Predecisional Draft - Do Not Cite

Biological Opinion

Klamath Project Operations

[April 1, 2002]

National Marine Fisheries Service
Southwest Region

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1. INTRODUCTION

This document transmits the National Marine Fisheries Service's (NMFS) biological opinion based on our review of the Bureau of Reclamation's (Reclamation) proposed operation of the Klamath Project (Project), and its effects on the southern Oregon/northern California coasts (SONCC) coho salmon (*Oncorhynchus kisutch*) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). This biological opinion is based on information provided in the February 25, 2002, biological assessment (BA), field investigations, and other sources of information. A complete administrative record of this consultation is on file at the NMFS Arcata, California field office.

The objective of this biological opinion is to determine whether the proposed operation of the Klamath Project is likely to jeopardize the continued existence of threatened SONCC coho salmon. Critical habitat has been designated for SONCC coho salmon. Conclusions regarding destruction or adverse modification of designated critical habitat are included in this Biological opinion.

2. CONSULTATION HISTORY

Reclamation forwarded a final BA addressing its 1998 Operations Plan for its Klamath Project to 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 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 2000a). 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."

On January 22, 2001, Reclamation requested initiation of formal ESA section 7 consultation regarding the ongoing operation of the Project, and forwarded a BA detailing their proposed operation of the Project into the future. NMFS subsequently issued an April 6, 2001, biological opinion (2001 Opinion, NMFS 2001a) in response to Reclamation's request. Th 2001 Opinion found that the proposed operation of the Project posed jeopardy to the southern Oregon/northern California coasts (SONCC) coho salmon, listed as threatened under the ESA. This determination was generally based on the expectation that the proposed operation of the Project would result in the continued decline in habitat conditions in the Klamath River below Iron Gate Dam. As a result, the survival and abundance of several freshwater life history stages of coho salmon would be expected to decrease and appreciably reduce the likelihood of survival and recovery of SONCC coho salmon. Accordingly, NMFS included a reasonable and prudent alternative (RPA) to the proposed Project operation in the 2001 Opinion (NMFS 2001a). The RPA included a minimum flow release regime for Iron Gate Dam (IGD), based on the best information available at the time the 2001 Opinion was issued.

Because of the expectation that additional information and analyses relevant to the relationship between IGD flows and suitable salmonid habitat (e.g., the Phase II Klamath River flow study report) would become available within a few months following the issuance of the NMFS 2001 Opinion, the RPA only included minimum IGD flows for the April through September 2001 period. In the 2001 Opinion (NMFS 2001a), NMFS stated the intention to prepare a supplemental biological opinion and RPA, addressing all water year types. Additionally, NMFS stated that the supplemental biological opinion could include a more refined minimum IGD flow regime for future "critically dry" water years (as defined by Reclamation), based on any new information or analyses.

Because we had not yet completed our supplemental biological opinion, we were concerned that Reclamation did not have incidental take coverage under section 7(a)(2) of the ESA for Klamath Project operations beyond September 30, 2001. To ensure that there was no lapse in Reclamation's incidental take coverage for the Klamath Project operations, NMFS provided an amendment to its 2001 Opinion (NMFS 2001a), on September 28, 2001, with recommended flows for the October through December 2001 period (NMFS 2001b), and a second amendment on December 28, 2001, with recommended flows for the January through February 2002 period (NMFS 2001c).

Subsequently, on February 27, 2002, Reclamation requested initiation of formal ESA section 7 consultation regarding the ongoing operation of the Klamath Project. The February 27, 2002, letter included a "Final Biological Assessment of the Effects of Proposed Actions Related to Klamath Project Operation (April 1, 2002 - March 31, 2012) on Federally-listed Threatened and Endangered Species" (Project operations BA, Reclamation 2002). However, NMFS was going to be unable to complete formal consultation on such short notice before the start of the April 1, 2002, irrigation season. Therefore, in a March 27, 2002, letter from Dave Sabo to Jim Lecky, Reclamation requested concurrence that their proposed flows during April and May in a "below average" water year would be "not likely to adversely affect the coho salmon." In a March 28, 2002, letter from Jim Lecky to Dave Sabo, NMFS concurred with Reclamation's determination. NMFS' letter also states, "this concurrence for April and May 2002, does not preclude NMFS from arriving at a different conclusion in its biological opinion...based on the best scientific data available at the time."

3. 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.

The curtailment of water available for 2001 irrigation deliveries and for National Wildlife Refuges precipitated a number of events. These events include some accelerated efforts to identify and presumably prepare to implement Klamath Basin-wide actions that could improve listed fish habitat conditions, and increased certainty regarding the availability of water supplies for irrigated agriculture and National Wildlife Refuges. Although it is not possible to determine the outcome of certain efforts, NMFS is encouraged that these efforts, regardless of their genesis, may help identify important restoration actions for Klamath River salmon habitat, identify sources of funding for these actions, and establish implementation schedules. Although not part of the "proposed action" section of Reclamation's BA (Reclamation 2002) discussed below, the BA did include an appendix of actions that could potentially lead to improved habitat conditions for fish listed under the ESA.

4. DESCRIPTION OF THE PROPOSED ACTION - Klamath Project 2002-2012

The description of Reclamation's proposed operation of the Klamath Project was provided in their February 25, 2002, final biological assessment regarding Project operations (Reclamation 2002). Reclamation proposes to operate the Project to divert, store, and deliver (from storage) Project water consistent with applicable law. Proposed operations would begin on April 1, 2002, and continue through March 31, 2012. After consultation under the Endangered Species Act with NMFS and the U.S. Fish and Wildlife Service, Reclamation will develop an operations plan that provides for the continued operation of the Project for a ten-year period. Actions proposed within the 10-year proposed operation of the Project as described in the biological assessment include providing water for agriculture pursuant to perpetual water contracts and temporary water contracts. The three primary Project reservoirs used for diversion, storage and delivery of water for Project purposes are Upper Klamath Lake, Clear Lake, and Gerber Reservoirs. Reclamation's 1992 Biological Assessment (Reclamation 1992) and its November 2000 Klamath Project Historic Operation report (Reclamation 2000b) describe the Project features and their operation. The reader should refer to those sources for a detailed description of the facilities.

4.1 Annual Operations Planning Criteria

Reclamation generally proposes to operate the Project consistent with the historic operation of the Project from water year 1990 through water year 1999 in such a way as to achieve or exceed the IGD flows that resulted from those operations. Reclamation proposes its Project operations planning as a four-step process:

Step 1: Reclamation will determine the water year type (above average, below average, dry or critically dry) using a 70 percent probability of exceedence and NRCS' April 1 runoff forecast. Water year types are defined in the January 22, 2001, Reclamation Project biological assessment. 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 Critically Dry (<185,000 af).

Step 2: Reclamation will preliminarily estimate the annual water supply that would be available for irrigation and refuge deliveries under the following criteria:

Upper Klamath Lake, Gerber Reservoir, and Clear Lake levels: Based on lake levels no lower than the minimum end-of-month elevations for the ten-year period **and,**

Klamath River flows below IGD for Above Average and Below Average Years: Based on daily average river flows no lower than the respective ten-year ***minimums*** or FERC flows, whichever are greater; **or**

Klamath River flows below IGD for Dry and Critically Dry Years: Based on daily average river flows no lower than the observed ten-year ***minimums***.

Step 3: Reclamation will estimate the annual water supply that would be available for irrigation and refuge deliveries under the following criteria:

Upper Klamath Lake, Gerber Reservoir, and Clear Lake levels: Based on lake levels no lower than the average end-of-month elevations for the ten-year period **and,**

Klamath River flows below IGD for Above Average and Below Average Years: Based on daily average river flows no lower than the respective ten-year ***minimums*** or FERC flows, whichever are greater; **or**

Klamath River flows below IGD for Dry and Critically Dry Years: Based on daily average river flows no lower than the observed ten-year ***averages,*** plus a pulse of 10,000 acre feet of water in April to facilitate smolt downstream migration.

Step 4: Finally, Reclamation will determine the desired size of a water bank by calculating the difference in Project water supply between Step 3 and Step 2. Reclamation states that the purpose of the water bank is to provide additional water supplies for fish and wildlife purposes and to enhance tribal trust resources. Reclamation anticipates the size of the water bank to be up to 100,000 acre feet.

Step 1 of the operating criteria is the routine method Reclamation has historically used to determine water year type on an annual basis. Steps 2-4 appear to be new to Project operation planning. In Steps 2-3 of the operating criteria, Reclamation will utilize minimum or average river flows from water years 1990 through 1999, varying by water year type. During "dry" and "critically dry" water years, Reclamation will provide a pulse of 10,000 acre feet of water to be released in April. However, except for "critically dry" water years, there is no other substantive difference between Step 2 and Step 3 for river flows. For critically dry years, the only difference is that ten-year **average** river flows will be used in Step 3 instead of 10-year **minimums** proposed in Step 2. Step 4 will be used to calculate the size of a water bank which will be used to augment any difference between Step 2 and Step 3.

Reclamation is proposing to use the above criteria to "provide boundaries" for the proposed action (i.e., water supply for irrigation and refuges) based on actual minimum and average lake levels and IGD river flows that occurred during water years 1990 through 1999 (Reclamation 2002). The biological assessment states that Project operations must stay within the minimum and maximum river flow values and will not go lower than the minimum. On the other hand, Reclamation reports that "actual flows could be lower than the proposed operation" (email from B. Davis, Bureau of Reclamation, March 18, 2002) and that "the proposed action does not commit to specific river flows...rather, it uses flows and lake levels experienced during the 1990's to aid in the development of operating critieria" (email from M. Ryan, Bureau of Reclamation, March 5, 2002). Based on this somewhat contradictory information regarding the IGD flows expected to occur from Reclamation's proposed action, NMFS assumes that Reclamation is proposing to use the specific operating criteria described above (Steps 1-4) to <u>assist</u> in the estimation of the annual water supply that would be available for irrigation and refuge delivers. For instance, Reclamation would use Step 3 to establish targets, as opposed to minimum standards, for minimum river flows and lake levels for planning purposes only. As a result, during water years 2002 through 2012, actual IGD river flows could fall short of these planning criterion (i.e., lower than the minimums reported in Table 5.9 of the biological assessment) (see table **?** in section **?** of this biological opinion). Therefore, it appears that Reclamation's 10-year proposed operation of the Project <u>does</u> <u>not</u> ensure specific minimum flows for release at Iron Gate Dam during any time period for any water year type. Nevertheless, for the purpose of our analysis of Project effects on coho salmon in this biological opinion, NMFS will assume Reclamation's proposed operation of the Klamath Project will achieve or exceed the IGD flows reported in Table 5.9 of the biological assessment. NMFS is not analyzing the potential affects to coho if actual IGD flows are lower than those reported in Table 5.9.

4.2 Ramping Rates

Reclamation's proposed Project operations do not include providing for any specific Iron Gate Dam ramping-down rates during any time period for any water year type.

4.3 Coordination

Reclamation proposes to meet with the USFWS, NMFS, Klamath Basin Tribes, PacificCorp, and irrigation districts periodically to coordinate activities and discuss water supply conditions, species status, and available options for Project operation and prepare an annual report documenting previous year's activities.

4.4 Other Proposed Actions

Reclamation is proposing other actions that may reduce entrainment of suckers into the A-Canal from Upper Klamath Lake and provide passage at Link River Dam for suckers.

4.5 Klamath Basin Water Supply Enhancement Act

Reclamation is proposing to conduct feasibility studies authorized by the Klamath Basin Water Supply Enhancement Act to study enhancing the water supply available for Project use. Implementation of actual projects or programs would be contingent upon the results of the feasibility studies, Congressional approval, authorization, and appropriation, and completion of appropriate environmental compliance activities. Whether this potential additional water supply would be used for fish and wildlife enhancement is not specified in the biological assessment.

4.6 Conservation Measures

Although Reclamation's biological assessment includes a list of actions that could be implemented to improve habitat conditions for coho salmon in the Klamath Basin, Reclamation is not proposing to implement them or any other specific measure to improve habitat conditions for SONCC coho salmon as part of their proposed action (see Appendix A, Reclamation 2002).

5. DESCRIPTION OF THE ACTION AREA

The action area is defined as the Klamath River downstream of IGD, located at approximately river mile 190, in northern California.

6. STATUS OF THE SPECIES AND CRITICAL HABITAT

6.1 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.

6.2 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 (young-of-the-year) 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 overwinter 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.

6.3 Population Trends

Available historical and recent SONCC coho salmon abundance information is summarized in the NMFS coast-wide status review (Weitkamp et al. 1995). Here 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 about 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).

6.4 Klamath River Basin Population Abundance 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 because the coho spawning migration is known to extend later in the season than chinook. 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. Thus, both adult and juvenile counts are valuable for documenting the presence of coho salmon in specific areas during key time periods, but have limited value for determining population status or trends. However, these counts provide an indication of the low abundance and precarious status of coho salmon populations in the Klamath River Basin.

6.4 Klamath River Basin Population Abundance Information

Limited information exists regarding coho salmon abundance in the Klamath River Basin. Adult and juvenile coho salmon are observed in tributaries and the mainstem of the Klamath River; however, these observations often occur incidentally to their purpose of determining fall chinook salmon escapement. Most observations of adult coho salmon occur at weir and hatchery locations. Once the counting of fall chinook ends, the weirs are removed prior to high winter flows. Therefore, counting efforts may not include a portion of the coho salmon migration because the coho spawning migration is known to extend later into the season than the chinook migration. Downstream of weir and hatchery locations, spawning and carcass surveys have been conducted in both tributaries and the mainstem Klamath River. However, these surveys have been conducted on an inconsistent basis due to the constraints of funding these efforts, and high flows.

The trapping of juvenile coho salmon occurs in the Klamath River and selected tributaries. Unfortunately, these counts are focused primarily on fall chinook and are therefore incomplete with regard to sampling for coho salmon juveniles. Thus, both adult and juvenile counts are valuable for documenting the presence of coho salmon in specific areas during key time periods, but have limited value for determining population status or trends. However, these counts provide an indication of the low abundance and precarious status of coho salmon populations in the Klamath River Basin.

6.4.1 Adult Data

Adult coho salmon are enumerated at the Iron Gate Hatchery and the Trinity River weir at Willow Creek, providing information on the relative abundance and fish returning to these locations (Table XX). Based on the identification of hatchery marks, approximately 90% of the adult coho escapement captured at the Trinity River weir at Willow Creek are of hatchery stock.

Table XX. Adult Coho Salmon counted at Willow Creek Weir and Iron Gate Hatchery

Year	Iron Gate Hatchery	Willow Creek Weir
1992	1,697	7,961
1993	675	5,048
1994	172	239
1995	1,501	15,477
1996	3,546	35,391
1997	1,872	1,984
1998	511	10,009
1999	151	4,912
2000	723	10,046
Average	1,205	10,119

Adult salmon counting weirs are operated in Bogus Creek and the Shasta and Scott rivers. In addition, coho salmon adult counts are 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.

Since 1991, observations of adult coho salmon at the Shasta River weir have varied from 0 fish in years 1996-1998, to 291 fish in 2001, with an average count of 34 (Table XX). During this period, adult coho salmon have been observed at the Shasta River weir as early as September 25 (1995), and as late as December 14 (2001). In 2001, the weir was pulled due to high flows on December 14, and it is likely more adult coho salmon entered the Shasta River following that date. Video observations at the weir provide some ability to identify coho adults as either of hatchery or wild origin. Of the 291 coho observed on video in 2001, only two exhibited an obvious left maxillary clip, which indicates Iron Gate Hatchery origin. However, of the 21 adult coho that were sampled as "washbacks" to the weir, six (29%) had left maxillary clips indicating Iron Gate Hatchery origin. This apparent discrepancy illustrates both the difficulty of detecting maxillary clips on video, and the difficulty of drawing conclusion from this data regarding the hatchery stray component of the adult spawning population.

Table XX. Coho salmon observed at the Shasta River weir 1991-2001 (CDFG unpublished data).

Year	Period of observations	Adult Coho Salmon
1991	October 19-November 5	9
1992	October 19-November 2	3
1993	October 2-October 19	4
1994	September 30-October 22	17
1995	September 25-November 7	12
1996	N/A	0
1997	N/A	0
1998	N/A	0
1999	N/A	27
2000	October 24	1
2001	October 2- December 14	291

In contrast to this recent period of observation, adult coho salmon observations during the 1970's at the Shasta River "Rack" averaged 217 fish during years in which the trap had a similar operating season

(1970, 1972, 1973 and 1977) (CDFG unpublished data) .   Despite the abundance of adult coho salmon in 2001, these data suggest a decline in the status of Shasta River coho salmon in the recent decade.

Weir counts in the Scott River averaged 25 adult coho (range: 5-37) during the 1982-1986 period (CDFG unpublished data) and four adult coho (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 variations 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; therefore, 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).

Adult coho salmon and coho salmon redds are occasionally observed during spawning and carcass surveys in the Klamath Basin. For example in 2001: six redds with adult coho salmon holding nearby were observed in the Klamath River between IGD and Interstate 5 (USFWS unpublished data 2002); and 64 adult coho salmon and five coho redds were observed in the Blue Creek drainage (Yurok Tribe unpublished data). Of these fish observed in Blue Creek, 11 had adipose clips indicating they are strays of a hatchery origin other than the Klamath River.

6.4.2 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 salmon at different life stages during certain times of the year. Based on the capture efficiency of these traps, indices of abundance have been developed for juvenile coho salmon, yielding averages of 548 smolts at the Big Bar Rotary Screw Trap on the Klamath River, and 2,975 smolts at the Willow Creek Rotary Screw Trap on the Trinity River. The actual numbers of coho salmon captured are quite lower (Tables XX, XX) These low numbers do provide indication of 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, NMFS believes the low number of smolts is another indication that the abundance wild coho salmon in the Klamath River is extremely low.

Table XX. Hatchery and wild juvenile (smolts, young-of-year) coho salmon captured at the Big Bar Rotary Screw Trap (USFWS 2001).

Year	Days Trapped	Wild Smolts	Hatchery Smolts	Young-of-Year
1997	126	17	3	13
1998	97	1	2	12
1999	118	4	6	38
2000	92	8	3	45
2001	**?**	49	312	155

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 indication of 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, NMFS considers the abundance of these populations to be extremely low.

Table XX. Hatchery and wild juvenile (smolts, young-of-year) coho salmon captured at the Trinity River Rotary Screw Trap (USFWS 2001).

Year	Days Trapped	Wild Smolts	Hatchery Smolts	Young-of-Year
1997	144	117	477	50
1998	189	42	351	11
1999	206	48	1,302	240
2000	231	47	97	31
2001	?	8	N/A	15

In 2001, the USFWS and other cooperators conducted direct-observation counting of fish occurring at various tributary confluence areas in the mainstem Klamath River while the mainstem flow was 1000 cfs. These efforts were repeated during the June through September period. In all, approximately 65 locations were sampled. Coho salmon juveniles were observed in 14 locations where the mainstem river temperatures varied from 15.7E to 25.5E C (USFWS unpublished data). Tributary water associated with these sampling locations were sometimes cooler, and ranged from 13.3E to 23.0E C. These data demonstrate that juvenile coho salmon do inhabit the mainstem Klamath River in tributary confluence areas when water temperatures are higher than some believe coho can tolerate.

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. Further, USFWS (1997a) concluded that coho salmon juveniles likely rear year-around in the mainstem Klamath River between Iron Gate Dam and Seiad Creek. Consistent with the findings of USFWS are the results of CDFG’s 2002 study that indicates the majority of juvenile coho salmon emigrated from the Scott and Shasta rivers during the period of April 23 through June 24, 2001(CDFG, 2002). Both USFWS (1997a) and CDFG (1994b) indicated that coho salmon fry emigrated from some tributaries to the mainstem Klamath River soon after emergence. Further evidence of coho salmon fry emigrating from tributaries to the mainstem Klamath River has been observed by the Yurok Tribe. In March 2002, Yurok Tribal Fisheries captured coho salmon fry in a downstream migrant trap on McGarvey Creek, close to the confluence of the Klamath River (personal communication H. Voight), and CDFG observed young-of-year coho on the Klamath River estuary (CDFG unpublished data) .

In summary, information on coho salmon population status or trends in the Klamath River Basin is incomplete, but what information exists suggests that adult population abundance is extremely low. All SONCC coho salmon populations within the 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 Klamath River population is heavily influenced by hatchery production, and a large component of the population is of hatchery origin, apparently with little natural production. The apparent declines in production suggest that the natural population may not be 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. 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.

6.5 Current Status

6.5.1 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, including six general exceptions. 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). 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.

6.5.2 Threats

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. 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; however, the Yurok Tribe recently published a report indicating the 2-3% of the fall-chinook run is taken by California sea lions in the Klamath estuary.

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.

In summary, 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 throughout the range of the ESU (October 31, 1996, 61 FR 56138). As described in detail below in the Summary of Effects section, NMFS believes that the conservation of populations that comprise each ESU must be ensured, and that Klamath River coho salmon are necessary for the continued survival and recovery of the SONCC ESU.

7. 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 conditions faced by of threatened and endangered species in the action area.

The environmental baseline sections of NMFS biological opinions usually 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. The environmental baseline usually establishes the base condition for natural resources, human usage, and species status in an action area which would be used as a point of comparison for evaluating the effects of an action.

In this biological opinion, however, NMFS is considering an action that requires us to deviate from that approach to establishing environmental baselines for an action. Specifically, Klamath Project operations and associated activities have occurred for at least 70 years, which pre-dates the ESA of 1973. The ongoing operations of the Project described in the BA (Reclamation 2002) are a "proposed action;" however, Project construction and operation have continued since the early 1900s, and thus in effect are a part of the environmental baseline. The effects of Project operation are, in part, reflected in the current status of the species being considered in this biological opinion.

Consequently, NMFS will treat all effects of Klamath Project operations that occurred during the life of the Project as part of the environmental baseline for this biological opinion. NMFS also observes that the Project has generally been operated to provide water to meet minimum flow targets below IGD since about 1962. The "Effects of the Action" section of this biological opinion will consider the expected effects of proposed Project operations, as proposed, into the future.

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.

7.1 Land Management

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.

7.2 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. 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.

7.3 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 Basin, 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. 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. On May 3, 2001, the U.S. District Court in the Eastern District of California ordered a preliminary injunction against full implementation of the Trinity Mainstem Fishery Restoration program. This injunction may be in place pending the completion of a supplemental Environmental Impact Statement addressing this program.

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).

7.4 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. In 1992, the State Water Resources Control Board (SWRCB) proposed that the Klamath River be listed 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.

7.5 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.

7.6 Hatchery Programs

Large hatcheries in the SONCC coho salmon ESU (e.g., Mad River, Trinity River) 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. However, 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).

Approximately 90 percent of the Klamath-Trinity basin coho salmon are of hatchery origin (Brown et al.1994), 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).

7.7 Recent Additions to the Environmental Baseline

ESA section 7 consultation on recent Project operations was addressed in the 2001 Opinion (NMFS 2001a) and subsequent amendments (NMFS 2001b, c), Project operations during this period were added to the previous environmental baseline. In addition to the completed ESA section 7 consultations on April 2001 through February 2002 Project operation, several other consultations addressing other activities within the action area have been completed. These recent consultations are for various projects including bridge replacements, road decommissioning, and fire hazard fuel reduction. Those projects that have been implemented do not result in any material changes to the environmental baseline of the action area.

Substantial new information became available shortly after the issuance of the NMFS 2001 Opinion. The public review draft of the Phase II flow study report (Hardy and Addley 2001) included the results of “no project” hydrologic modeling that provide a refined estimate of unimpaired monthly mean flows at the Iron Gate Dam site. When compared to the “baseline” flow regime description provided in Reclamation’s BA (Reclamation 2002), these estimates provide another description of hydrologic changes that have occurred as water management above Iron Gate Dam has intensified. The latest estimates of unimpaired flow approximate IGD discharge as if there were no diversions from the watershed upstream of Upper Klamath Lake. These estimates do not depict “pre-settlement” conditions because changes in the watershed (land use, loss of wetlands, etc.) are not considered. However, NMFS believes that these estimates provide the best available estimation of typical flows under which coho salmon in the Klamath River evolved. Therefore, NMFS finds that it is appropriate to use these estimated unimpaired flows a basis for examining effects of the proposed action.

The most recently updated no-project estimated mean (50% exceedence) monthly flows included in the draft Phase II report are as follows (Hardy and Addley 2001):

Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**
1589	1897	2282	2738	3072	3913	3841	3568	2689	1854	1425	1503

“Percent exceedence” means that X% of flows for a given period have been greater than the stated flow for that period. For instance, the monthly 50% exceedence flow given above means that half of the flows recorded for the given month have been greater than the stated flow, and half have been below the stated flow.

These estimates are somewhat different than the estimated pre-project monthly mean flows at the Iron Gate Dam site provided in the “Phase I” flow study report (INSE 1999), and were based on hydrologic modeling rather than analyses of flow gage and rainfall data only. NMFS understands that flow estimates and other information that are provided in the draft Phase II report are subject to revision as progress on the report continues.

Operation of the Project during the April 2001 through February 2002 period, consistent with Reclamation’s 2001 Annual Operations Plan and the NMFS 2001 Opinion and amendments (NMFS 2001a, b, c), leads NMFS to generally expect that it will result in survival benefits to Klamath Basin coho salmon during this period, relative to previous decades (as described in the 2001 Opinion).

7.8 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:

C 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.

C 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 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.

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.

NMFS believes that the SONCC coho salmon population in the Klamath River Basin is reduced to the point that it may not be able to maintain itself at current levels given the status of the environmental baseline. Such a severely reduced population may have lost sufficient resiliency to recover from additional adverse impacts to the current baseline condition, even if significant improvements are eventually made. The available evidence suggests that a significant part of the problem is lack of properly functioning habitat.

8. EFFECTS OF THE ACTION

In this section of the Biological opinion, NMFS assesses direct and indirect effects of the proposed action on SONCC coho salmon and critical habitat, and any interrelated and interdependent activities, added to the environmental baseline. The purpose of this section is to determine if it is reasonable to expect the proposed action to have direct or indirect effects on SONCC coho salmon and their critical habitat that reduce appreciably the likelihood of their survival and recovery in the wild.

8.1 National Academy of Sciences Report

Due to the controversy surrounding the basis for Klamath Project water allocation decisions in 2001, the Department of the Interior initiated a review of the situation by the National Academy of Science. Accordingly, the National Research Council formed the Committee on Endangered and Threatened Fishes in the Klamath River Basin (Committee), made up of scientists and other experts, to develop both a narrowly-focused interim report on the 2001 situation and a broader final report about the biological requirements of listed fish in the Klamath Basin.

The prepublication version of the Interim Report from the Committee, entitled “Scientific Evaluation of Biological Opinions on Endangered and Threatened Fishes in the Klamath River Basin” was released to the public in February 2002 (Interim NRC Report, National Academy Press 2002). Although the substance of the Interim NRC Report is “final,” a final interim report will reportedly be available in April 2002. The “Statement of Task” (Appendix to the Interim NRC Report) included the following language regarding the Interim NRC Report:

> The interim report will focus on the February 2001 biological assessments of the Bureau of Reclamation and the April 2001 biological opinions of the U.S. Fish and Wildlife Service and National Marine Fisheries Service regarding the effects of operations of the Bureau of Reclamation’s Klamath Project on listed species.
>
> The committee will provide a preliminary assessment of the scientific information used by the [USBR], [USFWS], and the [NMFS], as cited in those documents, and will consider to what degree the analysis of effects in the biological opinions of the [USFWS] and [NMFS] is consistent with that scientific information.
>
> The committee will identify any relevant scientific information it is aware of that has become available since the [FWS] and [NMFS] prepared the biological opinions. The committee will also consider any other relevant scientific information of which it is aware.

NMFS is grateful to all members of the Committee for volunteering to undertake an expedited review of 2001 proposed and implemented Project operations, and looks forward to the final report that will provide additional valuable information. Nevertheless, by definition, the Committee’s interim report task was different from NMFS’ Endangered Species Act section 7 responsibilities (i.e., ESA section 7 consultation consistent with the implementation regulations [50 CFR ' 402]). Although the context is different, additional data, analyses, and current conclusions always move the understanding of the Klamath River forward.

The conclusions of the Interim NRC Report with regard to coho salmon seem to be: (1) there is a paucity of data about coho salmon in the Klamath River Basin, but that population levels are unknown but probably low; (2) operation of the Klamath Project consistent with Reclamation’s January 22, 2001, biological assessment may not be scientifically supported; (3) substantial improvements in the amount of coho salmon habitat in the mainstem Klamath River cannot currently be attained in dry years, relative to river flows in the last decade; (4) factors limiting Klamath River coho salmon production are not related to conditions under the Project's control, at least during dry years; (5) current hatchery practices are flawed; (6) there is no substantial scientific foundation for changing the operation of the Project to maintain higher Klamath River mainstem flows for the threatened coho salmon (e.g., those flows recommended in the NMFS April 6, 2001, biological opinion RPA); (7) there is no substantial scientific evidence supporting changes in Project operations, nor the resulting IGD flows, relative to the past 10 years; (8) avoiding coho salmon stranding due to downward ramping rates at IGD seems reasonable and prudent; and, (9) that the Committee's conclusions are subject to modification in the future if scientific evidence becomes available to show that modifications of flows would promote the welfare of Klamath River coho salmon. NMFS has reviewed and considered the conclusions of the NRC Report, and has referred to and integrated these conclusions when appropriate in this biological opinion.

8.2 Analysis Approach

Operation of the Project as described in the Project operations BA (Reclamation 2002) 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 and other salmonids 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.

8.3 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).

IGD flow releases significantly influence flow rates in the Klamath River. 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. During the critically dry year 2001, IGD releases constituted a large proportion of the mainstem Klamath River as measured at Seiad Valley. During the late summer, comparison of flow gage data from below IGD and Seiad Valley shows that there were no appreciable accretions between these two points in 2001 (Figure XX); therefore, under certain conditions, IGD releases effectively constitute all flow in the upper mainstem (the area immediately downstream of IGD).

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.

8.4 Flow Study Activities and Recommendations

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

In the 1940s, 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 I flow study report,' INSE 1999). 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 I 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 I flow study, a follow-up Phase II 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. The most recent public review draft of the Phase II report became available in January 2002. The NRC Committee did not review the Phase II report, and NMFS did not base its April 2001, biological opinion on the Phase II report.

In the initial stages of the Phase II study, 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. During the Phase II 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. Coho salmon fry generally require similar habitat characteristics as chinook salmon. 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 (Hardy and Addley 2001).

Preliminary draft physical habitat modeling results are now available for the Klamath River below IGD. These results and additional information continue to be evaluated by the Technical Team. Figures 8 through 12 show the draft estimates of suitable habitat in two study reaches below IGD, by species and life history stage.

8.5 Effects of Project Operations

Table X. Average IGD flows, by time step, (values in CFS) predicted to result from the proposed action by water year type (from Table 5.9, Reclamation 2002).

Time Step	Above Average Water Years	Below Average Water Years	Dry Water Years	Critically Dry Water Years
Oct	1345	1345	879	920
Nov	1337	1324	873	912
Dec	1387	1621	889	929

Jan	1300	1334	888	1011
Feb	1300	1806	747	637
Mar 1-15	1953	2190	849	607
Mar 16-31	2553	1896	993	547
Apr 1-15	1863	1742	969	874
Apr 16-30	2791	1347	922	773
May 1-15	2204	1021	761	633
May 16-31	1466	1043	979	608
Jun 1-15	827	959	741	591
Jun 16-30	934	746	612	619
Jul 1-15	710	736	547	501
Jul 16-31	710	724	542	501
Aug	1039	1000	647	517
Sep	1300	1300	749	722

8.5.1 October through February

8.5.1.1 Adult Migration

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 estimated resultant flows included in the Project operations BA (Reclamation 2002), minimum IGD flows during the adult coho salmon in-migration season would likely vary from about 700 to 900 CFS in “critically dry” water years, to about 1,300 CFS during “average” and “above average” water years, and up to about 1600 in an “average” water year December. 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. Model results presented in the draft Phase II report (Hardy and Addley 2001) 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). NMFS expects that it is reasonable that adult coho salmon are also able to migrate successfully given this discharge and downstream flow accretions. At potential flows under the proposed action during dryer years (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 under Reclamation's proposed action. 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. Therefore, migration to spawning areas, spawning site selection, redd construction, mate selection, defense of redds and mates, and egg laying could be reduced in effectiveness if access to tributaries is blocked or delayed. Consequently, decreased spawning success may result during dryer years.

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. Therefore, we do not expect adverse effects due to water temperatures during the coho salmon adult migration period.

8.5.1.2 Spawning

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, T. Shaw, USFWS, pers. comm. 2002), 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: 5.6° - 13.3° 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).

Although the predicted flows are significantly lower than the unimpaired flow estimates in the draft Phase II report (Hardy and Addley 2001), we do not expect adverse effects to coho salmon related to egg and alevin survival if the flows predicted to occur in "above average," "below average," and "dry" years are realized. However, we believe that Reclamation's predicted flows in "critically dry" water years may lead to dewatering of redds and loss of eggs or alevins present within those redds when flows drop from 1101 CFS in January to 637 CFS in February. Additionally, if spawning takes place during significantly higher flows during uncontrolled spill from IGD in "dry" water years, those redds may be subject to dewatering when flows are brought back under control and reduced to the predicted levels.

As stated above, 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. Salmon that cannot access natal tributaries may stray and spawn in nearby areas. Therefore, NMFS is concerned that mainstem flow conditions that will likely result in "dry" and "critically dry" water years under the proposed action could result in an increase in mainstem spawning, which would put additional redds at risk of dewatering due to Project operations. In wetter years, NMFS believes that conditions in the mainstem eliminate these concerns.

8.5.1.3 Juvenile Rearing

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, juvenile coho salmon move into deeper pools featuring cover, and into flooded side channels and off-channel areas. By using these protected areas, some juvenile coho 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). However, juvenile coho may experience difficulty in returning to tributaries under low mainstem flow conditions predicted in dryer years, as described above for adult salmon passage into tributaries (Vogel and Marine 1994). These juvenile coho salmon rearing in the mainstem under the low flow conditions predicted in dryer years are less likely to find preferred habitat types such as flooded side channels featuring adequate cover, such as they would likely find in unregulated tributary streams. Therefore, NMFS expects that juvenile coho salmon may experience some level of adverse effects due to an inability to use optimal habitat types that are both less available in the mainstem, and inaccessible to them in some tributaries.

8.5.1.4 Summary of October - February Effects

In summary, NMFS believes that adverse effects due to the proposed action during the October through February period in dryer years may result in a reduction in the numbers, reproduction, and distribution of coho salmon in the Klamath River. Should the above described adverse impacts to individual coho salmon and reproductive success occur, even at a low level, NMFS believes that there may be significant additional impacts to the population's viability due to its extremely reduced population abundance and associated lack of resiliency.

8.5.2 March through June

8.5.2.1 Coho Fry and Juveniles (young-of-the-year)

As described in the "Status of the Species" section of this Biological opinion, coho salmon fry and juveniles rear in the mainstem Klamath River and some Klamath River tributaries during this period. Coho fry typically transition to what is considered the "juvenile" stage by about mid June–both stages are referred to collectively as "young-of-the-year." After emergence from redds, fry swim close to stream banks and seek available cover. As they become older, coho salmon fry 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 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 these young-of-the-year coho salmon as prey items found in midstream areas are generally unavailable because of weak swimming abilities of this life stage of coho salmon.

As previously mentioned, draft estimates of suitable habitat availability in the main stem under various IGD releases are available. Also, as noted in the Interim NRC Report, some have a general lack of confidence in the preliminary draft habitat modeling results for the mainstem Klamath River that were presented in the NMFS April 6, 2001, biological opinion. Although the currently available habitat modeling results (e.g., in Hardy and Addley 2001) are considered draft and subject to revision, NMFS believes that such results are worthwhile to consider in the context of ESA section 7 consultation. Although "cause and effect" relationships have not been established (e.g., number of adult coho salmon produced by a given amount of salmon fry habitat in the main stem), expectations must be developed in order to complete this analysis.

Under the proposed action, the amount of suitable physical habitat for young-of-the-year coho in the mainstem Klamath River could be dramatically reduced (see Figures 10 and 11 - Hardy habitat/discharge curves) **(Provide a table?)**. Additionally, field observations conducted by CDFG and USFWS indicate that coho fry habitat quality, as well as quantity, is dramatically reduced under flows predicted to occur in the spring under the proposed action in all water year types. The CDFG and USFWS observations and measurements show that marginal slack water and side channels with an appropriate combination of cover, depth, and velocity become increasingly unavailable as flows subside. The predicted flows under the proposed action will result in habitat quality that may provide sufficient depth and velocity in accessible portions of the main channel; however, appropriate shelter and escape cover availability is dramatically reduced. Young-of-the-year coho will be exposed to increased predation under such conditions, and availability of insect prey from riparian sources may be reduced. Because of weak swimming abilities, fry are not well equipped to seek out the fewer available suitable habitat locations available under the predicted flows. Coho fry habitat in the mainstem Klamath River becomes increasingly important late in the spring as irrigation depletions begin to limit available salmon fry habitat in some tributaries, especially in drier years. Also, coho salmon fry must compete with other species (e.g., chinook salmon) for available habitat in the spring. NMFS believes that this situation would result in decreased carrying capacities for young-of-the-year coho in the mainstem Klamath River. As a result, the survival of young-of-the-year coho is expected to decrease under the proposed action.

Proposed 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). Because Reclamation's current proposed action does not include specific ramping rates, NMFS expects that adverse impacts to coho salmon, including mortality of coho fry, due to hourly and daily ramping rates would continue to occur at times under the proposed action.

8.5.2.2 Coho Smolts

Juvenile coho salmon from the previous year's cohort also transform to the smolt life stage and migrate toward the sea down the mainstem Klamath 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 with a peak in May (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 potentially 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." This expectation, and additional supporting information, is also expressed in Reclamation's BA at pages 89 and 90. Based on available information, smolt survival in the Klamath River (particularly in the IGD to Seiad Valley reach) is expected to be higher with higher flows, and lower with lower flows. Under the proposed operations described in the current Reclamation BA, flows could be relatively low, especially in dryer years. As a result, survival of coho salmon smolts could be poor in those years.

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 an unfavorable environment for salmon.

8.5.2.3 Summary of March - June Effects

In summary, NMFS believes that the proposed action during the March through June period will increase predation upon coho fry, decrease feeding success, and reduce outmigration success of smolts; which will decrease the survivorship of both fry and smolts. As a result, the proposed action may cause reduction in the numbers and distribution of coho salmon in the Klamath River. Should the above described adverse impacts to individual coho salmon occur, even at a low level, NMFS believes that there may be significant additional impacts to the population's viability due to its extremely reduced population abundance and associated lack of resiliency.

8.5.3 July through September

Most coho fry move out of river systems during freshets in spring months, 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 during the July through September period. 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, as compared to spring when tributary accretions are greater.

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 responses 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 release temperatures do 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 flow, 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). **(Update - SIAM now available for model runs)**

Water temperatures and quality contribute to a hostile environment for juvenile salmon during the summer in the mainstem Klamath River. Temperatures are typically above the preferred range of coho salmon, and sometimes exceed one reported 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 flows that could result from the proposed operation of the Project as these fish can more easily succumb to bacterial diseases under these water quality conditions (i.e., higher diurnal temperature fluctuations) (see CDFG 2000b; S. Foote, USFWS biologist, pers. comm., 2000).

8.5.3.1 Thermal refugia

Thermal refugia are those areas where relatively cooler water is available to fish in sub-optimally warm water bodies. Contributions of cooler water may come from surface flow, such as from tributary confluence sources; or from groundwater, hyporheic flow, or other subsurface sources. Previous studies have indicated the presence of thermal refugia within the mainstem Klamath River that are associated with tributary confluence areas (e.g., Belchik 1997; McIntosh and Li 1998). Specifically, McIntosh and Li (1998) found areas in 1997 and 1998 where the difference between tributary and the mainstem Klamath River were between 1E and 2.9E C different. As previously mentioned, coho juveniles were observed to occupy some of these areas in 2001.

We suspect that affects to these thermal refugia are complicated and vary between individual locations, and are substantially affected by meteorological conditions and associated tributary flows and temperature regimes. In addition, the suitability of the potential fish habitats that exist in these areas are not solely a function of mean water temperatures, but also must provide appropriate water depth, velocity, cover, and should either provide adequate food resources or such resources should be available within close proximity. Again, based on the limited information available, NMFS finds that the extent to which the net “carrying capacity” of these refugia are enhanced or degraded by relatively high versus relatively low IGD summer releases has not been studied and is unknown. Without additional studies, it is not possible to determine how different IGD flows improve or diminish any survival benefits to coho salmon associated with these areas. Also, based on the extremely low tributary accretions to the mainstem between IGD and Seiad Valley during the summer of 2001, it is clear that it is overly simplistic to assume that the net "benefits" of associated refugia decrease with any IGD flow increases relative to those experienced in other drought years. For example, some aerial imagery suggests that at higher flows the cooler water may be pushed against the river bank into areas that may actually serve as better habitat for rearing fry, rather than being "blown out" or diluted as some people suggest.

8.5.3.2 Fish kills

Although only largely anecdotal information is available, there have been a series of juvenile salmonid "fish kills" in the main stem Klamath River during the 1990s. Reports of such fish kills seem to vary, with some suggesting that they have not occurred when summer IGD flows have been at or above 1,000 CFS. The NMFS is unaware of any conclusive, scientific connection between IGD flows and fish kills in the main stem river. However, a fish kill in June of 2000 was documented (CDFG XXXX) below Seiad Valley, and disease was generally determined as the cause. Since 2000, there has been an increased awareness of fish health in the Klamath River, and fish kill "responses" have been established. As a result, trained respondents may gather additional valuable information to further understand these incidents should they occur in the future.

8.5.3.3 Summary of July - September Effects

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 may be a production bottleneck.

8.6 Interrelated and Interdependent Actions

Interdependent actions are defined as actions having no independent utility apart from the proposed action (50 CFR §402.02). Interrelated actions are defined as actions that are part of a larger action and depend on the larger action for their justification (50 CFR §402.02). These are often thought of as actions that could not take place <u>but for</u> the proposed action.

The extremely low flows predicted to occur during the adult migration and spawning period could provide increased opportunities for poaching. Also, NMFS has observed harassment of migrating and spawning salmon by people and dogs during low flows in other river systems. Effects due to poaching are obviously related to increased mortality and injury to adult salmon. Harassment of adult salmon in the weakened condition they experience during spawning and migration can lead to mortality, delayed spawning, and reduced spawning success. These activities would be facilitated by the proposed action during periods when they would not typically occur.

Additionally, while it is known that water quality in the lower Klamath River adversely affects SONCC coho, it is not known to what extent Project-related activities are responsible for these conditions. Identifying and quantifying water quality degradation resulting from such interrelated and interdependent actions should be addressed by further studies.

8.7 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. During the fall and winter, Project operations can substantially affect mainstem Klamath River flows in the IGD to Shasta River reach and, depending on accretions form downstream tributaries, can also affect river flows further down the river. Passage conditions for migrating adult coho salmon in the mainstem and access to tributaries may be adversely affected during dryer water years under the proposed action. Coho salmon also spawn in the mainstem in the IGD to Shasta River reach, and spawning conditions and subsequent success may be adversely affected under certain flow conditions. This, in dryer years, coho salmon spawning success in the tributaries and mainstem river may decrease and, in turn, production of coho salmon may decrease under these conditions.

During the spring, Project operations substantially affect Klamath River flows in the IGD to Shasta River reach. In dryer years, the substantial influence of IGD releases extends farther downstream. The amount of flow in the mainstem river affects the amount of suitable habitat available for young-of-the-year coho salmon fry that either originated in the mainstem or were displaced from their natal tributaries. The amount of suitable rearing habitat available for salmon and steelhead fry in the mainstem may adversely affect their survival if sufficient habitat is not available for all salmonid fry in the mainstem (including coho salmon) that must compete for similar appropriate conditions. Tributary access for young-of-the-year coho salmon that attempt to move from the mainstem to tributaries may be adversely affected in the IGD to Shasta River reach, and further downstream during dryer water years featuring low accretions to the mainstem river. Young-of-the-year coho salmon that cannot find suitable rearing habitat will likely suffer decreased survival.

Also during the spring, yearling juvenile coho salmon are either already present in the mainstem or move into the mainstem to continue rearing and transforming into the smolt life stage. All juveniles transitioning to the smolt life stage must use the river as a corridor during their migration to the ocean. Although no Klamath River-specific relationships between river flow and smolt survival have been established, available information from other geographic areas indicate that smolt survival increases with river flow. NMFS is unaware of any information that suggests that higher spring flows lead to decreases in smolt survival. Thus, Project water storage and management activities are expected to affect smolt survival in the IGD to Seiad Valley reach of the Klamath River; stated simply, smolt survival in this reach is expected to be lower under lower IGD flows, and higher under higher IGD flows. The influence of IGD flows extends further down the river during some years, depending on meteorological conditions. As a result, IGD flows are also expected to influence smolt survival downstream, with the extent of this influence varying with meteorological conditions.

During the summer, IGD flows make up a substantial portion of Klamath River flows as measured at any given point in the river. This is particularly true during dryer water years. In 2001, summer flows in the IGD to Seiad Valley reach were almost exclusively IGD releases. The relationship between IGD flows and water quality and temperature is poorly understood, but evolving models and additional analyses continue to shed light on this relationship. The USGS SIAM model includes a water temperature model for the Klamath River, and some results have shown that under relatively high IGD flow, the daily mean summer temperatures immediately below IGD are expected to increase slightly relative to scenarios of lower IGD releases. However, Klamath River mean daily water temperatures as predicted at Seiad Valley are expected to decrease slightly under relatively high IGD flows and result in improved water temperatures in terms of total number of seasonal "chronic and acute" degree days (Campbell et al. 2001). These results may be due to the effect of mass heating in Iron Gate Reservoir has less importance than riverine heat exchange processes at this location which is approximately 80 km downstream. The heating of IGD releases downstream to Seiad Valley has been previously modeled (Deas and Orlob 1999), and these results are generally consistent with SIAM modeling results. The model developed at U.C. Davis (Deas and Orlob 1999) also indicates that in general, diurnal water temperature fluctuations in the Klamath River are expected to be lower under relatively high IGD flows.

As previously discussed, tributary confluence water mixing areas and other potential thermal refugia have been identified in the Klamath River. While NMFS believes the net effects to these refugia, in terms of juvenile salmonid carrying capacities, is unstudied and unknown, the Interim NRC Report notes that "[a]ddition of substantial amounts of warm water [from IGD] could be detrimental to coho salmon by reducing the size of these thermal refuges." In 2001, little to no accretions to Klamath River flows occurred between IGD and Seiad Valley; therefore, any flow measured in this reach of the river essentially comes from IGD releases. So, while NMFS is also concerned about the temperature of IGD releases during the summer, this represents the only water in the river in this location during "critically dry" water years (as defined by Reclamation). In addition, the ambient daily average and diurnal fluctuation of water temperatures near Seiad Valley may be modestly decreased at this location and therefore may be as beneficial to coho and conspecific species as some "cool water refugia" documented by McIntosh and Li (1998); the Interim NRC Report states that "[j]uvenile fish living there [in the mainstem] probably tolerate its temperature only because of ...pockets of cool water." If the ambient temperature of the mainstem is reduced to similar values as the referenced tributary confluence areas (e.g., those near Seiad Valley), it stands to reason that rearing habitat in the mainstem would generally be improved in terms of survival benefits for those coho salmon juveniles in the mainstem (similar to the refuge areas referenced in the Interim NRC Report).

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. Any improvement in the survival of any freshwater life stage of coho salmon should be manifest in the size of the initial marine population and, depending upon ocean conditions, in the adult return population. This is true whether or not coho salmon production increases are realized in some important tributaries (e.g., the Scott and Shasta rivers) within the next decade.

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:

3. The SONCC coho salmon comprises 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.

4. 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 their habitats in many areas of the SONCC coho salmon ESU.

5. 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. Also, the spawning population of the Klamath River coho salmon is “unknown” (Interim NRC Report at page 17), and such estimates will likely not be available in the next decade. Operation of the Project according to the proposed action 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 (and uncertainty) 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 Project BA (Reclamation 2002) is expected to result in an appreciably reduced likelihood that SONCC coho salmon will both survive and recover in the wild.

8.8 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 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 1990 to 1999 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.

9. 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.

In recent months, non-Federal actions that can affect salmon and steelhead habitat have received an increasing amount of attention. For example, it is known that water diversion activities in the upper Klamath Basin upstream of Upper Klamath Lake affect the amount and timing of water accretions to Upper Klamath Lake, and in turn the amount of water available for management by Reclamation's Klamath Project. Also, water diversion activities in sub-basins downstream of IGD (e.g., the Shasta River, Scott River, and Indian Creek) affect the timing and amount of water accretions to the mainstem Klamath River, which affects the amount of tributary and mainstem habitat, and associated water quality, available to Klamath Basin coho salmon.

On July 28, 2000, the California Fish and Game Commission (Commission) received a petition to list coho salmon north of San Francisco as an endangered species under the California Endangered Species Act (CESA). Subsequently, the California Department of Fish and Game (CDFG) determined that the petition included sufficient information to indicate that listing coho salmon may be warranted. On April 5, 2001, the Commission accepted the petition and as a result coho salmon occurring in California north of San Francisco are considered candidates for listing under CESA. California Fish and Game Code sections 2080 and 2085 prohibit the take of candidate species unless such take is authorized by CDFG. The Commission will vote on whether to list coho after public meetings to be held in April or May 2002.

At their April 5, 2001, meeting, the Commission also issued a Special Order Relating to Incidental

Take of Coho Salmon During the Candidacy Period, as allowed under Fish and Game Code section 2084 (CCR, Title 14, Section 749.1). Under the Order, certain activities that are consistent with some specific measures to protect coho salmon, but may result in the take of coho salmon, are allowed to continue. Should coho salmon north of San Francisco be listed under CESA, incidental take of this these fish would require authorization.

Although the CESA listing candidacy for coho salmon north of San Francisco and the associated take prohibitions and limitations will theoretically provide an added level of protection of these fish in the Klamath River Basin, it is difficult to quantify the associated survival benefit. Also, any additional survival benefits provided these fish may be lost following the candidacy period if the Commission does not list coho salmon north of San Francisco under CESA. In an attempt to pro-actively pursue improvements in coho salmon habitat in tributaries to the Klamath River prior to the listing decision, the CDFG has recently intensified their efforts. For example, CDFG has proposed the Scott River Watershed Stewardship Program that would focus on changes to water management in this sub-basin.

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. In addition, non-Federal actions that require authorization under section 10 of the ESA will be considered in the environmental baseline for future section 7 consultations.

10. 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 on into the future), and cumulative effects, it is NMFS' biological opinion that the action, as proposed, is likely to jeopardize the continued existence of SONCC coho salmon. NMFS has also determined that the action, as proposed, is likely to adversely modify critical habitat for the SONCC coho salmon.

11. REASONABLE AND PRUDENT ALTERNATIVES

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 expectation that the proposed operation of the Project would result in a continued decline in habitat conditions in the Klamath River relative to Project operations during previous decades. The reasonable and prudent alternative is intended to prevent further decline, and to increase the stability and resiliency 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. NMFS expects that further aquatic habitat studies, restoration planning, and restoration accomplishments will necessitate future adjustments to this reasonable and prudent alternative, or perhaps other reasonable and prudent alternatives will be identified over time.

The draft Interim NRC Report (National Academy Press 2002) concluded that there is no substantial scientific foundation for changing the operation of the Project to maintain higher flows in the mainstem Klamath River for coho salmon, but no specific definition of "substantial scientific foundation" was offered. Nevertheless, during ESA section 7 consultation, NMFS must consider information and develop life stage survival expectations and RPAs regardless of the absence or paucity of "scientific" evidence or foundation.

The Final ESA Section 7 Consultation Handbook (USFWS and NMFS 1998) includes the following instructions for proceeding with consultation when there is an absence of conclusive scientific information:

> Where significant data gaps exist there are two options: (1) if the action agency [Reclamation] concurs, extend the due date of the biological opinion until sufficient information is developed for a more complete analysis; or (2) develop the biological opinion with the available information giving the benefit of the doubt to the species.
>
> If the action agency... insists consultation be completed without the data or analyses requested, the biological opinion... should document that certain analyses or data were not provided and

why that information would have been helpful in improving the data base for the consultation. In formal consultation, this statement usually appears in the "effects of the action" section. The Services are then expected to provide the benefit of the doubt to the species concerned with respect to such gaps in the information base (H.R. Conf. Rep. No. 697, 96th Cong., 2nd Sess. 12 (1979)).

While NMFS may agree with the Committee's conclusion that there is no substantial scientific foundation for changing mainstem Klamath River flow management, NMFS cannot agree with the perceived Committee recommendation that absent conclusive scientific evidence the Project should be managed as it was in the 1990 to 2000 period. Consequently, NMFS cannot agree with the foundation of Reclamation's BA, and the resulting proposed action. Therefore, NMFS is proceeding with this consultation and development of an RPA using the best available information.

NMFS finds that our use of the existing data specific to Klamath River coho salmon is aided by consideration of more general, theoretical information concerning the dynamics of severely reduced populations. Such theoretical information is embodied in the discipline known as "conservation biology." "Conservation biology" is defined by Grumbine (1992) as "the science that studies biodiversity and the dynamics of extinction." Given the current level of data availability, we must make certain assumptions in development of this RPA–the principles of conservation biology allow us to make these assumptions within an accepted logical framework.

In developing this RPA, NMFS relied on the following principles:

1. Severely reduced populations of animals face an increased threat of extinction over time due to the loss of the population's resiliency (i.e., the ability of populations to recover from natural perturbations such as drought or other random, natural or human-caused events). Soulé (1986) states "such perturbations thin a population, but do not destroy it; once thinned, however, the population is at an increased risk from the same or from a different kind of random event. The smaller a population, the greater its vulnerability to such perturbations. Also, the shorter the interval between such events, the more likely the population will be pushed over the brink before it can recover to a safe size."

2. The SONCC coho salmon population of the Klamath River basin is reduced to the point that NMFS believes they have likely lost sufficient resiliency to protect them from extinction due to catastrophic events. (Regarding the availability of population data, the Interim NRC Report acknowledged that "[s]tocks of native coho salmon have declined greatly in the Klamath River Basin over the past several decades." This conclusion is consistent with the conclusions of this biological opinion.)

3. The probability of extinction of a population that remains at severely reduced levels increases over time due to increased probability that the population will be exposed to chance catastrophic events, such as severe drought, as well as other uncertainties such as inbreeding; inability to find mates; and fluctuating food supply. Therefore, simply maintaining small populations at extremely low levels increases the threat of extinction over time **(REF)**.

Based on these principles, NMFS concludes that the following considerations should aid the development of an RPA.

Any multi-year flow regime should avoid mimicking potentially deleterious perturbations, e.g., severe drought conditions. If, for example, the flows prescribed for "dry" water years mimic severe drought conditions in the spring, smolts will experience deleterious conditions that may affect recruitment of adults for that cohort, and the population may, as a result, continue to lose resiliency. Some frequency of "drought condition" is expected due to natural variability in climatic conditions. However, while it is not possible to describe what specific annual flow regime constitutes a severe drought with negative effects to the population, any prescribed flow regime should conservatively attempt to avoid such conditions. This is particularly important in light of the possibility of encountering dry conditions in several consecutive years over the course of a ten-year plan.

Also, any multi-year flow regime should provide for the possibility of "good years" in which the coho salmon population of the Klamath River experiences favorable conditions that improve the chances that the population will increase and thereby improve its resiliency. For example, high spring flows that improve conditions for outmigrating coho smolts are expected to increase survival, and therefore will provide the possibility of more of them returning as spawning adults. Increasing the population's resiliency over time helps decrease the possibility that unexpected deleterious events and conditions will result in loss of the population's viability.

11.1 March through June

The losses of available habitat for coho fry due to flow reductions in spring in the mainstem Klamath and major tributaries (e.g., Scott and Shasta rivers) have likely contributed to reducing production of this species in the Klamath River basin. Moreover, as described previously, the habitat requirements of salmonid fry are somewhat similar, and coho salmon fry must compete simultaneously with other species (e.g., chinook salmon) for available habitat. Sufficient habitat must be available for the species with which coho salmon share resources so that sufficient carrying capacity remains to support them. Therefore, efforts to restore coho fry habitat in the mainstem and improve migratory flows for the coho smolt stage are appropriate. In this RPA, NMFS must determine what level of flows are necessary to avoid appreciably reducing the likelihood of survival and recovery of Klamath River Basin coho salmon, and ultimately, SONCC coho salmon.

11.1.1 Use of Hardy Phase II Report

NMFS has reviewed Hardy and Addley (2001), a draft report describing habitat-discharge relations of chinook salmon, coho salmon, and steelhead in sections of the Klamath River downstream of IGD. We consider this report to represent the best available method for making flow recommendations for the mainstem Klamath River. However, the goal of the Phase II study is somewhat different that the goal of this RPA. The Phase II report states: *These flow recommendations are necessary to aid restoration efforts and the maintenance of the aquatic resources within the mainstem Klamath River in light of the Department of the Interior's trust responsibility to protect tribal rights and resources as well as other statutory responsibilities, such as the Endangered Species Act.* The goal of this RPA, as stated above, is to avoid the likelihood of jeopardizing the continued existence of SONCC coho salmon, or the destruction or adverse modification of its critical habitat.

Some may conclude that these two goals attempt to attain different standards–a standard of a harvestable excess versus a standard to maintain mere survival at current population levels. However, as explained above, over the course of the ten-year proposed action it is necessary to provide conditions that are likely to help the SONCC coho population increase such that they build resiliency against unforseen perturbations. Therefore, given that the two species have very similar habitat requirements, providing conditions that are likely to restore and maintain natural chinook salmon production is also likely to provide the conditions necessary to maintain SONCC coho populations over time.

The NAS Committee appears to have limited confidence in the estimates of the amount of suitable habitat available under various flow magnitudes, noting that such estimates in their final form require "...extensive field measurements that are not yet available." Nevertheless, the draft Phase II flow study report (Hardy and Addley 2001), which the NAS Committee did not review, includes extensive descriptions of the various methods (including field measurements) used to develop the currently available estimates of fish habitat in the Klamath River for the Committee's continued consideration.

NMFS has determined that the Phase II report constitutes a reasonable "starting point" for our development of an RPA for the spring months. In considering the appropriateness of the Phase II recommendations, we conducted several other analyses as described below. These analyses are intended to provide comparison of the Phase II recommendations against other techniques and results that could also be used to make flow recommendations. We then adjusted the Phase II recommendations, as needed, to provide the spring flow recommendations of this RPA.

11.1.2 Unimpaired Flow Estimates

As described above in the "Environmental Baseline" section of this biological opinion, the draft Phase II flow study report (Hardy and Addley 2001) included the results of "no project" hydrologic modeling that provide a refined estimate of unimpaired monthly mean flows at the IGD site. These estimates of unimpaired flow approximate River discharge as if there were no diversions from the watershed upstream of Upper Klamath Lake. These estimates do not depict "pre-settlement" conditions because changes in the watershed (land use, loss of wetlands, etc.) are not considered. However, NMFS believes that these estimates provide the best available estimation of typical average monthly flows with which coho salmon in the Klamath River evolved. Therefore, NMFS finds that it is appropriate to use these estimated unimpaired flows a basis for developing an RPA.

11.1.4 Water Year Types

In a section titled "The Rainbow Concept," Reclamation's BA describes their grouping of water year types as being analogous to "bands within a rainbow." While NMFS appreciates such colorful analogies, we note that a rainbow only appears to our eyes as bands of color; it is actually a continuum with no lines of division between colors. Continuing with this more accurate analogy, flow regimes would ideally be prescribed based on a "rule curve" in which each year's water forecast would match up with a unique flow regime. There would be no groups or bands of water years, rather, there would be a specific flow regime corresponding to where that water availability forecast matched up with a continuum of possible flow regimes. As in nature, any difference in water availability would result in a different flow in the river. NMFS believes there is ecological value in natural variability; however, due to operational constraints, natural variability within and between years is not possible. NMFS has chosen to use five water year types to structure its RPA, as described below. Our partitioning of water year types, while not ideal, does allow for more variability between years than that proposed by Reclamation.

Hardy and Addley (2001) used the unimpaired flow duration data to estimate typical unimpaired stream flows at IGD during March, April, May, and June for the 10% to 90% exceedence levels (Table X). NMFS selected the monthly 10% exceedence flows as typical unimpaired monthly flows during "wet" water years. Monthly 30% exceedence flows were selected as typical unimpaired monthly flows during "above average" water years. Monthly 50% exceedence flows were selected to typify unimpaired monthly flows during "average" water years. Monthly 70% exceedence flows were selected as typical unimpaired monthly flows during "below average" water years. Monthly 90% exceedence flows were selected as typical unimpaired monthly flows during "dry" water years. (See Table X) NMFS recognizes that additional, intensive hydrologic analysis could refine approximations of typical (i.e., average or median) monthly unimpaired flows during alternative water year types. However, we believe the estimates as presented are reasonable approximations of prevailing unimpaired spring flows during the various water year types.

Water Year Type	Total Upper Klamath Lake inflow
Dry	< ~260 thousand acre feet (TAF)
Below Average	> ~260 TAF < ~450 TAF
Average	> ~450 TAF < ~550 TAF
Above Average	> ~550 TAF < ~785 TAF
Wet	> ~785 TAF

11.1.4 Coho Fry Habitat

Coho salmon fry rear in the mainstem Klamath River and some tributaries during the March through June period (Hardy and Addley 2001). Coho fry habitat in the mainstem Klamath River becomes increasingly important late in the spring as irrigation depletions begin to limit available salmon fry habitat in some tributaries, especially in drier years. As detailed in the Effects of Project Operations section of this biological opinion, NMFS believes Reclamation's proposed Project operation could result in significantly reduced amounts of available salmon fry habitat in the Klamath River.

NMFS has reviewed the draft Hardy and Addley (2001) Phase II report, which describes habitat-discharge relations of chinook salmon, coho salmon, and steelhead in sections of the Klamath River downstream of IGD. This latest modeling effort together with recent estimates of unimpaired stream flows at IGD provide a way to estimate the level of habitat that would occur under unimpaired flows. The draft Phase II report uses an iterative process to arrive at monthly flow recommendations based on habitat availability for priority and non-priority species in various reaches of the mainstem Klamath River. NMFS supports the Phase II methodology, and refers the reader to this report for additional information regarding coho fry habitat in the mainstem Klamath River.

11.1.5 Coho Smolt Habitat

In addition to reducing habitat for coho fry, diminished spring flows can also adversely affect the downstream migration of coho salmon smolts. As discussed in the Effects of Project Operations section of this biological opinion, available information, apparently without exception, indicates that smolt survival is expected to increase with mainstem flow magnitudes in the spring. The Interim NRC Report also indicates that coho salmon smolts require adequate habitat, but does not provide any relevant conclusions. As these fish have already survived up to 16 months of sometimes difficult freshwater habitat conditions, and in consideration of the populations apparent status (and associated uncertainty), it seems prudent that management of the Klamath River mainstem should provide for expected increases in smolt survival as these fish will contribute to the adult population.

The draft Phase II report does not specifically use coho salmon smolt habitat requirements to make flow recommendations. We emphasize smolt outmigration conditions in the following sections as we provide additional analyses to refine the Phase II flow recommendations for the purposes of this RPA.

11.1.6 Single-year low flow - spring

As described above in the introduction to this RPA section, managed flow regimes should not prescribe flows that mimic deleterious natural conditions. Specifically, we want to be sure to not prescribe flows that constitute a drought condition that would adversely effect coho salmon survival in a given year.

11.1.6.1 First additional analysis

Our first analysis in determining the appropriateness of the Phase II flow recommendations for spring months involves making a determination of how low monthly spring flows can be in a single year before we would expect to see adverse impacts to coho fry and smolt survival. In other words, how far above or below the Phase II recommendations must the flows be in the spring to maintain Klamath River coho populations for one year? This determination is based on the discussion of conservation biology above.

The Phase II report provides 90% exceedence unimpaired flow estimates that can be reasonably thought of as the lowest flow regime that would be expected to occur once in every 10 years. We do not know exactly what flow constitutes a "deleterious drought," and we realize that the effects of such a drought would vary depending on other factors at play in a given year. However, we do not believe that a ten-year recurrence interval of the average monthly flows under which Klamath River coho salmon presumably evolved represents a level of drought that would be expected to have adverse impacts on the coho salmon population.

We can compare the Phase II flow recommendations against the unimpaired flow estimates to determine what the recommended flow's natural rate of occurrence would be. This estimate allows us to estimate the relative "severity" of a low flow. For example, the 80% exceedence unimpaired flow estimate for June is 1797 cfs; therefore we would expect to encounter that as the lowest flow that would occur at a rate of two in ten years (i.e., the five-year recurrence interval). When compared to the recommended flows in June, we find that it is approximately equal to the 70% exceedence recommendation (1800 cfs), i.e., the flow that would be encountered at a rate of three in ten years. Therefore, the lowest flow that would "naturally" occur at a rate of once in five years will occur at a rate of once in about three years under the Phase II recommendations.

The Phase II recommendations for dry years are approximately 200 to 350 CFS less than the estimated unimpaired flow level in a given month. While we do not have an estimate of the 95%

exceedence unimpaired flow, which would have a 20-year recurrence interval, we can roughly extrapolate from the differences between other exceedence levels. It seems reasonable from this rough extrapolation that the Phase II recommendations for spring are likely to be comparable to a twenty-year low flow under unimpaired conditions. Although our "comfort level" in this regard is subjective, it seems reasonable that 20-year low flow would constitute drought conditions that would begin to result in poor survival conditions for coho salmon.

The process used in Phase II to recommend flows is designed to "retain the same general habitat magnitude as the reference condition" for coho fry in the spring; however, the report does not specifically address conditions for outmigrating coho smolts. As described above, survival of smolts is generally higher under higher spring flows. While we shouldn't expect this flow/survival relationship to increase or decrease in a perfectly linear fashion, we are concerned that conditions for smolt outmigration would continue to deteriorate under decreasing flows, even while the "habitat magnitude" is retained for fry. Therefore, this first analysis leads us to conclude that, in a single year, the Phase II recommendations for a dry year are as low as we would reasonably recommend.

11.1.6.2 Second additional analysis

A second analysis involves comparing the results of recommendations derived from the "modified Tennant method" as described by Trihey and Associates (1996). Tennant (1976) describes flows in the spring as being "good" at 40% of the mean annual flow, and "fair or degrading" at 30% of the mean annual flow. The "modified Tennant method" apportions the mean annual flow to fit the shape of the annual hydrograph; therefore, we can apply the monthly 50% exceedence unimpaired flow estimates from the Phase II report to this method. In applying this method (calculating 40% of the 50% exceedence unimpaired flow), we arrive at 1565 cfs, 1536 cfs, 1427 cfs, and 1075 cfs for March through June, respectively. These flows are almost identical to the Phase II recommendations for dry years in March and April, and within approximately 175 to 275 cfs in May and June. Had these flows been considerably different than the Phase II recommendations (e.g., several hundred cfs higher or lower), we would have reason for concern. However, the differences do not point out any obvious concerns. Rather, we believe these results provide some verification of the Phase II recommendations.

11.1.6.3 Third additional analysis

A third analysis involves comparing returns of adult salmon that have resulted from particular flow conditions. The Yurok Tribe (2001) compared adult fall chinook run estimates against the total volume of April through June flow releases from IGD that the fish would have experienced as fry and outmigrating smolts. The lowest April through June volume for which chinook salmon had high returns was 325,000 acre feet in 1985. Again, using chinook salmon as a surrogate for coho, we have evidence that this particular spring flow volume may not be limiting to coho production. (Coho were not specifically analyzed because the are no reliable run size estimates for coho in the Klamath River

Basin.) The April through June volume of IGD flows that would result from the Phase II recommendations in a dry year is 274,000 acre feet, which is approximately 84% of the 1985 volume. Thus, the volume difference between presumably favorable conditions and the Phase II recommendations does not lead us to believe that Phase II flows are necessarily unfavorable.

11.1.7 Consecutive-year low flows - spring

We then consider what effects we can reasonably expect if the Phase II minimum dry year flow recommendations were in place over the ten-year life of the proposed action. Since shorter intervals between deleterious events decrease the likelihood of small populations attaining a safe size (i.e, realizing adequate resiliency) (Soulé 1986), we need to consider what may happen if there are consecutive dry water year types.

As explained above, we believe that the Phase II dry year flow recommendations are close to drought conditions that are probably not favorable to coho salmon, but are probably not low enough to jeopardize the species in a single year. However, due to the risk faced by the extremely reduced coho population in the Klamath River, we do not believe it is wise to implement these flow recommendations for two or more consecutive years. "Drought conditions" two years in a row would mean that coho fry that survived difficult rearing conditions in one dry spring, would then be subject to presumably sub-optimal outmigration conditions in the following spring. Therefore, we believe it is prudent to recommend that a second consecutive "dry" water year use the 80% exceedence flow recommendations from the Phase II report. A third consecutive dry year would revert back to the 90% exceedence Phase II recommendation, and so on. We note that only once in the history of the Klamath Project have two consecutive dry (based on our five water year type classification) water years occurred–in 1991 and 1992.

11.1.8 Other beneficial adjustments

We also examined the Phase II recommendations to see whether other beneficial adjustments could be made without significantly altering the report's underlying methods or rationale. For example, we believe that there is merit in attempting to mimic the shape of the natural hydrograph as much as possible. While the Klamath Project's operational constraints limit its ability to mimic the random "flow spikes" of a typical annual hydrograph, it is possible to somewhat mimic the shape of an average annual hydrograph.

During March, coho fry numbers increase as they emerge from the gravel, and fry habitat therefore becomes more important as the month proceeds. We believe it is necessary to provide the maximum recommended March flows later in the month, and that lower flows at the beginning of March are appropriate. Therefore, we have divided March into four weekly flow recommendations. This also provides a gradual step up to the higher flows recommended in April, and more closely mimics the natural snow-melt hydrograph.

We have also divided June into four weekly flow recommendations. The total volume of water is partitioned to allow gradually diminishing flows, thereby more closely mimicking the declining limb of a more natural hydrograph. This serves to reserve more water for smolt outmigration early in June, closer to the peak of the migration period, and provides more habitat for fry before the majority make the transition to the juvenile stage by approximately mid-June. Additionally, under the July through September section below, available water temperature information and analyses are discussed. As during the summer period, potential trade-offs between physical habitat, mean daily water temperatures, and diurnal water temperature fluctuations have to be considered when setting minimum instream flows for late June. Dividing June into weekly flow recommendations better accommodates these temperature considerations and more closely mimics a natural hydrograph.

We also note that in dry water years, using the Phase II recommendation, flows would be "flat-lined" at 1600 CFS from the end of March through May, if no uncontrolled spill were to take place. We believe it is prudent to avoid this unnatural condition to the extent practicable. Although we agree with the concept, as described in Reclamation's BA (Reclamation 2002), that a pulse of flow in the spring would be beneficial to smolts, we believe that it would be more beneficial in May, closer to the peak of outmigration, than in April. Because we are recommending to "step up" to the Phase II March flows, some volume of water would be saved compared to the volume needed to meet the Phase II recommendations. This volume could then be used beneficially to provide a pulse flow in May. Therefore, we recommend that 5000 acre feet be reserved to provide a flow pulse during the first week of May in "dry" water years. This recommendation is not necessary in wetter years, because the Phase II recommendations do not create this "flat-line" condition in the spring, and because it is more likely that uncontrolled spill will take place in wetter years. We believe that this does not represent a significant departure from the methods and rationale of the Phase II report.

We also believe that March flows should not be based on the previous April's water year forecast. The flow recommendation for the first week of March should be based on the 70% exceedence forecast typically released on February 6, and the remaining March flow should be based on the March 6 estimate. This will avoid a situation, for example, in which a "wet" water year leading into a "dry" water year would see March flows as high as 5400 CFS and April flows dropping to 1600 CFS.

11.2 July through September

During this time of year, Klamath River mainstem temperatures typically become elevated above those considered optimal for coho salmon. In addition, water quality can be degraded and salmon and steelhead in the mainstem sometimes succumb to diseases that contribute to "fish kills."

The relationship between Project operations, water temperature and quality of Iron Gate Dam releases, and conditions that exacerbate fish disease mechanisms is complicated and not fully understood. For example, the water temperature modeling component of SIAM indicates that, over the course of the irrigation season (April through September), water temperatures in the mainstem are likely affected by differential Project operations and associated water releases at IGD. Specifically, results from the this water temperature model as applied in dryer years suggest that in general, the mean daily temperature of IGD releases are slightly higher during the summer under relatively high IGD flows. The same modeled scenarios also suggest that at Seiad Valley this trend is reversed and mean daily water temperatures are expected to be slightly lower. In both locations, maximum daily water temperatures predicted by the companion regression model are expected to be closer to the mean water temperatures. Although the water temperature model applied by Deas and Orlob (1999) indicates that the magnitude of diurnal water temperature fluctuations differ from IGD to Seiad Valley, this model also indicates that temperatures increase more in this mainstem reach under relatively low flow, and less under higher flows. This supports the general expectation that diurnal temperature fluctuations in the mainstem are higher under lower summer flows.

In addition to affecting the summer temperature regime in the mainstem, IGD releases can also affect “cooler” refuge areas (defined in the Effects of the Proposed Action section of this biological opinion), both those that have been identified (e.g., see Belchik 1997 and McIntosh and Li 1998) and those that have not. We suspect that affects to these thermal refuge areas are complicated and vary between individual refuges (e.g., tributary confluence areas), and are substantially affected by meteorological conditions and associated tributary flows and temperature regimes. In addition, the suitability of the potential fish habitats that exist in these areas are not solely a function of mean water temperatures, but also must provide appropriate water depth, velocity, cover, and should either provide adequate food resources or such resources should be available within close proximity. Again, based on the limited information available, NMFS finds that the extent to which the net “carrying capacity” of these refuge areas are enhanced or degraded by relatively high vs. relatively low IGD summer releases has not been studied and is unknown. Finally, based on the extremely low tributary accretions to the mainstem between IGD and Seiad Valley during the summer of 2001, it is clear that it is overly simplistic to assume that the net “benefits” of associated refuge areas decrease with any IGD flow increases relative to those experienced in other drought years.

Previously in this biological opinion, the recommendations for summer flows that resulted from associated studies were discussed as well as the flows that would likely result from Reclamation’s proposed action. Given the substantial uncertainty of the expected affects to coho salmon rearing habitat in the mainstem, NMFS finds that a relatively moderate amount of water should be released from IGD during summer periods pursuant to this RPA. In addition, NMFS finds that this RPA should include a recommendation for further study of the mainstem river under different summer IGD flow regimes. Accordingly, NMFS recommends that minimum flows of 1,000 CFS should be released from IGD during the July through September period in all water year types until a well-designed study of the mainstem and refuge areas is developed and implemented.

It is crucial that such a study be designed in coordination with all interests in the Klamath Basin, and the results must provide robust information and analyses that are considered to be scientifically meaningful and valid. We acknowledge that such a study may have to be repeated under a variety of meteorological conditions and perhaps over several years, and should include the entire practicable range of IGD releases. Because of the complexity of such an experiment, and the need to solicit input from a variety of scientists, NMFS does not find it prudent to include an explicit experimental protocol in this RPA. Rather, NMFS includes the recommendation in this RPA that Reclamation immediately facilitate the formation of a scientific panel to design and oversee implementation of a summer flow experiment.

The membership of the scientific panel convened to design a summer flow experiment in the Klamath River should be established consistent with a consensus agreement between designated representatives of Reclamation, NMFS, USFWS, BIA, the Yurok Tribe, the Hoopa Valley Tribe, the Karuk Tribe, CDFG, and the farming community. Absent such consensus, NMFS will consider the views of all the involved parties and establish the membership of the summer flow study scientific panel.

The specifics of the study design and implementation details should be consistent with a consensus agreement of the scientific panel. Absent such consensus, NMFS will consider the views of all scientific panel members and establish these details. In turn, Reclamation will provide for the funding and implementation of this study. In the event that Reclamation is unable or unwilling to provide for implementation of this study, this RPA recommends that minimum July through September flows remain at 1,000 CFS, regardless of water year type, until such time as the previously mentioned study design process has occurred and Reclamation is prepared to facilitate implementation.

Should the scientific findings from the above described study warrant establishment of alternative minimum summer IGD flows, ESA section 7 consultation between NMFS and Reclamation shall be reinitiated. In lieu of such reinitiation, the minimum flow recommendation included in this RPA will remain at 1,000 CFS for all July through September periods following the completion of the scientific study described above.

11.3 October through February

During this time of year, adult coho salmon enter the Klamath River and begin their spawning migration. As previously discussed in this biological opinion, adequate passage conditions must be provided in the mainstem and depending on meteorological conditions, IGD releases may affect passage conditions along the length of the river. Regardless of meteorological conditions, IGD releases heavily influence passage and spawning conditions immediately downstream of IGD, and may influence passage conditions from the mainstem into individual tributaries where most coho salmon spawning occurs.

For wet, above average, and average water year types, NMFS finds that the IGD flows that are likely to result from implementation of the proposed action are sufficient and appropriate. In summary, the FERC minimum flow regime for this time period (1,300 CFS) was based on limited measurements and observations by biologists, and the draft Phase II Flow Study Report similarly found that fall chinook spawning habitat would be adequate in the IGD to Shasta River reach under this IGD discharge. NMFS assumes that mainstem passage, tributary access, and spawning habitat for coho salmon will also be adequate under this IGD flow regime.

During below average and dry water year types, the amount and timing of increased IGD releases (relative to the previous September flows) should be considered in the context of real-time water supply information, meteorological conditions, and adult salmon migration observations. Accordingly, NMFS now includes the recommendation for interagency and intergovernmental coordination during mid-September of any below average and dry water years. In addition to careful consideration of "real-time" data, this approach would allow for a rational transition for the end of a dryer year to the beginning of an unknown water year type.

Specifically, NMFS recommends in this RPA that no later than mid-September at the end of any below average or dry water year, Reclamation convene a group of representatives of Reclamation, NMFS, USFWS, BIA, CDFG, the Yurok Tribe, the Karuk Tribe, the Hoopa Valley Tribe, and the farming community to discuss current hydrologic, meteorologic, and biological conditions and seek consensus on IGD flow changes for the October through January time period. Although NMFS envisions that 1,300 CFS IGD releases should be the "starting point" for such discussions, NMFS also acknowledges that alternative IGD flows may be appropriate during the transition from the end of a below average or dry water year to an unknown year. Should the group convened by Reclamation for this purpose fail to reach consensus on fall and winter flows under these conditions, NMFS will consider the views of all of the group's members and establish a formal recommendation for the October through January period, and this recommendation will explicitly become part of this RPA. NMFS also anticipates that additional meetings of this group may be appropriate to consider additional information as it becomes available. At the end of the January period, new water supply forecasts available in early February will help guide IGD flow decisions associated with the next operations year as outlined in the "March through June" section of this RPA.

<table>
<tr><th rowspan="2">Month</th><th colspan="6">Iron Gate Dam Discharge By Water Year Type</th></tr>
<tr><th>Dry</th><th>Second consecutive Dry</th><th>Below Average</th><th>Average</th><th>Above Average</th><th>Wet</th></tr>
<tr><td>October</td><td>1,300*</td><td>1,300*</td><td>1,300*</td><td>1,300</td><td>1,300</td><td>1,300</td></tr>
<tr><td>November</td><td>1,300*</td><td>1,300*</td><td>1,300*</td><td>1,300</td><td>1,300</td><td>1,300</td></tr>
<tr><td>December</td><td>1,300*</td><td>1,300*</td><td>1,300*</td><td>1,300</td><td>1,300</td><td>1,300</td></tr>
<tr><td>January</td><td>1,300*</td><td>1,300*</td><td>1,300*</td><td>1,300</td><td>1,300</td><td>1,300</td></tr>
<tr><td>February</td><td>1,300*</td><td>1,300*</td><td>1,300*</td><td>1,300</td><td>1,300</td><td>1,300</td></tr>
<tr><td>March 1 - 7</td><td>1,300</td><td>1,500</td><td>1,800</td><td>2,800</td><td>3,400</td><td>4,200</td></tr>
<tr><td>March 8 - 16</td><td>1,400</td><td>1,600</td><td>2,000</td><td>3,000</td><td>3,700</td><td>4,600</td></tr>
<tr><td>March 17 - 24</td><td>1,500</td><td>1,800</td><td>2,200</td><td>3,200</td><td>4,000</td><td>5,000</td></tr>
<tr><td>March 25 - 31</td><td>1,600</td><td>2,000</td><td>2,400</td><td>3,400</td><td>4,300</td><td>5,400</td></tr>
<tr><td>April</td><td>1,600</td><td>1,900</td><td>2,200</td><td>3,300</td><td>4,100</td><td>5,200</td></tr>
<tr><td>May 1 - 8</td><td>1,925</td><td>2,175</td><td rowspan="2">2,100</td><td rowspan="2">3,100</td><td rowspan="2">3,700</td><td rowspan="2">4,500</td></tr>
<tr><td>May 9 - 31</td><td>1,600</td><td>1,850</td></tr>
<tr><td>June 1 - 7</td><td>1,600</td><td>1,850</td><td>2,100</td><td>2,700</td><td>3,500</td><td>4,500</td></tr>
<tr><td>June 8 - 16</td><td>1,400</td><td>1,700</td><td>1,900</td><td>2,500</td><td>3,200</td><td>4,000</td></tr>
<tr><td>June 17 - 24</td><td>1,300</td><td>1,550</td><td>1,700</td><td>2,200</td><td>2,700</td><td>3,600</td></tr>
<tr><td>June 25 - 30</td><td>1,100</td><td>1,200</td><td>1,500</td><td>1,800</td><td>2,200</td><td>3,100</td></tr>
</table>

July	1,000	1,000	1,000	1,000	1,000	1,000
August	1,000	1,000	1,000	1,000	1,000	1,000
September	1,000	1,000	1,000	1,000	1,000	1,000

* Convene team

11.4 Ramping Rates

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.

11.5 Additional Coordination

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, it 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" exceedence 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. 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.

11.6 Notification

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.

12. INCIDENTAL TAKE STATEMENT (Needs additional work)

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 minimally predictable, would have an impact that is not precisely known, and by extension, the impact to an unknown 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 operation 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 this 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 includes providing for more conservative ramping rates that may or may not be implemented at IGD. It is impossible to determine what actual down ramping rates will be implemented, and therefore it is impossible to even roughly estimate the potential for stranding of coho salmon and potential take. 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. Provided that conservative down ramping rates of IGD releases are realized, NMFS expects that low levels of coho salmon stranding will occur and consequently this risk would not pose jeopardy to the species.

12.1 Reasonable and Prudent Measures

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.

12.2 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 nondiscretionary. 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, identified opportunities with regard to water supplies, and current scoping of implementation strategies. This report will be provided to NMFS by February 1 of each year covered by this biological opinion.

13. 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.

14. 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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Add tables/figures