BEFORE THE PUBLIC UTILITY COMMISSION OF OREGON

UM-1209

In the Matter of MIDAMERICAN ENERGY HOLDINGS COMPANY Application for Authorization to Acquire Pacific Power & Light, dba PacifiCorp and To Exercise Substantial Influence Over the Policies and Actions of PacifiCorp	)))))))))	TESTIMONY OF THE PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS DOCUMENTS FOR JUDICIAL NOTICE IN THIS CASE

INTRODUCTION AND RELEVANCE

PacifiCorp owns and operates a number of small hydroelectric dams in southern Oregon, in the Upper Klamath Basin, comprising the Klamath Hydroelectric Project. These dams have had severe impacts on the natural resources of the State of Oregon, including completely blocking the river, eliminating fish passage and extinguishing once great anadromous salmon and steelhead runs that previously were pervasive throughout large potions of the Upper Klamath Basin.

These salmon and steelhead were also a cultural and subsistence resource protected by Treaty for the use of the Klamath Tribes. The deliberate extirpation of these salmon and steelhead runs has not only impoverished the Klamath Tribes and local communities, but also adversely affected fishing-dependent economies throughout the Klamath Basin and much of the coastline, including reducing salmon harvest opportunities drastically in several southern Oregon coastal ports.

These externalized environmental damage costs can become, and many may have already become, internalized costs to PacifiCorp which may affect the financial stability of the company as well as become an additional burden on its ratepayers, and are thus relevant to this PUC case. The Applicant, MidAmerican Energy Holding Company (MEHC) has pledged considerable infrastructure reinvestment, should its proposed transaction be approved, but noticeably absent is any commitment to reinvestment in PacifiCorp's deteriorating hydropower systems, nor any commitment to correct the serious environmental problems that system has created in the Klamath Basin and elsewhere.

The PUC has within its discretion the power to impose conditions in this transaction that would help offset, mitigate or potentially avoid massive future liabilities for some of these potential environmental damage costs and thus reduce the burden of these costs on both PacifiCorp, its ratepayers and the natural resources of Oregon.

DOCUMENTS OFFERED IN EVIDENCE

As evidence of these Klamath impacts, and the loss of salmon caused by lack of fish passage in these dams, the Pacific Coast Federation of Fishermen's Associations (PCFFA) offers the following documents for judicial notice in this case, as Attachments 1 through 4:

1. "Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams – A Synthesis of the Historical Evidence," a peer-reviewed scientific paper from *Fisheries*, Vol. 30, No. 4 (April 2005). *Fisheries* is a prestigious scientific journal published by the American Fisheries Society, the oldest and largest scientific society for fisheries biologists in the U.S.
2. Technical Memorandum (April 5, 2004) from Clearwater BioStudies, Inc., from C. W. Huntington, Aquatic Biologist, titled "Preliminary Estimates of the recent and historic potential for anadromous fish production above Iron Gate Dam." This document is drawn from the official record of the Federal Energy Regulatory Commission (FERC), in its Relicensing Docket No. 2082-027 from a filing dated April 25, 2004.
3. "Estimates of Pre-Development Klamath River Salmon Run Size, Economic Value and Post-Project Fishery Losses," published by the Institute for Fisheries

Resources, and drawn from the official record of the Federal Energy Regulatory Commission (FERC), in its Relicensing Docket No. 2082-027, as Attachment 5 from a filing dated April 25, 2004, filed by PCFFA, Institute for Fisheries Resources and others. Most of the citations in the document are peer-reviewed scientific reports or from official state or federal agency reports as cited therein.

4. Copy of a "Complaint for Damages" filed as Case No. CV04-644MO in the U.S. District Court for the District of Oregon on May 11, 2004. Plaintiffs were the Klamath Tribes of Oregon and several individual Tribal members against Defendant PacifiCorp, claiming $1 billion in damages for the loss of the Tribe's anadromous salmon and steelhead resources and subsistence fisheries as a result of lack of fish passage through the Klamath Hydroelectric Project. This case is currently on appeal to the Ninth Circuit Court of Appeal from an initial dismissal on disputed jurisdictional grounds.

All of these documents are relevant to the issue of contingent or current environmental damage liabilities that PacifiCorp now faces, which may soon become obligations of ratepayers, which are caused by the Klamath portion of its hydropower system, and which MEHC, should it take control over PacifiCorp pursuant to this transaction, will have some power to help correct as part of this transaction as a benefit to the public. We ask that the Administrative Law Judge allow these documents into the record by way of judicial notice, reserving the right of parties to argue their meaning.

Date: November 21, 2005 /s/________________________________

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Attachments Enclosed

CERTIFICATE OF SERVICE

I hereby certify that on November 21, 2005, I mailed an original and five copies of the foregoing Testimony of the Pacific Coast Federation of Fishermen's Associations, with all attachments, to:

Administrative Law Judge Traci Kirkpatrick
Administrative Law Judge Christina M. Smith
Public Utility Commission of Oregon
Attn: Filing Center
550 Capitol Street, NE, Suite 215
PO Box 2148, Salem, OR 97308-2148

Furthermore, I hereby certify that on November 21, 2005, this same document was electronically mailed to all persons on the Service List maintained by the Public Utility Commission for the UM-1209 Docket proceeding who had an email address posted. I further certify that a copy was physically sent, first class mail with postage prepaid, to all members of the Service List at the Service List mailing address identified below.

Date: November 21, 2005 /s/________________________
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fisheries history **feature**

Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams—A Synthesis of the Historical Evidence

ABSTRACT Knowledge of the historical distribution of anadromous fish is important to guide management decisions regarding the Klamath River including ongoing restoration and regional recovery of coho salmon (*Oncorhynchus kisutch*). Using various sources, we determined the historical distribution of anadromous fish above Iron Gate Dam. Evidence for the largest, most utilized species, Chinook salmon (*Oncorhynchus tshawytscha*), was available from multiple sources and clearly showed that this species historically migrated upstream into tributaries of Upper Klamath Lake. Available information indicates that the distribution of steelhead (*Oncorhynchus mykiss*) extended to the Klamath Upper Basin as well. Coho salmon and anadromous lamprey (*Lampetra tridentata*) likely were distributed upstream at least to the vicinity of Spencer Creek. A population of anadromous sockeye salmon (*Oncorhynchus nerka*) may have occurred historically above Iron Gate Dam. Green sturgeon (*Acipenser medirostris*), chum salmon (*Oncorhynchus keta*), pink salmon (*Oncorhynchus gorbuscha*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), and eulachon (*Thaleichthys pacificus*) were restricted to the Klamath River well below Iron Gate Dam. This synthesis of available sources regarding the historical extent of these species' upstream distribution provides key information necessary to guide management and habitat restoration efforts.

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Introduction

Gatschet's statement is that salmon ascend the Klamath river twice a year, in June and again in autumn. This is in agreement with my information, that the run comes in the middlefinger month [sic], May–June, and that the large fish run in the fall…They ascend all the rivers leading from Klamath lake (save the Wood river, according to Ball), going as far up the Sprague river as Yainax, but are stopped by the falls below the outlet to Klamath marsh.

—Spier (1930)

Parties coming in from Keno state that the run of salmon in the Klamath River this year is the heaviest it has [sic] ever known. There are millions of the fish below the falls near Keno, and it is said that a man with a gaff could easily land a hundred of the salmon in an hour, in fact they could be caught as fast as a man could pull them in…There is a natural rock dam across the river below Keno, which it [sic] is almost impossible for the fish to get over. In their effort to do so thousands of fine salmon are so bruised and spotted by the rocks that they become worthless. There is no spawning ground until they reach the Upper Lake as the river at this point is very swift and rocky.

—Front page article titled:
"Millions of Salmon—Cannot Reach Lake on Account Rocks (sic) in River at Keno"
Klamath Falls Evening Herald (24 September 1908)

The Klamath River watershed once produced large runs of Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*) and also supported significant runs of other anadromous fish, including coho salmon (*Oncorhynchus kisutch*), green sturgeon (*Acipenser medirostris*), eulachon (*Thaleichthys pacificus*), coastal cutthroat trout (*Oncorhynchus clarki clarki*), and Pacific lamprey (*Lampetra tridentata*). One estimate (Radtke, pers. comm. cited in Gresh et al. 2000) put the historical range of salmon abundance for the Klamath-Trinity River system at 650,000–1 million fish. These runs contributed to substantial commercial, recreational, subsistence, and Tribal harvests (Snyder 1931; Lane and Lane Associates 1981; USDI 1985; USFWS 1991; Gresh et al. 2000). In particular, the Upper Klamath River above Iron Gate Dam once supported the spawning and rearing of large populations of anadromous salmon and steelhead (Lane and Lane Associates 1981; FERC 1990).

The first impassable barrier to anadromous fish on the mainstem Klamath River was Copco 1 Dam, completed in 1918 (followed by Copco 2 Dam in 1925 and Iron Gate Dam in 1962; Figure 1). Prior to dam construction, anadromous fish runs accessed spawning, incubation, and rearing habitat in about 970 km (600 miles) of river and stream channel above the site of Iron Gate Dam. This dam, at river kilometer 307 (river mile 190; Photo 1), is the current limit of upstream passage. The Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program (USFWS 1991) identified the lack of passage beyond Iron Gate Dam as a significant impact to the Klamath River anadromous fishery. At present, significant un-utilized anadromous fish habitat exists upstream of Iron Gate Dam (Fortune et al. 1966; Chapman 1981; NRC 2003; Huntington 2004). The Klamath Hydroelectric Project operating license expires in 2006 and the relicensing process is currently under way.

Need for Information on the Upstream Extent of Anadromous Fish Distribution

Knowledge of the presence and the historical extent of the upstream distribution for anadromous species on the Klamath River is important for restoration planning and future management decision-making. Public Law 99-552, the Klamath River Basin Fishery Resources Restoration Act (Klamath Act), was adopted by Congress on 27 October 1986, for the purpose of authorizing a 20-year federal-state cooperative Klamath River Basin Conservation Area Restoration Program for the rebuilding of the river's fishery resources to optimal levels. Among other charges, the Klamath Act directs the Secretary of Interior to improve and restore Klamath River habitats and promote access to blocked habitats, to rehabilitate problem watersheds, to reduce negative impacts on fish and fish habitats, and to improve upstream and downstream migration by removing obstacles and providing facilities for avoiding obstacles.

In addition to the Klamath Act, the Department of the Interior and the Department of Commerce are authorized to protect and restore anadromous fish and their habitats under several authorities including the Federal Power Act (through the requirement of mandatory fishway prescription under Section 18 of the act). Other authorities include the Endangered Species Act; federal Tribal Trust responsibilities; Pacific Coast Salmon Plan; Magnuson-Stevens Fishery Conservation and Management Act (which incorporates delineation of "essential fish habitat"); Sikes Act, Title II; the Fish and Wildlife Coordination Act; the Wild and Scenic Rivers Act; the National Historic Preservation Act; Federal Lands Protection and Management Act; Northwest Forest Plan; and various policies and initiatives of the U.S. Bureau of Land Management, U.S. Forest Service, the National Park Service, NOAA Fisheries and the U.S. Fish and Wildlife Service (USFWS). The states of Oregon and California also have significant regulatory authorities and responsibilities related to hydropower relicensing and the recovery of listed species.

These authorities provide a basis for restoration of native anadromous fish to their historical habitats. However, there have been persistent questions regarding whether anadromous fish occurred historically above Iron Gate Dam. Thus, prior to implementing anadromous fish restoration and the design of potential fishways that would be species specific, it is important to evaluate the evidence regarding which native anadromous species were present historically above Iron Gate Dam and determine the extent of their upstream distribution.

Methods

We summarize existing information regarding both the recorded historical (tens to thousands of years) presence and, more specifically, the upstream extent of the distribution of native anadromous fish in the Klamath River, based upon photos, historical documents, logical reasoning, and other available information. A distinction was made between presence and the extent of upstream distribution because, for some species, there was clear evidence for presence in general terms, but only vague information on their farthest upstream distribution. When reliable information on the extent of upstream distribution was available, it was important to include this level of certainty for consideration during relicensing and anadromous fish restoration. The presence of species above one dam, but not another, has implications for relicensing.


DAVID WHITE, NOAA FISHERIES

Photo 1. Iron Gate Dam has no fish passage facilities.

In this article, references to the Klamath Upper Basin include the Klamath River watershed upstream from and including the section of the Klamath River known as Link River. (Link River Dam, as shown in Figure 1, is on this short reach of the mainstem Klamath River immediately below Upper Klamath Lake).

Photos

We reviewed historical photo collections of the Klamath County Museum and Klamath Historical Society for documentation of anadromous fish above Iron Gate Dam. We assumed that captions on photos correctly identified the taxa, locations, and dates. The photos used here were taken in the vicinity of Klamath Falls and adjacent Link River.

Documents and Reports

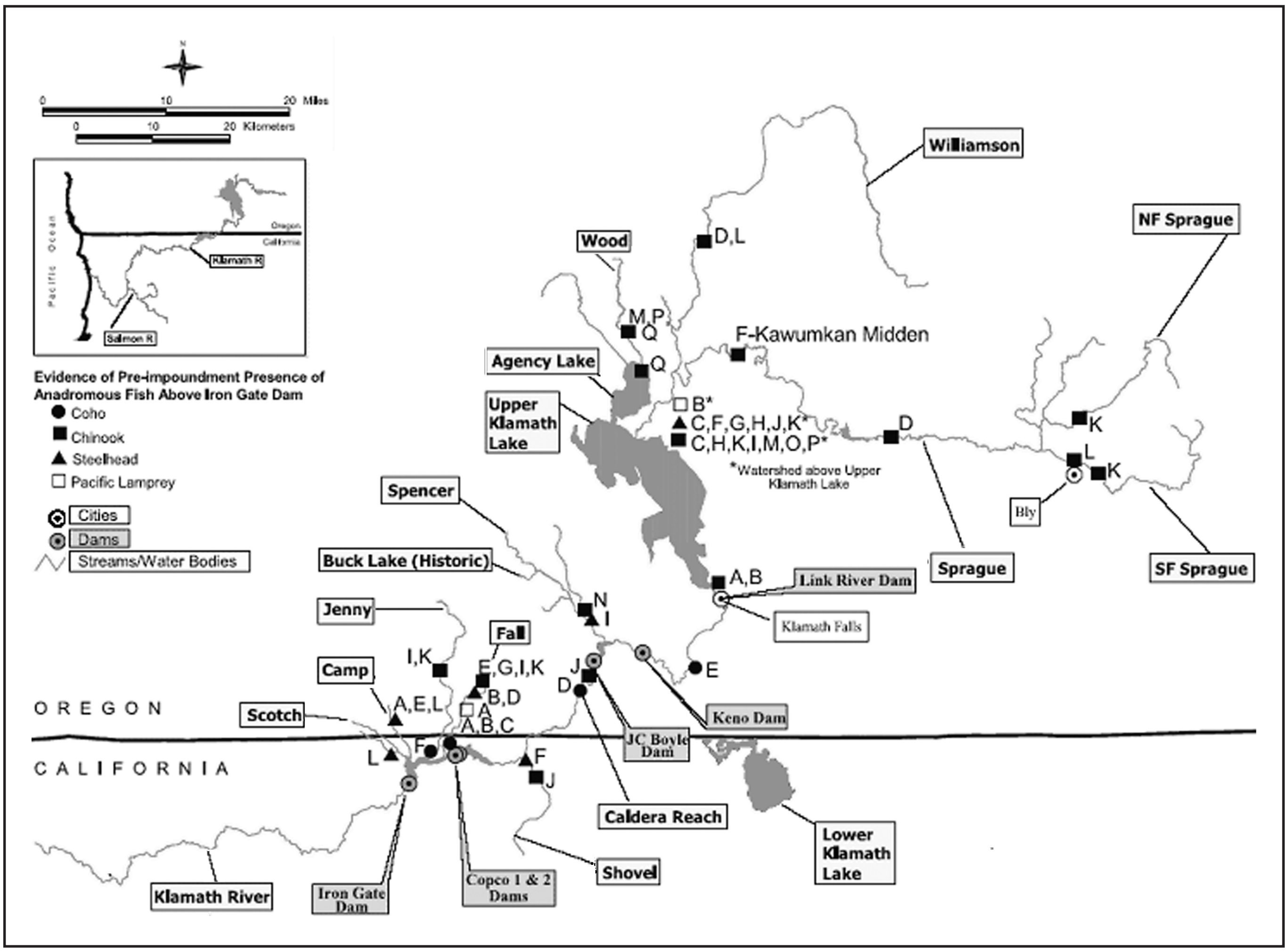
We reviewed published and unpublished fisheries, archeological, and ethnographic reports on the distribution and presence of anadromous fish in the Klamath River watershed. For a given reference we generally cited only the farthest upstream occurrence of a species in the Klamath River and/or its tributaries. When documents identified fish as only salmon, we assumed they were Chinook salmon. While ethnographic (Gatschet 1890; Spier 1930; Kroeber and Barrett 1960) and archaeological (Cressman et al. 1956) sources are cited, other reports from these disciplines may well contain additional documentation not specifically referenced in this paper. Fortune et al. (1966) referenced numerous articles from Klamath Falls newspapers regarding historical accounts of salmon above the current location of Iron Gate Dam. Of these, we have included only one (Klamath Falls Evening Herald 1908).

Personal Communications

We did not reference personal communications that included questionable identifications of species unless the communication included other supporting facts that would corroborate the identification of that species. For example, we discounted the identification of chum salmon (*Oncorhynchus keta*), coho salmon, and steelhead trout in the vicinity of Agency Lake and the Wood River, but included the reference to Chinook salmon because other information communicated on the size of these fish supported that identification.

Personal communications cited in Lane and Lane Associates (1981) regarding the presence of salmon in the Williamson and Sprague rivers were very numerous and we recommend that interested parties refer to this citation. We did not reference these personal communications individually here. When personal communications cited therein provided key information on presence or farthest upstream distribution of a species not cited elsewhere, we referenced Lane and Lane Associates (1981).

Figure 1. Extent of upstream distribution for anadromous fish in the Klamath River and tributaries based upon references in Table 1 (locations for citations are approximate).



Logical Reasoning

For Pacific lamprey and coho salmon we combined existing evidence with logical reasoning for a determination of the extent of upstream distribution of these species in the Klamath River watershed. This reasoning was partly based on the occurrence of the same species east of the Cascade Range in the Columbia River Basin. While we believe this reasoning is valid, we acknowledge that it does not have the same level of certainty as photographs, documents, reports, or personal communications for a specific determination of the limit of upstream distribution.

Results and Discussion

Table 1 summarizes sources of evidence for the historical distribution of Chinook salmon, steelhead, coho salmon, and Pacific lamprey above Iron Gate Dam on the Klamath River. Figure 1 is the corresponding map showing the locations cited for each species.

Evidence for the largest, most utilized species, Chinook salmon, was available from the greatest variety of sources and provided the highest level of certainty. Less information was available for the other three species. Nevertheless, there was substantial information and reasoning to determine that steelhead historically migrated to the Klamath Upper Basin and that the distribution of coho salmon and Pacific lamprey extended above Iron Gate Dam. More detailed information on our evaluation of sources and the presence and farthest upstream distribution is discussed below.

Chinook Salmon

Presence—Information cited here that provides evidence for the presence of Chinook salmon above the current site of Iron Gate Dam includes 2 historical photographs, 14 documents or reports, and 1 personal communication. Numerous other personal communications, testimony, and newspaper articles documenting the presence of Chinook salmon are referenced in Fortune et al. (1966) and Lane and Lane Associates (1981). We found one report that stated there was not enough information to conclude that Chinook salmon accessed tributaries of Upper Klamath Lake.

Chinook salmon spawned in Jenny Creek (Coots 1962; Fortune et al. 1966) and Fall Creek (Wales and Coots 1954; Coots 1957; Coots 1962; Fortune et al. 1966) prior to the construction of Iron Gate Dam. An interview with long-term resident of the area, W. G. Hoover, provided information on large concentrations of fall-run king salmon in Shovel Creek and on spawning that might have occurred near Shovel Creek in the mainstem Klamath River (Coots 1965). Hoover also noted that the river near the "Frame Ranch" was a favorite salmon spearing site and a potential spawning area (Coots 1965). Hoover was undoubtedly referring

Table 1. Documentation for pre-impoundment presence and extent of upstream distribution for anadromous fish in the Klamath River above Iron Gate Dam.

Source	**Species**			
	Chinook (■)	Steelhead (▲)	Coho (●)	Pacific Lamprey (❑)
Photos of historical presence above Iron Gate Dam	(A) Klamath County Historical Society Photo, Photo 2 (1860) (B) Klamath County Historical Society, Photo 3 (1891)			
Documents/reports/ other evidence	(C) *Gatschet (1890)* (D) *Spier (1930)* (E) *Wales and Coots (1954)* (F) *Cressman (1956)* (G) Coots (1957) (H) *Kroeber and Barrett (1960)* (I) Coots (1962) (J) Coots (1965) (K) Fortune et al. (1966) (L) Lane and Lane Associates (1981) (M) *Nehlsen et al. (1991)* (N) BLM et al. (1995) (O) *Thurow et al. (1997)* (P) *Moyle (2002)*	(A) Wright (1954) (B) Coots (1957) (C) *Kroeber and Barrett (1960)* (D) Coots (1962) (E) King et al. (1977) (F) Fortune et al. (1966) (G) Lane and Lane Associates (1981) (H) *Nehlsen et al. (1991)* (I) BLM et al. (1995) (J) *Thurow et al. (1997)* (K) *Moyle (2002)*	(A) Coots (1957) (B) Coots (1962) (C) CDWR (1964) (D) NMFS (1997) (E) IMST (2003)	(A) Coots (1957) (B) *Kroeber and Barrett (1960)*
Personal communications	(Q) Scarber (2004)	(L) Maria (2003)	(F) Bulfinch (2002)	
Logical reasoning			X	X

Italics = published literature. Reference identification letters correspond to symbols (■, ▲, ●, and ❑) showing approximate locations cited for each species (Figure 1).

to the "Frain Ranch" reach of the Klamath River, which is immediately upstream of the Caldera reach (Figure 1). BLM et al. (1995) referred to accounts of fall-run salmon in Spencer Creek and contained a photo taken prior to 1917 showing a Chinook salmon caught at the confluence of Spencer Creek and the Klamath River.

Two historical photographs document the presence of Chinook salmon at Link River. The Klamath County Historical Society provided these photos, dated 1860 and 1891, showing fishermen with their catch of salmon at Link River (Photos 2 and 3; Photo 2 is dated 1860 but may have been taken later in the nineteenth century; Judith Hassen, Klamath County Museum, pers. comm.). Fortune et al. (1966) reported that C. E. Bond, professor of fisheries at Oregon State University, examined a historical photo of salmonids from the Klamath Upper Basin and positively identified at least one fish as a Chinook salmon. We believe this photo may have been Photo 3 because it was available to the author and is the best known photo from the Klamath Upper Basin with a "salmon fishing" caption. The other three fish shown in this photo are clearly salmonids and likely were Chinook salmon as well.

In a footnote, Snyder (1931) referred to interviews he conducted with fishermen and long-time residents of the Klamath Lake region to learn of the past salmon runs. He reported that "testimony was conflicting and the lack of ability on the part of those offering information to distinguish between even trout and salmon was so evident, that no satisfactory opinion could be formed as to whether king salmon ever entered Williamson River and the smaller tributaries of the lake. However, this may be, large numbers of salmon annually passed the point where Copco Dam is now located." No information is provided in Snyder (1931) regarding the number of interviews or the effort made to interview fishermen and long-time residents.

In contrast, we found numerous historical accounts and fisheries reports referring to the presence of salmon in the tributaries to Upper Klamath Lake, in particular, the Williamson and Sprague rivers. Cressman et al. (1956) reported archeological evidence of salmon bones from the Kawumkan midden on the Sprague River (Figure 1), leading him to conclude that salmon passed the falls at the south end of Upper Klamath Lake. Lane and Lane Associates (1981) provided multiple accounts of the presence of anadromous salmonids and fishing in Sprague and Williamson rivers. This report was done under contract for the Bureau of Indian Affairs in the 1980s. Interviews were included in Lane and Lane Associates (1981) to ensure that a record of anadromous fish presence and the fishery on the Tribal reservation in the Klamath Upper Basin was maintained. In excerpts from 50 interviews, conducted in the 1940s, members of the Klamath Tribe and older non-Indian settlers in the region provided accounts of numerous salmon fishing locations on the Sprague River, the Williamson River, Upper Klamath Lake, and Spencer Creek. These accounts made a distinction between salmon and trout. In many instances the interviews in the document provided details on the weights of fish that indicated they could only be Chinook salmon.

One of the earliest references in Lane and Lane Associates (1981) is to the explorer Fremont's visit to the outlet of Upper Klamath Lake in May of 1846 and his observation of great numbers of salmon coming up the river to the lake. Most likely these would have been spring-run Chinook. Kroeber and Barrett (1960) stated that salmon ran up the Klamath into the Klamath lakes and their tributaries. Gatschet (1890) and Thurow et al. (1997) included the Klamath Upper Basin as within the range of Chinook salmon at the time of European settlement. Nehlsen et al. (1991) and Moyle (2002) referred to historical occurrences of fall, spring, and summer races of Chinook salmon in the Sprague, Williamson, and Wood rivers in the Klamath Upper Basin. Their accounts are similar to those of Fortune et al. (1966) and Lane and Lane Associates (1981) for the Sprague and Williamson rivers. For the Wood River, Nehlsen et al. (1991) and Moyle (2002) both state that Chinook salmon historically used this drainage. While one reference states that salmon did not go up the Wood River (cited in Spier 1930), an account of Chinook salmon harvest (Robert Scarber, former Klamath Agency Reservation resident, pers. comm., 2004) provides specific information that Chinook salmon occurred adjacent to and in the Wood River watershed. The Wood River has and continues to have suitable water quality and physical habitat to support anadromous salmonids. Without the presence of fish passage barriers, salmon undoubtedly inhabited this watershed.

Both spring and fall runs were reported above Upper Klamath Lake by Spier (1930) and Coots (1962). Fortune et al. (1966) provided reports and personal interviews that indicated the Sprague River was the most important salmon spawning stream, on the basis of testimony he received. According to four people interviewed by Fortune et al. (1966), salmon entered the Williamson River in autumn, possibly as early as August. One person interviewed provided the observation that, after salmon passed Link River, it took them five or six days to make their way through Klamath Lake before they reached the Williamson.

It is possible that fall-run Chinook reached Upper Klamath Lake and beyond in only wetter years. The lower Klamath River fall run (below Iron Gate Dam) is generally from August to October/November when flows and depths are often lowest for the year (Myers et al. 1998). Successful fish passage through the high gradient Caldera reach for large-bodied, fall-run Chinook may have been problematic during certain years. This low water passage difficulty was noted a short distance upstream at Keno in the Klamath Falls Evening Herald (1908). Spring-run Chinook salmon, on the other hand, have a bi-modal run distribution that spreads from April to August. The smaller sized, spring-run Chinook (their average weight was 5 kg or 11 lbs. according to Snyder 1931) encountered higher spring flows and would have been able to pass the Caldera reach. However, salmon runs to the Klamath Upper Basin undoubtedly had a fall-run component as evidenced by the size of salmon harvested (up to 27 kg or 60 pounds) and the timing of spawning noted in Lane and Lane Associates (1981).

Extent of Upstream Distribution—The extent of upstream distribution we found for Chinook salmon is shown in Figure 1. Chinook salmon utilized habitat in the Sprague River in the vicinity of Bly, Oregon, and further upstream. Fortune et al. (1966) reported that Chinook salmon spawned in the mainstem Sprague River; upstream on the South Fork of the Sprague above Bly to the headwaters; and on the North Fork of the Sprague as well (Figure 1). Lane and Lane Associates (1981) provided several independent testimonies that put the farthest upstream distribution of salmon for the Sprague River in the vicinity of Bly, Oregon. It should be noted that testimonies from Tribal members in Lane and Lane Associates (1981) were oriented toward harvest of adult salmon, which was restricted to within the reservation boundary, also located near Bly. Their report contained little information on the extent of anadromous salmonids in the Sprague River upstream of the reservation boundary. For the Williamson River, both Spier (1930) and Lane and Lane Associates (1981) listed the farthest upstream distribution of salmon as being the falls below the outlet to Klamath Marsh (Figure 1).

We note that accounts of Chinook harvest in general are based upon fisheries that took place in locations convenient for harvest, primarily in mainstem channels, and that the true farthest upstream distribution was probably above the sites where these fisheries took place.

Steelhead

Presence—Information cited here that provides evidence for the presence of steelhead above the current site of Iron Gate Dam includes 11 documents or reports and 1 personal communication. Other personal communications regarding steelhead above Iron Gate Dam are referenced in Lane and Lane Associates (1981). One report stated there was not enough information to conclude that steelhead accessed the Klamath Upper Basin.

BLM et al. (1995) includes a photo captioned "Fishing for steelhead on Spencer Creek…around 1900" from the photo collection of the Anderson Family, descendents of Hiram Spencer, an early settler in the Spencer Creek area. Fortune et al. (1966) cited a brochure from Southern Pacific Railroad, published in 1911, that referred specifically to the harvest of steelhead at the mouth of Shovel Creek (Figure 1).

KLAMATH COUNTY HISTORICAL SOCIETY

Photo 2. Link River salmon "fishing" around 1860. Site of present Klamath Falls.

KLAMATH COUNTY HISTORICAL SOCIETYKLAMATH COUNTY HISTORICAL SOCIETY

Photo 3. Gentlemen display their catch while salmon fishing on the rapids of Link River, 1891.

Extent of Upstream Distribution—The extent of upstream distribution we found for steelhead is shown in Figure 1. California Department of Fish and Game (CDFG) files include records of steelhead spawning in Camp Creek up to 1.6 km (one mile) upstream from the California state line, in at least one Camp Creek tributary approximately 0.8 km (0.5 mile) downstream from the California state line, and in nearby Scotch Creek (Dennis Maria, CDFG, pers. comm.). Wright (1954) and King et al. (1977) also reported that steelhead spawned in Camp Creek prior to the construction of Iron Gate Dam.

Coots (1957, 1962) discussed steelhead in Fall Creek. According to Puckett et al. (1966), steelhead were present as far upstream as Link River, but their presence above Upper Klamath Lake could not be documented. However, Kroeber and Barrett (1960), Nehlsen et al. (1991), Lane and Lane Associates (1981), Thurow et al. (1997), and Moyle (2002) all refer to steelhead accessing the Klamath Upper Basin. Fortune et al. (1966) states that due to the difficulty in differentiating steelhead from large rainbow trout (or redband trout, *Oncorhynchus mykiss irideus*), accurate information on the history of steelhead migrations in the Klamath Upper Basin was impossible to obtain. However, Fortune et al. (1966) also stated that there was enough agreement from interviews conducted to derive some general information. Included in this general information were accounts of steelhead in the Wood, Sprague, and Williamson rivers.

Generally, in watersheds where both Chinook salmon and steelhead are present, the range of steelhead is the same if not greater. The reports above, the overlapping distribution for the two species in most watersheds, and the fact that Chinook salmon were present in the Klamath Upper Basin are substantial evidence that steelhead were also present in tributaries to Upper Klamath Lake.

Coho Salmon

Presence—Information cited here that provides evidence for the presence of coho salmon above the current site of Iron Gate Dam includes five documents or reports and one personal communication. Snyder (1931) stated that "[s]ilver salmon are said to migrate to the headwaters of the Klamath to spawn. Nothing definite was learned about them from this inquiry because most people are unable to distinguish them." At the time, he said there was little interest in coho because Chinook salmon were so much larger and more abundant. Fortune et al. (1966) did not discuss coho salmon. However, Coots (1957, 1962) and the California Department of Water Resources (1964) reported that coho salmon spawned in Fall Creek, which now flows into Iron Gate Reservoir. Prior to construction of Iron Gate Dam, the confluence of Jenny Creek with the main stem Klamath River was well known by fishing guides as one of the best places in the upper river to fish for coho (Table 1 and Figure 1; Kent Bulfinch, Klamath River Basin Task Force representative, pers. comm.).

In 1911, 881 female coho were captured at the Klamathon Racks egg-taking facility about 8 km downstream from the current Iron Gate Dam site (CDFG 2002). Coho salmon are generally tributary spawners, and the only sizable tributary between the Klamathon Racks area and Iron Gate Dam is Bogus Creek. It is unlikely that all these spawning fish would have been destined for Bogus Creek and probable that a significant portion of the return was destined for tributaries above the current site of Iron Gate Dam. NOAA Fisheries estimated that within the Klamath River Basin, the construction of Iron Gate Dam blocked access to approximately 48 km (30 miles) of mainstem habitat, about 8% of the historical coho salmon habitat in the entire Klamath River Basin (NMFS 1997).

Extent of Upstream Distribution—The NOAA Fisheries estimate of the loss of approximately 48 km (30 miles) of mainstem coho salmon habitat above Iron Gate Dam would put the species' upper distribution in the vicinity of the J. C. Boyle powerhouse (Table 1 and Figure 1; NMFS 1997). Another report put the historical occurrence of coho salmon in the Klamath River as far upstream as the mouth of Lower Klamath Lake (IMST 2003). However, the report by Moyle (2002) stating that coho salmon once ascended the Klamath River and its tributaries at least as far upstream as Klamath Falls, Oregon, is an error resulting from the author's imprecise use of zoogeographic boundaries (Peter Moyle, University of California Davis, pers. comm.). To the best of his knowledge, there are no records of coho in the Klamath Upper Basin.

Given this information about the distribution of coho salmon in the mainstem Klamath River, the fact that coho are generally tributary spawners, our knowledge of their rearing and spawning habitat, and the characteristics of various Klamath River tributaries, we conclude that coho salmon would have used Spencer Creek, a medium-sized, low-gradient tributary, with suitable spawning habitat. Side channel and beaver pond areas in Spencer Creek would also have provided rearing habitat for this species. Thus, we reason that the farthest upstream distribution of coho salmon likely extended at least to this vicinity.

Anadromous Pacific Lamprey

Presence—We found two documents, but no personal communications, that provided evidence for the presence of Pacific lamprey above the current site of Iron Gate Dam. Coots (1957) reported that *Lampetra tridentata* entered Fall Creek, which now flows into Iron Gate Reservoir. Literature references to Pacific lamprey in the Klamath Upper Basin prior to the construction of downstream dams (Gilbert 1898; Evermann and Meek 1897) may have applied to a resident, non-anadromous taxon of uncertain systematic status (Stewart Reid, USFWS, pers. comm. 2004). Gilbert (1898) reported a "young" specimen that measured 26 cm in length. Lampreys of this size correspond with the larger lamprey taxon still encountered in Upper Klamath Lake, but are considerably smaller than anadromous adults in the Klamath River (Kan 1975; Lorion et al. 2000). The current lamprey taxon in Upper Klamath Lake was recognized as a distinct subspecies of *L. tridentata* by Kan (1975) in his unpublished dissertation, and as "non-anadromous" *L. tridentata* in Lorion et al. (2000) due to the lack of a formal systematic revision of the Klamath lampreys. Mitochondrial DNA analysis has shown no evidence of contemporary anadromous Pacific lamprey populations in the Klamath Upper Basin or Spencer Creek (Lorion et al. 2000; Margaret Docker, Great Lakes Institute for Environmental Research, pers. comm. 2004).

This taxonomic confusion would have made it difficult to distinguish anadromous Pacific lamprey from resident taxa. However, anadromous Pacific lamprey currently occur throughout the mainstem and principal tributaries of the lower Klamath River and fish fauna are generally considered to be similar throughout the mainstem Klamath River upstream to Spencer Creek. Historically, there were no physical barriers that would have prevented anadromous lampreys from migrating above Iron Gate Dam (Stewart Reid, USFWS, pers. comm.).

Extent of Upstream Distribution—Kroeber and Barrett (1960) reported that Pacific lamprey ascended to the Klamath Lakes, based on the accounts of Native Americans (Table 1, Figure 1). While the difficulty in distinguishing anadromous Pacific lamprey from Klamath Upper Basin resident lamprey taxa brings this account into question, we note that the historical distribution of Pacific lamprey in the Columbia and Snake rivers was coincident wherever salmon occurred (Simpson and Wallace 1978). Wydoski and Whitney (2003) stated that Pacific lampreys occur long distances inland in the Columbia and Yakima river systems. Pacific lamprey still migrate well upstream to at least the Snake River (Christopher Claire, Idaho Department of Fish and Game, pers. comm.) and Idaho's Clearwater River drainage (Cochnauer and Claire 2002). Current limits to the distribution of Pacific lampreys in the Columbia River system are at Chief Joseph Dam on the mainstem Columbia and Hells Canyon Dam on the Snake River (Close et al. 1995). Both of these dams are well over 800 km (500 miles) upstream from the ocean and Pacific lamprey distribution may have extended further upstream prior to the construction of these dams, which have no fish passage facilities. On the Willamette River, Pacific lamprey were historically able to pass upstream at Willamette Falls with winter steelhead and Chinook salmon (USDI 2003).

The extent of Pacific lamprey migrations in other coastal rivers, their general congruence with anadromous salmonid distributions, the historical absence of lamprey passage barriers in the mainstem Klamath River, and the homogeneity of the lower Klamath River fish fauna throughout the mainstem Klamath upstream to Spencer Creek suggest that, historically, anadromous Pacific lamprey would likely have migrated up the Klamath River past where Iron Gate Dam now exists and that their upstream distribution extended to at least Spencer Creek.

Other Anadromous Species

Sockeye Salmon— There is some evidence that a run of sockeye salmon may have occurred in the Klamath River above the current location of Iron Gate Dam. The southernmost distribution of sockeye (*Oncorhynchus nerka*) in North America is recorded as the Klamath River (Jordan and Evermann 1896; Scott and Crossman 1973). Cobb (1930) reported that 20 sockeye were taken in the Klamath River in the autumn of 1915. Sockeye salmon require a lake for rearing. The only potential lake rearing habitat in the Klamath River system accessible to anadromous fish would have been Upper Klamath Lake, Lower Klamath Lake, or Buck Lake (in the upper reaches of Spencer Creek before being drained, Figure 1). Lower Klamath Lake was probably too shallow to provide suitable rearing habitat for sockeye salmon, but some authors (Fry 1973; Behnke 1987) believe that a small run of sockeye may have occurred to Upper Klamath Lake, until eliminated by dams. However, Snyder (1931) reported that no evidence substantiated the statement of Jordan and Evermann (1896) that sockeye salmon occur in the Klamath River, and Moyle (2002) stated that individual anadromous sockeye found in streams south of the Columbia system are probably non-spawning strays or kokanee (the landlocked form of sockeye) that went out to sea. At any rate, if anadromous sockeye were present historically, they have been extirpated.

It is notable that kokanee salmon currently are observed in Upper Klamath Lake (Logan and Markle 1993), especially in springs on the west side of the lake (Bill Tinniswood, ODFW, pers. comm.). These are believed to be fish that have drifted downstream from the Four Mile Lake population, introduced in the 1950s or before (Bill Tinniswood, ODFW, pers. comm.; Roger Smith, ODFW, pers. comm.).

Green Sturgeon—To the best of our knowledge there is no evidence for the distribution of native sturgeon above the current location of Iron Gate Dam. Chuck Tracy (ODFW, pers. comm.) stated that the upstream limit of distribution appears to be Ishi-Pishi Falls (near the confluence of the Klamath River and the Salmon River) on the Klamath River. Moyle (2002) mentioned a green sturgeon spawning site in the Klamath River approximately

208 km (129 miles) below Iron Gate Dam. Sturgeon are known to spawn in the Salmon River, a tributary to the lower Klamath River, which flows into the Klamath River about 201 km (124 miles) below Iron Gate Dam. Kroeber and Barrett (1960) put the upstream-most distribution of sturgeon in the same vicinity. While some green sturgeon may presently migrate beyond the confluence of the Salmon and Klamath rivers, they are the exception rather than the rule (Tom Shaw, USFWS, pers. comm.).

Gilbert (1898) reported that green sturgeon were not observed in Upper Klamath Lake. The current small population of sturgeon in Upper Klamath Lake is derived from white sturgeon (*Acipenser transmontanus*) introduced in 1956 (ODFW 1997).

Eulachon—To the best of our knowledge there is no evidence of the distribution of eulachon above the current location of Iron Gate Dam. Eulachon are usually restricted to spawning in lower river reaches (Scott and Crossman 1973). Accounts of Yurok Tribal elders indicate that eulachon utilized the lower Klamath River for spawning at least as far upstream as 40 km (river mile 25; Larson and Belchik 1998). Historically abundant, they may now be extirpated in the Klamath River (Larson and Belchik 1998).

Cutthroat Trout—Typically, coastal cutthroat do not occur more than about 160 km (100 miles) from the coast (Behnke 1992). There are no accounts of cutthroat in the Klamath Upper Basin. Considering the multiple life history strategies cutthroat exhibit, had they been present above Iron Gate Dam historically, there would likely be resident populations in the upper basin or other tributaries above the dam.

Chum Salmon—To the best of our knowledge there is no evidence for the distribution of chum salmon, above the current location of Iron Gate Dam. The distribution of chum salmon is generally limited to lower river reaches (Scott and Crossman 1973). Small runs of this species still maintain themselves in the lower Klamath River (Moyle 2002).

In some historical accounts there are references to dog salmon in the Upper Klamath River Basin. Dog salmon is a common reference used for chum salmon in the Pacific Northwest and Alaska. However, the common name dog salmon was also applied to Chinook salmon in the Klamath River in early accounts (Snyder 1931; Lane and Lane Associates 1981). Hence, there may have been confusion as to the upstream distribution of chum salmon in the Klamath River.

Pink Salmon—To the best of our knowledge there is no evidence for the distribution of pink salmon (*Onchorynchus gorbuscha*) above the current location of Iron Gate Dam. The distribution of pink salmon is generally limited to lower river reaches (Scott and Crossman 1973). Small numbers of pink salmon have been reported in the lower Klamath River (Moyle 2002).

Conclusions

We found numerous sources of information regarding the occurrence of Chinook salmon, steelhead, coho salmon, and Pacific lamprey above the current location of Iron Gate Dam on the Klamath River. We are not aware of any credible reports that these species did not migrate beyond this point. For Chinook salmon and steelhead, we found one report for each species stating there was not enough information to say definitively they migrated into the Klamath Upper Basin. In contrast, we found several lines of evidence that clearly showed that Chinook salmon historically migrated to the Klamath Upper Basin. A determination of the upstream extent of distribution for steelhead, coho salmon, and Pacific lamprey was more difficult. However, available documentation indicates that steelhead accessed habitat in the tributaries of Upper Klamath Lake as well. Pacific lamprey probably accessed habitat upstream at least to Spencer Creek and possibly beyond, as did coho salmon. There is limited evidence that a small run of sockeye salmon may have accessed habitat in Upper Klamath Lake or Buck Lake. Green sturgeon distribution extended upstream to the vicinity of the Salmon River in the mid-Klamath River portion of the watershed. Chum salmon, pink salmon, eulachon, and cutthroat trout were limited to the lower Klamath River, well below the current location of Iron Gate Dam. This documentation resolves a great deal of the uncertainty regarding which species were present above Iron Gate Dam and the extent of their upstream distribution, both key to realizing fisheries restoration opportunities.

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Technical Memorandum

To: Larry Dunsmoor, Biologist, Klamath Tribes

From: C.W. Huntington, Aquatic Biologist

Subject: ***Preliminary estimates of the recent and historic potential for anadromous fish production above Iron Gate Dam***

Date: 05 April 2004

The following memorandum provides ***preliminary estimates*** of the recent and historical potential for anadromous fish production, and specifically chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*O. mykiss*) production, in portions of the Klamath Basin upstream of Iron Gate Dam (IGD; at km 305.9) on the Klamath River. ***These estimates are intended to provide interim answers to several questions that have been posed about this production potential and that will ultimately be answered in a more authoritative way through collaborative modeling efforts now underway in the basin.*** First, how much anadromous fish habitat is present above IGD? Second, what is known about the recent potential of this habitat to produce chinook salmon and steelhead if fish passage and survival problems are resolved at dams and associated slack-water areas along the mainstem Klamath River? Finally, what was the historic production potential of that portion of the drainage basin situated upstream of Upper Klamath Lake (at approximately km 454) and how might restoration of some of this potential influence the capacity of the entire area upstream of IGD to produce anadromous fish?

Anadromous Fish Habitat Above Iron Gate Dam

Working with representatives of multiple governmental agencies, Tribes, non-governmental organizations, and PacifiCorp, I am in the process of compiling available information on habitat within streams in the drainage basin above IGD. Many of these streams are known to have supported anadromous fish prior to the construction of dams on the Klamath River, although detailed data on which reaches of which streams supported a particular anadromous species are frequently unavailable. For some streams, documentation of historic use by these fish is weak or lacking even though the streams would clearly have provided suitable habitat when in good condition. The lack of historic documentation reflects that fish runs into the area were eliminated or blocked before there was any effort to catalog their freshwater production areas.

At present, I have developed a preliminary list of streams and stream reaches above IGD that appear likely to have had historic potential to produce chinook salmon or steelhead trout. Identification of these streams and reaches has been based on recent stream survey data (from the Forest Service, Oregon Department of Fish and Wildlife [ODFW], and the California Department of Fish and Game [CDFG], on trout abundance and distribution data (from the Forest Service, ODFW, CDFG, and the Klamath Tribe), on water quality and riparian condition data (from the Oregon Department of Environmental Quality and the Klamath Tribe), on model-based estimates of natural flow regimes in the basin's streams (from the Oregon Department of Water Resources), on discussions with local biologists, on reports by Chapman (1981) and Fortune et al. (1966), and on my own professional judgment. The list of historic chinook and steelhead streams will likely be refined during the next few months, but should already provide a reasonable approximation of the areas that at one time provided habitat suitable for use by these two species. Streams above IGD undoubtedly provided important habitat for coho salmon (*O. kisutch*) and Pacific lamprey (*Entosphenus tridentata*) prior to dam construction, but these species have not been a focus of my data compilation effort. Coho salmon would likely have been restricted to streams in the lower-most portions of the drainage basin above IGD, and there are no records or anecdotal accounts of which I am aware that suggest coho were ever present above UKL. Habitat suitable for use by lamprey is widespread in the basin above IGD.

Table 1 gives a brief summary of the just-described list of historic chinook and steelhead streams in the drainage basin above IGD, with the kilometers of suitable habitat that appears to have once been present along the streams contrasted with estimates of recently suitable habitat that were reported by Chapman (1981) and by Fortune et al. (1966). The preliminary estimates of historic habitat total approximately 1183 km of steelhead streams and 635 km of chinook streams, with 1030 km (87%) of the steelhead streams and 502 km (79%) of the chinook streams found above UKL. Streams were classified as historic chinook habitat if they had Rosgen (1996) C, E, F, or B-type channels with low to moderate gradients (<4%), widths of at least 5 meters, (natural) median August flows >0.25 cms (>9 cfs), and adult access unimpeded by barriers (note: 73 km of potential habitat in the upper Sycan River system was excluded due to uncertainty as to whether adult chinook would be able to pass through Sycan Marsh during low flow years). These threshold conditions describe the smaller Pacific Northwest streams in which I have found adult spring chinook during the spawning season and sounded reasonable to multiple salmon biologists with whom I discussed the issue. Both spring and fall-run chinook were present historically in the drainage network above IGD, and habitat of variable quality is still present for both.

Table 1. Estimates of historic and recently suitable rearing habitat for chinook salmon and steelhead trout in streams within the drainage basin above Iron Gate Dam.

Stream	Preliminary estimates of historic habitat (km) Steelhead	Chinook	Recent steelhead and chinook habitat (km) Fortune et al. (1966)	Steelhead and chinook habitat (km) Chapman (1981)
Areas below Upper Klamath Lake (UKL)				
Klamath River	44.6 (109.9)	44.6 (109.9)	43.4	43.4 (88.5)
Jenny Creek	2.5	2.5	---	---
Fall Creek	1.9	1.9	---	---
Shovel Creek	4.7	4.7	4.0	---
Spencer Creek	15.0	14.2	13.7	---
Others	19.0	---	---	---
Total	**87.7 (153.0)**	**67.9 (133.2)**	**61.1**	**43.4 (88.5)**
Smaller Tributaries to UKL				
Wood River	32.5	32.5	30.2	17.7
Annie Creek	20.0	15.9	---	---
Sun Creek	21.4	8.4	---	---
Fort Creek	6.1	6.1	---	---
Crooked Creek	15.6	15.6	---	---
Agency Creek	3.4	3.4	---	---
Sevenmile Creek	30.4	29.8	27.0	---
Short Creek	2.7	1.0	---	---
Fourmile Creek *	21.6	21.6	---	---
Cherry Creek *	16.1	15.3	---	---
Threemile Creek *	8.2	3.5	---	---
Fourmile (Lake) Creek *	25.9	---	---	---
Denny Creek	9.3	---	---	---
Others	11.6	---	---	---
Total	**224.8**	**147.7**	**57.3**	**17.7**
Williamson River system (excluding Sprague)				
Williamson River	39.9	39.9	33.8	33.8
Spring Creek	3.9	3.9	4.0	3.2
Larkin Creek	6.4	3.2	---	---
Sunnybrook Creek	1.1	---	---	---
Total	**51.3**	**47.0**	**37.8**	**37.0**
Sprague River system				
Sprague River	136.1	136.1	49.9	123.1
N.Fk. Sprague River	57.9	44.4	44.2	19.3
Dead Cow Creek *	6.9	---	---	---
School Creek	6.1	---	---	---
Meryl Creek *	14.0	---	---	---
Fivemile Creek	33.3	21.4	---	---
S.Fk. Sprague River	55.5	36.2	18.2	19.3
Buckboard Creek	6.6	---	---	---
Whitworth Creek *	17.4	---	---	---
Brownsworth Creek *	20.8	---	---	---
Ish Tish Creek	10.9	---	---	---
Paradise Creek	10.3	---	---	---
Fishhole Creek *	57.8	---	---	---
Sycan River	122.1	62.1	---	---
Skull Creek	10.3	---	---	---
Paradise Creek *	34.4	---	---	---
Long Creek *	47.8	---	---	---
Snake Creek *	22.4	---	---	---
Whisky Creek	13.5	6.8	---	---
Trout Creek *	10.3	---	---	---
Copperfield Creek	8.4	---	---	---
Others	59.1	---	---	---
Total	**753.5**	**307.0**	**112.3**	**161.7**
All Streams Above Irongate Dam	**1117.3 (1182.6)**	**569.6 (634.9)**	**268.5**	**259.8 (304.9)**

Note: Values in parentheses include riverine habitat inundated by slack-water by existing dams. Values not in parentheses are for habitat areas that are not currently inundated by slack-water. Asterisks (*) identify streams where one or more tributaries not explicitly identified in the table are included in the estimate of historic habitat.

The Chapman (1981) and Fortune et al. (1966) estimates of anadromous salmonid habitat above IGD will be discussed in greater detail later in this memorandum, but it is clear from Table 1 that they suggest the suitability of far less habitat than is included in my preliminary estimate of the historic condition. Neither Chapman (1981) nor Fortune et al. (1966) estimated the presence of more than about a quarter of the combined length of anadromous salmonid streams that my preliminary estimates suggest was once present above IGD. In the case of Chapman (1981), this may partly reflect the severely flow-depleted character of many of the basin's streams and a lack of information at the time on historic (natural) flows for most tributary streams. Fortune et al. (1996) took a very conservative view of the habitat capability of the basin's streams, most of which had been significantly degraded, during the mid-1960s.

Recent Potential for Chinook Salmon and Steelhead Production Above Iron Gate Dam

There have been three previous estimates of the potential for anadromous fish production within various portions of the drainage basin above IGD. These include the following:

- An estimate of what is labeled "pristine production" of anadromous salmonids above Copco Dam on the Klamath River (km 319.1) by D.W. Chapman (1981) that upon inspection appears to reflect relatively recent production potential in the absence of dams on the mainstem Klamath and of other migratory barriers in the system;

- An estimate Fortune et al. (1966) made of the chinook and steelhead production potential for areas above the upstream end of Copco Reservoir (km 327.8) in the mid-1960s.

- A preliminary estimate of current production potential for chinook salmon between IGD and Spencer Creek (PacifiCorp 2004);

I will review these estimates briefly below, then capture information contained within them as well as from other data sources to provide multiple estimates of recent production potential for chinook salmon and steelhead trout in areas above IGD.

Chapman (1981)

Chapman (1981) worked on an accelerated schedule under contract to the Bureau of Indian Affairs to develop an estimate of anadromous fish production capability lost due to dam construction on the mainstem Klamath River. In assessing the situation, his report notes that the relatively constant flows found in streams of the Upper Klamath Basin should lead to above-average smolt yields, compared to other salmon and steelhead rearing areas. However, Chapman's estimates of the historic level of loss in anadromous production potential do not appear to me to represent pristine conditions within the Upper Klamath Basin, as suggested by the title of his report ("Pristine Production of Anadromous Salmonids – Klamath River"). Rather, the Chapman (1981) estimates probably represent something closer to recent production potential in the absence of dams, associated reservoirs, and artificial migration barriers, provided that fish are able to pass downstream successfully into and through Upper Klamath Lake during their seaward migration. Chapman estimated production potential above Copco Dam (essentially above IGD, given a paucity of suitable habitat between the two) based on 1980 (degraded) habitat conditions in the largest available stream channels. He thus accounted for only a relatively small portion of the combined length of potential anadromous fish streams outlined earlier in Table 1. In fact, within the report itself the author notes that his estimates were conservatively low with reference to "pristine" conditions because they (1) were based on modeling of habitat already degraded by human activities and (2) did not incorporate the historic production potential of many tributary streams that undoubtedly produced salmon and/or steelhead.

In developing his estimates, Chapman (1981) concluded that chinook and steelhead production would be limited by available rearing habitat. He then used an instream flow-based approach at representative (randomly selected) locations to estimate weighted usable rearing area (WUA) within defined habitat strata, applied specific smolt densities per WUA in order to estimate production potential of the rearing habitat within each of these strata, and assumed reasonable rates of marine survival to predict the ability of the drainage basin to produce adult chinook and steelhead. He judged the smolt densities used to estimate the potential to produce steelhead smolts to be very conservative for the basin because they did not account for the stable, alkaline, and extremely productive conditions found in the upper Klamath Basin. The smolt densities Chapman (1981) used for chinook were from studies Bjornn (1978) conducted in the spring-fed and highly productive Lehmi River, but were likely somewhat conservative because they were based on total habitat areas (in the Lemhi River) and not WUAs (as applied in the report).

Ultimately, Chapman (1981) appears to have estimated that in the absence of migratory impediments (including dams), 304.9 km of rearing habitat suitable for anadromous salmonid production in the drainage basin above the site of Copco Dam would have the capacity to support 597,437 chinook smolts, 21,508 returning adult chinook, 106,942 steelhead smolts, and 10,694 returning adult steelhead. Looking more closely at his estimates, Chapman (1981) found that 216.4 km of habitat above UKL appeared to have the capacity to produce 15,052 (70%) of the adult chinook and 8,447 (79%) of the adult steelhead that might have returned above the Copco site in the absence of migratory impediments.

Fortune et al. (1966)

Fortune et al (1966) reported the results of a study of chinook salmon and steelhead production potential upstream of Copco Reservoir that was overseen by a multi-party steering committee that was considering reintroduction of anadromous salmonids to areas above Copco Reservoir. The authors noted that a series of migratory impediments on the mainstem Klamath River, beginning with a log crib structure built at Klamathon (near the current site of IGD) in the late 1880s, severely impeded salmon and steelhead runs into upper portions of the Klamath Basin. These runs were then largely blocked at Klamathon by fish trapping operations initiated by the Bureau of Commercial Fisheries (BOF) in 1910, and completely excluded from the upper basin when Copco Dam was completed in 1917.

In assessing the remaining potential for chinook salmon and steelhead production above Copco Dam (now essentially above IGD, given the paucity of suitable habitat between the two), Fortune et al. (1966) reconnoitered much of the drainage basin upstream for suitable habitat. The authors then developed rough estimates of the numbers of adult fish (i.e., spawners) that could be supported by the quantities of spawning gravel they considered present in channels where the depths and velocities of streamflow were judged sufficient to meet the needs of spawning salmon and steelhead. They thus assumed that spawning habitat in the system would constrain anadromous salmonid production, a conclusion different than that reached by Chapman (1981). They also noted that it was difficult to differentiate areas above UKL used by the large adfluvial redband trout from those historically used by steelhead.

Ultimately, Fortune et al. (1966) concluded that there were 268.3 km of stream still capable of providing suitable salmon and steelhead rearing habitat (excluding reservoirs) in the Klamath Basin above Copco Reservoir. All but 20.5 km of these streams either contained or were downstream of spawning gravel. They estimated that there was about 92,140 m^2 of good spawning gravel and 107,610 m^2 of total spawning gravel present in areas still suitable for salmon and steelhead use above Copco Dam. This quantity of gravel was estimated by Fortune et al. (1966) to be capable of supporting about 4590 spawning pairs of chinook salmon and 3650 pairs of steelhead.

PacifiCorp (2004)

In a recent Final License Application for its Klamath River projects, PacifiCorp (2004) provided a brief summary of *recent and very preliminary* EDT-based modeling of the current potential for chinook salmon production in the Klamath system from IGD upstream to and including Spencer Creek, but extending no farther into the upper basin. This preliminary modeling accounted for only one of the anadromous species (chinook) for which there is production potential above IGD and included only a small portion of the potential chinook production area above IGD (see Table 1). PacifiCorp (2004) indicates that the modeling suggests that the relatively small area considered would return about 4,500 adult chinook to the spawning grounds with 100% dam and reservoir survival, and no harvest. With 100% dam survival, model-predicted reservoir survivals, and current harvest rates, the preliminary modeling suggests returns to the spawning grounds of approximately 487 adults.

Preliminary Estimates of Recent Potential for Chinook and Steelhead Production Above IGD

After considering the previously discussed estimates of recent potentials for chinook and steelhead production above IGD, and additional available data, I used a multi-method approach to develop what might be termed preliminary "best estimates" of the production potential for each species, assuming 100 percent dam passage and reservoir survival, and no harvest. The resultant estimates are outlined in Table 2 and will be discussed below. For chinook, I used six methods to estimate a potential run of adult fish returning to areas above IGD that ranged from 9,180 to 32,040, with a mean or "best estimate" value of 21,245 fish. For steelhead, I used four of the six methods utilized for chinook to develop estimates of potential adult returns to areas above IGD ranging from 7,460 to 9,550, with a "best estimate" of 8,645 fish. The estimates for both species depend substantially on the ability of juvenile fish to pass downstream successfully into and through UKL during their seaward migration, a critical unknown at present.

Table 2. Multiple preliminary estimates of recent potential for chinook and steelhead returns to the Klamath Basin upstream of Iron Gate Dam assuming 100 % dam passage and reservoir survival, and no harvest[1].

Estimation method	Adult chinook	Adult steelhead
Method 1. Chapman (1981) instream flow method, adjusted for the presence of existing dams and associated slack-water areas along the mainstem Klamath River.	18,220	9,550
Method 2. Fortune et al. (1966) spawning area method.	9,180	7,460
Method 3a. Similar adjacent watershed method, with recent adult counts for Shasta R. expanded to the area above IGD based on the ratio of suitable stream miles in the basin above IGD per Chapman (1981) and in the Shasta R system per West et al. (1990).	26,510	8,640
Method 3b. Similar adjacent watershed method, with recent adult counts for Shasta R. expanded to the area above IGD based on the ratio of suitable stream miles in the basin above IGD per Fortune et al. (1966) and in the Shasta R. system per West et al. (1980).	27,400	8,930
Method 4a. Watershed-wide expansion of PacifiCorp's (2004) EDT-based estimates of production potential for areas between Iron Gate Dam and Spencer Creek, based on relative production potentials estimated by Chapman (1981).	32,040	---
Method 4b. Watershed-wide expansion of PacifiCorp's (2004) EDT-based estimates of production potential for areas between Iron Gate Dam and Spencer Creek, based on relative production potentials estimated by Fortune et al. (1966).	14,130	---
Mean values	**21,245**	**8,645**

[1] All estimates depend substantially on the ability of juvenile salmon and steelhead to pass downstream successfully into and through Upper Klamath Lake, a critical unknown.

Estimation Method 1. Method 1 consisted of taking Chapman's (1981) instream flow-based estimates of chinook and steelhead production potential for areas above IGD and adjusting them downward to account for Fortune et al.'s (1966) estimates of the miles of recently suitable riverine rearing habitat in the mainstem Klamath River. This was necessary because Chapman's estimates of production potentials assumed 88.5 km of riverine rearing habitat and the absence of dams, whereas Fortune et al. (1966) indicated that only 43.4 km of the mainstem provided suitable riverine rearing habitat. The result was a 15% reduction in Chapman's original estimate of chinook production potential (to 18,220 adults) and an 11% reduction in his estimate of steelhead production potential (to 9,550 adults).

Estimation Method 2. Under this method I simply accepted Fortune et al.'s (1966) estimates of anadromous salmonid production potential above IGD: 9,180 adult chinook salmon and 7,460 adult steelhead trout. As indicated earlier, these estimates were based entirely on a conservative accounting of available spawning area. I believe that these estimates of production potential should be fairly conservative because of difficulty in anticipating those habitat patches that will be used by spawning fish and my perception that spawning habitat is unlikely to limit anadromous fish production in the area above IGD as a whole. Chapman (1981) reviewed information on streams in the area and concluded that rearing habitat, not spawning habitat, was likely to limit anadromous salmonid production.

Estimation Method 3a. Estimates of recent production potential made using Method 3a were based on recent weir counts of adult chinook and steelhead returning to the Shasta River watershed, California, and recent estimates of suitable stream kilometers for each of the two species in that watershed as well as in the drainage basin above IGD. The Shasta River provides a relatively good surrogate for areas above IGD because it has the most geographically proximate Klamath Basin watershed of substantial size still accessible to anadromous fish, it has supported a mix of anadromous species similar to that once present above IGD, and it is a spring-influenced system rich in nutrients that has been strongly affected by riparian degradation and irrigation withdrawals of water.

For chinook salmon, the mean Shasta River adult count for the 20-year period from 1983 through 2002 (3418 fish; A. Manji, CDFG, pers comm.) was adjusted upward to account for approximate ocean harvest rates of 15% and freshwater rates of about 30%, yielding a mean run without harvest of about 5,745 fish. This figure was then scaled up to estimate a potential 26,510 adults returning to areas above IGD. The scaling was based on the ratio between the 259.8 km of suitable stream habitat above IGD in Chapman's (1981) assessment and 56.3 km of streams that West et al. (1990) have identified as being used as chinook rearing habitat within the Shasta River watershed.

For steelhead, the mean of 1,972 adult fish returning to the Shasta River during the four-year period (1979-82) having the highest and most complete annual weir counts (KRIS database) was adjusted upward to account for an assumed harvest rate of 33% (Huntington 1988), yielding a mean run without harvest of 2,943 adults. This figure was then scaled up to a potential run of 8,640 adult steelhead returning to areas above IGD, based on the ratio between the 259.8 km of suitable stream habitat accounted for in Chapman's (1981) assessment and 88.5 km of streams that West et al. (1990) identified as being used as steelhead rearing habitat within the Shasta River watershed.

Estimation Method 3b. Method 3b was identical to Method 3a except that it used Fortune et al.'s (1966) estimates of suitable stream habitat (268.5 km for chinook salmon and the same quantity for steelhead trout), rather than those included in Chapman (1981), to scale the sizes of fish runs into the Shasta River up to those that might return to areas above IGD. Potential returns of adult fish calculated by this method were 27,400 chinook salmon and 8,930 steelhead.

Estimation Method 4a. This method expanded the recent and very preliminary EDT-based estimate that 4,500 adult chinook would return to that portion of the area above IGD that is below but includes Spencer Creek to the entire drainage basin above IGD. The basis for this extrapolation was the relative production potentials for these areas estimated by Chapman (1981). Method 4a yielded an estimate of 32,040 adult chinook returning to areas above IGD without harvest.

Estimation Method 4b. Method 4b was identical to Method 4a except that it used Fortune et al.'s (1996) estimates of the relative production potentials of differing areas within the drainage basin above IGD as the basis for expanding the EDT-based estimate. Method 4b yielded a potential run of 14,130 adult chinook returning to areas above IGD without harvest.

Historic Potential for Chinook and Steelhead Production above Upper Klamath Lake

The ecological setting, recent data on stream conditions and fish populations, Tribal accounts (e.g., see Lane & Lane Associates 1981), the Fortune et al. (1966) report, and historical information reported by Snyder (1931) all lead me to conclude that areas above UKL once supported chinook salmon, both spring and fall-run fish, and steelhead trout. The spring-run chinook apparently began disappearing early in the development of the Klamath Basin, most likely due to a combination of over-fishing, migratory impediments, and early habitat degradation. This was a pattern repeated in many areas of the Pacific Northwest and reflects that this race of fish was a primary focus of early Euro-American fisheries and highly sensitive to environmental disturbance. Substantial numbers of what were apparently fall-run chinook were still being harvested in Sprague River up until about 1910 (Lane & Lane Associates 1981), the year in which the BOF began attempting to block fish runs at Klamathon in anticipation of construction of Copco Dam.

I developed low and high-end estimates of historic returns of adult chinook and steelhead to the area above UKL, based on expansion from the highest counts of these two species recorded at the weir on Shasta River (i.e., at Shasta Racks). The intent of these estimates was to develop some preliminary numbers that would bracket historic production values for the area above UKL. My low-end expansions were simply based on the ratios of watershed areas between the Shasta River and each of three suitable production areas above UKL (Williamson River, Sprague River, and Wood River Valley). The high-end expansions were based on the ratios of measured mean annual flows between the Shasta River and the lower-most gauged sites for the same three areas above UKL. Flows were used as an expansion factor because areas with higher unit water yields can be more productive for anadromous salmonids. I used mean annual flows and not mean late season (e.g., August) flows, because late season flows at the downstream ends of the basins of interest may be irregularly affected by irrigation practices at present, particularly in the Shasta River watershed. The historic steelhead returns estimated for areas above UKL were reduced by 50% to account for competitive interactions with redband trout and uncertainties about how the steelhead would have partitioned habitat above UKL with redbands expressing an adfluvial life history. This adjustment of the estimated steelhead returns likely makes my estimates conservative, but I have no information at present upon which to decrement steelhead production to account for the presence of adfluvial redbands.

My preliminary estimates of historic chinook salmon and steelhead trout returns to areas above UKL are summarized in Table 3. The estimates of historic chinook returns ranged from nearly 150,000 adults to more than 400,000 adults, while those for historic steelhead returns ranged from about 6,850 adults to about 20,000 adults. My estimates for the production of both species would have been higher if adjusted for catch that was occurring downstream of the weir on Shasta River during the return years upon which the estimates were based, but I lacked useful information on fish harvest rates. The estimates for both species, and for chinook salmon in particular, might also have been higher if I had accounted for the historic (and unknown) seasonal production potential of UKL itself. Overall, I think that my lower estimate may be closest to the historic potential for chinook production above UKL and that my higher estimate may be closest to the historic potential for steelhead production above the lake. Depending on the outcomes of interactions between anadromous and adfluvial trout, historic steelhead runs into the area above UKL might have been higher than the range contained by my low and high estimates for this species.

Table 3. Preliminary estimates of historic chinook salmon and steelhead trout returns to areas above Upper Klamath Lake, Oregon.

Subbasin/production area	Drainage area (mi^2)	Mean annual flow (cfs)	Maximum adult return: Chinook (1931)	Maximum adult return: Steelhead (1940)	Estimated historic returns of adults: Chinook Low	Chinook High	Steelhead Low	Steelhead High
Shasta R.	793	185	61811	5657	61811		5657	
Upper Klamath (above Klamath L.)								
Williamson R. (below Klamath Marsh)	149	280	---	---	11614	93552	531	4281
Sprague R.	1580	586	---	---	123154	195791	5636	8959
Wood River Valley	192	445	---	---	14966	148681	685	6804
					149734	**438023**	**6852**	**20044**

The estimates of historic production potential provided in Table 3 suggest that much of the historic capacity to produce anadromous salmonids above the current site of IGD was found in areas above UKL. Restoration of even a portion of this potential would have a dramatic influence on the salmon and steelhead production capacity of the entire drainage basin above IGD. The degree to which this capacity might be restored has yet to be examined.

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Estimates of Pre-Development Klamath River Salmon Run Size, Economic Value and Post-Project Fishery Losses

Historically, salmon were an important food source and cultural symbol for the Indian tribes of California. "It's been a part of the culture, the religion and the diet for thousands of years," said Mike Orcutt, Director of the Fisheries Department for the Hoopa Valley Tribe along the Trinity River. "The salmon runs were dependable and dried salmon provided food for the winter."[1]

"At present, no quantitative restoration targets for the Klamath have been enunciated beyond generalized intention to 'double stocks.'"[2]

Today the runs of the Klamath Basin have been seriously depleted from their prior abundance. The long term spawning escapement goal for Klamath River fall chinook salmon is presently only 115,000 adult fish, based on Klamath Basin escapement estimates for the early 1960s and includes 97,500 natural and 17,500 hatchery spawners.[3]

Coho runs from the North coast numbered about 150,000 annually in the 1940's decade, while steelhead runs were estimated to be about 300,000.[4]

Since no other information is available on coho and steelhead, a factor of 50 percent harvest rate is used in our calculations as an estimate of what would be potentially available. Thus the estimate is that the Klamath River could have supported harvests of up to 75,000 coho and 150,000 steelhead at that time.

For purposes of analysis some assumptions needed to be made about species/run composition of the chinook salmon harvested, since their economic value varies by species/run. Species of historically present, pre-development chinook are thus assumed to be in roughly the same proportion as in the Sacramento system (i.e. 5% late fall, 10% winter, 37% spring and 48% fall).

There are no generally accepted estimates of pre-development salmon run sizes for California rivers except for the Fisher estimates of Central Valley stocks.[5] For the Columbia River study, the

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1. *"California's Chinook Salmon: Upstream Battle to Restore the Resource," Water Education Foundation, Western Water, November/December 1992.*
2. *Meyer Resources, Inc., "A Financial Feasibility Envelope for Klamath Basin Planning," Appendix C in "Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program," prepared by the Klamath River Basin Fisheries Task Force, with assistance from William M. Kier Associates, January 1991.*
3. *Boydstun, L.B., "Draft Evaluation of Klamath River Fall Chinook Escapement Options," Memorandum, September 8, 1988, California Fish and Game.*
4. *"An Environmental Tragedy: Report on California Salmon and Steelhead Trout," State of California, California Department of Fish and Game, March 15, 1971.*

Northwest Power Planning Council made its estimates based on review of habitat and on historical catch records. However, using the number of square miles in a basin as a factor and interpolating production numbers from similar basins where data is more complete, it is possible to arrive at workable estimates of pre-development runs of up to 4 million fish in the Sacramento/San Joaquin system and 1.1 million in the Klamath system (Table 1). These are the figures assumed for purposes of our analysis.

Table 1: Comparison Between Three River Systems: Columbia River, Sacramento/San Joaquin System, and Klamath River, in Terms of Total Square Area, Salmon Habitat Miles, Best Estimate of Historical Harvests, and Present Escapement

	Total Salmon Habitat Land Area in Basin	Pre-Development Habitat Stream Miles	Historic Record Harvests (No. of Fish)	Estimated Pre-Development Runs	Escapement Goal
Columbia River System	163,000 sq. miles to 260,000 sq. miles /1	14,666 miles of stream /1	3 to 3.6 million /4, record canning pack 630,000 cases, about 40 million pounds	10–16 million fish	varies for stocks in the Columbia
Sacramento/ San Joaquin System	38,340 sq. miles /2	6,000 miles of stream /3	12 million pounds /5, average 5 million pounds from 1873–1910	1.95 million /6 to 4.0 million fish /7	122,000–180,000 /9 (mostly hatchery)
Klamath River System	9,691 sq. miles	no estimates	no estimates	0.66 to 1.1 million fish /8	97,500 natural, 17,500 hatchery /10

Notes: 1. Prior to development, over 163,000 square miles of salmon and steelhead habitat existed in the Columbia River. (Compilation of Information on Salmon and Steelhead Losses in the Columbia River Basin. Appendix D of the 1987 Columbia River Basin Fish and Wildlife Program. Northwest Power Planning Council. Portland, Oregon. Page 87.) The Columbia River drains a watershed that is 260,000 square miles. (Bonneville Power Administration. "The World's Biggest Fish Story: The Columbia River's Salmon." Backgrounder. July 1987. Page 4.)

2. John Snyder. California Department of Water Resources.
   Sacramento = 26,548 square miles
   San Joaquin = 11,792 square miles
   Delta = 4,154 square miles
   Personal communication, January 1996.
3. The California Department Fish and Wildlife feels this estimate made in 1928 is too high. ("An Environmental Tragedy." Report on California Salmon and Steelhead Trout. Assembly Concurrent Resolution #64/1970 Session. March 1971. California Department of Fish and Game.)
4. High years:
   1892 = 3.3
   1895 = 3.3
   1898 = 3.3
   1911 = 3.1
   1918 = 3.6
   1919 = 3.1
   1923 = 3.2
   1924 = 3.1
   1926 = 3.0

5. *Fisher, Frank W., "Past and Present Status of Central Valley Chinook Salmon," Conservation Biology, Vol. 8, No. 3, September 1994.*

Radtke, Hans D. and Shannon W. Davis. "Lower Columbia River/Youngs Bay Terminal Fisheries Expansion Project." Salmon For All. January 1996.

5. In 1882, the California commercial salmon catch reached its historic peak of 12 million pounds. (E.R.G. Pacific, Inc. "The Economic Issues Associated with the Commercial Salmon Fisheries and Limited Entry in California." A Report to the California Commercial Fishing Review Board. October 1986. Page 1.)
6. Fisher, Frank. "Past and Present Status of Central Valley Chinook Salmon." Conservation Biology. Volume 8, No. 3. September 1994.
7. This is the author's estimate based on the Columbia River Basin land area ratio to Sacramento/San Joaquin land area. This may be a high estimate, especially when compared to Frank Fisher's estimate of 1.95 million fish from the Columbia River.
8. Based on the land area ratios, the Klamath area could have had a pre-development run size of about 0.66 to 1.1 million adult fish.
9. Includes natural and hatchery fish. ("Review of 1994 Ocean Salmon Fisheries." Pacific Fishery Management Council. Portland, Oregon. 1994. Page 8.)
10. Although natural production from the Klamath system today includes both spring and fall runs, only the dominant fall run is managed by the PFMC. ("Review of 1994 Ocean Salmon Fisheries." Pacific Fishery Management Council. Portland, Oregon. 1994. Page 11.) The escapement goal has been changed to 33%–34% in 1987 with a floor of 35,000. "Natural" as defined by the California Dept. of Fish and Game is not, however, the same as "wild." "Natural" as CDFG uses it may include any hatchery-origin fish so long as it is found outside the hatchery.

How Much is the Klamath Salmon Fishery Worth?

Because most jobs in the fishing industry are seasonal rather than full-time, published employment figures of commercial and recreational fishing may be misleading. Therefore, full-time equivalent employment numbers must be calculated by dividing the estimated total personal income generated by fishing activity by a representative annual personal income average. In the rural Northern California coastal area a $20,000 per year wage or salary is a fair representative of a full-time equivalent job when considering all jobs that are generated by an activity, from crewmen to waitresses to sales clerks.

Each fish harvested produces a net economic benefit to society as it travels through the chain of commerce from the boat to the consumer's table. The combined sums of all those benefits is the net personal income impact of that one fish.[6] These values have been quantified for the Klamath Basin in previous studies. For instance, in a recent study entitled "Fishery Values of the Klamath Basin—A Report to CH2M Hill," by Meyer Resources, Inc., May 1984, printed in "Klamath River Basin Fisheries Resource Plan," U.S. Department of the Interior, February 1985, an estimate was made of the potential annual benefits associated with a catch of 1,000 adult Klamath salmonids to be $252,170 including all direct, indirect and induced market-based economic benefits expressed in 1996 dollars (see Table 3).

However, Meyer's study made no effort to assess historic run sizes. Using the numbers developed in this report by Radtke is appropriate as the best available estimate of the biological potential of the Klamath Basin for salmon production. We therefore combine Meyer's figures with the estimated pre-development run sizes derived in Table 1 to give us a number for the "net economic benefit" which is missing from the salmon-based economy due to recent declines and losses.

[6]. In other words, the sum of all the direct, indirect and induced economic activity generated by that product as it makes its way through the chain of commerce.

Assuming the escapement estimates developed above of between 657,500 to 1,090,000 million adult equivalents to be accurate, and assuming only a 50% harvest rate, this would indicate under Meyer's methodologies that the Klamath should be able to produce a total annual income stream of between $82,900,878/year and $137,432,650/year in *market-based* salmon related economic benefits alone (i.e., excluding any of Meyer's non-market values) when expressed in 1996 dollars.

From this we can easily calculate that a total job base (at $20,000/job, which is at or near regional median income) of *between 4,145 to 6,870 family wage jobs could potentially be supported by fishing in or generated by this basin. This is the potential economic productivity of the Klamath as a salmon producer in today's economy. It is also a measure of the potential number of jobs which are at risk if salmon declines in the basin continue.*

At a pre-development run size of about 1.1 million fish in the Klamath Basin (and again at a 50% harvest rate) it may be calculated that about 0.55 million fish could have been available for harvest at a sustainable level, compared to 250,000 to 300,000 fish that may have been harvested from the Klamath Basin in recent years. By not attaining the potential habitat productivity of the Klamath Basin for producing salmon, the Pacific Northwest and northern California region is therefore sacrificing between 250,000 to 300,000 additional fish. Using Meyer's estimates for the economic value per 1,000 adult harvested salmon (Table 3), this may be equated to *about 3,150 to 3,780 annual family wage jobs that are lost to the in-river and coastal salmon fishing economy as a direct result of the Klamath River Basin's damaged habitat.*[7]

Using the same methodologies and then applying various discount rate assumptions such as in Table 4, the estimated net asset value of the Klamath Basin salmon fishery as a whole (assuming this kind of potential income stream over time) could be at least $4.5 billion, using a 3% discount rates as shown in Table 4. In other words, the net value to society of the "natural capital" that these Klamath Basin wild salmon runs represent could be at least $4.5 billion under standard (even conservative) economic assumptions.

We use the term "at least" because using other less conservative (but still justifiable) assumptions gives values as high as $13.8 billion. Also, none of the indirect market benefits derived from potential additional harvest opportunities on other (non-Klamath) salmon which would likely be available once "weak stock management" constraints are removed (as they would be once weak stocks are restored) are calculated into these figures. These secondary benefits are outside the scope of this study but are likely to be substantial.

This figure also <u>excludes</u> all economic benefits allocated by Meyer (Table 3) to the category of "non-market benefits" and so may be greatly understating the true societal value of this fishery. If added back in for purposes of a similar analysis, these non-market economic benefits would bring the total annual personal income impacts to potentially as high as $374.86 million/year. Using the same discount assumptions (3% over a term of 100 years), the calculated net asset value of this fishery would then be potentially *as high $11.85 billion*. We have omitted these non-market values only because there is as yet no broadly accepted methodology for calculating

[7]. The range difference results from differences in run size, which vary naturally depending on variations in ocean conditions and other factors.

them, not because they are unimportant. However, this omission means our calculated net asset value of $4.5 billion is probably a very conservative estimate.

Table 2: Annual Potential Harvests Which Could Be Derived from Historic Salmon and Steelhead Run Sizes in the Klamath Basin

Species	Estimated Pre-Development Run Size - Range /1			Harvest (at 50% of Run Size) - Range			Average Weight per Fish (pounds)	Total Fish Weight (pounds) - Range		
Late Fall Chinook	22,500	-	45,000	11,250	-	22,500	15.0	168,750	-	337,500
Winter Chinook	45,000	-	90,000	22,500	-	45,000	15.0	337,500	-	675,000
Spring Chinook	160,000	-	320,000	80,000	-	160,000	15.0	1,200,000	-	2,400,000
Fall Chinook	205,000	-	410,000	102,500	-	205,000	15.0	1,537,500	-	3,075,000
Coho	75,000	-	75,000	37,500	-	37,500	9.0	337,500	-	337,500
Steelhead	150,000	-	150,000	75,000	-	75,000	8.5	637,500	-	637,500
Total	657,500	-	1,090,000	328,750	-	545,000		4,218,750	-	7,462,500

Notes: Based on square mile comparisons between Columbia River and estimates of historic species comparison of the Sacramento River for chinook. Coho and steelhead estimates are based on northern California harvest rates.

Table 3: Potential Annual Benefits Associated with a Catch of 1,000 Adult Klamath Salmonids (from Meyer) in 1984 Dollars

Benefiting Group	Business Benefits in Dollars	Non-Market Benefits in Dollars (based on restorative activity)	Subsistence, Cultural, Religious, & Social Benefits
Commercial Fishermen • Chinook • Coho	 22,090 14,040		Supports way of life Provides 7,000 to 7,500 lbs of food
Sport Fishermen • Chinook/coho • Steelhead	 28,730	 128,080 172,370	Provides 7,000 to 7,500 lbs of food
Indian Peoples • Chinook • Coho	 22,090 14,040		Maintains cultural and religious well-being Provides 7,000 to 7,500 lbs of food
Coastal Communities • Commercial chinook • Commercial coho • Sport fish	 10,030 6,380 56,510		Provides 7,000 to 7,500 lbs of food Supports basic community way of life

MARKET BENEFITS = $173,910 (expressed in 1984 dollars [8])

Note: One problem with using that figure today was that it was in 1984 dollars. In order to convert that into 1996 dollars one must use an escalation factor derived from the increases in the Consumer Price Index since that time. This factor turns out to be 1.45.[9] Thus in 1996 dollars 1,000 adult harvested Klamath salmon could generate as much as **$252,170** in total net economic benefits and personal income impacts in accordance with Meyer's figures.

Table 4: Estimated Asset Value of Pre-Development Klamath Salmon Runs at Various Discount Rates Assuming the Economic Benefits from Table 3.

Discount Rate	Low and High Estimated Fishery Asset Value In Billions of 1996 Dollars		
0%	$5,256	—	$13.826
1%	2.702	—	8.693
3%	**2.634**	**—**	**4.347**
5%	1.646	—	2.728
7%	1.183	—	1.961

Note: Assumes a term of 100 years, calculated on an annual basis at various discount rates assuming an annuity payment at the end of each annual period. Representative assumptions chosen in this report are3%, yielding an asset value of up to approximately $4.5 billion to the nearest significant figures.[10]

We should say a word about discount rates since all these equations are very sensitive to the discount rate assumed. For this report we have assumed a discount rate of 3% for our final figures, although indicating the results for larger discount rates as well.

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8. The Meyer report relied heavily on recreational and aesthetic non-market benefits to estimate total economic values of restoration. However, these values are inherently less certain and more speculative than purely market values. The decision was therefore made in this report to use commercial value as our sole indicator of economic value because it is the most easily quantifiable using well established methodologies.

9. These figures are expressed as 1995 dollars sinceat the time of this writing the Consumer Price Index figures for 1996 are not yet published. However there has been little inflation in the first three quarters of 1996 so the precise figure for 1996 would be virtually identical and can be used interchangeably here. The escalation factor "P" is derived as follows: P = CPI95 ÷ CPI84 = 150.2/103.9 = 1.45. The Consumer Price Index set by the Bureau of Labor for 1982-1984 = 100.

10. Figures are derived using a total number of fish available for harvest at (low value) 328,750 fish x $252,170/1000 = $82,900,888/year as the annual "annuity," and a potential harvest (high value) of 545,000 fish x $252,170/1000 = $137,432,650 as the annual "annuity," where this annuity is the net economic value treated as an income stream potentially generated annually by the Klamath Basin fishery were it still producing at the hypothetical pre-development run levels.

Discounting refers to the procedure by which economists balance the relative importance placed on fishery benefits in the near term versus those occurring in the more distant future. A positive discount rate values the present more highly than the future. A negative discount rate values the future more highly than the present. A zero discount rate values the future and the present equally. This discount rate should not be confused with interest rates, which indicate the required rate of return on investment.

Lind (1982) recommends a discount rate of 3% for projects in the public policy sphere, with sensitivity at 2% and 4.6%. The California Energy Commission (Wilson, 1981) also recommends a central discount rate of 3%, with sensitivity over a range of 1% to 4%. Bonneville Power Administration's environmental planning office utilizes a discount rate of 3%, with sensitivity analysis of 1% and 10% (See Bonneville Power Administration, 1986). Finally, the Salmon and Steelhead Advisory Committee to the California Legislature recommends discounting of fishery restoration projects at 1% and 0%, with a sensitivity analysis at -1% and 3%. Our chosen discount rate of 3% is thus quite consistent with many standard methodologies, and may even be conservative given that the economic value of fish—like many food commodities— tends to keep pace with inflation over time and thus could easily exhibit a discount value of 0%.

In summary, it appears that if salmon were restored in the Klamath Basin to nearer their historical levels, the Klamath's once abundant salmon fishery would be able to support up to about *6,870* family wage jobs. These are the jobs that are at risk in the basin as wild salmon continue to decline in abundance.

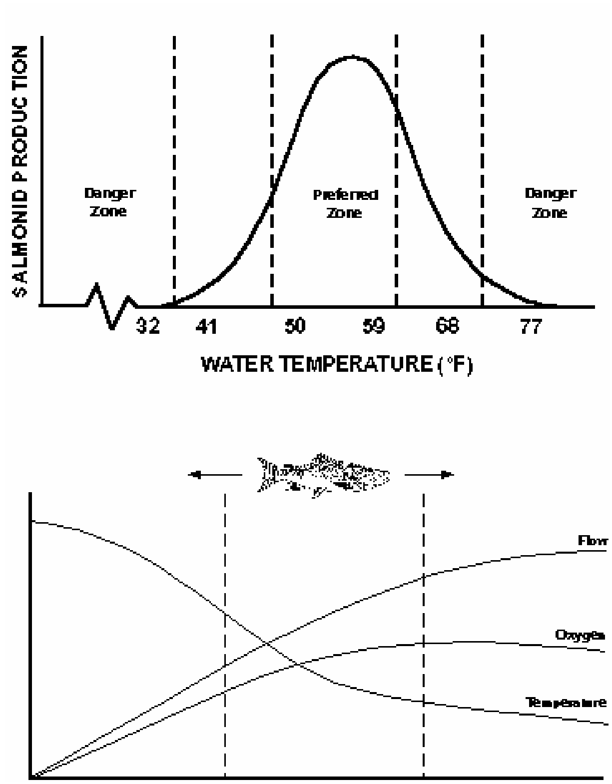
Up to about 3,780 family wage jobs have already been lost from the regional fishing economy, both in-river and coastal, as a direct result of these declines. The current fisheries job base is supported primarily by hatchery programs, not wild fish runs, and so if these hatchery programs continue to fail the remainder of this job base will also deteriorate. Many hatchery programs have in fact failed in recent times. Assuring a strong wild population helps mitigate these problems as well as helps preserve the vital genetic basis for later recolonization in each river system.

The distribution of the economic burden of Klamath Basin salmon declines falls mostly within a geographic range from just north of Coos Bay, OR to just south of Fort Bragg, CA, though there are some impacts both north and south of these areas. This is the range within which the majority of Klamath Fall Chinook and other commonly harvested chinook subspecies were harvested recently (so far as we can reconstruct that distribution from recent coded wire tag data), using the period between 1979 to 1982 as a representative baseline (See Figures 2 and 3).

Additional data would be required before it would be possible to quantify the economic impacts in each of these sectors separately—the job loss figures used in this report are the total of these losses in all sectors combined.

Job losses related to these declines have hit every sector of the fishing industry (commercial, recreational and Tribal), but especially commercial fishing ports within the Klamath Management Zone (KMZ) (Table 5), once among the best salmon producing ports in the country.

Figure 1: Relationship of Water Temperature, Flow and Dissolved Oxygen on Salmon Survival

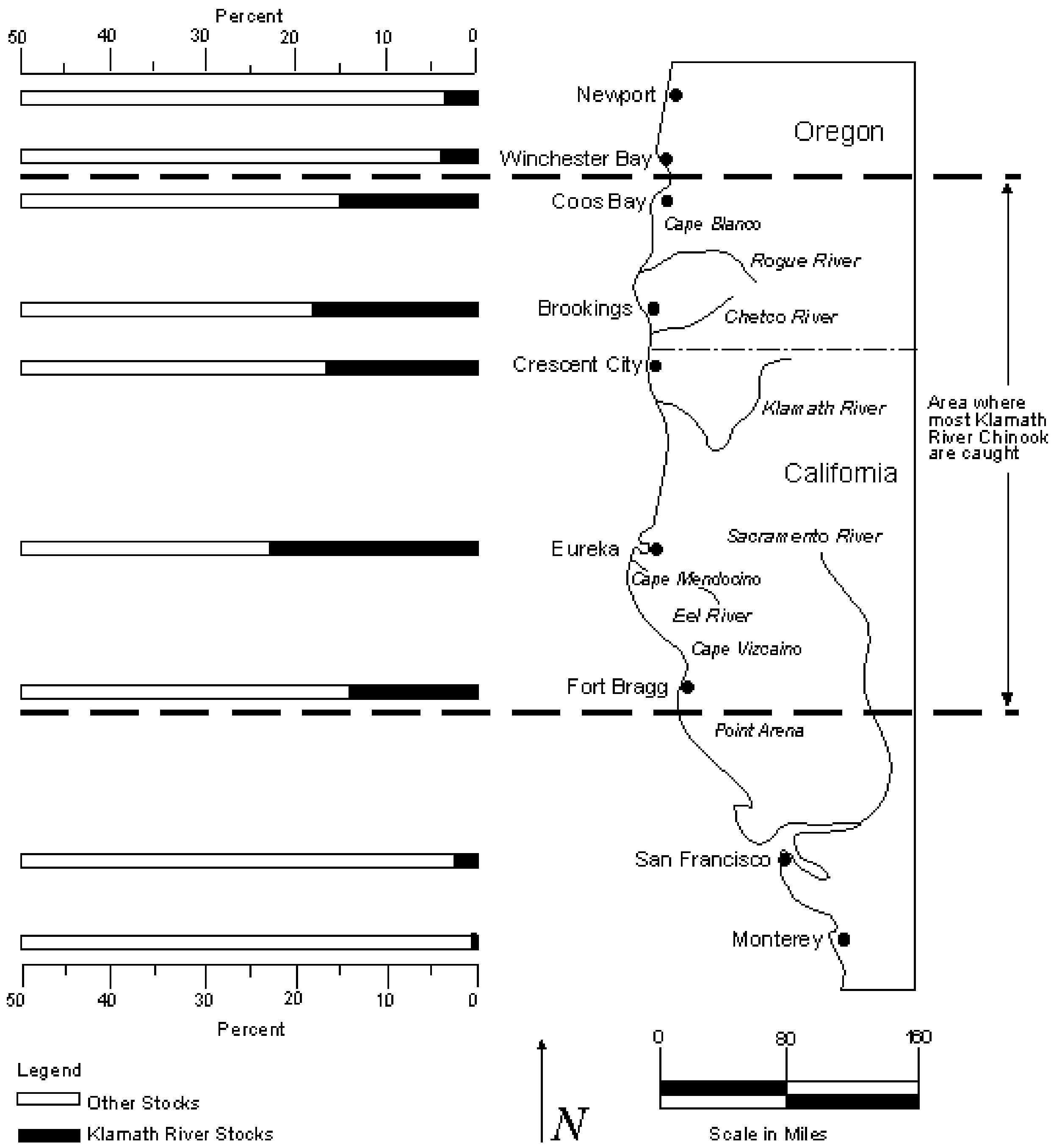


Source: Bottom, et al. (1985).

Note: Salmon can only exist within a limited range of conditions. Water much over about 59 (F^o) in temperature greatly increases stress and reduces survival. Reducing overall stream flow makes the remaining water easier for sunlight to heat up. Increased water temperature in turn reduces dissolved oxygen, disrupts the food chain, and has a multitude of overall negative impacts on salmon reproduction and survival. Less water in the system also means greater concentration of pollutants from agricultural or urban runoff. Stream flow issues are, therefore, intimately related to all other salmon survival factors.

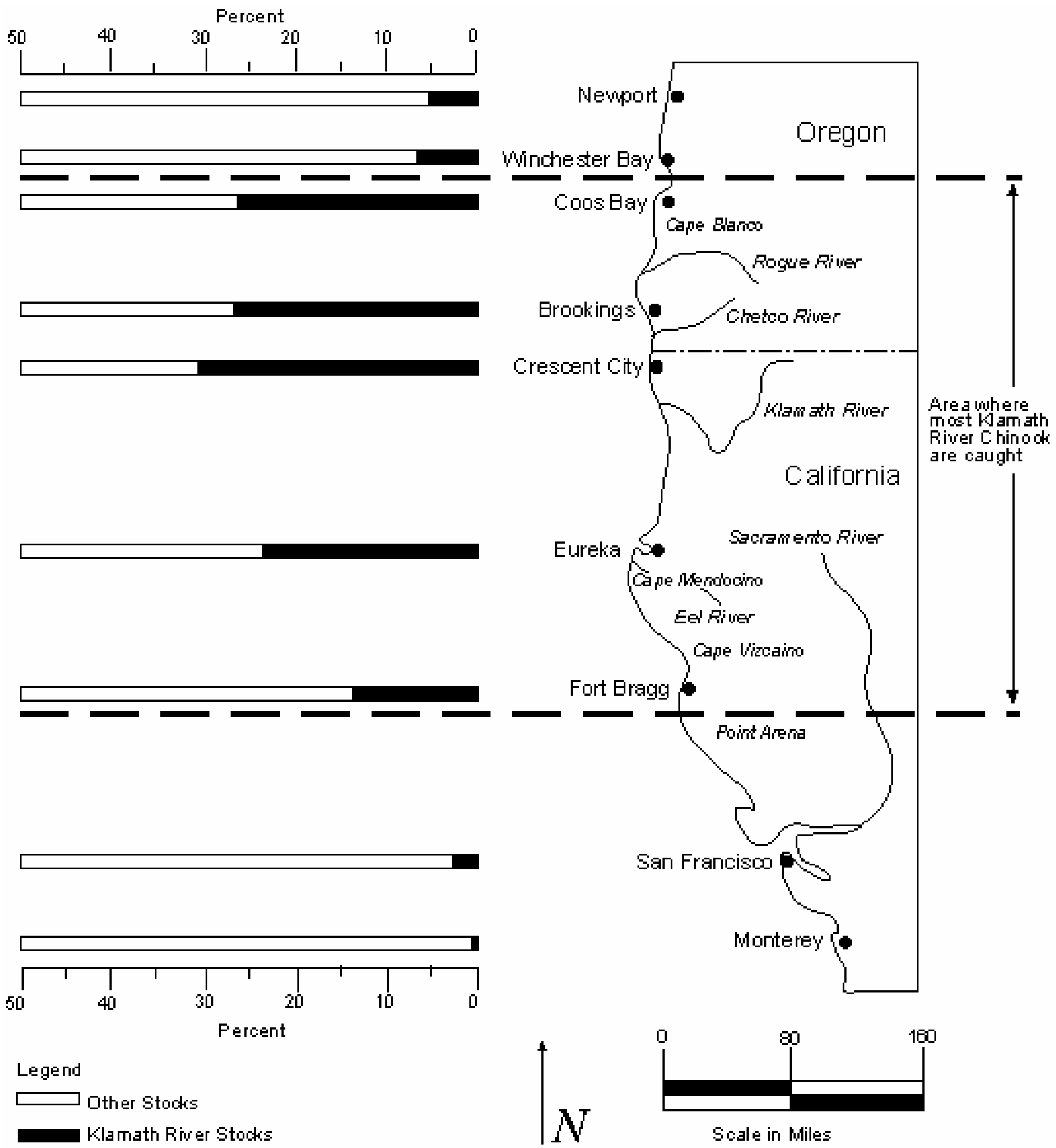
Figure 2

Distribution of Recoveries of Coded Wire Tagged Klamath Fall Chinook in the 1979–1983 Ocean Fisheries



Source: US Dept. of Interior (1985), maps prepared by CH2M Hill

Figure 3
Contribution of Coded Wire Tagged Klamath Fall Chinook by Port in the 1979–1982 Ocean Fisheries



Source: US Dept. of Interior (1985), maps prepared by CH2M Hill

Table 5: Pounds Of Salmon Landed By The Commercial Troll Ocean Fishery For Major Klamath Management Zone (KMZ) Port Areas[11]

Year or Average	Fort Bragg (CA)	Eureka (CA)	Crescent City (CA)	Brookings (OR)
Salmon Landings (thousands of dressed pounds)[12]				
1976-1980	1,726	1,794	753	1,057
1995	130	26	5	55
1996	278	92	3	142
1997	35	14	*	73
1998	35	22	1	52
1999	30	27	3	80
2000[13]	104	18	2	114

* = Fewer than 500 pounds

SALMON FISHERY LOSSES BY PORT AREA

(Yearly Average of Years Between 1976-1980 as compared to 2000 landings)

Port Area		Decline (%) of Fishery
Fort Bragg (CA)	=	**93.97% LOSS**
Eureka (CA)	=	**99.00% LOSS**
Crescent City (CA)	=	**99.73% LOSS**
Brookings (OR)	=	**89.21% LOSS**

[11] The port areas listed include landings in the following ports: Brookings also includes Port Orford and Gold Beach; Crescent City includes only Crescent City; Eureka also includes Trinidad and Humboldt Bay locations; Fort Bragg also includes Shelter Cove, Noyo Harbor, Mendocino and Pt. Arena. Brookings and Fort Bragg are at the far northern and southern ends, respectively, of the Klamath Management Zone, closed in 1992 to most commercial fishing to prevent harm to weak Klamath stocks, and thus would have received some landings from just north or south of the KMZ. These loss numbers are also in the *FLA Socioeconomics Final Technical Report* at pages 2-108 through 2-114, and especially Table 2.7-65 (pg. 2-113).

[12] Data from the Pacific Fishery Management Council (PFMC), *Review of 2000 Ocean Salmon Fisheries (2/01).* The coho fishery was closed completely in 1992 after years of increasing restrictions, so years after 1992 reflect only chinook landings.

[13] Preliminary numbers as of date of publication (2/01), many be slightly adjusted based on final figures.

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IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF OREGON

KLAMATH TRIBES OF OREGON, MILLER ANDERSON, JOSEPH HOBBS, ROBERT ANDERSON, JOSEPH KIRK, ORIN KIRK, LEONARD NORRIS, JR., PHILIP TUPPER, ROBERT BOJORCAS, AND KLAMATH CLAIMS COMMITTEE, Plaintiffs, v. PACIFICORP, a corporation, Defendants.	Case No. CV '04 644 MO COMPLAINT FOR DAMAGES

I. INTRODUCTION

1. The plaintiffs, Tribes and Tribal members, bring this action for damages against PacifiCorp for the destruction of the plaintiffs' federal treaty rights to fish for salmon in the

headwaters of the Klamath River. The treaty rights are undisputed; the Tribes' traditional reliance upon salmon for subsistence and trade is undisputed; and the existence of dams blocking salmon passage beginning in 1911 is undisputed.

II. JURISDICTION

2. Jurisdiction is established by 28 USC 1331 and 1362. Venue is proper because the plaintiffs are residents of the State of Oregon and PacifiCorp is an organization whose headquarters are in the State of Oregon.

III. PARTIES

3. The Klamath Tribes and their members retain the right to fish and hunt pursuant to a treaty entered into with the United States on October 14, 1864. The individual plaintiffs retained the sole right to the treaty rights from the time the Tribe was terminated in 1961, until the Tribe was restored by Congress in 1986. The individual plaintiffs and other members at termination established the Klamath Claims Committee as a representative body to pursue claims arising out of injuries to treaty rights and Reservation rights. The Klamath Claims Committee pursues treaty and Reservation claims in coordination with the Tribal Council – the governing body of the newly recognized Klamath Tribes. The Tribe and its members, including but not limited to the above named individual plaintiffs, are the beneficiaries of the treaty right to fish and hunt in the rivers and lands embraced within their historic Reservation. They have lived in the upper reaches of the Klamath River since time immemorial and have relied upon salmon for subsistence and commerce.

4. PacifiCorp currently owns and operates Iron Gate, COPCO 1 and 2, and JC Boyle Dams and generates power at stations connected to the federally owned Keno Dam. Each of the dams is placed in the bed of the Klamath River. Each of the power facilities is licensed by the Federal Energy Regulatory Commission under the Federal Power Act.

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IV. FACTUAL ALLEGATIONS

5. Prior to the construction of the PacifiCorp dams in the bed of the Klamath River, the plaintiffs and their ancestors enjoyed federal treaty rights to fish salmon in the upper reaches of the Klamath River. Thousands of salmon returned to the upper tributaries.

6. The Klamath Indians relied upon the salmon to feed their families and to trade for life necessities and to maintain their federal treaty protected right to occupy, free of interference from outsiders, the unique ecosystem of the Upper Klamath Basin.

7. PacifiCorp, through its predecessor, the California-Oregon Power Co. (COPCO), commenced construction of the first of the Klamath River dams on or about 1911. Within a year of the start of construction no salmon passed upstream and the plaintiffs and their ancestors have been denied salmon every since.

8. With the blockage of fish passage in 1911, newcomers to the Upper Klamath Basin were no longer restrained from depleting river flows and protecting river water quality. With fish passage in place, or in the absence of PacifiCorp dams in the bed of the Klamath River, applicable federal and state law (including the Klamath Tribes 1864 treaty rights and time immemorial instream water rights) would have protected the successful passage of salmon to the Sprague and Williamson Rivers.

9. The loss of salmon contributed to the devastating decline of the Klamath Tribes and their members and led to their temporary termination in the 1950s.

10. At the time of the construction of the dams, California and Oregon law required fish passage and COPCO represented to the Indians and others that indeed fish passage for salmon would be maintained. In 1916, COPCO (J. McKee, Vice President) made the following commitment to the Klamath Indians:

> We note that complaints have reached your office through the Klamath Indian Reservation that the run of salmon in the Klamath River has been interfered with by a dam which our Company has under construction upon the Klamath River.

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> In reply, we beg to say that the said dam will be completed by end of the present year, 1916. Ample provision has been made in the plans for the dam for a fish ladder which will permit unobstructed passage of fish up the Klamath River.

11. Despite the acknowledgment of the elimination of salmon above the PacifiCorp dams, and the dam builder's own commitment to establish fish passage, such passage has knowingly, recklessly and intentionally not been established for over 90 years.

12. PacifiCorp and its predecessor have intentionally and deliberately avoided their pledge and duty to provide fish passage notwithstanding the following:

a. The generation of millions of dollars in revenues from the sale of hydropower generated at the Klamath Project.

b. Congress' enactment of a compact on the Klamath River between California and Oregon which made preservation of fish resources a priority.

c. Congress' enactment in 1920 of the predecessor to the Federal Power Act, which authorized fish passage and conditioned construction of hydropower facilities on the preservation of the "public interest," which in the setting of the Upper Klamath Basin included preservation of the 1864 treaty rights.

d. PacifiCorp's failure to obtain any federal license permitting it to block fish passage in Upper Klamath navigable waters, described by the National Academy of Science, as a "unique" ecosystem, from 1920 to 1957.

e. PacifiCorp's failure to insert necessary fishway facilities in its 1957 license.

f. PacifiCorp's failure to insert fishway facilities in 1974, when the federal courts confirmed the continuing 1864 treaty rights of Klamath Tribal members to fishing, including anadromous fishing, in the Sprague and Williamson Rivers. *Kimball v. Callahan*, 493 F.2d 564 (9th Cir. 1974).

g. PacifiCorp's failure to insert the necessary fishway facilities in 1983, when the federal courts confirmed the immemorial instream water rights necessary to

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assure spawning of native fish, including anadromous fish, in the headwaters of the Klamath River. *United States v. Adair*, 723 F.2d 1394 (9th Cir. 1983).

h. PacifiCorp's continuing failure since 1911 to work in coordination with local residents and appropriate government entities to ensure that the Federal Power Act "public interest" concerns are addressed each year, as it generated millions of dollars off its obstructions placed in the bed of the Klamath River. PacifiCorp continued this failure even after 1986, when Congress made it explicit that power production and fish restoration were to be given equal consideration.

i. PacifiCorp's continuing failure to produce, after 90 years, a plan of fish passage in the face of the October 2003 National Academy of Science report on the destruction of the "unique" ecosystem of the Upper Klamath Basin and the commitment by the United States to develop a state of the art fish passage at the Keno Dam.

13. But for the inactions of PacifiCorp set forth above, salmon runs would have continued past 1911, and the other factors, which today contribute to the impairment of the "unique" Upper Klamath Basin ecosystem, would not have been permitted by the Klamath Tribes and their members, whose senior treaty and water rights provide them with the power to preserve healthy salmon runs.

V. FIRST CLAIM FOR RELIEF

14. Paragraphs 1-13 are hereby incorporated by reference.

15. The actions of the defendant and its predecessor have violated the federal treaty rights of the plaintiffs to enjoy salmon fishing, year to year, subject to varying river flows and appropriate conservation management.

16. The knowing and reckless actions and inactions of PacifiCorp render them subject to compensatory and punitive tort damages and interest since 1911.

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VI. SECOND CLAIM FOR RELIEF

17. Paragraphs 1-16 are hereby incorporated by reference.

18. The actions of the defendant and its predecessor unlawfully trespass upon and interfere with federally protected property rights of the plaintiffs and their predecessors.

19. The knowing and reckless actions and inactions of PacifiCorp render them subject to compensatory and punitive tort damages and interest since 1911.

VII. PRAYER FOR RELIEF

20. Plaintiffs request that the Court enter an order which:

a. finds that the defendant and its predecessor knowingly and recklessly destroyed the plaintiffs' federal treaty rights to consume and/or barter salmon and to maintain a way of life which relief upon anadromous fish;

b. finds that the defendant is liable for compensatory and punitive damages, including interest, to the plaintiffs and other individual Tribal members in an amount, including interest, in excess of $1 billion; and

c. finds that plaintiffs are entitled to their costs and attorney fees.

DATED this 11th day of May, 2004.

LANDYE BENNETT BLUMSTEIN LLP

By: ______________________
J.D. Williams, OSB #95156
Of Attorneys for Plaintiffs

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