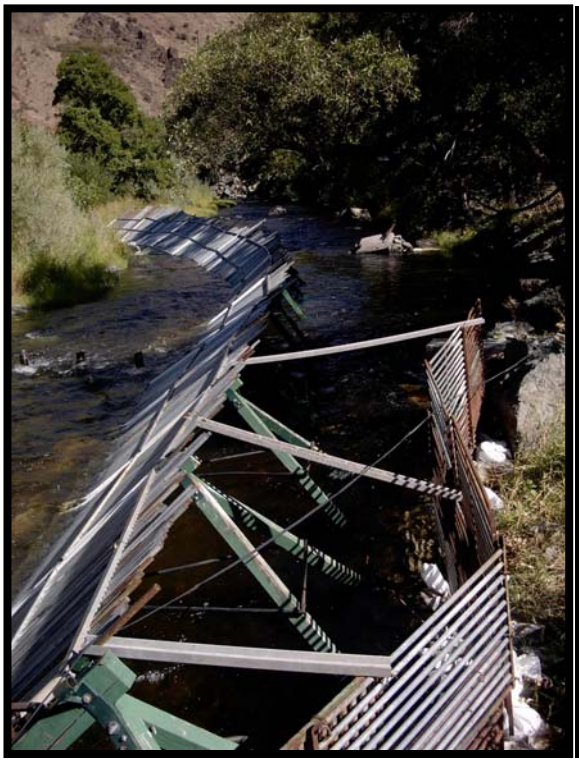
Shasta River Fish Counting Facility, Chinook and Coho Salmon Observations in 2003, Siskiyou County, CA



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ABSTRACT

An underwater video camera was operated in the flume of the Shasta River Fish Counting Facility twenty four hours a day, seven days a week, from 6 September through 28 December of 2003 to monitor fall run Chinook salmon migration into the Shasta River. A power outage and major snow storm in late December ended operation of the SRFCF on 28 December and the weir was removed from the river in early January. A total of 4,195 Chinook salmon were observed passing through the SRFCF between 8 September and 20 November. The run peaked on 2 October when 253 Chinook salmon were observed passing through the weir. A total of 318 Chinook salmon carcasses were examined during spawning ground surveys and 412 carcasses were collected as wash backs at the weir. Based on the proportion of the females, males and grilse observed in the spawning ground survey and as wash backs the entire run was comprised of an estimated 1,393 females, 2,647 adult males, and 155 grilse. Female Chinook salmon ranged in fork length from 50 cm to 95 cm and males ranged in fork length from 40 cm to 102 cm. Examination of the male fork length frequency distribution indicated that grilse were likely less or equal to 57 cm in fork length. A total of 25 adipose fin clipped (hatchery origin fish) Chinook salmon were observed passing through the SRFCF however, no heads form these ad-clipped fish were recovered in subsequent spawning ground surveys or as wash backs against the weir. Therefore, the contribution of hatchery fish was estimated by partitioning the number ad-clip salmon observed in the Shasta River based on the proportion of coded wire tags recovered at Iron Gate Hatchery. From this the Department estimates that approximately 436 of the 4,195 Chinook salmon observed in the Shasta River were of hatchery origin. Approximately 1,010 Chinook salmon, or 24.08% of the run, had one or more lamprey attached to them as they passed through the SRFCF.

A total of 187 adult coho salmon were observed passing through the SRFCF between 20 October and 28 December. Twenty seven (27) coho salmon carcasses were collected at wash backs against the weir between 8 November and 25 December. Six (6) of the coho salmon observed at the SRFCF were ad-clipped and these fish were likely strays from Oregon Department of Fish and Wildlife hatcheries along the southern Oregon Coast, most notably Cole Rivers Hatchery located on the Rogue River. Four (4) of the 27 coho salmon that were collected as wash backs has a left maxillary clip indicating that these fish likely originated from Iron Gate Hatchery.

INTRODUCTION

The Klamath River Project (KRP) of the California Department of Fish and Game (Department) is responsible for estimating the number of fall-run Chinook salmon (*Oncorhynchus tshawytscha*) that return to the Klamath River Basin, excluding the Trinity River Basin, each year. To achieve this task the KRP employs several techniques which include a creel survey of sport fishing efforts, recovery of fish returning to Iron Gate Hatchery (IGH), completion of cooperative spawning ground surveys in major tributary streams and rivers, and operation of a video fish counting weir on the Shasta River and Bogus Creek.

Video equipment was first installed at the Shasta River Fish Counting Facility (SRFCF) in 1998 and has been used to describe migration of fall-run Chinook salmon into the Shasta River ever since. Although the primary responsibility of the KRP is to enumerate and describe fall-run Chinook salmon populations with in the basin to assist harvest managers, data is recorded for

other fish species observed at the SRFCF during its normal period of operation from September through the first week of November.

The petition to list coho salmon (*Oncorhynchus kisutch*) under the California Endangered Species Act was received by the California Fish and Game Commission on 28th of July, 2000. Prior to and following receipt of this petition, the Department intensified efforts to document coho salmon presence with in the Klamath River Basin and elsewhere. Consistent with this effort, the KRP has elected to continue operating the SRFCF beyond its normal period of operation in an effort to document migration of coho salmon into the Shasta River. The Southern Oregon Northern California Coastal coho salmon were listed as threatened by the National Marine Fisheries Service under the Federal Endangered Species Act in 1997.

This report describes the characteristics of the Chinook and coho salmon runs that entered the Shasta River during the fall of 2003.

METHODS

Monitoring of the salmon run with in the Shasta River is accomplished through three primary efforts, operation of a video weir, collection of data from salmon carcasses that become impinged on the weir panels as they float downstream (wash backs), and completion of spawning ground surveys to obtain needed biological data from salmon carcasses.

The SRFCF consists of an Alaska Weir strategically placed in a diagonal direction across the river channel. Fish immigrating upstream are directed through a narrow flume, which passes in front of an underwater video camera. The camera was connected to a time lapse video recorder and monitor. A Panasonic Color CCTV Camera Model No.WV-CP150 equipped with a 3.5 – 8mm 1:1.4 Computar lens[1] was used throughout the season. A Panasonic time lapse video cassette recorder, model AG-6740, was used to record flume observations and SVHS 120 minute video tapes were used as the recording medium. The weir and video camera was installed during the first week of September and began recording on September 6th at 1200 hours. Recording speeds were set at 24 hour mode during the early part of the run from September 9th to September 14th. The recording speed was increased to record over a 12 hour period during the remainder of the operation of the video weir from September 15th until December 28th. The video recorder was set to include both a date and time stamp on every recording to accurately document run timing.

Unlike in previous years, the SRFCF was not manned continuously throughout the season do to budget constraints. Instead, KRP staff visited the SRFCF twice daily, once in the morning and once in the evening of each day. During each visit staff inspected the video system to insure that everything was operating as anticipated, changed the video tape, inspected and cleaned the weir panels and conducted routine maintenance of the facility. All equipment was secured under lock

[1] Use of trade names in this report does not imply endorsement by the Department of Fish and Game.

and key and access to the site was also controlled through a locked gate located on private property.

All tapes were immediately returned to the office where each was subsequently reviewed by seasonal and scientific aides in the video lab. During each review staff recorded the date, time (hour:min:sec), and species of each fish observed on each video tape. In addition, staff noted any adipose fin clips (ad-clips) observed, and recorded the presence of lampreys or any other distinguishable marks that were visible on the tape. All data was then entered into computer files and each data file was subjected to two independent edits prior to commencement of any data analysis.

Any salmon carcasses that drifted downstream and became impinged on the weir panels were recovered and processed. Data collected on these wash back carcasses included species identification, gender, and fork length. Scales were removed from the left side of each carcass at a location posterior to the dorsal fin just above the lateral line whenever possible. Scale samples were then provided to the Yurok Tribal Fisheries Department for analysis. Every carcass was also examined for the presence of any fin clips, marks or tags. Heads were collected from each ad-clipped fish for later coded wire tag recovery and analysis. Each carcass was also examined to determine whether successful spawning had likely occurred. Female salmon with more than 50% of their egg mass still present in their body cavity were identified as pre-spawn mortalities. Carcasses were then cut in half to prevent sample duplication and returned to the river downstream of the weir.

Spawning ground carcass surveys were limited to the lower section of the Shasta River downstream of the Interstate 5 Bridge crossing just north of the city of Yreka. The purpose of the spawning ground surveys was to gather biological data necessary to describe the physical characteristics of the run. Surveys were limited to areas typically used by spawning salmon. During each survey crews walked along the river bank searching for salmon carcasses. As carcasses were located crews identified each to species and gender, collected a fork length measurement (cm), and a scale sample collected from the left side of each carcass above the lateral line just posterior to the dorsal fin. All of the scale samples that were collected from Chinook salmon were provided to the Yurok Tribal Fisheries Department for age determination. This information is then used to assist the Klamath Fishery Management Council in determining the age composition of fall Chinook salmon in the Klamath basin for use in harvest management determinations. Each carcass was also examined for the presence of any clips, marks or tags. Heads were collected from any ad-clipped fish for later coded wire tag recovery and analysis. All female carcasses were examined internally to determine spawning success. Females with greater than 50% of their eggs remaining in their body cavity were identified as a pre-spawn mortality. Once examined all carcasses were cut in two to prevent potential recounting during later surveys.

Spawning ground carcass surveys were conducted twice each week, every Monday and Thursday, throughout the fall Chinook salmon spawning season. The first survey occurred on October 16th and the last survey occurred on November 11th.

Flow information was obtained from the USGS gauge (# 11517500) located near the mouth of the river a short distance upstream of the SRFCF. Hourly water temperature measurements were collected at the mouth of the Shasta River, just downstream of the SRFCF, with the use of Onset Computer Corporation Optic Stowaway water temperature device with a recording range from -5 to 37 degrees Celsius.

RESULTS

The SRFCF was operated from September 6th through December 28th of 2003. A power outage occurred on December 28th and monitoring of fish migration ceased on that date.

Chinook Salmon

A total of 4,195 Chinook salmon were observed at the SRFCF in 2003. The first Chinook salmon was observed passing through the video weir on September 8th and the last Chinook salmon was observed on November 20th. The run peaked on October 2nd when 253 Chinook salmon were observed passing through the SRFCF (Figure 1).

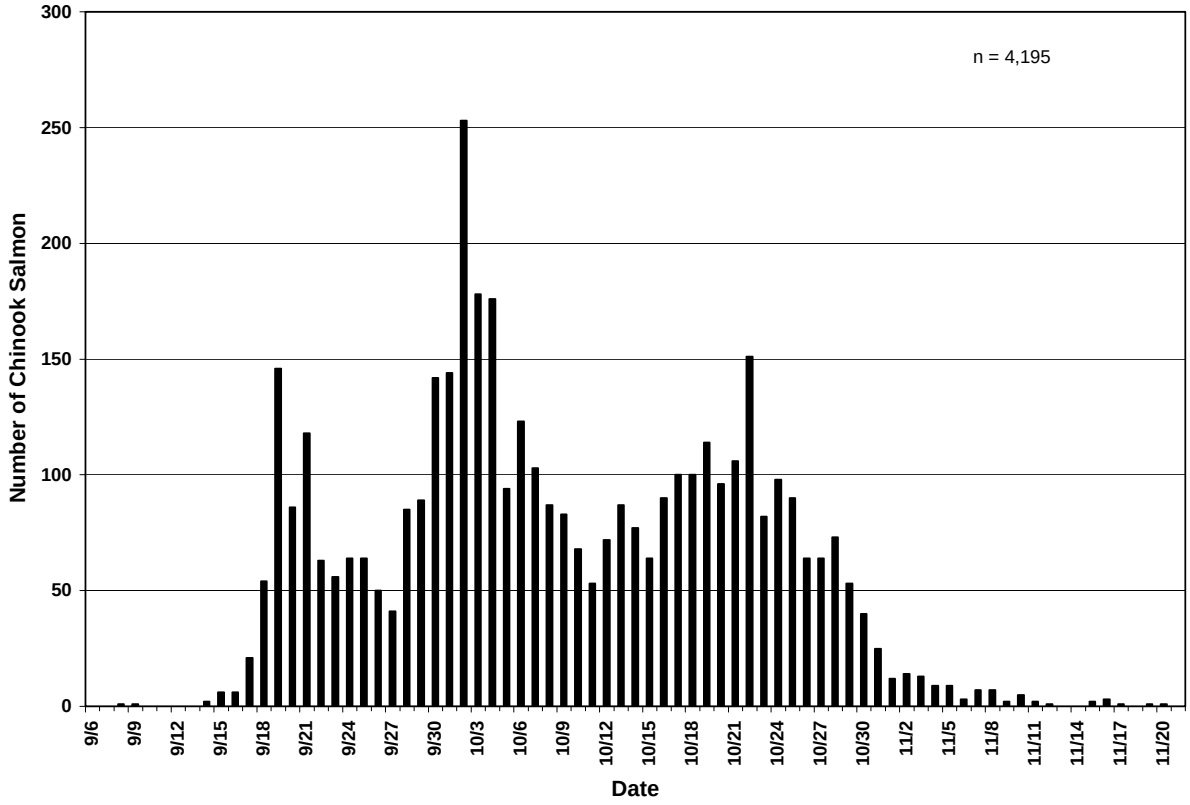

Figure 1. Run timing of fall Chinook salmon (n = 4,195 fish) observed at the Shasta River Fish Counting Facility in 2003.

The vast majority of Chinook salmon (87%) passed through the SRFCF during daylight hours between 0700 hours and 1800 hours (Figure 2). During the day, movement of Chinook salmon through the flume was deliberate in nature. Peak migration times occurred in the morning and and late afternoon hours. Although the number of Chinook salmon moving into the flume was much less at night, those few fish that did enter the flume appeared to be more hesitant to pass through the flume. It was not uncommon to observe individual fish entering the flume several times over a short period. Some of these fish eventually passed through the flume, while others appeared to have dropped back downstream and probably passed through the flume the following morning. There was never any indication that the weir caused migration delays upstream as large numbers of fish were not observed holding the pool downstream of the weir for prolonged periods of time, several days, during the season.

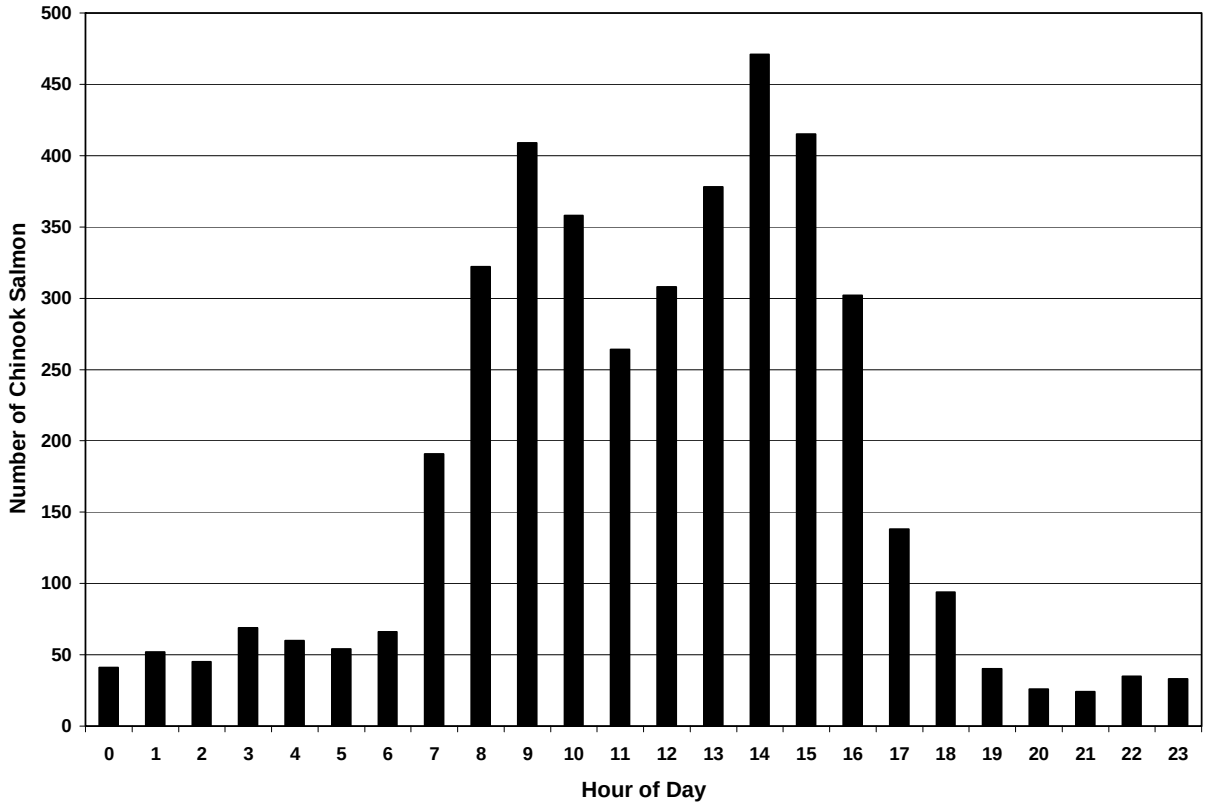

Figure 2. Diurnal timing of Chinook salmon movement through the Shasta River Fish Counting Facility during the 2003 season (n=4,195 fish).

The video camera is positioned on the right side of the flume, facing downstream, and therefore, the left side of each fish is visible to the camera as salmon migrate upstream. As staff reviewed each video tape, information was recorded on the presence of any lamprey, scars, ad-clips, or other abnormalities that are may be present on each fish. Since the right side of each fish cannot be seen during review of video tapes, any scars or abnormalities that may be present on the right side cannot be observed. However, in many cases, lamprey that are attached to the right side of fish can be seen dangling below, above, or behind, these fish as they pass through the flume.

Regardless, an unknown number of lamprey may be attached to the right side of migrating salmon, and therefore, may not be observed by staff as these fish pass through the flume. A total of 1,010 Chinook salmon (24.08% of the total run) had one or more lamprey attached to them as they passed through the flume.

A total of 25 Chinook salmon that were observed passing through the video flume appeared to have an ad-clip indicating that these fish maybe of hatchery origin. No ad-clipped Chinook salmon were recovered during the spawning ground survey or as wash backs against the weir. Since the heads of these 25 fish could not be recovered for tag extraction or verification a direct estimate of the total hatchery contribution could not be derived. However, if we assume that each of these ad-clip fish did in fact carry a CWT an estimate of the potential hatchery contribution to the Shasta River could be derived based on the proportion of CWTs that were observed at IGH during 2003 (Table 1). This assumes that the proportion of hatchery strays into

Table 1. Estimated contribution of 25 ad-clipped Chinook salmon observed at the SRFCF derived based on the proportion of CWT fish actually observed at IGH and expanded based on the production multiplier for each CWT release code.

Coded Wire Tag Code (CWT)	Brood Year	# of CWTs Observed at IGH	Proportion of CWTs Observed at IGH	Predicted # of CWTs from SRFCF ad-clips observed	CWT Production Multiplier	Hatchery Contribution Estimate for SRFCF
65254	1999	1	0.000729395	0.018234865	10.83	**0**
66351	1999	187	0.136396791	3.409919767	11.45912951	**39**
66352	1999	233	0.169948942	4.248723559	11.45921734	**49**
66353	2000	133	0.097009482	2.425237053	9.643396424	**23**
66354	2000	224	0.163384391	4.084609774	8.509614839	**35**
66355	2001	9	0.006564551	0.164113786	9.324617876	**2**
66356	2001	4	0.002917578	0.07293946	10.55047319	**1**
601020301	1998	1	0.000729395	0.018234865	26.3808408	**0**
601020303	1998	2	0.001458789	0.03646973	26.38111981	**1**
601020304	1998	1	0.000729395	0.018234865	26.38093052	**0**
601020305	2000	67	0.048869438	1.221735959	17.68625094	**22**
601020306	2000	44	0.032093363	0.802334063	17.75677166	**14**
601020307	2000	54	0.039387309	0.984682713	39.29886071	**39**
601020308	2000	61	0.044493071	1.112326769	32.43528734	**36**
601020309	1999	69	0.050328228	1.258205689	27.49330958	**35**
601020310	1999	83	0.060539752	1.5134938	27.49346726	**42**
601020311	1999	131	0.095550693	2.388767323	27.49384433	**66**
601020312	1999	65	0.047410649	1.185266229	27.49373021	**33**
601020401	2001	1	0.000729395	0.018234865	17.97416803	**0**
601020403	2001	1	0.000729395	0.018234865	30.66311208	**1**
Totals		**1,371**	**1**	**25**		**436**

*Estimate based on proportions of known IGH CWTs (1,371) applied to 25 ad-clip Chinook Salmon observed at SRFCF.

the Shasta River is equivalent to the proportion of CWT recoveries observed at IGH. Based on these assumptions, a total of 436 hatchery Chinook salmon may have strayed into the Shasta River during the 2003 season.

KRP staff processed a total of 318 carcasses during spawning ground surveys and 412 carcasses that wash backed against the weir during the season. Of these, fork length measurements and gender could be determined for 729 fish. Of the 729 fish processed, 487 were males and 242 were females. Male Chinook salmon ranged in fork length from 40 cm to 102 cm (Figure 3) and females ranged in fork length from 50 cm to 95 cm (Figure 4).

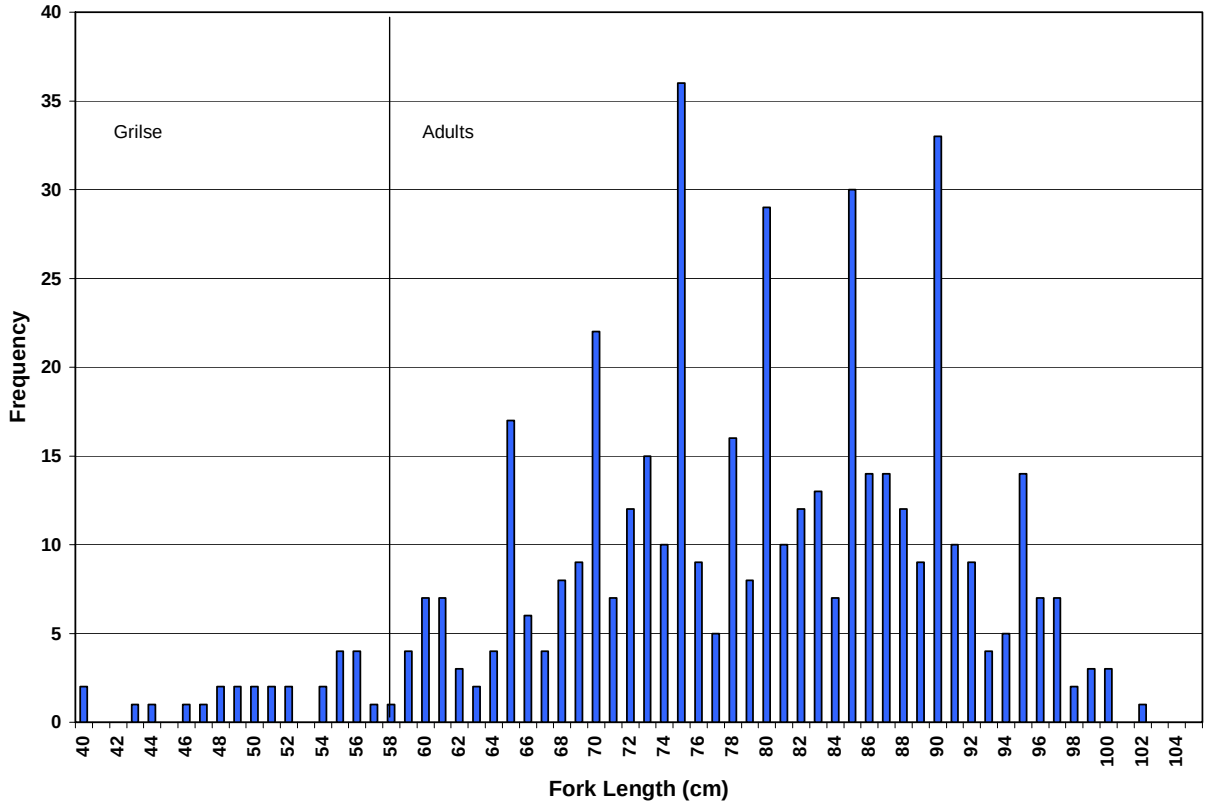

Figure 3. Fork length frequency distribution of male Chinook salmon examined (n = 487) during spawning ground carcass surveys and as wash backs against the SRFCF during the 2003 season.

From the above length frequency distribution (Figure 3) grilse, or two year old fish, were estimated to be ≤ 57 cm in fork length. Based on this grilse determination and the composition of male and female Chinook salmon observed in the spawning ground survey and as wash backs against the weir, the 2003 Chinook salmon run in the Shasta River is estimated to be comprised of 155 grilse (3.7%), 2,647 adult males (63.1%) and 1,393 adult females (33.2%).

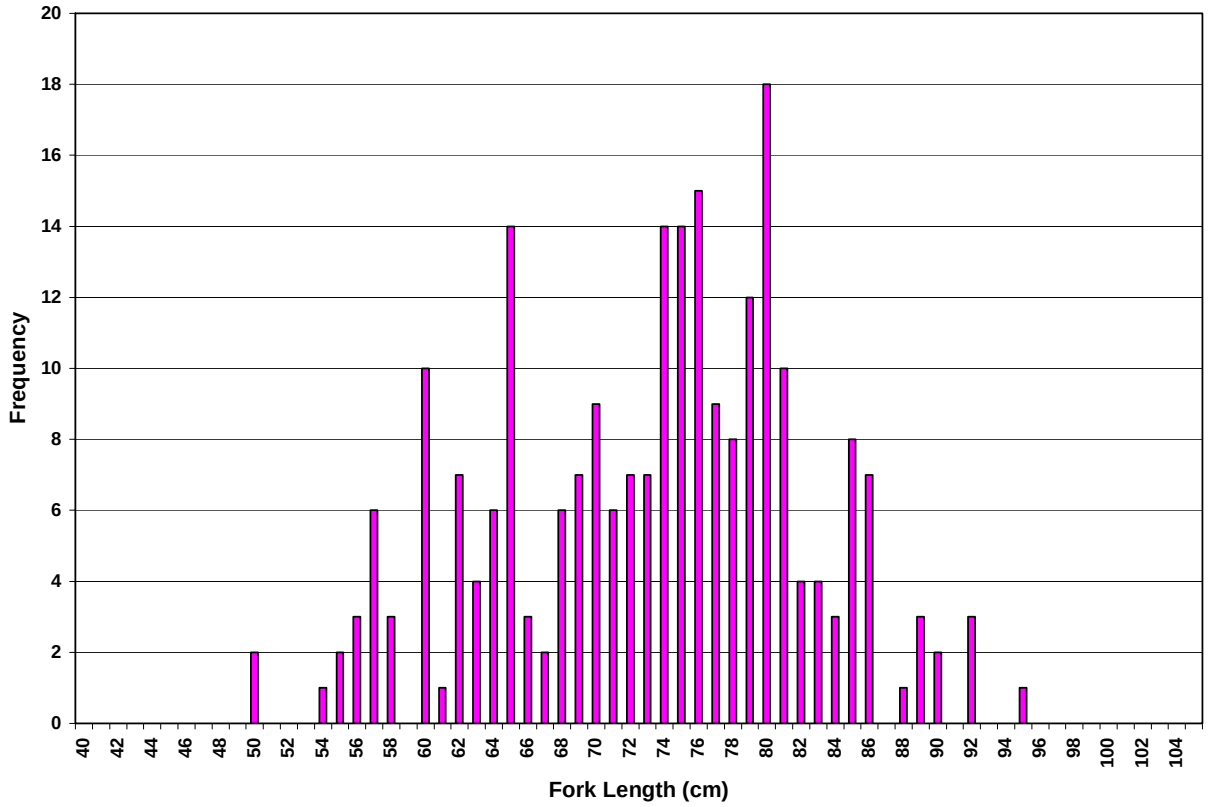

Figure 4. Fork length frequency distribution of female Chinook salmon examined (n = 242) during spawning ground carcass surveys and as wash backs against the SRFCF during the 2003 season.

Coho Salmon

A total of 187 coho salmon were observed passing through the SRFCF from October 20th through December 28th, when operations of the weir were forced to end due to power failure and pending high flows (Figure 5). The numbers of coho salmon that may have entered the Shasta River after December 28th is unknown therefore, the estimated 187 coho salmon that were observed may under estimate the actual number that coho salmon that entered the Shasta River during the 2003–2004 season. No coho salmon carcasses were recovered as during the spawning ground surveys which ended on November 11th. However, a total of 27 coho salmon were observed as wash backs against the weir between November 8th and December 25th. Of these, 22 were males and 5 were females. Male coho salmon ranged in fork length from 45 cm to 78 cm (average = 67 cm), and females ranged in fork length from 45 cm to 75 cm (average = 64 cm).

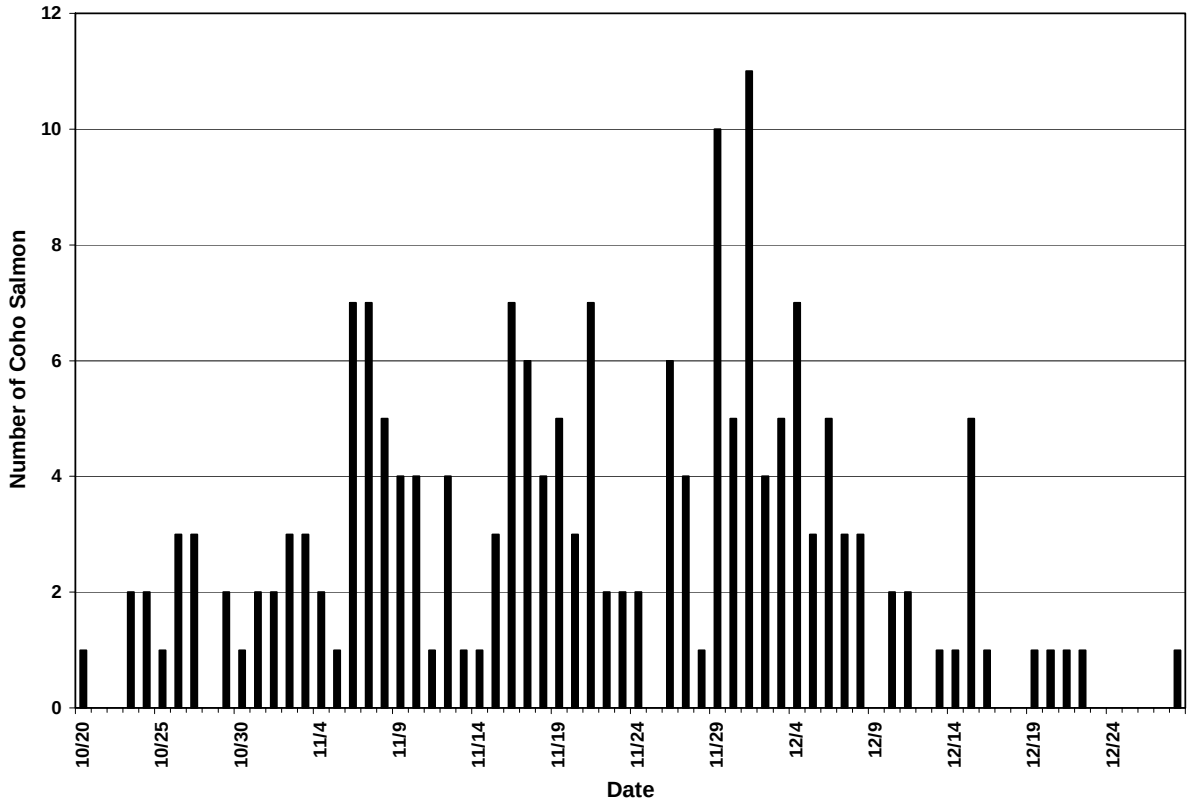

Figure 5. Run timing of coho salmon observed at the Shasta River Fish Counting Facility in 2003 (n = 187).

Six of the 187 coho salmon that were observed on the video tapes from the SRFCF appear to have been ad-clipped indicating that these fish were likely of hatchery origin. California does not apply an ad-clip to hatchery coho salmon released from state operated facilities. However, the Oregon Department of Fish and Wildlife (ODFW), in collaboration with NOAA fisheries, does mark coho salmon hatchery releases with a combination of external clips and/or CWTs for fishery management research purposes. The closest of these hatcheries is Cole Rivers Hatchery located at the base of Lost Creek Dam on the Rogue River about 153 river miles upstream from the Pacific Ocean on the Southern Oregon Coast. Cole Rivers Hatchery releases 200,000 coho salmon smolts annually, which include, 150,000 fish with an ad-clip only, 25,000 fish with an ad-clip and CWT, and 25,000 fish that are tagged with a CWT and are not ad-clipped (Robart, Randy, Pers Comm. February 18, 2004). Since Oregon has an extensive coho salmon marking and tagging program, incorporating various hatcheries along the Southern Oregon Coast, it is impossible to determine the precise origin of the ad-clipped coho salmon observed at the SRFCF without specific CWT recovery information. However, it appears likely that the ad-clipped coho salmon observed at the SRFCF originated from Oregon hatchery stocks that strayed into the Shasta River during the 2003 season.

Four of the 27 coho salmon that were observed as wash backs against the weir panels had left maxillary clips and one these was also ad-clipped. Beginning in 1996, all coho salmon released from IGH (75,000 yearlings) receive a left maxillary clip and all coho salmon released from TRH (500,000 yearlings) receive a right maxillary clip. Unfortunately, the picture quality of the video tapes does not allow for accurate determination of the presence of a maxillary clip. Therefore, the potential contribution of IGH coho salmon cannot be determined from video tape review. In addition, the video only records the left side of each fish as they pass through the flume on their upstream migration. Therefore, any coho salmon with a right maxillary clip (TRH) would not be visible even if the picture quality were good enough to detect the presence of this clip. IGH is not the only hatchery along the Pacific Coast that uses a left maxillary clip. ODFW also uses a left maxillary clip in combination with an ad-clip for coho salmon releases of approximately 10,000 yearlings in the Calapooua River. Regardless, it seems likely that the left maxillary clipped coho salmon observed as wash backs originated from IGH.

On December 5th at 11:45 am a radio tagged coho salmon passed through the SRFCF. The tag was attached to the dorsal surface immediately underneath the dorsal fin (Figure 6). The U.S. Fish and Wildlife Service and the Karuk Tribe conducted a radio tagging study of coho salmon captured at Ishi Pishi falls during their upstream migration. The purpose of the study was obtain migration timing and distribution information for coho salmon in the Klamath River.

Figure 6. Picture of radio tagged adult coho salmon observed at the SRFCF on December 5, 2003.

Sixteen coho salmon were observed with lamprey attachments. Since any lamprey attached to the fishes right side may not be visible on the video the number of coho salmon with lamprey attachments may actually be slightly greater. Nevertheless, a minimum of approximately 8.6% of the coho salmon run had lamprey attached to them during their migration into the Shasta River.

Other Species Observed

In addition to Chinook and coho salmon, the SRFCF also records the presence of other species that are recorded on the video tapes as they pass through the flume. Approximately 1,589 steelhead/rainbow trout (*Oncorhynchus giardneri*) was observed passing through the SRFCF facility during the season. These were comprised of both juvenile and adult fish. The data collected for steelhead trout was provided to the Department's Steelhead Research and Monitoring Program (SRAMP) office in Yreka for analysis and reporting and is not discussed further in this report.

A total of 13 Centrarchid species were observed moving upstream through the SRFCF from September 22nd to October 11th. Three of these fish could be easily identified as largemouth bass (*Micropterus salmoides*) and the remaining 10 fish were likely green sunfish (*Lepomis cyanellus*) or another common sunfish species.

A total of 162 Klamath smallscale sucker (*Catostomus rimiculus*) were observed at the SRFCF moving upstream into the Shasta River from the Klamath River between September 10th and December 19th, 2003. Migration of Klamath smallscale suckers peaked between September 14th and October 20th. Movement of suckers into the Shasta River decreased substantially after October 22nd as only an occasional fish was observed moving through the flume after that date.

A total of 62 speckled dace (*Rhinichthys osculus*) were observed moving the SRFCF from September 13th to October 22nd.

Flow

Flow data for the Shasta River was downloaded from the U.S. Geological Survey (USGS) gauge No. 11517500 located near the mouth of the Shasta River north of Yreka. Complete flow records are available for this gauge for water years 1934 through 1941 and 1946 through 2003. Flow data for the 2003 water year is still provisional at this time and may be subject to revision once these records have been finalized by the USGS. Annual discharge volumes in the Shasta River have ranged from a low of 56,299 acre feet (AF) in 1934 to a high of 263,128 AF in 1974. The average annual discharge for the period of record through September 30, 2003 is 133,525 AF. The 2003 water year, which runs from October 1, 2002 through September 30, 2003, yielded a total discharge of 141,457 AF, exceeding the average annual discharge by 7,932 AF.

Average daily flows in the Shasta River from September through December of 2003 ranged from a low of 54 cubic feet second (cfs) to a high of 221 cfs and averaged 151 cfs (Figure 8). The irrigation season on the Shasta River officially ends on October 1st of each year, after which time flows in the Shasta River typically increase. In September average daily flows in the Shasta River ranged from 54 to 113 cubic feet per second (cfs) and averaged 82 cfs. In October flows ranged from 118 cfs to 164 cfs and averaged 150 cfs. Flows gradually increased throughout the remainder of sampling period through to the end of December. Two heavy storms dropped

considerable amounts of snow in Siskiyou County in late December between Christmas Eve and New Years Day. These storms did not result in substantial flow increases, however considerable amounts of debris (broken limbs and aquatic vegetation) were washed downstream where they accumulated on the weir panels. Water turbidity levels also increased making it difficult to clearly identify fish as they passed through the SRFCF.

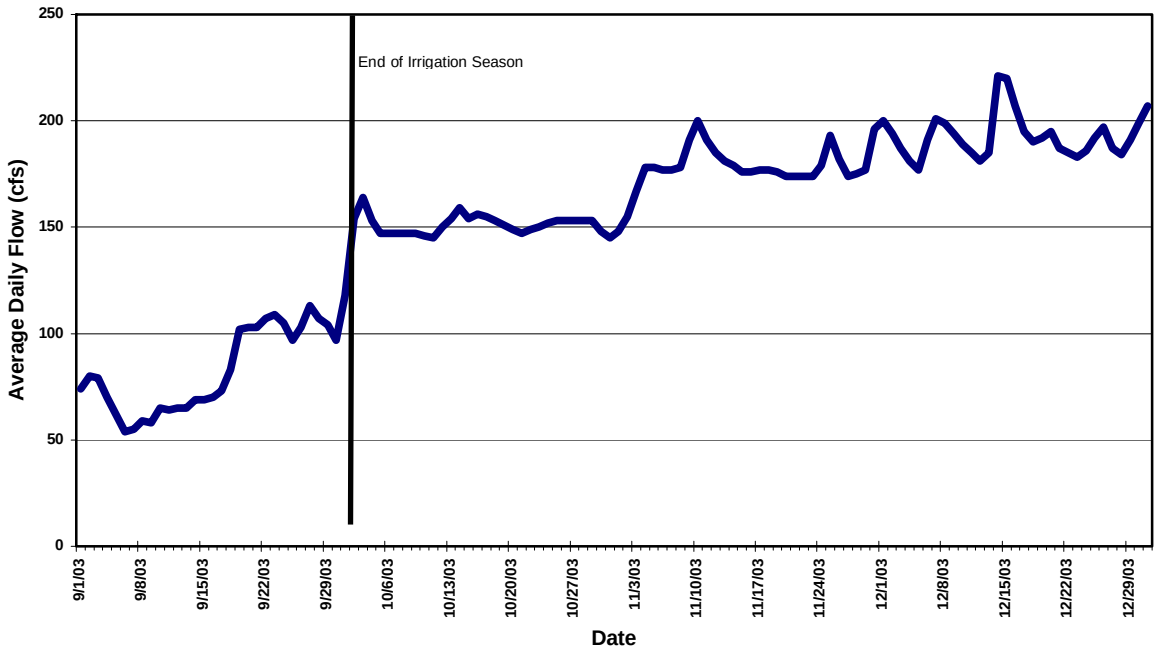

Figure 8. Average daily flows (cfs) in the Shasta River at USGS Gauge No. 11517500 from 1 September to 31 December, 2003. Data are provisional at this time and may be subject to revision.

Water Temperatures

The Department monitored water temperatures at the mouth of the Shasta River, just below the SRFCF. The KRP was provided with this data for the period from September 1st through December 31st, of 2003 (Figure 9). A summary of monthly mean, minimum, and maximum water temperatures (°F) recorded at the mouth of the Shasta River from September through December of 2003 is presented in Table 2. Water temperatures ranged from a low of 34.8°F (1.5°C) to a high of 75.9°F (24.4°C) and averaged 52.2 °F (11.2°C) for the period from September 1st through December 31st.

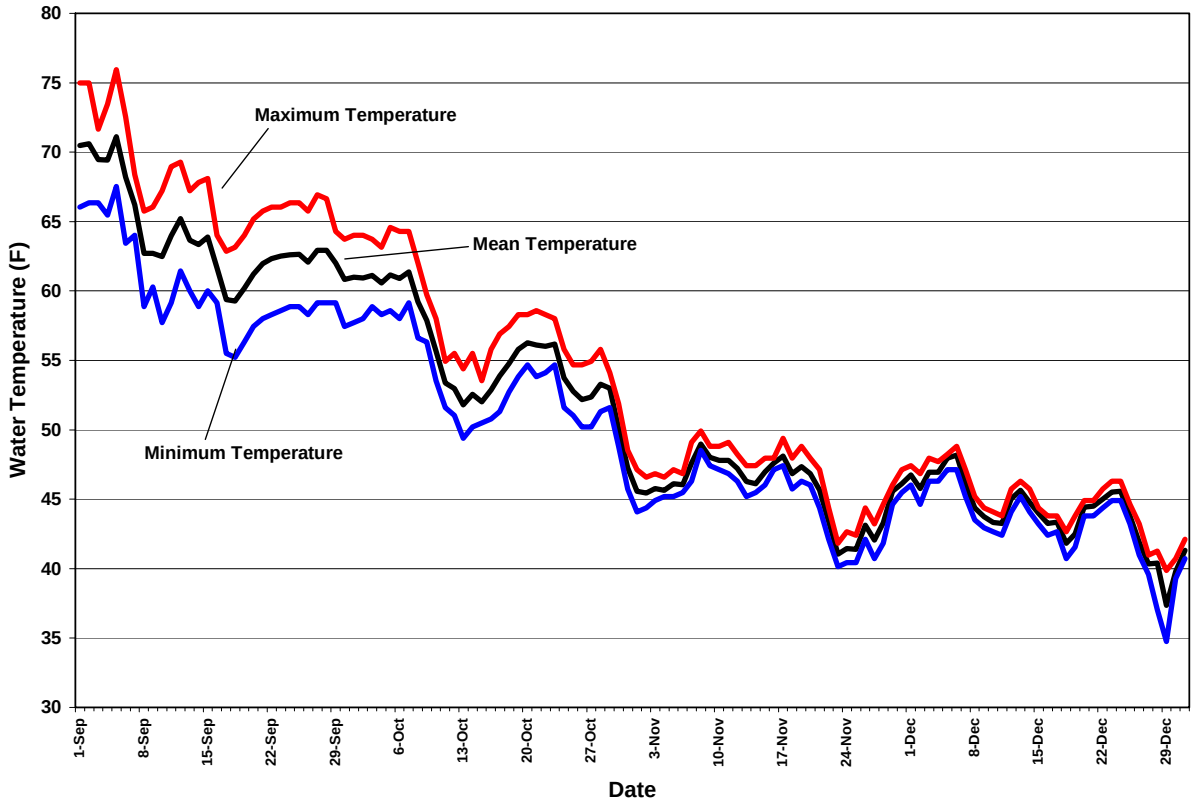

Figure 9. Water temperatures (Mean, Minimum and Maximum) observed near the mouth of the Shasta River from 1 September to 31 December, 2003.

Table 2. Summary of monthly mean, minimum, and maximum water temperatures observed in the Shasta River from September through December of 2003. Temperatures are displayed in Fahrenheit (Celsius).

Water Temperature	September	October	November	December
Mean	63.9 (17.7)	55.5 (13.0)	45.7 (7.6)	44.0 (6.7)
Min	55.2 (12.9)	45.8 (7.6)	40.1 (4.5)	34.8 (1.5)
Max	75.9 (24.4)	64.6 (18.1)	49.9 (10.0)	48.8 (9.3)

DISCUSSION

Chinook Salmon

Since 1978 the average annual run size of fall Chinook salmon in the Shasta River has averaged 5,621 fish, and has ranged from a low of only 533 fish in 1990 to a high of 18,731 fish in 1978. This 2003 fall Chinook salmon run totaled 4,195 fish, approximately 1,426 fish less than the average run size for the Shasta River and ranks as the 13th most abundant run for the period of record from 1978 to 2003 (Figure 10).

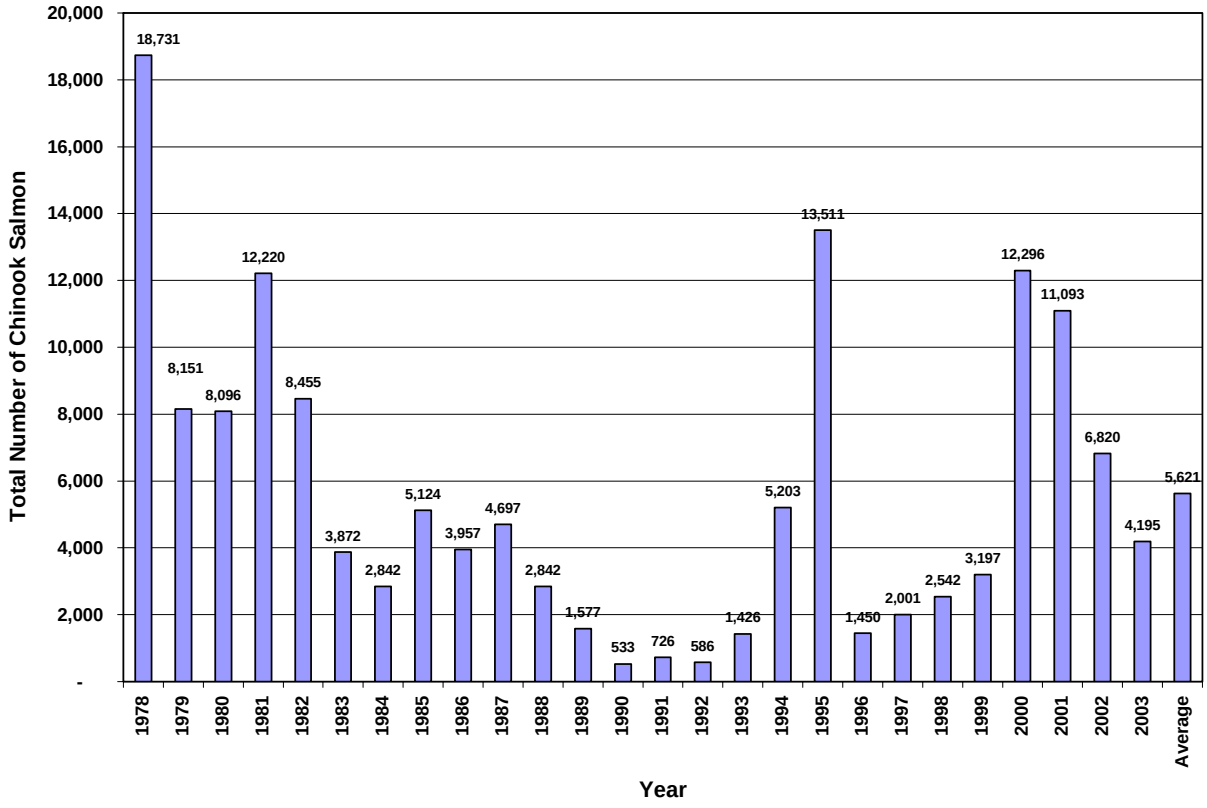

Figure 10. Chinook salmon run size estimates for the Shasta River from 1978 through 2003.

Although preliminary at this time, the total in river fall Chinook salmon run size in 2003 is estimated to be 196,413 fish. This estimate includes those Chinook that were harvested by tribal and sport fisheries, returned to the basins two hatcheries, and spawned naturally within the basin. Of the 196,413 Chinook salmon that returned to the basin in 2003, approximately 89,485 of these fish were estimated to have spawned naturally within the Klamath and Trinity Rivers and their tributary streams, including the Shasta River. Since 1978 the number of natural Chinook salmon spawners in the basin has ranged from a low of only 12,367 fish (1991) to a high of 179,118 fish

(1995). The 2003 natural spawning population of Chinook salmon within the Klamath Basin ranks as the fifth largest run recorded in the basin since 1978. Table 3 compares the percent contribution of Shasta River Chinook salmon relative the total natural Chinook salmon populations that have been recorded since 1978. The percent contribution of Shasta River Chinook salmon to the entire natural spawning population of Chinook salmon within the basin has ranged from 2% to 25% and has averaged 9%. The 2003 Chinook salmon run in the Shasta River comprised 5% of the total natural spawning population, and is substantially lower than has been observed over the last four years when Shasta River Chinook salmon contributions ranged from 10% to 14% of the basin's run.

Table 3. Percent Contribution of Shasta River Chinook Salmon compared to the total natural spawning populations of Chinook Salmon recorded within the Klamath River Basin since 1978.

Year	Chinook Salmon Natural Escapement		Percent Shasta
	Klamath Basin	Shasta River	
1978	74,906	18,731	25%
1979	37,398	8,151	22%
1980	48,465	8,096	17%
1981	50,364	12,220	24%
1982	50,597	8,455	17%
1983	33,310	3,872	12%
1984	21,349	2,842	13%
1985	61,628	5,124	8%
1986	142,302	3,957	3%
1987	110,489	4,697	4%
1988	91,930	2,842	3%
1989	49,377	1,577	3%
1990	16,946	533	3%
1991	12,367	726	6%
1992	17,171	586	3%
1993	25,683	1,426	6%
1994	38,578	5,203	13%
1995	179,118	13,511	8%
1996	87,500	1,450	2%
1997	50,369	2,001	4%
1998	45,343	2,542	6%
1999	28,904	3,197	11%
2000	89,122	12,296	14%
2001	85,580	11,093	13%
2002	69,502	6,820	10%
2003	89,485	4,195	5%
Average	**61,838**	**5,621**	**9%**

The migration of Chinook salmon into the Shasta River occurred in three major pulses. The first pulse began on September 14th and peaked on September 19th when 146 Chinook salmon were observed passing through the SRFCF. The second pulse of fish peaked on October 2nd when a total of 253 Chinook salmon were observed passing through the weir. Both of these two migration pulses coincide with increases in river flow (Figure 11). From September 16 to 19 flows increased from 70cfs to 102cfs (+32cfs), and from September 30 to October 2 flows increased from 97cfs to 154cfs (+57cfs). The third pulse of Chinook salmon began entering the river on October 15th and peaked on October 22nd when 151 Chinook salmon were observed passing through the weir. Unlike the first two migration pulses, the third pulse does not appear to be related to increased flow and likely River flows were remained fairly stable at about 150cfs during this period. Overall, flow conditions during the 2003 spawning run were greatly improved over the previous two years when flows were significantly lower during the month of September (Figure 12).

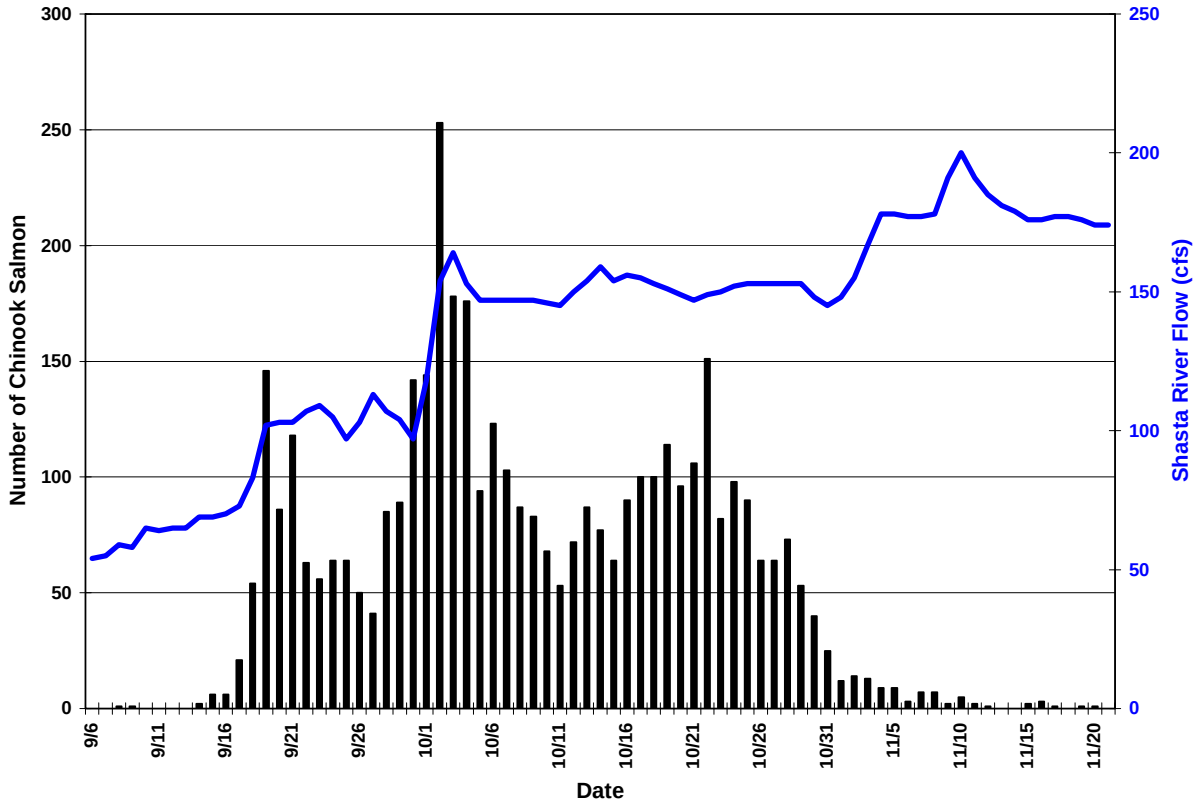

Figure 11. Run timing of Chinook salmon and average daily flows observed in the Shasta River during the fall of 2003. Flows were obtained from the USGS Gauge on the Shasta River (No. 11517500) and are provisional at this time.

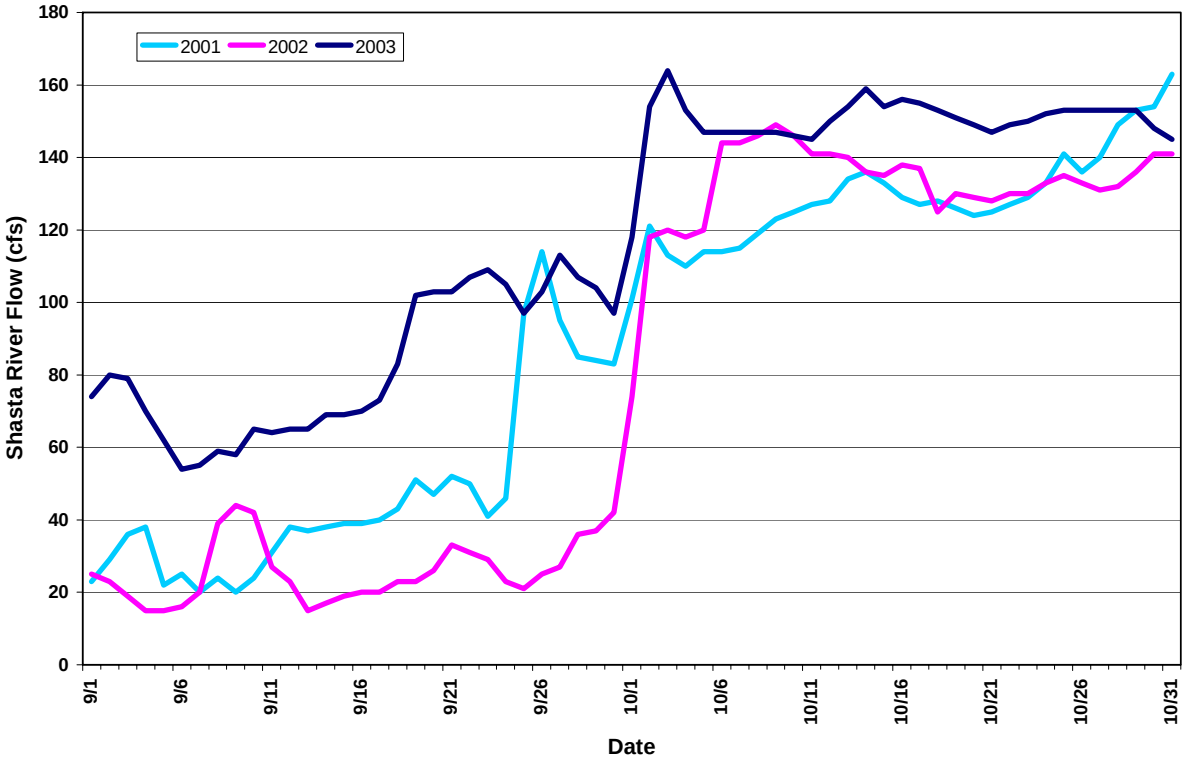

Figure 12. Average daily flows (cfs) in the Shasta River during September and October of 2001, 2002, and 2003. Data obtained from the USGS gauge (No. 11517500) located just upstream of the SRFCF.

Coho Salmon

Since 1979 the KRP has operated the SRFCF with the primary purpose of monitoring the escapement of fall Chinook salmon entering the river. During the course of these efforts coho salmon have been observed passing through the facility on various occasions. Unfortunately, high flows, common during the coho migration period, have greatly compromised our ability to gather consistent data on coho salmon run sizes annually. Since 2001, the KRP has operated the SRFCF beyond the Chinook salmon migration period in an effort to better document coho salmon returns in the Shasta River. However, high flows and large volumes of debris have prevented the SRFCF from operating beyond mid December in both 2001 and 2002. This year the Department was able to maintain operation of the SRFCF until December 28th when a power failure caused by heavy snow accumulations forced us to cease operation of the facility. Although, the majority of the coho salmon may have entered the river prior to this date there is still some uncertainty as to the number of coho that may have entered the river after December

28th. Therefore, information on coho salmon runs in the Shasta River is still incomplete and direct comparisons of coho numbers observed between years should acknowledge this problem. Regardless, this data is extremely important given the current status of coho salmon under the federal Endangered Species Act and California Endangered Species Act. Table 4 provides a summary of coho salmon observations that have been recorded at the SRFCF since 1979.

Table 1. Number of coho salmon that have been observed at the SRFCF from 1979 through 2003.

Year	# Coho	Last Day of Operations	Year	# Coho	Last Day of Operations
1979	355		1992	3	11/11/92
1981	418	1/6/82	1993	6	11/12/93
1982	263	2/28/83	1994	17	11/6/94
1983	36	1/19/84	1995	12	11/11/95
1984	69	11/19/84	1996	1	11/4/96
1985	3		1997	0	10/28/97
1986	0	11/3/86	1998	0	11/4/98
1987	0	10/12/87	1999	27	11/10/99
1988	3	11/2/88	2000	1	11/7/00
1989	6	10/21/89	2001	291	12/14/01
1990	2	10/28/90	2002	86	12/17/02
1991	9	11/11/91	2003	187	12/28/03

The number of coho salmon that were observed at the SRFCF in 2003 showed an increase of 101 fish when compared to the previous year (2002) but, and was less than the number of coho salmon observed in 2001 by 106 fish.

This year 27 coho salmon were observed as wash backs against the weir indicating that these fish likely spawned a short distance upstream of the weir. Of the 27 coho salmon examined, 22 were males and 5 were females. In 2002 we did not observe any coho salmon as wash backs against the weir panels however, the coho salmon run size in 2002 was less than half of the 2003 run and the lower numbers may in part be responsible for the lack of coho salmon wash backs observations. During the 2001 spawning season 21 coho salmon were collected as wash backs at the SRFCF and the run size estimate for that year was 291. In addition, 2 coho salmon carcasses were recovered in spawning ground surveys a short distance upstream of the weir in 2001 bringing the total number of coho salmon observations in the lower reach of the river to 23 fish. Based on the number coho salmon wash backs that were observed during the 2001 and 2003 seasons it would appear that several coho salmon likely spawn in the lower river each year. However, a complete description of the spawning distribution of Chinook and coho salmon over the last several years is uncertain since extensive spawning ground surveys have not been conducted.

Budget constraints and staffing limitations greatly limit the KRP's ability to conduct extensive spawning ground surveys throughout the Shasta River. Operation of the video camera at the SRFCF has greatly improved our ability to accurately monitor salmon escapement numbers as these fish enter the river. As a result, mark and recapture carcass surveys are no longer needed to estimate run sizes in the Shasta River. On the Scott and Salmon Rivers however, where flow conditions and remote locations greatly complicate installation and operation of a video fish counting station, the need to conduct extensive spawning ground surveys is crucial for estimating salmon run size numbers. Unfortunately, since extensive spawning ground surveys are not conducted on the Shasta River information describing the distribution of the run throughout the river is not collected. Collection of this type of information would improve our knowledge of salmon distribution, habitat use, and life histories within the Shasta River and may help direct future restoration efforts within the basin. With the current budget situation extensive spawning ground surveys in the Shasta River could only be accomplished through cooperation with local landowners. Participation in such a cooperative effort would also lead to a better appreciation and understanding of the difficulties that are faced by all of the stakeholders who rely on the Shasta River for its important water and fishery resources.

PERSONAL COMMUNICATIONS

Mr. Randy Robart, Hatchery Manager, Cole Rivers Hatchery, Oregon Department of Fish and Wildlife, phone conversation on February 18, 2004