruz are funding annual juvenile abundance surveys
- The Santa Cruz RCD and the California Coastal Conservancy are involved in numerous barrier removal/modification and sediment remediation projects
- The City of Santa Cruz is developing a HCP

Recovery Partners

Santa Cruz Fish and Wildlife Advisory Board
County of Santa Cruz
San Lorenzo River Restoration Institute
Sempervirens Fund
RWQCB
San Jose State University
City of Santa Cruz
Santa Cruz RCD
DFG
US Army Corps of Engineers
San Lorenzo Valley Water Agency
Monterey Bay Salmon and Trout Project

Immediate Needs

Develop a coordinated watershed strategy √
Address the sediment input from rural roads √



San Lorenzo River Priority Areas for Protection and Restoration
Cambr
Monte Sereno
Los Gatos
Lexington Hills
Deer
Kings
Bear
Boulder
Boulder Creek
Charlie Gulch
Mt.
Lompico
Newell
Love
Ben Lomond
Zayante
Lockhart Gulch
Bean
Scotts Valley
Felton
San Lorenzo River
Carbonera
Branciforte
venport
Soquel
Capitola
Santa Cruz
0
2
Miles
N
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Coho IP Not Considered
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
San Lorenzo River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	83	Poor	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	81%	Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	66,492 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<600 m^2	600-6000 m^2	6000-11400 m^2	>11400 m^2
NMFS	Best Prof. judgment	>10% of pop.	Poor	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	58	Fair	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	83	Poor	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	>75 (score)	Poor	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	28.5	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	3%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	28.5	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Poor	Poor	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	>75 (score)	Poor	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	6.77/10 IP-km	Poor	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	28.5	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	59%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	5.69%	Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.34%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	6%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	0.02	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	64%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	88%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	7 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	8.8 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Poor	Poor	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

San Lorenzo River Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Residential and Commercial Development	Medium	High	High	High	Very High	Very High			Very High
2	Roads and Railroads	Medium	High	High	High	Very High	Very High			Very High
3	Storms and Flooding	Medium	High	Medium	High	Very High	High			Very High
4	Droughts	High	Medium	Very High	Medium	High	Medium			High
5	Fire and Fuel Management	Medium	High	High	Medium	High	High			High
6	Channel Modification	Medium	Low	High	High	High	High			High
7	Water Diversion and Impoundment	High	Medium	High	Medium	High	-			High
8	Disease, Predation, and Competition	High	-	High	-	High	-			High
9	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	High	High			High
10	Recreational Areas and Activities	Medium	Low	High	Medium	High	Medium			High
11	Climate Change	Medium	Medium	High	Medium	Medium	Medium			High
12	Fishing and Collecting	High	-	Medium	Low	Medium	-			Medium
13	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
14	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium			Medium
15	Mining	Medium	Low	Low	Medium	Medium	Medium			Medium
16	Hatcheries and Aquaculture	Medium	-	-	Low	Low	-			Low
Threat Status for Targets and Project		Very High	High	Very High	High	Very High	Very High	-	-	Very High

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
SLR-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.	2		CDFG, NOAA RC, Private Consultants, Private Landowners						0	
SLR-A-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	3	30	California Coastal Conservancy, CalTrans, CDFG, City of Santa Cruz, Santa Cruz County, Santa Cruz RCD, USACE						TBD	Lower priority for coho but will benefit smolt transition and adult upmigration.
SLR-A-1.1.1.2	Action Step	Estuary	Remove structures impairing or reducing the historical feeding and salt water transition habit where feasible and where benefits to coho salmon and/or the estuarine environment are predicted. Evaluate benefits to lagoon tidal prism from modification and/or reduction in the size of Santa Cruz Boardwalk Amusement Park's parking lot.	3	30	CA Coastal Commission, California Coastal Conservancy, CDFG, City of Santa Cruz, Santa Cruz County, Santa Cruz RCD, USACE, USFWS						TBD	Costs of implementation will likely be significant. A new parking area may need to be constructed/designated for the area adjacent to the lagoon. This action will result in direct benefits for year-round rearing for federally listed CCC steelhead and benefit overall water quality in the lagoon. Benefits to CCC coho will be directed at smolt outmigration in preparation for ocean entry.
SLR-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										Emphasis should be directed at remaining floodplain habitats in Core and Priority 1 areas. This recommendation may be very costly and costs should be balanced with biological benefits and risks to floodplain function.
SLR-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.	1	60	California Coastal Conservancy, CDFG, City of Santa Cruz, FishNet 4C, NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD, USACE	333	333	333	333	333	20,000	This action addresses multiple poor habitat attributes and results in long term benefits by addressing a major underlying threat. Levee setback is unlikely on the San Lorenzo River due to the high concentration of urban infrastructure and recent rebuild of the lower levees by the Corps. However, this concept should be applied opportunistically, particularly in areas where biological benefits are predicted.
SLR-A-2.1.2	Recovery Action	Floodplain	Santa Cruz County and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.										
SLR-A-2.1.2.1	Action Step	Floodplain	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	15	CalTrans, City of Santa Cruz, FishNet 4C, Private Landowners, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD	6.67	6.67	6.67	6.67	6.67	100	Cost is for establishment of the program.
SLR-A-2.1.2.2	Action Step	Floodplain	Evaluate watershed for infrastructure at high risk of flooding.	3	10	City of Santa Cruz, FEMA, NRCS, Santa Cruz County, Santa Cruz RCD, State Parks	10.00	10.00	10.00	10.00	10.00	100	Most of these structures have likely been identified. Cost associated with ground truthing and site specific evaluation.
SLR-A-2.1.2.3	Action Step	Floodplain	Avoid new development within riparian zones and the 100 year floodprone zones.	1	60	City of Santa Cruz, FEMA, Private Landowners, Santa Cruz County						0	This cost is minimal and should result in a significant cost savings overtime due to avoidance of flood fighting and flood protection.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-2.1.2.4	Action Step	Floodplain	Consider raising structures in floodprone areas where appropriate.	3	60	FEMA, Private Landowners, Santa Cruz County						TBD	This should occur on an opportunistic basis. May result in long term cost savings due to avoidance of flood fighting and insurance savings. This type of action occurred in the Felton Grove area.
SLR-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
SLR-A-3.1.1	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
SLR-A-3.1.1.1	Action Step	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.	1	10	California Coastal Conservancy, CDFG, City of Santa Cruz, NMFS, NOAA RC, San Lorenzo Valley Water Agency, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, SWRCB	200	200	200	200	200	2,000	Cost will be for outreach and modeling of potential solutions to address ongoing depletion of summer baseflow in the watershed. Initial efforts should be focused in Core and Priority I areas.
SLR-A-3.1.1.2	Action Step	Hydrology	Work with SWRCB and landowners to maintain or re-establish natural flow regimes for smolt migration if determined to be limiting during all water years.	3	20	CDFG, City of Santa Cruz, NMFS, Private Landowners, San Lorenzo Valley Water Agency, Santa Cruz County Fish and Wildlife Advisory Board, SWRCB	10.00	10.00	10.00	10.00	10.00	200	Costs will included evaluation of critical passage areas and modeling of potential flow solutions during April and May to ensure smolts are able to access the ocean. Likely most limiting during drought periods.
SLR-A-3.1.2	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
SLR-A-3.1.2.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	20	California Coastal Conservancy, CDFG, NOAA RC, Private Landowners, San Lorenzo Valley Water Agency, Santa Cruz County, Santa Cruz RCD, SWRCB, Trout Unlimited	45.00	45.00	45.00	45.00	45.00	900	Promoting these type of projects will require a sustained effort to target willing landowners in critical stream reaches. Incentive programs devised by the numerous water agencies in the San Lorenzo River for individual rate payers could result in rapid acceptance of these types of water conservation programs.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-3.1.2.2	Action Step	Hydrology	Promote conjunctive use of water for water projects whenever possible to maintain or restore coho salmon habitat.	2	40	California Coastal Conservancy, CDFG, City of Santa Cruz, FishNet 4C, NRCS, Private Landowners, San Lorenzo Valley Water Agency, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD	2.50	2.50	2.50	2.50	2.50	100	Highlighting these issues will likely require the development of MOAs between water users.
SLR-A-3.1.3	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
SLR-A-3.1.3.1	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon. Focus initial efforts in Core and Phase 1 watersheds and the mainstem San Lorenzo River.	1	5	California Coastal Conservancy, CDFG, City of Santa Cruz, NMFS, San Lorenzo Valley Water Agency, Santa Cruz County, Santa Cruz RCD, SWRCB	100	100	100	100	100	500	Program can likely leverage off other assessment efforts in the San Lorenzo.
SLR-A-3.1.3.2	Action Step	Hydrology	Support SWRCB in regulating the use of streamside wells and groundwater.	1	60	CDFG, NMFS, NMFS OLE, Public, SWRCB						0	
SLR-A-3.1.3.3	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	1	60	CDFG, NMFS, Private Landowners, Public, SWRCB						TBD	Cost to promote SWRCB review existing diversions will likely vary between depending on the cooperation of the diverter.
SLR-A-3.1.3.4	Action Step	Hydrology	Work with the San Lorenzo Valley Water Agency to evaluate potential impacts to stream flow resulting from surface water diversions and timing of diversions. Encourage the San Lorenzo Valley Water Agency to adopt conservative protocols regarding yearly transition from surface water diversions to groundwater pumping.	1	5	CDFG, NMFS, San Lorenzo Valley Water Agency						TBD	Costs of working with the SLVWA should be minimal
SLR-A-3.1.4	Recovery Action	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	1	60	California Coastal Conservancy, CDFG, City of Santa Cruz, NMFS, NOAA RC, Private Landowners, San Lorenzo Valley Water Agency, Santa Cruz County Land Trust, Santa Cruz RCD, SWRCB						TBD	Costs will vary widely depending on quantity of water converted to instream use. Significant oversight by regulatory agencies may be required to ensure successful program implementation. Implementation and outreach should occur over the entire 60 year recovery horizon.
SLR-A-3.1.5	Recovery Action	Hydrology	Encourage the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	2	5	California Coastal Conservancy, City of Santa Cruz, NOAA RC, Private Landowners, Public, San Lorenzo Valley Water Agency, Santa Cruz County Fish and Wildlife Advisory Board	4.00	4.00	4.00	4.00	4.00	20	Cost should be minimal for outreach and education. Many existing documents exist and are part of some water agencies ongoing programs.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
SLR-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
SLR-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core and Phase I areas first.	1	5	City of Santa Cruz, FishNet 4C, NOAA RC, San Lorenzo Valley Water Agency, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Land Trust, Santa Cruz RCD, State Parks	4.00	4.00	4.00	4.00	4.00	20	A large part of this effort has been conducted through the work of Don Alley's sampling and San Lorenzo Salmonid Enhancement Plan. Most work will involve finding willing landowners and identifying specific reaches where LWD enhancement will create immediate benefits.
SLR-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	3	60							TBD	Costs should be minimal. This recommendation would be implemented only when an existing problem has been identified and is in needed of protection.
SLR-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	1	15	CalFire, California Coastal Conservancy, CalTrans, CDFG, City of Santa Cruz, FEMA, FishNet 4C, NMFS, NMFS OLE, NOAA RC, NRCS, Private Landowners, Public, RWQCB, San Lorenzo Valley Water Agency, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Land Trust, Santa Cruz RCD, State Parks, USACE	133	133	133	133	133	2,000	Costs estimates may vary depending on restoration approach adopted by landowners and funding agencies. Due to the large amount of urban interface adjacent to important spawning and rearing habitats in the San Lorenzo it is anticipated that many of the structures will be secured and engineered which will result in significant increases in cost. If unsecured LWD structures are placed into the wetted channel (at 1.5 to 2 times bankfull) costs may be significantly reduced. Installing unsecured LWD in sparsely populated Phase 1 watersheds should be pursued by regulatory and funding agencies as one of the highest restoration priorities in the San Lorenzo River watershed.
SLR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
SLR-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
SLR-A-8.1.1.1	Action Step	Sediment	Conduct a road survey beginning with inner gorge roads in sandy soils followed by roads in other settings.	2	20	CalFire, California Department of Mines and Geology, CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD	10.00	10.00	10.00	10.00	10.00	200	Costs are based on the fact that this work has been conducted in many subbasins in the watershed and additional assessments for these areas are not needed. Initial focus should be directed at the lower reaches of Bean, Zayante, Love, and Newell Creeks.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-8.1.2	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
SLR-A-8.1.2.1	Action Step	Sediment	Encourage County of Santa Cruz to increase enforcement of existing County regulations regarding grading, riparian and building violations, and sediment release from county roads.	1	60	Santa Cruz County						TBD	Costs would involve increased enforcement by County staff.
SLR-A-8.1.2.2	Action Step	Sediment	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF).	2	60								Core areas are the highest priority, followed by Phase I areas.
SLR-A-8.1.3	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										
SLR-A-8.1.3.1	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	3	60	CalFire, California Coastal Conservancy, California Department of Mines and Geology, CalTrans, CDFG, City of Santa Cruz, FEMA, NMFS, NOAA RC, NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD, SWRCB						0	Costs should be minimal because this should be adopted as a standard business practice of all agencies.
SLR-A-8.1.4	Recovery Action	Sediment	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage and support landowners who conduct operations in a manner compatible with CCC coho salmon recovery priorities.										
SLR-A-8.1.4.1	Action Step	Sediment	Develop a private road improvement fund to share costs and encourage private road associations to upgrade poorly constructed or improperly located roads.	3	60	CalTrans, NRCS, Private Landowners, Public, Santa Cruz County, Santa Cruz RCD, SWRCB						TBD	Costs would depend on outreach success of the program.
SLR-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
SLR-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key habitat attributes across the San Lorenzo River watershed. Prioritize Core area tributaries, followed by Phase I areas.										
SLR-A-9.1.1.1	Action Step	Viability	To better understand changes in sedimentation, monitoring in the basin should include: longitudinal profiles, cross-sections, V*, LWD volume and distribution, and embeddedness.	3	60	CDFG, City of Santa Cruz, NMFS, NOAA SWFSC, Santa Cruz County Fish and Wildlife Advisory Board						TBD	Standardized monitoring methods should be used to evaluate long-term effectiveness of restoration efforts. Monitoring should likely occur in a few select and representative watersheds.
SLR-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
SLR-A-9.1.2.1	Action Step	Viability	Upgrade the Felton diversion facility to allow assessment of smolt outmigration in addition to ongoing adult monitoring.	1	5	CDFG, City of Santa Cruz, NMFS, NOAA SWFSC, Santa Cruz County Fish and Wildlife Advisory Board	24.00	24.00	24.00	24.00	24.00	120	

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-9.1.2.2	Action Step	Viability	Continue ongoing juvenile sampling efforts in the watershed. Establish consistent reporting methods to ensure ESU-wide consistency.	3	10	CDFG, NOAA RC, Private Consultants, San Lorenzo Valley Water Agency, Santa Cruz County	40.00	40.00	40.00	40.00	40.00	400	
SLR-A-9.1.3	Recovery Action	Viability	Refine assessment methods to more accurately identify and measure key habitat attributes.										
SLR-A-9.1.3.1	Action Step	Viability	Implement standardized assessment protocols (i.e., DFG habitat assessment protocols) to ensure ESU-wide consistency.	3	60	CDFG, NOAA RC, NOAA SWFSC, Public						TBD	While standard methods are available, outreach will be required to encourage all landowners to utilize them. Costs for outreach and education are difficult to determine due to an unknown number of participants, staff turnover, etc. Costs for a statewide outreach and education program were estimated at $60K (DFG 2004). Costs for a watershed specific program would likely be a fraction of that.
SLR-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
SLR-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
SLR-A-10.1.1.1	Action Step	Water Quality	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	1	10	CalFire, California Coastal Conservancy, CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, Water Agencies	15.00	15.00	15.00	15.00	15.00	150	Initial costs of developing this program would likely be minor due to past efforts to educate the County and Public. This recommendation will require a sustained effort in order to change the perceptions of the public regarding watershed conditions and properly functioning conditions necessary for a viable fishery.
SLR-A-10.1.1.2	Action Step	Water Quality	Encourage County to develop property easement acquisition funds and acquire grant monies to purchase eroding private properties in riparian corridors or properties subject to frequent flooding though a buyout program.	3	60	Private Landowners, Santa Cruz County						TBD	Initial costs of developing such a program may be high in some areas, but long-term cost savings also likely to be high.
SLR-A-10.1.1.3	Action Step	Water Quality	Encourage County of Santa Cruz to establish wider riparian buffers in residential and urban areas.	3	60	CDFG, NMFS, Public, RWQCB, Santa Cruz County	1.67	1.67	1.67	1.67	1.67	100	Establishing a policy for new development will help minimize future impacts associated with flooding, impacts to water quality, and costs associated with flood fighting actions. Policy changes should include adequate funding for compliance monitoring and enforcement by the County.
SLR-A-10.1.1.4	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	3	60	CalFire, California Coastal Conservancy, NOAA RC, RWQCB, Santa Cruz RCD						TBD	Costs cannot be determined until an inventory of specific areas and opportunities for implementation are determined.
SLR-A-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
SLR-A-12.1.1	Recovery Action	Channel Modification	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
SLR-A-12.1.1.1	Action Step	Channel Modification	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	1	60	Private Landowners, Public, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz RCD, State Parks						0	Cost of allowing natural riparian processes to occur are minimal.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-12.1.1.2	Action Step	Channel Modification	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	1	2	CDFG, Santa Cruz County	10.00	10.00				20	Cost of policy development are expected to be minimal.
SLR-A-12.1.2	Recovery Action	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.	2	60	CA Coastal Commission, California Coastal Conservancy, California Department of Mines and Geology, CalTrans, City of Santa Cruz, FEMA, NMFS, NOAA RC, NRCS, Private Landowners, Public, RWQCB, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz RCD, State Parks						TBD	This should become a standard business practice for all agencies and consulting firms engaged in constructing and designing solutions to address channel stability.
SLR-A-12.1.2.1	Action Step	Channel Modification	Evaluate whether proposed stabilization projects will lead to additional instability either up- or downstream.	2	60	California Coastal Conservancy, California Department of Mines and Geology, CalTrans, CDFG, City of Santa Cruz, FEMA, NMFS, NOAA RC, Private Landowners, Public, RCD, RWQCB, Santa Cruz County, Santa Cruz RCD, State Parks						TBD	This recommendation should be adopted as a standard business practice for all agencies and consulting firms involved in actions that address stream stability.
SLR-A-12.1.2.2	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	60	CalFire, California Coastal Conservancy, California Department of Mines and Geology, CalTrans, CDFG, City of Santa Cruz, FEMA, NMFS, NOAA RC, NRCS, Private Landowners, Public, RWQCB, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Land Trust, Santa Cruz RCD, State Parks, USACE						0	Eliminating gabion baskets will result in long-term cost savings due implementation of longer lasting and better engineered solutions.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-12.1.3	Recovery Action	Channel Modification	Encourage the City of Santa Cruz to provide adult and smolt passage through the Lower San Lorenzo River and the flood control channel on Branciforte Creek according to recommendations in the Lower San Lorenzo River and Lagoon Management Plan.	2	10	CDFG, City of Santa Cruz, NMFS, NOAA RC, USACE	20.00	20.00	20.00	20.00	20.00	200	The City should immediately install baffles into existing slots in the Branciforte flood control channel as an interim measure.
SLR-A-12.1.4	Recovery Action	Channel Modification	Modify Federal, State, city and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	2	60							TBD	Santa Cruz County has many policies that, if effectively and consistently implemented, would be effective at protecting watershed processes. Modification of existing policies and/or creation of new policies will likely be controversial and implementation costs may be high. Available information indicates the County lack adequate funding to effectively enforce their current policies.
SLR-A-14.1	Objective	Disease, Predation, and Competition	Evaluate suitable methods and levels of marine mammal control when predation is identified as a significant limiting factor to recovery on an individual watershed basis.	3	10	CDFG, FishNet 4C, NMFS OLE, NOAA SWFSC, USFWS						TBD	Costs will likely be significant. This strategy will require extensive permitting and should only be implemented where a clear and significant benefit is predicted.
SLR-A-14.2	Objective	Disease, Predation, and Competition	Implement regulatory, abatement, and education measures to prevent the invasion of exotic species, (including exotic plants).	3	60	California Coastal Conservancy, CalTrans, City of Santa Cruz, NOAA RC, Private Landowners, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, State Parks						TBD	
SLR-A-15.1	Objective	Droughts	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts while also providing for CCC coho salmon recovery needs.	3									
SLR-A-15.1.1	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
SLR-A-15.1.1.1	Action Step	Droughts	Develop and implement critical flow levels for stream reaches impacted by water diversions.	1	10	CDFG, City of Santa Cruz, Lompico Water District, NMFS, NMFS OLE, Private Landowners, San Lorenzo Valley Water Agency, SWRCB						TBD	
SLR-A-15.1.1.2	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	1	10	CDFG, City of Santa Cruz, Lompico Water District, NMFS, NMFS OLE, Private Landowners, San Lorenzo Valley Water Agency, SWRCB						TBD	Assessment and implementation costs cannot be determined at this time

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-15.1.1.3	Action Step	Droughts	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by municipal water suppliers and other users in the watershed through conservation programs.	1	20	CDFG, City of Santa Cruz, Lompico Water District, NMFS, NMFS OLE, NRCS, Private Landowners, Public, San Lorenzo Valley Water Agency, Santa Cruz RCD, SWRCB, USFWS						TBD	Costs may be significant and cannot be predicted at this time. Initial focus should include the "Rincon" and "Three Rock" areas in the lower San Lorenzo River. These areas should be evaluated in light of the permitted diversion by the City of Santa Cruz at the Felton Diversion Dam.
SLR-A-15.1.1.4	Action Step	Droughts	Prohibit filling of all recreational instream summer dams during drought periods.	3	60	CDFG, NMFS OLE						0	Costs is expected to be minimal.
SLR-A-15.1.1.5	Action Step	Droughts	Modify low flow barriers through the Branciforte Creek flood control channel.	2	10	CDFG, City of Santa Cruz, NMFS HCD, USACE							As a short-term measure the City of Santa Cruz should install baffles into pre-existing slots in the flood control channel until a more significant fix is implemented. See "Channel Modification" for cost estimate.
SLR-A-15.1.2	Recovery Action	Droughts	Investigate feasibility of desalination to prevent stream dewatering and ensure a more stable source of water overtime.										
SLR-A-15.1.2.1	Action Step	Droughts	Encourage City of Santa Cruz to adequately size proposed desalination facility to facilitate reduced river diversions during drought periods.	2	10	CDFG, NMFS, NMFS OLE, San Lorenzo Valley Water Agency, Scotts Valley Water District, SWRCB, Water Agencies						TBD	Pooling of resources with other water agencies in Santa Cruz County could result in significant cost savings.
SLR-A-15.1.2.2	Action Step	Droughts	Encourage other water users (i.e., San Lorenzo Valley Water Districts, Lompico Water District, Scott Valley Water District, etc.) to investigate feasibility of working with cities of Santa Cruz and Soquel to help fund desalination facility that could provide additional water to upper San Lorenzo Valley water customers during drought conditions.	2	20	CDFG, City of Santa Cruz, Lompico Water District, NMFS, San Lorenzo Valley Water Agency, Santa Cruz County, Scotts Valley Water District, SWRCB						TBD	
SLR-A-15.1.3	Recovery Action	Droughts	Manage Loch Lomond reservoir to maintain suitable rearing conditions in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).										
SLR-A-15.1.3.1	Action Step	Droughts	Re-evaluate City of Santa Cruz's water right for Loch Lomond Reservoir to determine whether dam re-operation could result in benefits to the coho salmon and CCC steelhead fisheries in the watershed.	2	5	CDFG, City of Santa Cruz, NMFS HCD, SWRCB						TBD	All new development should demonstrate that water is available prior to construction. Cost cannot be determined at this time.
SLR-A-15.1.4	Recovery Action	Droughts	Identify and eliminate depletion of summer base flows from unauthorized water uses.	1	60	CDFG Law Enforcement, NMFS OLE, SWRCB						TBD	This is a largely regulatory action that will likely require oversight from the State Water Resources Control Board as well as NMFS OLE and DFG. This recommendation will likely need to continue over the entire recovery horizon.
SLR-A-15.1.4.1	Action Step	Droughts	Encourage SWRCB to bring diversion dams in Hare Creek into compliance with State law.	3	5	CDFG, NMFS, NMFS OLE, SWRCB						0	Providing information to the SWRCB should be of little expense.
SLR-A-15.1.4.2	Action Step	Droughts	Encourage Lompico Water District to come into compliance with DFG streambed alteration requirements.	2	3	CDFG, NMFS, NMFS OLE, Public, SWRCB						0	Cost of informing the Water District of bypass requirements should be minimal. The Lompico Water District has been informed by the regulatory agencies many times in the past regarding concerns over ongoing operations and impacts to listed salmonids.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-15.1.4.3	Action Step	Droughts	Ensure all diversions in the watershed are in compliance with all applicable laws and policies.	1	60	CDFG, City of Santa Cruz, NMFS PRD, Private Landowners, RWQCB, Santa Cruz County, SWRCB, USACE						TBD	
SLR-A-15.1.4.4	Action Step	Droughts	Protect sources of cool water input from future diversion.	1	60	CDFG, City of Santa Cruz, NMFS PRD, Private Landowners, RWQCB, Santa Cruz County, SWRCB, USACE						TBD	Cost of protecting these cool water sources is expected to be minimal. Areas of attention should be placed on protecting cool water inflow from natural springs. Particular focus should be placed on springs in Bean Creek near the Zayante Creek confluence and the lower San Lorenzo River (i.e. Pognip).
SLR-A-15.1.4.5	Action Step	Droughts	Work with DFG, County of Santa Cruz, municipalities (including all water districts in the San Lorenzo watershed), and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	2	10	CDFG, NMFS, Private Consultants, Santa Cruz County, SWRCB	15.00	15.00	15.00	15.00	15.00	150	Costs may include consulting expertise to construct a water budget for the San Lorenzo River.
SLR-A-15.1.4.6	Action Step	Droughts	Increase enforcement patrols by DFG and NMFS OLE in sensitive spawning and rearing areas.	2	0	CDFG Law Enforcement, NMFS OLE						0	Costs are anticipated to be absorbed into ongoing activities.
SLR-A-15.1.4.7	Action Step	Droughts	Target problematic summer dams in Branciforte Creek for removal.	3	20	CDFG, NOAA RC, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD	25.00	25.00	25.00	25.00	25.00	500	Costs were estimated for removal of summer dam in cooperation with willing landowners.
SLR-A-15.1.5	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, Caltrans, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	3	10	CalFire, CalTrans, CDFG, NMFS, RWQCB, SWRCB						TBD	
SLR-A-15.1.6	Recovery Action	Droughts	Evaluate performance of all existing fish ladders on the San Lorenzo River to pass migrating fish during drought conditions.	2	5	CalTrans, CDFG, NOAA RC, Santa Cruz County	3.00	3.00	3.00	3.00	3.00	15	Evaluation should include an evaluation of existing maintenance requirements and development of landowner agreements where appropriate.
SLR-A-16.1	Objective	Fire and Fuels Management	Develop measures protective of salmonids during fire suppression activities.										
SLR-A-16.1.1	Recovery Action	Fire and Fuels Management	Establish fire contingency plan developed by experts from CalFire, local fire districts, San Mateo RCD, and regulatory agencies with expertise in fisheries issues.										
SLR-A-16.1.1.1	Action Step	Fire and Fuels Management	Encourage CalFire to provide plan to all non-County fire fighters when providing fire fighting assistance in the Soquel Creek watershed (and all other watersheds in the County).	1	60	CalFire						0	Cost of providing the plan is minimal.
SLR-A-16.1.1.2	Action Step	Fire and Fuels Management	In the event of a wildfire, we recommend CalFire Resource Advisors contact the resource agencies for ESA consultation (or technical assistance) regarding the incident. The resource agencies can provide guidance regarding critical resources in the area that may be affected by fire fighting actions.	2	60	CalFire						0	Guidance could include informing CalFire in regards to the presence of sensitive biological resources in the watershed as well as recommendations regarding watersource locations (e.g., picking up water from areas other than San Lorenzo River lagoon). Protocols, similar to those recommended here, are already in place between USFWS, NMFS, BLM, and USFS which could provide a template for CalFire.
SLR-A-16.1.1.3	Action Step	Fire and Fuels Management	Implement sedimentation reduction techniques in concert with prescribed fire techniques to minimize sediment impacts to various coho salmon life stages.	1	60	CalFire						0	This recommendation should be considered a standard practice.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SLR-CCC-16.1.1.4	Action Step	Fire and Fuels Management	Immediately implement appropriate sediment control measures following completion of fire suppression while fire fighters and fire fighting equipment are on site.	1	60	CalFire						0	This recommendation will result in a net cost savings.
SLR-CCC-16.1.1.5	Action Step	Fire and Fuels Management	Reduce erosion from fire prevention or suppression activities by maintaining existing natural topography to the extent possible.	1	60	CalFire						0	Implementing erosion control measures when constructing firebreaks (if possible) or shortly thereafter will likely result in a net cost savings. It is much more financially efficient to implement these measures while the fire crews are present rather than months later after the fire is out.
SLR-CCC-16.1.1.6	Action Step	Fire and Fuels Management	Re-contour any new facility sites as soon as possible after site clean up and fire.	3	60	CalFire						0	Standard business practice.
SLR-CCC-16.1.2	Recovery Action	Fire and Fuels Management	Disseminate NMFS' October 9, 2007, jeopardy biological opinion on the use of fire retardants to local fire fighting agencies and CalFire.	2	2	CalFire						0	
SLR-CCC-16.2	Objective	Fire and Fuels Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.										
SLR-CCC-16.2.1	Recovery Action	Fire and Fuels Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.										
SLR-CCC-16.2.1.1	Action Step	Fire and Fuels Management	Use managed fire to promote revegetation of species that filter out fine sediment.	3	60	CalFire						TBD	
SLR-CCC-16.2.1.2	Action Step	Fire and Fuels Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	2	5	CalFire, NRCS, Santa Cruz County						0	Costs are developed for the Aptos watershed. The fire plan could be used in the San Lorenzo River watershed.
SLR-CCC-16.2.1.3	Action Step	Fire and Fuels Management	Reassess fire risk every ten years.	3	60	CalFire						TBD	This is an ongoing program of CalFire and should continue. Additional costs are not anticipated.
SLR-CCC-16.2.1.4	Action Step	Fire and Fuels Management	Work with County planners to define future impacts of proposed urban and infrastructure development on fire suppression and fuel load buildup.	2	10	CalFire, Santa Cruz County	5.00	5.00	5.00	5.00	5.00	50	
SLR-CCC-17.1	Objective	Fishing and Collecting	Minimize bycatch of CCC coho salmon from offshore commercial and sport fishing.	2	60	CDFG, NMFS, Pacific States Marine Fisheries Commission						0	
SLR-CCC-17.1.1	Recovery Action	Fishing and Collecting	Conduct outreach and education to anglers to reduce hook-and-release injury and mortality, and on methods to reduce salmonid gut hooking.	3	5	CDFG, NMFS, NMFS OLE	4.00	4.00	4.00	4.00	4.00	20	
SLR-CCC-17.1.2	Recovery Action	Fishing and Collecting	Prohibit offshore fishing until January 15 (or until sandbars open naturally) within one mile of the river mouth.	3	10	CDFG, City of Santa Cruz, NMFS						0	
SLR-CCC-17.1.2.1	Action Step	Fishing and Collecting	Work with DFG to monitor the river mouth until river flows naturally breach the sandbar.	2	60	CDFG						0	Costs should already be covered as part of ongoing monitoring efforts. If river mouth has been artificially breeched with out appropriate authorization, prohibitions on offshore should continue until appropriate flows occur.
SLR-CCC-20.1	Objective	Logging and Wood Harvesting	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches, particularly where large woody debris is found lacking.	3	10	CDFG, FishNet 4C, NMFS OLE, NOAA SWFSC, USFWS						TBD	
SLR-CCC-20.2	Objective	Logging and Wood Harvesting	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
SLR-CCC-20.2.1	Recovery Action	Logging and Wood Harvesting	Provide information to the appropriate regulatory bodies regarding the status of CCC coho salmon, priority watershed processes needing consideration, and recommendations that provide no take or incidental take assurances.	1	60	CDFG, NMFS, NMFS OLE						0	Cost should be minimal as this should be considered a part of ongoing activities by regulatory agencies.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-20.2.2	Recovery Action	Logging and Wood Harvesting	Encourage a watershed-wide HCP for all or multiple landowners within a watershed to pool resources as a means to facilitate long-term survival and recovery for coho salmon and their habitat.	3	10	CalFire, CDFG, City of Santa Cruz, Lompico Water District, NMFS, Private Landowners, Public, San Lorenzo Valley Water Agency, Santa Cruz County Land Trust, Scotts Valley Water District, State Parks	200	200	200	200	200	2,000	Cost may be much higher depending on number of land owners and number of covered activities.
SLR-A-20.2.3	Recovery Action	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within Core, Phase I and Phase II CCC coho salmon areas.	2	20	CDFG, FishNet 4C, NMFS, NMFS OLE, NOAA RC, Private Landowners, Public, Santa Cruz RCD, State Parks	1.25	1.25	1.25	1.25	1.25	25	
SLR-A-20.2.3.1	Action Step	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	NMFS	20.00	20.00	20.00	20.00	20.00	200	This action would require funding of a 1/2 time NMFS position for the Santa Cruz Mountains Diversity Stratum. The need for this action may change if the California Forest Practice Rules change and reach a no-take standard or the state receives incidental take authorization through the HCP process.
SLR-A-20.2.4	Recovery Action	Logging and Wood Harvesting	Provide information to BOF regarding CCC coho salmon priorities and recommend upgrading relevant forest practices.	1	2	CalFire, CDFG, NMFS						0	Cost is minimal because NMFS/DFG already participate in meetings the Board of Forestry. However, periodic updates, due to changing Board members, is likely necessary.
SLR-A-20.3	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.	1	60	CalFire, CDFG, NMFS, Public, Santa Cruz County						TBD	
SLR-A-20.4	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
SLR-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	60	CDFG, NMFS, NMFS OLE						0	Cost should be minimal as this should be considered a part of ongoing activities by regulatory agencies.
SLR-A-20.4.1.1	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	60	CalFire, Santa Cruz County						0	Cost is expected to be minimal
SLR-A-20.4.1.2	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	60	CalFire, Private Landowners						TBD	Cost is contingent on future rate of harvest and existing condition of the road network.
SLR-A-20.4.1.3	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	2	60	CalFire, Private Landowners						TBD	Most of these costs will likely be associated with planned ongoing harvest plans.
SLR-A-20.4.1.4	Action Step	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	2	60	CalFire, CalTrans, Private Landowners, Santa Cruz County						TBD	This cost is expected to be minimal because these areas should be indentified prior to permitting. Data should be housed in a central County repository.
SLR-A-20.4.2	Recovery Action	Logging and Wood Harvesting	Allow trees in riparian areas to age, die, and recruit into the stream naturally.										
SLR-A-20.4.2.1	Action Step	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.	2	60	CalFire, Private Landowners, State Parks						0	Cost of managing riparian areas is anticipated to be minimal.
SLR-A-22.1	Objective	Recreational Areas and Activities	Cease installing and operating instream summer dams.										

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SLR-A-22.1.1	Recovery Action	Recreational Areas and Activities	Remove all existing summer dams that create a passage impediment to migrating adults or juveniles.	3	20	CDFG, NMFS PRD, NOAA RC, Private Landowners, Public, Santa Cruz County, USACE	750	750	750	750	750	15,000	Costs may be high due to sediment deposition behind some dams and subsequent analysis of downstream impacts resulting from dam removal/sediment removal. The total cost is unknown due to the uncertainties regarding the extent of the problems and landowner willingness. Some summer dams on the San Lorenzo River have been permitted by the Corps and DFG. All future Corps section 7 consultations should consider impacts to IP-km and the consequence of the action to coho viability and recovery.
SLR-A-22.1.2	Recovery Action	Recreational Areas and Activities	Implement the most recent NMFS' Guidelines for Summer Dams for all new summer dams seeking 1600 Agreement or Corps 404 permit.	1	60	CDFG, NMFS, NMFS OLE, Private Landowners						0	Cost should be minimal to use existing guidelines when evaluating summer dams.
SLR-A-22.2	Objective	Recreational Areas and Activities	Reduce sediment input from parks and other recreation areas.										
SLR-A-22.2.1	Recovery Action	Recreational Areas and Activities	Develop a Road Sediment Reduction Plan for parklands. Plan should prioritize sites and outline implementation and timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	3	20	Santa Cruz County, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, State Parks	25.00	25.00	25.00	25.00	25.00	500	Cost could be combined with other road assessment priorities in the watershed.
SLR-A-22.2.2	Recovery Action	Recreational Areas and Activities	Educate users (including mountain bikers, hikers, ORV users, etc) to help prevent or control erosion and sediment problems along the stream.	3	10	CDFG, City of Santa Cruz, NMFS, NOAA RC, Santa Cruz County, Santa Cruz County Parks and Cultural Resources, State Parks	2.00	2.00	2.00	2.00	2.00	20	Cost could be offset with other education programs in the County.
SLR-A-22.2.3	Recovery Action	Recreational Areas and Activities	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										
SLR-A-22.2.3.1	Action Step	Recreational Areas and Activities	Ensure hiking and biking paths are properly winterized prior to winter rains.	2	60	CalFire, City of Santa Cruz, Public, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, State Parks						TBD	This should be considered an ongoing road and trail management action and cost should be minimal
SLR-A-22.2.3.2	Action Step	Recreational Areas and Activities	Ensure roads, hiking trails, and biking paths are properly winterized prior to winter rains according to California Forest Practice Rules standards under section 916.5.	2	10	CalFire, NMFS, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, State Parks	100	100	100	100	100	1,000	Costs are for initial implementation of sediment control structures. Long-term maintenance cost should be absorbed into ongoing road maintenance programs.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-22.2.4	Recovery Action	Recreational Areas and Activities	Close unauthorized (pioneer) trails and conduct appropriate decommissioning practices. Hydrologically disconnect trails from associated waterways.	2	30	California Coastal Conservancy, California Department of Mines and Geology, City of Santa Cruz, NMFS, NOAA RC, Private Landowners, Public, RWQCB, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, State Parks						TBD	Costs cannot be determined until appropriate assessments have been conducted. Costs may vary significantly depending on type of road related problems and whether roads are closed or decommissioned.
SLR-A-22.3	Objective	Recreational Areas and Activities	Restore habitats located in recreation areas.	1	60	CalFire, CDFG, NMFS, Public, Santa Cruz County						TBD	
SLR-A-22.3.1	Recovery Action	Recreational Areas and Activities	Encourage “managed retreat” (removal and/or modification of problematic infrastructure).	3	30	CA Coastal Commission, California Coastal Conservancy, CDFG, City of Santa Cruz, NOAA RC, Private Landowners, Public, Santa Cruz County, Santa Cruz RCD						TBD	Costs of implementation will likely be significant. Examples include the Santa Cruz Boardwalk parking lot.
SLR-A-23.1	Objective	Residential and Commercial Development	Improve stream maintenance practices to protect instream complexity, hydrologic processes and riparian functions.										
SLR-A-23.1.1	Recovery Action	Residential and Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating CCC coho salmon.	3	1	CDFG, City of Santa Cruz, NMFS PRD, USACE	20.00					20	Most cost are anticipated to be the result of focus in the lower San Lorenzo River.
SLR-A-23.1.2	Recovery Action	Residential and Commercial Development	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).										
SLR-A-23.1.2.1	Action Step	Residential and Commercial Development	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	2	5	Santa Cruz County	2.00	2.00	2.00	2.00	2.00	10	Cost is expected to be minimal.
SLR-A-23.1.2.2	Action Step	Residential and Commercial Development	Remove logs and debris from streams only as a “last resort” (i.e., failure to remove them will certainly cause the loss of an essential facility) after consultation with a hydrologist and/or qualified fisheries biologist.	1	60	CDFG, NMFS PRD, Private Consultants, Santa Cruz County						TBD	Cost is unknown but requires successful implementation of the newly adopted LWD policies adopted by the County of Santa Cruz. Costs may be highly variable depending on water year and flooding. Years of lower rainfall will likely have less need for site by site evaluation and costs will be less in those years. Cost will be significantly greater in wet years as more LWD is recruited to the stream.
SLR-A-23.2	Objective	Residential and Commercial Development	Maintain and restore hydrologic function, protect riparian and floodplain areas, and minimize adverse effects to water quality and instream rearing habitats resulting from commercial and urban development.										
SLR-A-23.2.1	Recovery Action	Residential and Commercial Development	Encourage the State Division of Water Rights to evaluate water rights compliance in all sub-watersheds where new development is proposed.	1	60	Public, Santa Cruz County, SWRCB						0	Costs should be minimal and are considered part of SWRCB existing authority and obligation.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-23.2.2	Recovery Action	Residential and Commercial Development	As mitigation for hydrograph consequences, municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	2	60	City of Santa Cruz, City of Scotts Valley, RWQCB, Santa Cruz County						0	Costs variable. Some of these costs will be absorbed in more urbanized setting by the SWMP requirements from the RWQCB.
SLR-A-23.2.3	Recovery Action	Residential and Commercial Development	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.										
SLR-A-23.2.3.1	Action Step	Residential and Commercial Development	Encourage counties to develop property easement acquisition funds and acquire grant monies to purchase eroding private properties in riparian corridors or properties subject to frequent flooding though a buyout program.	2	60	FEMA, NMFS, Private Landowners, Santa Cruz County						TBD	
SLR-A-23.2.3.2	Action Step	Residential and Commercial Development	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	1	60	City of Santa Cruz, City of Scotts Valley, FEMA, Private Consultants, Santa Cruz County						0	Costs should be minimal if this concept is adopted early in the planning process for all new development.
SLR-A-23.2.3.3	Action Step	Residential and Commercial Development	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	1	60	CDFG, City of Santa Cruz, City of Scotts Valley, Private Consultants, Private Landowners, Santa Cruz County						0	
SLR-A-23.2.3.4	Action Step	Residential and Commercial Development	Modify all County General Plans to eliminate provisions allowing new construction in undeveloped areas within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	2	10	Santa Cruz County						0	Costs should be minimal if incorporated into updated general plan.
SLR-A-23.2.3.5	Action Step	Residential and Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	2	60	City of Santa Cruz, City of Scotts Valley, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD						0	
SLR-A-23.2.4	Recovery Action	Residential and Commercial Development	Support the development and implementation of regulations for activities that intercept groundwater recharge (e.g., use of subsurface tiles in vineyards, impervious surfaces, etc.).	2	60	City of Santa Cruz, City of Scotts Valley, Santa Cruz County						0	Costs of changing existing regulations should be minimal. Many existing templates for this type of action already exist and could be incorporated into new regulations.
SLR-A-23.2.5	Recovery Action	Residential and Commercial Development	Avoid, or at a minimum regulate, the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	1	60	Public, RWQCB, Santa Cruz County, USEPA						0	Costs should be minimal and are considered part of SWRCB existing authority and obligation.
SLR-A-23.2.5.1	Action Step	Residential and Commercial Development	Work with jurisdictional agencies to prohibit transport of highly toxic chemicals on Highway 9 road corridor through the San Lorenzo River watershed.	2	60	CalTrans, Santa Cruz County						TBD	
SLR-A-23.2.5.2	Action Step	Residential and Commercial Development	Encourage increased oversight by appropriate regulatory agencies of activities that use hazardous commercial and industrial products in the watershed.	2	60	RWQCB, Santa Cruz County, USEPA						TBD	
SLR-A-23.2.6	Recovery Action	Residential and Commercial Development	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	60	City of Santa Cruz, City of Scotts Valley, RWQCB, Santa Cruz County						TBD	Costs variable but could result in long term cost savings due to reduced flood fighting. Some of these costs will be absorbed in more urbanized setting by the SWMP requirements from the RWQCB.
SLR-A-23.2.7	Recovery Action	Residential and Commercial Development	Sediment from existing and future commercial and urban development should be reduced to magnitudes appropriate to the geological setting of the watershed, resulting in no net increase in sedimentation over natural limits.										

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SLR-A-23.2.7.1	Action Step	Residential and Commercial Development	Encourage counties and local municipalities to expand riparian buffer widths for new development (including redevelopment).	2	60	City of Santa Cruz, City of Scotts Valley, Santa Cruz County						0	Costs should be minimal if this concept is adopted early in the planning process for all new development.
SLR-A-23.2.7.2	Action Step	Residential and Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.	2	60	CalTrans, City of Santa Cruz, City of Scotts Valley, HUD, Private Landowners, RWQCB, Santa Cruz County, USACE						0	Stringent review by permitting agencies is expected to reduce costs associated with poorly planned and poorly located developments. County of Santa Cruz should avoid promoting low income housing in floodprone areas.
SLR-A-23.2.7.3	Action Step	Residential and Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	2	60	City of Santa Cruz, City of Scotts Valley, Santa Cruz County, USACE						TBD	Cost to upgrade stormwater discharge points cannot be determined at this time, but it may be significant.
SLR-A-23.2.8	Recovery Action	Residential and Commercial Development	Assess impacts of swimming pool cleaning, filling, and discharge into local creeks.	3	3	CDFG, CDFG Law Enforcement, NMFS OLE, Santa Cruz County	8.33	8.33	8.33			25	
SLR-A-23.3	Objective	Residential and Commercial Development	Minimize rate, and subsequent adverse affects, of land conversion to residential and commercial development.										
SLR-A-23.3.1	Recovery Action	Residential and Commercial Development	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.	2	60	CalFire, CDFG, City of Scotts Valley, NMFS, Private Landowners, Santa Cruz County						0	Costs of changing existing regulations should be minimal. Many existing templates for this type of action already exist and could be incorporated into new regulations.
SLR-A-23.3.2	Recovery Action	Residential and Commercial Development	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).										
SLR-A-23.3.2.1	Action Step	Residential and Commercial Development	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	2	60	CalFire, CalTrans, City of Scotts Valley, Santa Cruz County						0	
SLR-A-23.3.2.2	Action Step	Residential and Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	1	60	City of Santa Cruz, City of Scotts Valley, Santa Cruz County						0	This action encourages implementation of many existing policies.
SLR-A-23.3.3	Recovery Action	Residential and Commercial Development	Encourage the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	2	20	City of Santa Cruz, City of Scotts Valley, Lompico Water District, Private Landowners, Public, San Lorenzo Valley Water Agency, Santa Cruz County, Santa Cruz RCD, Scotts Valley Water District	1.00	1.00	1.00	1.00	1.00	20	Outreach to landowners already occurs from many of the municipalities and water districts in the watershed. This action also addresses additional threats such as "Droughts/Predation/Competition."
SLR-A-23.3.4	Recovery Action	Residential and Commercial Development	Address failing septic systems in rural areas of the San Lorenzo watershed.	3	20	Santa Cruz County						TBD	County has been very proactive in attempting to address impacts to water quality in the San Lorenzo River .
SLR-A-23.3.5	Recovery Action	Residential and Commercial Development	New development in all historic CCC coho salmon watersheds should meet a zero net increase in storm-water runoff, changes in duration, or magnitude of peak flow.	1	60	Santa Cruz County						TBD	Cost may vary significantly. In more urbanized areas costs will likely be absorbed into SWMP requirements per the RWQCB. Costs in rural areas where these storm water plans are not required may be significant on a project by project basis.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-23.3.6	Recovery Action	Residential and Commercial Development	Standards and recommendations regarding development should apply to all jurisdictions, including school districts and other special districts not subject to county and/or state related ordinances or policies.	1	60	RWQCB, Santa Cruz County, USACE, USEPA						TBD	Costs may vary significantly depending on number of new projects constructed and standards typically implemented. Cost cannot be determined at this time.
SLR-A-23.4	Objective	Residential and Commercial Development	Encourage Santa Cruz County to assess the effectiveness of Sensitive Habitat Ordinance and implement improved performance measures as necessary.	3	1	CDFG, NMFS, Private Landowners, Santa Cruz County	15.00					15	
SLR-A-24.1	Objective	Roads and Railroads	Identify and remove existing passage barriers.										
SLR-A-24.1.1	Recovery Action	Roads and Railroads	Adopt NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	60	CalFire, CalTrans, CDFG, FEMA, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD, State Parks, USACE						TBD	Replacement of culverts/bridges and upgrading to NMFS standards will result in increased cost for materials and construction but will likely result in structures that can withstand large storm events better than many existing structures.
SLR-A-24.1.2	Recovery Action	Roads and Railroads	Amend County ordinances that discourage the use of inexpensive railcar bridges in favor of culverts.										
SLR-A-24.1.2.1	Action Step	Roads and Railroads	Educate county policy staff and Board of Supervisors on the benefits of railcar bridges and provide information from other counties where they are commonly used.	3	60	NMFS HCD, Santa Cruz County						0	Adoption of recommended policies regarding railcar bridges will result in a major cost savings to County Government and private landowners.
SLR-A-24.1.3	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	1	60	Santa Cruz County						TBD	Cost may vary significantly. In more urbanized areas costs will likely be absorbed into SWMP requirements per the RWQCB. Costs in rural areas where these storm water plans are not required may be significant on a project by project basis.
SLR-A-24.1.3.1	Action Step	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	2	60	CalFire, CDFG, Private Landowners						TBD	These practices are commonly implemented as part of ongoing THP practices.
SLR-A-24.1.4	Recovery Action	Roads and Railroads	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).										
SLR-A-24.1.4.1	Action Step	Roads and Railroads	Target low flow crossings in Branciforte Creek for removal.	3	10	Private Landowners, Santa Cruz County, Santa Cruz RCD	50.00	50.00	50.00	50.00	50.00	500	Cost of replacement may vary depending on replacement structure. Railcar bridges may result in large cost savings as compared to a seismically engineered bridge structure.
SLR-A-24.2	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
SLR-A-24.2.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	60	CalFire, CalTrans, CDFG, FEMA, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD, State Parks, USACE						TBD	
SLR-A-24.2.1.1	Action Step	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	3	20	CalTrans, CDFG, City of Santa Cruz, City of Scotts Valley, FishNet 4C, Santa Cruz County, Santa Cruz RCD						0	Similar existing programs could be modified and implemented at minimal cost.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-24.3	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
SLR-A-24.3.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	CalTrans, City of Santa Cruz, City of Scotts Valley, Santa Cruz County, State Parks						TBD	Cost may vary significantly. However, a well designed road management plan should result in overall cost savings.
SLR-A-24.3.2	Recovery Action	Roads and Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. The Counties should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with endangered salmonid habitat.	2	20	CalFire, CalTrans, City of Santa Cruz, City of Scotts Valley, FEMA, Private Landowners, Santa Cruz County, State Parks						TBD	Cost difficult to determine but may result in a long term cost savings. Current economic conditions will likely delay implementation of this recommendation, if adopted.
SLR-A-24.3.3	Recovery Action	Roads and Railroads	Improve enforcement of Erosion Control Ordinance for private roads. The current Santa Cruz Erosion Control Ordinance has provisions requiring the responsible parties to repair and alleviate erosion problems that are deemed severe. Santa Cruz Planning should create new erosion control staff positions to help coordinate the County's cooperative efforts, but also to conduct inspections and enforcement actions as necessary.	1	10	Santa Cruz County	300	300	300	300	300	3,000	Cost is anticipated to be primarily from staffing.
SLR-A-24.3.4	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	2	60	Santa Cruz County						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have roads addressed.
SLR-A-24.3.5	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	30	CalFire, CalTrans, CDFG, City of Santa Cruz, City of Scotts Valley, NRCS, Santa Cruz County, Santa Cruz RCD	167	167	167	167	167	5,000	Costs are a very rough estimate. Initial efforts should focus on roads in Branciforte, Bean, Zayante, Bear, and Kings Creek. Roads in urbanized areas will be very difficult to decommission; roads in more remote areas, particularly those used for timber harvest will likely be much easier to target for decommissioning.
SLR-A-24.4	Objective	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, Phase I within 10 years, and Phase II areas within 15 years (from 2010).										
SLR-A-24.4.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	20	CalTrans, City of Santa Cruz, City of Scotts Valley, Santa Cruz County, State Parks						TBD	Cost may vary significantly. However, a well designed road management plan should result in overall cost savings.
SLR-A-24.4.1.1	Action Step	Roads and Railroads	Implement a sediment reduction program for private roads.	1	30	CDFG, NOAA RC, Private Landowners, RWQCB, Santa Cruz County, Santa Cruz RCD						TBD	Cost will vary depending on landowner participation and site specific conditions.
SLR-A-24.4.1.2	Action Step	Roads and Railroads	Develop a private road database using standardized methods. The methods should document all road features, apply erosion rates, and compile information into a GIS database.	2	10	CalFire, CDFG, City of Santa Cruz, City of Scotts Valley, FishNet 4C, NOAA RC, Santa Cruz County, Santa Cruz RCD	50.00	50.00	50.00	50.00	50.00	500	This action encourages implementation of many existing policies.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-24.4.1.3	Action Step	Roads and Railroads	Design and implement a program of BMPs for road maintenance on private roads similar to the proposed program for public roads.	1	60	CDFG, FEMA, FishNet 4C, NOAA RC, Private Landowners, Public, Santa Cruz County, Santa Cruz RCD						TBD	Implementation costs cannot be determined at this time but are likely significant.
SLR-A-24.4.2	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	2	20	CalFire, CalTrans, City of Santa Cruz, City of Scotts Valley, FEMA, Private Landowners, Santa Cruz County, State Parks						TBD	Cost difficult to determine but may result in a long term cost savings.
SLR-A-24.4.2.1	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, CalTrans, RWQCB						TBD	This is a cost that is frequently absorbed into road projects.
SLR-A-24.4.2.2	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	1	20	CalFire, CalTrans, Santa Cruz County Department of Public Works	50.00	50.00	50.00	50.00	50.00	1,000	Roadside berms are common on many private and county roads in Santa Cruz County and result in concentrated water and sediment runoff. These features are often created to serve as a quasi safety device (in lieu of crash barriers or guard rails).
SLR-A-24.4.2.3	Action Step	Roads and Railroads	Install sediment traps for pretreatment, and a modified culvert system that can act as an efficient detention system.	3	60	CalFire, CalTrans, Private Landowners, Santa Cruz County Department of Public Works						TBD	Costs will vary depending on number of culvert upgrades occur on a road network and the inefficiency of the current drainage system. This information is currently unavailable and costs could not be estimated. Costs should also account for ongoing maintenance requirements.
SLR-A-24.4.2.4	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	2	5	CalTrans, CDFG, Santa Cruz County, Santa Cruz County Department of Public Works						0	Cost of coordination should be minimal. Coordination should include County fisheries experts.
SLR-A-24.4.3	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	1	60	CalFire, City of Santa Cruz, Private Landowners, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, State Parks						0	Cost should be considered part of land owner road management plans.
SLR-A-24.4.4	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, CalTrans, NRCS, Private Consultants, Private Landowners, RWQCB, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD						TBD	Cost cannot be determined at this time but should be adopted as part of future road actions.
SLR-A-24.5	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-24.5.1	Recovery Action	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	10	CalTrans, Private Landowners, Santa Cruz County, Santa Cruz County Department of Public Works						TBD	Cost associated with assessment and redesign cannot be determined at this time, however some assessment has already been conducted in some of the watershed. Cost of implementation will likely be high due to the large amount of existing infrastructure.
SLR-A-25.1	Objective	Storms and Flooding	Implement programs that provide community resiliency to storms and flooding.										
SLR-A-25.1.1	Recovery Action	Storms and Flooding	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.	1	60	CalFire, City of Santa Cruz, Private Landowners, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, State Parks						TBD	This will likely be an opportunistic restoration action and costs will be based on landowner willingness to participate and habitat suitability. Currently, these types of habitats have not been identified in the San Lorenzo River watershed.
SLR-A-25.1.2	Recovery Action	Storms and Flooding	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	1	60	CalTrans, City of Santa Cruz, City of Scotts Valley, FEMA, Santa Cruz County, USACE						0	Cost cannot be determined at this time but should be adopted as part of future road actions.
SLR-A-25.1.3	Recovery Action	Storms and Flooding	Implement performance standards in Stormwater Management Plans.	2	30	CalTrans, City of Santa Cruz, City of Scotts Valley, RWQCB, Santa Cruz County						TBD	Costs associated with this recommendation are an ongoing requirement for the affected agencies.
SLR-A-25.1.4	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).										
SLR-A-25.1.4.1	Action Step	Storms and Flooding	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	60	California Coastal Conservancy, City of Santa Cruz, FEMA, Private Landowners, Santa Cruz County, USACE						TBD	Adoption of these policies will result in significant short term expense but a long-term cost savings as a result of minimal future flood fighting actions.
SLR-A-25.1.4.2	Action Step	Storms and Flooding	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.	1	60	CalTrans, City of Santa Cruz, City of Scotts Valley, FEMA, Private Landowners, RWQCB, Santa Cruz County, USACE						TBD	Protecting these areas from impacts of development may be costly due to concerns of reverse condemnation, etc. Cost cannot be determined at this time due to a lack of information regarding where these existing habitats remain in juxtaposition to future development.
SLR-A-25.1.4.3	Action Step	Storms and Flooding	Flood control projects or other modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	1	60	CalTrans, City of Santa Cruz, City of Scotts Valley, NRCS, Private Landowners, Santa Cruz County, USACE						0	Not building flood control projects will not incur expenses.
SLR-A-25.1.5	Recovery Action	Storms and Flooding	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities specific to geological constraints in Santa Cruz County.	2	5	CDFG, NMFS HCD, Santa Cruz County	8.00	8.00	8.00	8.00	8.00	40	Cost will likely consist of existing staff time. It is presumed that existing protocols could be tailor to general Santa Cruz County constraints. Costs may be higher if new guidelines are developed that do not rely on protocols from past studies.

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-25.1.6	Recovery Action	Storms and Flooding	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	1	60	Santa Cruz County						TBD	
SLR-A-25.1.7	Recovery Action	Storms and Flooding	Work with local governments to incorporate protection of CCC coho salmon in any flood management activity (DFG 2004).	2	60	City of Santa Cruz, City of Scotts Valley, FEMA, NMFS, Santa Cruz County						0	Outreach and education are ongoing, and additional costs are expected to be minimal.
SLR-A-25.2	Objective	Storms and Flooding	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.										
SLR-A-25.2.1	Recovery Action	Storms and Flooding	Establish targeted polices, requirements and assistance for sandy soils areas.	2	60	California Department of Mines and Geology, Private Consultants, Private Landowners, RWQCB, Santa Cruz County						TBD	Cost of policy minimal. Cost of long-term assistance may be significant.
SLR-A-26.1	Objective	Water Diversion and Impoundment	Improve implementation of current laws and policies to control diversions and water use in order to maintain and restore surface flows.										
SLR-A-26.1.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon by establishing a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage (DFG 2004).	1	5	NMFS HCD, NMFS PRD	8.00	8.00	8.00	8.00	8.00	40	Cost will be existing staff time.
SLR-A-26.1.1.1	Action Step	Water Diversion and Impoundment	Develop and enforce stream flow bypass requirements for diversions in the San Lorenzo River and its tributaries Zayante, Fall, Bear, Boulder, and Branciforte creeks (DFG 2004).	1	10	CDFG, NMFS, NMFS OLE, SWRCB	60.00	60.00	60.00	60.00	60.00	600	Cost may vary considerably depending on existing baseflow and existing uses of water being diverted.
SLR-A-26.1.1.2	Action Step	Water Diversion and Impoundment	Petition the SWRCB to declare the Santa Margarita aquifer as fully adjudicated.	2	10	CDFG, NMFS, Santa Cruz County, SWRCB	10.00	10.00	10.00	10.00	10.00	100	Cost is a rough estimate of regulatory agency staff time and commitment and associated compilation of studies. The aquifer is currently over drawn and the result of this are reduced water volumes in the San Lorenzo River.
SLR-A-26.1.2	Recovery Action	Water Diversion and Impoundment	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	3	60	CDFG, NMFS OLE, NMFS PRD, NRCS, Santa Cruz County, SWRCB						0	Existing authorities of permitting agencies facilitate implementation at minimal cost.
SLR-A-26.1.3	Recovery Action	Water Diversion and Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	1	10	SWRCB						TBD	Costs may be significant due to lack of adequate staffing at SWRCB.
SLR-A-26.1.4	Recovery Action	Water Diversion and Impoundment	Monitor, identify problems, and prioritize needed changes to water diversion on current or potential coho streams that go dry in some years (DFG 2004).	2	10	CDFG, NMFS HCD, NMFS OLE, NMFS PRD, Private Consultants, SWRCB	100	100	100	100	100	1,000	Cost of policy minimal. Cost of long-term assistance may be significant.
SLR-A-26.1.5	Recovery Action	Water Diversion and Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	2	30	CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, SWRCB						TBD	Costs may be significant depending on site conditions and number of devices installed
SLR-A-26.1.6	Recovery Action	Water Diversion and Impoundment	Ensure water supply demands can be met without impacting flow either directly or indirectly through groundwater withdrawals and aquifer depletion.	1	20	SWRCB						TBD	Costs may be significant due to lack of adequate staffing at SWRCB.
SLR-A-26.1.6.1	Action Step	Water Diversion and Impoundment	Continue to prohibit new or increased summer diversions.	1	60	CDFG, NMFS, SWRCB						0	This action may result in decreased economic development but information to assesses whether or not this may happen was unavailable. The cost of not permitting more water extraction should me minimal.
SLR-A-26.1.7	Recovery Action	Water Diversion and Impoundment	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).										

San Lorenzo River (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SLR-A-26.1.7.1	Action Step	Water Diversion and Impoundment	Require the SWRCB to conduct interagency consultation with the California Department of Fish and Game, and seek technical assistance from NMFS on the issuance of water rights permits.	1	60	CDFG, NMFS, SWRCB						TBD	
SLR-A-26.2	Objective	Water Diversion and Impoundment	Petition SWRCB to have San Lorenzo River declared as fully appropriated (year round) to resolve over-allocation of water resources.	2	10	CDFG, NMFS HCD, NMFS OLE, NMFS PRD, Private Consultants, SWRCB	10.00	10.00	10.00	10.00	10.00	100	
SLR-A-26.3	Objective	Water Diversion and Impoundment	Develop new policies and regulations to provide suitable flow conditions for CCC coho salmon.										
SLR-A-26.3.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon.										
SLR-A-26.3.1.1	Action Step	Water Diversion and Impoundment	Evaluate and monitor 1600 program compliance related to all water diversions (DFG 2004).	1	1	CDFG, SWRCB	100					100	Cost is based on a one year pilot study. The study would evaluate rates of compliance and overall impact of currently permitted diversion to coho salmon and steelhead survival and recovery.
SLR-A-26.3.1.2	Action Step	Water Diversion and Impoundment	Work with the City of Santa Cruz and the San Lorenzo Valley Water District (and other major diverters) to minimize impacts of their diversions.	2	10	CDFG, City of Santa Cruz, NMFS HCD, NMFS PRD, San Lorenzo Valley Water Agency, SWRCB						TBD	Currently, the City of Santa Cruz is working on a HCP to address impacts. San Lorenzo Valley Water District and other major water diverters should bring their diversions into ESA compliance.
SLR-A-26.3.1.3	Action Step	Water Diversion and Impoundment	Encourage County of Santa Cruz and municipalities within the watershed to increase oversight when issuing building permits in regards to water supply.	1	60	CDFG, City of Santa Cruz, City of Scotts Valley, Santa Cruz County, SWRCB						0	
SLR-A-26.4	Objective	Water Diversion and Impoundment	Promote water conservation by the public, water agencies, agriculture, private industry, and the citizenry.										
SLR-A-26.4.1	Recovery Action	Water Diversion and Impoundment	Investigate feasibility of desalination to prevent stream dewatering and ensure a more stable source of water overtime.	1	30	CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, SWRCB						TBD	Costs may be significant depending on site conditions and number of devices installed
SLR-A-26.4.1.1	Action Step	Water Diversion and Impoundment	Work with cities of Santa Cruz and Soquel to increase size of proposed desalination plant.	2	5	CDFG, City of Santa Cruz, NMFS HCD, NMFS PRD, SWRCB						0	Cost of working with the City will be absorbed into ongoing HCP negotiations. Cost of expanding plant will result in a significant increase in cost to City Water Dept.
SLR-A-26.4.2	Recovery Action	Water Diversion and Impoundment	Promote conjunctive use of water with water projects whenever possible to maintain or restore coho salmon habitat.	1	30	CDFG, NMFS HCD, NMFS PRD, Santa Cruz County, Santa Cruz RCD						TBD	
SLR-A-26.4.3	Recovery Action	Water Diversion and Impoundment	Investigate water recharge possibilities in Scotts Valley quarries.	2	20	California Department of Mines and Geology, Santa Cruz County, Santa Cruz RCD, USFWS						TBD	Aquifer recharge through the quarries should have the stated goal of replenishing overdrawn aquifers and contingent on not facilitating additional development in the watershed. Careful coordination will be necessary with the USFWS to ensure this strategy does not conflict with other ESA listed species.
SLR-A-26.4.4	Recovery Action	Water Diversion and Impoundment	Investigate the potential for expansion of the Scott Valley water reclamation system.	2	15	CDFG, City of Scotts Valley, RWQCB, SWRCB						TBD	Scotts Valley is located above the anadromous portions of the San Lorenzo River watershed. Water savings in Scotts Valley should result in increased flow into San Lorenzo River tributaries.

San Vicente Creek

San Vicente Creek

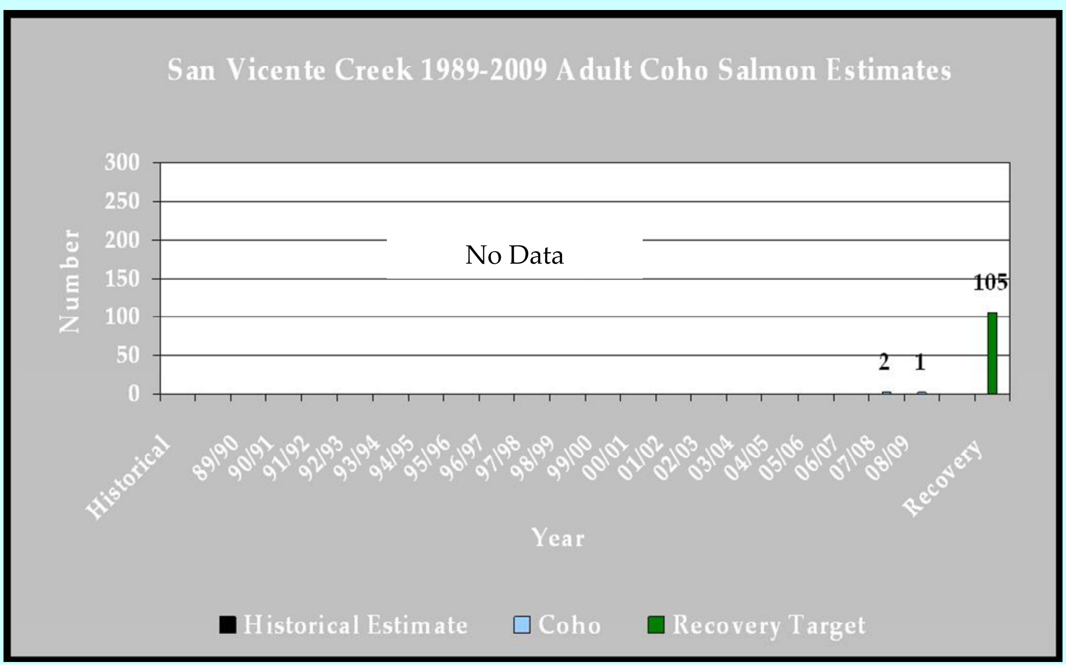
Dependent Population
3.1 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

San Vicente Creek drains approximately 11 square miles of the Santa Cruz Mountains in western Santa Cruz County. San Vicente Creek enters the Pacific Ocean at the town of Davenport about ten miles north of Santa Cruz, where it flows under a highway and through a railroad tunnel. About 60 percent of the San Vicente Creek watershed is coniferous forest and about 30 percent of the watershed area is either shrubland, montane or riparian hardwood forest. The San Vicente Creek watershed has moderate to high erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. Karst geology appears to help provide a source of relatively cool water during the summer low flow period. The SWRCB listed San Vicente Creek as having water quality impaired for sediment in 2001. The water quality impairment listing determined that sediment was impairing habitats beneficial to coho salmon including migration, spawning and rearing habitats, and identified non-point source silviculture as the probable cause. Ninety-nine percent of the San Vicente Creek watershed is in private ownership; the remaining one percent is state-owned forest lands. The Trust for Public Land recently purchased the property owned by Coast Dairies and we anticipate this land will be turned over to State Parks and BLM. Land use in the watershed includes rural residential, forestry, commercial (in the town of Davenport) and quarrying. Within the past ten years, about 22 percent of the San Vicente Creek watershed has been under timber harvest plans. Housing development within the San Vicente Creek watershed is moderate to low; approximately 450 housing units are present in the watershed.

Coho salmon smolt from San Vicente Creek
Photo by Chris Berry, City of Santa Cruz Water Department

The Watershed at a Glance

Spawning Quantity & Quality:	**POOR to GOOD**
Summer Water Temperatures:	**GOOD**
Depth & Shelter of Pools:	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**FAIR to GOOD**
Off channel/Floodplain Quality:	**POOR to GOOD**
Estuary Function:	**POOR**



San Vicente Creek

Recovery Target: 105 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Mining
- Roads and Railroads
- Droughts
- Fire and Fuel Management
- Climate Change

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the San Vicente Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Create, and/or expand the quantity and quality of spawning habitat
- Improve and increase pool habitat
- Increase and improve off channel habitat
- Increase the amount of large wood in streams
- Reduce the number of roads in the watershed and minimize the effects from the remaining roads
- Diminish sediment sources

Passage impediment on San Vicente Creek
Photo by Jerry Smith, SJSUL

Advancing recovery of coho

salmon in San Vicente Creek requires these priority **recovery actions:**

- Target restoration and habitat enhancement that will provide functioning habitat at flows between winter base flow and flood stage.
- Install properly sized LWD to increase the frequency and condition of pool habitat.
- Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically close/disconnect the roads (remove fills and culverts restoring the natural hydrology of hillslope).
- Encourage SWRCB to bring illegal water diverters, and out-of-compliance diverters, into compliance with State law.

. . . in these **core areas:** entire San Vicente Creek planning watershed

Conservation Highlights

- The San Vicente TAC, Santa Cruz RCD, California Coastal Conservancy, and BLM are working to restore off channel habitats as well as implement side channel LWD projects

We Need Your Photo Here

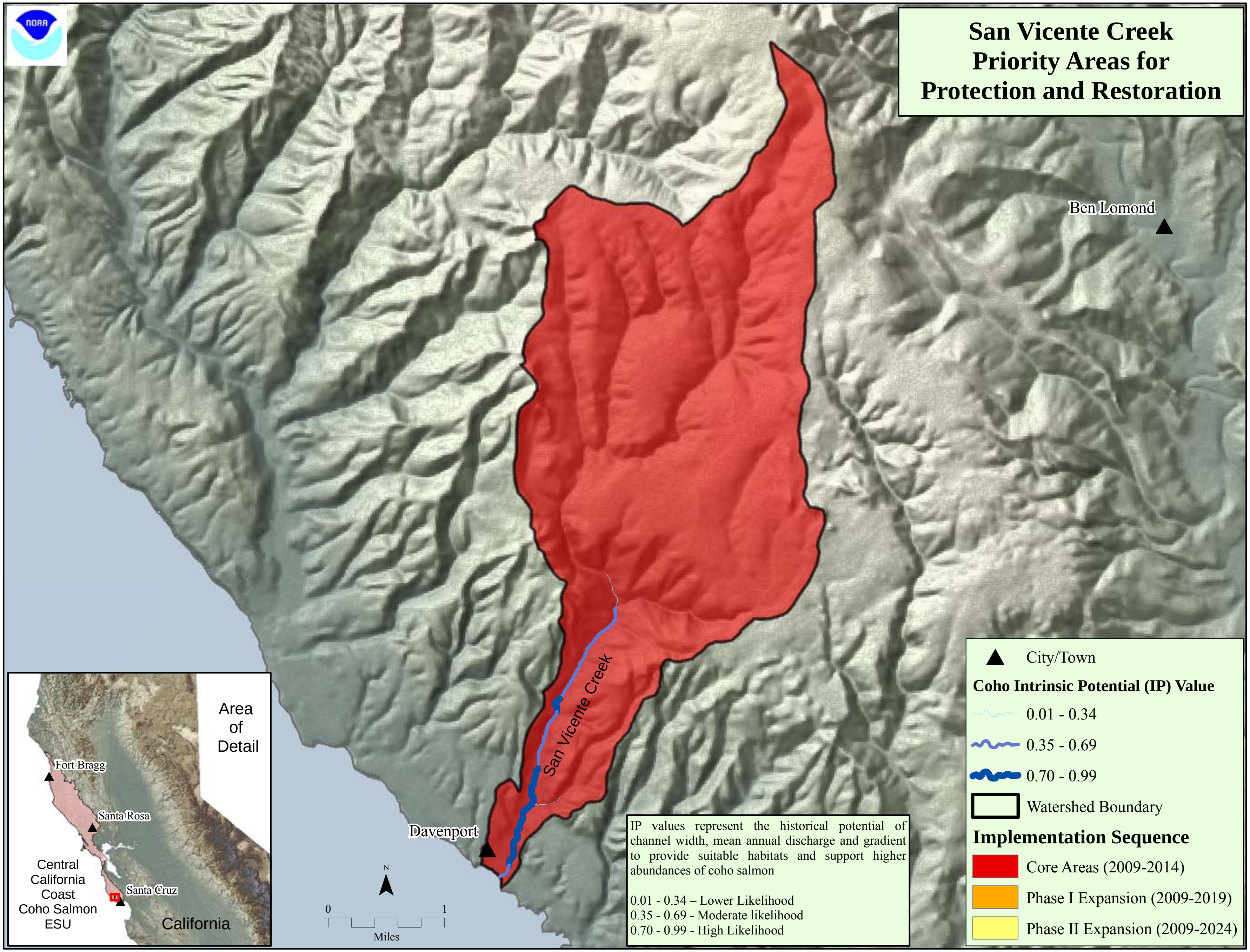
San Vicente Creek
Photo © Your Name Here, AFFIL

Recovery Partners

CEMEX
BLM
Coast Dairies
Santa Cruz RCD
San Vicente TAC
NMFS
DFG

Immediate Needs

Develop more instream habitat projects √
Protect instream flows √


San Vicente Creek
Priority Areas for
Protection and Restoration
Ben Lomond
Davenport
San Vicente Creek
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
San Vicente Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	50	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	NA	Poor	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-200 m^2	200-300 m^2	>300 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	42	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	58	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	Poor	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	67	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	11.7	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	2%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Good	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	11.7	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Poor	Poor	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	35-50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0/10 IP-km	Very Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	11.7	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	55%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.80%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	1.53%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	22%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	0	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	NA	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	68%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	78%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	4 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	3.2 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	1-20 per IP-km	Fair	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	35-50%	Good	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

San Vicente Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Mining	Medium	High	High	High	Very High	Medium			Very High
2	Roads and Railroads	Low	Medium	Medium	High	Very High	High			High
3	Droughts	Medium	Medium	Very High	Medium	High	Medium			High
4	Fire and Fuel Management	Medium	High	High	Medium	High	Medium			High
5	Climate Change	Medium	Medium	High	Medium	High	Medium			High
6	Water Diversion and Impoundment	Low	Medium	Medium	Medium	High	Medium			Medium
7	Storms and Flooding	Medium	Medium	Medium	Medium	Medium	Medium			Medium
8	Disease, Predation, and Competition	Low	-	High	-	Low	-			Medium
9	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Logging and Wood Harvesting	Medium	Medium	Medium	Medium	Low	Medium			Medium
11	Recreational Areas and Activities	Medium	Medium	Low	Medium	Medium	Medium			Medium
12	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
13	Channel Modification	Medium	Low	Medium	Medium	Low	Medium			Medium
14	Livestock Farming and Ranching	Low	Low	Medium	Medium	Low	Medium			Medium
15	Fishing and Collecting	Low	-	Medium	Low	Low	-			Low
16	Hatcheries and Aquaculture	-	-	-	Low	-	Low			Low
Threat Status for Targets and Project		High	High	Very High	High	Very High	High	-	-	Very High

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SVC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
SVC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
SVC-A-2.1.1.1	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	1	10	Alnus Ecological, BLM, California Coastal Conservancy, CDFG, NOAA RC, Santa Cruz RCD						0	Long term monitoring and evaluation are essential to ensure long-term application of the over wintering pilot program in the San Vicente watershed. Monitoring should include a biological component regarding coho occupancy and utilization. Costs are estimated under viability
SVC-A-2.1.1.2	Action Step	Floodplain	Identify an entity to ensure off channel habitats are adequately monitored and maintained. Develop landowner agreements.	1	2	BLM, California Coastal Conservancy, CDFG, CEMEX, NMFS PRD, NOAA RC, Private Consultants, Santa Cruz RCD	5.00	5.00				10	Cost are reduced due to generally cooperative landowners in the San Vicente Watershed. Most costs are likely associated with staff time.
SVC-A-2.1.2	Recovery Action	Floodplain	Counties and municipalities should adopt a policy of “managed retreat” (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.										
SVC-A-2.1.2.1	Action Step	Floodplain	Evaluate lower San Vicente watershed for infrastructure at high risk.	2	2	Alnus Ecological, BLM, California Coastal Conservancy, CEMEX, FEMA, Private Landowners, Santa Cruz RCD, USACE	5.00	5.00				10	Many of these areas should already be identified on FEMA maps and hydraulic analysis on San Vicente Route 1 and railroad bores by Balance Hydrologics in 2008.
SVC-A-2.1.2.2	Action Step	Floodplain	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	2	60	BLM, California Coastal Conservancy, FEMA, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz RCD, USACE						TBD	Costs are likely relatively low due to relative low density within the watershed. Costs are presumed to be for willing landowners only.
SVC-A-2.1.3	Recovery Action	Floodplain	Encourage Bureau of Land Management to minimize land management activities within the 100 year floodplain of San Vicente Creek that may impair floodplain connectivity.	2	60	BLM, NMFS						0	This recovery plan should serve as an appropriate tool to encourage BLM to minimize impacts to floodplain areas.
SVC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
SVC-A-3.1.1	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.										
SVC-A-3.1.1.1	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	2	20	BLM, California Coastal Conservancy, CDFG, CEMEX, NMFS, Santa Cruz County, Santa Cruz RCD						TBD	Additional information under Water Diversions and Impoundment.
SVC-A-3.1.2	Recovery Action	Hydrology	Institutionalize programs to purchase easements on water rights to encourage the maintenance of surface flows.										

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SVC-A-3.1.2.1	Action Step	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	2	60	BLM, California Coastal Conservancy, CDFG, CEMEX, NMFS, Santa Cruz RCD, SWRCB						TBD	The price at which water is sold on environmental water markets is determined by negotiations between landowners and purchasing entities. The aggregate fiscal cost of cost of water acquisition will depend on the quantity of water acquired and whether water rights will be permanently transferred or purchased for single periods. Cost will also depend on water rights holders willingness to participate in this program. Cost cannot be determined at this time.
SVC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
SVC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
SVC-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.	1	2	Alnus Ecological, BLM, California Coastal Conservancy, CDFG, CEMEX, NOAA RC	12.50	12.50				25	Identification is a high priority in order to rapidly initiate restoration actions to increase coho survival and then increase carrying capacity in the San Vicente watershed.
SVC-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	3	60	BLM, California Coastal Conservancy, CDFG, CEMEX, NMFS PRD, NOAA RC, Private Consultants, Santa Cruz County, Santa Cruz RCD, USACE						0	Costs should be minimal as this recommendation applies to modification of future actions and practices in the watershed.
SVC-A-6.1.1.3	Action Step	Pool Habitat	Install properly sized large woody debris to appropriate viability table targets.	1	10	BLM, California Coastal Conservancy, CDFG, CEMEX, FEMA, NOAA RC, Santa Cruz RCD	80.00	80.00	80.00	80.00	80.00	800	Most LWD structures will need some engineering design and will need to be secured to minimize concerns due to downstream infrastructure including the Highway 1 and Railroad bores. Impacts to watersurface elevations per FEMA concerns may also be required.
SVC-A-6.1.2	Recovery Action	Pool Habitat	Encourage retention of existing large woody debris to maintain current stream complexity, pool frequency, and depth.	1	60	Alnus Ecological, BLM, California Coastal Conservancy, CalTrans, CDFG, CEMEX, FEMA, NMFS, Private Consultants, Private Landowners, Railroad, RWQCB, Santa Cruz RCD						0	Resource agency personnel should make this a priority and convey this information to land owners and land managers as long as coho (and steelhead) are listed in the San Vicente watershed.
SVC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
SVC-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SVC-A-8.1.1.1	Action Step	Sediment	NMFS and other stakeholders will work with RCD, BLM, CEMEX, NRCS, and others to encourage hiring of consultants to conduct road assessments.	2	5	BLM, California Coastal Conservancy, CalTrans, CDFG, CEMEX, NOAA RC, NRCS, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Costs are estimated under Roads section.
SVC-A-8.1.2	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
SVC-A-8.1.2.1	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	2	10	BLM, CalFire, CalTrans, CEMEX, Santa Cruz County Department of Public Works						TBD	Costs are estimated in Roads section.
SVC-A-8.1.2.2	Action Step	Sediment	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF).	2	15	BLM, CalFire, CalTrans, CEMEX, Santa Cruz County Department of Public Works						TBD	Costs can be estimated following completion of a road assessment.
SVC-A-8.1.2.3	Action Step	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	15	BLM, CalFire, CEMEX, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Costs can be estimated following completion of road assessments.
SVC-A-8.1.3	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										
SVC-A-8.1.3.1	Action Step	Sediment	Permitting agencies (State, Federal, and local landowners) should evaluate all authorized erosion control measures during the winter period.	3	60	CalFire, CDFG, NMFS PRD, RWQCB, Santa Cruz County						0	Costs should be considered a standard business practice for all regulatory agencies.
SVC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
SVC-A-9.1.1	Recovery Action	Viability	Measure or estimate response of key habitat attributes to recovery efforts across the watershed.										
SVC-A-9.1.1.1	Action Step	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	3	60	BLM, CalFire, CDFG, CEMEX, NOAA RC, Santa Cruz RCD						TBD	
SVC-A-9.1.1.2	Action Step	Viability	To better understand changes in sedimentation, monitoring in the basin should include: longitudinal profiles, cross-sections, V*, LWD volume and distribution, and embeddedness.	3	60	Alnus Ecological, BLM, CalFire, California Coastal Conservancy, CDFG, CEMEX, NOAA RC, Santa Cruz RCD						TBD	
SVC-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
SVC-A-9.1.2.1	Action Step	Viability	Monitor population response in off-channel habitats compared to instream habitat, similar to work conducted by Environmental Science Associates et al. (2004).	1	6	Alnus Ecological, BLM, California Coastal Conservancy, CDFG, NOAA RC, Private Consultants	58.33	58.33	58.33	58.33	58.33	350	Monitoring is essential for the stream restoration actions in San Vicente in order to evaluate their effectiveness and to allow adaptive management based on predictions of population response. Monitoring should include smolt outmigration estimates from San Vicente pond similar to the efforts of ESA (ESA 2003).

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SVC-A-9.1.2.2	Action Step	Viability	Conduct periodic surveys of adult abundance.	2	9	BLM, CDFG, CEMEX, NMFS, NOAA SWFSC, Santa Cruz County Fish and Wildlife Advisory Board	13.33	13.33	13.33	13.33	13.33	120	Surveys should assess a minimum of three cohort. Although a Dependent watershed, San Vicente has recently reestablished its coho run and is a watershed where significant instream restoration actions have occurred and more are planned in the near future. Therefore, surveys of adult abundance (possibly through redd counts using the methods of Gallagher - DFG) could provide an index one of the last remaining coho populations in the Santa Cruz Mountains Diversity stratum.
SVC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
SVC-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
SVC-A-10.1.1.1	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	3	15	Alnus Ecological, CEMEX, NRCS, Private Landowners, Santa Cruz RCD	0.67	0.67	0.67	0.67	0.67	10	Early focus should be placed in lower watershed - particularly those areas with invasive vegetation that affects streamside canopy. Costs will vary depending on revegetation methods and exotic vegetation removal methods.
SVC-A-10.1.1.2	Action Step	Water Quality	Increase summer baseflows in rearing reaches that are currently impacted by water use.	2	60	BLM, CDFG, CEMEX, NMFS HCD, SWRCB						TBD	Additional information is provided in Water Diversion
SVC-A-14.1	Objective	Disease, Predation, and Competition	Determine modes and/or methods of transport of all significant salmonid pathogens and develop appropriate minimization and avoidance measures.										
SVC-A-14.1.1	Recovery Action	Disease, Predation, and Competition	Evaluate impacts of fish disease (e.g., black spot) to the San Vicente population.	2	6	BLM, CDFG, NOAA RC, Private Consultants, Santa Cruz RCD	8.33	8.33	8.33	8.33	8.33	50	Monitoring should include an assessment of adult return ratios. Cost should be part of the overall monitoring assessment costs discussed under Viability. This cost would be due to additional expenses incurred.
SVC-A-15.1	Objective	Droughts	Prepare contingency plans to ensure persistence of the San Vicente population during droughts.										
SVC-A-15.1.1	Recovery Action	Droughts	Coordinate efforts among landowners and regulatory agencies to ensure adequate flows are maintained in San Vicente Creek.										
SVC-A-15.1.1.1	Action Step	Droughts	Work with DFG, Counties, other agencies, and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	2	60	BLM, CalFire, CDFG, CEMEX, NMFS HCD, NMFS OLE, NMFS PRD, Private Landowners, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD						TBD	
SVC-A-15.1.1.2	Action Step	Droughts	Work with CEMEX to ensure adequate and proper consideration is given to fish needs. Develop agreements, which will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	2	60	BLM, CEMEX, NMFS HCD, NMFS PRD, SWRCB						TBD	Costs cannot be determined until a water budget for San Vicente is conducted.
SVC-A-15.1.1.3	Action Step	Droughts	Evaluate impact of water diversions in the Mill Creek watershed.	2	5	BLM, CDFG, NMFS HCD, SWRCB						TBD	
SVC-A-16.1	Objective	Fire and Fuels Management	Develop measures protective of salmonids during fire suppression activities.										
SVC-A-16.1.1	Recovery Action	Fire and Fuels Management	Establish fire contingency plan developed by experts from CalFire, local fire districts, Santa Cruz RCD, and regulatory agencies with expertise in fisheries issues.										

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SVC-A-16.1.1.1	Action Step	Fire and Fuels Management	Encourage CalFire to provide plan to all non-County fire fighters when providing fire fighting assistance in the San Vicente Creek watershed (and all other watersheds in the County).	1	5	BLM, CalFire						0	The plan should provide information on accepted procedures for protecting fish populations and critical habitat during pre-planning, initial attack, prolonged attack and rehabilitation phases of fire control efforts.
SVC-A-16.1.1.2	Action Step	Fire and Fuels Management	In the event of a wildfire, we recommend CalFire Resource Advisors contact the resource agencies for ESA consultation (or technical assistance) about the incident. The resource agencies can provide guidance regarding critical resources in the area that may be affected by fire fighting actions.	2	60	BLM, CalFire						0	Guidance could include informing CalFire of sensitive biological resources in the watershed as well as recommendations regarding watersource locations (e.g., picking up water from areas other than the lower San Vicente pond when using helicopters for water drops).
SVC-A-16.1.1.3	Action Step	Fire and Fuels Management	Implement sedimentation reduction techniques in concert with prescribed fire techniques to minimize sediment impacts to various coho salmon life stages.	1	60	CalFire						0	This recommendation should be considered a standard practice.
SVC-A-16.1.1.4	Action Step	Fire and Fuels Management	Immediately implement appropriate sediment control measures following completion of fire suppression while fire fighters and fire fighting equipment are on site.	1	60	BLM, CalFire						0	This recommendation will result in a net cost savings.
SVC-A-16.1.1.5	Action Step	Fire and Fuels Management	Reduce erosion from fire prevention or suppression activities by maintaining existing natural topography to the extent possible.	1	60	BLM, CalFire						0	Implementing erosion control measures when constructing firebreaks (if possible) or shortly thereafter will likely result in a net cost savings. It is much more financially efficient to implement these measures while the fire crews are present rather than months later after the fire is out.
SVC-A-16.1.2	Recovery Action	Fire and Fuels Management	Disseminate NMFS' October 9, 2007, jeopardy biological opinion on the use of fire retardants to local fire fighting agencies and CalFire.										
SVC-A-16.1.2.1	Action Step	Fire and Fuels Management	Avoid use of aerial fire retardants and foams within 300 feet of riparian areas throughout the current range of CCC coho salmon.	2	60	BLM, CalFire						0	This recommendation only applies to situations where lives and structures are not immediately threatened by wildfire.
SVC-A-16.1.2.2	Action Step	Fire and Fuels Management	Develop guidance that directs CalFire and other agencies and organizations using fire retardants to conduct an assessment of site conditions following wildfire where fire retardants have entered waterways, to evaluate the changes to on site water quality and the structure of the biological community.	2	60	BLM, CalFire, CDFG, NMFS, USEPA, USFWS						0	Cost are developed for the Aptos watershed and the guidance could be applied elsewhere.
SVC-A-16.1.2.3	Action Step	Fire and Fuels Management	Use non-toxic retardants. Avoid dropping fire retardant into streams. To the maximum extent feasible, orient air drops so that the drop goes perpendicular to streams as opposed to parallel.	2	60	CalFire						TBD	
SVC-A-16.2	Objective	Fire and Fuels Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.										
SVC-A-16.2.1	Recovery Action	Fire and Fuels Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.										
SVC-A-16.2.1.1	Action Step	Fire and Fuels Management	Use managed fire to promote revegetation of species that filter out fine sediment.	3	60	CalFire						TBD	
SVC-A-16.2.1.2	Action Step	Fire and Fuels Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	2	5	BLM, CalFire, Santa Cruz County						0	Costs are developed for the Aptos watershed. The fire plan could be used in the San Vicente watershed.
SVC-A-16.2.1.3	Action Step	Fire and Fuels Management	Reassess fire risk every ten years.	3	60	BLM, CalFire, CEMEX, Santa Cruz County						TBD	
SVC-A-16.2.1.4	Action Step	Fire and Fuels Management	Work with County planners to define future impacts of proposed urban and infrastructure development on fire suppression and fuel load buildup.	2	10	BLM, CalFire, Santa Cruz County						TBD	Cost for San Vicente watershed should be minor due to the relatively small size of the watershed and the relatively low amount of infrastructure in the watershed.
SVC-A-21.1	Objective	Mining	Minimize adverse effects to water quality resulting from mining operations.										
SVC-A-21.1.1	Recovery Action	Mining	Refine mining operations to reduce erosion and other impacts.										

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SVC-A-21.1.1.1	Action Step	Mining	For all mining locations, saving topsoil preserves the natural growing medium for plants that will be used to revegetate spoils.	2	60	BLM, California Department of Mines and Geology, CEMEX						0	Costs should be minimal and should be part of Reclamation Plan.
SVC-A-21.1.1.2	Action Step	Mining	Tailings, settling ponds, and other attributes of mining should be secured to ensure sediment, toxins, and other deleterious substances do not enter streams through either direct runoff or subsurface flow.	1	60	BLM, CalFire, CDFG, CEMEX						TBD	Costs cannot be determined at this time. An assessment of potential site specific threats is needed in order to evaluate total costs. However, this recommendation is typically a standard business practice for mining operation due to a variety of regulatory requirements.
SVC-A-21.1.1.3	Action Step	Mining	Promote riparian vegetation that remediates toxins, sediment and other deleterious substances when and where necessary.	2	60	BLM, CalFire, California Department of Mines and Geology, CEMEX						TBD	These costs are likely minimal and should be incorporated into Reclamation Plan.
SVC-A-21.1.1.4	Action Step	Mining	Active and future mining areas should be located in areas where operations will not result in any changes to downstream water quality, including changes in turbidity, pH, temperature, and rate of sedimentation.	2	60	BLM, CalFire, California Department of Mines and Geology, CDFG, CEMEX						0	Costs of avoiding environmental impacts should be minimal with proper and conservative planning.
SVC-A-21.1.1.5	Action Step	Mining	All abandoned mining areas should comport to the requirements of the Surface Mine Control and Reclamation Act.	2	60	BLM, California Department of Mines and Geology, CEMEX						TBD	This should be considered a standard business practice. A site specific evaluation is likely needed. Costs of implementing this recommendation should be borne by the quarry operator.
SVC-A-21.1.2	Recovery Action	Mining	Evaluate Mill Creek dam for potential sediment input, fish passage constraints, and upstream habitat attributes.										
SVC-A-21.1.2.1	Action Step	Mining	Remove the dam if no long-term adverse impacts to the downstream fishery are predicted.	2	10	California Department of Mines and Geology, CDFG, CEMEX, NMFS HCD, NOAA RC, Private Consultants, Santa Cruz RCD						TBD	Removing the dam could increase the carrying capacity of the San Vicente coho salmon population. However this action should not move forward until issues regarding adverse affects to downstream survival of coho salmon is evaluated and determined to be insignificant. Removal costs will vary depending on sediment toxicity and quantity in the dam. Costs need to be weighed against quality and quantity of upstream habitat.
SVC-A-21.1.2.2	Action Step	Mining	Install fish passage device if upstream habitat is suitable for spawning and rearing.	2	11	CalFire, California Coastal Conservancy, CDFG, CEMEX, NMFS HCD, NOAA RC, Santa Cruz RCD						TBD	Costs can vary significantly depending on type of passage remediation necessary to ensure passage of all life stages.
SVC-A-24.1	Objective	Roads and Railroads	Initiate dialog with railroad and Caltrans to outline issues associated with railroad and highway crossings on San Vicente Creek, and their effects to CCC coho salmon and their habitats.										
SVC-A-24.1.1	Recovery Action	Roads and Railroads	Discuss the opportunity for railroad and Caltrans to assist in monitoring, retrofitting, and maintaining tunnels in lower San Vicente Creek.										
SVC-A-24.1.1.1	Action Step	Roads and Railroads	Evaluate impact of Railroad and Caltrans bore to fish passage during high flow events.	2	2	Alnus Ecological, CalTrans, Railroad, USACE	5.00	5.00				10	Confirmation of findings from Balance Hydrologics (related to the railroad and CalTrans bores) is likely the only significant cost remaining in this evaluation.
SVC-A-24.1.1.2	Action Step	Roads and Railroads	Install baffles in the tunnel bore diameter as necessary.	3	20	CalTrans, Railroad, USACE						TBD	Evaluation should not occur unless the bore diameter is also increased.
SVC-A-24.2	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
SVC-A-24.2.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SVC-A-24.2.1.1	Action Step	Roads and Railroads	Implement a sediment reduction program for private roads.	2	60	BLM, CalFire, CalTrans, CEMEX, NRCS, Private Landowners, Public, Santa Cruz County Department of Public Works, USACE						TBD	Costs will vary depending on quantity of sediment delivery and landowner cooperation. Costs cannot be evaluated until a road assessment is conducted.
SVC-A-24.2.1.2	Action Step	Roads and Railroads	Develop a road database using standardized methods. The methods should document all roads features, apply erosion rates, and compile information into a GIS database.	2	60	BLM, California Department of Mines and Geology, CalTrans, CEMEX, Private Landowners, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Most of the necessary infrastructure is believed to be in place for such a database. Maintenance costs and input of site specific information cannot be estimated at this time.
SVC-A-24.2.1.3	Action Step	Roads and Railroads	Develop a private road improvement fund to share costs and encourage private road associations to upgrade poorly constructed or improperly located roads.	2	60	CEMEX, FEMA, Private Landowners, Public, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Cost will vary depending on County/FEMA willingness to implement this program.
SVC-A-24.2.1.4	Action Step	Roads and Railroads	Design and implement a program of BMPs for road maintenance on private roads similar to the proposed program for public roads.	2	60	BLM, CalFire, CalTrans, CEMEX, NMFS PRD, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Cost of design should be minimal because many standards are already developed and readily accessible. Implementation cost may be significant depending on the magnitude of problems in the watershed, landowner cooperation, and cost sharing questions. These issues cannot be resolved or estimated without a sediment budget/roads assessment.
SVC-A-24.2.2	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.										
SVC-A-24.2.2.1	Action Step	Roads and Railroads	Improve enforcement of Erosion Control Ordinance for private roads. The current Santa Cruz Erosion Control Ordinance has provisions requiring the responsible parties to repair and alleviate erosion problems that are deemed severe. Santa Cruz Planning should create new erosion control staff positions to help coordinate the County's cooperative efforts, but also to conduct inspections and enforcement actions as necessary.	1	5	Santa Cruz County	8.00	8.00	8.00	8.00	8.00	40	This cost will likely require additional staffing. The number of visits per year to this important watershed will likely be minimal due to the small size of the watershed. Additional costs will be necessary to meet the obligations in the ordinance in other watersheds and this expense could be spread out across the County. This cost is estimated for San Vicente only for five years.
SVC-A-24.2.2.2	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	5	CalFire, California Department of Mines and Geology, CalTrans, Santa Cruz County	2.00	2.00	2.00	2.00	2.00	10	The cost estimate is low because NMFS believes relatively little grading will occur due to the small size of the watershed.
SVC-A-24.2.2.3	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	2	10	BLM, CalTrans, CEMEX, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Evaluation costs should be absorbed into the watershed wide roads/sediment sources assessments. Road size berms are a common feature on roads in Santa Cruz County.
SVC-A-24.2.2.4	Action Step	Roads and Railroads	Install sediment traps for pretreatment, and a modified culvert system that can act as an efficient detention system.	2	20	BLM, CEMEX, NOAA RC, NRCS, Santa Cruz RCD						TBD	Costs cannot be estimated until a watershed assessment is completed.

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SVC-A-24.2.2.5	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	3	60	BLM, CalFire, CalTrans, CEMEX, Santa Cruz County Department of Public Works						0	These costs should be minimal and costs could be reduced with close coordination between all the major landowners in the watershed.
SVC-A-24.2.3	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.										
SVC-A-24.2.3.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	60	BLM, CalFire, CalTrans, CEMEX, Private Landowners, Santa Cruz County Department of Public Works						0	This should be considered a standard business practice for all landowners and managers in the watershed.
SVC-A-24.2.4	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	BLM, CalTrans, CEMEX, Private Landowners, Santa Cruz County Department of Public Works, Santa Cruz RCD						0	These BMPs should be incorporated into all road management practices and may result in long term cost savings due to lower maintenance and repair costs.
SVC-A-24.2.4.1	Action Step	Roads and Railroads	Encourage all permanent and year-round access roads beyond the THP parcel be surfaced after harvest completion with base rock and road gravel, asphalt, or chipseal, as appropriate.	2	30	CalFire, Private Landowners							
SVC-A-24.2.5	Recovery Action	Roads and Railroads	Conduct a road survey beginning with inner gorge roads in sandy soils followed by roads in other settings.	2	5	BLM, CalFire, California Coastal Conservancy, CDFG, CEMEX, NMFS PRD, NOAA RC, Private Landowners, Public, Santa Cruz County Department of Public Works, Santa Cruz RCD							This is an important action that sets in motion many subsequent actions and costs.
SVC-A-24.3	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
SVC-A-24.3.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	3	30	BLM, CalFire, CalTrans, CEMEX, Private Landowners, Santa Cruz RCD						TBD	Costs cannot be estimated until a watershed wide road assessment/sediment source assessment is conducted.
SVC-A-24.3.2	Recovery Action	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	60	BLM, CalFire, CalTrans, CEMEX, Santa Cruz County Department of Public Works						TBD	Costs cannot be estimated until a watershed wide road assessment/sediment source assessment is conducted. Costs could be significant.
SVC-A-24.3.3	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	10	BLM, CalFire, CalTrans, CEMEX, Santa Cruz County, Santa Cruz County Department of Public Works						TBD	
SVC-A-24.4	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SVC-A-24.4.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	10	BLM, CalTrans, CEMEX, FishNet 4C, NRCS, Santa Cruz RCD	2.00	2.00	2.00	2.00	2.00	20	Costs are an estimate of overall watershed contribution based on an ongoing County-wide program over the next ten years.
SVC-A-24.4.2	Recovery Action	Roads and Railroads	Develop a Salmon Certification Program for road maintenance staff.	2	10	BLM, CalTrans, CEMEX, FishNet 4C, Santa Cruz County Department of Public Works, Santa Cruz RCD						0	Costs should be minimal if existing programs are used.
SVC-A-24.5	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
SVC-A-24.5.1	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.										
SVC-A-24.5.1.1	Action Step	Roads and Railroads	Encourage BLM and CEMEX to decommission riparian roads. At a minimum, the BLM and CEMEX should avoid stabilizing riparian roads through bank hardening actions along mainstem San Vicente Creek.	2	20	BLM						TBD	A roads assessment is needed in order to evaluate costs.
SVC-A-24.5.1.2	Action Step	Roads and Railroads	Encourage BLM to avoid construction of large scale recreational facilities adjacent to water courses.	2	60	BLM, NMFS, Public, USFWS						0	No cost should result from not building facilities.
SVC-A-26.1	Objective	Water Diversion and Impoundment	Improve and/or enforce current laws and policies to control diversions and water use in order to maintain and restore surface flows.										
SVC-A-26.1.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon by establishing a more natural hydrograph, by-pass flows, season of diversion, and off-stream storage (DFG 2004).										
SVC-A-26.1.1.1	Action Step	Water Diversion and Impoundment	Develop and enforce stream flow bypass requirements for diversions on the mainstem San Vicente and Mill creeks (DFG 2004).	2	5	CDFG, CEMEX, NMFS HCD, Santa Cruz County, SWRCB, USFWS	15.00	15.00	15.00	15.00	15.00	75	This cost will require transects and measurements of streamflow in the lower reaches over a multiple year period. Costs may vary depending on gauging requirements per CEMEX 1600 stream diversion requirements.
SVC-A-26.1.1.2	Action Step	Water Diversion and Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	2	5	BLM, CalFire, CEMEX, NMFS HCD, SWRCB, USFWS	6.00	6.00	6.00	6.00	6.00	30	
SVC-A-26.1.1.3	Action Step	Water Diversion and Impoundment	Encourage USFWS to initiate consultation with NMFS for CEMEX's red-legged frog HCP regarding diversions from San Vicente Creek and impacts to coho salmon and CCC steelhead.	3	5	CDFG, NMFS, USFWS						0	
SVC-A-26.1.2	Recovery Action	Water Diversion and Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.										
SVC-A-26.1.2.1	Action Step	Water Diversion and Impoundment	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	1	10	BLM, CDFG, CEMEX, NMFS HCD, Private Landowners, Public, SWRCB, USFWS						0	Cost are estimated under avoiding adverse effects.
SVC-A-26.1.2.2	Action Step	Water Diversion and Impoundment	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	1	60	CDFG, NMFS HCD, NMFS OLE, Private Landowners, Public, SWRCB, USFWS						0	

San Vicente Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SVC-A-26.1.3	Recovery Action	Water Diversion and Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	2	10	BLM, CDFG, CEMEX, NMFS HCD, NOAA RC, Private Landowners, SWRCB, USACE, USFWS						TBD	Costs will vary depending on number of diversions and types of existing infrastructure that would need to be upgraded to address this action. This information is currently unavailable.
SVC-A-26.1.4	Recovery Action	Water Diversion and Impoundment	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	1	5	CDFG, NMFS, Public, SWRCB, USFWS						0	This is a regulatory requirement of the SWRCB. Particular attention should be directed to the diversion to the pond on CEMEX property occupied by California red legged frogs.
SVC-A-26.2	Objective	Water Diversion and Impoundment	Develop new policies and regulations to provide suitable flow conditions for CCC coho salmon.										
SVC-A-26.2.1	Recovery Action	Water Diversion and Impoundment	Identify and eliminate depletion of summer base flows from unauthorized water uses.										
SVC-A-26.2.1.1	Action Step	Water Diversion and Impoundment	Develop and implement critical flow levels for stream reaches impacted by water diversions.	1	5	BLM, CDFG, CEMEX, Santa Cruz RCD, SWRCB	8.00	8.00	8.00	8.00	8.00	40	
SVC-A-26.2.1.2	Action Step	Water Diversion and Impoundment	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	1	60							0	
SVC-A-26.2.1.3	Action Step	Water Diversion and Impoundment	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by CEMEX and the community of Davenport through conservation programs.	1	60	CDFG, CDFG Law Enforcement, NMFS OLE, NMFS PRD, SWRCB						TBD	
SVC-A-26.2.1.4	Action Step	Water Diversion and Impoundment	Petition the SWRCB to declare San Vicente Creek fully appropriated during summer and fall months (DFG 2004).	2	5	CDFG, NMFS, Public	1.00	1.00	1.00	1.00	1.00	5	The County of Santa Cruz and the California Coastal Commission stated in their conditional use permits for CEMEX construction of a new kiln in Davenport and in the General Plan that San Vicente Creek is a fully allocated watershed.
SVC-A-26.2.1.5	Action Step	Water Diversion and Impoundment	Determine and monitor 1600 program compliance related to water diversions (DFG 2004).	3	1	CDFG, CDFG Law Enforcement	10.00					10	

SCOTT CREEK

Scott Creek

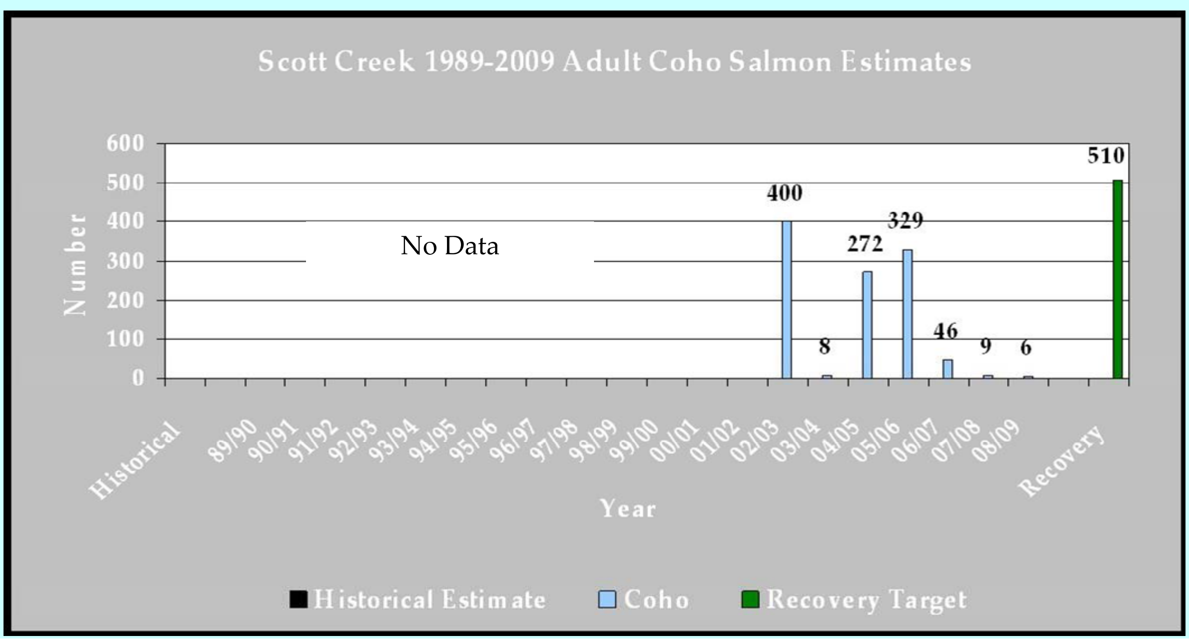
Dependent Population
15.0 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

Scott Creek drains approximately 30 square miles of the Santa Cruz Mountains in northwestern Santa Cruz County. Scott Creek enters the Pacific Ocean approximately two miles northwest of Davenport and 12 miles northwest of the City of Santa Cruz. About 70 percent of the Scott Creek watershed is coniferous forest and about 30 percent of the watershed is either shrubland, grasslands, or montane or riparian hardwood forest. The Scott Creek watershed has moderate to high erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. Ninety-five percent of the Scott Creek watershed is in private ownership; the remaining five percent is state and military owned lands. Land uses in the watershed include forestry, rural residential development, and agriculture. Within the past ten years, about six percent of the Scott Creek watershed has been under timber harvest plans. There are two dams within the watershed that impede or block salmon migration, and an additional 21 other barriers to salmon migration caused by road crossings, diversions, and natural structures. Scott Creek is the most important creek in the Santa Cruz diversity stratum because it maintains the largest remaining coho salmon populations and possibly individuals from all three year classes. Monterey Bay Salmon and Trout Project, in cooperation with Big Creek Timber Company, SWFSC, and DFG run a critical hatchery that is used for the coho broodstock program in the Scott Creek watershed. Unfortunately, over 7,000 acres of this watershed burned during the 2009 Lockheed fire, placing the remaining coho in severe jeopardy from increased erosion with the upcoming winter rains.

Scott Creek
Photo by Jerry Smith, SJSU

The Watershed at a Glance

Spawning Quantity & Quality	**FAIR to VERY GOOD**
Summer Water Temperatures	**FAIR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency	**POOR**
Riparian Canopy	**GOOD**
Off channel/Floodplain Quality	**POOR to GOOD**
Estuary Function	**POOR**



Scott Creek

Recovery Target: 510 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Roads and railroads
- Logging and Wood Harvesting
- Storms and Flooding
- Channel Modification
- Droughts
- Agricultural Practices
- Climate Change

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Scott Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve fire and fuel management practices
- Enhance riparian buffers
- Preserve existing forest lands
- Improve channel modifications
- Improve planning for natural disasters
- Decrease the number of roads near the stream and reduce impacts from remaining roads

Scott creek
Photo by Jerry Smith, SJSU

Advancing recovery of coho

salmon in Scott Creek requires these priority **recovery actions:**

- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.
- Maintain and promote conservation measures including Kingfisher Flat Hatchery per Dept. of Fish and Game and NMFS guidelines
- Promote, via technical assistance and/or regulatory of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph
- Conduct erosion site assessments to identify chronic sediment sources and assess runoff sources from networks.
- Addressing and remediating the devastating effects resulting from the 2009 Lockheed fire.

. . . in these **core areas:** Scott Creek, Big Creek, and Little Creek planning watersheds

Conservation Highlights

- Santa Cruz RCD, sediment remediation project
- Scott Creek watershed assessment
- Ongoing actions include Monterey Bay Salmon and Trout Project broodstock program and NOAA SWFSC population estimates.

We Need Your Photo Here

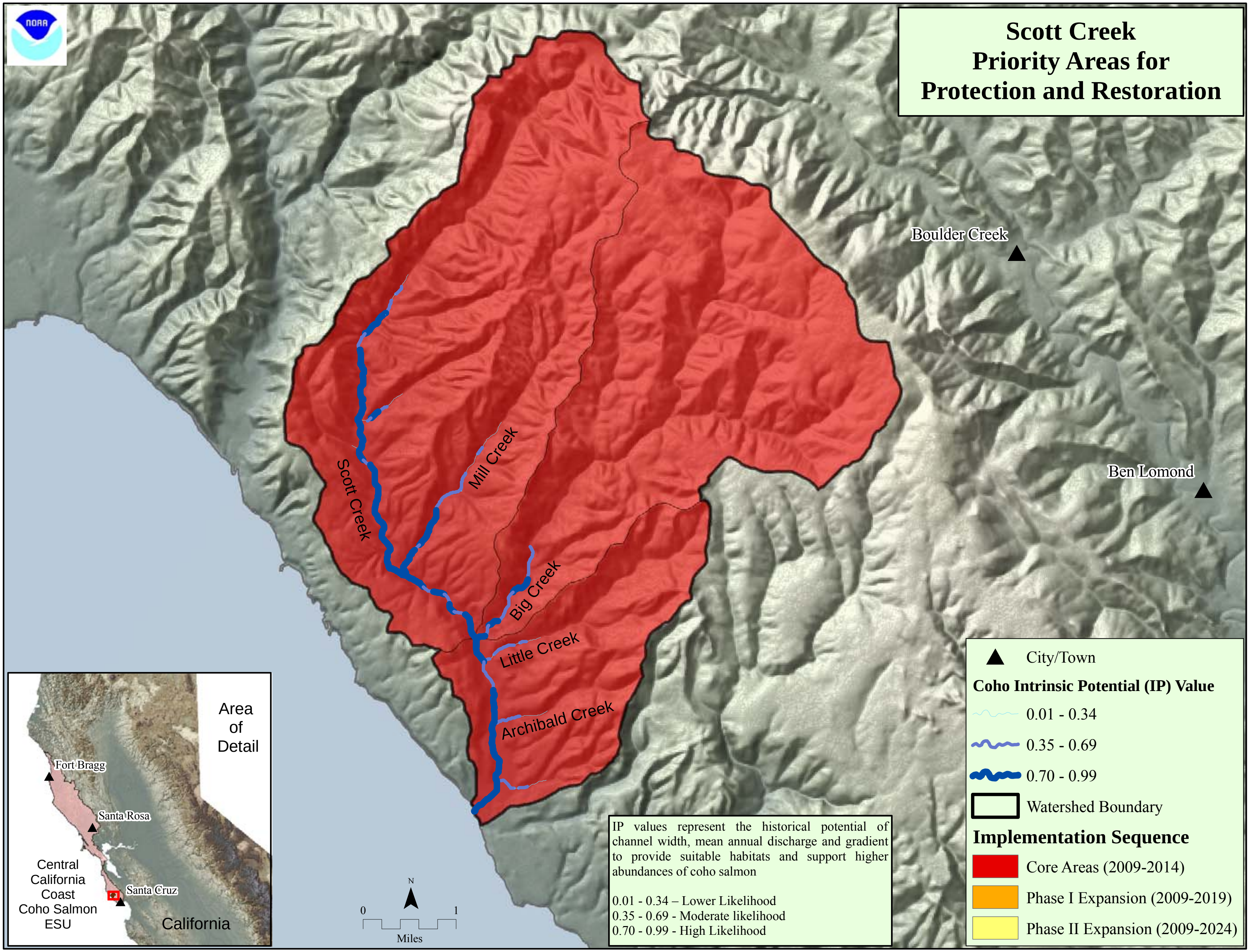
Scott Creek
Photo © Your Name Here, AFFIL

Recovery Partners

Scott Creek Watershed Counsel
Monterey Bay Salmon and Trout Project
CalPoly
Big Creek
NOAA SWFSC
Caltrans
CalFire

Immediate Needs

Address sediment impacts following the 2009 Lockheed Fire √
Install large wood debris √



Scott Creek
Priority Areas for
Protection and Restoration
Boulder Creek
Ben Lomond
Scott Creek
Mill Creek
Big Creek
Little Creek
Archibald Creek
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Scott Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	35-50	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	30-60 days	Fair	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	8729 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-800 m^2	800-1600 m^2	>1600 m^2
NMFS	Best Prof. judgment	5-10%	Fair	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	33	Very Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	83	Poor	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	75	Fair	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	43.5	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	5%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	43.5	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Poor	Poor	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	67	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	2.67/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	43.5	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	54%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.19%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.20%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	6%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	4.4	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	61%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	92%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	3 mi/sq.mi.	Fair	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	2.8 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	0.2-0.5 fish/m^2	Fair	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	35-50%	Good	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Scott Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Fire and Fuel Management	Medium	High	High	High	High	Medium			High
2	Roads and Railroads	High	High	High	Medium	Low	High			High
3	Logging and Wood Harvesting	Medium	Medium	Very High	Medium	Low	Medium			High
4	Storms and Flooding	High	High	Medium	Medium	Low	High			High
5	Channel Modification	Medium	Medium	High	Medium	High	Medium			High
6	Droughts	Medium	Medium	High	Medium	High	Medium			High
7	Agricultural Practices	Medium	Medium	High	Medium	Medium	Medium			High
8	Climate Change	High	Medium	Medium	Medium	Medium	Medium			High
9	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Residential and Commercial Development	Medium	Medium	Medium	Medium	Low	Medium			Medium
11	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Low	Medium			Medium
12	Mining	Medium	Low	Medium	Medium	Low	Medium			Medium
13	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Low	Medium			Medium
14	Disease, Predation, and Competition	-	-	Low	-	Medium	-			Low
15	Hatcheries and Aquaculture	Low	-	Low	Low	Low	Low			Low
16	Fishing and Collecting	Low	-	Low	Low	Low	-			Low
Threat Status for Targets and Project		High	High	Very High	High	High	High	-	-	Very High

Table

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
ScC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
ScC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.										
ScC-A-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	3	20	California Coastal Conservancy, CalPoly, CalTrans, CDFG, NMFS, NRCS, Santa Cruz County, Santa Cruz RCD, State Parks, USACE						TBD	Lower priority for coho but will benefit smolt transition and adult upmigration.
ScC-A-1.1.1.2	Action Step	Estuary	Remove structures impairing or reducing the historical tidal prism where feasible and where benefits to coho salmon and/or the estuarine environment are predicted. Evaluate benefits to lagoon tidal prism from the proposed bridge replacement for the US Route 1 bridge over Scott Creek lagoon.	1	10	CalPoly, CalTrans, CDFG, FEMA, NMFS, NOAA SWFSC, RWQCB, Santa Cruz County, Santa Cruz RCD, USACE, USFWS						TBD	Cost cannot be determined due to the unknown number of projects in the area and landowner willingness to assist in estuary restoration. It is likely that other projects will occur opportunistically over the next 60 years recovery horizon and should implemented when landowners are willing and funding is available. Caltrans is currently evaluating bridge replacement - differentiating between anticipated replacement costs and additional actions for coho recovery benefits can not be estimated at this time due to uncertainty regarding Caltrans preferred alternative. Replacement of the bridge offers a rare opportunity to restore two sharp bends to the lower channel and replace the leveed and straightened channel.
ScC-A-1.1.1.3	Action Step	Estuary	Enhance and restore estuary function by improving complex habitat features.	2	30	CalPoly, CalTrans, CDFG, NMFS, RWQCB, Santa Cruz RCD, USACE, USFWS						TBD	Improving complex habitat features will provide salt-water transition opportunities for smolts and improve feeding habitats.
ScC-A-1.1.1.4	Action Step	Estuary	Post durable and attractive interpretive signage at the beach to discourage casual breaching of the lagoon sandbar.	2	2	CalTrans, CDFG Law Enforcement, NMFS OLE, State Parks	0.15	0.15				0	
ScC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
ScC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
ScC-A-2.1.1.1	Action Step	Floodplain	Encourage counties to develop property easement acquisition funds and acquire grant monies to purchase eroding private properties in riparian corridors or properties subject to frequent flooding though a buyout program.	2	60	FEMA, Private Landowners, Santa Cruz County						TBD	Costs would vary and would depend on landowner participation. A long term cost savings in some locations would likely result from implementation of this action.
ScC-A-2.1.1.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	15	Big Creek Lumber Co., California Coastal Conservancy, CalPoly, CDFG, NMFS, NOAA RC, Santa Cruz RCD, Scotts Creek Watershed Council						TBD	Costs cannot be determined until riparian habitats are evaluated and the proper measures are identified.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-2.1.1.3	Action Step	Floodplain	Breech existing levees in lower Scott Creek watershed to increase flood-flow detention and promote flood-tolerant land uses. Evaluate feasibility of removing the lower levee constructed by Caltrans in 1940 for the Highway 1 bridge over Scott Creek.	1	10	CalPoly, CalTrans, FEMA, NMFS, NOAA RC, NRCS, Santa Cruz RCD, Scotts Creek Watershed Council, USACE, USFWS	40.00	40.00	40.00	40.00	40.00	400	Costs may vary depending on restoration methods used. Total removal would be more expensive than estimated here. Strategic breaching would be less expensive. Costs could be offset if adopted by Caltrans as a mitigation measure.
ScC-A-2.1.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	20	Big Creek Lumber Co., CalFire, CalPoly, CDFG, NMFS, NRCS, Private Landowners, RWQCB, Santa Cruz RCD, Scotts Creek Watershed Council, USACE						TBD	Costs will vary depending on site conditions, restoration techniques, and landowner participation. Scott Creek does not have a restoration plan that targets these habitat options and therefore costs cannot be determined at this time.
ScC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
ScC-A-3.1.1	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.										
ScC-A-3.1.1.1	Action Step	Hydrology	Develop more efficient and coordinated use of water resources to provide increased supply, restore groundwater levels, and increase dry weather baseflows through conjunctive management, use of reclaimed wastewater, and increased storage or utilization of excess winter stream flows.	1	3	California Coastal Conservancy, CalPoly, Farm Bureau, Monterey Bay Salmon and Trout Project, NMFS, NRCS, Scotts Creek Watershed Council, SWRCB, Trout Unlimited	33.33	33.33	33.33			100	Costs may vary depending on landowner participation. Cost estimate is based on full landowner participation and necessary coordination by landowner representatives. Cost estimate does not include improvements to infrastructure or development of storage facilities. These costs cannot be estimated until a water availability analysis is conducted.
ScC-A-3.1.1.2	Action Step	Hydrology	Work with the SWRCB to develop and enforce stream flow bypass requirements for diversions in mainstem Scott Creek, Big Creek, and Mill Creek (DFG 2004).	1	5	CDFG, NMFS HCD, NMFS OLE, SWRCB						TBD	
ScC-A-3.1.2	Recovery Action	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.										
ScC-A-3.1.2.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	1	20	California Coastal Conservancy, CalPoly, CDFG, Farm Bureau, Monterey Bay Salmon and Trout Project, NMFS, NRCS, Santa Cruz RCD, Scotts Creek Watershed Council, SWRCB, Trout Unlimited, USFWS						TBD	Costs will vary depending on land owner participation and potential solutions.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-3.1.2.2	Action Step	Hydrology	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (DFG 2004).	2	60	California Coastal Conservancy, CalPoly, CDFG, NMFS HCD, Scotts Creek Watershed Council, SWRCB, USACE						TBD	Cost is expected to be minimal
ScC-A-3.1.2.3	Action Step	Hydrology	Evaluate requests for on-stream dams above coho migratory reaches for effects on the natural hydrograph and the supply of spawning gravel for recruitment downstream (DFG 2004).	3	60	California Coastal Conservancy, CDFG, NMFS, NRCS, Private Consultants, Private Landowners, RWQCB, Santa Cruz RCD, SWRCB, USACE, USEPA, USFWS						0	
ScC-A-3.1.3	Recovery Action	Hydrology	Improve compliance with existing water resource regulations via monitoring and enforcement.										
ScC-A-3.1.3.1	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	1	3	CDFG Law Enforcement, NMFS OLE, Private Landowners, Public, RWQCB, SWRCB	33.33	33.33	33.33			100	Estimate is for regulatory agency staff time to investigate potential illegal diversions.
ScC-A-3.1.3.2	Action Step	Hydrology	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of coho salmon and their habitats, and avoidance of adverse impacts caused by water diversion (DFG 2004).	2	60	CDFG, NMFS, NRCS, RWQCB, Santa Cruz County, SWRCB, USACE, USEPA, USFWS						TBD	Costs cannot be determined at this time.
ScC-A-3.1.3.3	Action Step	Hydrology	Encourage compliance with the most recent update of NMFS' Water Diversion Guidelines.	1	60	CalFire, CalPoly, CDFG, Farm Bureau, NRCS, Private Landowners, Santa Cruz County, SWRCB, USACE						TBD	Costs should be minimal if this concept is adopted early in the planning process for all new development.
ScC-A-3.1.4	Recovery Action	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion on current or potential coho streams (DFG 2004).										
ScC-A-3.1.4.1	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	1	3	California Coastal Conservancy, CalPoly, CDFG, NMFS HCD, Private Consultants, Scotts Creek Watershed Council	20.00	20.00	20.00			60	This should happen concurrently with the water availability analysis study. This cost estimate is for the coho salmon flow portion of the study.
ScC-A-3.1.4.2	Action Step	Hydrology	Support SWRCB in regulating the use of streamside wells and groundwater.	2	60	CDFG, NMFS, Public, RWQCB, SWRCB, USEPA, USFWS						0	Costs should be minimal if incorporated into updated general plan.
ScC-A-3.1.4.3	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of coho salmon and authorized diverters (DFG 2004).	2	60	CDFG, NMFS, RWQCB, Santa Cruz County, USACE, USEPA, USFWS						TBD	
ScC-A-3.1.5	Recovery Action	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).										
ScC-A-3.1.5.1	Action Step	Hydrology	Encourage CalFire to modify water right for diversion in upper headwaters of Scott Creek.	3	5	CalFire, CDFG, NMFS, SWRCB	4.00	4.00	4.00	4.00	4.00	20	

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-3.1.5.2	Action Step	Hydrology	Encourage Lockheed to remove dam on Mill Creek and cease water diversions in Mill Creek.	3	5	CDFG, NMFS, SWRCB						TBD	Cost will depend on landowner willingness to participate in coho recovery.
ScC-A-3.1.5.3	Action Step	Hydrology	Evaluate dam and impacts of water diversion in Boyer Creek (tributary to Big Creek).	3	5	CDFG, NMFS, Scotts Creek Watershed Council, SWRCB						TBD	Costs for evaluation are not expected to be significant, however dam modification may be expensive.
ScC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
ScC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
ScC-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity and initiate restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.	1	15	Big Creek Lumber Co., CalFire, California Coastal Conservancy, CalPoly, CalTrans, CDFG, FEMA, NOAA RC, NRCS, Private Landowners, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Land Trust, Santa Cruz RCD, Scotts Creek Watershed Council, USACE						TBD	
ScC-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody debris (preferably large diameter redwood trees) into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	3	60	City of Santa Cruz, City of Scotts Valley, Santa Cruz County, USACE						TBD	Cost will depend on number of stream bank protection projects in Scott Creek. This number is unknown and will vary depending on water year. Cost of LWD may be less expensive in this watershed due to ongoing timber management actions.
ScC-A-6.1.1.3	Action Step	Pool Habitat	Educate landowners, land managers, and County and municipal staffs on the importance of LWD to coho survival and recovery, and watershed processes.	2	10	Big Creek Lumber Co., CalFire, CalPoly, CDFG, FishNet 4C, Monterey Bay Salmon and Trout Project, NMFS, Private Landowners, Santa Cruz County, Santa Cruz RCD, USFWS	1.00	1.00	1.00	1.00	1.00	10	Costs are anticipated to be lower in Scott Creek than in many of the more urbanized watersheds in the Santa Cruz Mtns Diversity Stratum due to the familiarity of many landowners with salmon and their habitat requirements.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-6.1.1.4	Action Step	Pool Habitat	Install properly sized large woody debris to appropriate viability table targets.	1	15	Big Creek Lumber Co., CA Coastal Commission, CalFire, California Department of Mines and Geology, CalPoly, CDFG, NMFS PRD, NOAA RC, NRCS, RWQCB, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, Scotts Creek Watershed Council, USACE, USFWS	66.67	66.67	66.67	66.67	66.67	1,000	Most LWD structures will need some engineering design and may need to be secured to minimize concerns due to downstream infrastructure. Impacts to watersurface elevations per FEMA concerns may also be required. Due to the large number of roads adjacent to the stream, access costs may be reduced. DFG (2004) estimated costs ranging between 60,000 dollars per stream mile in a small rocky stream to 140,000 per stream mile in large rocky stream. It is unknown how close these LWD estimates are to the viability table targets.
ScC-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.										
ScC-A-6.1.3	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.	1	60	CDFG, NMFS, NMFS OLE, Private Landowners						0	
ScC-A-6.1.3.1	Action Step	Pool Habitat	Mitigate LWD removal at a 3:1 ratio. LWD should be of comparable size and length.	2	60	CalFire, CalPoly, CalTrans, CDFG, FEMA, NMFS PRD, NRCS, Santa Cruz County, USFWS						TBD	These practices are commonly implemented as part of ongoing THP practices.
ScC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
ScC-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).										
ScC-A-7.1.1.1	Action Step	Riparian Vegetation	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	3	60	Big Creek Lumber Co., CalFire, California Coastal Conservancy, CalPoly, Farm Bureau, FEMA, NRCS, Private Landowners, Santa Cruz County, State Parks						TBD	Initial focus should be directed towards habitats in the lower portion of the Scott Creek watershed.
ScC-A-7.1.2	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	10	CDFG, City of Santa Cruz, NMFS, NOAA RC, Santa Cruz County, Santa Cruz County Parks and Cultural Resources, State Parks	2.00	2.00	2.00	2.00	2.00	20	

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-7.1.2.1	Action Step	Riparian Vegetation	Fully implement the County of Santa Cruz's Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	60	Big Creek Lumber Co., CalFire, CalPoly, Farm Bureau, FEMA, NRCS, Santa Cruz County Department of Public Works						TBD	
ScC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
ScC-A-8.1.1	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
ScC-A-8.1.1.1	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	2	60	Big Creek Lumber Co., CalFire, CalPoly, CalTrans, Farm Bureau, NRCS, Santa Cruz County Department of Public Works, USACE	0.25	0.25	0.25	0.25	0.25	15	Costs will vary on landowner participation and year to year variation in rainfall patterns. This cost estimate does not include maintenance obligations.
ScC-A-8.1.1.2	Action Step	Sediment	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF).	1	60	Big Creek Lumber Co., CalFire, California Coastal Conservancy, CalPoly, CalTrans, CDFG, Farm Bureau, FEMA, NMFS, NRCS, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, State Parks, USACE, USEPA, USFWS						TBD	Implementation costs cannot be determined at this time but are likely significant. Costs cannot be determined until appropriate assessments have been conducted. Costs may vary significantly depending on type of road related problems and whether roads are closed or decommissioned.
ScC-A-8.1.2	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										
ScC-A-8.1.2.1	Action Step	Sediment	Permitting agencies (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	2	60	CalFire, CDFG, FEMA, Mines and Geology, NMFS PRD, NRCS, RWQCB, Santa Cruz County, USACE, USEPA, USFWS						0	This should be considered a standard business practice for all regulatory and oversight agencies.
ScC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
ScC-A-9.1.1	Recovery Action	Viability	Measure or estimate response of key habitat attributes to recovery efforts across the watershed.										

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-9.1.1.1	Action Step	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	3	5	CalFire, CalPoly, CDFG, NMFS, NRCS, Private Consultants, RWQCB, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, USFWS						TBD	While standard methods are available outreach will be required to encourage all landowners, funding entities, and researchers to utilize them. Cost for outreach and education are difficult to determine due to an unknown number of participants and problems arising from staff turnover, etc. Costs for a statewide outreach and education program were estimate at 60,000 dollars (DFG 2004). Costs for a watershed specific program would likely be a fraction of that. A lower priority in Scott than some other watersheds due to the number of ongoing monitoring projects in the watershed.
ScC-A-9.1.2	Recovery Action	Viability	Continue funding the Scott Creek lifecycle station operated by NOAA's Santa Cruz Science Center.	1	5	CDFG, Monterey Bay Salmon and Trout Project, NOAA SWFSC, Pacific States Marine Fisheries Commission	100	100	100	100	100	500	
ScC-A-9.1.3	Recovery Action	Viability	Monitor population status for response to recovery actions.										
ScC-A-9.1.3.1	Action Step	Viability	Continue ongoing juvenile sampling efforts in the watershed. Establish consistent reporting methods to ensure ESU-wide consistency.	2	10	CDFG, NOAA SWFSC, Private Consultants	10.00	10.00	10.00	10.00	10.00	100	Juvenile monitoring is currently being conducted by J Smith of SJSU and to a lesser degree by the SWFSC.
ScC-A-9.2	Objective	Viability	Continue to operate MBSTP Kingfisher Flat Hatchery as a conservation hatchery, following the guidelines of the DFG and NMFS (DFG 2004).	1		CDFG, Monterey Bay Salmon and Trout Project, NMFS PRD, NOAA SWFSC, Pacific States Marine Fisheries Commission							Continued operation of this facility is essential to the immediate conservation and genetic viability of coho in the southern watersheds. It is anticipated that the hatchery will need to operate for more than 10 years.
ScC-A-9.2.1	Recovery Action	Viability	Expand the Kingfisher Flat Hatchery as appropriate.	2	10	Big Creek Lumber Co., CDFG, Monterey Bay Salmon and Trout Project, NMFS PRD, NOAA SWFSC, Pacific States Marine Fisheries Commission, Santa Cruz County Fish and Wildlife Advisory Board	80.00	80.00	80.00	80.00	80.00	800	Expansion should only occur (1) if water supply reliability, in quantity and quality, can be ensured. This estimate includes improving rearing ponds into a series of individual raceways and (2) if feedback from monitoring validates assumptions regarding the efficacy of the broodstock program
ScC-A-9.2.2	Recovery Action	Viability	Work with MBSTP to find secure sources for long term funding of the facility.										
ScC-A-9.2.2.1	Action Step	Viability	Obtain funding to initiate a full time monitoring program in order to evaluate the success of the propagation efforts.	1	10	CDFG, Monterey Bay Salmon and Trout Project, NMFS, Public, Santa Cruz County	70.00	70.00	70.00	70.00	70.00	700	Current monitoring of the success of this project is inadequate. Additional monitoring is essential in order to allow adaptive modifications to maximize the benefits from this facility and make adjustments, as necessary.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-9.2.2.2	Action Step	Viability	Obtain funding to ensure long term operation of this facility for the purpose of coho salmon propagation.	1	10	CDFG, Monterey Bay Salmon and Trout Project, NMFS, NOAA RC, NOAA SWFSC, Santa Cruz County Fish and Wildlife Advisory Board	150	150	150	150	150	1,500	Currently funding sources to operate this facility are not secure, much of the current funding comes from donations which have decreased in recent years due to decreased angling opportunities. Due to the importance of this facility for the coho population south of San Francisco Bay, it is very important that adequate funds are secured to ensure the long term viability of this operation. This facility is currently considered essential to preventing the extirpation of CCC coho salmon in the Santa Cruz Mountains Diversity Stratum.
ScC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
ScC-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
ScC-A-10.1.1.1	Action Step	Water Quality	Encourage County of Santa Cruz to establish wider riparian buffers in residential and urban areas.	2	60	CDFG, NMFS, Public, RWQCB						TBD	Not building flood control projects will not incur expenses.
ScC-A-10.1.1.2	Action Step	Water Quality	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	2	60	CalFire, California Coastal Conservancy, CalPoly, CDFG, Farm Bureau, FEMA, FishNet 4C, Mines and Geology, NRCS, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, Scotts Creek Watershed Council, State Parks, USACE, USEPA, USFWS						TBD	This is a long term action that will require continued emphasis to ensure buy-in from the public and local landowners to ensure long term improvements in water quality. Leveraging existing documents and programs could significantly reduce costs.
ScC-A-11.1	Objective	Agricultural Practices	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.										
ScC-A-11.1.1	Recovery Action	Agricultural Practices	Work with the agricultural community and Scott Creek Watershed Council to educate landowners and enhance practices that provide for functional watershed processes.	3	60	Big Creek Lumber Co., CalFire, CalPoly, CDFG, Farm Bureau, FishNet 4C, NOAA RC, RWQCB, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD						TBD	Costs should be minimal.
ScC-A-11.2	Objective	Agricultural Practices	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches and where habitat is in poor or fair condition.										

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-11.2.1	Recovery Action	Agricultural Practices	Implement Best Management Practices such as those in the Fish Friendly Farming program (Laurel Marcus and Associates, 2004) used by Sotoyome Resource Conservation District within Sonoma and Mendocino counties (DFG 2004), across all counties where agriculture is a land use. Best management practices should include implementation of buffers and water conservation.	2	5	CalPoly, CDFG, Farm Bureau, FishNet 4C, NMFS HCD, NRCS, Private Consultants, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD	20.00	20.00	20.00	20.00	20.00	100	Most of the cost will likely consist of funding for workshops. Costs may be significantly reduced if existing programs and protocols are used. It is important to note that these practices are not commensurate with the levels of protection necessary to avoid unauthorized take of listed salmonids. They do however, provide a starting point by which a landowner can evaluate the impacts of their land management actions.
ScC-A-11.2.2	Recovery Action	Agricultural Practices	Implement the NRCS/RCD coordinated program for fishery restoration practices.	3	7	California Coastal Conservancy, Farm Bureau, NMFS PRD, NRCS, Santa Cruz RCD						0	
ScC-A-11.2.3	Recovery Action	Agricultural Practices	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.										
ScC-A-11.2.3.1	Action Step	Agricultural Practices	With willing landowners, protect riparian vegetation buffer zones through conservation planning, acquisition, and easements (DFG 2004). Focus initial efforts on landowners that currently have grazing or agricultural operations along the estuary.	3	60	Big Creek Lumber Co., CalPoly, Conservation Fund, Santa Cruz County Land Trust, The Nature Conservancy						TBD	Cost will vary depend on market conditions, land owner participation, and available funding.
ScC-A-11.3	Objective	Agricultural Practices	Promote agricultural practices that protect and restore habitats for CCC coho salmon.										
ScC-A-11.3.1	Recovery Action	Agricultural Practices	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
ScC-A-11.3.1.1	Action Step	Agricultural Practices	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	1	60	CalPoly, Farm Bureau, NRCS, Private Landowners, RWQCB, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD						0	Roadside berms are common on many private and county roads in Santa Cruz County.
ScC-A-11.3.1.2	Action Step	Agricultural Practices	Develop grazing management plans to increase vegetation on pasture lands by practicing rotational grazing and removing exotics that do not provide forage.	3	60	CalPoly, Farm Bureau, NRCS, Private Landowners						TBD	Cost will vary depending on site conditions and availability of forage and access.
ScC-A-11.3.1.3	Action Step	Agricultural Practices	Promote dry-land farming instead of irrigated crops to reduce impacts of water diversions.	3	60	CalPoly, Farm Bureau						TBD	
ScC-A-11.3.1.4	Action Step	Agricultural Practices	Continue the use of cover crops in agriculture fields.	2	60	CalPoly, Farm Bureau, NRCS, RWQCB, Santa Cruz RCD						0	This should be considered a standard business practice.
ScC-A-11.4	Objective	Agricultural Practices	Reclaim current agricultural land that poses a high risk to salmonid habitat, or has a high recovery benefit to key lifestages, back to a natural landscape.										
ScC-A-11.4.1	Recovery Action	Agricultural Practices	Enhance and restore estuary function by improving complex habitat features.	3	60	Big Creek Lumber Co., California Coastal Conservancy, CalPoly, CalTrans, Farm Bureau, NRCS, Private Consultants, Santa Cruz RCD, State Parks						TBD	Cost will vary according to landowner participation. Benefits to coho will likely be focused on the smolt life stage whereas this recommendation will provide year round benefits to federally threatened CCC steelhead.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
ScC-A-12.1.1	Recovery Action	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.										
ScC-A-12.1.1.1	Action Step	Channel Modification	Evaluate whether proposed stabilization projects will lead to additional instability either up- or downstream.	2	60	California Coastal Conservancy, California Department of Mines and Geology, CalTrans, CDFG, FEMA, NMFS, NRCS, RWQCB, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD, USACE, USEPA, USFWS						0	This recommendation should be adopted as a standard business practice for all agencies and consulting firms involved in actions to address channel and bank stability.
ScC-A-12.1.1.2	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	60	CalFire, California Coastal Conservancy, California Department of Mines and Geology, CalTrans, CDFG, FEMA, NMFS PRD, NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD, USACE						0	
ScC-A-12.1.1.3	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. where critical infrastructure is located) for bank hardening projects.	2	60	California Coastal Conservancy, CalTrans, CDFG, Farm Bureau, FEMA, FishNet 4C, NMFS, NRCS, RWQCB, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, USACE						0	
ScC-A-12.1.1.4	Action Step	Channel Modification	For riparian roads, promote road relocation as a preferred alternative to bank stabilization.	2	60	CalFire, California Coastal Conservancy, California Department of Mines and Geology, CalPoly, CDFG, FEMA, NMFS, NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD, USACE						TBD	Riparian roads constrain channel function in many areas of Scott Creek. Moving roads where feasible may result in significant long term ecological and financial benefits to the riparian areas in the watershed. Particular emphasis should be placed on unpaved private or semi private roads that have relatively little traffic. Ultimate cost will depend on landowner participation and site specific constraints. Abandoned road segments should be properly decommissioned.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-12.1.2	Recovery Action	Channel Modification	Modify Federal, State, and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones, in all historic CCC coho salmon watersheds.	3	30							TBD	Costs are variable. Some costs will be absorbed in more urbanized setting by SWMP requirements from the RWQCB.
ScC-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
ScC-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	2	60	California Coastal Conservancy, CalPoly, NMFS, NRCS, Private Landowners, RWQCB, Santa Cruz County Fish and Wildlife Advisory Board, SWRCB, Trout Unlimited						TBD	The price at which water is sold on environmental markets is determined by negotiations between landowners and purchasing entity. In circumstances where potential agricultural sellers of water rights do not shift to groundwater pumping or make other arrangements such that lands are not left fallow, potential sellers may forgo the agricultural profits they would have gained from irrigating. Cost will vary depending on water availability and landowner participation. It is unknown if this program will gain widespread acceptance in the watershed and therefore costs cannot be estimated. However, it is recommended that the equations used in the State Coho Plan for socioeconomic costs be utilized when more information regarding landowner participation is gathered.
ScC-A-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
ScC-A-15.2.1	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	3	10	Big Creek Lumber Co., CalPoly, CDFG, NMFS, RWQCB, SWRCB	5.00	5.00	5.00	5.00	5.00	50	
ScC-A-15.2.2	Recovery Action	Droughts	Establish minimum summer releases from the Mill Creek reservoir to ensure rearing habitat is maintained in Mill Creek.	1	3	CDFG, Lockheed, NMFS, SWRCB	8.33	8.33	8.33			25	Regulatory agency staff time. This important coho salmon rearing stream dried down to isolated pools during the drought years of 1988, 2007, and 2008. A contingency plan should also be developed to provide a pulse release from the reservoir in drought years to facilitate adult entry (for broodstock capture for the hatchery) as well as for wild spawning.
ScC-A-15.3	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
ScC-A-15.3.1	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	2	20	Big Creek Lumber Co., CalPoly, Lockheed, Private Landowners, San Lorenzo Valley Water Agency, SWRCB	1.00	1.00	1.00	1.00	1.00	20	Outreach to landowners already occurs from many of the municipalities and water districts in the watershed.
ScC-A-15.3.1.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	1	5	CDFG, CDFG Law Enforcement, NMFS HCD, NMFS OLE, NMFS PRD, Private Landowners, Public, SWRCB						0	

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-15.3.2	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
ScC-A-15.3.2.1	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	2	5	CDFG, NMFS, Private Consultants						0	A recommendation for critical flow studies is outlined under Hydrology. Therefore no costs are estimated here.
ScC-A-15.3.2.2	Action Step	Droughts	If predicted flows are below a level considered critical to maintain habitat conditions for coho salmon, measures to reduce water consumption should be initiated by users in the watershed through conservation programs.	1	60	Big Creek Lumber Co., CalFire, CalPoly, CDFG, Farm Bureau, NMFS, NRCS, Private Landowners, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, SWRCB, Trout Unlimited						TBD	
ScC-A-15.3.3	Recovery Action	Droughts	Evaluate and prepare contingency plans to breach estuary sandbars to facilitate adult upmigration when instream flows are adequate for passage and spawning if sandbar remains closed by mid-January and hatchery remains in operation.	1	60	CA Coastal Commission, CDFG, Monterey Bay Salmon and Trout Project, NMFS, NOAA SWFSC, RWQCB, State Parks, USACE, USFWS	0.17	0.17	0.17	0.17	0.17	10	This option is likely most viable in Scott Creek due to the Hatchery and the importance of obtaining CCC coho for the current Broodstock program. This recommendation must be viewed with extreme caution in other watersheds. This recommendation should only be implemented in close cooperation with the NOAA SWFSC, MBSTP, DFG, USACE, State Parks, and other relevant entities. Permitting issues should be worked out well in advance by the regulatory agencies.
ScC-A-15.3.4	Recovery Action	Droughts	Increase oversight on water diversions.	2	60	CDFG Law Enforcement, NMFS OLE, RWQCB, Santa Cruz County, SWRCB, USFWS						TBD	Cost may vary significantly. In more urbanized areas costs will likely be absorbed into SWMP requirements per the RWQCB. Costs in rural areas where these storm water plans are not required may be significant on a project by project basis.
ScC-A-15.3.4.1	Action Step	Droughts	Increase enforcement patrols by DFG and NMFS OLE in sensitive spawning and rearing areas.	2	60	CDFG Law Enforcement, NMFS OLE						0	Costs are expected to be absorbed into ongoing activities.
ScC-A-15.3.4.2	Action Step	Droughts	Work with DFG, County of Santa Cruz, Scott Creek Watershed Council, and knowledgeable biologists (e.g. DFG, NOAA Santa Cruz Science Center, private consultants, CalPoly, etc.) to develop emergency rules and adopt implementation agreements.	2	3	Big Creek Lumber Co., CalFire, CalPoly, CDFG, CDFG Law Enforcement, Farm Bureau, NMFS, Santa Cruz County, Scotts Creek Watershed Council, SWRCB	16.67	16.67	16.67			50	Emergency rules should initially focus on Mill Creek.
ScC-A-16.1	Objective	Fire and Fuels Management	Develop measures protective of salmonids during fire suppression activities.										
ScC-A-16.1.1	Recovery Action	Fire and Fuels Management	Establish fire contingency plan developed by experts from CalFire, local fire districts, Santa Cruz RCD, and regulatory agencies with expertise in fisheries issues.										
ScC-A-16.1.1.1	Action Step	Fire and Fuels Management	Encourage CalFire to provide plan to all non-County fire fighters when providing fire fighting assistance in the Scott Creek watershed (and all other watersheds in the County).	1	5	CalFire						0	Cost of providing the plan is minimal.
ScC-A-16.1.1.2	Action Step	Fire and Fuels Management	In the event of a wildfire, we recommend CalFire Resource Advisors contact the resource agencies for ESA consultation (or technical assistance) about the incident. The resource agencies can provide guidance regarding critical resources in the area that may be affected by fire fighting actions.	2	0	CalFire, CDFG, NMFS, USFWS						TBD	Guidance could include informing CalFire of sensitive biological resources in the watershed as well as recommendations regarding watersource locations (e.g., picking up water from areas other than lagoons when using helicopters).

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-16.1.1.3	Action Step	Fire and Fuels Management	Implement sedimentation reduction techniques in concert with prescribed fire techniques to minimize sediment impacts to various coho salmon life stages.	1	60	CalFire						0	This recommendation should be considered a standard practice.
ScC-A-16.1.1.4	Action Step	Fire and Fuels Management	Immediately implement appropriate sediment control measures following completion of fire suppression while fire fighters and fire fighting equipment are on site.	1	60	Big Creek Lumber Co., Bodega Land Trust						0	This recommendation will result in a net cost savings.
ScC-A-16.1.1.5	Action Step	Fire and Fuels Management	Reduce erosion from fire lines.	1	60	CalFire						0	Implementing erosion control measures when constructing firebreaks (if possible) or shortly thereafter will likely result in a net cost savings. It is much more financially efficient to implement these measures while the fire crews are present rather than months later after the fire is out. Methods should include out-sloping, waterbars, breaks in fire lines (pick up blades on dozers occasionally, especially where fuels are sparse), minimize gradient of fire lines, change fire-line alignment onto occasional flats as often as possible (and especially near watercourses) to allow flows to dissipate and settle sediment. To the maximum extent possible, don't change the ground's topography -- keep water where it naturally flows, not concentrated.
ScC-A-16.1.1.6	Action Step	Fire and Fuels Management	Re-contour any new facility sites as soon as possible after site clean up and fire.	3	60	CalFire						0	Standard business practice.
ScC-A-16.1.2	Recovery Action	Fire and Fuels Management	Disseminate NMFS' October 9, 2007, jeopardy biological opinion on the use of fire retardants to local fire fighting agencies and CalFire.										
ScC-A-16.1.2.1	Action Step	Fire and Fuels Management	Avoid use of aerial fire retardants and foams within 300 feet of riparian areas throughout the current range of CCC coho salmon.	2	60	CalFire						0	This recommendation only applies to situations where people and structures are not immediately threatened by wildfire.
ScC-A-16.1.2.2	Action Step	Fire and Fuels Management	Develop guidance that directs CalFire and other agencies and organizations using fire retardants to conduct an assessment of site conditions following wildfire where fire retardants have entered waterways, to evaluate the changes to on site water quality and the structure of the biological community.	2	60	CalFire, CDFG, NMFS, USFWS						0	Costs are developed for the Aptos watershed and the guidance could be applied elsewhere.
ScC-A-16.1.2.3	Action Step	Fire and Fuels Management	Use non-toxic retardants. Avoid dropping fire retardant into streams. To the maximum extent feasible, orient air drops so that the drop goes perpendicular to streams as opposed to parallel.	2	60	CalFire						TBD	
ScC-A-16.2	Objective	Fire and Fuels Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.										
ScC-A-16.2.1	Recovery Action	Fire and Fuels Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.										
ScC-A-16.2.1.1	Action Step	Fire and Fuels Management	Use managed fire to promote revegetation of species that filter out fine sediment.	3	60	CalFire						TBD	
ScC-A-16.2.1.2	Action Step	Fire and Fuels Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	2	5	CalFire, CDFG, NMFS, NRCS, Santa Cruz County, USFWS						0	Costs are developed for the Aptos watershed. The fire plan could be used in the Scott watershed.
ScC-A-16.2.1.3	Action Step	Fire and Fuels Management	Reassess fire risk every ten years.	3	60	Big Creek Lumber Co., CalFire, CalPoly, Santa Cruz County						TBD	
ScC-A-16.2.1.4	Action Step	Fire and Fuels Management	Work with County planners to define future impacts of proposed urban and infrastructure development on fire suppression and fuel load buildup.	2	5	CalFire, Santa Cruz County	2.00	2.00	2.00	2.00	2.00	10	
ScC-A-17.1	Objective	Fishing and Collecting	Minimize bycatch of CCC coho salmon from offshore commercial and sport fishing.										

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-CCC-17.1.1	Recovery Action	Fishing and Collecting	Conduct outreach and education to anglers to reduce hook-and-release injury and mortality, and on methods to reduce salmonid gut hooking.	3	5	CDFG, NMFS, Pacific States Marine Fisheries Commission	4.00	4.00	4.00	4.00	4.00	20	Costs may vary significantly depending on number of new projects constructed and standards typically implemented. Cost cannot be determined at this time.
ScC-CCC-17.1.1.1	Action Step	Fishing and Collecting	Work with DFG to improve the Fishing Regulation manual to clearly identify differences in body morphology of all potentially present adult salmonids with color photos of diagnostic features (e.g., caudal fin spotting, caudal fin shape, coloration of lower jaw, peduncle width, etc.).	2	5	CDFG, NMFS	1.00	1.00	1.00	1.00	1.00	5	
ScC-CCC-17.1.1.2	Action Step	Fishing and Collecting	Work with DFG to monitor the Scott Creek sandbar until river flows naturally breach the sandbar.	2	60							0	Costs should be covered already as part of ongoing monitoring efforts.
ScC-CCC-17.2	Objective	Fishing and Collecting	Minimize interception of CCC coho salmon during the trout and steelhead freshwater sport fishing season.										
ScC-CCC-17.2.1	Recovery Action	Fishing and Collecting	Promote CalTip to discourage poaching (DFG 2004).	2	60	CDFG, NMFS, NMFS OLE, Public						0	
ScC-CCC-17.2.2	Recovery Action	Fishing and Collecting	Work with landowners to conduct actions (e.g., maintain road and trail closures) that prevent trespass and poaching.	2	20	Big Creek Lumber Co., CalFire, CalPoly, CDFG, NMFS, Private Landowners, Public, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, Scotts Creek Watershed Council	0.50	0.50	0.50	0.50	0.50	10	Cost is expected to be minimal and already largely covered as part of an existing outreach program to landowners and concerned citizen in the Scott Creek watershed.
ScC-CCC-20.1	Objective	Logging and Wood Harvesting	Devise incentive programs and incentive-based approaches to encourage and support landowners who conduct operations in a manner compatible with CCC coho salmon recovery priorities.										
ScC-CCC-20.1.1	Recovery Action	Logging and Wood Harvesting	Encourage a watershed-wide HCP for all or multiple landowners within a watershed to pool resources as a means to facilitate long-term survival and recovery for coho salmon and their habitat.	2	30	Big Creek Lumber Co., CalPoly, CDFG, NMFS, Private Landowners, Santa Cruz County, State Parks, USFWS	20.00	20.00	20.00	20.00	20.00	600	If existing information is adequate regarding watershed conditions for covered species, it is possible to reduce overall costs considerably. However, if HCP negotiations are contentious and protracted, costs could increase considerably.
ScC-CCC-20.2	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
ScC-CCC-20.2.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
ScC-CCC-20.2.1.1	Action Step	Logging and Wood Harvesting	Discourage Santa Cruz County from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	60	Board of Forestry, CalFire, Santa Cruz County, Santa Cruz County Land Trust						0	Costs should be minimal if Santa Cruz County readily adopts this recommendation.
ScC-CCC-20.2.1.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	1	60	Board of Forestry, CalFire, CDFG, Public, Santa Cruz County, Santa Cruz County Land Trust						0	
ScC-CCC-20.3	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
ScC-CCC-20.3.1	Recovery Action	Logging and Wood Harvesting	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	3	5	Big Creek Lumber Co., CalFire, CalPoly, CDFG, Private Landowners, RPFs						TBD	Financial impact will depend on rate of harvest in the watershed. Overall costs should be minimal.
ScC-A-20.3.1.2	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	2	60	Big Creek Lumber Co., CalFire, CalPoly, CDFG, RWQCB						TBD	Most of these costs will likely be associated with planned ongoing harvest.
ScC-A-20.3.1.3	Action Step	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	2	60	CalFire, California Department of Mines and Geology, CDFG, RWQCB, Santa Cruz County						TBD	This cost is expected to be minimal because these areas should be identified prior to permitting by appropriate regulatory agencies. These data should be held in a central repository by either the County of Santa Cruz and or CalFire.
ScC-A-20.3.1.4	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	60	CalFire, California Department of Mines and Geology, Private Landowners, RPFs, RWQCB						0	Cost is expected to be minimal.
ScC-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Conduct conifer release to promote growth of larger diameter trees where appropriate.	3	60	Big Creek Lumber Co., CalFire, CalPoly, Private Landowners, RPFs, RWQCB						0	Conifer release in Scott Creek should only occur in stream reaches where instream temperatures have been previously demonstrated as suitable for coho salmon. Cost should be minimal as it is anticipated this recommendation will only be implemented as part of an approved timber harvest plan.
ScC-A-20.3.3	Recovery Action	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.	3	60	Big Creek Lumber Co., CalFire, CalPoly, CDFG, Private Landowners, RWQCB, Santa Cruz County						0	Some costs may be incurred by landowner depending on management philosophy.
ScC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
ScC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	60	CalFire, CalTrans, Private Consultants, Private Landowners, RWQCB, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD	0.17	0.17	0.17	0.17	0.17	10	Ongoing programs, such as FishNet 4C, could facilitate this recommendation.
ScC-A-24.1.2	Recovery Action	Roads and Railroads	Educate county policy staff and Board of Supervisors on the benefits of railcar bridges and provide information from other counties where they are commonly used.	3	60	CDFG, NMFS, Santa Cruz County						0	
ScC-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
ScC-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1	60	Big Creek Lumber Co., CalFire, CalPoly, Mines and Geology, Private Landowners, RWQCB, Santa Cruz RCD	16.67	16.67	16.67	16.67	16.67	1,000	Costs may vary widely depending on number of riparian roads and the magnitude of the problem associated with the roads.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-24.2.2	Recovery Action	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	60	Big Creek Lumber Co., CalFire, CalPoly, CDFG, Farm Bureau, Santa Cruz County						TBD	This is a long term plan that would require cooperation from the majority of the landowners in the watershed. It is unknown if this is a feasible alternative for Scott Creek. Primary emphasis should be placed on removing riparian roads with high sediment delivery potential adjacent to key spawning and rearing areas.
ScC-A-24.3	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
ScC-A-24.3.1	Recovery Action	Roads and Railroads	Address sediment sources from road networks and other actions that deliver sediment to stream channels.										
ScC-A-24.3.1.1	Action Step	Roads and Railroads	Provide and maintain adequate energy dissipaters for culverts and other drainage pipe outlets where needed.	2	60	Big Creek Lumber Co., CalFire, CalPoly, Farm Bureau, NRCS, RWQCB, Santa Cruz County Department of Public Works, USACE	0.67	0.67	0.67	0.67	0.67	40	A culvert inventory is needed.
ScC-A-24.3.1.2	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	Big Creek Lumber Co., CalFire, California Department of Mines and Geology, CalPoly, CDFG, RWQCB						TBD	This is a cost that is frequently absorbed into new road projects and should be considered a standard business practice.
ScC-A-24.3.1.3	Action Step	Roads and Railroads	Evaluate and remove roadside berms that lead to increased runoff velocities and result in increased sediment discharge.	2	20	Big Creek Lumber Co., CalFire, CalPoly, Farm Bureau, NRCS, Private Landowners, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD, USACE	2.50	2.50	2.50	2.50	2.50	50	Roadside berms are a common feature on many private and county roads in Santa Cruz County. Many of the private timberland roads have been upgraded and are hydrologically disconnected. A similar effort should occur on the remaining roads in the watershed. The cost of this effort cannot be estimated until a complete watershed wide inventory in conducted.
ScC-A-24.3.1.4	Action Step	Roads and Railroads	Install sediment traps for pretreatment, and a modified culvert system that can act as an efficient detention system.	3	60	Big Creek Lumber Co., CalFire, CalPoly, CDFG, NRCS, RWQCB, Santa Cruz RCD, USACE						TBD	Cost will vary depending on the number of culvert upgrades on the road network and the maintenance requirements and accessibility. An inventory of the culvert system is necessary before costs can be estimated.
ScC-A-24.3.2	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.	2	5	CDFG, NMFS HCD, NMFS OLE, NMFS PRD, Private Consultants, SWRCB	10.00	10.00	10.00	10.00	10.00	50	This recommendation may involve increased intra-watershed coordination among the landowners (locking and installing gates, etc.).
ScC-A-24.3.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	60	Big Creek Lumber Co., CalFire, CalPoly, Private Landowners, Santa Cruz County						TBD	
ScC-A-24.3.3	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	Big Creek Lumber Co., CalFire, California Department of Mines and Geology, CalPoly, NRCS, Private Landowners, RPFs, RWQCB, Santa Cruz County, Santa Cruz RCD						TBD	Cost cannot be determined at this time but should be adopted as part of future road actions and maintenance practices.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
ScC-A-24.3.4	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.										
ScC-A-24.3.4.1	Action Step	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	2	60	Big Creek Lumber Co., CalFire, CalPoly, RWQCB, Santa Cruz County, USACE						TBD	
ScC-A-24.3.4.2	Action Step	Roads and Railroads	The proposed bridge replacement for Highway 1 over Scott Creek should be relocated to allow Scott Creek to re-establish its historical outlet into the ocean. Relocating the replacement bridge could facilitate the re-establishment of the historical tidal prism in the lower lagoon.	2	10	CalTrans, CDFG, NMFS						TBD	Costs were not estimated because Caltrans is planning to replace the existing Highway 1 bridge. Increased costs may be associated with the proposed recommendation but this information is currently unavailable.
ScC-A-24.4	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
ScC-A-24.4.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	CalFire, CalPoly, CalTrans, CDFG, Private Landowners, Santa Cruz County						TBD	Cost may vary significantly. However, a well designed road management plan should result in overall cost savings due to reduced flood fighting actions, and stream bank and road stabilization projects.
ScC-A-24.4.2	Recovery Action	Roads and Railroads	Improve enforcement of Erosion Control Ordinance for private roads. The current Santa Cruz Erosion Control Ordinance has provisions requiring the responsible parties to repair and alleviate erosion problems that are deemed severe. Santa Cruz Planning should create new erosion control staff positions to help coordinate the County's cooperative efforts, but also to conduct inspections and enforcement actions as necessary.	1	10	Santa Cruz County	5.00	5.00	5.00	5.00	5.00	50	Costs are estimated for Scott Creek watershed only. Costs are an estimate of County staff time.
ScC-A-24.4.3	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	1	5	Farm Bureau, Private Landowners, RWQCB, Santa Cruz County						TBD	
ScC-A-25.1	Objective	Storms and Flooding	Conduct outreach and education regarding how local, city, county, State and Federal planning can put in place mechanisms that provide community resiliency to storms and flooding.										
ScC-A-25.1.1	Recovery Action	Storms and Flooding	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	1	60	CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD						0	Santa Cruz County is well under way in the development of this program.
ScC-A-25.1.2	Recovery Action	Storms and Flooding	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	1	60	Farm Bureau, FEMA, HUD, NRCS, RWQCB, Santa Cruz County, USACE						TBD	Cost will vary depending on site specific conditions. Avoiding building in channel migration zones can result in long term cost saving due to reduced flood fighting and consequent stabilization measures.
ScC-A-25.1.3	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).										
ScC-A-25.1.3.1	Action Step	Storms and Flooding	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	3	60	FEMA, Private Landowners, Santa Cruz County, USACE						TBD	This could be a costly recommendation depending on the infrastructure and the feasibility of removing it. Some infrastructure may be relatively easy to remove while other infrastructure will be extremely difficult. This recommendation should be viewed as an opportunistic strategy and should be used strategically.

Scott Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
ScC-A-25.1.3.2	Action Step	Storms and Flooding	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.	1	60	CDFG, FEMA, HUD, NRCS, RWQCB, Santa Cruz County, USACE						0	
ScC-A-25.1.3.3	Action Step	Storms and Flooding	Flood control projects or other modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	1	60	FEMA, NRCS, RWQCB, San Mateo RCD, USACE						0	
ScC-A-25.1.3.4	Action Step	Storms and Flooding	Modify County General Plan to eliminate provisions allowing new construction in undeveloped areas within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	1	5	FEMA, HUD, Santa Cruz County						TBD	
ScC-A-25.1.4	Recovery Action	Storms and Flooding	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	1	5	CDFG, NMFS, NRCS, RWQCB, Santa Cruz County, Scotts Creek Watershed Council, USACE	4.00	4.00	4.00	4.00	4.00	20	Existing documents and policies can be used for this recommendation. Costs would increase if a number of site specific conditions and criteria are developed.
ScC-A-25.1.5	Recovery Action	Storms and Flooding	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	1	60	Big Creek Lumber Co., CalFire, CalPoly, CalTrans, FEMA, NRCS, Santa Cruz County, Santa Cruz RCD, USACE						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have roads and other infrastructure addressed to improve hydrologic function. As a general recommendation for future development, costs may vary depending on existing infrastructure and site specific conditions.
ScC-A-25.1.6	Recovery Action	Storms and Flooding	Work with local governments to incorporate protection of CCC coho salmon in any flood management activity (DFG 2004).	2	10	CDFG, FEMA, Private Landowners, Santa Cruz County, USACE						0	Outreach and education are ongoing, and additional costs are expected to be minimal.
ScC-A-25.2	Objective	Storms and Flooding	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.										
ScC-A-25.2.1	Recovery Action	Storms and Flooding	Establish targeted polices, requirements and assistance for sandy soils areas.	3	60	CalFire, CalTrans, Santa Cruz County						TBD	

SOQUEL CREEK

Soquel Creek

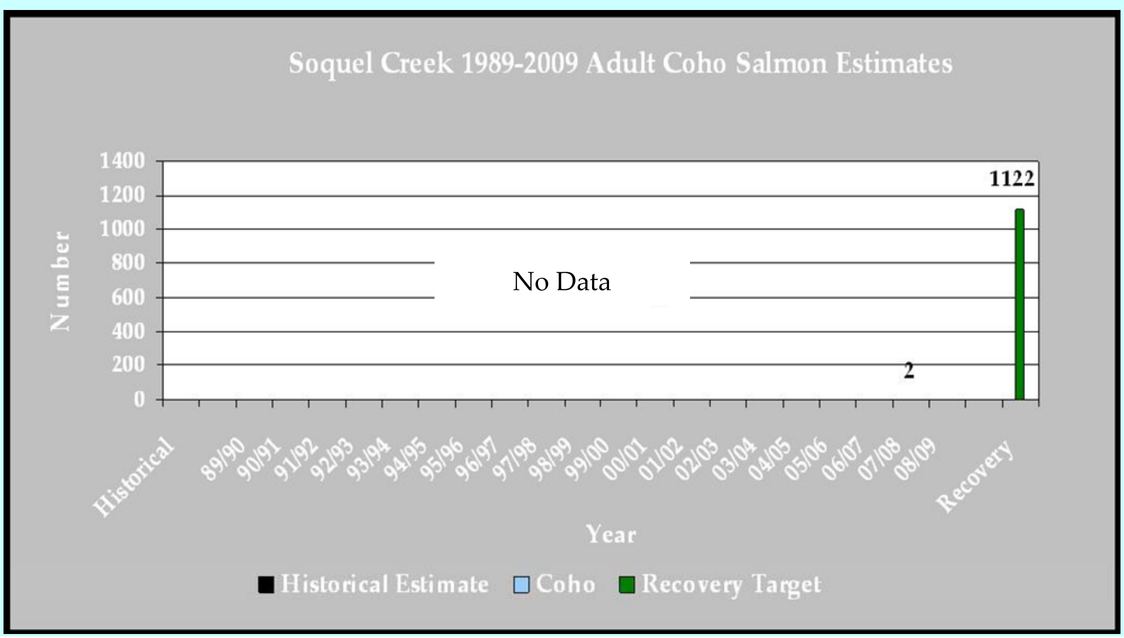
Dependent Population
33.0 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

Soquel Creek drains approximately 42 square miles of the Santa Cruz Mountains in western Santa Cruz County. Soquel Creek enters the Pacific Ocean at the town of Soquel. About 64 percent of the Soquel Creek watershed is redwood coniferous forest and approximately 20 percent is shrubland; the remaining 16 percent is either riparian oak woodland, grassland, agriculture, and urban development. The Soquel Creek watershed has moderate to high erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. The SWRCB listed the Soquel Creek lagoon as having water quality impaired for sediment, nutrients, and pathogens in 2003. The water quality impairment listing determined that sediment, nutrients, and pathogens were impairing migration, spawning and rearing habitats beneficial to coho salmon. Additional probable causes include; identified natural sources, septage disposal, nonpoint sources, construction and development, and urban runoff during storm events. Eighty-eight percent of the Soquel Creek watershed is in private ownership; the remaining 12 percent is state owned forest lands. Housing development within the Soquel Creek watershed is moderate to high; approximately 7,000 housing units are present in the watershed. There are 8 dams within the watershed that impede or block salmon migration, Impassable barriers block salmonids for 10 to 30 percent of the watershed.

Soquel Creek
Photo by D.W. ALLEY & Associates

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD**
Summer Water Temperatures:	**FAIR**
Depth & Shelter of Pools	**FAIR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**GOOD**
Off channel/Floodplain Quality:	**POOR**
Estuary Function:	**POOR**



Soquel Creek

Recovery Target: 1,122 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Residential and
- Commercial Development
- Storms and Flooding
- Droughts
- Fire and Fuel Management
- Roads and Railroads
- Water Diversion and Impoundment
- Climate Change
- Logging and Wood Harvesting

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Soquel Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Increase the quantity of off channel habitat
- Increase the amount of large wood in streams
- Limit the number of new roads and decrease the amount of existing near-stream roads
- Diminish the amount of sediment input into the streams
- Improve and expand the estuary
- Enhance and increase the shelter provided within pools
- Improve floodplain connectivity to provide rearing habitat

Critically important woody debris cut in half and removed from Soquel Creek
Photo by Michelle Leicester, DFG

Advancing recovery of coho

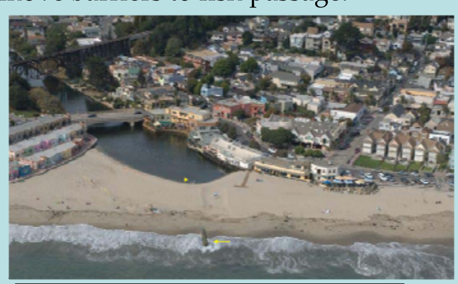
salmon in Soquel Creek requires these priority **recovery actions:**

- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.
- Install properly sized LWD to increase the size and frequency of pool habitat.
- Encourage SWRCB to bring illegal water diverters, and out-of-compliance diverters, into compliance with State law.
- Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).

. . . in the Soquel Creek planning watershed.

Conservation Highlights

- The City of Capitola has an active lagoon management program
- The County of Santa Cruz and the Santa Cruz Resource Conservation District work to remove barriers to fish passage.



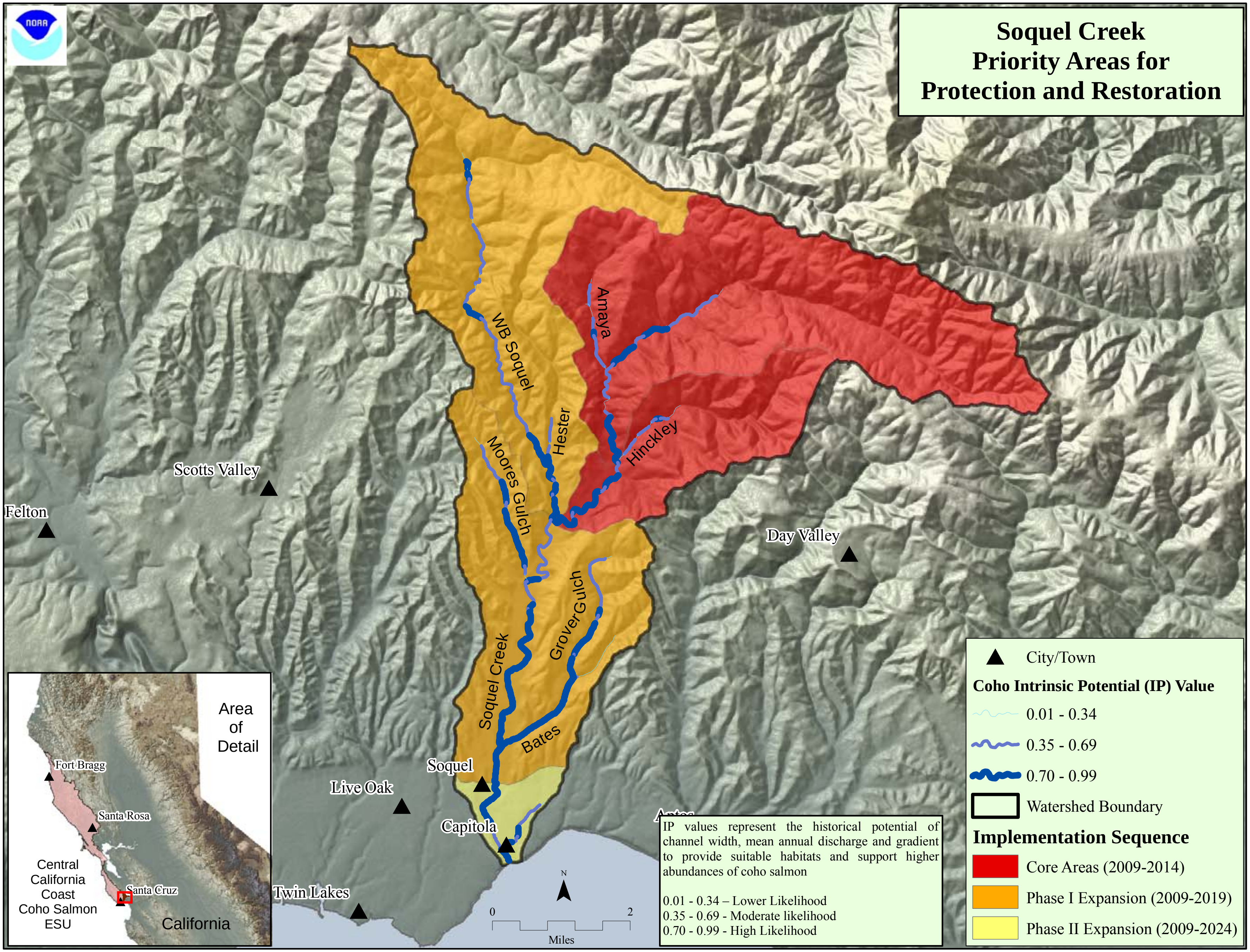
Soquel Lagoon
Photo by Michelle Leicester, DFG

Recovery Partners

Soquel Water District
Santa Cruz RCD
DFG
State Parks
Soquel Demonstration State Forest
City of Capitola
County of Santa Cruz
Friends of Soquel Creek
Santa Cruz Land Trust

Immediate Needs

Adopt watershed wide conservation strategies √
Install instream structures to add complexity √
Address road sediment input √


Soquel Creek
Priority Areas for
Protection and Restoration
Amaya
WB Soquel
Hester
Hinckley
Moores Gulch
GroverGulch
Soquel Creek
Bates
Scotts Valley
Felton
Day Valley
Soquel
Live Oak
Capitola
Twin Lakes
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
N
0
2
Miles
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Soquel Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	NA	NA	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	78%	Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	NA	NA	Spawning Adults	Sediment	Amount of Gravel*	<2 m^2	2-1500 m^2	1500-3000 m^2	>3000 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	NA	NA	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	NA	NA	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	NA	NA	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	<50% Connected	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	NA	NA	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	4.8/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	NA	NA	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	<50%	Poor	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	NA	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	1.24%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	1.29%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	0%		Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Very Good	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	0.6	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	55-69%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	> 80%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	≤ 69% density "D" across IP-km	70 -79%	> 80%	
NMFS	CDF THP Dataset	4.1 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	4 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m2	0.2-0.5 fish/m2	0.5-1.0 fish/m2	>1.0 fish/m2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

	Soquel Creek Threats Across Targets	Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages	Overall Threat Rank
	Project-specific threats	1	2	3	4	5	6	
1	Residential and Commercial Development	Medium	High	Very High	High	High	High	Very High
2	Storms and Flooding	Low	High	High	High	High	High	High
3	Droughts	High	Medium	Very High	Medium	Medium	Medium	High
4	Fire and Fuel Management	Medium	High	Very High	Medium	Medium	Medium	High
5	Roads and Railroads	Medium	High	High	High	Medium	High	High
6	Water Diversion and Impoundment	Medium	Medium	Very High	Medium	Medium	Medium	High
7	Climate Change	Medium	Medium	High	Medium	Medium	Medium	High
8	Logging and Wood Harvesting	Medium	Medium	High	Medium	Medium	Medium	High
9	Mining	Low	Medium	High	Low	Low	Medium	Medium
10	Fishing and Collecting	High	-	Medium	Low	Medium	-	Medium
11	Disease, Predation, and Competition	Medium	-	Medium	-	High	-	Medium
12	Livestock Farming and Ranching	Medium	Medium	Medium	Medium	Medium	Medium	Medium
13	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium	Medium
14	Channel Modification	Medium	Low	Medium	Medium	Low	Medium	Medium
15	Recreational Areas and Activities	Medium	Low	Low	Medium	Low	Medium	Medium
16	Hatcheries and Aquaculture	-	-	-	Low	Low	-	Low
	Threat Status for Targets and Project	High	High	Very High	High	High	High	Very High

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
SoC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.										
SoC-A-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	3	15	California Coastal Conservancy, CDFG, City of Capitola, NMFS, RWQCB, Santa Cruz County, USACE						TBD	Lower priority for coho but will benefit smolt transition and adult upmigration. Improvements to estuarine conditions will directly benefit listed CCC steelhead.
SoC-A-1.1.2	Recovery Action	Estuary	Where appropriate, remove structures and/or modify practices which impair or reduce the historical tidal prism and/or estuarine function where feasible and where benefits to coho salmon and/or the estuarine environment are predicted.	3	30	California Coastal Conservancy, CDFG, City of Capitola, NMFS, NRCS, USACE						TBD	Lower priority for coho but will benefit smolt transition and adult upmigration.
SoC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
SoC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
SoC-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	1	5	California Coastal Conservancy, CDFG, NOAA RC, Santa Cruz RCD	10.00	10.00	10.00	10.00	10.00	50	Most of this data may be available from existing watershed assessments and GIS.
SoC-A-2.1.1.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	60	CalFire, California Coastal Conservancy, CDFG, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Land Trust, Santa Cruz RCD, USACE						TBD	
SoC-A-2.1.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	60	California Coastal Conservancy, CDFG, City of Capitola, FEMA, FishNet 4C, NMFS, NRCS, Private Landowners, San Mateo RCD, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz County Land Trust, Santa Cruz RCD, USACE						TBD	Costs will vary depending on site specific conditions and degree of landowner participation. Many of these areas have urban infrastructure which increases the importance of those remaining flood plain areas in Soquel.
SoC-A-2.1.3	Recovery Action	Floodplain	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	2	10	Santa Cruz County, Santa Cruz County Land Trust						0	Cost of establishment would likely occur on a countywide basis. Cost was originally estimated for the San Lorenzo River implementation table and would apply to all targeted streams in the Santa Cruz Mountains Diversity Stratum.
SoC-A-5.1	Objective	Passage	Identify and remove existing passage barriers.										
SoC-A-5.1.1	Recovery Action	Passage	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.										

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-5.1.1.1	Action Step	Passage	Continue to refine, update, and maintain the Coastal Conservancy database of barriers to fish passage (DFG 2004).	3	60	California Coastal Conservancy						0	Database is already in existence. Costs to maintain it, while not without expense, should be minimal.
SoC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
SoC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
SoC-A-6.1.1.1	Action Step	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity and implement restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core and Phase 1 areas and lower mainstem reaches of Soquel Creek.	1	10	CDFG, City of Capitola, NOAA RC, Private Landowners, Santa Cruz County Fish and Wildlife Advisory Board, Soquel Demonstration State Forest, State Parks, USACE	70.00	70.00	70.00	70.00	70.00	700	Properly sized LWD should be installed according to viability table targets. Immediate efforts should occur in the East Branch of Soquel Creek. Costs are difficult to determine at this time and will vary depending on specific stream reaches and concerns among the public regarding alterations to water surface elevations and potential impacts to populated areas downstream. LWD will likely need to be secured in some reaches due to these concerns over flooding.
SoC-A-6.1.1.2	Action Step	Pool Habitat	Incorporate large woody material into stream bank protection projects, where appropriate. Do not use aqua logs (cylindrical concrete rip rap).	2	60	CalTrans, CDFG, City of Capitola, NOAA RC, Santa Cruz County, Santa Cruz RCD, USACE						TBD	This is an opportunistic action step and should be incorporated into bank stabilization projects. Costs cannot be determined due to the opportunistic nature of this recommendation.
SoC-A-6.1.1.3	Action Step	Pool Habitat	Educate landowners, land managers, and County and municipal staffs on the importance of LWD to coho survival and recovery, and watershed processes.	1	10	Alnus Ecological, CDFG, FEMA, FishNet 4C, NMFS, Santa Cruz County, Soquel Demonstration State Forest	4.00	4.00	4.00	4.00	4.00	40	This cost can likely be extrapolated to other watersheds and combined with other efforts. However, this will likely need a sustained effort to convince landowners and others of the importance of LWD in the Soquel watershed.
SoC-A-6.1.1.4	Action Step	Pool Habitat	Install properly sized large woody debris to appropriate viability table targets.	1	20	Alnus Ecological, CDFG, FEMA, NOAA RC, Private Landowners, Santa Cruz County, Soquel Demonstration State Forest, State Parks, USACE						TBD	Costs are difficult to determine at this time and will vary depending on stream reach and concerns regarding alterations to water surface elevations and potential impacts to populated areas downstream. LWD will likely need to be secured in some reaches due to (often misplaced) flooding concerns.
SoC-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	1	60	CalTrans, CDFG, City of Capitola, FEMA, NMFS PRD, NOAA RC, NRCS, Private Landowners, Santa Cruz County, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks, USACE						TBD	This recommendation should be applied over the life of the recovery process, and should be considered a standard business practice for all entities engaged in stream restoration. Restoration and enhancement projects in the Soquel Creek watershed must focus on increasing freshwater survival rather than just increasing capacity (e.g. barrier removal) in the watershed.
SoC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	60	CDFG, Santa Cruz County, Santa Cruz County Land Trust, The Nature Conservancy							Focusing purchase and establishment of streamside conservation measures could protect important watershed functions into the future.
SoC-A-7.1.2	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, ivy, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	10	CDFG, NOAA RC, NRCS, Santa Cruz County, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks						TBD	Initial efforts should focus in the more populated areas of the watershed where the majority of the exotic vegetation infestations are located.
SoC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
SoC-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.	2	60	CalFire, CalTrans, FEMA, NRCS, Santa Cruz County, Santa Cruz RCD, USACE						TBD	See Roads section for more specific information.
SoC-A-8.1.2	Recovery Action	Sediment	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.										
SoC-A-8.1.2.1	Action Step	Sediment	Permitting agencies and funding (State, Federal, and local) should evaluate all authorized erosion control measures during the winter period.	1	60	CalFire, CDFG, NMFS PRD, NRCS, Santa Cruz County, Santa Cruz RCD, USACE						0	This should be considered a standard business practice for all permitting agencies.
SoC-A-8.1.3	Recovery Action	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	3	10	CalFire, CalTrans, NRCS, Santa Cruz County Department of Public Works, Santa Cruz RCD	4.00	4.00	4.00	4.00	4.00	40	This cost estimate does not include long-term maintenance obligations.
SoC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
SoC-A-9.1.1	Recovery Action	Viability	Refine assessment methods to more accurately identify and measure key habitat attributes.	3	60	California Coastal Conservancy, CDFG, NMFS, NRCS, Private Consultants, Santa Cruz RCD						TBD	This is an ongoing process, and costs depend on outcomes of adaptive changes.
SoC-A-9.1.2	Recovery Action	Viability	Conduct periodic, standardized spawning surveys to estimate adult abundance in the watershed. Surveys should include all three cohorts.	3	9	CDFG, NMFS, NOAA SWFSC, Private Consultants, Santa Cruz County Fish and Wildlife Advisory Board	55.56	55.56	55.56	55.56	55.56	500	Periodic surveys (redd surveys may be the most viable survey method in Soquel) are likely the preferred alternative in Soquel (a Dependent watershed) due to the other adult monitoring all ready occurring in other Dependent watersheds in the Santa Cruz Mtn. Diversity Stratum.
SoC-A-9.1.3	Recovery Action	Viability	Conduct periodic, standardized smolt outmigration surveys to estimate smolt abundance in the watershed. Surveys should occur during the same period as adult spawning surveys.	3	9	CDFG, NMFS, Santa Cruz County Fish and Wildlife Advisory Board	44.44	44.44	44.44	44.44	44.44	400	Periodic surveys are likely the preferred alternative in Soquel (a Dependent watershed) due to the other monitoring all ready occurring in other Dependent watersheds in the Santa Cruz Mtn. Diversity Stratum. Costs will vary depending on sampling intensity, duration, and location. Survey effort should include all three cohorts.
SoC-A-9.1.4	Recovery Action	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	3	10	CalFire, CDFG, NMFS PRD, Private Consultants, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks						TBD	Existing DFG habitat survey protocols may be utilized at little or no cost for development.

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SoC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
SoC-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
SoC-A-10.1.1.1	Action Step	Water Quality	Encourage County of Santa Cruz to establish wider riparian buffers in residential and urban areas.	2	60	California Coastal Conservancy, CDFG, Private Landowners, Public, RWQCB, Santa Cruz County							Establishing a policy for new development will help minimize future impacts associated with flooding, impacts to water quality, and costs associated with flood fighting actions. This policy and costs associated with its development can be expanded to other watersheds in the County. See other relevant strategies for Soquel under Logging and Wood Harvesting and Droughts.
SoC-A-10.1.1.2	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	1	20	CalFire, CalTrans, CDFG, FEMA, NOAA RC, NRCS, Private Landowners, Public, Santa Cruz County Department of Public Works, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks, USACE						TBD	Cost will vary depending on landowner acceptance and participation.
SoC-A-11.1	Objective	Agricultural Practices	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
SoC-A-11.1.1	Recovery Action	Agricultural Practices	Support the development of new regulations to minimize impacts on summer baseflow from riparian water rights users.	3	60	Farm Bureau, NRCS, RWQCB, Santa Cruz RCD							
SoC-A-11.1.1.1	Action Step	Agricultural Practices	Work with the SWRCB to develop, implement, and enforce stream flow bypass requirements for all diversions in the watershed.	1	10	CDFG, NMFS HCD, NMFS OLE, Private Landowners, SWRCB, Water Agencies	20.00	20.00	20.00	20.00	20.00	200	
SoC-A-11.1.2	Recovery Action	Agricultural Practices	Reduce impacts of sediment inputs related to agricultural practices.										
SoC-A-11.1.2.1	Action Step	Agricultural Practices	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	1	60	CalFire, CDFG, City of Capitola, Farm Bureau, NMFS, NRCS, Private Landowners, Santa Cruz County, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks						TBD	
SoC-A-11.1.2.2	Action Step	Agricultural Practices	Encourage Regional Water Quality Control Board to extend greater oversight regarding effectiveness of erosion control measures.	1	60	RWQCB						TBD	This should be considered a standard business practice. Costs will vary depending on staffing and total number of project implemented. This number will vary from year to year.

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-11.1.3	Recovery Action	Agricultural Practices	Improve riparian and instream conditions in rearing habitats by establishing riparian protection zones that extend the distance of a site potential tree height from the outer edge of a channel, and by adding LWD.										
SoC-A-11.1.3.1	Action Step	Agricultural Practices	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	1	60	Farm Bureau, NRCS, Private Landowners, Santa Cruz RCD						0	Maintaining intact buffers will result in minimal costs.
SoC-A-11.1.4	Recovery Action	Agricultural Practices	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	2	60	Farm Bureau, NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD						TBD	
SoC-A-11.2	Objective	Agricultural Practices	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage and support landowners who conduct operations in a manner compatible with CCC coho salmon recovery priorities.										
SoC-A-11.2.1	Recovery Action	Agricultural Practices	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	2	60	Farm Bureau, NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD						TBD	
SoC-A-11.2.1.1	Action Step	Agricultural Practices	Promote adequate monitoring and enforcement of existing conservation easements in the watershed to ensure compliance with stated easement goals and habitat targets.	3	60	Farm Bureau, Private Landowners, Santa Cruz County, Santa Cruz County Land Trust						0	This should be considered a standard business practice.
SoC-A-11.3	Objective	Agricultural Practices	Promote agricultural practices that protect and restore habitats for CCC coho salmon.										
SoC-A-11.3.1	Recovery Action	Agricultural Practices	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	2	60	CDFG, City of Capitola, Farm Bureau, NOAA RC, NRCS, Private Landowners, Santa Cruz RCD, Soquel Creek Water District, Trout Unlimited						TBD	Costs will vary depending on degree of cost sharing potential provided by water purveyors and willingness of land owners to adopt this recommendation. An educational component will likely be needed. Many existing designs are available.
SoC-A-11.3.2	Recovery Action	Agricultural Practices	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
SoC-A-11.3.2.1	Action Step	Agricultural Practices	Continue the use of cover crops in agriculture fields.	1	60	Farm Bureau, NRCS, Private Landowners, RWQCB, Santa Cruz RCD						0	This should be considered a standard business practice in the agricultural community. Implementation of this recommendation can result in significant reductions of sediment input.
SoC-A-12.1	Objective	Channel Modification	Modify Federal, State, city and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	2	10	CalTrans, City of Capitola, FEMA, HUD, NMFS, Santa Cruz County, USACE, USEPA						TBD	
SoC-A-12.2	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
SoC-A-12.2.1	Recovery Action	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.										

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-12.2.1.1	Action Step	Channel Modification	Evaluate whether proposed stabilization projects will lead to additional instability either up- or downstream.	2	60	CalFire, CalTrans, CDFG, City of Capitola, FEMA, Mines and Geology, NMFS, NRCS, Private Consultants, Private Landowners, Santa Cruz County Department of Public Works, Santa Cruz RCD, USACE						0	This should be considered a standard practice for all individuals, agencies, and companies engaged in instream work.
SoC-A-12.2.1.2	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	60	CalFire, CalTrans, CDFG, City of Capitola, FEMA, Mines and Geology, NMFS PRD, NOAA RC, NRCS, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD, Soquel Demonstration State Forest, USACE						TBD	Adoption of this standard practice will result in increased costs for some projects but will ultimately result in long term savings due to better designed and constructed projects with long term persistence.
SoC-A-12.2.1.3	Action Step	Channel Modification	For riparian roads, promote road relocation as a preferred alternative to bank stabilization.	1	60	CalFire, CalTrans, CDFG, City of Capitola, FEMA, NMFS PRD, NOAA RC, NRCS, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks, USACE						TBD	Road relocation should be carefully and thoughtfully evaluated prior to designing new bank stabilization measures. Road relocation in some circumstances can result in long term cost savings and significant fisheries benefits.
SoC-A-12.2.2	Recovery Action	Channel Modification	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	1	5	CDFG, RWQCB, Santa Cruz County, USACE, USFWS	6.00	6.00	6.00	6.00	6.00	30	LWD is limiting in Soquel Creek and until recently instream LWD was actively removed by Santa Cruz County. It will likely take many years to replace those LWD structures through natural recruitment. A mitigation policy could immediately help jump start the process of restoring instream habitat into the Soquel watershed.
SoC-A-14.1	Objective	Disease, Predation, and Competition	Evaluate suitable methods and levels of marine mammal control when predation is identified as a significant limiting factor to recovery on an individual watershed basis.	3	60	CDFG, NMFS, NOAA SWFSC						TBD	
SoC-A-14.2	Objective	Disease, Predation, and Competition	Implement regulatory, abatement, and education measures to prevent the invasion of exotic species, (including exotic plants).	2	60	CalTrans, CDFG, City of Capitola, FEMA, NMFS, NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD, USACE						TBD	
SoC-A-15.1	Objective	Droughts	All Federal, State and local, planning should include considerations and allowances to ensure continued water use while also providing for CCC coho salmon recovery needs during droughts.										

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-15.1.1	Recovery Action	Droughts	Use the emergency drought operations center (EDOC) to coordinate protection measures and develop rules for augmenting water supplies and mitigating the effects of drought on fish.										
SoC-A-15.1.1.1	Action Step	Droughts	Work with DFG, County of Santa Cruz, State Parks, municipalities, and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	2	5	City of Capitola, NMFS, NRCS, Private Landowners, RWQCB, Santa Cruz County, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Parks and Cultural Resources, Soquel Demonstration State Forest, State Parks, SWRCB, USFWS						TBD	This program should be up and running within five years.
SoC-A-15.1.1.2	Action Step	Droughts	Increase enforcement patrols by DFG and NMFS OLE in sensitive spawning and rearing areas.	2	60	CDFG Law Enforcement, NMFS OLE						TBD	
SoC-A-15.1.1.3	Action Step	Droughts	Work with water managers on regulated streams to assure adequate and proper consideration is given to fish needs. Develop agreements, which will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	1	5	CDFG, NMFS PRD, Soquel Creek Water District, SWRCB, Trout Unlimited	50.00	50.00	50.00	50.00	50.00	250	
SoC-A-15.1.2	Recovery Action	Droughts	Identify and eliminate depletion of summer base flows from unauthorized water uses.										
SoC-A-15.1.2.1	Action Step	Droughts	Encourage SWRCB to bring illegal water diverters and out-of-compliance diverters into compliance with State law.	1	5	CDFG, City of Capitola, NMFS, Private Landowners, Public, Soquel Creek Water District, SWRCB						TBD	Cost cannot be determined and will vary depending on landowner cooperation and SWRCB staffing.
SoC-A-15.1.3	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
SoC-A-15.1.3.1	Action Step	Droughts	Develop and implement critical flow levels for stream reaches impacted by water diversions.	1	3	CDFG, CDFG Law Enforcement, NMFS OLE, NMFS PRD, Private Consultants, Soquel Creek Water District, SWRCB	33.33	33.33	33.33			100	
SoC-A-15.1.3.2	Action Step	Droughts	If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated by municipal water suppliers and other users in the watershed through conservation programs.	2	20	CDFG, City of Capitola, Private Landowners, Santa Cruz County, Soquel Creek Water District, SWRCB						TBD	
SoC-A-15.1.4	Recovery Action	Droughts	Investigate feasibility of desalination to prevent stream dewatering and ensure a more stable source of water overtime.	2	10	Soquel Creek Water District, SWRCB						TBD	A regional approach would result in significant cost reductions through economy of scale. Currently Soquel Water District is considering partnering with the City of Santa Cruz on a desalination facility. While costly, desalination offers a highly reliable alternative than many other water conservation alternatives.

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-16.1	Objective	Fire and Fuels Management	Develop measures protective of salmonids during fire control.										
SoC-A-16.1.1	Recovery Action	Fire and Fuels Management	Establish fire contingency plan developed by experts from CalFire, local fire districts, Santa Cruz RCD, and regulatory agencies with expertise in fisheries issues.	2	10	Soquel Creek Water District, SWRCB						TBD	
SoC-A-16.1.1.1	Action Step	Fire and Fuels Management	Disseminate plan to all local fire fighting agencies.	2	3	CalFire, Santa Cruz County, Santa Cruz RCD						0	
SoC-A-16.1.1.2	Action Step	Fire and Fuels Management	Encourage CalFire to provide plan to all non-County fire fighters when providing fire fighting assistance in the Soquel Creek watershed (and all other watersheds in the County).	2	3	CalFire, Santa Cruz RCD						0	
SoC-A-16.1.1.3	Action Step	Fire and Fuels Management	In the event of a wildfire, we recommend CalFire Resource Advisors inform the resource agencies for ESA consultation (or technical assistance) about the incident. The resource agencies can provide guidance regarding critical resources in the area that may be affected by fire fighting actions.	3	60	CalFire, CDFG, NMFS, Santa Cruz County, Santa Cruz RCD, USEPA, USFWS						0	
SoC-A-16.1.1.4	Action Step	Fire and Fuels Management	Immediately implement appropriate sediment control measures following completion of fire suppression while fire fighters and fire fighting equipment are on site.	1		CalFire, Santa Cruz County, Santa Cruz RCD						0	Sediment control is a requirement for all post fire fighting actions. Immediately implementing these measures (when feasible) when equipment and crews are available will minimize mobilization costs and result in a long term cost savings.
SoC-A-16.1.2	Recovery Action	Fire and Fuels Management	Disseminate NMFS' October 9, 2007, jeopardy biological opinion on the use of fire retardants and its impacts to salmonids, to local fire fighting agencies and CalFire.										
SoC-A-16.1.2.1	Action Step	Fire and Fuels Management	Avoid use of aerial fire retardants and foams within 300 feet of riparian areas throughout the current range of CCC coho salmon.	2	60	CalFire						0	
SoC-A-16.1.2.2	Action Step	Fire and Fuels Management	Develop guidance that directs CalFire and other agencies and organizations using fire retardants to conduct an assessment of site conditions following wildfire where fire retardants have entered waterways, to evaluate the changes to on site water quality and the structure of the biological community.	3	60	CalFire, Santa Cruz County						TBD	
SoC-A-16.2	Objective	Fire and Fuels Management	Identify historical fire frequency, intensities and durations and manage fuel loads in a manner consistent with historical parameters.										
SoC-A-16.2.1	Recovery Action	Fire and Fuels Management	Conduct fuel load monitoring and compare the results to estimated historical fuel loads.										
SoC-A-16.2.1.1	Action Step	Fire and Fuels Management	Review prescribed fire plans to ensure they provide adequate protection for riparian corridors.	3	10	CalFire, Santa Cruz County						TBD	
SoC-A-16.2.1.2	Action Step	Fire and Fuels Management	Reassess fire risk every ten years.	3	60	CalFire, Santa Cruz County						0	This should be a standard business practice.
SoC-A-16.2.1.3	Action Step	Fire and Fuels Management	Work with County planners to define future impacts of proposed urban and infrastructure development on fire suppression and fuel load buildup.	3	60	BLM, CalFire, Private Landowners, Public, Santa Cruz County						0	
SoC-A-20.1	Objective	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within Core CCC coho salmon areas.										
SoC-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10		5.00	5.00	5.00	5.00	5.00	50	This action would require funding of a 1/8 time NMFS position who would focus part of their effort in the Soquel watershed. The need for this action may change if the California Forest Practice Rules change and reach a no-take standard.
SoC-A-20.1.2	Recovery Action	Logging and Wood Harvesting	Provide information to the appropriate regulatory bodies regarding the status of CCC coho salmon, priority watershed processes needing consideration, and recommendations that provide no take or incidental take assurances.	1	2	NMFS PRD							The recovery plan should serve as an adequate source of information.

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-20.1.2.1	Action Step	Logging and Wood Harvesting	Encourage a watershed-wide HCP for all or multiple landowners within a watershed to pool resources as a means to facilitate long-term survival and recovery for coho salmon and their habitat.	3	30	CDFG, City of Capitola, NMFS PRD, Private Landowners, Santa Cruz County, Santa Cruz County Land Trust, Soquel Creek Water District, Soquel Demonstration State Forest, State Parks, USFWS	40.00	40.00	40.00	40.00	40.00	1,200	The HCP should not exceed 30 years in duration and should focus on the larger landowners and water diverters. HCPs can be developed for multiple landowners engaged in multiple (otherwise legal) practices. Cost estimate is for development of the HCP. Development costs are highly variable and are contingent on proposed covered activities, regulatory agency staffing, and interpersonal dynamics during negotiations.
SoC-A-20.2	Objective	Logging and Wood Harvesting	Solicit cooperation from CalFire, NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage and support landowners who conduct operations in a manner compatible with CCC coho salmon recovery priorities.										
SoC-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches, particularly where large woody debris is found lacking.	1	60	Board of Forestry, CalFire, NMFS, RPFs, RWQCB, USACE						0	
SoC-A-20.3	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										
SoC-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
SoC-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	60	Board of Forestry, CalFire, CDFG, Public, Santa Cruz County, State Parks						0	
SoC-A-20.3.1.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	1	60	Board of Forestry, CalFire, CDFG, Public, Santa Cruz County, Santa Cruz County Land Trust, Soquel Demonstration State Forest						TBD	
SoC-A-20.4	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
SoC-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Allow trees in riparian areas to age, die, and recruit into the stream naturally.										
SoC-A-20.4.1.1	Action Step	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.	2	60	CalFire, CDFG, City of Capitola, NMFS, Private Landowners, Public, Santa Cruz County, Santa Cruz County Parks and Cultural Resources, Soquel Demonstration State Forest, State Parks						0	Cost of managing riparian areas is anticipated to be minimal.

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-20.4.2	Recovery Action	Logging and Wood Harvesting	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	60	CalFire, CDFG, Santa Cruz County, Soquel Demonstration State Forest, State Parks						TBD	Costs will vary depending on landowner participation and site specific needs. This strategy can be implemented at relatively little costs in areas zoned for timber production as a component of future harvest plans.
SoC-A-22.1	Objective	Recreational Areas and Activities	Reduce sediment input from parks and other recreation areas.										
SoC-A-22.1.1	Recovery Action	Recreational Areas and Activities	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	60	CalFire, CDFG, Santa Cruz County, Soquel Demonstration State Forest, State Parks						TBD	
SoC-A-22.1.1.1	Action Step	Recreational Areas and Activities	Ensure roads, hiking trails, and biking paths are properly winterized prior to winter rains according to California Forest Practice Rules standards under section 916.5.	1	60	NRCS, Private Landowners, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks						TBD	This recommendation should be implemented every year.
SoC-A-22.1.1.2	Action Step	Recreational Areas and Activities	Close unauthorized trails and conduct appropriate decommissioning practices. Hydrologically disconnect trails from associated waterways.	2	10	CalFire, California Department of Mines and Geology, Private Landowners, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz County Land Trust, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks						TBD	This action should be completed within 10 years.
SoC-A-22.1.2	Recovery Action	Recreational Areas and Activities	Educate users (including mountain bikers, hikers, ORV users, etc) to help prevent or control erosion and sediment problems along the stream.										
SoC-A-22.1.2.1	Action Step	Recreational Areas and Activities	Place educational materials/signage at stream crossings and interpretive centers regarding salmon and their habitats and recommendations on how to minimize impacts.	3	5	CDFG, City of Capitola, NOAA RC, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks	2.00	2.00	2.00	2.00	2.00	10	
SoC-A-23.1	Objective	Residential and Commercial Development	Improve stream maintenance practices to protect instream complexity, hydrologic processes and riparian functions.										

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-23.1.1	Recovery Action	Residential and Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating CCC coho salmon.	2	5	CDFG, FEMA, NMFS PRD, Santa Cruz County Department of Public Works, USACE	100	100	100	100	100	500	The purpose of this recommendation is to ensure any in stream maintenance that continues to occur is not the result of the legacy of past management practices but is in fact occurring for a demonstrable benefit to public/private property. Actions that are demonstrated as resulting in no or minimal benefit to public/private property should be discontinued.
SoC-A-23.1.1.1	Action Step	Residential and Commercial Development	Encourage Santa Cruz County to assess the effectiveness of Sensitive Habitat Ordinance and implement improved performance measures as necessary.	1	5	CDFG, NMFS, Private Consultants, Santa Cruz County							See Aptos Creek implementation table for a County-wide cost estimate.
SoC-A-23.1.2	Recovery Action	Residential and Commercial Development	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004). Removal should only occur after careful review and consideration.	2	5	CDFG, FEMA, NMFS PRD, Santa Cruz County Department of Public Works, USACE						0	
SoC-A-23.2	Objective	Residential and Commercial Development	Maintain and restore hydrologic function, protect riparian and floodplain areas, and minimize adverse effects to water quality and instream rearing habitats resulting from commercial and urban development.										
SoC-A-23.2.1	Recovery Action	Residential and Commercial Development	Encourage the State Division of Water Rights to evaluate water rights compliance in all sub-watersheds where new development is proposed.	1	60	Santa Cruz County, SWRCB						0	Costs should be minimal and are considered part of SWRCB existing authority and obligation. The recommendation should be implemented every year over the 60 year planning horizon.
SoC-A-23.2.2	Recovery Action	Residential and Commercial Development	As mitigation for hydrograph consequences, municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	1	60	Santa Cruz County, SWRCB						0	Costs should be minimal and are considered part of SWRCB existing authority and obligation.
SoC-A-23.2.2.1	Action Step	Residential and Commercial Development	Develop an incentive program for a roof runoff collection system for detaining runoff and providing for landscape irrigation.	2	60	NOAA RC, NRCS, Pacific States Marine Fisheries Commission, Santa Cruz County, Santa Cruz RCD, Soquel Creek Water District						TBD	
SoC-A-23.2.3	Recovery Action	Residential and Commercial Development	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.										
SoC-A-23.2.3.1	Action Step	Residential and Commercial Development	Encourage Santa Cruz to develop property easement acquisition funds and acquire grant monies to purchase eroding private properties in riparian corridors or properties subject to frequent flooding though a buyout program.	3	60	CDFG, FEMA, NMFS, Private Landowners, Santa Cruz County						TBD	This recommendation may be difficult to implement unless Santa Cruz realizes a cost savings (due to reduced flood fighting, etc). A financial analysis will likely be needed.
SoC-A-23.2.3.2	Action Step	Residential and Commercial Development	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	1	60	City of Capitola, FEMA, Private Landowners, RWQCB, Santa Cruz County, Santa Cruz County Department of Public Works, USACE						0	Costs should be minimal if this concept is adopted early in the planning process for all new development.
SoC-A-23.2.3.3	Action Step	Residential and Commercial Development	Modify all County General Plans to eliminate provisions allowing new construction in undeveloped areas within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	2	10	Santa Cruz County						0	Costs should be minimal if incorporated into updated general plan. Significant cost savings would result due to avoidance of emergency response and repair on part of local, Federal, and state governments.

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-23.2.3.4	Action Step	Residential and Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	2	60	CalFire, CalTrans, CDFG, City of Capitola, HUD, NMFS, NRCS, Private Landowners, RWQCB, Santa Cruz County, Soquel Demonstration State Forest, State Parks						0	Costs should be minimal if incorporated into updated general plan.
SoC-A-23.2.4	Recovery Action	Residential and Commercial Development	New development in all historic CCC coho salmon watersheds should meet a zero net increase in storm-water runoff, changes in duration, or magnitude of peak flow.	1	60	RWQCB, Santa Cruz County, USACE, USEPA						TBD	Cost may vary significantly. In more urbanized areas costs will likely be absorbed into SWMP requirements per the RWQCB. Costs in rural areas where these storm water plans are not required may be significant on a project by project basis.
SoC-A-23.2.5	Recovery Action	Residential and Commercial Development	Sediment from existing and future commercial and urban development should be reduced to magnitudes appropriate to the geological setting of the watershed, resulting in no net increase in sedimentation over natural limits.	2	60	RWQCB, Santa Cruz County, USACE, USEPA						TBD	Cost may vary significantly. In more urbanized areas costs will likely be absorbed into SWMP requirements per the RWQCB. Costs in rural areas where these storm water plans are not required may be significant on a project by project basis.
SoC-A-23.2.5.1	Action Step	Residential and Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.	2	60	California Department of Mines and Geology, CalTrans, CDFG, City of Capitola, NMFS PRD, Private Landowners, RWQCB, Santa Cruz County, USACE						0	Stringent review by permitting agencies is expected to reduce costs associated with poorly planned and poorly located developments.
SoC-A-23.2.5.2	Action Step	Residential and Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	3	60	City of Capitola, Private Landowners, RWQCB, Santa Cruz County						TBD	Cost to upgrade stormwater discharge points cannot be determined at this time, but it may be significant.
SoC-A-23.2.5.3	Action Step	Residential and Commercial Development	Encourage counties and local municipalities to expand riparian buffer widths for new development (including redevelopment).	2	60	City of Capitola, Santa Cruz County						TBD	
SoC-A-23.2.6	Recovery Action	Residential and Commercial Development	Avoid, or at a minimum regulate, the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	2	60	RWQCB, Santa Cruz County, USEPA						TBD	
SoC-A-23.2.7	Recovery Action	Residential and Commercial Development	Toxic waste products from urban activities should receive the appropriate treatment before being discharged into any body of water that may enter any historic CCC coho salmon waters.	2	60	City of Capitola, Private Landowners, RWQCB, Santa Cruz County, USEPA						0	This recommendation emphasizes compliance with existing laws and should not be considered an additional restoration expense.
SoC-A-23.3	Objective	Residential and Commercial Development	Standards and recommendations regarding development should apply to all jurisdictions, including school districts and other special districts not subject to county and/or state related ordinances or policies.	2	60	California Department of Mines and Geology, HUD, Public, RWQCB, Santa Cruz County, USEPA						TBD	
SoC-A-24.1	Objective	Roads and Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources in Core CCC coho salmon areas within five years, and Phase I within 10 years.										
SoC-A-24.1.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	60	City of Capitola, Private Landowners, RWQCB, Santa Cruz County, USEPA						TBD	

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-24.1.1.1	Action Step	Roads and Railroads	Encourage Redwood Empire and State Parks to address wetted road crossings and sediment runoff from their riparian roads located on Hinckley Creek, tributary to East Branch Soquel.	1	5	CalFire, CDFG, NMFS PRD, Redwood Empire, Santa Cruz County, State Parks	40.00	40.00	40.00	40.00	40.00	200	This road is used by residents in an inholding on Hinckley Creek. The sediment should be stabilized within five years. Ultimately, this road should be closed and decommissioned.
SoC-A-24.1.1.2	Action Step	Roads and Railroads	Improve enforcement of Erosion Control Ordinance for private roads. The current Santa Cruz Erosion Control Ordinance has provisions requiring the responsible parties to repair and alleviate erosion problems that are deemed severe. Santa Cruz Planning should create new erosion control staff positions to help coordinate the County's cooperative efforts, but also to conduct inspections and enforcement actions as necessary.	1	10	Santa Cruz County	50.00	50.00	50.00	50.00	50.00	500	Cost likely amounts to a 1/2 time position in the Soquel Creek/Aptos Creek watersheds. Costs were estimated over a ten year interval and will likely need further refinement if this recommendation is carried out over a longer duration.
SoC-A-24.1.1.3	Action Step	Roads and Railroads	Implement a sediment reduction program for private roads.	1	60	California Department of Mines and Geology, CDFG, City of Capitola, NOAA RC, NRCS, Pacific States Marine Fisheries Commission, RWQCB, Santa Cruz RCD, USACE						TBD	
SoC-A-24.1.1.4	Action Step	Roads and Railroads	Develop a private road improvement fund to share costs and encourage private road associations to upgrade poorly constructed or improperly located roads.	3	60	California Coastal Conservancy, City of Capitola, RWQCB, Santa Cruz County, Santa Cruz RCD						TBD	Costs would depend on outreach success of the program.
SoC-A-24.1.2	Recovery Action	Roads and Railroads	Conduct a road survey beginning with inner gorge roads in sandy soils followed by roads in other settings.										
SoC-A-24.1.2.1	Action Step	Roads and Railroads	Document and improve THP access roads. The use of existing multiple-use roads to access THP parcels is common. This presents an opportunity to document existing conditions on private roads to improve the road database and for upgrading deficient roads.	3	60	CalFire, Private Landowners, Redwood Empire, Soquel Demonstration State Forest						0	This cost could be minimal if incorporated into future timber harvest plans.
SoC-A-24.1.2.2	Action Step	Roads and Railroads	Encourage all permanent and year-round access roads beyond the THP parcel be surfaced after harvest completion with base rock and road gravel, asphalt, or chipseal, as appropriate.	2	60	CalFire, Private Landowners, Redwood Empire, RWQCB, Santa Cruz County, Soquel Demonstration State Forest						TBD	Costs cannot be determined at this time. An assessment of permanent and year-round access roads is required before a cost estimate can be estimated.
SoC-A-24.1.2.3	Action Step	Roads and Railroads	NMFS and other stakeholders will work with RCD or NRCS to encourage hiring of consultants to conduct road assessments (first for subwatersheds in Core areas, then for Phase I areas).	2	5	Alnus Ecological, NMFS PRD, NOAA RC, NRCS, Private Consultants, Santa Cruz RCD	40.00	40.00	40.00	40.00	40.00	200	An accurate estimate is difficult to determine. An assessment of permanent and year-round access roads is required before a cost estimate can be estimated. Existing information and assessments conducted by the County and private consultants could (if compiled) result in a significant cost reduction.
SoC-A-24.1.3	Recovery Action	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.										

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SoC-A-24.1.3.1	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, California Department of Mines and Geology, CalTrans, Santa Cruz County Department of Public Works						TBD	This is a cost that is frequently absorbed into road projects.
SoC-A-24.1.4	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, California Department of Mines and Geology, CalTrans, CDFG, City of Capitola, Redwood Empire, RWQCB, Santa Cruz County Department of Public Works, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks						TBD	Cost cannot be determined at this time but should be adopted as part of future road actions.
SoC-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
SoC-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	60	CalFire, CalTrans, City of Capitola, NRCS, Private Landowners, Redwood Empire, RWQCB, Santa Cruz County, Santa Cruz County Land Trust, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks						TBD	Cost cannot be determined at this time. Cost will depend on landowner willingness to participate and site specific conditions. The most likely candidates for this recommendation include roads on State Parks, private timberlands, and Soquel Demonstration State Forest. Mainline public roads, although a major issue, are unlikely to be decommissioned due to common infrastructure and high property acquisition expense.
SoC-A-24.2.2	Recovery Action	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	3	10	CalTrans, Private Landowners, RWQCB, Santa Cruz County Department of Public Works						TBD	Cost associated with assessment and redesign cannot be determined at this time, however some assessment has already been conducted in the watershed.
SoC-A-24.3	Objective	Roads and Railroads	Identify and remove existing passage barriers.										
SoC-A-24.3.1	Recovery Action	Roads and Railroads	Amend County ordinances that discourage the use of inexpensive railcar bridges in favor of culverts.										
SoC-A-24.3.1.1	Action Step	Roads and Railroads	Educate county policy staff and Board of Supervisors on the benefits of railcar bridges and provide information from other counties where they are commonly used.	2	5	CalFire, NMFS, Santa Cruz County	2.00	2.00	2.00	2.00	2.00	10	Implementation of this recommendation could result in a significant cost savings for Santa Cruz County.
SoC-A-24.3.2	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.										

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SoC-A-24.3.2.1	Action Step	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	3	60	CalFire, FEMA, Private Landowners, Redwood Empire, RWQCB, Soquel Demonstration State Forest						TBD	Implementation of this recommendation could result in a significant cost savings for Santa Cruz County.
SoC-A-24.4	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
SoC-A-24.4.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	60	City of Capitola, FishNet 4C, Santa Cruz County Department of Public Works, Santa Cruz RCD, State Parks						TBD	
SoC-A-24.5	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
SoC-A-24.5.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	CalFire, CalTrans, City of Capitola, Santa Cruz County Department of Public Works						TBD	Cost may vary significantly. However, a well designed road management plan should result in overall cost savings.
SoC-A-24.5.2	Recovery Action	Roads and Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. The Counties should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with endangered salmonid habitat.	3	60	Santa Cruz County						TBD	Cost may vary significantly. However, a well designed road management plan should result in overall cost savings.
SoC-A-24.5.3	Recovery Action	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	1	5	Santa Cruz County							
SoC-A-24.5.4	Recovery Action	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	1	60	CalFire, CalTrans, City of Capitola, RWQCB, Santa Cruz County Department of Public Works						0	
SoC-A-25.1	Objective	Storms and Flooding	Conduct outreach and education regarding how local, city, county, State and Federal planning can put in place mechanisms that provide community resiliency to storms and flooding.										

Soquel Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
SoC-A-25.1.1	Recovery Action	Storms and Flooding	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	2	10	Board of Forestry, CalFire, California Department of Mines and Geology, CDFG, City of Capitola, Farm Bureau, FEMA, FishNet 4C, NMFS, NRCS, Pacific States Marine Fisheries Commission, RWQCB, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz County Fish and Wildlife Advisory Board, Santa Cruz County Parks and Cultural Resources, Santa Cruz RCD, Soquel Demonstration State Forest, State Parks, USACE, USEPA						TBD	
SoC-A-25.1.2	Recovery Action	Storms and Flooding	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.	2	60	CDFG, City of Capitola, NOAA RC, Private Landowners, Santa Cruz County						TBD	
SoC-A-25.1.3	Recovery Action	Storms and Flooding	Design new development to allow streams to meander in historical patterns, Protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	1	60	Santa Cruz County						0	
SoC-A-25.1.4	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).										
SoC-A-25.1.4.1	Action Step	Storms and Flooding	Flood control projects or other modifications facilitating new development (as opposed to protecting existing infrastructure) should be avoided.	1	60	City of Capitola, FEMA, NRCS, RWQCB, Santa Cruz County, USACE						0	
SoC-A-25.1.4.2	Action Step	Storms and Flooding	Modify Federal, State, city and county regulatory and planning processes to eliminate provisions allowing new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historic CCC coho salmon watersheds.	2	10	City of Capitola, FEMA, NRCS, RWQCB, Santa Cruz County, USACE						TBD	Costs will likely be associated with modifying regulations but these costs may be offset by a long term cost savings resulting from reduced flood control infrastructure and bank stabilization projects.
SoC-A-25.1.4.3	Action Step	Storms and Flooding	Evaluate watershed for infrastructure at high risk of flooding.	3	10	City of Capitola, FEMA, Santa Cruz County	7.50	7.50	7.50	7.50	7.50	75	Most of these structures have likely been identified. Cost associated with ground truthing and some site specific evaluation.
SoC-A-25.2	Objective	Storms and Flooding	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.										
SoC-A-25.2.1	Recovery Action	Storms and Flooding	Establish targeted polices, requirements and assistance for sandy soils areas.	3	60	California Department of Mines and Geology, FEMA, NRCS, RWQCB, Santa Cruz County, USACE						TBD	

TEN MILE RIVER

Ten Mile River

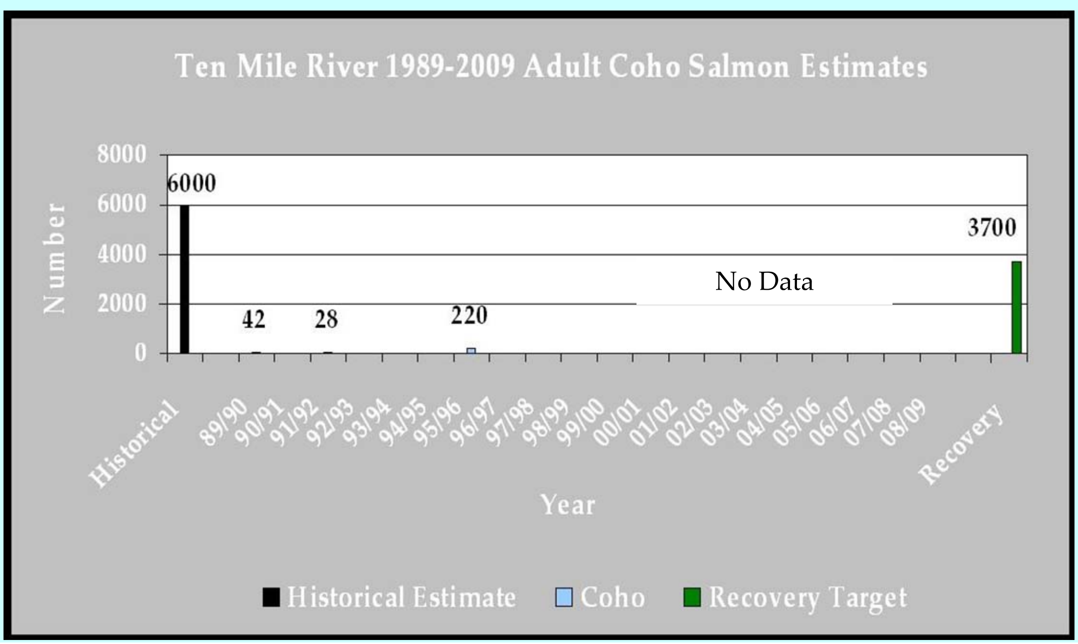
Independent Population
105.1 IP-Km of potential coho salmon habitat
Coho salmon, Chinook salmon, and steelhead present

The **Ten Mile River** drains approximately 120 square miles of western Mendocino County, and enters the Pacific Ocean about eight miles north of the town of Fort Bragg. The mouth of the river is semi-enclosed by a sandbar which forms a tidal estuary. About 75 percent of the Ten Mile River watershed is redwood coniferous forest and about 12 percent of the watershed area is either montane or riparian hardwood forest. The Ten Mile River watershed has moderate to high soil erodibility. The EPA listed the Ten Mile as having water quality impaired for sediment in 1998. The listing determined that sediment was impairing salmonids and identified non-point source silviculture as the probable cause. Since then, the EPA has established a TMDL for the watershed. Nearly the entire Ten Mile River watershed is in private ownership; only 18 acres are in public park land. The dominant land use within the Ten Mile River watershed is forestry. Timber harvest began about 1870. Second growth logging began in the 1960s and continues today. Most of the watershed's forest land is managed using about a 60 year average rotation age. Within the past 10 years, about 43 percent of the Ten Mile River watershed has been under a timber harvest plan. Housing development within the Ten Mile River watershed is low – about 120 housing units are present in the watershed.

South Fork Ten Mile River.
Photo provided by KRIS Information System, and is used with permission.

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools:	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**POOR**
off channel/Floodplain Quality:	**POOR to GOOD**
Estuary Function:	**GOOD**



Ten Mile River

Recovery Target: 3,700 Adult Coho Salmon

Increasing the survival of coho salmon requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvesting
- Roads and Railroads throughout the watershed

Preventing the extinction of coho salmon means **restoring** many key habitat attributes within the Ten Mile River watershed that are in poor condition. The highest priorities for restoration are to:

- Improve pool complexity and increase number of pools
- Reduce summer stream temperature
- Increase large wood in streams and riparian tree size
- Increase the frequency of off channel habitat and floodplain connectivity
- Reduce the amount of roads throughout the watershed
- Reduce sources of sediment
- Improve gravel quality by reducing sediment inputs

We Need Your Photo Here

Ten Mile River
Photo © Your Name Here, AFFIL

Advancing recovery of coho salmon in Ten Mile River requires these priority **recovery actions:**

- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats. Restore floodplain connectivity to increase number and size of over-wintering habitats.
- Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth.
- Provide for watershed processes by promoting long term sustainable forestry practices that support coho salmon.
- Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment to adjacent watercourses to decrease fine sediment.

. . . in these **core areas:** Little North Fork Ten Mile, Bear Haven Creek, Churchman Creek, Smith Creek, and Campbell Creek.

Conservation Highlights

- Campbell Timberland Management, Trout Unlimited, DFG, and Blencowe Forestry have collaborated on placement of large woody debris structures and sediment remediation projects.
- Problem roads have been decommissioned, reducing sediment inputs to streams.

We Need Your Photo Here

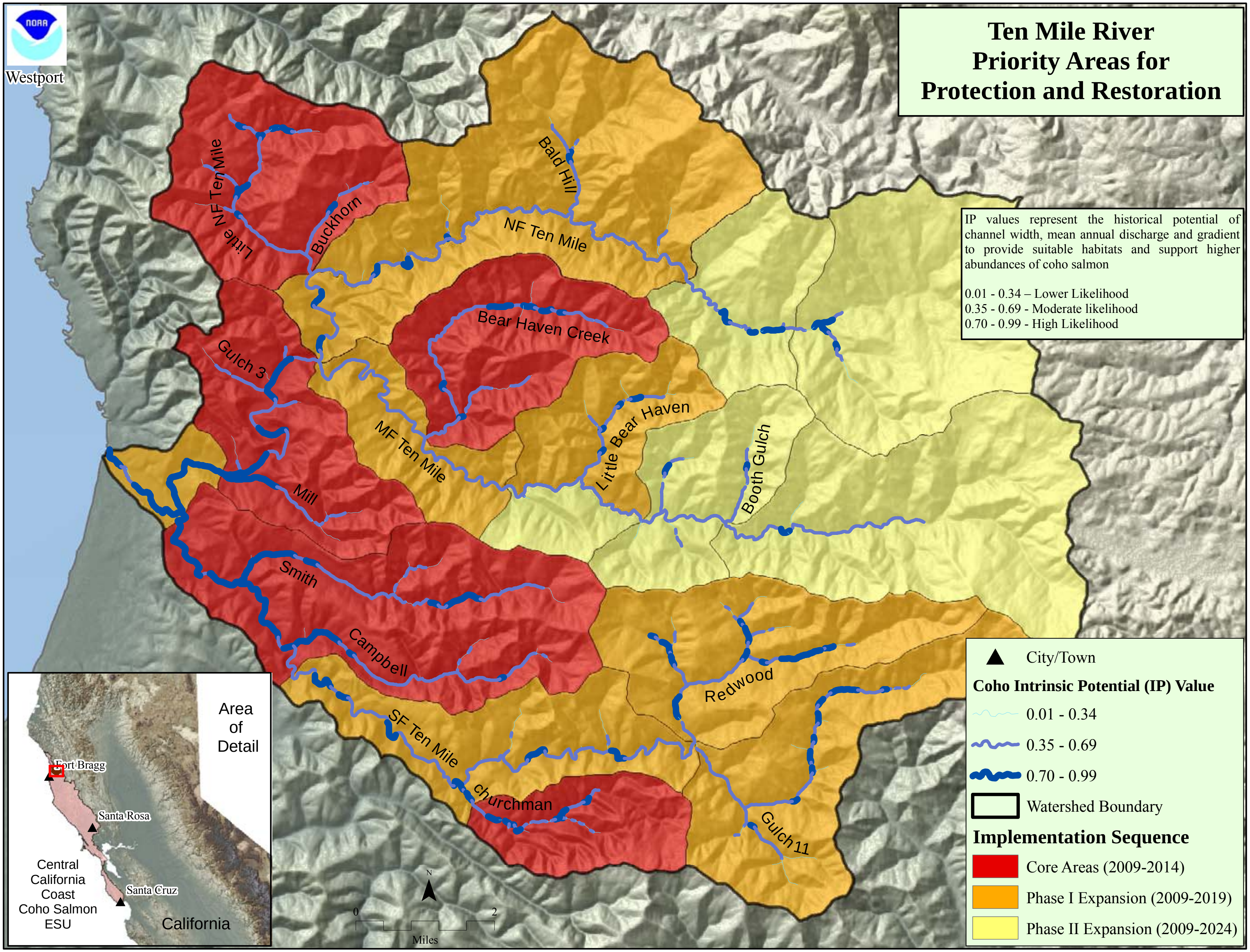
Ten Mile River
Photo © Your Name Here, AFFIL

Immediate Needs

√ Initiate a study of the estuary.
√ Identify restoration actions to improve overwintering habitats.

Recovery Partners

NMFS
DFG
Campbell Timberland Management
Trout Unlimited
Blencowe Forestry
California Regional Water Quality Control Board


Ten Mile River
Priority Areas for
Protection and Restoration
Westport
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
Little NF Ten Mile
Buckhorn
Bald Hill
NF Ten Mile
Bear Haven Creek
Gulch 3
MF Ten Mile
Little Bear Haven
Booth Gulch
Mill
Smith
Campbell
Redwood
SF Ten Mile
churchman
Gulch 11
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
0
2
Miles
N
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Ten Mile River
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	50	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	30-60 days	Fair	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	5000-9600 m^2	Good	Spawning Adults	Sediment	Amount of Gravel*	<500 m^2	500-5000 m^2	5000-9600 m^2	>9600 m^2
NMFS	Best Prof. judgment	5-10%	Fair	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	50	Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	50	Good	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	12%	Poor	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	50	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	44	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	16%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	44	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Good	Good	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	42	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0.57/10 IP-km	Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	44	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	39%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.16%	Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	5%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	42%	Poor	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Fair	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	0.429	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	35%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	60-70%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	7.2 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	6.2 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	20-34%	Fair	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Ten Mile River Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Roads and Railroads	Medium	High	High	High	Medium	Very High			Very High
2	Logging and Wood Harvesting	Medium	Medium	High	High	Medium	Very High			High
3	Droughts	Medium	Medium	Medium	Medium	High	Medium			High
4	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium			Medium
5	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Mining	Medium	Medium	Medium	Medium	Medium	Medium			Medium
7	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
8	Channel Modification	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium			Medium
12	Storms and Flooding	Low	Medium	Medium	Medium	Medium	Medium			Medium
13	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium			Medium
14	Disease, Predation, and Competition	Medium	-	Medium	-	Medium	-			Medium
15	Fishing and Collecting	Medium	-	Low	Low	Low	-			Low
16	Hatcheries and Aquaculture	Low	-	Low	Low	Low	Low			Low
Threat Status for Targets and Project		High	High	High	High	High	Very High	-	-	Very High

Ten Mile River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
TMR-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
TMR-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.	2	60	California Coastal Conservancy, CDFG, NMFS, RWQCB, UC Extension, USFWS						TBD	Existing authorities of permitting agencies facilitate implementation at minimal costs.
TMR-A-1.1.1.1	Action Step	Estuary	Initiate estuary study to evaluate limiting factors in the Ten Mile River estuary.	3	5	California Coastal Conservancy, CDFG, NMFS, RWQCB, USACE	18.00	18.00	18.00	18.00	18.00	90	Estimate based on a three year study period and relative costs from other estuary studies. Development of a multi-disciplinary Technical Advisory Committee (TAC) to develop the scientific foundation for this study is recommended. The TAC should be familiar with other estuaries and estuary reaches within the Lost Coast Diversity Stratum as well as past and ongoing studies within the CCC ESU.
TMR-A-1.1.1.2	Action Step	Estuary	Where feasible, remove structures and modify practices that degrade or reduce the historical estuarine extent or functions to benefit salmon and steelhead.	3	10	Private Landowners						0	TBD- Ten Mile Estuary is relatively intact and likely has few structures that have significantly modified the historical tidal prism and feeding and transition habitat. Cost cannot be determined until after an evaluation is conducted that outlines the extent of the habitat loss.
TMR-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
TMR-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
TMR-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	3	5	CalFire, Campbell Timberland Management, Private Landowners	8.00	8.00	8.00	8.00	8.00	40	This may be a GIS exercise with ground truthing. Available information exists from past habitat typing that may streamline this analysis and further reduce the overall cost.
TMR-A-2.1.1.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	2	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG							Costs depend on level of technical assistance required and types of projects proposed. Many salmon recovery efforts and management programs are currently ongoing. It is possible that there could be additional salmon restoration costs identified based on recovery needs of the species; however, at this time there is not sufficient information to estimate those potential costs or identify the actions under which they might fall.
TMR-A-2.1.2	Recovery Action	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, Private Landowners						TBD	Costs to promote and support restoration efforts depend on the level of technical assistance provided and the types of projects proposed.
TMR-A-4.1	Objective	Land Disturbance	Reduce percentage of watershed area subject to timber harvest over a ten year period. (See also strategies for reducing the threat of Logging and Wood Harvesting below).										
TMR-A-4.1.1	Recovery Action	Land Disturbance	Encourage a watershed-wide HCP for all or multiple landowners within a watershed to pool resources as a means to facilitate long-term survival and recovery for coho salmon and their habitat.	3	30	Campbell Timberland Management, CDFG, Private Landowners, RWQCB, USFWS	26.67	26.67	26.67	26.67	26.67	800	Cost is a rough estimate and may vary considerably depending on the number of species and activities covered. A multiple landowner HCP is preferable due to economy of scale and overall, similar land management actions across the watershed. The high cost of HCP development is considered a major impediment and disincentive for many landowners.
TMR-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										

Ten Mile River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
TMR-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).	1	10	California Coastal Conservancy, Campbell Timberland Management, CDFG, NMFS, NOAA RC, Private Landowners	70.00	70.00	70.00	70.00	70.00	700	Costs may vary significantly due to access, varying paucity of large wood between sub-watersheds, and installation techniques. The Ten Mile has been habitat typed and thus the stream reaches lacking wood can be readily identified. Permitting should be streamlined because of programmatic biological opinions for these types of actions; however, more effort on the part of regulatory agencies is needed. Many key areas in Ten Mile have been targeted for LWD enhancement, and total costs may be significantly less than projected. Campbell Timberlands has implemented numerous LWD projects at relatively low cost due their use of non-anchored material. This is significantly less expensive than engineer approaches.
TMR-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	1	60	CalFire, Campbell Timberland Management, CDFG, Private Landowners, RCD, RWQCB						0	Costs may vary significantly due to stream access, varying paucity of large wood between sub-watersheds, and installation techniques. The Ten Mile has been habitat typed and thus the stream reaches lacking wood can be readily identified. It is assumed that most projects will occur as part of ongoing timber harvest actions and that overall cost should be less than those restoration projects occurring absent timber management equipment already nearby. To implement this recommendation, additional streamlining of the THP process for LWD input by regulatory agencies is necessary.
TMR-A-6.1.3	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.										
TMR-A-6.1.3.1	Action Step	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.	1	5	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, NMFS, NOAA RC, NRCS, RWQCB, UC Extension, USACE	5.00	5.00	5.00	5.00	5.00	25	Cost of the plan should be relatively inexpensive in the Ten Mile River Watershed due to the large amount of instream habitat typing data and THP data currently available. The plan should review areas with high IP-km scores as high priority areas for immediate enhancement and restoration.
TMR-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
TMR-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).										
TMR-A-7.1.1.1	Action Step	Riparian Vegetation	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, NMFS, NOAA RC, Private Landowners						TBD	Most of these lands (inset floodplains and riparian corridors) are used for forest management and it is anticipated that most of this cost will be absorbed as part of on going forestry practices. Additional cost may be incurred in the lower watershed where other land management actions occur, including some farming and minimal grazing. Many of the areas used for agricultural purposes have been extensively cleared of all riparian vegetation. Targeting restoration in these areas may result in some lands no-longer being farmed for hay production, etc. Extensive landowner outreach will likely be required in these areas.

Ten Mile River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
TMR-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
TMR-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
TMR-A-8.1.1.1	Action Step	Sediment	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	2	5	CalFire, Campbell Timberland Management, Private Landowners, RWQCB, USEPA						TBD	A road sediment reduction plan should tier off recommendations in the Ten Mile River TMDL.
TMR-A-8.1.1.2	Action Step	Sediment	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas (DFG 2004).	2	5	CalFire, Campbell Timberland Management, Private Landowners							Cost is likely minimal because these sites are likely already identified and cataloged by CalFire and private landowners in existing GIS databases from ongoing timber harvest plans.
TMR-A-8.1.2	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
TMR-A-8.1.2.1	Action Step	Sediment	Restoration projects that upgrade or decommission high risk roads in Core areas should be considered an extremely high priority for funding (e.g., PCSRF).	2	5	CalFire, Campbell Timberland Management, Private Landowners	600	600	600	600	600	3,000	TBD- difficult to estimate cost because assessments for the magnitude of the problem were not available. Additionally, many roads in Core watersheds have been addressed - often through the timber harvest process - and these costs should be considered an ongoing operation expense.
TMR-A-8.1.2.2	Action Step	Sediment	All roads alongside inner gorge areas or in potentially unstable headwall areas should be removed, if feasible.	2	30	CalFire, Campbell Timberland Management, Private Landowners							TBD- difficult to estimate cost because assessments for the magnitude of the problem were not available. Additionally, many inner gorge roads have been addressed - often through the timber harvest process - and these costs should be considered an ongoing operation expense.
TMR-A-8.1.2.3	Action Step	Sediment	Where restricting winter access to unpaved roads is not feasible, encourage measures such as rocking to prevent sediment from reaching coho salmon streams (DFG 2004).	2	60	CalFire, Campbell Timberland Management, Private Landowners, RWQCB							Minimal- difficult to estimate cost because assessments for the magnitude of the problem were not available. Additionally, many roads have been rocked - often through the timber harvest process - and these costs should be considered an ongoing operation expense.
TMR-A-8.1.3	Recovery Action	Sediment	Stabilize the Miller Pond dam in Little North Fork Ten Mile to prevent catastrophic failure and massive sediment input into critical downstream spawning and rearing areas.	1	5	CDFG, Private Landowners, RWQCB	6.00	6.00	6.00	6.00	6.00	30	
TMR-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
TMR-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key habitat attributes across the watershed. Prioritize Core tributaries first, followed by Phase I and Phase II areas as appropriate.										
TMR-A-9.1.1.1	Action Step	Viability	Implement standardized assessment protocols (i.e., DFG habitat assessment protocols) to ensure ESU-wide consistency.	3	60	Campbell Timberland Management, CDFG, Private Landowners, RWQCB						TBD	The watershed has been habitat typed and has had extensive instream monitoring occur in the past.
TMR-A-9.1.2	Recovery Action	Viability	Establish a life cycle stations in the Ten Mile River watershed (Gallagher and Gallagher 2005). Consider placing a life cycle station on one key tributary (e.g., Little North Fork Ten Mile, Bear Haven, Campbell creeks) or, if possible, in each subwatershed (North Fork, Clark Fork, South Fork).	2	20	Campbell Timberland Management, CDFG, NMFS, NOAA RC, Private Landowners	100	100	100	100	100	2,000	Monitoring costs may vary considerably depending on the number of subwatersheds surveyed. Average annual cost is anticipated to range between $80,000 and $120,000. An average of $100,000 per year was calculated for this action. Initial cost may vary depending on infrastructure (permanent vs. annual) used for the monitoring efforts. Monitoring in the Ten Mile watershed should be closely coordinated and complementary with other ongoing monitoring efforts in the Lost Coast Diversity Stratum. Due to the costs associated with monitoring and the difficultly in funding current ongoing monitoring, the short term implementation of this recommendation will be problematic.

Ten Mile River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
TMR-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
TMR-A-10.1.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
TMR-A-10.1.1.1	Action Step	Water Quality	Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody debris.	3	20	CalFire, Campbell Timberland Management, Private Landowners, RWQCB						TBD	TBD - Additional cost related to recovery are expected to be minimal. The cost will likely vary significantly depending on types of programs proposed and policies proposed for modification. In the Ten Mile River watershed acceptance of programs by landowners is likely higher for LWD retention and maintenance of channel integrity than in other more urban watersheds and therefore, the costs may be less here than in other areas.
TMR-A-10.1.1.2	Action Step	Water Quality	Plant native vegetation to promote streamside shade where otherwise deficient (i.e., lower reaches of North Fork and South Fork).	2	60	CalFire, Campbell Timberland Management, Private Landowners, RWQCB						TBD	Cost will vary depending on land owner participation. Costs may be higher in the lower watershed where significant areas of site 1 soils where extensive forests were removed for agricultural purposes. Reestablishing a functional riparian forest in these areas (provided landowners are willing) will likely require extensive oversight until the trees become established.
TMR-A-10.1.1.3	Action Step	Water Quality	Increase LWD frequency in mainstem reaches of Ten Mile River.	1	10	CalFire, Campbell Timberland Management, CDFG, NOAA RC, Private Landowners							See Pools strategies for cost estimates. Overall costs in Ten Mile likely moderate due to close road proximity along most of the three major forks in the Ten Mile. In the Ten Mile River watershed acceptance of programs by landowners is likely higher for LWD retention and maintenance of channel integrity than in other more urban watersheds and therefore, the costs may be less here than in other areas.
TMR-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
TMR-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	3	60	CDFG, NOAA RC, Private Landowners						TBD	Cost is unknown. The main benefit of this action is to improve flow conditions in the lower portion of the watershed where the majority of home owners and agricultural use occurs.
TMR-A-15.2	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
TMR-A-15.2.1	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	2	10	Campbell Timberland Management, CDFG, NMFS OLE, SWRCB						TBD	Costs depend on extent of unauthorized use and receptivity of water users.
TMR-A-15.2.2	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
TMR-A-15.2.2.1	Action Step	Droughts	Develop and implement critical flow levels for stream reaches impacted by water diversions.	3	60	CDFG, NMFS, Private Landowners, SWRCB	1.67	1.67	1.67	1.67	1.67	100	Relatively few diversions occur in the watershed. Studies should be focused at the impact of diversions in the lower portion of the watershed where the majority of diversions are believed to occur.
TMR-A-15.2.2.2	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	3	60	CDFG, NMFS, Private Landowners, SWRCB						0	This action is contingent on the above action. If predicted flows are below a level considered critical to maintain viable rearing habitat for salmonids, measures to reduce water consumption should be initiated in the watershed through conservation programs.
TMR-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										

Ten Mile River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
TMR-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
TMR-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Discourage Counties from rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	5	CalFire, California Coastal Conservancy, Mendocino County, NMFS, Private Landowners, USEPA, USFWS						0	
TMR-A-20.1.1.2	Action Step	Logging and Wood Harvesting	Discourage home building or other incompatible land use in areas identified as timber production zones (TPZ).	1	60	Mendocino County						0	
TMR-A-20.2	Objective	Logging and Wood Harvesting	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches, particularly where large woody debris is found lacking.	1	60	CalFire, CDFG, NMFS, RWQCB						0	This recommendation is contingent on regulatory agencies developing a streamlined process to facilitate enhancement projects through the THP process.
TMR-A-20.3	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.										
TMR-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
TMR-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	2	20	Board of Forestry, CalFire, Campbell Timberland Management, CDFG						TBD	Extension of monitoring period is expected to have minimal costs, however, remediation of identified issue may incur greater costs.
TMR-A-20.3.1.2	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	2	60	CalFire, Campbell Timberland Management, Private Landowners						TBD	Most of these cost will likely be associated with planned or ongoing harvest plans.
TMR-A-20.3.1.3	Action Step	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	2	60	CalFire, Campbell Timberland Management, Private Landowners							This cost is expected to be minimal because the main land management action is timber harvest and the mapping will occur as part of the THP process.
TMR-A-20.3.1.4	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	2	60	CalFire, Campbell Timberland Management, Private Landowners							Cost is expected to be minimal.
TMR-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.										
TMR-A-20.3.2.1	Action Step	Logging and Wood Harvesting	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	60	CalFire, Campbell Timberland Management, Private Landowners						0	Cost is expected to be minimal because most of the watershed is subject to active timber management. Additional cost may be incurred in the lower watershed where other land management actions occur.
TMR-A-20.3.2.2	Action Step	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.	2	60	CalFire, Campbell Timberland Management, Private Landowners							TBD- the cost of this action may be minimal depending on the harvest philosophy of the landowner.
TMR-A-20.4	Objective	Logging and Wood Harvesting	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
TMR-A-20.4.1	Recovery Action	Logging and Wood Harvesting	Provide information to the appropriate regulatory bodies regarding the status of CCC coho salmon, priority watershed processes needing consideration, and recommendations that provide no take or incidental take assurances.	1	10	CalFire, CDFG, NMFS	4.00	4.00	4.00	4.00	4.00	40	The recovery plan should serve as the appropriate vehicle to deliver this information.

Ten Mile River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
TMR-A-20.4.2	Recovery Action	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within Core, Phase I and Phase II CCC coho salmon areas.										
TMR-A-20.4.2.1	Action Step	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	2	10	NMFS	70.00	70.00	70.00	70.00	70.00	700	This action will likely require funding for at least one full time NMFS position for the Lost Coast Diversity Stratum. The need for this action may change if Forest Practices Rules change and achieve a no-take standard.
TMR-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
TMR-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of County road engineers and maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	10	CalFire, Campbell Timberland Management, FishNet 4C, Mendocino County Department of Public Works, Private Landowners						0	Cost is a rough estimate prorated for the Ten Mile River watershed. Existing programs and templates already exist for this recommendation and are currently implemented by most operators and road engineers in the watershed.
TMR-A-24.2	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
TMR-A-24.2.1	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1	15	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, NOAA RC, NRCS, Private Landowners, RCD, RWQCB						TBD	Costs may vary widely depending on number of riparian roads and the magnitude of the problem associated with the roads. Additionally, many roads in Core watersheds have been addressed and hydrologically disconnected - often through the timber harvest process - and these costs should be considered an ongoing operation expense. Focus initial efforts (and/or continue ongoing efforts) in Little North Fork Ten Mile, Bear Haven (DFG 2004), Mill, Campbell, and Smith Creeks.
TMR-A-24.2.2	Recovery Action	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	2	20	CalFire, Campbell Timberland Management, Mendocino County Department of Public Works, NOAA RC, Private Landowners, RWQCB						TBD	Costs associated with assessment and redesign cannot be determined at this time. Costs may be significant and should be weighed against additional upland disturbance and overall costs. This recommendation is more feasible within the Ten Mile watershed because a large portion of the watershed in owned by one landowner.
TMR-A-24.3	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within ten years (from 2010). Move into Phase I followed by Phase II watersheds as soon as practicable.										
TMR-A-24.3.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
TMR-A-24.3.1.1	Action Step	Roads and Railroads	Fully implement the Ten Mile River TMDL.	2	40							TBD	The Ten Mile River does not have time lines specified. Rapid implementation will result in greater cost, but it could result in significant benefits. The TMDL targets high priority areas for implementation that are similar to NMFS prioritization for coho protection. It is anticipated most cost will be included as part of upgrades associated with future timber harvest actions.

Ten Mile River (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
TMR-A-24.3.1.2	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	1	60	CalFire, California Department of Mines and Geology, Campbell Timberland Management, Private Landowners						TBD	Costs likely to be incurred as part of timber harvest operations. However, in some circumstances this may be a stand alone cost.
TMR-A-24.3.1.3	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, and with County road maintenance staff as appropriate.	2	60	CalFire, Campbell Timberland Management, CDFG, Mendocino County Department of Public Works, Private Landowners						0	These areas are likely already established. Efforts should be made to coordinate storage with all landowners in the basin to minimize costs and impacts.
TMR-A-24.3.1.4	Action Step	Roads and Railroads	Fully maintain all roads with inside ditches unless these roads have been properly decommissioned. All roads with inside ditches should be evaluated, and problems addressed, prior to the winter season.	1	60	CalFire, Campbell Timberland Management						0	Many roads in the watershed have inside ditches. Cost should be considered part of road maintenance costs.
TMR-A-24.3.2	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized and impacting uses to decrease fine sediment loads.										
TMR-A-24.3.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	60	CalFire, Campbell Timberland Management, Mendocino County Department of Public Works, Private Landowners						0	This action is part of ongoing road maintenance and should be directed at the entire road network.
TMR-A-24.3.3	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	60	CalFire, Campbell Timberland Management, Private Landowners						TBD	
TMR-A-24.3.4	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.										
TMR-A-24.3.4.1	Action Step	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	3	60	CalFire, California Department of Mines and Geology, Campbell Timberland Management, Private Landowners						TBD	Costs will vary depending on number of actual crossings not meeting passage criteria. Many roads in the watershed have been upgraded recently. This recommendation is generally implemented as part of the THP process
TMR-A-24.4	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
TMR-A-24.4.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	Board of Forestry, Campbell Timberland Management, CDFG, Mendocino County						0	
TMR-A-24.4.2	Recovery Action	Roads and Railroads	Improve CalFire enforcement of THP erosion control measures.	1	60	CalFire						0	CalFire can implement this action immediately at minimal cost.

USAL CREEK

Usal Creek

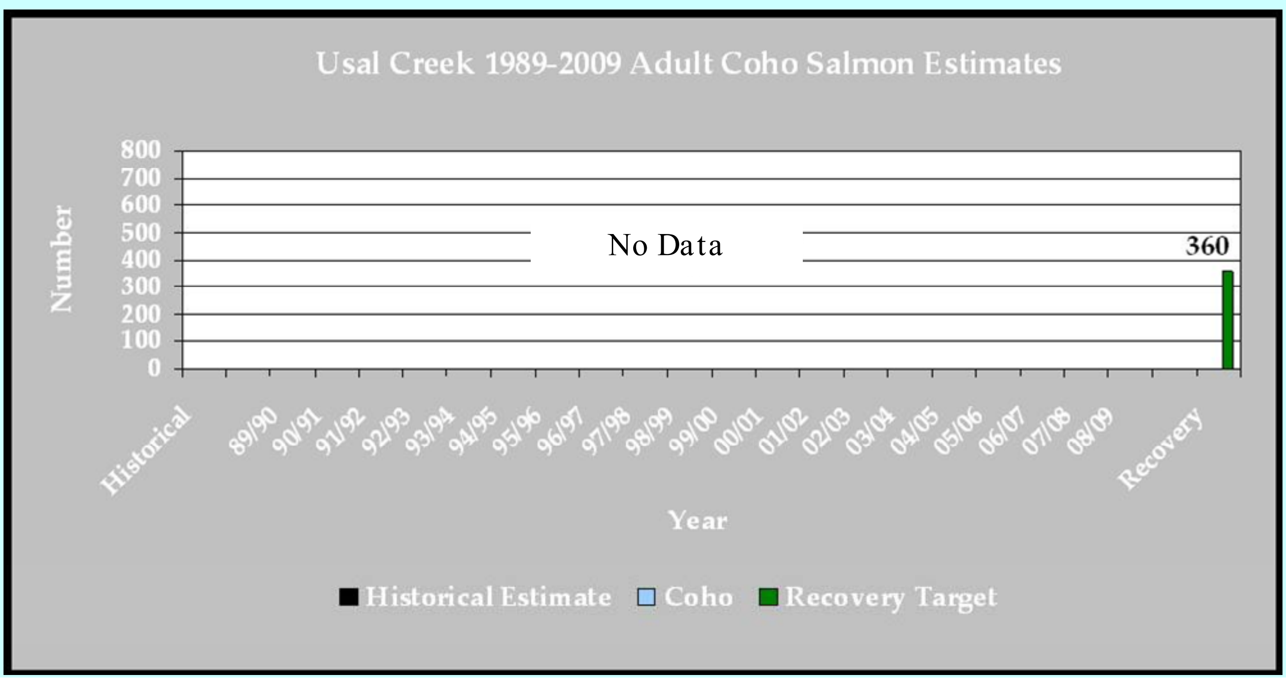
Dependent Population
10.6 Km of Potential Habitat
Coho salmon and steelhead present

Usal Creek drains an area of approximately 28 square miles of western Mendocino County, and enters directly to the Pacific Ocean about 30 miles north of the town of Fort Bragg. About 70 percent of the Usal Creek watershed is redwood coniferous forest and about 20 percent of the watershed area is either montane or riparian hardwood forest. The entire Usal Creek watershed has been characterized as being highly erodible after considering slope, precipitation, and the susceptibility of failure of underlying geology. The watershed consists of 98 percent private lands, with about two percent of the watershed is in public parks and recreation lands. The dominant land use within the Usal Creek watershed is forestry. Within the past ten years, about ten percent of the Usal Creek watershed has been under a timber harvest plan. Housing development within the watershed is rare – only two houses are present.

Usal Creek
Copyright (C) 2002-2009 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org.

The Watershed at a Glance

Spawning Quantity & Quality:	**GOOD to VERY GOOD**
Summer Water Temperatures:	**GOOD**
Depth & Shelter of Pools	**FAIR**
Large Wood Frequency:	**FAIR**
Riparian Canopy:	**GOOD to VERY GOOD**
off channel/Floodplain Quality:	**FAIR**
Estuary Function:	**POOR**



Usal Creek

Recovery Target: 360 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Roads and Railroads

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Usal Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve pool complexity
- Reduces sources of sediment
- Reduce the amount of roads throughout watershed
- Reduce the amount of roads in riparian areas
- Improve estuary condition

Advancing recovery of coho

salmon in Usal Creek requires these priority **recovery actions:**

- Install large wood, boulders, and other structures to increase stream complexity and improve pool frequency and depth.
- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.
- Decommission riparian road systems and/or upgrade roads and skid trails that deliver sediment to streams.
- Provide for watershed processes by promoting long term sustainable forestry practices that support coho salmon
- Build no more roads within floodplains, riparian areas, areas with unstable soils or other sensitive characteristics until a watershed or specific road management plan is created and implemented.

. . . **throughout** the Usal Creek watershed.

Series of photos documenting landslide on Soldier Creek (upper left and right) **and turbidity plume downstream to confluence with Usal Creek** (lower right) **and continuing downstream on Usal Creek** (lower left)**.**
Photo provided by the National Marine Fisheries Service and is used with permission.

Conservation Highlights

- To improve aquatic habitat Campbell Timberland Management and Redwood Forest Foundation have collaborated on sediment remediation projects.

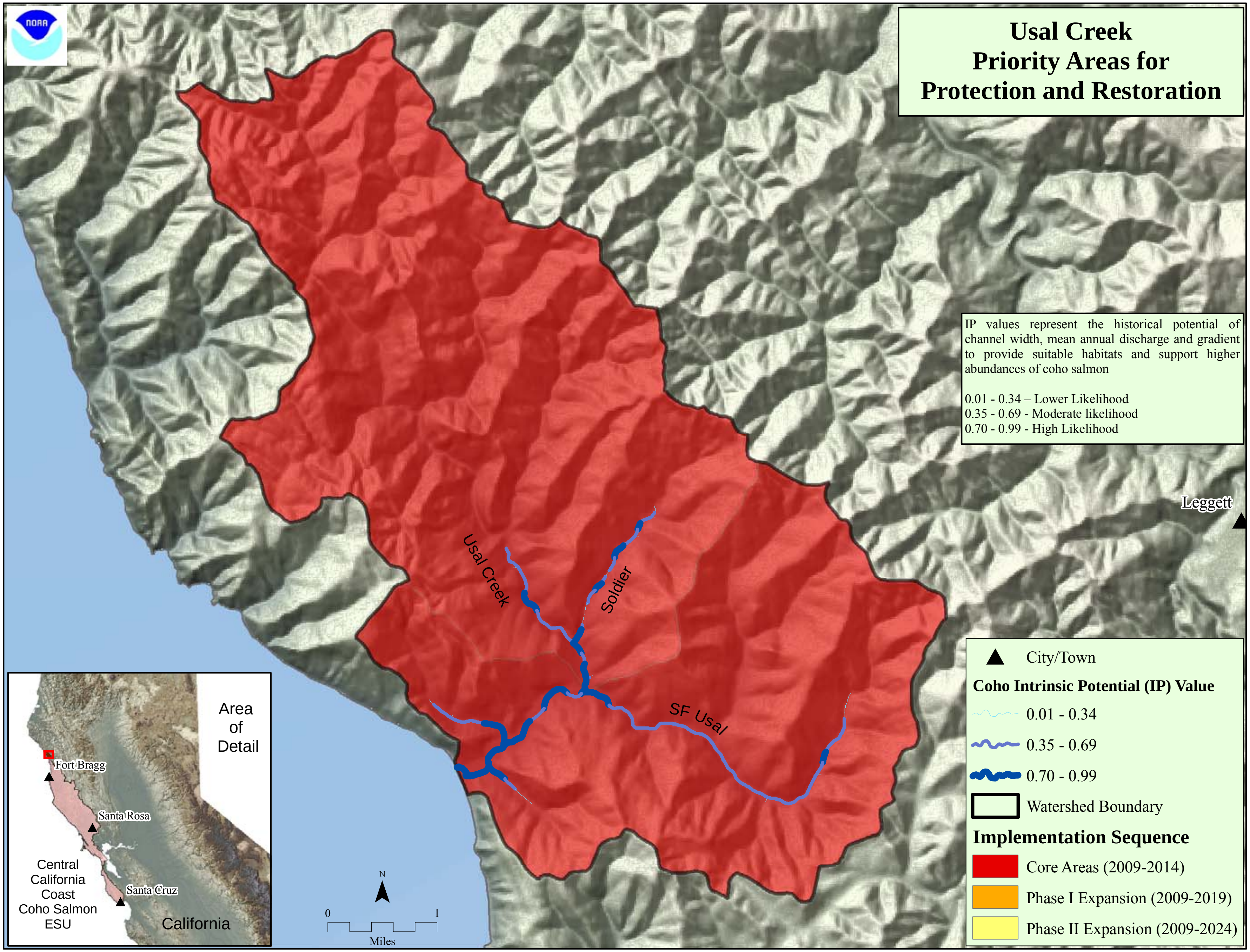
Usal Creek (left) Soldier Creek confluence. This is the same location, 12 years later, as the lower right photo of the previous figure.
Photo provided by Redwood Forest Foundation, Inc., and is used with permission. All rights reserved.

Immediate Needs

√ Place instream structures to improve habitat
√ Road sediment remediation

Recovery Partners

DFG
Campbell Timberland Management
Redwood Forest Foundation, Inc.
California State Parks
Trout Unlimited



Usal Creek
Priority Areas for
Protection and Restoration
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
Leggett
Usal Creek
Soldier
SF Usal
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California
N
0
1
Miles

CCC Coho Salmon
Usal Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	NA	NA	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	NA	NA	Spawning Adults	Sediment	Amount of Gravel*	<100m2	100-500m2	500-1,000m2	>1,000
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	NA	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	91%	Good	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	NA	NA	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	NA	NA	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	NA	NA	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	NA	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	Poor	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	NA	NA	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0/10 IP-km	Very Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	NA	NA	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	Good	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	NA	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.12%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.00%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	10%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	<25%	Poor	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	55-69%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	75-85%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	3.5 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	4.3 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m²	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m²	0.2-0.5 fish/m²	0.5-1.0 fish/m²	>1.0 fish/m²
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Usal Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages	Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	
1	Roads and Railroads	Medium	Medium	High	Medium	Medium	High	High
2	Droughts	Medium	Low	High	Medium	High	Low	High
3	Fire and Fuel Management	Medium	Low	Medium	Medium	Medium	High	Medium
4	Logging and Wood Harvesting	Medium	Low	Medium	Medium	Medium	High	Medium
5	Fishing and Collecting	High	-	Medium	-	Medium	-	Medium
6	Disease, Predation, and Competition	-	-	Medium	-	High	-	Medium
7	Channel Modification	Medium	Low	Medium	Medium	Medium	Medium	Medium
8	Climate Change	Medium	Low	Medium	Medium	Medium	Medium	Medium
9	Mining	Medium	Low	Medium	Medium	Medium	Medium	Medium
10	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium	Medium
11	Storms and Flooding	Low	Low	Medium	Medium	Medium	Medium	Medium
12	Residential and Commercial Development	-	Low	Low	Low	Medium	Medium	Medium
13	Water Diversion and Impoundment	Low	Low	Medium	Low	Medium	-	Medium
14	Agricultural Practices	-	Low	Low	-	-	Medium	Low
15	Hatcheries and Aquaculture	Low	-	-	-	-	-	Low
16	Livestock Farming and Ranching	Low	-	-	-	-	-	Low
	Threat Status for Targets and Project	High	Medium	High	Medium	High	High	High

Usal Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
UsC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
UsC-A-1.1.1	Recovery Action	Estuary	Evaluate all potential solutions to restore Usal estuary to improve rearing and migration conditions for salmonids.										
UsC-A-1.1.1.1	Action Step	Estuary	Implement Large Woody Debris loading project, proposed by Campbell Timberland Management and NMFS HCD, to scour channel and mobilize aggraded stream bed in upper estuarine reach.	2	2	Campbell Timberland Management, Mendocino County, Redwood Forest Foundation, State Parks	50.00	50.00				100	The upper estuary and mainstem Usal is potentially high value juvenile rearing habitat. Under current conditions, the upper estuary and mainstem Usal go dry. The likely cause of this is sediment aggradation from upslope sources. The purpose of this action is to reestablish channel thalwag and channel meander (using existing channel forming features as reference points). Bio-engineered willow baffles could help form riparian floodplain terraces and maintain the reestablished channel width to depth ratio.
UsC-A-1.1.1.2	Action Step	Estuary	Conduct conifer release by thinning hardwoods in lower reaches of South and North Fork Usal Creek. Conifers could serve as a source for future large woody debris recruitment into the estuary and aid in cooler water temperatures flowing into estuary.	2	2	Campbell Timberland Management, Redwood Forest Foundation	15.00	15.00				30	Cost would be almost completely for personnel. Little permitting costs anticipated.
UsC-A-1.1.1.3	Action Step	Estuary	Initiate riparian planting of conifers within the riparian zones that are currently dominated by hardwoods.	2	5	Campbell Timberland Management, CDFG, State Parks	8.00	8.00	8.00	8.00	8.00	40	Initial efforts should focus on the alder dominated riparian areas along the mainstem and lower North and South Forks of Usal Creek.
UsC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
UsC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest.										
UsC-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	2	Campbell Timberland Management, CDFG, Redwood Forest Foundation, State Parks	10.00	10.00				20	Assessments have already been conducted but additional site specific field checks and mapping are likely needed.
UsC-A-2.1.1.2	Action Step	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.	3	20	Campbell Timberland Management, CDFG, NOAA RC, Redwood Forest Foundation, State Parks						TBD	Difficult to estimate cost until an evaluation of habitat enhancement opportunities are conducted.
UsC-A-2.1.1.3	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	20	Campbell Timberland Management, CDFG, NOAA RC, Redwood Forest Foundation, RWQCB, State Parks, USACE						TBD	Cost cannot be determined due to the unknown quantity of opportunities to enhancement existing habitat conditions. Areas with perennial flow and high IP-km scores should be targeted first for this measure.
UsC-A-2.1.1.4	Action Step	Floodplain	Conduct collaborative evaluations of priorities for treatment of CCC coho salmon passage barriers, such as the Fish Passage Forum (DFG 2004). Smolt outmigration constraints should also be evaluated, particularly during drought years through the aggraded estuary and lower reaches of N Fk Usal.	2	10	Campbell Timberland Management, CDFG, Redwood Forest Foundation						TBD	
UsC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
UsC-A-6.1.1	Recovery Action	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams.										

Usal Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
UsC-A-6.1.1.1	Action Step	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	Campbell Timberland Management, Redwood Forest Foundation, State Parks						0	Keeping instream structure will result in no increased costs.
UsC-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover.										
UsC-A-6.1.2.1	Action Step	Pool Habitat	Install LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004).	1	5	Campbell Timberland Management, CDFG, NOAA RC, Redwood Forest Foundation, RWQCB, State Parks	40.00	40.00	40.00	40.00	40.00	200	Costs should reflect a relative savings due to the fact that the watershed has been habitat typed and key areas of coho refuge have been identified. Most materials for instream habitat improvement are available on site and therefore material costs should be minimal . It is assumed, due to the lack of infrastructure that the majority of instream structures will consist of trees felled directly into the creek and left unsecured. Large wood enhancement should occur in the lower portions of South Fork and North Fork Usal first, and work upstream. Improving habitat conditions in the upper reach of the heavily aggraded mainstem is likely the highest restoration priority in the entire watershed. If positive channel response is observed, additional loading should occur in the currently aggraded mainstem.
UsC-A-6.1.3	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	1	60	CalFire, Campbell Timberland Management, CDFG, Mendocino County, State Parks						0	Cost should be minimal if actions occur as part of ongoing timber harvest operations. This assumes DFG, NMFS, CalFire, and RWQCB are able to streamline the permitting process.
UsC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
UsC-A-8.1.1	Recovery Action	Sediment	Address sources from road networks, trails, and other actions.										
UsC-A-8.1.1.1	Action Step	Sediment	Provide incentives to restore high priority sites as determined by watershed analysis, DFG, or CalFire.	3	60	California Coastal Conservancy, CDFG, FEMA, NOAA RC, State Parks						TBD	
UsC-A-8.1.1.2	Action Step	Sediment	Roads or landings shall be maintained at the design standards that lower risk of mass wasting sediment delivery.	2	60	CalFire, Mendocino County Department of Public Works, Redwood Forest Foundation, State Parks						TBD	This cost should be incorporated into ongoing road maintenance duties and responsibilities.
UsC-A-8.1.2	Recovery Action	Sediment	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.										
UsC-A-8.1.2.1	Action Step	Sediment	Assess effectiveness of erosion control measures throughout the winter period.	2	60	CalFire, Campbell Timberland Management, Mendocino County Department of Public Works, Redwood Forest Foundation, State Parks						TBD	Costs should be incorporated into ongoing road management operations.

Usal Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
UsC-A-8.1.3	Recovery Action	Sediment	Reduce the number of road crossings across watercourses. Prioritize installation of appropriately sized bridges on N.F. Usal Riparian Road.	3	30	CalFire, Campbell Timberland Management, CDFG, Redwood Forest Foundation, State Parks						TBD	Costs are unknown until a road assessment is conducted and feasibility determined.
UsC-A-8.1.4	Recovery Action	Sediment	Close unauthorized trails and conduct appropriate decommissioning practices. Hydrologically disconnect trails from associated waterways. Focus initial efforts in areas draining directly to areas with extant coho salmon populations.	3	20	CalFire, California Department of Mines and Geology, Campbell Timberland Management, NOAA RC, Redwood Forest Foundation, State Parks						TBD	Cost cannot be determined until a road and trail assessment is conducted.
UsC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
UsC-A-9.1.1	Recovery Action	Viability	Measure or estimate response of key habitat attributes to recovery efforts across the watershed.	3	60	Campbell Timberland Management, CDFG, NOAA RC, Redwood Forest Foundation, State Parks						TBD	The Redwood Forest Foundation lacks staff to do this type of work and would likely rely almost totally on outside funding sources to implement this recommendation.
UsC-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
UsC-A-9.1.2.1	Action Step	Viability	Continue and improve upon monitoring activities to determine the population status of adult and smolt salmonids in the watershed.	3	20	CDFG, NOAA RC, Redwood Forest Foundation						TBD	This recommendation has a lower priority due to the Dependent status of the watershed and the amount of ongoing monitoring in the Lost Coast Diversity Stratum. Redd counts may cost approximately 35,000 dollars per year if implemented.
UsC-A-24.1	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.										
UsC-A-24.1.1	Recovery Action	Roads and Railroads	Assess and redesign transportation network to minimize road density and maximize transportation efficiency.	2	30	CalFire, Mendocino County Department of Public Works, Redwood Forest Foundation, State Parks						TBD	Cost likely to be significant. However, the cost is difficult to determine pending a road assessment and prioritization. Some upgrades have already occurred.
UsC-A-24.1.2	Recovery Action	Roads and Railroads	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	1	30	CalFire, California Department of Mines and Geology, Mendocino County Department of Public Works, Redwood Forest Foundation, RWQCB						TBD	This action should be implemented in the near future. However, a longer duration is associated with the action due to the long amount of time anticipated to fully implement this recommendation. North Fork Usal's mainline riparian road should be considered one of the top priorities for decommissioning.
UsC-A-24.2	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within ten years (from 2010).										
UsC-A-24.2.1	Recovery Action	Roads and Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										

Usal Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
UsC-A-24.2.1.1	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, California Department of Mines and Geology, Campbell Timberland Management, Redwood Forest Foundation, State Parks						TBD	Costs will depend on the frequency of the action which cannot be determined at this time.
UsC-A-24.2.1.2	Action Step	Roads and Railroads	Establish adequate spoils storage sites throughout the watershed so that material from landslides and road maintenance can be stored safely away from coho streams. Coordinate these efforts with all landowners in the watershed, CalTrans, and county road maintenance staff as appropriate.	3	60	CalFire, Campbell Timberland Management, Redwood Forest Foundation						0	These areas have likely been identified in the Usal watershed.
UsC-A-24.2.1.3	Action Step	Roads and Railroads	Encourage County of Mendocino to address sediment input from the Usal County road into Waterfall Gulch (tributary to North Fork Usal).	1	5	CDFG, Mendocino County Department of Public Works, RWQCB						TBD	The Usal County Road should be properly winterized to ensure sediment from this dirt road does not continue to enter Usal Creek.
UsC-A-24.2.2	Recovery Action	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized individuals and impacting uses to decrease fine sediment loads.										
UsC-A-24.2.2.1	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	2	60	CalFire, Campbell Timberland Management, Mendocino County Department of Public Works, Redwood Forest Foundation, State Parks						TBD	Cost should be considered part of ongoing road maintenance.
UsC-A-24.2.3	Recovery Action	Roads and Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	2	60	CalFire, Mendocino County Department of Public Works, Redwood Forest Foundation, State Parks						TBD	This is likely already considered a standard practices by land managers in the watershed. Particular focus is necessary for the Usal County Road bridge over Usal Creek, which is vulnerable to drift accumulation.
UsC-A-24.2.3.1	Action Step	Roads and Railroads	Stream crossings on THP parcels should be identified and mapped with the intention of replacement or removal if they cannot pass 100 year flow. Design should include fail safe measures to accommodate culvert overflow without causing massive road fill failures.	2	30	CalFire, Campbell Timberland Management, CDFG, Redwood Forest Foundation, RPFs, RWQCB						0	These will likely be replaced as part of future timber harvest plans in the watershed.
UsC-A-24.3	Objective	Roads and Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.										
UsC-A-24.3.1	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.										
UsC-A-24.3.1.1	Action Step	Roads and Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	1	60	CalFire, Campbell Timberland Management, Mendocino County Department of Public Works, Redwood Forest Foundation, State Parks						TBD	Most of the landowners in the Usal watershed operate under these standards. However, the County of Mendocino should adopt these standard for the Usal County Road (dirt).

Usal Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
UsC-A-24.3.2	Recovery Action	Roads and Railroads	Use best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).										
UsC-A-24.3.2.1	Action Step	Roads and Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.	3	10	CalFire, Campbell Timberland Management, CDFG, Redwood Forest Foundation						0	A lower priority due to the projected lack of timber harvest actions in the watershed for the next (approximately) ten years. A suitable plan for this watershed may incorporate a road sediment reduction plan as part of the future timber harvest planning scenario for the watershed.

WADDELL CREEK

Waddell Creek

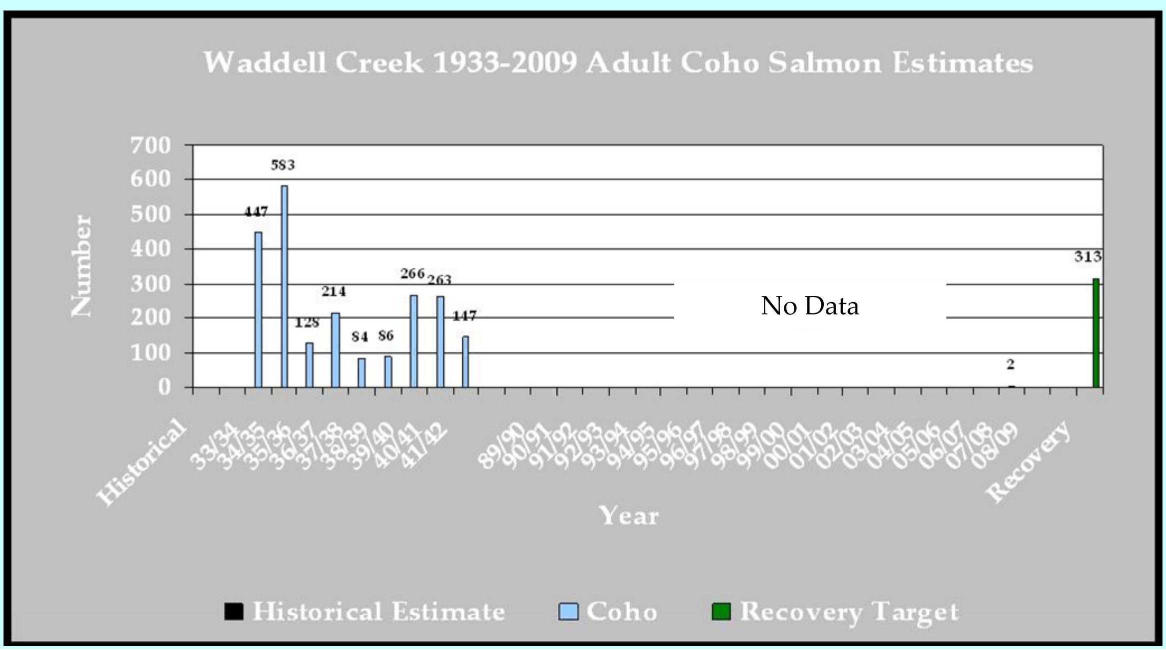
Dependent Population
9.2 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

Waddell Creek drains approximately 24 square miles of the Santa Cruz Mountains in northwestern Santa Cruz County. Waddell Creek enters the Pacific Ocean about 15 miles north of Santa Cruz. About 85 percent of the Waddell Creek watershed is coniferous forest and about 14 percent of the watershed is shrubland. The SWRCB listed the East branch of Waddell Creek as having water quality impaired for nutrients in 2003. The water quality impairment listing determined that nutrients were impairing habitats beneficial to coho salmon including migration, spawning, and rearing habitats, and identified municipal point sources as the probable cause. Eighty-six percent of the Waddell Creek watershed is in state-owned forest lands; the remaining 14 percent is private ownership. There are 2 dams within the watershed that block salmon migration, and an additional 24 other barriers to salmon migration caused by road crossings, diversions, and natural structures. Impassable barriers block salmonids for less than 10 percent of the watershed. Seminal work on the life history of coho salmon and steelhead occurred in Waddell Creek from 1933 to 1942 (Shapavolof and Taft 1954). Their study examined the various life stages of coho salmon with particular emphasis on adult and smolt run timing and survival ratios. Their work serves as the foundation for most studies on coho salmon life history in California. Unfortunately, coho salmon are nearly extripated in Waddell Creek today.

Waddell Creek
Photo by Jerry Smith, SJSU

The Watershed at a Glance

Spawning Quantity & Quality	**VERY GOOD**
Summer Water Temperatures	**FAIR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency	**POOR**
Riparian Canopy	**GOOD to VERY GOOD**
Off channel/Floodplain Quality	**FAIR**
Estuary Function	**FAIR**



Waddell Creek

Recovery Target: 313 Adult Coho Salmon

Increasing the survival of coho salmon

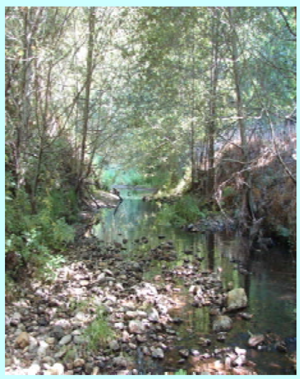
requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Droughts
- Roads and Railroads
- Channel Modifications

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Waddell Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve and expand pool habitat
- Increase the amount of large wood in streams
- Decrease existing and limit new near-stream roads, alleviating effects from remaining roads
- Augment and improve off channel habitat



Waddell Creek
Photo by Jerry Smith, SJSU

Advancing recovery of coho

salmon in Waddell Creek requires these priority **recovery actions:**

- Install LWD, boulders, and other features to increase stream complexity and improve pool frequency and depth.
- Evaluate source of ongoing fish kills in upper Waddell Creek and implement appropriate restoration actions.
- Identify and work with water users and appropriate regulatory agencies to minimize depletion of summer base flows from unauthorized water uses.
- Work with landowners to assess effectiveness of erosion control measures throughout the winter period.

. . . in these **core areas:** Northern and southwestern portion of the Waddell Creek planning watershed.

Conservation Highlights

- Annual juvenile abundance surveys conducted by San Jose State University faculty and students provides important population data on coho salmon in the Waddell Creek watershed.

We Need Your Photo Here

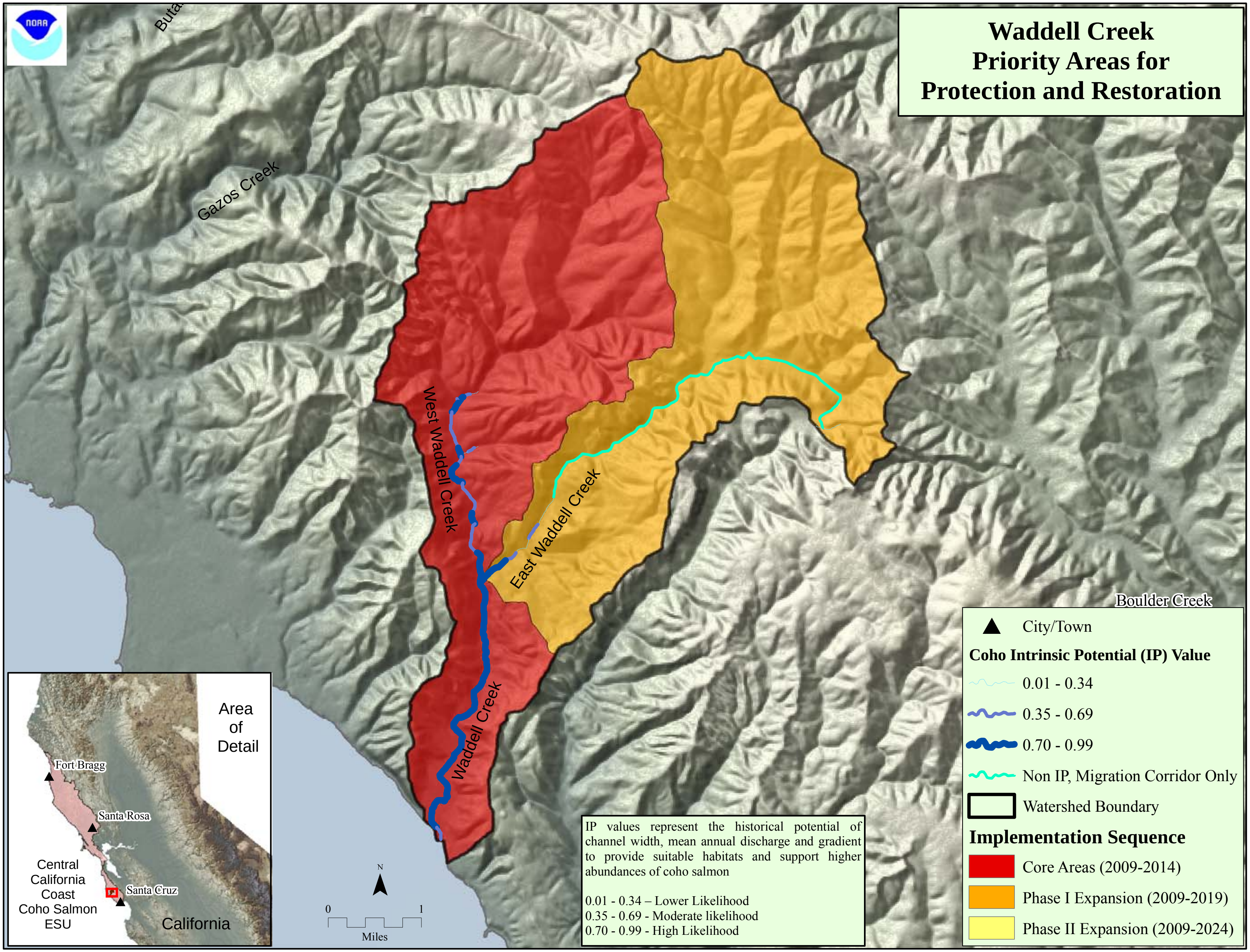
Waddell Creek
Photo © Your Name Here, AFFIL

Recovery Partners

State Parks
San Jose State University
Waddell Creek Association
NOAA SWFSC
Caltrans

Immediate Needs

Identify the source of upper Waddell Creek fish kills √


Waddell Creek
Priority Areas for
Protection and Restoration
Gazos Creek
West Waddell Creek
East Waddell Creek
Waddell Creek
Boulder Creek
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Non IP, Migration Corridor Only
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
N
0
1
Miles
Area of Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central California Coast Coho Salmon ESU
California

CCC Coho Salmon
Waddell Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	33	Very Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	30-60 days	Fair	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	6,948 m^2	Very Good	Spawning Adults	Sediment	Amount of Gravel*	<100 m^2	100-500 m^2	500-1100 m^2	>1100 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	25	Very Good	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	75	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Good	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	Fair	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	42	Good	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	38.3	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	8%	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	38.3	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	50	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	2.17/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	38.3	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	77%	Good	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.17%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.31%	Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	0%	Very Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	0	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Many Sources	8.8	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	Historical Conditions	Very Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	78%	Good	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	80%	Good	Multiple Life Stages	Riparian Veg.	Canopy Cover	<75 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	2.1 mi/sq.mi.	Good	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	2 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Fair	Fair	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Waddell Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Droughts	Medium	Medium	High	Medium	High	Medium			High
2	Roads and Railroads	Medium	Low	Medium	High	High	Medium			High
3	Channel Modification	Low	Low	Medium	High	High	Medium			High
4	Climate Change	Medium	Low	High	Medium	Medium	Low			Medium
5	Storms and Flooding	Low	Low	Medium	Medium	High	Medium			Medium
6	Disease, Predation, and Competition	-	-	Medium	-	High	-			Medium
7	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
8	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium			Medium
11	Residential and Commercial Development	Low	Low	Medium	Medium	Medium	Medium			Medium
12	Logging and Wood Harvesting	Low	Low	Medium	Medium	Medium	Low			Medium
13	Mining	Low	Low	Medium	Medium	Medium	Low			Medium
14	Livestock Farming and Ranching	Low	Low	Low	Medium	Low	Low			Low
15	Hatcheries and Aquaculture	-	-	-	Low	Low	Low			Low
16	Fishing and Collecting	-	-	-	Low	Low	-			Low
Threat Status for Targets and Project		Medium	Medium	High	High	Very High	Medium	-	-	High

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WadC-A-1.1	Objective	Estuary	Restore and enhance estuary habitat in the watershed.										
WadC-A-1.1.1	Recovery Action	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.										
WadC-A-1.1.1.1	Action Step	Estuary	Restore estuarine habitat and the associated wetlands and sloughs by providing fully functioning habitat (DFG 2004).	2	10	CA Coastal Commission, California Coastal Conservancy, CDFG, Counties, Private Landowners, USEPA, Water Agencies						TBD	Lower priority for coho but will benefit smolt transition and adult upmigration.
WadC-A-1.1.1.2	Action Step	Estuary	Promote and evaluate alternatives to the current Highway One bridge to improve estuary function.	2	5	CalTrans, CDFG, State Parks, USACE, USFWS						TBD	The current bridge is planned for a rebuild by Caltrans. A new bridge should account for sandbar formation and likely impacts to lagoon function. A new structure should be constructed in order to have minimal influence on sandbar opening and closing during (for all potential water years). Cost could not be determined at this time due to unknown financial considerations being evaluated by Caltrans for bridge design and reconstruction. The bridge location may have resulted in some channel incision which isolates the channel from the marsh and results in a lack of backwater habitat in the estuary.
WadC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
WadC-A-2.1.1	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
WadC-A-2.1.1.1	Action Step	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	5	CDFG, NMFS, Private Consultants, State Parks	4.00	4.00	4.00	4.00	4.00	20	
WadC-A-2.1.1.2	Action Step	Floodplain	Evaluate alternatives to improve habitat at the north and south swales.	3	15	CDFG, NMFS, State Parks						TBD	
WadC-A-2.1.1.3	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	20	CDFG, NMFS, Santa Cruz County Fish and Wildlife Advisory Board, State Parks, USACE						TBD	Costs will be determined by the type of project, the number of projects, and site specific constraints.
WadC-A-2.1.1.4	Action Step	Floodplain	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	10	California Coastal Conservancy, CalTrans, CDFG, Private Landowners, Santa Cruz County, Santa Cruz County Land Trust, State Parks							
WadC-A-3.1	Objective	Hydrology	Improve survival at all life stages by restoring the historical spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
WadC-A-3.1.1	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.	2	10	CDFG, Private Landowners, State Parks, SWRCB	10.00	10.00	10.00	10.00	10.00	100	Cost will be for outreach and modeling of potential solutions to address ongoing depletion of summer baseflow in the watershed.
WadC-A-3.1.2	Recovery Action	Hydrology	Monitor, identify problems, and prioritize needed changes to water diversion on current or potential coho streams that go dry in some years (DFG 2004).										

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WadC-A-3.1.2.1	Action Step	Hydrology	Work with the SWRCB to develop and enforce stream flow bypass requirements for diversions in Waddell Creek.	2	10	CDFG, Santa Cruz County, State Parks, SWRCB						0	Costs should be covered by existing programs of SWRCB.
WadC-A-3.1.3	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
WadC-A-3.1.3.1	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	3	20	CDFG, RCD, RWQCB, Santa Cruz County, State Parks	10.00	10.00	10.00	10.00	10.00	200	Promoting these type of projects will require a sustained effort to target willing landowners in critical stream reaches.
WadC-A-3.1.3.2	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	3	20	CDFG, Private Landowners, RCD, Santa Cruz County, State Parks	10.00	10.00	10.00	10.00	10.00	200	Promoting these type of projects will require a sustained effort to target willing landowners in critical stream reaches.
WadC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
WadC-A-6.1.1	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
WadC-A-6.1.1.1	Action Step	Pool Habitat	Install LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004).	1	5	California Coastal Conservancy, CDFG, NOAA RC, Private Landowners, Santa Cruz County, Santa Cruz RCD, State Parks	20.00	20.00	20.00	20.00	20.00	100	Cost estimate based on DFG 2004, at approximately $20K/mile, and assuming approximately 5 miles would be treated. Costs will be higher if engineered large wood placement approaches are used. Significant cost savings (and ecological benefits) would likely be realized if unsecured woody material (sized at 1.5 to 2 times bankfull) is used. Large woody debris should be targeted to reach density and volume outlined in the Viability table in this document.
WadC-A-6.1.1.2	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	California Coastal Conservancy, CDFG, NOAA RC, Private Landowners, Santa Cruz County, Santa Cruz RCD, USACE						0	Cost should be minimal. This recommendation should be adopted as a reoccurring recommendation for all restoration projects by individuals, agencies, and organizations that fund restoration projects.
WadC-A-6.1.1.3	Action Step	Pool Habitat	Encourage retention and recruitment of large woody debris for all historic CCC coho salmon streams to maintain and enhance current stream complexity, pool frequency, and depth. Consult a hydrologist and qualified fisheries biologist before removing wood from streams.	1	60	California Coastal Conservancy, CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, State Parks						0	
WadC-A-6.1.1.4	Action Step	Pool Habitat	If log jams are opened up for fish passage, retain LWD for instream enhancement projects that address poor shelter rating for juveniles and smolts. Create winter velocity refuge between stream mile 4 and 8 (footbridge). Create winter velocity refuge in stream above and below tramway springs.	2	5	CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, State Parks	12.00	12.00	12.00	12.00	12.00	60	Costs associated with velocity refuge habitat enhancement assumed to be similar to installation of LWD structures. DFG estimated 20K per structure (DFG 2004). Significant oversight and evaluation should occur prior to removal of any large wood structure.
WadC-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.										

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WadC-A-6.1.2.1	Action Step	Pool Habitat	Explore restoration approaches to regain flooding of the north and south swale during more frequent flow events. Address channel incision issues and reduced stream complexity between the Highway one bridge (stream mile 0) and the footbridge (stream mile 8).	2	5	CDFG, NOAA RC, Santa Cruz County, Santa Cruz RCD, State Parks	32.00	32.00	32.00	32.00	32.00	160	Accurate costs depend on selected approaches. DFG estimated LWD installation costs at approximately $20K/mile (DFG 2-004).
WadC-A-6.1.3	Recovery Action	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	CDFG, NMFS, Private Landowners, Santa Cruz County, State Parks						0	Purpose of action is to stop removal of LWD and other habitat elements, so costs are expected to be minimal, and cost savings may occur.
WadC-A-6.1.4	Recovery Action	Pool Habitat	Conserve and manage forestlands for older forest stages.										
WadC-A-6.1.4.1	Action Step	Pool Habitat	Conduct conifer release to promote growth of larger diameter trees where appropriate.	3	30	CalFire, CDFG, Private Landowners, Santa Cruz County, State Parks						TBD	Conifer release must take a comprehensive approach and should only be initiated in stream reaches with adequate canopy cover and where increases in instream temperatures are unlikely.
WadC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
WadC-A-7.1.1	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	5	CDFG, Santa Cruz County, Santa Cruz RCD, State Parks						TBD	Costs depend on type and extent of reclamation and enhancement required.
WadC-A-7.1.2	Recovery Action	Riparian Vegetation	Manage riparian areas for their site potential composition and structure.	2	60	CDFG, Santa Cruz County, State Parks						0	Costs are expected to be minimal.
WadC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
WadC-A-8.1.1	Recovery Action	Sediment	Decommission riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses (DFG 2004).	2	20	California Coastal Conservancy, CalTrans, Private Landowners, Santa Cruz County, Santa Cruz RCD, State Parks						TBD	Decommissioning and rerouting road and trails can be expensive, however, costs cannot be determined due to an unknown number of miles of roads that may be targeted.
WadC-A-8.1.2	Recovery Action	Sediment	Place instream structures to improve gravel retention and habitat complexity.	2	10	CDFG, Private Landowners, Santa Cruz County, Santa Cruz RCD, State Parks	100	100	100	100	100	1,000	DFG estimated LWD structures cost approximately $20K each (DFG 2004). Assumed 50 structures would be needed.
WadC-A-8.1.3	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.	2	15	NRCS, RWQCB, Santa Cruz County, Santa Cruz RCD	3.33	3.33	3.33	3.33	3.33	50	This work would be in addition to the road evaluation study. Cost savings could be realized through the use of air photography and interviews with landowners to identify major sources of sediment input.
WadC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
WadC-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key habitat attributes across the watershed.	3	2	CDFG, Private Landowners, State Parks	50.00	50.00				100	Standardized habitat typing per DFG protocol could identify the majority of limiting factors within the watershed.
WadC-A-9.1.2	Recovery Action	Viability	Monitor population status for response to recovery actions.										
WadC-A-9.1.2.1	Action Step	Viability	Establish life cycle station in the Waddell Creek watershed, and utilize it to compare productivity with existing historical data for the watershed (Gallagher and Gallagher 2005).	2	6	CDFG, NOAA SWFSC, Private Landowners, State Parks	100	100	100	100	100	600	Cost is a rough estimate and may be reduced through the development of cooperative relationships between researchers. Although Waddell is rated as a Dependent watershed and other monitoring is occurring in an adjacent Dependent watershed (Scott Cr), Waddell is of particular historical importance to assessing long term trends of coastal salmonids due to the past work of Shapovalov and Taft (1954) during the 1930's

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WadC-A-9.1.2.2	Action Step	Viability	Implement consistent monitoring and reporting methods to ensure ESU-wide consistency.	3	60	CDFG, NOAA RC, NOAA SWFSC, Private Consultants						TBD	While standard methods are available, outreach will be required to encourage all landowners and consultants to utilize them. Costs for outreach and education are difficult to determine due to an unknown number of participants, staff turnover, etc. Costs for a statewide outreach and education program were estimated at $60K (DFG 2004). Costs for a watershed specific program would likely be a fraction of that.
WadC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
WadC-A-10.1.1	Recovery Action	Water Quality	Conserve and manage forestlands for older forest stages.	2	60	CalFire, Private Landowners, State Parks						0	
WadC-A-10.1.2	Recovery Action	Water Quality	Determine site-specific recommendations, including incentives, to remedy high temperatures and implement accordingly (DFG 2004) .										
WadC-A-10.1.2.1	Action Step	Water Quality	Evaluate source of ongoing fish kills in upper Waddell Creek and implement appropriate restoration actions.	1	3	CDFG, NMFS OLE, State Parks	16.67	16.67	16.67			50	
WadC-A-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
WadC-A-12.1.1	Recovery Action	Channel Modification	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow “emergencies”.										
WadC-A-12.1.1.1	Action Step	Channel Modification	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	1	2	CDFG, Santa Cruz County						0	Cost of policy development are expected to be minimal. These costs were developed for San Lorenzo River strategies and should be able to be applied to Waddell at no additional cost.
WadC-A-12.1.2	Recovery Action	Channel Modification	Projects should seek alternatives to bank hardening.										
WadC-A-12.1.2.1	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. where critical infrastructure is located) for bank hardening projects.	2	60	California Coastal Conservancy, CalTrans, CDFG, NMFS, NRCS, RWQCB, Santa Cruz County, State Parks, USACE						TBD	Costs will vary by project and need.
WadC-A-12.2	Objective	Channel Modification	Ensure current populations of CCC coho salmon are protected from harm or take and protect all historical habitats from further habitat degradation.										
WadC-A-12.2.1	Recovery Action	Channel Modification	Encourage full implementation and enforcement of the Santa Cruz County Sensitive Habitat Ordinance.	3	60	Santa Cruz County						0	
WadC-A-14.1	Objective	Disease, Predation, and Competition	Reduce predation from non-native predators.										
WadC-A-14.1.1	Recovery Action	Disease, Predation, and Competition	Develop a predator control program targeting striped bass in the lower watershed.										
WadC-A-14.1.1.1	Action Step	Disease, Predation, and Competition	Evaluate likely impact of non-native species to anadromous salmonids in the Waddell estuary.	3	2	CDFG, NOAA SWFSC, Private Consultants, State Parks	37.50	37.50				75	Cost is a rough approximation of financial commitment necessary to adequately sample the estuary and write necessary reports. Final reports should include a series of recommendations and the feasibility of implementing these recommendations.

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WadC-A-14.1.1.2	Action Step	Disease, Predation, and Competition	Coordinate with DFG to develop and implement the predator control program.	3	5	CDFG, NMFS, NOAA SWFSC, Santa Cruz County Fish and Wildlife Advisory Board, State Parks						TBD	Cost cannot be determined until all potential control methods are evaluated and total magnitude of the impact of anadromous salmonids ascertained. Total duration of predator control efforts may be longer depending on recommendations of plan.
WadC-A-15.1	Objective	Droughts	All local and state planning and development should consider, and provide contingencies for, droughts in a manner compatible with CCC coho salmon recovery needs.										
WadC-A-15.1.1	Recovery Action	Droughts	Implement water conservation strategies that provide for drought contingencies without relying on interception of surface flows or groundwater depletion.										
WadC-A-15.1.1.1	Action Step	Droughts	Develop and implement critical flow levels for stream reaches impacted by water diversions.	3	10	CDFG, NMFS HCD, State Parks, SWRCB						TBD	
WadC-A-15.1.1.2	Action Step	Droughts	Critical flow values should include minimum bypass flow requirements to support upstream adult migration during winter months and juvenile rearing in the summer and fall months.	3	10	CDFG, NMFS HCD, State Parks, SWRCB						TBD	
WadC-A-15.1.1.3	Action Step	Droughts	If predicted flows are below a level considered critical to maintain habitat conditions for coho salmon, measures to reduce water consumption should be initiated by users in the watershed through conservation programs.	2	10	CDFG, NOAA RC, NRCS, Pacific States Marine Fisheries Commission, SWRCB						TBD	
WadC-A-15.1.1.4	Action Step	Droughts	Identify and work with water users and appropriate regulatory agencies to minimize depletion of summer base flows from unauthorized water uses.	1	5	CDFG, Farm Bureau, NMFS, Private Landowners, State Parks, SWRCB, Trout Unlimited						TBD	Cost should be minimal and would largely consist of staff time to reconnoiter the watershed and conduct outreach to landowners.
WadC-A-15.1.1.5	Action Step	Droughts	Evaluate and implement rainfall capture from impervious surfaces for irrigation use to protect water quality and reduce water demand in summer.	2	15	CDFG, Farm Bureau, NMFS HCD, Private Landowners, State Parks, Trout Unlimited						TBD	
WadC-A-24.1	Objective	Roads and Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.										
WadC-A-24.1.1	Recovery Action	Roads and Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	3	60	CalTrans, NRCS, Santa Cruz County Department of Public Works, Santa Cruz RCD						TBD	Similar existing programs could be modified and implemented at minimal cost.
WadC-A-24.1.2	Recovery Action	Roads and Railroads	Encourage ongoing implementation of the County of Santa Cruz's Integrated Vegetation Management Plan for Roads Near Perennial Waters (URS Corporation, 2008) regarding roadside maintenance activities to discourage or eliminate unwanted vegetation and promote desirable (native) vegetation.	3	60	Santa Cruz County, State Parks						0	
WadC-A-24.2	Objective	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within five years (from 2010).										
WadC-A-24.2.1	Recovery Action	Roads and Railroads	Address sediment sources from road networks and other actions that deliver sediment to stream channels.										
WadC-A-24.2.1.1	Action Step	Roads and Railroads	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.	2	10	California Department of Mines and Geology, NRCS, Private Consultants, Santa Cruz County, State Parks	15.00	15.00	15.00	15.00	15.00	150	Assessment should be conducted by a qualified geologist or road engineer with experience regarding road impacts to anadromous fisheries. The assessment should prioritize sites and outlines implementation and timelines of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WadC-A-24.2.1.2	Action Step	Roads and Railroads	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas (DFG 2004).	2	10	California Department of Mines and Geology, CDFG, Private Consultants, Private Landowners, Santa Cruz RCD, State Parks						TBD	
WadC-A-24.2.1.3	Action Step	Roads and Railroads	Identify and modify road maintenance activities that generate fine sediment to decrease fine sediment loads (DFG 2004).	1	5	CalFire, California Department of Mines and Geology, Santa Cruz County	2.00	2.00	2.00	2.00	2.00	10	
WadC-A-24.2.1.4	Action Step	Roads and Railroads	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	1	2	CDFG, NRCS, Santa Cruz RCD	12.50	12.50				25	
WadC-A-24.2.1.5	Action Step	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	15	CalFire, California Department of Mines and Geology, Private Landowners, Santa Cruz County, Santa Cruz County Department of Public Works, Santa Cruz RCD, State Parks, USACE						0	These standards should be applied to all roads in the watershed.
WadC-A-24.2.1.6	Action Step	Roads and Railroads	Encourage enforcement of Erosion Control Ordinance for private roads.	1	60	Santa Cruz County						TBD	County should provide adequate staffing to ensure standards per their Erosion Control Ordinances are applied appropriately.
WadC-A-24.2.2	Recovery Action	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific road management plan is created and implemented.	2	10	CalFire, Private Landowners, Santa Cruz County, State Parks						TBD	
WadC-A-25.1	Objective	Storms and Flooding	Support economic incentives to reduce the impacts of storms and flooding from current and future planned urban infrastructure.										
WadC-A-25.1.1	Recovery Action	Storms and Flooding	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.										
WadC-A-25.1.1.1	Action Step	Storms and Flooding	Where existing infrastructure exists within historical floodplains or offchannel habitats in any historical coho watersheds, and restoration is found feasible, encourage willing landowners to restore these areas through conservation easements, etc.	3	60							TBD	Cost of this recommendation could be significant. This recommendation should be implemented on an opportunistic basis such as when a property is damaged after flooding or when a property owner moves away from the property in question. Adoption of these policies may result in significant short term expense but a long-term cost savings as a result of minimal future flood fighting actions.
WadC-A-25.2	Objective	Storms and Flooding	Modify current and future planning of urban infrastructure to address impacts of storms and flooding on watersheds.										
WadC-A-25.2.1	Recovery Action	Storms and Flooding	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC coho salmon watercourse.										
WadC-A-25.2.1.1	Action Step	Storms and Flooding	Protect high-risk shallow-seeded landslide areas and surfaces prone to erosion from being mobilized by intense storm events.	2	60	California Department of Mines and Geology, Santa Cruz County						TBD	This is a site specific recommendation and costs will vary depending on existing infrastructure and risk tolerance.

Waddell Creek (Santa Cruz Mountains) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WadC-A-25.2.2	Recovery Action	Storms and Flooding	Existing areas with floodplains or off channel habitats should be protected from future urban development of any kind.	1	60	California Department of Mines and Geology, CalTrans, Private Landowners, Santa Cruz County, USACE						TBD	Protecting these areas from impacts of development may be costly due to concerns of reverse condemnation, etc. Cost cannot be determined at this time due to a lack of information regarding where these existing habitats remain in juxtaposition to future development.

Wages Creek

Wages Creek

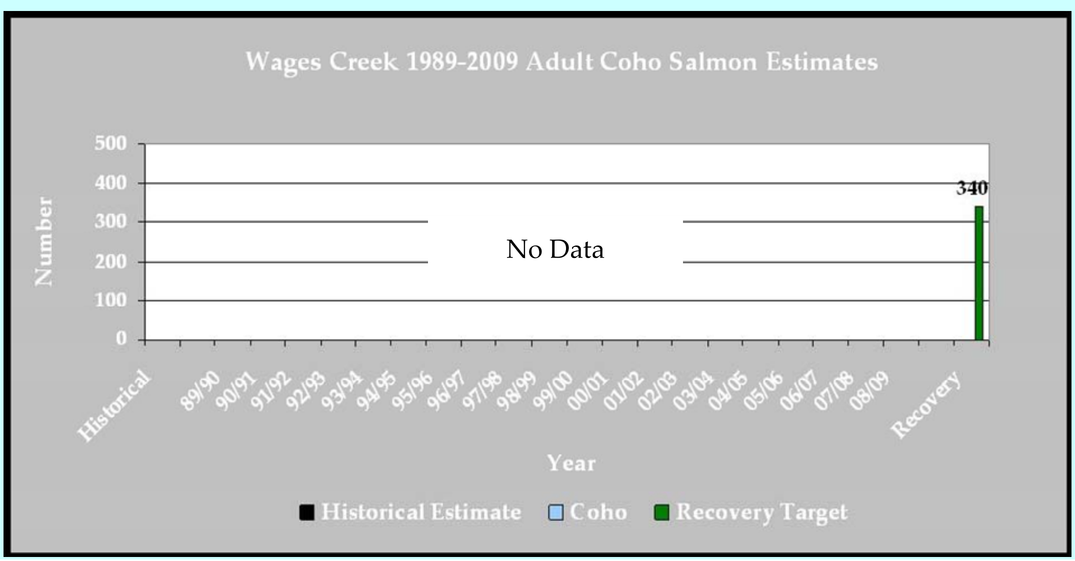
Dependent Population
10 IP-Km of potential coho salmon habitat
Coho salmon, Chinook salmon, and steelhead present

Wages Creek drains about 13 square miles, in western Mendocino County, and enters the Pacific Ocean about one mile north of the town of Westport. About 79 percent of the Wages Creek watershed is redwood coniferous forest and about 13 percent of the watershed area is either montane or riparian hardwood forest. The entire Wages Creek watershed has moderately high erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. Nearly the entire Wages Creek watershed is in private ownership; only 21 acres of the watershed is public park land. The dominant land use within the Wages Creek watershed is forestry. Within the past 10 years, about 29 percent of the Wages Creek watershed has been under a timber harvest plan. Housing development within the watershed is moderately low – about 90 homes are present in the watershed.

Wages Creek estuary and campground.

The Watershed at a Glance

Spawning Quantity & Quality:	**FAIR**
Summer Water Temperatures:	**VERY GOOD**
Depth & Shelter of Pools:	**POOR to FAIR**
Large Wood Frequency:	**POOR to FAIR**
Riparian Canopy:	**FAIR to GOOD**
off channel/Floodplain Quality:	**FAIR**
Estuary Function:	**FAIR**



Wages Creek

Recovery Target: 340 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The highest ranked threats are:

- Logging and Wood Harvesting
- Roads and Railroads
- Storms and Flooding

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Wages Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve estuary condition
- Improve pool complexity and increase number of pools
- Increase large wood in streams
- Increase the frequency of off channel habitat and floodplain connectivity
- Reduce the amount of roads in and near the riparian zone and throughout the watershed

We Need Your Photo Here

Wages Creek
Photo © Your Name Here, AFFIL

Advancing recovery of coho

salmon in Wages Creek requires these priority **recovery actions:**

- Install large wood, boulders, and other structures to increase stream complexity and gravel retention, and improve and improve pool frequency and depth.
- Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats. Improve floodplain connectivity.
- Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, and bank stabilization.
- Discourage rezoning forestlands to rural residential or other land uses (e.g., vineyards).
- Conduct annual inspections of all roads prior to winter and repair or maintain roads to reduce sediment inputs to waterways.

. . . **throughout** the Wages Creek watershed.

Conservation Highlights

- Campbell Timberland Management has undertaken sediment remediation projects.
- The Wages Creek Monitoring Study Group, a collaborative effort, is conducting effectiveness monitoring to assess current conditions and long term trends in channel conditions.

We Need Your Photo Here

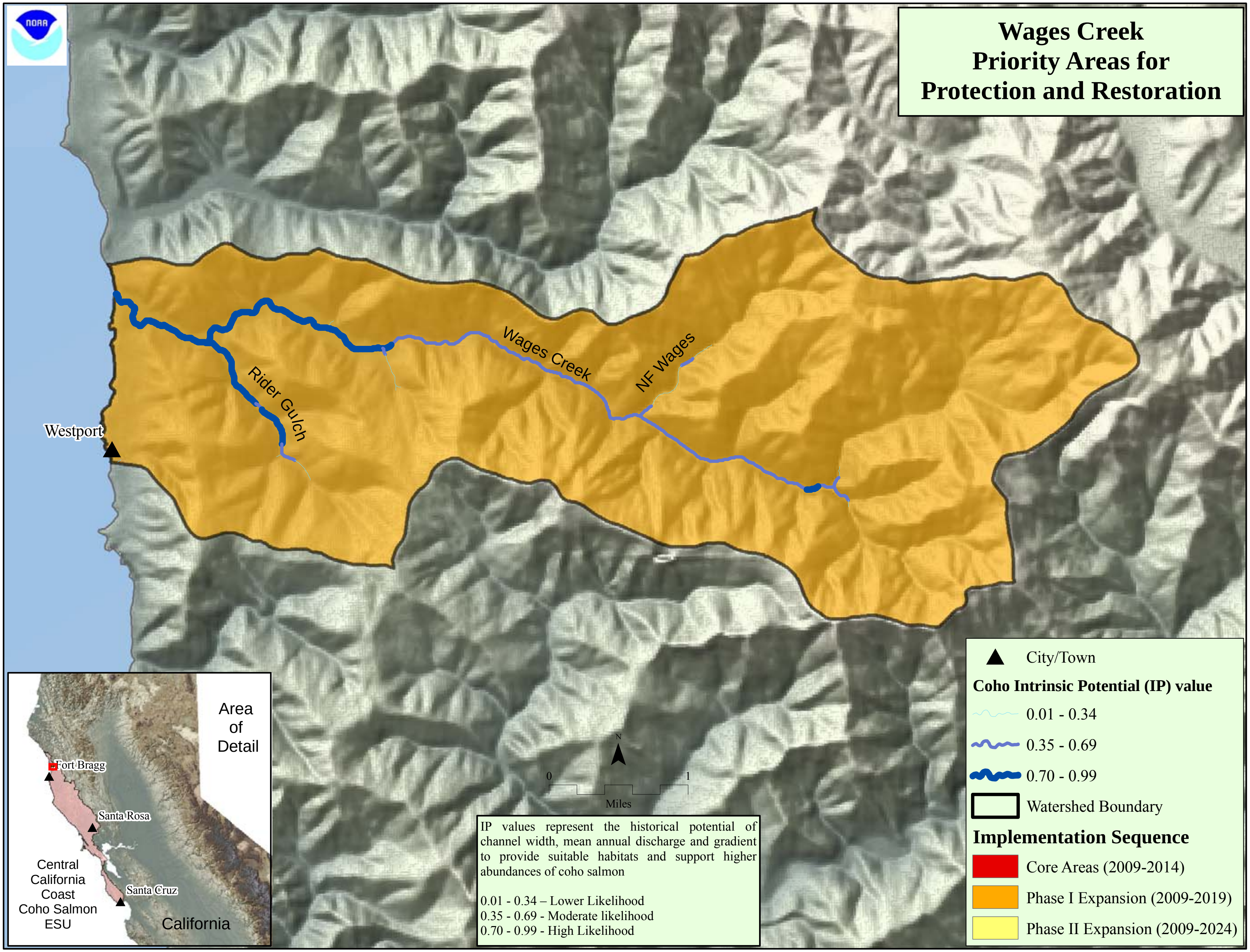
Wages Creek
Photo © Your Name Here, AFFIL

Immediate Needs

√ Identify and address sources of sediment input to streams from roads.

Recovery Partners

NMFS
DFG
Campbell Timberland Management
Westport Water District
Board of Forestry Monitoring Study Group
Ballard Forestry



Wages Creek
Priority Areas for
Protection and Restoration
Wages Creek
NF Wages
Rider Gulch
Westport
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
1
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Wages Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	NA	NA	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	100%	Very Good	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	60-90 days	Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	NA	NA	Spawning Adults	Sediment	Amount of Gravel*	<100m^2	100-500	500-900	>900
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	NA	NA	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Fair	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	NA	NA	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	NA	NA	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	NA	NA	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Fair	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	Poor	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	NA	NA	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	3/10 IP-km	Fair	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	NA	NA	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	>80%	Good	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	NA	Fair	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.20%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	0.00%	Very Good	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	29%	Fair	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	>50%	Good	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	40-54%	Fair	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	70-80%	Fair	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	5.9 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	5.7 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Good	Good	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Wages Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages	Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	
1	Droughts	Medium	Medium	High	Medium	Very High	Medium	High
2	Roads and Railroads	High	High	High	Medium	Medium	High	High
3	Logging and Wood Harvesting	High	High	Medium	Medium	Medium	High	High
4	Storms and Flooding	High	Medium	Medium	Medium	Medium	Medium	High
5	Recreational Areas and Activities	Medium	Low	Medium	Medium	High	Medium	Medium
6	Disease, Predation, and Competition	Medium	-	High	-	Medium	-	Medium
7	Climate Change	Medium	Medium	Medium	Medium	Medium	Medium	Medium
8	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium	Medium
9	Residential and Commercial Development	Medium	Medium	Medium	Medium	Medium	Medium	Medium
10	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium	Medium
11	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium	Medium
12	Water Diversion and Impoundment	Medium	Low	Medium	Medium	Medium	Medium	Medium
13	Channel Modification	Medium	Low	Low	Medium	Medium	Medium	Medium
14	Fishing and Collecting	Medium	-	Medium	-	Medium	-	Medium
15	Hatcheries and Aquaculture	Medium	-	-	-	Medium	-	Medium
16	Mining	-	-	-	-	Low	-	Low
	Threat Status for Targets and Project	High	High	High	High	Very High	High	High

Wages Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WagC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
WagC-A-6.1.1	Recovery Action	Pool Habitat	Encourage the development and implementation of large woody debris supplementation programs to increase stream complexity and gravel retention, and improve pool frequency and depth (DFG 2004).										
WagC-A-6.1.1.1	Action Step	Pool Habitat	Increase LWD frequency in mainstem reaches of Wages Creek.	1	10	Campbell Timberland Management, CDFG, Private Landowners	30.00	30.00	30.00	30.00	30.00	300	Costs may be higher in Wages Creek than in some of the other watersheds in the Lost Coast Diversity Stratum due to the presence of rural residences in the lower portion of the watershed. Due to the presence of these structures, additional engineering may be required.
WagC-A-6.1.2	Recovery Action	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CalFire, Campbell Timberland Management, CDFG, NMFS, Private Landowners						0	Cost of encouraging implementation of restoration projects is likely to be low.
WagC-A-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
WagC-A-7.1.1	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).										
WagC-A-7.1.1.1	Action Step	Riparian Vegetation	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, NMFS, NOAA RC, Private Landowners						TBD	Most of the land is used for forest management, so most of this cost will be absorbed as part of on going forestry practices.
WagC-A-7.1.2	Recovery Action	Riparian Vegetation	Conduct conifer release to promote growth of larger diameter trees where appropriate.	2	60	Campbell Timberland Management, Private Landowners						TBD	Cost is expected to be minimal and would likely be included as part of ongoing forest management in the watershed.
WagC-A-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
WagC-A-8.1.1	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.										
WagC-A-8.1.1.1	Action Step	Sediment	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas (DFG 2004).	2	5	CalFire, Campbell Timberland Management, Private Landowners						TBD	
WagC-A-8.1.2	Recovery Action	Sediment	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.										
WagC-A-8.1.2.1	Action Step	Sediment	Locations for sediment catchment basins should be identified, developed and maintained, where appropriate.	2	60	CalFire, Campbell Timberland Management, Private Landowners	50.00	50.00	50.00	50.00	50.00	3,000	This estimate was taken from the Ten Mile Creek watershed. Ongoing maintenance will likely occur as part of a yearly evaluation prior to the winter period. Maintenance costs were estimated at $50,000/yr.
WagC-A-8.1.2.2	Action Step	Sediment	All roads alongside inner gorge areas or in potentially unstable headwall areas should be removed, if feasible.	2	30	CalFire, Campbell Timberland Management, Private Landowners						TBD	TBD- difficult to estimate cost because assessments for the magnitude of the problem were not available. Additionally, many inner gorge roads have been addressed - often through the timber harvest process - and these costs should be considered an ongoing operation expense.

Wages Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WagC-A-8.1.2.3	Action Step	Sediment	Where restricting winter access to unpaved roads is not feasible, encourage measures such as rocking to prevent sediment from reaching coho salmon streams (DFG 2004).	2	60	CalFire, Campbell Timberland Management, Private Landowners, RWQCB						TBD	Minimal- difficult to estimate cost because assessments for the magnitude of the problem were not available. Additionally, many roads have been rocked - often through the timber harvest process - and these costs should be considered an ongoing operation expense.
WagC-A-9.1	Objective	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.										
WagC-A-9.1.1	Recovery Action	Viability	Measure or estimate the condition of key attributes across the watershed.										
WagC-A-9.1.1.1	Action Step	Viability	Implement standardized assessment protocols (i.e., DFG habitat assessment protocols) to ensure ESU-wide consistency.	3	60	Campbell Timberland Management, CDFG, NMFS, Private Landowners						TBD	A large proportion of the watershed has likely been habitat typed by Campbell Timber. New habitat assessment methods may have future (unknown) costs.
WagC-A-10.1	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
WagC-A-10.1.1	Recovery Action	Water Quality	Plant native vegetation to promote streamside shade.	2	60	CalFire, Campbell Timberland Management, Private Landowners, RWQCB						tbd	Majority of this effort should be focused in the lower watershed where the original forest cover was removed.
WagC-A-14.1	Objective	Disease, Predation, and Competition	Implement regulatory, abatement, and education measures to prevent the invasion of exotic species, (including exotic plants).	3	60	CDFG, Mendocino County, NMFS, Private Landowners						TBD	Cost is dependent on measures chosen.
WagC-A-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										
WagC-A-15.1.1	Recovery Action	Droughts	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for coho salmon recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of coho salmon (DFG 2004)(Water Code § 1707).	3	60	CDFG, NOAA RC, Private Landowners						TBD	The price at which water is sold on environmental markets is determined by negotiations between landowners and purchasing entity. Cost will vary depending on water availability and landowner participation. It is unknown if this program will gain widespread acceptance in the watershed and therefore costs cannot be estimated. It is recommended that the equations used in the State Coho Plan for socioeconomic cost be utilized when more information regarding landowner participation is gathered.
WagC-A-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.										
WagC-A-15.2.1	Recovery Action	Droughts	DFG, SWRCB, RWQCB, CalFire, and other agencies and landowners, in cooperation with NMFS, should evaluate the rate and volume of water drafting for dust control in streams or tributaries and where appropriate, minimize water withdrawals that could impact coho salmon. These agencies should consider existing regulations or other mechanisms when evaluating alternatives to water as a dust palliative (including EPA-certified compounds) that are consistent with maintaining or improving water quality (DFG 2004).	2	60	CalFire, Campbell Timberland Management, CDFG, Private Landowners, RWQCB, SWRCB						TBD	Cost is expected to be minimal.
WagC-A-15.3	Objective	Droughts	All Federal, State and local, planning should include considerations and allowances that ensure continued operations during droughts while also providing for CCC coho salmon recovery needs.										
WagC-A-15.3.1	Recovery Action	Droughts	Identify and work with water users to minimize depletion of summer base flows from unauthorized water uses.	2	20	CDFG, NMFS, SWRCB						TBD	Estimating cost is difficult at this time.
WagC-A-20.1	Objective	Logging and Wood Harvesting	Maintain and expand California's working forestlands and forestlands held by the State, and prevent future conversion of forestlands to agriculture or other land uses.										

Wages Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WagC-A-20.1.1	Recovery Action	Logging and Wood Harvesting	Coordinate with the agencies that authorize conversions to minimize conversions in key watersheds and discourage forestland conversions.										
WagC-A-20.1.1.1	Action Step	Logging and Wood Harvesting	Discourage rezoning forestlands to rural residential or other land uses (e.g., vineyards).	1	5	CalFire, California Coastal Conservancy, Mendocino County, NMFS, Private Landowners, USEPA, USFWS						0	Cost is expected to be the result of focused staff time directed at Mendocino BOS and various land use organizations.
WagC-A-20.2	Objective	Logging and Wood Harvesting	Provide for properly functioning watershed processes (e.g., cycles of wood, water and sediment) by promoting long term sustainable forestry practices that support coho salmon habitats.	2	30	Campbell Timberland Management, CDFG, NMFS, NOAA RC, Private Landowners						0	cost is expected to be minimal.
WagC-A-20.2.1	Recovery Action	Logging and Wood Harvesting	Minimize sediment-related effects to coho salmon habitat from road building and other soil-disturbing activities.										
WagC-A-20.2.1.1	Action Step	Logging and Wood Harvesting	Map unstable soils and use that information to guide land use decisions, road design, THPs, and other activities that can promote erosion.	3	60	CalFire, Campbell Timberland Management, CDFG						TBD	TBD - As most of the land is used for forest management most of this cost will be absorbed as part of on going forestry practices.
WagC-A-20.2.1.2	Action Step	Logging and Wood Harvesting	Extend the monitoring period and upgrade THP road maintenance after harvest.	3	60	CDFG, NMFS, Private Landowners, SWRCB						TBD	Cost is predicated on related strategies located above.
WagC-A-20.2.1.3	Action Step	Logging and Wood Harvesting	New THPs should identify problematic legacy roads within WLPZ's, decommission them, and revegetate the area with appropriate native species.	1	60	CalFire, California Coastal Conservancy, Campbell Timberland Management, CDFG, Private Landowners, RWQCB						0	
WagC-A-20.2.1.4	Action Step	Logging and Wood Harvesting	Encourage tree retention on the axis of headwall swales. Any deviations should be reviewed and receive written approval by a licensed engineering geologist.	3	60	Campbell Timberland Management, CDFG, Private Landowners, RPFs, RWQCB							
WagC-A-20.2.2	Recovery Action	Logging and Wood Harvesting	Manage riparian areas for their site potential composition and structure.										
WagC-A-20.2.2.1	Action Step	Logging and Wood Harvesting	Conserve and manage forestlands for older forest stages.	2	60	CalFire, Campbell Timberland Management, Private Landowners						TBD	TBD- the cost of this action may be minimal depending on the harvest philosophy of the landowner.
WagC-A-20.2.2.2	Action Step	Logging and Wood Harvesting	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	2	60	CalFire, Campbell Timberland Management, CDFG, Private Landowners						0	
WagC-A-20.3	Objective	Logging and Wood Harvesting	Improve existing coordination and oversight of timber operations by regulatory agencies.										
WagC-A-20.3.1	Recovery Action	Logging and Wood Harvesting	Establish greater oversight and post-harvest monitoring by the permitting agency of operations within Core, Phase I and Phase II CCC coho salmon areas.										
WagC-A-20.3.1.1	Action Step	Logging and Wood Harvesting	Assign NMFS staff to conduct THP reviews of the highest priority areas using revised "Guidelines for NMFS Staff when Reviewing Timber Operations: Avoiding Take and Harm of Salmon and Steelhead" (NMFS 2004).	3	10	NMFS						0	Cost would likely be minimal in the Wages Creek watershed and consist of overview by an already funded position engaged in THP review. Cost are estimated in Ten Mile and pertain to the entire Lost Coast Diversity stratum.
WagC-A-20.3.2	Recovery Action	Logging and Wood Harvesting	Provide information to BOF regarding CCC coho salmon priorities and recommend upgrading relevant forest practices.	2									

Wages Creek (Lost Coast-Navarro Point) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WagC-A-20.3.2.1	Action Step	Logging and Wood Harvesting	Discourage all activities (e.g., roads, harvest, yarding, etc.) in unstable areas (e.g., steep slopes, headwall swales, inner gorges, streambanks, etc.) unless a detailed geological assessment is performed by a certified engineering geologist that shows there is no potential for increased sediment delivery to a watercourse as a result.	2	60	CalFire, Campbell Timberland Management, CDFG, NMFS						TBD	
WagC-A-24.1	Objective	Roads and Railroads	Minimize sediment input from existing road networks into the aquatic environment.										
WagC-A-24.1.1	Recovery Action	Roads and Railroads	Conduct actions that hydrologically disconnect roads in Core areas within ten years (from 2010).										
WagC-A-24.1.1.1	Action Step	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.	2	60	CalFire, Campbell Timberland Management, CDFG, Private Landowners						TBD	Initial focus should be directed in steeper portions of the upper watershed.
WagC-A-24.1.2	Recovery Action	Roads and Railroads	Use available best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	5	Campbell Timberland Management, Mendocino County, Private Landowners						TBD	
WagC-A-24.1.2.1	Action Step	Roads and Railroads	Licensed engineering geologists should review and approve grading on inner gorge slopes.	2	60	CalFire, California Department of Mines and Geology, Campbell Timberland Management, Private Landowners						tbd	
WagC-A-24.1.3	Recovery Action	Roads and Railroads	Minimize sediment delivery from roads during the winter period.										
WagC-A-24.1.3.1	Action Step	Roads and Railroads	Limit winter use of unsurfaced roads and recreational trails by unauthorized individuals and impacting uses to decrease fine sediment loads.	2	60	CalFire, Campbell Timberland Management, Private Landowners						0	
WagC-A-24.1.3.2	Action Step	Roads and Railroads	Conduct annual inspections of all roads prior to winter. Correct conditions that are likely to deliver sediment to streams. Hydrologically disconnect roads.	1	60	Campbell Timberland Management, Private Landowners						0	This is part of ongoing maintenance requirements. Correct conditions that are likely to deliver sediment to streams, otherwise roads will be hydrologically closed/disconnected (fills and culverts removed, natural hydrology of hillslope largely restored).
WagC-A-24.1.4	Recovery Action	Roads and Railroads	Reduce sediment sources from road networks and other actions that deliver sediment to stream channels through improved or new laws and policy.										
WagC-A-24.1.4.1	Action Step	Roads and Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific and/or agency/company specific road management plan is created and implemented.	2	20	CalFire, Campbell Timberland Management, CDFG, Mendocino County Department of Public Works, RWQCB						0	
WagC-A-24.2	Objective	Roads and Railroads	Ensure all existing and new road crossings allow upstream and downstream passage for coho salmon.										
WagC-A-24.2.1	Recovery Action	Roads and Railroads	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	2	20	California Department of Mines and Geology, Campbell Timberland Management, CDFG, Private Landowners						tbd	

WALKER CREEK

Walker Creek

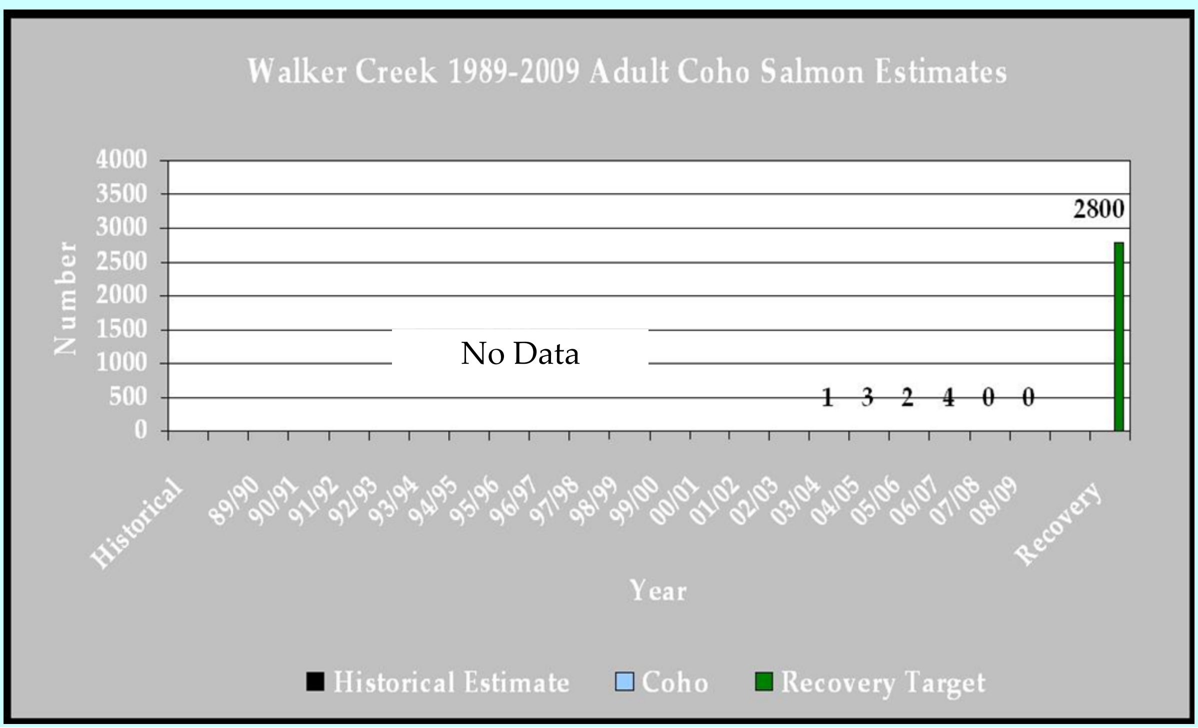
Independent Population
76.2 IP-km of potential coho salmon habitat
Coho salmon and steelhead present

Walker Creek drains approximately 75 square miles of northern Marin County and empties into Tomales Bay. Approximately 61 percent of the Walker Creek watershed is grassland and about 24 percent of the watershed area is either montane or riparian hardwood forest. The Walker Creek watershed has low to moderate erodibility after considering slope, precipitation, and the susceptibility of failure of underlying geology. The SWRCB listed the lower 16 miles of the Walker Creek watershed as having water quality impaired for mercury, nutrients, and sediment in 2003. The water quality impairment listing determined that mercury, nutrients, and sediment were impairing habitats beneficial to coho salmon, including migration, spawning, and rearing habitats, and identified surface mining, mine tailings, and agricultures as the probable causes. Ninety-six percent of the Walker Creek watershed is in private ownership; the remaining four percent is state and local owned lands. The dominant land use within the Walker Creek watershed is dairy rangeland. Housing development within the Walker Creek watershed is low; approximately 300 housing units are present in the watershed. There are three dams within the watershed that impede or block salmon migration, and additional numerous partial barriers to salmon migration caused by road crossings and water diversions. Impassable barriers block salmonids from 30 to 50 percent of the watershed.

Walker Creek
Photo by Bob Coey, NMFS

The Watershed at a Glance

Spawning Quantity & Quality:	**FAIR to VERY GOOD**
Summer Water Temperatures:	**POOR**
Depth & Shelter of Pools	**POOR**
Large Wood Frequency:	**POOR**
Riparian Canopy:	**POOR**
off channel/Floodplain Quality:	**POOR to FAIR**
Estuary Function:	**FAIR**



Walker Creek

Recovery Target: 252 Adult Coho Salmon

Increasing the survival of coho salmon

requires **protecting** all individuals from threats that are jeopardizing coho salmon. The only threat that ranked high in the Walker Creek waterhshed was:

- Livestock Farming and Ranching

Preventing the extinction of coho salmon

means **restoring** many key habitat attributes within the Walker Creek watershed that are in poor condition. The highest priorities for restoration are to:

- Improve spawning habitat
- Increase frequency of pool habitat
- Increase riparian shading to cool streams
- Improve flows
- Promote riparian vegetation conservation
- Reduce impacts to the streams from agriculture
- Increase the amount of large wood in and near streams
- Decrease the number of roads near streams and reduce the impacts of existing roads
- Eliminate sources of sediment and toxins

Advancing recovery of coho

salmon in Walker Creek requires these priority **recovery actions:**

- Develop site-specific recommendations, including incentives, to remedy high temperatures and implement (DFG 2004) initially in core areas, following with Phase 1 and 2 areas.
- Implement high priority coho salmon enhancement projects for the reduction of sediment delivery and the restoration of riparian corridors as listed in the Walker Creek Enhancement Plan
- Address water quality and nutrient loading issues by encouraging sustainable land management practices, controlling sediment sources, protecting riparian zones and employing BMPs that encourage permeability and infiltration
- Promote grazing and ranching practices that protect and restore CCC coho salmon habitats.

. . . in these **core areas:** Walker Creek are above Chileno Creek of the Lower Walker Creek planning watershed; Mainstem Walker Creek and Frink Canyon of the Upper Walker Creek planning watershed

Conservation Highlights

- Coho salmon from broodstock programs were released into the watershed
- Erosion control efforts are taking place to control sediment in the watershed
- Dairy and farming Best Management Practices have been developed and implemented in the Walker Creek Watershed

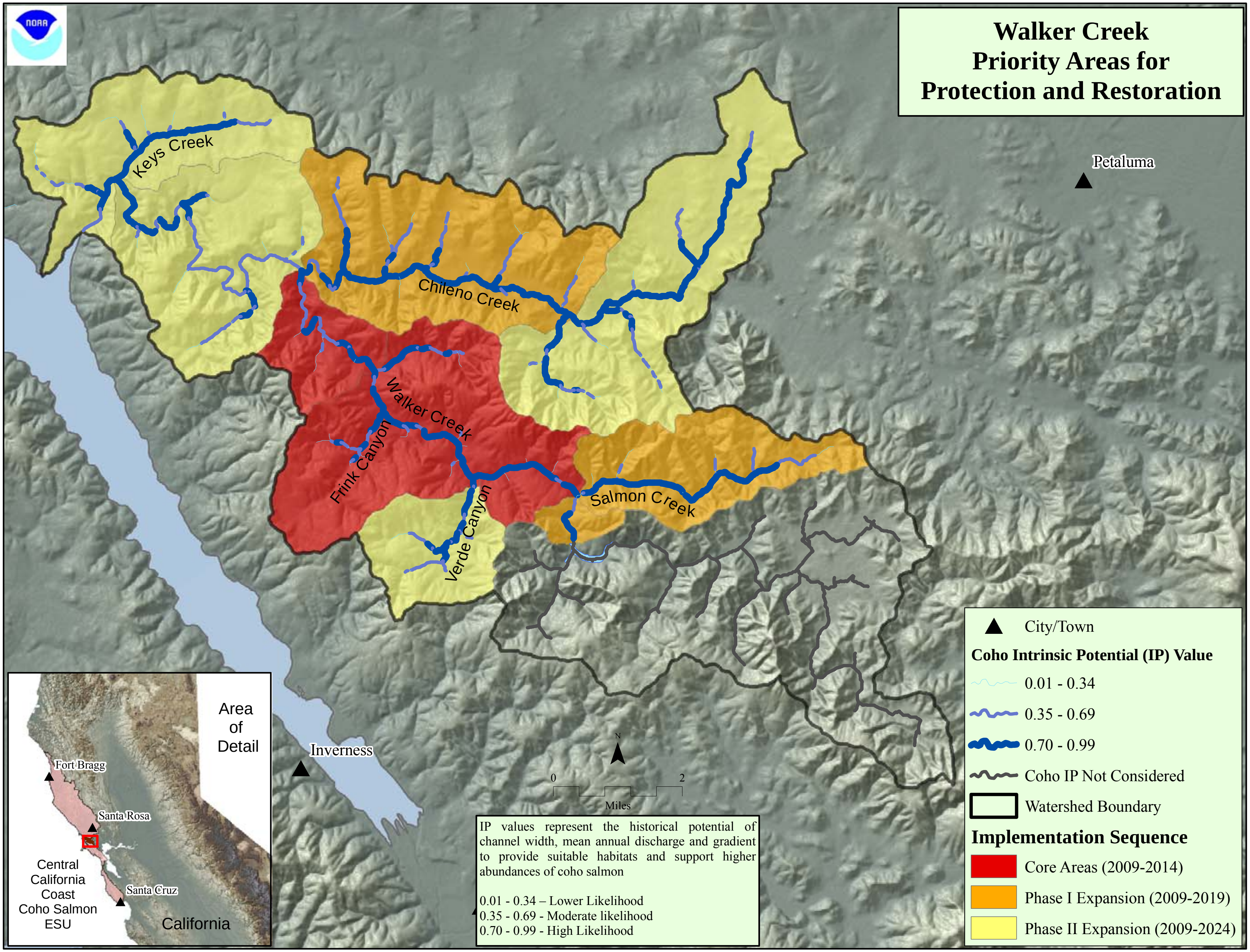
Streambank restoration on Walker Creek
Photo by Bob Coey, NMFS

Immediate Needs

√ Assess and prioritize sediment sources from road networks
√ Conduct landowner outreach to expand broodstock releases/monitoring
√ Explore passage above water diversions and dams

Recovery Partners

MMWD
Marin RCD
DFG
UCCE
Tomales Bay Watershed Council Private



Walker Creek
Priority Areas for
Protection and Restoration
Petaluma
Keys Creek
Chileno Creek
Walker Creek
Frink Canyon
Verde Canyon
Salmon Creek
Inverness
Area
of
Detail
Fort Bragg
Santa Rosa
Santa Cruz
Central
California
Coast
Coho Salmon
ESU
California
N
0
2
Miles
IP values represent the historical potential of channel width, mean annual discharge and gradient to provide suitable habitats and support higher abundances of coho salmon
0.01 - 0.34 – Lower Likelihood
0.35 - 0.69 - Moderate likelihood
0.70 - 0.99 - High Likelihood
City/Town
Coho Intrinsic Potential (IP) Value
0.01 - 0.34
0.35 - 0.69
0.70 - 0.99
Coho IP Not Considered
Watershed Boundary
Implementation Sequence
Core Areas (2009-2014)
Phase I Expansion (2009-2019)
Phase II Expansion (2009-2024)

CCC Coho Salmon
Walker Creek
CAP Viability Table Results

Analyst	Source	Result	Rating	Target	Habitat Attribute	Indicator	Poor	Fair	Good	Very Good
Flow Panel	Decision Matrix	42	Good	Spawning Adults	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	PSMFC Database	70%	Fair	Spawning Adults	Passage	Physical Barriers	<50% of IP-km	50-70% of IP-km	70-90% of IP-km	>90% of IP-km
NCWAP	Decision Matrix	>90 days	Very Good	Spawning Adults	Passage	Passage at Mouth	<30 days	30-60 days	60-90 days	>90 days
SEC	CDFG HAB 8	500-4900 m^2	Fair	Spawning Adults	Sediment	Amount of Gravel*	<500 m^2	500-4900 m^2	4900-9400 m^2	>9400 m^2
NMFS	Best Prof. judgment	<5%	Good	Spawning Adults	Viability	Freshwater Harvest	>10% of pop.	5-10%	<5%	
Flow Panel	Decision Matrix	58	Fair	Eggs	Hydrology	Instantaneous Condition	>75 (score)	51-75	35-50	<35
Flow Panel	Decision Matrix	58	Fair	Eggs	Hydrology	Redd Scour	>75 (score)	51-75	35-50	<35
SEC	Many Sources	NA	Poor	Eggs	Sediment	Gravel Quality	>17% 0.85mm and or >30% 6.3mm	15-17% 0.85	12-14% 0.85mm and or <30% 6.3mm	<12% 0.85
SEC	CDFG HAB 8	NA	NA	Eggs	Sediment	Gravel Quality (Embeddedness)	<25% of scores 1s&2s	25-50% of scores 1s&2s	>50% of scores 1s&2s	
Flow Panel	Decision Matrix	83	Poor	Summer Rearing	Hydrology	Baseflow	>75 (score)	51-75	35-50	<35
SEC	CDFG HAB 8	<60 avg. rating	Poor	Summer Rearing	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
SEC	CDFG HAB 8	<30% pools by length	Poor	Summer Rearing	Pool Habitat	Primary Pools	<30% pools by length	30-40%	40-50%	>50%
SEC/NMFS	Many Sources	NA	Poor	Summer Rearing	Water Quality	Temperature	>30% of IP > 17 C MWMT	Does not meet Good or Very Good	30-60% of IP < 15C MWMT	>60% of IP < 15C MWMT
SEC	CDFG HAB 8	Poor	Poor	Winter Rearing	Floodplain	Complex Habitat**	<50% Connected	50-80% connected	>80% connected	
NMFS	NCWAP	Fair	Fair	Smolts	Estuary	Estuary				
Flow Panel	Decision Matrix	58	Good	Smolts	Hydrology	Passage Flows	>75 (score)	51-75	35-50	<35
SEC	SWRCB	0.6/10 IP-km	Good	Smolts	Passage	# of Diversions**	>5 / 10 IP km	1.1-5	0.01-1	0
SEC	CDFG HAB 8	<60 avg. rating	Poor	Multiple Life Stages	Pool Habitat	Shelter Rating	<60 avg. rating	60-80	80-100	>100
NMFS	Best Prof. judgment	50-80%	Fair	Multiple Life Stages	Floodplain	Floodplain Connectivity	<50%	50-80%	>80%	not defined
NMFS	CDF CWHR	0%	Poor	Multiple Life Stages	Hydrology	Stand Age			>40 years old	
SEC	NLCDB	0.22%	Very Good	Multiple Life Stages	Hydrology	Impervious Surfaces	>12.01% of WS by area	7.01-12%	3.01-7%	0-3%
SEC	FMMP	33.38%	Poor	Multiple Life Stages	Land disturbance	Agriculture	>30% of WS by area	10-30%	0.1-10%	<0.1%
NMFS	CDF THP Dataset	10 - 25%	Good	Multiple Life Stages	Land disturbance	Timber Harvest	>35% of WS by area	25 - 35%	10 - 25%	<10%
SEC	Many Sources	0.2 / 100 m	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 0-10)	<4key pcs/100m	4-6/100m	6-11/100m	>11/100m
SEC	Best Prof. judgment	NA	Poor	Multiple Life Stages	Pool Habitat	LWD Freq. (BFW 10-100)	<1/100m	1-1.3/100m	1.3-4/100m	>4/100m
NMFS	CDF CWHR	<25%	Poor	Multiple Life Stages	Riparian Veg.	Species Composition	<25%	25-50%	>50%	Historical Conditions
NMFS	CDF CWHR	0%	Poor	Multiple Life Stages	Riparian Veg.	DBH	<39% Class 5 and 6	40-54%	55-69%	>69%
SEC	CDFG HAB 8	<60%	Poor	Multiple Life Stages	Riparian Veg.	Canopy Cover	<45 % avg. over IP-km	75-85%	85-95%	>95%
NMFS	CDF THP Dataset	1.3 mi/sq.mi.	Very Good	Multiple Life Stages	Sediment Transport	Road Density	>3 miles/sq. mile	3 to 2.5	2.5 to 1.6	<1.6
NMFS	CDF THP Dataset	3 mi/sq.mi.	Poor	Multiple Life Stages	Sediment Transport	Road density 100	>1 miles/sq. mile	1-0.5	0.5-0.1	<0.1
NMFS	Many Sources	Poor	Poor	Multiple Life Stages	Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No evidence of toxins or Contaminants
NMFS	Best Prof. judgment	<1 per IP-km	Poor	Spawning Adults	Viability	Adult Density	<1 per IP-km	1-20 per IP-km	20-40 per IP-km	>40 per IP-km
NMFS	Best Prof. judgment	< 0.2 fish/m^2	Poor	Summer Rearing	Viability	Juvenile Density	< 0.2 fish/m^2	0.2-0.5 fish/m^2	0.5-1.0 fish/m^2	>1.0 fish/m^2
NMFS	Best Prof. judgment	<20% IP-km occupied	Poor	Summer Rearing	Viability	Juvenile Distribution	<20% IP-km occupied	20-34%	35-50%	>50%

See Appendix C for a full description of the analysis methods for the Viability Table Reports

* = watershed specific numbers

** = Ratings defined by the distribution of results

Walker Creek Threats Across Targets		Spawning Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Multiple Life Stages			Overall Threat Rank
Project-specific threats		1	2	3	4	5	6	7	8	
1	Livestock Farming and Ranching	High	High	Very High	High	Medium	High			Very High
2	Droughts	Medium	Medium	High	Medium	Medium	Low			Medium
3	Roads and Railroads	Medium	Medium	Medium	Medium	Low	High			Medium
4	Channel Modification	Medium	Medium	Medium	Medium	Medium	Medium			Medium
5	Fire and Fuel Management	Medium	Medium	Medium	Medium	Medium	Medium			Medium
6	Agricultural Practices	Medium	Low	Medium	Medium	Medium	Medium			Medium
7	Climate Change	Medium	Medium	Medium	Medium	Medium	Low			Medium
8	Mining	Medium	Low	Medium	Medium	Medium	Medium			Medium
9	Recreational Areas and Activities	Medium	Low	Medium	Medium	Medium	Medium			Medium
10	Residential and Commercial Development	Medium	Low	Medium	Medium	Low	Medium			Medium
11	Storms and Flooding	Low	Medium	Medium	Medium	Low	Medium			Medium
12	Water Diversion and Impoundment	Medium	Medium	Medium	Medium	Low	Low			Medium
13	Disease, Predation, and Competition	Low	-	Medium	-	Medium	-			Medium
14	Logging and Wood Harvesting	Low	Low	Low	Medium	Low	Low			Low
15	Hatcheries and Aquaculture	Low	-	Medium	Low	Low	Low			Low
16	Fishing and Collecting	Low	-	-	Low	Low	-			Low
Threat Status for Targets and Project		High	High	Very High	High	High	High	-	-	Very High

Walker Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
WalC-A-1.1	Objective	Estuary	Support a coho salmon limiting factors assessment in Keys Estero and Tomales Bay (DFG 2004).	1	5	MMWD, Tomales Bay Watershed Council	4.00	4.00	4.00	4.00	4.00	20	
WalC-A-2.1	Objective	Floodplain	Improve over-winter survival by increasing the frequency and functionality of off-channel habitats.										
WalC-A-2.1.1	Recovery Action	Floodplain	Delineate reaches possessing both potential winter rearing habitat and floodplain areas.	2	5	Marin RCD, MMWD	10.00	10.00	10.00	10.00	10.00	50	
WalC-A-2.1.2	Recovery Action	Floodplain	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, or remove or setback levees, and use streamway concept where appropriate.										
WalC-A-2.1.2.1	Action Step	Floodplain	Support landowners and the Marin RCD in developing projects to improve channel conditions and restore natural channel geomorphology, including side channels and dense contiguous riparian vegetation (DFG 2004).	3	40	Marin County, MMWD, Tomales Bay Watershed Council						TBD	Cost cannot be determined due to unknown number of projects at various scales.
WalC-A-2.1.3	Recovery Action	Floodplain	Target habitat restoration and enhancement that will function between winter base flow and flood stage.										
WalC-A-2.1.3.1	Action Step	Floodplain	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	1	60	Marin County, MMWD, Tomales Bay Watershed Council						TBD	Need additional information on number of projects to make cost estimate.
WalC-A-2.1.4	Recovery Action	Floodplain	Encourage willing landowners to restore historical floodplains or offchannel habitats through conservation easements, etc.										
WalC-A-2.1.4.1	Action Step	Floodplain	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	2	40	MMWD	250	250	250	250	250	10,000	
WalC-A-3.1	Objective	Hydrology	Improve survival at all life stages by improving spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.										
WalC-A-3.1.1	Recovery Action	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for coho salmon.	2	10	CDFG, MMWD, NMFS	10.00	10.00	10.00	10.00	10.00	100	
WalC-A-3.1.2	Recovery Action	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use.										
WalC-A-3.1.2.1	Action Step	Hydrology	Continue to assess the release of water from Soulejule Reservoir to develop the optimum flow release for coho salmon (DFG 2004).	2	60	CDFG, MMWD, NMFS	1.67	1.67	1.67	1.67	1.67	100	
WalC-A-3.1.3	Recovery Action	Hydrology	Institutionalize programs to purchase easements on water rights to encourage the maintenance of surface flows.	2	10	CDFG, DWR, NMFS, RWQCB						TBD	
WalC-A-3.1.4	Recovery Action	Hydrology	Manage reservoirs and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	2	60	CDFG, MMWD, NMFS						TBD	
WalC-A-3.1.5	Recovery Action	Hydrology	Manage riparian areas for their site potential composition and structure.	3	60	Marin County, MMWD, Tomales Bay Watershed Council						TBD	
WalC-A-3.1.6	Recovery Action	Hydrology	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.										
WalC-A-3.1.6.1	Action Step	Hydrology	Monitor, identify problems, and prioritize needed changes to water diversion on current or potential coho streams that go dry in some years (DFG 2004).	2	60	MMWD, SPAWN						TBD	
WalC-A-3.1.6.2	Action Step	Hydrology	Promote, via technical assistance and/or regulatory action, the reduction of water use affecting the natural hydrograph, development of alternative water sources, and implementation of diversion regimes protective of the natural hydrograph.	2	30	Marin County, Marin RCD, MMWD						TBD	
WalC-A-3.1.6.3	Action Step	Hydrology	Promote off-channel storage to reduce impacts of water diversion (e.g. storage tanks for rural residential users).	1	30	Marin County, Marin RCD, MMWD						TBD	

Walker Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K)						Comments
							FY1	FY2	FY3	FY4	FY5	Entire Duration	
WalC-A-3.1.6.4	Action Step	Hydrology	Promote development of alternative water sources via technical assistance and/or regulatory actions.	2	30	Marin County, MMWD, RCD						TBD	
WalC-A-3.1.6.5	Action Step	Hydrology	Provide incentives to water rights holders willing to convert some or all of their water right to instream use via petition change of use and §1707 (DFG 2004).	2	10	DWR, NMFS, SWRCB						TBD	
WalC-A-3.1.7	Recovery Action	Hydrology	Work with SWRCB and landowners to improve passage flow regimes for adult migration to spawning habitats and smolt outmigration.	2	20	CDFG, DWR, Marin RCD, MMWD, RWQCB, SWRCB						TBD	
WalC-A-3.1.8	Recovery Action	Hydrology	To improve connectivity of surface flows with groundwater reduce aggradation and overall sediment load at the watershed scale by treating roads and sources of mass wasting.	3	10	Marin RCD						TBD	
WalC-A-5.1	Objective	Passage	Evaluate the feasibility of bypassing large dams (DFG 2004) in the watershed.										
WalC-A-5.1.1	Recovery Action	Passage	Develop strategies with MMWD to evaluate passage above Soulahoulie Reservoir	3	20	MMWD, NMFS						TBD	Evaluate truck and trap operations
WalC-A-6.1	Objective	Pool Habitat	Improve summer rearing, winter rearing, and smolt survival by increasing instream channel complexity in potential rearing and migration reaches. Additionally, improve egg survival by reducing redd scour in streams characterized by high bedload mobility.										
WalC-A-6.1.1	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
WalC-A-6.1.1.1	Action Step	Pool Habitat	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	3	10	Marin County	10.00	10.00	10.00	10.00	10.00	100	
WalC-A-6.1.2	Recovery Action	Pool Habitat	Identify historic CCC coho salmon habitats lacking in channel complexity, and promote restoration projects designed to create or restore complex habitat features that provide for localized pool scour, velocity refuge, and cover. Prioritize Core areas first followed by Phase I areas.										
WalC-A-6.1.2.1	Action Step	Pool Habitat	Install LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004).	1	10	Marin RCD, MMWD	100	100	100	100	100	1,000	
WalC-A-6.1.2.2	Action Step	Pool Habitat	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	2	60	Marin RCD, MMWD						TBD	
WalC-A-6.1.2.3	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	20	Marin RCD, MMWD						TBD	
WalC-A-6.1.3	Recovery Action	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	1	60	Marin RCD, MMWD						TBD	
WalC-A-6.1.4	Recovery Action	Pool Habitat	Promote bio-engineering solutions as appropriate (e.g. except where critical infrastructure is located) for bank hardening projects.	3	60	Marin County, MMWD						TBD	
WalC-A-7.1	Objective	Riparian Vegetation	Restore and enhance riparian structure and function in the Walker Creek watershed.										
WalC-A-7.1.1	Recovery Action	Riparian Vegetation	Encourage programs to purchase land/conservation easements to re-establish and enhance natural riparian communities.	2	10	Marin RCD, MMWD	50.00	50.00	50.00	50.00	50.00	500	
WalC-A-7.1.2	Recovery Action	Riparian Vegetation	Improve riparian and instream conditions in rearing habitats by establishing riparian protection zones that extend the distance of a site potential tree height from the outer edge of a channel.	2	20	Marin RCD, MMWD	750	750	750	750	750	15,000	
WalC-A-7.2	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-6.1.2	Recovery Action	Pool Habitat	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.										
SaC-CCC-6.1.2.1	Action Step	Pool Habitat	Allow trees in riparian areas to age, die, and recruit into the stream naturally.	3	60	CDFG, Gold Ridge RCD						tbd	
SaC-CCC-6.1.2.2	Action Step	Pool Habitat	Encourage landowners to implement restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	60	CDFG, Gold Ridge RCD						tbd	
SaC-CCC-6.1.2.3	Action Step	Pool Habitat	Continue to study the effects of LWD placement and subsequent sheltered pool formation and monitor response of summer and winter rearing juvenile use.	3	5	CDFG						tbd	
SaC-CCC-6.1.3	Recovery Action	Pool Habitat	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (DFG 2004).	2	60	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-6.1.4	Recovery Action	Pool Habitat	Install LWD, boulders, and other instream features to increase habitat complexity and improve pool frequency and depth (DFG 2004).										
SaC-CCC-6.1.4.1	Action Step	Pool Habitat	Where feasible, design and engineer pool enhancement structures to increase the number of pools (Gold Ridge Resource Conservation District & Prunuske Chatham, Inc., 2007; DFG 2004).	3	60	CDFG, Gold Ridge RCD, NOAA RC						tbd	
SaC-CCC-7.1	Objective	Riparian Vegetation	Improve the structure and composition of riparian areas to provide shade, large woody debris input, nutrient input, bank stabilization, and other CCC coho salmon needs.										
SaC-CCC-7.1.1	Recovery Action	Riparian Vegetation	Increase the canopy along Salmon Creek by planting a succession of native riparian vegetation where shade canopy is not at acceptable levels. Non-anadromous reaches should also be assessed for revegetation as water temperatures throughout are affected from upstream (Gold Ridge Resource Conservation District & Prunuske Chatham, Inc., 2007; DFG 2004).										
SaC-CCC-7.1.1.1	Action Step	Riparian Vegetation	Encourage the cultivation and availability of locally indigenous riparian plants for use in restoration and bank stabilization (DFG 2004)	2	60	CDFG, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners						tbd	
SaC-CCC-7.1.2	Recovery Action	Riparian Vegetation	Support landowners and the RCD to restore riparian zones and manage livestock to increase stream protection and soil retention (Gold Ridge Resource Conservation District & Prunuske Chatham, Inc., 2007; DFG 2004).	3	20	Gold Ridge RCD, Private Consultants, Private Landowners						TBD	
SaC-CCC-7.1.3	Recovery Action	Riparian Vegetation	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (DFG 2004).	3	5	Gold Ridge RCD, Private Consultants, Private Landowners	40.00	40.00	40.00	40.00	40.00	200	
SaC-CCC-7.1.4	Recovery Action	Riparian Vegetation	Promote bio-engineering solutions as appropriate (e.g. where critical infrastructure is located) for bank hardening projects.	3	20	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-7.1.5	Recovery Action	Riparian Vegetation	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (DFG 2004).	2	20	CDFG, Gold Ridge RCD, NMFS, NRCS, Private Consultants, Private Landowners, USFWS						TBD	

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-7.1.6	Recovery Action	Riparian Vegetation	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	20	California Coastal Conservancy, CDFG, Sonoma County						tbd	
SaC-CCC-7.1.7	Recovery Action	Riparian Vegetation	Manage riparian areas for their site potential composition and structure.	2	30	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners, Sonoma County						TBD	
SaC-CCC-8.1	Objective	Sediment	Improve habitat conditions at multiple life stages by reducing sediment inputs to the stream at the watershed scale.										
SaC-CCC-8.1.1	Recovery Action	Sediment	Continue to implement erosion control projects that were assessed and inventoried in sediment assessment plans (DFG 2004).	3	60	Gold Ridge RCD, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-8.1.2	Recovery Action	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.	3	60	Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-8.1.3	Recovery Action	Sediment	Address sources from slides and gullies that deliver sediment and runoff to stream channels.	3	20	Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-9.1	Objective	Viability	Re-establish a naturally reproducing run of coho salmon in appropriate subwatersheds.										
SaC-CCC-9.1.1	Recovery Action	Viability	Continue the operation of the Captive Broodstock Program in Salmon Creek.										
SaC-CCC-9.1.1.1	Action Step	Viability	Fund monitoring actions in Salmon Creek to evaluate success of adult reintroductions towards salmon recovery.	1	10	CDFG						TBD	
SaC-CCC-9.1.1.2	Action Step	Viability	Conduct outreach with landowners to expand broodstock releases within core areas, and remaining extirpated streams within the watershed.	1	2	Gold Ridge RCD						TBD	
SaC-CCC-9.1.2	Recovery Action	Viability	Minimize departure from the genetic profile that historically existed in the population.										
SaC-CCC-9.1.2.1	Action Step	Viability	Evaluate recent adult stocking efforts to guide adult spawner release sources.	2	5	NOAA SWFSC						TBD	
SaC-CCC-9.1.2.2	Action Step	Viability	Annually capture or retain (during rescue efforts) - small numbers of surplus fish from drying streams/habitats in Marin and Sonoma Counties for purposes of broodstock in Russian River, Walker and Salmon Creeks.	1	10	CDFG						tbd	
SaC-CCC-9.1.2.3	Action Step	Viability	Use surplus broodstock to repopulate remaining extirpated streams within the watershed.	1	10	CDFG, NMFS						tbd	
SaC-CCC-9.1.3	Recovery Action	Viability	Continue to rescue juvenile coho salmon with existing permittees that are under an imminent risk of stranding and mortality and relocate to suitable habitat when deemed appropriate by NMFS and CDFG	1	10	CDFG, Gold Ridge RCD, NMFS, Trout Unlimited							Existing operations
SaC-CCC-9.2	Objective	Viability	Conduct periodic, standardized spawning surveys to estimate adult abundance in the watershed. Surveys should include all three cohorts.	1	20	CDFG, Gold Ridge RCD, NMFS	200	200	200	200	200	4,000	
SaC-CCC-9.3	Objective	Viability	Conduct periodic, standardized smolt outmigration surveys to estimate smolt abundance in the watershed. Surveys should occur during the same period as adult spawning surveys.	2	20	CDFG, Gold Ridge RCD, NMFS	400	400	400	400	400	8,000	
SaC-CCC-9.4	Objective	Viability	Monitor the effectiveness and maintenance of watershed restoration projects and augment inventories as needed (DFG 2004).	2	20	CDFG, Gold Ridge RCD, NMFS	50.00	50.00	50.00	50.00	50.00	1,000	

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-10.1	Objective	Water Quality	Assess the water temperature regime during the summer season for three to five years to determine the role of water temperature as a limiting factor in coho salmon production (DFG 2004).	2	5	Gold Ridge RCD, Private Consultants, Private Landowners	60.00	60.00	60.00	60.00	60.00	300	
SaC-CCC-10.2	Objective	Water Quality	Improve summer rearing survival by reducing instream temperatures in potential rearing reaches. See also strategies for restoring and enhancing riparian vegetation.										
SaC-CCC-10.2.1	Recovery Action	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC coho salmon in specific streams (DFG 2004).										
SaC-CCC-10.2.1.1	Action Step	Water Quality	Plant native vegetation to promote streamside shade.	3	20	Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Sonoma County						TBD	
SaC-CCC-12.1	Objective	Channel Modification	Restore or minimize impacts to watershed processes (e.g., riparian, sediment transport, hydrology and estuary function).										
SaC-CCC-12.1.1	Recovery Action	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.										
SaC-CCC-12.1.1.1	Action Step	Channel Modification	Evaluate whether proposed stabilization projects will lead to additional instability either up- or downstream.	2	10	CalTrans, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Public, Sonoma County						TBD	Costs may vary significantly depending on level of commitment from local government and private landowners. The majority of the costs would likely include local government and consultant staff time.
SaC-CCC-12.1.1.2	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	2	10	CalTrans, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Public, Sonoma County						TBD	Costs may vary significantly depending on level of commitment from local government and private landowners. The majority of the costs would likely include local government and consultant staff time.
SaC-CCC-12.1.1.3	Action Step	Channel Modification	Where feasible, remove obsolete bank stabilization structures from the channel which contribute to channel incision and reduced habitat complexity.	2	10	CalTrans, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Public, Sonoma County						TBD	Costs may vary significantly depending on level of commitment from local government and private landowners. The majority of the costs would likely include local government and consultant staff time.
SaC-CCC-12.1.2	Recovery Action	Channel Modification	Develop a mitigation policy that requires in-kind replacement of removed large woody debris at a 3:1 ratio.	2	10	CalTrans, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Consultants, Private Landowners, Public, Sonoma County						TBD	Costs may vary significantly depending on level of commitment from local government and private landowners. The majority of the costs would likely include local government and consultant staff time.
SaC-CCC-15.1	Objective	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.										

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-15.1.1	Recovery Action	Droughts	Work with land owners or public agencies to acquire water that would be utilized to minimize effects of droughts.	2	20	, Gold Ridge RCD, Private Landowners, Sonoma County						TBD	
SaC-CCC-15.1.2	Recovery Action	Droughts	Work with DFG, County of Sonoma, State Parks, municipalities, and knowledgeable biologists to develop emergency rules and adopt implementation agreements.	1	20	, Cities, Sonoma County, State Parks						TBD	
SaC-CCC-15.2	Objective	Droughts	Minimize water use and seek alternatives during droughts.	1	20	, Cities, Private Landowners, Sonoma County						TBD	
SaC-CCC-19.1	Objective	Livestock Farming and Ranching	Reduce the adverse effects of grazing and ranching to water quality.										
SaC-CCC-19.1.1	Recovery Action	Livestock Farming and Ranching	Support grazing practices that minimize impacts to riparian and instream habitat: livestock exclusion, rotational grazing, etc.										
SaC-CCC-19.1.1.1	Action Step	Livestock Farming and Ranching	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take priority for riparian fencing programs over steer operations.	2	20	Farm Bureau, Gold Ridge RCD, NRCS						TBD	
SaC-CCC-19.1.1.2	Action Step	Livestock Farming and Ranching	To minimize gully initiation, grazing should be kept at relatively low intensities on the steeper slopes in this area.	2	60	Farm Bureau, Gold Ridge RCD, Private Landowners, Sonoma County						TBD	
SaC-CCC-19.1.1.3	Action Step	Livestock Farming and Ranching	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	20	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners						TBD	
SaC-CCC-19.1.2	Recovery Action	Livestock Farming and Ranching	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	20	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners						TBD	
SaC-CCC-19.2	Objective	Livestock Farming and Ranching	Locate water sources away from riparian areas.										
SaC-CCC-19.2.1	Recovery Action	Livestock Farming and Ranching	Encourage riparian restoration to regain riparian corridors damaged from livestock and other causes.	2	30	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners						TBD	
SaC-CCC-19.2.2	Recovery Action	Livestock Farming and Ranching	Increase the use of water storage and catchment systems that collect rainwater in the winter for use during the dry summer and fall seasons.	2	30	Farm Bureau, Gold Ridge RCD, NRCS, Private Landowners						TBD	
SaC-CCC-24.1	Objective	Roads and Railroads	Reduce road densities by 10 percent over the next 10 years, prioritizing high risk areas in historical habitats or Core CCC coho salmon watersheds.	2	20	, Private Landowners, Sonoma County						TBD	This is the only road parameter that received a high or very high threat (density of roads in riparian zone)
SaC-CCC-25.1	Objective	Storms and Flooding	Conduct outreach and education regarding how local, city, county, State and Federal planning can put in place mechanisms that provide community resiliency to storms and flooding.										
SaC-CCC-25.1.1	Recovery Action	Storms and Flooding	Agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow “emergencies”.	1	20	Cities, FEMA, Sonoma County, Water Agencies						TBD	
SaC-CCC-25.1.2	Recovery Action	Storms and Flooding	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	2	60	Bodega Land Trust, CalFire, Farm Bureau, FEMA, FishNet 4C, Gold Ridge RCD, NRCS, Private Landowners, RWQCB						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have roads addressed.

Salmon Creek (Coastal) Threats and Associated Recovery Actions

Recovery Strategy Number	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partners	Costs ($K) FY1	FY2	FY3	FY4	FY5	Entire Duration	Comments
SaC-CCC-25.1.3	Recovery Action	Storms and Flooding	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	5	CDFG, FEMA, FishNet 4C, Gold Ridge RCD, NMFS, NRCS, Sonoma County, USACE, USFWS	4.00	4.00	4.00	4.00	4.00	20	Existing documents and policies can be used for this recommendation. Costs would increase if a number of site specific conditions and criteria are developed.
SaC-CCC-25.1.4	Recovery Action	Storms and Flooding	Patterns of water runoff, including surface and subsurface drainage, should match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	1	60	CalFire, CalTrans, FEMA, Gold Ridge RCD, RWQCB, San Mateo RCD, Sonoma County, USACE						TBD	Costs will vary significantly depending on site specific conditions and landowner willingness to have roads and other infrastructure addressed to improve hydrologic function. As a general recommendation for future development cost may vary depending on existing infrastructure and site specific conditions.
SaC-CCC-25.1.5	Recovery Action	Storms and Flooding	Work with local governments to incorporate protection of CCC coho salmon in any flood management activity (DFG 2004).	2	10	CDFG, Cities, FEMA, Gold Ridge RCD, NMFS, Sonoma County, USACE						0	Outreach and education are ongoing, and additional costs are expected to be minimal.
SaC-CCC-26.1	Objective	Water Diversion and Impoundment	Improve current laws and policies to control diversions and water use in order to maintain and restore surface flows.	1	Ongoing	CDFG, NMFS, RWQCB, SWRCB						TBD	
SaC-CCC-26.2	Objective	Water Diversion and Impoundment	Promote water conservation by the public, water agencies, agriculture, private industry, and the citizenry.										
SaC-CCC-26.2.1	Recovery Action	Water Diversion and Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	2	5	CDFG, Gold Ridge RCD, Private Landowners, RWQCB, Sonoma County						TBD	
SaC-CCC-26.2.2	Recovery Action	Water Diversion and Impoundment	Promote the use of reclaimed water for agricultural or other uses.	2	10	Gold Ridge RCD, Private Landowners, RWQCB, Sonoma County, Sonoma County Water Agency						TBD	
SaC-CCC-26.3	Objective	Water Diversion and Impoundment	Develop new policies and regulations and or enforce existing policies and regulations to provide suitable flow conditions for CCC coho salmon.										
SaC-CCC-26.3.1	Recovery Action	Water Diversion and Impoundment	Avoid and/or minimize the adverse effects of water diversion on CCC coho salmon.										
SaC-CCC-26.3.1.1	Action Step	Water Diversion and Impoundment	Determine and monitor 1600 program compliance related to water diversions (DFG 2004).	2	5	CDFG Law Enforcement, NMFS OLE, SWRCB						TBD	
SaC-CCC-26.3.1.2	Action Step	Water Diversion and Impoundment	Develop and implement regulations for groundwater use.	2	5	RWQCB, Sonoma County, SWRCB						TBD	

CHAPTER 11: MONITORING

"It is imperative that California, which is well behind other states in the Pacific Northwest, begin conducting monitoring at spatial scales relevant to recovery planning if we are to have any hope of accurately evaluating status and progress towards recovery."

Spence et al. 2008

INTRODUCTION

The purpose of this chapter is to describe coho recovery monitoring necessary to evaluate all viable salmonid population (VSP) criteria (McElhany *et al.* 2000) and associated listing factors and threats (Crawford and Rumsey 2009) in relation to recovery criteria for the CCC coho salmon ESU described in Chapter 9. Implementation of this recovery plan will require monitoring to determine with scientific certainty that recovery actions identified herein are working to improve coho salmon populations, their habitats, and that limiting factors and threats to survival are diminishing. Because of the length and complexity of the coho salmon's life cycle and the diversity of environments they occupy, there are many uncertainties regarding the effectiveness of management prescriptions for improving production, survival, and habitat and reducing threats. Identifying relationships between management actions and salmonid responses are challenging scientific questions. It is important monitoring is directed at answering basic questions regarding assessment methods, responses, progress, success, failure, additional data needs, and evaluation methods. Including an adaptive management component will allow NMFS, as well as others, to learn from past experiences through experimentation via altering actions based on measured effectiveness, a basic tenant of science. Finally, all monitoring data must be coordinated in a regional set of databases or distributed data system using a common set of metadata and data dictionaries that fits within an integrated master sample program (Crawford and Rumsey 2009).

> "Given the imperiled nature of coho…in California it is critical that coastwide instream monitoring programs be implemented and maintained to allow warning of impending problems to these valuable resources. Without the existing minimal monitoring effort, since coho are not commercially fished or regulated, there would be little notice of their decline."
>
> *MacFarlane et al. 2008, in draft*

Existing adult coho salmon escapement monitoring programs in the CCC coho salmon ESU are currently inadequate to estimate VSP criteria with any statistical certainty for the management purposes of: (1) providing a sound basis for assessing recovery of listed populations; and (2) monitoring the success of restoration programs. Similarly, spatial pattern, diversity, and limiting factor and threat (including habitat status and trend) monitoring efforts are either inadequate or nonexistent. Recently, NMFS published the draft "Guidelines for Monitoring Recovery of Pacific Northwest Salmon and Steelhead" in Idaho, Oregon, and Washington (Crawford and Rumsey 2009). The authors make recommendations for data collection and reporting, monitoring VSP status and trends, and monitoring listing factors and threats (including habitat status and trends, hatchery, harvest, and regulatory actions). In this chapter these guidelines are incorporated with ongoing efforts to develop and implement a coast wide salmonid monitoring program in California (Boydstun and McDonald 2005, Adams *et al.* in review) to identify high priority monitoring needs specific to the CCC coho salmon ESU.

MONITORING CCC COHO SALMON ESU VSP STATUS AND TRENDS

VSP Adult Spawner Abundance

The most important metric for population viability criteria is spawner abundance over multiple generations. Systematic and comprehensive long-term monitoring of adult CCC coho salmon is critical and immediate initiation of monitoring consistently across the ESU is imperative for recovery. Currently there is not a coordinated statewide long-term monitoring program and this has significant adverse ramifications to our ability to evaluate the status and trends of populations within the ESU. Only a few organizations are conducting some level of adult monitoring and, while it provides valuable information for specific watersheds, these efforts are insufficient to track the status of populations and recovery goals across the ESU. These efforts need integration with a cohesive master sample design. Boydstun and McDonald (2005) and Adams *et al.* (in review) recommend a two-stage sampling approach for monitoring the status and trends of California's coastal salmonids at evolutionarily significant regional spatial scales that can also be decomposed to provide population level estimates. First stage sampling is comprised of extensive regional spawning surveys to estimate escapement from redd counts collected in stream reaches selected under a Generalized Random Tessellation Sampling (GRTS, Larsen *et al*. 2008) rotating panel design at a survey level of 10 percent of available habitat each year. Second stage sampling consists of producing escapement estimates in intensively monitored census streams (also called Life Cycle Monitoring stations) through either total fish counts of returning adults or capture-recapture studies. The second stage estimates are considered to represent true adult escapement and resulting spawner to redd ratios are used to calibrate first stage estimates of regional adult abundance (Gallagher and Wright 2008). The Life Cycle Monitoring stations are places where smolt and summer rearing abundance are monitored to estimate freshwater and marine survival and to evaluate life histories which help with interpreting regional status and trend information (the stage one data). These streams are also intended to be focal points for evaluating restoration and encouraging further research. The NMFS monitoring guidelines (Crawford and Rumsey 2009) recommend using a robust unbiased spawner abundance sampling scheme that has known precision and accuracy. Similar to Adams *et al.* (in review) they offer probabilistic sampling of all accessible spawning areas using unbiased randomized sites (GRTS) with rotating panels as an option that will produce statistically valid estimates of spawner abundance with known certainty. Monitoring needs and recommendations presented below draw heavily on NMFS's "Guidelines for Monitoring Recovery of Pacific Northwest Salmon and Steelhead" (Crawford and Rumsey 2009).

Adult CCC coho salmon males collected at the Pudding Creek weir Life Cycle Monitoring station, Fort Bragg, California. Pudding Creek maintains one of the stronger remaining runs of coho salmon in the ESU. The lifecycle station is a cooperative effort between Hawthorne Timber Company (HTC) and DFG (partially funded by the Fisheries Restoration Grants Program) and is an important source of information regarding adult coho salmon returns. (Photos courtesy of David Wright – HTC)

1. Implement, as soon as possible, an unbiased two stage GRTS based ESU-wide monitoring program of adult CCC coho salmon that has known precision and accuracy. Monitoring should include:

    a. Yearly adult spawner abundance estimates for the entire ESU, for each diversity stratum, and where possibly for each population identified in Table 8 and 9 of Chapter 5 that incorporates existing monitoring into a master sample GRTS design;

    b. Establish (at a minimum one or preferably two) Life Cycle Monitoring streams in each diversity stratum, and maintain current lifecycle stations in Lagunitas Creek in Marin County, Pudding Creek in Mendocino County, and Scott Creek in Santa Cruz County to estimate spawner: redd ratios for calibrating regional redd counts and adults in/smolts out for estimating survival- these streams may also serve as intensively monitored watersheds for evaluating restoration actions;

    c. Strive to have ESU level adult spawner data with a coefficient of variation (CV) on average of 15% or less;

    d. Regional spawner data should have the statistical power to detect a change of ± 30% with 80% certainty within 10 years;

    e. Strive to have abundance estimates at the Life Cycle Monitoring stations with CV on average of 15% or less;

f. Estimate migration rates between basins and tributaries of larger basins to validate assumptions that underlie population delineations and to assess potential role of interbasin exchange on extinction probabilities;

g. Evaluate hatchery impacts and hatchery wild ratios (this should cover a range of issues from genetic changes to brood stock mining) and implement hatchery recommendations per Spence *et al.* 2008; and

h. Monitoring should utilize the protocols published in the American Fisheries Society Salmonid Field Protocols Handbook (Johnson et al. 2007).

VSP Productivity

1. Develop a 12 year or greater data set of accurate spawner information to estimate geometric mean recruits per spawner and evaluate population trends.

2. Implement yearly smolt abundance monitoring in at least one significant population in each diversity strata. The Life Cycle Monitoring stations should cover this requirement.

    a. Juvenile monitoring should strive to have data with a CV on average of 15 percent or less;

    b. Power analysis for each monitored juvenile population should be conducted to determine the statistical power of the data to detect significant changes in abundance; and

    c. Estimate apparent marine and fresh water survival (couple adult data with the smolt abundance estimates).

VSP Spatial Distribution

1. Determine the spatial distribution of coho salmon in the CCC ESU with the ability to detect a change of ≥ 15 percent with 80 percent certainty. Follow Boydstun and McDonald (2005) and Adams *et al.* (in review) to develop and implement, as soon as possible, randomized probabilistic (GRTS) summer and fall snorkel survey sampling of juvenile coho salmon within the ESU.

2. Evaluate changes in adult spawning areas using probabilistic sampling.

VSP Diversity

1. Monitor status and trends of spawn timing, sex ratio, age distribution, fecundity, and etc. (see Adams *et al.* in review) at one Life Cycling Monitoring Stream per diversity strata and within and among diversity strata.

2. Develop a genetic baseline of DNA micro satellite markers for each population in the ESU.

MONITORING CCC COHO SALMON LISTING FACTORS AND THREATS

1. Develop and implement a GRTS based habitat status and trend monitoring program which is coordinated with the juvenile spatial structure evaluations and the Life Cycle Monitoring stations.

    a. Develop a standardized survey methodology for evaluating habitat attributes;

    b. Integrate ongoing habitat assessment work into a master GRTS sample design;

    c. Incorporate consistent habitat monitoring protocols that provide comparable watershed information; and

    d. Develop and employ suitable habitat assessment criteria and models that provide high level indicators of watershed conditions.

2. Wherever possible, habitat restoration activities should have both an implementation and an effectiveness monitoring component. Work in Life Cycle Monitoring stations and intensively monitored watersheds should also incorporate validation monitoring.

    a. Restoration efforts should be reported and correlated with habitat limiting factors so cumulative impacts can be tracked within the ESU;

    b. Reach scale effectiveness monitoring should be conducted following the Before After Control Impact (BACI) design;

    c. Habitat restoration in the Life Cycle Monitoring stations should follow the BACI design, have enough of the watershed treated and monitored to effect a detectable change in fish abundance, occur in streams with all life stages of coho salmon, and occur in proximity to similar sized watersheds that can serve as controls; and

    d. Establish at least one Intensively Monitored Watershed (as detailed in Crawford and Rumsey 2009) within the ESU. Conduct power analysis early in development to determine amount of watershed required to be treated necessary to detect 30-50 percent change in fish response.

3. Currently no monitoring program exists that tracks freshwater harvest or ocean bycatch. NMFS recommends the California Fish and Game commission, in collaboration with NMFS, devise an appropriate mechanism for tracking.

4. Water quality monitoring relevant to salmonids is recommended as part of recovery monitoring.

5. To assess adequacy of regulatory actions implement a recovery plan tracking system to document if local and State agencies have implemented actions proposed in this recovery plan.

6. Climate change is a significant potential threat and monitoring the effects of this on coho salmon should include changes in stream flow and temperature and their effects on fresh water survival.

DATA MANAGEMENT AND REPORTING

1. All monitoring data must be coordinated in a regional set of databases or distributed data system using a common set of metadata and data dictionaries that fits within an integrated master sample program. This should be should be housed and maintained in one place by one entity.

2. All entities collecting habitat and fish monitoring data should coordinate their sampling and data collection to fit into a master sample program for the CCC coho salmon ESU.

COSTS ESTIMATES

Regional spawning ground surveys cost about $ 3,000 to survey one reach a sufficient number of times each season to generate reliable redd counts (Gallagher and Wright 2008). There are 339 0.1km to 3.9km reaches encompassing 834 km of spawning habitat in coastal Mendocino County from Usal Creek in the North to Schooner Gulch in the South (S. Gallagher unpublished). Tables 8 and 9 in Chapter 5 indicate there are 827 IP/km in this area and a total of 2398 IP/km in the CCC coho salmon ESU. A 10% sample of 3 km reaches in the ESU would result in a sample draw of approximately 80 reaches at an annual cost of ~$240,000, not including data storage and report preparation. Adult monitoring at the Pudding Creek Life Cycle Monitoring station in Mendocino County costs about $36,000 per year (Gallagher and Wright 2008). This estimate does not include smolt or summer rearing abundance estimates nor does it include data analysis and reporting. It costs about $15,000 per year to conduct the juvenile monitoring in Pudding Creek for an approximate grand total of $51,000 per Life Cycle Station. One Life Cycle Station per recovery domain comes out to at least $204,000 per year. Note that this estimate is based on Pudding Creek, a small stream classified as having a dependent coho salmon population. To conduct life cycle monitoring in the nearby Ten Mile River (a functionally independent population) would be more difficult and much more expensive due to the lack of infrastructure and the larger size of the river. Juvenile spatial structure and habitat monitoring likely will run about $1,000 per reach. There is a great deal more juvenile habitat than spawning habitat, perhaps twice as much, thus an annual sample of 160 reaches might cost about $160,000 per year. This estimate does not include data analysis, storage, or report preparation. Sample size and reach variance issues will have to be developed for juvenile spatial structure and habitat monitoring. Determining actual costs of this monitoring could be part of this evaluation and will need to include cost estimates for evaluating restoration actions, implementing a recovery tracking system, and for developing and maintaining a coordinated data management system. Finally, monitoring the recovery of coho salmon in the CCC ESU will require continuing evaluation of costs, dedicated funding, and a long term commitment of resources by all involved parties.

CHAPTER 12: IMPLEMENTATION & COSTS

"Recovery plans and the threats assessment process will provide the guide map for priority setting. Once recovery plans are in place, species protection and conservation will be facilitated by ongoing use of the plans to guide policy and decision-making. The Division will refocus its priorities from a project-by-project approach to one that focuses efforts on those activities or areas that have biologically significant beneficial or adverse impacts on species and ecosystem recovery."

NMFS SWR PRD Strategic Plan for 2007-2011 (NMFS 2006)

INTEGRATING RECOVERY INTO NMFS ACTIONS

It is a worthy challenge to reverse the path of a species away from extinction and toward recovery. This will require fundamental changes in long-standing polices and practices both within NMFS and other management agencies, as well as with private landowners, professional organizations, communities, and individuals. These changes can only be accomplished with effective outreach and education, strong partnerships, focused recovery strategies and solution-oriented thinking that can shift agency and societal attitudes, practices and understanding.

To promote species and ecosystem conservation, NMFS must approach species conservation more strategically. NMFS will become a more proactive and effective force for conservation by focusing priorities toward those activities and areas that have biologically significant impacts. NMFS will incorporate recovery goals and actions into all of the programs and critical habitat designations under ESA section 4, ESA consultations under section 7, and permit actions under ESA section 10. NMFS will institutionalize the recovery plan goals and take every opportunity to incorporate them in daily efforts and decision-making.

Implementation of the recovery plan by NMFS will take many forms. The PRD Strategic Plan (NMFS 2006; Appendix G) describes both general and specific ways NMFS will implement the recovery plan. The Recovery Planning Guidance (NMFS 2007) also outlines how NMFS will cooperate with other agencies on plan implementation. These documents, in addition to the ESA, will be used by NMFS to set the framework and environment for plan implementation.

NMFS actions to promote and implement recovery planning shall include:

- ❑ Formalizing recovery planning goals on a program-wide basis to prioritize work load allocation and decision-making, including developing mechanisms to promote implementation (*e.g.*, restoration);

- Aligning regulatory requirements (*e.g.*, section 7 consultations, critical habitat designations, and 4(d) rules) with recovery actions;
- Promoting rapid implementation of existing restoration plans and recovery actions, particularly those directed toward Core Areas;
- Conducting an outreach and education program;
- Facilitating a consistent framework for research, monitoring, and adaptive management that directly informs recovery objectives and goals; and
- Establishing an implementation tracking system that is adaptive and pertinent to annual reporting for the Government Performance and Results Act, Bi-Annual Recovery Reports to Congress, and 5-Year Reviews of each species listing status.

Working with Constituents

Successful implementation of this recovery plan will require the efforts and resources of many entities, from Federal agencies to individual members of the public. NMFS' efforts must be as far-reaching as the issues adversely affecting the species, extending beyond the direct regulatory jurisdiction of NMFS. NMFS commits to working cooperatively with other individuals and agencies to implement recovery actions and to encourage other Federal agencies to implement actions where they have responsibility, initiative, or authority. To achieve recovery, NMFS will promote the recovery plan and provide technical information and assistance to other entities that implement actions that may impact the species' recovery. For example, NMFS will work with partners on high priorities such as facilitating revisions to the water rights process, formalizing California Forest Practice Rules so they adequately protect salmonids, and working with counties (particularly Mendocino and Santa Cruz) to ensure protective measures are included in their General Plans for the highest priority areas.

Beyond NMFS' statutory authorities and obligations, we are engaged in significant outreach efforts to various constituencies to provide technical assistance regarding listed salmonids, their habitat needs, and various life history requirements. Most of the land in the CCC coho salmon domain is privately owned. Section 7 has limited reach on these private lands. Therefore, developing partnerships through providing technical assistance is critical for recovery implementation. NMFS will focus outreach and assistance efforts in key areas critical for recovery through the following actions:

- Work with the counties of Mendocino, Sonoma, Marin, San Mateo, and Santa Cruz to recommend county planning and policies protective of coho salmon through FishNet 4C as well as with the individual counties;

- Continue working with Natural Resources Conservation Service, Resource Conservation Districts, and the Frost Protection Task Force to improve agricultural practices and land use practices of rural residential landowners;

- Encourage Smart Growth policies and provide outreach and education to urban planners and builders. Encourage planning that accounts for natural events such as droughts, storms, flooding, and climate change;

- ❑ Prioritize cooperation and assistance to landowners (including permitting assistance) proposing activities or programs designed to achieve recovery objectives;
- ❑ Establish policies and compliance that preserve and protect stream flows required by all freshwater life stages of coho salmon;
- ❑ Develop and distribute no-take guidelines for land use practices and other activities that may take or harm CCC coho salmon;
- ❑ Assemble a NMFS Water Rights Team that works with the DFG and SWRCB to focus on restoring and maintaining natural streamflow regimes across the ESU;
- ❑ Review select timber harvest plans (THPs) in Core watersheds to evaluate potential impacts to coho salmon, giving top priority to THPs associated with forest conversion;
- ❑ Work to acquire funding and staff for full enforcement of existing protective laws, codes, regulations and ordinances across the CCC coho salmon ESU; and
- ❑ Develop outreach and educational materials to inform the general public and inspire them to contribute to recovery.

Ongoing Regulatory Practices

The ESA provides NMFS with many tools for protecting and then recovering listed species. Generally, the ESA focuses on recovery planning provisions in section 4, cooperation with States in section 6, and direction to Federal agencies in section 7(a)(1). Specifically, the ESA focuses first on identifying species and ecosystems in danger of immediate or foreseeable extinction or destruction, and protecting them as their condition warrants. Then, the ESA focuses on preventing further declines in species' condition through the consultation provisions of section 7(a)(2); habitat protection and enhancement provisions of sections 4 and 5; take prohibitions of sections 4(d) and 9; cooperation with the state(s) in which these species are found (section 6); and needed research, enhancement, and non-Federal conservation actions (section 10).

NMFS has already utilized many of the ESA's provisions to conserve threatened and endangered species. NMFS has listed populations of salmon and steelhead in California and designated critical habitat. NMFS has worked with Federal agencies and private landowners on fishery management actions and consultations conducted under the Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) and sections 7(a)(2) and 10(a)(1) of the ESA to avoid and minimize harm to these species. Significant benefits have accrued to the listed species from changes in land and water use practices. Unfortunately, CCC coho salmon populations continue to decline.

Recovery plans have a greater scope than the more reactive, project-by-project focus of most efforts taken under EFH provisions, section 7, and section 10. NMFS intends to use this broader perspective to achieve more significant and focused benefits for CCC coho salmon. NMFS will strive to implement every action within this recovery plan for which it has authority. The Recovery Planning Guidance (NMFS 2007) describes how recovery plans will shape NMFS' actions:

> "...the ESA clearly envisions recovery plans as the central organizing tool for guiding each species' recovery process. They should also guide Federal agencies in fulfilling their obligations under section 7(a)(1) of the ESA… and provide context and a framework for implementing other provisions of the ESA such as section 7(a)(2), development of Habitat Conservation Plans or Safe Harbor agreements under section 10, special rules for threatened species under section 4(d)."

The specific approaches NMFS will use when implementing various sections of the ESA and MSFCMA are discussed in detail below and summarized in Table 21. These approaches are intended to incorporate the recovery plans in the daily efforts and decision-making at NMFS in the Southwest Region. Some of these approaches address issues of staffing and workload NMFS currently faces. As a result, our commitment to implementing recovery plans extends to the ways we prioritize the many requests for technical assistance, consultations, and permits received.

Section 4 provides mechanisms to list new species as threatened or endangered, designate critical habitat, develop protective regulations for threatened species, and develop recovery plans. Critical habitat designations may be revised to reflect recovery strategies. Critical habitat is designated in specific geographical areas where physical or biological features essential to the species are found and where special management considerations or protections may be needed to preserve and protect them. Critical habitat for CCC coho salmon was designated in 1999 (64 FR 24049), and included all areas occupied by naturally spawned populations at that time. NMFS will reevaluate the designation in light of the data and criteria developed for this plan, and may designate additional habitat (including marine habitat), or currently unoccupied habitat deemed essential for the conservation of the species.

Unlike endangered species, which are automatically subject to the prohibitions of section 9, special regulations must be developed under section 4(d) to prohibit take of threatened species. Tailored 4(d) section 9 take prohibitions and regulatory limits that contribute to the recovery of the species may be developed for threatened species. However, because CCC coho salmon are listed as endangered, section 7(a)(2), section 10 processes are the only legal mechanisms available under the ESA to address activities that may result in take.

Table 26: Recovery Plan Implementation under the ESA and MSFCMA by NMFS

Authority	Description	Implementation Actions
ESA Section 7	Section 7(a)(1) Interagency Cooperation (Use of authorities)	Use threats assessments and recovery actions to guide Federal partners to further the conservation of CCC coho salmon.
ESA Section 7	Section 7(a)(2) Interagency Cooperation (Consultation)	Use recovery criteria and objectives to determine effects of proposed actions on the likelihood of species' recovery, and to develop conservation recommendations and reasonable and prudent measures and alternatives.
	Note: Permits issued under section 10(a)(1) of the ESA also undergo section 7 consultation prior to issuance.	Use threats assessments and recovery strategy to prioritize consultations when making workload decisions.
		Prioritize consultations for actions that implement recovery strategy or specific recovery actions.
		Streamline consultations for actions with little or no effect on recovery areas or priorities.
ESA Section 9	Section 9 Enforcement	Prioritize actions and areas deemed of greatest threat or importance for focused efforts to halt illegal take of listed species.
		Develop no-take guidelines for land use activities associated with high threats in Core Areas, Phase I, and Phase II Areas.
ESA Section 10	Section 10(a)(1)(A) Research and Enhancement Permits	Prioritize permit applications that address research and monitoring needs identified in the recovery plan.
	Section 10(a)(1)(B) Incidental Take Permits	Prioritize cooperation and assistance to landowners proposing activities or programs designed to achieve recovery objectives.
		Standardize monitoring methods in HCPs to conform to TRT research needs and the recovery plan template.
Magnuson-Stevens Fishery Management	Fishery Management	Implement fishery regulations to maintain salmon harvest levels at or below those necessary to allow the recovery of listed salmon and steelhead.
		Implement fishery regulations to reduce bycatch of salmon in Federally-managed fisheries.

ESA Section 4

Section 4 provides mechanisms to list new species as threatened or endangered, designate critical habitat, develop protective regulations for threatened species, and develop recovery plans. Critical habitat designations may be revised to reflect recovery strategies. Critical habitat is designated in specific geographical areas where physical or biological features essential to the species are found and where special management considerations or protections may be needed to preserve and protect them. Critical habitat for CCC coho salmon was designated in 1999 (64 FR 24049), and included all areas occupied by naturally spawned populations at that time. NMFS will reevaluate the designation in light of the data and criteria developed for this plan, and may designate additional habitat (including marine habitat), or currently unoccupied habitat deemed essential for the conservation of the species.

Unlike endangered species, which are automatically subject to the prohibitions of section 9, special regulations must be developed under section 4(d) to prohibit take of threatened species. Tailored 4(d) section 9 take prohibitions and regulatory limits that contribute to the recovery of the species may be developed for threatened species. However, because CCC coho salmon are listed as endangered, section 7(a)(2), section 10 processes are the only legal mechanisms available under the ESA to address activities that may result in take.

ESA Section 5

Section 5 is a program that applies to land acquisition with respect to the National Forest System. No National Forest lands are present within the range of CCC coho salmon. It is unlikely new National Forests will be established within this species range in the foreseeable future. Therefore, this program will not benefit coho recovery.

ESA Section 6 and the PCSRF

Section 6 describes protocols for consultation and agreements between NMFS and the states for the purpose of conserving threatened or endangered species. California is currently developing a section 6 agreement with NMFS.

As another means of providing funding to the states, Congress established the PCSRF to contribute to the restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho, Nevada, and Alaska, and the Pacific Coastal and Columbia River tribes receive PCSRF appropriations through NMFS each year. The funds supplement existing state, tribal, and local programs to foster development of Federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. NMFS has established memoranda of understanding (MOU) with the states of Washington, Oregon, California, Idaho, and Alaska, and with three tribal commissions on behalf of 28 Indian tribes. The MOUs establish criteria and processes for funding priority PCSRF projects.

NMFS intends to work with California to ensure the CCC coho salmon recovery strategy and priorities are included in the allocation of funding for projects. NMFS also intends to use PCSRF reports to highlight areas and actions pertinent to recovery that might not occur in the absence of PCSRF funds.

ESA Section 7

Section 7(a)(1) provides that all Federal agencies shall "…in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species…." Section 7(a)(1) allows a Federal agency the discretion to give the conservation of endangered species a high priority. "Conservation" is defined in the ESA as those measures necessary to delist a species. In other words, the theme is *recovery*. To date, other Federal agencies have not fully embraced section 7(a)(1) requirement to develop conservation programs for CCC coho salmon. To prompt Federal agencies to develop conservation programs, NMFS shall:

- ❑ Establish a framework for cooperation to further the purposes of the ESA that specifically outlines a process for coordinating and implementing appropriate recovery actions identified in recovery plans (e.g., MOU similar to a now-expired 1994 MOU between Bureau of National Affairs Inc. 1994 and Agencies which expired in 1999).
- ❑ Prepare, and deliver after recovery plan approval, a letter to other appropriate Federal agencies outlining their section 7(a)(1) obligations and opportunities, and discussing salmonid conservation and recovery priorities;
- ❑ Encourage development of Conservation Bank Agreements for creating an array of conservation bank sites that will provide credits as compensation for actions that may affect anadromous salmonids within the NCCC recovery domain. Focus conservation bank sites in key CCC coho salmon watersheds, particularly in Core and Phase I areas;
- ❑ Encourage meaningful and focused mitigation, in alignment with recovery goals for restoration and threat abatement, for all actions that incidentally take coho salmon or affect their habitat in Core areas and Phase I and Phase II expansion areas;
- ❑ Encourage Federal partners and their constituents to include recovery actions in project proposals; and

The purpose of section 7(a)(2) is to "insure that any action authorized, funded, or carried out by [a Federal agency] is not likely to jeopardize the continued existence of any [listed species] or result in the destruction or adverse modification of [a listed species' critical habitat]." The theme is not one of recovery but of avoiding "jeopardy" to the species or "adverse modification" of critical habitat. Federal agencies request interagency consultation with NMFS (and/or USFWS) when they determine an action may affect a listed species or its critical habitat. NMFS then conducts an analysis of potential effects of the action. In the process of consultation, NMFS expends considerable effort to assist agencies in avoiding and minimizing the potential effects of proposed actions, and to ensure agency actions do not jeopardize a species or destroy or degrade habitat. Consultations have helped avoid and minimize direct take but have not led to recovery of CCC coho salmon.

Because section 7(a)(2) applies only to Federal actions, its applications are limited. In the CCC ESU there are few Federal lands and a large proportion of lands are in private ownership. Most of the land use practices on private ownership that impact salmonids do not trigger interagency consultation. This lack of consultation nexus is due in large part to the USACE's Clean Water Act section 404(f) exemptions for farming, logging, and ranching activities. These exemptions eliminate Federal oversight and review for these land management activities, including actions adversely affecting coho salmon and their habitat. Without a nexus, the contribution section 7(a)(2) provides to CCC coho salmon recovery is limited.

The limited effectiveness of 7(a)(2) to protect and recover CCC coho salmon might be best illustrated by the current status of the population south of San Francisco Bay. Coho salmon were listed by the State of California as endangered in 1994. In their 1993 listing petition to the Fish and Game Commission, the County of Santa Cruz Fish and Wildlife Commission predicted coho salmon might go extinct between 2008 and 2010. Since the follow-up Federal listing in 1996, NMFS has conducted numerous section 7 consultations in this area, yet the species' current abundance trend in Santa Cruz and San Mateo counties continues steeply downward. For example, Scott Creek in Santa Cruz County was the last remaining stream south of San Francisco with all three coho year classes still present. Unfortunately, the strong year class (the 2008 cohort) remaining at Scott Creek was decimated due to extremely poor ocean conditions. Many fisheries experts, based on the implications of this loss, now believe coho salmon are on the verge of complete extirpation south of San Francisco. Unless dramatic changes in the regulatory process and oversight, land and water management practices, restoration focus, and ocean conditions, occur in the very near future, the earlier predictions by the Santa Cruz Fish and Wildlife Commission may, unfortunately, be realized.

Currently, NMFS expends significant staff time and resources on conducting section 7 consultations (funded mandates). Implementation of this recovery plan will require improvements to the application of section 7(a)(2) consultation process across the ESU. In order to devote more resources to recovery action implementation and to ensure section 7(a)(2) consultations are effective, NMFS will utilize its authorities to:

- Use recovery criteria, objectives, and ongoing monitoring efforts as a reference point to determine effects of proposed actions on the likelihood of species' recovery;
- Place high priority on consultations for actions that implement the recovery strategy or specific recovery actions;
- Develop and maintain databases to track the amount of incidental take authorized and the effectiveness of conservation and mitigation measures;
- Incorporate recovery actions in formal consultations as Reasonable and Prudent Measures, Reasonable and Prudent Alternatives, and Conservation Recommendations;

- Prioritize staff time to carefully and consistently consider short- and long-term impacts to watershed processes when conducting jeopardy analyses for Federal actions occurring in CCC coho salmon Core areas and Phase I expansion areas;

- Focus staff priorities, to the extent possible, away from section 7 compliance in watersheds not designated as a priority for recovery and direct efforts to recovery implementation by developing 4(d) rules for low impact activities, etc.;

- Streamline consultations for actions with little or no effect on recovery areas or priorities. Develop streamlined programmatic approaches for actions not posing a threat to the survival and recovery of the species;

- Apply the VSP framework and recovery priorities to evaluate population and area importance in jeopardy and adverse modification analysis;

    - Work with established conservation bank programs to influence conservation bank agreements and actions that provide measurable contributions to threat abatement and recovery.

In addition, in an effort to be more proactive in leading conservation efforts, NMFS will utilize its authorities to encourage:

- Amendments to the USACE section 404 Clean Water Act exemptions for farming, logging, and ranching activities. Terminating section 404(f) exemptions for discharges of dredged or fill material into waters of the United States associated with certain normal agricultural activities (defined as logging, ranching, and farming) would allow interagency consultations in key dependent and independent watersheds and provide incidental take coverage for individuals, corporations, and agencies engaged in those activities;

- The Federal Emergency Management Agency (FEMA) to fund upgrades for flood-damaged facilities to meet the requirements of the ESA and facilitate recovery;

- The Environmental Protection Agency (EPA) to prioritize actions on pesticides known to be toxic to fish and/or are likely to be found in fish habitat, and to take protective actions, such as restrictions on pesticide use near water;

- The FHWA and Caltrans to develop and follow pile driving guidelines approved by NMFS for bridge construction projects in key dependent, independent, and other watersheds with extant coho salmon populations;

- Development of section 7 Conservation Recommendations based on recovery actions to help prioritize Federal funding towards recovery actions (NFMS, USFWS, NRCS, EPA, *etc.*) during formal consultations;

- All Federal agencies who designate a non-Federal representative to conduct informal consultation or prepare a biological assessment to ensure the associated documentation comports to 50 CFR 402.14(c) prior to initiating consultations with NMFS. Compliance with these requirements will increase consultation effectiveness and timeliness;

- ❑ All Federal agencies, or their designated representatives, to field-review projects and actions upon completion, to determine whether the projects were implemented as planned and approved. Encourage all Federal agencies, or their designated representatives, to report findings of field review to NMFS; and

- ❑ Federal agencies to coordinate and develop programmatic incidental take authorization for activities that contribute to the recovery of CCC coho salmon, and to streamline their permitting processes, particularly for restoration or recovery actions.

ESA Section 9

Section 9 prohibits any person from harming members of listed species including direct forms of harm such as killing an individual, or indirect forms such as destruction of habitat where individuals rear or spawn. The recovery plan will assist NMFS' Enforcement personnel by targeting key watersheds essential for species recovery. Core recovery areas identified in this plan should be considered the highest priority areas for oversight. NMFS PRD staff will work closely with NMFS Enforcement to identify threats and other activities believed to place coho salmon at high risk of take and/or extirpation. Actions will include the following:

- ❑ NMFS will prioritize actions and areas deemed of greatest threat or importance for focused efforts to halt illegal take of listed species;
- ❑ Land use activities identified as high priority threats in each watershed will be evaluated for their potential to take or harm coho salmon. No-take guidelines will be developed and implemented for all land use activities associated with high threats to coho salmon, focusing on Core and Priority I Areas;
- ❑ When take has occurred in a high priority area, NMFS PRD will work with OLE, to the extent feasible, to develop a take statement;
- ❑ NMFS OLE will work with the DFG, in conjunction with the Joint Enforcement Agreement, to increase patrols and landowner outreach in critical watersheds, particularly during droughts, when coho salmon are at greater threat of unauthorized taking; and

ESA Section 10

Section 10(a)(1)(A) provides permits for the authorization of take for scientific research, or to enhance the propagation or survival of listed species. Typically NMFS has authorized conservation hatcheries and research activities under section 10(a)(1)(A). Section 10(a)(1)(B) provides permits for otherwise lawful activities that incidentally take listed species. Habitat conservation plans minimizing and mitigating the incidental take of listed species from non-Federal activities are prepared under section 10(a)(1)(B). Currently, both processes take a significant amount of time to implement and recovery plans have not been available to guide priorities for permit issuance. To improve the section 10 authorization process, NMFS will utilize its authorities in the following ways:

Section 10(a)(1)(A) Research Permits

- ❑ Explore securing a regional coordinator and expanding staff assigned to research permits.
- ❑ Prioritize permit applications that address identified research and monitoring needs in the recovery plan, and/or enhance the survival of populations of CCC coho salmon (*e.g.*, captive broodstock programs). Develop streamlined approaches to permitting similar types of research and monitoring in the 28 focus watersheds.
- ❑ Evaluate proposed activities against the identified threats, recovery strategy, and recovery actions identified in the plan.
- ❑ Develop and maintain a tracking database to output real-time information for NMFS staff on current research taking place, locations and findings..

Section 10(a)(1)(B) Habitat Conservation Plans

We recommend all future HCPs where coho salmon are a covered species adopt the viability and threats assessment protocols established in this recovery plan. Adoption of these guidelines will facilitate standardization and could help in the tracking of recovery actions and threats abatement. Additionally, adoption of the assessment protocols should streamline jeopardy analysis and assist applicants in identification of limiting factors and strategically targeting beneficial and conservation and mitigation opportunities and locations. Finally, adoption of the assessment protocols will facilitate consistency in the development of standards to determine the appropriate levels of mitigation necessary to ensure the continued existence of CCC coho salmon. The Habitat Conservation Planning Handbook stresses the need for consistency of mitigation measures for a species and for specific standards. Although, not a preferred option (according to the USFWS/NMFS HCP Handbook), if offsite mitigation is necessary this recovery plan can be used to direct mitigation toward identified high priority watersheds. Priority should be given to Core areas, followed by areas designated as Phase I and then Phase II. In some circumstances off-site mitigation may provide greater recovery benefits than onsite mitigation (*e.g.*, if an HCP's covered activities occur in a non-focus watershed where the species no longer persists).

Within this framework NMFS will utilize its authorities to:

- ❑ Prioritize cooperation and assistance to landowners proposing activities or programs designed to achieve recovery objectives.
- ❑ Standardize monitoring methods in HCPs to the TRT's identified research needs and the recovery plan template. Consistent data collection techniques and the ability to compare similar data sets over space and time will set the framework for the five year review and help track recovery progress.
- ❑ Encourage the State Board of Forestry to seek no-take rules or apply for a statewide Forestry HCP (similar to that developed for Washington State); and
- ❑ Prioritize areas and actions where threat abatement has the potential to provide the most significant contribution to species recovery, based on the threats assessment developed and updated as part of the recovery plan; and

Section 10(j) Experimental Populations

Among the significant changes made in the 1982 amendments to the ESA was the creation of section 10(j), which provides for the designation of specific populations of species listed as "experimental populations" so long as they are wholly separate from other non-experimental populations. Under section l0(j), reintroduced populations of endangered or threatened species established outside the current range but within the species' historical range may be designated, at the discretion of NMFS, as "experimental," lessening the ESA's regulatory authority over such populations. Because these populations are not provided full ESA protection, management flexibility is increased, local opposition is reduced, and more reintroductions are possible.

Two types of experimental population designations exist: essential and nonessential. An essential experimental population is a reintroduced population whose loss would be likely to appreciably reduce the likelihood of the survival of the species in the wild. These populations are treated as threatened species (with special rules) for the purposes of section 9 of the ESA. Therefore, they can be managed with greater flexibility with regard to incidental take and regulated take.

A nonessential experimental population is a reintroduced population whose loss would not be likely to appreciably reduce the likelihood of the survival of the species in the wild. These populations, besides being treated as threatened species, are treated as proposed species for the purposes of section 7. The establishment of experimental populations is a valuable tool for use in the recovery of some listed species

To facilitate the implementation of species reintroduction, and to minimize the regulatory prohibitions that may create opposition to reintroduction programs, candidate reintroduction areas in the Domain should be considered for 10(j) rule proposals. Additional analysis is needed to determine if specific populations should be proposed as essential or non-essential. However, we have evaluated reintroduction potential for several historic, currently unoccupied habitats and recommend that 10(j) rules be developed for several watersheds within the San Francisco Bay diversity strata, and possibly for other areas where extirpation has occurred.

Fisheries Management and EFH

CCC coho salmon habitat is located in an area identified as Essential Fish Habitat (EFH) for the Pacific Coast Salmon Fishery Management Plan (FMP) under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). NMFS will implement fishery regulations to maintain salmon harvest levels at or below those necessary to allow for the recovery of listed salmon. Recovery strategies and objectives will serve as a guide when providing conservation recommendations for actions that may adversely affect EFH. In addition, NMFS will work to implement fishery regulations to reduce bycatch of salmon in Federally-managed fisheries.

Coordination with other NMFS Divisions

Other line offices and programs within NOAA can contribute significantly to recovery. NMFS PRD staff will coordinate with the SWFSC, NMFS Habitat Conservation Division, OLE, and NOAA Restoration Center to assist in recovery planning and implementation across the NCCC Domain. In addition, collaboration with other NOAA line offices and NMFS Programs are also expected to benefit recovery efforts.

TIME AND COST ESTIMATES

Section 4(f) of the ESA requires that recovery plans include "estimates of the time required and the cost to carry out those measures needed to achieve the Plan's goal and to achieve intermediate steps toward that goal" (16 U.S.C. 1531-1544, as amended). NMFS estimates recovery for CCC coho salmon, like for most of the ESA-listed Pacific Northwest salmon and steelhead, will take 50 to 100 years. The list of actions is extensive and many uncertainties exist in predicting the course and cost of recovery. Such uncertainties include biological and ecosystem responses to recovery actions, status of the larger economy, and the offset of costs as NMFS and other entities implement their laws and policies as a matter of practice in doing business.

The analysis and consideration of recovery costs were derived primarily from three sources: (1) Recovery Strategy for California Coho Salmon (DFG, 2004); (2) Habitat Restoration Cost References for Salmon Recovery Planning (Thompson and Pinkerton, 2008) and (3) coordination with NOAA Restoration Center Office in Santa Rosa, California. Costs were developed, where possible, for many (but not all) lower level recovery actions in each population (e.g., watershed). These are displayed in associated implementation tables in Chapter 10. Costs for each population were not aggregated to determine a total cost. This would result in a inaccurate cost estimate due to the high number of actions not assigned a cost and the uncertainty associated with the current cost estimates. NMFS is working at a regional scale and across all recovery domains to develop a consistent method of assigning costs to individual recovery actions. Thus, for the purposes of this public draft recovery plan NMFS is requesting information from the public and finds the Recovery Strategy for Coho Salmon (DFG, 2004) is a relevant general reference for the likely costs for CCC coho salmon recovery.

The State of California conducted a comprehensive cost analysis for coho salmon recovery in 2004. To generate cost estimates, they reviewed historical project data, but did not correct the costs to reflect inflation or the ever increasing cost of project implementation. The total cost for recovering CCC coho salmon across two ESUs (the Southern Oregon Northern California and the CCC ESU) was estimated by California. The estimate included direct fiscal costs of physically performing a recovery action, such as the expenditure required to purchase, plant, and maintain riparian vegetation. The estimate also included socioeconomic costs such as foregone income from land taken out of production to provide riparian buffers. NMFS subtracted costs identified for the Southern Oregon Northern California ESU and for the Shasta and Scott River Pilot Program, to arrive at an estimate of between at between $3,848,658,328.00 and $5,130,658,328.00 (depending on Alternatives implemented) (DFG, 2004) to achieve recovery for CCC coho salmon.

This estimate may under or over estimate the full cost of implementation, because not all costs could be quantified, and some costs may be incurred even without implementation of the plan. In addition, the State Plan made recommendations that differ from those presented in this plan. The State Coho Recovery Strategy for California Coho Salmon also notes that these costs were presented in the simplest possible terms: the current dollar cost of completing the action in 2004.

NMFS produced a report providing information on costs associated with restoration activities (Appendix H) {Thomson and Pinkerton 2008}. Data from publicly available sources were used to obtain estimates of restoration costs for a variety of restoration activities. All costs described in the report pertain to direct expenditures on restoration and do not include economic opportunity costs (*e.g.*, foregone profits associated with restrictions on livestock grazing, timber harvest and other activities). The information in the report is difficult to apply in the CCC coho salmon ESU. The report contains extensive data from the northernmost part of California, Oregon, Washington, and Idaho, where costs (labor, materials, equipment, *etc.*) are likely to be lower than on the Central Coast of California. The report offers ranges of costs applicable at the ESU scale. Actual costs may vary widely from one watershed to another and across the extent of the NCCC Domain due to differences in regional labor costs, property values, availability of expert contractors and materials, and permitting issues, *etc*.

Although there are differences between the State Coho Recovery Plan and the Federal CCC coho salmon recovery plan, NMFS will use the State cost estimates as they currently represent the best available information most relevant to the CCC coho salmon ESU. During the public comment period, we will further evaluate the cost analysis with assistance from the NMFS Science Center, NOAA Restoration Center and others including additional requests to the public for more precise cost estimates associated with restoration, monitoring and threat abatement.

In closing, we find it imperative to acknowledge that healthy salmon populations provide significant economic benefits. Entire communities, businesses, and jobs have been built around the salmon of California. Based on studies that examined streams in Colorado and salmon restoration in the Columbia River Basin, the San Joaquin River, and the Elwha River, the value of California coho salmon recovery could be significantly larger than the fiscal or socioeconomic costs of recovery (DFG 2004). Importantly, the general model for viewing cost versus benefits must be viewed in terms of long-term benefits derived from short-term costs. Recovery actions taken on behalf of coho salmon are likely to benefit other listed species in the NCCC Domain, thus increasing the cost effectiveness of the actions. Habitats restored to highly functioning conditions offer tangible benefits such as improved water quality, and less tangible benefits such as reduced expenditures on bank stabilization or flood control. Restoration activities will generate positive socioeconomic benefits. Because of the direct and indirect economic value of salmon as a resource for fishing, recreation and tourism related activities, each dollar spent on salmon recovery may generate thousands of dollars for local, state, Federal, and tribal economies. In other words, salmon recovery is best viewed not as a cost, but as an investment and opportunity to diversify and strengthen the economy. The dollars required to recover salmon should be made available without delay such that the benefits can begin to accrue as soon as possible.

Chapter 13: Restoration

"The secret of getting started is breaking your complex overwhelming tasks into manageable tasks, and then starting on the first one."

Mark Twain

RESTORING OUR WATERSHEDS

Recovering CCC coho salmon populations will require addressing multiple factors leading to their decline. One of the leading causes resulting in the decline of CCC coho salmon is habitat degradation. Habitat degradation has diminished population carrying capacities and reduced their likelihood of survival in most watersheds across the range of CCC coho salmon. Addressing degraded habitats can take two approaches: (1) abating threats and allowing habitats to recover at natural rates or (2) abating threats and accelerating the recovery of degraded habitats through active restoration and enhancement actions. Due to the status of CCC coho salmon, active restoration and enhancement actions are essential to ensure the survival of this species. Recovery will require a systematic and sustained watershed by watershed approach to rehabilitate impaired habitats and degraded watershed processes. Recovery actions recommend implementation of general and site-specific restoration strategies, on a watershed by watershed basis.

Recommended restoration and enhancement actions take a two pronged approach: returning habitats to properly functioning condition, and in some cases creating entirely new habitat. Examples of actions that restore habitats to proper function include: replanting riparian areas; creating riparian buffers; excluding livestock from instream and riparian areas; installing large wood or other instream habitat features; treating sediment sources and decommissioning unpaved roads; improving water diversion practices; and providing off-channel habitats. Creating new habitat involves building and maintaining artificial structures, and utilizing best management practices to reduce the negative effects of urban development, agriculture, water diversion, and other land use impacts. The majority of actions recommended in this recovery plan focus on returning habitats to properly functioning conditions rather than creating new habitats.

PRIORITIZING RESTORATION ACTIONS

CCC coho salmon habitat quality currently diverges significantly from historical conditions. This divergence, along with a recent shift in marine conditions that has lowered marine survival, has led to the extreme decline in CCC coho salmon abundance across the ESU. CCC coho salmon populations are so low that simply improving one element of habitat condition or access to additional habitat will not halt their decline. Prioritization is necessary to emphasize restoration techniques which are sufficient to ensure the existence of CCC coho salmon into the future. For example, retrofitting a problem culvert can improve passage upstream, but unless habitat exists that allows completion of all life stages there will not be an increase in the population. In this recovery plan, restoration actions are emphasized which directly improve survival, increase carrying capacity, and ultimately improve population numbers.

In Chapter 10, subwatersheds (also called planning watersheds) for all twenty-eight focus populations were ranked based on current occupancy patterns and the importance of these subwatersheds for short-term and long-term coho salmon survival. Ranking is an attempt to prioritize limited restoration monies and expertise, and to guide practitioners and land managers towards projects for immediate and long-lasting habitat improvement. Specific actions recommended for each subwatershed will vary based on assessment information, and the status of watershed conditions and land use development. The immediate priority of this recovery plan is to improve habitat, or access to habitats, in subwatersheds where coho salmon still persist (*i.e.*, core habitat areas). Once restoration of "Core areas" is accomplished, the next priority is to restore subwatersheds with generally suitable habitat conditions that are currently unoccupied, or nearly so (i.e., Phase I areas). Finally, as a long-term goal, the plan recommends restoring unoccupied watersheds (*i.e.*, Phase II areas), which can be utilized in the future by expanding coho salmon populations once conditions improve. The three ranks, the rationale behind their definitions, and the strategy for restoration and subsequent monitoring are described below:

- <u>Core Areas</u>

  Core Areas are subwatersheds believed to maintain at least one coho salmon lineage. The goal of restoration in Core Areas is to improve and protect occupied habitats as soon as possible to ensure survival and long-term persistence. Project types will likely include (a) protecting intact habitat through regulatory actions, conservation easements, and other means; (b) installing large woody debris for cover and stream scour (leading to pool formation); (c) creating/providing additional access to off channel over-wintering habitat for juveniles; (d) controlling sediment input from roads; and (e) addressing instream flows. High-cost intensive efforts are appropriate in these areas. Watershed assessments to focus restoration actions, water quality monitoring, and fish population trend monitoring are necessary to provide feedback on the effectiveness of restoration actions.

- <u>Phase I Areas</u>

  Phase I areas are watersheds adjacent to, or near, Core Areas that (a) recently supported coho salmon populations; (b) currently support coho salmon in low numbers relative to other occupied subwatersheds; (c) maintain most of the instream habitat conditions necessary for successful completion of all freshwater life stages; and/or (d) may receive strays from Core Areas. Due to their proximity to many Core Areas, Phase I areas are likely to provide seasonal refuge when habitat in Phase II areas is inhabitable. The goal of restoration activities in these watersheds is to improve habitat for populations of coho salmon expanding from Core Areas. Careful analysis of limiting factors and connectivity of project sites is needed to ensure restoration activities address the highest priority limiting factors in the correct sequence. Project types will likely include (a) improving habitat and channel complexity; (b) removing barriers to suitable habitat; (c) controlling sediment input from roads; and (c) improving riparian corridors. In addition to presence/absence monitoring of habitat usage by coho salmon, monitoring water and habitat quality and quantity is also important to track restoration success, in space and time, within Phase I areas.

- Phase II Areas

  Phase II areas are subwatersheds are unlikely to receive appreciable numbers of strays or to support small populations in the immediate future. These subwatersheds often have habitats highly divergent from historical conditions. Phase II areas are essential for long-term recovery goals, but they need large-scale and sustained long-term restoration efforts. It will likely take many decades to restore habitat conditions in some Phase II areas. Priority project types include improving passage upstream to Core and Phase I areas, remediating degraded watershed processes that affect downstream Core and Phase I areas, protecting riparian areas to aid natural re-vegetation, inserting instream structure to remediate homogenous habitats, and gradually changing or improving land management practices to restore natural watershed processes.

RESTORATION PLANNING

Successful restoration projects require an understanding of channel processes and local limiting factors for coho salmon. Restoration must take into account the relative influence and spatial scales of channel processes and biological constraints at the project site. Projects should be based on the best available science and the biological constraints of coho salmon. Labor-intensive projects must be built to appropriate specifications and have appropriate funding commitments to ensure they are adequately maintained. Monitoring must reflect the goals and scale of the project. Monitoring and evaluation do not usually affect the success of individual projects, but they improve the design of future projects and are an important component of a restoration strategy.

Early coordination is essential for timely approval and execution of restoration projects, particularly when many stakeholders are involved. Considerable support is available to those willing to undertake restoration projects. Local, state, and Federal agencies provide technical assistance, cost share, and grant funding for design, implementation, and monitoring. Numerous non-governmental organizations provide similar services and also offer project management, liability coverage, and environmental compliance coordination and support. These services are typically provided at no or low cost to the landowner or project proponent. Private consulting firms also provide technical assistance, project management, environmental compliance, monitoring, as well as engineering and other services necessary for successful project implementation.

The availability of in-kind services and grant funding depends on:

- Location: most programs serve a limited geographic area;
- Land ownership and use: some programs serve only private, public, agricultural or urban lands;

- Importance or priority of the project;
- The identification of a project in a stream inventory, watershed plan, or within a local/state/federal management plan;
- Ecosystem type: some programs focus on streams, wetlands, estuaries or uplands; and
- Cost share, commitment or participation by private landowners or a local sponsor.

Permitting and project management can be considerable obstacles to landowners, individuals, and small groups wishing to carry out restoration projects. Permit waivers or programmatic permits can reduce costs and streamline the regulatory process by providing umbrellas for local/state or federal consultation. However, the availability of permit waivers or programmatic permits depends on a project's type and location, and additional work by public agencies is often needed to facilitate projects and remove regulatory obstacles. Further permit streamlining will be necessary to provide incentives to landowners and managers wanting to implement restoration and enhancement projects.

<u>Opportunities and Challenges for Restoration Projects</u>

Many projects use well-understood and documented techniques that have been consistently demonstrated to benefit coho salmon and their habitats. Examples include: removing barriers; installing woody debris; and establishing riparian buffers.

High priority projects which may lead to long term restoration of functional stream processes, but that are not as well understood, require more research, monitoring, and long-term evaluation of their success. These include:

- ❑ Reconnecting incised channels with their floodplains;
- ❑ Reconnecting wetlands and re-creating off channel habitat, especially in developed areas where channel stability is questionable or flooding is a concern; and
- ❑ Providing safe passage for adults and smolts through urbanized areas with channelized streams and inadequate flows.

Other high priority projects need regulatory solutions to reduce costs, time and risk to private landowners and public entities to be more widely utilized:

- ❑ Off channel water storage during winter, with the goal of reducing dependency on summer riparian rights (without increasing total annual water withdrawals);
- ❑ Addition of secured and engineered large woody debris projects upstream of culverts, bridges and urban infrastructure; and
- ❑ Actions to improve degraded lagoons and estuaries where flooding is a concern or conflicts with other listed/protected species occur.

Because many of the actions outlined in this recovery plan will be carried out on a voluntary basis, public support is important. NMFS believes public participation and a stewardship role, led by private land owners and public land managers, is essential to the survival and long-term recovery of CCC coho salmon, particularly in light of the significant amount of private land ownership within the range of this species. Conducting outreach and assisting interested and affected parties in becoming partners in restoration and recovery is critical to success. Stakeholders in restoration projects include:

- Landowners who wish to carry out restoration activities on their own property, either alone or in cooperation with agencies and NGOs. Project management and grant funding is available to help landowners carry out projects at no or low cost to themselves;
- Resource Conservation Districts and NGOs. These organization often work as a bridge between government agencies and private landowners to assuage fears regarding regulations, and also work to encourage landowners to implement recovery actions;
- Members of the public who do not own land suitable for restoration can make significant contributions by volunteering and participating in restoration, monitoring, and planning efforts; and
- Clubs, social organizations, and other organized groups can assist in restoration by providing volunteer labor for projects, conducting outreach within their communities, and coordinating and contacting regulatory agencies.

RESTORATION PARTNERS

The following is a partial list of organizations that can assist in restoration design and implementation. Additional resources are available in most areas from watershed groups, alliances, or other NGOs. Occasional funding may be available from agencies in the form of mitigation or disbursements from environmental fines.

The Pacific Coast Salmon Recovery Fund

Congress established the Pacific Coast Salmon Recovery Fund (PCSRF) to contribute to restoration and conservation of Pacific salmon and steelhead populations and their habitats. The states of Washington, Oregon, California, Idaho, and Alaska, and Pacific Coastal and Columbia River tribes, receive PCSRF appropriations from NMFS each year. The fund supplements existing state, tribal and local programs to foster development of Federal-state-tribal-local partnerships in salmon and steelhead recovery and conservation. The PCSRF supports grant programs that directly fund recovery actions, such as: (a) instream habitat improvement; (b) watershed evaluations; (c) assessment, planning and project design; (d) education and outreach; (e) watershed organizational support and assistance; (f) public involvement and capacity building; (g) private sector training and education; (h) monitoring of salmonid populations and restoration projects; (i) cooperative rearing; project maintenance; fish screening of diversions; tailwater management; water conservation measures; water measuring devices; and water purchase and lease.

It is imperative PCSRF funds are granted consistent with recovery planning goals and be creative in funding a wide variety of actions promoting recovery. Projects should be based on the strongest scientific foundation and should include monitoring and maintenance to inform future recovery efforts.

The NOAA Restoration Center

The NOAA Restoration Center provides funding and technical assistance to restoration projects benefiting NOAA trust resources, including salmon and steelhead. Since 1996, the NOAA Restoration Center has funded over 300 projects benefiting California salmon and steelhead. The Restoration Center works with NMFS staff to develop and implement projects addressing limiting factors to salmonid recovery; partners with grassroots organizations to encourage hands-on citizen participation, and delivers technical support to help ensure project success.

NMFS PRD will work with the Restoration Center to coordinate recovery efforts for CCC coho salmon. PRD and the Restoration Center, in combination with other funding programs, will facilitate funding, permit streamlining, technical assistance, and outreach to the restoration community. The Restoration Center will bring its funding and restoration partners into the recovery process, while also networking to find new recovery partners and determining who is best suited to take on specific recovery actions. The Restoration Center's goal to fund community-based habitat restoration and provide technical restoration assistance directly compliments the goals of the recovery plan for CCC coho salmon.

NMFS Science Centers

NMFS PRD will coordinate with the NMFS' Southwest Fisheries Science Centers to identify and address research needs regarding coho salmon recovery. They will also coordinate on captive broodstock conservation programs to ensure that outplantings and restoration activities compliment each other.

State & Local Governmental Agencies

CCC coho salmon are listed as endangered by the State of California. NMFS will coordinate with state agencies on planning, research, monitoring, and carrying out projects and programs. These agencies include: DFG; CalFire; California Coastal Conservancy; University of California Cooperative Extension; California Conservation Corps; Resource Conservation Districts; the State Water Resources Control Board; local flood control districts; water agencies; and city and county governments.

Non-Governmental Organizations

Numerous non-profits, volunteer groups, professional organizations, and quasi-governmental organizations are engaged in ecological restoration. Where their focus intersects with NMFS recovery goals, NMFS will coordinate with them to facilitate planning, research, monitoring, and project implementation.

RESTORATION ASSISTANCE

Federal programs that provide information, funding and/or technical assistance:

- NMFS, Southwest Region swr.nmfs.noaa.gov

- NOAA Restoration Center nmfs.noaa.gov/habitat/restoration/
- USFWS Partners for Fish and Wildlife fws.gov/partners/ and Coastal Programs fws.gov/coastal/CoastalProgram
- US EPA epa.gov
- NRCS nrcs.usda.gov
- USACE http://www.usace.army.mil/missions/environment.html

State programs that provide information, funding and/or technical assistance:

- California Department of Fish and Game www.dfg.ca.gov/fish/
- California Coastal Conservancy www.scc.ca.gov
- State Water Resources Control Board www.swrcb.ca.gov
- California Conservation Corps www.ccc.ca.gov/
- University of California Cooperative Extension http://ucanr.org/index.cfm

Local and regional programs that provide information, funding and/or technical assistance:

- CalFish www.calfish.org
- Coastal Watershed Planning and Assessment Program (CWPAP) http://coastalwatersheds.ca.gov/Home/tabid/54/Default.aspx
- Resource Conservation Districts www.carcd.org
    - Santa Cruz Resource Conservation District http://www.rcdsantacruz.org/
    - San Mateo County Resource Conservation District http://www.sanmateorcd.org/
    - Gold Ridge Resource Conservation District http://www.goldridgercd.org/
    - Sotoyome Resource Conservation District http://sotoyomercd.org/
    - Marin Resource Conservation District http://www.marinrcd.org/
    - Southern Sonoma Resource Conservation District http://www.sscrcd.org/
    - Mendocino County Resource Conservation District http://www.mcrcd.org/
    - And others
- City and County Governments
- Five Counties Salmonid Conservation Program www.5counties.org
- Fishnet 4C http://fishnet.marin.org
- The Fish Passage Forum http://www.calfish.org/ProgramsandProjects/FishPassageForum/tabid/127/Default.aspx
- Klamath Resource Information System (KRIS) http://www.krisweb.com/
- Salmonid Restoration Federation http://www.calsalmon.org/

- Trout Unlimited http://www.tu.org/
- California Trout http://www.caltrout.org/
- And others

CHAPTER 14: 5-YEAR REVIEWS AND POST-DELISTING

"We won't forge a sustainable society until we have nurtured a generation that is imbued by a guiding environmental ethic."

Gaylord Nelson,
former U.S. Senator

5-YEAR REVIEWS OF SPECIES STATUS

It is a worthy challenge to reverse the path of a species away from extinction and toward recovery. This will require fundamental changes in long-standing polices and practices both within NMFS ESA section 4(c)(2) requires a periodic analysis of a species' status conducted to ensure that the listing classification of a species is accurate, called a 5-Year Review. Guidance has been developed by the U.S. Fish and Wildlife Service and NMFS (2006): *5-Year Review Guidance: Procedures for Conducting 5-Year Reviews Under the Endangered Species Act*. The 5-year reviews do not involve rulemaking, it is a process to request information from the public, review the classification of a species and track the progress of a species towards recovery and to propose appropriate next steps for its conservation. The 5-year reviews provide the agency with the mechanism to obtain additional information to: (1) Summarize and analyze status of a species; (2) Track a species' progress towards recovery; (3) Record the deliberative process used to make a recommendation on whether or not to reclassify a species; and (4) Recommend whether reclassification of the species is indicated.

In 2013, NMFS shall initiate the five year review of the CCC coho salmon ESU in accordance with Guidance. The general process to conduct the 5-year review involves 5 steps:

(1) Information Gathering
   a. Publish a *Federal Register* notice announcing a species is under active review. This is required under *50 CFR 424.21* for the purpose of notifying the public and to request information to assist in the review. A template is provided in the 5-Year Review Guidance.
   b. Solicit information directly from outside sources, including State agencies, other Federal agencies, tribes, universities, institutions, experts and other interested parties. Solicitation will be made by letter and a template is provided in the 5-Year Review Guidance document.
   c. All requests are to be kept for the agency administrative record.

(2) Completion of the 5-Year Review Template
   a. The template provided in the Guidance was developed to aid in national consistency, to streamline the documentation of the review, and to document the deliberative process required for the review.
   b. The template includes general information, review analysis, results, recommendations for future actions and references.

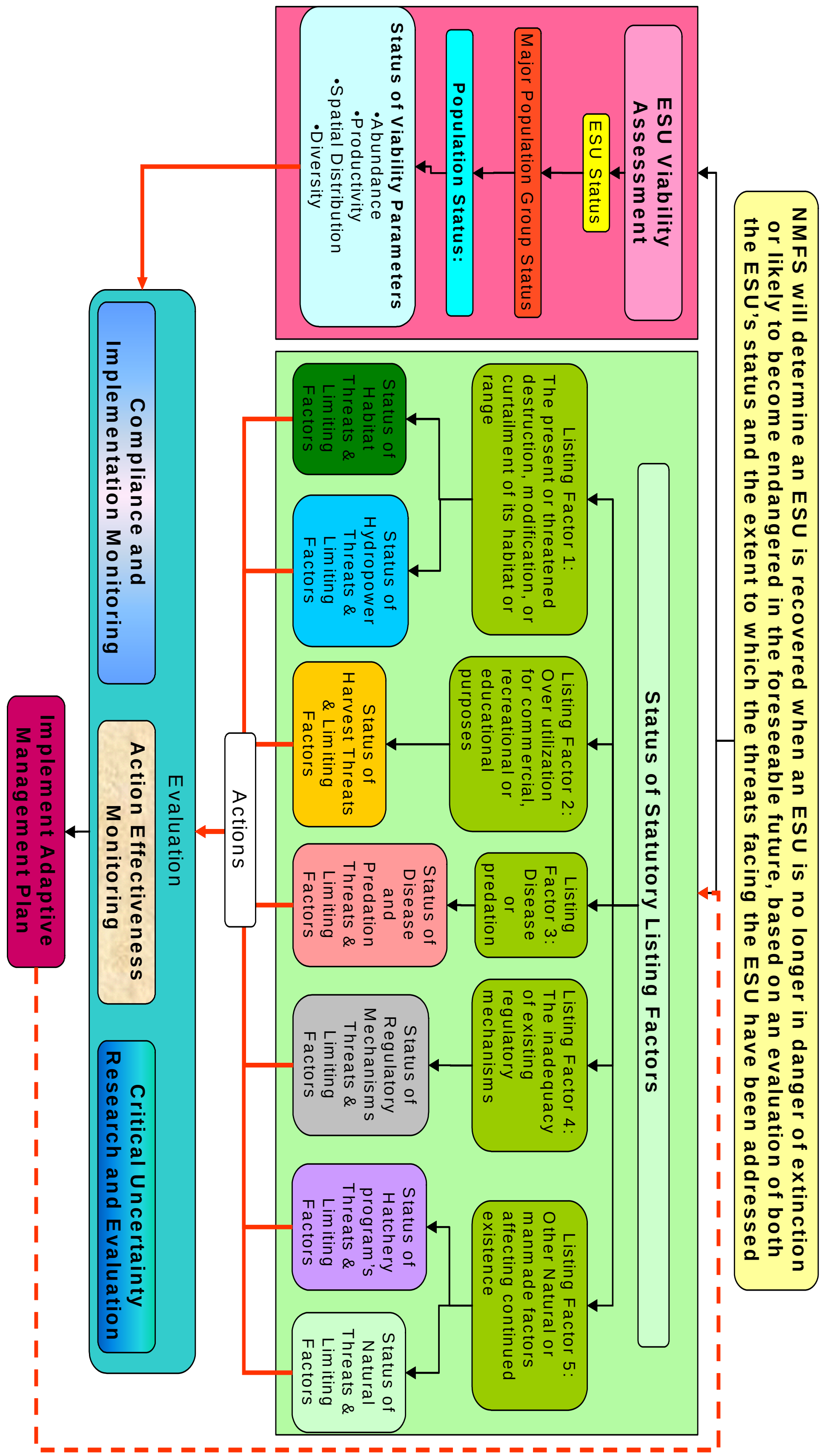
(3) Conduct a Peer Review of the Template (if found appropriate)

(4) Concurrence by the NMFS Regional Administrator
(5) Reporting and Public Notification of Results
    a. Post results on regional and national websites;
    b. Include information into Biennial Report to Congress; and
    c. Announce results in *Federal Register* (optional).

POST-DELISTING MONITORING

Post-delisting monitoring (PDM) refers to activities undertaken to verify that a species delisted, due to recovery, remains secure from risk of extinction after it has been removed from the protections of the ESA. The primary goal of PDM is to confirm that the species does not require relisting as threatened or endangered during the period following removal of ESA protections. Section 4(g), added to the ESA in the 1988 reauthorization, requires NMFS to implement a system in cooperation with the states to monitor for not less than five years the status of all species that have recovered and been removed from the lists of threatened and endangered {50 CFR 17.11, 17.12, 224.101, and 227.4}. Section 4(g) directs NMFS to make prompt use of their emergency listing authorities under section 4(b)(7) to prevent a significant risk to the well-being of any recovered species. While not specifically mentioned in section 4(g), authorities to list species in accordance with the process prescribed in section 4(b)(5) and 4(b)(6) may also be utilized to reinstate species on the list of threatened or endangered, if such an action is found to be appropriate.

NMFS Listing Status Decision Framework



LITERATURE CITED

16 U.S.C. 1531-1544. 1973. Endangered Species Act. US Code, Title 16 Conservation, Chapter 35 Endangered Species, Section 1531 and following.

16 U.S.C. 1826. 1995. High seas driftnet fishing moratorium protection act. 16 U.S.C.: 1826d-1826g.

50 CFR 17. 2008. Code of Federal Regulations. Title 50--Wildlife and fisheries. Part 17--Endangered and threatened wildlife and plants. Section 17.11--Endangered and threatened wildlife. Section 17.12--Endangered and threatened plants.

50 CFR 224. 2008. Code of Federal Regulations. Title 50--Wildlife and fisheries. Part 224--Endangered marine and anadromous species. Section 224.101--Enumeration of endangered marine and anadromous species.

50 CFR 227. 2008. Code of Federal Regulations. Title 50--Wildlife and fisheries. Part 227--.

50 CFR 402. 2008. Interagency cooperation--Endangered Species Act of 1973, as amended. Code of Federal Regulations, Title 50, Wildlife and Fisheries: part 402.

50 CFR 424. 2008. Listing endangered and threatened species and designating critical habitat. Code of Federal Regulations, Title 50, Wildlife and Fisheries: part 424.

59 FR 21744. 1994. Endangered and threatened species: Coho salmon in Scott and Waddell Creeks, California. Federal Register, 59: 21744-21746.

59 FR 24271. 1994. Endangered and threatened wildlife and plants: notice of interagency cooperative policy on information standards under the Endangered Species Act. Federal Register, 59: 24271

60 FR 38011. 1995. Endangered and threatened species; proposed threatened status for three contiguous ESUs of coho salmon ranging from Oregon through central California. Federal Register, 60: 38011-38030.

61 FR 41541. 1996. Endangered and Threatened Species: Proposed Endangered Status for Five ESUs of Steelhead and Proposed Threatened Status for Five ESUs of Steelhead in Washington, Oregon, Idaho, and California. Federal Register, 61: 41541-41561.

61 FR 56138. 1996. Final rule: Endangered and threatened species: threatened status for central California coho salmon evolutionarily significant unit (ESU). Federal Register, 61: 56138-56149.

62 FR 43937. 1997. Endangered and Threatened Species: Listing of Several Evolutionary Significant Units (ESUs) of West Coast Steelhead. Federal Register, 62: 43937-43954.

63 FR 11482. 1998. Endangered and Threatened Species: Proposed Endangered Status for Two Chinook Salmon ESUs and Proposed Threatened Status for Five Chinook Salmon ESUs; Proposed Redefinition, Threatened Status, and Revision of Critical Habitat for One Chinook Salmon ESU; Proposed Designation of Chinook Salmon Critical Habitat in California, Oregon, Washington, Idaho. Federal Register, 63: 11482-11520.

63 FR 13347. 1998. Endangered and Threatened Species: Threatened Status for Two ESUs of Steelhead in Washington, Oregon, and California. Federal Register, 63: 13347-13371.

64 FR 14308. 1999. Endangered and Threatened Species; Threatened Status for Three Chinook Salmon Evolutionarily Significant Units (ESUs) in Washington and Oregon, and Endangered Status for One Chinook Salmon ESU in Washington. Federal Register, 64: 14308-14328.

64 FR 24049. 1999. Designated critical habitat: central California coast and southern Oregon/northern California coasts coho salmon. Federal Register: 24049-24062.

64 FR 50393. 1999. Endangered and Threatened Species; Threatened Status for Two Chinook Salmon Evolutionarily Significant Units (ESUs) in California; Final Rule. Federal Register, 64: 50393-50415.

65 FR 6960. 2000. Endangered and Threatened Species: Threatened Status for One Evolutionarily Significant Unit of Steelhead in California. Federal Register, 65: 6960-6975.

65 FR 36074. 2000. Endangered and Threatened Species: Threatened Status for One Steelhead Evolutionarily Significant Unit (ESU) in California. Federal Register, 65: 36074-36094.

65 FR 42422. 2000. Endangered and threatened species; final rule governing take of 14 threatened salmon and steelhead evolutionarily significant units (ESUs). 65: 42422-42481.

66 FR 49718. 2001. Guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by federal agencies ("Data Quality Act of 2002"). Federal Register, 66: 49718-49725.

67 FR 1116. 2002. Endangered and threatened species; final rule governing take of four threatened evolutionarily significant units (ESUs) of West Coast salmonids. Federal Register, 67: 1116-1133.

68 FR 15100. 2003. Policy for evaluation of conservation efforts when making listing decisions. Federal Register, 68: 15100-15115.

69 FR 33102. 2004. Endangered and threatened species: proposed listing determinations for 27 ESUs of West Coast salmonids. Federal Register, 69: 33102-33179.

70 FR 37160. 2005. Endangered and threatened species: final listing determinations for 16 ESUs of West Coast Salmon, and final 4(d) protective regulations for threatened salmonid ESUs. Federal Register, 70: 37160.

70 FR 52488. 2005. Endangered and threatened species; designation of critical habitat for seven evolutionarily significant units of Pacific salmon and steelhead in California. Federal Register, 70: 52488-52627.

71 FR 834. 2006. Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead. Federal Register, 71: 834-862. ‘

71 FR 14683. 2006. Endangered and threatened species: 90-day finding on petition to redefine the southern extent of the central California coho salmon evolutionarily significant unit. Federal Register, 71: 14683-14687. ‘

437 U.S. 153. 1978. Tennessee Valley Auth. v. Hill, 437 U.S. 153 (1978). US Supreme Court Cases & Opinions, 437: 153-213. ‘

Aalto, R. 2004. Report on sediment accumulation rates for a floodplain of the Laguna de Santa Rosa (CA) determined with 210Pb geochronology. Prepared for the U.S. Army Corps of Engineers, Seattle, Washington, NOAA Doc. No. SR64307. 9 pp.

Adams, P. B., L. B. Boydstun, S. P. Gallagher, M. Lacy, T. McDonald & K. Shaffer. In review. The California coastal salmonid monitoring plan: overall design and methods. Fish Bulletin. California Department of Fish and Game. 64 pp.

Agrawal, A., R. S. Schick, E. P. Bjorkstedt, R. G. Szerlong, M. N. Goslin, B. C. Spence, T. H. Williams & K. M. Burnett. 2005. Predicting the potential for historical coho, Chinook, and steelhead habitat in northern California. U.S. Department of Commerce, NOAA-TM-NMFS-SWFSC-379. 34 pp.

Allendorf, F. W., D. Bayles, D. L. Bottom, K. P. Currens, C. A. Frissell, D. Hankin, J. A. Lichatowich, W. Nehlsen, P. C. Trotter & T. H. Williams. 1997. Prioritizing Pacific salmon stocks for conservation. Conservation Biology, 11: 140-152.

Alley, D. W., J. Dvorsky, J. Ricker, K. Schroeder & J. Smith. 2004. San Lorenzo River salmonid enhancement plan: fisheries enhancement strategy for the San Lorenzo River. Santa Cruz, California. Prepared for Santa Cruz County Environmental Health services. 177 pp.

Altimira, J. 1823. Diario de la expedicion verificada con objecto de reconocer terrnos para la nueva planta de la Mision de Nuestro Padre San Francisco principiada le dia 25 de Junio de 1823.

Ambrose, J. 2008. Personal communication. (Ed. by Dawson, A.), pp. Email confirmation that fingerlings collected in San Mateo Creek indicate spawning coho. Eldridge, California.

Anderson, K. R. 1995. A Status Review Of The Coho Salmon (Oncorhynchus Kisutch) in California South Of San Francisco Bay. California Department of Fish and Game, Region 3, Monterey; prepared for the California Fish and Game Commission. 131 pp.

Armour, C. L., D. A. Duff & W. Elmore. 1991. The effects of livestock grazing on riparian and stream ecosystems. Fisheries, 16: 7-11.

Battin, J., M. W. Wiley, M. H. Ruckelshaus, R. N. Palmer, E. Korb, K. K. Bartz & H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. Proceedings of the National Academy of Sciences of the United States of America, 104: 6720-6725.

Beamish, R. J. & C. Mahnken. 2001. A critical size and period hypothesis to explain natural regulation of salmon abundance and the linkage to climate and climate change. Progress in Oceanography, 49: 423-437.

Beamish, R. J., C. Mahnken & C. M. Neville. 1997. Hatchery and wild production of Pacific salmon in relation to large-scale, natural shifts in the productivity of the marine environment. ICES Journal of Marine Science, 54: 1200-1215.

Beamish, R. J., C. Mahnken & C. M. Neville. 2004. Evidence that reduced early marine growth is associated with lower marine survival of coho salmon. Transactions of the American Fisheries Society, 133: 26-33.

Beamish, R. J., D. J. Noakes, G. A. McFarlane, L. Klyashtorin, V. V. Ivanov & V. Kurashov. 1999. The regime concept and natural trends in the production of Pacific salmon. Canadian Journal of Fisheries and Aquatic Sciences, 56: 516-526.

Beamish, R. J., D. J. Noakes, G. A. McFarlane, W. Pinnix, R. Sweeting & J. King. 2000. Trends in coho marine survival and relation to the regime concept. Fisheries Oceanography, 9: 114-119.

Becker, G. & I. Reining. 2007. Information on coho salmon distribution in coast streams south of San Francisco. Center or Ecosystem Management and Restoration.

Beechie, T. J., E. A. Steel, P. Roni & E. Quimby. 2003. Ecosystem recovery planning for listed salmon: an integrated assessment approach for salmon habitat. pp. 183: National Marine Fisheries Service.

Behnke, R. J. 1980. Salmo gairdneri (Richardson), Rainbow trout. In: D.S. Lee et al. ,Atlas of North American Freshwater Fishes. North Carolina Museum of Natural History Raleigh NC. pp. 106.

Bell, C. 2003. Evaluation of Garcia River Restoration with Recommendations for Future Projects. Prepared for the California Department of Fish and Game by Craig Bell of Trout Unlimited.

Bell, E. 2001. Survival, growth and movement of juvenile coho salmon (Oncorhyncus kisutch) over-wintering in alcoves, backwaters, and main channel pools in Prairie Creek, California. Humboldt State University, Arcata, CA.

Bell, E. & W. G. Duffy. 2007. Previously undocumented two-year freshwater residency of juvenile coho salmon in Prairie Creek, California. Transactions of the American Fisheries Society, 136: 966-970.

Bisson, P. A., R. E. Bilby, M. D. Bryant, C. A. Dolloff, G. B. Grette, R. A. House, M. L. Murphy, K. V. Koski & J. R. Sedell. 1987. Large woody debris in forested streams in the Pacific Northwest: Past, present, and future. In: Streamside management: forestry and fishery interactions (Ed. by Salo, E. O. & Cundy, T. W.). pp. 143-190.

Bisson, P. A. & G. E. Davis. 1976. Production of juvenile chinook salmon, Oncorhynchus tshawytcha, in a heated model stream. Fishery Bulletin, 74: 763-774.

Bjorkstedt, E. P., B. C. Spence, J. C. Garza, D. G. Hankin, D. Fuller, W. E. Jones, J. J. Smith & R. Macedo. 2005. An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the north-central California coast recovery domain. U.S.

Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-382. 210 pp.

Boehlert, G. W., G. R. McMurray & C. E. Tortorici (editors). 2008. Ecological effects of wave energy in the Pacific Northwest. National Marine Fisheries Service. 174 pp.

Boesch, D. F., J. N. Butler, D. A. Cacchione, J. R. Geraci, J. M. Neff, J. P. Ray & J. M. Teal. 1987. An assessment of the long-term environmental effects of U.S. offshore oil and gas development activities: future research needs. In: Long-term Environmental Effects of Offshore Oil and Gas Development (Ed. by Boesch, D. F. & Rabalais, N. N.). Elsevier Applied Science. London. pp. 1-53.

Bograd, S. 2007. Email from S. Bograd to J. Weeder with 5 page attachment. December 11, 2007.

Boydstun, L. B. & T. McDonald. 2005. Action plan for Monitoring California's coastal salmonids. Final report to NOAA Fisheries, Santa Cruz, CA. NOAA Fisheries, Santa Cruz, CA.

Contract Number WASC-3-1295. 78 pp. plus appendices pp.

Bradford, M. J. 1995. Comparative review of Pacific salmon survival rates. Canadian Journal of Fisheries and Aquatic Sciences, 52: 1327-1338.

Brannon, E. L. & A. W. Maki. 1996. The Exxon Valdez oil spill: analysis of impacts on the Prince William Sound pink salmon. Reviews in Fisheries Science, 4: 289-337.

Brewer, P. G. & J. Barry. 2008. Rising acidity in the ocean, the other CO2 problem. Scientific American.

Brown, L. R. & P. B. Moyle. 1991. Status of Coho Salmon in California. Department of Wildlife and Fisheries Biology, University of California Davis. Prepared for the National Marine Fisheries Service. 89 pp.

Brown, L. R., P. B. Moyle & R. M. Yoshiyama. 1994. Historical Decline and Current Status of Coho Salmon in California. North American Journal of Fisheries Management, 14: 237–261.

Brown, R. F. & B. R. Mate. 1983. Abundance, movements and feeding habits of harbor seals (Phoca vitulina) at Netarts and Tillamook bays, Oregon. NOAA Fishery Bulletin, 81: 291–301.

Bryant, G. J. 1994. Status review of coho salmon populations in Scott and Waddell Creeks, Santa Cruz County, California. National Marine Fisheries Services Southwest Region, Santa Rosa. 102 pp.

Buchanan, D. V., J. E. Sanders, J. L. Zinn & J. L. Fryer. 1983. Relative susceptibility of four strains of summer steelhead to infection by Ceratomyxa shasta. Transactions of the American Fisheries Society, 112: 541-543.

Bureau of National Affairs Inc. 1994. Memorandum of understanding between federal agencies on implementation of the Endangered Species Act, signed September 28, 1994. Daily Environmental Report, 188 (July-December): E-1.

Burgett, J. 2009. Climate Change and its Implications for Conservation and Policy. In: Presentation given at Climate Change, Natural Resources, and Coastal Management Workshop. 29 January 2009. San Francisco, CA.

Burns, J. W. 1972. Some effects of logging and associated road construction on northern California streams. Transactions of the American Fisheries Society, 101: 1-17.

Bustard, D. R. & D. W. Narver. 1975. Aspects of the winter ecology of juvenile coho salmon (Oncorhynchus kisutch) and steelhead trout (Salmo gairdneri). Journal of the Fisheries Research Board of Canada 32: 667-680.

California Climate Action Registry. http://www.climateregistry.org/.

California Department of Forestry & Fire Protection. 2008. Final environmental impact report for the Jackson Demonstration State Forest management plan. California State Board of Forestry & Fire Protection, SCH# 2004022025.

California Water Code. 17. http://www.leginfo.ca.gov/calaw.html

Carranco, L. & J. Labbe. 1975. Logging the Redwoods. The Caxton Printers, Ltd. Caldwell, Idaho.

Casola, J. H., J. E. Kay, A. K. Snover, R. A. Norheim, L. C. W. Binder & C. I. Group. 2005. Climate impacts on Washington's hydropower, water supply, forests, fish, and agriculture. Center for Science in the Earth System, Joint institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, Washington. 44 pp.

CDF. 2008. Jackson Demonstration State Forest management plan. California Department of Forestry and Fire Protection. 291 pp.

Chartrand, S., B. Hecht & D. Shaw. 2003. Soquel Creek watershed assessment: geomorphology and baseflow hydrology. Prepared by Balance Hydrologics, Inc. for the Santa Cruz County Resource Conservation District, Santa Cruz County, California. In addition to figures, 89 pp.

Circuit Rider Productions Inc., Sonoma State University Department of Biology & U. o. C. B. D. o. I. Biology. 2001? Giant reed (Arundo donax) in the Russian River watershed: invasion status, impacts and effective control methods. 12 pp.

Clark, R. N. & D. R. Gibbons. 1991. Recreation. In: Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats (Ed. by Meehan, W. R.). American Fisheries Society, Special Publication 19. Bethesda MD.

Coey, R. Personal communication from R. Coey, former DFG supervisory fishery biologist.

Coey, R., S. Nossaman-Pearce, C. Brooks & Z. Young. 2002. 2002 Draft Russian River Basin Fisheries Restoration Plan. California Department of Fish and Game. 133 pp.

Cole, J. 2000. Coastal sea surface temperature and coho salmon production off the north-west United States. Fisheries Oceanography, 9: 1-16.

Conrad, M. T., S. Chartrand & J. Owens. 2003. Gazos Creek Watershed Assessment and Enhancement Plan. Coastal Watershed Council, Santa Cruz CA, and Balance Hydrologics, Berkeley CA; prepared for the Coastal Watershed Council. 92 pp.

Conrad, M. T. & J. Dvorsky. 2003. Aptos Creek Watershed Assessment and Enhancement Plan. Coastal Watershed Council and Swanson Hydrology & Geomorphology , Santa Cruz CA; prepared for the Coastal Watershed Council. 101 pp.

Cooney, R. T., J. R. Allen, M. A. Bishop, D. L. Eslinger, T. Kline, B. L. Norcross, C. P. McRoy, J. Milton, V. Patrick, A. J. Paul, D. Salmon, D. Scheel, G. L. Thomas, S. L. Vaughan & T. M. Willette. 2001. Ecosystem control of juvenile pink salmon (Onchorynchus gorbuscha) and Pacific herring (Clupea pallasi) populations in Prince William Sound, Alaska: Sound Ecosystem Assessment (SEA). Fisheries Oceanography, 10: 1-13.

County of Santa Cruz. 1976. Preliminary Report San Lorenzo Watershed Planning Process

. 49-56 pp.

County of Santa Cruz. 2001. Draft San Lorenzo River watershed management plan update. Santa Cruz, California, County of Santa Cruz Water Resources Program, Environmental Health Services, and Planning Department. 82 pp.

Crawford, B. A. & S. Rumsey. 2009. Guidance for monitoring recovery of Pacific Northwest salmon and steelhead listed under the Federal Endangered Species Act (Idaho, Oregon, and Washington). National Marine Fisheries Service, Northwest region. 129 pp.

Cury, P. & C. Roy. 1989. Optimal environmental window and pelagic fish recruitment success in upwelling areas. Canadian Journal of Fisheries and Aquatic Sciences, 46: 670-680.

D. W. Alley and Associates. 2009. Soquel Creek lagoon monitoring report, 2008. Prepared for the City of Capitola, Capitola, California, Project #106-18. 145 pp.

Dawson, A. 1998. From Arrowhead Mountain to Yulupa: The Stories Behind Sonoma Valley Place Names. Kulupi Press. Glen Ellen, California.

Dawson, A. 2002. The Oral History Project; A report on the Sonoma Ecology Center's Oral History Project, focusing on Sonoma Creek and the historical ecology of Sonoma Valley. Includes interview transcripts, appendixes & maps. Sonoma Ecology Center, Sonoma, California. 330 pp.

Deiner, K., J. C. Garza, R. Coey & D. J. Girman. 2006. Population structure and genetic diversity of trout (Oncorhynchus mykiss) above and below natural and man-made barriers in the Russian River, California. Conservation Genetics, 8: 437-454. DFG. Coastal Watershed Planning and Assessment Program;

DFG. 1969. The Russian River drainage - a summary report on the fish and wildlife resources and their problems. Prepared by the California Department of Fish and Game, Inland Fisheries and Wildlife staffs, Region 3, under the supervision of Elden H. Vestal and Robert W. Lassen. 21 pp.

DFG. 2000. Annual performance report: federal aid in Sport Fish Restoration Act. California Department of Fish & Game. Grant title: inland and anadromous sport fish management and research. Grant agreement F-52-R-13. Project No. 22: north central district salmon and steelhead management. Job No. 5: evaluation of hatchery coho releases.

DFG. 2002. Status review of California coho salmon north of San Francisco bay. Report to the California Fish and Game Commission. California Department of Fish and Game, Sacramento, California. 234 pp.

DFG. 2004. Recovery Strategy for California Coho Salmon. Report to the California Fish and Game Commission. California Department of Fish & Game, Sacramento CA. 594 pp.

DFG. 2005. Status Review of Coho Salmon (Oncorhynchus kisutch) in California South of San Francisco. Report to the Fish and Game Commission. California Department of Fish and Game.

DFG. 2006. Stream inventory report: Soldier Creek. California Department of Fish & Game. 24 pp.

DFG. 2006. Stream inventory report: Hotel Gulch. California Department of Fish & Game. 25 pp.

DFG. 2006. Stream inventory report: Bear Creek. California Department of Fish & Game. 25 pp. http://coastalwatersheds.ca.gov/Portals/1/Watersheds/NorthCoast/MendocinoCoast/docs/UsalWages/BearCreek_2006_StreamInvRpt.pdf

DFG. 2006. Stream inventory report: Usal Creek. California Department of Fish & Game. 25 pp. http://coastalwatersheds.ca.gov/Portals/1/Watersheds/NorthCoast/MendocinoCoast/docs/UsalWages/UsalCreek_2006_StreamInvRpt.pdf

DFG. 2006. Stream inventory report: south fork Usal Creek. California Department of Fish & Game. 27 pp.

DFG. 2006. Stream inventory report: Julias Creek. California Department of Fish & Game. 24 pp.

DFG. 2006. Stream inventory report: Little Bear Creek. California Department of Fish & Game. 24 pp.

DFG. 2006. Stream inventory report: Shady Dell. 23.

DFG. 2006. Stream inventory report: Mark West Creek. California Department of Fish and Game. 17 pp.

DFG. 2006. Stream inventory report: Matanzas Creek. California Department of Fish and Game. 12 pp.

DFG. 2006. Stream inventory report: Santa Rosa Creek. California Department of Fish and Game. 27 pp.

DFG. 2007. 2007-2008 California freshwater sport fishing regulations. California Department of Fish and Game.

DFG. 2008. Master Plan for Marine Protected Areas. California Department of Fish and Game.

DFG & NMFS. 2002. Guidelines for Maintaining Instream Flows to Protect Fisheries Resources Downstream of Water Diversions in Mid-California Coastal Streams, Draft. California Department of Fish and Game, Sacramento CA, and National Marine Fisheries Services, Southwest Region, Santa Rosa CA. 23 pp.

Donahue, D. L. 1999. The western range revisited; removing livestock from public lands to conserve native biodiversity. Legal History of North America Series (Vol. 5). University of Oklahoma Press. Norman OK. 352 pp.

Downie, S., B. deWaard, E. Dudik, D. McGuire & R. Rutland. 2006. Big River Basin Assessment Report. North Coast Watershed Assessment Program, California Resources Agency, and California Environmental Protection Agency, Sacramento CA. approx. 400 pp.

Downie, S. T., C. M. LeDoux-Bloom, K. Spivak & F. Yee. 2004. Albion Basin Assessment Report. North Coast Watershed Assessment Program. California Resources Agency, and California Environmental Protection Agency, Sacramento CA. 218 pp.

Dunne, G. c. 1990. Pioneer Spirit: A History of the Winterhalder Family in Santa Cruz County.

Dunne, G. no date. 1001 Stagnaros.

Dunne, T., J. Agee, S. Beissinger, W. E. Dietrich, D. Gray, M. E. Power, V. H. Resh & K. Rodriques. 2001. A scientific basis for the prediction of cumulative watershed effects. University of California, Berkeley. 103 pp.

Dykstra, C. 2007. Personal communication. Survey manager, International Pacific Halibut Commission.

Emmett, R. L. & D. B. Sampson. 2007. The relationships between predatory fishes, forage fishes, and juvenile salmonid marine survival off the Columbia River: a simple trophic model analysis. California Cooperative Oceanic Fisheries Investigations Reports, 48: 92-105.

Emmett, R. L., S. L. Stone, S. A. Hinton & M. E. Monaco. 1991. Distribution and Abundance of Fishes and Invertebrates in West Coast Estuaries. Volume II: Species Life History Summaries. National Oceanic and Atmospheric Administration, National Ocean Service, Strategic Environmental Assessments Division, Rockville, MD, ELMR Report Number 8. 334 pp.

ENTRIX Inc. 2004. Russian River biological assessment. Prepared for U.S. Army Corps of Engineers, San Francisco District, and Sonoma County Water Agency.

Entrix Inc., Pacific Watershed Associates, Circuit Rider Productions Inc., Navarro Watershed Community Advisory Group & D. T. Sicular. 1998. Navarro Watershed Restoration Plan. Published jointly by Anderson Valley Land Trust Inc., California State Coastal Conservancy, and Mendocino County Water Agency. 544 pp.

Environmental Science Associates, Pacific Watershed Associates, O'Connor Environmental Inc., Albion Environmental Inc. & D. Jackson. 2004. Pescadero-Butano Watershed Assessment. Final report prepared for Monterey Bay National Marine Sanctuary Foundation, Monterey CA. 248 pp.

EPA. 1998. Garcia River sediment total maximum daily load. U.S. Environmental Protection Agency, Region IX. 20 pp.

EPA. 1999. Noyo River Total Maximum Daily Load for Sediment. U.S. Environmental Protection Agency, Region IX. 87 pp.

EPA. 2000. Navarro River total maximum daily loads for temperature and sediment. U.S. Environmental Protection Agency, Region IX. 45 pp.

EPA. 2000. Ten Mile River total maximum daily load for sediment. U.S. Environmental Protection Agency, Region IX. 86 pp.

Ettlinger, E., E. Childress, M. Piovarcsik & G. Andrew. 2008. Lagunitas Creek Salmon Spawner Report 2007 - 2008. Prepared for the Marin Municipal Water District.

Fimrite, P. 2008. Scientists thrilled by surprising find of fish. In: San Francisco Chronicle, pp. 1. San Francisco.

Fisher, J. P. & W. G. Pearcy. 1988. Growth of juvenile coho salmon (Oncorhynchus kisutch) off Oregon and Washington, USA, in years of differing coastal upwelling. Canadian Journal of Fisheries and Aquatic Sciences, 45: 1036-1044.

Florsheim, J. L. & P. Goodwin. 1993. Geomorphic and hydrologic conditions in the Russian River, California: historic trends and existing conditions. Prepared by Philip Williams & Associates, Ltd. for the California State Coastal Conservancy and the Mendocino County Water Agency, #791/813.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey & B. Collins. 1998. California salmonid stream habitat restoration manual. California Department of Fish & Game.

Furniss, M. J., T. D. Roelofs & C. S. Yee. 1991. Road construction and maintenance. In: Influences of forest and rangeland management on salmonid fishes and their habitats (Ed. by Meehan, W. R.). American Fisheries Society, Special Publication 19. Bethesda, MD. pp. 297-324.

Garza, J. C. & E. Gilbert-Horvath. 2003. Report on the genetics of coho salmon (Oncorhynchus kisutch) held at Warm Springs (Don Clausen) hatchery for recovery efforts in the Russian River. Santa Cruz Laboratory, NOAA Southwest Fisheries Science Center. 15 pp.

Georgia-Pacific & Campbell Timberland Management. 1993-1999. Unpublished fishery monitoring data from streams in the Noyo River watershed.

Gibson, R. E. 1994. San Lorenzo Once was Full of Fish: The River was Santa Cruz's No. 2 Tourist Draw. In: San Jose Mercury News, pp. 1.

Gobalet, K. W. 2008. Response to communication of James Buchal.

Gobalet, K. W. 2008 in press.

Gobalet, K. W., P. D. Schulz, T. A. Wake & N. Siefkin. 2004. Archaeological Perspectives on Native American Fisheries of California, with Emphasis on Steelhead and Salmon. Trans. AM. Fish. Soc., 133: 801-833.

Godfrey, H. 1965. Salmon of the North Pacific ocean. Part IX. Coho, chinook and masu salmon in offshore waters. 1. Coho salmon in offshore waters. Int. N. Pac. Fish. Comm. Bull., 16: 1-39.

Gold Ridge Resource Conservation District & Prunuske Chatham Inc. 2007. The Salmon Creek watershed assessment and restoration plan. Prepared by Lisa Hulette, Patricia Hickey, and Brittany Heck at Gold Ridge RCD and Lauren Hammack and Chris Choo at Prunuske Chatham, Inc., Occidental, California. 92 pp.

Goley, D. & A. Gemmer. 2000. Pinniped/salmonid interactions on the Smith, Mad and Eel rivers in northern California between 31 August and 15 December 1999. Unpublished report. Humboldt State University Marine Mammal Education and Research Program, Arcata, California.

Good, T. P., R. S. Waples & P. B. Adams. 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, NMFS-NWFSC-66. 598 pp.

Gordon Jr., D. C. & N. J. Prouse. 1973. The effects of three oils on marine phytoplankton photosynthesis. Marine Biology, 22: 329-333.

Graham Matthews & Associates. 2004. Project scale effectiveness monitoring for the south fork Wages Creek watershed. Prepared for Campbell Timberland Management and California Department of Forestry and Fire Protection, Fort Bragg, California. 46 pp.

Groot, C. & L. Margolis. 1991. Pacific Salmon Life Histories. University of British Columbia Press. Vancouver, British Columbia.

Grover, A. M., M. S. Mohr & M. L. Palmer-Zwahlen. 2002. Hook-and-release mortality of chinook salmon from drift mooching with circle hooks: Management implications for California's ocean sport fishery. American Fisheries Society Symposium: 39-56.

Gunsolus, R. T. 1978. The status of Oregon coho and recommendations for managing the production, harvest and escapement of wild and hatchery-reared stocks. Oregon Department of Fish and Wildlife Proceedings Report. Oregon Department of Fish and Wildlife.

Hagans, D. & W. E. Weaver. 1994. Handbook for forest and ranch roads: a guide for planning, designing, constructing, reconstructing, maintaining and closing wildland roads. Prepared for the Mendocino County Resource Conservation District in cooperation with the California Department of Forestry and the U.S.D.A. Soil Conservation Service. 198 pp.

Hallock, R. J. & D. H. Fry, Jr. 1967. Five species of salmon, Oncorhynchus, in the Sacramento River, California. California Fish and Game, 53: 5-22.

Hamilton, J. & B. Konar. 2007. Implications of substrate complexity and kelp variability for south-central Alaska nearshore fish communities. Fishery Bulletin, 105: 189-196.

Hanson, L. C. 1993. The foraging ecology of harbor seals, Phoca vitulina, and California sea lions, Zalophus californianus, at the mouth of the Russian River, California. Sonoma State University, Rohnert Park, California.

Hare, J. A. & P. E. Whitfield. 2003. An integrated assessment of the introduction of lionfish (Pterois volitans/miles complex) to the western Atlantic Ocean. NOAA Technical Memorandum NOS NCCOS 2. 21 pp.

Hare, S. R. & R. C. Francis. 1995. Climate change and salmon production in the northeast Pacific Ocean. In: Climate change and northern fish populations (Ed. by Beamish, R. J.). Canadian Special Publication of Fisheries and Aquatic Sciences 121. pp. 357- 372.

Hartt, A. C. 1980. Juvenile salmonids in the oceanic ecosystem: the first critical summer. In: Salmonid ecosystems of the North Pacific (Ed. by McNeil, W. J. & Himsworth, D. C.). Oregon State University Press. Corvallis, Oregon. pp. 25-37.

Hassler, T. J. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest) coho salmon. Humboldt State University, California Cooperative Fishery Research Unit; U.S. Fish and Wildlife Service, National Wetland Research Center, Slidell, LA for U.S. Army Corps of Engineers, Coastal Ecology Group, Waterways Experiment Station and for U.S. Department of the Interior, Fish and Wildlife Service, Research and Development, National Wetlands Research Center, Washington, DC, Arcata, USFWS Biological Report 82 (11.70); COE report TR EL-82-4. 19 pp.

Healy, M. C. 1980. The ecology of juvenile salmon in Georgia Strait, British Columbia. In: Salmonid ecosystems of the North Pacific (Ed. by McNeil, W. J. & Himsworth, D. C.). Oregon State University Press. Corvallis, OR. pp. 203-229.

Hecht, B. & G. Kittleson. 1998. An Assessment of Streambed Conditions and Erosion Control Efforts in the San Lorenzo River Watershed, Santa Cruz County, California. Balance Hydrologics, Inc., Berkeley CA; prepared for Environmental Health Dept., Santa Cruz County. 114 pp.

Higgins, C. G. 1952. Lower course of the Russian River, California. University of California Press. Berkeley and Los Angeles. pp. 216-225.

Higgins, P. 1996. Russian River winter creel census and spawning survey. Sotoyome - Santa Rosa Resource Conservation District, Santa Rosa, California. 15 pp.

Hobday, A. J. & G. W. Boehlert. 2001. The role of coastal ocean variation in spatioal and temporal patterns in survival and size of coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences, 58: 2021-2036.

Holtby, L. B. 1988. Effects of logging on stream temperatures in Carnation Creek, British Columbia, and associated impacts on the coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences, 45: 502-515.

Holtby, L. B., B. C. Andersen & R. K. Kadowaki. 1990. Importance of smolt size and early ocean growth to interannual variability in marine survival of coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences, 47: 2181-2194.

Hope, D. 1993. Executive Summary, 1993 Petition to list South of San Francisco Coho. North Coast Regional Waterboard, Santa Rosa CA.

Hopkirk, J. D. & P. T. Northen. 1980. Technical report on fisheries of the Russian River. Part of the aggregate resources management study conducted by the county of Sonoma. Sonoma County Planning Department. 30 pp.

Hose, J. E., M. D. McGurk, M. G. D., D. E. Hinton, E. D. Brown & T. T. Baker. 1996. Sublethal effects of the Exxon Valdez oil spill on herring embryos and larvae: morphological, cytogenetic, and histopathological assessments, 1989, 1991. Canadian Journal of Fisheries and Aquatic Sciences, 53: 2355-2365.

House, F. 1998. Totem Salmon: Life Lessons from Another Species. Beacon Press. Boston.

Hyden Associates Landscape Architecture & Golden Bear Biostudies. 1993? City of Sebastopol Laguna de Santa Rosa Park Master Plan. Volume 1: master plan. City of Sebastopol, Sebastopol, California. 48 pp.

Hyden Associates Landscape Architecture & Golden Bear Biostudies. 1993? City of Sebastopol Laguna de Santa Rosa Park Master Plan. Volume 2: technical information., Sebastopol, California. 66 pp.

Intergovernmental Panel on Climate Change. 2007. Climate Change 2007 Synthesis Report: Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change, Geneva, Switzerland. 104 pp.

Janssen, H. 2008. Interview Transcript. Sonoma Ecology Center.

Johnson, D. H., B. M. Shrier, J. S. O'Neal, J. A. Knutzen, X. Augerot, T. A. O'Neil & T. N. Pearsons. 2007. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society. Bethesda, Maryland.

Johnson, S. L. 1988. The effects of the 1983 El Niño on Oregon's coho, Oncorhynchus kisutch, and chinook, O. tshawytscha, salmon. Fisheries Research, 6: 105-123.

Johnson, S. W., M. L. Murphy, D. J. Csepp, P. M. Harris & J. F. Thedinga. 2003. A survey of fish assemblages in eelgrass and kelp habitats of Southeastern Alaska. National Marine Fisheries Service, NOAA Technical Memorandum: NMFS-AFSC-139.

Koslow, J. A., A. J. Hobday & G. W. Boehlert. 2002. Climate variability and marine survival of coho salmon (Oncorhynchus kisutch) in the Oregon production area. Fisheries Oceanography 11: 65-77.

Kovalchik, B. L. & W. Elmore. 1992. Effects of cattle grazing systems on willow-dominated plant associations in central Oregon In: Proceedings--ecology and management of riparian shrub communities, 1991 May 29-31, Sun Valley ID. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Gen. Tech. Rep. INT-289, 111-119 pp.

Kruzic, L. M., D. L. Scarnecchia & B. B. Roper. 2001. Comparison of midsummer survival and growth of age-0 hatchery coho salmon held in pools and riffles. Transactions of the American Fisheries Society.

Larsen, D. P., A. R. Olsen & D. L. Stevens. 2008. A regional approach to monitoring salmonid abundance trends: A pilot project for the application of the California Coastal Salmonid Monitoring Plan in coastal Mendocino County, Year III. California Department of Fish and Game, Coastal Watershed Planning and Assessment Program, Fortuna, CA.

Laurel Marcus and Associates. 2004. Fish Friendly Farming;

Lawson, P. W. 1993. Cycles in ocean productivity, trends in habitat quality, and the restoration of salmon runs in Oregon. Fisheries, 18: 6-10.

Leaman, B. 2007. Personal communication. Executive Director, International Pacific Halibut Commission.

Lehmann, S. 2000. Fully Developed Context Statement for the City of Santa Cruz. prepared for the City of Santa Cruz Planning and Development Department.

Leidy, R. A. 2007. Ecology, Assemblage Structure, Distribution, and Status of Fishes in Streams Tributary to the San Francisco Estuary. San Francisco Estuary Institute.

Leidy, R. A., G. Becker & B. N. Harvey. 2005. Historical Status of Coho Salmon in Streams of the Urbanized San Francisco Estuary, California. California Fish and Game, 91: 219-254.

Levene, B., W. Brad, L. Krasner, G. Petrykowski & R. Zucker. 1976. Mendocino County Remembered: An Oral History. Mendocino County Historical Society. Mendocino County.

Ligon, F., A. Rich, G. Rynearson, D. Thornburgh & W. Trush. 1999. Report of the scientific review panel on California Forest Practice Rules and salmonid habitat. The Resources Agency of California and the National Marine Fisheries Service, Sacramento. 21 pp.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson & J. G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramneto-San Joaquin basin;

Little Hoover Commission. 1994. Timber Harvest Plans: A Flawed Effort to Balance Economic and Environmental Needs. Report #126. State of California.

Logerwell, E. A., P. W. Mantua, P. W. Lawson, R. C. Francis & V. N. Agostini. 2003. Tracking environmental processes in the coastal zone for understanding and predicting Oregon coho (Onchorhynchus kisutch) marine survival. Fisheries Oceanography, 12: 554-568.

Louisiana-Pacific Corporation. 1997. Sustained yield plan for coastal Mendocino County. Samoa, California.

Lufkin, A. 1991. California's Salmon and Steelhead: The Struggle to Restore an Imperiled Resource. University of California Press. Berkeley.

Lydon, S. 2008. (personal communication via email). (Ed. by Dawson, A.), pp. author is Historian Emeritus, Cabrillo College, Aptos.

MacFarlane, R. B., S. Hayes & B. Wells. 2008. Coho and Chinook Salmon Decline in California during the Spawning Seasons of 2007/08. Unpublished memo. National Marine Fisheries Service, Southwest Fisheries Science Center 6pp.

Mantua, N. J., S. R. Hare, Y. Zhang, J. M. Wallace & R. C. Francis. 1997. A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society, 78: 1069-1079.

Marcus, L. a. A. 2004. Watershed Assessment Atascadero Green Valley Creek Watershed. prepared for Gold Ridge Resource Conservation District.

Mark West Creek Associates. 2003. The preservation of Mark West Creek. Prepared in 1973 by students at California State College, Sonoma and Chico. Reprinted in 2003 by The Alpine Club, Inc. 25 pp.

Mathews, S. B. & R. Buckley. 1976. Marine mortality of Puget Sound coho salmon (Oncorhynchus kisutch). Journal of the Fisheries Research Board of Canada, 33: 1677-1684.

McBain and Trush & Trout Unlimited. 2000. Allocating streamflows to protect and recover threatened salmon and steelhead populations in the Russian River and other northcoast rivers of California. Commentary No. 3. In addition to appendices, 41 pp.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright & E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionary significant units. United States Department of Commerce, National Oceanic Atmospheric Administration, National Marine Fisheries Service, Resource Enhancement and Utilization Technologies Division, Northwest Fisheries Science Center, Santa Cruz/Tiburon Laboratory, Salmon Analysis Branch, Southwest Fisheries Science Center, NMFS-NWFSC-42. 158 pp.

McMahon, D. 1997. Floods and Flood Control on the San Lorenzo River in the City of Santa Cruz.

McMahon, T. E. & G. Hartman. 1989. Influence of cover complexity and current velocity on winter habitat use by juvenile coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences, 46: 1551-1557.

Meehan, W. R. (editors). 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. Special Publications (American Fisheries Society), No. 19. American Fisheries Society, Bethesda MD, 09-132-35687. 751 pp.

Meehan, W. R. & T. C. Bjornn. 1991. Salmonid distribution and life histories. In: Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats (Ed. by Meehan, W. R.). American Fisheries Society, Special Publication 19. Bethesda MD. pp. 47-82.

Mendocino County Resource Conservation District. 1992. Garcia River watershed enhancement plan. Prepared for the California State Coastal Conservancy by Mendocino County Resource Conservation District; report prepared by Jack Monschke Watershed Management, Debra Caldon, William M. Kier Associates, Ukiah, California. Approx. 122 pp.

Mendocino Redwood Company. 2004. Watershed analysis for Mendocino Redwood Company's ownership in the Garcia River watershed.

Mendocino Redwood Company. 2004. Watershed analysis for Mendocino Redwood Company's ownership in the Albion River watershed.

Mendocino Redwood Company. 2005. Watershed Analysis for Mendocino Redwood Company’s Ownership in the Cottaneva Creek Watershed. Mendocino Redwood Co., LLC, Ukiah CA. approx. 100 pp. http://www.mrc.com/monitoring/cottaneva_creek_watershed.html

Mendocino-Beacon. 1890. Untitled. Issue date: February 22, 1890. In: Mendocino Beacon. Mendocino, California.

Merritt-Smith-Consulting. 1996. Santa Rosa Subregional Long-Term Wastewater Project, Anadromous Fish Migration Study Program reports. Circuit Rider Productions, Inc, Lafayette, CA.

Moles, A. & S. D. Rice. 1983. Effects of crude oil and naphthalene on growth, caloric content, and fat content of pink salmon juveniles in seawater. Transactions of the American Fisheries Society, 112: 205-211.

Monschke, J., D. Caldon, Mendocino County Resource Conservation District, W. Management & K. Associates. 1992. Garcia River Watershed Enhancement Plan. prepared for the California State Coastal Conservancy, Ukiah, CA.

Mortensen, D., A. Wertheimer, S. Taylor & J. Landingham. 2000. The relation between early marine growth of pink salmon, Oncorhynchus gorbuscha, and marine water temperature, secondary production, and survival to adulthood. Fishery Bulletin: 319-335.

Moyle, P. B. 2002. Inland fishes of California. University of California Press. Berekely and Los Angeles, CA. 502 pp.

Moyle, P. B., J. A. Israel & S. Purdy. 2008. SOS: California's Native Fish Crisis: Status and Solutions for Restoring Our Vital Salmon, Steelhead, and Trout Populations. commissioned by California Trout.

Munro-Fraser, J. P. 1880. History of Sonoma County: including its geology, topography, mountains, valleys and streams; together with a full and particular record of the Spanish grants; its early history and settlement. Alley, Bowen & Co. San Francisco.

Murray Dam Committee. 1997? Application for Department of Army Permit for summer dam at Murray's Camp on Austin Creek.

National land cover data. 2001. Multi-vector consortium.

National Research Council. 1996. Upstream: Salmon and society in the Pacific Northwest. National Academy Press. Washington, D.C. 451 pp.

National Research Council. 2003. Oil in the Sea III: Inputs, Fates, and Effects. National Academies Press. Washington, D.C.

Nelson, J. & P. Anderson. 1996. Stream-Specific Coho Salmon Habitat Deficiencies and Limitations, Coastal Streams of San Mateo and Santa Cruz Counties Currently Supporting Coho Salmon or Under Consideration for Coho Salmon Recovery Efforts. California Department of Fish and Game, Region 3, Monterey; prepared for Environmental Services Division, Sacramento CA. 80 pp.

Nelson, J., E. Baglivio & T. Kahles. 2007. Baseline assessment of juvenile salmonid populations in Bogess Creek, Harrington Creek and La Honda Creek, tributaries to San Gregorio Creek, 2007. California Department of Fish & Game and California Conservation Corps. In addition to data tables, 24 pp.

Nelson, R. L., M. L. McHenry & W. S. Platts. 1991. Mining. In: Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats (Ed. by Meehan, W. R.). American Fisheries Society, Special Publication 19. Bethesda MD. pp. 425-482.

Nickelson, T. E. 1986. Influences of upwelling, ocean temperature, and smolt abundance on marine survival of coho salmon (Oncorhynchus kisutch) in the Oregon Production Area. Canadian Journal of Fisheries and Aquatic Sciences, 43: 527-535.

Nickelson, T. E., J. D. Rodgers, S. L. Johnson & M. F. Solazzi. 1992. Seasonal changes in habitat use by juvenile coho salmon (Oncorhynchus kisutch) in Oregon coastal streams. Can. J. Fish. Aquat. Sci., 49: 783-789.

NMFS. 1997. Investigation of scientific information on the impacts of California sea lions and pacific harbor seals on salmonids and on the coastal ecosystems of Washington, Oregon, and California. National Marine Fisheries Service, Northwest Fisheries Science Center and Northwest Region, Seattle WA, NOAA Tech. Memo. NMFS-NWFSC-28. 172 pp.

NMFS. 1998. Factors Contributing to the Decline of Chinook Salmon: An Addendum to the 1996 West Coast Steelhead Factors for Decline Report. National Marine Fisheries Service, Portland OR. 71 pp.

NMFS. 1999a. Supplemental Biological Opinion and Incidental Take Statement: The Pacific Coast Salmon Plan and Amendment 13 to the Plan. National Marine Fisheries Service, Northwest and Southwest Regional Sustainable Fisheries Divisions.

NMFS. 1999b. Biological Opinion: Fishing conducted under the Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery. National Marine Fisheries Service.

NMFS. 2001a. Guidelines for salmonid passage at stream crossings. pp. 14: National Marine Fisheries Service, Southwest Region. http://swr.nmfs.noaa.gov/hcd/NMFSSCG.PDF

NMFS. 2001b. Status review update for coho salmon (Oncorhynchus kistuch) from the central California coast and the California portion of the Southern Oregon/Northern California coasts evolutionarily significant units (revision). National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, CA. 40 pp.

NMFS. 2005a. Pacific Coast Groundfish Essential Fish Habitat (EFH) Final Environmental Impact Statement. National Marine Fisheries Service, Portland, OR.

NMFS. 2005b. Biological opinion for the proposed 2005 Pacific sardine harvest guideline.

NMFS. 2006a. Interim endangered and threatened species recovery planning guidance. National Marine Fisheries Service, Silver Spring, MD. 121 pp.

NMFS. 2006b. Strategic Plan, Fiscal Years 2007 through 2011. NOAA, National Marine Fisheries Service, Southwest Region, Protected Resources Division. 24 pp.

NMFS. Undated. Russian River basin anadromous fish stream guide. National Marine Fisheries Service, Habitat Conservation Branch, Santa Rosa, California. 47 pp.

NMFS & USFWS. 2005. Final recovery plan for the Gulf of Maine distinct population segment of Atlantic salmon (Salmo salar). National Marine Fisheries Service and US Fish and Wildlife Service, Northeastern Region.

NOAA. 2007. NOAA 10-Year Plan for the NOAA Aquaculture Program. National Oceanic and Atmospheric Administration http://www.aquaculture.noaa.gov

Norberg, B. 2009. Rare Coho Hooked in Fishing Contest. In: Santa Rosa Press Democrat. Santa Rosa, California.

Noss, R. F. & A. Cooperrider. 1994. Saving nature's legacy. Island Press. Washington DC. 443 pp.

O'Connor, M., B. Rosser & Circuit Rider Productions Inc. 2003. Green Valley Creek spawning substrate characterization and fluvial geomorphic analysis. Prepared for Sonoma County Water Agency, Healdsburg, California. 24 pp.

Oregon Department of Transportation. 1999. Routine road maintenance: Water quality and habitat guide, best management practices. Oregon Department of Transportation. 43 pp.

Oreskes, N. 2004. The scientific consensus on climate change. Science, 306: 1686.

Overton, C. K., G. L. Chandler & J. A. Pisano. 1994. Northern/Intermountain Regions' fish habitat inventory: grazed, rested, and ungrazed reference stream reaches, Silver King Creek, California. U. S. Department of Agriculture, Forest Service, Intermountain Research Station, General Technical Report INT-GTR-311. 28 pp.

Paddack, M. J. & J. A. Estes. 2000. Kelp forest fish populations in marine reserves and adjacent exploited areas of Central California. Ecological Applications, 10: 855-870.

Palmer-Zwahlen, M. 2007. Personal communication. California Department of Fish and Game biologist.

Pearcy, W. G. 1992. Ocean ecology of North Pacific salmonids. University of Washington Press. Seattle WA. 179 pp.

Pearcy, W. G. & J. P. Fisher. 1990. Distribution and abundance of juvenile salmonids off Oregon and Washington, 1981-1985. National Marine Fisheries Service, NOAA Technical Report NMFS 93.

Pert, H. A. 1993. Winter food habits of coastal juvenile steelhead and coho salmon in Pudding Creek, northern California. University of California, Berkeley, California.

Peterman, R. M. 1982. Model of salmon age and structure and its use in preseason forecasting and studies of marine survival. Canadian Journal of Fisheries and Aquatic Sciences, 39: 1444-1452.

Peterson, N. P. 1982. Immigration of juvenile coho salmon (Oncorhynchus kisutch) into riverine ponds. Canadian Journal of Fisheries and Aquatic Sciences, 39: 1308-1310.

Peterson, W. T., R. C. Hooff, C. A. Morgan, K. L. Hunter, E. Casillas & J. W. Ferguson. 2006. Ocean conditions and salmon survival in the Northern California Current. National Marine Fisheries Service, Northwest Fisheries Science Center, Fish Ecology Division, Newport, OR. http://www.nwfsc.noaa.gov/research/divisions/fed/ecosysrep.pdf

PFMC. 1998. Coastal Pelagic Species Fishery Management Plan (Amendment 8 to the Northern Anchovy Fishery Management Plan). Pacific Fishery Management Council.

PFMC. 2007. Preseason Report I: Stock abundance analysis for 2007 ocean salmon fisheries. Pacific Fishery Management Council, Portland, OR.

Philip Williams & Associates Ltd. 2001. Laguna de Santa Rosa feasibility study: year one geomorphic investigation. Final report. Volume 1. Prepared for the U.S. Army Corps of Engineers, San Francisco District, and Sonoma County Water Agency., PWA ref. #1411-08. 76 pp.

Philip Williams & Associates Ltd. 2004. Sediment sources, rate & fate in the Laguna de Santa Rosa, Sonoma, California. Prepared for U.S. Army Corps of Engineers, San Francisco District, and Sonoma County Water Agency, NOAA SR63426. PWA Ref. 1411.20 Laguna de Santa Rosa. Approx. 138 pp.

Phillips, R. W., R. L. Lantz, E. W. Claire & J. R. Moring. 1975. Some effects of gravel mixtures on emergence of coho salmon and steelhead trout fry. Trans. AM. Fish. Soc., 104: 461-466.

Pintler, H. E. & W. C. Johnson. 1958. Chemical control of rough fish in the Russian River drainage, California. California Fish and Game, 44: 91-124.

Prunuske Chatham Inc. 2001. Walker Creek watershed enhancement plan. Prepared for Marin County Resource Conservation District, Point Reyes Station, California. 101 pp.

PSMFC. 2008. California fish passage assessment database. www.calfish.org

Quinn, T. P. 2005. The behavior and ecology of Pacific salmon and trout. American Fisheries Society. Bethesda, MD. 378 pp.

Quinn, T. P. & N. P. Peterson. 1996. The influence of habitat complexity and fish size on over-winter survival and growth of individually marked juvenile coho salmon (Oncorhynchus kisutch) in Big Beef Creek, Washington. Can. J. Fish. Aquat., 53: 1555-1564.

Redwood City Times and Gazette. 1877. May 19. In: Redwood City Times and Gazette. Redwood City, California.

Redwood Forest Foundation Inc. 2007. Usal Redwood Forest; http://www.rffi.org/UsalRedwoodForest.html.

Reeves, G. H., F. H. Everest & J. D. Hall. 1987. Interactions between the redside shiner (Richardsonius balteatus) and the steelhead trout (Salmo gairdneri) in western Oregon: The influence of water temperature. Can. J. Fish. Aquat., 44: 1603-1613.

Resource Management Associates Inc. 1995. Simulation of water temperature within Lake Sonoma, Dry Creek and the Russian River. Prepared for the Sonoma County Water Agency, Suisun City, California. 23 pp.

Rich, A. 1997. Aggregate resources management plan for the upper Russian River, Mendocino County. Status of fishery resources. Prepared by A. A. Rich and Associates for Philip Williams & Associates., San Anselmo, California. In addition to appendices, 98 pp.

Ristow, P. L. 2006. California Dairies: Protecting Water Quality. University of California, Agriculture and Natural Resources Department, Davis CA, UC Publ. 21630. 16 pp.

Russell, S. & B. Levene. 1991. Voices and Dreams: A Mendocino County Native American Oral History. Mendocino County Library. Ukiah, CA.

Ryding, K. E. & J. R. Skalski. 1999. Multivariate regression relationships between ocean conditions and early marine survival of coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences, 56: 2374-2384.

Sandercock, F. K. 1991. Life history of coho salmon. In: Pacific Salmon Life Histories (Ed. by Groot, C. & Margolis, L.). University of British Columbia Press. Vancouver, B.C. pp. 397-445.

Sanders, J. E., J. J. Long, C. K. Arakawa, J. L. Bartholomew & J. S. Rohovec. 1992. Prevalence of Renibacterium salmoninarum among downstream-migrating salmonids in the Columbia River. Journal of Aquatic Animal Health, 4: 72-75.

Santa Cruz County Code. 2008. Title 13--Planning and zoning regulations. Chapter 13.14--Rural residential density determinations. Section 13.14.06--Matrix calculation. County of Santa Cruz, Santa Cruz, California.

Santa Cruz Sentinel. 1859. April 16. In: Santa Cruz Sentinel. Santa Cruz.

Santa Cruz Sentinel. 1864. April 16. In: Santa Cruz Sentinel. Santa Cruz.

Santa Cruz Sentinel. 1867. July 6. In: Santa Cruz Sentinel. Santa Cruz.

Santa Cruz Sentinel. 1871. May 20. In: Santa Cruz Sentinel. Santa Cruz.

Santa Cruz Sentinel. 1873. October 14. In: Santa Cruz Sentinel. Santa Cruz.

Santa Cruz Sentinel. 1877. November 17. In: Santa Cruz Sentinel. Santa Cruz, California.

Scheel, D. & K. R. Hough. 1997. Salmon fry predation by seabirds near an Alaskan hatchery. Marine Ecology Progress Series, 150: 45-48.

Scheffer, T. H. & C. C. Sperry. 1931. Food habits of the Pacific harbor seal, Phoca vitulina richardsi. Journal of Mammalogy, 12: 214–226.

Schmidt, E. 1997. Resource management planning for the Coast Dairies property: analysis if existing research and data resources. Prepared by the Land Trust of Santa Cruz County, December 15, 1997.

Schubert, J. C. 2005. Guerneville early days, a history of the lower Russian River. John C. Schubert. Guerneville, California.

Scotts Creek Watershed Council. c. 2004. Scotts Creek Watershed Assessment. Scotts Creek Watershed Council, Davenport CA. approx. 100 pp.

Shaffer, A. 2004. Preferential use of nearshore kelp habitats by juvenile salmon and forage fish. In: Proceedings of the Georgia Basin/Puget Sound Research Conference (Ed. by Droscher, T. W. & Fraser, D. A.). Vancouver, B.C. pp. 1-11.

Shapovalov, L. 1949. Fish rescue and stream improvement work in the north coast area in 1945. California Division of Fish and Game. Bureau of Fish Conservation. 11 pp.

Shapovalov, L. & A. C. Taft. 1954. The life histories of the steelhead rainbow trout (Salmo gairdneri gairdneri) and silver salmon (Oncorhynchus kisutch) with special reference to Waddell Creek, California, and recommendations regarding their management. Inland Fisheries Branch, California Department of Fish and Game, Fish Bulletin No. 54.

Shared Strategy for Puget Sound. 2007. Puget Sound Salmon Recovery Plan. Plan adopted by the National Marine Fisheries Service January 19, 2007, Seattle, Washington.

Singer, S. 2009. County log jam removal program, March 4, 2009 Board agenda item. Letter to Santa Cruz County Board of Supervisors. February 18, 2009., Santa Cruz, California.

Sommarstrom, S., A. Caneday & T. Stephens. 2002. A Water Quality And Stream Habitat Protection Manual For County Road Maintenance In Northwestern California Watersheds, Administrative Draft. Prepared for the Five Counties Salmon Conservation Program. 324 pp.

Sonoma County Water Agency. 1995. Staff report: Sonoma County Water Agency Russian River activities workshop. Sonoma County Water Agency, Santa Rosa, California. 54 pp.

Sonoma County Water Agency & Circuit Rider Productions Inc. 1998. A guide to restoring native riparian habitat in the Russian River watershed. Windsor, California. 80 pp.

Spence, B., E. P. Bjorkstedt, J. C. Garza, J. J. Smith, D. G. Hankin, D. Fuller, W. E. Jones, R. Macedo, T. H. Williams & E. Mora. 2008. A framework for assessing the viability of threatened and endangered salmon and steelhead in North-Central California Coast Recovery Domain. NOAA-TM-NMFS-SWFSC-423.

Spence, B. C. 2008. Personal communication.

Spence, B. C., E. P. Bjorkstedt, J. C. Garza, D. Hankin, D. Fuller, W. E. Jones, J. Smith & R. Macedo. 2005. An analysis of the historical population structure for Evolutionarily Significant Units of Chinook Salmon, Coho Salmon, and Steelhead in the North-Central California Coast Recovery Domain. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-383. 231 pp.

Spence, B. C., S. L. Harris, J. Weldon, M. N. Goslin, A. Agrawal & E. Mora. 2005. Historical occurrence of coho salmon in streams of the central California coast coho salmon evolutionarily significant unit. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, NOAA-TM-NMFS-SWFSC-383. 88 pp.

Springer, Y., C. Hays, M. Carr & M. Mackey. 2007. Ecology and management of the bull kelp, Nereocystis luetkeana: A synthesis with recommendations for future research. Lenfest Ocean Program. Washington, D.C.

State of California. 2006. Sustainable Oceans Act.

Stebbins, B. 1986. The Noyo: Being an account of history at the mouth of the Noyo River, on the Mendocino County coast of California from 1852 into 1920 and a little beyond. Bear and Stebbins. Mendocino, CA.

Steiner Environmental Consulting. 1996. A history of the salmonid decline in the Russian River. Sponsored by Sonoma County Water Agency, California State Coastal Conservancy, and Steiner Environmental Consulting. 86 pp.

Steiner Environmental Consulting & R2 Resource Consultants Inc. 1999. Proposal to conduct preliminary feasibility studies for the Lake Mendocino bypass. Potter Valley, California. 26 pp.

Strelow and Associates, D. W. Alley and Associates, Balance Hydrologics Inc., Greening Associates & Coastal Watershed Council. 2003. Soquel Creek watershed assessment and enhancement project plan. Prepared for the Santa Cruz County Resource Conservation District, Capitola, California. Approx 64 pp.

Swanson Hydrology & Geomorphology, Native Vegetation Network & Hagar Environmental Science. 2002. Lower San Lorenzo River and lagoon management plan. Prepared for City of Santa Cruz Redevelopment Agency, San Lorenzo Urban River Task Force, City of Santa Cruz, and State Coastal Conservancy., Santa Cruz, California.

TetraTech Inc. 2002. Bolinas Lagoon ecosystem restoration project: draft environmental impact study/environmental impact report, Marin County, California. Prepared for U.S. Army Corps of Engineers and Marin County Open Space District. 311 pp.

The Nature Conservancy. 2007. Conservation action planning workbook user manual, version 5a. The Nature Conservancy's Global Conservation Approach Team, Technology and Information Systems. 129 pp. Most current version of manual is available at

The Trust for Public Land. 2004. Coast Dairies Long-Term Resource Protection and Access Plan.

The-Sonoma-Democrat. 1876. Salmon and Brook Trout. In: The Sonoma Democrat. Santa Rosa, California.

Thompson, L. 1916. To the American Indian: Reminiscences of a Yurok Woman. Original published by the author. Reprinted by Heyday Books 1991. Berkeley (1991 reprint).

Thompson, T. H. 1877. Sonoma County Historical Atlas. published by the author. Oakland, CA.

Thorpe, J. E. 1994. Salmonid fishes and the estuarine environment. Estuaries, 17: 76-93.

Trout Unlimited. North Coast Coho Project;

Tschaplinski, P. J. & G. F. Hartman. 1983. Winter distribution of juvenile coho salmon (Oncorhynchus kisutch) before and after logging in Carnation Creek, British Columbia, and some implications for overwinter survival. Canadian Journal of Fisheries and Aquatic Sciences, 40: 452-461.

U.S. Government Accountability Office. 2006. Endangered species: time and costs required to recover species are largely unknown. GAO-06-463R. 27 pp.

Unwin, M. J. 1997. Fry-to-adult survival of natural and hatchery-produced Chinook salmon (Oncorhynchus tshawytscha) from a common origin. Canadian Journal of Fisheries and Aquatic Sciences, 54: 1246-1254.

URS Corporation. 2008. County Of Santa Cruz Integrated Vegetation Management Plan For Roads Near Perennial Waters. URS Corporation, San Jose CA. Prepared for County of Santa Cruz, Dept. of Public Works. 186 pp.

USACE. 1982. Russian River basin study. Northern California streams investigation. U.S. Army Corps of Engineers, San Francisco District, San Francisco. In addition to appendices, 131 pp.

USFWS & NMFS. 1996. Habitat conservation planning handbook US Fish & Wildlife Service and National Marine Fisheries Service. Approx. 115 pp.

USFWS & NMFS. 2006. 5-Year Review Guidance: Procedures for Conducting 5-Year Reviews Under the Endangered Species Act. U.S. Fish and Wildlife Service and National Marine Fisheries Service. 74 pp.

Valentine, B. E. & M. Jameson. 1994. Little North Fork Noyo fishery study, 1992. California Department of Forestry and Fire Protection, Coast Cascade Region, Santa Rosa, California. 48 pp.

Van Doornik, D. M., D. J. Teel, D. R. Kuligowski, C. A. Morgan & E. Casillas. 2007. Genetic analyses provide insight into the early ocean stock distribution and survival of juvenile coho salmon off the coasts of Washington and Oregon. North American Journal of Fisheries Management, 27: 220-237.

Waples, R. S. 1991. Genetic interactions between hatchery and wild salmonids: lessons from the Pacific Northwest. Can. J. Fish. Aquat. Sci., 48: 124-133.

Washington Department of Fish and Wildlife. 2001. Drought contingency plan. Washington Department of Fish and Wildlife

Washington Department of Natural Resources. 2005. Forest Practices Habitat Conservation Plan. Washington Department of Natural Resources.

Weitkamp, L., A., T. C. Wainwright, G. J. Bryant, G. B. Milner, D. J. Teel, R. G. Kope & R. S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. United States Department Of Commerce; National Oceanic and Atmospheric Administration; National Marine Fisheries Service, Seattle, NMFS-NWFSC-24.

Weitkamp, L. A. & K. Neely. 2002. Coho salmon (Oncorhynchus kisutch) ocean migration patterns: insight from marine coded-wire tag recoveries. Canadian Journal of Fisheries and Aquatic Sciences, 59: 1100-1115.

Wells, B. K., C. G. Grimes, J. C. Field & C. S. Reiss. 2006. Covariation between average lengths of mature coho (Oncorhynchus kisutch) and Chinook salmon (O. tshawytscha) and the ocean environment. Fisheries Oceanography, 15: 67-79.

Welsh, H. H., Jr., G. R. Hodgson, B. C. Harvey & M. E. Roche. 2001. Distribution of Juvenile Coho Salmon in Relation to Water Temperatures in Tributaries of the Mattole River, California. North American Journal of Fisheries Management, 21: 464-470.

Willette, M. 1996. Impacts of the Exxon Valdez oil spill on the migration, growth, and survival of juvenile pink salmon in Prince William Sound. In: Proceedings of the Exxon Valdez Oil Spill Symposium. pp. 533-550.

Williams, E. H. & T. J. Q. II. 2000. Pacific herring, Clupea pallasi, recruitment in the Bering Sea and north-east Pacific Ocean, II: relationships to environmental variables and implications for forecasting. Fisheries Oceanography, 9: 300-315.

Williams, R. N., P. A. Bisson, D. L. Bottom, L. D. Calvin, C. C. Coutant, M. W. Erho, C. A. Frissell, J. A. Lichatowich, W. J. Liss, W. E. McConnaha, P. R. Mundy, J. A. Stanford & R. R. Whitney. 1999. Scientific Issues in the restoration of salmonid fishes in the Columbia River. Fisheries, 24: 10-19.

Williamson, K. & D. Hillemeyer. 2001. An Assessment of Pinniped Predation Upon Fall-run Chinook Salmon in the Klamath River Estuary, California , 1999. Yurok Tribal Fisheries Program.

Wilson, C., S. Manchester, M. Rowley & R. Smith. c. 2004. Scott Creek Watershed Assessment. Scott Creek Watershed Council, Davenport CA. approx. 100 pp.

Wright, D. 2009. Personal communication from D. Wright, fishery biologist. Campbell Timberlands Management, Fort Bragg, CA.

Zatkin, R. C. 2002. San Mateo County Streams (San Gregorio Creek Watershed). NMFS #1659. CDFG Region 3.