Stanislaus River Fall Chinook Salmon Escapement Survey 2004

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Introduction

San Joaquin River fall-run chinook salmon are currently a candidate species under the Federal Endangered Species Act. Population levels in the Stanislaus River, a tributary to the San Joaquin River, have declined in the past 50 years from approximately 35,000 returning adults in 1953 to a low of 160 in 1996 (Heyne, 2000). Escapement estimates for the past 5 years have ranged from a low of approximately 3,150 in 1998 to a high of approximately 8,500 in 2000 (Marston et al., 2002). The decline of the species can be attributed to many factors. In general, reduction of spawning and rearing habitat and stream flow management practices, are thought to be major factors limiting overall population numbers. Numerous additional factors including but not limited to predation, streambed alteration, pump diversions, gravel mining, land use practices, and ocean angler harvest contribute to a web of complex population dynamics which effect population numbers within the habitat currently available to Stanislaus River chinook salmon.

The California Department of Fish and Game (CDFG) has conducted escapement surveys on the Stanislaus River since 1953. The Schaefer mark recapture escapement estimation model (1951) has been utilized since 1971. Philip Law (1994) determined the Jolly-Seber model (1973) yielded a more accurate population estimate over all variable ranges when compared with the Schaefer model. The 2004 escapement survey was analyzed using both the Jolly-Seber and Schaefer models.

The current objectives of the Stanislaus River escapement surveys are:

- Estimate the escapement of fall-run chinook salmon on the Stanislaus River.
- Evaluate the distribution of salmon redds throughout the study area.
- Collect fork-length and sex data.
- Collect scale and otolith samples with which to conduct age determination and subsequent cohort analysis.
- Collect DNA samples for storage at the CDFG Salmonid Tissue Archive for subsequent genetic analysis.
- Collect and analyze coded wire tag data from marked hatchery fish to determine escapement contribution of hatchery produced salmon, and evaluate smolt survival.

Study Area

The 2004 Stanislaus River escapement survey covered a 25-mile reach beginning at river mile (RM) 58, and continuing downstream to Riverbank (RM 33). The survey is divided up into four sections, with section 1 being the upstream most reach. Section 1 begins below Goodwin Dam (RM 58) and extends downstream to Knight’s Ferry (RM 55) and includes riffles A1 thru C2. Section 2 begins at Knight’s Ferry (RM 55) and continues downstream to Horseshoe Road Recreation Area (RM 50.5) and includes riffles E1 thru J2. Section 3 begins at Horseshoe Road Recreation Area (RM 50.5) and continues downstream to the Oakdale Recreation Area (RM 39.5) and includes riffles J3 thru T4. Section 4 begins at the Oakdale Recreation Area (RM 39.5) and continues downstream to Jacob Myers Park (RM 33) and includes riffles U1 thru Z2.

All riffles in the study area have been geo-referenced using a Trimble GPS TDC1 and mapped with the GIS computer program Arc View. In 2001, each riffle within the entire four section spawning reach was systematically re-named using sequential letter/number designations for river mile and riffle respectively. For example, the first riffle immediately below Goodwin Dam is named A1. Each letter designates a different river mile length (riffle A= RM 58, riffle B= RM 57 etc.). This numbering system is a departure from the historical riffle numbering system. However, the new riffle identification system is more logical and is more conducive to editing as river morphology changes.

In 2004, each riffle within the study reach was mapped prior to the spawning season. These updated riffle numbers, and river mile, are located in Table 1 and are cross-referenced with the 2002 riffle numbers. Riffle cross-reference for the historical cross-referencing system can be found in the 2001 and 2002 Stanislaus River escapement reports

Methods

Population Estimation

Both the Schaefer (1951) and Jolly-Seber (1973) mark-recapture method were used to estimate fall-run escapement on the Stanislaus River. Under this scheme, carcasses are marked and subsequently recovered during weekly surveys of the spawning reach. A ratio of recoveries to total fish counted (handled) is used to calculate weekly population estimates, which are then summed to estimate the total spawning population. Total fish counted (handled) includes total fish tagged, skeletons, and fresh recoveries by week. The CDFG survey began on October 4, 2004 (Week 1) and concluded on January 5, 2005 (Week 14). Carcasses were tagged for the first 12 weeks and weeks 13 and 14 were limited to the recovery of carcasses. During the two recovery weeks (weeks 13 and 14), carcasses were collected, examined for jaw tags and chopped in half. During this period, all untagged fish were chopped and counted as skeletons.

Weekly drift boat surveys were conducted in sections 2, 3, and 4 using a three person crew. All visible carcasses were collected from each riffle and pool immediately below. Multiple passes were made through each pool to ensure that the entire area of that pool was examined. Every carcass handled was designated as fresh, decayed, skeleton, or recovery depending on the degree of decomposition or the presence of an aluminum jaw tag in the case of recoveries. The fresh carcass designation criteria during 2004 were at least one clear eye and the presence of blood remaining in the gills (Figures 1 and 2). Decayed fish had cloudy eyes and no blood in the gills. Skeletons were fish judged to be in an advanced state of decay and unlikely to have the same probability of recapture as fresh and decayed specimens. Criteria for skeleton designation during the 2004 survey included the presence of fungus covering the entire body at the freshest end of the skeleton designation (approximately one week) to actual skeleton at the most decayed end (Figure 3 and 4).

All fresh and decayed carcasses were given a unique number by attaching an aluminum head tag to the lower jaw. These newly tagged carcasses were redistributed to river current near the lower end of the riffle for recovery in subsequent weeks. For tagged recoveries, the unique tag number was noted and the carcass was chopped and returned to the river. All skeletons were enumerated, chopped and returned to the river to avoid double counting.

Section 1 is too dangerous to float by drift boat, therefore this section was surveyed by foot and consisted of a 2 person crew walking to accessible pool and riffle combination areas where carcasses are known to aggregate based upon previous carcass surveys. Retrieved carcasses were enumerated, chopped, and released back into the water to avoid duplicate counting. No effort to conduct a tagged capture/recapture (i.e., Schaefer etc.) survey was initiated. The escapement population estimate for Section 1 consisted of calculating a divisor comprised of the ratio of retrieved tagged carcasses to the total number of carcasses tagged in Sections 2, 3, and 4 (i.e., to determine visible fraction of total carcasses present), then dividing the actual number of fish handled in Section 1 by this divisor.

Weekly Fish Distribution and Redd Counts

Weekly live fish observations and redd counts were conducted during the survey. These counts were conducted for each riffle and pool using the riffle identification system noted earlier. Counts were made using tally counters as the field crews drifted through riffles and pools. Live and redd counts were conducted through the entire fourteen week escapement survey period.

Individual Fish Data Collection

Fork length (to the nearest 0.5 centimeter) and sex data are collected for all tagged carcasses. Scale and genetic samples are collected from a percentage of specimens to determine the size, age, and genetic composition of annual spawning runs. Coded wire tag's (CWT) were collected from hatchery produced (adipose fin clipped) carcasses returning to the Stanislaus River as part of long term survival testing releases of marked outmigrating smolts and to determine incidence of straying from other river systems. CWT specimens are also used to validate scale and otolith age determination work.

Genetic samples; caudal, dorsal, or pectoral fin clips were stored in tris-buffer and delivered to the CDFG Salmonid Tissue Archive at the end of the survey. These samples are being used in an evaluation of the genetic structure of chinook in the Central Valley. Scale samples were collected from both wild and CWT carcasses and are catalogued at the CDFG La Grange Field Office. Coded wire tags and otoliths are collected via removal of the head minus the lower tagged jaw. Extraction and analysis of otoliths and CWT's is conducted by CDFG staff after the spawning season. All fish samples are catalogued by the fish's unique jaw tag number, which allows the samples to be tracked to the specific date and riffle number of collection.

Additionally, in 2004 a study was initiated to determine the occurance of any pre-spawn mortality. All fresh female carcasses were cut open and examined for the presence of remaining eggs. Carcasses were classified as fully spawned, partially spawned, or unspawned.

Results

Escapement Estimate

In Sections 2, 3, and 4 a total of 888 carcasses (503 fresh) were tagged during the 2004 Stanislaus River escapement survey. An additional 851 skeletons were tallied and chopped giving a total of 1,739 individual chinook salmon handled during the escapement survey. Four hundred and sixty-nine tagged carcasses (259 fresh) were recovered for an overall 52.8 % tagged carcass recovery rate, and a fresh tagged carcass recovery rate of 51.5 %. Based on the Schaefer model, using all tagged fish, the 2004 escapement estimate for sections 2 through 4 is 3,458 salmon. The Jolly-Seber model yielded an estimate of 2,787 for sections 2 through 4. Both models utilize the number of recoveries of tagged carcasses, the total number of tagged fish and the total number of carcasses handled each week (Table 2) to generate weekly escapement estimates. Schwarz (1993) shows that the Jolly-Seber model is biased when counts are low (<10) for marks or recoveries in any one week. We had low counts in weeks 1 and 9, so it is believed that the Schaefer model represents a more accurate estimate. The total numbers of carcasses tagged each week and the number of recoveries made in subsequent weeks in relation to tag week are shown in Table 3. Weekly cumulative Schaefer and Jolly-Seber estimates are graphed in Figure 5.

In Section 1, carcasses were not recovered so the Schaefer and Jolly-Seber models could not be used to generate an estimate. For this section, a simple expansion estimate was made based on the number of fish handled (322 fish) and the recovery rate for the lower sections (52.8%). The resulting estimate was 610 fish in Section 1. Combining the Schaefer estimate for Sections 2 through 4, using all tagged fish, with the Section 1 estimate yields a grand total of **4,068** fall-run chinook salmon spawning in the Stanislaus River in 2004.

Live Salmon, Redd, and Carcass Counts

Weekly live fish observations increased steadily and peaked in week 6, with 1,487 live fish being observed, then sharply declined after week 7. Redd counts peaked in week 7 with a high of 1,379 redds counted (Table 4 and Figure 6). The number of live fish, redds, and tagged carcasses observed by week are graphed in Figure 7. The maximum number of redds counted for individual riffles is presented in Table 5. The highest concentration of spawning (119 redds per river mile) occurred within Section 2. Sections 1 and 3 had approximately 95 and 52 redds per river mile respectively, and Section 4 had 22 redds per mile (Figure 8).

Population Composition
Coded wire tagged fish comprised 8% of the total tagged carcasses based on the ratio of adipose clipped fish to total tagged carcasses (Table 2). Skeletons were not checked for adipose fin clips due to their advanced state of decomposition. However, it is likely that ratios calculated for tagged fish are representative for skeletons as well. The total contributions (tagged fish only) to the spawning population were 37% for natural males, 3% for CWT males, 55% for natural females, and 5% for CWT females (Figure 9).

A total of 81 heads were collected from adipose fin clipped fish during the escapement survey, CWTs were found in 74 of these heads. An additional five adipose fin clipped fish were collected by S.P. Cramer staff at the Stanislaus River Weir. CWT verification and tag reading showed that 58.2% of CWT fish were out of basin orgin (52% Mokelumne, 5% Nimbus, and 1.2% Feather). The remaining 41.8% of CWT fish were Merced River Hatchery origin; with 34.2% being VAMP study fish, 6.3% Stanislaus Survival, and 1.3% Tuolumne Survival. Appendix 1 shows the results of all CWTs that were recovered on the Stanislaus River during the 2004 study period.

Length frequency histograms of male and female (both natural and CWT) display bimodal peaks (Figures 10, 11, 12, and 13). The first peaks are likely grilse (age 1 and 2) and the second peaks are likely adults (age 3, 4, and 5). Because the histograms display overlap between age groups, separation of cohorts will be determined upon completion of age determination studies (CWT, scale, and otolith analysis).

Based on the San Joaquin River Basin length frequency histograms, the 2004 breakpoint between grilse and adults were as follows; natural males 74 cm, CWT males 70 cm, natural females 66 cm, and CWT females 63 cm. Grilse accounted for 30% of the total tagged fish. This is up from 2003, when 13.9% of the tagged fish were grilse. The grilse and adult compositions for all handled fish are provided in Table 6.

Sample Collection
Scales, otolith, and DNA samples were collected from both natural and adipose fin clipped fish throughout the survey period and survey area (Tables 7, 8, and 9). Distribution of sampling is intended to best represent the spawning population over time, space, and origin. One hundred DNA samples were collected by CDFG staff and delivered to the CDFG Salmonid Tissue Archive. Scale and otolith samples will be utilized in the CDFG age determination program and for subsequent cohort analysis of the San Joaquin River Basin chinook salmon populations.

Pre-Spawn Mortality Evaluation
A total of 354 fresh female carcasses were examined in order to determine the level of pre-spawn mortality in the Stanislaus River. A total of 10 fish were found to be partially spawned, and 6 fish were classified as unspawned. This represents 2.8% of examined fish that were partially spawned, and 1.7% that were unspawned. All of these unspawned fish were found in weeks 6 and 7, when live and redd counts were at there highest. This suggests that pre-spawn mortality on the Stanislaus River is most likely density dependent.

Egg Production Estimation

An estimate for the number of eggs produced by the 2004 fall run was generated using a standard regression equation (158.45 * fork length cm – 6138.91= number of eggs). This fork length-fecundity relationship was determined for 48 San Joaquin fall-run chinook salmon females ranging from 62.5 to 94.0 cm fork length (Loudermilk et al. 1990). In the 2004 Stanislaus River escapement survey, the number of eggs was calculated for the expanded natural (n=2237) and CWT (n=203) female population, based on the Schaefer estimate. The number of natural female carcasses collected was 616 with an average egg production of 5,534 eggs per female. The number of CWT female carcasses collected was 50 with an average egg production of 5,615 eggs per female. Expanding the total egg production for the Stanislaus River in 2004 using the egg production regression equation yields a total of 13,524,072 eggs based on the Schaefer population estimate, with 12,381,999 produced by natural females and 1,142,073 produced by CWT females.

Stanislaus River Flows

Stanislaus River flows for the period of October 1, 2004 through January 15, 2005 are shown in Figure 14 (preliminary data obtained from the California Data Exchange Center). River flows recorded at Orange Blossom Bridge (OBB) and Goodwin Dam (GDW) are reported, because the OBB gauge does not accurately record high flow events. A pulse flow (attraction flow) was initiated on October 25, for five days with a maximum flow of approximately 800 cubic feet per second (cfs) released over Goodwin Dam. The purpose of fall pulse flows, occurring in the Stanislaus and other San Joaquin River tributaries is threefold: 1) attract salmon into the Stanislaus River from the San Joaquin River; 2) cool water temperatures in the lower reaches of both the Stanislaus and San Joaquin River; and 3) improve oxygen conditions in the Stockton Deep Water Ship Channel. Spawning period flows in the Stanislaus River, OBB gauge, ranged from 280 cfs to 650 cfs from November 1, 2004 through December 31, 2004.

Stanislaus River Temperature

Water temperature in the Stanislaus River was recorded at several locations in 2004. Water temperatures are monitored at various locations within the New Melones Reservoir Complex (i.e., Melones, Tulloch, and Goodwin), as well as in seven locations within the lower Stanislaus River between Goodwin Dam and the confluence with the San Joaquin River. In-river water temperature data is recorded on an hourly basis and the average daily water temperature for three stations (Knights Ferry, Orange Blossom Bridge, and Oakdale Recreation Area) are presented in Figure 15.

Discussion

Population Estimate

The 2004 Stanislaus River escapement Schaefer estimate using all tagged fish was 4,068. This is down from the 2003 estimate of 5,902 (Guignard, 2004). River conditions and water clarity were ideal for carcass recovery, live counts, and redd counts until December 29, 2004 (week 13) when turbidity increased greatly due to a series of rain events through

the end of the season. This high turbidity resulted in visibilities approaching zero, which lead to no carcasses being recovered during the final 2 weeks of the survey.
The Section 1 expansion estimate is most likely a very conservative estimate. The reason for this is fourfold: 1) This section has a much higher gradient than the rest of the river, with a series of runs and deep pools, causing the carcasses to drift further and most likely fall out in the deep pools. 2) Only carcasses that "fall-out" near the shore are accessible, carcasses away from the edges are often unrecoverable due to the dangerous currents. 3) The steep canyon topography makes much of this section inaccessible, thus some spawning areas are not surveyed. 4) Also, in 2004, the lower sections had a fairly high rate of recovery which led to a lower estimate for Section 1 in comparison to previous years. It is recommended that further analysis be done on this section in order to obtain a more accurate estimate.

Spawning Distribution
Redd counts are strongly affected by time of day, visibility, sunlight, wind rippling the water surface, redd superimposition, and other physical factors as well as the natural variability between observers. Furthermore, redd counts are conducted with a single pass as opposed to an intensive systematic approach beyond the scope of this study. In the primary spawning riffles of Section 1 and 2 the problem of redd superimposition is acute and leads to undercounting. On the other hand, redds further down the river are easily delineated as clean patches of freshly worked gravel among patches of darker undisturbed gravel. In these sections redd counts are accurate indicators of spawning density. For these reasons, the disparity between spawning density is likely greater than displayed in Figure 8. River miles 57 and 55 show no spawning activity because these sections of the Goodwin Canyon reach were not surveyed.

Population Composition
Peak fork lengths for males and females, both natural and CWT, were similar indicating that returning hatchery fish were similar in age structure to returning natural females. The CWT contribution to the spawning population was estimated to be 3% (n= 31) male and 5% (n= 50) female. This is similar to the 2003 estimate of 4% male CWT and 7% female CWT. Scale and otolith samples collected during the 2004 survey will be used for further cohort analysis.

Stanislaus River Temperatures
Stanislaus River water temperatures remained above 13 C for most of October in the lower areas of the spawning reach (e.g., sections 3 and 4) as shown in Figure 15. With the fall pulse flow event, temperatures in the lower reach dropped to a suitable temperature. Spawning activity began to proliferate concurrent with water temperature cooling. Figure 15 shows the weekly redd counts in relation to water temperature.

Table 1. Riffle Identification cross-reference for 2004 (New ID) and 2002 (Old ID). The corresponding river mile is noted next to the new riffle ID.

Section 1[a]		Section 2[b]		Section 3[c]		Section 4[d]	
New ID (RM)	Old ID	New ID (RM)	Old ID	New ID (RM)	Old ID	New ID (RM)	Old ID
A1N (58.3)	A1	E1 (54.5)	aE1	J3 (50.5)	J3	U1 (39.1)	U1
A1S** (58.3)	A1a	E2 (54.3)	E1	J4 (50.2)	J4	V1 (38.7)	
A2 (58.2)	A2	E3 (54.2)	E2	K1 (49.7)	K1	V2 (38.4)	V1
A3 (58.1)	A3	F1 (53.9)	F1	K1s** (49.6)	K1s	V3 (38.2)	
A4 (58.1)	A4	F2 (53.4)	F2	K2 (49.6)	K1a	W1 (37.6)	W1
B1 (57.9)	B1	F3S (53.2)	F3	K3 (49.5)	K1b	W2 (37.5)	W1a
C1 (56.9)	C1	F3N** (53.2)	F3a	K4 (49.3)	K1c	W3 (37.3)	W1b
C2 (56.8)	C2	F4 (53.1)	F4	K5 (49.2)	K2	W4 (37.1)	W2
		G1* (52.9)		L1 (48.9)	L1	X1 (36.1)	X1
		G2 (52.8)	G1	L2 (48.6)	L2	Y1 (35.9)	X2
		G3 (52.6)	G2	L3 (48.1)	L3	Y2 (35.5)	X3
		G4 (52.5)	G2a	M1 (47.8)	M1	Z1 (34.6)	Z1
		G5 (52.4)	G3	M2 (47.4)	M2	Z2 (34.1)	Z2
		G6 (52.3)	G3	M3 (47.3)	M3		
		G7 (52.1)	G4	M4 (47.1)	M4		
		H1 (51.9)	H1	N1 (46.9)	N1		
			H1a	N2 (46.6)	N2		
		H2** (51.8)	H1b	N3 (46.5)	N3		
		H3 (51.6)	H2	N4 (46.3)	N4		
		H4 (51.5)	H2a	N5 (46.1)	N5		
		H5** (51.5)	H2s	O1 (45.9)	O1		
		H6 (51.4)	H2b	O2 (45.8)	O1a		
		H7 (51.2)	H3	O3 (45.6)	O2		
		J1 (50.9)	J1	O4 (45.5)			
		J2 (50.8)	J2	O5 (45.1)	O3		
				P1 (44.8)	P1		
				P2 (44.6)	P2		
				P3 (44.5)	P3		
				P4 (44.1)	P4		
				Q1 (43.9)	P5		
				Q2 (43.6)	Q1		
				Q3 (43.5)	Q2		
				Q4 (43.3)	Q3		
				Q5 (43.1)	Q4		
				R1 (43.0)	R1		
				R2 (42.1)	R2		
				S1 (41.7)	S1		
				T1 (40.6)	T1		
				T2 (40.5)	T2		
				T3 (40.4)	T3		
				T4 (40.2)	T4		

[a] Includes reach from Goodwin Dam to Knight's Ferry
[b] Includes reach from Knight's Ferry to Horseshoe Road Recreation Area
[c] Includes reach from Horseshoe Road Recreation Area to Oakdale Recreation Area
[d] Includes reach from Oakdale Recreation Area to Jacob Meyers Park
** Side channels surveyed during 2004 survey

Table 2. Weekly totals (does not include Section I).

Week	Total Tagged	Skeletons	Recoveries	Total Counted*	CWT's
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	10	6	0	16	0
5	76	45	3	124	0
6	227	139	36	402	11
7	216	129	94	439	20
8	212	207	105	524	16
9	92	156	123	371	16
10	37	131	85	253	11
11	17	36	21	74	3
12	1	2	2	5	4
13	0	0	0	0	0
14	0	0	0	0	0
Grand Total	**888**	**851**	**469**	**2208**	**81**

*Includes total tagged, skeletons, and recoveries

Table 3. Schaefer distribution of mark week versus recovery week, number of tags recovered per week with survey totals. (Does not include Section I)

Recovery Week	Tag Week								Number of Tags Recovered	Total Carcasses Handled	Weekly Escapement Estimate
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
2	3								3	16	461
3		36							36	124	788
4		5	89						94	402	1034
5			33	72					105	439	953
6			15	18	90				123	524	640
7			1	11	36	37			85	371	282
8				1	3	7	10		21	253	130
9								2	2	79	43
Recoveries per Tag Week	3	41	138	102	129	44	10	2			
Tagged Carcasses	10	76	227	216	212	92	37	18	**Overall Recovery Rate**		**Total Escapement Estimate**
Recovery Percentage per Tag Week	30.0	53.9	60.8	49.5	60.9	47.8	27.0	11.1	**52.8 %**		**3,458**

Table 4. Total live fish, redds and carcass counts by survey week.

Week	Lives	Redds	Carcasses [a]
1	24	0	0
2	67	2	0
3	121	8	0
4	266	149	2
5	1237	722	18
6	1487	1127	171
7	1447	1379	427
8	1081	1161	396
9	630	1077	459
10	262	664	260
11	212	996	170
12	62	565	53
13	4	330	2
14	0	100	0
Total	6900	8280	1959

[a] Carcasses includes all tagged carcasses and skeletons but does not include recoveries

Table 5. Maximum redd count for each riffle over the course of the escapement survey by section.

Section 1		Section 2		Section 3		Section 4	
Riffle	**Maximum # of Redds**	**Riffle**	**Maximum # of Redds**	**Riffle**	**Maximum # of Redds**	**Riffle**	**Maximum # of Redds**
A1N	38	E1	33	J3	12	U1	8
A1S	27	E2	81	J4	15	V1	9
A2	9	E3	54	K1	13	V2	18
A3	22	F1	55	K1S	7	V3	2
A4	62	F2	60	K2	11	W1	14
B1	11	F3N	8	K3	13	W2	21
C1	47	F3S	9	K4	18	W3	3
C2	69	F4	16	K5	18	W4	23
		G1	63	K6	23	X1	3
		G2	12	L1	22	Y1	17
		G3	65	L1A	28	Y2	3
		G4	21	L2	10	Z1	4
		G5	18	L3	7	Z2	4
		G6	13	M1	17		
		G7	49	M2	31		
		H1	51	M3	29		
		H2	0	M4	12		
		H3	13	N1	15		
		H4	11	N2	13		
		H5	28	N3	10		
		H6	11	N4	9		
		H7	20	N5	12		
		J1	9	O1	10		
		J2	14	O2	1		
				O3	2		
				O4	17		
				O5	17		
				P1	2		
				P2	9		
				P3	24		
				P4	3		
				Q1	5		
				Q2	13		
				Q3	13		
				Q4	1		
				Q5	6		
				R1	40		
				R2	20		
				S1	9		
				T1	10		
				T2	7		
				T3	5		
				T4	12		
Subtotals	**285**		**716**		**571**		**129**
Total Redds				**1701**			

Table 6. Handled fish composition of natural and CWT grilse and adult salmon.

	Male	Female	Male (n=439)		Female (n=666)	
			Adclip	Natural	Adclip	Natural
Grilse	16% (n=181)	14% (n=150)	1% (n=9)	40% (n=176)	1% (n=3)	22% (n=147)
Adult	23% (n=258)	47% (n=516)	6% (n=26)	53% (n=232)	7% (n=47)	70% (n=469)

Table 7. Distribution of scale samples collected by section and week for natural salmon. Adipose fin clipped salmon (cwt's) are noted in parenthesis.

Week	Section				Weekly Totals
	1	2	3	4	
1	0	0	0	0	**0**
2	0	0	0	0	**0**
3	0	0	0	0	**0**
4	0	0	0	0	**0**
5	1	2	1	0	**4**
6	7 (5)	13 (2)	7 (1)	0	**35**
7	2 (1)	27 (3)	13 (2)	0	**48**
8	0	28 (5)	11 (2)	2	**48**
9	0	16 (3)	13 (1)	(1)	**34**
10	2 (1)	8 (3)	5 (1)	1	**21**
11	0	3	3	3	**9**
12	0	0	0	0	**0**
Section Totals	**19**	**113**	**60**	**7**	**199**

Table 8. Distribution of heads collected by section and week from adipose fin clipped salmon (cwt's). Heads collected from natural salmon are noted in parenthesis.

Week	Section				Weekly Totals
	1	2	3	4	
1	0	0	0	0	**0**
2	0	0	0	0	**0**
3	0	0	0	0	**0**
4	0	0	0	0	**0**
5	(1)	(2)	1	0	**4**
6	6 (3)	4 (7)	1 (5)	0	**26**
7	5	12 (8)	3 (1)	0	**29**
8	4	8 (6)	4 (4)	(1)	**27**
9	2	9	4	1	**16**
10	1	3	6	1	**11**
11	0	1	2	0	**3**
12	0	2	1	1	**4**
Section Totals	**22**	**62**	**32**	**4**	**120**

Table 9. Distribution of DNA samples collected from salmon.

Week	Section				Weekly Totals
	1	2	3	4	
1	0	0	0	0	**0**
2	0	0	0	0	**0**
3	0	0	0	0	**0**
4	0	0	0	0	**0**
5	1	2	1	0	**4**
6	3	6	5	0	**14**
7	2	10	5	0	**17**
8	0	17	8	3	**28**
9	0	11	8	0	**19**
10	0	9	4	1	**14**
11	0	3	0	0	**3**
12	0	0	0	0	**0**
Section Totals	**6**	**58**	**31**	**4**	**99**

Figure 1. Fresh carcass indicated by clear eye.

Figure 2. Fresh carcass indicated by presence of blood remaining in gill.

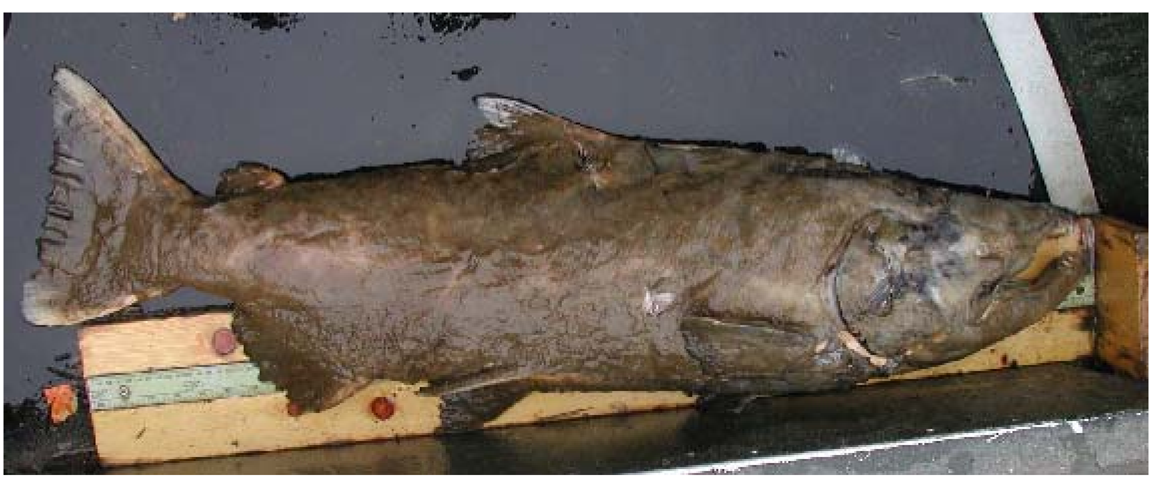

Figure 3. Fungus covered skeleton.

Figure 4. Two skeletons showing varied degrees of decomposition and a fresh carcass.

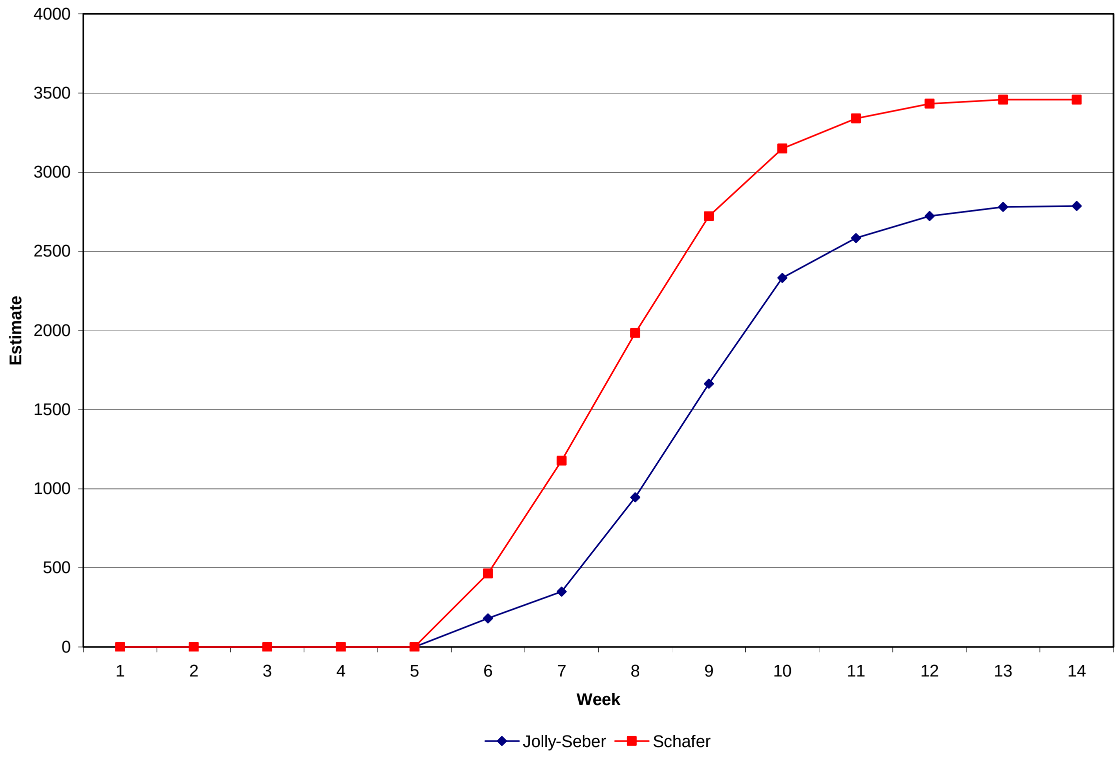

Figure 5. Weekly cumulative Schaefer and Jolly-Seber estimates (does not include Goodwin Canyon reach).

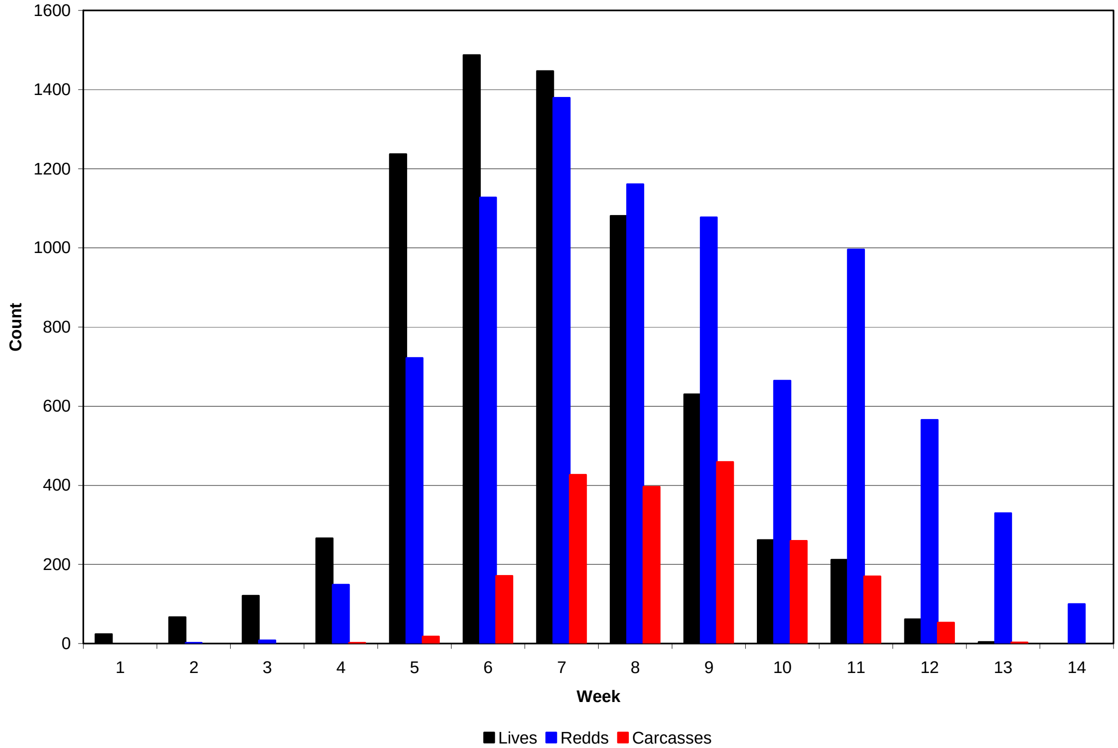

Figure 6. Live fish observation, redd, and total carcass weekly counts. Total carcasses includes all tagged carcasses and skeletons.

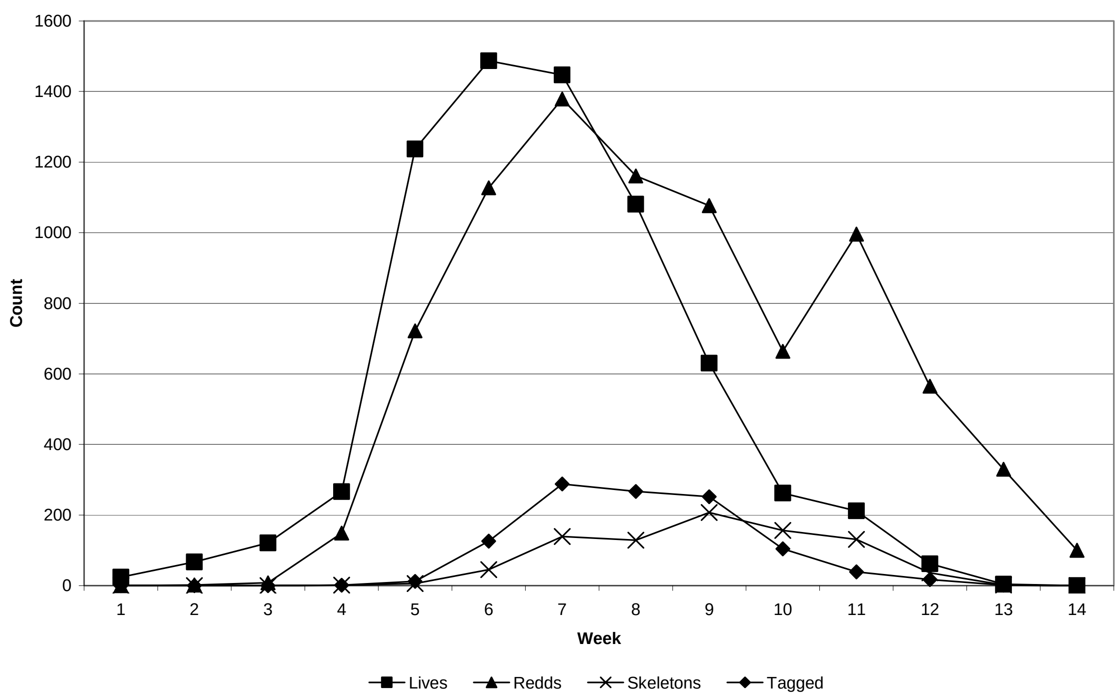

Figure 7. Maximum number of live fish, redds, skeletons, and total tagged carcasses by survey week.

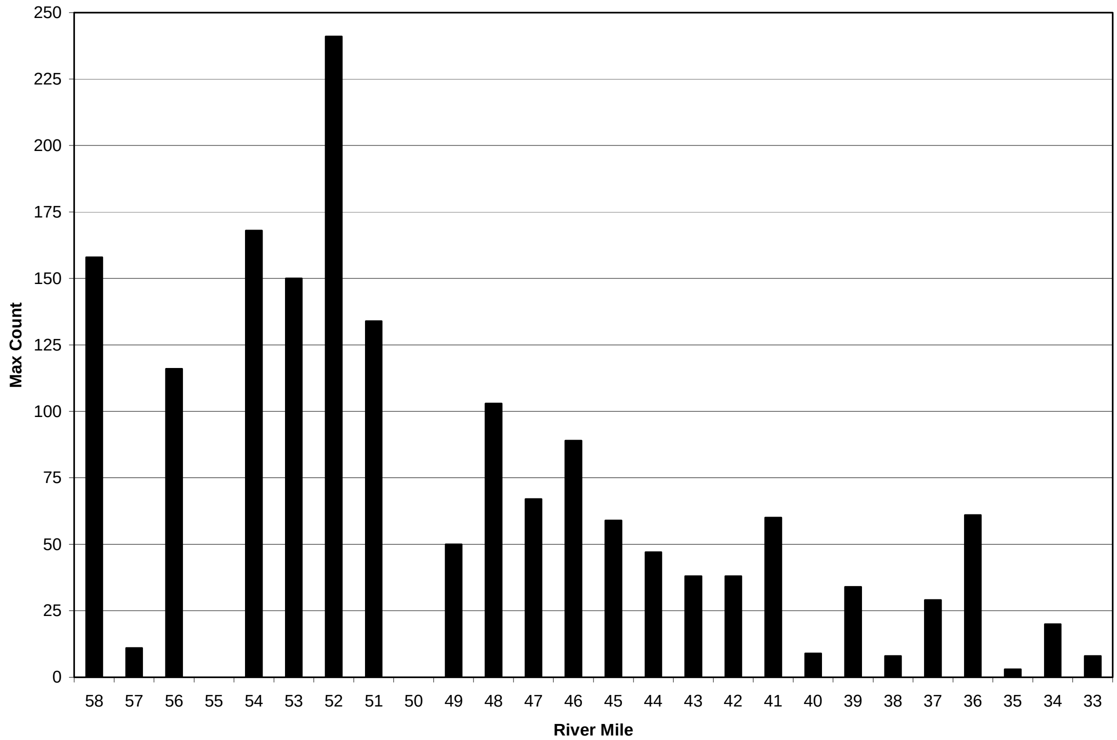

Figure 8. Maximum number of redds observed by river mile.

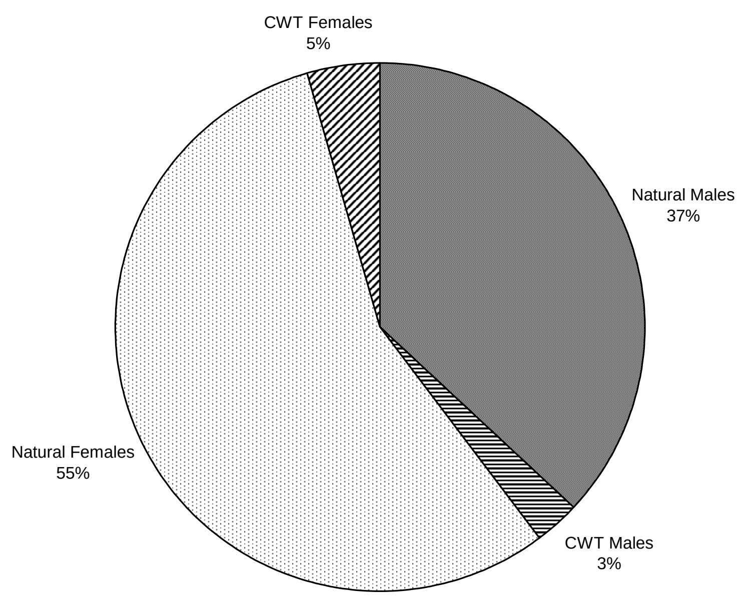

Figure 9. Contribution of male natural, male CWT, female natural, female CWT to the 2004 Stanislaus River escapement.

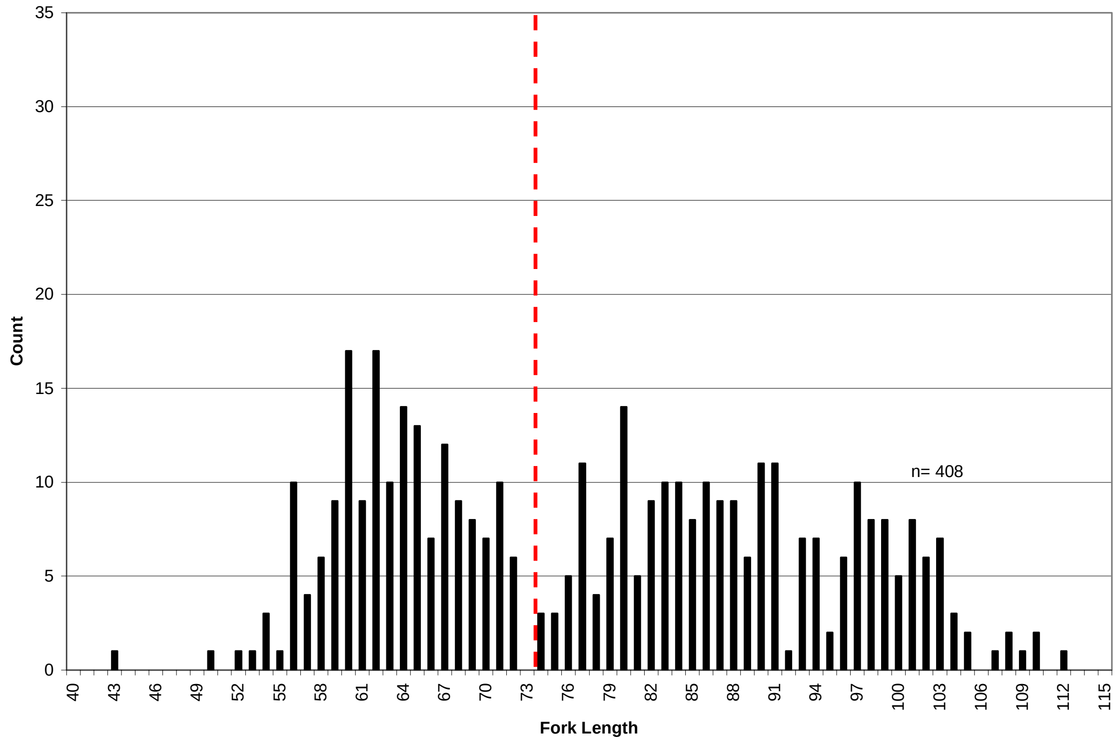

Figure 10. Length frequency histogram of natural male chinook salmon.

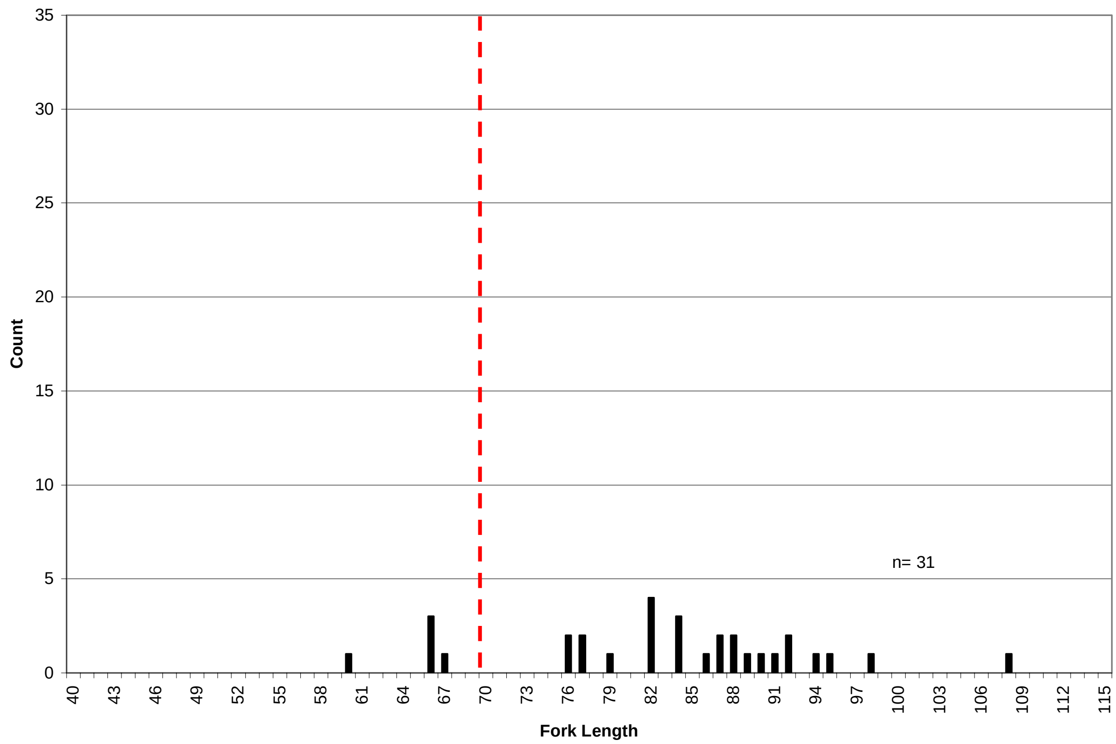

Figure 11. Length frequency histogram of CWT male chinook salmon.

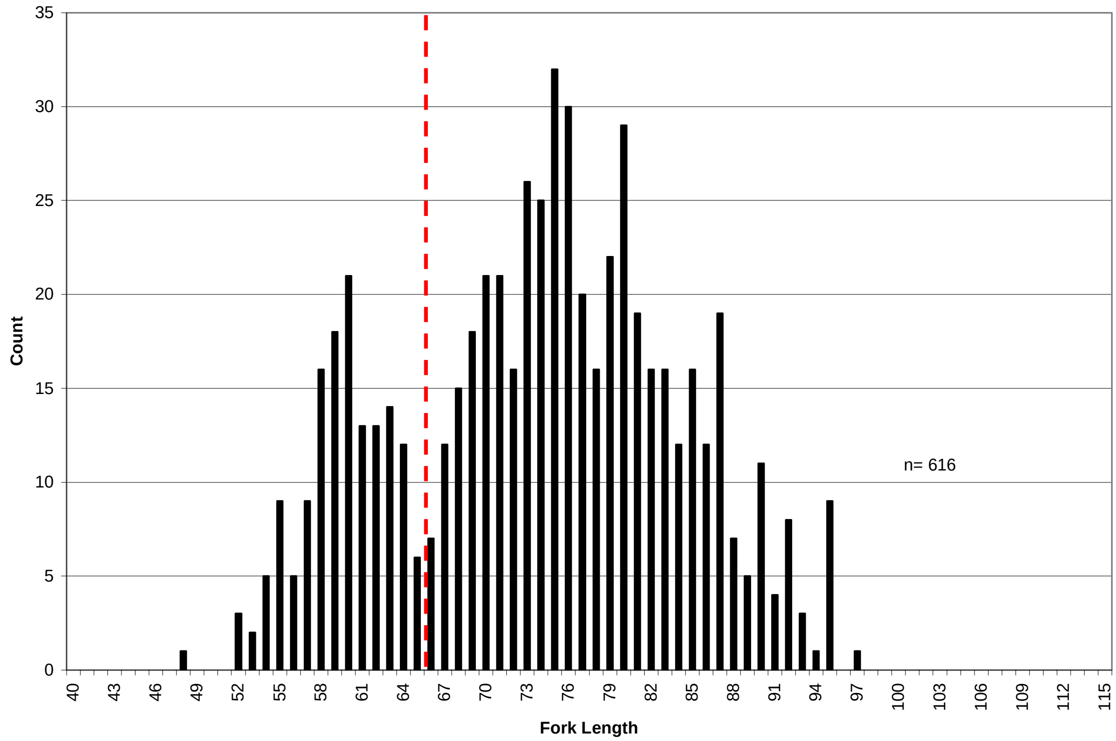

Figure 12. Length frequency histogram of natural female chinook salmon.

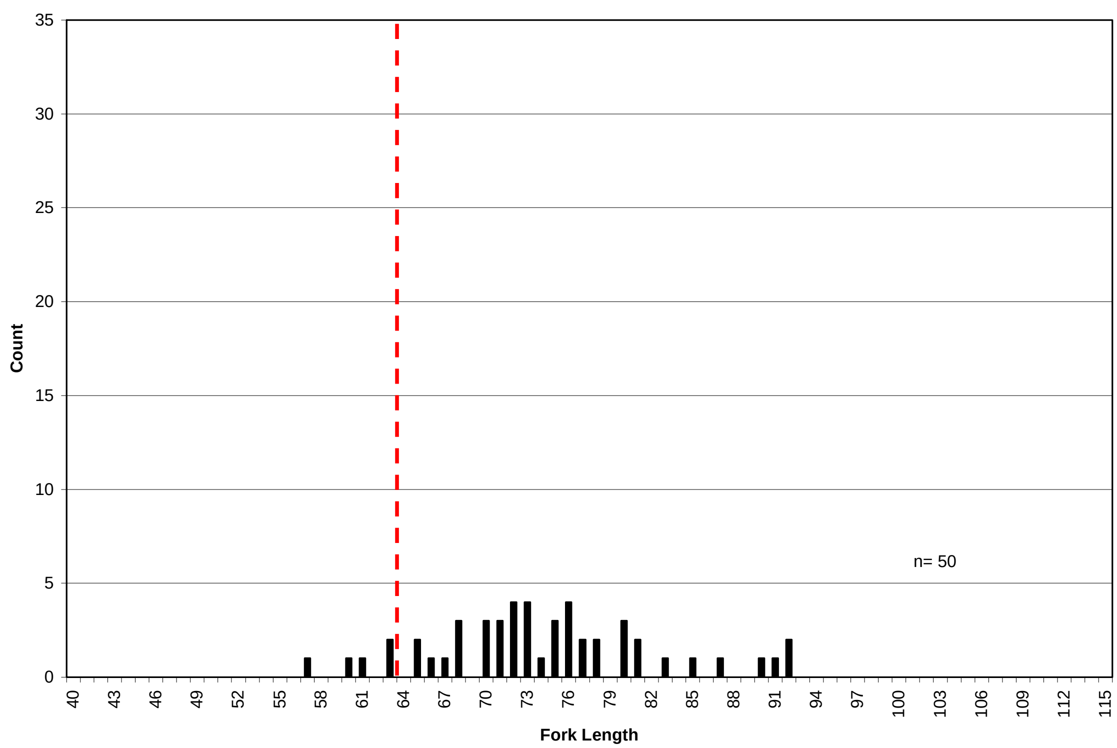

Figure 13. Length frequency histogram of CWT female chinook salmon.

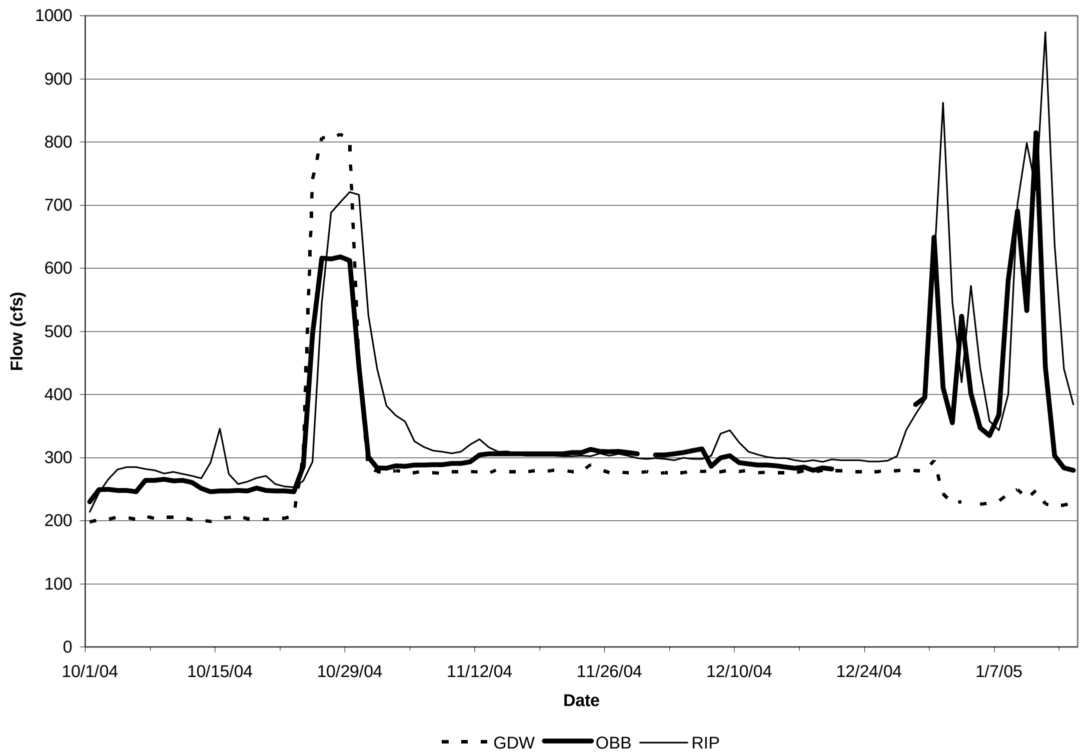

Figure 14. Average daily Stanislaus River flow (cubic feet per second) during the 2004 escapement survey. Preliminary data obtained from the California Data Exchange Center.

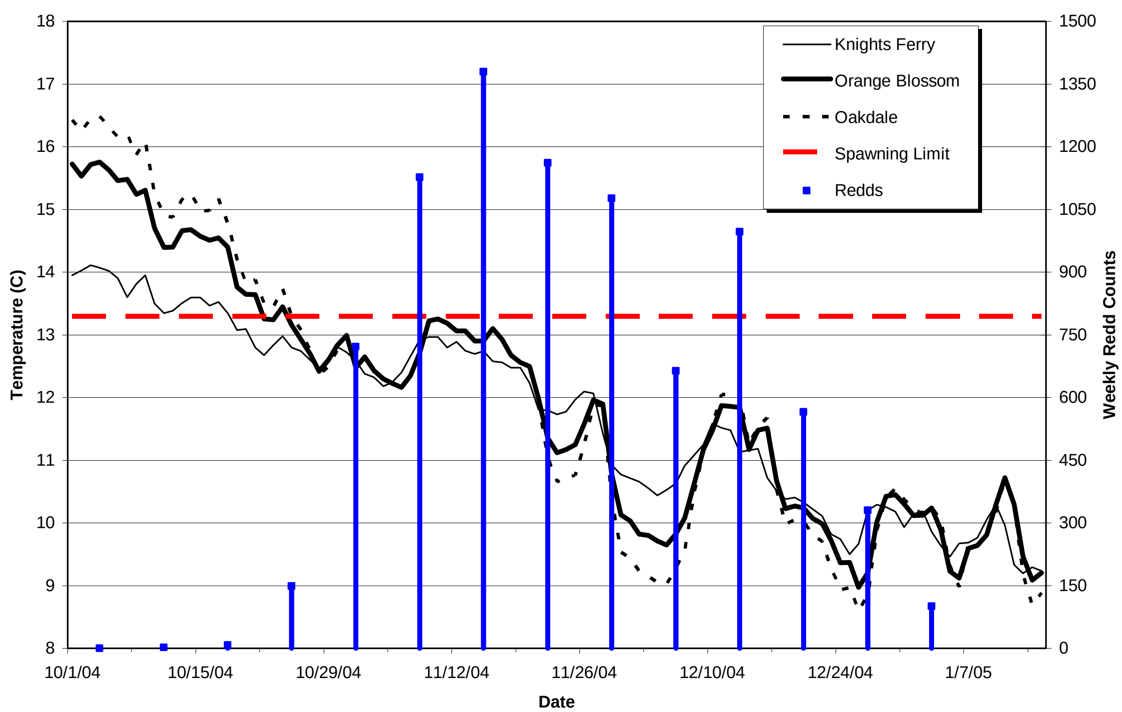

Figure 15. Weekly redd counts in relation to average daily water temperature.

Appendix 1. 2004 Stanislaus River coded wire tag collection results

Tag Code	Brood Yr	Release Yr	Hatchery Location	Release Location	# Recovered
06-27-74	2002	2003	Feather River	Crockett	1
06-49-28	2001	2002	Mokelumne	Sherman	3
06-49-29	2001	2002	Mokelumne	Sherman	3
06-49-30	2001	2002	Mokelumne	Sherman	2
06-49-31	2001	2001	Mokelumne	Sherman	6
06-02-70	2000	2001	Mokelumne	Jersey Point	2
06-02-71	2000	2001	Mokelumne	Jersey Point	1
06-27-22	2001	2002	Mokelumne	Jersey Point	3
06-27-23	2001	2002	Mokelumne	Jersey Point	1
06-44-53	2001	2002	Mokelumne	Jersey Point	8
06-58-63	2001	2002	Mokelumne	Jersey Point	8
06-44-41	2000	2001	MRFF	Jersey Point	2
06-44-81	2001	2002	MRFF	Jersey Point	1
06-44-32	2000	2001	MRFF	Mossdale	1
06-27-49	2002	2003	MRFF	Mossdale	1
06-44-57	2001	2002	MRFF	Mossdale	3
06-44-58	2001	2002	MRFF	Mossdale	1
06-02-82	2002	2003	MRFF	Durham Ferry	1
06-27-46	2002	2003	MRFF	Durham Ferry	1
06-27-47	2002	2003	MRFF	Durham Ferry	1
06-44-29	2000	2001	MRFF	Durham Ferry	1
06-44-30	2000	2001	MRFF	Durham Ferry	1
06-44-31	2000	2001	MRFF	Durham Ferry	1
06-44-37	2000	2001	MRFF	Durham Ferry	1
06-44-71	2001	2002	MRFF	Durham Ferry	1
06-44-72	2001	2002	MRFF	Durham Ferry	2
06-44-73	2001	2002	MRFF	Durham Ferry	4
06-44-74	2001	2002	MRFF	Durham Ferry	2
06-44-75	2001	2002	MRFF	Durham Ferry	1
06-44-69	2001	2002	MRFF	Old Fisherman's Club	1
06-44-47	2001	2002	MRFF	Knights Ferry	1
06-45-67	2002	2003	MRFF	Knights Ferry	1
06-45-68	2002	2003	MRFF	Knights Ferry	1
06-45-69	2002	2003	MRFF	Knights Ferry	1
06-01-11-07-15	2000	2001	MRFF	Stanislaus	1
06-26-66	2001	2002	Nimbus	Wickland	1
06-26-67	2001	2002	Nimbus	Wickland	1
06-54-56	2000	2001	Nimbus	Wickland	1
06-54-57	2000	2001	Nimbus	Wickland	1
Stanislaus Weir Recoveries					
06-44-46	2001	2002	MRFF	Knights Ferry	1
06-49-30	2001	2002	Mokelumne	Sherman	2
06-02-70	2000	2001	Mokelumne	Jersey Point	1
06-49-29	2001	2002	Mokelumne	Sherman	1

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