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DEPARTMENT OF FISH AND WILDLIFE
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

July 28, 2015

Subject: **2014 Scott River Salmon Studies, Final Report**

All,

Please find attached a copy of the subject report. This report describes our fall Chinook and coho sampling efforts on the Scott River. Should you have any questions regarding this report, please direct inquiries to either Senior Environmental Scientist Wade Sinnen at (707) 822-5119, wade.sinnen@wildlife.ca.gov, or Environmental Scientist Morgan Knechtle at (530) 842-3109, morgan.knechtle@wildlife.ca.gov.

Sincerely,

Tony LaBanca
Fisheries Program Manager

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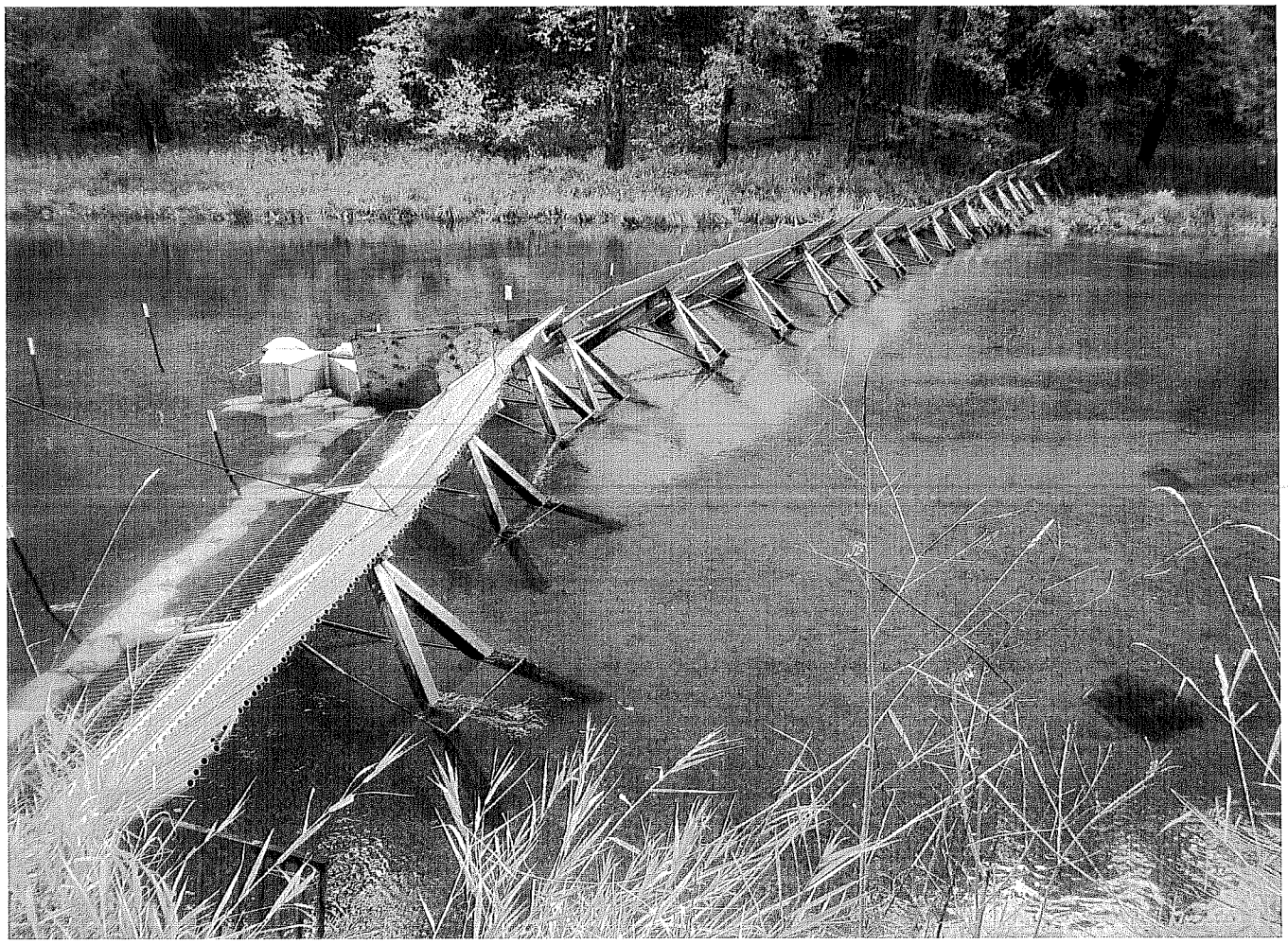
2014 SCOTT RIVER SALMON STUDIES

FINAL REPORT



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SCOTT RIVER SALMON STUDIES, 2014

California Department of Fish and Wildlife
Northern Region
Klamath River Project

ABSTRACT

The California Department of Fish and Wildlife'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 2014 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 Chinook salmon and coho salmon into the Scott River. Video fish counting operations began on September 30, 2014, and ended on December 6, 2014, due to high river flows.

The total number of Chinook salmon that entered the Scott River during the 2014 season is estimated to be **12,471** 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 5,992 (48.0%) males and 6,479 (52.0%) females. Based on scale age analysis, adults comprised approximately 83.55% (10,420 fish) and grilse comprised 16.45% (2,051 fish) of the run. Males ranged in fork length (FL) from 38cm to 105cm and averaged 72.9cm. Females ranged in FL from 44cm to 95cm and averaged 76.2cm. KRP staff estimated that 15 of the Chinook salmon that returned were of hatchery origin.

The first adult coho salmon was observed at the Scott River Fish Counting Facility (SRFCF) on October 23, 2014, and the last coho salmon was observed on December 6, 2014. A net total of **485** coho salmon were observed moving upstream through the SRFCF during the season. No additional coho were estimated in the main stem or tributaries downstream of the SRFCF. Based on the proportion of male and female coho salmon that were sampled during the season, the run was comprised of approximately 306 (63.2%) males and 179 (36.8%) females. Based on observed carcasses, adults comprised approximately 78.9% (383 fish) and grilse comprised 21.1% (102 fish) of the run. Males ranged in FL from 40cm to 80cm and averaged 63.8cm. Females ranged in FL from 64cm to 72cm and averaged 66.9cm. Based on observed carcasses, none of the coho salmon were estimated to be of hatchery origin.

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 (SRFCF) 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). Chinook salmon typically return to the Scott River to spawn from mid-September to late December. The coho salmon spawning run typically occurs from mid-October to early January and steelhead run from November to April.

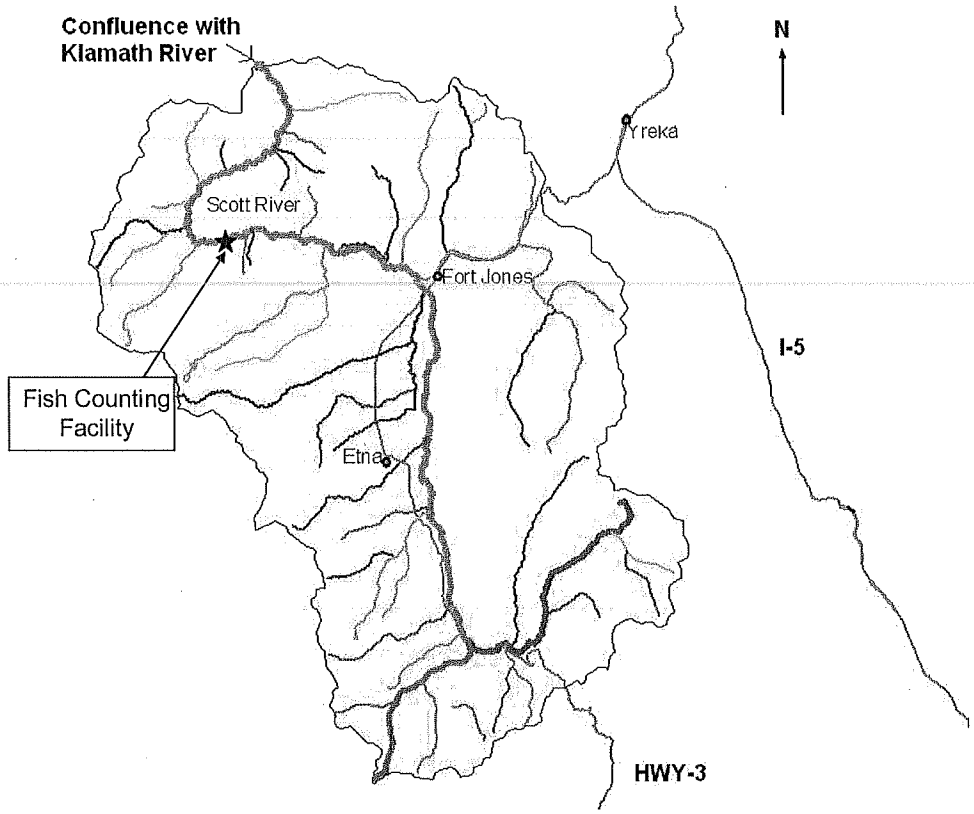

Figure 1. Location of the Scott River, tributary to the Klamath River, Siskiyou County, CA.

KLAMATH RIVER PROJECT AND THE SCOTT RIVER STUDY

The Scott River study is one component of the Klamath River Project (KRP) (initiated in 1978). The goals of the KRP include obtaining information on species composition, hatchery composition, run timing, age structure, spawning distribution, fork length (FL) frequency and sex ratios 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 (Williams et al. 2008) 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 main stem Scott River which included an approximately 5.5 mile reach near Etna and a 4.75 mile reach 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 of 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 Department 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 private ownership. 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. The level of cooperation from local landowners has varied over the years. However, since the 2001 and 2002 spawning seasons, the number of landowners who have denied permission for access has increased. Controversies associated with the listing of the SONCC under the California Endangered Species Act and other regulatory actions have reduced the amount of cooperation provided by local landowners to the extent that the Department has been denied permission to survey a large portion of the salmon 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 while Cormack-Jolly-Seber (CJS) mark recapture carcass-based estimates are conducted in the areas downstream of the counting station. 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 distribution, and sex ratio for Chinook and coho salmon in the Scott River.

C) Collect scale samples from carcasses and look for hatchery marks 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 SRFCF on September 30, 2014, at 1200 hours Pacific Standard Time. A temporary weir (Alaskan weir design) 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 during the Chinook and coho salmon migration. 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 ECOR 264) 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.

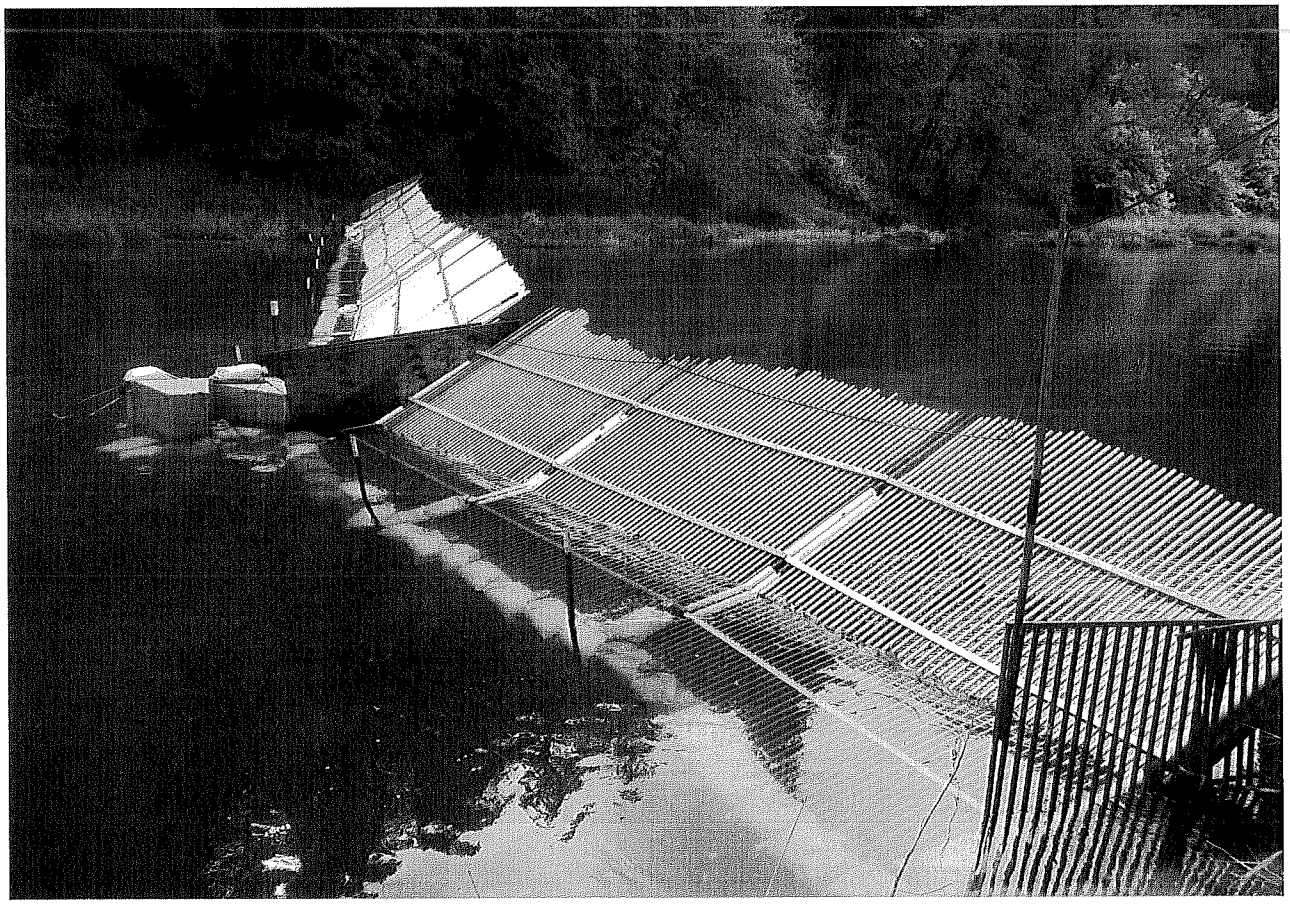

Figure 2. SRFCF located in Siskiyou County, California, 2014.

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 species unknown. Staff also noted any ad-clipped fish observed and recorded the presence of lamprey and any other distinguishable marks that were visible on the image. All data was then entered into computer files and each data file was subjected to one independent review prior to commencement of data analysis. When the counting facility was inoperable, fish passage was estimated for that period by averaging the number of observed fish migrations for the specific time periods for which the counting facility was inoperable two days prior and two days after the malfunction.

SPAWNING GROUND SURVEYS

Spawning ground surveys were conducted twice a week on Mondays and Thursdays throughout the salmon spawning season starting October 13, 2014, and ending November 24, 2014. Additional surveys were conducted during the coho period through December 30, 2014. A total of 143 surveys were performed during the spawning season (Appendix 1). On the morning of each survey, crews of at least two people each 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 flagged and mapped 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, 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 two 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. Path 3 carcasses were returned to the river for subsequent future recapture. Therefore, Path 3 carcasses could be recaptured multiple times. Path 3 carcasses were returned to the river for future recapture as long as the adipose fin clip determination could still be made with confidence. Once an adipose fin had deteriorated to the point that adipose fin clip determination couldn't be made with confidence, the carcass was chopped in half and removed from the mark recapture experiment. 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.

The final Chinook salmon run size estimate for reaches below the counting facility was calculated using the CJS model as presented in Bergman et al. 2012.

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 private lands where permission had been granted by the 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. Historically, the highest observed densities of Chinook salmon spawning areas within Scott Valley were 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).

To assist in developing stock identification baseline information, KRP staff collected both genetic tissue and otolith samples during the season. Tissue samples were collected for future DNA analysis from 136 Chinook salmon and 19 coho salmon. Tissue was collected from the first Chinook from each reach and each survey date and all coho salmon for which samples could be collected. 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 100 Chinook salmon and 19 coho salmon (otoliths were collected from the first Chinook from each reach and each survey date and all coho salmon for which samples could be collected). All otoliths collected were archived for future microchemistry analysis. All otolith samples were collected following standard protocols described by Stevenson (1992).

Table 1. Description of cooperative spawning ground survey reach locations along the Scott River during the 2014 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

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. The CJS model was used to estimate abundance in Reaches 1 through 6. The landowners in a 0.5 mile section of Reach 3 would not allow twice-weekly access for carcass based surveys and as a result a single pass redd survey (post peak spawning) was used to estimate total in this specific area using the following formula: Total run= (2*total redd count)/(1-proportion jacks). To estimate total escapement in the Scott River, the number of Chinook salmon carcasses derived from the CJS model were estimated (utilizing data from Reach 1 through Reach 6 only) and added to the count of all Chinook salmon observed passing through the video counting facility plus the estimated number of fish in the redd only area of Reach 3.

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 December 2, 2014, in the main stem and December 30, 2014, in tributaries (Tompkins Creek, Kelsey Creek, and Canyon Creek) below the counting facility. To estimate total adult coho salmon escapement in the

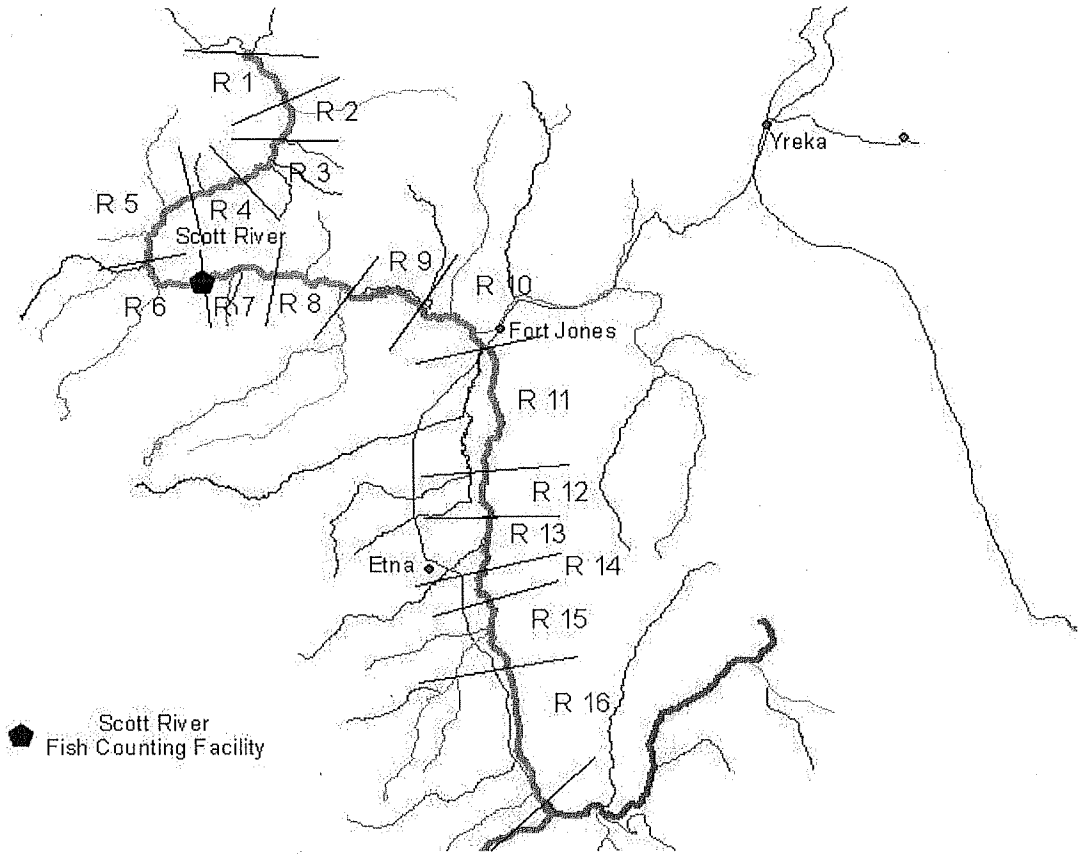

Figure 3. Location of the SRFCF and spawning ground survey reaches on the Scott River used during the 2014 field season.

Scott River, the number of observed coho salmon redds downstream of the counting station were multiplied by two in order to estimate each redd) and were added to the count of all coho salmon the number of adult coho (assuming two unique individuals participated in the construction of observed passing through the SRFCF. The grilse component from below the counting facility was then added back into the total (total run= adults/(1-%jacks estimated).

Hatchery Contribution Rates

The hatchery contribution rates for Chinook and coho have been estimated both through the recovery of carcasses and through reviewing fish images observed at the fish counting facility. Annually, decisions are made on which method produces the most accurate estimate based on sample sizes generated from each method. During the 2014 season hatchery contribution rates were based on collection of data from observed carcasses for Chinook and coho salmon. To estimate total Chinook hatchery contribution, a sample expansion (3.84) based on the inverse of the number of carcasses (3,250) examined during the spawning ground survey divided by the total number of Chinook salmon that were estimated (12,471), was applied to all CWT recoveries (Table 3). A sample expansion is utilized to account for areas of anadromy that are not included in the survey. To estimate total coho hatchery contribution, the observed hatchery contribution rates generated from observed carcasses are applied to the total estimate.

RESULTS

Operation of the Scott River Fish Counting Facility

The SRFCF began recording fish movements on October 2, 2014. The first Chinook salmon was observed at the SRFCF on October 2, 2014, and the last Chinook salmon was observed on December 5, 2014. The run peaked between October 23, 2014, and October 31, 2014, when 77.5% of the Chinook migration was observed (Figure 4). The majority (76.7%) of Chinook salmon passed through the SRFCF during daylight hours and peaked in the afternoon between 1200 and 1600 hours (Figure 5).

A net total of 9,476 Chinook salmon were estimated to have passed through the SRFCF during the 2014 season (8,192 upstream and 76 downstream). 1,189 Chinook were included in the total as an expansion for periods of time when the camera was not functioning. Additionally, 171 Chinook were added to the total from unknown species passing upstream through the video flume. Unknown species were assigned species based on the daily proportion of images that could accurately be identified to species. During the Chinook spawning period, the camera was not functioning on three separate occasions for a total of 144 hours and 75 minutes (Table 2).

Spawning Ground Surveys

A total of 3,195 Chinook carcasses were sampled during the spawning ground survey as Path 1 or Path 2 carcasses. Of these, 1,535 (48.0%) were male and 1,660 (52.0%) were female. Males ranged in FL from 38cm to 105cm and averaged 72.9cm (Figure 6). Females ranged in FL from 44cm to 95cm and averaged 76.2cm (Figure 7). One ad-clipped Chinook was observed during the spawning ground survey effort and was recovered in Reach 12. After

expanding for production and sampling, this one fish expanded to an estimated 15 hatchery fish for a total basin hatchery fraction of .0012 (Table 3). After examination of the length frequency distribution and scale age analysis of Path 1 and Path 2 carcasses, a maximum grilse cut-off of < 61cm was established for Scott River Chinook.

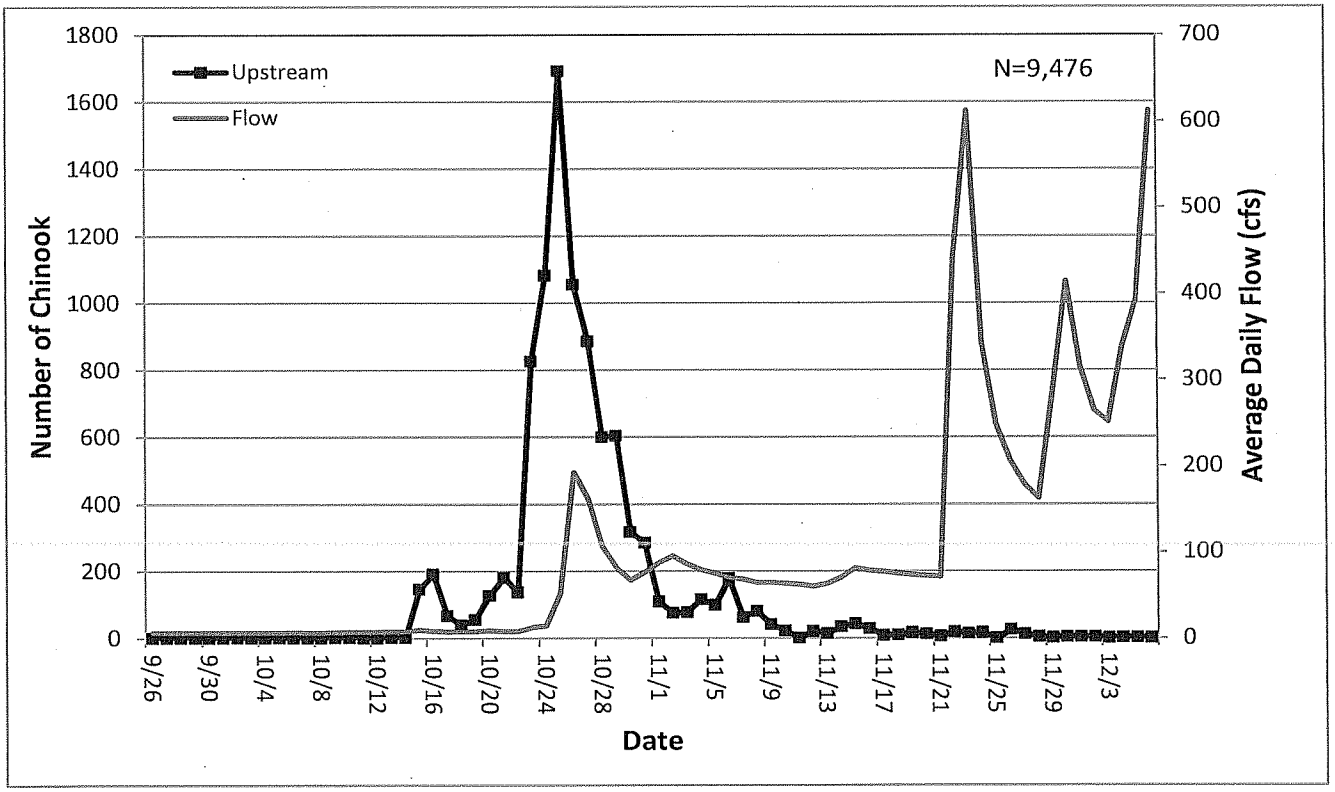

Figure 4. Run timing of Chinook salmon through the SRFCF during the 2014 season (N=9,476), and average daily flows observed at USGS Gauge No. 11519500.

A total of 590 Path 1 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. Spawning status was defined as un-spawned (many eggs remaining in the body) or spawned (few or no eggs remaining). Of the 590 female Chinook salmon carcasses examined, 536 females (90.8%) were found to have spawned, and 54 females (9.2%) were identified as un-spawned.

In 2014 the CJS mark recapture data collected during the spawning ground survey was analyzed for Reaches 1-6 only. The basin estimate was derived by adding the CJS estimate generated from Reaches 1-6 to the total number of Chinook observed passing through the counting facility plus the total estimated from the redd only section of Reach 3. The CJS point estimate and 95% CI for Reaches 1-6 was 2,908 +/- 215. The total Chinook salmon run size estimate (based on summing the video estimate (9,476), the CJS point estimate from Reaches 1-6 below the weir (2,908) and the redd estimate (87)) was 12,471 fish. Based on scale age analysis, adults comprised approximately 83.5% (10,419 fish) and grilse comprised 16.5% (2,051 fish) of the run (KRTAT 2015).

Table 2. Specific dates and times during the 2014 season when filming stopped and re-started, the number of hours without data and the number of Chinook, coho, and steelhead estimated during that time.

	Date	Time	Number of hours : minutes without data	Number of Chinook estimated	Number of Coho estimated	Number of Steelhead estimated
Filming Stopped	10/26/2014	0000	24 : 0	1054	14	22
Filming Started	10/27/2014	0000	0 : 0	0	0	0
Filming Stopped	11/2/2014	1945	4 : 15	11	0	1
Filming Started	11/3/2014	0830	8 : 30	32	2	3
Filming Stopped	11/22/2014	1500	9 : 0	5	7	9
	11/23/2014		24 : 0	14	35	42
	11/24/2014		24 : 0	16	44	53
Filming Started	11/25/2014	1545	15 : 45	11	16	20
Filming Stopped	12/3/2014	1045	1 : 15	0	0	0
Filming Started	12/4/2014	1000	10 : 00	1	2	26
Totals				1144	120	176

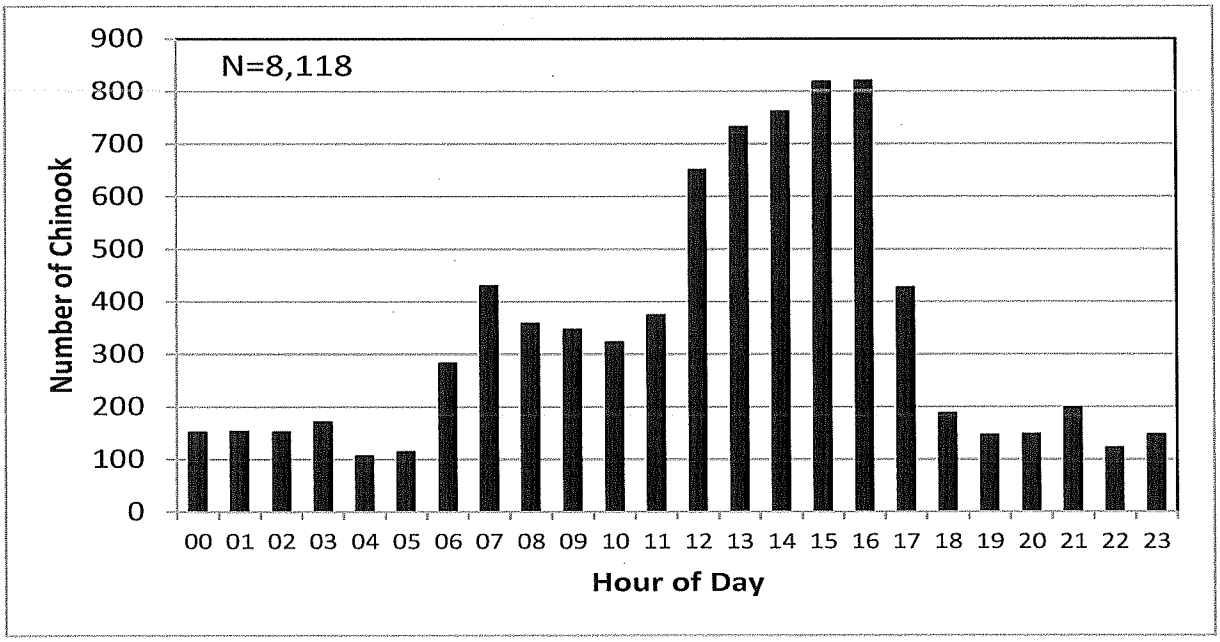

Figure 5. Summary of daily run timing of Chinook salmon observed at the SRFC during 2014 (N=8,118).

Table 3. Estimated contribution of hatchery origin fall Chinook salmon in Scott River 2014.

Spawning Ground Surveys									
Coded Wire Tag	Location	Release Type	Brood Year	Age	Sample Number	Production Multiplier	Production Estimate	Sample Expansion	Total Estimate
68825	TRH	f	2009	5	1	4.02	4	3.84	15
				Sub Total=	1			Sub Total=	15
Estimated contribution of lost CWT's					0			Sub Total=	15
								Total Estimated Hatchery Contribution=	**15**

a/ Release type; Ff=Fall fingerling, Fy=Fall Yearling
b/ Production Multiplier value is the inverse of the proportion of effectivily tagged and total release from IGH

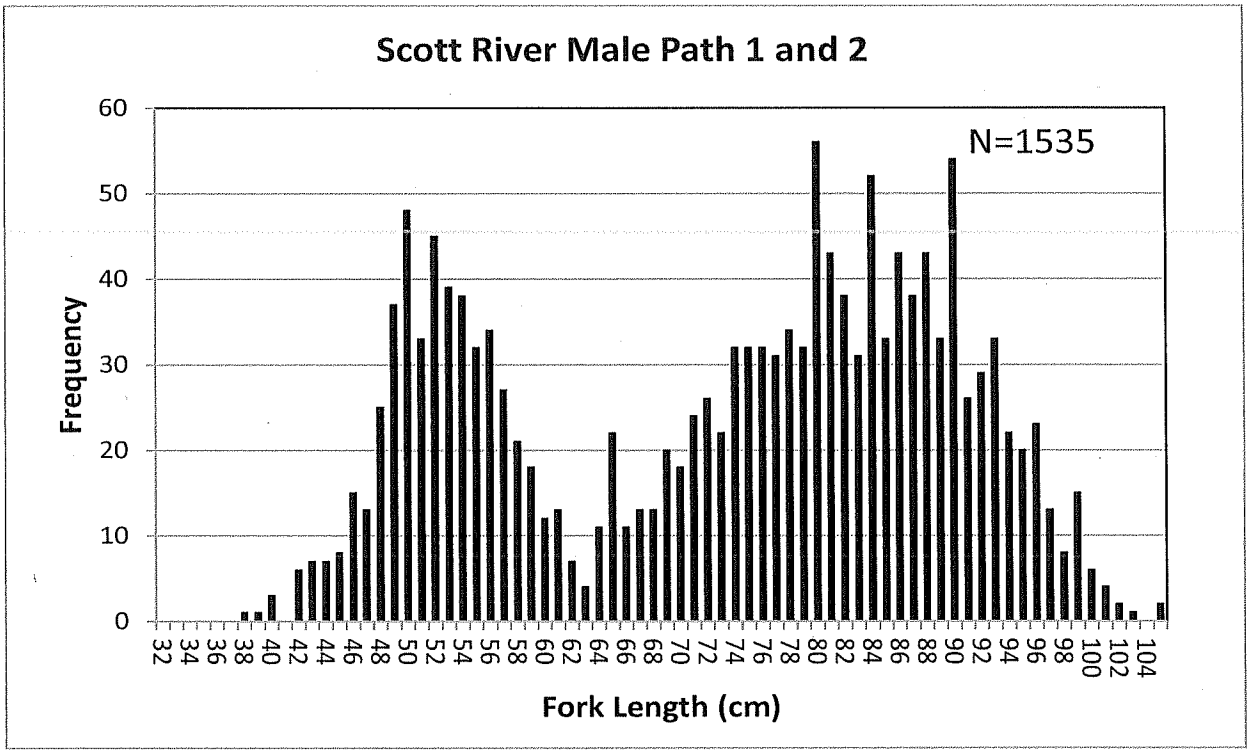

Figure 6. Length Frequency distribution of Path 1 and Path 2 male Chinook salmon observed during spawning ground surveys in the Scott River, 2014 (N=1,535).

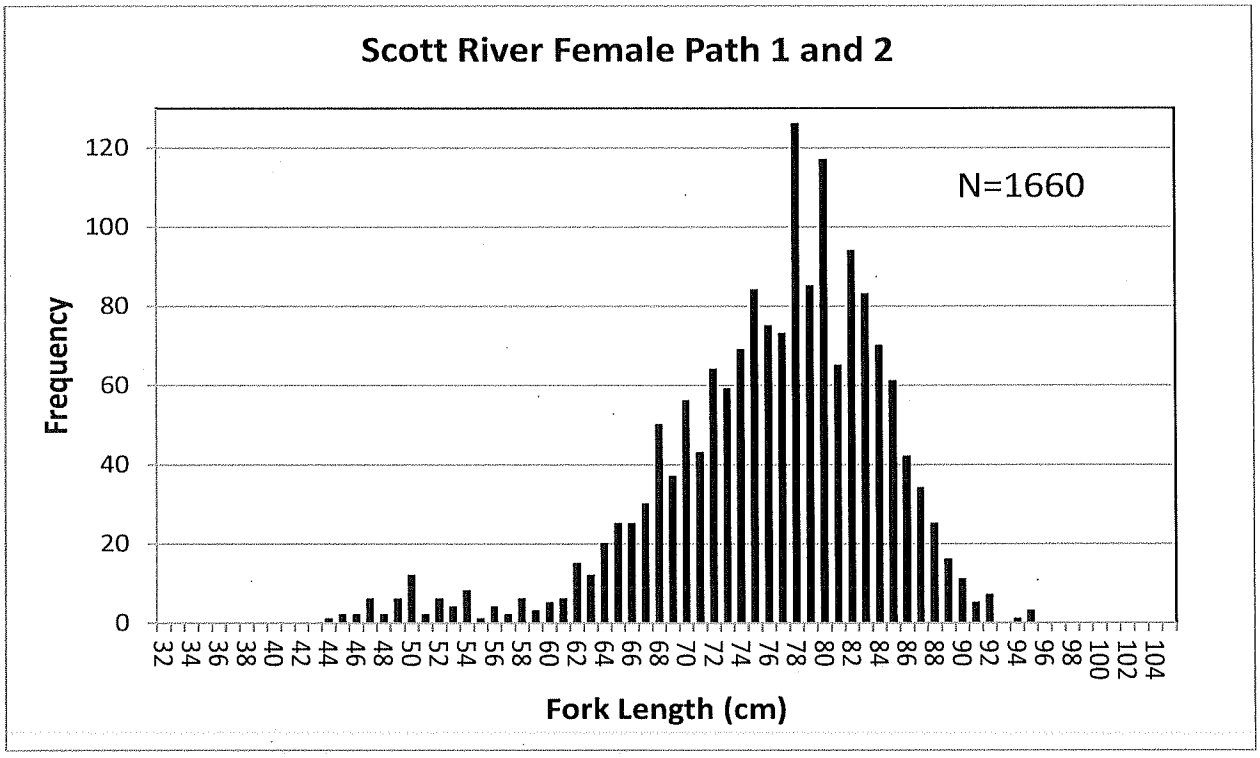

Figure 7. Length frequency distribution of Path 1 and Path 2 female Chinook salmon observed during spawning ground surveys in the Scott River, 2014 (N=1,660).

COHO SALMON

The first adult coho salmon was observed at the counting facility on October 23, 2014, and the last coho salmon was observed on December 6, 2014 (Figure 8). A net total of 361 coho salmon (360 upstream and 1 downstream) were observed moving through the SRFCF during the season. One-hundred twenty (120) additional coho were added for periods of time in which the camera was not functioning properly (Table 2). Adding the net total upstream observations (360) to the estimated number of coho from periods when the camera was not functioning (120) generates a season total estimate of 485. Coho salmon migration peaked during the nine-day period from November 22, 2014, through November 30, 2014, when 322 or 66.4% of the coho were observed. One additional pulse of coho migration was documented from October 23, 2014, through November 1, 2014, when 108 observations were made. During these two pulses which occurred over 19 days, 88.7% of the seasonal total was observed. One coho salmon was observed swimming downstream during the season. During the 2014 season, KRP staff attempted to estimate the number of grilse in the Scott River by enumerating the number of coho observed in the video flume that were shorter or longer than 56cm. Utilizing this method, KRP staff identified 96.9% adults and 3.1% grilse (See the discussion for further information on seasonal estimates of age proportions).

Diel movements of coho salmon through the SRFCF were higher in the morning hours and peaked between 0700 hours and 0800 hours (Figure 9). Unlike previous seasons' observations, migrations were generally higher during the day and decreased from the late afternoon through early morning.

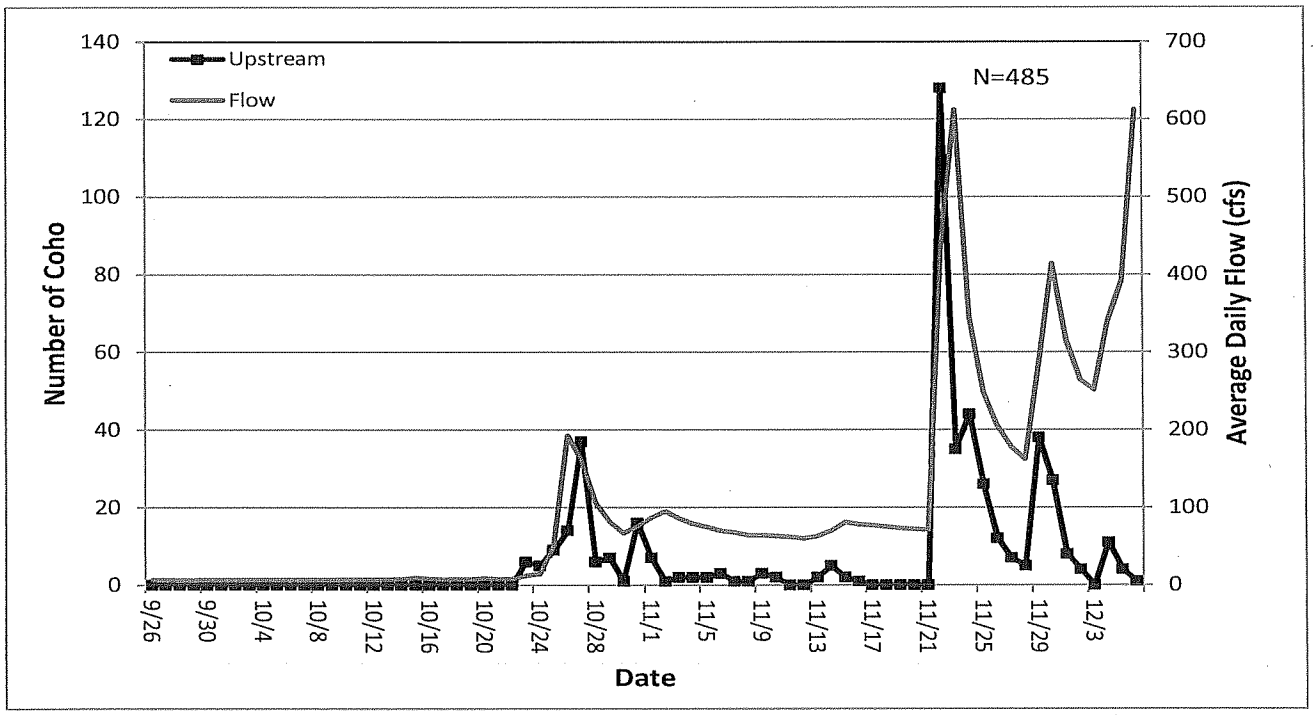

Figure 8. Run timing of coho salmon observed passing through the SRFCF during the 2014 season (N=485), and average daily flows observed at USGS Gauge No. 11519500.

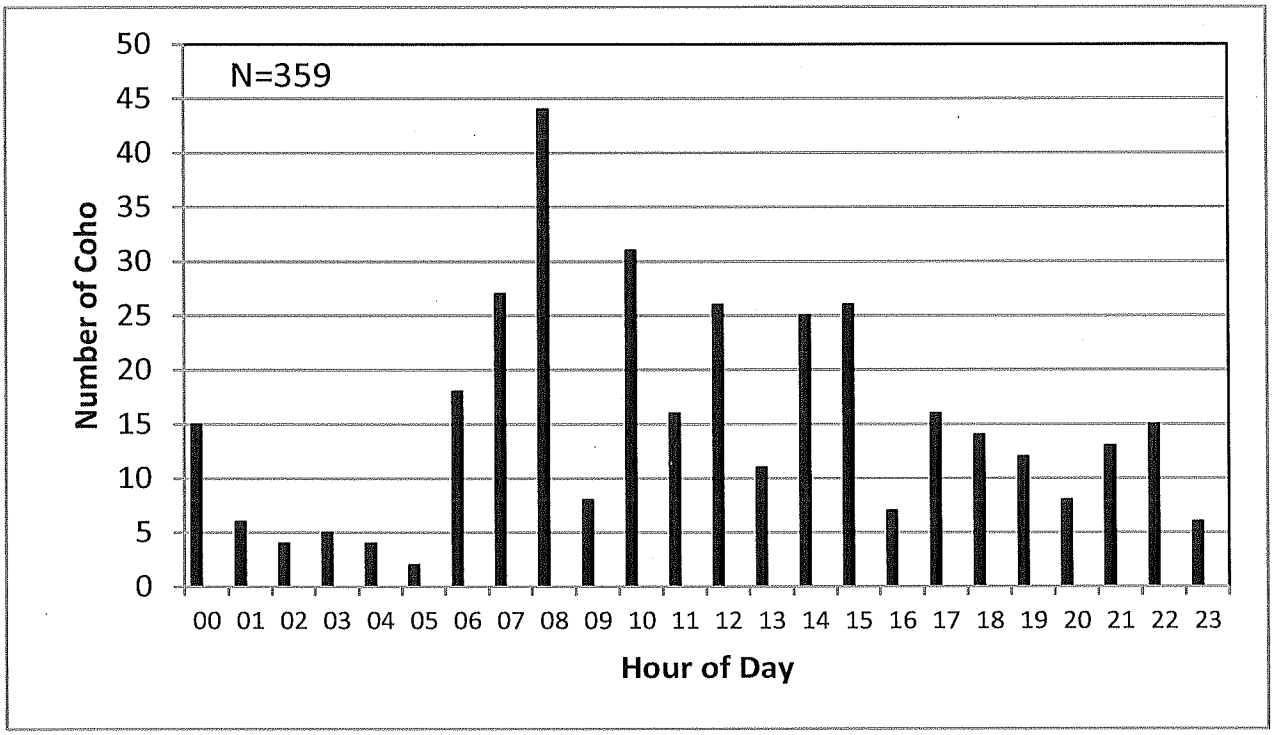

Figure 9. Diel migration patterns of coho salmon observed moving through the SRFCF in 2014 (N=359).

SPAWNING GROUND SURVEYS

One coho carcass was observed during the cooperative spawning ground survey on the main stem Scott River in Reach 12 on November 19, 2014. Eighteen (18) additional coho carcasses were observed in Scott River main stem (Reaches 12 through 16) and tributaries during surveys coordinated by the Siskiyou Resource Conservation District (SRCD) (Magranet, 2015). No coho carcasses were collected as wash backs at the counting facility (Figure 10). Utilizing all of the recoveries throughout all areas, the sex ratio of observed coho salmon carcasses in the Scott River during 2014 was 36.8% (178) female and 63.2% (307) male. None of the 19 coho carcasses examined had a maxillary clip resulting in an estimated hatchery composition of zero. Based on the FL frequency distribution of the carcasses measured during the season, a maximum grilse FL was established at <58cm. Applying the maximum grilse FL cutoff to the total number of measured carcass recoveries generated an age two proportion of 21.1% and an age three proportion of 78.9%. All of the carcasses examined were sampled for tissue and collected samples were supplied to the NOAA Southwest Fisheries Science Center located in Santa Cruz, California for stock identification purposes. Coho redds were not observed in Canyon Creek, Kelsey Creek or Tompkins Creek.

A total of 485 coho salmon were estimated moving upstream through the SRFCF during the season. Additionally, zero coho redds were observed in areas below the counting facility resulting in no additional coho downstream of the counting station. Therefore, the total number of estimated coho salmon that entered the Scott River during the 2014-2015 season is **485**. Utilizing the observed age proportions, derived from FL frequency of sampled carcasses, the resulting number of age two and age three fish are 102 (21.1%) and 383 (78.9%), respectively.

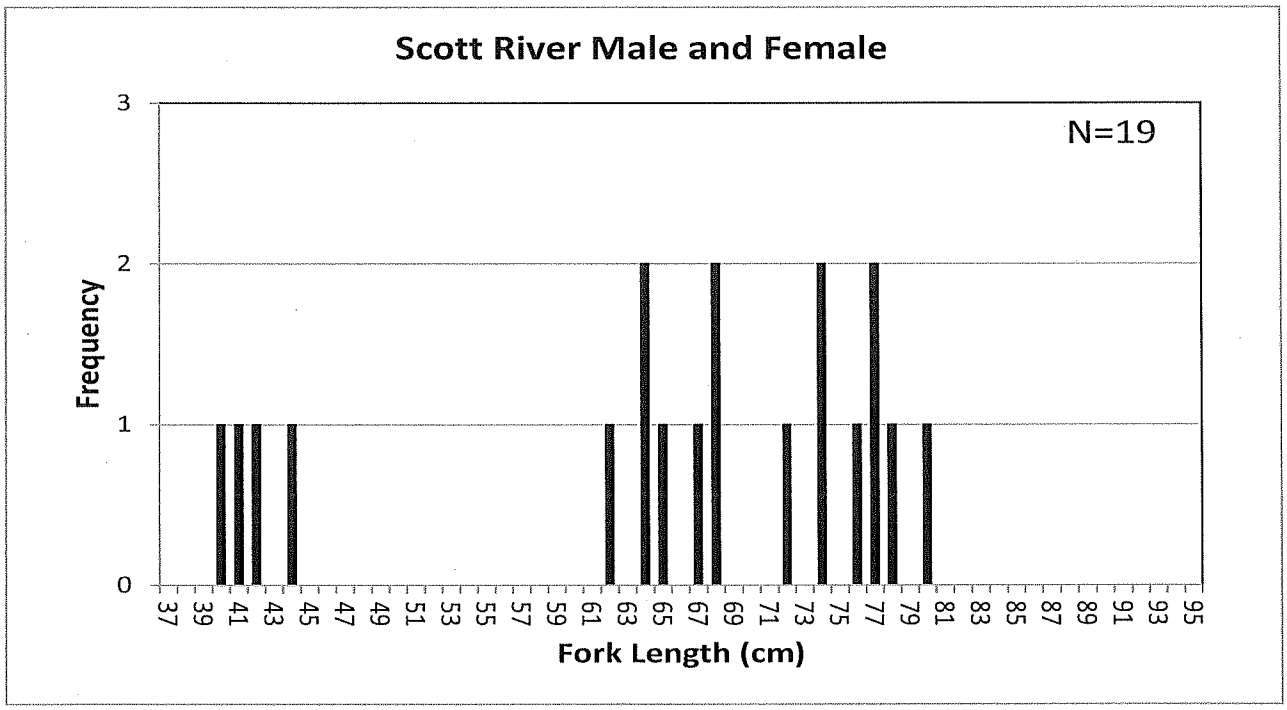

Figure 10. Length frequency distribution of coho salmon observed during cooperative spawning ground surveys (1), SRCD spawning ground surveys (18) and as wash backs (0) on the SRFCF, during the 2014-2015 spawning season (N=19).

STEELHEAD

In 2014, a net total of 917 adult (>16") steelhead (Figure 11) were estimated to have entered and remained in the Scott River during the video recording season from September 30, 2014, to December 6, 2014. The peak of migration for adult steelhead was observed from November 22, 2014, through December 6, 2014, in association with an increase in flow (Figure 11) when 75.1% (689 fish) of the season's steelhead were observed. Lines on the back of the video flume were set at 16 inches (40.64cm) to delineate sub-adults versus adults. The 2014 season was the fifth year that lines delineating adult steelhead and sub-adult steelhead were used.

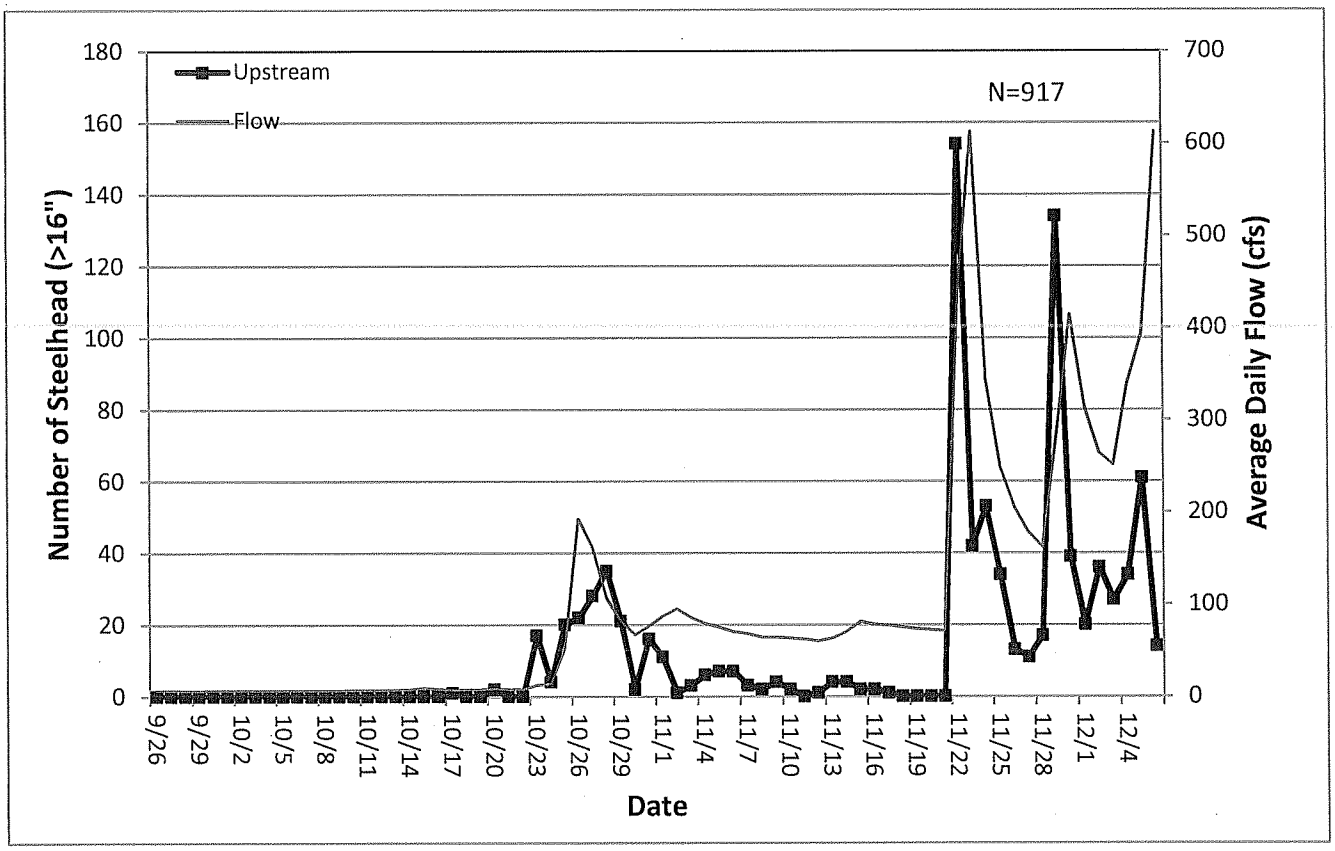

Figure 11. Run timing of steelhead trout (>16") observed passing through the SRFCF during the 2014 season (N=917), and average daily flows observed at USGS Gauge No. 11519500.

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 5,502 fish (Figure 12). The 2014 Chinook salmon run in the Scott River ranks second (12,470 fish) out of 37 years of monitoring. The 2014 run was 126.6% higher than the 37 year average. A total of 9,476 Chinook salmon were estimated to have passed through the SRFCF during the 2014 season. A total of 2,908 +/-215 (95% CI) Chinook salmon carcasses were estimated in reach 1 through reach 6, and an additional 87 Chinook were estimated from single pass redd survey in a 0.5 mile section of Reach 3 yielding a total run size estimate of 12,471 Chinook salmon. During the 2014 season, the CJS mark-

recapture estimator was utilized for areas downstream of the SRFCF, and as a result, only the total estimate and not subarea estimates are available upstream of the counting station. Table 4 presents the various sub basin proportions of the Chinook distribution for years 2008-2014 and identifies the importance of the entire watershed to Chinook salmon. From 2008 through 2014, an average of 76% of the Chinook run spawned upstream of the counting station (Reaches 7 through 16). The addition of the fish counting facility has allowed for an accurate estimation of Chinook utilization of spawning habitat in the valley Reaches without having to conduct spawning ground surveys in these reaches.

Table 4. Scott River Chinook salmon abundance estimates by area and percentages of the total above and below the Counting Station during the 2008-2014 seasons.

Year	Downstream of Counting Station	Upstream of Counting Station	% Downstream of Counting Station	% Upstream of Counting Station	Total Basin Estimate
2008	1439	3234	31%	69%	4673
2009	1014	1197	46%	54%	2211
2010	280	2228	11%	89%	2508
2011	983	4538	18%	82%	5521
2012	1208	8144	13%	87%	9352
2013	1252	3372	27%	73%	4624
2014	2995	9476	24%	76%	12471
Average	1310	4598	24%	76%	5909

The Scott River is an important component of the Klamath Basin Chinook runs. The Scott River has contributed an average of 9% of the basin-wide (including Trinity River) natural spawning escapement to the Klamath River during the period from 1978 to 2014 (Table 5). The Scott River Chinook population tracks very similarly to the total Klamath Basin population ($r=0.762$ p-value <0.001) indicating that forces outside the Scott River watershed play an important role in influencing abundance of this population of Chinook (Figure 13). The production of emigrating 0+ Chinook has been estimated in the Scott River since Brood Year 1999 (Debrick et al. 2014). The number of 0+ Chinook produced per adult has been calculated for Brood Years 1999 through 2013 and has ranged from a low of 14.4 to a high of 383.0 and averaged 107.8 (Figure 14). As the watershed approaches carrying capacity, the number of 0+ Chinook produced per adult is a direct measure of in-river productivity and as habitat conditions improve or diminish, this measure will reflect those conditions.

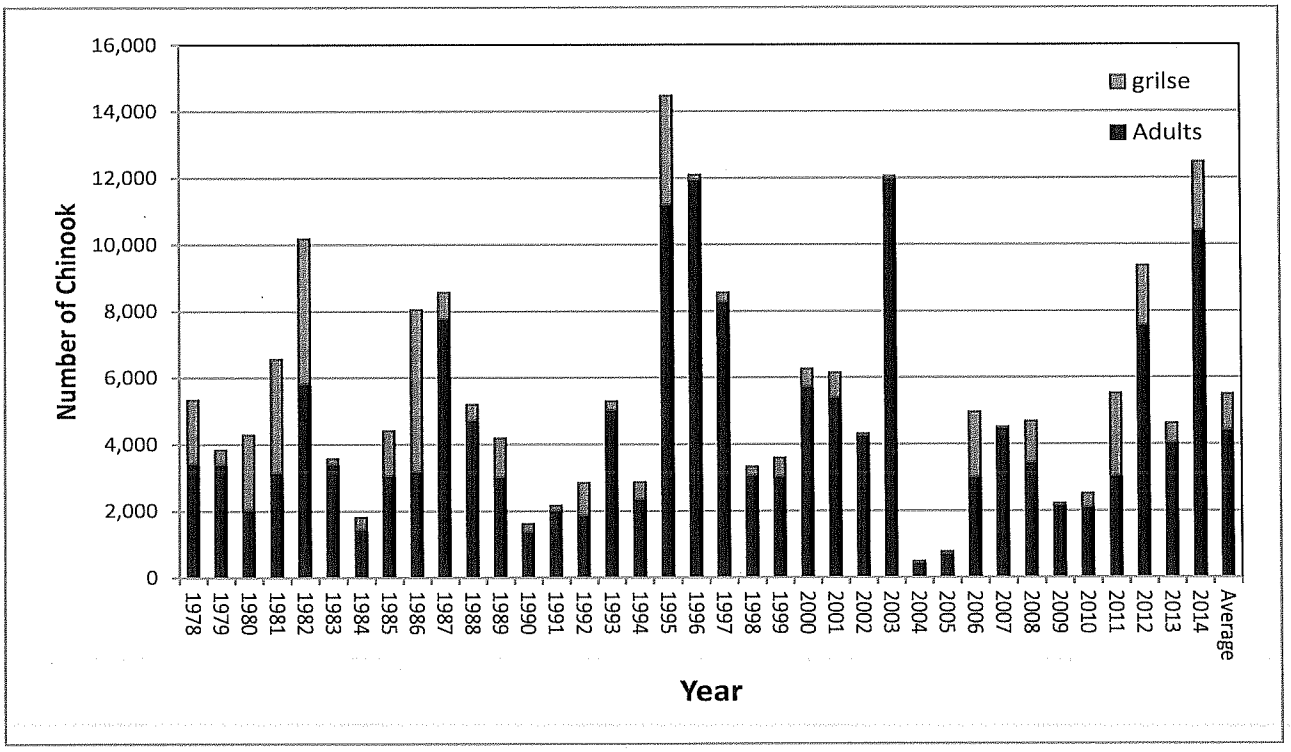

Figure 12. Estimated escapement of Chinook salmon returning to the Scott River from 1978 to 2014.

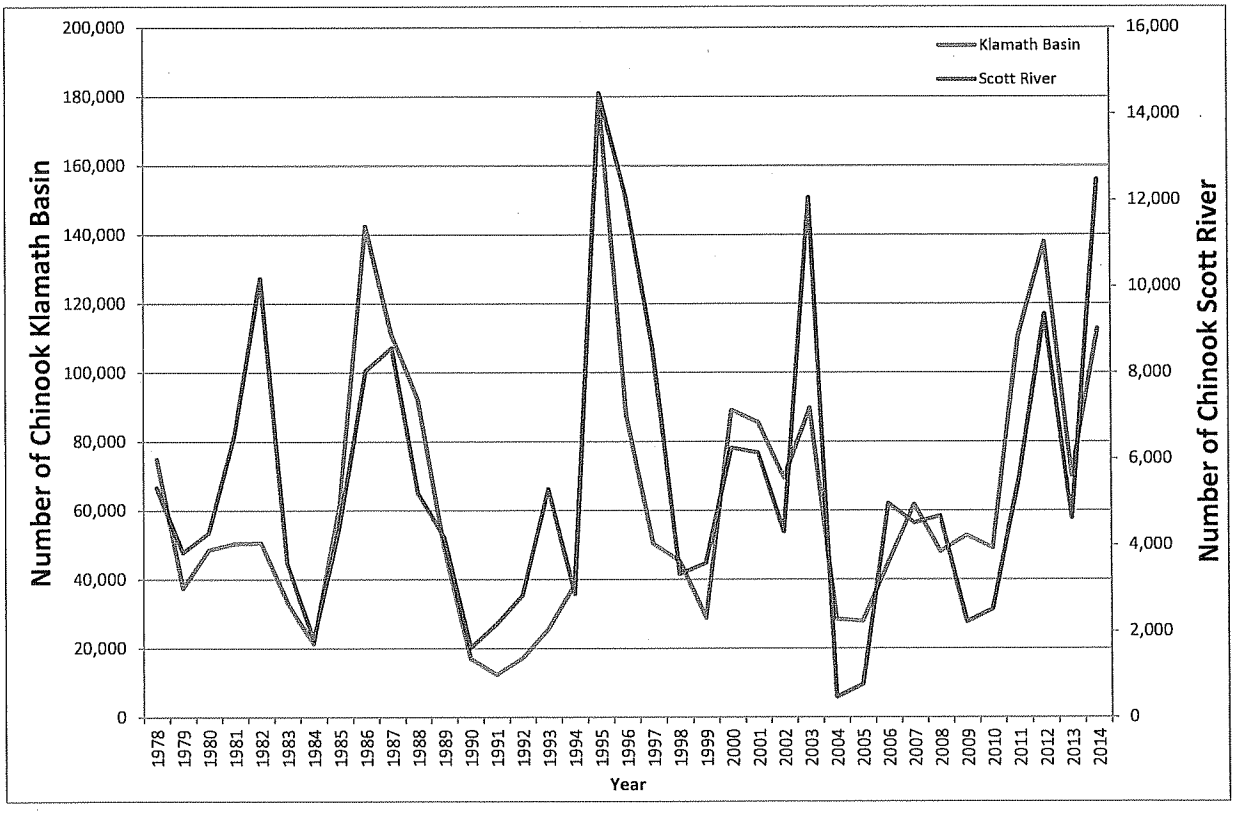

Figure 13. Chinook salmon Klamath Basin natural spawner escapement (primary y-axis) and the Scott River natural spawner escapement (secondary y-axis) from 1978 through 2014.

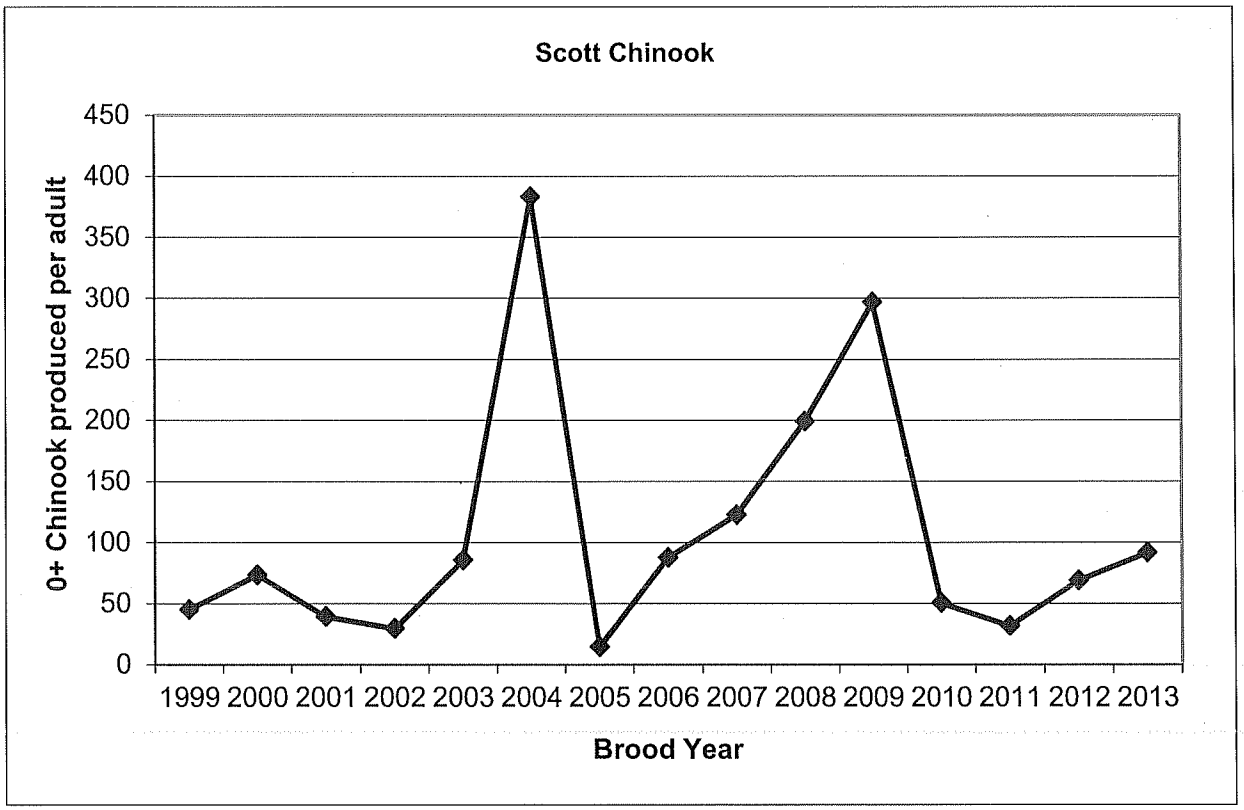

Figure 14. Number of 0+ Chinook produced per adult spawner in the Scott River by brood year, for Brood Years 1999-2013.

Table 5. Klamath Basin and Scott River Chinook natural spawner escapements (age 2-5), 1978-2014.

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%
2010	49,027	2,508	5%
2011	110,554	5,521	5%
2012	137,724	9,352	7%
2013	69,986	4,624	7%
2014	112,599	12,470	11%
Average	**63,565**	**5,502**	**9%**

COHO SALMON

Since video operations began in 2007 the estimated escapement of coho salmon in the Scott River has ranged from a low of 63 to a high of 2,752 and averaged 811 (Figure 15). The adult run size of coho salmon prior to 2007 is unknown and with the addition of the counting facility the Department's ability to monitor this ESA-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 2014 indicates significant variation in brood year strength (Debrick et al. 2014). Results of the first eight years of adult monitoring at the SRFCF support this observation. The cohort that returned in 2014 is the second strongest cohort in the Scott River. In one generation, the 2014 coho salmon

returns of 485 increased 36.6% when compared to 2011 returns of 355, an increase in brood year strength of 130 fish. It is very encouraging that over the past four seasons a positive growth rate for Scott River coho salmon has been observed. It should be noted that the 2014 monitoring season ended prior to the end of the coho migration and the 2014 estimate is believed to underestimate the actual run size. Even though the 2014 estimated run size is likely low, 485 adult coho were observed indicating that the abundance of this brood year is increasing. In an effort to evaluate the magnitude of the underestimate of the 2014 coho run due to the removal of the counting station prior to the end of the adult migration, the observed average smolt survival of 5.99% (Brood Years 2004-2008 and 2010-2011) was applied to the yearling point estimate of 7,927 from 2013 which yields a predicted 2014 estimated return of 475. The observed number of coho (485) is 10 greater than the predicted number of returns (475) providing some evidence that if adults were missed at the tail end of the migratory window due to removing the counting facility, it was likely very few.

The estimated proportion of hatchery origin coho in the Scott River during 2014 has been estimated two independent ways, first through the recovery of carcasses during spawning ground survey efforts and second through clip identification of images collected at the video weir. Both the spawning ground survey data and video data produced hatchery proportions of zero. The sample sizes that the spawning ground survey and video data relied on were 19 and 359, respectively. Due to the significantly larger sample size available from video data, the estimated proportion of hatchery origin coho in the Scott River during the 2014 season has been estimated using the video data and is estimated to be 0.0%.

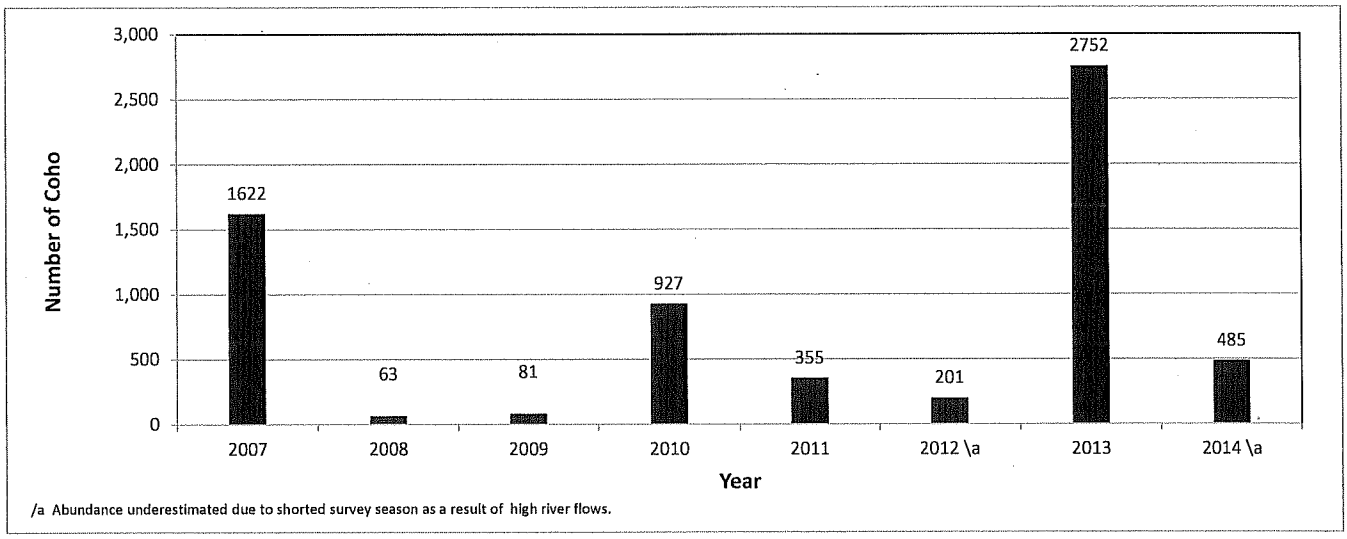

Figure 15. Estimated escapement of adult and grilse coho salmon (age 2 and age 3) returning to the Scott River from 2007 to 2014.

Utilizing the number of coho smolts produced in the Scott River (Debrick et al. 2014) and the results of the adult abundance estimates allows for analysis of Scott River freshwater production and out-of-basin survival by brood year. For Brood Years 2004 to 2008 and 2010 and 2011, the out-of-basin survival has averaged 5.99 percent and ranged from a low of 1.47 percent to a high of 16.47 percent (Table 6). Due to the extremely high observed percent smolt survival of 71.64 for Brood Year 2009, data from this brood year has been omitted from this analysis. It is possible that the smolt estimate generated for brood year 2009

underestimated the actual number of out migrants. Although the proportion of smolts 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 6. Coho smolt outmigrant abundance point estimates, age 2 and age 3 coho abundance estimates, and proportion of outmigrant smolts that returned by brood year for the Scott River, Brood Years 2004-2011.

Brood Year	Smolt Year	Smolt point Estimate	Age 3 Return Year	Age 2 Return	Age 3 Return	Age 2 and 3 Return	Percent smolt survival
2004	2006	75097	2007	0	1622	1622	2.16
2005	2007	3931	2008	0	63	63	1.60
2006	2008	941	2009	0	81	81	8.61
2007	2009	62207	2010	0	913	913	1.47
2008	2010	2174	2011	14	344	358	16.47
2009	2011	275	2012	11	186	197	71.64
2010	2012	50315	2013	13	2631	2644	5.25
2011	2013	7927	2014	121	383	504	6.36

Analyzing the comparisons of coho smolt production estimates to estimated female adult coho returns produces freshwater survival estimates in the form of coho smolts produced per adult female return. For Brood Years 2007 through 2012, the number of coho smolts produced per returning adult female has ranged from a low of 6.71 to a high of 78.62 and has averaged 56.43 (Table 7). Due to the difficulty in estimating abundance of outmigrants at low abundance levels, it is unclear if the smolts produced per adult female ratio generated for Brood Year 2009 are a result of decreased freshwater productivity or a result of sampling difficulty. As additional years of data become available, the freshwater production of coho salmon in the Scott River can be further evaluated. The number of smolts produced per returning adult female by brood year is a direct measure of freshwater survival. For levels below carrying capacity, it can be stated that as the number of smolts produced per returning adult female increases, it can be inferred that in-river conditions for coho salmon are improving. Conversely as the number of smolts produced per returning adult female decreases it can be inferred that in-river conditions for coho salmon are getting worse. The number of smolts produced per returning adult is influenced by inter-annual variation in sex ratios and age structure, and these variables have been accounted for in this analysis.

Table 7. Adult coho estimate, coho smolt production point estimate, and ratio of coho smolts produced per adult female return for the Scott River, Brood Years 2007 through 2012.

Adult Year Brood Year	Adult Estimate	Adult Female Estimate	Smolt Year	Smolt point Estimate	Smolts produced per Female
2007	1622	860	2009	62207	72.33
2008	63	32	2010	2174	67.94
2009	81	41	2011	275	6.71
2010	927	640	2012	50315	78.62
2011	355	170	2013	7927	46.63
2012	201	86	2014	5708	66.37
				Average	**56.43**

STEELHEAD

The number of returning adult steelhead has been monitored at the SRFCF beginning in 2007. During the 2007 through 2009 seasons an unknown number of subadult steelhead may have been counted as adults. Starting in 2010 lines on the back of the video flume were set at 16 inches (40.64cm) to delineate sub-adults versus adults. Since this time, the number of steelhead >16" observed in the Scott River has been 419, 251, 164, 119 and 917 for 2010, 2011, 2012, 2013 and 2014, respectively (Figure 16). From 2007 to present, the number of observed adult steelhead has ranged from a high of 917 to a low of 119 with an average of 303. The run size of adult steelhead prior to 2007 is unknown and with the addition of the counting facility, the Department's ability to monitor this run has greatly improved. Although recent adult run size data is sparse on the Scott River, monitoring of the juvenile emigration has taken place since 2003. It is believed that the majority of adult steelhead migration occurs outside the operational window of the SRFCF. Therefore, the number of observed steelhead should be considered minimum number of returns and not basin estimates. The use of a DIDSON camera in the Scott River after the end of the coho migration may add in the Department's ability to monitor the steelhead migration.

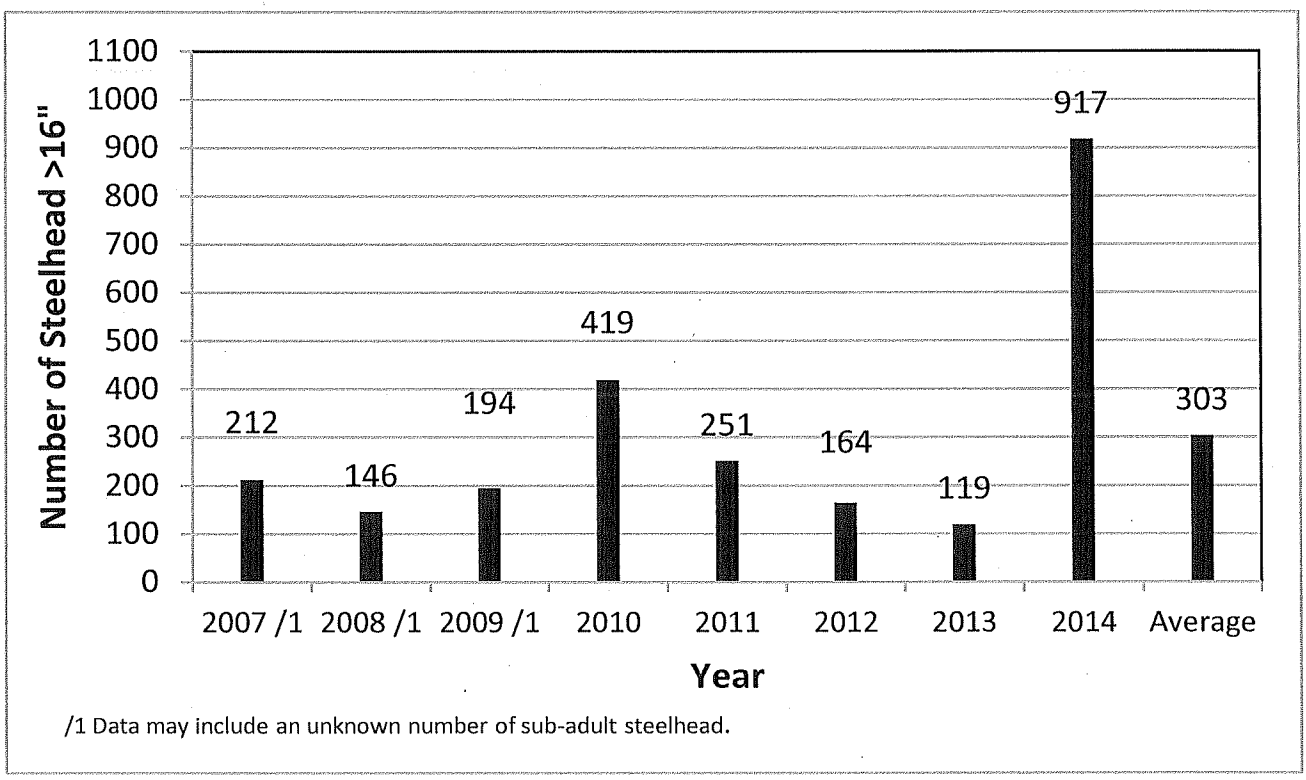

Figure 16. Number of observed Steelhead >16" at the SRFCF from 2007 to 2014.

ACKNOWLEDGEMENTS

The California Department of Fish and Wildlife would like to thank Sport Fish Restoration Fund for their financial assistance in the operation of the SRFCF during 2014. The cooperative spawning ground surveys would not be possible without the assistance of the U.S. Fish and Wildlife Service Yreka office, and the USFS. Additionally, this work would not be possible without the cooperation and participation of the SRCD, Karuk Tribe, Quartz Valley Tribe, USFS, Northern California Resource Center, Americorps, and Etna High School, who assisted in completing spawning ground surveys on the Scott River. We would also like to express our appreciation to the various landowners who have provided permission to access the Scott River on their lands. The Department also thanks Klamath National Forest for providing funding to the SRCD to conduct coho surveys and sends thanks to the SRCD for making their data available for this report.

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Appendix 1. Summary of surveys conducted in the Scott River watershed during the 2014 spawning season by date and by reach.

	Reach																		
Survey lead	CDFW	CDFW	CDFW	CDFW	CDFW	CDFW	CDFW	CDFW	SRCD	SRCD	SRCD	SRCD	SRCD	CDFW	CDFW	CDFW	SRCD	SRCD	SRCD
Survey Date	1	2	3	4	5	6	7	8	12	13	14	15	16 (lower)	Canyon Creek	Kelsey Creek	Tompkins Creek	French (lower)	Shackelford (lower)	Mill
10/13/2014	1	1	1	1	1	1													
10/16/2014	1	1	1	1	1	1	1	1											
10/20/2014	1	1	1	1	1	1	1	1											
10/21/2014						1									1				
10/23/2014	1	1	1	1		1	1	1											
10/27/2014	1	1	1	1	1	1		1											
10/28/2014									1	1	1	1							
10/30/2014	1	1	1	1	1			1	1	1	1	1							
11/3/2014	1	1		1	1	1	1	1	1	1	1	1							
11/6/2014	1	1	1	1	1	1		1	1	1		1							
11/7/2014											1								
11/10/2014	1	1		1	1	1	1	1	1	1	1								
11/11/2014												1							
11/12/2014									1	1			1						
11/13/2014	1	1	1	1	1	1													
11/14/2014												1					1		
11/15/2014											1								
11/17/2014	1	1		1	1	1			1	1			1						
11/18/2014													1						
11/19/2014						1			1	1				1	1				
11/20/2014	1	1	1	1	1	1					1	1							
11/21/2014													1						
11/24/2014									1	1									
11/26/2014	1		1	1	1	1												1	1
11/28/2014																	1		
12/1/2014						1					1	1		1	1				
12/2/2014													1						
12/4/2014																1			
12/15/2014														1	1				
12/16/2014																1			
12/30/2014														1	1	1			