Shasta River Fish Counting Facility, Chinook and Coho Salmon Observations in 2005, Siskiyou County, CA

By:

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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 8 September until 1 December when high flows forced the removal of the video camera and weir. High flows also forced a temporary halt to operations for a total of 7 days from the morning of 7 November until the afternoon of 14 November. A total of 2,129 Chinook salmon were estimated to have entered the Shasta River during the 2005 spawning season. KRP staff processed a total of 24 carcasses during spawning ground surveys, of which, staff was able collect fork lengths for 19 fish. A total of 395 Chinook salmon carcasses were collected as wash backs against the weir during the season. Chinook salmon ranged in fork length from 35 cm to 102 cm (Figure 5) and grilse were determined to be $\leq$ 52 cm in fork length. The run was comprised of 38 grilse (1.8%), 911 adult males (42.8%), and 1,180 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 38 grilse, 1,409 age 3 fish, 3,600 age 4 fish, and 82 age 5 fish. A total of 32 ad-clipped Chinook salmon were observed passing through the SRFCF during the season, indicating that these fish maybe of hatchery origin. Heads from 12 ad-clipped Chinook salmon were recovered from carcasses examined in the wash back sample. Of these, 11 coded wire tags (cwts) were recovered and one head did not contain a cwt (shed tag). All of the cwts recovered in the Shasta River were progeny from Iron Gate Hatchery and included brood years 2001 and 2002. Based on sample expansion values and hatchery production multipliers, a total of 469 or 22% of the total number Chinook salmon estimated in the Shasta River may have been of hatchery origin.

A total of 78 coho salmon were observed passing upstream through the SRFCF and 9 coho salmon were observed passing downstream through the SRFCF from October 20th to November 6th and from November 14th to November 30th, 2005. The weir was not operating from November 7 until the afternoon of November 14th due to high flow releases. Since 9 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 69 fish. Two coho salmon carcasses were recovered as wash backs at the SRFCF on November 27th. Both of these fish were males with a fork length of 64cm and 75cm and the 64cm coho also had a left maxillary clip indicating that this fish was progeny from IGH.

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 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 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. 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. Operation of the SRFCF has been extended through December, or until high flows force removal of equipment, since the 2001 season.

This report describes the characteristics of the Chinook and coho salmon runs that entered the Shasta River during the fall of 2005.

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 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 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 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.

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

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

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.

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 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. The surveys were conducted once a week throughout the fall Chinook salmon spawning season. The first survey occurred on October 19th and the last survey occurred on November 16th. High flows occurred on November 6th and spawning ground surveys were cancelled during the week following this flow event because of safety considerations.

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

RESULTS

SRFCF Period of Operation

Operation of the SRFCF began on the morning of September 8th at approximately 8:47am, Pacific Standard Time. The camera and SVHS recorder malfunctioned on three occasions during the month of October. In the evening of October 11 the recorder failed to start properly after the video tape exchange was made, and therefore, the SRFCF did not record fish movements from approximately 16:38 hours on October 11 to 05:53 hours on October 12 for a total elapsed time of approximately 13:15 hours. On October 14 the video equipment malfunctioned for approximately 2:55 hours from 13:30 hours to 16:25 hours and on October 21 the equipment malfunctioned again for approximately 2:50 hours from 13:39 hours to 16:29 hours. A power outage was likely the cause of the latter two malfunctions that occurred, while operator error was responsible for the malfunction on the evening of October 11-12.

An early storm caused flows to increase on November 7 and the video equipment and several weir panels had to be temporarily removed to protect the equipment (Figure 1). The weir panels and video equipment was reinstalled on November 14 and began recording at 2:52pm PST. Another large storm passed through Siskiyou County on December 1st causing a rapid increase in river flows (Figure 2). In anticipation of flood flows KRP staff began removing the weir panels at the SRFCF at 10:30 hours on the morning of December 1 and the video camera and SVHS recorder stopped recording at approximately 15:54 hours. The flood caused some damage to the weir and camera box which forced an end to the operation of the SRFCF for the season.

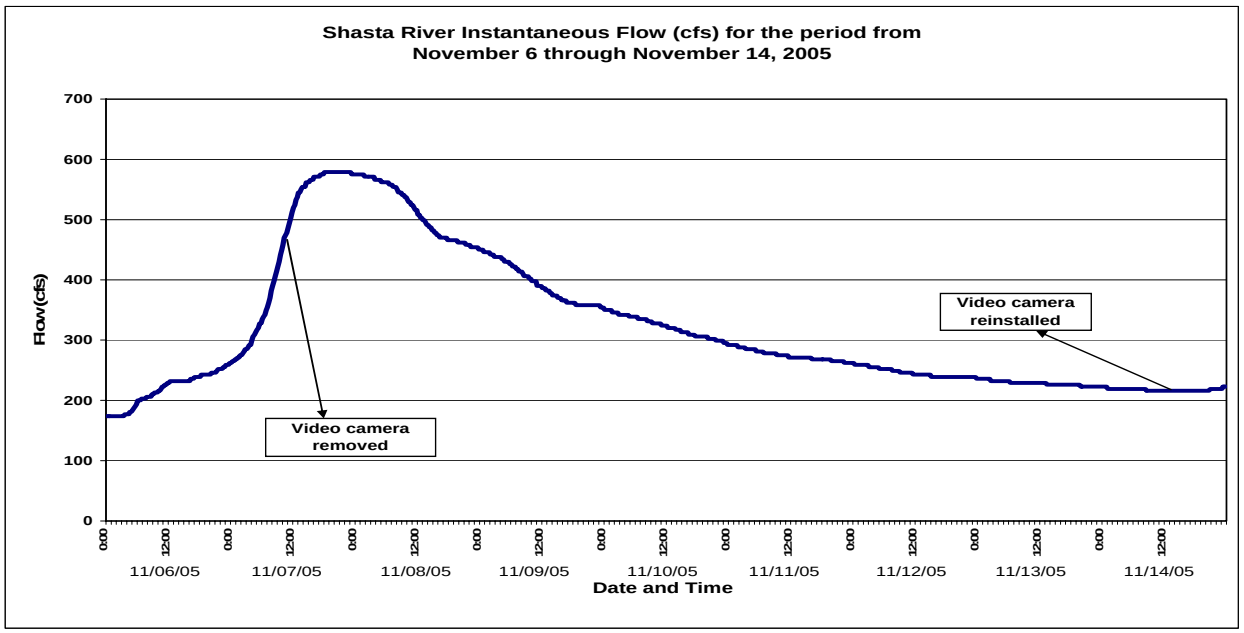

Figure 1. Shasta River flows (cfs) recorded at the USGS Gauge #11517500 from November 6 through November 14, 2005.

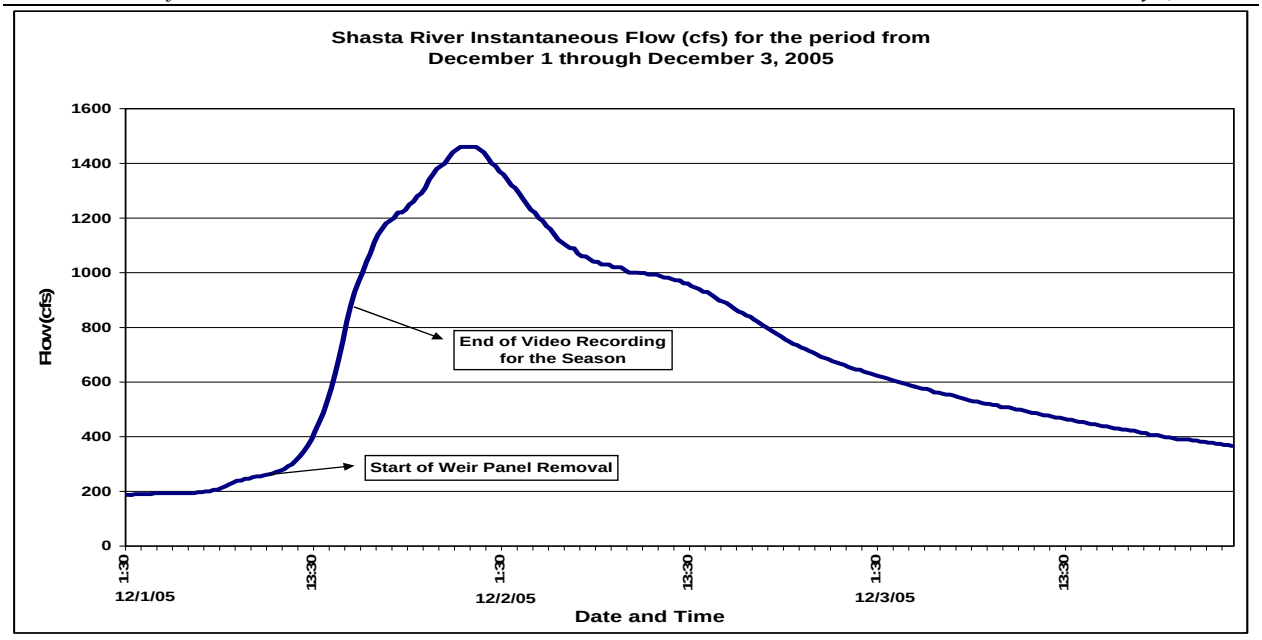

Figure 2. Shasta River flows (cfs) recorded at the USGS Gauge #11517500 from December 1 through December 3, 2005.

By November 7th the Chinook salmon migration into the Shasta River was nearly over and although some additional Chinook may have entered the Shasta River after November 7, this number is not believed to significant based on the trends observed both in 2005 and in previous years.

Chinook Salmon Observations

A total of 2,086 Chinook salmon were observed passing through the SRFCF on video tapes during the 2005 season between September 8th and November 7th. As was discussed previously, there were three periods of time when the video equipment failed to operate properly. The malfunctions occurred on October 11, 14, and 21 for a total of 19:00:58 hours. During those periods there was no monitoring of Chinook salmon movements through the SRFCF. To estimate the number of Chinook salmon that may have passed through the SRFCF during those down times, the number of Chinook salmon that passed through the SRFCF during the same time period on the day prior to and after the each video malfunction was used to interpolate an estimate of the number of Chinook that may have entered the Shasta River during the periods when the video equipment was not working properly. Using this method, a total of 43 additional Chinook salmon was estimated to have entered the Shasta River. Therefore, the total run size of Chinook salmon in the Shasta River was estimated to be **2,129** fish during the 2005 season.

The first Chinook salmon that was observed at the SRFCF passed through the facility on September 8 and the last Chinook salmon was observed on November 5th, two days prior to the high flow event that forced a temporary end to monitoring efforts from November 7th to

November 14th. The run entered the Shasta River in three pulses which peaked on September 21st, October 1st, and October 14th (Figure 3).

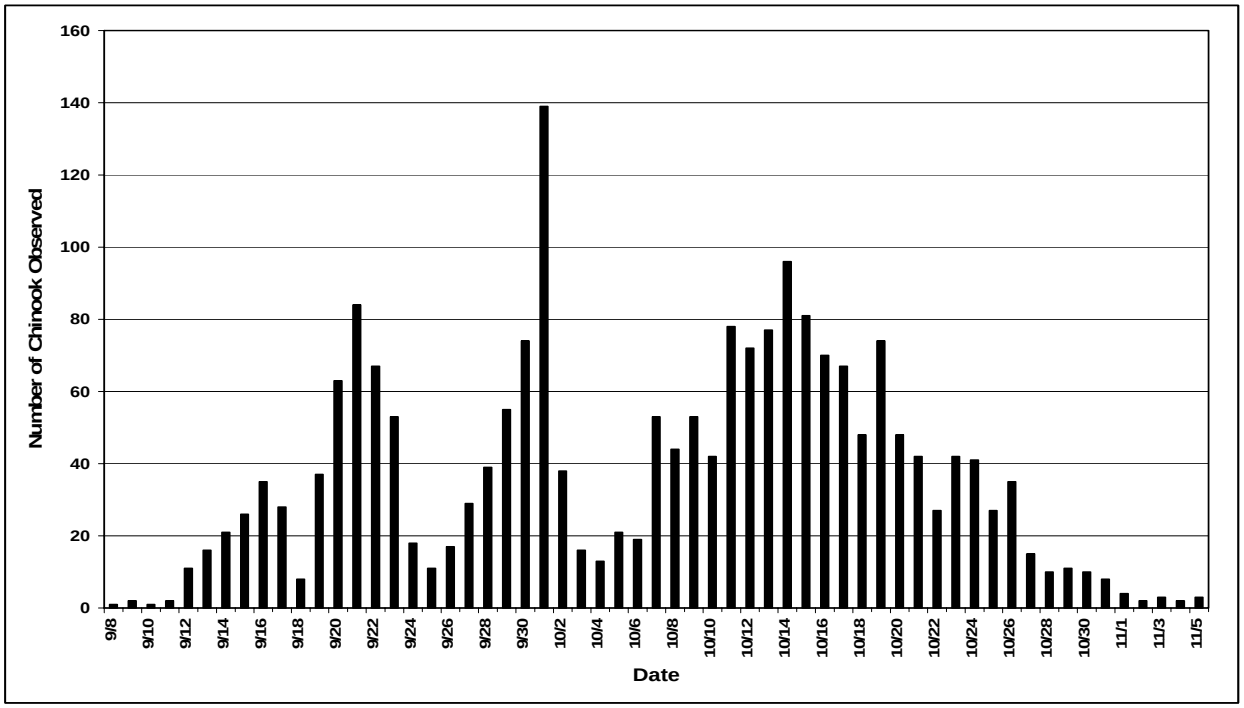

Figure 3. Run timing of fall Chinook salmon (n = 2,129 fish) observed at the Shasta River Fish Counting Facility in 2005.

Consistent with previous years, the majority of Chinook salmon (82%) passed through the SRFCF during day light hours between 06:00 and 17:00 hours (Figure 4).

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 387 Chinook salmon, 18.6% of the total number of Chinook salmon observed at the SRFCF, had live lamprey attached to their bodies.

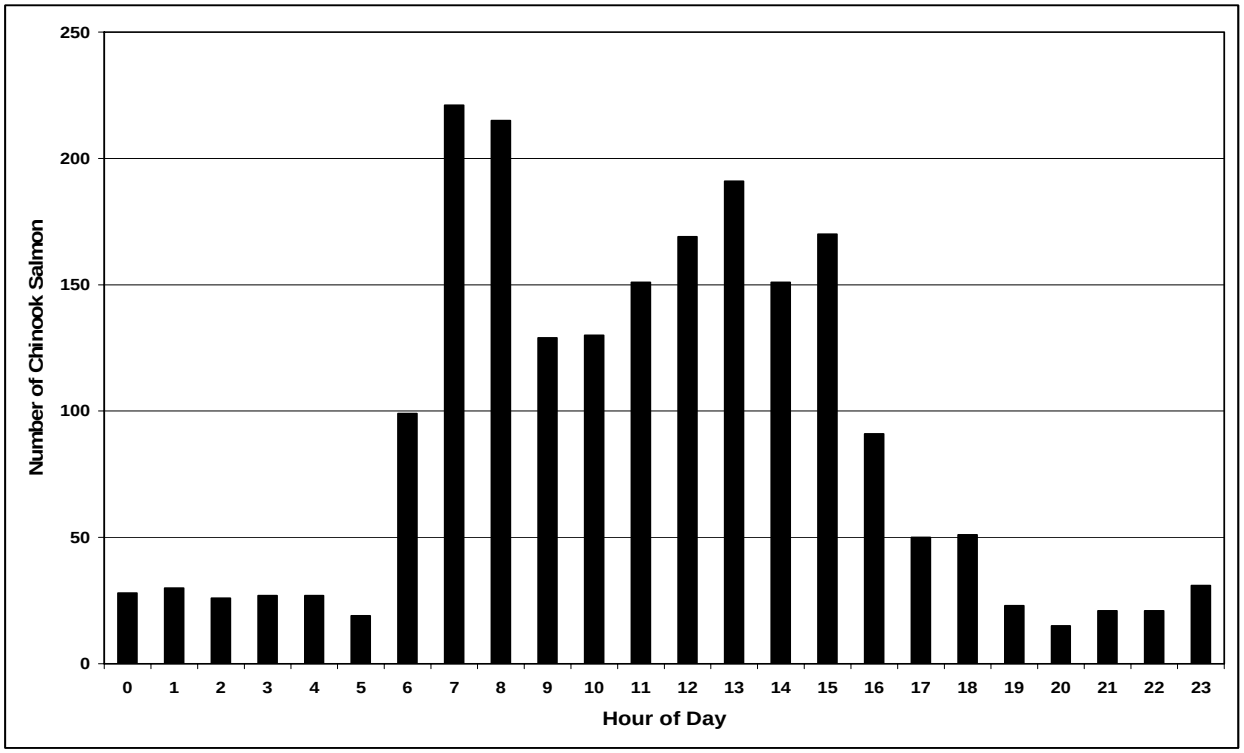

Figure 4. Diel run timing of Chinook salmon movement through the Shasta River Fish Counting Facility during the 2005 season.

A total of 24 Chinook salmon carcasses were sampled during spawning ground surveys conducted in the lower canyon section of the river. Spawning ground surveys were conducted weekly (every Wednesday) 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. Favorable flows likely improved migration conditions in the river allowing a greater number of Chinook salmon access to spawning habitats located in the upper Shasta Valley. Unfortunately, access to the upper river is restricted by private ownership and KRP staff was not granted permission to survey these habitats located near the Big Springs Ck confluence.

Since the spawning ground survey failed to provide an adequate sample (< 25 fish), KRP staff had to rely on biological data gathered from wash back carcasses that drifted downstream and became impinged on the weir panels. During the season a total of 395 Chinook carcasses were sampled at the weir site. A total of 301 males (76.2%) and 94 females (23.8%) 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 develop and compare run estimates using the sex ratios that were observed in the Bogus Creek spawning ground survey sample as a surrogate. 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 5). Based on this length frequency distribution, KRP staff determined that grilse salmon (2 year old fish) were ≤ 52 cm in fork length.

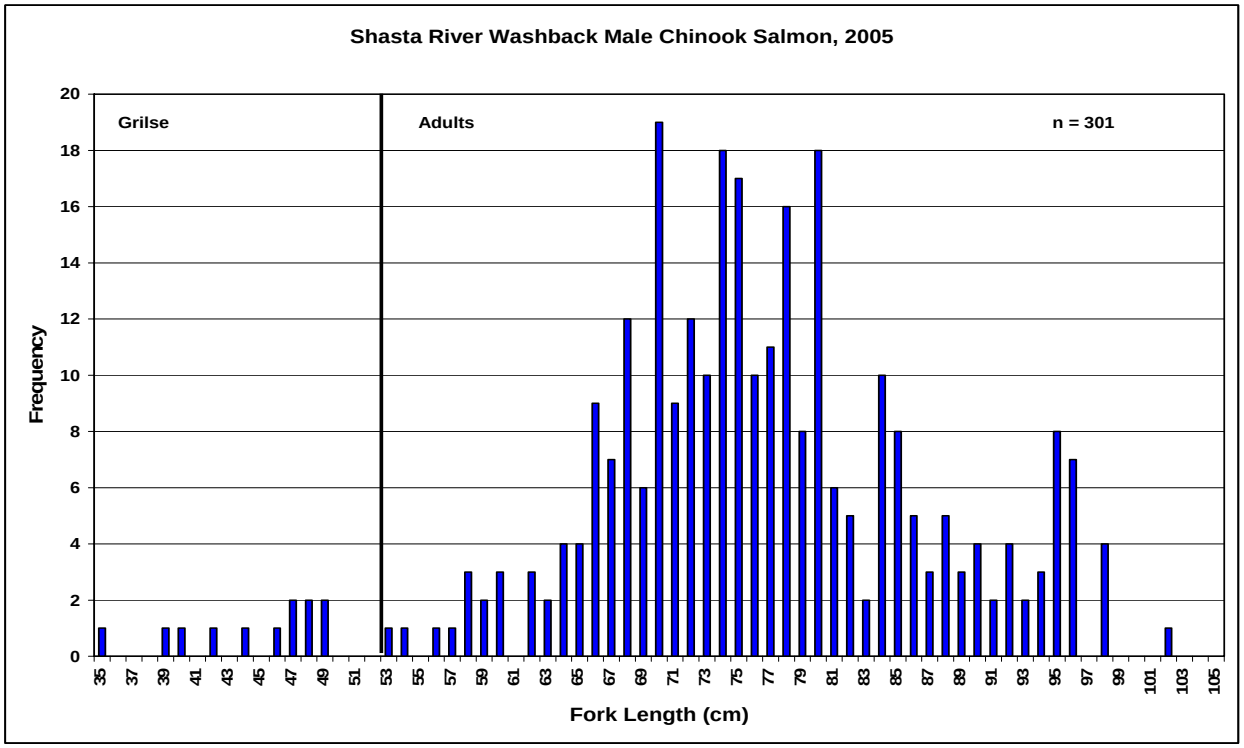

Figure 5. Length frequency distribution of male Chinook salmon carcasses that drifted downstream and became impinged (wash backs) on the weir panels of the SRFCF during the 2005 season.

The sex ratio observed for Chinook salmon in Bogus Creek was used as a surrogate to estimate the sex composition for the Shasta River Chinook salmon run. The grilse/adult ratio observed for male Chinook salmon in the Shasta River wash back sample was then applied to the estimated 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 38 grilse (1.78%), 911 adult males (42.79%), and 1,180 adult females (55.44%).

A total of 32 Chinook salmon that were observed passing through the SRFCF appeared to have an adipose fin clip (ad-clip) indicating that these fish maybe of hatchery origin. Heads from 12 ad-clipped Chinook salmon were recovered from carcasses examined in the wash back sample. Of these, 11 coded wire tags (cwts) were recovered and one head did not contain a cwt (shed tag). All of the cwts recovered in the Shasta River were progeny from Chinook salmon brood years 2001 and 2002 that were released from Iron Gate Hatchery (IGH). To estimate the number of hatchery origin Chinook salmon that entered the Shasta River in 2005 a sample expansion was applied based on the inverse of the number of heads recovered (12) divided by the number of ad-

clipped Chinook that were observed entering the Shasta River through the SRFCF (32). The estimated number of individual cwts was then multiplied the hatchery production multiplier to estimate the total number of hatchery Chinook salmon present (Table 1). A total of 469 Chinook salmon from IGH was estimated to have entered the Shasta River during the 2005 spawning season. Based on these calculations, the KRP estimates that approximately 22% of the Chinook salmon run in the Shasta River included progeny from IGH.

Table 1. Summary of cwt recoveries, sample expansion, production multipliers, and estimated total hatchery contribution observed in the Shasta River during the 2005 season.

Coded Wire Tag (cwt)	Brood Year	Age	# of Tags	Sample Expansion	CWT Production Multiplier	Total Hatchery Contribution
66355	2001	4	1	2.67	9.32	25
66356	2001	4	1	2.67	10.55	28
66357	2001	4	5	2.67	9.81	131
66360	2002	3	1	2.67	7.99	21
601020406	2002	3	3	2.67	32.97	264
				Total Contribution Estimate =		**469**

Coho Salmon

A total of 78 coho salmon were observed passing upstream through the SRFCF and 9 coho salmon were observed passing downstream through the SRFCF from October 20th to November 6th and from November 14th to November 30th, 2005. The weir was not operating from November 7 until the afternoon of November 14th due to high flow releases. Since 9 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 69 fish. The numbers of coho salmon that may have entered the Shasta River between November 7th and November 14th and after December 1st is unknown therefore, the number of coho salmon observed (69 fish) under estimate the actual number that coho salmon that may have entered the Shasta River during the 2005 season. The first coho salmon of the season was observed passing through the SRFCF on October 20th and the last coho salmon was observed on November 27th (Figure 6).

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. Two coho salmon carcasses were recovered as

wash backs at the SRFCF on November 27th. Both of these fish were males with a fork length of 64cm and 75cm and the 64cm coho also had a left maxillary clip indicating that this fish was progeny from IGH.

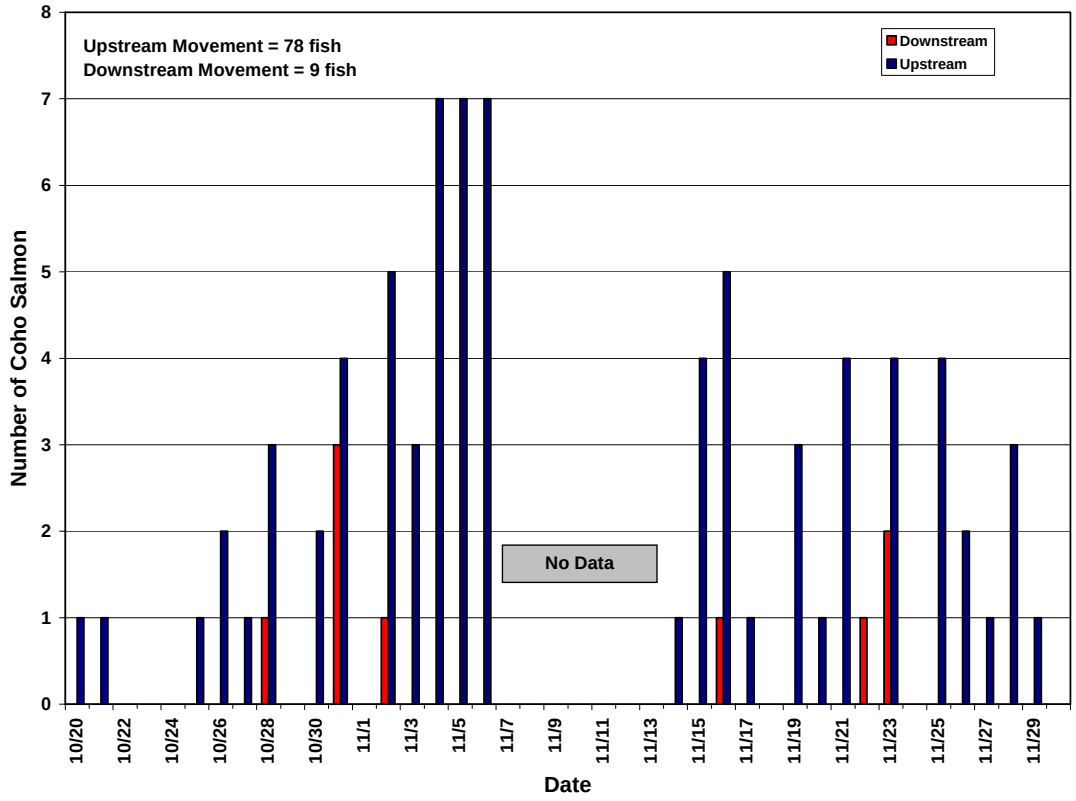

Figure 6. Run timing of coho salmon observed at the Shasta River Fish Counting Facility in 2005. Seventy eight (78) coho salmon were observed moving upstream and 9 coho salmon were observed moving downstream yielding a total of 69 coho salmon.

No coho salmon carcasses were recovered during the spawning ground surveys which ended on November 16th.

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. A total of 4 coho salmon with caudal clips and/or Floy tags attached (unmarked coho released from IGH) were seen passing through the SRFCF during the 2005 season. One of these caudal clipped coho swam back downstream shartly after entering the SRFCF leaving a net total of 3 caudal clipped coho in the Shasta River.

Twenty three (23) 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 1.08% of the coho salmon run had lamprey attached to them as they entered the SRFCF.

Steelhead Trout

A total of 303 rainbow/steelhead trout were observed at the SRFCF during the 2005 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 1.33
Fish in middle section of flume,
Estimated fork length = video screen measurement x 1.60
Fish in back section of flume,
Estimated fork length = video screen measurement x 2.00

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 8 September and 7 November and between 14 November and 1 December of 2005.

Other Species Observed

A total of 5 Centrarchid species were observed moving through the SRFCF from September 12th to September 29th. Four of these fish were identified as largemouth bass (*Micropterus*

salmoides) and one was likely a green sunfish (*Lepomis cyanellus*).

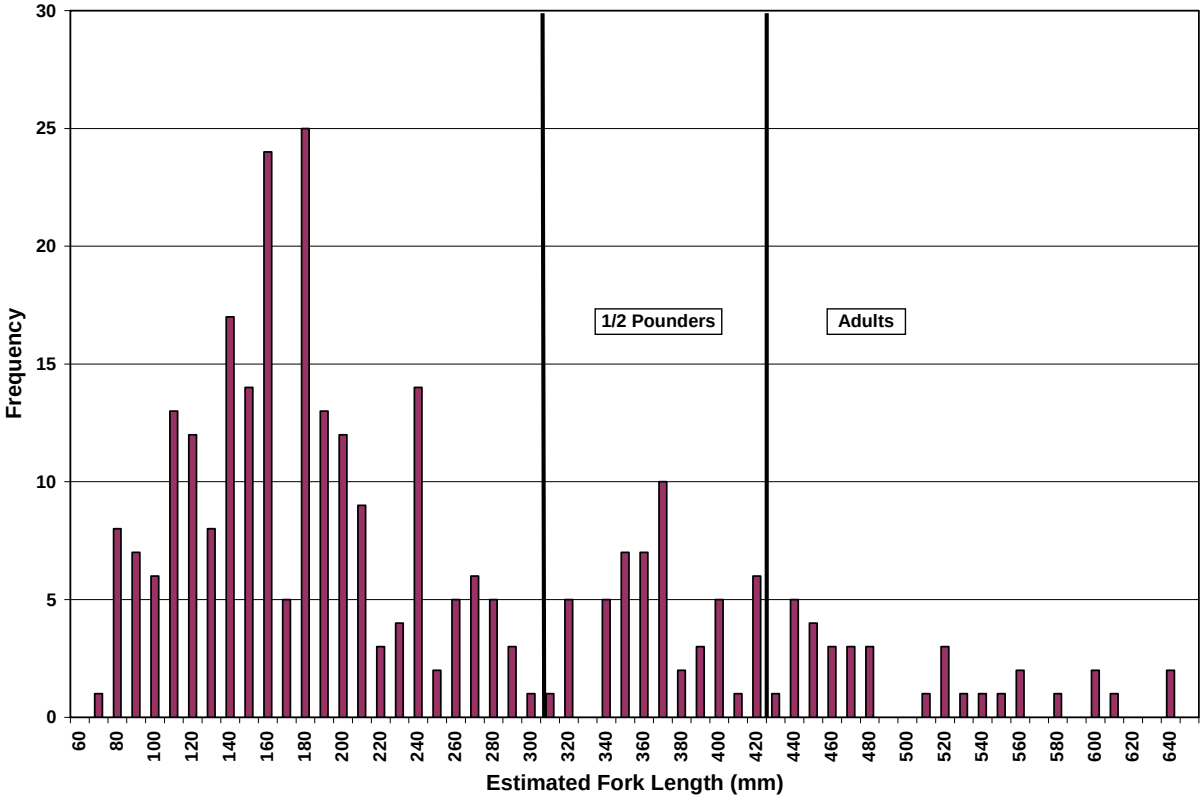

Figure 7. Summary of steelhead estimated fork lengths observed at the SRFCF during the 2005 season (n=303).

A total of 70 Klamath smallscale sucker (*Catostomus rimiculus*) were observed at the SRFCF moving upstream into the Shasta River from the Klamath River between September 8th and November 27th. Migration of Klamath smallscale suckers peaked on September 30 and October 1st when 12 and 18 Klamath smallscale suckers were observed at the SRFCF. It appears that sucker movement into the Shasta River from the Klamath River coincides with increased flows associated with the end of the irrigation season.

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 2005-2006 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 1st of 2005 ranged from a low of 36 cubic feet second (cfs) on September 1st to a high of 623cfs on December 1st (Figure 7). 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 by about 100cfs. In September of this year average daily flows in the Shasta River ranged from 36 to 110cfs and averaged 63cfs. Flows increased gradually between September 23 (68cfs) and October 2 (145cfs) as the end of the irrigation diversion season approached. During October river flows remained stable ranging from 126cfs on October 1 to 155cfs on October 4th with an average flow of 145cfs for the month. On November 6th a winter storm moved through Siskiyou County and flows in the river increased in response to the storm precipitation. Instantaneous flows peaked during the evening of November 7th (18:00 hrs) at 579 cfs. Flow levels decreased to less than 200cfs by November 17th and fluctuated between 181 and 199cfs for the remainder of the month.

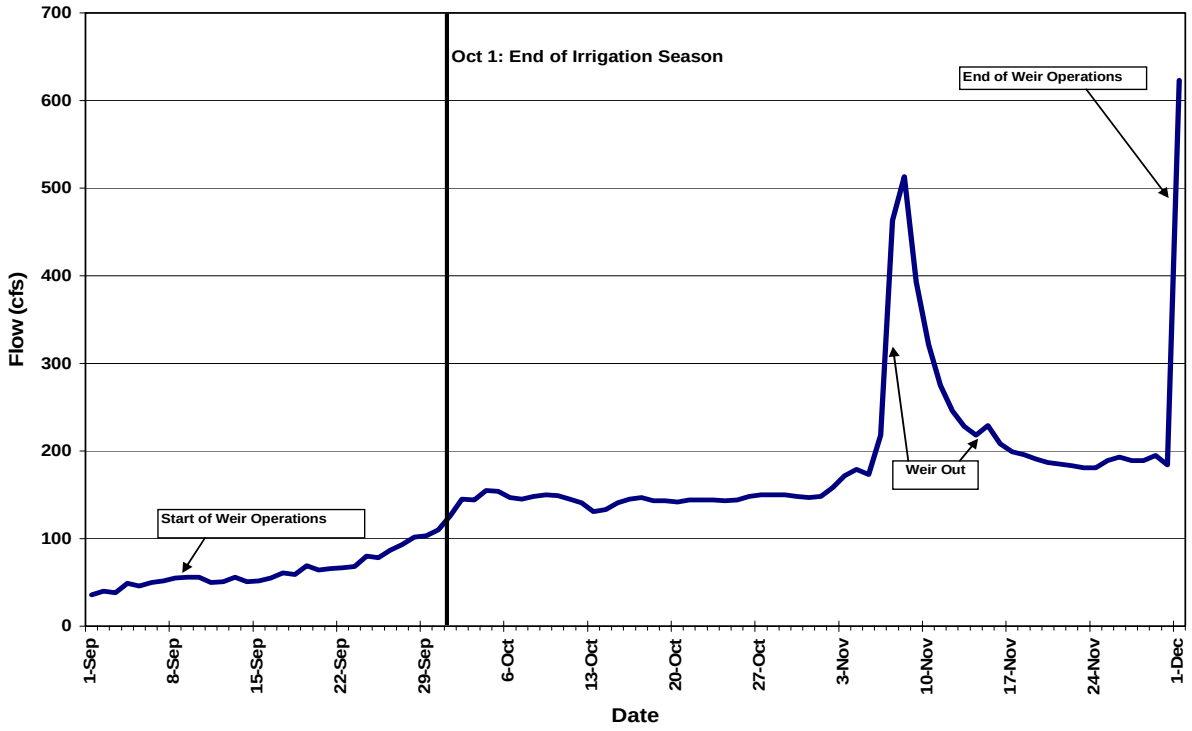

Figure 7. Average daily flows (cfs) in the Shasta River at USGS Gauge No. 11517500 from 1 September to 1 December, 2005. Data are provisional at this time and may be subject to revision.

DISCUSSION

Chinook Salmon

Since 1978 the average annual run size of fall Chinook salmon in the Shasta River has averaged 5,330 fish, and has ranged from a low of only 533 fish in 1990 to a high of 18,731 fish in 1978. The 2005 fall Chinook salmon run totaled 2,129 fish, approximately 3,201 fish less than the

average run size for the Shasta River and ranks as the 9th lowest run ever recorded since 1978 (Figure 8). The Klamath River Technical Advisory Team (KRTAT) developed a description of the age structure of the fall Chinook salmon run in the Klamath basin including the Shasta River. The run reconstruction and age composition analysis was based on preliminary a run size estimate developed in January of 2006. For the Shasta River Chinook salmon the KRP provided the KRTAT with a preliminary run estimate of 2,055 fish. The run size estimate was later increased to 2,129 after a second review of video tapes from the SRFCF found that some fish were either missed during the first review or were improperly identified as either coho salmon or steelhead trout.

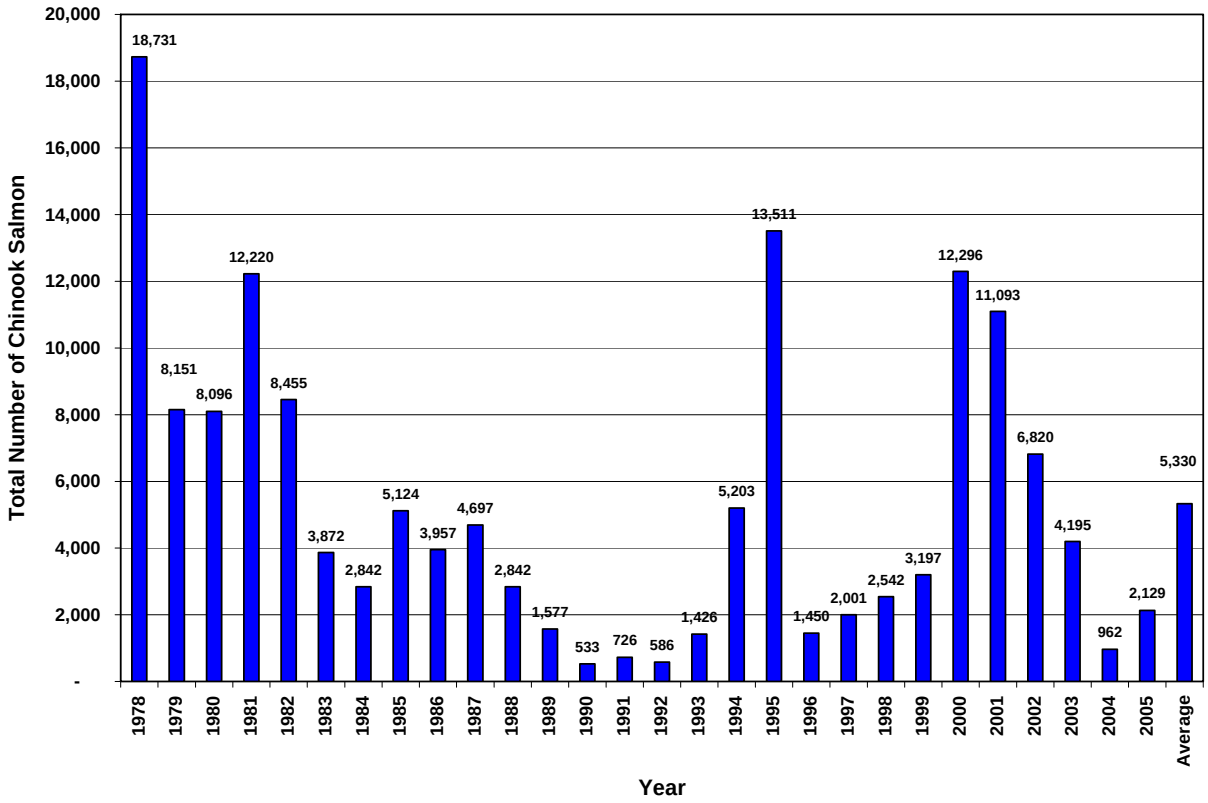

Figure 8. Chinook salmon run size estimates for the Shasta River from 1978 through 2005.

The age structure for the Shasta River is based on scale analysis conducted by the Yurok Tribal Fisheries Department from samples provided by KRP staff during the season. Based on the preliminary run size of 2,055 fish, the KRTAT estimated that the 2005 Chinook run was comprised of 37 (1.8%) grilse, 1,361 (66.2%) age three, 579 (28.2%) age four, and 79 age five fish (KRTAT 2006). Given the increase in the final run size estimate from 2,055 fish to 2,129 fish, the final age structure for the Shasta River is comprised of 38 grilse, 1,409 age 3, 600 age four, and 82 age five fish.

Although preliminary at this time, the total Klamath Basin in river fall Chinook salmon run size for 2005 is estimated to be 67,579 fish. This estimate includes those Chinook that were

harvested by tribal and sport fisheries, returned to the basin's two hatcheries, or spawned naturally within the basin. Of the 67,579 Chinook salmon that returned to the basin in 2005, approximately 28,388 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). Table 2 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 2005 Chinook salmon run in the Shasta River comprised about 7% of the total natural spawning population.

Table2. Percent contribution of Shasta River Chinook compared to the total natural spawning populations of Chinook salmon in Klamath Basin since 1978.

Year	Chinook Natural Spawner Escapement		% 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	6,818	10%
2003	89,220	4,195	5%
2004	29,053	962	3%
2005	28,388	2,129	7%
Average	59,463	5,330	9%

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 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 3). In 2005 the percentage of hatchery strays into the Shasta River has decreased to 22%.

Table 3. Total number of Chinook and estimated number of hatchery origin strays in the Shasta River from 2002 through 2005.

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%

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 14 December in 2001, 17 December in 2002, 28 December in 2003, and on 8 December in 2004. In 2005 high flows forced the temporary suspension of operations for 7 days in November and the entire operation was forced to end on 1 December.

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 4.

Table 4. 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	1/6/1982	
1982	263	2/28/1983	Weir opened for 2 days Dec 29-30 to fluch gravel from upstream.
1983	36	1/19/1984	high water made weir inoperable from Nov 12 to Jan 10.
1984	69	11/19/1984	
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	12/28/2003	
2004	373	12/8/2004	
2005	69	12/1/2005	Missed 7 days from 11/7 to 11/14 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). 2006. Klamath River Fall Chinook Age-Specific Escapement, 2005 Run. Available from U.S. Fish and Wildlife Service, 1829 South Oregon Street, Yreka, CA, 96097.