Distribution of Anadromomous 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 in 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 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, com-

pleted 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 unutilized 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.

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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

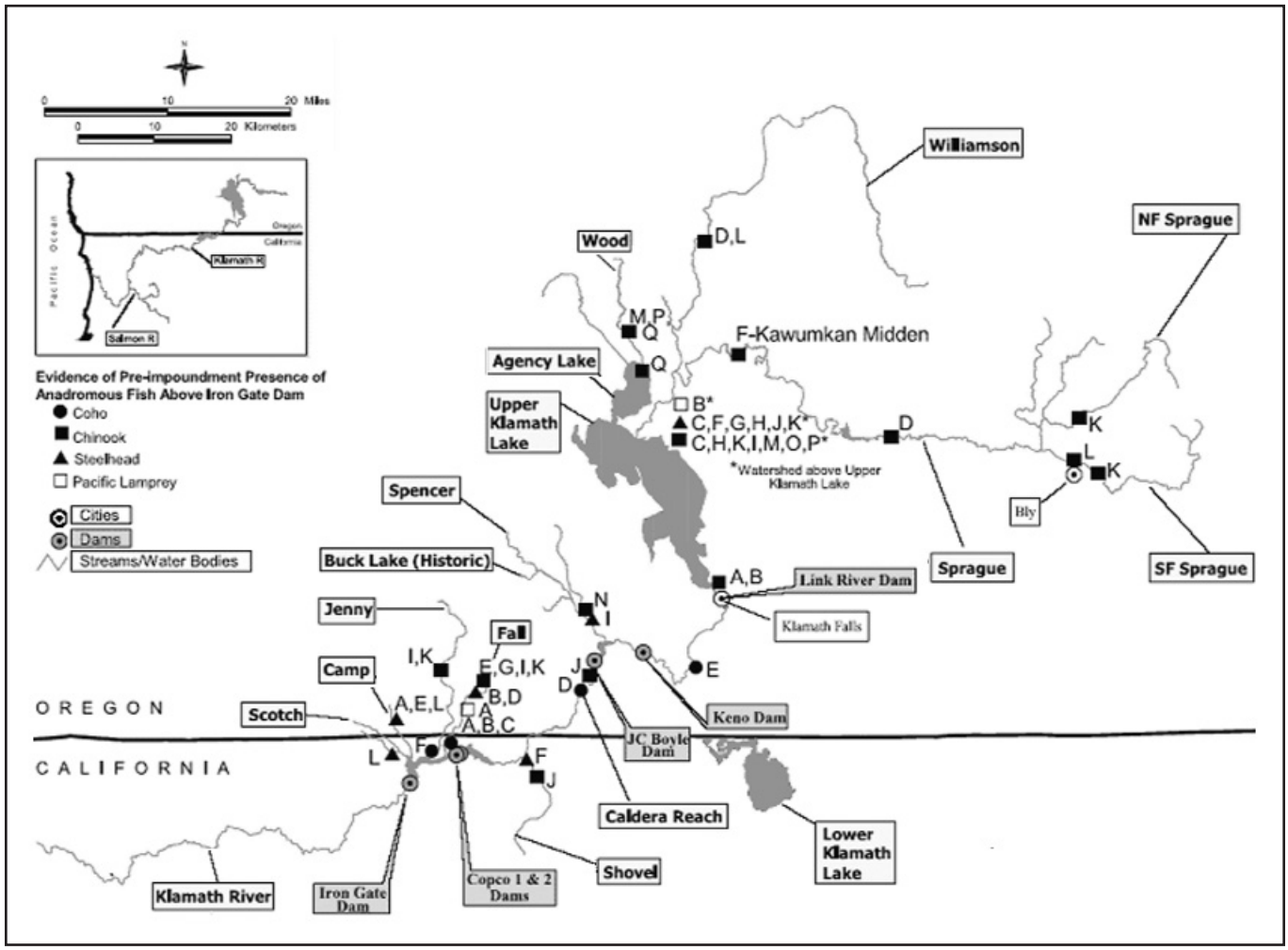
We reviewed published and unpublished fisheries, archeological, and ethnographic reports on the distribution and presence of anadromous fish in the Klamath River watershed. For a given reference we generally cited only the farthest upstream occurrence of a species in the Klamath River and/or its tributaries. 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.

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 above, 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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