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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
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APR 6 2001

Mr. Karl E. Wirkus
Bureau of Reclamation
Klamath Basin Area Office
6600 Washburn Way
Klamath Falls, Oregon 97603

Dear Mr. Wirkus,

The purpose of this letter is to transmit our biological opinion regarding the impacts of the on-going Klamath Project operations on Southern Oregon/Northern California Coasts (SONCC) coho salmon, a species listed as threatened under the Endangered Species Act (see enclosure).

On January 22, 2001, the Bureau of Reclamation (Reclamation) requested formal section 7 consultation on the effects of the on-going operations of the Klamath Project on SONCC coho salmon. After reviewing the current status of SONCC coho salmon, the environmental baseline for the action area, the effects of the proposed action and cumulative effects, the National Marine Fisheries Service (NMFS) provided Reclamation a draft jeopardy opinion and reasonable and prudent alternative on March 19, 2001. Following review and consideration of comments and information received on our March 19, 2001, draft opinion and reasonable and prudent alternative, it is NMFS's opinion that the ongoing operation of the Klamath Project into the future, as proposed, is likely to jeopardize the continued existence of SONCC coho salmon and adversely modify its designated critical habitat. Our jeopardy determination is generally based on the expectation that the proposed operation of the Project would result in a continued decline in habitat conditions in the Klamath River below Iron Gate Dam (IGD) relative to Project operations during previous decades. As a result, the survival and abundance of several freshwater life history stages of coho salmon would be expected to decrease–appreciably reducing the likelihood of survival and recovery of SONCC coho salmon.

Regulations (50 CFR §402.02) implementing section 7 of the Endangered Species Act require "jeopardy" biological opinions to identify any "reasonable and prudent alternatives" to the proposed action. A "reasonable and prudent alternative" is an alternative action, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would avoid the likelihood of jeopardizing the continued existence of listed species or result in the destruction or adverse modification of critical habitat. Although several factors present difficulties in identifying reasonable and prudent alternatives for the Reclamation's proposed action, the enclosed biological opinion identifies one reasonable and prudent alternative (RPA) that NMFS believes meets these criteria. For instance, the minimum Iron Gate Dam flow releases and ramping rates identified in the RPA are actions within the Reclamation's authority and jurisdiction and would allow the Klamath Project to meet its intended purpose in most years. NMFS believes that the RPA would provide necessary and adequate survival levels to avoid the likelihood of jeopardizing the continued existence of SONCC coho and adversely modifying its critical habitat.

Because NMFS expects additional information and analyses relevant to the relationship between Iron Gate Dam (IGD) flows and suitable habitat for salmonid habitat to become available over the next few months, the RPA includes specific IGD minimum flows for the April through September 2001 period only, based on the best information currently available. We intend to develop and provide Reclamation a comprehensive biological opinion and RPA, addressing all water year types, on or before June 7, 2001–the statutory deadline to complete this consultation. This comprehensive biological opinion and RPA could include a different and more refined minimum IGD flow regime for future "critically dry" water years, based on new information and analyses that we expect to be available in the near future.

Since this biological opinion has concluded that your proposed action is likely to jeopardize the continued existence of SONCC coho salmon, Reclamation is required to notify NMFS of its final decision on the implementation of the RPA. The NMFS looks forward to further coordination with Reclamation as existing efforts toward salmonid restoration activities continue, and new cooperative opportunities are identified.

Sincerely,

Rebecca Lent
Regional Administrator

Enclosure

Biological Opinion

Ongoing Klamath Project Operations

April 6, 2001

National Marine Fisheries Service
Southwest Region

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Consultation History

The Bureau of Reclamation (Reclamation) forwarded a final biological assessment (BA) addressing its 1998 Operations Plan for its Klamath Project (Project) to the National Marine Fisheries Service (NMFS) on June 2, 1998 (Reclamation 1998). The June 2, 1998, transmittal letter stated that the "...BA fulfills Reclamation's responsibilities...under Section 7 of the Endangered Species Act [ESA] regarding preparation of the BA and for providing information for determining the need for formal consultation." Although NMFS considered this, functionally, as a request for formal consultation under the ESA, insufficient human resources precluded proceeding with formal consultation until preparation of Reclamation's 1999 Project Operations Plan.

On March 9, 1999, Reclamation forwarded a draft Klamath Project 1999 Annual Operations Plan Environmental Assessment (EA) to NMFS (and the public), and requested formal consultation under section 7 of the ESA (Reclamation 1999a). The March 9, 1999, transmittal letter stated that the "...preferred alternative in the 1999 EA is virtually the same as...[that] presented in the 1998 EA." On June 18, 1999, Reclamation modified their proposed April 1999 through March 2000 operations of the Project as described in a letter from K. Wirkus to D. Reck (Reclamation 1999b). On July 12, 1999, NMFS issued a biological opinion on operation of the Project through March 2000 (1999 Opinion, NMFS 1999).

On April 4, 2000, NMFS informed Reclamation that the 1999 Opinion and associated incidental take statement had expired on March 31, 2000, and that they should request ESA section 7 consultation regarding operation of the Klamath Project (NMFS 2000).

On April 26, 2000, Reclamation acknowledged that section 7(d) of the ESA prohibits the irreversible and irretrievable commitment of resources that foreclose the formulation of reasonable and prudent alternatives which would avoid violating section 7(a)(2) of the ESA (Reclamation 2000). Specifically, the April 26, 2000, letter stated that "[b]ased on the information available to Reclamation at this date, we have determined that the proposed flows [included in the April 26, 2000, letter]...are both sufficient and necessary to avoid possible 7(d) foreclosures and to fulfill Reclamation's obligation to protect Tribal trust resources."

Subsequently, on January 22, 2001, Reclamation requested initiation of formal ESA section 7 consultation regarding the ongoing operation of the Klamath Project. The January 22, 2001, letter included a "biological assessment of the Klamath Project's continuing operations on Southern Oregon/Northern California ESU coho salmon and critical habitat for Southern Oregon/Northern California ESU coho salmon" (ongoing Project operations BA, Reclamation 2001).

Background

The Project is located in southern Oregon and provides irrigation water for approximately 220,000 acres in three counties located in Oregon and California. Project water is stored primarily in Upper Klamath Lake in the headwaters of the Klamath River Basin and Gerber and Clear Lake reservoirs in the Lost River watershed. Project facilities are located upstream of Iron Gate Dam (IGD), owned and operated by PacifiCorp, which is currently a barrier to anadromous salmonid migrations in the mainstem Klamath River. The development of dams in this location of the Klamath River began with Klamathon Dam prior to 1900. Copco No. 1 dam was completed in 1918, and by 1921 Link River Dam was constructed to supply water for irrigated agriculture and wildlife refuges, and to supply power. The construction of Copco No. 2 dam was completed in 1925, supplying more hydroelectric power. Due to high fluctuations in flow releases from Copco, the United States Bureau of Fisheries recommended an "equalizing dam" be constructed below Copco No. 2 dam to stabilize flows. IGD construction was completed in 1962 and is located at approximately river mile 190. A minimum flow regime was prescribed in the Federal Energy Regulatory Commission (FERC) license covering operation of IGD.

Although a myriad of human induced and natural factors affect fish species of concern in the Klamath River, Project operation largely affects water available for release from IGD during portions of the year. In turn, flow releases from IGD affect the quantity and quality of aquatic habitat in the mainstem Klamath River in California. Investigations into an appropriate flow regime below IGD have resulted in several recommendations, and ongoing data collection and analysis efforts are expected to provide for refined recommendations in the future. These topics are discussed in the "Effects of the Action" section of this biological opinion (Opinion).

Since 1996, Reclamation has been planning their operations of the Project annually. During this same period, Reclamation has been working to develop a multi-year operations plan and more recently has been preparing a draft Environmental Impact Statement describing the effects of future alternative Project operations.

The objective of this Opinion is to determine whether the proposed ongoing operation of the Klamath Project is likely to jeopardize the continued existence of threatened Southern Oregon/Northern California Coasts (SONCC) coho salmon (*Oncorhynchus kisutch*). Klamath Mountains Province (KMP) steelhead occur in the Klamath River, but are not currently listed under the ESA (April 4, 2001; 66 FR 12845).

Critical habitat has been designated for SONCC coho salmon. Conclusions regarding destruction or adverse modification of designated critical habitat are included in this Opinion.

Description of the Proposed Action

Reclamation prepared a BA (Reclamation 2001) describing proposed ongoing Project operations from the present until such time as additional ESA consultation addressing a future operations scenario analyzed in an Environmental Impact Statement (EIS) supercedes the resulting 2001 NMFS biological opinion. Actions proposed within the ongoing Project operations BA included providing water for agriculture, National Wildlife Refuges, and downstream aquatic habitat. In addition, Upper Klamath Lake is managed to maintain habitat for endangered fish under the United States Fish and Wildlife Service's (USFWS) ESA jurisdiction. Other actions proposed included participation in salmon and steelhead monitoring activities in the Klamath River, the continued implementation of Reclamation's Water Supply Initiative aimed at obtaining additional water supplies, conducting a feasibility study on raising the maximum operating water surface elevation of Upper Klamath Lake by up to 2 feet, implementation of several groundwater investigations, conducting an appraisal study on raising Gerber Dam by 3 feet, and development of a management plan for Agency Lake Ranch.

PacifiCorp operates Link River Dam in accordance with Reclamation's annual operations plans for the Klamath Project, and owns and operates Keno Dam, J.C. Boyle Dam, Copco No. 1 and Copco No. 2 Dams, and Iron Gate Dam, downstream of Reclamation's Klamath Project. In their ongoing Project operations BA, Reclamation also proposes to work to develop a plan of closer operational coordination and data sharing with PacifiCorp to reduce the scope of impacts of depressed flows that occur during the April through June period. NMFS believes that this is intended to address IGD flow ramping concerns during this period.

The ongoing Project operations BA includes specific proposed average minimum flows for release at Iron Gate Dam, by four water year types (see Table 1). These water year types are defined in terms of April through September inflow to Upper Klamath Lake: Above Average (>500,400 acre feet [af]); Below Average (312,800 - 500,400 af); Dry (185,000 - 312,800 af); and Critical (<185,000 af). These proposed minimum flows are the average monthly or biweekly (as applicable) minimums that were measured below Iron Gate Dam during the 1961 through 1997 period, by water year type (Reclamation 2001).

<u>Description of the Action Area</u>
For the purposes of this Opinion, the action area is defined as the Klamath River downstream of IGD, located at approximately river mile 190, in northern California.

Species Description

The coho salmon is an anadromous salmonid species that was historically widely distributed throughout the North Pacific Ocean from central California to Point Hope, Alaska, through the Aleutian Islands, and from Anadyr River, Russia, south to Hokkaido, Japan. Coho salmon are very similar in appearance to chinook salmon (*O. tshawytscha*) while at sea (blue-green back with silver flanks), but they are smaller than chinook salmon. Coho salmon adults can be distinguished from small chinook salmon by the lack of spots on the lower portion of the tail. During the twentieth century, naturally-producing populations of coho salmon have declined or have been extirpated in California, Oregon, and Washington. The coho salmon status review identified six distinct population segments (Evolutionarily Significant Units - ESUs) in these states and noted that natural runs in all ESUs are substantially below historical levels (Weitkamp et al. 1995). The action area is within the range of the SONCC coho salmon ESU.

Life History

General life history information for coho salmon is summarized below. Further information is available in the status review (Weitkamp et al. 1995), the proposed rule for listing coho salmon (July 25, 1995; 60 FR 38011), and the final rule listing the SONCC coho salmon ESU (May 6, 1997; 62 FR 24588).

In contrast to the life history patterns of other Pacific salmonids, coho salmon generally exhibit a relatively simple three-year life cycle. They spend approximately 18 months in fresh water and 18 months in salt water (Shapovalov and Taft 1954). The primary exception to this pattern are "jacks," which are sexually mature males that return to fresh water to spawn after only 5 to 7 months in the ocean. Most coho salmon enter rivers between September and February and spawn from November to January (Hassler 1987), and occasionally into February and March (Weitkamp et al. 1995). Coho salmon river entry timing is influenced by many factors, one of which appears to be river flow (Sandercock 1991). In addition, many small California stream systems have sandbars that block their mouths for most of the year except winter. In these systems, coho salmon and other Pacific salmonid species are unable to enter the rivers until sufficiently strong freshets open passages through the bars (Weitkamp et al. 1995). In general, earlier migrating fish spawn farther upstream within a basin than later migrating fish, which enter rivers in a more advanced state of sexual maturity (Sandercock 1991). Spawning is concentrated in riffles or in gravel deposits at the downstream end of pools with suitable water depth and velocity.

Coho salmon eggs incubate for approximately 35 to 50 days between November and March. The duration of incubation may change depending on ambient water temperatures (Shapovalov and Taft 1954). Successful incubation depends on several factors including dissolved oxygen levels, temperature, substrate size, amount of fine sediment, and water velocity. Fry start emerging from the gravel two to three weeks after hatching (Hassler 1987). Following emergence, fry move into shallow areas near the stream banks. As coho salmon fry grow larger, they disperse upstream and downstream and establish and defend a territory (Hassler 1987).

During the summer, coho salmon fry prefer pools and riffles featuring adequate cover such as large woody debris, undercut banks, and overhanging vegetation. Juvenile coho salmon prefer to over-winter in large mainstem pools, backwater areas and secondary pools with large woody debris, and undercut bank areas (Hassler 1987; Heifetz et al. 1986). Juveniles primarily eat aquatic and terrestrial insects (Sandercock 1991). Coho salmon typically rear in fresh water for up to 15 months, then migrate to the sea as smolts between March and June (Weitkamp et al. 1995).

While living in the ocean, coho salmon remain closer to their river of origin than do chinook salmon (Weitkamp et al. 1995). Nevertheless, coho salmon have been captured several hundred to several thousand kilometers away from their natal stream (Hassler 1987). Coho salmon typically spend two growing seasons in the ocean before returning to their natal streams to spawn as three-year-olds.

Population Trends

Available historical and recent coho salmon abundance information is summarized in the NMFS coast-wide status review (Weitkamp et al. 1995). Following are some excerpts from this document.

Gold Ray Dam adult coho passage counts provide a long-term view of coho salmon abundance in the upper Rogue River. During the 1940s, counts averaged ca. 2,000 adult coho salmon per year. Between the late 1960s and early 1970s, adult counts averaged fewer than 200. During the late 1970s, dam counts increased, corresponding with returning coho salmon produced at Cole Rivers Hatchery. Coho salmon run size estimates derived from seine surveys at Huntley Park near the mouth of the Rogue River have ranged from ca. 450 to 19,200 naturally-produced adults between 1979 and 1991. In Oregon south of Cape Blanco, Nehlsen et al. (1991) considered all but one coho salmon population to be at "high risk of extinction." South of Cape Blanco, Nickelson et al. (1992) rated all Oregon coho salmon populations as "depressed."

Brown and Moyle (1991) estimated that naturally-spawned adult coho salmon returning to California streams were less than one percent of their abundance at mid-century, and indigenous, wild coho salmon populations in California did not exceed 100 to 1,300 individuals. Further, they stated that 46 percent of California streams which historically supported coho salmon populations, and for which recent data were available, no longer supported runs.

No regular spawning escapement estimates exist for natural coho salmon in California streams. California Department of Fish and Game (CDFG) (1994a) recently summarized most information for the northern California region of this ESU. They concluded that "coho salmon in California, including hatchery populations, could be less than six percent of their abundance during the 1940s, and have experienced at least a 70 percent decline in the 1960s." Further, they reported that coho salmon populations have been virtually eliminated in many streams, and that adults are observed only every third year in some streams, suggesting that two of three brood cycles may already have been eliminated.

The rivers and tributaries in the California portion of this ESU were estimated to have average recent runs of 7,080 natural spawners and 17,156 hatchery returns, with 4,480 identified as "native" fish occurring in tributaries having little history of supplementation with non-native fish. Combining recent run-size estimates for the California portion of this ESU with Rogue River estimates provides a rough minimum run-size estimate for the entire ESU of about 10,000 natural fish and 20,000 hatchery fish (May 6, 1997; 62 FR 24588).

Klamath River Basin Population Information

Limited information exists regarding coho salmon abundance in the Klamath River Basin. Adult coho salmon have been counted in a few Klamath River tributaries; however, these counts are incomplete because they are typically only made incidentally to their purpose of determining fall chinook salmon escapement and they may not account for fish that spawn below the weirs. Once the counting of fall chinook ends, the counting weirs are removed prior to high winter flows and therefore counting efforts may not include a portion of the coho salmon migration. In addition, some juvenile trapping occurs on the Klamath River and tributaries. Unfortunately, these counts are also focused on fall chinook and therefore incomplete with regard to sampling for coho salmon juveniles. As such, both adult and juvenile counts are valuable for documenting the presence of coho salmon in specific areas during key time periods, but less valuable for determining population status or trends. However, they do highlight the low abundance and precarious status of coho salmon populations in the Klamath River Basin.

Adult data

Adult salmon counting weirs are operated in Bogus Creek and the Shasta and Scott rivers. In addition, coho salmon adult counts are also made at the Trinity River weir in Willow Creek. Between 1981 and 1986 (four sample years), an average of five coho salmon adults (range: 0-12) were counted in Bogus Creek (CDFG unpublished data). Between 1992 and 2000 (nine sample years), an average of four coho adults (range: 0-10) were counted in Bogus Creek (CDFG unpublished data). Typically, coho salmon are first observed at the weir in the first or second week of October.

Weir and video observations of coho salmon in the Shasta River have yielded an average of approximately eight coho salmon adults (range: 0-24) between the years 1991-2000 (CDFG unpublished data). During the 1991-2000 period, coho salmon have been observed at the Shasta River weir as early as September 25 (CDFG unpublished data). These adult counts during two years out of nine account for approximately 44 percent of the fish during this period and there was only one or zero fish counted during four of the ten years (CDFG unpublished data). Further evidence of the decline of the Shasta River coho salmon population is found in a comparison of counts from the 1970's with counts from the 1990's during years when trapping began and ended at about the same time (began first week of September, ended second week of November). During the years 1970, 1972, 1973, and 1977, an average of 217 adult coho salmon were counted (CDFG unpublished data). During the years 1991-1993 and 1995, an average of seven adult coho salmon were counted (CDFG unpublished data). These data suggest a dramatic decline in the status of Shasta River coho salmon.

Weir counts in the Scott River averaged twenty-five fish (range: 5-37) during the 1982-1986 period (CDFG unpublished data) and four adults (range: 0-24) between the years 1991-1999 (CDFG unpublished data). Again, this information should include a qualification that one year accounted for approximately 65 percent of the total number of coho observed during the 1991-1999 period and zero coho were observed in four of the nine years (CDFG unpublished data). Coho salmon were observed in the Scott River during the 1991-1999 period as early as September 21.

Adult coho salmon counts in the Trinity River weir better reflect the total number of coho found in the Trinity River because the counts are made relatively low in the system below much of the spawning habitat. Unfortunately, these counts are incomplete as well because the weir is typically removed by the second week of November and trapping does not occur every day. Therefore, the trapping effort may not include a portion of the run and even relatively small day to day differences in fish counts may skew the results. In addition, the majority of the fish trapped are of hatchery-origin, and 100 percent marking of hatchery coho salmon has only recently occurred so estimates of naturally-produced coho are only available since the 1997 return year (CDFG 2000a). The results of counting from these three years yields an estimated 198, 1001, and 491 naturally produced adult coho salmon for the 1997-1998, 1998-1999, and 1999-2000 seasons, respectively (CDFG 2000a). Coho salmon were first observed at the Trinity River weir during the week of September 10 during the 1999-2000 trapping season (CDFG 2000a).

Juvenile data

The USFWS operates downstream juvenile migrant traps on the mainstem Klamath and Trinity rivers. Again, the incomplete trapping record provides limited information in terms of abundance or trends, but does indicate the presence of coho at different life stages during certain times of the year. Indices of abundance (expanded from actual numbers trapped) for coho salmon smolts from trapping conducted on the Klamath River at Big Bar yielded an average of 548 naturally-produced smolts (range: 137-1268) for the 1991-2000 period (USFWS 2000). Trapping at Willow Creek on the Trinity River yielded an average of 2,975 coho salmon smolts (range: 565-5084) for the same period (USFWS 2000). These low numbers do provide insight into the limited size of coho salmon populations in the Klamath River Basin, although some early outmigrants may be missed. Even if these numbers were doubled to account for time when trapping did not occur, these populations would be considered extremely low.

In 1997, the USFWS completed a report that described the life history periodicities for anadromous salmonids, including coho salmon, in the Klamath River Basin (USFWS 1997a). The USFWS determined, both through the operation of juvenile outmigrant traps and review of relevant literature, that coho salmon fry are present in the mainstem Klamath River from at least April through late July and coho yearlings are present from mid-March through August. Both coho salmon yearlings and fry have been observed in every month of the summer. Also, both USFWS (1997a) and CDFG (1994b) indicated that coho salmon fry emigrated from some tributaries to the mainstem Klamath River soon after emergence. The USFWS (1997a) concluded that coho salmon juveniles likely rear year-around in the mainstem Klamath River between Iron Gate Dam and Seiad Creek.

In summary, information on coho salmon population status or trends in the Klamath River Basin is incomplete, but what information exists suggests adult populations are small to nonexistent in some years. Existing information also indicates that adult coho salmon are present in the Klamath River in early September and juvenile coho salmon are present in the mainstem Klamath River throughout the year, including the summer months.

Current Status

Listing History

The SONCC coho salmon ESU was listed as threatened under the ESA on May 6, 1997 (62 FR 24588). This ESU includes coho salmon populations between Cape Blanco, Oregon, and Punta Gorda, California. An interim rule under section 4(d) of the ESA was published on July 18, 1997 (62 FR 3847) applying the prohibitions contained in section 9(a) of the ESA to the California portion of the ESU. Critical habitat was designated for the SONCC coho salmon ESU on May 5, 1999 (64 FR 24049). Critical habitat includes all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The NMFS has identified twelve dams in the range of these ESUs that currently block access to habitats historically occupied by coho salmon. However, NMFS has not proposed these inaccessible areas as critical habitat because areas downstream were believed to be sufficient for the conservation of the ESUs.

<u>Threats</u>
The SONCC coho salmon ESU was listed as threatened due to numerous factors including several long-standing, human-induced factors (e.g., habitat degradation, harvest, water diversions, and artificial propagation) that exacerbate the adverse effects of natural environmental variability (e.g., floods, drought, poor ocean conditions). Habitat factors that may contribute to the decline of coho salmon in the SONCC ESU include changes in channel morphology, substrate changes, loss of instream roughness and complexity, loss of estuarine habitat, loss of wetlands, loss and/or degradation of riparian areas, declines in water quality, altered stream flows, impediments to fish passage, and elimination of habitat. The major activities identified as responsible for the decline of coho salmon in Oregon and California include logging, road building, grazing, mining, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation (May 6, 1997; 62 FR 24588).

Tribal harvest is not considered a major factor in the decline of coho salmon in the SONCC ESU. In contrast, over fishing in non-tribal fisheries is believed to have been a significant factor (May 6, 1997; 62 FR 24588). Disease and predation are not believed to be major causes in the species decline; however, they may have substantial impacts in local areas. For example, Higgins et al. (1992) and CDFG (1994a) reported that Sacramento River pikeminnow have been found in the Eel River basin and are considered to be a major threat to native coho salmon. Furthermore, California sea lions and Pacific harbor seals, which occur in most estuaries and rivers where salmonid runs occur on the West Coast, are known predators of salmonids. Harbor seals are present year-round near Cape Mendocino. California sea lions are present near Cape Mendocino in the fall and spring. At the mouth of the Eel River, harbor seals haul-out in large numbers (600-1,050 seals). More than 1,200 harbor seals have been counted in the vicinity of Trinidad Head. Coho salmon may be vulnerable to impacts from pinniped predation. In the final rule listing the SONCC coho salmon ESU, NMFS indicated that it was unlikely that pinniped predation was a significant factor in the decline of coho salmon on the west coast, although they may be a threat to existing depressed local populations. The NMFS (1997) has recently determined that although pinniped predation did not cause the decline of salmonid populations, in localized areas where they co-occur with salmonids (especially where salmonids concentrate or passage may be constricted), predation may preclude recovery of these populations. Specific areas where predation is/may preclude recovery cannot be determined without extensive studies.

Artificial propagation is also a factor in the decline of coho salmon due to the genetic impacts on indigenous, naturally-reproducing populations, disease transmission, predation of wild fish, depletion of wild stock to enhance brood stock, and replacement rather than supplementation of wild stocks through competition and the continued annual introduction of hatchery fish.

Existing regulatory mechanisms, including land management plans (e.g., National Forest Land Management Plans, State Forest Practice Rules), Clean Water Act section 404 activities, urban growth management, and harvest and hatchery management all contributed to varying degrees to the decline of coho salmon due to lack of protective measures, the inadequacy of existing measures to protect coho salmon and/or its habitat, or the failure to carry out established protective measures. Since the listing of the SONCC coho salmon ESU, no new threats have been identified.

Environmental Baseline

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species. The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area (50 CFR § 402.02), and a summary of the status of threatened and endangered species in the action area.

The environmental baseline discussion in NMFS' biological opinions generally summarize the effects of past and present human and natural phenomena on the current status of threatened and endangered species and their habitat in an action area, in order to evaluate the effects of an action.

The proposes action being analyzed in this biological opinion is, the ongoing operations of the Klamath Project described in the BA (Reclamation 2001). However, the Project was constructed in and has been operated since the early 1900s, and thus past impacts from the project have contributed to the environmental baseline. The effects of past Project operations are reflected in the current status of the species being considered in this biological opinion. The NMFS also observes that the Project has generally been operated to provide water to meet minimum flow targets set by FERC below IGD since about 1962.

The factors presenting risks to naturally-reproducing coho salmon populations are numerous and varied. The Klamath River Basin Fisheries Task Force (KRBFTF, created in 1986 by Public Law 99-552) described salmon and steelhead habitat issues in their Long Range Basin Restoration Plan (KRBFTF 1991). Habitat issues were discussed by type of associated human activities: Land management (timber harvesting, mining, and agriculture) and water management (water and power projects, and water diversions) categories. The KRBTFT described the history of these issues, and the activities that have led to present aquatic habitat conditions. The following is a supplemented summary of the KRBFTF's discussion of these issues.

<u>Land Management</u>
Industrious land management began in the late 1880s. During the Depression, many new roads were built in the Klamath Basin and new territory was opened up for logging. Many of these roads featured stream crossings that were not designed to allow for upstream and downstream fish passage. After World War II, technological improvements such as power saws, bulldozers, rafts, tugs, trucks and trailers allowed for an increased rate of timber harvest in the Basin. Many of these activities had deleterious effects to the watershed, transferring soils and logging debris into small streams and tributaries, effectively destroying fish habitat.

Roads associated with timber harvesting account for a large portion of the erosion occurring in logged areas. Poor road design, location, construction and maintenance caused erosion of all types: mass soil movement, surface, gullies, and stream bank. Harvesting has expanded from established roads into more inaccessible terrain and areas of greater environmental risk.

The effects of land management activities on streams and fish habitat are well documented (Sullivan et al. 1987; Hartman and Scrivener 1990; Meehan 1991). Forest management activities that influence the quantity, quality, or timing of stream flows affect fish habitat primarily through changes in the normal levels of peak flows or low flows (Sullivan et al. 1987; Chamberlin et al. 1991). Water outflows from hillsides to streams are affected through changes in evapotranspiration, soil water content, and soil structure. In general, timber management activities allow more water to reach the ground, and may alter water infiltration into forest soils such that less water is absorbed or the soil may become saturated faster thereby increasing surface flow. Road systems, skid trails, and landings where the soils become compacted may also accelerate runoff. Ditches concentrate surface runoff and intercept subsurface flow bringing it to the surface (Chamberlin et al. 1991; Furniss et al. 1991). Significant increases in the magnitude of peak flows or the frequency of channel forming flows can increase channel scouring or accelerate bank erosion.

Increases in sediment contributions to streams are generally attributable to changes in rates of erosion on hillslopes through such processes as increased landslide activity, sheetwash erosion associated with road management activities (construction and maintenance) and yarding operations, and fires (both wildfires and controlled burns). The largest contributions of sediment are typically from road construction activities (Furniss et al. 1991). Significant increases in the sediment supplied to streams can cause channel aggradation, pool filling, additional bank erosion, and losses of channel structures and habitat diversity. Stable large woody debris structures within the stream channel may be lost through direct removal, channel aggradation, debris torrents, or gradual attrition through lack of recruitment. These losses result in a reduction in sediment storage capacity, fewer and shallower scour pools, and a reduction of instream cover for fish (Chamberlin et al. 1991).

Changes in peak flows and sediment yield directly related to the removal of vegetation will typically persist for only a few years and tend to decrease over time as the watershed recovers and new vegetation grows. Changes associated with roads persist indefinitely as roads are maintained or abandoned without treatment. Stream channel responses may take decades or centuries to recover (Chamberlin et al. 1991; Furniss et al. 1991).

Mining activities within the Klamath Basin began prior to 1900. Many of the communities in the Klamath River Basin originated with the gold mining boom in the 1800s. Water was diverted and pumped for use in sluicing and hydraulic mining operations. This resulted in dramatic increases in turbidity levels altering stream morphology. Some believed that the hydraulic mining period resulted in greater impacts to the salmon fishery than the large fish canneries of the era. The negative impacts of stream siltation on fish abundance was observed as early as the 1930s. Several streams impacted by mining operations and containing large volumes of silt seldom had large populations of salmon or trout (Smith 1939).

Since the 1970s, mining operations have been curtailed due to stricter environmental regulations. However, mining operations continue including suction dredging, placer mining, gravel mining, and lode mining. These mining operations can adversely affect spawning gravels, result in increased poaching activity, decreased survival of fish eggs and juveniles, decrease benthic invertebrate abundance, adversely affect water quality, and impact stream banks and channels.

Crop cultivation and livestock grazing in the upper Klamath Basin began in the mid-1850s. Since then, valleys have been cleared of brush and trees to provide more farm land. By the turn of the century, native perennial grasses were replaced by various species of annual grasses and forbes. This, combined with soil compaction, resulted in higher surface erosion and greater peak water flows in streams. Other annual and perennial crops cultivated included grains, alfalfa hay, potatoes and corn.

As the value of farm lands increased, flood control measures were implemented. During the 1930s, the U.S. Army Corps of Engineers implemented flood control measures in the Scott River valley by removing riparian vegetation and building dikes to constrain the stream channel. As a result, the river channelized, water velocities increased, and the rate of bank erosion accelerated. To minimize damage, the Siskiyou Soil Conservation Service planted willows along the streambank and recommended channel modifications take place that re-shaped the stream channel in a series of gentle curves.

Agricultural practices may adversely impact the aquatic environment. Stream pollution from agriculture runoff is a persistent cause of damage. Animal wastes, fertilizers, pesticides, and herbicides enter the stream as a result of storm runoff and return flows from irrigation. This has resulted in elevated nutrient levels in the Klamath River and some tributaries. Livestock trampling in and near the stream channel can reduce fish egg survival and increase sedimentation due to bank erosion. Agricultural practices that reduce riparian vegetation in turn reduce large woody debris recruitment and simplify the stream channel. Removal of riparian vegetation has also resulted in elevated water temperatures in the Klamath Basin. Temperatures periodically reach levels that are lethal to some fish species. This, combined with elevated nutrient levels, results in stimulation of aquatic plant and algae growth. As water temperatures rise and plants and algae decompose, the level of dissolved oxygen decreases. Dissolved oxygen levels in the Klamath River often fall below the state's water quality objective of 7.0 mg/l.

Current Federal Land Management

Since 1994, the U.S. Forest Service and Bureau of Land Management have been managing their lands in the Klamath River Basin consistent with the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (Northwest Forest Plan; USDA and USDI 1994). This is expected to result in improved freshwater salmon habitat conditions within Federal forest lands through time, as conservative approaches to timber harvest and road-related activities are applied. The NMFS previously completed a biological opinion on the continued implementation of the Northwest Forest Plan on Bureau of Land Management and National Forest lands in the basin.

Water Management

The upper Klamath River Basin is at relatively high elevations and features seasonal accumulations of snow. Also, numerous lakes and wetlands serve to store and gradually release winter precipitation. The Basin is underlain with pervious, water-bearing volcanic rock. Under natural conditions the upper Klamath Basin was the principal source of late summer Klamath River flows, and of flows during years of below-normal precipitation and extended drought (Hecht and Kamman 1996).

Dams impounding water for mining and farming operations were first built in the Klamath Basin during the 1850s. Some of these dams blocked fish passage in a number of tributary streams. The first hydroelectric dams were built in the Shasta River and the upper Klamath River Basin just prior to the turn of the century.

In 1905, Reclamation began developing its irrigation project near Klamath Falls, Oregon. Marshes were drained, dikes and levees were constructed, and the level of Upper Klamath Lake was raised. Irrigation water in the upper Basin was primarily provided by diversion from Upper Klamath Lake and the Lost River system.

Starting around 1912, construction and operation of the numerous facilities associated with the Project have significantly altered the natural hydrographs of the upper and lower Klamath River. These facilities include the A-Canal, Lost River Diversion Dam, Copco Nos. 1 and 2 Dams, J.C. Boyle Hydroelectric Dam, IGD, and Keno Dam. Changes in the flow regime at Keno, Oregon, after the construction of the A-Canal, Link River Dam, and the Lost River Diversion Dam, can be seen in the 1930-to-present flow records. These changes include a reduction of average summer monthly flows, and alteration of the natural seasonal variation of flows to meet peak power and diversion demands (Hecht and Kamman 1996).

The Copco facilities were operated in power-peaking mode, and flow releases fluctuated according to anticipated energy demands. Flows could vary by an order of magnitude or more within a 20 minute period, creating a hazard for both fish and fishermen. Fish and their food base were often stranded, resulting in mortality. The detrimental effect to the fishery was pronounced (KRBFTF 1991).

Hecht and Kamman (1996) viewed the hydrologic records for similar water years (pre- and post-Project) at several locations. The authors concluded that: (1) there was much less variability between mean, minimum, and maximum flows in the Klamath River at Keno prior to construction of the Project, and (2) the timing of peak and low flows changed significantly after construction of the Project, and operation increases flows in October and November and decreases flows in the late spring and summer as measured at Keno, Seiad, and Klamath. Their report also noted that water diversions in areas outside the Project boundaries occur as well.

Around the 1920s, water resources in the Shasta and Scott Rivers were developed for irrigated agriculture. Dwinell Dam in the Shasta River Basin was constructed in 1928 to impound irrigation water for the Montague Water Conservation District. The dam effectively blocked access to the southern headwaters. No minimum flow regimes were established, and the nutrient-rich Lake

Shastina reservoir suffered from elevated water temperatures, increased algae growth, and decreased dissolved oxygen levels. Nutrient sources into the Lake include those from agricultural, urban, and suburban land use. The Dam also prevented spawning gravel recruitment into the downstream River reach.

By the 1960s, CDFG noted that diversion dams denied fish migration passage over numerous diversion dams in the Shasta River, and in 1974, CDFG noted that agricultural activities and fishery values were largely incompatible. While natural low water conditions can be unfavorable to salmonids, the problem is exacerbated by numerous water diversions. The Shasta and Scott rivers historically supported strong populations of chinook salmon, coho salmon, and summer-run steelhead (KRBFTF 1991).

The Klamath River Compact was approved by Congress in 1957, and provided first water right priorities to irrigated agriculture, including a superior right for adequate water to irrigate 300,000 acres in addition to that land already irrigated ca. 1957 (KRBFTF 1991). Water for fish use ('recreational use') was third in priority. Numerous water right conflicts still exist, and the state of Oregon is currently adjudicating all water rights claims in the Oregon portion of the Klamath River Basin.

The IGD was completed by 1962 to re-regulate flow releases from the Copco facilities, but it did not restore the "pre-project" hydrograph. The pre-project hydrograph (at Keno, Oregon) and the post IGD hydrograph (below IGD) can be seen in Figures 1 and 2. Minimum stream flows and ramping rate regimes were established in the FERC license covering operation of IGD. As a mitigation measure for the loss of fish habitat between Iron Gate and Copco No. 2 Dams, a fish hatchery was established.

In 1964, the Trinity and Lewiston dams were completed in the Trinity River Basin. The initial operation plan diverted at least 80 percent of the Trinity River flow into the Sacramento River Basin. The remaining Trinity River flow was inadequate to meet the hydrological needs to maintain a healthy river system. Flood induced sediment transport ceased, and riparian vegetation encroached into the channel margin, "fossilizing" the bars and further impeding sediment transport above the North Fork Trinity River. In 1992, minimum flow releases from Lewiston Dam were slightly increased in the Trinity River.

The USFWS and the Hoopa Valley Tribe subsequently published the Trinity River Flow Evaluation Final Report (TRFE) in June 1999. Subsequently, the USFWS, Reclamation, Hoopa Valley Tribe, and Trinity County forwarded the TRFE recommendations as the preferred alternative in a draft EIS addressing mainstem Trinity River restoration. The NMFS issued a biological opinion on the draft EIS preferred alternative and determined that implementation of the proposed actions was not likely to jeopardize SONCC coho salmon. In October 2000, the Trinity River Mainstem Fishery Restoration final EIS was published, and an associated Record of Decision selecting the preferred alternative was signed by the Secretary of the Interior on December 19, 2000.

Indian tribes in the Klamath River Basin also have a profound interest in water management. Downstream tribal reserved water rights consist of an instream flow sufficient to protect the right to take fish within their reservations. The tribes' water rights may have a priority date as early as 1855, and include the right to prevent others from depleting the stream flow below a protected level and the right to water quality and flow to support all life history stages of fish (Reclamation 1999).

Summary of Water Quality Conditions

In addition to the hydrologic changes resulting from the activities discussed above, human activities have also resulted in degraded water quality in the action area. The Klamath River, from source to mouth, is listed as water quality impaired (by both Oregon and California) under Section 303(d) of the Federal Clean Water Act (CWA). In 1992, the State Water Resources Control Board (SWRCB) proposed that the Klamath River be listed under the CWA as impaired for both temperature and nutrients, requiring the development of Total Maximum Daily Load (TMDL) limits and implementation plans. The United States Environmental Protection Agency (USEPA) and the North Coast Regional Water Quality Control Board (NCRWQCB) accepted this action in 1993. The basis for listing the Klamath River as impaired was aquatic habitat degradation due to excessively warm water temperatures and algae blooms associated with high nutrient loads, water impoundments, and agricultural water diversions (USEPA 1993).

In 1997, the NCRWQCB updated the 303(d) list and added dissolved oxygen as an additional limiting factor for aquatic habitat in the Klamath River (NCRWQCB 1998). The impairment listing regarding dissolved oxygen was prompted by a 1997 USFWS report. The USFWS' concerns included the current status of salmonid populations in the Klamath River, the effects of past and current land use on water quality, annual fish and temperature monitoring data, documented fish kills, and current water quality monitoring data which indicate that acute and chronic values for temperature and dissolved oxygen are observed in the mainstem Klamath River, particularly during some summer periods (USFWS 1997b). The Klamath River is scheduled to have TMDLs established for temperature, nutrients, and dissolved oxygen by December 31, 2004.

The fact that the Klamath River is listed for temperature, nutrients and dissolved oxygen is especially important due to the relationship between these three water quality parameters. As described by Campbell (1995), increased water temperatures and lower saturated oxygen concentrations typically occur in the Klamath River during summer months, the same time of year that the growth and respiration cycles of aquatic plants affect dissolved oxygen concentration. These three parameters interact synergistically, and can have a much greater impact on water quality and salmonids than either temperature or dissolved oxygen alone (Campbell 1995).

Nutrient loading leads to increased growth of aquatic plants and algae in the Klamath River channel. The growth of aquatic plants and algae fosters sediment accumulation which decreases the quality of salmonid spawning and rearing habitat and leads to decreased dissolved oxygen concentration and high pH values on a diel cycle (Campbell 1995). The increased growth of aquatic plants and algae can also retard water velocity at low stream flows, contributing to higher stream temperatures in the Klamath River (Trihey and Associates 1996).

Low flow conditions can cause an increase in absolute concentrations of water pollutants. In some geographic areas, high flows may result in lower concentrations of pollutants due to dilution (Campbell 1995). Increasing flows during summer months may improve water quality downstream, but the direct effect of IGD flows is diminished in the lower river during some times of the year. Another positive effect of increased flows on water quality is that of dampening the diurnal fluctuations in temperature and dissolved oxygen. Low stream flows compound high water temperature problems, because a smaller volume of water is more easily heated and cooled, causing larger diurnal changes in the water temperature of the Klamath River (Trihey and Associates 1996; INSE 1999).

The Klamath River has probably always been a relatively warm river (Hecht and Kamman 1996), although there are no historical data to confirm this nor characterize the historic temperature regime. More recently, using a weekly mean temperature of 15E C as a threshold for chronic salmonid stress and a daily mean temperature of 20E C as an acute threshold, the 1966-1982 Klamath River temperatures at Orleans violated the acute and chronic thresholds a substantial portion of the time (Bartholow 1995). Campbell (1995) analyzed water quality data for 22 sites in the Klamath basin, applying the 1986 USEPA criteria. The most common water quality criteria exceeded were temperature at all 22 sites, and dissolved oxygen concentration at 11 sites.

Coho Salmon Harvest

Overfishing in non-tribal fisheries is believed to have been a significant factor in the decline of coho salmon. This included significant overfishing that occurred from the time marine survival turned poor for many stocks (ca. 1976) until the mid-1990s when harvest was substantially curtailed (May 6, 1997; 62 FR 24588).

Since 1994, the retention of coho salmon has been prohibited in marine fisheries south of Cape Falcon, Oregon. Coho salmon are still impacted, however, as a result of hook-and-release mortality in chinook salmon-directed fisheries. Since 1970, the ocean exploitation rate index on Oregon Production Index (OPI) coho salmon stocks (including coho salmon ESUs listed under the ESA) have generally declined from a high of about 80 percent to less than 10 percent in recent years. This has resulted from implementing non-retention fisheries of the Oregon and California coasts. Sport and commercial fishing restrictions ranging from severe curtailment to complete closures in recent years may be providing an increase in adult coho salmon spawners in some streams, but trends cannot be established from the existing data.

Coho salmon from the action area are contacted by ocean fisheries primarily off California. Coded-wire tagged coho salmon released from hatcheries south of Cape Blanco have a southerly recovery pattern, primarily in California (65-92 percent), with some recoveries in Oregon (7-34 percent), and almost none (1 percent) in Washington or British Columbia (percent data represent range of recoveries for five hatcheries by state or province) (Weitkamp et al. 1995). Ocean exploitation rates for SONCC coho salmon are based on the exploitation rate on Rogue/Klamath hatchery stocks and have only recently become available. The estimated ocean exploitation rates were 5 percent in 1996 and 1997, 12 percent in 1998, and are projected to be 5 percent in 1999 (PFMC 1997, 1998, 1999). The extent to which coded-wire tagged recovery patterns of these hatchery stocks coincide with the distribution patterns of wild coho salmon is not known.

Brown et al. (1994) estimated that approximately 90 percent of the Klamath-Trinity basin coho salmon are of hatchery origin. The annual tribal harvest of coho salmon over the past 5 years has been reported as 670 fish, of which 70 may have been naturally spawning. If the minimum population of naturally spawning SONCC coho salmon is about 10,000 fish (Weitkamp et al. 1995), the tribal impact on listed coho salmon has been relatively small, on average less than 100 fish per year during the past 6 years and less than 1 percent of the SONCC coho salmon ESU. Estimated tribal harvest rates on Klamath Basin coho salmon averaged 5 percent from 1992-1997. There are no tribal fisheries on coho salmon populations in the Rogue, Smith, Eel, or Mattole rivers.

Hatchery Programs

Large hatcheries in the SONCC coho salmon ESU (e.g., Mad River, Trinity River) have released 400,000-600,000 coho salmon annually between 1987 and 1991. In addition, Cole Rivers Hatchery and Iron Gate Hatchery released an average of about 270,000 and 150,000 coho salmon, respectively, during this period. All coho salmon hatchery programs in the California portion of this ESU have a history of transplants from areas outside of the SONCC coho salmon ESU. Although records are incomplete, the frequency and magnitude of out-of-basin-plants in this ESU appears to be relatively low (Weitkamp et al. 1995).

The Klamath and Trinity Basin coho salmon runs are now composed largely of hatchery fish, although there still may be wild runs remaining in some tributaries (CDFG 1994a). Because of the predominance of hatchery stocks in the Klamath River Basin, stock transfers into the Trinity and Iron Gate Hatcheries may have had a substantial impact on natural populations in the basin (July 25, 1995; 60 FR 38011).

Integration and Synthesis of the Environmental Baseline

The decline of Pacific salmonids is not the result of a single factor, and to search for the single cause is a misleading oversimplification. Multiple factors have contributed to the decline and multiple factors may still be preventing recovery. The identification of one such factor does not rule out the possibility that others are also acting, perhaps synergistically, to prolong the decline. Furthermore, the causes for the decline appear to include both natural and anthropogenic influences.

Coho salmon stocks in the northern California region of the SONCC coho salmon ESU could be at less than six percent of their abundance during the 1940s and have declined at least 70 percent since the 1960s. This decline prompted NMFS to list the SONCC ESU as threatened. Likewise, populations of chinook salmon, steelhead, and coastal cutthroat trout have declined to levels that have warranted their consideration for listing.

Dam construction has blocked access to coho salmon habitat in the Eel, Mad, Trinity, Klamath, and Rogue river basins. Within the Klamath River Basin, an estimated 20 percent of historical coho salmon habitat is no longer available (November 25, 1997; 62 FR 62741). This undoubtably decreased the production capacity of the basin.

Water development in the Klamath Basin has altered the hydrology, and the magnitude and timing of water flows has dramatically changed in the Trinity, Klamath, Shasta, and Scott rivers. Agricultural activities associated with Klamath Basin diversions have also contributed to increased nutrient loading. Undoubtably these activities resulted in adverse effects to coho salmon (and other salmonids), as these fish are adapted to historical flow conditions and high water quality.

Timber harvest activities, associated road construction, grazing, and mining activities have also degraded aquatic habitat conditions. This was acknowledged and addressed in the Northwest Forest Plan (USDA and USDI 1994), which guides Federal land management activities in the Klamath Basin.

The entire Klamath River is listed under the Clean Water Act as water quality impaired. The River is not scheduled for TMDL and implementation plans will not be established until about 2005.

Previous coho salmon harvest activities have also contributed to the decline of SONCC coho salmon. Ocean harvest rates for coho salmon remain at approximately 5 percent. Poor and uncertain hatchery practices in the past continue to have lingering adverse effects on natural populations in the action area.

In the face of all these changes and influencing factors, the SONCC coho salmon may not be able to maintain themselves. The available evidence suggests that a significant part of the problem is lack of properly functioning habitat.

Effects of the Action

Analysis Approach

Operation of the Project as described in the ongoing Project operations BA (Reclamation 2001) will affect flows in the Klamath River below the Project during portions of any given year, and will affect water quality as well. In turn, changes in flow due to Project operations will affect the amount of suitable habitat available to coho salmon in the Klamath River. The relationship between changes in habitat quantity and quality, and the status and trends of fish and wildlife populations has been the subject of extensive scientific research and publication, and the assumptions underlying our assessment are consistent with this extensive scientific base of knowledge. For detailed discussions of the relationship between habitat variables and the status of salmon populations, readers should refer to the work of FEMAT (USDA Forest Service et al. 1993), Gregory and Bisson (1997), Hicks et al. (1991), Murphy (1995), National Research Council (1996), Nehlsen et al. (1991), Spence et al. (1996), Thomas et al. (1993), The Wilderness Society (1993), and others.

The relationship between habitat and population is embodied in the concept of carrying capacity. The concept of carrying capacity recognizes that a specific area of land or water can support a finite population of a particular species because food and other resources in that area are finite

(Odum 1971). By extension, increasing the carrying capacity of an area (increasing the quality or quantity of resources available to a population within that area) increases the number of individuals the area can sustain over time. By the same reasoning, decreasing the carrying capacity of an area (decreasing the quality or quantity of resources available to a population) decreases the number of individuals the area can support over time. In either case, there is a corresponding, but non-linear relationship between changes in the quality and quantity of resources available to a species in an area and the number of individuals that the area can support.

The approach used in this assessment is intended to determine if the ongoing and proposed action is likely to degrade the quantity and quality of natural resources necessary to support populations of coho salmon in the action area. Finally, the assessment approach is intended to determine if any changes are likely to decrease the size, number, dynamics, or distribution of listed coho salmon populations in the action area in ways that appreciably reduce the likelihood of both the survival and recovery of SONCC coho salmon in the wild.

Effects of Flow Regulation

Coho salmon populations occur in the mainstem Klamath River year round, and also inhabit a number of tributaries (Henriksen 1995; INSE 1999). Between Seiad Valley and IGD, coho salmon populations are believed to occur in Bogus Creek, Shasta River, Humbug Creek, Empire Creek, Beaver Creek, Horse Creek, and Scott River. Between Orleans and Seiad Valley, coho salmon populations are believed to occur in Seiad Creek, Grider Creek, Thompson Creek, Indian Creek, Elk Creek, Clear Creek, Dillon Creek, and Salmon River. Finally, between Orleans and Klamath (mouth of the river), coho salmon populations are believed to occur in Camp Creek, Red Cap Creek, Trinity River, Turwar Creek, Blue Creek, Tectah Creek, Hunter Creek, Hoppaw Creek, Saugep Creek, Waukell Creek, McGarvey Creek, Tarup Creek, Omagaar Creek, Pularvasar Creek, Ah Pah Creek, Bear Creek, Little Surpur Creek, Johnson Creek, Pecwan Creek, Roach Creek, Mettah Creek, Tully Creek, and Pine Creek (INSE 1999; Yurok Tribe 2001).

The influence of IGD releases (relative to total Klamath River flow) decreases with distance downstream from the dam, and typically depends on time of year. The river reach between IGD and the Shasta River is heavily influenced by dam releases. During the July through October period between 1962 and 1991, IGD releases contributed an average of between about 60 and 85 percent of the river flow measured at Seiad (Figure 3). During this same period, IGD releases contributed an average of between about 50 and 65 percent of the river flow measured at Orleans (Figure 4). These averages increase during drought years. For example, monthly IGD releases contributed up to over 90 percent of the flow at Seiad during late summer in dry years.

Actual flows occurring in the Klamath River (measured at a given point) also depend on factors other than Project operations, including meteorological conditions (e.g., precipitation magnitude and timing) and other water management activities. For example, Figure 5 displays average daily flows in the Klamath River at IGD during the April through August 1998 period.

Water Temperature and Quality Modeling

The University of California at Davis constructed a set of reservoir and mathematical models capable of assessing potential water quantity and quality regulation measures for restoration and protection of anadromous fisheries in the Klamath River from Iron Gate Reservoir to Seiad Valley (Deas and Orlob 1999). The project consisted of two general activities: (1) the development and implementation of a water temperature monitoring program, and (2) the implementation and application of mathematical water quality models to Iron Gate Reservoir and the Klamath River from IGD to Seiad Valley.

Using available field data and model application to the historic periods of May through October of 1996 and 1997, general system response under existing operational conditions were defined. Impacts of seasonal variations in flow, meteorological conditions, and operations were evaluated for both the reservoir and river systems. Definition of existing conditions provided a starting point for assessment and interpretation of alternatives using 1996 and 1997 conditions. General findings included that during the late spring, summer, and early fall period, increased flows reduced water transit time in the Iron Gate Reservoir to Seiad Valley study reach, moderating the diurnal temperature range and providing modest temperature benefits. However, flow magnitudes can also result in increased reservoir release temperatures (Deas and Orlob 1999).

The Iron Gate Reservoir water temperature model provides confidence in the model forecasting ability, with simulated outfall temperatures falling within about 1EC (1.8EF) of measured values. Reservoir releases to the river are generally cool, and well below equilibrium temperature in the spring period. By early summer, the epilimnion of the reservoir has heated to a sufficient depth that water released to the River does not provide appreciable thermal benefits, with the exception of a moderated diurnal cycle (Deas and Orlob 1999).

Further data collection and development of the models continue (M. Deas, pers. comm., March 29, 2001). Future model runs should provide further predictive capability and water management scenario analyses. Also, a U.S. Geological Survey (USGS) suite of Klamath River water temperature and quality models (SIAM) continue to be refined and are expected to provide further insight into the effects of Project water management scenarios in the future (S. Williamson, USGS, pers. comm., February 28, 2001).

Flow Study Activities and Recommendations

This section of the opinion discusses previous and ongoing flow study activities. Additional information regarding the effects of Project operations on coho salmon is provided in the "Effects of Ongoing Project Operations" section below.

Biologists with the CDFG conducted habitat measurements and visual estimates and concluded that any reduction in discharge below about 1,000 cubic feet per second (CFS) would lead to a diminished fishery (Wales 1944). Wales (1944) also noted that any reduction in flows below 2,000 CFS, as measured around Fall Creek, would be expected to materially affect salmon and steelhead populations downstream to the Shasta River. In 1955, a CDFG biologist estimated that

1,000 CFS provided year-round would be required to maintain game fish at 1955 levels (Sletteland 1995).

On behalf of the Yurok Tribe, Trihey and Associates (1996) prepared a report including a quantification of the instream flows required to meet the needs of Tribal Trust species, including salmon and steelhead. In a companion report, Hecht and Kamman (1996) provided an analysis of the quantity and timing of historical stream flows and a discussion of the effect of Klamath Project operations on the flow regime. To estimate the minimum flow requirement, Trihey and Associates (1996) employed a modified Tennant (1976) method. This choice was driven, in part, by available data needed to utilize various estimation techniques. Sixty percent of the average pre-Project annual stream flow volume (estimated by Hecht and Kamman [1996]) was selected, and the recommended minimum IGD release schedule was "shaped" to more closely resemble the pre-Project hydrograph. The recommended monthly instream requirements for Tribal Trust species were estimated to be: 1,200 CFS in October, 1,500 CFS between November and March, 2,000 CFS in April, 2,500 CFS in May, 1,700 CFS in June, and 1,000 CFS between July and September.

A final report prepared for the Department of the Interior provided substantial new analyses regarding flows required for fisheries below IGD ('Phase 1 flow study report,' INSE 1999 (Hardy Phase I study)). Additional estimates of pre-Project flows under various water year-types were developed, and the results of various methods applied to estimate the appropriate flow regime needed to meet the habitat requirements of salmon and steelhead were also included. Specifically, the Phase 1 flow study report discusses the potential use of many methods to determine instream flow requirements, and provides a summary of the results of those techniques used by INSE (1999) to estimate flow requirements. These techniques fall into two categories: hydrology-based methods and field-based methods. In light of the different flow regimes prescribed by these several techniques, and continuing uncertainty about which technique(s) should be employed in the Klamath River, results were averaged (on a monthly basis). The resulting flow regime was forwarded as an interim recommendation, until additional analyses can be completed. The INSE (1999) recommended the following interim monthly instream flows below IGD: 1,476, 1,688, 2,082, 2,421, 3,008, 3,073, 3,307, 3,056, 2,249, 1,714, 1,346, and 1,395 CFS, during October through September, respectively.

Following the Phase 1 flow study, a follow-up "Phase 2" effort began, and included extensive coordination with a Technical Team representing fishery co-managers, including USFWS, CDFG, U.S. Geological Survey, Yurok Tribe, Karuk Tribe, Hoopa Valley Tribe, and NMFS. In the initial stages, data were collected for one dimensional and two dimensional physical habitat modeling. Insufficient information was available to develop Klamath River-specific coho salmon habitat suitability criteria (HSC) for use in physical habitat modeling for the Phase 1 study. During the Phase 2 flow study, preliminary "envelope" HSC incorporating those available in the literature for this species and life history stage were developed. Klamath River-specific HSC for chinook salmon fry and spawners were developed by the Technical Team and used in physical habitat modeling, and coho salmon fry generally require similar habitat characteristics. Because of the empirically observed importance of cover elements for small vulnerable fry (e.g., submerged and emergent vegetation), cover coding was incorporated into channel indices and used to more rationally reflect habitat suitability (Phase 2 Technical Team, pers. comm., 2000; INSE in prep.).

Preliminary draft physical habitat modeling results are now available for the Iron Gate Dam to Shasta River reach of the Klamath River and for the Shasta River to Scott River reach. These results and additional information continue to be evaluated by the Technical Team. Figures 8 through 12 show the preliminary draft estimates of suitable habitat in the Klamath River, by species and life history stage.

Effects of Ongoing Project Operations

October through March

Adult coho salmon migrate into the Klamath River between September and December (Weitkamp et al. 1995; Trihey and Associates 1996), and travel upstream and into tributaries to spawn. During this time, the requirements of adult coho salmon include a migratory corridor with suitable water depth and velocities, resting pools, and adequate water quality conditions. Successful immigration also depends on adequate fish passage conditions in the mainstem river and access to tributaries. Water depth and velocity of the mainstem Klamath River between the mouth and IGD will vary with water flows and are dependent upon meteorological conditions and water management activities. Under the proposed minimum flows included in the Project operations BA (Reclamation 2001), minimum IGD flows during the adult coho salmon inmigration season would vary from about 500 to 900 CFS in Critically Dry water years to about 1,000 to 1,300 CFS during Above Average water years. Because the proposed minimum flows are monthly or biweekly averages, instantaneous flows could be higher or lower. The actual IGD flows would vary within any given year depending on meteorological conditions, available water storage capacity in the upper Klamath Basin, and water management activities.

Mainstem Klamath River passage conditions for fall adult chinook salmon were examined in 1994 (Vogel and Marine). The authors provided a description of the factors that affect timing of the adult migration, including water temperature regimes, seasonal timing of instream flows, and natural timing of salmon reproductive physiological events (Vogel and Marine 1994). Vogel and Marine (1994) also note that (ca. 1994) specific reservoir releases necessary for adequate mainstem flows for salmon had not been defined.

Physical habitat modeling specific to adult coho salmon in the Klamath River has not occurred. Preliminary draft model results for chinook salmon spawning habitat indicates that spawning habitat is maximized at approximately 1,300 CFS in the IGD to Shasta River reach (Figure 12). It is reasonable to expect that adult coho salmon are able to migrate successfully given this discharge and downstream flow accretions. At potential flows under the proposed action (e.g., less than 900 CFS) chinook spawning habitat availability is reduced, and salmon passage conditions may deteriorate. Also, passage conditions from the mainstem River into some tributaries have been a concern under relatively low flow conditions (Vogel and Marine 1994), and tributary access would likely be adversely affected by the minimum flows that could occur in dryer water years. The potential adverse effects to mainstem passage conditions and tributary access may result in spawning migration delays or straying due to natal stream inaccessibility. Because adult salmon do not feed during their freshwater spawning migration, individuals have a finite amount of energy reserves. Consequently, increased pre-spawning mortality and decreased spawning success may result.

Available information indicates that, in general, water temperatures decrease in the mainstem Klamath River in October (Figure 6 and Figure 7). By mid-October, temperatures measured at IGD and at Seiad typically drop below 15E C and are within the range associated with normal coho salmon migration: 7.2E - 15.6E C (Reiser and Bjornn 1979). By mid-December, temperatures typically decrease below 7E C in these locations.

Coho salmon spawning typically occurs during December and January in the Klamath River Basin (Weitkamp et al. 1995). Although coho salmon have been observed spawning in the mainstem Klamath River (Reclamation 1998), this activity is probably not prevalent. Successful spawning is dependent in part on the availability of suitable conditions including substrate, water depth, water velocity, and water quality. Water temperatures in the Klamath River during the December and January period (Figures 6 and 7) are typically within the acceptable range associated with coho salmon spawning in California: 5.6E - 13.3E C (Briggs 1953).

Coho salmon eggs incubate for about 35 to 50 days in gravel redds following successful spawning, and fry emerge from the gravel about two to three weeks after hatching (Hassler 1987). The survival of salmon eggs and alevins are dependent, in part, on stream and stream bed conditions. For example, high winter flows and resulting gravel movement can result in heavy losses (Sandercock 1991). As previously mentioned, flows released at IGD and downstream flow accretions are variable during this period. Water temperatures measured at Seiad are typically similar to those at IGD during this period (Figures 6 and 7), and fall within the preferred range for incubating salmonids (Bell 1991).

Water temperatures during this period are generally within a tolerable range for juvenile coho salmon (Figures 6 and 7; Bell 1991). In early autumn, as water temperatures decline, coho salmon fingerlings move into deeper pools featuring cover; by utilizing cover and side channels, some fish avoid being displaced downstream during winter freshets (Hartman 1965; Bustard and Narver 1975). Any coho salmon juveniles that survive displacement from tributary habitat due to unfavorable environmental conditions during the summer may find opportunities to migrate back to the tributaries as they become more hospitable (Sandercock 1991). In some situations, this type of migration may result in relatively high survival rates (Tschaplinski and Hartman 1983).

During this period, juvenile coho also rear in the mainstem Klamath River. Given that an adequate flow, e.g., 1,300 CFS, is provided (for salmon passage, spawning, and incubation), adequate habitat for juveniles is expected.

<u>April through June</u>

During this period, coho salmon fry rear in the mainstem Klamath River and some tributaries. After emergence from redds, these fish swim close to stream banks and seek available cover. As they become older, coho salmon move through a succession of preferred habitats: back eddies, log jams, undercut or open bank areas, and higher velocity water in midstream and the stream margins

(Lister and Genoe 1970). During this time, feeding juvenile coho salmon are highly dependent on visual cues for locating and capturing insect material in suspension or on the water surface (Hoar 1958). Marginal slack water areas are particularly important for juvenile coho salmon as prey items found in midstream areas are generally unavailable to these fish.

Under the proposed minimum flows, the amount of suitable physical habitat for these fish could be dramatically reduced (see Figures 10 and 11). For example, in dry water years under the proposed minimum flows, the proposed action could result in approximately 40 and 16 percent of maximum available habitat in the IGD to Shasta reach and Shasta to Scott reach, respectively (Table 2). This would result in decreased carrying capacities for salmonid fry in the mainstem Klamath River and displacement of fry into less suitable habitat. Because of weak swimming abilities, fry are not well equipped to seek suitable habitats after displacement. As a result, the survival of salmon fry is expected to decrease under the proposed action.

Project operations may also affect the survival of young-of-the-year coho salmon through potential stranding of these fish during decreases in IGD flows. For example, Project operations during the week of April 19, 1998, appear to have resulted in stranding of fish. Flows through IGD dropped from 3,300 CFS to 1,800 CFS, resulting in the stranding of coho fry as well as other fish species (USFWS 1998). The extent of mortality was unknown; however, USFWS biologists rescued 7 coho salmon fry and 738 chinook salmon fry in 3 isolated edge water pools. In 1999, a similar change in flows was implemented over a longer time period to decrease potential stranding (L. Dugan, Fishery Biologist, Reclamation, pers. comm., April 9, 1999). Although Reclamation proposes to coordinate more closely with PacifiCorp regarding flow changes at IGD that may occur during this period in any given year, NMFS must expect that adverse impacts to coho salmon due to hourly and daily ramping rates would continue to occur at times under the proposed action.

Coho salmon from the previous year's cohort also migrate toward the sea as smolts during this period. The size of the fish, flow conditions, water temperature, dissolved oxygen levels, day length, and the availability of food all tend to affect the time of migration (Shapovalov and Taft 1954). In the Klamath River basin, coho salmon smolt migration generally occurs between March and June (Weitkamp et al. 1995) but continues into July (INSE 1999).

Coho salmon begin the smoltification process by beginning to defend their territories less vigorously and forming aggregations (Sandercock 1991), and they rise to the surface at night and move downstream (Hoar 1951). Several other physiologic and behavioral changes also accompany smoltification of Pacific salmonids, including negative rheotaxis and decreased swimming ability (McCormick and Saunders 1987). Both of these smolt attributes support the expectation that these fish would outmigrate faster with higher water velocities and experience higher survival because of shorter travel time with associated lower mortality due to migratory delays, predation, and exposure to poor mainstem habitat conditions. Although the relationship between flow and smolt survival has not been studied in the Klamath River Basin, Cada et al. (1994) concluded that relevant studies in other geographic areas "generally supported the premise that increased flow led to increased smolt survival." Based on available information, smolt survival in the Klamath River is expected to be higher with higher flows, and lower with lower flows. Under the proposed minimum flows in the Project operations BA, flows could be relatively low during some years and, in turn, survival of coho salmon smolts could be poor.

By mid-June, water temperatures in the Klamath River typically exceed the "preferred" range of coho salmon described by Bell (1991). Prior to about mid-June, water temperatures measured at Seiad and below IGD are similar. From about mid-June through September, water released from IGD is typically several degrees C cooler than that measured at Seiad (Figure 6 and 7), and high water temperatures and poor water quality contribute to a hostile environment for salmon.

<u>July through September</u>

Most coho fry move out of river systems during freshets, and during periods of stable flow fry continue to migrate (Sandercock 1991). Coho fry are very territorial, and those fish that cannot find or defend a suitable territory are generally displaced downstream. If adjacent downstream habitat is occupied, migrants continue to be displaced downstream (Sandercock 1991). Some of those fish displaced downstream may later move back upstream, or they may migrate along the shoreline and enter other streams (Otto and McInerney 1970).

As a result of their behavior and available habitat, coho salmon juveniles are distributed along the mainstem Klamath River and tributary habitats. Suitable habitat for this life history stage includes adequate space, appropriate stream bed substrate for cover and food base production, cover components, adequate water quality and quantity, and areas of appropriate water velocity. Operation of the Project substantially affects summer flows in the Klamath River below IGD, and its influence extends further downstream during this period.

Water temperatures and quality contribute to a hostile environment for juvenile salmon during the summer. Temperatures are typically above the preferred range of coho salmon, and sometimes exceed their lethal limit of 25.5E C (Bell 1991). Although additional flow releases from IGD would not be expected to cool the mainstem river to the preferred range, higher flow releases from IGD than those that would occur under the proposed action during the June through September period are not expected to result in elevated water temperatures downstream. In addition, the increased thermal mass of higher IGD releases during this period would result in generally decreased diurnal temperature fluctuations that can be stressful to fish. Juvenile coho salmon that rear in the mainstem Klamath River would likely experience higher mortality during this period under the proposed minimum flows as these fish can more easily succumb to bacterial diseases under these water quality conditions (see CDFG 2000b; S. Foote, USFWS biologist, pers. comm., 2000).

In summary, juvenile coho salmon in the Klamath River during this period are expected to encounter marginal to lethal water quality conditions. Daily average and maximum water temperatures are quite high, and the diurnal variation of temperatures is also stressful to fish. Further, survival of this life history stage is suspected to be a production bottleneck.

Summary of Effects
Operation of the Klamath Project can potentially affect several coho salmon life history stages: migrating adults, spawning adults, incubating eggs, rearing fry and juveniles, and migrating smolts. The expected survival and reproduction of coho salmon in the freshwater environment can be conceptually thought of as a product of the component survival values of these life history stages. Except for the summer period, the extent to which Project operations affect coho salmon and their habitat is variable during most years, being somewhat dependent on meteorological conditions. However, the Project substantially affects flows and fish habitat during the June through September period in all years. This includes the low flow period when water quality in the Klamath River is a substantial problem. One constituent water quality element is temperature, and this is linked to dissolved oxygen saturation levels. Water temperatures and dissolved oxygen levels vary in daily cycles, and between days, months, and years. Because of the typically degraded water temperatures in the Klamath River during the summer period, the INSE (1999) suggested that the flow dependent nature of the thermal regime on a seasonal basis needs to be factored into any flow recommendations.

Trihey and Associates (1996) recommended higher summer flows than the IGD FERC license minimums, as these additional flows are expected to "(1) reduce the growth of aquatic plants and algae, (2) provide additional wetted and surface turbulence in riffles, and (3) provide a larger volume of water in the river channel to decrease the amplitude of daily stream temperature cycles." The INSE (1999) summarized a preliminary modeling effort to simulate water temperatures near Seiad Valley (river mile 129) under a number of summer flow scenarios between 200 and 3,000 CFS. From this "first approximation" analysis, INSE (1999) preliminarily concluded that the results demonstrated a clear relationship between flow release and thermal response in the river, and that at flows below about 1,000 CFS adverse thermal extremes were expected to be exacerbated.

Based on the best available information, NMFS believes that the ongoing operation of the Klamath Project according to the proposed action will adversely affect coho salmon populations in the Klamath River. In particular, Project operations can adversely affect Klamath River aquatic habitat in the summer, and exacerbate adverse temperature and water quality conditions suspected to cause a coho salmon production bottleneck. Several factors are believed to affect the survival of juvenile coho salmon in the Klamath River during the summer, including the availability of suitable habitat (water depth and velocity, and cover), the availability of cool water refugia, ambient water temperatures and diurnal fluctuations, and water quality (e.g., dissolved oxygen). These factors are all affected by the magnitude and timing of IGD flows.

A major difficulty in determining the requirements for survival and recovery of coho salmon ESUs is the substantial degree of uncertainty regarding their status, population trends, and genetic integrity. The combination of existing and imminent risks and uncertainty regarding the status, population trends, and genetics of the SONCC coho salmon ESU dictates that NMFS establish the following conservative assumptions regarding population factors for carrying out the ESA Section 7(a)(2) analysis described in this document:

1. The SONCC coho salmon is comprised of multiple populations, each of which may be uniquely adapted to local sub-basin or watershed environments. Preservation of the remaining genetic diversity embodied in these undefined populations may be essential for the survival and recovery of the ESU as a whole.

2. All SONCC coho salmon populations within this ESU are depressed relative to their past abundance, based on the limited data available (July 25, 1995, 60 FR 38011; May 6, 1997, 62 FR 24588). The main populations in this ESU (Rogue River, Klamath River, and Trinity River) are heavily influenced by hatcheries, apparently with little natural production. The apparent declines in production suggest that the natural populations are not self-sustaining. These declines in natural production are suspected to be related, at least in part, to degraded conditions of the essential features of spawning and rearing habitat in many areas of the SONCC coho salmon ESU.

3. The status of coho salmon populations within this ESU are depressed relative to their past abundance, based on the limited data available: In the 1940s, estimated abundance of coho salmon in this ESU ranged from 50,000 to 125,000 native coho salmon, while in 1996, it was estimated that there were probably less than 6,000 naturally-produced coho salmon (October 31, 1996, 61 FR 56138).

Based on these assumptions, NMFS believes that the conservation of populations that comprise each ESU must be ensured when conducting section 7 consultation analyses. While these assumptions are necessarily conservative to minimize risk to a population in the face of limited information, they will be appropriately modified when better information becomes available.

Using the above assumptions, NMFS considers Klamath River coho salmon to be necessary for the continued survival and recovery of the SONCC ESU. Operation of the Project according to the preferred alternative would generally result in degraded habitat condition, even when compared to the last 40 years when the FERC minimum flow schedule generally guided Project operations with regard to Klamath River flows. Given the status of Klamath River coho salmon, the proposed action constitutes an unacceptable risk. Based on available information, NMFS has determined that Project operation under the proposed action included in the ongoing Project BA (Reclamation 2001) is expected to result in an appreciably reduced likelihood that SONCC coho salmon will both survive and recover in the wild.

SONCC Coho Salmon Critical Habitat

Designated critical habitat for SONCC coho salmon occurs downstream of IGD (May 5, 1999; 64 FR 24049). In designating critical habitat, NMFS focuses on the known physical and biological features (primary constituent elements) within the designated area that are essential to the conservation of the species. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation. Within the essential habitat types (spawning, rearing, juvenile migration corridors), essential features of coho salmon critical habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions (May 5, 1999; 64 FR 24049).

As previously discussed, the ongoing operation of the Project is expected to result in changes to the hydrograph in the Klamath River below IGD, and affects available fish habitat, water temperatures, and dissolved oxygen levels during the summer period. Operation of the Project during the 1962 to 1997 period similarly affected fish habitat. The extent to which Project operation may appreciably diminish the value of proposed critical habitat for both the survival and recovery of SONCC coho salmon currently depends, in part, on IGD flow schedules in any given year. As previously mentioned, the proposed Project operation includes managing water to meet the lowest average monthly or biweekly IGD flows on record for the 1961 to 1997 period (by water year type). In addition, because the proposed minimum flows are monthly or biweekly averages, instantaneous flows could be much lower. As discussed above, all necessary freshwater habitats required by coho salmon could be adversely affected, especially during dryer years. The level of potential adverse effects of Project operation on mainstem Klamath River habitat is greater under the proposed Project operation than during the 1961 through 1997 period. During this period, the status of Klamath River coho salmon declined and ultimately contributed to their listing under the ESA, in part due to mainstem Klamath River habitat conditions. Therefore, NMFS has determined that existing proposed critical habitat is likely to be affected so as to appreciably diminish the value of designated critical habitat for both the survival and recovery of the species.

Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." For the purposes of this analysis, the action area encompasses the Project and downstream aquatic habitat below IGD in the Klamath River.

The dominant land-use activities on non-federal lands adjacent to the action area are forestry and agriculture. Significant improvements in SONCC coho salmon production within non-Federal lands are unlikely without changes in forestry, agriculture, and other practices that occur in riparian areas.

Now that SONCC coho salmon are listed as threatened, NMFS assumes that non-Federal land owners will recognize the need to take steps to curtail or avoid land management practices that may result in potential unauthorized take of listed coho salmon. For actions on non-Federal lands, which the land owner or administering non-Federal agency believes are likely to result in adverse effects to SONCC coho salmon or their habitat, the land owner or agency should contact NMFS regarding the appropriate section 10 incidental take permits, which require submission of Habitat Conservation Plans. If an incidental take permit is requested, NMFS would seek appropriate measures to avoid or minimize adverse effects and taking of listed and proposed anadromous fish.

Until improvements in non-Federal land management practices are actually implemented, NMFS assumes that future private and State actions will continue at similar intensities as in recent years. Given the degraded environmental baseline for listed and proposed Pacific salmonids, actions that do not lead to improvement in habitat conditions over time could contribute to species extinctions.

Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or have been) reviewed through separate section 7 consultation processes.

Conclusion

After reviewing the current status of SONCC coho salmon, the environmental baseline for the action area, the effects of the proposed action (i.e., ongoing operation of the Klamath Project), and cumulative effects, NMFS' biological opinion is that the action, as proposed, is likely to jeopardize the continued existence of SONCC coho salmon. The NMFS has also determined that the action, as proposed, is likely to adversely modify critical habitat for the SONCC coho salmon.

Reasonable and Prudent Alternative

Regulations (50 CFR §402.02) implementing section 7 of the ESA define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technologically feasible; and (4) would, NMFS believes, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

This biological opinion has identified one reasonable and prudent alternative that NMFS believes meets the criteria outlined above. A basic premise for this reasonable and prudent alternative is that operation of the Klamath Project substantially affects flows, fish habitat, and water quality in the Klamath River below IGD. The second premise is that the existence and operation of the Klamath Project is not the only factor and human activity that adversely affects aquatic habitat and anadromous salmonid populations in the Klamath River. Accordingly, NMFS prepared this reasonable and prudent alternative with an awareness of the larger context of actions that will affect threatened salmon in the Klamath River.

Our jeopardy determination is generally based on the conclusion that the proposed operation of the Project would result in a continued decline in habitat conditions in the Klamath River. Further, Reclamation's proposed minimum flows (see Reclamation 2001) are not based on the biological requirements of the species. The reasonable and prudent alternative is intended to prevent further decline of the listed fish that we concluded were likely to be jeopardized by the proposed action while longer-term protections can be implemented to affect the recovery of the species. The NMFS expects that further aquatic habitat studies, restoration planning, and restoration accomplishments will necessitate occasional adjustments to this reasonable and prudent alternative, or perhaps other reasonable and prudent alternatives will be identified over time.

<u>Reasonable and Prudent Alternative</u>

Several factors present difficulties in identifying a reasonable and prudent alternative to the river flow-related component of Reclamation's proposed action, both in the short-term (e.g., April through September 2001) and long-term include: (1) the limited availability of specific information on the effects of IGD releases on water temperature and quality during the April through September period in critically dry years such as is forecast for 2001, (2) the lack of quantitative tools to estimate the probability of coho salmon persistence and recovery in the Klamath River under various Project operational scenarios, (3) uncertainty regarding the amount of water that will be available during the April through September 2001 period, (4) uncertainty about the timing of inflow to Project facilities, and (5) the current practical necessity to, at least initially, plan for April through September Project operations by early April 2001.

Given that NMFS expects additional information and analyses relevant to the relationship between IGD flows and fish habitat to become available over the next few months, and the fact that NMFS is in the process of developing a comprehensive biological opinion and reasonable and prudent alternative, addressing all water year types, to be provided to Reclamation on or before June 7, 2001 (the statutory deadline consistent with 50 CFR § 402.12), this biological opinion constitutes a subset of the comprehensive biological opinion for this year's operations. This reasonable and prudent alternative includes specific IGD minimum flows for the April through September 2001 period only, based on the best available information. In essence, this biological opinion constitutes a subset component of the comprehensive biological opinion for this year's operations. Since the NMFS anticipates it will be incorporating new scientific data in the opinion to be provided by June, this opinion may include a minimum IGD flow regime for future "critically dry" water years that differ form this RPA (as currently defined by Reclamation [2001]).

Because of the limited and uncertain amount and timing of available water, NMFS and the USFWS also had to consider the potential biological risks and consequences of various Upper Klamath Lake elevation and Klamath River flow regimes in preparing their biological opinions. Given the immediate need to plan for the April through September 2001 Project operations under these circumstances, NMFS has developed the following reasonable and prudent alternative including a minimum flow regime for this period, designed to provide for the biological requirements of Klamath River Basin coho salmon. Because of limited Project inflow and storage, the risks presented by providing additional spring river flows that may preclude providing adequate summer flows later in the year were also considered.

During the months of April and May 2001, coho salmon fry are the most vulnerable life stage in the mainstem Klamath River, and require adequate suitable physical habitat and adequate water temperatures and quality. Preliminary physical habitat modeling results indicate that in the IGD to Shasta River reach of the Klamath River, approximately 50 percent of maximum habitat for coho salmon fry and 65 percent of maximum habitat for chinook salmon fry would be available during April and May 2001 under IGD releases of 1,700 CFS (Figure 10). Under 1,700 CFS IGD releases, approximately 41 percent of the maximum habitat for coho salmon fry and 50 percent of maximum habitat for chinook salmon fry would be available in the Shasta River to Scott River reach (Figure 11). During this period, water temperatures below IGD are generally within the optimum range for coho salmon described by Bell (1991).

Coho smolts also outmigrate to the ocean during this period, and substantially higher flows (e.g., 1,700 CFS) are expected to result in increased smolt survival. This expectation is due to the decreased travel time under significantly higher water velocities and associated lower mortality due to migratory delays and predation (as discussed in the 'Effects of the Action' section of this opinion). Because elevated Klamath River water temperatures are not generally a problem at this time, an extended exposure of smolts to mainstem river water conditions are not a concern.

Although higher flows during this period would provide additional suitable habitat for coho salmon fry, the reality of a finite but uncertain available water supply, forecast to be the lowest in the relevant period of record (1961-2000), must also be considered. If a relatively large volume of water is used to provide for additional coho salmon fry habitat and increased smolt survival during this period, adequate water to provide for better habitat conditions later in the summer may not be available. After considering the risk of potential competing habitat requirements between coho salmon fry in the spring, and juvenile coho salmon in the summer, it is NMFS judgement that providing 40 to 50 percent of maximum fry habitat between IGD and the Scott River under flows of 1,700 CFS during April and May 2001 is appropriate to maximize coho salmon survival during this critically dry year and will not jeopardize the species.

During June 2001, coho salmon fry will continue to grow larger and will typically transition to the juvenile life stage, will develop better swimming abilities, and become better equipped to survive potential displacement to alternative areas in the river. Also during this period, coho salmon smolts continue to migrate to the ocean. As previously discussed in this biological opinion, high Klamath River water temperatures typically become a concern by late June. As previously discussed, coho salmon smolt survival would be expected to be higher for those smolts that are prepared for migration to the ocean prior to exposure to elevated mainstem water temperatures in late June. Substantially higher flows that provide significantly higher amounts of suitable coho salmon fry habitat (e.g., greater than 50 percent of maximum) and associated increased water velocity and decreased travel time are expected to result in decreased exposure of smolts to elevated water temperatures. Although higher flows are expected to generally result in higher smolt survival during this period, again the risk of insufficient water availability later in the summer and fall must be considered. In order to better facilitate moving coho salmon smolts downstream to the ocean prior to experiencing elevated water temperatures, it is NMFS judgement that 2,100 CFS flows during the June 1-15, 2001 period will be adequate to provide a reasonable level of smolt survival during this critically dry year and will not jeopardize the species. As the ability of IGD releases to decrease ambient water temperatures diminishes and mainstem temperatures become a concern, it is NMFS judgement that IGD releases of 1,700 CFS flows during the June 16-30 period are sufficient to avoid jeopardizing the species.

During the July through August 2001 period, coho juveniles rear in the mainstem Klamath River. Although necessary suitable physical habitat (in terms of water depth and velocity) must be provided for these fish, high water temperatures and poor water quality are also of concern at this time. Water temperature modeling results generally indicate that IGD releases have a limited ability to moderate high water temperatures and diurnal temperature fluctuations in the mainstem river during the July and August period. Available water temperature modeling results for various Klamath River flow scenarios used 1996 and 1997 water temperature and meteorological conditions as model inputs (Deas and Orlob 1999). The NMFS is unaware of any modeling analyses that have considered the expected Upper Klamath Lake inflows, Project operational limitations, and reservoir/river responses upstream of the modeled area (Iron Gate Reservoir to

Seiad Valley) associated with the currently-forecast extremely dry conditions likely to occur during the April through September 2001 period. Therefore, available modeling information provides a limited and incomplete understanding of system behavior with respect to water temperature during the mid-June through September 2001 period. Accordingly, NMFS believes it is necessary to also consider the summer base flow recommendations previously developed by fishery biologists. For example, a July and August river flow of at least 1,000 CFS is generally consistent with the summer flow recommendations of CDFG biologists (e.g., Wales 1944) and Trihey and Associates (1996).

Although the recommended flows included in the Phase 1 flow study report (INSE 1999) recommended higher flows during the July through August period, this recommendation did not specifically consider the risk of insufficient water supplies in the summer and fall period. As previously discussed, NMFS believes it is necessary to consider these risks in 2001. Given the available information and analyses, it is NMFS judgement that IGD releases of 1,000 CFS during the July through August 2001 period are both necessary and appropriate in this critically dry year and will not jeopardize the species.

During September 2001, coho salmon adults will be migrating into the Klamath River. The habitat requirements of adult coho salmon include a migratory corridor with suitable water depth and velocities, resting pools, and adequate water quality conditions. Successful immigration also depends on adequate fish passage conditions in the mainstem river and access to tributaries. Observations of adult salmon migrating upstream in the Klamath River indicate that passage problems in the mainstem typically occur during IGD flow releases lower than about 900 CFS (T. Fletcher, Yurok Tribe, pers. comm., March 21, 2001). There are no studies that indicate the preferred flow regime of Klamath River coho salmon for this time period during a critically dry year. Based on available information, it is NMFS judgment that minimum IGD releases of 1,000 CFS are appropriate in September 2001 to provide minimally sufficient adult migration conditions that will lead to sufficient spawning success during this critically dry year and which will not jeopardize the species.

In summary, this reasonable and prudent alternative includes the following instantaneous minimum IGD water releases, by time step, for the April through September 2001 period:

Time Step	Iron Gate Dam Discharge (CFS)
April 2001	1,700
May 2001	1,700
June 1-15 2001	2,100
June 16-30 2001	1,700
July 2001	1,000

August 2001	1,000
September 2001	1,000

In addition, in order to prevent potential coho salmon stranding, Reclamation will operate the Project to provide for the following down ramping rates below IGD: (1) decreases in flows of 300 CFS or less per 24-hour period and no more than 125 CFS per four-hour period when IGD flows are above 1,750 CFS; or (2) decreases in flows of 150 CFS or less per 24-hour period and no more than 50 CFS per two-hour period when IGD flows are 1,750 CFS or less.

If, based on the best available information (e.g., NRCS forecasts, and associated model output and interpretation), Reclamation expects they will be unable to operate the Project to provide for the above minimum flow regime and maximum down ramping rates below IGD, while also complying with the ESA requirements regarding listed species under the jurisdiction of the USFWS, NMFS and USFWS in will determine how best to meet the biological requirements of all species of concern. Specifically, when this situation exists, representatives from Reclamation, USFWS, and NMFS shall coordinate with representatives from the Bureau of Indian Affairs and appropriate Indian tribes and states to consider and discuss available options for Project operation and necessary levels of protection for listed species. The following process will be used:

1. Data Collection and Analysis

A. Reclamation shall provide NMFS and FWS with a projection of available water to satisfy river flow requirements of coho salmon and lake level management for listed suckers.

B. The agencies shall conduct risk analyses, based on available information including the results of discussions between relevant Federal, tribal, and state representatives.

2. Potential development and use of in-season management techniques to allocate scarce water resources to protect aquatic resources; these may include, but are not limited to:

A. Consideration of the current status of species of concern and risks associated with critically dry years;

B. Consideration of the most up-to-date information regarding the location, size, and movements of young-of-the-year and juvenile fish;

C. Consideration of the most up-to-date expectations of water temperature and quality parameters in Upper Klamath Lake and the Klamath River below IGD, given the expected water supply outlook;

D. Consideration of pro-rating IGD releases or Upper Klamath Lake elevation regimes based on “within water year type” exceedance levels for critically dry years;

E. Consideration of reserving a volume of water for release below IGD during particularly hot period(s) to improve water quality.

3. The NMFS and USFWS will provide the results of the coordination and risk analysis process to Reclamation in writing with detailed instructions regarding measures to employ in order to best protect each listed species.

Because this biological opinion has found jeopardy and adverse modification of critical habitat, Reclamation is required to notify NMFS of its final decision on implementation of the reasonable and prudent alternative.

Incidental Take Statement

Section 9 of the ESA and federal regulations adopted pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Adverse effects of management actions such as these are largely unquantifiable in the short-term, given the lack of relevant studies and quantitative tools available to develop such estimates. The NMFS expects some level of incidental take to occur due to implementation of some of the actions outlined in the reasonable and prudent alternative. However, the best scientific and commercial data available are not sufficient to enable NMFS to estimate a specific amount of incidental take of Klamath River coho salmon. The NMFS anticipates that water quality and habitat conditions for various coho salmon life stages that would result from implementation of the reasonable and prudent alternative would likely result in a level of take that does not constitute jeopardy to SONCC coho salmon. Take of individual coho salmon would be difficult to detect because finding a dead or injured salmon is unlikely due to the fact that salmonids occur in dynamic habitat, (i.e., flowing water, that makes such detection difficult). Water quality and habitat conditions resulting from the reasonable and prudent alternative, while somewhat predictable, would have an impact that is not precisely known, and by extension, the impact to a quantity of coho salmon expected to be present in the mainstem Klamath River is not precisely known. However, while the water quality and habitat impacts resulting from Project operations have been reduced by the reasonable and prudent alternative, and precise impacts to coho salmon and their habitat are unknown, each incremental reduction in water quality and habitat in the stream channel represents a portion of the combined impacts to salmon in a given watershed.

As stated earlier in the biological opinion, some take may occur due to down ramping of releases from IGD and associated stranding of small coho salmon. However, the reasonable and prudent alternative requires Reclamation to provide sufficient flows to enable PacifiCorp to implement conservative ramping rates at IGD. It is difficult to determine the actual down ramping rates that will be implemented during the April through July 2001 period, because at levels above 1,750 cfs PacifiCorp does not have the capability to regulate flows in small increments. Therefore, predicting the potential for stranding of coho salmon and potential take is difficult. However, NMFS expects that several flow study and water temperature and quality data collection efforts will be ongoing during this period, and observations may provide in-season information regarding actual fish strandings that may occur. If the proposed conservative down ramping rates of IGD implemented, NMFS expects that low levels of coho salmon stranding will occur and consequently this risk would not pose jeopardy to the species.

This incidental take statement is effective provided that Reclamation implements the flow and ramping rate components of the reasonable and prudent alternative above, but this conditional take coverage is only effective until September 30, 2001. This incidental take statement is expected to be superceded by a new incidental take statement with NMFS' issuance of the long-term, comprehensive biological opinion and reasonable and prudent alternative, as described earlier in this opinion.

Reasonable and Prudent Measures

The NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize the likelihood of take of SONCC coho salmon resulting from the ongoing operation of the Project.

Reclamation shall:

1. Arrange for the ongoing collection and analysis of information to further understand the relationship between IGD water releases and suitable downstream salmon habitat in the Klamath River;

2. Continue its efforts to identify additional water supplies in the Klamath Basin.

Terms and Conditions

In order to enjoy the protections provided under section 7(b)(4) or 7(o)(2) of the ESA, Reclamation must comply with the following terms and conditions, which implement and document implementation of the reasonable and prudent measures described above. These terms and conditions are non-discretionary. Reclamation shall do the following:

1. In coordination with PacifiCorp, provide for the completion, integration, and/or modifications of water routing and water quality models that potentially provide an increased understanding of water temperature and quality conditions in Upper Klamath Lake and in the lower Klamath River. Development of this integrated model(s) should be

coordinated with fishery co-managers and other water quality experts, and shall be completed by January 2002.

2. Provide a summary report outlining the status of the water supply initiative, identifying opportunities with regard to water supplies, and identifying current scoping of implementation strategies. This report will be provided to NMFS by February 2002.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information.

The NMFS believes the following conservation recommendations are consistent with these obligations, and therefore recommends that the following conservation measures be implemented by Reclamation:

1. Reclamation should aggressively seek sufficient funding to continue with, and to enhance, their Klamath Basin Water Supply Initiative.

2. Reclamation should actively participate in restoration planning activities with other entities with an active interest in addressing Klamath River fishery, habitat, and water quality restoration.

Reinitiation of Consultation

This concludes formal consultation on Reclamation's proposed ongoing operation of the Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

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Tables

Table 1. Proposed average minimum flows at Iron Gate Dam on the Klamath River (from Table 4, Reclamation 2001).

Time Step	Above Average Water Years	Below Average Water Years	Dry Water Years	Critically Dry Water Years
Oct	1329	1308	852	904
Nov	1337	1324	873	909
Dec	1387	1435	889	914
Jan	1127	1334	888	1011
Feb	910	1546	747	525
Mar 1-15	1953	1439	725	501
Mar 16-31	2101	1748	724	521
Apr 1-15	1781	1455	728	569
Apr 16-30	1629	1305	754	574
May 1-15	1730	1010	761	525
May 16-31	1026	1003	924	501
Jun 1-15	760	728	712	476
Jun 16-30	742	696	612	536
Jul 1-15	705	709	547	429
Jul 16-31	680	682	542	427
Aug	1011	701	647	398
Sep	1035	725	749	538

Table 2. Estimated weighted usable area, expressed as a percentage of the maximum, for coho salmon and chinook salmon in the Iron Gate Dam to Shasta River and Shasta River to Scott River reaches of the Klamath River. Underlying data are displayed in Figures 10 and 11. Pre-Project 90% exceedance flow estimates are from INSE (1999), and are included for comparison purposes. 1961-1997 average and minimum values (for biweekly time steps), and the definition of "dry" years are included in Reclamation (2001).

April Dry Year		Estimated Percent of Maximum Fry Habitat			
		Iron Gate Dam to Shasta River		Shasta River to Scott River	
Iron Gate Dam Discharge (cubic feet per second)		Coho Salmon	Chinook Salmon	Coho Salmon	Chinook Salmon
Pre-Project 90% Exceedance Flow	2,771	67	86	51	62
1961-1997 Dry Year Average	1,183 1,039	43 41	55 53	19 18	23 20
1961-1997 Dry Year Minimum	728 754	40 40	50 50	15 16	16 16

May Dry Year		Estimated Percent of Maximum Fry Habitat			
		Iron Gate Dam to Shasta River		Shasta River to Scott River	
Iron Gate Dam Discharge (cubic feet per second)		Coho Salmon	Chinook Salmon	Coho Salmon	Chinook Salmon
Pre-Project 90% Exceedance Flow	2,560	65	84	53	61
1961-1997 Dry Year Average	968 996	40 40	52 53	18 18	18 18
1961-1997 Dry Year Minimum	761 924	40 40	50 52	16 17	16 18

Figures

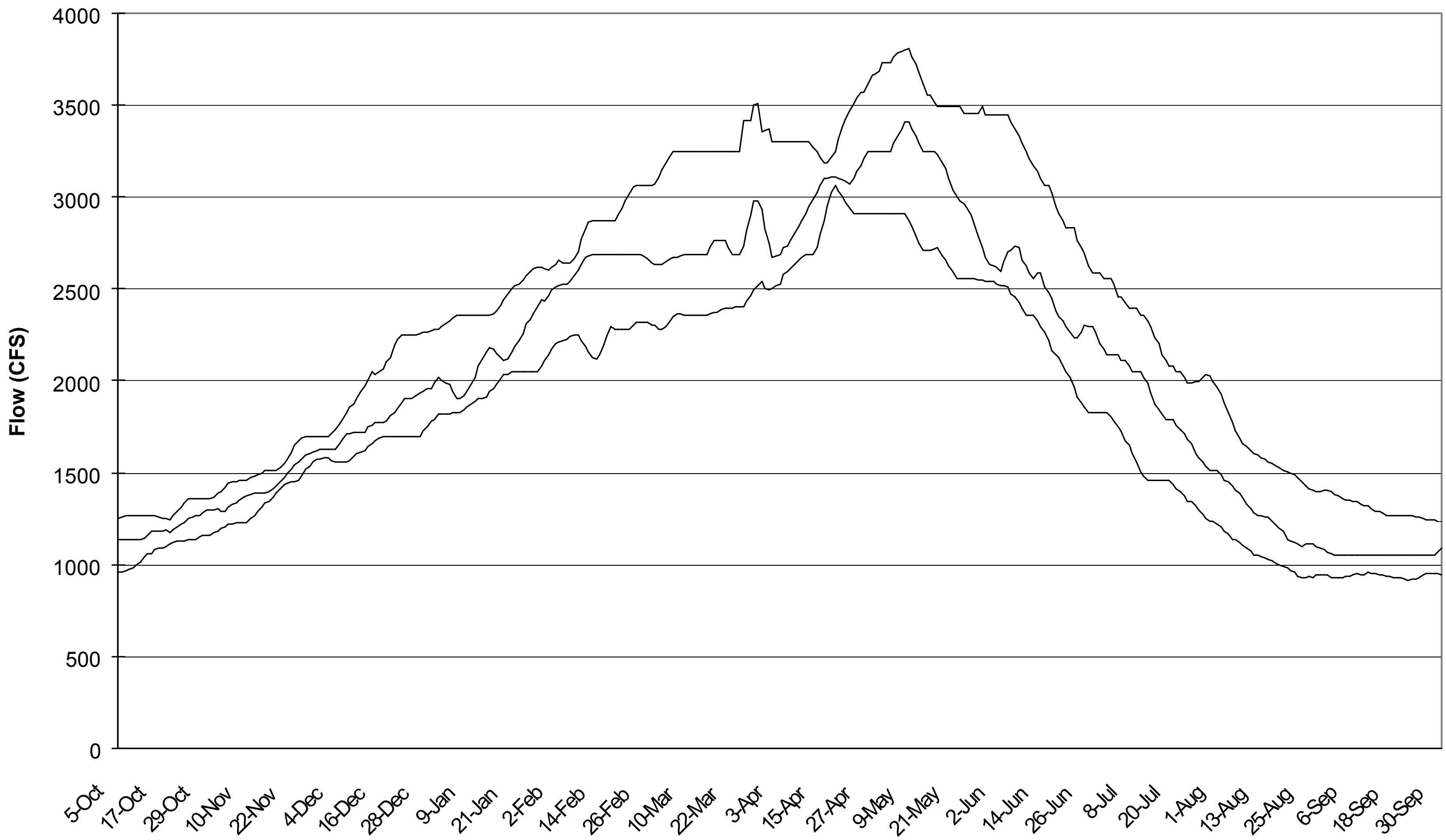

Figure 1. Average Klamath River flow at Keno, Oregon - Historic median, 25th and 75th percentile (1905-1913; 5 day moving average). Data are from Hydrosphere Data Products, Inc. (1993).

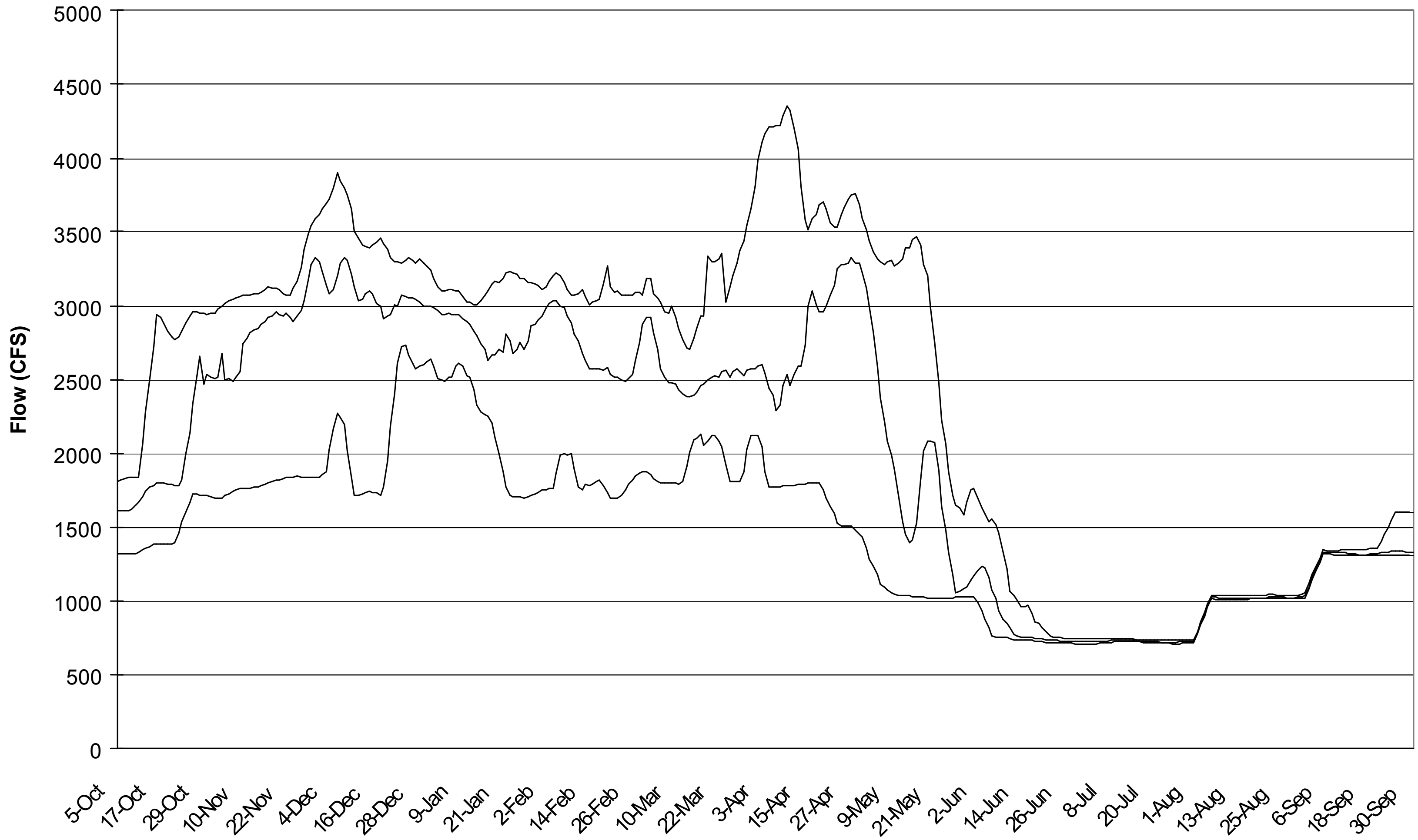

Figure 2. Average Klamath River flow at Iron Gate Dam, California - Normal water year median, 25th and 75th percentile (1963, 1966, 1969, 1970, 1973, 1985, 1989; 5 day moving average). Data are from Hydroshere Data Products, Inc. (1993).

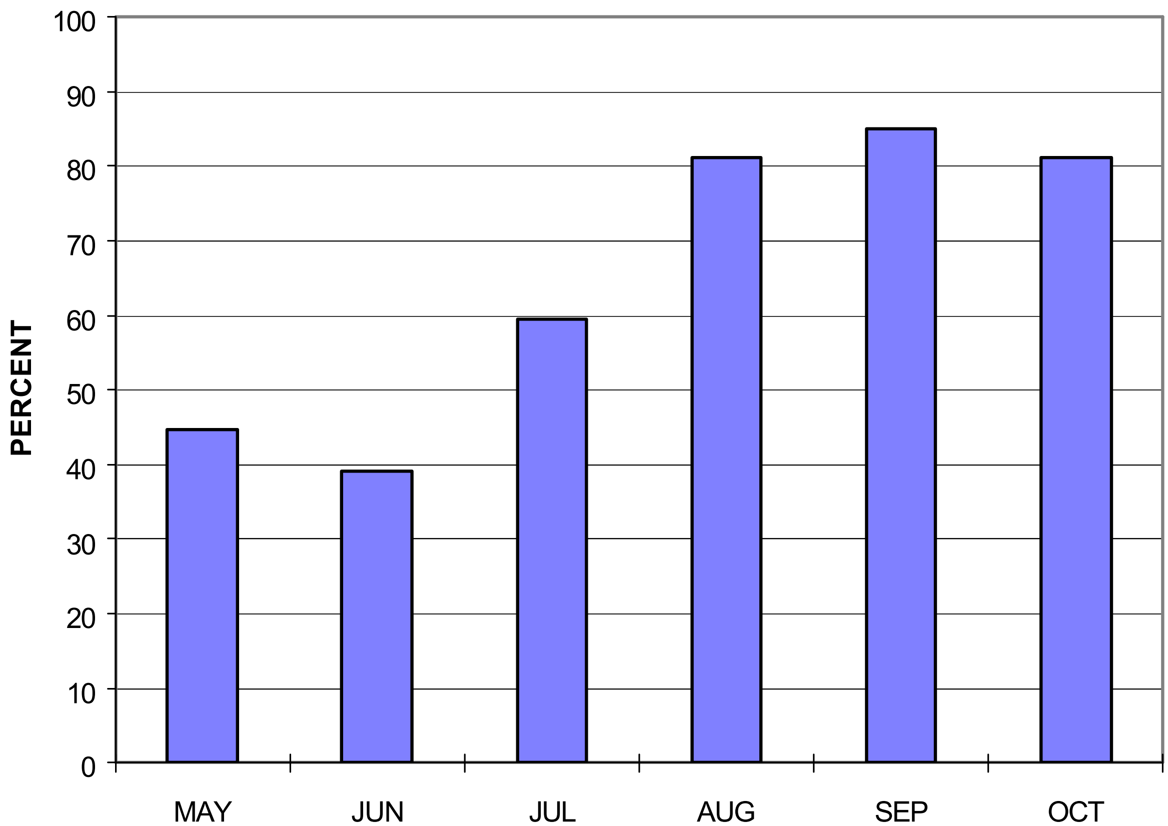

Figure 3. Monthly average Iron Gate Dam contributions to Klamath River flows measured at Seiad (1962-1991). Data are from Hydrosphere Data Products, Inc. (1993).

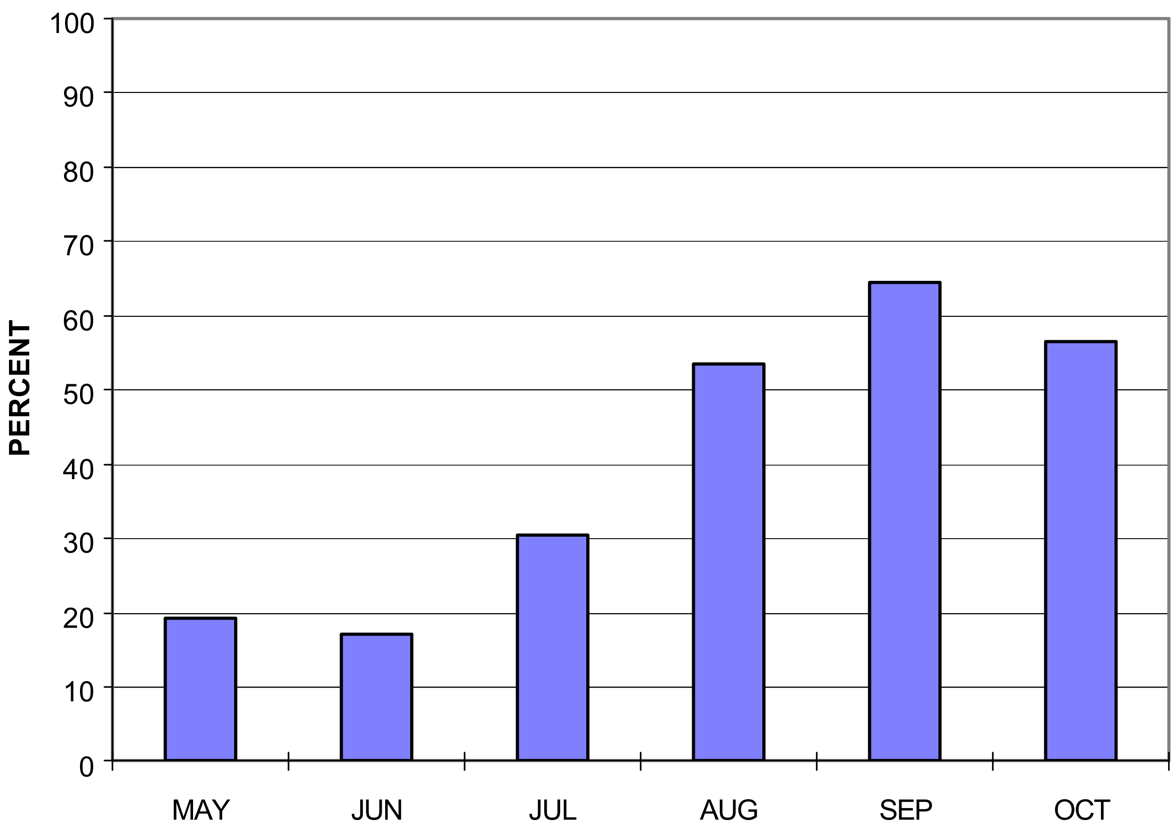

Figure 4. Monthly average Iron Gate Dam contributions to Klamath River flows measured at Orleans (1962-1991). Data are from Hydrosphere Data Products, Inc. (1993).

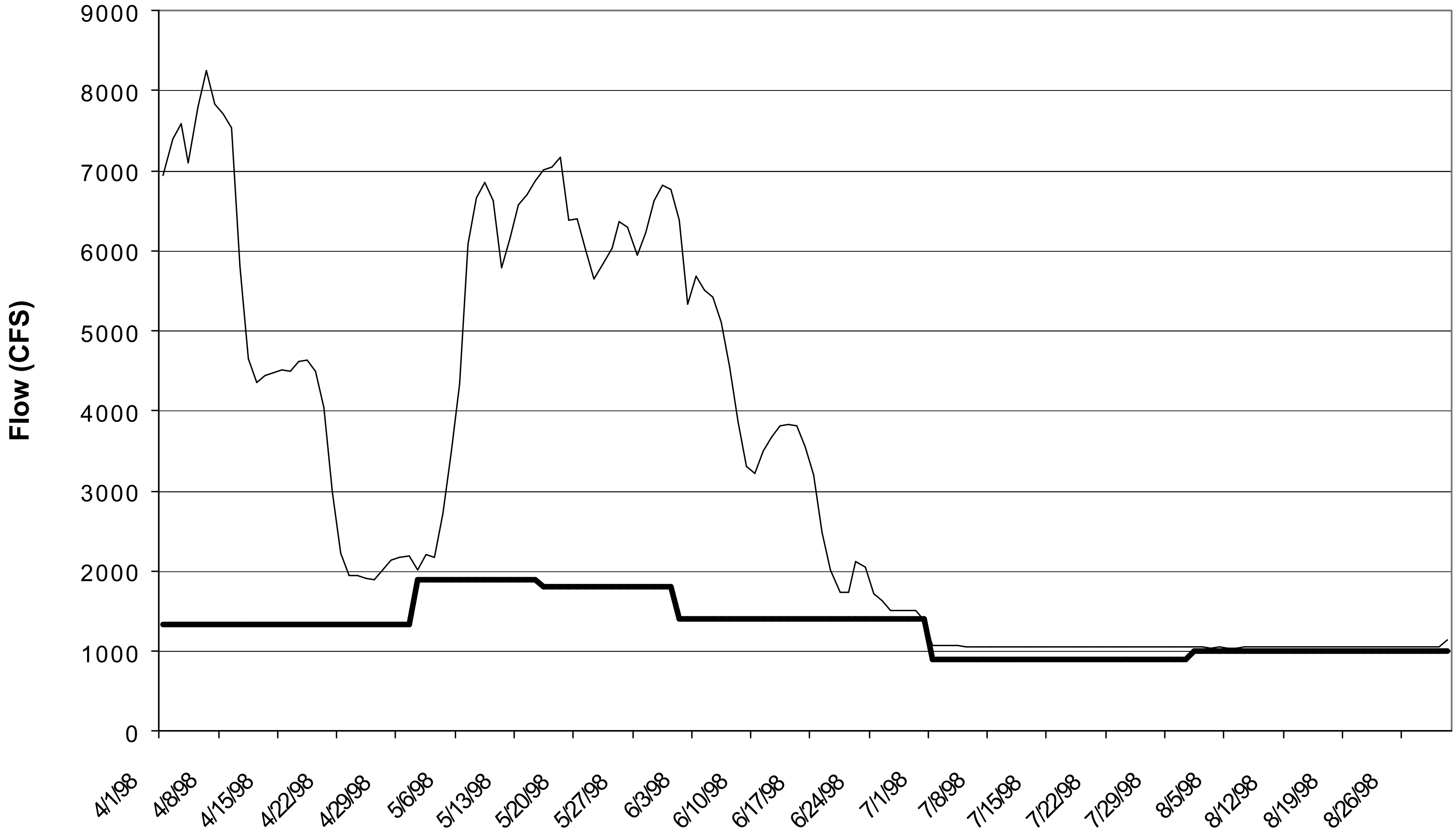

Figure 5. Daily average Klamath River flows measured at Iron Gate Dam (April through August, 1998). Bold line is the minimum flow regime from the 1998 biological assessment of Klamath Project operations (Reclamation 1998).

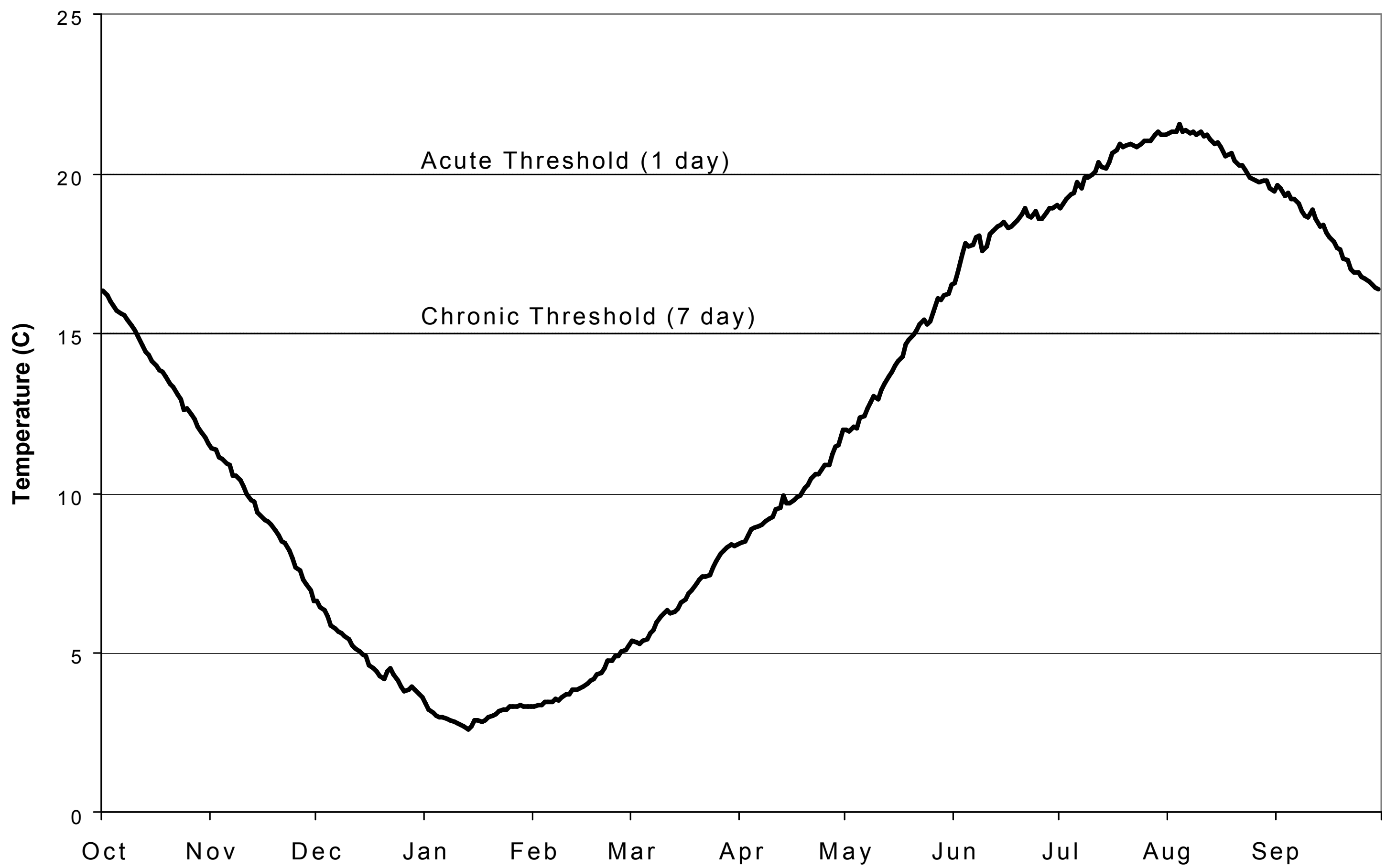

Figure 6. Average daily maximum water temperatures in the Klamath River below Iron Gate Dam (1963-1979). Acute and chronic high temperature thresholds are 1986 Environmental Protection Agency criteria (Campbell 1995). Data are from Hydrosphere Data Products, Inc (1993).

Figure 7. Average daily maximum water temperatures in the Klamath River at Seiad (1964-1978). Data are from Hydrosphere Data Products, Inc. (1993).

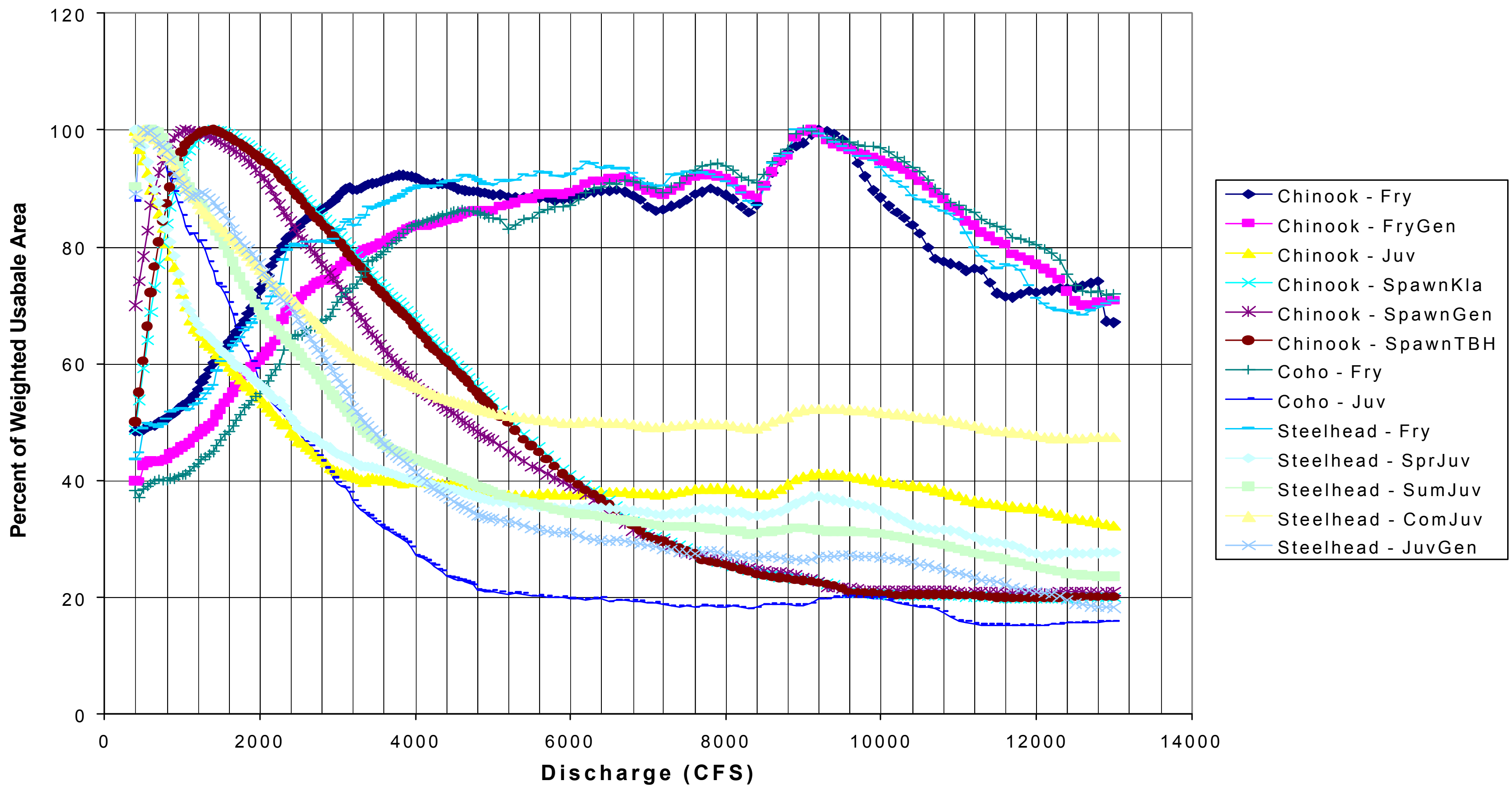

Figure 8. Normalized estimates of weighted usable area for various salmon and steelhead life history stages in the Iron Gate Dam to Shasta River reach of the Klamath River. Data are from INSE (in prep.).

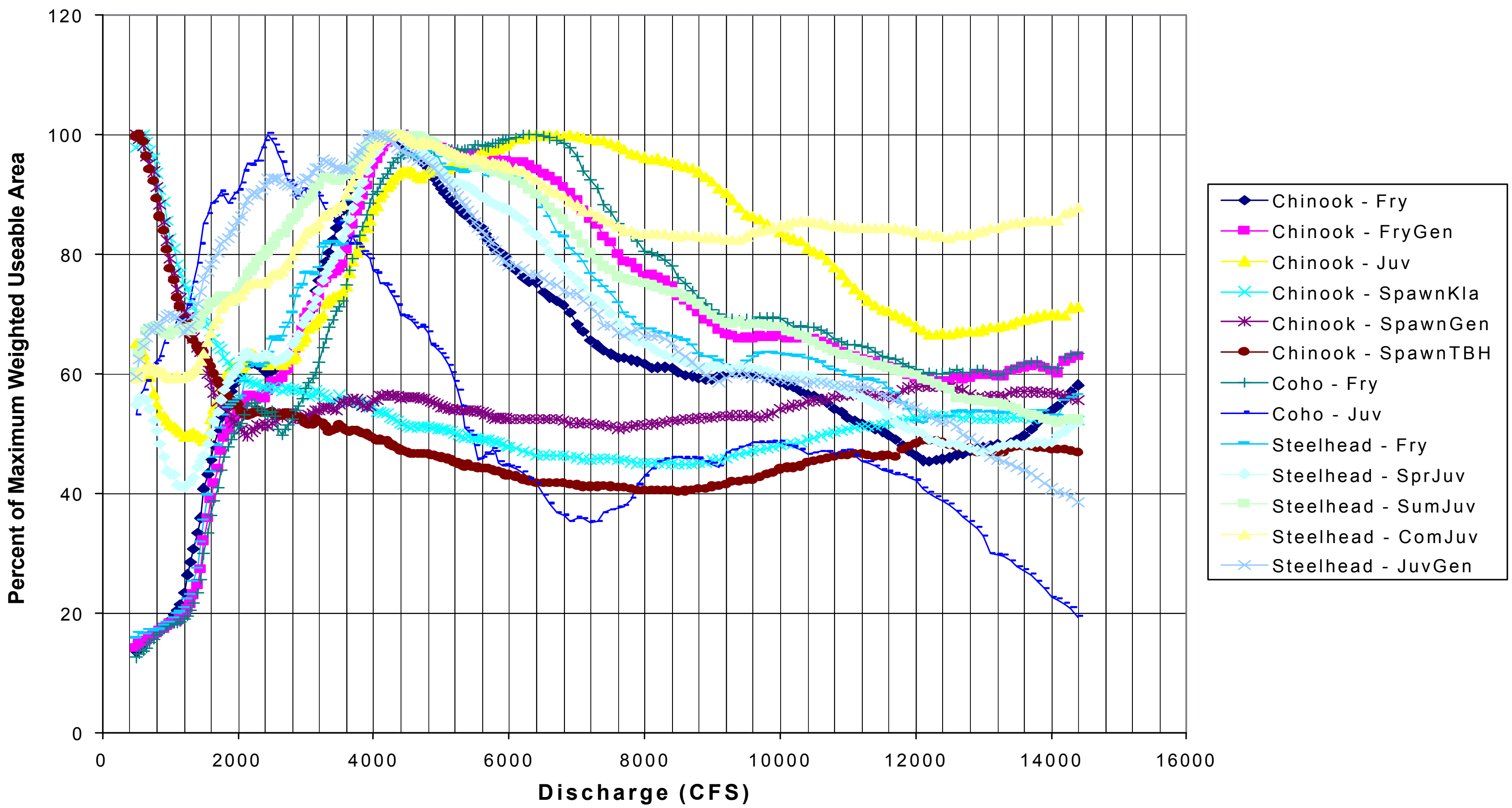

Figure 9. Normalized estimates of weighted useable area for various salmon and steelhead life history stages in the Shasta River to Scott River reach of the Klamath River. Data are from INSE (in prep.).

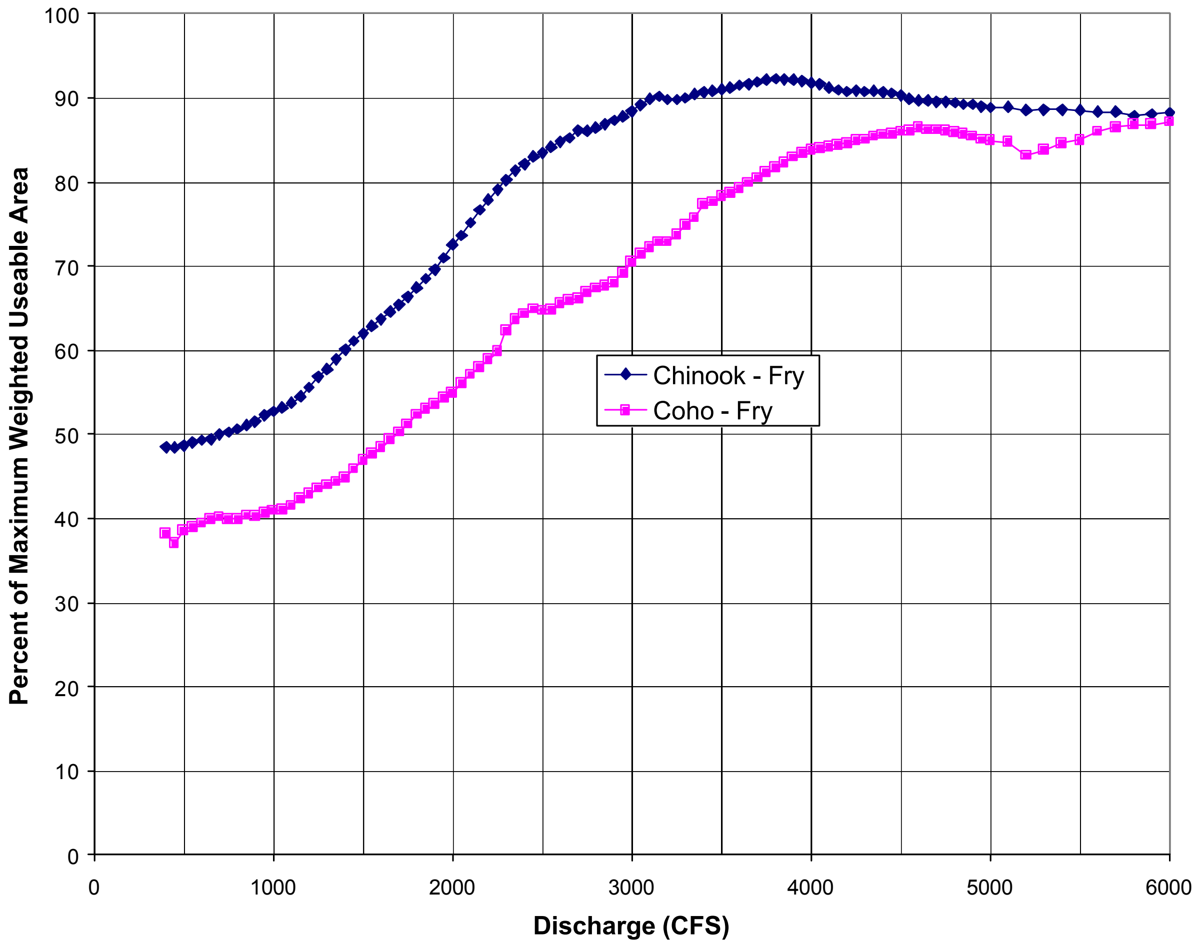

Figure 10. Normalized estimates of weighted useable area for coho salmon and chinook salmon fry in the Iron Gate Dam to Shasta River reach of the Klamath River. Data are from INSE (in prep.).

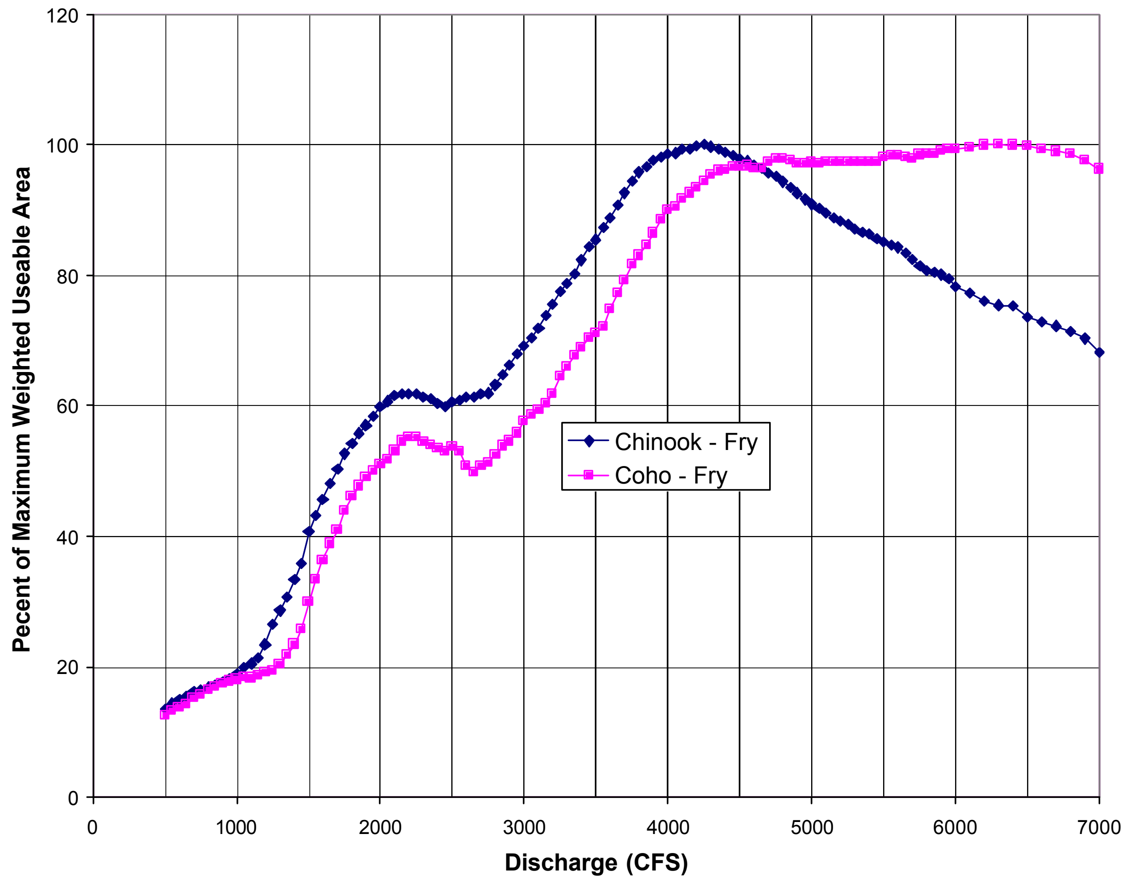

Figure 11. Normalized estimates of weighted useable area for coho salmon and chinook salmon fry in the Shasta River to Scott River reach of the Klamath River. Data are from INSE (in prep.).

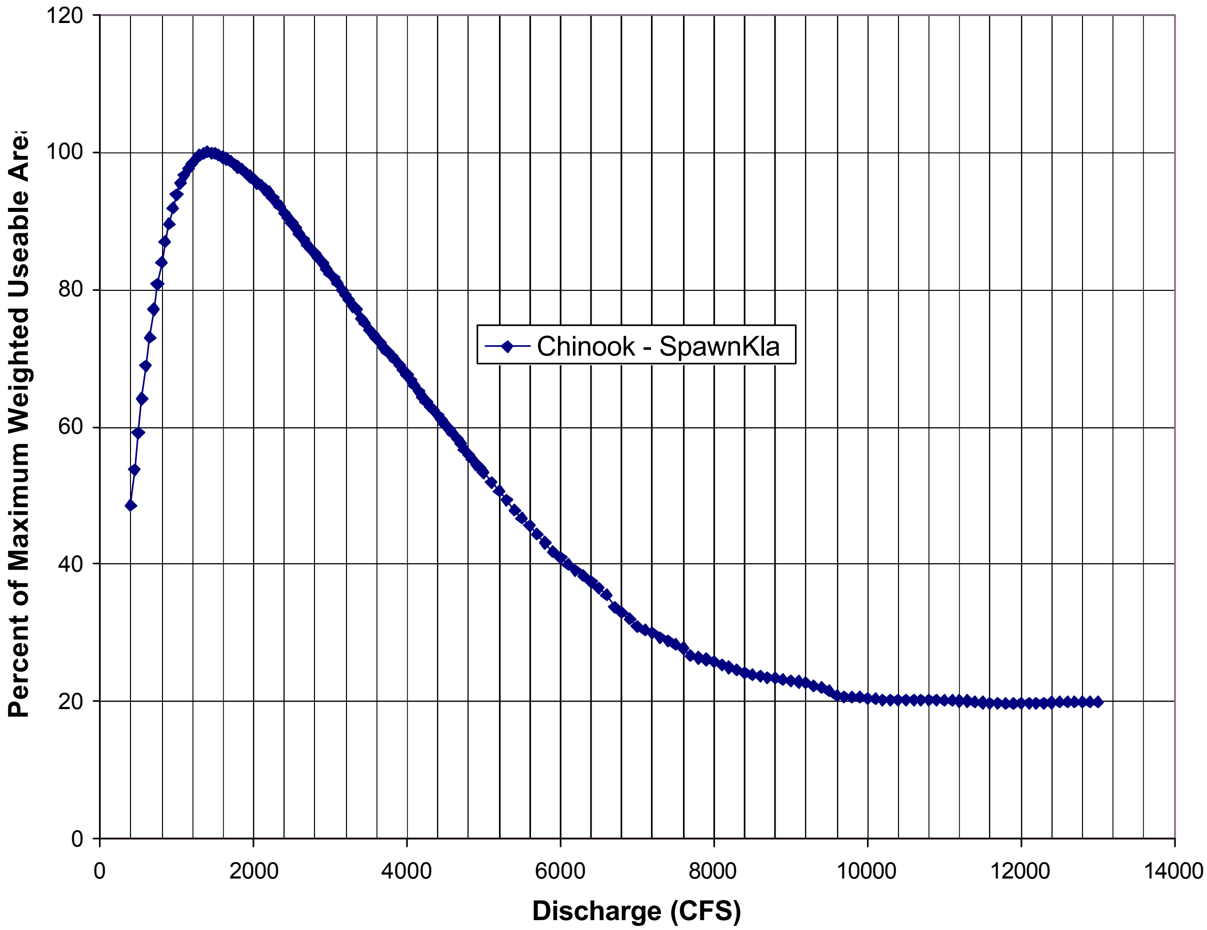

Figure 12. Normalized estimates of weighted useable area for chinook salmon spawning in the Iron Gate Dam to Shasta River reach of the Klamath River. Data are from INSE (in prep.).