3.5 Fishery Resources

Fishery resources include fish populations, their habitats, and the harvest of those populations. This section discusses the existing environment within the Trinity River Basin, Lower Klamath River Basin / Coastal Area, and Central Valley with regard to native anadromous fish, resident native and non-native fish, and reservoir species, and ocean fisheries economics, as well as the environmental consequences of implementing each of the alternatives presented in Chapter 2. (See Table 3-19 in Section 3.5.3 for a summary of impacts for fishery resources.) (See Recreation [Section 3.8] for inriver sportfishing economics; the economics of tribal harvest were not assessed.)

The conclusions reached through this chapter are based on detailed technical studies described at much greater length in the Fishery Resources Technical Appendix B. To the degree possible, the conclusions described in this chapter are expressed in language understandable to lay readers, as well as in relatively uncomplicated quantitative terms embodied in tables.

3.5.1 Native Anadromous Species

Anadromous fisheries have been impacted by a number of factors, including dams, which have substantially reduced habitat on the Trinity and Klamath Rivers and rivers in the Central Valley.

Anadromous fisheries have been impacted by a number of factors, including dams, which have substantially reduced habitat on the Trinity and Klamath Rivers and rivers in the Central Valley. In spite of those impacts, reduced anadromous salmonid fishery resources are still found within the Trinity River Basin, Lower Klamath River Basin / Coastal Area, and the Central Valley. Many of the fish species found within the lower Klamath River Basin are also found within the Trinity River Basin. The coastal areas adjacent to the Klamath River Basin provide essential habitat for maturing and adult anadromous fish species that return to the lower Klamath and Trinity River Basins. The TRSSH is intended to mitigate for the reduced salmon and steelhead production resulting from the loss of habitat and associated production upstream of Lewiston Dam by releasing chinook and coho salmon and steelhead young into the Trinity River. Other native anadromous fish species found in the areas affected by the project include Pacific lamprey and green and white sturgeon, and eulachon.

Affected Environment.

Trinity River Basin. The native anadromous salmonid species of interest in the mainstem Trinity River and its tributaries include chinook salmon, coho salmon, and steelhead. Of the three species, there are two spawning populations of chinook salmon (spring and fall) and two spawning populations of steelhead (winter and summer). All anadromous species begin their life in fresh water,

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then migrate to the ocean to mature, and return to spawn in fresh water. Some life history and habitat requirements of these species and the spawning populations within species are presented in Table 3-10.

Although the three species have similar growth and migration patterns (Figure 3-34), they differ in the time of year they migrate and spawn, as well as when egg incubation typically occurs (Figure 3-35).

TABLE 3-10
Life History and Habitat Needs for Anadromous Salmonid Fish in the Trinity River Basin

Name	Migration	Spawning	Rearing	Rearing Habitat Description
Chinook (spring)	Spring-Summer	Early Fall	Winter-Spring-Summer	Shallow, slow-moving waters adjacent to higher water velocities for feeding.
Chinook (fall)	Fall	Fall	Spring	Shallow, slow-moving waters adjacent to higher water velocities for feeding.
Steelhead (winter)	Fall-winter	February-April	Year round	Areas of clean cobble where there is refuge from high velocities; juveniles overwinter for 1-2 or more years.
Steelhead (summer)	Spring-Summer	February-April	Year round	Areas of clean cobble where there is refuge from high velocities; juveniles overwinter for 1-2 or more years.
Coho	October-December	November-December	Year round	Backwater areas of slow water and pool margins; juveniles overwinter 1 year.

Adequate flows, temperatures, water depths and velocities; appropriate spawning and rearing substrates; and availability of instream cover and food are critical for the production of all anadromous salmonids.

Adequate flows, temperatures, water depths and velocities; appropriate spawning and rearing substrates (e.g., riverbed gravels); and availability of instream cover and food are critical for the production of all anadromous salmonids. Spring chinook salmon and summer steelhead also need long-term adult holding habitat in which pool size and depth, temperature, cover, and proximity to spawning gravel are important requirements. Newly emerged fry and juveniles of all species require rearing habitat with low velocities, open cobble substrate, and cool water temperatures. Emigration of smolts to the ocean and the immigration of spawning adults require adequately timed flows with the appropriate temperature, depth, and velocity.

Native non-salmonid anadromous species found in the Trinity River Basin include green and white sturgeon and Pacific lamprey. These fish spend their early life stages in fresh water, migrate to the ocean

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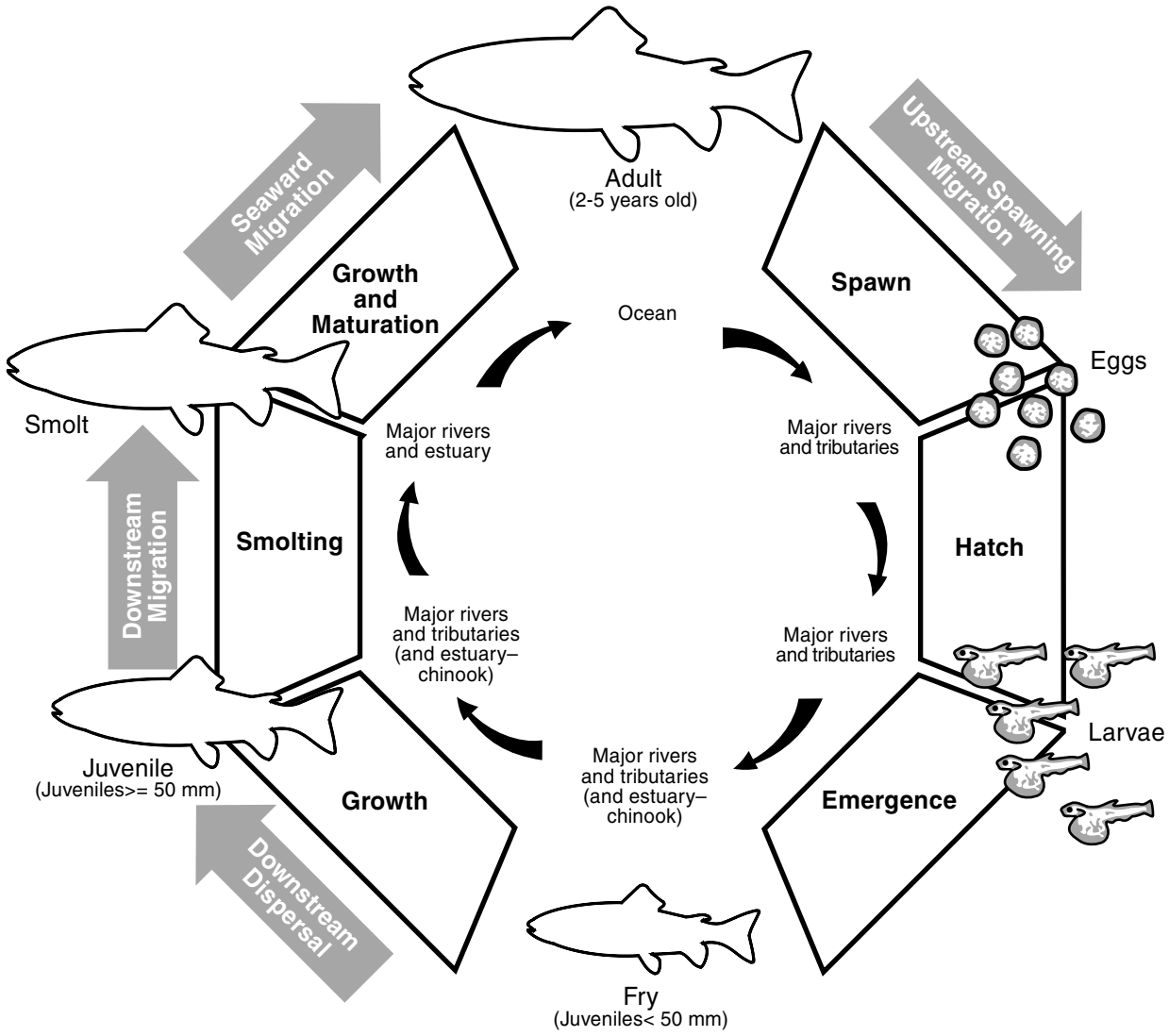

FIGURE 3-34
GENERAL LIFE HISTORY
OF ANADROMOUS SALMONIDS
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

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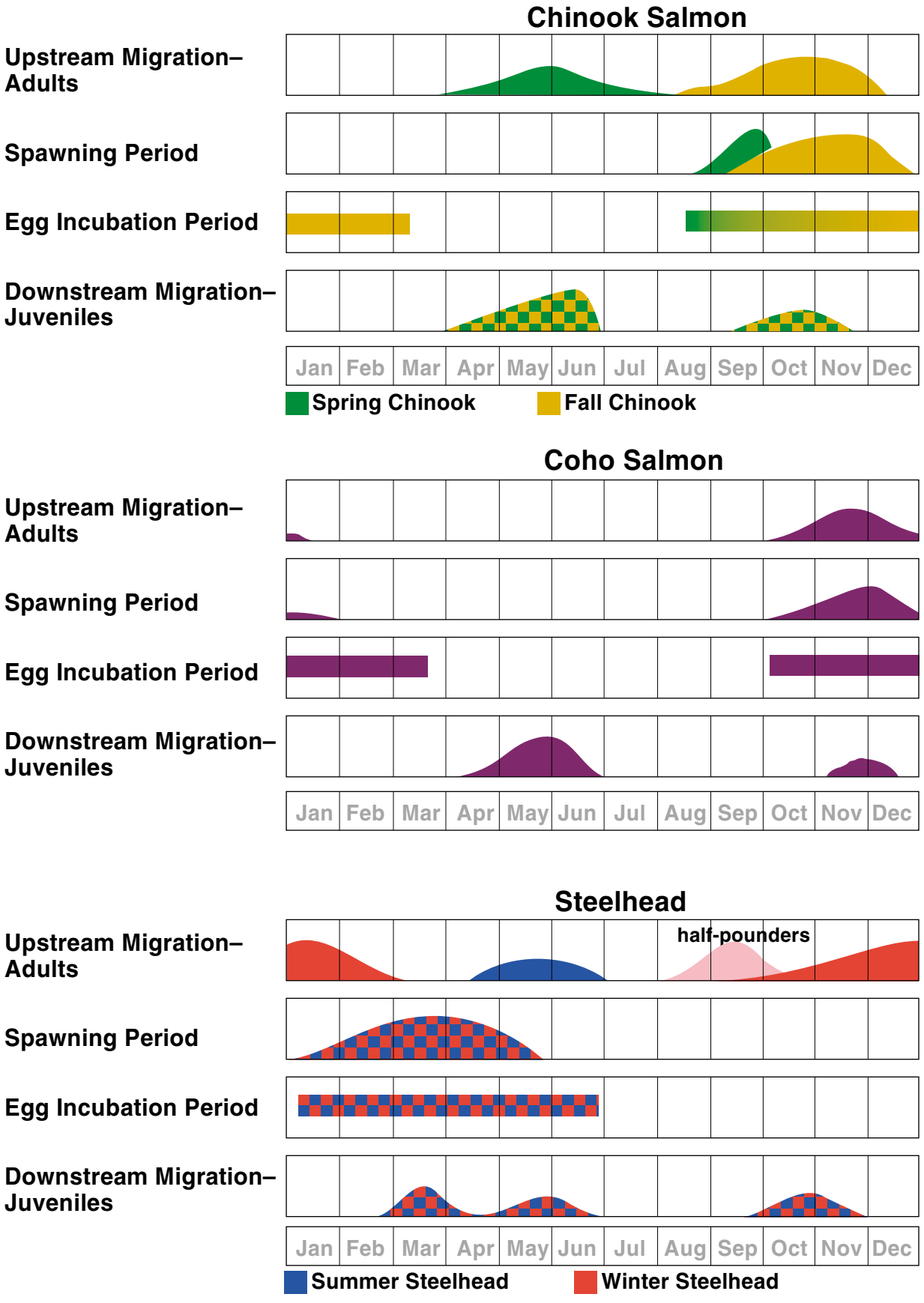

FIGURE 3-35
TEMPORAL DISTRIBUTION OF ANADROMOUS SALMONID REPRODUCTION
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

for maturation, and return to their natal stream to spawn (Table 3-11). Status information on native non-salmonid anadromous species residing in the Trinity River Basin is very limited. However, the Klamath / Trinity River Basin is known to contain the largest spawning population of green sturgeon in California. In contrast, only small runs of white sturgeon occur.

TABLE 3-11
Life History and Habitat Characteristics of Non-salmonid Native Anadromous Fish in the Trinity River and/or Klamath River Basins

Name	Migration	Spawning	Rearing	Rearing Habitat Descriptions
Pacific lamprey	April-July	Spring-early summer	Year round	Developing larvae burrow into silty river-bottom substrates, where they remain for 4-5 years before emigrating to the ocean.
Green and white sturgeon	February-July	March – July	Year round	Juveniles inhabit estuarine environments for 4-6 years before migrating to the ocean.
Eulachon	March-April	March-April	--	Adhesive eggs anchored to bottom until hatched; larvae quickly transported to ocean.

Trinity River Restoration Program Goals. The 1983 EIS on the Trinity River Basin Fish and Wildlife Management Program (U.S. Fish and Wildlife Service, 1983) documented the inriver spawner escapement goals and the TRSSH production goals developed by CDFG. The goals were subsequently adopted by the TRRP as escapement numbers. The inriver goals represent the total number of naturally produced adult spawners (excluding ***jacks***) for the Trinity River Basin below Lewiston Dam and exclude fish caught by the fisheries (Table 3-12). The hatchery goals represent numbers of adult fish needed by the hatchery, exclusive of fisheries for chinook and coho salmon (an undefined inriver harvest is included in the restoration program goals for steelhead).

TABLE 3-12
Trinity River Restoration Program Goals

Species	Inriver Spawner Goals	Hatchery Goals	Total
Fall chinook salmon	62,000	9,000	71,000
Spring chinook salmon	6,000	3,000	9,000
Coho salmon	1,400	2,100	3,500
Steelhead	40,000	10,000	50,000

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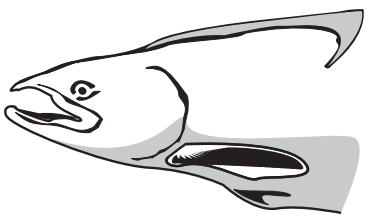
Restoration and maintenance of natural production implies that the fish spawning inriver began their life as eggs in the river, and that a sufficient percentage of their eggs spawned in the river survive to return as adults to spawn.

The relatively low returns of naturally produced fish are indicative of low survival rates of young freshwater life stages.

Recent changes have been enacted to reduce hatchery overproduction and competition of hatchery-produced fish with naturally produced spawners.

Chinook Salmon



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Because the project purpose is the restoration and maintenance of the natural production of anadromous salmonids below Lewiston Dam, the following discussions concern the inriver spawner escapement goals (adults only) and the numbers of fish returns (jacks and adults) that were naturally produced. Restoration and maintenance of natural production implies that the fish spawning inriver began their life as eggs in the river (i.e., were not raised in the hatchery), and that a sufficient percentage of their eggs spawned in the river survive to return as adults to spawn; in other words, naturally producing populations are self-sustaining.

Inriver spawner escapement is the number of fish returning to spawning grounds, which in reality consists of two factions: naturally produced fish and hatchery-produced fish. However, hatchery-produced fish are not considered to contribute towards the inriver spawner escapement goals of the TRRP, although their offspring do (i.e., if hatchery-produced fish spawn inriver and their offspring survive to return to spawn, these offspring are naturally produced by definition [see "natural production" in glossary]). The best available data indicate that large numbers of hatchery-produced fish spawn inriver. Typically, more fish spawn inriver than are spawned at the hatchery, and relatively fewer inriver eggs survive to return as adults. Assuming that hatchery and naturally produced fish are subject to the same environmental conditions after the hatchery releases its fish (typically as smolts), the relatively low returns of naturally produced fish are indicative of low survival rates of young freshwater life stages (eggs, fry, and / or juvenile fish).

Fall Chinook Salmon Populations. Although annual pre-dam escapement data are sporadic, estimates of chinook salmon in the Trinity River prior to 1964 above the North Fork have ranged from 19,000-75,600, and averaged 45,600 for the 5 years of available data. Comparisons between pre- and post-dam averages are problematic because (1) few pre-dam estimates exist; (2) pre-dam estimates typically represent fish spawning in the river above the North Fork, while post-dam estimates are above Willow Creek; and (3) post-dam estimates are only for the river below Lewiston and are confounded by large numbers of hatchery-produced fish that spawn in natural areas (recent changes have been enacted to reduce competition of hatchery-produced fish with naturally produced spawners).

Comparisons between pre-dam escapements and the TRRP inriver spawner escapement goals are also problematic because the inriver goals represent the numbers of fish that could be produced in the entire Trinity River Basin below Lewiston Dam once successful restoration is completed, whereas the pre-dam numbers are sporadic and limited to the Trinity River above the North Fork. Because of these problems, the following discussions focus on the current post-

dam estimates relative to the TRRP inriver spawner escapement goals as an indicator. This is a conservative indicator because the TRRP goals represent adult returns, and the numbers for naturally produced fish include jacks and adults (information relative to adults only was not available).

According to the TRRP goals, the hatchery is to produce 9,000 returning fall chinook spawners for the hatchery, and the river below Lewiston is supposed to produce 62,000 naturally produced fall chinook spawners. Both of these goals are exclusive of harvest. Yearly estimates of fall chinook salmon runs in the Trinity River Basin have been made by the CDFG since 1978, as a part of the Klamath Basin Fall Chinook Salmon Spawning Escapement Estimate (see the Fishery Resources Technical Appendix B). CDFG's post-dam inriver spawner escapement estimates for the Trinity River Basin upstream of the Willow Creek weir from 1982 through 1997 averaged 34,670 fall chinook salmon, of which an average of 22,440 fish are hatchery-produced fish. Naturally produced fish have ranged from 10-94 percent of inriver spawner escapements (Figure 3-36), with an annual average of 47 percent. The river below Lewiston produced an average of 12,230 naturally produced fall chinook spawners, which is approximately 20 percent of the TRRP goal of 62,000 naturally produced fall chinook salmon (Table 3-13).

TABLE 3-13
Comparison of TRRP Inriver Spawner Escapement Goals to Average Numbers of Naturally Produced Fish

Species	TRRP Inriver Spawner Escapement Goals	Average Inriver Escapement of Naturally Produced Fish	Years of Available Data	Percent of TRRP Goal Met
Fall chinook salmon	62,000	12,230	1982-1997	20
Spring chinook salmon	6,000	2,370	1982-1997 (excluding 1983 and 1995)	40
Coho salmon	1,400	200	1991-1995	14
Steelhead	40,000	1,870	1992-1996	5

Spring Chinook Salmon Populations. Escapement surveys for the years 1982 through 1997 (excluding 1983 and 1995 because surveys were not conducted in those years) indicate that an average of 65 percent of the inriver spawner escapement of Trinity River spring chinook salmon is hatchery produced. Conversely, only 35 percent (2,370 annually) were naturally produced, which represents approximately 40 percent of the TRRP goal of 6,000 spring chinook in the Trinity River (Table 3-13).

Coho Salmon Populations. Trinity River coho salmon populations were historically much smaller than chinook salmon populations. Pre-dam estimates for coho salmon spawning above Lewiston were

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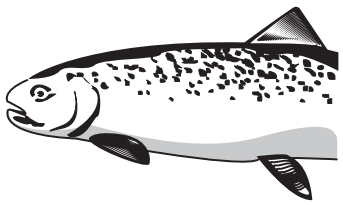
From 1991 through 1995 naturally produced coho salmon spawning in the Trinity River upstream of the Willow Creek weir averaged 200 fish.

5,000 fish (U.S. Fish and Wildlife Service / California Department of Fish and Game, 1956). Total run size for Trinity River coho salmon below Lewiston Dam for 1973 through 1980 averaged 3,300 adults (Leidy and Leidy, 1984). The estimate includes hatchery production. From 1991 through 1995 naturally produced coho salmon spawning in the Trinity River upstream of the Willow Creek weir averaged 200 fish, ranging from 0 to 14 percent of the total annual escapement (an annual average of 3 percent). Approximately 8,100 of the coho salmon spawning inriver are produced by the hatchery. The average of 200 naturally produced coho salmon represents approximately 14 percent of the TRRP goal (Table 3-13).

Steelhead



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Estimates of naturally produced spawning steelhead for the years 1992 through 1997 averaged 1,870 fish upstream of the Willow Creek weir.

Steelhead. Pre-dam winter steelhead spawner escapements in the Trinity River and its tributaries upstream of Lewiston have been estimated to range from 6,900-24,000 adults. From 1992 through 1996, the estimated total escapement of the fall / early winter portion of the winter steelhead escapement upstream of the Willow Creek weir averaged 3,340 fish. Estimates of naturally produced spawning steelhead for the years 1992 through 1996 averaged 1,870 fish upstream of the Willow Creek weir (surveys from fall and early winter period only). This average represents approximately 5 percent of the TRRP inriver spawner escapement goal of 40,000 adult steelhead (Table 3-13). Estimates for the remaining winter portion of the escapement are unavailable because increased river flows render fish-counting weirs inoperable.

Pre-dam summer steelhead spawner escapements for the Trinity River upstream of Lewiston were estimated to average 8,000 adults annually. Recent post-dam CDFG survey estimates have ranged from 20-1,037 adult summer steelhead in the tributaries and mainstem Trinity River. The TRRP escapement goals do not establish specific targets for summer steelhead in the Trinity River, nor does the TRSSH mitigate specifically for summer steelhead.

Some Trinity River steelhead return to the river 4-6 months after first emigrating to the ocean. Upon their return these fish are known as ***half-pounders***. They feed in the river but do not spawn. They subsequently return to the ocean before returning to spawn. When in the half-pounder phase, these fish are not counted as part of the escapement, but they are important to the sport fishery.

Species Listed and Proposed for Listing under the Endangered Species Act (ESA) and California Endangered Species Act (CESA). The Southern Oregon / Northern California ESU of coho salmon was listed as threatened pursuant to the ESA on April 25, 1997. This listing

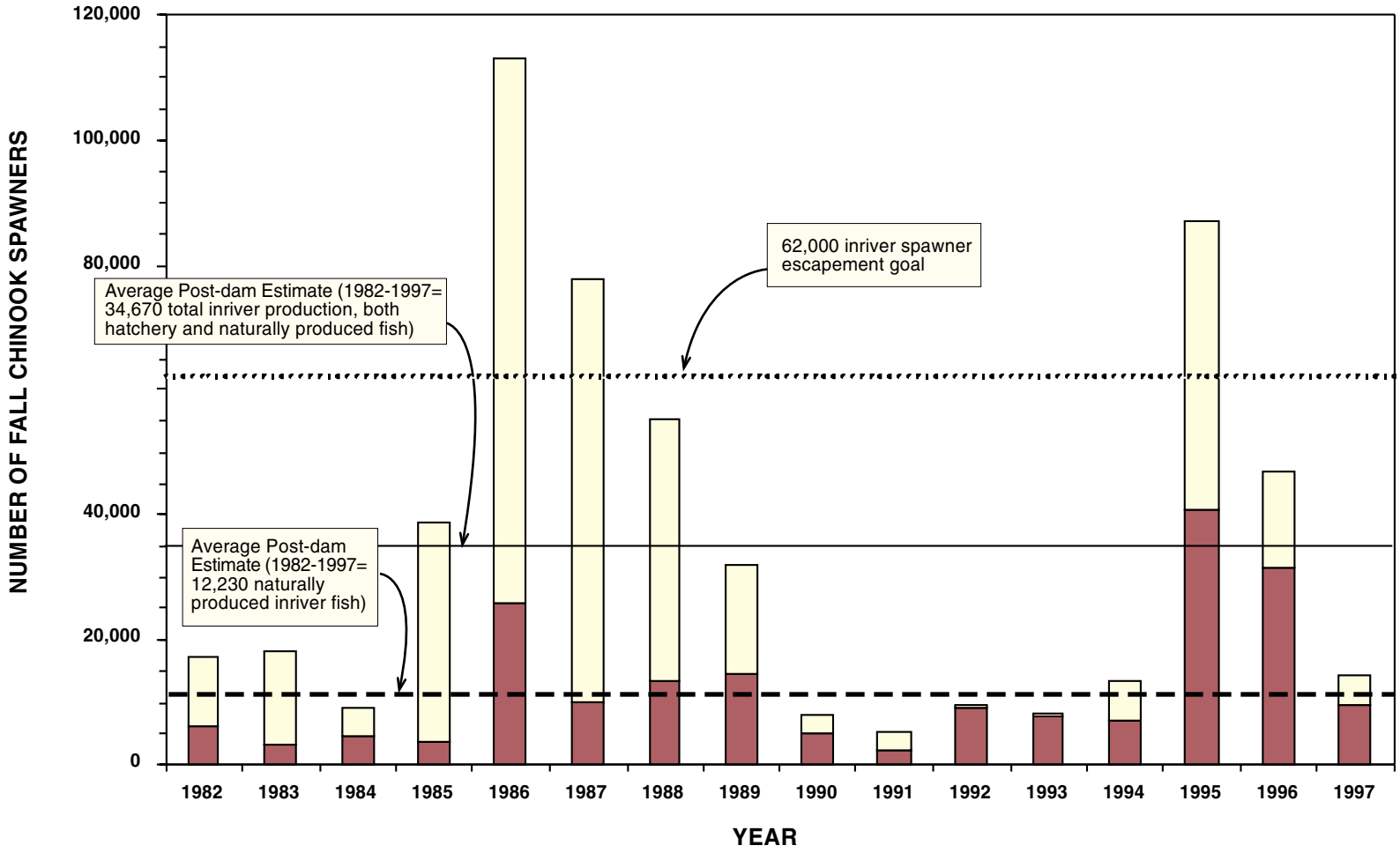

FIGURE 3-36
FALL CHINOOK SPAWNER ESCAPEMENT IN THE MAINSTEM TRINITY RIVER (1982-1997)
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

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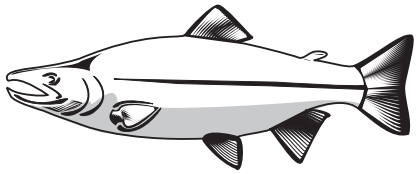
includes coho from the Trinity River and Klamath River Basins. Critical habitat for the ESU was designated on May 5, 1999.

The Klamath Mountains Province ESU of steelhead, which includes stocks from the Trinity River, was proposed for listing as threatened on March 16, 1995; but on February 7, 1998, NMFS determined that the population did not warrant threatened status. However, NMFS determined that the ESU did warrant candidate status (as defined by NMFS; see the glossary).

Trinity River Salmon and Steelhead Hatchery. The TRSSH is operated by CDFG and funded by Reclamation to mitigate for the loss of salmonid production above Lewiston Dam. TRSSH's current goals are to release sufficient juveniles to provide for returns to the hatchery of 12,000 chinook (3,000 spring and 9,000 fall), 2,100 coho, and 10,000 steelhead through ***artificial propagation***. Concerns regarding the potential impacts of hatchery operations on naturally produced populations of the Klamath River Basin (including the Trinity River) prompted the CDFG to institute new hatchery operations in 1996 to minimize future impacts.

Fish Harvest. The harvest of Klamath River Basin fall chinook salmon (including Trinity River Basin) is managed jointly by the CDFG, Oregon Department of Fish and Wildlife, California Fish and Game Commission, Yurok Tribe, Hoopa Valley Tribe, NMFS, and BIA. The PFMC and the KFMC are allocation forums for the ocean and ocean/inriver fisheries, respectively. The mixed-stock ocean population is harvested by commercial and sport fisheries; and the inriver population is harvested by tribal (ceremonial, subsistence, and commercial) and sport fisheries. Chinook salmon harvest (both fall and spring) includes both naturally produced and hatchery-produced fish. Coho salmon harvest has been prohibited along the west coast since 1994. Steelhead are rarely caught in the ocean commercial and sport fisheries, but are harvested by the inriver tribal and sport fisheries.

Coho Salmon



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Historically, Klamath/Trinity River chinook and coho populations have been harvested in the ocean from Monterey County, California, to the Oregon/Washington border. Ocean harvest of naturally produced salmon may have been sufficient in the late 1970s to cause declines in Klamath River Basin (including Trinity River) populations, but, based on the best available data, fall chinook harvest management restrictions implemented since 1986 have decreased harvest impacts to levels believed to be sustainable.

Habitat Conditions. Construction and operation of the TRD, combined with watershed erosion, large-scale gold dredging, and other harmful land management activities, have caused major changes in

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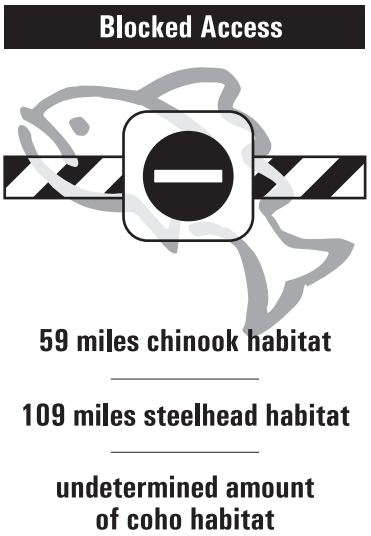
habitat conditions in the Trinity River. Factors that have resulted in adverse effects on fish habitat include:

- Obstruction to river reaches upstream of Lewiston Dam
- Changes to quantity and timing of flows
- Changes in channel geomorphology
- Changes in substrate composition caused by addition of fine sediments and restriction of gravel recruitment
- Changes in water temperature



The TRD dams blocked access to 59 miles of chinook salmon habitat, 109 miles of steelhead habitat, and an undetermined amount of coho salmon habitat (U.S. Fish and Wildlife Service, 1994). Much of this habitat was prime spawning and rearing habitat. In the case of the chinook, it represented 50 percent of spawning habitat in the basin. As early as 1980, overall decline in spawning habitat was estimated at 80-90 percent (U.S. Fish and Wildlife Service, 1980). Furthermore, elimination of the upstream reaches greatly reduced the diversity of the entire river system, thereby reducing habitat choices for salmonids.

For the first 21 years of TRD operations, Lewiston Dam releases to the Trinity River were only 21 percent of natural flows. The volume of water initially set aside for Trinity River fishery resources during this time period was 120 taf, which was only exceeded during extreme storm events or for fishery studies. Perhaps more significantly, the peak winter and spring flows were eliminated or greatly reduced. The harmful effects of the reduced flows were manifested in several ways, including changes to channel geomorphology, substrate composition, and water temperatures. Ultimately, the reduction in flows has lead to a reduction in habitat. For example, spawning habitat losses have been estimated to be 80 percent in the first 2 miles below Grass Valley Creek, and 50 percent in the 6 miles downstream of that confluence (U.S. Fish and Wildlife Service, 1994).

Reduced river flows, increases in fine sediment input, and reductions in coarse sediment recruitment are the primary factors in changes to channel geomorphology resulting (in degradation of fish habitat).

Reduced river flows, increases in fine sediment input, and reductions in coarse sediment recruitment are the primary factors in changes to channel geomorphology resulting in the reduced quality, quantity, and suitability of fish habitat and reduced survival of freshwater life stages. The altered channel geomorphology reduced the number and quality of alternate bar sequences. Important salmonid habitats associated with alternate bars include: pools that provide cover from predators and cool resting places for juveniles and adults; gravelly riffles where adults typically spawn; open gravel/cobble bars that

create shallow, low-velocity zones important for emerging fry; and slack-water habitats for rearing juveniles.

Since TRD operation, the Trinity River has become channelized (i.e., the river banks have become more vertical, and there is little lateral movement of the channel within the floodplain). Consistently low river flows allowed the encroachment and establishment of riparian vegetation. The roots of the vegetation, which bound spawning gravel, and the stalks of the vegetation, which encouraged deposition of fine sediment, lead to the formation of sand berms along the river banks. This encroachment of riparian vegetation and subsequent berm formation further narrows the channel and reduces shallow, low-velocity salmonid rearing habitat and habitat diversity. (See the Geomorphic Environment section [3.2] for additional information.)

Changes in substrate composition have occurred because of increases in fine sediment (from increased watershed erosion and attenuation of sediment-transporting flows) and the reduction of coarse sediment (e.g., gravel) recruitment (due to the dams). Fine sediment fills in spaces between gravels and cobbles, which inhibits the percolation of water through these areas, degrading and reducing available spawning habitats. Sedimentation of spawning areas can inhibit flow (and thus oxygen) to incubating eggs as well as create an impenetrable barrier that prevents salmon sac-fry from emerging from their gravel nest. Accumulation of fine sediments can also decrease the amount of space between gravel and cobble, thereby decreasing the amount of available habitat for overwintering juvenile coho salmon and steelhead that burrow into the substrate. Sedimentation may also decrease aquatic invertebrate production and diversity, thereby limiting the primary food source for juvenile salmonids.

Construction and operation of the TRD changed the thermal diversity available to Trinity River anadromous salmonids. The dams blocked access to the upstream reaches that are dominated by snowmelt runoff and remain cool throughout the year. Prior to the dam, these areas provided important juvenile rearing and adult holding habitats for salmonids when the majority of the lower mainstem habitats (i.e., below Lewiston) had likely become too warm. The upstream tributaries (dominated by snowmelt) provided increased flows and decreased temperatures during the spring and early summer that aided smolt emigration through much of the mainstem. Because these habitats are now blocked by the TRD, and much of the snowmelt is retained in the TRD reservoirs, it is necessary to artificially maintain cooler temperatures below the dam than those that existed prior to the dam. In other words, the mainstem below the dam must now function thermally like the upstream reaches and tributaries (for anadromous salmonids).

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Exacerbating the problem is the decrease in geomorphic diversity below the dam. Prior to the TRD, water temperatures in the deep mainstem pools stratified; bottom layers were documented as much as 7°F cooler than upper layers (Moffett and Smith, 1950). The cool temperatures at the bottom of the pools provided important thermal refugia for migrating adult and rearing juvenile salmonids. The altered flow regime and channel geomorphology decreased or eliminated the temperature stratification in pools in the summer/early fall months. Although average post-dam monthly water temperatures at Lewiston are cooler than pre-dam temperatures during June to November, this benefit has not fully compensated for the lost thermal diversity in the system (i.e., above the dams) or for the reduction in stratified pools.

Habitat Restoration Projects. Since the early 1980s, the Trinity River Basin Fish and Wildlife Restoration Program has conducted a variety of restoration activities in the mainstem Trinity River and its tributaries. Some activities conducted in tributaries include watershed restoration work, as well as habitat enhancement projects, and dam construction and pool dredging in Grass Valley Creek to decrease the amount of fine sediment entering the mainstem Trinity River. Restoration activities that have been implemented in the mainstem include gravel placement, pool dredging, and construction of several channel rehabilitation projects (side channels and bank rehabilitation of point bars).

(Channel rehabilitation) projects were constructed by physically removing vegetated sand berms along the bank to restore the channel to a pre-dam configuration.

The Trinity River Basin Fish and Wildlife Restoration Program constructed twenty-seven channel rehabilitation projects on the mainstem Trinity River between Lewiston Dam and the North Fork: 18 side-channel projects and 9 bank rehabilitation projects (also known as feathered-edge projects). Monitoring documented chinook salmon spawning within the constructed side-channels. Observations also indicate that the side channels are used extensively during the spring by rearing chinook salmon juveniles.

The remaining nine projects were bank rehabilitation projects between Lewiston Dam and the North Fork. The projects were constructed by physically removing vegetated sand berms along the bank to restore the channel to a pre-dam configuration. Channel rehabilitation sites are significantly wider and shallower than corresponding control sites at intermediate and high flows. Along with promoting formation of alluvial features characteristic of unregulated rivers, channel rehabilitation projects have been shown to increase the amount and diversity of habitat for adult and juvenile salmon and steelhead. During recent investigations, salmonid fry habitat indexes were greater at rehabilitation sites than at corresponding control sites. Catch-per-effort for chinook salmon fry was also greater at rehabilitation sites than at control sites, suggesting

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greater habitat use at these sites. Spawning surveys at project locations have also shown high use of these areas by spawning chinook salmon.

Lower Klamath River Basin / Coastal Area. The Klamath River is California's second largest river, with an average annual flow in excess of 13 maf. The river provides habitat for chinook and coho salmon, and winter and summer steelhead. Coastal cutthroat trout are also found in the lower reaches.

Native non-salmonid anadromous fish found in the Klamath River include Pacific lamprey and green and white sturgeon. Large runs of candlefish (eulachon) occurred in the lower Klamath River as recently as the 1970s; however, today the run size is small and sporadic. In some years, e.g., 1999, a small run is documented, while in other years the run goes unnoticed. The reasons for their decline are not known.

The coastal area adjacent to the Klamath River Basin provides habitat for the oceanic stages of anadromous fish found in the lower Klamath and Trinity River Basins. Habitat conditions in the coastal area and ocean environment are subject to natural ecosystem productivity as affected by physical and biological oceanic processes, weather, and climate. The primary influence of humans on anadromous salmonids in the coastal areas adjacent to the Klamath River Basin is ocean commercial and sport harvest.

CDFG compiles annual estimates of fall chinook spawner escapements and tribal and sport harvests in the Klamath River Basin. The 1997 total escapement was estimated at 70,000 chinook salmon (including jacks). Klamath River Basin fall chinook are managed for a 33-34 percent brood escapement rate, or a minimum escapement level of 35,000 fish, whichever is greater (excluding returns to hatcheries). This minimum was established in 1989 by the PFMC. Long-term declines of Klamath River Basin fish populations have been attributed to land use conflicts, water diversions, harvest, ocean conditions, dams, and inriver habitat conditions.

The lower Klamath River supports a sport fishery for anadromous salmonids. In addition, approximately 80 percent of the Klamath / Trinity Indian gill-net harvest of salmon occurs in the lower Klamath River.

Central Valley. The Central Valley provides habitat for several species of native anadromous fish, including freshwater stages of chinook salmon and steelhead. (A thorough discussion of Central Valley fisheries is provided in the CVPIA PEIS and associated appendices.) The Sacramento and San Joaquin Rivers provide

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corridors to the ocean for anadromous salmonids spawned and reared within Central Valley rivers, streams, and hatcheries.

(The Sacramento River) along with the hatcheries on its tributaries, produces more than 90 percent of the Central Valley salmon and steelhead.

The Sacramento River is the largest river system in California and, along with the hatcheries on its tributaries, produces more than 90 percent of the Central Valley salmon and steelhead. The Sacramento River supports four runs of chinook salmon: fall, late-fall, winter, and spring, with fall chinook being the most abundant. From 1967-1991 the fall chinook spawner escapement in the mainstem Sacramento River averaged 77,000 fish; for late-fall chinook it averaged 14,000 fish, and for spring chinook it average 11,000 (U.S. Bureau of Reclamation, 1997). Most of the Central Valley fall steelhead are also found in the Sacramento River Basin. Coho salmon and cutthroat trout are not currently known to reside in the Central Valley.

Many factors affect the abundance of anadromous fishery resources in the Central Valley. Many of the same factors that resulted in declines in fishery resources over the past 150 years continue to plague existing populations. Those factors include: modification and loss of habitat, reduction in magnitude and change in timing of streamflows, damming and diversions, deterioration of water quality (including temperature), increases in sport and commercial harvest, and competition and genetic introgression with hatchery-produced fish. The direct cause and effect relationships of any one or all of these factors as they may have and continue to affect anadromous fish populations are unknown. Cumulatively, they have taken their toll on these species' ability to exist in the Central Valley. Ongoing efforts to arrest the decline and restore native anadromous fish populations, including projects resulting from the 1992 CVPIA, are ongoing in an attempt to reverse the decline of those populations.

Native non-salmonid anadromous fish in the Central Valley include green sturgeon, white sturgeon, and Pacific lamprey. The population of adult white sturgeon in the Central Valley has been estimated to be 64,000 fish. Adult green sturgeon abundance is estimated at 870 fish. There are no estimates of Pacific lamprey in the Central Valley.

The population status of most, if not all, of these species are less precisely known than that of the anadromous salmonids in the Central Valley. With the exception of hatchery and commercial harvest, the factors affecting the abundance of native non-salmonid anadromous species are likely similar to those for native salmonid species. Reductions and timing of flows, loss of habitat quantity and quality, and water diversions likely have been largely responsible for declines in population of these species.

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Limiting Factors. Major factors limiting native anadromous fish populations in the Central Valley include:

- Water diversions, including several large diversions and hundreds of unscreened diversions throughout the Sacramento and San Joaquin Rivers.
- Water diversions at the State and federal pumps in the Delta.
- Increased water temperatures within Central Valley rivers and the Delta.
- Blockage of habitat by major dams (e.g., Shasta Dam).
- Habitat loss and degradation in the rivers and the Delta.
- M&I, agricultural, and mining waste discharge that degrades water quality.
- Predation by introduced species.
- Inadequate instream flows within the rivers and reduced outflows in the Delta.
- Altered Delta inflow and outflow that affect salinity, currents, nutrient levels, and pollutant concentrations.

Species Listed and Proposed for Listing under the ESA and CESA. Winter chinook salmon were listed endangered under the CESA in 1989. They were listed as threatened under the ESA in 1989 under emergency provisions, and formally listed in 1990. (For a discussion of the legal requirements created by both CESA and ESA, see Chapter 5.) On January 4, 1994, they were reclassified as endangered. On June 16, 1993, NMFS designated critical habitat for the species as the Sacramento River from Keswick Dam to San Francisco Bay. The Central Valley ESU of steelhead was listed as threatened under the ESA on May 18, 1998. Spring chinook salmon were listed as threatened under the CESA on February 6, 1999, and will be listed as threatened under the ESA on or about November 9, 1999. Fall and late-fall chinook salmon ESUs remain candidates for listing under ESA.

Environmental Consequences.

Methodology. The following assumptions were used in the analysis of environmental consequences.

- The TRSSH would be operated as it is currently, and operations would not impact natural production of anadromous salmonids.
- All anadromous salmonid species would respond similarly to actions of any particular project except as noted below.

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- In the year 2020, any rehabilitiation sites and/or watershed work are assumed to be completed, and the river system processes would be functioning at the full level of their ability within the given flow regime(s); and anadromous fish populations, although not constant from year to year due to varying environmental conditions (especially oceanic factors), would be at their long-term average.
- Except as noted, the analysis assumed the historic distribution of Trinity River Basin water-year classes.

The Trinity River System Attribute Analysis Method (TRSAAM) was developed to analyze the proposed alternatives. The TRSAAM was based on the fundamentals and relationships of key river system characteristics and functions that create and maintain diverse salmonid habitats (see the Geomorphic Environment section [3.2]). The methodology used to analyze the geomorphic environment (i.e., healthy alluvial river model) was modified and used to evaluate the impacts of the alternatives on fishery resources. The TRSAAM used the same 10 attributes and objectives presented in Table 3-1, plus an additional attribute specific to salmonid temperature and habitat requirements. Temperatures were evaluated as to their ability to meet salmonid smolt emigration requirements and NCRWQCB objectives. These 11 attributes were identified as essential to the integrity of a healthy alluvial river system and to the restoration of naturally produced salmon and steelhead populations.

Restoring (the physical processes identified in the TRSAAM) attributes will restore the diverse, high-quality habitats that salmon and steelhead need to survive and successfully reproduce.

The basic assumption of this analysis is that the geomorphic environment and the quality and quantity of fish habitat are intrinsically connected. Restoring these attributes would restore the diverse, high-quality habitats that salmon and steelhead need to survive and successfully reproduce; the more high-quality habitat available, the better the populations' recovery will be. Because there are three species of salmonids, each with different depth and velocity preferences for each life stage, a wide variety of habitats is needed to provide suitable conditions for all life stages of all species. It was assumed that if all Trinity River ecosystem functions were restored to a healthy condition, the TRRP spawner escapement goals would be met.

A wide variety of habitats is needed to provide suitable conditions for all life stages of all species (of anadromous salmonids).

Each alternative's flow schedule(s) was assessed for its ability to meet the thresholds and frequencies associated with the 11 attributes (uncontrolled spills were not assessed). Each objective of the attributes was assigned a score of 0, 1, or 2, depending on how well the objective was satisfied. For each alternative, the total score was divided by the maximum potential score. This proportion was multiplied by the TRRP escapement goals to calculate a spawner escapement for each species. The spawner escapement values and harvest estimates (see Section 3.5.4. and the Fishery Resources Technical

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Appendix B for harvest methodology) were summed to produce a production index for each alternative.

The assumptions used in the TRSAAM analysis included:

- If actions are made that move closer to meeting desirable system attributes, fish production will increase.
- All attributes are weighted equally for evaluation of fish production. (This assumption was made because data were not available to determine a relative weighting of the attributes.)
- Attributes provide and maintain habitat for all freshwater life stages of anadromous fish.
- Changes in fish numbers are not linearly correlated with flow.
- Decline of one attribute can negate the benefits to fish of all other attributes. (For example, a failure to provide cold water during the time that adult salmon are holding in the river below Lewiston Dam could virtually eliminate a cohort, even if other attributes were met.)
- Numbers derived from this analysis are considered an index, intended to show differences for alternatives, not actual population estimates.

The following additional assumptions were used to qualitatively evaluate effects of project alternatives on native anadromous species in the lower Klamath River Basin:

- Increased coldwater releases to the Trinity River are not harmful for emigrating and immigrating anadromous salmonids in the lower Klamath River Basin.
- Large increments of increased flow in the Trinity River would improve habitat conditions and river health in the lower Klamath River Basin.
- Mechanical rehabilitation of riverine habitats within the Trinity River would not affect anadromous salmonids in the lower Klamath River Basin.
- Watershed protection in the Trinity River would improve habitat conditions and system health in the lower Klamath River Basin.

Except as noted below, it was assumed that any benefits or adverse effects on native non-salmonid anadromous fish in the Trinity and Klamath River Basins would be the same as those for anadromous salmonids. This assumption is based on the fact that native non-salmonid anadromous fish evolved in and adapted to the same pre-dam environment that native salmonids did.

Trinity River System Attribute Analysis Method

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It was assumed that there would be no measurable effects on food availability, rates of survival, or other impacts to anadromous salmonids in the adjacent coastal areas as a result of any of the alternatives.

The effects of each alternative on the anadromous salmonids in the Sacramento River were evaluated using Reclamation's Sacramento River Salmon Mortality Model (see the Fishery Resources Technical Appendix B). The Sacramento River Salmon Mortality Model estimated effects to chinook salmon eggs and fry for all four runs of chinook salmon spawning in the Sacramento River from Keswick Dam to Woodson Bridge. Because there is no model similar to the salmon mortality model, effects on steelhead were estimated by extrapolating late-fall chinook salmon mortality estimates due to the insimilarity in temporal distribution of this species.

Increases in salmon egg and fry life-stage mortality are assumed to occur as the result of increased water temperatures. The Reclamation salmon loss model uses weekly average water temperatures obtained from the Sacramento River Water Temperature Model and tracks water temperature impacts on chinook salmon egg and larval (sac-fry) development. Algorithms are used to compute cumulative survival of eggs spawned in a particular week through fry emergence from the spawning gravel. Temperature mortality schedules (relationships) for chinook salmon eggs and larvae were developed establishing temperature-related instantaneous daily mortality rates for modeling salmon losses. The model uses spatial and temporal distribution information of spawning activity specific for each salmon run in the Sacramento River. Three river reaches: Keswick to Balls Ferry (upper); Balls Ferry to Red Bluff (middle); and downstream of Red Bluff (lower) are used in the analysis of temperature-related losses of chinook salmon. Within each river reach, a specific temperature-related loss estimate is calculated. From these three partial loss estimates, a cumulative salmon loss estimate, for each run, is then calculated for each water year for the simulated period of 1922 through 1990. The average annual estimated loss for the period of simulation for each alternative was then compared to that for No Action. The precision of the mortality model is unknown; however, it is believed that differences in estimated mortalities greater than 2 percent would be significantly different.

To distinguish differences between project alternatives and the No Action Alternative for non-salmonid anadromous fish, including sturgeons, comparisons of Sacramento River flows and outflows from the Delta were conducted. Changes in these flows were assumed to affect habitat quantity and quality. Significant decreases in flows in the Sacramento River may reduce habitat area for

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spawning, rearing, and food production, and may result in increased water temperatures and poorer habitat quality. These factors may act to adversely affect populations of the lifestages of those species while occupying the Sacramento River. Reductions of outflows from the Delta may result in reduced habitat area and quality for spawning and rearing life stages of Delta species. Additionally, food production is affected by outflows in the Delta. Changes in food productivity may adversely affect growth and survival of young life stages while in the Delta.

Significance Criteria. Effects were considered significant for anadromous salmonids and other native anadromous species if they resulted in any of the following:

- Potential for reductions in the number, or restrictions of the range, of an endangered or threatened native anadromous species or a native anadromous species that is a candidate for state listing or proposed for federal listing as endangered or threatened
- Potential for substantial reductions in the habitat of any native anadromous species other than those that are listed as endangered or threatened or are candidates (CESA) or proposed (ESA) for endangered or threatened status
- Potential for causing a native anadromous fish population to drop below self-sustaining levels
- Substantial adverse effect, either directly or through habitat modifications, on any native anadromous species identified as a sensitive or special-status species in local or regional plans, policies, or regulations
- Substantial interference with the movement of any native anadromous species
- A conflict with, or violation of, the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan relating to the protection of native anadromous species
- Mortality of state or federally listed anadromous species, or species that are candidates for listing (CESA) or proposed for listing (ESA)
- Reductions in the size of a native anadromous species' population sufficient to jeopardize its long-term persistence
- Temporary impacts to habitats such that native anadromous species suffer increased mortality or lowered reproductive

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success that jeopardizes the long-term persistence of those local populations

- Permanent loss of essential habitat of a listed species or special-status native anadromous species
- Reduction in the quantity or quality of habitats in which native anadromous populations occur sufficient to reduce the long-term abundance and productivity of local populations

TRSAAM results indicated that fishery habitat in the mainstem Trinity River in the year 2020 (under the No Action Alternative) would not provide the conditions necessary to restore and maintain salmonid populations.

No Action. The No Action Alternative performed poorly in meeting the river system attributes and habitat requirements necessary for restoring the natural production of anadromous salmonids in the mainstem Trinity River. TRSAAM results indicated that fishery habitat in the mainstem Trinity River in the year 2020 would not provide the conditions necessary to restore and maintain salmonid populations, including the threatened (federal) coho salmon population (Table 3-14). The spawner escapement estimates for chinook and coho salmon and steelhead represent approximately 8 percent of the TRRP escapement goals. This decrease in estimated spawner escapement from current conditions results from continued degradation from now to the year 2020.

TABLE 3-14
Estimated Spawning Escapement and Production Index for Trinity River Naturally Produced Chinook, Coho, and Steelhead

	No Action	Maximum Flow	Flow Evaluation	Percent Inflow	Mechanical Restoration	State Permit
Chinook						
Escapement	5,500	55,100	45,900	15,600	11,900	0
Harvested	10,100	101,400	84,500	28.700	21,900	0
Production Index	15,600	156,500	130,400	44,300	33,800	0
Coho						
Escapement	100	1,100	900	300	200	0
Harvested	200	2,200	1,800	600	400	0
Production Index	300	3,300	2,700	900	600	0
Steelhead						
Escapement	3,200	32,400	27,000	9,200	7,000	0
Harvested	1,000	10,400	8,700	3,000	2,200	0
Production Index	4,200	42,800	35,700	12,200	9,200	0

Maximum Flow. The Maximum Flow Alternative would result in very substantial improvements to habitat for native anadromous salmonids in the Trinity River relative to the No Action Alternative. Improved habitat would benefit rearing and juvenile life stages and improve juvenile emigration, which would result in greater production and substantial increases in anadromous salmonid populations. Inriver spawner escapement estimates for chinook and coho salmon and steelhead are approximately 81 percent of the TRRP inriver spawner escapement goals, which is 10 times greater than the estimate for the No Action Alternative. This alternative would also provide some benefit to native anadromous species in the lower Klamath River Basin by providing increased juvenile outmigration flows and lower water temperatures.

Compared to the No Action Alternative, the Maximum Flow Alternative, which does not include diversions to the Sacramento Valley, would result in an increase in water temperatures in the Sacramento River thereby increasing fall (2 percent), winter (8 percent), and spring chinook salmon (2 percent) early life stage losses (Table 3-15). These impacts would be significant. Increased losses of eggs and sac-fry of fall, winter, and spring chinook salmon as compared to No Action primarily occurred as a result of increased water temperatures during drought conditions (1924, 1931 through 1935, and 1977). These temperature increases would result in higher mortality of incubating and developing salmon eggs and pre-emergent fry life stages as compared to No Action.

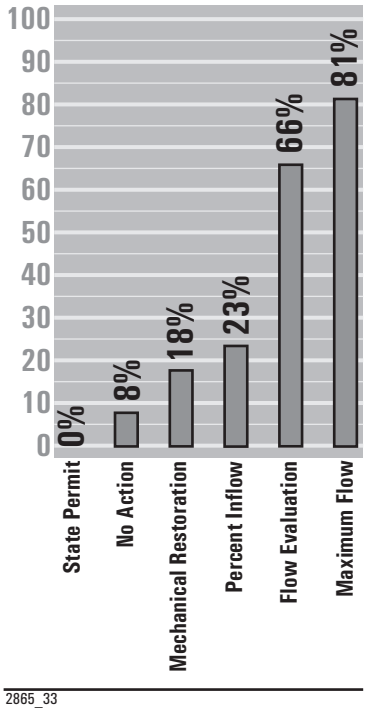
TABLE 3-15
Percent Change in Temperature-related Losses of the Early Life Stages of Anadromous Salmonids in the Sacramento River

	Estimated Change in Average Annual Loss[a]					
Species	**Maximum Flow**	**Flow Evaluation**	**Percent Inflow**	**Mechanical Restoration**	**State Permit**	**Preferred Alternative to Existing Conditions**
Fall chinook	+2	+1	+1	0	-1	+2
Late-fall chinook	0	0	0	0	0	0
Winter chinook	+8	+2	0	0	-1	+3
Spring chinook	+2	0	0	0	-3	+3
Steelhead	0	0	0	0	0	0

[A]Estimated average annual losses over the 1922-1990 simulation period compared to No Action.

Flow Evaluation. This alternative would result in substantial benefits to habitat for native anadromous species in the Trinity River relative to the No Action Alternative. Improved habitat conditions would benefit rearing and juvenile life stages and improve juvenile

TRSAAM Naturally Produced Spawner Escapement Index for 2020



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emigration, which would result in greater production and substantial increases in anadromous fish populations. Spawner escapement estimates for chinook and coho salmon and steelhead range from 64-74 percent of the TRRP goals, which is approximately eight times greater than the estimate for the No Action Alternative in the year 2020. This alternative would also provide some benefit to native anadromous species in the lower Klamath River Basin by providing increased juvenile outmigration flows and lower water temperatures.

There would be significant adverse impacts to Sacramento River fall (1 percent) and winter (2 percent) chinook salmon runs (Table 3-15). These impacts would be significant. Similar to the case for the Maximum Flow Alternative, increased losses of eggs and sac-fry fall chinook salmon would occur as a result of increased water temperatures during drought conditions (1924, 1931 through 1934, and 1977). These temperature increases would result in higher mortality, compared to No Action, of incubating and developing salmon eggs and pre-emergent fry life stages.

Percent Inflow. The Percent Inflow Alternative would result in some benefits to habitat for native anadromous species in the Trinity River relative to the No Action Alternative. This alternative would increase the variability of inter- and intra-year flows, particularly for snowmelt peak and recession flows, which would at times benefit outmigrating salmonid smolts. Spawner escapement estimates for chinook and coho salmon and steelhead range from 23-25 percent of the TRRP goals, which is almost three times greater than the estimate for the No Action Alternative in the year 2020. This alternative would also provide some benefit to native anadromous species in the lower Klamath River Basin by providing increased juvenile outmigration flows and lower water temperatures.

There would be significant adverse impacts to Sacramento River fall chinook (Table 3-15). Similar to the case for the Maximum Flow and Flow Evaluation alternatives, increased losses of eggs and sac-fry fall chinook salmon would occur as a result of increased water temperatures during drought conditions. These temperature increases would result in higher mortality, compared to No Action, of incubating and developing salmon eggs and pre-emergent fry life stages.

Mechanical Restoration. The Mechanical Restoration Alternative would result in some benefits to habitat conditions for native anadromous salmonids relative to the No Action Alternative. These benefits would be largely limited to restoration sites, although upper watershed restoration activities would reduce overall fine sediment input to the river. Spawner escapement estimates for chinook and coho salmon and steelhead range from 14-19 percent of the TRRP goals, which is a little more than twice as great as the estimate for the No Action Alternative in the year 2020. Flow-related impacts to the

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Klamath River Basin would be the same as the No Action Alternative; however, the watershed protection component of the alternative would reduce fine sediment input into the lower Klamath River. The alternative would have no impact on Central Valley native anadromous fish.

State Permit. Native anadromous species in the Trinity River Basin would be significantly adversely impacted by implementation of the State Permit Alternative due to inadequate habitat conditions and water temperatures required for adult spawning, incubation, and juvenile rearing and outmigration. This alternative was assumed to result in the elimination of naturally produced chinook and coho salmon and steelhead in the Trinity River. Populations of naturally produced anadromous salmonids would be at such low levels that any remaining fish would be indistinguishable from strays from the TRSSH unless the hatchery were to mark all released fish every year. Naturally produced populations would likely become functionally extinct in the Trinity River with the implementation of this alternative. Native anadromous species would be marginally adversely affected by implementation of the State Permit Alternative in the lower Klamath River Basin due to lower flows and increased water temperatures.

Survival of early stages of fall, winter, and spring chinook salmon in the Sacramento River could increase modestly (Table 3-15). This is a result of cooler water temperature conditions during egg and sac-fry development.

Existing Conditions versus Preferred Alternative. Implementation of the Preferred Alternative would substantially restore the diverse fish habitats necessary for restoration and maintenance of anadromous fish populations compared to existing conditions. The degree of improvement is similar to that of the Flow Evaluation Alternative over the No Action Alternative. Although the river and its fish habitats would continue to gradually degrade under the No Action Alternative, the majority of the degradation occurred in the decades immediately following dam construction. Therefore, naturally producing anadromous fish numbers are not expected to substantially change from existing conditions versus the projected numbers for the No Action Alternative (TRSAAM was not designed to detect temporal changes). Because the Preferred Alternative also includes the watershed protection component of the Mechanical Restoration Alternative, it would likely accelerate and enhance the improvements in habitat and the resultant increases in fish production. The Preferred Alternative would also benefit the Klamath River beyond the benefits accrued by either the Flow Evaluation Alternative or Mechanical Restoration Alternative individually.

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The Preferred Alternative would impact native anadromous fish in the Central Valley similar to the impacts of the Flow Evaluation compared to the No Action Alternative, but to a greater degree, particularly with regard to spring chinook. Compared to existing conditions, the Preferred Alternative would adversely affect fall, winter, and spring chinook salmon by significantly increasing mortality of early life stages of these species within the upper Sacramento River (Table 3-15). Much of this increased impact (in comparison to the Flow Evaluation Alternative versus No Action Alternative) is associated with the incremental impact expected to occur between the existing conditions and No Action Alternative. This is evidenced by the increase in spring chinook losses (+3 percentage) for the Preferred Alternative compared to existing conditions, while there is no detectable loss anticipated in comparing the Flow Evaluation to the No Action Alternative. These increases in losses of these species are a result of increased water temperatures during egg and sac-fry development.

Mitigation. Anticipated significant impacts to anadromous salmonids in the Trinity River from implementation of the State Permit Alternative would be unmitigatable. Significant impacts requiring mitigation for adverse effects to anadromous salmonids in the Sacramento River system associated with the Maximum Flow, Flow Evaluation, and Percent Inflow Alternatives would include re-consultation with NMFS under the 1993 Biological Opinion for Winter Chinook Salmon. In those years (primarily drought conditions) when carryover storage in Shasta Reservoir is less than 1.9 maf, Reclamation and NMFS would re-initiate consultation in an attempt to minimize losses of winter chinook salmon. Reclamation would re-operate Shasta Dam in an effort to reduce losses of winter chinook salmon to less than that resulting in a jeopardy opinion.

3.5.2 Resident Native and Non-Native Fish

Affected Environment.

Trinity River Basin. Resident native fish species found in the Trinity River Basin include gamefish such as rainbow trout, and non-gamefish such as speckled dace, Klamath smallscale sucker, three-spined stickleback, and coast range sculpin. The abundance of resident native species, and the factors affecting their abundance within the basin, are not well understood; however, all these species evolved and existed in the pre-dam Trinity River and are presumably adapted to those conditions.

Non-native fish species found in the Trinity and Klamath River Basins include striped bass, American shad, brown trout, and brook trout. Striped bass have only recently been reported to occur in the Trinity and Klamath River Basins; reports are rare. American shad

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are known to occur in the lowermost portions of the Trinity River Basin, but are primarily found in the lower Klamath River Basin. Anadromous brown trout were propagated in the TRSSH until 1977 when this practice was discontinued because of the small numbers and the lack of anadromous characteristics of fish entering the hatchery. Currently, brown trout are largely limited to the upper portions of the river, although some brown trout exhibit anadromous characteristics. Brook trout provide a significant sport fishery in the tributary streams and high elevation lakes of the Trinity River Basin. Its life cycle and habitat requirements are similar to that of brown trout.

The abundance of all of these species in the Trinity and lower Klamath River Basins is unknown. Factors that affect their abundance in the Trinity and lower Klamath River Basins are generally unknown, but may be similar to those factors affecting native anadromous species.

Lower Klamath River Basin / Coastal Area. In addition to the native resident species found in the Trinity River Basin, marbled sculpin, threespine stickleback, staghorn sculpin, coastal cutthroat, and starry flounder are known to occur in the lower Klamath River Basin. Marine species such as topsmelt, shiner perch, arrow goby, and sharpnose sculpin may occasionally occur in the lower Klamath River estuary. The abundance and distribution of all of these species, and the factors affecting their abundance in the lower Klamath River Basin, are not known.

In the coastal area, numerous native marine species are found in tidepool and nearshore habitats adjacent to the lower Klamath River Basin. There are as many as 250 species of tidepool and nearshore fish in the coastal waters of California, most of which would be expected to occur in the coastal waters adjacent to the project. Important recreational species include halibut and sanddab, herring, surf perch, lingcod, greenling, smelt, sole, flounder, and rockcod. In addition, important commercial fisheries exist for the flatfish, sablefish, Pacific hake, rockfish, albacore tuna, and lingcod. Most or all of these species are landed in Eureka and Crescent City, California, and Brookings, Oregon.

There are as many as 250 species of tidepool and nearshore fishes in the coastal waters of California, most of which would be expected to occur in the coastal waters adjacent to the project.

Central Valley. Many of the native fish found in the lower Klamath and Trinity River Basins also occur in the Central Valley. In addition to those, the following native resident species also occur: Pacific brook lamprey, hardhead, hitch, blackfish, California roach, Sacramento squawfish, Sacramento sucker, tule perch, prickly sculpin, longfin smelt, Sacramento splittail, and Delta smelt.

The Delta smelt was listed as threatened by federal and state governments in 1993. The species occurs in the Delta and within the lower

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Sacramento River downstream of Isleton and in the lower San Joaquin River downstream of Mossdale. It is rarely found in habitats where salinity is greater than 10-12 ppt; it prefers salinity of approximately 2 ppt. Critical habitat for Delta smelt was determined by the Service to include portions of Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties (U.S. Fish and Wildlife Service, 1994). Provisions within the Delta Accord, including the allowable ratio of Delta inflows to exports (generally 35 percent inflows / exports for February through June and 65 percent inflows / exports for July through January) have direct bearing on delta aquatic species. Reduction of Delta outflows, high Delta outflows, losses to ***entrainment*** at water diversions, changes in food organisms, toxic substances, disease, competition, predation, and loss of genetic integrity in the Delta are suspected causes in the population declines of Delta smelt. The Sacramento splittail was listed as threatened on February 8, 1999. They are found in the Sacramento San Joaquin estuary, although their historic ***range*** was greater. They have declined by 62 percent over a 13-year period.

Reduction of Delta outflows, high Delta outflows, losses to entrainment at water diversions, changes in food organisms, toxic substances, disease, competition, predation, and loss of genetic integrity in the Delta are suspected causes in the population decline (of Delta smelt).

Many of the fish in the Central Valley and Bay-Delta are introduced species. CDFG estimates that at least 50 species of fish have been introduced at one time or another into the Delta and San Francisco Bay estuary. Of 79 total fish species in the Central Valley, 32 were introduced. Principal introduced gamefish include striped bass, other basses, channel and white catfish, American shad, and sunfish. Notable non-gamefish include threadfin shad, goldfish, carp, golden shiners, fathead minnows, mosquitofish, and yellowfin goby.

Environmental Consequences.

Methodology. Except as noted below it was assumed that any benefits or adverse effects on resident native fish species in the Trinity and Klamath River Basins would be similar to those for anadromous salmonids. This assumption is based on the premise that native resident fish evolved in and adapted to the same pre-dam environment that native anadromous salmonids did (the assumption does not apply to non-native resident fish). Additional assumptions included:

- Mechanical rehabilitation projects in Trinity River would not affect resident native or non-native species in the lower Klamath River Basin.
- Watershed protection in the Trinity River would benefit resident native and non-native fish in the lower Klamath River.

Impacts to resident native and non-native fish in the Sacramento River were assessed qualitatively based on known population status, life history, and habitat needs. Impacts on fish in the Delta were

assessed based on changes in Delta flows. A detailed evaluation was conducted on the Delta smelt and Sacramento splittail because of their threatened status.

To distinguish differences between project alternatives and the No Action Alternative for resident fish, including Delta smelt and Sacramento splittail, comparisons of Delta inflow to export ratios, position of X2 (salinity in the Delta equal to 2 ppt), and outflow from the Delta were conducted. The months most critical to Delta smelt and Sacramento splittail, February through June, were scrutinized to determine if changes in flows in those months would be significant enough to potentially adversely affect those species in the Delta regions of the Central Valley. Changes in the ratio of inflow to exports, position of X2, and outflows from the Delta could negatively affect sensitive Delta species by adversely moving the position of optimal larval and juvenile rearing habitat area in Suisun Bay. Changes in flows in the Delta may also adversely affect those species by transporting larvae and juveniles into areas in the Delta where they may become entrained by the State and Federal Pumps.

To distinguish differences between project alternatives and the No Action Alternative for non-native resident fish, including striped bass and American shad, comparisons of Sacramento River flows, Delta inflow to export ratios, position of X2, and outflow from the Delta were also conducted. Excessive water exports compared to inflows in the Delta result in flow patterns in the Delta that can lead to greater numbers of fish eggs and larvae being entrained and lost at the Delta Pumps. Food productivity may also be negatively affected by changes in Delta outflows. Reductions in food availability could adversely affect populations of important gamefish species such as striped bass and shad.

Significance Criteria. Impacts are considered significant to resident native and non-native fish species if they result in any of the following:

- Potential for reductions in the number, or restrictions of the range, of an endangered or threatened resident or non-resident fish or a resident or non-resident fish that is a candidate for state listing or proposed for federal listing as endangered or threatened
- Potential for substantial reductions in the habitat of any resident or non-resident fish other than those that are listed as endangered or threatened or are candidates (CESA) or proposed (ESA) for endangered or threatened status
- Potential for causing a resident or non-resident fish population to drop below self-sustaining levels

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- Substantial adverse effect, either directly or through habitat modifications, on any resident or non-resident fish identified as a sensitive or special-status species in local or regional plans, policies, or regulations
- Substantial interference with the movement of any resident or non-resident fish.
- More than 10 percent modeled exceedance in the ratio of Delta inflows to exports, Delta outflows, and changes in X2 position, during the February through June period (most sensitive period for Delta smelt and Sacramento splittail) over the 69-year simulation period (this percentage was judged to be conservative given it would be applied over the entire the analysis period). Such reductions in Delta flows are considered to be significant with regard to potentially adversely affecting habitats for Delta species, particularly Delta smelt and Sacramento splittail.
- A conflict with, or violation of, the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan relating to the protection of resident fish
- Mortality of state or federally listed resident fish, or species that are candidates for listing (CESA) or proposed for listing (ESA)
- Reductions in the size of a resident fish population sufficient to jeopardize its long-term persistence
- Temporary impacts to habitats such that resident fish suffer increased mortality or lowered reproductive success that jeopardizes the long-term persistence of those local populations
- Permanent loss of essential habitat of a listed species or special-status resident fish
- Reduction in the quantity or quality of habitats in which resident fish populations occur sufficient to reduce the long-term abundance and productivity of local populations

No Action. As described under the Native Anadromous Species discussion above, the No Action Alternative performed poorly in achieving the Trinity River system attributes that benefit fish. Implementation of the No Action Alternative would result in the continued degradation of Trinity River habitat for resident native and non-native fish, although the degradation would not be as great as occurred immediately following TRD implementation. Impacts to resident native and non-native species in the Lower Klamath River Basin / Coastal Area and Central Valley would likely be unchanged from existing conditions.

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Maximum Flow. The Maximum Flow Alternative would provide suitable habitat and greatly enhanced conditions for resident native and non-native species in the Trinity River compared to the No Action Alternative. The impacts of improved habitat conditions on non-native brown trout in the Trinity River are unknown, but it is unlikely they would benefit to a greater extent than native salmonid species. Conditions in the lower Klamath River would be somewhat improved relative to the No Action Alternative.

In the Central Valley, the allowable ratio of Delta inflows to exports, were not exceeded for any year simulated. However, during June, and to a lesser degree, May and February, Delta outflows were greater than 10 percent less than those for No Action for up to 9 percent of the years simulated (Table 3-16). Those reductions in Delta outflows may be significant and may adversely affect habitat for Delta species.

TABLE 3-16
Percent of Years with Delta Outflows at Least 10 Percent Less than the Baseline

	Compared to No Action				Preferred Alternative to Existing Conditions
Month	Maximum Flow	Flow Evaluation	Percent Inflow	State Permit	
February	4	0	1	0	17
March	1	0	0	0	13
April	1	1	0	0	3
May	4	1	3	0	9
June	9	9	3	0	16

Flow Evaluation. The Flow Evaluation Alternative would provide greatly enhanced conditions for resident native and non-native species in the Trinity River compared to the No Action Alternative. Conditions in the lower Klamath River would be somewhat improved relative to the No Action Alternative.

In the Central Valley, the allowable ratio of Delta inflows to exports, agreed upon in the Delta Accord, were not exceeded for any year simulated. However, during June, and to a lesser degree, April and May, Delta outflows were greater than 10 percent less than those for No Action for up to 9 percent of the years simulated (Table 3-16). Those reductions in Delta outflows may be significant and may adversely affect habitat for Delta species.

Percent Inflow. Implementation of the Percent Inflow Alternative would benefit resident native and non-native species in the Trinity River by enhancing habitat conditions for juvenile and adult life stages compared to the No Action Alternative. Conditions in the lower Klamath River would likely be unchanged relative to the No Action Alternative.

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In the Central Valley, the allowable ratio of Delta inflows to exports, agreed upon in the Delta Accord, were not exceeded for any year simulated. However, during May and June, Delta outflows were greater than 10 percent less than those for No Action in 3 percent of the years simulated (Table 3-16). Those reductions in Delta outflows may be significant and may adversely affect habitat for Delta species.

Mechanical Restoration. Implementation of the Mechanical Restoration Alternative would benefit resident native and non-native species in the Trinity River by enhancing habitat conditions for juvenile and adult life stages compared to the No Action Alternative. Conditions in the lower Klamath River and Central Valley would likely be unchanged relative to the No Action Alternative.

State Permit. Due to reductions in flows and increased water temperatures, juveniles and adult life stages of resident native and non-native fish would likely be significantly adversely affected in terms of reduced habitat in the Trinity River Basin. Conditions in the lower Klamath River Basin would likely be somewhat impacted relative to the No Action Alternative.

Existing Conditions versus Preferred Alternative. Trinity River impacts of the Preferred Alternative to existing conditions would be similar to the impacts of the Flow Evaluation Alternative compared to the No Action conditions in the year 2020. However, the watershed protection component of the Preferred Alternative would benefit resident native fish by reducing sediment inputs to the Trinity River.

In the Central Valley, the allowable ratio of Delta inflows to exports, agreed upon in the Delta Accord, were not exceeded for any year simulated. However, during all months from February through June, Delta outflows were greater than 10 percent less than those for existing conditions for up to 17 percent of the years simulated (Table 3-16). Those reductions in Delta outflows may be significant and may adversely affect habitat for Delta species.

Mitigation. Anticipated significant impacts to resident fish in the Trinity River from implementation of the State Permit Alternative would be unmitigatable. Mitigation for impacts to the Delta smelt and Sacramento splittail would consist of consulting with the Service on impacts and implementing any required conservation measures.

3.5.3 Reservoirs

Affected Environment.

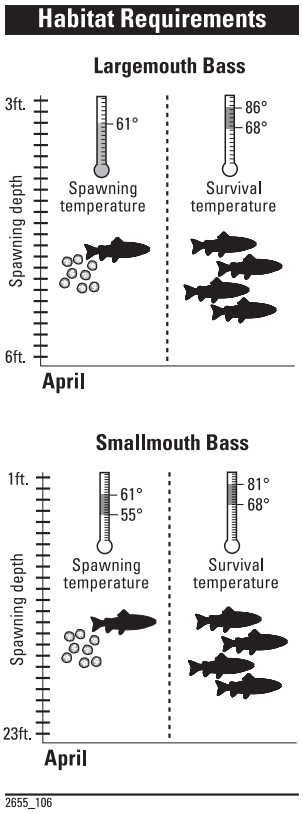
Trinity River Basin. Trinity Reservoir supports a trophy smallmouth bass fishery and provides significant sport fishing for largemouth bass, trout, kokanee salmon, landlocked chinook salmon, and other

gamefish. The maximum surface area of the reservoir is 16,500 acres, with an irregular shoreline of about 145 miles. As is typical with most reservoirs, Trinity Reservoir is characterized by steep sides, with the upper one-fifth of the reservoir consisting of gentle slopes. Thermal stratification occurs between May and November, while the remainder of the year the reservoir is relatively isothermal (i.e., water temperature is the same at all depths). The banks of Trinity Reservoir have high erosion potential, and under windy conditions contribute to high turbidity near the shoreline.

Lewiston Reservoir is principally a trout fishery. Its total storage capacity is 14,600 af, covering about 610 acres with 15 miles of shoreline. Because Lewiston Reservoir is fairly shallow, thermal stratification can develop quickly when discharge from Trinity Reservoir is low. Historically, exports to the Central Valley have been intermittent, which results in rapid swings in Lewiston Reservoir surface temperatures.

Historically, exports to the Central Valley have been intermittent, which results in rapid swings in Lewiston Reservoir surface temperatures and water elevations.

Habitat and Life History Characteristics of Principal Species. Habitat conditions and forage for smallmouth bass in Trinity Reservoir appear to be nearly ideal. The cool water and the high percentage of gravel-rubble bottom have resulted in record-size smallmouth bass being taken. The species requires clean sand, gravel, or debris-littered bottoms to spawn, at depths of 1-3 feet up to 23 feet. Spawning begins in April. Optimal water temperatures for spawning are 55-61°F; optimal temperature for growth and survival is 68-81°F. Largemouth bass also begin spawning in April, typically when water temperatures reach 61°F. Spawning occurs at depths of 3-6 feet on sand, gravel, or debris-littered bottoms. Optimal growth and survival for largemouth bass occurs at water temperatures of 68-86°F.



Kokanee salmon are the non-anadromous (i.e., land-locked) form of sockeye salmon. They were introduced and have become well established in both Trinity and Lewiston Reservoirs. The species makes its spawning migration into streams between early August and February. They prefer spawning in water temperatures between 43-55°F.

Rainbow trout are the most abundant salmonid found in the two reservoirs. They spawn in the spring in streams flowing into the reservoirs. Juvenile trout migrate out of the spawning streams to enter the reservoir to forage and mature where the cold, deep water provides suitable habitat. Optimum temperatures for growth are between 55° and 70°F.

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Variable numbers of hatchery trout are stocked by CDFG into Trinity and Lewiston Reservoirs each year to support the sport fisheries. The timing and numbers of planted fish are dependent upon several factors, including water temperature, availability of hatchery fish, and reservoir surface acreage.

Fluctuating water level. . . limited cover…rising water elevations…(and) severe drawdown of Trinity Reservoir could adversely affect (bass production) in some years.

Factors Affecting Abundance. Fluctuating water level is frequently identified as the main adverse impact affecting reservoir fish production. Limited cover, associated with surface-level fluctuation, has also been identified as a primary limiting factor in terms of production. Rising water elevations during spring could cause largemouth bass to abandon nests. Conversely, severe drawdown of Trinity Reservoir could adversely affect both smallmouth and largemouth bass production in some years.

Temperatures within the reservoirs are dependent on season and reservoir storage conditions. Generally, temperatures are adequate to sustain reservoir fisheries. However, cool water in Trinity Reservoir might not be optimal for largemouth bass and kokanee salmon. Cold water in the reservoir appears to cause low zooplankton production and could be responsible for the stunted size (6-8 inches) of kokanee salmon.

Lower Klamath River Basin / Coastal Area. No reservoirs exist in this area.

Central Valley. The Central Valley contains numerous reservoirs supporting both coldwater and warmwater sport fisheries. The principal reservoirs include Shasta, Whiskeytown, San Luis, Folsom, and Oroville. These reservoirs were evaluated because they are the principal storage elements of the CVP and SWP, contain significant sport fisheries, and habitats supporting those fisheries may be affected by project operations. Operations of the CVP and the SWP may affect the fish habitat by changing reservoir storage conditions (surface area and volume of reservoirs). Changes in reservoir surface area, depths, and timing of these changes may decrease or increase spawning and rearing habitats and food production supporting those reservoirs' warmwater gamefish. Principally, those CVP and SWP reservoirs are warmwater (bass, catfish, and sunfish) fisheries that are self-sustaining by natural reproduction. Coldwater fisheries in those reservoirs are supplemented by stocking programs and, as such, are less affected by changes in reservoir operations and habitat conditions.

Shasta Reservoir provides an outstanding fishery, with both coldwater and warmwater species commonly pursued by recreational anglers.

Shasta Reservoir provides an outstanding fishery, with both coldwater and warmwater species commonly pursued by recreational anglers. Coldwater gamefish include chinook and kokanee salmon and rainbow and brown trout. Warmwater gamefish include largemouth, smallmouth, and spotted bass, sunfish, black crappie,

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channel and white catfish, and bullhead. Whiskeytown Reservoir receives diverted water from Lewiston Reservoir via the Clear Creek Tunnel. Gamefish found in Whiskeytown Reservoir include rainbow and brown trout, kokanee salmon, largemouth bass, crappie, sunfish, catfish, and bullhead.

San Luis Reservoir principally serves to store and deliver water received from the Delta diversions for delivery to farmland in western Merced, Fresno, and Kings Counties. Due to pattern of water deliveries, drawdowns in excess of 60 feet occur annually. More than 30 fish species are known to occur in San Luis Reservoir. The species were generally introduced by transport as larvae or fry from the Delta. CDFG has periodically stocked catfish and largemouth bass in this reservoir, but the principal gamefish has been striped bass.

Folsom Reservoir contains a warmwater fishery of large and smallmouth bass, sunfish, and catfish, and a coldwater fishery of rainbow trout that is stocked by CDFG on an annual basis. Oroville Reservoir's warmwater sport fishery is for largemouth, spotted, and smallmouth bass and catfish. The coldwater fishery consists of rainbow and brown trout and chinook salmon.

Environmental Consequences.

Methodology. A spreadsheet model was developed for the Trinity and Lewiston Reservoirs to evaluate the changes in reservoir habitat resulting from fluctuations of water-surface elevations and area. Impacts of the alternatives on warmwater fish communities in Trinity Reservoir were evaluated by calculating a spawning habitat index and a rearing habitat index for largemouth and smallmouth bass. The changes in surface elevations and area are assumed to directly affect fish abundance and production. Changes in habitat indices, therefore, reflect expected changes in relative population abundance and production. Impacts of the alternatives on coldwater fish communities were evaluated qualitatively based on knowledge of habitat requirements.

Changes in reservoir acreages in Shasta, Trinity, Whiskeytown, San Luis, Folsom, and Oroville Reservoirs were evaluated for each alternative. Mean reservoir surface acreage for the primary spawning and rearing months (March through July) were compared among the alternatives to evaluate impacts to reservoir species over the 69-year simulation period.

Significance Criteria. Impacts to reservoir fisheries are considered significant if they result in any of the following:

- Potential for reductions in the number, or restrictions of the range, of an endangered or threatened reservoir fish or a

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reservoir fish that is a candidate for state listing or proposed for federal listing as endangered or threatened

- Potential for substantial reductions in the habitat of any reservoir fish other than those that are listed as endangered or threatened or are candidates (CESA) or proposed (ESA) for endangered or threatened status
- Potential for causing a reservoir fish population to drop below self-sustaining levels
- Substantial adverse effect, either directly or through habitat modifications, on any reservoir fish identified as a sensitive or special-status species in local or regional plans, policies, or regulations
- Substantial interference with the movement of any reservoir fish
- A conflict with, or violation of, the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan relating to the protection of reservoir fish
- Mortality of state or federally listed reservoir fish, or species that are candidates for listing (CESA) or proposed for listing (ESA)
- Reductions in the size of a reservoir fish population sufficient to jeopardize its long-term persistence
- Temporary impacts to habitats such that reservoir fish suffer increased mortality or lowered reproductive success that jeopardizes the long-term persistence of those local populations
- Permanent loss of essential habitat of a listed species or special-status reservoir fish
- Reduction in the quantity or quality of habitats in which reservoir fish populations occur sufficient to reduce the long-term abundance and productivity of local populations

Potentially significant impacts to reservoir fisheries were judged to occur if reservoir water surface areas (which correlate with habitat quantity and fish abundance) were reduced over 10 percent during the months of March through July over the 69-year simulation period.

No Action. Conditions under the No Action Alternative would remain relatively unchanged compared to existing conditions (Table 3-17).

TABLE 3-17
Qualitative Impact Analysis for Fishery Resources (compared to the No Action Alternative)

Resource Concern	Geographical Area	Maximum Flow	Flow Evaluation	Percent Inflow	Mechanical Restoration	State Permit	Preferred Alternative to Existing Conditions
Native Anadromous Species	Trinity River Basin	HB	HB	B	B	A	HB
	Lower Klamath River Basin	B	B	B	B	A	B
	Central Valley	A	A	A	NC	B	A
Resident Native Species	Trinity River Basin	B	B	B	B	A	B
	Lower Klamath River Basin	B	B	NC	NC	A	B
	Central Valley	A	A	A	NC	B	A
Reservoir Species-Trinity Basin	Warmwater species	A	NC	NC	NC	NC	NC
	Coldwater species	NC	NC	NC	NC	NC	NC
Reservoir Species-Central Valley	All species	NC	NC	NC	NC	NC	NC

A = Adverse Change

NC = No Change

B = Beneficial Change

HB = Highly Beneficial Change

Maximum Flow. The Maximum Flow Alternative would adversely affect both largemouth and smallmouth bass spawning in Trinity Reservoir. The frequency in which spawning and rearing indices fell below the target range exceeded 10 percent, a significant adverse impact. Impacts to other reservoirs would be negligible (Table 3-18).

Flow Evaluation. Trinity Reservoir spawning habitat for bass would be impacted because of decreased average water-surface levels, but to a less than significant degree. Impacts to other reservoirs would be negligible.

Percent Inflow. Trinity Reservoir spawning habitat for bass would be impacted because of decreased average water-surface levels and surface area, but to a less than significant degree. Trinity Reservoir habitat would increase in dry years as water levels would increase compared to the No Action Alternative. Impacts to other reservoirs would be negligible.

Mechanical Restoration. Same as No Action.

State Permit. Trinity Reservoir spawning habitat for bass would increase because of increased water-surface level and area as compared to the No Action Alternative. Impacts to other reservoirs would be negligible.

Existing Conditions versus Preferred Alternative. The difference between existing conditions and the Preferred Alternative would be nearly identical to the difference between the No Action and the Flow Evaluation Alternative. This is because the other components of the Preferred Alternative (i.e., watershed protection) would not affect reservoirs, and there is little expected change in reservoir conditions between existing conditions and No Action.

Mitigation. To reduce the impact of the Maximum Flow Alternative on warmwater fish species in the Trinity Reservoir to a less than significant level, the following mitigation should be implemented:

- A smallmouth and largemouth bass stocking program should be initiated similar to the existing stocking program for coldwater species.

3.5.4 Ocean Fisheries Economics

Affected Environment.

Trinity River Basin. The economic value of affected sport fisheries in the Trinity River Basin is described in Recreation (Section 3.8). The economic value of tribal harvests was not assessed; the tribes felt that it was not possible to quantify the value of the fishery to their way of life.

TABLE 3-18
Percent Changes in Reservoir Water Surface Areas During the Warmwater Fish Spawning and Rearing Months of March through July

	Alternatives Compared to No Action				
	Maximum Flow	**Flow Evaluation**	**Percent Inflow**	**State Permit**	**Preferred Alternative to Existing Conditions**
Shasta	-3.5 to –1.7	-2.2 to –0.6	-1.3 to -0.1	0.0 to +4	-3.1 to -1.0
Trinity	-16.4 to –10.2	+1.6 to +3.9	-1.6 to +3.6	+4.9 to +9.5	-1.4 to +0.8
Whiskeytown	0.0 to +0.1	-0.1 to 0.0	-0.1 to 0.0	0.0	+0.1 to +0.9
Oroville	+0.1 to +0.3	-0.1 to 0.0	-0.2 to 0.0	+4 to +0.7	-4.3 to -2.2
Folsom	-1.9 to +5.8	-1.5 to –0.2	-0.6 to 0.0	-0.1 to +1.9	-2.3 to -1.3
San Luis	-1.4 to +1.0	-1.7 to +0.3	-0.3 to 0.0	0.0 to +0.3	-2.6 to 0.0

Lower Klamath River Basin / Coastal Area. The economic value of lower Klamath River sport fishing is described in Recreation (Section 3.8). The economic value of tribal harvests was not assessed because the tribes did not feel that the value of the fishery to their way of life could be quantified.

Ocean Sportfishing. Ocean sport salmon fishing takes place primarily from privately owned pleasure craft or charter boats. In 1996, there were 225,500 salmon angler trips for salmon in California and 43,900 in Oregon. About 80 percent of the California trips occurred in the San Francisco and Monterey Regions. About 65 percent of the angler trips for salmon in Oregon coastal waters occurred in the Northern / Central Oregon Coastal Region, which includes the port areas of Coos Bay and Tillamook.

Based on 269,400 trips taken in the study region in 1996, the benefits of ocean sport salmon fishing are estimated at $19.4 million.

The recreation benefits of ocean sport salmon fishing are estimated at $72 per trip (indexed to 1997 dollars). This value is also referred to as net economic benefits or economic surplus, which represents the difference between the amount that an individual is willing to pay (as determined by models discussed in the Recreation Resources Technical Appendix D) and the amount that an individual does pay. Based on 269,400 trips taken in the study region in 1996, the benefits of ocean sport salmon fishing are estimated at $19.4 million. The benefits (net income) to charter boat operators are estimated at $2.06 million in 1996, based on average expenditures of $76 per trip and a 30 percent profitability factor for the 90,350 charter boat trips taken.

Ocean Commercial Fishing. Commercial salmon fishing in the coastal regions has been regulated since 1977 in California and 1979 in Oregon. Regulation of commercial salmon fishing to protect various stocks of salmon has substantially affected the fishing effort along the West Coast in some years by reducing the number of days when fishing is allowed. This has led to reductions in total catch and associated gross and net income received by the salmon harvesting industry. This has been especially true since 1991 in the Klamath Management Zone (KMZ), a special management area established primarily to protect Klamath and Trinity River salmon (Figure 3-37).

(Commercial) salmon landings in the KMZ-California Region were only 11,700 fish in 1996, or 97 percent less than the 1971-1975 average.

In 1996, approximately 167,000 salmon were commercially harvested in the Northern / Central Oregon Coastal Region, representing a 78 percent reduction from average harvest levels over 1971-1990. Only 8,500 salmon were commercially harvested in the KMZ-Oregon Region, representing a 91 percent reduction relative to the 1971-1990 average. Salmon landings in the KMZ-California Region were only 11,700 fish in 1996, or 95 percent less than the 1971-1990 average.

Salmon harvest trends have been somewhat different south of the KMZ, with average harvest levels remaining relatively high through the late 1980s. Since 1989, however, commercial salmon harvest

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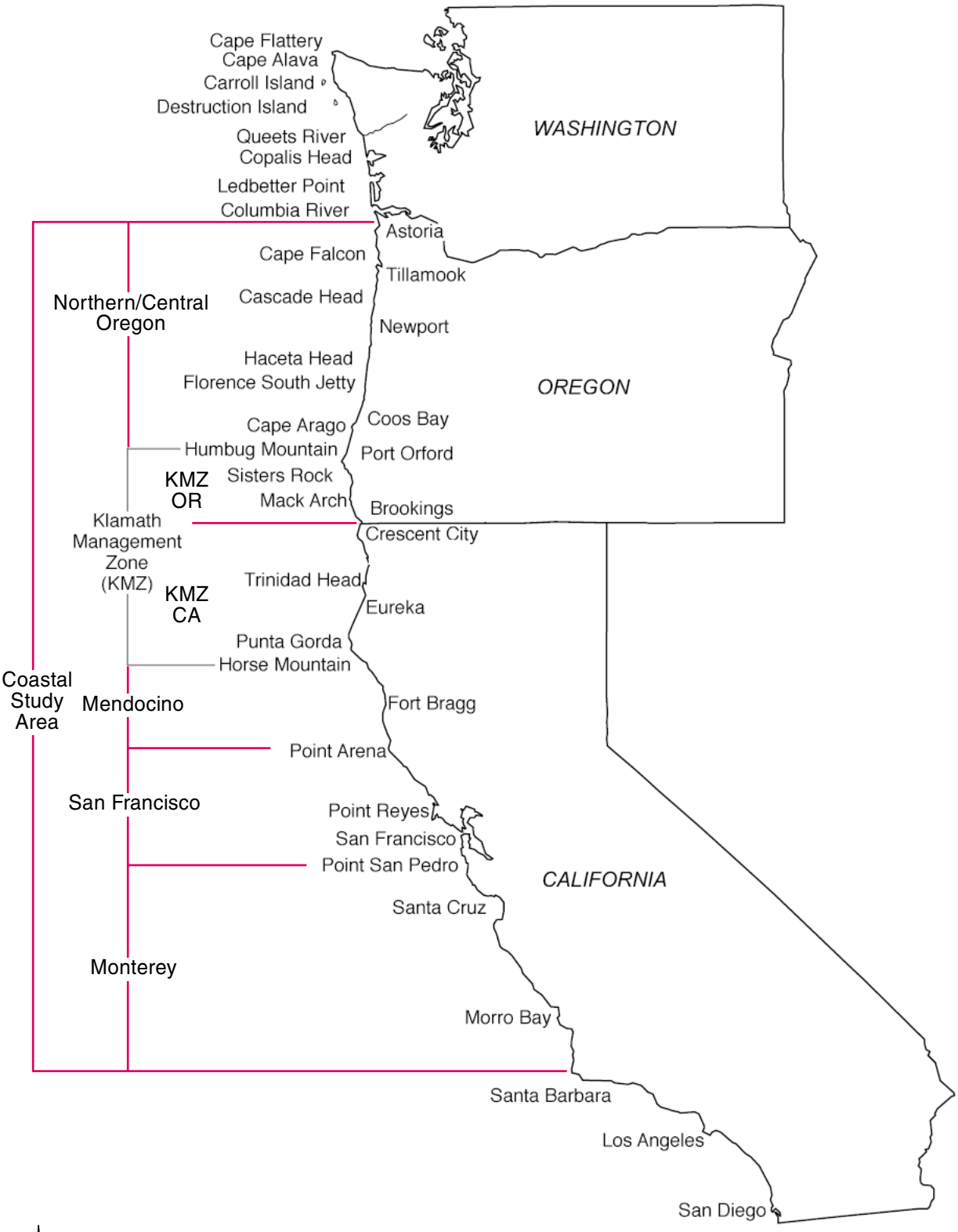

FIGURE 3-37
GEOGRAPHIC LOCATION OF COASTAL STUDY AREA
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

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levels in the Mendocino Region have fallen, almost disappearing between 1992 and 1995, before increasing to 20,000 salmon in 1996. The 1996 harvest was still 90 percent lower than the 1971-1990 average. Commercial salmon harvests in the San Francisco Region have remained relatively constant over the last 25 years averaging 193,500 salmon harvested per year, although harvests dropped dramatically to 67,000 in 1992 when harvest levels along the West Coast fell substantially. Harvests have rebounded to some extent, with 152,000 salmon harvested in the San Francisco Region in 1996. In 1996, 181,000 salmon were harvested in the Monterey Region, exceeding the average of 104,000 for 1971-1990.

Revenues generated by the commercial salmon harvest in the six coastal study regions have generally fluctuated in response to harvest levels and market conditions. Market prices for salmon change annually based on local and world supply and demand conditions. Additionally, prices received by individual fishers (referred to as ex-vessel prices) are affected by marketing avenues used for selling salmon (e.g., sales to dockside buyers / processors or through farmers markets).

In California, gross revenues from commercial salmon fishing totaled $5.7 million in 1996, substantially lower than the $22.7 million (in 1997 dollars) in average annual gross income generated by the industry between 1971 and 1990.

The Oregon ocean commercial salmon fishing industry generated approximately $3.0 million in gross revenue in 1996, with approximately 93 percent of this revenue generated in the Northern / Central Oregon Region and the remainder in the KMZ-Oregon Region. In California, gross revenues from commercial salmon fishing totaled $5.7 million in 1996, substantially lower than the $22.7 million (in 1997 dollars) in average annual gross income generated by the industry between 1971 and 1990. Net income received by the salmon harvesting industry has historically averaged approximately 33 percent of gross salmon revenues in Oregon and 39 percent of gross salmon revenues in California.

Central Valley. The economics of Central Valley sport fisheries are not expected to be substantially affected by project alternatives, given impacts to Sacramento River sport fish production are expected to be relatively negligible as described in the Fishery Resources section.

Environmental Consequences.

Methodology. A full description of the methods used to estimate impacts to ocean sport and commercial fisheries is presented in the Fishery Resources Technical Appendix B. The ocean sport fishery impact assessment estimated project-related changes in sportfishing trips for salmon and the associated benefits to anglers and charter boat operators in the six coastal regions as a function of estimated salmon harvest levels for each alternative. Ocean salmon sport-fishery harvest numbers were estimated based on the ratio of the ocean sport to commercial salmon harvest in each region, as derived

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from the 10-year average between 1987 and 1996. This period was used to reflect conditions that are expected to exist in 2020.

For the ocean commercial salmon fishery, the impact analysis focused on estimating changes in the total ocean commercial harvest of salmon resulting from various changes in the harvest of salmon originating naturally from the Trinity River under the project alternatives. The numbers of salmon available for commercial harvest vary throughout the coastal regions, with salmon stock sizes determining the allowable harvest in each region. As any particular stock size increases or decreases, relative numbers of salmon available for harvest in each region shift. Changes in the abundance of naturally produced Trinity River salmon would, therefore, affect overall harvest levels throughout coastal regions.

Changes in the commercial harvest of salmon were assumed to directly affect gross revenues and net personal income for the salmon harvesting sector in each region.

Estimates of commercial harvest of naturally produced Trinity River salmon, and the associated total harvest of salmon originating from all sources, are shown in Table 3-19. The number of salmon naturally originating from the Trinity River that would be available for harvest were estimated by the Trinity River Fish and Channel Restoration Team for each alternative based on estimated changes in escapement and other factors. Total harvests were estimated by the Service using data available through the Klamath River Ocean Harvest Model and other sources. A complete description of the methodology is presented in the Fishery Resources Technical Appendix B.

Changes in the commercial harvest of salmon were assumed to directly affect gross revenues and net personal income (i.e., profit) for the salmon harvesting sector in each region. The value of the commercial salmon harvest was assessed based on estimated harvest levels and assumed market prices received by commercial fishers. Net personal income was estimated based on the proportion of gross revenue represented by income to the operator. This proportion has historically averaged 33 percent of gross salmon revenues in Oregon and 39 percent in California.

Commercial salmon harvest impacts were considered substantial if harvest levels within a region change by more than 30 percent relative to No Action levels.

Commercial salmon harvest impacts were considered substantial if harvest levels within a region changed by more than 30 percent relative to No Action levels. This threshold was selected because it approximates the variation in harvest levels within the coastal regions between 1970 and 1990. Impacts to ocean sportfishing for

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TABLE 3-19
Ocean Salmon Sportfishing Trips and Angler Benefits (in 1997 dollars)

Trips and Benefits by Region of Activity	No Action	Change Compared to No Action: Maximum Flow	Flow Evaluation	Percent Inflow	Mechanical Restoration	State Permit	Change to Existing Conditions: 1995 Existing Conditions	2020 Preferred Alternative
Northern/Central Oregon[a]								
Total Trips	186,710	207,050	205,830	201,720	201,170	161,880	150,740	205,830
Angler benefits	$13,443,120	$14,907,600	$14,819,400	$14,523,840	$14,484,240	$11,655,720	$10,853,640	$14,819,400
Net change in angler benefits		$1,464,480	$1,376,280	$1,080,720	$1,041,120	-$1,787,400		$3,965,760
Percent change in angler benefits		11%	10%	8%	8%	-13%		37%
KMZ-Oregon[a]								
Total Trips	56,970	95,970	94,390	88,280	87,300	49,330	38,960	94,390
Angler benefits	$4,101,840	$6,909,840	$6,796,080	$6,356,160	$6,285,600	$3,551,760	$2,805,120	$6,796,080
Net change in angler benefits		$2,808,000	$2,694,240	$2,254,320	$2,183,760	-$550,080		$3,990,960
Percent change in angler benefits		68%	66%	55%	53%	-13%		142%
KMZ-California[a]								
Private boat trips	40,930	50,080	49,540	47,430	47,130	32,890	27,720	49,540
Private boat angler benefits	$2,516,400	$3,605,760	$3,566,880	$3,414,960	$3,393,360	$2,367,360	$1,879,200	$3,566,520
Net change in angler benefits[a]		$1,089,360	$1,050,480	$898,560	$876,960	-$149,040		$1,687,320
Percent change in angler benefits		43%	42%	36%	35%	-6%		90%
Charter boat trips	1,290	2,250	2,210	2,070	2,050	1,170	1,020	2,210
Charter boat angler benefits	$92,880	$162,000	$159,120	$149,040	$147,600	$84,240	$73,440	$159,120
Net change in angler benefits[a]		$69,120	$66,240	$56,160	$54,720	-$8,640		$85,680
Percent change in angler benefits		74%	71%	60%	59%	-9%		117%
Mendocino[a]								
Private boat trips	29,700	39,680	38,970	35,970	35,440	22,170	21,060	38,970
Private boat angler benefits	$2,137,680	$2,856,960	$2,805,840	$2,589,840	$2,551,680	$1,596,240	$1,516,320	$2,805,840
Net change in angler benefits		$719,280	$668,160	$452,160	$414,000	-$541,440		$1,289,520
Percent change in angler benefits		34%	31%	21%	19%	-25%		85%
Charter boat trips	4,020	6,270	6,110	5,390	5,290	2,580	2,860	6,110
Charter boat angler benefits	$290,160	$451,440	$439,920	$388,080	$380,880	$185,760	$205,920	$439,920
Net change in angler benefits		$161,280	$149,760	$97,920	$90,720	-$104,400		$234,000

TABLE 3-19
Ocean Salmon Sportfishing Trips and Angler Benefits (in 1997 dollars)

		Change Compared to No Action					Change to Existing Conditions	
Trips and Benefits by Region of Activity	**No Action**	**Maximum Flow**	**Flow Evaluation**	**Percent Inflow**	**Mechanical Restoration**	**State Permit**	**1995 Existing Conditions**	**2020 Preferred Alternative**
Percent change in angler benefits		56%	52%	34%	31%	-36%		114%
San Francisco[a]								
Private boat trips	57,100	57,100	57,100	57,100	57,100	54,330	44,800	57,100
Private boat angler benefits	$4,110,480	$4,110,480	$4,110,480	$4,110,480	$4,110,480	$3,911,760	$3,225,600	$4,110,480
Net change in angler benefits		$0	$0	$0	$0	-$198,720		$884,880
Percent change in angler benefits		0%	0%	0%	0%	-5%		27%
Charter boat trips	82,310	83,390	83,390	83,390	83,390	76,930	64,600	83,390
Charter boat angler benefits	$5,926,320	$6,004,080	$6,004,080	$6,004,080	$6,004,080	$5,538,960	$4,651,200	$6,004,080
Net change in angler benefits		$77,760	$77,760	$77,760	$77,760	-$387,360		$1,352,880
Percent change in angler benefits		1%	1%	1%	1%	-7%		29%
Monterey[a]								
Private boat trips	89,070	89,070	89,070	89,070	89,070	84,890	56,040	89,070
Private boat angler benefits	$6,413,040	$6,413,040	$6,413,040	$6,413,040	$6,413,040	$6,112,080	$4,034,880	$6,413,040
Net change in angler benefits		$0	$0	$0	$0	-$300,960		$2,378,160
Percent change in angler benefits		0%	0%	0%	0%	-5%		59%
Charter boat trips	43,710	43,710	43,710	43,710	43,710	40,610	27,500	43,710
Charter boat angler benefits	$3,147,120	$3,147,120	$3,147,120	$3,147,120	$3,147,120	$2,923,920	$1,980,000	$3,147,120
Net change in angler benefits		$0	$0	$0	$0	-$223,200		$1,167,120
Percent change in angler benefits		0%	0%	0%	0%	-7%		59%
Totals for All Regions								
Total trips	591,820	674,570	670,320	654,130	651,650	526,780	435,300	670,320
Total angler benefits	$42,179,040	$48,568,320	$48,261,960	$47,096,640	$46,918,080	$37,927,800	$31,225,320	$48,261,960

[a]For Oregon ports, only one model for predicting the number of boat (both private and charter) trips taken by sportfishers was available; for California ports, separate models for predicting trips taken by charter and private boats were available for analyzing benefits of ocean sportfishing activity.

salmon were considered substantial if they changed by more than 20 percent relative to No Action levels.

No Action. Angler benefits associated with ocean sportfishing for salmon are shown by region in Tables 3-20 and 3-21. Across all regions, this alternative generates an estimated $35.2 million in angler benefits, with San Francisco and Monterey accounting for nearly 56 percent of all angler benefits. Harvest levels, gross revenues, and net income associated with ocean commercial fishing for salmon are shown in Table 3-21. Under the No Action Alternative, net income associated with ocean commercial fishing for salmon across all regions is estimated at $6.8 million, with the Northern / Central Oregon Coastal Region accounting for nearly 40 percent of this total.

Maximum Flow. The Maximum Flow Alternative would have a substantial beneficial impact on angler benefits in both KMZ regions and the Mendocino Region (Table 3-19). Net income for charter boat operators who fish for ocean salmon in these regions also would increase substantially. Across all regions, this alternative generates a 16 percent increase in angler benefits relative to the No Action Alternative. Increased benefits for all measures of ocean commercial fishing (i.e., harvest, gross revenue, and net income) would range from 57 percent higher in the Northern / Central Oregon Coastal Region to more than 1,000 percent higher in the KMZ-California Region compared to levels under the No Action Alternative (Table 3-21).

Commercial and sport fishing for salmon in the San Francisco and Monterey Regions would be largely unaffected because these regions have historically been less affected by restraints imposed to protect Klamath Basin salmon.

Flow Evaluation. The Flow Evaluation Alternative would have a substantial beneficial impact on angler benefits in both KMZ regions and the Mendocino Region (Table 3-21). Net income for charter boat operators who fish for ocean salmon in these regions also would increase substantially. Across all regions, this alternative generates a 15 percent increase in angler benefits relative to the No Action Alternative. Increased benefits for all measures of ocean commercial fishing would range from 53 percent in the Northern / Central Oregon Coastal Region to more than 950 percent in the KMZ-California Region compared to No Action levels (Table 3-21). Commercial and sport fishing for salmon in the San Francisco and Monterey Regions would be largely unaffected because these regions have historically been less affected by restraints imposed to protect Klamath Basin salmon.

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TABLE 3-20
Fish Harvest Estimates by Alternative

	Alternatives					
	No Action	**Maximum Flow**	**Flow Evaluation**	**Percent Inflow**	**Mechanical Restoration**	**State Permit**
Ocean Salmon Commercial Fishery						
Northern /Central Oregon						
Trinity River naturally produced	1,390	21,520	17,330	4,810	3,440	0
Total	369,100	580,300	565,500	517,700	511,600	197,500
KMZ-Oregon						
Trinity River naturally produced	50	1,280	990	220	150	0
Total	2,500	27,100	25,200	18,800	17,900	0
KMZ-California						
Trinity River naturally produced	50	1,070	860	190	120	0
Total	2,100	23,800	22,100	16,500	15,800	0
Mendocino						
Trinity River naturally produced	150	3,480	2,710	630	430	0
Total	13,700	96,600	85,600	49,800	45,200	0
San Francisco						
Trinity River naturally produced	1,030	4,470	4,170	2,330	1,910	0
Total	199,300	208,200	208,200	208,200	208,200	144,700
Monterey						
Trinity River naturally produced	800	3,480	3,240	1,820	1,490	0
Total	155,100	155,100	155,100	155,100	155,100	112,300
Totals for All Regions						
Trinity River naturally produced	3,470	35,300	29,300	10,000	7,540	0
Total	741,800	1,091,100	1,061,700	966,100	953,800	454,500
Ocean Salmon Sport Fishery						
Northern/Central Oregon	99,200	156,000	152,100	139,200	137,600	53,100
KMZ-Oregon	3,600	38,700	36,000	26,900	25,600	3,600
KMZ-California	4,000	45,200	42,000	31,300	30,000	4,000
Mendocino	2,200	15,600	13,800	8,000	7,300	2,200
San Francisco	73,800	77,100	77,100	77,100	77,100	53,600
Monterey	50,000	50,000	50,000	50,000	50,000	36,200
Total for All Regions	**232,800**	**382,600**	**371,000**	**332,300**	**327,600**	**152,700**

TABLE 3-21
Total Ocean Commercial Salmon Harvest Impacts Compared to No Action (in 1997 dollars)

Region of Harvest	No Action	Maximum Flow		Flow Evaluation		Percent Inflow		Mechanical Restoration		State Permit	
		Net Change	Percent Change	Net Change	Percent Change	Net Change	Percent Change	Net Change	Percent Change	Net Change	Percent Change
Northern/Central Oregon											
Salmon landed	369,100	211,200	57	196,400	53	148,600	40	142,500	39	-171,600	-46
Pounds landed (1,000)	3,469.5	1,985.3	57	1,846.2	53	1,396.8	40	1,339.5	39	-1,613.0	-46
Gross harvest revenue ($1,000)	$7,999.1	$4,577.1	57	$4,256.4	53	$3,220.5	40	$3,088.3	39	-$3,718.9	-46
Net harvest income ($1,000)	$2,655.7	$1,519.6	57	$1,413.1	53	$1,069.2	40	$1,025.3	39	-$1,234.7	-46
KMZ-Oregon											
Salmon landed	2,500	24,600	984	22,700	908	16,300	652	15,400	616	-2,500	-100
Pounds landed (1,000)	23.5	231.2	984	213.4	908	153.2	652	144.8	616	-23.5	-100
Gross harvest revenue ($1,000)	$54.2	$533.1	984	$492.0	908	$353.3	652	$333.7	616	-$54.2	-100
Net harvest income ($1,000)	$18.0	$177.0	984	$163.3	908	$117.3	652	$110.8	616	-$18.0	-100
KMZ-California											
Salmon landed	2,100	21,700	1,033	20,000	952	14,400	686	13,700	652	-2,100	-100
Pounds landed (1,000)	20.6	212.7	1,033	196.0	952	141.1	686	134.3	652	-20.6	-100
Gross harvest revenue ($1,000)	$61.9	$639.9	1,033	$589.8	952	$424.6	686	$404.0	652	-$61.9	-100
Net harvest income ($1,000)	$24.2	$249.6	1,033	$230.0	952	$165.6	686	$157.6	652	-$24.2	-100
Mendocino											
Salmon landed	13,700	82,900	605	71,900	525	36,100	264	31,500	230	-13,700	-100
Pounds landed (1,000)	134.3	812.4	605	704.6	525	353.8	264	308.7	230	-134.3	-100
Gross harvest revenue ($1,000)	$404.0	$2,444.6	605	$2,120.2	525	$1,064.5	264	$928.9	230	-$404.0	-100
Net harvest income ($1,000)	$157.6	$953.4	605	$826.9	525	$415.2	264	$362.3	230	-$157.6	-100
San Francisco											
Salmon landed	199,300	8,900	4	8,900	4	8,900	4	8,900	4	-54,600	-27
Pounds landed (1,000)	1,953.1	87.2	4	87.2	4	87.2	4	87.2	4	-535.1	-27
Gross harvest revenue ($1,000)	$5,877.0	$262.4	4	$262.4	4	$262.4	4	$262.4	4	-$1,610.0	-27
Net harvest income ($1,000)	$2,303.8	$102.9	4	$102.9	4	$102.9	4	$102.9	4	-$631.1	-27
Monterey											
Salmon landed	155,100	0	0	0	0	0	0	0	0	-42,800	-28
Pounds landed (1,000)	1,520.0	0.0	0	0.0	0	0.0	0	0.0	0	-419.4	-28
Gross harvest revenue ($1,000)	$4,573.6	$0.0	0	$0.0	0	$0.0	0	$0.0	0	-$1,262.1	-28
Net harvest income ($1,000)	$1,614.5	$0.0	0	$0.0	0	$0.0	0	$0.0	0	-$445.5	-28

TABLE 3-21
Total Ocean Commercial Salmon Harvest Impacts Compared to No Action (in 1997 dollars)

		Maximum Flow		Flow Evaluation		Percent Inflow		Mechanical Restoration		State Permit	
Totals for All Regions											
Salmon landed (1,000)	741,800	349,300	47	319,900	43	224,300	30	212,000	29	-287,300	-39
Pounds landed (1,000)	7,121.0	3,328.8	47	3,047.4	43	2,132.1	30	2,014.5	29	-2,743.9	-39
Gross harvest revenue ($1,000)	$18,969.8	$8,457.1	45	$7,720.8	41	$5,325.3	28	$5,017.3	26	-$7,111.1	-37
Net harvest revenue ($1,000)	$6,773.8	$3,002.5	44	$2,736.2	40	$1,870.2	28	$1,758.9	26	-$3,509.1	-37

Note: Under the Preferred Alternative, harvest, gross revenue, and net income levels would be similar to levels under the Flow Evaluation Alternative. Relative to levels under modeled 1995 existing conditions, which are assumed to be similar to levels under the No Action Alternative, effects of the Preferred Alternative would be similar to effects shown in this table for the Flow Evaluation Alternative.

Percent Inflow. This alternative would result in a substantial, beneficial impact on angler benefits in both KMZ regions and the Mendocino Region (Table 3-19). Net income for charter boat operators who fish for salmon in these regions would increase substantially. Across all regions, this alternative generates a 12 percent increase in angler benefits relative to the No Action Alternative. Increased benefits for all measures of ocean commercial fishing would range from 40 percent in the Northern / Central Oregon Coastal Region to approximately 690 percent in the KMZ-California Region compared to No Action levels (Table 3-21).

Commercial and sport fishing for salmon in the San Francisco and Monterey Regions would be largely unaffected because these regions have historically been less affected by restraints imposed to protect Klamath Basin salmon.

Mechanical Restoration. This alternative would result in a substantial beneficial impact on angler benefits in both KMZ regions and the Mendocino Region. Net income for charter boat operators who fish for ocean salmon in these regions would increase substantially. This alternative would generate a 12 percent increase in angler benefits across all regions, relative to the No Action Alternative. Increased benefits for all measures of ocean commercial fishing would range from 39 percent in the Northern / Central Oregon Coastal Region to 650 percent in the KMZ-California Region compared to No Action levels (Table 3-21). Commercial and sport fishing for salmon in the San Francisco and Monterey Regions would be largely unaffected because these regions have historically been less affected by restraints imposed to protect Klamath Basin salmon.

State Permit. The State Permit Alternative would adversely affect angler benefits and the net income of charter boat operators in all regions, but these impacts would be substantial only in the Mendocino Region (Table 3-19). Commercial fishing would be adversely affected under this alternative, with reductions in harvests and related economic benefits ranging from 100 percent in the KMZ and Mendocino Regions (because of closures to protect Trinity River fish populations) to 27 percent in the San Francisco Region (Table 3-21)

Existing Conditions versus Preferred Alternative. Sportfishing and commercial fishing effects under the Preferred Alternative compared to existing conditions (i.e., 1995) would be similar to the changes between the Flow Evaluation and No Action Alternatives, although sportfishing activity for salmon would continue to increase in response to population (human) growth (Table 3-19).

Mitigation. No mitigation is available for harvest-related reductions under the State Permit Alternative.

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3.6 Tribal Trust

The need for the proposed action to restore and maintain the natural production of anadromous fish in the Trinity River mainstem stems, in part, from the federal government's trust responsibility to protect the fishery resources of the region's Indian tribes[7]. The alternatives under consideration differ in how they satisfy this need. In addition, the alternatives may affect tribal access to other trust-protected assets including non-anadromous fish, water, wildlife, and vegetation. These impacts could consequently affect the sociocultures and economies of the tribes. It is for this reason that the tribes are not solely concerned with fish numbers, but more broadly, riverine health, although anadromous fish are recognized as an extremely important indicator of this health.

The need for the proposed action…stems, in part, from the federal government's trust responsibility to protect the fishery resources of the region's Indian tribes.

In this section the Affected Environment is divided into:

- History of the Reservations
- Indian Reserved Rights
- Potentially Impacted Indian Trust Assets
- Cultural Environment
  - Salmon Culture
  - Hupa Traditions
  - Yurok Traditions
  - Hupa Language Resources and Oral Tradition
  - Yurok Language Resources and Oral Tradition
- Fishing History
- The Damming of the River

The Environmental Consequences section is divided into:

- Methodology
- Significance Criteria
- An assessment of the impacts from each of the alternatives

As stated in Chapter 1, the term cultural as it is used here refers to the cultural anthropology of the tribes, not their archaeologically significant artifacts and monuments (which are addressed in Section 3.12).

The trust assets discussion focuses principally on the interests of the Hoopa Valley and Yurok Tribes since, of the Indian tribes of the Klamath/Trinity Region, their interests would be the most directly affected by the project. It should be understood, however, that the

[7] The Trinity River Basin Fish and Wildlife Management Reauthorization Act of 1995 expressly acknowledges the tribal interest in the Basin's fishery resources by declaring that the measure of successful restoration of the Trinity River fishery includes the "ability of dependent tribal…fisheries" to participate fully, through enhanced inriver "harvest opportunities, in the benefits of restoration." In addition, the 1992 CVPIA specifically recognizes the federal trust responsibility in regard to the Trinity River fishery.

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impacts are pertinent to the Karuk and Klamath people as well since they share a common regional heritage with the Hupa and Yurok and may be impacted by the project, particularly as it affects the hydrology of the Klamath River.

Affected Environment.

History of the Reservations. The United States' original recognition of the central importance of rivers and fish to the Indian people of the Klamath / Trinity Region is exemplified by the very shape and location of the lands first set aside for their reservations. The Secretary's own instructions at the time were, "to select these reservations from such 'tracts of land adapted as to soil, climate, water privileges, and timber, to the comfortable and permanent accommodation of the Indians' " (Kappler, 1904). In 1855, Indian Agent S. Whipple, when speaking of the Yurok, noted that: "The river is abundantly supplied with Salmon. A fine large fish quite easily taken by the Indians and which is very properly regarded by the Indian as his staff of life" (S. G. Whipple, 1855).

The central importance of rivers and fish to the Indian people of the Klamath/Trinity Region is exemplified by the very shape and location of the lands first set aside for their reservations.

In that same year, President Pierce established the Klamath River Reservation. The reservation (not to be confused with the Klamath Reservation in Oregon) was designated as a strip of territory commencing at the Pacific Ocean and extending 1 mile in width on each side of the Klamath River for a distance of approximately 20 miles. This reservation was created entirely within the aboriginal territory of the Yurok. Although the federal government's intent was to eventually move all the region's Indians onto the Klamath River Reservation, only some Yurok and Tolowa were moved. Flooding along the Klamath River in 1862 led to the closing of the area's Indian Bureau office and contributed to the erroneous belief that the reservation had been abandoned, though it was still occupied by the Yurok (Thomas Gates, personnel communication, 1997).

On August 21, 1864, the DOI issued a proclamation and instructions that established the Hoopa Valley Reservation on the Trinity River pursuant to legislation enacted by Congress that same year. The reservation is 12 miles square and bisected by 15 miles of the river (it has often been called the Square or the 12-mile Square). In 1876 President Grant issued an Executive Order formally establishing the boundaries of the Hoopa Valley Reservation, and provided that the land contained within those boundaries, "be withdrawn from public sale, and set apart in California by act of Congress approved April 8, 1864" (Kappler, 1904).

Efforts soon began to provide a single contiguous homeland for the region's Indian people by connecting the Klamath River Reservation to the Hoopa Valley Reservation. Paris Folsom, a Special Agent for the DOI, proposed that the two reservations be connected in his

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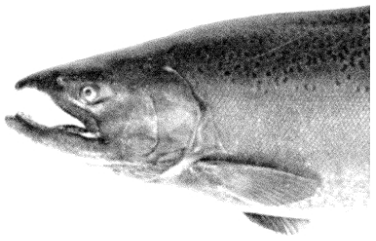
"Report of Special Agent on Conditions and Needs of Non-Reservation Klamath Indians," sent to the Commissioner of Indian Affairs in 1885. In that report Mr. Folsom wrote:

> Nature seems to have done her best here to fashion a perfect paradise for these Indians … She filled the mouth of the Klamath River with a sand-bar and huge rocks, rendering ordinary navigation impossible, and pitched the mountains on either side into such steep and amazing confusion that the river has a hard struggle to drive its way through the wonderful gorges ... Tremendous bowlders (sic) and cragged points jut into the river and change its course, forming innumerable eddies and back currents, where salmon seek to rest, to be taken in large numbers by means of Indian nets. (Folsom, 1885)

In 1891 President Harrison extended the Hoopa Valley Reservation from the mouth of the Trinity River to the ocean, thereby encompassing and including the Hoopa Valley Reservation, the original Klamath River Reservation, and the connecting strip between. By that time, as a result of the Dawes Act of 1887, much of the Klamath River Reservation and extension lands (the 20-mile strip that connected the two reservations is commonly referred to as the "Connecting Strip" or "Extension") not already claimed as allotments by resident Indians had been opened up to non-Indian settlement. This led to checkerboard ownership of the Yurok portions of both the Extension and former Klamath River Reservation. Through various means, several timber companies quickly consolidated and heavily logged much of this land.

From 1891 through 1988 the Hoopa Valley Reservation was comprised of the Hoopa Valley Square, the Extension, and the original Klamath River Reservation. In 1988, Congress, under the Hoopa-Yurok Settlement Act, separated the Hoopa Valley Reservation into the present Yurok Reservation (a combination of the original Klamath River Reservation and Extension) and Hoopa Valley Reservation (the reservation as proclaimed in 1864: Figure 3-38).



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Indian Reserved Rights. By first creating reservations "for Indian Purposes," the United States sought to provide the Hoopa Valley and Yurok Tribes with the opportunity to remain mostly self-sufficient, exercise their rights as sovereigns, and maintain their traditional ways of life (Pevar, 1992). Implicit in this objective was an expectation that the federal government would protect the tribes and their resources (a protection that extended beyond reservation borders).

Fishing Rights. Salmon, steelhead, sturgeon, and lamprey that spawn in the Trinity River pass through the Hoopa Valley and Yurok Reservations and are harvested in tribal fisheries. The fishing traditions of these tribes stem from practices that far pre-date the arrival

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of non-Indians. Accordingly, when the federal government established what are today the Hoopa Valley and Yurok Indian Reservations on the Trinity and lower Klamath Rivers, it reserved for the benefit of the Indian tribes of those reservations a right to the fish resources in the rivers running through them. The United States has long recognized the rights of the tribes of the Klamath / Trinity River Basin to fish. The federal government, as trustee, has an affirmative obligation to manage tribal rights and resources for the benefit of the tribes.

Tribal fishing rights are vested property rights held in trust by the United States for the benefit of the Indians. These rights have been acknowledged and confirmed by the executive, legislative, and judiciary branches of the federal government in a number of authorities including: (1) Secretarial Issue Document on Trinity River Fishery Mitigation, issued January 14, 1981; (2) Opinion of the Solicitor of the DOI re: Fishing Rights of the Yurok and Hoopa Valley Tribes (M-36979: October 4, 1993); (3) the CVPIA (3406 (b)(23)); and (4) *Parravano v. Babbitt*, 837 F. Supp. 1034 (N.D. Calif. 1993), 861 F. Supp. 914 (N.D. Calif. 1994), affirmed 70 F.3d 539 (9th Cir. 1995), cert. denied, 518 U.S. 1016 (1996). In most cases, tribal fishing rights cannot be supplanted by state or federal regulation.

The above referenced 1993 solicitor's opinion: (1) reaffirms the historic and legal basis of the reserved fishing rights of the Hoopa Valley and Yurok Tribes; (2) acknowledges the federal government's cognizance of the importance of fish to these Indians at the time it first established reservations on their behalf; (3) concludes that the tribes' reserved fishing rights entitle them to what is necessary to support a moderate standard of living, or 50 percent of the harvestable share of the Klamath-Trinity Basin fishery, whichever is less; (4) recognizes that under the current depleted condition of the fishery, a 50 percent allocation does not adequately meet the tribes' needs; and (5) argues that it was the degree of the Hoopa Valley and Yurok Tribes' dependence on fisheries at the time their reservations were first created or expanded, and not the tribes' specific uses of the fish, that is relevant in quantifying their fishing rights.

The reserved fishing right includes the right to harvest quantities of fish that the Indians require to maintain a moderate standard of living.

Today, the reserved fishing right includes the right to harvest quantities of fish that the Indians require to maintain a moderate standard of living, unless limited by the 50 percent allocation. Specifically, the tribes have a right to harvest all trust species of Klamath and Trinity River fish for their subsistence, ceremonial, and commercial needs. Tribal harvest of these species is guided by conservation requirements outlined in carefully developed tribal harvest management plans.

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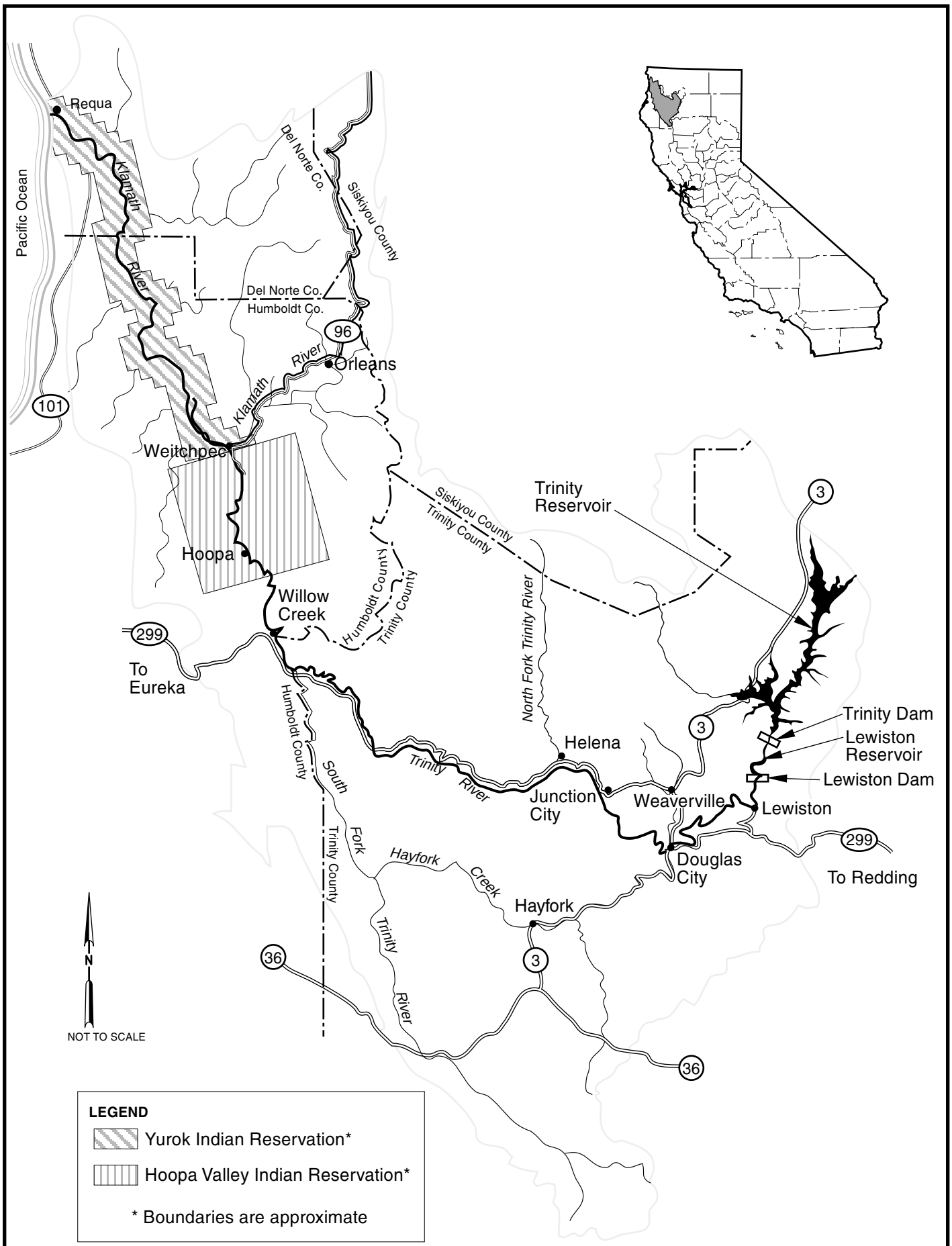

FIGURE 3-38
TRINITY BASIN INDIAN RESERVATIONS
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

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Water Rights. In addition to fish, the tribes have reserved rights to water. The concept of reserved rights in general, and Indian reserved water rights specifically, originated just after the start of the 20th century with *Winters v. United States*, 207 U.S. 564 (1908). The ruling in this case, commonly referred to as the Winters Doctrine, states that when the federal government established a reservation, it implicitly reserved a quantity of water necessary to fulfill the purposes of said reservation. Generally, all original documents related to the establishment of reservations—treaty, executive order, or statute—indicate, at a minimum, that the purpose of the reservations is to provide a permanent home for the tribe(s) in question. In cases where reservations have been created with specific language stating or implying reserved fishing, hunting, gathering, or other rights, the *Winters* Doctrine has been interpreted to mean that adequate water supplies for these purposes have been reserved (even in addition to more general uses - see *U.S. v. Adair*, 723 F.2d 1410 [9th Cir. 1983]).

The DOI solicitor's office reaffirmed these rights with respect to Reclamation's activities, stating that: "Reclamation is obligated to ensure that project operations not interfere with the Tribes' senior water rights. This is dictated by the doctrine of prior appropriations as well as Reclamation's trust responsibility to protect tribal trust resources" (U.S. Department of the Interior, Office of the Solicitor, Pacific Southwest Region, 1995). Furthermore, the solicitor's office notes that the Secretary, "through Reclamation, must operate reclamation projects consistent with vested, fairly implied senior Indian water rights" (U.S. Department of the Interior, Office of the Solicitor, Pacific Southwest and Northwest Regions, 1997). Further, absent a "completed adjudication or other determination, of the senior water rights," projects must be "operated based on the best available information."

Reclamation is obligated to ensure that project operations not interfere with the Tribes' senior water rights.

The alternatives in this DEIS/EIR have important implications for the federal government's duty to protect those rights. Pursuant to statutory and fiduciary obligations, sufficient water must remain in the Trinity River to support the anadromous fishery and other trust resources.

Rights to Wildlife and Vegetation Resource. While the focus of the legal history surrounding Indian rights to resources has mostly focused on water and fisheries, it is important to recognize that other resources such as wildlife and vegetation are extremely important to the tribes and no less reserved. In the case of the Hoopa Valley and Yurok Tribes, the decline in the health of the region's rivers has limited the availability of grasses and other plants important to traditional basketry, art, and medicine. Thus, while anadromous fish are the focus of the proposed action, other trust assets such as vegetation also fall under the umbrella of the federal government's trust

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Other trust assets such as vegetation also fall under the umbrella of the federal government's trust responsibility and accordingly, need to be considered in the decision-making process.

responsibility and, accordingly, need to be considered in the decision-making process.

Potentially Impacted Indian Trust Assets. Indian tribes of the Klamath / Trinity Region have firmly established federally protected rights to numerous natural resources. These general resource groupings represent culturally important Indian trust assets. A partial list of trust assets, particularly those potentially affected by the alternatives, is presented in Table 3-22. While each tribe has its own uses for the species / resources presented, the table provides a general summary of what these uses are.

TABLE 3-22
Partial List of Tribal Trust Assets

Asset	Primary Uses by Tribes
Fish[a]	
Fall chinook salmon	Subsistence, ceremonial, commercial
Spring chinook salmon	Subsistence, ceremonial, commercial
Summer steelhead	Subsistence, ceremonial, commercial
Fall steelhead	Subsistence, ceremonial, commercial
Winter steelhead	Subsistence, ceremonial, commercial
Coho salmon	Subsistence, ceremonial, commercial
Pacific lamprey	Subsistence, ceremonial, commercial
Sturgeon	Subsistence, ceremonial, commercial
Eulachon	Subsistence, ceremonial, commercial
Vegetation	
Willow shoots	Basketry, ceremonial
Cottonwood	Basketry
Wild grape	Basketry
Bulrush	Basketry
Hazel sticks	Basketry and weaving, ceremonial
Tules	Medicine
Spearment	Medicine, subsistence
Blackberries	Subsistence
Water	Subsistence, ceremonial, commercial, medicine
Wildlife	
Bear	Subsistence
Bald eagle	Ceremonial
Blue heron	Ceremonial
Mallard	Ceremonial

[a] While many of the fish listed are not currently commercially harvested by the tribes of the region, historically, all these trust species were used for commercial purposes, and the tribes continue to have the right for commercial harvest.

Sources: Hoopa Valley, Karuk, and Yurok Tribes

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Cultural Environment. Indian uses of natural resources, and the cultural significance of those resources, developed over many centuries. Since time immemorial Indian people have lived in the heavily forested drainages of the Klamath and Trinity Rivers and adjacent streams in Northwestern California. Over the centuries they learned to efficiently utilize the natural bounty of their territories; hunting, fishing, and gathering were the foundation of their societies. Tribes in the area included: the Hoopa Valley, Chilula, Whilkut, and Nongatl speaking Athabascan languages; the Yurok and Wiyot speaking Algonkian languages; the Karuk, Shasta, and Chimariko speaking Hokan languages; and the Wintun speaking a Penutian language.

Some of these tribes, such as the Chilula, no longer exist. Others, including the Chimariko and Wintu, have never been officially recognized by the United States as a distinct and sovereign people. In fact, amongst the Indian peoples still present within the region, only the Hoopa Valley, Karuk, Klamath, and Yurok Tribes have received this recognition.

The aboriginal lands of the Hupa people are centered on the drainages of the Hoopa Valley of the Trinity River. The aboriginal lands of the Yurok were generally centered on the Klamath River drainage from the mouth of the river at the Pacific Ocean up to and including Slate Creek Drainage. Yurok ancestral territory also extends up the Trinity River to Tank Creek and includes the village of Oslegoits, 6 miles from the Trinity's confluence with the Klamath.

There have always been strong social, cultural, and economic ties among the tribes of the Klamath/Trinity Basin; ties based in large part on a shared reliance on the region's rivers and associated resources, particularly salmon. This reliance extends well beyond subsistence and commerce to the cultural and social fabric of their societies; as evidenced by their traditional, ceremonial, and spiritual ways of life which focus and center on the rivers and the fish, wildlife, and vegetation they support. For Indians of the Klamath/Trinity Region, the interaction and identification with the natural environment so defines their cultures, lifestyles, and religions, that its degradation has had a profoundly devastating impact.

The Salmon Culture. Salmon far exceeds other resources in its importance to the diet and cultures of the Hoopa Valley, Yurok, and other tribes who have historically lived in the Klamath/Trinity Basin (Swezey and Heizer, 1977; Warburton and Endert, 1966). The United States Court of Appeals for the Ninth Circuit recognized in *Blake v. Arnett*, 663 F.2d 906, 909 (9th Cir. 1981)(quoting *U.S. v. Winans*, 198 U.S. 371, 381 [1905]), the primary importance of salmon to these tribes when the court concluded that the fishery was "not much less necessary to the existence of the Indians than the atmosphere they

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breathed." The abundance of salmon has always been an important measure of tribal well-being—where feasting is not simply an exercise in eating, but has deep rooted connections to the vitality of the Earth and a traditional connotation of community health (Gunther, 1926). The timing and cycle of many tribal societal, religious, and economic activities were made to closely coincide with the seasonal and geographic variations in fish runs, particularly the arrival of the first salmon.

Despite variations in the size of the semi-annual runs, in times past, the tribes could typically procure enough salmon for their people. The abundance of fish once supported by the region's rivers is well documented, with stories that recount the challenge of fording the Trinity, and even Klamath River, because the salmon runs were so thick. It is estimated that prior to non-Indian settlement along California's North Coast, the region's Indians consumed over 2 million pounds of salmon annually from runs which are believed to have exceeded half a million fish (U.S. Bureau of Indian Affairs, 1985). Fishing by the Hupa and Yurok had one of the highest yield-to-effort ratios (i.e. was the most efficient) of any subsistence undertaking in all of North America (Swezey and Heizer, 1977). This was due not only to the abundance of fish, but the various fishing techniques developed by both tribes. As stated by Roberts (1982), "native technology was developed to the point of enabling their maximum use of the resource, while ensuring adequate propagation of the species."

The tribes also shared a strong spirit of cooperation in their use of the region's fishery resources. For example, salmon runs historically were protected by a very strict series of laws and traditional mores prohibiting over-fishing and ensuring that only the amount needed by tribal communities was taken. Laws also served to guarantee that upstream people received a fair share of the salmon, and most importantly, that weir gates (i.e., fish dams) were kept opened for extended periods during harvest time to insure that adequate numbers of salmon could reach their spawning grounds. Other management activities included the clearing of smaller tributaries to facilitate fish migration. Furthermore, the tribes heeded tales that warned against eating too much and wasting food lest it run out, and they had a belief system that stated that the salmon would be withheld if abused or mistreated (Lewis, 1994). Such prohibitions continue to be voiced today by tribal elders.

During the pre-Euro-American contact period, fisheries were an essential part of the economy of the region's tribes. The sharing, trading, and consumption of fish was so important that fishing places were acquired as property. Fish were also used for commercial purposes, and were traded in substantial volume. Northwest

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California Indians have been catching salmon for trade with other tribes since time immemorial. Trade enabled them to acquire food, raw materials, and manufactured goods. The trade, which involved both necessities and luxuries of native life, existed because of the variation in available local resources. Food preservation methods were developed, which allowed fish to be stored throughout the year and transported over great distances. Salmon continues to this day to represent an important economic resource for the Hoopa Valley and Yurok Tribes.

Hupa Traditions. Without the Trinity River, the Hupa, and their traditions, would not have developed as they are today (Lois Risling, personal communication, April 10, 1997). The Trinity River is of unique and irreplaceable value to the Hupa. It is a vital natural resource that is the foundation of their social and cultural way of life. At its most basic level, the river has always been a source for food and other necessities of daily Hupa life. The river also provides basket materials, fishnet materials, and a means of transportation. Even rocks from the river are used by Hupa people to practice their cultural ways. That every traditional Hupa village was located and built along the Trinity River underscores the vital importance of the river to Hupa culture and traditions. One of these villages, *Me'dilding*, "boat-place" was named for its proximity to the river and its central importance as a boat landing. The Trinity River is traveled during religious ceremonies and in recreational activities; it is integral to the Hupa language and its oral tradition and truly represents the binding force of their community.

The Trinity River is of unique and irreplaceable value to the Hupa. It is a vital natural resource that is the foundation of their social and cultural way of life.

Hupa use of the river developed over a long period of time, as evidenced by the complexity of their religious ceremonies and practices. Early contact and early ethnographic periods, circa 1850-1930, indicate that uses of the Trinity River by the Hupa people were directed toward fisheries and religious ceremonies[8], and that such activities were highly integrated (Goddard, undated).

The Fish Dam. Each year, the Hupa built a fish dam across the Trinity River (Bennett, undated). Construction of the fish dam is perhaps the best example of how the material or economic aspects of Hupa life are interconnected with the spiritual, how the river is vital to Hupa experience, and how Hupa culture has been adversely impacted by declining river health.

The dam was assembled through a cooperative effort of all Hupa men. Its construction began in the summer prior to the fall salmon run (September / October) after the Yurok's ritual establishment of the Cappell fish dam above the mouth of the Klamath River. The dam was built from stakes driven into the river bottom in pairs,

[8] Ceremonies that involve prayers offered by people trained to make medicine.

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crossing near the top, and tethered together. A lattice work on the upper side of the dam served to stop the upward migration of salmon. Small platforms built out from the dam provided fishermen places to stand while netting fish. Hupa men fished the fall salmon run at the dam until the first high water washed out the dam.

Hupa Ceremonies. The Hoopa Valley Tribe continues to conduct many of their traditional religious ceremonies. The cultural significance of the Trinity River and its sacred localities is captured in many of these ceremonies. Religious sites on the river are ancient and were designated by spiritual deities at a time beyond living memory. Hupa ceremonies are of unique importance not only to Hupa Indians, but to other Northwest California Indians as well. Prayers at the dances are directed toward the well being of everyone, and food served at the dances is shared with all who attend.

The White Deerskin and Jump Dances, the Flower Dance, and the Brush Dance are all examples of Hupa ceremony which demonstrate the importance of Trinity River flows to the Hupa people and how rivers are vital to Hupa familial and tribal material well-being and self-esteem. The Hupa report that, while these dances and other religious ceremonies have prevailed in modern times, the decline of the Trinity River's health has made their practice increasingly difficult for Hupa medicine people, dancers, and others. Thus, the adverse impacts of an unhealthy river extend beyond the fisheries to religious ceremonies, affecting the very oldest of tribal elders to newborn infants and future generations.

The federal government recognizes that fishing and fish are an integral and indispensable part of the religious ceremonial life of both tribes.

In the past, federal regulations governing fishing on the Hoopa Valley and Yurok Reservations have permitted the taking of fish for ceremonial purposes even when the fisheries were closed to harvest; clear evidence that the federal government recognizes that fishing and fish are an integral and indispensable part of the religious ceremonial life of both tribes. Unfortunately, the poor condition of the inriver fishery in recent times has in some instances forced the Hupa and Yurok to purchase fish from sources off their reservations in order to feed all who attend their ceremonies. Nelson stated:

> A lack of fish has resulted in the scaling down or even cancellation of ceremonies. The continual practice of ceremonies represents an important means for keeping tribal members who live off the reservations connected to their culture and families. However, without enough salmon, many do not come back; and the planning of ceremonies, once a time to appreciate nature's abundance and of spiritual celebration, often brings significant anxiety to the region's native peoples. (Byron Nelson, personal communication, November 1996).

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Hupa White Deerskin Dance and Jump Dance. In two major ceremonies celebrating world renewal, the White Deerskin Dance and Jump Dance, the Hupa honor the Earth and Creator for providing sustenance and the continuance of the Hoopa Valley Tribe. One of the ways of referring to the White Deerskin dance is as the *hun'q'eh-ch'idilye*, "along the river religious dance." This major ceremony is conducted at village sites and resting places by the Trinity River and involves travel on the river.

The White Deerskin Dance is held from late August into September. The exact timing of each of the dances depends upon the river and its waters. The Jump Dance follows 10 days after the conclusion of the White Deerskin Dance. Both dances are held for a period of 10 days. The Hupa bring salmon they have caught at their fishing sites to share with the participants and attendees and offer them for the ceremony.

The dancers set out from *Ta'k'imilding*, the main Hupa village on the northern division of the valley, and move from one village to another. First, they go up the Trinity River to *Xowunq'it*, across from *Me'dilding*, the major village in the southern division of the valley. Here they dance on the afternoon of their arrival, and again the next morning. Then they go by boat to *Tse:mita'h*, on the river just below the mouth of Hostler Creek, and dance one afternoon and one morning. In the afternoon they board boats which have been decorated for the dance.

The Boat Dance is a moving and spectacular part of the White Deerskin Dance, involving dancing and singing while crossing the Trinity River. The Boat Dance coincides with the move of the households in the camps accompanying the dancers from *Tse:mit'ah* on the east side of the Trinity River to *Ch'e:indiqot'ding* on the west side. Its practice celebrates the river's flows and their connotation of river health. The next day, as the dance continues, the camps move to *Tse:k'iwotɬ'ding*, *Ts'ilunding*, *Dahsita:ne:q'it* (resting place: at the foot of Bald Hill), and finally, on Bald Hill, to *Niłtuquluy*, where the last White Deerskin dances are held.

The Hupa's Jump Dance is held at *Ta'k'imilding*, along the Trinity River. This dance is also held for the good of the world, has its own dance steps, songs, and regalia, and involves daily feasting. The completion of the Jump Dance signals a blessing for the year to come, that everyone may be satisfied with small quantities and have their needs met. Both the White Deerskin Dance and the Jump Dance depend on a healthy river for fish, basket materials, bathing, and ambiance. The flows of the river itself are also a central element of these dances as it influences the dancer's ability to travel the river as did their ancestors. The Hupa claim that as the river's flows have declined, so have the Hupa's ability to practice these ceremonies.

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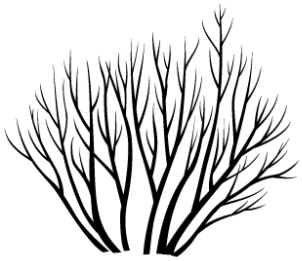

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Hupa Brush and Flower Dances. The Brush Dance is held for the purpose of curing a sick baby or child. At Brush Dances there are designated camps for the downstream Yurok people, and for the Karuk people upstream on the Klamath River. Hupa people themselves traditionally bathe in the Trinity River each morning of the dance, and baskets made with materials from along the river are used in the ceremony. The dance is called the "Brush" Dance because part of the ceremony requires filling quivers with willow brush that grows along the river. As TRD operations have impacted Trinity River flows in the Hoopa Valley, they are thought to have altered and reduced the abundance of willow brush and other basket-making materials vital to this dance and other facets of Hupa life.

The Flower Dance is held at Hupa towns along the river. The purpose of this dance is to train a girl who has just reached adolescence to lead a good life as an adult woman. The girl for whom the dance is held, the *kinahxdung*, traditionally bathes at seven sacred places in the river during training in the Flower Dance ceremony (Bennett, 1994).

Yurok Traditions. The Yurok have many traditional dances and ceremonies which they have long practiced along the banks of the Klamath and Trinity Rivers. Thus, like the Hupa, the Yurok's ceremonial way of life has greatly suffered with deterioration of the region's rivers. The Yurok have always depended on the Klamath and Trinity Rivers and the sustenance that their flows provide; they name themselves after the rivers, and much of their universe is defined in terms of their physical relation to rivers. Residency, natural and cultural resource sites, ceremonial practices, oral history, transportation routes, economic and sociological resources, indeed the Yurok identity, are all intricately woven into the ecosystems of the Klamath and Trinity Rivers.

Residency, natural and cultural resource sites, ceremonial practices, oral history, transportation routes, economic and sociological resources, indeed the Yurok identity, are all intricately woven into the ecosystems of the Klamath and Trinity Rivers.

With the steep terrain and temperate rainforest climate of the Klamath / Trinity Basin, the sun's rising and setting are not an accurate means of tracking time and direction. Thus, the Yurok have always based time and direction on the Klamath's flows. As one Yurok elder said, "without this river we would not know who we are, where we're from or where we're going" (Susie Long, personal communication, October 1996). Under natural conditions, the rates and sounds of the river's flow tell the Yurok both the season and time of day. The skill of the Yurok fisherman has always been measured by his ability to navigate the Klamath River in the dark. Navigation is not done by the stars or landmarks, but by correlating the location and swiftness of the current and back eddy of the river with the sounds that are unique to each bend, slick, and riffle. Every feature of water's movement and characteristics are named by the

Yurok. Even when the Yurok are away from the river they remain acutely aware of their location in relation to it, always measuring direction by the river's flow. For example, it is not uncommon to refer to the burners on a kitchen stove as up- or down-river burners depending on their position in relation to the river's flow.

The Yurok's connection to rivers, and their flows, go far beyond time and direction. Through a long history of observation and inter-generational education they have developed an extensive knowledge of rivers, an ability to astutely interpret what changes in the river's flows and ecosystem mean for the Yurok people. For example, it is known that the spring run of salmon will come soon after the budding of the thimble berry that grows along the Klamath River. It is known that willow-root basket materials are best gathered in a straight narrow section of the river where a flood's raging waters have scoured the roots. The Yurok people have developed numerous ceremonies that officiate this human connection and communication with all these river processes.

A Yurok elder recalls in the 1920s canoeing down the Klamath River with his father. As they approached within 5 miles of the coast they noticed that the river was backed up and stagnant because the sand buildup prevented it from flowing out to the ocean. Prayers and offerings were made on the sandbar. According to the elder, a day later a spirit guardian, represented as a large rock, granted the request; and the river broke through the sand bar, allowing fish to once again enter (Thomas Gates, personal communication, 1997).

The majority of the Yurok cultural sites on the Klamath and Trinity Rivers are traditional fishing spots owned by Yurok families. Fishing spots are locations where there are deep holes, significant back eddies, and ideal spots to set a net or erect a platform out over the river. Fishing spots can be given, inherited, loaned, leased, and bought and sold, and are central to the Yurok economy. Over time, as the rivers' flows have changed, so have the locations of these cultural sites. With nearby mining activity and dam-impeded river flushing, many of these sites have been filled with sediment and are no longer viable for fishing. To this day the Yurok continue to live upon some of the 44 village sites that line the Klamath and lower Trinity Rivers and practice many of their historic traditions. These are places Yurok have lived, fished, gathered, prayed, and been buried for centuries.

Yurok Ceremonies. In early spring, the first salmon to enter the Klamath River was speared and ritually eaten by medicine men. This event traditionally signified the beginning of the fishing season for the Yurok. The ritual also marked the scheduling of the construction of the fish dam at Cappell, located 33 miles from the river's mouth on the Pacific. The fish dam was constructed in conjunction

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with ceremony and sanctified the taking, distribution, and consumption of salmon. Salmon are ritually managed to assure that Yurok people are all provided for, that up-river people are assured a percentage of the fishery, and that enough fish are allowed to repopulate the species. While there still remains a general reverence for salmon, a strong belief prevails that without proper ceremony the salmon will not return in sufficient numbers. All other ceremonies were scheduled after the fish dam construction ceremony took place. The Yurok have many ceremonies in common with the Hupa such as the Jump Ceremony and the White Deerskin Ceremony. An integrated part of the White Deerskin Ceremony is the Boat Dance Ceremony. The river is central to all these ceremonies.

The Brush Dance held in many of the traditional village sites along the Klamath River requires the proper scenic river qualities and the availability of river resources. As a brush dance unfolds over a 4-day period it attests to the wealth that the riverine environment provides. Baskets made of plant materials collected at the water's edge are used to hold food and ceremonial medicine. Acorns, cooked in the baskets, are converted into a nourishing mush that is rendered by placing special hot rocks, gathered off of specific river bars, into the acorn flour and water placed in the baskets. Regalia that adorns the dancers are constructed out of the various plant and animal products that the riverine environment provides. Ceremonial bathing in the river and its tributary creeks is a requirement for some dance participants. Ceremonialists also prepare themselves by listening to the river's sounds. While many guests today arrive by car, many more arrive by the traditional transportation method: boats.

Just as children coming into the Yurok world are introduced in various ways to the rivers and the culture that surrounds their people's riverine way of life, so do the elderly depart from this world via the river and its features. Rocks located in the Klamath and Trinity Rivers and at their edges are seen as spirit people who guide Yurok knowledge concerning proper burial procedures. The deceased's last worldly journey is a boat ride up-river. At each of eighteen rocks from the mouth up to Slate Creek and up the Trinity, various burial rites and prohibitions are observed to assure the best departure for the deceased as well as those that remain in this world. There are several rocks in the mid-section of the rivers that contain rare petroglyphs giving instructions from the Creator to the Yurok people. One such instruction is a warning that when the rivers stop flowing it will mark the end of the Yurok world. Accordingly, some elders have prophesied that the manipulation of flows by damming represents the beginning of the end for the Yurok.

Hupa Language Resources and Oral Tradition. The Hupa language reflects much of what it is to be Hupa and thus represents an

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important factor in preserving their identity. As testament to the importance the Hupa place on language, they have continued to pass their language on to successive generations despite enormous pressures to stop speaking it. Today's tribal elders were actually forbidden to speak their language while in school and were sent to schools many miles away from their homeland to keep them from practicing their cultural ways. These same individuals are currently teaching this complex indigenous language so that Hupa children and others may benefit from the language itself as well as the cultural context in which it developed and flourished.

Some Hupa words depend on the river for their meaning. For example, the four directions and their extensions, by which the Hupa orient themselves to the world, are related to the Trinity River: upstream is *yinuq*, uphill is *yiduq*; downstream is *yide'*, downhill is *yits'en*. Extensions of these directions use their four basic terms, for example, back downstream is *na:yide'*, and way upstream is *yo:inuq*.

Also, Hupa names for other tribes are based on their directional relationship with the Hupa. Yurok people are known as *Yida:ch'in* (from downstream), whereas Chimariko and Wintu people are known as *Yinahch'in* (from upstream). In the past, these words referred to a river that was thriving and healthy. Today, with the perception that the river is no longer healthy, there is selective inhibition of using words that evoke images of a lost past and create a feeling of sadness in the speakers.

Yurok Language Resources and Oral Tradition. As discussed previously, rivers are the mainstream of the Yurok people. Nearly every aspect of Yurok life, their ceremonies, society, and economy, was, and continues to be, bound by the river. Therefore, it is not coincidental that Yurok language and oral history, like that of the Hupa, reflect a strong connection to the riverine environment. Yurok knowledge and tradition is handed down and preserved from generation to generation in stories. Stories are an important part of the education received by younger generations.

The anthropologist Alfred Kroeber traveled throughout the Yurok's territory in the early 1900s interviewing Yurok people and documenting the tribe's way of life. Of the 169 stories that Kroeber presents in his book *Yurok Myths* (Kroeber, 1978), 77 make direct reference to the river. Among those stories, there are tales of the construction of the fish dams, locations and origins of ceremonies held along the river, bad places in the river, where the first salmon was created, what one must do with salmon caught at certain locations, how the river came to flow the way it does, and death passage on the river. It is evident from transcriptions of Yurok stories that rivers are an integral part of their way of life and a basis of their

It is evident from transcriptions of Yurok stories that rivers are an integral part of their way of life and a basis of their traditions and culture.

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traditions and culture. These stories are based on and derived from healthy and vibrant river ecosystems.

Fishing History**.** Until the discovery of gold in 1849, the tribes of the Klamath/Trinity Region had only minimal contact with non-Indians. News of the first gold strikes resulted in a massive influx of prospectors and other Euro-American settlers and immigrants. Non-Indian settlement and the resulting wars had a devastating impact on the region's Indian tribes.

The first non-Indian commercial fishery for Klamath and Trinity chinook salmon was established in 1876 on the lower Klamath River. The first cannery was started at Requa in the late 1880s. While non-Indian settlement and commercial fishing in the region began to erode the Hupa's and Yurok's ability to live in their traditional ways, both adapted as best as they could to the new economic opportunities that were created (Byron Nelson, personal communication, November 1996). The canneries themselves were not owned by the tribes; however, all of the fish reaching the canneries were supplied by Indians since they were the only ones permitted access to the inriver fishery.

The peak of salmon canning on the Klamath took place in 1912-1915. In 1912 it is estimated that 141,000 salmon were canned. Local Indians were not only employed to harvest the fish, but also performed most of the work at the canneries. With little regulation or coordination of inriver, and particularly, ocean commercial and sport fishing activities, the Klamath and Trinity River stocks were fished to the limit during the first several decades of the 20th century. In 1933, under pressure from sport fishing interests, the state of California, assuming it had jurisdiction to regulate Indian fishing activities[9], banned the use of gill-nets on the lower 20 miles of the Klamath (even for subsistence fishing), closed the canneries, and prohibited the sale of river-caught salmon. The state claimed that the purpose of these regulations was to halt the precipitous decline of both rivers' fisheries as a result of fishing, mining, logging, and farming. The state however, did not impose any restrictions on ocean fishing activity, effectively increasing the ocean commercial and recreational access to the fishery. This had severe implications for the tribes, as they were increasingly dependent on the economic opportunities provided by their fishery resources. Both tribes resisted the CDFG restrictions, the issue coming to a head in the 1960-70s when on several occasions Hupa and Yurok tribal members were cited for violations of the state game and fish code, and armed confrontations were narrowly averted.

[9] The courts later found that the State lacked the authority to regulate tribal inriver fishing -- See *Arnett v. Five Gill Nets* 48 Cal. App. 3d 459, 121 Cal. Rptr. 906 (1975), cert. denied, 425 U.S. 907 (1976).

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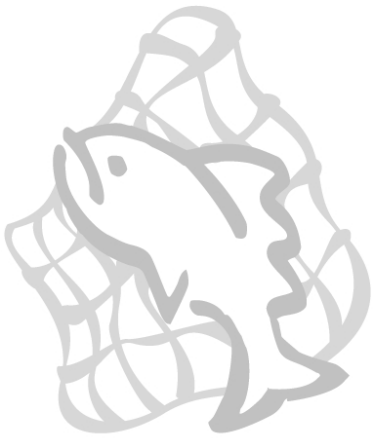
In 1969 Raymond Mattz, a Yurok fisherman, challenged the state's jurisdiction over Indian fishing after his gill nets were confiscated by state game wardens from the bank of the Klamath River. Mattz asserted that, as he was a Yurok Indian fishing in "Indian Country," state law did not apply. While he lost his case in two lower courts, in 1973 the Supreme Court found that the area in question was still an Indian reservation (*Mattz v. Arnett*, 412 U.S. 481 (1973)). Then, in 1975, in *Arnett v. 5 Gill Nets,* the First District Court of California concluded that the state lacked jurisdiction over Indian fishing on the reservation.

In 1977, based on the federal court's reaffirmation of the reservation Indians' right to fish, the DOI reopened the lower Klamath to Indian gill net subsistence and commercial fishing. In August 1978, the commercial fishery was closed for conservation purposes. The commercial fishery was placed under a "Conservation Moratorium" which remained in effect until 1987 (Pierce, 1998).

During the 9 years that Indian inriver commercial fishing was restricted for conservation purposes, both inriver and off-shore non-Indian fishermen landed an average of 140,130 Klamath-origin chinook per year, and Indian fishermen harvested an average of 20,660 chinook annually (Pierce, 1990).



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The moratorium was lifted in 1987 due to new allocation agreements under the KFMC and an increase in salmon stock abundance predictions. The Yurok Tribe conducted commercial fisheries in 1987 through 1989. Since 1990, tribal commercial harvest has not been allowed, except in 1996, due to low stock abundance predictions; at the same time subsistence fishing has been severely limited. The decreased harvests have had a significant impact on the tribal economies.

In 1993, the DOI Solicitor quantified the fishing rights of the Hoopa and Yurok Tribes, fixing their share of the harvestable Klamath / Trinity Basin salmon fishery as an amount, "sufficient to support a moderate standard of living or 50 percent…whichever is less" (U.S. Department of the Interior, Office of the Solicitor, 1993: see the section on Indian Reserved Rights). The Department of Commerce concurred. Subsequently, ocean commercial fishermen sued the Secretaries of Interior and Commerce, claiming that the decision forced them to reduce their harvest and that their harvest rights under the Magnuson Fishery Management and Conservation Act had been violated. The suit ended in 1995 when the U.S. 9th Circuit Court of Appeals ruled in favor of the federal government and the Yurok Tribe (see *Parravano v. Babbitt*). The Court found that under the Magnuson Act the Department of Commerce must meet the purposes of all applicable law, including its trustee obligation to protect tribal fishing rights.

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The Damming of the River. Despite significant degradation of the river ecosystems of the Klamath/Trinity Region through the latter 19th and first half of the 20th centuries, the Hupa and Yurok persisted in their traditional reliance on the Trinity River and its resources. Though increasingly difficult, both tribes continued to practice their ceremonies and religions; gathered vegetation for baskets, food, medicines, and other purposes; and met and ate together along the river's banks. Trinity River fish caught by their own people, as much as possible, continued to be an important component of their diets. Thus, many of today's older Hupa and Yurok did grow up with a strong physical connection to the Trinity River and a great appreciation for the traditions and ways of life of their ancestors. As one Yurok elder stated, "the river flows like our blood. It is our veins and arteries" (Susie Long, written correspondence, March 5, 1996).

One of the primary reasons that the tribes were able to maintain some modicum of their traditional relationship to the Trinity River was that the river's flows remained relatively unimpeded. This all changed with implementation of the TRD.

TRD operations, along with other diversions and impoundments within the Klamath/Trinity Basin, have dramatically altered the region's rivers. Fishing- and traditional-use sites have become clogged with debris, and declines in fish populations have been exacerbated. Sherman stated:

> Even when there are salmon in the rivers, tribal nets fill with moss because flows aren't adequate to keep the water cool, a depressing reminder that the rivers are no longer healthy. Watching the rivers deteriorate each year, unable to protect those resources they so cherish, has had a tremendous adverse psychological effect on the region's native peoples. (Jill Sherman, personal communication, September 1996)

Cultural stress related to an unhealthy river has resulted in a broad spectrum of social and educational problems, including the disruption of traditional occupations and the loss of opportunities for religious practice and community participation in tribal culture.

Byron Nelson, a Hupa elder, states:

> Though many Hupa and Yurok still hold to traditional beliefs and engage in certain time-honored practices such as shamanism and basketry, the decline of the rivers' health, the center of their culture and spirituality has led to a loss of self-esteem, an increase in cynicism and has greatly hurt the cohesiveness and health of these tribal communities. The rivers are the focalizing element of the society, with their loss, it seems much of the hope has also been lost. (Byron Nelson, personal communication, November 1996)

According to Nelson (1996), cultural stress related to an unhealthy river has resulted in a broad spectrum of social and educational problems, including the disruption of traditional occupations and the

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loss of opportunities for religious practice and community participation in tribal culture.

Limitations in the tribes' access to resources has restricted the practice of some of their most important traditions. This includes freely fishing the once prolific semi-annual salmon runs and participating in the cycle of ceremonies initiated concurrently. While many ethnographers have worked to characterize these traditions, little has been done to assess the impact on the tribes from their loss. Younger tribal members are increasingly prone to leave the area. Nelson has observed that in the past:

> Hupa and Yurok rarely left their territories. Today, the inability to meet subsistence needs from the fishery, a perception that the rivers are dirty, and a general malaise in our communities has compelled many to seek employment and community elsewhere. Even tribal health has experienced a decline as processed foods have replaced the fish and other natural foods that were once a staple of our diets. (Byron Nelson, personal communication, November 1996)

Nelson (1996) further states that "the lack of water in the rivers has rendered many ceremonies hollow." For example, for the Boat Dance in August/September the Hupa typically ask Reclamation to increase dam releases so their people may safely perform the ceremony. Even though the river's flows without these additional releases are believed to be above pre-dam levels, the additional water is usually not adequate to mitigate for changes in the river channel considered attributable to dam operations (i.e., the water's depth is still too low). For the boats and dancers this creates a great risk of capsizing in shallow water. If boats capsize, it has negative spiritual implications.

Environmental Consequences. The purpose of this section is to evaluate the potential impacts of the alternatives on tribal trust assets, and the subsequent effects those impacts may have on the Indian tribes of the Klamath/Trinity Basin.

The tribal trust impact analysis focuses on … the health of the Trinity River, as the river's overall health is a primary factor determining not only the availability of fish, but many trust assets including water, wildlife, and vegetation.

Methodology. While the proposed action is aimed at improving the river's anadromous fisheries, any assessment of how the alternatives may actually impact the Indian tribes of the Klamath/Trinity Region, and the federal government's trust responsibilities to those tribes, must go beyond numbers of fish. This is not to suggest that the goal of restoring the river's fishery is not relevant to tribal trust concerns, but that tribal values are multi-dimensional. Towards this end, the tribal trust impact analysis focuses on the potential affect of the alternatives on the health of the Trinity River, as the river's overall health is a primary factor determining not only the availability of

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fish, but many trust assets including water, wildlife, and vegetation. Thus, increased numbers of chinook salmon and Pacific lamprey, and the rejuvenation of other trust assets, represents an expected beneficial by-product of improved riverine health. The potential tribal trust impacts were not evaluated on a trust asset by trust asset basis.

A model was used to evaluate the impacts of alternatives on the fluvial and geomorphic processes (river attributes) that create and maintain a healthy river. A detailed explanation of the model is provided in the Geomorphic Environment section (3.2).

In the case of tribal trust resources, it is useful to assess project impacts relative to the tribe's traditional reliance upon the rivers in their pristine condition. Using pristine conditions as a baseline discloses the efficacy of the alternatives in meeting the federal government's tribal trust responsibilities, while still allowing for a comparison of the alternatives relative to the No Action Alternative (i.e., the year 2020). Although the "healthy river" model actually compares impacts relative to pre-dam conditions, which may have differed from pristine conditions due to 19th and early 20th century activities such as mining, the model is likely a good measure against pristine conditions as well.

Significance Criteria. No specific significance criteria were applied in the evaluation of potential tribal trust consequences.

(In the No Action Alternative) the tribes' access to Trinity River fish, wildlife, and other trust resources are likely to drop below their already depleted levels.

No Action. Under the No Action Alternative, it is projected that by the year 2020 the river would exhibit about 8 percent of the attributes consistent with a healthy river ecosystem (Table 3-23). Thus, the river will differ from the ecosystem that was the foundation of the tribes' socioeconomic and cultural ways of life. In addition, the tribes' access to Trinity River fish, wildlife, and other trust resources are likely to drop below their already depleted levels, threatening a continued decline of their communities. Without any hope of a restored fishery or river, important economic opportunities from commercial fishing and tourism will go unrealized.

TABLE 3-23
Impacts to Tribal Trust Resources

	River Health Score as a Percentage of Pre-dam Conditions	Comments
No Action	8	Significant degradation
Maximum Flow	81	Very significant benefits
Flow Evaluation	66	Significant benefits
Percent Inflow	23	Marginal improvement
Mechanical Restoration	18	Marginal improvement
State Permit	0	Extreme degradation

Note: see Geomorphic Environment section for methods

Maximum Flow. Under the Maximum Flow Alternative, it is projected that by the year 2020 the river would exhibit 81 percent of the

attributes consistent with a healthy river ecosystem. The very significant improvements to the river's health should greatly improve tribal access to many trust resources, to the significant benefit of their communities.

Flow Evaluation. Under the Flow Evaluation Alternative, it is projected that by the year 2020 the river would exhibit about 66 percent of the attributes consistent with a healthy river ecosystem. The significant improvements to the river's health should substantially improve tribal access to trust resources to the significant benefit of the communities.

Percent Inflow. Under the Percent Inflow Alternative, it is projected that by the year 2020 the river would exhibit about 23 percent of the attributes consistent with a healthy river ecosystem. Marginal improvements in river health would be expected, leading to little or no change in terms of tribal access to trust resources and cultural vitality of the tribal community.

Mechanical Restoration. Under the Mechanical Restoration Alternative, it is expected that by the year 2020 the river would exhibit about 18 percent of the attributes consistent with a healthy river ecosystem. Marginal improvements in river health would be expected, leading to little or no change in terms of tribal access to trust resources and cultural vitality in the tribal community.

State Permit. Under the State Permit Alternative, it is expected that by the year 2020 the river would exhibit about 0 percent of the attributes consistent with a healthy river ecosystem. Further degradation of river health would be expected, leading to further decline in tribal access to trust resources and erosion of cultural vitality in the tribal community.

Existing Conditions versus Preferred Alternative. The differences between 1995 existing conditions and the year 2020 under the Preferred Alternative (in regards to tribal assets) are comparable to the differences between No Action and Flow Evaluation. Substantial progress would be made in restoring tribal access to trust resources. However, the Preferred Alternative would go even further in providing these benefits in that the watershed protection component of the alternative would reduce sediment inputs into tributaries, and subsequently, into the Trinity River by 240,000-480,000 yd^3/yr. Such a reduction would improve water quality on the Hoopa Valley and Yurok Reservations.