SANTA YNEZ RIVER WATERSHED REPORT
Final Report: May, 2013

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INTRODUCTION

California's statewide population of steelhead trout, *Oncorhynchus mykiss* (*O. mykiss*), is in decline. Steelhead populations in Southern California are the least well known and most jeopardized of all California steelhead populations. Development along the Southern California coast, dams, and water diversions, have hindered the migration of steelhead from the ocean to their historic spawning grounds leading to large population declines. Due to these declining population numbers, the National Marine Fisheries Service (NMFS) federally listed the Southern California Steelhead Evolutionary Significant Unit (ESU) as Endangered from Point Conception south to Malibu Creek in 1997. This range was then expanded in 2002, to include all coastal creeks and rivers to the Mexican border. Resource assessment and identification of factors limiting steelhead populations in southern California streams have been identified as high priorities in the Department of Fish and Wildlife's Steelhead Restoration and Management Plan for California (McEwan and Jackson 1996).

The Santa Ynez River has been identified as a Core 1 population in the NMFS Recovery Plan for Southern California Steelhead, indicating that it is a high priority for recovery actions. This once vital river had the largest run of steelhead in Southern California prior to the construction of three large dams between 1920 and 1953. After the construction of these dams access to upstream spawning grounds and juvenile rearing habitat was extremely diminished. In addition water diversion dramatically limited flows and changed the hydrologic function of the river.

The Pacific States Marine Fisheries Commission (PSFMC), the California Department of Fish and Wildlife (CDFW), along with the NMFS Southwest Regional office in Long Beach, have determined that the assessment of habitat and population status within the Santa Ynez River watershed will play an important role in the recovery of this species. This information will be used to protect existing spawning and rearing habitat, as well as restore critical habitat.

An inventory of the Santa Ynez River watershed and its associated tributaries was conducted by PSMFC staff with training and assistance provided by CDFW and NMFS. This inventory had several main objectives; to determine the quality and quantity of suitable steelhead habitat both above and below manmade barriers, to document the extent of steelhead and resident rainbow trout throughout the watershed, and to identify potential restoration activities. This inventory took place in two phases; phase 1: November 16, 2010 to May 12, 2011, and phase 2: December 21, 2011 to September 5, 2012. The Santa Ynez Watershed survey began upstream of the estuary at the mouth of the Santa Ynez River. The survey extended 161.3 miles throughout the watershed; with 88.79 surveyed miles and 72.52 miles unsurveyed due to logistical constraints. The survey ended 1.0 mile downstream of Jameson reservoir, approximately 88 miles upstream from the Pacific Ocean.

SUBBASIN SCALE

For the purposes of this study, the Santa Ynez watershed was divided into a lower and upper basin, downstream and upstream of Bradbury Dam. This division is made based on differences in land use and accessibility to anadromous fishes. Eight drainage areas were surveyed within the Santa Ynez watershed (see Appendix 1, Map 1 for all surveyed reaches). Six drainage areas were surveyed in phase 1: the mainstem of the lower Santa Ynez River, Salsipuedes Creek, El Jaro Creek, Nojoqui Creek, the mainstem of the upper Santa Ynez River (which lay between Lake Cachuma and the Gibraltor Reservoir), and Oso Creek. In phase 2, work continued to complete the survey of the upper Santa Ynez River between Lake Cachuma and the Gibraltar Reservoir, in addition to surveying the two remaining drainage areas: Santa Ynez-Lake Cachuma (which contained Lake Cachuma and its associated tributaries) and the Santa Ynez Headwaters (which contained Gibraltar Reservoir, Jameson Lake, the Santa Ynez River, and all the associated tributaries above Gibraltar Dam). This report discusses the lower and upper Santa Ynez basins separately. The lower Santa Ynez subbasin includes the following drainages: lower Santa Ynez River, Salsipuedes Creek, El Jaro Creek, and Nojoqui Creek. The upper Santa Ynez subbasin includes the upper Santa Ynez River, Santa Ynez-Lake Cachuma, and the Santa Ynez Headwaters drainages.

For each stream survey efforts were made to survey from the stream mouth upstream to a natural barrier to salmonid migration. Barriers were assessed based on fish passage guidelines from the *California Salmonid Stream Habitat Restoration Manual*. Natural barriers were considered to be non-manmade barriers to fish passage; such as waterfalls, steep gradients, or landslides. Unsurveyed reaches were often due to a lack of public access to the location, but also sometimes due to remoteness, vegetation overgrowth, or terrain. The eight survey drainages are described in detail in the individual subbasin reports.

WATERSHED OVERVIEW

Climate

The Santa Ynez River watershed has a Mediterranean climate with alternating wet and dry cycles. Most of the rainfall occurs in the winter; however yearly rainfall amounts can be incredibly variable. In addition to temporal variation in rainfall, average annual rainfall varies greatly throughout the watershed. Headwaters often receive almost twice as much rainfall as the lower watershed. Average annual rainfall for the City of Santa Ynez is 16.20in (1951-2012), whereas for Gibraltar Reservoir the average annual rainfall is 28.11in (1951-2012) (Santa Barbara County Public Works). Figure 1, below, illustrates the higher amounts of rain received on an annual basis in the headwaters compared to the lower watershed with a comparison of annual and average rainfall in the City of Santa Ynez (lower watershed) and Gibraltar Reservoir (headwaters) from 1951 to 2012 (Santa Barbara County Public Works).

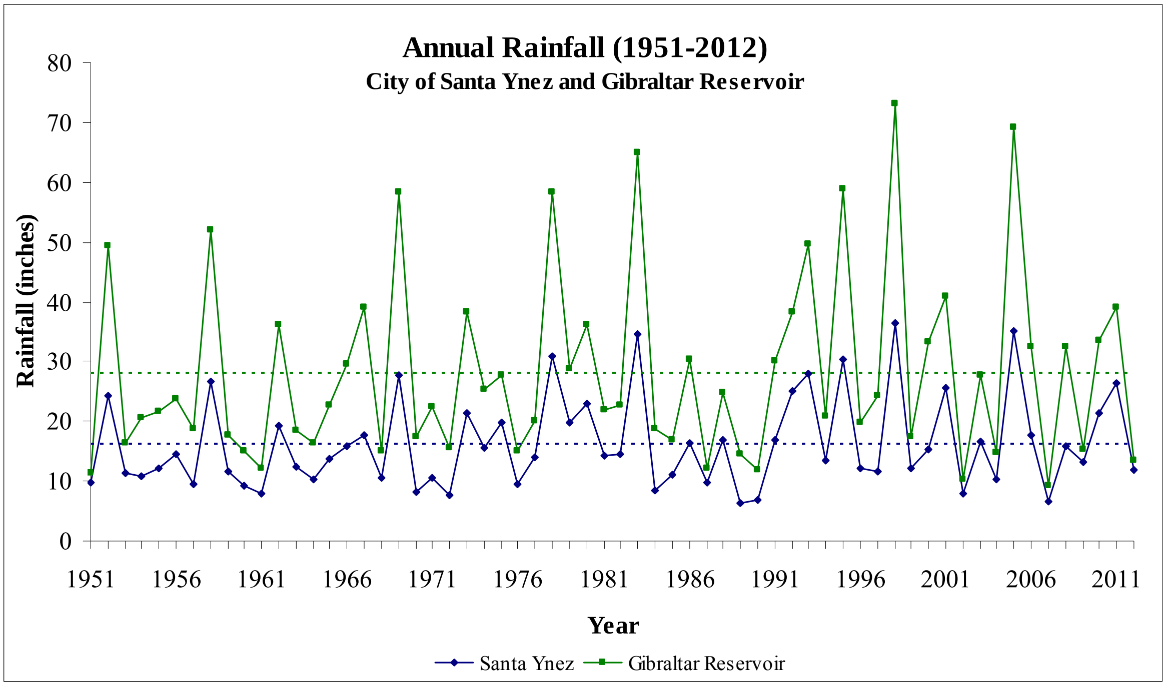

Figure 1: Comparison of rainfall in the Lower and Upper Santa Ynez River watersheds

Stream flows within this watershed are highly influenced by precipitation events; therefore the variable rainfall amounts can lead to a pattern and magnitude of stream flow that is seasonally and interannually variable. Many streams will have high flows during wetter winter months and low to no flows during the drier summer months.

Hydrology

The Santa Ynez River, with a mainstem length of approximately 92 miles, drains from its headwaters in the Santa Ynez Mountains westward through the Santa Ynez Valley before emptying directly into the Pacific Ocean. Located in Santa Barbara County, California, it passes through the cities of Santa Ynez, Solvang, Buellton, and Lompoc. Its location is 34:41:14.0N and 120:35:02.0W, LLID number 1205840346873. As seen in Map 1, the Santa Ynez watershed drainage area encompasses the lower Santa Ynez (Reach 1, 2, and 3), Salsipuedes Creek, El Jaro Creek, Nojoqui Creek, Lake Cachuma, upper Santa Ynez, Oso Creek, and Headwaters drainage areas that total approximately 897 square miles. According to the United States Geological Survey (USGS), the Santa Ynez River is a fourth order river that has approximately 2,077 miles of total stream length divided between 1,663 intermittent miles, 350 perennial miles, and 63 miles of manmade channels. Elevations range from 4 feet at the head of the estuary to 6820 feet in the Santa Ynez Mountain Headwaters.

Fire History and Management

Southern California has an extensive fire history. Fire rotation intervals average between 30 and 40 years and site specific return intervals range from less than 5 to over 100 years (Keeley and Fotheringham 2001). Relatively frequent natural fires have shaped the Santa Ynez watershed ecosystem, by maintaining more fire tolerant species. The Chumash Native Americans who inhabited this region used fire as a way to maintain grasslands and support the production of seeds, bulbs and green shoots that were used as food resources. Current fire management involves both prescribed burns and manipulation of fuel availability as ways to prevent extreme fires (2005 USDA Land Management Plan, Part 2 Los Padres National Forest Strategy).

The upper watershed of the Santa Ynez River lies largely within Los Padres National Forest, which is one of the most fire prone forests in the National forest system. Historically, an average of 28,000 acres of land has been burned annually by wildfires within Los Padres National Forest. Wildfires have increased in recent history likely due to increased urbanization as well as increased recreational use of the forest (Henson 2007).

Fires can have large impacts on aquatic ecosystems. Fire can cause changes to riparian habitat, increases in sedimentation, changes in temperatures, and changes to water chemistry (Rieman et al. 2005). These effects of fire can sometimes negatively impact local fish populations, particularly when the recovery time between fires is short.

Sedimentation, in particular, can negatively impact salmonid species, through decreases in essential habitat. One way that sedimentation can decrease potential habitat is by filling in pools that are used by salmonids for shelter from predators and extreme temperatures. In addition, increased sedimentation can degrade spawning habitat, by introducing fine sediments to spawning gravel. Salmonids use gravel at pool tail crests to create nests (redds), where they lay their eggs. Introduction of too many fine sediments can suffocate eggs by filling in interstitial spaces in the gravel thereby reducing, or eliminating water flow to the eggs (Waters 1995).

Historically, many fires have influenced the Santa Ynez watershed; the largest and most recent of these was the Zaca Fire in 2007, which is summarized below.

Zaca Fire 2007

The 2007 Zaca fire was a human induced fire, which started on July 4th and burned for close to 9 weeks. The fire began North of Los Olivos near Zaca Lake and spread North and East toward the Sisquoc River and the San Rafael wilderness area. The fire then continued East and South across Los Padres National forest, through San Rafael Wilderness area, Dick Smith Wilderness area and toward Matilija wilderness area. The Zaca fire burned 240,207 acres of land in total, mostly within Los Padres National Forest. In addition, the fire affected four large watersheds including the Santa Ynez River, Santa Maria River, Sisquoc River and Cuyuma River watersheds (see Appendix 1, Map 14).

This fire was fueled by drought conditions and freeze killed chaparral; due to uncharacteristically cold temperatures the preceding winter. Also, much of the affected area had not previously burned and many areas that had previously experienced fires had fully recovered, leading to high fuel loads (Henson 2007).

As a result of the Zaca fire, much higher than normal erosion rates were predicted for two areas within the Santa Ynez watershed. Mono Creek was predicted to have an erosion rate that is 196 times the normal erosion rate, and the East Fork Santa Cruz creek was expected to have 194 times the normal erosion rate. These two stream systems had the largest erosion effects, however all affected areas were expected to have erosion rates that were at least 38 times normal levels (ZACA BAER). These increased erosion rates can cause increased debris flows and sedimentation in effected watersheds.

In addition to higher erosion rates, the fire drastically altered riparian vegetation. Although, riparian habitats were impacted by the Zaca Fire, the BAER report indicates that fire effects on these areas would be minimal due to the lower intensity at which riparian habitats usually burn. They predicted that most riparian ecosystems would see effects from this fire for 3-5 years. The stream surveys discussed in this report were completed 4-5 years after this fire. Therefore, based on the initial estimations the streams should be nearing recovery from this incident.

Vegetation

The vegetation observed during surveys throughout the Santa Ynez River watershed was dominated by common riparian species. These species included, willow (*Salix sp.*), western sycamore (*Platanus racemosa*), cottonwood (*Populus fremontii*), coast live oak (*Quercus agrifolia*), alder (*Alnus rhombifolia*), mulefat (*Baccharis salicifolia*), coyote bush (*Baccharis pilularis*), wild rose (*Rosa californica*) and poison oak (*Toxicodendron diversiloba*). Riparian vegetation within the lower Santa Ynez subbasin was generally less dense and provided slightly less cover; due to the wider nature of the lower Santa Ynez River, compared to the upper. In addition, the lower subbasin had more observations of non-native plant species including cape ivy (*Delairea odorata*), pampas grass (*Cortaderia selloana*), eucalyptus (*Eucalyptus s.*), and arundo (*Arundo donax*); non-natives were much less common in the upper subbasin.

Riparian areas were surrounded by grasslands, coastal sage scrub, chaparral, and oak woodlands (SWRCB). The upper Santa Ynez subbasin is almost entirely within Los Padres National forest, within the National forest there are six major vegetation types. These include chaparral, mixed evergreen and oak forest, oak woodland, pinion-juniper woodland, conifer forest, and grassland. Ecosystems within Los Padres can have a huge range; the areas where this study was completed were largely semi-arid landscapes, with chaparral and oak woodland being the most common. The six different cover types found in Los Padres National Forest, as recorded in early 2006, are summarized in Table 1 (Henson 2007).

Table 1: Cover Types in Los Padres National Forest

Cover Types in Los Padres National Forest (Henson 2007)	Estimated Cover (%)
Chaparral	68
Mixed evergreen and oak forest	6
Oak woodland	3
Pinion and juniper woodland	13
Coulter, Jeffrey, and Ponderosa Pine	8
Grassland (natural and type conversion)	2

Land and Resource Use

Pre-European Settlement

The Chumash people inhabited the Santa Ynez region approximately 9000 years before the arrival of Europeans. The Chumash were dependent on hunting, gathering, and fishing subsistence practices. At the end of the 18th century the human population in this region was estimated to be around 15,000, with groups of 500 to 1000 people commonly encountered (Timbrook et al. 1982).

Although the Chumash were not thought to be an agricultural society, there is some evidence that they modified the landscape to suite their needs. One way the Chumash modified their landscape was through prescribed burning. This burning likely created a more grassland and oak savanna dominated ecosystem in contrast to the largely coastal sage scrub and chaparral ecosystems which dominate in these areas today. It is suggested that this prescribed burning increased the seed bearing plants, green shoots and bulbs which were favored and used heavily as food sources (Timbrook et al. 1982, Keeley 2002). Burning might also have improved hunting by removing brush and allowing easier movement through the landscape. Historical accounts suggest frequent small fires were common in this region prior to European fire suppression (Timbrook et al. 1982).

European Settlement

The Mission era in Southern California began in the late 18th century with the development of Spanish missions. This time period marked a change in land use from the hunter-gatherer Native American culture to one largely based on livestock grazing and agriculture. Due to differences in priorities for land use between the local native populations and the Spanish settlers there were conflicts between these groups. The Chumash practice of burning the land to propagate seed bearing plants and bulbs conflicted with the Spanish settlers need to feed their livestock on those same grasslands. Due to this conflict, the Chumash were removed from these grasslands by the Spanish settlers and the regular burning was stopped (McBride and Jacobs 1980).

The US took control of California from Mexico in 1848; this was also when gold was discovered in California. This caused an influx of people as well as a slight change in land use in some areas of Southern California where mining practices began. In addition after gold deposits were depleted many of these people began ranching and farming in the valleys, while others started a timber industry. Mining, logging and burning for range land were largely stopped in the early 1900’s with the development of the US Forest Service and the establishment of Federal Forest Reserves (McBride and Jacobs 1980).

Present

There are a variety of land uses in the Santa Ynez region at present. These uses include urban, residential, agricultural, ranching, vineyards, and National Forest lands.

The lands adjacent to the lower Santa Ynez River Drainage consist primarily of privately owned property within the jurisdiction of Santa Barbara County; an exception to this is Vandenburg Airforce Base, which controls areas around the river mouth and estuary (SYRTAC). Much of the watershed runs through urban and residential zones associated with the cities of Santa Ynez, Solvang, Buellton and Lompoc. Agricultural lands, ranch lands, and vineyards are also common in the more rural areas.

The lands adjacent to the upper Santa Ynez, Lake Cachuma, and Headwaters drainages are primarily within Los Padres National Forest, and therefore have somewhat limited anthropogenic influences. However, three reservoirs have been constructed within the watershed: Lake Cachuma, Gibraltar Reservoir, and Jameson Lake. Lake Cachuma is the largest of the three reservoirs and provides water to the Cities of Santa Barbara, Goleta, Montecito and Carpinteria. Much of the watershed east and north of Lake Cachuma lacks paved roads, although 4WD only roads are in place. These roads provide access to the upper Santa Ynez subbasin given they are not closed due to storm events and high flows.

Population

The population of the Santa Ynez watershed is centered in the cities of Santa Ynez, Solvang, Buellton and Lompoc. The population in Lompoc CCD (census county division) according to the 2010 US census was 57,742, and the Solvang-Santa Ynez CCD (including Buellton) was 22,670. These two combined make up the majority of the population in the Santa Ynez Watershed, approximately 80,412 people. In addition to residents there are a large number of people that visit Los Padres National Forest for recreational purposes from many of the surrounding areas. Visitors to the park on a yearly basis are estimated to be over 1 million.

Forest Management

There is presently no timber harvest industry in the Santa Ynez watershed. This is largely due to the unsuitability of the vegetation for this type of activity. The majority of timber resources within the watershed are within Los Padres National Forest and timber is only produced through forest health procedures, such as thinning and reduction of hazardous fuels (USDA). The US Forest Service uses thinning, and removal of dead vegetation, as ways to decrease the risk of large intense wildfires.

Roads and Railroads

The majority of the roads in the lower watershed are paved and maintained roads. Large access roads to the area which cross the mainstem of the Santa Ynez River include, Highways 1, 246, 101 and 154. Most of the paved road access is to areas in the lower Santa Ynez subbasin. The upper subbasin, which lies largely within Los Padres National Forest has limited paved road access. Highway 154 provides access to Paradise Rd., which runs along the Santa Ynez for approximately 10 miles; this makes up the majority of the paved road access to the upper Santa Ynez. The only other paved road access available is on Happy Canyon Rd. which allows access to the upper reaches of Cachuma Creek. The roads in the upper portion of the watershed are almost all 4WD dirt roads with varying degrees of accessibility and maintenance. Many of these roads are closed during rain events, making access to large portions of the upper watershed impossible. There are also additional road closures caused by the presence of threatened and endangered species. During this survey, access to large portions of the upper watershed was cut off due to breeding of the federally threatened red-legged frog on one of the road crossings.

There is one railroad that impacts this system. This is a coastal railroad that crosses at the Santa Ynez estuary, by way of a bridge (see picture and description in lower Santa Ynez barriers section).

Water Use: Dams, Diversions and Water Rights

One of the major problems associated with fish passage in the Santa Ynez watershed has to do with the construction of dams on the mainstem. Three dams were built between 1920 and 1953; Gibraltar Dam was the first to be built in 1920 by the City of Santa Barbara. The construction of this dam and Gibraltar Reservoir were the first major structures to limit steelhead access to the upper watershed. In 1930 Juncal Dam was built by the Montecito Water District, forming Jameson Lake. The construction of Juncal Dam did not further hinder upstream migration of steelhead from the ocean; however it did provide a barrier to the movement of resident rainbow trout and landlocked steelhead confined to the upper watershed. The largest of the three reservoirs is Lake Cachuma, which was created in conjunction with Bradbury Dam between 1950 and 1953. These three dams were built mainly for water supply purposes, not specifically for flood control (SYRTAC).

In an effort to control sediment input into the reservoirs there were several debris dams constructed on major tributaries around the same times as the three major dams. These debris dams further impact the movement of fishes among the tributaries and the mainstem above Bradbury dam. Restricted movement can have a negative impact on fish populations as there is less population mixing, possibly decreased genetic diversity of the resident population, as well as limiting access to historic spawning areas in these upper tributaries.

Even with the two debris dams associated with Gibraltar Reservoir the reservoir is still almost completely filled in. Within only 24 years of the construction of the reservoir it had lost half of its total capacity (Shapavolov 1944). Mono Debris Dam, built in 1935, was completely filled in by 1938; while the Agua Caliente Debris Dam, built in 1937, was completely filled in by 1944 (Shapavolov 1944).

In addition to limiting the movement of steelhead and other fishes throughout the watershed, these dams have drastically altered the flow of water to the lower Santa Ynez River watershed. One result of this is that Cachuma is required to release water to comply with downstream water rights as well as releases for fish and habitat maintenance. Water releases from the reservoir are not made every year, but in average and dry years; when the river channel below Cachuma is dry (SYRTAC).

Fish Habitat Relationship

Fishery Resources

California's statewide population of steelhead trout is in decline. Total population estimates are currently half of what they were 30 years ago, with approximately 250,000 adults statewide (McEwan and Jackson 1996). In Southern California steelhead runs have declined from between 32,000 and 46,000 to less than 500 returning steelhead (Williams et al. 2011).

Historically, the Santa Ynez River supported one of the largest steelhead runs in Southern California. The exact size of this historic run is unknown as there is minimal documentation from before construction of the first dam, Gibraltar Dam in 1920. From the information available, runs were estimated to be between 13,000 and 25,000 individuals before dams were constructed on the Santa Ynez River (Titus et al. 2001). Recent run sizes in the Santa Ynez River (since 2000) have been between 0 and 4 anadromous adults, with the exception of 2008 which had 16 anadromous adults (Williams et al. 2011).

Run sizes of southern steelhead have decreased dramatically; largely due to loss of access to habitat. With the construction of Bradbury Dam (1953), Gibraltar Dam (1920) and Juncal Dam (1930), access to upstream spawning grounds and juvenile rearing habitat was extremely diminished. In addition, water deviation dramatically limited flows downstream of Lake Cachuma. The urbanization of surrounding towns has also rendered much of the watershed inaccessible to steelhead returning from the ocean, due to the construction of a number of impassable manmade structures.

Southern California Steelhead, Oncorhynchus mykiss

Oncorhynchus mykiss (*O. mykiss*), commonly known as Coastal Rainbow/Steelhead Trout, has evolved two life history strategies (resident and anadromous) to protect against catastrophic events that occasionally occur in freshwater creeks and in the ocean. For the purposes of this report, *O. mykiss* will be used to refer to both forms. However where appropriate, the term resident trout or steelhead will be used to distinguish which form is being discussed.

Steelhead trout, the anadromous form of *O. mykiss*, populate waters from Baja California in the South up the Pacific coast of North America and into Asia. NMFS federally listed the Southern California Steelhead ESU as Endangered from Point Conception south to Malibu Creek in 1997. In 2002 the range of the ESU was expanded to include all coastal creeks and rivers to the Mexican border. In 2006 NMFS determined that the ESU designation of steelhead was not appropriate and reclassified the steelhead populations within the State as Distinct Population Segments. In 2011 steelhead classifications were reviewed by NMFS as required under the ESA (Williams et al. 2011). These actions did not alter the endangered status of southern steelhead.

Southern steelhead are winter-run steelhead that typically enter streams from December to April to spawn with high winter flows. Post-spawn steelhead, known as kelts, rejuvenate after spawning and, if conditions permit, return to the ocean to then spawn again the following year. The offspring can remain in the freshwater stream of their birth as residents, or become anadromous and thus migrate to the ocean to mature. A single stream can have both resident and migratory forms and can have some interbreeding between the two (Busby et al. 1996, NMFS 2012). The anadromous form can vary in the amount of time spent in freshwater, but usually spend one to two years rearing in the freshwater stream before going to the ocean (Shapavolov 1967). Adult fish may return to their stream of origin, or they may stray, which is an effective way to re-colonize streams that have been extirpated due to prolonged drought, devastating fires, or other adverse effects (Clemento et al. 2008). Of the 16 anadromous fish seen in the Santa Ynez River in 2008, 38% were found to have origins outside of the Santa Ynez River watershed (Williams et al. 2011), indicating that strays from other watershed may play an important role in this population.

In the early 1900’s, the Santa Ynez River was believed to have supported the largest run of southern steelhead but due to loss of habitat access stemming from the construction of migration barriers, the population has dwindled to less than a hundred fish (Williams et al. 2011). After the construction of Bradbury Dam, as well as Gibraltar and Juncal Dams, access to upstream spawning grounds and juvenile rearing habitat was extremely diminished, while water diversion dramatically limited flows and changed the hydrologic function of the river.

Stocking and origins of trout

Stocking of *O. mykiss* has been known to occur in the Santa Ynez River, as well as some of its tributaries. Stocking by the CA Department of Fish and Wildlife (CDFW) occurred recently in Lake Cachuma and in areas along the mainstem between Lake Cachuma and Gibraltar Dam to support a recreational fishery; however the area has not been stocked, by CDFW, since 2010. Stocking of Lake Cachuma continues through alternate sources. Historically this area has been stocked with *O. mykiss* from hatcheries in addition to the relocation of fish from drying sections of the mainstem to areas with perennial water.

Although there is a history of stocking non-resident *O. mykiss,* it appears that very little genetic material from hatchery fish has been integrated into the native population (Garza and Clemento 2007, Clemento et al. 2008). Four populations (Salsipuedes Creek, Hilton Creek, Santa Cruz Creek, and Juncal Creek), both above and below Bradbury dam, in the Santa Ynez watershed were examined in a study by Garza and Clemento (2007) and all of these populations were shown to have primarily coastal steelhead ancestry. There are several reasons why hatchery fish may not have a large genetic impact on these populations. There may be behavioral differences, which inhibit spawning between the native and hatchery populations. Additionally, hatchery fish may not be surviving long enough to interbreed substantially, as they are not adapted to the relatively extreme conditions found in Southern California streams.

In addition to stocking of hatchery *O. mykiss* there is also a history of relocation of fish from the lower watershed to the upper watershed, and other areas with perennial water (the lagoon, and mainstem near Solvang), as part of rescue efforts. Shapavolov (1944) noted the relocation of thousands of fish on a yearly basin within the Santa Ynez watershed, with numbers ranging from 29,000 fish relocated in 1939 to 662,300 in 1944. These numbers give an idea of the number of fish that used to inhabit this system prior to the construction of Bradbury Dam in 1953.

Santa Ynez Native Fishes

In addition to steelhead trout, there are several other native fishes found in the Santa Ynez Watershed. According to the Lower Santa Ynez River Fish Management Plan and Cachuma Project Biological Opinion for Southern Steelhead Trout, fish species known to inhabit the Santa Ynez watershed can be observed in Table 2: Santa Ynez Watershed Native Fish Species.

In addition to Southern California steelhead, there is one other federally endangered fish species found in this area, the tidewater goby. Tidewater gobies are found in the estuary of the Santa Ynez River. These fish are small, less than 2 inches in length, and inhabit areas of the river that are tidally influenced. Although these fish are listed as federally endangered they can be locally abundant.

One other anadromous species is found within this watershed, the Pacific lamprey. Pacific lamprey spend one to two years in the ocean, and four to seven in freshwater. Like the steelhead they require high enough water flows to enable movement upstream to spawning areas, and are similarly negatively impacted by fish passage barriers.

There are two other native fishes that will come up into the river, the prickly sculpin and the threespine stickleback. Prickly sculpin are known to be found in Lake Cachuma as well as the Santa Ynez River below Bradbury Dam. They are incredibly tolerant to changes in temperature and salinity which allows them to live in a wide range of habitats. Threespine stickleback are mostly found in freshwater in the Santa Ynez watershed, they have been identified both above and below Lake Cachuma and have also been found in some of the tributaries.

Table 2: Santa Ynez Watershed Native Fish Species

Common Name	**Scientific Name**	**Location**
Pacific herring	*Clupea harengus*	L
Pacific lamprey	*Lampetra tridentate*	R
Prickly sculpin	*Cottus asper*	RATCL
Shiner perch	*Cymatogaster aggregate*	L
Staghorn sculpin	*Leptocottus armatus*	L
Starry flounder	*Platichthys stallatus*	L
Steelhead/Rainbow trout	*Oncorhynchus mykiss*	RATCL
Striped Mullet	*Mugil cephalus*	L
Threespine stickleback	*Gasterosteus aculeatus*	RATCL
Tidewater goby	*Eucyclogobius newberryi*	L
Topsmelt	*Atherinops affinis*	L

R = Santa Ynez River below Bradbury Dam, T = Tributary Streams, C = Cachuma Lake, A = Santa Ynez River above Cachuma Lake, L = Santa Ynez River lagoon.

Habitat Overview

Historic Conditions

Several previous studies have examined the presence of steelhead trout in different parts of the Santa Ynez Watershed, as well as the presence of suitable habitat. These studies are important because they pinpoint areas that are of particular interest in terms of restoration potential, in addition to areas that are in need of further study.

A large study was completed on the lower Santa Ynez River by the Santa Ynez Technical Advisory Committee in 1999 to determine and implement management actions that would benefit fisheries resources in the lower Santa Ynez. This management plan summarizes studies looking at habitat conditions on the Santa Ynez below Bradbury Dam. These studies found that the most promising habitat for *O. mykiss* existed in the reaches just below Bradbury Dam. They found these areas to have the highest amounts of shading and best water temperatures. Although there is some suitable habitat found on the lower mainstem, the majority of suitable habitat is found in the lower tributaries. They found suitable spawning and rearing habitat in Hilton Creek, Quiota Creek, Salsipuedes Creek and El Jaro Creek. Nojoqui Creek was found to have suitable habitat conditions however there was little evidence for the presence of *O. mykiss* in this tributary. In the present study, the lower mainstem Santa Ynez River, Salsipuedes Creek, El Jaro Creek, and Nojoqui Creek were surveyed.

A study was completed in 2007 evaluating habitat availability in the upper Santa Ynez basin, much of this work was a compilation of forest service surveys in the area (AMC, Chubb 1997). They found that 13 of the identified upper basin streams had good potential high benefit for *O. mykiss* based on their spawning and rearing habitat. The identified streams included the Santa Ynez River (between Bradbury and Gibraltar dams), Santa Cruz Creek, Coche Creek, Devil Canyon's Creek, Gidney Creek, Mono Creek, Indian Creek, Buckhorn Creek, Blue Canyon Creek, Escondido Creek, Alder Creek, and North Fork Juncal Creek. Of these 13 streams identified as having potential high benefits for *O. mykiss,* five were evaluated in the present survey, the mainstem of the Santa Ynez River, Santa Cruz Creek, Mono Creek, Indian Creek, and Buckhorn Creek.

Current Conditions

A habitat inventory was conducted in the Santa Ynez River between November 2010 and September 2012, in two phases: phase 1: November 16, 2010 to May 12, 2011, and phase 2: December 21, 2011 to September 2012. The habitat inventory conducted in the Santa Ynez River Watershed follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998) and the Montgomery-Buffington Channel Morphology methodology (1997). The PSMFC biologist and fisheries technicians that conducted the inventory were trained in standardized habitat inventory methods designed by the CDFW and standardized channel morphology typing methods designed by NMFS. The purpose of the habitat inventory was to categorize stream habitat of the mainstem Santa Ynez River, as well as some of its tributaries, in order to determine the quantity and quality of habitat for Southern steelhead trout.

The survey consisted of the Santa Ynez River mainstem, from the estuary to Gibraltar Dam, and 9 of its tributaries. The 9 tributaries surveyed included, in the lower watershed, El Jaro, Salsipuedes, and Nojoqui Creeks; and in the upper watershed, Cachuma, Santa Cruz, Oso, Mono, Indian and Buckhorn Creeks. The mainstem was surveyed in fragmented sections due to limited access to portions of the river found on private property. This problem was largely contained to the first phase of the project which took place in the lower watershed. The mainstem and tributaries in the upper watershed were able to be more fully surveyed; due to the fact that they are mostly located on US Forest Service Land, with the exceptions of Cachuma and Santa Cruz Creeks.

Currently, the only areas available for steelhead spawning are in the lower watershed; as Bradbury Dam blocks any further passage into the upper watershed. Very few fish were observed during the survey of the lower Santa Ynez subbasin; however there have been previous reports of spawning in El Jaro and Salsipuedes Creeks. These two creeks were found to have a moderate amount of suitable spawning habitat in this study, with a number of pools with suitable sized gravel and cobble at the tail crests and appropriate levels of embeddedness.

The upper Santa Ynez subbasin was found to contain suitable habitat for steelhead, however in general the upper subbasin did not have appropriate spawning conditions, with the exception of

Santa Cruz Creek. Many of the tail crests had high amounts of silt or sand which is not suitable for salmonid spawning. In addition many of the tail crests were highly embedded, making the gravel and cobble almost impossible to move. So, although there is appropriate fish habitat, suitable spawning areas are lacking. Santa Cruz Creek, unlike the rest of the surveyed sections of the upper subbasin had both excellent spawning and rearing habitat.

In general during the survey there were adequate flows, with the exception of some sections of the Santa Ynez mainstem. The tributaries had sufficient flows, mostly between 1 and 5cfs, providing adequate water movement throughout the systems. The mainstem of the Santa Ynez however, did have some large dry sections, particularly in the upper watershed. The upper Santa Ynez River had long and wide dry sections with scattered large, deep bedrock scour pools. Under appropriate flow conditions this area would provide excellent habitat for steelhead.

More in depth evaluations of habitat quality and quantity can be found in the lower and upper subbasin sections of this report.

Adverse Conditions affecting Steelhead Recovery

Barriers

A number of barriers were encountered during the survey, both manmade and natural. In total, 62 manmade structures were found that impact the stream, however not all of these structures negatively impact fish movement. Man made structures included Arizona Crossings, Bridges, Culverts, trail crossings, and dams. Several of the Arizona Crossings had natural bottoms which provided very low to no impact on fish movement (see individual lower and upper watershed reports for descriptions of barriers). In addition to manmade structures, 10 natural barriers to fish movement were observed during the survey. Many of the barriers encountered during the survey are partial barriers, meaning that they are impassable to fish only under certain flow conditions, largely low flows. Natural limits to salmonid migration were reached on Nojoqui Creek, Cachuma Creek, Indian Creek and Buckhorn Creek. These natural limits to anadromous migration consisted of large waterfalls and persistent dry reaches. In addition to the barriers listed in each subbasin report, there were additional partial natural barriers encountered that were likely only barriers to fish migration under very low flow conditions, and were therefore not included.

By far, the largest barriers to fish movement within this watershed are the three dams located on the mainstem of the Santa Ynez. Due to a lack of fish passage around these dams, there is no possibility of movement of anadromous fishes between the ocean and the upper watershed, above Bradbury Dam. This severely restricts available spawning and rearing habitat for steelhead trout as historically they utilized the headwater streams for these purposes. In addition to the three dams on the mainstem of the Santa Ynez there were additional debris dams built in conjunction with the reservoirs. These debris dams further limit fish movement within the upper watershed, cutting off resident fish from suitable spawning habitat in major tributaries.

More in depth information on barriers encountered during the survey is located in the Bridges, Barriers and Culverts sections, of the individual subbasin reports.

Introduced fish species

Non-native fishes can pose a threat to native fish populations through competition for resources and predation. Many of the non-natives found in the Santa Ynez watershed come from stocking done in Lake Cachuma, specifically the bait and game species, largemouth and smallmouth bass, green sunfish, and black bullhead catfish (SYRTAC). Table 3, Santa Ynez Watershed Introduced Fish Species, shows the non-native fishes that are found within the Santa Ynez watershed (Cachuma, 2003).

The arroyo chub, which was introduced into the Santa Ynez River in the 1930's, is actually a native species to the Southern California region, however not historically present in the Santa Ynez River. The arroyo chub is a state species of special concern and was introduced to the Santa Ynez River from other nearby streams. They are a small minnow, generally less than 5 inches in length and they generally prefer areas with slow moving water and sandy substrate. They are not expected to negatively impact steelhead in any way.

Table 3: Santa Ynez Watershed Introduced Fish Species

Common Name	**Scientific Name**	**Location**
Arroyo chub	*Gila orcutt*	RATCL
Black bullhead	*Ameiurus melas*	RATCL
Black crappie	*Pomoxis nigromaculatus*	RC
Bluegill	*Lepomis macrochirus*	RAC
Common Carp	*Cyprinus carpio*	RAC
Channel catfish	*Ictalurus punctatus*	RACL
Fathead minnow	*Pimephales promelas*	RTL
Goldfish	*Carassius auratus*	RAC
Green sunfish	*Lepmois cyanellus*	RATCL
Largemouth bass	*Micropterus salmoides*	RATC
Mosquitofish	*Gambusia affinis*	RATCL
Redear sunfish	*Lepomis microlophus*	RC
Smallmouth bass	*Micropterus dolomieui*	RACL
Threadfin shad	*Dorosoma petenense*	C
White Crappie	*Pomoxi annularis*	C

R = Santa Ynez River below Bradbury Dam, T = Tributary Streams, C = Cachuma Lake, A = Santa Ynez River above Cachuma Lake, L = Santa Ynez River lagoon.

HABITAT SURVEY METHODS

The Santa Ynez inventory was conducted in three parts: the habitat inventory, the Montgomery-Buffington (M-B) channel typing inventory, and the biological inventory. The objective of the biological inventory survey was to determine the observable current status of fish populations in the watershed. The objective of the M-B channel typing was instituted as a method for classifying stream channel morphology that defines a framework to investigate spatial and temporal patterns of channel responses in drainage basins (Montgomery, et al., 1997). The objective of the habitat inventory survey, and this stream inventory report was to document the current habitat conditions, determine suitability of steelhead habitat and recommend options for the potential enhancement of habitat in the Santa Ynez watershed for steelhead. The survey was conducted in two phases during two consecutive years. The survey was completed in multiple phases due to logistical constraints. Completing the survey in two stages likely impacted the results, especially with differences in rainfall impacting stream flows. In addition, much of the survey was executed in fragments due to lack of public access. Recommendations for habitat improvement activities were based on target habitat values suitable for southern steelhead (*O. mykiss*) in California's south coast streams.

The habitat inventory conducted in the Santa Ynez River Watershed follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998) and the Montgomery-Buffington Channel Morphology methodology (1997). The PSMFC biologist and fisheries technician that conducted the inventory were trained in standardized habitat inventory methods designed by the CDFW and standardized channel morphology typing methods designed by NMFS.

Sampling Strategy

The inventory used a method that sampled approximately 10% of the habitat units within the survey reach. All habitat units included in the survey were classified according to habitat type and their lengths were measured. All pool units were measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time were measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one was randomly selected for complete measurement.

Habitat Inventory Components

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Santa Ynez River to record measurements and observations. There were nine components to the inventory form.

1. Flow:

Flow was estimated in cubic feet per second (cfs) near the bottom of the stream survey reach. This estimate was derived by taking the average of three measurements of surface flow, and then extrapolating an estimate based on previous experience of survey members with stream flow measurements or by using flow measurements where stream gages were in place.

2. Channel Type:

Channel typing was conducted using the Montgomery-Buffington Channel Morphology protocol provided by NMFS. For comparison, channel typing was also done using the Rosgen classification system as described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing was conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There were five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics were measured using a hand level, hip chain, tape measure, and a stadia rod.

3. Temperatures:

Both water and air temperatures were measured and recorded at every tenth habitat unit. The time of the measurement was also recorded. Both temperatures were taken in degrees Fahrenheit under the cover of shade. The water temperature was always recorded in flowing water.

4. Habitat Type:

Habitat typing used the 24 habitat classification types defined by McCain and others (1990). Habitat units were numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Four additional habitat classification types were added for dry units, manmade culverts, unsurveyed units, and unsurveyed units due to marshes. Santa Ynez River habitat typing used standard basin level measurement criteria. These parameters required that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All measurements were in feet to the nearest tenth. Habitat characteristics were measured using a hip chain, tape measure, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas was measured by the percent of the cobble that was surrounded or buried by fine sediment. In Santa Ynez River, embeddedness was estimated by eye. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter are those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density-related competition for prey. All cover was classified according to a list of nine cover types. In Santa Ynez River, standard qualitative shelter values of 0 (none), 1 (low), 2 (medium), or 3 (high) were assigned according to the complexity of the cover, as follows:

Instream Shelter Complexity Value	
Value	**Instream Shelter Complexity Value Examples**
0	No shelter
1	One to five boulders; Bare undercut bank or bedrock ledge; Single piece of large wood (>12" diameter and 6' long) defined as large woody debris (LWD).
2	One or two pieces of LWD associated with any amount of small wood (<12" diameter) defined as small woody debris (SWD); Six or more boulders per 50 feet; Stable undercut bank with root mass, and less than 12" undercut; A single root wad lacking complexity; Branches in or near the water; Limited submersed vegetative fish cover; Bubble curtain.

3	Combinations of: LWD/boulders/root wads; Three or more pieces of LWD combined with SWD; Three or more boulders combined with LWD/SWD; Bubble curtain combined with LWD or boulders; Stable undercut bank with greater than 12" undercut, associated with root mass or LWD; Extensive submersed vegetative fish cover.

A quantitative estimate of the percentage of habitat unit cover was made using an overhead view. The shelter rating was then calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream. For example, a pool with 45% of the overhead surface area of the habitat unit covered via boulders, a bubble curtain, and large woody debris, would be given a shelter value of 3 and a total shelter rating of 135.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs was recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Santa Ynez River, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. Only hardwood trees were observed throughout the survey.

9. Bank Composition and Vegetation:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Santa Ynez River, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

10. Comments and Landmarks:

In order to better describe the current conditions of the stream channel and riparian corridor, notes on landmarks, vegetation, animal species observed, erosion sites, potential migration impediments, land use, erosion sites, water diversions and influences, water quality, and any other observable characteristics of note were recorded.

Montgomery-Buffington Channel Morphology

The Montgomery-Buffington (M-B) Channel Morphology protocol was selected as the preferred method by NMFS. Training of the field crew was provided by Lee Harrison and David

Boughton of the National Oceanic and Atmospheric Administration (NOAA). The protocol required each main channel page length (also referred to as the M-B Channel Morphology subreach) be assigned a M-B channel morphology type out of the 6 designated channel morphology types: Dune-Ripple, Pool-Riffle, Plane Bed, Step Pool, Cascade, and Bedrock. The M-B Channel Morphology protocol did not assign channel types to braided streams or stream channels with side channels; however, braided channels and side channels were noted within the data. The M-B Channel Morphology stream lengths differed slightly from the lengths designated by the habitat survey so the M-B stream lengths were determined using the distance between GIS waypoints. For this reason, percentages based off M-B Channel Morphology stream lengths were determined and, then by using the habitat survey lengths, M-B Channel Morphology stream lengths were recalculated.

The M-B Channel Type Protocol:

1) GPS waypoints were taken for the start and end of each page length, as well as the starting latitude and longitude.
2) All pools within the page length were assigned pool-forming mechanisms using the M-B Pool-Forming Mechanism Key. The eight pool-forming mechanisms included: CWD (Coarse Woody Debris) Forced Pools, Bedrock Self-Formed Pools, Bedrock Forced Pools, Constructed Forced Pools, Constructed Pools, Step Pools (Self-Formed), Boulder Self-Formed Pools, and Self-Formed Pools. Only Self-Formed Pools affected M-B Channel Typing.
3) M-B Channel Morphology was designated using the M-B Channel Morphology Subreach Designation Key. Prioritized in order from highest to lowest, the key used seven indicators: Predominant bed material, Channel-Bed Pattern, Dominant Roughness Elements, Dominant Sediment Sources, Confinement, and Pool Spacing. Each indicator was designated using a number of variables where the dominant and subdominant variable of indicator was identified.

Examples of the Pool-Forming Mechanism Key and M-B Channel Morphology Key can be seen in Appendix 3.

Biological Inventory

Various methods of biological sampling are often employed during a stream inventory to determine fish species and their distribution in the stream. Fish sampling methods were limited to visual observations and dip net sampling while conducting the habitat inventory of the creek. Further presence/absence studies should be conducted to determine the current status of fish populations in the system. Focused surveys were not performed for reptiles, amphibians, mammals, or birds but observations were noted and, if possible, fauna was identified to species.

DATA ANALYSIS

Data from the habitat inventory forms was entered into Stream Habitat 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Wildlife. This program processed and summarized the data, and produced the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

Graphics were produced from the tables using Microsoft Excel. Graphics developed for Santa Ynez River include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

DISCUSSION

The Santa Ynez River watershed survey took place between November 16, 2010, and September 5 2012, and was performed by PSMFC field crew members and CDFW employees. The Santa Ynez Watershed survey consisted of a total length of 161.3 stream miles divided between 72.52 unsurveyed miles, 83.79 surveyed mainstem miles, and 5 miles of side channels (88.79 total surveyed miles). Over the entire survey period, a total of 86 field days (between 10-12 hour days) were completed with the field crew managing an average rate of 1.03 miles per field day.

The objectives of the habitat surveys and this stream inventory report were to document the current habitat conditions, determine the Montgomery-Buffington Channel Morphology through the surveyed reaches, determine habitat suitability for southern steelhead, and recommend options for the potential enhancement of habitat throughout the Santa Ynez watershed. While the surveys focused on habitat parameters associated with southern steelhead, additional observations in relation to flora, fauna, habitat alterations, manmade stream channel alterations, and historical surveys of note were also included.

Thirteen separate mainstem channels were analyzed: the lower Santa Ynez mainstem (between the Pacific Ocean and Bradbury Dam), Salsipuedes Creek, El Jaro Creek, Nojoqui Creek, Cachuma Creek, Santa Cruz Creek, East Fork Santa Cruz Creek, West Fork Santa Cruz Creek, the upper Santa Ynez (between Lake Cachuma and Gibraltar Dam, and above Gibraltar Dam), Oso Creek, Mono Creek, Indian Creek, and Buckhorn Creek. The Santa Ynez survey exhibited all 6 M-B Channel Morphology types (Table 4, below), ranked in order from most common to least common: Plane-Bed (15.79%; 25.47 miles), Step-Pool (14.19%; 22.89 miles), Pool-Riffle (12.32%; 19.88 miles), Dune-Ripple (4.68%; 7.55 miles), Bedrock (0.71%; 1.14 miles), and Cascade (0.09%; 0.14 miles). In addition, 11.71 miles (7.26%) were not designated as a result of side channels and braided streams; and 72.52 miles (44.96%) were not designated because they were unsurveyed. Due to lack of public access and storm events, the field crew was forced to survey the watershed in fragmented segments, resulting in the large number of unsurveyed miles. The survey was terminated in the upper Santa Ynez approximately 88 miles upstream from the Pacific Ocean and 1 mile downstream from Jameson Lake.

Table 4: **Santa Ynez Watershed Montgomery-Buffington Channel Morphologies**

Montgomery and Buffington Channel Morphology (Percentages)								
Drainage	Bedrock	Cascade	Dune Ripple	Plane Bed	Pool Riffle	Step Pool	N/A	Unsurveyed
Lower Santa Ynez	0.38%	0.00%	19.89%	0.00%	14.70%	0.00%	5.28%	59.74%
Salsipuedes Creek	6.91%	0.00%	0.00%	0.00%	59.92%	0.00%	0.00%	33.17%
El Jaro Creek	0.00%	2.37%	0.00%	0.00%	46.01%	0.00%	0.00%	51.62%
Nojoqui Creek	0.00%	0.00%	0.00%	0.00%	11.42%	4.99%	0.00%	83.59%
Cachuma Creek	0.00%	0.00%	0.00%	0.00%	0.00%	20.00%	0.27%	79.73%
Santa Cruz Creek	0.00%	0.00%	0.00%	0.00%	0.00%	24.63%	0.18%	75.19%
West Fork Santa Cruz Creek	1.65%	0.00%	0.00%	0.00%	0.00%	88.58%	9.77%	0.00%
East Fork Santa Cruz Creek	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%
Upper Santa Ynez	0.95%	0.00%	0.00%	39.79%	5.14%	0.00%	27.79%	26.33%
Oso Creek	0.00%	0.00%	0.00%	44.28%	42.90%	12.81%	0.00%	0.00%
Mono Creek	0.00%	0.00%	0.00%	26.94%	7.93%	15.85%	2.23%	47.05%
Indian Creek	1.04%	0.00%	0.00%	48.88%	6.20%	39.21%	1.42%	3.25%
Buckhorn Creek	0.00%	0.00%	0.00%	0.00%	9.93%	89.11%	0.96%	0.00%
Total Watershed	0.71%	0.09%	4.68%	15.79%	12.32%	14.19%	7.26%	44.96%

Throughout the entire Santa Ynez survey, water temperatures varied greatly, from 35 degrees Fahrenheit to 84 degrees Fahrenheit. Air temperatures ranged from 28 degrees Fahrenheit to 98 degrees Fahrenheit. Water temperatures recorded throughout the Santa Ynez watershed ranged from very good to poor for southern California steelhead growth and development according to the *Guide to the reference values used in south-central/southern California coast steelhead conservation action planning (CAP) workbooks* (NMFS and Keir and Associates 2008, Table 5). Our surveys that took place during the summer showed high temperatures in the streams surveyed, including the highest of 84°F; in addition to increasingly large dry sections. It is possible that deep pools provide thermal refuges for fishes during times of low water and high water temperatures. However, to make any further conclusions, temperatures need to be monitored more continually, and in a variety of habitat types, to get a better idea of daily and seasonal temperature fluctuations, particularly maximum temperatures in the warm summer months.

***Table 5:* Water temperatures for southern California steelhead**

MWAT Range	Description
< 62.6ºF (17ºC)	Very Good
62.6-72.6ºF (17-22.5ºC)	Good
72.5-77.0ºF (22.5-25ºC)	Fair
≥ 77ºF	Poor

In terms of spawning habitat, conditions were generally moderate, the best conditions were found in El Jaro Creek and Santa Cruz Creek, which had relatively frequent deep pools (>2ft), with a high percentage of appropriately sized spawning gravel at pool tail crests, with acceptable levels of embeddedness. Following El Jaro and Santa Cruz Creeks, spawning conditions were as follows, with streams with the most suitable habitat listed first: upper Santa Ynez, lower Santa Ynez, Oso Creek, Salsipuedes Creek, Buckhorn Creek, Nojoqui Creek, Mono Creek, Indian Creek, and Cachuma Creek. All of the creeks provided some habitat for both spawning and rearing, however the amount of these different habitat types varied between streams. For example, Mono and Indian Creek lacked suitable spawning gravel at tail crests, which is why they are at the end of the above list; however they did have a high number of pools which could provide substantial over summering habitat.

Flows throughout the surveyed sections of the watershed appear to be adequate. The majority of the streams surveyed had consistent flowing water, with a few exceptions. Water flows are likely not a problem in the winter when a large portion of these streams were surveyed, however lower flows in the summer could create passage barriers and confine fish to a few limited areas with available deep water habitat.

High canopy densities, around 80% canopy cover, were found in several of the streams (Nojoqui, Salsipuedes, Cachuma, Buckhorn), however others had much lower percentages of canopy cover and could potentially benefit from increases in canopy creating bank vegetation (lower Santa Ynez, El Jaro, Mono, Indian, upper Santa Ynez). Increases in canopy cover can help increase shading and moderate water temperatures during the warm spring and summer months.

There appear to be some carry over effects from the Zaca fire in the upper watershed that could have contributed to habitat conditions in this area. There are still fairly obvious burn areas with less vegetative cover present along Indian Creek, Mono Creek, and upper Buckhorn Creek. In addition there were no *O. mykiss* seen in the headwater tributaries surveyed, with the exception of Santa Cruz Creek. This was surprising as previous studies indicated that there were abundant trout in most of these streams (Stoecker 2004, AMC 2007). It is possible that the populations in this watershed were negatively impacted by the Zaca fire and have not rebounded. This could be due to a difficulty of movement within the watershed, resulting from the three dams on the mainstem and the two debris dams blocking access to tributaries.

One factor which could have negatively impacted populations in the upper watershed is sedimentation from increased erosion after the Zaca fire. Although there is still suitable habitat for adults and juveniles in many of these streams, there is a definite lack of suitable spawning gravel. In areas where gravel and cobble of appropriate size were found, these often coincided with other negative factors such as the presence of fine sand or silt around gravel, or an apparent cementation of the gravel at the tail crest (see picture below). These conditions could partly be due to increased sedimentation in the streams from the Zaca fire.

Gravel cemented together in East Fork Santa Cruz Creek (left) and Cachuma Creek (Right)

Due to access issues, as well as time and logistical constraints some streams and sections of streams were not able to be surveyed. Additional habitat surveys should be planned to examine the rest of the watershed, whereby this report should be used for historical reference and as a basis for comparison. Future surveys should also be paired with this report in order to prioritize the actions needed in order to further restore southern steelhead populations within the Santa Ynez watershed.

RECOMMENDATIONS

1) The Santa Ynez watershed supports a resident *O. mykiss* population, as well as a small southern steelhead population whose numbers have dwindled when compared with historical records. The entire watershed should be managed as an anadromous, natural production stream.

2) Historically present, only one southern steelhead was observed in the lower Santa Ynez

subbasin in El Jaro Creek. *O. mykiss* were only found on the mainstem of the Santa Ynez River and Santa Cruz Creek in the upper Santa Ynez subbasin. The survey however, did not include all means of determining the presence of *O. mykiss*, such as seining, snorkeling, and electrofishing. In order to ascertain the presence/absence of *O. mykiss*, as well as other native fish species within the Santa Ynez watershed, it would be advised to conduct more formal surveys throughout sections of creek with suitable habitat. Additionally, setting up a remote sensing device that records migrating steelhead would be helpful.

3) The limited water temperature data available suggest that the majority of temperatures were within the acceptable range for juvenile salmonids. Some of the summer time water temperatures observed may be unsuitable for steelhead. A more complete yearly record of the range and average temperatures experienced by fishes throughout the watershed is necessary before determining the overall suitability of water temperatures.

4) Where feasible, design and engineer pool enhancement structures to increase the number and depth of pools. This must be done where the banks are stable or in conjunction with appropriate stream bank protection to prevent erosion.

5) Increase woody cover in the pools and flatwater habitat units. Adding high quality complexity with woody cover in the pools is desirable, and may help to maintain cooler pool temperatures during spring and summer.

6) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.

7) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.

8) Suitable size spawning substrate in the Santa Ynez watershed was limited to relatively few locations. Projects should be designed at suitable sites to trap and sort spawning gravel.

9) Increase the canopy within the Santa Ynez watershed by planting appropriate native vegetation along the stream where shade canopy is not at acceptable levels (particularly in Mono and Indian Creeks). The reaches above the surveyed reaches should be inventoried and treated as well, since the water flow is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

10) There are sections in the watershed being impacted by cattle trampling the riparian zone, particularly in the lower watershed. Alternatives should be explored with the land owners and developed if possible. Fencing of the stream and riparian zone could prove beneficial.

11) Water quality sampling should also be conducted in Santa Ynez River to determine if water quality measurements for pH, dissolved oxygen, salinity, electrical conductivity, and nutrient loads are suitable for Southern California Steelhead throughout the year. Special attention should be given to sections that run through urban zones Lompoc, Buellton, Solvang, and Santa Ynez, which may be contaminated by urban runoff. The numerous vineyards and farms throughout the watershed would also increase the amount of agricultural runoff, thus affecting water quality in these areas.

12) Numerous man-made migration barriers were observed throughout the watershed and their removal or modification should be considered. Each barrier should be prioritized according to the quality of habitat that becomes accessible after the removal or modification of the barrier. In addition, the removal of barriers which no longer serve a purpose should be highly considered.

13) There were several log debris accumulations present within Salsipuedes Creek that were retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.

LOWER SANTA YNEZ SUBBASIN REPORT

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LOWER SANTA YNEZ SUBBASIN OVERVIEW

The lower Santa Ynez subbasin was surveyed from November 16, 2010 to May 12, 2011 during the first phase of this project. The lower Santa Ynez subbasin survey began at the mouth of the Santa Ynez River just upstream of the estuary. The survey extended 59.4 miles throughout the watershed; however, only 24.5 miles were able to be surveyed while 34.9 miles went unsurveyed due to lack of public access and logistical constraints. The lower Santa Ynez subbasin survey ended below Lake Cachuma at Bradbury Dam. The drainages surveyed included, the lower Santa Ynez River drainage, Salsipuedes Creek drainage, El Jaro Creek drainage, and Nojoqui Creek drainage.

The lands adjacent to the lower Santa Ynez River subbasin consisted primarily of privately owned property as much of the stream passes through urban and residential zones near the cities and agricultural lands, ranch lands, or vineyards in the more rural areas.

HYDROLOGY

The lower Santa Ynez subbasin (below Bradbury Dam) totals approximately 479 square miles. According to the USGS Santa Ynez 7.5 minute quadrangle, the lower Santa Ynez has approximately 902 miles of total stream length divided between 697 intermittent miles, 184 perennial miles, and 21 miles of manmade channels. Elevations range from 4 to 4,561 feet.

The lower Santa Ynez River survey encompassed a total of 37.96 miles; however, only 13.00 miles were able to be surveyed while 24.96 miles went unsurveyed. The mainstem of the lower Santa Ynez River passes through the urban and residential zones of Lompoc, Buellton, Solvang, and Santa Ynez and extends upstream from the mouth, at the Pacific Ocean, to Bradbury Dam, approximately 49 miles upstream. Due to the fragmented nature of the survey, in addition to its extended length, the lower Santa Ynez was divided into three reaches with each reach divided again into subreaches. Reach 1 (SY1) was divided into seven subreaches, subreaches A through G (SY1SRA-SY1SRG), with four surveyed reaches and three unsurveyed reaches (see Appendix 1:Map 2). Reach 1 and Reach 2 were separated at the Salsipuedes-Santa Ynez confluence. Reach 2 (SY2) was divided into six subreaches, subreaches A through F (SY1SRA-SY1SRG), with three surveyed reaches and three unsurveyed reaches (see Appendix 1:Map 3). Reach 2 and Reach 3 were separated at the Nojoqui-Santa Ynez confluence near the Highway 101 Bridge. Reach 3 (SY3) was divided into three sub reaches, one surveyed reach, one unsurveyed reach, and one final reach that extended upstream 6.8 miles from the last surveyed unit until Bradbury Dam; however, this final reach was not included in the data analysis. Bradbury Dam marked the end of the lower Santa Ynez survey, although the survey never reached the dam due to lack of public access.

Salsipuedes Creek, a tributary to the Santa Ynez River, is located at 34:37:53.0N and 120:24:41.0W, LLID number 1204115346315. According to the USGS Lompoc 7.5 minute quadrangle, Salsipuedes is a second order stream and contains approximately 130 miles of total stream length divided between 108 intermittent miles and 22 perennial miles. Salsipuedes Creek drains a watershed of approximately 52 square miles. Elevations range from 113 feet at the Salsipuedes-Santa Ynez confluence to 1,817 feet in the headwaters. The Salsipuedes survey encompassed a total of 7.64 miles with 5.19 surveyed miles and 2.45 unsurveyed miles. The survey was terminated before the natural limit to salmonid migration due to lack of public access. The Salsipuedes drainage area can be seen in Map 5 (Appendix 1) whereas the surveyed length of stream can be seen in Map 6 (Appendix 1).

El Jaro Creek, a tributary to Salsipuedes Creek, is located at 34:35:03.0N and 120:24:25.0W, LLID number 120408345841. According to the USGS Lompoc 7.5 minute quadrangle, El Jaro is a second order stream that contains approximately 88 miles of total stream length divided between 74 intermittent miles and 15 perennial miles. El Jaro Creek drains a watershed of approximately 33 square miles. Elevations range from 234 feet at the El Jaro-Salsipuedes confluence to 1,811 feet in the headwaters. The El Jaro survey extended upstream for 5.74 miles with the first 2.95 miles going unsurveyed and the next 2.79 miles being surveyed. Once again, the survey was terminated before reaching a natural limit to salmonid migration due to lack of public access (see Appendix 1, Map 6).

Nojoqui Creek, is located at 34:36:01.0N and 120:11:20.0W, LLID number 1201890346001. According to the USGS Solvang 7.5 minute quadrangle, Nojoqui is a second order stream that contains approximately 36 miles of total stream divided between 17 intermittent miles and 19 perennial miles. Nojoqui Creek drains a watershed of approximately 16 square miles. Elevations range from 316 feet at the Nojoqui-Santa Ynez Confluence to 2,848 feet in the headwaters. The Nojoqui survey extended upstream for 8.09 miles with the first 6.71 miles going unsurveyed and the next 1.39 being surveyed. The survey ended at the Nojoqui waterfall, which is considered to be an impassable barrier (Appendix 1, Map 7).

LAND AND RESOURCE USE

Historic land use

Chumash Native Americans historically inhabited the lower Santa Ynez region. They were largely a hunter/ gatherer society that lived off the land and native plants and animals. It is likely, however, that they did manipulate the habitat, as discussed in more detail in the general watershed overview. Landscape manipulation, through vegetation burning, was done to promote the growth of preferred food sources, as well as increase hunting abilities.

Current land use

The lower Santa Ynez River watershed has urban and residential zones around the cities, Lompoc, Buellton, Solvang, and Santa Ynez, interspersed with parcels containing agricultural land, ranch land, and vineyards. In all three reaches throughout the mainstem, private ownership limited access to much of the river; however, the denial of access was especially noted throughout reach 3 (Appendix 1: Map 4). In addition, access was also limited as a result of impassable sections due to heavy vegetation, deep pools, limited vehicle access, and fragmented parcels. In Reach 1 through Vandenberg Air Force Base (VAFB) land, the river could only be accessed at the 13th Street bridge; however, heavy vegetation, heavy flows, and deep flows limited in-stream progress. As it passed through Lompoc, the river passed through urban and residential zones and was easily accessible via bridge crossings and parks. In Reach 2, the river could only be accessed after receiving land access permits from private landowners. Arizona crossings were observed throughout Reach 2; however the only public crossings were observed at the Avenue of the Flags and Highway 101 bridges. Reach 2 passed through agricultural land, ranch land, and vineyards. Observations in Reach 3 were limited. Three bridge crossings were observed at Alisal, Refugio, and Highway 154, as well as an Arizona crossing at Meadowlark. Reach 3 mostly passed through ranch land with some vineyards and agricultural land observed.

The Salsipuedes watershed was dominated by privately owned land, most of it used as ranch land. Public roads crossed over the mainstem of Salsipuedes Creek using three bridges: the Santa Rosa Bridge, the Highway 1 Bridge, and the Jalama Road bridge. Two private bridges were also observed within Freedom Ranch private land.

The El Jaro Creek watershed consisted primarily of privately owned ranch land and was crossed numerous times by Highway 1, which ran above its banks for most of the length of the mainstem.

The Nojoqui Creek watershed was dominated by privately owned ranch and agricultural land although the upper watershed was located in Los Padres National Forest.

DATA ANALYSIS

Biological Inventory Results

For the Santa Ynez habitat survey, presence/absence was conducted via bankside observations. Southern California steelhead and resident *O. mykiss* were known to inhabit the watershed. During the survey, *O. mykiss* were only observed in El Jaro Creek; however, juvenile *O. mykiss* were also observed in Salsipuedes Creek by Cachuma Operation and Maintenance Board biologists who have established fish traps throughout the system.

In addition to *O. mykiss*, several fish species were observed throughout the Santa Ynez watershed. Native species observed included threespine stickleback (*Gasterosteus aculeatus*), which were observed in the upper and lower Santa Ynez mainstem, as well as Salsipuedes and El Jaro Creeks. Introduced species observed included arroyo chub (*Gila orcuttii*, which is a listed southern California species that was introduced to the Santa Ynez watershed), common carp (*Cyprinus carpio*), black bass, and sun fish, which were all observed in the upper and lower Santa Ynez mainstem.

Aquatic macro-invertebrates were present throughout the surveyed area in the Santa Ynez watershed where continuous flow was observed, such as water boatman, water striders, giant water bugs, mayflies, caddisflies, and midge larva. Macro-invertebrates would provide a food source for rearing juvenile *O. mykiss*. A more focused survey could provide greater insight into the abundance of macro-invertebrates and water quality conditions.

Additional aquatic species were also observed throughout the survey. Amphibians observed included native California and Pacific treefrogs (*Pseudacris cadaverina* and *Pseudacris regilla*); as well as bullfrogs (*Rana catesbeiana*), an invasive species that is known to have detrimental effects on native aquatic populations. In addition, there were numerous sightings of unidentified tadpoles. Southwestern pond turtles (*Clemmys marmorata*), were also observed throughout the watershed. In addition, numerous beaver ponds were observed throughout the mainstem of the lower Santa Ynez

Aside from southern steelhead, listed species found within the watershed include arroyo chub, tidewater goby, California red-legged frog, and southwestern pond turtle.

Numerous populations of non-native vegetative species were observed throughout the watershed; most notably through the urban zones. Non-native species included cape ivy (*Delairea odorata*), pampas grass (*Cortaderia selloana*), eucalyptus (*Eucalyptus s.*), and arundo (*Arundo donax*). Arundo, a known problem invasive, was observed throughout Reach 1 in the lower Santa Ynez. The last noted observation was slightly after the survey started within Reach 2 in the lower Santa Ynez. Multiple stands were observed in the lower reaches that have out-competed all other plant species. These populations should be removed, starting with the farthest upstream populations, to avoid repopulation in the watershed downstream from an upstream specimen.

Native vegetation increased as the watershed moved upstream and away from the cities. Throughout the Los Padres National Forest, native vegetation was quite prolific and diverse. Alders (*Alnus rhombifolia*), willows (*Salix sp.*), western sycamores (*Platanus racemosa*), coast live oak (*Quercus agrifolia*), and cottonwood (*Populus trichocarpa*) composed the upper canopy of the surveyed reaches, while the under story was dominated by poison oak (*Toxicodendron diversilobum*), and blackberry species.

Habitat Inventory Results

The lower Santa Ynez stream habitat inventory was conducted by Aaron Francis, Jon Trilli, Julie Hall, and Ben Chubak of PSMFC. The survey was conducted between 11/16/2010 and 5/12/2011 over six separate systems: the mainstem of the lower Santa Ynez, Salsipuedes Creek, El Jaro Creek, and Nojoqui Creek. The total length of the survey was 59.42 miles including unsurveyed lengths and side channels. This length was divided between 22.48 surveyed miles, 2 miles of side channel, and 34.94 unsurveyed miles.

All habitat inventory tables and graphs associated with the lower Santa Ynez subbasin are located in Appendix 6.

Lower Santa Ynez Habitat Inventory

The habitat inventory of the lower Santa Ynez was conducted between 1/27/2011 and 5/12/2011. The total length of stream surveyed was 215,370 feet (40.79 miles) divided between 131,772 unsurveyed feet (24.96 miles), 68,657 surveyed main channel feet (13.00 miles), and an additional 14,941 feet (2.83 miles) of side channel.

Stream Flow:

The mean stream flow within the lower Santa Ynez was estimated at 52 cfs (cubic feet per second) with a median of 40 cfs. The maximum flow observed during the survey was 132 cfs, whereas the minimum flow was 25 cfs. All flows were estimated using USGS stream gages near the surveyed areas on the date of the survey. Subsurface flow was observed in the lower Santa

Ynez in some sections before the rain events of the 2010-2011 water year. Storm events throughout the survey period resulted in a dramatic range of flows.

Rosgen Channel Type:

The lower Santa Ynez River was considered to be a C5 stream channel type for the entire surveyed length. C5 channels are meandering point-bar, riffle/pool alluvial channels with broad well defined floodplains on low gradients and sand dominant substrates.

Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 48 to 63 degrees Fahrenheit (˚F) with a mean of 56 ˚F and a median of 57 ˚F. Air temperatures ranged from 46 to 79 degrees Fahrenheit with a mean and median of 59 ˚F.

Summary of Habitat Types:

The surveyed section of the mainstem of the lower Santa Ynez River was 215,370 feet with 585 total units. The Lower Santa Ynez Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 34% flatwater units, 38% pool units, 3% dry units, 21% riffle units, 1% culvert units, 1% marsh units, and 1% unsurveyed units, (Lower Santa Ynez Graph 1). Based on total length of Level II habitat types there were 17% flatwater units, 12% pool units, 1% dry units, 6% riffle units, 0% culvert units, 1% marsh units, and 61% unsurveyed units (Lower Santa Ynez Graph 2).

Nineteen Level IV habitat types were identified in the lower Santa Ynez (Lower Santa Ynez Table 2). The most frequent habitat types by percent occurrence were Low Gradient Riffle units at 21%, Run units at 21%, and Mid-Channel Pool units at 19% (Lower Santa Ynez Graph 3). Based on percent total length, the most dominant habitat types were Glide units at 10%, Run units at 8%, and Low Gradient Riffle units at 6%. However, unsurveyed units dominated the length of the survey at 61%. Typical Glide (left) and Run (right) units are pictured below.

Summary of Pools:

A total of 224 pools were identified in the lower Santa Ynez (Lower Santa Ynez Table 3). Main Channel pools were the most frequently encountered, at 57% (Lower Santa Ynez Graph 4), and comprised 59% of the total length of all pools (Lower Santa Ynez Table 3). The lower Santa Ynez Table 4 is a summary of maximum residual depth by pool habitat types. Pool quality for salmonids increases with depth. Seventy-nine of the 223 pools had a residual depth of three feet or greater (Lower Santa Ynez Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. In the lower Santa Ynez out of 223 pools measured, 14 had a value of 1 (6.3%), 6 had a value of 2 (2.7%), 8 had a value of 3 (3.6%), 39 had a value of 4 (17.5%), and 156 had a value of 5 (70%) (Lower Santa Ynez Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300, with 0 being the lowest rating and 300 being the highest. In the lower Santa Ynez, Riffle habitat types had a mean shelter rating of 46, flatwater habitat types had a mean shelter rating of 35, and pool habitats had a mean shelter rating of 57 (Lower Santa Ynez Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 41, Scour pools had a mean shelter rating of 65, and Backwater pools had a mean shelter rating of 69 (Lower Santa Ynez Table 3).

Habitat Cover:

The Lower Santa Ynez River Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation was the dominant cover types in the lower Santa Ynez River. Lower Santa Ynez Graph 7 describes the pool cover. Terrestrial vegetation was the dominant pool cover type followed by small woody debris.

Substrate:

Lower Santa Ynez River Table 6 summarizes the dominant substrate by habitat type and, for a majority of habitat units, sand was the dominant substrate. Lower Santa Ynez River Graph 8 depicts the dominant substrate observed in pool tail-outs. Sand was the most dominant substrate observed in 67% of pool tail-outs, followed by gravel observed in 26% of pool tail-outs, and small cobble observed in 3% of pool tail-outs.

Canopy:

The canopy through the entirety of the Santa Ynez watershed consisted of hardwood trees. The mean percent canopy density for the surveyed length of lower Santa Ynez River was 12%, meaning 88% of the canopy was open (Lower Santa Ynez Graph 9).

Bank Vegetation and Composition:

For the lower Santa Ynez, the mean percent right bank vegetated was 40%. The mean percent left bank vegetated was 40%. The dominant elements composing the structure of the stream banks consisted of 93% sand/silt/clay, 4% cobble/gravel, and 3% bedrock (Lower Santa Ynez Graph 10). Deciduous trees were the dominant vegetation type observed in 73% of the units surveyed. Additionally, 26% of the units surveyed had brush as the dominant vegetation type (Lower Santa Ynez Graph 11).

Salsipuedes Creek Habitat Inventory

The habitat inventory of the Salsipuedes Creek was conducted between 1/10/2011 and 1/26/2011. The total length of stream surveyed was 40,599 feet (7.69 miles) divided between 12,919 unsurveyed feet (2.45 miles), 27,424 surveyed main channel feet (5.19 miles), and an additional 256 feet (0.05 miles) of side channel.

Stream Flow:

The mean stream flow within Salsipuedes Creek was estimated at 7.39 cfs (cubic feet per second) with a median of 7.40 cfs. The maximum flow observed during the survey was 8.8 cfs, whereas the minimum flow was 6.4 cfs. All flows were estimated using USGS stream gages near the surveyed areas on the date of the survey.

Rosgen Channel Type:

Salsipuedes Creek was considered to be a B5 stream channel type for the entire 19,628 feet of Reach 2. Reach 4 was considered to be a G5 channel type for the entire 8,016 feet length. B5 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and sand dominant substrates. G5 channels are entrenched "gully" step-pool channels on moderate gradients with low width /depth ratios and sand dominant substrates.

Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 41 to 55 °F with a mean of 48.2 °F and a median of 48°F. Air temperatures ranged from 41 to 75 degrees Fahrenheit with a mean of 59.87 °F and a median of 61°F.

Summary of Habitat Types:

The total length of the Salsipuedes Creek survey was 40,599 feet with 487 total units. Salsipuedes Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 44% riffle units, 30% pool units, and 25% flatwater units

(Salsipuedes Creek Graph 1). Based on total length of Level II habitat types there were 32% pool units, 23% riffle units, 13% flatwater units; however, the two unsurveyed units also comprised 31.8% of the total length (Salsipuedes Creek Graph 2).

Sixteen Level IV habitat types were identified in Salsipuedes Creek (Salsipuedes Creek Table 2). The most frequent habitat types by percent occurrence were Low Gradient Riffle units at 42%, Run units at 24%, and Mid-Channel Pool units at 15% (Salsipuedes Creek Graph 3). Based on percent total length, the most dominant habitat types were Low Gradient Riffle units at 21.5%, Mid-Channel Pool units at 13.9%, and Run units at 12.8%. However, unsurveyed units dominated the length of the survey at 31.8%. Typical Low Gradient Riffle (left) and Mid-Channel Pool (right) units are pictured below.

Summary of Pools:

A total of 137 pools were identified in the Salsipuedes Creek (Salsipuedes Creek Table 3). Main Channel pools were the most frequently encountered at 55% (Salsipuedes Creek Graph 4), and comprised 52% of the total length of all pools (Salsipuedes Creek Table 3). Salsipuedes Creek Table 4 is a summary of maximum residual depth by pool habitat types. Pool quality for salmonids increases with depth. One hundred-three of the 137 pools had a residual depth of two feet or greater (Salsipuedes Creek Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. In Salsipuedes Creek out of 137 pools measured, 43 had a value of 1 (31.4%), 0 had a value of 2 or 3, 24 had a value of 4 (17.5%), and 70 had a value of 5 (51.1%) (Salsipuedes Creek Graph 6).

Shelter Rating:

In the Salsipuedes Creek, Riffle habitat types had a mean shelter rating of 71, flatwater habitat types had a mean shelter rating of 60, and pool habitats had a mean shelter rating of 87 (Salsipuedes Creek Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 78, Scour pools had a mean shelter rating of 100, and Backwater pools had a mean shelter rating of 40 (Salsipuedes Creek Table 3).

Habitat Cover:

Salsipuedes Creek Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation was the dominant cover types in Salsipuedes Creek. Salsipuedes Creek Graph 7 describes the pool cover. Whitewater was the dominant pool cover type followed by terrestrial vegetation.

Substrate:

Salsipuedes Creek Table 6 summarizes the dominant substrate by habitat type and, for a majority of habitat units, sand was the dominant substrate. Salsipuedes Creek Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the most dominant substrate observed in 42% of pool tail-outs, followed by sand observed in 36%, and bedrock observed in 9%.

Canopy:

The canopy through the entirety of the Salsipuedes watershed consisted of hardwood trees. The mean percent canopy density for the surveyed length of Salsipuedes Creek was 64%, meaning 36% of the canopy was open (Salsipuedes Creek Graph 9).

Bank Vegetation and Composition:

For Salsipuedes Creek, the mean percent right bank vegetated was 49% while the mean percent left bank vegetated was 42%. The dominant elements composing the structure of the stream banks consisted of 85% sand/silt/clay, 13% bedrock, and 2% boulder (Salsipuedes Creek Graph 10). Deciduous trees were the dominant vegetation type observed in 81% of the units surveyed. Additionally, 18 % of the units surveyed had brush as the dominant vegetation type (Salsipuedes Creek Graph 11).

El Jaro Creek Habitat Inventory

The El Jaro Creek habitat inventory was conducted from 4/12/2011 and 4/14/2011. The total length of stream surveyed was 30,610 feet (5.8 miles) divided between 15,578 unsurveyed feet (2.95 miles), 14,736 surveyed main channel feet (2.79 miles), and an additional 296 feet (0.06 miles) of side channel.

Stream Flow:

The mean and median stream flow within El Jaro Creek was estimated at 20 cfs. The maximum flow observed during the survey-able days was 21 cfs, whereas the minimum flow was 19 cfs.

Rosgen Channel Type:

El Jaro Creek was considered to be a B4 stream channel type for the entire 15,032 feet of Reach 2. B4 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and gravel dominant substrates.

Water and Air Temperatures:

Water temperatures taken during the El Jaro survey period ranged from 51 to 62 °F with a mean of 56 °F and a median of 55°F. Air temperatures ranged from 54 to 68 °F with a mean of 60 °F and a median of 59 °F.

Summary of Habitat Types:

The total length of the El Jaro Creek survey was 30,610 feet with 232 total units. The El Jaro Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 38% pool units, 34% riffle units, and 27% flatwater units (El Jaro Creek Graph 1). Based on total length of Level II habitat types there were 17% pool units, 17% flatwater, and 15% riffle; however, the one unsurveyed unit also comprised 51% of the total length (El Jaro Creek Graph 2).

Eleven Level IV habitat types were identified in El Jaro Creek (El Jaro Creek Table 2). The most frequent habitat types by percent occurrence were Low Gradient Riffle units at 33%, Run units at 24%, and Mid-Channel Pool units at 15% (El Jaro Creek Graph 3). Based on percent total length, the most dominant habitat types were Run units at 15%, Low Gradient Riffle units at 14%, and Mid-Channel Pool units at 14%. However, the unsurveyed unit dominated the length of the survey at 51%. Typical Run (left) and Low Gradient Riffle (right) units are pictured below.

Summary of Pools:

A total of 88 pools were identified in the El Jaro Creek (El Jaro Creek Table 3). Scour pools were the most frequently encountered, at 60% (El Jaro Creek Graph 4), and comprised 59% of the total length of all pools (El Jaro Creek Table 3). El Jaro Creek Table 4 is a summary of maximum residual depth by pool habitat types. Fifty-two of the 88 pools had a residual depth of two feet or greater (El Jaro Creek Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. In El Jaro Creek out of 88 pools measured, 4 had a value of 1 (4.5%), 3 had a value of 2 (3.4%), none had a value of 3 or 4, and 36 had a value of 5 (40.9%) (El Jaro Creek Graph 6).

Shelter Rating:

In the El Jaro Creek, Riffle habitat types had a mean shelter rating of 81, flatwater habitat types had a mean shelter rating of 19, and pool habitats had a mean shelter rating of 54 (El Jaro Creek Table 1). Of the pool types, the Scour pools had a mean shelter rating of 53, Main Channel pools had a mean shelter rating of 26, and Backwater pools had a mean shelter rating of 180 (El Jaro Creek Table 3).

Habitat Cover:

El Jaro Creek Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation was the dominant cover types in El Jaro Creek. El Jaro Creek Graph 7 describes the pool cover. Terrestrial vegetation was the dominant pool cover type followed by small woody debris.

Substrate:

El Jaro Creek Table 6 summarizes the dominant substrate by habitat type. For a majority of habitat units, sand was the dominant substrate. El Jaro Creek Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the most dominant substrate observed in 56% of pool tail-outs, followed by sand observed in 38% of pool tail-outs, and small cobble observed in 3% of pool tail-outs.

Canopy:

The canopy through the entirety of the El Jaro watershed consisted of hardwood trees. The mean percent canopy density for the surveyed length of El Jaro Creek was 49%, meaning 51% of the canopy was open (El Jaro Creek Graph 9).

Bank Vegetation and Composition:

For El Jaro Creek, the mean percent right bank vegetated was 37% while left bank vegetated was 32%. The dominant elements composing the structure of the stream banks consisted of 89% sand/silt/clay, 9% bedrock, and 1% boulder/1% cobble/gravel (El Jaro Creek Graph 10). Deciduous trees were the dominant vegetation type observed in 92% of the units surveyed. Additionally, 8 % of the units surveyed had brush as the dominant vegetation type (El Jaro Creek Graph 11).

Nojoqui Creek Habitat Inventory

The habitat inventory of the Nojoqui Creek was conducted between 4/6/2011 and 5/3/2011. The total length of stream surveyed was 42,738 feet (8.1 miles) divided between 35,415 unsurveyed feet (6.71 miles), and 7323 surveyed main channel feet (1.39 miles).

Stream Flow:

The mean stream flow within Nojoqui Creek was estimated at 1 cfs (cubic feet per second). There were no USGS stream gages near the surveyed area so flows were estimated based on the judgment of the survey crew.

Rosgen Channel Type:

Nojoqui Creek was considered to be a B4 stream channel type for the entire 7,323 feet of Reach 2. B4 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and gravel dominant substrates.

Water and Air Temperatures:

Water temperatures taken during the Nojoqui survey period ranged from 52 to 63 °F with a mean and median of 55 °F. Air temperatures ranged from 48 to 82 °F with a mean of 61 °F and a median of 63 °F.

Summary of Habitat Types:

The total length of the Nojoqui Creek survey was 42,738 feet with 89 total units. Nojoqui Creek Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 36% riffle units, 33% flatwater units, and 27% pool units (Nojoqui Creek Graph 1). Based on total length of Level II habitat types there were 8% riffle units, 6% flatwater, and 3% pool; however, the one unsurveyed unit also comprised 83% of the total length (Nojoqui Creek Graph 2).

Eleven Level IV habitat types were identified in Nojoqui Creek (Nojoqui Creek Table 2). The most frequent habitat types by percent occurrence were Low Gradient Riffle units at 33%, Run units at 19%, and Step Run units at 13% (Nojoqui Creek Graph 3). Based on percent total length, the most dominant habitat types were Low Gradient Riffle units at 7%, Step Run units at 5%, and Run units at 2%. However, the unsurveyed unit dominated the length of the survey at 83%. Typical Low Gradient Riffle and Step Run units are shown below, at left and right respectively.

Summary of Pools:

A total of 24 pools were identified in Nojoqui Creek (Nojoqui Creek Table 3). Scour pools were the most frequently encountered, at 71% (Nojoqui Creek Graph 4), and comprised 60% of the total length of all pools (Nojoqui Creek Table 3). Nojoqui Creek Table 4 is a summary of maximum residual depth by pool habitat types. Fifteen of the 24 pools had a residual depth of two feet or greater (Nojoqui Creek Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. In Nojoqui Creek out of 24 pools measured, 1 had a value of 1 (4.2%), 2 had a value of 2 (8.3%), 3 had a value of 3 (12.5%), 9 had a value of 4 (37.5%), and 9 had a value of 5 (37.5%) (Nojoqui Creek Graph 6).

Shelter Rating:

In Nojoqui Creek, Riffle habitat types had a mean shelter rating of 94, flatwater habitat types had a mean shelter rating of 25, and pool habitats had a mean shelter rating of 58 (Nojoqui Creek Table 1). Of the pool types, the Scour pools had a mean shelter rating of 71, and Main Channel pools had a mean shelter rating of 28 (Nojoqui Creek Table 3).

Habitat Cover:

Nojoqui Creek Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation was the dominant cover type in Nojoqui Creek. Nojoqui Creek Graph 7 describes the pool cover. Terrestrial vegetation was the dominant pool cover type followed by boulders.

Substrate:

Nojoqui Creek Table 6 summarizes the dominant substrate by habitat type and, for a majority of habitat units, gravel was the dominant substrate, followed by sand. Nojoqui Creek Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the most dominant substrate observed in 56% of pool tail-outs, followed by sand observed in 38% of pool tail-outs, and small cobble observed in 3% of pool tail-outs.

Canopy:

The canopy through the entirety of the Nojoqui watershed consisted of hardwood trees. The mean percent canopy density for the surveyed length of Nojoqui Creek was 79%, meaning 21% of the canopy was open (Nojoqui Creek Graph 9).

Bank Vegetation and Composition:

For Nojoqui Creek, the mean percent right bank vegetated was 36%, while the mean percent left bank vegetated was 33%. The dominant elements composing the structure of the stream banks consisted of 93% sand/silt/clay, 5% boulder, and 2% cobble/gravel (Nojoqui Creek Graph 10). Deciduous trees were the dominant vegetation type observed in 79% of the units surveyed. Additionally, 21% of the units surveyed had brush as the dominant vegetation type (Nojoqui Creek Graph 11).

Montgomery-Buffington Channel Morphology Results

Lower Santa Ynez Bank Full Width:

In the lower Santa Ynez, bankfull widths ranged from 38 feet to 316 feet; however, some sections were too heavily vegetated to be measured properly. The average bankfull width was 124 feet with a median of 115 feet. Averaged widths for the three reaches were determined to be 143 feet in Reach 1, 98 feet in Reach 2 and 115 feet in Reach 3.

Lower Santa Ynez M-B Channel Morphology:

Three M-B Channel Morphology Types were observed in the lower Santa Ynez: Dune Ripple, Pool-Riffle, and Bedrock. Based on percentage of total length for the entire 38 miles, the most dominant was Dune-Ripple (19.89%), followed by Pool-Riffle (14.70%) and Bedrock (0.38%). Additionally, 59.47% of the total length went unsurveyed, whereas 5.28% was not assigned a specific channel morphology type due to braided stream lengths, side channels, or marsh-like sections.

The Dune Ripple channel type was only observed in the lower Santa Ynez Reach 1, whereas the Bedrock channel type was only observed in the lower Santa Ynez Reach 2. Braided sections, as well as marsh-like sections were observed in all three reaches.

Salsipuedes Creek Bank Full Width:

Throughout Salsipuedes Creek, bankfull widths ranged from 10 to 63 feet. The average bankfull width was 31 feet with a median of 35 feet. Throughout the entire mainstem, the streambed was deeply incised.

Salsipuedes Creek M-B Channel Morphology:

Two M-B Channel Morphology Types were observed in the Salsipuedes Creek: Pool-Riffle and Bedrock. Based off percentage of total length for the entire 7.6 miles, the most dominant was Pool-Riffle (59.92%) followed by Bedrock (6.91%). The Bedrock channel type was only observed in Reach 2, the first surveyed reach of Salsipuedes Creek. In addition, 33.17% of the total length went unsurveyed.

El Jaro Creek Bank Full Width:

Throughout El Jaro Creek, bankfull widths ranged from 40 feet to 67 feet. The average bankfull width was 51 feet with a median of 52 feet. Throughout the entire mainstem, the streambed was deeply incised.

El Jaro Creek M-B Channel Morphology:

Two M-B Channel Morphology Types were observed in the lower Santa Ynez: Pool-Riffle and Cascade. Based off percentage of total length for the entire 5.7 miles, the most dominant was Pool-Riffle (46.01%) followed by Cascade (2.37%). In addition, 51.62% of the total length went unsurveyed.

Nojoqui Creek Bank Full Width:

Throughout Nojoqui Creek, bankfull widths measured ranged from 14 feet to 51 feet. The average bankfull width was 34 feet with a median of 37 feet.

Nojoqui Creek M-B Channel Morphology:

Two M-B Channel Types were observed in Nojoqui Creek: Pool-Riffle and Step Pool. Based off percentage of total length for the entire 8.1 miles, the most dominant was Pool-Riffle (11.42%) followed by Step Pool (4.99%). Additionally, 83.59% of the total length went unsurveyed.

LOWER SANTA YNEZ BRIDGES, BARRIERS AND CULVERTS

All manmade structures and natural barriers affecting the stream channel were document as survey progressed upstream. Such structures included manmade bridges, culverts, Arizona crossings, as well as natural waterfalls. Each notable structure throughout the surveyed area was photographed, measured, and their location was recorded, if possible. Matt Stoecker's Santa Ynez Barrier Inventory was used as a basis for comparison if the same barrier was crossed during both reports (Stoecker, 2004).

Lower Santa Ynez River Watershed Bridges, Barriers, and Culverts

NAME: Santa Ynez River Estuary Rail Road Crossing Bridge	
GPS: SYRRBRG	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.69142, -120.60025
Description: This natural bottom bridge had multiple concrete support pillars in stream bed.	

Santa Ynez River, Railroad Crossing

NAME: **Santa Ynez Estuary Flood Dam**	
GPS: SYFLDDAM	**Stoecker ID:** No Stoecker ID
Barrier Type: Dam	**Location:** 34.68697, -120.58728
Description: Overflow dam	

Santa Ynez Estuary Flood Dam

NAME: 13th Street Bridge	
GPS: SYVBBRDG1	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge with riprap around concrete pillars	**Location:** 34.67766, -120.55414
Description: This natural bottom bridge measured a length of 500ft and had eight concrete support pillars. There was a distance of 55ft between each pillar and each pillar was one foot wide and surrounded by riprap. Four of the pillars were in the wetted stream bed.	

Santa Ynez River, 13th Street Bridge

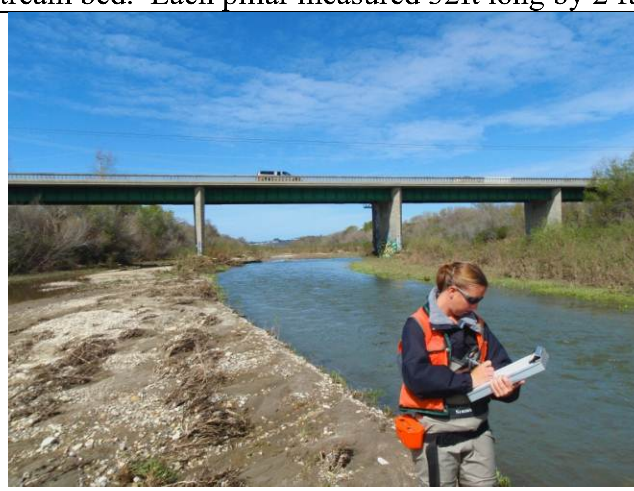
NAME: Floridale Bridge	
GPS: SYFLORBRG	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.67201, -120.49293
Description: This natural bottom bridge measured a width of 43ft and was supported by four concrete pillars.	

Santa Ynez River, Floridale Bridge Downstream

NAME: HWY 1 Bridge	
GPS: SYHWY1BRG1	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.66835, -120.45813
Description: This natural bottom bridge had multiple concrete support pillars in the stream bed. Three of the pillars were in the wetted channel.	

Santa Ynez River, Highway 1 Bridge Upstream

NAME: HWY 246 Bridge	
GPS: SYRPBRDG	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.64383, -120.43175
Description: This natural bottom bridge measured 260ft long and 60ft wide. It had four concrete support pillars in the stream bed. Each pillar measured 32ft long by 2 ft wide.	



Santa Ynez River, Highway 246 Bridge Downstream

NAME: SY06 Arizona Crossing 01	
GPS: SY06AZ01	**Stoecker ID:** No Stoecker Id
Barrier Type: Natural bottom Arizona crossing	**Location:** 34.61888, -120.37898
Description: Natural bottom Arizona crossing.	

Santa Ynez River, Arizona Crossing 1 Upstream

NAME: SY06 Arizona Crossing 02	
GPS: **SY06AZ02**	**Stoecker ID:** No Stoecker Id
Barrier Type: Corrugated pipe culvert	**Location:** 34.61501, -120.37347
Description: This corrugated metal culvert pipe Arizona crossing measured 45ft wide. It had four pipes that measured a 2.5ft diameter.	

Santa Ynez River, Arizona Crossing 2 Upstream

NAME: SY06 Arizona Crossing 03	
GPS: SY06AZ03	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom Arizona crossing	**Location:** 34.61408, -120.37215
Description: This natural bottom Arizona crossing measured a length of 86 ft and crossed from RB to LB.	

Santa Ynez River, Arizon Crossing 3 Downstream

NAME: SY06 Arizona Crossing 04	
GPS: SY06AZ04	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom Arizona crossing	**Location:** 34.6145, -120.36873
Description: This natural bottom Arizona crossing measured 32 ft long by 56ft wide.	

Santa Ynez River, Arizona Crossing 4, Upstream

NAME: SY06 Arizona Crossing 05	
GPS: SY06AZ05	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom Arizona crossing	**Location:** 34.6154, -120.36671
Description: This natural bottom Arizona crossing crossed the main stem of the channel and connected to SY06AZ05B, which crossed the adjacent side channel.	

Santa Ynez River, Arizona Crossing 5, View from RB

NAME: SY06 Arizona Crossing 05B	
GPS: SY06AZ05B	**Stoecker ID:** No Stoecker ID
Barrier Type: Arizona crossing	**Location:** 34.61505, -120.36631
Description: This corrugated metal culvert Arizona crossing consisted of two metal culvert pipes.	

Santa Ynez River, Arizona Crossing 5B Upstream

NAME: SY06 Arizona Crossing 06	
GPS: SY06AZ06	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom Arizona crossing	**Location:** 34.61449, -120.33165
Description: Natural bottom Arizona crossing.	

Santa Ynez River, Arizona Crossing structure 6 View of LB

NAME: SYFLG Arizona Crossing	
GPS: SYFLGAZ01	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom Arizona crossing	**Location:** 34.60641, -120.19858
Description: This natural bottom Arizona crossing had been modified by the addition of gravel and boulders. The Arizona crossing crossed from LB to RB.	

Santa Ynez River, Flag Arizona Crossing, View of RB

NAME: Avenue of Flags Bridge	
GPS: SYFLAG BRG	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.60672, -120.19407
Description: This natural bottom bridge measured 43 ft wide. It had two concrete support pillars with 100 ft between the concrete pillars.	

Santa Ynez River, Avenue of the Flags Upstream

NAME: Alisal Road Bridge	
GPS: SYALISAL BRG	**Stoecker ID:** No Stoecker ID
Barrier Type: Bridge	**Location:** 34.58487, -120.14493
Description: No picture	

NAME: Refugio Road Bridge	
GPS: SYRFGBRG	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.58506, -120.10046
Description: This natural bottom bridge had two concrete support pillars in wetted channel.	

Santa Ynez River, Refugio Bridge Downstream

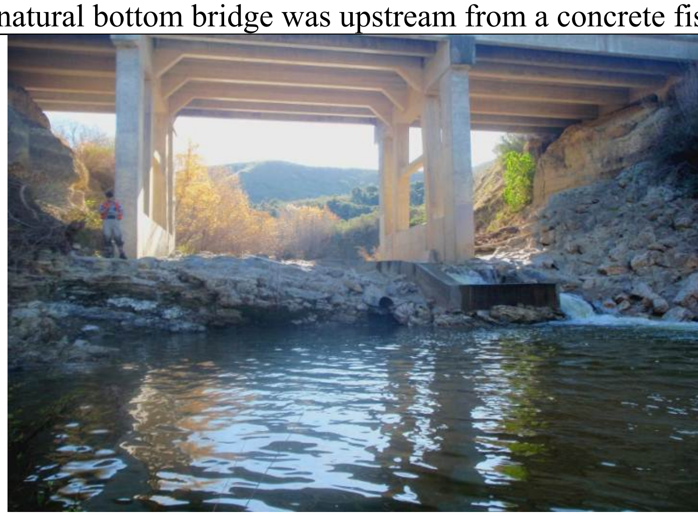
NAME: Bradbury Dam	
GPS: SYBRADBURY	**Stoecker ID:** SY_6
Barrier Type: Dam	**Location:** 34.58657, -119.98422
Description: No picture	

Salsipuedes Creek Bridges, Barriers, and Culverts

NAME: Santa Rosa Bridge 01	
GPS: SPCASR01	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.62191, -120.42200
Description: Natural bottom bridge.	

Salsipuedes Creek, Santa Rosa Bridge, Upstream

NAME: HWY 1 Bridge	
GPS: SYHWY1SALSI	**Stoecker ID:** SY_SS_2
Barrier Type: Bridge	**Location:** 34.59670, -120.41313
Description: This natural bottom bridge was upstream from a concrete fish ladder.	



Salsipuedes Creek, Highway 1 Bridge, Upstream

NAME: Jalama Rd Bridge	
GPS: SYJALSALSI1	**Stoecker ID:** SY_SS_3
Barrier Type: Bridge	**Location:** 34.58960, -120.40905
Description: Bridge and fish ladder	

Salsipuedes Creek, Jalama Road Bridge and Fish Ladder, Upstream

NAME: Jalama Rd Bridge	
GPS: SALPJUL02	**Stoecker ID:** SY_SS_4
Barrier Type: Bridge	**Location:** 34.56413, -120.40852
Description: No picture	

NAME: SPCB Bridge 01	
GPS: SPCBBRDG1	**Stoecker ID**: No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.55325, -120.40390
Description: This natural bottom bridge had concrete supports on both banks.	

Salsipuedes Creek, SPCB Bridge 1Upstream

NAME: SPCB Bridge 02	
GPS: SPCBBRDG2	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.55187, -120.40292
Description: This natural bottom bridge had concrete supports on both banks.	

Salsipuedes Creek, SPCB Bridge 2, Upstream

El Jaro Creek Bridges, Barriers, and Culverts

NAME: HWY 1 Bridge	
GPS: ELJHGH01	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.58347, -120.38512
Description: This natural bottom bridge had two concrete support pillars and small cobble riprap both banks. The riprap extended from the channel up to the base of the concrete pillars.	

El Jaro Creek, El Jaro Bridge 1, Upstream

Nojoqui Creek Bridges, Barriers, and Culverts

NAME: SYNJA Bridge 01	
GPS: SYNJABRDG01	**Stoecker ID:** No Stoecker ID
Barrier Type: Bridge with concrete apron	**Location:** 34.53543, -120.17883
Description: This natural bottom bridge measured 40ft long by 15 ft wide. It had two metal pillars supports in wetted channel. Additionally, there was a concrete bottom plunge downstream from bridge.	

Nojoqui Creek, Nojoqui Bridge 1, Downstream

NAME: Alisal Road Bridge	
GPS: SYNJBBRDG01	**Stoecker ID:** SY_NI_7
Barrier Type: Corrugated metal culvert bridge	**Location:** 34.53517, -120.17595
Description: This bridge measured 17ft long by 39 ft wide and had a 4ft diameter culvert pipe for water to flow through. The culvert pipe was encased in sacrete walls. There was also broken up concrete debris on both banks.	

Nojoqui Creek, Nojoqui B Bridge 1, Upstream

NAME: SYNJB Bridge 02	
GPS: SYNJBBRDG02	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.52955, -120.17388
Description: This natural bottom bridge measured 14 ft long and 6 ft wide.	

Nojoqui Creek, Nojoqui B 2 Bridge, Upstream

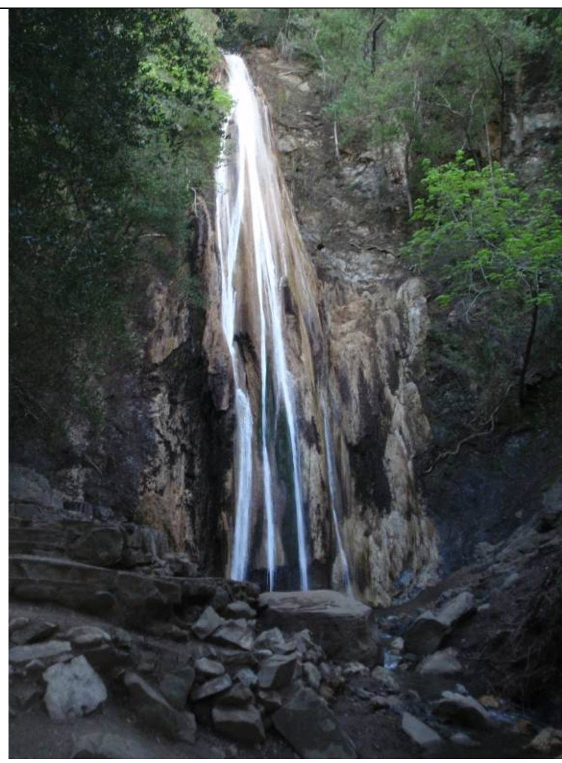
NAME: SYNJB Bridge 03	
GPS: SYNJBBRDG03	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.52937, -120.17368
Description: This natural bottom bridge measured 15ft long by 6 ft wide.	

Nojoqui Creek, Nojoqui B 3 Bridge, Upstream

NAME: SYNJB Bridge 04	
GPS: SYNJBBRDG04	**Stoecker ID:** No Stoecker ID
Barrier Type: Natural bottom bridge	**Location:** 34.52909, -120.17270
Description: This natural bottom bridge measured 15ft long by 6ft wide.	

Nojoqui Creek, Nojoqui B 4 Bridge, Upstream

NAME: Nojoqui Creek Waterfall	
GPS: SYNJB029	**Stoecker ID:** SY_NI_8
Barrier Type: Waterfall	**Location:** 34.52845, -120.17228
Description: This waterfall is over 75ft high and was composed of calcium and magnesium carbonate (travertine). It was determined to be the natural limit of anadromous migration for Nojoqui Creek.	



Nojoqui Creek Waterfall

STREAM DISCUSSIONS

Lower Santa Ynez Discussion

The lower Santa Ynez subbasin survey took place between 1/27/2011 and 5/12/2011. The survey began near the mouth of the Santa Ynez River after the estuary, approximately 2.77 miles from the Pacific Ocean. The lower Santa Ynez River terminated at Bradbury Dam, 49 miles upstream from the Pacific Ocean; however, the survey ended at the last surveyed reach, approximately 38 miles upstream from start of the survey and 41 miles upstream from the Pacific Ocean. The entire surveyed length of the lower Santa Ynez River was designated as a C5 channel type using the Rosgen Stream Classification. According to the Montgomery-Buffington Channel Morphology, the lower Santa Ynez was dominated by Dune-Ripple channel morphology (19.89%), followed by Pool-Riffle (14.70%) and Bedrock (0.38%); however, braided or marsh-like sections occupied 5.28% and unsurveyed lengths occupied 59.74%.

The survey was conducted in subreaches where public land access was possible, or permission was obtained from landowners. Reach1 began immediately after the Santa Ynez estuary and continued until the Salsipuedes- Santa Ynez confluence, while consisting of four surveyed subreaches and three unsurveyed subreaches (see Map 2). The Reach 1 survey passed through Vandenberg Airforce Base (VAFB) before entering the city of Lompoc. Listed from the farthest downstream to upstream, five bridges crossed the mainstem: the U.S. railroad bridge, the 13th St. bridge (on VAFB territory), the Floridale bridge, the Highway 1 bridge, and the Highway 246 bridge. Much of the Santa Ynez River surveyed through VAFB territory was heavily vegetated although river access near the prison was limited due to impassable sections resulting from heavy vegetation and deep pools. The river then moved upstream through the urban and residential zones of Lompoc. The last surveyed subreach ended shortly after the Highway 246 bridge. After the Highway 246 bridge, the Santa Ynez River entered a stretch referred to as the Narrows. Reach 2 began at the Salsipuedes Creek- Santa Ynez River confluence and proceeded upstream until the Nojoqui Creek- Santa Ynez River confluence at Highway 101 in Buellton. It consisted of three unsurveyed subreaches and three surveyed subreaches. Many of the bankside parcels throughout Reach 2 consisted of agricultural land, ranch land, and vineyards. Vehicle access was limited to private Arizona crossings until Buellton where the river was crossed by two bridges: the Avenue of the Flags bridge and the Highway 101 bridge. Some Arizona crossings observed in Reach 2 appeared to be illegally constructed, diverting the stream bed in some cases. Reach 3 proceeded upstream from the confluence of Nojoqui Creek and the Santa Ynez River. Access to Reach 3 was extremely limited and only one small reach was surveyed. Three bridges crossed over the river in this reach: Alisal bridge, Refugio bridge, and Highway 154. An Arizona crossing was also maintained at Meadowlark Road.

Lower Santa Ynez Reach 1 was characterized by long glides and long trench pools. The entirety of Reach 1 was designated a Dune Ripple M-B channel morphology. Reach 2 was characterized by pools, riffles, and runs, with numerous braided sections, side channels, and one short bedrock section. Reach 2 M-B Channel Morphology switched from Dune-Ripple to Pool Riffle, however, one short bedrock section was observed as well as lengthy braided or marsh-like sections. Numerous beaver dams altered the stream channel throughout Reach 2. Reach 3 only contained one short surveyed sectioned that was defined by pools and riffles, in addition to one large braided section.

Water temperatures in lower Santa Ynez ranged from 48 to 63 degrees Fahrenheit, while air temperatures ranged from 46 to 79 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months (an ongoing project currently undertaken by NOAA), and more extensive biological sampling should occur.

Flatwater habitat types comprised 17% of the total length of the lower Santa Ynez survey, pools 12%, and riffles 6%; however, 61% was unsurveyed. The pools were relatively shallow with 79 of the 221 (35%) having a maximum residual depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In fourth order streams, a primary pool is defined to have a maximum residual depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Twenty of the 223 pool tail-outs measured had embeddedness ratings of 1 or 2, and 47 pool tail-outs had embeddedness ratings of 3 or 4. One hundred fifty-six pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate suitable spawning substrate for salmon and steelhead. Sediment sources in Santa Ynez River should be mapped and rated according to their potential sediment yields, and control measures should be taken. One hundred fifty-seven of the 223 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools was 57, 46 for riffle habitats, and 35 for flatwater habitats. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in the lower Santa Ynez River. Terrestrial vegetation was the dominant cover type in pools followed by small woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 12%. In general, revegetation projects are considered when canopy density is less than 80%. The percentage of right and left bank covered with vegetation was moderate at 40% and 40%, respectively. Depending on the section of the stream, vegetation ranged from heavy to barren. Invasive species were also observed throughout the river, especially in the lower reaches of the stream. Arundo, a known problem invasive, was observed in isolated stands. The last observed arundo stand occurred approximately 20 miles upstream from the Pacific Ocean within Reach 2, subreach B. These populations should be monitored and removed, and, in areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of trees, in conjunction with bank stabilization, is recommended.

Salsipuedes Creek Discussion

Salsipuedes Creek, a tributary of the Santa Ynez River, entered the river approximately 12.5 miles upstream from the Pacific Ocean. The Salsipuedes-Santa Ynez confluence was located in a section of the Santa Ynez River referred to as the Narrows. The Salsipuedes Creek survey was conducted between 1/10/2011 and 1/26/ 2011. The survey was divided into four reaches and extended upstream for approximately 7.64 miles with 5.19 miles surveyed and 2.45 miles unsurveyed. The first surveyed reach (Reach 2) began approximately 0.62 miles upstream from and continued until the El Jaro-Salsipuedes confluence, approximately 3.68 miles upstream from the start of the survey, and 4.27 miles upstream from the Salsipuedes-Santa Ynez confluence. Unsurveyed Reach 3 continued upstream from the El Jaro-Salsipuedes confluence for approximately 1.83 miles before the survey commenced in Reach 4. Reach 4 continued for an additional 1.52 miles before the survey was terminated due to lack of public access. The natural limit to salmonid migration was not reached.

Reach 2 was characterized by pools and riffles. According to the Rosgen Stream Classification, Salsipuedes Creek Reach 2 was designated as a B5 channel type, and Reach 4 was designated as a G5 channel. As the Salsipuedes Creek survey continued upstream, the stream channel became increasingly narrower and more incised, thus accounting for the change from a B5 channel type to a G5 channel type. The substrate also became finer with Reach 4 consisting primarily of sand and silt. The Montgomery-Buffington Channel Morphology classification was dominated by Pool-Riffle (59.52%), followed by Bedrock (6.91%); however, unsurveyed lengths occupied 33.17%.

Reach 1, although unsurveyed, passed through privatized natural forest and agricultural lands. Reach 2 began immediately before the Santa Rosa bridge and continued upstream through vineyards, pastures, and natural forest. Including the Santa Rosa bridge, Reach 2 was crossed by two additional bridges: the Highway 1 bridge and the Jalama Road bridge. Both bridges were modified by CDFW and fish passage ladders constructed beneath both structures. Reach 2 ended at the Salsipuedes-El Jaro confluence. Unsurveyed Reach 3 passed through agricultural zones and pastures. Jalama Road crossed the mainstem of Salsipuedes once more during Reach 3. Reach 4 continued through Freedom Ranch, a ranch for wild horses. There were two additional bridges observed on Freedom Ranch land before the survey was terminated at the end of the parcel.

The water temperatures recorded during the Salsipuedes Creek survey ranged from 41 to 55 degrees Fahrenheit, while air temperatures ranged from 41 to 75 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Pool habitat types comprised 32% of the total length of this survey, riffles 23%, and flatwater units13%, whereas 32% of the total length was unsurveyed. The pools were relatively deep, with 103 of the 137 (75%) pools having a maximum residual depth greater than 2 feet. In second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Forty-three of the 137 pool tail-outs measured had embeddedness ratings of 1 or 2, 24 pool tail-outs had embeddedness ratings of 3 or 4, and 70 pool tail-outs had a rating of 5. Sediment sources in Salsipuedes Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken. Sixty-five of the 137 pool tail-outs measured had gravel or small cobble as the dominant substrate; which is considered suitable for steelhead redd construction.

The mean shelter rating for pools was 87, 60 for flatwater habitats, and 71 for riffle habitats. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in Salsipuedes Creek. Whitewater was the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat.

The mean percent canopy density for the stream was 64%. Reach 2 had a canopy density of 45%, and Reach 4 had a canopy density of 88%. In general, revegetation projects are considered when canopy density is less than 80%. The percentage of right and left bank covered with vegetation was moderate at 49% and 42%, respectively. Planting endemic species of trees, in conjunction with bank stabilization, is recommended.

Historically, steelhead trout were known to inhabit the Salsipuedes watershed. During the survey, resident juvenile *O. mykiss* were observed by Cachuma Operation and Maintenance Board biologists who have established fish traps throughout the watershed; however, adult steelhead were not observed during this habitat assessment survey.

El Jaro Creek Discussion

El Jaro Creek, a tributary of the Salsipuedes watershed, entered Salsipuedes Creek approximately 4.3 miles upstream from the Salsipuedes-Santa Ynez confluence. The survey was conducted between 4/12/2011 and 4/14/2011 and extended upstream for 5.74 miles, divided into two reaches. The first unsurveyed reach moved upstream from the El Jaro-Salsipuedes confluence for 2.95 miles before the survey commenced for the next 2.79 miles. The survey was terminated before the natural limit to anadromy due to lack of public access.

According to the Rosgen Stream Classification, El Jaro Creek Reach 2 was designated as a B4 channel type. The Montgomery-Buffington Channel Morphology classification was dominated by Pool-Riffle channel morphology (46.01%), followed by Cascade (2.37%); however, the unsurveyed length occupied 51.62%.

Reach 1, although unsurveyed, passed mostly through private natural forest and ranch land, whereas Reach 2 was dominated mostly by ranches and pastures. One bridge was observed during the survey; however, for a majority of the stream, El Jaro Creek followed Highway 1, which crossed the stream numerous times.

Water temperatures during the survey ranged from 51 to 62 degrees Fahrenheit, whereas air temperatures ranged from 54 to 68 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 17% of the total length of this survey, pools 17%, and riffles 15%, while unsurveyed units composed 51%. The pools were relatively deep, with 52 of the 88 (59%) pools having a maximum residual depth greater than 2 feet. Seven of the 88 pool tail-outs measured had embeddedness ratings of 1 or 2, 45 had embeddedness ratings of 3 or 4, and 36 had a rating of 5. Sediment sources in El Jaro Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken. 52 of the 88 pool tail-outs measured had gravel or small cobble as the dominant substrate; which are desirable substrate types for steelhead redd construction.

The mean shelter rating for pools was 53, 19 for flatwater habitats, and 81 for riffles. A pool shelter rating of approximately 100 is desirable. The amount of cover that now existed was provided primarily by terrestrial vegetation in El Jaro Creek. Terrestrial vegetation was the dominant cover type in pools followed by small woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat.

The mean percent canopy density for the stream was 49%. The percentage of right and left bank covered with vegetation was moderate at 37% and 32%, respectively; however, this could be attributed to the bank steepness within the watershed. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of trees, in conjunction with bank stabilization, is recommended.

The only resident *O. mykiss* observed by the field crew during the lower Santa Ynez survey were observed in El Jaro Creek.

Nojoqui Creek Discussion

Nojoqui Creek, a tributary to the Santa Ynez River, entered the river approximately 31.3 miles upstream from the Pacific Ocean. The Nojoqui Creek survey was conducted between 4/6/2011 and 5/3/2011 and contained 8.09 miles divided into two reaches. The first unsurveyed reach extended upstream from the confluence of Nojoqui Creek and the Santa Ynez River for 6.71 miles until the survey commenced for 1.39 miles before terminating at the limit of anadromy resulting from a waterfall deemed impassable to adult steelhead.

According to the Rosgen Stream Classification, Nojoqui Creek Reach 2 was designated as a B4 channel type. The Montgomery-Buffington Channel Morphology classification was dominated by Pool-Riffle channel morphology (11.42%), followed by Step-Pool (4.99%); however, the unsurveyed reach occupied 83.59%.

Unsurveyed Reach 1 followed Highway 101 for most of its length and consisted primarily of privatized natural forest, agricultural land, and ranch land. As the survey began, Reach 2 passed through ranch land until it reached federally owned Nojoqui Park. Throughout Reach 2, Nojoqui was crossed by four separate crossing. The first two crossing were deemed partial barriers to steelhead. Nojoqui Bridge 1 contained a concrete apron, which created plunge; however, with sufficient flow and pool depth, this barrier would be passable. The second bridge was a concrete pipe culvert that was 39 feet wide, 17 feet long, and constructed around corrugated metal pipe with a 4 ft. diameter. With the appropriate flow, this culvert could be passed; however, lack of velocity breaks and increased velocity due to forced flow would make this barrier difficult to pass for steelhead.

Water temperatures throughout the Nojoqui survey ranged from 52 to 63 degrees Fahrenheit, and air temperatures ranged from 48 to 82 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Riffle habitat types comprised 8% of the total length of this survey, flatwater 6%, and pools 3%, while the unsurveyed unit contained 83%. The pools were relatively deep, with 15 of the 24 (62%) pools having a maximum residual depth greater than 2 feet. Three of the 24 pool tail-outs measured had embeddedness ratings of 1 or 2, 12 had embeddedness ratings of 3 or 4, and 9 had a rating of 5. Sediment sources in Nojoqui Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken. Fifteen of the 24 pool tail-outs measured had gravel or small cobble as the dominant substrate; which are desirable substrate types for steelhead redd construction.

The mean shelter rating for pools was 58, 25 for flatwater habitats, and 94 for riffle habitats. The amount of cover that now existed was provided primarily by terrestrial vegetation in Nojoqui Creek. Terrestrial vegetation was also the dominant cover type in pools followed by boulders. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat.

The mean percent canopy density for the stream was 79%. The percentage of right and left bank covered with vegetation was moderate at 36% and 33%, respectively; however, this could be attributed to bank steepness within the watershed. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species in conjunction with bank stabilization, is recommended.

LOWER SUBBASIN CONCLUSIONS

Habitat surveys were conducted throughout the lower Santa Ynez subbasin, below Bradbury Dam, from November 16, 2010 until May 12, 2011. Areas surveyed within the watershed included: the lower Santa Ynez River (between the Pacific Ocean and the Bradbury Dam), Salsipuedes Creek, El Jaro Creek, and Nojoqui Creek. The main objectives of the habitat surveys and stream inventory report were to document the current habitat conditions, determine the Montgomery-Buffington Channel Morphology through the surveyed reaches, determine habitat suitability for southern steelhead, and recommend options for the potential enhancement of habitat throughout the Santa Ynez watershed. While the surveys focused on habitat parameters associated with southern steelhead, additional observations in relation to flora, fauna, habitat alterations, and manmade stream channel alterations were also included.

Populations of resident *O. mykiss*, as well as a small population of ocean-run southern steelhead, are supported throughout the lower watershed. However, lack of habitat due to impassable migration barriers, along with diverted flow, have dramatically reduced the population. The most notable barrier was the Bradbury Dam, which cuts off migration to the entire upper watershed. Based on overall observed habitat conditions and the results of the habitat typing survey, El Jaro Creek within the Salsipuedes watershed provided the most habitat for spawning steelhead and rearing juveniles in terms of habitat units with gravel or small cobble substrate size at pool tail-outs, and the overall number of pools; El Jaro was followed by the lower Santa Ynez, Salsipuedes and Nojoqui Creeks. Adequate flow regimes appear throughout the surveyed area, and all streams surveyed offered adequate instream habitat conditions for spawning and rearing *O. mykiss* and other native fish species. Historically, the Santa Ynez has supported the largest steelhead run in southern California, and with proper migration barrier modifications, as well as habitat restoration in areas with suitable *O. mykiss* habitat, the watershed could easily be revitalized to develop an increasing population of southern steelhead.

Unfortunately, lack of public land access, along with logistical constraints, prohibited a large portion of the lower watershed from being surveyed. Future habitat surveys should be planned to examine the rest of the watershed, whereby this report could be used for historical reference and as a basis for comparison. Additional studies to provide further insight into the viability of the Santa Ynez watershed as a southern steelhead stream should include barrier assessments, water temperature monitoring during the summer months to determine if temperatures remain suitable, a bioassessment to determine the relative health of the watershed in relation to macro-invertebrate population numbers and diversity, and water quality sampling for measurements such as pH, dissolved oxygen, salinity and nutrient levels to determine if conditions are suitable for the needs of *O. mykiss*.

UPPER SANTA YNEZ SUBBASIN REPORT

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UPPER SANTA YNEZ SUBBASIN OVERVIEW

The upper Santa Ynez survey began above Bradbury Dam. This portion of the project included surveys of the Santa Ynez-Lake Cachuma drainage (Cachuma and Santa Cruz Creeks), the upper Santa Ynez River drainage, Oso Creek drainage, as well as the headwaters drainage area (Mono Creek, Indian Creek and Buckhorn Creek). These surveys took place between November 2010 and September 2012, and extended a total of 101.88 miles throughout the upper watershed, with 64.27 miles surveyed, and 37.62 miles unsurveyed due to logistics and time constraints.

The majority of the upper Santa Ynez subbasin lies on National Forest Land, and because of this is made up of natural forest, park lands and campgrounds. Although, the majority of the upper watershed is within Los Padres National Forest, there is some private land surrounding Lake Cachuma. This private land consists mostly of range and agricultural lands, with some natural forest.

HYDROLOGY

The upper Santa Ynez River proceeded after Lake Cachuma, which was created by Bradbury Dam, approximately 49 miles upstream from the Pacific Ocean. Lake Cachuma is approximately 8 miles long and it was estimated that the upper Santa Ynez River began approximately 57 miles upstream from the Pacific Ocean. Including the Santa Ynez Headwaters drainage area, the Upper Santa Ynez River drainage area totals approximately 280 square miles. According to the USGS Hildreth Peak 7.5 minute quadrangle, the Upper Santa Ynez and Santa Ynez Headwaters contain approximately 814 miles of total stream length divided between 736 intermittent miles, 62 perennial miles, and 17 manmade miles. Elevations range from 753 feet to 6820 feet.

Without the Santa Ynez Headwaters, the upper Santa Ynez River drainage area totals approximately 65 square miles and contains approximately 164 miles of total stream length divided between 122 intermittent miles, 37 perennial miles, and 5 manmade miles. Elevations range from 753 feet to 4449 feet. The upper Santa Ynez survey extended 30.91 miles upstream and was divided into 7 reaches. The first 4.72 miles upstream from Lake Cachuma was unsurveyed and used primarily as ranch land. The survey commenced for the next 10.9 miles to just below Gibraltar Dam. This second reach was divided into two subreaches based on differences in channel type. The survey continued, into the headwaters drainage area, with an unsurveyed reach from just below Gibraltar Dam and through the reservoir for 3.46 miles and then continued with surveyed reaches for 10.24 miles to just below Juncal Dam. The Santa Ynez River above Jameson Reservoir was found to be dry by a CDFW biologist and therefore was not included in this survey.

Oso Creek, a tributary of the upper Santa Ynez River, entered the river approximately 7.84 miles upstream from Lake Cachuma. Its location is 34:32:42.0N and 119:46:29.0W, LLID number 1197748345451. According to the USGS Little Pin Mtn. 7.5 minute quadrangle, Oso contains approximately 21 miles of total stream divided between 19 intermittent miles and 2 perennial miles. Oso Creek drains a watershed of approximately 8 square miles and elevations range from

753 feet to 4494 feet. The Oso Creek survey extended upstream from the confluence of Oso Creek and the Santa Ynez River for 4.18 miles; however, the survey was terminated before a natural limit to anadromous migration was reached, due to time constraints. Although a complete barrier was not reached, several partial natural barriers were encountered.

The Lake Cachuma drainage area consisted of all the tributaries that entered the lake above Bradbury Dam but excluding everything above where the mainstem of the upper Santa Ynez River began. The Lake Cachuma drainage area, including the Santa Ynez Headwaters and upper Santa Ynez, drains a watershed of approximately 417 square miles and consists of 1175 total stream miles divided between 967 intermittent miles, 166 perennial miles, and 42 manmade miles. Elevations range from 750 feet to 6819 feet. Excluding the Santa Ynez Headwaters and upper Santa Ynez, Lake Cachuma drains a watershed of approximately 16 square miles and consists of 361 total stream miles divided between 231 intermittent miles, 105 perennial miles, and 25 manmade miles. Elevations range from 750 feet to 6581 feet. Surveys were completed on Cachuma Creek which is located at 34:35:18.0N and 119:57:21.0W, LLID number 1199557345883 and Santa Cruz Creek which is located at 34:34:18.0N and 119:56:03.0W, LLID number 1199343345716. Cachuma creek consisted of three reaches and according to the USGS Figueroa Mtn. 7.5 minute quadrangle, consisted of 8.9 perennial stream miles and 1.6 intermittent stream miles. The first unsurveyed reach extended from where Cachuma Creek entered Lake Cachuma upstream 7.25 miles. The surveyed reach continued upstream an additional 2.05 miles where it was terminated due to heavy overgrowth of vegetation. The survey continued on the road, reach 3, to where it was evident the stream had dried. Santa Cruz Creek was divided into three separate streams: Santa Cruz Creek, East Fork Santa Cruz Creek, and West Fork Santa Cruz Creek. According to the USGS San Rafael Mtn. 7.5 minute quadrangle, Santa Cruz Creek consists of 13.8 perennial stream miles and 0.2 intermittent miles, while West Fork Santa Cruz has 4.7 perennial miles and 1.1 intermittent miles, and East Fork Santa Cruz has 6.7 perennial miles and 1.1 intermittent miles. In addition to Cachuma Creek and Santa Cruz Creek, Coche Creek a tributary to Santa Cruz Creek, was examined generally for water presence and temperatures at trail crossings (see West Fork Santa Cruz Creek Discussion).

The Santa Ynez Headwaters began at Gibraltar Dam, which is located approximately 73 miles upstream from the Pacific Ocean and forms Gibraltar Reservoir. The Santa Ynez Headwaters drain a watershed of approximately 216 square miles and consist of 651 total stream miles divided between 614 intermittent miles, 25 perennial miles, and 12 manmade miles. Elevations range from 1285 feet to 6820 feet. Surveys were completed on Mono, Indian and Buckhorn Creeks as well as the Santa Ynez River above Gibraltar Reservoir during the second phase of the project. Mono Creek is located at 34:31:12.0N and 119:37:56.0W, LLID number 1196322345199. According to the USGS Madulce Peak 7.5 minute quadrangle, Mono contains approximately 27.6 intermittent stream miles. Indian Creek is located at 34:32:03.0N and 119:37:56.0W, LLID number 1196321345342. According to the USGS Big Pine Mtn. 7.5 minute quadrangle Indian Creek has 17.7 intermittent stream miles. Buckhorn Creek is located at 34:34:41.0N and 119:40:11.0W, LLID number 1196697345781. According to the USGS Little Pine Mtn. 7.5 minute quadrangle Buckhorn Creek consists of 5.4 intermittent stream miles. Mono Creek was surveyed from its confluence with the Santa Ynez River, upstream approximately 10.7 miles to just below an area referred to as the narrows. Due to logistical constraints the survey was completed just before the narrows and two reference reaches of approximately 1 mile each were chosen at random from the remaining 11 miles, from the narrows to the expected upstream limit to salmonid migration. Due to logistical constraints, only the uppermost reference reach was surveyed. Indian Creek is a tributary to Mono Creek and joins Mono Creek approximately 1.5 miles upstream from the Mono Creek- Santa Ynez River confluence. The survey began at the Indian Creek- Mono Creek confluence and continued upstream 10.2 miles to within 0.3 miles of a two stage bedrock waterfall considered to be the natural limit to salmonid migration on this creek. The last 0.3 miles to the barrier were walked, but not surveyed, due to logistical constraints. Buckhorn creek is a tributary to Indian Creek and was surveyed from its confluence with Indian Creek upstream approximately 3 miles to where there was no evidence of recent flow.

LAND AND RESOURCE USE

Historic land use

The majority of native peoples in the Santa Ynez watershed inhabited the coastal and foothill regions, however some did persist in the valleys of the coastal ranges. The native people in this region were part of hunter gatherer societies; however there is some evidence of manipulation of the landscape by these populations.

The Chumash peoples of the region had a large impact on the landscape through regular burning of shrublands. It is thought that this burning was done to promote the growth of herbaceous species, which produce more of the seeds and bulbs used as dominant food sources (Timbrook et al. 1982, Keeley 2002). There is evidence of regular burning in both coastal sage scrub and chaparral plant communities. Chaparral is one of the predominant vegetation types in the upper Santa Ynez subbasin.

Land use in this region dramatically changed at the time of European colonization, with the start of more intensive agricultural practices and increasing development of range land. This likely had a larger impact on coastal areas of the lower Santa Ynez subbasin, than the upper Santa Ynez subbasin, due to the topography of the region.

Current land use

The upper Santa Ynez subbasin consists of natural forest, park lands, and campgrounds within Los Padres National Forest.

The upper Santa Ynez River lies almost entirely within Los Padres National Forest; with the exception of the privately owned ranch lands near the mouth of the upper Santa Ynez at Lake Cachuma. On the Santa Ynez River between Lake Cachuma and Gibraltar Reservoir, there are 7 concrete Arizona crossings. These crossings are for Paradise Road, which provides access to recreation areas along the Santa Ynez River. There are an additional 2 concrete Arizona crossings between Gibraltar and Juncal Dams, providing some additional access to the upper Santa Ynez River.

The drainage area surrounding Lake Cachuma is a mix of park land and privately owned land. In addition Lake Cachuma and Bradbury Dam are under the jurisdiction of the US Department of Reclamation. The southern half of the lake is devoted to Lake Cachuma Park land, with a golf course developed on the south eastern end. The northern side of the lake is privately owned and consists of natural forest and range land. The headwaters of the watershed are within Los Padres National Forest.

Oso Creek watershed runs entirely through Los Padres National Forest land and is dominated by natural forest with campgrounds near the confluence of Oso Creek and the Santa Ynez River. Two bridges cross Oso Creek from Paradise Road and two Arizona crossings occur upstream of the campground.

The Santa Ynez Headwaters drainage is dominated by natural forest within Los Padres National Forest, although Gibraltar Dam is controlled and maintained by Santa Barbara County. Juncal Dam, which forms Jameson Lake, is located approximately 87 miles upstream from the Pacific Ocean. Vehicle access to these areas is limited to 4WD-only and fire access roads.

The three dams on the mainstem of the Santa Ynez River are used to supply water to many of the local coastal areas including Santa Barbara, Goleta, Carpinteria, Montecito, as well as parts of the Santa Ynez Valley (SYRTAC). A more in depth discussion of the Dams and water use is available in the watershed overview section.

DATA ANALYSIS

Biological Inventory Results

O. mykiss were observed in the upper Santa Ynez River as well as one of its tributaries, Santa Cruz Creek. One potential *O. mykiss* was seen on the mainstem of the upper Santa Ynez below Gibraltar Dam. There were 41 *O. mykiss* observed above Gibraltar Reservoir on the mainstem Santa Ynez, ranging from 2-8 inches. In mainstem Santa Cruz Creek 918 fish were observed, most of which were between 2 and 4 inches (858 fish), but ranged in size from 2 inches to 12 inches. The most fish were seen in the West Fork of Santa Cruz Creek, with a total of 2,252 fish, with the majority between 2 and 4 inches (1972 fish) and the remaining ranging from 5 to 12 inches. Forty seven fish were also seen on the East Fork of Santa Cruz Creek, below the lowest waterfall. No fish were observed above the first waterfall on East Fork Santa Cruz Creek.

No *O. mykiss* were observed in any of the tributaries to the upper Santa Ynez River except Santa Cruz Creek, as mentioned above. The lack of fish in the headwater tributaries; Mono, Indian and Buckhorn, is concerning as previous surveys, including one in 2003 (Stoecker 2004), had numerous sightings throughout these streams. It is possible that this absence of *O. mykiss* could be a result of a large wildfire that burned in this area in 2007, the Zaca Fire. The fire likely negatively impacted these populations and perhaps numbers have not rebounded due to the difficulty of fish movement within this region. Santa Cruz Creek would be an exception to this, as the area had large numbers of *O. mykiss*. East Fork Santa Cruz Creek was one of the most intensely burned streams, along with Mono Creek; leading to these streams having the highest erosion rates. The fact that no fish were observed on East Fork Santa Cruz Creek above the lowest barrier may be evidence of the impact of the fire on this stream. As there are many fish in both the mainstem Santa Cruz Creek as well as in the West Fork it is possible that fish have not been able to recolonize the East Fork due to the presence of the waterfall on this stream. Since

2007, the flow conditions may not have been favorable for fish to move above this waterfall, resulting in the current absence of fish in this stream.

In addition to *O. mykiss,* one other native fish species was observed in the upper watershed. This was the threespine stickleback, which was seen on the mainstem of the Santa Ynez between Cachuma and Gibraltar, as well as between Gibraltar and Jameson reservoirs. In addition to these native species several non-native fishes were observed including, carp, bass, arroyo chub, sunfish, and catfish. The majority of the fish sightings were made on the Santa Ynez mainstem. In general the tributaries had few to no fish sighted during the surveys, with the exception of Santa Cruz Creek.

Several amphibian and reptile species were also sited during the surveys. There were numerous sightings of the California and Pacifc tree frogs in all of the streams surveyed. In addition, two federally endangered species were observed, the arroyo toad and red-legged frog. Two juvenile arroyo toads were observed on the bank near the confluence of Indian Creek and Buckhorn Creek. Red-legged frog juveniles and tadpoles were observed on the Santa Ynez mainstem above Gibraltar Reservoir. Hundreds of invasive bullfrog tadpoles were also seen in several of the streams. In terms of reptiles there were numerous sightings of the Western pond turtle throughout the watershed, as well as the two-striped garter snake; both of which are California species of special concern. There was also one sighting of a California kingsnake and two sightings of western rattlesnakes.

Aquatic macro-invertebrates were present throughout the surveyed area in the Santa Ynez watershed where continuous flow was observed, such as water boatman, water striders, giant water bugs, mayflies, caddisflies, and midge larva. Macro-invertebrates would provide a food source for rearing juvenile *O. mykiss*. A more focused survey could provide greater insight into the abundance of macro-invertebrates and water quality conditions.

Few mammals were observed during the survey; however there was evidence of their presence throughout the watershed. In several areas of the mainstem between Lake Cachuma and Gibraltar Reservoir, as well as above Gibraltar Reservoir, there was clear evidence of beaver activity. This included chewed down branches and trees, as well as several small beaver dams. A female black bear and her cub were seen on Coche Creek, a tributary to Santa Cruz Creek. In addition, many tracks were visible along the banks of the streams including deer, raccoon, bobcat, black bear, and mountain lion.

Habitat Inventory Results

The majority of the upper Santa Ynez stream habitat inventory was conducted by Heidi Block, Jon Trilli, and Matt Groce of PSMFC, additional help was provided by Esther Balla (CDFW), Chris Lima (CDFW), and Jill Taylor (CCC/PSMFC). The majority of this survey took place between 12/21/2011 and 5/15/2012 and included a portion of the upper Santa Ynez River below Gibraltar Dam, the Santa Ynez River above Gibraltar Dam, Cachuma Creek, Santa Cruz Creek, Mono Creek, Indian Creek and Buckhorn Creek. Oso Creek and one portion of the upper Santa Ynez River were surveyed by Aaron Francis, Jon Trilli, Julie Hall, and Ben Chubak of PSMFC between 11/16/2010 and 5/12/2011. The survey extended a total of 101.88 miles throughout the upper watershed, with 64.27 miles surveyed and 37.62 miles going unsurveyed due to logistical and time constraints.

All habitat inventory tables and graphs associated with the upper Santa Ynez subbasin are located in Appendix 6.

Cachuma Creek Habitat Inventory

The habitat inventory of Cachuma Creek was conducted between 1/31/2012 and 2/1/2012. The total length of the stream surveyed was 53,121 feet with an additional 145 feet of side channel. Of the 53,121 feet of stream, only 10,654 feet were surveyed on foot, while 42,467 feet went unsurveyed due to a lack of public access.

Stream Flow:

The mean stream flow in Cachuma Creek was estimated to be 4 cfs during the survey period. Flows decreased greatly as the survey increased in elevation to where the creek was completely dry. Flows ranged from 5 and 6 cfs at the start of the surveyed reach to 0.5 cfs at the end.

Rosgen Channel Type:

Cachuma Creek is a B2 channel type for the entire surveyed portion of the stream (10,654 ft, Reach 2). B2 channels are moderately entrenched, moderate gradient, riffle dominated boulder substrate channels, with infrequently spaced pools. There were two additional reaches that were unsurveyed, Reach 1 which was 38,273 feet and Reach 3, which was 4,194 feet.

Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 45 to 58 °F, with an average of 52.7 °F. Air temperatures ranged from 50 to 73 °F, with an average of 58.7 °F.

Summary of Habitat Types:

Cachuma Creek Table 1 summarizes the Level II riffle, flatwater, and pool habitat types found in Cachuma Creek. Based on frequency of occurrence there were 44% flatwater units, 35% riffle units, 19% pool units, and 1% unsurveyed units (Cachuma Creek Graph 1). Based on total length of Level II habitat types there were 12% flatwater units, 6% riffle units, 2% pool units, and 80% unsurveyed units (Cachuma Creek Graph 2).

Ten Level IV habitat types were identified in Cachuma Creek (Cachuma Creek Table 2). The most frequent habitat types by percent occurrence were Step Run units (25%), followed by Run units (19%) and Low Gradient Riffle units (18%) (Cachuma Creek Graph 3). The three most common habitat types based on percent total length were Step Run units at 10%, Low Gradient Riffle at 4% and Run units at 3% of the total length. The majority of the total length consisted of unsurveyed units at 80%. Typical step run (left) and riffle (right) units from Cachuma Creek are pictured below.


Summary of Pools:

A total of 41 pools were identified in Cachuma Creek (Cachuma Creek Table 3). Scour pools were the most frequently encountered, at 51% (Cachuma Creek Graph 4), and comprised 39% of the total length of all pools (Cachuma Creek Table 3).

Cachuma Creek Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Seven of the 41 pools (17%) had a residual depth of two feet or greater (Cachuma Creek Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 42 pool tail-outs measured, 1 had a value of 1 (2.4%); 3 had a value of 2 (7.1%); 6 had a value of 3 (14.3%); 1 had a value of 4 (2.4%); 31 had a value of 5 (73.8%) (Cachuma Creek Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 25 , flatwater habitat types had a mean shelter rating of 21 , and pool habitats had a mean shelter rating of 61 (Cachuma Creek Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 68, Scour pools had a mean shelter rating of 53, Backwater pools had a mean shelter rating of 90 (Cachuma Creek Table 3).

Habitat Cover:

Cachuma Creek Table 5 summarizes mean percent cover by habitat type. Terrestrial Vegetation is the dominant cover type in Cachuma Creek. Cachuma Creek Graph 7 describes the pool cover in Cachuma Creek. Boulders are the dominant pool cover type followed by terrestrial vegetation.

Substrate:

The dominant substrate by habitat type is summarized in Cachuma Creek Table 6. Boulders were the dominant substrate for the majority of habitat units. Cachuma Creek Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the most dominant pool tail-out substrate at 38%, with boulders being the next most common at 33%.

Canopy:

The canopy in Cachuma Creek consisted entirely of hardwood tress. The mean percent canopy density for the surveyed length of Cachuma Creek was 80%, leaving 20% of the canopy open (Cachuma Creek Graph 9).

Bank Vegetation and Composition:

For the surveyed reach in Cachuma Creek, the mean percent right bank and left bank vegetated were 33% and 34% respectively. The dominant elements composing the structure of the stream banks consisted of 84% boulder, 9% sand/silt/clay, 4% cobble/gravel, and 3% bedrock (Cachuma Creek Graph 10). Hardwood trees were the dominant bank vegetation type, observed in 78.6% of the units surveyed. Additionally, 21.4% of the units surveyed had brush as the dominant bank vegetation type (Cachuma Creek Graph 11).

Santa Cruz Creek Habitat Inventory

The habitat inventory of Santa Cruz Creek took place between 7/10/2012 and 7/17/2012. The total length of stream surveyed was 73,787 feet (13.98 miles) with an additional 128 feet of side channel. Of the 73,787 feet of stream, 54,853 feet (10.39 miles) went unsurveyed due to lack of public access, and 18,934 feet (3.59 miles) of the main channel were surveyed on foot. The surveyed section of the stream extended from the private property line (indicated with a gate across the creek) to the split of the East and West Forks of Santa Cruz Creek.

Stream Flow:

Stream flow was estimated to be between 2.5 and 4cfs during the survey period, with an average of 3.4cfs.

Rosgen Channel Type:

Santa Cruz Creek was a B2 channel type for the entire surveyed reach, 18,934 feet (3.59 miles) (Reach 2). B2 channels are moderately entrenched, moderate gradient, riffle dominated boulder substrate channels, with infrequently spaced pools. There was also an additional unsurveyed reach that was 54,853 feet (10.39 miles) (Reach 1).

Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 66 to 84 degrees Fahrenheit, with an average of 74.5°F. Air temperatures ranged from 77 to 98 degrees Fahrenheit, with an average of 91.1°F.

Summary of Habitat Types:

Santa Cruz Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence flatwater units were most common (44%), followed by riffle units (34%), pool units (22%) and 0.4% unsurveyed units (Santa Cruz Graph 1). In terms of total length of Level II habitat types the unsurveyed unit was largest and took up 74% of the total length, followed by flatwater units at 12%, riffle units at 10% and pool units at 4% (Santa Cruz Graph 2).

Ten Level IV habitat types were identified during the survey (Santa Cruz Table 2). The most frequent habitat types by percent occurrence were Low Gradient Riffle units (32%), Run units (28%), and Lateral Scour Pool - Bedrock Formed units (15%) (Santa Cruz Graph 3). The habitat types that made up the highest percentages of total length were Low Gradient Riffle units (9%), Run units (7%), and Step Run units (6%). In terms of percent total length, the largest habitat type was the unsurveyed unit at 74%. Representative Low Gradient Riffle and Run units are pictured below at left and right respectively.


Summary of Pools:

A total of 51 pools were identified in Santa Cruz Creek (Santa Cruz Table 3). Scour pools were the most frequently encountered, at 88% (Santa Cruz Graph 4), and comprised 88% of the total length of all pools (Santa Cruz Table 3).

Santa Cruz Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Thirty eight of the 47 pools (81%) had a residual depth of two feet or greater, while 25 had a residual depth of three feet or greater (Santa Cruz Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 51 pool tail-outs measured, 2 had a value of 1 (3.9%); 10 had a value of 2 (19.6%); 10 had a value of 3 (19.6%); 6 had a value of 4 (11.8%); 23 had a value of 5 (45.1%) (Santa Cruz Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle and Pool habitat types had mean shelter ratings of 86, while flatwater habitat types had a mean shelter rating of 64 (Santa Cruz Table 1). Of the pool types, the scour pools had a mean shelter rating of 88, while main channel pools had a mean shelter rating of 82 (Santa Cruz Table 3).

Habitat Cover:

Santa Cruz Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant habitat cover type in Santa Cruz Creek. Santa Cruz Graph 7 describes the pool cover in Santa Cruz Creek. Boulders are the dominant pool cover type followed by terrestrial vegetation.

Substrate:

Santa Cruz Table 6 summarizes the dominant substrate by habitat type. Boulders were the dominant substrate type for the majority of habitat units, followed by large cobble. Santa Cruz Graph 8 depicts the dominant substrate observed in pool tail-outs. The most commonly found substrate in pool tail-outs was small cobble, observed in 31% of pool tail-outs. After small cobble, gravel and boulders were observed in 24% of pool tail-outs

Canopy:

The mean percent canopy density for the surveyed length of Santa Cruz Creek was 48%; with 52% open (Santa Cruz Graph 9). Hardwood trees make up all of the canopy cover in Santa Cruz Creek.

Bank Vegetation and Composition:

For the stream reach surveyed, the mean percent right bank vegetated was 33%. The mean percent left bank vegetated was 28%. The dominant elements composing the structure of the stream banks consisted of boulders (42%), bedrock (25%), cobble/gravel (25%), and sand/silt/clay (8%) (Santa Cruz Graph 10). Deciduous trees were the dominant vegetation type observed in 74% of the units surveyed. Additionally, 24% of the units surveyed had brush as the dominant vegetation type, and 2% had grass as the dominant vegetation (Santa Cruz Graph 11).

East Fork Santa Cruz Creek Habitat Inventory

East Fork Santa Cruz Creek was surveyed between 7/17/2012 and 8/7/2012. The total length of the stream surveyed was 11,261feet (2.13 miles). The entire stream length, 11,261 feet, was surveyed on foot.

Stream Flow:

The mean stream flow within East Fork Santa Cruz Creek was estimated to be 1.6cfs (cubic feet per second). During the time of the survey flows ranged from 0.5 to 5cfs.

Rosgen Channel Type:

East Fork Santa Cruz Creek is an A2 channel type for 798 feet of the stream surveyed (Reach 1), and a B2 channel type for the remaining 10,463 feet of the stream surveyed (Reach 2). A2 channel types are steep, narrow, step-pool streams with high energy/debris transport in a boulder dominant substrate. B2 channels are moderately entrenched, moderate gradient, riffle dominated boulder substrate channels, with infrequently spaced pools. A change from an A2 channel to a B2 channel in this stream is associated with a change in entrenchment. The section of the stream that is A2 was highly entrenched with very steep canyon walls, there was not a change in stream gradient in this case.

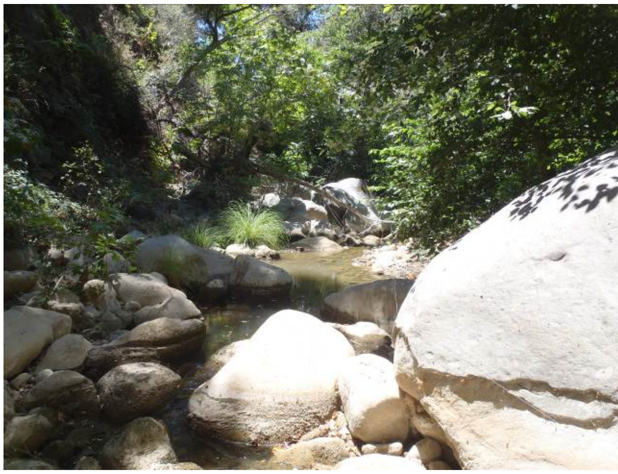
Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 66 to 84 degrees Fahrenheit, with an average of 71.3°F. Air temperatures ranged from 73 to 96 degrees Fahrenheit with an average of 89.9°F.

Summary of Habitat Types:

East Fork Santa Cruz Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% pool units, 36% flatwater units, 22% riffle units, and 1% dry units (East Fork Santa Cruz Graph 1). Based on total length of Level II habitat types there were 57% flatwater units, 31% pool units, 11% riffle units, and 1% dry units (East Fork Santa Cruz Graph 2).

Eleven Level IV habitat types were identified (East Fork Santa Cruz Table 2). The most frequent habitat types by percent occurrence were Step Run units (31%), Step Pool units (16%), and Lateral Scour Pool - Bedrock Formed units (15%)(East Fork Santa Cruz Graph 3). Based on percent total length the most common habitat types were, Step Run units (53%), Step Pool units (18%), and Lateral Scour Pool - Bedrock Formed units (7%). Representative Step Run and Step Pool units are pictured below at left and right respectively.




Summary of Pools:

A total of 56 pools were identified (East Fork Santa Cruz Table 3). Scour pools were the most frequently encountered, at 62% (East Fork Santa Cruz Graph 4), and comprised 41% of the total length of all pools (East Fork Santa Cruz Table 3).

East Fork Santa Cruz Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Forty eight of the 56 pools (86%) had a residual depth of two feet or greater (East Fork Santa Cruz Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 56 pool tail-outs measured, 1 had a value of 1 (1.8%); 4 had a value of 2 (7.1%); 3 had a value of 3 (5.4%); 7 had a value of 4 (12.5%); 41 had a value of 5 (73.2%)(East Fork Santa Cruz Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 80, flatwater habitat types had a mean shelter rating of 56, and pool habitats had a mean shelter rating of 79 (East Fork Santa Cruz Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 78, Scour pools had a mean shelter rating of 81 (East Fork Santa Cruz Table 3).

Habitat Cover:

Mean percent cover by habitat type is summarized in East Fork Santa Cruz Table 5. Boulders are the dominant cover type overall, as well as the dominant cover type in pools, followed by terrestrial vegetation (East Fork Santa Cruz Graph 7).

Substrate:

East Fork Santa Cruz Table 6 summarizes the dominant substrate by habitat type. Boulders were the dominant substrate type in the majority of habitat units. The dominant substrate observed in pool tail-outs was sand at 34% or pool units, followed by gravel at 21% (East Fork Santa Cruz Graph 8).

Canopy:

The mean percent canopy density for the surveyed length of East Fork Santa Cruz Creek was 65%; leaving the remaining 35% open (East Fork Santa Cruz Graph 9). Of the canopy present, the mean percentages of hardwood and coniferous trees were 99% and 1%, respectively.

Bank Vegetation and Composition:

For the surveyed reach in East Fork Santa Cruz Creek, the mean percent right bank and left bank vegetated were 17% and 25% respectively. The dominant elements composing the structure of the stream banks consisted of 70% boulder, 28% bedrock, and 2% sand/silt/clay (East Fork Santa Cruz Graph 10). Hardwood trees were the dominant vegetation type observed in 69% of the units surveyed. Additionally, 27% of the units surveyed had brush as the dominant vegetation type, and 5% had grass as the dominant vegetation (East Fork Santa Cruz Graph 11).

West Fork Santa Cruz Creek Habitat Inventory

The habitat inventory of West Fork Santa Cruz Creek was conducted between 7/18/2012 and 7/25/2012. The total length of stream surveyed was 21,228 feet (4.02 miles), divided between 19,972 surveyed main channel feet (3.78 miles) and 1,256 unsurveyed feet (0.24 miles).

Stream Flow:

Stream flow was estimated to be between 0 and 4cfs during the survey period, with an average of 1.7cfs. Dry reaches became increasingly more common over the 2 weeks of the stream survey.

Rosgen Channel Type:

West Fork Santa Cruz Creek is a B2 channel type for 4,882.00 feet of the stream surveyed (Reach 1), a C2 channel type for 6,702.00 feet of the stream surveyed (Reach 2), and then returns to a B2 channel type for the remaining 9,644.00 feet of the stream surveyed (Reach 3). B2 channels are moderately entrenched, moderate gradient, riffle dominated boulder substrate channels, with infrequently spaced pools. While C2 channels are meandering point-bar riffle/pool alluvial channels with broad well defined floodplains on low gradients and boulder dominant substrates.

Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 58 to 73 degrees Fahrenheit, with an average of 65.6°F. Air temperatures ranged from 69 to 84 degrees Fahrenheit with an average of 79.1°F.

Summary of Habitat Types:

The Level II riffle, flatwater, and pool habitat types are summarized in West Fork Santa Cruz Table 1. Based on frequency of occurrence there were 38% flatwater units, 31% pool units, 30% riffle units, and 2% dry units (West Fork Santa Cruz Graph 1). Based on total length of Level II habitat types there were 53% flatwater units, 22% riffle units, 21% pool units, and 5% dry units (West Fork Santa Cruz Graph 2).

Twelve Level IV habitat types were identified (West Fork Santa Cruz Table 2). The most frequent habitat types by percent occurrence were Step Run units (24%), Low Gradient Riffle units (21%), and Run units (14%) (West Fork Santa Cruz Graph 3). The most common habitat types based on percent total length were: Step Run units (40%), Low Gradient Riffle units (18%), and Run units (13%). Representative step run (left) and riffle (right) units from West Fork Santa Cruz Creek are pictured below.

Summary of Pools:

A total of 88 pools were identified (West Fork Santa Cruz Table 3). Scour pools were the most frequently encountered, at 76% (West Fork Santa Cruz Graph 4), and comprised 55% of the total length of all pools (West Fork Santa Cruz Table 3).

West Fork Santa Cruz Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Seventy one of the 87 pools (82%) had a residual depth of two feet or greater (West Fork Santa Cruz Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 87 pool tail-outs measured, 2 had a value of 1 (2.3%); 15 had a value of 2 (17.2%); 14 had a value of 3 (16.1%); 3 had a value of 4 (3.4%); 53 had a value of 5 (60.9%) (West Fork Santa Cruz Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 52, flatwater habitat types had a mean shelter rating of 57, and pool habitats had a mean shelter rating of 80 (West Fork Santa Cruz Table 1). Of the pool types, the Scour pools had a mean shelter rating of 85, while Main Channel pools had a mean shelter rating of 72 (West Fork Santa Cruz Table 3).

Habitat Cover:

Mean percent cover by habitat type is summarized in West Fork Santa Cruz Table 5. Boulders are the dominant cover types in West Fork Santa Cruz Creek. West Fork Santa Cruz Graph 7 describes the pool cover in the creek. Boulders are the dominant pool cover type followed by terrestrial vegetation.

Substrate:

West Fork Santa Cruz Table 6 summarizes the dominant substrate by habitat type. In general boulders were found to be the dominant substrate type, followed by bedrock. West Fork Santa Cruz Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the most common substrate found at pool tail-outs at 31%, followed by boulders which were observed in 28% of pool tail-outs.

Canopy:

The mean percent canopy density for the surveyed length of West Fork Santa Cruz Creek was 59%. Forty one percent of the canopy was open. Hardwood trees made up all of the observed canopy cover. The mean percent canopy cover is described in West Fork Santa Cruz Graph 9.

Bank Vegetation and Composition:

For the stream reach surveyed, the mean percent right bank vegetated was 23%, while the left bank had a mean percent vegetated of 31%. The dominant elements composing the structure of the stream banks consisted of 68% boulder, 26% bedrock, 3% cobble/gravel, and 3% sand/silt/clay (West Fork Santa Cruz Graph 10). Deciduous trees were the dominant vegetation type observed in 80% of the units surveyed. Additionally, 10% of the units surveyed had brush as the dominant vegetation type, and 9% had grass as the dominant vegetation (West Fork Santa Cruz Graph 11).

Upper Santa Ynez River Habitat Inventory

The habitat inventory of the upper Santa Ynez was conducted in four parts, the first between 11/16/2010 and 12/15/2010, the second on 12/21/2011, the third between 2/14/2012 and 3/15/2012, and the fourth between 8/20/2012 and 9/5/2012. The second part was surveyed at the same time as the start of Mono Creek and consisted of 1.0 mile above Gibraltar Dam. The third part of the survey was completing the survey between Lake Cachuma and Gibraltar Dam. The fourth part of the survey was completing the section between Gibraltar Reservoir and Jameson Lake. The total length of stream surveyed was 160,060 feet (30.3 miles) with an additional 7,048 feet (1.33 miles) of side channel. The 160,060 feet surveyed was divided between 43,158 unsurveyed feet (8.14 miles) and 116,902 surveyed main channel feet (22.14 miles), below and above Gibraltar Dam.

Stream Flow:

The mean stream flow within upper Santa Ynez was estimated to be 0.5 cfs (cubic feet per second), with a range of 0-2cfs. During the time of the survey the surface flow was observed in fragmented sections; with sections of low flow separated by dry reaches.

Rosgen Channel Type:

Upper Santa Ynez River was considered to be a D4 stream channel type for the entire 22,029 feet of Reach 2. D4 channels have multiple channels with longitudinal and transverse bars; a very wide channel with eroding banks and gravel as the dominant substrate. Reach 3 was considered a C3 channel type for 35,533 feet. C3 channels are meandering point-bar riffle/pool alluvial channels with broad well defined floodplains on low gradients and cobble dominant substrates. Reach 5 was considered a C4 channel type for 10,942 feet, with a slightly more gravel just after Gibraltar Reservoir. Reach 6 was a change back to a C3 channel type for 35,670 ft, which indicates a change from predominantly gravel substrate to a cobble dominated substrate. Lastly, Reach 7 had a change to a C2 channel type for 12,728, indicating a change from cobble substrates to predominantly boulder substrates. Two unsurveyed reaches did not have channel classifications, Reach 1 (24,987 feet) and Reach 4 (18,261 feet).

Water and Air Temperatures:

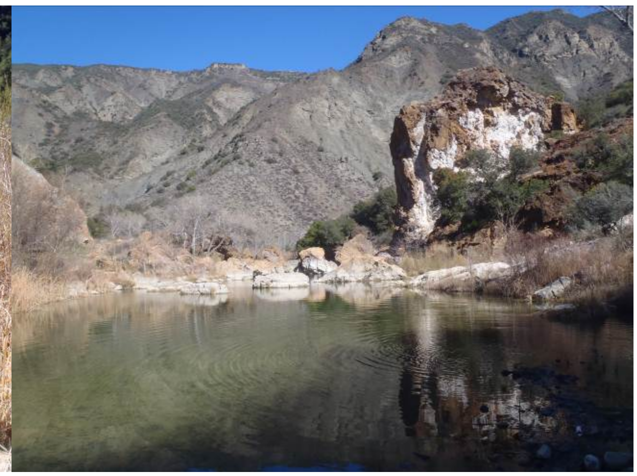
Water temperatures taken during the upper Santa Ynez River survey period ranged from 39 to 82 °F. Air temperatures during the survey ranged from 40 to 95 °F.

Summary of Habitat Types:

The total length of the upper Santa Ynez River survey was 167,108 feet with 486 total units. Upper Santa Ynez Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 13% dry units, 31% pool units, 20% riffle units, 34% flatwater units, and 2% culvert units (Upper Santa Ynez Graph 1). Based on the total length of Level II habitat types there were 16% pool units, 5% riffle units, and 19% flatwater units; in addition 26% of the total length went unsurveyed and 34% consisted of dry units (Upper Santa

Ynez Graph 2).

Seventeen Level IV habitat types were identified (Upper Santa Ynez Table 2). The most frequent habitat types by percent occurrence were Run units at 31%, Low Gradient Riffle units at 20%, and Bedrock Lateral Scour Pools at 12% (Upper Santa Ynez Graph 3). Based on percent total length, the most dominant habitat types were Run units at 15%, Bedrock formed Lateral Scour Pools at 7%, and Mid-Channel pools at 5%. The unsurveyed and dry units, however, dominated the length of the survey at 26% for unsurveyed units, and 34% for dry units. A typical run unit for the upper Santa Ynez is pictured below on the left; and an example of a large bedrock scour pool on the right.

Summary of Pools:

A total of 172 pools were identified in upper Santa Ynez River (Upper Santa Ynez Table 3). Scour pools were the most frequently encountered, at 62% (Upper Santa Ynez Graph 4), and comprised 60% of the total length of all pools (Upper Santa Ynez Table 3). Upper Santa Ynez Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Seventy of the 168 pools (42%) had a residual depth of three feet or greater (Upper Santa Ynez Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. In upper Santa Ynez out of the 150 pool tail-outs measured, 10 had a value of 1 (6.7%); 26 had a value of 2 (17.3%); 16 had a value of 3 (10.7%); 3 had a value of 4 (2%); 95 had a value of 5 (63.3%) (Upper Santa Ynez Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. In the upper Santa Ynez River, Riffle habitat types had a mean shelter rating of 92, flatwater habitat types had a mean shelter rating of

52, and pool habitats had a mean shelter rating of 70 (Upper Santa Ynez Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 73, Scour pools had a mean shelter rating of 72, and Backwater pools had a mean shelter rating of 49 (Upper Santa Ynez Table 3).

Habitat Cover:

Upper Santa Ynez Table 5 summarizes mean percent cover by habitat type. Terrestrial Vegetation was the dominant cover type in upper Santa Ynez River. Boulders were the dominant cover type in pools, followed by terrestrial vegetation (Upper Santa Ynez Graph 7).

Substrate:

Upper Santa Ynez Table 6 summarizes the dominant substrate by habitat type, for a majority of habitat units cobble was the dominant substrate followed by boulders. Upper Santa Ynez Graph 8 depicts the dominant substrate observed in pool tail-outs. Boulders were the most dominant substrate observed in 44% of pool tail-outs, followed by gravel observed in 16% of pool tail-outs.

Canopy:

The canopy through the entirety of the upper Santa Ynez River consisted of hardwood trees. The mean percent canopy density for the surveyed length of upper Santa Ynez River was 33%, meaning 67% of the canopy was open (Upper Santa Ynez Graph 9).

Bank Vegetation and Composition:

For the upper Santa Ynez River, the mean percent right bank vegetated was 42%, while the mean percent left bank vegetated was 40%. The dominant elements composing the structure of the stream banks consisted of 41% boulder, 27% cobble/gravel, 14% bedrock, and 18% sand/silt/clay (Upper Santa Ynez Graph 10). Deciduous trees were the dominant bank vegetation type observed in 66% of the units surveyed. Additionally, 33% of the units surveyed had brush as the dominant bank vegetation type (Upper Santa Ynez Graph 11).

Oso Creek Habitat Inventory

The habitat inventory of the Oso Creek was conducted between 5/3/2011 and 5/12/2011. The total length of stream surveyed was 22,057 feet (4.18 miles) with an additional 46 feet of side channel (0.01 miles).

Stream Flow:

The mean stream flow within Oso Creek was estimated at 1 cfs (cubic feet per second). Prior to the storm events during the start of the 2010-2011 water season, much of Oso Creek was observed to be dry; however, when the survey took place at the start of May, continuous flow was observed throughout Oso Creek.

Rosgen Channel Type:

Oso Creek was considered to be a B4 stream channel type for the entire 22,057 feet. B4 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and gravel dominant substrates.

Water and Air Temperatures:

Water temperatures taken during the Oso Creek survey period ranged from 54 to 75 °F with a mean of 65 °F and median of 66 °F. Air temperatures ranged from 59 to 88 °F with a mean of 69 °F and median of 68 °F.

Summary of Habitat Types:

The total length of the Oso Creek survey was 22,103 feet with 347 total units. Oso Creek Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 46% riffle units, 29% flatwater units, and 24% pool units (Oso Creek Graph 1). Based on total length of Level II habitat types there were 74% riffle units, 17% flatwater, and 9% pool units (Oso Creek Graph 2).

Ten Level IV habitat types were identified in Oso Creek (Oso Creek Table 2). The most frequent habitat types by percent occurrence were Low Gradient Riffle units at 43%, Run units at 25%, and Lateral Scour Pool units at 8% (Oso Creek Graph 3). Based on percent total length, the most dominant habitat types were Low Gradient Riffles at 72%, Run units at 13%, and Step Run units at 4%. Typical riffle (left) and run (right) units from Oso Creek are pictured below.

Summary of Pools:

A total of 84 pools were identified in Oso Creek (Oso Creek Table 3). Scour pools were the most frequently encountered at 92% (Oso Creek Graph 4), and comprised 86% of the total length of all pools (Oso Creek Table 3). Oso Creek Table 4 is a summary of maximum residual depth by pool habitat types. Pool quality for salmonids increases with depth. Twenty-seven of the 84 pools had a residual depth of two feet or greater (Oso Creek Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. In Oso Creek out of 84 pools measured, 1 had a value of 1 (1.2%), 7 had a value of 2 (8.3%), 61 had a value of 3 (72.6%), 14 had a value of 4 (16.7%), and 1 had a value of 5 (1.2%) (Oso Creek Graph 6).

Shelter Rating:

In Oso Creek, Riffle habitat types had a mean shelter rating of 64, flatwater habitat types had a mean shelter rating of 31, and pool habitats had a mean shelter rating of 45 (Oso Creek Table 1). Of the pool types, the Scour pools had a mean shelter rating of 46, and Main Channel Pools had a mean shelter rating of 44 (Oso Creek Table 3).

Habitat Cover:

Oso Creek Table 5 summarizes mean percent cover by habitat type. Boulders, whitewater, and terrestrial vegetation were the dominant cover types in Oso Creek, depending on the habitat types. Oso Creek Graph 7 describes the pool cover. Boulders were the dominant pool cover type followed by whitewater and then bedrock ledges.

Substrate:

Oso Creek Table 6 summarizes the dominant substrate by habitat type. For a majority of habitat units, sand was the dominant substrate, followed by cobble or gravel. Oso Creek Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the most dominant substrate observed in 90% of pool tail-outs, followed by small cobble observed in 8% of pool tail-outs, and sand observed in 1% of pool tail-outs.

Canopy:

The canopy through the entirety of the Oso Creek watershed consisted of hardwood trees. The mean percent canopy density for the surveyed length of Oso Creek was 49%, meaning 51% of the canopy was open (Oso Creek Graph 9).

Bank Vegetation and Composition:

For Oso Creek, the mean percent right bank vegetated was 27% while the mean percent left bank vegetated was 27%. The dominant elements composing the structure of the stream banks consisted of 83% sand/silt/clay and 17% bedrock (Oso Creek Graph 10). Deciduous trees were the dominant vegetation type observed in 84% of the units surveyed. Additionally, 16% of the units surveyed had brush as the dominant vegetation type (Oso Creek Graph 11).

Mono Creek Habitat Inventory

The habitat inventory of Mono Creek took place between 12/21/2011 and 5/15/2012. The total length of stream surveyed was 116,935 feet with an additional 2,662 feet of side channel. Of the total length of stream surveyed, 56,276 feet went unsurveyed due to logistical and time constraints.

Stream Flow:

Stream flow was estimated to be 4.6cfs, with a range of 0.5 to 5cfs, for the survey period.

Rosgen Channel Type:

Mono Creek is a C4 channel type for 5,563.00 feet of the stream surveyed (Reach 1), a C3 channel type for the 9,299.00 feet of the stream surveyed (Reach 2), a B3 channel type for 22,925.00 feet of the stream surveyed (Reach 3), a B2 channel type for 18,104.00 feet of the stream surveyed (Reach 4), and a C3 channel type for 4,768.00 feet of the stream surveyed (Reach 6), in addition there was an unsurveyed reach for 56,276.00 feet of the stream surveyed (Reach 5) with no channel type. Rosgen C type channels are characterized by meandering point-bar riffle/pool alluvial channels with broad well defined floodplains on low gradients. A C3 channel type indicates cobble dominated substrate, while a C4 channel type indicates gravel as the dominant substrate. Rosgen B type channels are defined by a riffle dominated channel with infrequently spaced pools, which is moderately entrenched and on a moderate gradient. B3 channels have cobble dominated substrates, while B2 channel types have boulder dominated substrates.

Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 36 to 70 °F, with an average of 49.6 °F. Air temperatures ranged from 28 to 82 °F, with an average of 61.2 °F.

Summary of Habitat Types:

Level II riffle, flatwater, and pool habitat types are summarized in Mono Creek Table 1. Based on frequency of occurrence there were 36% flatwater units, 36% riffle units, 27% pool units, <0.01% culvert units, <0.01% no survey units (Mono Creek Graph 1). Based on total length of Level II habitat types there were 25% flatwater units, 20% riffle units, 8% pool units, 0% culvert units, 47% no survey units (Mono Creek Graph 2).

Eighteen Level IV habitat types were identified (Mono Creek Table 2). The most frequent habitat types by percent occurrence were Low Gradient Riffle units (29%), followed by Run units (29%) and Lateral Scour Pool - Boulder Formed units (11%) (Mono Creek Graph 3). Based on percent total length, Run units (19%) were highest, followed by Low Gradient Riffle units (17%), and Step Run units (5%). The highest percent total length was taken up by the unsurveyed unit (47%). Typical run (left) and riffle (right) units from Mono Creek are pictured below.


Summary of Pools:

A total of 202 pools were identified (Mono Creek Table 3). Scour pools were the most frequently encountered, at 78% (Mono Creek Graph 4), and comprised 74% of the total length of all pools (Mono Creek Table 3).

Mono Creek Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Ninety three of the 202 pools (46%) had a residual depth of two feet or greater, while only 28 of the pools had residual depths greater than three feet ((Mono Creek Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 197 pool tail-outs measured, 1 had a value of 1 (0.5%); 36 had a value of 2 (18.3%); 14 had a value of 3 (7.1%); 2 had a value of 4 (1%); 144 had a value of 5 (73.1%) (Mono Creek Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 31, flatwater habitat types had a mean shelter rating of 30, and pool habitats had a mean shelter rating of 49 (Mono Creek Table 1). Of the pool types, the scour pools had a mean shelter rating of 47, Main Channel pools had a mean shelter rating of 54, and backwater pools had a mean shelter rating of 45 (Mono Creek Table 3).

Habitat Cover:

Mean percent cover by habitat type is summarized in Mono Creek Table 5. Terrestrial Vegetation was the dominant cover type in Mono Creek. Mono Creek Graph 7 describes the pool cover in Mono Creek. Terrestrial Vegetation was the dominant pool cover type followed by boulders.

Substrate:

Dominant substrate by habitat type is summarized in Mono Creek Table 6. The majority of habitat units had cobble or boulder as the dominant substrate. Mono Creek Graph 8 depicts the dominant substrate observed in pool tail-outs. The two most dominant substrate types in pool tail-outs were boulders at 32%, and sand at 24%.

Canopy:

The mean percent canopy density for the surveyed length of Mono Creek was 20%, with the remaining 80% open. The entire canopy present was composed of hardwood tress. Mono Creek Graph 9 describes the mean percent canopy in Mono Creek.

Bank Vegetation and Composition:

For the stream reach surveyed, the mean percent right and left bank vegetated was 25%. The dominant elements composing the structure of the stream banks consisted of 14% bedrock, 36% boulder, 27% cobble/gravel, and 24% sand/silt/clay (Mono Creek Graph 10). Deciduous trees were the dominant vegetation type observed in 58% of the units surveyed. Additionally, 42% of the units surveyed had brush as the dominant vegetation type, and 1% had grass as the dominant vegetation (Mono Creek Graph 11).

Indian Creek Habitat Inventory

The habitat inventory of Indian Creek took place between 1/17/2012 and 5/3/2012. The total length of the stream surveyed was 55,582 feet (10.5 miles) with an additional 800 feet of side channel. The total length of stream surveyed was divided between 53,748 feet (10.18 miles) of surveyed stream and 1,834 feet (0.35 miles) unsurveyed.

Stream Flow:

Stream flow was estimated to be 4.9cfs during the survey period. A range of 3 to 7cfs was observed over the length of the survey.

Rosgen Channel Type:

Indian Creek is a C3 channel type for 3,495.00 feet of the stream surveyed (Reach 1), a B3 channel type for 37,562.00 feet of the stream surveyed (Reach 2), a B2 channel type for 14,525.00 feet of the stream surveyed (Reach 3). A C3 channel type indicates meandering point-bar riffle/pool alluvial channels with broad well defined floodplains on low gradients and cobble dominant substrates. The channel then changed to a B3 channel indicating a change in the gradient and entrenchment of the channel. A B type channel is a riffle dominated channel with infrequently spaced pools, which is moderately entrenched and on a moderate gradient. B3 channels have cobble dominated substrates. The final change to a B2 channel type indicates a change from cobble dominated substrate to boulder dominated substrate.

Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 35 to 66 °F, with an average of 51.6 °F. Air temperatures ranged from 34 to 85 °F, with an average of 61.7 °F.

Summary of Habitat Types:

Level II riffle, flatwater, and pool habitat types are summarized in Indian Creek Table 1. Based on frequency of occurrence there were 40% riffle units, 33% flatwater units, <0.1% culvert units, 27% pool units, <0.1% no survey units (Indian Creek Graph 1). Based on total length of Level II habitat types there were 46% riffle units, 38% flatwater units, <0.1% culvert units, 13% pool units, 3% no survey units (Indian Creek Graph 2).

Sixteen Level IV habitat types were identified (Indian Creek Table 2). The most frequent habitat types by percent occurrence were Low Gradient Riffle units (27%), followed by Run units (27%), and Lateral Scour Pool - Bedrock Formed units (12%) (Indian Creek Graph 3). Based on percent total length there were 35% Low Gradient Riffle units, 30% Run units, 3% Glide units, 7% Lateral Scour Pool - Bedrock Formed units, and 7% High Gradient Riffle units. Typical riffle (left) and run (right) units are pictured below.

Summary of Pools:

A total of 187 pools were identified (Indian Creek Table 3). Scour pools were the most frequently encountered, at 79% (Indian Creek Graph 4), and comprised 75% of the total length of all pools (Indian Creek Table 3).

Indian Creek Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Seventy seven of the 187 pools (41%) had a residual depth of two feet or greater, 19 of the 187 pools (10%) had a residual depth of three feet or greater (Indian Creek Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 185 pool tail-outs measured, 4 had a value of 1 (2.2%); 33 had a value of 2 (17.8%); 13 had a value of 3 (7%); 4 had a value of 4 (2.2%); 131 had a value of 5 (70.8%) (Indian Creek Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 41, flatwater habitat types had a mean shelter rating of 28, and pool habitats had a mean shelter rating of 41 (Indian Creek Table 1). Of the pool types, the Scour pools had a mean shelter rating of 39, Backwater pools had a mean shelter rating of 55, Main Channel pools had a mean shelter rating of 40 (Indian Creek Table 3).

Habitat Cover:

Mean percent cover by habitat type is summarized in Indian Creek Table 5. Terrestrial Vegetation was the dominant cover type in Indian Creek. Indian Creek Graph 7 describes the pool cover in Indian Creek. Terrestrial Vegetation was the dominant pool cover type followed by boulders.

Substrate:

The dominant substrate by habitat type is summarized in Indian Creek Table 6. The majority of habitat types had either cobble or boulder dominated substrates. Indian Creek Graph 8 depicts the dominant substrate observed in pool tail-outs. Boulders were observed in 34% of pool tail-outs and sand was observed in 24% of pool tail-outs.

Canopy:

The mean percent canopy density for the surveyed length of Indian Creek was 30% with 70% of the canopy open. All of the canopy cover was provided by hardwood trees. Indian Creek Graph 9 describes the mean percent canopy in Indian Creek.

Bank Vegetation and Composition:

For the stream reach surveyed, the mean percent right bank vegetated was 30%, and left bank was 32%. The dominant elements composing the structure of the stream banks consisted of 55% boulder, 20% bedrock, 14% cobble/gravel, and 11% sand/silt/clay (Indian Creek Graph 10). Deciduous trees were the dominant vegetation type observed in 55% of the units surveyed. Additionally, 44% of the units surveyed had brush as the dominant vegetation type, and 1% had grass as the dominant vegetation (Indian Creek Graph 11).

Buckhorn Creek Habitat Inventory

The habitat inventory of Buckhorn Creek was conducted between 4/4/2012 and 4/5/2012. The survey began at the confluence of Buckhorn Creek and Indian Creek and extended upstream 3.2 miles. The total length of the stream surveyed was 16,741 feet with an additional 164 feet of side channel.

Stream Flow:

Stream flow was estimated to be on average 1cfs, with a range of 0.5-2cfs during the survey period.

Rosgen Channel Type:

Buckhorn Creek was a B3 channel type for the entire surveyed length of the stream (16,741ft). A B3 channel is a riffle dominated channel with infrequently spaced pools, which is moderately entrenched and on a moderate gradient. B3 channel types have cobble dominated substrate.

Water and Air Temperatures:

Water temperatures taken during the survey period ranged from 43˚F to 66˚F with a mean of 51˚F. Air temperatures ranged from 39˚F to 70˚F with a mean of 57˚F.

Summary of Habitat Types:

Level II riffle, flatwater, and pool habitat types are summarized in Table 1. Based on frequency of occurrence there were 39% flatwater units, 24% pool units, 36% riffle units, and 1% dry units (Buckhorn Creek Graph 1). Based on total length of Level II habitat types there were 33% flatwater units, 5% pool units, 44% riffle units, and18% dry units (Buckhorn Creek Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 34% Low Gradient Riffle units (typical riffle unit pictured below, Left), 26% Run units (typical run unit pictured below right), and 12% Step Run units (Buckhorn Creek Graph 3). Based on percent total length, 43% Low Gradient Riffle units 18% Run units, 18% Dry units, and 16% Step Run units were the most frequent habitat types.

Summary of Pools:

A total of 37 pools were identified (Buckhorn Creek Table 3). Scour pools were the most frequently encountered, at 70% (Buckhorn Creek Graph 4), and comprised 62% of the total length of all pools (Buckhorn Creek Table 3).

Buckhorn Creek Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Nine of the 36 pools (25%) had a residual depth of two feet or greater (Buckhorn Creek Graph 5).

Embeddedness:

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 36 pool tail-outs measured, 4 had a value of 1 (11.1%); 5 had a value of 2 (13.9%); 5 had a value of 3 (13.9%); 5 had a value of 4 (13.9%); 17 had a value of 5 (47.2%)(Buckhorn Creek Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

Shelter Rating:

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 23, flatwater habitat types had a mean shelter rating of 21, and pool habitats had a mean shelter rating of 50 (Buckhorn Creek Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 46, Scour pools had a mean shelter rating of 53 (Buckhorn Creek Table 3).

Habitat Cover:

Buckhorn Creek Table 5 summarizes mean percent cover by habitat type. Terrestrial Vegetation was the dominant cover type in Buckhorn Creek. Buckhorn Creek Graph 7 describes the pool cover in Buckhorn Creek. Terrestrial Vegetation was the dominant pool cover type followed by boulders.

Substrate:

The dominant substrate by habitat type is summarized in Buckhorn Creek Table 6. The majority of habitat types had cobble as the dominant substrate. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 32% of pool tail-outs, and sand and small cobble were observed in 19% of pool tail-outs.

Canopy:

The mean percent canopy density for the surveyed length of Buckhorn Creek was 82%. Eighteen percent of the canopy was open. The entire canopy was composed of hardwood trees. Graph 9 describes the mean percent canopy in Buckhorn Creek.

Bank Vegetation and Composition:

For the stream reach surveyed, the mean percent right bank vegetated was 52%. The mean percent left bank vegetated was 51%. The dominant elements composing the structure of the stream banks consisted of 58% boulder, 21% cobble/gravel, 19% sand/silt/clay, and 2% bedrock (Graph 10). Hardwood trees were the dominant vegetation type observed in 69.4% of the units surveyed. Additionally, 30.6% of the units surveyed had brush as the dominant vegetation type (Graph 11).

Montgomery-Buffington Channel Morphology Results

Cachuma Creek Bankfull Width:

The bankfull widths found in the surveyed portion of Cachuma creek ranged from 18 to 55 feet. The average bankfull width was 32.7 feet.

Cachuma Creek M-B Channel Morphology:

Only step-pool M-B Channel Morphology was observed in the surveyed portion (2.02 miles) of Cachuma Creek. When taken as a percentage of the total stream length (10.06 miles surveyed and unsurveyed) the step-pool channel morphology makes up 20.00%, the unsurveyed reaches make up 79.73%, and side channels make up the remaining 0.27%.

Santa Cruz Creek Bankfull Width:

Bankfull widths in Santa Cruz Creek ranged from 30 feet to 81 feet. The average bankfull width was 50.5 feet.

Santa Cruz Creek M-B Channel Morphology:

Santa Cruz Creek had Step-Pool channel morphology for the entire surveyed section (3.4 miles), 25% of the total stream length. There was also one unsurveyed reach, from where Santa Cruz Creek enters Lake Cachuma up approximately 10.5 miles, making up 75% of the total stream length.

East Fork Santa Cruz Creek Bankfull Width:

Bankfull widths in East Fork Santa Cruz Creek ranged from 25 to 58 feet, with an average of 42.6 feet.

East Fork Santa Cruz Creek M-B Channel Morphology:

East Fork Santa Cruz Creek exhibited only one M-B channel morphology, step-pool, for 100% of the surveyed length (2.13 miles).

West Fork Santa Cruz Creek Bankfull Width:

Bankfull widths on West Fork Santa Cruz Creek ranged from 30 to 63 feet. The average bankfull width for West Fork Santa Cruz Creek was 44.2 feet.

West Fork Santa Cruz Creek M-B Channel Morphology:

Two different channel morphologies were found in West Fork Santa Cruz Creek, Step-Pool and Bedrock. Based off percentage of total length for the entire 4.35 miles (surveyed and unsurveyed), the most dominant was Step-Pool (83.96%) followed by Bedrock (1.53%). In addition, 5.47% of the total length went unsurveyed, whereas 9.04% was braided and therefore not assigned a specific channel morphology.

Upper Santa Ynez Bankfull Width:

Throughout upper Santa Ynez, bankfull widths ranged from 32 feet to 150 feet. The average bankfull width was 72 feet. However, bankfull widths were unable to be determined in certain sections due to heavy vegetation or extremely wide/braided channels.

Upper Santa Ynez M-B Channel Morphology:

Three M-B Channel Morphology Types were observed in upper Santa Ynez: Pool-Riffle, Plane-Bed and Bedrock. Based off percentage of total length for the entire 21 miles (surveyed, unsurveyed and side channels), the most dominant was Plane-Bed (39.78%) followed by Pool-Riffle (5.14%) and Bedrock (0.95%). In addition, 26.33% of the total length went unsurveyed, whereas 27.79% was not assigned a channel morphology type due to braided stream lengths or side channels.

Oso Creek Bankfull Width:

Throughout Oso Creek, bankfull widths measured ranged from 20 feet to 97 feet. The average bankfull width was 37 feet with a median of 34 feet. The stream channel became increasingly more incised as Oso Creek moved upstream.

Oso Creek M-B Channel Morphology:

Three M-B Channel Morphology Types were observed in Oso Creek: Plane-Bed, Pool-Riffle, and Step Pool. Based off percentage of total length for the entire 8.9 miles, the most dominant was Plane-Bed (44.28%), followed by Pool-Riffle (42.90%) and Step-Pool (12.81%). The entire length was surveyed.

Mono Creek Bankfull Width:

Bankfull widths ranged from 18 to 100 feet throughout the surveyed sections of Mono Creek. The average bankfull width was 66.58 feet.
Mono Creek M-B Channel Morphology:

Indian Creek Bankfull Width:

Bankfull widths ranged from 31 to 95 feet throughout the surveyed portion of Indian Creek. The average bankfull width was 52.2 feet. Channel widths decreased as the survey moved upstream.

Indian Creek M-B Channel Morphology:

Four M-B Channel Morphology Types were encountered in Indian Creek: Pool-Riffle, Plane Bed, Step-Pool, and Bedrock. In terms of percent of total stream length, Plane Bed was the most dominant channel morphology (49.05%), followed by Step-Pool (39.11%), Pool-Riffle (6.18%) and Bedrock (1.00%). The remaining 4.66% was split between side channels (1.42%) and unsurveyed (3.24%).

Buckhorn Creek Bankfull Width:

Bankfull widths ranged from 14 feet to 28 feet throughout Buckhorn Creek. The average bankfull width was 22 feet. The bankfull width became narrower after the second left bank tributary, where the stream channel went completely dry.

Buckhorn Creek M-B Channel Morphology:

Two M-B Channel Morphology Types were observed in Buckhorn Creek: Pool-Riffle and Step-Pool. In terms of percentage of the total length, the most dominant channel morphology was Step-Pool (90%), followed by Pool-Riffle (10%).

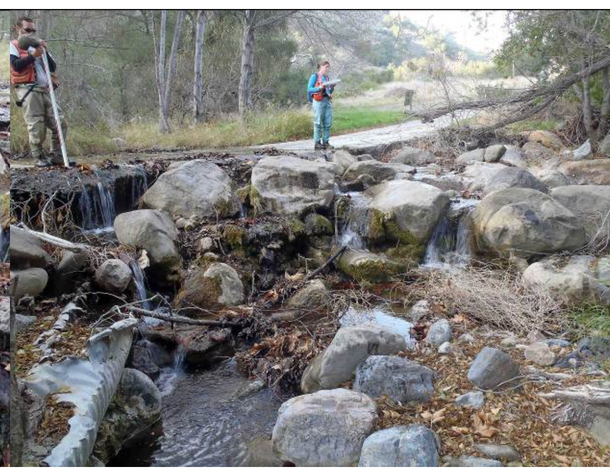
UPPER SANTA YNEZ BRIDGES, BARRIERS, AND CULVERTS

All manmade structures and natural barriers affecting the stream channel were document as survey progressed upstream. Such structures included manmade bridges, culverts, Arizona crossings, as well as natural waterfalls. Each notable structure throughout the surveyed area was photographed, measured, and their location was recorded, if possible. Matt Stoecker's Santa Ynez Barrier Inventory was used as a basis for comparison if the same barrier was crossed during both reports (Stoecker, 2004).

Cachuma Creek Bridges, Barriers and Culverts

<table>
<tr><td colspan="2">Name: Happy Canyon Road Crossing</td></tr>
<tr><td>GPS: HAPPYCYNRD</td><td>Stoecker ID: SY_CA_1</td></tr>
<tr><td>Barrier Type: Concrete Arizona crossing</td><td>Location: 34.70268, -119.91690</td></tr>
<tr><td colspan="2">Description: This is a low flow concrete road crossing. The concrete crossing measured 55ft in total length, and 25ft of active channel flow; the crossing width was 14ft. The road height from the surface of the downstream pool was 2.5ft, and the downstream pool depth was 0.8ft deep. This road crossing would be a barrier under low flow conditions as the jump height is too great. There is a boulder cascade on the downstream side of the road which may allow for easier crossing under moderate flow conditions.</td></tr>
</table>

Happy canyon road crossing, upstream plunge



upstream road and boulder cascade

Name: Cachuma Dry	
GPS: CACDRY	**Stoecker ID:** No ID
Barrier Type: No flow	**Location:** 34.72470, -119.91827
Description: 0.8 miles of the creek was surveyed from the road as it was too difficult to survey in the stream due to vegetative cover. From the road, the point where the stream was completely dry was determined. At this point there is likely no fish migration even under slightly higher flow conditions due to the gradient at and before this location.	

Cachuma creek completely dry

Santa Cruz Creek Bridges, Barriers and Culverts

Name: Private Property Gate	
GPS: SC001	**Stoecker ID:** No ID
Barrier Type: Gate	**Location:** 34.63000, -119.78842
Description: This is a gate that runs across the stream indicating the private property boundary. This gate does not touch the stream bed, but could collect debris during high flows causing a passage impediment.	

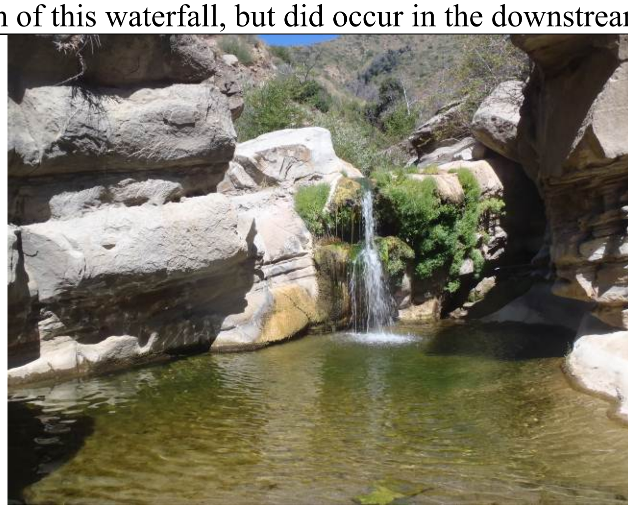
Private property gate across stream channel

Name: Santa Cruz Road Crossing	
GPS: SCRD1	**Stoecker ID:** No ID
Barrier Type: Natural Bottom Airzona Crossing	**Location:** 34.63265, -119.76098
Description: This is a natural bottom Arizona crossing that does not affect fish movement. This road provides access to the Santa Cruz Ranger station, and is not open to public motorized traffic.	

Santa Cruz road crossing from right bank

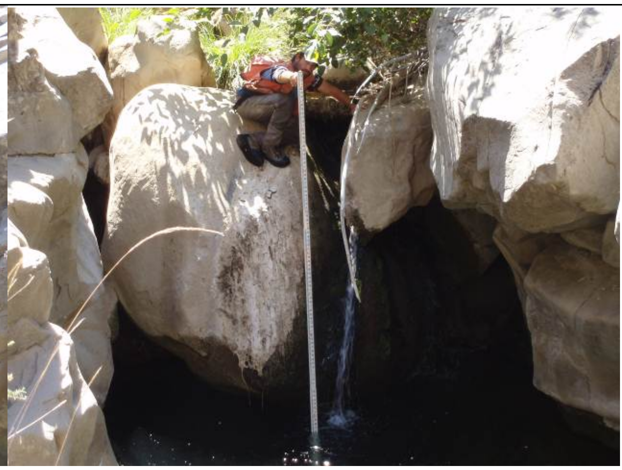
East Fork Santa Cruz Creek Bridges, Barriers and Culverts

Name: East Fork Santa Cruz Waterfall 1	
GPS: SCEFBAR1	**Stoecker ID:** SY_SC_EF_1
Barrier Type: Waterfall	**Location:** 34.64173, -119.75020
Description: This waterfall has a vertical plunge of 11 feet to the water surface, with a shallow pool at the top of the waterfall. The water depth below the plunge was 2.2ft, while the maximum depth was 3.8ft. This waterfall is a full barrier to resident *O. mykiss,* but it is possible that large adult steelhead may be able to pass this barrier under very limited conditions. No *O. mykiss* were observed upstream of this waterfall, but did occur in the downstream pools.	



East Fork Santa Cruz Creek waterfall barrier 1

Name: East Fork Santa Cruz Waterfall 2	
GPS: SCEFBAR2	**Stoecker ID:** SY_SC_EF_2
Barrier Type: Waterfall	**Location:** 34.64727, -119.74306
Description: This waterfall has a vertical plunge of 8.5 ft, with a downstream pool depth below the plunge of 6.8ft. The maximum depth of the downstream pool was estimated to be at least 11ft. This waterfall provides a further hindrance to upstream salmonid migration. It is possible that under high flow conditions when the downstream pool fills adult steelhead could possibly pass this feature.	

East Fork Santa Cruz waterfall barrier 2

West Fork Santa Cruz Creek Bridges, Barriers and Culverts

Name: West Fork Debris and Boulder Jam	
GPS: SCWFBAR1	**Stoecker ID:** No ID
Barrier Type: Debris Jam	**Location:** 34.67748, -119.78309
Description: This is a large debris jam, approximately 20ft tall with large boulders and LWD. This is a partial barrier, under high flow conditions step pools would be created along the side of the debris jam allowing fish passage.	

Upstream view of log and boulder jam

Name: West Fork Steep Gradient	
GPS: SCWFBAR2	**Stoecker ID:** SY_SC_WF_1
Barrier Type: Steep gradient	**Location:** 34.68090, -119.78602
Description: This barrier was not reached during the survey. The survey came within 0.2 miles of the steep gradient barrier, but due to logistical constraints could not be surveyed further. This is reported as a steep gradient full barrier, which would limit all salmonid upstream migration.	

Upper Santa Ynez River Bridges, Barriers, and Culverts

Name: SYA Arizona Crossing 01	
GPS: SYAAZ01	**Stoecker ID:** SY_7
Barrier Type: Concrete Arizona Crossing	**Location:** 34.54534, -119.79133
Descriptions: The Arizona crossing at Ranger Station into the campground measured 151 ft across the channel and its bank dammed the stream. The road is 13 ft wide and the downstream crest riprap is approximately 16.5 ft wide with a mild slope.	


Upper Santa Ynez, Arizona Crossing 1, Upstream

Name: SYA Arizona Crossing 02	
GPS: SYAAZ02	**Stoecker ID:** SY_8
Barrier Type: Concrete Arizona Crossing	**Location:** 34.54611, -119.77715
Descriptions: This concrete Arizona crossing measured 162ft across the channel and is14ft wide.	

Santa Ynez River, Arizona Crossing 2, Upstream

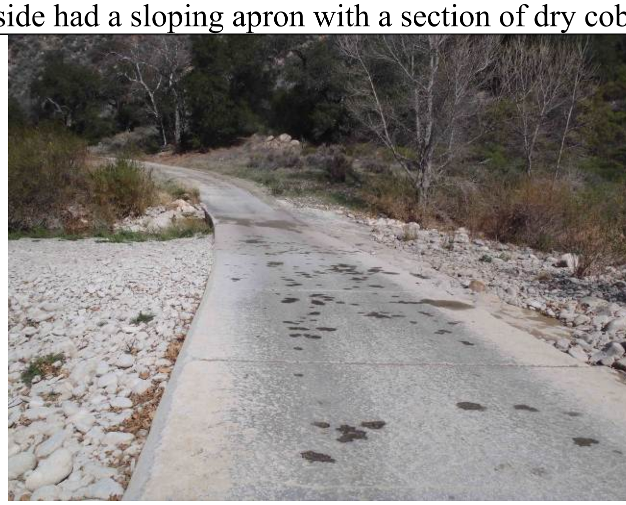
Name: SYA Arizona Crossing 03	
GPS: SYAAZ03	**Stoecker ID:** SY_9
Barrier Type: Concrete Arizona Crossing	**Location:** 34.53836, -119.74778
Description: This Arizona crossing measured 166ft across the channel and the road was 14 ft wide. There appears to have been a new concrete apron with boulders added to this crossing since the survey for the Stoecker report in Nov. 2003 which showed undercutting on the road and a 6 foot drop. The downstream edge of the road has a steep slope down to the natural stream level. The road has a height of 3.8ft from where a pool would naturally form.	

Santa Ynez Arizona crossing 3, picture taken from right bank

Name: SYA Arizona Crossing 04	
GPS: SYAAZ04	**Stoecker ID:** SY_10
Barrier Type: Concrete Arizona crossing	**Location:** 34.53493, -119.72448
Description: This concrete Arizona crossing measured 170ft across the channel and influenced the active stream for 90ft. The width of the road was 15ft. The downstream plunge from the road was 1ft, upstream the road was level with the streambed.	

Santa Ynez Arizona crossing 4, picture taken from left bank

Name: SYA Arizona Crossing 05	
GPS: SYAAZ05	**Stoecker ID:** SY_11
Barrier Type: Concrete Arizona crossing	**Location:** 34.53692, -119.72337
Description: This road crossing measured 108ft across the channel and the road had a width of 14ft. The downstream side had a sloping apron with a section of dry cobble.	



Santa Ynez Arizona crossing 5, picture taken from right bank

Name: SYA Arizona Crossing 06	
GPS: SYAAZ06	**Stoecker ID:** SY_12
Barrier Type: Concrete Arizona crossing	**Location:** 34.53983, -119.71662
Description: The road crosses two separate channels at this point with the left bank channel having the majority of the flow and then the flow crosses over to the right bank. The road crossing of the right bank channel had no flow at the time of the survey. The road crossing measured 133ft across the left channel. The road width was 14ft and there was a sloping apron downstream with the road height from downstream being 3.7ft.	

Santa Ynez Arizona crossing 6, left channel crossing   Downstream, right channel crossing

Name: SYA Arizona Crossing 07	
GPS: SYAAZ07	**Stoecker ID:** SY_13
Barrier Type: Concrete Arizona crossing	**Location:** 34.53466, -119.71298
Description: This road crossing measured 90ft across the channel and influenced the active channel for 35ft. The downstream side had a gradually sloping apron with a maximum drop from the road of 0.8ft.	

Santa Ynez Arizona crossing 7, upstream

Name: Gibraltar Dam	
GPS: N/A	**Stoecker ID:** SY_14
Barrier Type: Concrete Arch Dam	**Location:** N/A
Description: Ground survey was completed just prior to Gibraltar Dam. This dam provides a complete barrier to anadromy as there are no fish passage facilities. At the time of the survey the reservoir was at 53% capacity with a water elevation of 1387.77 ft leaving large sections of the reservoir dry.	

Name: SYA Arizona Crossing 08	
GPS: SYAAZ08	**Stoecker ID:** SY_15
Barrier Type: Concrete Arizona crossing	**Location:** 34.48647, -119.54159
Description: This is the Romero Camuesa Rd Crossing. The road crossing measured 115 feet across the channel, with 25ft influencing the active channel. A portion of the concrete and boulder apron has separated from the road crossing. The downstream plunge from the road is 3ft with a water depth of 0.1ft.	

Romero Camuesa Rd Crossing, looking across

Looking upstream

Name: SYA Arizona Crossing 09	
GPS: SYAAZ09	**Stoecker ID:** SY_16
Barrier Type: Concrete Arizona crossing	**Location:** 34.48933, -119.51681
Description: This road crossing measured 102ft across the channel; and the stream and crossing were dry at the time of the survey. The downstream side had a rock and concrete sloping apron that extended approximately 26ft downstream. This is the first road crossing downstream of Juncal Dam.	

Santa Ynez Arizona crossing 9, upstream

Oso Creek Bridges, Barriers, and Culverts

NAME: Oso Creek Bridge 01	
GPS: SYOSOBRDG01	**Stoecker ID:** No Stoecker Id
Barrier Type: Natural bottom bridge	**Location:** 34.54562, -119.77498
Descriptions: This natural bottom bridge measured 22ft long by 15ft wide with concrete supports on both banks.	

Oso Creek, Oso Bridge 1, Upstream

NAME: Oso Creek Bridge 02	
GPS: SYOSOBRDG02	**Stoecker ID:** No Stoecker Id
Barrier Type: Natural bottom bridge	**Location:** 34.54508, -119.77059
Descriptions: This natural bottom bridge measured 35ft long by 16ft with concrete supports on both banks.	

Oso Creek, Oso Bridge 2, Upstream

NAME: Oso Creek Arizona Crossing 01	
GPS: SYOSOAZ01	**Stoecker ID:** SY_OO_1
Barrier Type: Arizona Crossing	**Location:** 34.55488, -119.77009
Descriptions: This natural bottom Arizona crossing measured 21ft long by 15ft wide that consisted of mostly large and small cobble and a few small boulders.	

Oso Creek, Oso Arizona Crossing 01, Upstream

NAME: Oso Creek Bridge 03	
GPS: SYOSOBRDG03	**Stoecker ID:** No Stoecker ID
Barrier Type: Pipe Culvert	**Location:** 34.55552, -119.77121
Descriptions: 6.5ft plunge from road above to top of water. A concrete wall with 2ft plunge was 8ft downstream from a concrete bottom bridge with 6.5ft plunge. The concrete bridge measured 60 ft long and 16ft wide. The stream no longer flowed through the three metal pipes due to sediment buildup but, instead, flowed over the road.	

Oso Creek, Oso Bridge 3, Upstream　　　　Downstream

NAME: Oso Creek Arizona Crossing 02	
GPS: SYOSOAZ02	**Stoecker ID:** SY_OO_2
Barrier Type: Concrete Arizona crossing	**Location:** 34.55745, -119.77168
Descriptions: This concrete bottom Arizona crossing measured 32 ft long and 14 ft wide and was slightly elevated above streambed.	

Oso Creek, Oso Arizona Crossing 2, Downstream

NAME: Oso Creek Santa Cruz Trail Crossing	
GPS: SYOSOTRAIL	**Stoecker ID:** No Stoecker ID
Barrier Type: Santa Cruz Trail crossing	**Location:** 34.57329, -119.75560
Descriptions: This natural bottom trail crossing is part of the Santa Cruz Trail, which follows the stream mostly along the right bank until it crosses the river and veers off and follows a tributary that merges with Oso Creek just downstream from the trail crossing. Just downstream of the trail crossing large boulders create a partial barrier under low flows, plunge height of 4.0ft and a pool depth of 1.3ft.	

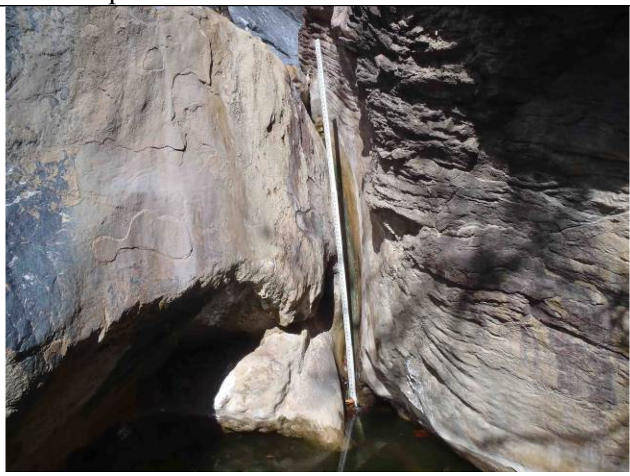
Oso Creek, Oso Trail, Downstream

Upstream

NAME: Oso Creek partial barrier waterfall	
GPS: SYOSO226	**Stoecker ID:** No Stoecker ID
Barrier Type: Waterfall	**Location:** 34.57232, -119.75617
Descriptions: This waterfall has a 10 ft plunge with a jump pool depth of 2.5 ft. This waterfall is a partial barrier under low and moderate flow conditions.	

Oso Creek, looking upstream

NAME: Oso Creek partial barrier waterfall	
GPS: SYOSO227	**Stoecker ID:** No Stoecker ID
Barrier Type: Waterfall	**Location:** 34.57244, -119.75618
Descriptions: This is a 7.6 ft tall waterfall with 2.9 ft deep jump pool. This waterfall presents a partial barrier under low and moderate flow conditions. Fish passage may be possible under higher flows as the downstream pool fills.	



Mono Creek Bridges, Barriers and Culverts

Name: Mono Debris Dam	
GPS: MONODAM	**Stoecker ID:** SY_MO_1
Barrier Type: Debris Dam	**Location:** 34.53027, -119.63062
Description: Debris dam constructed in 1935 to limit downstream sediment flow to Gibraltar reservoir. The dam is approximately 20 feet high, 4 feet wide and spans 100 feet across the creek. The dam is filled in with silt, sand and cobble on the upstream side.	

Mono debris dam, upstream

Mono debris dam, downstream

Name: Camuesa road crossing	
GPS: MONOCAMRD	**Stoecker ID:** SY_MO_2
Barrier Type: Arizona Crossing	**Location:** 34.53658, -119.63227
Description: Low-flow road crossing, steep gradient on downstream side, height= . This provides a barrier to fish passage during low flows.	

Camuesa rd. crossing, view from RB looking upstream

Name: Pie Canyon Rd. Crossing	
GPS:MONOPIECYN	**Stoecker ID:** No ID
Barrier Type: Natural bottom arizona crossing	**Location:** 34.56670, -119.61608
Description: Pie Canyon trail arizona crossing, has natural bottom and does not impede fish passage.	

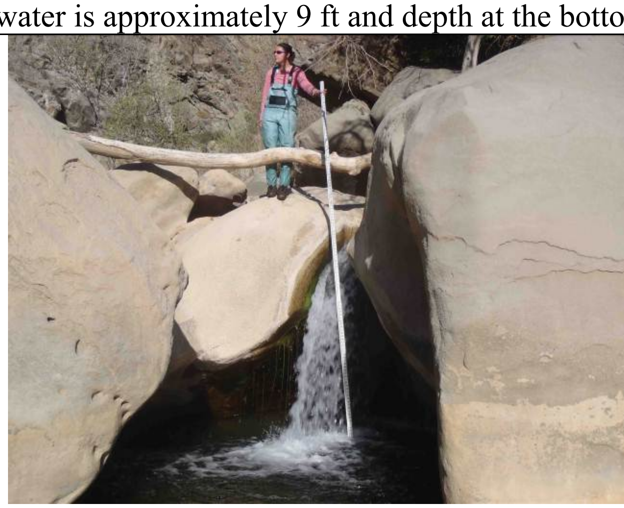
Name: Ogilvy Ranch Rd., 6N30A	
GPS: MONORANCHRD1	**Stoecker ID:** No ID
Barrier Type: Natural bottom arizona crossing	**Location:** 34.56892, -119.61544
Description: Natural bottom road crossing, does not impede fish passage.	

Ogilvy Ranch Road, view from RB

Name: Ogilvy Ranch Rd., 6N30A	
GPS: MONORANCHRD2	**Stoecker ID: No ID**
Barrier Type: Natural bottom arizona crossing	**Location:** 34.58444. -119.61149
Description: Natural bottom road crossing; does not impede fish passage.	

Ogilvy Ranch Rd. arizona crossing, view from RB

Name: Mono partial barrier	
GPS: MONOBAR1	**Stoecker ID:** No ID
Barrier Type: Waterfall, partial	**Location:** 34.58444. -119.61149
Description: This is a boulder formed waterfall located in a narrow section of the channel just at the start of the narrows. This is likely a partial barrier under low to moderate flow conditions; under high flow conditions the plunge pool should fill decreasing the jump height. Plunge height from the surface of the water is approximately 9 ft and depth at the bottom of the plunge is 4 ft.	



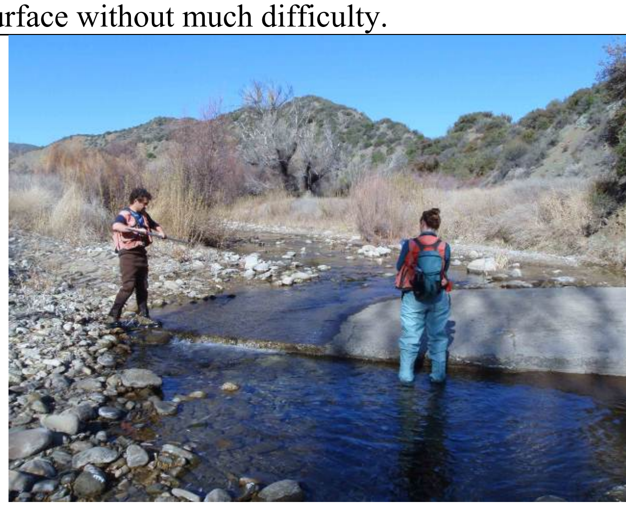
Mono partial barrier, upstream

Name: Mono Reference Reach Road Crossings	
GPS: MONOR2RD1-6	**Stoecker ID:** No ID
Barrier Type: Natural bottom road crossings	**Location:** 34.65806, -119.50586 to 34.66548, -119.51063
Description: There are 6 natural bottom road crossings in the upper reference reach on Mono Creek. These road crossings are from the Don Victor Fire Trail and pose no barrier to fish movement. They have natural bottoms and appear not to have been traveled in several years.	

Don Victor Valley Fire Trail crossings

Indian Creek Bridges, Barriers and Culverts

Name: Indian Creek Camuesa Rd. crossing 1	
GPS: INDCAMRD1	**Stoecker ID:** SY_MO_IN_1
Barrier Type: Arizona crossing	**Location:** 34.53651, -119.63346
Description: This is a low flow concrete road crossing. The road impacts the creek for 51ft, with a 12ft wetted channel crossing the road, the road was 14ft wide. There was a slight drop on the downstream edge of 1ft. This would be a low flow barrier, with the shallow water depth crossing the road surface causing a barrier to migration. Under moderate to high flow salmonids should be able to cross the road surface without much difficulty.	



Camuesa rd. crossing 1, upstream

Name: Indian Creek Camuesa Rd. crossing 2	
GPS: INDCAMRD2	**Stoecker ID:** SY_MO_IN_2
Barrier Type: Arizona crossing	**Location:** 34.53993, -119.63620
Description: This is a low flow concrete road crossing. The total concrete crossing measured 73ft from bank to bank, and spanned the active channel for 40 ft, the width of the crossing measured16ft. The downstream side of the crossing was 0.3ft above the downstream pool surface. The downstream pool had a maximum depth of 1.7ft. Fish passage would be prevented only under low flow conditions.	

Camuesa rd. crossing 2, upstream

Name: Indian Creek Camuesa Rd. crossing 3	
GPS: INDCAMRD3	**Stoecker ID:** SY_MO_IN_3
Barrier Type: Arizona crossing	**Location:** 34.54039, -119.63645
Description: This is a low flow concrete road crossing. The total concrete crossing is 69ft from bank to bank, the crossing influenced the active channel for a distance of 48ft, and the width of the crossing measured 14ft. The downstream edge of the crossing had a height of 0.5ft from the surface of the downstream pool, which had a depth of 0.7ft. This would only be a barrier to fish passage under low flow conditions.	

Camuesa rd. crossing 3, upstream

Name: Indian Creek Weir	
GPS: INDWEIR	**Stoecker ID:** SY_MO_IN_4
Barrier Type: Weir	**Location:** 34.54330, -119.64220
Description: This is a concrete weir, which measured 110ft long, extending up both banks, the weir thickness was 1.5ft. The weir forms a V and water spills over at the low point. The downstream pool had a maximum depth of 7ft, and the jump height was 1.5ft, from the surface of the water to the top of the weir. This is a barrier only under low flow conditions.	

Indian creek weir, upstream

Name: Indian Creek Waterfall	
GPS: INDIANBARRIER	**Stoecker ID:** SY_MO_IN_5
Barrier Type: Waterfall	**Location:** 34.62381, -119.66611
Description: This is a two stage bedrock waterfall, and is a complete barrier to salmonid migration. The upper waterfall is approximately 16 feet high and drops into a pool that connects the two falls. The second waterfall is approximately 27 feet high and drops into a deep narrow bedrock pool. Height measurements were taken from Stoecker 2004, as the water levels were too high at the time of the survey to take measurements of the waterfalls.	

Indian Creek Waterfall, complete barrier

Buckhorn Creek Bridges, Barriers and Culverts

Name: Buckhorn Creek Low Flow	
GPS: BUCKBARRIER	**Stoecker ID:** MO_IN_BU_1
Barrier Type: Dry	**Location:** 34.59056, -119.70461
Description: No evidence of recent flow, stream bed is completely dry and has grasses and other terrestrial plants growing in stream bed. Buckhorn Creek appears to be largely fed by two left bank tributaries. The last left bank tributary provides all of the water in upper Buckhorn, Buckhorn is dry after this tributary (34.58947, -119.70015). Creek is dry from this point to the listed Stoecker barrier.	

Start of dry section at second trib., Upstream

Buckhorn Creek, Dry Barrier, Upstream

STREAM DISCUSSIONS

Cachuma Creek Discussion

The survey of Cachuma Creek extended a total of 53,121 feet, 10.06 miles; however there were two unsurveyed reaches, the first 38,273 feet due to a lack of public access, and the last 4,194 feet due to heavy vegetative overgrowth (Reaches 1 and 3).

According to the Rosgen stream classification system Cachuma Creek is a B2 channel type for 10,654 feet of stream surveyed. The suitability of B2 channel types for fish habitat improvement structures is as follows: B2 channel types are excellent for plunge weirs, single and opposing wing-deflectors, as well as log cover. In the Montgomery-Buffington channel typing, Cachuma Creek was considered to have a step-pool channel type for the entire surveyed reach (10,654ft, 2.02mi).

In the section of Cachuma creek which was surveyed on foot, in the creek, only one man-made barrier was found, the happy canyon rd. crossing just before the confluence of Lion Creek and Cachuma Creek. This was a partial barrier with fish passage limited under low flow conditions. Some potential natural barriers were also found throughout the section of Cachuma Creek above the road crossing. The gradient becomes fairly steep with step pool sections of low flow. Relatively low flows were observed during the survey, between 0.5 and 5cfs, which creates several natural boulder and bedrock formed barriers that would be impassable, with shallow jump pools of 1-2 feet and jump heights of 2-4ft. Under moderate to high flow conditions the steps between pools would be passable, as there would be an increase in the jump pool depth and a corresponding decrease in the jump height. No obvious barriers to anadromy were encountered in the section that was surveyed on foot. The survey was terminated due to high vegetative cover over the creek and was continued from the road. It is possible that there could be a natural steep gradient barrier to salmonid migration in this section; however the creek was not visible in many areas due to the vegetative cover which makes this difficult to conclude. The point at which there was no more surface flow occurred 2.7 miles from the start of the survey, and approximately 9.9 miles from where Cachuma Creek enters Lake Cachuma.

The water temperatures recorded from 1/31/2012 to 2/1/2012, ranged from 45 to 58 degrees Fahrenheit. Air temperatures ranged from 50 to 73 degrees Fahrenheit. Water temperatures encountered during this survey appear suitable for salmonids, however to make any further conclusions, temperatures would need to be monitored more continually throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 12% of the total length of this survey, riffles 6%, and pools 2%. The pools were relatively shallow, with only 7 of the 41 (17%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.
Four of the 42 pool tail-outs measured had embeddedness ratings of 1 or 2. Seven of the pool

tail-outs had embeddedness ratings of 3 or 4. Thirty one of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered suitable quality spawning substrate for salmon and steelhead. Sediment sources in Cachuma Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken. Seventeen of the 42 pool tail-outs measured had gravel or small cobble as the dominant substrate; which are desirable substrate types for steelhead redd construction. The remaining 25 were composed of silt, sand, large cobble, boulders or bedrock as the dominant substrate, which are generally considered unsuitable as steelhead spawning substrate. Much of the substrate at pool tail-outs had been cemented in place and was very difficult to move, so even when suitable spawning substrate was present, in terms of substrate size, it would be impossible for a salmonid to create a redd.

The mean shelter rating for pools was 61. The shelter rating in the flatwater habitats was 21. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Terrestrial Vegetation in Cachuma Creek. Boulders are the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and reduces density related competition by dividing territorial units.

The mean percent canopy density for the stream was 80%. The percentage of right and left bank covered with vegetation was moderate at 33% and 34%, respectively. The bank coverage was moderate on this stream due to the presence of large trees and somewhat less undergrowth in some areas. There was an incredibly high amount of vegetation over the stream channel, as the stream channel was very narrow, leading to a high percent canopy density.

Santa Cruz Creek Discussion

Santa Cruz Creek is a tributary to the Santa Ynez River. This creek used to empty directly into the Santa Ynez River, however now it is one of the main creeks emptying into Lake Cachuma. Santa Cruz Creek was not surveyed for the first 54,853 feet (10.39 miles) due to a lack of public access. The creek was surveyed from the private property boundary upstream for the next 18,934 feet (3.59 miles) to the split of the East and West Forks.

According to the Rosgen channel typing method Santa Cruz Creek was considered a B2 channel type for the entire surveyed reach of 18,934 feet. There are several fish habitat improvement structures suitable for B2 channel types, as follows: B2 channel types are excellent for plunge weirs, single and opposing wing-deflectors, as well as increased log cover. In the Montgomery-Buffington channel typing, the entire surveyed section of the stream had a Step-Pool channel type.

There were no barriers to fish movement encountered during the survey of Santa Cruz Creek. At the very start of the survey there was a gate across the channel which under high flow conditions could cause debris to accumulate and limit fish passage upstream. There was also, one road crossing that has a natural stream bottom and does not influence the flow of the stream channel. This road crossing was near the Santa Cruz campsite and ranger station.

The water temperatures recorded on the survey days 7/10/2012 to 7/17/2012, ranged from 66 to 84 degrees Fahrenheit, with an average of 74.5°F. Air temperatures ranged from 77 to 98 degrees Fahrenheit, with an average of 91.1°F. To make any further conclusions, temperatures would need to be monitored more continually to get an idea of true daily minimum and maximum temperatures, as well as temperatures in different habitat types.

Flatwater habitat types comprised 12% of the total length of this survey, riffles 10%, and pools 4%. The pools are relatively deep, with 38 of the 47 (81%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channels width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Twelve of the 51 pool tail-outs measured had embeddedness ratings of 1 or 2. Sixteen of the pool tail-outs had embeddedness ratings of 3 or 4. Twenty three of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate suitable spawning substrate for salmon and steelhead. Twenty eight of the 51 pool tail-outs measured had gravel or small cobble as the dominant substrate; which are considered appropriate substrates for steelhead redd construction. Sediment sources in Santa Cruz Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

A pool shelter rating of approximately 100 is considered desirable; during the survey a mean shelter rating of 86 was found for pools and a shelter rating of 64 was found for flatwater habitats. The amount of cover that now exists is being provided primarily by boulders in Santa Cruz Creek. Boulders are also the dominant cover type in pools, followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 48%. Revegetation projects may be considered as the canopy density is less than 80%. The percentage of right and left bank covered with vegetation was moderate at 33% and 28%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

East Fork Santa Cruz Discussion

The survey of East Fork Santa Cruz Creek extended 11,261 feet (2.13 miles), from where it joins West Fork Santa Cruz Creek up to the unnamed left bank tributary just below Grapevine Creek. The survey was completed after passing two suspected partial barriers that would only be passable to steelhead under very limited conditions. These barriers were waterfalls, the first was a bedrock waterfall and the second was a boulder and bedrock waterfall. The survey continued past these barriers to determine if others existed upstream.

East Fork Santa Cruz Creek is an A2 channel type for the first 798 feet of stream surveyed and a B2 channel type for the remaining 10,463 feet. Fish habitat improvement structures are generally not suitable for A2 channel types, however B2 channel types are excellent for plunge weirs, single and opposing wing-deflectors, and log cover. The entire surveyed stream length had a step-pool Montgomery-Buffington channel type.

Two natural waterfall barriers were encountered during the East Fork Santa Cruz Creek survey. Both of these waterfalls were considered partial barriers, only allowing fish passage under certain flow conditions. No complete barriers were encountered on East Fork Santa Cruz Creek; however passage past the first two waterfalls would be very limited.

The water temperatures recorded on the survey days 7/17/2012 to 8/7/2012, ranged from 66 to 84 degrees Fahrenheit. Air temperatures ranged from 73 to 96 degrees Fahrenheit. The upper water temperatures may be reaching temperatures that are too high for salmonids, but would require more continual monitoring to make conclusions about suitability for salmonids.

Flatwater habitat types comprised 57% of the total length of this survey, riffles 11%, and pools 31%. The pools were relatively deep, with 48 of the 56 (86%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Five of the 56 pool tail-outs measured had embeddedness ratings of 1 or 2, while 10 had ratings of 3 or 4. Forty one of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate suitable spawning substrate for salmon and steelhead. Sediment sources in East Fork Santa Cruz Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken. Several of the pool tail-outs had sediment that was cemented together creating very poor spawning substrate. Eighteen of the 56 pool tail-outs measured had gravel or small cobble as the dominant substrate, which is generally considered suitable for spawning salmonids.

The mean shelter rating for pools was 79, while the shelter rating in the flatwater habitats was 56. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in East Fork Santa Cruz Creek. Boulders are the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 65%. Reach 1 had a canopy density of 49%, while Reach 2 had a higher canopy density at 68.2%. Revegetation projects could be considered as the canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate to low at 17% and 25%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

West Fork Santa Cruz Discussion

The survey of West Fork Santa Cruz Creek extended for a total of 21,228 feet (4.02 miles) and ended 0.3 miles below the expected high gradient barrier to salmonid migration. Coche Creek, a tributary to West Fork Santa Cruz Creek, was examined at trail crossings to determine water presence and general streambed composition and temperatures. A short discussion of these findings is included at the end of this section.

According to the Rosgen stream classification, West Fork Santa Cruz Creek is a B2 channel type for the first 4,882 feet of stream surveyed (Reach 1), a C2 channel type for the next 6,702 feet (Reach 2) and a B2 channel type for the remaining 9,644 feet (Reach 3). For fish habitat improvement structures B2 and C2 channel types are excellent for plunge weirs, single and opposing wing-deflectors, and log cover. Using the Montgomery-Buffington Channel Typing method, West Fork Santa Cruz Creek exhibited two different channel morphologies, Step-Pool and Bedrock. Based off percentage of total length for the entire 4.35 miles (surveyed and unsurveyed), the most dominant was Step-Pool (83.96%) followed by Bedrock (1.53%). In addition, 5.47% of the total length went unsurveyed, whereas 9.04% had braided channels.

No complete barriers were encountered during the survey of West Fork Santa Cruz Creek. A large debris and boulder jam was encountered which would be considered a partial barrier. It is possible that under specific flow conditions fish could get around this barrier using step pools created along the edges of the channel. Approximately 0.3 miles from this debris jam is a predicted steep gradient barrier, which was not reached during the survey due to logistical and time constraints.

The water temperatures recorded on the survey days 7/18/2012 to 7/25/2012, ranged from 58 to 73 degrees Fahrenheit, with an average of 65.6°F. Air temperatures ranged from 69 to 84 degrees Fahrenheit, with an average of 79.1°F. To make any further conclusions, temperatures would need to be monitored more continually to determine true daily temperature fluctuations.

Flatwater habitat types comprised 53% of the total length of this survey, riffles 22%, and pools 21%. The pools are relatively deep, with 71 of the 87 (82%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Eighty seven pool tail-outs were measured during the survey. Seventeen of these 87 had embeddedness ratings of 1 or 2; an additional 17 had embeddedness ratings of 3 or 4. Fifty three of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered suitable quality spawning substrate for salmon and steelhead. Sediment sources in West Fork Santa Cruz Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken. Thirty four of the 87 pool tail-outs measured had gravel or small cobble as the dominant substrate. Small cobble and gravel are considered appropriate substrates for steelhead redd construction.

The mean shelter rating for pools was 80. The shelter rating in the flatwater habitats was 57. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in West Fork Santa Cruz Creek. Boulders are also the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 59%. Reach 1 had a canopy density of 25.88%, Reach 2 had a canopy density of 60.8%, and Reach 3 had a canopy density of 73.29%. Revegetation projects may be beneficial as the canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low to moderate at 23% and 31%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

Coche Creek Discussion

Coche Creek was examined at trail crossings on 8/8/2012. The stream was not surveyed fully due to the density of overgrowth in the stream channel as well as excessive heat.

The survey team walked a trail running along the creek and examined the creek at the crossings, where the stream was visible. Water temperature, air temperature (in shade), major substrate, habitat type, and flow were noted at each crossing.

The wetted width of the stream channel was on average approximately 3 feet and the depth was between 2 and 4 inches. In addition when hiking back along the trail it was noted that some of the crossings that had flowing water 1-2 hours previously were now dry (see pictures below).

The picture on the left was taken around 12pm. The picture on the right was taken 2 hours later.

The water temperatures found in Coche Creek ranged from 62-70°F, with an average of 66.2°F. Air temperatures in the shade were between 87 and 93°F, with an average of 89.8°F. Water temperatures were surprisingly cool considering how quickly areas of the stream dried.

In terms of substrate types, the stream started with gravel and sand dominated substrate and as the survey moved upstream there were increasingly more cobbles and boulders mixed in. The habitat types observed at and around the trail crossings were all low gradient riffle habitat units. Some of these areas may have more run habitat units under higher flow conditions, during the survey the flows were less than 0.5cfs.

In general the habitat observed in the lower sections of Coche Creek was not suitable for salmonids. It is possible that pools may occur farther upstream that provide refuge from the drying occurring in the surveyed sections. The survey did not continue upstream to the salmonid migration barrier due to excessive heat.

Upper Santa Ynez Discussion

The upper Santa Ynez River survey extended a total distance of 160,060 feet, 30.32 miles, with an additional 7048 feet of side channel. The upper Santa Ynez River however, was unsurveyed due to accessibility for 24,897 feet at the start of the survey (Reach 1), and the area surrounding Gibraltar Dam and Reservoir, 18,261 feet (Reach 4). The upper Santa Ynez River was defined by long run and riffle units with several large (500ft long) bedrock scour pools.

According the Rosgen channel classification system the surveyed sections of the upper Santa Ynez River had a D4 channel type for the first 22,029 feet of stream surveyed (Reach 2), a C3 channel type for the next 35,533 feet (Reach 3), a C4 channel type 10,942 feet (Reach 5), then a change back to a C3 channel type for 35,670 feet, with a final change to a C2 channel type for the remaining 12,728 feet. These channel types are suitable for the following fish habitat improvement structures: D4 channel types are most suited for bank placed boulders, single and opposing wing deflectors and channel constrictors; C3 and C4 channel types are most suited for bank placed boulders, followed by single and opposing wing deflectors and plunge weirs. Using the Montgomery-Buffington Channel Typing method, the upper Santa Ynez was predominantly Plane-Bed (39.79%) followed by Pool-Riffle (5.14%) and Bedrock (0.95%). The remaining either went unsurveyed or was not assigned a channel type due to classification as a side channel or braided channel.

The upper Santa Ynez River is mostly located on National forest land, with the exception of the reservoirs, and a small area of private property following Lake Cachuma. No natural barriers were found on the upper Santa Ynez River; however there were several man-made structures that were encountered. There were 9 concrete Arizona road crossings, in addition to Gibraltar Dam which is found within this section of the river. The Arizona crossings provide access to recreation areas along the Santa Ynez River by way of Paradise Road and Romero-Camuesa Road.

The water temperatures recorded on the survey days 11/16/2010 to 9/5/2012, ranged from 39 to 82 degrees Fahrenheit. Air temperatures ranged from 40 to 95 degrees Fahrenheit. Water temperatures were mostly within acceptable limits for Southern steelhead, except for areas of stagnant water during the summer surveys; however, to make any further conclusions, temperatures would need to be monitored more continually to get an idea of true daily highs and lows.

Flatwater habitat types comprised 19% of the total length of this survey, riffles 5%, and pools 16%. The pools are relatively deep, with 110 of the 168 (65%) pools having a maximum residual depth greater than 2 feet, and 70 (42%) having a maximum residual depth greater than 3 ft. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum residual depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Cobble embeddedness measured to be 25% or less, a rating of 1, is considered suitable spawning substrate for salmon and steelhead. Of the 150 pool tail-outs measured 36 had embeddedness ratings of 1 or 2, 19 had embeddedness ratings of 3 or 4, and 95 of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Sediment sources in Santa Ynez River should be mapped and rated according to their potential sediment yields, and control measures should be taken. Gravel and small cobble are generally considered suitable for spawning salmonids. Fifty two of the 164 pool tail-outs measured had gravel or small cobble as the dominant substrate.

The mean shelter rating for pools was 70. The shelter rating in the flatwater habitats was 52. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in upper Santa Ynez River. Boulders are the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 33%. Reach 2 had a canopy density of

25.01%, Reach 3 had a canopy density of 20.82%, Reach 5 had a canopy density of 63.86%, Reach 6 had a canopy density of 54.85%, and Reach 7 had a canopy density of 83%. The reaches above Gibraltar Reservoir, Reaches 5-7 had higher percent canopy densities than the lower reaches. This is likely due to narrower channels in these reaches. Revegetation projects may be considered in the lower reaches where canopy density is less than 80%.

Oso Creek Discussion

Oso Creek was surveyed between 5/3/2011 and 5/11/2011. When the survey took place, continuous flow was observed throughout the entire stream. However, when the upper Santa Ynez River survey passed Oso Creek in November and December, 2010, Oso Creek was dry upstream of the Oso Creek-Santa Ynez River confluence. The Oso Creek survey contained one surveyed reach that extended upstream for 4.18 miles; however, the survey was terminated before the natural limit to anadromy due to time constraints.

Oso Creek was dominated by riffles and runs as the stream moved through the lower Oso campground. As Oso Creek passed through the campground, the stream grade increased while riffles and pools became more prevalent. According to the Rosgen Stream Classification, Oso Creek was designated as a B4 channel type for its entire surveyed length. The Montgomery-Buffington Channel Morphology classification was dominated by Plane-Bed channel morphology (44.28%), followed by Pool-Riffle (42.90%), and Step-Pool (12.81%).

Oso Creek initially passed through campgrounds and park land. As it moved farther upstream above the campground, Oso Creek was dominated by natural forest. Five crossing structures passed over or through the creek: two bridges near the confluence of Oso Creek and the Santa Ynez River, followed by a natural bottom Arizona crossing, a concrete pipe culvert, and a concrete Arizona crossing farther upstream. The concrete pipe culvert was deemed a partial barrier due to a 6.5 ft. plunge created by the culvert. Three pipes ran beneath the culvert, however, sediment buildup upstream of the culvert obstructed the pipes as the creek flowed over the crossing. There was minimal depth beneath the plunge, therefore, the crossing would only be passable during times of extreme flow or if a pool with suitable depth was scoured out beneath the plunge.

Water temperatures recorded during the Oso Creek survey ranged from 54 to 75 degrees Fahrenheit, while air temperatures ranged from 59 to 88 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Riffle habitat types comprised 74% of the total length of this survey, flatwater 17%, and pools 9%. The pools were relatively shallow, with only 27 of the 84 (32%) pools having a maximum residual depth greater than 2 feet. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy. Eight of the 84 pool tail-outs measured had embeddedness ratings of 1 or 2, 75 had embeddedness ratings of 3 or 4, and 1 had a rating of 5. Sediment sources in Oso Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken. Eighty-three of the 84 pool tail-outs measured had gravel or small cobble as the dominant substrate; which are suitable substrates for steelhead redd construction.

The mean shelter rating for pools was 45, 31 for flatwater habitats, and 64 for riffle habitats. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by whitewater in Oso Creek. Boulders were the dominant cover type in pools followed by whitewater. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat.

The mean percent canopy density for the stream was 49%. The percentage of right and left bank covered with vegetation was low at 27% and 27%, respectively. This could be attributed to landscaped vegetation surrounding the campgrounds and bank steepness farther upstream in Oso Creek.

Mono Creek Discussion

Mono Creek was surveyed from the confluence with the Santa Ynez River upstream 10.66 miles to just below an area called The Narrows. The survey was completed just below The Narrows due to logistical and time constraints. Two reference reaches were chosen above the narrows, however due to logistical constraints only one was able to be surveyed. This reference reach was located approximately at stream mile 21 and was 0.9 miles long.

Mono Creek was dominated by long riffle and run units, with sections of step pools interspersed as the survey moved upstream. Mono Creek was a C4 channel type for the first 5,563 feet of the stream surveyed (Reach1), a C3 channel type for 9,299 feet of stream surveyed (Reach 2), a B3 channel type for 22,925 feet surveyed (Reach 3), a B2 channel type for 18,104 feet surveyed (Reach 4), and finally a C2 channel type for 4,768 feet surveyed (Reach 6). There was also an additional unsurveyed reach of 56,276 feet (Reach 5). In terms of fish habitat improvement structures, C channel types are suitable for bank placed boulders, single and opposing wing deflectors and plunge weirs; while B channel types are generally suitable for plunge weirs, single and opposing wing-deflectors, as well as log cover.

Mono Creek is almost entirely located on National Forest land; however there is one area of private property approximately 3 miles from the confluence with the Santa Ynez River, Ogilvy Ranch. The location of this creek contributes to the low number of man-made structures impacting the stream. There were 4 road crossings, however only one road crossing was concrete; the others had natural stream bottoms with no impact on fish movement. In addition to these road crossings there was also a debris dam on this creek, located 1 mile upstream from the Mono Creek-Santa Ynez river confluence.

The water temperatures recorded on the survey days between 12/21/2011 and 5/15/2012, ranged from 36 to 70 degrees Fahrenheit. Air temperatures ranged from 28 to 82 degrees Fahrenheit. Water temperatures during the time of the survey appear to be within acceptable ranges for salmonids in this area however, to make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 25% of the total length of this survey, riffles 20%, and pools 8%. The pools are relatively shallow, with only 93 of the 202 (46%) pools having a maximum residual depth greater than 2 feet, and only 28 (14%) having a depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum residual depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Thirty seven of the 197 pool tail-outs measured had embeddedness ratings of 1 or 2, while 16 had embeddedness ratings of 3 or 4. One hundred and forty four of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate suitable quality spawning substrate for salmon and steelhead. Sediment sources in Mono Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken to improve available spawning locations.

Fifty six of the 201 pool tail-outs measured had gravel or small cobble as the dominant substrate, which is generally considered suitable for spawning salmonids, the remaining 145 had substrates considered unsuitable for spawning such as boulders, bedrock, large cobble, silt or sand.

The mean shelter rating for pools was 49. The shelter rating in the flatwater habitats was 30. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in Mono Creek. Terrestrial vegetation is the dominant cover type in pools followed by boulders. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 20%. Reach 1 had a canopy density of 26.2%, Reach 2 had a canopy density of 20.2%, Reach 3 had a canopy density of 13.6%, Reach 4 had a canopy density of 13.7%, and Reach 6 had a canopy density of 57.5%. For the main section of Mono surveyed, Reaches 3 and 4, canopy cover was generally very low due to an absence of tall hardwood trees. In Reaches 1 and 2, there were slightly higher percentages of canopy cover due to the presence of larger hardwoods, specifically cottonwoods and sycamores near the reservoir. The most common hardwood trees present for the majority of the Mono Creek Survey were willows, which were not always apparent in canopy readings where the creek was wide, leading to lower percentages of canopy cover. Reach 6 had much higher canopy cover percentages than the other reaches, as this section of the creek was incredible narrow with willows encroaching heavily on the channel. Revegetation projects may be beneficial in the lower reaches of Mono Creek, as they are generally considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 25% and 25%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of hardwood trees, in conjunction with bank stabilization, is recommended.

Indian Creek Discussion

Indian Creek was surveyed between 1/17/2012 and 5/3/2012. There was water present throughout the entire length of the survey. The survey extended up Indian Creek a total of 56,382 feet (10.5 miles), with 53,748 feet of the mainstem surveyed, 800 feet of side channels surveyed, and 1834 feet went unsurveyed. The unsurveyed section was the last 0.35 miles before a 2 stage bedrock waterfall, which is considered to be the uppermost limit of salmonid migration. The last section could not be surveyed due to time constraints; however the survey team did walk this reach up to the waterfall and found flowing water throughout as well as no significant habitat changes from the preceding reach, Reach 2.

Indian Creek was largely dominated by riffle and run habitat units, with an increase in pools as the survey neared the waterfall barrier. The pool habitat near the waterfall barrier was excellent for trout. Indian Creek is a C3 channel type for the first 3,495 feet of stream surveyed (Reach 1), a B3 channel type for the next 37,562 feet (Reach 2), and a B2 channel type for the remaining 14,525 feet. The suitability of these channel types for fish habitat improvement structures is as follows: C3 channel types are most suited for bank placed boulders, followed by single and opposing wing deflectors and plunge weirs; B2 and B3 channel types are most suited for plunge weirs, boulder clusters and bank placed boulders, single and opposing wing-deflectors, as well as log cover. The Montgomery-Buffington Channel Morphology classification was dominated by Plane-Bed channel morphology (48.88%), followed by Step-Pools (39.21%), and Pool-Riffle (6.2%).

Indian Creek is located entirely on USFS land within Los Padres National Forest, because of this there are not many man made structures impacting the stream. Near the confluence on Indian and Mono Creeks there are 3 road crossings of Camuesa Road, as well as a channel spanning v-shaped weir. All three road crossings are concrete Arizona crossings, which could create passage problems for salmonids under low flow conditions. The concrete weir on Indian Creek could also be a barrier to salmonid passage under low flow conditions; however under the flow conditions observed during the survey it would be easily passable by adult salmonids.

The water temperatures recorded on the survey days between 1/17/2012 and 5/3/2012, ranged from 35 to 66 degrees Fahrenheit. Air temperatures ranged from 34 to 85 degrees Fahrenheit. The water temperatures during this survey appear to be within acceptable salmonid limits, however, to make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 38% of the total length of this survey, riffles 46%, and pools 13%. The pools are relatively shallow, with only 77 of the 187 (41%) pools having a maximum residual depth greater than 2 feet, and only 19 having a residual depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat, which is the case with Indian Creek. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, while in 3rd and 4th order streams maximum residual depth is at least 3 feet, the pool must occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Thirty seven of the 185 pool tail-outs measured had embeddedness ratings of 1 or 2. Seventeen of the pool tail-outs had embeddedness ratings of 3 or 4. One hundred and thirty one of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered suitable quality spawning substrate for salmon and steelhead. Sediment sources in Indian Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken as the large majority of pool tail-outs did not provide suitable spawning habitat for salmonids. Only 57 of the 187 pool tail-outs measured had gravel or small cobble as the dominant substrate, which is considered suitable for spawning salmonids.

The mean shelter rating for pools was 41. The shelter rating in the flatwater habitats was 28. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in Indian Creek. Terrestrial vegetation is the dominant cover type in pools followed by boulders. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 30%. Reach 1 had a canopy density of 37%, Reach 2 had a canopy density of 20%, and Reach 3 had a canopy density of 53%. Canopy cover increased as the channel became more confined closer to the barrier. In addition, the canopies in the upper reach of Indian Creek, just before the barrier, were taken in the spring, with new leaves increasing the canopy in this location. Revegetation projects could be considered for this stream, and could be especially beneficial in the lower reaches, where the stream is much more open. The percentage of right and left bank covered with vegetation was moderate to low at 30% and 32%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of hardwood trees, in conjunction with bank stabilization, is recommended.

Buckhorn Creek Discussion

Buckhorn Creek was surveyed on 4/4/2012 and 4/5/201, and extended 3.2 miles from the confluence with Indian Creek to an area of the stream with no evidence of recent flow.

Buckhorn Creek is a B3 channel type for the entire 16,741 feet, 3.2 miles of stream surveyed. B3 channel types are excellent for several different types of fish habitat improvement structures as follows: plunge weirs, boulder clusters and bank placed boulders, single and opposing wing-deflectors, as well as log cover. Using the Montgomery-Buffington channel typing method Buckhorn Creek was predominantly Step-Pool (90%), with some Pool-Riffle (10%) around the confluence with Indian Creek.

Buckhorn Creek had no man-made structures; this creek is located adjacent to wilderness areas and has no road access. The only barriers encountered on this creek were associated with low flow conditions; large dry sections were observed that would not allow salmonid passage. It appears that buckhorn creek may not have flow in the uppermost reach for the majority of the year, if at all. The second left bank unnamed tributary to Buckhorn creek did have flow, approximately 1cfs, and may provide more consistent habitat for fishes throughout the year. Approximately 0.3 miles of this uppermost tributary was walked during the survey and was found to have adequate habitat consisting of mostly riffle and run habitat with several bedrock scour pools.

The water temperatures recorded on the survey days between 4/4/2012 and 4/5/2012, ranged from 43 to 66 degrees Fahrenheit. Air temperatures ranged from 39 to 70 degrees Fahrenheit. The water temperatures encountered during this survey are suitable for salmonids however, to make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 33% of the total length of this survey, riffles 44%, and pools 5%. The pools are relatively shallow, with only 9 of the 36 (25%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy.

Nine of the 36 pool tail-outs measured had embeddedness ratings of 1 or 2. Ten of the pool tail-outs had embeddedness ratings of 3 or 4. Seventeen of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered suitable spawning substrate for salmon and steelhead. Sediment sources in Buckhorn Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken. Nineteen of the 37 pool tail-outs measured had gravel or small cobble as the dominant substrate; which are considered suitable substrates for steelhead redd construction. The remaining 18 had substrate which is generally considered unsuitable for redd construction, silt, sand, large cobble, boulders or bedrock.

The mean shelter rating for pools was 50. The shelter rating in the flatwater habitats was 21. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in Buckhorn Creek. Terrestrial vegetation is the dominant cover type in pools followed by boulders. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 82%. In general, revegetation projects are considered when canopy density is less than 80%, and therefore would not be recommended for this stream. The percentage of right and left bank covered with vegetation was moderate at 52% and 51%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species hardwood trees, in conjunction with bank stabilization, is recommended.

UPPER SUBBASIN CONCLUSIONS

The majority of the upper Santa Ynez survey took place during phase 2 of the project, between December 2011 and September 2012. Surveys of Oso Creek and part of the Santa Ynez mainstem took place in May 2011, and November 2010 respectively. The survey included the mainstem of the upper Santa Ynez River, Cachuma Creek, Santa Cruz Creek, East Fork Santa Cruz Creek, West Fork Santa Cruz Creek, Oso Creek, Mono Creek, Indian Creek and Buckhorn Creek. The upper Santa Ynez survey extended 101.88 miles, with 64.27 miles surveyed and 37.62 miles going unsurveyed due to logistical constraints.

The surveyed streams were dominated by riffle and run habitat units with infrequently spaced, relatively shallow pools. One area where this was not the case was on the upper Santa Ynez River, which had long and deep bedrock scour pools that made up 22% of the total length. Spawning habitat, described as pool tail-outs with gravel or small cobble, was somewhat lacking in all of the streams surveyed, except for Santa Cruz Creek, with only a few areas on each creek with acceptable sized spawning gravel, that was neither too embedded nor too sandy. The creek with the highest number of pool tail-outs with appropriately sized spawning gravel was Santa Cruz Creek, followed by West Fork Santa Cruz Creek, the mainstem of the upper Santa Ynez River, Oso Creek, East Fork Santa Cruz Creek, Buckhorn Creek, Mono Creek, Indian Creek, and Cachuma Creek. All of the creeks provided suitable rearing habitat.

There appear to be some lasting effects of the Zaca fire in the upper watershed that could have contributed to habitat conditions in this area. There are still fairly obvious burn areas with less vegetative cover, particularly along Indian Creek and Mono Creek. In addition, no *O. mykiss* were observed in any of the tributaries to the Santa Ynez, except for Santa Cruz Creek and West Fork Santa Cruz Creek, during this survey. This was surprising as previous reports have indicated that there were abundant trout in almost all of these streams (Stoecker 2004, AMC 2007). It is possible that the populations in this watershed were negatively impacted by the Zaca fire and have not rebounded. This is possibly due to the difficulty of movement within the watershed due to the three dams on the mainstem and the two debris dams blocking access to tributaries. The *O. mykiss* population on Santa Cruz Creek seems to have escaped long term negative impacts of the Zaca Fire, excluding the population on East Fork Santa Cruz Creek. The population in this stream seems to be thriving, based on the number of fish observed during the surveys. A total of 3,217 *O. mykiss* were observed when the three Santa Cruz Creeks are combined.

One factor which could have negatively impacted populations in the upper watershed is sedimentation from increased erosion after the Zaca fire. Although there is still suitable habitat for adults and juveniles in many of these streams, there is a lack of suitable spawning gravel. In areas where gravel and cobble of appropriate size were found, these often coincided with other negative factors such as the presence of fine sand or silt around gravel, or an apparent cementation of the gravel at the tail crest, to the point that it is almost impossible to move (see pictures below). These conditions could partly be due to increased erosion of fine sediments from the Zaca fire. Improving spawning habitat in these streams would likely be beneficial for population recovery.

Gravel cemented together in East Fork Santa Cruz Creek (left) and Cachuma Creek (Right)

Cachuma Creek and Buckhorn Creek both had adequate canopy cover, around 80%. The other streams in the upper watershed however, had much lower percentages and would likely benefit from increases in canopy creating vegetation. Lower canopy cover percentages were highly influenced by the size of the streams, as readings are taken from mid-channel. The two streams with high cover are the smallest surveyed in this region. Due to the size of the streams bankside vegetation encroaches highly on the channel causing high amount of shading, where the much wider streams are only shaded along the edges even when substantial streamside vegetation is present. These highly shaded streams could potentially maintain cooler temperatures in the summer and provide refuges for fish from nearby streams with more open channels.

The tributaries that were surveyed would all likely benefit from increases in pool habitat in terms of the quantity and quality of pools. Increases in shelter, as well as canopy cover would be beneficial in providing refuges for fishes during the hot summer months, where large portions of the tributaries will go completely dry. The mainstem of the Santa Ynez River appears to have suitable salmonid habitat, with large pools that would provide refuge from summer temperatures and the drying of run and riffle sections. One of the biggest problems with the upper Santa Ynez River salmonid habitat is connectivity. With two large dams, Gibraltar and Juncal, on the mainstem, as well as two smaller debris dams on Mono Creek and Agua Caliente Creek, movement of fishes throughout the upper watershed is severely limited. Providing access around these dams, where possible, could have a positive impact on the native fish population in the region. In addition the removal of filled debris dams on the tributaries would provide access to a large amount of habitat currently blocked to salmonids in the upper watershed.

Due to access issues, as well as logistical constraints, some creeks and sections of the mainstem were not able to be surveyed. In order to truly get an idea of spawning and rearing habitat conditions within the watershed some additional surveys would be beneficial. Gaining access to survey some of the lower reaches of potential spawning, and historic spawning streams, such as lower Cachuma and Santa Cruz Creeks, could provide a better estimate of habitat quantity and quality.

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