

# **SCOTT RIVER SALMON STUDIES**

**2008**



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## ABSTRACT

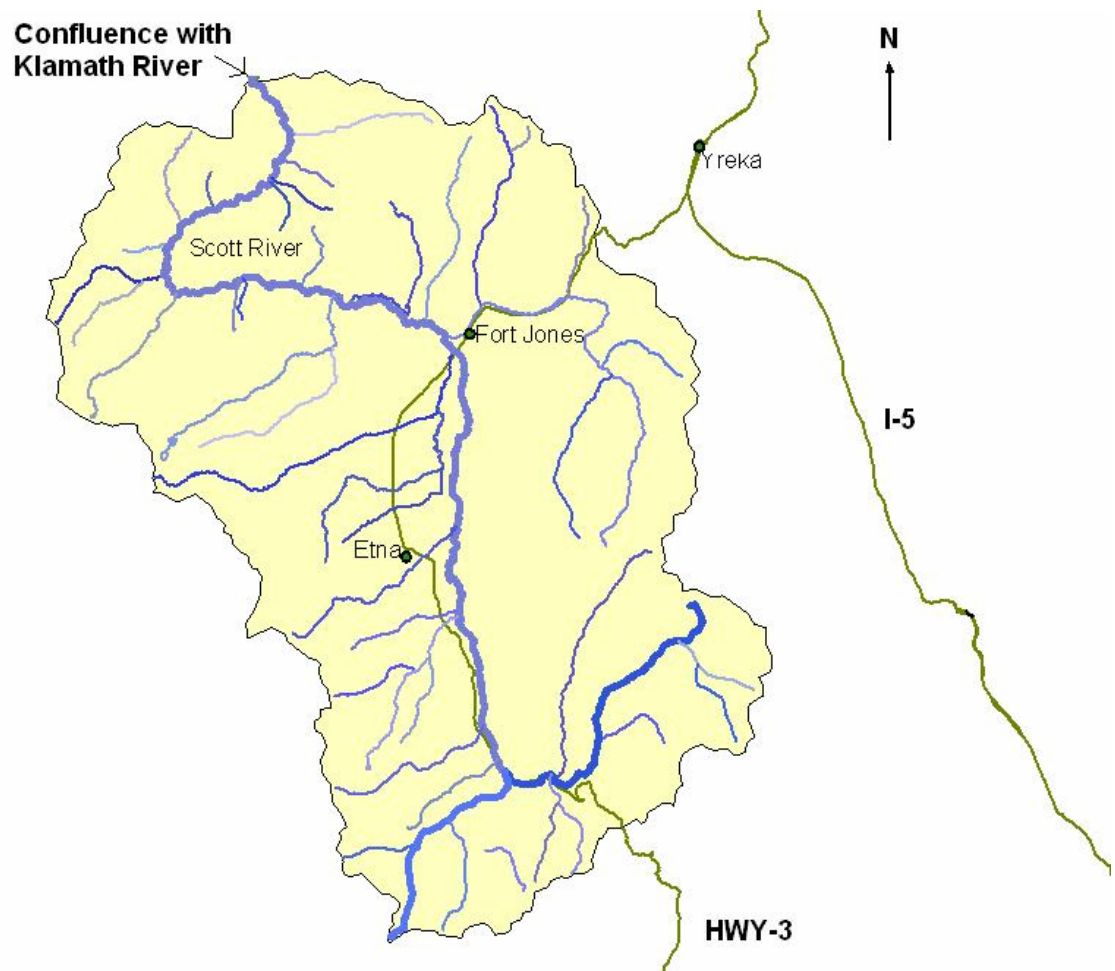
The California Department of Fish and Game's (Department), Klamath River Project (KRP) operated a video fish counting facility and conducted cooperative spawning ground surveys (carcass surveys) on the Scott River during the 2008 fall-run Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*Oncorhynchus kisutch*) spawning season. The purpose of these surveys is to describe the run characteristics of adult fall-run Chinook salmon and coho salmon into the Scott River. Video fish counting operations began on October 4, 2008 and ended on December 27, 2008 due to forecasted high in-river flows. The total number of Chinook salmon that entered the Scott River during the 2008 season is estimated to be **4,673** fish. Based on the proportion of male and female Chinook salmon that were sampled during the spawning ground surveys the run was comprised of approximately 2,337 (50.01%) males and 2,336 (49.99%) females. Based on a scales age analysis, adults comprised approximately 73.7% (3,444 fish) and grilse comprised 26.3% (1,229 fish) of the run. Males ranged in fork length (FL) from 30cm to 104cm and averaged 70.0cm. Females ranged in FL from 35cm to 95cm and averaged 77.7cm. KRP staff estimated that none of the Chinook salmon were of hatchery origin.

The first adult coho salmon was observed at the Scott River Fish Counting Facility on November 2, 2008 and the last coho salmon was observed on December 27, 2008. A total of 62 coho salmon were observed moving upstream through the Scott River Fish Counting Facility (SRFCF) during the season. One coho was sampled below the weir on January 8, 2009 bringing the total coho salmon estimate to 63. Due to the extremely low abundance of coho salmon returning in 2008 and the lack of an adequate sample collected during spawning ground survey efforts the proportion of male to females, the proportion of age two and age three fish and the proportion of hatchery origin fish is unknown. Future advances in video quality may allow for these metrics to be estimated without handling the fish.

## INTRODUCTION

### STUDY LOCATION AND RUN TIMING

The Scott River is a major tributary of the Klamath River located in Siskiyou County, and enters the Klamath River at river mile 143 (Figure 1). The Scott River fish counting facility is located at river mile 18.2 near the downstream edge of Scott Valley between the Indian Scotty Campground and Jones Beach picnic area (041° 38' 10.93" N; 123° 04' 3.08" W). Fall-run Chinook salmon typically return to the Scott River to spawn from mid September to late December. The coho salmon spawning run occurs from mid October to early January and steelhead run from November to March.



**Figure 1. Location of the Scott River, tributary to the Klamath River, Siskiyou County.**

**KLAMATH RIVER PROJECT AND THE SCOTT RIVER STUDY**

The Scott River study is one component of the KRP (initiated in 1978). The goals of the KRP include obtaining information on species composition, spawning distribution, FL frequency and sex ratios for salmonids, primarily fall-run Chinook salmon (Chinook), in various tributaries to the Klamath River including the Salmon, Scott, and Shasta rivers, as well as Bogus Creek and a dozen other smaller tributaries. The Scott River is particularly important because it is a major salmon spawning tributary. For example, during the 1996-98 spawning seasons, an average of 30.6% (8,914) of the total number of natural area adult Chinook salmon spawners above the Trinity River confluence were estimated to have entered the Scott River to spawn. Therefore, a significant portion of natural escapement to the Klamath Basin would be unaccounted for if the Scott River studies were not conducted. In addition to providing valuable escapement estimates to the Pacific Fisheries Management Council for the effective management and allocation of fall Chinook salmon in the Klamath River Basin, the Scott River studies provide an opportunity to monitor an independent population within the state and federally listed Southern Oregon/Northern California Coast coho salmon (SONCC) range.

In the early years of the KRP, spawning ground surveys were conducted in the major spawning areas of the river which included about 5.5 miles of the Scott River near Etna and 4.75 miles of river downstream of the State Highway 3 Bridge crossing near Fort Jones. From 1989 through 1991 spawning ground surveys were limited to the lower river because high flows hampered the migration of fall Chinook to spawning areas upstream. In 1982 a temporary fish marking weir was installed on the lower river at



river mile 1.6 and was operated during each spawning season until 1991. Operation of the weir was often hampered by high flows, and beginning in 1992 operation of the weir was dropped in favor in conducting more intensive mark recapture spawning ground surveys in cooperation with USFS fisheries staff.

In 1994 the California State Legislature passed the Leslie Amendment (SB 779). The passage of SB 779 required Departmental staff to obtain landowner permission prior to accessing private lands to conduct biological investigations. The entire length of the Scott River within the Scott Valley passes through privately owned agricultural lands. Although the Scott River likely meets the standards that have been established for navigable easements, the Northern Region of the Department began requesting landowners permission to access the Scott River as it passes through private lands prior to conducting spawning ground surveys along the river. As a result, since 1994, spawning ground surveys have been limited to those areas of the river on private land where landowner permission was granted each year. The level of cooperation from local landowners has varied over the years. However, during the 2001 and 2002 spawning seasons, the number of landowners that have denied permission for access has increased dramatically. Controversies associated with the recent listing of SONCC coho salmon under the California Endangered Species Act (CESA) substantially reduced the amount of cooperation provided by local landowners to the extent that the Department has been denied permission to survey nearly all of the Chinook spawning reaches present in the Scott Valley. As a result of the limited landowner access to the valley reaches the Department proposed installation of a fish counting facility to be located at the upper end of the canyon reaches. The location of the fish counting station allows for monitoring fish abundance into the valley. The counting facility is also located upstream of canyon tributaries that can produce significant fall and winter stream flows, thereby reducing the probability of having the counting facility inoperable due to high stream flows.

#### **SCOTT RIVER STUDY OBJECTIVES SUMMARIZED:**

- A) Determine the in-river run size (escapement) of Chinook and coho salmon returning to the Scott River.
- B) Determine run timing, spawning distribution, length frequency (FL) distribution, and sex ratio for Chinook and coho salmon in the Scott River.
- C) Collect scale samples and recover heads (containing coded wire tags) from ad-clipped Chinook in order to determine age composition of the run.
- D) Collect biological data for all steelhead observed during the Chinook and coho salmon spawning seasons.

### **METHODS**

#### **OPERATION OF THE SCOTT RIVER FISH COUNTING FACILITY**

The video fish counting system was installed at the Scott River Fish Counting Facility on October 4,

2008 at 0900 hours Pacific Standard Time (PST). A temporary resistance board weir was installed to direct migrating fish into a flume where they pass in front of a video camera (Figure 2). The underwater video system consisted of a digital color video camera, water proof camera housing, viewing window, and counting flume which allowed for recording unimpeded fish passage through the facility. The facility was operated 24 hours a day, seven days a week throughout the Chinook and coho salmon migration period. A splash cam digital color video camera equipped with a 3.6mm wide angle lens with an auto iris was used to collect the photo image and an Ever Focus Digital Video Recorder (Model EDSR100) was used to record the image to external hard drives. The time lapse DVR was set to record continuously and drive changes were made at least twice a week.



Figure 2. Scott River Fish Counting Facility located in Siskiyou County, California 2008.

All hard drives were immediately returned to the office where each was subsequently downloaded and reviewed by project staff 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. If the species could not be determined because of poor visibility or picture quality, staff recorded that observation as fish unknown. Staff also noted any ad-clipped fish observed, recorded the presence of lamprey scars and any other distinguishable marks that were visible on the tape. All video data was then entered into computer files and each data file was subjected to one independent edit prior to commencement of data analysis.

## SPAWNING GROUND SURVEYS

Spawning ground surveys were conducted twice a week on Mondays and Thursdays throughout the Chinook salmon spawning season starting October 16, 2008 and ending December 11, 2008. A total of sixteen surveys were performed during the spawning season. On the morning of each survey, crews of at least two people were given daily instructions, data sheets, field equipment, vehicle assignments, and were assigned a survey reach. Crews walked their assigned reach in a downstream direction looking for salmon carcasses and spawning redds. All new redds were mapped once a week, recorded on USGS topographic maps, and the information was provided to the Klamath National Forest. When a carcass was located crew members identified each to species and gender, checked for marks or tags, obtained a FL measurement, collected a scale sample for age composition analysis, and examined females for spawning success.

For purposes of the mark recapture estimate, each carcass was categorized into one of four pathways (Paths). Fresh carcasses, those with clear eyes and/or firm flesh were designated as Path 1. Individually numbered jaw tags were attached to the lower right jaw of all Path 1 carcasses and returned to the river for potential recapture during later surveys. Older carcasses, those with cloudy eyes and/or mushy flesh, were categorized as Path 2. All Path 2 carcasses were cut in half and returned to the river after all biological data was collected. Path 3 carcasses included all of the Path 1 carcasses (with jaw tag) that were recaptured during subsequent surveys. Any carcasses that could be observed by a survey crew but could not be retrieved for data collection, because they were located in inaccessible or unsafe locations, were designated as Path 4. Path 4 designations were rarely encountered during the survey.

The final Chinook salmon run-size estimate for reaches below the counting facility was calculated using the Schafer Method as follows (Ricker 1975):

$$\text{Escapement} = \sum((R_{ij}) (M_i/R_i)(C_j/R_j))$$

Where:

- M = The total number of fish marked
- $M_i$  = The number of fish marked in period i
- $R_i$  = The total number of marked fish recaptured in period i
- $R_j$  = The total number of marked fish recaptured in period j
- C = The total number of fish recaptured during the season
- $C_j$  = The total number of fish recaptured in period j

## SURVEY REACHES

The survey reaches have remained fairly consistent since the beginning of the cooperative spawning ground survey in 1992. During the Chinook salmon spawning season, decisions regarding which reaches should be surveyed was based on the known distribution of the Chinook salmon run each week, the available labor force present during each survey, and on private lands was limited to those areas where permission has been granted by private landowners.

A total of 16 survey reaches, covering approximately 53.6 river miles, have been identified on the Scott River (Table 1, Figure 3). Access to private lands along the Scott River is critically important to the survey in those spawning areas that are present in Scott Valley. The most important Chinook salmon spawning areas within Scott Valley are located downstream of the State Highway 3 Bridge crossing (rm

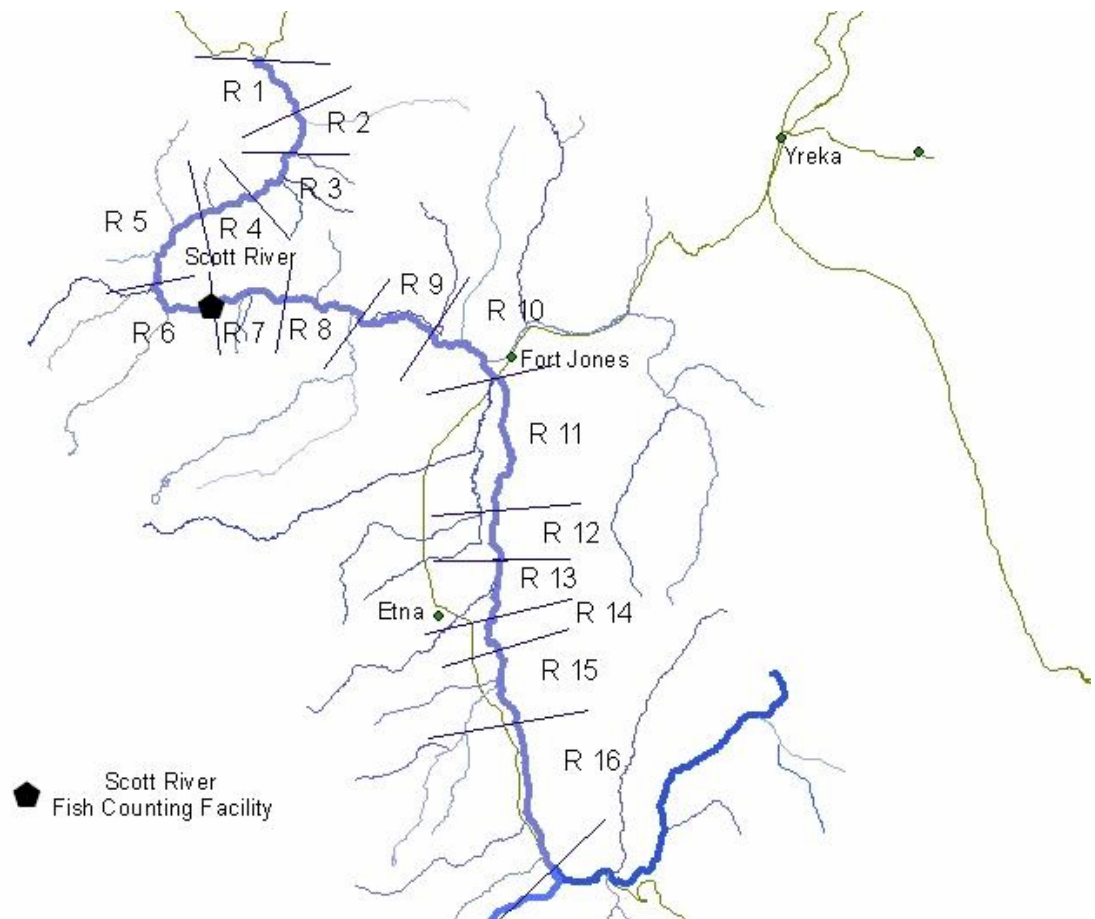
34.6) to the USGS gauging station located at river mile 21 (Reaches 8, 9, and 10), and in that reach of the river located downstream of Young's Dam (rm 46) to about river mile 42 located upstream of the Eller Lane Bridge crossing (Reaches 12, 13, and 14).

Table 1. Description of cooperative spawning ground survey reach locations along the Scott River during the 2008 season.

<b>Reach Number</b>	<b>Downstream Limit</b>	<b>RM</b>	<b>Upstream limit</b>	<b>RM</b>	<b>Length (miles)</b>
1	Mouth	0.00	Mid Point	2.60	2.60
2	Mid Point	2.60	Pat Ford Ck	4.90	2.30
3	Pat Ford Ck	4.90	George Allen Gulch	7.80	2.90
4	George Allen Gulch	7.80	Townsend Gulch	10.50	2.70
5	Townsend Gulch	10.50	Bridge Flat	14.20	3.70
6	Bridge Flat	14.20	Counting Weir	18.20	4.00
7	Counting Weir	18.20	USGS Stream Gage	21.00	2.80
8	USGS Stream Gage	21.00	Meamber Bridge	24.40	3.40
9	Meamber Bridge	24.40	Dunlop	29.50	5.10
10	Dunlop	29.50	Highway 3 Bridge	35.60	6.10
11	Highway 3 Bridge	35.60	Eller Lane	41.10	5.50
12	Eller Lane	41.10	Sweezy Bridge	42.10	1.00
13	Sweezy Bridge	42.10	Horn Lane	43.90	1.80
14	Horn Lane	43.90	Young's Dam	46.00	2.10
15	Young's Dam	46.00	Fay Lane	49.60	3.60
16	Fay Lane	49.60	East Fork Confluence	53.60	4.00

To assist in developing stock identification baseline information the KRP collected both genetic tissue and otolith samples during the season. DNA samples were collected from 281 Chinook salmon and 5 coho salmon. All samples were collected following protocols provided by the National Oceanic Atmospheric Administration's (NOAA) Southwest Fisheries Science Center. Samples were sent to the Salmonid Genetic Tissue Repository located at the NOAA Santa Cruz Laboratory for archiving and analysis. Otoliths were collected from 114 Chinook salmon and 5 coho salmon throughout the season. All otoliths collected were supplied to Rebecca Quinones at the United States Forest Service/University of California at Davis for further microchemistry analysis. All samples were collected following protocols provided by Rebecca Quinones.





**Figure 3. Location of the fish counting facility and spawning ground survey reaches on the Scott River used during the 2008 field season.**

### **POPULATION ESTIMATE**

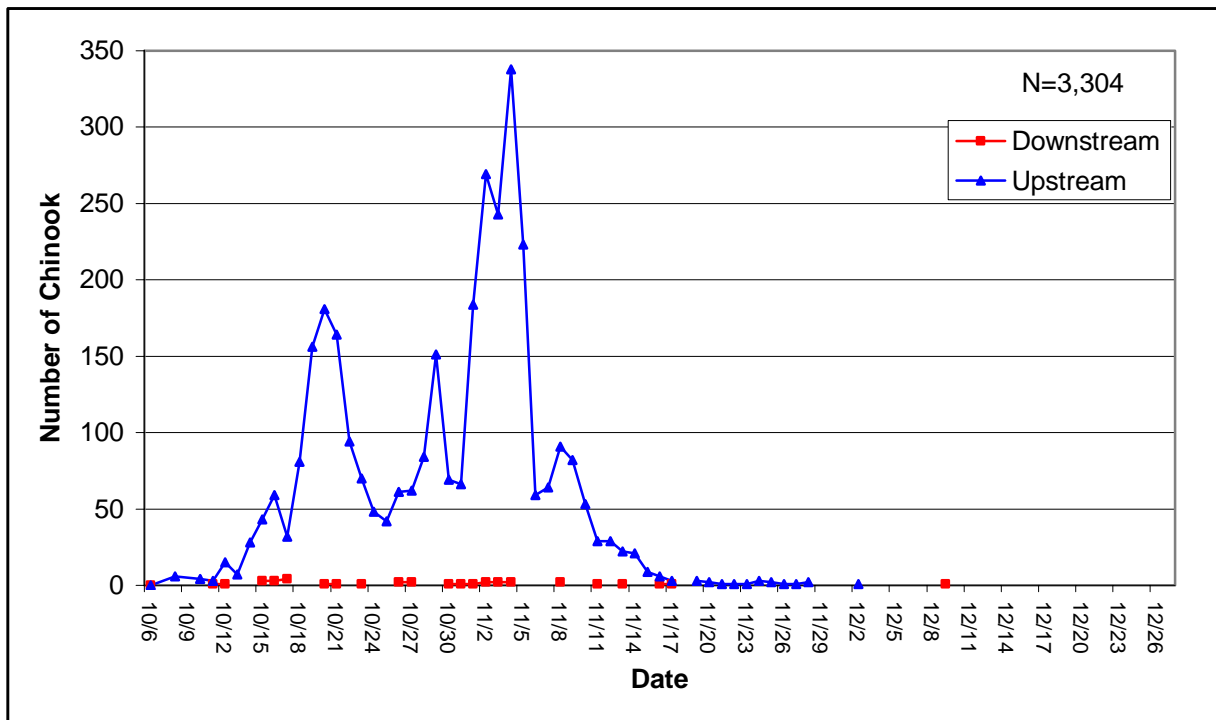
The Chinook salmon spawner escapement for the area of Scott River upstream of the counting facility was derived from a direct count of all Chinook salmon observed at the video counting facility. To estimate total escapement in the Scott River, the number of Chinook salmon carcasses estimated from the Schaffer estimate (utilizing data from reach 1 through reach 6 only) was added to the count of all Chinook salmon that were observed passing through the video counting facility. The coho salmon spawner escapement for the area of the Scott River upstream of the counting facility was also derived from a direct count of all coho salmon observed at the video counting facility. Spawning ground surveys were conducted through mid December in areas below the counting facility with the goal of adding these fish to the video count, but only one coho salmon carcasses was observed in the spawning ground surveys below the counting facility.



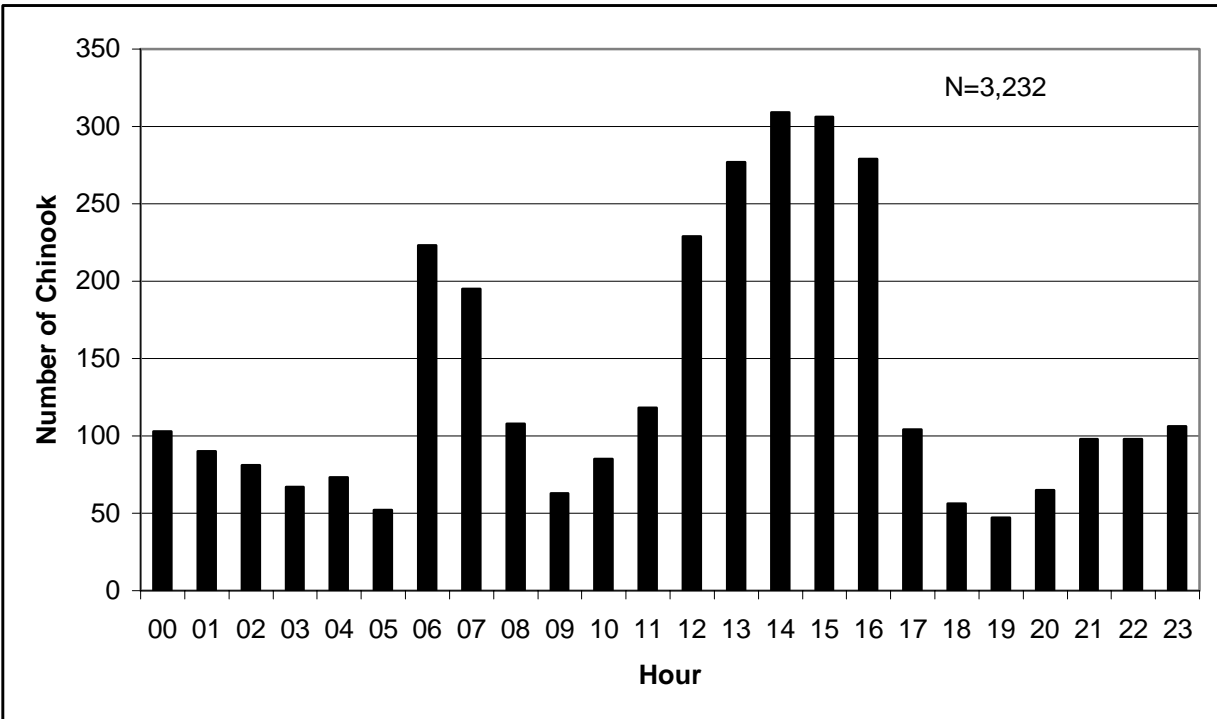
## RESULTS

### OPERATION OF THE SCOTT RIVER FISH COUNTING FACILITY

The SRFCF began recording fish movements on October 4, 2008. The first Chinook salmon was observed at the SRFCF on October 6, 2008 and the last Chinook salmon was observed on December 1, 2008. The run peaked between October 18, 2008 and November 7, 2008 when 83.5% of the Chinook migration was observed (Figure 4). The majority of Chinook salmon passed through the SRFCF during daylight hours and peaked in the afternoon between 1200 and 1600 hours (Figure 5).



**Figure 4. Run timing of Chinook salmon through the Scott River Fish Counting Facility during the 2008 season. Both upstream and downstream movements through the counting flume are shown (N=3,304).**



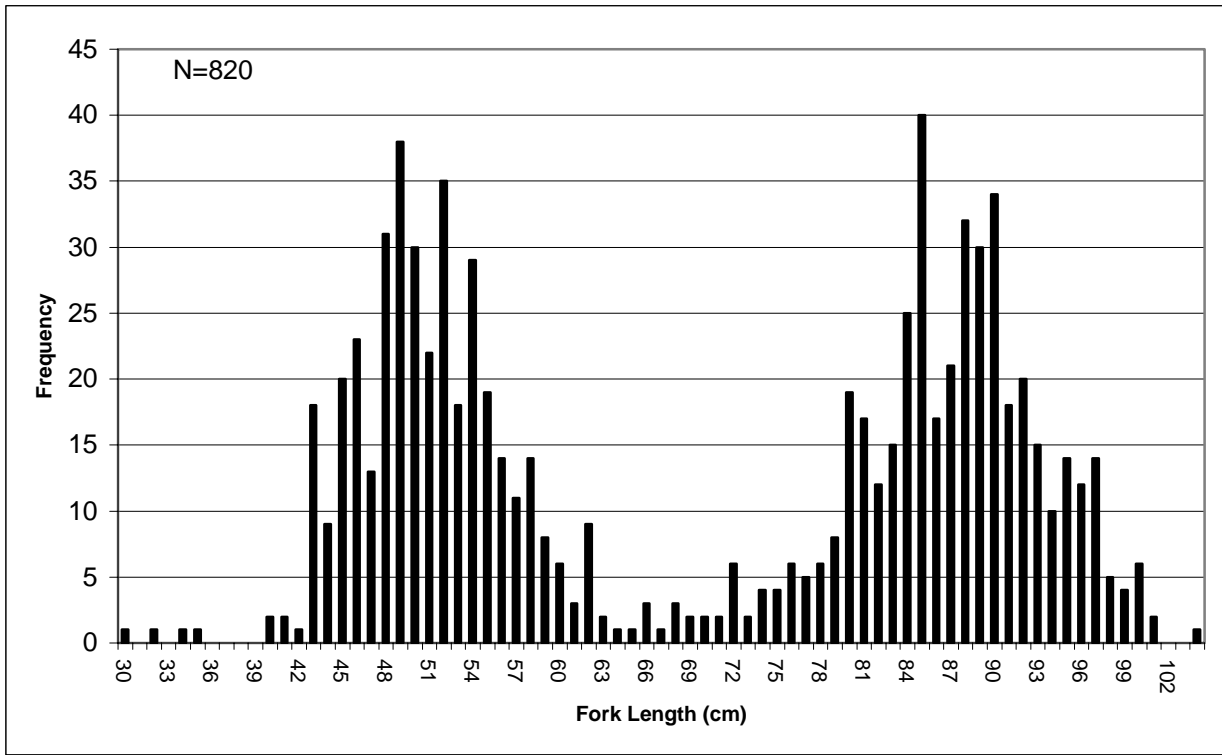
**Figure 5. Summary of daily run timing of Chinook salmon observed at the Scott River Fish Counting Facility during 2008.**

A total of 3,234 Chinook salmon were estimated to have passed through the Scott River Fish Counting Facility during the 2008 season. No fish were added to the total as an expansion for periods of time when the camera was not functioning.

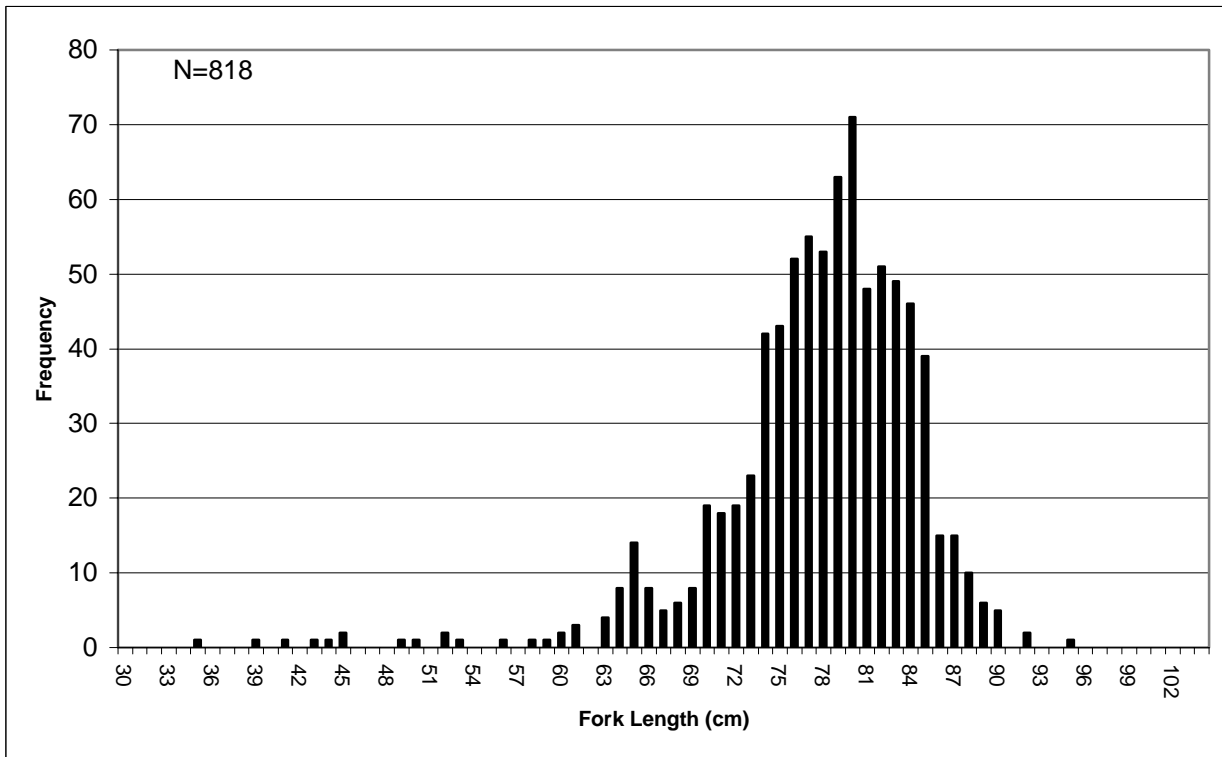
**SPAWNING GROUND SURVEYS**

A total of 1,667 Chinook carcasses were sampled during the spawning ground survey as Path 1 or Path 2 carcasses. Of these 820 (50.01%) were male and 818 (49.99%) were female (29 unknown sex). Males ranged in FL from 30cm to 104cm and averaged 70.0cm (Figure 6). Females ranged in FL from 35cm to 95cm and averaged 77.7cm (Figure 7). No ad-clipped Chinook were observed during the spawning ground surveys. Examination of the length frequency distribution of Path 1 and Path 2 carcasses, a grilse cut-off of < 61 cm was established for Scott River.

A total of 818 Chinook salmon female carcasses were observed during the spawning ground survey. Each female carcass was examined to determine if it had successfully spawned prior to death. Females with approximately 50% or more of their eggs still present in the body cavity when examined were identified as a pre-spawn mortality. Of the 818 female Chinook salmon carcasses examined, 799 females (97.7%) were found to have spawned, and 19 females (2.3%) still contained more than 50% of their spawn and were identified as pre-spawn mortalities.



**Figure 6. Length Frequency distribution of Path 1 and Path 2 male Chinook salmon observed during spawning ground surveys in the Scott River, 2008 (n = 820).**



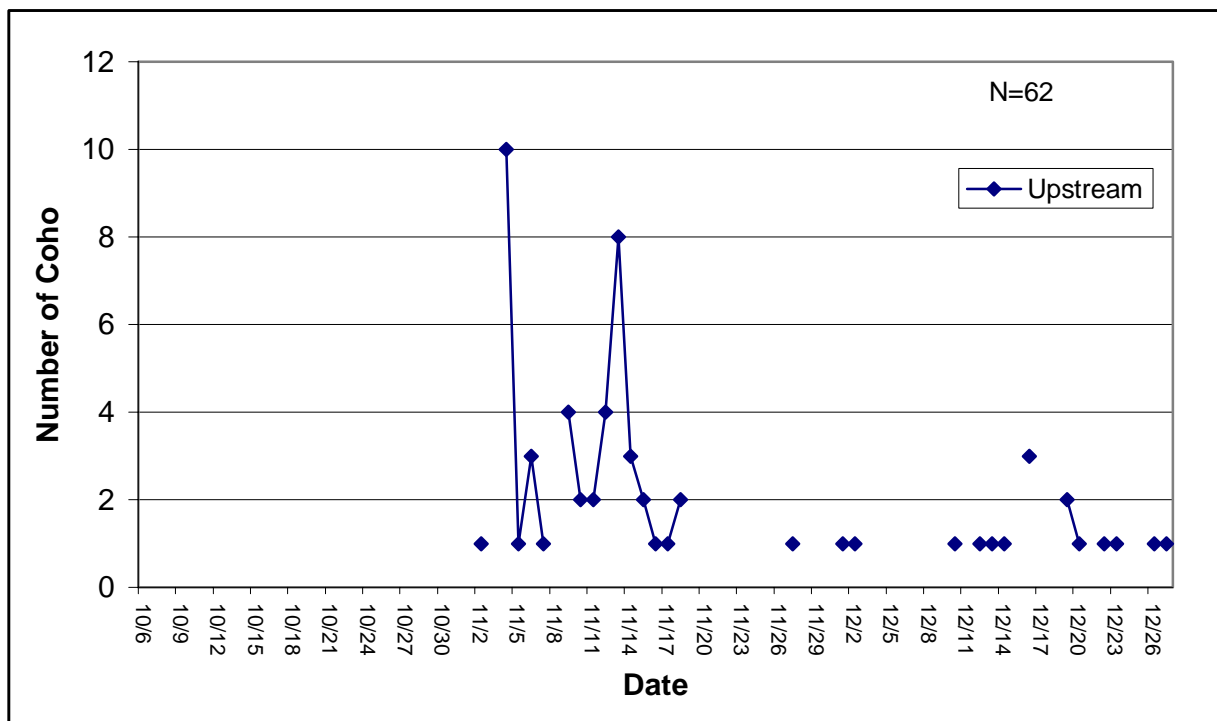
**Figure 7. Length frequency distribution of Path 1 and Path 2 female Chinook salmon observed during spawning ground surveys in the Scott River, 2008 (n = 818).**



In 2008 the Schaffer mark recapture data generated from the spawning ground survey was segregated by reaches and analyzed independently for four areas: 1) all reaches, 2) reaches 1-6 (below the counting facility), 3) reaches 7-8 and 4) reach 8 alone. The basin estimate was derived by adding the Schaffer estimate generated from reaches 1-6 to the total number of Chinook observed passing through the counting facility. The Schaffer estimate for all reaches, reaches 1-6, reaches 7-8, and reach 8 were 3,235; 1,439; 2,034 and 1,652 respectively. For all reaches 1,677 Chinook were recovered, 842 were marked and 442 were subsequently recaptured yielding a recapture rate of 52.5%. For reaches 1-6 400 Chinook were recovered, 191 were marked and 55 were recaptured yielding a recapture rate of 28.8%. For reach 7 and 8 together 1,196 Chinook were recovered, 600 were marked and 364 were recaptured yielding a recapture rate of 60.7%, for reach 8 alone, 950 Chinook were recovered, 462 were marked and 276 were recaptured yielding a recapture rate of 59.7%. The total Chinook salmon run size estimate was estimated to be 4,673 fish. Based on a maximum grilse fork length of 61cm the KRP estimates that the 2008 Scott River Chinook salmon run was comprised of 1,117 grilse (23.9%) and 3,556 (76.1%) adults.

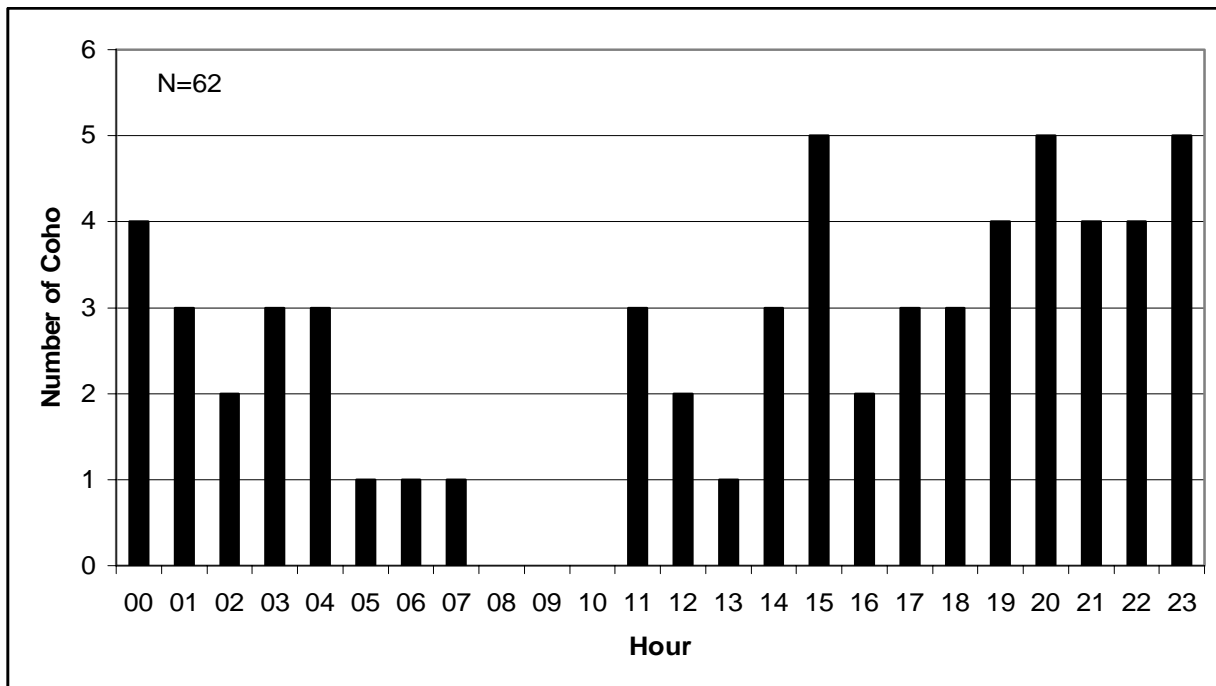
### COHO SALMON

The first adult coho salmon was observed at the counting facility on November 2, 2008 and the last coho salmon was observed on December 27, 2008. A total of 62 coho salmon were observed moving upstream through the SRFCF during the season (Figure 8). Coho salmon migration peaked during the 17 day period from November 2, 2008 to November 18, 2008 when 45 or 72.6% of the coho were observed. No coho salmon were observed swimming downstream during the season. None of the 62 coho salmon observed were caudal clipped or floy tagged indicating that they were an unmarked coho salmon that previously entered IGH and was subsequently released after marking.



**Figure 8. Run timing of coho salmon observed passing through the Scott River Fish Counting Facility during the 2008 season (N=62). No downstream movements were observed of coho salmon.**

Diel movements of coho salmon through the SRFCF were higher in the evening hours and peaked between 1400 hours and 0000 hours (Figure 9). This movement pattern is consistent with observations from previous seasons. The absence of observed migrations during 0800 and 1000 hours may be a result of the timing of the daily maintenance of the counting facility which occurred during these hours.



**Figure 9. Diel migration patterns of coho salmon observed moving through the Scott River Fish Counting Facility in 2008 (N=62).**

### SPAWNING GROUND SURVEYS

A total of 5 coho salmon carcasses were sampled during the spawning ground survey (Table 2), two of which were collected during the cooperative spawning ground surveys and two were collected during coho surveys coordinated by the Siskiyou Resource Conservation District (SRCD), and one was collected at the counting facility the day it was removed. The two carcasses sampled during the cooperative surveys were both male with fork lengths of 73 cm and 75 cm and were recovered in Reach 14 and Reach 15 respectively by the SRCD. Cooperative spawning ground surveys were conducted bi-weekly in the reaches below the counting facility through December 11, 2008 and no coho salmon carcasses were recovered. After the cooperative spawning ground surveys ended three additional coho carcasses were sampled, one on December 24, 2008 in Reach 11, a 63cm female and another on January 8, 2009 in Reach 6 (below the counting facility) a 75 cm female (Pers comm. Eric Yokel, SRCD). The last remaining carcass was a 68 cm, male recovered just upstream of the counting facility on January 5, 2009. None of the five coho salmon carcasses recovered had any clips or marks indicating that they were all of natural origin.

Table 2. Coho salmon carcasses recovered during the 2008 field season.

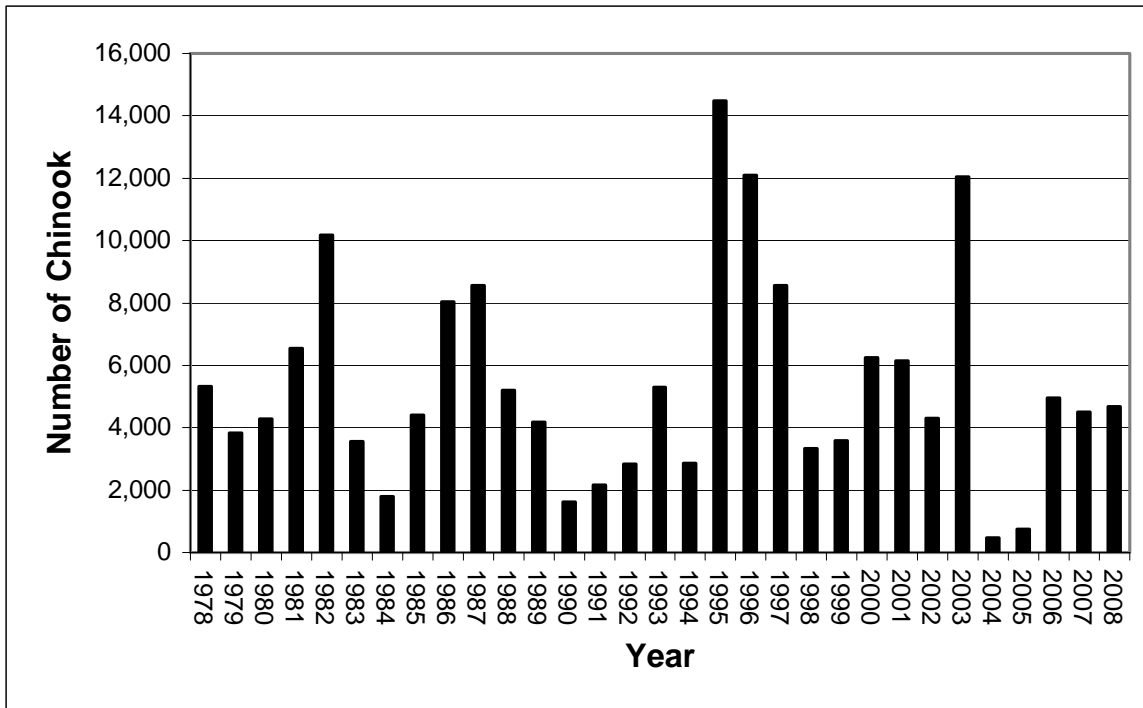
Date	Reach	Sex	Fork Length (cm)	Clips
12/8/2009	14	M	73	None
12/11/2009	15	M	75	None
12/24/2008	11	F	63	None
1/5/2009	7	M	68	None
1/8/2009	6	F	75	None

## DISCUSSION

### CHINOOK SALMON RUNS

Since 1978 the Chinook salmon run in the Scott River has ranged from 14,477 fish (1995) to 467 fish (2004) and has averaged 5,383 fish (Figure 10). The 2008 Chinook salmon run in the Scott River ranks fifteenth (4,673 fish) out of 31 years of data. The 2008 run was 13% lower than the 31 year average. A total of 3,234 Chinook salmon were estimated to have passed through the Scott River Fish Counting Facility during the 2008 season. A total of 1,439 Chinook salmon carcasses were estimated in reach 1 through reach 6, yielding a total run size estimate of 4,673 Chinook salmon. A total of 2,034 Chinook salmon were estimated in reaches 7 and 8. If the total number of Chinook estimated in reach 7 and 8 are subtracted from the counting facility estimate the proportion of the run that utilized areas in and upstream of the valley can be estimated. During 2008 25.7% (1,200) of the Chinook run utilized areas of the watershed above Meamber Bridge. Reach 8, a 3.4 mile section of the river, between Meamber Bridge and the USGS gauging station accounted for 1,653 Chinook salmon. These 1,653 fish that utilized reach 8 accounted for 51% and 35% of the total spawning above the weir and total spawning throughout the entire watershed respectively. The Schaffer mark recapture carcass estimate for the entire watershed that was surveyed was 3,235 fish. These 3,235 fish underestimate the total estimate by 30.7%. The addition of the fish counting facility has yielded a more accurate estimate of the total number of Chinook in the Scott River and has allowed for accurate estimation of Chinook utilization in the valley reaches without having to survey these reaches.

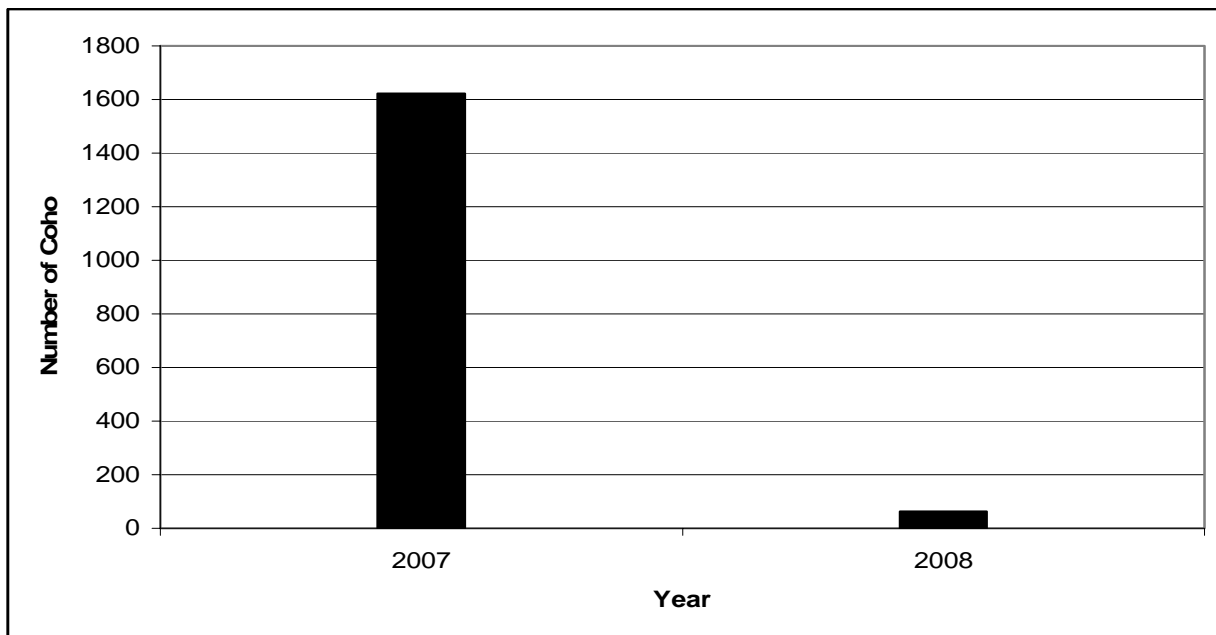




**Figure 10. Estimated escapement of adult Chinook salmon returning to the Scott River from 1978 to 2008.**

### COHO SALMON

Since video operations began in 2007 the estimated escapement of coho salmon in the Scott River has been 1,622 and 63 for 2007 and 2008 respectively (Figure 11). The adult run size of coho salmon in the recent past prior to 2007 was unknown and with the addition of the counting facility our ability to monitor this listed run has greatly improved. Although recent adult run size data is sparse on the Scott River, monitoring of the yearling juvenile emigration has taken place since 2003. The emigration data generated from 2003 through 2007 indicates significant variation in brood year strength (Chesney, 2009). Results of the first two years of adult monitoring at the SRFCF support this observation. The estimated number of yearling out migrants during 2008 indicates that again in 2009 the returning adult brood year will be weak (Pers. Comm. Bill Chesney, 2009).



**Figure 11. Estimated number of adult coho salmon migrating above the Scott River Fish Counting Facility during 2007 and 2008.**

### **ACKNOWLEDGEMENTS**

The California Department of Fish and Game would like to thank NOAA and PSMFC for their financial assistance in the operation of the SRFCF during 2008. The cooperative spawning ground surveys would not be possible without the assistance of the USFWS Yreka office and the USFS. Additionally this work would not be possible without the cooperation and participation of the Siskiyou Resource Conservation District, Karuk Tribe, Quartz Valley Tribe, USFS, Northern California Resource Center, Americorps and Etna High School who assisted KRP staff in completing spawning ground surveys on the Scott River. We would also like to express our appreciation to the various landowners who have graciously provided permission to access the Scott River on their lands.

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