Biological Opinion

Klamath Project Operations

May 31, 2002

National Marine Fisheries Service

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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 (SONC) 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, and comments received from review of the May 16, 2002 draft Biological Opinion. 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 SONC coho salmon or result in the destruction or adverse modification of habitat of SONC 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 SONC 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 SONC coho salmon from proposed Klamath Project operations between April 1, 2002 and March 31, 2012. Since SONC 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 National Research Council (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 main-stem Klamath River below Iron Gate Dam 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.

In addition to consulting with NMFS regarding the effects of proposed Klamath Project operations between April 1, 2002 and March 31, 2002 on listed species Reclamation is required to consult with NMFS regarding Essential Fish Habitat (EFH), pursuant to the Magnuson-Stevens Fishery

Conservation and Management Act, as amended. NMFS has used Reclamation's Biological Assessment (BA) and the body of information considered in this opinion as the basis for developing EFH recommendations for SONC coho salmon evolutionarily significant unit (ESU), Upper Klamath-Trinity Rivers chinook salmon ESU and SONC chinook salmon ESU. NMFS' EFH recommendations are appended to this biological opinion (see attachment A).

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 little flexibility remained to modify the plan. Therefore, formal consultation was deferred 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. The 2001 Opinion found that the proposed operation of the Project posed jeopardy to SONC 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 SONC 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, 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 Iron Gate Dam 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 Iron Gate Dam 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 Iron Gate Dam 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, Reclamation requested, and 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."

On May 16, 2002, NMFS transmitted its draft biological opinion and reasonable and prudent alternative to Reclamation. That same day, Reclamation posted the draft opinion on its website and requested comments on the document until May 24, 2002. Extensive comments were received from water users, tribes, a fishing organization, private citizens, an environmental organization, and the California Department of Fish and Game. NMFS has considered all of these comments and made appropriate changes to the biological opinion and reasonable and prudent alternative where appropriate.

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, owned and operated by PacifiCorp, which is currently a barrier to anadromous salmonid migrations in the main stem 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. Iron Gate Dam 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 Iron Gate Dam.

Although a myriad of human induced and natural factors affect fish species of concern in the Klamath River, Project operation affects the quantity, quality, and timing of water available for release from Iron Gate Dam during much of the year. In turn, flow releases from Iron Gate Dam affect the quantity and quality of aquatic habitat in the main stem Klamath River in California. Investigations into an appropriate flow regime below Iron Gate Dam have resulted in several recommendations for flows to address interests in the Klamath River below Iron Gate Dam. 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 use by National Wildlife Refuges 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. 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. NMFS concurs with Reclamation that these studies and programs could benefit coho and has incorporated some of them as appropriate as part of the reasonable and prudent alternative.

The NRC Committee on Threatened and Endangered Fishes in the Klamath River Basin (NRC 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 an interim 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 main stem 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 NRC Committee's conclusion stands in contrast to the conclusions of the Hardy Phase I (1999), which was considered by the Committee, and the draft Hardy and Addley Phase II (2001) reports which suggest increased flows would aid restoration and the maintenance of aquatic resources within the main stem 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 (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 hydrologic conditions that are more natural in the lower Klamath Basin. Hardy and Addley assert that the native fish community, including threatened coho salmon, would benefit from restoration of these conditions. The general assumption underlying the draft Hardy and Addley (2001) report is that aquatic species will react to changes in the hydraulic environment (pg. 154, Hardy and Addley 2001).

The NRC Committee on Endangered and Threatened Fishes in the Klamath River Basin also recognized that changes in the flow regime in the Klamath River may affect other fishes (e.g., ESUs of steelhead and chinook salmon), but they restricted their analysis to only the biological assessment and opinion on the affects of the Project on coho salmon. While the committee 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.

Likewise, in its April 30, 2002 response to NMFS' request for clarification of several issues in the interim report, the Committee reiterated its finding that the evidence and arguments for increased flows in the main stem were weak. For example, while coho smolts should benefit from higher flows that would reduce migration time and exposure to predation, there was no evidence from existing information to support that conjecture. Neither did the Committee find convincing evidence in the 2001 biological opinion or other documents that the main stem is a significant rearing area for coho. The Committee's findings are a function of the lack of information on distribution and abundance of coho adults, spawners, and juveniles throughout the Klamath River Basin, and the lack of studies focused on coho and factors limiting its population in the Klamath River Basin.

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:

> 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)).

The approach of giving the benefit of the doubt to the species concerned has been termed the precautionary approach. The precautionary approach is becoming a prominent tool in conservation biology as a risk management tool. The NRC Committee on Threatened and Endangered Fishes in the Klamath Basin stated in its April 30, 2002 letter of clarification that the committee did not conclude that NMFS must be wrong. While the committee found the evidence and arguments for main-stem flows to be weak, they stated this finding does not necessarily mean that NMFS' recommendations were incorrect. NMFS' view of the interim report and the clarifying letter is that they point out more specific information needs to be developed to understand the effect that modification of flows has had on coho salmon and to determine the extent to which the natural hydrograph needs to be restored to ensure the long-term survival and recovery of coho salmon. While some studies could be concluded rather quickly (in a few years), studies necessary to correlate year class strength or other biological indicators of success with flows will be difficult given the small size and scattered nature of the present native coho population and will likely take several coho life cycles (i.e., a decade or more) to demonstrate these correlations with scientific rigor. Therefore, NMFS has taken a cautious approach to evaluating Reclamation's proposed action and has considered the body of evidence available to it including the interim NRC report and clarifying letter and the draft Hardy and Addley report.

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 ESA 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 BA 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 Iron Gate Dam 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 Natural Resources Conservation Service's 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 Iron Gate Dam 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 Iron Gate Dam 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 Iron Gate Dam 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 Iron Gate Dam 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** critically dry water year river flows will be used in Step 3 instead of the 10-year **minimums** critically dry water year river flows 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 Iron Gate Dam river flows that occurred during water years 1990 through 1999 (Reclamation 2002). The BA 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 criteria" (email from M. Ryan, Bureau of Reclamation, March 5, 2002). Also, in a May 24, 2002, letter to NMFS, Reclamation clarified that the "proposed action will result in flows no lower than the minimums observed during water years 1990 through 1999, varying by water year type..." and "In rare instances...flows may drop as low as the minimums for the 1990's by water year type." For these reasons, 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. In these instances, Reclamation would implement the water bank to meet the target flows. 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, and the water bank is insufficient to meet minimum flows Reclamation would reinitiate consultation.

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 Iron Gate Dam flows reported in Table 5.9 of the biological assessment. NMFS is not analyzing the potential effects to coho if actual Iron Gate Dam flows are lower than those reported in Table 5.9.

Reclamation anticipates annual water bank requirements of up to 100,000 acre feet, depending on year type. Although the mechanism for establishing a water bank is not specified in the BA, Reclamation believes, based on experience during the 2001 drought and progress in investigating water supply enhancement, that several sources, including offstream storage, irrigation demand reduction, and groundwater development hold promise and may aid in establishing the water bank. Off-stream storage opportunities in Agency Lake Ranch, Lower Klamath area lands, and winter storage in the Tule Lake area. Irrigation demand reduction, would involve compensating farmers to idle their lands in any given year. Ground water conjunctive use would involve use of wells to supplement surface water supplies. Reclamation indicates in the BA that it has authority to pursue these elements and develop a water bank.

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 SONC 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 Iron Gate Dam, 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 SONC 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 SONC 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 main stem 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). Coho salmon smolts have been observed emigrating through the Klamath River estuary in mid-to late-May when water temperature ranged from 53.6 to 68°F (CDFG 2002).

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 SONC coho salmon abundance information is summarized in the NMFS coast-wide status review (Weitkamp et al. 1995). Here are some excerpts from this document:

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

Brown and Moyle (1991) estimated that naturally-spawned adult coho salmon returning to California streams 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.

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 main stem 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 main stem 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 main stem Klamath River year round, and coho also inhabit a number of Klamath tributaries (Henriksen 1995; INSE 1999;Yurok Tribe 2001; CDFG 2002).

- Between Iron Gate Dam and Seiad Valley, coho salmon populations are known to occur in Bogus Creek, Little Bogus Creek, Shasta River, Humbug Creek, Little Humbug Creek, Empire Creek, Beaver Creek, Horse Creek, and Scott River.

- Between Seiad Valley and Orleans, coho salmon populations are known to occur in Seiad Creek, Grider Creek, Indian Creek, Elk Creek, East Fork Elk Creek, Clear Creek, Dillon Creek, China Creek, Fort Goff Creek, Portuguese Creek, Swillup Creek, Independence Creek, Ukonom Creek, and Salmon River.

- Between Orleans and Klamath (mouth of the river), coho salmon populations are known to occur in Camp Creek, Trinity River, Turwar Creek, Blue Creek, West Fork Blue Creek, Nickowitz Creek, One-Mile Creek, Crescent City Fork, Tectah Creek, Hunter Creek, East Fork Hunter Creek, Mynot 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.

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 main stem of the Klamath River between Iron Gate Dam and Interstate 5 (USFWS unpublished data 2002).

6.4.2 Juvenile Data

The USFWS operates downstream juvenile migrant traps on the main stem 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	54	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	149	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 main stem Klamath River while the main stem flow was 1,000 cubic feet per second (CFS). Approximately 65 locations were sampled. Coho salmon juveniles were observed in 14 locations where the main stem 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 can be found in the main stem Klamath River near some tributary confluences and Klamath tributaries when water temperatures are higher than some believe coho can tolerate and when Iron Gate Dam 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 main stem 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 main stem Klamath that showed coho fry are present in the Iron Gate Dam to Scott River and Salmon River to Trinity River reaches of the main stem Klamath River from February through June and in the Scott River to Salmon River reach of the main stem Klamath River from February through May; coho juveniles were found to be in the entire main stem in all months of the year. Further, USFWS (1997a) concluded that coho salmon juveniles likely rear year-around in the main stem 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 main stem Klamath River soon after emergence. Further evidence of coho salmon fry emigrating from tributaries to the main stem 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 main stem Klamath River 0.7 miles above Highway I-5 captured 9 and 848 coho fry, respectively. During the same period, their rotary trap and fyke net trap on the main stem Klamath River just below Bogus Creek captured ten and 762 coho fry, respectively. An unpublished 2002 Karuk Tribe Department of Natural Resources states that on April 25, 2002, as flows below Iron Gate Dam declined due to a combination of a receding hydrograph and diminished releases from the project, 18 chinook fry and 101 coho fry were documented in isolated side channels. These fish were rescued by CDFG, FWS , Forest Service, and Karuk Tribal biologists and returned to the main stem.

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 SONC 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 SONC coho salmon ESU. Poor survival of coho fry and juveniles in the main stem Klamath River, as indicated by upriver versus downriver trapping results, suggests that degraded main stem rearing habitat is limiting coho production. Existing information also indicates that adult coho salmon are present in the main stem Klamath River from early September through January and juvenile coho salmon are present in the main stem Klamath River throughout the year, including the summer months.

6.5 Status

6.5.1 Listing History

The SONC 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 SONC 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.

In April, 2002, the California Department of Fish and Game (CDFG) issued a report titled “Status Review of California Coho salmon North of San Francisco: Report to the California fish and Game Commission. CDFG concluded that the California portion of the SONC coho ESU should be listed as threatened under the California Endangered Species Act, and the Central California Coast ESU of coho salmon, which occurs to the south of the SONC coho, should be listed as endangered. The California Fish and game Commission will accept this report and take action on the recommendations later in 2002.

6.5.2 Factors for Decline

The SONC 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 SONC 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).

Coho salmon harvested by California Native American tribes in the northern California portion of the SONC ESU is primarily incidental to larger chinook salmon subsistence fisheries in the Klamath and Trinity Rivers; in neither basin is tribal harvest considered to be a major factor for the decline of coho salmon. Harvest management practiced by the tribes is conservative and has resulted in limited impacts on the coho salmon stocks in the Klamath and Trinity Rivers. (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 SONC 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 SONC 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 SONC 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 to this point 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 late 1800s, 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 facilities associated with the Project, and other facilities, 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, Iron Gate Dam, 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 Iron Gate Dam was completed by 1962 to re-regulate flow releases from the Copco facilities, but it did not, nor was it intended, to restore the “pre-project” hydrograph. The pre-project hydrograph (at Keno, Oregon) and the post Iron Gate Dam hydrograph (below Iron Gate Dam) can be seen in Figure 1. Minimum stream flows and ramping rate regimes were established in the FERC license covering operation of Iron Gate Dam. As a mitigation measure for the loss of fish habitat between Iron Gate and Copco No. 2 Dams, a fish hatchery was established. Approximately 30 miles of coho salmon habitat are blocked above Iron Gate Dam (CDFG 2002).

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 main stem 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 SONC coho salmon. In October 2000, the Trinity River Main stem 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 Main stem Fishery Restoration program. On May 6, 2002, the court modified this injunction to allow an additional 100 TAF of water to be released to the Trinity River in 2002 to provide the geomorphic benefit of higher flows to aid in restoration of riverine habitat in the Trinity River. Nevertheless, 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 main stem 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 Iron Gate Dam 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 exceeded 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 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 SONC 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 SONC 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 SONC 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 SONC coho salmon ESU. The only out-of-basin transfers of coho salmon to Iron Gate Hatchery occurred in 1966-1968 with Cascade River, OR stock (CDFG 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.

Iron Gate hatchery has a production goal of 75,000 coho salmon yearlings per year. However, this is only about 44% of the hatchery's 5-year average annual production between 1987 and 1991. The most recent hatchery release consisted of 46,254 brood-year 1999 yearlings, which were released into the Klamath River at the hatchery (CDFG 2002).

The majority of hatchery fish produced in the Iron Gate 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. CDFG and NMFS have evaluated Iron Gate Hatchery practices and implemented changes to help minimize adverse effects to naturally produced salmon and steelhead. For example, release of the 4.9 million chinook salmon smolts produced in 2002 was modified from a three-day forced release in early June to a phased approach beginning in mid-May. These fish will be volitionally released in four or five separate lots over a month long period. CDFG and NMFS expects this release schedule to minimize competition between hatchery and naturally produced fish, as well as competition between hatchery fish.

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 flows at the Iron Gate Dam site. When compared to the "baseline" flow regime description provided in Reclamation's BA (Reclamation 2002), these estimates provide another description of hydrologic changes that have occurred as water management above Iron Gate Dam has intensified. The latest estimates of unimpaired flow approximate Iron Gate Dam 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 Effects of the Action section of this biological opinion.

The most recently updated unimpaired estimated monthly 50% exceedence 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:

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

C Water development in the Klamath Basin has altered the hydrology, and the magnitude and timing of water flows has dramatically changed in the Trinity, Klamath, Shasta, and Scott rivers. Agricultural activities associated with Klamath Basin diversions have also contributed to increased nutrient loading. 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 characteristics.

C 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.

C 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.

C Previous coho salmon capture during non-tribal ocean salmon harvest activities have contributed to the decline of SONC 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 SONC 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. While harvest, hatchery practices, and poor ocean conditions have contributed to this decline, NMFS thinks the lack of properly functioning habitat is an important factor inhibiting recovery of the ESU.

8. EFFECTS OF THE ACTION

This section of the Biological Opinion, NMFS assesses the direct and indirect effects of the proposed action on SONC coho salmon and critical habitat, and the effects of 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 SONC

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 Iron Gate Dam 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. Iron Gate Dam 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)

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

Main stem 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 produced in tributaries but washed down or displaced down stream to the main stem, 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, some young-of-year coho move into the main stem 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, main stem rearing habitat will be more important than it otherwise might be and NMFS will consider adverse effects to main stem 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 main stem 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 SONC coho salmon.

For purpose of clarity within this document, the term "reference period" will refer to water years 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 reference period could be accomplished only with increased risk to coho salmon. Therefore, NMFS investigated the difference in operations between those flows that were 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 SONC 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 reference period's 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 Iron Gate Dam that occurred during the reference period, NMFS calculated the difference between the mean monthly flows for the reference period and those likely to occur under Reclamation's annual operating plan 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 main stem because all of the smolts from the entire river basin must use the main stem to get to the ocean. The summer months were excluded because of the temperature problems that exist in the main stem in the summer. 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 reference period. NMFS then calculated mean monthly flows that would occur if Reclamation were to meet the flows identified in its 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 demonstrate an average annual reduction in the volume derived from the 10 year mean flows of about 250 TAF (see Table 6).

Table 6. Comparison of monthly mean flows for the 10-year reference period with a hypothetically calculated 10-year period 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 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 Section 4.1 description of the proposed action). Rather than establishing a conservative planning target (e.g., 10-year mean for the reference period), Reclamation has calculated the mean and minimum flows for each water year type 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 from the reference period are used for planning targets, rather than the mean, then down-stream flows will likely begin oscillating about the minimum and the mean will decline, over time, from where it was during the reference period.

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. NMFS realizes that some portion of this volume is likely attributable to uncontrolled spills that occur in the spring of some wet years. However, at some point in the spring of wet years, operations transition from uncontrolled to controlled operations. At the point the target for managing operations is the minimum flow that occurred during the six wet years in the reference period. Therefore some portion of this volume will likely contribute to a decline in the average flows compared to the reference period. The reason there is no difference between historical and expected flows in below average water years is that there is only one below average water year in the reference period therefore the historical mean and operational target of the minimum are the same value. Likewise, there is only one dry year in the reference period, so the described steps to protect the average from declining in dry years are meaningless. The only differences between the historical and expected flows in dry and critically dry year is the 10,000 acre foot pulse flow proposed for April. NMFS does not think that the 10,000 acre foot pulse flow in April of dry and critically dry years is sufficient to prevent the average from declining.

Finally, the description of the how the size of the water bank will be calculated and how and when it is anticipated to be used leads NMFS to conclude that it will only be available in dry and critically dry water year and that it will be used to ensure that the minimum target flows are met. Therefore, the water bank, as described in the BA, does not appear be a tool for preventing the average flows over the 10 year period of operations covered in the BA from declining relative to the average for flows by water- year type that occurred in the reference period. NMFS thinks that the management strategy described in the BA will result in operations that begin to oscillate about the minimum flows identified for the reference period and the mean flows for each water year type will decline toward the minimums that occurred during the reference period.

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 tend to 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 irrigation water deliveries 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 from June 1, 2002 through 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 main stem 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 “baseline hydrology.” This “baseline hydrology” 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.

As described in Reclamation’s BA, the amount of habitat available to coho fry in the main stem Klamath River is reduced under the proposed action. The BA 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 hydrology” flows, and as “minor” when the reduction is 11% or less. Fry habitat in February and March is affected by the proposed action. Major decreases in fry habitat occur with the proposed action compare to the baseline in “above average,” “below average,” and “dry” water years. Habitat losses range from 27% in March 1-15 of “below average” water years 51% in February of “above average water years. Minor losses occur in “critical dry” water years (11%). There are no instances of increased habitat in February or March. Reclamation sets these reductions in habitat aside by stating that there is no empirical data demonstrating a clear association between a reduction in Klamath River flow and the recruitment and survival ov coho salmon in the Klamath River.

While NMFS agrees that Reclamation’s statement is consistent with the NRC report, NMFS is concerned about the magnitude of reduction in habitat associated with planned operations. The 51% reducing in main-stem habitat in February of “above average” years compared to “no project,” is likely inflated by comparing operations that do not account for uncontrolled spills with a baseline that does, but there are regular reductions in habitat of between 20% and 35% in months where uncontrolled spills are not likely to occur. Further these reduction in habitat are relative to baseline conditions that are impaired by other diversions and land use activities. NMFS thinks this emphasizes the importance to expand the science effort in the Klamath River below Iron Gate Dam to determine the importance of main-stem habitat for tributary oriented coho salmon, particularly in the spring months that are important for smolt down-stream migration

Coho fry habitat in the main stem 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 dryer 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 main stem Klamath River. As a result, the survival of young-of-the-year coho in the main stem 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 Iron Gate Dam flows. For example, Project operations during the week of April 19, 1998, appear to have resulted in stranding of fish. Flows through Iron Gate Dam 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 seven coho salmon fry and 738 chinook salmon fry in three 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, 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

Out migrating coho salmon smolts in the Klamath Basin must use the main stem 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 less vigorously defending their territories and forming aggregations (Sandercock 1991) while rising to the surface at night and moving 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 main stem habitat conditions. Although the relationship between flow and smolt survival has not been studied in the Klamath River Basin, this issue has been studied extensively. Several of these studies [Cada et al. (1994), Giorgi (1993), Smith et al., unpublished, and Berggren and Filardo (1993)] in other geographic areas generally supported the premise that increased flow led to increased smolt survival. Scarneccia (1981) also found a highly significant positive relation between total stream flows during the freshwater residency, and the rate of survival to the adult life stage for coho in five Oregon rivers. 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 Iron Gate Dam to Seiad Valley reach) is expected to be higher with higher flows, and lower with lower flows. NMFS notes that SONC coho smolt outmigration timing coincides with natural high seasonal flows. Under the proposed operations described in the current Reclamation BA, flows could be relatively low, especially in dry and critically dry water years.

Although NMFS expects a concomitant reduction in survial of smolts with reduced flows, the NRC Committee found there was no evidence from existing information to support this conjecture. As stated in the April 30, 2002, letter from the NRC Committee, "if low spring flows were limiting survival in dry years, then year classes from wet years should have been stronger than those from dry years, but no evidence was presented that they were. The committee recognized that while smolts theoretically might benefit from higher spring flows that could reduce passage time and exposure to predators, there was no evidence from existing information to support this conjecture." However, NMFS notes that high flows past Iron Gate Dam occurred during the smolt outmigration period (spring of 1999) of the 2001 adult Klamath River coho year class. Flows at Iron Gate Dam averaged 5784 cfs, 3103 cfs, and 1934 cfs in April, May, and June, respectively. The resulting 2001 adult wild coho returns to the Klamath River appear to be the highest since the 1970s (see Status of the Species section). This is the type of information that is necessary to establish the correlations between flow and survival that the NRC noted are lacking for the Klamath River, and this data point emphasizes the need to maintain and expand the Klamath Basin monitoring effort to ensure creation of meaningful data series to better assess the impacts of adverse effects to coho habitat in the main stem of the Klamath River.

8.3.3 Summary - March through June

In summary, NMFS thinks that the proposed action during the March through June period will reduce habitat availability and instream flow. These effects to coho habitat could result in increased predation upon coho fry in the main stem, decreased feeding success of coho young-of-the-year, and reduced out migration success of smolts. These adverse impacts could decrease the survivorship of both young-of-the-year and smolts. As a result, the proposed action may cause reduction in the numbers and distribution of coho salmon in the Klamath River over time.

8.3.4 July through September - Young-of-Year Juveniles

Coho fry are territorial. Fry 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 main stem 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 Iron Gate Dam, 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 Iron Gate Dam to Seiad Valley.

The relationship between Project operations, water temperature and quality of Iron Gate Dam releases, and conditions that exacerbate fish disease mechanisms is complicated and not fully understood. 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 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 main stem 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 Iron Gate Dam would not be expected to cool the main stem river to the preferred range, higher flow releases from Iron Gate Dam (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 Iron Gate Dam releases during this period would result in decreased diurnal temperature fluctuations.

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 main stem 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 main stem 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 main stem 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 Iron Gate Dam summer releases has not been studied and is unknown. Without additional studies, NMFS cannot determine how different Iron Gate Dam flows improve or diminish any survival benefits to coho salmon associated with these areas.

Also, based on the extremely low tributary accretions to the main stem between Iron Gate Dam and Seiad Valley during the summer of 2001, NMFS thinks it is inappropriate to assume that the net "benefits" of associated refugia decrease with Iron Gate Dam flow releases relative to those experienced in dryer years. For example, some aerial imagery suggests that at main stem flows at or above 1,000 CFS thermal areas may be pushed against river banks and into areas that could provide better habitat for rearing coho juveniles. Although thermal areas may remain intact under Reclamation's proposed summer Iron Gate Dam releases in some areas, NMFS suspects they could also be less beneficial or suitable for juvenile coho because lower Iron Gate Dam 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 Iron Gate Dam 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 main stem 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, Iron Gate Dam 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 main stem Klamath River below Iron Gate Dam.

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. Further investigation of the relationship between flows and structure of thermal refugia is needed.

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 main stem river and access to tributaries. Water depth and velocity of the main stem Klamath River between the mouth and Iron Gate Dam 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 Iron Gate Dam 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 Iron Gate Dam flows would vary within any given year depending on meteorological conditions, available water storage capacity in the upper Klamath Basin, and water management activities.

Main stem 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 main stem flows for salmon had not been defined.

Physical habitat modeling specific to adult coho salmon migration 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 Iron Gate Dam to Shasta River reach (Figure 5). 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 drier years, when resultant flows may be less than 900 CFS, chinook spawning habitat availability is reduced, and salmon passage conditions may deteriorate. Also, salmon passage conditions from the main stem Klamath River into some tributaries have been a concern under relatively low main stem and tributary flow conditions (Vogel and Marine 1994). Vogel and Marine (1994) determined that "Because water temperatures and instream flows in these tributaries (the Scott and Shasta rivers) were hostile to maturing salmon at that time of year, providing access for salmon into the tributaries in late August through September (by increasing main-stem flows) was moot." The authors also conclude that "Increasing main-stem flows later in the season (e.g., late September or October) could be a justifiable management action to benefit salmon." Indeed, tributary water temperatures and flows typically become suitable during the coho spawning migration; therefore, low main stem flows would become the overriding factor preventing tributary access. Accordingly, NMFS thinks that tributary access would likely be adversely affected by the minimum main-stem flows that could occur in drier water years under Reclamation's proposed action.

The potential adverse effects from main-stem 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 drier years.

Available information indicates that, in general, water temperatures decrease in the main stem Klamath River in October (Figure 7 and Figure 8). By mid-October, temperatures measured at Iron Gate Dam 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). Relatively few coho salmon have been observed spawning in the main stem 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 7 and 8) 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 Iron Gate Dam and downstream flow accretions are variable during this period. Water temperatures measured at Seiad are typically similar to those at Iron Gate Dam during this period (Figures 7 and 8), 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 if flows drop from 1101 CFS in January to 637 CFS in February (see Table 5). Additionally, if spawning takes place during significantly higher flows during uncontrolled spill from Iron Gate Dam 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 main stem 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 drier water years. Salmon that cannot access natal tributaries may stray and spawn in nearby areas. Therefore, NMFS is concerned that main stem flow conditions that will likely result during “dry” and “critically dry” water years under the proposed action could result in an increase in main stem spawning, which would put additional redds at risk of dewatering due to Project operations. In wetter years, NMFS believes that conditions in the main stem 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 7 and 8; 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 main stem flow conditions predicted in drier years, as described above for adult salmon passage into tributaries (Vogel and Marine 1994). These juvenile coho salmon rearing in the main stem under the low flow conditions predicted in drier 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 main stem, 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 drier 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 know that water quality in the lower Klamath River adversely affects SONC 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 drier years, Project operations can adversely affect main stem Klamath River flows in the Iron Gate Dam 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 main stem and access to tributaries may be adversely affected during drier water years under the proposed action. Coho salmon also spawn in the main stem in the Iron Gate Dam to Shasta River reach, and spawning conditions and subsequent success may be adversely affected under certain flow conditions. Thus, in drier years, coho salmon spawning success in the tributaries and main stem 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 Iron Gate Dam to Shasta River reach. In dry and critically dry water years, the influence of Iron Gate Dam releases extends farther downstream. The amount of flow in the main stem river affects the amount of suitable habitat available for young-of-the-year coho salmon fry that either originated in the main stem or were displaced from their natal tributaries. The amount of suitable rearing habitat available for salmon and steelhead fry in the main stem may adversely affect their survival if sufficient habitat is not available for all salmonid fry in the main stem (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 main stem to tributaries may be adversely affected in the Iron Gate Dam to Shasta River reach, and further downstream during drier water years featuring low accretions to the main stem 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 main stem or move into the main stem 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. Thus, Project water storage and management activities are expected to affect smolt survival in the Iron Gate Dam to Seiad Valley reach of the Klamath River. The influence of Iron Gate Dam flows extends further down the river during some years, depending on meteorological conditions and tributary inflow. As a result, Iron Gate Dam flows are also expected to influence smolt survival downstream, with the extent of this influence varying with meteorological conditions.

During the summer, Iron Gate Dam flows make up a substantial portion of Klamath River flows as measured at any given point in the river. This is particularly true during drier water years. In 2001 (a "critically dry" water year), summer flows in the Iron Gate Dam to Seiad Valley reach were almost exclusively Iron Gate Dam releases. The relationship between Iron Gate Dam 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 Iron Gate Dam flow, the daily mean summer temperatures immediately below Iron Gate Dam are expected to increase slightly relative to scenarios of lower Iron Gate Dam releases. However, Klamath River mean daily water temperatures as predicted at Seiad Valley are expected to decrease slightly under relatively high Iron Gate Dam 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 Iron Gate Dam 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, the range of diurnal water temperature fluctuations in the Klamath River are expected to be smaller under relatively high Iron Gate Dam flows.

As previously discussed, tributary confluence water mixing areas and other potential thermal refugia have been identified in the Klamath River. While NMFS is aware that effects to these refugia, in terms of juvenile salmonid survival, are unstudied and unknown, the Interim NRC Report notes that "[a]ddition of substantial amounts of warm water [from Iron Gate Dam] 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 Iron Gate Dam and Seiad Valley; therefore, any flow measured in this reach of the river essentially came from Iron Gate Dam releases. So, while NMFS is also concerned about the temperature of Iron Gate Dam releases during the summer, this represents the only water in the river in this location during "critically dry" water years (as defined by Reclamation).

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.

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

SONC 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 SONC 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 SONC coho salmon ESU. The status of coho salmon populations within this ESU are depressed relative to their past abundance, based on the limited data available. For these reasons, NMFS considers Klamath River coho salmon to be necessary for the continued survival and recovery of the SONC coho ESU. The Klamath River population is a major component of the SONC 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 Klamath Project according to the proposed action described in Reclamation's biological assessment would generally result in degraded habitat conditions, 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 Iron Gate Dam 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 increase the risk of extinction to Klamath Basin coho salmon by allowing average flows to decline below those which occurred in the reference period and due to adverse affects to coho habitat in the main-stem of the Klamath River and the individuals occupying that habitat.

8.6 SONC Coho Salmon Critical Habitat

Designated critical habitat for SONC coho salmon occurs downstream of Iron Gate Dam (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 Iron Gate Dam relative to no project conditions and unimpaired conditions, 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 SONC coho salmon currently depends, in part, on Iron Gate Dam flow schedules in any given year. Except for critically dry water years, the proposed Project operation includes managing water to meet the lowest average monthly or biweekly Iron Gate Dam 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 lower. As discussed above, main-stem habitat required by coho salmon life stages could be adversely affected, especially during drier years. The level of potential adverse effects of Project operation on main stem Klamath River habitat is greater under the proposed Project operation than during the 1961 through 1997 historical period of record and the 1990 to 2000 reference period. During the historical period of record, the status of Klamath River coho salmon declined and ultimately contributed to their listing under the ESA, in part, probably due to main stem Klamath River habitat conditions. 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. Therefore, NMFS has determined that critical habitat within the main stem of the Klamath River is likely to be adversely modified.

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 Iron Gate Dam 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 SONC coho salmon production within non-Federal lands are unlikely without changes in forestry, agriculture, and other practices that occur in riparian areas.

Now that SONC 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 SONC 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 Iron Gate Dam (e.g., the Shasta River, Scott River, and Indian Creek) affect the timing and amount of water accretions to the main stem Klamath River, which affects the amount of tributary and main stem 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 SONC 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 SONC coho salmon. Based on the NRC report (2002a), NMFS finds that the action, as proposed, is likely to adversely modify critical habitat for the SONC coho salmon.

11. REASONABLE AND PRUDENT ALTERNATIVES

11.0 Reasonable and Prudent Alternatives

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

This RPA consists of the following elements:

1) specific water management measures over the next 10 years (2002 - 2012);

2) a water bank and water supply enhancement program to provide flows to the Klamath River below Iron Gate Dam to improve coho salmon habitat;

3) an agreed upon long-term flow target to be achieved by 2010 (see Table 8);

4) an inter-governmental task force to develop, procure, and manage water resources in the Klamath River Basin; and

5) an inter-governmental science panel to develop and implement a research program to identify and fill gaps in existing knowledge regarding coho salmon and their habitat requirements during various life history stages and water year types.

NMFS thinks that this approach provides a reasonable balance between the findings of the NRC Committee on Threatened and Endangered Fishes in the Klamath River Basin (2002a, 2002c) and the findings of Hardy and Addley (2001). NRC concluded that given the absolute scarcity of coho, it seemed unlikely to the committee that the coho is saturating its available main-stem habitat, even without augmentation of main-stem flows. The Committee did not find convincing evidence that the main stem is a significant rearing area for coho, even though it seems likely that the main stem is an important rearing area for other anadromous species. Neither did the committee find evidence from existing information to support the conjecture that smolts might benefit from higher spring flows that could reduce passage time and exposure to predators. Hardy and Addley (2001) present a detailed analysis of the effects of the Klamath Project on main-stem habitat for a suite of species including the anadromous fish. Inherent in Hardy and Addley's claim that their flow recommendations are necessary to aid restoration efforts and the maintenance of the aquatic resources within the main stem of the Klamath River is an assumption that aquatic species will react to changes in the hydraulic environment (Hardy and Addley 2001). The NRC committee concluded that a convincing case had not been made that marginal increases in habitat would lead to marginal increases in growth or survival, especially in view of this species' scarcity, which suggests failure of the species to saturate its main-stem habitat under current conditions (NRC 2002c). Hardy and Addley (2001) point out that their assumption that aquatic resources will react to changes in the hydraulic environment is rooted in ecological principals and has been demonstrated to be valid in applied research (several examples are referenced). Although there is no direct evidence that Klamath River coho will benefit from higher spring flows, NMFS thinks that at least under some conditions (e.g., critically dry years) the assumption that increases in coho main-stem habitat may be beneficial to at least some coho life history stages (e.g., smolts) may be valid. Coho smolts must compete with chinook and steelhead smolts for resting areas and spaces to avoid predators during their migration to sea. Increase flows would provide more area for this complex of species and reduce interspecific competition for space. In addition, NMFS notes that benefits derived from quicker passage to the ocean are not necessarily density dependent, so increases in survival derived from quicker passage of smolts to the ocean should be derived regardless of whether the habitat is limiting or not. While the NRC Committee concluded that there currently is little scientific support for minimum flows as a means of enhancing the maintenance and recovery of the coho population, it pointed out in its April 30, 2002 letter (NRC 2002c) that it did not conclude that NMFS must be wrong in its recommendations on main-stem flows in its April 6, 2001 RPA. As stated in the interim report, the NRC committee, as required by its task, considered the scientific basis for the NMFS recommendations and, in doing so, found the evidence and arguments for main-stem flows to be weak, but this finding does not necessarily mean that the NMFS recommendations are incorrect.

NMFS thinks a prudent approach to consideration of the best available science, in light of the current status of SONC coho salmon would give deference to these potential benefits by developing a science based program to test the assumptions underlying Hardy and Addley's (2001) work and developing tools (e.g., water bank and conservation program) to provide the flexibility to increase flows over time. While NMFS agrees with the NRC committee's conclusion that there is no direct evidence from the Klamath River that coho will benefit from increased flow, NMFS' professional judgement based on studies for the Columbia River (Cada et. al., 1994) and the Sacramento and San Joaquin Rivers (DOI 1999) is that augmentation of spring flows likely would benefit coho in the Klamath River. Therefore, this RPA includes a science program to refine flow recommendations, a water bank to improve spring flows for smolts, and recommended flow schedule to be implemented by 2010, unless modified by new scientific information.

Further, NMFS thinks that this RPA is consistent with the findings of the NRC interim report because it provides for use of the water bank to buffer against allowing the average flows to decline below those of the reference period. In Reclamation's proposed operations, the water bank would have operated to meet the flow described in Table 5.9 of the BA. Under this RPA, the water bank will be used to exceed the flows in Table 5.9 of the BA and contribute to improved spring time and, if appropriate, summer habitat conditions. This provides the precautionary mechanism to improve smolt out migration habitat and improve smolt survival during smolt migration to the ocean. The size of the water bank will increase from 30 TAF to 100 TAF through four incremental steps. In addition, Reclamation has committed to provide its share of the flows that are recommended by NMFS to optimize habitat for coho smolts in the main stem in the Shasta to Scott River reach of the Klamath River, and to a process that will include the States of California and Oregon in providing the remainder of those flows. Finally, Reclamation has committed to convening a science panel to oversee design and implementation of experiments to improve the quality of science regarding the relationship between flows and coho survival and recovery in the Klamath River. These experiments will be conducted to refine the long-term flow targets (Table 9) established by NMFS based on the habitat suitability curves for coho fry contained in Hardy and Addley (2001). NMFS recognizes that Hardy and Addley (2001) habitat suitability criteria, upon which it relied to deriving long-term flow target found in Table 9 may change as the report progresses through public comment and peer review to a final report, and that even then new information from the science program embodied in this RPA could refine that information further. Therefore, NMFS views the flows recommended in Table 9 as planning targets that could be adjusted as the body of scientific information increases. NMFS thinks this a risk averse approach that provides incremental improvements in habitat conditions while the science is developed to allow refinement of our understanding of the role of main-stem habitat in coho survival and recovery and it provides a mechanism to increase flows to the extent the need is supported by the science that is developed.

11.1 Overview of Development of RPA

On April 23, 2002 Department of Interior and Reclamation leaders met with NMFS to discuss NMFS jeopardy finding and NMFS view that consideration should be given to protecting main-stem Klamath River habitat. NMFS presented a proposal that recognized both the NRC view that scientific support for increased flows was weak and a conservative view that main-stem habitat may be limiting, particularly for the smolt population which is dependent on suitable conditions in the main stem to complete its migration to the ocean. NMFS proposed flows (RPA flows) which were calculated based on use of the habitat suitability curves in the Hardy and Addley draft phase II report (2001) (see section 11.4.2 and Table 9). Interior indicated that these RPA flows were not viable in its view, because they would result in deficiencies in deliveries to project contractors of such a magnitude and frequency that the RPA flows could not be considered reasonably to allow Reclamation to operate in a manner consistent with the intended purpose of the project.

One reason the deficiencies are large is that the calculation of the RPA flows relied on unimpaired flow estimates from Hardy and Addley's draft phase II report which in Reclamation's view holds them accountable for depletions in flows that are attributable to water development that had been permitted or allowed by the States of California and Oregon subsequent to the Klamath Projects authorization, acquisition of water rights, and initiation of operations. NMFS reiterated its view that the appropriate (i.e. risk averse from an ESA perspective) consideration of the Hardy and Addley draft phase II reports was to give it a level of consideration commensurate with the NRC findings (NMFS thinks that the NRC committee confirmed this view with its recognition that its finding does not necessarily mean that the NMFS recommendations are incorrect). In NMFS view, Reclamation should implement a strong science based program to either verify or reject the underlying assumptions in the Hardy and Addley draft phase II report, and implement a water management program that has sufficient flexibility to ensure that there are no incremental depletions beyond those that are reflected in the reference period (as suggested by NRC committee) and to provide increased flows if the science develops to support increased flows. NMFS and Reclamation agreed to continue discussions to develop an RPA, and on April 29 and 30, 2002, NMFS and Reclamation met to further develop an RPA.

In that meeting, Reclamation acknowledged that to the extent that coho are harmed by reductions in flows in the Klamath River below Iron Gate Dam, it is responsible for a share of the remedy proportional to Project impacts and it expects to be a key player in facilitating complete achievement of the remedy. Reclamation proposed using a calculation of percent irrigable acres in the upper Klamath Basin that are irrigated by project contractors to determine its share of the remedy. As a result, Reclamation would be responsible for 57% of the releases at Link River Dam needed to result in the Iron Gate Dam flows described in NMFS' RPA flows or the flows that are identified in Table 5.9 of the BA, whichever are greater.

NMFS pointed out that establishing flows of only 57% of the RPA flows may not avoid jeopardy over the 10-year period of proposed Project operations, and therefore would not constitute a viable RPA. This problem was resolved when Reclamation agreed that it would use its authorities to establish a multi-agency task force/working group, comprising Federal, State, Tribal and, where possible, local agencies and interests, to develop the other 43% of the flows identified in the RPA. The water to achieve these additional flows would come from areas outside the boundaries of the Klamath Project. This approach anticipates that the States of California and Oregon will participate in the process, step up enforcement of existing water rights or water rights laws, and develop programs to improve flows in the tributaries to the Klamath above and below the Project.

At the meeting, NMFS and Reclamation explored Reclamation's current capability to meet their 57% share of the RPA flows and determined that Reclamation needed time to develop resources to meet that obligation. Reclamation stated that development of the water bank was its preferred approach to making progress toward 57%. Reclamation agreed to a phased approach and schedule that would build the water bank to 100 thousand acre feet (TAF) to be dedicated to making progress toward its 57% share in four increasing annual increments. By water year 2006, Reclamation will have developed a water bank of 100 TAF to augment Iron Gate Dam flows and other measures and actions to make up any difference between 100 TAF and 57% in the years where more water would be required.

Also beginning in water year 2002, Reclamation will initiate a State/Federal process to improve conditions in the tributaries, including increase flows that would contribute to meeting the RPA flow (i.e., the other 43%). Initially this process would focus on refinement of the science to determine what the best main-stem flow should be for the purpose of providing sufficient main-stem habitat conditions for coho salmon, additional non-flow measures to improve the baseline for coho habitat, and then develop and implement programs to increase instream flow in the tributaries that would also augment instream flows in the main stem. By water year 2009, NMFS would expect to see progress by this task force, and by water year 2010, NMFS would expect the RPA flows to be realized, unless those flows had been modified by results of scientific investigations conducted throughout the course of the decade covered by the proposed action.

Reclamation also agreed to convene a panel of experts to assist in designing additional studies to improve our understanding of the relationship between flows and fish survival. Reclamation also agreed to initiate experiments in the summer of 2002, to begin testing the effect of various flows on thermal refugia in the main-stem Klamath River.

Given that coho are primarily tributary spawners, that main-stem spawning and rearing habitat is likely not limiting at the current population size, and recognizing the importance of the main-stem as a migratory corridor for adult and down-stream migrating smolts, NMFS thinks that the approach contained in this RPA sufficiently addresses the adverse effects of the Klamath Project to SONC coho salmon and its critical habitat by incrementally improving smolt migration habitat over conditions that would be achieved in the BA and those suggested in the NRC interim report. It provides a conservative approach to increase main-stem habitat incrementally while the studies are conducted to better refine the understanding of the relationship between flows and population response. In the event the studies determine more flows are needed, Reclamation will be prepared to provide them either as their contribution via project resources or through facilitation of an inter-governmental process. In the contrary, the flow targets may be reduced to levels supported by the science.

The following table (Table 8) summarizes the major components of the RPA:

<table>
<tr><th colspan="11">Table 8. Proposed RPA Elements by Water Year</th></tr>
<tr><td>Phase</td><td colspan="4">Phase I</td><td colspan="4">Phase II</td><td colspan="2">Phase III</td></tr>
<tr><td>water year</td><td>02</td><td>03</td><td>04</td><td>05</td><td>06</td><td>07</td><td>08</td><td>09</td><td>10</td><td>11</td></tr>
<tr><td>water bank</td><td>30 taf</td><td>50 taf</td><td>75 taf</td><td>100 taf</td><td>100 taf</td><td>100 taf</td><td>100 taf</td><td>100 taf</td><td>100 taf</td><td>100 taf</td></tr>
<tr><td>57 % [1]</td><td></td><td></td><td></td><td></td><td>57%</td><td>57%</td><td>57%</td><td>57%</td><td>57%</td><td>57%</td></tr>
<tr><td>task force</td><td>develop MOU</td><td colspan="2">acquire resources and establish taskforce</td><td colspan="2">plan development, continued studies, non-flow measures</td><td colspan="3">non-flow measures and incremental contributions to making up remaining 43% or RPA flows</td><td colspan="2">Long-term RPA flows achieved</td></tr>
<tr><td rowspan="3">initial studies</td><td colspan="4">resolve summer flow v. temperature issue</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">smolt survival v. flows</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="10">monitoring distribution and abundance of adults and juveniles: determine importance of main stem for coho juvenile rearing habitat</td></tr>
</table>

1 - in a few instances the flow resulting from 57% of the RPA flows is less that the flows proposed by Reclamation in its BA . In those instances, Reclamation will meet the flow proposed in the BA.

The following sections provide an overview of the RPA's program elements within each of its three phases.

11.2 Phase I - 2002 - 2005

During the first three years of implementing this BO, NMFS expects Reclamation to 1) lay the ground work for gaining cooperation of Oregon, California, and Klamath River Tribes; 2) establish scientific panel to guide investigations to address issues identified in the interim and final NRC committee reports on threatened and endangered fishes in the Klamath River Basin; 3) and begin to develop water supplies that are devoted to increasing flows in the Klamath River below Iron Gate Dam; and 4) operate to the minimum flows identified in Table 5.9 of Reclamation's BA (Reclamation 2002), as modified on an annual basis by agreed upon use of the water bank for improved spring flows and/or summer flows manipulated to accommodate study of the effect of higher summer flows on the integrity and structure of thermal refugia.

11.2.1 Hydrology

11.2.1.1 Water Year Types

NMFS thinks there is ecological value in natural variability; however, due to operational constraints, truly natural variability within and between years is not possible. Therefore, NMFS proposed 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. The manner in which Reclamation's four water year types are partitioned results in above average and below average water year types, and corresponding flow regimes, spanning 80% of all possible water supply forecasts. Hardy and Addley's partitioning of water year types spans four possible flow regimes over this same set of water availability forecasts. Natural variability in flow, both within and between years, plays an important role in maintaining the various ecological functions of rivers (Poff, et al 1997). Therefore, NMFS thinks that the four water year types proposed by Reclamation do not adequately partition and reflect the a range of flow variation that NMFS thinks 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).

In producing flow recommendations for each of these five water year types, NMFS used the unimpaired flow estimates provided in the Hardy Phase II report to help calculate appropriate instream flows below Iron Gate Dam. These unimpaired flow estimates are given in increments of 10% exceedence, while water year types are designated over ranges of Upper Klamath Lake inflow volume exceedence values. For example, an "average" water year is designated as having an Upper Klamath Lake inflow exceedence range of 40% to 60%, and the Hardy Phase II unimpaired values are available for specific 10% exceedences of 40%, 50%, and 60%. Therefore, NMFS had to select which specific unimpaired flow exceedence value from the Hardy Phase II report best represented the range of water available in a given water year type. 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, NMFS believes the estimates as presented are reasonable approximations of prevailing unimpaired spring flows during the various water year types.

11.2.1.2 Flow Management

During water year 2002, Reclamation will provide flows for a below average water year plus a 30 TAF water bank (used in May 2002). For 2003 through 2005, Reclamation will meet or exceed the Iron Gate Dam flows described in Table 5.9 of the final biological assessment as modified by conversion to five water types plus the additional volume to be provided by the water bank. Specifically, the minimum volume of additional water during water years 2003 through 2005 will be 50 TAF, 75 TAF, and 100 TAF, respectively. If Reclamation does not meet or exceed the Iron Gate Dam flows described in Table 5.9 and provide the additional volume of water specified during water years 2003 through 2005, it must reinitiate section 7 consultation with NMFS. The amount of this additional water continues to increase with each successive water year as Reclamation continues to develop water resources to support a reliable water bank. This additional water should improve instream flows for coho in the lower Klamath River main stem beyond the flows established in Table 5.9 and could be used to: (1) improve downstream smolt survival and improve coho fry survival in the spring; (2) investigate effect on increased summer flows on summer rearing conditions for juveniles in the main stem; or (3) used to both achieve some combination of (1) and (2). By March 31 of each year, NMFS and USBR will determine how this additional water will be distributed for release.

In addition, in order to prevent potential coho salmon stranding, Reclamation will operate the Project to provide water and coordinate with Pacificorp to achieve the following rates for ramping down of flows between monthy or biweekly timesteps below Iron Gate Dam: (1) decreases in flows of 300 CFS or less per 24-hour period and no more than 125 CFS per four-hour period when Iron Gate Dam 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 Iron Gate Dam flows are 1,750 CFS or less.

11.2.2 Conservation Implementation Program

Achieving the target flows NMFS has proposed based on the Hardy and Addley (2001) coho fry habitat suitability curves, will likely require more contributions to flow than can be reasonably provided by Reclamation alone. The States of California and Oregon have played a key role in determining how the Klamath River Basin's water resources have been developed and allocated and a direct role in enforcing existing water rights. At the same time, the States are responsible for management of fish and wildlife resources. Similarly, Reclamation is a pivotal player because it is responsible for the operation of the Klamath Project which substantially affects flows, fish habitat, and water quality in the Klamath

River below Iron Gate Dam. PacificCorp has interest because it uses instream flows resulting from Reclamation's Klamath Project to generate hydropower. NMFS, through the Secretary of Commerce, is responsible for administering the ESA. Tribes also have considerable interest in water management in the Klamath River Basin because the Tribes' established fishing rights are dependent upon sufficient instream flows to support viable tribal fisheries.

Because the existence of the Klamath Project is not the only human activity that adversely affects aquatic habitat and anadromous salmonid populations in the Klamath River, this RPA strives to addresses the larger context of actions that affect threatened salmon in the Klamath River Basin. To begin to effectively address these broader issues, Reclamation will establish in Phase I, by a Memorandum of Understanding (MOU) among NMFS, FWS, Reclamation, BIA, the States of California and Oregon, and the Tribes a "Conservation Implementation Committee." The MOU will be completed by the end of 2002. The immediate responsibilities of the Committee will include, but will not be limited to:

- Establishment of a science review panel and oversight of the development and implementation of scientific studies to refine the long-term RPA targets and address other prioritized investigations.

- Oversight of the identification and implementation of actions, beyond the operation of the Klamath Project, to supplement main-stem flows achieved in Phase II to achieve long-term RPA targets and improve habitat conditions for salmon on important lower Klamath Basin main-stem tributaries.

- Further develop information to define the relative importance of the main stem and tributary habitat in the Klamath River Basin, including a program to monitor the distribution and abundance of naturally spawning coho and juvenile coho. The lack of this basic data is a deficiency that needs to be addressed so that the correlations between flow and coho survival that NRC Committee found lacking can be established.

NMFS also expects this Committee to facilitate:

- Development and implementation of feasibility studies, under the Klamath Basin Water Supply Act (P.L. 106-498) to identify opportunities for increased surface storage, ground water development, and winter irrigation.

- Review and application of new studies that improve understanding of the factors limiting the recovery of coho salmon in the Klamath Basin. Possible reports include the NRC's report scheduled for finalization in March 2003.

- Review of the methodology and results of the determination of Reclamations proportion of responsibility. NMFS and Reclamation used proportion of acres irrigated to define this amount. The committee should review this approach to determine whether the irrigated acreages are correct and whether irrigated acres is an appropriate measure or whether volume of water diverted or consumed would be a better measure.

- Leasing of water rights in the upper Klamath Basin (outside of Project) to improve main stem flows and leasing of water rights in the Scott and Shasta Rivers to improve both main stem and tributary instream flows. Assurances should be provided that leased water remains in the rivers to benefit coho.

- Consider elimination of inter-basin transfer of Klamath River water to the Rogue River Basin to improve flows in the Klamath River.

- Pacificorp's active participation in the development of the water bank and recognition of headwater benefits that will potentially result from increased Klamath Project flows.

- California's Department of Water Resources enforcement of established water rights on the Scott and Shasta Rivers, and Oregon Department of Water Resources enforcement of water rights application process while and until the Upper Klamath River Basin adjudication process is completed.

- Coordinated water management plans in the Shasta and Scott Rivers to minimize the potential that simultaneous water diversions will strand salmon.

- Initiation of studies to identify minimum instream flows to conserve coho on the Shasta and Scott Rivers.

- Screening and gaging of all diversions in the Shasta and Scott Rivers.

- Gaging diversions in the above Upper Klamath Lake to ensure compliance with water rights applications.

11.2.3 Investigations and Science Review Panel

In order to continue to refine the RPA target flows identified in section 11.4, Reclamation will immediately implement scientific studies to address the questions described below.

(1) What are the effects of various summer Iron Gate Dam flow regimes on habitat refugia in the main stem Klamath River ?

(2) To what extent do different spring Iron Gate Dam flow regimes effect survivorship of coho smolts during outmigration?

The methodologies used to address these questions must provide robust information and analyses that are considered to be scientifically meaningful and valid. To accomplish these goals, Reclamation will appoint, with NMFS concurrence, a multi-disciplinary independent Scientific Review Panel, by December 2002, to advise in the development and implementation of investigations to better understand the effects of Klamath River main stem flows on coho survival. Reclamation will review with NMFS the composition and role of this panel, and they will jointly determine if modifications to the composition of the panel would be beneficial. The specifics of the study design and implementation details should be consistent with a consensus agreement of the Scientific Review Panel. The use of a Scientific Review Panel will assist in the development of scientifically-supportable study designs and appropriate implementation of recommended study methodologies, and to ensure scientifically supportable conclusions are achieved. Reclamation should provide for funding to support the convening of the Scientific Review Panel and implementation of the studies.

During implementation of the study design developed by the Scientific Review Panel, Reclamation may vary Iron Gate Dam flows under this RPA during any water year type as long as any alteration of Iron Gate Dam flows follow the methodology approved by the Scientific Review Panel. 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 Iron Gate Dam releases. If the scientific findings from the above described study warrant establishment of alternative Iron Gate Dam flows, NMFS will amend the RPA long-term target flows.

As mentioned above, the Conservation Implementation Committee will identify additional studies that improve understanding of the factors limiting the recovery of coho salmon in the Klamath Basin. The Committee will utilize the Scientific Review Panel to assist in the development of scientifically-supportable study designs and appropriate implementation of recommended study methodologies to ensure scientifically supportable conclusions are achieved.

11.3 Phase II - 2006 - 2010

During the second phase of implementation of this BO (2006 - 2010), NMFS expects Reclamation to 1) maintain a water bank of 100 TAF, 2) contribute 57% of the long-term RPA flow to the river below Iron Gate Dam or the flow identified in its BA which ever is greater, 3) implement non-flow mitigation measures in cooperation with the Conservation Implementation Program, and 4) continue to conduct investigation to refine RPA flows and relationship between flow and coho survival.

11.3.1 Hydrology

By water year 2006 and through water 2012, Reclamation will meet or exceed its proportional share of its influence to Iron Gate Dam flows or Table 5.9 flows, whichever is greater. Reclamation's proportional share is calculated in the following manner. Using water from Upper Klamath Lake, Reclamation's Klamath Project irrigates 206,149 acres of land in the Upper Klamath Basin. Outside of the Project area, 157,000 acres of land are irrigated using water from the Klamath River above Upper Klamath Lake. The total irrigated area that affects flows in the Klamath River above Iron Gate Dam is 363,149 acres. Thus, the Project service area is responsible for 57 percent of the irrigated area that affects flows in the Klamath River above Iron Gate Dam. This percentage represents Reclamation's proportional share of responsibility of influence to Iron Gate Dam flows. To calculate Reclamation's proportional share of minimum Iron Gate Dam Flows, the long-term RPA flows were multiplied by 0.57 for each water year type. In the instances where this calculation results in lower flow than are proposed in Reclamations biological assessment, Reclamation will provide the flows contained in the biological assessment (Table 5.9).

11.3.2 Conservation Implementation Program

During Phase II, NMFS expects the Committee to evaluate the results from investigations that were implemented in Phase I, and to make progress toward increasing flows toward the longterm planning target, as modified by new information.

11.4.0 Phase III

By water year 2010 and through water year 2011, NMFS expects that implementation of the Conservation Implementation Program will have resulted in achieving main stem lower Klamath River flow targets described below. NMFS expects Reclamation and other parties to manage the water resources of the basin to meet these flows unless NMFS modifies them based on results of scientific investigations conducted throughout the course of the decade covered by this RPA. In the event that BOR and the Conservation Implementation Committee are not successful in meeting the RPA flows (as adjusted by better understanding of the flow/coho survival relationship), NMFS and Reclamation will reinitiate consultation to: review the status of coho; consider modifying the flow schedule to reflect the best available science at that time, and additional measures to ensure SONC coho are not jeopardized by continuing operation of the Klamath Project.

11.4.1 Rationale for Long-term flow targets

11.4.2 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 Iron Gate Dam, and finds that the report contains information and analyses that provide an acceptable basis for development of long-term flow targets. In developing long-term flow targets NMFS thinks focusing on conditions that provide adequate migration flows and daytime refuge habitat to optimize coho smolt survival is appropriate. Given that coho smolts have survived often difficult conditions for at least 15

months, and that all smolts must migrate to the sea through the main-stem Klamath River, NMFS thinks that the smolt life stage is an important life stage to protect and for which suitable conditions in the main stem Klamath should be provided.
As described in the Effects of the Proposed Action section of this biological opinion, NMFS expects smolt survival to increase with increasing spring flows.

NMFS is aware that the NRC Committee concluded in its April 30, 2002, letter to NMFS, that while smolts theoretically might benefit from higher spring flows that could reduce passage time and exposure to predators, there was no evidence from existing information to support this conjecture and that if low spring flows were limiting survival in dry years, then year classes from wet years should have been stronger than those from dry years.

NMFS is also aware that demonstrating a statistically significant correlation between year class strength and magnitude of flows is complicated by within year variability (i.e. a wet spring followed by hot dry summer would likely not produce the same benefit as wet spring followed by a cool summer), in river variability of other environmental parameters (competition from other fluctuating populations of other salmon species and variable predations rates by fluctuating predator populations) that affect survival and environmental variability in the ocean. Consequently, demonstrating a statistically significant correlation between flow and year class strength will likely take several generations of coho. Nevertheless, NMFS thinks that some evidence is available that suggests that coho smolts in the Klamath Basin benefitted from higher spring flows in 1998 and 1999. As reported in Section 8.3.2 of this biological opinion, water years 1998 and 1999 rank among the wettest years in historical record of the Klamath Project. Coho fry rearing in the tributaries and Klamath main stem probably experienced better habitat conditions during the spring of 1998. Due to the high flows in the Klamath River the following spring, the 1998 year class of coho fry should have again experienced relatively better habitat and survival conditions in the Klamath River during their outmigration as smolts in 1999. In the winter of 2001, wild adult coho returns from the 1998 brood stock to at least one Klamath River tributary (i.e., Scott River) was the highest since the 1970's. While this represents only one data point, NMFS thinks it is supportive of the conjecture that smolts benefit from good quality habitat during their migration to sea. It also supports NMFS view that continued monitoring of coho distribution and abundance is essential to understanding the relationship between flow and coho survival and that prudent planning for long-term management of flows below Iron Gate Dam should consider providing improved habitat for coho smolts.

While NMFS currently does not have a metric for determining the precise main-stem 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 for the following reasons. 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 least 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 daytime 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 necessarily 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).

McMahon and Holtby (1992) studied coho smolt behavior in a small, wood dominated stream on Vancouver Island. They found that coho smolt abundance was highly correlated to woody debris volume, and that 82% of smolts (N = 1260) observed during the day were within one meter, and 95% were within two meters, of woody debris. These smolts were generally found in the same habitats and areas as coho fry. The main stem Klamath River is not a wood dominated stream; however, woody debris cover is available along the rivers margins (Tom Shaw, USFWS, pers. comm, May 2002).

Also, crews from USFWS snorkeled rivers in western Washington to study habitat use by fish, and to determine the habitat value of riprap. Their observation of coho smolts during daylight hours lead them to the following conclusions (Roger Peters, USFWS, pers. comm.): (1) they are generally found in the same areas in which you would expect to see coho fry (near woody debris); (2) smolt behavior seems to be temperature dependent, with smolts being very photo-negative and deeply hidden in cover when water temperatures are cool (i.e., <10 degrees C), and more active and visible when temperatures are warmer; and (3) they are most often found rearing during the day in cover located near the bottom in eddy, dead water, or backwater (slough) habitats.

Therefore, NMFS thinks that evidence both from empirical observations in the Klamath River and other systems indicates the validity of using coho fry habitat as a surrogate for coho smolt habitat and flow conditions appropriate to optimize smolt survival during their downstream outmigration to the ocean.

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 Iron Gate Dam releases are the dominant contributor of flow to this reach, and this reach is the first main stem 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, the two-dimensional curve for the Iron Gate Dam 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 indiscernible 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 harm the population. However, we note that reducing levels of fry habitat in the section between Iron Gate Dam and Shasta River by more than 20% would reduce habitat during average, above average, and wet spring months such that habitat conditions in the main stem 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.

Assuming the long-term need to restore coho habitat in the Klamath River main stem, NMFS' opinion is that fry habitat should be maintained at not less than 80% of unimpaired levels (i.e., a reduction of not more than 20% of unimpaired) as a long-term target.

Using coho fry habitat suitability curves as a surrogate for coho smolts, we determined the long-term Iron Gate Dam 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 20% of available habitat, depending on the water year type, to arrive at the flow that would provide the corresponding level of available habitat. Next, we estimate accretions between Iron Gate Dam and the midpoint of the Shasta to Scott River reach by calculating the differences in the simulated unimpaired monthly flows for the Shasta River and Scott River reach and the simulated unimpaired monthly flows for the Iron Gate to Shasta River reach (Tables 51 and 54 in Hardy and Addley, 2001). We then subtract the estimated accretions between Iron Gate Dam and the midpoint of the Shasta to Scott River reach to determine the necessary Iron Gate Dam release needed to produce the recommended flow in that reach. See Figure 9 for an example of this technique. Using this technique, NMFS calculated the long-term target flows. Under this RPA, NMFS considers these minimum instantaneous flows (see Table 9).

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 2750 CFS and April flows dropping to 1500 CFS.

11.4.3 July through September

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

The relationship between Project operations, water temperature and quality of Iron Gate Dam releases, and conditions that exacerbate fish disease mechanisms is complicated and not fully understood. For example, the water temperature modeling component of SIAM indicates that, over the course of the irrigation season (April through September), water temperatures in the main stem are likely affected by differential Project operations and associated water releases at Iron Gate Dam. Specifically, results from the water temperature model as applied in dryer water years (when ambient temperatures are higher) suggest that in general, the mean daily temperature of Iron Gate Dam releases are higher during the summer directly below Iron Gate Dam under relatively high Iron Gate Dam 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 Iron Gate Dam 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 Iron Gate Dam 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 Iron Gate Dam to Seiad Valley, this model also indicates that temperatures increase more in this main stem reach under relatively low flows, and less under higher flows. This supports the general expectation that diurnal temperature fluctuations in the main stem are higher under lower summer flows.

In addition to affecting the summer temperature regime in the main stem, Iron Gate Dam 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. NMFS suspects that the interaction between Iron Gate Dam releases and these thermal refuge areas are complicated and vary among 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. Based on the extremely low tributary accretions to the main stem between Iron Gate Dam and Seiad Valley during the summer of 2001, NMFS cannot simply assume that the net “benefits” of associated refuge areas decrease with any Iron Gate Dam flow increases relative to those experienced in other drought years. 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 Iron Gate Dam summer releases is unknown and needs to be investigated.

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 main stem; (2) Hardly and Addley 2001 recommend minimum dry summer flows of 1,000 cfs and higher summer flows in wetter years; and (3) coho juveniles have been observed in the main stem in water in excess of 20 EC; 4) higher flow, in the vicinity of 1000 cfs are not expected to increase temperatures and would have the benefit of dampening the magnitude of diurnal fluctuations in temperature (Deas and Orlob, 1999); NMFS recommends maintaining 1,000 cfs as a long-term planning target for releases from Iron Gate Dam during the July through September period in all water year types until a well-designed study of the main stem and refuge areas is developed and implemented under the conditions established in section 11.2.3.

11.4.4 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 main stem and depending on meteorological conditions, Iron Gate Dam releases may affect passage conditions along the length of the river. Regardless of meteorological conditions, Iron Gate Dam releases influence passage and spawning conditions immediately downstream of Iron Gate Dam, and may influence passage conditions from the main stem into individual tributaries where most coho salmon spawning occurs.

For wet, above average, and average water year types (as defined in section 11.2.2), NMFS finds that the Iron Gate Dam 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 Iron Gate Dam to Shasta River reach under this Iron Gate Dam discharge. NMFS assumes that main stem passage, tributary access, and spawning habitat for coho salmon will also be adequate under this Iron Gate Dam flow regime.

During below average and dry water year types (as defined in section 11.2.2), the amount and timing of increased Iron Gate Dam 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, unless modified by future study results, NMFS 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. This would preclude the possibility of releasing water unnecessarily and attracting adult coho to poor quality habitat that will likely exist prior to commencement of fall rains.

As part of this RPA, in below average and dry water years, Reclamation will convene a group of representatives of Reclamation, NMFS, USFWS, BIA, CDFG, the Yurok Tribe, the Karuk Tribe, the Hoopa Valley Tribe, the fishing industry and the farming community by mid-September to discuss current hydrologic, meteorologic, and biological conditions and seek consensus on Iron Gate Dam flow changes for the October through January time period. Although NMFS envisions that 1,300 CFS Iron Gate Dam releases should be the "starting point" for such discussions, NMFS also acknowledges that alternative Iron Gate Dam 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 Iron Gate Dam flow decisions associated with the next operations year as outlined in the "March through June" section of this RPA. Reclamation will evaluate whether utilization of such a group for these purposes would require an exemption under the Federal Advisory Committee Act.

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.

11.4.5 Long-term flow targets and future modifications

By water year 2006 and through water year 2012, Reclamation will meet or exceed its proportional share of its influence to the Iron Gate Dam flows identified in Table 9 of this RPA or flows described in Table 5.9 of the BA (Reclamation 2002), whichever are greater. By water year 2010 and through water year 2011, NMFS expects that the implementation of the Conservation Implementation Program to have resulted in achieving main stem lower Klamath flows identified in Table 9 below. If the scientific findings from additional studies and reports, including those proposed under Section 11.2.2 and 11.2.3 of this RPA, the final NRC report, and final Hardy II report, at any time during the 10-year period warrant modifying Iron Gate Dam flows identified in Table 9, NMFS will consider those findings and make appropriate adjustments to Table 9. Future adjustments to long-term flows may also include an evaluation of whether adjustments should be made to better mimic the shape of the natural hydrograph and minimize the potential for stranding events during monthly transitions between flow targets. For example, monthly flows should probably avoid "flat-line" flows that do not produce some variability in flow for extended periods (e.g., between months). Adjustments could also include dividing certain months (e.g., March through June) into weekly flow recommendations to better mimic the natural hydrograph. In addition, additional adjustments in spring months might be necessary in dry and below average water years to be more conservative in years when risk to coho could be greater (e.g. a reduction of not more than 10% of habitat as opposed to a reduction of 20%). If NMFS finds that the long-term flows should be modified based on the findings from these additional studies and reports, NMFS will amend the long-term flows accordingly.

The following Table is a summary of the Iron Gate Dam long-term flow targets expected to be achieved by water year 2010 unless modified by study results. These flow targets are instantaneous minimum flows.

Table 9. Recommended Long Term 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	1,450	1,725	2,750	2,525	2,300
April	1,500	1,575	2,850	2,700	2,050
May	1,500	1,400	3,025	3,025	2,600
June	1,400	1,525	1,500	3,000	2,900
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”

NMFS notes that the flow for wet years are less that for above average flows in March through June and that flows for above average years are less that average years for March and April. This a result of the shape of the coho fry habitat suitability curve from Hardy and Addley (2001) which was used to derive the flows in the Table (see Figure 6). This characteristic of the curve may change when the final Hardy and Addley report is finalized. NMFs does not view this a problem because in most wet years (as defined by the 10% probability of exceedence will have uncontrolled spill in March, April, and perhaps May.

11.5.0 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. 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 SONC 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 main stem 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 spring time reductions in flow as the project transitions for uncontrolled spills to controlled operations. Rates for ramping down releases during this transition prescribed to minimize stranding of juvenile coho. However, NMFS is unable to predict water year types so NMFS cannot determine what actual flows will be below Iron Gate Dam in the future. Therefore NMFS is not able to estimate number of strandings of coho salmon that might occur as result of reducing flows. However, NMFS expects that several flow study and water temperature and quality data collection efforts will be ongoing during this period, and observations will provide in-season information regarding actual fish strandings that may occur. NMFS expects that this circumstance will only affect the small portion of the population that is resident in the main stem below Iron Gate Dam and it will be mitigated observation of the prescribed ramping rates and rescue efforts similar to those that were implemented in 2000 and 2001by State, Federal, and Tribal biologists. The low levels of coho salmon stranding resulting in mortality is not likely to cause 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 SONC 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 Iron Gate Dam 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.

2. Reclamation shall 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 shall 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 shall 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 shall 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 shall 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 shall 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 shall investigate the feasibility of discontinuing the inter-basin transfer of water from the Klamath River to the Rogue River Basin and reserving that water for instream flow in the Klamath River below Iron Gate Dam.

13. CONSERVATION RECOMMENDATIONS

Reclamation should ensure that the environmental documentation necessary to implement increased flow in the Trinity River consistent with the Trinity River Restoration Program and the existing court order limiting implementation of the Record of Decision is completed as quickly as possible.

Reclamation should assist the State of Oregon in revitalizing and completing the Alternative Dispute Resolution process established to resolve water right adjudication disputes in the Upper Klamath Basin.

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. Specific to element (2) above, NMFS will evaluate the final Hardy and Addley report and the final report from the NRC Committee on Threatened and Endangered Fishes in the Klamath River Basin and determine whether they contain new information that would warrant reinitiation of consultation. Finally, if any of the provisions of the RPA are not implement as anticipated, NMFS will request Reclamation to reinitiate consultation.

15. LITERATURE CITED

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Figures

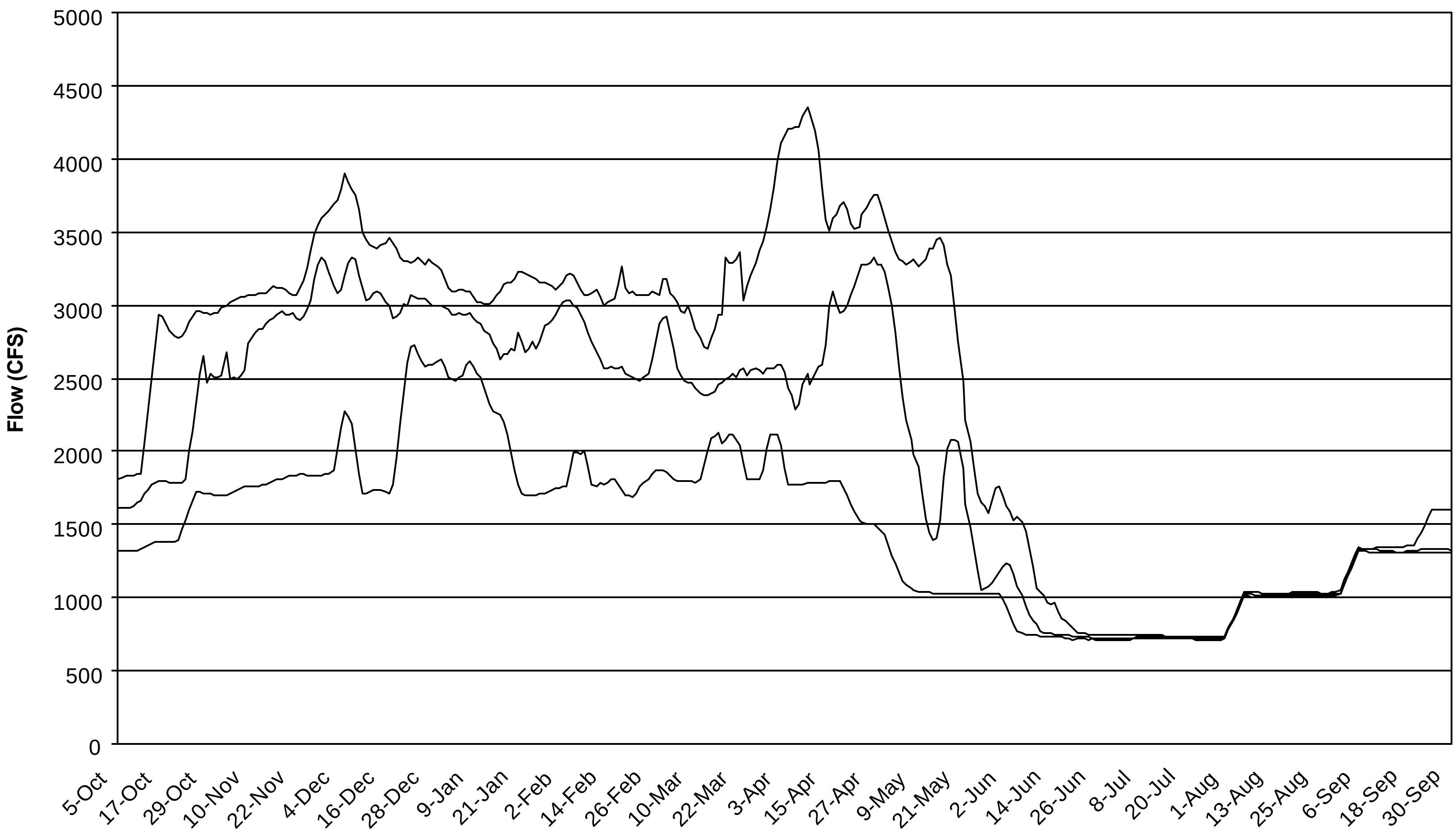

Figure 1. Average Klamath River flow at Iron Gate Dam, California - Normal water year median, 25th and 75th percentile (1963, 1966, 1969, 1970, 1973, 1985, 1989; 5 day moving average). Data are from Hydroshere Data Products, Inc. (1993).

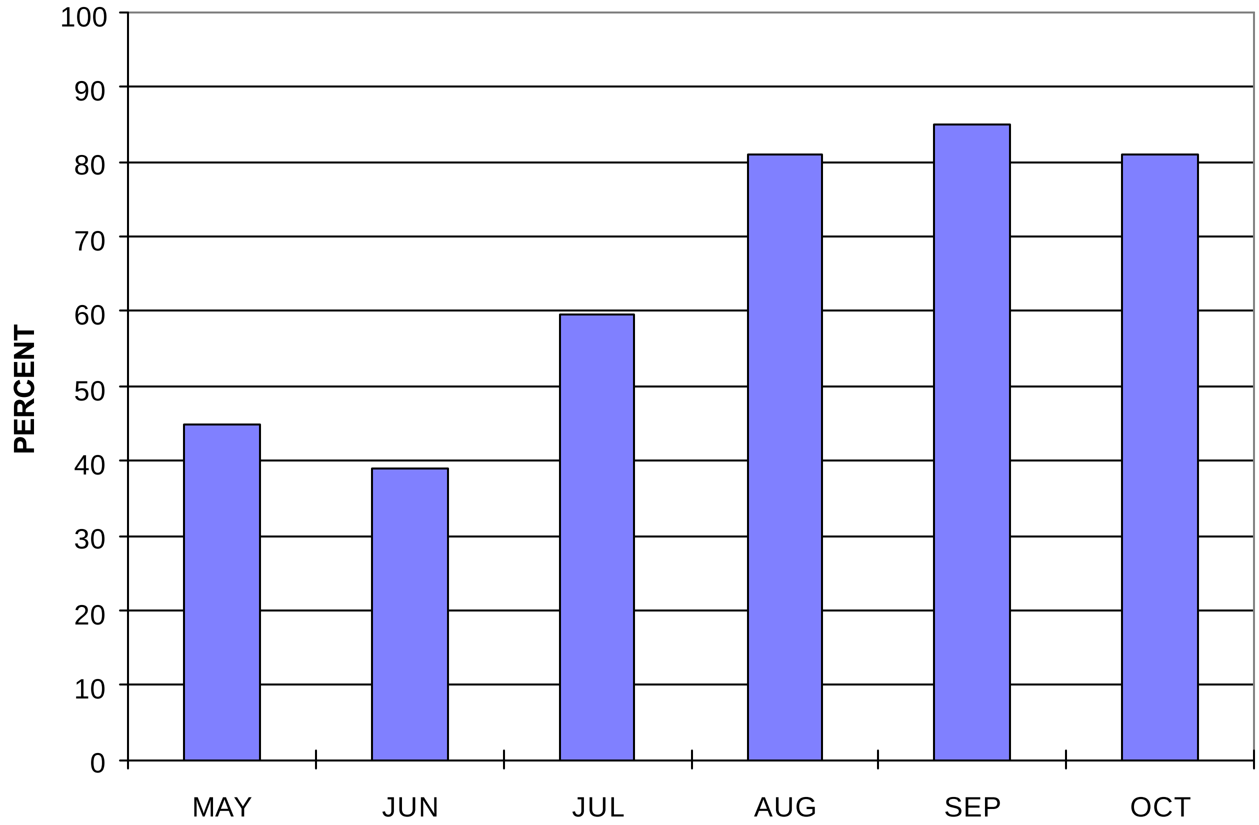

Figure 2. Monthly average Iron Gate Dam contributions to Klamath River flows measured at Seiad (1962-1991). Data are from Hydrosphere Data Products, Inc. (1993).

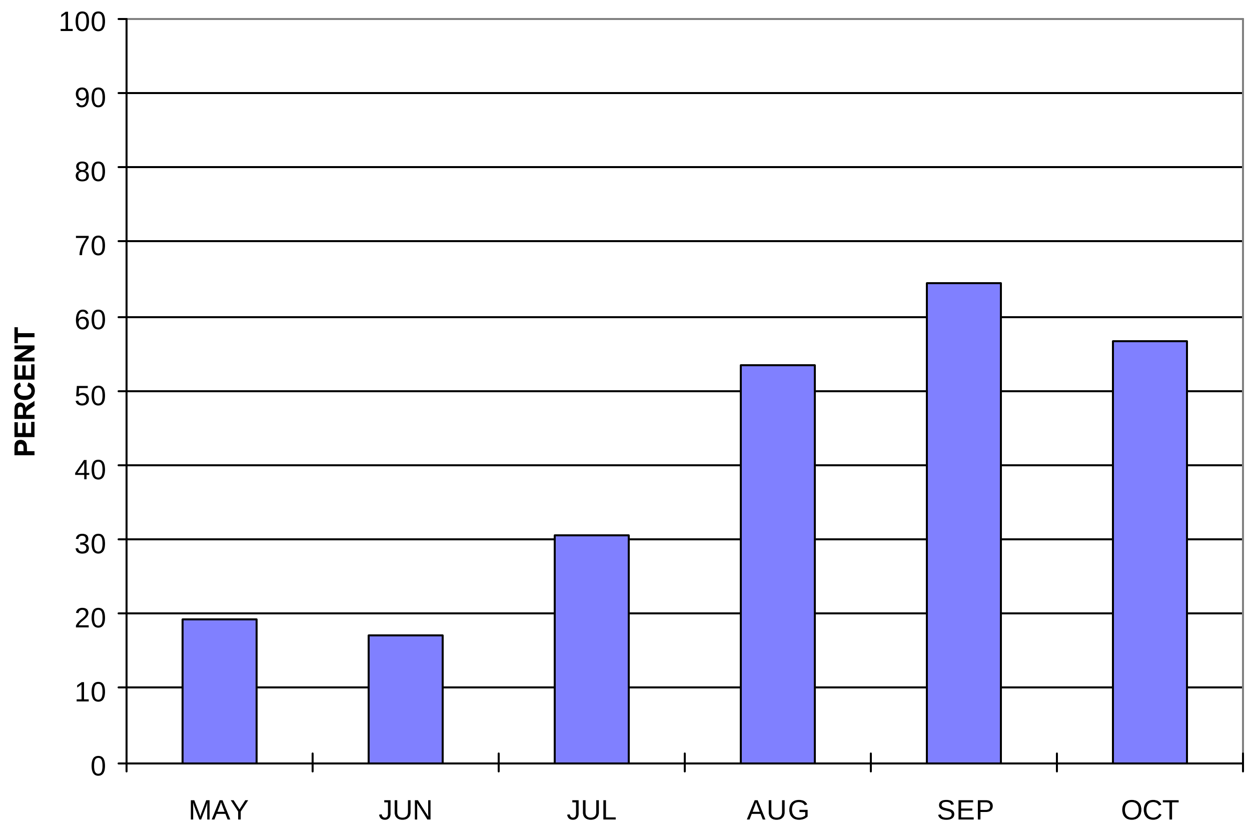

Figure 3. Monthly average Iron Gate Dam contributions to Klamath River flows measured at Orleans (1962-1991). Data are from Hydrosphere Data Products, Inc. (1993).

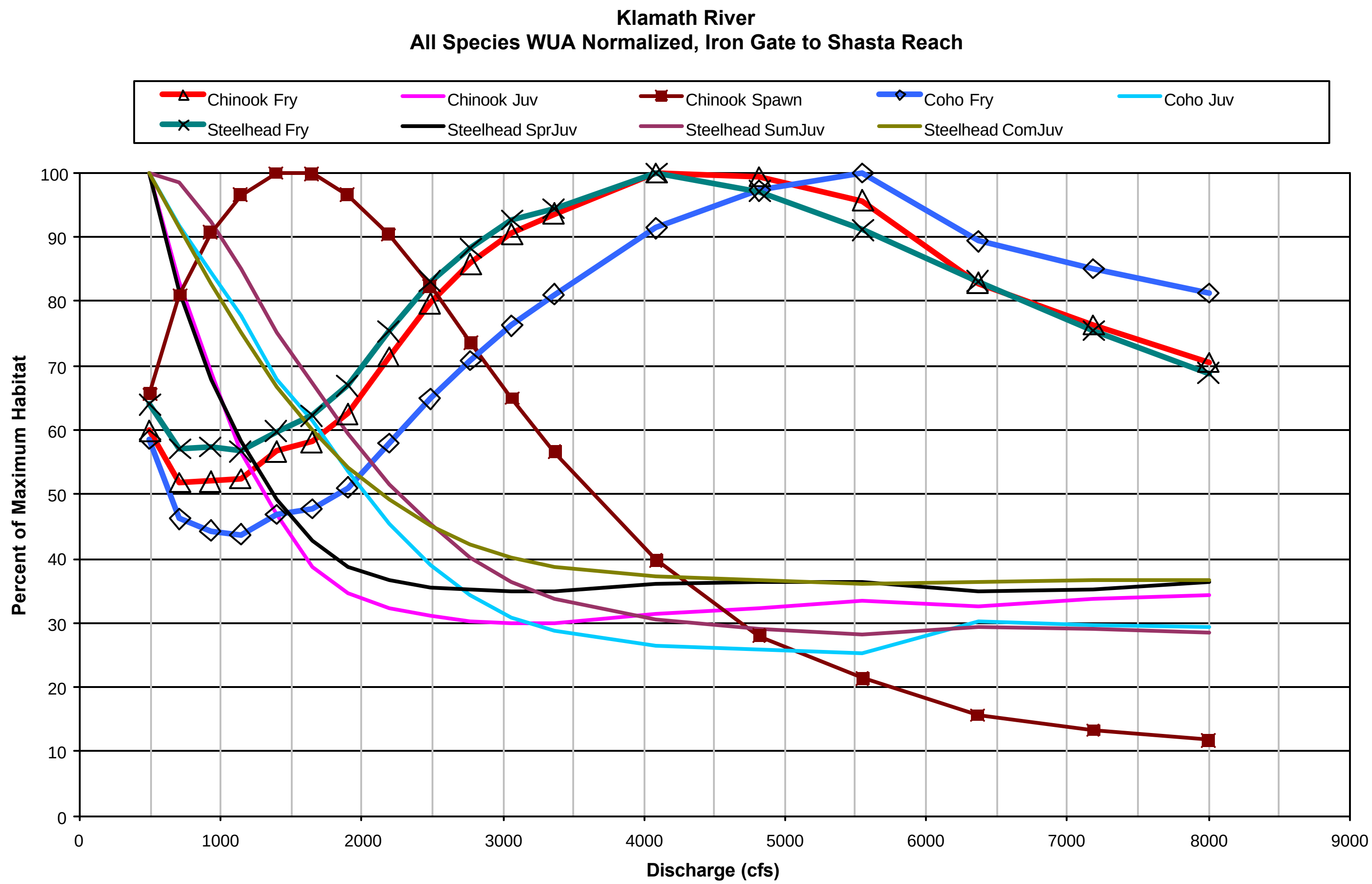

Figure 4 Relationship between percent of maximum habitat and discharge for each species and life stage for the Iron Gate to Shasta River reach. (Figure 128 of Hardy and Addley 2001)

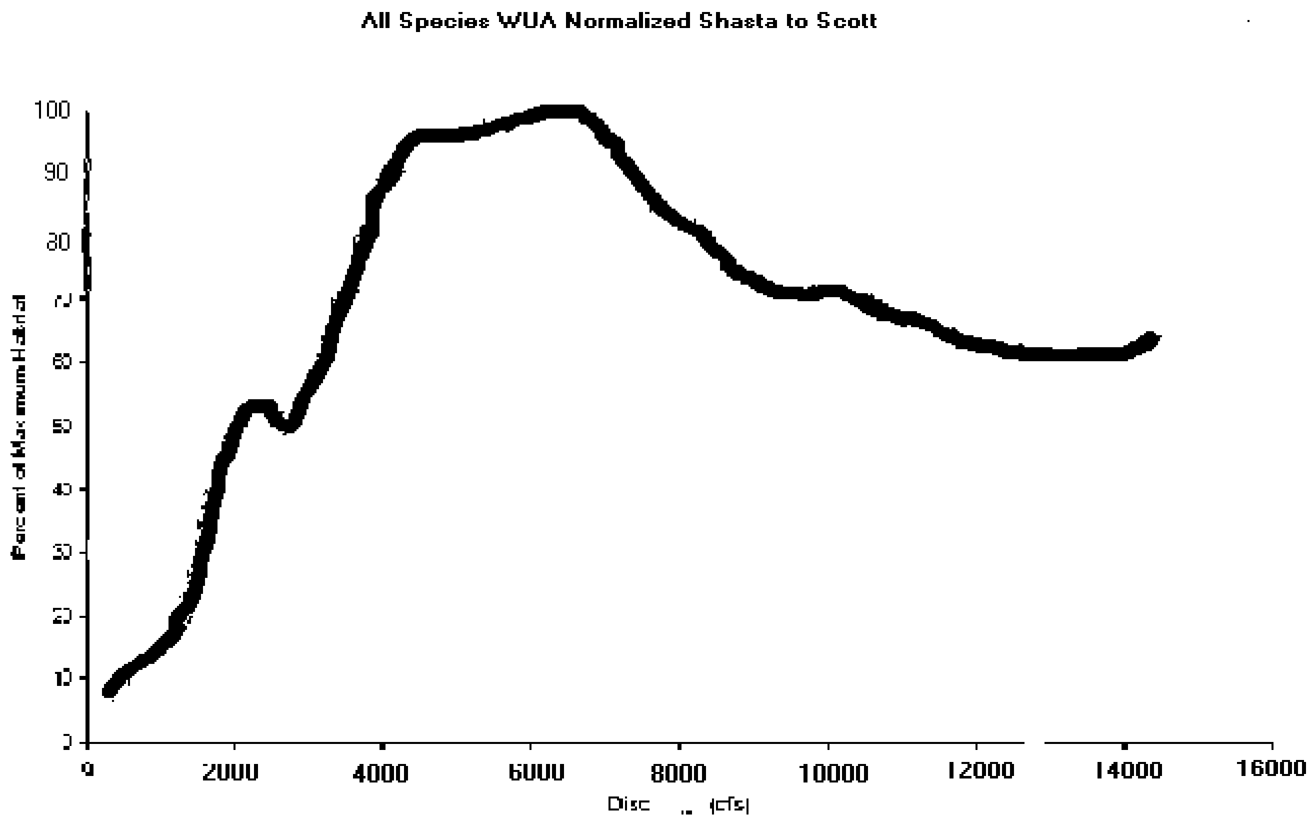

Figure 5 Relationship between percent of maximum habitat and discharge for coho fry for the Shasta River to Scott River reach. (Adapted from Figure 90 of Hardy and Addley 2001)

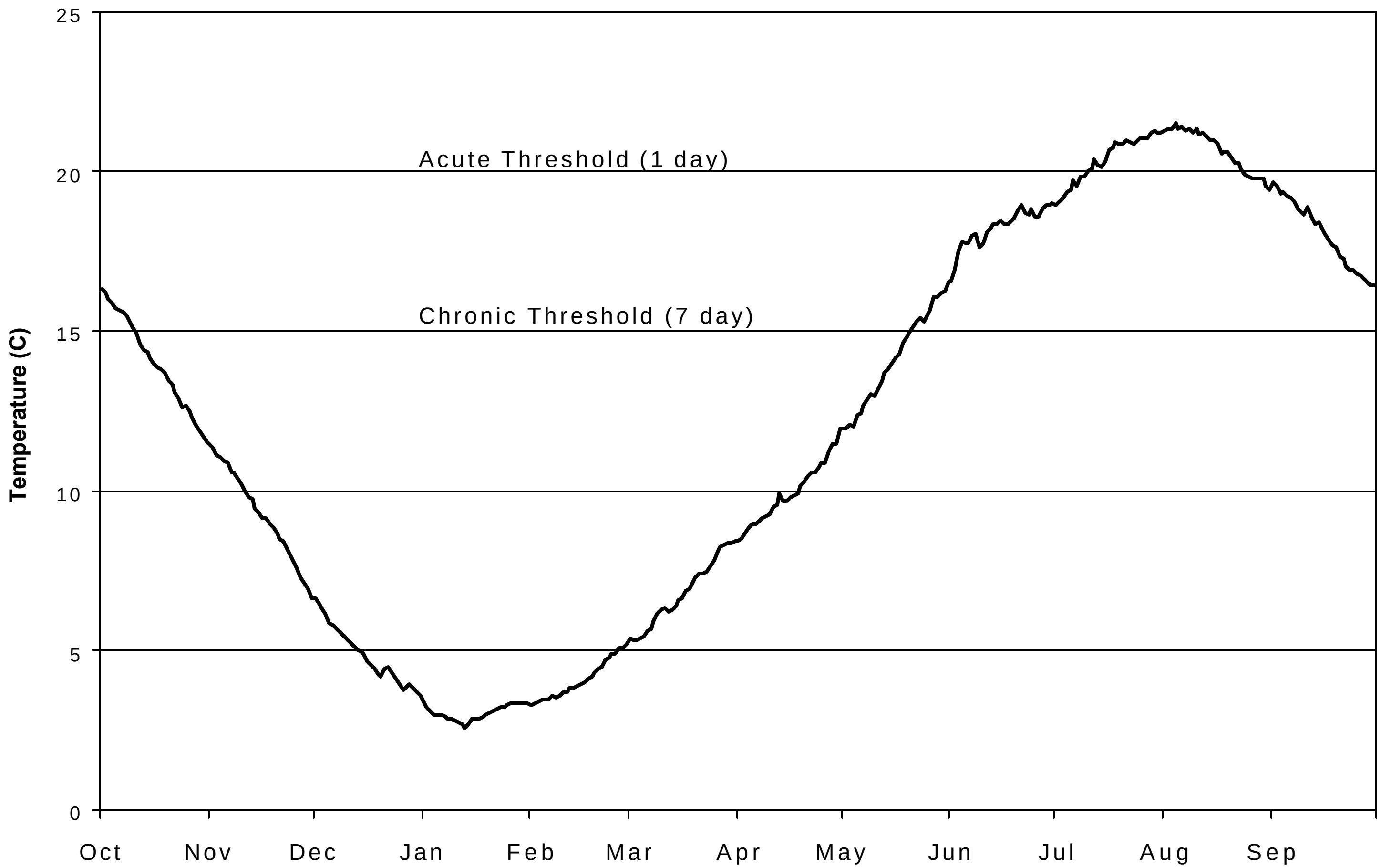

Figure 6. Average daily maximum water temperatures in the Klamath River below Iron Gate Dam (1963-1979). Acute and chronic high temperature thresholds are 1986 Environmental Protection Agency criteria (Campbell 1995). Data are from Hydrosphere Data Products, Inc (1993).

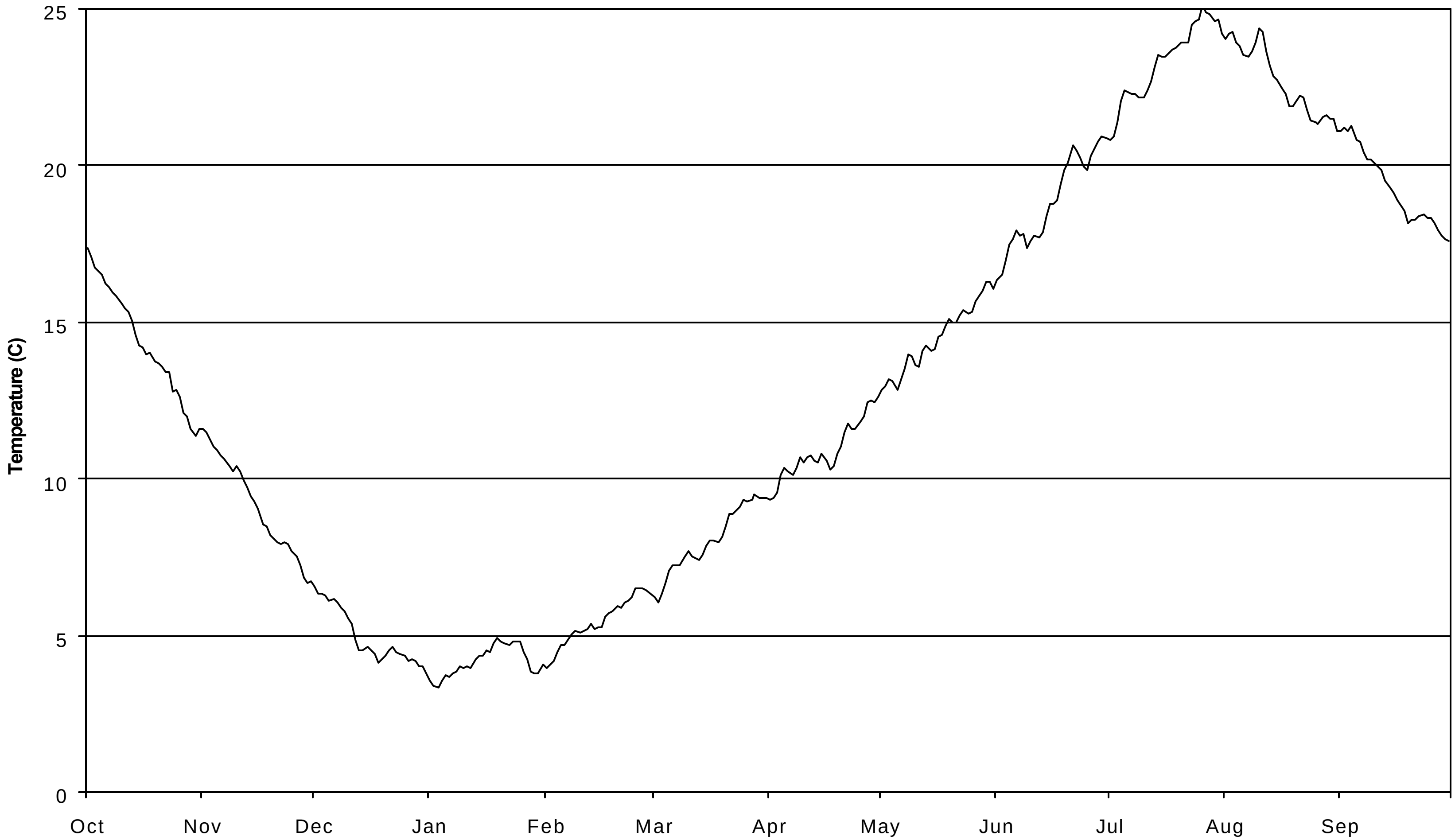

Figure 7. Average daily maximum water temperatures in the Klamath River at Seiad (1964-1978). Data are from Hydrosphere Data Products, Inc. (1993).

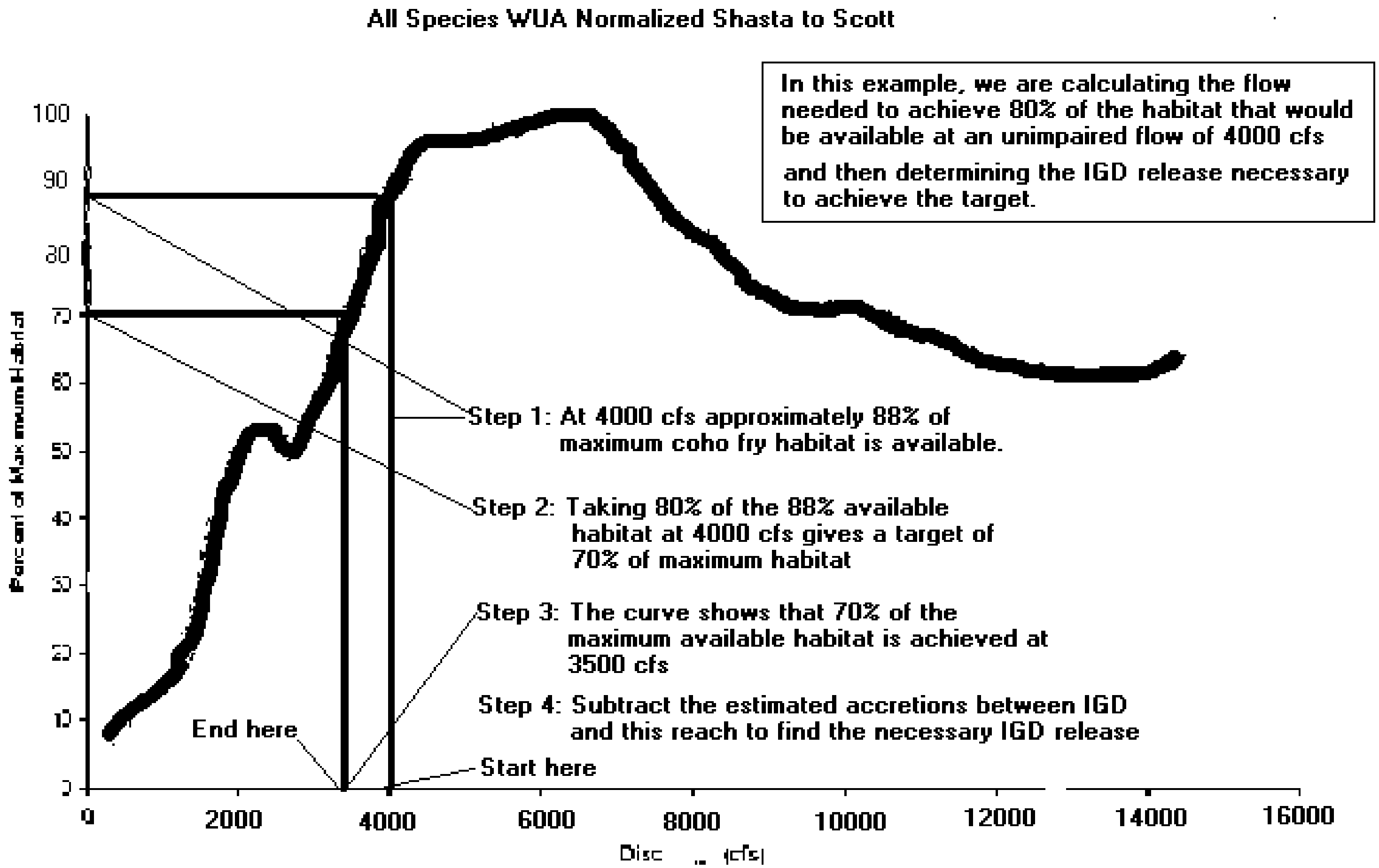

Figure 8. Example of method used to determine necessary flow release from IGD to achieve a target of 80% or 90% of maximum habitat available at a given unimpaired flow in the Shasta to Scott river reach.

Attachment A

MAGNUSON-STEVENS FISHERY CONSERVATION [1]
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.

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.

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[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 (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)). §Section 600.920(a)(1) of the EFH final regulations state that consultations are required of Federal action agencies for renewals, reviews, or substantial revisions of actions if the renewal, review, or revision may adversely affect EFH. 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.

The National Marine Fisheries Service's biological opinion (Opinion) on Reclamation's proposed operation of the Klamath Project between June 1, 2002, and March 31, 2012 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 basin 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 consultation addresses both species but also refers the reader to more specific information pertaining to the habitat requirements of coho salmon contained in the Opinion.

II. ESSENTIAL FISH HABITAT REQUIREMENTS FOR CHINOOK SALMON AND COHO 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 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 sub-yearling 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 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 main stem 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).

Spawning Habitat

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 Iron Gate Dam 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.

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 main stem 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 4.0 of the Opinion.

III. EFFECTS OF THE PROJECT ACTION

As described in the Opinion, the proposed action can adversely affect coho salmon by decreasing survival and abundance of several freshwater life history stages of coho, including fry, juveniles, and outmigrating smolts. In drier water years, adult coho may be adversely affected by operation of the project. Adverse effects to the EFH of chinook salmon may be greater due to their greater reliance on main-stem habitat. However, the following summarizes the adverse affects to EFH for both species.

In dry and critically dry water years during October through March, the proposed action could adversely affect the EFH function of providing passage conditions for upstream migrating salmon and their spawning success in the Klamath main stem, as well as successfully migrating into tributaries.

Spring flows in the main stem provide important EFH that supports rearing functions. During the spring months of drier water years, the proposed action will affect Klamath River flows which will affect salmon fry rearing for individuals either originating from the main stem or migrating down from tributaries. Because the amount of flow in the main stem is related to the amount of suitable EFH for rearing salmon, salmon fry may be adversely affected if sufficient flows in the main stem are not maintained at appropriate levels. The survival of chinook salmon fry 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. NMFS is concern that the proposed action results in flows that frequently create conditions that effectively distance the much of 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 also facilitate the outmigration of salmon smolts. As reported in the Opinion, specific relationships between Klamath River flows and smolt survival have not been established. However, because information from other locations indicate a positive relationship between smolt survival and river flows, the proposed project will likely affect coho and chinook smolt survival.

Adverse effects to EFH can also result from reductions in water quality (e.g., water temperatures). While the relationship between Iron Gate Dam flows and water temperature is poorly understood, the Opinion concluded that diurnal water temperature fluctuations in the Klamath River are generally expected to be lower under relatively high Iron Gate Dam flows. Similarly, during summer months, flows from Iron Gate Dam comprise a substantial portion of Klamath River flows especially during drier water years. During summer months coinciding with “critically dry” water years, there may be no tributary accretions in certain reaches of the Klamath River and releases from Iron Gate Dam would represent the only water in the river in certain areas.

IV. CONCLUSION

Upon review of the effects of Reclamation’s proposed operation of Klamath Project, NMFS thinks 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 thinks that the proposed project would result in a continued decline in EFH conditions in the Klamath River over time, and thereby preclude rebuilding of the coho salmon population and reduce the habitat required to support a sustainable chinook fishery.

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

V. EFH CONSERVATION RECOMMENDATIONS

The NRC committee on threatened and endangered fishes of Klamath River Basin states: "(C)hanges in the flow regime of the 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). The Committee, however, is charged with studying specifically the requirements of the three fish species mentioned above (*coho salmon, shortnose sucker and Lost River sucker*), and not of other species in the Klamath River Basin." Therefore, the Committee's conclusions regarding the importance of main-stem Klamath River habitat to coho salmon do not necessarily apply to chinook salmon. Accordingly, NMFS thinks that main-stem flow conditions required by chinook salmon may differ from those required by chinook salmon. Hardy and Addley (2001) draft recommendations are optimized for fall run chinook in March, April, and May. NMFS is not prepared to recommend that Reclamation implement those flows because the draft recommendations may be modified as the report proceeds through public comment and peer review. Some commenters have pointed out deficiencies in the draft report that could result in changes to the recommendations (e.g. see W. J. Miller, 2002), therefore, NMFS thinks that reopening the EFH consultation when the final Phase II report is issued would be appropriate.

These recommendations are provided as advisory measures to Reclamation. Reclamation should:

1. Implement the Opinion's Reasonable and Prudent Alternative and the terms and conditions of the Incidental Take Statement.

2. Reinitiate EFH consultation with NMFS upon publication of the final report being prepared by Hardy and Addley, currently titled: Evaluation of Interim Instream Flow Needs in the Klamath River: Phase II - Volume I, to evaluate whether implementation of the final flow recommendations are necessary to prevent further decline of EFH conditions for chinook salmon over time.

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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