2009 SCOTT RIVER SALMON STUDIES

FINAL REPORT

Prepared By:

Morgan Knechtle and Diana Chesney

California Department of Fish and Game
Northern Region
Klamath River Project
1625 South Main Street
Yreka, California 96097
(530) 842-3109

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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 2009 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 5, 2009 and ended on January 11, 2010. The total number of Chinook salmon that entered the Scott River during the 2009 season is estimated to be **2,211** 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 688 (31.1%) males and 1,523 (68.9%) females. Based on a scales age analysis, adults comprised approximately 98.0% (2,167 fish) and grilse comprised 2.0% (44 fish) of the run. Males ranged in fork length (FL) from 38cm to 106cm and averaged 75.1cm. Females ranged in FL from 49cm to 98cm and averaged 72.4cm. 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 20, 2009 and the last coho salmon was observed on January 1, 2010. A total of 81 coho salmon were observed moving upstream through the Scott River Fish Counting Facility (SRFCF) during the season. Due to the extremely low abundance of coho salmon returning in 2009 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 image 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 (041º 38' 10.93" N; 123º 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.

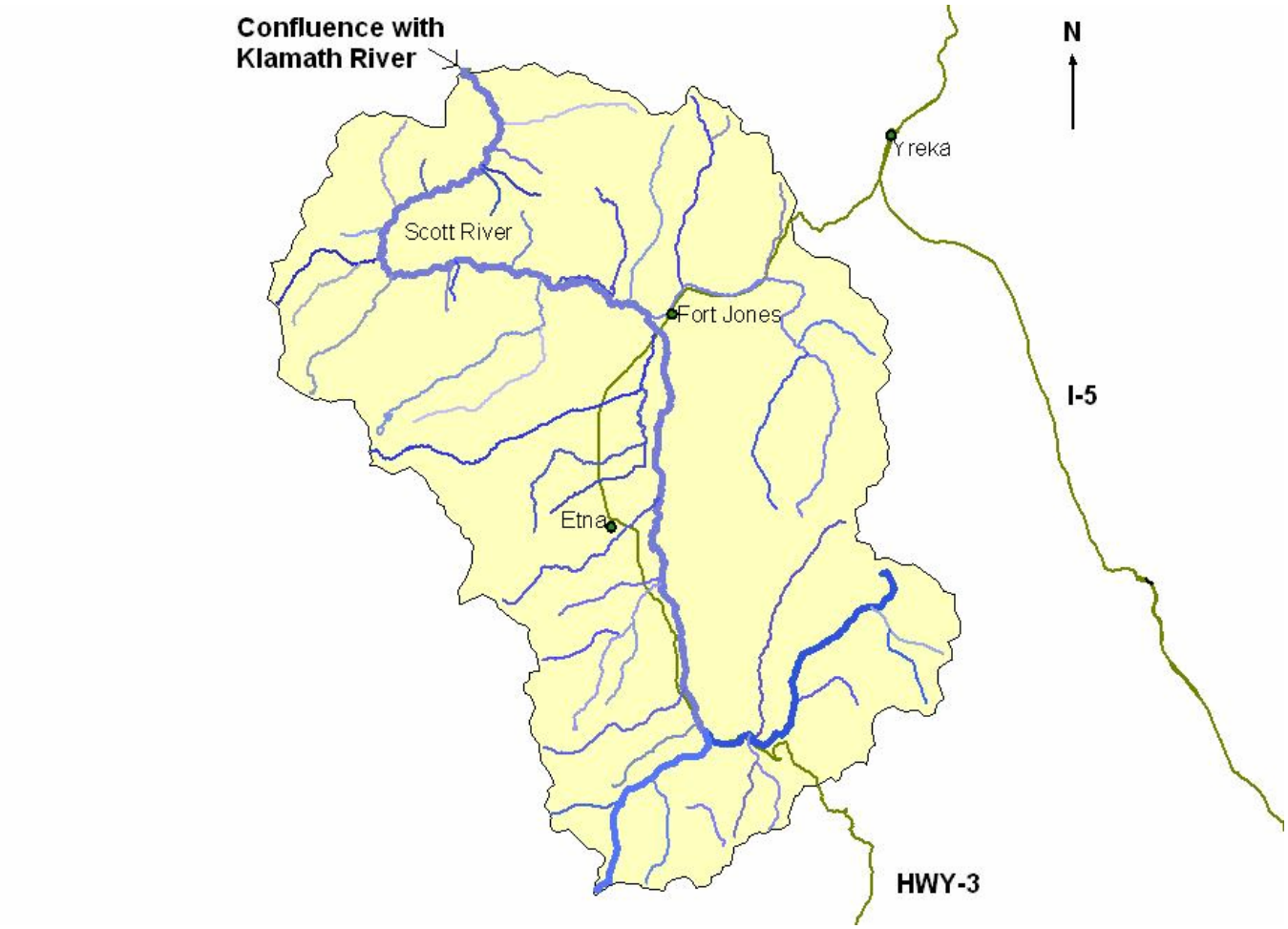

Figure 1. Location of the Scott River, tributary to the Klamath River, Siskiyou County.

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 Klamath River 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 originating from 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. In 1985 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 USDA Forest Service (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 (above river mile 24) 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 has been granted each year. The level of cooperation from local landowners has varied over the years. However, since the 2001 and 2002 spawning seasons, the number of landowners that have denied permission for access has increased dramatically. Controversies associated with the listing of SONCC coho salmon under the California Endangered Species Act (CESA) and other regulatory actions have 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 reach. The location of the fish counting station allows for monitoring fish abundance into the valley. The counting facility is also located upstream of several tributaries that can produce significant fall and winter stream flows, thereby reducing the probability of having the counting facility inoperable due to high flow events.

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 and hatchery contribution rates 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 5, 2009 at 1300 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 2009.

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 image. If the species could not be determined due to 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 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 12, 2009 and ending December 7, 2009. A total of fifteen 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. All carcasses recovered were identified to species and gender, checked for marks or tags, measured (FL), a scale sample was collected for age composition analysis, and females were examined 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

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 were 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 highest observed densities of 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, river mile 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 2009 season.

Reach Number	Downstream Limit	RM	Upstream limit	RM	Length (miles)
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 134 Chinook 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 102 Chinook salmon. All otoliths collected were supplied to Rebecca Quinones (USFS/University of California at Davis) for further microchemistry analysis. All otolith samples were collected following protocols provided by Rebecca Quinones.

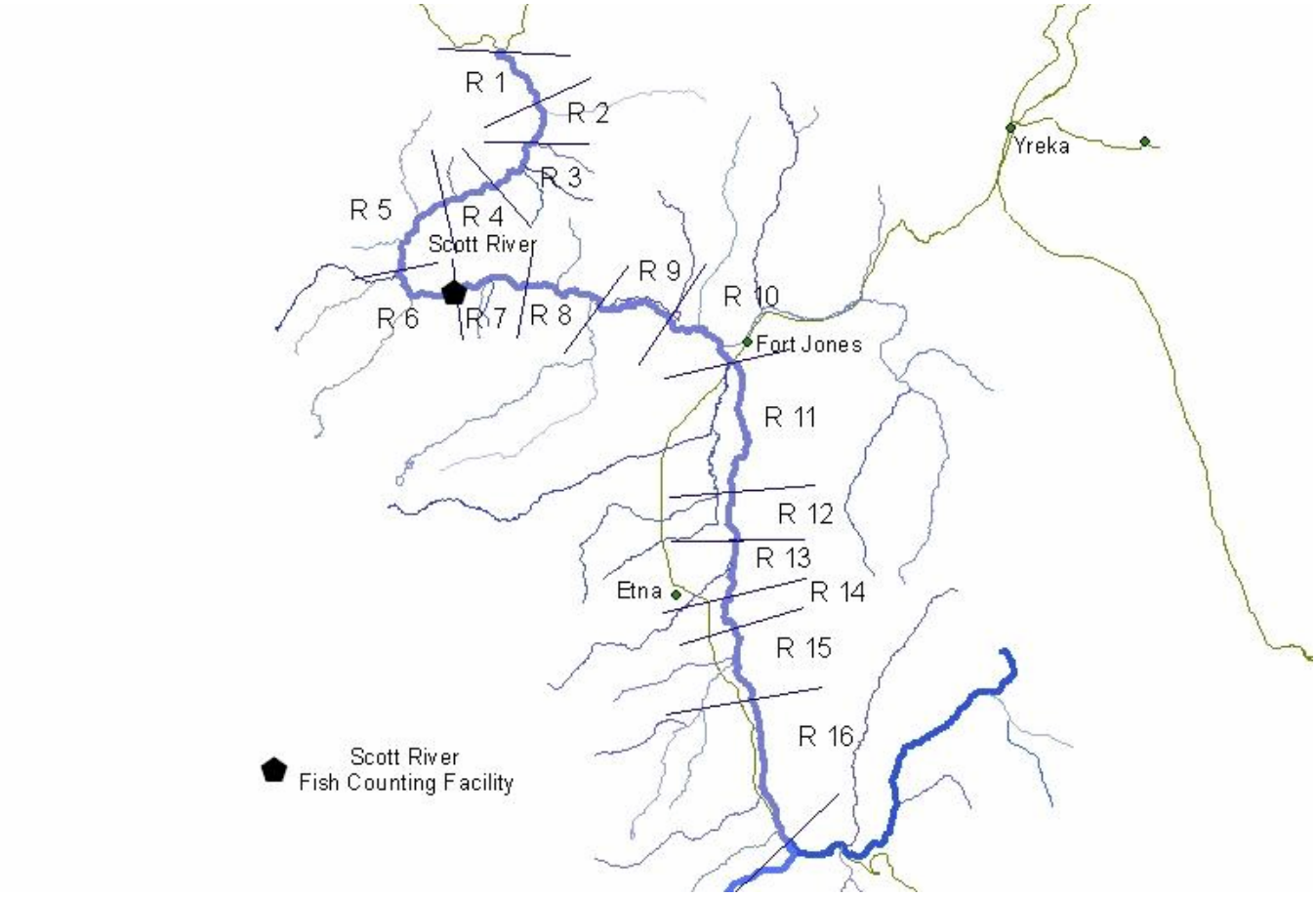

Figure 3. Location of the fish counting facility and spawning ground survey reaches on the Scott River used during the 2009 field season.

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 derived from the Schaffer estimate (utilizing data from reach 1 through reach 6 only) were added to the count of all Chinook salmon 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 no coho salmon carcasses were 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 5, 2009. The first Chinook salmon was observed at the SRFCF on October 14, 2009 and the last Chinook salmon was observed on December 22, 2009. The run peaked between October 14, 2009 and October 27, 2009 when 62.7% 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 1700 hours (Figure 5).

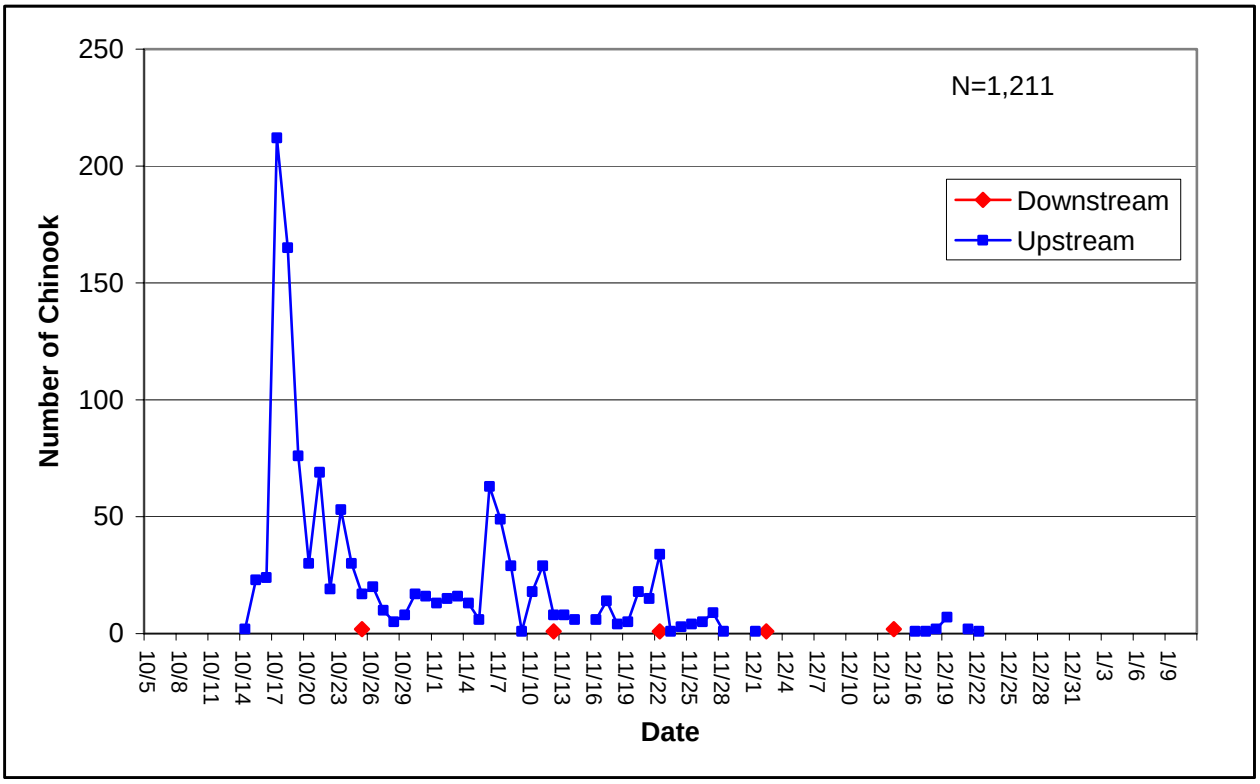

Figure 4. Run timing of Chinook salmon through the Scott River Fish Counting Facility during the 2009 season. Both upstream and downstream movements through the counting flume are shown (N=1,211).

A total of 1,197 Chinook salmon were estimated to have passed through the Scott River Fish Counting Facility during the 2009 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 812 Chinook carcasses were sampled during the spawning ground survey as Path 1 or Path 2 carcasses. Of these 251 (31.1%) were male and 555 (68.9%) were female (6 unknown sex). Males ranged in FL from 38cm to 106cm and averaged 75.1cm (Figure 6). Females ranged in FL from 49cm to 98cm and averaged 72.4cm (Figure 7). No ad-clipped Chinook were observed during the spawning ground surveys. After examination of the length frequency distribution of Path 1 and Path 2 carcasses, a grilse cut-off of < 59 cm was established for Scott River.

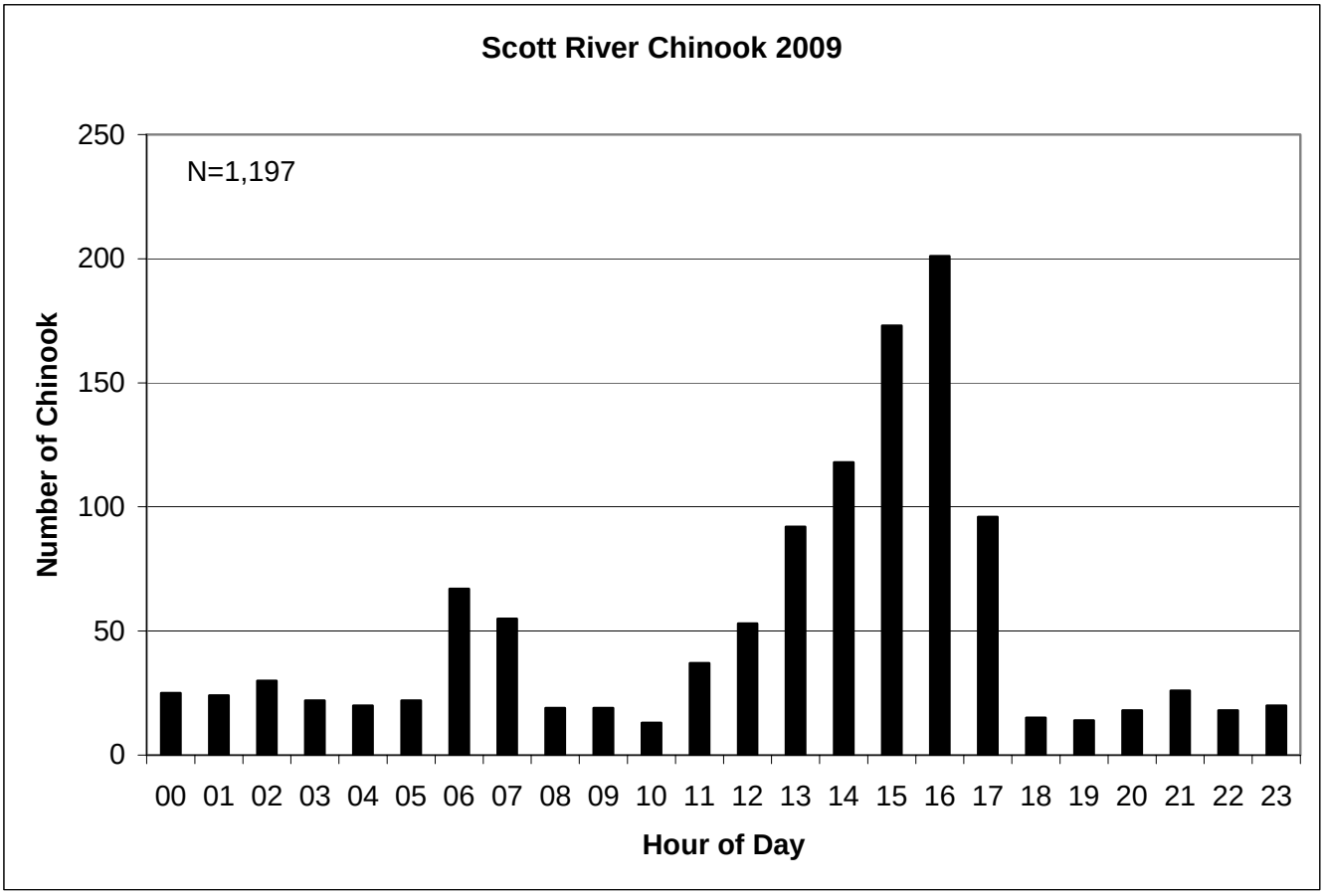

Figure 5. Summary of daily run timing of Chinook salmon observed at the Scott River Fish Counting Facility during 2009.

A total of 555 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 555 female Chinook salmon carcasses examined, 524 females (94.4%) were found to have spawned, and 31 females (5.6%) still contained more than 50% of their spawn and were identified as pre-spawn mortalities.

In 2009 the Schaffer mark recapture data generated form 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 1,674; 1,014; 402 and 387 respectively. For all reaches 825 Chinook were recovered, 594 were marked and 299 were subsequently recaptured yielding a recapture rate of 50.1%. For reaches 1-6, 443 Chinook were recovered, 352 were marked and 156 were recaptured yielding a recapture rate of 44.3%. For reach 7 and 8 together 354 Chinook were recovered, 221 were marked and 133 were recaptured yielding a recapture rate of 60.1%, for reach 8 alone, 349 Chinook were recovered, 217 were marked and 133 were recaptured yielding a recapture rate of 61.3%. The total Chinook salmon run size estimate was estimated to be 2,211 fish. Based on a scales age analysis, adults comprised approximately 98.0% (2,167 fish) and grilse comprised 2.0% (44 fish) of the Chinook run (KRTAT 2010).

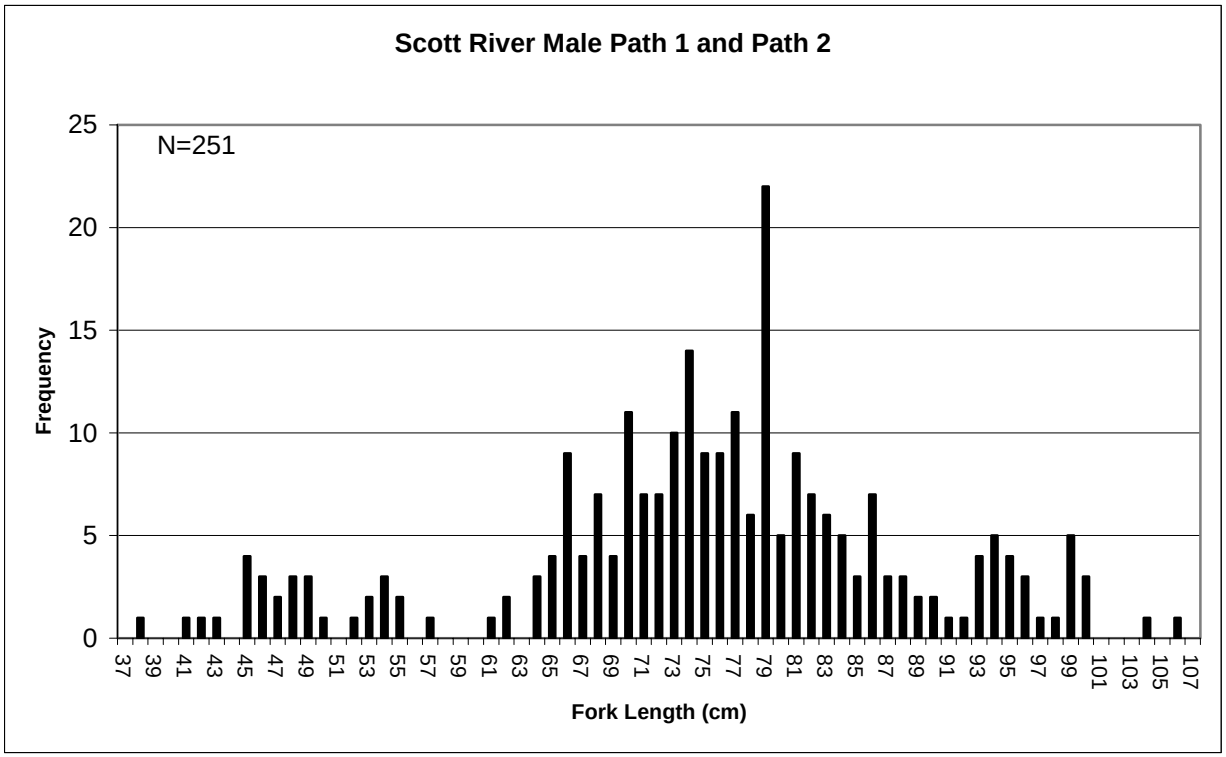

Figure 6. Length Frequency distribution of Path 1 and Path 2 male Chinook salmon observed during spawning ground surveys in the Scott River, 2009 (n = 251).

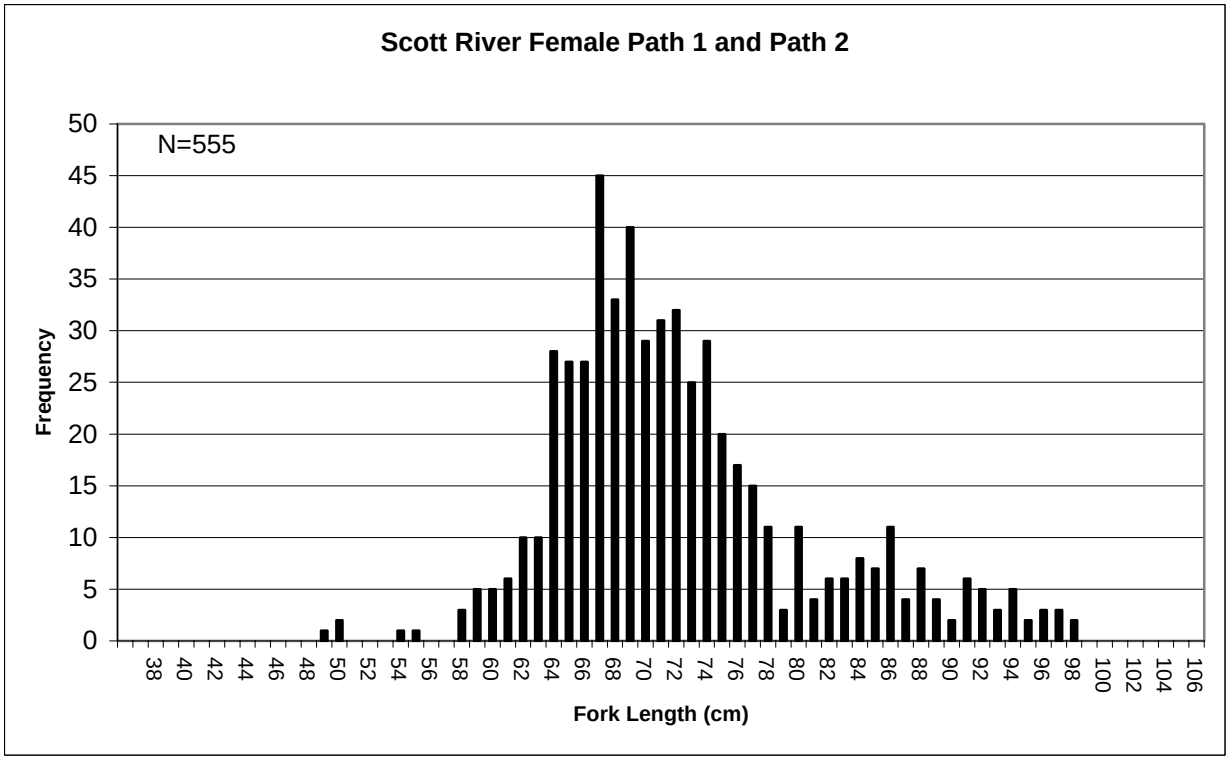

Figure 7. Length frequency distribution of Path 1 and Path 2 female Chinook salmon observed during spawning ground surveys in the Scott River, 2009 (n = 555).

COHO SALMON

The first adult coho salmon was observed at the counting facility on November 20, 2009 and the last coho salmon was observed on January 1, 2009. A total of 81 coho salmon were observed moving upstream through the SRFCF during the season (Figure 8). Coho salmon migration peaked during the 13 day period from December 11, 2009 to December 23, 2009 when 74 or 91.3% of the coho were observed. No coho salmon were observed swimming downstream during the season. None of the 81 coho salmon observed were unmarked coho salmon that previously entered IGH and were subsequently released.

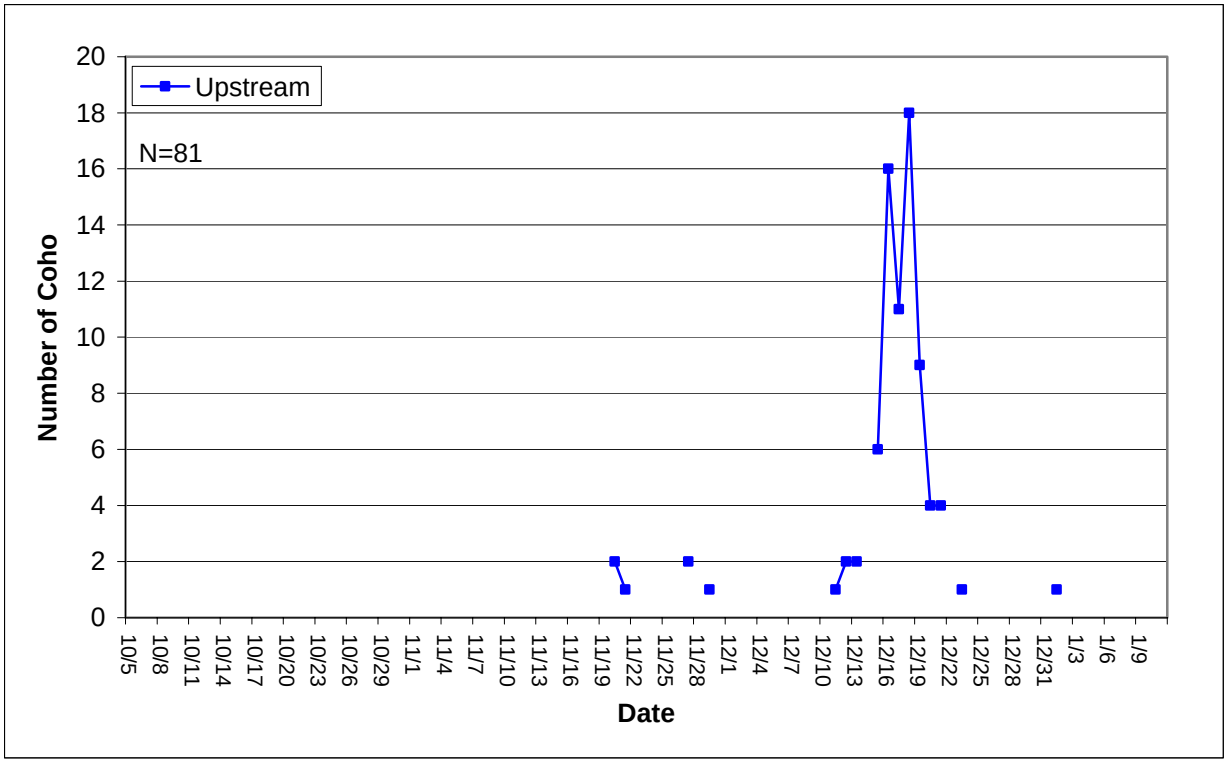

Figure 8. Run timing of coho salmon observed passing through the Scott River Fish Counting Facility during the 2009 season (N=81). No downstream movements were observed of coho salmon.

Diel movements of coho salmon through the SRFCF were higher in the evening hours and peaked between 1800 hours and 1900 hours (Figure 9). This movement pattern is consistent with observations from previous seasons. Very few observed migrations during daylight hours may have been a result of increased human activity at the counting facility during the day.

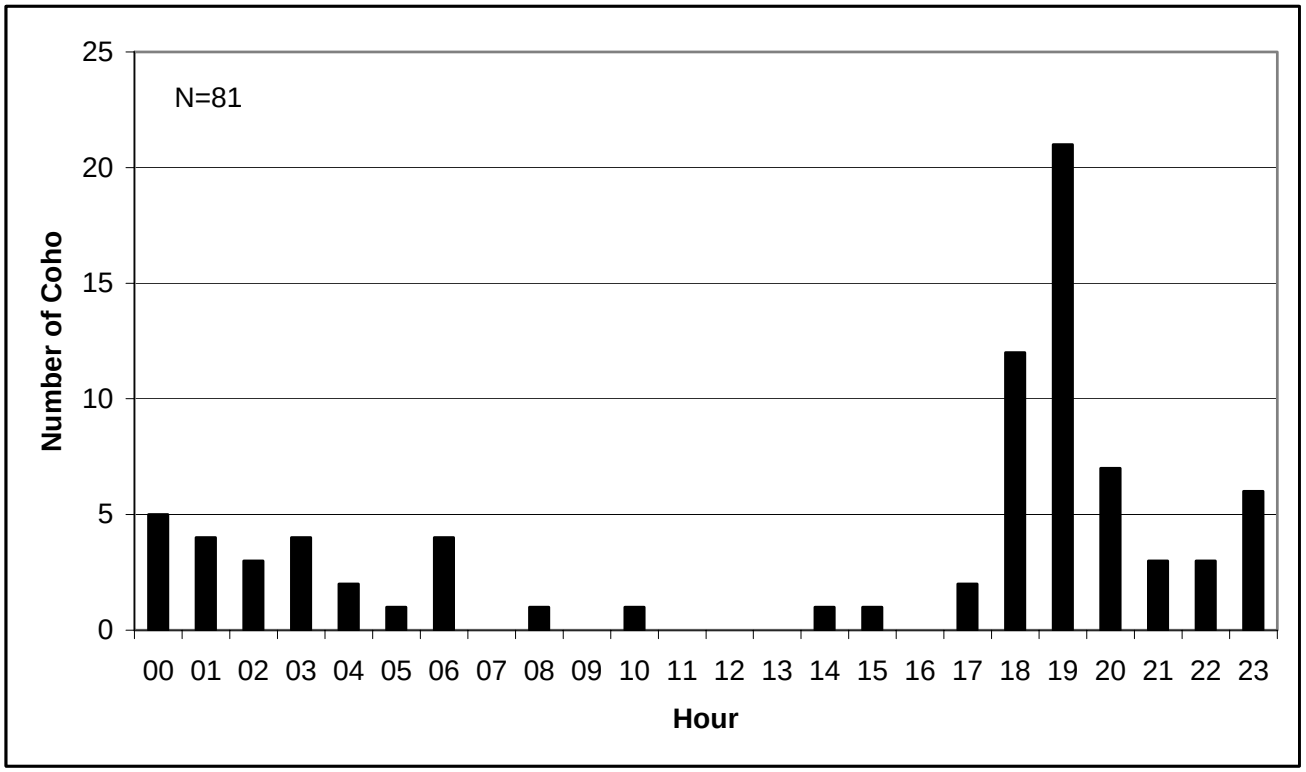

Figure 9. Diel migration patterns of coho salmon observed moving through the Scott River Fish Counting Facility in 2009 (N=81).

SPAWNING GROUND SURVEYS

A total of 3 coho salmon carcasses were sampled during the spawning ground survey (Table 2), one of which was collected during the cooperative spawning ground surveys and two were collected during coho surveys coordinated by the Siskiyou Resource Conservation District (SRCD). The one carcass sampled during the cooperative surveys was a 39 cm fork length male with a right maxillary clip indicating it was a hatchery origin fish released from Trinity River Hatchery. This hatchery fish was found 150 meters upstream of the confluence with the Klamath River and appeared to have been unspawned. It is unknown if this fish successfully spawned in the Scott River. This hatchery origin coho was found dead prior to the peak of the coho migration in the Scott River and found in an area outside the documented spawning distribution of Scott River coho, therefore this fish has not been included in the 2009 estimate for coho salmon in the Scott River. Cooperative spawning ground surveys were conducted bi-weekly in the reaches below the counting facility through December 11, 2009 and no additional coho salmon carcasses were recovered. After the cooperative spawning ground surveys ended, two additional coho carcasses were sampled by the Siskiyou Resource Conservation District, both in Reach 14 (Pers. comm..Yokel, 2010).

Table 2. Coho salmon carcasses recovered during the 2009 field season.

Date	Reach	Sex	Fork Length (cm)	Clips
11/23/2009	1	M	39	Right Maxillary
12/30/2009	14	M	70	None
1/11/2010	14	F	63	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 5,284 fish (Figure 10). The 2009 Chinook salmon run in the Scott River ranks twenty-seventh (2,211 fish) out of 32 years of population estimates. The 2009 run was 58% lower than the 32 year average. A total of 1,197 Chinook salmon were estimated to have passed through the Scott River Fish Counting Facility during the 2009 season. A total of 1,014 Chinook salmon carcasses were estimated in reach 1 through reach 6, yielding a total run size estimate of 2,211 Chinook salmon. A total of 402 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 2009, 36.0% (795) 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 387 Chinook salmon. These 387 fish that utilized reach 8 accounted for 32% and 18% 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 1,674 fish. These 1,674 fish underestimate the total estimate by 24.3%. 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.

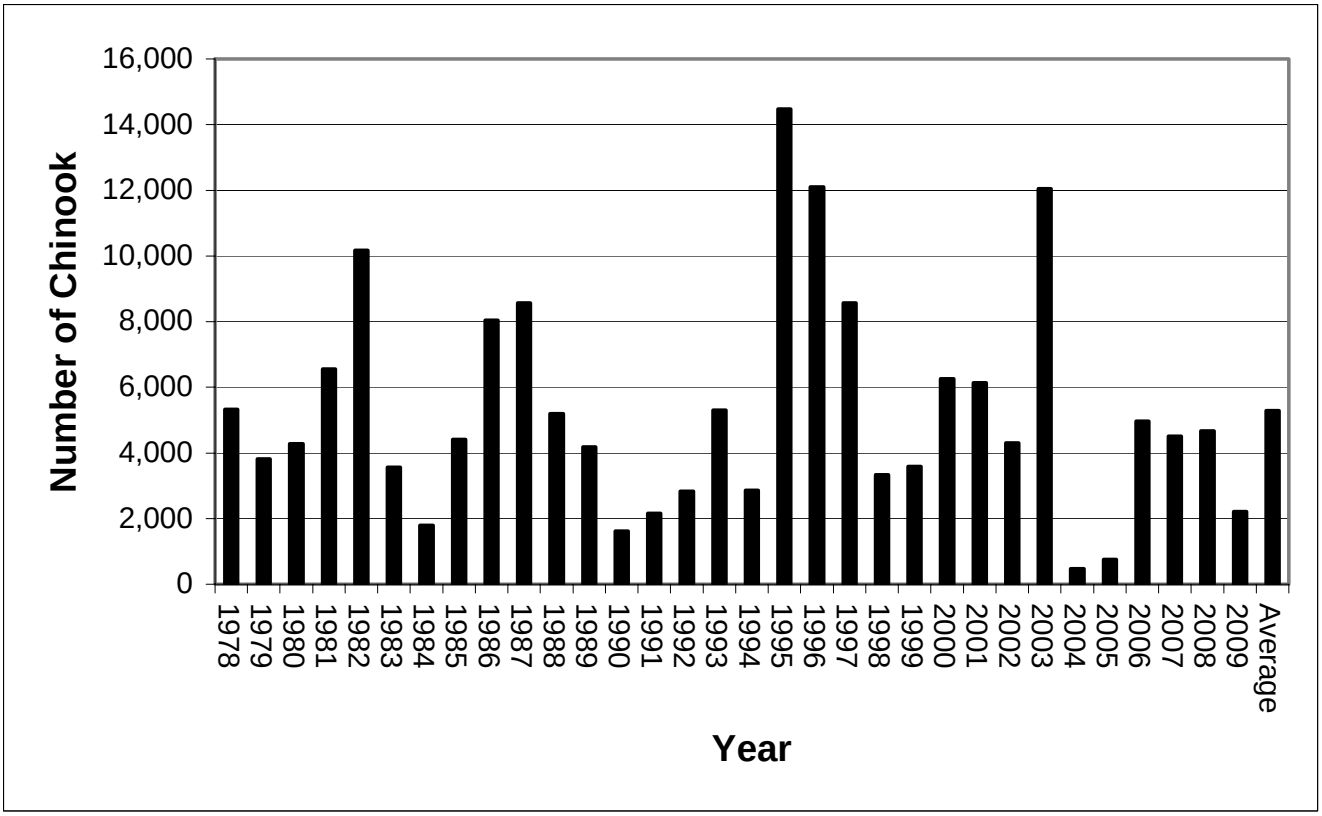

Figure 10. Estimated escapement of adult Chinook salmon retuning to the Scott River from 1978 to 2009.

The Scott River is an important component of the Klamath Basin Chinook runs. Table 3 shows that the Scott River has contributed an average of 10 percent of the basin-wide natural spawning escapement during the period from 1978 to 2009. The river under its current habitat conditions generally produces more 0+ Chinook as more adults return, indicating that the watershed has not reached a "saturated level" or a "carrying capacity" for Chinook salmon (Figure 11). The Scott River has been known for its productive conditions and at the current levels of fish abundance the Scott River is spawner limited. The number of 0+ Chinook produced per adults is a direct measure of in-river productivity and as habitat conditions improve or diminish this measure will reflect those conditions. It is encouraging that the number of 0+ Chinook produced per adult is increasing and has increased each season starting with brood year 2005 (Figure 12).

Table 3. Klamath Basin and Scott River Chinook natural spawner escapements (age 2-5), 1978-2009.

Year	Chinook Natural Spawner Escapement		% Scott
	Klamath Basin	Scott River	
1978	74,906	5,332	7%
1979	37,398	3,824	10%
1980	48,465	4,277	9%
1981	50,364	6,556	13%
1982	50,597	10,176	20%
1983	33,310	3,568	11%
1984	21,349	1,801	8%
1985	61,628	4,408	7%
1986	142,302	8,041	6%
1987	110,489	8,566	8%
1988	91,930	5,200	6%
1989	49,377	4,188	8%
1990	16,946	1,615	10%
1991	12,367	2,165	18%
1992	17,171	2,838	17%
1993	25,683	5,300	21%
1994	38,578	2,863	7%
1995	179,118	14,477	8%
1996	87,500	12,097	14%
1997	50,369	8,561	17%
1998	45,343	3,327	7%
1999	28,904	3,584	12%
2000	89,122	6,253	7%
2001	85,581	6,142	7%
2002	69,502	4,308	6%
2003	89,744	12,053	13%
2004	28,516	467	2%
2005	27,931	756	3%
2006	45,002	4,960	11%
2007	61,741	4,505	7%
2008	48,073	4,673	10%
2009	52,702	2,211	4%
Average	**58,500**	**5,284**	**10%**

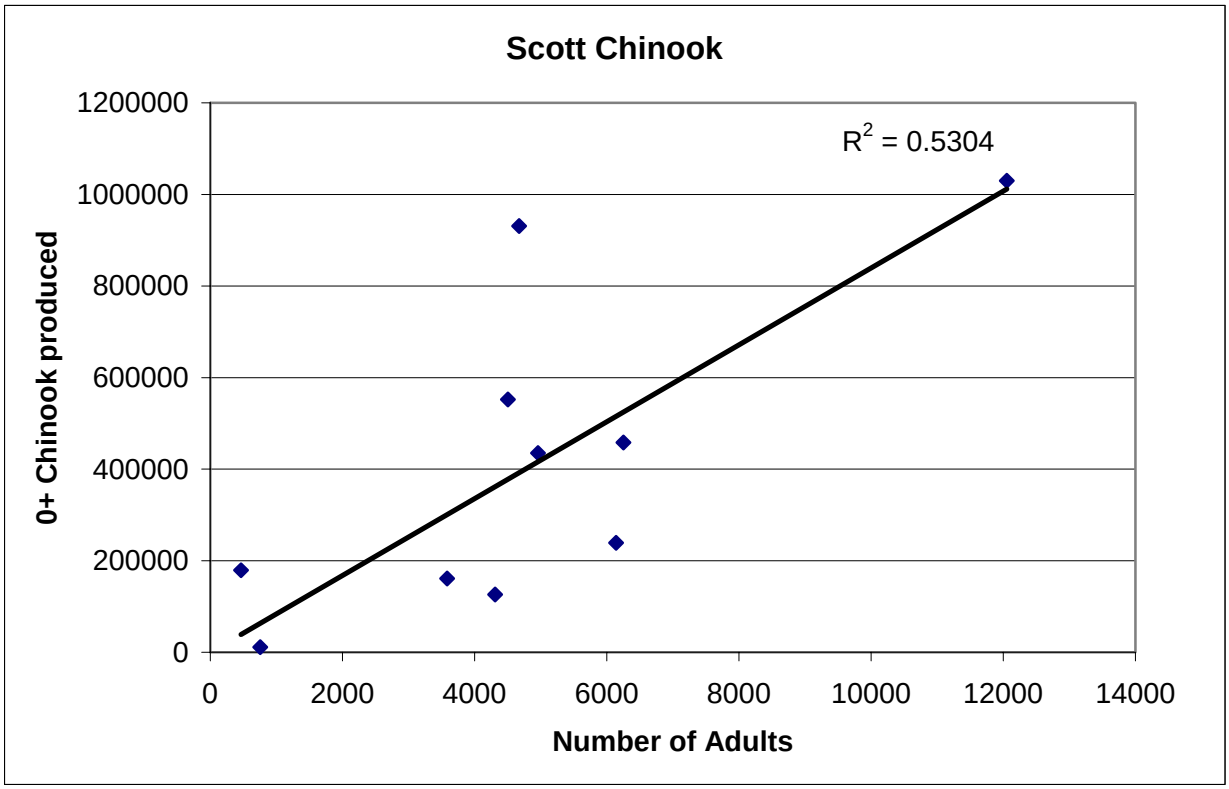

Figure11. Number of 0+ Chinook produced per adult spawner in the Scott River, Brood Years 1999-2008.

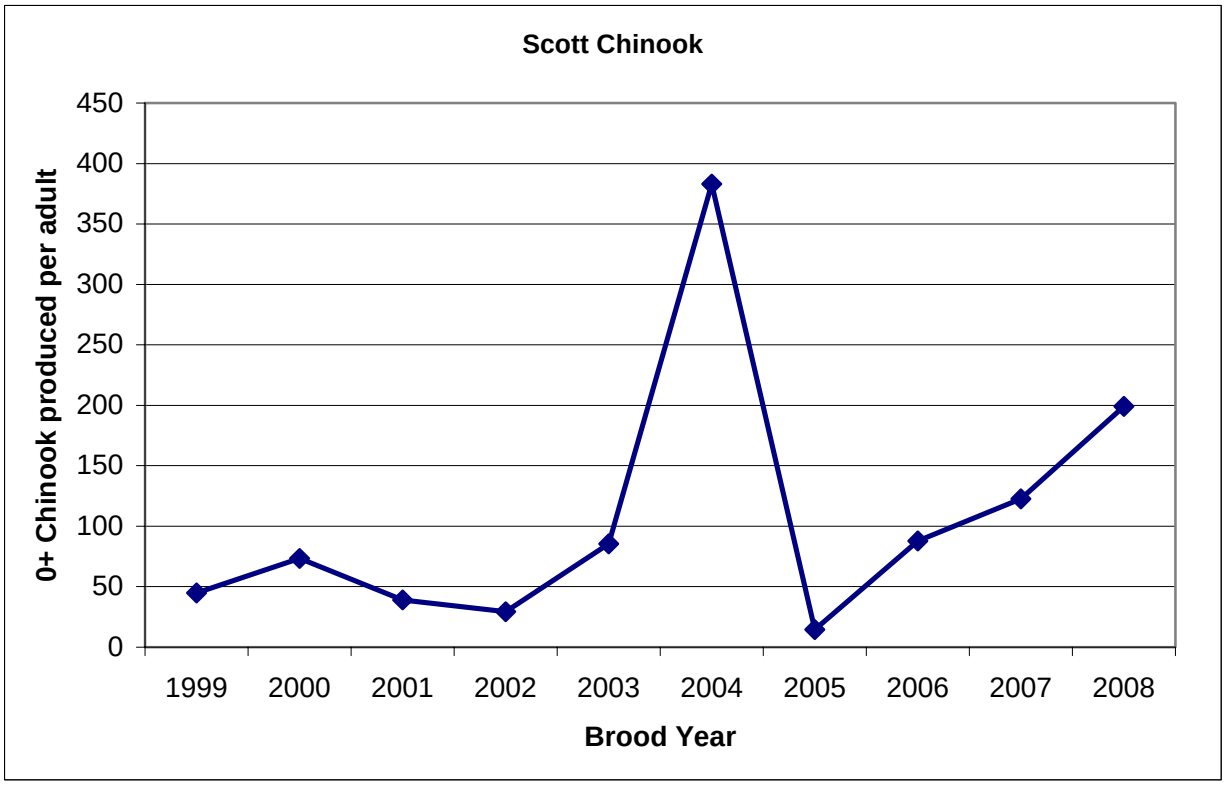

Figure12. Number of 0+ Chinook produced per adult spawner in the Scott River by brood year, for Brood Years 1999-2008.

COHO SALMON

Since video operations began in 2007 the estimated escapement of coho salmon in the Scott River has been 1,622, 63 and 81 for 2007, 2008 and 2009 respectively (Figure 13). The adult run size of coho salmon in the recent past prior to 2007 was unknown and with the addition of the counting facility the Department's 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 three years of adult monitoring at the SRFCF support this observation. The estimated number of yearling out migrants during 2009 (Pers. Comm. Bill Chesney, 2010) indicates that in 2010 the strongest of the three year classes will return.

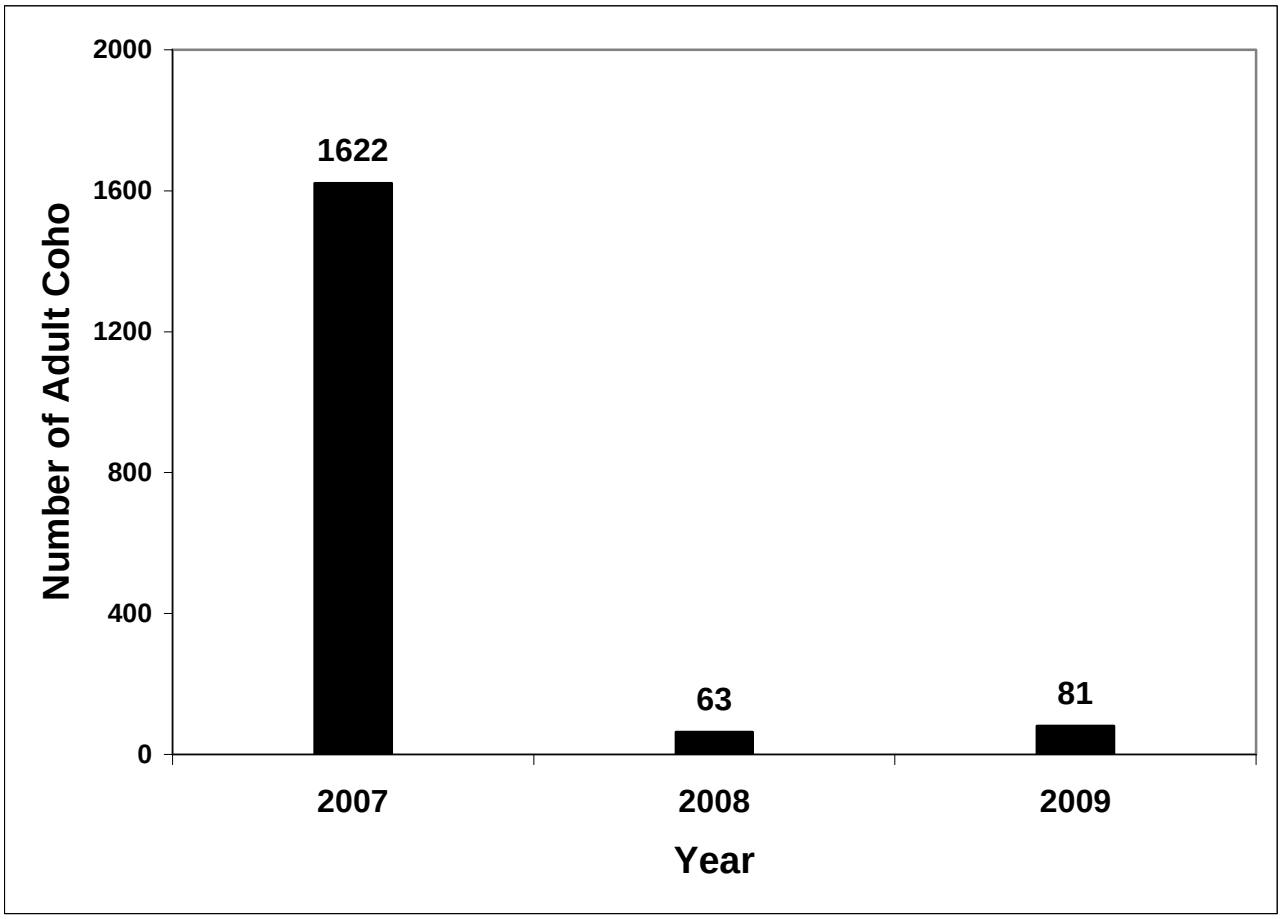

Figure 13. Estimated number of adult coho salmon migrating above the Scott River Fish Counting Facility during 2007 through 2009.

Utilizing the number of yearling coho produced in the Scott River (Pers. Comm. Bill Chesney, 2010) and the results of the adult abundance estimates allows for analysis of freshwater production and out of basin survival by brood year. For brood years 2004 and 2005 the number of yearling coho that were required to produce a single adult coho averaged 53.49 and ranged from a low of 46.30 to a high of 63.40. The corresponding out of basin survival has averaged 1.87 percent and ranged from a low of 1.58 percent to a high of 2.16 percent (Table 4). Utilizing the estimated number of yearling outmigrants and the average percent yearling survival value of 1.87 percent the number of returning adults in 2010 can be forecasted at 1,163. Due to the difficulty in estimating abundance of outmigrants at low abundance

levels, data from brood year 2006 has been omitted from this analysis. Although the proportion of yearlings that survive outside the Scott River watershed is largely driven by uncontrollable factors it is important to track this survival metric to accurately evaluate ongoing restoration efforts taking place within the watershed.

Table 4. Yearling coho outmigrant abundance point estimates, adult coho abundance estimates, ratio of outmigrant yearlings to adult returns and proportion of outmigrant yearlings that returned as adults by brood year for the Scott River, Brood Years 2004-2007.

Brood Year	Yearling Year	Yearling point Estimate	Adult Year	Adult Estimate	Yearlings to adult	Percent yearling survival
2004	2006	75097	2007	1622	46.30	2.16
2005	2007	3931	2008	62	63.40	1.58
2006	2008	941	2009	81	11.62	8.61
2007	2009	62207	2010	**1163**[/2]	**53.49**[/2]	**1.87**[/1]

/1 Average percent yearling survival from brood years 2004 and 2005

/2 Projected adult estimate and yearling to adult ratio based on yearling point estimate of 62,207 and average percent yearling survival from brood years 2004 and 2005.

Analyzing the comparisons of yearling coho production estimates (Pers. Comm. Bill Chesney, 2010) to estimated adult coho returns produces freshwater survival estimates in the form of yearling coho produced per adult return. Brood Year 2007, the only year in which the number of yearling coho produced per returning adult can be calculated, was 38.35 (Table 5). As additional years of data become available the freshwater production of coho salmon in the Scott River can be further evaluated. To give some context to the 38.35 yearlings produced per adult in the Scott River, this value in the Shasta River has averaged 20.0 and ranged from a low of 4.4 to a high of 38.0 for brood years 2001-2006. The number of yearlings produced per returning adult by brood year is a direct measure of freshwater survival. As the number of yearlings produced per returning adult increases it can be inferred that in river conditions for coho salmon are improving. Conversely as the number of yearlings produced per returning adult decreases it can be inferred that in river conditions for coho salmon are getting worse.

Table 5. Adult coho estimate, yearling coho production point estimate and ratio of yearling coho produced per adult return for the Scott River, Brood Year 2007.

Adult Year Brood Year	Adult Estimate	Yearling Year	Yearling point Estimate	Yearlings produced per adult
2007	1622	2009	62207	38.35

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