Instream Flow Requirements For Tribal Trust Species in the Klamath River

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The Yurok People have long depended on the fish resources of the Klamath River. For centuries, the Klamath River provided fish throughout the year to meet the needs of the Yurok Tribe as well as of the Karuk, Hoopa and the Klamath tribes. The river is still central to the everyday lives of the Yurok People. Historically, adult salmon and steelhead returning each year to spawn, included spring and fall chinook salmon, coho salmon and steelhead, probably numbered more than one million fish. At this time large numbers of eulachon, lamprey and green sturgeon also inhabited the river. These fish were harvested for cultural, subsistence and commercial purposes. They are referred to in this report as the Yurok Tribal Trust Species. (Hereafter Tribal Trust Species).

All of the Tribal Trust Fish Species are in serious decline. Steelhead and coho salmon have undergone status review by the National Marine Fisheries Service under the federal Endangered Species Act. In the Klamath River, these fish have been proposed for listing as “threatened”. Spring and fall chinook are currently being considered for listing and their status reviews are nearly complete. Euchalon, lamprey and green sturgeon populations, suspected of being in serious decline, are currently being assessed by the Y urok tribal biologists.

The declines in the stocks of the Klamath River anadromous fishery are due principally to the Ioss of aquatic habitat in the mainstem Klamath River. This loss of habitat in turn is, to a large degree, due to the construction of dams and the diversions of water associated with the Klamath Irrigation Project.

During the spring of 1995 the Bureau of Reclamation (BOR) initiated a planning study to develop criteria for operating the Klamath Project during different periods of water availability (wet, normal, dry and critically dry years). The BOR acknowledged its obligation to meet its trust responsibilities to the Yurok Tribe and other native people within the Klamath Basin. However, in late November 1995 it stated it was unable to quantify the instream flows necessary for the protection of the Klamath River anadromous fishery. The Yurok Tribe therefore undertook to quantify the needed instream flows and to evaluate the likely impacts of past and proposed Klamath River operations on the anadromous fishery. In order for the instream flow needs of the anadromous fish to be included in the Klamath Project Operations Plan (KPOP), an appropriate instream flow regime had to be presented by 15 March 1996. This report presents the instream flow regime developed on behalf of the Yurok Tribe for use in the KPOP process.

The purpose of this report is to quantify the monthly streamflow requirements of the Tribal Trust Species in the mainstem Klamath River below Iron Gate Dam so that the BOR can satisfy the Tribe's reserved water rights and the BOR's trust responsibilities to the Yurok Tribe. In providing this quantification we identify the fish species of importance to the Yurok People, explain why these fish are dependent on the mainstem Klamath River, identify the monthly streamflows required to satisfy their needs, and describe how that water should be released from Iron Gate Dam throughout the year.

We selected the Tennant method as the best instream methodology to quantify the instream flow requirements of the Tribal Trust Species. The Tennant method is widely known and accepted throughout North America and has been successfully applied to large rivers inhabited by anadromous salmonids.

In our application of the Tennant Method we selected 60% of the average annual discharge for three compelling reasons: first, important biological activities occur at all times during the year because six Tribal Trust Species utilize the mainstem river; second, the populations of the Tribal Trust Species are severely depleted; third, the flow regime currently specified in the Federal Energy Regulatory Commission (FERC) license for Iron Gate Dam has proven inadequate to reverse, or even stabilize, the precipitous decline in Tribal Trust Species. The FERC flow regime represents 46% of the average annual streamflow at Iron Gate, and has been in effect for more than twenty-five years.

Using the Tennant method and average annual streamflow data from Balance Hydrologies, and based on our experience with the Tennant and other instream flow methodologies in a variety of watersheds, we determined the instream flows necessary to support the Tribal Trust Species to be:

Monthly Instream Flow Requirements of Tribal Trust Species in the Klamath River Below Iron Gate Dam (Hereafter Tribal Trust Flow Regime)

Month	Instream Requirement (cfs)	Volume (acre ft)
October	1,200	73,660
November to March	1,500	448,470
April	2,000	118,800
May	2,500	153,450
June	1,700	100,980
July to September	1,000	182,160
	TOTAL	**1,077,520**

Past operation of the Klamath Project has resulted in a streamflow pattern which is unnatural and incapable of providing essential habitat during the spring and summer months. Thus, maintaining the status-quo will not reverse the decline of Tribal Trust fish populations.

The Tribal Trust flow regime better represents the natural streamflow pattern of the Klamath River, which is biologically important to support the Tribal Trust Species. In comparison to the current streamflow pattern it provides additional streamflow during spring to assist juvenile fish migrating downstream and during summer to ameliorate undesirable temperature and dissolved oxygen conditions. Implementation of the Tribal Trust flow regime is expected to improve the quality of mainstem habitats, and fish populations will likely respond positively. Studies to determine the response of fish habitats and populations should be initiated concurrent with implementation of the Tribal

Trust flow regime. Results from these studies would provide a basis for adjusting the flow regime presented in this report to better meet the needs of the Tribal Trust Species.

1 .O INTRODUCTION

During the spring of 1995 the BOR began work on a planning study to develop criteria for operating the Klamath Project during different types of water years (wet, normal, dry and critically dry). Because of their dependence on the Klamath River and its fish resources, and because they hold reserved fishing and water rights in the Klamath River and tributaries, the Yurok Tribe has actively participated in this process from its inception. Early in the KPOP process, the BOR acknowledged its obligation to meet its trust responsibilities to the Yurok Tribe and other native people within the Klamath Basin. However, in late November 1995 the BOR stated it was unable to quantify the instream flows necessary for the protection of the fish resources important to the Yurok Tribe (M. Belchik pers. comm 1996). Lacking quantification, the instream flows necessary to sustain the species of importance to the Yurok Tribe likely would not be included in the KPOP. The Yurok Tribe therefore undertook to quantify the instream flows required to meet the needs of the Tribal Trust Species. In order for the instream flow needs of the anadromous fish to be included in the KPOP, an appropriate instream flow regime had to be developed within a two month period.

Two consulting firms were engaged by Alexander & Karshmer, counsel for the Yurok Tribe. to assist the Tribe in developing the needed instream flow regime. Trihey & Associates was asked to review the available biological information and determine the instream flow requirements of the Klamath River anadromous fish. In doing so, the best available method and biological information was to be used. Balance Hydrologies was asked to perform the hydrologic analysis necessary to determine the quantity and timing of historical streamflows and to determine the extent to which meeting the instream flow regime depended on water currently being impounded or diverted by the Klamath Project. This report presents the instream flow regime developed on behalf of the Yurok Tribe for use in the KPOP process.

The Yurok People have long depended on the fish resources of the KIamath River. For centuries, the Klamath River provided fish throughout the year to meet the needs of the Yurok Tribe and the needs of the Karuk, Hoopa and KIamath tribes which also inhabit the basin. The Klamath River ecosystem, from the lakes and marshes in the upper basin to the tidal estuary of the lower river, supported large runs of anadromous fish.

The KIamath River is central to the identity of the Yurok People and is the principal landscape feature of their reservation and territory. The Klamath River also provides the fundamental basis for the Yurok culture, philosophy and religion. It is central to the Yurok sense of identity. "The river flows like our blood. It is our veins and arteries," said one tribal elder from Weitchpec, California (M. Belchik pers comm. 1996).

The Yurok culture revolves around the river and its fish resources. When the salmon return to the Klamath River, the First Fish ceremonies are conducted at the mouth of the river to welcome them. Salmon were harvested at the fish dams built 33 miles upriver and the fish dam ceremonies began the fall Yurok religious ceremonies. During these ceremonies, fish were harvested and consumed as a part of these religious meetings. Fish are an integral part of the identity of the Yurok People (T. Gates pers comm. 1996).

When the original Klamath River Reservation was established in 1855, fish were abundant in the Klamath River. Adult salmon and steelhead returning each year to spawn probably averaged more than one million fish annually, including spring and fall chinook salmon, coho salmon and steelhead. In addition large numbers of eulachon, lamprey and green sturgeon inhabited the river. These fish were harvested by the Yurok Tribe for their cultural, subsistence and commercial needs, and they are referred to in this report as the Yurok Tribal Trust Fish Species (hereafter Tribal Trust Species).

In 1855 Special Indian Agent S. Whipple, in his investigation report to Washington DC, recognized the strong relationship between anadromous fish, the river and the Yuroks when he stated, "The river is abundantly supplied with salmon, a fine large fish quite easily taken by the Indians and which is very properly regarded by the Indian as his staff of life."

Non-Indians also recognized the abundance of the fish resources in the Klamath River. In 1892, a scientist from the US Fish Commission proposed setting aside an entire coastal watershed as a great national nursery for salmon (McEvoy 1986 as cited by Kier 1991). This scientist proposed the Klamath River as a likely candidate for a preserve since it had abundant resources and was already excluded from commercial harvest due to its status as an Indian Reservation.

The Klamath River basin is located in south central Oregon and north western California. The river basin drains approximately 15,600 square miles (USFWS 1992) and has an average annual flow of approximately 17,000 cfs at its mouth. The upper Klamath River basin drains approximately 4,600 square miles in south central Oregon and north central California. The estimated average annual discharge for the Klamath River at the present day location of Iron Gate Dam was 1.8 million acre feet prior to the Klamath Project (Balance Hydrologies 1996).

The Klamath Reclamation Project was initiated by the BOR during the early 1900's. Today. the Klamath Project delivers irrigation water to more than 200,000 acres in the Lower Klamath, Tule Lake and Lost River areas. The draining of vast wetlands and the construction of various dams and diversions has substantially altered the natural hydrograph of the Klamath River near Iron Gate Dam (Figure 1 Balance Hydrologies 1996). Numerous uses other than irrigation also exist for water in the Klamath Basin. Among these other uses are. (1) The lake level needs of endangered species in the upper basin and (2) the instream flow needs of the downstream anadromous fish. When operating the Klamath Project to fulfill its obligation to provide a reliable water supply to agriculture. the BOR must first satisfy the instream flow and lake level requirements of the ESA and the reserved fishing and water rights of the Yurok and other Klamath River Tribes (Solicitor 1995).

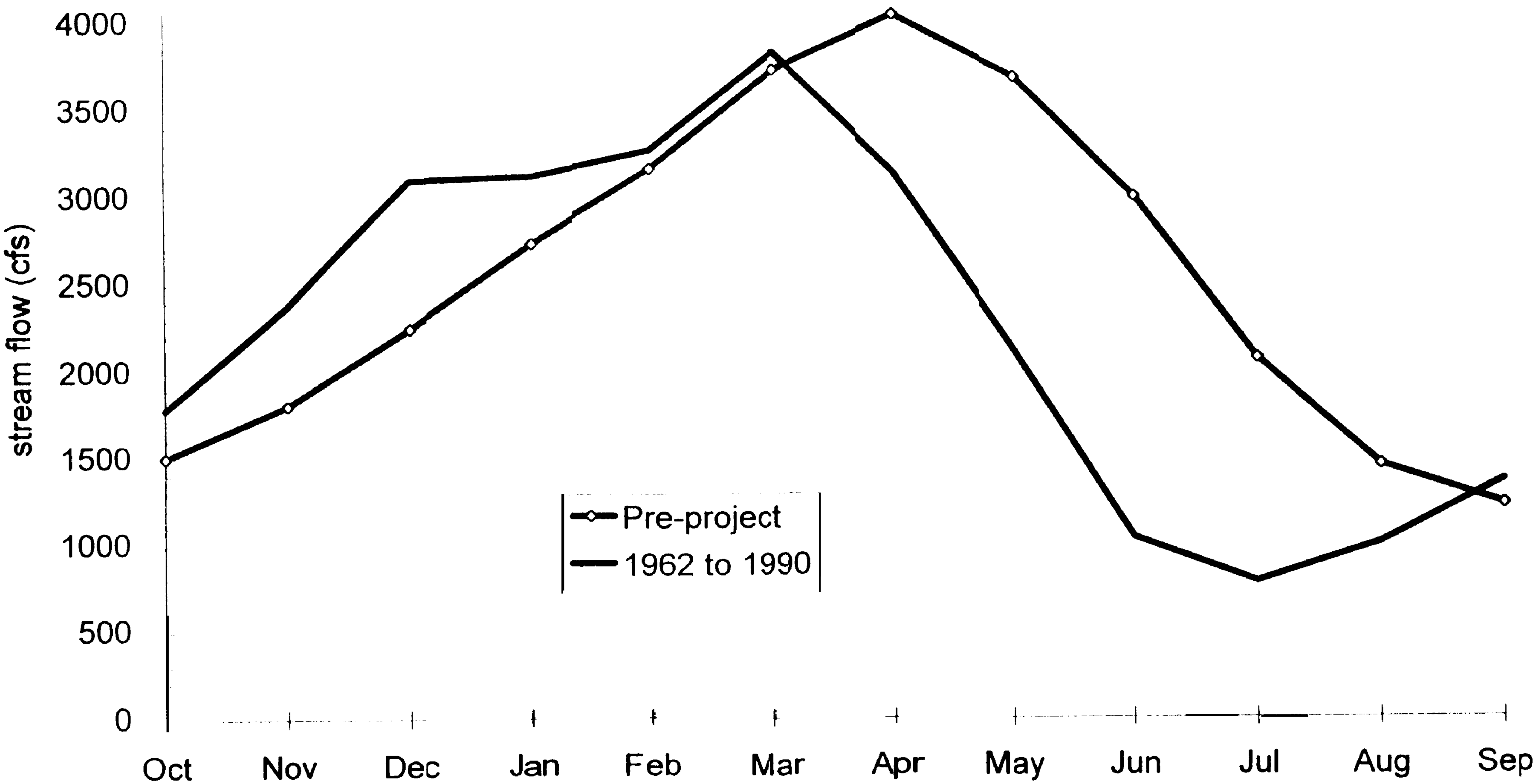

Figure 1. Comparison Between Average Monthly Streamflows at the Iron Gate Damsite Prior to the Klamath Project (Pre-project) and Following Operation of Iron Gate Dam (1962-1990). Adapted from Balance Hydrologics 1996.

It is for this reason, presumably, that the BOR is attempting to develop an operations plan for the Klamath Project. The BOR stated that the KPOP is intended to reduce uncertainty associated with Project operations by clarifying the distribution of water under four hydrologic scenarios: wet, normal, dry and critically dry. The KPOP will determine how senior water rights will be satisfied and project needs are met.

The BOR has identified the priority for water allocation as being: (1) compliance with the Endangered Species Act (this may include listed species such as the suckers in the Klamath lakes as well as proposed species such as coho salmon and steelhead in the lower Klamath River), (2) Tribal Trust responsibilities of the Department of the Interior (this would include meeting the lake level requirements of suckers in Upper Klamath Lake and instream flow requirements for chinook and coho salmon, steelhead, lamprey, sturgeon and eulachon, (3) water deliveries to agriculture interests for irrigation and to refuges within the Klamath Project for wetlands maintenance (USFWS 1995). Although the BOR identified priorities for water allocation, BOR staff indicated that they did not know how to quantify the water deliveries needed to provide adequate habitat for the Klamath River anadromous fishes and, therefore, did not know how to satisfy their legal obligations and trust responsibilities to the downstream tribes (M. Belchik pers. comm. 1996).

The instream flow requirements presented in this report should be considered a first approximation of the stream flows required to halt the precipitous decline of anadromous fish stocks and provide an opportunity for these stocks to begin to rebound. Because operation of the Klamath Project is expected to extend well into the future and because considerable time may elapse before the BOR is able to fully satisfy its trust responsibilities, it would be prudent to initiate fish population habitat assessments at this time for later use to fine-tune the flow regime presented in this report. These site-specific studies should be undertaken to define the relationship between streamflow, stream temperature and fish habitat by maintaining the response of fish populations and habitats to the Tribal Trust flow regime.

2.0 OVERVIEW OF TRIBAL TRUST SPECIES

Four Native American Tribes are located within the Klamath Basin: the Yurok, Hoopa, Karuk, and Klamath. The Yurok Tribe is the largest and is the major in-river harvester of Klamath River salmon. In addition to chinook salmon *(Oncorhynchus tshawytscha), both* spring and fall, the Yurok Tribe depends on coho salmon (0. *kisutch),* steelhead (0. *mykiss),* green sturgeon *(Acipenser medirostris),* pacific lamprey *(Lampertra tridentata)* and eulachon *(Thaleichthys pacifzcus)* for ceremonial, subsistence and commercial purposes. These fish are referred to in this report as the Yurok Tribal Trust Species. The river and all its biological resources are highly valued by the Yurok Tribe, including such other species as suckers, white sturgeon, and coastal cutthroat trout.

The decline of the Tribal Trust Species in the Klamath River basin is directly related to alterations of the natural streamflow, stream temperature and sediment regimes of the Klamath River and its tributaries which began in the latter part of the nineteenth and continued through the twentieth centuries. Activities such as mining, water diversion, dam construction, wetland draining, hydro-power generation, logging and grazing have resulted in substantial alteration of the streamflow and thermal regimes of the river and its tributaries (Kier 1991). The primary causes of the decline of the Tribal Trust Species include changes in access to, and in the quality of, aquatic habitat within the mainstem Klamath River and its tributaries (Weitkamp 1995).

The decline of Klamath River salmon and steelhead populations is documented by escapement and run size estimates provided during the past twenty years by knowledgeable biologists. The total salmon annual catch and escapement between 19 15 and 1928 was estimated at between 300,000 and 400,000 (Rankel 1978). Millard Coots estimated that 148,500 chinook entered the Klamath River system in 1972. Between 1978 and 1995 the average annual fall chinook escapement, including hatchery-produced fish, was 58,820. with a low of 18,133 (CDFG 1995). The annual run of coho salmon in the Klamath River is believed to range from 15,400 to 20,000 (USFWS 1983). CDFG

(1994 as cited by Weitkamp et al. 1995) concluded that these estimates of coho abundance, including hatchery stocks, could be less than 6 percent of their abundance during the 1940's and have experienced at least a 70 percent decline in numbers since the 1960's. The mean annual steelhead run in the Klamath River was estimated to be 400,000 fish in 1960 (USFWS 1960), 250,000 in 1967 (Coots 1967), 241,000 in 1972 (Coots 1972) and 135,000 in 1977 (Boydston 1977). Busby et al. (1994) reported that the hatchery influenced summer/fall-run in the Klamath Basin (including Trinity River stocks) may now number 100,000 while the winter-run size is approximately 20,000.

The current minimum escapement goal for naturally spawning fall chinook in the Klamath River is 35,000 fish (M. Zuspan pers. comm. 1995). This modest goal has only been met (or surpassed) in 6 of the last 18 years (CDFG 1995). Even though the fall chinook salmon numbers have declined drastically, adult returns are stronger than adult returns for other salmon or steelhead. This is likely attributable to hatchery production and to juvenile fall chinook being less dependent on freshwater habitats for summer and fall rearing than are juvenile coho salmon. spring chinook salmon or steelhead. Because of differences in life history behavior juvenile fall chinook salmon do not remain in mainstem or tributary habitats during the summer and fall months in the same relative proportions as do other juvenile salmonids. Hence juvenile fall chinook salmon are not subjected to the same degree of stress and mortality because of poor summer and fall habitat conditions in mainstem and tributary habitats.

Spring chinook salmon appear to be in remnant numbers within the Klamath River Basin and have been completely extirpated from some of their historically most productive streams, such as the Shasta River (Wales 1951). Spring and fall chinook salmon are currently being considered for listing under the Endangered Species Act (ESA) and their status review is nearly complete. Steelhead and coho salmon have undergone status review under ESA and have been proposed for listing as “threatened”. Eulachon, now thought to be extremely rare in the Klamath River, are currently being assessed by Yurok

Tribal biologists along with lamprey and green sturgeon populations, which are also suspected of being in decline.

It is apparent therefore, that the Tribal Trust Species have seriously low population levels. In fact, population levels are so low that the Yurok Tribal Council has voluntarily placed a moratorium on the commercial harvest of fall chinook salmon by Tribal members during low escapement years. Hence, during these years salmon can only be taken by Tribal members for cultural or subsistence purposes.

TRIBAL TRUST SPECIES'

Fall chinook salmon, the most significant anadromous fish to the Yurok Tribe, are harvested in larger numbers than any other species. Fall chinook salmon are fished by the Tribe from mid-July through early December.

Spring chinook salmon have always been highly valued by Tribal members. They are the first salmon to enter the river and, historically, arrived in larger numbers than fall chinook and other salmonids (Hume as cited by Snyder 193 1). The number of spring chinook salmon harvested might have been lower than the number of fall run harvested because of the difficulties associated with fishing during spring and early summer runoff events. In recent years, the Tribal harvest of spring chinook salmon has been restricted because the run has been so depleted (D. Hillemeier pers. comm. 1996). Spring chinook salmon are fished by the Tribe in the lower river beginning in early April through mid-July.

Coho salmon have been a relatively minor component in the Tribal fishery in this century, however, they were traditionally smoked and stored for the late winter months. The coho's low fat content made it possible to store them without spoiling. It is unknown

The principal source of information appearing in this section is the Yurok Tribal Fisheries Program, Contact Mike Belchik at (707) 482-2841.

what relative importance they might have had, but in recent years, they have taken on increasing importance because of the decline of chinook salmon. Coho salmon are fished by the Tribe in the lower river from mid-September through mid-January.

Steelhead have always been very important to the Yurok Tribe, especially during years when salmon runs are low. The actual number of steelhead harvested by the Tribe in past years would depend on river conditions. During times of high streamflow the river is turbid and fishing is not very effective. Tribal biologists are monitoring current harvests. Fall steelhead are harvested by the Tribe when fishing for fall chinook in the lower river. Winter steelhead are fished by Tribal members from mid-December through mid-April. Summer steelhead are harvested while Tribal members are fishing for spring chinook and sturgeon. The catch is reduced during the self imposed closure on salmon fishing.

Pacific lamprey are fished with eel hooks, dip nets and eel baskets when they migrate upstream during winter and early spring. The peak lamprey fishing occurs at the mouth of the river in late December and early January. There can also be a spring peak depending upon weather and streamflow (W. Lara Sr. pers. comm. 1996). Along with steelhead. lamprey provide fresh fish for Tribal members during the winter months, and are highly prized by Tribal fishers. It appears that the number of lamprey returning to the Klamath has declined dramatically in recent years. It was common for Tribal members to catch over a hundred lamprey in a single outing; now it is rare to catch more than ten.

Green sturgeon are targeted by Tribal gill netters when they migrate upriver to spawn in the spring and again when they return to the ocean in the late summer and fall. The average harvest is around 320 fish per year (Yurok Tribal Fisheries Program unpublished data compiled from USFWS annual reports 1980-1991).

Eulachon were once an important component of the Tribal fishery and were fished during the late winter and early spring months in the lower 13.5 miles of the Klamath River (downstream of Lamb's riffle). A eulachon run of appreciable size has not been observed in the Klamath River since the 1980's (Moyle et al. 1995. T. Kisanuki pers. comm. 1996). Eulachon are prized because of their high fat content and are also an important food fish for other Tribal Trust Species. When eulachon are concentrated near the mouth of the river prior to their spawning run, they typically attract congregations of predatory species, including sturgeon and salmon (Hart 1980, Morrow 1980).

Although Tribal members would generally agree that the chinook salmon is today the most important fish to the Tribe, it would be difficult to rank the relative importance of the other Tribal Trust Species because different Tribal members would assign various rankings to these fish based on personal preference.

3.0 GENERAL HABITAT REQUIREMENTS OF TRIBAL TRUST SPECIES

The information in this section provides a basic description of the time of year that various life stages of the Tribal Trust Species are dependent on the mainstem Klamath River. The phenology chart, presented as Figure 2, demonstrates that Tribal Trust Species are dependent upon mainstem habitats throughout the year and that no single month or small number of months exist when this dependency on mainstem habitats is unimportant.

Fall chinook salmon begin entering the Klamath River as early as late July and continue through early December (Leidy and Leidy 1984, Yurok Tribal Fisheries Program unpublished data). Their upriver migration typically peaks in mid-October (CH_2M Hill 1995b). although the migration peak in the lower river may be as early as late August (Yurok Tribal Fisheries Program unpublished data). Spawning occurs from mid-September through January, with a peak in mid-November (Leidy and Leidy 1984). Salmon are known to spawn within the mainstem Klamath River for a distance of 100 miles below Iron Gate Dam. Prior to the construction of Iron Gate Dam, a principal salmon spawning area within the mainstem Klamath River extended from Copco Dam downstream to the mouth of the Shasta River, a distance of approximately 22 miles (CDWR 1964). Construction of Iron Gate Dam and Reservoir blocked access and inundated the upstream 7 miles of this 22 mile stream segment. There is evidence that the spawning habitat in the E-mile stream segment between Iron Gate Dam and the Shasta River is today of poorer quality than it was prior to the construction of Iron Gate Dam (Shaw 1994,1995).

Juvenile fall chinook salmon begin to emerge from gravels in December and continue through early March (Leidy and Leidy 1984). The majority of these young fish migrate

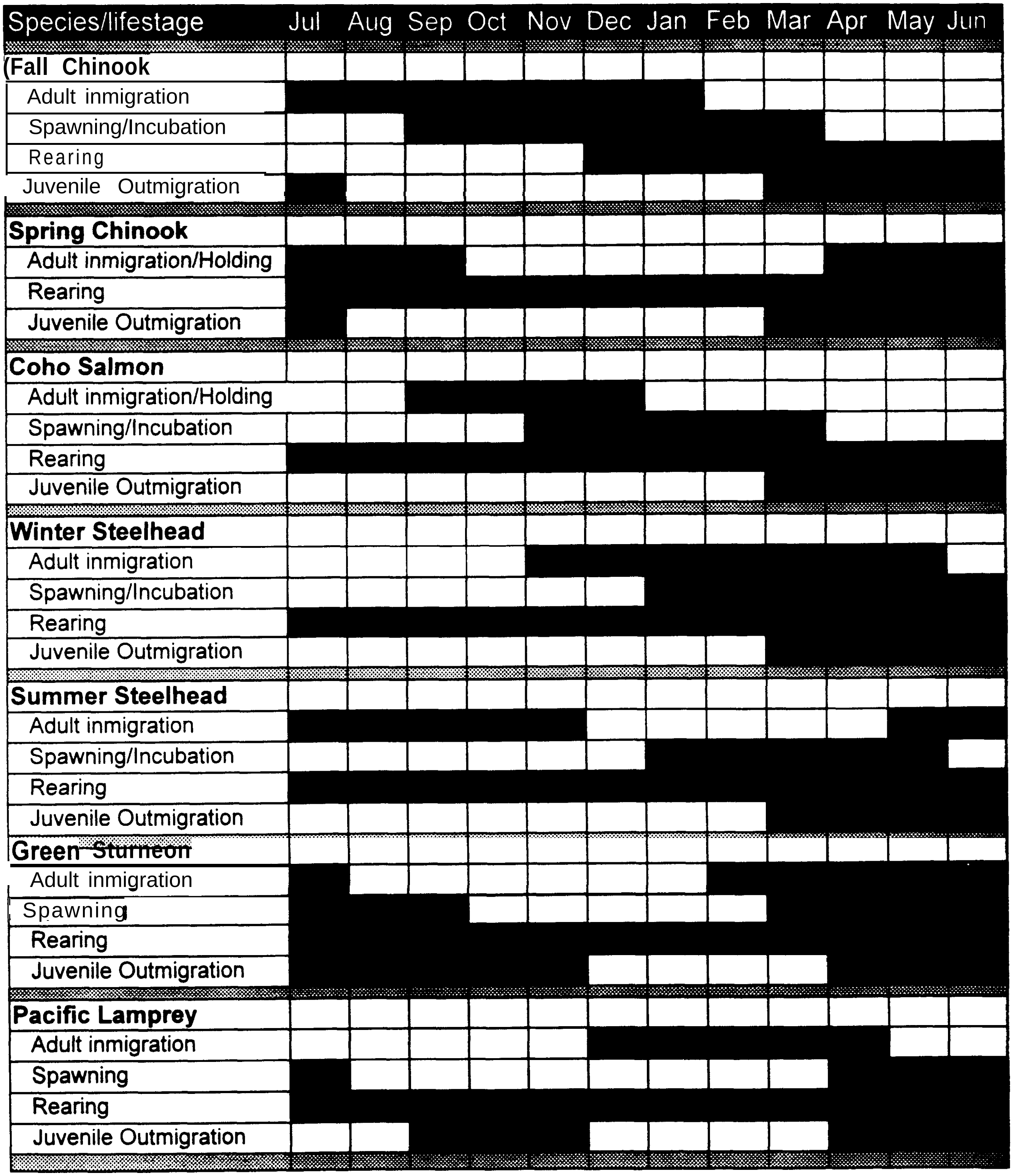

Figure 2. Phenology Chart for Tribal Trust Species Inhabiting the Mainstem Klamath River.

to the ocean from early March through mid-July, with the peak of their downstream movement being late May or early June in most years (CH_2M Hill 1995b). A lesser number of juvenile fall chinook salmon will remain in the river and tributaries through the summer and then migrate downstream during October and November of the year in which they emerged (CH_2M Hill 1995b). Still fewer will remain in the river through winter and migrate in February or March of the following year (CH_2M Hill 1995b).

Juvenile salmonids utilize a variety of in-river habitat including high velocity areas for drift feeding, lower velocity areas for holding and areas with cover for protection from predators (Everest and Chapman 1972, Vogel 1993 as cited in U.S. Bureau of Reclamation 1996). The mainstem Klamath is utilized by juveniles produced within the mainstem and within the tributaries. In recent years, the mainstem Klamath has become of increased importance as a nursery area because such tributaries as the Shasta and Scott rivers often have high water temperatures and low dissolved oxygen concentrations during the summer and fall months of dry years. Pulsed streamflows have been used to flush juvenile salmon and steelhead from the Shasta River into the mainstem Klamath to increase their chances of survival during the irrigation season (D. Webb pers. comm. 1996). It is believed that Shasta River juveniles are being successfully flushed into the Klamath River from the Shasta River because the size of the juvenile fish being captured in the Klamath River rotary trap at Scott River increased coincident with pulsed streamflows occurring in the Shasta River (J. Craig pers. comm. 1996).

Spring chinook salmon begin their upstream migration in the Klamath River in early April through mid-September (Leidy and Leidy 1984, D. Hillemeier pers. comm. 1996). Spring chinook salmon typically spawn in tributary streams (mainly the Trinity and Salmon rivers) from mid-September through late October (West 1991).

Leidy and Leidy (1984) states that the downstream migration for spring chinook is similar to that of fall chinook, however, more recent studies may indicate that spring chinook may migrate downstream slightly later than fall chinook. In the Sacramento

River system, spring chinook salmon juveniles emerge and migrate downstream later than fall juveniles, because the spring chinook salmon spawn and incubate in the cooler headwaters, where development is slower (C. Harvey pers. comm. 1994). In the South Fork Trinity River, where temperatures are high in summer, it would appear to be an advantage to migrating downstream as early as possible, however, approximately 10 to 15% stay in the river through the summer (Dean 1995). Scale analysis indicated that some Trinity River spring chinook appear to take up residency for significant blocks of time downstream in the Klamath either in the river or the estuary (Dean 1995).

Upstream migration by adult ***coho salmon*** begins in mid-September and continues through mid-January (Leidy and Leidy 1984). Coho salmon typically spawn in tributary streams from November through January. However, coho salmon have been observed spawning in side channels, tributary mouths and shoreline margins of the mainstem Klamath River between Independence and Beaver creeks (T. Shaw, M. Magnusen, A. Olsen, pers. comm. 1996). Juveniles usually emerge from the gravels between February and mid-May and remain in the system through the summer and winter to migrate downstream between March and June of the following year (Leidy and Leidy 1984). The peak downstream movement usually occurs between April and May (Leidy and Leidy 1984).

Steelhead may enter the Klarnath River during all months of the year (Busby et al. 1994), although they are generally lumped into distinct categories. In the Klamath River, three distinct runs are recognized: fall-run, winter-run, and summer-run. For the purposes of this document, the fall-run will be considered part of the summer-run (Busby et al. 1994). In the Pacific Northwest, summer-run steelhead enter the river from May through October, while winter-run steelhead enter between November and April (Barnhart 1986, Busby et al. 1994).

Winter steelhead begin their upstream migration in November, with the peak migration occurring between mid-January and mid-February, and continuing through May (Leidy and Leidy 1984). Spawning can begin in January and continue through May, but peak spawning occurs in March and April (Leidy and Leidy 1984, CH_2M Hill 1995b). Steelhead eggs and alevins incubate in streambed gravels for approximately two months, and the juvenile fish will usually emerge by late June (Leidy and Leidy 1984). Steelhead juveniles usually stay in the river for one to three years (Moyle 1976, Leidy and Leidy 1984). The majority of downstream migration occurs from March through June. (Leidy and Leidy 1984)

Summer steelhead usually migrate upstream from May through November (Leidy and Leidy 1984). They remain the river system throughout fall and winter to spawn during January and mid-May of the following year (CH_2M Hill 1995b). Juvenile summer steelhead remain in the system and migrate to the ocean in a manner similar to winter steelhead (CH_2M Hill 1995b).

Half-pounders are steelhead that return to freshwater after only 2 to 4 months of saltwater residence (Busby et al. 1994). Kesner and Bamhart (1972) describe Klamath River half-pounders as being 250 to 349 mm (approx. 11 to 14 inches). The half-pounders migration has been termed a "false spawning run" because few half-pounders are believed to be sexually mature (Busby et al. 1994). Half-pounders typically enter the Klamath River from July through September, remain through the winter and return to saltwater in the spring (Barnhart 1986). While in the river half-pounders are actively feeding (Barnhart 1986). Scale analysis from steelhead indicate that the great majority of mature fish from the larger tributaries to the Klamath have a half-pounder life stage (Hopelain 1987). The specific percentages of summer-run steelhead that have been half-pounders are: Shasta 98%, Scott 92%, Salmon 82% and Bogus Creek 89% (Hopelain 1987).

***Pacific** lamprey* migrate upstream through the lower river during winter and early spring, with their peak upstream movement occurring in early January (D. Hillemeier pers. comm. 1996). In some years, there is a second peak in March (W. Lara Sr. pers. comm.

1996). Lamprey spawn between early April and late July (Moyle 1976). They construct redds in gravels of a smaller diameter than those used by of salmon and, like salmon, die after spawning (Moyle and Cech 1988). Juveniles can remain in the river for 3 to 7 years and are primarily filter feeders remaining partially imbedded in the gravels (Moyle and Cech 1988). There are possibly three peaks to juvenile downstream migration; spring, summer and fall (CH_2M Hill 1995b).

Green sturgeon enter the Klamath River between late February and mid-July and have been reported to migrate as far upstream as Happy Camp (river mile 107). However , the usual extent of the spawning migration appears to be Ishi Pishi Falls (river mile 70) (USFWS 1994). The spawning period for green sturgeon is March through July, with the peak being from mid-April to mid-June (USFWS 1994). Spawning takes place in deep, fast water. A pool known as the "sturgeon hole" (approximately 1 mile upstream from Orleans) appears to be a major spawning site, because leaping and other behavior associated with courtship and spawning are often observed at this location during spring and early summer (Moyle 1976). After spawning green sturgeon return to the ocean. The juvenile downstream migration begins in mid-April and extends through mid-November, with a peak in August and September (USFWS 1990).

Although ***eulachon*** spend the majority of their life in a marine environment they spawn in freshwater habitats (Moyle 1976). In the Klamath River, eulachon migrate mostly in March and April (Moyle 1976) and the peak spawning occurs in late March or early April (D. Webster pers. comm. 1996). Spawning takes place over coarse sand and pea-size gravel in water up to 25 feet deep (Morrow 1980). Both males and females mature around 3 to 4 years of age and females produce between 17,000 and 60,000 eggs (Morrow 1980), which hatch out in 30 to 40 days in 4.4 to 7.2 °C temperature water (Hart 1980) and are quickly washed out to sea by river currents (Moyle 1976).

4.0 STREAMFLOW REQUIREMENTS OF TRIBAL TRUST SPECIES

Numerous methods have been developed for identifying the streamflow requirements of fish and other aquatic resources (Stalnaker and Amett 1978, Trihey 1979, Wesche and Rechard 1980). All of the analytic methods can be classified as being either habitat, hydraulic or hydrologic-based. Each of these “types” of instream flow methods has its particular strengths and weaknesses. We selected the Tennant (1976) method for developing an instream flow regime for Tribal Trust Species because this is the best method is to apply for analysis of the existing data.

Habitat-based methods such as useable area or PHABSIM embody complex multidisciplinary analyses. These methods also require considerable knowledge of species composition, season distribution and life history requirements in order to properly select study sites. After study sites are selected site-specific knowledge must be obtained regarding the hydrologic, geomorphologic and hydraulic conditions which interact under various combinations of streamflow and stream temperature to provide fish habitat. With regard to applying the Instream Flow Incremental Method (IFIM) to the mainstem Klamath River, from three to five years of study would likely be required to collect the necessary information. It was not practical to undertake any habitat-based instream flow assessment for the KPOP process because insufficient data exists to support such an analysis.

Hydraulic-based instream flow methods, such as R-2 Cross or Wetted Perimeter, do not require as detailed knowledge of stream biology as do habitat-based methods but they still require the site-specific evaluation of hydraulic and habitat conditions often at multiple streamflows. Study sites are often selected on the basis of seasonal habitat considerations and then field measurements are obtained at these locations during that time of year when the species life phase or habitat concern is present. This approach requires a years worth of seasonal data and thus, was not practical to undertake for the KPOP process.

Hydrologic-based instream flow methods, such as the Tennant method, do not require detailed knowledge of either the stream biology or of site-specific hydraulic conditions. These methods are based upon the accepted theory that the general condition of fish habitats, and populations are directly related to the prevailing streamflow and water quality conditions. Good streamflow and water quality conditions result in good fish habitats and populations, while, poor streamflow and water quality conditions result in poor quality habitats and low fish populations.

To apply a biologically reliable hydrologic-based instream flow method, one needs long-term streamflow records and a general knowledge of the aquatic resources and watershed conditions. The instream flow requirement is derived from analysis of the hydrologic records, and typically it is expressed as a portion or percentage of the streamflow hydrograph. The criteria used to select a particular portion or percentage of the streamflow hydrograph is based upon knowledge of the biological requirements of the fish and a determination of a particular level of habitat quality. Hydrologic-based instream methods, if used in conjunction with sound professional judgment, provide reliable estimates of the magnitude of streamflow required to achieve a variety of instream flow objectives.

In our efforts to identifl the instream flow requirement for Tribal Trust Species in the Klamath River, we applied the Tennant method. This method was developed during the late 1960's and early 1970's to protect aquatic resources in both warm water and cold water streams (Tennant 1976)[2]. Today, the Tennant method is the most widely applied

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2 Tennant conducted detailed studies on 11 streams between 1964 and 1974 in three States. These studies included physical, chemical and biological analyses of 38 different flows at 58 cross sections on 196 stream miles affecting both coldwater and warm water fisheries Tennant's results revealed that the condition of aquatic habitat is remarkably similar in streams carrying the same portion of the average annual flow.

hydrologic-based instream flow method in North America (Reiser et al. 1989). It has also been successfully applied on both small streams and large rivers to establish instream flow requirements for anadromous salmonids (Estes 1995).

The Tennant method consists of determining the average annual streamflow at the locations where the instream flow is to apply and then determining the amount of that annual streamflow which provides a particular quality of aquatic habitat. The criteria associated with the Tennant method are: from 60% to 100% of the average annual streamflow provide “optimum” habitat conditions, 60 % provides “outstanding” habitat, 30% provides “good” habitat and 10% of the average annual flow provides “poor” or “minimum quality” habitat.

In our application of the Tennant method to develop an instream flow regime for Tribal Trust Species, we selected his 60% criteria for three important reasons. First, several important life history activities occur at all times during the year because six Tribal Trust Species utilize the mainstem river. Second, the populations of the Tribal Trust Species are severely depleted. Third, the flow regime currently specified in the Federal Energy Regulatory Commission (FERC) license for Iron Gate Dam has proven inadequate to reverse, or even to stabilize, the precipitous decline in Tribal Trust Species.

As previously described in Section 2.0 of this report, the Tribal Trust Species have declined to such low populations that coho salmon and steelhead have been proposed for listing as threatened under the ESA, spring and fall chinook are undergoing status review, and Tribal biologists are currently studying eulachon, lamprey and green sturgeon populations, which are suspected of having seriously declined.

The recovery and stabilization of Tribal Trust Species at levels which can again support cultural, subsistence and commercial harvest by Tribal members is among other things, a fundamental goal among all Klamath River Tribes. And, because of the severely depleted populations of the Tribal Trust Species, high quality mainstem habitat conditions are considered necessary in order to reverse the decline and rebuild these populations.

Although Tribal Trust Species have been in a state of decline for decades, available data appear to indicate that a substantial decline occurred during the past thirty-five years (USFWS 1960, Coots 1967, Coots 1972, Boydston 1977). Although several factors have contributed to this decline, construction and operation of the Klamath Project with its associated drainage of wetlands and construction of dams and diversions for agricultural use is among the principal causes (Kier 1991, Balance Hydrologies 1996).

Currently, minimum streamflows for the Klamath River at Iron Gate Dam are supposedly ensured by the Federal Energy Regulatory Commission (FERC) license which was issued 27 March 1961 (FPC 1961). These minimum streamflows are identified in Table 1 and, taken collectively, constitute a total annual release of 83 1,422 acre feet.

Table I FERC Monthly Minimum Streamflows at Iron Gate Dam (FPC 1961)

Dates	Flow (cfs)	Volume (acre ft)
September 1 to April 30	1,300	622,908
May 1 to May 31	1,000	61,380
June 1 to July 3 1	710	85,754
August 1 to August 3 1	1,000	61,380
		TOTAL 831,422[3]

3 The 0.83 million acre foot release associated with the FERC license requirement is equivalent to a constant streamflow of 1,148 cfs.

Table 2 Months During Which Iron Gate Releases Did Not Meet FERC Minimum Streamflows.[4] (Adapted From CH_2M Hill 1995a)

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
1962	-	-	-	-	-	-	-	-	-	-	-	-
1963	-	-	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	-	-	-	-	-	-
1965	-	-	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	-	-	-	-	-	-
1967	-	-	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	708	-	747	1048
1969	-	-	-	-	-	-	-	-	-	-	-	
1970	-	-	-	-	-	-	-	-	-	-	-	
1971	-	-	-	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	706	701	725
1974	-	-	-	-	-	-	-	-	-	-	-	-
1975	-	-	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	724	761	-	-	-	718	1014
1978	-	-	-	-	-	-	-	-	-	-	-	-
1979	-	-	-	-	-	-	-	-	-	-	-	-
1980	-	-	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-	-	916
1982	-	-	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-	-	-	-		
1988	-	-	-	-	-	-	1155	966	-	632	-	1030
1989	1030	1168	-	-	-	-	-	-	-	-		
1990	-	-	-	-	-	-	-	-	-	544	649	1178
1991	-	-	-	-	757	905	790	886	674	423	411	753
1992	889	874	886	885	512	506	713	514	520	-	-	556
1993	903	906	906	1002	912	-	-	-	-	567	635	-
1994	-	-	-	1092	711	621	556	723	706	-	-	902
1995	902	901	894	1143	1016	-	-	-	-	-	-	-
FERC Min.	1300	1300	1300	1300	1300	1300	1300	1000	710	710	1000	1300

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[4] Numeric values are the recorded monthly streamflows at Iron Gate for the months that the FERC minimum streamflows were not met. Small dash "-" indicates the FERC minimum streamflow was met or exceeded.

Overall, releases from Iron Gate Dam were less than the FERC minimum monthly streamflows 57 of 408 months. Three of these times the actual release was less than 5 cfs below the required minimum. Thus, it can be concluded that overall compliance with the FERC minimums has been nearly 87%. But in spite of this degree of compliance Tribal Trust Species populations have continued to decline significantly.

The U.S. Fish and Wildlife Service has associated the poor condition of juvenile salmonids captured in the mainstem Klamath River with low streamflow, elevated water temperature and low dissolved oxygen concentrations during the summer and fall months (Craig 1991 and 1992). The summer and fall streamflow levels specified by the FERC license are notably different from the natural run-off hydrograph previously presented as Figure 1.

Thus, we strongly suspect that the existing FERC flow regime, even if fully complied with, is inadequate to reverse the decline of Tribal Trust Species. In our opinion this inadequacy is derived from both an insufficient total annual release, and from the unnatural streamflow pattern which results from compliance with the monthly schedule of FERC minimum flows.

The average annual pre-Project (pre-19 12) streamflow of the Klamath River at the present day location of Iron Gate Dam has been estimated to be 1.8 million acre-feet (Balance Hydrologies 1996). Applying Tennant's sixty percent criteria to this 1.8 million acre-feet indicates that 1.08 million acre-feet of water is needed to satisfy the requirement of the Tribal Trust Species. In comparison, the FERC minimum streamflows provide 0.83 million acre-feet or 46% of the estimated pre-Project streamflow.

The 1.08 million acre-feet streamflow requirement derived from application of Tennant's method is equivalent to a constant streamflow throughout the year of 1,500 cfs. Because streamflows vary from season to season in natural rivers, and because there are sound biological reasons for different streamflow levels to exist in the Klamath River during different times of the year, the 1,500 cfs streamflow requirement derived from application of Tennant's method was apportioned throughout the year as indicated in Table 3.

Such allocation of different amounts of streamflow to different tunes of the year is embodied in Tennant's original paper (Tennant 1976) as well as in numerous applications of Tennant's method (Ott and Tarbox 1977, Bayha 1978, Estes, 1985, Femet 1987).

Table 3 *Monthly Instream Flow Requirements for Tribal Trust Species in the Klamath River Below Iron Gate Dam*

Month	Instream Requirement (cfs)	Volume (acre ft)
October	1,200	73,660
November to March	1,500	448,470
April	2,000	118,800
May	2,500	153,450
June	1,700	100,980
July to September	1,000	182,160
	TOTAL	1,077,520

The application of Tennant's method to develop a streamflow recommendation which approximates the shape of the natural hydrograph is so common, that such an application is known among instream flow practitioners as the "modified" Tennant method. Monthly streamflow recommendations derived from the modified Tennant method are obtained in a variety of ways, but the most common are:

a) Tennant's Flushing Flow criteria is applied in conjunction with different base flow criteria for spring-summer and fall-winter,
b) Spring-summer and fall-winter base flow recommendations are adjusted to compare favorably with rninimum monthly streamflow records or with results of streamflow duration analyses, and

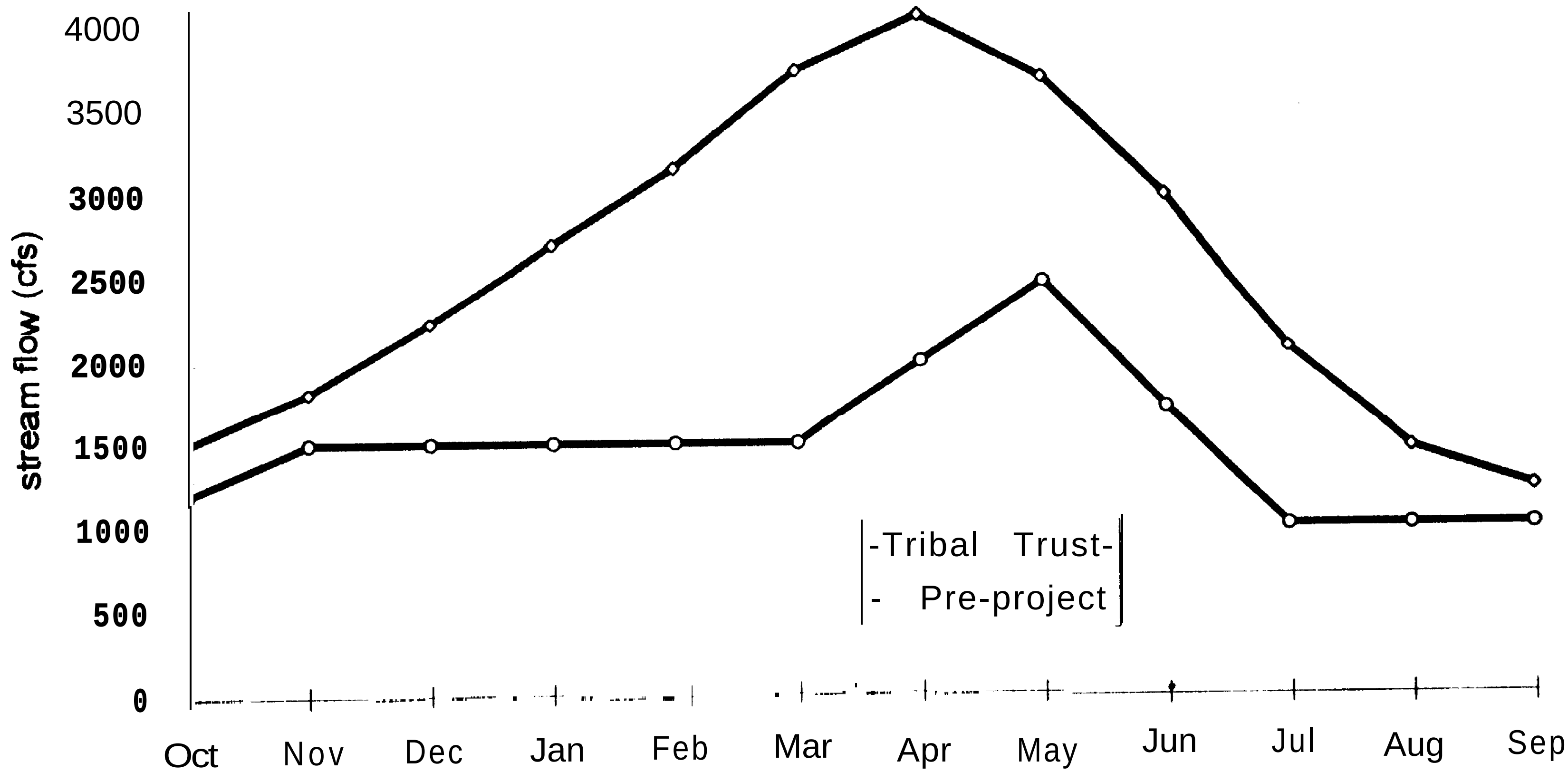

Figure 3. Comparison between monthly Tribal Trust Instream Flow Requirements and estimated monthly average pte-project streamflows.

c) Spring-summer and fall-winter base flow recommendations are modified on the basis of informed professional judgment regarding life history behavior and habitat requirements of the species of interest.

In our determination of monthly instream flow requirements for Tribal Trust Species we relied upon informed professional judgment because we felt this approach would result in a streamflow regime most compatible with the seasonal needs of the Tribal Trust Species. The thought processes and technical information which support the shape of the Tribal Trust instream flow regime are discussed in the following section of this report.

5.0 MONTHLY STREAMFLOW REQUIREMENTS

The instream flow requirement for the Tribal Trust Species consists of twelve average monthly streamflows designed to address the seasonal requirements of different species and life stages of fish. These monthly streamflows were selected on the basis of previously conducted Klamath River studies, applicable data and study results from other river systems and the experiences and insights of professional biologists familiar with the Klamath River. Although the Tribal Trust instream flow requirement is described in terms of monthly release rates, it should not be assumed that releases from Iron Gate Dam would be constant throughout a particular month. Pending the outcome of further study, it may be decided to vary the instream flow release from week to week, or from day to day so as to replicate natural variations in streamflow.

The Yurok Tribe instream flow regime is an annual hydrograph that addresses the needs of fish for upstream migration and holding, spawning, incubation, downstream migration and freshwater rearing. To simplify discussion of the Tribal Trust instream flow requirement, the year has been divided into three periods which generally correspond to the seasonal life phase activities of anadromous salmonids: upstream migration, spawning and incubation (October through March); juvenile downstream migration (April through June); and summer rearing and holding (July through September). Insufficient knowledge exists at this time regarding eulachon, lamprey and green sturgeon for these species to have been considered at the same level of detail as were the anadromous salmonids. However, the streamflow requirements derived from the application of the Tennant method protect aquatic resources at and ecosystem level and thereby provides protection for these species as well as salmonids.

Fall-winter streamflows

As described in Section 4.0, the Tribal Trust streamflow requirement for the Klamath River at Iron Gate is 1.08 million acre-feet annually. This equates to an average daily streamflow throughout the year of approximately 1,500 cfs. We selected a streamflow of 1,500 cfs as the instream flow requirement for spawning and incubation (November through March). A spawning flow of 1,500 cfs is supported by the prior work of Wales (1944) and Coots (1958) who evaluated spawning conditions in the Klamath River near the present-day location of Iron Gate Dam. Our recommendation of 1,500 cfs is mid-way between the 1,000 cfs minimum recommended by Coots (1958) and the 2,000 cfs minimum recommended by Wales (1944). Prior to the Klamath Project average monthly streamflows in the vicinity of Iron Gate Dam during the spawning season typically ranged between 1,500 and 3,500 cfs from November through March (Figure 3). The 1,500 cfs requirement for spawning and incubation, which was derived from the application of Tennant's 60% criteria, compare favorably with prior recommendations and observed streamflow levels during fall and winter.

During October an instream flow of 1,200 cfs, rather than 1,500 cfs, was selected in order to provide a more natural appearing increase in the streamflow from September into November and to assure that streamflows would be continually increasing at the onset of the migration/spawning season (to stimulate upstream migration).

Spring Streamflows

Important biological activities of Tribal Trust Species in the mainstem during spring include: the downstream migration of salmonid smolts; rearing of juvenile salmonids and sturgeon; winter steelhead holding; and possibly spawning by winter steelhead. Prior to the alteration of wetlands, and diversion of upper basin streamflows, monthly streamflows typically averaged above 3,500 cfs during March, April and May. The average June flow was 3,000 cfs (Figure 3). When determining an instream flow requirement for Tribal Trust Species during the spring months we placed considerable emphasis on the needs of downstream migrants. The specific streamflows selected for April, May, and June are 2,000 cfs, 2,500 cfs, and 1,700 cfs, respectively.

Young fish rely upon high streamflows to facilitate their downstream migration. The swimming ability of smolts[5] is poor and they move downstream in a passive fashion, drifting along with the river current (Thorpe and Morgan 1978). Studies have shown that there is a positive relationship between increased streamflow during the smolt migration periods and subsequent adult returns (Petrosky 1991, Achord et al. 1995). Travel time decreases as streamflow increases and smolt survival has been found to be inversely related to travel time (Raymond 1988). Travel time is particularly important to smolt survival when elevated stream temperatures occur during smolt migration (USFWS 1993) as longer travel times reduce survival.

The absence of high streamflows during spring in the FERC flow regime (Figure 4) is considered by resources agencies and Tribal biologists to be a significant contributor to the continued decline of the Tribal Trust Species (Higgins et al. 1992, Elliott 1995, Belchik 1996). By including high monthly streamflows during April, May and June in the Tribal Trust streamflow regime, we expect to substantially increase smolt survival.

Summer Streamflows

Currently, low streamflows, elevated water temperatures and low dissolved oxygen concentrations typify mainstem habitat conditions in the Klamath River during summer. These conditions adversely affect the quality of juvenile rearing habitats and have likely contributed to low survival rates for juvenile coho and steelhead. Both coho salmon and steelhead populations are in decline and have been proposed for listing as “threatened” under the federal ESA.

5 Juvenile salmonids undergo physiological changes that allow them to transition from fresh water to salt water environment. In addition to the internal physiological changes, their outward appearance also changes and they become more silvery. These changes begin in freshwater and are completed in saltwater. Fish undergoing this transformation are called smolts.

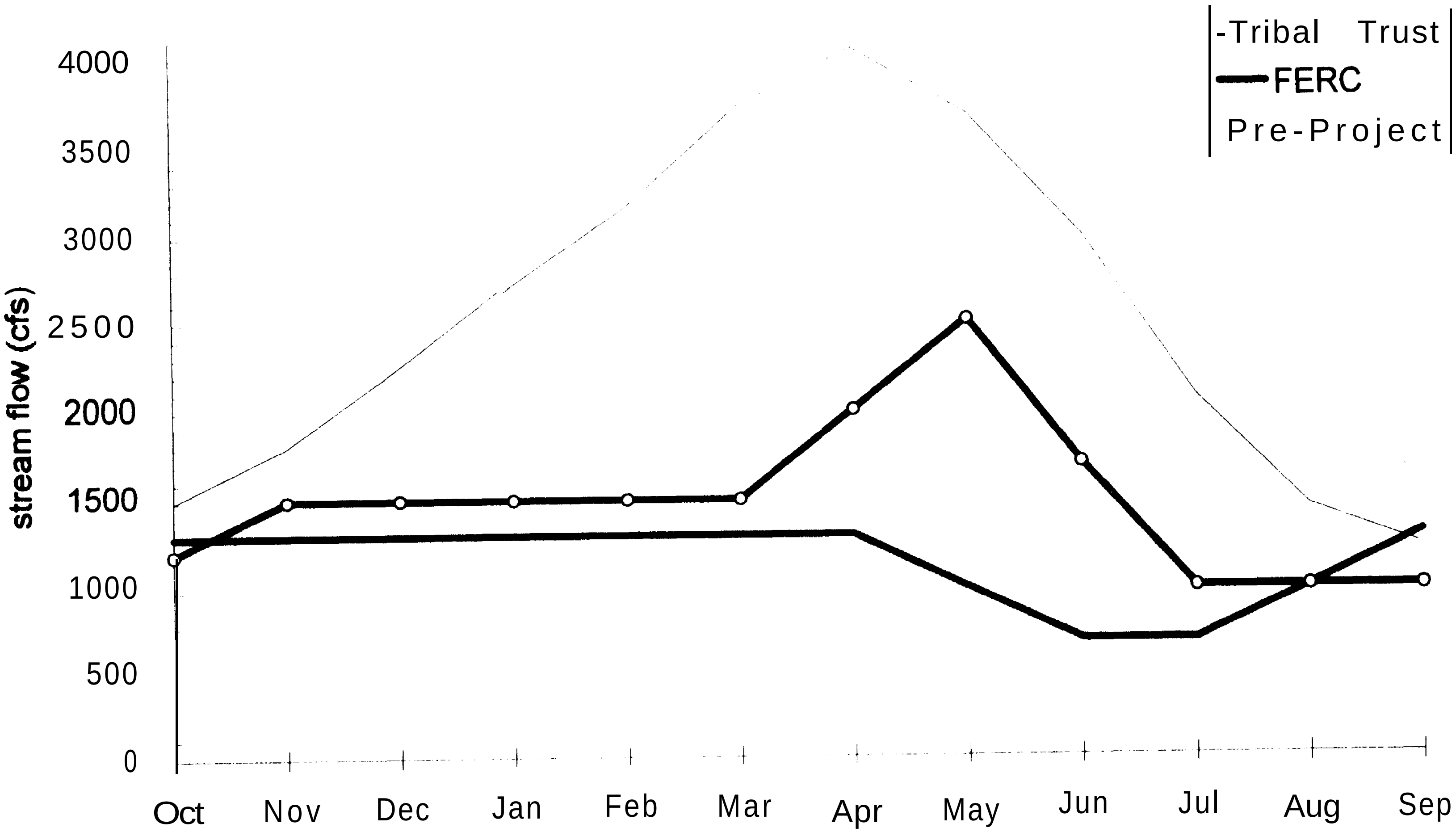

Figure 4. Comparison Between FERC Minimum Streamflow Requirements and Tribal Trust Instream Flow Requirements at Iron Gate Dam

Prior to the Klamath Project, the lowest streamflows of the year (near Iron Gate Dam) would occur from August through October, with September being the month of lowest streamflow. Average monthly pre-Project strearnflows for August, September and October have been estimated as being 1,700 cfs, 1,400 cfs, and 1,450 cfs, respectively (Balance Hydrologies 1996). Today, the lowest streamflows of the year occur from June to September with July being the month of lowest streamflow (refer to Figure 1). As a result of low streamflows occurring earlier and persisting throughout the hottest time of year, main channel habitat conditions are substantially degraded from natural conditions and even from those conditions which existed approximately 35 years ago.

In recent years, compliance with the FERC minimum flow regime has typically resulted in summer streamflows between 700 and 750 cfs. During the drought of the late 1980's and early 1990's summer streamflows were often closer to 500 cfs than the FERC minimum flows (CH_2M Hill 1995a). Wales (1944) reported that streamflows of 500 cfs or less would be severely damaging to fish populations in the Klamath River.

Important biological activities occurring in the mainstem during the summer months are: late outmigration of some salmonid smolts; rearing of coho salmon, steelhead, lamprey and sturgeon; adult spring chinook and early fall chinook holding; and half-pounder rearing.

The purpose, of the Yurok Tribe flow regime during summer is to provide minimum acceptable habitat conditions in the mainstem Klamath River. The specific objectives of the summer instream flow releases are to: (1) reduce the growth of aquatic plants and algae, (2) provide additional wetted area and surface turbulence in riffles, and (3) provide a larger volume of water in the river channel to decrease the amplitude of daily stream temperature cycles. To accomplish these purposes and objectives, we have identified a minimum summer streamflow of 1,000 cfs.

The growth of aquatic plants and algae in the river channel can retard velocity at low streamflows and contribute to higher stream temperatures. Extensive algae growth also causes pronounced daily fluctuations in dissolved oxygen concentration resulting in stressful conditions for salmonids. Higher streamflows should result in greater surface area and turbulence at riffles to increase the entrainment of dissolved gasses, thereby improving dissolved oxygen levels. Higher streamflows over riffle areas would also increasing living space for juvenile steelhead and chinook salmon.

Under the present conditions, undesireably warm water temperatures often occur in the mainstem Klamath River during late summer. Low streamflows exacerbate the water temperature problem by favoring larger fluctuations in stream temperature. A small volume of water is more easily heated and cooled thereby resulting in higher maximum and cooler minimum daily stream temperatures.

The anticipated effect of the Yurok Tribe’s flow regime on Klamath River streamflows at Iron Gate can be inferred from Figure 5. Little change is expected in existing streamflows during the winter and spring months (October through April), but existing summer streamflows (May through August) are expected to increase.

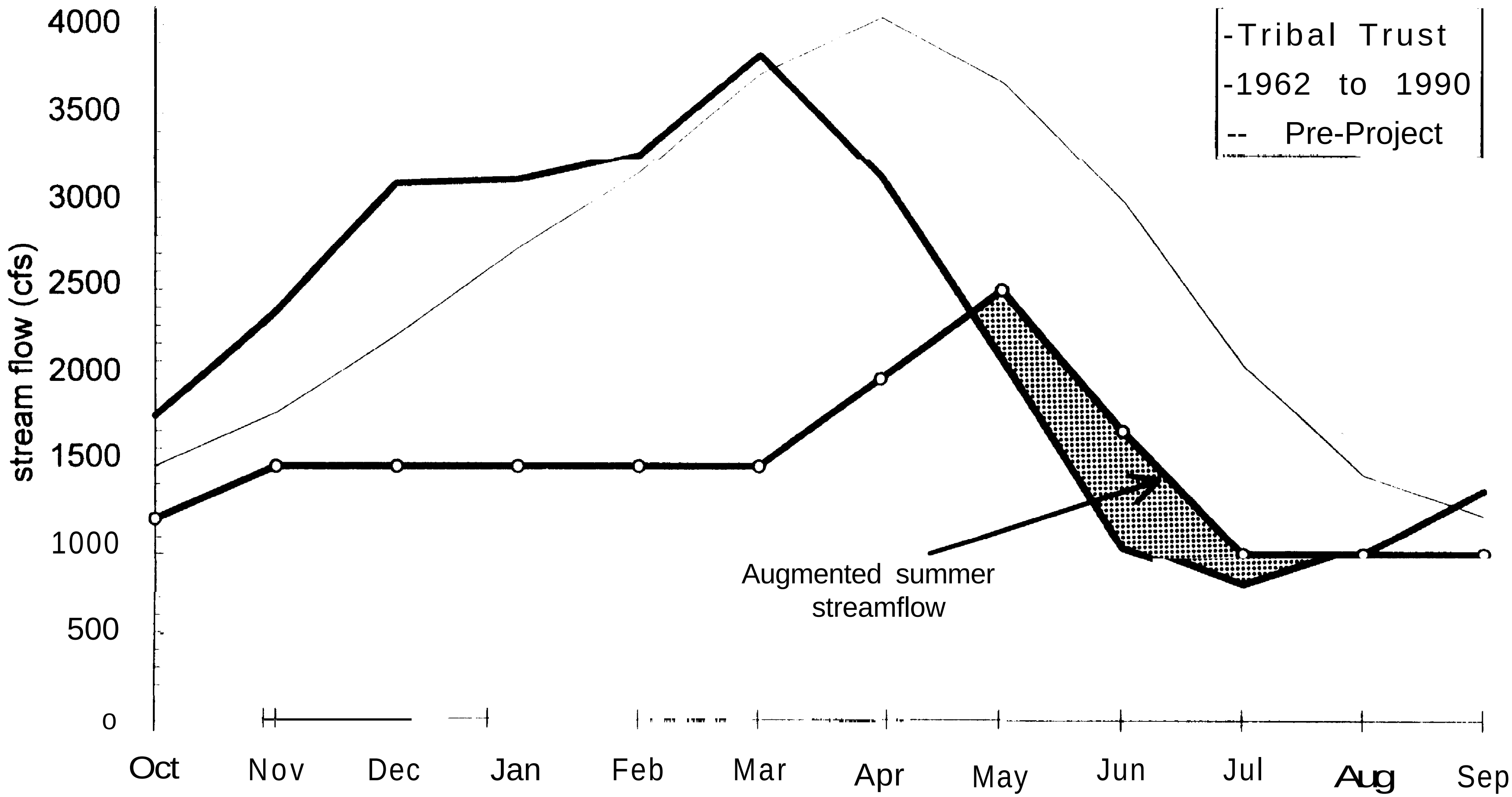

Figure 5. Comparison between existing monthly streamflows at Iron Gate Dam and Tribal Trust Instream Flow Requirements.

6.0 SUMMARY

Existing habitat conditions in the mainstem Klamath River have proved inadequate to support the Tribal Trust Species. The operation of Iron Gate Dam and upstream water diversions have resulted in a streamflow pattern which is unnatural and incapable of providing essential habitat during the spring and summer months. Thus, continuing to operate the Klamath Project as in the past, will do nothing to reverse the decline of Tribal Trust fish populations.

The flow regime developed by the Yurok Tribe better represents the natural streamflow pattern during spring and summer and provides additional necessary streamflow for those life history stages dependent upon the mainstem Klamath River during this period. Implementation of the Yurok instream flow regime is necessary to improve the quality of mainstem habitats to better meet the needs of the Tribal Trust Species dependent on these habitats. The flow regime developed by the Yurok Tribe will provide greater streamflow during spring to assist juvenile fish migrating downstream and during summer to ameliorate undesirable temperature and dissolved oxygen conditions. The degree of improvement that will result in these populations can best be assessed by implementing the flow regime and then systematically monitoring the responses of juvenile and adult fish.

It is worth noting that the populations of those fish species with life history stages dependent on summer habitat are the most depressed. Both coho salmon and steelhead are proposed for listing as threatened under the ESA and both coho salmon and steelhead require rearing habitat during the summer months for juvenile fish. The mainstem Klamath River provided rearing habitat for both of these species. Summer flows in the Klamath River have been reduced by the operation of the Klamath Project. The Yurok instream flow regime described in this report increases spring and summer flows which we expect will have direct benefits to rearing coho salmon and steelhead juveniles.

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