Klamath River Hydroelectric Project

California Klamath Wild and Scenic River

Section 7(a) Wild and Scenic Rivers Act

Preliminary Determination Report

November 27, 2006

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Acknowledgements: John Hamilton, USFWS, Yreka, CA; and Kevin McKurnan, Yurok Tribe, Klamath, CA. for providing additional review.

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Klamath River Hydroelectric Project,
Klamath Wild and Scenic River (California)

November 2006

I. Introduction

In September, 2005, the Federal Energy Regulatory Commission (FERC) issued a Draft Environmental Impact Statement (DEIS) for Relicensing of the Klamath River Project, No. 2082-027. This report documents the analysis of effects on the fish, wildlife, scenery and recreational values of the Klamath Wild and Scenic River in California (CA Klamath WSR) from relicensing of the Klamath River Hydroelectric Project. Section 7(a) provides a specific standard for review of developments below or above a designated river. The initial question to be addressed in a WSR Section 7(a) determination is whether the Alternatives of the DEIS invade the designated river. The term invade is defined as encroachment or intrusion upon. None of the alternatives propose construction of any project works in the WSR corridor. Therefore, the project proposal will not invade the area with the possible exception of gravel introduction or short term sediment release.

The next question to be answered, relative to the standard in Section 7(a), is whether any of the DEIS alternatives will "unreasonably diminish" the fish, wildlife, scenic or recreational values of the designated river. Given that the standard implies some diminution of values may be acceptable, there are two questions to consider:

1. Do the proposed alternatives evaluated in the DEIS cause diminution of the scenic, recreational, fish or wildlife values of the designated river as present at the date of designation?

2. If there is diminution, is it unreasonable? This would suggest an evaluation of the magnitude of the loss. Factors to be considered include: (1) whether the value contributed to the designation of the river (i.e., outstandingly remarkable); and, (2) the current condition and trends of the resource. (If diminution is determined unreasonable, measures may be recommended to reduce adverse effects to within acceptable levels.)

The purpose of this report is to answer Question 1. Question 2 will be addressed in the Section 7(a) Preliminary Determination. The evaluation considers the conditions under each DEIS alternative in comparison with conditions at the date of the river's designation into the National WSR system (January 19, 1981). For each of the four resources specified in WSR Act Section 7a (scenery, recreation, fish and wildlife), one to five criteria are used to assess the potential effects of the current project (No Action) and the

DEIS action alternatives. These effects are characterized as unchanged, increased or decreased, or a similar conclusion, by criteria, to determine whether diminishment would result for that resource.

For each resource section, the report presents background of the environmental setting and of the criteria, including current project effects. This is followed by the resource analysis section, which addresses the effects of each of the alternatives based on these criteria, and the resource overall.

Data is limited for 1981 conditions, so the analysis utilizes the best available information, including the DEIS, available studies and scientific literature. In many cases, a conclusion regarding the effects relative to 1981 baseline conditions was not possible.

II. Fisheries Resources Evaluation

Background

Fish Population and Habitat Conditions:
In 1981, the Klamath River was designated a (WSR) because of the outstandingly remarkable anadromous fisheries, including that of salmon and trout (salmonids). At the time of the designation, its salmonid populations were already experiencing abundance trends that reflected the effects from instream habitat conditions, influenced by dam construction, and hatchery propagation. Nehlsen et al. (1991), Moyle (2002), and Good et al. (2005), among others, cite dam construction as a primary influence on decreasing salmonid trends in the Klamath River system. Dam construction and operations related to hydropower generation in the Klamath River have increased summer water temperatures, changed the natural flow regime, decreased dissolved oxygen levels in portions of the river, and blocked access to more than 300 miles of spawning, incubation and rearing habitat (Hardy and Addley 2001, NRC 2004, Hamilton et al. 2005, Powers et al. 2005). Recent scientific evidence has shown that Chinook salmon, coho salmon, cutthroat trout and steelhead trout were historically present above Iron Gate Dam (River Mile 190), currently the upstream boundary to fish migration in the Klamath River (Hamilton et al. 2005). Iron Gate Hatchery was built and managed in order to mitigate for the loss of anadromous fish spawning habitat upstream of Iron Gate Dam (IGD). The operation of Iron Gate Hatchery is part of at least three of the four DEIS alternatives for relicensing the Klamath River Hydroelectric Project (FERC Project No. 2082-027).

Although the Klamath River once supported 55 separate stocks of salmonids, runs of chum (*Oncorhynchus keta*) and pink salmon (*O. gorbuscha*) are now nearly extinct (KBERO, 1995. Nehlsen 1991, NRC 2004). Historical runs of salmonids have declined to the point that several species were listed, or have been candidates for listing, for protection under the Endangered Species Act. In order to assess whether a species warranted listing, NOAA Fisheries National Marine Fisheries Service (NMFS) conducted status reviews which included fish native to the Klamath River. The status of Chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), cutthroat trout (*O. clarki clarki*), and

steelhead trout (*O. mykiss*) were reviewed in 1998, 1995, 1999, and 1996, respectively. A comprehensive status review of salmonids listed in the Pacific Northwest also was conducted in 2005. After these reviews were conducted, one species was determined to warrant listing; coho salmon stock of the Klamath River, a sub-population of the southern Oregon and northern California coast evolutionarily significant unit, were listed as threatened in 1997 (62 FR 24588). Coho salmon were also listed as threatened by the state of California in 2005 and they remain federal- and state-listed at the time of this report. This assessment builds on these reviews and examines potential habitat changes in Chinook, coho, and steelhead populations over time. It examines whether fish abundance has changed, and if so, whether there has been a trend of increase or decrease since 1981. Because the Klamath Hydroelectric Project influence on coastal cutthroat is thought to be minor, if any, this species will not be further addressed in this report. The cutthroat population trend analysis that was done at the time the other three species were assessed is summarized in the Appendix.

Background on Evaluation Criteria and Current Project Effects:
The fisheries resource evaluation criteria are stream flow regime (criteria 1); water temperature (criteria 2); water quality (physical, biological and chemical) (criteria 3); sediment regime and substrate quality (criteria 4); and species population conditions (criteria 5). These five factors are interdependent. They are not a comprehensive set of habitat and population indicators potentially affected by the project; however, we consider them to be the best indicators of the condition and trend of the anadromous fishery in the California Klamath WSR (CA Klamath WSR).

Chemical, nutrient and thermal processes are influenced by flow regime, as is physical habitat (criteria 1) and sediment transport and substrate quality (criteria 4). Together with hatchery operations, the various habitat elements influence population dynamics. For criteria 1- 4, the evaluation is limited to the mainstem Klamath River from Iron Gate Dam to the estuary, unless otherwise specified. For criteria 5, population conditions, the analysis area includes populations that inhabit tributary streams downstream from the project area.

Current project effects are summarized for each factor, in order to augment the analysis of effects of project alternatives. The alternatives include measures that would modify the existing condition for fish habitat and populations in ways that are highlighted in the Fisheries Resource Analysis.

Fisheries Evaluation Criteria 1 – Instream flow regime and ramping rates compared with conditions present when the Klamath River segment was designated as a National WSR.

Flows are a key component of cumulative effects from water management on the aquatic environment. The flow regime downstream of IGD affects aquatic resources through instream flow influences on physical habitat (depth, velocity, substrate and cover) and on water quality that may affect the prevalence of disease pathogens (FERC, 2006, DEIS ,

page 3-257). Flows affect water quality by dilution of various constituents, aeration, and thermal lag. The latter affects heating and cooling rates as the released water flows from Iron Gate to the estuary. River substrate composition is largely controlled by sediment transport processes that are influenced by the flow regime, as is discussed under criteria 4. Riparian cover is also discussed there.

Hardy and Addley (2001) recommended instream flows downstream from IGD needed to provide sufficient useable habitat to sustain anadromous species. In addition to physical habitat, they considered bioenergetic needs (required by feeding, escape, and other behavior) given typical temperature conditions in the river and recommended flow levels by month and water year type below IGD. The flows were evaluated for the U.S. Bureau of Reclamation (Reclamation) for its Klamath Reclamation Project.

Instream flows at the upper end of the WSR segment are largely controlled by inflows from Link River Dam, and agricultural diversions and return flows to Keno Reservoir. Most of this is controlled by Reclamation during its operation of the Klamath Irrigation Project, particulary from April through October. The flows released from IGD are regulated by the terms and conditions of the NMFS's 2002 Biological Opinion (BiOp). To clarify the contribution of the project, U.S. Department of Interior (USDI), Fish and Wildlife Service (FWS), has stated in its 10(j) instream flow recommendations that "based upon the configuration of Project facilities, it is unlikely that the Applicant is capable of providing any appreciable flows in excess of Project inflow on a continuous basis. Project inflow is derived from a combination of tributary inflow, spring accretion flow, irrigation return flows and releases made by the U.S. Bureau of Reclamation from its Klamath Reclamation Project." (USDI, FWS, 2006.) These are further described under the Fisheries Resource Analysis section for criteria 1. **When the storage capacity of all project reservoirs is considered, PacifiCorp can currently control around 12,000 acre-feet, an estimated 2.5% of the storage that is controlled by Reclamation (DEIS, page 3-258). FERC estimated that this volume of water is useful for contributing flows during short-term events (i.e., days) but is not sufficient to allow substantial augmentation over inflows.**

High ramping rates can adversely impact fish survival by increasing outmigration rates and predation pressure on stranded individuals, as well as causing energy deficits in fish responding to rapid changes in flow.

<u>Fisheries Evaluation Criteria 2</u> – Water temperature conditions compared with conditions present when the Klamath River segment was designated as a National WSR.

Changes to natural water temperature seasonality caused by current project operations include spring and early summer cooling of the water downstream from Iron Gate reservoir and elevated river temperatures during late summer and autumn. According to water quality modeling performed by PacifiCorp comparing Existing Project to Without Project Scenarios, the Project has a contribution of up to several degrees warmer or

cooler water, depending on the year and week (PacifiCorp 2004a and 2006). The late summer warming effect extends far downstream of IGD, with the likely limit of project effect on water temperature falling between the confluences of the Scott and Salmon rivers (47 and 124 miles downstream, respectively) (DEIS, page 3-136). **This warming occurs during critical holding and spawning periods for fall-run Chinook salmon, coho salmon and summer steelhead. The warming also contributes to disease-promoting conditions. These changes can decrease the success of spawning salmon because exposure to warmer water temperatures during upstream migration decreases the amount of energy reserves available for reproduction.** That is because more energy expenditure during migration can result in a reduction of energy available for spawning (Moyle and Cech, 1986).

Fisheries Evaluation Criteria 3 - Water quality parameters compared with conditions present when the Klamath River segment was designated as a National WSR.

This factor includes dissolved oxygen concentrations (DO), nuisance algae distribution, nutrient regimes, and fish disease conditions. These elements interact to affect the quality of habitat for aquatic species, including salmonids. Salmonids need well-oxygenated water. The California Water Quality Control Plan for the North Coast Region (Basin Plan) has a water quality objective of 8 mg/L average monthly DO level or 50% or more monthly DO readings >10 mg/L for this river segment (CaWQCB, 2006, as cited on DEIS page 3-94). Water temperature strongly controls DO, although the degree of river water turbulence and oxygen demand from biological and sediment components in project and non-project reservoirs also influence DO.

Klamath fish stocks have been thought by some investigators to have been impacted increasingly since the 1990's by diseases commonly found in streams with increased nutrient supply, high temperatures, and low flows. Two of these, *Ceratomyxa shasta* (*C. shasta)* and *parvocapsula*, have an alternative host that flourishes in attached algae. One algae specie, *Cladophera* has been observed to be increasing in its distribution downstream of Iron Gate reservoir. The reason for this trend is thought to be seasonally-increased nutrient inputs from Project reservoirs, and progressive streambed armoring over time (DEIS page 3-311). Bed armoring leads to a stable substrate for attached algae. See criteria 4 discussion for streambed effects.

C. shasta is a significant disease in the Klamath system, with up to 50% of the juvenile outmigrating Chinook population infected. Most or all of these are expected to die. Infection by *C. shasta* is considered lethal to juvenile Chinook, and is thought to be harmful to juvenile steelhead. Researchers Scott Foott (USDI, FWS) and Jeri Bartholomew (Oregon State University) have said that sustainability for some fish stocks would be questionable if current disease rates persist for an extended period of time (OSU, 2004). Disease rates appear to be especially high in the autumn and are likely connected with the elevated fall temperatures associated with hydropower operations (DEIS, page 5-38). The disease *Columnaris*, also influenced by river temperature, may

play a significant role in limiting the upriver extent of spring Chinook and summer steelhead distribution.

Aquatic pathogen researcher Scott Footte (of USDI, FWS Anderson, CA Fish Health Center in Anderson, CA) reports that infection rates for the fish disease *Ceratomyxa shasta* were low during monitoring in 1992, 1993, and 1994, but they rose to the current high rates in 1995. The cause of this increase is not known, but is suspected to be at least partially due to changing *Cladophara* distributions. (Scott Foott, personal communication, 2005).

Reservoirs provide habitat for nitrogen-fixing algae. Changes in algal composition can impact food webs and ecosystem function. Algal blooms are known to impact water chemistry, including pH, DO, and nutrients such as free ammonia. A nutrient study, conducted by the California State Water Resources Control Board (Water Board), to support the Clean Water Act Section 401 certification (in development), combined nutrient concentration data with hydrologic data. The study, which computed nutrient mass during the year, showed that Iron Gate and Copco 1 generate as well as trap nutrients during different seasons. "The more robust seasonal analysis presented here does not support an earlier PacifiCorp (2004, 2005) broad postulation that the reservoirs benefit water quality by processing organic matter and nutrients from upstream sources….(T)here is clear indication that the reservoirs periodically increase nutrient loading downstream. Likely pathways for this increased load include internal sediment loading and nitrogen fixation by cyanobacteria." (Water Board, 2005.) The question of reservoir sequestering of nutrients over time needs to be answered in order to determine if a trend of increasing nitrogen releases to the WSR segment are occurring over time. For example, what proportion of nutrients that has settled in the hypolimnion gets released downstream during reservoir turnover and what proportion remains in the reservoirs?

<u>Fisheries Evaluation Criteria 4</u> - Sediment regime and substrate quality compared with conditions present when the Klamath River segment was designated as a National WSR.

Sediment delivered to the river from natural and human-accelerated sources is efficiently trapped behind dams. The transport of sediment within a river is a primary physical process, setting the stage for numerous ecological processes. These include the scour and sorting of spawning gravels, and the creation and maintenance of complex instream habitat. Sediment trapping behind project dams has led to a sediment deficit in the reaches downstream of project dams, but especially below IGD. Over time, this has led to a coarsening of substrate particle size and consequently a change in streambed mobility because the larger particle sizes move less frequently. Hence, the bed progressively becomes dominated by cobble and larger size particles as smaller gravels are transported without being replaced (PacifiCorp, 2004b).

The quantity, as well as quality, of spawning gravel is important to fish spawning success. Both are affected by streambed mobility.

A 1981 study reported on the quality of spawning conditions in the reach immediately downstream from IGD (Buer, 1981). The report's authors concluded that a coarsening of the bed below the dam had already occurred by 1981, the year the WSR was designated: "Few salmon now spawn in the reach below IGD because the riffles are now armored by cobbles too large for salmon to move…The reach below Iron Gate was a prime spawning area; it now produces few salmon." A recent study by PacifiCorp (2004b) was unable to directly compare current conditions with the earlier study because the location of original sites was not documented. PacifiCorp interpreted the 1981 data differently than Buer did. (Buer had concluded that particle sizes were primarily too large for salmon, while PacifiCorp felt that –based on Buer's data- over half the sites were of sizes generally accepted in the literature as suitable). Because the original sample sites could not be located for comparison it is not known whether there has been a coarsening trend from 1981 to the present.

The PacifiCorp study did, however, conclude that current gravel conditions have coarsened as an effect of Project dams (PacifiCorp, 2004b). FERC validated PacifiCorp's conclusions and said that decreased bed mobility has also led to increased algae growth, including the attached algae species that harbors an alternate host of two known pathogens (DEIS, page 3-33). Criteria 3 discussed this and other related disease-promoting processes.

Streambed changes and sediment supply influence riparian vegetation distribution and makeup. Edge habitat is important for juvenile salmonid cover. When considering the variables of relative sediment and flow regimes that Grant, et al, use to predict geomorphic change caused by dams, one would expect the geomorphic changes below Iron Gate to include an increase in critical flows needed to transport sediment. This increase is expected due to armoring and coarsening of bedload sediment (Grant, G.E., et al, 2003). However, flows greater than 1700 cubic feet per second (cfs) below IGD -- the ones with the most potential impacts on channel bedload transport and floodplain inundation – are essentially unaffected by the project because the facilities pass, unregulated, high flow events. Most winter flows and their associated stream power are conveyed over the spillway.

The frequency of flows that reach the velocity required to move the D50 particle size (median grain size for bedload to initiate movement as bedload sediment) was analyzed by PacifiCorp to compare the With Project and Without Project conditions. The findings, reported in PacifiCorp's Final Technical Report (FTR) and FERC's DEIS show that, for most project reaches, "the project consistently increases the estimated discharge required to mobilize the bed." (PacifiCorp, 2004b and DEIS, page 3-35). For the reaches downstream of IGD, the frequency was reduced from a roughly semi-annual event to five or more times less frequent. Using the ratio of with project-to-without project percent of historic flows that exceeded the threshold of mobility as an index of effect, the DEIS categorized 13 sample sites between IGD and Seiad Valley. A ratio of 1.0 predicts no change, and 0.0 is equivalent to a 0% probability that without-project bedload mobility would be met. All 13 sites had a ratio of <0.5, and all but one had a value of <0.2 (near

the I-5 rest area). Seiad Valley would have a probable bed moving flow every 10 years, while Tree of Heaven Campground reach would only undergo such flows every 20 years. For the reach immediately below IGD, the most impacted substrate area of all the project reaches, the ratio was 0. This change has resulted from the dams' interruption of downstream sediment transport over time, leading to an increase in the median particle size. That has led to a "diminished supply of spawning gravel and other altered geomorphological processes (including sand and silt starvation) that may influence aquatic habitat and adversely influence the establishment of riparian vegetation" (DEIS, page 3-39). FERC's analysis shows that reduction in transport of fine sediment (clay, silt and sand) is caused by the current project.

In considering what pre-WSR designation (1981) conditions may have been, we recognize that the reach from IGD to Shasta River confluence was scoured by daily peak flows from Copco operations for around 50 years, prior to construction of Iron Gate dam. There is little tributary influence in this reach, except for Cottonwood, Bogus and Little Bogus Creeks, which the PacifiCorp study concluded have little gravel to contribute (Bogus and Little Bogus have little gravel-size sediment because of the surrounding geology and Cottonwood Creek because the gravel was extracted for construction of I-5) (PacifiCorp, 2004b).

Stream bed armoring can decrease habitat diversity within channels, making the river less hospitable to juvenile salmonids. Armoring can also lead to the cementation of spawning gravels, impairing the ability of spawning adults to make redds. Armoring can also decrease the amount of habitat available (interstitial spaces) to marcroinvertebrates, an important food source for fish. **Given the findings of the Buer 1981 study (that spawning was impaired), we conclude the much of the riverbed coarsening may have already taken place by the date of designation.**

Riparian vegetation is an important cover component of fish habitat. Taller woody vegetation on narrower streams can influence stream shade, but on the Klamath River, non woody vegetation on the stream margins provides hiding cover for juvenile fish. Riparian vegetation also provides an important substrate where food sources such as insects can thrive. Vegetation changes are strongly tied to changes in sediment supply, especially deposition of fine sediment. The DEIS notes that "…fluctuations in the annual hydrograph and decreased sediment supply also influence the recruitment and maintenance of riparian vegetation. As the lowest dam in the project, discharge from IGD may influence recruitment for some distance downstream. In addition, the reach downstream would theoretically face the largest sediment deficit of any reach related to the project." (DEIS, page 3-27.) FERC concluded that the Project has affected riparian vegetation conditions over time in the IGD to Shasta River confluence reach. These changes are discussed in detail under the Wildlife Resources Evaluation section of this report.

Fisheries Evaluation Criteria 5 - Anadromous salmonid species abundance, including hatchery effects on populations, compared with conditions present when the Klamath River segment was designated as a National WSR.

Anadromous fish are the ORV of the CA Klamath River WSR. The environmental review that supported the proposed WSR designation did not specify which runs, or whether natural and/or hatchery populations were included. For the purpose of this analysis, both components will be addressed including the relationships between them. The Klamath River provides needed habitat for anadromous species including spring-run and fall-run Chinook salmon, coho salmon, coastal cutthroat trout, summer and winter steelhead, green and white sturgeon, and Pacific lamprey. The main stem Klamath River is designated as Critical Habitat for coho salmon. Coho were listed under the federal and state Endangered Species Acts after the Klamath was designated as a WSR. Fall-run Chinook salmon, green and white sturgeon and Pacific lamprey are known to actively spawn in the main stem. The juveniles of all species spend at least some time migrating and rearing in the main stem Klamath River. In addition, warm water temperatures support small populations of introduced game fish such as large mouth bass (Hampton, personal communication, 2006).

Anadromous Salmonids Status- This analysis describes the trends in abundance for three species: Chinook salmon, coho salmon, and steelhead trout, with the use of trend analysis on abundance indices. These species were selected here as indicators for the overall condition of the anadromous fishery because of the relative availability of historic data. In order to allow for direct comparisons, we built on the status reviews conducted by the NMFS for several species (Busby et al. 1994; Weitkamp et al. 1995; Myers et al. 1998; Johnson et al. 1999; Good et al. 2005) through the incorporation of recent literature and information. Whenever possible, the same data (trend) analysis that was used in the status reviews was used while including the most recent abundance data for pertinent stocks. The analysis was contingent on the type and amount of data available for each species and stock. This document describes the current conditions of these species in portions of the Klamath River basin located downstream of IGD. Abundance trends were used as a measure of the potential effect of the Klamath Hydroelectric Project on Klamath River anadromous fisheries since the beginning of Project operations and to assess 1981 conditions. In some cases, the abundance of anadromous fish in tributaries to the main stem Klamath River was evaluated. Presumably, anadromous fish are exposed to instream habitat conditions affected by the management of the Klamath River Hydroelectric Project as they migrate through the main stem and interact with hatchery-produced fish throughout much of their lives (DEIS, 2006, Section 3.3.3.1.3).

Iron Gate Hatchery operations are a connected action with the hydroelectric license decision. Although managed by the State of California, PacifiCorp is the primary financial contributor, and certain management operations are part of the license application. The hatchery was built in order to mitigate the loss of habitat located upstream of IGD. Impacts on natural populations downstream of Iron Gate Hatchery from hatchery operations are unknown. One potential impact results from the spring release of about 5,000,000 fall Chinook smolts, which compete with wild fish for rearing habitat in the spring and summer. Genetic mixing between hatchery and natural stocks is another potential effect.

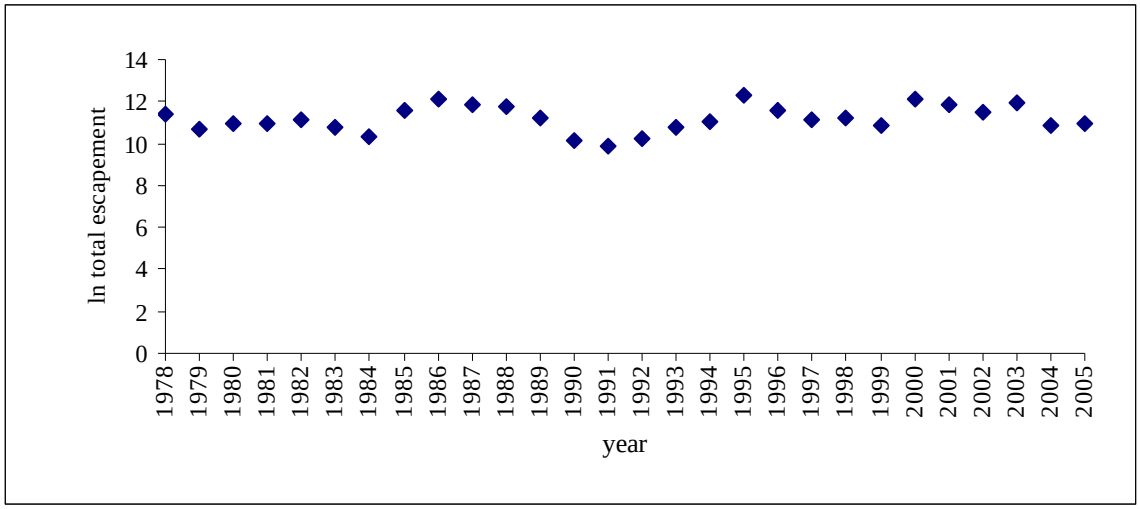
Population trends were built using data that met criteria listed in the Fish Abundance Analysis Methods and Results Appendix. The Appendix also gives the criteria used in determining which changes in abundance numbers were used to detect abundance trends. The term significant was used to describe the statistical determination of the trend analysis. See the Appendix for further detail about the how abundance was assessed for the three species that are summarized here, as well as for coastal cutthroat trout.

Chinook salmon

The status review of Chinook salmon from Washington, Idaho, and Oregon was completed by NMFS in 1998 (Myers et al. 1998). Subsequently, NMFS updated the status review of certain Evolutionarily Significant Units (ESUs), including the Upper Klamath and Trinity River ESU, in 2005 (Good et al. 2005). In that document, Klamath River Chinook salmon were included in two separate ESUs. Chinook spawning in stream reaches from the mouth of the Klamath River to the confluence with Trinity River were included in the Southern Oregon and Northern California Coastal (SONCC) ESU; Chinook spawning in areas of the Klamath River located upstream of the Trinity River were included in the Upper Klamath and Trinity River ESU. Trends in Klamath River Chinook salmon abundance were evaluated by compiling and analyzing "[1] recent total spawning escapement, [2] percent annual change in total escapement, [3] recent naturally produced spawning escapement, and … [4] percentage of natural spawners that were of hatchery origin" for fall-run Chinook.

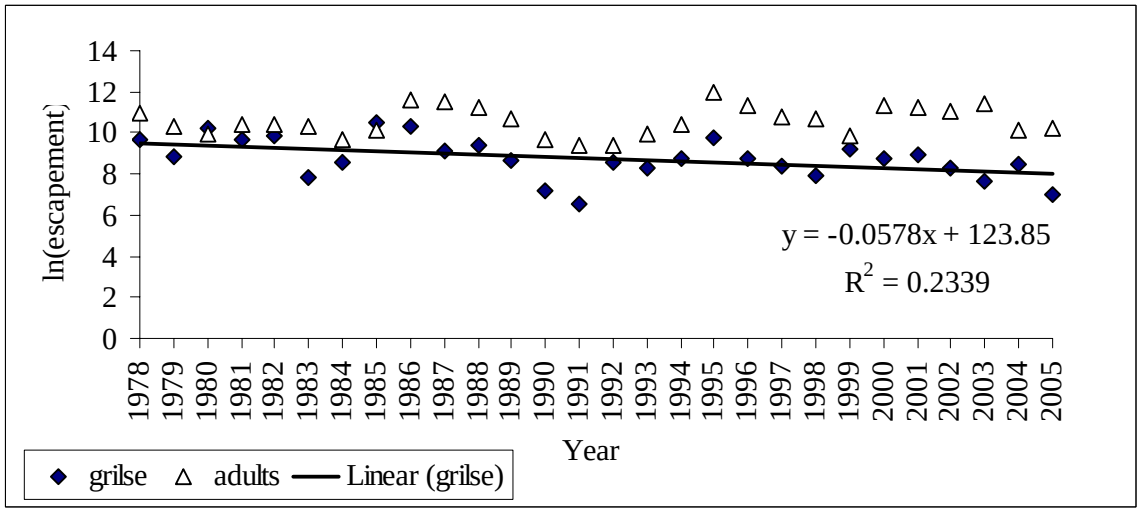
Like in Myers et al. (1998), estimates of total spawning escapement numbers and recent naturally produced spawning escapement for fall-run (ocean-type) Chinook salmon in the Klamath River basin were obtained from California Department of Fish and Game, but including data for years 1997 to 2005 (CDFG 2006). However, this analysis compiled the abundance information for all runs in the Klamath River basin and did not analyze separately the stocks belonging to the Southern Oregon and California Coastal and Upper Klamath and Trinity River ESUs. Regression of total escapement on year did not detect a trend in escapement numbers.

Figure 1. Fall-run Chinook salmon total spawner ln(escapement) on year,1978 to 2005, Klamath River basin, California (Source: CDFG 2006).



In order to analyze two population components of the spawning run, the number of grilse and number of adult natural spawners were regressed on year (Figure 2). The resulting analysis suggested that the number of grilse contributing to natural escapement has decreased since 1978. Grilse are young, mature salmon that return to spawn after spending only a year at sea. A trend was not detected in adult escapement.

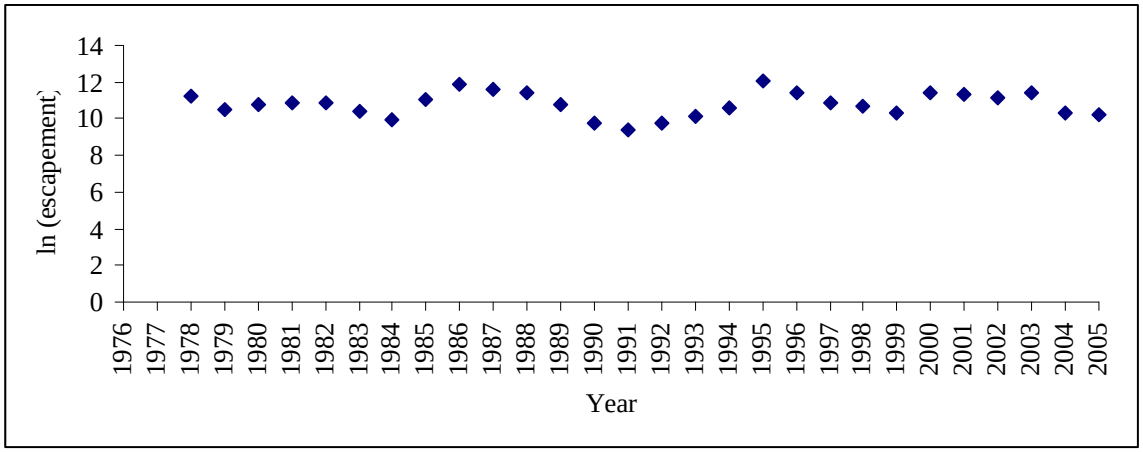
Figure 2. Fall-run Chinook salmon natural escapement (ln), adults and grilse, 1978 to 2005, Klamath River basin, California (Source: CDFG 2006).



Escapement (log transformed) of natural spawners (Figure 3) reflected the same general pattern as seen in total escapement, with the exception that natural spawner escapement decreased from 2004 (29,053) to 2005 (28,388) while total escapement increased slightly. Also, less than 35,000 natural spawners (adults and grilse) returned to spawn in 1983 (33,310), 1984 (21,349), 1990 (16,946), 1991 (12,367), 1992 (17,171), 1993 (25,683), 1999 (28,904), 2004 (29,053) and 2005 (28,388). The Pacific Coast Salmon Fishery

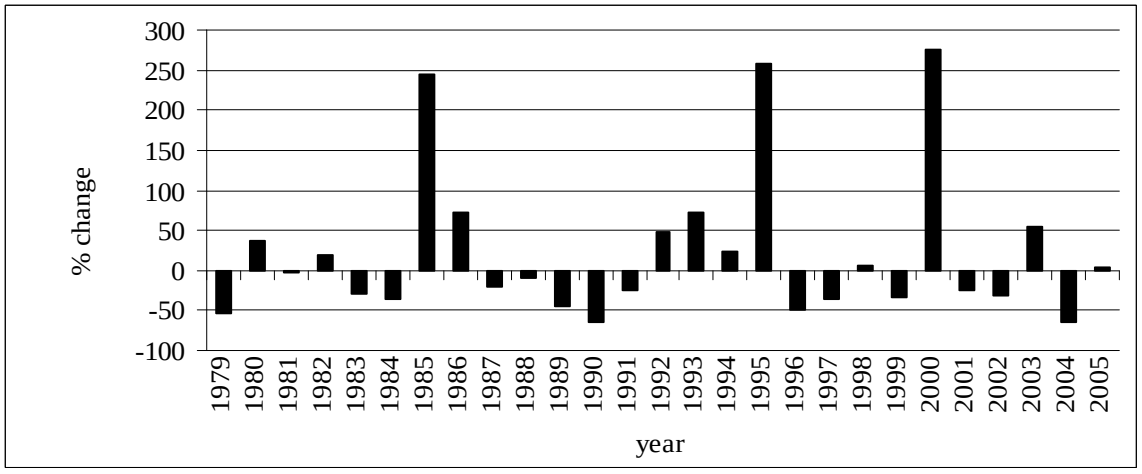
Management Plan established a minimum escapement of 35,000 fall Chinook natural spawners as a conservation goal (PFMC 1988). The analysis did not detect a trend for natural spawner escapement.

Figure 3. Escapement (ln) of fall-run Chinook salmon natural spawners, Klamath River basin, California, 1978 to 2004 (Source: CDFG 2006).



Escapement numbers varied from year to year, depicted by the percent annual change in total escapement (Figure 4). The biggest percent annual change from a previous year occurred in 2000, when escapement numbers increased from 50,088 (1999) to 188,642 (2000). Of the 26 years reviewed, 11 experienced increases and 15 experienced decreases from previous year's numbers. The most obvious downward trend in escapement numbers occurred from 1986 to 1991 when escapement numbers declined continuously for a period of five years. The Klamath River was designated a Wild and Scenic River in 1981.

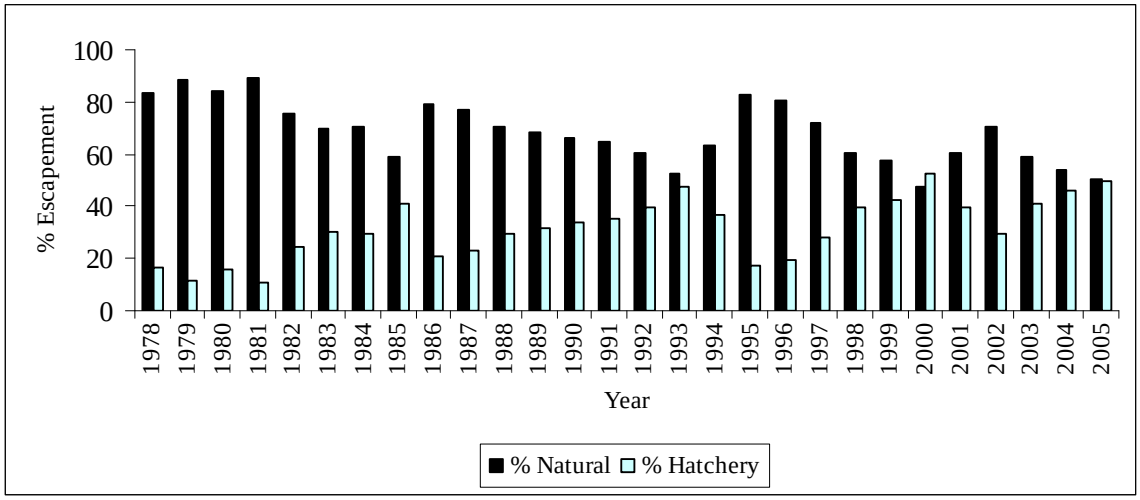
Figure 4. Percent annual change of fall-run Chinook salmon total escapement from each previous year (1979 – 2004), Klamath River basin, California (Source: Hampton 2006).



Estimates of recent naturally produced spawning escapement may include individuals that hatched and reared in hatcheries but did not return to the hatchery to spawn (hatchery strays).

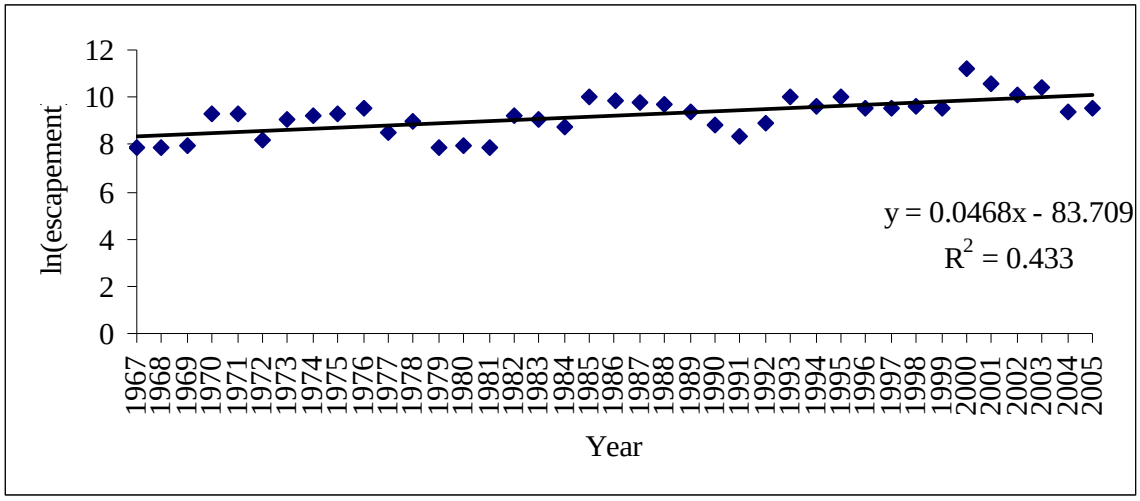
The proportion of natural (in-river) spawners of hatchery origin (hatchery strays) in specific years increased three-fold from the 1980's (maximum = 4.4%) to the 2000's (maximum = 13.1%; Figure 5**). Regression analysis of the percentage of natural spawners of hatchery origin suggested that the proportion of hatchery strays throughout the basin increased significantly over time**.

Figure 5. Natural and Hatchery Spawners' Proportions (%) of basinwide escapement, Klamath River basin, California, 1978 to 2005 (Source: Hampton, personal comm., 2006).



Furthermore, the escapement of fall-run Chinook salmon returning to Iron Gate Hatchery has significantly increased since 1967 (Figure 6).

Figure 6. Fall-run Chinook salmon escapement (ln) to Iron Gate Hatchery, 1967 to 2005, Klamath River, California (Source: Rushton 2006).



Moyle (2002) determined the status of Chinook salmon in California to be stable or increasing. Similarly, trend analysis suggested that fall-run Chinook salmon populations in the Klamath River are not in decline. However, this trend may be masked by the increasing proportion of spawners of hatchery origin (hatchery strays) as compared to natural spawners in the Klamath River fall-run, suggesting that hatchery production is a substantial contributor to escapement. Regression of hatchery vs. natural escapement described a significant relationship between these two populations. Case studies in other basins have shown that hatchery stocks can be unreliable for sustainable fisheries because of vulnerability to disease, and other challenges to maintaining stock viability. Estimates based on this analysis of historic data, for escapement to the mainstem Klamath River of fall Chinook were:

1981
Natural spawners: 4000.
Iron Gate Hatchery spawners: 21,595.

2005
Natural spawners: 4654.
Iron Gate Hatchery spawners: 13,997.

The estimates for natural spawners include hatchery strays. A cautionary note: because populations fluctuate widely from year to year, comparing any two years is not valid, but with the trend graphs, one can make some conclusions regarding abundance.

Coho salmon

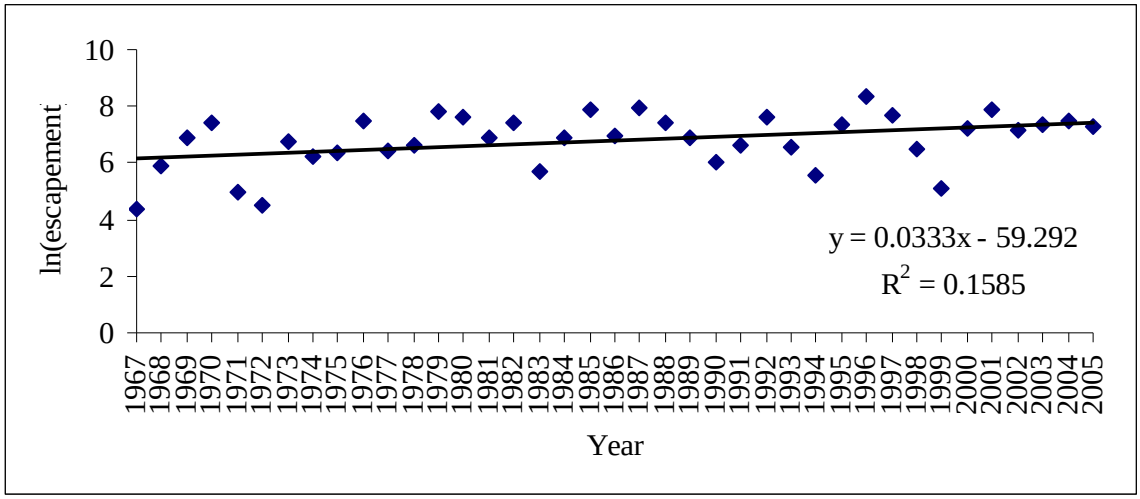
Coho salmon abundance (1945-1995), in southern Oregon and northern California, has declined by approximately 90% to 95% of historical abundance (Brown et al. 1994, Spence et al. 2005). Although historical information is limited for the Klamath River system, records of commercial gill net catch estimated that 11,162 coho salmon were caught in a 30-day period in September and October of 1919 (Snyder 1931). Also,

Spence et al. (2005) reported estimates of coho salmon spawner abundance for the Klamath River as 15,400 in 1965 (CDFG 1965), 3,400 from 1984 to 1985 (Wahle and Pearson 1987) and 1,860 from 1987 to 1991 (Brown et al. 1994).

Coho salmon abundance estimates, in the Klamath River, are confounded by hatchery production from both the Iron Gate and Trinity River Hatcheries (Brown and Moyle 1991). **Current natural spawning of coho salmon in the system is thought to be minor, resulting in populations that are largely sustained by hatchery production (Brown et al. 1994). Although Iron Gate Hatchery reduced its juvenile coho salmon production by 50% in the last 10 years, genetic risks resulting from hatchery and wild populations may remain** (Spence et al. 2005).

Coho salmon escapement to Iron Gate Hatchery was analyzed, in order to determine possible population trends of the hatchery stock (Figure 7). **Trend analysis described a significant increase in coho adults returning to Iron Gate Hatchery over the years**.

Figure 7. Coho salmon escapement (ln) to Iron Gate Hatchery, Klamath River, California, 1967 to 2005 (Source: Rushton 2006).



The lack of long-term historical and recent coho abundance data specific to the Klamath River made population trend analysis of natural populations impractical (Brown and Moyle 1991, Brown et al. 1994, Weitkamp et al. 1996, NRC 2004). However, low occupancy rates (37-61%) of historical coho streams indicated the continued low abundance of coho salmon in California (Spence et al. 2005). Specifically, "**the percentage of streams [used by coho salmon] in the Klamath-Trinity system appears to have declined from 66-71% in 1987 to 55-62% in 1995" (Spence et al. 2005). Although populations in Iron Gate Hatchery appear to be increasing, estimated numbers of coho salmon in the basin by 1994 were around 10% of what they were before 1920** (Brown, et al, 1994) and (Weinkamp, et al, 1995). This is consistent with estimates in Spence et al. (2005) that the population is currently at less than 10%. According to the Administrative Law Judge (ALJ) decision, the SONCC coho salmon population has experienced a 70% decline since the 1960s (ALJ, 2006, at 34, page 7-3).

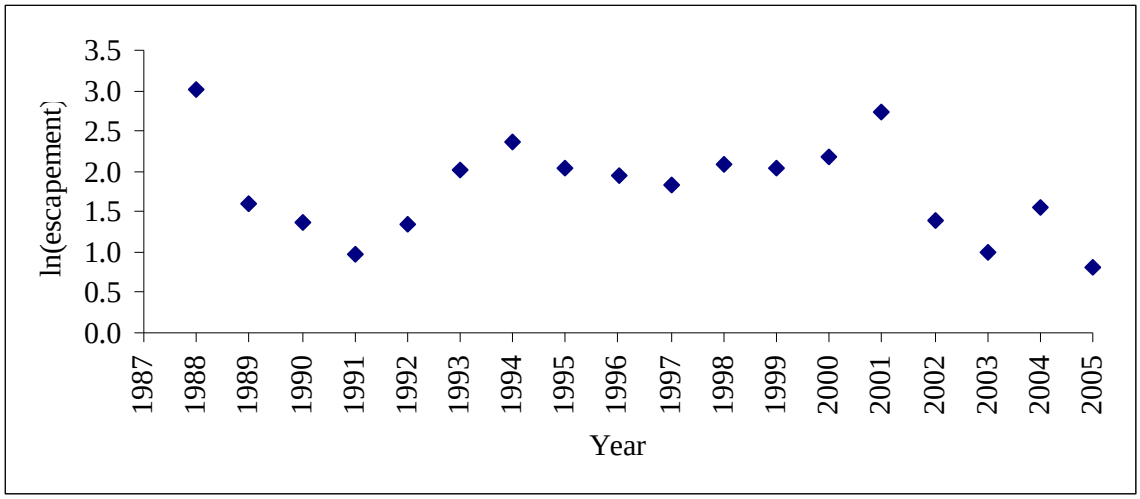
Because of these low numbers, coho are considered at risk of extinction in the Klamath River system.

Steelhead trout

Steelhead trout in the Klamath River basin belong to the Klamath Mountains Province ESU (Busby et al. 1994). In their status review, NMFS compiled and analyzed angler catch, dam and weir counts, and instream adult survey data. Weir counts did not separate natural from hatchery produced fish. The average percent annual change in adult spawner escapement was used as an overall indication of trend (Busby et al. 1994).

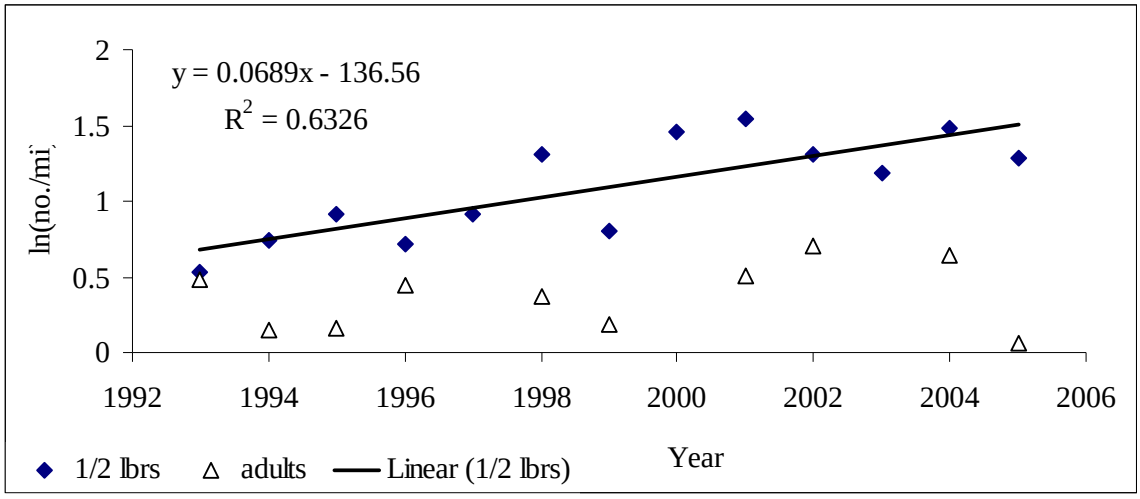
The analysis described in this document was based on instream adult survey data, primarily for summer steelhead adults, because abundance estimates for winter steelhead were not available. However, escapement estimates of hatchery and natural populations were analyzed separately. Summer steelhead trout escapement numbers collected in the Salmon River (1988 to 2005) were used in the analysis, but, the analysis did not detect a trend for summer steelhead escapement in the Salmon River (Figure 9).).

Figure 8. Summer steelhead escapement (ln), 1988 to 2005, Salmon River, California (Source: KNF 2006).



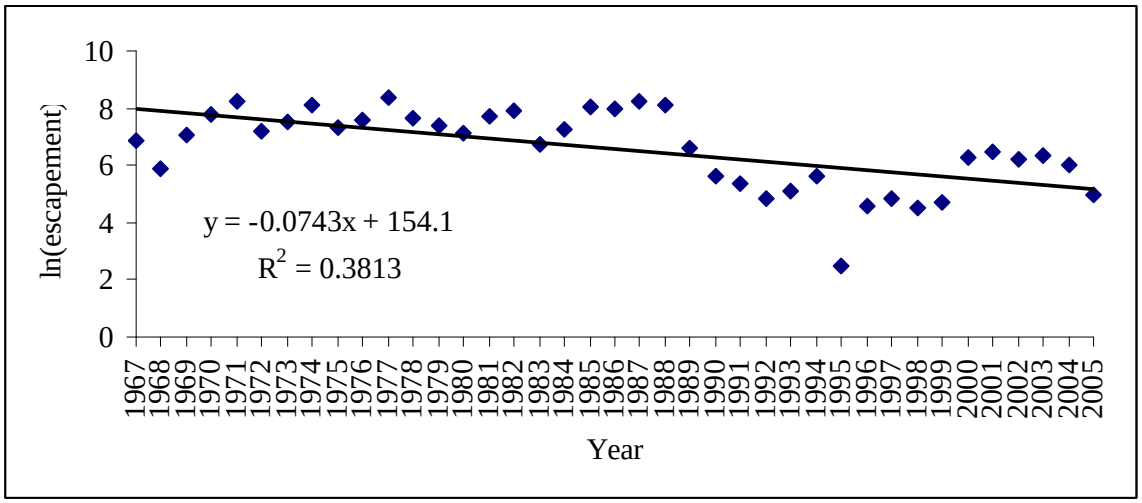
Because adults and half-pounders were reported separately since 1993, age classes were analyzed separately for fish observed in the North and South Forks of the Salmon River (Figure 9). Although the analysis did not detect a trend in adult abundance, the numbers of half-pounder summer steelhead were determined to have increased significantly in the North and South Forks, from 1993 to 2005. However, the analysis was confounded by data collection errors, therefore making the results unreliable.

Figure 9. Summer steelhead half-pounders and adults [ln(no./mi.)], North Fork and South Fork Salmon River, California, 1993 to 2005 (Source: KNF 2006).



Although the analysis did not detect trends in adult abundance, escapement (ln) of summer steelhead adults returning to Iron Gate Hatchery decreased significantly since 1967 (Figure 10). Hatchery estimates of summer steelhead numbers include numbers of "fall-run" steelhead as defined in Busby et al. (1994).

Figure 10. Summer steelhead escapement (ln), Iron Gate Hatchery, Klamath River, California, 1967 to 2005 (Source: Rushton 2006).



Based on the analysis of the data with the longest time series (escapement to Iron Gate Hatchery), it appears that summer steelhead abundance is significantly declining in the Klamath River basin. **Although this trend may not be indicative of natural stock trends, convention states that hatchery-produced steelhead trout often have a competitive advantage over naturally-produced fish because of their larger size and more aggressive behavior (Busby et al. 1994, Kostow and Zhou 2006). Therefore, it is likely that naturally producing summer steelhead trout are also in decline.** The lack of trend detection in natural escapement possibly resulted from conducting analysis on a shorter time series (< 20 years vs. 38 years).

The analysis resulted in similar conclusions as those drawn by Moyle (2002) and Busby et al. (1994). **Moyle (2002) concluded that Klamath Mountains Province winter steelhead were widely distributed and fairly common, although in greatly reduced numbers. In comparison, summer steelhead trout were in danger of extinction, with population estimates at less than 10% of historic levels (Moyle 2002).** He cited dam construction, poor watershed management, decreased flows (resulting in increased temperatures and changes to stream channel morphology/composition), and interactions with hatchery produced steelhead as contributing factors to the decline in steelhead abundance.

Although not at risk of extinction at the time of the status review, Busby et al. (1994) also concluded that Klamath Mountains Province steelhead were likely to become endangered in the foreseeable future if trends continued as they were. They concluded that winter steelhead were probably in low abundance in the Klamath River, but that they had insufficient information to validate this claim. **Summer steelhead trout were determined to be at moderate to high risk of extinction (Nehlsen et al. 1991) with largely depressed abundance numbers.** Estimated run sizes for steelhead in the Klamath River were 20,000 for winter steelhead and 110,000 (1977-1991) for summer steelhead. Like Moyle (2002), they cited dam construction and habitat degradation as contributing factors to the decline of steelhead numbers. Both winter and summer runs have significantly declined from historical levels. Some investigators have concluded that summer runs are at the edge of extinction (Moyle, 2002, Busby, et al, 1994, andALJ, 2006.

Summary of fish habitat and abundance background:
The current Project has led to increased summer and fall temperatures which exacerbate disease conditions. Nutrients, and their affect on promoting reservoir algal blooms as well as downriver attached algal beds, may have led to an increase in fish disease first noticed in the mid 1990s. The Project has depressed summertime DO levels for some distance downstream to well below conditions needed for salmonids to thrive. Because 1981 water quality data is scarce, at best, it is unknown whether there are changes related to secondary effects from sediment accumulation in the reservoirs. It is known that sediment trapping has affected downriver vegetation condition, important for juvenile salmonid escape cover, and also streambed mobility. While the change from 1981 vegetation conditions is not known, it is likely that streambed mobility has not worsened significantly. Until recently, Project flows have been low, although they met the instream flow requirements in place at the date of WSR designation. Cumulative effects such as these and others from non-Project impacts, have led to changes in the anadromous fishery since WSR designation. Analysis of abundance estimates for three anadromous species in the Klamath River basin suggested that specific life histories of two species have decreased since 1981. Statistically significant decreases were calculated for fall-run Chinook salmon grilse (Klamath River basin), and summer steelhead adults (Iron Gate Hatchery). In comparison, the abundance of three species increased significantly in some parts of their range. Escapement of fall-run Chinook salmon and coho salmon to Iron Gate Hatchery, and half-pounder steelhead trout to the Salmon River significantly

increased over the years of data collection. However, there likely was no increase in half-pounder trout abundance in the Salmon River because the data are not reliable. More studies are needed to establish the population trends of half-pounders in the Salmon River. The percentage of fall-run Chinook salmon natural spawners of hatchery origin (hatchery strays) also increased significantly since 1978.

It is uncertain whether anadromous fish, if one disregards origin, are in a general decline basinwide or are stable. Some stocks are in a declining trend and others are stable or in an increasing trend.

The analysis suggested an increasing dependence on hatchery propagation for Chinook salmon production and agrees with other study results that coho salmon production is reliant in the same way (Brown and Moyle 1991, Brown et al. 1994). Impacts of hatchery production on natural stocks have been documented world-wide (Weitkamp et al. 1995, Groot and Margolis 1991). Weitkamp et al. (1995) noted that the advancement and compression of run timing common to hatchery populations can affect future generations of naturally spawning fish because fry from early-spawning adults can grow faster and displace the fry of adults spawning at a later time. Although early-spawning adults may not establish a self-sustaining population, they may still adversely affect the natural population (Nickelson et al. 1986). Also, interactions between hatchery and natural fish may "change the genetic bases or phenotypic expression of life history characteristics in a natural population in such a way that the population might seem either less or more distinctive than it was historically" (Myers et al. 1998). In other words, there would be less genetic diversity and fitness resulting from increasing fractions of hatchery reared fish. Consequently, smolt age, fitness, productivity, migration and spawn timing may be altered in natural populations. Interactions between hatchery and natural populations may also result in the loss of genetic diversity that "buffers populations against periodic or unpredictable changes in the environment" (Fagen and Smoker 1989), making populations more vulnerable to changing environmental conditions. Ultimately, this could lead to non-viable populations and a collapse of the fishery.

Several stressors have been identified as potentially having a detrimental effect on Klamath River anadromous populations. Potential stressors included low stream flows, high water temperatures, increased sedimentation of stream substrates, interactions between hatchery-reared and naturally-produced fish, unfavorable ocean conditions, overexploitation by commercial harvest, detrimental land use practices, barriers to fish passage, severe floods, extensive forest fires, and disease (West et al. 1989, KRBFTF 1991, Cooperrider and Garrett 1995, CDFG 2003, NRC 2004). Of these, interactions between hatchery-reared and naturally-produced fish, barriers to fish migration and disease are expected to continue under PacifiCorp's proposal. The loss of metapopulations above the dams after Copco I construction (1920) have lead to a loss of genetic diversity, hence less robust anadromous fish populations over time. Two stocks (Chinook natural spawners and all grilse-age, and summer steelhead) have undergone population declines since the date of WSR designation.

Fisheries Resource Effects Analysis

Evaluation Criteria 1 – Stream flow regime

PacifiCorp Proposal, Staff Alternative, and Staff Alternative with Mandatory Conditions

Instream flows - PacifiCorp proposes to maintain instream flows and ramp rates below IGD in accordance with the U.S Bureau of Reclamation (Reclamation) project's annual operations plans. A 2006 court order mandated that "Phase III" target flows in the NMFS 2002 BiOp for coho salmon, for the Reclamation project be met or that irrigation be curtailed in an attempt to provide target flows**.** These target flows will be referred to as BiOp Phase III or Phase III flows for the remainder of this document.

The BiOp Phase III flows would be 1000 cfs from July through September in all water types. The 1981 conditions were the minimum instream flows in the current 1955 FERC license, as amended in 1961. Those minimum instream flows were 710 cfs in June and July, 1000 cfs in May and August, and 1300 cfs from September through April (DEIS, page 3-79). June flows would vary from 1400-3000 cfs, depending on water year type, which amounts to a doubling of flows in dry years and a quadrupling in above average and wet years (DEIS page 3-83). **As long as these flows remain in effect, or if they increase as a result of future NMFS biological opinions, they are more suitable for salmonids than conditions present at the date of WSR (1981) designation in all months except for September**. Table 1 compares the Phase III flows to the 1981 flows.

Table 1 – comparison of proposed flows[1] to flows at the date of WSR designation[2]

Flows in cfs		
Month	**Phase III**	**1981 Conditions in Current License**
January	1300	1300
February	1300	1300
March	1450-2300[3]	1300
April	1500-2850[3]	1300
May	1044-3025[3]	1000
June	1400-3000[3]	710
July	1000	710
August	1000	1000
September	1000	1300
October	1300	1300
November	1300	1300
December	1300	1300

[1]Proposed flows are Bi Op Phase III IGD releases criteria based on water year, contained in the 2002 NMFS BiOp (Reclamation, 2006).

[2]Flows required by the current license and being provided by the hydroelectric project were the conditions at the date of WSR designation (1981).
[3]Maximum range specified in the BiOp. The lower number is typically for dry and below average years, while the higher number is for average to wet years.

Ramping rates – Ramping rates are also proposed to follow the 2002 biological opinion for the Klamath Irrigation Project. The current license specifies a rate of 250 cfs change per hour or three inches in water level per hour, whichever is less (DEIS, page 3-79). This was nearly always met from 1961 through 2002, including during the time of WSR designation (Hardin-Davis, Inc., 2000). The BiOp ramp rates vary by instream flow level: above 1750 cfs, not more than 125 cfs per 4 hour period and not exceeding 300 cfs per 24 hour period; at 1750 cfs or less, not more than 50 cfs per 4 hour period and not exceeding 150 cfs per 24 hour period. PacifiCorp's proposed ramp rates are, therefore, much more protective of fish than those operating at the time of WSR designation. The proposal should result in less stranding, thermal stress/mortality, and predation. In its 10(j) ramping rate recommendations, the USDI, FWS, confirmed that "stranding of anadromous salmonids and other fish in the Klamath River has been documented at these high [current license] ramp rates." (USDI, FWS, 1998, as cited in USDI, FWS, 2006)

The minimum instream flows and the ramp rates that PacifiCorp proposes to follow would improve habitat conditions for fish. In addition to the increased useable physical habitat area (due to more suitable depths, velocities, cover and substrate for various age classes), increased flows would improve water quality. There would be less mortality of juveniles rearing in the river from stranding and predation.

Retirement of Copco 1 and Iron Gate

Instream flows would remain the same, but the proposed ramping rates would be modified to include a provision for down-ramping of two inches per hour downstream of IGD, with a maximum daily limit of 12 inches during the Chinook salmon spawning and incubation period. These conditions are also more protective of fish than those in place at the time of WSR designation, unless such ramping occurs more frequently (daily to weekly vs. a few times a year) due to the infeasiblity of reregulating peaking flow releases below J.C. Boyle powerplant. This operational feature was not clear in the alternative description.

The removal of Copco 1 and Iron Gate Dams would result in slightly more variable flows, because flows would equal releases from upstream dams plus runoff downstream from J.C Boyle without impoundment behind Copco 1 and Iron Gate Dams. **This greater variability would influence the daily temperature regime, providing for greater minimums and maximums (PacifiCorp, 2004a). Early fall freshet flows would be more frequent, and could help signal holding fish to migrate, thereby reducing crowding.** As with ramping, if variability is due to frequent peaking, this could have detrimental effects on downstream habitat.

Evaluation Criteria 2 – Water Temperature

PacifiCorp Proposal

The applicant's commitment to explore the "potential" measure of a low-level release of cooler water stored in Iron Gate reservoir's hypolimnion during summer could ultimately lead to cooling during brief, critical periods. This measure, #2P in the DEIS, is to be evaluated during the state Water Board's Clean Water Act Section 401 certification process. This process, with a scheduled outcome the end of March 2007, will provide an additional data source for the WSR final determination. The dispensation of this measure is unknown at the time of this evaluation. The potential benefit is expected to last from days to a couple of weeks (DEIS page 3-137). Elevated temperatures resulting from the heating and thermal lag of impounded water last several weeks to months. There would be no improvement in the event the Water Board deems infeasible or ineffective the potential for release of cool water storage. In 2005, the licensee responded to a FERC AIR request by saying it didn't feel any "substantial relief to warm summer and fall temperatures downstream of IGD" was feasible (PacifiCorp, 2006). Temperature conditions at the time of WSR designation (1981) are not well documented, nor have they been modeled. Real or predicted changes from WSR baseline conditions are not known; however, it is unlikely that the current temperature regime has changed substantially.

In summary, temperature conditions are influenced by the current project, and this alternative does not propose actual measures to mitigate those effects (spring cooling and summer/fall warming). Adverse conditions to salmonid habitat associated with dam construction and Project implementation will still be present but will be similar to the likely temperature patterns at the date of WSR designation.

Staff Alternative and Staff Alternative with Mandatory Conditions

This alternative would modify the proposed measure #2P to include a temperature management plan that would include an engineering feasibility study of the IGD structure for emergency cool water releases, and development of protocols to define salmonid survival-critical triggers to guide cold water pool releases. PacifiCorp's measure #4P (separate reservoir water quality management plans that did not explicitly include water temperature) is modified in this alternative to be a comprehensive water management plan for all project-affected waters. It includes water temperature as a component, which PacifiCorp's Proposal did not specifically include. The Staff proposed plan would add: 1) consideration of cool warm release in late summer to help with returning spawner Chinook, 2) consideration of warm water spillage from IGD in late spring to help with survival of outmigrating juvenile fall Chinook, 3) greater geographic scope of the plan beyond project reservoirs and reaches, and 4) long-term monitoring. This alternative could reduce hourly temperatures by 1.1 degrees C, with a maximum of 1.8 degrees, for up to 1 ½ months if the cold water pool was managed for maximum duration. If managed for a target release of 15 degrees C or less, Iron Gate's cold water pool (an estimated 20,000 acre-feet) could be sustained at 1000 cfs for around 10 days. If managed for a shorter duration to maximize the temperature reduction, a maximum 10 degree reduction

in downstream water temperature could be sustained at lower flows for around 2 weeks. The Staff recommended this strategy. The modeled temperature benefits become reduced as water moves downstream to the stream gage near Seiad Valley, with no discernable benefit by the time it reaches Clear Creek around river mile 90. Thus the lower 100 miles of river would be unaffected. The monitoring element, if it includes temperature, would enable adaptive management of any operational changes and lead to incremental improvements. Monitoring would identify unanticipated adverse effects of emergency releases so that they could be corrected. Tradeoffs of low-level (cool pool) releases could include a decrease in dissolved oxygen downstream of IGD and impairment of hatchery operations unless alternative cool water sources for that facility are found. Habitat conditions would be improved for fish that are holding in the main stem and that are outmigrating from the upper mid-Klamath tributaries. The colder stretch of river would function as a thermal refuge to fish in the upper part of the watershed, during stressful summer high temperatures. A feasibility study for alternative sources is part of this alternative.

As noted under the PacifiCorp Proposal discussion, temperature conditions at the date of designation are not well defined. **However, assuming that temperatures have not dramatically changed since WSR designation, water temperature could potentially be increased in spring, and decreased in summer and fall, from 1981 conditions, if this alternative is fully implemented.** Implementation of this alternative would enhance salmonid survival during summer flows.

Retirement of Copco 1 and Iron Gate Dams

Measure #2P would be eliminated in this alternative. “The temperature regime downstream from Iron Gate would be more suitable for salmon” (DEIS Executive Summary, page xxxii). PacifiCorp’s modeled results show that without the project (no mainstem dams at all) the temperatures in the spring and early summer are as much as 5 degrees C warmer. Temperatures are predicted to be cooler in summer and fall than with the existing condition. Temperatures currently stay at more than 20 degrees C in dry years with little variability for much of July and August (DEIS, page 3-134). While summer temperatures are more variable in the “without project” scenario, median temperatures would be substantially lower (DEIS, page 3-135). Dry year summer temperature differences between With-Project and Without Project scenarios would be more extreme than in other water year types, but similar trends would occur in all year types. **Summer and fall temperatures would be more conducive to salmon rearing, migrating and spawning than the conditions that were probable at the date of designation.**

<u>Evaluation Criteria 3 – Water Quality</u>

PacifiCorp Proposal

This alternative proposes DEIS measure #3P, an oxygenation diffusion system for hypolimnetic oxygenation in Iron Gate Reservoir, with additional aeration of turbine

released water if conditions warrant. The system would be operated each year from spring until fall when the reservoir becomes destratified. PacifiCorp's water quality modeling results showed that the current project depresses Copco 1 and Iron Gate reservoir dissolved oxygen concentrations to well below the Basin Plan objective from late spring through early fall. This effect is thought to extend at least as far downstream as the mouth of the Shasta River (DEIS, page 3-138). The modeled Without- Project scenario, on the other hand, only shows short duration drops below Basin Plan objectives. **While measure #3P would improve levels somewhat, FERC staff believe DO would fall "far short" of meeting water quality objectives, and likely not meet them for much of the summer and fall (DEIS page 3-139 to 3-141). Injecting oxygen into the hypolimnion could have unintended adverse effects.** These include a slight rise in outflow temperatures in August and September, turbulence that potentially leads to premature reservoir destratification which would initiate loss of the cold water pool. It could initiate an increase in nutrients that favor algal blooms. In addition to planktonic algae increases in the reservoir, hypolimnetic oxygenation could lead to uptake of inorganic nitrogen which could increase the growth of attached algae in the river downstream of the dam. An additional measure, #4P, would be development and implementation of a water quality management plan that would evaluate effectiveness and feasibility of several technologies for DO enhancement as well as nutrient-related problems. **Implementation of the plan could result in reduced reservoir nutrient loads which in turn could reduce the downstream occurrence of Cladophera algae populations that form habitat for a fish pathogen host.** There is considerable uncertainty, however, as to what is to be contained in the plan, and whether and when effective measures would be implemented by the licensee.

Dissolved oxygen effects compared to baseline:
Baseline data is lacking, and so it is unknown if that dissolved oxygen seasonal cycles are similar to what they are today. The annual mixing of the reservoir, and aeration from winter flows could lead to the conclusion that the reservoirs "reset" DO conditions each year. However, the gradual accumulation of sediments (19.6 million cubic yards total, in Copco 1 and Iron Gate (California Coastal Conservancy, 2006 memo) in the bottom of reservoirs could be gradually increasing the sediment oxygen demand. This could mean a potential trend of decreasing DO levels under the right chemical conditions, from one year to the next. Under that assumption, the proposed action would likely have a very minor improvement from 1981 DO conditions, perhaps offsetting such a trend. This is especially true if oxygen levels are adaptively managed to meet the Basin Plan objective. It is possible that the reservoirs are not being flushed of nutrients adsorbed to sediments and organic matter, leading to sequestering of nutrients. This would create increasing anoxic conditions with the passage of time and a continuing decline in summertime DO releases downstream of IGD. **It is uncertain whether the modest increases in DO from this alternative would have any improvement in concentrations present at the date of WSR designation even if DO is slightly increased over existing conditions.**
Modeling of DO using a scenario of 1981 simulated conditions that takes into account the changes over time in sediment- and biological oxygen demands, could help answer this question.

Nutrient conditions compared to baseline:
A 1978 U.S. Environmental Protection Agency (US EPA) study looked at phosphorus and nitrogen levels coming into and leaving Iron Gate reservoir over the course of one year (1975). It concluded that Iron Gate Reservoir ranked last in overall trophic quality of 24 California lakes and reservoirs sampled that year as part of a National Eutrophication Study. The study found that **nitrogen outflow from Iron Gate reservoir was 21% higher than inflow** while **outflowing phosphorus was 7% less than inflow.** The "apparent loss of nitrogen during the sampling year…may have been due to nitrogen fixation in the reservoir, solubilization of previously sedimented nitrogen…..or (probably) insufficient outlet sampling…." The study was able to conclude that the river, rather than its tributaries, contributed the bulk of inflow nutrient loads (97 and 98% for nitrogen and phosphorus, respectively). "Since most of the load is in the outflow of naturally eutrophic Klamath Lake, it appears that little can be done to improve the trophic condition of Iron Gate Reservoir." It has been pointed out that the EPA study did not attempt to examine nutrient retention patterns or produce a reservoir mass nutrient budget (Kann and Asarian, 2005), and therefore it cannot be determined what the role of the reservoir in nutrient cycling was, nor can the 1975 results be compared with the 2005 Water Board study. Thus, **it cannot be definitively determined whether there has been a declining, improving, or stable trend in nutrient releases since the time of river designation.** However, nutrient-related problems could potentially be increasing from year-to-year as inorganic nutrients settle out in reservoirs during the winter season, and accumulate in the sediments. This can occur through adsorption or simple burial of decaying organic matter in the sediments. The nutrient compounds could be stored at the bottom of the reservoirs until the right chemical conditions (i.e. pH) enable reduction/oxidation to take place. These processes trigger nutrient release into the water column. Based on modeling by PacifiCorp, and the follow-up studies by Kann and Asarian (2005), and Asarian and Kann (2006), it appears that residual nutrient amounts carry over, being assimilated following reservoir mixing in the fall, to be released the following spring and summer. This might be associated with the progressive sediment trapping by project reservoirs, due to the ever increasing number of sediment particles to bind with nutrient compounds.

Nuisance algae distribution and incidence of fish disease compared to baseline:
Nuisance algal blooms were occurring in Iron Gate reservoir, especially in drought years, prior to the date of designation (Van de Water, personal observation). The 1975 reservoir eutrophication study (US EPA, 1978), discussed under the Fisheries Resource Evaluation section, indicates that there was a concern by the mid-1970s, and evidence that Iron Gate and Copco reservoirs had a net positive annual nitrogen release downstream prior to WSR designation. During the following summer months, under the right chemical conditions, these nutrients are readily released from the sediments into the water column, to be released downstream to stimulate attached algae growth (Kann and Asarian, 2005). This is especially true for the nitrogen "species", particularly since the Klamath River below Iron Gate is known to be nitrogen-limited. **The effect of this alternative in arresting or advancing the downstream spread of Cladophera is unknown (reservoir water quality plans were proposed but not described), and depends on the**

effectiveness of treating reservoir nutrient loading. If successful, the proposal could stem the increase of fish pathogen host habitat, and subsequently certain fish disease outbreaks. If not successful, there would be a worsening of a potential fish disease trend that apparently began in the 1990's. Although summer minimum flows will be increased by around 50%, no flushing flows are planned. Regular observations since 1978 by Klamath National Forest River Ranger Dave Payne indicate that "changes…over time associated with the (attached) algae seem to be directly tied to the scouring of flood flows and the redistribution of sediments after flood events" (Payne, 2006, personal communication). His observations concur with recent findings by Eilers, et al (2005). Eilers suggested that results of his periphyton distribution study in the river were significantly influenced by an antecedent flow release from IGD (Eilers, et al, 2005).

Because it is not known whether there has been a worsening trend, or no change since 1981 algal conditions, we are unable to conclude whether disease conditions would be unchanged, intensified, or have slightly reduced intensity. Reduced intensity of outbreaks could be a successful outcome of any future measures that result from implementation of the reservoir management plan; however, there are no plan details at this time. As discussed under criteria 1, increased summer and fall flows should affect water quality to some extent. Payne concluded that "higher flows reduce the amount of algae growth during the summer" (Payne, 2006, personal communication).

In conclusion, dissolved oxygen, algae, nutrients and disease effects of this alternative could improve slightly over current conditions, depending upon reservoir water quality management plan measures to be developed during the new license term. However, due to unknowns regarding the effectiveness of the alternative's measures, and unknown baseline conditions, the effect of water quality compared to conditions at the time of WSR designation is unknown.

Staff Alternative and Staff Alternative with Mandatory Conditions

FERC staff recommends further study of hypolimnetic oxygenation prior to implementation, in order to see if benefits outweigh the adverse effects listed above. Concurrently with the study, the Staff Alternative proposes to inject air into turbine outflows to meet an immediate need, especially in dry to critically dry years. It would provide some short term relief during periods of low DO, but may still fall short of meeting State standards (DEIS, page xxxiii). The DO results would be comparable to the Proposed Action without the adverse effects. To supplement IGD aeration, Copco 1 or Copco 2 oxygen injection could increase the DO of water entering Iron Gate reservoir. This benefit would carry through to be released at Iron Gate, since there is little mixing of these surface waters during the summer. Spillage of surface water could be used during select periods to increase DO downstream of IGD without the negative effects on nutrients and temperature in the reservoir that the PacifiCorp proposed hypolimnetic treatment would have. Monitoring and an adaptive management approach would be followed for five years before implementing additional measures. Another measure that was not part of PacifiCorp's Proposal is a cooperative disease monitoring and management plan to address cumulative disease-related effects. However, there is

insufficient detail regarding what "other entities" it includes, and what measures might be included in order to assess the plan's effectiveness at stemming disease trends. The DEIS Executive Summary (page xxxv) specifies that the licensee's efforts would be focused between IGD and the Shasta River, and apparently does not include downstream reaches. Therefore, it is difficult to assess the beneficial effects of this measure, and their temporal and geographic scope. As with PacifiCorp's Proposal, there is insufficient information on this alternative's effects and on WSR baseline conditions to assess their relative effects. **However, the improved dissolved oxygen level is likely to be an increase over 1981 levels in summer months. In addition, the comprehensive plan should ultimately identify and set the stage for reversal of potentially increasing nutrient trends and cumulative effects that exacerbate fish disease.**

Retirement of Copco 1 and Iron Gate Dams

The DEIS says that this alternative would eliminate the major sources of water quality problems that are project-associated. (DEIS page 3-289). **Removal of the two dams would enhance downstream water quality for salmonids, and conditions that foster disease outbreaks would be reduced.** However, Keno reservoir would remain in place (as would J.C. Boyle and Copco 2). Keno has serious water quality problems, some of which are Project-influenced. The alternative would "reduce cumulative effects that contribute to downstream fish kills caused by disease and poor water quality (low DO, high water temperature, variable pH and ammonia levels, [fish] crowding, nutrients….)". DO levels would usually meet applicable Basin Plan objectives over the long term. Nitrogen load would be reduced downstream of Iron Gate after a short term increase over 1981 levels, which may reduce abundance of algae that form habitat for the intermediate host for at least two salmon pathogens." (DEIS Executive Summary, pages xxxiii and xxxv). (See discussion under PacifiCorp Proposal regarding the potential for an existing trend of nitrogen load over time.) The reduction in fish crowding would result from reduced temperature-induced stress (see criteria 2) and may allow for spawning to begin earlier in the fall (page 3-289). See the Dam Retirement Alternative under criteria 4 for a discussion of short term effects on water quality associated with the release of sediment now stored behind the dams.

Evaluation Criteria 4 - Changes in sediment transport/storage and substrate conditions

PacifiCorp Proposal

In order to mitigate the project effects on spawning habitat, PacifiCorp proposes to place 1800-3500 cubic yards of gravel downstream of IGD. Although there is some uncertainty as to whether PacifiCorp intended this to be an annual or one-time deposit, FERC assumes in its analysis that this is a one-time treatment that would result in "minor enhancement" of spawning gravel supply (DEIS Executive Summary, page xxxii). No related flow measures, such as flushing flows would be provided to distribute the gravel, beyond natural flushing flows. This minor enhancement would not likely reverse the

coarsening that the riverbed has undergone since IGD construction in 1961. Over the term of a new license (30 to 50 years), this alternative would result in continued reduction of spawning gravels from that which was available at the date of WSR designation. **The bed coarsening caused by the current project from altered sediment transport and storage, and spawning gravel conditions would largely continue for the Proposed Action. However, much of the riverbed coarsening had probably already occurred as of 1981 (see criteria 4 Background). Therefore, this alternative would not result in a significant change from WSR baseline conditions. There would be no improvement in riparian vegetation, which may have already been diminished in extent between IGD and the Shasta River, although the 1981 conditions are unknown**. See the Wildlife Resource Analysis for further discussion.

Staff Alternative and Staff Alternative with Mandatory Conditions

These alternatives would base the amount and frequency of spawning gravel deposition on habitat condition mapping and monitoring of gravel distribution according to habitat needs. This would result in moderate enhancement of substrate conditions for spawning, over time (DEIS Executive Summary, page xxxii). Results of analysis of this criterion indicate spawning conditions could be improved from current conditions but may or may not return to 1981 conditions. By that time, spawning habitat was already thought to be impacted (Buer, 1981) although whether there was a declining or improving trend in streambed conditions since 1981 is not known. The geographic and temporal effect of measures implemented will not be known until the plan is developed, but an adaptive management approach should lead to improvement over time. While FERC agrees with several agencies on the value of flushing flows for encouraging more favorable riparian species and cleansing existing and augmented spawning gravels, no such flushing flows below IGD are included in this alternative. The alternative could provide a moderate improvement of spawning gravels between IGD and the confluence of the Shasta River. **However, the geographic and temporal scope of this benefit cannot be determined until the gravel restoration plan is developed. This plan could enhance spawning habitat from 1981 conditions, especially if monitoring can strategically guide adaptive gravel management. Riparian vegetation effects would be the same as for the PacifiCorp Proposal.**

Retirement of Copco and Iron Gate Dam

According to FERC's environmental analysis, "sediment stored in Iron Gate Reservoir would likely be released to downstream reaches which would have short term adverse effects on aquatic habitat but eventually stabilize, and spawning gravel released from the reservoir could enhance spawning habitat." (DEIS Executive Summary, page xxxii.) Restoring natural sediment processes would contribute to scour of attached algae (e.g. *Cladophera spp*.), and deposited sand and gravel would be a less favorable substrate for the algae because of greater particle mobility during high flow events than the existing armored substrate. As discussed under criteria 3, a reduction in such algae would lead to reduced habitat for the fish pathogen alternate host. (DEIS, page 3-290.)

In the near term, an increase in fine sediment is expected to reduce the quality of anadromous spawning habitat downstream from IGD. This would only affect habitat in the main stem but could impact all fish in the river system if they are in the Klamath River by causing gill abrasion, and changes in migration/holding patterns. Tributaries may reflect increases in fish densities if fish begin moving into them to avoid adverse conditions. If so, that could lead to increased competition for food and space. Most of the spawning Chinook, which use tributary spawning habitats, would be unaffected (DEIS, page 3-292.) Depending on the time of year, sediment releases could also affect green sturgeon and Pacific lamprey spawning, holding and rearing in the main stem. No estimate was available for the downstream extent or the duration of this impact.

Discussion:
Under Unavoidable Adverse Effects, the DEIS notes that the magnitude and duration of increased turbidity of the water downstream of IGD are related to several factors. "Based on these factors, we expect the adverse effects from increased turbidity during and following dam removal to range from relatively short-term, minimum increases in turbidity, to increases in turbidity that could last for several years. If sediments should be contaminated, any release of such contaminants during dam removal could also adversely affect water quality" (DEIS, page 3-157). In the worst case scenario described in the DEIS (a dry water year following 3 months of low flow at the beginning of reservoir draw down), the model assumed that the removal of the dam would take 6 months to complete. Results of the simulation indicate that there would be a maximum of less than 4 feet of sediment deposition downstream of the dam and upstream of river mile 183. After two weeks, the maximum sediment deposit would decrease to less than 2 feet. Almost all the stored sediment is modeled to disappear in 6 months following the final stage of dam removal, and no sediment deposition is predicted downstream of river mile 183 (DEIS, 3.3.32.6,3-57). A recent press release from PacifiCorp on its plan to decommission the Condit dam said it "calls for blasting a hole near the dam's base and releasing 2.2 million cubic yards of sediment built up behind the structure. A draft environmental impact statement prepared by the [Washington] Department of Ecology found that the sediment plume would kill all fish and other aquatic species below the dam..." A NMFS biological opinion on the project determined that there would be adverse short term effects to fisheries but that all anadromous species would benefit in the long term (Durban, Kathie, October 20, 2006 article in the Columbian). In the Klamath Project DEIS, FERC anticipated that the quality as well as quantity of spawning habitat would increase in the long term (DEIS, page 3-292). Retrospective studies of sediment release from dam removal have shown a release, in the short term, of nutrients and decline of nutrients retained by the reservoir. (Doyle, M.W., 2000). Iron Gate and Copco are known to retain nutrients, at least during winter months (Kann and Asarian, 2005). Winter is considered the optimal time for the bulk of the sediment to be released, raising the question of how much nutrient load would be flushed out, and how much is transported vs. stored in riverine reaches.

The California Coastal Conservancy filed a preliminary report of a sediment study with FERC on Sept. 26, 2006. The purpose of the study was to look at decommissioning feasibility based on proposed approaches and methods to retire mainstem dams. The

report addressed sediment volume, grain size distribution and toxicity as well as assumptions related to the potential for downstream flooding should sediment be released in the course of decommissioning. This study, performed by Dennis Gathard, resulted in an updated estimate of sediment volume from PacifiCorp's Study (PacifiCorp, 2004b), based on sediment cores drilled in J.C. Boyle, Copco 1, and Iron Gate reservoirs. The Coastal Conservancy study also refined assumptions based on a 2004 engineering feasibility study for a worst case sediment release scenario where 1,800,000 cubic yards and 1,600,000 cubic yards would be released from Copco 1 and Iron Gate dams, respectively (Stillwater Sciences, 2004). The new estimate assumed a staged release of sediment which would amount to 3,770,000 cubic yards. The sand and gravel portion (5% of Copco 1 reservoir's and 30% of Iron Gate's total sediment volume) can potentially be deposited in the downstream reach. The gravel component is relatively immobile and would likely be metered out gradually during subsequent storm events. The majority of the volume, the silt and clay component, is assumed to pass downstream as suspended sediment, traveling out to sea during winter flows. This period of suspended sediment could theoretically last for 6 months at a high concentration levels. Concentrations of suspended sediment exceeding 100 mg/L are known to have a variety of sub lethal effects on fish when prolonged for 6 months. (Meehan, ed., 1991). Reduced growth and feeding activity have occurred when concentrations exceed 300 mg/L. Direct mortality has been reported at higher concentrations (greater than 1000-1200 mg/L) (Meehan, ed., 1991).

Stillwater Sciences, who previously reported on *A Preliminary Evaluation of the Potential Downstream Sediment Deposition Following the Removal of Iron Gate, Copco, and J.C.Boyle Dams, Klamath River* (Stillwater Sciences, 2004), did a reevaluation of their earlier simulation that is enclosed in the Coastal Conservancy memo (California Coastal Conservancy, 2006, Exhibit 3). The earlier report was of a worst case scenario, and after Gathard's analysis, Stillwater Sciences notes that "because the gravel will be transported downstream lagging behind sand, the amount of sediment released during the removal of the Iron Gate cofferdam will constitute primarily sand, or 593,000 cubic yards." A combined total of 3.8 million yards of sediment would be released downstream of IGD, assuming the simultaneous removal of J.C. Boyle, Copco 1, and Iron Gate. This has a greater estimate of effects than what would be released in FERC's Dam Retirement alternative, which leaves J.C. Boyle facilities intact. The 2006 Gathard study found that "ample information exists to accurately predict the amount of sediment that would erode downriver and that sediment transport below Iron Gate dam would be unlikely to cause flooding" (California Coastal Conservancy, 2006).

The final draft of the study is due later this year, and was not available in time for this WSR Sec. 7 report. The study is not expected to analyze the water quality or aquatic habitat effects although those effects could be substantial (Michael Bowen of the Coastal Conservancy, personal communication, 10/16, 2006). Such effects include the magnitude, timing, temporal duration, and downriver extent. No sediment routing study has been conducted on this river reach for the Dam Retirement Alternative. Such a study would predict likely deposition and scour areas and associated elevations. A preliminary investigation performed by G and G Associates, *Klamath River Dam Removal*

Investigation, for American Rivers (G and G, 2003) summarized downstream issues that needed to be examined, but that were outside the scope of their investigation. These included effects to aquatic life (fish and their food sources), changes in riverbed elevations (aggradation and degradation), especially near structures, changes in river course, and changes in water quality (temperature, turbidity, organic content, and dissolved oxygen). The authors recommended an analysis of mitigation requirements for effects on the river and associated structures and water uses. Further study recommendations included:

- all water use downstream of the dam, which could lead to mitigation measures for impacts to water users.
- potential flooding risks, including a review of all structures in and over the river that may potentially be affected by higher water elevations. (This may be included in the final Coastal Conservancy report.)

Grant and O'Connor cite five key uncertainties regarding dam removal: **what's in the sediment; how fast will the sediment be washed away; where will it go, where will it deposit**, and **what downstream changes will it cause?** (Grant and O'Connor, 2000.) Of these, the first has been covered by the Coastal Conservancy preliminary report. However, it is uncertain at the time of this analysis whether the other four questions will be answered in time to inform FERC for its final decision.

In summary, information about habitat conditions at the time of WSR designation are lacking; however, it is likely that trends of river coarsening, increasing habitat for attached algae, and reduced recruitment and maintenance of riparian vegetation were already underway at the time of WSR designation due to Project facilities and operations. **This alternative would reduce those trends in the long term, and restore natural sediment transport processes, which were no longer in place by 1981. There are questions regarding short term impacts to water quality and aquatic habitat that are unanswered as of this assessment, so we are unable to determine what the impacts would be in general and relative to probable conditions at the date of designation. Based on the information to date, including retrospective studies, there are indications that conditions could be adversely impacted for some period of time. However, aquatic habitat conditions are expected to be improved from conditions in 1981, in the long term.**

Potential for toxic contaminants in sediments

FERC states that "sampling being done by the California Coastal Conservancy should provide information on contaminant levels prior to issuance of the FEIS" (DEIS, page 5-58). The California Coastal Conservancy preliminary report indicated that sediments sampled in project reservoirs for toxics were below screening standards for many compounds, and overall, toxicity of these sediments was consider sufficiently low to make dam removal economically feasible. However, dioxins and volatile organochloride samples indicated possible presence at levels that warrant further inquiry. There are no recommended levels for cyanide screening, but cyanide was present in two of the three samples measured. The contractor who collected these samples noted that additional testing may be required, because several of the contaminant tests were only adequate for

screening level study (California Coastal Conservancy, 2006. Exhibit 2). There is evidence that contaminants in reservoir water and/or sediments (i.e. metals and pesticides) are already present in fish tissue, according to a study of toxic residues in fish tissue in Project reservoirs (PacifiCorp, 2004c and DEIS page 3-120).**Additional study will likely be needed before an assessment of effects on aquatic habitat can be made and what mitigation measures would be appropriate given any risks that such study might identify**.

Evaluation Criteria 5 – Changes in anadromous salmonid abundance trends

PacifiCorp Proposal

Effects from PacifiCorp's proposal are expected to be similar to those felt by salmonid populations today. Both summer steelhead and coho salmon are at risk of extinction due to their current low numbers. Chinook abundance is declining for natural stocks although hatchery stocks remain healthy. One age class, grilse, is declining in the Chinook population as a whole.

Several stressors have been identified as potentially having a detrimental effect on Klamath River anadromous populations. Potential stressors influenced at least partly by the Project include low stream flows, high water temperatures, interactions between hatchery-reared and naturally-produced fish, barriers to fish passage, and disease. **Of these, high water temperatures, interactions between hatchery-reared and naturally-produced fish, barriers to fish migration, and disease are expected to continue under PacifiCorp's proposal.**

The effects from low stream flow should be mitigated for by implementation of the BiOp Phase III flows. The slower ramping rate should reduce the incidence of stranding and thermal stress associated with rapidly changing stream flows. Effects from the proposed gravel augmentation (1800 to 3500 cy) are not expected to improve spawning gravel condition sufficiently to improve the reproductive success of spawning salmonids.

Impacts of interactions between hatchery reared and naturally-produced Chinook salmon can be detrimental if the genetic integrity of natural populations is compromised by interbreeding with hatchery stocks so that they are no longer adapted to habitat conditions specific to the Klamath River basin. Natural populations of Chinook salmon in southern Oregon and northern California are readily distinguished from more northerly coastal populations by their oceanic migration patterns, primarily off the Oregon and California coasts. They also differ from other populations in their morphology and physiology (McGregor 1923 in Myers et al. 1998, Snyder 1931). Interbreeding between hatchery- and naturally-produced Chinook salmon can lead to a "loss of fitness in local populations and loss of diversity among populations" (Weitkamp et al. 1995).

Dam construction eliminated access to approximately 970 km (600 miles) of spawning habitat for spring-run Chinook salmon, increasing the potential for interbreeding between

spring and fall runs (Hamilton et al. 2005). As runs become genetically homogenous due to interbreeding, they become more vulnerable to changing environmental conditions because they are less able to adapt (Griffiths et al. 1999). The first man-made barrier to fish passage in the Klamath River was Copco 1 Dam, completed in 1918. Currently, IGD, completed in 1962, prevents fish from migrating further upstream.

The PacifiCorp proposal will continue to adversely impact coho salmon because the dams associated with the Project act as a barrier to at least 48 km (30 miles) of habitat that was historically used by coho salmon (Hamilton et al. 2005). In addition, interactions between hatchery- and naturally-produced coho salmon are believed to have reduced the genetic diversity of natural stocks as well as made the natural stocks more susceptible to disease (Powers et al. 2005).

The PacifiCorp proposal will continue to adversely impact steelhead trout because the dams prevent access to spawning and rearing habitat located upstream of IGD. Continued interactions between hatchery-reared and naturally produced stocks can adversely impact natural populations in the same manner as noted for Chinook and coho salmon (above). The PacifiCorp proposal is expected to contribute to a continued decrease of natural Chinook, coho and steelhead abundance from 1981 levels.

Staff Alternative

The staff alternative is expected to improve habitat conditions for salmonids using the Klamath River downstream of IGD. The slower ramping rate should reduce the incidence of stranding and thermal stress associated with rapidly changing stream flows. Also, this alternative provides provisions that address the need for warmer or cooler water releases from Iron Gate Reservoir depending on the season, resulting in more favorable conditions for fish emerging in the spring and migrating or holding in the summer. The alternative also addresses the need for monitoring of hypolimnetic oxygenation as a method to improve dissolved oxygen concentrations, as well as disease outbreaks that may result from increased nutrient loading. The alternative increases the amount and frequency of gravel augmentation which could locally increase the amount of available spawning habitat in the main stem. However, without requiring flushing flows in combination with the gravel augmentation, it is uncertain how effectively the addition of gravel could reduce stream bed armoring and increase stream bed mobility. Without such flows, the habitat complexity of the main stem may not be affected. Increased habitat complexity of the main stem would provide migrating and rearing fish with increased protection from high flows and predation. Potentially adverse impacts resulting from the implementation of this alternative include interactions between hatchery- and naturally-reared fish, and the use of trap and haul (trucking) techniques to reintroduce anadromous fish to habitats upstream of IGD. Transportation and handling can increase mortality or induce sub lethal effects that reduce fitness in fish (Johnson et al. 1990). Because hatchery-produced stocks will continue to be released into the river, naturally-produced stocks will continue to compete for habitat and resources. **This alternative is expected to improve the habitat conditions for all salmonids in the main stem,**

regardless of their origin. But if interactions between hatchery- and naturally-produced stocks follow the same trend as in the past 20 + years, the value of improved habitat may be offset by these interactions so that the abundance of natural stocks will continue to decline. The staff alternative will most likely result in continued decline in anadromous fish numbers as compared to 1981, because of hatchery interactions and lack of access to upstream habitat.

Staff Alternative with Mandatory Conditions

This alternative is the same as the Staff Alternative except that it provides for fish passage facilities at all project developments. Access to spawning and rearing habitat upstream of the dams could enhance salmonid productivity. However, upstream as well as downstream migrating fish may need additional stimuli to successfully guide them through passage facilities and reservoirs (Coutant 2001). **FERC's analysis for this alternative indicates several risks. These issues, including smolts migrating through existing reservoirs with large populations of predatory fish and disease issues that are present below Iron Gate dam were addressed in the EPAct trial-type hearings in August 2006.** The judge ruled, based on the body of fact presented in the hearings that none of these issues are insurmountable (ALJ, 2006, at 85 and 86, Ultimate Findings of Fact and Conclusions of Law, Issues 3, 4, and 5. The Staff alternative with fish passage could reverse continued declines as compared to 1981. **This alternative could increase fish populations by providing up to 58 miles of useable habitat within the project area additional miles of habitat and increasing run time.** Specifically, for SONCC coho, this additional habitat would benefit the population by 1) extending the range and distribution of the species, thereby increasing the coho's reproductive potential, 2) increasing genetic diversity in the coho stocks, 3) reducing the specie's vulnerability to the impacts of habitat degradation, and 4) increasing the abundance (ALJ Decision, 2006, at 86, Ultimate Findings of Fact and conclusions of Law USFWS/NMFS Issue 7). For Pacific lamprey, access to the additional 58 miles of habitat would benefit the population by providing additional spawning and rearing grounds (ALJ Decision, 2006 at 86, Ultimate Findings of Fact and conclusions of Law USFWS/NMFS Issue 8). Steelhead would likely find suitable spawning and rearing habitat within the project area (ALJ Decision, 2006 at 33, page 6-4). If habitat quality in and upstream of the reservoirs is improved to the point where fish have cues and can successfully navigate through the reservoirs in both directions, an estimated 350 miles of additional habitat above the project area would be available to anadromous fish species that was historically used (Hamilton, et al, 2005).

Retirement of Copco No. 1 and Iron Gate

Dam retirement could provide the most benefit to anadromous salmonids of the alternatives evaluated, assuming that the sediments accumulated behind the dams are not toxic and are disposed of in a controlled manner. However, as discussed under criteria 4, a number of questions would need to be answered regarding the severity of the initial adverse affects on the fishery partly analyzed in the DEIS (on pages 3-157, 3-292, 5-58

and elsewhere). Natural riparian functions, such as riparian revegetation and bed stability may take years to stabilize. More studies are needed to evaluate how the short-term effects of dam removal will affect anadromous fisheries in the long-term.

Over the term of the new license, removal of the dams could eliminate the source of most of the water quality issues on the WSR that are Project influenced. In particular, it would mitigate late summer and fall heating, summertime DO depletion, in-reservoir nutrient cycling with resultant summer releases of nitrogen downstream (DEIS, page 3-289 to 291). Consequently, disease outbreaks may be diminished. Removal of the dams would also result in habitat conditions that more closely resemble natural conditions, e.g. flow and temperature ranges should be more reflective of climatic forces than of water regulation. Chinook salmon, coho salmon and steelhead trout would have access to a portion of the spawning and rearing habitat that they used prior to dam construction. It is unknown whether Iron Gate Hatchery would also be dismantled. If so, this would result in a reduction of problematic interactions between hatchery- and naturally-produced salmonids. If the hatchery continues to operate, this could reduce the beneficial effects described above by continuing the pressures on natural stocks that were discussed under the Proposed and Staff Alternatives. With both the hatchery and passage barriers gone, we would expect increases in abundances for Chinook, coho, and steelhead over 1981 levels after a period of adjustment, although benefits to habitat quality may not be realized for several generations of fish.

It is not clear how sediment dispersal would occur if dams were removed. If dam removal allowed all sediment to be released into the river, the short-term adverse impact from the release of sediment stored behind the dam could be sufficient to cause significant smothering of spawning gravels, pool infilling, gill abrasion in fish exposed to increased turbidities, and changes to holding and migration patterns. If severe enough, populations currently at low levels (e.g. coho) could take a long time to recover. These impacts may be mitigated by timing the sediment release to minimize impacts to fish or through the removal and disposal of sediments to uphill sites. Without additional information, it is not possible to determine the WSR effects of dam removal.

Summary of Fisheries Resources Effects

<u>Instream Flow and ramping rates</u>

For **all alternatives**, the streamflow regime would be an increase over conditions at the date of designation, improving migration and holding for Chinook salmon and steelhead trout, as well as migration for juvenile coho salmon. The project has only a minor control over flows released to the WSR, and these are subject to change with future regulatory requirements for the Bureau of Reclamation Project, but the alternatives do incorporate instream flows and ramping rates that are more protective of fish than the current license requirements in place in 1981. **The Dam Retirement Alternative** would differ slightly from the other three alternatives in that summer flows would be more variable than they were in 1981 which would have further benefits to anadromous fish habitat and populations. If ramping became more frequent in this alternative, due to J.C.Boyle

peaking flows that would no longer be reregulated at Iron Gate Dam, that could adversely affect habitat.

Water temperature and quality, and substrate quality/sediment regime

For the other habitat elements, the effect of the alternatives varies. Water temperature would remain unchanged in **PacifiCorp's Proposal**, and dissolved oxygen releases from the current project would remain at levels harmful to fish downstream of Iron Gate Dam, especially if the adverse water quality effects from hypolimnetic injection are not mitigated. It is possible that dissolved oxygen is on a declining trend since 1981, due to increasing sediment- and biological- oxygen demands from accumulated sediments and organic material. Because of the absence of 1981 data, it cannot be ascertained whether future DO would decline from 1981 conditions or remain stable. The alternative would maintain the high nutrient and algae contributions from project reservoirs that affect fish downriver, unless reservoir management plans are successful at improving conditions. Similar to a potentially cumulative oxygen demand, the sediments in reservoir bottom waters may be sequestering nutrients over time; however, sufficient information on 1981 conditions is non-existent, therefore the contributions of this alternative to high attached algae and fish disease conditions in the river downstream from Iron Gate is unknown. It would remain unchanged at best.

The **Staff Alternative** and the **Staff Alternative with Mandatory Conditions** would improve the survival of emergent and migrating juvenile salmonids. While the level of effect of disease on fall Chinook salmon populations in the Klamath system remains unknown, both alternatives would potentially decrease the impacts from disease. This is particularly true for Chinook during the May to July period when *C. shasta* causes mortality of outmigrants in some years. At least one disease appears to have caused an increased trend of fish infection detected since the 1990s. Like the PacifiCorp Proposal, the Staff Alternatives provide for a plan to manage water quality, however, the Staff proposes several improvements: 1) the water quality management plan is more integrated and has a broader geographic scope (includes affected river reaches), 2) a disease management plan, if implemented, would assess and collaboratively manage disease conditions, 3) short term releases would improve migration and holding habitat during critical periods for fish based on agency-developed triggers, 4) hypolimnetic releases would occur only once the adverse water quality effects more closely studied and, if necessary, mitigated to realize positive benefits, 5) immediate installation and operation of turbine injection would provide some DO improvement for fish downstream of Copco and Iron Gate, although results are predicted to fall short of Basin Plan DO objectives. The **Dam Retirement Alternative** could improve migration, holding, and spawning habitat in the long term by eliminating the source of most of the water quality issues on the WSR that are Project influenced. In particular, it could mitigate late summer and fall heating, summertime DO depletion, and in-reservoir nutrient cycling that results in summer releases of nitrogen downstream. Consequently, disease outbreaks that appear to be population-limiting may also be diminished. Dam Retirement would also result in habitat conditions that more closely resemble natural conditions than the warmer impounded water and regulated flows that were present in 1981.

There would be no change in bed mobility with the PacifiCorp Proposal, except for localized one-time augmentation of spawning gravels downstream from Iron Gate. Spawning conditions are thought to have been poor at the time of designation for the reach immediately downstream from Iron Gate, but the Alternative would enhance this situation to a minor degree. The poor water quality conditions in this reach during spawning season are a further deterrent to spawning that has multiple sources. The Proposal would maintain degraded though stable streambed conditions that are conducive to growth of algae mats that harbor an important fish pathogen host. There isn't clear evidence whether these algae mats are undergoing an increase over time, and although there is a clear Project connection through reservoir nutrient releases in the summer, this condition may be unchanged from the time of WSR designation. **Both Staff Alternatives** would improve spawning through habitat surveys and assessments, and adaptively managing gravel augmentation. **Dam Retirement** would improve conditions from 1981 because sediment trapping below J.C.Boyle Dam would cease.

Anadromous fish population abundance and sustainability

The **PacifiCorp and Staff Alternative** would not reverse the declining trends of two salmonid stocks. **The major difference between the Staff Alternative and the Staff Alternative with Mandatory Conditions for this WSR is that anadromous fish would be provided with fishways for passage.** This would open up volitional passage to an estimated 58 miles of additional useable habitat within the project reach. There would be engineering and biological challenges to overcome, however, this would result in a much greater abundance of fish than in 1981 (ALJ Decision, 2006., Ultimate Findings of Fact and Conclusions of Law. USFWS/NMFS issue 6). With the **Dam Retirement Alternative**, Chinook salmon, coho salmon and steelhead trout would have access to a portion of the spawning and rearing habitat that they used prior to dam construction. The estimated additional useable habitat would be the same as described above for the **Staff Alternative with Mandatory Conditions**, but there would be less risk associated with fish holding and handling at fishways. If the hatchery continues to operate, this could reduce the beneficial effects by continuing the competition and genetic pressures on natural stocks. The short-term adverse impact from the release of sediment stored behind the dam could be sufficient to cause significant smothering of spawning gravels, pool infilling, gill abrasion in fish exposed to increased turbidities, and changes to holding and migration patterns. If severe enough, populations currently at low levels (e.g. coho) could take a long time to recover.

These impacts may be mitigated by controlling the sediment release, to minimize aquatic ecosystem effects or through the removal of sediments to uphill sites. We recommend that prior to analyzing any Dam Retirement alternative that is to be considered in detail, more detailed studies are needed to determine the short term effects of the Dam Retirement alternative on water quality and aquatic habitat.

For the **PacifiCorp Proposal**, and the two **Staff Alternatives**, hatchery operations would remain with continued reliance on hatchery propagation for population maintenance. The pressure of hatchery on natural stocks (competition and genetic dilution) and adverse impacts to natural populations would continue to contribute to declines. Each species has

had a slightly different result in population trend since hatchery operations began. It was not clear from the DEIS whether the hatchery would continue to operated under the **Dam Retirement Alternative**, although such operation would not be required by a license under a Retirement scenario. It is not known how sustainable a hatchery-bolstered fishery would be in the long term.

Table 2 – Summary of effects of relicensing alternatives on fish resources, relative to conditions at time of WSR designation

Effects of Alternatives relative to conditions at the date of WSR designation (1981)					
Criteria	**Subfactor**	**PacifiCorp Proposal**	**Staff Alternative[1]**	**Staff Alternative with Mandatory Conditions**	**Dam Retirement Alt.**
1. Streamflow regime	a. Minimum instream flows	a. increased in 11 of 12 months	a. increased in 11 of 12 months	Same as for Staff Alt.	a. increased in 11 of 12 months
	b. ramping rates	b. more protective of fish (less stranding, desiccation, predation)	b. more protective of fish (less stranding, desiccation, predation)	Same as for Staff Alt.	b. more protective of fish (less stranding, predation)
	c. flow variability	c. no change	c. no change	Same as for Staff Alt.	c. more variable due to less dampening of climatic effects and upriver hydropower operations on summer daily flows below JC Boyle
2. Water temperature	a. changes to spring and	a. No change	a. potential for limited spring warm water spills would help outmigrant juvenile growth and natural fish competitiveness with hatchery released fish	Same as for Staff Alt.	a. and b. improved spring through fall water temperature resulting from removing 2 largest Project sources of thermal lag. Short-term increases in pool temperature or loss of pools (including refugial areas) from sediment storage of unknown duration and geographic extent. Long term formation of new pools, esp. in previously lacking reach above Shasta River, would result in

					temperature improvement from 1981 for spring through fall.
	b. late summer-fall temperatures	b. no change	b. potential for limited late summer cool water releases to relieve fish crowding during holding and extend fall Chinook return migration season up to 2 weeks.	Same as for Staff Alt.	(See row above)
3. Water Quality	a. Dissolved oxygen	a. Very slight improvement in DO with attendant adverse effects (on temperature, DO, algal bloom stimuli)	a. Slight improvement in DO immediately, without adverse w.q. effects of proposed action, potential for even greater DO improvement in long term	Same as for Staff Alt.	a. Substantially improved DO levels during much of summer.
	b. Nutrients	b. No change, unless proposed reservoir management plans can devise effective solutions (uncertain). Potentially perpetuates a trend of increased nutrient cycling within reservoirs (uncertain).	b. Potential for improved nutrient conditions if more comprehensive water quality plan is successful (uncertain). Potentially perpetuates a trend of increased nutrient cycling within reservoirs (uncertain).	Same as for Staff Alt.	b. Increased nutrient release from old reservoirs in short term (undetermined period), but improved nutrient assimilation due to restoration of riverine system in long term.
	c. algae	c. No change; continued habitat for nuisance algae both in reservoir and downstream unless reservoir management plan is successful at curbing reservoir algae. In-river attached algae would be unchanged.	c. Potential for improved algae conditions if more comprehensive water quality plan is successful (uncertain). Potentially perpetuates a trend of increased nutrient cycling within reservoirs (uncertain).	Same as for Staff Alt.	c. Improved conditions in short term from increased bed mobility, and in long term due to a shift in an upstream direction in nutrient assimilation process, favoring less nuisance species in WSR reach
	d. fish disease	d. No change and potential for continuation of trend in increasing disease outbreaks	d. Potential for decreasing incidences of disease, depending on cumulative	Same as for Staff Alt.	d. Decreasing incidences of *parvalocapsula* and *Ceratomyxa Shasta* due to

			effects solutions that could result from disease management plan, and emergency water releases for temperature mitigation.		loss of *Cladophera* algal beds which provide ideal pathogen host habitat. Reduced thermal stress and crowding of returning spawners
4. Sediment regime/substrate quality	a. streambed mobility	a. no change in bed mobility except in localized area of gravel augmentation	a. no change in bed mobility except for areas of gravel augmentation	Same as for Staff Alt.	a. increased bed mobility due trapped sediment release.
	b. substrate conditions (spawning habitat quality and quantity)	b. minor, localized addition to spawning-size gravel from 1981 (already coarsened) conditions.	b. moderate improvement to spawning-size gravel in habitat-selected areas that is distributed by flushing flows	Same as for Staff Alt.	b. decline in spawning conditions for undetermined "short term" with rejuvenated spawning and other habitat types over long term.
	c. riparian vegetation maintenance	c. no change in riparian veg. likely, although 1981 conditions not assessed.	c. no change in riparian vegetation.	Same as for Staff Alt.	c. fine sediment deposition and point bar development resulting in vegetation re-colonization/rejuvenation.
5. Aquatic Species populations	a. Chinook salmon	a. Migration and holding habitat conditions improved from increased flows. Continued dilution of natural stocks due to interactions with hatchery fish. No change in habitat availability (fish passage barriers still present), Continued decrease in abundance of total grilse age class and of natural stock while hatchery stock remain stable or increasing.	a. Migration and holding habitat conditions improved, survival of emergent and migrating juveniles enhanced, survival of migrating adults enhanced. Minor increase in the amount of spawning habitat. Fewer impacts from disease, continued increase of hatchery strays can offset beneficial effects to natural population. Continued decrease in abundance of total grilse age class and of natural stock while hatchery	Could increase abundance and run timing by increasing available habitat by an estimated 58 miles within the project area.	a. Migration, holding and spawning habitat improved. Access to available habitat increased by an estimated 58 miles within the project area. Potential reduction in the interactions between hatchery and natural stocks. Short-term adverse effects to habitat, w/potential long-term beneficial effects. Decrease in the incidence of disease. increase in abundance

			stock remain stable or increasing.		
	b. Coho	b. Increased flow will improve conditions for migrating juveniles, no change in habitat availability, and continued reliance on hatchery propagation for population maintenance. Abundance of natural stocks not expected to return to 1981 levels (reflection of importance of tributaries, thus not a direct Project effect). Iron Gate Hatchery populations will likely continue to increase	b. Increased flow will improve conditions for migrating juveniles. Continued reliance on hatchery propagation for population maintenance. Abundance not expected to return to 1981 levels (reflection of importance of tributaries) , thus not a direct Project effect). Iron Gate Hatchery populations likely to continue increasing	Could increase abundance and run timing by increasing available habitat.	b. Migration, holding and spawning habitat improved. Access to spawning habitat increased, potential reduction in the interactions between hatchery and natural stocks, undefined short-term adverse effects to habitat from release of stored sediment, potential long-term beneficial effects due to decrease in the incidence of disease, increase in abundance and habitat improvement
	c. Steelhead trout	c. Same as for Chinook, especially current declines for summer steelhead returning to Iron Gate Hatchery.	c. Same as for Chinook especially current declines for summer steelhead returning to Iron Gate Hatchery.	Could increase abundance and run timing by increasing available habitat.	c. Same as for Chinook

III. Wildlife Resources Evaluation

Background

Riparian ecosystems are those with a high water table because of proximity to an aquatic ecosystem. Riparian ecosystems have distinct vegetation and soil characteristics. Aridity, topography, and presence of depositional soils most strongly influence the extent of high water tables and associated riparian vegetation (Mitsch and Gosselink 2000). Riparian vegetation occurs on either side of the river's edge, in areas where high flows have scoured, then delivered silt and sand to the flood plain. Areas of high quality riparian habitat provide resources necessary for survival, reproduction, and movement of fish and wildlife species. Despite their limited area, high quality riparian habitats contribute significantly to the maintenance of local and regional biological diversity.

As an example, sixty-seven percent of all wildlife species found on the Klamath National Forest are directly dependent upon, or disproportionately use, riparian habitat for breeding, feeding, resting and migration. (USDA Forest Service 1995). The CA Klamath WSR and its designated corridor, downstream from the Iron Gate dam to the mouth on the California Pacific Coast, provide a diversity of habitats for national, regional, and locally important populations of indigenous wildlife species. Habitat diversity is created by mosaics in vegetation resulting in changes in aspect, elevation, temperature, moisture, geology, soils and disturbances (e.g. fire, disease, and wind).

Riparian habitat below IGD is typical of many semiarid regions where riparian zones provide habitat for communities with greater species richness and abundance than the surrounding uplands. Contrast between riparian and adjacent upland micro-climates, vegetation, and animal communities gradually become less dramatic as the Klamath River flows west through the Siskiyou Mountains and enters the wet northern California coastal forest. Consequently, wildlife communities of the Pacific coastal riparian zones are not strikingly more diverse than those of the adjacent uplands (Naiman et al,2001). The list of species found along the WSR that are highlighted in this evaluation is given under Presence of Special Status Species, below.

Background on Evaluation Criterion and Current Project Effects

Special status species, for the purpose of this analysis, are those species protected under the Federal Endangered Species Act, US Forest Service and Bureau of Land Management's Survey and Manage guidelines, and the Klamath and Six Rivers National Forest Special Status Species programs (for National Forest system lands along the WSR corridor). The State of California also has species listed under the state's Endangered Species Act. A list of these species can be accessed at http://www.dfg.ca.gov/hcpb. A complete list of wildlife species that are associated with the riparian habitat located on the Klamath River can be found in the California Department of Fish and Game publications California Wildlife (Zeiner et al 1990) also available from this website.

Special status species are for the most part habitat specialists, meaning they require good quality and appropriate quantities of their specific habitats. As a result these species are generally good indicators of the overall health of their associated habitats. The criterion was used to determine the magnitude of effects, conditions and trends of Project operation on wildlife resources. Changes in the habitat of several riparian-dependent species that are not considered special status species are also considered. Wildlife populations have not been systematically surveyed on the Klamath River. Baseline data was not collected in 1981; therefore, population numbers or trends are not available for most species in specific areas like the Wild and Scenic River corridor. Population data are available on some species such as bald eagles and northern spotted owls but the data are regional and of little value when addressing site-specific impacts of the Klamath Hydroelectric Project. Impacts created by the Project are addressed as negative or positive with the likely result being a decrease or increase in existing populations. The analysis focuses on two key habitat elements for many special status species: riparian vegetation for cover, and fish as a food source.

<u>Wildlife Evaluation criterion</u> - Changes in habitat for special status species due to project operation, in relationship to conditions present at the date of WSR designation.

Presence of special status species (defined above)

- **Bald eagles** *(Haliaeetus leucocephalus)* are listed under the federal Endangered Species Act as threatened. There are currently nine known bald eagle nests located on the Wild and Scenic Section of the Klamath River below IGD (Sam Cuenca Personal Communication 2006), with two new nests located on the Klamath National Forest adjacent to the WSR (in 2004 and 2006). There could be additional nests along the river between the downstream Klamath National Forest boundary and the ocean. Surveys for nesting bald eagles are not conducted on a systematic basis but are reported by the public or as incidental sightings associated with other projects. As a result the status of the population of bald eagles on the Klamath WSR is unknown, but with new nest sites being reported the population trend for this species appears to be increasing slowly.
- **Northern spotted owls** *(Strix occidentalis caurina)* are listed under the federal Endangered Species Act as threatened. Surveys for northern spotted owls are not systematically conducted so the number and trend of northern spotted owls located along the Klamath WSR is not known. However, past surveys have located several northern spotted owl territories in upland habitat adjacent to the river. In large regional demographic studies, the northern spotted owl population has been found to be on a downward trend throughout most of its range (Anthony et al 2004). Northern spotted owls are not riparian-dependent and do not eat fish, therefore Project operations are not expected to have a direct effect on populations. This species is considered because of potential for indirect or cumulative effects from changes in ecosystem function.
- **Peregrine falcons** *(Falco peregrinus)* are on the Regional Forester's sensitive species list in Pacific Southwest Region (Region 5) of the U.S. Forest Service. Again, surveys are not conducted regularly so the number and trend of peregrine

- Brown pelican (*pelecanus occidentalis*) is listed as endangered under the federal Endangered Species Act. Brown pelicans thrive near coasts and on offshore islands, and can be found at the mouth of the Klamath river. They rely in part on the actions of salmon and other marine predators to force schools of fish to the surface where pelicans can catch them. Pelicans also will feed on juvenile salmonids at the mouth of the river, and so may be affected by the project's role in cumulative effects on salmonid juvenile numbers. In 2002, there was a proposal to delist the California brown pelican subspecies because the population had sufficiently recovered as a result of pesticide restrictions that affected breeding success. (Oregon Fish and Wildlife Office, 2002.)
- **Pacific fisher** *(Martes pennanti pacifica)* is listed as a candidate under the federal Endangered Species Act. Surveys for Pacific fisher are not regularly conducted so their population and trend are not available. Surveys have been conducted sporadically on the Klamath National Forest and adjacent private lands and Pacific fisher have been located in upland and riparian habitats on the CA Klamath WSR from Interstate 5 west to the confluence with the Pacific Ocean.
- **Northwestern pond turtles** *(Clemmys marmorata marmorata)* are on the Regional Forester's sensitive species list for Region 5 of the U.S. Forest Service. Northwestern pond turtles are regularly observed in the WSR, however, regular surveys are not conducted so numbers and population trends are not available.
- **Willow flycatchers** *(Empidonax traillii)* are listed as a threatened species by the State of California. Willow flycatchers are irregular nesters on the Klamath River below IGD. A few breeding individuals are captured each year at the Seiad Valley banding station. Migrating willow flycatchers are much more abundant at the banding station in the fall and spring, (Sam Cuenca Personal Communication, 2006) indicating the importance of the Klamath River as a migration corridor for this species. While data are available, a willow flycatcher abundance trend has not been analyzed.
- **Del Norte salamanders** *(Plethodon elongates)* are category D in the Survey and Manage Standards and Guidelines (USDA Forest Service, 2001). Del Norte salamanders are common within their limited range that includes the Klamath River downstream from Happy Camp to the Pacific Coast. No trend information is available.
- **Siskiyou Mountain salamanders** *(Plethodon stormi)* are category C in the Survey and Manage Standards and Guidelines (USDA Forest Service, 2001). Siskiyou Mountain salamanders occupy a small range from Happy Camp to the area around the confluence of the Klamath River and the Scott River. Siskiyou Mountain salamanders were recently divided into two separate species (Mead et al, 2006). The newly described species, the Scott Bar Salamander *(Plethodon*

- **Oregon Red tree** voles *(Arborimus longicaudus)* are category C in the Survey and Manage Standards and Guidelines (USDA Forest Service, 2001). Oregon red tree voles are present in the upland habitats adjacent to the Klamath River from the area around Orleans California to the mouth of the river. No numbers or trend information is available. Oregon red tree voles are not riparian-dependent therefore Project operations are not expected to have a direct effect on populations.
- **Bluegray tail dropper** *(Prophysaon coeruleum)* slug (mollusk) is listed as category A in the Survey and Manage Standards and Guidelines (USDA Forest Service, 2001). As an example, bluegray tail dropper is present on the Klamath National Forest in similar habitats as those located adjacent to the Klamath River downstream from Seiad Valley, California. Surveys are not required for this species except when activities will result in ground disturbance; therefore, no surveys have been conducted adjacent to the Klamath River due to protections from disturbance specified in the Six Rivers and Klamath National Forest Land and Resources Management Plans' Standards and Guidelines.

Many species of wildlife that are riparian dependant (either riparian obligates or associates) are not special status species but are an important part of the recreational experience. Black bear, great blue herons, river otter, mink, yellow breasted chat, bats and waterfowl are just a few that are regularly observed on the Klamath River.

Special Status Species Habitat – Riparian Vegetation

Habitat quantity and quality depend upon riparian conditions. The ways that the Project can affect such conditions is discussed below. The exposed stream channel in the reach below IGD is composed of large cobble, has very little non-woody vegetation (i.e. forbes, grasses, sedges and rushes), and has a very narrow riparian zone of shrubs and trees. Below Cottonwood Creek the conditions improve slightly, however much of channel is still dominated by larger cobble and has very little non-woody vegetation. There is a noticeable increase in the amount of non-woody vegetation below the confluence with the Shasta River and the width and diversity of the woody riparian zone increase significantly. Fine sediment visible in the stream channel increases with each additional tributary, and the riparian zone increases in width and diversity. The dams on the Klamath River have been collecting and storing sediments for decades, while reaches below the dams have been deprived and scoured of gravel and finer sediments. The Project impacts alluvial features on the Klamath River from Iron Gate to the confluence with Cottonwood Creek (PacifiCorp 2004b).

The riverbed between IGD and the Shasta River is coarsened as smaller gravels are transported downstream during high water events without being replaced, and larger

gravels and cobbles dominate. The Project's regulated flows are relatively static from spring through early fall. The resulting hydrologic conditions do not provide alluvium in areas where woody vegetation such as willows have the best potential to establish. Riparian hardwoods and other woody vegetation typically germinate and establish on freshly deposited fine alluvium in channel positions low enough to provide adequate moisture but high enough to escape scour (Scott et al. 1993). Non-woody vegetation (grasses, rushes, etc.) also requires fine sediments to become established after flood events. Continued operation of the Project will contribute to the lack of willows in streamside areas (PacifiCorp 2004b). Riparian vegetation provides habitat for feeding, breeding, and sheltering for willow flycatchers and northwestern pond turtles. There is no reference condition for the riparian vegetation in 1981 (Oakley, C., 2006).

Fish/Forage

Anadromous fish populations provide an abundant source of protein for wildlife. Bald eagles regularly forage on dead and moribund salmon along the Klamath River during the fall and into the winter. Osprey and bald eagles feed on young salmon and steelhead in the river from spring until fall. Anadromous fish runs that are compressed as a result of hatchery operations will reduce the time the fish are available for bald eagles, osprey, great blue herons and other wildlife. If the duration of the run is reduced during the nesting season, or if the number of fish decline, the reduced food supply may result in reduced productivity of bald eagles, osprey and other wildlife. Winter bald eagle counts have been conducted on the Klamath River each year and the number of bald eagles, although apparently increasing slowly, varies greatly each year. Numbers depend on weather conditions and available food sources. Project operation has created conditions that are not favorable to maintaining anadromous fish populations. The fish population issues associated with hatchery operations as well as habitat effects were discussed under the Fisheries Resource Evaluation.

Wildlife Resources Effects Analysis

<u>Evaluation criterion</u> - Changes in habitat for special status species due to project operation, in relationship to conditions present at the date of WSR designation

PacifiCorp Proposal

The Project as proposed will continue to have a negative effect on riparian wildlife habitat communities and the species they support, in the river reach from IGD to the confluence with the Shasta River, by the project operation. Under PacifiCorp's proposal, only small changes in existing operations would occur in the Klamath River WSR below IGD.

Riparian Habitat
The proposed gravel augmentation measure "does not compensate for any of the fine-sediment deficit, which is important for riparian vegetation" (DEIS Section 3.3.1.2.3, 3-47). FERC determined that the deficit attributable to the Project extended from IGD to an area near Lime Gulch, approximately 20 miles downstream (DEIS, page 3-45). In terms of riparian vegetation recruitment and geomorphology, the two key elements for successful recruitment are clean, bare mineral soil and adequate hydrologic conditions. Both variables are altered on the Klamath River downstream from the Project area.

PacifiCorp concludes that "minimal willow reproduction was observed" in the reach below Iron Gate dam, and goes on to suggest that "it may be that there are no river bars at appropriate elevations to support cottonwood and species of willow other than coyote willow." Although bars may be too high for effective riparian recruitment, this could be a result of channel entrenchment caused by flow and sediment alterations from upstream project dams. Alternatively, these bars may be at an appropriate elevation but too coarse because of scour and a lack of replenishing sediment. This latter notion is supported by PacifiCorp when in concludes that "it may be that the general scarcity of finer sediment moving through the river is limiting the ability of large flows to deposit fresh sediment into the flood plain" (DEIS Section 3.3.1.2.3. page 3-53, line 14-22).

FERC concludes that the ramp rate currently being used and proposed for future use by PacifiCorp is too steep to allow tree roots to chase the declining water table. "As such we expect that the 2002 NMFS BiOp Phase III flows would not provide the conditions needed for riparian recruitment at locations downstream of Iron Gate dam that are within the dam's range of hydrologic influence and have channel configurations similar to that of the USGS gage downstream of the dam." (DEIS, section 3.3.1.2.3, 3-53, 35-37)

FERC also said that "Based on information available we conclude that project effects on sediment supply may be combining with the Klamath River's flow regime downstream of Iron Gate dam, (dictated primarily by the NMFS 2002 BiOp for Reclamation's Klamath River Project) and other factors to cumulatively affect riparian vegetation" (DEIS, section 3.3.1.3, 3-58, 1-3. **The continued operation of the Project, in essentially the same manner as the existing project, will cause the continued decline of habitat for special status species on the Klamath River from IGD to the confluence with the Shasta River. This is because lack of sediment recruitment will continue to reduce the vigor and diversity of the riparian habitat communities in this reach of the Klamath River. These habitat effects will impact those species that are riparian obligates like northwestern pond turtle, willow flycatcher, yellow breasted chat, great blue heron and many others.**

Fish/Forage
The Fisheries Resources Evaluation in this report describes the effectiveness of the proposed mitigation and enhancement measures in improving salmon habitat conditions including water quality and spawning substrates. In regard to fish forage, PacifiCorp's

Proposal has no specific provisions for restoration of anadromous fish beyond the one-time deposit of gravel downstream from IGD and hypolimnetic aeration (DEIS 2.2.3).

FERC further concluded that the Project, as proposed, would likely continue to adversely affect water quality conditions, which adversely affect fish, as discussed in the Fisheries Resources Evaluation section. A reservoir-specific water quality management plan would identify measures that could be implemented to minimize project-related water quality degradation of salmon and steelhead habitat. However, because these plans would not be developed until the new licensing period, such measures and their effects are unknown at the time of this analysis. Wildlife populations that use, or are dependent on, the anadromous fish for food may continue to be adversely affected by the operation of the Project as proposed by PacifiCorp**.**

Based on the information provided in the FERC's DEIS on the Klamath River Hydroelectric Project, very little will change from current conditions on the Klamath River below Iron Gate dam to the confluence of the Shasta River. **The project operated as PacifiCorp proposed would continue to negatively affect riparian and river habitat, and those species that are riparian obligates like northwestern pond turtle, willow flycatcher, yellow breasted chat, great blue heron and many others. These declines were likely already occurring at the time of WSR designation.**

Staff Alternative

The main differences between the Staff Alternative and PacifiCorp's proposal that would affect the Klamath River below Iron Gate dam are as follows: 1) turbine venting at Iron Gate would replace the hypolimnetic oxygenation proposed by PacifiCorp (5.1.2, Table 5-1), 2) gravel enhancement below Iron Gate dam would be increased from a minor to a moderate level of enhancement, based on habitat needs (5.1.2, Table 5-1), 3) the alternative calls for an adaptive approach to restoring anadromous fish to most appropriate project reaches using primarily trap and hauls techniques, telemetry and smolt collection to assess use of habitat, and concentrated restoration effort to the most promising areas. Provision for expanding the program to other project reaches would be based on monitoring results (5.1.2, Table 5-1).

Riparian Habitat

The Staff Alternative does not propose any measures to address the lack of fine sediments in the Klamath River below Iron Gate dam to the confluence with the Shasta River, therefore, the impacts to the riparian habitat will continue as described for the PacifiCorp Proposal.

Fish/Forage

The Staff Alternative proposed several measures to recover anadromous fish in the river reach between Project dams as well as in the tributaries above Klamath Lake, and a few measures to benefit aquatic habitat downstream from the project. **Natural Chinook**

salmon runs and steelhead populations would continue to decline. Coho salmon could show some improvement but would not likely return to 1981 levels (see Fisheries Resources table). Declining trends in the fisheries would continue to impact terrestrial wildlife. Species that depend on fish, such as bald eagles, osprey and river otter would be negatively impacted.

Staff Alternative with Mandatory Conditions

The riparian habitat effects are the same as for the Staff Alternative.

Fish/Forage
The Staff Alternative, with mandatory conditions, requires fish passage to be installed at all facilities in the Project. Analysis for this alternative includes several risks to anadromous fish discussed in the Fisheries Evaluation section. As noted in that discussion, many of these issues can be mitigated or managed as recommended in the Decision outcome from the EPAct trial-type hearings of August, 2006 (ALJ, 2006, page 85 and 86, Ultimate Findings of Fact and Conclusions of Law). **Even with the risks, this alternative could increase fish populations and increase run time. These would provide improved forage opportunities for riparian obligate wildlife leading to increased survivability and productivity of those species, including several special status species.**

Dam Retirement Alternative

Riparian Habitat
Riparian vegetation in the Wild and scenic corridor below the Iron Gate dam would significantly benefit from this alternative especially in the reach between the dam and the Shasta River confluence. Fine sediment released into this section would allow the establishment of both woody and non-woody riparian vegetation. However, if the J.C. Boyle dam is operated in other than a run of the river operation, hardwood seedlings may not be able to become established due to ramp rates that are too rapid for the roots to respond. Special status species that are dependent on riparian habitat, such as the willow fly catcher, northwestern pond turtle, yellow breasted chat, would benefit greatly from successful riparian habitat recovery below IGD down to the confluence with the Shasta River. Down river from that point, the riparian dependent wildlife would still benefit from increased diversity and amounts of riparian vegetation, but these benefits might be offset by some potential short-term impacts as the released sediment moves downstream, into areas that are currently in better condition.

Fish/Forage
In addition to improving riparian habitat, the fish resources would be improved in the long term with this alternative, thus providing increased forage for wildlife species that depend upon fish as a food source. The area currently blocked by dams will provide additional available habitat for anadromous fish significantly as well as improve the quality of anadromous fish habitat in the area below Iron Gate dam. The increase in

habitat quality and quantity should allow the number of anadromous fish number to increase significantly. This would increase available forage, improving the probability that more bald eagles would survive the winter and enter into the next breeding season in good condition. Increased numbers of fish would also create greater forage opportunities for other riparian species like river otter, osprey and black bear.

It is currently unknown how sediment behind the dams will be dispersed. However, if sediment in Project reservoirs is allowed to erode downstream during and following dam removal, it would affect downstream habitat in the portions of the Klamath River. Potential adverse effects include increased fine sediment in spawning gravels, pool filling, and increased levels of suspended sediment and turbidity. Most of these effects are predicted by the modeling efforts to be of relatively short duration (DEIS, 3.3.32.6,3-57). However, **more detailed studies are needed that can model sediment transport and describe the magnitude, duration and geographic scope of effects to the aquatic ecosystem**. Removal of Copco 1 and Iron Gate dams with the silt left in place to erode naturally would inundate the area below the dams with as much as four feet of silt for a short period of time. The amount of time that the silt remains in place and the thickness depends on river flows. If the dams were removed in a dry year there could be several feet of sediment for several weeks. **This amount of siltation would likely kill most aquatic invertebrates (insects, bivalves etc.). Northwestern pond turtles depend heavily on invertebrates for their forage base, the loss of this forage base would, most likely result in the loss of a significant portion of the pond turtle population in the area affected by the sediment. Other species like river otter and fish would also experience loss of or reducing of forage species requiring them to migrate out of the area, or perish.** Depending on the length of river affected the pond turtle and aquatic species populations could suffer dramatic declines.

Wildlife Evaluation Summary

Table 3 summarizes the effects to special species habitats by alternative.
The Dam Retirement Alternative provides the best opportunities for the recovery of the riparian vegetation and river channel downstream from Iron Gate dam. Increased sediment of all sizes will allow riparian vegetation to diversify and increase in both quantity and quality. With this increase in quality and quantity, the riparian dependent species will also increase in number and productivity. More detailed study is needed to understand the effects of sediment on several special status species if substantial sediment is to be released downstream. For example, in the worst case scenario described in the DEIS, the amount of mobilized sediment would be several feet thick for several weeks. This amount of siltation would likely kill most aquatic invertebrates (insects, bivalves, etc.) and this would have an impact on Northwestern pond turtle populations. Other species like river otter would also experience reduction or loss of forage species, requiring them to migrate or perish. In the long term, the Dam Retirement Alternative will provide additional habitat for anadromous fish, which would increase available forage for bald eagles.

The Staff Alternative with Mandatory Conditions could also improve forage for eagles and other species by making more anadromous fish habitat available than was available at the date of WSR designation. However, the alternative would not substantially improve fish habitat below IGD. Riparian conditions would not improve and could continue to decline as future fine sediment is trapped behind the dams.

There would be only marginal changes to wildlife species and habitat associated with the PacifiCorp and Staff Alternatives.

Table 3 - Summary of the effects to special species habitats by alternative.

Effects of Alternatives relative to conditions at the date of WSR designation (1981)				
Analysis Factor	**PacifiCorp Proposal**	**Staff Alternative**	**Staff Alternative with Mandatory Conditions**	**Dam Retirement**
Bald eagle.	Continued decline in anadromous fish/forage. Wintering eagles continue reduced productivity and survival, Slow increase in nesting population	Some improvement in anadromous fish populations, but continued declines still expected in Chinook and steelhead, coho increase but not to 1981 levels. Bald eagle winter populations suffer reduced productivity and survival. Slow increase in nesting population	Improved forage opportunities for bald eagle populations resulting from additional fish habitat and potentially substantial increase in anadromous fish numbers and run timing.	Anadromous fish numbers increase due to increased availability of habitat above IGD and long term improvement in habitat below IGD. Wintering bald eagle populations increase and survival and productivity increase. Nesting bald eagle populations increase in proportion to increasing fish numbers and run length.
Northwestern Pond Turtle	Riparian habitat continues in degraded condition due to lack of fine sediments. Pond turtles lack basking structures and forage opportunities. Populations remain at current levels	Same as PacifiCorp Proposal	Same as PacifiCorp Proposal	Riparian vegetation/ habitats improve after short adverse effects due to sediment depth. Increase hardwood production increasing basking structures and forage opportunities.
Willow Flycatcher	Nesting habitat not currently located in	Same as PacifiCorp proposal.	Same as PacifiCorp Proposal	Increase riparian vegetation, due to

	river reach located between Iron Gate dam and confluence of Shasta River. Migration habitat very limited due to degraded riparian vegetation. Exposing birds to increased predation by aerial predators			increased fine sediments. Riparian habitat becomes more abundant and diverse. Nesting and migration habitat is available, increase in abundance expected.
Northern spotted owl Peregrine falcon Pacific fisher Del Norte Salamander Siskiyou Mountain Salamander Oregon red tree vole Blue gray tail dropper	No effects	No effects	No effects.	No effects

IV. Scenery Resources Evaluation

Background

The CA Klamath WSR displays 189 continuous miles of largely attractive, natural appearing images as it winds its way through rugged canyons accented with diverse forest vegetation, ever-changing riverbeds and beaches, rock outcrops, cobble bars and riverside riparian wetlands. The majority of these scenic values are viewed from the river itself as well as from over 90 miles of riverside state highways and roads, numerous river recreation areas, rural communities and scattered residences. Visible evidence of humans along the WSR is intermittent and relatively small in scale, as created by riverside roads, rural communities, residences, and scattered recreational, agricultural and forestry developments. When seen from vantage points inside the river corridor, the water appearance is less pristine due to conditions related to flows and water quality.

The Klamath Hydroelectric Project potentially influences water appearance and fish and wildlife viewing as far downstream as the confluence with the Pacific Ocean. Project effects from flow and to riparian vegetation are typically obscured below the Salmon and Trinity Rivers due to the influence of those tributaries.

Background for Scenic Evaluation Criteria and Current Project Effects
Scenery within the CA Klamath WSR is dominated by natural settings. Its characteristic river flows, water appearance, anadromous fish and riparian vegetation are the primary scenic aspects that have been sequentially influenced by the series of Project area dams constructed between 1918 and 1961. Since 1981, when the WSR was designated, flow regimes have varied moderately in response to water resource competition within the Klamath River Basin. During summer months, these have typically been due to non-Project water diversions. The Project influences flow to a minor extent as explained in the discussion of Fisheries Evaluation criteria 1. The scenic conditions of 1981, compared with resulting scenery effects of the proposed Project DEIS alternatives, are combined to provide the key points for evaluation of Klamath WSR scenic values.

Scenic evaluation criteria for the Klamath WSR are water flow character, water appearance, fish and wildlife viewing, and riparian vegetation. These criteria have many interdependent relationships. Together they address the potentially affected scenic condition and trends of the California Klamath WSR segment, and how these could be influenced by the Klamath Hydropower Project DEIS alternatives.

Scenic Evaluation Criteria 1 -Water Flow Character (river flows and accompanying river width, depth and channel inundation or exposure) compared with conditions present when the Klamath River segment was designated as a National WSR.

Evaluation of the river's scenic water flow character focuses on the lower summertime flows released from Iron Gate Dam, which have the greatest potential to cause adverse scenic impacts. The moderate and higher flows released into the WSR are not likely to be changed significantly, and are expected to remain consistent with the river's scenic character established prior to dam construction.

When river flows are lower than its characteristic scenic variability, the quality of the scenery is decreased in a variety of ways. These decreases in scenery include excessively frequent or severe displays of dry riverbed channels and cobble bars; exposed shoreline "bathtub ring"; exposed large rock outcrops; loss of large deep pools, riffles, and powerful whitewater rapids, and broad, braided river and island characteristics. These features of the CA Klamath WSR scenery are vulnerable to flow reductions in the lower flow months of summer. This period coincides with the river's primary recreation season, when the river's scenery is most enjoyed by visitors, tourists, white water boaters and local residents.

The river's lowest historic flows since CA Klamath WSR designation in 1981 can be identified by USGS gage data from Iron Gate Dam gage No. 11516530. The lowest monthly summertime flows within the 21-year historical record at Iron Gate Dam before 1981 represents this evaluation's lower limits of characteristic flow variability which still expresses its historic scenic character. Before 1981, USGS records shows no Iron Gate Dam flow releases below 700 cfs. The fact that these uncharacteristically low flows almost never occurred before 1981, but then occurred repeatedly during the late 80s,

early 90s, and more recently in 2002 and 2004 (flows less than 700 cfs at IGD occurred in seventeen months since 1981), indicates a moderately adverse long-term trend upon the WSR's scenic water flow character since the 1981 date of designation.

The Project influences only a small part of these flows, as described in the Fisheries Background section. Currently Reclamation Project's BiOp Phase III flows require minimums of 1000 cfs from July-September, 1044+ in May, 1300 from January to February, and 1450+ in March, April and June (with "+" indicating higher minimum flows for some water year types). These recently increased Project flow releases to the CA Klamath WSR are higher overall than those required at the 1981 date of WSR designation, and therefore are expected to provide some improvement to the water flow character aspects of the WSR scenic values. See Fisheries Evaluation criteria 1 background discussion for details, including Table 1 that compares these flow requirements with 1981 license conditions.

<u>Scenic Evaluation Criteria 2</u> - Water Appearance (clarity/turbidity, color, depth of view, and prominence of algae) compared with conditions present when the Klamath River segment was designated as a National WSR.

Elements of scenic water appearance include water clarity/turbidity, color, depth of view, and presence of floating and attached algae. Relatively low flows and increased presence of suspended algae matter significantly contribute to an adversely cloudy, colored and turbid water appearance, as well as an excessive presence of attached algae mats along shorelines and riverbeds. High levels of organic and inorganic nutrients within the river system also contribute to these adverse water appearance conditions, which have been recognized throughout most if not all reaches of the CA Klamath WSR.

Information provided in the PacifiCorp Water Quality Aesthetics Report (PacifiCorp, 2004), and in other sources provide a portrayal of recent water appearance conditions for the CA Klamath WSR, and some historic condition information. The turbidity data did not show a trend, and were not conclusive because they were not systematically collected to address summertime conditions. In the WSR reach, turbidity in other seasons generally reflects non-Project inorganic sources, but summer months are when most of the viewing public notices the scenic quality of the water.

A 1978 EPA report concluded that, in 1975 Iron Gate Reservoir eutrophication was already occurring, and that net annual releases of nitrogen were occurring even before the WSR designation (EPA, 1978). The summer turbidity conditions, with green coloration, are from floating organic material. As described in the PacifiCorp report and supported by local knowledge, much of the CA Klamath WSR can be characterized as having similar water conditions and appearance to its source in Upper Klamath Lake. Klamath WSR waters are naturally warm and nutrient-rich, creating potential for a water appearance that is naturally less than crystal clear and free of suspended solids, algae and coloration. Green tinted, cloudy and algae-bearing waters are considered by many people to be less than desirable from an aesthetic, or scenic perspective, per the PacifiCorp Project Area Recreational Visitor Survey (27% of visitors said the water quality had

detracted from the quality of their experience to the project area) (PacifiCorp, 2004d, Recreation FTR page 2-111. River viewers typically accept limited amounts of these adverse conditions to be consistent with the ecological and scenic character of the warm, nutrient-rich Klamath River system.

The PacifiCorp Water Quality Aesthetics Report also indicates that the CA Klamath WSR turbidity and overall water appearance gradually improves with distance downstream from the Project Area, due to dilution from other cooler, and typically more clear, downstream tributaries. While the adverse water quality conditions of the CA WSR scenery may be reduced from the Project area's levels, they are often undesirable within river reaches downstream during low flow years, especially in dry summer months. The DEIS, on page 3-145, states that a large attached algae (*Cladophora)* bed exists at Tree of Heaven Campground, 20+ miles downstream from the project area, and the USFS reports similar algae beds in and below the Happy Camp area 50 miles further downstream. It is at the above-mentioned times when more stagnant waters and algae concentrations on beaches and river bars can more frequently dominate the river's shoreline scenery.

Impoundment of waters within Project reservoirs is suspected to influence the water appearance elements listed above for the CA WSR, particularly the presence of floating and attached algae during summer months (refer to Fisheries Analysis Factor 3/Water Quality section and DEIS 3-144-153). More definitive information about the nutrient contribution of these reservoirs will be made available by a Water Board study scheduled for completion in March 2007.

Project flow releases to the CA Klamath WSR also influences its water appearance. Recent Phase III flow requirements are higher overall than those required at the 1981 date of WSR designation, and therefore are expected to provide some improvement to the water appearance aspects of scenic values that were present in the WSR at its date of its designation as discussed under criteria 1. The current flow requirements are likely to provide improved flushing, mixing and aeration of many otherwise stagnant water locations and algae mat concentrations within CA Klamath WSR for most, if not all, water year types.

Refer to the Fisheries Evaluation criteria 3 (water quality) background discussions for more specific information on processes affecting the water appearance elements of CA WSR scenery.

<u>Scenic Evaluation Criteria 3</u> - Fish and Wildlife Viewing compared with conditions present when the Klamath River segment was designated as a National WSR.

Fish and wildlife viewing is a very popular recreation activity nationwide, and within northern California. It ranked as the most popular recreation activity within the Klamath National Forest's 2000 National Visitor Use Monitoring survey, with 78.4% participation (followed closely only by the "viewing natural features" activity, with 77.5% participation). Salmon and steelhead, due to their sheer size, historic abundance, and the

associated annual migrations and angling events, are important "live" fish viewing attractions of the Klamath WSR. Fish viewing most typically coincides with fish migration, spawning or holding periods when they concentrate at particular reaches, pools, riffles and falls. Other important scenic values of the WSR are the many river-dependent wildlife viewing attractions. These include the enjoyable sightings and observations of black bear, river otter, mink, bats, pond turtle, bald eagle, osprey, great blue heron, willow flycatchers, yellow breasted chat and waterfowl. Fish and wildlife viewing varies widely by species, time of year, and location in the river.

The Klamath River's historically abundant large fish (Chinook and coho salmon and steelhead trout) are highly valued scenic viewing attractions. Since the late 1980s, soon after the Klamath River was designated a WSR for the primary purpose of protecting its "outstandingly remarkable" fishery values, the cumulative trend for these anadromous fish populations has been one of steep decline. The decline had begun prior to 1981. The magnitude of this decline is most dramatic in the Chinook salmon, grilse life stage, and the summer steelhead trout, with 90+% reductions in these populations over the past few decades. Populations of two other major Klamath WSR scenic fish viewing attractions, the coho and adult Chinook salmon and coastal cutthroat trout, both now have stable populations. These reduced fish populations greatly reduce the opportunity to view large fish in the river, and decrease the characteristic scenic identity and richness of the Klamath WSR. While many of the contributors to this decline are non-Project sources, some are Project-influenced. Some investigators attribute abrupt fish declines in the 1990's to diseases associated with eutrophic waterbodies aggravated by seasonally-increased nutrient inputs from the reservoirs. Sediment retention by dams has led to progressive streambed armoring in the WSR segment (DEIS 3-311). (Refer to the Fisheries Resource Evaluation for details.)

Wildlife viewing as a WSR scenic value is most widely affected by the Project through its influences on fish populations in the river, which provide an important food source for numerous wildlife species. In addition, the Project currently deprives the river's upper reach (Iron Gate Dam to Shasta River confluence) of its natural supply of gravels and sediments. This portion of the river has poor quality salmon spawning habitat and a narrow band of riparian habitat of importance could benefit both fish and wildlife. These existing adverse habitat conditions resulted from Project dam installation. Changes and trends to these conditions and their corresponding influence on wildlife habitat populations that may have existed at the 1981 date of WSR designation are unknown. (Refer to the Wildlife section of this report for additional information on riparian vegetation).

<u>Scenic Evaluation Criteria 4</u> - Riparian Vegetation compared with conditions present when the Klamath River segment was designated as a National WSR.

Scenic riparian vegetation characteristic of the CA Klamath WSR is made up of a highly attractive mosaic of discontinuous grasses, emergent wetlands, and shrubby willows at the channel margins. Colorful deciduous groves of alder, maple, ash, and poplar also occur in intermittent patterns near the active channel, typically with backdrops of oak,

pine, mixed hardwood and mixed conifer forest canopies located further up the riverside flood terraces and river canyon walls. Robust riparian vegetation conditions can also provide habitat for the river's scenic fish and wildlife attractions.

The CA Klamath WSR riparian vegetation is typically well contained within floodplains, terraces, canyon walls and side tributaries. Further expansion is limited by these features as well as natural river inundation, shoreline mobilization and scour. Historic river channel and riparian changes have been intermittent and localized, as a result of tributary and in-channel mining, and flood events. These riparian conditions may be similar to the overall riparian vegetation mosaic present at the Klamath WSR's 1981 date of designation but this is not known. One recognized Project effect on the WSR riparian vegetation is the deprival of its natural supply of gravels and sediments in the river between Iron Gate Dam and the Shasta River confluence, and the lack of riverside non-woody riparian within that segment of the river. The dam began trapping sediment in 1965, so riparian vegetation was likely already affected by the date of designation (Refer to the Fisheries criteria 4 and Wildlife sections of this Report for additional riparian vegetation information.)

Scenic Resource Effects Analysis

<u>Evaluation Criteria 1</u> - Water Flow Character (river flows and accompanying river width, depth and channel inundation or exposure)

All Alternatives

All alternatives propose to maintain the flow release schedule below the Iron Gate Dam in accordance with the 2002 NMFS BiOP Phase III specifications. As long as these flows remain in affect, or if they increase as a result of future requirements, they would increase the scenic water flow character over the flows required at the 1981 date of WSR designation, with a relatively insignificant exception for the month of September. Refer to Table 1 for comparison of these two flow requirements.

The proposed Phase III flows would in almost all cases provide more attractive and beneficial scenic water flow character within the Klamath WSR. These scenic increases would include more frequent displays of greater hydraulic forces, a more full, active and diverse river channel of greater depth, more powerful rapids, and more broad or braided river channel and island characteristics. These conditions would occur throughout the entire year, with possible minor exceptions during September of some dry water years. These scenic water flow character benefits would coincide with the river's primary recreation season, when the river's scenery is most enjoyed by visitors, tourists, white water boaters and local residents.

<u>Evaluation Criteria 2</u> - Water Appearance (clarity/turbidity, color, depth of view, and prominence of algae)

PacifiCorp Proposal

Beneficial scenic water appearance effects would be provided by the PacifiCorp proposal through maintenance of river flows below Iron Gate in accordance with the BiOP Phase III requirements. As long as these flows remain in effect, or if they increase as a result of future requirements, they would improve many of the scenic water appearance elements of the CA WSR as compared to the 1981 scenery conditions through their superior oxygenation, streambed renewal, and algae flushing capabilities. Excessive levels of attached algae along shorelines and riverbeds are also moderated through reduction and dilution of nutrients, and the increased turbulence, resulting from these flow levels.

Impoundment of waters within Project reservoirs would continue to adversely influence water appearance aspects of downstream WSR scenery, by contributing nitrogen and floating algae (EPA, 1978). These contributions result in a greater frequency of unattractive levels of algae (both suspended and as riverbed/shoreline mats), water coloration and clarity reduction. More definitive information regarding these effects of the reservoirs will be made available by the Water Board in March 2007.

Proposed oxygenation Measure #3P at Iron Gate has the potential to worsen algae blooms, therefore releasing additional nutrients to accelerate the growth of attached algae in the river downstream. This would further decrease the CA WSR scenic water appearance.

Organic and inorganic nutrients from above the Project will continue to contribute substantially to the existing adverse water appearance aspects of the downstream CA WSR scenery. The reservoir management plans for improving water quality (Measure #4P) may reduce nutrient-related problems and therefore improve water appearance, when implemented.
Refer to this document's Fisheries Evaluation criteria 3 (Water Quality) discussions for more specific information on processes affecting the water appearance elements of WSR scenery.

Staff Alternative and Staff Alternative with Mandatory Conditions

This alternative would provide similar but slightly better water appearance than the PacifiCorp proposal. This alternative proposes Measure #4, Water Quality Management Plan, which may result in scenic water appearance benefits, but these are as uncertain as is the plan's content, degree of implementation, and ultimate effectiveness. This alternative also provides the benefit of a modified Measure #3P, which would provide a turbine-injected oxygenation system to release slightly higher level DO water downstream, without the environmental risks associated with the PacifiCorp Proposal. Reduction of nutrients within the Klamath River system would also benefit the scenic water appearance aspects of the WSR, by reducing concentrations of both floating and attached algae, and their accompanying contributions to the river's green coloration, cloudiness and depth of view to the riverbed. The proposed introduction of annual high flow flushing events could also moderate excessive levels of attached algae on the CA WSR riverbed and shoreline; however, these were not required.

Retirement of Copco 1 and Iron Gate Dams

Retirement of Copco 1 and Iron Gate Dams "would eliminate the major sources of water quality problems that are project-associated" (DEIS page 3-289). Removal of the two dams would also enhance downstream water appearance for the CA WSR scenery through its benefits of superior mixing and oxygenation of waters upstream from the WSR, renewal of streambeds through more frequent high flow flushing events, and reversal of suspected nutrient increases within Copco 1 and Iron Gate reservoirs. However, three mainstem dams would remain, including Keno, which has especially poor water quality. Reduction of nutrients within the Klamath River system would also benefit the scenic water appearance aspects of the WSR, by reducing concentrations of both floating and attached algae, and their accompanying contributions to the river's green coloration, cloudiness and depth of view to the riverbed. These processes of restoring a riverine ecosystem in lieu of reservoirs could moderate the presence of suspended algae and its associated water coloration and clarity impacts to the WSR water appearance. Water coloration from suspended algae, as well as attached algae along shorelines and

riverbeds, could also be reduced through a reduction in the nutrients currently being released from the reservoirs.

Spawning gravels released downstream from within the retired reservoirs would restore some natural sediment processes and contribute to scour of attached downstream algae. The deposited sand and gravel on the downstream reaches would be a less favorable habitat for the algae because of greater particle mobility during high flow events (DEIS Executive Summary, page xxxii). This would significantly benefit the scenic water appearance (clarity and algae reduction) within the river between Iron Gate Dam and the Shasta River confluence, and would likely have similar but reduced downstream benefits.

Information about scenery water appearance condition at the time of WSR designation is lacking; however, it is likely that the trend of increasing habitat for attached algae with its associated water coloration, cloudiness, and limitations on depth of view was already underway at the time of WSR designation. This alternative would reduce that trend in the long term by restoring natural sediment movement in the streambed and reducing opportunities for algae attachment, to a degree not possible in 1981 due to the presence of these two dams. Depending on how sediment is released, there may be short term adverse impacts to the turbidity and potentially silt exposed on river margins, aspects of water appearance which are yet undefined, so it is unknown what these impacts would be relative to conditions at the date of designation. Further study would help to answer these questions.

Scenic Evaluation Criteria 3 - Fish & Wildlife Viewing

PacifiCorp Proposal

The Pacificorp alternative proposes a one-time gravel augmentation and the following water quality measures: oxgenation of waters released from Iron Gate Dam and implementation of reservoir plan for water quality improvement. These measures are not likely to improve the downward population trends of the WSR's large anadromous fish. If these trends continue downward, the Klamath River's scenic fish viewing opportunities would remain substantially decreased from conditions existing at the 1981 date of WSR designation. Scenic WSR wildlife viewing opportunities are unknown. (Refer to Background for some species viewed on this WSR.) Sub-optimal riparian wildlife habitat within the Iron Gate Dam to Shasta River segment would remain in current conditions.

Staff Alternative

This alternative would offer a larger set of mitigation measures (turbine venting to increase disolved oxygen in waters released from Iron Gate Dam and implementation of several plans to improve anadromous fish habitat). Even with these measures in place, some of the WSR's anadromous fish populations are not expected to return to their 1981 numbers, thus scenic fish viewing opportunities would also remain below 1981 conditions.

Staff Alternative with Mandatory Conditions

Water quality mitigation would be the same as the Staff Alternative. However, this altenative also includes volitional passage of anadromous fish which could open up 58 miles or more of habitat. This would significantly increase the habitat for fish. This alternative has the potential to significantly increase the fish abundance and subsequently wildlife who depend on the fish for protein, particularly if Keno Dam and reserrvoir fish barriers are removed.

Retirement of Copco 1 and Iron Gate Dams

This alternative could restore the abundance of large anadromous fish as scenic fish viewing attractions in the Klamath WSR. Increased fish viewing would be most prominent during fish migration, spawning or holding periods, when they concentrate at particular reaches, pools, riffles and falls. The potential restoration of the anadromous fish populations would largely be the result of its significant increase of anadromous fish habitat within the upper Klamath River Basin, along with major water quality improvements within the Klamath WSR downstream of the Project. Specific effects on river-dependent wildlife populations and scenic viewing opportunities are unknown. Riparian habitat within and potentially beyond the Iron Gate Dam to Shasta River segment of the WSR would be greatly improved by this alternative, and proportional increases in wildlife presence and scenic wildlife viewing are expected.

<u>Scenic Evaluation Criteria 4</u> - Riparian Vegetation

PacifiCorp Proposal, Staff Alternative. and Staff Alternative with Mandatory Conditions

Other than normal succession and growth, the scenic riparian vegetation is not expected to change due to implementation of the PacifiCorp Proposal. The WSR's highly attractive riverside mosaics of trees, shrubs, grasses, forbs and aquatic edge plants, and the scenic wildlife attractions that depend on riparian areas for habitat would remain the same as current conditions. This would include continuation of adverse Project influences on this scenic value between Iron Gate Dam and the Shasta River confluence, through deprival of sediment necessary for establishment of shoreline riparian vegetation.

Retirement of Copco 1 and Iron Gate Dams

This alternative provides the best opportunity for recovery of impaired riparian vegetation conditions within the WSR between Iron Gate dam and the Shasta River confluence. Increased riparian quality and quantity in this segment would result from both sediment deposition and scour, thus increasing the presence and scenic variety of the vegetation within this segment as well as further downstream within the WSR. This would likely moderately increase overall scenic riparian vegetation conditions over those present at the WSR's 1981 date of designation.

Summary of Scenic Effects by Criteria

Water Flow Character

The minimum instream flows (Phase III BiOp) proposed in all alternatives of the DEIS would moderately improve flow characteristics for CA Klamath WSR scenery as compared to the flows required at the 1981 date of WSR designation. Scenery-adverse flow occurrences and trends common since WSR designation would be improved, and a more scenic and characteristic water flow character would be maintained if the proposed Phase III flows were continued into the future.

Water Appearance

Proposed minimum Phase III flows would moderately increase the WSR scenic water appearance within all alternatives. The Staff and Staff with Mandatory Conditions Alternatives would also provide an uncertain degree of additional improvement to WSR water appearance through implementation of a water quality improvement plan. The Dam Retirement Alternative would possibly result in short term reductions in water clarity; however, it would provide major long term increases in scenic water appearance that would be realized for significant portions of the Klamath WSR. Immediately upstream from the WSR, this alternative would substantially reduce nutrient releases while increasing scour, mobility and renewal of riverbeds, and provide superior mixing and oxygenation of river waters. These processes would decrease levels of suspended algae and related water coloration and cloudiness, increase water clarity and depth of views to the riverbed, and decrease the frequency and size of attached algae mats along the shorelines and riverbed. As compared to estimated conditions at the 1981 date of WSR designation, these improvements would very likely increase the scenic water appearance for a considerable distance downstream.

Fish and Wildlife Viewing

The PacifiCorp Proposal and Staff Alternative would both make minor improvements in fish abundance and scenic fish viewing within the WSR, but would not approach restoration to the conditions present at the date of WSR designation in 1981. As a result of those alternatives, the scenic wildlife viewing would likely also remain at levels below the conditions of 1981, resulting in a similar decrease since WSR designation. The Staff Alternative with Mandatory Conditions and the Dam Retirement Alternative, however, would restore both fish and wildlife abundance and scenic viewing opportunities to levels comparable to or above the corresponding levels existing at the 1981 date of WSR designation.

Riparian Vegetation

The PacifiCorp proposal would not change the scenic riparian vegetation within the WSR. The Staff Alternative and Staff Alternative with Mandatory Conditions would have similar results. The Dam Retirement Alternative would provide a moderate improvement over the 1981 riparian vegetation conditions, resulting from its major restorative benefits to the impaired riparian conditions in the upper reaches of the WSR.

Table 4 – Summary of Scenic Analysis by Alternative

Summary of WSR SCENIC Effects from the DEIS Alternatives				
Scenic Resource Evaluation Criteria	PacifiCorp Proposal	Staff Alternative	Staff Alternative w/Conditions	Dam Retirement Altern
Water Flow Character (river flows, river width & depth, channel inundation or exposure, channel variety)	Moderate Improvement since '81 Improves long term adverse low flow trends	Moderate Improvement since '81 Improves long term adverse low flow trends	Moderate Improvement since '81 Improves long term adverse low flow trends	Moderate Improvement '81 Improves long term adv low flow trends Improves channel varie attractiveness in upper reaches
Water Appearance (clarity/turbidity, color, depth of view, prominence of algae)	Minor Improvement to long term adverse water appearance, due to increased flows, plus uncertain minor reservoir water quality plan benefits	Minor Improvement to long term adverse water appearance, due to increased flows, plus uncertain minor river water quality improvements	Minor Improvement to long term adverse water appearance, due to increased flows, plus uncertain minor river water quality improvements	Major Improvement to long term adverse wa appearance due to dam removal & greater river mobility, plus increased flows Short term decline in cl
Fish & Wildlife Viewing (presence & abundance of fish, and fish-dependent wildlife)	Minor Improvement to long term adverse fish declines, due to minor habitat improvements	Minor Improvement to long term adverse fish declines, due to minor to moderate habitat improvements	Moderate Improvement The fishways would increase habitat significantly. It would also likely increase fish abundance and subsequently fish and	Moderate to Major Improvement to long term adverse fis declines, due to major habitat improvements, plus uncertain short ter adverse effects

			wildlife viewing.	
Riparian Vegetation (presence & abundance)	No Change Long term adverse riparian condition in upper reaches persists	Minor Overall Improvement Moderately improves long term adverse riparian condition in upper reaches	Minor Overall Improvement Moderately improves long term adverse riparian condition in upper reaches	Moderate Overall Improvement Greatly improves long adverse riparian conditi upper reaches

V. Recreational Resources Evaluation

Background

The diverse pattern of CA Klamath WSR recreational activities, settings and facilities extends for 189 miles along its beaches, waterways, roadways and trails, from Iron Gate Dam to the Pacific Ocean. Recreation values of the CA Klamath WSR segment downstream from the Project Area are directly influenced by the Klamath Hydroelectric Project. Project proposals that continue, modify or discontinue current facilities and operations will inevitably influence a wide range of CA Klamath WSR recreational activities and settings via river flows, water quality and fisheries populations.

The Project has potential to affect the CA Klamath WSR's most popular recreation activities, such as whitewater boating at a variety of skill levels, salmon and steelhead fishing, riverside sightseeing, swimming and water play. The Project will continue to affect WSR recreation opportunities to degrees yet unknown, as far downstream as the Salmon River for most activities, and as far as the Pacific Ocean for the recreational fishing activity.

Also potentially affected by the Project, are the CA Klamath's WSR recreation settings: the characteristic warm, mainly clear waters with historically abundant anadromous fishery attractions winding through an uncrowded, natural river canyon landscape. The current set of recreational activities, settings and facilities have evolved to form a unique recreational pattern adapted to river flow levels, water quality and fishery conditions. Current recreational facilities range from private river resorts, public and private campgrounds, river access sites, riverside state highways, roads and trails, various lodging and supply services, private boat and equipment rentals, and shuttle and outfitter guide services. Private outfitters and guides support over three quarters of the WSR's recreational boating and fishing pursuits. This pattern of recreation activities, settings, facilities and services combine with the rivers flows, water quality and fisheries populations to provide the recreational experience currently enjoyed by visitors, tourists and local residents.

Background on Recreation Evaluation Criteria and Current Project Effect
Evaluation criteria for the WSR recreation values are whitewater boating, recreational fishing, and recreation setting. These criteria and the key elements influencing them (flows, water quality, and fish abundance) are interdependent. While the criteria do not address every type of recreation, they represent the primary WSR recreation values potentially affected by the DEIS alternative proposals. The following is a discussion of each of these criteria and how they were used to analyze the alternatives.

Recreation Evaluation Criteria 1 - Whitewater Boating (private and commercial) compared with conditions present when the Klamath River segment was designated as a National WSR.

River Flow

River flows released into the Klamath WSR are prescribed according to the NMFS BiOp Phase III flow specifications. These flows released from Iron Gate Dam greatly influence the river's summer recreation season's whitewater boatability, challenge levels, safety hazards, potential for equipment damage, and the opportunity to access and experience the river's full range of rapids and channels. Exceptionally low summertime flow releases are especially adverse to CA Klamath WSR boating activities. Key considerations are as follows. These apply to the reach starting just below Iron Gate and extending to the Salmon River. (The source of the information is PacifiCorp's Recreation Resource FTR (PacifiCorp, 2004d)).

Minimally Boatable Flows of 850-900 cfs are necessary for standard whitewater boating on the CA Klamath WSR between Iron Gate Dam and Seiad Valley. This flow level offers a marginal whitewater setting for the CA Klamath WSR segment, necessary to avoid excessive hazards, multiple groundings and equipment damage. Some hazards, injuries, groundings, equipment damage, and a diminished whitewater experience can still be expected at this level. Per PacifiCorp's Recreation Resource FTR p. 2-112 discussions on CA Klamath WSR boating, "minimum flows can have substantial effects on boating in dry years or in the drier periods during average years (which includes the main summer season). These are the periods when minimum base flows determine the type and quality of boating trips. If minimum flows are set below 1,500 cfs, standard trips are sub optimal and offer less whitewater challenge. If they are set below 1,000 cfs, trips become even more technical (non-standard for CA Klamath WSR) in nature; by 800 cfs, standard trips are no longer acceptable." The FTR also states that the quality of boating continues to increase for standard boating opportunities until it reaches the optimal range at 1,500 cfs.

Minimum commercial whitewater flows of 900 cfs between Iron Gate Dam and Seiad Valley are the minimal flows that can support commercial whitewater trips of the CA Klamath WSR segment (over two thirds 2/3 of all CA Klamath WSR whitewater runs). This would allow commercially sized craft to marginally maneuver, with few channel and rapid options, providing a demanding and technical, somewhat tedious whitewater experience, with multiple stops and some groundings. Hazards to whitewater boaters and equipment are much more likely to occur below this flow level. Flows above 900 cfs are needed to sustain commercial trips and prevent boaters and clients from seeking alternative rivers for more favorable boating experiences.

Preferred or optimal flows for all CA Klamath WSR whitewater activities are 1500-2000 cfs (FTR page 2-109). This flow range offers a wide range of channel and rapid options, powerful hydraulics to support play-boating and an optimal white water experience. commercial recreational white water boating activity on the Klamath National Forest portion of the CA Klamath WSR has increased steadily, by about 34% since 1981. A total of 14,451 permitted river recreation days were recorded within the Six Rivers and Klamath National Forest in 2004 (river miles 40 to 174). Private whitewater boating on the National Forests is estimated to be 15% additional river days, for a total of 16,600 whitewater river days in 2004. Similar recreation activities occur downstream from the National Forests, almost continuously to the Pacific Ocean. These activities generate substantial economic benefits to local riverside communities, through

expenditures on gas, food, supplies, equipment, lodging and guide services. The average expenditures from commercial and private whitewater boating users in the Lower Klamath were $1.56 to $1.77 million per year (PacifiCorp Socioeconomic FTR page 2-103, PacifiCorp, 2004e).

Big Water boating The higher range of acceptable standard boating flows is 2,000 to 4,500 cfs and **the optimal range for Big Water boating is 3,000 to 5,000 cfs** (PacifiCorp's Recreational Resources FTR, page 2-109:2-110). Also according to the FTR, due to the low gradient and generally lower challenge rapids on the CA WSR Segment, relatively few boaters are interested in the Big Water Opportunity.

Play Boating - In addition to floating through the river, there are play boating (cyclic or continuous boat play within unique hydrological features) opportunities on the Klamath that are affected by flows. The primary play boating spot is the School House Wave. According to the PacifiCorp's Recreation Resource FTR, **the School House Wave play boating opportunity is acceptable between 900 and 1,400 cfs and best between 1,000 and 1,300 cfs.**

In Table 5 below, recently improved BiOp Phase III flow requirements are compared with flows required at the WSR's 1981 date of designation for each month of the year. Whitewater boating benefits realized by the increased Phase III flows are also identified.

Table 5 – Comparison of recent "Phase III"[1] flow requirements versus previous 1981[2] requirements and the resulting changes in whitewater boating opportunities

WSR Flows per Month (in cfs) & changes to whitewater boating opportunities			
Month	BiOp Phase III (Applies to All Action Alternatives)	1981 conditions	Change in whitewater boating opportunities
Jan.	1300 (in acceptable boating flow[4] range/optimal play boating range)	1300 (in acceptable boating flow range/optimal playboating range)	Unchanged
Feb.	1300 (in acceptable boating flow range/optimal play boating)	1300 (in acceptable boating flow range/optimal play boating)	Unchanged
March	1450-2300[3] (in acceptable to optimal range/play boating not provided)	1300 (in acceptable boating flow range/optimal play boating)	The quality of standard boating opportunities would be increased in some water years and in other water years conditions would remain unchanged. Play boating opportunities would be decreased.
April	1500-2850[3] (in acceptable to optimal range/playboating not	1300 (in acceptable boating flow range/optimal play	The quality of standard boating opportunities would be increased in some water years and in other

	provided)	boating range)	water years conditions would remain unchanged. Play boating opportunities would be decreased.
May	1044-3025[3] (in acceptable to optimal range/optimal playboating provided only in the lower flow range)	1000 (in acceptable boating flow range/optimal play boating)	The quality of standard boating opportunities would be increased in some water years and in other water years conditions would remain unchanged. Play boating opportunities would be decreased in some water years.
June	1400-3000[3] (in acceptable to optimal range/acceptable playboating provided only at lower end of the flow range)	710 (does not meet minimum boatable flow or play boating opportunities)	The quantity and quality of standard boating opportunities would be increased. Play boating opportunities would also be increased.
July	1000 (in acceptable boating flow range/optimal play boating range)	710 (does not meet minimum boatable flow or play boating opportunities)	The quantity and quality of standard boating opportunities would be increased. Play boating opportunities would also be increased.
Aug.	1000 (in acceptable boating flow range/optimal play boating range)	1000 (in acceptable boating flow range/optimal play boating range)	Unchanged
Sept.	1000 (in acceptable boating flow range/optimal play boating range)	1300 (in acceptable boating flow range/optimal play boating range)	The quality of standard boating opportunities would be decreased slightly. However, both flow regimes would still provide for acceptable boating opportunities. Play boating opportunities would remain similar.
Oct.	1300 (in acceptable boating flow range/optimal play boating range)	1300 (in acceptable boating flow range/optimal play boating range)	Unchanged
Nov.	1300 (in acceptable boating flow range/optimal play boating range)	1300 (in acceptable boating flow range/optimal play boating range)	Unchanged
Dec.	1300 (in acceptable boating flow range/optimal play boating range)	1300 (in acceptable boating flow range/optimal play boating range)	Unchanged

[1]Proposed flows are Phase III Iron Gate Dam releases criteria based on water year, contained in the 2002 NMFS BiOp (Reclamation, 2006).
[2]Flows required by the current license (1961 amendment) and being provided by the hydroelectric project were the conditions at the date of WSR designation (1981).
[3]Maximum range specified in the BiOp. The lower number is typically for dry and below average years, while the higher number is for average to wet years.
[4] Since the standard boating experience is the primary desired opportunity, the optimal and preferred flow range for this activity are used in our analysis

It should be noted that the proposed rates of transition between specified flow releases (ramping rates) have been specified by the BiOp Phase III and are insignificant in terms of perceivable whitewater boating effects within the CA Klamath WSR.

Water Quality
Water quality issues in the Klamath, including algae blooms and *Microcystis* toxin from one species of blue-green algae, affect river recreation users. "Whitewater boaters may be more affected by water quality issues than reservoir users" (DEIS page 3-410). Water quality, including excessive nutrients and green-colored, turbid water in the summer, is a project-related effect. Water quality issues existed since the time of designation. There is some evidence indicating that these issues may have increased since that time, including progressively over the past five years (Kann and Corum); however, data for 1981 are lacking and modeling has not been conducted to validate this possibility. Refer to the Recreation setting criteria 3 sections below for more information on water quality influences on whitewater boating and other recreation values.

<u>Recreation Evaluation Criteria 2</u> - Recreational Fishing (private and commercial river fishing) compared with conditions present when the Klamath River segment was designated as a National WSR.

The CA Klamath WSR segment is a high quality and popular fishing river (Recreation FTR 4-49 (PacifiCorp, 2004d)). The primary fish of the Klamath are the Chinook (king) and coho (silver) salmon, steelhead, and native trout. Potential recreational fishing influences from the Project encompass the entire length of the CA Klamath WSR and beyond into the Pacific Ocean. Salmon and steelhead provide the most valued fishing opportunities within the WSR (Recreation FTR 4-49 (PacifiCorp, 2004d)). Several commercial fishing guides use this river as a primary resource for their business and the recreational satisfaction of their clients. In addition, local communities and individuals regularly enjoy the recreational fishing opportunities within the WSR. The three primary elements affecting this factor are river flows, fish abundance/catch-and-keep opportunity, and water quality.

In-Stream Flows
Minimum flows of 800 cfs are necessary to avoid unacceptable boat-based fishing conditions in the WSR between Iron Gate Dam (river mile 189) and Seiad Valley (river mile 128), per Recreation FTR page 2-112. The **acceptable range** of flows for fishing is 800-1,000 and then 1,500 to 2,500 cfs, per Recreation FTR page 2-107. **Preferred flows**

for recreational fishing activities in the CA Klamath WSR below Iron Gate Dam are 1000 to 1500 cfs. This flow is compatible with bank fishing, wading and boat-based fishing.

The Phase III flow requirements for flows released into the Klamath WSR are consistent with the above "Preferred flows" for recreational fishing. This flow level is an improvement over flows required at the 1981 date of WSR designation. These flows would largely eliminate previous low flow occurrences of boat-based fishing safety hazards, potential for grounding and equipment damage, and limitations to access the river's full riverbed and their fishing opportunities.

The most popular months for salmon and steelhead fishing are as follows (DEIS, page: 3-313 to 325 and Recreation FTR 4-49 (PacifiCorp, 2004d))

Summer/Fall Steelhead – Late summer/ October
Winter Steelhead – November - February
Fall Chinook Run – Peaks in late fall – mid January

In addition, the Klamath River fishery contributes to the ocean recreational, commercial and tribal fishing. The most popular seasons for ocean fishing are the spring and summer. If these months are combined, the most popular period for fishing in the Klamath River is July through February.

Table 6 below shows differences between the 1981 river flow conditions and BiOp Phase III flows, and their relationship with the minimum, acceptable, and optimal or preferred boat-based fishing flows. Overall, the increased flows improve summer opportunities now precluded by low flows. In some water years the high flows in the spring are greater than preferred or acceptable fishing flows.

Table 6 – comparison of recent Phase III [1] flow requirements versus previous 1981[2] requirements and the resulting changes in fishing

WSR Flows per Month (in cfs) & resulting changes to fishing opportunities			
Month	BiOp Phase III (All Action Alternatives)	1981 conditions	Change in fishing opportunities based solely on flows
Jan.	1300 (in optimal fishing range)	1300 (in optimal fishing range)	Unchanged
Feb.	1300 (in optimal fishing range)	1300 (in optimal fishing range)	Unchanged
March	1450-2300[3] (in acceptable to optimal range)	1300 (in optimal fishing range)	In some water years, the fishing opportunity would remain optimal and in other water years the quality would be reduced from optimal to acceptable.
April	1500-2850[3] (most flows in acceptable to optimal	1300 (in optimal fishing range)	In dry water years, the fishing opportunities would remain optimal. In other water year types, except the

	range/flows higher than about 2500 are outside the acceptable range)		average year, the quality of the fishing opportunity would be reduced from optimal to acceptable. In the average water year, the quality of the fishing flows would be reduced from optimal to unacceptable due to the flows being too high for fishing.
May	1044-3025[3] (most flows in acceptable to optimal range/flows higher than about 2500 are outside the acceptable range)	1000 (in optimal fishing range)	During dry and below average water years, the quality of the fishing opportunity would remain optimal. In other water years, the quality would be reduced from optimal to unacceptable due to the flows being too high for fishing.
June	1400-3000[3] (most flows in acceptable to optimal range/flows higher than about 2500 are outside the acceptable range)	710 (does not meet minimum fishing flow)	The quality and quantity of fishing opportunities would be increased from unacceptable to optimal in average, below average, and dry water year types. In both 1981 and the proposed flows for wet and above average water years, the fishing flow would be unacceptable due to the flows being too high for fishing.
July	1000 (in optimal fishing range)	710 (does not meet minimum fishing flow)	The quantity and quality of fishing opportunities would be increased from unacceptable to optimal.
Aug.	1000 (in optimal fishing range)	1000 (in optimal fishing range)	Unchanged
Sept.	1000 (in optimal fishing range)	1300 (in optimal fishing range)	Unchanged. Both flows provide for optimal fishing flows.
Oct.	1300 (in optimal fishing range)	1300 (in optimal fishing range)	Unchanged
Nov.	1300 (in optimal fishing range)	1300 (in optimal fishing range)	Unchanged
Dec.	1300 (in optimal fishing range)	1300 (in optimal fishing range)	Unchanged

[1]Proposed flows are "Phase III" Iron Gate Dam releases criteria based on water year, contained in the 2002 NMFS BiOp (Reclamation, 2006).
[2]Flows required by the current license (1961 amendment) and being provided by the hydroelectric project were the conditions at the date of WSR designation (1981).
[3]Maximum range specified in the BiOp. The lower number is typically for dry and below average years, while the higher number is for average to wet years.

Anadromous fish abundance & sustainability; Opportunity to catch and keep.
Fishing in the Klamath River is directly related to the abundance and sustainability of the fish species, primarily salmon and steelhead. As stated in the DEIS, "The Klamath Hydroelectric Project contributes to adverse cumulative effects on coho salmon by blocking access to tributary habitats upstream of Iron Gate dam" (DEIS, 2006). Although fish populations are cyclical, population abundance analysis shows that for 2 species, during at least some of their life history, populations have been declining since the date of designation. It is likely that they began declining prior to WSR designation. However, escapement of fall-run Chinook salmon and coho salmon to Iron Gate Hatchery have increased. The effect on salmon populations was discussed in detail in the Fisheries Resource section.

The health and abundance of the fisheries affects how agencies regulate recreational fishing catch and keep policies. Sport fishing regulations for most Klamath anadromous stocks have been significantly restricted over the last two decades. Sport fishing for coho salmon (hatchery or wild) has been prohibited since 1994. All wild (non-hatchery marked) steelhead must be released unharmed where fishing is allowed. Only one brown trout and either one hatchery steelhead or trout can be kept. Adult steelhead fishing is not allowed in key areas, while catch and release fishing only is allowed in some areas up to a designated calendar date. The quota for fall Chinook vary yearly. For 2006 the quota was zero for the entire Klamath River Basin (DEIS page 3-220). This is an indirect Project affect because the continued presence and operation of the dams have contributed to some degree to the decline in fisheries. This contribution influenced to the closure of the coho sport fishery harvest in the Klamath River.

Water Quality
Several anglers interviewed during PacifiCorp flow studies commented on water quality issues. These issues are worse at low flow periods, where water plant growth in fishing holes is more extensive. Specific problems relating to fishing include: (1) large algae blooms in fishing holes limit the amount of fishing area in some places and (2) algae can stick to fishing lines and possibly diminish success (Recreation FTR page 2-111 (PacifiCorp, 2004d)). It is possible that nutrients are being sequestered in the reservoirs in association with settling of sediments and decaying organic matter. Such nutrients are thought to be fueling an increase in nuisance attached algae over time; however, this has not been clearly demonstrated to date. Additional information should be available from the State Water Board in late March, 2007.

Other Recreation Fishing Considerations
Fishing-related economic benefits can be estimated through private and commercial fishing-related local and regional spending on equipment, support services, guide services, etc. The average yearly expenditures for river fishing from private and commercial users from 1978 to 2002 were $1.5 million (Socioeconomic FTR, page 2-103 (PacifiCorp, 2004e)).

<u>Recreation Evaluation Criteria 3</u> - Recreational setting (water quality related aesthetic odors, tastes, contacts, and public health and safety aspects) compared with conditions present when the Klamath River segment was designated as a National WSR. The Project's existing and potential influences on Klamath WSR recreation settings are primarily through water quality conditions, which in turn result in aesthetic odors, tastes, contacts of the water and edible river resources. In addition, some public health and safety hazards have been attributed to the reservoirs and potentially river waters downstream.

The quality of Klamath WSR recreation experiences relies heavily on the compatibility of the settings in which the recreation activities take place. The Project will likely continue to influence the settings in which whitewater boating, recreational fishing, river swimming, shoreline water play, and riverside sightseeing activities take place. (Refer to the scenic resources sections of this document for information about recreational sightseeing). The quality of Klamath WSR recreation settings also significantly contributes to the local quality of life for resident of river and nearby communities, and is very important to the sustainability of local and regional tourism-related socioeconomic benefits.

. As was discussed within the whitewater boating and fishing background discussions above, the Phase III river flow requirements in the Klamath WSR recently mandated moderate flow increases, thereby reducing chronic occurrences of low summertime flows with associated impairments to water aesthetics and fishery health (refer to recreation criteria 1 & 2 background sections and scenic criteria 1-3 background sections for more information on river flows and their influence on whitewater boating, fishing, scenic water flows, water appearance and fish and wildlife viewing).

Whitewater boating, fishing, riverside swimming and water play activities have often been adversely affected by low summertime flows in previous dry and perhaps even normal years. Low flows have resulted in impaired recreation setting aspects such as shallow waters with excessively high temperatures, dense shoreline algae concentrations, and cloudy, discolored water with floating and potentially toxic algae. According to PacifiCorp's Recreation surveys, such conditions significantly deter swimmers and waders from enjoying the Project reservoirs, with similar effects in the CA Klamath WSR segment (Recreation FTR page 2-111 (PacifiCorp, 2004d). In order to improve these recreational setting elements to marginally acceptable levels, minimum flows of 800 cfs or more from Iron Gate Dam are necessary, to adequately dilute poor water quality that is adverse to most recreation activities.

The DEIS states that the presence of the toxin from *Microcystis aeruginosa* (a blue-green algae) is a threat to public safety and recreation users (DEIS, page 3-144). Algae blooms within Project reservoirs provide conditions that support *Microcystis.* The toxin from *Microcystis* (called microsystin) was known to be present in the Upper Klamath, but only in recent years (2005 and 2006) were major outbreaks identified within Copco and Iron Gate reservoirs, and also in the WSR downstream at reduced yet unknown levels. It is quite possible that this toxin has increased since 1981, especially in recent years as noted above. However, there is no available 1981 data regarding the toxin. *Microcystin* is a

Project induced threat to public safety and enjoyment of the Klamath River which impairs the recreation setting for all activities.

Influences of the reservoirs upon downstream WSR recreation settings are widespread and adverse, including reduced water clarity, increased suspended algae and water coloration, the *microcystis* health threat mentioned above, and increased odor from algae mats attached to the riverbed and shorelines. Diminished water quality in the reservoirs has also been attributed to undesireable taste and odor of WSR waters, and could affect the taste and odor of the flesh of fish and other aquatic resources in the WSR. Public surveys indicate two thirds of project area recreationists (just upstream of the WSR) had negative perceptions of water quality, commenting on its color, turbidity, and odor. (DEIS 3-149.)
An ongoing Water Board analysis in support of a Clean Water Act Section 401 certification decision should help inform solutions to reduce adverse water quality contributions of the reservoirs, and benefit the WSR recreation setting's water quality aspects (DEIS 3-148). It is scheduled for completion in March 2007.
Fish abundance in the Klamath WSR also contributes to the recreational setting. Refer to the Recreation criteria 2 - Fishing section of this document as well as the Fish Evaluation for additional information.

Recreational Resources Effects Analysis

<u>Evaluation Criteria 1</u> - Whitewater Boating (private and commercial)

PacifiCorp Proposal

River Flow
The primary factor relating to whitewater boating opportunites is the flow regime. PacifiCorp proposes to maintain the Phase III flow schedule below Iron Gate in accordance with the 2002 NMFS BiOP. The 1981 conditions were pursuant to the existing FERC license, as amended in 1961. Those minimum instream flows were 710 cfs in June and July, 1000 cfs in May and August, and 1300 cfs from September through April. (DEIS, page 3-79). The Phase III flows would be 1000 cfs from July through September in all water types. June flows would vary from 1400-3000 cfs, depending on water year type, which is a doubling of flows in dry years, and a quadrupling in above average and wet year types (DEIS page 3-83). Table 6 in the Recreation criteria 1 background section compares the current Phase III BiOp flow requirements with the 1981 flow requirements and displays the resulting change (typically improved) whitewater boating opportunities.

The table shows no change in the flow regime or resulting quality or quantity of standard whitewater boating opportunities from the time of designation from October to February and August. In March to May, there would be an increase in quality of boating opportunities from the acceptable to optimal range in some water years and in other water years the quality of boating opportunities would remain the same. In June and July, both the quantity and quality of whitewater boating opportunities would increase from the time

of designation, when the minimum whitewater boating flows were not provided during these months. Depending on the water year type, the proposed flows would provide for flows in the acceptable to optimal range in June. In July, the flow provided would be consistent with the acceptable boating flow range. In September, the proposed flows would be less than the flow provided at the time of designation. This decrease would result in a decrease in quality of whitewater boating opportunities during this month that is still within the acceptable flow range.

Playboating opportunities would remain unchanged in August to February. In March to May, play opportunities would be decreased. This opportunity would be increased in June and July.

As stated in the whitewater boating background section, the most critical months for whitewater boating are the summer months (June – September). The flow-related quality and quantity of all whitewater boating opportunities would be increased in June and July. In August, the conditions would remain unchanged. In September there would be a slight decrease in quality of the standard whitewater boating opportunities. Overall, the flow-related quality and quantity of whitewater boating opportunities would be increased in all the action alternatives.

Water Quality
This alternative includes the least effective measures to improve water quality. The DEIS states "If the project is relicensed without removal of Iron Gate or Copco No. 1 dams, the project would likely continue to adversely affect water quality conditions downstream of Iron Gate dam." These adverse water quality affects would continue to impair the whitewater boating experience with PacifiCorp's Proposal.

Summary
This alternative has improved river flows and largely unchanged adverse water-quality trends, resulting in an overall slightly improved whitewater boating experience compared to those existing at the date of designation in 1981.

Staff Alternative and Staff Alternative with Mandatory Conditions

River Flow
All alternatives would result in the same effects on white water boating, as described for the PacifiCorp Proposal above.

Water Quality
These alternatives would include a modified set of measures to improve water quality, which may reduce a possible negative trend since 1981 conditions. However, the project would continue to have adverse affects on water quality. It is not known whether such conditions would be improved, degraded or unchanged from those present at the date of designation.

Summary

As with the PacifiCorp Proposal, the combined improvement to river flows and the largely unchanged adverse water-quality trends an overall slightly improved whitewater boating experience compared to existing at the date of designation in 1981.

Retirement of Copco 1 and Iron Gate Dam

River Flow
All alternatives would result in the same effects on white water boating, as those described for the PacifiCorp Proposal above. However, this alternative would also provide some additional variablity in flows, that will depend in part on operations at J.C.Boyle powerplant as well as BiOp ramping requirements.

Water Quality
Removal of Iron Gate and Copco 1 dams would improve water quality conditions over exisiting conditions and the 1981 conditions in the long term. The DEIS states "the major souces of project-related water quality problems would be eliminated" with this alternative. With improved water quality, the white water boating recreation experience would also be improved.

Temporary Effects
In addition, this alternative would likely have temporary impacts on whitewater boating opportunities due to massive amounts of sediment that would be released into the river. Over time the river would stabilize and whitewater boating opportunities would likely be similar to conditions in 1981, but with higher water quality. There is little information about how the sediment would be released and if/how much would be removed. More evaluation of this is needed in the FEIS to make a determination of the temporary and long term affects of this alternative.

Summary
This alternative would likely have temporary adverse impacts on whitewater boating; however if properly mitigated and the river stabilizes, the quantity and quality of whitewater boating opportunities would increase in the long term. Both river flow and water quality conditions would be improved over the 1981 conditions, and this would enhance the whitewater boating recreation experience of the WSR.

<u>Recreation Criteria 2</u> - Recreational Fishing (private and commercial river fishing) compared with conditions present when the Klamath River segment was designated as a National WSR.

PacifiCorp Proposal

River Flow
Table 6 in the background section shows the flow comparison of the 1981 condition to the proposed flows in the BiOp Phase III and consistency with the minimum, acceptable, and optimal boat-based fishing flows. In August – February, the boat-based fishing opportunity in relationship to flows would remain unchanged. In March these fishing

opportunities in relationship to flow would remain optimal in some water year scenarios and in other water year types the quality would be reduced from optimal to acceptable. In April to May, the quality of boat-based fishing opportunities in relationship to flow would vary depending on water year type. The flows would either remain optimal, be reduced from optimal to acceptable, or in some cases be reduced from optimal to unacceptable. In June, the quality of the boat-based fishing opportunity in regards to flow would also vary by water year type. The quality would either be increased from unacceptable to optimal or remain unchanged. In July, in all water year types the quality of boat-based fishing opportunities based on flow would be increased from unacceptable to optimal.
For the months when salmon and steelhead fishing is most popular (refer to criteria 2 background section), the boat-based fishability in terms of flow would either remain unchanged or be enhanced by the new Phase III flows.

Anadromous Fish abundance & sustainability; Opportunity to catch and keep
Salmon and steelhead runs have been significantly reduced for at least some of their life histories since the dams were constructed. On-going impacts related to water quality, limited fish habitat (through dam blockage), and fish diseases have further impacted the fishery and aquatic resources. There has been a clear downward trend for natural fall Chinook and summer steelhead stocks since the 1981 conditions. The fisheries resource evaluation in this report also indicates that some investigators believe that fish stocks in the Klamath to have been impacted increasingly since the 1990's by diseases associated with eutrophic waterbodies. The reasons for this are likely associated with seasonally-increased thermal and nutrient inputs from reservoirs and progressive streambed armoring over time (DEIS page 3-311). In addition, fishing regulations in response to the reduction in fisheries affects fishing opportunities in the Klamath Basin. The PacifiCorp proposal is expected to contribute to a continued decrease of natural chinook, coho and steelhead abundance from 1981 levels. However, hatchery fish would remain stable or increase.

Water Quality
This alternative would include the fewest mitigation measurses to improve water quality. These measures are not likely to reduce the downward trend of the Chinook and Steelhead. If this trend is continued the fishing opportunties in the Klamath would be decreased as compared to the opportunity present at the 1981 date of WSR designation, although fishing opportunities for other other classes of anadramous fish would continue. The proposed measures would not meet current water quality standards in the summer and in addition the hypolimnetic oxygenation measure may have unintended advsere effects of increasing algae concentrations, including the toxin producing *Microcystis* algae, which has recently be detected in the WSR. Although use of an algacide is proposed to poison the algae within the reservoirs, Project induced water quality impairment would most likely continue to present, at times, a threat to the public safety and enjoyment of the Klamath River including its fishing opportunities. This is most likely an adverse condition that did not exist in 1981, however, the questions of when it first appeared and if there is a worsening trend has not been answered to date by interested health officials.

Summary
This alternative would decrease the WSR's recreational fishing opportunties from the 1981 conditions, due to the combination of moderately beneficial increased summer flows, continuation of depleted fish abundance and catch/keep opportunity, and only a very slight potential to remedy adverse water quality.

Staff Alternative

River Flow
Flow effects on recreational fishing are the same for all alternatives, as described above for the PacifiCorp Proposal.

Fish Abundance & Sustainability; Opportunity to catch and keep
This alternative includes a different set of mitigation measures with somewhat greater effectiveness than the PacifiCorp Proposal. Even with these measures in place, salmon and steelhead populations would not likely not return to their 1981 conditions. This adverse trend, coupled with the increase in fishing regulations which are a result of fishery decline, would likely result in a decrease in fish abundance and opportunity to catch and keep, in comparison to the conditions in the CA WSR segment in 1981.

Water Quality

This alternative includes an expanded set of measures as compared to the PacifiCorp Proposal. While these measures would be more effective than PacifiCorp Proposal, water quality standards for DO and temperature would still likely not be met. No *microcystis*-related measures for the WSR segment are proposed.

Summary
This alternative would decrease the WSR's recreational fishing opportunties from the 1981 conditions, due to the combination of moderately beneficial increased summer flows, continuation of depleted fish abundance and catch/keep opportunity, and only a slight potential to remedy adverse water quality.

Staff Alternative with Mandatory Conditions

Instream flows and water quality aspects of recreational fishing would be the same as the Staff Alternative. This alternative proposes volitional passage of anadromous fish through the project which could significantly expand fish habitats and would likely increase fish abundance. This alternative has the potential to moderately or significantly increase fish abundance and the fishability of the river.

Retirement of Copco 1 and Iron Gate Dams

River Flow

Flow effects on the recreational fishing activity are the same for all alternatives, as described above for the PacifiCorp Proposal.

Fish Abundance & Sustainability; Opportunity for catch and keep
The geographic extent of Klamath River fish habitat would be significantly expanded over 1981 conditions (see WSR fishery analaysis). It is unclear how the removal of the Iron Gate hatchery from the project would affect anadromous fish, however existing associated gene pool impairment and water pollution as well as fish disease would be improved, thereby reducing fish disease. Increased fish populations are expected to rise to undetermined levels in the future. This would likely result in fewer catch and keep fishing restrictions.

Water Quality
The retirement of Iron Gate and Copco shall improve water quality conditions over both existing conditions and the 1981 conditions. The DEIS states "the major souces of project-related water quality problems would be elminated". Temperature regime dowsntream of Iron Gate would be more suitable for salmon, DO would usually meet objectives, nutrient load would be reduced downstream of Iron Gate, which may reduce algae abundance that form habitat for the intermediate host for at least two salmon pathogens". This degree of water quality improvement would likely increase the quality of the fishing opportunities through increased fishery habitat and population.

Temporary Effects
As described in the fishery analysis in this report, there would be temporary impacts on the fisheries and water quality aspects due to the increased sediment in the river. There is little information about how the sediment would be released and if/how much would be removed. More evaluation of this is needed in the FEIS to make a determination of the temporary and long term affects of this alternative. In addition, if this alternative is chosen, adequate measures would be needed to mitigate any impacts which could possibly include removing sediment from the river or releasing it in stages. It is likely that once the temporary impacts are mitigated and the river stabilizes, both the fisheries and water quality would be significantly improved. There also may be temporary impacts on the fishability due to the potential for sediment clogging fishing holes or possibly making the river less navigable. These effects would be temporary and the fishability would be improved or remain similar once the river stabilizes.

Summary
This alternative would likely have temporary negative impacts on fishing. However, once these impacts are mitigated and the river stabilizes, this alternative would increase the quantity and quality of fishing opportunities in the CA Klamath River WSR segment.

<u>Recreation Criteria 3</u> - Recreational Setting (aesthetic odors, tastes & contacts; public health and safety)

PacifiCorp Proposal

River Flow
The Phase III flow requirements applied by all alternatives would result in minor recreation setting water quality improvements in comparison to 1981 conditions, and these would be most significant in the river upstream from Seiad Valley (RM 128) approximately 50 miles downstream from Iron Gate dam. Adverse odors, tastes, contacts and public health and safety risks could be slightly improved by these flows in comparison to those of 1981. In comparison to 1981 flow requirements, Phase III flows increase the overall water quality through improved oxygenation, streambed renewal, algae flushing and dilution capabilities, moderation of suspended algae and its associated water coloration and clarity impacts. Attached algae along shorelines and riverbeds is also moderated through reduction and dilution of nutrients, and the increased turbulence that results from these flow levels, especially during the low flow months of the summer recreation season. These minor flow improvements to the recreational setting would slightly benefit the experience of individuals engaged whitewater boating, recreational fishing, swimming, shoreline water play, and nature appreciation activities.

Water quality
The PacifiCorp Proposal provides water quality improvement measures that would create slight improvements to the WSR's odor, taste and contacts. The project would continue to have adverse effects on water quality. Unintended adverse affects from the measures could also increase algae in the river, including the toxin-bearing *Microcystis aeruginosa.* This algae presents a threat to public health and safety (DEIS 3-144), and inhibits enjoyment of Klamath River recreation activities. *Microcystis* has known to be present in the Upper Klamath, but only in recent years (2005 and 2006), were major outbreaks present in Copco and Iron Gate and in the river downstream (Kann and Corum, 2006). This suggests that the toxin has increased since the 1981 conditions. Cumulative water quality effects on the WSR recreation setting (not including increased flows discussed above) would likely be less than, or comparable to, 1981 conditions.

Summary
The PacifiCorp Proposal's combined effects of minor flow-related improvements and neutral water quality changes results in a slight overall improvement to the Klamath WSR recreation setting.

Staff Alternative & Staff Alternative with Mandatory Conditions

River Flow
Flow effects on the recreational setting of the WSR would be the same for all alternatives, as described above for the PacifiCorp Proposal.

Water Quality
These Staff Alternatives provides some potential water quality improvements to the WSR, in part due to inclusion of a yet-to-be-defined river water quality management plan. These alternatives would likely provide better WSR water quality conditions over PacifiCorp's proposal, and would not risk unintended increased health and safety threats

from toxin of *Microcystis*. However, the alternatives still may not meet water quality standards and does not include the river below IGD in its microcystis study plan. Similar to the PacifiCorp proposal, the project would continue to have adverse affects on water quality with only a slight potential to remedy those effects.

Summary
The Staff Alternative and Staff Alternative with Mandatory Conditions combined effects of minor flow-related improvements and minor potential for positive water quality changes results in a cumulative minor overall improvement to the Klamath WSR recreation setting.

Retirement of Copco 1 and Iron Gate Dams

River Flow
Flow effects on the recreational setting of the WSR would be the same for all alternatives, as described above for the PacifiCorp Proposal.

Water Quality
The removal of Iron Gate and Copco would improve water quality conditions over exisitng conditions and the 1981 conditions. The DEIS states "the major souces of project-related water qualtiy problems would be eliminated. Temperature regime downstream of Iron Gate would be more suitable for salmon, DO would ussally meet objectives, nutrient load would be reduced downstream of Iron Gate, which may reduce algae abundance that form habitat for the intermediate host for at least two salmon pathogens. This major water quality improvement would increase the quality of the recreation setting within a considerable portion of the entire WSR over the long run.

Temporary Effects
As described in the fishery analysis in this report, there would be temporary impacts on water quality due to the increased sediment in the river. Once the river stabilizes, both the water quality and recreation setting would be significantly improved. There also may be temporary impacts on the various recreation settings due to the potential for sediment clogging fishing holes, or possibly making the river less navigable, or even less accessible along shorelines temporarily blocked by sediment deposits. Alternatively, new beaches and riparian areas may become established to increase the variety of shoreline settings. Most of these affects would be temporary and many aspects of the WSR's recreation setting would be considerably improved once the river stabilizes.

Summary
The Dam Retirement alternative's combined effects of minor flow-related improvements and major positive water quality changes results in a cumulative moderate to major overall improvement to the Klamath WSR recreation setting.

Summary of Recreational Resources Effects

Whitewater boating

In the PacifiCorp Proposal, river flows are improved, yet the adverse water-quality and fishery trends remain largely unchanged. The whitewater boating opportunities would be improved over the conditions existing at the date of designation in 1981. Similar to the PacifiCorp Proposal, the **Staff Alternative** offers improved river flows, but also may provide additional water quality improvements through its comprehensive reservoir and affected river reaches water quality plan. The resulting whitewater boating opportunity would be improved over the conditions existing at the date of designation in 1981. The **Staff Alternative with Mandatory Conditions** would have the same effect on whitewater boating as the other alternatives. The quantity and quality of whitewater boating and recreational fishing opportunities would increase to a moderate degree with the Dam Retirement Alternative, after potential temporary adverse effects.

Recreational fishing

The **PacifiCorp Proposal and Staff Alternatives** would decrease the WSR's recreational fishing opportunities from the 1981 conditions, primarily due a decrease in the fishery. The recreational fishing opportunity would likely be improved over the long term due to the proposed fishways and resulting increased fish habitat in the **Staff Alternative with Mandatory Conditions**. The **Dam Retirement Alternative** would likely have temporary adverse impacts on recreational fishing. In the long term after the river stabilizes, both river flow and water quality conditions would be significantly improved over 1981 conditions. More information is needed to further evaluate these temporary impacts and potential ways to avoid or mitigate them.

Recreational Setting

The recreation setting would be slightly improved through the increased flows and minor water quality improvements which may still not meet state water quality standards in both the PacifiCorp Proposal and the Staff Alternative through the increased flows and minor water quality improvements which may still not meet state water quality standards. The recreation setting would be moderately improved in the **Staff Alternative with Mandatory Conditions** due to improved flows, minor water quality improvements, and improved fishery. There would be a moderate to major improvement in the recreational setting for all river activities with the Dam Retirement Alternative, primarily due to water quality improvements over the term of the license.

Table 7 – Summary of Recreational Effects Analysis by Alternative

Recreation Resource Evaluation Criteria	PacifiCorp Proposal	Staff Alt	Staff Alt w/Conditions	Dam Retirement Alternative
Whitewater Boating (Flows for Standard Whitewater & Play Boating)	Flows Improved over 1981 WSR Designation Date Conditions	Flows Improved over 1981 WSR Designation Date Conditions	Flows Improved over 1981 WSR Designation Date Conditions	Flows Improved over 1981 WSR Designation Date Conditions
Recreational Fishing (Fish Presence and Abundance; Opportunity for Catch and Keep)	Decline from '81 No change to long term adverse fish decline, Minor Improvement from increased flows, Possible slight improvement to Fish related Water Quality	Decline from '81 No change to long term adverse fish decline, Minor Improvement from increased flows, Probable minor improvement to Fish related Water Quality	Moderate to Major Improvement from 1981 This alternative proposes volitional passage of anadromous fish through the project which would significantly expand fish habitat. This alternative has the potential to significantly increase fish abundance and fishabitliy over the long term.	Moderate to Major Improvement from 1981 Moderate improvement to long term adverse fish abundance trends due to expanded fish habitat and increased water quality, Minor improvement from increased flows, Uncertain short term adverse effects on fish abundance and fishing opportunity due to released sediment from reservoirs.
Recreation Setting (River's Odors, Tastes & Contacts; Public Health & Safety)* * Affects all Recreation Settings and Activities	Negligible Improvement from 1981 Beneficial Increased flows, plus Reservoir Water Q. Plans offer a minor improvement to long term adverse water aesthetics Health/safety hazards from	Minor Improvement from 1981 Beneficial Increased flows, plus uncertain River Water Quality Plans offer some improvement to long term adverse water aesthetics Health/safety hazards from	Minor Improvement from 1981 Moderately improves long term adverse riparian condition in upper reaches Improvement from 1981Beneficial Increased flows, plus uncertain River Water	Moderate to Major Beneficial increased flows, plus elimination of the Project's water quality impairment sources offer major improvements to the long term adverse water aesthetics (excessive algae, water odor, taste &

	Micrcystis toxin potentially increased	(*Microcystis* toxin) slightly decreased	Quality Plans offer some improvement to long term adverse water aesthetics Health/safety hazards from (*Microcystis* toxin) slightly decreased	feel) and related potential health hazards (*Microcystis* toxin) Short term adverse sediment laden waters, possible shoreline scouring and beach creation in upper reaches

VI. Conclusions

Fisheries Resource Evaluation - Several habitat criteria as well as anadromous fish populations for four species were analyzed to compare the effect of alternatives with 1981 conditions. None of the alternatives are expected to have an effect on coastal cutthroat trout populations. For **all alternatives**, the streamflow regime would be an increase over conditions at the date of designation, improving migration and holding for Chinook salmon and steelhead trout, as well as migration for juvenile coho salmon. The project has only a minor control over flows released to the WSR, and these are subject to change with future regulatory requirements for the Bureau of Reclamation Project, but the alternatives do incorporate instream flows and ramping rates that are more protective of fish than the current license requirements in place at time of WSR designation. The Dam Retirement Alternative would differ slightly from the other three alternatives in that summer flows would be more variable than they were in 1981 which would have further benefits to anadromous fish habitat and populations.

For the **PacifiCorp Proposal**, and the two **Staff Alternatives**, hatchery operations would remain with continued reliance on hatchery propagation for population maintenance. The pressure of hatchery on natural stocks (competition and genetic dilution) and adverse impacts to natural populations would continue to contribute to declines. Each species has had a slightly different result in population trend since hatchery operations began. It was not clear from the DEIS whether the hatchery would continue to operated under the **Dam Retirement Alternative**, although such operation would not be required by a license under a Retirement scenario. The effect of hatchery operations could be largely offset by the effect of other habitat improvement measures in all alternatives on fish abundance. While hatchery operations would continue to weaken the genetic stock, make fish more prone to disease and compete with natural runs, they could keep total fish numbers stable for some species. However, it is not known how sustainable such a fishery would be in the long term. The possible exception is the Dam Retirement alternative.

For other habitat elements (water quality and sediment/substrate), the effect of the alternatives varies. Water temperature would remain unchanged in **PacifiCorp's**

Proposal, and dissolved oxygen releases from the current project would remain at levels harmful to fish downstream of Iron Gate Dam, especially if the adverse water quality effects from hypolimnetic injection are not mitigated. It is possible that dissolved oxygen is on a declining trend since 1981, due to increasing sediment- and biological- oxygen demands from accumulated sediments and organic material. Because of the absence of 1981 data, it cannot be ascertained whether future DO would decline from 1981 conditions or remain stable. The alternative would maintain the high nutrient and algae contributions from project reservoirs that affect fish downriver, unless reservoir management plans are successful at improving conditions. Similar to a potentially cumulative oxygen demand, the sediments in reservoir bottom waters may be sequestering nutrients over time, however, sufficient information on 1981 conditions is non-existent, therefore the contributions of this alternative to high attached algae and fish disease conditions in the river downstream from Iron Gate is unknown. It would remain unchanged at best. There would be no change in bed mobility, except for localized one-time augmentation of spawning gravels downstream from Iron Gate. Spawning conditions are thought to have been poor at the time of designation for the reach immediately downstream from Iron Gate, but the Alternative would enhance this situation to a minor degree. The poor water quality conditions in this reach during spawning season are a further deterrent to spawning that has multiple sources. The Proposal would maintain degraded though stable streambed conditions that are conducive to growth of algae mats that harbor an important fish pathogen host. There isn't clear evidence whether these algae mats are undergoing an increase over time, and although there is a clear Project connection through reservoir nutrient releases in the summer, this condition may be unchanged from the time of WSR designation.

The **Staff Alternative** and the **Staff Alternative with Mandatory Conditions** would improve the survival of emergent and migrating juvenile salmonids. While the level of effect of disease on fall Chinook salmon populations in the Klamath system remains unknown, both alternatives would potentially decrease the impacts from disease. This is particularly true for Chinook during the May to July period when c. Shasta causes mortality of outmigrants in some years. At least one disease appears to have caused an increased trend of fish infection detected since the 1990s. Like the PacifiCorp Proposal, the Staff Alternatives provide for a plan to manage water quality, however, the Staff proposes several improvements: 1) the water quality management plan is more integrated and has a broader geographic scope (includes affected river reaches), 2) a disease management plan, if implemented, would assess and collaboratively manage disease conditions, 3) short term releases would improve migration and holding habitat during critical periods for fish based on agency-developed triggers, 4) hypolimnetic releases would occur only once the adverse water quality effects more closely studied and, if necessary, mitigated to realize positive benefits, 5) immediate installation and operation of turbine injection would provide some DO improvement for fish downstream of Copco and Iron Gate, although results are predicted to fall short of Basin Plan DO objectives. **The major difference between the Staff Alternative and the Staff Alternative with Mandatory Conditions for this WSR is that anadromous fish would be provided with fishways for passage.** This would open up volitional passage to an estimated 58

miles of additional useable habitat within the project reach. There would be engineering and biological challenges to overcome, however, this would result in a much greater abundance of fish than in 1981 (ALJ Decision, 2006., Ultimate Findings of Fact and Conclusions of Law. USFWS/NMFS issue 6).

The **Dam Retirement Alternative** could improve migration, holding, and spawning habitat in the long term by eliminating the source of most of the water quality issues on the WSR that are Project influenced. In particular, it could mitigate late summer and fall heating, summertime DO depletion, and in-reservoir nutrient cycling that results in summer releases of nitrogen downstream. Consequently, disease outbreaks that appear to be population-limiting may also be diminished.

Dam Retirement would also result in habitat conditions that more closely resemble natural conditions than the warmer impounded water and regulated flows that were present in 1981. Chinook salmon, coho salmon and steelhead trout would have access to a portion of the spawning and rearing habitat that they used prior to dam construction. The estimated additional useable habitat would be the same as described above for the Staff Alternative with Mandatory Conditions, but there would be less risk associated with fish holding and handling at fishways. If the hatchery continues to operate, this could reduce the beneficial effects by continuing the competition and genetic pressures on natural stocks. The short-term adverse impact from the release of sediment stored behind the dam could be sufficient to cause significant smothering of spawning gravels, pool infilling, gill abrasion in fish exposed to increased turbidities, and changes to holding and migration patterns. If severe enough, populations currently at low levels (e.g. coho) could take a long time to recover.

These impacts may be mitigated by controlling the sediment release, to minimize aquatic ecosystem effects or through the removal of sediments to uphill sites. We recommend that prior to analyzing any Dam Retirement alternative that is to be considered in detail, more detailed studies are needed to determine the short term effects of the Dam Retirement alternative on water quality and aquatic habitat.

Wildlife Resource Evaluation - **PacifiCorp's Proposal** would not propose any measures to improve on riparian habitat conditions between Iron Gate Dam and the confluence of the Shasta River. Riparian vegetation provides habitat for feeding, breeding, and sheltering for willow flycatchers, yellow-breasted chat, northwestern pond turtles, and other riparian obligate species. As discussed above, this alternative does little to recover or stabilize populations of anadromous fish beyond adopting the improved flow schedule. The Project will continue to contribute to the cumulative effect on habitat conditions which limit these populations. There is a secondary affect on wildlife from reduced abundance of the declining fish stocks because they provide an abundant source of protein for wildlife. Bald eagles and other riparian dependent species regularly feed on fish. Unfortunately there is little data on population abundance or trends from 1981 or

since, so it is difficult to know what impact declining fish stocks have had on wildlife numbers since WSR designation.

The **Staff Alternative** would also have no measures to reverse the riparian vegetation impacts from Iron Gate Dam to the confluence with the Shasta River. However, this alternative differs on effects to wildlife because it proposes several measures to recover anadromous fish in the river. The improvement in habitat (see fish discussion) is not expected to substantially reverse the decreasing trend in Chinook salmon or summer steelhead abundance since 1981 therefore there would be somewhat less forage for wildlife that feed on fish.

The **Staff Alternative with Mandatory Conditions** would be the same as the Staff Alternative except for fishways at each dam. Over the long term, this provision could increase the abundance of Chinook, coho, and steelhead relative to numbers by making additional anadromous fish habitat available.

The **Dam Retirement** Alternative would reverse the sediment trapping action of Iron Gate and Copco Dams. It would provide a short term discharge of abundant amounts of fine sediment that would stimulate riparian recolonization and growth between the site of Iron Gate Dam and the confluence of the Shasta River, and even further downstream. In the long term it would return the WSR to more natural processes in the riparian community. The increase in quality and quantity of riparian habitat is expected to increase the numbers and productivity of wildlife dependant species. This alternative would potentially have short term reductions in numbers of several species from the reduction fish and other aquatic organisms which are important food sources. In the long term, however, healthier anadromous fish runs would increase available forage, relative to 1981. This would increase the probability that more bald eagles would survive the winter and enter into the next breeding season in good condition. Increased numbers of fish would also create greater forage opportunities for other riparian species like river otter, osprey and black bear.

Scenic Resource Evaluation - The flows recently required to be released into the California segment of the WSR are proposed in **all alternatives**, thereby improving the river's summertime flow appearance above conditions characteristic at its date of designation. This would moderately reduce the frequency of unattractive summertime flows, which are unattractive because they display views of exposed riverbeds, murky, stagnant water, and algae-coated shorelines in summer months. This flow level increases the river's scenic views to water-filled riverbeds, deep pools and braided channels, along with improved water clarity due to reduced concentrations of floating organic material.

The **PacifiCorp Proposal** and the **Staff Alternative** offer additional minor improvements to the WSR's scenic attractions of water, fish, wildlife and riparian vegetation. The Staff Alternative includes more water quality measures including a comprehensive plan for the project reservoirs and downstream river reaches, but their benefits are uncertain. This would provide some additional scenery benefits above the PacifiCorp Proposal.

The **Staff Alternative with Mandatory Conditions** would offer similar minor improvements to the WSR's scenic water appearance and riparian vegetations. However it would also offer a substantial increase in fish habitat through its fish passage measures. This should result in moderate improvements to scenic fish viewing.

In contrast, the **Dam Retirement Alternative** would offer major scenery benefits over the long term of the new license. In the short term, and of an unknown duration, there would be both positive and negative scenery effects. These include water that may be cloudy for up to several years, and concentrations of silt deposits along the shoreline and in pools. Ultimately, this alternative could eliminate the river's major Project-caused water appearance problems. It could expand anadromous fish habitat and populations, which would have a secondary effect of increased fish viewing opportunities within the WSR. It would also restore a slightly more natural variation in river flows in response to late summer through early fall storms, providing a more characteristic scenic variety to the channel and shoreline, and associated increases in scenic riparian, fish and wildlife attractions in the upper reaches.

Recreational Resource Evaluation - the **PacifiCorp Proposal** would have many of the same effects to whitewater boating and fishing activities, and the river's overall recreation setting as was described for scenery. River flows are improved, yet the adverse water-quality and fishery trends remain largely unchanged. The whitewater boating opportunities would be improved over the conditions existing at the date of designation in 1981. This proposal would decrease the WSR's recreational fishing opportunities from the 1981 conditions, primarily due a decrease in the fishery. The recreation setting would be slightly improved through the increased flows and minor water quality improvements which may still not meet state water quality standards.

Similar to the PacifiCorp Proposal, the **Staff Alternative** offers improved river flows, but also may provide additional water quality improvements through its comprehensive reservoir and affected river reaches water quality plan. The resulting whitewater boating opportunity would be improved over the conditions existing at the date of designation in 1981. There would be a decrease in the fishing opportunity since 1981, primarily due to a decrease in the fishery. The recreation setting would be slightly improved through the increased flows and minor water quality improvements which may still not meet state water quality standards.

The **Staff Alternative with Mandatory Conditions** would have the same effect on whitewater boating as the other alternatives. The recreational fishing opportunity would likely be improved over the long term due to the proposed fishways and resulting increased fish habitat. The recreation setting would also be moderately improved due to improved flows, minor water quality improvements, and improved fishery.

The **Dam Retirement Alternative** would likely have temporary adverse impacts on whitewater boating and recreational fishing. More information is needed to further evaluate these temporary impacts and potential ways to avoid or mitigate them. In the

long term after the river stabilizes, both river flow and water quality conditions would be significantly improved over 1981 conditions. The quantity and quality of whitewater boating and recreational fishing opportunities would increase to a moderate degree. There would also be a moderate to major improvement in the recreational setting for all river activities, primarily due to water quality improvements.

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Appendix

Fish Abundance Analysis Methods and Results

Anadromous Salmonids Status- This analysis describes the trends in abundance for four species: Chinook salmon, coho salmon, cutthroat trout and steelhead trout, with the use of trend analysis on abundance indices. In order to allow for direct comparisons, we built on the status reviews conducted by the NMFS for several species (Busby et al. 1994; Weitkamp et al. 1995; Myers et al. 1998; Johnson et al. 1999; Good et al. 2005) through the incorporation of recent literature and information. Whenever possible, the same data (trend) analysis that was used in the status reviews was used while including the most recent abundance data for pertinent stocks. The analysis was contingent on the type and amount of data available for each species and stock. This document describes the current conditions of these species in portions of the Klamath River basin located downstream of IGD. Abundance trends were used as a measure of the potential effect of the Klamath Hydroelectric Project on Klamath River anadromous fisheries since the beginning of Project operations and to assess 1981 conditions. In some cases, the abundance of anadromous fish in tributaries to the main stem Klamath River was evaluated. Presumably, anadromous fish are exposed to instream habitat conditions affected by the management of the Klamath River Hydroelectric Project as they migrate through the main stem and interact with hatchery-produced fish throughout much of their lives (DEIS, 2006, Section 3.3.3.1.3).

Iron Gate Hatchery operations are a connected action with the hydroelectric license decision. Although managed by the State of California, PacifiCorp is the primary financial contributor, and certain management operations are part of the license application. The hatchery was built in order to mitigate the loss of habitat located upstream of IGD. Impacts on natural populations downstream of Iron Gate Hatchery from hatchery operations are unknown. One potential impact results from the spring release of about 5,000,000 fall Chinook smolts, which compete with wild fish for rearing habitat in the spring and summer. Genetic hybridization between hatchery and natural stocks is another potential effect.

Population trends were built using data that met the following criteria: [1] abundance numbers were collected using the same methods for at least eight consecutive years, and [2] data set did not contain more than 35% zero values (Spence et al. 2005). These criteria were set by the Biological Review Teams conducting the status reviews for NMFS. Whenever possible, trends were based on adult spawner abundance estimates as in Myers et al. (1998) with data sets that did not contain any zero values. Abundance estimates were log transformed (ln) in order to reduce the influence of outliers and increase the ability to meet distributional and variance assumptions required for linear models (Quinn and Keough 2002). Log transformation is monotypic, meaning that the order of data values remains the same before and after transformation. Trend lines were subsequently tested (two-tailed t test) to see if they were statistically different from a straight line (slope = 0), in order to determine if population abundance had changed over time (Sokal and Rohlf 1995). Trend lines were determined to be significantly different

from a straight line when the probability (p) value was less than a level of significance of 0.05. Consequently, the term significant was used to describe the statistical determination of the trend analysis. The analyses were used to describe general trends in abundance numbers and should not be used as predictive models. The power of each analysis also was calculated in order to determine the sensitivity of each analysis to changes in abundance numbers (Quinn and Keough 2002). Only analyses with power values higher than 0.50 were able to detect changes in abundances.

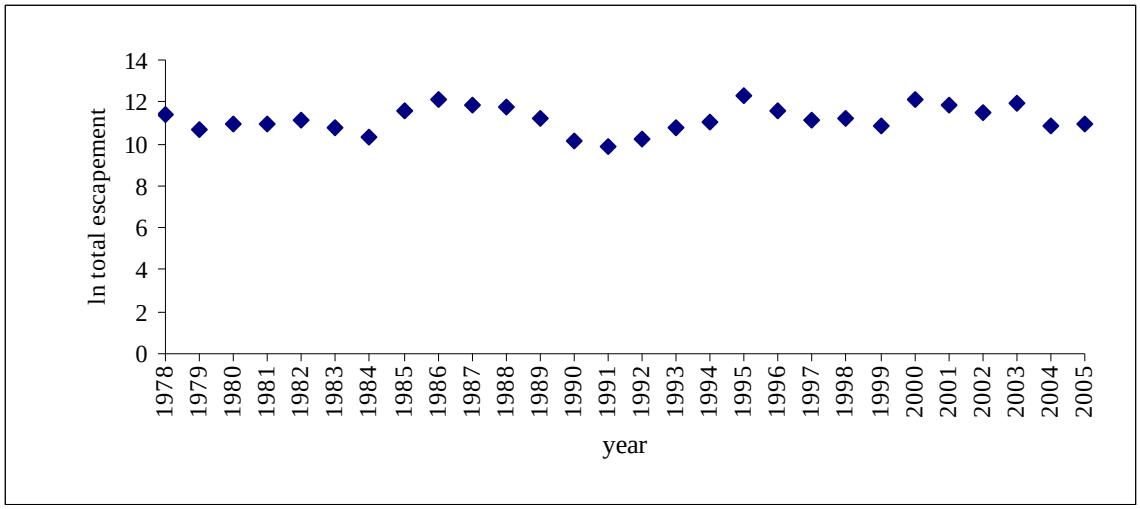
Chinook salmon

The status review of Chinook salmon from Washington, Idaho, and Oregon was completed by NMFS in 1998 (Myers et al. 1998). Subsequently, NMFS updated the status review of certain Evolutionarily Significant Units (ESUs), including the Upper Klamath and Trinity River ESU, in 2005 (Good et al. 2005). In that document, Klamath River Chinook salmon were included in two separate ESUs. Chinook spawning in stream reaches from the mouth of the Klamath River to the confluence with Trinity River were included in the Southern Oregon and California Coastal ESU; Chinook spawning in areas of the Klamath River located upstream of the Trinity River were included in the Upper Klamath and Trinity River ESU. Trends in Klamath River Chinook salmon abundance were evaluated by compiling and analyzing "[1] recent total spawning escapement, [2] percent annual change in total escapement, [3] recent naturally produced spawning escapement, and … [4] percentage of natural spawners that were of hatchery origin" for fall-run Chinook.

Like in Myers et al. (1998), estimates of total spawning escapement numbers and recent naturally produced spawning escapement for fall-run (ocean-type) Chinook salmon in the Klamath River basin were obtained from California Department of Fish and Game, but including data for years 1997 to 2005 (CDFG 2006). However, this analysis compiled the abundance information for all runs in the Klamath River basin and did not analyze separately the stocks belonging to the Southern Oregon and California Coastal and Upper Klamath and Trinity River ESUs. Also, least-squares linear regression of the natural logarithm (ln) of fall-run Chinook salmon spawner escapement on year was used to describe population trends as in Myers et al. (1998). All Chinook salmon data were retrieved from the Calfish database (www.calfish.org), which is recognized by NMFS as the official site for anadromous fish abundance information.

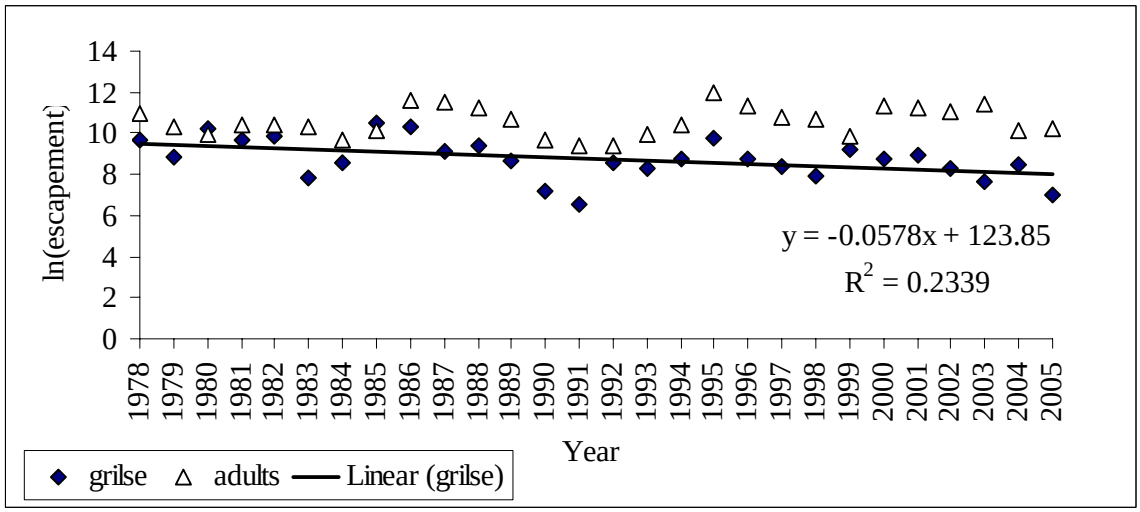
After transformation, total fall-run Chinook salmon spawner escapement (natural and hatchery adults and grilse) oscillated in four continuous cycles (trough to trough), each lasting six (1979 to 1984; 1999 to 2004) to nine (1991 to 1999) years. The lowest and highest total spawner escapements for the basin were documented, respectively, in 1991 (19,121) and 1995 (217,312). Regression of ln(total escapement) on year ($p = 0.27$, $r^2 = 0.05$, power = 0.19; Figure 1) did not detect a trend in escapement numbers.

Figure 1. Fall-run Chinook salmon total spawner ln(escapement) on year,1978 to 2005, Klamath River basin, California (Source: CDFG 2006).



In order to analyze two population components of the spawning run, the ln(number of grilse) and ln(number of adult) natural spawners were regressed on year (Figure 2). The resulting analysis suggested that the number of grilse contributing to natural escapement has decreased since 1978 ($p = 0.009$, $r^2 = 0.23$, power = 0.77). A trend was not detected in adult escapement ($p = 0.38$, $r^2 = 0.03$, power = 0.14).

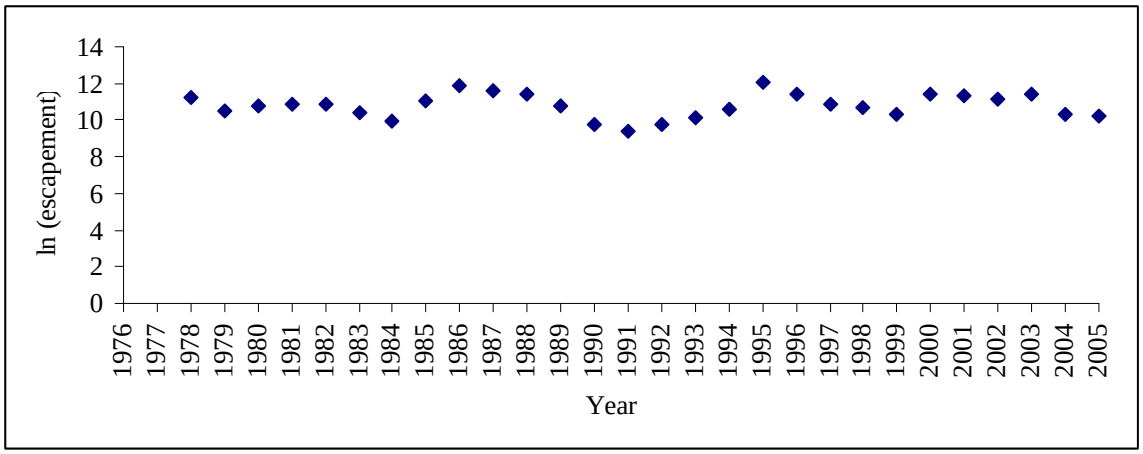
Figure 2. Fall-run Chinook salmon natural escapement (ln), adults and grilse, 1978 to 2005, Klamath River basin, California (Source: CDFG 2006).



Escapement (log transformed) of natural spawners (Figure 3) reflected the same general pattern as seen in total escapement, with the exception that natural spawner escapement decreased from 2004 (29,053) to 2005 (28,388) while total escapement increased slightly. Also, less than 35,000 natural spawners (adults and grilse) returned to spawn in 1983 (33,310), 1984 (21,349), 1990 (16,946), 1991 (12,367), 1992 (17,171), 1993 (25,683), 1999 (28,904), 2004 (29,053) and 2005 (28,388). The Pacific Coast Salmon Fishery Management Plan established a minimum escapement of 35,000 fall Chinook natural

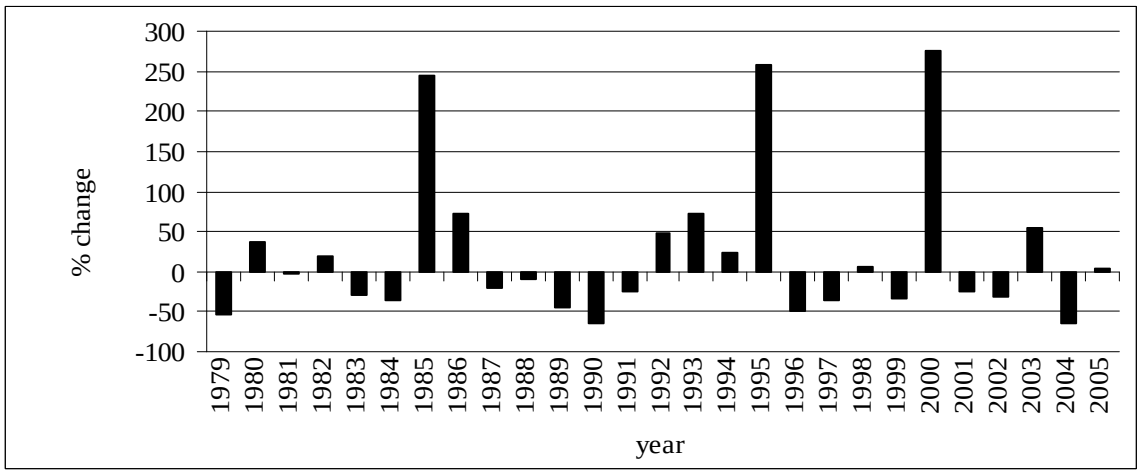
spawners as a conservation goal (PFMC 1988). The analysis did not detect a trend for ln(natural spawner escapement) ($p = 0.90$, $r^2 = 0.0006$, power = 0.05).

Figure 3. Escapement (ln) of fall-run Chinook salmon natural spawners, Klamath River basin, California, 1978 to 2004 (Source: CDFG 2006).



Escapement numbers varied from year to year, depicted by the percent annual change in total escapement (Figure 4). The biggest percent annual change from a previous year occurred in 2000, when escapement numbers increased from 50,088 (1999) to 188,642 (2000). Of the 26 years reviewed, 11 experienced increases and 15 experienced decreases from previous year's numbers. The most obvious downward trend in escapement numbers occurred from 1986 to 1991 when escapement numbers declined continuously for a period of five years. The Klamath River was designated a WSR in 1981.

Figure 4. Percent annual change of fall-run Chinook salmon total escapement from each previous year (1979 – 2004), Klamath River basin, California (Source: Hampton 2006).

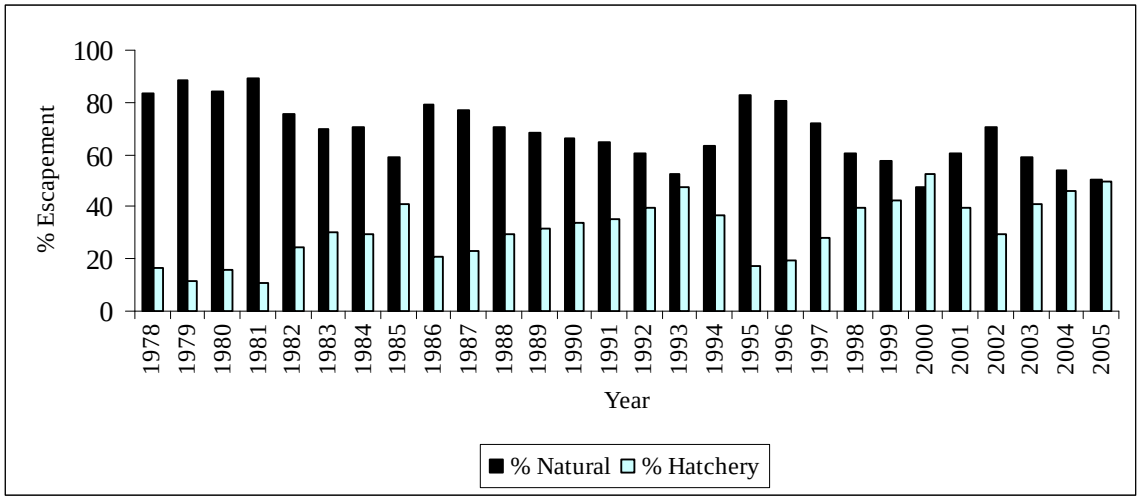


Estimates of recent naturally produced spawning escapement may include individuals that hatched and reared in hatcheries but did not return to the hatchery to spawn (hatchery strays). The percent of natural spawners of hatchery origin was estimated by expanding

coded wire tag recoveries with production multipliers specific to brood year and tag number (Hampton, personal comm., 2006) and comparing these numbers to the estimated total number of natural spawners.

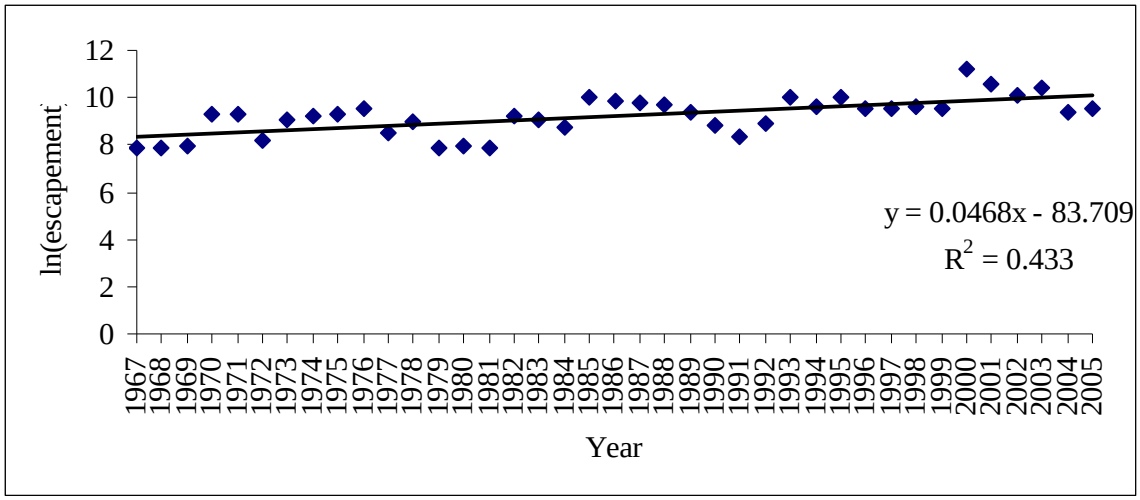
The proportion of natural (in-river) spawners of hatchery origin (hatchery strays) in specific years increased three-fold from the 1980's (maximum = 4.4%) to the 2000's (maximum = 13.1%; Figure 5). Regression analysis of the percentage of natural spawners of hatchery origin suggested that the proportion of hatchery strays throughout the basin increased significantly over time ($p = 0.04$, $r^2 = 0.18$, power = 0.56). The analysis was based on the recovery of coded wire tags of adults tagged up to the year 2000. Therefore, the proportion of hatchery strays spawning in rivers may have been underestimated for years 2002, 2003 and 2004.

Figure 5. Natural and Hatchery Spawners' Proportions (%) of basinwide escapement, Klamath River basin, California, 1978 to 2005 (Source: Hampton, personal comm., 2006).



Furthermore, the escapement (ln) of fall-run Chinook salmon returning to Iron Gate Hatchery has significantly increased ($p < 0.0001$, $r^2 = 0.43$, power = 0.99) since 1967 (Figure 6). Although Iron Gate Hatchery has been spawning returning adult fall-run Chinook salmon since 1962, only data from 1967 and later was used in the analysis because of the uncertainty that fish ladders were kept open throughout the spawning run prior to that year (Rushton, personal comm., 2006).

Figure 6. Fall-run Chinook salmon escapement (ln) to Iron Gate Hatchery, 1967 to 2005, Klamath River, California (Source: Rushton 2006).



Moyle (2002) determined the status of Chinook salmon in California to be stable or increasing. Similarly, trend analysis suggested that fall-run Chinook salmon populations in the Klamath River are not in decline. However, this trend may be masked by the increasing proportion of spawners of hatchery origin (hatchery strays) as compared to natural spawners in the Klamath River fall-run, suggesting that hatchery production is a substantial contributor to escapement. Regression ($r^2 = 0.28$) of hatchery vs. natural escapement described a positive and significant relationship ($p = 0.0036$) between these two populations. Case studies in other basins have shown that hatchery stocks can be unreliable for sustainable fisheries because of vulnerability to disease, and other challenges to maintaining stock viability. Estimates based on this analysis of historic data, for escapement to the mainstem Klamath River of fall Chinook were:

1981
Natural spawners: 4000.
Iron Gate Hatchery spawners: 21,595.

2005
Natural spawners: 4654.
Iron Gate Hatchery spawners: 13,997.

The estimates for natural spawners include hatchery strays. A cautionary note: because populations fluctuate widely from year to year, comparing any two years is not valid, but with the trend graphs, one can make some conclusions regarding abundance.

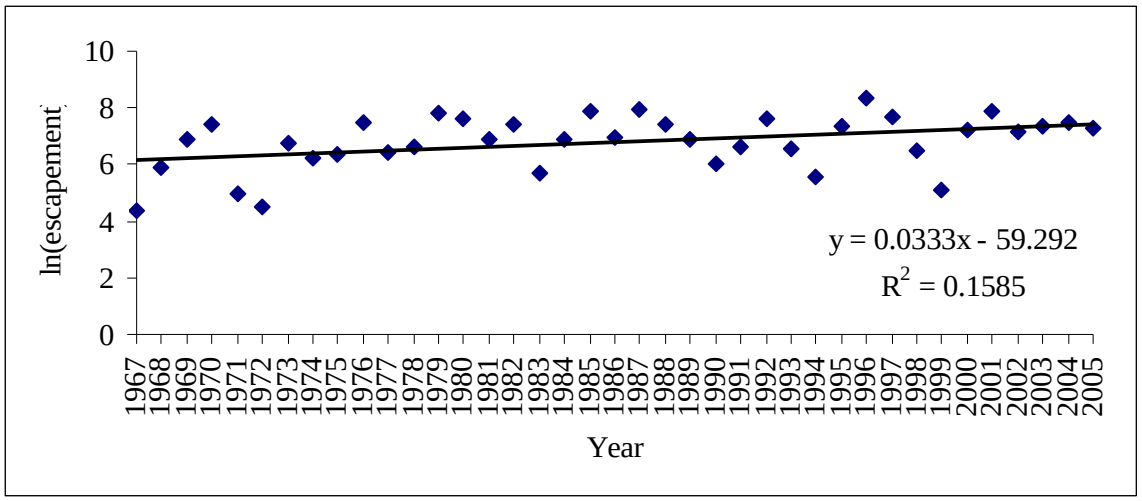
Coho salmon

Coho salmon abundance (1945-1995), in southern Oregon and northern California, has declined by approximately 90% to 95% of historical abundances (Brown et al. 1994, Spence et al. 2005). Although historical information is limited for the Klamath River system, records of commercial gill net catch estimated that 11,162 coho salmon were caught in a 30-day period in September and October of 1919 (Snyder 1931). Also, Spence et al. (2005) reported estimates of coho salmon spawner abundance for the Klamath River as 15,400 in 1965 (CDFG 1965), 3,400 from 1984 to 1985 (Wahle and Pearson 1987) and 1,860 from 1987 to 1991 (Brown et al. 1994).

Coho salmon abundance estimates, in the Klamath River, are confounded by hatchery production from both the Iron Gate and Trinity River Hatcheries (Brown and Moyle 1991). Current natural spawning of coho salmon in the system is thought to be minor, resulting in populations that are largely sustained by hatchery production (Brown et al. 1994). Although Iron Gate Hatchery reduced its juvenile coho salmon production by 50% in the last 10 years, genetic risks resulting from hatchery and wild populations may remain (Spence et al. 2005).

Coho salmon escapement to Iron Gate Hatchery was analyzed, in order to determine possible population trends of the hatchery stock (Figure 7). Although hatchery workers have been capturing and spawning returning coho adults since 1962, the numbers of returning coho from 1962 to 1966 were not included because it was uncertain whether fish ladders, which allow access into the facility, were open throughout the entire spawning run (Rushton, personal comm., 2006). Trend analysis described a significant increase in coho adults returning to Iron Gate Hatchery over the years ($p = 0.01$, $r^2 = 0.16$, power = 0.73).

Figure 7. Coho salmon escapement (ln) to Iron Gate Hatchery, Klamath River, California, 1967 to 2005 (Source: Rushton 2006).



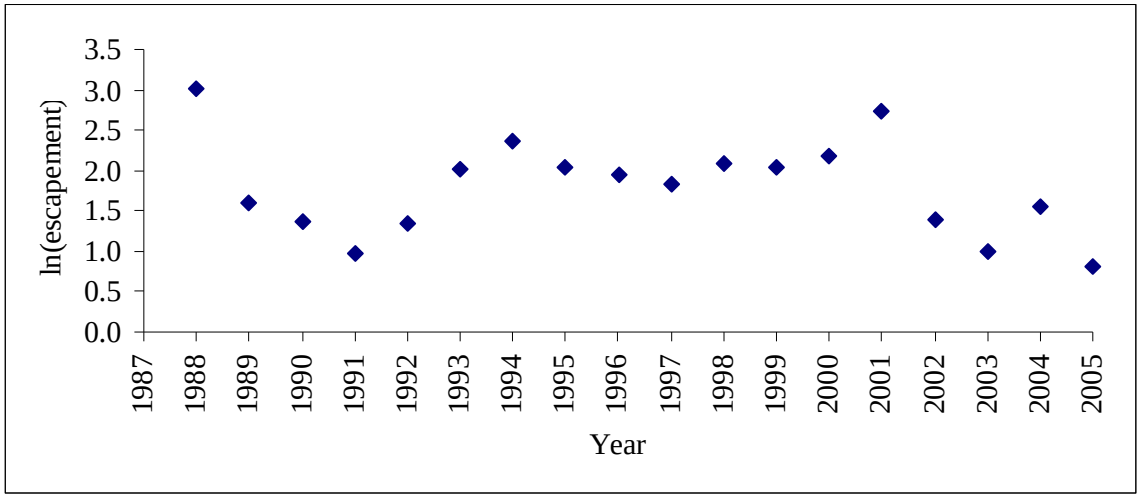
The lack of long-term historical and recent coho abundance data specific to the Klamath River made population trend analysis of natural populations impractical (Brown and Moyle 1991, Brown et al. 1994, Weitkamp et al. 1996, NRC 2004). However, low occupancy rates (37-61%) of historical coho streams indicated the continued low abundance of coho salmon in California (Spence et al. 2005). Specifically, "the percentage of streams [used by coho salmon] in the Klamath-Trinity system appears to have declined from 66-71% in 1987 to 55-62% in 1995" (Spence et al. 2005). Although populations in Iron Gate Hatchery appear to be increasing, estimated numbers of coho salmon in the basin by 1994 were around 10% of what they were before 1920 (Brown, et al, 1994) and (Weinkamp, et al, 1995). This is consistent with estimates in Spence et al. (2005) that the population is currently at less than 10%. Because of these low numbers, coho are considered at risk of extinction in the Klamath River system.

Steelhead trout

Steelhead trout in the Klamath River basin belong to the Klamath Mountains Province ESU (Busby et al. 1994). In their status review, NMFS compiled and analyzed angler catch, dam and weir counts, and instream adult survey data. Weir counts did not separate natural from hatchery produced fish. The average percent annual change in adult spawner escapement was used as an overall indication of trend (Busby et al. 1994).

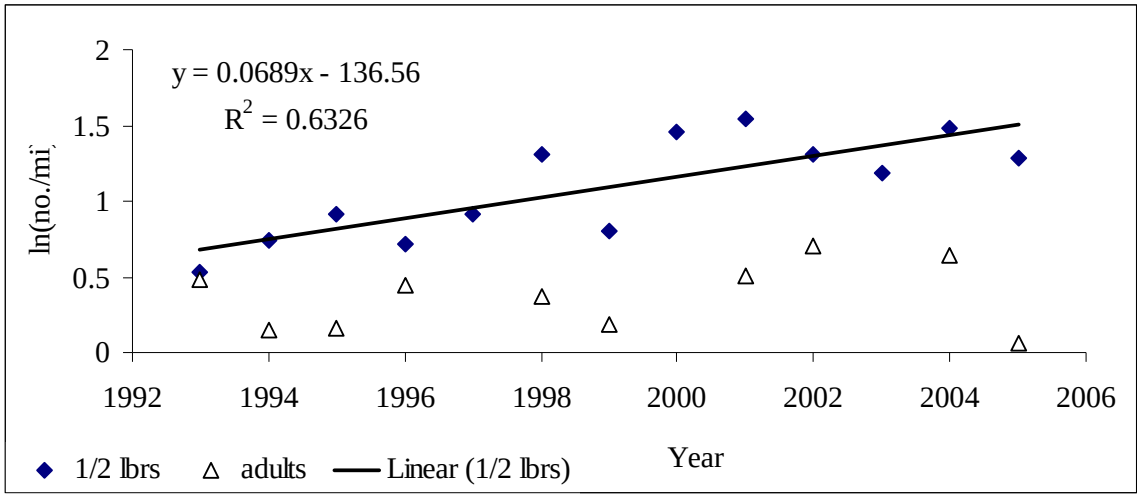
The analysis described in this document was based on instream adult survey data, primarily for summer steelhead adults, because abundance estimates for winter steelhead were not available. However, escapement estimates of hatchery and natural populations were analyzed separately. Summer steelhead trout escapement numbers collected in the Salmon River (1988 to 2005) were used in the analysis. Estimates of escapement were collected by continuous and concurrent direct observation (snorkel) surveys in approximately 121 total kilometers (75 mi) of the South Fork, North Fork and main stem Salmon River (KNF 2006). An abundance index for escapement was created as the log (ln) transformation of the number of steelhead trout observed after dividing by the total number of stream miles surveyed (Figure 9). But, the analysis did not detect a trend for summer steelhead escapement in the Salmon River ($p = 0.32$, $r^2 = 0.06$, power = 0.16).

Figure 8. Summer steelhead escapement (ln), 1988 to 2005, Salmon River, California (Source: KNF 2006).



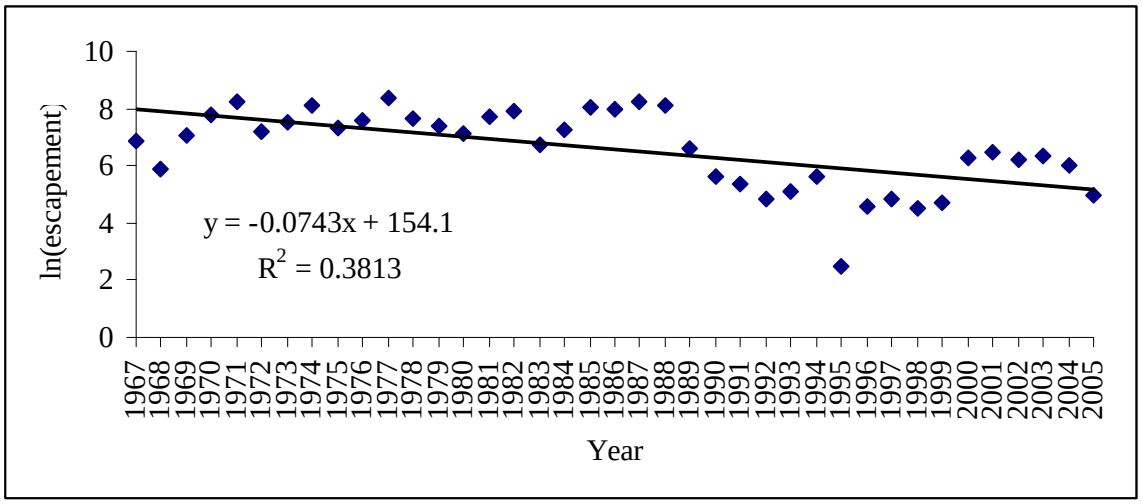
Because adults and half-pounders were reported separately since 1993, age classed were analyzed separately for fish observed in the North and South Forks of the Salmon River (Figure 10). Although the analysis did not detect a trend in adult abundances ($p = 0.97$, $r^2 < 0.01$, power = 0.05; Figure 18), the numbers of half-pounder summer steelhead were determined to have increased significantly in the North and South Forks, from 1993 to 2005 ($p = 0.0012$, $r^2 = 0.63$, power = 0.98). However, the analysis was confounded by the misidentification of large resident trout as half-pounder steelhead.

Figure 9. Summer steelhead half-pounders and adults [ln(no./mi.)], North Fork and South Fork Salmon River, California, 1993 to 2005 (Source: KNF 2006).



Although the analysis did not detect trends in adult abundances, escapement (ln) of summer steelhead adults returning to Iron Gate Hatchery decreased significantly since 1967 (Figure 11; $p < 0.0001$, $r^2 = 0.38$, power = 0.99). Hatchery escapement numbers were assumed to reflect the total run for each year because the fish ladder, allowing access into the facility, was open throughout the duration of the run (Rushton, personal comm., 2006). Hatchery estimates of summer steelhead numbers include numbers of "fall-run" steelhead as defined in Busby et al. (1994).

Figure 10. Summer steelhead escapement (ln), Iron Gate Hatchery, Klamath River, California, 1967 to 2005 (Source: Rushton 2006).



Based on the analysis of the data with the longest time series (escapement to Iron Gate Hatchery), it appears that summer steelhead abundance is significantly declining in the Klamath River basin. Although this trend may not be indicative of natural stock trends, convention states that hatchery-produced steelhead trout often have a competitive advantage over naturally-produced fish because of their larger size and more aggressive behavior (Busby et al. 1994, Kostow and Zhou 2006). Therefore, it is likely that

naturally producing summer steelhead trout are also in decline. The lack of trend detection in natural escapement possibly resulted from conducting analysis on a shorter time series (< 20 years vs. 38 years).

The analysis resulted in similar conclusions as those drawn by Moyle (2002) and Busby et al. (1994). Moyle (2002) concluded that Klamath Mountains Province winter steelhead were widely distributed and fairly common, although in greatly reduced numbers. In comparison, summer steelhead trout were in danger of extinction, with population estimates at less than 10% of historic levels (Moyle 2002). He cited dam construction, poor watershed management, decreased flows (resulting in increased temperatures and changes to stream channel morphology/composition), and interactions with hatchery produced steelhead as contributing factors to the decline in steelhead abundance.

Although not at risk of extinction at the time of the status review, Busby et al. (1994) also concluded that Klamath Mountains Province steelhead were likely to become endangered in the foreseeable future if trends continued as they were. They concluded that winter steelhead were probably in low abundance in the Klamath River, but that they had insufficient information to validate this claim. Summer steelhead trout were determined to be at moderate to high risk of extinction (Nehlsen et al. 1991) with largely depressed abundance numbers. Estimated run sizes for steelhead in the Klamath River were 20,000 for winter steelhead and 110,000 (1977-1991) for summer steelhead. Like Moyle (2002), they cited dam construction and habitat degradation as contributing factors to the decline of steelhead numbers. Both winter and summer runs have significantly declined from historical levels. Some investigators have concluded that summer runs are at the edge of extinction (Moyle, 2002, and Busby, et al, 1994, Administrative Law Judge (ALJ), 2006).

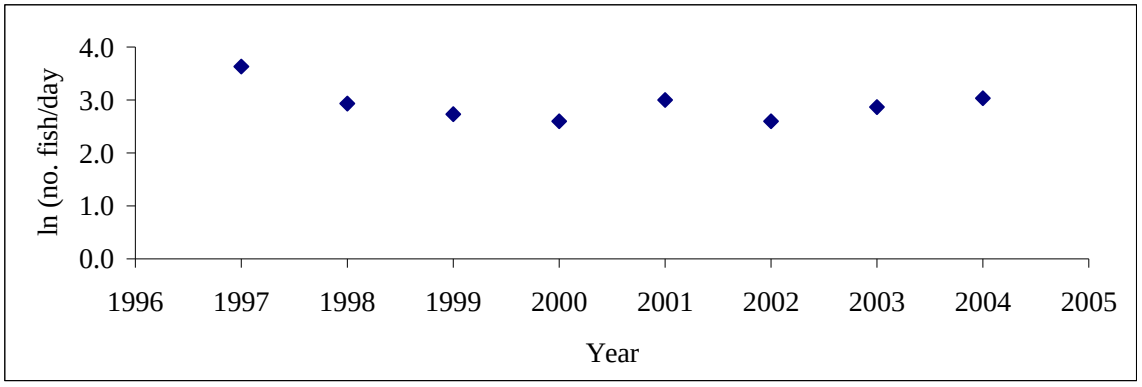
Coastal cutthroat trout

Coastal cutthroat trout in the Klamath River belong to the Southern Oregon/California Coasts ESU. The 1999 NMFS status review contained trend analysis on "escapement numbers from dam or weir counts, and smolt abundance estimates from downstream migrant traps" (Johnson et al. 1999). In their review, current abundance estimates were represented as the geometric mean of the most recent five years reported, whenever data was available. Trends were calculated as the slope of regression of the natural log of abundance against year. No attempt was made to account for the influence of hatchery production. However, no major effects from hatchery production have been identified in northern California.

Trend analysis for this document was based on the number of outmigrating coastal cutthroat trout in McGarvey Creek, estimated from 1997 to 2004 (Gale 2006b). McGarvey Creek is located approximately 9.7 km (6 miles) from the mouth of the Klamath River (Hillemeier 2006). Cutthroat trout numbers were calculated from mark-recapture expansions based on pipe trap efficiency estimates. In order to compare the trend analysis with the one conducted by NMFS, the natural log of the abundance index (no. fish per day) was regressed against year (Figure 8). The analysis did not detect a

trend in the numbers of 1+ cutthroat trout outmigrating from McGarvey Creek ($p = 0.32$, $r^2 = 0.17$, power = 0.15).

Figure 11. Number (ln) of cutthroat trout, older than one year, captured in Mc Garvey Creek, 1997 to 2004 (Source: Gale 2006b).



Although a trend in cutthroat numbers was not detected for McGarvey Creek, NMFS determined that short-term trends for coastal cutthroat trout numbers (adults) in the lower Klamath River appeared to be increasing but that "major declines in coastal cutthroat trout populations have occurred since historical times" (Johnson et al. 1999). Other status reviews have supported the conclusion that coastal cutthroat trout are not in immediate danger of extinction. Nehlsen et al. (1991) designated coastal cutthroat trout in California as at moderate risk of extinction. Gerstung (1997) concluded that coastal cutthroat trout trends since the 1980s were stable or increasing although numbers appear to be depressed. Finally, Moyle (2002) listed coastal cutthroat trout in California as a species of special concern. **The influence of the Klamath Hydroelectric Project on coastal cutthroat populations is thought to be minor if any.**