Biological Opinion

Klamath Project Operations

[April 17, 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 its review of the Bureau of Reclamation's (Reclamation) proposed operation of the Klamath Project (Project), and the project's effects on the southern Oregon/northern California coast (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 Reclamation's February 25, 2002, biological assessment (BA); published literature and reports including the National Research Council's (2002) Interim Report "Scientific Evaluation of Biological Opinions and Endangered and Threatened Fishes in the Klamath River Basin," and Hardy and Addley's (2001) "Evaluation of Interim Instream Flow needs in the Klamath River - Phase II Final Report;" 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, based on the best scientific and commercial data available, whether the proposed operation of the Klamath Project is likely to jeopardize the continued existence of threatened SONCC coho salmon or result in the destruction or adverse modification of habitat of SONCC coho salmon which has been determined by the Secretary to be critical. National Marine Fisheries Service's analysis of the effects of the proposed action on SONCC coho salmon and its critical habitat and NMFS' conclusions resulting from that analysis are presented in this document.

On February 27, 2002, Reclamation requested formal consultation pursuant to section 7 of the ESA on the effects on SONCC coho salmon from proposed Klamath Project operations between April 1, 2002 and March 31, 2012. Since SONCC coho salmon were listed by NMFS in 1997, NMFS has advised Reclamation to develop a multi-year Klamath Project proposal to both assist Reclamation in meeting its section 7(a)(2) obligations and provide more certainty in Klamath Project operational plans. While NMFS' is pleased that Reclamation is proposing a multi-year plan, it notes that relevant information regarding the Klamath Project and coho salmon in the Klamath River is being developed that would aid in its analysis of the proposal. Within a year, NMFS anticipates that the NRC will finalize another report that takes a broader approach to evaluation of evidence for long-term requirements of the threatened and endangered fishes of the Klamath Basin. Likewise, Dr. Thomas Hardy and associates are expected to finalize their analysis of flow-habitat relationships in the mainstem Klamath River below Iron Gate Dam (IGD) and refine their instream flow recommendations. When these reports are available NMFS will review them and determine whether they contain substantial new information not considered in this opinion and determine whether consultation on the 10 year plan should be reinitiated.

Reclamation has not initiated consultation on the potential adverse affects of proposed Klamath Project operations between April 1, 2002 and March 31, 2002 on Essential Fish Habitat (EFH), pursuant to the Magnuson-Stevens Fishery conservation and Management Act, as amended (U.S.C cite ?). Nevertheless, NMFS will use Reclamation's BA and the body of information considered in this opinion as the basis for developing EFH recommendations for SONCC coho salmon ESU, Upper Klamath-Trinity Rivers chinook salmon ESU and SONCC chinook salmon ESU. NMFS' EFH recommendations are appended to 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 request for formal consultation under the ESA, it arrived late in the water year and and little flexibility remained to modify the plan. Therefore, formal consultation was defered for 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).

On March 27, 2002, NMFS received a letter from Reclamation regarding its proposed operation of the Klamath Project for the period between April 1 and May 31, 2002 only. In the letter, Reclamation proposed to operate the project consistent with proposed operations for a "below average water year"as described in its February 2002 BA and requested that NMFS concur with Reclamation's determination that the proposed operation of the project during that period would not likely adversely affect coho salmon. In a letter to Reclamation on March 28, 2002, NMFS concurred with Reclamation's "not likely to adversely affect" determination for April through May 2002 time period. Our letter also stated that, "this concurrence for April and May 2002, does not preclude NMFS from arriving at a different conclusion for below average year operations in its biological opinion, which it expects to complete by June 1, 2002, based on the best scientific data available at the time."

3. BACKGROUND

The Project is located in southern Oregon and northern California 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 the quantity, quality and timing of water available for release from IGD during much 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 recommendation for flows to address interests in the Klamath River below IGD. Ongoing data collection and analysis are expected to provide 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 use precipitated a number of events. These events include 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 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.

The NRC Committee on Threatened and Endangered Fishes in the Klamath River Basin (Committee) reviewed Reclamation's biological assessment (2001) and the NMFS biological opinion of 2001 regarding the effects of Klamath Project operations on coho salmon (NRC 2002a). In that review, they completed a preliminary assessment of the scientific information used by the agencies and other relevant scientific information, and they considered the degree to which the biological assessment and biological opinion were supported by that information. The Committee did not find scientific support for NMFS' proposed minimum flows as a means of enhancing the maintenance and recovery of the coho population. However, the Committee noted that progressive depletions of flows in the Klamath River mainstem would at some point be detrimental to coho salmon through stranding or predation losses. Thus, incremental depletions beyond those that are reflected in the recent historical record could be accomplished only with increased risk to salmon. The proposal put forth by Reclamation in its 2001 biological assessment could lead to more extreme suppression of flows than has been seen in the past and cannot be justified either. The Committee concluded that on the whole, there is no convincing scientific justification at present for deviation from flows derived from operational practices in place between 1990 and 2000.

The Committee's conclusion stands in contrast to the conclusions of the Hardy Phase I (1999), which was considered by the Committee, and Hardy and Addley Phase II (2001) reports which suggest increased flows would aid restoration and the maintenance of aquatic resources within the mainstem of the Klamath River.

Hardy Phase I (1999) provides interim minimum flow recommendations to address minimum instream flows required to support ecological needs of aquatic resources, particularly anadromous fish species, in the Klamath Basin. Subsequently, Hardy and Addley (2001) refined those flow recommendations to address variable hydrologic conditions in the Basin. They state, "These flow recommendations are necessary to aid restoration efforts and the maintenance of the aquatic resources within the main stem Klamath River in light of the Department of Interior's trust responsibility to protect tribal rights and resources as well as other statutory responsibilities, such as the Endangered Species Act."

Hardy and Addley (2001) recognize that many other factors within the Klamath Basin such as appropriate flow regimes in the tributary systems, and a variety of land-use related restoration efforts will be required before successful restoration can be achieved, but restoration of Klamath River flows is an important first step. Hardy and Addley's conclusions are consistent with NRC's prepublication report "Riparian Areas: Functions and Strategies for Management"(NRC 2002b). Although that report addresses the value of riparian habitat broadly, it does recognize as do Hardy and Addley (2001) that maintaining biodiversity is one of the most important functions of riparian areas and is the basis for many valued fisheries, in addition to bird and other wildlife.

The NRC recognizes in its report on riparian habitat that there are also situations where permanent changes in hydrologic disturbance regimes (e.g. dams), natural processes (e.g. global climate change), channel and floodplain morphology (e.g. channel incision), and other impacts (e.g. extirpation of species, biotic invasions) may preclude recovery to the composition and functions that previously existed. Nevertheless, even in such situations, there are often opportunities to effect significant ecological improvement of riparian areas and to restore, at least in part, many of the functions riparian areas formerly performed. Hardy and Addley (2001) recognize that the Klamath River hydrograph has been altered substantially by water development in the upper Klamath Basin and in tributary basins, such as the Shasta and Scott valleys. Their report presents recommendations, based on their estimates of water availability, that would restore the shape of the natural hydrograph and thereby begin to recreate hydrolic conditions that are more natural to the lower Klamath Basin. Hardy and Addley assert that the native fish community, including threatened coho salmon, would benefit from restoration of these conditions.

While the NRC Committee on Endangered and Threatened Fishes in the Klamath River Basin recognized that in fact changes in the flow regime in th Klamath River may affect other fishes that have been proposed for listing as threatened species but are not yet listed (e.g. ESUs of steelhead and chinook salmon, they restricted their analysis to only the biological assessment and opinion on the affects of the Project on coho. While they did not dispute that coho might benefit from restoration of the normal hydrograph, they state that although modeling habitat may be useful, convincing evidence of a relationship between the welfare of coho and environmental conditions must be drawn to some extent from direct observations. For example, year class strength, abundance of various life history stages, or other biological indicators of success, when related to specific flow conditions, would greatly improve the utility of modeling and other information.

NRC on the one hand has apparently embraced the principles relied on by Hardy and Addley (2001) in recommending flows to restore the shape of the normal hydrograph in the Klamath River and on the other, concluded that there is no convincing scientific justification at present to demonstrate that coho salmon would benefit from such a deviation in flows relative to the flows derived from operational practices in place between 1990 and 2000. The NRC also recognizes that given the small size and scattered nature of the present native coho population collection of such information will be difficult. NMFS would add that it will take several coho live cycles (i.e., a decade or more) to demonstrate such relationships with scientific rigor.

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 (i.e., "the precautionary approach").
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> 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...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)).

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 size of a water bank by calculating the difference in Project water supply between proposed operations (Step 3) and preliminary calculations (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 through 4 appear to be new to Project operation planning. In Steps 2 and 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 difference between Step 2 and Step 3 for river flows for above average, below average, and dry water year types. 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.

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 contradictory information regarding the IGD flows expected to occur from Reclamation's proposed action, NMFS concludes that Reclamation is proposing to use the specific operating criteria described above (Steps 1 through 4) to assist in the estimation of the annual water supply that would be available for irrigation and refuge delivers. Reclamation would use Step 3 to establish targets, as opposed to minimum standards, for minimum river flows and lake levels for planning purposes only. For instance, given use of a 70 percent exceedence forecast, less water than forecast will be available on average 30 percent of the time. If contractual obligations have first priority, then operating targets for river flows or lake levels may not be met in years when realized hydrology turns out to be less than forecasted on April 1. During those years when less water will be available, Reclamation is also unable to predict how much less actual IGD flows might be compared to the expected flows described in Table 5.9 (pers. comm. B. Davis, Bureau of Reclamation, April 9, 2002).

For the purpose of its analysis of Project effects on coho salmon in this biological opinion, NMFS assumes 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 effects to coho if actual IGD flows are lower than those reported in Table 5.9 because Reclamation is unable to quantify the extent of the potential short fall at this time (pers. comm. B. Davis, Bureau of Reclamation, April 2002).

The Bureau anticipates annual water bank will requirements of up to 100,000 acre feet, depending on year type. Although the mechanism for establishing a bank is not specified, the Bureau believes several sources, including offstream storage, irrigation, demand reduction, and groundwater hold promise and may aid in establishing the water bank. Offstream storage opportunities Agency Lake Ranch, Lower Klamath area lands, and winter storage in the Tule Lake area. Irrigation demand reduction,would involve compensating farmers to idel their lands in any given year. Ground water conjunctive use will involve use of wells to supplement surface supplies.

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.

Moreover, given the amount of time necessary to develop new water supplies, actual increases in available water supplies for either Project purposes or fish and wildlife enhancement will not be realized for several to many years from now.

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

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

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."
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> Brown and Moyle (1991) estimated that naturally-spawned adult coho salmon returning to California streams in the late 1980's 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.
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> 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 and Distribution 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 main purpose of determining fall chinook salmon escapement. Most observations of adult coho salmon occur at weir, hatchery and tribal fishery 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 coho spawning is known to extend later into the season than the chinook spawning. Spawning and carcass surveys have been conducted in both tributaries and the mainstem Klamath River. However, these surveys have generally been incomplete and been conducted on an inconsistent basis due to the constraints of funding these efforts, and working in high flows.

The sampling of juvenile coho salmon occurs in the Klamath River and selected tributaries. While adult and juvenile counts are valuable for documenting the presence or absence of coho salmon in specific areas during key time periods, they have limited value for determining exact population abundance. However, these counts provide an indication of the low abundance and precarious status of coho salmon populations in the Klamath River Basin.

Coho salmon occur in the mainstem Klamath River year round, and coho also inhabit a number of Klamath tributaries (Henriksen 1995; INSE 1999;Yurok Tribe 2001).

- Between IGD and Seiad Valley, coho salmon populations are believed to occur in Bogus Creek, Shasta River, Humbug Creek, Empire Creek, Beaver Creek, Horse Creek, and Scott River.

- Between Seiad Valley and Orleans, 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.

- 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.

6.4.1 Adult Data

Adult coho salmon are enumerated at the Iron Gate and Trinity River Hatcheries and the Trinity River weir at Willow Creek, providing information on the relative abundance of fish returning to these locations (Table 1) (the Willow Creek weir estimates total adult hatchery vs. natural coho escapement to the Trinity River above Willow Creek. 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 1. Adult Coho Salmon counted at Trinity River weir at Willow Creek 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 currently operated on Bogus Creek and the Shasta River. Previously, weirs were operated on the Scott and Salmon Rivers. In addition, coho salmon are marked at the Willow Creek weir in the Trinity River and recaptured at the Trinity River Hatchery so that a mark and recapture methodology can be use to estimate the population abundance. 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 2). 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 (in the past, the weir has usually been pulled by the end of the second week of November), and it is likely more adult coho salmon entered the Shasta River following that date. Video observations at the weir in 2001 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 (there is no hatchery on the Shasta River). 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 2. 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 relatively greater abundance of adult coho salmon observed at the Shasta River rack in 2001, these data suggest a decline in the status of Shasta River coho salmon during the decade of the 1990s.

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 the 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). Again, coho salmon appear to have declined further in the Scott River basin during the 1990s. Coho salmon were observed in the Scott River during the 1991-1999 period as early as September 21.

The mark/recapture method used to estimate coho abundance in the Trinity River above the Willow Creek weir more accurately reflects population abundance, rather than just a representation of fish counted during a portion of the run. 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 chinook salmon spawning and carcass surveys in the Klamath Basin. For example in 2001: six redds with adult coho salmon holding nearby were observed in the mainstem of the Klamath River between IGD and Interstate 5 (USFWS unpublished data 2002).

6.4.2 Juvenile Data

The USFWS operates downstream juvenile migrant traps on the mainstem Klamath and Trinity rivers. Again, the incomplete trapping record and lack of a quantified emigration estimate provides limited information in terms of abundance or trends, but do indicate the presence of coho salmon at different life stages during certain times of the year. Based on abundance indices developed for juvenile coho salmon, the traps caught 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 were much lower (Tables 3 and 4) These low numbers do provide an indication of the depressed status 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 the time when trapping did not occur, NMFS thinks the low number of smolts is another indication that the abundance of wild coho salmon in the Klamath River is extremely low.

Table 3. 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 an 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 4 Hatchery and wild juvenile (smolts, young-of-year) coho salmon captured at the Willow Creek 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

Between May and November 2001, the USFWS and other cooperators conducted weekly direct-observation counting of fish occurring at various tributary confluences along the mainstem Klamath River while the mainstem flow was 1,000 cubic feet per second (CFS). 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 was 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 some tributary confluence areas and Klamath tributaries when water temperatures are higher than some believe coho can tolerate and when IGD river flow is 1,000 CFS.

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 late July. Hardy and Addley (2001) compiled life stage periodicities for coho salmon in the mainstem Klamath that showed coho fry are present in the IGD to Scott River and Salmon River to Trinity River reaches of the mainstem Klamath River from

February through June and in the Scott River to Salmon River reach of the mainstem Klamath River from February through May; coho juveniles were found to be in the entire mainstem in all months of the year. 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 2001 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 in the Klamath River estuary (CDFG unpublished data).

Additionally, between March 13 and April 12, 2002, the USFWS rotary trap and fyke net trap on the mainstem Klamath River 0.7 miles above Highway I-5 captured nine and 848 coho fry, respectively. During the same period, their rotary trap and fyke net trap on the mainstem Klamath River just below Bogus Creek captured ten and 762 coho fry, respectively.

In summary, information on coho salmon population status or trends in the Klamath River Basin is incomplete, but what information exists suggests that adult abundance is extremely low and has been declining for most of the past two decades. 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 limited natural production. The apparent declines in production suggest that the natural population may not be self-sustaining (May 6, 1997, 62 FR 24588). These declines in natural production are 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. Poor survival of coho fry and juveniles in the mainstem Klamath River, as indicated by upriver versus downriver trapping results, suggests that degraded mainstem rearing habitat is limiting coho production. Existing information also indicates that adult coho salmon are present in the mainstem Klamath River from early September through January 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 until such time as a Recovery Team is convened to address whether additional habitat is necessary to recover coho salmon.

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 (May 6, 1997, 62 FR 24588). 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 may preclude recovery cannot be determined without extensive studies; however, the Yurok Tribe (2001) recently published a report indicating that 2-3% of the fall-chinook run was taken by California sea lions in the Klamath River estuary during 1998 and 1999. Coho predation rates may be lower if early winter precipitation causes higher flows during coho inmigration periods.

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.

Artificial propagation may also have been a factor in the decline of coho salmon in California although the degree of impact is unknown. The State of California operates two hatcheries in the Klamath Basin, Iron Gate Hatchery on the Klamath and Trinity River Hatchery on the Trinity. Both facilities were constructed to mitigate for lost habitat upstream due to dam construction and are currently operated in a manner minimizing impacts on naturally spawning fish and using very strict production constraints not to exceed their mitigation goals. Although the biological assessment (Reclamation 2002) indicates that few natural coho salmon remain in the tributaries and that tributary coho populations are dominated by hatchery production, it does not provide any evidence to support this conclusion. According to CDFG, all Trinity River and Iron Gate Hatchery coho production has been marked (maxillary clip) every year since 1996. None of the 57 coho spawner carcasses examined during spawner surveys conducted in the Scott River Basin during December 2000 and 2001 bore any hatchery marks. Preliminary 2001 data from adult coho surveys on the Shasta River using a video camera at the Shasta racks, counts of spawned-out fish that washed back to the racks and carcass surveys in the Shasta River found only six adults out of a total of 291 that were of hatchery origin (i.e., Iron Gate Hatchery). These data suggest that Klamath Basin tributary coho populations are relatively free of hatchery influence and that hatchery coho stray very little during adult spawning runs.

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 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 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.

Klamath Project operations and associated activities have occurred for nearly 100 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. 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, large-scale commercial mining operations have been eliminated 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 late spring and summer monthly flows, an increase in average winter flows and alteration of the natural seasonal variation of flows due to reduced natural water storage and to meet peak power and diversion demands (Hecht and Kamman 1996).

The Copco 1 and 2 hydropower 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-Klamath 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; (2) the timing of peak and low flows changed significantly after construction of the Project; and (3) 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 in the Shasta River, and the water quality in Lake Shastina reservoir deteriorated as a result of elevated water temperatures, increased algae growth, and decreased dissolved oxygen levels. Nutrient sources in the Basin are from agricultural, urban, and suburban land use. The Dam also prevented spawning gravel recruitment into the downstream River reach.

The Shasta and Scott rivers historically supported strong populations of chinook salmon, coho salmon, and summer-run steelhead (KRBFTF 1991). By the 1960s, CDFG noted that diversion dams denied fish migration passage over numerous diversion dams in the Shasta River Basin. While natural low water conditions can be unfavorable to salmonids, the problem is exacerbated by numerous water diversions. In 1980, the Superior Court of Siskiyou County issued the Scott River Adjudication which appropriated legal water rights in the Scott River Basin. Appropriated water rights in the Shasta River Basin were adjudicated in 1932 by the Superior Court of Siskiyou County. These adjudications have not resulted in minimum instream flows sufficient to conserve salmon in either the Scott or Shasta Rivers and water rights are probably “over allocated” in both basins. Seasonal withdrawals in both basins are not sufficiently managed and sometimes simultaneous water withdrawals result in instream flows dropping 100 cfs or more within a 24-hour period at the start of the irrigation season in late-March and early-April. Because many water divisions in the Scott and Shasta have no gages to control and measure water removals, enforcement of existing water rights is difficult. Gages need to be installed on screened diversions, and unscreened diversions need to be screened, to facilitate State enforcement of over-withdrawal violations.

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 remain 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. The Tribes' rights include the right to certain conditions of water quality and flow to support all life stages of fish. (Solicitor's Opinion 1995). The tribes' water rights may have a priority date as early as 1855 and the Yurok Tribe's water right might extend to time immemorial.

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 factor in the decline of coho salmon. This included 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 naturally-produced coho salmon has been prohibited in marine fisheries south of Cape Falcon, Oregon. For the last few years, retention of marked hatchery fish has been allowed off the coast of Oregon. Naturally-produced coho salmon are still impacted, however, as a result of hook-and-release mortality in chinook salmon-directed fisheries fisheries and selective coho fisheries off the coasts of Oregon and Washington. 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.

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 harvest rates in the Yurok Tribal fishery on Klamath Basin coho salmon averaged less than 4.3 % between 1992-2000 (pers. comm., D. Hillemeier, April 2002). There are no tribal fisheries on coho salmon populations in the Rogue, Smith, Eel, or Mattole rivers.

7.6 Hatchery Programs

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. The only out-of-basin transfers of coho salmon to Iron Gate Hatchery occurred in 1966-1968 with Cascade stock (pers. comm. CDFG, April 2002). Out-of-basin transfers to Iron Gate Hatchery have not occurred since 1968. Thus, the frequency and magnitude of out-of-basin plants and transfers in this ESU appears to have been relatively low (Weitkamp et al. 1995).

Although interbasin transfers have ceased, the proportion of hatchery fish in the Klamath Basin remains high. Approximately 90 percent of the Klamath-Trinity basin coho salmon are of hatchery origin (Brown et al.1994). Recent information from the CDFG suggests that 95% of the coho run in the Trinity River above Willow Creek and about 65% of the coho run in the Klamath River above Weitchipek consists of hatchery origin fish (pers. comm., CDFG April 2002).
In the absence of hatchery reforms to address potential genetic issues, the fitness of the wild population may be affected.

The majority of hatchery fish produced in the Iron Gate Dam hatchery and Trinity River hatchery is chinook salmon. Release of large numbers of hatchery chinook into the Klamath Basin has the potential to increase inter-specific competition for resources which could affect survival of young-of-year coho.

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.

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) provides a refined estimate of unimpaired monthly mean flows at the IGD 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 as a basis for examining effects of the proposed action in the Affects of the Action section of this biological opinion.

The most recently updated unimpaired 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, “monthly 70% exceedence flow” means that 70% of the flows recorded for the given month have been greater than the stated flow, and 30% 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 unimpaired flow estimates as defined in the draft Phase II report (Hardy and Addley 2001) and other information that are provided in the 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 that were in the Klamath Basin 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:

- 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 undoubtedly decreased the production capacity of the basin.

- Water development in the Klamath Basin has altered the hydrology, and the magnitude and timing of water flows has dramatically changed in the Trinity, Klamath, Shasta, and Scott rivers. Agricultural activities associated with Klamath Basin diversions have also contributed to increased nutrient loading. Undoubtedly 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 capture during non-tribal ocean salmon harvest activities have contributed to the decline of SONCC coho salmon. Capture rates for coho salmon have been reduced from a high of 80 percent to 5 percent in recent years in non-tribal chinook salmon fisheries. Only incidental “hook-and-release” mortality continues in ocean salmon fisheries directed at chinook salmon. 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.

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. 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 (i.e., the “jeopardy” standard identified in 50 CFR § 402.02).

Table 5 below represents IGD flows, by time step, (values in CFS) Reclamation predicted to result from the proposed action by water year type (from Table 5.9, Reclamation 2002):

Table 5

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

8.1 Analysis Approach

Mainstem conditions directly affect tributary coho populations by providing adequate passage conditions for adults into tributaries, by facilitating movement of juveniles into and between tributaries, by providing rearing habitat for fry and juveniles, and by providing adequate conditions for coho smolts as they emigrate from tributaries and migrate to the sea. Although NMFS thinks that recovery of the Klamath Basin coho salmon population depends on improving conditions in Lower Klamath Basin tributaries, efforts to improve habitat conditions in these tributaries will take several years to decades to be realized. As described in the Environmental Baseline section of this biological opinion, habitat in many of the tributaries is degraded from various land-use practices. As a result, young-of-year coho move into the mainstem to avoid these adverse conditions, especially in critically dry and dry water years when instream flows are exceedingly low in some of the tributaries. NMFS must consider whether conditions resulting from the proposed action are adequate to provide immediate conditions that will allow coho salmon populations to maintain themselves until tributary conditions are adequate to support their recovery. Until Klamath Basin tributary habitat is restored, mainstem rearing habitat will be more important than it otherwise might be and NMFS will consider adverse effects to mainstem rearing habitat as a risk factor.

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. However, NMFS is unaware of specific, quantitative estimates of coho salmon habitat requirements in the mainstem Klamath River necessary to maintain the species. Therefore, we do not have a specific “target” that must be met to determine the precise point at which jeopardy to the species occurs. As a result, NMFS must develop an alternative analysis approach for evaluating whether the project is likely to jeopardize the continued existence of SONCC coho salmon.

For purpose of clarity within this document, the term “reference period” will refer to the historical period, water year 1990 through water year 1999, used for reference in Reclamation’s Biological Assessment (2002), which appears to be Reclamation’s interpretation of the NRC Committee’s reference to recent historical record. This will distinguish the term “reference period” from the term “historical period of record” which is typically defined as water years 1961 to 1997.

The NRC Committee concluded that there is no convincing scientific justification for deviating from the flows derived from the operational practices in place between 1990 and 2000. They also observed that incremental depletions beyond those that are reflected in the recent historical record could be accomplished only with increased risk to coho salmon. Therefore, NMFS investigated the difference in operations between what was observed during the reference period and the operations proposed for the ten year period April 1, 2002, and March 31, 2012, to determine whether any additional incremental depletions in Klamath River Flow might be expected. NMFS then considered the expected effects of the proposed operations on coho salmon and their habitat. Results of both steps were used to determine whether or not the proposed action was likely to jeopardize the survival and recovery of threatened SONCC coho salmon.

8.2. Effect of Reclamation's Proposed Operations on Reference Period Flows

Reclamation proposes to manage the project operations so that they stay within the range of minimum and maximum lake level and river flow values, being careful not to let the average creep down. To determine whether Reclamation's proposal would likely stay within the historic range of minimum and maximum flows at IGD that occurred during the reference period, NMFS calculated the difference in mean monthly flows for the reference period and those likely to occur under Reclamations flows for the months of March through June. NMFS selected the spring months for this analysis because they are the months when coho fry are emerging and redistributing themselves throughout the watershed as they search for suitable rearing habitat, and when juvenile coho are smolting and migrating to sea. smolts moving downstream must find suitable temperature, flow, and habitat conditions compatible with their physiological transformation during migration (Wedemeyer et al. 1980 cited in NRC 2002a). This is especially applicable to the mainstem because all of the smolts from the entire river basin must use the mainstem to get to the ocean. The summer months were excluded because of the temperature problems that exist in the mainstem in the summer and the lack of empirical data to determine whether a decrease in mean flows in summer months would be adverse or not. Fall and winter flow are for the most part dominated by uncontrolled releases so they were not compared in the analysis.

For this comparison, NMFS calculated the mean monthly flows for the period of reference. NMFS then calculated mean monthly flows that would occur if Reclamation were to meet the flows identified in Table 5.9 of their BA (Reclamation 2002, see Table 5 above) over a ten year period in which the distribution of water year types was identical to the distribution of water year types that occurred during the reference period (i.e. six above average years, one below average year, one dry year, and two critically dry years. The results of this comparison are contained in Table 6 and demonstrate a reduction in the volume derived from the 10 year mean flows of about 250,000 acre feet.

Table 6. Comparison of monthly mean flows for the ten year reference period with a calculated 10 year based on Reclamation's proposed management regime, assuming the same frequency of water year types as occurred during the reference period.

Month	10 year mean 1990 - 1999 flows (CFS)	Predicted BR 10 year mean Flows (CFS)	Difference (CFS)	Volume (Acre Feet)
March	3361	1764	1597	98196
April	2817	1810	1007	59922
May	2311	1415	896	55094
June	1422	802	620	36894
Total Volume				250,106

The reason for this difference is apparent when the steps for developing an annual operations plan are reviewed (see description of the proposed action). Rather than establishing a conservative planning target (10-year mean for the reference period), Reclamation has calculated the mean and minimum flows that occurred during the reference period and then established a planning target for each water year type. In above average and below average years, Reclamation will estimate available supply (step 2) and proposed water supply (step 3) based on daily average river flows no lower than the minimums or FERC flows which ever are greater. There is only one dry year in the reference period so there is no difference between the minimum and mean for that year. Therefore, the only water year type for which Reclamation will use the mean flows for planning purposes are critically dry years. The difference between minimum and mean in critically dry years are small, so there is little benefit in preventing the average from creeping down. If minimums during the reference period are used for planning targets, rather than the mean, then the mean will decline over time.

NMFS also used Reclamation's approach of calculating means for each water year type with in the reference period. The mean monthly flows were converted to volumes and these volumes were compared to the volumes in Spring flow expected to result from the proposed action for each water year type (Table 7). This demonstrates a difference of nearly 440,000 acre feet in above average years. The reason there is no difference between historical and expected flows in below normal water years is that there is only one below normal water year in the reference period therefor the historical mean and operational target of the minimum are the same. The differences between the historical and expected flows in dry and critically dry year is the 10,000 acre foot pulse flow proposed for April.

Table 7 Volume differences between the Bureau's proposal and mean flows by water year type within the reference period 1990 to 1999.

Water year type	difference between Bureau's proposal and the average during the 10 reference period, 1990 to 1999
Above Average	- 422,000 acre feet
Below average	0
Dry	10,000 acre feet pulse flow
Critically Dry	10,000 acre feet pulse flow

While Reclamation states in its BA that it must be careful not to let the mean creep down, it has developed a planning methodology that will drive the mean down and it included no mechanisms to ensure the mean does not decline. This problem is exacerbated even further by the fact that the flows expected to result from the proposed project are only planning targets and not minimum operating rules. In addition, Reclamation uses a 70 percent exceedence forecast in its project planning. This means that, on average, less water than forecast will be available in 30 percent of the years. If firm commitments for water delivery are made on April 1 and then a water year develops that is dryer than forecast the Project will compensate for the difference between its commitments for delivers and expected flows by either reducing flow, reducing lake levels, or operating the water bank. If flows were reduced the mean would decline even further than predicted above.

Based on this analysis, NMFS expects that the proposed action is likely to result in incremental depletions in flows over the course of the period April 1, 2002 to March 31, 2012, and that will result in increased risk to the continued existence of threatened coho salmon in the Klamath River.

8.3 Expected Effects of the Proposed Operations on Coho Salmon and their Habitat

8.3.1 March through June - Coho fry and juveniles

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 March through June. 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.

In their biological assessment (Reclamation 2002), Reclamation provides an analysis of reductions of available coho fry habitat that would occur under their proposed action versus that which would be available under what they term “baseline hydrology.” This “baseline hydrology” presumably describes available monthly average flows predicted to occur without Project diversions, but with diversion of Klamath Basin water occurring outside the Project, and all Project facilities remaining in place. Reclamation’s analysis represents the effects on coho fry habitat from operation of the Project as opposed to not operating the Project. Reclamation’s analysis does not include or consider what flows could actually be delivered below IGD by certain aspects of Project operations. Reclamation’s “baseline hydrology” also does not describe the conditions under which coho salmon evolved. Therefore, NMFS finds that the usefulness of this “baseline hydrology” is limited to describing reductions in habitat availability due to operating the project versus not operating it.

As described in Reclamation’s biological assessment, the amount of habitat available to coho fry in the mainstem Klamath River is reduced under the proposed action. The biological assessment describes reductions of available habitat as being “major” when there is a reduction of 27% or more from the amount that would be available under “baseline” flows, and as “minor” when the reduction is 11% or less. Reclamation goes on to state that as a result of these decreases in available habitat, coho fry survival may decrease–presumably regardless of whether the reduction is “major” or “minor” and in all water year types. NMFS agrees that coho fry survival in the mainstem may decrease. Moreover, should Reclamation not meet their proposed flows, conditions would be worse than analyzed above.

Coho fry habitat in the mainstem Klamath River becomes increasingly important in the spring as irrigation depletions within tributaries begin to limit available salmon fry habitat in those 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 availability of resources for fry and juvenile coho in the mainstem Klamath River. As a result, the survival of young-of-the-year coho is expected to decrease in this period 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). Given direct field observation of the stranding of coho at the current ramping rates and mortality this is implicit in these observations, the NRC Committee found that reduction in ramping rates specified in the NMFS April 6, 2001, biological opinion seemed a reasonable and prudent measure for protection of coho. 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.

8.3.2 March through June - Coho Smolts

Outmigrating coho salmon smolts in the Klamath Basin must use the mainstem river as their corridor to the sea. Juvenile coho salmon from the previous year's cohort transform to the smolt life stage and migrate toward the sea during the spring. 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).

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 biological assessment on 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 dry and critically dry water years. As a result, survival of coho salmon smolts could be poor in those years.

8.3.3 Summary - March through June

In summary, NMFS believes that the proposed action during the March through June period will reduce habitat availability and instream flow, which may result in increased predation upon coho fry in the mainstem, decreased feeding success of coho young-of-the-year, and reduced outmigration success of smolts. These adverse impacts will likely decrease the survivorship of both young-of-the-year and smolts. As a result, the proposed action is likely to 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 thinks that there may be substantial additional adverse impacts to the population's viability due to its reduced population abundance and associated lack of resiliency.

8.3.4 July through September - Young-of-Year Juveniles

Coho fry are 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, 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.

The relationship between Project operations, water temperature and quality of IGD releases, and conditions that exacerbate fish disease mechanisms is complicated and not fully understood. 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).

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 the lethal limit of 25.5E C reported by Bell (1991), although coho salmon have been observed in the Klamath River at temperatures greater than 25.5E C (USFWS, unpublished data). Although additional flow releases from IGD would not be expected to cool the mainstem river to the preferred range, higher flow releases from IGD (e.g., greater than 1,000 CFS), 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–relatively large daily temperature fluctuations can be stressful to fish. Under the IGD flows that could result from the proposed operation of the Project during this period, juvenile coho salmon that rear in the mainstem Klamath River would likely experience some mortality 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).

8.3.4.1 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 differences between tributary and the mainstem Klamath River were between 1E and 2.9E C different. As previously discussed in section 6.4.2, juvenile coho salmon were observed to occupy some of these areas from March through late July 2001 (USFWS unpublished data).

We suspect that mainstem river flows influence these thermal refugia in complicated ways, which vary between individual locations. Refugia are also likely affected by meteorological conditions and associated tributary flows and temperature regimes. The suitability of the potential fish habitats that exist is a function of appropriate water depths, velocities, cover, and temperatures. These areas should also either provide adequate food resources or such resources should be available within close proximity. Based on the limited information available, NMFS finds that the extent to which the net value 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, NMFS cannot 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, NMFS thinks it is inappropriate to assume that the net “benefits” of associated refugia decrease with IGD flow releases relative to those experienced in dryer years. For example, some aerial imagery suggests that at mainstem flows at or above 1,000 CFS thermal refugial areas may be pushed against river banks and into areas that could provide better habitat for rearing coho juveniles. Although thermal refugial areas may remain intact under Reclamation’s proposed summer IGD releases in some areas, NMFS thinks they could also be less beneficial or suitable for juvenile coho because lower IGD flows would be less likely to push the cooler mixing zones near to the river bank. As a result, the cooler mixing zones would extend further into the main channel and into areas away from vegetative and woody cover that is not flooded during lower flows.

8.3.4.2 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. NMFS is unaware of any conclusive, scientific connection between IGD flows and fish kills in the main stem river. However, a fish kill was documented (CDFG 2000) which began in mid- to late June 2000, continued into late July and affected more than 60 miles of river between Coon Creek and Pecwan Creek. Direct mortality was likely caused by a combination of at least two pathogens endemic to the Klamath Basin. High water temperatures in the mainstem Klamath River and several tributaries exacerbated the problem. Estimates of the magnitude of the kill as documented by CDFG staff and others ranged from “tens of thousands” to one to three hundred thousand juvenile chinook salmon and steelhead. Hatchery and naturally produced chinook salmon and steelhead were involved and, although no dead coho salmon were observed, they are thought to have been present in the area of the kill. Since 2000, there has been an increased awareness of fish health in the Klamath River, and trained fish kill "response teams" have been established. As a result, trained respondents may gather additional valuable information to further understand these incidents should they occur in the future. In 2001, IGD flows were 1,700 CFS between June 16-30 and flows were 1,000 CFS from July through September. During this critically dry water year in the Klamath Basin, no similar fish kills were reported on the mainstem Klamath River below IGD.

8.3.5 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 under Reclamation's proposed operation of the Project. Daily average and maximum water temperatures are quite high, and the diurnal variation of temperatures is also stressful to fish. At Reclamation's proposed flows, availability of river edge habitat with appropriate cover elements could become limited, which may reduce the value of thermal refugia. As a result, survival of this life history stage may be a production bottleneck.

8.3.6 October through February

8.3.6.1 Adult Migration

Adult coho salmon generally migrate into the Klamath River between October and December, with some migration also observed in September (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 "below 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 indicate that spawning habitat is maximized at approximately 1,300 CFS in the IGD to Shasta River reach (Figure 6). NMFS thinks 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 from mainstem passage conditions and tributary access are 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 8 and Figure 9). 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.

8.3.6.2 Spawning and Incubation

Coho salmon spawning and incubation in the Klamath River Basin occurs from November through March with some egg incubation occurring as late as April (Hardy and Addley 2001). Coho salmon have been observed spawning in the mainstem Klamath River (Reclamation 1998, T. Shaw, USFWS, pers. comm. 2002); however, the importance and prevalence of this activity is unknown. 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 November through April period (Figures 8 and 9) are typically within the acceptable range associated with coho salmon spawning in California: 5.6E - 13.3E C (Briggs 1953).

Coho salmon eggs incubate for about 35 to 50 days in gravel redds following successful spawning, and fry emerge from the gravel about two to three weeks after hatching (Hassler 1987). The survival of salmon eggs and alevins are dependent, in part, on stream and stream bed conditions. For example, high winter flows and resulting gravel movement can result in heavy losses (Sandercock 1991). As previously mentioned, flows released at IGD and downstream flow accretions are variable during this period. Water temperatures measured at Seiad are typically similar to those at IGD during this period (Figures 8 and 9), 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 during “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.

8.3.6.3 Juvenile Rearing

Water temperatures during this period are generally within a tolerable range for juvenile coho salmon (Figures 8 and 9; 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.

8.3.6.4 Summary of October - February Effects

In summary, NMFS thinks 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. Further loss of reproductive success diminishes the population's viability due to further loss of the population's resiliency.

8.4 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 but for the proposed action.

While we known that water quality in the lower Klamath River adversely affects SONCC coho salmon, we do not know to what extent Project-related activities are responsible for these conditions. Identifying and quantifying water quality degradation resulting from interrelated and interdependent actions such as pesticide and fertilizer application should be addressed by further studies.

8.5 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 in dryer years, Project operations can adversely affect mainstem Klamath River flows in the IGD to Shasta River reach and, depending on accretions from 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. Thus, in dryer years, coho salmon spawning success in the tributaries and mainstem river may decrease and, in turn, production of coho salmon may be reduced 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 in the spring. 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, which are comparable to perpetual drought conditions, are expected to affect smolt survival in the IGD to Seiad Valley reach of the Klamath River, and NMFS expects smolt survival in this reach to be lower under the flows expected to result from Reclamation's proposed action. 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 (a "critically dry" water year), 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 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 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. All SONCC coho salmon populations within this ESU are depressed relative to their past abundance, based on the limited data available. 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. The status of coho salmon populations within this ESU are depressed relative to their past abundance, based on the limited data availabl. For these reasons, NMFS considers Klamath River coho salmon to be necessary for the continued survival and recovery of the SONCC coho ESU. The Klamath River population is a major component of the SONCC coho ESU both in terms of its potential numbers of fish, and because of the existence of "remnant" naturally produced inland-migrating (versus the more prevalent short-migration coastal populations) component of the run.

Efforts to restore important coho habitat in tributaries will take several years to decades to be realized. Operation of the Project according to the proposed action described in Reclamation's biological assessment 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 or when compared to historic range of minimum and maximum flows at IGD that occurred during the past 10 years. Based on available information and in combination with the existing baseline, NMFS has determined that Project operation under the proposed action included in the Project BA (Reclamation 2002) is expected to result in an unacceptable risk to Klamath Basin coho salmon.

8.6 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., operation of the Klamath Project through March 2012), 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

11.1 Development of a Reasonable and Prudent Alternative

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

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

Our jeopardy determination is generally based on the 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. Specific conditions expected to result from Project operations, and analyses of how these conditions lead to our jeopardy determination, are provided in the "Effects of the Action" section above. In the following discussion, NMFS describes how Project operations can avoid jeopardizing SONCC coho.

The reasonable and prudent alternative is intended to prevent further decline, and to increase the stability and resiliency of SONCC coho salmon 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.

11.1.1 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 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 is adopting water year types defined in the draft Phase II flow study report (Hardy and Addley 2001) as the best existing division and description of various water year type classifications in this RPA. NMFS thinks that the four water year types proposed by Reclamation do not adequately partition and reflect the full range of flow variation, as we think is necessary to accommodate the needs of coho salmon. Also, the KPSIM water quantity model used by Reclamation for water management planning has recently been revised to handle five water year types.

The boundaries between water year types are designated by Upper Klamath Lake April through September inflow volume exceedence values (i.e., the percentage of years in the 1961 through 1999 period of record that an individual annual inflow volume is exceeded): 88%, 60%, 40%, and 12% (See Table 19 of Hardy and Addley 2001.). Based on Upper Klamath Lake inflow data provided by Reclamation, this results in the following water year types:

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. 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.

11.1.2 March through June

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 NMFS to make flow recommendations for the mainstem Klamath River in this RPA. 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. While the respective goals may be relatively different, NMFS finds that the report contains information and analyses that provide an acceptable basis for development of flow recommendations.

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. 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. Estimates of habitat under unimpaired conditions are useful because they provide a benchmark by which various alternatives can be compared.

NMFS thinks it is appropriate to recommend conditions that provide adequate migration flows and daytime refuge habitat for coho smolts. As described in the Effects of the Proposed action section of this biological opinion, smolt survival is increased with relatively high spring flows. Also, given that unimpaired flows were typically greater than 3,500 cfs during most water year types in April and May and that successful smolt outmigration is tied to high spring flows, it is reasonable to restore spring flows. Given that coho smolts have survived often difficult conditions for at least 15 months, and that every single smolt must migrate to the sea through the mainstem Klamath River, we think that the smolt is the most important life stage to protect and optimize conditions for in the mainstem Klamath. Therefore, consideration of smolt habitat and flow requirements is our primary concern when making recommendations for spring flow releases from IGD in the spring.

While we do not have a metric for determining the precise mainstem Klamath River flows required to provide adequate flows for smolts, NMFS thinks that appropriate smolt holding habitat and flow conditions will be provided if adequate coho fry habitat is also provided. Since coho fry and smolts co-occur during periods of the year that historically had peak river flows, both life stages would have likely evolved life history characteristics that would have optimized their survival. Therefore, providing adequate habitat conditions for one life stage would likely produce at adequate habitat conditions for the other. Field observations in the Klamath River confirm that both life stages tend to use habitats that are most available at relatively high flows. Smolts appear to require resting habitat in the form of slack water, preferably with cover, and tend to use side channels adjacent to turbulent flow in the Klamath River (pers. comm. Tom Shaw, USFWS, April 2002). Field observations by USFWS note that coho fry are not typically found in the same locations as smolts, likely because of the adjacent turbulent flow, but apart from the turbulence, the slack water component of the habitat is similar to coho fry habitat. The USFWS observations also confirm that this smolt habitat is available over the same range of flows as coho fry habitat (i.e., the smolt habitat is increasingly unavailable as flows subside). Therefore, NMFS examined the availability of coho fry habitat as a surrogate for coho smolt habitat conditions.

Levels of coho fry habitat available under unimpaired flows were estimated by cross-referencing the one-dimensional habitat-discharge relations developed by Hardy and Addley (2001) (see Figure 6) with the monthly flow estimates for the Shasta River to Scott River reach for each water year type. NMFS chose the Shasta River to Scott River reach habitat-discharge curve for this analysis because IGD releases are the dominant contributor of flow to this reach, and this reach is the first mainstem reach encountered by relatively high numbers of smolts emigrating from the Shasta River. NMFS chose to use the one-dimensional curves because the two-dimensional coho fry habitat-discharge curves provided in the Phase II report provide questionable results at lower modeled flows (see Figure 5). For example, two-dimensional curve for the IGD to Shasta River reach suggests that coho fry habitat ceases its downward trend as modeled flows drop to approximately 1100 CFS, and begins to rise sharply as modeled flows drop to approximately 700 CFS. NMFS and the Phase II Technical Team generally think that this anomaly does not reflect reality. This “tail problem” also does not allow us to use the technique that we think is the most appropriate for determining flows levels for coho smolts. Additionally, the Phase II report summarizes the comparison of one-dimensional and two-dimensional modeling as follows:

> Both sets of simulations show expected habitat response functions that match well with field based observations for fry and spawning life stages as well as producing consistent results in terms of the juvenile life stages. We consider the results for both modeling approaches to represent valid but independent estimates of the flow versus habitat relationships within these two reaches. We also considered that the observed differences are within expected ranges of variability given the nature and differences in the respective modeling approaches from our experience in other systems.

Hardy and Addley (2001) provide habitat-discharge relations in the form of graphs depicting the relationship between flow and available weighted useable area (WUA) (i.e., habitat-discharge curves) (Figures 5 and 6). Maximum habitat is equivalent to the greatest quantity of WUA reached over the range of modeled flows. NMFS used the habitat-discharge relations and estimates of monthly unimpaired flow to estimate available habitat (i.e., WUA) for unimpaired flows during alternative water year types.

Given potential errors of 10% associated with stream gaging estimates and stream habitat modeling, a true loss of 10% WUA is probably indiscernable by the modeling procedures and may not reflect actual habitat losses. It seems reasonable that maintenance of flows providing habitat within 10% of unimpaired levels would probably have no predictable impact to the population. Whereas, reductions of more than 10% would be more likely to reflect actual diminishments of habitat from unimpaired levels. We face difficulty determining at what precise point further reductions in habitat jeopardize the population. However, we note that reducing levels of fry habitat in the section between IGD and Shasta River by more than 20% would reduce habitat during average, above average, and wet spring months such that habitat conditions become comparable to an unimpaired dry or below normal year. For example, the flow providing 20% less habitat than unimpaired flow during a below average April in the reach between Shasta River and Scott River is 1900 cfs, which is less than the 2059 CFS unimpaired flow in a dry April.

Given the low numbers of listed coho salmon in the Klamath basin, and the associated loss of the population's resiliency, recommending flows that increase the likelihood of coho in the mainstem experiencing drought-like conditions in a given year could reasonably be expected to appreciably reduce the likelihood of their survival and recovery. Given the need to restore coho habitat in the Klamath River mainstem, NMFS' opinion is that, except for dry and below average water years, fry habitat should be maintained at not less than 80% of unimpaired levels (i.e., a reduction of not more than 20% of unimpaired). Given the status of coho salmon in the Klamath River and the associated level of risk presented by low flows in dry and below average years, it is also our opinion that fry habitat should be maintained at not less than 90% of unimpaired levels (i.e., a reduction of not more than 10% of unimpaired).

We determined the necessary IGD flow release regime by first estimating the amount of habitat that would be available in the Shasta River to Scott River reach under unimpaired flows using the one-dimensional habitat-discharge curve for coho fry in Hardy and Addley (2001) (Figure 6). We then subtract either 10% or 20% of available habitat, depending on the water year type, to arrive at the flow that would provide the corresponding level of available habitat. We then subtract the estimated accretions between IGD and the midpoint of the Shasta to Scott River reach (as presented in Hardy and Addley 2001) to determine the necessary IGD release needed to produce the recommended flow in that reach. See Figure 9 for an example of this technique.

We also examined the results to see whether recommendations made sense when compared to the shape of a natural hydrograph. The above described method resulted in flows that are inconsistent with the shape of a natural hydrograph in below average Mays and average Aprils, and in March, April, and May of wet years because of an artifact that results from using our method when WUA values are subtracted in the range where the habitat-discharge curve changes direction. To account for these anomalous values, we picked reasonable points between the next drier and wetter years. In the March, April, and May of wet years, we simply adjusted the flow to match the highest calculated flow for an above average year. NMFS thinks that setting wet years at this flow level is not likely to be of concern because the flows at IGD are determined by spill and flood control releases during this period. Also, we interpret the NRC's observation that, "(i)n wet years, any benefits from increased flow will be realized without special limitation," to apply to this period of uncontrolled spill from IGD.

Also, some of our preliminary calculations for dry spring months result in flows higher than the Phase II recommended flows. As described above, the goals of our recommendations are not the same as the goals of the Phase II report, and NMFS interprets the objectives of the Phase II report to be designed to achieve a somewhat higher standard than this RPA. Therefore, we decrease our flows to match the Phase II recommended flows when necessary. Despite the perception that the Phase II recommendations may achieve a higher standard, we think it is appropriate to adjust downward to match them in dry years as a precautionary approach during times when the population will experience poor conditions in the watershed.

We also examined our preliminary recommendations to see whether other beneficial adjustments could be made without altering the total volume of water necessary to achieve the flows in a given month. 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, NMFS thinks 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 think it is necessary to provide the maximum recommended March flows later in the month with lower flows at the beginning of March. 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 think that there are good reasons to avoid "flat-line" flows that do not produce some variability in flow for extended periods. Natural variability likely plays a role in maintaining various ecological functions (Poff, et al 1997). Therefore, we divide April and May into biweekly recommendations and adjust the flows to be higher during one half of each month and lower in the other half while maintaining the monthly average. We provide the higher flows in the second half of April and the first half of May to better accommodate the needs of coho smolts near the expected peak of their outmigration.

We also think 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.

11.1.3 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 IGD 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 water years (when ambient temperatures are higher) suggest that in general, the mean daily temperature of IGD releases are higher during the summer directly below IGD under relatively high IGD flows. The same modeled scenarios also suggest that at Seiad Valley this relationship is reversed and mean daily water temperatures are expected to be relatively lower under relatively high IGD flows. In both locations, maximum daily water temperatures predicted by the companion regression model are expected to be closer to the mean water temperatures with higher IGD flows in the summer. 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 flows, 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 value of these refuge areas are enhanced or degraded by relatively high versus 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, NMFS cannot simply 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 that (1) there is substantial uncertainty of the expected affects to coho salmon summer rearing habitat in the mainstem, (2) there is a preponderance of recommendations of minimum summer flows of 1,000 CFS, including the Phase II report, which recommends higher summer flows in wetter years, and (3) there have been no fish kills observed at 1,000 CFS; 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.

Such a study must 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.

11.1.4 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.

11.2 Reasonable and Prudent Alternative

The following subsections provide the individual elements of the RPA.

11.2.1 IGD flow schedule

Table 8 provides the IGD flow release schedule that constitutes the primary element of this RPA. Table 9 provides the differences in total water volume for the March through September period, expressed in acre-feet, between Reclamation's proposed flows and NMFS' recommended flows. In other words, this is how much additional water is required to meet NMFS' recommended flows compared to the flows Reclamation expects will result from operation of the Project. Because

Reclamation uses four water year types, and NMFS uses five, the water year types do not allow for direct comparison between the respective flow schedules. For example, Reclamation's Below Average water year type spans the 50% through 80% exceedence range of the Upper Klamath Lake inflow volume, while NMFS' Below Average water year spans the range from 60% to 88%. Therefore, Table 9 is constructed to account for these overlaps, and to allow the reader to estimate the volume difference of all possible water year type scenarios.

Table 8
Recommended Iron Gate Dam Discharge By Water Year Type

Month	Dry	Below Average	Average	Above Average	Wet
October	1,300*	1,300*	1,300	1,300	1,300
November	1,300*	1,300*	1,300	1,300	1,300
December	1,300*	1,300*	1,300	1,300	1,300
January	1,300*	1,300*	1,300	1,300	1,300
February	1,300*	1,300*	1,300	1,300	1,300
March 1 - 7	1,300	1,800	2,400	2,450	2,800
March 8 - 16	1,400	2,000	2,600	2,550	2,900
March 17 - 24	1,500	2,200	2,800	2,650	3,000
March 25 - 31	1,600	2,400	3,000	2,750	3,100
April 1-15	1,400	1,800	2,700	2,750	2,700
April 16-30	1,800	2,200	3,500	3,150	3,500
May 1-15	1,800	2,400	3,500	3,500	3,500
May 16-31	1,400	1,800	2,700	2,700	2,700
June 1 - 7	1,600	1,975	2,000	3,100	3,000
June 8 - 15	1,400	1,875	1,900	2,900	2,800
June 16 - 23	1,300	1,675	1,700	2,800	2,600
June 24 - 30	1,100	1,475	1,600	2,600	2,400
July	1,000	1,000	1,000	1,000	1,000
August	1,000	1,000	1,000	1,000	1,000
September	1,000	1,000	1,000	1,000	1,000

* Convene “Between Year Transition Group”

Table 9. Differences in volume between RPA flows and Proposed flows for all combinations if RPA and Proposed water year types		
Reclamation Water Year Type	NMFS Water Year Type	Difference (acre feet)
Above Average	Wet	283,474
Above Average	Above Average	261,953
Above Average	Average	205,324
Below Average	Average	315,974
Below Average	Below Average	149,360
Dry	Below Average	273,798
Dry	Dry	164,904
Critical Dry	Dry	213,385

11.2.2 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.

11.2.3 Convene "Between Year Transition Group"

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.

11.2.4 Basis for March Flows

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.

11.2.5 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.

11.2.6 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

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 non-discretionary. Reclamation shall do the following:

1. 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:

CONSERVATION RECOMMENDATIONS:

3. Reclamation should work with non-governmental organizations to develop a plan for acquiring water rights in the Scott and Shasta River Basins. Reclamation should seek funding to purchase water rights as identified in the plan. Reclamation should research and identify water rights, develop a basis of negotiation and seek willing sellers over a 5-year period. Any water rights acquired by Reclamation will be used to enhance fish and wildlife resources in the Scott and Shasta River Basins and will include water-master services to ensure this water accrues downstream for anadromous fish.

2. Reclamation should study methods to treat and/or recycle agricultural return flows from the Klamath Project service area before release into the Klamath River within the next three years. Once effective methods are identified, Reclamation should seek funding to develop and operate such systems in the Klamath Project service area.

3. Reclamation should conduct a feasibility study to develop off-stream storage in the Lower Klamath Lake area to store additional water for fish and wildlife enhancement purposes. Reclamation should seek funding to develop such storage areas for these purposes.

4. Reclamation should fund a study on the feasibility of developing groundwater resources to replace surface water use or by discharging groundwater directly into Shasta and/or Scott Rivers.
5. Reclamation should fund instream flow studies on both the Shasta River (from Dwinell Dam to Parks Creek) and Scott Rivers to assist in the development of minimum instream flows.

6. Reclamation should provide funding to support installation of screened diversions on unscreened diversions and gaging devices on diversions in the Scott River and Shasta River to facilitate better State enforcement of appropriated water rights and reduce fish entrainment.

7. Reclamation should work with non-governmental organizations and the State of California to develop a management plan on the Scott River and Shasta River that coordinates simultaneous diversions of instream flows to minimize dramatic reductions in flow, and the stranding of fish, at the beginning of the irrigation season in March and April.

8. Reclamation should implement the Trinity River ROD.

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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Figures

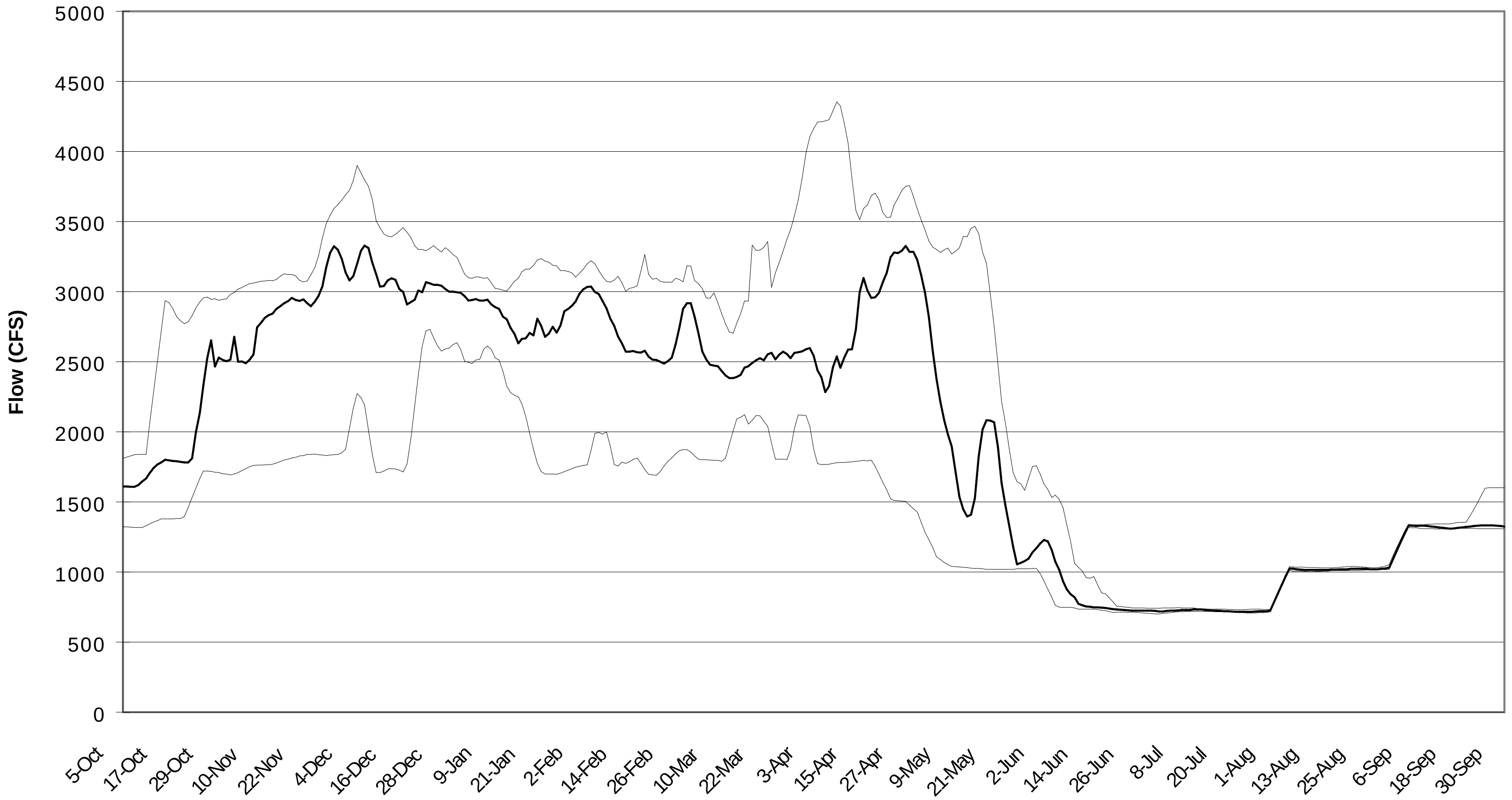

Figure 1. Average Klamath River flow at Iron Gate Dam, California - Normal water year median, 25th and 75th percentile (1963, 1966, 1969, 1970, 1973, 1985, 1989; 5 day moving average). Data are from Hydroshere Data Products, Inc. (1993).

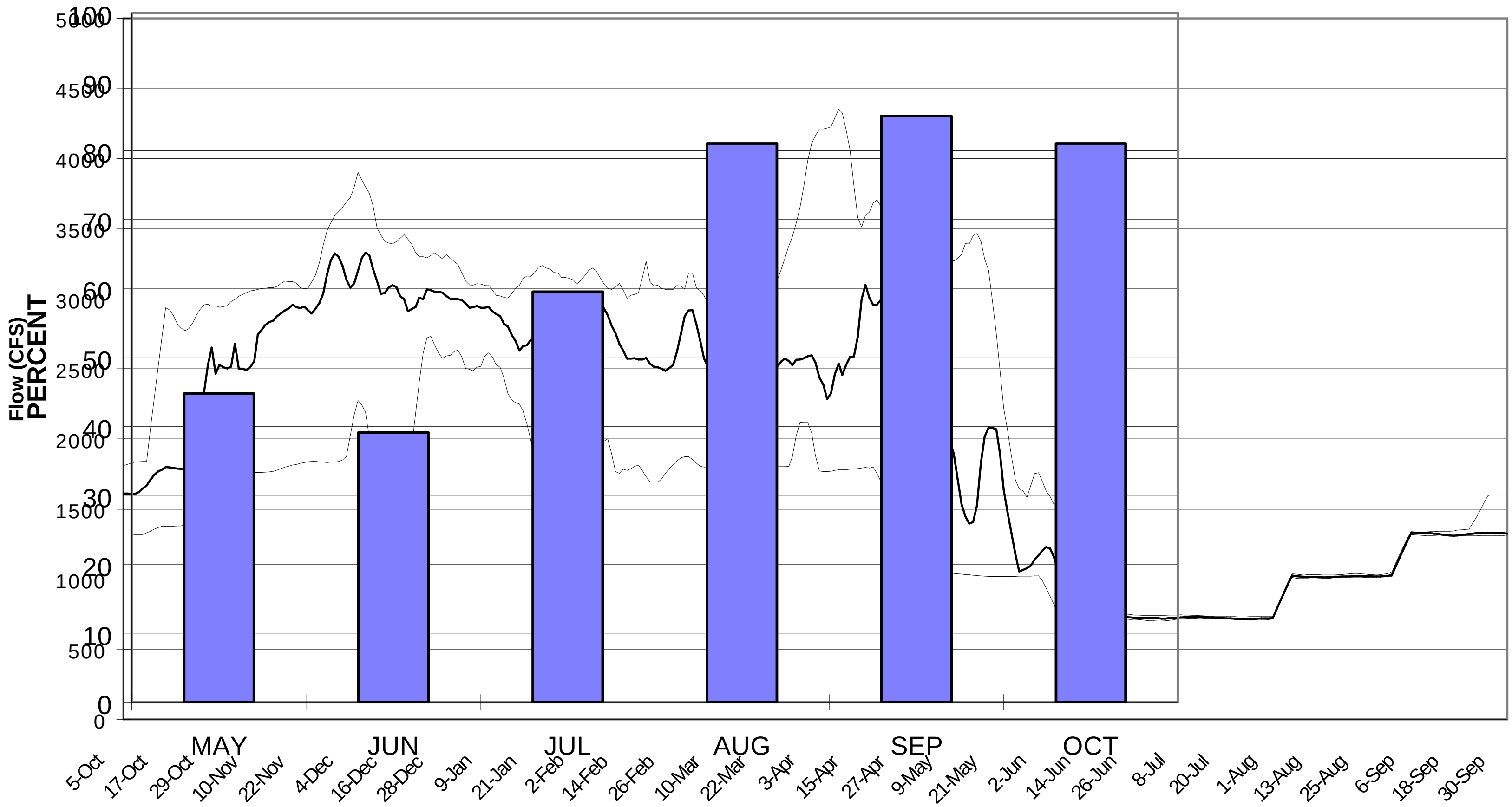

Figure 3. Monthly average Iron Gate Dam contributions to Klamath River flows measured at Seiad (1962-1991). Data are from Hydrosphere Data Products, Inc. (1993).

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

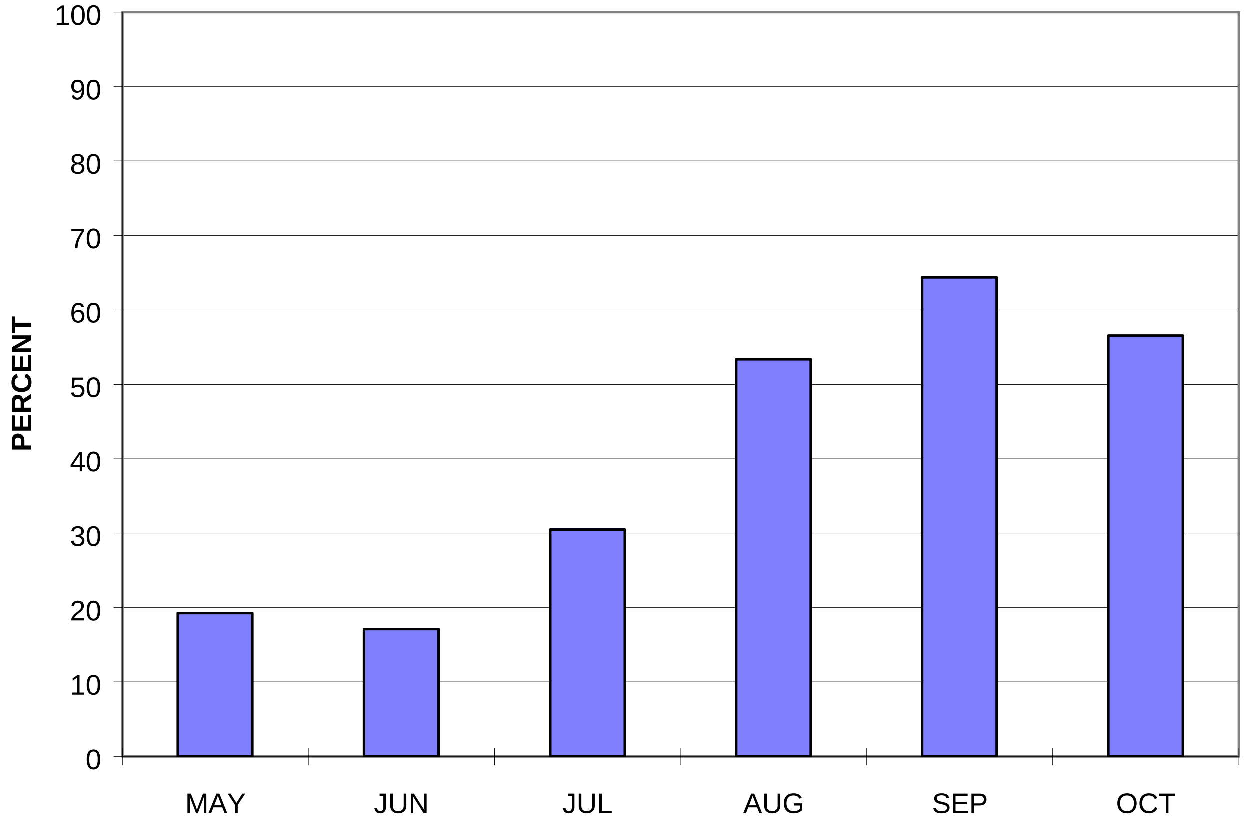

Figure 4. Monthly average Iron Gate Dam contributions to Klamath River flows measured at Orleans (1962-1991). Data are from Hydrosphere Data Products, Inc. (1993).

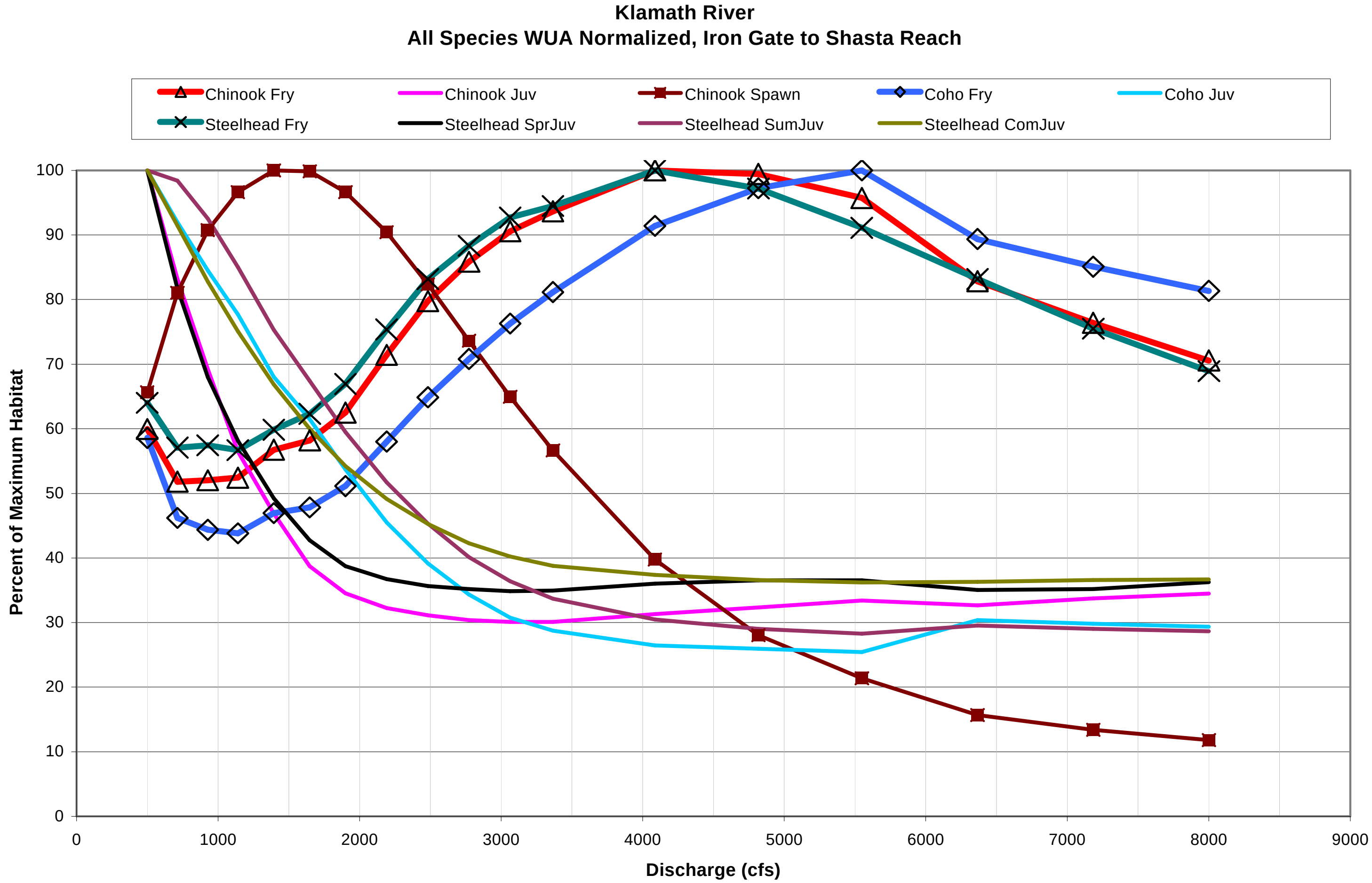

Figure 5 Relationship between percent of maximum habitat and discharge for each species and life stage for the Iron Gate to Shasta River reach. (Figure 128 of Hardy and Addley 2001)

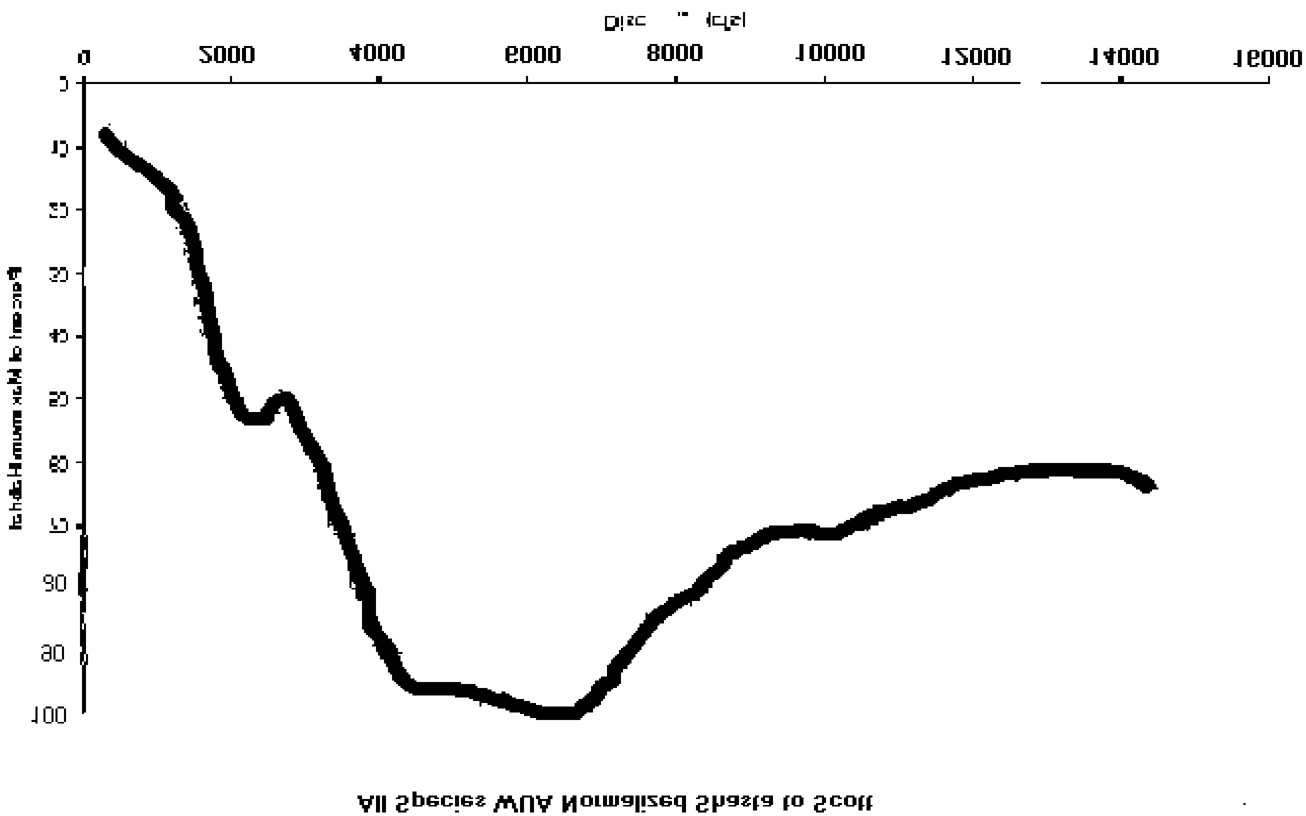

Figure 6 Relationship between percent of maximum habitat and discharge for coho fry for the Shasta River to Scott River reach. (Adapted from Figure 90 of Hardy and Addley 2001)

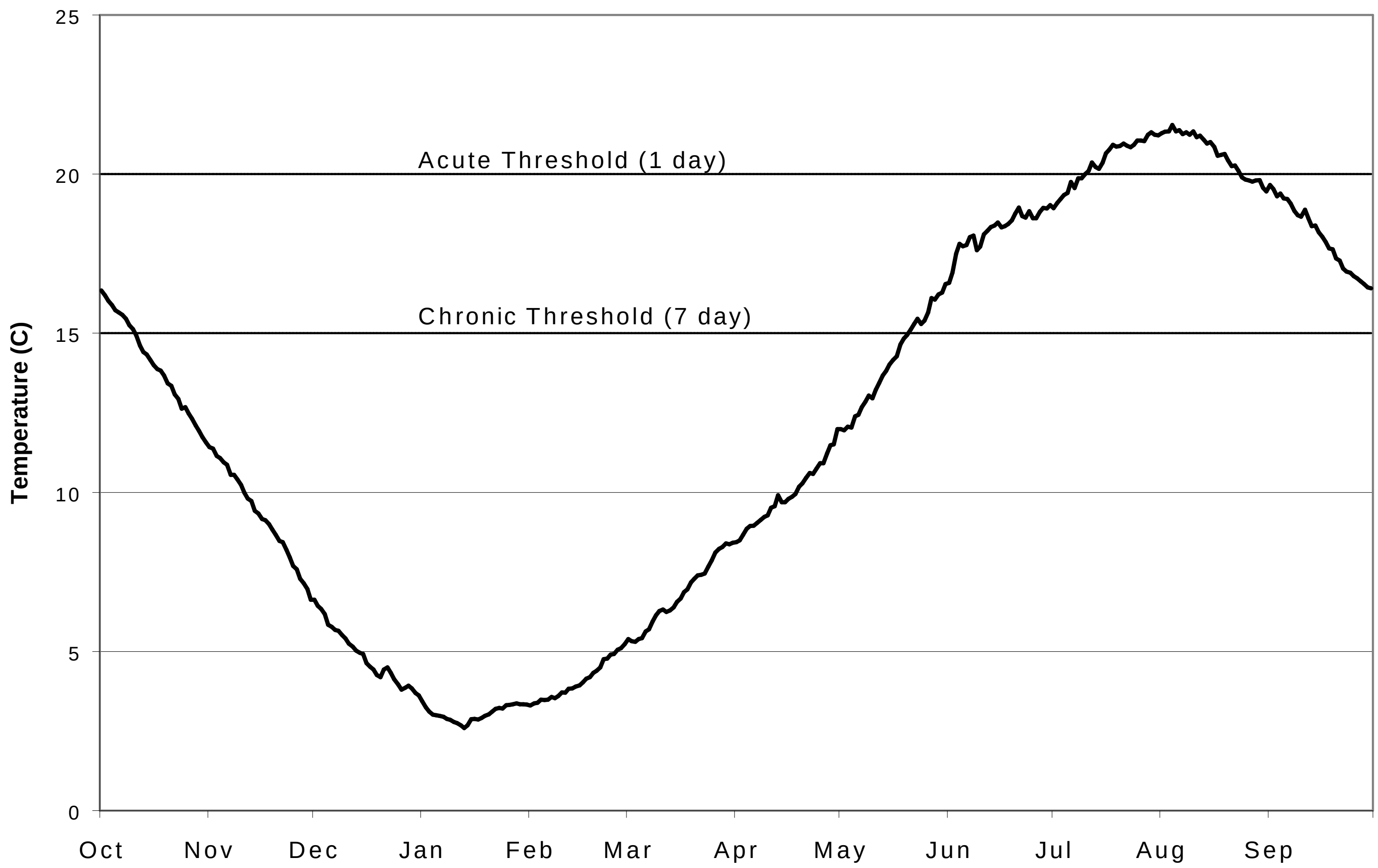

Figure 7. Average daily maximum water temperatures in the Klamath River below Iron Gate Dam (1963-1979). Acute and chronic high temperature thresholds are 1986 Environmental Protection Agency criteria (Campbell 1995). Data are from Hydrosphere Data Products, Inc (1993).

Figure 8. Average daily maximum water temperatures in the Klamath River at Seiad (1964-1978). Data are from Hydrosphere Data Products, Inc. (1993).

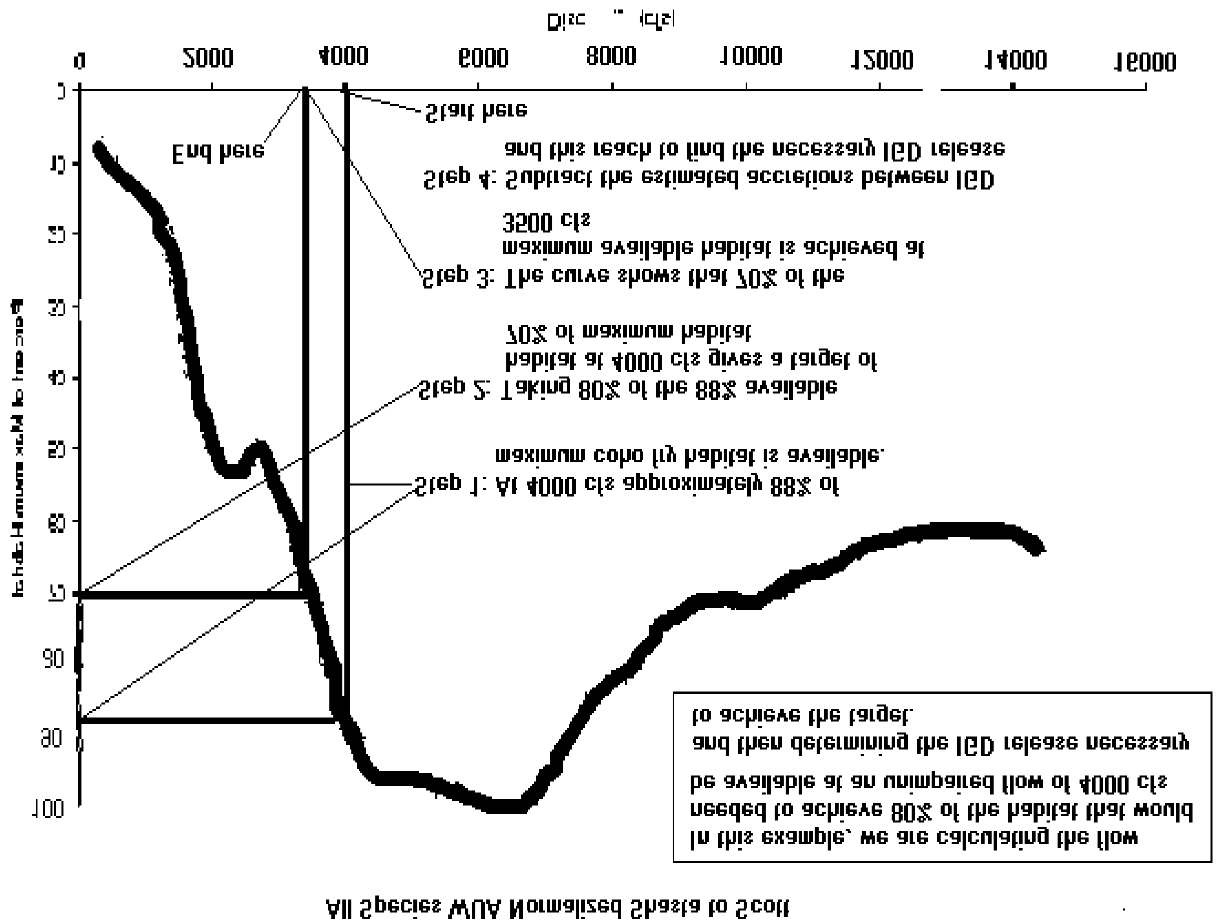

Figure 9. Example of method used to determine necessary flow release from IGD to achieve a targ 80% or 90% of maximum habitat available at a given unimpaired flow in the Shasta to S river reach.

Attachment A

MAGNUSON-STEVENS FISHERY CONSERVATION [1]

[1]The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) mandates Federal action agencies which fund, permit, or carry out activities that may adversely impact the essential fish habitat

AND MANAGEMENT ACT (Magnuson-Stevens Act)

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS [2]
U. S. Bureau of Reclamation Klamath Project Operations

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The geographic extent of freshwater essential fish habitat (EFH) for the Pacific salmon fishery is proposed as waters currently or historically accessible to salmon within specific U.S. Geological Survey hydrologic units (PFMC,1999). For the Klamath River watershed, the aquatic areas identified as EFH for chinook salmon and coho salmon are within the hydrologic unit map numbered 18010206 (Upper Klamath River) and 18010209 (Lower Klamath River). The upstream extent of Pacific salmon EFH in the Klamath River is Iron Gate Dam (IGD).

Essential fish habitat is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH, "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

The attached biological opinion (Opinion) thoroughly addresses impacts to the threatened Northern California/Southern Oregon ESU coho salmon (*Oncorhynchus kisutch*), listed as threatened under the Endangered Species Act (ESA). These impacts include adverse effects to the habitat conditions required by coho salmon and which are also identified EFH as provided by the Magnuson-Stevens Act. The Klamath River system also provides EFH to chinook salmon (*O. tshawytscha*), which are covered under the EFH provisions of Magnuson-Stevens Act, but are not listed under the ESA. This

(EFH) of Federally managed fish species to consult with the National Marine Fisheries Service (NMFS) regarding the potential adverse effects of their actions on EFH(Section 305 (b)(2)). Under Amendment 14 to the Pacific Coast Salmon Fishery Management Plan (PFMC, 1999), the Pacific Fisheries Management Council has identified and described EFH for chinook and coho salmon. The statute also requires Federal action agencies receiving NMFS' EFH Conservation Recommendations to provide a detailed written response to NMFS within 30 days upon receipt detailing how they intend to avoid, mitigate or offset the impact of the activity on EFH (Section 305(b)(4)(B).

[2] The EFH regulations require that Federal action agencies obligated to consult on EFH also provide NMFS with a written assessment of the effects of their action on EFH (50 CFR § 600.920). Because an EFH Assessment was not received for this project, NMFS relied on other sources of information including the attached Biological Opinion in preparing its EFH Conservation Recommendations.

EFH consultation addresses both species but does refer the reader to more specific information pertaining to the habitat requirements of coho salmon contained in the attached Opinion.

II. ESSENTIAL FISH HABITAT REQUIREMENTS FOR CHINOOK SALMON

Chinook: General life history information for chinook salmon is summarized below. Further detailed information on chinook salmon ESUs are available in the NMFS status review of chinook salmon from Washington, Idaho, Oregon, and California (Myers et al. 1998), and the NMFS proposed rule for listing several ESUs of chinook salmon (NMFS 1998).

The Klamath Basin system contains populations of spring run and fall-run chinook (Campbell and Moyle 1990, Healey 1991, USFS 1995). Within the Upper Klamath River Basin, there are statistically significant, but fairly modest, genetic differences between the fall and spring runs. The majority of spring- and fall-run fish emigrate to the marine environment primarily as subyearlings, but have a significant proportion of yearling smolts. These chinook salmon populations all exhibit an ocean-type life history. The majority of fish emigrate to the ocean as subyearlings, although yearling smolts can constitute up to approximately a fifth of outmigrants from the Klamath River Basin. However, the proportion of fish which smolted as subyearling versus yearling varies from year to year (Snyder 1931, Schluchter and Lichatowich 1977, Nicholas and Hankin 1988, Barnhart 1995). This fluctuation in age at smoltification is more characteristic of an ocean-type life history.

Coho: General life history information for coho salmon is provided in the attached Opinion and further information is available in the status review (Weitkamp et al. 1995). Primarily, adult and juvenile coho salmon are observed in tributaries and the mainstem of the Klamath River although these observations often occur incidentally to efforts to monitor fall-run chinook salmon escapement.

<u>Adult Immigration</u>

Chinook*:* Run timing for spring-run chinook salmon in this area typically begins in March and continues through July, with peak migration occurring in May and June (Table 1). Hardy and Addley (2001) noted that spring chinook can enter as early as February. Run timing for fall-run chinook salmon varies depending on the size of the river. Adult Upper Klamath fall chinook salmon return to freshwater in August and September and spawn in late October and early November (Snyder 1931, Nicholas and Hankin 1988, Barnhart1995). In other coastal rivers and the lower reaches of the Klamath River, fall-run freshwater entry begins later in October, with peak spawning in late November and December–often extending into January (Leidy and Leidy 1984, Nicholas and Hankin 1988, Barnhart 1995). Late-fall or "snow" chinook salmon from Blue Creek, on the lower Klamath River, were described as resembling the fall-run fish from the Smith River in run and spawning timing, as well as the degree of sexual maturation at the time of river entry (Snyder 1931).

Table 1. Summary of timing for key salmon life history events related to EFH.

SPECIES	MONTHS		
	Adult Immigration	**Spawning**	**Smolt Emigration**
Spring run chinook	Feb. -July	late Aug - Sept. peak in Sept.	March - July
Fall run chinook	Aug. - Sept.	Sept. - early Jan.	April - June
Late-fall run	Nov.- Dec. but maybe as late as Feb.	Unavailable	Unavailable
Coho salmon	Sept. - December	Nov. - March	March - July with peak in May

All chinook stocks utilize resting pools as they migrate upstream (Myers et al. 1998). As noted in Myers et al. (1998), these pools provide an energetic refuge from river currents, a thermal refuge from high summer and autumn temperatures, and a refuge from potential predators (Berman and Quinn 1991, Hockersmith et al. 1994). Furthermore, the utilization of resting pools may maximize the success of the spawning migration through decreases in metabolic rate and the potential reduction in susceptibility to pathogens (Bouck et al. 1975, Berman and Quinn 1991).

Spawning for spring run chinook salmon may occur from September through mid - November (Hardy and Addley 2001) and can peak in September (Myers et al. 1998). Historically, spring-run spawning areas were located in the river headwaters (generally above 400 m). Spawning for fall-run chinook begins in September through early January.

Coho: In general, river entry and spawn timing showed considerable spatial and temporal variability. 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).

<u>Spawning Habitat</u>

Chinook: Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths greater than 6 inches, usually 1-3 feet to 10-15 feet. Preferred spawning substrate is clean and loose, medium to large-sized gravel. Hardy and Addley (2001) report that chinook also use small cobble substrate. Physical habitat modeling indicates that spawning habitat is maximized at approximately 1,300 CFS in the IGD to Shasta River reach during the October - February time frame (Hardy and Addley 2001). Egg incubation generally occurs from 40-60 days with alevins and fry remaining in the gravel between 2 -4 weeks and begin emerging during December.

Hardy and Addley (2001) reported that suitable incubation temperatures were assumed to be between approximately 5^0 and 14^0 C as significant mortality occurs beyond this range.

Coho: 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.

Rearing Habitat

Chinook: At the time of emergence from their gravel nests, most fry disperse downstream towards the estuary, hiding in the gravel or stationing in calm, shallow waters with fine sediment substrates and riparian bank cover such as tree roots, logs, and submerged or overhead vegetation. As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food, shade and protect juveniles from predation. Chinook salmon in the Southern Oregon and California Coastal ESU exhibit an ocean-type life history, that is, they typically migrate to seawater in their first year of life (NMFS 1998). However, when environmental conditions are not conducive to subyearling emigration, ocean-type chinook salmon may remain in freshwater for their entire first year (NMFS 1998).

The fish rear in calm, marginal areas of the river, particularly back eddies, behind fallen trees, near undercut tree roots or over areas of bank cover, and emigrate as smolts from April through June. Hardy and Addley (2001) noted that chinook fry utilized habitat along the stream margins in association with cover verus the use of the main river channel. The authors also noted that a relatively small proportion of chinook fry were found associated with substrate specific cover compared to inundated streamside vegetation cover types at depths less than 2 feet. This association with shallow, vegetative escape cover indicates the importance of riparian habitat to the early life history stage of juvenile chinook. As noted in the attached Biological Opinion, coho salmon fry generally require similar habitat characteristic as chinook salmon fry (NMFS 2002).

Principal foods of chinook while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as *Daphnia,* flys, gnats, mosquitoes or copepods (Kjelson et al. 1982), stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates.

Coho: Fry start emerging from the gravel two to three weeks after hatching (Hassler 1987). Following emergence, fry move into shallow areas near the stream banks. As coho salmon fry grow larger, they disperse upstream and downstream and establish and defend a territory (Hassler 1987).

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

II. PROPOSED ACTION

The proposed action is described in Section 8.0, ***Description of the Proposed Action***, in the attached Opinion prepared for the southern Oregon/northern California coast coho salmon ESU.

III. EFFECTS OF THE PROJECT ACTION

As described in the attached Opinion for coho salmon (NMFS 2002), the proposed project can adversely affect several life history stages of coho including migrating adults, spawning adults, rearing fry, and migrating smolts at varying times of the year. Another way of viewing these impacts to coho survival is to consider the adverse effects to the EFH of both coho and chinook salmon. Examining both species is appropriate due to the overlap in timing of important life history events (Table1) and the similar habitat requirements of both. The following summarizes the adverse affects to salmon EFH.

In dryer years, during fall and winter months, the proposed project can adversely affect the mainstem Klamath River flows in the initial reaches below IGD. Depending on accretion from downstream tributaries, this will also affect downstream Klamath flows which may potentially affect the EFH function of providing passage conditions for upstream migrating salmon and their spawning success in the mainstem as well as successfully migrating to connecting tributaries. The outcome of reduced flows is that it can adversely affect salmon EFH and subsequently reduce salmon production during dry years.

Spring flows in the mainstem provide important EFH that supports rearing functions. During the spring months of dryer years, the proposed project will substantially affect Klamath River flows affecting salmon rearing for individuals either originating from the mainstem or migrating down from tributaries. Because the amount of flow in the mainstem is related to the amount of suitable EFH for rearing salmon, fry and smolt survival may be affected if sufficient flows in the mainstem are not maintained at appropriate levels. The survival of chinook salmon fry and smolts that cannot find suitable rearing EFH will most likely be impacted, thereby resulting in reduced survival. As noted in the section on rearing habitat, much of salmon rearing is associated with riparian corridors.

The riparian zone acts as the interface between terrestrial and aquatic ecosystems by moderating the effects of upslope processes and provides important ecological functions including bank stabilization, nutrient cycling, food-web support, and important stream microclimate and shading functions (Spence et al. 1996, Flosi et al. 1998, NRC 2002a). Riparian vegetation, including shaded riverine aquatic (SRA) cover, provides juvenile salmon cover from predators, increases habitat complexity, provides a source of insect prey and provides shade for maintaining water temperatures within suitable ranges for all life stages. The functional values of riparian corridors and the benefits they provide to stream fish populations are well documented (Karr and Schlosser 1978, Wesche et al. 1987, Gregory et al. 1991, Caselle et al. 1994, Wang et al. 1997). As noted by the NRC (2002a), the reintroduction or maintenance of the full range of flow regimes to mimic the natural hydograph, in addition to minimum stream flow, is essential for restoring and sustaining, respectively, healthy riparian systems. While NMFS is not aware of impacts to the riparian zone in the lower mainstem Klamath River associated with operation of the Project, we are concerned that flows consistently below unimpaired levels create conditions that effectively distance the riparian zone from the waters of the river, thereby limiting the function of the riparian zone.

In addition to supporting important riparian habitat functions, spring flows are also important as they function as a migratory corridor in the mainstem for outmigrating salmon to the estuary and ocean. As reported in the attached Opinion (NMFS 2002), specific relationships between Klamath River flows and smolt survival have not been established. However, as argued in the Opinion, because other information from other locations indicate a positive relationship between smolt survival and river flows, the proposed project will most surely affect coho and chinook smolt survival in particular reaches of the Klamath River.

Adverse effects to EFH can also be interpreted as reductions in water quality such as water temperatures. While the relationship between IGD flows and water temperature is poorly understood, the Opinion notes that diurnal water temperature fluctuations in the Klamath River are generally expected to be lower under relatively high IGD flows. Similarly, during summer months, flows from IGD comprise a substantial portion of Klamath River flows especially during dryer water years. During summer months coinciding with “critically dry” water years (as defined by the Bureau), there may be no accretions to Klamath flows from its tributaries in certain reaches and releases from IGD would represent the only water in the river in particular reaches. These flows will also be important to maintain riparian habitat functions.

IV. CONCLUSION

Upon review of the effects of the Bureau's operation of Klamath River flows, NMFS believes that the proposed project on the Klamath River will adversely affect the spawning, rearing and migratory EFH functions of Pacific salmon currently or previously managed under the Magnuson-Stevens Act. Primarily, NMFS believes that the proposed project would result in a continued decline in EFH conditions for the Klamath River, and thereby preclude rebuilding of the coho salmon population and reduce the habitat required to support a sustainable chinook fishery and its contribution to a healthy ecosystem.

Besides providing EFH for coho and chinook salmon to occupy, instream flows also provide other important habitat functions. NMFS believes that the IGD flow releases should not be viewed just in terms of the maintenance of one or more fish populations, as stated in the NRC (2002b) report, but rather, in holistic terms of protecting ecological processes. In other words, IGD releases should be sufficient for complementing an ecosystem-management approach that maintains the physical and biological processes operating within the Klamath River. However, because of the complex relationship between IGD releases and EFH conservation, defining appropriate instream flows, even with thorough analyses, will always leave uncertainties regarding the appropriate levels for EFH conservation. In the face of these uncertainties, the need to apply a precautionary approach such that instream flows are risk-adverse in conserving the EFH of coho and chinook is emphasized. Further, the need exists to implement an adaptive management strategy for Klamath River releases such that once instream flows are set, the effects of these flows on EFH are appropriately monitored and the instream flows are accordingly adjusted to assure proper EFH functioning.

The EFH Conservation Recommendations below are designed to prevent further decline of EFH conditions.

V. EFH CONSERVATION RECOMMENDATIONS

Because both coho and chinook have very similar habitat requirements, providing conditions that are likely to increase the stability and resiliency of listed coho salmon will also conserve the EFH of chinook salmon. Consequently, NMFS will use the Reasonable and Prudent Measures and respective Term and Condition, and the conservation recommendations listed in the Incidental Take Statement prepared for threatened Northern California/Southern Oregon ESU coho salmon in the attached Biological Opinion in crafting its EFH Conservation Recommendations. These recommendations are provided as advisory measures to the Bureau that they:

1. Implement the Reasonable and Prudent Alternative outlined in the attached Opinion.

2. Adopt the Reasonable and Prudent Measures and Terms and Conditions listed in the Incidental Take Statement of the attached Opinion.

3. 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.

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

5. 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.

6. Work with non-governmental organizations to develop a plan for acquiring water rights in the Scott and Shasta River Basins. Reclamation should seek funding to purchase water rights as identified in the plan. Reclamation should research and identify water rights, develop a basis of negotiation and seek willing sellers over a 5-year period. Any water rights acquired by Reclamation should be used to enhance fish and wildlife resources in the Scott and Shasta River Basins and should include water-master services to ensure this water accrues downstream for anadromous fish

7. Study methods to treat and/or recycle agricultural return flows from the Klamath Project service area before release into the Klamath River within the next three years. Once effective methods are identified, Reclamation should seek funding to develop and operate such systems in the Klamath Project service area.

8. Conduct a feasibility study to develop off-stream storage in the Lower Klamath Lake area to store additional water for fish and wildlife enhancement purposes. Reclamation should seek funding to develop such storage areas for these purposes.

9. Fund a study on the feasibility of developing groundwater resources to replace surface water use or by discharging groundwater directly into Shasta and/or Scott Rivers.

10. Fund instream flow studies on both the Shasta River (from Dwinell Dam to Parks Creek) and Scott Rivers to assist in the development of minimum instream flows.

11. Provide funding to support installation of screened diversions on unscreened diversions and gaging devices on diversions in the Scott River and Shasta River to facilitate better State enforcement of appropriated water rights and reduce fish entrainment.

12. Work with non-governmental organizations and the State of California to develop a management plan on the Scott River and Shasta River that coordinates simultaneous diversions of instream flows to minimize dramatic reductions in flow, and the stranding of fish, at the beginning of the irrigation season in March and April.

VI. ACTION AGENCIES STATUTORY REQUIREMENTS

Section 305(b)(4)(B) of the Magnuson-Stevens Act and Federal regulations (50 CFR § 600.920) to implement the EFH provisions of the Magnuson-Stevens Act require federal action agencies to provide a detailed written response to NMFS, within 30 days of its receipt, responding to the EFH Conservation Recommendations. The response must include a description of measures adopted by the Agencies for avoiding, mitigating, or offsetting the impact of the project on Pacific salmon EFH. In the case of a response that is inconsistent with NMFS' recommendations, the Agencies must explain their reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR § 600.920(k)).

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