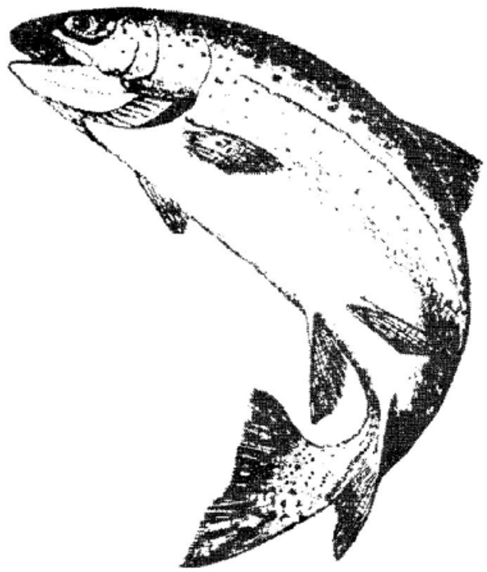
SUMMARY OF
THE NINTH

PACIFIC COAST STEELHEAD MANAGEMENT MEETING



March 9-11, 2004
Fort Worden State Park and Conference Center
Port Townsend, Washington

Sponsored by:

Pacific States Marine Fisheries Commission

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U.S. Fish and Wildlife Service

TABLE OF CONTENTS

Pacific Coast Steelhead Management Workshop
March 9-11, 2004
Fort Worden State Park and Conference Center
Port Townsend, Washington

Introduction

From March 9-11, 2004, the Pacific States Marine Fisheries Commission, with partial support from the U.S. Fish and Wildlife Service – Sport Fish Restoration Program, sponsored the ninth in a series of workshops on steelhead (*Oncorhynchus mykiss*) management. The meeting, held in Port Townsend, Washington, was attended by approximately 60 Pacific Coast fisheries managers, researchers and other interested parties from the states of Alaska, Washington, Idaho, Oregon, and the province of British Columbia. Topics for this workshop included:

- an update on the status of steelhead in each management jurisdiction;
- updates on continuing steelhead life history research;
- steelhead escapement considerations and research;
- integrated vs. segregated steelhead management in Washington; and,
- contributed reports on current steelhead research projects.

An evening session was held featuring SalmonScape, a website of interactive maps featuring information on Washington salmon populations, created by WDFW.

The workshop was structured as a series of individual presentations by topic area, followed by a panel discussion and/or questions from the audience. The meeting allowed steelhead managers and researchers on a coastwide basis to discuss common problems and to share insights into possible solutions. The following abstracts prepared by the speakers summarize their presentations.

Workshop Steering Committee:

Roger Harding, Alaska Department of Fish and Game
Art Tautz, Ministry of Water, Land and Air Protection, British Columbia
Bob Leland, Washington Department of Fish and Wildlife (Chairperson)
Bill Horton, Idaho Department of Fish and Game
Charles Corrarino, Oregon Department of Fish and Wildlife
Katie Perry, California Department of Fish and Game
Mick Jennings, Confederated Tribes of the Warm Springs
Nick Gayeski, Washington Trout
Stephen Phillips, Pacific States Marine Fisheries Commission

Steelhead Stock Status Review by Jurisdiction

Session Chair: Roger Harding, Alaska Department of Fish and Wildlife

California

Katie Perry, California Department of Fish and Game

In general, California's steelhead populations appear to be relatively stable, but remain at very low levels compared to historical levels. In 2000 we reported to this group that monitoring efforts were inadequate to properly measure population abundance and trends and that any conclusions about stock status were very tenuous. This is still the case in 2004. Only a few streams are monitored for adult returns, and where we have juvenile abundance or density data we do not know how these data relate to the status of the adult populations.

The National Marine Fisheries Service (NOAA Fisheries) is in the process of reviewing the Endangered Species Act (ESA) status of 27 Pacific salmon and steelhead evolutionarily significant units (ESUs). In February 2003 NOAA Fisheries released a co-manager review draft of the preliminary scientific conclusions of the Biological Review Team (BRT). The BRT's preliminary conclusions indicate that five of the six California steelhead ESUs are either likely to become endangered or are in danger of extinction. The previous BRT had similar conclusions with the exception of the South-Central California Coast and the Central California Coast (Busby et al. 1996). These two ESUs were in danger of extinction in 1996, but were listed as threatened in the final rule for each ESU.

Table 1.

STEELHEAD ESU	STATUS	EFFECTIVE DATE	DRAFT BRT CONCLUSIONS UPDATED STATUS REVIEW
Southern California	Endangered	Oct. 17, 1997	In danger of extinction
South-Central California Coast	Threatened	Oct. 17, 1997	Likely to become endangered
Central California Coast	Threatened	Oct. 17, 1997	Likely to become endangered
Central Valley	Threatened	May 18, 1998	In danger of extinction
Northern California	Threatened	August 7, 2000	Likely to become endangered
Klamath Mountains Province	Not warranted	March 28, 2001	NA

Klamath Mountains Province ESU

This ESU encompasses steelhead from the Elk River in Oregon to the Klamath and Trinity Rivers in California. In March 2001 NOAA Fisheries determined that this ESU did not warrant listing. The ESU includes summer, winter, and half-pounder runs of steelhead. The recent updated status review did not include the Klamath Mountains Province. In September 2002 there was a massive fish kill on the Klamath River. Approximately 33,000 salmon and steelhead were killed; however, steelhead were a small percentage of the total (~650 to 1,500).

Northern California ESU

This ESU includes coastal basins from Humboldt County to Mendocino County. It includes summer and winter steelhead runs as well as a half-pounders. Time-series data of winter steelhead in the upper Eel River at Cape Horn Dam have declined from a maximum of 9,528 in 1944/45 to 102 in 2002/03 (combined wild and hatchery). Wild steelhead number less than 100. Time-series data are also available for winter steelhead in the Mad River and combined counts of summer and winter steelhead in the South Fork Eel River at Benbow Dam. Overall, population abundances remain low relative to historic estimates and recent trends are downward. Summer steelhead abundance is also low. Figure 1 shows that recent summer steelhead counts on the Middle Fork Eel River remain low. The main threats to steelhead include poor forest practices, poor land use practices, and non-native Sacramento pikeminnow predation, and high water temperatures.

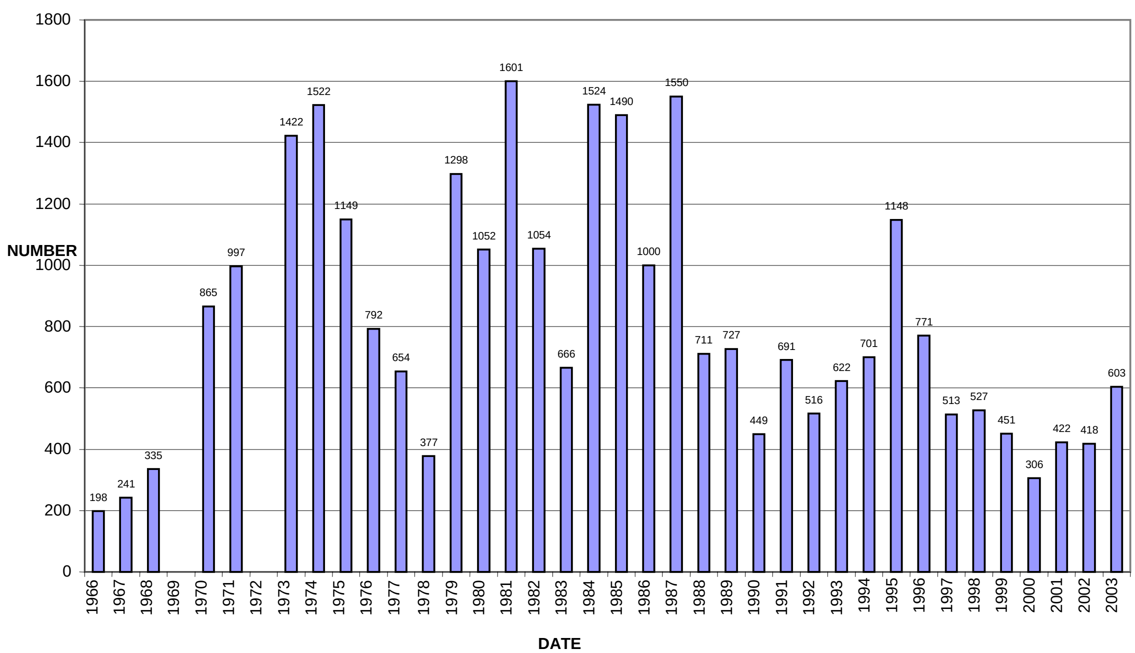


Figure 1. Adult summer steelhead counts from 1966 to 2003, Middle Fork Eel River. Surveys were not conducted in 1969 and 1972.

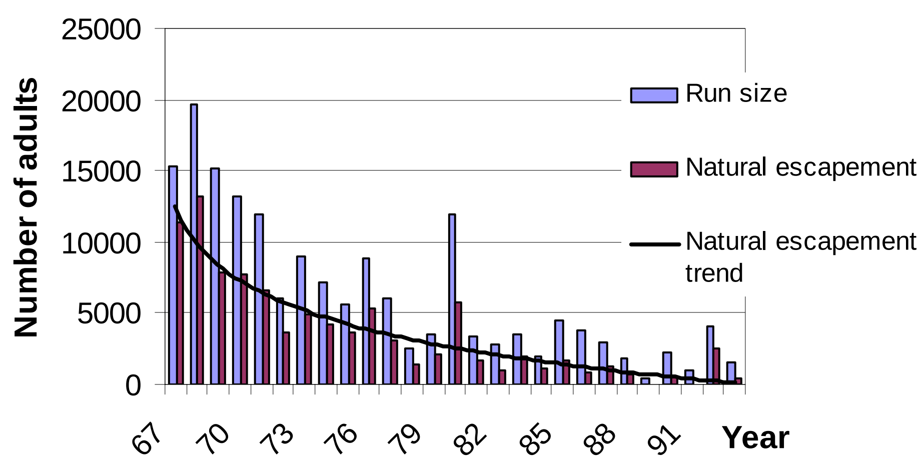
Central California Coast ESU

This ESU includes coastal basins from the Russian River in Sonoma County to Soquel Creek in Santa Cruz County. Also included are populations in the streams of San Francisco and San Pablo Bays. The ESU contains only winter steelhead. Impacts to steelhead in this ESU include habitat blockages, urbanization, poor land use practices, habitat degradation, and dewatering due to irrigation and diversion. Habitat restoration efforts have been undertaken in many rivers and streams in this ESU. There are several active stakeholder groups working in the San Francisco Bay area tributaries (e.g. Alameda Creek Alliance, the Stevens and Permanente Creeks Watershed Council). Their actions are focused on improving access through barrier removal and development of watershed plans.

Central Valley ESU

This ESU occupies the Sacramento and San Joaquin Rivers and their tributaries. Historically steelhead were abundant and widespread throughout the Central Valley. Population estimates vary, but historically they may have approached 1 to 2 million adults annually. By the 1960s run size had dropped to about 40,000 adults. Counts of steelhead passing Red Bluff Diversion Dam (RBDD) have dropped from a high of almost 20,000 in 1968 to about 1,500 in 1993 (Fig 2.). Since 1993 the gates at RBDD have been raised to facilitate passage of winter-run Chinook salmon and counts for adults steelhead are no longer possible. In recent years steelhead have been found in the San Joaquin River and tributaries, however, their abundance is unknown. The primary stressors affecting Central Valley steelhead are all related to water development and water management, and the single greatest stressor is the substantial loss of habitat. Over 80% of steelhead spawning and rearing habitat has been lost due to impassable dams on rivers and tributaries.

Fig. 2 Red Bluff Diversion Dam Steelhead Counts (ended in 1993)



Ongoing conservation and habitat restoration actions are being funded by the CALFED Bay-Delta Program and the Anadromous Fish Restoration Program (AFRP). The CALFED Bay-Delta Program is a cooperative effort of more than 20 state and federal agencies working with local communities to improve the quality and reliability of California's water supplies and to restore the San Francisco Bay-Delta ecosystem. The AFRP is tasked by the Central Valley Project Improvement Act to make "all reasonable efforts to at least double natural production of anadromous fish in California's Central Valley streams on a long-term, sustainable basis".

South-Central California Coast ESU

This ESU extends from the Pajaro River basin in Monterey Bay south to, but not including, the Santa Maria River Basin near the town of Santa Maria. Updated adult steelhead counts for the Carmel River at San Clemente Dam are available from the Monterey Peninsula Water Management District (Fig. 3). Recent counts suggest that the abundance of adults has been increasing since the six year drought in the late 1980s and early 1990s, but the counts remain below 1,000 fish.

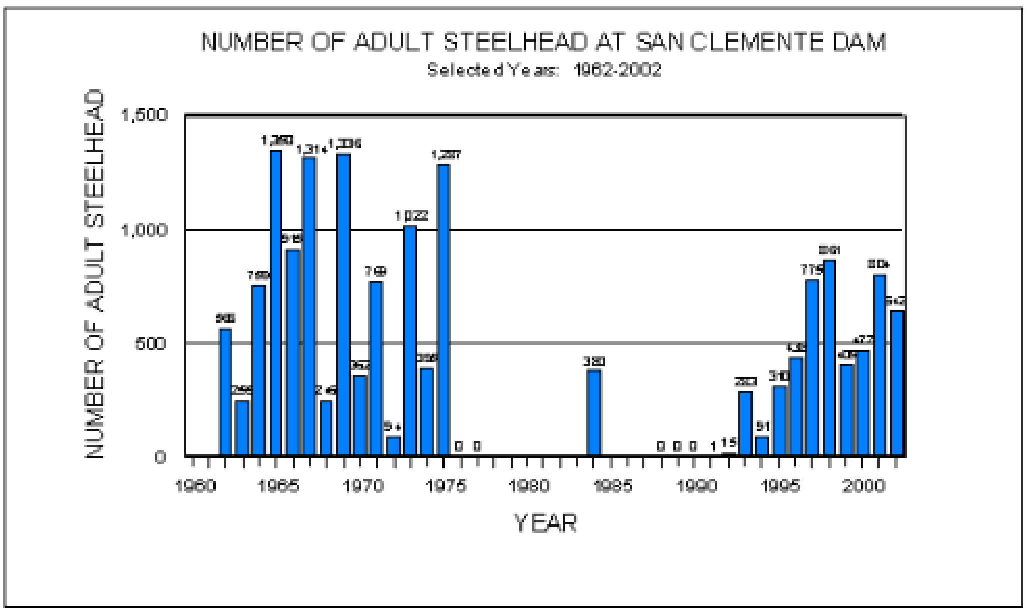


Figure 3

The main threats to stocks in this ESU include habitat blockages and habitat degradation from water management practices (e.g., dewatering stream channels, unregulated ground water withdrawal) and lagoon breaching.

Southern California ESU

This ESU extends from the Santa Maria River basin to the United States border with Mexico. The range was extended from Malibu Creek to the border in July 2002 after California Department of Fish and Game found steelhead in Topanga Creek (Los Angeles County) and San Mateo Creek (San Diego County). There is little time series data available for this ESU other than 10 years of migration data for the Santa Ynez and 3 years of fish counts for Topanga Creek in the Santa Monica Mountains. Run sizes for the largest river systems in this ESU are less than 200 fish (e.g., Santa Ynez, Ventura, Santa Clara). Habitat restoration projects have been implemented on a number of the streams in this ESU. Most of these projects have restored access through removal or redesign of barriers and diversions. A major fish passage facility is being constructed on the Ventura River at Robles Diversion Dam. This project, along with the removal of Matilija Dam, will open up approximately 20 miles of historic steelhead habitat. The State Water Resources Control Board (SWRCB) recently held a hearing regarding the U.S. Bureau of Reclamation water rights permits on the Santa Ynez River to determine whether any modifications in permit terms or conditions are necessary to protect public trust values and downstream water rights below Bradbury Dam (Cachuma Reservoir). State and Federal fishery agencies want the SWRCB to include fish passage feasibility studies as well as improved flows to help restore steelhead in this river, which historically had the largest runs for steelhead in the ESU.

California Coastal Salmonid Monitoring Plan

Monitoring efforts throughout coastal California are not adequate to determine the status of salmonids and trends in abundance over time. The California Department of Fish and Game and the National marine Fisheries Service have an interest in recovering salmonids in coastal California. Parties from both agencies prepared a proposal to develop a sampling plan to estimate status and trends in coastal California salmonid abundance at the ESU or other appropriate spatial scale. They received funding for this project from the Department's Fisheries Restoration Grant Program. The ultimate goal is to implement a long-term monitoring program which will develop a dataset necessary to support delisting assessments at the Federal and State Endangered Species Act levels. The sampling plan will have sufficient statistical power to detect a status and trends within a noisy dataset. It is also expected to include methods to optimize the allocation of resources between monitoring and restoration. In the past, this has been done subjectively. The sampling plan will be developed through a series of three workshops; the first one is scheduled for March 9 through 11, 2004. The workshops will start with evaluating existing protocols and datasets; they will consider the structure of the Oregon Plan as an initial model of the plan to be developed; and they will have an overview of operations research applications for allocating cost of restoration and monitoring. The coastal salmonid monitoring plan is expected to be completed by March 2005.

Central Valley Steelhead Monitoring Plan

In California's Central Valley the lack of adequate monitoring is also a problem. An interagency group composed of staff from California Department of Fish and Game, NOAA Fisheries, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, California Department of Water Resources, and U.S. Forest Service is currently developing a proposal to address this need. We expect that this proposal when completed will be submitted to the CALFED Bay-Delta Program for funding consideration.

Oregon

Steve Jacobs, Oregon Department of Fish and Wildlife

Two races of steelhead occur in Oregon. Winter-run steelhead typically return to fresh water during late-fall through early-spring and spawn after a relatively short fresh water residence. Winter-run steelheads occur throughout coastal watersheds, in the Willamette basin upstream through the Calapooia River and in Columbia River tributaries upstream through Fifteenmile Creek, which is located just west of the Deschutes Basin. Summer-run steelhead return to freshwater during the spring through early-fall and typically spawn after a prolonged residence in freshwater. Native populations of summer steelhead co-occur with winter steelhead in three coastal basins, the Rogue, North Umpqua and the Siletz Rivers and in the Hood River. Summer steelhead are the exclusive race of steelhead in all other tributaries of the Columbia and Lower Snake Rivers.

Long-term abundance data are available at 10 locations throughout the range of Oregon steelhead. These data are either adult passage counts through fishways or annual redd counts. To assess status I examined trends at each of these sites over the 30-year period of 1974-2003. A similar pattern of abundance generally occurred at each of these monitoring locations. This pattern was characterized by an initial 10-year period of relatively high abundance, a period of peak abundance during the mid 1980s, a precipitous decline and sustained low abundance during the 1990s, and finally a rebound during the last three years to relatively high levels of abundance. This general pattern exists for both races.

A statistically significant correlation ($p<0.001$) between a composite of steelhead abundance trends and survival of Oregon Production Index coho suggests that variation in marine survival has had a strong influence in the abundance of Oregon steelhead populations.

Washington

Amilee Wilson, Washington Department of Fish & Wildlife

Washington State is divided into seven ESUs designated by NOAA fisheries. Some ESUs encompass the entire boundary of Washington; however, most share these areas with bordering states such as Oregon and Idaho as well as British Columbia. These ESUs include Puget Sound, Olympic Peninsula, Southwest Washington, Lower Columbia River, Middle Columbia River, Upper Columbia River and the Snake River Basin.

Steelhead stocks that reside in the Puget Sound and Olympic Peninsula ESUs are listed as *Not Warranted* by NOAA fisheries. According to the Department of Fish & Wildlife (WDFW) Salmonid Stock Inventory (SaSI), there are several wild steelhead stocks within this ESU that maintain a status of *Depressed* or *Critical*. According to WDFW observation, it would be wise for NOAA fisheries to revisit their listing status, particularly in the Puget Sound ESU. Several stocks within the Olympic Peninsula ESU remain *Healthy* according to SaSI status. This ESU has maintained the highest number of healthy wild steelhead stocks in Washington State.

The Lower and Middle Columbia River ESUs as well as the Snake River Basin are listed as *Threatened* by NOAA fisheries. These areas contained the highest number of *Depressed* or *Unknown* stocks (mainly summer steelhead stocks) within Washington State according to SaSI ratings.

The Upper Columbia River ESU is listed as *Endangered* by NOAA fisheries. WDFW has very little information on steelhead stocks that reside in this ESU. Many are listed as *Depressed* or *Unknown* according to SaSI status. However, the Priest Rapids Dam is responsible for passing virtually all steelhead destined for this ESU and has a rather elaborate coding and trapping system in place to help separate three different hatchery stocks from the wild steelhead runs.

The number of *Healthy* steelhead stocks in Washington State has declined in recent years. The number of wild steelhead stocks listed as *Depressed* has decreased. Unfortunately, a number of steelhead stocks with known status have reverted to *Unknown* status because the abundance trend data (usually harvest data) is no longer available due to wild steelhead season closures and release regulations. Often the wild steelhead stocks are not monitored for escapement. SaSI maintains very little escapement data for wild summer steelhead runs often due to nearly impossible weather and river conditions during the spring.

In conclusion, the status for wild steelhead stocks in Washington State continues to look grim as Washington biologists, fisheries managers and co-mangers strive to improve habitat and find a balance between harvest quotas and preserving our native steelhead resource.

Idaho

Bill Horton, Idaho Department of Fish and Game

Idaho historically produced about 55% of the total summer steelhead in the Columbia River basin. An average of 70,000 wild adult summer steelhead entered the Snake River during the 1960s, based on Ice Harbor Dam counts. During this period, steelhead were the most numerous anadromous fish returning to the Snake Basin. The documented thirty-year decline of Snake River steelhead led to their listing as threatened in October 1997, pursuant to the federal Endangered Species Act.

Development of the Federal Columbia River Power System (FCRPS), particularly the four dams and reservoirs on the Lower Snake River, is considered to be the primary factor in Snake River steelhead decline.

The majority of steelhead entering the Snake River return to Idaho. About 60% of the historical steelhead habitat in Idaho is still available, primarily in the Salmon and Clearwater river drainages. About 30% of Idaho's existing steelhead habitat is included within designated wilderness or wild and scenic river corridors. Because approximately 69% of the lower Snake River basin is comprised of lands within the jurisdiction of the federal government, most of the steelhead spawning and rearing habitat in Idaho is federally managed.

Some positive change has occurred in the status of Idaho steelhead since the start of the new century. During the 1990s, the naturally-produced steelhead run, as counted at Lower Granite Dam (uppermost Snake River dam), averaged only 11,900. This was an 83% decline from the 1962-70 period. The 1995-99 average was even worse at 8,200 adult steelhead counted at Lower Granite Dam. However, from 2000-2003 the counts have improved sharply to an average of 32,100, likely because of improved migration and ocean conditions.

There is likely a complex composition of steelhead stocks in Idaho for which Idaho Department of Fish and Game (IDFG) is doing a comprehensive genetic survey. For Idaho management purposes, natural and hatchery-produced steelhead are classified as A-run and B-run groups. Naturally-produced steelhead are further defined by production lineage as "wild" (endemic) or "natural" (non-endemic or hatchery-influenced). B-run steelhead return exclusively to Idaho and are characterized by later freshwater entry and larger adult size at age with a predominantly two-ocean return.

Naturally-produced A and B index groups at Lower Granite Dam averaged 6,400 and 1,800 adult steelhead during the 1995-99 period, demonstrating the especially critical status of B-run steelhead. Parr density information generally reflects the poor adult returns counted at Lower Granite Dam. The new decade began with an upswing in the A-run index count at the dam (10,000 and 17,000 steelhead in 99-00 and 00-01), but the B-run index lagged behind at 900 and 2800 for those years. However, during the last three years, adult returns have been promising, and have elevated the most recent 5-year average to more than three times the late 1990s values for both groups (A-run = 22,300 and B-run = 5,500).

There is a mix of natural and hatchery steelhead production strategies in Idaho, ranging from wilderness genetic refugia to large-scale hatchery smolt programs. Idaho Department of Fish and Game estimates the statewide accessible habitat could produce at least 4 million steelhead smolts. Areas managed as wild steelhead include expansive contiguous habitat: the Lochsa and the Selway river drainages of the Clearwater River, and the Middle and South fork drainages of the Salmon River. A few smaller tributaries are also included. Much of the wild steelhead refugia habitat is in areas designated as wilderness or wild and scenic river status.

Since the 1960s, the composition of the steelhead run entering Idaho has changed. The proportion of hatchery origin steelhead has steadily increased due to declining natural spawner return and development of hatcheries. During 1965-69, the Snake River steelhead run was essentially 100% wild. From 1975-79, the steelhead run at Lower Granite Dam averaged 59% naturally-produced fish and from 1985-89, the run averaged 24% naturally-produced fish. From 1995-99, the run slipped further to an average of 11% naturally-produced steelhead. Again, at the start of the century, the natural steelhead have rebounded to about 17% of the total steelhead production above Lower Granite Dam. All steelhead hatcheries in Idaho were developed during this period as mitigation for federal and private hydropower production. IDFG has utilized steelhead smolt production almost exclusively to support sport harvest opportunity for hatchery steelhead in selective fisheries. Steelhead harvest declined from nearly 20,000 wild steelhead annually in the 1950s and 1960s to near 10,000 as wild fish numbers plummeted in the 1970s, and we closed sport fishing some years. Selective fisheries were implemented in the late 1970s. Legal wild fish sport harvest was terminated with the advent of mass marking (adipose fin-clip) in the mid 1980s. Harvest increased to an average of 41,000 hatchery steelhead during the last 10-year period.

The future of steelhead in Idaho and the Snake River Basin will be defined by improvement in smolt-to-adult return rates (SAR). Egg-to-smolt survival, particularly in wild fish areas, has probably not declined significantly from the 1960s. Currently, SARs are not sufficient for consistent replacement. National Marine Fisheries Service (NMFS) has indicated that naturally-produced Snake River steelhead are at significant risk of extinction. For migratory years 1990-2001, SARs ranged from 0.1% to 1.8% for naturally-produced juvenile steelhead tagged with Passive Integrated Transponder tags and detected as adults at Lower Granite Dam (based on IDFG unpublished data). The carrying capacity of Idaho's habitat hasn't been reached in many years and the 2% to 6% SARs necessary for consistent replacement are not being attained, either.

British Columbia

Bob Hooton, British Columbia Ministry of Water, Land & Air Protection

British Columbia contains approximately 580 steelhead streams third order or greater in size. These streams support one or more of three different stock groups – winter steelhead, coastal summer steelhead and interior summer steelhead. The cumulative total number of stocks occupying the various streams is estimated at 630. Winter steelhead stocks dominate at about 85%, followed by interior summer steelhead at 12 % and coastal summers at 3%. Index streams are monitored by a combination of methods focused on both adults (snorkel surveys, weirs, electronic counters) and juveniles (smolt trapping, electro-fishing surveys, snorkel observations). The general trend over the length of the province's coast since the late 1990s has been a dramatic decline in steelhead abundance in southern regions, a less dramatic decline in the central coast region and relative stability among stocks further north. Freshwater spawning and rearing conditions have varied widely between times and places but steelhead stocks have shown little, if any, response to this variability. Compelling evidence that persistent low marine survival is the limiting factor emanates from a thirty year research program at the Keogh River on northern Vancouver Island. Summer steelhead (both interior and coastal varieties) were uniformly weaker in 2003 than in the preceding several years, at least in southern BC. Winter steelhead returns to date in 2004 appear to be at or near all time lows in several of the index streams within the Georgia Basin and west coast Vancouver Island area. Management measures (angling closures, stream habitat restoration programs, living gene bank program, conventional fish culture program) designed to reverse declines in abundance and/or sustain angling opportunity have been only marginally successful at best.

Alaska

Stephen Hoffman, Alaska Department of Fish and Game

Steelhead *(Oncorhyncus gairdneri)* are found in coastal waters in Alaska from Dixon Entrance to the Alaska Peninsula. The number of documented streams containing this species decreases as you move from SE Alaska through the distribution of this species. Steelhead populations north of the Situk River at Yakutat are primarily fall run while those populations south of Yakutat are spring run (80%) or a combination of spring and fall run (20%). Steelhead throughout Alaska are utilized by three different user groups; sport, subsistence, and commercial fishermen. Commercial seine and gillnet fisheries account for the largest harvest of this species as by catch in salmon fisheries followed by subsistence and sport fisheries. Limited in stream data is collected on the status of steelhead stocks by ADF&G or Federal resource agencies and consist of weir counts, index stream snorkel surveys, and catch/harvest estimates. Weir Counts in the Southcentral area are limited to the Ninilchik River and tributaries of the upper Copper River where escapement numbers ranging from 100 to 400 fish have been noted. Counts of post-spawning kelts at weirs on the Karluk and Ayakulik Rivers on Kodiak Island are used to monitor those stocks with kelt counts ranging from 800 to 2,000 over the last four years which are substantially lower than historical numbers, especially on the Karluk River. No weir projects have been operated on the Alaska Peninsula. Counts of post-spawning kelts at the Situk River weir peaked in 1999 which were followed by declines for three years and a substantial rebound in 2003. Weir counts on the Sitkoh Creek have averaged around 700 fish each time the weir has been operated including last year. Snorkel surveys are only conducted on index streams in Southeast Alaska. Since the beginning of these surveys in 1997, peak counts have decreased but are beginning to rebound as noted in surveys for 2003. Catch and harvest estimates for the Southcentral and Kodiak areas indicate declining numbers of steelhead in these areas. No coastal catch and harvest data is available for the Alaska Peninsula area. Coastal survey data from SE Alaska also indicates somewhat of a general decline but analysis of this data is more difficult due to the effect of multiple catch and releases on individual fish especially on the Situk River. Continued general declines in Alaska’s steelhead populations plus severely limited stock status data demonstrates the need for continued restrictive regulations for all fisheries that are directed at harvesting this resource.

Steelhead Life History

Session Chair: Nick Gayeski, Washington Trout

The Mating System Structure and Mating Tactics of Sympatric Steelhead and Resident Rainbow Trout on the Olympic Peninsula, Washington State

John McMillan, The Wild Salmon Center

The objective of this study was to examine the mating system structure and behavior of sympatric steelhead and resident rainbow trout. Snorkel surveys, redd counts, and behavioral observations were used to determine the arrival time, spawn time, and mating strategies of anadromous/resident *O. mykiss* in the Calawah River and Sol Duc River, Washington State. Between 1999 and 2003 steelhead spawned from January through July with a peak in April-May, and there was variation between some survey sites. Female steelhead density was highest in April-May, while male steelhead density remained at relatively stable levels from February through May, and resident rainbow trout density was greatest in May-July. The cumulative distribution of females to males (e.g., gender ratio) was skewed towards females, especially later in the spawning season when male steelhead abundance was depleted. Most mating interactions (51%) observed occurred between one male and female steelhead. However, there was substantial mating interaction between one female and multiple male steelhead (32%), and male resident rainbow trout and a female steelhead (16%). The gender ratio of steelhead during observed spawning activity was 58% male when considering only steelhead and 65% male when including contributions from resident rainbow trout. Male steelhead mating strategies were almost equally divided between guard and sneak tactics, while the majority of resident rainbow trout fertilizations resulted from sneak tactics. Preliminary results indicate that O. mykiss in the Calawah River and Sol Duc River exhibit a highly dynamic mating system that includes extensive interactions between male resident rainbow trout and female steelhead.

Genetic Relationships among Resident and Anadromous Oncorhynchus mykiss in Cedar River, Washington: Improving the Chances for Recovery, or Clash of the Phenotypes?

Anne R. Marshall[1], Maureen Small, and Steve Foley, Washington Department of Fish and Wildlife

Our research project is aimed at assisting development of a steelhead restoration plan for Cedar River, a Puget Sound drainage. Fish passage at Landsburg Dam (RM 21) was completed in 2003, restoring accessibility of 17.5 miles of habitat blocked since 1900. Steelhead abundance in the lower watershed had been critically low during the last 12 years, leaving potentially few fish to naturally re-colonize opened habitat.

[1] presenter

However, resident rainbow trout are present throughout the river, and appeared abundant in below-dam areas. Previous genetic data showed that above- and below-dam juvenile *O*. *mykiss* were somewhat divergent, but genetic relationships between adult steelhead and above- and below-dam adult resident trout were unknown. Through two years of basin-wide sampling of adult phenotypes, our goal is to understand genetic population structure of Cedar River Basin *O. mykiss* so that managers can design and implement strategies that effectively conserve and recover native steelhead and rainbow trout resources. We will address issues such as whether steelhead produce the majority of resident fish, whether resident fish contribute to smolt production, and whether resident fish are exotic origin and producing negative impacts on native fish. We also will determine extent of hybridization with cutthroat trout. We will use microsatellite DNA, nuclear DNA species, and mitochondrial DNA markers and a variety of statistical analyses to accomplish our objectives. In 2003 we acquired samples from 9 of 12 targeted populations. Although sampled steelhead averaged twice the size of lower Cedar River resident adult *O. mykiss*, age structure was relatively similar between both groups. The largest resident trout sampled was 58.4 cm forklength, and several residents were phenotypically identified as hybrids. Genetic analyses for 2003 samples will be completed shortly and a progress report will be available in June 2004.

The Quandary of a Highly Polymorphic Species under the U.S. Endangered Species Act

Kathryn Kostow, Oregon Department of Fish and Wildlife

NOAA Fisheries Service (NMFS) listed steelhead, the anadromous life history of *Oncorhynchus mykiss*, as threatened or endangered under the Endangered Species Act (ESA) throughout most of the Columbia Basin and California in the late 1990s. In their original listing decisions, some *O. mykiss* trout populations were included in the Evolutionarily Significant Units (ESUs) along with steelhead, but were not listed. As a result of a recent court decision which found that the federal listing agencies cannot list only part of an ESU, NMFS is now reevaluating their original ESA listing decisions for *O. mykiss*. Central to this issue is the NMFS formal policy and criteria for defining ESUs, which requires both reproductive isolation and evolutionary significance in order to establish ESU boundaries. While trout and steelhead can be argued to be distinctive from each other and each "evolutionarily significant", the available data indicates that many populations are not reproductively isolated to the degree that they could be placed in separate ESUs consistent with other listing decisions. An ESU that includes both trout and steelhead may have a very different extinction risk compared to one that has only steelhead. ESUs may be secured by trout while the steelhead life history is at risk. The loss of the steelhead life history would represent a significant, and possibly irreversible, change in the character of the ESUs. While the ESA clearly speaks to the avoidance of extinction, it is not clear how it would address a "change in character". This quandary is currently before NMFS, which is expected to release a decision on how to deal with this issue this spring.

Reproductive Effort of Steelhead and Life History Diversity of O. mykiss in Kamchatka

Nick Gayeski, Washington Trout, University of Montana

Steelhead exhibit three characteristics that make them important organisms for the study of salmonid life history: iteroparity, spring spawning, and the capacity for reproductive interactions with non-anadromous conspecifics. Rainbow trout (*Oncorhynchus/Parasalmo mykiss)* in river basins of western Kamchatka display a dramatic array of life history phenotypes. In 2001 I began study of reproductive effort of female steelhead and resident rainbow trout in Kamchatka in conjunction with the ongoing international conservation and research effort initially known as the Kamchatka Steelhead Project, now the Kamchatka Salmonid Biodiversity Project. I have found that Kamchatkan steelhead exhibit high fecundity upon river entry (September/October) relative to most steelhead populations in the Pacific Northwest. This high fecundity is combined with a strongly female-biased sex ratio (>65%) and high incidence of repeat spawning, indicating that high reproductive effort has been selected for in these populations. I discuss the significance of these features of steelhead life history in relation to environmental factors, the apparently high reproductive interactions between steelhead and non-anadromous life history phenotypes, and the diversity of life histories of rainbow trout in rivers of western Kamchatka.

An Evolutionary Perspective of Anadromy in O. mykiss

Bob Behnke, Colorado State University

On a scale of flexible-labile to fixed in relation to anadromy or migratory behavior, *O. mykiss* is intermediate between *O. clarki* and species of Salvelinus on one hand and Pacific salmon on the other. Chum and pink salmon are genetically programmed to have a fixed or obligatory behavior for migration with least dependency on freshwater habitat. The genetic basis for anadromous vs. completely freshwater life histories in *O. mykiss* and *O. nerka* is slight and subject to rapid evolutionary change.

The Antismolt—When Bad Things Happen to Good Fishes

Cameron Sharpe, Brian Beckman, Patrick Hulett, Sewall Young, Howard Fuss
Washington Department of Fish and Wildlife

Residual hatchery steelhead are defined as juveniles that, after release, fail to migrate as smolts with the rest of their cohort. Projects monitoring steelhead smolt outmigrations routinely reveal a large deficit in abundance of juveniles accounted for by migrant trapping. Projects directly estimating abundance of steelhead juveniles that adopt residency are sparse but typically do not detect an adequate number of resident fish to explain the deficit of migrants. Non-migration of hatchery-reared steelhead may pose genetic and ecological risks to endemic fishes. We present a review of recent work exploring the incidence of non-migration of steelhead juveniles and discuss our understanding of (1) the mechanisms contributing to residualism, (2) the potential for controlling the incidence of residualism, and (3) the relationship between residualism and residency in the species.

Steelhead Escapement Goal Development

Co-Chairs: Nick Gayeski, Washington Trout
Bob Leland, Washington Department of Fish and Wildlife

Ecosystem Diagnosis and Treatment (EDT): Its Value as a Tool in Developing Escapement Goals

Bryce Glaser, Washington Department of Fish and Wildlife

The Ecosystem Diagnosis and Treatment model (EDT) is a habitat-based model that assesses ecosystem performance through the use of an indicator species. The model links salmonid performance to both current and historical environmental conditions. Salmonid performance is estimated by examining the productivity, capacity, and life history diversity of the indicator species in relation to the environmental attributes of its habitat. Forty-five environmental attributes in four major categories (hydrologic characteristics, water quality, biological community, and stream corridor structure) are modeled utilizing biological data pertaining to adult and juvenile age structure, sex ratio, fecundity, juvenile migration patterns, spawning distribution, and smolt to adult survival. EDT identifies and ranks "preservation/restoration" reaches within a watershed and the limiting factors by life stage within each reach as they pertain to the indicator species.

The EDT model produces an array of reports/outputs that graphically summarize ecosystem and salmonid performance for the watershed and species of interest; these include a Beverton-Holt Spawner-Recruitment Relationship (SRR). SRRs are frequently used as at tool in evaluating salmon and steelhead stock performance, and can be useful in developing escapement goals for these stocks. EDT can provide SRRs for watersheds where empirical spawner-recruit data is limited or non-existent. However, many assumptions are made within the EDT model, and model outputs should be tested for validity. To test the EDT analysis conducted on Lower Columbia River tributaries in Southwest Washington, EDT Beverton-Holt SRRs were compared to areas where empirical spawner-recruit (both adult and juvenile recruit) data was available. EDT SRR outputs were found to reasonably approximate spawner-recruit curves fit to empirical data sets; however, a tighter relationship was seen when comparing spawner/smolt data than when comparing spawner/adult data. This is likely due to the variability associated with smolt to adult survivals and a lack of long-term empirical data sets that capture the true range of this variability. Escapement goals are based on policy, numeric, genetic, and social guidelines. EDT should be considered one possible tool available to aid in developing escapement goals. However, development of escapement goals should include a thorough assessment of stock status, level of risk, data uncertainty, variability in ocean conditions, genetic diversity, and management objectives.

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Climate Insurance for NW Steelhead Fisheries: Thoughts on Incorporating the Influence of Variable Ocean Conditions in Steelhead Management

Nate Mantua, University of Washington

There is a wealth of evidence highlighting the impacts of natural environmental changes on year-to-year changes in the productivity of salmonid populations. Recent studies highlight the impacts of changing ocean conditions on large year-to-year fluctuations in smolt-to-adult survival rates. I review evidence for recent changes in marine habitat and northwest salmon and steelhead productivity, and describe the results of recent studies aimed at understanding the mechanisms linking ocean conditions to marine survival for salmonids. I will conclude with a short list of recommendations for incorporating climate information in steelhead management decisions.

Escapement Goals? We Don't Need No 'Scapement Goals!

Hal Michael, Washington Department of Fish and Wildlife

Steelhead have historically managed through the application of an intra-species analysis. How many spawners are necessary to produce an optimum number of parr. The studies on the Keogh River in BC suggested that external factors such as stream habitat condition and nutrient availability exerted a greater control than steelhead spawner escapement. Data from Snow and Salmon creeks on the Olympic Peninsula showed that increasing levels of chum salmon spawning resulted in larger steelhead smolts. Data from Soos Creek, a Green River tributary, suggested that wild steelhead productivity, as measured by escapement four years following spawning, was positively related to coho escapement. A confounding factor was stream flows with lower than average flows negating the benefit of coho spawners. It appears that steelhead population health may benefit more by concentrating on improvement of rearing habitat and increasing salmon escapement than by simply managing for a specific number of steelhead spawners.

Evaluation of Conservation Hatchery Rearing and Release Strategies for Steelhead Recovery in the Hamma Hamma River

Barry Berejikian[1], Julie Scheurer[1], Joy Lee[2], Donald VanDoornik[1], Eric Volk[3], Thom Johnson[3], and Rick Endicott[2]

Conservation hatcheries for anadromous salmonids have the dual role of supplementing depleted populations, while at the same time minimizing genetic and ecological risks to the extant wild population(s). Conservation hatchery practices designed to aid in

[1] National Marine Fisheries Service, Northwest Fisheries Science Center, Resource Enhancement and Utilization Technologies Division, Manchester Research Station
P.O. Box 130, Manchester, WA 98353. barry.berejikian@noaa.gov
[2] Long Live the Kings, 1305 Fourth Avenue, Suite 810, Seattle, WA 98101
[3] Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia Washington 98501

population recovery continue to evolve, and there remain numerous uncertainties regarding the demographic and genetic effects of supplementation programs on the status of the wild population targeted for recovery. The present study evaluated the effects of two rearing and release strategies in a supplementation program for steelhead (*Oncorhynchus mykiss*). The cultured steelhead were reared and released at two different life history stages (age-2 smolts and age-4 adults). Artificially propagated smolts were released in 2000 and 2001 and age-4 captive-reared adults in 2002 (81 females, 116 males) and 2003 (2 females, 2 males). A total of 158 redds were observed in the Hamma Hamma River in 2002 and 83 in 2003; which is markedly greater than the 22 or fewer redds that had been observed in any of the previous 7 years. Increases in redd abundance have not occurred in non-supplemented streams similarly monitored in the Hood Canal watershed. Thus, the supplementation program has markedly increased the number of spawners in the Hamma Hamma River. Detailed reproductive behavior and DNA pedigree analyses conducted in an experimental spawning channel indicated that captive-reared females deposited an average of 97% of their estimated fecundity. All 24 captive-reared females and all but 1 of 24 captive-reared males produced viable fry. Two-year exposure to elevated water current velocities during rearing (~ 1 body length per second) improved the ability of captive-reared males to dominate access to nesting females, but did not result in significant increases in adult-to-fry reproductive success. We conclude that the supplementation program is meeting its initial goal of substantially increasing natural production in the Hamma Hamma River, and that released captive-reared adults constructed the majority of redds in the Hamma Hamma River in 2002 . The productivity and genetic structure of the population will continue to be monitored and will provide greater resolution of the long-term effects of the supplementation program.

Integrated vs. Segregated Steelhead Management

Chair: Hal Michael, Washington Department of Fish and Wildlife

The True Genetic and Behavioral Differences between Hatchery and Wild Steelhead

Ernie Brannon, University of Idaho

The use of hatcheries has been controversial in the management of salmon and trout resources in the Pacific Northwest. The controversy has resulted in part from the wide distribution of hatchery fish in circumstances where natural populations were disadvantaged by management policy rather than hatchery propagation. That issue was underscored in an article by the Independent Scientific Advisory Board (ISAB) on surplus hatchery fish in the December 2002 issue of Fisheries. They recommended against letting hatchery fish spawn in the wild because they believed domestication, lower spawning efficiency of hatchery fish in the wild, and the risk of compromising the fitness of wild fish, were problems. However, the ISAB recommendation was less than objective and ignored the critical role that hatchery fish must have in recovery or supplementation of wild stocks. Even some of the sportsmen newsletters have an agenda to eliminate hatchery fish, and selectively ignore positive studies that demonstrate hatchery fish from local stock do very well in the local habitat. While there may be justifiable concerns about hatchery fish impacts on wild populations from past management decisions, the fact-of-the matter is that wild fish cannot sustain sport and commercial fisheries under the present habitat diminution in the Pacific Northwest. The Columbia Basin, for example has less than 20% of the original habitat remaining for summer steelhead. The solution is to differentiate the effects of management policy with hatchery fish from the effects of artificial propagation on fish in the wild, and reform hatchery technology that doesn't preserve the genetic and biological attributes of wild fish in the hatchery programs. There is no evidence that the risk of biological impairment is too high to allow excess hatchery fish to spawn in the wild, and if local stock is used for propagation and supplementation with the right temporal synchrony, there is no reason to expect that hatcheries will promote negative effects on wild fish.

Management Goals for Hatchery Broodstocks: Genetic Integration versus Segregation

Don Campton, U.S. Fish and Wildlife Service

Hatcheries have been propagating Pacific salmon and steelhead in the Pacific Northwest for more than 100 years. Until recently, the primary purpose of these hatcheries was to produce fish for harvest. However, a new conservation role for salmon hatcheries is emerging. This new role has been motivated by concerns regarding the potential impacts of hatchery-origin fish on natural populations and recent ESA listings. In response, each hatchery program must explicitly state (1) the specific purpose and desired benefits to be derived from hatchery-origin fish and (2) the genetic management goals for the broodstock relative to naturally spawning populations. In the past, these purposes and goals have not been clearly defined, quantified, or distinguished. In the future, all hatchery programs will need to identify the genetic management goal of each broodstock as either "integrated" or "segregated" relative to naturally spawning populations. Hatchery programs are classified as *integrated* if the principal goal is to manage the broodstock as an artificially propagated component of a naturally spawning population. The goal of an *integrated* program is to increase the demographic abundance or productivity of an existing natural population while allowing natural environment to dominate the mean fitness of the population as a whole. This can be accomplished by ensuring that the proportion of a hatchery broodstock composed of natural-origin fish each year exceeds the proportion of natural spawners composed of hatchery-origin fish (i.e. gene flow from the natural environment to the hatchery environment must exceed the reverse rate of gene flow). In an idealized integrated program, natural-origin and hatchery-origin fish represent two genetically equal components of a single gene pool that is adapted to the natural environment. Conversely, hatchery programs are classified as *segregated* if the principal goal or strategy is to manage a broodstock as a genetically discrete, hatchery-adapted population relative to naturally spawning populations. Hatchery broodstocks for segregated programs are derived primarily, if not exclusively, from hatchery-origin adults returning back to the hatchery. Although segregated broodstocks are inherently simpler to operate, hatchery-origin fish from segregated programs may pose unacceptable genetic and ecological risks to naturally spawning populations. Recognizing the fundamental distinction between *genetically integrated* and *genetically segregated* hatchery broodstocks and adapting these principles to future programs is the underlying foundation of hatchery reform in the Pacific Northwest.

Federal Concerns Regarding Hatchery Steelhead Spawning in the Wild

Richard B. Turner, NOAA Fisheries[1]

NOAA Fisheries has an integrated mission, in which it must balance meeting Endangered Species Act (ESA) responsibilities, Treaty Trust responsibilities, supporting the continuation and enhancement of recreational fisheries under Recreational Fisheries Policy and promoting sustainable commercial and recreational fisheries under the Magnuson-Stevens Fishery Conservation & Management Act. Artificial propagation has long been used to achieve a number of these objectives, but special care must be taken to reduce or minimize conflicts with natural population viability. Artificial propagation programs that may directly or indirectly harm listed species must obtain authorization under the ESA. The Salmon Recovery Division is responsible for reviewing hatchery programs to ensure that they will not appreciably reduce the likelihood of survival and recovery of the listed species. The Division also works with

[1] NOAA Fisheries, Salmon Recovery Division, 525 NE Oregon Street, Suite 510, Portland, OR 97232, (503) 736-4737, rich.turner@noaa.gov

the action agencies to identify measures that will minimize impacts on listed species from artificial propagation programs. Artificial propagation is analyzed based on the program's purpose, which is generally separated into three groups: conservation, integrated harvest, and segregated harvest. Each type of program is designed to minimize adverse effects on listed populations while achieving their specific objectives, be they conservation or harvest augmentation. Integrated steelhead programs are designed to meet these objectives and minimize impacts by attempting to approximate the natural population. Segregated steelhead programs are designed to support recreational fisheries while attempting to avoid interactions between the hatchery population and natural populations.

NOAA Fisheries' concerns regarding segregated hatchery programs include impacts from genetic introgression of hatchery steelhead into natural populations, juvenile interactions, straying, and harvest impacts. Genetic introgression impacts are estimated based on the number of hatchery steelhead spawning naturally and the extent to which the hatchery steelhead spawning overlaps temporally and spatially with the naturally produced population. Juvenile steelhead that result from earlier spawning hatchery steelhead tend to be larger than naturally produced steelhead, providing the hatchery progeny with a competitive advantage that can reduce the productivity of the natural population. Adverse genetic and demographic impacts on other naturally produced populations can result from the straying of hatchery steelhead adults into other basins; straying may be exacerbated by the practice of recycling hatchery steelhead to allow additional harvest opportunities. Harvest impacts on listed species may occur if the hatchery steelhead increase the abundance in mixed stock fisheries causing greater catch and release mortalities for naturally produced steelhead. Monitoring of segregated hatchery programs should be able to estimate the number of hatchery steelhead spawning naturally and their overlap with the naturally spawning population. The program should be meeting harvest contribution goals, minimizing incidental impacts from the fisheries, and minimizing straying into other basins. All monitoring activities should provide an accounting of returning adult steelhead. Monitoring should also determine if the juvenile steelhead produced from natural spawning hatchery steelhead are interacting negatively with the listed steelhead and other species.

If monitoring determines that these impacts are occurring then there are a number of measures that hatchery programs can implement, including changing to an integrated program, altering release timing and locations, and reducing overall production. Changing to an integrated program could minimize the more drastic effects of genetic introgression and juvenile interactions. Changing release locations can cause hatchery steelhead to home to, and hold in, areas away from naturally spawning populations. An example of how a change in release location has increased the segregation between hatchery steelhead and the naturally spawning population is provided.

Hatchery Culture of Steelhead—What Can We Do?

Kathy Hopper, Long Live the Kings

Long Live the Kings is a private, non-profit organization committed to restoring wild salmon to the waters of the Pacific Northwest. Using a science-based, collaborative approach, LLTK projects seek to identify under what conditions hatcheries and fish rearing techniques can be used to help recover naturally spawning salmon and steelhead populations and support sustainable fisheries. The topic of this talk is the role of hatcheries within the context of developing and implementing steelhead management strategies.

What Are Managers Required to Provide Their Constituents?

Bob Leland, Washington Department of Fish and Wildlife

The Washington Fish and Wildlife Commission directed the agency to complete within two years a Statewide Steelhead Management Plan (SHMP). The SHMP will identify the agency's management objectives such as: maintaining healthy wild runs, providing hatchery steelhead for harvest, meeting Federal Court legal requirements, working with the co-managers, and meeting Endangered Species Act requirements. In addition, recommendations from the Hatchery Scientific Review Group (HSRG) will be incorporated wherever possible. The HSRG reviewed all of the 100 or so hatchery facilities in Puget Sound and Coastal Washington operated by the Washington Department of Fish and Wildlife, Puget Sound and Coastal Indian Tribes and Nations, and the U.S. Fish and Wildlife Service. Many useful recommendations came from the HSRG, however some of the integrated and segregated stock recommendations need to be analyzed more fully, river-by-river before being applied. The Hoh River was randomly chosen to illustrate potential HSRG implementation stumbling blocks, as they relate to agency and co-manager steelhead management objectives.

Contributed Papers

Chair: Bill Horton, Idaho Department of Fish and Game

Implementation of a Program to Monitor Oregon Coastal Populations of Steelhead

Steve Jacobs and Gary Susac, Oregon Department of Fish and Wildlife

We instituted the first year of a multiyear monitoring program to assess status and trends of populations of winter steelhead inhabiting Oregon coastal watersheds. This program uses cumulative redd counts as a measure of spawner abundance. Proportions of the spawning run resulting from naturally produced and hatchery fish are estimated through observations of live adipose fin-clipped fish observed on surveys. Survey sites are selected using a stratified random probability design that provides a spatially-balanced sample across the range of steelhead spawning distribution. The accuracy of this sampling design and survey methodology was evaluated during 2000-2003 in Smith River, a mid-coast watershed with about 225 miles of steelhead spawning habitat. Results of this evaluation showed redd counts to be a reliable indicator of spawner abundance.

In 2003, we conducted 430 surveys to access spawn timing, redd distribution and redd abundance. Surveys were stratified among five Monitoring Areas (MAs). Among these MAs, spawn timing varied substantially, with the date of 50% completion of redd construction ranging from 1 March in the Umpqua MA to 15 April in the North Coast MA. Mean redd density ranged from 8 redds per mile in the Mid Coast MA to 18 redds per mile in the North Coast MA. Redd densities averaged 2.5 times higher in streams dominated by basalticly-derived substrate compared to streams flowing through sedimentary substrate. Within our sampling frame, across all MAs, we estimated a total of 81,000 redds were constructed in 2003. About 10% of these redds were constructed by hatchery-origin spawners.

In general, our initial results showed Oregon coastal populations of winter steelhead to be relatively abundant, widely distributed and remote from significant interbreeding with hatchery fish. We are continuing this monitoring in 2004 and 2005 and are also developing a similar program for Oregon tributaries of the Lower Columbia River.

Genetic Population Structure of Snake River Basin Steelhead in Idaho

Alan Byrne, Idaho Department of Fish and Game

Idaho Department of Fish and Game (IDFG) collected tissue samples from 74 wild juvenile steelhead *O. mykiss* populations throughout the state and five hatchery stocks in 2000. These samples were used to determine the genetic population structure of Idaho’s steelhead assemblage. DNA was amplified and analyzed for 1905 fish samples at the USGS Alaska Science Center, Anchorage. Genetic variation found at 11 microsatellite loci was used to describe population structure for steelhead (*Oncorhynchus mykiss*) from 36 populations in the Snake River basin, Idaho. The remaining 43 wild populations are being processed and a final report will be issued once the analysis is completed.

Significant regional spatial structuring of populations was apparent among 10 different river drainages. Many *O. mykiss* populations were most closely related genetically to other *O. mykiss* from streams within the same drainage. Significant allelic frequency differences were found in 98.5% of all pairwise comparisons for the 36 *O. mykiss* populations. AMOVA analyses showed that 2.8% of the molecular variance could be attributed to differences among 10 major river drainages (Clearwater, Middle Fork Clearwater, South Fork Clearwater, Salmon, Middle Fork Salmon, South Fork Salmon, Little Salmon, Lochsa, Selway and Snake rivers). All Idaho steelhead hatchery populations were shown to contain genetic diversity that was similar to that found in geographically proximate wild *O. mykiss*, with the exception of the East Fork Salmon "B-run" hatchery population that contained allelic structure most closely related to Ten Mile Creek *O. mykiss* in the Clearwater River drainage.

How Wild Steelhead Win the Race

Brenda Wright, U.S. Forest Service[1]

We compare steelhead trout and coho salmon young-of-the-year (YOY) growth in two watersheds in southeast Alaska. Coho salmon YOY emerge from the gravel in mid-April to late May with an average forklength of 38mm. Steelhead trout emerge from the gravel in mid-July with an average forklength of 29mm. When measured in mid-September, steelhead grew 2 to 4 times faster than coho salmon during the same time period. Steelhead grew an average of 36mm in 62 days and coho salmon grew an average of 17mm in 123 days in a watershed in southern southeast Alaska. In a second more northern watershed (250 miles north) steelhead grew 15mm and coho salmon 20mm for a similar time period. Water temperature and food supply may account for the differences in growth between the two species. Steelhead YOY emerge when water temperatures are near the summer peak and food supply may be more abundant and better quality. For example, steelhead YOY emerge when adult pink salmon are spawning which may provide both free floating salmon eggs and increased drift invertebrates from redd construction. Temperatures during July and August usually reach the summer maximum (8-12^{o}C) and adult pink salmon adults are reaching maximum numbers in freshwater by late August. In the northern watershed, water temperature did not go above 4 ^{o}C until late June. Steelhead win the growth race by emergence timing with warmer water and increased high quality food supply (salmon eggs).

[1] Pacific Northwest Research Station, Juneau Forestry Sciences Laboratory, 2770 Sherwood Lane 2A, Juneau, AK 99801, (907) 586-8811 ext. 244, bwright01@fs.fed.us

Quantifying Genetic Diversity Steelhead Stocks

Eric Parkinson, Art Tautz and Bob Hooton; British Columbia Ministry of Water, Land & Air Protection

We developed a classification system for steelhead stocks based on molecular genetics, habitat similarity and shared management issues. Steelhead distribution is mapped on a 1:50000 digital watershed atlas. The smallest independent units are stock which have independent demography and are large enough to be viable. These units are intended to correspond closely with the Viable Salmonid Population definition. Based on observed patterns of genetic differentiation, stocks were defined by listing tributaries of the ocean and large rivers using the watershed atlas. Watershed area and anadromous stream length were used to estimate capacity and watersheds with maximum run sizes of <30 adults were not considered viable. This list was reviewed by Regional biologists for obvious errors based on local knowledge. Stocks were grouped into 3 major phylogenetic groups based on similarities in molecular genetic profiles. A variety of watershed characteristics (gradient, size, snowfield size, lake area, distance from ocean) can be used define groups of stocks that share similar habitats and, presumably similar selective regimes for adaptive traits. Stocks that share common management issues and policies can be defined using information such as hatchery stocking, commercial harvest data, land use data and angler use statistics. We believe that this system will facilitate the identification of rare and unusual ecotypes as well as the process of managing hundreds of stocks with almost no stock status data.

Evening Session

SalmonScape

Ann Blakley, Washington Department of Fish and Game

SalmonScape is a GIS-based, interactive web application that provides a wide range of information on Washington salmon and steelhead stock abundance and status, distribution, and habitat. SalmonScape also provides information about fish passage barriers, hatchery programs, smolt traps, and recovery efforts. Viewers can create a wide range of maps that display much of the habitat and distribution data and can download stock-specific text-based reports from the 2002 Salmonid Stock Inventory (SaSI).

SalmonScape can be accessed at http://wdfw.wa.gov/mapping/salmonscape.

Attendance List

Alaska Department of Fish and Game

Tom Brookover
304 Lake St. Room 103
Sitka, AK 99835
(907) 747-3881
tom_brookover@fishgame.state.ak.us

Roger Harding
P.O. Box 240020
Douglas, AK 99824
(907) 465-4311
roger_harding@fishgame.state.ak.us

Steve Hoffman
2030 Sea Level Drive, Suite 205
Ketchikan, AK
(907) 225-2889
steve_hoffman@fishgame.state.ak.us

British Columbia
Ministry of Water, Land & Air Protection

Bob Hooton
2080 A. Labieux Rd.
Nanaimo, BC V9T6J9
(250) 751-3109
Bob.Hooton@gems1.gov.bc.ca

Eric Parkinson
2204 Main Mall, HBG
Vancouver, BC V6T 124
(604) 222-6761
Eric.Parkinson@gems9.gov.bc.ca

Miles Stratholt
PO Box 9363
Stn. Prov. Gov.
Victoria, BC V8W9M2
(250) 387-9560
Miles.Stratholt@gems3.gov.bc.ca

British Columbia Conservation Foundation

Alan Lill
5569 Cortez Rd.
N. Vancouver, BC V7R4P9
(604) 980-4366
alanlill@shaw.ca

The Confederated Tribes of the Warm Springs Reservation of Oregon

Mick Jennings
6030 Dee Highway
Parkdale, OR 97041
(541) 352-9326
mjennings@gorge.net

Alexis Vaivoda
6030 Dee Highway
Parkdale, OR 97041
(541) 352-9326
vaivoda@gorge.net

Hoh Tribe

Jim Jorgenson
2464 Lower Hoh Road
Forks, WA 98331
(360) 374-6548
jjsalmo@hotmail.com

Idaho Department of Fish and Game

Alan Byrne
600 South Walnut Avenue
Boise, ID 83707
(208) 334-3700
abyrne@idfg.state.id.us

Bill Horton
600 So. Walnut Avenue
Boise, ID 83707
(208) 374-3791
bhorton@idfg.state.id.us

National Oceanic and Atmospheric Administration – Fisheries

Barry Berejikian
Manchester Research Station
P.O. Box 130
Manchester, WA 98353
(206) 842-5434
barry.berejikian@noaa.gov

Paul McElhany
2725 Montlake Blvd. E.
Seattle. WA 98112
(206) 860-5608
paul.mcelhany@noaa.gov

Rich Turner
525 NE Oregon St., Suite 510
Portland, OR 97232
(503) 786-4737
rich.turner@noaa.gov

Gary Winans
2725 Montlake Blvd. E.
Seattle, WA 98112
(206) 860-3265
gary.winans@noaa.gov

Oregon Department of Fish and Wildlife

Steve Jacobs
28655 Hwy 34
Corvallis, OR 97333
(541) 758-4617
jacobss@fsl.orst.edu

Kathryn Kostow
17330 SE Evelyn
Clackamas, OR 97015
(503) 657-2000
kathryn.e.kostow@state.or.us.

Jim Muck
510 Arcadia Drive
Roseburg, OR 97470
(541) 440-3353
jim.b.muck@state.or.us

Steve Pribyl
3701 W 13th
The Dalles, OR 97058
(541) 296-4628
steve.pribyl@state.or.us

Brad Smith
65495 Alder Slope Rd.
Enterprise, OR 97828
(541) 896-3183
gofish@oregontrail.net

Pacific States Marine Fisheries Commission

Stephen Phillips
205 SE Spokane Street, Suite 100
Portland, OR 97202
(503) 595-3100
stephen_phillips@psmfc.org

U.S. Forest Service

Sheila Jacobson
Craig Rd - P.O. Box 500
Craig, AK 99921
(907) 826-1629
sajacobson@fs.fed.us

Don Martin
8904 Gee St.
Juneau, AK 94801
(907) 586-8712
dmartin02@fs.fed.us

Brenda Wright
2770 Sherwood Lane, 2A
Juneau, AK 99801
(907) 586-8811
bwright01@fs.fed.us

U.S. Fish and Wildlife Service

Bill Ardren
1440 Abernathy Creek Rd.
Longview, WA 98632
(360) 425-6072
William_Ardren@r1.fws.gov

Dan Campton
1440 Abernathy Creek Rd.
Longview, WA 98632
(360) 425-6072
Don_Campton@r1.fws.gov

Douglas DeHart
911 NE 11th Avenue
Portland, OR 97232
(503) 231-2386
douglas_dehart@fws.gov

Washington Department of Fish and Wildlife

Thom H. Johnson
283236 Hwy 101
Port Townsend, WA 98361
(360) 765-3979
johnsthj@dfw.wa.gov

Pat Michael
600 Capitol Way N.
Olympia, WA 98501
(360) 902-2628
michapjm@dfw.wa.gov

Randy Cooper
283236 Hwy. 101
Port Townsend, WA 98368
(360) 765-3979
coopervc@dfw.wa.gov

Manuel Farinas
48 Devonshire Road
Montesano, WA 98661
(360) 753-2600
farinmaf@dfw.wa.gov

Bill Freymond
48 Devonshire Road
Montesano, WA 98661
(360) 753-2600
freymbhf@dfw.wa.gov

Steve Foley
16018 Mill Creek Blvd.
Mill Creek, WA 98012
(425) 775-1311 x 102
foleysrf@dfw.wa.gov

Eric Truscott
3515 Hwy 97-A
Wenatchee, WA 98801
(509) 664-1227
trusckdt@dfw.wa.gov

Mike Scharpf
600 Capitol Way N.,
Olympia, WA 98501
(360) 902-2710
scharms@dfw.wa.gov

Larry Phillips
600 Capitol Way N.
Olympia, WA 98501
(360) 902-2721
phillicp@dfw.wa.gov

Jon Anderson
600 Capitol Way N.
Olympia, WA 98501
(360) 902-2711
anderjda@dfw.wa.gov

Ann Blakley
600 Capitol Way N.
Olympia, WA 98501
(360) 902-2712
blaklab@dfw.wa.gov

Mike Gross
48 Devonshire Road
Montesano, WA 98661
(360) 753-2600
grossmlg@dfw.wa.gov

Rick Ereth
48 Devonshire Road
Montesano, WA 98661
(360) 753-2600
erethrje@dfw.wa.gov

Bryce Glaser
2108 Grand Blvd.
Vancouver, WA 98611
(360) 906-6761
glasebg@dfw.wa.gov

Chris Gleizes
804 Allen St., #3
Kelso, WA 98626
(360) 577-0197
gleizcmg@dfw.wa.gov

Jeff Haymes
600 Capitol Way N.
Olympia, WA 98501
(360) 902-2727
haymejrh@dfw.wa.gov

Paul Hoffarth
2620 N. Commercial Avenue
Pasco, WA 99301
(509) 545-2284
hoffarph@dfw.wa.gov

Curt Holt
48 Devonshire Road
Montesano, WA 98661
(360) 753-2600
holtclh@dfw.wa.gov

Pat Hulett
804 Allen St., #3
Kelso, WA 98626
(360) 577-0197
huletplh@dfw.wa.gov

Chad Jackson
16018 Mill Creek Blvd.
Mill Creek, WA 98012-1296
(425) 775-1311 ext 113
jacksonsj@dfw.wa.gov

Karen Kloempken
600 Capitol Way N.
Olympia, WA 98501
(360) 902-2686
kloemkak@dfw.wa.gov

Bob Leland
600 Capitol Way N.
Olympia, WA 98501
(360) 902-2817
lelanrfl@dfw.wa.gov

John Long
600 Capitol Way N.
Olympia, WA 98501
(360) 902-2853
longjal@dfw.wa.gov

Anne Marshall
600 Capitol Way No.
Olympia, WA 98501
(360) 902-2769
marsharm@dfw.wa.gov

Glen Mendel
529 W. Main St.
Dayton, WA 99328
(509) 382-1005
mendegwm@dfw.wa.gov

Hal Michael
600 Capitol Way No.
Olympia, WA 98501
(360) 902-2659
michahhm@dfw.wa.gov

Charles Morrill
600 Capitol Way No.
Olympia, WA 98501
(360) 902-2747
morricfm@dfw.wa.gov

Mark Schuck
401 S. Cottonwood
Dayton, WA 99328
(509) 382-1004
schucmls@dfw.wa.gov

Cam Sharpe
804 Allen St., #3
Kelso, WA 98626
(360) 577-0197
sharpcss@dfw.wa.gov

Art Viola
3860 Chelan Hwy N.
Wenatchee, W A 98801
(509) 665-3337
violaaev@dfw.wa.gov

Chris Wagemann
804 Allan St., #3
Kelso, WA 98626
(360) 577-0197
wagemcww@dfw.wa.gov

Aimilee Wilson
600 Capitol Way No.
Olympia, WA 98501
(360) 902-2856
wilsoalw@dfw.wa.gov

Washington Trout

Nick Gayeski
P.O. Box 402
Duvall, WA 98019
(425) 788-1167
nick@washingtontrout.org

Ramon Vanderbrulle
P.O. Box 402
Duvall, WA 98109
(425) 788-1167
ramon@washingtontrout.org

Bill McMillan
Washington Trout
40104 Savage Rd.
Sedro-Woolley, WA 98284
(360) 826-4235
monksend@fidalgo.net

Wild Salmon Center

John McMillan
PO Box 2331
Forks, WA 98331
jmcmillan@wildsalmoncenter.org.

David Moskowitz
721 NW Ninth Avenue, Suite 290
Portland, OR 97209
(503) 222-1804
dmoskowitz@wildsalmoncenter.org

Long Live the Kings

Kathleen Hopper
1305 4th Avenue, Suite 810
Seattle, Washington
(206) 382-9555
Khopper@lltk.org

Barbara Cairns
1305 4th Avenue, Suite 810
Seattle, WA
(206) 382-9555
bcains@lltk.org

Special Guests

Robert Behnke
Colorado State University
3429 East Prospect Rd.
Fort Collins, CO 80525
(970) 482-1078
risjbehnke@earthlink.net

Ernie Brannon
University of Idaho
College of Natural Resources
P.O. Box 441142
Moscow, ID 83844
cbrannon@moscow.com

Nathan Mantua
University of Washington
5217 8th Avenue N.W.
Seattle, WA 98107
(206) 616-5347
mantua@atmos.washington.edu

Steelhead Trout Club of Washington

John Sharpf
16343 84th Avenue N.E.
Kenmore, WA 98028
(425) 488-2773
JandKsharf@aol.com

Jim Hearn
13251 S.E. 43rd Street
Bellevue, WA 98006-2111
(425) 746-7249
unkjim813@msn.com

Others

Patrick Trotter
Consultant
4926 26th Avenue S.
Seattle, WA 98108
(206) 725-7648
ptrotter@holcya.com

Dick Burge
Wild Steelhead Coalition
1261 Leland Va. Road E.
Quilcene, WA 98376
(360) 765-3815
fskibum@olypen.com