Klamath River (Iron Gate Dam to Seiad Creek) Life Stage Periodicities for Chinook, Coho and Steelhead

U.S. Fish and Wildlife Service
Coastal California Fish and Wildlife Office
Arcata, California

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LIFE STAGE PERIODICITIES FOR CHINOOK, COHO, AND STEELHEAD

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Prepared by:

Department of Interior
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Coastal California Fish and Wildlife Office
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INTRODUCTION

This report is a compilation of historic and recent published and unpublished literature, field notes, and personal communications pertaining to life stage periodicities for races of chinook salmon (Onchorhynchus tshawytscha), coho salmon (O. kisutch) and steelhead trout (O. mykiss) in the Klamath River, northern California. Periodicity information is necessary to evaluate the effects of magnitude, duration and timing of discharge from Iron Gate Dam on microhabitat for anadromous salmonids of interest in the Klamath River.

In 1984, periodicities for anadromous salmonids were described for the entire Klamath River Basin based on a round table discussion among personnel of the U.S. Fish and Wildlife Service, U.S. Forest Service, California Department of Fish and Game and several private consulting firms (USFWS 1984a). Since 1984, additional information has been collected by numerous agencies which will aid in refining the periodicities described in that report.

Currently the United States Geological Survey, Midcontinent Ecological Science Center (USGS) and the U.S. Fish and Wildlife Service, Coastal California Fish and Wildlife Office (CCFWO) are in the process of quantifying the microhabitat available for each life stage of chinook salmon, coho salmon and steelhead trout that utilize the Klamath River between Iron Gate Dam (306.1 rkm) and the confluence of Seiad Creek (209.6 rkm). Periodicity information collected for this report focused on this study reach. This updated and more complete periodicity information will be used in conjunction with life stage specific discharge versus microhabitat relationships to assess the effects of alternative flow regimes on anadromous salmonids below Iron Gate Dam.

Study Area

The study area, Iron Gate Dam to the confluence of Seiad Creek, covers 96.5 river kilometers (rkm) of the mainstem Klamath River (Figure 1). Other locations on the map relevant to information included in the report such as weir, hatchery and juvenile trap locations, harvest areas, and other field investigations.

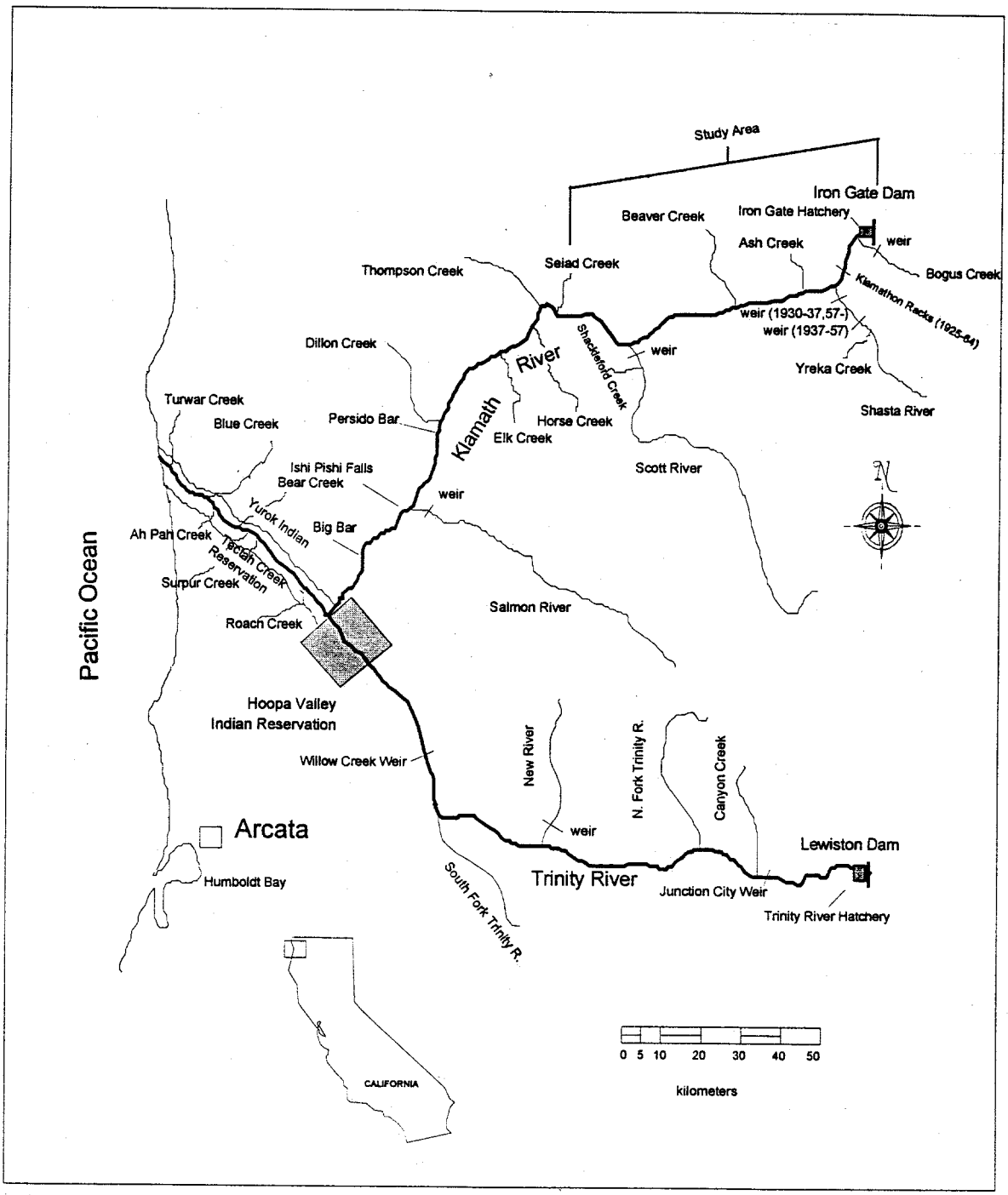

Figure 1. Map of the Klamath-Trinity River Basin showing locations of USFWS flow study area, weir sites (Bogus Creek, Junction City, Klamathon Racks, New River, Salmon River, Scott River, Shasta River, Willow Creek), hatcheries, and tributaries referenced in the periodicity report.

METHODS

The hierarchy for information gathering began with the attempt to acquire raw data from the source agency relative to the Klamath River mainstem and tributaries entering the mainstem within the study area (Table 1). This information was supplemented by reports pertinent to other areas within Klamath (Table 2). When data related to the Klamath was unavailable, information was obtained from studies conducted on the Trinity River (Table 3).

The most recent years of data were selected when available. Historical run timing (pre-Iron Gate Dam) was available for adult fall chinook, coho and steelhead holding and migration only. Data was presented as mean percent of season total to emphasize timing, not magnitude. References have not been included in this section but are listed throughout the body of the report.

Holding and Migration

Tribal harvest monitoring data collected by CCFWO and the Yurok Tribe Natural Resources Department (YTNRD) and beach seining conducted by California Department of Fish and Game (CDFG) were used to determine the timing of adult fall chinook (adults and jacks), coho and steelhead (adults and half pounders) moving through the lower Klamath River (Highway 101 bridge area to the confluence of the Trinity River). Weekly counts from Iron Gate Fish Hatchery (IGH) and weirs located in Bogus Creek, Shasta River and Scott River were used to determine the run timing of adults to the hatchery and tributaries. Runback steelhead timing was based on New River (Trinity River tributary) weir operations. Snorkel surveys conducted during the summer months by the U.S. Forest Service (USFS) in tributaries within and below the study reach provided timing information for spring chinook and summer steelhead. Carcass survey data was not included in this report.

Using comparisons between the movement through lower Klamath River, and the entrance into tributaries, inferences were made on holding and migration timing. Sport fishermen and guides were also interviewed to substantiate these findings. Adult chinook, coho and steelhead counts recorded at the Klamathon (chinook and steelhead only) and Shasta Racks were used as a historical (pre-Iron Gate Dam) baseline.

Spawning

Mainstem fall chinook spawning information was obtained from CCFWO redd survey data. These surveys determined the location, magnitude and timing of spawning fall chinook from Iron Gate dam to the confluence of Indian Creek. Information on mainstem Klamath River spring chinook spawning was unavailable. Timing for spring chinook spawning was obtained from the CDFG Trinity River salmon and steelhead monitoring program.

Coho and steelhead spawning information is limited for the mainstem Klamath River. Coho information was obtained from literature sources and interviews with CCFWO and USFS personnel. Steelhead spawn timing was determined from tributary redd surveys conducted by USFS and information presented in the Klamath River Stock Identification Committee report to the Klamath River Task Force.

Table 1. Sources of information, pertinent to the Klamath River mainstem and tributaries entering the mainstem within the study area, which were used to identify the timing of adult holding and migration (X), spawning (S), emergence (E), and juvenile rearing and emigration (O) of salmonids.

Source Agency	Type of Operation	Location (rkm)	Years Evaluated [a]	SPECIES		
				Chinook	Coho	Steelhead
CDFG	Weir - Klamathon	114.4	1939-1958	X		X
CDFG	Weir - Shasta Racks	0.8 - 10.4 [b]	1949-1957	X	X	X
CDFG	Fish Ladder - IGH	305.0	1973-1995	X	X	X
CDFG	Weir - Bogus Creek	0.8 [c]	1981-1994	X	X	
CDFG	Weir - Scott River	0.8 [d]	1982-1991	X	X	X
CDFG	Weir - Shasta River	0.8 [b]	1980-1995	X	X	X
CDFG	Snorkel Surveys - Scott River	< 0.1 [d]	1993-1995	X		X
USFS	Snorkel Surveys - Scott River		1995	X		
CCFWO	Redd Surveys	171.7-305.0	1993-1996	S,E	S	
USFS	Redd Surveys	Various Locations	1988-1989			S
CDFG	Downstream Migrant Trap - Bogus Creek	0.8 [c]	1986-1990	O	O,E	O,E
CDFG	Downstream Migrant Trap - Shasta River	0.8 [b]	1986-1989	O	O,E	O,E
CCFWO	Downstream Migrant Trap - below Scott River	230.0	1994	O	O	
CDFG	Beach Seining	170.5-305.1	1984-1985	O		O

[a] specific years used for each species and life stage are included in the body of the report
[b] from the mouth of Shasta River (rkm 284.1)
[c] from the mouth of Bogus Creek (rkm 305.1)
[d] from the mouth of Scott River (rkm 230.1)

Table 2. Sources of information, pertinent to the Klamath River outside the study area, which were used to identify the timing of adult holding and migration (X), and juvenile rearing and emigration (O) of salmonids.

Source Agency	Type of Operation	Location (rkm)	Years Evaluated [a]	Species		
				Chinook	Coho	Steelhead
CCFWO	Harvest Monitoring	0.0 - 70.0	1981-1992	X	X	X
CCFWO	Beach Seining	0.4	1987-1988		X	
CDFG	Beach Seining	3.6-5.2	1984-1987		X	X
YTNRD	Harvest Monitoring	0.0 - 70.0	1995-1996			X
USFS	Snorkel Surveys	Various[b] Tributaries	1994-1995			X
CCFWO	Downstream Migrant Trap - Big Bar	81.0	1992-1995	O	O	O
CCFWO	Downstream Migrant Trap - Presido Bar	131.0	1994	O	O	
USFS	Downstream Migrant Trap - Elk Creek (rkm 170)		1994	O		O

[a] specific years used for each species and life stage are included in the body of the report.

[b] tributaries below study reach: Indian Creek, Dillon Creek, Clear Creek, Salmon River et al.

Table 3. Sources of information, pertinent to the Trinity River, which were used to identify the timing of adult holding and migration (X) and spawning (S) of salmonids.

Source Agency	Type of Operation	Location (rkm)	Years Evaluated [a]	Species		
				Chinook	Coho	Steelhead
CDFG	Weir - Junction City	127.3 [b]	1989-1992	X,S		
CCFWO	Weir - New River	3.5 [c]	1994			X

[a] specific years used for each species and life stage are included in the body of the report

[b] from the mouth of the Trinity River (rkm 70)

[c] from the mouth of New River (rkm 70.1 from the mouth of the Trinity River)

Emergence

Emergence timing of fall chinook salmon in the mainstem Klamath River was calculated based on daily temperature units required for emergence and timing of fall chinook spawning in the mainstem Klamath

River. Because coho and steelhead redd information on the mainstem was not available, fork length information gathered from CDFG downstream migrant trapping results on Bogus Creek and Shasta River was instead used to estimate emergence timing. Fry coho with fork lengths (FL) of 30-35 mm and steelhead (FL = 21-30 mm) indicated recent emergence. Recent emergence of chinook in these tributaries was also estimated using information from the CDFG downstream migrant traps (FL = 25-30 mm).

Juvenile Rearing and Emigration

Presence and timing of chinook, coho and steelhead juveniles were determined from tributary emigration studies conducted by CDFG on Bogus Creek and Shasta River. CDFG also conducted beach seining in the mainstem within the study area. This information was compared with emigration data collected by CCFWO in the Big Bar emigration trapping operation (1992-1995) located 80 river kilometers from the mouth of the Klamath River. Data was also obtained from cooperative (CCFWO, USFS, and Karuk Tribe) emigration trapping operations conducted just below the Scott River and at Presido Bar in 1994. By comparing the movement of outmigrating juveniles from the tributaries and the timing through the Big Bar emigration trap on the mainstem Klamath, inferences were made on the timing of juveniles through the study reach.

RESULTS

Holding and Migration

Chinook Salmon

Fall Chinook

Fall Chinook enter the mouth of the Klamath River in early to mid-July. Coded wire tag results collected by CCFWO during tribal gill-net harvest monitoring indicate that fall chinook enter the estuary during the month of July (USFWS 1989). Fall chinook harvest from the mouth of the Klamath River to the confluence of the Trinity River typically peaks in early September and tails off in early October (USFWS 1988-89, 1991-92, 1994a, Figure 2). While harvest information gives an indication of when chinook are migrating through the lower Klamath River, the inclusion of Trinity River fall chinook may influence overall timing.

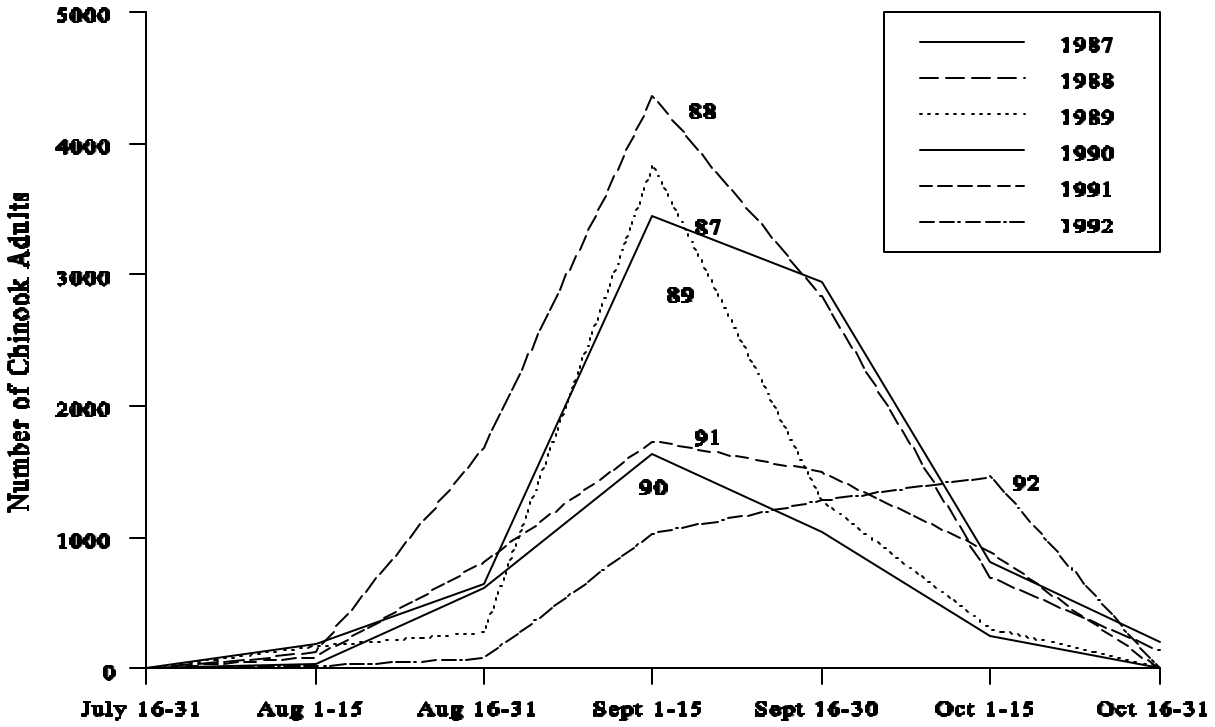

Figure 2. Fall chinook harvest on the Yurok Indian Reservation between the 101 bridge (above the Klamath River estuary) and the confluence of the Trinity River, 1987-1992 (USFWS 1988-89, 1991-92, 1994a).

Recent information is lacking for chinook migration and timing through the Klamath River mainstem, upstream of the confluence of the Trinity River. Historically, observations of fall chinook were made at the Klamathon Racks, a California Department of Fish and Game (CDFG) weir operated on the mainstem (rkm 114.4), from 1925 until the early sixties (CDFG 1962). With the exception of the 1933 season, chinook salmon eggs were taken annually until 1940, when the racks became primarily a counting facility. The earliest count of chinook passing through the weir was August 18, 1940. Peak daily fish counts occurred in mid to late September of each year (Figure 3). Data for other years between 1925 and the early sixties was not readily available.

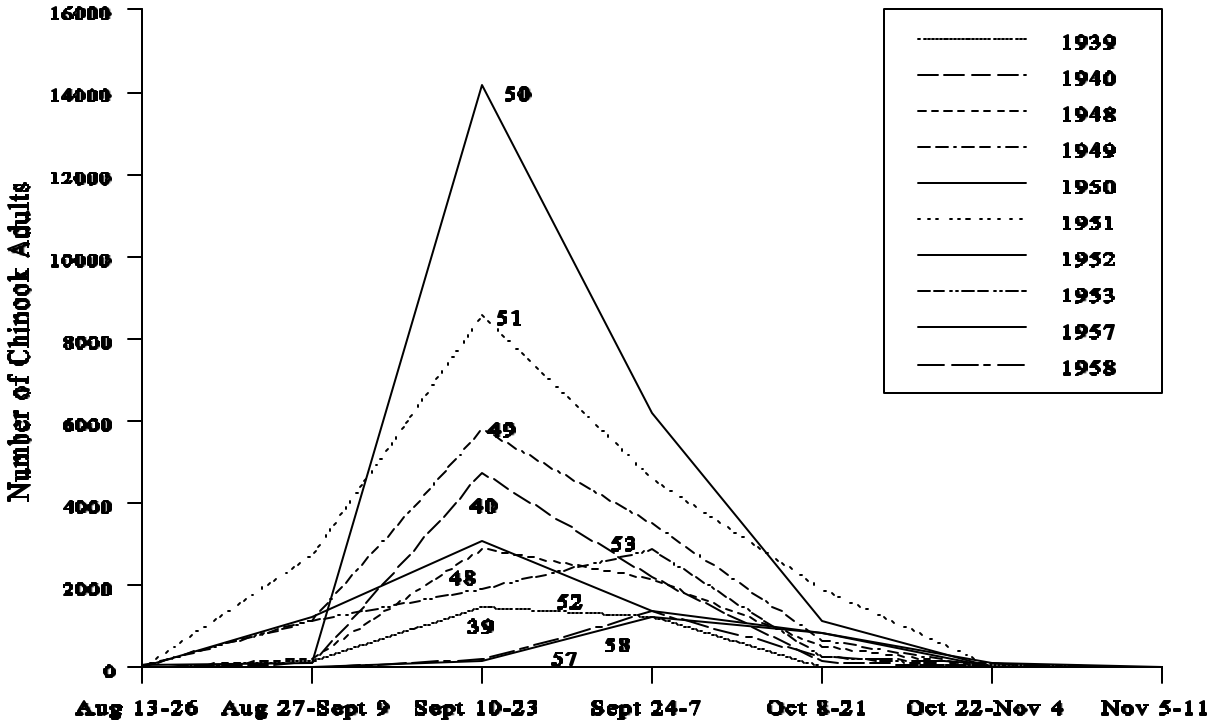

Figure 3. Fall chinook adults captured at the Klamathon Racks, a CDFG weir between 1939 and 1958 (CDFGe, 1953b, 1962).

On the Shasta River, historical observations were made at the Shasta Racks, located approximately .8 rkm above the mouth (1930-1934, Brown, 1938). In 1938 the weir was moved upstream to a steelhead egg collecting station 10.4 rkm above the mouth (CDFG 1958). Chinook salmon were generally seen at the mouth of the river seven to ten days before being observed at the weir site. The counts at this locality furnished only a partial count of chinook that entered the river. Field observations of spawning activity indicated that the majority of fish spawned below this location. In 1957, the weir was again relocated approximately .8 rkm above the mouth. The earliest date chinook were observed at the mouth (1949-1957) was September 1 (1955) while the earliest observation at the weir was on September 10 (1953). Peak numbers were counted in October and had dropped off by the time the weir was pulled at the end of October each year (CDFG 1950, 1952, 1953a, 1955, 1958).

Counts collected by CDFG at Iron Gate Fish Hatchery (CDFGa, 1993, 1994a), Bogus Creek weir (CDFGb), Shasta River weir (CDFGd) and Scott River weir (CDFGc) show more recent timing of fall chinook migration. During the five most recent years of operation at these locations migration began during the second or third week of September with peak numbers occurring in mid-October (Figure 4). The current peak migration appears to occur one to four weeks later than historic run timing at Shasta and Klamathon Racks (before construction of Iron Gate Dam). Information collected at weirs and fish ladders does not address fish migration and holding below the tributary confluences and counting stations. In addition, the run timing of hatchery chinook is directly related to operation of the fish ladder, which may open and close throughout the season. Recent snorkel surveys (1993-1995) at a pool near the mouth of the Scott River found chinook holding through mid-December (Lau, CDFG, personal communication, 1996). Information was lacking on returns to other tributaries in the study area.

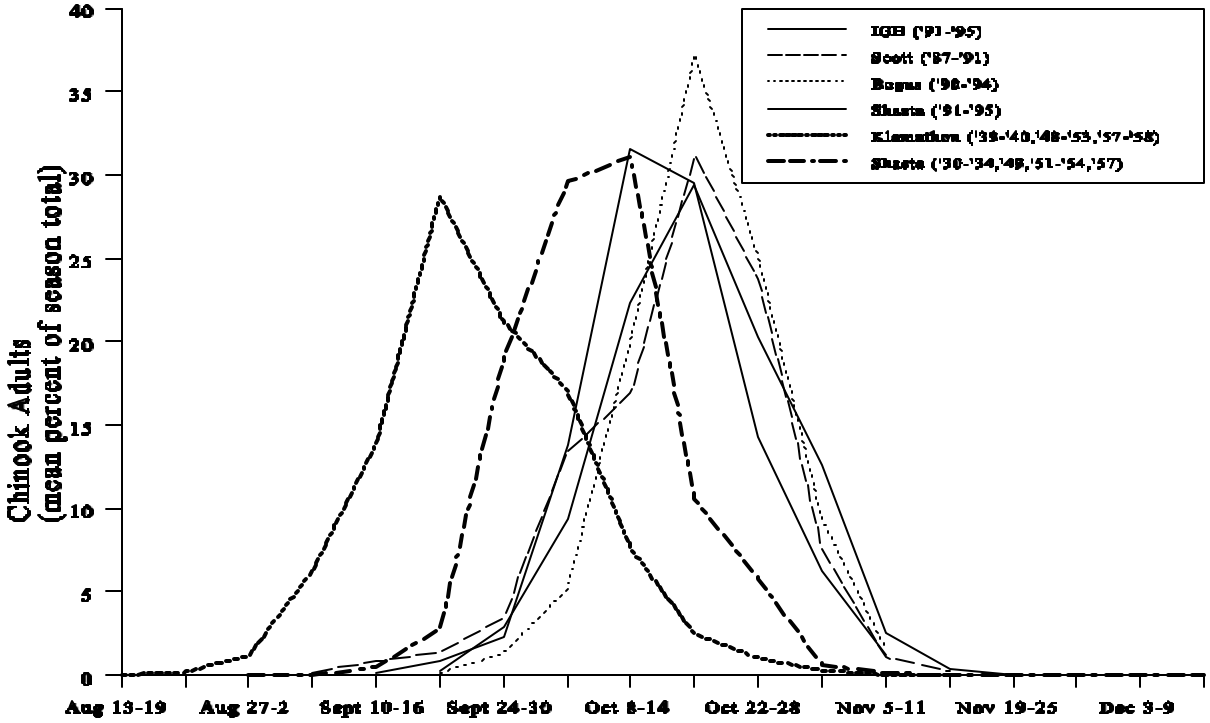

Figure 4. A comparison of fall chinook adult historic timing at Klamathon Racks (CDFGe, 1953b, 1962) and Shasta Racks (Brown, 1938; CDFG 1950, 1952, 1953a, 1955a, 1958) with current timing at Iron Gate Fish Hatchery (CDFGa, 1993, 1994a), Bogus Creek weir (CDFGb), Shasta River weir (CDFGd) and Scott River weir (CDFGc) presented as mean percent of season total (includes jacks).

Fall Chinook Jacks

Fall chinook jacks are precocious (reproductively mature) two year old males and are a common occurrence among salmon. Jacks migrate upstream along with mature adults and spawn either with an unpaired female or by sneaking into redds to release sperm simultaneously with a mated pair (Moyle

and Cech 1988). The contribution of jacks to the total fall chinook run varies from year to year but their migrational patterns generally coincide with the adult migration (Figure 5a-d). Peak migration timing may also shift one or two weeks in either direction depending on the location and year (note the differences in peak migration timing between Figure 4 and Figure 5a-d). The migration into the tributaries for both jacks and adults, begins during the second week of September with peak numbers occurring in October.

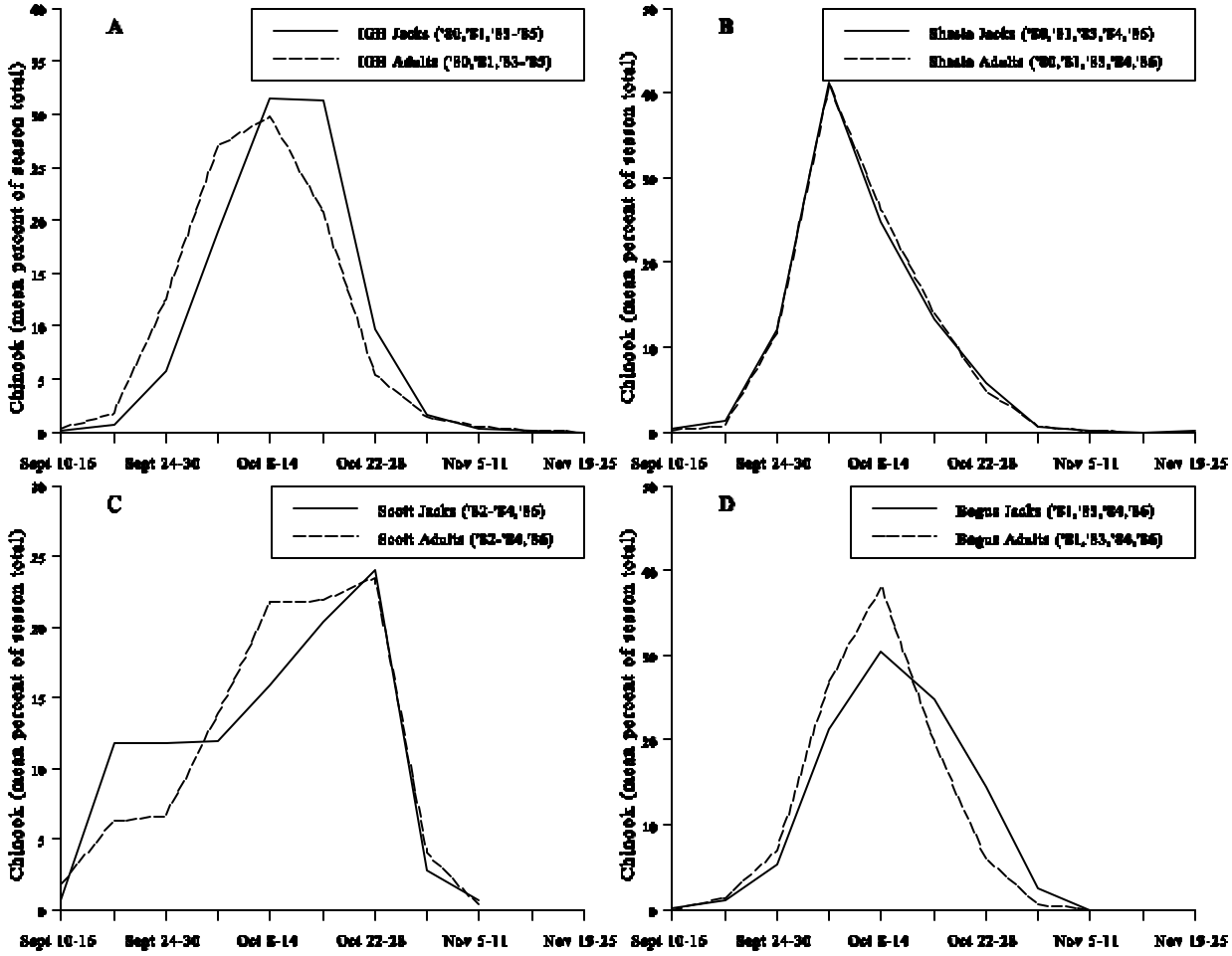

Figure 5. A comparison of fall chinook adult and jack run timing at A) IGH (CDFGa, 1982b, 1983, 1985, 1987a), B) Shasta River weir (CDFGd), C) Scott River weir (CDFGc), and D) Bogus Creek weir (CDFGb) presented as mean percent of season total.

Spring Chinook

Spring chinook used to be the dominant run on the Klamath River, however, by the early 1930's the run was greatly depleted. In 1935, attempts to reestablish the spring run were undertaken by The Division of Fish and Game (Snyder, 1936). They obtained eggs from the Columbia River in an exchange

program with the state of Oregon. These eggs were held and hatched at the Fall Creek Hatchery on the Klamath River. Historically, the run began in early spring, with the peak occurring in August. The California Department of Water Resources (1965) indicated "The spring salmon migration in the Klamath River system was once very great, but it has now become reduced, and is of considerably less economic importance."

Small numbers of wild spring chinook returned to IGH and were successfully spawned from 1973 through 1976 (CDFG 1975, 1977a, b, c). In 1975, 53 spring chinook were captured at IGH between July 2 and August 18. In 1977 their were no spring returns to the hatchery (CDFG 1979). In 1978, 17 spring chinook returned to the hatchery but none were successfully spawned (CDFG 1982a). This was the last year spring chinook returned to the hatchery.

During a 1995 Scott River spring chinook/summer steelhead holding survey two spring chinook were observed (USFS 1995). Other infrequent sightings of spring chinook in upper Klamath River tributaries (Beaver Creek, Grider Creek, mouth of Bogus Creek and Scott River) by Forest Service personnel were also confirmed (USFS 1995).

Due to the lack of information on spring chinook in the upper Klamath River, the timing and magnitude of the run was generated from other sources. USFWS (1990) stated that spring chinook begin entering the Klamath River mouth as early as February, with the timing of the typical run occurring from late March to mid-June (based on observations made by the Service=s net harvest monitoring crews). The report also states that spring chinook have been observed in holding pools on the Salmon River as early as June.

Coded wire tag results collected by CCFWO (1988) during tribal gill-net harvest monitoring indicated that some spring chinook from Trinity River Hatchery were still in the estuary as late as July (USFWS 1989). On the Trinity River, spring chinook peak migration through the CDFG, Junction City weir occurs in late June, early July (CDFG 1992a, 1992b, 1994c, 1995). By early to mid-September, the spring run had passed the weir site (1989-1992).

Coho Salmon

Information on the migration and holding patterns of coho salmon within the study reach is also limited. During CCFWO beach seining operations, at the mouth of the Klamath River, the first coho was captured on September 9 in 1987 (USFWS 1988) and September 1 in 1988 (USFWS 1989). In 1987 the majority of coho were captured during the week of September 28-October 2 (n=69) with the peak seine catch of 27 fish occurring on September 28. Only 19 coho were captured during the 1988 beach seining operation. Since beach seining targeted fall chinook and operations were usually completed by the end of September, the peak of the coho run was not determined. Adult coho were first captured during seining operations (3.6 - 5.2 rkm) conducted by CDFG (1984-1987) in the third week of September (CDFG 1988). The CDFG seining efforts were terminated before the peak of the coho run but it was assumed by CDFG that the peak coho migration through the seining location occurred in mid-October (CDFG 1988).

Coho are caught during the fall chinook net harvest season which runs from August 1 to October 31 in the Department of Interiors Management Area II (USFWS 1985). In this area (Surpur Creek to the confluence of the Trinity River) small numbers of coho are first captured in early September and are still actively migrating through the area at the end of the harvest season (Figure 6, USFWS 1982-83, 1984b, 1985-89).

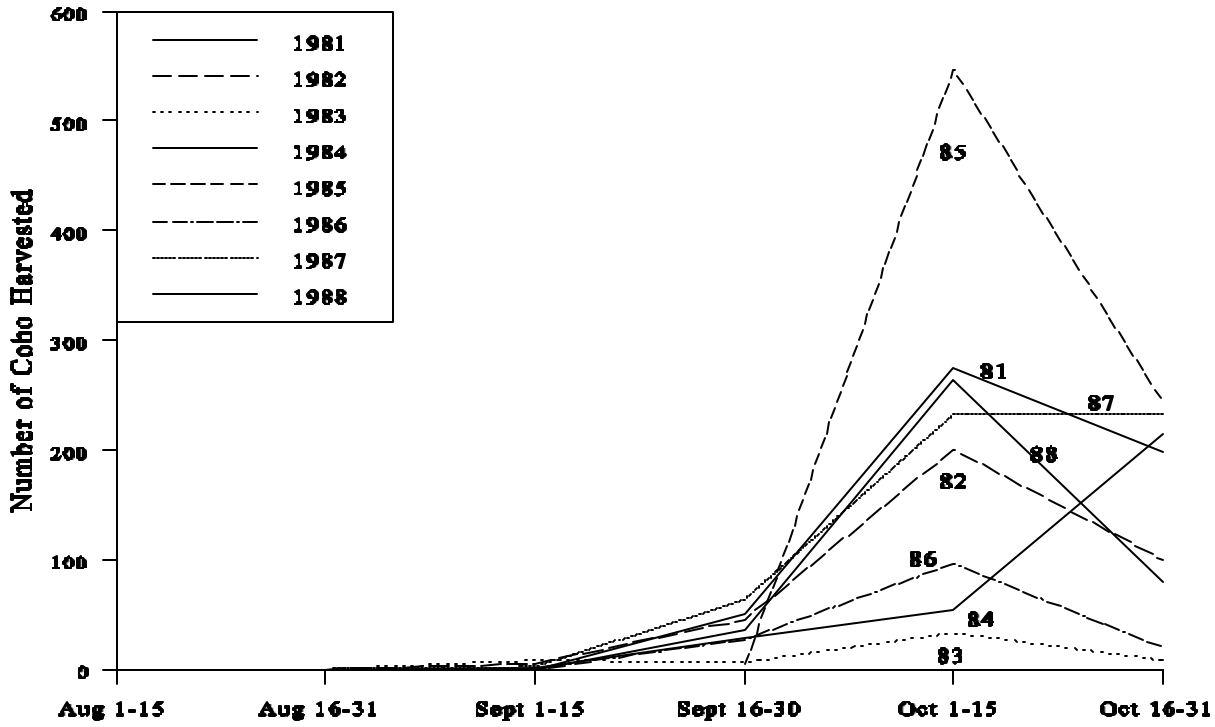

Figure 6. Coho harvested from Surpur Creek to the confluence of the Trinity River during the fall chinook net harvest season, 1981-88 (USFWS 1982-83, 1984b, 1985-89).

Timing of adult returns to tributaries with CDFG counting weirs and IGH was used to approximate entrance timing into the study area (Figure 7). Coho adults entered IGH (1991-1995) during the third week of October, peaked during the first two weeks of November and tailed off by the end of December (CDFGa, 1993, 1994a). Small numbers of coho were counted by CDFG at Bogus Creek (1981, 1991-93; CDFGb), Shasta River (1978-80; CDFGd) and Scott River weirs (1983-84, 1986-87; CDFGc) beginning in late September at Bogus and early October at Scott and Shasta (Figure 7). Current data for Shasta River weir (1991-1995) was not included because only 55 coho were captured during those years, half of which were captured by early October.

The Shasta River weir was operated through the second week of January (1978-1980) and coho adults were captured through the end of December. Late runs of coho into Bogus Creek and Scott River may have been missed, since the operations on these tributaries ended in November.
Limited historical information on coho run timing was collected by CDFG at the Shasta Racks (1949, 1951, 1953, 1957) but usually this operation was concluded by the end of October (CDFG 1950, 1952, 1953a, 1958). In 1949, when the weir was operated from September 12 through January 20 small numbers of coho were captured from October 24 to December 18 (CDFG 1950).

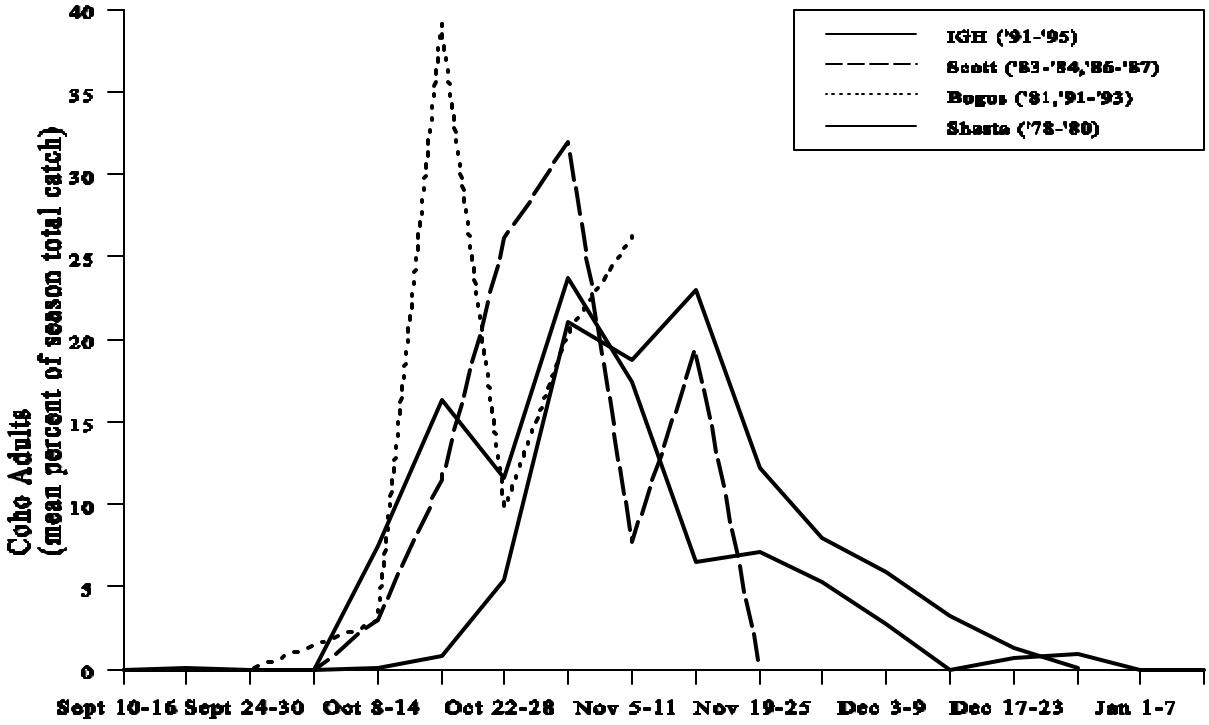

Figure 7. Coho adults counted by CDFG at IGH (1991-1995; CDFGa, 1993, 1994a), Bogus Creek weir (1981, 1991-93; CDFGb), Shasta River weir (1978-80; CDFGd) and Scott River weir (1983-84, 1986-87; CDFGc) presented as mean percent of season total.

Steelhead

Adult steelhead may migrate into the Klamath River throughout the year. Anglers catch adults (greater than 22 inches) in the Klamath River during every month of the year according to CDFG Steelhead Report-Restoration Card Surveys (Jackson 1996, personal communication). Steelhead are divided into summer (spring), fall and winter races (KRSIC 1993, CDFG 1987b, USFWS 1984a, USFWS 1979) based on their time of entry into the basin and to some extent, where they hold after entry (KRSIC 1993). Because very little information is available on the timing of the three races in the Klamath River Basin, discrepancies exist between reports that have attempted to describe them (Table 4).

Some authors recognize two races of steelhead on the Pacific Coast based on the state of sexual maturity at time of entrance (Burgner et al. 1992; NMFS 1994; CDFG 1996). The summer-run enters between May and October and matures in river while the winter-run enters in a mature condition between November and April (NMFS 1994). This report will evaluate steelhead based on three races (summer, fall and winter) because these categories pertain specifically to the estuary and tributary entrance timing for the Klamath River.

Another life history stage which should be addressed is the Ahalf-pounder@ (Snyder 1925). Many Klamath River steelhead return to freshwater 3 to 4 months after initial juvenile entrance into salt water. These half-pounders (250-344 mm) are unique to streams located in extreme northern California and southern Oregon (CDFG 1987b, Kesner and Barnhart 1972).

Table 4. Timing of spring, fall and winter race adult steelhead migration into the Klamath River as cited by four different reports.

Steelhead Race	KRSIC (1993)	CDFG (1987b)	USFWS (1984a)	USFWS (1979)
Spring/Summer	May - July	March -June	May - June	April - June
Fall	August - October	July - October	October - November	August - November
Winter	November - February	November - March	December - January	November - February

Summer Steelhead

There have been no tribal harvest or monitoring programs in recent years during the summer steelhead

migration period to verify the run timing suggested in Table 4. Little information exists regarding the presence of summer steelhead in the study reach. Two possible summer steelhead were observed on August 4, 1994 during a summer steelhead holding survey conducted on the Scott River (Kilgore, personal communication, 1996). Nels Brownel (USFS, personal communication, 1996) stated that Aspring@ steelhead have been observed in Beaver Creek (rkm 259). Kent Bulfinch (California In-River Sport Fishing Community Representative, personal communication, 1996) stated that there are few summer run steelhead, if any, in our study area mainly due to high water temperatures.

Annual snorkel surveys conducted by USFS in tributaries below the study reach (Indian Creek, Dillon Creek, Clear Creek, Salmon River et al.) find summer steelhead from July through September (Gerstung, personal communication, 1995 *in* USFWS 1996). Summer steelhead in the Shasta river are thought to have been eliminated due to degraded habitat and adverse summer water temperature conditions (KRBFTF 1991 *in* CDFG 1996).

Summer steelhead weir information collected during 1994 by the USFWS on New River, a tributary to the Trinity River (USFWS 1996), showed that summer steelhead entrance began in late March, with numbers peaking in late June through early July, 1994 (Figure 8).

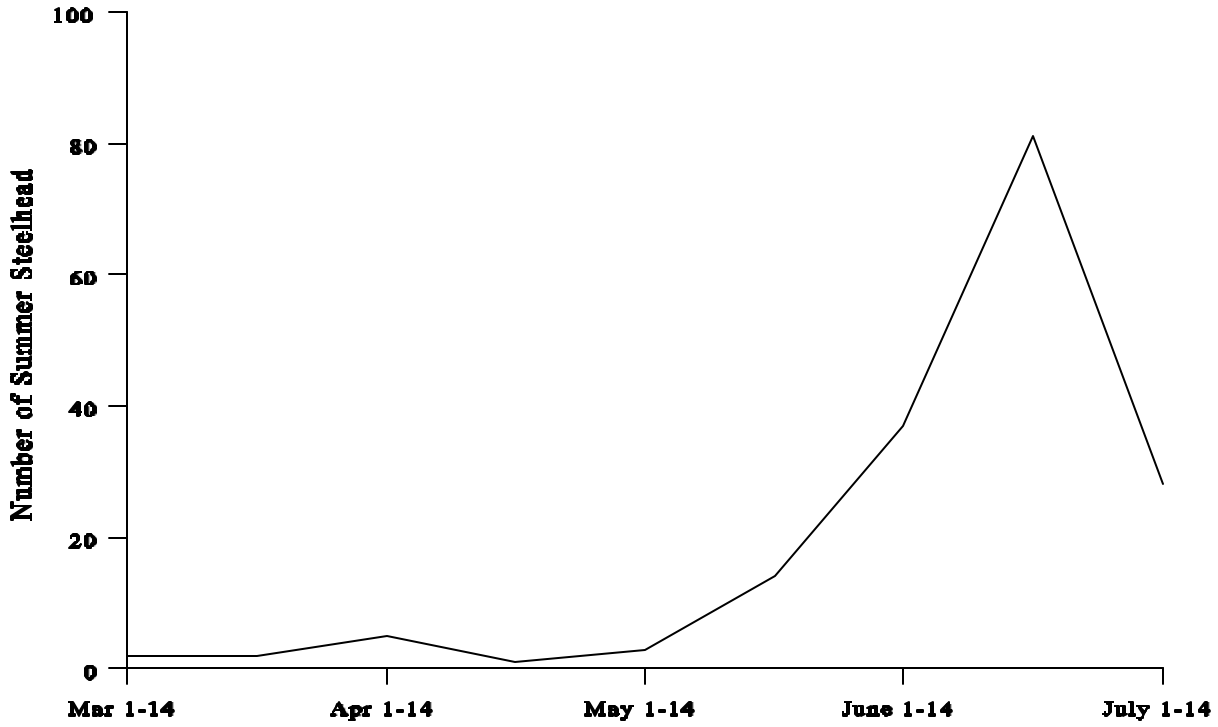

Figure 8. Summer steelhead counted at a resistance-board weir on New River (rkm 3.5), 1994 (USFWS 1996).

Fall steelhead

Small numbers of fall steelhead have been observed during net harvest monitoring in the Klamath River estuary as early as July (n=4, USFWS 1983; n=68, USFWS 1985; n=21, USFWS 1986; n=3, USFWS 1987; n=15, USFWS 1988). This is consistent with CDFG=s (1987b) suggestion for fall steelhead run timing (Table 4). Beach seining operations conducted by CDFG between 3.6 and 5.2 rkm from the mouth of the Klamath River captured steelhead in the estuary through mid-October (Figure 9, CDFG 1988).

Within the study area, adult steelhead migration timing was compared for IGH (1980-81, 1983-85, 1991-1995), Shasta River (1978-81, 1983-84, 1986, 1991-95) and Scott River (1982-84, 1986-91) (Figure 10). IGH entrance begins the second week of October and tails off by the last week of December (CDFGa, 1982b, 1983, 1985, 1987a, 1993, 1994a). Peak timing varies from year to year but generally occurs from late October to mid-November. Wild steelhead begin entering Shasta River (CDFGd) and Scott River (CDFGc) in mid-September and peak numbers are counted in mid-October. From 1978 through 1981 the Shasta River weir counted small numbers of steelhead through the end of December but this may have included winter run steelhead. For all other years (with available data) the weirs were not monitored past mid-November. Less than ten steelhead were captured in the Shasta River weir each season from 1991 to 1995.

Bogus Creek weir captured a total of 38 fall steelhead between the last week of September and the end of October in 1981, 1983-84, and 1986 (not included in Figure 10). Less than five steelhead were captured each season at this weir from 1990 to 1994.

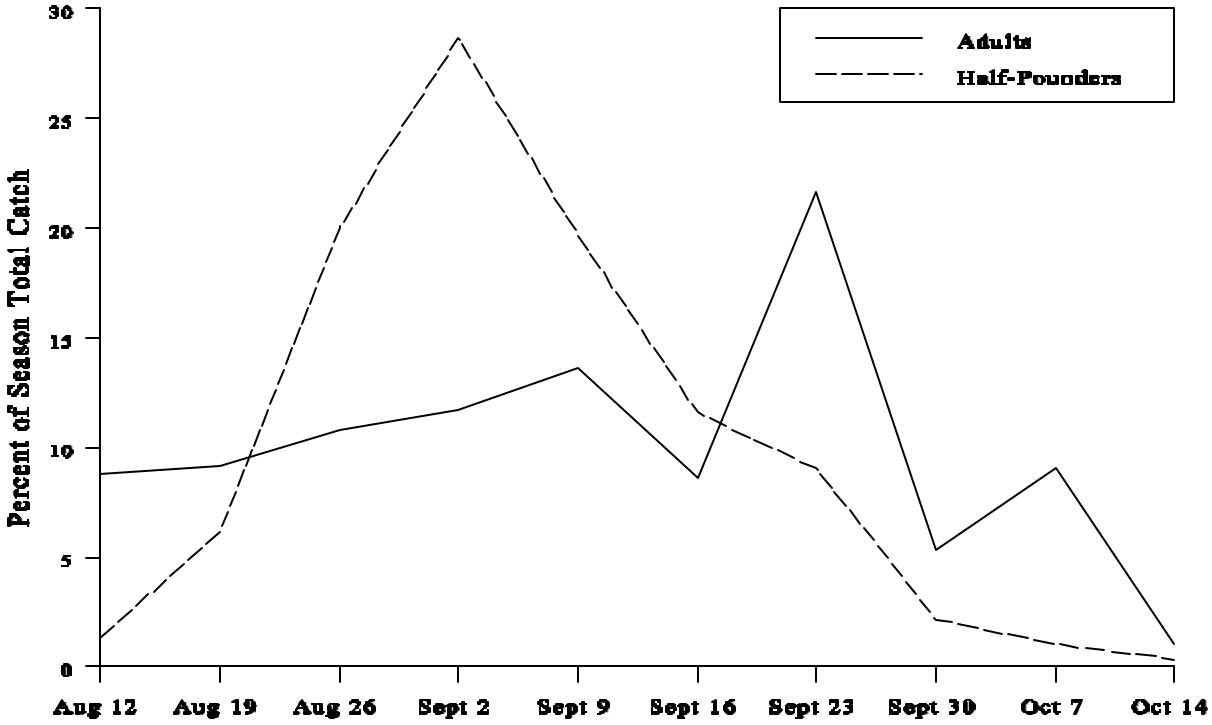

Figure 9. Adult steelhead and half-pounders captured during beach seining operations conducted by CDFG between 3.6 and 5.2 rkm from the mouth of the Klamath River, 1984-1987 (CDFG 1988) presented as mean percent of season total.

Historic fall steelhead counts at Klamathon racks (1939-40, 1952, 1954) are consistent with current timing at the Scott and Shasta River weirs while the peak historic count at Shasta Racks (1949, 1951-54, 1957) occurred two weeks earlier than the current peak count at Shasta River weir (Figure 10). The Klamathon and Shasta racks targeted chinook salmon and were usually shut down by the end of October with the exception of the 1949 season when Shasta racks remained in operation through the third week of January.

Winter Steelhead

Information regarding holding patterns and migration of winter steelhead is limited. Winter steelhead harvest on the Yurok Indian Reservation was monitored from December 17, 1995 to March 24, 1996 by the Yurok Tribe Natural Resources Department (Hillemeier, personal communication, 1996). Four hundred and ninety-nine steelhead were captured between the last week of December and the third week of March. The timing of the catch was highly dependent on flow conditions.

All steelhead which arrive at IGH after December 31 are termed Aspring@ steelhead (CDFG 1983). Each year Aspring@ steelhead are counted at IGH through early April but the fish ladder is only opened sporadically from January through April. Tributary weir operations, which primarily focus on fall chinook, are usually concluded before the entrance of winter steelhead. In 1981 the Shasta River weir

was operated through April 6. There was a three week gap between the fall and winter run into IGH but almost no distinction between the timing of the two races into Shasta River, during the 1980-81 season (Figure 11).

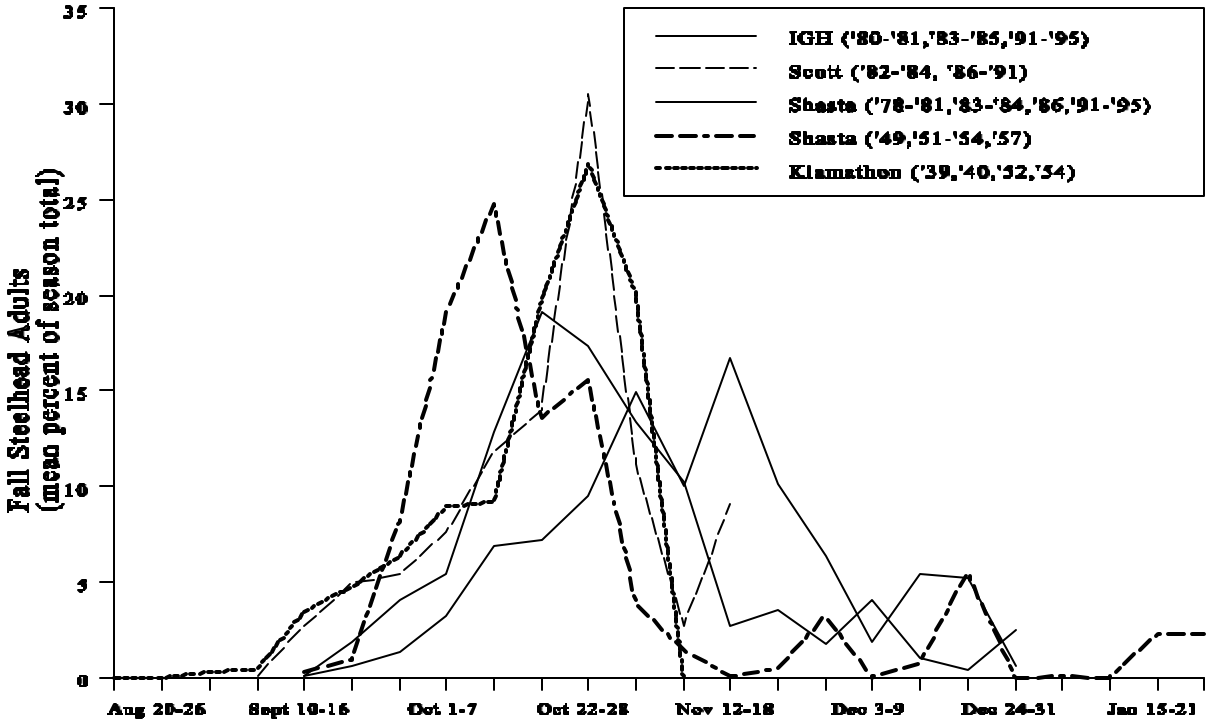

Figure 10. A comparison of fall steelhead adult historic timing at Klamathon Racks (CDFGe, 1954, 1955b) and Shasta Racks (CDFG 1950, 1952, 1953a, 1955a, 1958) with current timing at IGH (CDFGa, 1982b, 1983, 1985, 1987a, 1993, 1994a), Scott River weir (CDFGc) and Shasta River weir (CDFGd) presented as mean percent of season total.

Steelhead Report-Restoration Card Surveys indicate there is some angler effort during the winter run period but these surveys do not indicate where the steelhead were caught (Jackson, personal communication, 1996). Ron DeNardi, Klamath River guide (1976-present), has caught Awinter@ steelhead as early as November and ripe females as late as February in the study reach (personal communication, 1996). He has observed no mainstem spawning.

Half-pounders

The mainstem Klamath River tributaries have the highest incidence of a half-pounder life history within the Klamath-Trinity system. Scales from fall steelhead sampled from the Shasta, Scott and Salmon Rivers, Bogus and Horse creeks, and IGH indicated from 90-100% of the juveniles return to fresh water four to five months later as half-pounders (CDFG 1987b). Three 1990 brood year, left ventral/adipose fin clipped steelhead released from Trinity River Hatchery March 18, 1991 were recaptured in a USFWS beach seining operation in the Klamath River estuary (3.8 rkm) as they were returning to the river, on August 19 of the same year (Craig, USFWS, personal communication, 1997).

The majority of Klamath River steelhead smolts enter the ocean in mid-April or early May and return as half-pounders in September (Kesner and Barnhart 1973). The incidence of a half-pounder life history pattern is 95.2% for fall steelhead, 23.2% for winter steelhead and 22.2% for spring run in the North Fork of the Trinity River (CDFG 1987b).

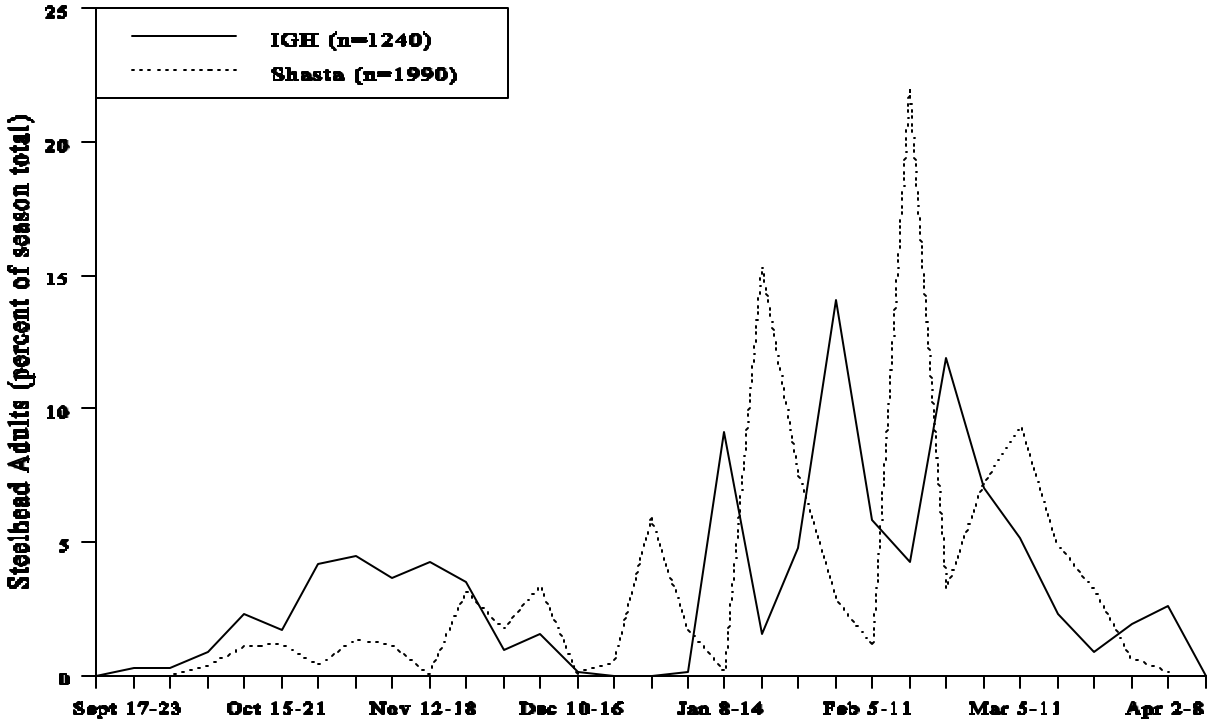

Figure 11. A comparison of fall and winter steelhead run timing at IGH (CDFG 1982b) and Shasta River weir (CDFGd), 1980-81.

Information collected by the CDFG Klamath River beach seining study between 3.6 and 5.2 rkm (Figure 9) indicated that half-pounders migrate through the lower estuary beginning in mid-August, peak during the last week of August through the second week of September and are declining by mid-October (CDFG 1988). In the study reach, the early half-pounders are believed to follow fall chinook salmon up and arrive in September. Bob Claypole (Klamath River guide, personal communication 1996) stated that he usually sees half-pounders near Beaver Creek (259 rkm) in the winter from December-February and higher up the system as late as April. Tom Kisanuki (USFWS, personal communication, 1997) caught half-pounders on the mainstem at Big Bar in late March, 1988. During electrofishing surveys of Bear Creek (31 rkm), USFWS field crews captured three half-pounders on March 29, 1978 (USFWS 1979).

Spawning

Chinook Salmon

Fall Chinook

Redd surveys on the mainstem Klamath River, from Iron Gate Dam to the confluence of Indian Creek, were initiated by the USFWS in 1993 and have continued through the fall of 1996. Redd counts have ranged from 330 in 1993, 1,655 in 1994, 3,240 in 1995 to 1372 in 1996 (USFWS 1994b, 1995, 1997a). In all years, redds were distributed throughout the study reach with the highest numbers occurring between Iron Gate Dam and Ash Creek (Figure 12). The first redds were observed during the second week of October with peak redd counts occurring, in all three years, during the last week of October. By the end of November, spawning activity was over (Figure 12).

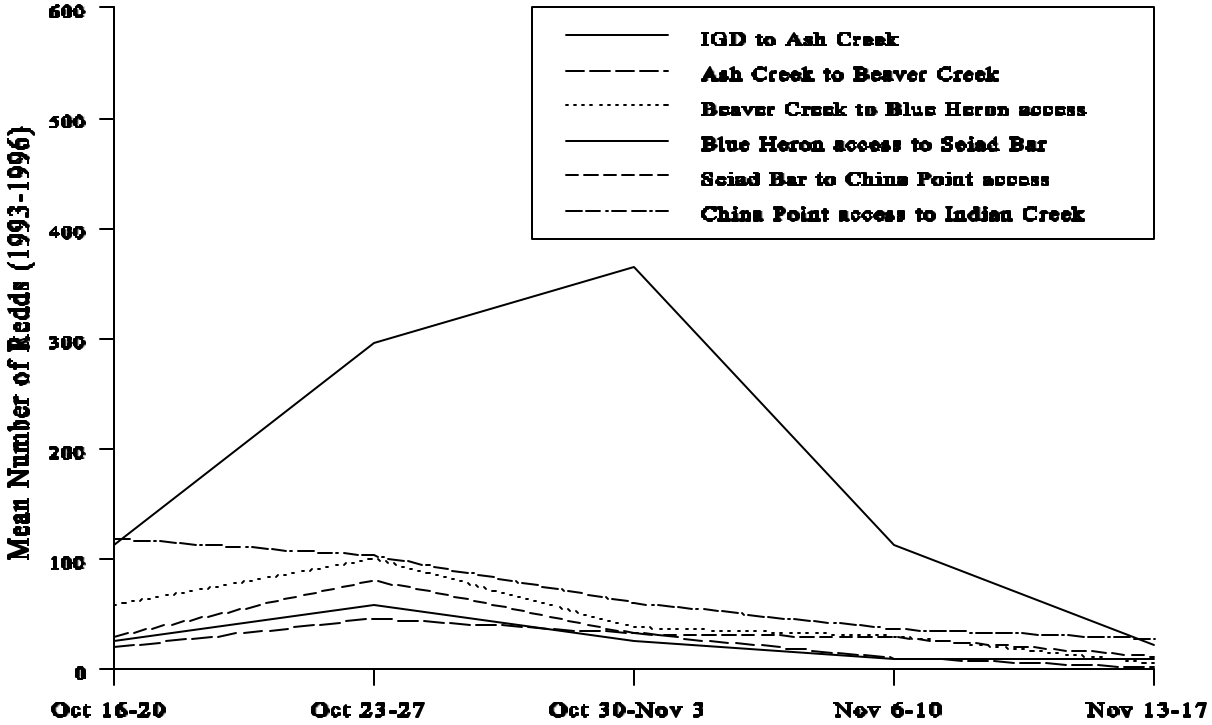

Figure 12. Mean fall chinook salmon redd counts in six reaches between Iron Gate Dam and Indian Creek for 1993-1996 (USFWS 1994b, 1995, 1997a).

Spring Chinook

Spring chinook are not known to spawn in the mainstem Klamath River. CDFG IGH did not mitigate for spring chinook salmon and returns to Iron Gate Dam have been extirpated (see Spring Chinook in Holding and Migration section). In the mainstem Trinity River, spring chinook spawning peaks during the first two weeks of October with numbers decreasing by the end of October (CDFG 1995).

Coho Salmon

The USFWS (1984a) postulates that coho spawn from November through January but little information exists regarding coho spawning in the mainstem Klamath River. Nels Brownel stated that a side channel located at Seiad Bar had numerous coho spawning in November and December of 1993 (personal communication, 1996). In early December 1995, CCFWO personnel observed coho spawning in this side channel (USFWS 1997a).

Steelhead

Steelhead redd surveys have not been conducted on the mainstem Klamath River. In tributaries to the mainstem within our study reach (Shackleford Creek - tributary of Scott River - 230 rkm, Beaver Creek - 259 rkm, and Yreka Creek - tributary of Shasta River - 284.1 rkm) steelhead spawning was observed from mid-March to early May (USFS 1990). In Elk Creek (169.7 rkm) spawning was first observed in late February, peaked in mid-April, and was completed by mid- May (USFS 1990). The opinion of KRSIC (1993) is that summer steelhead spawn from December through February, fall steelhead spawn from February through April, and winter steelhead spawning extends from January through April.

Adult steelhead downstream migration and repeat spawners

After steelhead spawn, a percentage return back to the ocean for additional rearing and may repeat their upstream spawning migration. CDFG (1987b), through scale analysis, determined that 21.8% of steelhead returning to the Scott River and 16.2% of those returning to Bogus Creek had spawned two times while 21.8% of those returning to the Shasta River had spawned three times. Nels Brownel (USFS, personal communication, 1997) has captured winter steelhead runbacks at the mouth of Beaver Creek (rkm 259) in early May.

Little information exists regarding the timing of downstream migration of adult steelhead on the Klamath River. On New River, a tributary to the Trinity River, downstream run steelhead appeared at the weir during the second week of March 1994. Downstream migrants peaked in mid-April with numbers diminishing by the end of May. New River is known for its relatively large run of summer steelhead, so the above numbers may be indicative of downstream migration of summer run fish.

Emergence

Chinook Salmon

Emergence timing of chinook salmon fry is highly dependent on water temperature during egg incubation

(Piper et al., 1982) as well as time of spawning. Spawning (USFWS 1994b, 1995) and temperature data (Karuk Tribe of California, unpublished data) collected in 1993 and 1994 were used to predict emergence timing for the 1994 and 1995 water years using daily temperature unit (DTU) calculations as described by Piper et al. (1982). The emergence from the 1993 fall chinook mainstem spawners began in early February and peaked in early March compared to water year 1995 when emergence began in early March and peaked in late March and early April (Figure 13).

Emergence timing in Bogus Creek and Shasta River may be slightly earlier than the mainstem. Downstream migrant traps operated by CDFG, 0.8 rkm from the mouths of these tributaries, captured chinook fry (FL = 30-36 mm) beginning in mid-January, 1988.

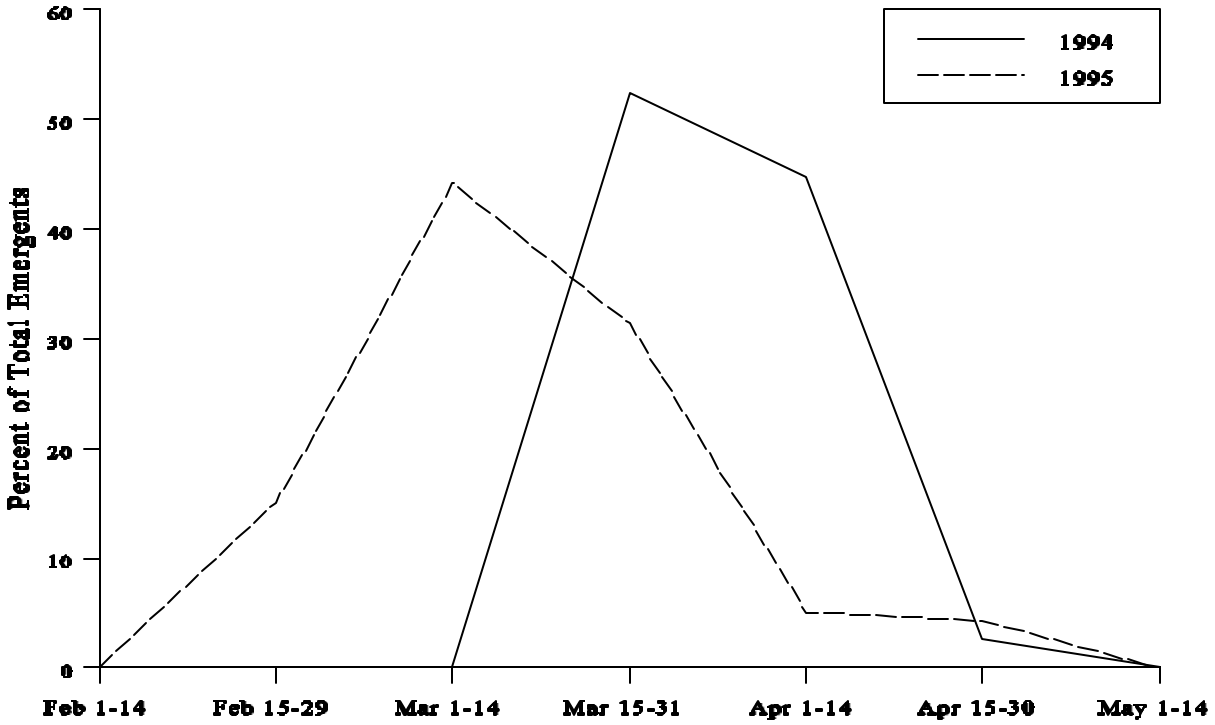

Figure 13. Predicted emergence timing of mainstem Klamath fall chinook, 1994-1995. Based on time of spawning (USFWS 1994b, 1995) and temperature data (Karuk Tribe of California, unpublished data) collected in 1993 and 1994.

Coho Salmon

Coho emergence timing for the mainstem Klamath is not available. The timing of coho fry captured in CDFG juvenile emigration traps on Bogus Creek (.8 rkm, 1986-1990) and Shasta River (.8 rkm, 1986-1989) give an indication of emergence timing in these tributaries. In 1988, coho fry first appeared in the Bogus Creek juvenile emigration trap during the first week of March (CDFG 1994b). The

average fork lengths for initial captures ranged from 31-39 mm. Fork lengths in the 30-35 mm range continued through the middle of May.

The earliest appearance of coho fry in the Shasta River emigration trap occurred March 4, 1988 (CDFG 1994b). Coho fry in the 30-35 mm range were captured the week of April 15, 1989 with a minimum size of 25 mm occurring during that week. This fork length data suggests emergence is spread out from late February through the middle of April.

Steelhead

Steelhead emergence timing for the mainstem Klamath River is presently not available. Fry (25-30 mm) were captured in the Bogus Creek juvenile out-migration trap (1986-1990) from mid-March through the end of June (CDFG 1994b). During the last week of June, 1989 a steelhead fry was captured measuring 21 mm indicating emergence continued. Fry captures in the Shasta River juvenile emigration trap (1986-1990) occurred from early April through mid-June (CDFG 1994b).

Juvenile Rearing and Emigration

Chinook Salmon

Sullivan (1989) used scale analysis to identify three juvenile life histories from wild Klamath River fall chinook adults:

Type I - rear in freshwater for several months before migrating to the ocean during the summer months.

Type II - rear in freshwater for an extended time period and migrate to the ocean in the autumn or as late as mid-winter. This type includes both juveniles that rear in the tributaries until autumn rains, and those that migrate into the main river in spring or early summer and then rear in either the mainstem or estuary until ocean entry.

Type III - rear in freshwater through the summer, autumn, and winter before entering the ocean in the following spring as yearlings.

The peak period of emigration for the three types of juvenile chinook were not defined by Sullivan (1989) and are difficult to determine based on available data. Juveniles will therefore be referred to as young of the year (YOY) or yearlings in this report, based on size at time of capture.

It is likely that some emigration of juvenile chinook occurs year round. Timing depends on rearing conditions during the summer months in the mainstem and tributaries. The Bogus Creek juvenile emigration trap captured 23 yearlings, between mid-January and mid-May (1986-1990) while no

chinook yearlings were captured in the Shasta River trap during the same period (CDFG 1994b). This is probably due to high summer rearing temperatures in the Shasta River (Sullivan 1989). Yearlings were captured on the mainstem at Big Bar (1992-1995) sporadically from early March through mid-June and on the mainstem below Scott River (1994) and Presido Bar from the time the traps were deployed in early May through mid-June (Figure 14, USFWS 1997b, c).

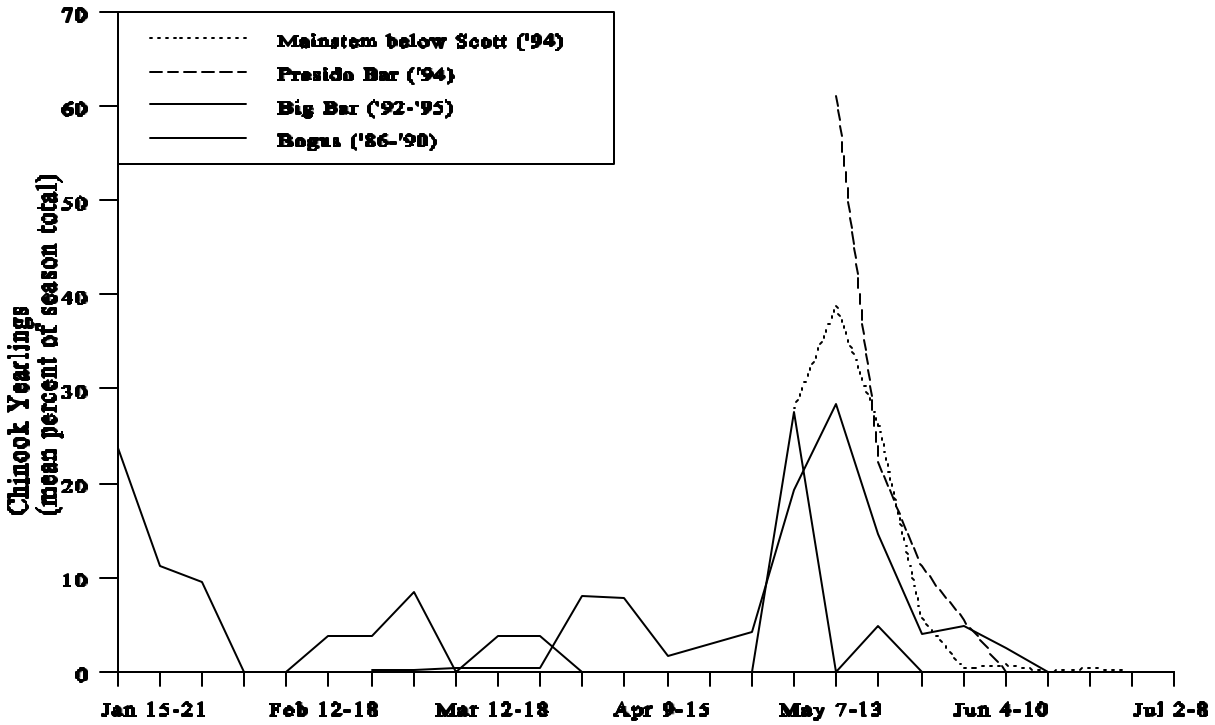

Figure 14. Chinook yearlings captured in downstream migrant traps at: Bogus Creek (1986-1990), the mainstem below Scott River (1994), Presido Bar (1994) and Big Bar (1992-1995) presented as mean percent of season total (CDFG 1994b; USFWS 1997b, c).

Young of the year emigration through Bogus Creek and Shasta River began in mid-January, peaked from mid-March through late April, and tailed off by early June (Figure 15, CDFG 1994b). Based on the calculated emergence timing in the mainstem (Figure 13) of February through May, chinook rearing in the study reach is likely to occur through June. The first arrival of juvenile chinook at the downstream migrant trap at Big Bar (81 rkm, 1992-1995) occurred in mid-March with numbers peaking in mid-June and dropping off by the end of July (Figure 15, USFWS 1997b). A cooperative juvenile trapping operation between the USFS and CCFWO was conducted on the mainstem below the mouth of the Scott River (230 rkm, 1994) but the trap was not deployed until May so the early chinook emigrants were missed (USFWS 1997c). Catch had dropped off significantly by the time the trap was pulled in mid-July (Figure 15).

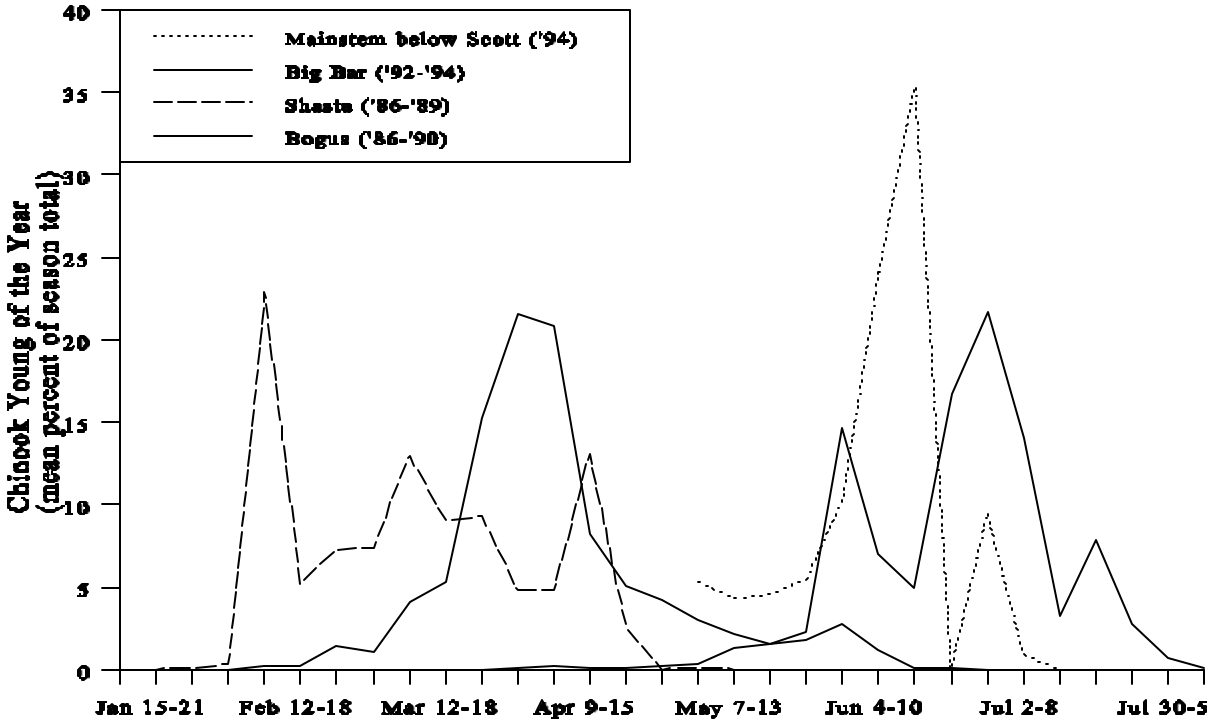

Figure 15. Chinook young of the year captured in downstream migrant traps at Bogus creek (1986-1990), Shasta River (1986-1989), the mainstem below Scott River (1994) and Big Bar (1992-1995) presented as mean percent of season total (CDFG 1994b, USFWS 1997b, c).

Fall trapping operations at Big Bar, the mainstem below Scott River and Elk Creek indicate that young of the year continue to emigrate through the fall months. Chinook were captured at Big Bar and the mainstem below the Scott River from mid-September until the traps were pulled in early to mid-December although the majority of captures after October were thought to be hatchery fish from Iron Gate Hatchery (USFWS 1997b, c). A downstream migrant trap on Elk Creek, operated by USFS (1994), captured YOY throughout the trapping period from late April through the end of September (Olson, personal communication, 1996).

A downstream migrant trap located on the Trinity River, 6 rkm downstream of the town of Willow Creek, was run year round from 1992 to 1994 with the exception of the high flow period between mid-December and late February. Chinook young of the year were captured throughout the trapping period during these years (USFWS 1997b). In 1993, two wild fall chinook marked by CDFG natural stocks marking program at Sky Ranch (133.7 rkm) in May and one marked at Hard Hat (148.1 rkm) in April on the Trinity River were recaptured in this trap between October 29 and November 10, 1993. Wild chinook, therefore, continue to emigrate during the fall.

Beach seining conducted by CDFG in 1984 and 1985 in the upper Klamath River (Tree of Heaven Campground, Happy Camp and the mouths of Bogus Creek, Cottonwood Creek, Beaver Creek, Horse Creek, Scott River and Indian Creek) found chinook rearing in the mainstem from mid-May through mid-October (CDFG 1990a, 1990b). Catches in late July and August were highest at the

mouths of Beaver and Indian Creeks where the temperatures were three or more degrees (Celsius) cooler than the mainstem (CDFG 1990a). Catches after mid-June were dominated by Iron Gate Hatchery fish.

Coho Salmon

According to USFWS (1984) coho salmon emerge from February through mid-May, rear in freshwater for about one year and then outmigrate as yearlings from February through mid-June. Downstream migration data collected on Bogus Creek and Shasta River indicate that young of the year coho in addition to yearling smolts are migrating into the mainstem. Coho fry measuring 37-65 mm fork length were captured in the Bogus Creek outmigrant trap from March 4 through June 24 in 1988 (CDFG 1994b). On the Shasta River (1988) young of the year coho measuring 32-74 mm fork length were captured from March 4 through May 20 (CDFG 1994b). Coho passed through the trapping locations at Bogus Creek (1986-1990) and Shasta River (1986-1989) from late January, through early to mid July (Figure 16). Young of the year and yearling coho were not separated out at these traps because the subsample of measured fish was not large enough to determine the ages of all fish captured.

Coho that rear in the mainstem may be forced to seek cold water refugia either within the study reach, downstream, or in cool water tributaries, during adverse temperature conditions. Once water temperature conditions are more favorable it is believed that juvenile coho recolonize the mainstem (Bartholow 1995).

Small numbers of coho young of the year were captured by CCFWO on the mainstem of the Klamath River at Big Bar (1992-1995), below the Scott River (1994) and at Presido Bar (1994) beginning in April, peaking in May and diminishing in late July (Figure 16, USFWS 1997b,c). During a fall trapping operation on the mainstem at Big Bar, 18 coho young of the year measuring 68-87mm fork length were captured in November, 1994.

Few yearling coho were identified during the Bogus Creek and Shasta River emigration studies (CDFG 1994b). In 1988, 75 yearling were measured at the Shasta River trap beginning in mid- January and diminishing by the first week in May. On Bogus creek, 82 yearling were measured in 1990 beginning in mid-January, peaking in mid-March and diminishing by mid-April. The Big Bar trapping operation (1992-1995) first captured coho yearlings in mid to late March, and continued to catch them until early August but because unmarked yearlings were released from Iron Gate Hatchery in March of each year it is difficult to determine if this information is relevant to the timing of wild yearlings (USFWS 1997b). NMFS (1995) reviewed coho emigration timing in the Klamath River Basin. Emigration from the lower tributaries (Blue, Hunter, Turwar, Bear, Ah Pah, Tectah and Roach Creeks) occurred between March and July.

Steelhead

Scales from adult fall run steelhead sampled at Iron Gate Hatchery, Shasta, Scott and Salmon rivers,

and Bogus and Horse creeks, generally have shown juvenile steelhead stay in fresh water for two years before entering the ocean at a size of 21 to 23 cm fork length (CDFG 1987). Steelhead smolts from every run may be found emigrating during all months of the year (USFWS 1984a).

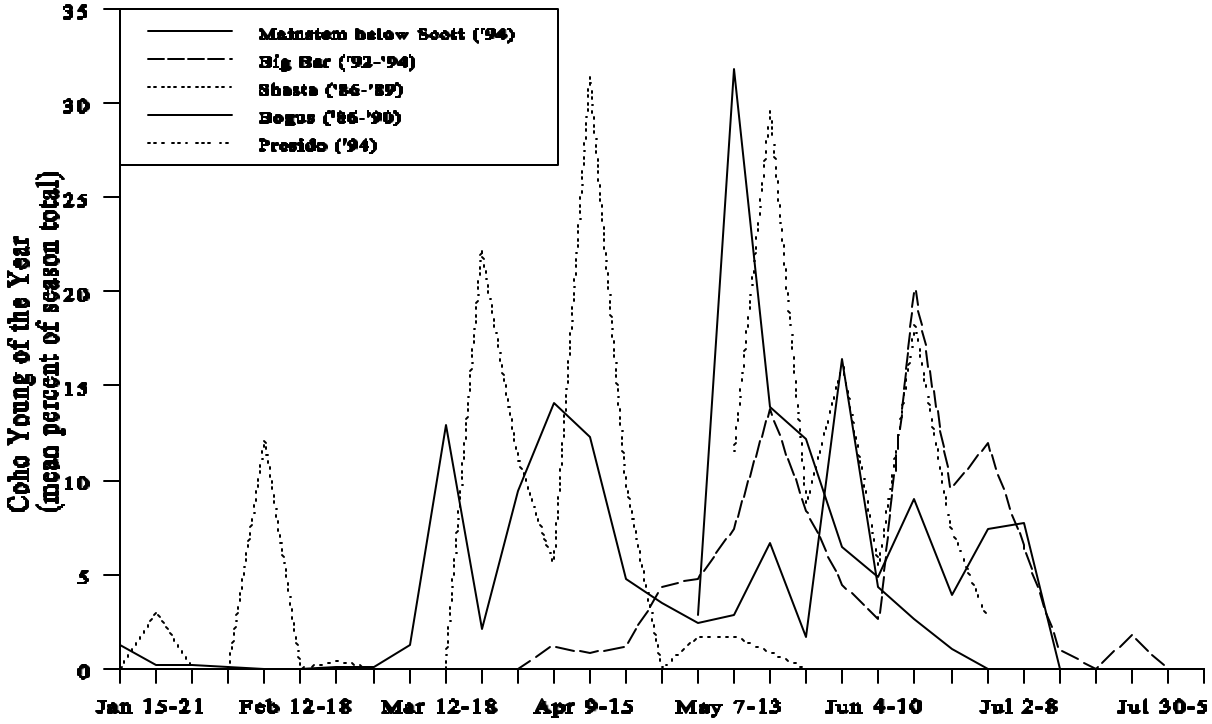

Figure 16. Coho captured in downstream migrant traps at Bogus Creek (includes yearlings, 1986-1990), Shasta River (includes yearlings, 1986-1989), mainstem below Scott River (1994), Big Bar (1992-1995) and Presido Bar (1994) presented as mean percent of season total (CDFG 1994b, USFWS 1997b, c).

Information collected at the Bogus Creek and Shasta River downstream migrant traps suggests that large numbers of steelhead are entering the mainstem Klamath River as young of the year and yearlings (Figure 17, CDFG 1984b). The total number of steelhead of each age class captured could not be determined at these traps because all of the fish were not measured. Based on the measurements that were taken it appears that young of the year steelhead left Shasta and Bogus from mid-April through the end of the trapping season in early July, while yearling plus steelhead were captured throughout the trapping season. These juveniles most likely rear in the mainstem within the study reach before outmigrating as two-year-olds.

At the downstream migrant trap on the mainstem at Big Bar (1992-1995), young of the year steelhead were captured from early May through the end of the trapping season in early August and yearlings were captured throughout the trapping season (USFWS 1997b).
During fall trapping operations conducted at on the mainstem at Big Bar (1992, 1994) steelhead young of the year and yearlings, 66 to 270 mm fork length, were captured for the duration of the trapping seasons from mid-September to mid-December.

Emigration trapping conducted by the USFS on Elk Creek (1994) showed young of the year steelhead passing through the trap beginning in early May and continuing through late September. Yearling plus steelhead were captured during the initial sampling in late March and continuing through late September, 1994 (Olson, personal communication, 1996).

Beach seining conducted by CDFG in 1984 and 1985 in the upper Klamath River (Tree of Heaven Campground, Happy Camp and the mouths of Bogus Creek, Cottonwood Creek, Beaver Creek, Horse Creek, Scott River and Indian Creek) found small numbers of steelhead young of the year rearing in the mainstem from mid-May through mid-October (CDFG 1990a, 1990b). During this study (1984) steelhead fry (FL = 26-28 mm) were captured in the mainstem though mid-June. One and two year old steelhead were also captured sporadically throughout the study.

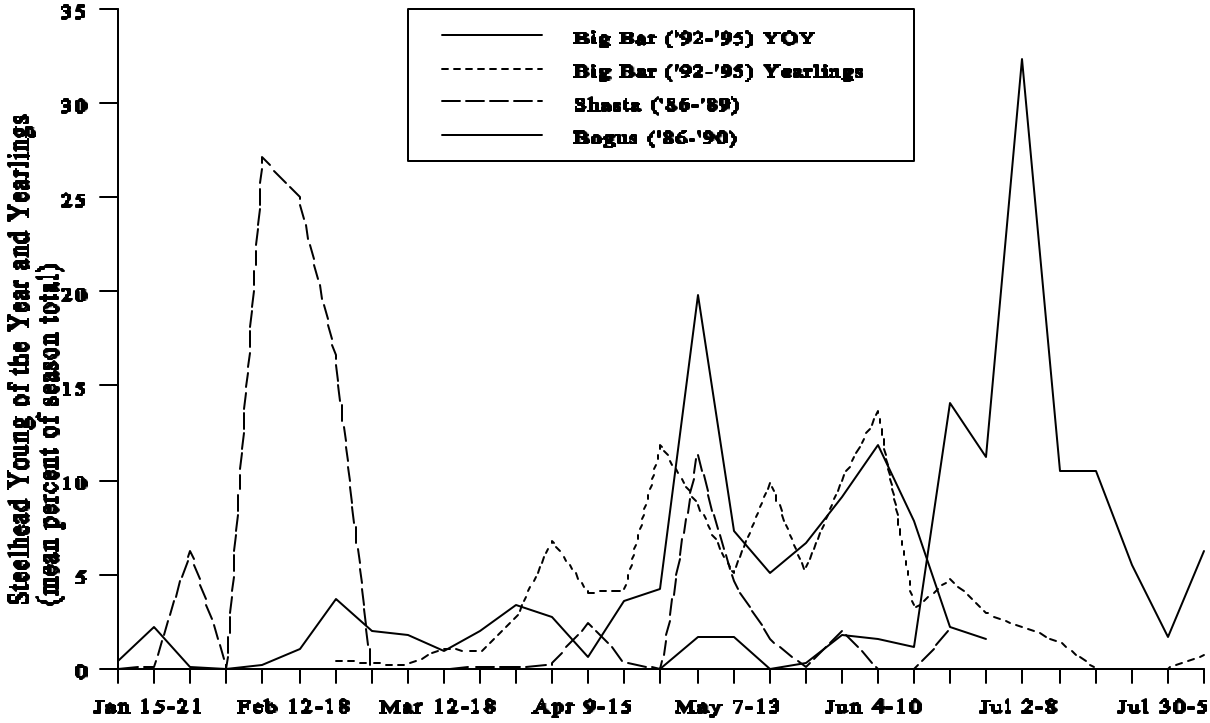

Figure 17. Steelhead captured in downstream migrant traps at Bogus Creek (1986-1990), Shasta River (1986-1989) and on the mainstem at Big Bar (1992-1995) presented as mean percent of season total (CDFG 1994b, USFWS 1997b).

SUMMARY

Periodicity information collected and presented in this report should not be considered conclusive. Data will continue to be collected to further define the spacial and temporal distributions of salmonids in the Klamath River basin. A synopsis of life stage periodicities for chinook, coho and steelhead within the study area, Iron Gate Dam to the city of Seiad, based on monitoring studies conducted in the Klamath River basin is presented in Tables 5, 6 and 7.

Chinook Salmon

Fall Chinook Adults

Fall chinook begin entering the study area in September and can be found holding through November. Some late run fall chinook have been observed at the mouth of the Scott River as late as mid-December. The peak of the migration occurs in October. Historically fall chinook entered the study area in mid to late August. Fall chinook jacks migrate concurrently with adults. Spawning in the mainstem Klamath begins during the second week of October, peaks during the last week of October and declines by the end of November.

Spring Chinook Adults

Although limited spring chinook spawn in tributaries to the study reach, it is believed that spring chinook enter the study area during the first two weeks of June. Peak migration on the Trinity River occurs from late June to early July and tails off by early to mid-September. Spring chinook returned to Iron Gate Hatchery in the mid-seventies throughout July and August. It is unknown if spring chinook spawn in the mainstem Klamath River. On the Trinity River, spring chinook spawning occurs from mid-September through the first two weeks of October and declines by the end of October.

Chinook Juveniles

Emergence of juveniles is believed to occur from early February through the end of April but is highly dependent on water temperature. Sullivan (1989) used scale analysis to identify three juvenile life histories from wild Klamath River adult fall chinook. While emigration timing of each life history strategy is difficult to determine from the available data, juvenile rearing in the study area is likely to occur year round.

Emigration from tributaries (Bogus Creek and Shasta River) occurs soon after emergence in mid-January, peaks in mid-March through late April and declines by early July. Juveniles may emigrate directly to the estuary or remain in the mainstem and emigrate as yearlings. Yearlings were captured in Bogus Creek between mid-January and mid-May and in the mainstem at Big Bar, Presido Bar and below Scott River through mid-June. Young of the year were captured in the study area from May through mid-December.

Coho Salmon

Coho Adults

Coho begin migrating through the study reach in mid-September, peak in early to late October, and decline in November. Late arrivals continue to migrate through the study area in November and December. USFS and USFWS personnel both agree that coho spawning does occur in the mainstem Klamath River. Since no surveys have been conducted during the coho spawning period, information is not available regarding the distribution and magnitude of the mainstem Klamath River coho run. It is believed that coho spawning occurs from November through January.

Coho Juveniles

Coho emergence is believed to occur from late February through April. Coho fry were observed outmigrating from tributaries (Bogus Creek and Shasta River) from early March through late-June. Coho fry were captured at the Big Bar trap from early April through late July during spring trapping and in November during fall trapping. Yearling coho were captured during the Bogus Creek and Shasta River emigration studies from mid-January (Bogus 1990) through mid-April. In the mainstem yearlings were captured from mid-March through early August. Coho are likely to rear in the study area year round.

Steelhead

Summer Run Adults

Although few summer steelhead spawn in tributaries within the study reach, it is believed that run timing is similar to New River (Trinity River tributary). Summer steelhead begin to enter New River in early March, peak in late May through June and decline in mid-July (USFWS 1996). They are thought to spawn in the tributaries between December and February.

Fall Run Adults

Fall steelhead migrate into tributaries within the study area between September and December. Current run timing does not differ from historic timing recorded at the Klamathon and Shasta Racks. Fall steelhead spawning is thought to occur in the tributaries from February through April. There is no evidence of mainstem spawning.

Winter Run Adults

No new information was found to support previous estimates for winter steelhead run timing. Iron Gate Hatchery catagorize all steelhead which arrive at the ladder after December 31 as Aspring@ steelhead.

On the Shasta river (1981) there was no clear distinction between the timing of the fall and winter runs. Collected information suggests that winter run steelhead are in the study reach from late December through mid-April. Spawning probably occurs in the tributaries from February through mid-May.

Half-Pounders

The early half-pounders are believed to follow the salmon up and arrive in August and September. Bob Claypole (Klamath River guide, personal communication 1996) stated that he usually sees half-pounders near Beaver Creek in the winter from December-February. Claypole further stated that he observed half-pounders higher up as late as April. More information is needed to determine the timing of half pounders in the study reach.

Steelhead Runbacks

Adult steelhead emigration after spawning in New River (tributary to the Trinity River) occurs from mid-March through late May. No information is available to determine the timing of adult steelhead emigration in the study reach.

Steelhead Juveniles

The majority of mainstem Klamath River juvenile steelhead are believed to originate from tributaries. One and two year olds enter the mainstem beginning in mid-January. Young of the year also emigrate to the mainstem beginning in April and most likely rear in the mainstem before emigrating as two year olds. On the mainstem at Big Bar, juveniles were captured from May through early August and mid-September to mid-December.

Table 5. Life history periodicity for fall chinook salmon in the study area, mainstem Klamath River from Iron Gate Dam to the confluence of Seiad Creek, based on monitoring studies conducted within the Klamath River Basin.

Life Stage / Monitoring Location / Type	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Adult Holding and Migration												
Iron Gate Dam to Seiad Creek			====	====	====	==						
Lower Klamath / Harvest[a]	(==	==++	++++	++==	)							
Scott River Mouth / Snorkeling				(	====	==)						
Scott River / Weir			(	====	++++	==)						
Shasta River / Weir			(==+	++++	===					)		
Shasta River (Historic) / Weir			(=	===+	+++=	====	==)					
Klamathon (Historic) / Weir			(==	=+++	+===	==)						
Bogus Creek / Weir				(===	++++	==)						
Iron Gate Dam / Hatchery				(==+	++++	+===	=			)		
Spawning												
Iron Gate Dam to Seiad Creek					===	====						
Study Area / Redd Surveys[a]					(=+	+===	)					
Emergence												
Iron Gate Dam to Seiad Creek								====	====	====		
DTU - Piper et al. 1982								====	====	====		
Shasta River / Trap (fl<30mm)							(==	====	==			)
Bogus Creek / Trap (fl<30mm)							(==	====	=			)
Juvenile Rearing and Emigration[b]												
Iron Gate Dam to Seiad Creek	====	====	====	====	====	====	====	====	====	====	====	====
Study Area / Beach Seining	====	====	====	==)							(===	====
Bogus Creek / Trap	)						(YY	====	==++	+===	Y===	====
Shasta River / Trap							(==	=+==	=+==	=+==	====	)
Mainstem below Scott R. / Trap	=)		(==	====	====	==)				(	====	+++=
Elk Creek / Trap	====	====	====	)						(	====	+===
Mainstem at Presido Bar / Trap[c]											(=YY	= =)
Mainstem at Big Bar / Trap	+===	==)	(==	====	====	==)		(=	====	====	YYY=	+==+

= chinook observed, captured, counted or predicted (using DTU=s for emergence) at this time.

+,Y greater than 10% of mean percent of season total captured (Y = yearlings).

( ) beginning/ending of observation period.

[a] conducted by CCFWO. [b] YOY and yearlings. [c] yearlings only.

Table 6. Life history periodicity for coho salmon in the mainstem Klamath River, from Iron Gate Dam to the confluence of Seiad Creek based on monitoring studies conducted within the Klamath River Basin.

Life Stage / Monitoring Location / Type	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Adult Holding and Migration												
Iron Gate Dam to Seiad Creek			==	====	====	====						
Estuary / Seining (CCFWO)	(		===	=)								
Estuary / Seining (CDFG)		(	==	=)								
Lower Klamath / Harvest[a]	(		==++	++++	)							
Scott River / Weir			(	==++	++=)							
Shasta River / Weir			(==	==++	++==	= ==				)		
Shasta River (Historic) / Weir			(=	====	====	====	==)					
Bogus Creek / Weir			(	==+=	++)							
Iron Gate Dam / Hatchery			(	===	++++	====				)		
Spawning	More information needed to determine timing in study area.											
Study Area / Redd Surveys[a]				(		=)						
Emergence												
Iron Gate Dam to Seiad Creek								=	====	====	==	
Shasta River / Trap (fl<35mm)							(		====	==		)
Bogus Creek / Trap (fl<35mm)							(		====	====	==	)
Juvenile Rearing and Emigration[b]												
Iron Gate Dam to Seiad Creek	====	====	====	====	====	====	====	====	====	====	====	====
Bogus Creek / Trap[c]							(===	= =	=+==	++==	====	+==)
Shasta River / Trap[c]							(=	+ =	++	=+=	===	)
Mainstem below Scott R. / Trap	=)										(=+++	====
Elk Creek / Trap	++ =	== =	)								(== +	==++
Mainstem at Presido Bar / Trap	)										(++=	+=+=
Mainstem at Big Bar / Trap	== =	)	(		===	)			(	====	====	====

= coho observed, captured or counted.

+ greater than 10% of mean percent of season total captured.

( ) beginning/ending of observation period.

[a] CCFWO.

[b] includes yearlings.

[c] coho captured in January and early February are yearlings.

Table 7. Life history periodicity for Steelhead in the mainstem Klamath River, from Iron Gate Dam to the confluence of Seiad Creek based on monitoring studies conducted within the Klamath River Basin.

Life Stage / Race / Monitoring Location / Type	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Adult Holding and Migration												
Summer Steelhead												
Iron Gate Dam to Seiad Creek	Infrequent siting in study area.											
Tributaries[a] / Snorkel Survey	====	====	====									
Scott River / Snorkel Survey		=										
New River / Weir	++)			(					====	====	====	++++
Fall Steelhead												
Iron Gate Dam to Seiad Creek			====	====	====	====						
Lower Klamath / Harvest[b]	(==	====	====	====)								
Estuary / Seining (CDFG)		(==+	+++=	==)								
Scott River / Weir			(====	=+++	+==)							
Shasta River (Historic) / Weir			(===	++++	====	=+	= =)					
Shasta River Weir			(===	=+++	++==	====				)		
Klamathon (Historic) / Weir		(	====	==++	+=)							
Iron Gate Hatchery			(===	====	++++	====				)		
Winter Steelhead												
Iron Gate Dam to Seiad Creek						=	====	====	====	===		
Lower Klamath / Harvest[c]						(=	====	====	===)			
Shasta River Weir[d]			(				==+=	==+=	=+==	=)		
Iron Gate Hatchery[d]			(				=+==	+==+	====	==)		
Half-Pounders	More information needed to determine timing in study area.											
Estuary Seining CDFG		(==+	++==	==)								
Electroshocking - Bear Creek									=			
Beaver Creek Mouth / Fishing[e]						====	====	====				
Big Bar / Fishing[f]									=			
Spawning	No evidence of spawning in study area.											
Tributaries[g] / Redd Surveys								(=	====	====	==)	
Adult Downstream Migration	More information needed to determine timing in study area.											
Beaver Creek Mouth / Fishing[h]											==	
New River / Weir	)			(					==	====	====	

Table 7. Continued.

Life Stage	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Monitoring Location / Type												
Emergence												
Iron Gate Dam to Seiad Creek									====	====	====	====
Shasta River / Trap (fl<30mm)							(		=		=	)
Bogus Creek / Trap (fl<30mm)	)						(		=	===	====	====
Juvenile Rearing and Emigration[i]												
Iron gate Dam to Seiad Creek	====	====	====	====	====	====	====	====	====	====	====	====
Study Area / Beach Seining	====	====	====	==)							(==	====
Bogus Creek / Trap[j]	)						(===	====	====	====	+===	=+==
Shasta River / Trap[j]							(==	YYY	=	===	+===	= =)
Elk Creek / Trap	====	====	====	)						(=	====	====
Mainstem Trap at Big Bar[k]	+++=	==)	(==	====	====	==)		(=	====	===Y	====	YY++

= steelhead observed, captured or counted.
+, Y greater than 10% of mean percent of season total captured (Y - yearlings).
( ) beginning/ending of observation period.
[a] Tributaries below study area - Indian Creek, Dillon Creek, Clear Creek, Salmon River et al.
[b] CCFWO.
[c] YTNRD.
[d] 1981data. Winter steelhead defined by IGH as arriving after December 31.
[e] Bob Claypole: personal communication.
[f] Tom Kisanuki: personal communication.
[g] Shackleford Creek, Beaver Creek, Yreka Creek, Elk Creek (USFS).
[h] Nels Brownel: personal communication.
[I] includes yearlings
[j] steelhead captured before April are yearlings except one captured in Bogus, March 1986.
[k] steelhead captured before May are yearlings.

DATA GAPS AND RECOMMENDED FUTURE STUDIES

The following data gaps and suggested studies (-) will help further define the timing of Klamath River salmonid life stages.

Fall Chinook:

1) When do selected tributary-destined adults pass through the mainstem?

   -radio tracking and tributary coded wire tagging studies

2) When do Type-I, Type-II, and Type-III juvenile chinook emigrate through the Klamath?

   -year round upper mainstem juvenile emigration trapping studies, juvenile salmonid seining study

3) Where do Type-II and Type-III over summer during adverse mainstem temperature periods?

   -tributary surveys, thermal refugia studies, juvenile salmonid seining study

Spring Chinook:

1) Is there still a viable population of spring chinook in the study reach (Iron Gate Dam to the city of Seiad)?

   -summer tributary adult counts

2) When do selected tributary-destined adults pass through the mainstem?

   -radio tracking studies

3) When do spring chinook juveniles outmigrate.

   -tributary emigration studies

Coho:

1) When do adult coho migrate through the study reach?

   -radio tracking studies

2) What is the temporal and spatial distribution of natural coho spawners?

   -tributary spawning and adult counts, juvenile snorkeling surveys

3) What is the magnitude of the natural Klamath River coho?

-tributary spawning and adult counts

4) Where do the YOY coho emigrating from upper tributaries reside during the warm summer months?

-tributary surveys, thermal refugia studies, juvenile salmonid seining study

Steelhead:

1) What happens to YOY and yearling steelhead once Klamath River instream temperatures elevate to adverse levels?

-tributary surveys, thermal refugia studies, juvenile salmonid seining study

2) What is the age composition of juvenile steelhead emigrating from upper Klamath River tributaries?

-tributary emigration studies with scale analysis, juvenile salmonid seining study

3: What is the spatial and temporal distribution of half-pounders and adults in the Klamath River?

-radio tracking studies

4: How many races/runs of steelhead are present in the Klamath system?

-year round seining at the mouth of the Klamath with genetic studies

5: What is the spatial and temporal distribution of spawning steelhead?

-tributary spawning surveys

6: What percentage of steelhead repeat spawn?

-tributary spawning surveys with scale collection and age analysis

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