**Trinity River Restoration Program Goals.** Congressional directives identified the goals as the restoration and maintenance of fish populations in the Trinity River in order to meet the federal government's trust responsibility to area Indian tribes and to provide a meaningful tribal, commercial, and sport fishery. Although quantifiable project objectives for fish numbers and habitat area were considered for this DEIS/EIR, they were ultimately not adopted because of the complexity, uncertainty, and other confounding factors involved in establishing and monitoring such targets. However, the Trinity River Basin Fish and Wildlife Task Force (Task Force) adopted the Trinity River ***inriver spawner escapement*** goals and TRSSH production goals developed by CDFG (Table 1-1). These goals were subsequently documented in the 1983 EIS on the Trinity River Basin Fish and Wildlife Management Program (U.S. Fish and Wildlife Service, 1983). Because the Task Force now operates under the guidance of the Trinity River Restoration Program (TRRP), the goals are sometimes referred to as TRRP goals. They are provided here for reference purposes only.

**TABLE 1-1**
Trinity River Restoration Program Goals

| Species | Inriver Spawning 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 |

Current spawner escapement levels are extremely low compared to historic estimates (see Section 3.5) and the TRRP inriver spawner escapement goals. The post-dam average of naturally produced fall chinook salmon represents only 20 percent of the 62,000 goal; whereas, the averages for naturally produced spring chinook salmon, coho salmon, and steelhead (winter only) represent 40, 14, and 5 percent, respectively, of their inriver escapement goals. Although the fall chinook spawner escapement has occasionally exceeded the inriver goals, many of those fish were hatchery produced. These infrequent large escapements are not indicative of healthy, naturally producing populations, but of hatchery surplus (see Section 3.5 for additional information on historic and current fish populations).

Restoration and maintenance of natural production requires that a sufficient number of the fish that spawn inriver begin their lives not in the hatchery, but as eggs in the river. Unfortunately, a very small proportion of inriver eggs survive to return as spawning adults;

## 1.1.1.1 Trinity River Basin

This section discusses the current status of anadromous salmonid resources and their habitats in the mainstem Trinity River, downstream of Lewiston Reservoir, and the factors influencing these resources. The following native anadromous salmonids are found in the mainstem Trinity River and its tributaries: fall and spring chinook salmon, coho salmon, and winter and summer steelhead (Table B-1). A description of sportfishing activity along the Trinity River was presented in the Recreation Technical Appendix D of the 1999 DEIS/DEIR.

**Habitat Characteristics and Requirements**. The anadromous salmonids native to the Trinity River Basin have similar life history characteristics. These species all begin life in fresh water as eggs and alevins (larval fish), which are hatched in gravely riffle area in the mainstem Trinity River or in its tributaries. Figure B-1 illustrates the generalized life history of anadromous salmon and steelhead. The time spent in fresh water as incubating eggs and alevins, or rearing fry (earliest free swimming life stage) and juveniles (pre-emigrating immature fish), and emigrating smolts (juveniles physiologically adapting for life in the marine environment) varies with each species, as does the time spent maturing in salt water before returning to their natal stream to spawn (reproduce). The generalized temporal distribution of chinook and coho salmon and steelhead is shown on Figure B-2.

Habitat needs of anadromous salmonids are similar, but each species does differ somewhat in its freshwater habitat needs. These differences are important and have implications from a resource management standpoint. Specific life history information for anadromous salmonids are provided in Table B-2. (A more detailed discussion of chinook, coho, and steelhead life cycles in the Trinity River can be found in Frederiksen, Kamine, and Associates, 1980, or U.S. Fish and Wildlife Service and Hoopa Valley Tribe, 1999.)

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 salmonid fish. 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 adults require adequately timed flows with the appropriate temperature, depth, and velocity.

**Populations**. The following discussion considers population estimates of the anadromous salmonids in the mainstem Trinity River. A key to understanding anadromous fish populations is the concept of "escapement." Annual spawner escapement is defined as the number of fish of a particular species that successfully return from the ocean ("escape" harvest and natural mortality) to spawn within a specific river. For the purposes of this document, inriver spawner escapement refers to the number of returning fish (adult and jacks) that physically spawn in the river. Hatchery escapement refers to the number of adults and jacks that return from the ocean to the TRSSH where they are artificially spawned.

Other terms used in this discussion include the following:

- Naturally produced—refers to the progeny of fish that physically spawned in the river or its tributaries, without human intervention.

- Hatchery produced—refers to the progeny of fish that were spawned and raised at the TRSSH.
- Jacks (sometimes referred to as "grilse")—refers to sexually mature fish that return as 2-year old fish to spawn; nearly all jacks are male.
- Half-pounders—refers to sexually immature steelhead, which after residing in fresh water for up to 3 years and salt water for less than 1 year return to fresh water, but not for the intent purpose of spawning; half-pounders subsequently return to the ocean and make their spawning migration months to years later.
- Run size—the total estimated annual number of adults and jacks, including inriver spawner escapement and hatchery escapement, as well as inriver harvest by tribal fisheries and inriver sport anglers. Annual estimates of fall chinook salmon run size in the Trinity River Basin have been compiled by the California Department of Fish and Game (CDFG) since 1978, as a part of the Klamath Basin Fall Chinook Salmon Spawner Escapement Estimates (California Department of Fish and Game, 2003). (Attachment B1, Table B1-1). In addition, since 1977, fall and spring chinook salmon, coho salmon, and adult winter steelhead (in some years) run size, spawner escapement, and angler harvest have been estimated by CDFG. These run size estimates are derived in part from data collected at fish counting weirs are installed annually near Willow Creek and usually Junction City on the mainstem Trinity River. CDFG, Hoopa Valley Tribe (HVT), U.S. Fish and Wildlife Service (Service), and U.S. Forest Service (USFS) have also conducted annual summer steelhead surveys in several tributaries to the mainstem Trinity River to estimate the population of this species.

**Trinity River Restoration Program Goals**. The 1983 Environmental Impact Statement (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 established by the Trinity River Basin Fish and Wildlife Restoration Program (TRRP) as escapement numbers that could be met once restoration was completed. 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. 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 goal for hatchery steelhead). A summary of these restoration goals are shown as Table B-3.

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," for the purposes of this report, is the number of returning fish that physically spawn in the river, which in reality consists of two factions: naturally produced fish and hatchery-produced fish. This term is analogous to the term "natural spawner escapement" used by CDFG. However, we chose not to use the CDFG term because it is confusing in discussions pertaining to naturally and hatchery-produced fish. "Total basin escapement" refers to the total number of fish that spawned inriver plus those fish that were spawned at the TRSSH.

Hatchery-produced fish are not considered to contribute towards the inriver spawner escapement goals of the Trinity River Restoration Program, 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 likely indicative of low survival rates of young freshwater life stages (eggs, fry, and/or juvenile fish).

Spring Chinook Salmon. Fisheries investigations conducted during 1942 through 1946, prior to the construction of the Trinity and Lewiston Dams, identified spring, summer, and fall chinook salmon populations in the Trinity River above the North Fork Trinity River (North Fork) confluence (Moffett and Smith, 1950). In 1955 an inriver spawner escapement estimate of 3,000 spring, 5,000 summer, and 24,000 fall chinook salmon upstream of Lewiston was reported by CDFG (California Department of Fish and Game/U.S. Fish and Wildlife Service, 1956). Contrary to these previous reports, Hubbell (1973) stated that review of data collected up to that time (1973) indicated that only spring and fall chinook salmon existed in the Trinity River, and since that time only estimates of spring and fall chinook salmon have been made by CDFG.

The Service (1983) estimated that prior to the construction of the dams, the average annual mainstem Trinity River spring chinook spawner escapement between the North Fork and Lewiston was approximately 3,500 adults. An additional 300-3,000 spring chinook were estimated to spawn annually upstream of Lewiston. For the years during 1978 through 2002, CDFG estimated that total spring chinook spawner escapements, upstream of the Junction City weir, have averaged approximately 16,000 and have ranged from approximately 2,000-55,000 fish (Attachment B1, Table B1-2). It must be noted that these estimates include hatchery fish spawned at the TRSSH and all spring chinook salmon (hatchery- and naturally produced fish) that spawned in the river. In recent years, estimates of the proportion of hatchery-produced and naturally produced fish contributing to the inriver spring chinook spawner escapement have been made (U.S. Fish and Wildlife Service, 1998 and CDFG, 2003). Escapement estimates for the years 1982 through 2002 (excluding 1983 and 1995) indicated that an average of approximately 82 percent (approximately 14,000) of the in-river spawner escapement of Trinity River spring chinook salmon were hatchery produced (Table B-5). Conversely, only 18 percent (approximately 3,217 annually) were naturally produced, which represents approximately 53 percent of the TRRP goal of 6,000 natural spring chinook in the Trinity River.

Fall Chinook Salmon. Annual pre-dam estimates averaged 45,600 fall chinook salmon, based on studies conducted during 1944, 1945, 1954, 1955, and 1963. Although limited in duration, these pre-dam estimates were the best numerical estimates available from the pre-dam era for the mainstem Trinity River upstream of the North Fork confluence. A review of the literature indicates that, before the construction of Lewiston Dam, approximately 50 percent of the mainstem Trinity River fall chinook salmon above the North Fork confluence spawned above Lewiston (Moffett and Smith, 1950; Gibbs, 1956; LaFaunce, 1965). Fifty percent of the pre-dam average of 45,600 would represent approximately 23,250 adults and jacks in the Trinity River upstream of Lewiston, and 22,350 adults and jacks from the North Fork to Lewiston prior to construction of the dams (Table B-4).

CDFG's 1978 through 2002 fall chinook salmon run-size estimates for the Trinity River Basin upstream of the Willow Creek weir have averaged approximately 43,000 adults and jacks (Table B-5) and ranged from approximately 9,200 (1991) to 148,000 (1986). These estimates are shown in Attachment B1, Table B1-3. These estimates include inriver spawner escapements, TRSSH hatchery returns, and harvest (inriver anglers and tribal) for the entire Trinity River Basin above the Willow Creek weir. As shown in Table B-5, the average annual Trinity basin in-river spawner escapement estimate is approximately 39,600 fall chinook. However, as previously discussed, these estimates include a component of hatchery-produced chinook salmon that spawn in the Trinity River and not at TRSSH. Table B-5 provides an estimate of Trinity River naturally and hatchery-produced fall chinook salmon spawner escapement for the years 1982 through 2002 (Figure B-3). CDFG's post-dam inriver spawner escapement estimates for the Trinity River Basin upstream of the Willow Creek weir from 1982 through 2002 averaged 30,400 fall chinook salmon, of which an average of 12,047 fish are naturally-produced fish. Naturally produced fish have ranged from 10-94 percent of inriver spawner escapements, with an average of 42 percent (Table B-5).

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 (adult only information 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 these goals are exclusive of harvest.

The 1982-2002 mean annual estimated naturally produced spawner escapement upstream of Willow Creek is 12,047, approximately 19 percent of the restoration goal of 62,000 naturally produced fall chinook salmon for the Trinity River Basin (Table B-4). These estimates indicate that a significant improvement in escapement must be made to meet the Trinity River restoration goals for fall chinook salmon. A complete summary of the Trinity River fall chinook salmon run sizes, in-river and hatchery escapements, angler harvests, and estimated proportions of naturally and hatchery-produced fish contributing to the inriver spawner escapements for the Trinity River for 1977 through 2002 are shown in Attachment B1, Table B1-3 (California Department of Fish and Game, 2003.

There were large runs of fall chinook salmon in the mainstem Trinity River during 1986 through 1989, and again in 1995 as compared to other years since 1977 (Attachment B1, Table B1-3). These years greatly influenced the long-term mean inriver spawner escapement estimates for the fall chinook salmon in the Trinity River. The large spawner escapements for the years 1986-1989 may have been related to wetter water years during brood years beginning in the 1983 water year. Wetter than normal water years and associated increases in streamflow may have resulted in improved habitat conditions during those brood years. These improvements in stream flows and habitat conditions may have also resulted in significant increases in smolt production and smolt out-migration success during those brood years. This in turn may have resulted in increased run sizes and spawner escapements beginning in the fall of 1986 and continuing through 1989. Harvest restrictions, particularly since 1985, and improved ocean conditions and survival may have also contributed to greater runs and spawner escapements during 1986-1989 and in 1995.

Coho Salmon. Coho salmon populations were historically much smaller than chinook salmon in the Trinity River. Holmberg (1972) reported that the estimated number of coho salmon in the Trinity Basin was approximately 8,000. An average annual pre-dam spawner escapement of approximately 5,000 adult coho above Lewiston was cited by CDFG and Service (1956). After construction of Lewiston Dam, coho in-river escapement estimates below Lewiston ranged from approximately 460-2,100 during 1969 through 1971 (Smith, 1975; Rogers, 1972; and Rogers, 1982). Leidy and Leidy (1984) reported that the returns to Trinity River Hatchery for the period 1973-1980 averaged 3,300 adults. The total Trinity River basin run size estimate for 1977 through 2002 has averaged 16,500 adult coho (CDFG, 2003) (Table B-5**)**.

Averages for CDFG's annual coho run-size, inriver spawner escapement, TRSSH escapements, angler harvest, and proportions of naturally and hatchery-produced spawners contributing to the inriver spawner escapement estimates for the years 1977 through 2002 are shown in Table B-5. Since 1978, CDFG has estimated that coho inriver escapements have ranged from approximately 850 (1993) to 55,700 (1987) (Attachment B1, Table B1-4), with an annual average of 16,100 coho salmon (adults and jacks) upstream of the Willow Creek weir. These total basin escapement estimates indicate that recent post-dam spawner escapement may be as great or greater than the "pre-dam" estimates. However, like those estimates for spring and fall chinook salmon, these estimates include both TRSSH escapement and hatchery-produced adults that spawned in the river.

Estimates of the naturally produced coho salmon spawning in the mainstem Trinity River upstream of the Willow Creek weir for the years 1991-1995, and 1997-2002 have been made (CDFG, 2003). Table B-5 shows the average estimated spawner escapement of naturally and hatchery-produced coho salmon for those years. Since 1991 naturally produced coho salmon spawning in the Trinity River upstream of the Willow Creek weir averaged approximately

582 fish, ranging from 0-19 percent of the total annual escapement (an annual average of 7 percent). Approximately 93 percent (11,332) of the coho salmon spawning in-river are produced by the hatchery.

The estimated 582 naturally produced coho spawning in the mainstem Trinity River upstream of the Willow Creek weir represents approximately 42 percent of the restoration program spawner escapement goal of 1,400 for naturally produced adult coho (Table B-3).

Steelhead. Winter steelhead spawner escapements within the Trinity River and its tributaries upstream of Lewiston prior to the construction of the dams were estimated to range from approximately 6,900-24,000 adults (California Department of Fish and Game/U.S. Fish and Wildlife Service, 1956).

Winter steelhead spawner escapement estimates have been highly variable in the Trinity River and its tributaries since 1963. The 1964 steelhead spawner escapement estimate was approximately 8,000 fish (LaFaunce, 1965). A spawner escapement estimate of approximately 1,000 steelhead was made for the year 1972 (Rogers, 1973).

From 1980 through 2002 (for the years in which data is available), the estimated total basin escapement of winter steelhead spawning upstream of the Willow Creek weir has ranged from approximately 2,750 (1992) to 33,700 (1989) (Attachment B1, Table B1-5) and has averaged approximately 9,400 (California Department of Fish and Game, 2003). However, weir data is typically available for fall and early winter period only. Estimates for the remaining winter portion of the escapement are unavailable because increased river flows render weirs inoperable. Estimates of naturally produced winter steelhead for the years 1980, 1982, and 1992 to 1995 and 2002 were made by the CDFG (2003). On the average for those years, approximately 4,700 naturally produced winter steelhead spawned in the Trinity River upstream of the Willow Creek weir (Table B-5). However, this average is largely influenced by the 1980 and 1982 years. The average naturally produced inriver escapement for 1980 and 1982 was 10,675, while the average escapement for 1992-1995 and 2002 was approximately 2,326 adults. The overall average (4,711) represents approximately 12 percent of the restoration goal of 40,000 adult steelhead, while the 1992-1995 and 2002 average represents 6 percent of this goal (Table B-5). The latter average is more likely to represent the current status of the Trinity River steelhead population, because it is more recent, and fairly consistent from year to year. The data available for winter steelhead hatchery and inriver spawner escapements for the years since 1977 are shown in Attachment B1, Table B1-5.

Adult summer steelhead primarily hold in the headwaters of mainstem Trinity tributaries during the summer months, and subsequently spawn in the following late winter/early spring. Average annual summer steelhead inriver spawner escapements for the Trinity River upstream of Lewiston, prior to the construction of the dams, were estimated to average 8,000 adults (California Department of Fish and Game /U.S. Fish and Wildlife Service, 1956). In recent years, CDFG, Service, USFS, and HVT have conducted population surveys for these fish in the North Fork, South Fork, Canyon Creek, and New River tributaries and the upper Trinity River. Population estimates have ranged from a low of 20 adults in the South Fork in 1985 to 1,037 adult summer steelhead in the North Fork in 1991 (California Department of Fish and Game, 1997, unpublished). The estimated mean annual populations of summer steelhead from 1980-1996 are: 460 (North Fork), 40 (South Fork), 15 (Canyon

Creek), 11 (upper Trinity River), and 404 (New River). Summaries of those estimates are shown in Attachment B1, Table B1-6 of the Fishery Technical Appendix to the 1999 DEIS/DRIR.

The steelhead of the Trinity River are characterized by the unique "half-pounder" phase of their life history. An immature steelhead that returns to fresh water from the ocean during July-September after remaining in the ocean only a few months is referred to as a "half-pounder"(U.S. National Marine Fisheries Service, 1994). This phase includes the summer migration in which it does not spawn, followed by winter or spring emigration back to the ocean. These fish are typically 12-14 inches in length and are rarely greater than 16 inches (ACWA, 1995). Half-pounders are highly sought after by sportfishers.

**Species Listed and Proposed for Listing under the Endangered Species Act (ESA)**. After a coast-wide status review by the U.S. National Marine Fisheries Service (NOAA-Fisheries), the Southern Oregon/Northern California evolutionarily significant unit (ESU) naturally produced coho salmon was proposed for listing as threatened on July 25, 1995. Under the ESA, an ESU is a population (or group of populations) that:

- Is substantially reproductively isolated from other nonspecific population units
- Represents an important component in the evolutionary legacy of the species

On October 24, 1996, NOAA-Fisheries extended the period of review and final determination of this ESU's proposed listing for 6 months until April 25, 1997. On June 5, 1997, NOAA-Fisheries announced its final action that this species would be listed as threatened in the California range of its distribution, which includes the Trinity and Klamath River Basins.

Additionally under the ESA, the Klamath Mountains Province ESU steelhead, which includes stocks from the Trinity River, were proposed for listing as threatened on March 16, 1995. On July 31, 1996, NOAA-Fisheries determined that this species warranted listing as a threatened species under ESA, but the decision to list the species was deferred on August 11, 1997, for 6 months to gather more scientific information. A final ruling on its status was made on April 4, 2001, when NOAA-Fisheries determined that this species did not warrant listing as threatened at that time.

**Factors Influencing Trinity River Basin's Anadromous Salmonid Populations**.
<u>Trinity River Salmon and Steelhead Hatchery</u>. TRSSH was constructed by the U.S. Bureau of Reclamation (Reclamation) in 1963 and is operated by CDFG to mitigate for the loss of salmonid habitat and production above Lewiston Dam due to construction of the Trinity River Division (TRD) of the Central Valley Project (CVP). The hatchery was modernized in 1991 as part of the TRRP. The TRSSH's current goals are to produce sufficient juveniles to provide for returns to the hatchery (exclusive of harvest) of 12,000 chinook salmon (3,000 spring; 9,000 fall); 2,100 coho salmon; and 10,000 steelhead. Fingerling and yearling production of chinook, coho, and steelhead at the TRSSH (and its predecessor facilities) from 1958 through 1996 are summarized in Attachment B1, Table B1-7 of the 1999 DEIS/DEIR Fishery Appendix. Since that time (January, 1997) the TRSSH has operated under new stocking goals and constraints criteria. These goals and constraints are summarized in Table B-6.

Hatchery operations, including the magnitude and the timing of hatchery releases and the subsequent return of adult hatchery-produced fish, can directly affect the behavior, growth, survival, and ultimate success of naturally produced salmon and steelhead. Factors such as competition, predation, and disease organisms transmitted by hatchery-produced fish may adversely affect naturally produced anadromous salmonids within the Trinity River Basin. In a 1991 study of hatchery- and naturally produced juvenile chinook, coho, and steelhead, TRSSH coho juveniles were found to be in poor health resulting from bacteria kidney disease (Foote and Walker, 1992). The diseased coho juveniles may have influenced smolt survival of several naturally produced Trinity River Basin salmonid stocks (Foote and Walker, 1992).

Annual numbers (adults and jacks) of chinook, coho, and steelhead entering TRSSH (or its predecessor facilities) since 1958 are shown on Figure B-4. Since the beginning of operations, there have been two periods of significantly increased numbers of chinook returning to the TRSSH (Figure B-4). The numbers of chinook salmon trapped at the TRSSH peaked in 1988 with more than 20,000 fall and 16,000 spring chinook entering TRSSH. More than 23,000 coho entered the TRSSH in 1987-1988. Except as noted above, since the peaks of the 1980s, TRSSH returns of chinook and coho salmon have generally decreased. Since operations began, the numbers of steelhead entering the TRSSH have varied widely, ranging from 13 fish in 1976-1977 to nearly 7,000 in 1964-1965 (Figure B-4). Since 1990, there have been less than 1,000 adult steelhead trapped annually at the hatchery.

Introductions of Klamath River fall chinook salmon juveniles raised from eggs reared at the TRSSH were made into the Trinity River during 1971, 1977, and 1983 (California Department of Fish and Game, TRSSH Reports: 1971, 1977, and 1983) (Table B-7). Since 1983, no additional fall chinook salmon genetic stocks have been introduced into the Trinity River Basin.

Native Trinity River coho salmon stocks have been potentially intermingled with four out-of-basin coho stocks introduced by the TRSSH since 1965 (Table B-7). Coho salmon juveniles, reared from eggs at the TRSSH, from the Eel and Noyo Rivers (California) were introduced into the Trinity River in 1965 and 1970, respectively (California Department of Fish and Game, TRSSH Reports: 1965 and 1970). Juvenile coho salmon from genetic strains from Alsea River Hatchery (Oregon) were introduced into the Trinity River in 1970 and 1971 (California Department of Fish and Game, TRSSH Reports: 1970 and 1971). Juvenile coho salmon from the Cascade Hatchery (Oregon) were also introduced in 1970. No other coho salmon stocks from out-of-basin sources have been introduced into the Trinity River since 1971. The impact of these introductions are not understood at the present time.

Native Trinity River winter steelhead stocks may also have been intermingled with introduced steelhead from outside the Trinity River Basin (Table B-7). In 1963, American River (California) fall steelhead fry were received and reared at the TRSSH until they were planted into the Trinity River in the spring of 1964 (California Department of Fish and Game, TRSSH Report 65-5). Juvenile winter steelhead reared from eggs received from the Cowlitz River Hatchery (Washington) in 1969, and juveniles from the Roaring River Hatchery (Oregon) were planted into the Trinity River at China Slide in 1970 and 1971 (California Department of Fish and Game, TRSSH Reports 70-19 and 72-4). Winter steelhead fry and juveniles reared from eggs transferred from the CDFG’s Iron Gate Hatchery on the Klamath

River were released at TRSSH beginning in 1971 and continued yearly through 1987 (California Department of Fish and Game, TRSSH Reports: 1970-1988) (Table B-7).

Summer steelhead stocks from two hatchery sources outside the Trinity River Basin have been introduced into the basin: Cedar Creek Hatchery (California) and Skamania Hatchery (Washington) were introduced into the Trinity River from eggs reared to fry or juveniles and released at the TRSSH during 1971 through 1975. (Table B-7) (California Department of Fish and Game, TRSSH Reports: 1971-1976).

The precise impacts on natural anadromous populations downstream of Lewiston from releases of salmonids from the TRSSH are unknown. Hatchery fish pose six primary threats to naturally produced fish (Hilborn,1992):

- Direct competition for food
- Predation of hatchery-produced fish on naturally-produced fish
- Genetic dilution of native fish stocks by hatchery fish allowed to spawn inriver
- Increased fishing pressure on naturally produced stocks due to hatchery production
- Disease transmission from hatchery-produced fish to naturally produced fish
- Direct competition for habitat

Recent concerns involving the potential impacts of hatchery operations on the naturally producing stocks of the Klamath Basin (including the Trinity River) prompted the CDFG to hold a workshop to address these concerns and revise their hatchery operation procedures. New hatchery operating procedures were instituted in 1997 to minimize the potential impacts of hatchery-produced fish on naturally producing stocks.

Recently adopted TRSSH operations designed to minimize impacts include:

- All mature salmon returning to the hatchery are processed and destroyed, in order to reduce the occurrence of hatchery stock spawning with natural stocks. Allowing all hatchery fish (including surplus spawners) entry to the hatchery also reduces competition between hatchery- and naturally produced stocks for appropriate spawning sites. Steelhead are spawned and returned to the river because, unlike salmon, they are capable of spawning in subsequent years.

- Juvenile salmonids from TRSSH are released to mimic natural out-migration patterns at Lewiston prior to dam construction, which are slightly delayed relative to outmigrating naturally produced juveniles in the river reach below Lewiston (Table B-6).

- Hatchery production goals are not to be exceeded (Table B-6).

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, (Commission) Yurok Tribe, HVT, NOAA-Fisheries, and Bureau of Indian Affairs (BIA). The Pacific Fishery Management Council (PFMC) and the Klamath Fishery Management Council (KFMC) are allocation forums for the ocean and ocean/in-river fisheries, respectively. The mixed-stock ocean population is harvested by commercial and sport fisheries; and the in-river population is harvested by tribal (ceremonial, subsistence, and commercial) and sport fisheries. Chinook salmon harvest (both spring and fall runs) includes both naturally and hatchery-produced fish. Coho harvest in the ocean commercial troll fishery has been prohibited in California and Oregon, and reduced in Washington, since 1994. Coho harvest has also been prohibited in the California ocean sport fishery, and reduced in Oregon. Coho harvest is allowed in the tribal in-river fisheries and currently occurs as incidental take during the harvest of chinook salmon. Steelhead are rarely caught in the ocean commercial and sport fisheries, but are harvested by the in-river tribal and sport fisheries. Frederiksen, Kamine, and Associates (1980) stated that ocean harvest of naturally produced salmon stocks had been sufficient to have caused steady declines in Trinity River spawner escapements at the time of their report. 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 fall chinook harvest management restrictions implemented since 1986 have decreased harvest impacts to levels believed to be sustainable, based on the best available data. A description of sportfishing activity along the Trinity River is presented in the Recreation Resources Technical Appendix D of the 1999 DEIS/DEIR. Information on tribal fisheries is presented in the Tribal Trust section (3.6) of the 1999 DEIS/DEIR.

Habitat Conditions. Reduced river flow due to the construction and operation of the TRD, combined with excessive watershed erosion, large-scale gold dredging, and other harmful land management activities, have caused major changes in the inriver habitat conditions of the Trinity River (U.S. Fish and Wildlife Service, 1994) since the construction of the Trinity and Lewiston Dams. Factors that have resulted in adverse effects on fish habitat (Frederiksen, Kamine, and Associates, 1980) include the following:

- Obstruction to the river reaches upstream of Lewiston Dam
- Changes in natural flow regime in both quantity and timing
- Changes in water temperature.
- Changes in river channel geomorphology and restriction of river meandering
- Changes in substrate composition, addition of fine sediments, and restriction of gravel recruitment

The quantity and quality of anadromous fish habitat have been seriously reduced since construction of the TRD. The dams blocked fish 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, 1983). Much of this habitat was prime spawning and rearing habitat. In the case of chinook salmon, this habitat represented 50 percent of the spawning habitat in the Trinity Basin. Furthermore, elimination of the upstream reaches, which were dominated by snowmelt and hydrologically different from the river habitats downstream of Lewiston, greatly reduced the diversity of the entire river system, thereby reducing habitat choices for salmonids.

Reduced river flows and disruption of the sediment flow in the mainstem (post-TRD), as well as altered watersheds (both pre- and post-dam), have altered geomorphic processes, particularly in the mainstem above the confluence of the North Fork. For the first 21 years of TRD operations, Trinity River flows were only 21 percent of natural flows. 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, as evidenced by sand filling in holding pools of adult salmonids, increased fine sediment accumulation in river substrates, and increased channelization of the mainstem (which has made the river banks more vertical and does not allow lateral movement of the channel within the floodplain). The effects of these processes have significantly reduced total wetted habitat and salmonid spawning and rearing habitat area and suitability in the mainstem Trinity River below Lewiston Dam (Frederiksen, Kamine, and Associates, 1980). For example, spawning habitat losses have been estimated to be 80 percent in the first 2 miles below Grass Valley Creek, and at 50 percent in the next 6 miles since construction of Lewiston Dam (California Resources Agency, 1980).

Since the completion of the dams, the degradation of habitat, beginning downstream of Lewiston and adversely affecting approximately 40 river miles (RM) downstream to the North Fork, has generally been accompanied by a decline in salmonid populations (Frederiksen, Kamine, and Associates, 1980). Shallow riffles have been replaced by glides and deeper water habitats, resulting in reduction in total habitat areas suitable for the production of food organisms (Frederiksen, Kamine, and Associates, 1980). Reduced river flows and changes in sediment input are the primary factors in changes to channel geomorphology and, therefore, the degradation of fish habitat. The altered channel geomorphology includes a reduction in 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. The static nature of the altered river has allowed the root systems of riparian plants to encroach into the river channel. The roots bind spawning gravel and encourage 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] of the 1999 DEIS/DEIR 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. This accumulation of fine sediment decreases survival of eggs and sac-fry and decreases the amount of habitat for overwintering juvenile coho and steelhead (which burrow between gravels and cobbles). Fine sediment accumulation may have also impacted habitat for aquatic invertebrates, which are the primary food source for juvenile salmonids.

Seasonal changes in water temperature and turbidities since the construction of the TRD, particularly in the reach from Lewiston to the North Fork, have been observed (Frederiksen, Kamine, and Associates, 1980). On the average, and prior to the construction of the TRD, water temperatures in the Lewiston-to-North Fork reach of the mainstem Trinity River were warmer than current water temperatures during the migration, holding, and spawning periods of spring chinook salmon. Temperature conditions in the Trinity River during the late summer baseflow periods have been more favorable (cooler) to rearing salmonids than those prior to the construction of the TRD because of an overall increase in summer baseflow. (For more information on flows and temperatures, see the Water Resources section [3.3] of the 1999 DEIS/DEIR.) These changes in water temperatures have implications on the temporal and geographic distribution and life history attributes of the fish resources in the Trinity River.

Construction and operation of the TRD changed the thermal diversity available to Trinity River anadromous salmonids. The dams blocked access to the cool 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). 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 degrees Fahrenheit (°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-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.

The Trinity River also has a significant influence on the water temperatures in the Klamath River downstream of it's confluence at Weitchpec. Cool water releases from Lewiston Dan during the warm months can benefit anadromous species and their habitats not only within the Trinity River, assisting in rearing, immigration, and smolt outmigration, but also benefits the Klamath fishery. In 2002, low flow conditions in the Lower Klamath River, warm water temperatures, and an above average fall run Chinook salmon escapement combined to create conditions favorable to an epizootic outbreak resulting in a huge fish die-off (TRPP, 2003). At a hearing in response to this die-off, Federal District Court Judge Oliver Wanger directed the Department of the Interior to determine what actions would be necessary to "assure against the risk of fish losses that occurred…." (in 2002). Subsequently, in April, 2003 a ruling also allowed Reclamation to use an additional 50,000 acre-feet of water from the Trinity River Division of the CVP to prevent a recurrence of the September, 2002 fish die-off. In a summary report of the monitoring of that flow release, the Trinity River Restoration Program concluded that the implementation of the 2003 Trinity River Fall Flows Action Plan was successful in reducing the risk of a major die-off event in 2003. A memorandum outlining the methodology and results of the flow releases made by Reclamation during the late-summer of 2003 in response to these orders are attached to this Appendix as Attachment B2.

Finally, in it's investigation on the causes of decline and strategies for recovery of the endangered and threatened fishes in the Klamath River Basin, the National Academy of Sciences final report (NAS, 2003) recommended: "That it is vital that management of the Trinity River, including releases from Lewiston Dam be viewed in the context of the entire Klamath watershed" (NAS,2003). Furthermore the Report states: "While it may be attractive to use Trinity flows to influence conditions in the Lower Klamath River, it must not occur at the expense of the Trinity River restoration goals" (NAS, 2003).

Food Production. During the freshwater phase of their life history, the major food source of anadromous salmonids are aquatic benthic macroinvertebrate (insect) organisms. The production of these organisms occurs on the constantly submerged (wetted) portions of a streambed (Frederiksen, Kamine, and Associates, 1980). The particle size and substrate material of the wetted streambed can greatly affect the production of this food source. Boles (1980) found that when a riffle in the Junction City reach of the Trinity was flushed of its load of granite sand, a marked increase in productivity, biomass, and diversity of benthic organisms occurred.

Food production capability within the mainstem Trinity River was good and compared favorably with that of the North Fork and the Smith River, which have not been impacted by siltation and water diversions (Frederiksen, Kamine, and Associates, 1980). Results of aquatic insect studies, which monitored the mainstem Trinity River upstream of the North Fork confluence, indicated that over the course of the multi-year study, improvements have occurred in the biotic condition indices (BCI) measured at six sampling locations, but habitat conditions could be improved (Mangum, 1995). These results indicated that good to excellent potential food conditions exist at the study sites monitored downstream of Lewiston, particularly for larger juvenile fish (Mangum, 1995). From these investigations it appears that benthic food production may not be a major factor in limiting fish production in the mainstem Trinity River at the current time.

Habitat Restoration Projects. Since the early 1980s, the Trinity River Basin Fish and Wildlife Restoration Program 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).

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

### 1.1.1.2 Lower Klamath River Basin

The Klamath River is California's second largest river, with an average annual water yield in excess of 13 million acre-feet (maf). Like the Trinity Basin, the lower Klamath River Basin provides habitat for anadromous spring and fall chinook salmon, coho salmon, and steelhead. In addition, coastal cutthroat trout frequent the lower reaches of the basin. All anadromous fish from the Trinity Basin must migrate through the lower Klamath Basin and estuary. The estuary at the mouth of the Klamath is an important rearing and migration area for these anadromous species. Approximately 80 percent of the Native American salmon gill-net fishery occurs within the lower Klamath River, as well as a sport fishery for chinook and coho salmon, steelhead, and coastal cutthroat trout. A description of sportfishing activity along the lower Klamath River is presented in the Recreation Technical Appendix D in the 1999 DEIS/DEIR.

**Habitat Characteristics and Requirements**. Habitat requirements and characteristics for anadromous salmonids in the lower Klamath River Basin are similar to those discussed for the Trinity River Basin (refer to Trinity River Basin Habitat Characteristics and Requirements). The lower Klamath River Basin provides significant seasonal habitat for anadromous salmonids. Causes for the decline of the numbers of salmonids in the Klamath River Basin have been attributed to land use, water diversions, harvest, ocean conditions, dams, and inriver habitat conditions (California Department of Fish and Game, 1992b). Some of these activities are thought to have degraded juvenile salmonid rearing and nursery habitats (California Department of Fish and Game, 1997.).

Water quality of the Klamath River has been negatively effected by nutrient-rich agricultural runoff. Runoff from the upper Klamath Basin (including reservoirs) contains many inorganic compounds that lead to large plankton blooms, which can make the river turbid in appearance. As evidenced by field crews above Weitchpec during 1997, warm water and high phytoplankton abundance can also periodically lead to low dissolved oxygen levels, which can have a negative effect on fish survival. With increasing distance from Iron Gate Dam, however, the water quality improves through dilution by tributaries, including the Trinity River, largest of tributaries (see Water Quality).

CDFG (1992a, 1992b, 1993a, 1993b, 1994a, 1994b, and 1995) has been conducting investigations to describe fish habitats and monitor water quality in the lower Klamath River and estuary. Their findings have determined that seasonal habitat changes occur as plant growth (especially algae) and fine sediments gradually increase in the summer and fall seasons due to decreased river flows and increased water temperatures. A sand bar occasionally closes the estuary and impounds the outflow of the Klamath River during this time. Salt water dominates the estuary during these months of high biological productivity, and a resulting salt wedge provides thermal refuge for rearing salmonids during the warm summer and fall months.

**Populations**. Since 1978, CDFG has compiled the inriver and hatchery spawner escapements and Indian net and angler harvests for fall chinook salmon for the Klamath Basin including the lower Klamath and Trinity River Basins. These estimates are compiled annually and are referred to as the “mega-table” (Attachment B1, Table B1-1). Harvest (ocean and inriver combined) of fall chinook salmon is managed for a 33-34 percent escapement for all brood years, or a minimum inriver spawner escapement level (floor) of 35,000 fall chinook salmon adults, whichever is greater. These harvest goals were established in 1989 by the PFMC on the recommendation of the Klamath River Technical Advisory Team (PFMC, 1997). Factors influencing the anadromous salmonid populations inhabiting the Klamath River Basin include: Iron Gate Hatchery operations, harvest (both inriver tribal and sports fisheries, and ocean commercial and sport fisheries), freshwater habitat conditions (including flows from the Trinity and upper Klamath River and its major tributaries, such as the Shasta and Scott Rivers), and ocean productivity conditions.

A description of sportfishing activity along the lower Klamath River is presented in the Recreation Resources Technical Appendix D of the 1999 DEIS/DEIR. Information on tribal fisheries is presented in the Tribal Trust section (3.6) of the 1999 DEIS/DEIR.

## 1.1.1.3 Coastal Area

The coastal area adjacent to the Klamath River Basin provides habitat for the maturing and adult life stages of the anadromous salmonids found in the lower Klamath and Trinity River Basins. Habitat conditions in this coastal near shore and ocean environment are subject to natural productivity as affected by physical and biological oceanic processes, atmospheric weather, and climate patterns. The influence of humans on anadromous salmonid populations in the coastal areas adjacent to the Klamath River Basin is primarily a result of commercial and recreational harvest activities. The 1999 DEIS/DEIR described recent ocean sport and commercial salmon fishing activity for the six study regions along the California and Oregon coast that could be affected by the project.

## 1.1.1.4 Central Valley

**Habitat Characteristics and Requirements**. The Central Valley of California provides essential habitat for the freshwater life stages for chinook salmon as well as steelhead. Within the Central Valley, the Sacramento and San Joaquin Rivers provide corridors for the anadromous salmonids resources found within the valley. The Sacramento River is the largest river system in California and produces more than 90 percent of the Central Valley salmon and steelhead. The Sacramento River supports four runs (races) of chinook salmon: fall, late-fall, winter, and spring. Fall chinook is the predominant salmon in the Central Valley. Fall steelhead are also found in the Central Valley with almost the entire population restricted to the Sacramento River system. Unlike the Trinity and Klamath River Basins, the Central Valley is not known to contain coho salmon or cutthroat trout. Estimates of the abundance of the chinook salmon and steelhead populations found in the Central Valley are shown in Tables B1-8 and B1-9 in Attachment B1 of the 1999 DEIS/DEIR Fishery Appendix.

**Limiting Factors**. Major limiting factors in the Central Valley that have affected anadromous salmonids (U.S. Fish and Wildlife Service, 1995) include the following:

- Diversions, such as the Red Bluff Diversion Dam/Tehama-Colusa Canal; the Glen-Colusa Irrigation District Canal; the Anderson-Cottonwood Irrigation District Canal; and hundreds of small unscreened diversions throughout the Sacramento and San Joaquin Rivers and the Sacramento-San Joaquin River Delta (Delta)
- Blockage of habitat by major dams (i.e. Shasta Dam)
- Water diversions at the state and federal pumps in the Delta
- Increased water temperatures within the Central Valley rivers and the Delta
- Habitat loss and degradation in the rivers and the Delta
- Industrial, municipal, 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

Approximately 25 percent of all warmwater and anadromous sportfishing and 80 percent of the state's commercial fishery are dependent on species that live in or migrate through the Delta. Most of the state's anadromous fish, including several state Species of Special Concern, inhabit the waters of the Delta.

Delta outflow plays a key role in influencing the abundance and distribution of fish and invertebrates in San Francisco Bay through changes to salinity, currents, nutrient levels, and pollutant concentrations. The response of organisms to Delta outflow is species and life-stage dependent. The effect of Delta outflow on San Francisco Bay aquatic organisms is determined by timing, magnitude, and duration of the outflow. Fluctuations in water temperature also play an influential role in the productivity of the Bay. The San Francisco Bay provides essential migration and rearing habitat for the anadromous salmonid species of the Central Valley. These species migrate through the bay on their way to and from the ocean as well as rear on their way out of the system.

**Species Listed or Proposed for Listing under the Endangered Species Act (ESA) or the California Endangered Species Act (CESA)**. Special-status anadromous salmonids found in the Central Valley include the federal and State of California endangered winter chinook salmon. Winter chinook salmon were listed endangered under the California Endangered Species Act (CESA) in 1989 and were declared threatened by NOAA-Fisheries on November 5, 1990. NOAA-Fisheries reclassified winter chinook salmon as endangered on January 4, 1994. On June 16, 1993, NOAA-Fisheries published the final rule designating the critical habitat for this species as the Sacramento River from Keswick Dam (Shasta County) to Chipps Island at the westward margin of the Delta. In addition, all waters westward of Chipps Island to Carquinez Bridge, all of San Pablo Bay, and San Francisco Bay north of the San Francisco/Oakland Bay Bridge were designated as critical habitat for winter chinook salmon (U.S. National Marine Fisheries Service, 1997).

The Central Valley ESU steelhead was proposed for listing as threatened under the federal ESA March 16, 1995. On July 31, 1996, NOAA-Fisheries determined that this species warranted listing as a threatened species under ESA, but the decision to list the species was deferred on August 11, 1997, for 6 months to gather more scientific information. A final ruling on its status resulted in the listing of this species as threatened on May 18, 1998.

In April of 1996, the Commission rejected a petition submitted to list the Sacramento River spring chinook salmon as an endangered species under CESA. However, in February 1997, the State of California Superior Court in San Francisco ruled that the Commission committed an error in their finding that the listing of the Sacramento River spring chinook salmon as endangered was not warranted. This resulted in the conclusion by the Commission that the species should be listed as a candidate for endangered status and required CDFG to submit a report to the Commission within one year indicating whether the species should be listed. The State of California listed Sacramento River spring chinook salmon as threatened on February 6, 1999.

In March 9, 1998, NOAA-Fisheries proposed spring chinook salmon ESU as endangered, and fall and late-fall chinook salmon ESU’s were proposed as threatened in the Central Valley. On September 9, 1999, NOAA-Fisheries announced that the Central Valley spring chinook ESU was listed as threatened on or about November 15, 1999. The fall/late-fall ESU remains a Federal candidate species.

## 1.1.2 Environmental Consequences

### 1.1.2.1 Methodology

**Trinity River Basin**. The salmon pre-smolt production model (SALMOD) developed for the Trinity River (Williamson, et al., 1993) was previously evaluated as a tool for assessing the effects of project alternatives on anadromous salmonids. For the purposes of the 1999 Draft Environmental Impact Statement/Environmental Impact Report (DEIS/DEIR) it was determined that the SALMOD model is not useful in distinguishing project alternatives because SALMOD was developed only for the uppermost 25-mile reach of the mainstem Trinity River downstream of Lewiston to Dutch Creek; only chinook salmon are modeled; the model covers a limited time-frame (from September 2 to June 9); and the model uses current channel configuration and conditions. Because of these limitations, an alternative methodology was developed and used to determine effects of project alternatives on salmonid fish resources for the 1999 DEIS/DEIR. This methodology was also used in the analysis of impacts and benefits to anadromous salmonids in the Trinity River in this SEIS. In addition to the methodology used in the 1999 DEIS/DEIR, a supplemental and more robust analysis of the effects of river flows and resulting water temperatures on the smolt life-stages of anadromous salmonids was conducted.