Shasta River Fish Counting Facility, Chinook and Coho Salmon Observations in 2006, 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 14 September until 13 December. A total of 2,184 Chinook salmon were estimated to have entered the Shasta River during the 2006 spawning season. KRP staff processed a total of 44 carcasses during spawning ground surveys. A total of 457 Chinook salmon carcasses were collected as wash backs against the weir during the season. Chinook salmon ranged in fork length from 36 cm to 98 cm and grilse were determined to be $\leq$ 59 cm in fork length. The run was comprised of 863 grilse (1.8%), 229 adult males (42.8%), and 1092 females (55.4%). Based on age proportions derived from analysis of scales conducted by the Yurok Tribal Fisheries Department, the age structure of the run included 863 grilse, 253 age 3 fish, 1,042 age 4 fish, and 27 age 5 fish. A total of 7 ad-clipped Chinook salmon were observed passing through the SRFCF during the season, indicating that these fish maybe of hatchery origin. The head from 1 ad-clipped Chinook salmon was recovered from carcasses examined in the wash back sample. The analysis of the cwt (#066359) recovered from this head indicated that this fish was released from Iron Gate Hatchery (IGH) in November of 2003 as a yearling. Expansion of this cwt by the production multiplier yielded an estimate of 10 hatchery origin Chinook salmon. For the remaining 6 ad-clipped Chinook that were observed at the SRFCF an estimate of hatchery contribution was derived based on applying the proportion of cwt recoveries observed at IGH to these 6 ad-clipped fish. Using this method a total of 96 additional hatchery origin Chinook salmon may have entered the Shasta River during the 2006 run. This yields a total estimate of 106 hatchery Chinook or 4.9% of the total run observed in 2006.

A total of 85 coho salmon were observed passing upstream through the SRFCF and 38 coho salmon were observed passing downstream through the SRFCF from October 13th to December 5th. Since 38 coho salmon were observed leaving the Shasta River through the SRFCF, the total number of coho salmon that are known to have remained in the Shasta River is 47 fish. The first coho salmon of the season was observed passing through the SRFCF on October 13th and the last coho salmon was observed on December 5th.

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 video fish counting weirs 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 to assist harvest managers, data is recorded for other fish species observed at the SRFCF during its normal period of operation as well.

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. A 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. On August 30, 2002, the Commission found that coho salmon warranted listing as a threatened species under the California Endangered Species Act from Punta Gorda north to the California Oregon border. However, rather than proceeding immediately with regulatory action under Title 14, Section 670.5 of the California Code of Regulations, the Commission directed the California Department of Fish and Game (Department) to prepare a Recovery Strategy for coho salmon, a process that took 18 months and was completed in February of 2004 (CDFG 2004). Following review of the Recovery Plan on August 5, 2004, the Commission proposed to amend Section 670.5 of Title 14, CCR, to add coho salmon populations between San Francisco and Punta Gorda to the list of Endangered Species and to list coho salmon populations between Punta Gorda and northern border of California (including the Klamath River) to the list of Threatened Species. In response to these listings, beginning in the fall of 2001 the Department intensified efforts to document coho salmon presence within the Klamath River Basin and elsewhere. Consistent with this effort, the KRP elected to continue operating the SRFCF beyond the end of the Chinook salmon run, through the end of December in an effort to document migration of coho salmon into the Shasta River.

This report describes the characteristics of the Chinook and coho salmon runs that entered the Shasta River during the fall of 2006.

METHODS

Monitoring of the salmon run within 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 a video camera, counting flume and an Alaska style 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 JVC digital color video camera (Model No TK-C92OU) equipped with a 5 – 50mm 1:1.3 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 8th. Recording speeds were set at 12 hour mode during the entire period of operation. The video recorder was set to include both a date and time stamp on every recording to accurately document run timing.

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

KRP staff visited the SRFCF twice daily, once in the morning and once in the evening. 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 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. 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 data analysis.

All 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, 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 conducted in 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 additional 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. All of the scale samples 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 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. The surveys were conducted once a week throughout the fall Chinook salmon spawning season. The first survey occurred on October 25 and the last survey occurred on November 22.

Flow information was obtained from the USGS gauge (# 11517500) located near the mouth of the river a short distance upstream of the SRFCF.

RESULTS

Operation of the SRFCF began the morning of September 14 at approximately 8:43am, Pacific Standard Time. The camera, SVHS recorder and lighting system malfunctioned on ten occasions during the month of September and once during the month of October. However, only three of the aforementioned malfunctions resulted in significant loss. In the evening of September 22 the lighting system malfunctioned, and therefore, fish movements recorded at the SRFCF were not visible from approximately 21:30 hours on September 22 to 05:36 hours on September 23 for a total elapsed time of 08:06 hours. Again, on September 26 the lighting system malfunctioned and fish movements were not visible from 18:13 hours on September 26 to 06:10 hours on September 27 for a total elapsed time of 11:57 hours and on October 16 the camera equipment failed to record fish movements from 16:46 hours on October 16 to 06:34 hours on October 17. A power outage was the cause of the latter two malfunctions that occurred, while operator error was likely responsible for the malfunction on the evening of October 16-17.

Several storm systems passed through Siskiyou County during the first week of December. On December 12 at approximately 15:54 hours video recording was ended in anticipation of high flows. The morning of December 13 at approximately 08:15 hours KRP staff removed the Weir and Camera Box at the SRFCF (Figure 1).

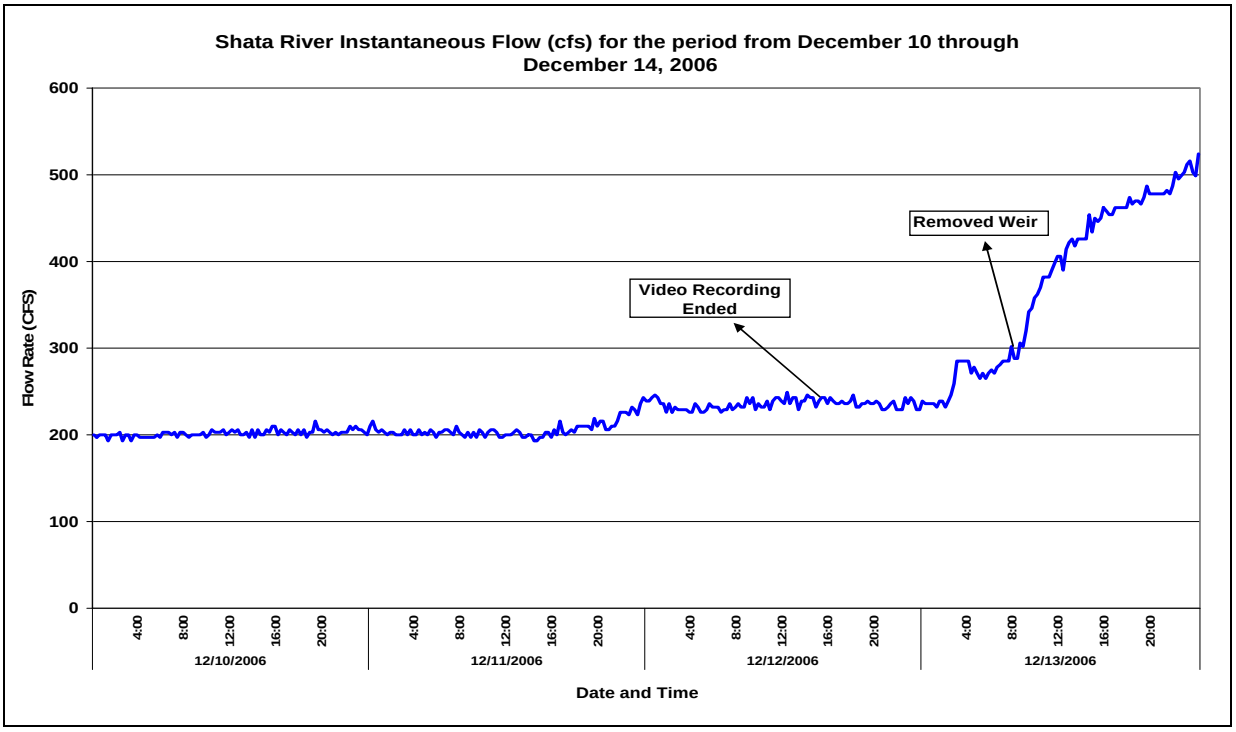

Figure 1. Shasta River flows (cfs) recorded at the USGS Gauge #11517500 from December 10 through December 13, 2006.

Chinook Salmon

A total of 2,172 Chinook salmon were observed passing through the SRFCF during the 2006 season between September 14 and December 12. As was discussed previously, there were three significant periods of time when the video equipment failed to operate properly. The malfunctions occurred on September 16-17, 22-23 and October 16-17, for a total of 33:51:54 hours. During those periods Chinook salmon movements through the SRFCF were not monitored. To approximate the number of Chinook salmon that may have passed through the SRFCF during equipment malfunctions, Chinook salmon movements during the same time period two days prior and two days after each video malfunction were averaged to calculate an estimate of the number of Chinook salmon that may have passed through the facility. Using this method, a total of 12 additional Chinook salmon was estimated to have entered the Shasta River. Therefore, the total run size of Chinook salmon in the Shasta River during the 2006 season was estimated to be **2,184** fish.

The first Chinook salmon movement was observed on September 14 and the last Chinook salmon was observed on December 1. The run entered the Shasta River in two pulses which occurred between September 19th and 21st, and between October 1st and 2nd (Figure 2).

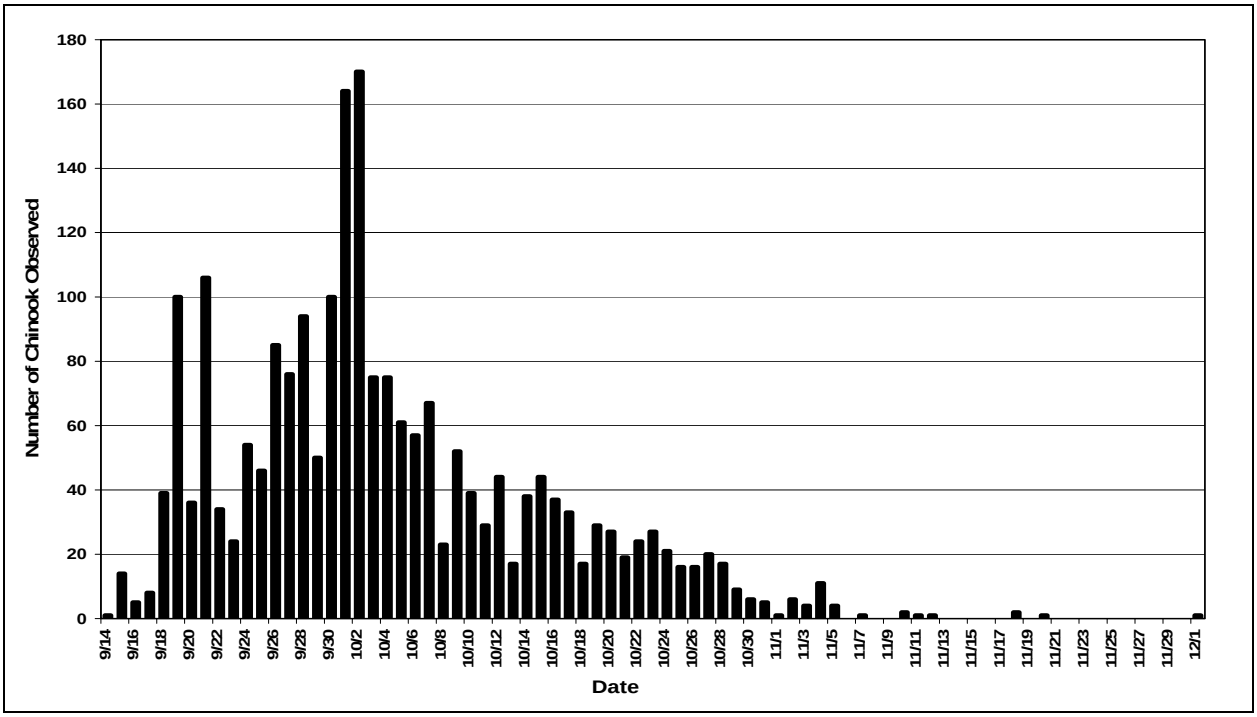

Figure 2. Run timing of fall Chinook salmon (n = 2,184 fish) observed at the Shasta River Fish Counting Facility in 2006.

Consistent with previous years, the majority of Chinook salmon (87%) passed through the SRFCF during day light hours between 06:00 and 17:00 hours (Figure 3).

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, 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. 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. Therefore, some lamprey which maybe attached to the right side may not be visible on the video recordings. As a result, the estimated number of fish observed with lamprey attached likely underestimates the actual occurrence of lamprey attachments by a small portion. A total of 407 Chinook salmon, 18.7% of the total number of Chinook salmon observed at the SRFCF, had live lamprey attached to their bodies.

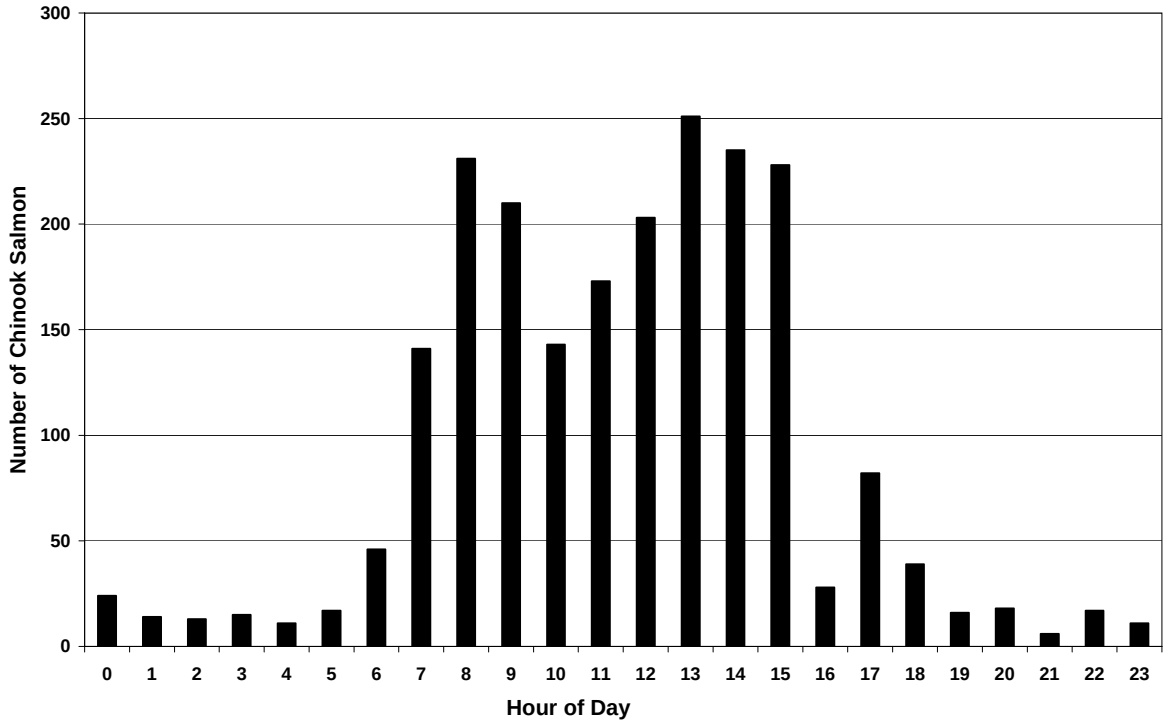

Figure 3. Diel run timing of Chinook salmon movement through the Shasta River Fish Counting Facility during the 2006 season (n = 2,184).

A total of 44 Chinook salmon carcasses were sampled during spawning ground surveys conducted in the lower canyon section of the river. Spawning ground surveys were conducted in the lower 7 miles of the Shasta River on publicly owned lands or on private lands where permission was obtained. Survey crews were hindered by access limitations, higher flow conditions, poor visibility, rugged terrain, and thick riparian vegetation.

A total of 430 males (94.1%) and 27 females (5.9%) were observed in the wash back sample. It was readily apparent that the wash back sample was heavily biased toward males. To reduce or potentially eliminate bias associated with the sex composition observed in the wash back sample, KRP staff elected to assume that the sex composition of the run of was comprised of an even number of male and female salmon during the 2006 run. In 2006 the sex composition of Chinook salmon observed in Bogus Creek was 48% male and 52% female. At Iron Gate Hatchery the sex composition was 56% male and 44% female. Although the wash back sample appears to contain a strong bias towards collection of male sex salmon, it does not appear that size selection is biased within the male sample based on simple examination of the male length frequency distribution. Therefore, the grilse cut-off and subsequent grilse/adult proportions were derived from the male Chinook length frequency distribution provided by the wash back sample (Figure 4). Observations elsewhere in the Klamath Basin also found a very high number of grilse which validates the high number of grilse that were observed in the wash back sample in the Shasta River. Based on this length frequency distribution, KRP staff determined that grilse salmon (2 year old fish) were ≤ 59 cm in fork length.

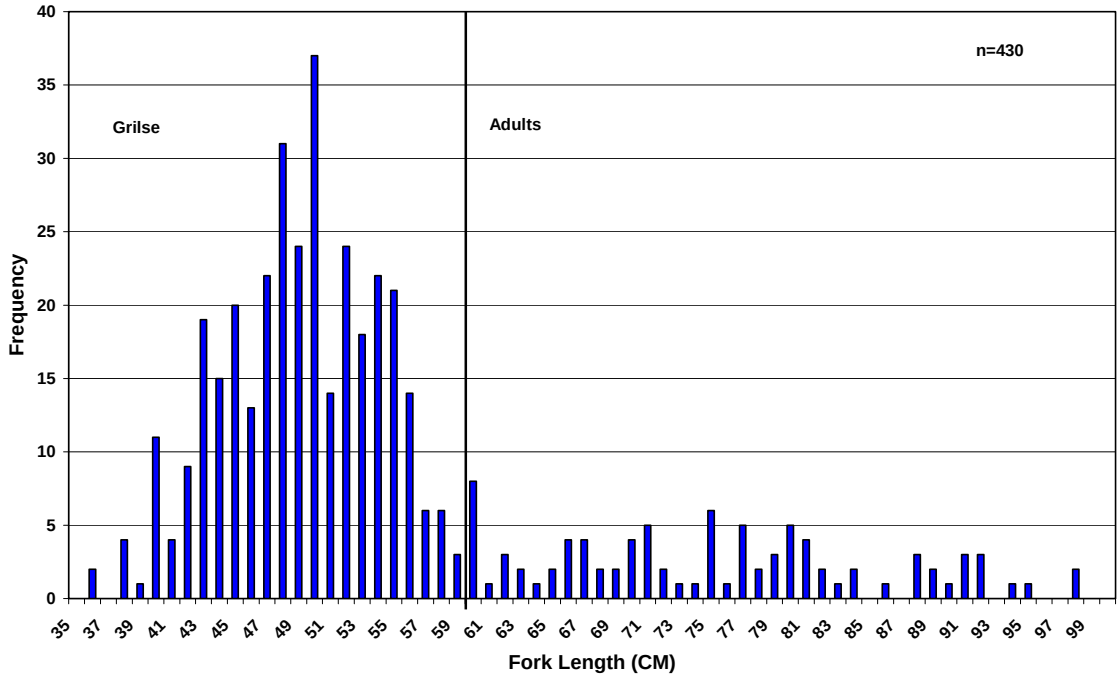

Figure 4. Length frequency distribution of male Chinook salmon carcasses that drifted downstream and became impinged (wash backs) on the weir panels of the SRFCF during the 2006 season.

The grilse/adult ratio observed for male Chinook salmon in the Shasta River wash back sample was then applied to the male population to estimate the overall grilse adult composition. The results of these analysis yield a Chinook salmon run size estimate for the Shasta River that is comprised of 863 grilse (39.5%), 229 adult males (10.5%), and 1,092 adult females (50%).

A total of 7 Chinook salmon observed passing through the SRFCF appeared to have an adipose fin clip (ad-clip) indicating that these fish may be of hatchery origin. A head from one ad-clipped Chinook salmon was recovered from carcasses examined in the wash back sample. The cwt (#066359) recovered was from the 2002 Chinook salmon brood year released from Iron Gate Hatchery (IGH) as a yearling on November 11, 2003. Expansion of this recovery by the hatchery production multiplier (9.99) yields an estimate of 10 fish. Heads from the other six ad-clipped fish observed at the SRFCF were not recovered. Therefore, the origin and production multiplier could not be derived for these fish. 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 2006 (Table 1). This assumes that the proportion of hatchery strays into the Shasta River is equivalent to the proportion of CWT recoveries observed at IGH. Based on these assumptions, a total of up to 96 hatchery Chinook was estimated for the 6 ad-clipped Chinook salmon heads that were not recovered. Therefore, a total estimate of 106 (4.85% of the run) hatchery origin Chinook salmon may have entered the Shasta River during the 2006 season.

Table 1. Estimated contribution of 6 ad-clipped Chinook salmon observed at the SRFCF based on the number of CWT fish actually observed at IGH and expanded based on the production multiplier for each CWT release code.

Coded Wire Tag	Brood Year	Production Multiplier	# of CWTs observed at IGH	IGH CWT Proportion	Estimated # of CWTs	Estimated Hatchery Contribution
66355	2001	9.32	3	0.0069	0.0416	0.3876
66356	2001	10.55	5	0.0115	0.0693	0.7310
66357	2001	8.81	7	0.0162	0.0970	0.8545
66358	2002	9.52	41	0.0947	0.5681	5.4086
66359	2002	9.99	62	0.1432	0.8591	8.5826
66360	2002	6.99	68	0.1570	0.9423	6.5864
601020404	2002	17.32	34	0.0785	0.4711	8.1600
601020405	2002	16.74	31	0.0716	0.4296	7.1909
601020406	2002	33.97	22	0.0508	0.3048	10.3558
601020407	2002	29.47	13	0.0300	0.1801	5.3087
601020408	2003	19.20	12	0.0277	0.1663	3.1926
601020409	2003	19.28	13	0.0300	0.1801	3.4731
601020500	2003	18.80	8	0.0185	0.1109	2.0841
601020501	2003	20.34	2	0.0046	0.0277	0.5637
601020502	2003	14.11	31	0.0716	0.4296	6.0611
601020503	2003	21.42	5	0.0115	0.0693	1.4841
601020504	2004	17.12	16	0.0370	0.2217	3.7957
601020505	2004	16.61	22	0.0508	0.3048	5.0636
601020506	2004	34.04	24	0.0554	0.3326	11.3205
601020507	2004	37.42	9	0.0208	0.1247	4.6667
601020508	2004	9.10	5	0.0115	0.0693	0.6305
		Total=	**433**		**6**	**96**
					Hatchery Contribution for 6 unknown ad-clipped Chinook Salmon =	**96**
					Expansion of known CWT (066359) =	**10**
					Total estimated contribution of hatchery origin Chinook =	**106**

Coho Salmon

A total of 85 coho salmon were observed passing upstream through the SRFCF and 38 coho salmon were observed passing downstream through the SRFCF from October 13th to December 5th. Since 38 coho salmon were observed leaving the Shasta River through the SRFCF, the total number of coho salmon that are known to have remained in the Shasta River is 47 fish. The first coho salmon of the season was observed passing through the SRFCF on October 13th and the last coho salmon was observed on December 5th (Figure 6).

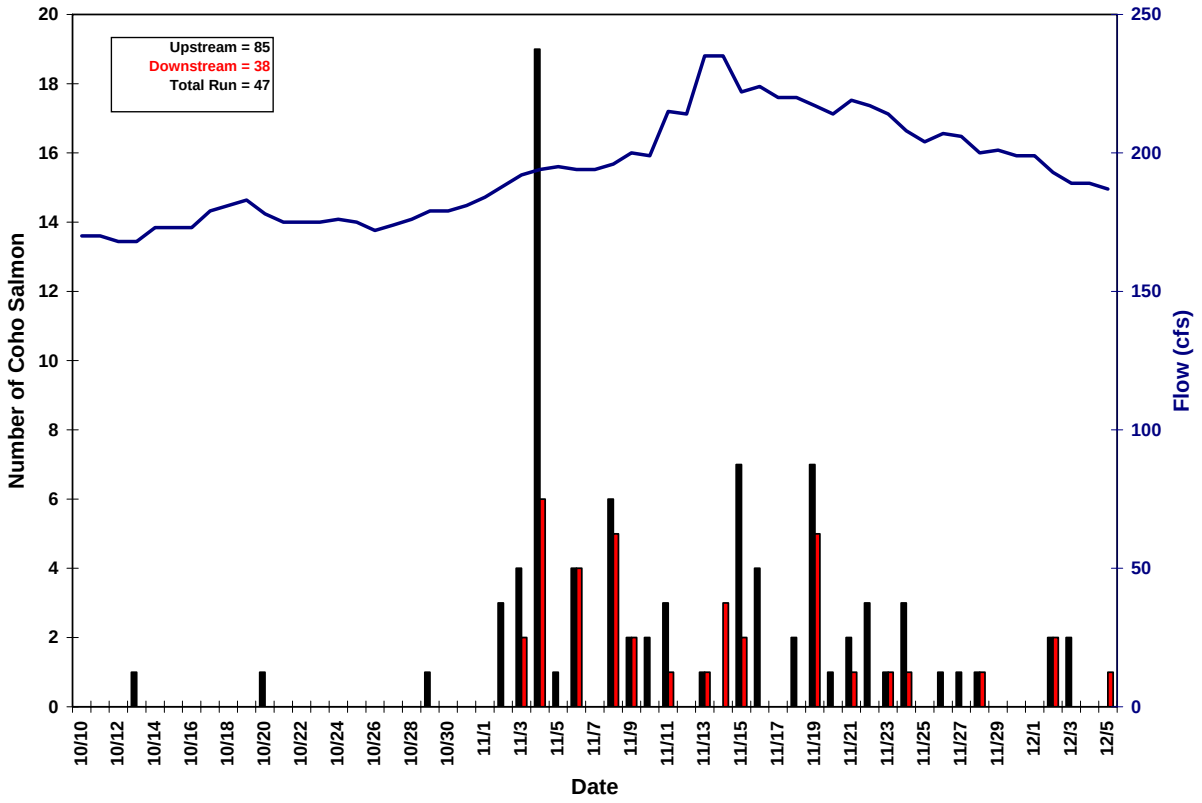

Figure 6. Run timing of coho salmon observed at the Shasta River Fish Counting Facility in 2006. Eighty five (85) coho salmon were observed moving upstream and 38 coho salmon were observed moving downstream yielding a total of 47 coho salmon.

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, 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. No coho salmon carcasses were recovered during the spawning ground surveys.

In the fall of 2004, the Department, in collaboration with NOAA Fisheries, initiated a new program intended to reduce potential take of unmarked coho salmon that enter Iron Gate Hatchery. Under this program all unmarked coho, with the exception of a small number of fish (10) that were incorporated into the spawn with marked coho, were released back to the river providing them the opportunity to spawn naturally. Prior to release, each unmarked coho was given an upper caudal clip and an individually numbered Floy tag. These marks were applied to allow the Department and others to track the movements of these fish after release from the hatchery. The caudal clip provided a means to easily identify these fish should they pass through one of the video fish counting facilities which are operated by the Department on Bogus Creek and the Shasta River. One coho salmon with a caudal clip and/or Floy tag attached (unmarked coho released from IGH) was seen passing through the SRFCF during the 2006 season. The caudal clipped coho swam back downstream shortly after entering the SRFCF leaving a net total of zero caudal clipped coho in the Shasta River.

Twelve (12) coho salmon were observed with lamprey attachments as they passed through the SRFCF. 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, approximately 32.4% of the coho salmon run had lamprey attached to them as they entered the SRFCF.

Steelhead Trout

A total of 285 rainbow/steelhead trout were observed at the SRFCF during the 2006 season. Many of these were juveniles. In an attempt to further describe the characteristics of the steelhead run observed estimates of fork length were derived from recorded video images projected on the monitor. Fork length (mm) measurements and the relative location of each fish within the flume (front, middle, back) were recorded during video tape review for all steelhead observed. Since this measurement does not provide the actual fork length for each fish a correction factor was used. The correction factor was determined based on the length of a ruler placed in the flume at three locations, front (nearest the camera), middle, and back. The correction factor for these locations was:

Fish in front section of flume,
Estimated fork length = video screen measurement x 1.025641
Fish in middle section of flume,
Estimated fork length = video screen measurement x 1.081081
Fish in back section of flume,
Estimated fork length = video screen measurement x 1.333333

This correction factor was then multiplied by the video fork length measurement to estimate the actual fork length of each fish. The fork length frequency distribution for steelhead trout is presented in Figure 7. Adult steelhead were determined to be > 420mm and half pounders were

estimated to be > 300mm and ≤ 420 mm and juvenile steelhead were estimated to be ≤ 300 mm in fork length. Based on these delineations, the KRP estimates that 34 adult steelhead and 52 half pounders entered the Shasta River during when the SRFCF was operational this season. These numbers do not accurately reflect the entire steelhead run, only those steelhead that entered the Shasta River between September 14 and December 11 of 2006.

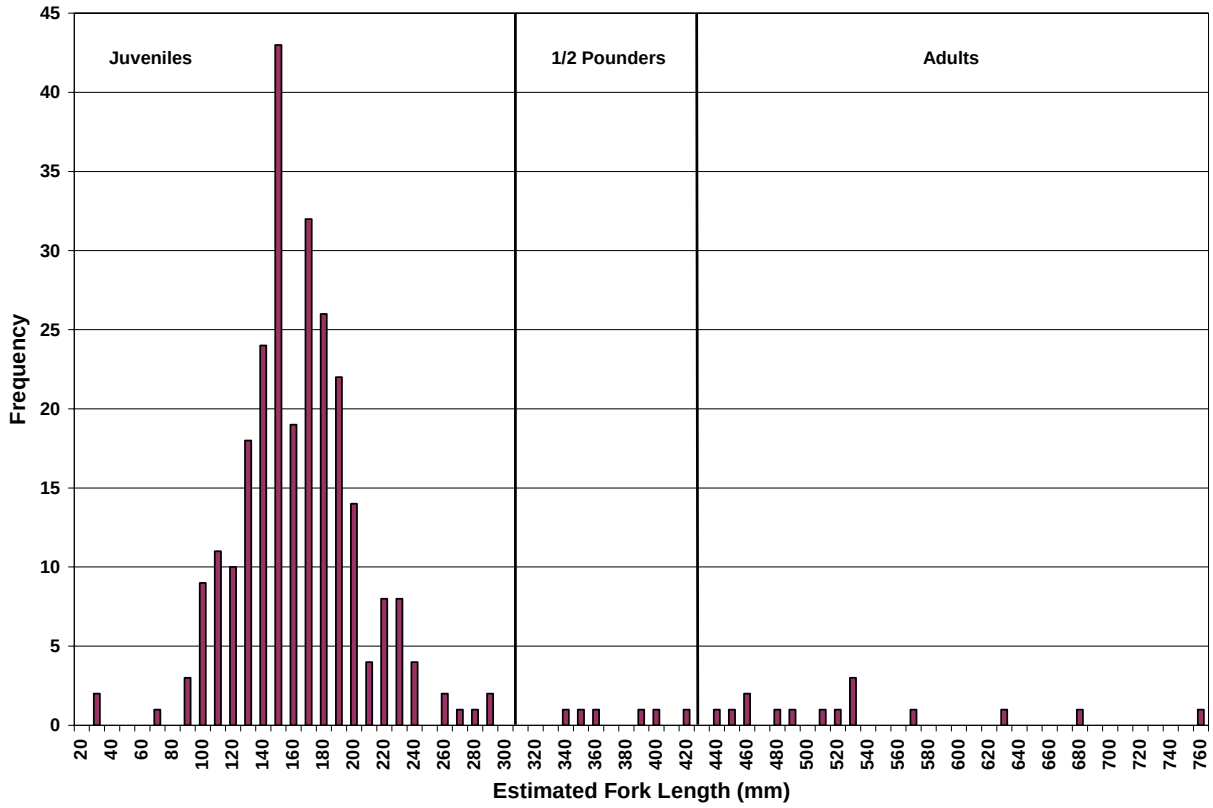

Figure 7. Summary of steelhead estimated fork lengths observed at the SRFCF during the 2005 season (n=285).

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 to present day. Flow data for the 2006-2007 water year is 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.

Average daily flows in the Shasta River from September 1st through December 31st of 2006 ranged from a low of 49 cubic feet second (cfs) on September 5th to a high of 549 cfs on December 14th (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 of

this year average daily flows in the Shasta River ranged from 49 to 134 cfs and averaged 99 cfs. Flows increased by 48 cfs between September 28 (126 cfs) and October 4 (174 cfs) as the irrigation season came to an end. After October 4th flows in the Shasta River remained fairly stable ranging between 171 cfs and 182 cfs with the average flow of 175 cfs during October. In November flows gradually increased during first half of the month with a peak flow of 232 cfs occurring on November 14th. Flows gradually decreased during the second half of November and into the first week of the December with the lowest flow of 187 cfs recorded on December 5th and 6th. Flows began to increase on December 12th in response to rain storms that passed through the region. Between December 12th and December 14th flows increased from 232 cfs to 549 cfs. In response to this increased flow the Department was force to pull the weir and camera housing from the SRFCF on December 13th effectively ending our monitoring effort for the season.

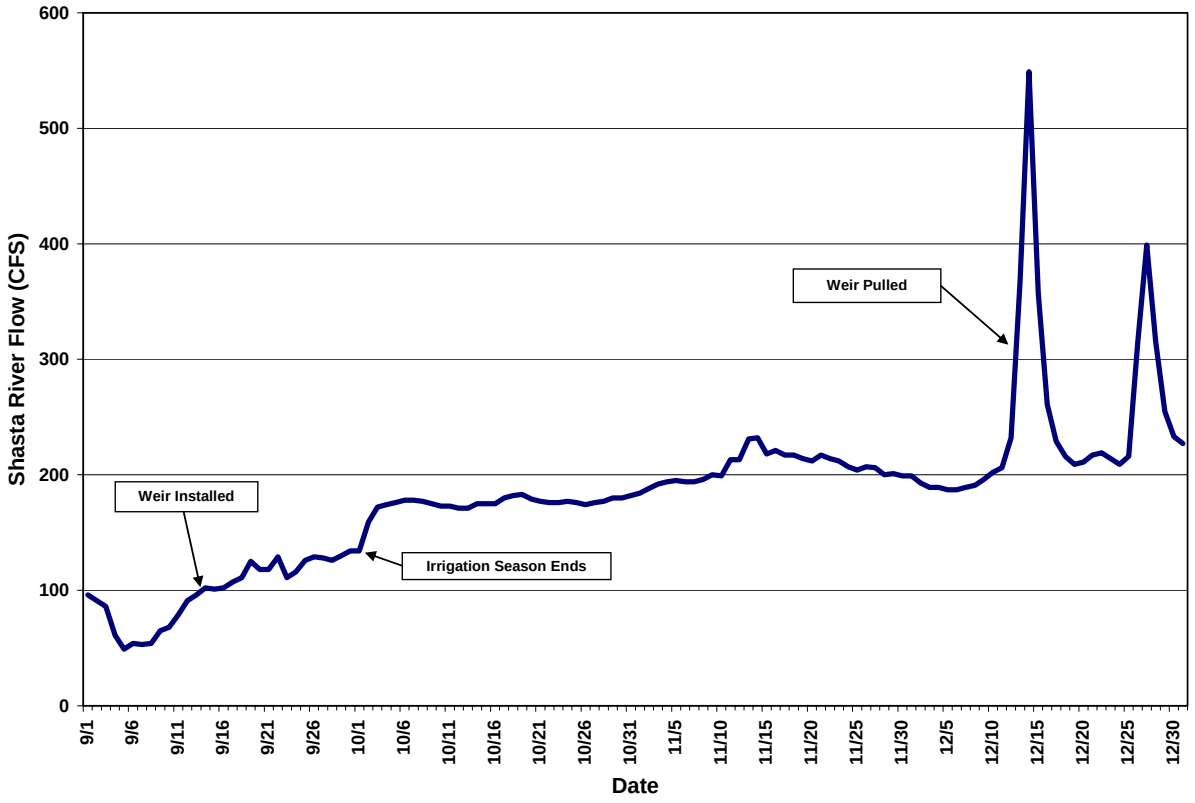

Figure 8. Average daily flows (cfs) in the Shasta River at USGS Gauge No. 11517500 from 1 September to 31 December, 2006.

DISCUSSION

Chinook Salmon

Since 1978 the average annual run size of fall Chinook salmon in the Shasta River has averaged 5,221 fish, and has ranged from a low of only 533 fish in 1990 to a high of 18,731 fish in 1978. The 2006 fall Chinook salmon run totaled 2,184 fish, approximately 3,040 fish less than the

average run size for the Shasta River (5,224 fish) and ranks as the 10th lowest run ever recorded since 1978 (Figure 9).

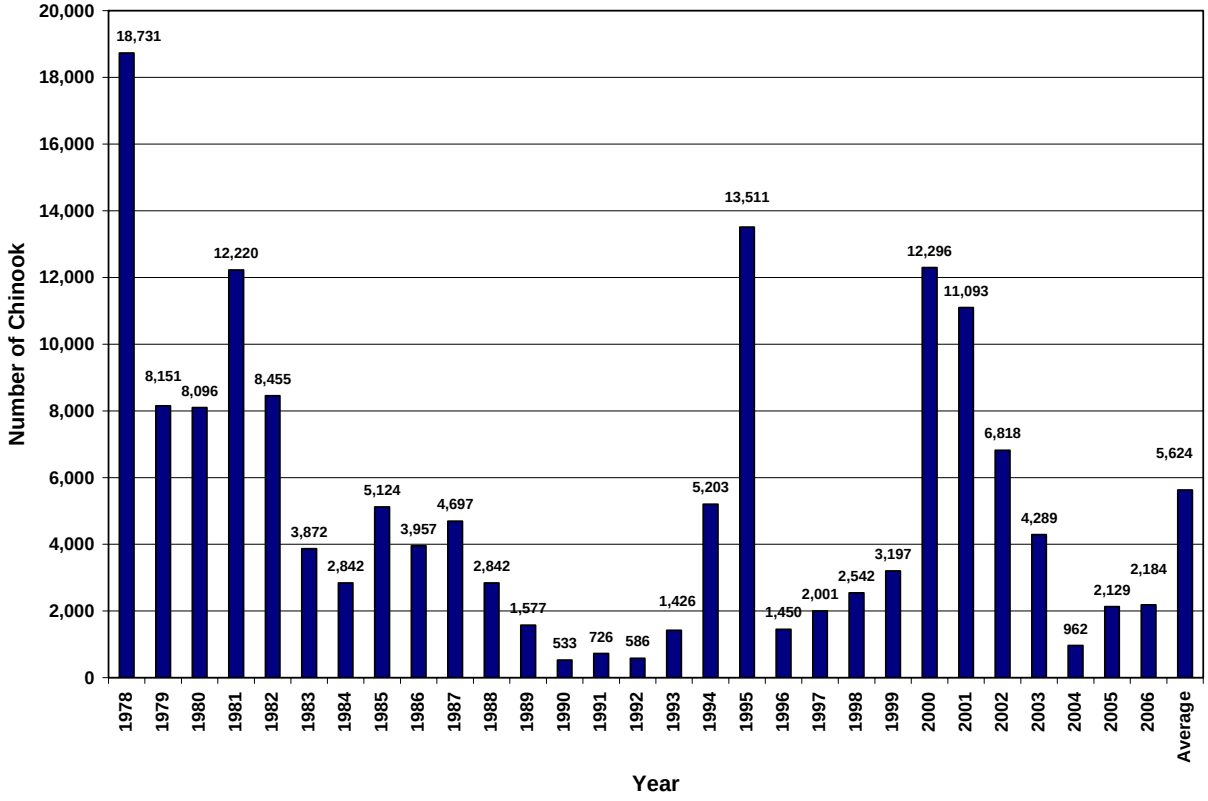

Figure 9. Chinook salmon run size estimates for the Shasta River from 1978 through 2006.

In recent years, since 2002, the KRP has estimated the number of hatchery origin fall Chinook salmon that may have strayed into the Shasta River. These estimates have been based on sample expansions from tag recoveries obtained from the Shasta River, as was the case this year, or have been based on the proportional distribution of cwt recoveries observed at IGH and applied to the number of ad-clip Chinook salmon that were observed passing through the SRFCF during the season. This later method was used to estimate the number hatchery stays in the Shasta River during the 2002, 2003, and 2004, and 2006 seasons. Since 2001 the percent estimated contribution of hatchery strays to the Shasta River has ranged from a low of 1.2% in 2002 to a high of 38.7% in 2004 (Table 2). In 2006 the percentage of hatchery strays into the Shasta River has decreased substantially to 4.9%.

Table 2. Total number of Chinook and estimated number of hatchery origin strays in the Shasta River from 2002 through 2006.

Year	Total Number of Chinook	Hatchery Stray Estimate	Percent Hatchery
2002	6,820	79	1.2%
2003	4,195	436	10.4%
2004	962	372	38.7%
2005	2,129	469	22.0%
2006	2,184	106	4.9%

Each year the Klamath River Technical Advisory Team determines the age composition for fall Chinook salmon populations that return to the Klamath River and its tributary streams. These analyses are based on both length frequency distributions and results of scale age analysis conducted for each sub basin with the Klamath River watershed. This data is used in the ocean harvest model to estimate ocean populations and develop harvest management recommendations for the following season. A summary of the age composition determinations for Shasta River fall Chinook salmon are provided in Table 3.

Table 3. Age composition of Shasta River fall-run Chinook salmon from 2002 through 2006.

Year	Age 2	Age 3	Age 4	Age 5	Total Adults	Total Run
2002	386	4,286	2,088	58	6,432	6,818
2003	155	2,798	1,325	11	4,134	4,289
2004	129	184	484	166	833	962
2005	38	1,409	600	82	2,091	2,129
2006	863	253	1,042	27	1,321	2,184

In 2006, grilse (Age 2) were the most abundant age class present in the run and age 4 Chinook was the dominate age class for adult spawners. The poor return of age 3 (2003 BY) fish in 2006 likely indicates the age 4 year class will return in small numbers in 2007. However, the strong return of grilse in 2006 may result in a strong return of age 3 adults in 2007 which may compensate for the poor rates that have been observed for the 2003 BY. The 2002 BY which returned as grilse in 2004, age 3 in 2005 and age 4 in 2006 has provided the foundation for the adult spawners that returned during those years. The 2004 BY may also turn out to be the

dominate age class for the adult return in 2007 and 2008. Unfortunately, high flows during the winter of 2005/2006 appear to have negatively impacted Chinook salmon fry production from the 2005 spawning run. Rotary migrant trapping conducted in the Shasta River in the spring of 2006 by the Anadromous Fish Research and Monitoring Program (AFRAMP) found that fry survival was significantly reduced from prior years leading to speculation that flood flows likely scoured incubating eggs deposited by the adult spawners in the fall of 2005. If true, the grilse return in 2007 should be dramatically reduced from prior years. If the 2005 BY fails to produce adequate numbers of returning adults to the Shasta River, then future production will once again be dependant on one dominate year class, the 2004 BY. Should this scenario ring true, survival of the offspring from the 2004 BY will important to insure future production of Shasta River fall-run Chinook salmon.

Coho Salmon

The KRP has operated the SRFCF with the primary purpose of monitoring the escapement of fall Chinook salmon entering the river since 1979. However, 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 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. High flows have prevented the SRFCF from operating beyond December. Thus far operation of the SRFCF has yet to extend beyond December in any year since 2001. Annually, operations have been suspended on December 14th in 2001, December 17th in 2002, December 28th in 2003, December 8th in 2004, and on December 1 in 2005. In 2006 high flows forced the entire to end on December 13th.

Because of the inconsistencies in sampling duration over the years, direct comparisons of coho numbers observed between years should acknowledge this problem. Although sampling difficulties, usually associated with high flows, have often forced the removal of the SRFCF prior to the end of the coho run, the data collected is extremely important given the current status of coho salmon under the federal Endangered Species Act and California Endangered Species Act. A summary of coho salmon observations that have been documented by the KRP is presented in Table 3.

Table 3. Summary of coho salmon observations in the Shasta River at the SRFCF.

Year	Number	Last Day of Operation	Comments
1979	355	Ukn	No date information provided in report.
1981	418	1/6/82	
1982	263	2/28/83	Weir opened for 2 days Dec 29-30 to fluch gravel from upstream.
1983	36	1/19/84	high water made weir inoperable from Nov 12 to Jan 10.
1984	69	11/19/84	
1985	3	Early December	High water forced removal of weir in early December, no date given.
1986	0	11/3/86	
1987	0	10/12/87	
1988	3	11/2/88	Three coho salmon sampled in spawning ground surveys.
1989	6	10/21/89	High flows made weir inoperable from Sept 18-20.
1990	2	10/28/90	
1991	9	11/11/91	
1992	3	11/11/92	
1993	6	11/12/93	
1994	17	11/6/94	
1995	12	11/11/95	
1996	1	11/4/96	
1997	0	10/28/97	
1998	0	11/4/98	
1999	27	11/10/99	
2000	1	11/7/00	
2001	291	12/14/01	Weir operations extended beyond November 11 to monitor Coho Salmon.
2002	86	12/17/02	
2003	187	12/28/03	
2004	373	12/8/04	
2005	69	12/1/05	Missed 7 days from 11/7 to 11/14 due to high flows.
2006	47	12/13/06	Weir Operations ended 12/13/06 due to high flows.

The operation of the video camera at the SRFCF in recent years has greatly improved the Departments 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. Since extensive spawning ground surveys are not conducted on the Shasta River, information describing the spawning distribution of the run throughout the river is not collected. In addition, the vast majority of the Shasta River, upstream of the lower canyon, flows through private agriculture lands and access to these areas requires landowner permission. Insufficient funding levels combined with the large areas of private land in the Shasta River basin greatly complicate the Department's ability to conduct large scale spawning ground surveys which would otherwise provide valuable information necessary to describe spawning distributions and habitat use. With additional resources, collection of this information would benefit habitat restoration efforts and improve our knowledge of habitat use and salmon life cycle traits specific to the Shasta River. If adequate funding and access was available throughout the Shasta River staff would be able to gather additional data from carcasses that would provide better information on the distribution of spawning adults, presence of hatchery strays, age structure, and genetic profiles. This type of information would further our knowledge on run characteristics for both Chinook and coho salmon populations in the Shasta River.

LITERATURE CITED

KRTAT (Klamath River Technical Advisory Team). 2007. Klamath River Fall Chinook Age-Specific Escapement, 2006 Run. Available from U.S. Fish and Wildlife Service, 1829 South Oregon Street, Yreka, CA, 96097.