UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District	)	
	)	
and	)	Project No. 2299
	)	
Modesto Irrigation District	)	

2005 LOWER TUOLUMNE RIVER ANNUAL REPORT

Report 2005-1

2005 Spawning Survey Report

Prepared by

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California Department of Fish and Game
Anadromous Fisheries Program
San Joaquin Valley Southern Sierra Region (Region 4)

March 2006

<u>No report at this time from CDFG</u>

UNITED STATES OF AMERICA
BEFORE THE
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Turlock Irrigation District	)	
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Modesto Irrigation District	)	

2005 LOWER TUOLUMNE RIVER ANNUAL REPORT

Report 2005-2

Spawning Survey Summary Update

Prepared by

Tim Ford
Turlock and Modesto Irrigation Districts

and

Steve Kirihara
Stillwater Ecosystem, Watershed & Riverine Sciences
Berkeley, CA

March 2006

No report at this time due to absence of necessary data from CDFG

March 2006

UNITED STATES OF AMERICA
BEFORE THE
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Turlock Irrigation District	)	
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and	)	Project No. 2299
	)	
Modesto Irrigation District	)	

2005 LOWER TUOLUMNE RIVER ANNUAL REPORT

Report 2005-3

2005 Seine/Snorkel Report and Summary Update

Prepared by

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March 2006

EXECUTIVE SUMMARY

The 2005 seining survey was conducted at two-week intervals from 19 January to 25 May for a total of 10 sample periods. This was the 20th consecutive annual seining study on the Tuolumne River conducted by the Turlock and Modesto Irrigation Districts.

A total of 1,341 natural Chinook salmon were caught in the Tuolumne River and eight in the San Joaquin River. Peak density of salmon caught in the Tuolumne was 21.9 salmon per 1,000 square feet on 02 March. Maximum fork length (FL) in the Tuolumne River increased from 45 mm FL to 97 mm FL from 19 January to 27 April and overall FL ranged from 30 mm to 110 mm.

Flows during the sampling period ranged from about 180 to 7,140 cubic feet per second (cfs) in the Tuolumne River at La Grange and from about 2,770 to 15,100 cfs in the San Joaquin River at Vernalis. Flows in 2005 were relatively high due to above average precipitation.

Water temperature in the Tuolumne ranged from 9.7°C to 15.2°C and in the San Joaquin from 8.6°C to 21.7°C. Conductivity in the Tuolumne River ranged from 34 to 224 μS and in the San Joaquin from 96 to 1,051 μS.

A comparative review of fork length and salmon density for the 2000-2005 period is included. Increase in average fork length in 2005 was typical in timing and magnitude to the pattern observed in other years.

The peak period of fry (≤ 50 mm) density from 02 February to 02 March was more prolonged than other years and was significantly lower in magnitude as a result of a smaller parent run size. The density of juveniles (> 50 mm) peaked on 16 March, similar in timing to most other years in the period. In 2005, the average density of salmon in the Tuolumne River was 8.9 salmon per 1,000 ft^2 and was in the lower range of values for the entire 1986-2005 period.

A snorkel survey was conducted on 20-22 September, within a 20-mile section below La Grange Dam. Preliminary USGS flow at La Grange was about 340 cfs and water temperature ranged from 12.0°C to 18.9°C in September. Five adult Chinook salmon and 139 rainbow trout were observed. Other species observed were Sacramento sucker, Sacramento pikeminnow, hardhead, riffle sculpin, largemouth bass, and smallmouth bass.

S.P. Cramer conducted supplemental seining in four surveys during Feb-May as part of monitoring studies for the Grayson River Ranch Project west of Modesto (East Stanislaus Resource Conservation District and Friends of the Tuolumne). The draft report is attached as Appendix 1. Additional seine monitoring data was collected by Stillwater Sciences on 30May for the nearby Big Bend Project (Tuolumne River Trust) and is included in Appendix 2. No salmonids were captured at either project location.

CONTENTS

1 INTRODUCTION

Stillwater Sciences and SP Cramer and Associates conducted seine and snorkel fishery monitoring in the Tuolumne and San Joaquin Rivers in 2005 for the Turlock and Modesto irrigation districts (TID/MID).

Seine sampling was done in both rivers pursuant to the Don Pedro FERC Project river-wide monitoring program. A primary objective was to document juvenile salmonid size, abundance and distribution, including the relationship of flow and other environmental variables. The salmon in 2005 were the progeny of the 2004 fall spawning run, estimated at about 1,700 fish. This was the 20th consecutive annual TID/MID seining study and a summary of salmonid data since 1986 is contained in this report.

Tuolumne River snorkel surveys began in 1982 with the number, location, and area sampled by site having varied over the years. Summer surveys occurring within the June to September period have been conducted in most years since 1988, although very wet years with high summer flows, such as 1995 and 1998, were not sampled. Locations were selected to include a range of habitat types (i.e., riffles, runs, pools) at sites where salmonids may occur and are spaced at intervals down the river in general areas of suitable access. The overall river section examined is limited to the reach with suitable underwater visibility, this generally being in the 20-mile section from La Grange Dam downstream to near Waterford.

Prior to 2005, a single June or July snorkel survey had been done as part of the FSA monitoring since 1996 to evaluate the abundance, size, and distribution of salmonids and other fish species - 12 sites per survey have been done since 2001. High flow conditions in 2005 precluded a comparable early summer snorkel survey. A September snorkel survey, done since 2001, was conducted on 20-22 September 2005. A comparison of the salmonids observed in the 2001-2005 period is included.

1.1 STUDY SITES

1.1.1 Seine

The area studied was the Tuolumne River from La Grange Dam (river mile [RM] 52.0) to its confluence (RM 0) with the San Joaquin River at RM 83.8, and the San Joaquin River from Laird Park (RM 90.2) to Gardner Cove (RM 77.8) (Fig. 1). A total of ten sites were sampled each survey period, eight on the Tuolumne and two on the San Joaquin - due to the high flow conditions, locations #2 (Riffle 4B or 5) and #7 (Riverdale Park or Venn Ranch) varied during the season. The locations of the sites were as follows:

Site	Location	River Mile
	Tuolumne River	
1	Old La Grange Bridge (OLGB)	50.5[a]
2	Riffle 4B, 5	48.4, 48.0
3	Tuolumne River Resort (TRR)	42.4
4	Hickman Bridge	31.6
5	Charles Road	24.9
6	Legion Park	17.2

7	Riverdale Park, Venn Ranch	12.3, 7.4
8	Shiloh Road	3.4
	San Joaquin River	
9	Laird Park	90.2[b]
10	Gardner Cove	79.4

a. From the confluence with the San Joaquin River.
b. From the confluence with the Sacramento River.

The Tuolumne River was stratified into three sections. The upper section (RM 52 to 34), sites 1-3, is a higher gradient area that includes most of the primary spawning riffles in the river. The middle section (RM 34 to 17), sites 4-6, is the transitional area from the gravel-bedded to sand-bedded river reaches. This section contains much of the in-channel sand/gravel mined areas. The lower section (RM 17 to 0), sites 7-8, is a lower gradient, mostly sand-bottom reach downstream of the Dry Creek confluence.

1.1.2 Snorkel

The snorkel survey was conducted in a 20-mile reach from Riffle A3/A4 (RM 51.6) downstream to Riffle 57 (RM 31.5) below Hickman Bridge near Waterford.

1.2 2005 TUOLUMNE AND SAN JOAQUIN RIVER SAMPLING CONDITIONS

1.2.1 Seine

Flows in the Tuolumne River below La Grange Dam were approximately 175 cfs in January when the surveys began. Flows began increasing in February to maintain Don Pedro Reservoir flood storage space (Fig. 2). Flows increased from 1,000 to 3,000 cfs during the month. In late March flows increased to 6,000-7,000 cfs and decreased to about 4,000 during April and May. Flows were about 6,500 in late May and began declining to about 2,800 cfs through June.

Flows in the San Joaquin River at Vernalis (RM 72.5) ranged from 2,800-15,100 cfs from January to late May. Flows then decreased to about 5,800 cfs through June.

Flows upstream of Vernalis, at Patterson Bridge (RM 98.5) and Maze Road (RM 77.3), represent flow levels at the sampling locations of Laird Park upstream of the Tuolumne and Gardner Cove downstream of the Tuolumne, respectively.

The minimum water temperature recorded in the Tuolumne River during the study period, based on hand-held temperature measurements, was 9.7 °C (49.5 °F) at Hickman Br. on 19 January, and the maximum temperature was 15.2 °C (59.4 °F) at Shiloh Road on 25 May (Fig. 3). The lowest San Joaquin River water temperature, 8.6 °C (47.5 °F) was at Laird Park on 19 January; the highest was 21.7 °C (71.1°F) at Laird Park on 25 May.

1.2.2 Snorkel

The flow at La Grange during the snorkel surveys in September was about 340 cfs. Water temperature ranged from 12.0 °C (53.6 °F) at Riffle A7 on 20 September to 18.9 °C (66.02 °F) at Riffle 57 on 22 September.

2 METHODS

2.1 STUDY TIMING

The 2005 seining study began on 19 January and ended on 25 May. Sampling was done at two-week intervals, with a total of 10 sampling dates. The snorkel survey was conducted 20-22 September.

2.2 SAMPLING METHODS AND DATA RECORDING

2.2.1 Seine

Seining was done using 6-ft high, 1/8-inch mesh nylon seine nets in lengths of 20 or 30 feet. The same general areas were sampled each time, to permit comparisons through the sampling period, but sample areas varied somewhat as a result of changes in flow. Seine hauls were made with the current and parallel to shore. The salmon caught were anesthetized with MS-222, measured (FL in mm) and then revived before being released. Other measurements taken were area sampled, (determined from estimating average length and width of a seine haul) water temperature, visibility, conductivity, and maximum depth of the area sampled. Other observations include time of day, weather conditions, habitat type, and substrate type. Other fish species were recorded separately. Any salmon undergoing outward signs of smoltification, such as losing scales during handling, were also noted.

2.2.2 Snorkel

Underwater observations were conducted using an effort-based method where a snorkeler examined within a specified area for a given period of time and recorded the species, numbers, and size estimates of fish observed. A combination of different habitat types were observed, including riffles, runs, and pools. The overall river section examined is limited to the reach with suitable underwater visibility, this generally being a 20-mile section below La Grange Dam downstream to Waterford. The snorkeling method provided an index of species abundance.

Each habitat type sampled mostly involved one observer snorkeling a specified habitat area for a certain time period. Whenever feasible, the surveys were conducted moving upstream against the current - a side-to-side (zigzag) pattern was used as the width of the survey section required. Occasionally, two snorkelers moved upstream in tandem, with each person counting fish on their side of the center of the survey section. Whenever possible, the entire width of the habitat section selected was carefully surveyed. The only exceptions were the habitat areas that were too wide to effectively cover. If high water velocity precluded upstream movement, snorkelers would float downstream with the current, remaining as motionless as possible through the study area, although stream margins at those sites would still be viewed in an upstream direction.

Usually the total length of an observed fish was estimated using a ruler outlined on the diving slate to the nearest 10 mm. For some larger fish, the lengths may be estimated by viewing the fish in reference to adjacent objects and then measuring that estimated length. In cases where larger numbers of fish are observed, the observer estimated the length range and number of fish in the group. Care was taken to observe and count each fish just once in the survey area.

Other data recorded for each location included water temperature, electrical conductivity, turbidity, and horizontal visibility. Site-specific data that was recorded included area sampled, average depth, sample time, general habitat type, and substrate type.

2.3 DATA ANALYSIS

Seining catch data was examined by location, river section, and river. Catch densities of salmon were divided into two size groups for analysis. The density index for “fry” (fish ≤50 mm FL) and for “juveniles” (>50 mm), by site and by section, were computed by multiplying the number of salmon caught by 1,000 and dividing it by the area sampled. These indices of population density (relative abundance), were used for comparisons. Densities and sizes of salmon fry and juveniles by upper, middle, and lower river sections were examined.

3 RESULTS AND DISCUSSION

3.1 SEINE CATCH

A total of 1,341 salmon were caught in the Tuolumne River and eight in the San Joaquin (Table 1). Of these, 780 salmon were measured and riverwide peak density for the Tuolumne was 21.9 salmon per 1,000 ft^2 on 02 March.

3.1.1 Density of Fry and Juvenile Salmon

Salmon up to 45 mm fork length (FL) were caught in the Tuolumne River on 19 January in the first sampling period. The highest density of salmon fry in the Tuolumne was 20.5 fry/1,000 ft^2 found on 02 March (Table 2). The highest density of juvenile salmon in the Tuolumne was 8.2 juveniles/1,000 ft^2 found on 16 March.

The density of salmon fry by location exhibited a peak for most sites from 16 February to 02 March. The density of juveniles by location generally peaked from 16 March to 13 April for most locations (Fig. 4).

The density of salmon fry in sections of the Tuolumne River had a peak in the upper and lower sections on 02 March and in the middle section on 16 February (Fig. 5). The density of juveniles by section shows a peak in the upper section on 13 April, a peak in the middle section on 16 March, and a peak in the lower section on 27 April. Only eight wild salmon were caught in the San Joaquin River, 7 at Laird Park on 02 March and 1 at Gardner Cove on 27 April.

3.1.2 Size, Growth, and Smoltification

The fork length of salmon from the Tuolumne River caught in 2005 ranged from 30 mm to 110 mm. The average fork length (FL) of salmon generally showed a steady increase from 16 February to 25 May (Fig. 6).

An indirect method to estimate growth rate was made by dividing the amount of increase in maximum FL, over an extended period of time, by the number of days during the period. Maximum FL in the Tuolumne River increased from 45 to 97 mm during the 19 January to 27 April period (Fig. 6). This indicates a potential FL increase of approximately .53 mm per day (52 mm / 98 days).

Length frequency distributions reflect the change in average fork length through the entire study period (Fig. 7 & 8). The change in FL by location generally show an increase from late January to late May at most of the Tuolumne River sampling locations (Fig. 9). Salmon estimated to be large enough to undergo smoltification (> 70 mm FL) were present by mid-March. The first salmon exhibiting smolting characteristics was caught on 13 April. Fry were present through 13 April.

3.1.3 Conductivity and Turbidity

Conductivity in the Tuolumne River generally increased with increasing distance below La Grange Dam, from a low of 34 µS at Old La Grange Bridge to a high of 224 µS at Shiloh Road (Table 3). Conductivity also increased as flows were reduced (Fig. 10).

Conductivity in the San Joaquin River was much higher than in the Tuolumne and ranged from a low of 96 µS at Gardner Cove to a high of 1051 µS at Laird Park.

Turbidity in the Tuolumne River was less than 11.5 Nephelometric Turbidity Units (NTU's) except for three readings at Legion Park, Venn Ranch and Shiloh Road on 02 February. Turbidity also generally increased with increasing distance below La Grange Dam and generally decreased with higher flows.

Turbidity in the San Joaquin River ranged from 11.0 at Gardner Cove to 77.5 NTU at Laird Park.

3.1.4 Other Fish Species Caught

The numbers of other fish species caught during the seining study by species, location, and date are in Table 4. Fourteen species other than Chinook salmon were caught in the Tuolumne River and 11 other species in the San Joaquin River. Seven of these species were common to both rivers and 18 species were caught overall. One rainbow trout fry (27 mm FL) was caught in the Tuolumne River on 16 March at OLGB. The distribution of species in the Tuolumne was generally determined by habitat and water temperature with coldwater species such as rainbow trout and riffle sculpin found in the upper third of the river. The San Joaquin River had a significantly lower number of fish species than in recent years, perhaps due to much colder water temperatures observed in 2005.

3.1.5 Coded-Wire-Tagged Salmon

About 79,000 coded-wire-tag (CWT) salmon were released by CDFG in the Tuolumne River on 18 April at Old La Grange Bridge. The lower release of 51,429 tagged salmon was made on 20 April at the Old Fishermen's Club on the San Joaquin River.

3.2 SNORKEL SURVEY

Survey conditions and fish observations from the snorkel survey conducted on 20-22 September are summarized in Table 5. The fish species observed were all native species characteristic of the lower elevation zone adjacent to the Sierra foothills with the exception of the largemouth bass and smallmouth bass. In 2005, fewer fish species were observed than in recent years. Noticeably missing were other members of the Centrarchidae family.

In the September surveys, adult Chinook salmon were observed and rainbow trout were observed downstream to Riffle 35A (RM 37.1). Other species seen were Sacramento sucker, Sacramento pikeminnow, hardhead, riffle sculpin, largemouth bass, and smallmouth bass.

4 COMPARATIVE REVIEW

4.1 SEINE: 1986-2005

Annual TID/MID Tuolumne River seining surveys began in 1986, with the number, location, and sampling frequency of sites having varied over time (Tables 6 & 7). The number of salmon captured in the Tuolumne has ranged from 120 (1991) to 14,825 (1987) - the total number of salmon captured in 2005 (1,341) is the lowest since 1997. In 2005, the average density of salmon in the river was 8.9 salmon per 1,000 ft^2 and was similar to densities found in 1996.

The San Joaquin River has been sampled upstream and downstream of the Tuolumne River confluence in each of the study years. The total number of salmon caught has ranged from 0 to 854 with average density much lower than the Tuolumne (Table 6).

Comparative review of fork length and density is mostly for 2000-2005 in this report.

4.1.1 Size and Growth

Minimum FL found in 2005 remained low through March and continued increasing after that date. It was most similar to 2003 (Fig. 11). In 2005, the increase in average FL during the January to March period was similar in timing and magnitude to the pattern observed in the 2000-2005 period (Fig. 12). The increase in average FL peaked on 25 May. . Maximum FL in 2005 increased from January through May (Fig. 13). The estimated 2005 growth rate of .53 mm per day was in the middle range of growth rate values for 1986-2005 (Table 6).

4.1.2 Fry and Juvenile Salmon Density

In 2005, the density of salmon fry (≤ 50 mm) in the Tuolumne River peaked on 02 March at the lowest level for the 2000-2005 period (Fig. 14). The 02 March timing of peak fry density was also the latest peak during the study period.

The density of salmon juveniles (>50 mm) in 2005 peaked on 16 March and was similar in timing to 2000 and 2004 (Fig. 15).

Combined fry and juvenile densities for the Tuolumne River are shown for the years 2000-2005 (Fig. 16). The 2005 densities peaked in early March at the lowest level of all years during the study period.

4.1.2.1 Tuolumne River Section Density

Upper section density of fry generally peaks from mid-January to mid-February and steadily declines through March (Fig. 17A). For 2005, the density of fry peaked in early March, later than the general pattern. Upper section density of juveniles typically increases beginning in late February and peaks in mid March to early April. In 2005, juvenile salmon density peaked in mid April.

Middle section density of fry generally peaks from mid January to late February about 2 weeks after the peak in the upper section (Fig. 17B). In 2005, the density of fry peaked in mid February. Middle section density of juveniles often peak from mid February to late March. In 2005 juvenile density peaked in mid-March.

Lower section density of fry and juvenile salmon has been relatively low in most years. This section was often sampled only at the Shiloh Road location in prior years. Since 1999, two sites have been sampled. Peak density of fry was similar in timing to other years during the 2000-2005 period (Fig. 17C). In 2005 fry density peaked on 02 March most similar to 2000 and 2001 that also had higher flow conditions. In 2005 juvenile density peaked in late April.

Section abundance indices of fry and juvenile salmon combined were standardized as a percent of the annual riverwide average abundance index and plotted at section midpoints for recent years (Fig. 18). In general, the abundance indices decline from the upper to lower sections. In 2005 the standardized section abundance indices exhibited the typical decline from the upper to lower sections.

4.1.2.2 San Joaquin River Density

Densities of salmon caught in the San Joaquin River at Laird Park and Gardner Cove or nearby sites were reviewed to compare relative abundance of salmon upstream and downstream of the Tuolumne River confluence. The abundance indices were calculated for fry and juvenile salmon combined due to low numbers caught. The average salmon abundance at Laird Park, downstream of the Merced confluence, was extremely low for all years during the 1986-2005 period (Fig. 19). The total number of wild salmon caught at Laird Park during this period was 142. Seven wild salmon were caught at Laird Park in 2005 (sampled 8 times). The average abundance at Gardner Cove, downstream of the Tuolumne River confluence, was much higher in 1986 and 1999 and moderately higher in 1995, 1998 and 2001. A total of 1049 salmon were caught at this location during the 1986-2005 period, 509 of which were caught in 1999. One wild salmon was caught at Gardner Cove in 2005.

4.1.3 Tuolumne River Fry Density Versus Number of Female Spawners

A polynomial equation analysis of peak fry density in the Tuolumne River and the estimated total number of female spawners (TID/MID data), from the preceding fall-run, resulted in an R-squared of .68 for the 1986-2005 period (Fig. 20, Table 8). A similar result with R-squared of .73 was found using average fry density from 15JAN-15MAR (Figure 21). In past years, a linear regression analysis was calculated for the same data set that resulted in similar R-squared values.

4.1.4 Other Fish Species

The number of fish species, other than Chinook salmon, caught during 1986-2005 has ranged from 11 to 16 on the Tuolumne River. Table 4 has the counts from each site and date for fish species caught in 2005. Fourteen other species were caught including 7 native species in the Tuolumne; 11 fish species, including 3 native, were caught on the San Joaquin River in 2005 (Table 4).

Of native species, Pacific lamprey, rainbow trout, hardhead, and riffle sculpin were caught only in the Tuolumne River. The only native species caught in both rivers was the Sacramento sucker, Sacramento pikeminnow, and prickly sculpin. Native species not caught in either river in 2005 were Sacramento blackfish, hitch, Sacramento splittail, and tule perch.

4.2 SNORKEL: 2001-2005

Annual Tuolumne River snorkel surveys under the FSA began in 1996. The precursor to these surveys was the 1988-1994 summer flow studies. This comparative review of 2001-2005 considers the total number and density of salmonids observed during the September surveys.

The locations sampled during the recent late season observations conducted in September were the same each year (Table 9). The total number of salmon and rainbow trout observed in September was 5 and 139 respectively in 2005. The absence of juvenile salmon in September 2005 was similar to the low numbers observed in 2001-04 as there has been a decrease observed between the June and September sampling periods each of those 4 years. September 2005 observations of rainbow trout were the highest since the surveys began in 2001 and trout were observed about 5 miles further downstream than in the other years.

5 SUPPLEMENTAL SEINE SAMPLING

S.P. Cramer and Stillwater Sciences monitored two downstream restoration projects on the lower Tuolumne River for the utilization of inundated floodplain primarily by juvenile Chinook salmon and steelhead. Seine sampling was conducted at both project locations. No salmonids were captured at either of the restoration project locations. S.P. Cramer surveyed the Grayson River Ranch project four times in February-May, and captured three native fish species and eight introduced species in the sloughs (Table 2 in Appendix 1). At the Big Bend project, which was surveyed on 30 May by Stillwater Sciences, four introduced fish species were captured (Appendix 2).

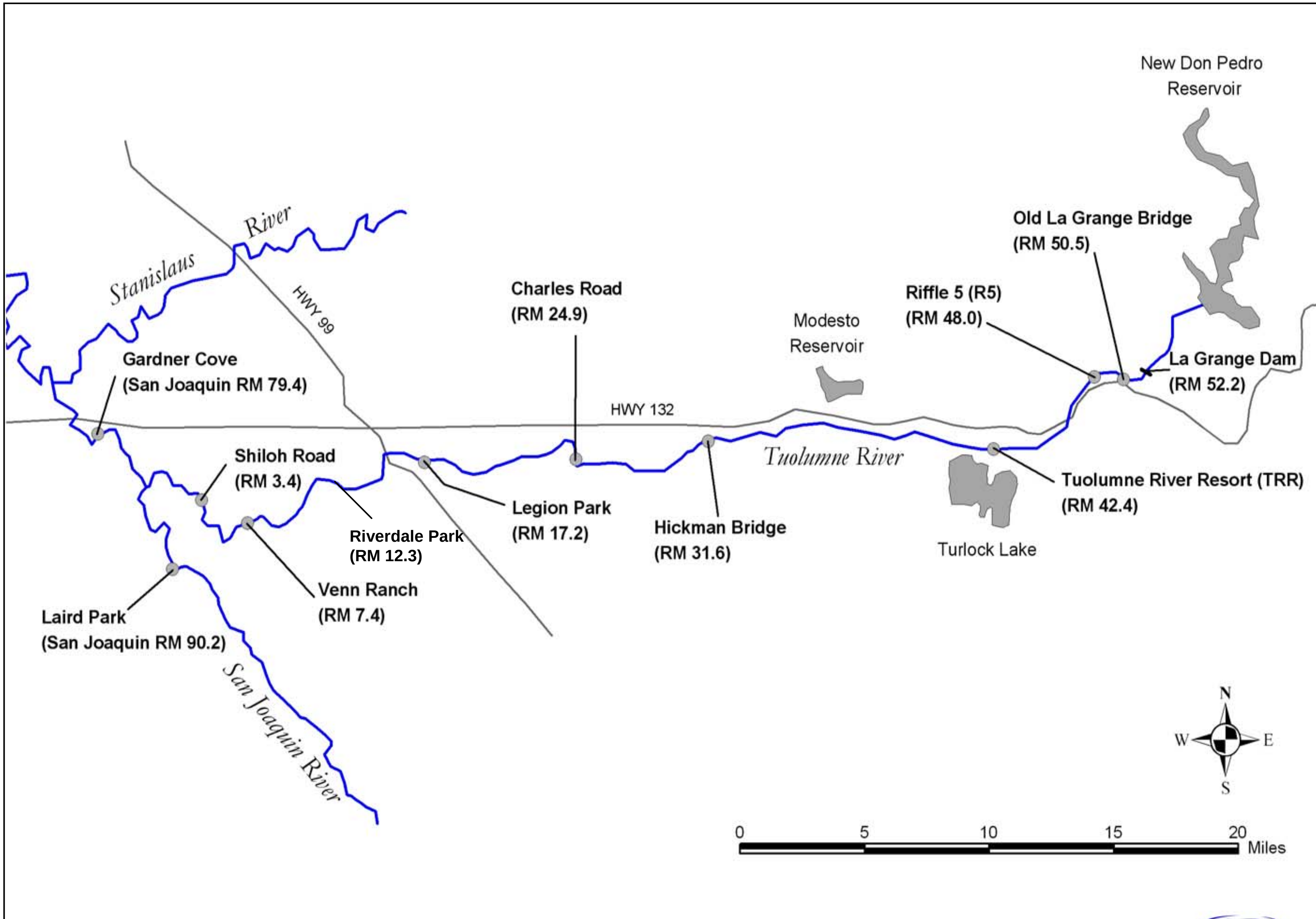
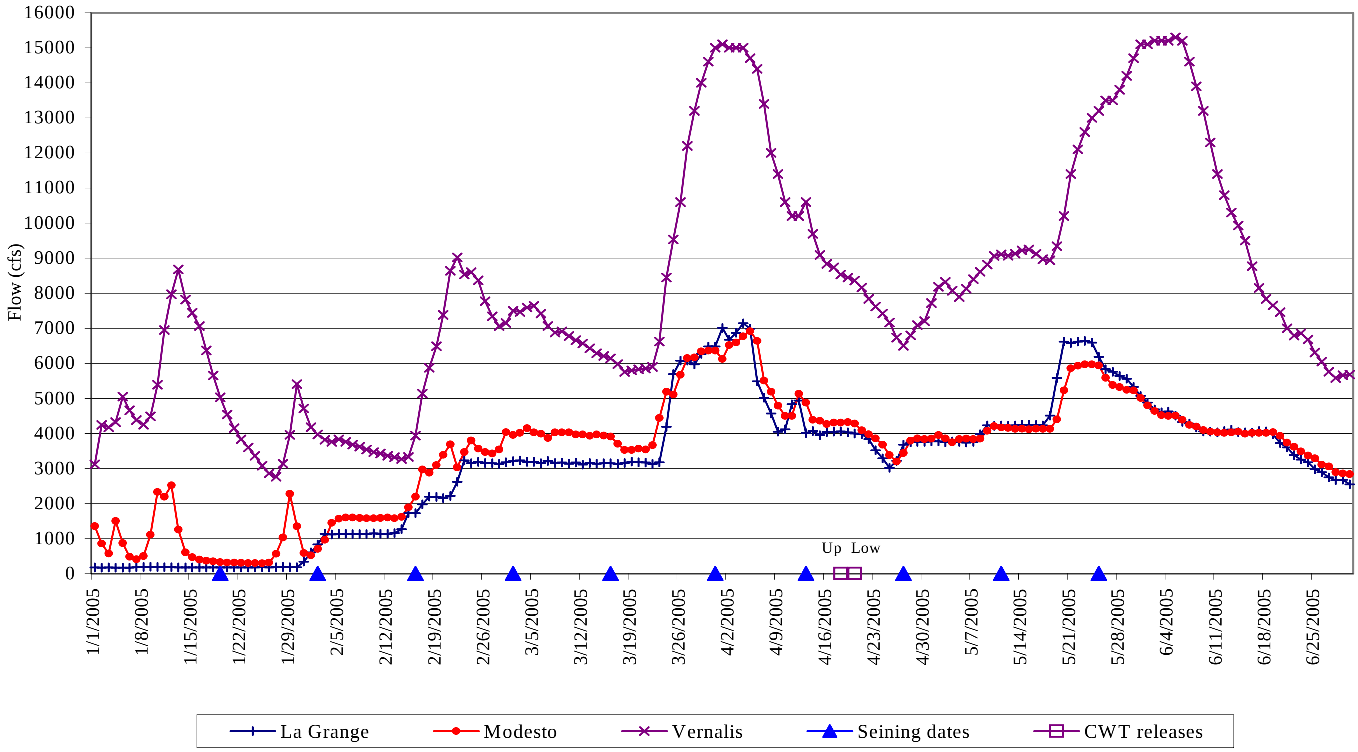


Figure 1. Locations of seine sampling sites on the lower Tuolumne and San Joaquin Rivers, 2005.

Stillwater Sciences

2005 Tuolumne and San Joaquin River daily mean flow
Provisional USGS data



2005 San Joaquin River daily mean flow
Provisional CDEC data

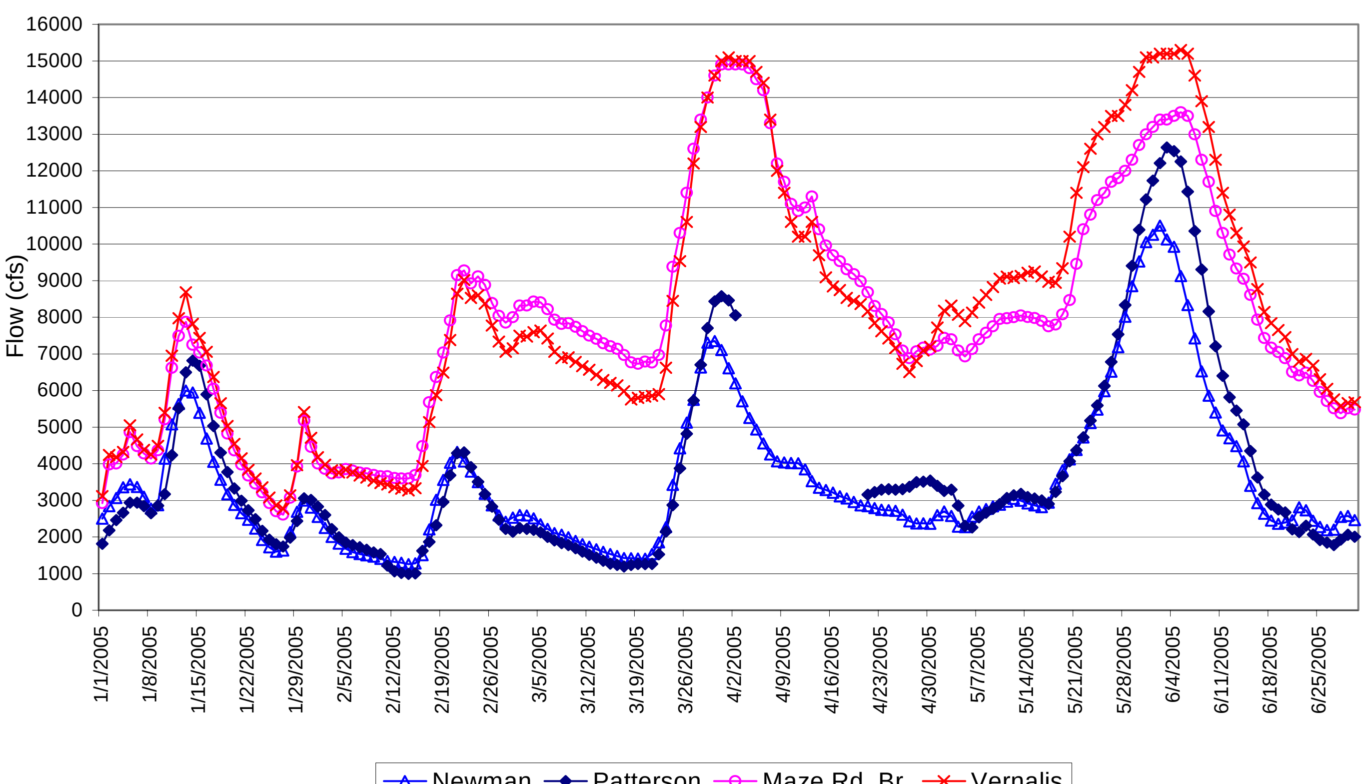


Figure 2. Tuolumne and San Joaquin River daily average flow.

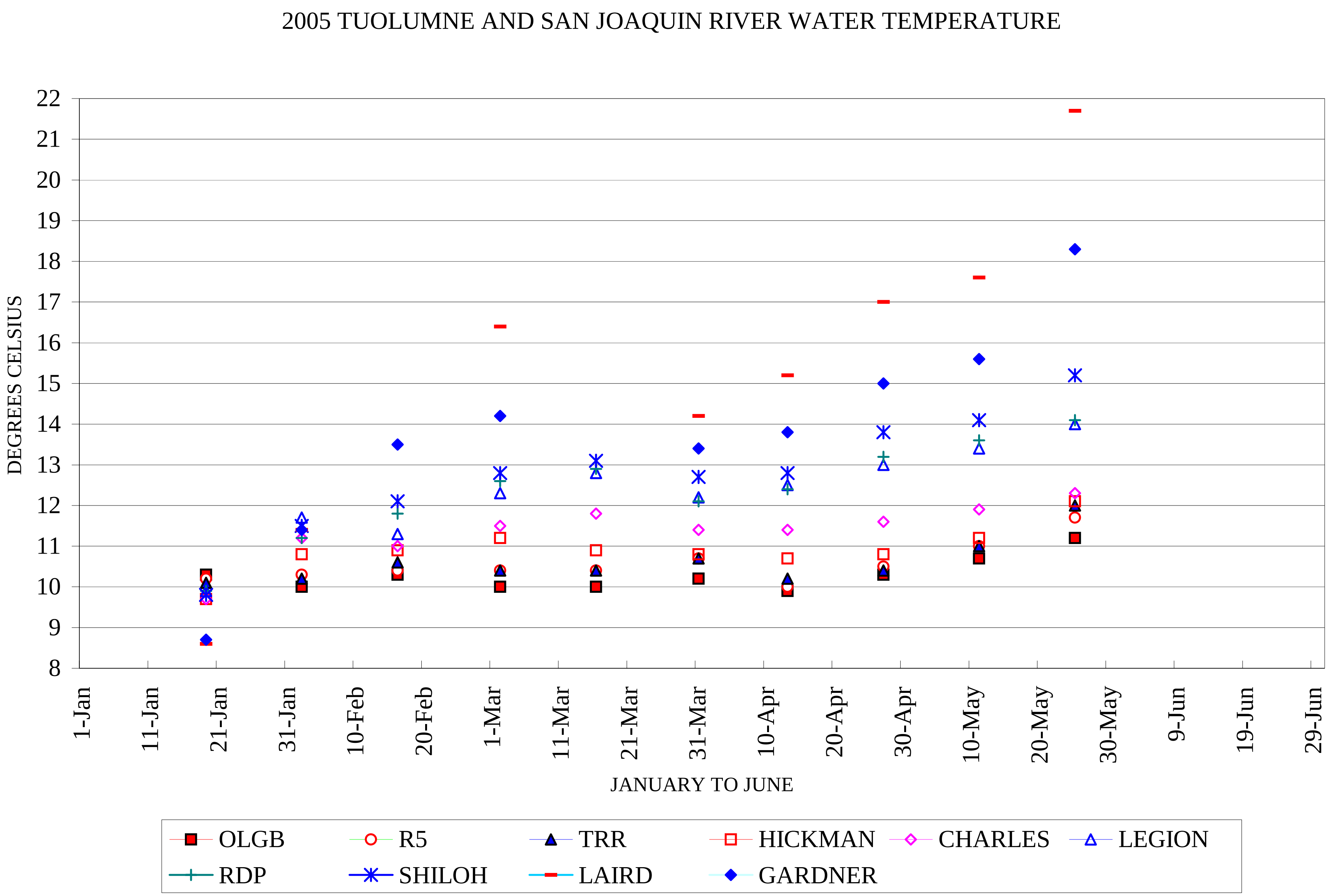
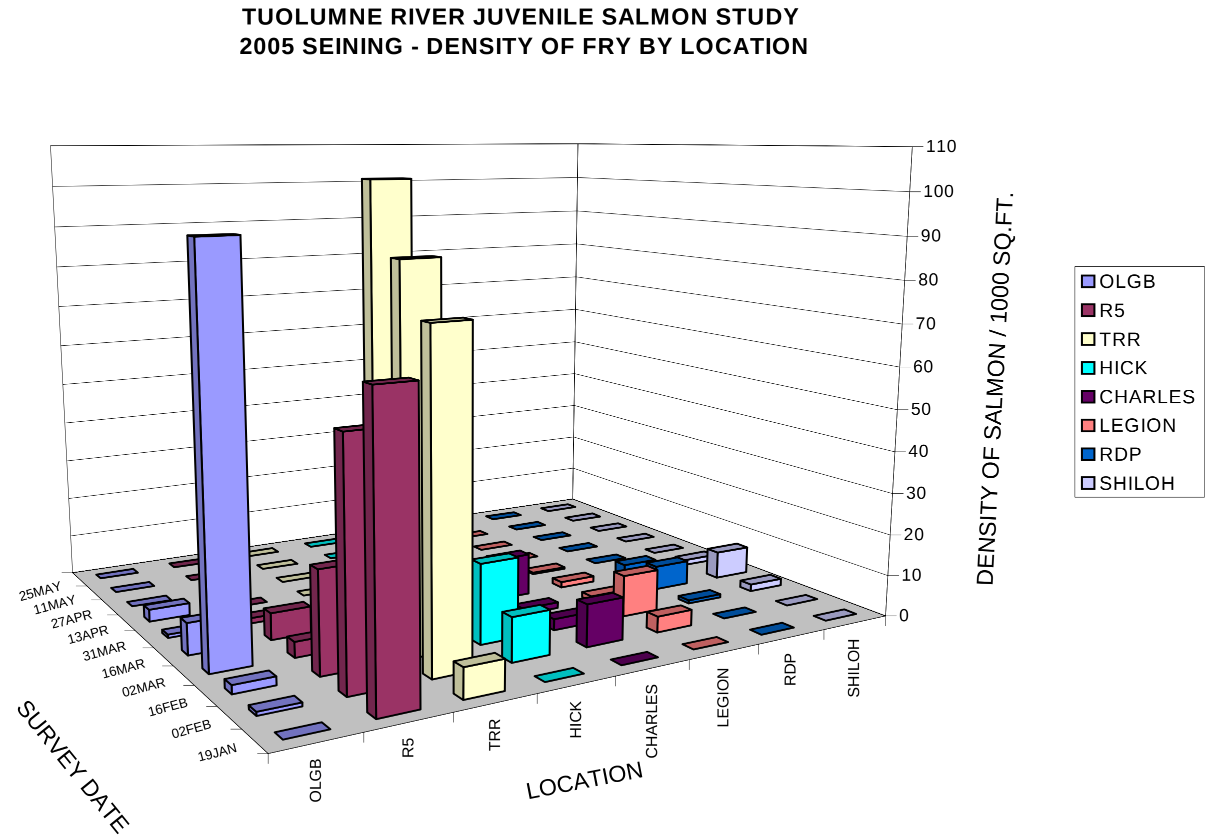


Figure 3. 2005 San Joaquin and Tuolumne River water temperature.



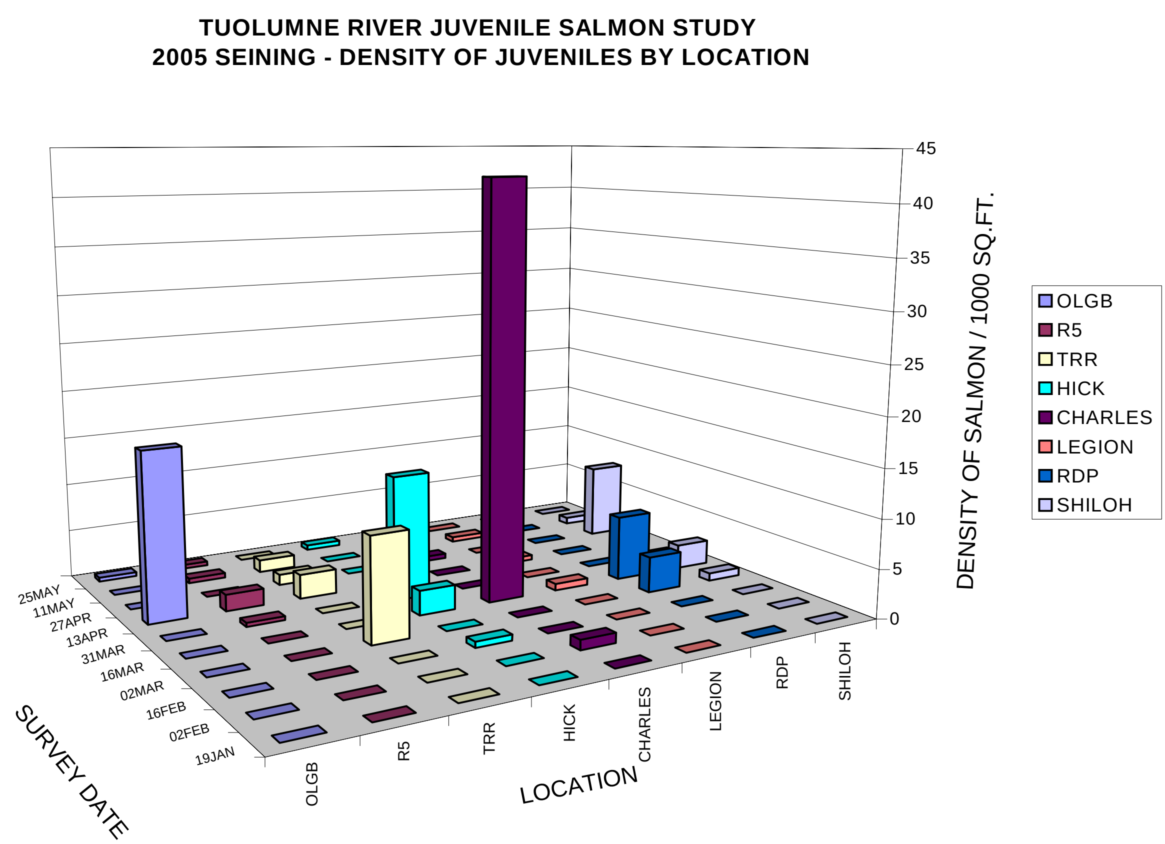


Figure 4. Tuolumne River density of fry and juvenile salmon by location.

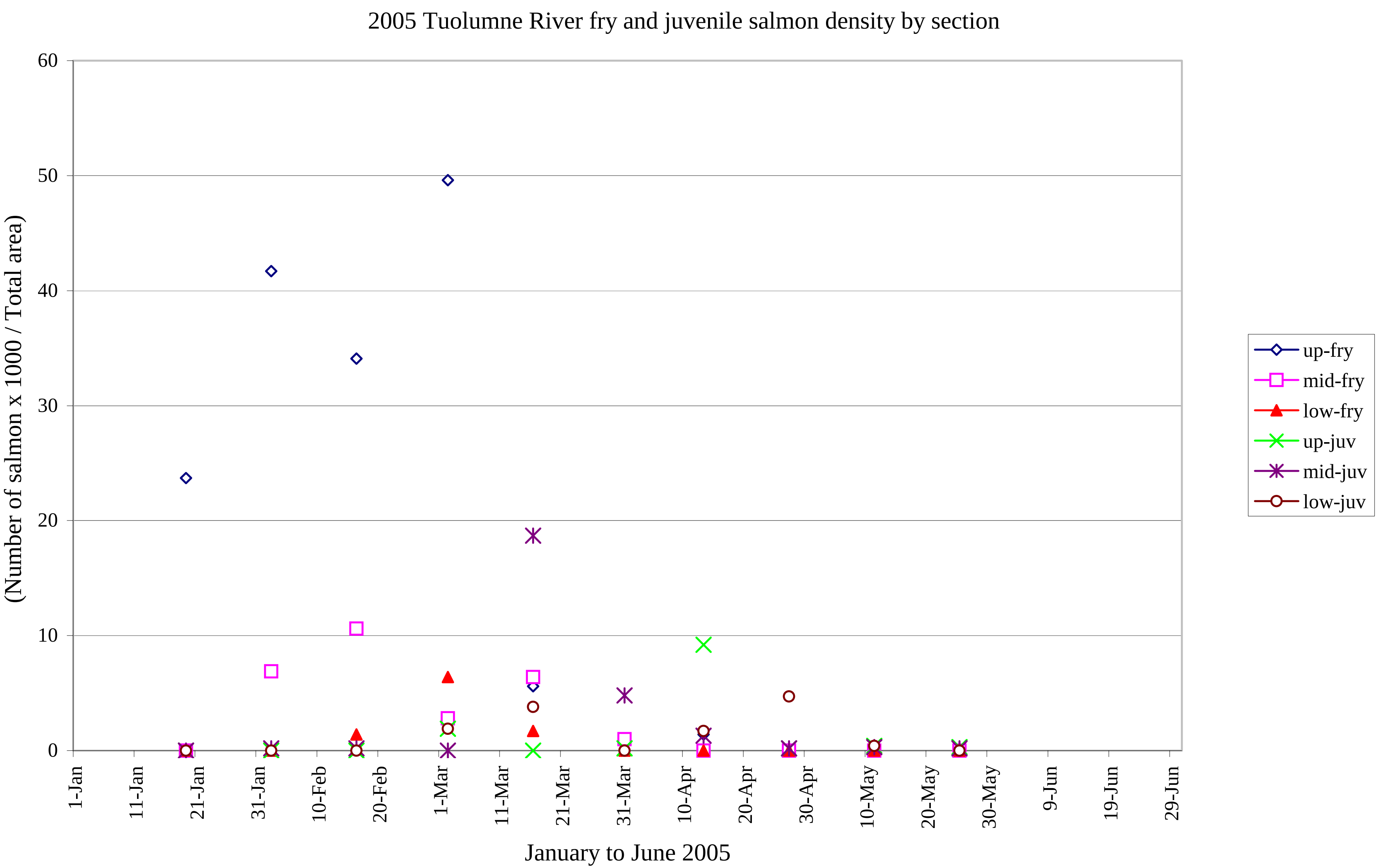


Figure 5. 2005 Tuolumne River fry and juvenile salmon density by section.

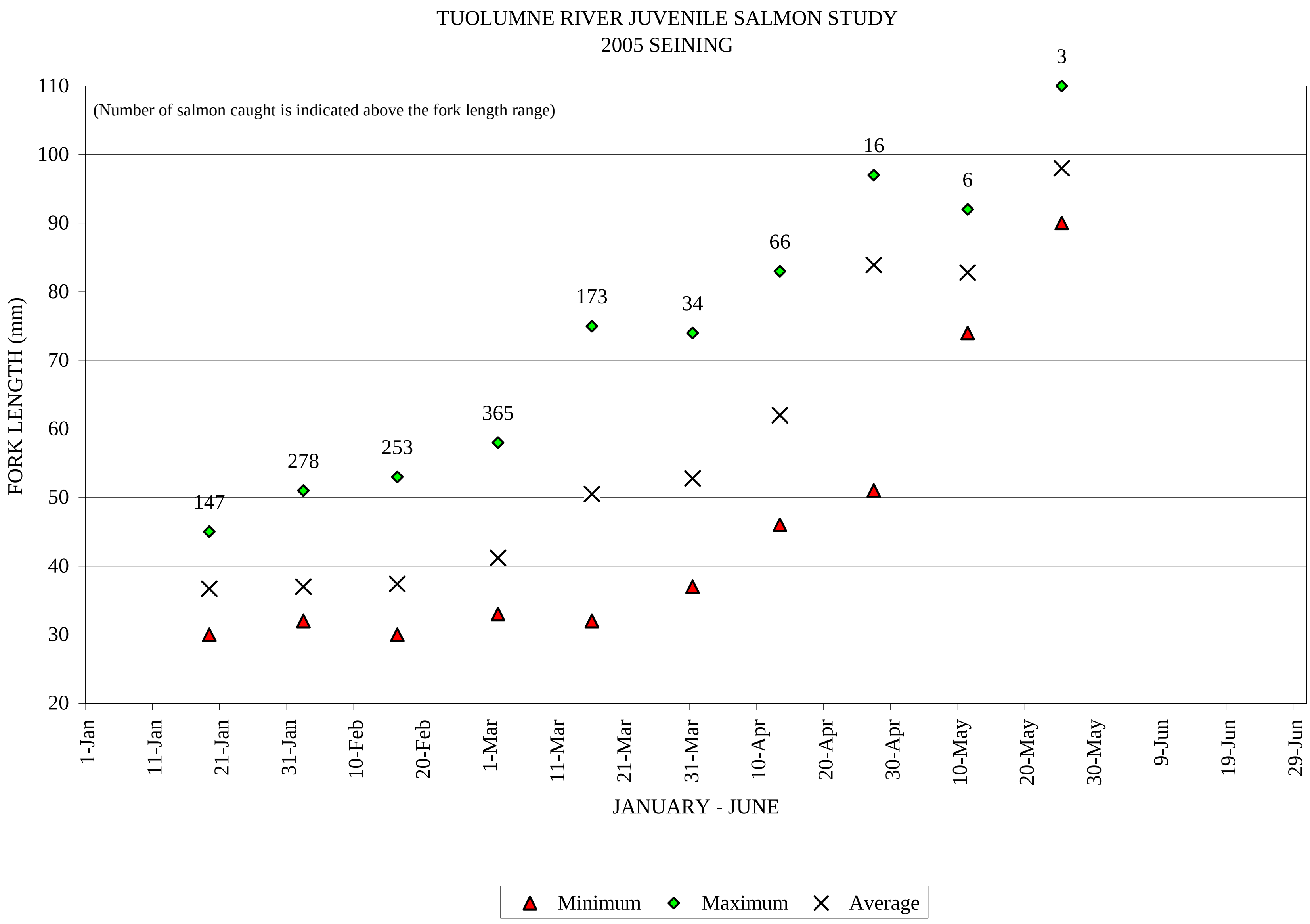


Figure 6. Fork length ranges of wild salmon in the Tuolumne River, 2005.

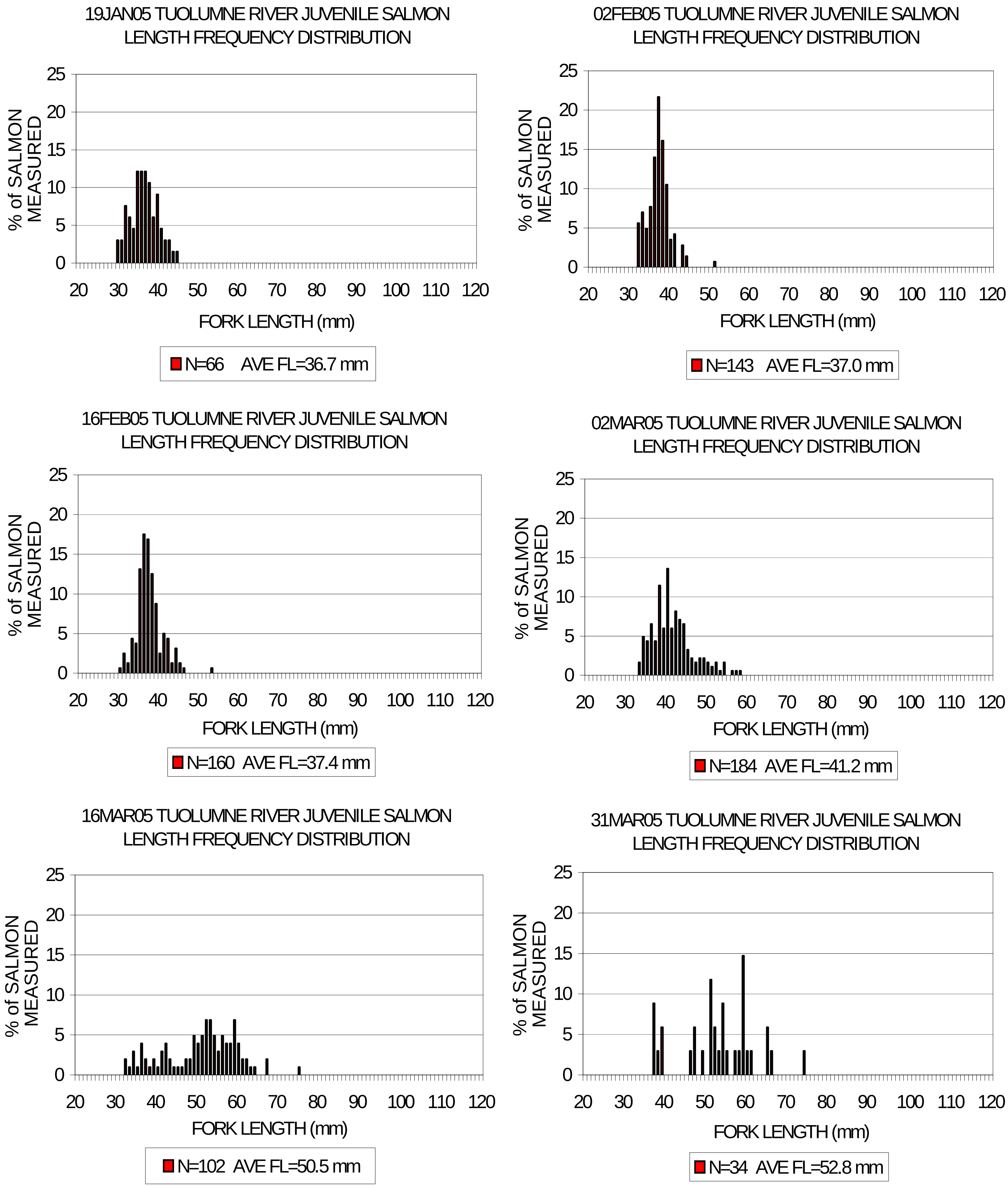


Figure 7. Length frequency distribution by date of salmon in the Tuolumne River, 2005.

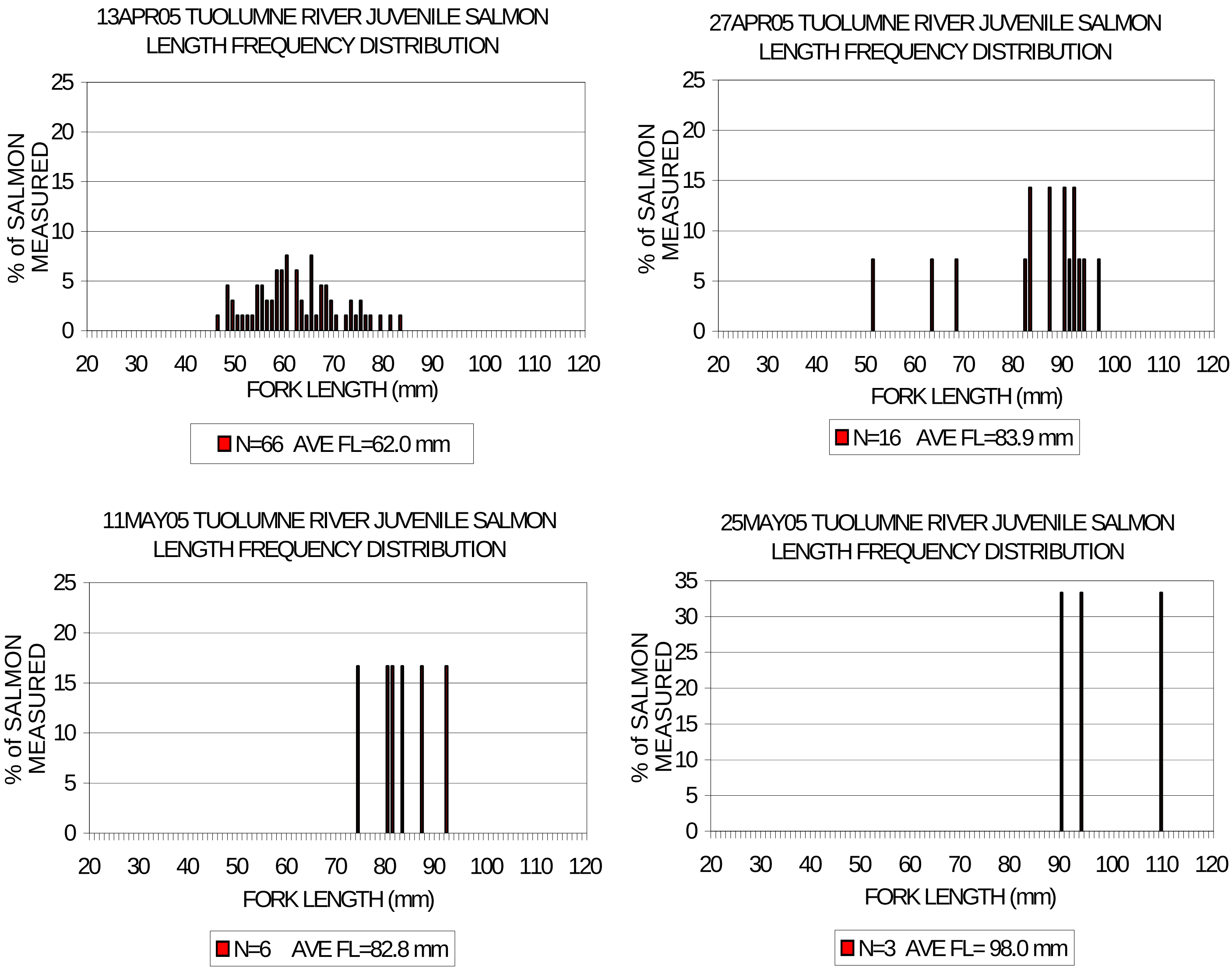


Figure 8. Length frequency distribution by date of salmon in the Tuolumne River, 2005.

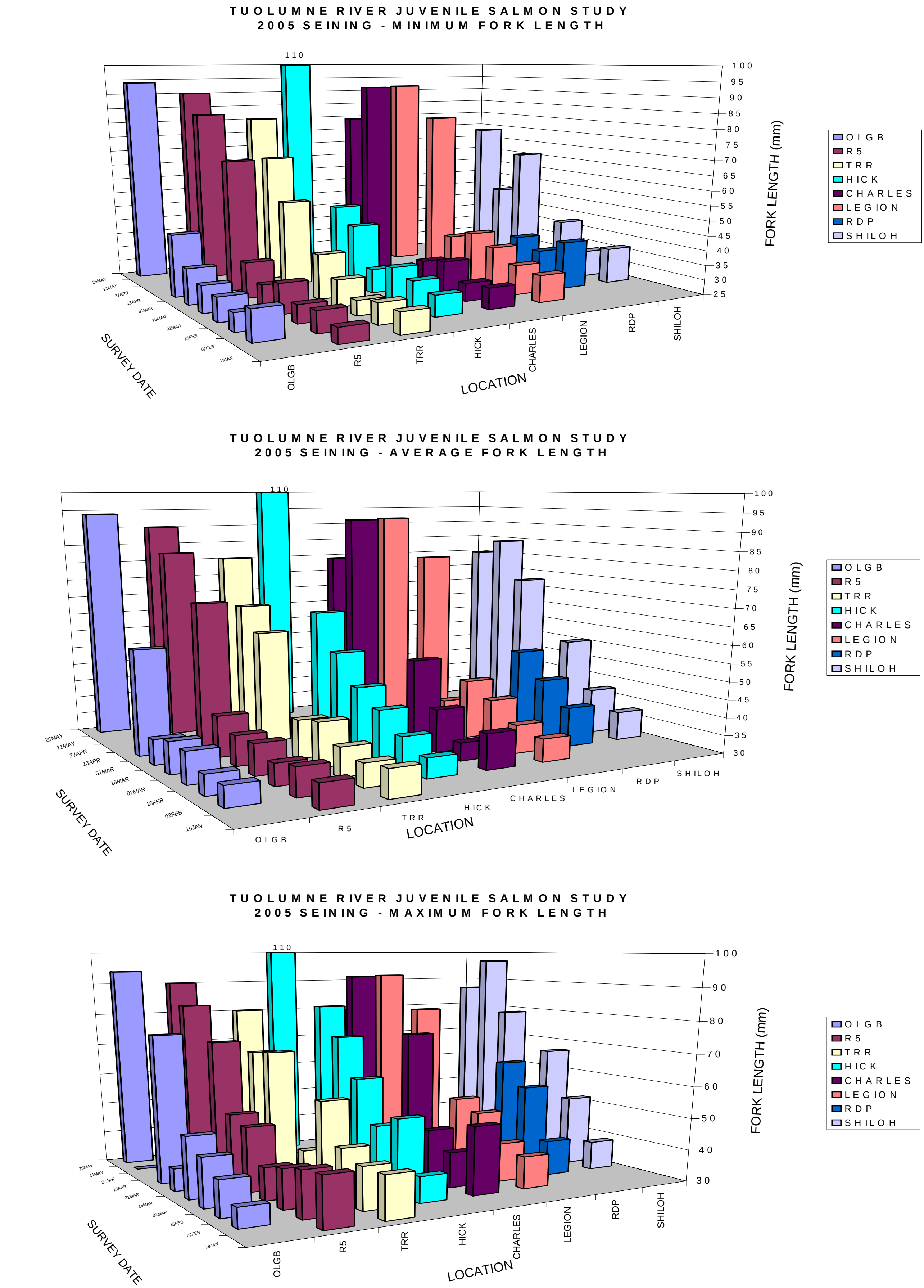
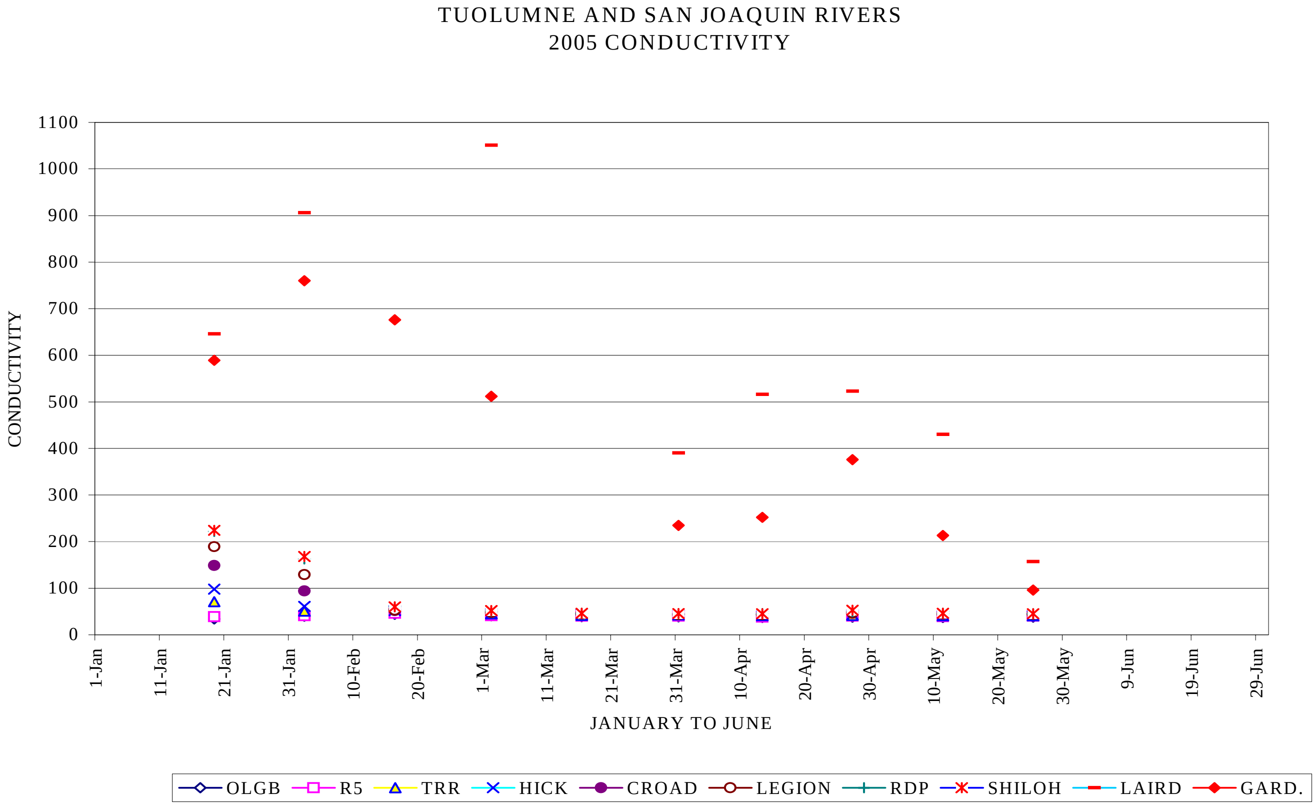


Figure 9. Minimum, average, and maximum fork length by location and survey period, 2005.



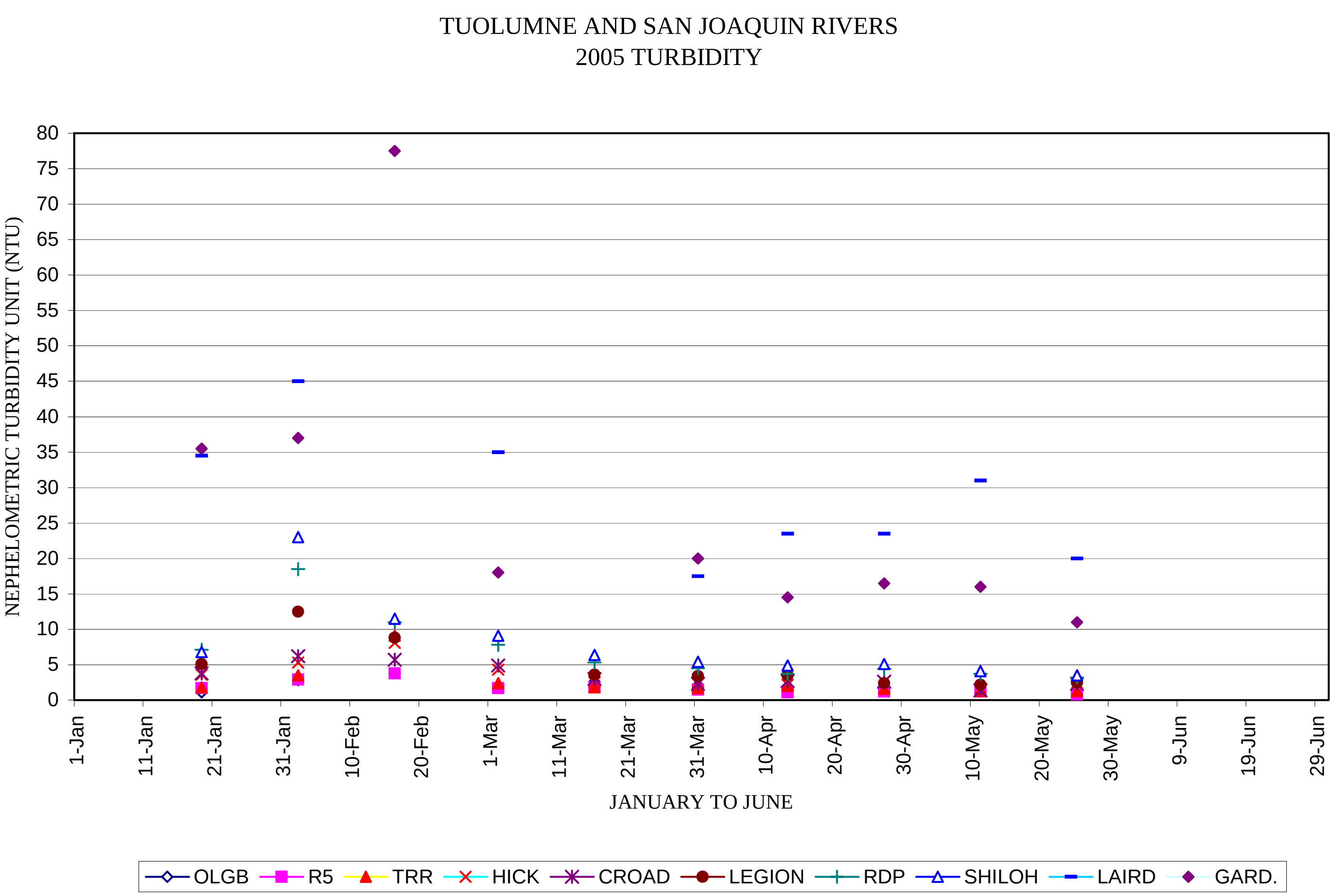
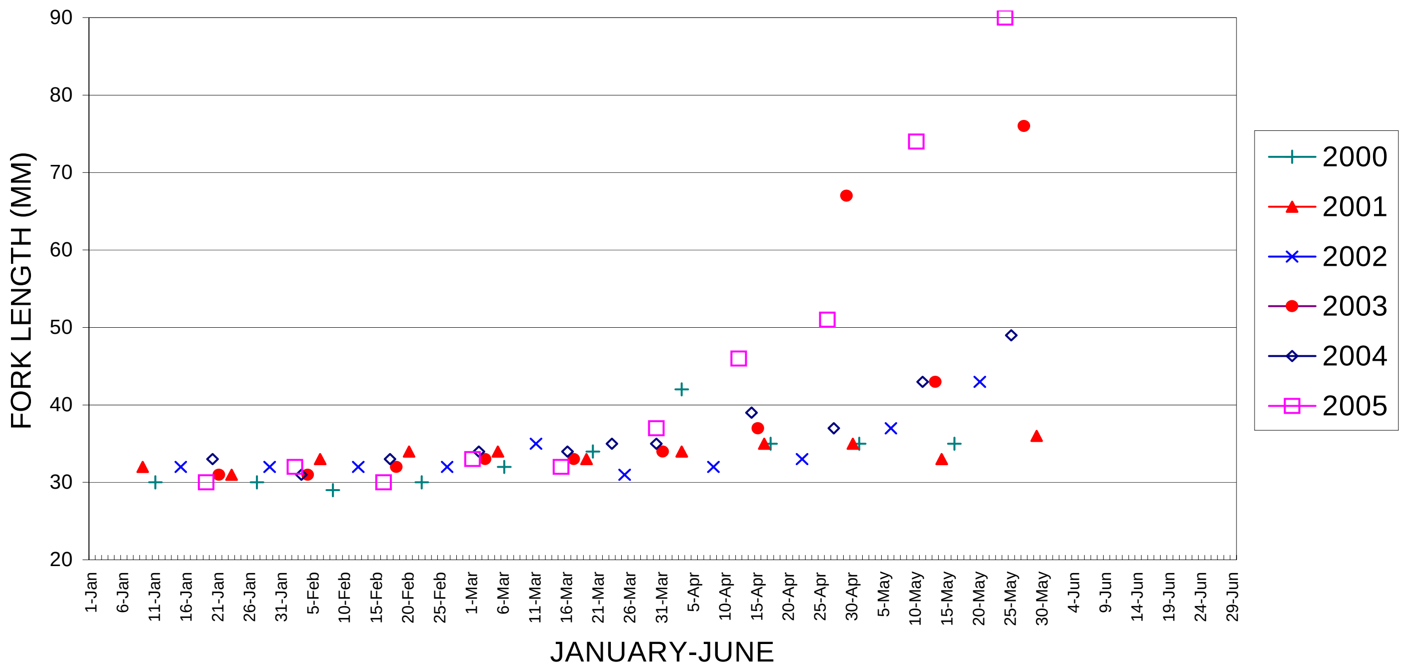
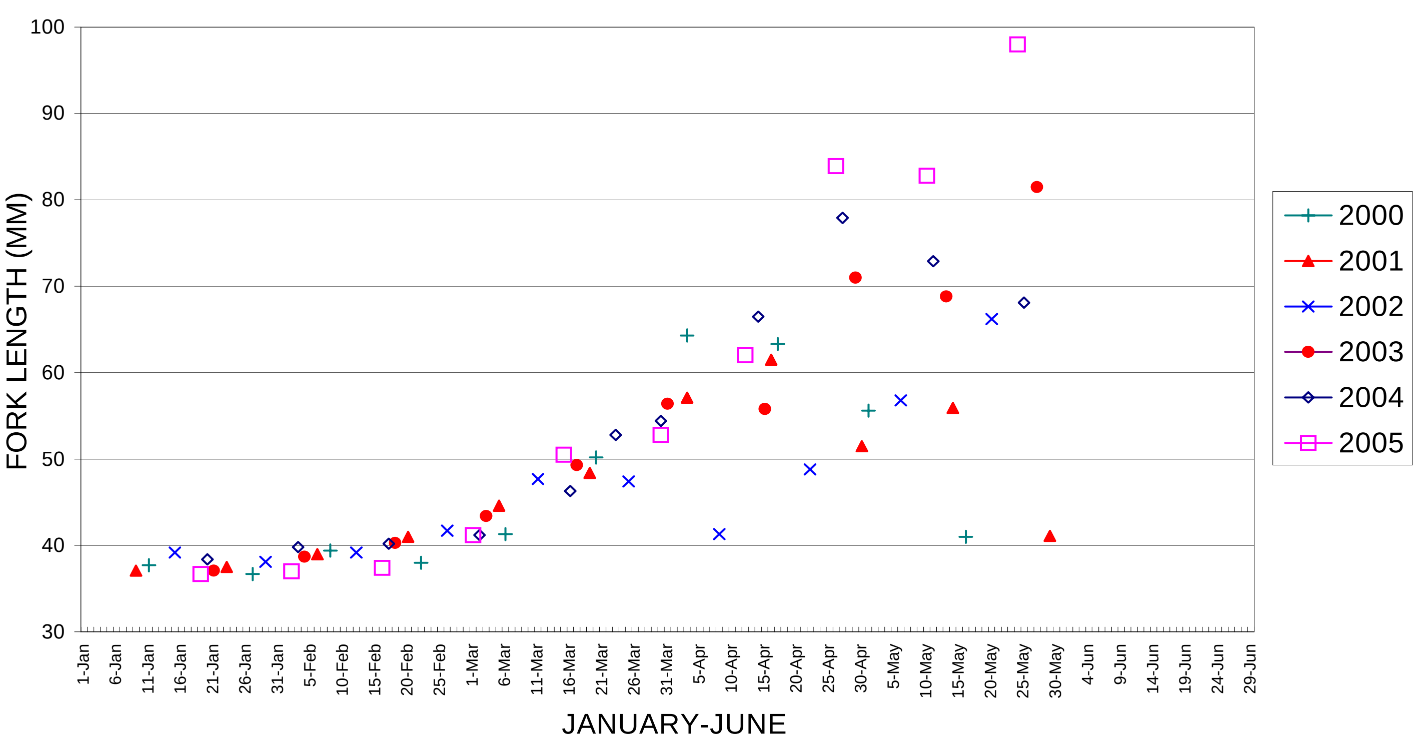


Figure 10. Conductivity and turbidity in the Tuolumne and San Joaquin Rivers, 2005

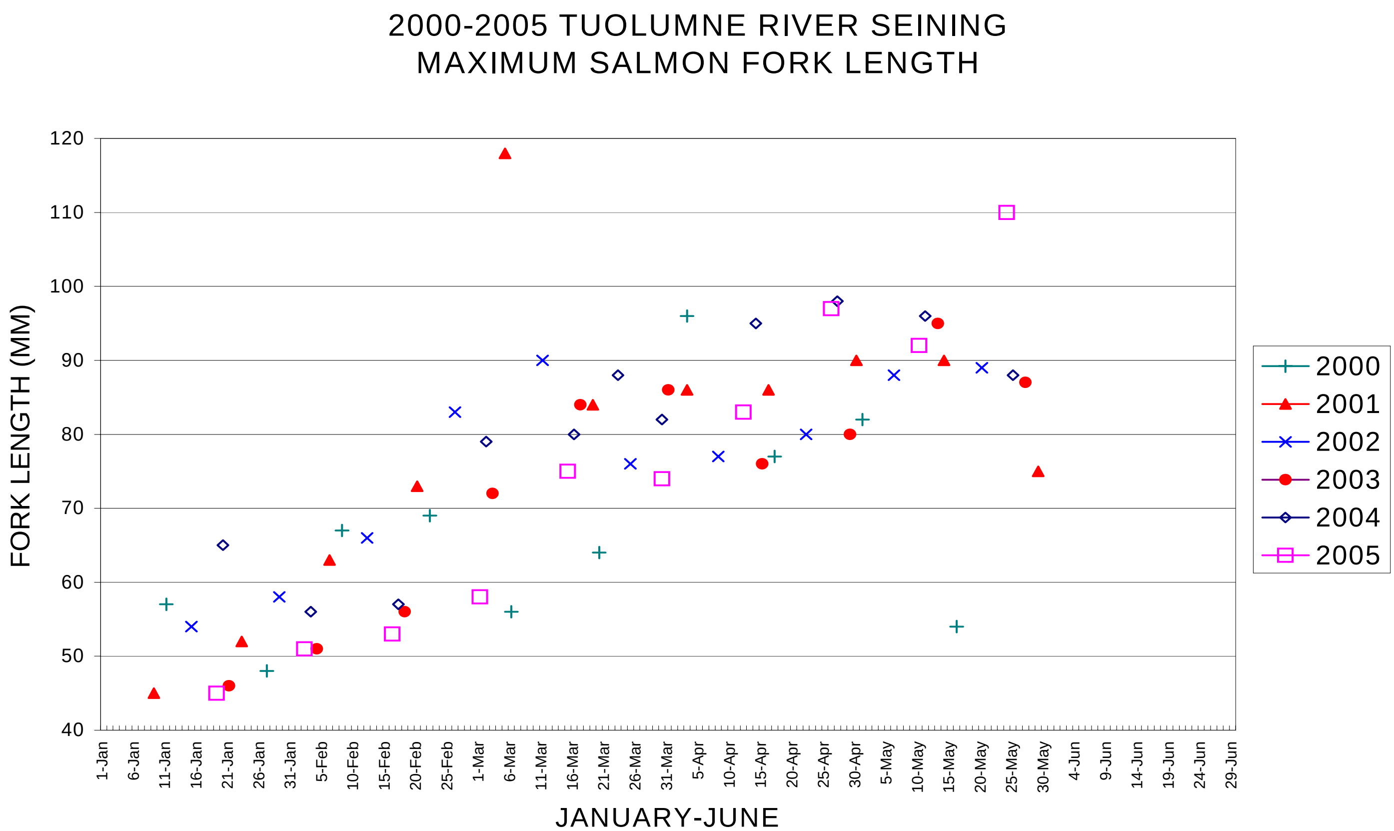
2000-2005 TUOLUMNE RIVER SEINING
MINIMUM SALMON FORK LENGTH

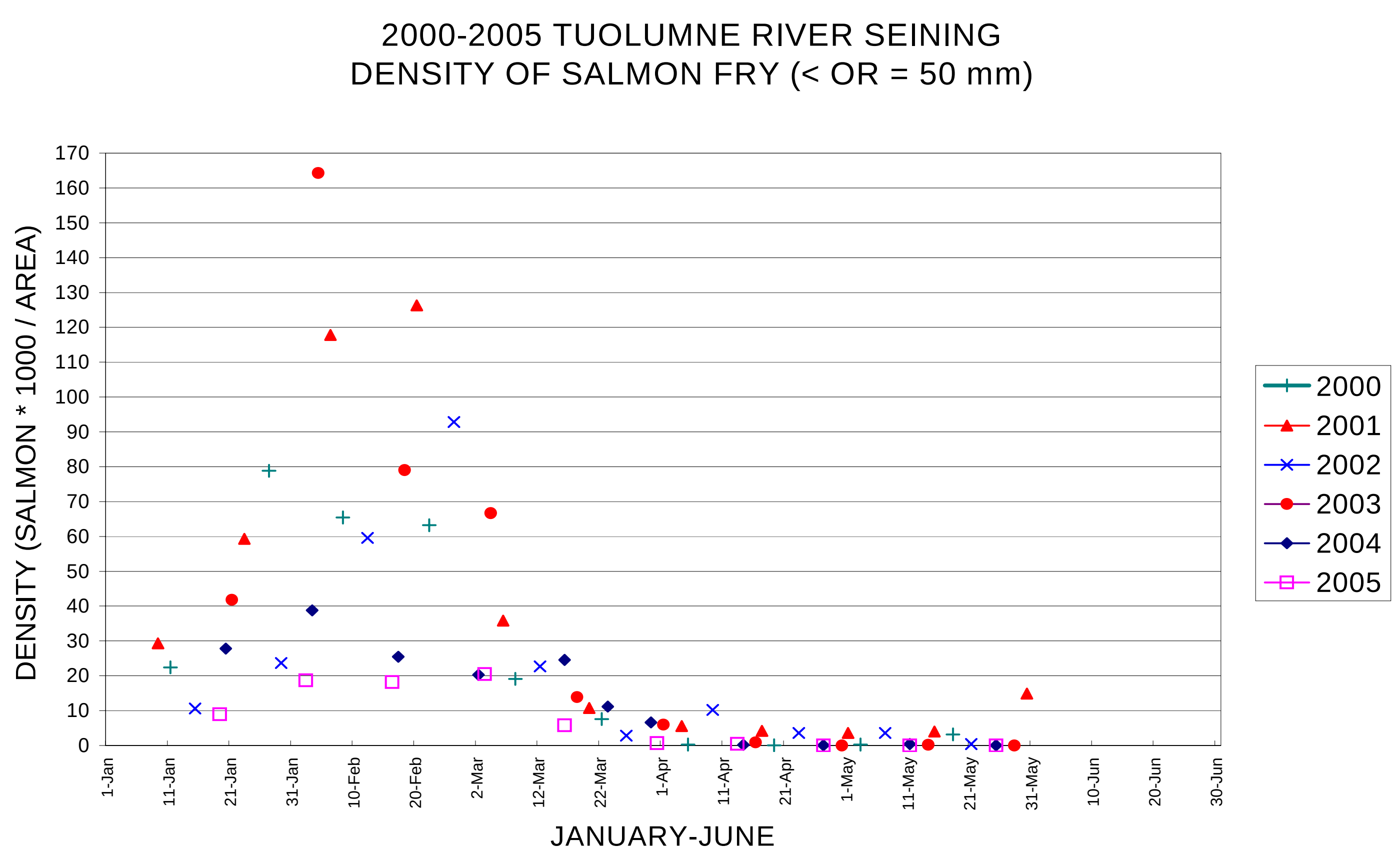


2000-2005 TUOLUMNE RIVER SEINING
AVERAGE SALMON FORK LENGTH

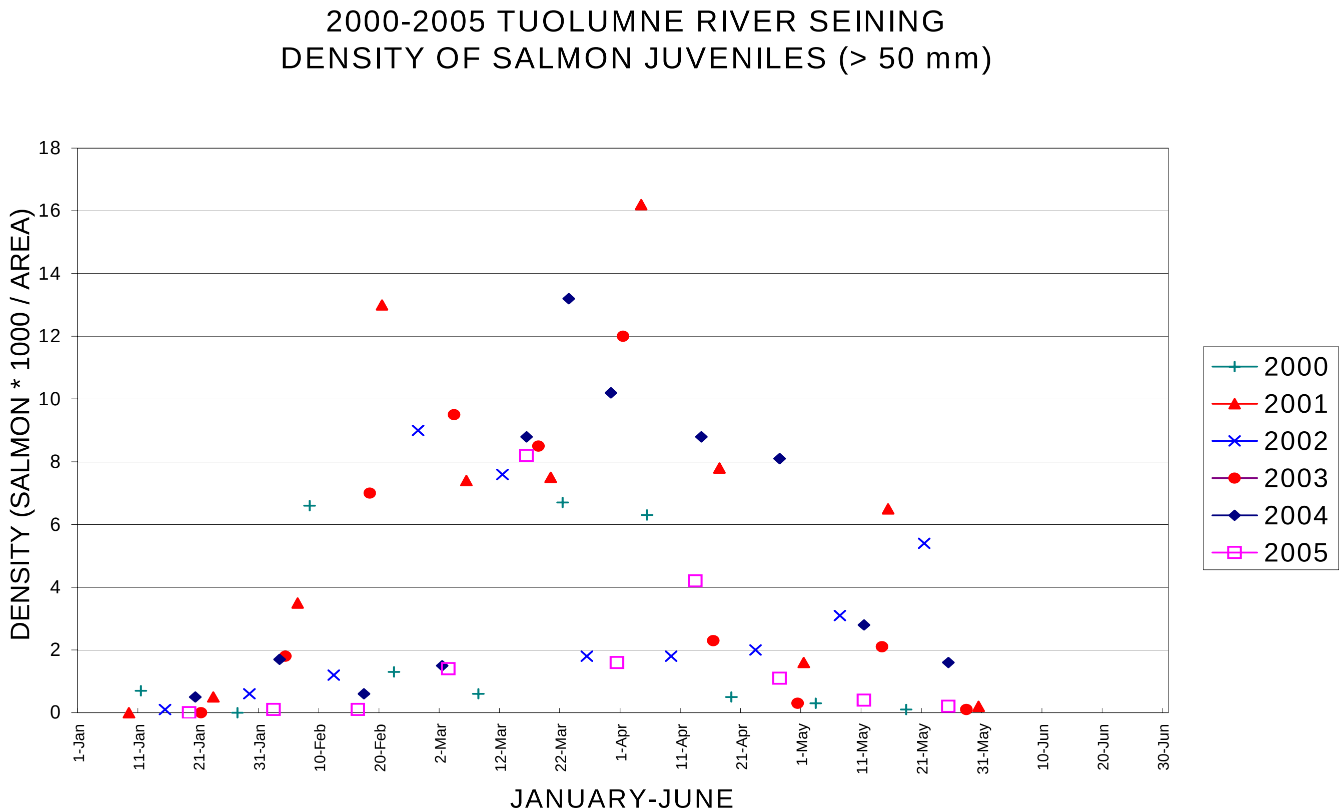


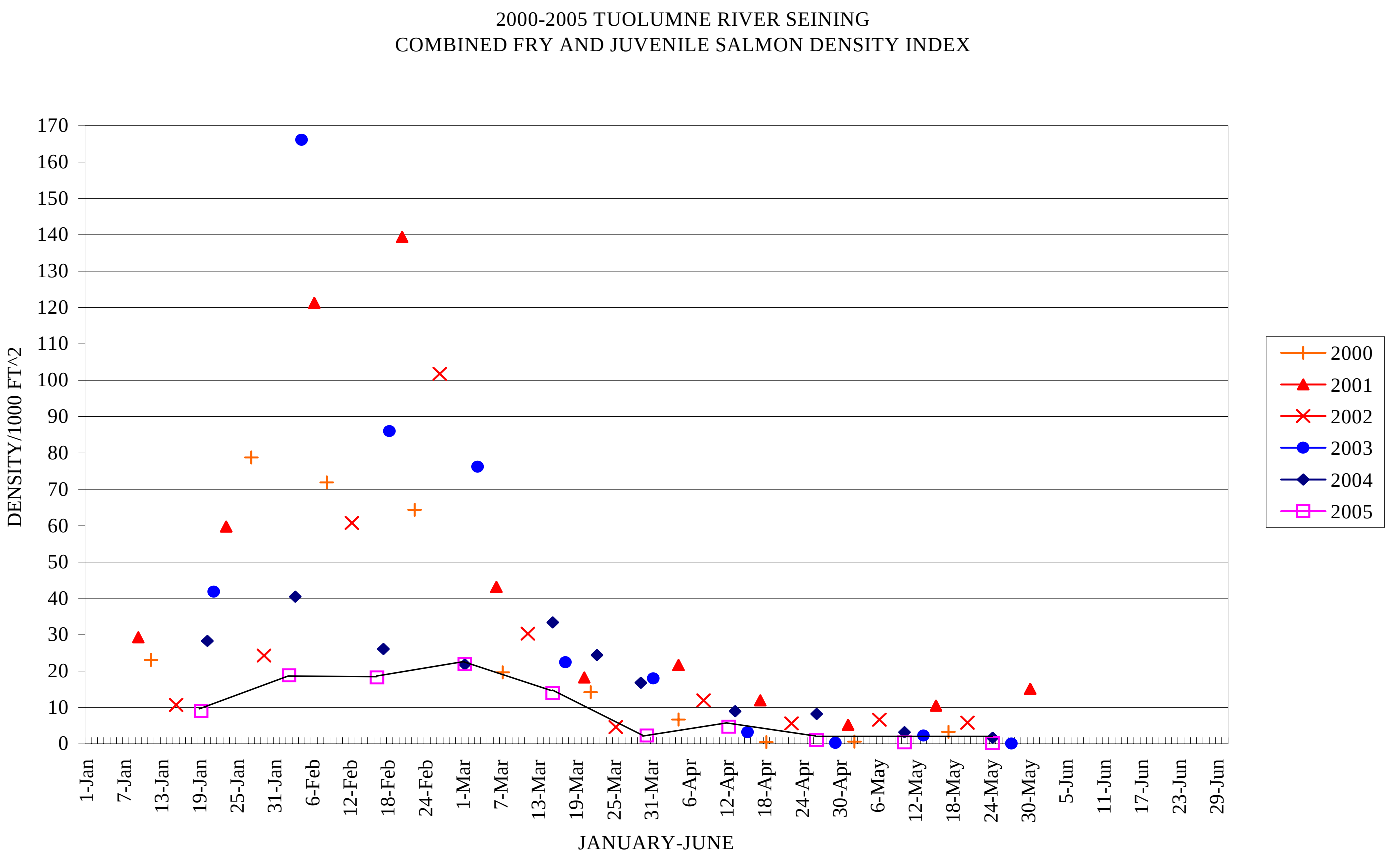
Figures 11 & 12. Minimum and average fork lengths of Tuolumne River salmon, 2000-2005.



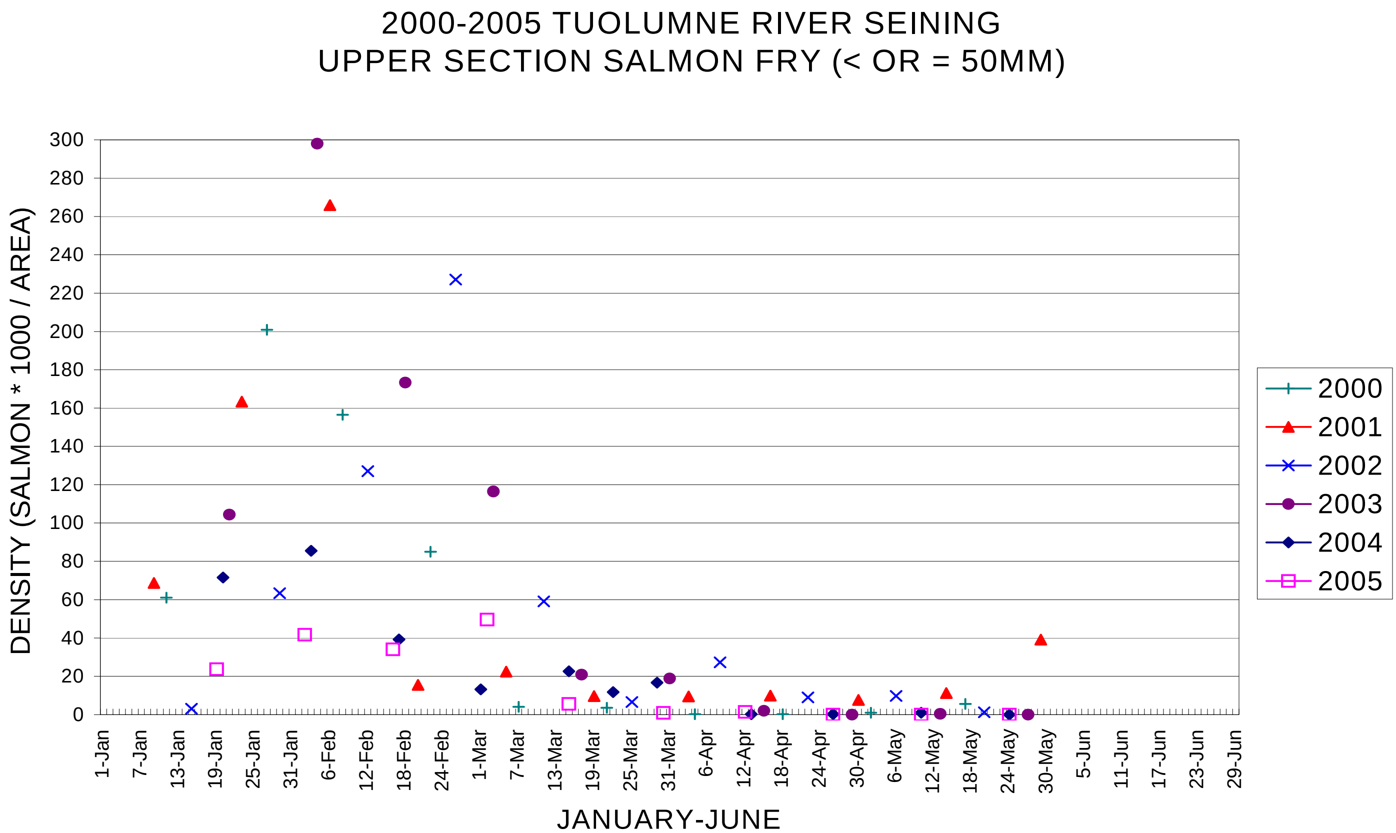


Figures 13 & 14. Maximum fork length and Density index of salmon fry, 2000-2005.





Figures 15 & 16. Density index of salmon juveniles and total river salmon catch, 2000-2005.



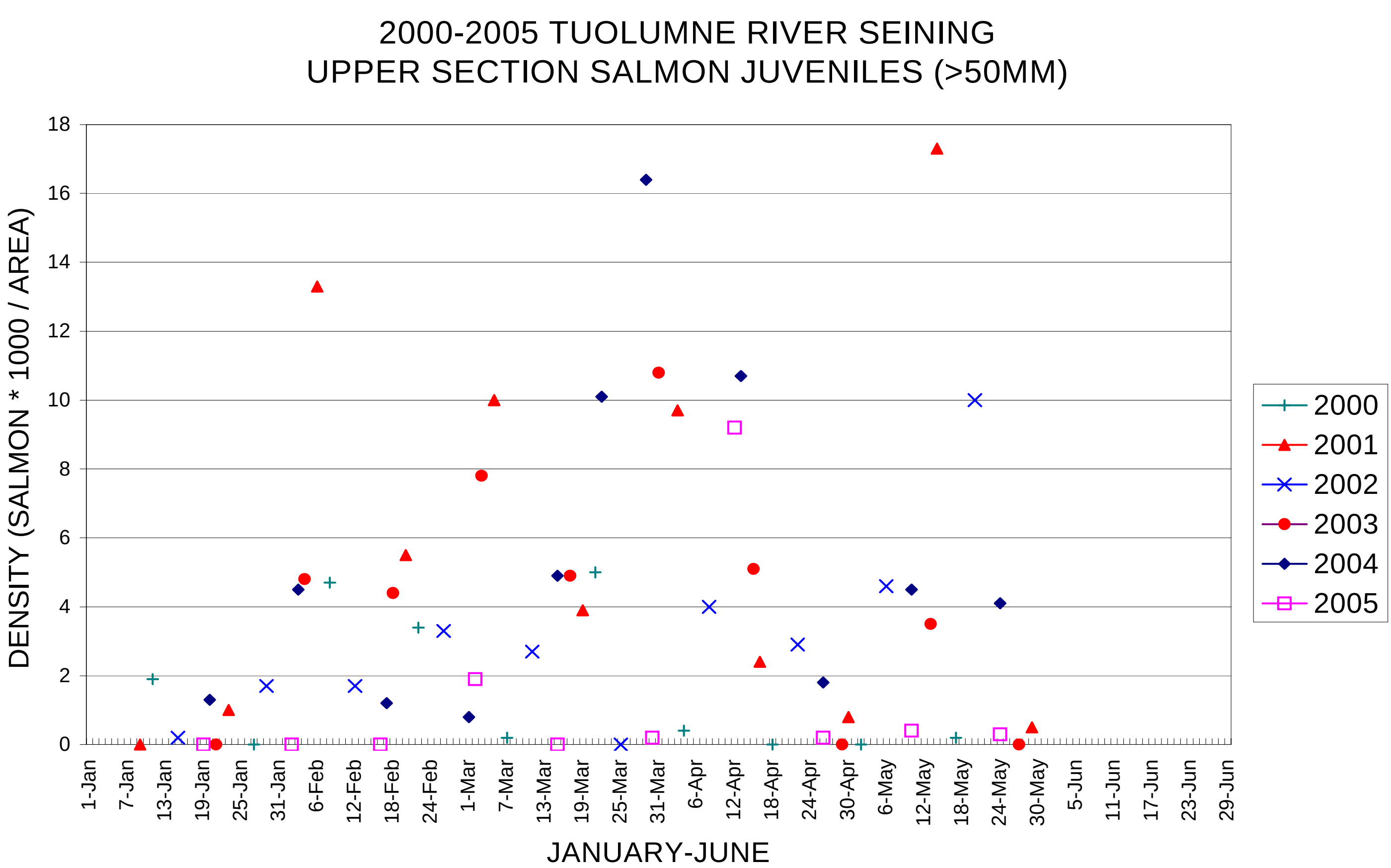
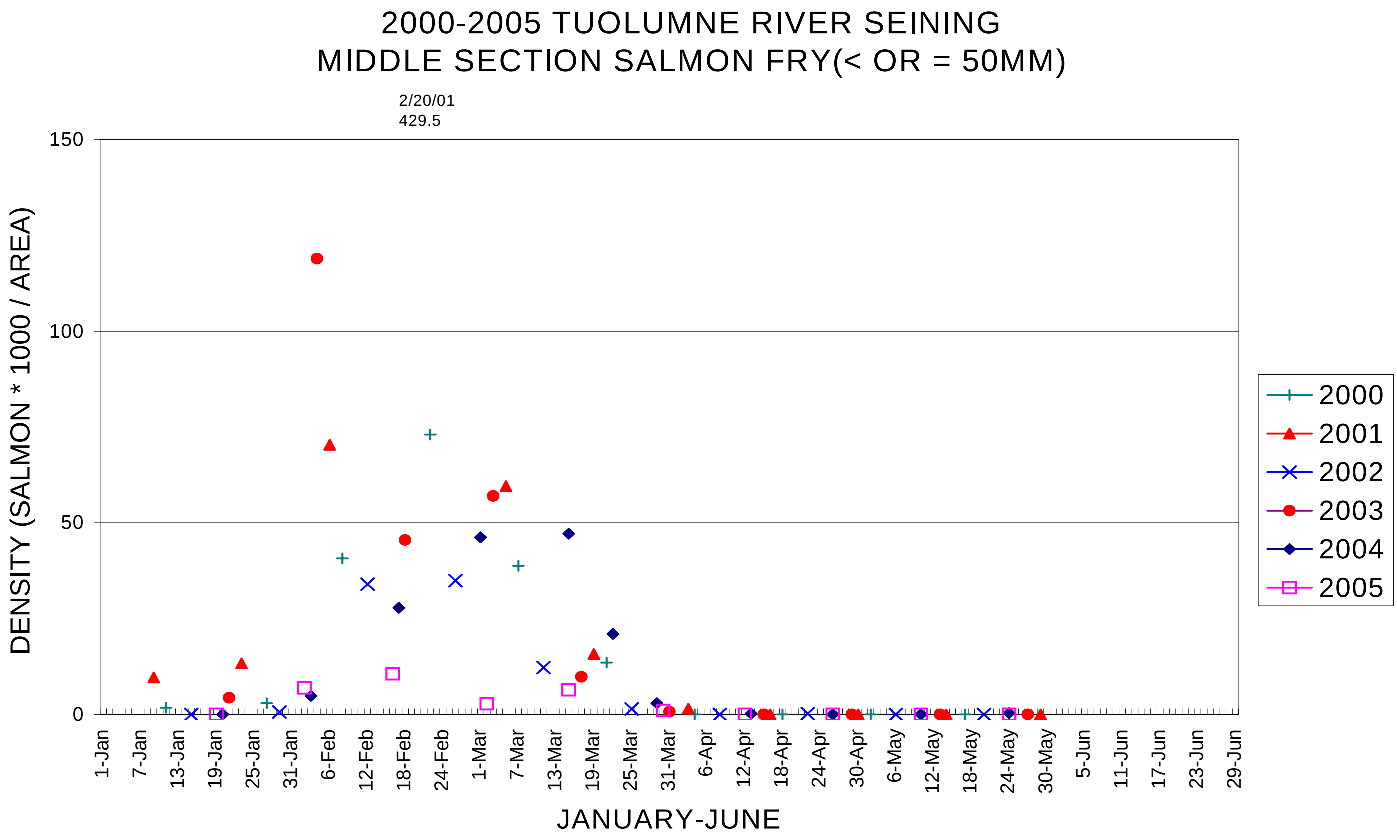


Figure 17A. Upper section density indices for salmon fry and juveniles, 2000-2005.



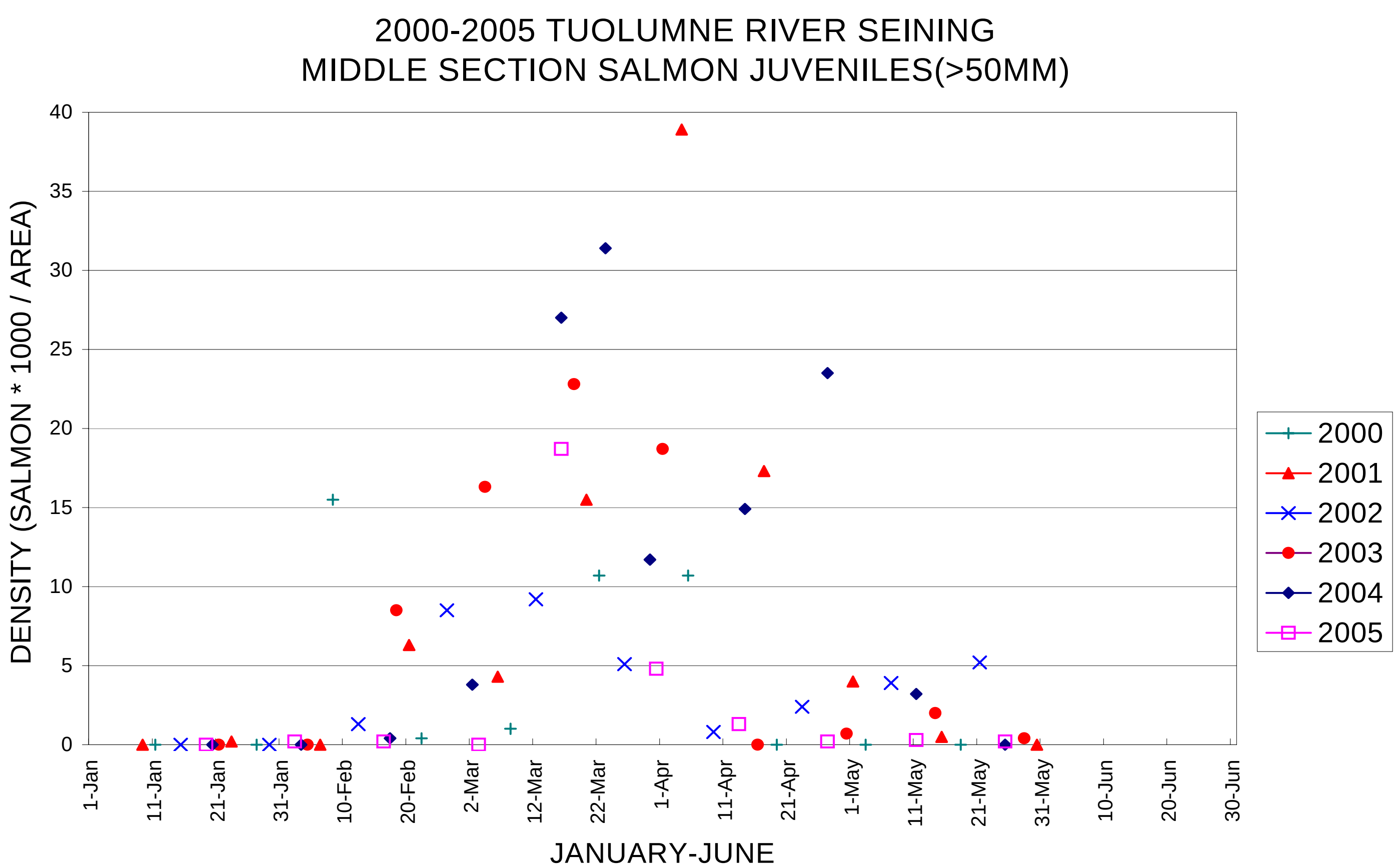
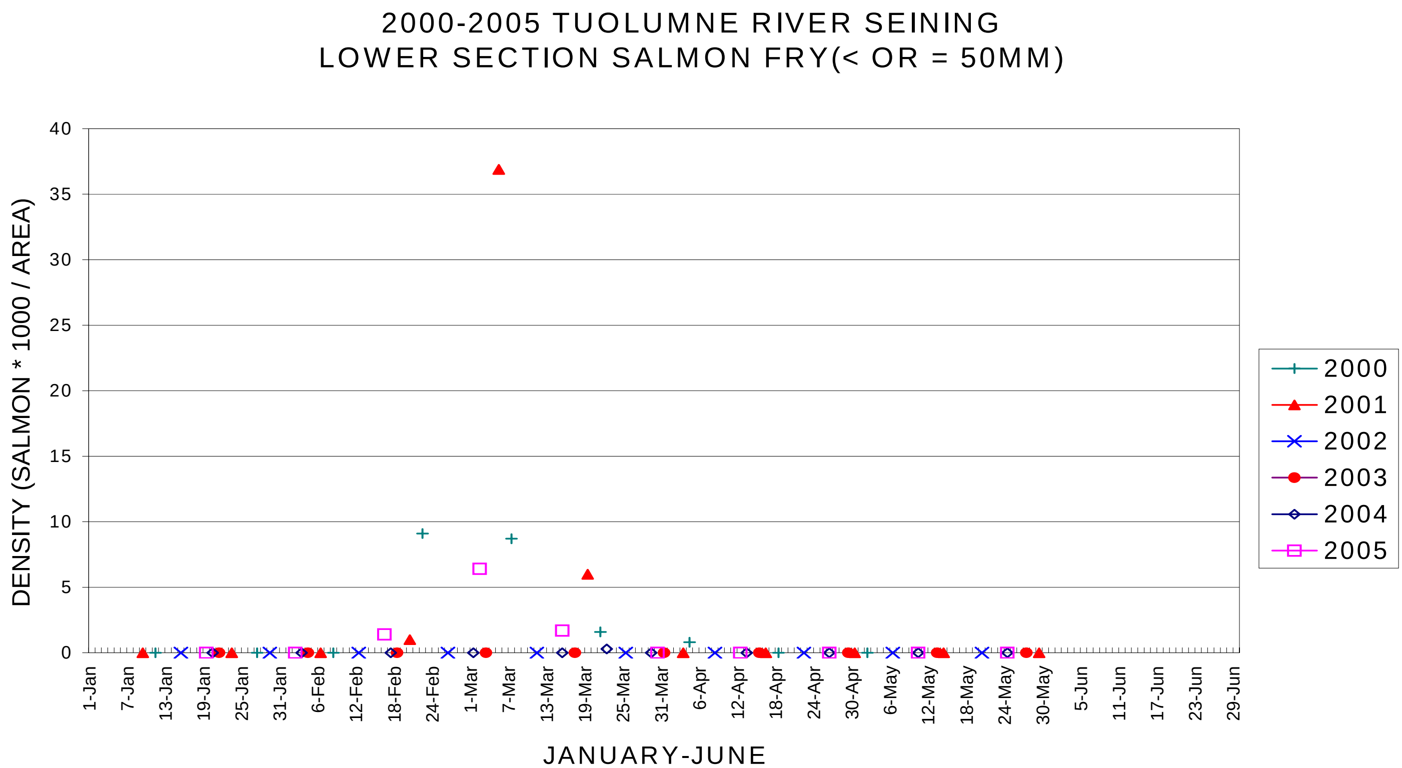


Figure 17B. Middle section density indices for salmon fry and juveniles, 2000-2005.



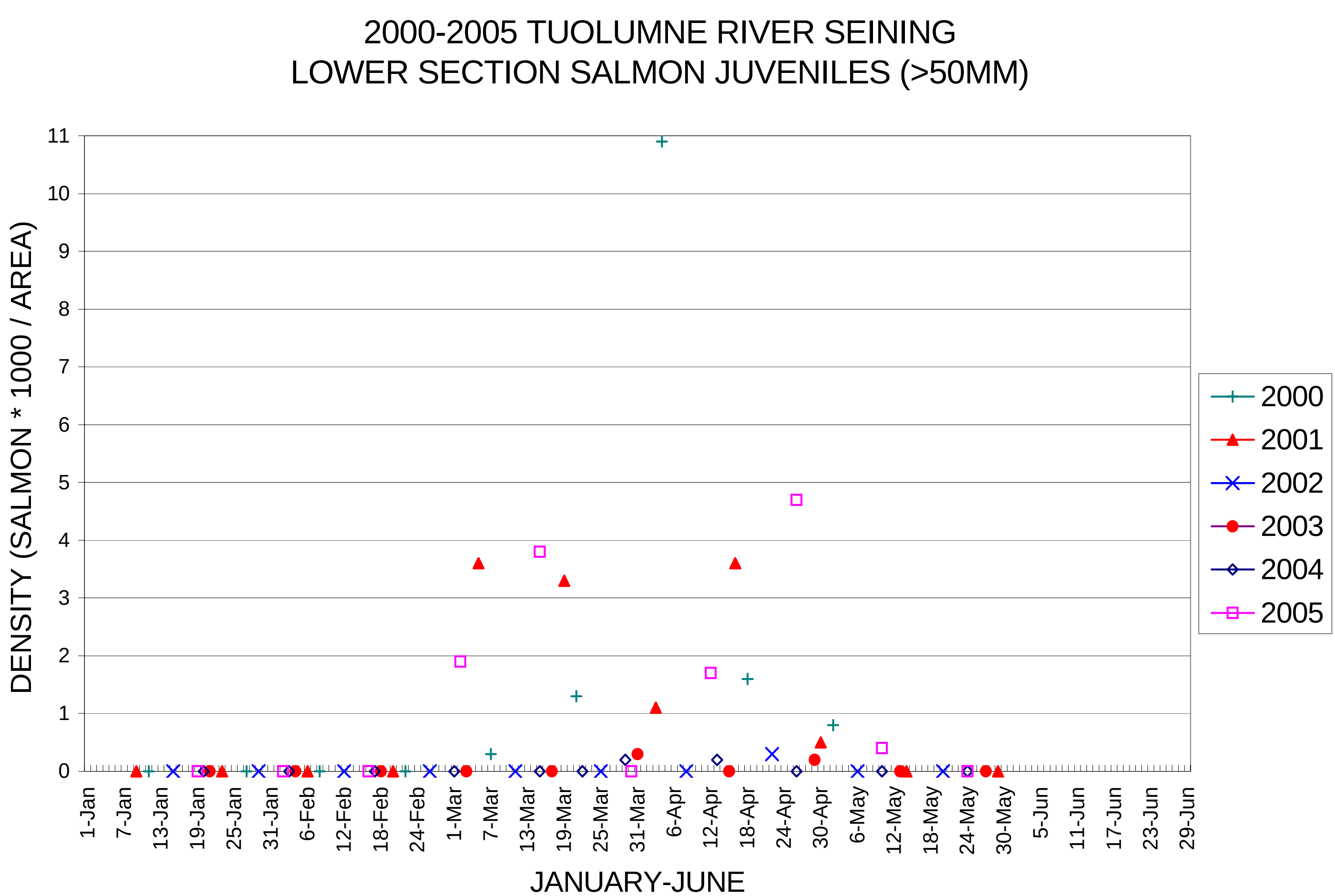


Figure 17C. Lower section density indices for salmon fry and juveniles, 2000-2005.

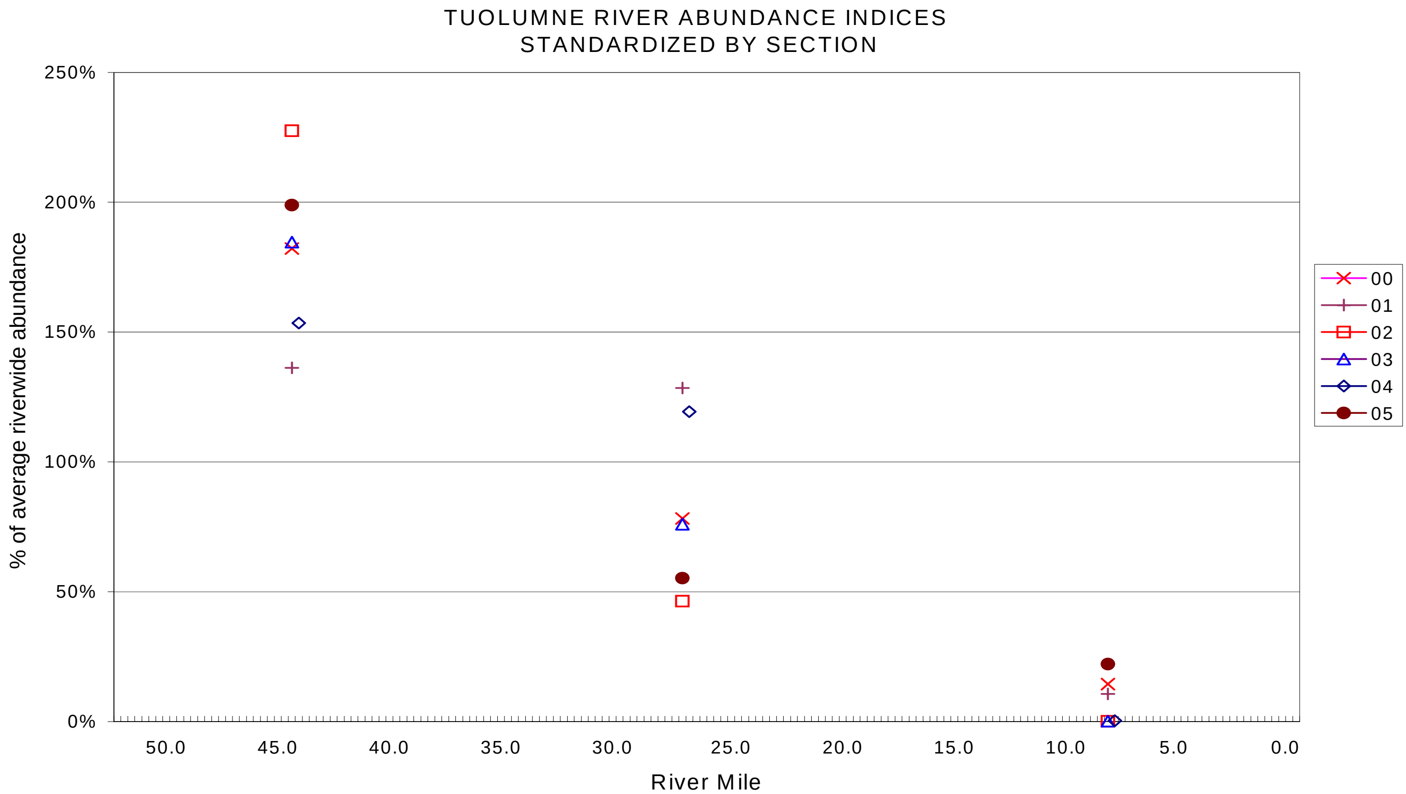


Figure 18. Tuolumne River abundance indices standardized by section, 2000-2005.

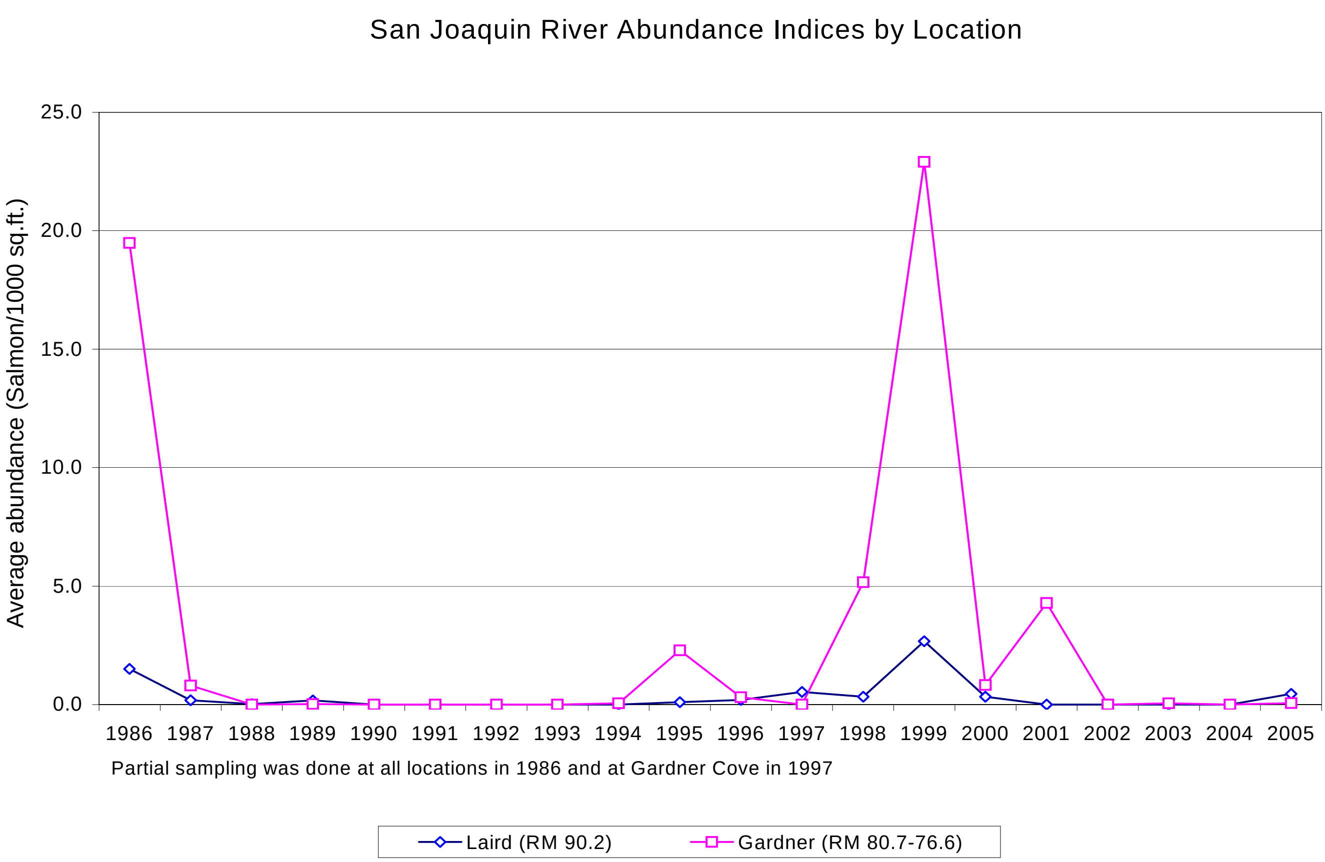


Figure 19. San Joaquin River abundance indices by location, 1986-2005.

PEAK FRY DENSITY VS FEMALE SPAWNER

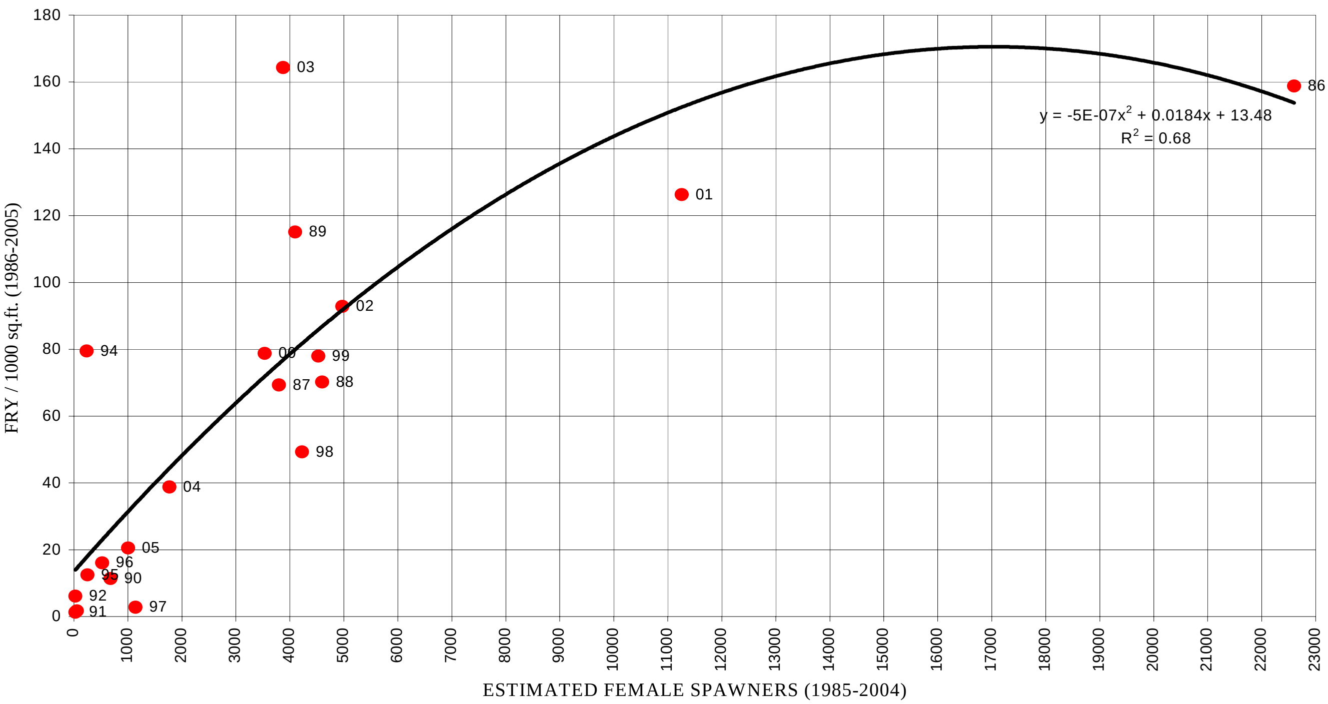


Figure 20. Tuolumne River peak fry density vs female spawners.

AVERAGE FRY DENSITY VS FEMALE SPAWNERS
(15JAN-15MAR PERIOD)

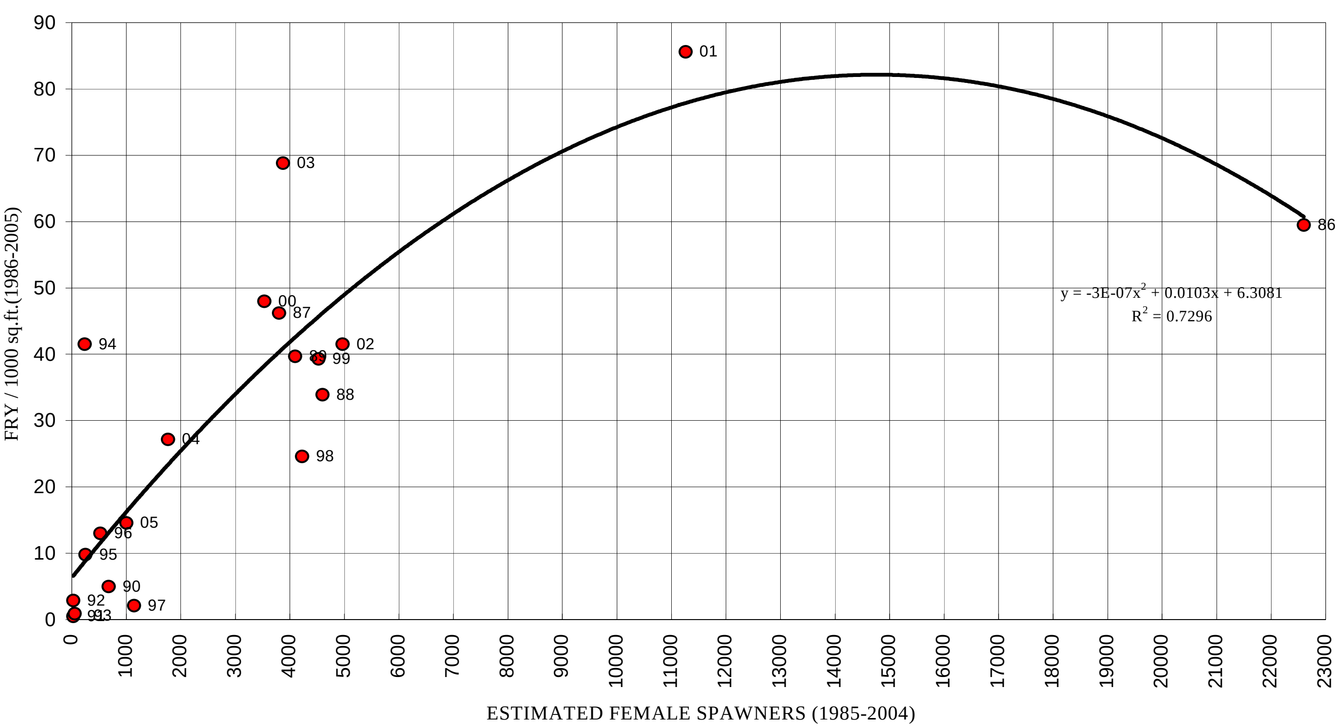


Figure 21. Tuolumne River average fry density vs female spawners.

Table 1. Summary table of weekly seine catch for the Tuolumne and San Joaquin Rivers, 2005.

2005 JUVENILE SALMON SEINING STUDY (TID/MID)

TUOLUMNE RIVER

DATE	SALMON CATCH	AREA (SQ. FT.)	DENSITY (/1000 ft^2)	MINIMUM FL	MAXIMUM FL	AVERAGE FL	NUMBER MEAS.	SACFRY	NUMBER KILLED
19JAN	147	16,400	9.0	30	45	36.7	66	4	4
02FEB	278	14,800	18.8	32	51	37.0	143	0	0
16FEB	253	13,850	18.3	30	53	37.4	160	0	0
02MAR	365	16,670	21.9	33	58	41.2	184	1	1
16MAR	173	12,350	14.0	32	75	50.5	102	1	2
31MAR	34	14,800	2.3	37	74	52.8	34	0	0
13APR	66	14,000	4.7	46	83	62.0	66	0	0
27APR	16	14,460	1.1	51	97	83.9	16	0	0
11MAY	6	15,960	0.4	74	92	82.8	6	0	0
25MAY	3	17,600	0.2	90	110	98.0	3	0	0
TOTAL:	1,341	150,890	8.9				780	6	7

SAN JOAQUIN RIVER

DATE	SALMON CATCH	AREA (SQ. FT.)	DENSITY (/1000 ft^2)	MINIMUM FL	MAXIMUM FL	AVERAGE FL	NUMBER MEAS.	SACFRY	NUMBER KILLED
19JAN	0	4,000	0.0						
02FEB	0	3,800	0.0						
16FEB	0	2,200	0.0						
02MAR	7	4,400	1.6	39	68	53.7	7	0	0
16MAR	-------	-------							
31MAR	0	2,050	0.0						
13APR	0	4,000	0.0						
27APR	1	3,480	0.3	60	60	60.0	1	0	0
11MAY	0	4,800	0.0						
25MAY	0	3,600	0.0						
TOTAL:	8	32,330	0.2				8	0	0

Table 2. Summary table of weekly seine catch by location for the Tuolumne and San Joaquin Rivers, 2005

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	MIDDLE SECTION Density Fry	LOWER SECTION Density Fry	UPPER SECTION Density Juvenile	MIDDLE SECTION Density Juvenile	LOWER SECTION Density Juvenile
19JAN	OLGB	0	2,200					0.0		23.7	0.0	0.0	0.0	0.0	0.0
19JAN	R5	133	2,000	52	0	66.5	0.0	66.5	36.5						
19JAN	TLSRA	14	2,000	14	0	7.0	0.0	7.0	37.6						
19JAN	HICKMAN	0	1,800					0.0							
19JAN	CHARLES	0	2,000					0.0							
19JAN	LEGION	0	2,400					0.0							
19JAN	VENN	0	1,800					0.0							
19JAN	SHILOH	0	2,200					0.0							
19JAN	LAIRD	0	1,800					0.0							
19JAN	GARDNER	0	2,200					0.0							
TUOL.TOT.		147	16400	66	0	9.0	0.0	9.0	36.7						
SJR. TOT.		0	4000					0.0							

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	MIDDLE SECTION Density Fry	LOWER SECTION Density Fry	UPPER SECTION Density Juvenile	MIDDLE SECTION Density Juvenile	LOWER SECTION Density Juvenile
02FEB	OLGB	2	2200	2	0	0.9	0.0	0.9	35.5	41.7	6.9	0.0	0.0	0.2	0.0
02FEB	R5	91	1650	51	0	55.2	0.0	55.2	37.7						
02FEB	TRR	151	2000	56	0	75.5	0.0	75.5	36.4						
02FEB	HICKMAN	14	1350	14	0	10.4	0.0	10.4	35.5						
02FEB	CHARLES	11	1000	10	1	10.0	1.0	11.0	39.8						
02FEB	LEGION	9	2400	9	0	3.8	0.0	3.8	36.4						
02FEB	VENN	0	1800					0.0							
02FEB	SHILOH	0	2400					0.0							
02FEB	LAIRD	0	2000					0.0							
02FEB	GARDNER	0	1800					0.0							
TUOL.TOT.		278	14800	142	1	18.7	0.1	18.8	37.0						
SJR. TOT.		0	3800					0.0							

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	MIDDLE SECTION Density Fry	LOWER SECTION Density Fry	UPPER SECTION Density Juvenile	MIDDLE SECTION Density Juvenile	LOWER SECTION Density Juvenile
16FEB	OLGB	4	2000	4	0	2.0	0.0	2.0	35.5	34.1	10.6	1.4	0.0	0.2	0.0
16FEB	R5	53	2250	53	0	23.6	0.0	23.6	36.0						
16FEB	TRR	144	1650	51	0	87.3	0.0	87.3	38.0						
16FEB	HICKMAN	35	1800	34	1	18.9	0.6	19.4	38.7						
16FEB	CHARLES	5	1850	5	0	2.7	0.0	2.7	35.0						
16FEB	LEGION	7	700	7	0	10.0	0.0	10.0	38.0						
16FEB	VENN	1	1200	1	0	0.8	0.0	0.8	41.0						
16FEB	SHILOH	4	2400	4	0	1.7	0.0	1.7	38.0						
Not sampled	LAIRD														
16FEB	GARDNER	0	2200					0.0							
TUOL.TOT.		253	13850	159	1	18.2	0.1	18.3	37.4						
SJR. TOT.		0	2200					0.0							

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	MIDDLE SECTION Density Fry	LOWER SECTION Density Fry	UPPER SECTION Density Juvenile	MIDDLE SECTION Density Juvenile	LOWER SECTION Density Juvenile
02MAR	OLGB	222	2400	69	0	92.5	0.0	92.5	38.7	49.6	2.8	6.4	1.9	0.0	1.9
02MAR	R5	11	3000	11	0	3.7	0.0	3.7	38.6						
02MAR	TRR	82	720	49	5	103.3	10.5	113.9	42.3						
02MAR	HICKMAN	13	2200	13	0	5.9	0.0	5.9	43.7						
02MAR	CHARLES	3	2200	3	0	1.4	0.0	1.4	42.0						
02MAR	LEGION	3	2400	3	0	1.3	0.0	1.3	43.0						
02MAR	RDP	13	1350	8	5	5.9	3.7	9.6	47.2						
02MAR	SHILOH	18	2400	16	2	6.7	0.8	7.5	42.7						
02MAR	LAIRD	7	2000	1	6	0.5	3.0	3.5	53.7						
02MAR	GARDNER	0	2400					0.0							
TUOL.TOT.		365	16670	172	12	20.5	1.4	21.9	41.2						
SJR. TOT.		7	4400	1	6	0.2	1.4	1.6	53.7						

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	MIDDLE SECTION Density Fry	LOWER SECTION Density Fry	UPPER SECTION Density Juvenile	MIDDLE SECTION Density Juvenile	LOWER SECTION Density Juvenile
16MAR	OLGB	9	1200	9	0	7.5	0.0	7.5	38.8	5.6	6.4	1.7	0.0	18.7	3.8
16MAR	R5	8	1250	8	0	6.4	0.0	6.4	38.4						
16MAR	TRR	3	1100	3	0	2.7	0.0	2.7	40.7						
16MAR	HICKMAN	8	1600	4	4	2.5	2.5	5.0	48.0						
16MAR	CHARLES	123	2350	10	42	10.1	42.3	52.3	54.1						
16MAR	LEGION	3	1400	2	1	1.4	0.7	2.1	46.7						
16MAR	RDP	10	1050	3	7	2.9	6.7	9.5	54.0						
16MAR	SHILOH	9	2400	3	6	1.3	2.5	3.8	55.8						
16MAR	LAIRD	NOT SAMPLED													
16MAR	GARDNER	NOT SAMPLED													
TUOL.TOT.		173	12350	42	60	5.8	8.2	14.0	50.5						
SJR. TOT.															

Table 2 (Continued)

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	EXTRAPOLATED MIDDLE SECTION Density Fry	EXTRAPOLATED LOWER SECTION Density Fry	EXTRAPOLATED UPPER SECTION Density Juvenile	EXTRAPOLATED MIDDLE SECTION Density Juvenile	EXTRAPOLATED LOWER SECTION Density Juvenile
31MAR	OLGB	2	2400	2	0	0.8	0.0	0.8	37.0	0.9	1.0	0.0	0.2	4.8	0.0
31MAR	R4B	4	2400	3	1	1.3	0.4	1.7	41.5						
31MAR	TRR	0	1000					0.0							
31MAR	HICK	27	1800	4	23	2.2	12.8	15.0	56.1						
31MAR	CHARLES	0	600					0.0							
31MAR	LEGION	1	2400	1	0	0.4	0.0	0.4	39.0						
31MAR	RDP	0	2400					0.0							
31MAR	SHILOH	0	1800					0.0							
31MAR	LAIRD	0	1350					0.0							
31MAR	GARDNER	0	700					0.0							
TUOL.TOT.		34	14800	10	24	0.7	1.6	2.3	52.8						
SJR. TOT.		0	2050					0.0							

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	EXTRAPOLATED MIDDLE SECTION Density Fry	EXTRAPOLATED LOWER SECTION Density Fry	EXTRAPOLATED UPPER SECTION Density Juvenile	EXTRAPOLATED MIDDLE SECTION Density Juvenile	EXTRAPOLATED LOWER SECTION Density Juvenile
13APR	OLGB	48	2400	7	41	2.9	17.1	20.0	59.3	1.4	0.0	0.0	9.2	1.3	1.7
13APR	R4B	3	1800	0	3	0.0	1.7	1.7	70.7						
13APR	TRR	2	800	0	2	0.0	2.5	2.5	61.5						
13APR	HICKMAN	6	2200	0	6	0.0	2.7	2.7	66.3						
13APR	CHARLES	0	1200					0.0							
13APR	LEGION	1	2000	0	1	0.0	0.5	0.5	81.0						
13APR	RDP	0	1200					0.0							
13APR	SHILOH	6	2400	0	6	0.0	2.5	2.5	72.8						
13APR	LAIRD	0	2400					0.0							
13APR	GARDNER	0	1600					0.0							
TUOL.TOT.		66	14000	7	59	0.5	4.2	4.7	62.0						
SJR. TOT.		0	4000					0.0							

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	EXTRAPOLATED MIDDLE SECTION Density Fry	EXTRAPOLATED LOWER SECTION Density Fry	EXTRAPOLATED UPPER SECTION Density Juvenile	EXTRAPOLATED MIDDLE SECTION Density Juvenile	EXTRAPOLATED LOWER SECTION Density Juvenile
27APR	OLGB	0	2400					0.0		0.0	0.0	0.0	0.2	0.2	4.7
27APR	R5	0	2400					0.0							
27APR	TRR	1	880	0	1	0.0	1.1	1.1	68.0						
27APR	HICKMAN	0	1700					0.0							
27APR	CHARLES	1	2200	0	1	0.0	0.5	0.5	92.0						
27APR	LEGION	0	1900					0.0							
27APR	RDP	0	1180					0.0							
27APR	SHILOH	14	1800	0	14	0.0	7.8	7.8	84.5						
27APR	LAIRD	0	1080					0.0							
27APR	GARDNER	1	2400	0	1	0.0	0.4	0.4	60.0						
TUOL.TOT.		16	14460	0	16	0.0	1.1	1.1	83.9						
SJR. TOT.		1	3480	0	1	0.0	0.3	0.3	60.0						

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	EXTRAPOLATED MIDDLE SECTION Density Fry	EXTRAPOLATED LOWER SECTION Density Fry	EXTRAPOLATED UPPER SECTION Density Juvenile	EXTRAPOLATED MIDDLE SECTION Density Juvenile	EXTRAPOLATED LOWER SECTION Density Juvenile
11MAY	OLGB	0	2400					0.0		0.0	0.0	0.0	0.4	0.3	0.4
11MAY	R5	1	2200	0	1	0.0	0.5	0.5	83.0						
11MAY	TRR	1	760	0	1	0.0	1.3	1.3	81.0						
11MAY	HICKMAN	0	2000					0.0							
11MAY	CHARLES	1	2000	0	1	0.0	0.5	0.5	80.0						
11MAY	LEGION	1	2000	0	1	0.0	0.5	0.5	92.0						
11MAY	VENN	0	1800					0.0							
11MAY	SHILOH	2	2800	0	2	0.0	0.7	0.7	80.5						
11MAY	LAIRD	0	2400					0.0							
11MAY	GARDNER	0	2400					0.0							
TUOL.TOT.		6	15960	0	6	0.0	0.4	0.4	82.8						
SJR. TOT.		0	4800					0.0							

2005 Weekly Summary of TID/MID Seining Study
Salmon Density is the Number of Salmon / 1000 sq. ft.

Date	Location	Total Catch	Area	Measured Fry	Measured Juvenile	Extrapolated Density Fry	Extrapolated Density Juvenile	Density Total	Average FL	EXTRAPOLATED UPPER SECTION Density Fry	EXTRAPOLATED MIDDLE SECTION Density Fry	EXTRAPOLATED LOWER SECTION Density Fry	EXTRAPOLATED UPPER SECTION Density Juvenile	EXTRAPOLATED MIDDLE SECTION Density Juvenile	EXTRAPOLATED LOWER SECTION Density Juvenile
25MAY	OLGB	1	2400	0	1	0.0	0.4	0.4	94.0	0.0	0.0	0.0	0.3	0.2	0.0
25MAY	R4B	1	2400	0	1	0.0	0.4	0.4	90.0						
25MAY	TRR	0	1800					0.0							
25MAY	HICK	1	2000	0	1	0.0	0.5	0.5	110.0						
25MAY	CHARLES	0	1800					0.0							
25MAY	LEGION	0	2400					0.0							
25MAY	RDP	0	2400					0.0							
25MAY	SHILOH	0	2400					0.0							
25MAY	LAIRD	0	2400					0.0							
25MAY	GARDNER	0	1200					0.0							
TUOL.TOT.		3	17600	0	3	0.0	0.2	0.2	98.0						
SJR. TOT.		0	3600					0.0							

Table 3. Summary table of weekly seine catch by location for the Tuolumne and San Joaquin Rivers, 2005.

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
19JAN	OLGB	50.5	0	2,200	0.0							10.3	34		23.7	0.0	0.0	1.1	9.9
19JAN	R5	48.0	133	2,000	66.5	30	45	36.5	52	4	3	10.2	39					1.7	10.2
19JAN	TRR	42.3	14	2,000	7.0	32	43	37.6	14		1	10.1	71					1.8	10.3
19JAN	HICK	31.6	0	1,800	0.0							9.7	98					3.6	10.8
19JAN	CHARLES	24.9	0	2,000	0.0							9.7	149					3.8	10.3
19JAN	LEGION	17.2	0	2,400	0.0							9.9	189					5.1	10.0
19JAN	VENN	7.4	0	1,800	0.0							9.9	222					7.1	10.2
19JAN	SHILOH	3.4	0	2,200	0.0							9.8	224					6.8	10.0
19JAN	LAIRD	90.2	0	1,800	0.0							8.6	646					34.5	9.1
19JAN	GARDNER	79.5	0	2,200	0.0							8.7	589					35.5	9.5
TR TOT.			147	16400	9.0	30	45	36.7	66	4	4								
SJR TOT.			0	4000	0.0				0										

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
02FEB	OLGB	50.5	2	2200	0.9	35	36	35.5	2	0	0	10.0	40		41.7	7.2	0.0	2.8	11.7
02FEB	R5	48.0	91	1650	55.2	32	44	37.7	51	0	0	10.3	41					2.9	12.3
02FEB	TRR	42.3	151	2000	75.5	32	43	36.4	56	0	0	10.2	51					3.5	10.8
02FEB	HICK	31.6	14	1350	10.4	32	38	35.5	14	0	0	10.8	61					5.3	10.7
02FEB	CHARLES	24.9	11	1000	11.0	32	51	39.8	11	0	0	11.2	94					6.2	10.0
02FEB	LEGION	17.2	9	2400	3.8	34	40	36.4	9	0	0	11.7	129					12.5	9.4
02FEB	VENN	7.4	0	1800	0.0							11.2	163					18.5	9.7
02FEB	SHILOH	3.4	0	2400	0.0							11.5	168					23.0	9.4
02FEB	LAIRD	90.2	0	2000	0.0							11.4	906					45.0	8.8
02FEB	GARDNER	79.5	0	1800	0.0							11.4	760					37.0	8.8
TR TOT.			278	14800	18.8	32	51	37.0	143	0	0								
SJR TOT.			0	3800	0.0														

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
16FEB	OLGB	50.5	4	2000	2.0	31	41	35.5	4	0	0	10.3	44		34.1	10.8	1.4	3.8	12.4
16FEB	R5	48.0	53	2250	23.6	31	42	36.0	53	0	0	10.4	46					3.8	12.6
16FEB	TRR	42.3	144	1650	87.3	30	46	38.0	51	0	0	10.6	59					9.1	11.2
16FEB	HICK	31.6	35	1800	19.4	34	53	38.7	35	0	0	10.9	52					8.1	11.1
16FEB	CHARLES	24.9	5	1850	2.7	31	41	35.0	5	0	0	11.0	52					5.7	10.8
16FEB	LEGION	17.2	7	700	10.0	35	42	38.0	7	0	0	11.3	53					8.8	10.6
16FEB	VENN	7.4	1	1200	0.8	41	41	41.0	1	0	0	11.8	60					11.0	10.4
16FEB	SHILOH	3.4	4	2400	1.7	37	39	38.0	4	0	0	12.1	60					11.5	12.3
Not sampled	LAIRD	90.2																	
16FEB	GARDNER	79.5	0	2200	0.0							13.5	676					77.5	9.5
TR TOT.			253	13850	18.3	30	53	37.4	160	0	0								
SJR TOT.			0	2200	0.0														

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
02MAR	OLGB	50.5	222	2400	92.5	33	45	38.7	69	0	1	10.0	41		51.5	2.8	8.3	1.9	12.7
02MAR	R5	48.0	11	3000	3.7	35	40	38.6	11	0	0	10.4	41					1.7	12.8
02MAR	TRR	42.3	82	720	113.9	34	58	42.3	54	0	0	10.4	45					2.4	12.4
02MAR	HICK	31.6	13	2200	5.9	36	49	43.7	13	1	0	11.2	45					4.3	11.7
02MAR	CHARLES	24.9	3	2200	1.4	36	46	42.0	3	0	0	11.5	48					4.9	11.1
02MAR	LEGION	17.2	3	2400	1.3	39	50	43.0	3	0	0	12.3	48						11.0
02MAR	RDP	12.3	13	1350	9.6	36	57	47.2	13	0	0	12.6	51					7.8	10.7
02MAR	SHILOH	3.4	18	2400	7.5	34	52	42.7	18	0	0	12.8	52					9.1	10.8
02MAR	LAIRD	90.2	7	2000	3.5	39	68	53.7	7	0	0	16.4	1051					35.0	8.8
02MAR	GARDNER	79.5	0	2400	0.0							14.2	512					18.0	9.9
TR TOT.			365	16670	21.9	33	58	41.2	184	1	1								
SJR TOT.			7	4400	1.6	39	68	53.7	7										

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
16MAR	OLGB	50.5	9	1200	7.5	34	49	38.8	9	1	0	10.0	39		5.6	25.0	5.5	2.6	12.8
16MAR	R5	48.0	8	1250	6.4	32	50	38.4	8	0	0	10.4	40					1.8	13.3
16MAR	TRR	42.3	3	1100	2.7	40	41	40.7	3	0	0	10.4	42					1.8	11.9
16MAR	HICK	31.6	8	1600	5.0	33	62	48.0	8	0	0	10.9	44					2.5	11.8
16MAR	CHARLES	24.9	123	2350	52.3	34	75	54.1	52	0	2	11.8	45					3.0	11.5
16MAR	LEGION	17.2	3	1400	2.1	42	53	46.7	3	0	0	12.8	45					3.6	11.2
16MAR	RDP	12.3	10	1050	9.5	39	64	54.0	10	0	0	12.9	46					5.3	10.8
16MAR	SHILOH	3.4	9	2400	3.8	43	67	55.8	9	0	0	13.1	46					6.4	10.7
16MAR	LAIRD	90.2	NOT SAMPLED																
16MAR	GARDNER	79.5	NOT SAMPLED																
TR TOT.			173	12350	14.0	32	75	50.5	102	1	2								
SJR TOT.			-----	-----															

Table 3 (Continued)

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
31MAR	OLGB	50.5	2	2400	0.8	37	37	37.0	2	0	0	10.2	39		1.0	5.8	0.0	2.1	12.6
31MAR	R4B	48.4	4	2400	1.7	37	52	41.5	4	0	0	10.7	40					1.5	12.3
31MAR	TRR	42.3	0	1000	0.0				0			10.7	43					1.7	11.1
31MAR	HICK	31.6	27	1800	15.0	46	74	56.1	27	0	0	10.8	42					2.5	11.4
31MAR	CHARLES	24.9	0	600	0.0				0			11.4	43					2.3	10.7
31MAR	LEGION	17.2	1	2400	0.4	39	39	39.0	1	0	0	12.2	43					3.4	10.4
31MAR	RDP	12.3	0	2400	0.0				0			12.1	45					4.5	10.3
31MAR	SHILOH	3.4	0	1800	0.0				0			12.7	46					5.4	10.2
31MAR	LAIRD	90.2	0	1350	0.0				0			14.2	391					17.5	8.7
31MAR	GARDNER	79.5	0	700	0.0				0			13.4	235					20.0	9.3
TR TOT.			34	14800	2.3	37	74	52.8	34	0	0								
SJR TOT.			0	2050	0.0				0										

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
13APR	OLGB	50.5	48	2400	20.0	46	76	59.3	48	0	0	9.9	37		10.6	1.3	1.7	1.6	12.4
13APR	R4B	48.4	3	1800	1.7	69	73	70.7	3	0	0	10.0	38					1.1	12.7
13APR	TRR	42.3	2	800	2.5	54	69	61.5	2	0	0	10.2	41					2.0	11.9
13APR	HICK	31.6	6	2200	2.7	51	83	66.3	6	0	0	10.7	41	83				2.2	12.1
13APR	CHARLES	24.9	0	1200	0.0				0			11.4	44					2.7	11.1
13APR	LEGION	17.2	1	2000	0.5	81	81	81.0	1	0	0	12.5	43	81				3.5	10.9
13APR	RDP	12.3	0	1200	0.0				0			12.4	46					3.7	10.6
13APR	SHILOH	3.4	6	2400	2.5	66	79	72.8	6	0	0	12.8	45	75,77,79				4.9	10.6
13APR	LAIRD	90.2	0	2400	0.0				0			15.2	516					23.5	10.1
13APR	GARDNER	79.5	0	1600	0.0							13.8	252					14.5	10.6
TR TOT.			66	14000	4.7	46	83	62.0	66	0	0								
SJR TOT.			0	4000	0.0														

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
27APR	OLGB	50.5	0	2400	0.0				0			10.3	38		0.2	0.2	4.7	1.4	12.1
27APR	R5	48.0	0	2400	0.0				0			10.5	40					1.2	12.2
27APR	TRR	42.3	1	880	1.1	68	68	68.0	1	0	0	10.4	42					1.6	11.3
27APR	HICK	31.6	0	1700	0.0				0			10.8	43					1.8	11.4
27APR	CHARLES	24.9	1	2200	0.5	92	92	92.0	1	0	0	11.6	46	92				2.6	10.8
27APR	LEGION	17.2	0	1900	0.0				0			13.0	47					2.4	10.8
27APR	RDP	12.3	0	1180	0.0				0			13.2	50					4.4	10.5
27APR	SHILOH	3.4	14	1800	7.8	51	97	84.5	14	0	0	13.8	53	82-97				5.1	10.5
27APR	LAIRD	90.2	0	1080	0.0				0			17.0	523					23.5	9.7
27APR	GARDNER	79.5	1	2400	0.4	60	60	60.0	1	0	0	15.0	376					16.5	10.5
TR TOT.			16	14460	1.1	51	97	83.9	16	0	0								
SJR TOT.			1	3480	0.3	60	60	60.0	1	0	0								

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
11MAY	OLGB	50.5	0	2400	0.0							10.7	37		0.4	0.3	0.4	1.4	12.8
11MAY	R4B	48.4	1	2200	0.5	83	83	83.0	1	0	0	11.0	39	83				1.2	12.7
11MAY	TRR	42.3	1	760	1.3	81	81	81.0	1	0	0	11.0	41	81				1.3	12.1
11MAY	HICK	31.6	0	2000	0.0							11.2	41					1.7	12.1
11MAY	CHARLES	24.9	1	2000	0.5	80	80	80.0	1	0	0	11.9	44	80				1.4	11.3
11MAY	LEGION	17.2	1	2000	0.5	92	92	92.0	1	0	0	13.4	45	92				2.2	11.2
11MAY	RDP	12.3	0	1800	0.0							13.6	46					3.7	11.0
11MAY	SHILOH	3.4	2	2800	0.7	74	87	80.5	2	0	0	14.1	46	87				4.1	11.1
11MAY	LAIRD	90.2	0	2400	0.0							17.6	430					31.0	10.8
11MAY	GARDNER	79.5	0	2400	0.0							15.6	213					16.0	10.8
TR TOT.			6	15960	0.4	74	92	82.8	6	0	0								
SJR TOT.			0	4800	0.0														

2005 TUOLUMNE RIVER SEINING STUDY (TID/MID)

DATE	LOCATION	RIVER MILE	CATCH	AREA	DENSITY (/1000ft^2)	FL MIN.	FL MAX.	FL AVG.	NO. MEAS.	SACFRY	NO. KILLED	WATER TEMP.	ELEC. COND.	SMOLT FL	SECTION DENSITY UPPER	MIDDLE	LOWER	TURB.	D.O. (ppm)
25MAY	OLGB	50.5	1	2400	0.4	94	94	94.0	1	0	0	11.2	38	94	0.3	0.2	0.0	0.9	12.2
25MAY	R4B	48.4	1	2400	0.4	90	90	90.0	1	0	0	11.7	40	90				0.8	11.8
25MAY	TRR	42.3	0	1800	0.0							12.0	41					1.3	11.1
25MAY	HICK	31.6	1	2000	0.5	110	110	110.0	1	0	0	12.1	41	110				2.4	11.1
25MAY	CHARLES	24.9	0	1800	0.0							12.3	44					2.3	10.7
25MAY	LEGION	17.2	0	2400	0.0							14.0	44					2.5	10.4
25MAY	RDP	12.3	0	2400	0.0							14.1	45					3.2	10.4
25MAY	SHILOH	3.4	0	2400	0.0							15.2	45					3.5	10.3
25MAY	LAIRD	90.2	0	2400	0.0							21.7	157					20.0	7.7
25MAY	GARDNER	79.5	0	1200	0.0							18.3	96					11.0	9.2
TR TOT.			3	17600	0.2	90	110	98.0	3	0	0								
SJR TOT.			0	3600	0.0														

Table 4. Key to other species caught and distribution

KEY TO OTHER SPECIES SAMPLED AND DISTRIBUTION
(List includes all species caught during 1986-2005 seining studies)

FAMILY	COMMON NAME	NATIVE SPECIES	ABBREV.	SAN JOAQUIN	TUOL.
Petromyzontidae	Pacific lamprey	N	LP		X
Clupeidae	threadfin shad		TFS		
Salmonidae	Chinook salmon	N	CS	X	X
Salmonidae	rainbow trout	N	RT		X
Cyprinidae	carp		CP	X	
Cyprinidae	goldfish		GF	X	
Cyprinidae	golden shiner		GSH		
Cyprinidae	Sacramento blackfish	N	SBF		
Cyprinidae	hitch	N	HCH		
Cyprinidae	hardhead	N	HH		X
Cyprinidae	Sacramento pikeminnow	N	PM	X	X
Cyprinidae	Sacramento splittail	N	ST		
Cyprinidae	red shiner		PRS	X	X
Cyprinidae	fathead minnow		FHM	X	
Catostomidae	Sacramento sucker	N	SKR	X	X
Ictaluridae	channel catfish		CCF		
Ictaluridae	white catfish		WCF		
Ictaluridae	brown bullhead		BBH		
Poeciliidae	western mosquitofish		GAM		X
Atherinidae	inland silverside		ISS	X	X
Percichthyidae	striped bass		SB		
Centrarchidae	white/black crappie		WCR/BCR	WCR	
Centrarchidae	warmouth		WM		
Centrarchidae	green sunfish		GSF		X
Centrarchidae	bluegill		BG	X	X
Centrarchidae	redear sunfish		RSF		X
Centrarchidae	largemouth bass		LMB	X	X
Centrarchidae	smallmouth bass		SMB		
Percidae	bigscale logperch		BLP		
Embiotocidae	tule perch	N	TP		
Cottidae	prickly sculpin	N	PSCP	X	X
Cottidae	riffle sculpin	N	RSCP		X
TOTAL:	32			12	15

2005 species presence designated with 'X'

Table 4. 2005 OTHER SPECIES SAMPLED DURING SEINING STUDIES ON JUVENILE SALMON

OTHER SPECIES SAMPLED (ACTUAL COUNTS OR ESTIMATED ABUNDANCE)

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
19JAN	1	OLGB	50.5																													
19JAN	2	R5	48.0										25				10															
19JAN	3	TRR	42.3										2						1													
19JAN	4	HICK	31.6																3													
19JAN	5	CHARLES	24.9																					1								
19JAN	6	LEGION	17.2														YOY															
19JAN	7	VENN	7.4												4				6													
19JAN	8	SHILOH	3.4												4									3								
19JAN	9	LAIRD	90.2												50					6												
19JAN	10	GARDNER	77.8												200					10				6	1							

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
02FEB	1	OLGB	50.5														1															
02FEB	2	R5	48.0										3				11															
02FEB	3	TRR	42.3	1																												
02FEB	4	HICK	31.6																													
02FEB	5	CHARLES	24.9																													
02FEB	6	LEGION	17.2																													
02FEB	7	VENN	7.4												2					1				1	1							
02FEB	8	SHILOH	3.4												2				2						1					1		
02FEB	9	LAIRD	90.2												500	6				30												
02FEB	10	GARDNER	77.8												60					20				3	1							

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
16FEB	1	OLGB	50.5																													
16FEB	2	R5	48.0										15				30		1													
16FEB	3	TRR	42.3								2		11				1															
16FEB	4	HICK	31.6																													
16FEB	5	CHARLES	24.9																	1												
16FEB	6	LEGION	17.2								1																					
16FEB	7	VENN	7.4																													
16FEB	8	SHILOH	3.4												5				3					1	1							
16FEB	9	LAIRD	90.2																													
16FEB	10	GARDNER	77.8												500					15				15	1							

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
02MAR	1	OLGB	50.5																6													
02MAR	2	R5	48.0										20				1															
02MAR	3	TRR	42.3								1		10				3		6													
02MAR	4	HICK	31.6																													
02MAR	5	CHARLES	24.9										1						1													
02MAR	6	LEGION	17.2																2					1								
02MAR	7	RDP	12.3												25				2													
02MAR	8	SHILOH	3.4												10				3					1	1							
02MAR	9	LAIRD	90.2												200					20												
02MAR	10	GARDNER	77.8												10									6	1							

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
16MAR	1	OLGB	50.5			1											1		3													
16MAR	2	R5	48.0										2																			
16MAR	3	TRR	42.3								2		1				1		13				1									
16MAR	4	HICK	31.6																					1								
16MAR	5	CHARLES	24.9														1			4												
16MAR	6	LEGION	17.2														2		1					11	1							
16MAR	7	RDP	12.3												30								1	1	1							
16MAR	8	SHILOH	3.4												3									1	1							
16MAR	9	LAIRD	90.2																													
16MAR	10	GARDNER	77.8																													

Table 4.(Continued)

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
31MAR	1	OLGB	50.5																													
31MAR	2	R4B	48.4								2													1								
31MAR	3	TRR	42.3								2						3															
31MAR	4	HICK	31.6																													
31MAR	5	CHARLES	24.9																													
31MAR	6	LEGION	17.2												1																	
31MAR	7	RDP	12.3												50																	
31MAR	8	SHILOH	3.4												20					1												
31MAR	9	LAIRD	90.2												40					1												
31MAR	10	GARDNER	77.8												20					1												

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
13APR	1	OLGB	50.5														2		1													
13APR	2	R4B	48.4																													
13APR	3	TRR	42.3								1																					
13APR	4	HICK	31.6																													
13APR	5	CHARLES	24.9																													
13APR	6	LEGION	17.2								1				1				10													
13APR	7	RDP	12.3												50														PSCP-2			
13APR	8	SHILOH	3.4												1														PSCP-1			
13APR	9	LAIRD	90.2												50					10												
13APR	10	GARDNER	77.8												100	1								1								

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
27APR	1	OLGB	50.5																													
27APR	2	R5	48.0								1																					
27APR	3	TRR	42.3																													
27APR	4	HICK	31.6																										3			
27APR	5	CHARLES	24.9																2						1							
27APR	6	LEGION	17.2														C		20													
27APR	7	RDP	12.3												60														PSCP-4			
27APR	8	SHILOH	3.4												3														PSCP-2			
27APR	9	LAIRD	90.2										2		100																	
27APR	10	GARDNER	77.8										1		80																	

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
11MAY	1	OLGB	50.5																12													
11MAY	2	R4B	48.4																													
11MAY	3	TRR	42.3																													
11MAY	4	HICK	31.6																													
11MAY	5	CHARLES	24.9														YOY															
11MAY	6	LEGION	17.2												1				10										PSCP-6			
11MAY	7	RDP	12.3												50					1					1				PSCP-4			
11MAY	8	SHILOH	3.4												20					2												
11MAY	9	LAIRD	90.2										2		300	1																
11MAY	10	GARDNER	77.8												30					10												

DATE	SITE	LOCATION	MILE	LP	TFS	RT	CP	GF	GSH	SBF	HH	HCH	PM	ST	PRS	FHM	SKR	WCF	GAM	ISS	SB	WCR	GSF	BG	LMB	SMB	BLP	TP	RSCP	RSF	CCF	CENT
25MAY	1	OLGB	50.5														YOY												10			
25MAY	2	R4B	48.4														YOY							1					10			
25MAY	3	TRR	42.3								1								1										4			
25MAY	4	HICK	31.6														YOY															
25MAY	5	CHARLES	24.9																													
25MAY	6	LEGION	17.2														YOY												PSCP			
25MAY	7	RDP	12.3												20														PSCP			
25MAY	8	SHILOH	3.4												20		YOY															
25MAY	9	LAIRD	90.2				2								200	1						1			2							
25MAY	10	GARDNER	77.8					5							100		2								3				PSCP			1

Table 5. Tuolumne River snorkel summary, 2005.

															NUMBER COUNTED (ESTIMATED TOTAL LENGTH OR SIZE RANGE IN MM)												
DATE	START TIME	LOCATION	RIVER MILE	SITE	AREA (Sq. Ft.)	AVG. DEPTH (FEET)	TIME (Min.)	HABITAT	SUBSTRATE	WATER TEMP. (C)	DO (mg/l)	EC	TURB. (NTU)	HORIZ. VISIB. (FEET)	CHINOOK count/est.	CHINOOK size	RAINBOW count/est.	RAINBOW size	SACRAMENTO SUCKER	SACRAMENTO PIKEMINNOW	HARDHEAD	RIFFLE SCULPIN	LARGEMOUTH BASS	SMALLMOUTH BASS	REDEAR SUNFISH	BLUEGILL	CARP
20SEP	0945	Riffle A7	50.7	1	8,000	1.8	25.0	Riffle	cobble,gravel,boulder	12.0	11.6	26	0.6	21.0	1	(600)	1	(350)									
	0946			2	4,000	4.0	20.0	Run	cobble,gravel,sand								9	(110-500)									
20SEP	1113	Riffle 2	49.9	1	10,000	1.8	35.0	Riffle	gravel,cobble,sand	12.7	11.7	28	0.8	18.0								(25)					
	1139			2	4,500	7.0	22.0	Pool	cobble,bedrock,boulder								3	(240,380,420)		(320,420,440)							
	1142			3	15,625	3.5	18.0	Run-Pool	cobble,sand,boulder								4	(225,250,260,280)		(375)							
20SEP	1349	Riffle 3B	49.1	1	4,400	1.8	24.0	Riffle	cobble,gravel,sand	14.2	11.7	28	0.6	17.0			3	(360,400,460)		(600)		(50,60)					
	1355			2	7,000	2.5	21.0	Run-Riffle	cobble,gravel,boulder						3	(650,700,700)	3	(180,250,325)				(70)					
20SEP	1502	Riffle 5B	47.9	1	3,600	1.8	15.0	Riffle	cobble,gravel,sand	14.8	11.5	29	0.6	17.0			14	(110-480)									
	1536			2	12,000	5.0	30.0	Run	cobble,bedrock,sand								4	(130,140,425,450)		(450,500)							
	1507			3	7,500	4.0	20.0	Run-Pool	bedrock,boulder,cobble								18	(120-300)	(500,550)	(350,380)			(325)				
					76,625		230.0			**Subtotal**					**4**		**59**		**2**	**9**		**4**	**1**				
21SEP	1051	Riffle 7	46.9	1	6,000	1.8	20.0	Riffle	cobble,gravel,sand	12.7	11.2	29	0.9	19.0			2	(160,260)									
	1043			2	8,000	4.0	22.0	Run	bedrock,cobble,sand										45(380-600)	(420)		(40)					
21SEP	1159	Riffle 13B	45.5	1	4,500	2.5	26.0	Run-Riffle	cobble,gravel,sand	13.7	11.0	29	0.8	19.0			42	(70-260)									
	1158			2	4,000	1.8	20.0	Riffle	gravel,cobble,bedrock						1	(780)	4	(140-180)									
21SEP	1443	Riffle 21	42.9	1	3,000	2.0	15.0	Riffle	cobble,gravel,sand	15.7	11.3	32	0.9	16.0			10	(175-250)									
	1442			2	9,000	4.5	20.0	Run-Pool	cobble,sand,vegetation								5	(120-220)	(80)	(220,230)	(240)						
21SEP	1354	Riffle 23C	42.3	1	3,000	3.0	18.0	Run-Riffle	cobble,bedrock,gravel	16.1	11.2	34	1.3	15.0			10	(175-225)	(190,200,220)								
	1349			2	4,000	1.8	17.0	Riffle	cobble,gravel,bedrock								4	(120-180)			(160,170)						
					41,500		158.0			**Subtotal**					**1**		**77**		**49**	**3**	**3**	**1**					
22SEP	1034	Riffle 31	38.0	1	4,000	2.8	18.0	Riffle	cobble,gravel,boulder	16.0	10.8	42	1.6	12.5					5(480-750)								
	1041			2	13,500	3.5	19.0	Run-Pool	cobble,gravel,sand								1	(300)	45(400-650)				(225)				
22SEP	1318	Riffle 35A	37.1	1	3,000	1.8	20.0	Riffle	cobble,gravel,sand	17.6	11.1	44	1.9	11.0			2	(120,130)	(90)								
	1322			2	8,000	3.5	15.0	Run	cobble,sand,gravel										35(375-600)	18(225-350)							
22SEP	1436	Riffle 41A	35.3	1	3,125	2.3	22.0	Run-Riffle	cobble,gravel,sand	18.0	10.7	45	1.2	9.0					(340,360,390)			(45)					
	1433			2	1,000	4.5	7.0	Pool	gravel,sand,bedrock											(140,160,220)			(100,110)	(110)			
	1441			3	4,500	2.5	10.0	Run-Riffle	cobble,gravel,sand										(650)				(120)	(90,100,110,110)			
22SEP	1553	Riffle 57	31.5	1	3,125	1.5	17.0	Riffle	cobble,gravel,sand	18.9	10.9	49	1.4	9.0					7(400-675)					(240)			
	1558			2	9,600	2.5	18.0	Run-Riffle	cobble,bedrock,sand														(90,90,100)	(110,240)			
					49,850		146.0			**Subtotal**					**0**		**3**		**97**	**21**		**1**	**7**	**8**			
										TOTAL#					**5**		**139**		**148**	**33**	**3**	**6**	**8**	**8**	**0**	**0**	**0**

Young of the year sucker were commonly observed along the banks.

Table 6. Yearly seining summary for the Tuolumne, San Joaquin, and Stanislaus Rivers, 1986-2005.

Tuolumne River Seining Study Summary (Tuolumne, San Joaquin and Stanislaus Rivers)

	TUOLUMNE RIVER					SAN JOAQUIN			STANISLAUS				
Sampling Year	Sampling Periods	Salmon Captured	Sites Sampled	Average Density	Growth Rate Index (mm/day)	Salmon Captured	Sites Sampled	Average Density	Salmon Captured	Sites Sampled	Average Density	Start Date	End Date
1986	18	5514	8	20.7	0.45	854	3	14.2	---	---		22JAN	27JUN
1987	21	14825	11	22.4	0.45	734	6	1.9	---	---		05JAN	04JUN
1988	14	6134	11	14.3	0.58	295	4	2.1	84	1	2.9	05JAN	17MAY
1989	13	10043	11	27.0	0.64	83	3	0.6	1206	1	45.4	05JAN	12MAY
1990	14	2286	11	6.0	0.57	48	3	0.5	---	---		04JAN	11MAY
1991	8	120	11	0.5	No estimate	0	3	0	3	1	0.2	15JAN	24MAY
1992	5	144	7	1.2	No estimate	0	3	0	54	1	3.9	27JAN	13MAY
1993	7	124	8	0.8	0.68	0	3	0	6	1	0.3	26JAN	12MAY
1994	7	2068	5	21.6	0.65	2	2	0	---	---		25JAN	20MAY
1995	8	512	5	6.1	0.79	43	2	1.1	---	---		09FEB	12JUL
1996	8	785	6	7.6	0.66	7	2*	0.2	---	---		17JAN	13JUN
1997	10	379	7	2.7	0.48	11	2*	0.4	---	---		14JAN	28MAY
1998	10	1950	7	14.4	0.46	99	2	2.5	---	---		14JAN	21MAY
1999	10	3443	8	24.6	0.54	560	2	13.6	---	---		14JAN	19MAY
2000	10	3213	8	27.0	0.46	19	2	0.6	---	---		11JAN	17MAY
2001	11	5567	8	41.3	0.67	83	2	2.6	---	---		09JAN	30MAY
2002	10	3486	8	25.6	0.64	0	2	0	---	---		15JAN	21MAY
2003	10	5983	8	39.3	0.68	1	2	0	---	---		21JAN	28MAY
2004	11	3280	8	19.3	0.55	0	2	0	---	---		20JAN	25MAY
2005	10	1341	8	8.9	0.53	8	2*	0.2	---	---		19JAN	25MAY

--- Not Sampled

*All San Joaquin River locations were not always sampled

Table 7. Summary table of locations sampled, 1986-2005

1986 TO 2005 SEINING LOCATIONS

TUOLUMNE RIVER

Site	Location	River Mile	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	Old La Grange Bridge	50.5	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X
2	Riffle 4B	48.4	X	X	X	X	X	X				X	X	X	X							
3	Riffle 5	47.9		X	X	X	X	X	X	X	X					X	X	X	X	X	X	X
4	Tuolumne River Resort	42.4			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	Turlock Lake State Rec. Area	42.0	X	X																		
6	Reed Gravel	34.0	X	X	X	X	X	X														
7	Hickman Bridge	31.6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8	Charles Road	24.9		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X
9	Legion Park	17.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	Riverdale Park / Venn	12.3 / 7.4		X	X	X	X	X								X	X	X	X	X	X	X
11	McCleskey Ranch	6.0	X	X	X	X	X	X	X	X	X											
12	Shiloh Bridge	3.4	X	X	X	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X

SAN JOAQUIN RIVER

Site	Location	River Mile	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
13	Laird Park	90.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14	Gardner Cove	77.8		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15	Maze Road	76.6	X	X	X																	
16	Sturgeon Bend	74.3		X	X																	
17	Durham Ferry Park	71.3	X	X	X	X	X	X	X	X												
18	Old River	53.7		X																		

STANISLAUS RIVER

Site	Location	River Mile	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
19	Caswell State Park	8.5			X	X		X	X	X												

DRY CREEK

Site	Location	River Mile	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
20	Beard Brook Park	0.5							X	X												

In 1987 additional sites on the Tuolumne, San Joaquin, Merced and Stanislaus Rivers were sampled occasionally (1987 annual report).

Table 8. Tuolumne River analysis of female spawners to fry density.

TUOLUMNE RIVER ANALYSIS OF FEMALE SPAWNERS TO FRY DENSITY (TID/MID)

		JUVENILE SEINING			LOG TRANSFORMATION		
TUOL.R. FALL-RUN	TOTAL FEMALE SPAWNERS		PEAK FRY DENSITY	AVERAGE FRY DENSITY 15JAN-15MAR	TOTAL FEMALE SPAWNERS	PEAK FRY DENSITY	AVERAGE FRY DENSITY 15JAN-15MAR
1985	22600	86	158.8	59.5	4.4	2.2	1.8
1986	3800	87	69.3	46.2	3.6	1.8	1.7
1987	4600	88	70.2	33.9	3.7	1.8	1.5
1988	4100	89	115.1	39.7	3.6	2.1	1.6
1989	680	90	11.4	5.0	2.8	1.1	0.7
1990	28	91	1.3	0.5	1.4	0.1	-0.3
1991	28	92	6.1	2.9	1.4	0.8	0.5
1992	55	93	1.7	0.9	1.7	0.2	0.0
1993	237	94	79.5	41.5	2.4	1.9	1.6
1994	249	95	12.5	9.8	2.4	1.1	1.0
1995	522	96	16.1	13.0	2.7	1.2	1.1
1996	1142	97	2.8	2.1	3.1	0.4	0.3
1997	4224	98	49.3	24.6	3.6	1.7	1.4
1998	4527	99	78.0	39.3	3.7	1.9	1.6
1999	3535	00	78.8	48.0	3.5	1.9	1.7
2000	11260	01	126.3	85.6	4.1	2.1	1.9
2001	4970	02	92.8	41.5	3.7	2.0	1.6
2002	3876	03	164.3	68.8	3.6	2.2	1.8
2003	1768	04	38.8	27.2	3.2	1.6	1.4
2004	1004	05	20.5	14.56	3.0	1.3	1.2

LINEAR REGRESSION ON LOG VALUES
Total females to peak fry density (1986-2005)
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.832379971
R Square	0.692856416
Adjusted R Square	0.675792883
Standard Error	0.375613096
Observations	20

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.728695678	5.728695678	40.60451	5.30686E-06
Residual	18	2.539533563	0.141085198		
Total	19	8.268229242			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.55405001	0.328961871	-1.68423776	0.109396	-1.245173786	0.137073775	-1.245173786	0.137073775
X Variable 1	0.657619505	0.103201863	6.372167014	5.31E-06	0.440800269	0.874438741	0.440800269	0.874438741

LINEAR REGRESSION ON LOG VALUES
Total females to average fry density (1986-2005)
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.835800625
R Square	0.698562685
Adjusted R Square	0.681816167
Standard Error	0.366194273
Observations	20

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	5.593761816	5.593761816	41.71391	4.46674E-06
Residual	18	2.413768417	0.134098245		
Total	19	8.007530233			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.79871847	0.320712868	-2.490447213	0.022755	-1.472511722	-0.12492521	-1.472511722	-0.124925214
X Variable 1	0.64982856	0.100613987	6.458630474	4.47E-06	0.438446255	0.861210866	0.438446255	0.861210866

Table 9. Summary table of salmonids observed during the 2001-2005 (September) snorkel surveys.

Late summer snorkel survey comparison

	TUOLUMNE RIVER SNORKEL SUMMARY -- YEARLY COMPARISON OF CHINOOK OBSERVED					**TUOLUMNE RIVER SNORKEL SUMMARY -- YEARLY COMPARISON OF O. mykiss OBSERVED**				
	CHINOOK 2001	**CHINOOK 2002**	**CHINOOK 2003**	**CHINOOK 2004**	**CHINOOK 2005**	**RAINBOW 2001**	**RAINBOW 2002**	**RAINBOW 2003**	**RAINBOW 2004**	**RAINBOW 2005**
DATES	Sept. 18-20	Sept. 24-26	Sept. 17-19	Sept. 15-17	Sept. 20-22	Sept. 18-20	Sept. 24-26	Sept. 17-19	Sept. 15-17	Sept. 20-22
LOCATIONS										
Riffle A7 (RM 50.7)	21	2	2	0	1	3	1	16	11	10
Riffle 2 (RM 49.9)	0	0	1	0	0	3	4	2	7	7
Riffle 3B (RM 49.1)	0	0	3	0	3	1	1	21	7	6
Riffle 5B (RM 47.9)	0	0	4	0	0	2	0	10	6	36
Sec. Total	**21**	**2**	**10**	**0**	**4**	**9**	**6**	**49**	**31**	**59**
Riffle 7 (RM 46.9)	0	1	0	0	0	0	2	9	2	2
Riffle 13B,13A (RM 45.5 / 45.6)	0	0	0	0	1	0	4	6	0	46
Riffle 21 (RM 43.1)	0	0	1	0	0	3	0	6	7	15
Riffle 23B-C (RM 42.3)	0	0	0	0	0	0	0	1	0	14
Sec. Total	**0**	**1**	**1**	**0**	**1**	**3**	**6**	**22**	**9**	**77**
Riffle 31 / 30B (RM 38.1 / 38.5)	0	0	0	0	0	0	0	0	0	1
Riffle 37 / 35A (RM 36.2 / 37.1)	0	0	1	0	0	0	0	0	0	2
Sec. Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
Riffle 41A (RM 35.3)	0	0	1	0	0	0	0	0	0	0
Riffle 57 (RM 31.5)	0	0	0	0	0	0	0	0	0	0
Sec. Total	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Grand Total	**21**	**3**	**13**	**0**	**5**	**12**	**12**	**71**	**40**	**139**

Table 9. (Continued)

TUOLUMNE RIVER SNORKEL SUMMARY -- YEARLY COMPARISON OF DENSITY INDICES (CHINOOK OBSERVED / 1000 SQ. FT.)									YEARLY COMPARISON OF DENSITY INDICES (O. mykiss OBSERVED / 1000 SQ. FT.)					
	CHINOOK 2001	**CHINOOK 2002**	**CHINOOK 2003**	**CHINOOK 2004**	**CHINOOK 2005**				**RAINBOW 2001**	**RAINBOW 2002**	**RAINBOW 2003**	**RAINBOW 2004**	**RAINBOW 2005**	
DATES	Sept. 18-20	Sept. 24-26	Sept. 17-19	Sept. 15-17	Sept. 20-22				Sept. 18-20	Sept. 24-26	Sept. 17-19	Sept. 15-17	Sept. 20-22	
LOCATIONS														
Riffle A7 (RM 50.7)	2.97	0.14	0.21	0	0.08				0.42	0.07	1.68	1.06	0.83	
Riffle 2 (RM 49.9)	0	0	0.09	0	0.00				0.20	0.21	0.19	0.31	0.23	
Riffle 3B (RM 49.1)	0	0	0.33	0	0.26				0.08	0.12	2.33	0.60	0.53	
Riffle 5B (RM 47.9)	0	0	0.32	0	0.00				0.16	0	0.80	0.26	1.56	
Sec. Total	**0.45**	**0.03**	**0.24**	**0.00**	**0.05**				**0.19**	**0.09**	**1.18**	**0.46**	**0.77**	
Riffle 7 (RM 46.9)	0	0.19	0.00	0	0.00				0	0.38	1.15	0.15	0.14	
Riffle 13B,13A (RM 45.5 / 45.6)	0	0	0.00	0	0.12				0	0.48	0.74	0.00	5.41	
Riffle 21 (RM 43.1)	0	0	0.17	0	0.00				0.67	0	1.03	0.52	1.25	
Riffle 23B-C (RM 42.3)	0	0	0.00	0	0.00				0	0	0.19	0	2.00	
Sec. Total	**0.00**	**0.04**	**0.04**	**0.00**	**0.02**				**0.12**	**0.22**	**0.82**	**0.22**	**1.86**	
Riffle 31 (RM 38.1)	0	0	0.00	0	0.00				0	0	0.00	0	0.06	
Riffle 37 (RM 36.2)	0	0	0.14	0	0.00				0	0	0.00	0	0.18	
Sec. Total	**0.00**	**0.00**	**0.07**	**0.00**	**0.00**				**0.00**	**0.00**	**0.00**	**0.00**	**0.11**	
Riffle 41A (RM 35.3)	0	0	0.13	0	0.00				0	0	0.00	0	0	
Riffle 57 (RM 31.5)	0	0	0.00	0	0.00				0	0	0.00	0	0	
Sec. Total	**0.00**	**0.00**	**0.05**	**0.00**	**0.00**				**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
Grand Total														

Appendix 1

Presence, Relative Abundance, and Distribution of Fishes at Grayson River Ranch 2005

DRAFT REPORT
October 2005

Prepared by
Andrea N. Fuller
Michele Simpson

Submitted to
East Stanislaus Resource Conservation District

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INTRODUCTION

Study Area Description

The Grayson River Ranch Perpetual Easement and Habitat Restoration Project (GRR Restoration Project) is adjacent to 1.2 miles of river on the south bank of the Tuolumne River, and is located 5.1 miles upstream of the confluence with the San Joaquin River (Figure 1). The Tuolumne River is the largest of the three major tributaries to the San Joaquin River (i.e., Tuolumne, Merced, and Stanislaus Rivers), originating in the central Sierra Nevada and flowing west between the Merced River to the south and the Stanislaus River to the north. The San Joaquin River flows north and joins the Sacramento River in the Sacramento-San Joaquin Delta. The Tuolumne River is dammed at several locations for generation of power, water supply, and flood control – the largest impoundment is Don Pedro Reservoir.

The lower Tuolumne River corridor extends from La Grange Dam to its confluence with the San Joaquin River. The site of La Grange Dam, approximately 52.2 river miles upstream from the San Joaquin River confluence, has been the limit of upstream migration of anadromous fish since 1871.

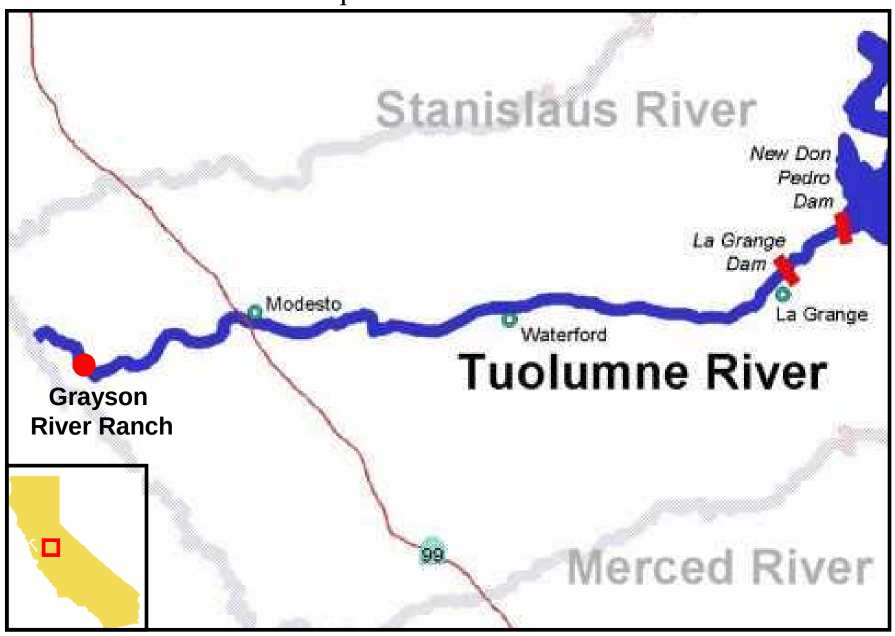

Figure 1. Location map of study area on the Tuolumne River.

Purpose and History of Study

The Grayson River Ranch (GRR) project area was intensely cultivated until 1997 when floodwaters caused considerable damage to the property and inundated the entire project area. Due to this damage and recurrent flooding of portions of the area, the landowner applied for and received a Natural Resources Conservation Service grant to establish a perpetual conservation easement. A CALFED grant was then acquired in 1999 by the East Stanislaus Resource Conservation District and Friends of the Tuolumne for restoration of the conservation area.

The primary objective of the restoration effort is to restore a naturally self-sustaining riparian floodplain, with emphasis placed on enhancing habitat for migrating fall-run Chinook salmon and for salmon and steelhead juvenile rearing (East Stanislaus Resource Conservation District and Friends of the Tuolumne 1998). Restoration of the GRR floodplain occurred during the summer of 2000, followed by re-vegetation of the site in the fall/winter of 2000/2001. The monitoring effort described herein represents the first fisheries monitoring in the restored area and was conducted as an initial evaluation of the short-term benefits associated with this project. Although the GRR Restoration Project was completed several years ago, the first year that flows reached a sufficient elevation to inundate the restoration area and potentially result in fish entering the sloughs occurred in 2005.

METHODS

During the spring of 2005, S.P. Cramer & Associates (SPC&A) technicians conducted seining surveys at GRR to document fish presence, relative abundance, and distribution following inundation of the GRR Restoration Project area. Sampling was also conducted in the nearby Tuolumne River mainstem for comparison of species composition and relative abundance. A total of four surveys were conducted: February 24, March 10, April 8, and May 24-25.

During each survey, we sampled a total of 10 locations between the GRR sloughs and the main channel of the Tuolumne River (Figure 2). Seven sites were located in the GRR sloughs including one site (AB) at the confluence of the two sloughs with the Tuolumne River and three sites (A-A3 and B-B3) within each slough (Figure 2). Sites were selected based on several factors including the predicted suitability of the site for sampling over a range of inundation levels; need to document fish distribution throughout the sloughs; and proximity to obvious landmarks which allow subsequent surveys to be conducted in the same locations.

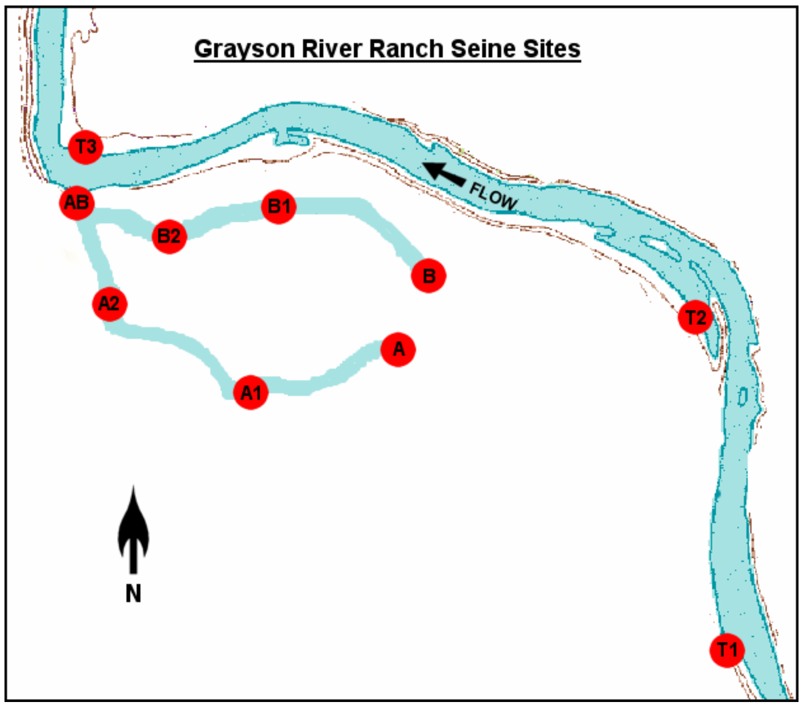

Figure 2. Sampling sites at Grayson River Ranch and in the adjacent areas of the main channel of the Tuolumne River.

We also seined three sites (T1-T3) in the main channel of the Tuolumne River (Figure 2). These sites were selected based on predicted suitability of each site for sampling over a range of flows, proximity to obvious landmarks for subsequent surveys, and to provide a comparison of relative fish use between the GRR sloughs and main channel.

During each survey, multiple seine hauls were attempted at each site; however, due to challenges inherent to seining, such as low or high water elevation (Figure 3) and interference of vegetation (Figure 4) the hauls attempted were not always successful. At least one successful haul was made at each site during each survey. A 4’ X 10’ seine and a 7’ X 20’ seine were used depending on the site characteristics, and both seines were constructed of 1/8” mesh. The area sampled during each seine haul was estimated for density calculations to be made in the future for the purpose of comparison among sites and among years (Appendix A).

Figure 3. Low water elevation in seine site B.

Figure 4. Emergent vegetation in seine site A.

All fish captured were identified to species and enumerated. Fork length was measured and recorded to the nearest millimeter for a subset of the individuals of each species captured at each site. For the purpose of condition factor analysis, total length (nearest mm) and weight (nearest 0.1 g) were also measured and recorded for all salmonids. Chinook salmon smolting appearance was rated on a scale of 1 to 3, with 1 an obvious parr (highly visible parr marks) and 3 an obvious smolt (silvery appearance, easily shed scales, blackened fin tips).

We also collected instantaneous environmental data (i.e., water temperature, turbidity, and maximum water depth) at each site during each survey to evaluate potential correlations of fish presence, relative abundance, and distribution with site inundation level, water temperature, and turbidity. Water depth was recorded at all sample sites and maximum water depth in the sloughs occurred at the mouth where the elevation is lowest. Instantaneous turbidity was measured with a LaMotte turbidity meter, model 2020. A water sample was collected at each site during each survey event and later tested at the field station. Turbidity was recorded in nephelometric turbidity units (NTU).

A total of four hourly recording thermographs were deployed on March 25 and were retrieved at the end of the study period. Three thermographs were located in the GRR sloughs including one at the confluence of the two sloughs with the Tuolumne River (i.e., sampling site AB) and one in the middle of each slough (i.e., sampling sites A1 and B1). One thermograph was placed on the north bank of the Tuolumne River mainstem between sites T2 and site T3. Daily average flow in the Tuolumne River at the Modesto gauging station was obtained from the California Data Exchange Center website (station “MOD”).

RESULTS

The GRR sloughs were inundated intermittently during freshets between February 21 and February 23, and then continually inundated from February 24 through at least May 25 when the last survey was conducted. Flows during the inundation period generally ranged from 3,400 cfs to 6,900 cfs at Modesto (Figure 5), and were primarily the result of flood control releases from New Don Pedro Reservoir. Storm run-off below the dam-primarily from Dry Creek- also contributed to the flows observed at Modesto, but to a much lesser degree relative to reservoir releases. As river flows fluctuated, maximum water depth at the mouth of the sloughs increased by 10” to 15” between each survey event and ranged from 17” in late February to 54” in late May (Table 1).

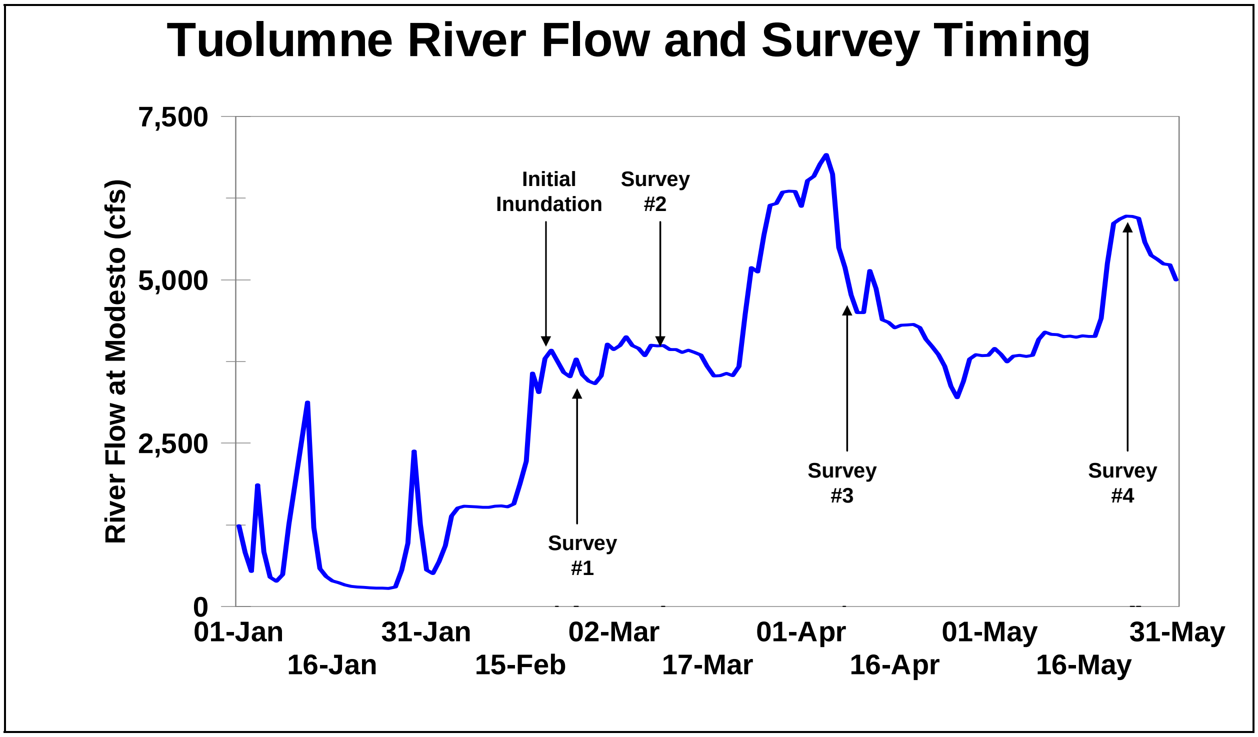

Figure 5. Tuolumne River flow at Modesto during spring 2005 and dates when the Grayson River Ranch sloughs and adjacent Tuolumne River habitats were surveyed.

With the exception of the first survey, maximum turbidity in the sloughs exceeded turbidity in the adjacent Tuolumne River (Table 1). During the surveys conducted in early April and late May, turbidity was significantly higher at all sampling sites in the sloughs relative to the adjacent river area, with the highest turbidity observed in slough B. Elevated turbidity in the sloughs and differences in turbidity between sampling sites within each slough appeared to be primarily caused by substrate disturbance resulting from carp spawning activity (see “Species Utilizing the Grayson River Ranch Sloughs”). Detailed turbidity data for each site is provided in Appendix B.

Table 1. Summary of environmental conditions in the Grayson River Ranch sloughs and at adjacent sampling sites in the Tuolumne River during each survey event.

	Tuolumne River			Grayson River Ranch Sloughs						
				Mouth			Slough A		Slough B	
Survey Date	Flow MOD (cfs)	Temp (F)	Turb (NTU)	Max. Depth	Temp (F)	Turb (NTU)	Temp (F)	Turb (NTU)	Temp (F)	Turb (NTU)
24-Feb	3,788	52-53	7.0–7.0	17”	53	5.9	54-56	6.0-6.1	55-55	6.0-6.1
10-Mar	3,996	57-57	4.9–5.2	32”	59	4.2	59-65	3.5-4.6	65-71	4.9-9.6
08-Apr	5,185	51-54	3.0–3.0	42”	58	3.4	58-59	4.6-4.6	58-60	9.1-9.1
24-25-May	5,955	57-59	1.5-3.0	54”	68	3.7	72-77	5.0-8.7	75-79	4.7-7.8

Minimum, maximum, and average daily water temperatures in the sloughs and adjacent river area were calculated from hourly thermograph data collected during the study period (Appendix C). On average, water temperatures at the approximate midpoint of each slough were consistently several degrees warmer than in the adjacent Tuolumne River (Figure 6). Average daily temperatures also suggest that slough B had similar or slightly cooler average water temperatures than slough A.

In contrast, instantaneous temperatures indicated that slough B had consistently higher temperatures than slough A (Table 1). The apparent discrepancy between these observed trends is explained by the daily range of temperatures recorded by the thermographs in each slough. Although average daily temperatures in slough B were similar or cooler than slough A, maximum daily temperatures were much higher (Figure 7) and minimum daily temperatures were much lower in slough B (Figure 8).

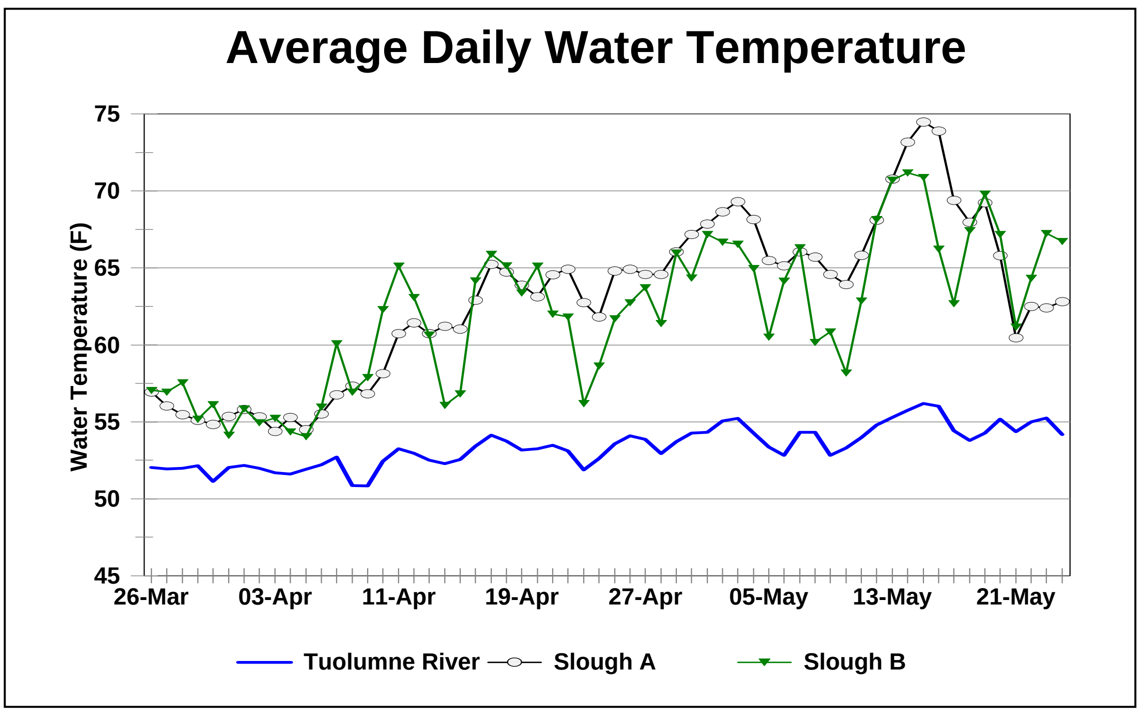

Figure 6. Daily average water temperature in the GRR sloughs and adjacent Tuolumne River.

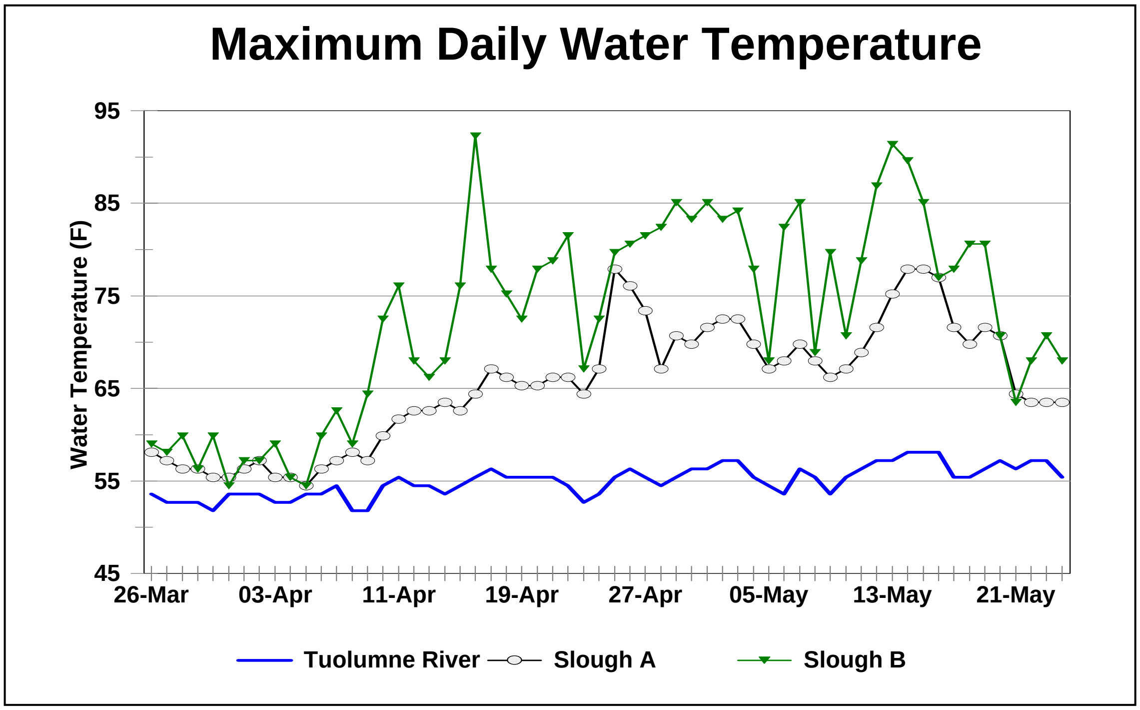

Figure 7. Daily maximum water temperature in the GRR sloughs and adjacent Tuolumne River.

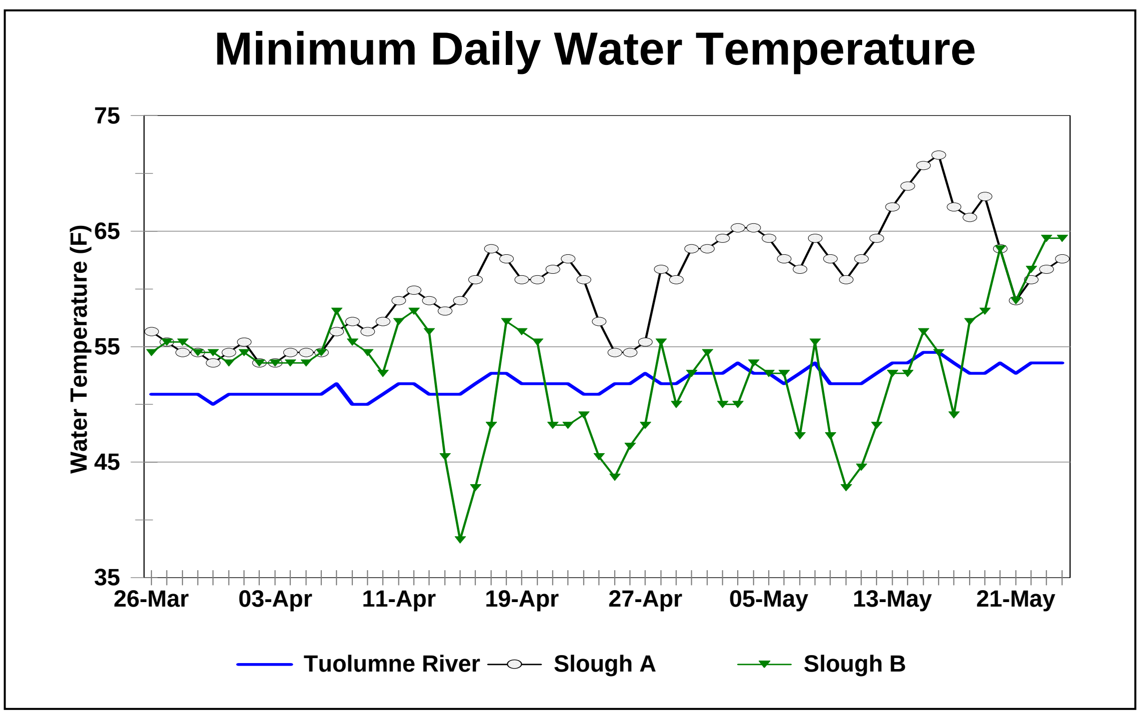

Figure 8. Daily minimum water temperature in the GRR sloughs and adjacent Tuolumne River.

Species Utilizing the Grayson River Ranch Sloughs

A total of four fish species native to the Tuolumne River drainage were captured in the GRR sloughs during the study period (Table 2). Native species utilizing the restored area included, in order of decreasing abundance, Sacramento sucker, Sacramento pikeminnow, Sacramento blackfish, and logperch. Chinook salmon and steelhead were not captured or observed in the GRR sloughs during any of the surveys. A total of seven introduced species were also captured and included, in order of decreasing abundance, carp, mosquitofish, bluegill sunfish, green sunfish, red shiner, and inland silverside (Table 2). Of all of the fish captured in the sloughs, 12% of the individuals were native species and 88% were introduced species.

Carp were by far the most abundant fish species inhabiting the sloughs, representing 87% of all fish captured in the slough complex. No carp were observed or captured in the sloughs during the first survey. Carp observed and captured during the second survey were predominantly spawning adults (Figure 9). By the next survey, most of the adults had vacated the sloughs and young-of-the-year dominated the catch.

Figure 9. Adult carp spawning in the sloughs.

Table 2. Species captured in the Grayson River Ranch sloughs and sampling sites in the Tuolumne River.

	Common Name	Scientific Name	Slough A	Slough B	Mouth	River	Total
Native species							
	Chinook salmon	*Oncorhynchus tshawytscha*	-	-	-	8	8
	Logperch	*Percina macrolepida*	-	1	-	-	1
	Prickly sculpin	*Cottus asper*	-	-	-	16	16
	Sac. blackfish	*Orthodon microlepidotus*	-	1	-	-	1
	Sac. pikeminnow	*Ptychocheilus grandis*	1	3	1	1	6
	Sac. sucker	*Catostomus occidentalis*	6	270	8	95	379
Introduced species							
	Bluegill sunfish	*Lepomis macrochirus*	-	2	2	9	13
	Carp	*Cyprinus carpio*	516	1339	168	1	2024
	Green sunfish	*Lepomis cyanellus*	2	-	-		2
	Goldfish	*Carassius auratus*	-	1	-		1
	Inland silverside	*Menidia beryllina*	1	-	-	1	2
	Largemouth bass	*Micropterus salmoides*	-	-	-	1	1
	Mosquitofish	*Gambusia affinis*	3	1	4	419	427
	Red-ear sunfish	*Lepomis microlophus*	-	-	-	1	1
	Red shiner	*Cyprinella lutrensis*	-	1	-	40	41
	Smallmouth bass	*Micropterus dolomieu*	-	-	-	1	1
		TOTAL	529	1619	183	593	2924

*Two fish captured were not positively identified to species and are not included in this table.

Species Utilizing the Adjacent Main Channel Tuolumne River

A total of four fish species native to the Tuolumne River drainage were captured in the Tuolumne River mainstem during the study period (Table 2). Native species utilizing the restored area included, in order of decreasing abundance, Sacramento sucker, prickly sculpin, Chinook salmon, and Sacramento pikeminnow. Steelhead were not captured or observed in the main channel sampling sites during any of the surveys. A total of eight introduced species were also captured and included, in order of decreasing abundance, mosquitofish, red shiner, bluegill sunfish, carp, red-ear sunfish, and smallmouth bass (Table 2). Mosquitofish dominated the overall catch in the river sites, representing 71% of the total number of fish captured. Of all fish captured in the riverine sampling sites adjacent to the Grayson River Ranch sloughs, 20% of the individuals were native species and 80% were introduced species.

DISCUSSION

In recent years, studies elsewhere have shown that floodplain habitat is important for productivity and diversity in riverine communities (Sommer et al. 1997; Sommer et al. 2001a; Sommer et al. 2001b; Bayley 1991; Halyk and Balon 1983). Inundation of floodplains is thought to benefit anadromous fish directly by increasing food supply to juveniles present in flooded lands, increasing available habitat area, and increasing the overall nutrient supply to the river system (Junk et al.1989).

The GRR Restoration Project, which was implemented in 2000, is relatively young compared to other Central Valley floodplain restoration projects such as Yolo Bypass (Sommer et al. 2001a; Sommer et al. 2001b) and the Cosumnes River (CBDA 2003; Whitener and Kennedy 1998) completed in the mid-1990s. In addition, the GRR Restoration Project is uniquely different from these other projects due to two factors: 1) there is currently an upstream levee blocking conveyance flows through the restored floodplain, and 2) the project area has only been inundated once since its completion nearly 5 years ago. In contrast, the Yolo Bypass and Cosumnes River sites are conveyance floodplains (i.e., open at both the upstream and downstream ends) that are inundated annually. At the GRR Restoration Project, the upper levee will eventually be breached by natural floodwaters resulting in a conveyance floodplain and site conditions are expected to evolve over time as an essential part of the ecosystem function of this terrestrial/aquatic ecotone (Pinay et al. 1990, Schlosser 1991). Although beneficial responses to floodplain restoration have already been observed in the Yolo Bypass and Cosumnes River projects, it will likely take several more years before the full benefit of restoration at GRR for fish populations can be documented, particularly since reliable correlations of population responses to habitat improvement prescriptions generally require many years of trend data (CDFG 1998).

During this first year of inundation and evaluation, the GRR project area was utilized mostly by introduced species (i.e., 88% of catch), in particular by carp for spawning and juvenile rearing. In the adjacent mainstem Tuolumne River, introduced species were also predominant and represented a similar proportion of the catch (i.e., 80% of catch); however, mosquito fish were the most abundant. A total of six native species were captured between the sloughs and river but only two of these species were found in all locations (i.e., Sacramento pikeminnow and Sacramento sucker). One logperch and one Sacramento blackfish were captured in slough B, and eight Chinook salmon and 16 prickly sculpin were captured in the river mainstem. Differences in species composition between the sloughs and the river mainstem are likely due to the respective habitat preferences of each species.

Of the two native fish species targeted by the restoration effort (i.e., Chinook salmon and steelhead) none were observed utilizing the GRR restored floodplain area and only a few Chinook salmon (i.e., 8) and no steelhead were observed in the nearby Tuolumne River during this first year.

Chinook Salmon

Previous studies of Chinook salmon have shown that rearing juveniles prefer habitat with suitable amounts of space, food supply, abundant instream and overhead cover (i.e., logs, roots, other woody debris, shallow riffles, undercut banks, and submergent, emergent, and dense overhead vegetation); floodplain habitat; adequate water depth (i.e., 0.5- 4.0 ft.); flow (i.e., velocity greater than zero, but less than 1.5 ft/s); and temperatures ranging from 45°F to 58°F (CDFG 1998, Reiser and Bjornn 1979; Whitener and Kennedy 1998; EPA 2003 as cited in Deas et al. 2004). Juvenile rearing generally occurs from January through May.

The GRR project has resulted in an expanded amount of space available for juvenile rearing in the lower Tuolumne River including water depths during the study period that were generally adequate for juvenile Chinook rearing, ranging from 6 to 54 inches (0.5 ft to 4.5 feet) at all sampling sites (Table 1 and Appendix A). However, flow (i.e., water velocity), food supply, temperature, and overhead and instream cover in the sloughs were found to be less than optimal for juvenile Chinook rearing which may, at least in part, explain the absence of Chinook salmon in the GRR sloughs during 2005.

Currently, the GRR sloughs are closed at the upper end by an existing levee and are only connected to the river at the downstream end (Figure 10). Water does not flow through the sloughs as it would in a conveyance floodplain. Instead, water enters and exits the sloughs through their single connection with the river and elevations within the sloughs vary as Tuolumne River flows fluctuate.

In contrast, both the Yolo Bypass and the Cosumnes River floodplains are conveyance floodplains whereby water enters the upstream end of the floodplain, and moves across it before reentering the river at the downstream end. Past research indicates that water flowing across floodplains, rather than simply being stored on floodplains, is important to the health of floodplain ecosystems (CBDA 2003) and salmon use. For example, flows through conveyance floodplains were found to increase the ability of the floodplain to provide key nutrients and food sources to the river (CBDA 2003). In addition,

Figure 10. Channel extending from the mouth of the sloughs to the main channel of the Tuolumne River (looking from the mouth of the sloughs towards the main river channel).

studies of the Cosumnes River floodplains found that flow seemed much more critical than either habitat or temperature in determining whether salmon used a particular site (Whitener and Kennedy 1998); ninety percent of the total salmon caught were found at sites that had some movement of water through the habitat.

The GRR project area will become a conveyance floodplain once the levee at the upstream end of the project area is breached naturally by floodwaters. The GRR sloughs were designed with the expectation that the upper levee would eventually fail and would beneficially capture flood flows while also reducing scouring along the south bank of the adjacent mainstem river channel. In the past 10 years, the levee had failed twice (i.e., 1997 and 1998) and was restored. Once the levee breaks again, it will not be repaired so that flows will be unimpeded through the channel. This scenario will likely improve juvenile salmonid use of the project area for rearing by improving access, flow, and water quality conditions in the restored floodplain area

The lack of flow conveyance, in conjunction with low amounts of riparian vegetation, has likely contributed to sub-optimal water temperatures in the sloughs. Daily average water temperatures consistently exceeded the preferred range (i.e., 58°F) for juvenile Chinook rearing in slough A after April 10 (i.e. 73 percent of days recorded) and on most days in slough B after April 6 (i.e., 68 percent of days recorded). Little vegetative cover exists in slough B (Figure 11), and as a result, maximum daily water temperatures are much higher and minimum daily water temperatures much lower than in slough A where plantings have grown more rapidly to provide a greater amount of shading and insulation (Figure 12). The wider diel range in temperature observed for slough B relative to slough A is undoubtedly a reflection of differences in the amount of riparian vegetation associated with each slough. Instantaneous temperatures reported in Table 1 are most similar to the daily maximum temperatures recorded by hourly thermographs (Figure 9) and are likely due to the instantaneous measurements being collected primarily between mid-day and late afternoon when temperatures would have been elevated by solar influence.

These observed temperature patterns are consistent with typical riparian vegetation influences on water temperature including: 1) incoming short-wave solar radiation that would otherwise be absorbed by the water is absorbed by riparian vegetation which reduces daily maximum water temperature; 2) riparian vegetation emits long-wave radiation which increases daily minimum water temperatures; and 3) riparian vegetation decreases evaporation and convection in the near steam area and this microclimate moderates diel and seasonal fluctuations in stream temperature (i.e., prevents extremely low or high temperatures; Rutherford et al. 1997; Beschta et al. 1987).

As riparian plantings become more established around each slough, water temperature conditions are expected to improve. However, until conveyance flows through the sloughs are established, it is unknown if the improvement in riparian canopy alone will be sufficient to maintain suitable water temperatures.

The absence of juvenile Chinook salmon in the GRR sloughs may also be attributed, at least in part, to the overall low abundance of Chinook in the Tuolumne River this year. Spawner escapement during fall 2004 was relatively low (Figure 13), and as a result, juvenile abundance during 2005 was also low as indicated by density indices (Figure 14; TID/MID annual seining reports to FERC, 1999-2005; TID/MID unpublished data).

Figure 11. Photograph of slough B illustrating lack of vegetative cover typical of the majority of the slough.

Figure 12. Photograph of slough A illustrating level of vegetative cover typical of the majority of the slough.

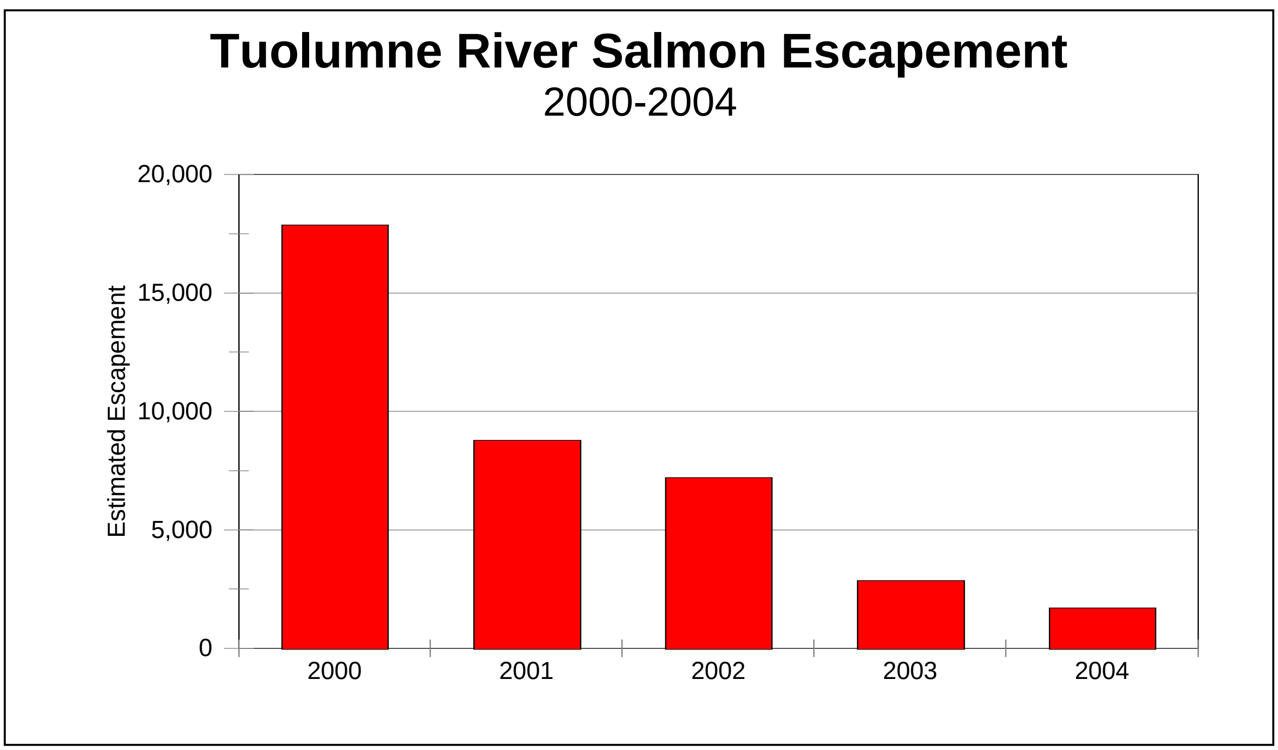

Figure 13. Annual estimated escapement of fall-run Chinook salmon to the Tuolumne River, 2000-2004.

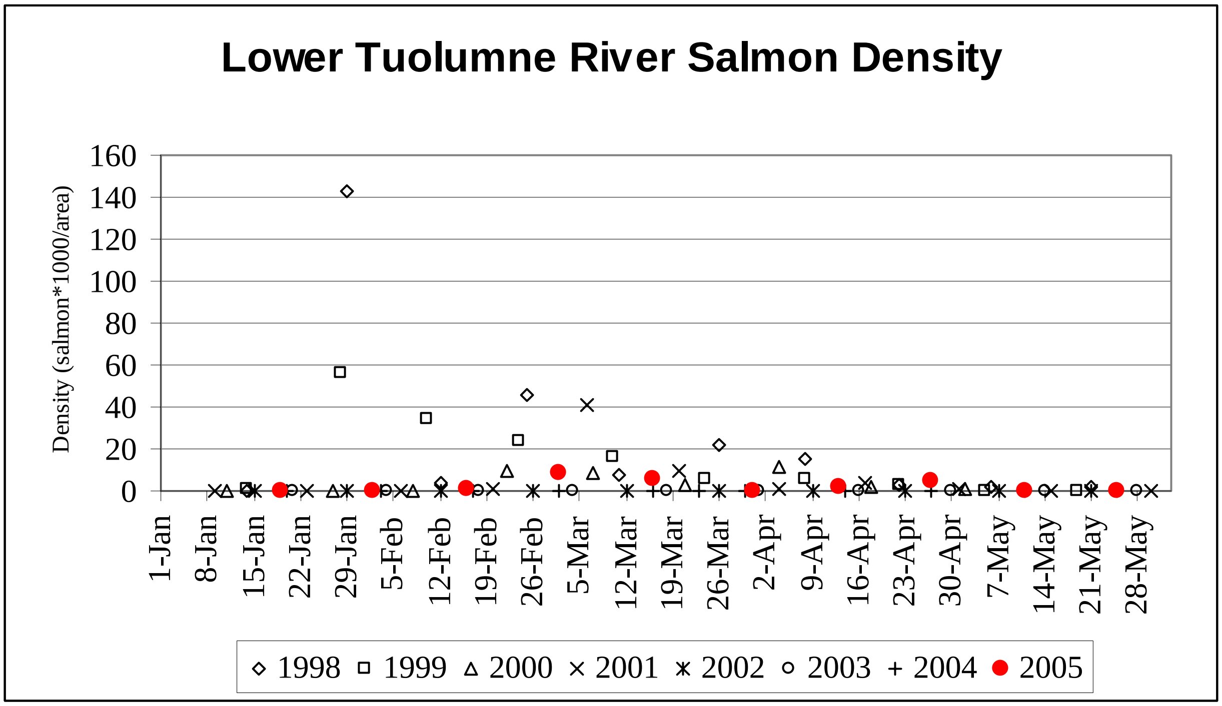

Figure 14. Average densities of juvenile Chinook salmon at TID/MID seine sites in the lower Tuolumne River near Grayson River Ranch.

Steelhead

Juvenile steelhead habitat preferences are similar to Chinook salmon and include adequate depth (i.e., 0.8-1.7 feet; Bovee 1978 as cited in McEwan and Jackson 1996), flow (i.e., velocity greater than zero, but less than 1.6 ft/s; Reiser and Bjornn 1979), and temperatures ranging from 45°F to 60°F (Mc Ewan and Jackson 1996; Reiser and Bjornn 1979; EPA 2003 as cited in Deas et al. 2004). Juvenile steelhead rearing occurs year-round.

Since juvenile steelhead habitat preferences are similar to those of Chinook salmon, use of the restored area by steelhead is likely limited by the same habitat related factors (i.e., flow, riparian vegetation, and water temperatures). However, the overall low abundance of migrating steelhead observed in the adjacent river may be the most important factor influencing steelhead use of the GRR restoration area. Very few steelhead appear to outmigrate from the Tuolumne River during the winter-spring inundation period so their presence in the project area is expected to be rare, at least initially. For instance, only two steelhead have been captured during 11 years of salmonid outmigrant abundance monitoring using rotary screw traps in the main channel of the Tuolumne River at Grayson (RM 5.2) and Shiloh (RM 3.4) (CDFG and SPCA unpublished data). Steelhead abundance is expected to increase as a result of past and future restoration actions in the Tuolumne River and throughout the San Joaquin Basin, and this may influence future use of the GRR restoration area.

SUMMARY

- The GRR Restoration Project was implemented during the summer of 2000, followed by re-vegetation of the site in the fall/winter of 2000/2001.

- Initial opportunity for fish to use the GRR project area occurred in 2005 when the slough was first inundated beginning on February 21. Inundation extended through at least May 25 when sampling was discontinued.

- During this initial inundation period, the GRR project area was utilized mostly by introduced species (i.e., 88% of catch), in particular by carp for spawning and juvenile rearing.

- No target species (i.e., Chinook salmon and steelhead) were observed utilizing the sloughs and only a few juvenile Chinook (i.e., 8) were observed in the adjacent mainstem Tuolumne River.

- Absence of target species in the GRR sloughs may be due to one or more of the following factors:

    - lack of conveyance flows through the sloughs (i.e., only one downstream entrance),
    - relatively high water temperatures (i.e., >60 °F),
    - lack of riparian vegetation,
    - and absence or low abundance of target species in the vicinity of the sloughs during the inundation period.

- The GRR project is expected to become a conveyance floodplain once an existing upper levee is naturally breached by floodwaters, resulting in greater use of the project by juvenile salmonids.

- Water temperatures will likely decrease in the future as the sloughs become conveyance floodplains and/or riparian vegetation becomes established.

- Numbers of target fish in the vicinity of the GRR project are expected to increase due to other restoration efforts resulting in an increased likelihood that salmonids will utilize the GRR sloughs.

- Long-term data sets will be required to identify the full restoration benefits of the GRR project.

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APPENDICES

Appendix A. Dimensions of each seine haul conducted at each site sampled in the Grayson River Ranch sloughs and adjacent riverine sites during spring 2005.

				Haul Dimensions			
Site	**Date**	**Time**	**Haul #**	**Width (ft)**	**Length (ft)**	**Depth (in)**	**Area (sq. ft)**
AB	2/24/2005	1145	1	10	130	15	1,300
AB	2/24/2005	1145	2	10	30	15	300
AB	2/24/2005	1145	3	10	30	15	300
AB	2/24/2005	1145	4	20	80	15	1,600
A	2/24/2005	1305	1	10	30	6	300
A1	2/24/2005	1300	1	10	30	8	300
A2	2/24/2005	1245	1	10	30	15	300
A2	2/24/2005	1245	2	10	30	15	300
A2	2/24/2005	1245	3	10	30	15	300
A2	2/24/2005	1245	4	10	30	15	300
B	2/24/2005	1315	1	20	50	8	1,000
B	2/24/2005	1315	2	20	50	8	1,000
B1	2/24/2005	1330	1	20	50	10	1,000
B1	2/24/2005	1330	2	20	50	10	1,000
B1	2/24/2005	1330	3	20	50	10	1,000
B2	2/24/2005	1345	1	20	50	14	1,000
B2	2/24/2005	1345	2	20	50	14	1,000
B2	2/24/2005	1345	3	20	50	14	1,000
T1	2/24/2005	1410	1	10	30	3.5	300
T2	2/24/2005	1440	1	10	50	48	500
T2	2/24/2005	1440	2	10	50	24	500
T2	2/24/2005	1440	3	10	50	24	500
T3	2/24/2005	1525	1	20	70	48	1,400
T3	2/24/2005	1525	2	20	30	48	600
T3	2/24/2005	1525	3	20	30	48	600
AB	3/10/2005	1000	1	10	130	32	1,300
AB	3/10/2005	1000	2	10	30	32	300
AB	3/10/2005	1000	3	10	30	32	300
AB	3/10/2005	1000	4	20	80	32	1,600
A	3/10/2005	1110	1	20	40	21	800
A1	3/10/2005	1050	1	10	20	17	200
A1	3/10/2005	1050	2	10	30	17	300
A2	3/10/2005	1030	1	20	30	21	600
A2	3/10/2005	1030	2	20	30	21	600
A2	3/10/2005	1030	3	20	30	21	600
B	3/10/2005	1125	1	20	30	18	600
B	3/10/2005	1125	2	20	30	18	600
B	3/10/2005	1125	3	20	30	18	600
B1	3/10/2005	1200	1	20	30	16	600
B1	3/10/2005	1200	2	20	30	16	600
B1	3/10/2005	1200	3	20	30	16	600
B2	3/10/2005	1240	1	20	30	18	600
B2	3/10/2005	1240	2	20	30	18	600
B2	3/10/2005	1240	3	20	30	18	600
T1	3/10/2005	1400	1	10	30	42	300
T2	3/10/2005	1300	1	20	30	40	600
T2	3/10/2005	1300	2	20	50	40	1,000

				Haul Dimensions			
Site	**Date**	**Time**	**Haul #**	**Width (ft)**	**Length (ft)**	**Depth (in)**	**Area (sq. ft)**
T2	3/10/2005	1300	3	20	50	40	1,000
T3	3/10/2005	1455	1	20	50	46	1,000
T3	3/10/2005	1455	2	20	30	46	600
T3	3/10/2005	1455	3	20	30	46	600
AB	4/8/2005	1500	1	20	50	42	1,000
AB	4/8/2005	1500	2	20	80	42	1,600
A	4/8/2005	1400	1	20	30	42	600
A	4/8/2005	1400	2	20	50	42	1,000
A1	4/8/2005	1415	1	20	40	42	800
A1	4/8/2005	1415	2	20	40	42	800
A2	4/8/2005	1445	1	20	40	42	800
A2	4/8/2005	1445	2	20	40	42	800
B	4/8/2005	1605	1	20	60	36	1,200
B1	4/8/2005	1545	1	20	30	18	600
B1	4/8/2005	1545	2	20	30	18	600
B2	4/8/2005	1520	1	20	30	24	600
B2	4/8/2005	1520	2	20	30	24	600
T1	4/8/2005	1240	1	20	50	42	1,000
T2	4/8/2005	1200	1	20	75	36	1,500
T3	4/8/2005	1630	1	20	50	48	1,000
T1	5/24/2005	1430	1	10	20	36	200
T2	5/24/2005	1415	1	10	20	42	200
T2	5/24/2005	1415	2	10	20	42	200
T2	5/24/2005	1415	3	10	25	42	250
T3	5/24/2005	1130	1	10	30	36	300
T3	5/24/2005	1130	2	10	30	36	300
T3	5/24/2005	1130	3	10	20	36	200
AB	5/24/2005	1215	1	20	40	54	800
AB	5/24/2005	1215	2	20	50	54	1,000
AB	5/24/2005	1215	3	20	40	54	800
A	5/25/2005	1145	1	20	50	42	1,000
A	5/25/2005	1145	2	20	50	42	1,000
A1	5/25/2005	1115	1	10	20	42	200
A1	5/25/2005	1115	2	10	20	42	200
A1	5/25/2005	1115	3	10	20	42	200
A2	5/25/2005	1045	1	10	20	48	200
A2	5/25/2005	1045	2	10	30	48	300
A2	5/25/2005	1045	3	10	20	48	200
B	5/25/2005	1315	1	20	40	54	800
B	5/25/2005	1315	2	20	40	54	800
B1	5/25/2005	1230	1	20	40	36	800
B1	5/25/2005	1230	2	20	35	36	700
B2	5/25/2005	1200	1	10	20	42	200
B2	5/25/2005	1200	2	10	20	42	200
B2	5/25/2005	1200	3	10	20	42	200

Appendix B. Environmental conditions in the Grayson River Ranch sloughs and adjacent riverine sites at the time each survey was conducted during spring 2005.

Date	Start Time	End Time	Site	GPS Coordinates		Weather	Turbidity (NTU)	Temperature (F)
2/24/2005	1145	1230	AB	N37 35 03.8	W121 07 42.6	CLD	5.9	53
2/24/2005	1305	1310	A	N37 34 56.8	W121 07 17.0	CLD	6.1	56
2/24/2005	1300	1305	A1	N37 35 00.3	W121 07 38.9	CLD	6	54
2/24/2005	1245	1300	A2	N37 34 56.1	W121 07 28.3	CLD	6	54
2/24/2005	1315	1330	B	N37 35 00.4	W121 07 18.0	CLD	6.1	55
2/24/2005	1330	1340	B1	N37 35 03.2	W121 07 37.8	CLD	6	55
2/24/2005	1345	1400	B2	N37 35 06.4	W121 07 26.4	CLD	6	55
2/24/2005	1410	1430	T1	N37 34 43.6	W121 06 58.9	CLD	7	53
2/24/2005	1440	1500	T2	N37 35 03.0	W121 07 07.2	CLD	7	53
2/24/2005	1525	1615	T3	N37 35 10.9	W121 07 38.6	CLD	7	52
3/10/2005	1000	1030	AB	N37 35 03.8	W121 07 42.6	CLR	4.2	59
3/10/2005	1110	1120	A	N37 34 56.8	W121 07 17.0	CLR	3.6	65
3/10/2005	1050	1104	A1	N37 35 00.3	W121 07 38.9	CLR	3.5	64
3/10/2005	1030	1042	A2	N37 34 56.1	W121 07 28.3	CLR	4.6	59
3/10/2005	1125	1150	B	N37 35 00.4	W121 07 18.0	CLR	9.6	69
3/10/2005	1200	1230	B1	N37 35 03.2	W121 07 37.8	CLR	6	71
3/10/2005	1240	1255	B2	N37 35 06.4	W121 07 26.4	CLR	4.9	65
3/10/2005	1400	1420	T1	N37 34 43.6	W121 06 58.9	CLR	4.9	57
3/10/2005	1300	1350	T2	N37 35 03.0	W121 07 07.2	CLR	5.2	57
3/10/2005	1455	1530	T3	N37 35 10.9	W121 07 38.6	CLR	5.2	57
4/8/2005	1500	1520	AB	N37 35 03.8	W121 07 42.6	RAN	3.42	58
4/8/2005	1400	1415	A	N37 34 56.8	W121 07 17.0	CLD	4.55	59
4/8/2005	1415	1430	A1	N37 35 00.3	W121 07 38.9	CLD	4.55	58
4/8/2005	1445	1500	A2	N37 34 56.1	W121 07 28.3	CLD	4.55	59
4/8/2005	1605	1615	B	N37 35 00.4	W121 07 18.0	RAN	9.05	60
4/8/2005	1545	1605	B1	N37 35 03.2	W121 07 37.8	RAN	9.05	59
4/8/2005	1520	1540	B2	N37 35 06.4	W121 07 26.4	RAN	9.05	58
4/8/2005	1240	1300	T1	N37 34 43.6	W121 06 58.9	CLD	3.01	54
4/8/2005	1200	1210	T2	N37 35 03.0	W121 07 07.2	RAN	3.01	54
4/8/2005	1630	1645	T3	N37 35 10.9	W121 07 38.6	CLD	3.01	51
5/24/2005	1215	1245	AB	N37 35 03.8	W121 07 42.6	CLR	3.68	68
5/25/2005	1145	1200	A	N37 34 56.8	W121 07 17.0	CLR	8.65	77
5/25/2005	1115	1130	A1	N37 35 00.3	W121 07 38.9	CLR	4.95	73

Date	Start Time	End Time	Site	GPS Coordinates		Weather	Turbidity (NTU)	Temperature (F)
5/25/2005	1045	1100	A2	N37 34 56.1	W121 07 28.3	CLR	6.87	72
5/25/2005	1315	1345	B	N37 35 00.4	W121 07 18.0	CLR	7.81	79
5/25/2005	1230	1300	B1	N37 35 03.2	W121 07 37.8	CLR	5.92	77
5/25/2005	1200	1215	B2	N37 35 06.4	W121 07 26.4	CLR	4.74	75
5/24/2005	1430	1445	T1	N37 34 43.6	W121 06 58.9	CLR	-	58
5/24/2005	1415	1430	T2	N37 35 03.0	W121 07 07.2	CLR	2.96	57
5/24/2005	1130	1200	T3	N37 35 10.9	W121 07 38.6	CLR	1.5	59

Appendix C. Daily river flow at Modesto and daily minimum, average, and maximum water temperature in the Grayson River Ranch sloughs and adjacent riverine area during spring 2005.

	Slough A			Slough B			Mouth			Tuolumne River			Flow at
	Min. (F)	Avg. (F)	Max. (F)	Min. (F)	Avg. (F)	Max. (F)	Min. (F)	Avg. (F)	Max. (F)	Min. (F)	Avg. (F)	Max. (F)	MOD (cfs)
26-Mar-05	56.30	56.94	58.10	54.50	57.05	59.00	51.80	52.74	53.60	50.90	52.03	53.60	5,683
27-Mar-05	55.40	56.04	57.20	55.40	56.94	58.10	51.80	52.70	53.60	50.90	51.95	52.70	6,140
28-Mar-05	54.50	55.47	56.30	55.40	57.54	59.90	51.80	52.81	53.60	50.90	51.99	52.70	6,168
29-Mar-05	54.50	55.10	56.30	54.50	55.17	56.30	51.80	53.00	53.60	50.90	52.14	52.70	6,342
30-Mar-05	53.60	54.84	55.40	54.50	56.11	59.90	50.90	52.33	52.70	50.00	51.12	51.80	6,358
31-Mar-05	54.50	55.36	55.40	53.60	54.12	54.50	51.80	53.15	55.40	50.90	52.03	53.60	6,350
01-Apr-05	55.40	55.81	56.30	54.50	55.85	57.20	53.60	54.65	55.40	50.90	52.18	53.60	6,124
02-Apr-05	53.60	55.32	57.20	53.60	54.95	57.20	51.80	53.23	54.50	50.90	51.99	53.60	6,520
03-Apr-05	53.60	54.39	55.40	53.60	55.25	59.00	51.80	53.00	54.50	50.90	51.69	52.70	6,584
04-Apr-05	54.50	55.29	55.40	53.60	54.35	55.40	51.80	52.74	53.60	50.90	51.61	52.70	6,775
05-Apr-05	54.50	54.50	54.50	53.60	54.05	54.50	51.80	53.15	54.50	50.90	51.91	53.60	6,919
06-Apr-05	54.50	55.51	56.30	54.50	55.96	59.90	52.70	55.03	59.00	50.90	52.21	53.60	6,618
07-Apr-05	56.30	56.75	57.20	58.10	60.09	62.60	58.10	59.08	59.90	51.80	52.70	54.50	5,490
08-Apr-05	57.20	57.31	58.10	55.40	56.94	59.00	55.40	57.50	59.00	50.00	50.86	51.80	5,185
09-Apr-05	56.30	56.83	57.20	54.50	57.88	64.40	55.40	57.05	59.00	50.00	50.82	51.80	4,773
10-Apr-05	57.20	58.14	59.90	52.70	62.30	72.50	56.30	57.84	59.00	50.90	52.44	54.50	4,499
11-Apr-05	59.00	60.73	61.70	57.20	65.11	76.10	59.00	60.65	63.50	51.80	53.26	55.40	4,497
12-Apr-05	59.90	61.44	62.60	58.10	63.09	68.00	53.60	54.73	58.10	51.80	52.96	54.50	5,144
13-Apr-05	59.00	60.72	62.60	56.30	60.65	66.20	52.70	56.83	62.60	50.90	52.51	54.50	4,866
14-Apr-05	58.10	61.21	63.50	45.50	56.08	68.00	57.20	60.28	64.40	50.90	52.29	53.60	4,388
15-Apr-05	59.00	61.02	62.60	38.30	56.83	76.10	59.00	61.48	65.30	50.90	52.55	54.50	4,349
16-Apr-05	60.80	62.90	64.40	42.80	64.18	92.30	59.00	60.95	64.40	51.80	53.41	55.40	4,268
17-Apr-05	63.50	65.23	67.10	48.20	65.90	77.90	56.30	60.76	67.10	52.70	54.12	56.30	4,305
18-Apr-05	62.60	64.74	66.20	57.20	65.15	75.20	55.40	58.81	63.50	52.70	53.75	55.40	4,310
19-Apr-05	60.80	63.87	65.30	56.30	63.39	72.50	53.60	57.99	63.50	51.80	53.15	55.40	4,316
20-Apr-05	60.80	63.13	65.30	55.40	65.11	77.90	58.10	60.39	65.30	51.80	53.26	55.40	4,272
21-Apr-05	61.70	64.55	66.20	48.20	62.00	78.80	62.60	67.66	73.40	51.80	53.49	55.40	4,090
22-Apr-05	62.60	64.93	66.20	48.20	61.81	81.50	63.50	66.61	69.80	51.80	53.11	54.50	3,975
23-Apr-05	60.80	62.75	64.40	49.10	56.19	67.10	61.70	63.65	66.20	50.90	51.88	52.70	3,858
24-Apr-05	57.20	61.81	67.10	45.50	58.63	72.50	59.00	63.24	67.10	50.90	52.63	53.60	3,677
25-Apr-05	54.50	64.81	77.90	43.70	61.70	79.70	54.50	60.42	68.00	51.80	53.56	55.40	3,371
26-Apr-05	54.50	64.93	76.10	46.40	62.75	80.60	50.00	59.34	67.10	51.80	54.09	56.30	3,196
27-Apr-05	55.40	64.59	73.40	48.20	63.73	81.50	51.80	60.65	71.60	52.70	53.86	55.40	3,445

	Slough A			Slough B			Mouth			Tuolumne River			Flow at
	Min. (F)	Avg. (F)	Max. (F)	Min. (F)	Avg. (F)	Max. (F)	Min. (F)	Avg. (F)	Max. (F)	Min. (F)	Avg. (F)	Max. (F)	MOD (cfs)
28-Apr-05	61.70	64.59	67.10	55.40	61.40	82.40	53.60	54.58	55.40	51.80	52.93	54.50	3,790
29-Apr-05	60.80	66.05	70.70	50.00	65.98	85.10	52.70	61.18	70.70	51.80	53.71	55.40	3,854
30-Apr-05	63.50	67.18	69.80	52.70	64.36	83.30	54.50	63.84	72.50	52.70	54.28	56.30	3,837
01-May-05	63.50	67.85	71.60	54.50	67.18	85.10	57.20	65.45	77.00	52.70	54.31	56.30	3,845
02-May-05	64.40	68.64	72.50	50.00	66.69	83.30	54.50	59.56	67.10	52.70	55.06	57.20	3,949
03-May-05	65.30	69.31	72.50	50.00	66.54	84.20	59.90	68.53	76.10	53.60	55.21	57.20	3,859
04-May-05	65.30	68.15	69.80	53.60	64.96	77.90	67.10	70.51	73.40	52.70	54.28	55.40	3,742
05-May-05	64.40	65.49	67.10	52.70	60.50	68.00	56.30	61.21	68.00	52.70	53.37	54.50	3,834
06-May-05	62.60	65.15	68.00	52.70	64.14	82.40	54.50	62.26	70.70	51.80	52.81	53.60	3,846
07-May-05	61.70	66.05	69.80	47.30	66.31	85.10	54.50	65.34	74.30	52.70	54.31	56.30	3,829
08-May-05	64.40	65.71	68.00	55.40	60.16	68.90	59.90	63.50	66.20	53.60	54.31	55.40	3,847
09-May-05	62.60	64.59	66.20	47.30	60.84	79.70	53.60	55.29	62.60	51.80	52.81	53.60	4,091
10-May-05	60.80	63.91	67.10	42.80	58.18	70.70	52.70	57.20	62.60	51.80	53.30	55.40	4,202
11-May-05	62.60	65.83	68.90	44.60	62.86	78.80	56.30	60.84	67.10	51.80	53.98	56.30	4,168
12-May-05	64.40	68.11	71.60	48.20	68.15	86.90	57.20	62.79	68.90	52.70	54.80	57.20	4,160
13-May-05	67.10	70.78	75.20	52.70	70.70	91.40	59.00	65.30	71.60	53.60	55.29	57.20	4,128
14-May-05	68.90	73.18	77.90	52.70	71.19	89.60	58.10	63.73	70.70	53.60	55.74	58.10	4,138
15-May-05	70.70	74.49	77.90	56.30	70.89	85.10	61.70	66.54	71.60	54.50	56.19	58.10	4,121
16-May-05	71.60	73.89	77.00	54.50	66.24	77.00	57.20	63.20	68.00	54.50	56.00	58.10	4,145
17-May-05	67.10	69.39	71.60	49.10	62.68	77.90	59.90	62.53	67.10	53.60	54.42	55.40	4,130
18-May-05	66.20	67.96	69.80	57.20	67.44	80.60	56.30	62.67	67.10	52.70	53.79	55.40	4,132
19-May-05	68.00	69.24	71.60	58.10	69.80	80.60	54.50	57.39	63.50	52.70	54.28	56.30	4,410
20-May-05	63.50	65.79	70.70	63.50	67.18	70.70	55.40	56.41	58.10	53.60	55.18	57.20	5,252
21-May-05	59.00	60.46	64.40	59.00	61.17	63.50	53.60	55.78	58.10	52.70	54.35	56.30	5,866
22-May-05	60.80	62.49	63.50	61.70	64.33	68.00	55.40	57.01	59.00	53.60	54.99	57.20	5,931
23-May-05	61.70	62.41	63.50	64.40	67.25	70.70	55.40	57.57	59.00	53.60	55.25	57.20	5,972
24-May-05	62.60	62.82	63.50	64.40	66.73	68.00	56.30	56.68	57.20	53.60	54.17	55.40	5,970

Appendix D. Individual data for fish captured by seine in the Grayson River Ranch sloughs and adjacent riverine sampling sites during spring 2005.

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
2/24/2005	1305	A	1	NONE	--	--	--	--	1
2/24/2005	1300	A1	1	NONE	--	--	--	--	1
2/24/2005	1245	A2	1	NONE	--	--	--	--	1
2/24/2005	1245	A2	2	NONE	--	--	--	--	1
2/24/2005	1245	A2	3	NONE	--	--	--	--	1
2/24/2005	1245	A2	4	NONE	--	--	--	--	1
2/24/2005	1145	AB	1	NONE	--	--	--	--	1
2/24/2005	1145	AB	2	NONE	--	--	--	--	1
2/24/2005	1145	AB	3	NONE	--	--	--	--	1
2/24/2005	1145	AB	4	NONE	--	--	--	--	1
2/24/2005	1315	B	1	NONE	--	--	--	--	1
2/24/2005	1315	B	2	NONE	--	--	--	--	1
2/24/2005	1330	B1	1	NONE	--	--	--	--	1
2/24/2005	1330	B1	2	NONE	--	--	--	--	1
2/24/2005	1330	B1	3	NONE	--	--	--	--	1
2/24/2005	1345	B2	1	NONE	--	--	--	--	1
2/24/2005	1345	B2	2	NONE	--	--	--	--	1
2/24/2005	1345	B2	3	NONE	--	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	17	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	22	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	21	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	20	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	14	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	12	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	17	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	24	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	15	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	18	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	14	--	--	--	1
2/24/2005	1410	T1	1	Mosquitofish	19	--	--	--	1
2/24/2005	1410	T1	1	Smallmouth bass	50	--	--	--	1
2/24/2005	1440	T2	1	Bluegill sunfish	125	--	--	--	1
2/24/2005	1440	T2	1	Bluegill sunfish	150	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
2/24/2005	1440	T2	1	Mosquitofish	38	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	19	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	25	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	22	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	21	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	18	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	14	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	23	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	23	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	19	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	20	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	22	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	13	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	11	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	18	--	--	--	1
2/24/2005	1440	T2	1	Mosquitofish	16	--	--	--	1
2/24/2005	1440	T2	2	NONE	--	--	--	--	1
2/24/2005	1440	T2	3	NONE	--	--	--	--	1
2/24/2005	1525	T3	1	Chinook salmon	40	43	0.8	2	1
2/24/2005	1525	T3	1	Largemouth bass	81	--	--	--	1
2/24/2005	1525	T3	1	Mosquitofish	22	--	--	--	1
2/24/2005	1525	T3	1	Red shiner	35	--	--	--	1
2/24/2005	1525	T3	1	Red shiner	11	--	--	--	1
2/24/2005	1525	T3	2	Mosquitofish	22	--	--	--	1
2/24/2005	1525	T3	2	Red shiner	37	--	--	--	1
2/24/2005	1525	T3	3	Chinook salmon	40	43	0.8	2	1
2/24/2005	1525	T3	3	Chinook salmon	43	46	0.8	2	1
2/24/2005	1525	T3	3	Chinook salmon	43	45	0.8	2	1
2/24/2005	1525	T3	3	Chinook salmon	37	39	0.6	2	1
2/24/2005	1525	T3	3	Chinook salmon	33	35	0.4	2	1
2/24/2005	1525	T3	3	Mosquitofish	18	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	16	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	28	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	17	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	20	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
2/24/2005	1525	T3	3	Mosquitofish	22	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	15	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	35	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	22	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	24	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	20	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	26	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	31	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	22	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	20	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	19	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	22	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	24	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	30	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	27	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	21	--	--	--	1
2/24/2005	1525	T3	3	Mosquitofish	18	--	--	--	1
2/24/2005	1525	T3	3	Inland silverside	37	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	24	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	32	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	30	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	19	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	18	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	28	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	20	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	17	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	24	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	25	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	35	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	41	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	21	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	22	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	26	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	13	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	24	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
2/24/2005	1525	T3	3	Red shiner	22	--	--	--	1
2/24/2005	1525	T3	3	Red shiner	16	--	--	--	1
2/24/2005	1525	T3	3	Sac. pikeminnow	49	--	--	--	1
3/10/2005	1110	A	1	NONE	--	--	--	--	1
3/10/2005	1050	A1	1	Mosquitofish	31	--	--	--	1
3/10/2005	1050	A1	2	NONE	--	--	--	--	1
3/10/2005	1030	A2	1	NONE	--	--	--	--	1
3/10/2005	1030	A2	2	NONE	--	--	--	--	1
3/10/2005	1030	A2	3	NONE	--	--	--	--	1
3/10/2005	1000	AB	1	Bluegill sunfish	60	--	--	--	1
3/10/2005	1000	AB	2	Bluegill sunfish	47	--	--	--	1
3/10/2005	1000	AB	3	NONE	--	--	--	--	1
3/10/2005	1000	AB	4	Mosquitofish	24	--	--	--	1
3/10/2005	1000	AB	4	Mosquitofish	19	--	--	--	1
3/10/2005	1125	B	1	Carp	610	--	--	--	1
3/10/2005	1125	B	1	Carp	470	--	--	--	1
3/10/2005	1125	B	2	Carp	700	--	--	--	1
3/10/2005	1125	B	2	Goldfish	315	--	--	--	1
3/10/2005	1125	B	3	Carp	840	--	--	--	1
3/10/2005	1125	B	3	Carp	460	--	--	--	1
3/10/2005	1125	B	3	Carp	620	--	--	--	1
3/10/2005	1125	B	3	Carp	480	--	--	--	1
3/10/2005	1125	B	3	Carp	460	--	--	--	1
3/10/2005	1125	B	3	Carp	500	--	--	--	1
3/10/2005	1200	B1	1	Carp	600	--	--	--	1
3/10/2005	1200	B1	1	Carp	550	--	--	--	1
3/10/2005	1200	B1	1	Carp	540	--	--	--	1
3/10/2005	1200	B1	2	Carp	550	--	--	--	1
3/10/2005	1200	B1	2	Carp	650	--	--	--	1
3/10/2005	1200	B1	2	Carp	690	--	--	--	1
3/10/2005	1200	B1	3	NONE	--	--	--	--	1
3/10/2005	1240	B2	1	Sacramento blackfish	410	--	--	--	1
3/10/2005	1240	B2	2	NONE	--	--	--	--	1
3/10/2005	1240	B2	3	NONE	--	--	--	--	1
3/10/2005	1400	T1	1	Bluegill sunfish	42	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
3/10/2005	1400	T1	1	Bluegill sunfish	44	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	23	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	21	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	22	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	15	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	15	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	19	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	18	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	19	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	20	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	20	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	20	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	25	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	22	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	27	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	23	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	22	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	18	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	17	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	20	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	23	--	--	--	1
3/10/2005	1400	T1	1	Mosquitofish	--	--	--	--	22
3/10/2005	1400	T1	1	Red-ear sunfish	55	--	--	--	1
3/10/2005	1400	T1	1	Red shiner	30	--	--	--	1
3/10/2005	1300	T2	1	Bluegill sunfish	47	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	--	--	--	--	11
3/10/2005	1300	T2	1	Mosquitofish	19	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	18	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	22	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	16	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	15	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	20	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	19	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	19	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	20	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
3/10/2005	1300	T2	1	Mosquitofish	21	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	20	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	37	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	37	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	24	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	18	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	17	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	21	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	21	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	18	--	--	--	1
3/10/2005	1300	T2	1	Mosquitofish	30	--	--	--	1
3/10/2005	1300	T2	1	Red shiner	17	--	--	--	1
3/10/2005	1300	T2	1	Red shiner	40	--	--	--	1
3/10/2005	1300	T2	1	Red shiner	17	--	--	--	1
3/10/2005	1300	T2	1	Red shiner	21	--	--	--	1
3/10/2005	1300	T2	2	Bluegill sunfish	43	--	--	--	1
3/10/2005	1300	T2	3	NONE	--	--	--	--	1
3/10/2005	1455	T3	1	Bluegill sunfish	36	--	--	--	1
3/10/2005	1455	T3	1	Chinook salmon	46	49	1	3	1
3/10/2005	1455	T3	2	NONE	--	--	--	--	1
3/10/2005	1455	T3	3	Chinook salmon	56	60	1.7	3	1
3/10/2005	1455	T3	3	Mosquitofish	22	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	27	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	18	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	19	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	32	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	19	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	23	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	15	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	21	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	22	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	25	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	32	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	23	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	24	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
3/10/2005	1455	T3	3	Mosquitofish	26	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	23	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	22	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	20	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	31	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	22	--	--	--	1
3/10/2005	1455	T3	3	Mosquitofish	--	--	--	--	22
3/10/2005	1455	T3	3	Red shiner	36	--	--	--	1
3/10/2005	1455	T3	3	Red shiner	29	--	--	--	1
3/10/2005	1455	T3	3	Red shiner	35	--	--	--	1
3/10/2005	1455	T3	3	Red shiner	41	--	--	--	1
3/10/2005	1455	T3	3	Red shiner	33	--	--	--	1
4/8/2005	1400	A	1	NONE	--	--	--	--	1
4/8/2005	1400	A	2	Inland silverside	69	--	--	--	1
4/8/2005	1400	A	2	Sacramento sucker	--	--	--	--	2
4/8/2005	1415	A1	1	NONE	--	--	--	--	1
4/8/2005	1415	A1	2	Carp	22	--	--	--	1
4/8/2005	1415	A1	2	Carp	21	--	--	--	1
4/8/2005	1415	A1	2	Carp	23	--	--	--	1
4/8/2005	1415	A1	2	Carp	20	--	--	--	1
4/8/2005	1415	A1	2	Carp	18	--	--	--	1
4/8/2005	1415	A1	2	Sac. pikeminnow	46	--	--	--	1
4/8/2005	1415	A1	2	Sacramento sucker	32	--	--	--	1
4/8/2005	1445	A2	1	NONE	--	--	--	--	1
4/8/2005	1445	A2	2	NONE	--	--	--	--	1
4/8/2005	1500	AB	1	Carp	23	--	--	--	1
4/8/2005	1500	AB	1	Carp	24	--	--	--	1
4/8/2005	1500	AB	1	Carp	20	--	--	--	1
4/8/2005	1500	AB	1	Carp	17	--	--	--	1
4/8/2005	1500	AB	1	Carp	19	--	--	--	1
4/8/2005	1500	AB	1	Carp	21	--	--	--	1
4/8/2005	1500	AB	1	Carp	20	--	--	--	1
4/8/2005	1500	AB	1	Carp	19	--	--	--	1
4/8/2005	1500	AB	1	Sacramento sucker	24	--	--	--	1
4/8/2005	1500	AB	2	Carp	21	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
4/8/2005	1500	AB	2	Carp	22	--	--	--	1
4/8/2005	1500	AB	2	Carp	22	--	--	--	1
4/8/2005	1500	AB	2	Carp	20	--	--	--	1
4/8/2005	1500	AB	2	Carp	18	--	--	--	1
4/8/2005	1500	AB	2	Carp	20	--	--	--	1
4/8/2005	1500	AB	2	Carp	23	--	--	--	1
4/8/2005	1500	AB	2	Carp	20	--	--	--	1
4/8/2005	1500	AB	2	Carp	19	--	--	--	1
4/8/2005	1500	AB	2	Carp	23	--	--	--	1
4/8/2005	1500	AB	2	Carp	24	--	--	--	1
4/8/2005	1500	AB	2	Carp	17	--	--	--	1
4/8/2005	1500	AB	2	Carp	22	--	--	--	1
4/8/2005	1500	AB	2	Carp	24	--	--	--	1
4/8/2005	1500	AB	2	Carp	18	--	--	--	1
4/8/2005	1500	AB	2	Carp	30	--	--	--	1
4/8/2005	1500	AB	2	Carp	22	--	--	--	1
4/8/2005	1500	AB	2	Carp	21	--	--	--	1
4/8/2005	1500	AB	2	Carp	20	--	--	--	1
4/8/2005	1500	AB	2	Carp	21	--	--	--	1
4/8/2005	1500	AB	2	Carp	--	--	--	--	24
4/8/2005	1500	AB	2	Sac. pikeminnow	31	--	--	--	1
4/8/2005	1500	AB	2	Sacramento sucker	17	--	--	--	1
4/8/2005	1500	AB	2	Sacramento sucker	24	--	--	--	1
4/8/2005	1500	AB	2	Sacramento sucker	23	--	--	--	1
4/8/2005	1500	AB	2	Sacramento sucker	22	--	--	--	1
4/8/2005	1605	B	1	Carp	23	--	--	--	1
4/8/2005	1605	B	1	Carp	22	--	--	--	1
4/8/2005	1605	B	1	Carp	20	--	--	--	1
4/8/2005	1605	B	1	Carp	18	--	--	--	1
4/8/2005	1605	B	1	Carp	13	--	--	--	1
4/8/2005	1605	B	1	Carp	18	--	--	--	1
4/8/2005	1605	B	1	Carp	16	--	--	--	1
4/8/2005	1605	B	1	Carp	16	--	--	--	1
4/8/2005	1605	B	1	Carp	20	--	--	--	1
4/8/2005	1605	B	1	Carp	23	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
4/8/2005	1605	B	1	Carp	14	--	--	--	1
4/8/2005	1605	B	1	Carp	20	--	--	--	1
4/8/2005	1605	B	1	Carp	20	--	--	--	1
4/8/2005	1605	B	1	Carp	16	--	--	--	1
4/8/2005	1605	B	1	Carp	17	--	--	--	1
4/8/2005	1605	B	1	Carp	20	--	--	--	1
4/8/2005	1605	B	1	Carp	18	--	--	--	1
4/8/2005	1605	B	1	Carp	26	--	--	--	1
4/8/2005	1605	B	1	Carp	18	--	--	--	1
4/8/2005	1605	B	1	Carp	21	--	--	--	1
4/8/2005	1605	B	1	Carp	--	--	--	--	59
4/8/2005	1545	B1	1	Carp	22	--	--	--	1
4/8/2005	1545	B1	1	Carp	20	--	--	--	1
4/8/2005	1545	B1	1	Carp	21	--	--	--	1
4/8/2005	1545	B1	1	Carp	20	--	--	--	1
4/8/2005	1545	B1	1	Carp	24	--	--	--	1
4/8/2005	1545	B1	1	Carp	13	--	--	--	1
4/8/2005	1545	B1	1	Carp	20	--	--	--	1
4/8/2005	1545	B1	1	Carp	22	--	--	--	1
4/8/2005	1545	B1	1	Carp	15	--	--	--	1
4/8/2005	1545	B1	1	Carp	21	--	--	--	1
4/8/2005	1545	B1	1	Carp	23	--	--	--	1
4/8/2005	1545	B1	1	Carp	21	--	--	--	1
4/8/2005	1545	B1	1	Carp	17	--	--	--	1
4/8/2005	1545	B1	1	Carp	22	--	--	--	1
4/8/2005	1545	B1	1	Carp	30	--	--	--	1
4/8/2005	1545	B1	1	Carp	20	--	--	--	1
4/8/2005	1545	B1	1	Carp	12	--	--	--	1
4/8/2005	1545	B1	1	Carp	20	--	--	--	1
4/8/2005	1545	B1	1	Carp	17	--	--	--	1
4/8/2005	1545	B1	1	Carp	19	--	--	--	1
4/8/2005	1545	B1	1	Carp	--	--	--	--	18
4/8/2005	1545	B1	1	Sac. pikeminnow	31	--	--	--	1
4/8/2005	1545	B1	1	Sac. pikeminnow	66	--	--	--	1
4/8/2005	1545	B1	1	Sacramento sucker	24	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
4/8/2005	1545	B1	2	Carp	--	--	--	--	24
4/8/2005	1520	B2	1	Carp	21	--	--	--	1
4/8/2005	1520	B2	1	Carp	19	--	--	--	1
4/8/2005	1520	B2	1	Carp	17	--	--	--	1
4/8/2005	1520	B2	1	Carp	21	--	--	--	1
4/8/2005	1520	B2	1	Carp	20	--	--	--	1
4/8/2005	1520	B2	1	Carp	13	--	--	--	1
4/8/2005	1520	B2	1	Carp	21	--	--	--	1
4/8/2005	1520	B2	1	Carp	22	--	--	--	1
4/8/2005	1520	B2	1	Carp	17	--	--	--	1
4/8/2005	1520	B2	1	Carp	20	--	--	--	1
4/8/2005	1520	B2	1	Carp	22	--	--	--	1
4/8/2005	1520	B2	1	Carp	21	--	--	--	1
4/8/2005	1520	B2	1	Carp	22	--	--	--	1
4/8/2005	1520	B2	1	Carp	16	--	--	--	1
4/8/2005	1520	B2	1	Carp	20	--	--	--	1
4/8/2005	1520	B2	1	Carp	18	--	--	--	1
4/8/2005	1520	B2	1	Carp	18	--	--	--	1
4/8/2005	1520	B2	1	Carp	12	--	--	--	1
4/8/2005	1520	B2	1	Carp	13	--	--	--	1
4/8/2005	1520	B2	1	Carp	22	--	--	--	1
4/8/2005	1520	B2	1	Carp	--	--	--	--	72
4/8/2005	1520	B2	1	Sacramento sucker	30	--	--	--	1
4/8/2005	1520	B2	2	Carp	--	--	--	--	13
4/8/2005	1520	B2	2	Sac. pikeminnow	46	--	--	--	1
4/8/2005	1240	T1	1	Bluegill sunfish	84	--	--	--	1
4/8/2005	1240	T1	1	Sacramento sucker	--	--	--	--	10
4/8/2005	1200	T2	1	Sacramento sucker	--	--	--	--	12
4/8/2005	1630	T3	1	NONE	--	--	--	--	1
5/24/2005	1215	AB	1	Carp	30	--	--	--	1
5/24/2005	1215	AB	1	Carp	22	--	--	--	1
5/24/2005	1215	AB	1	Carp	24	--	--	--	1
5/24/2005	1215	AB	1	Carp	25	--	--	--	1
5/24/2005	1215	AB	1	Carp	25	--	--	--	1
5/24/2005	1215	AB	1	Carp	35	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
5/24/2005	1215	AB	1	Carp	31	--	--	--	1
5/24/2005	1215	AB	1	Carp	29	--	--	--	1
5/24/2005	1215	AB	1	Carp	27	--	--	--	1
5/24/2005	1215	AB	1	Carp	28	--	--	--	1
5/24/2005	1215	AB	1	Carp	22	--	--	--	1
5/24/2005	1215	AB	1	Carp	24	--	--	--	1
5/24/2005	1215	AB	1	Carp	25	--	--	--	1
5/24/2005	1215	AB	1	Carp	28	--	--	--	1
5/24/2005	1215	AB	1	Carp	25	--	--	--	1
5/24/2005	1215	AB	1	Carp	22	--	--	--	1
5/24/2005	1215	AB	1	Carp	25	--	--	--	1
5/24/2005	1215	AB	1	Carp	18	--	--	--	1
5/24/2005	1215	AB	1	Carp	30	--	--	--	1
5/24/2005	1215	AB	1	Carp	36	--	--	--	1
5/24/2005	1215	AB	1	Carp	--	--	--	--	23
5/24/2005	1215	AB	1	Sacramento sucker	24	--	--	--	1
5/24/2005	1215	AB	1	Unidentified	20	--	--	--	1
5/24/2005	1215	AB	2	Carp	--	--	--	--	61
5/24/2005	1215	AB	2	Mosquitofish	25	--	--	--	1
5/24/2005	1215	AB	2	Mosquitofish	23	--	--	--	1
5/24/2005	1215	AB	2	Sacramento sucker	20	--	--	--	1
5/24/2005	1215	AB	2	Sacramento sucker	21	--	--	--	1
5/24/2005	1215	AB	3	Carp	--	--	--	--	12
5/24/2005	1430	T1	1	Mosquitofish	--	--	--	--	250
5/24/2005	1415	T2	1	Bluegill sunfish	50	--	--	--	1
5/24/2005	1415	T2	1	Prickly sculpin	34	--	--	--	1
5/24/2005	1415	T2	1	Prickly sculpin	35	--	--	--	1
5/24/2005	1415	T2	1	Prickly sculpin	26	--	--	--	1
5/24/2005	1415	T2	1	Prickly sculpin	35	--	--	--	1
5/24/2005	1415	T2	1	Prickly sculpin	33	--	--	--	1
5/24/2005	1415	T2	1	Prickly sculpin	39	--	--	--	1
5/24/2005	1415	T2	1	Prickly sculpin	31	--	--	--	1
5/24/2005	1415	T2	1	Prickly sculpin	40	--	--	--	1
5/24/2005	1415	T2	1	Sacramento sucker	34	--	--	--	1
5/24/2005	1415	T2	1	Sacramento sucker	30	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
5/24/2005	1415	T2	2	Mosquitofish	29	--	--	--	1
5/24/2005	1415	T2	2	Mosquitofish	40	--	--	--	1
5/24/2005	1415	T2	2	Prickly sculpin	30	--	--	--	1
5/24/2005	1415	T2	2	Prickly sculpin	28	--	--	--	1
5/24/2005	1415	T2	2	Prickly sculpin	52	--	--	--	1
5/24/2005	1415	T2	2	Red shiner	52	--	--	--	1
5/24/2005	1415	T2	3	Prickly sculpin	37	--	--	--	1
5/24/2005	1415	T2	3	Prickly sculpin	30	--	--	--	1
5/24/2005	1415	T2	3	Prickly sculpin	35	--	--	--	1
5/24/2005	1415	T2	3	Prickly sculpin	27	--	--	--	1
5/24/2005	1415	T2	3	Sacramento sucker	25	--	--	--	1
5/24/2005	1415	T2	3	Sacramento sucker	23	--	--	--	1
5/24/2005	1415	T2	3	Sacramento sucker	20	--	--	--	1
5/24/2005	1415	T2	3	Sacramento sucker	24	--	--	--	1
5/24/2005	1415	T2	3	Sacramento sucker	17	--	--	--	1
5/24/2005	1415	T2	3	Unidentified	16	--	--	--	1
5/24/2005	1130	T3	1	Carp	24	--	--	--	1
5/24/2005	1130	T3	1	Sacramento sucker	23	--	--	--	1
5/24/2005	1130	T3	1	Sacramento sucker	22	--	--	--	1
5/24/2005	1130	T3	1	Sacramento sucker	30	--	--	--	1
5/24/2005	1130	T3	2	Sacramento sucker	24	--	--	--	1
5/24/2005	1130	T3	2	Sacramento sucker	21	--	--	--	1
5/24/2005	1130	T3	2	Sacramento sucker	22	--	--	--	1
5/24/2005	1130	T3	2	Sacramento sucker	19	--	--	--	1
5/24/2005	1130	T3	2	Sacramento sucker	20	--	--	--	1
5/24/2005	1130	T3	3	Prickly sculpin	45	--	--	--	1
5/24/2005	1130	T3	3	Red shiner	44	--	--	--	1
5/24/2005	1130	T3	3	Red shiner	35	--	--	--	1
5/24/2005	1130	T3	3	Red shiner	38	--	--	--	1
5/24/2005	1130	T3	3	Red shiner	37	--	--	--	1
5/24/2005	1130	T3	3	Red shiner	41	--	--	--	1
5/24/2005	1130	T3	3	Red shiner	41	--	--	--	1
5/24/2005	1130	T3	3	Red shiner	37	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	22	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	24	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
5/24/2005	1130	T3	3	Sacramento sucker	31	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	35	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	25	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	22	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	27	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	27	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	34	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	30	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	22	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	27	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	24	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	20	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	26	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	24	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	25	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	20	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	24	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	24	--	--	--	1
5/24/2005	1130	T3	3	Sacramento sucker	--	--	--	--	38
5/25/2005	1145	A	1	Carp	--	--	--	--	76
5/25/2005	1145	A	1	Mosquitofish	27	--	--	--	1
5/25/2005	1145	A	2	Carp	--	--	--	--	117
5/25/2005	1145	A	2	Mosquitofish	24	--	--	--	1
5/25/2005	1115	A1	1	Carp	--	--	--	--	71
5/25/2005	1115	A1	1	Green sunfish	136	--	--	--	1
5/25/2005	1115	A1	2	Carp	--	--	--	--	125
5/25/2005	1115	A1	2	Green sunfish	96	--	--	--	1
5/25/2005	1115	A1	3	Carp	--	--	--	--	28
5/25/2005	1045	A2	1	Carp	52	--	--	--	1
5/25/2005	1045	A2	1	Carp	35	--	--	--	1
5/25/2005	1045	A2	1	Carp	34	--	--	--	1
5/25/2005	1045	A2	1	Carp	31	--	--	--	1
5/25/2005	1045	A2	1	Carp	25	--	--	--	1
5/25/2005	1045	A2	1	Carp	26	--	--	--	1
5/25/2005	1045	A2	1	Carp	35	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
5/25/2005	1045	A2	1	Carp	30	--	--	--	1
5/25/2005	1045	A2	1	Carp	31	--	--	--	1
5/25/2005	1045	A2	1	Carp	31	--	--	--	1
5/25/2005	1045	A2	1	Carp	33	--	--	--	1
5/25/2005	1045	A2	1	Carp	26	--	--	--	1
5/25/2005	1045	A2	1	Carp	29	--	--	--	1
5/25/2005	1045	A2	1	Carp	24	--	--	--	1
5/25/2005	1045	A2	1	Carp	35	--	--	--	1
5/25/2005	1045	A2	1	Carp	32	--	--	--	1
5/25/2005	1045	A2	1	Carp	30	--	--	--	1
5/25/2005	1045	A2	1	Carp	23	--	--	--	1
5/25/2005	1045	A2	1	Carp	22	--	--	--	1
5/25/2005	1045	A2	1	Carp	26	--	--	--	1
5/25/2005	1045	A2	1	Carp	--	--	--	--	1
5/25/2005	1045	A2	2	Carp	--	--	--	--	34
5/25/2005	1045	A2	2	Sacramento sucker	25	--	--	--	1
5/25/2005	1045	A2	3	Carp	--	--	--	--	39
5/25/2005	1045	A2	3	Sacramento sucker	22	--	--	--	1
5/25/2005	1045	A2	3	Sacramento sucker	27	--	--	--	1
5/25/2005	1315	B	1	Carp	21	--	--	--	1
5/25/2005	1315	B	1	Carp	26	--	--	--	1
5/25/2005	1315	B	1	Carp	36	--	--	--	1
5/25/2005	1315	B	1	Carp	40	--	--	--	1
5/25/2005	1315	B	1	Carp	45	--	--	--	1
5/25/2005	1315	B	1	Carp	27	--	--	--	1
5/25/2005	1315	B	1	Carp	31	--	--	--	1
5/25/2005	1315	B	1	Carp	41	--	--	--	1
5/25/2005	1315	B	1	Carp	44	--	--	--	1
5/25/2005	1315	B	1	Carp	31	--	--	--	1
5/25/2005	1315	B	1	Carp	29	--	--	--	1
5/25/2005	1315	B	1	Carp	32	--	--	--	1
5/25/2005	1315	B	1	Carp	33	--	--	--	1
5/25/2005	1315	B	1	Carp	44	--	--	--	1
5/25/2005	1315	B	1	Carp	31	--	--	--	1
5/25/2005	1315	B	1	Carp	34	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
5/25/2005	1315	B	1	Carp	40	--	--	--	1
5/25/2005	1315	B	1	Carp	28	--	--	--	1
5/25/2005	1315	B	1	Carp	31	--	--	--	1
5/25/2005	1315	B	1	Carp	36	--	--	--	1
5/25/2005	1315	B	1	Carp	35	--	--	--	1
5/25/2005	1315	B	1	Carp	37	--	--	--	1
5/25/2005	1315	B	1	Carp	59	--	--	--	1
5/25/2005	1315	B	1	Carp	33	--	--	--	1
5/25/2005	1315	B	1	Carp	39	--	--	--	1
5/25/2005	1315	B	1	Carp	51	--	--	--	1
5/25/2005	1315	B	1	Carp	38	--	--	--	1
5/25/2005	1315	B	1	Carp	34	--	--	--	1
5/25/2005	1315	B	1	Carp	53	--	--	--	1
5/25/2005	1315	B	1	Carp	56	--	--	--	1
5/25/2005	1315	B	1	Carp	--	--	--	--	75
5/25/2005	1315	B	1	Carp	--	--	--	--	240
5/25/2005	1315	B	1	Red shiner	35	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	45	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	31	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	27	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	42	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	22	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	40	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	23	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	35	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	39	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	37	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	23	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	36	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	25	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	27	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	30	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	22	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	36	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	44	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
5/25/2005	1315	B	1	Sacramento sucker	42	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	44	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	30	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	25	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	40	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	52	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	37	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	44	--	--	--	1
5/25/2005	1315	B	1	Sacramento sucker	--	--	--	--	83
5/25/2005	1315	B	2	Carp	--	--	--	--	425
5/25/2005	1315	B	2	Logperch	46	--	--	--	1
5/25/2005	1315	B	2	Sacramento sucker	--	--	--	--	75
5/25/2005	1230	B1	1	Bluegill sunfish	51	--	--	--	1
5/25/2005	1230	B1	1	Carp	27	--	--	--	1
5/25/2005	1230	B1	1	Carp	35	--	--	--	1
5/25/2005	1230	B1	1	Carp	40	--	--	--	1
5/25/2005	1230	B1	1	Carp	34	--	--	--	1
5/25/2005	1230	B1	1	Carp	25	--	--	--	1
5/25/2005	1230	B1	1	Carp	24	--	--	--	1
5/25/2005	1230	B1	1	Carp	33	--	--	--	1
5/25/2005	1230	B1	1	Carp	36	--	--	--	1
5/25/2005	1230	B1	1	Carp	34	--	--	--	1
5/25/2005	1230	B1	1	Carp	37	--	--	--	1
5/25/2005	1230	B1	1	Carp	26	--	--	--	1
5/25/2005	1230	B1	1	Carp	38	--	--	--	1
5/25/2005	1230	B1	1	Carp	19	--	--	--	1
5/25/2005	1230	B1	1	Carp	19	--	--	--	1
5/25/2005	1230	B1	1	Carp	30	--	--	--	1
5/25/2005	1230	B1	1	Carp	20	--	--	--	1
5/25/2005	1230	B1	1	Carp	23	--	--	--	1
5/25/2005	1230	B1	1	Carp	26	--	--	--	1
5/25/2005	1230	B1	1	Carp	24	--	--	--	1
5/25/2005	1230	B1	1	Carp	22	--	--	--	1
5/25/2005	1230	B1	1	Carp	--	--	--	--	1
5/25/2005	1230	B1	2	Carp	--	--	--	--	15

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
5/25/2005	1230	B1	2	Sacramento sucker	54	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	51	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	24	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	25	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	23	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	24	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	25	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	22	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	17	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	27	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	20	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	22	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	24	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	27	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	24	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	23	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	19	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	23	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	24	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	25	--	--	--	1
5/25/2005	1230	B1	2	Sacramento sucker	--	--	--	--	11
5/25/2005	1200	B2	1	Carp	--	--	--	--	125
5/25/2005	1200	B2	1	Sacramento sucker	27	--	--	--	1
5/25/2005	1200	B2	1	Sacramento sucker	17	--	--	--	1
5/25/2005	1200	B2	1	Sacramento sucker	19	--	--	--	1
5/25/2005	1200	B2	1	Sacramento sucker	16	--	--	--	1
5/25/2005	1200	B2	1	Sacramento sucker	20	--	--	--	1
5/25/2005	1200	B2	2	Carp	--	--	--	--	75
5/25/2005	1200	B2	2	Sacramento sucker	--	--	--	--	28
5/25/2005	1200	B2	3	Bluegill sunfish	159	--	--	--	1
5/25/2005	1200	B2	3	Carp	--	--	--	--	72
5/25/2005	1200	B2	3	Mosquitofish	27	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	21	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	19	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	31	--	--	--	1

Date	Time	Site	Haul #	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	Smolt Index	Count
5/25/2005	1200	B2	3	Sacramento sucker	23	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	20	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	26	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	22	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	23	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	21	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	19	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	23	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	21	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	24	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	23	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	24	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	21	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	20	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	24	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	19	--	--	--	1
5/25/2005	1200	B2	3	Sacramento sucker	19	--	--	--	1

Appendix 2
Big Bend Fish Utilization Seine Results

Prepared by Wayne Swaney
Stillwater Ecosystem, Watershed & Riverine Sciences
Berkeley, California

As part of on-going monitoring at the Big Bend Restoration Project site on the Lower Tuolumne River (River Miles 5.8 7.4), a one-day beach seine sampling event was conducted at the Venn Ranch on May 30, 2005. Three inundated floodplain fields were sampled using standard seine methods to document fish utilization. Preliminary results are presented below in Table 1.

The project is being managed by the Tuolumne River Trust, in partnership with the USDA Natural Resources Conservation Service, the California Department of Water Resources, the National Oceanic and Atmospheric Administration, and the East Stanislaus Resource Conservation District. The project, which involves an evaluation of the extent and timing of floodplain inundation, the success of native re-vegetation plantings, and fish utilization of improved floodplain habitat, is scheduled to be completed in 2007.

Table 1. Results of Big Bend Fish Utilization Seine Sampling 30 May, 2005.

Location	# of Sample Sites	Total Hauls	Est. Area (sq. ft.)	Maximum Depth (ft.)	Average Depth (ft.)	Water Temp. (C)	DO (mg/l)	Turbidity (NTU)
Field 1A	3	9	9600	3.5	1.25	17.7	10.1	32.6
Species:	Common Carp	450 mm						
	Mosquitofish	28 mm						
	Mosquitofish	20 mm						
Field 1B	3	9	9250	2.5	1.50	15.7	10.8	31.3
Species:	Common Carp	550 mm						
	Common Carp	470 mm						
	Pikeminnow	70 mm						
	Pikeminnow	65 mm						
	Pikeminnow	58 mm						
	Pikeminnow	46 mm						
	White crappie	148 mm						
Field 6A	3	9	5875	4.0	2.75	12.8	9.8	3.7
Species:	Pikeminnow	140 mm						
	Pikeminnow	48 mm						

In addition to the species listed above, an unidentified larval species was captured in Fields 1A and 1B.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District	)	
	)	
and	)	Project No. 2299
	)	
Modesto Irrigation District	)	

2005 LOWER TUOLUMNE RIVER ANNUAL REPORT

Report 2005-4

2005 Grayson Screw Trap Report

Prepared by

Andrea Fuller
Michele Simpson
Chrissy Sonke

S. P. Cramer and Associates
Gresham, OR

Outmigrant Trapping of Juvenile Salmonids in the Lower Tuolumne River at Grayson 2005

FINAL REPORT
March 2006

Prepared by
Andrea N. Fuller
Michele Simpson
and
Chrissy L. Sonke

Submitted to
Turlock and Modesto Irrigation Districts

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INTRODUCTION

Study Area Description

The Tuolumne River is the largest of the three major tributaries (Tuolumne, Merced, and Stanislaus Rivers) to the San Joaquin River, originating in the central Sierra Nevada and flowing west between the Merced River to the south and the Stanislaus River to the north (Figure 1). The San Joaquin River itself flows north and joins the Sacramento River in the Sacramento-San Joaquin Delta. The Tuolumne River is dammed at several locations for generation of power, water supply, and flood control – the largest impoundment is Don Pedro Reservoir.

The lower Tuolumne River corridor extends from its confluence with the San Joaquin River to La Grange Dam at river mile (RM) 52.2. The La Grange Dam site has been the upstream limit for anadromous migration since 1871.

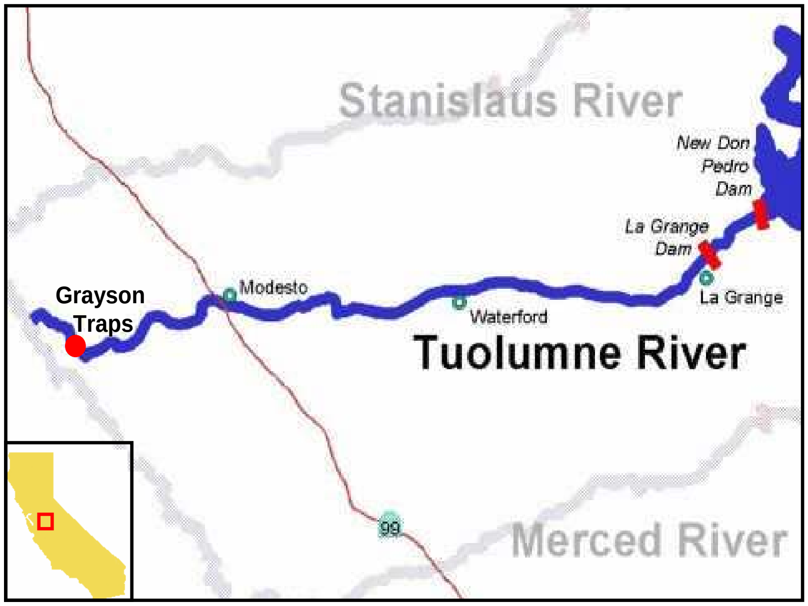


Figure 1. Location map of study area on the Tuolumne River.

Purpose and History of Study

Rotary screw trap monitoring has been conducted annually near the mouth of the Tuolumne River since 1995 for the purpose of monitoring the abundance and migration characteristics of juvenile salmonids and other fishes. Trapping was conducted at the Shiloh Bridge (RM 3.4) from 1995 through 1998 by Turlock and Modesto Irrigation Districts (Districts) and California Department of Fish and Game (CDFG), at Grayson (RM 5.2) from 1999 through 2003 by CDFG, and from 2004 through 2005 by S.P. Cramer & Associates (SPC). The sampling periods have varied greatly between years with monitoring starting anywhere between January 3 and April 18, and ending anywhere between May 24 and July 1 (Table 1). Shorter sampling seasons from 1995 through 1998 were mainly associated with smolt survival studies using coded wire tagged (CWT) Merced River Hatchery salmon under the Don Pedro Project fish study program. With funding provided by the CVPIA sampling periods were longer from 1999 through 2002. The Don Pedro Project fish study program ended smolt survival studies in 2002. An initial summary of sampling conducted from 1995 through 2004 can be found in the Summary Report for the Lower Tuolumne River (TID/MID 2005).

Table 1. Lower Tuolumne River outmigrant trapping history.

Year	***Location***	***Start Date***	***End Date***	***Results Reported In***
1995	Shiloh (RM 3.4)	April 25	June 1	Heyne and Loudermilk 1997
1996	Shiloh (RM 3.4)	April 18	May 29	Heyne and Loudermilk 1997
1997	Shiloh (RM 3.4)	April 18	May 24	Heyne and Loudermilk 1998
1998	Shiloh (RM 3.4)	February 15	July 1	Blakeman 2004
1999	Grayson (RM 5.2)	January 12	June 6	Vasques and Kundargi 2001
2000	Grayson (RM 5.2)	January 9	June 12	Vasques and Kundargi 2001
2001	Grayson (RM 5.2)	January 3	May 29	Vasques and Kundargi 2002
2002	Grayson (RM 5.2)	January 15	June 6	Blakeman 2004
2003	Grayson (RM 5.2)	April 1	June 6	Blakeman 2004
2004	Grayson (RM 5.2)	April 2	June 8	Fuller 2004

METHODS

Juvenile Outmigrant Monitoring

Trapping Site and Sampling Gear

In 2005, two rotary screw traps were fished side-by-side in the mainstem of the lower Tuolumne River near Grayson (RM 5.2) to sample juvenile salmonids and other fishes as they migrated downstream. The screw traps, manufactured by E.G. Solutions, consisted of a funnel shaped cone suspended between two pontoons. Each trap was positioned in the current so that water entered the eight-foot wide funnel mouth and struck the internal screw core, causing the funnel to rotate. As the funnel rotated, fish were trapped in pockets of water and forced rearward into a livebox, where they could not escape.

The traps were initially held in place by an overhead cable strung between an anchor in the north bank levee and a tree on the south bank. However, the anchor points began to fail on the first night that the traps were fished. Sampling was temporarily suspended until the overhead cable was re-strung between two large trees located on opposing banks and approximately 75 yards downstream from the original trapping site. At both locations, leader cables descended from the overhead cable and were attached to the front of each of four trap pontoons. The downstream force of the water on the traps kept the leader cables taut (see cover photo).

Trap Monitoring

The traps were initially installed between March 29 and April 1, 2005, and sampling began on April 1. The traps sampled for only one night before the anchoring points on both the north and south banks began to fail due to a combination of saturated soil and the force caused by high flows (>7,000 cfs). The traps were temporarily raised until an alternative anchoring system was implemented on April 5, and sampling began immediately thereafter. From April 5 until sampling was terminated on June 17, the traps were operated continuously (24 hours per day, 7 days per week), with the exception of the traps being raised from June 11-13.

The traps were checked twice daily throughout the sampling period, once in the morning and once in the evening. During each trap check, we removed the contents of the liveboxes, identified and counted all fish captured, and noted if any fish were marked. In addition, random samples of up to 50 Chinook and 20 of each non-Chinook species during each morning check and up to 20 Chinook and 10 of each non-Chinook species during each evening check were anesthetized, measured (forklengths in millimeters), and recorded. In addition, Chinook smolting appearance was rated on a scale of 1 to 3, with 1 indicating an obvious parr (highly visible parr marks) and 3 an obvious smolt (silvery appearance, easily shed scales, blackened fin tips).

Chinook daily catch was equivalent to the sum of Chinook captured during a morning check plus the number of Chinook captured during the preceding evening check. For example, the daily Chinook catch for April 10 is the sum of Chinook from the morning trap check on April 10 and the evening trap check conducted on April 9. Separate daily catch data was maintained for marked and unmarked Chinook salmon.

After all fish were measured and recorded, we cleaned the traps to prevent accumulation of debris that might impair trap rotation or cause fish mortality within the liveboxes. Trap cleaning included removal of debris from all trap surfaces and from within the liveboxes. The amount of debris load in the liveboxes was estimated and recorded whenever the traps were checked.

Experimental Releases

Smolt Survival Releases Conducted by CDFG

Although the Don Pedro Project fish study program ended smolt survival studies in 2002, CDFG independently conducted a study during 2005. A total of 78,854 CWT hatchery salmon (tag code 05-51-36) were released at La Grange on April 18. Tagged fish were recovered at Grayson and daily passage of CWT hatchery salmon was estimated (see “Estimating Trap Efficiency and Juvenile Abundance”).

Trap Efficiency Releases

Experimental releases were not conducted during 2005 to evaluate trap efficiency.

Estimating Trap Efficiency and Juvenile Abundance

In previous years, trap efficiency estimates were developed by regressing trap efficiency test results against river flow at Modesto (Fuller 2004; Vasques and Kundargi 2001). Annual regression equations were then used to predict trap efficiency for a given day based on the daily average river flow at Modesto. However, no trap efficiency tests were conducted during 2005 so a regression equation for estimating daily trap efficiency was derived from observations made in past years when flow conditions were similar to 2005.

Secondarily, the proportion of flow sampled by the traps was also used as surrogate for trap efficiency. Specifically, the proportion of flow sampled was estimated by the following equation:

$$P = \frac{V_n\left(3.14 * \frac{r^2}{2}\right) + V_s\left(3.14 * \frac{r^2}{2}\right)}{F}$$

where, P is the estimated proportion of flow sampled, V_n and V_s are the daily measured velocities at the mouth of the north and south traps, r is the radius of each trap, and F is the daily flow measured at Modesto. If velocity data were not available for one or both of the traps on a given day, the average of all velocity measurements taken during the season was substituted.

Daily fish passage for unmarked and CWT salmon was estimated by dividing daily catch by the daily trap efficiency estimate and then summed to obtain total estimated outmigrant passage for the entire sampling period. Estimates were calculated separately for unmarked and CWT salmon, and using each of the two methods described for estimated trap efficiency. Data used for passage calculations are provided in Appendix A.

Monitoring Environmental Factors

Flow Measurements and Trap Speed

Provisional daily average flow for the Tuolumne River at Modesto was obtained from the USGS at http://waterdata.usgs.gov/ca/nwis/dv/?site_no=11290000&agency_cd=USGS. Velocity of water entering the traps was measured using two methods. First, we measured the water velocity entering the traps each day with a Global Flow Probe, manufactured by Global Water (Fair Oaks, CA). Second, each morning we calculated an average daily trap rotation speed for each trap by measuring the time, in seconds, for three contiguous revolutions. Separate measurements were taken each morning before and after the traps were cleaned. The average time per revolution before and after cleaning was then calculated for each trap.

River Temperature and Relative Turbidity

Instantaneous water temperature was measured daily with a mercury thermometer or YSI meter (model 550A) at the trap site. An hourly recording thermograph was also maintained by the Districts near the Grayson trapping site at Shiloh Road (RM 3.4). Instantaneous turbidity was measured daily with a LaMotte turbidity meter, model 2020. A water sample was collected each morning and later tested at the field station. Turbidity was recorded in nephelometric turbidity units (NTU).

RESULTS AND DISCUSSION

Chinook Salmon

Number of Unmarked Chinook Captured

Juvenile Chinook salmon outmigration in the San Joaquin Basin may extend from January through May (Vasques and Kundargi 2001; SRFG 2004). Since no sampling occurred at Grayson from January through March, the 2005 outmigration data is incomplete and underestimates the juvenile Chinook population.

Daily catches of juvenile Chinook at Grayson between April 5 and June 17, 2005, ranged from 0 to 57 fish and totaled 1,317 fish (Figure 2). Chinook salmon were captured every day the traps sampled between April 10 and June 17, and daily catches were highest from late-April through late-May. There was no clear relationship observed between Chinook catch and river flow during 2005 (Figure 2).

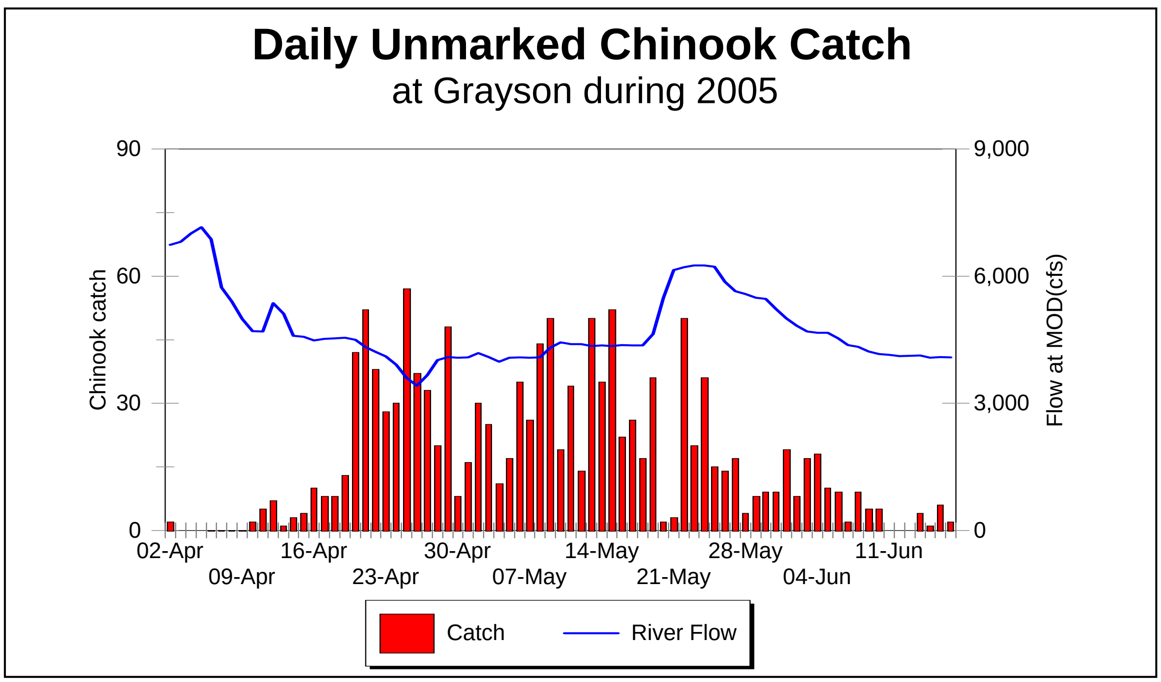


Figure 2. Daily catch of unmarked Chinook salmon at Grayson, and river flow at Modesto (MOD) during 2005.

Number of CWT Chinook Captured

Coded wire tagged fish were released by CDFG at La Grange on April 18 and the first CWTs arrived at Grayson on April 20. Daily catches of CWTs at Grayson ranged from 0 to 140 and totaled 355 (Figure 3). Catches were highest on April 20 and April 21, and approximately 70% of the total CWT catch occurred on these two days. No CWTs were captured after May 31.

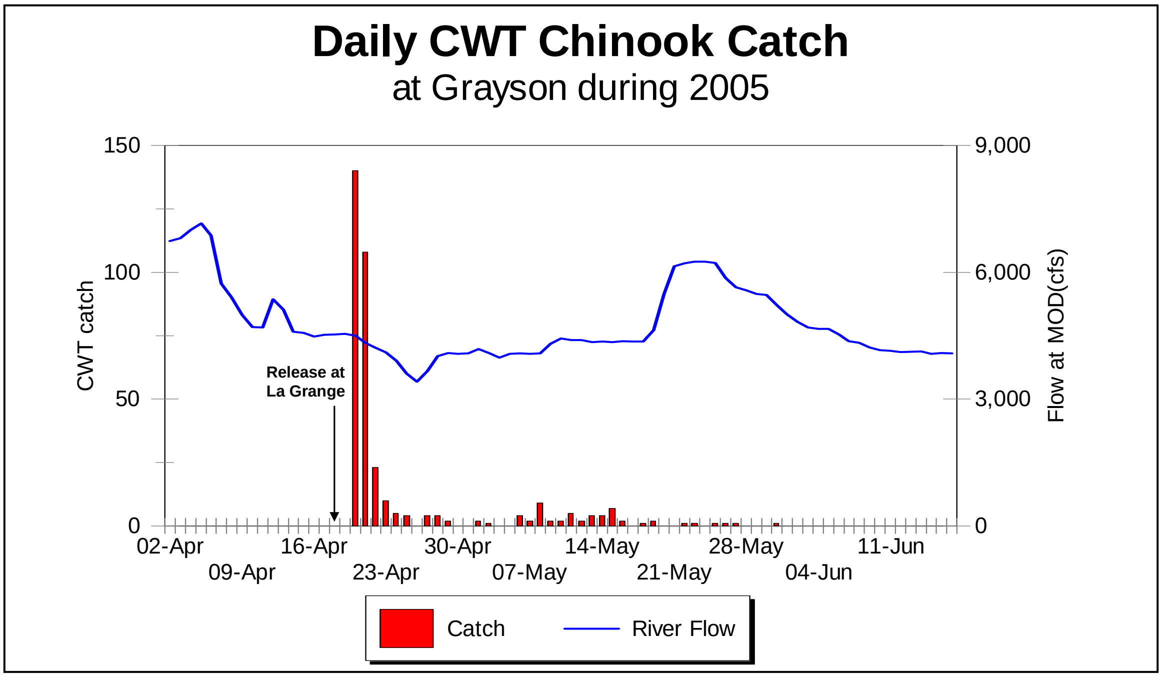


Figure 3. Daily catch of CWT marked Chinook salmon at Grayson, and river flow at Modesto (MOD) during 2005.

Trap Efficiency

River flow at Modesto during 2005 ranged between 3,410 cfs and 7,150 cfs. Seven trap efficiency tests from previous years were conducted under similar flow conditions (i.e., 3,015 cfs to 5,912 cfs;
Table 2). These seven tests were used as the basis for the regression equation used to estimate daily trap efficiencies for 2005. Potential biases associated with this approach include the possibility that trap efficiency observations in past years may not be representative of actual trap efficiencies during 2005, and that predicted trap efficiencies resulting from extrapolation beyond the range of the original data set (i.e., 10 days when flows were greater than 5,912 cfs) may be incorrect. Predicted daily trap efficiency values for 2005 are presented in Appendix A.

Table 2. Trap efficiency results from 1999 and 2000 used to derive the regression equation for predicting daily trap efficiency at Grayson during 2005.

Release Date	Origin	Adjusted # Released	Number Recaptured	% Recaptured	Avg. Length at Release (mm)	Avg. Length at Recapture (mm)	Flow (cfs) at MOD
11-Mar-99	Hatchery	1,946	28	1.4%	54	53	4,578
24-Mar-99	Hatchery	1,938	67	3.5%	61	61	3,091
29-Apr-99	Hatchery	1,959	14	0.7%	79	80	3,015
01-Mar-00	Hatchery	1,964	30	1.5%	56	53	4,506
16-Mar-00	Hatchery	1,548	22	1.4%	56	56	5,912
23-Mar-00	Hatchery	1,913	55	2.9%	59	60	3,151
06-May-00	Hatchery	1,987	41	2.1%	85	85	3,057

Daily instantaneous velocities measured in front of each trap ranged from 3.0 ft/s to 4.4 ft/s, and averaged 3.8 ft/s over the course of the sampling season. These measurements were used along with flow data from Modesto to estimate the proportion of the total river flow that passed through the traps each day, and this proportion was applied as an estimate of trap efficiency. This approach is biased in that it assumes that fish are evenly distributed throughout the water column and across the channel, and estimates based on actual mark-recapture tests are preferred because they account for the expected uneven distribution of fish within the channel.

Estimated Abundance of Unmarked Chinook

Applying the regression method, a total of 78,085 unmarked Chinook salmon were estimated to have passed Grayson between April 2 and June 17, 2005. Daily estimated passage ranged from 0 to 4,376 salmon, and peak passage occurred on May 22 following an increase in flow from approximately 4,000 to 6,000 cfs between May 18 and May 22 (Figure 4). Consistent with the trend observed for raw catch, estimated passage was also highest from late-April through late-May.

Expanding catches by the proportion of flow sampled by the traps, an estimated 31,334 unmarked Chinook salmon passed Grayson during 2005. Although this estimate is much lower than the estimate calculated by regression, the trend in passage over the course of the sampling period is similar. Because the trends are similar between both methods used to estimate trap efficiency and the regression method is preferred, all figures showing passage are based on regression.

Estimated Abundance of CWT Chinook

Applying the regression method, total of 20,149 CWT Chinook salmon were estimated to have passed Grayson. Daily estimated passage ranged from 0 to 8,119 CWT salmon, and peak passage occurred on the second and third days (e.g., April 20 and 21) following the release at La Grange.

Expanding catches by the proportion of flow sampled by the traps, an estimated 8,478 CWT Chinook salmon passed Grayson during 2005.

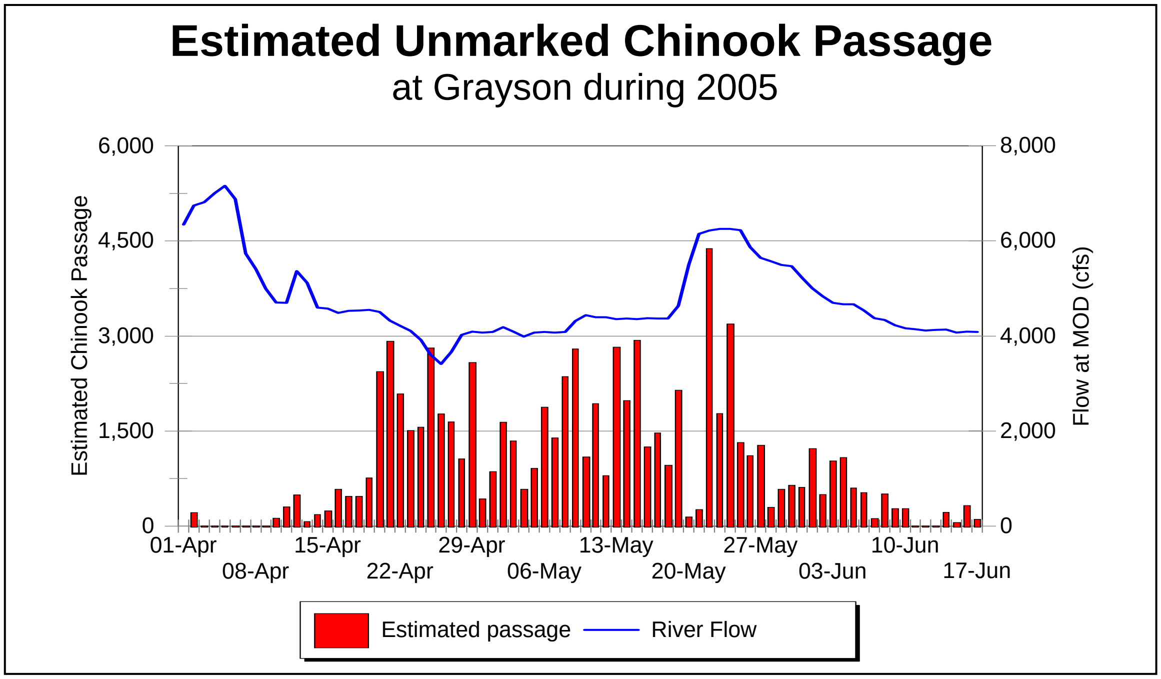


Figure 4. Daily estimated passage of unmarked Chinook salmon at Grayson and river flow at Modesto (MOD) during 2005.

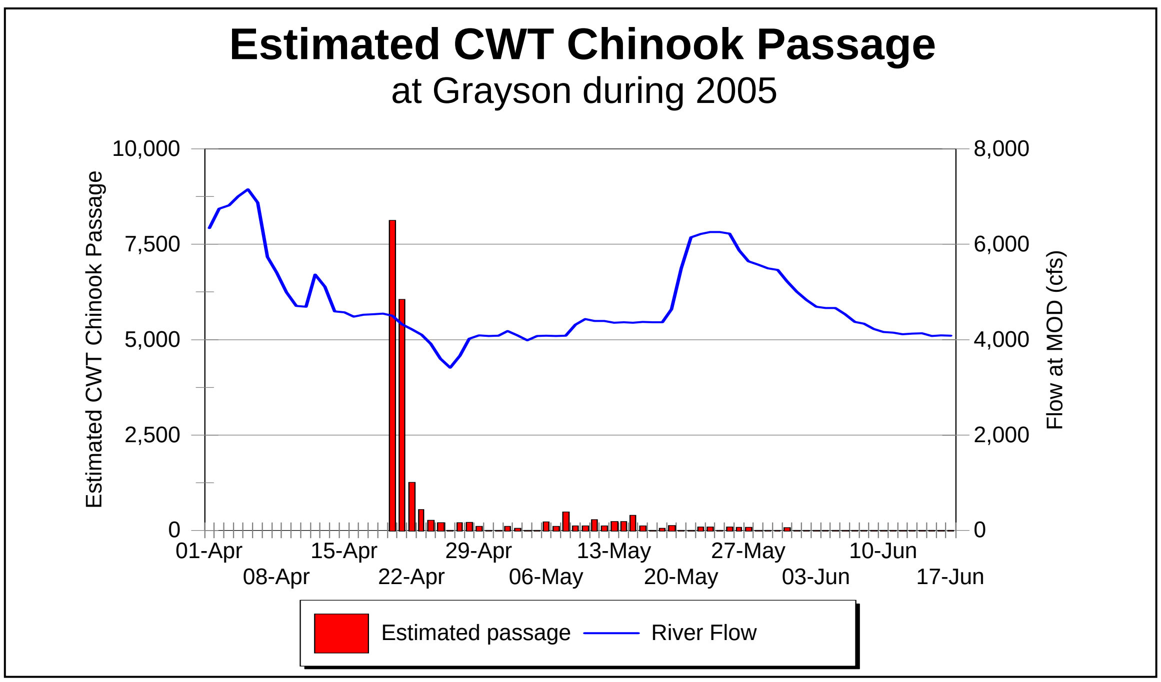


Figure 5. Daily estimated passage of CWT marked Chinook salmon at Grayson and river flow at Modesto (MOD) during 2005.

Environmental Factors

Generally, river flow at Modesto gradually declined from nearly 7,000 cfs in early April to approximately 3,000 cfs in late April (Figure 2). Flows increased shortly thereafter to approximately 4,000 cfs and remained fairly constant through mid-May. Flows then rose to approximately 6,000 cfs in late May before gradually declining to a stable flow of approximately 4,000 cfs again by June 9.

Daily average water temperatures at Shiloh varied over a relatively low and narrow range (i.e., 52.1°F to 59.1°F) during the 2005 sampling period (

Figure 6). Temperatures generally increased from early April through mid-June, and there was no clear relationship observed between water temperature and estimated passage at Grayson during 2005 (Figure 4).

Turbidity was also low and relatively stable. Daily instantaneous turbidity values fluctuated between 1.7 NTU and 4.4 NTU, and there was no clear relationship observed between turbidity and estimated passage during 2005 (Figure 7).

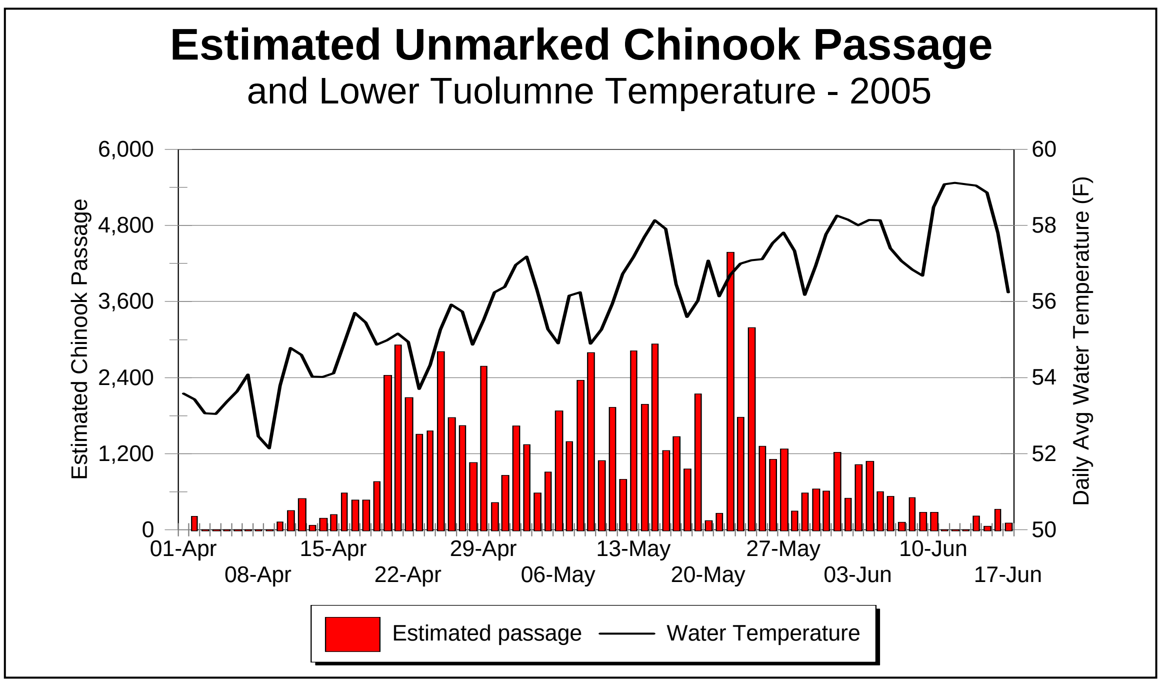


Figure 6. Daily estimated passage of unmarked Chinook salmon at Grayson and daily average water temperature at Shiloh during 2005.

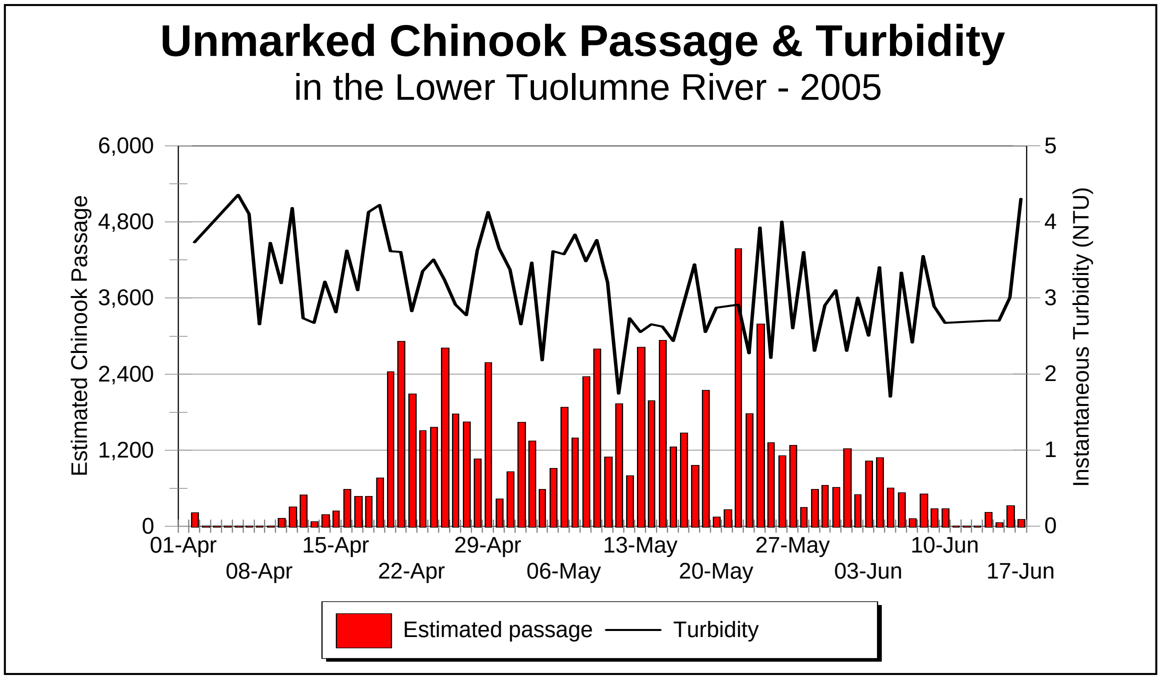


Figure 7. Daily estimated passage of unmarked Chinook salmon and instantaneous turbidity at Grayson during 2005.

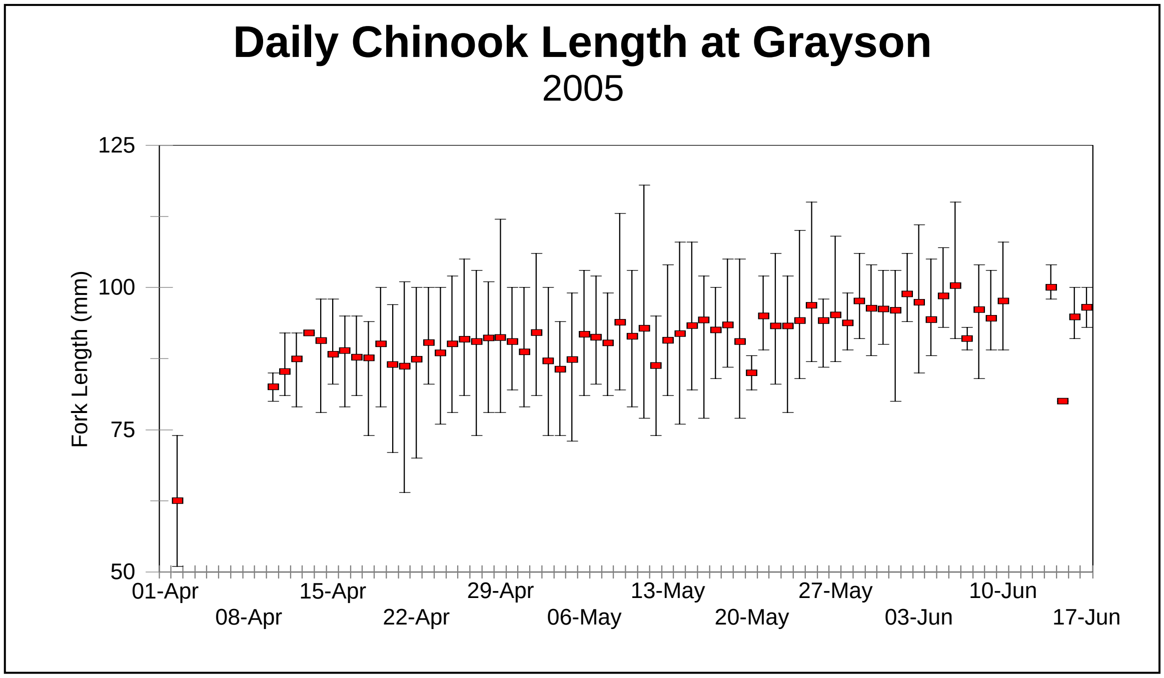
Chinook Length at Capture

Individual forklengths of unmarked Chinook salmon captured at Grayson during 2005 ranged from 51 mm to 118 mm, and average length gradually increased from approximately 80 mm to 100 mm over the course of the sampling period with the exception of the first day of sampling when average length was about 63 mm (Figure 8). Unmarked Chinook measuring 90 mm to 99 mm were most common (51.6%), followed by those measuring 80 mm to 89 mm (33.5%) and those measuring greater than 99 mm (10.6%; Figure 10). Less than 5% of the unmarked Chinook captured at Grayson during 2005 were smaller than 80 mm forklength.

Individual forklengths of CWT marked Chinook salmon captured at Grayson during 2005 ranged from 71 mm to 113 mm. The trend in average length of CWT marked salmon was the same as that observed for unmarked Chinook, with a gradual increase from approximately 80 mm to 100 mm over the course of the sampling period. CWT Chinook measuring 80 mm to 89 mm were most common (55.8%).

Chinook Developmental Stage at Capture

All unmarked Chinook captured at Grayson during 2005 appeared to be smolting, with 99.5% classified as obvious smolts (i.e., smolt index 3). The remaining 0.5% of Chinook were at an intermediate stage of smolting and classified as smolt index 2. All CWT



Chinook were classified as obvious smolts.

Figure 8. Daily minimum, average, and maximum fork lengths of unmarked Chinook salmon captured at Grayson during 2005.

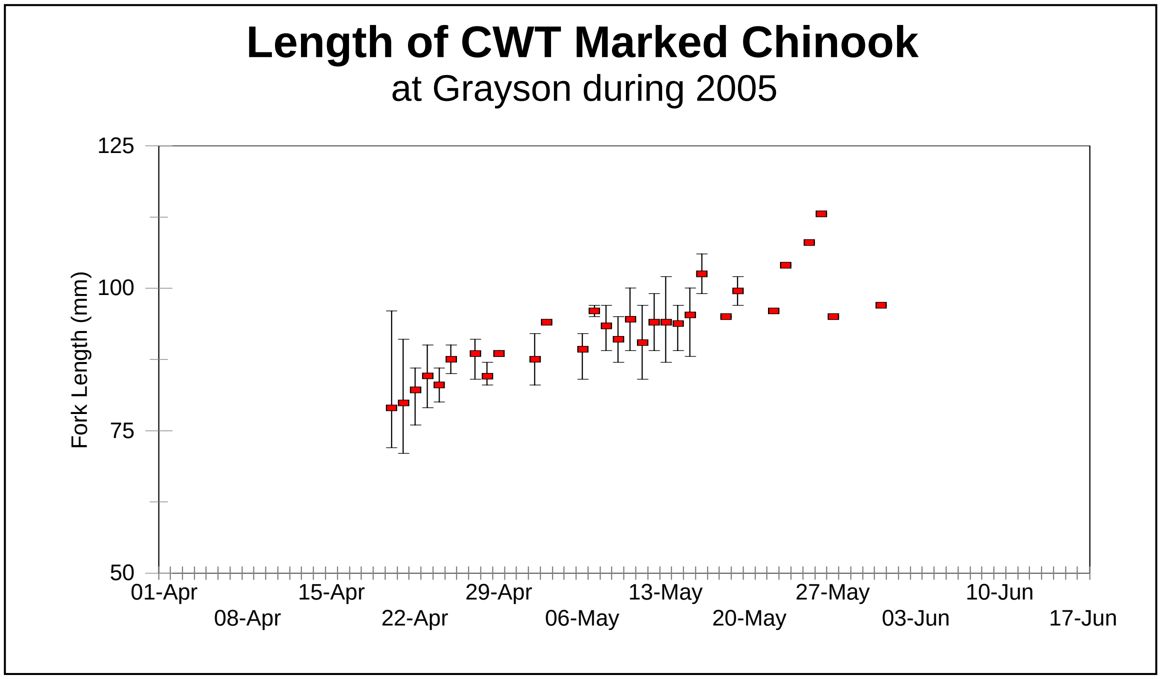
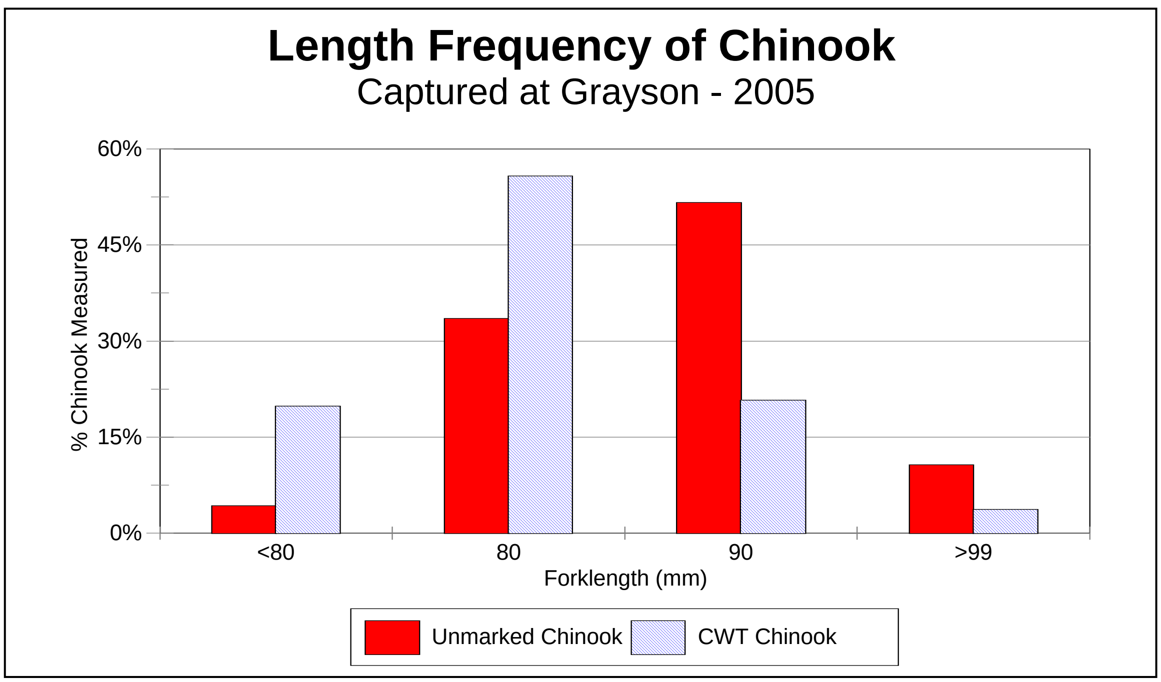


Figure 9. Daily minimum, average, and maximum fork lengths of CWT marked Chinook salmon



captured at Grayson during 2005.

Figure 10. Length frequency of unmarked and CWT marked Chinook salmon captured at Grayson during 2005.

Rainbow/steelhead trout

One rainbow/steelhead trout fry measuring 33 mm was captured at Grayson on May 14.

Other Fish Species Captured

A total of 195 non-salmonids representing at least 19 species (6 native, 13 introduced) were captured during operation of the Grayson traps in 2005 (

Table 3 and Appendix B). Catch of non-salmonids was dominated by introduced species including white catfish, channel catfish, golden shiner, red shiner, fathead minnow, goldfish, mosquitofish, inland silverside, bluegill, redear sunfish, warmouth, largemouth bass, and smallmouth bass. Native non-salmonid species captured included hardhead, hitch, Sacramento sucker, Sacramento pikeminnow, lamprey, and tule perch. Lamprey captured in the traps were primarily ammocoetes and were not identified to species or measured.

Table 3. Non-salmonid species captured at Grayson during 2005. Native species are indicated in bold.

Common Name	Scientific Name	Total Catch	Minimum Length (mm)	Average Length (mm)	Maximum Length (mm)
Catfish Family					
Channel catfish	*Ictalurus punctatus*	3	58	74.3	100
White catfish	*Ictalurus catus*	51	41	64.7	160
Lamprey Family					
Lamprey - unidentified	-	**13**	-	-	-
Livebearer Family					
Mosquitofish	*Gambusia affinis*	10	22	31.6	44
Minnow Family					
Fathead minnow	*Pimephales promelas*	1	53	53.0	53
Hardhead	***Mylopharodon conocephalus***	**2**	**47**	**48.5**	**50**
Hitch	***Lavinia exilicauda***	**1**	**54**	**54.0**	**54**
Goldfish	*Carassius auratus*	2	163	286.5	410
Golden shiner	*Notemigonus crysoleucas*	10	37	55.5	97
Red shiner	*Cyprinella lutrennsis*	5	37	49.2	63
Sac. pikeminnow	***Ptychochelius grandis***	**42**	**34**	**54.8**	**90**
Silverside Family					
Inland silverside	*Menidia beryllina*	5	35	64.6	91
Sucker Family					

Sacramento sucker	***Catostomus occidentalis***	**4**	**29**	**35.5**	**44**
Sunfish Family					
Bluegill	*Lepomis macrochirus*	19	30	68.1	243
Largemouth bass	*Micropterus salmoides*	15	24	34.6	42
Redear Sunfish	*Lepomis microlophus*	1	122	122.0	122
Smallmouth bass	*Micropterus dolomieu*	6	41	68.3	115
Warmouth	*Lepomis gulosus*	1	56	56.0	56
Surfperch Family					
Tule Perch	***Hysterocarpus traski***	**1**	**34**	**34.0**	**34**
Unidentified species	-	3	23	25.3	28

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Appendix A. Daily Chinook catch, length, and passage at Grayson and environmental data from 2005.

	Unmarked Chinook Salmon						CWT Chinook Salmon						Predicted	Estimated					
		Fork Length (mm)			Estimated Passage			Fork Length (mm)			Estimated Passage		Efficiency	Proportion of	Flow at	Velocity		Temp	
Date	Catch	Min	Avg	Max	Regress	% Volume	Catch	Min	Avg	Max	Regress	% Volume	(Regress)	Flow Sampled	MOD (cfs)	North	South	at Shiloh	Turbidity
01-Apr-05															6340			53.6	
02-Apr-05	2	51	62.5	74	208	71							0.0096	0.0280	6740	3.6	3.9	53.4	3.7
03-Apr-05	ns	ns	ns	ns	0	0							0.0094	0.0000	6810	ns	ns	53.1	ns
04-Apr-05	ns	ns	ns	ns	0	0							0.0087	0.0000	7000	ns	ns	53.0	ns
05-Apr-05	ns	ns	ns	ns	0	0							0.0082	0.0000	7150	ns	ns	53.4	ns
06-Apr-05	0	-	-	-	0	0							0.0092	0.0295	6870	4.4	3.7	53.6	4.4
07-Apr-05	0	-	-	-	0	0							0.0131	0.0355	5730	4.1	4.0	54.1	4.1
08-Apr-05	0	-	-	-	0	0							0.0142	0.0384	5400	4.2	4.1	52.5	2.7
09-Apr-05	0	-	-	-	0	0							0.0156	0.0366	4990	3.8 [1]	3.5	52.1	3.7
10-Apr-05	2	80	82.5	85	121	54							0.0166	0.0368	4700	3.8 [1]	3.1	53.8	3.2
11-Apr-05	5	81	85.2	92	301	126							0.0166	0.0397	4690	3.7	3.7	54.8	4.2
12-Apr-05	7	79	87.4	92	489	187							0.0143	0.0375	5360	4.0	4.0	54.6	2.7
13-Apr-05	1	92	92.0	92	66	24							0.0152	0.0425	5110	4.4	4.2	54.0	2.7
14-Apr-05	3	78	90.7	98	177	74							0.0169	0.0408	4590	3.7	3.8	54.0	3.2
15-Apr-05	4	83	88.3	98	235	95							0.0170	0.0422	4570	3.9	3.8	54.1	2.8
16-Apr-05	10	79	88.9	95	578	230							0.0173	0.0434	4480	3.8	3.9	54.9	3.6
17-Apr-05	8	81	87.7	95	466	189							0.0172	0.0422	4520	3.8 [1]	3.8 [1]	55.7	3.1
18-Apr-05	8	74	87.6	94	467	198							0.0171	0.0405	4530	3.6	3.7	55.4	4.1
19-Apr-05	13	79	90.1	100	760	313							0.0171	0.0415	4540	3.6	3.9	54.9	4.2
20-Apr-05	42	71	86.5	97	2,436	1,103	140	72	79.0	96	8,119	3,677	0.0172	0.0381	4500	3.1	3.8	55.0	3.6
21-Apr-05	52	64	86.1	101	2,912	1,132	108	71	79.8	91	6,048	2,351	0.0179	0.0459	4320	4.1	3.8	55.2	3.6
22-Apr-05	38	70	87.4	100	2,084	885	23	76	82.1	86	1,262	535	0.0182	0.0430	4210	3.6	3.6	54.9	2.8
23-Apr-05	28	83	90.3	100	1,505	609	10	79	84.6	90	537	217	0.0186	0.0460	4100	3.8	3.8	53.7	3.4
24-Apr-05	30	76	88.5	100	1,558	669	5	80	83.0	86	260	111	0.0193	0.0448	3910	3.5	3.5	54.3	3.5
25-Apr-05	57	78	90.1	102	2,807	1,219	4	85	87.5	90	197	86	0.0203	0.0468	3600	3.4	3.3	55.3	3.2
26-Apr-05	37	81	90.9	105	1,766	837					0	0	0.0210	0.0442	3410	3.0	3.0	55.9	2.9
27-Apr-05	33	74	90.5	103	1,642	740	4	84	88.5	91	199	90	0.0201	0.0446	3660	3.2	3.3	55.7	2.8
28-Apr-05	20	78	91.2	101	1,059	433	4	83	84.5	87	212	87	0.0189	0.0462	4020	3.7	3.7	54.9	3.6
29-Apr-05	48	78	91.2	112	2,575	1,101	2	88	88.5	89	107	46	0.0186	0.0436	4090	3.5	3.6	55.5	4.1
30-Apr-05	8	82	90.5	100	428	180					0	0	0.0187	0.0444	4070	3.6	3.6	56.2	3.7
01-May-05	16	79	88.7	100	857	382					0	0	0.0187	0.0419	4080	3.2	3.6	56.4	3.4
02-May-05	30	81	92.1	106	1,636	703	2	83	87.5	92	109	47	0.0183	0.0427	4180	3.4	3.7	57.0	2.7

	Unmarked Chinook Salmon						CWT Chinook Salmon						Predicted	Estimated					
		Fork Length (mm)			Estimated Passage			Fork Length (mm)			Estimated Passage		Efficiency	Proportion of	Flow at	Velocity		Temp	
Date	Catch	Min	Avg	Max	Regress	% Volume	Catch	Min	Avg	Max	Regress	% Volume	(Regress)	Flow Sampled	MOD (cfs)	North	South	at Shiloh	Turbidity
03-May-05	25	74	87.1	100	1,341	558	1	94	94.0	94	54	22	0.0186	0.0448	4090	3.6	3.7	57.2	3.5
04-May-05	11	74	85.6	94	579	239					0	0	0.0190	0.0461	3980	3.6	3.7	56.3	2.2
05-May-05	17	73	87.4	99	909	383					0	0	0.0187	0.0444	4070	3.7	3.5	55.3	3.6
06-May-05	35	81	91.7	103	1,874	758	4	84	89.3	92	214	87	0.0187	0.0462	4080	3.8	3.7	54.9	3.6
07-May-05	26	83	91.3	102	1,390	582	2	95	96.0	97	107	45	0.0187	0.0447	4070	3.6	3.6	56.2	3.8
08-May-05	44	81	90.3	99	2,356	953	9	89	93.3	97	482	195	0.0187	0.0462	4080	3.7	3.8	56.2	3.5
09-May-05	50	82	93.9	113	2,795	1,144	2	87	91.0	95	112	46	0.0179	0.0437	4310	3.8	3.7	54.9	3.8
10-May-05	19	79	91.4	103	1,087	423	2	89	94.5	100	114	45	0.0175	0.0449	4430	3.9	4.0	55.3	3.2
11-May-05	34	77	92.8	118	1,930	772	5	84	90.4	97	284	113	0.0176	0.0441	4390	3.8	3.9	55.9	1.7
12-May-05	14	74	86.3	95	795	314	2	89	94.0	99	114	45	0.0176	0.0446	4390	4.0	3.8	56.7	2.7
13-May-05	50	81	90.7	104	2,816	1,124	4	87	94.0	102	225	90	0.0178	0.0445	4350	3.9	3.8	57.2	2.6
14-May-05	35	76	91.9	108	1,975	798	4	89	93.8	97	226	91	0.0177	0.0438	4360	4.0	3.7	57.7	2.7
15-May-05	52	82	93.3	108	2,929	1,217	7	88	95.3	100	394	164	0.0178	0.0427	4350	3.7	3.7	58.1	2.6
16-May-05	22	77	94.3	102	1,244	532	2	99	102.5	106	113	48	0.0177	0.0414	4370	3.7	3.5	57.9	2.4
17-May-05	26	84	92.5	100	1,467	618					0	0	0.0177	0.0421	4360	3.8 [1]	3.5	56.5	2.9
18-May-05	17	86	93.4	105	959	388	1	95	95.0	95	56	23	0.0177	0.0438	4360	3.8 [1]	3.8 [1]	55.6	3.4
19-May-05	36	77	90.5	105	2,143	851	2	97	99.5	102	119	47	0.0168	0.0423	4630	4.0	3.8	56.0	2.6
20-May-05	2	82	85.0	88	144	56					0	0	0.0139	0.0357	5490	3.8 [1]	4.0	57.1	2.9
21-May-05	3	89	95.0	102	257	89					0	0	0.0117	0.0335	6140	4.4	3.8 [1]	56.1	
22-May-05	50	83	93.2	106	4,376	1,437	1	96	96.0	96	88	29	0.0114	0.0348	6210	4.2	4.4	56.7	2.9
23-May-05	20	78	93.3	102	1,771	614	1	104	104.0	104	89	31	0.0113	0.0326	6250	3.8 [1]	4.3	57.0	2.3
24-May-05	36	84	94.2	110	3,188	1,054					0	0	0.0113	0.0342	6250	4.3	4.2	57.1	3.9
25-May-05	15	87	96.9	115	1,317	422	1	108	108.0	108	88	28	0.0114	0.0355	6220	4.4	4.4	57.1	2.2
26-May-05	14	86	94.1	98	1,110	398	1	113	113.0	113	79	28	0.0126	0.0352	5860	4.1	4.1	57.5	4.0
27-May-05	17	87	95.2	109	1,272	460	1	95	95.0	95	75	27	0.0134	0.0370	5640	4.2	4.1	57.8	2.6
28-May-05	4	89	93.8	99	294	111					0	0	0.0136	0.0361	5570	4.1	3.9	57.3	3.6
29-May-05	8	91	97.6	106	577	221					0	0	0.0139	0.0361	5490	4.1	3.8	56.2	2.3
30-May-05	9	88	96.3	104	644	242					0	0	0.0140	0.0373	5460	4.2	3.9	56.9	2.9
31-May-05	9	90	96.2	103	608	243	1	97	97.0	97	68	27	0.0148	0.0371	5220	3.8 [1]	3.9	57.8	3.1
01-Jun-05	19	80	96.0	103	1,222	485					0	0	0.0155	0.0392	5000	3.9	3.9	58.3	2.3
02-Jun-05	8	94	98.9	106	496	205					0	0	0.0161	0.0390	4830	3.9	3.6	58.1	3.0
03-Jun-05	17	85	97.4	111	1,024	429					0	0	0.0166	0.0396	4690	3.7	3.7	58.0	2.5
04-Jun-05	18	88	94.3	105	1,078	452					0	0	0.0167	0.0398	4660	3.7	3.6	58.1	3.4
05-Jun-05	10	93	98.5	107	599	241					0	0	0.0167	0.0415	4660	3.8	3.9	58.1	1.7

	Unmarked Chinook Salmon						CWT Chinook Salmon						Predicted	Estimated					
		Fork Length (mm)			Estimated Passage			Fork Length (mm)			Estimated Passage		Efficiency	Proportion of	Flow at	Velocity		Temp	
Date	Catch	Min	Avg	Max	Regress	% Volume	Catch	Min	Avg	Max	Regress	% Volume	(Regress)	Flow Sampled	MOD (cfs)	North	South	at Shiloh	Turbidity
06-Jun-05	9	91	100.3	115	525	214					0	0	0.0171	0.0421	4530	3.8	3.8	57.4	3.3
07-Jun-05	2	89	91.0	93	113	47					0	0	0.0177	0.0425	4370	3.8 [1]	3.6	57.1	2.4
08-Jun-05	9	84	96.1	104	505	199					0	0	0.0178	0.0453	4330	3.9	3.9	56.8	3.6
09-Jun-05	5	89	94.6	103	275	112					0	0	0.0182	0.0446	4220	3.8	3.7	56.7	2.9
10-Jun-05	5	89	97.6	108	272	115					0	0	0.0184	0.0435	4160	3.6	3.6	58.5	2.7
11-Jun-05	ns	ns	ns	ns	0	0					0	0	0.0185	0.0000	4140	ns	ns	59.1	ns
12-Jun-05	ns	ns	ns	ns	0	0					0	0	0.0186	0.0000	4110	ns	ns	59.1	ns
13-Jun-05	ns	ns	ns	ns	0	0					0	0	0.0185	0.0000	4120	ns	ns	59.1	ns
14-Jun-05	4	98	100.0	104	216	85					0	0	0.0185	0.0468	4130	3.9	3.8	59.0	2.7
15-Jun-05	1	80	80.0	80	53	21					0	0	0.0187	0.0469	4070	3.8 [1]	3.8 [1]	58.9	2.7
16-Jun-05	6	91	94.8	100	322	132					0	0	0.0186	0.0454	4090	3.7	3.7	57.8	3.0
17-Jun-05	2	93	96.5	100	107	43					0	0	0.0187	0.0462	4080	3.8	3.7	56.2	4.3

1 No measurement taken. Average seasonal velocity was substituted.

Appendix B. Daily counts of non-salmonids captured at Grayson during 2005.

Date	BGS	CHC	FHM	GF	GSN	HCH	HH	LAM	LMB	MQK	MSS	RES	RSN	SASQ	SASU	SMB	TP	UNID	W	WHC
2-Apr								2		2				11						2
3-Apr																				
4-Apr																				
5-Apr																				
6-Apr							1							5						3
7-Apr														2						1
8-Apr										4	1			2				1		1
9-Apr								1						3						
10-Apr					1								1							
11-Apr	1											1		2						2
12-Apr					1									1						1
13-Apr								1						2						
14-Apr					1									1						2
15-Apr					1						1			1						
16-Apr																1				
17-Apr																				
18-Apr	1																			1
19-Apr								2												3
20-Apr																				1
21-Apr		1			1									1		1				1
22-Apr	2							1												
23-Apr								2						1						
24-Apr					1											1				
25-Apr	1													1						
26-Apr	1				1	1								4						
27-Apr	8													1						2
28-Apr														1						1
29-Apr																			1	
30-Apr	1																			
1-May														1		1				
2-May																				2
3-May																				
4-May					1															3
5-May				1																
6-May																				
7-May																				1
8-May											1									1
9-May				1																2

Date	BGS	CHC	FHM	GF	GSN	HCH	HH	LAM	LMB	MQK	MSS	RES	RSN	SASQ	SASU	SMB	TP	UNID	W	WHC
10-May																				
11-May																				1
12-May		1																		2
13-May		1																		1
14-May																				1
15-May																				
16-May																				
17-May																				1
18-May																				1
19-May																				
20-May															1					
21-May																				
22-May														1						2
23-May								3			1				1					
24-May								1								1				2
25-May																				2
26-May										2										1
27-May														1			1			2
28-May																				
29-May																				
30-May																				
31-May															1			1		
1-Jun	1												1							
2-Jun									1				1							1
3-Jun	1																			1
4-Jun							1		1											
5-Jun									4									1		
6-Jun	1								1											
7-Jun										1										
8-Jun									6		1									2
9-Jun	1												1			1				
10-Jun										1										
11-Jun																				
12-Jun																				
13-Jun																				
14-Jun			1										1							1
15-Jun					2															
16-Jun									1						1					
17-Jun									1											
Total	19	3	1	2	10	1	2	13	15	10	5	1	5	42	4	6	1	3	1	51

Key to species codes

BGS	Bluegill
CHC	Channel catfish
CHNF	Chinook
FHM	Fathead minnow
GF	Goldfish
GSF	Green sunfish
GSN	Golden shiner
HH	Hardhead
HCH	Hitch
LAM	Lamprey, unidentified species
LMB	Largemouth bass
MQK	Mosquitofish
MSS	Inland silverside
RBT	Rainbow trout
RES	Redear sunfish
RSN	Red shiner
SASQ	Sacramento pikeminnow
SASU	Sacramento sucker
SMB	Smallmouth bass
TP	Tule perch
UNID	Unidentified species
W	Warmouth
WHC	White catfish

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District	)	
	)	
and	)	Project No. 2299
	)	
Modesto Irrigation District	)	

2005 LOWER TUOLUMNE RIVER ANNUAL REPORT

Report 2005-5

Rotary Screw Trap Summary Update

Prepared by

Andrea Fuller

S. P. Cramer and Associates
Gresham, OR

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INTRODUCTION

Since 1995, rotary screw trap monitoring has been conducted annually near the mouth of the Tuolumne River to assess abundance and migration characteristics of juvenile Chinook salmon and other fishes. Trapping was conducted at the Shiloh Bridge (RM 3.4) from 1995 through 1998 by the Turlock and Modesto Irrigation Districts (Districts) and the California Department of Fish and Game (CDFG); and at Grayson (RM 5.2) from 1999 through 2003 by CDFG and from 2004 through 2005 by S.P. Cramer & Associates (SPC&A). This report summarizes results of the 1995 through 2005 trapping efforts (Table 1).

Available data for all years of sampling was compiled and summarized for this report, and a table noting the status of data availability was generated (Table 2). All 2004 and 2005 data was available from either a database or summary spreadsheets maintained by SPC&A. Electronically accessible data from CDFG is incomplete for all years prior to 2004. The only data available for all years sampled is daily Chinook catch and total estimated Chinook passage.

Table 1. Rotary screw trap monitoring in the Lower Tuolumne River at Shiloh (RM 3.4) and Grayson (RM 5.2), 1995-2005. Two traps were used in all years except 1998 when only a single trap was deployed.

Year	*Site*	*Period Sampled*	*Proportion of Outmigration Period Sampled*	*Total Catch*	*Total Estimated Passage*	*Results Reported In*
1995	Shiloh	Apr 25-Jun 01	24%	141	15,667	Heyne and Loudermilk 1997
1996	Shiloh	Apr 18 - May 29	27%	610	40,385	Heyne and Loudermilk 1997
1997	Shiloh	Apr 18 - May 24	24%	57	2,850	Heyne and Loudermilk 1998
1998	Shiloh	Feb 15 - Jul 01	70%	2,546	1,615,673	Blakeman 2004a
1999	Grayson	Jan 12 - Jun 06	93%	19,327	1,073,669	Vasques and Kundargi 2001
2000	Grayson	Jan 09 - Jun 12	95%	2,250	132,017	Vasques and Kundargi 2001
2001	Grayson	Jan 03 - May 29	97%	6,478	111,644	Vasques and Kundargi 2002
2002	Grayson	Jan 15 - Jun 06	91%	436	14,540	Blakeman 2004b
2003	Grayson	Apr 01 - Jun 06	40%	359	7,261	Blakeman 2004c
2004	Grayson	Apr 01 - Jun 09	40%	509	12,567	Fuller 2005
2005	Grayson	Apr 02 – Jun 17	39%	1,317	74,471	Fuller and others 2006

Table 2. Data collected and presently available for rotary screw trap sampling at Shiloh (RM 3.4) and Grayson (RM 5.2), 1995-2005.

Data Type	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*
Chinook Salmon											
Daily catch	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Daily average length	NP	NP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual length	NP	NP	NP	Yes	Yes	Yes	Yes	Yes	NP	Yes	Yes
Daily est. passage	NP	NP	Yes	NP	NP	Yes	Yes	NP	NP	Yes	Yes
Total est. passage	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Smolt index	NP	NP	NP	Yes	Yes	Yes	Yes	Yes	NP	Yes	Yes
Other Species											
Daily catch	Yes	Yes	NP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual length	NP	NP	NP	Yes	Yes	Yes	Yes	Yes	NP	Yes	Yes
Trap Efficiency											
Time of release	NP	NP	NP	NP	NP	NP	NP	NP	NP	Yes	Yes
Release location	NP	NP	NP	Yes	NP	NP	NP	NP	NP	Yes	Yes
Length at release	Yes	NP	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length at recapture	NP	Yes	Yes	Yes	Yes	Yes	NP	NP	NP	Yes	Yes
Trap Operation And Environmental Information											
Trap status	NP	NP	NP	Yes	Yes	Yes	Yes	Yes	NP	Yes	Yes
Trap condition	NP	NP	NP	Yes	Yes	Yes	Yes	Yes	NP	Yes	Yes
Velocity	NP	NP	NP	Yes	NP	Yes	NP	NP	NP	Yes	Yes
Turbidity	X	X	X	Yes	Yes	Yes	Yes	Yes	NP	Yes	Yes

Key to codes:
Yes= Data was collected and obtained from CDFG or S.P. Cramer & Associates.
NP= Data was collected but not found in easily accessible sources (i.e., CDFG in annual reports, misc. spreadsheets, or on the Bay Delta and Tributaries website).
X= Data was not collected.

SUMMARY UPDATE

Juvenile Chinook Salmon

Juvenile Chinook Catch

Total annual catch of juvenile Chinook salmon has varied substantially between years (Table 1, Figure 1). This variation is likely due to differences in one or more factors including the duration and timing of the sampling periods, flow conditions, and overall fish abundance (Table 1, Figure 1).

Juvenile Chinook outmigration in the San Joaquin Basin typically occurs during the winter and spring, extending from January through May (Vasques and Kundargi 2001; SRFG 2004). The winter migration period is dominated by fry migrants that are typically less than 50 mm forklength, and the spring period is dominated by smolts which are typically greater than 70 mm forklength.

Sampling periods have varied between years with sampling initiated as early as January or as late as April and continuing through May/June. During 1999-2002, sampling encompassed the majority of the expected winter/spring outmigration season (i.e., January-May/June) and can be described as comprehensive (Figure 1 and Figure 2). In contrast, sampling was only conducted during the spring smolt outmigration period (i.e., April-May/June) in 1995-1997 and 2003-2005, so sampling was incomplete for these years. Sampling during 1998 began in February but was limited to a single trap (note: two traps were operated in all other years); thus, 1998 sampling covered an intermediate proportion of the entire outmigration period relative to all other years of monitoring.

Of the winter/spring sampling years, total trap catch at Grayson ranged from a high of 19,327 during 1999 to a low of 436 during 2002, and averaged 7,123 juvenile Chinook salmon (Figure 1). In all years of spring-only sampling, catches ranged from a high of 1,239 during 2001 to a low of 57 during 1997.

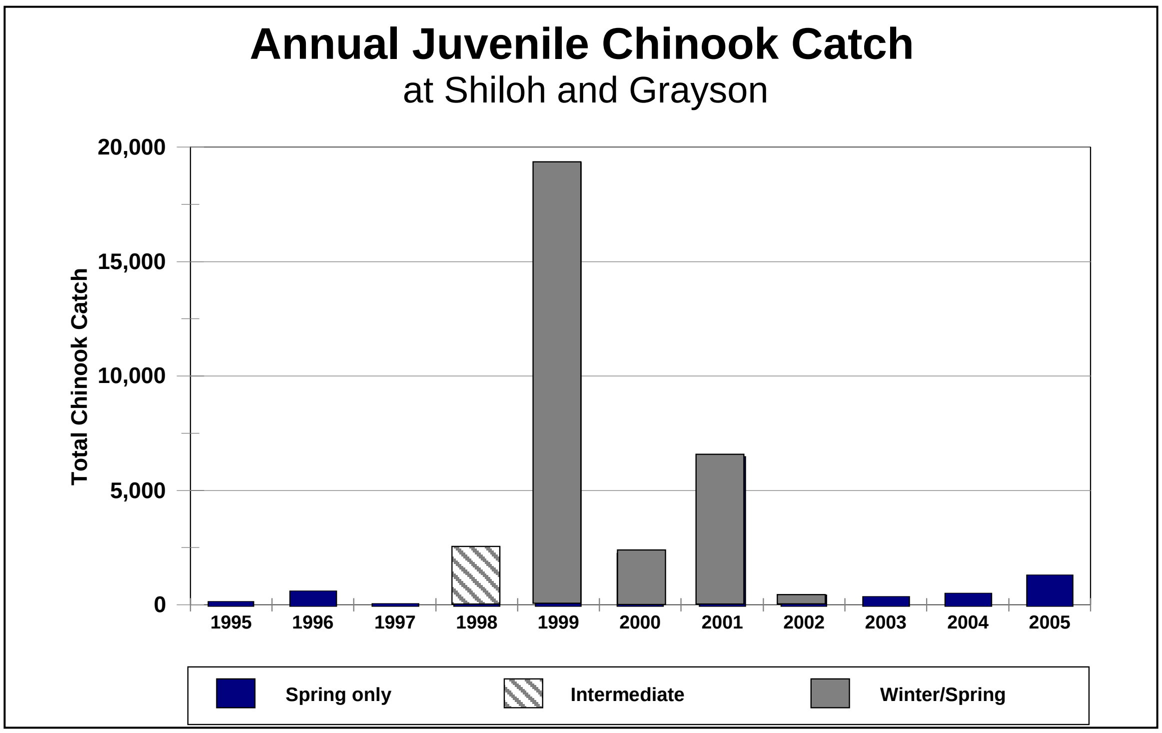

Figure 1. Annual number of juvenile Chinook salmon captured in the lower Tuolumne River at Shiloh (RM 3.4) and Grayson (RM 5.2) and sampling period type, 1995-2005.

The proportion of the typical outmigration period monitored each year ranged from 91% to 97% during winter/spring sampling years, from 24% to 40% during spring-only sampling years, and was 70% in the intermediate sampling year (Table 1). These proportions were calculated by taking the total number of sampling days in a given year and dividing by the total number of days for a typical complete outmigration period (i.e., January 1 through May 31).

The proportion of the outmigration period sampled may not be representative of the proportion of the juvenile population migrating during the sample period because migration timing can be influenced by environmental factors such as flow. For example, in years of low winter flows relatively few salmon reach the site prior to April (Figure 2). Under low flow conditions in 2002 (i.e., 265 cfs to 1,738 cfs) when sampling was conducted from January through early June, 94% of the juvenile Chinook catch occurred after April 1, yet this represented only 40% of the typical outmigration window. In contrast, most juveniles emigrated as fry from late January through early March during high flow years (i.e., flows exceeding 4,000 cfs at Modesto).

Changes in flow, particularly flow increases, were often associated with increased catches. Peak fry catches occurred at flows in excess of approximately 2,000 cfs. Fewer smolts appear to migrate after mid-May when flow often decreases to less than 1,000 cfs and water temperatures rise substantially. Smolts have been captured as late as June 17 (last day of sampling) during 2005 when flows remained relatively high through the late spring (i.e., greater than approximately 4,000 cfs), and water temperatures remained cooler than typical for that time of year.

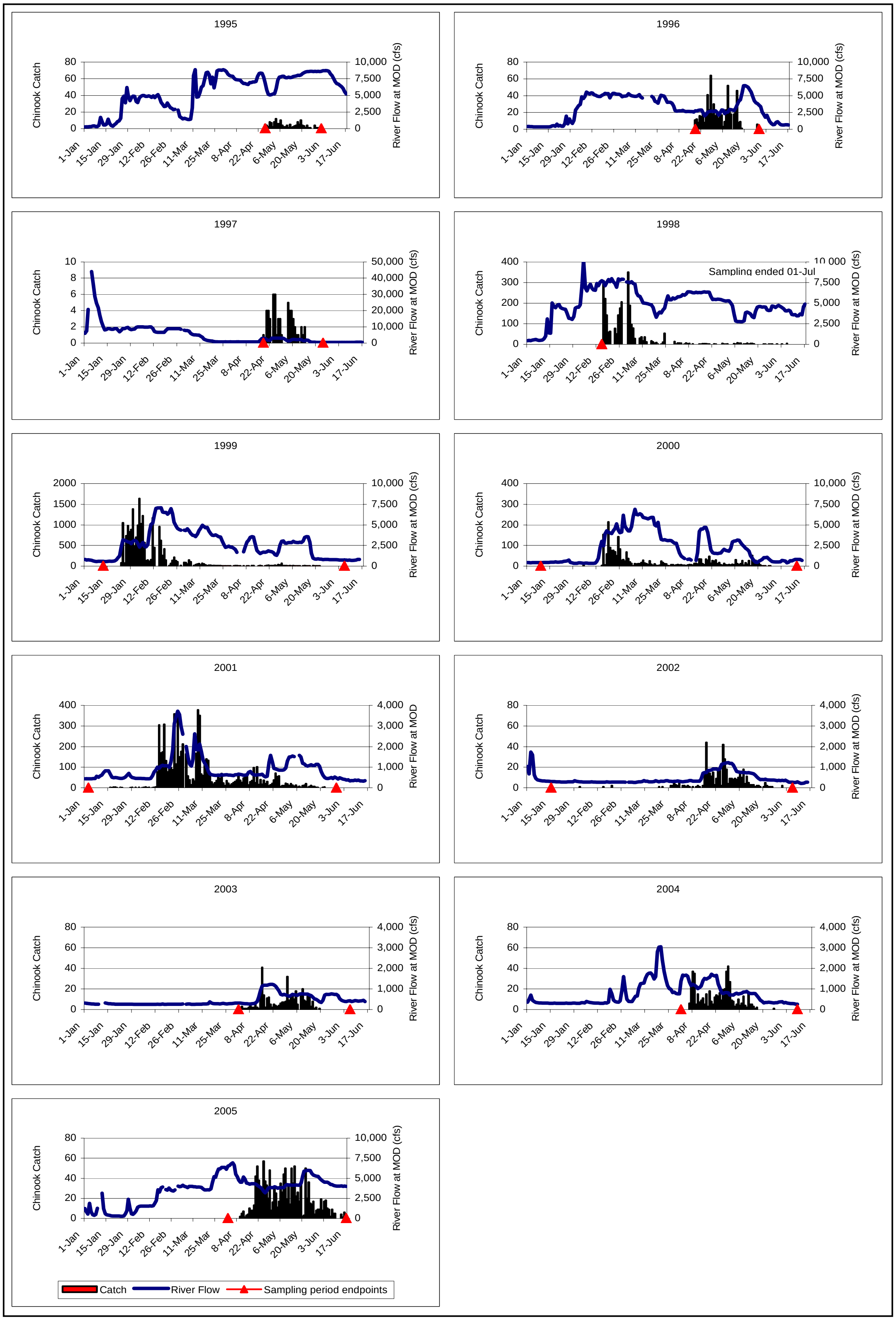

Figure 2. Daily Chinook catch at Shiloh/Grayson and river flow at Modesto, 1995-2005.

Trap Efficiency and Juvenile Chinook Abundance

Trap Efficiency

During all years except 2005, trap efficiency was estimated at Shiloh or Grayson by releasing known numbers of marked Chinook salmon from the Merced River Hatchery a short distance upstream of the trap (i.e., approximately one mile). The number of trap efficiency tests conducted annually ranged from 4 to 13 tests (Appendix B), with the number of tests generally dependent upon the number of weeks sampled. The proportion of marked fish recaptured from each group serves as an estimate of trap efficiency and these estimates are used to estimate juvenile Chinook abundance from daily trap catches. Generally this was done by developing regressions of trap efficiency and flows for each year to predict efficiency for all trapping days based on river flow measured at Modesto. There is some uncertainty about the accuracy of the estimates derived by this approach in that it does not account for the potential influence of turbidity and fish size on trap efficiency. Developing a model of trap efficiency or applying weekly trap efficiency estimates to the catch occurring during the same week may provide more accurate estimates.

In general, estimated efficiency at Shiloh and Grayson declined as river flow increased and was low and relatively consistent at flows greater than 1,000 cfs at Modesto (Figure 3 and Figure 4, Appendix B). Trap efficiency was consistently low at Shiloh from 1995 through 1998 (i.e., less than 4%) and this was one of the primary factors that contributed to the decision to move the trapping location to Grayson in 1999 (Figure 4, Appendix B). However, low trap efficiency at Shiloh may have been the result of high flows rather than the influence of the bridge piers upstream of the trap since results were similar between the two sites for tests conducted at comparable flows (i.e., greater than 1,000 cfs). Trap efficiency was more variable at Grayson, ranging from 0.5% to 21.2% from 1999 through 2004 (Figure 4, Appendix B), and this likely reflects differences in the range of flows and fish sizes evaluated at each site.

For example, at flows less than 1,000 cfs (Modesto gage) significant variability in trap efficiency was observed. This variability cannot be explained by flow alone, and there is some indication that fish size may account for some of this variability. The greatest range in trap efficiency occurred during 2002 when efficiency ranged between 0.5% and 21.2% at flows ranging from 280 cfs to 403 cfs. A regression of the average fish size and resulting trap efficiency for this subset of release events indicates a relatively strong relationship (R^2= 0.817; p=0.002) between fish size and trap efficiency where trap efficiency decreases as fish size increases.

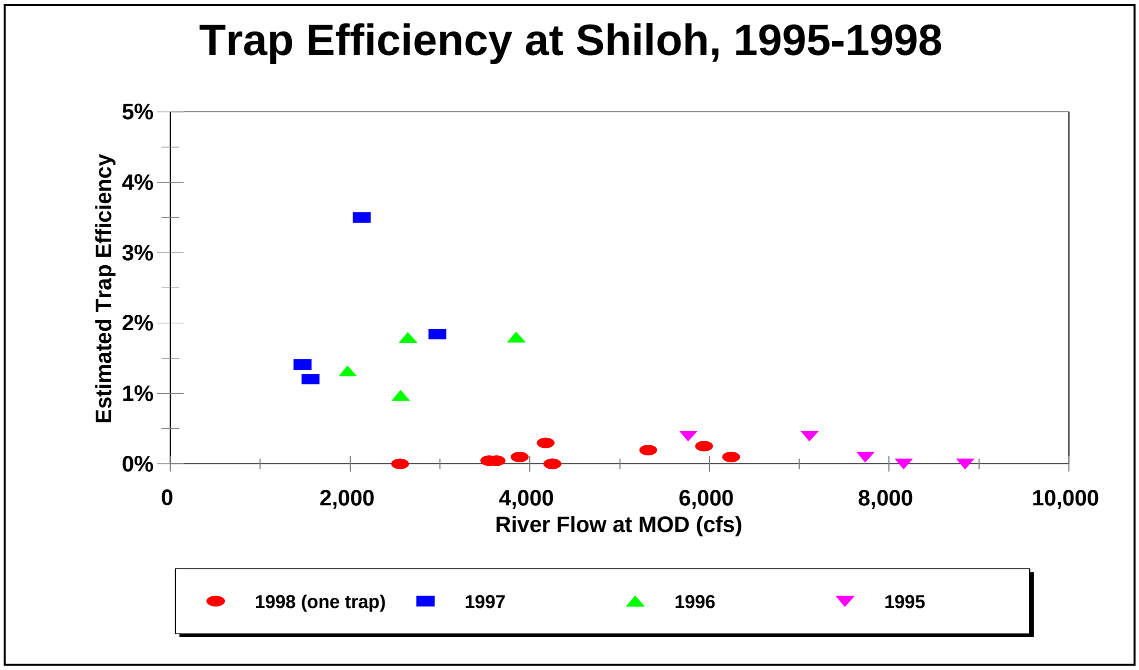

Figure 3. Estimated trap efficiency at Shiloh from 1995 through 1998.

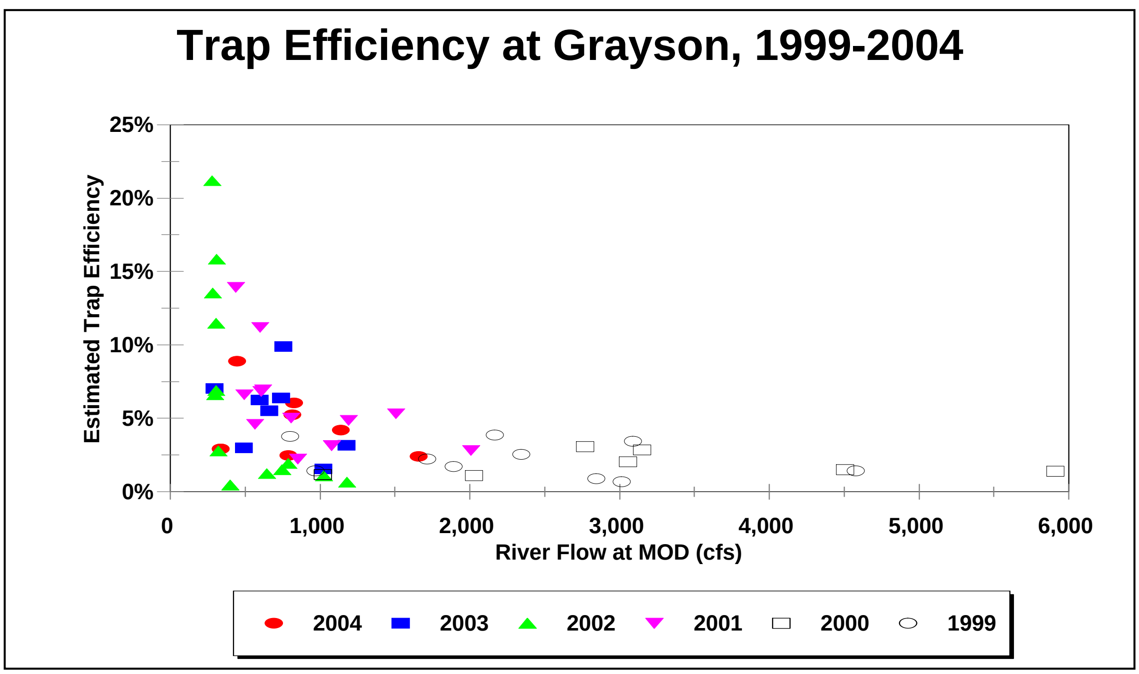

Figure 4. Estimated trap efficiency at Grayson from 1999 through 2004.

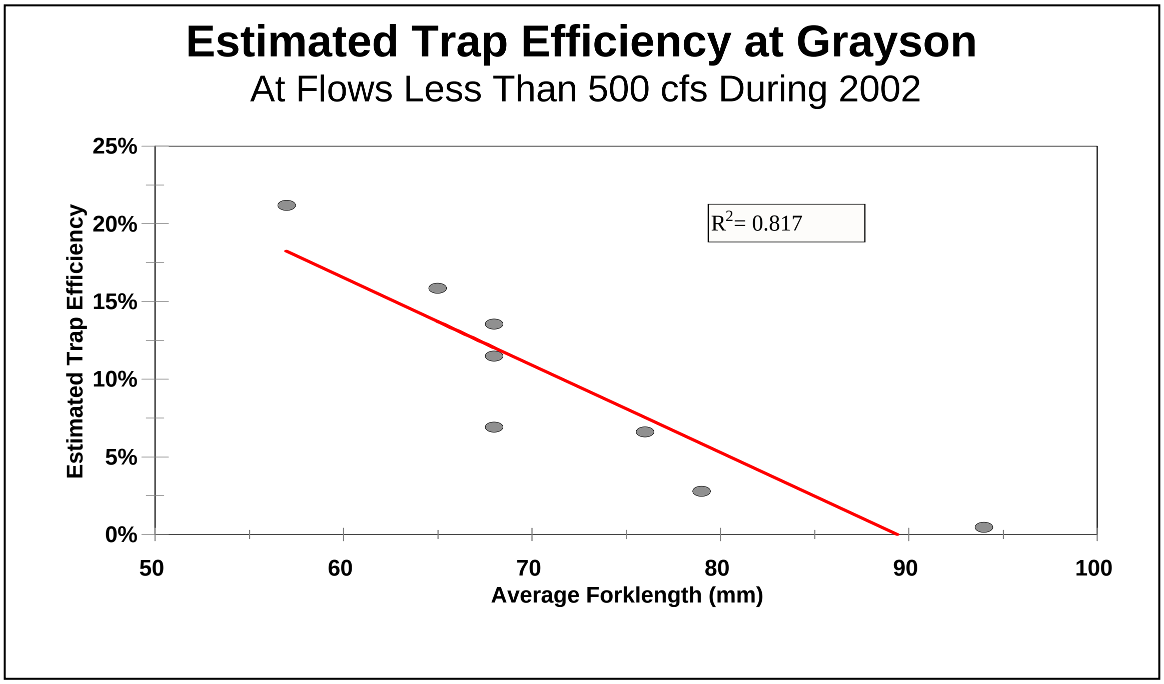

Figure 5. Estimated trap efficiency and average fish size at release at Grayson during 2002 for releases ranging from 280 cfs to 403 cfs.

Juvenile Chinook Abundance

Since sampling effort did not encompass the entire outmigration period in all years (Table 1, Figure 6), it is appropriate to describe expanded catches as estimated passage during the specific period sampled. Total estimated passage at Grayson during winter/spring sampling years ranged from a high of 1,073,669 during 1999 to a low of 14,540 during 2002 (Table 1, Figure 6). During spring-only sampling years at Grayson and Shiloh, estimated passage ranged from a high of 40,385 in 1996 to a low of 7,261 during 2003 (Table 1, Figure 6). Estimated passage was highest during 1998 (Table 1, Figure 6) when sampling effort was intermediate (i.e., February-July). However, the 1998 passage estimate may be inflated because no trap efficiency tests were conducted with fry. The regression equation for predicting daily trap efficiency during 1998 was based on tests conducted with larger fish and as described previously, there is a relatively strong relationship between fish size and trap efficiency. Therefore, the application of efficiencies predicted by this equation to fry captured during February could inflate estimated passage.

Comparison of trends in estimated daily Chinook passage between years and relative to environmental factors will be included in future reports when the data is available. At the time of this report, daily passage estimates are available for five of the eleven years sampled.

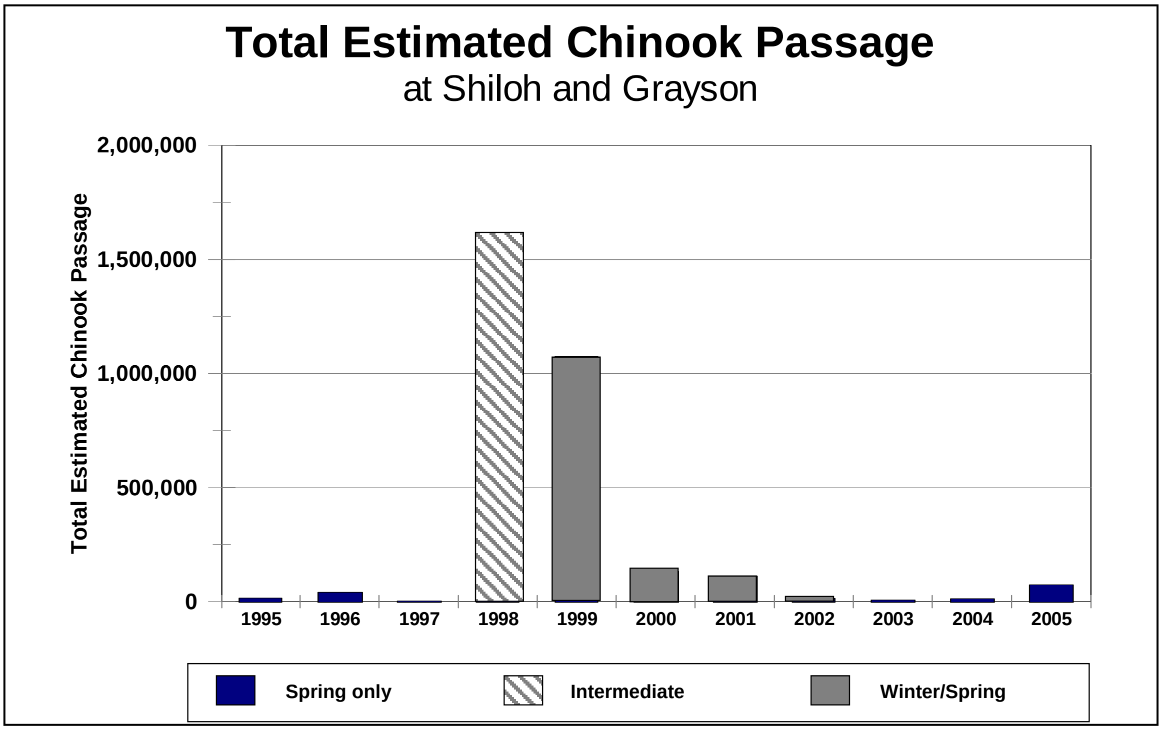

Figure 6. Total estimated Chinook passage and proportion of the typical outmigration period sampled annually at Shiloh and Grayson from 1995 through 2005.

Juvenile Chinook Emigration Timing

As described previously, juvenile Chinook outmigration in the San Joaquin Basin typically extends from January through May (Vasques and Kundargi 2001; SRFG 2004) and sampling effort was incomplete in many years. As such, timing of juvenile emigration can be compared among all years for the spring smolt period only. Since estimated daily passage data are not presently available for the 1999 and 2002 winter/spring sampling years, entire emigration timing can only be evaluated during 2000 and 2001.

Comparison of cumulative passage at Grayson during 2000 and 2001 indicates that migration timing was nearly identical in these two years, with few fish passing Grayson prior to February 15 or after mid-May (Figure 7). The majority of emigration occurred from mid-February through early March (fry) and from early April through mid-May (smolts), and passage was relatively low during most of March. Although this timing differs from the typical timing for the San Joaquin Basin in that few fish passed during January, high catches during 1999 suggests that passage may be high during January in some, but not all years.

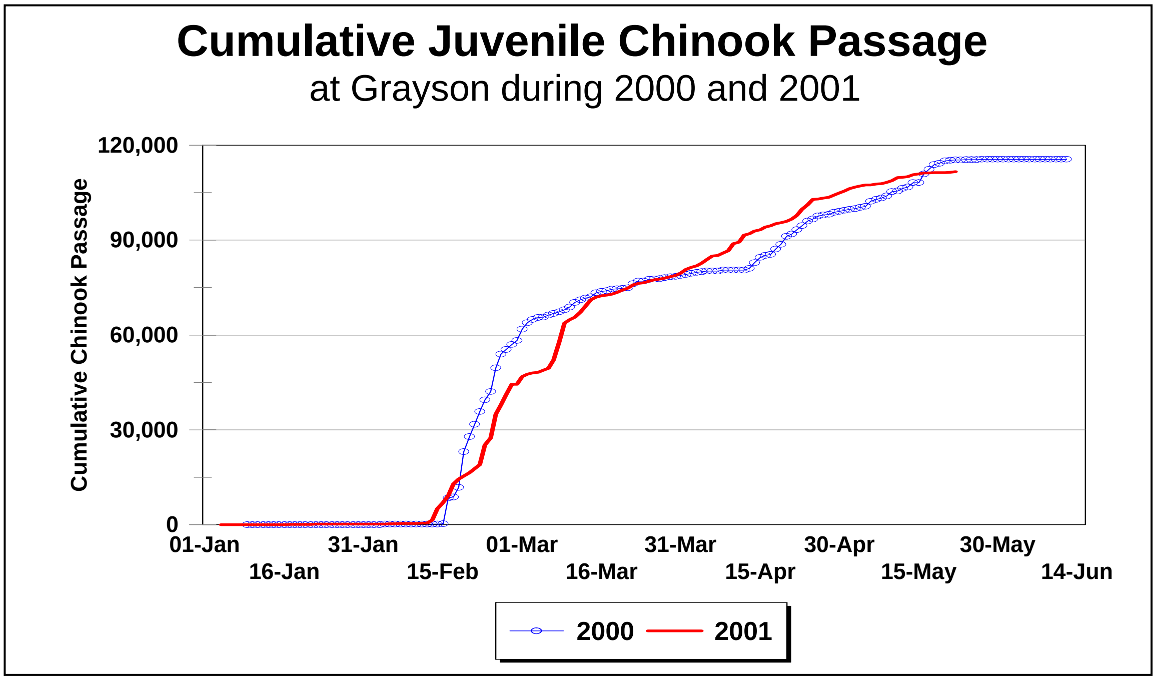

Figure 7. Cumulative estimated passage of juvenile Chinook salmon at Grayson (RM 5.2) during comprehensive sampling, 2000-2001. Data is not available for 1999 and 2002.

Size of Juvenile Chinook Outmigrants

Daily mean lengths of juvenile Chinook salmon captured at Shiloh/Grayson are presently available for 1997-2002 and 2004-2005 (Table 1). To simplify interannual comparison of how average Chinook length changes through the typical outmigration period, daily mean lengths were averaged per Julian week. The averages for some weeks were excluded due to low sample size.

Generally, average fish length was around 35-40 mm (forklength) during January and February then gradually increased to 90-100 mm by late May (Figure 8). From late March through early May, average size for a given week ranged widely between years. For example, during the week of April 2, average size differed by 25 mm from a low of 69 mm in 2000 to a high of 84 mm in 2002.

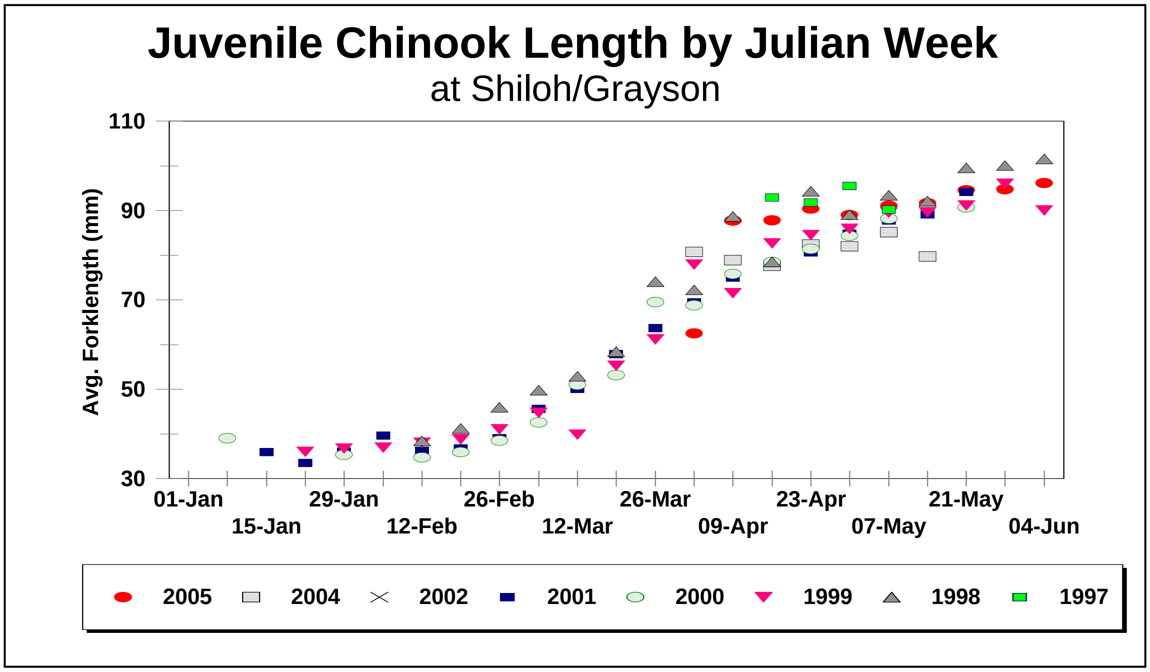

Figure 8. Weekly average forklengths of juvenile Chinook salmon captured at Shiloh (RM 3.4) and Grayson (RM 5.2), 1997-2002 and 2004-2005. Data is not available for 1995, 1996, and 2003.

Forklength data for individual juvenile Chinook salmon captured and measured at Shiloh and Grayson is available for 1998-2002 and 2004-2005 but is not presently available for 1995, 1996, 1997, and 2003. Therefore, length frequency distributions using available data were calculated for comparison. During years when lengths were sub-sampled (i.e., not all captured Chinook were measured), the length frequency distribution of measured fish on a given day was applied to the overall catch for the day.

Individual forklength data was available for the Grayson traps from 1999 through 2001 when sampling throughout the full season (i.e., winter/spring) occurred. The length frequency distributions for years (Figure 9) illustrate that juvenile Chinook catch was consistently dominated by fry (i.e., less than 50 mm) which represented 60% to 93% of the total annual catch. During 1999, only 7% of the fish captured were greater than 50 mm. In contrast, fish greater than 50 mm represented roughly one-third of the catch during 2000 and 2001. Less than 1% of the fish captured from 1999 through 2001 were greater than 100 mm.

Length frequency distributions of juvenile Chinook captured during April and May were also generated and compared for all years when data is available (i.e., 1998 through 2002 and 2004). These April/May distributions suggest that the dominant size class of smolts passing Shiloh/Grayson varies between years (Figure 10). During the years compared, peaks were observed in the 70-79 mm, 80-89 mm, and 90-99 mm classes. This trend will be further evaluated in future analyses.

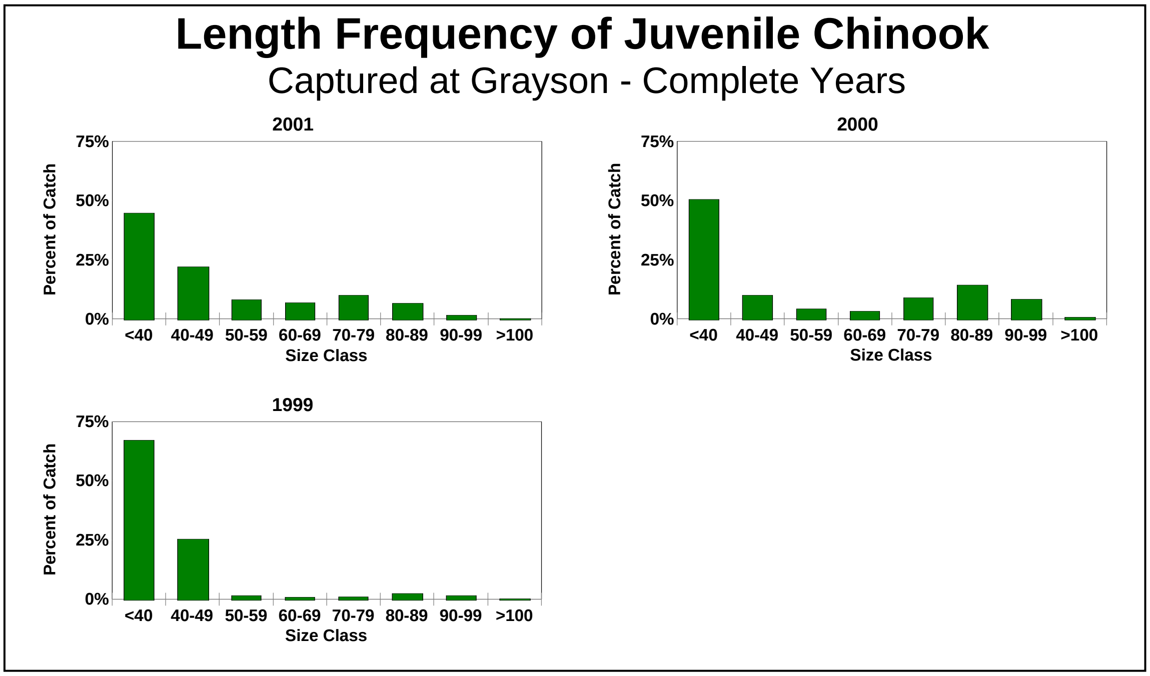

Figure 9. Length frequency distribution of juvenile Chinook captured at Grayson during 1999, 2000, and 2001 when sampling was complete.

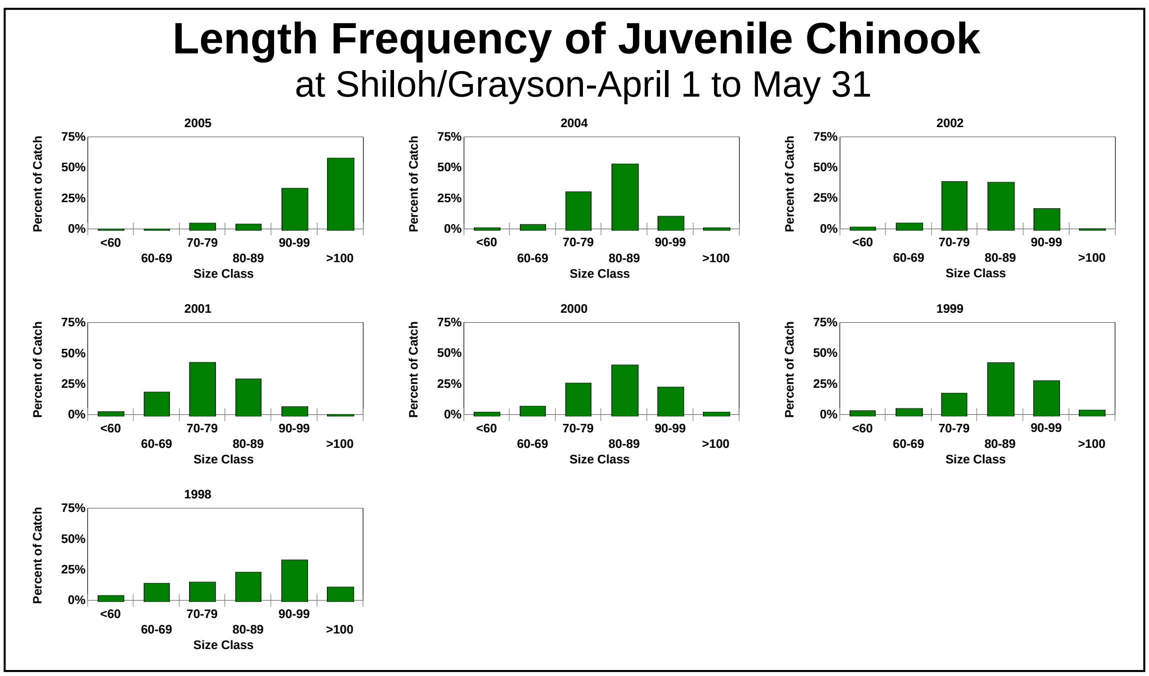

Figure 10. Length frequency distribution of juvenile Chinook captured from April 1 through May 31 at Shiloh during 1998 and at Grayson during 1999-2002 and 2004-2005.

Rainbow/steelhead trout

Over all years of outmigrant monitoring at Shiloh/Grayson, two rainbow/steelhead trout have been captured (Table 3).

Table 3. Rainbow/steelhead trout captured at Shiloh/Grayson from 1995 through 2005.

Date Captured	*Forklength (mm)*
2/21/2000	230 mm
5/14/2005	33 mm

Other Fish Species

Daily catch of species other than Chinook salmon is presently available for all years of monitoring at Shiloh and Grayson, with the exception of 1997. A total of 38 species have been represented in the catch (Table 4), including Chinook salmon. Of these, 29% are native to the Tuolumne River drainage and 71% are introduced species. Similarly, 23% (n=4,006) of the individuals captured have been native species and 77% (n=13,516) introduced, excluding Chinook salmon.

Over all years combined, white catfish were the most commonly captured species, followed by Pacific lamprey, largemouth bass, smallmouth bass, and bluegill (Table 4). Species rarely captured (i.e., fewer than 10 individuals captured) at Shiloh and Grayson include rainbow trout, brown bullhead, yellow bullhead, American shad, fathead minnow, hitch, hardhead, bigscale logperch, riffle sculpin, and striped bass.

Table 4. Species other than salmon captured at Shiloh 1995-1998 and at Grayson 1999-2005.

Common Name	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	TOTAL
Catfish Family												
Bullhead catfish	0	2		0	0	0	0	0	0	0	0	**2**
Black bullhead	1	0		3	5	0	0	0	2	0	0	**11**
Brown bullhead	0	0		1	2	0	0	0	0	0	0	**3**
Channel catfish	1	1		8	15	61	28	12	12	12	3	**153**
White catfish	14	2		64	198	616	890	2,141	1,196	625	51	**5,797**
Yellow bullhead	0	0		1	0	0	0	0	0	0	0	**1**
Unidentified catfish	0	40		0	1	82	5	0	12	29	0	**169**
Herring Family												
American shad	0	0		1	0	4	0	2	0	1		**8**
Threadfin shad	0	1		46	4	312	85	43	13	3		**507**
Lamprey Family												
Pacific lamprey*	0	0		3	755	442	393	215	788	4	0	**2,600**
Unid. lamprey	0	0		0	0	0	172	76	0	4	13	**265**
Livebearer Family												
Mosquitofish	21	22		35	1	71	42	60	53	68	10	**383**
Minnow Family												
Carp	1	0		0	4	10	3	0	1	1	0	**20**
Fathead minnow	0	0		0	0	0	1	1	0	3	1	**6**
Hitch*	0	1		0	1	3	0	0	0	1	1	**7**
Golden shiner	2	11		0	6	144	105	5	14	5	10	**302**
Goldfish	32	12		75	5	6	1	3	0	0	2	**136**
Hardhead*	0	1		0	0	6	0	0	1	0	2	**10**
Red shiner	12	2		19	2	73	97	225	140	56	5	**631**
Sac. blackfish*	0	1		0	1	12	7	2	0	2	0	**25**
Sac. pikeminnow*	11	2		46	1	342	20	23	3	2	42	**492**
Sac. splittail*	0	0		0	2	12	1	3	2	0	0	**20**
Unid. minnow	570	0		0	7	93	26	10	4	0	0	**710**
Perch Family												
Bigscale logperch	0	0		0	0	0	1	3	0	0	0	**4**
Salmonid Family												
Rainbow trout*	0	0		0	0	1	0	0	0	0	1	**2**
Sculpin Family												
Prickly sculpin*	0	0		4	135	14	6	3	1	0	0	**163**
Riffle sculpin*	0	0		0	4	0	0	0	0	0	0	**4**
Unidentified sculpin	0	3		0	0	0	0	0	0	0	0	**3**
Silverside Family												
Inland silverside	3	102		18	7	92	55	48	19	15	5	**364**
Smelt Family												
Wakasagi	0	0		19	0	0	0	0	0	0	0	**19**
Sucker Family												
Sacramento sucker*	39	12		2	94	114	126	58	12	17	4	**478**
Sunfish Family												
Bass- unid. species	0	0		0	0	0	0	0	0	29	0	**29**
Black crappie	0	0		0	41	1	2	66	0	0	0	**110**
Bluegill	1	26		8	80	431	446	168	16	37	19	**1,232**
Green sunfish	2	2		0	7	8	5	8	10	2	0	**44**
Largemouth bass	2	56		2	26	264	137	474	0	638	15	**1,614**
Redear sunfish	0	0		1	1	4	2	3	1	0	1	**12**
Red-eye bass	0	0		0	0	1	0	0	0	0	0	**1**
Smallmouth bass	0	0		1	2	58	40	510	17	785	6	**1,419**
Spotted bass	0	0		0	0	33	0	125	2	0	0	**160**
Warmouth	0	1		15	2	8	1	9	2	0	1	**38**
White crappie	0	3		0	21	10	5	1	1	0	0	**41**
Unidentified sunfish	3	2		8	4	42	17	30	306	8	0	**420**
Surfperch Family												
Tule Perch	0	0		0	0	0	0	0	0	0	1	**1**
Temperate Bass Family												
Striped bass	0	0		0	2	4	0	1	0	0	0	**7**

* Indicates species native to the Tuolumne River.

LITERATURE CITED

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Appendix A. Presently available information for daily Chinook catch, mean length, and passage at Shiloh and Grayson from 1995 through 2005.

	Daily Catch of Chinook Salmon											Daily Chinook Mean Length (mm)								Estimated Chinook Passage				
Date	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	1997	1998	1999	2000	2001	2002	2004	2005	1997	2000	2001	2004	2005
01-Jan																								
02-Jan																								
03-Jan																								
04-Jan							1									86.0						29		
05-Jan																								
06-Jan																								
07-Jan																								
08-Jan																								
09-Jan																					0			
10-Jan						1									39.0						53			
11-Jan																					0			
12-Jan																					0			
13-Jan																					0			
14-Jan																					0			
15-Jan																								
16-Jan							2									36.5					0	23		
17-Jan							1									37.0					0	11		
18-Jan							3									36.0					0	33		
19-Jan							3									34.0					0	32		
20-Jan							1									36.0					0	11		
21-Jan																					0			
22-Jan							2									33.0						21		
23-Jan					79		1							35.4		34.0					0	11		
24-Jan					1050									35.0							0			
25-Jan					75									36.3							0			
26-Jan					735									36.2							0			
27-Jan					980									36.1							0			
28-Jan					829		1							36.8		140.0					0	1		
29-Jan					890		2							37.2		39.0						23		
30-Jan					1386									36.4							0			
31-Jan					480		2							36.5		36.0					0	22		
01-Feb					698			1						36.9			37				0			

	Daily Catch of Chinook Salmon											Daily Chinook Mean Length (mm)								Estimated Chinook Passage				
Date	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	1997	1998	1999	2000	2001	2002	2004	2005	1997	2000	2001	2004	2005
02-Feb					993		2							36.4		35.0					0	22		
03-Feb					1642									36.5							0			
04-Feb					1030	3	1							36.9	35.3	34.0					158	11		
05-Feb					1222		2							37.7		44.5						24		
06-Feb					568		4							36.2		77.7					0	90		
07-Feb					130		1							37.0		35.0					0	11		
08-Feb					147		2							36.3		36.5					0	22		
09-Feb					116									36.6							0			
10-Feb					155		1							37.0		103.0					0	72		
11-Feb					1168		2							38.0		42.5					0	25		
12-Feb					450		4							39.2		36.8						47		
13-Feb							77									36.5					0	917		
14-Feb							305									36.0					0	3595		
15-Feb					956	3	169	1						37.4	34.0	36.0	37				158	2025		
16-Feb				309	620	154	173						37.9	37.5	34.6	36.5					8108	2090		
17-Feb				221	257	5	308						38.4	37.9	34.0	35.7					263	3682		
18-Feb				142	418	59	132						39.0	38.1	36.4	36.0					3107	1589		
19-Feb				59	147	214	77						40.1	37.6	36.1	35.7					11269	920		
20-Feb				63		90	97	2					37.8		35.5	35.9	83				4739	1146		
21-Feb					16	75	98							38.3	35.1	35.4					3949	1208		
22-Feb					65	76	88							40.4	35.9	38.7					4002	1240		
23-Feb				77	136	69	358						45.2	38.9	35.3	36.6					3634	6233		
24-Feb				50	213	50	115						39.3	39.2	37.3	36.9					2633	2229		
25-Feb				142	133	142	362						43.9	38.3	36.3	37.9					7478	7518		
26-Feb				175	103	83	150						44.6	38.4	35.6	37.4					4371	2975		
27-Feb				206		28	177						46.2		36.2	38.9					1474	3105		
28-Feb					18	31	212							41.6	36.5	39.0					1633	3440		
29-Feb						24									41.8						1264			
01-Mar					87	68	164							40.0	41.2	38.5					3581	2355		
02-Mar				350	86	37	57						47.6	41.2	39.9	37.9					1948	746		
03-Mar				189	46	20	39						45.7	39.5	39.1	41.0					1053	505		
04-Mar				97	144	13	15						45.7	45.3	37.4	40.5					685	191		
05-Mar				78	105	1	42						48.0	43.0	34.0	45.2					53	602		
06-Mar				28		12	32						47.0		44.3	49.0					632	660		
07-Mar					18	10	167							47.8	49.8	44.5					527	2592		

	Daily Catch of Chinook Salmon											Daily Chinook Mean Length (mm)								Estimated Chinook Passage				
Date	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	1997	1998	1999	2000	2001	2002	2004	2005	1997	2000	2001	2004	2005
08-Mar					35	11	378							43.6	42.4	44.4					579	5787		
09-Mar				29	47	11	351						50.6	48.3	41.7	46.1					579	5887		
10-Mar				35	55	17	67						50.7	44.4	42.8	44.5					895	1014		
11-Mar				17	24	28	60						52.5	41.2	43.2	45.4					1475	868		
12-Mar				36	68	15	109						51.0	39.6	44.1	47.6					790	1560		
13-Mar				11	52	11	140						53.7	38.2	46.8	50.7					579	2061		
14-Mar					26	7	133							37.6	48.4	48.8					369	1828		
15-Mar					11	25	64							41.9	55.9	49.5					1317	870		
16-Mar				17	19	8	28						54.4	36.4	54.8	49.7					421	379		
17-Mar				12	20	3	18						57.3	45.3	45.3	49.8					158	244		
18-Mar				5	9	10	24						48.2	39.4	61.3	54.3					527	340		
19-Mar				8	14	3	35	1					51.4	50.6	48.3	55.4	64				158	515		
20-Mar				1	11	2	52						55.0	55.6	45.5	54.9					105	762		
21-Mar					13	4	45	1						53.5	50.5	53.6	105				211	652		
22-Mar				1	11	24	69						58.0	46.2	56.0	58.2					1264	1063		
23-Mar				10	10	17	23						64.6	56.5	53.2	61.4					895	377		
24-Mar				53	5	12	10						62.9	55.2	59.2	59.9						161		
25-Mar					3	10	34							69.0	58.8	61.3					527	562		
26-Mar					7	2	22	2						61.9	87.0	64.8	95.5				105	386		
27-Mar					6	1	13	2						48.0	45.0	64.2	75				53	232		
28-Mar					3	6	19	6						66.0	62.3	62.6	81.17				316	319		
29-Mar					7	6	25	3						72.0	69.8	61.2	88.67				316	407		
30-Mar				14	2	3	30	2					70.8	50.0	72.7	61.4	77.5				158	497		
31-Mar				1	3	5	38	5					84.0	61.7	74.8	64.8	76.2				263	669		
01-Apr				6	10	7	64						67.3	68.3	74.7	66.8					369	1170		
02-Apr				6	12	5	37	2	1	0	2		69.2	69.3	57.8	64.9	76		62.5		263	664		208
03-Apr				5	3	6	26	2	3				73.0	76.0	67.2	66.0	90				316	477		0
04-Apr					6	4	47	1	1					80.7	77.8	70.1	104				211	913		0
05-Apr				1	2	4	56	2	1				82.0	54.5	57.7	69.5	79				211	1089		0
06-Apr				6	4	2	55	1	1	6	0		66.0	81.5	72.5	68.3	75	83.7	-			1058	171	0
07-Apr				3	1	5	14		2	24	0		72.7	98.0	76.6	72.2		78.3	-			305	611	0
08-Apr				4	3	7	29	1	4	37	0		70.3	85.3	72.0	74.8	80	80.2	-		368	686	976	0
09-Apr					4	6	35		2	35	0			80.5	81.8	74.3		80.7	-			785	902	0
10-Apr				2	1	4	98	1	2	5	2		70.0	69.0	72.8	74.4	94	80.0	82.5			2138	125	121
11-Apr					10	13	24	2	5	15	5			66.1	74.8	75.4	88.5	79.5	85.2			529	351	301

	Daily Catch of Chinook Salmon											**Daily Chinook Mean Length (mm)**								**Estimated Chinook Passage**				
Date	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	1997	1998	1999	2000	2001	2002	2004	2005	1997	2000	2001	2004	2005
12-Apr					8	14	101	1	2	7	7			79.3	72.9	76.6	79	75.4	87.4			2300	170	489
13-Apr					1	9	16		1	9	1			72.0	73.1	72.9		77.2	92.0		474	347	227	66
14-Apr				1	1	34	40	2	13	11	3		100.0	61.0	76.6	75.7	85	80.9	90.7		1790	894	326	177
15-Apr				1	3	33	17	13	41	5	4		96.0	72.3	78.0	75.3	77.08	78.0	88.3		1738	383	160	235
16-Apr				3	14	11	37	44	14	15	10		90.3	77.4	74.2	75.6	75.94	84.4	88.9		579	815	467	578
17-Apr				3	5	6	20	16	2	3	8		89.0	87.6	79.3	76.4	74.93	85.0	87.7		316	448	97	466
18-Apr		11	1	3	2	33	30	14	11	18	8	93.0	84.0	78.5	81.4	77.6	80.09	78.8	87.6	64	1738	696	603	467
19-Apr		12	0	2	7	28	9	11	12	8	13		83.0	83.7	79.8	76.4	76.1	55.5	90.1	0	1474	254	300	760
20-Apr		8	4	1	16	47	15	15	5	5	42	98.8	46.0	81.1	79.0	77.8	77.67	79.0	86.5	262	2475	494	180	2436
21-Apr		16	4		21	14	21	3	2	12	52	89.8		84.6	76.5	83.2	71	79.8	86.1	209	737	726	421	2912
22-Apr		15	3		11	26	38	9	5	14	38	90.0		85.3	78.6	80.3	80.56	80.9	87.4	160	1369	1099	504	2084
23-Apr		19	0	2	12	24	71	16	4	13	28		82.5	82.3	78.9	80.4	75.85	84.7	90.3	0	1263	1958	347	1505
24-Apr		8	6	1	11	29	54	17	3	16	30	88.3	104.0	86.1	80.4	78.9	78.19	80.3	88.5	392	1527	1395	383	1558
25-Apr		19	6		19	12	57	2	4	9	57	97.5		80.9	81.1	81.1	77.5	88.2	90.1	392	632	1685	190	2807
26-Apr	5	41	1		9	17	6	42	6	19	37	88.0		86.6	78.4	79.7	81.79	78.6	90.9	66	895	163	394	1766
27-Apr	4	23	3		39	6	10	28	7	20	33	78.3		85.0	82.5	80.4	84.75	82.1	90.5	197	316	281	426	1642
28-Apr	2	64	3	4	28	4	10	18	7	37	20	95.3	93.8	85.0	82.5	80.8	80.6	82.2	91.2	197	211	282	786	1059
29-Apr	8	18	1	1	67	13	22	4	8	42	48	103.0	97.0	85.4	85.8	83.1	74	80.2	91.2	65	684	701	889	2575
30-Apr	7	30	0	1	13	6	19	9	32	27	8		90.0	88.8	82.0	82.6	85.62	81.7	90.5	0	316	679	542	428
01-May	2	16	0	2	9	5	12	9	9	9	16		89.5	85.0	82.6	85.1	85.33	81.1	88.7	0	263	539	181	857
02-May	8	20	0		9	7	20	8	13	8	30			86.4	84.4	82.4	86	83.0	92.1	0	369	819	161	1636
03-May	12	13	5		3	5	13	9	13	3	25	96.2		86.7	83.2	84.4	83.44	83.7	87.1	247	263	446	62	1341
04-May	6	18	4		11	8	7	8	10	5	11	88.5		89.2	83.6	84.7	82.62	80.0	85.6	200	421	313	105	579
05-May	6	17	4	3	4	6	13	10	18	10	17	99.8	87.7	82.3	88.0	88.9	85.12	84.3	87.4	228	316	331	206	909
06-May	10	3	3	1	8	30	3	14	5	4	35	97.3	89.0	82.6	86.6	85.3	89.43	79.8	91.7	174	1580	72	83	1874
07-May	4	9	2	7	6	12	7	10		6	26	91.5	93.7	93.8	87.6	84.8	83.7	84.5	91.3	115	632	324	126	1390
08-May	2	23	1	5	5	7	2	18	13	13	44	95.0	92.2	85.2	86.9	81.5	88.4	84.1	90.3	57	369	76	279	2356
09-May	2	52	1	5	6	12	10	4	20	4	50	85.0	92.0	88.8	86.4	87.3	83.33	80.0	93.9	57	632	421	87	2795
10-May	4	23	0		4	26	13	11	9	2	19			86.5	87.0	86.9	86.56	85.0	91.4	0	1369	541	44	1087
11-May	1	18	2	2	1	4	20	5	8	16	34	84.5	90.5	94.0	87.5	89.9	82.6	88.6	92.8	115	211	898	339	1930
12-May	5		1	2	5	16	2	3	13	5	14	92.0	95.0	90.6	90.5	93.0	90	85.0	86.3	52	842	105	104	795
13-May	1	18	2	5	8	8	6	3	12	5	50	93.0	97.0	87.5	91.3	90.4	86.33	88.8	90.7	101	421	279	104	2816
14-May	2	25	0	1	3	26	11	3	3	3	35		90.0	86.7	92.2	91.0	85.67	82.0	91.9	0	1369	563	63	1975
15-May	3	46	0	4	3	1	6	1	8	1	52		89.8	88.7	88.0	89.0	102	80.0	93.3	0	53	258	21	2929
16-May	4	8	0	4	6	51	6	2	1	2	22		93.0	89.6	91.1	88.0	97	77.0	94.3	0	2685	253	40	1244

Daily Catch of Chinook Salmon

Date	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
17-May	8	9	0	2	2	29	2	2	2	0	26
18-May	5	1	0		9	27	2	1		0	17
19-May	10		0		7	9			1	0	36
20-May	4		0		6	13		1		0	2
21-May	3	0	0		3	5	2	5		0	3
22-May	1		0		3	1	4	2		0	50
23-May	4		0	1	1	1		1		0	20
24-May	1		0	1	2	1		1		0	36
25-May	1				1			1		0	15
26-May	0			1	2	1				1	14
27-May	0			1		1				0	17
28-May	4	6		1	1					0	4
29-May	1	1									8
30-May	1										9
31-May	0			1				2			9
01-Jun	0				1					0	19
02-Jun										0	8
03-Jun				1						0	17
04-Jun										0	18
05-Jun					1					0	10
06-Jun				4	2					0	9
07-Jun										0	2
08-Jun										0	9
09-Jun										0	5
10-Jun											5
11-Jun											
12-Jun											
13-Jun											
14-Jun											4
15-Jun											1
16-Jun											6
17-Jun											2

Daily Chinook Mean Length (mm)

Date	1997	1998	1999	2000	2001	2002	2004	2005
17-May		95.5	94.5	92.1	83.5	86.5		92.5
18-May			91.4	93.3	94.0	91		93.4
19-May			88.4	90.5				90.5
20-May			87.7	89.6		82		85.0
21-May			93.7	89.0	91.0	85.75		95.0
22-May			85.3	90.0	97.3	85.5		93.2
23-May		96.0	86.0	92.0		90		93.3
24-May		104.0	92.5	90.0		112		94.2
25-May			93.0			89		96.9
26-May		98.0	96.0	96.0			87.0	94.1
27-May		100.0		87.0				95.2
28-May		98.0	100.0					93.8
29-May								97.6
30-May								96.3
31-May		99.0						96.2
01-Jun			92.0					96.0
02-Jun								98.9
03-Jun		103.0						84.4
04-Jun								94.3
05-Jun			89.0					98.5
06-Jun		101.5	91.0					100.3
07-Jun								91.0
08-Jun								96.1
09-Jun								94.6
10-Jun								97.6
11-Jun								
12-Jun								
13-Jun								
14-Jun								100.0
15-Jun								80.0
16-Jun								94.8
17-Jun								96.5

Estimated Chinook Passage

Date	1997	2000	2001	2004	2005
17-May	0	1526	70	0	1467
18-May	0	1421	119	0	959
19-May	0	474		0	2143
20-May	0	684		0	144
21-May	0	263	74	0	257
22-May	0	53	186	0	4376
23-May	0	53		0	1771
24-May	0	53		0	3188
25-May		0		0	1317
26-May		53		17	1110
27-May		53		0	1272
28-May		0		0	294
29-May		0		ns	577
30-May		0		ns	644
31-May		0		ns	608
01-Jun		0		0	1222
02-Jun		0		0	496
03-Jun		0		0	1024
04-Jun		0		0	1078
05-Jun		0		0	599
06-Jun		0		0	525
07-Jun		0		0	113
08-Jun		0		0	505
09-Jun		0		0	275
10-Jun		0			272
11-Jun		0			0
12-Jun		0			0
13-Jun					0
14-Jun					216
15-Jun					53
16-Jun					322
17-Jun					107

Appendix B. Trap efficiency releases conducted at Shiloh and Grayson, 1995-2004.

Release Date	Origin	Mark	Release Time	Number Released	Number Recaptured	% Recaptured	Length at Release (mm)	Length at Recap. (mm)	Flow (cfs) at MOD
GRAYSON									
13-Apr-04	Hatchery	Dorsal fin green	2030	1992	84	4.2%	79	74	1140
20-Apr-04	Hatchery	Anal fin green	2000	1980	48	2.4%	81	79	1660
27-Apr-04	Hatchery	Top caudal green	2020	1941	118	6.1%	86	85	826
04-May-04	Hatchery	Bottom caudal green	2030	2008	50	2.5%	90	87	789
11-May-04	Hatchery	Anal fin green	2040	1972	104	5.3%	86	79	815
18-May-04	Hatchery	Dorsal fin green	2045	1996	178	8.9%	88	77	446
25-May-04	Hatchery	Top caudal green	2045	2013	59	2.9%	92	90	337
10-Apr-03	Hatchery	Top caudal green	NP	1956	138	7.1%	77	NP	294
17-Apr-03	Hatchery	Bottom caudal green	NP	2047	65	3.2%	77	NP	1178
24-Apr-03	Hatchery	Anal fin green	NP	1979	31	1.6%	88	NP	1022
01-May-03	Hatchery	Dorsal fin green	NP	2044	113	5.5%	96	NP	662
08-May-03	Hatchery	Top caudal green	NP	2078	206	9.9%	83	NP	755
15-May-03	Hatchery	Bottom caudal green	NP	1996	125	6.3%	83	NP	598
20-May-03	Hatchery	Anal fin green	NP	1989	60	3.0%	89	NP	491
28-May-03	Hatchery	Dorsal fin green	NP	1950	125	6.4%	94	NP	740
20-Feb-02	Hatchery	Bottom caudal red	NP	2094	444	21.2%	57		280
06-Mar-02	Hatchery	Anal fin red	NP	2331	316	13.6%	68		283
13-Mar-02	Hatchery	Top caudal red	NP	2042	324	15.9%	65		311
20-Mar-02	Hatchery	Dorsal fin red	NP	2105	242	11.5%	68		307
27-Mar-02	Hatchery	Bottom caudal red	NP	2121	147	6.9%	68		307
03-Apr-02	Hatchery	Anal fin red, ad-clip	NP	1962	130	6.6%	76		298
09-Apr-02	Hatchery	Top caudal red, ad-clip	NP	1995	56	2.8%	79		322
17-Apr-02	Hatchery	Dorsal fin red, ad-clip	NP	2048	40	2.0%	84		788
25-Apr-02	Hatchery	Bottom caudal red, ad-clip	NP	2001	22	1.1%	86		1027
01-May-02	Hatchery	Anal fin red, ad-clip	NP	2033	14	0.7%	89		1182
08-May-02	Hatchery	Dorsal fin red, ad-clip	NP	2021	31	1.5%	95		746
15-May-02	Hatchery	Top caudal red, ad-clip	NP	2047	26	1.3%	97		645
22-May-02	Hatchery	Bottom caudal red, ad-clip	NP	2043	10	0.5%	94		403
18-Jan-01	Hatchery	Top caudal blue	NP	1810	120	6.6%	37		496
08-Feb-01	Hatchery	Bottom caudal blue	NP	1980	276	13.9%	47		438
01-Mar-01	Hatchery	Top caudal yellow	NP	2017	57	2.8%	41		2010
14-Mar-01	Hatchery	Bottom caudal yellow	NP	1487	75	5.0%	46		807
21-Mar-01	Hatchery	Bottom caudal blue, Dorsal fin blue, Top caudal yellow	NP	3025	207	6.8%	61		607
28-Mar-01	Hatchery	Anal fin blue	NP	1954	219	11.2%	51		602
11-Apr-01	Hatchery	Bottom caudal yellow, ad-clip	NP	2021	141	7.0%	66		621
18-Apr-01	Hatchery	Top caudal blue, ad-clip	NP	2060	95	4.6%	68		566
25-Apr-01	Hatchery	Dorsal fin yellow, Bottom caudal blue, Dorsal fin blue, ad-clip	NP	1515	34	2.2%	71		853
02-May-01	Hatchery	Anal fin blue, ad-clip	NP	3053	163	5.3%	72		1507
09-May-01	Hatchery	Bottom caudal yellow,	NP	3002	147	4.9%	75		1192

Release Date	Origin	Mark	Release Time	Number Released	Number Recaptured	% Recaptured	Length at Release (mm)	Length at Recap. (mm)	Flow (cfs) at MOD
		ad-clip							
16-May-01	Hatchery	Top caudal blue, ad-clip	NP	2942	93	3.2%	76		1078
01-Mar-00	Hatchery	Top caudal blue	NP	1964	30	1.5%	56	53	4506
16-Mar-00	Hatchery	Bottom caudal blue	NP	1548	22	1.4%	56	56	5912
23-Mar-00	Hatchery	Anal fin blue	NP	1913	55	2.9%	59	60	3151
30-Mar-00	Hatchery	Top caudal blue	NP	1942	60	3.1%	62	63	2772
29-Apr-00	Hatchery	Top caudal blue, ad-clip	NP	1931	22	1.1%	81	82	2027
06-May-00	Hatchery	Bottom caudal blue, ad-clip	NP	1987	41	2.1%	85	85	3057
24-May-00	Hatchery	Top caudal blue, ad-clip	NP	2010	24	1.2%	85	85	1018
11-Mar-99	Hatchery	Anal fin blue	NP	1946	28	1.4%	54	53	4578
24-Mar-99	Hatchery	Bottom caudal blue, ad-clip	NP	1938	67	3.5%	61	61	3091
31-Mar-99	Hatchery	Top caudal blue, ad-clip	NP	1885	73	3.9%	65	64	2167
07-Apr-99	Hatchery	Bottom caudal blue, ad-clip	NP	1949	50	2.6%	68	68	2345
14-Apr-99	Hatchery	Anal fin blue, ad-clip	NP	1953	34	1.7%	73	72	1893
20-Apr-99	Hatchery	Top caudal blue, ad-clip	NP	2007	45	2.2%	73	75	1714
29-Apr-99	Hatchery	Bottom caudal blue, ad-clip	NP	1959	14	0.7%	79	80	3015
04-May-99	Hatchery	Anal fin blue, ad-clip	NP	2008	18	0.9%	83	82	2845
18-May-99	Hatchery	Top caudal blue, ad-clip	NP	2001	29	1.4%	86	84	969
26-May-99	Hatchery	Bottom caudal blue, ad-clip	NP	1984	75	3.8%	96	92	799
SHILOH									
18-Mar-98	Hatchery	Top caudal blue	NP	1956	2	0.1%	57	57	3890
02-Apr-98	Hatchery	Bottom caudal blue	NP	2005	2	0.1%	66	66	6240
08-Apr-98	Hatchery	Anal fin blue	NP	1962	5	0.3%	71	71	5940
15-Apr-98	Hatchery	Bottom caudal red	NP	2000	4	0.2%	77	77	5320
22-Apr-98	Hatchery	Top caudal red	NP	1998	6	0.3%	79	79	4180
29-Apr-98	Hatchery	Anal fin red	NP	1979	1	0.1%	85	85	3630
06-May-98	Hatchery	Bottom caudal red	NP	1955	0	0.0%	89	89	2560
14-May-98	Hatchery	Top caudal red	NP	1975	1	0.1%	88	88	3550
27-May-98	Hatchery	Anal fin red	NP	2000	0	0.0%	95	95	4250
21-Apr-97	Hatchery	Top caudal blue	NP	2149	26	1.2%	63	63	1560
28-Apr-97	Hatchery	Bottom caudal blue	NP	2001	37	1.8%	67	68	2970
05-May-97	Hatchery	Anal fin blue	NP	1995	70	3.5%	66	67	2130
12-May-97	Hatchery	Top caudal blue	NP	1487	21	1.4%	66	67	1470
24-Apr-96	Hatchery	NP	NP	2038	27	1.3%	NP	64	1972
30-Apr-96	Hatchery	NP	NP	2164	39	1.8%	NP	70	2647
08-May-96	Hatchery	NP	NP	2147	21	1.0%	90	76	2566
15-May-96	Hatchery	NP	NP	2105	38	1.8%	80	79	3850
25-Apr-95	Hatchery	NP	NP	1000	4	0.4%	72	78	7113
02-May-95	Hatchery	NP	NP	999	4	0.4%	80	73	5768
11-May-95	Hatchery	NP	NP	1003	1	0.1%	82	77	7735
18-May-95	Hatchery	NP	NP	2000	0	0.0%	85	NP	8164
25-May-95	Hatchery	NP	NP	2000	0	0.0%	89	NP	8845

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District	)	
	)	
and	)	Project No. 2299
	)	
Modesto Irrigation District	)	

2005 LOWER TUOLUMNE RIVER ANNUAL REPORT

<u>Report 2005-6</u>

Coded-wire Tag Summary Update

Prepared by

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EXECUTIVE SUMMARY

Releases of coded-wire-tagged (CWT) fall-run Chinook salmon originating from the San Joaquin Basin, primarily from the Merced River Hatchery, have been made in the San Joaquin River and tributaries since 1978. Beginning in 1986, CWT hatchery smolt releases have been made in mid-April to early-May of most years to study differential survival of smolts released at various river flows and locations.

This report, an update of FERC Reports 1996-13 and 2004-8, summarizes the available recovery data for the 2000-2002 and 2005 basin release groups. The principal focus of this report is the Tuolumne River CWT smolt survival studies, which began in 1986 under the Don Pedro Project FERC fish study program. Relative survival indices for upper and lower Tuolumne release groups are calculated for juvenile and adult recovery locations from various sampling programs. CWT smolt releases in the Tuolumne River resumed in 2005 after last being made in 2002. Updated adult survival indices for expanded ocean harvest for 2000, 2001 and 2002 releases were 0.55, 0.24 and 1.90, respectively, based on 2005 ocean harvest data. Escapement survival indices for 2000 and 2001 releases were 0.53 and 0.16, respectively. Data for three and four-year old salmon spawners returning from the 2002 releases are not yet available. These adult indices so far indicate moderate survival for the 2000 study, low survival for the 2001 study, and high survival for the 2002 study. Juvenile survival indices for the 2005 releases, initially made at a La Grange flow of 4,000 cfs, ranged from .49 to 1.54 for recoveries made at the delta export fish salvage operations and at the Antioch and Chipps Island trawls.

The review of survival estimates from 1986-2005 Tuolumne study releases from up to 7 recovery sources per test found, in general, the survival indices are variable, but trend from relatively low survival with low flows (<700 cfs) to relatively high survival with flood flows (>4,000 cfs); results with medium flows (1,300-3,000 cfs) ranged from low to high, but with a majority of indices in an intermediate range of 0.35-0.75. Some recommendations for further data analyses are included.

CWT releases in the Merced, Stanislaus, and San Joaquin rivers that originated from the Merced River Hatchery are summarized in Table 1 for the 2000-2005 period.

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CODED-WIRE TAG SUMMARY UPDATE

1. INTRODUCTION

This report summarizes data on coded-wire tagged (CWT) hatchery salmon reared by the California Department of Fish and Game (CDFG) at the Merced River Hatchery (MRH) or other San Joaquin basin facilities. Specific focus here is on the results of large Tuolumne River smolt survival study releases. Included are updated release and recovery data for all tag codes used in the basin since 2000 as part of the FERC study program. An independent CWT smolt evaluation was made by CDFG in the Tuolumne River in 2005.

This report updates Federal Energy Regulatory Commission (FERC) Report 1996-13 (TID/MID 1997) which included data available through 1996 and Report 2004-8 (TID/MID 2005) which included data available through 2004. Springtime CWT smolt releases of MRH salmon in the San Joaquin system began in 1986 (brood year 1985) under the Don Pedro Fish Study Program. Since 1998, some CWT salmon were also pan-jet marked and released in smaller groups, often over extended periods and at various locations.

Prior to 1999, CDFG conducted the tagging and releases of hatchery Chinook salmon. Starting in 1999, a private contractor has conducted most of the tagging operation at the Merced River Hatchery. For these studies, a CWT is inserted into the snout of each juvenile salmon. The wire tags are coded by group, usually in lots of about 25,000 tags. The code allows for later determination of the group release date and release location for recovered fish. The tagged fish also have the adipose fin removed to provide an external mark to enable identification of fish containing tags during various sampling efforts. Large CWT releases often include more than one tag code. For most years, an estimate is available of the tag loss, or shed, rate.

Tag recoveries are made from (1) sacrificed adipose-clipped juvenile salmon captured at several inland monitoring locations and (2) heads of adult tagged fish retained from port landings, hatcheries, and carcasses found in spawning run surveys. The tags are dissected from the specimens and decoded by CDFG or the U.S. Fish and Wildlife Service (USFWS). Analyses of the decoded data enable estimates of relative and absolute survival indices and the contribution of the tagged fish to the commercial/sport ocean catch and to spawning runs. The CWT smolt survival index studies were primarily intended to examine relative survival rates of hatchery smolts in specific river reaches at various flows within the San Joaquin River (SJR) system and Sacramento-San Joaquin delta.

The Tuolumne River evaluations of 1996-2002 were conducted for the Tuolumne River Technical Advisory Committee (TRTAC) pursuant to the 1995 Don Pedro Project FERC Settlement Agreement. More data details and discussion of study assumptions and implementation are contained in Baker and Speed (1998), Neillands and Loudermilk (1998), the TRTAC peer review process of December 1998 (Centers for Water and Wildland Resources 1998), and FERC Report 2004-7 which is a detailed review of the results of large Tuolumne River CWT study releases focusing on Mossdale recovery data in the 1987-2002 period.

2. METHODS

2.1 Data Summary Format

Each CWT release group was catalogued by tag code(s) and recoveries were summarized by code and release group. Inland recoveries of juvenile salmon and ocean and inland adult salmon were made at various locations (Table 1). Data were grouped by year and location for the Merced, Tuolumne, Stanislaus, and the lower San Joaquin Rivers (SJR). Juvenile recovery locations include a trawl near Mossdale on the San Joaquin River, the state (SWP) and federal (CVP) fish salvage operations at the two largest delta water export facilities, the USFWS Chipps Island trawl, and the Jersey Point or Antioch trawl operations by Hanson Environmental, Inc. (1997-2005). In addition to these recovery sites, a pushnet was used one year (1987) in the SJR below the Tuolumne confluence and screw traps has been used at Shiloh Road or Grayson River Ranch in the Tuolumne River from 1995-2005 (Figure 1). Survival indices from pushnet and screw traps are presented, but not used in the analyses, as that sampling does not meet study criteria in the few years available. CWT recoveries at screw traps in the Stanislaus and Merced Rivers are not included in this report.

Adult recovery data are from the commercial and sport ocean harvest at various ports. Ocean harvest data were obtained from Pacific States Marine Fisheries Commission (2006) and includes preliminary 2005 data from CDFG, Oregon Department of Fish and Wildlife (ODFW) and other agencies. Inland recoveries of CWT spawners are from escapement surveys and hatchery return data from CDFG (1986-2003) and are limited to the San Joaquin tributaries and other northern CA hatcheries (2001-2002). CDFG has not provided inland adult recovery data from the 2004 runs for the Merced or Tuolumne Rivers. Adult recoveries are presented by age group and inland recoveries listed by river. The inland adult recovery data for 2000-2002 is incomplete for those cohorts. The juvenile recovery data is from CDFG (Region 4) and USFWS (Bay-Delta Office, Stockton). CDFG has not provided data for 2005 Mossdale CWT recoveries.

2.2 Data Analysis

Salmon recovery data were analyzed by comparing recovery numbers of release groups for each recovery location. The release locations were chosen to compare the relative survival of salmon in various reaches of the river system. Upstream and downstream release locations in the San Joaquin tributaries were intended to identify relative survival differences between release sites under certain flow conditions. The San Joaquin River release locations were chosen to provide survival differences of salmon within reaches of that river and in migration routes through the delta.

A survival index of 1.0 indicates no difference in survival of the two groups. Survival index values substantially greater than one may indicate problems of two types: 1) that there is a significant difference between the two release groups, such as disease, stress, behavioral, or physiological factors, and/or 2) the likelihood of recovery from each group differed due to sampling effort, timing, migration rates, or other factors. Survival indices of less than 1.0 may have similar problems that are not readily evident and require careful review to see if study assumptions are met. For example, if fish of either group migrate at different rates or after flows have changed, then data comparability may be compromised. Low recovery numbers (e.g. less than 4 for either group) also lead to highly variable results. The ocean harvest data may represent the most reliable recovery data due to the number of tag recoveries and the extended recovery period, assuming that other study criteria are met. Sampling close to the lower release group can result in greater potential for differential capture probability and spurious data - this problem may occur at Mossdale in some years.

Relative survival index values were calculated for the Tuolumne River releases made in 1986, 1987, 1990, 1994-2002, and 2005 (Table 2). Expanded recoveries that account for sampling effort were used for SWP, CVP, and ocean harvest indices in the analysis. Actual recoveries were used for the Tuolumne River screw trap, and adult inland spawner indices. Mossdale trawl indices are shown for unadjusted and adjusted values. The survival index values were calculated by dividing the number of recoveries from the upper release group by the lower release group, adjusting to account for different numbers in the release groups. Adult recoveries are (1) expanded estimates for fish recovered from the ocean harvest port surveys, and (2) actual carcasses found during basin spawning surveys or hatchery returns; both consist of 1+ to 5- year old salmon. Spawning recovery survival estimate for 2002 will be considered when data on three-year olds from the 2004 run is available. Indices were also averaged for Delta trawls, Delta pump salvage, and “adult” (ocean and spawning) sources.

The original analysis of survival indices was plotted against release flow at La Grange at the time of the upper releases. Because there has often been extended migration and recapture periods, the target release flow did not necessarily represent the flow conditions entirely experienced by the study fish. As a result of the TRTAC review, it was decided to also use an adjusted flow at La Grange (accounting for lag time to Mossdale) that was weighted by the daily recaptures at the Mossdale trawl as a better estimate of the flow conditions encountered by the CWT smolts. Another adjustment was made to the Mossdale trawl survival indices to account for varying daily capture effort (time that trawling was in operation) over the recovery period. Indices for recoveries made at pump salvage facilities, Chipps Island and Antioch/Jersey Point trawls, and ocean harvest are also based on expanded values that are weighted for sample effort. The TRTAC review of Mossdale recovery data determined that 1990, 1994, and 1997 Tuolumne studies should be considered invalid due to failure to meet key study assumptions. Fortunately, those studies were done at low and medium flows similar other study years.

3. RESULTS AND DISCUSSION

3.1 Updated Survival Index Results for Tuolumne River CWT Smolt Releases

2000, 2001, 2002 Adult Survival Indices and 2005 Juvenile Survival Indices

Updated ocean harvest survival indices for 2000, 2001, and 2002 CWT smolt releases were 0.55, 0.24, and 1.90 based on preliminary 2005 expanded ocean harvest data (Table 2). Escapement survival indices for the 2000, 2001, and 2002 releases were 0.53, 0.16, and 0.17 respectively based on data through the 2003 run. The 2002 escapement data is limited to 2-year old salmon at present. Survival indices for adult recoveries from 2000-2002 smolt releases are incomplete at this time.

Juvenile survival indices for recoveries of 2005 CWT smolt releases were .84 for expanded SWP recoveries, .49 for expanded CVP recoveries, 1.54 for Antioch trawl and 1.24 for the Chipps Island trawl recoveries.

3.2 Survival Indices and Tuolumne Flow Analysis

Figure 2 includes all years and indices for all recovery sources that captured 4 or more salmon from either upper or lower release group plotted against unadjusted release flow at La Grange. Figure 3 excludes those years determined to be invalid (1990, 1994, 1997 – FERC Report 2002-4) and has a power trend line R^2 value of 0.3903, using all indices. Figure 4 has the same indices as Figure 3, except has adjusted Mossdale indices, plotted at the adjusted La Grange flows. Figure 4 has a power trend line R^2 value of 0.3921, using all indices. Table 3 includes the values used for Figures 3 and 4.

In general, the survival indices, when examined for all recovery locations, are quite variable, but trend toward higher survival (all indices >0.5) in the four years with high flood release flow conditions (>4,000 cfs as adjusted flow) – results at low flows (500-700 cfs) had all values of less than 0.7. In some cases the indices exceed 1.0 and/or are based on few recoveries. Survival results grouped by general flow categories (using adjusted Mossdale indices and adjusted La Grange flows) are:

Low Flows
There are two valid years in this category (1990 was excluded). Survival indices for 1987 and 2001 at 560-640 cfs show relatively low, but still variable, survival results. The 1987 juvenile survival indices ranged from .11 to .67 and both adult indices were 0.29. The 2001 juvenile survival indices ranged from 0.17 to 0.27 and the incomplete adult survival indices are 0.16-0.24.

Medium Flows
There are four valid years in this category (1994 and 1997 were excluded). Survival indices for 1996, 1999, 2000, and 2002 with adjusted medium flows (1,300-3,000 cfs) show highly variable results, ranging from 0.18-1.90. The adult survival indices were relatively high, ranging from 0.53-1.90, while some of the juvenile-based values were lower.

High Flows
There are four years in this category; there was no Mossdale trawling in 1986. Survival indices for 1986, 1995, 1998, and 2005 with high adjusted flow conditions (4,000-8,200 cfs) ranged from 0.49 to 1.89. These indices indicate relatively high survival with flood management flows, but with variable results.

3.3 Other Data in Table 1

Table 1 includes CWT recovery data from: (1) Merced River smolt releases made between 2000-2005, (2) Stanislaus River smolt releases made in 2000-2003, (3) Lower San Joaquin River/Delta smolt releases made in 2000-2005 which originated from the Merced Hatchery. Data for earlier years were in FERC Reports 1998-5 and 2004-8.

3.4 Summary and Recommendations

Detailed review by the TRTAC resulted in removal of three study years based on a review of Mossdale recovery and other data. That review also resulted in capture effort-adjusted survival indices for Mossdale and some adjustments in the applicable La Grange study flows. In general, when examined for all recovery locations (up to 7 per test), the survival indices are variable, but trend from relatively low survival with low flows (<700 cfs) to relatively high survival with flood flows (>4,000 cfs); results with medium flows (1,300-3,000 cfs) ranged from low to high, but with a majority of indices in an intermediate range of 0.35-0.75. In some cases, indices exceeded 1.0 or are based on relatively few recoveries (Table 2). Complete adult recovery data through the run of 2009 from releases in 2005 will conclude the data resulting from these studies.

Recommendations are:

- Recovery data from delta sampling sites other than Mossdale should be reviewed to examine the timing pattern of recoveries.
- Consider analyzing individual tag code recoveries to examine variation in the results forming the basis of the entire release group survival index.
- Absolute survival to adult, accounting for harvest, could be estimated for release groups. This could require inland adult recovery data that accounts for sampling effort for each tributary.
- Consider if adjustment for the difference in distance between release groups is warranted, since the downstream release locations have varied over 15.5 river miles.
- Consider use of multivariate methods to analyze the indices and determine confidence intervals. Some grouping of recovery data (e.g. combined salvage) or other data treatment could be considered.
- Link within-Tuolumne indices to other CWT data in the San Joaquin River and Delta to examine potential combined downstream survival in the inland reach down to Jersey Point in the central Delta.
- Continue comparison of Tuolumne results to those of other San Joaquin tributaries.

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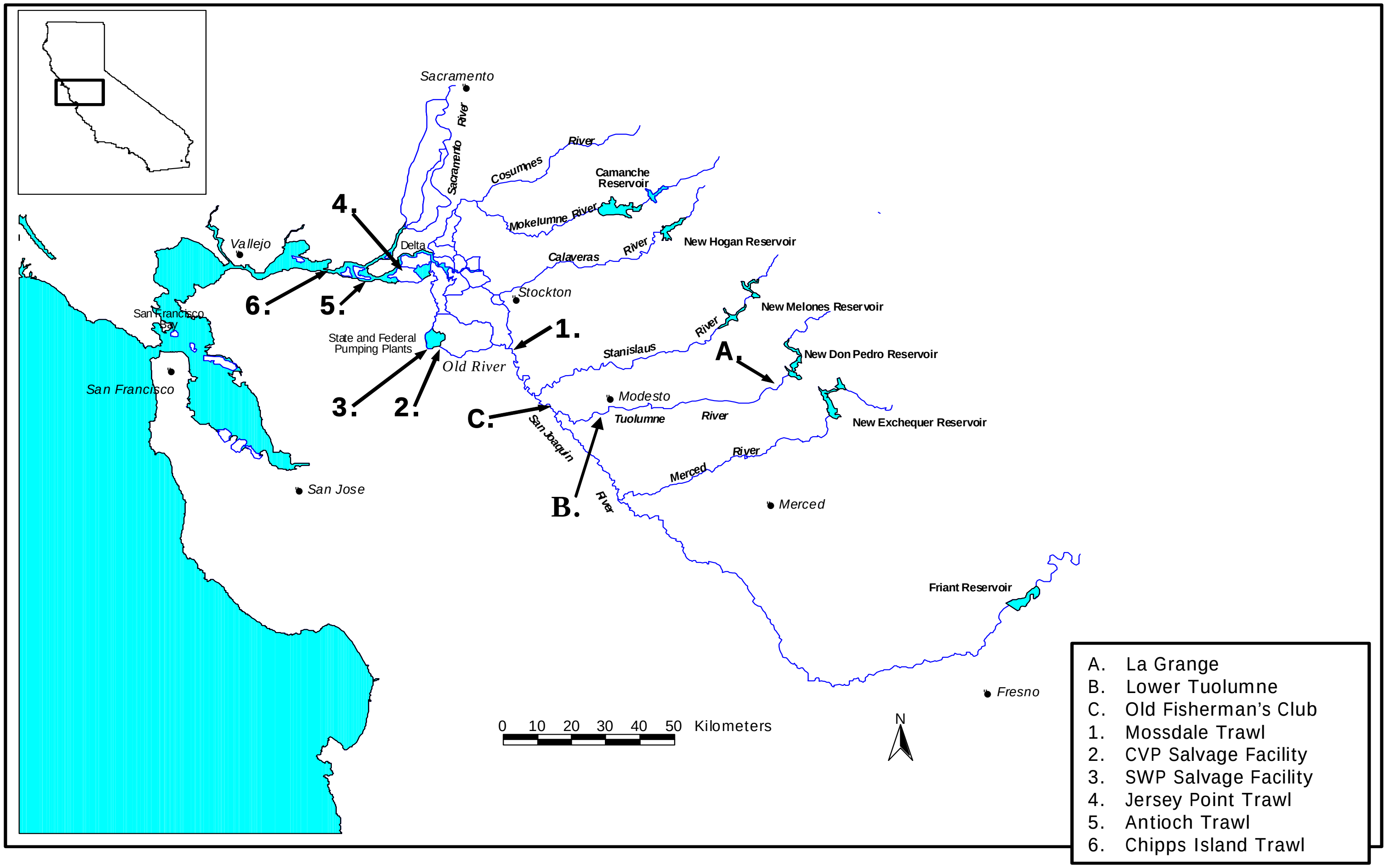

Tuolumne River CWT Release Locations and Smolt Recovery Sites

Figure 1. Tuolumne River CWT release locations and smolt recovery sites

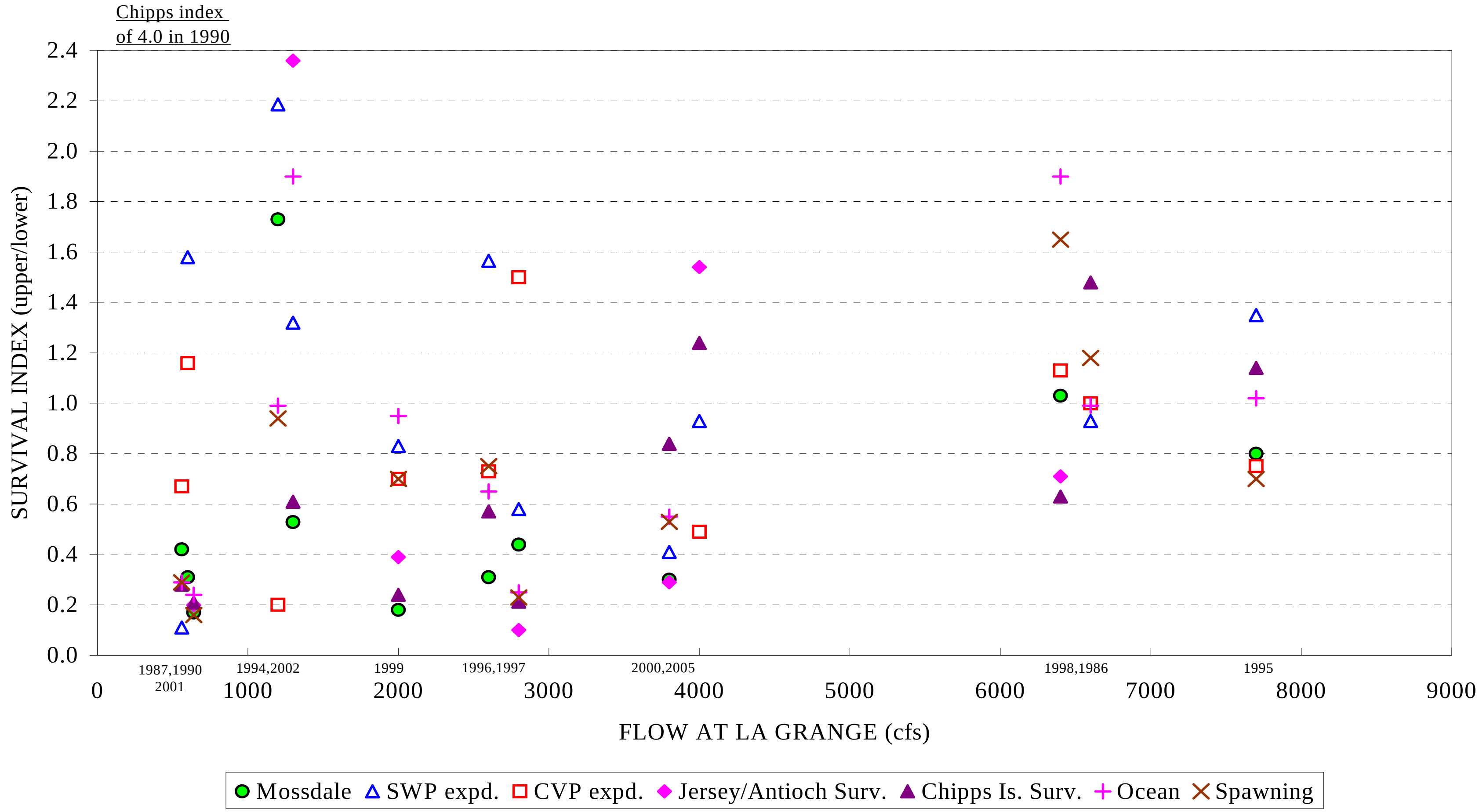

Figure 2. Survival indices (min. 4 recoveries from either release group) of all Tuolumne CWT smolt studies plotted at initial flow.

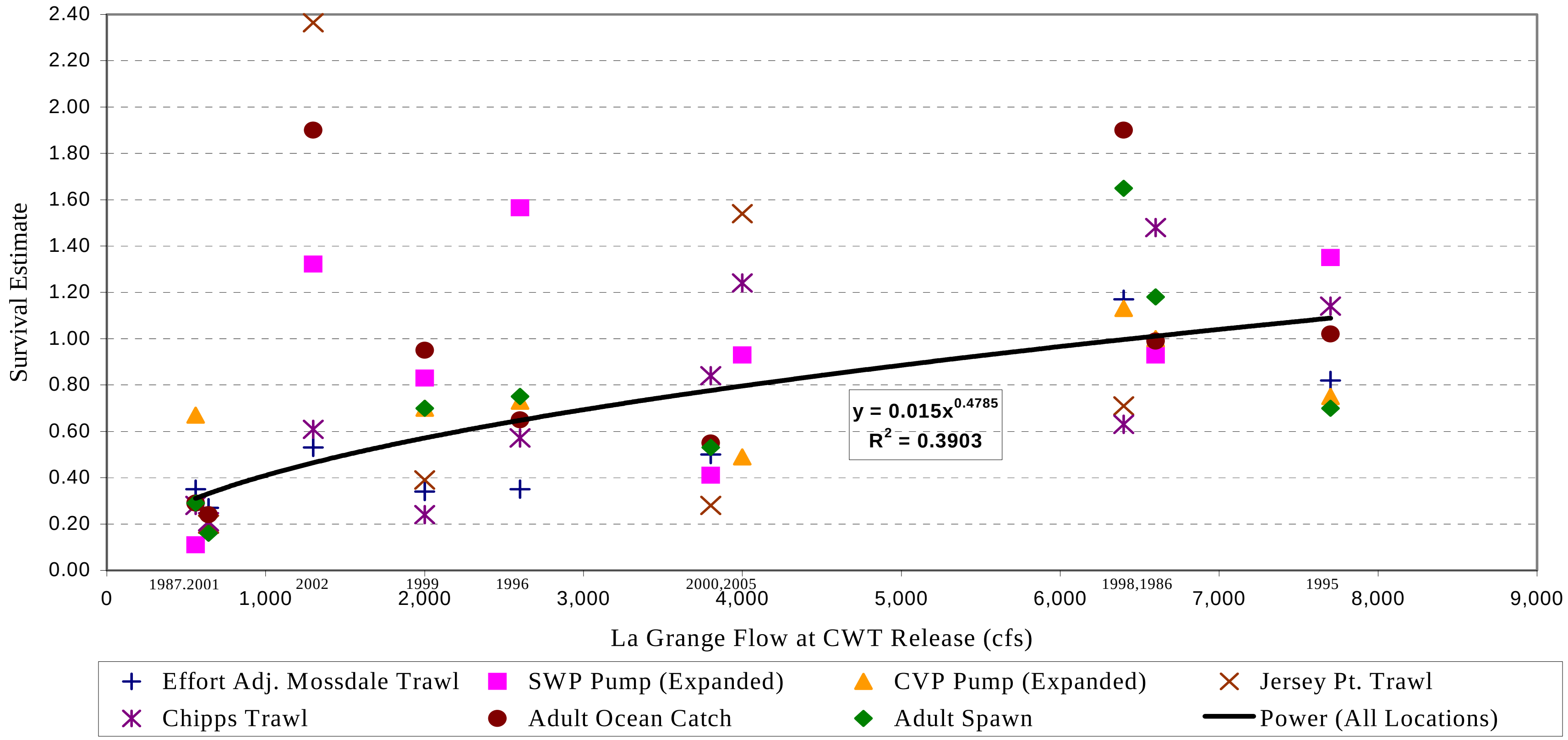

Figure 3. Survival indices (min. 4 recoveries from either release group; using adjusted Mossdale values) of validated Tuolumne CWT smolt studies (excluding 1990, 1994, 1997) plotted at initial flow.

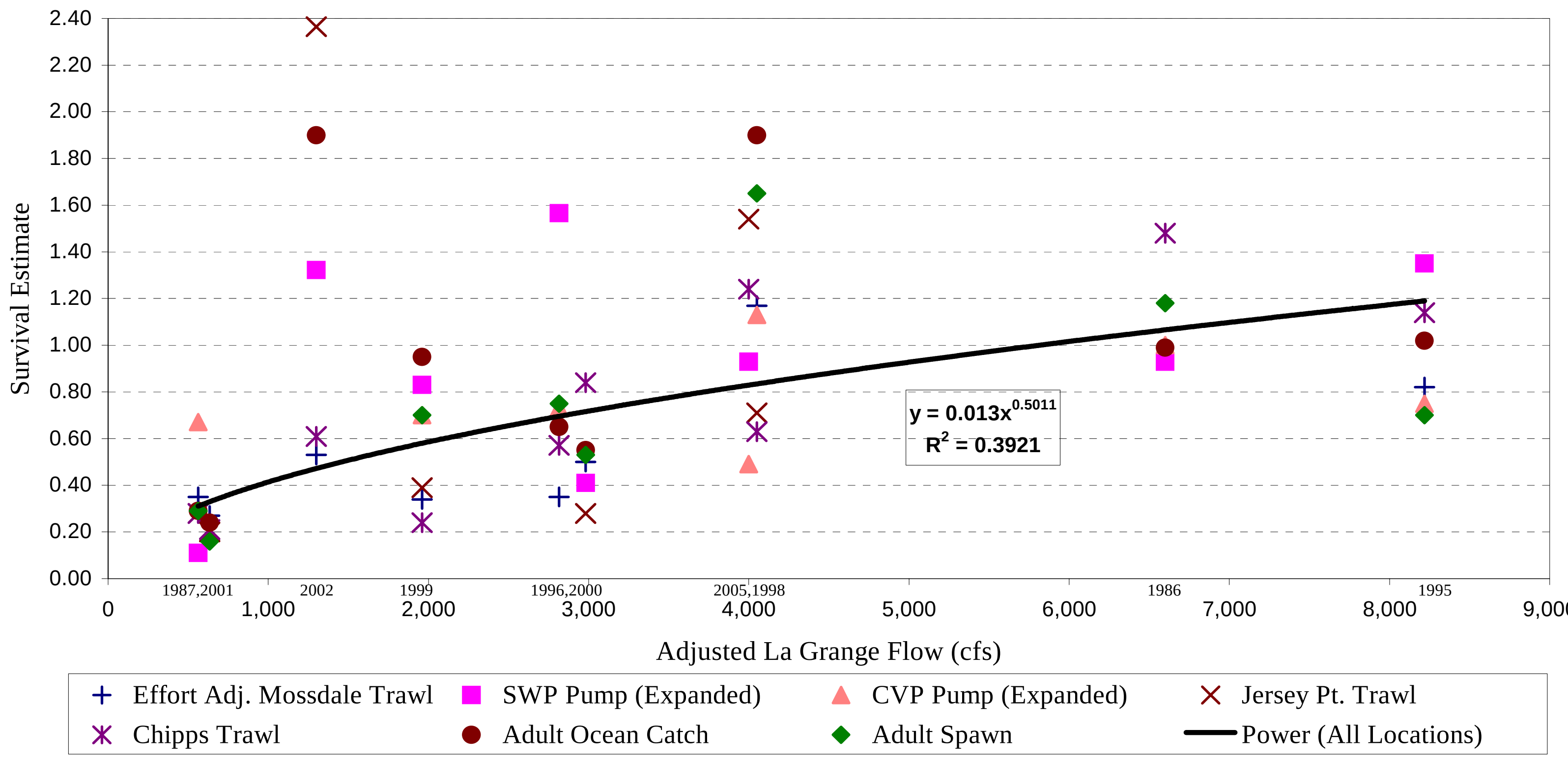

Figure 4. Survival indices (min. 4 recoveries from either release group; using adjusted Mossdale values) of validated Tuolumne CWT smolt studies (excluding 1990, 1994, 1997) plotted at adjusted flow.

Table 1. Tuolumne River CWT (2000-2005)

TUOLUMNE RIVER	JUVENILE SALMON CWT RELEASES					JUVENILE RECOVERIES						ADULT OCEAN RECOVERIES																	
		EFFECTIVE	RELEASE		SMOLTS/							ESTIMATED													ADULT INLAND TOTAL				Age
	TAG NO.	RELEASE	SITE	DATE	YEARLING	SJR PUSH.	MOSSDALE	SWP	CVP	CHIPPS	JERSEY	1+			2+			3+			4+			1+ - 4+	(HATCHERY AND SURVEY)				2 to 5
						/SCREWTRAP					Antioch	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	TOTAL	2	3	4	5	TOTAL
BY99	06-45-56	23603	OLGB	13APR00	SMOLTS		17	13	1	6	5	0	0	0	55	14	69	0	3	3	0	0	0	72	8	26	4		38
	06-45-57	22096	OLGB	15APR00	SMOLTS		15	4	2	1	2	0	14	14	33	32	64	0	3	3	0	0	0	81	5	19	4		28
	06-45-58	26975	OLGB	15APR00	SMOLTS		8	10	0	5	3	0	7	7	28	20	48	9	4	13	0	0	0	68	6	23	2		31
	06-45-59	23071	OFC(SJR)	16APR00	SMOLTS		33	27	1	4	12	0	2	2	101	31	132	5	2	7	0	0	0	141	17	33	3		53
	06-45-60	21698	OFC(SJR)	14APR00	SMOLTS		49	20	1	5	10	0	4	4	70	24	94	3	5	8	0	0	0	106	18	33	9		60
	06-45-61	17936	RF/HUGH.	4/13-5/5	SMOLTS		7	10	2			0	12	12	24	7	31	2	4	6	0	0	0	49	8	15	1		24
	06-45-62	19198	RF/HUGH.	4/13-5/5	SMOLTS		9	6	0			3	0	3	13	11	24	0	0	0	0	0	0	27	7	13	1		21
	06-46-08	11803	GRAYSON	4/16-5/23	SMOLTS		8	1	0			0	3	3	7	3	10	0	0	0	0	0	0	13	1	8	0		9
TOTAL		72674	OLGB			241	40	27	3	12	10	0	21	21	116	66	181	9	10	19	0	0	0	221	19	68	10		97
TOTAL		44769	0FC(SJR)			------	82	47	2	9	22	0	6	6	171	55	226	8	7	15	0	0	0	247	35	66	12		113
BY00	06-44-12	24600	OLGB	22APR01	SMOLTS		38	0	0	2	2			0	7	0	7	0	0	0	0	0	0	7	6	1			7
	06-44-13	22758	OLGB	22APR01	SMOLTS		40	0	1	2	6			0	19	4	23	0	0	0	0	0	0	23	2	0			2
	06-44-14	21527	OLGB	22APR01	SMOLTS		32	0	0	4	10			0	12	3	15	0	0	0	0	0	0	15	1	3			4
	06-44-43	22051	OFC(SJR)	28APR01	SMOLTS		165	0	0	13	35	6	4	10	30	8	38	11	0	11	0	0	0	59	13	14			27
	06-44-44	24393	OFC(SJR)	26APR01	SMOLTS		262	2	1	12	25	0	12	12	40	5	44	5	5	10	0	0	0	66	15	12			27
TOTAL		68885	OLGB			109	110	0	1	8	18	0	0	0	38	7	45	0	0	0	0	0	0	45	9	4			13
TOTAL		46444	0FC(SJR)			------	427	2	1	25	60	6	16	22	70	13	82	16	5	21	0	0	0	125	28	26			54
BY01	06-44-06	24976	OLGB	24APR02	SMOLTS		65	2	1	1	3	0	0	0	19	9	28	4	0	4				32	1				
	06-44-67	24813	OLGB	24APR02	SMOLTS		63	2	0	7	5	0	0	0	16	0	16	2	0	2				18	0				
	06-44-68	25220	OLGB	24APR02	SMOLTS		51	2	1	0	3	0	0	0	21	0	21	0	0	0				21	0				
	06-44-61	25701	OFC(SJR)	26APR02	SMOLTS		116	1	0	6	1	0	0	0	4	10	14	0	0	0				14	1				
	06-44-69	23870	OFC(SJR)	29APR02	SMOLTS		25	2	1	3	2	0	0	0	4	7	11	0	0	0				11	3	1			
	06-44-62	15434	GRAYSON	4/3-5/30	SMOLTS			0	1	1	3	0	0	0	0	5	5	0	0	0				5	0				
TOTAL		75009	OLGB			1008	179	6	2	8	11	0	0	0	56	9	65	6	0	6				71	1				
TOTAL		49571	0FC(SJR)			------	141	3	1	9	3	0	0	0	8	17	25	0	0	0				25	4				
BY04	05-51-36	75696	OLGB	18APR05	SMOLTS			39	29	7	5																		
	05-11-69	47376	OFC(SJR)	20APR05	SMOLTS			29	37	4	2																		
TOTAL		75696	OLGB					39	29	7	5																		
TOTAL		47376	OFC(SJR)					29	37	4	2																		

Table 1. Tuolumne River CWT (2000-2005)

TUOLUMNE RIVER	TAG NO.	INLAND TOTAL BY RIVER Age 2 SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY99	06-45-56							8	
	06-45-57							5	
	06-45-58							6	
	06-45-59							7	10
	06-45-60				1			5	12
	06-45-61							7	1
	06-45-62					1		6	
	06-46-08							1	
TOTAL								19	0
TOTAL								12	22
BY00	06-44-12							6	
	06-44-13							2	
	06-44-14							1	
	06-44-43						2	5	6
	06-44-44							5	10
TOTAL							0	9	0
TOTAL							2	10	16
BY01	06-44-06							1	
	06-44-67								
	06-44-68								
	06-44-61								1
	06-44-69							1	2
	06-44-62								
TOTAL								1	0
TOTAL								1	3
BY04	05-51-36								
	05-11-69								
TOTAL									
TOTAL									

TUOLUMNE RIVER	TAG NO.	INLAND TOTAL BY RIVER Age 3 SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY99	06-45-56			1				22	3
	06-45-57							19	
	06-45-58							20	3
	06-45-59						1	16	16
	06-45-60						2	20	11
	06-45-61							15	
	06-45-62							12	1
	06-46-08							7	1
TOTAL							0	61	6
TOTAL							3	36	27
BY00	06-44-12							1	
	06-44-13								
	06-44-14							3	
	06-44-43						4	5	5
	06-44-44						3	5	4
TOTAL							0	4	0
TOTAL							7	10	9
BY01	06-44-06								
	06-44-67								
	06-44-68								
	06-44-61								
	06-44-69						1		
	06-44-62								
TOTAL									
TOTAL									
BY04	05-51-36								
	05-11-69								
TOTAL									
TOTAL									

TUOLUMNE RIVER	TAG NO.	INLAND TOTAL BY RIVER Age 4 SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	INLAND TOTAL BY RIVER Age 5 SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY99	06-45-56							4									
	06-45-57							4									
	06-45-58							2									
	06-45-59							2	1								
	06-45-60							7	2								
	06-45-61							1									
	06-45-62							1									
	06-46-08																
TOTAL								10	0								
TOTAL								9	3								
BY00	06-44-12																
	06-44-13																
	06-44-14																
	06-44-43																
	06-44-44																
TOTAL																	
TOTAL																	
BY01	06-44-06																
	06-44-67																
	06-44-68																
	06-44-61																
	06-44-69																
	06-44-62																
TOTAL																	
TOTAL																	
BY04	05-51-36																
	05-11-69																
TOTAL																	
TOTAL																	

Table 1. Merced River CWT (2000-2005)

MERCED RIVER		JUVENILE SALMON CWT RELEASES				JUVENILE RECOVERIES						ADULT OCEAN RECOVERIES ESTIMATED													ADULT INLAND TOTAL (HATCHERY AND SURVEY)				Age 2 to 5
	TAG NO.	EFFECTIVE RELEASE	RELEASE SITE	DATE	SMOLTS/ YEARLING	SJR PUSH. /SCREWTRAP	MOSSDALE	SWP	CVP	CHIPPS	JERSEY Antioch	1+ COMM.	SPORT	TOTAL	2+ COMM.	SPORT	TOTAL	3+ COMM.	SPORT	TOTAL	4+ COMM.	SPORT	TOTAL	1+ - 4+ TOTAL	2	3	4	5	TOTAL
BY 1999	06-45-39	25313	MRH	4/12-4/13	SMOLTS		9	5	0	5	2	0	2	2	18	0	18	3	0	3	0	0	0	23	6	15	0		21
	06-45-40	25507	MRH	4/12-4/13	SMOLTS		7	11	0	3	9	0	0	0	6	3	9	13	0	13	0	0	0	22	9	9	1		19
	06-45-41	25318	MRH	4/12-4/13	SMOLTS		14	8	1	4	2	0	0	0	8	0	8	2	0	2	0	0	0	10	9	15	2		26
	06-45-42	25395	MRH	4/12-4/13	SMOLTS		12	10	1	5	2	0	0	0	32	18	50	5	4	9	0	0	0	59	4	19	1		24
	06-45-43	24525	HATFIELD	4/13-4/14	SMOLTS		45	28	1	5	8	7	7	14	58	36	93	8	0	8	0	0	0	115	14	24	0		38
	06-45-44	24490	HATFIELD	4/13-4/14	SMOLTS		51	25	0	6	9	0	0	0	35	13	48	28	4	31	0	0	0	79	15	32	2		49
	06-45-45	24432	HATFIELD	4/13-4/14	SMOLTS		41	29	1	2	8	6	3	9	83	32	114	14	0	14	0	0	0	137	13	29	6		48
TOTAL	UPPER	101533	MRH				42	34	2	17	15	0	2	2	64	21	85	23	4	27				114	28	58	4		90
TOTAL	LOWER	73447	HATFIELD				137	82	2	13	25	13	10	23	176	81	255	50	4	53				331	42	85	8		135
BY 1999	06-45-49	25433	MRH	24APR00	SMOLTS		5	2	0	5	3	0	4	4	31	4	35	0	0	0	2	0	2	41	3	15	5		23
	06-45-50	27042	MRH	24APR00	SMOLTS		10	2	3	6	2	0	8	8	22	0	22	6	0	6	0	0	0	36	9	12	0		21
	06-45-51	24378	MRH	24APR00	SMOLTS		8	6	0	1	8	0	5	5	10	0	10	0	4	4	0	0	0	19	11	15	0		26
	06-45-52	25293	MRH	24APR00	SMOLTS		6	0	1	4	7	0	0	0	17	6	23	3	0	3	0	0	0	26	9	25	2		36
	06-45-53	25794	HATFIELD	27APR00	SMOLTS		24	12	0	5	13	6	0	6	35	7	42	11	4	15	0	0	0	63	17	23	4		44
	06-45-54	26189	HATFIELD	27APR00	SMOLTS		26	20	1	4	5	0	4	4	75	18	93	0	0	0	0	0	0	97	22	36	5		63
	06-45-55	25444	HATFIELD	27APR00	SMOLTS		23	16	2	6	10	0	4	4	30	6	36	0	0	0	0	0	0	40	11	27	5		43
TOTAL	UPPER	102146	MRH				29	10	4	16	20	0	17	17	80	10	90	9	4	13	2	0	2	122	32	67	7		106
TOTAL	LOWER	77427	HATFIELD				73	48	3	15	28	6	8	14	140	31	171	11	4	15	0	0	0	200	50	86	14		150
BY00	06-44-15	25107	MRH	21APR01	SMOLTS		59	0	0	3	3			0	13	0	13	11	0	11	0	0	0	24	5	7			12
	06-44-16	24270	MRH	21APR01	SMOLTS		39	1	0	3	10			0	21	8	29	4	0	4	0	0	0	33	13	7			20
	06-44-17	24537	MRH	21APR01	SMOLTS		48	1	0	1	1	0	9	9	16	0	16	0	2	2	0	0	0	27	7	8			15
	06-44-18	24229	MRH	21APR01	SMOLTS		49	0	0	0	7	0	4	4	8	3	12	0	5	5	0	0	0	21	8	6			14
	06-44-19	24974	HATFIELD	26APR01	SMOLTS		164	3	0	8	11	3	11	14	22	9	32	8	0	8	0	0	0	54	6	4			10
	06-44-20	24989	HATFIELD	26APR01	SMOLTS		154	3	2	6	17	4	8	12	31	9	40	0	0	0	0	0	0	52	6	9			15
	06-44-21	24916	HATFIELD	26APR01	SMOLTS		153	3	0	17	24			0	39	0	39	5	0	5	0	0	0	44	15	19			34
TOTAL	UPPER	98143	MRH				195	2	0	7	21	0	13	13	58	11	70	15	7	22	0	0	0	105	33	28			61
TOTAL	LOWER	74879	HATFIELD				471	9	2	31	52	7	19	26	92	18	111	13	0	13	0	0	0	150	27	32			59
BY00	06-44-22	25311	MRH	08MAY01	SMOLTS		39	0	0	2	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2			2
	06-44-23	24685	MRH	08MAY01	SMOLTS		51	0	0	1	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2			2
	06-44-24	26534	MRH	08MAY01	SMOLTS		36	0	0	1	12	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3			4
	06-44-25	23641	MRH	08MAY01	SMOLTS		57	0	0	0	7	0	0	0	6	0	6	0	0	0	0	0	0	6	0	0			0
	06-44-26	23074	HATFIELD	11MAY01	SMOLTS		138	0	0	1	19	0	0	0	7	4	11	2	0	2	0	0	0	13	0	2			2
	06-44-27	23186	HATFIELD	13MAY01	SMOLTS		122	0	0	1	20	0	0	0	8	0	8	0	0	0	0	0	0	8	1	2			3
	06-44-28	23387	HATFIELD	13MAY01	SMOLTS		116	1	0	4	14	0	0	0	6	0	6	0	0	0	0	0	0	6	0	3			3
TOTAL	UPPER	100171	MRH				183	0	0	4	38	0	0	0	6	0	6	0	0	0	0	0	0	6	1	7			8
TOTAL	LOWER	69647	HATFIELD				376	1	0	6	53	0	0	0	21	4	25	2	0	2	0	0	0	27	1	7			8
BY01	06-44-63	23188	MRH	31MAR02	SMOLTS		2	1	1	1	1	0	0	0	0	0	0	0	0	0				0					
	06-44-64	23915	MRH	31MAR02	SMOLTS		0	0	0	0	0	0	0	0	0	0	0	0	0	0				0					
	06-44-65	23775	MRH	31MAR02	SMOLTS		0	0	0	0	0	0	0	0	0	0	0	0	0	0				0					
	06-44-66	23185	MRH	31MAR02	SMOLTS		2	0	0	0	0	0	0	0	0	0	0	0	0	0				0					
	06-44-51	24380	HATFIELD	4/3-4/5	SMOLTS		118	9	40	2	10	0	0	0	0	0	0	0	0	0				0	4				
	06-44-52	24228	HATFIELD	4/3-4/5	SMOLTS		140	6	41	1	1	0	0	0	11	4	15	1	0	1				16	1				
	06-45-48	24890	HATFIELD	4/3-4/5	SMOLTS		146	9	44	3	3	0	0	0	6	0	6	0	0	0				6	0				
TOTAL	UPPER	94063	MRH				4	1	1	1	1	0	0	0	0	0	0	0	0	0				0					
TOTAL	LOWER	73498	HATFIELD				404	24	125	6	14	0	0	0	17	4	21	1	0	1				22	5				
BY01	06-44-82	22522	MRH	21APR02	SMOLTS		4	0	0	0	0	0	0	0	0	0	0	0	0	0				0					
	06-44-83	23086	MRH	21APR02	SMOLTS		11	0	0	0	1	0	0	0	0	0	0	0	0	0				0					
	06-44-84	23140	MRH	21APR02	SMOLTS		10	0	0	0	0	0	0	0	4	0	4	0	0	0				4					
	06-44-85	22183	MRH	21APR02	SMOLTS		9	0	0	0	0	0	0	0	0	0	0	0	0	0				0					
	06-44-86	23349	HATFIELD	4/26-4/29	SMOLTS		44	1	1	2	2	0	0	0	4	0	4	3	0	3				7	0				
	06-44-87	23363	HATFIELD	4/26-4/29	SMOLTS		50	2	0	0	5	0	1	1	0	4	4	0	0	0				5	1				
	06-44-88	23639	HATFIELD	4/26-4/29	SMOLTS		50	1	0	1	2	0	0	0	0	3	3	0	0	0				3	2				
TOTAL	UPPER	90931	MRH				34	0	0	0	1	0	0	0	4	0	4	0	0	0				4					
TOTAL	LOWER	70351	HATFIELD				144	4	1	3	9	0	1	1	4	7	11	3	0	3				15	3				

Table 1. Merced River CWT (2000-2005)

MERCED RIVER	JUVENILE SALMON CWT RELEASES					JUVENILE RECOVERIES						ADULT OCEAN RECOVERIES ESTIMATED													ADULT INLAND TOTAL (HATCHERY AND SURVEY)				Age 2 to 5
	TAG NO.	EFFECTIVE RELEASE	RELEASE SITE	DATE	SMOLTS/ YEARLING	SJR PUSH. /SCREWTRAP	MOSSDALE	SWP	CVP	CHIPPS	JERSEY Antioch	1+ COMM.	SPORT	TOTAL	2+ COMM.	SPORT	TOTAL	3+ COMM.	SPORT	TOTAL	4+ COMM.	SPORT	TOTAL	1+ - 4+ TOTAL	2	3	4	5	TOTAL
BY02	06-44-89	22677	MRH	13APR03	SMOLTS			1	2	1	3	0	0	0	0	0	0							0					
	06-44-90	22816	MRH	13APR03	SMOLTS			0	0	1	1	0	0	0	4	0	4							4					
	06-44-91	22946	MRH	13APR03	SMOLTS			1	0	0	2	0	3	3	0	0	0							3					
	06-44-92	21725	MRH	13APR03	SMOLTS			1	0	1	0	4	0	4	0	0	0							4					
	06-44-93	23274	HATFIELD	16APR03	SMOLTS			3	1	4	6	0	3	3	0	0	0							3					
	06-44-94	23872	HATFIELD	16APR03	SMOLTS			2	1	1	2	0	5	5	5	0	5							10					
	06-44-95	23833	HATFIELD	16APR03	SMOLTS			0	1	4	4	0	3	3	4	0	4							7					
TOTAL	UPPER	90164	MRH					3	2	3	6	4	3	7	4	0	4							11					
TOTAL	LOWER	70979	HATFIELD					5	3	9	12	0	11	11	9	0	9							20					
BY02	06-44-96	24232	MRH	25APR03	SMOLTS			0	0	0	0	0	0	0	4	0	4							4					
	06-44-97	23869	MRH	25APR03	SMOLTS			0	0	0	0	0	0	0	4	0	4							4					
	06-44-98	23757	MRH	25APR03	SMOLTS			0	0	0	1	0	0	0	0	0	0							0					
	06-44-99	23950	MRH	25APR03	SMOLTS			0	1	0	0	0	0	0	0	0	0							0					
	06-45-64	24545	HATFIELD	29APR03	SMOLTS			0	0	0	0	0	0	0	2	2	4							4					
	06-45-65	24483	HATFIELD	29APR93	SMOLTS			0	0	2	0	0	0	0	2	0	2							2					
	06-45-66	24358	HATFIELD	29APR03	SMOLTS			1	0	0	1	0	0	0	0	0	0							0					
TOTAL	UPPER	95808	MRH					0	1	0	1	0	0	0	8	0	8							8					
TOTAL	LOWER	73386	HATFIELD					1	0	2	1	0	0	0	4	2	6							6					
BY02	06-27-77	23590	MRH	04MAY03	SMOLTS			0	0	1	0	0	0	0	5	2	8							8					
	06-27-78	23862	MRH	04MAY03	SMOLTS			0	1	0	0	0	0	0	0	0	0							0					
	06-44-49	23512	MRH	04MAY03	SMOLTS			0	1	1	1	0	0	0	3	0	3							3					
	06-44-50	24330	MRH	04MAY03	SMOLTS			1	0	2	0	0	4	4	3	0	3							7					
	06-45-46	22603	HATFIELD	07MAY03	SMOLTS			0	0	1	0	0	2	2	9	4	14							16					
	06-45-47	22714	HATFIELD	07MAY03	SMOLTS			0	0	0	2	0	7	7	2	2	4							11					
	06-45-72	22649	HATFIELD	07MAY03	SMOLTS			0	0	2	0	0	3	3	24	0	24							27					
TOTAL	UPPER	95294	MRH					1	2	4	1	0	4	4	11	2	14							18					
TOTAL	LOWER	67966	HATFIELD					0	0	3	2	0	12	12	35	6	42							54					
BY03	06-45-92	23628	SHAFFER	19APR04	SMOLTS		15	0	0	0	0	0	0	0															
	06-45-93	22440	SHAFFER	19APR04	SMOLTS		17	0	0	0	1	0	0	0															
	06-45-94	23489	HATFIELD	20APR04	SMOLTS		101	0	0	1	0	0	0	0															
	06-45-95	23037	HATFIELD	20APR04	SMOLTS		102	1	0	1	0	0	0	0															
TOTAL	UPPER	46068	SHAFFER		CRS 500cfs	0.16	32	0	0	0	1	0	0	0															
TOTAL	LOWER	46526	HATFIELD				203	1	0	2	0	0	0	0															
BY03	06-46-64	25501	SHAFFER	27ARP04	SMOLTS		22	0	0	0	0	0	0	0															
	06-46-65	25489	SHAFFER	27APR04	SMOLTS		32	0	0	1	0	0	0	0															
	06-46-66	24511	HATFIELD	28APR04	SMOLTS		224	0	1	2	0	0	0	0															
	06-46-67	25307	HATFIELD	28APR04	SMOLTS		212	1	2	0	0	0	0	0															
TOTAL	UPPER	50990	SHAFFER		CRS 900cfs	0.12	54	0	0	1	0	0	0	0															
TOTAL	LOWER	49818	HATFIELD				436	1	3	2	0	0	0	0															
BY03	06-45-96	25028	MRFF	09MAY04	SMOLTS		29	0	2	0	0	0	0	0															
	06-45-97	25358	MRFF	09MAY04	SMOLTS		38	0	0	0	0	0	0	0															
	06-46-68	25340	MRFF	09MAY04	SMOLTS		49	1	1	0	0	0	0	0															
	06-46-69	24417	MRFF	09MAY04	SMOLTS		46	0	0	0	0	0	0	0															
	06-45-81	24274	HATFIELD	12-13MAY	SMOLTS		132	2	1	1	0	0	0	0															
	06-45-98	24897	HATFIELD	12-13MAY	SMOLTS		117	0	0	0	0	0	0	0															
	06-45-99	24769	HATFIELD	12-13MAY	SMOLTS		84	2	3	0	0	0	0	0															
TOTAL	UPPER	100143	MRFF		CRS1600cfs	0.36	162	1	3	0	0	0	0	0															
TOTAL	LOWER	73940	HATFIELD				333	4	4	1	0	0	0	0															
BY04	06-46-76	25067	MRFF	17APR05	SMOLTS			7	11	2	0																		
	06-46-77	25141	MRFF	17APR05	SMOLTS			6	19	1	0																		
	06-46-78	24384	MRFF	17APR05	SMOLTS			6	12	0	0																		
	06-46-79	24996	MRFF	17APR05	SMOLTS			6	9	3	0																		
	06-46-80	24278	HATFIELD	19APR05	SMOLTS			7	19	3	0																		
	06-46-81	23647	HATFIELD	19APR05	SMOLTS			5	9	2	1																		
	06-46-82	23733	HATFIELD	19APR05	SMOLTS			5	11	1	0																		
TOTAL	UPPER	99588	MRFF				0	25	51	6	0																		
TOTAL	LOWER	71658	HATFIELD				0	17	39	6	1																		
BY04	06-46-83	25157	MRFF	26APR05	SMOLTS			1	5	0	0																		
	06-46-84	25029	MRFF	26APR05	SMOLTS			8	5	2	0																		
	06-46-85	25107	MRFF	26APR05	SMOLTS			4	1	3	0																		
	06-46-86	24553	MRFF	26APR05	SMOLTS			8	4	0	1																		
	06-46-87	23345	HATFIELD	28APR05	SMOLTS			1	9	1	1																		
	06-46-88	24315	HATFIELD	28APR05	SMOLTS			0	11	4	2																		
	06-46-89	23338	HATFIELD	28APR05	SMOLTS			1	9	3	2																		
TOTAL	UPPER	99846	MRFF				0	21	15	5	1																		
TOTAL	LOWER	70998	HATFIELD				0	2	29	8	5																		
BY04	06-46-92	25029	MRFF	08MAY05	SMOLTS			12	2	1	0																		
	06-46-93	25009	MRFF	08MAY05	SMOLTS			9	5	1	0																		
	06-46-96	25312	MRFF	08MAY05	SMOLTS			16	1	0	0																		
	06-46-90	22868	HATFIELD	11MAY05	SMOLTS			10	7	1	1																		
	06-46-91	22739	HATFIELD	11MAY05	SMOLTS			6	5	0	0																		
TOTAL	UPPER	75350	MRFF				0	37	8	2	0																		
TOTAL	LOWER	45607	HATFIELD				0	16	12	1	1																		

Table 1. Merced River CWT (2000-2005)

MERCED RIVER		INLAND TOTAL BY RIVER								INLAND TOTAL BY RIVER								INLAND TOTAL BY RIVER								INLAND TOTAL BY RIVER							
	TAG NO.	Age 2								Age 3								Age 4								Age 5							
		SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY 1999	06-45-39								6				1				14																
	06-45-40								9	1							9								1								
	06-45-41								9					1			14								2								
	06-45-42								4								19								1								
	06-45-43								14			1		1			22																
	06-45-44								15			1					31								2								
	06-45-45	2							11			1					28							1	5								
TOTAL	UPPER								28	1	0	0	1	1			56							0	4								
TOTAL	LOWER								40	0	0	3	0	1			81							1	7								
BY 1999	06-45-49								3								15								5								
	06-45-50							1	8								12																
	06-45-51								11								15																
	06-45-52								9							1	24								2								
	06-45-53								17				1			3	19								4								
	06-45-54								22								36								5								
	06-45-55								11							1	26								5								
TOTAL	UPPER							1	31							1	66								7								
TOTAL	LOWER							0	50							4	81								14								
BY00	06-44-15								5								7																
	06-44-16			1					12							1	6																
	06-44-17								7								8																
	06-44-18								8								6																
	06-44-19								6								4																
	06-44-20								6								9																
	06-44-21								15								19																
TOTAL	UPPER								32							1	27																
TOTAL	LOWER								27							0	32																
BY00	06-44-22																2																
	06-44-23																2																
	06-44-24								1								3																
	06-44-25																																
	06-44-26																2																
	06-44-27								1								2																
	06-44-28																3																
TOTAL	UPPER								1								7																
TOTAL	LOWER								1								7																
BY01	06-44-63																																
	06-44-64																																
	06-44-65																																
	06-44-66																																
	06-44-51								4																								
	06-44-52								1																								
	06-45-48																																
TOTAL	UPPER																																
TOTAL	LOWER								5																								
BY01	06-44-82																																
	06-44-83																																
	06-44-84																																
	06-44-85																																
	06-44-86																																
	06-44-87								1																								
	06-44-88								2																								
TOTAL	UPPER																																
TOTAL	LOWER								3																								

Table 1. Merced River CWT (2000-2005)

MERCED RIVER	TAG NO.	INLAND TOTAL BY RIVER Age 2								INLAND TOTAL BY RIVER Age 3								INLAND TOTAL BY RIVER Age 4								INLAND TOTAL BY RIVER Age 5							
		SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY02	06-44-89																																
	06-44-90																																
	06-44-91																																
	06-44-92																																
	06-44-93																																
	06-44-94																																
	06-44-95																																
TOTAL	UPPER																																
TOTAL	LOWER																																
BY02	06-44-96																																
	06-44-97																																
	06-44-98																																
	06-44-99																																
	06-45-64																																
	06-45-65																																
	06-45-66																																
TOTAL	UPPER																																
TOTAL	LOWER																																
BY02	06-27-77																																
	06-27-78																																
	06-44-49																																
	06-44-50																																
	06-45-46																																
	06-45-47																																
	06-45-72																																
TOTAL	UPPER																																
TOTAL	LOWER																																
BY03	06-45-92																																
	06-45-93																																
	06-45-94																																
	06-45-95																																
TOTAL	UPPER																																
TOTAL	LOWER																																
BY03	06-46-64																																
	06-46-65																																
	06-46-66																																
	06-46-67																																
TOTAL	UPPER																																
TOTAL	LOWER																																
BY03	06-45-96																																
	06-45-97																																
	06-46-68																																
	06-46-69																																
	06-45-81																																
	06-45-98																																
	06-45-99																																
TOTAL	UPPER																																
TOTAL	LOWER																																
BY04	06-46-76																																
	06-46-77																																
	06-46-78																																
	06-46-79																																
	06-46-80																																
	06-46-81																																
	06-46-82																																
TOTAL	UPPER																																
TOTAL	LOWER																																
BY04	06-46-83																																
	06-46-84																																
	06-46-85																																
	06-46-86																																
	06-46-87																																
	06-46-88																																
	06-46-89																																
TOTAL	UPPER																																
TOTAL	LOWER																																
BY04	06-46-92																																
	06-46-93																																
	06-46-96																																
	06-46-90																																
	06-46-91																																
TOTAL	UPPER																																
TOTAL	LOWER																																

Table 1. Stanislaus River CWT (2000-2003)

STANISLAUS RIVER		JUVENILE SALMON CWT RELEASES				JUVENILE RECOVERIES						ADULT OCEAN RECOVERIES													ADULT INLAND TOTAL				Age
		EFFECTIVE	RELEASE		SMOLTS/							ESTIMATED																	
	TAG NO.	RELEASE	SITE	DATE	YEARLING	SJR PUSH.	MOSSDALE	SWP	CVP	CHIPPS	JERSEY	1+			2+			3+			4+			1+ - 4+	(HATCHERY AND SURVEY)				2 to 5
						/SCREWTRAP					Antioch	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	TOTAL	2	3	4	5	TOTAL
BY 99	06-44-07	25511	KNIGHTS F	19MAY00	SMOLTS		66	18	17	3	0	0	0	0	7	0	7	0	0	0	0	0	0	7		1			1
	06-44-08	25786	KNIGHTS F	18MAY00	SMOLTS		77	21	12	1	0	0	0	0	4	0	4	0	0	0	0	0	0	4		0			0
	06-44-09	26140	KNIGHTS F	18MAY00	SMOLTS		71	17	13	0	0	0	0	0	0	0	0	3	0	3	0	0	0	3		1			1
	06-44-10	25712	TWO RIVERS	20MAY00	SMOLTS		91	52	23	4	0	0	0	0	0	4	4	8	0	8	0	0	0	12		4			4
	06-44-11	24835	TWO RIVERS	20MAY00	SMOLTS		157	32	12	0	0	0	0	0	0	0	0	6	0	6	0	0	0	6		3			3
TOTAL	UPPER	77437					214	56	42	4	0	0	0	0	11	0	11	3	0	3	0	0	0	14		2			2
	LOWER	50547					248	84	35	4	0	0	0	0	0	4	4	14	0	14	0	0	0	18		7			7
BY00	0601110804	24273	KNIGHTS F	22MAY01	SMOLTS		51	0	2	0	0	0	0	0	11	0	11	0	0	0	0	0	0	11					
	0601110805	24225	KNIGHTS F	22MAY01	SMOLTS		69	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
	0601110715	25634	TWO RIVERS	25MAY01	SMOLTS		32			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			1		
TOTAL	UPPER	48498					120	0	4	0	0	0	0	0	11	0	11	0	0	0	0	0	0	11					
	LOWER	25634					32			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
BY01	06-44-46	23745	KNIGHTS F	01MAY02	SMOLTS		76	0	1	2	1	0	0	0	4	0	4	0	0	0				4		1			
	06-44-47	24236	KNIGHTS F	01MAY02	SMOLTS		82	1	0	2	5	0	4	4	4	10	14	0	0	0				18		1			
	06-44-48	24646	TWO RIVERS	04MAY02	SMOLTS		196	0	0	1	3	0	0	0	0	0	0	0	0	0				0	2				
TOTAL	UPPER	47981					158	1	1	4	6	0	4	4	8	10	18	0	0	0				22					
	LOWER	24646					196	0	0	1	3	0	0	0	0	0	0	0	0	0				0	2				
BY 02	06-45-67	25599	KNIGHTS F	25APR03	SMOLTS			0	0	0	1	0	0	0	4	0	4							4	1				
	06-45-68	26226	KNIGHTS F	25APR03	SMOLTS			0	0	1	0	0	0	0	2	0	2							2	1				
	06-45-69	26136	KNIGHTS F	25APR03	SMOLTS			0	0	0	1	0	11	11	5	0	5							16	1				
	06-45-70	26101	TWO RIVERS	27APR03	SMOLTS			0	0	0	1	0	0	0	4	0	4							4					
	06-45-71	26632	TWO RIVERS	28APR03	SMOLTS			0	0	0	3	0	0	0	8	0	8							8					
TOTAL	UPPER	77961						0	0	1	2	0	11	11	11	0	11							22					
	LOWER	52733						0	0	0	4	0	0	0	12	0	12							12					

Table 1. Stanislaus River CWT (2000-2003)

STANISLAUS RIVER		INLAND TOTAL BY RIVER							
	TAG NO.	Age 2							
		SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY 99	06-44-07								
	06-44-08								
	06-44-09								
	06-44-10								
	06-44-11								
TOTAL	UPPER								
	LOWER								
BY00	0601110804								
	0601110805								
	0601110715								
TOTAL	UPPER								
	LOWER								
BY01	06-44-46								
	06-44-47								
	06-44-48							1	1
TOTAL	UPPER								
	LOWER							1	1
BY 02	06-45-67						1		
	06-45-68						1		
	06-45-69						1		
	06-45-70								
	06-45-71								
TOTAL	UPPER								
	LOWER								

STANISLAUS RIVER		INLAND TOTAL BY RIVER							
	TAG NO.	Age 3							
		SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY 99	06-44-07						1		
	06-44-08								
	06-44-09						1		
	06-44-10						2	1	1
	06-44-11							2	1
TOTAL	UPPER								
	LOWER								
BY00	0601110804								
	0601110805								
	0601110715								
TOTAL	UPPER								
	LOWER								
BY01	06-44-46						1		
	06-44-47						1		
	06-44-48								
TOTAL	UPPER								
	LOWER								
BY 02	06-45-67								
	06-45-68								
	06-45-69								
	06-45-70								
	06-45-71								
TOTAL	UPPER								
	LOWER								

STANISLAUS RIVER		INLAND TOTAL BY RIVER							
	TAG NO.	Age 4							
		SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY 99	06-44-07								
	06-44-08								
	06-44-09								
	06-44-10								
	06-44-11								
TOTAL	UPPER								
	LOWER								
BY00	0601110804								
	0601110805								
	0601110715						1		
TOTAL	UPPER								
	LOWER								
BY01	06-44-46								
	06-44-47								
	06-44-48								
TOTAL	UPPER								
	LOWER								
BY 02	06-45-67								
	06-45-68								
	06-45-69								
	06-45-70								
	06-45-71								
TOTAL	UPPER								
	LOWER								

STANISLAUS RIVER		INLAND TOTAL BY RIVER							
	TAG NO.	Age 5							
		SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY 99	06-44-07								
	06-44-08								
	06-44-09								
	06-44-10								
	06-44-11								
TOTAL	UPPER								
	LOWER								
BY00	0601110804								
	0601110805								
	0601110715								
TOTAL	UPPER								
	LOWER								
BY01	06-44-46								
	06-44-47								
	06-44-48								
TOTAL	UPPER								
	LOWER								
BY 02	06-45-67								
	06-45-68								
	06-45-69								
	06-45-70								
	06-45-71								
TOTAL	UPPER								
	LOWER								

Table 1. San Joaquin River CWT (2000-2005)

SAN JOAQUIN RIVER	JUVENILE SALMON CWT RELEASES					JUVENILE RECOVERIES						ADULT OCEAN RECOVERIES													ADULT INLAND TOTAL				Age
		EFFECTIVE	RELEASE		SMOLTS/							ESTIMATED													(HATCHERY AND SURVEY)				2 to 5
	TAG NO.	RELEASE	SITE	DATE	YEARLING	SJR PUSH.	MOSSDALE	SWP	CVP	CHIPPS	JERSEY	1+			2+			3+			4+			1+ - 4+					
						/SCREWTRAP					Antioch	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	COMM.	SPORT	TOTAL	TOTAL	2	3	4	5	TOTAL
BY 99	06-45-63	24457	DFP	17APR00	SMOLTS		20	40	1	11	11	6	4	10	147	78	225	10	0	10	0	0	0	245	19	58	3		80
	06-04-01	23529	DFP	17APR00	SMOLTS		20	33	2	7	6	3	11	14	130	46	176	20	0	20	0	4	4	214	32	50	1		83
	06-04-02	24177	DFP	17APR00	SMOLTS		19	31	2	10	10	2	18	20	148	57	205	1	3	4	0	0	0	229	23	67	2		92
	06-44-01	23465	MOSSDALE	18APR00	SMOLTS		7	41	1	9	14	0	13	13	138	47	185	8	0	8	0	0	0	206	18	67	7		92
	06-44-02	22784	MOSSDALE	18APR00	SMOLTS		10	45	1	9	16	5	4	9	121	28	150	11	4	15	0	0	0	174	13	54	2		69
	06-44-05	23371	MOSSDALE	4/19-5/03	SMOLTS		21	32	1	7	9	4	4	8	87	52	140	7	0	7	0	0	0	155	19	51	6		76
	06-44-03	25527	JERSEY PT	20APR00	SMOLTS			0	0	24	50	12	44	56	399	142	542	39	10	48	0	0	0	646	68	122	5		195
	06-44-04	25824	JERSEY PT	20APR00	SMOLTS			0	0	41	47	10	14	24	455	142	597	73	11	85	0	0	0	706	84	121	5		210
TOTAL		72163	DFP				59	104	5	28	27	11	33	44	425	181	606	31	3	34	0	4	4	688	74	175	6		255
TOTAL		69620	MOSSDALE				38	118	3	25	39	9	21	30	346	127	475	26	4	30	0	0	0	535	50	172	15		237
TOTAL		51351	JERSEY PT				0	0	0	65	97	22	58	80	854	284	1139	112	21	133	0	0	0	1352	152	243	10		405
BY 99	0601060914	23698	DFP	28APR00	SMOLTS		27	15	1	7	8	0	4	4	29	10	39	3	0	3	0	0	0	46	13	21	3		37
	0601060915	26805	DFP	28APR00	SMOLTS		32	19	2	5	15	0	4	4	32	0	32	8	0	8	0	0	0	44	6	23	3		32
	0601110814	23889	DFP	28APR00	SMOLTS		35	12	1	10	8	0	0	0	61	9	70	0	0	0	0	0	0	70	1	16	0		17
	0601061001	25572	JERSEY PT	01MAY00	SMOLTS			1	0	48	76	0	14	14	223	63	286	44	12	56	0	0	0	356	43	60	5		108
	0601061002	24661	JERSEY PT	01MAY00	SMOLTS			1	0	30	76	11	22	33	140	42	182	13	0	13	0	0	0	228	25	36	3		64
TOTAL		74392	DFP				94	46	4	22	31	0	8	8	122	19	141	11	0	11	0	0	0	160	20	60	6		86
TOTAL		50233	JERSEY PT					2	0	78	152	11	36	47	363	105	468	57	12	69	0	0	0	584	68	96	8		172
BY 00	06-44-29	23354	DFP	30APR01	SMOLTS			0	1	14	28	0	4	4	57	12	69	19	3	22	0	0	0	95	15	19	1		35
	06-44-30	22837	DFP	30APR01	SMOLTS			0	2	22	30	3	24	26	99	20	119	12	0	12	0	0	0	157	31	18	1		50
	06-44-31	22491	DFP	30APR01	SMOLTS			0	4	17	18	0	4	4	78	14	92	14	0	14	0	0	0	110	23	16	1		40
	06-44-32	23000	MOSSDALE	01MAY01	SMOLTS			2	2	17	18	4	12	16	84	19	104	3	0	3	0	0	0	123	23	17	1		41
	06-44-33	22177	MOSSDALE	01MAY01	SMOLTS			0	1	14	15	0	0	0	87	19	107	0	0	0	0	0	0	107	26	29	0		55
	06-44-34	24443	JERSEY PT	04MAY01	SMOLTS					50	156	13	38	50	346	41	386	31	0	31	0	0	0	467	64	32	0		96
	06-44-35	24992	JERSEY PT	04MAY01	SMOLTS					61	173	27	45	72	335	101	437	37	9	46	0	0	0	555	78	42	0		120
TOTAL		68682	DFP					0	7	53	76	3	32	34	234	46	280	45	3	48	0	0	0	362	69	53	3		125
TOTAL		45177	MOSSDALE					2	3	31	33	4	12	16	171	38	211	3	0	3	0	0	0	230	49	46	1		96
TOTAL		49435	JERSEY PT							111	329	40	83	122	681	142	823	68	9	77	0	0	0	1022	142	74	0		216
BY 00	06-44-36	24025	DFP	07MAY01	SMOLTS			1	1	2	8	0	5	5	6	3	9	3	0	3	0	0	0	17	3	12	0		15
	06-44-37	24029	DFP	07MAY01	SMOLTS			0	0	5	11	4	4	9	17	11	29	9	0	9	0	0	0	47	3	6	1		10
	06-44-38	24177	DFP	07MAY01	SMOLTS			1	1	2	10	0	4	4	18	6	24	0	0	0	0	0	0	28	1	10	0		11
	06-44-39	23878	MOSSDALE	08MAY01	SMOLTS			0	1	4	8	0	11	11	3	5	8	6	0	6	0	0	0	25	3	2	0		5
	06-44-40	25308	MOSSDALE	08MAY01	SMOLTS			2	1	4	11	0	0	0	21	6	27	0	0	0	0	0	0	27	2	6	0		8
	06-44-41	25909	JERSEY PT	11MAY01	SMOLTS					17	43	0	18	18	171	22	194	28	3	31	0	0	0	243	30	17	2		49
	06-44-42	25465	JERSEY PT	11MAY01	SMOLTS					27	53	9	4	13	253	46	299	23	0	23	0	0	0	335	29	17	0		46
TOTAL		72231	DFP					2	2	9	29	4	13	18	41	20	62	12	0	12	0	0	0	92	7	28	1		36
TOTAL		49186	MOSSDALE					2	2	8	19	0	11	11	24	11	35	6	0	6	0	0	0	52	5	8	0		13
TOTAL		51374	JERSEY PT							44	96	9	22	31	424	68	493	51	3	54	0	0	0	578	59	34	2		95
BY01	06-44-71	23920	DFP	18APR02	SMOLTS			2	1	4	11	0	0	0	21	8	30	0	3	3				33	2	1			3
	06-44-72	25176	DFP	18APR02	SMOLTS			7	5	9	20	0	12	12	61	23	85	0	0	0				97	2	2			4
	06-44-73	23872	DFP	18APR02	SMOLTS			5	0	4	12	0	0	0	41	26	67	7	0	7				74	1	4			5
	06-44-74	24747	DFP	18APR02	SMOLTS			7	2	4	20	0	0	0	52	12	65	3	0	3				68	1	2			3
	06-44-57	25515	MOSSDALE	19APR02	SMOLTS			14	2	6	13	0	0	0	47	28	75	0	0	0				75	0	3			3
	06-44-58	25272	MOSSDALE	19APR02	SMOLTS			7	6	7	29	0	0	0	55	15	70	0	0	0				70	0	1			1
	06-44-59	24802	JERSEY PT	22APR02	SMOLTS					46	101	2	39	41	297	130	428	8	9	17				486	0	0			0
	06-44-60	24128	JERSEY PT	22APR02	SMOLTS					37	89	0	40	40	286	88	375	24	11	34				449	0	0			0
TOTAL		97715	DFP					21	8	21	63	0	12	12	175	69	247	10	3	13				272	6	9			15
TOTAL		50787	MOSSDALE					21	8	13	42	0	0	0	102	43	145	0	0	0				145	0	4			4
TOTAL		48930	JERSEY PT							83	190	2	79	81	583	218	803	32	20	51				935	0	0			0
BY01	06-44-70	24680	DFP	25APR02	SMOLTS			1	3	3	6	0	0	0	16	3	18	0	0	0				18	1	0			1
	06-44-75	24659	DFP	25APR02	SMOLTS			4	0	5	2	0	3	3	16	0	16	3	0	3				22	2	1			3
	06-44-76	24783	DFP	25APR02	SMOLTS			4	2	3	4	0	0	0	5	2	8	0	0	0				8	1	0			1
	06-44-77	24381	DFP	25APR02	SMOLTS			4	2	4	6	0	0	0	4	0	4	2	0	2				6	3	0			3
	06-44-78	24519	MOSSDALE	26APR02	SMOLTS			8	1	2	3	0	2	2	21	0	21	3	0	3				26	5	0			5
	06-44-79	24820	MOSSDALE	26APR02	SMOLTS			3	0	3	4	0	0	0	14	0	14	0	0	0				14	0	0			0
	06-44-80	24032	JERSEY PT	30APR02	SMOLTS					18	43	0	14	14	187	93	280	7	0	7				301	12	0			12
	06-44-81	22880	JERSEY PT	30APR02	SMOLTS					28	32	0	19	19	216	47	263	5	0	5				287	13	1			14
TOTAL		98503	DFP					13	7	15	18	0	3	3	41	5	46	5	0	5				54	7	1			8
TOTAL		49339	MOSSDALE					11	1	5	7	0	2	2	35	0	35	3	0	3				40	5	0			5
TOTAL		46912	JERSEY PT							46	75	0	33	33	403	140	543	12	0	12				588	25	1			26

Table 1. San Joaquin River CWT (2000-2005)

SAN JOAQUIN RIVER	JUVENILE SALMON CWT RELEASES					JUVENILE RECOVERIES						ADULT OCEAN RECOVERIES ESTIMATED													ADULT INLAND TOTAL (HATCHERY AND SURVEY)				Age 2 to 5
	TAG NO.	EFFECTIVE RELEASE	RELEASE SITE	DATE	SMOLTS/ YEARLING	SJR PUSH. /SCREWTRAP	MOSSDALE	SWP	CVP	CHIPPS	JERSEY Antioch	1+ COMM.	1+ SPORT	1+ TOTAL	2+ COMM.	2+ SPORT	2+ TOTAL	3+ COMM.	3+ SPORT	3+ TOTAL	4+ COMM.	4+ SPORT	4+ TOTAL	1+ - 4+ TOTAL	2	3	4	5	TOTAL
BY02	06-02-82	24563	DFP	21APR03	SMOLTS			0	2	0	1	0	5	5	4	0	4							9	1				
	06-02-83	26036	DFP	21APR03	SMOLTS			0	1	2	4	0	0	0	0	0	0							0	0				
	06-27-42	24179	DFP	21APR03	SMOLTS			1	2	1	1	0	8	8	2	0	2							10	0				
	06-27-48	24706	MOSSDALE	22APR03	SMOLTS			0	0	2	2	0	0	0	3	0	3							3	0				
	06-27-43	25480	MOSSDALE	22APR03	SMOLTS			0	0	3	2	0	0	0	3	0	3							3	0				
	06-27-44	24649	JERSEY PT	25APR03	SMOLTS					57	71	0	99	99	113	23	136							235	0				
TOTAL		74778	DFP					1	5	3	6	0	13	13	6	0	6							19	1				
TOTAL		50186	MOSSDALE					0	0	5	4	0	0	0	6	0	6							6	0				
TOTAL		24649	JERSEY PT							57	71	0	99	99	113	23	136							235	0				
BY02	06-27-45	24815	DFP	28APR03	SMOLTS			0	1	0	0	0	0	0	3	3	6							6	0				
	06-27-46	25319	DFP	28APR03	SMOLTS			0	1	0	0	0	0	0	0	0	0							0	1				
	06-27-47	24758	DFP	28APR03	SMOLTS			0	0	0	0	0	0	0	4	0	4							4	1				
	06-27-49	24219	MOSSDALE	29APR03	SMOLTS			0	1	0	0	0	3	3	2	0	2							5	1				
	06-27-50	24505	MOSSDALE	29APR03	SMOLTS			0	0	1	0	0	0	0	0	0	0							0	0				
	06-27-51	25950	JERSEY PT	02MAY03	SMOLTS					39	36	0	124	124	222	50	273							397	0				
TOTAL		74892	DFP					0	2	0	0	0	0	0	7	3	10							10	2				
TOTAL		48724	MOSSDALE					0	1	1	0	0	3	3	2	0	2							5	1				
TOTAL		25950	JERSEY PT							39	36	0	124	124	222	50	273							397	0				
BY03	06-27-52	23440	DFP	22APR04	SMOLTS			1	2	0	1	0	0	0															
	06-27-53	21714	DFP	22APR04	SMOLTS			0	3	1	1	0	0	0															
	06-27-54	23328	DFP	22APR04	SMOLTS			0	2	1	0	0	0	0															
	06-27-55	23783	DFP	22APR04	SMOLTS			1	0	1	0	0	0	0															
	06-46-70	25319	MOSSDALE	23APR04	SMOLTS			0	0	0	1	0	0	0															
	06-45-82	23586	MOSSDALE	23APR04	SMOLTS			0	2	1	0	0	0	0															
	06-45-83	24803	MOSSDALE	23APR04	SMOLTS			1	0	2	0	0	0	0															
	06-45-80	22911	JERSEY PT	26APR04	SMOLTS			0	1	25	22	2	12	14															
TOTAL		92265	DFP					2	7	3	2	0	0	0															
TOTAL		73708	MOSSDALE					1	2	3	1	0	0	0															
TOTAL		22911	JERSEY PT					0	1	25	22	2	12	14															
BY04	06-46-72	23414	DFP	02MAY05	SMOLTS			5	38	5	0																		
	06-46-73	23193	DFP	02MAY05	SMOLTS			2	25	2	2																		
	06-46-74	23660	DFP	02MAY05	SMOLTS			7	37	4	3																		
	06-46-75	23567	DFP	02MAY05	SMOLTS			4	19	1	1																		
	06-46-97	22302	DOS REIS	03MAY05	SMOLTS			1	0	1	1																		
	06-46-98	24149	DOS REIS	03MAY05	SMOLTS			0	0	1	3																		
	06-45-91	22675	DOS REIS	03MAY05	SMOLTS			0	0	1	3																		
	06-45-88	22767	JERSEY PT	06MAY05	SMOLTS			0	0	32	31																		
TOTAL		93834	DFP					18	119	12	6																		
TOTAL		69126	DOS REIS					1	0	3	7																		
TOTAL		22767	JERSEY PT					0	0	32	31																		
BY04	06-45-84	22777	DFP	09MAY05	SMOLTS			19	16	2	1																		
	06-45-85	22968	DFP	09MAY05	SMOLTS			15	6	1	1																		
	06-45-86	23012	DFP	09MAY05	SMOLTS			17	14	3	3																		
	06-45-87	22806	DFP	09MAY05	SMOLTS			9	7	0	2																		
	06-45-89	21443	DOS REIS	10MAY05	SMOLTS			1	0	3	5																		
	06-45-90	23755	DOS REIS	10MAY05	SMOLTS			0	0	2	2																		
	06-46-99	23448	DOS REIS	10MAY05	SMOLTS			0	0	1	0																		
	06-47-00	23231	JERSEY PT	13MAY05	SMOLTS			0	0	38	27																		
TOTAL		91563	DFP					60	43	6	7																		
TOTAL		68646	DOS REIS					1	0	6	7																		
TOTAL		23231	JERSEY PT					0	0	38	27																		

Table 1. San Joaquin River CWT (2000-2005)

SAN JOAQUIN RIVER		INLAND TOTAL BY RIVER								INLAND TOTAL BY RIVER								INLAND TOTAL BY RIVER								INLAND TOTAL BY RIVER							
	TAG NO.	Age 2								Age 3								Age 4								Age 5							
		SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY 99	06-45-63			1			1	6	11			1		1	10	26	20						1	2									
	06-04-01			2			1	9	20	1			1		6	23	20						1										
	06-04-02						1	4	18			1			5	25	36						1	1									
	06-44-01			1		1		4	12					1	9	20	37						4		3								
	06-44-02	1		1			1	3	7			2			3	11	38							1	1								
	06-44-05							5	14	1				2	8	11	30						2	2	2								
	06-44-03			7	3	12	1		45	2		16	6	11	7	8	74						1	1	3								
	06-44-04			11	4	14		5	50	2		15	10	14	3	7	72						1		4								
TOTAL		0		3	0	0	3	19	49	1	0	2	1	1	21	74	76						3	3									
TOTAL		1		2	0	1	1	12	33	1	0	2	0	3	20	42	105						6	3	6								
TOTAL		0		18	7	26	1	5	95	4	0	31	16	25	10	15	146						2	1	7								
BY 99	0601060914							4	9			2		1	3	8	7						1	1	1								
	0601060915						1	2	3					1	4	11	7						1	2									
	0601110814			1											4	5	7																
	0601061001			8	3	3	2	3	24			1	5	5	2	7	40						1	2	2								
	0601061002			3	1	4			17	1	1	5	2	2	2	5	19						1		2								
TOTAL		0	0	1	0	0	1	6	12	0	0	2	0	2	11	24	21						2	3	1								
TOTAL		0	0	11	4	7	2	3	41	1	1	6	7	7	4	12	59						2	2	4								
BY 00	06-44-29			1			2	1	11						10	3	6						1										
	06-44-30			2			5	10	14						9	4	5						1										
	06-44-31			1	1		4	3	14						8	5	3						1										
	06-44-32						5	6	12						6	3	8						1										
	06-44-33			2			2	2	20						12	5	12																
	06-44-34			8	1	6		2	47						5	1	26																
	06-44-35	1		6	5	6	4	4	52						6	3	33																
TOTAL		0	0	4	1	0	11	14	39						27	12	14																
TOTAL		0	0	2	0	0	7	8	32						18	8	20																
TOTAL		1	0	14	6	12	4	6	99						11	4	59																
BY 00	06-44-36								3						3	1	8																
	06-44-37						1	0	2						3	2	1						1										
	06-44-38								1						3	3	4																
	06-44-39							1	2								2																
	06-44-40						1	0	1						3	1	2																
	06-44-41	1		1	1	5	1	0	21						4	1	12						2										
	06-44-42	1		1	2	5	1	2	17						2	1	14																
TOTAL							1	0	6						9	6	13																
TOTAL							1	1	3						3	1	4																
TOTAL		2	0	2	3	10	2	2	38						6	2	26																
BY01	06-44-71						1		1						1																		
	06-44-72							1	1						2																		
	06-44-73								1						4																		
	06-44-74								1						2																		
	06-44-57														3																		
	06-44-58														1																		
	06-44-59																																
	06-44-60																																
TOTAL							1	1	4																								
TOTAL							0	0	0																								
TOTAL							0	0	0																								
BY01	06-44-70							1																									
	06-44-75						1	1							1																		
	06-44-76							1																									
	06-44-77						3																										
	06-44-78						3		2																								
	06-44-79																																
	06-44-80								12																								
	06-44-81						1		12						1																		
TOTAL							4	3	0																								
TOTAL							3	0	2																								
TOTAL							1	0	24																								

Table 1. San Joaquin River CWT (2000-2005)

SAN JOAQUIN RIVER		INLAND TOTAL BY RIVER Age 2								INLAND TOTAL BY RIVER Age 3								INLAND TOTAL BY RIVER Age 4								INLAND TOTAL BY RIVER Age 5							
	TAG NO.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.	SAC.	BATT.	FEATH.	AMER.	MOK.	STAN.	TUOL.	MER.
BY02	06-02-82						1																										
	06-02-83																																
	06-27-42																																
	06-27-48																																
	06-27-43																																
	06-27-44																																
TOTAL																																	
TOTAL																																	
TOTAL																																	
BY02	06-27-45																																
	06-27-46						1																										
	06-27-47						1																										
	06-27-49						1																										
	06-27-50																																
	06-27-51																																
TOTAL																																	
TOTAL																																	
TOTAL																																	
BY03	06-27-52																																
	06-27-53																																
	06-27-54																																
	06-27-55																																
	06-46-70																																
	06-45-82																																
	06-45-83																																
	06-45-80																																
TOTAL																																	
TOTAL																																	
TOTAL																																	
BY04	06-46-72																																
	06-46-73																																
	06-46-74																																
	06-46-75																																
	06-46-97																																
	06-46-98																																
	06-45-91																																
	06-45-88																																
TOTAL																																	
TOTAL																																	
TOTAL																																	
BY04	06-45-84																																
	06-45-85																																
	06-45-86																																
	06-45-87																																
	06-45-89																																
	06-45-90																																
	06-46-99																																
	06-47-00																																
TOTAL																																	
TOTAL																																	
TOTAL																																	

Table 2. Recovery data and survival indices for Tuolumne River CWT smolt survival releases.

RELEASE YEAR	TAG NO.	EFFECT. RELEASE	AVG. FL (mm)	RIVER WT	RELEASE SITE	DATE	SMOLT RECOVERIES PUSHNET/ RS TRAP	MOSS-DALE	SWP PUMPS	EXPAND. SWP	CVP PUMPS	EXPAND. CVP	JERSEY PT. (ANTIOCH)	JERSEY(ANT) SURV.	CHIPPS IS.	CHIPPS SURV.	OCEAN CATCH	OCEAN CATCH EXPD.	SPAWN
1986	06-46-54	49,630			OLGB	14APR86	-	-	131		183		-	-	16		226	976	60
LG FLOW:	06-46-55	49,518			OLGB	14APR86	-	-	135		205		-	-	18		210	929	58
6600 cfs	06-46-56	51,300			MAPES	14APR86	-	-	159		255		-	-	10		219	969	54
w/o HORB	06-46-57	52,174			MAPES	14APR86	-	-	155		238		-	-	10		231	1037	50
TOTAL	UPPER	99,148	81	51	OLGB	RM diff.	-	-	266	6573	388	3312	-	-	34	0.40	436	1905	118
TOTAL	LOWER	103,474	80	51	MAPES	= 50	-	-	314	7351	493	3465	-	-	20	0.27	450	2006	104
1987	06-46-60	29,953			OLGB	16APR87	97	47	20		44		-	-	2		10	32	2
	06-46-61	30,609			OLGB	16APR87	137	47	23		48		-	-	0		6	37	1
LG FLOW:	06-46-62	29,037			OLGB	16APR87	120	34	22		46		-	-	3		7	31	5
560 cfs	06-46-63	30,703			RDP	16APR87	374	109	184		71		-	-	4		25	142	12
w/o HORB	06-45-01	31,869			RDP	16APR87	339	91	213		62		-	-	5		25	141	8
	06-45-02	30,937			RDP	16APR87	353	117	204		79		-	-	8		23	82	9
TOTAL	UPPER	89,599	85	55	OLGB	RM diff.	354	128	65	593	138	1648	-	-	5	0.05	23	100	8
TOTAL	LOWER	93,509	82	64	RDP	= 38	1066	317	601	5685	212	2569	-	-	17	0.18	73	365	29
1990	H601110201	23,494			OLGB	30APR90	-	19	40		23		-	-	1		0	0	0
	H601110202	21,766			OLGB	30APR90	-	12	27		11		-	-	1		0	0	0
LG FLOW:	H601110114	24,134			OLGB	30APR90	-	21	45		25		-	-	1		2	12	0
600 cfs	H601110115	24,259			OLGB	30APR90	-	11	34		18		-	-	1		1	5	0
w/o HORB	H601110203	27,263			MAPES	01MAY90	-	47	29		26		-	-	1		1	1	0
	H601110204	26,067			MAPES	01MAY90	-	47	21		21		-	-	0		1	17	0
	H601110205	24,905			MAPES	01MAY90	-	75	2		27		-	-	0		0	0	0
TOTAL	UPPER	93,653	83	52	OLGB	RM diff.	-	63	146	878	77	440	-	-	4	0.04	3	17	0
TOTAL	LOWER	78,235	72	66	MAPES	= 50	-	169	52	463	74	316	-	-	1	0.01	2	18	0
1994	0601110302	27,803			OLGB	23APR94	-	85	2	7	1	12	-	-	2		24	86	39
LG FLOW:	0601110303	27,803			OLGB	23APR94	-	62	2	40	1	12	-	-	1		23	86	44
1200 cfs	0601110304	27,802			OLGB	23APR94	-	60	2	4	0	0	-	-	0		24	81	31
w/ HORB	0601110305	25,029			MAPES	24APR94	-	47	0	0	3	48	-	-	1		28	110	46
	0601110306	25,029			MAPES	24APR94	-	25	2	14	2	24	-	-	1		15	43	27
TOTAL	UPPER	83,408	85	51	OLGB	RM diff.	-	207	6	51	2	24	-	-	3	0.03	71	253	114
TOTAL	LOWER	50,058	82	62	MAPES	= 50	-	72	2	14	5	72	-	-	2	0.04	43	153	73
1995	H61110311	29,989			OLGB	04MAY95		22	28	474	48	510	-	-	8		87	290	50
LG FLOW:	H61110312	28,988			OLGB	04MAY95		16	13	177	43	461	-	-	5		96	337	59
7700 cfs	H61110313	30,287			OLGB	04MAY95		20	17	277	55	572	-	-	8		108	373	54
w/o HORB	H61110314	27,770			SERVICE	05MAY95		23	19	236	57	607	-	-	5		91	315	67
	H61110315	29,139			SERVICE	05MAY95		23	19	203	67	707	-	-	7		96	310	82
TOTAL	UPPER	83,549	86	48	OLGB	RM diff.	11	58	58	928	146	1543	-	-	21	0.25	291	1000	163
TOTAL	LOWER	53,298	89	51	SERV.RD	= 41.5	11	46	38	439	124	1314	-	-	12	0.22	187	625	149
1996	H61110506	21,501			OLGB	26APR96		25	2	18	14	192	-	-	0		1	3	2
LG FLOW:	H61110507	22,761			OLGB	26APR96		16	2	8	7	84	-	-	2		2	9	2
2600 cfs	H61110508	22,893			OLGB	26APR96		23	4	24	11	132	-	-	1		3	8	5
w/o HORB	H61110509	22,715			SERVICE	27APR96		67	2	24	13	180	-	-	1		3	10	4
	H61110510	27,745			SERVICE	27APR96		89	2	0	17	240	-	-	3		4	13	5
TOTAL	UPPER	67,155	88	49	OLGB	RM diff.	222	64	8	50	32	408	-	-	3	0.04	6	20	9
TOTAL	LOWER	50,460	90	57	SERVICE	= 41.5	133	156	4	24	30	420	-	-	4	0.07	7	23	9
1997	H61110607	35,004			OLGB	22APR97	4	8	1	12	7	84	1		1		3	6	18
	H61110608	33,695			OLGB	22APR97	5	12	3	16	16	204	2		0		7	29	11
LG FLOW:	H61110609	27,622			OLGB	22APR97	4	10	1	8	8	96	3		1		8	30	7
2800 cfs	H61110610	8,882			OLGB	22APR97	0	2	0	0	1	12	0		1		1	3	2
w/ HORB	H61110604	31,739			SERVICE	23APR97	52	14	4	28	4	48	19		6		25	83	55
	H61110605	32,297			SERVICE	23APR97	66	22	3	14	6	72	13		2		21	84	46
	H61110606	27,075			SERVICE	23APR97	43	20	2	6	7	84	7		4		11	46	26
TOTAL	UPPER	93,501	71	48	OLGB	RM diff.	13	32	5	36	32	396	6	0.01	3	0.04	19	68	38
TOTAL	LOWER	72,464	75	56	SERVICE	= 41.5	161	56	9	48	17	204	39	0.11	12	0.17	57	213	127

Table 2. Recovery data and survival indices for Tuolumne River CWT smolt survival releases.

Tuolumne River RELEASE YEAR	TAG NO.	EFFECT. RELEASE	AVG. FL (mm)	RIVER WT	RELEASE SITE	DATE	SMOLT RECOVERIES PUSHNET/ RS TRAP	MOSS- DALE	SWP PUMPS	EXPAND. SWP	CVP PUMPS	EXPAND. CVP	JERSEY PT. (ANTIOCH)	JERSEY(ANT) SURV.	CHIPPS IS.	CHIPPS SURV.	OCEAN CATCH	OCEAN CATCH EXPD.	SPAWN
1998	61110703	32787			OLGB	15APR98		51	1	6	26	284	26	0.14	25	0.42	31	94	22
	61110704	26633			OLGB	15APR98		40	0	0	22	280	4	0.03	5	0.09	24	75	21
LG FLOW:	61110705	27404			OLGB	15APR98		30	1	6	25	312	8	0.05	19	0.36	32	104	27
6400 cfs	61110706	7234			OLGB	15APR98		9	2	22	7	84	0	0.00	2	0.13	14	45	8
w/o HORB	61110707	25754			OFC(SJR)	16APR98		34	0	0	17	212	13	0.09	17	0.35	12	44	10
	61110708	22006			OFC(SJR)	17APR98		30	0	0	18	220	5	0.05	19	0.45	11	41	14
TOTAL	UPPER	94058	83	51	OLGB	RM diff.		130	4	34	80	960	38	0.05	51	0.25	101	318	78
TOTAL	LOWER	47760	86	59	OFC(SJR)	= 53.5		64	0	0	35	432	18	0.07	36	0.40	23	85	24
1999	06-46-01	25534			OLGB	17APR99		10	56	355	41	339	6	0.05	3	0.07	23	84	26
	06-46-02	25679			OLGB	18APR99		17	67	475	58	542	6	0.05	2	0.05	28	91	36
LG FLOW:	06-46-03	25008			OLGB	19APR99		18	61	390	62	538	3	0.03	2	0.05	29	88	35
2000 cfs	06-46-04	25121			OFC(SJR)	18APR99		49	78	426	83	883	11	0.10	11	0.27	30	92	49
w/o HORB	06-46-05	25836			OFC(SJR)	19APR99		115	94	559	52	466	15	0.12	9	0.21	31	93	43
TOTAL	UPPER	76221	86		OLGB	RM diff.	202	45	184	1220	161	1419	15	0.04	7	0.06	80	263	97
TOTAL	LOWER	50957	85		OFC(SJR)	= 53.5		164	172	985	135	1349	26	0.11	20	0.24	61	185	92
2000	06-45-56	23603			OLGB	13APR00		17	13	59	1	12	5	0.05	6	0.13	23	72	38
	06-45-57	22096			OLGB	15APR00		15	4	22	2	24	2	0.02	1	0.02	24	81	28
LG FLOW:	06-45-58	26975			OLGB	15APR00		8	10	59	0	0	3	0.03	5	0.11	22	68	31
3800 cfs	06-45-59	23071			OFC(SJR)	16APR00		33	27	116	1	12	12	0.12	4	0.09	44	141	53
w/ HORB	06-45-60	21698			OFC(SJR)	14APR00		49	20	95	1	12	10	0.10	5	0.12	35	106	60
TOTAL	UPPER	72674	74		OLGB	RM diff.	241	40	27	140	3	36	10	0.03	12	0.09	69	221	97
TOTAL	LOWER	44769	74		OFC(SJR)	= 53.5		82	47	211	2	24	22	0.11	9	0.10	79	247	113
2001	06-44-12	24600			OLGB	22APR01		38	0	0	0	0	2	0.02	2	0.04	2	7	7
	06-44-13	22758			OLGB	22APR01		40	0	0	1	12	6	0.05	2	0.04	4	23	2
LG FLOW:	06-44-14	21527			OLGB	22APR01		32	0	0	0	0	10	0.09	4	0.09	5	15	4
620 cfs	06-44-43	22051			OFC(SJR)	28APR01		165	0	0	0	0	35	0.30	13	0.28	17	58	27
w/ HORB	06-44-44	24393			OFC(SJR)	26APR01		262	2	12	1	12	25	0.19	12	0.23	18	66	27
TOTAL	UPPER	68885	82	52	OLGB	RM diff.	109	110	0	0	1	12	18	0.05	8	0.06	11	45	13
TOTAL	LOWER	46444	84	68	OFC(SJR)	= 53.5		427	2	12	1	12	60	0.25	25	0.26	35	124	54
2002	06-44-06	24976			OLGB	24APR02		65	2	12	1	12	3	0.020	1	0.020	10	33	1
	06-44-67	24813			OLGB	24APR02		63	2	12	0	0	5	0.037	7	0.141	5	18	0
LG FLOW:	06-44-68	25220			OLGB	24APR02		51	2	18	1	12	3	0.023	0	--	6	21	0
1300 cfs	06-44-61	25701			OFC(SJR)	26APR02		116	1	6	0	0	1	0.007	6	0.111	4	14	1
w/ HORB	06-44-69	23870			OFC(SJR)	29APR02		25	2	15	1	12	2	0.015	3	0.063	3	11	3
TOTAL	UPPER	75009	86	54	OLGB	RM diff.	1008	179	6	42	2	24	11	0.026	8	0.053	21	72	1
TOTAL	LOWER	49571	86	62	OFC(SJR)	= 53.5		141	3	21	1	12	3	0.011	9	0.087	7	25	4
2005	05-51-36	75696			OLGB	18APR05			39	210	29	349	5	0.013	7	0.047			
~4000 cfs	05-11-69	47376			OFC(SJR)	20APR05			29	141	37	444	2	0.008	4	0.038			
TOTAL	UPPER	75696			OLGB	RM diff.			39	210	29	349	5	0.013	7	0.047			
TOTAL	LOWER	47376			OFC(SJR)	= 53.5			29	141	37	444	2	0.008	4	0.038			

Notes:

1990 groups had different origin, rearing conditions, and sizes

1994 lower release occurred prior to pulse

1996 recoveries at Shiloh and Mossdale are considered to be invalid; also a high tag loss rate

1997 fish sizes were small; also a high tag loss rate

River mile differences range from 38 to 53.5 miles

2002 Mossdale survival indices were calculated using tagcode 06-44-61 only, for the lower release group.

Table 2. Recovery data and survival indices for Tuolumne River CWT smolt survival releases.

Tuolumne River RELEASE YEAR	TAG NO.	SMOLT SURVIVAL INDEX (Upper / Lower; corrected for release group number) PUSHNET/ RS TRAP	MOSS-DALE	SWP PUMPS	SWP EXPD.	CVP PUMPS	CVP EXPD.	JERSEY PT. (ANTIOCH)	JP(ANT) SURV.	CHIPPS IS.	CHIPPS SURV.	OCEAN CATCH	OCEAN CATCH EXPD.	SPAWN
1986	06-46-54													
LG FLOW:	06-46-55													
6600 cfs	06-46-56													
w/o HORB	06-46-57													
TOTAL	UPPER	NA	NA	0.88	0.93	0.82	1.00	NA		1.77	1.48	1.01	0.99	1.18
TOTAL	LOWER													
1987	06-46-60													
	06-46-61													
LG FLOW:	06-46-62													
560 cfs	06-46-63													
w/o HORB	06-45-01													
	06-45-02													
TOTAL	UPPER	0.35	0.42	0.11	0.11	0.68	0.67	NA		0.31	0.28	0.33	0.29	0.29
TOTAL	LOWER													
1990	H601110201													
	H601110202													
LG FLOW:	H601110114													
600 cfs	H601110115													
w/o HORB	H601110203													
	H601110204													
	H601110205													
TOTAL	UPPER	NA	0.31	2.35	1.58	0.87	1.16	NA		3.34	4.00	1.25	0.79	NO
TOTAL	LOWER													RECOVS.
1994	0601110302													
LG FLOW:	0601110303													
1200 cfs	0601110304													
w/ HORB	0601110305													
	0601110306													
TOTAL	UPPER	NA	1.73	1.80	2.19	0.24	0.20	NA		0.90	0.89	0.99	0.99	0.94
TOTAL	LOWER													
1995	H61110311													
LG FLOW:	H61110312													
7700 cfs	H61110313													
w/o HORB	H61110314													
	H61110315													
TOTAL	UPPER	0.64	0.80	0.97	1.35	0.75	0.75	NA		1.12	1.14	0.99	1.02	0.70
TOTAL	LOWER													
1996	H61110506													
LG FLOW:	H61110507													
2600 cfs	H61110508													
w/o HORB	H61110509													
	H61110510													
TOTAL	UPPER	1.25	0.31	1.50	1.57	0.80	0.73	NA		0.56	0.57	0.64	0.65	0.75
TOTAL	LOWER													
1997	H61110607													
	H61110608													
LG FLOW:	H61110609													
2800 cfs	H61110610													
w/ HORB	H61110604													
	H61110605													
	H61110606													
TOTAL	UPPER	0.06	0.44	0.43	0.58	1.46	1.50	0.12	0.10	0.19	0.21	0.26	0.25	0.23
TOTAL	LOWER													

Table 2. Recovery data and survival indices for Tuolumne River CWT smolt survival releases.

Tuolumne River RELEASE YEAR	TAG NO.	SMOLT SURVIVAL INDEX (Upper / Lower; corrected for release group number) PUSHNET/ RS TRAP	MOSS-DALE	SWP PUMPS	SWP EXPD.	CVP PUMPS	CVP EXPD.	JERSEY PT. (ANTIOCH)	JP(ANT) SURV.	CHIPPS IS.	CHIPPS SURV.	OCEAN CATCH	OCEAN CATCH EXPD.	SPAWN
1998	61110703													
	61110704													
LG FLOW:	61110705													
6400 cfs	61110706													
w/o HORB	61110707													
	61110708													
TOTAL	UPPER		1.03			1.16	1.13	1.07	0.71	0.72	0.63	2.23	1.90	1.65
TOTAL	LOWER													
1999	06-46-01													
	06-46-02													
LG FLOW:	06-46-03													
2000 cfs	06-46-04													
w/o HORB	06-46-05													
TOTAL	UPPER		0.18	0.72	0.83	0.80	0.70	0.39	0.39	0.23	0.24	0.88	0.95	0.70
TOTAL	LOWER													
2000	06-45-56													
	06-45-57													
LG FLOW:	06-45-58													
3800 cfs	06-45-59													
w/ HORB	06-45-60													
TOTAL	UPPER		0.30	0.35	0.41	0.92	0.92	0.28	0.29	0.82	0.84	0.54	0.55	0.53
TOTAL	LOWER													
2001	06-44-12													
	06-44-13													
LG FLOW:	06-44-14													
620 cfs	06-44-43													
w/ HORB	06-44-44													
TOTAL	UPPER		0.17			0.67	0.67	0.20	0.20	0.22	0.21	0.21	0.24	0.16
TOTAL	LOWER													
2002	06-44-06													
	06-44-67													
LG FLOW:	06-44-68													
1300 cfs	06-44-61													
w/ HORB	06-44-69													
TOTAL	UPPER		0.53	1.32	1.32	1.32	1.32	2.42	2.36	0.59	0.61	1.98	1.90	0.17
TOTAL	LOWER													
2005	05-51-36													
~4000 cfs	05-11-69													
TOTAL	UPPER			0.84	0.93	0.49	0.49	1.56	1.54	1.10	1.24			
TOTAL	LOWER													

Table 3. Tuolumne Smolt Survival Index -- min. of 4 recoveries in one release group and excluding 1990, 1994, and 1997

RELEASE YEAR	LG FLOW (cfs)	ADJUSTED LG FLOW	Trawl MOSS-DALE	Adjusted MOSS-DALE	"pump" SWP EXPD.	"pump" CVP EXPD.	Trawl JERSEY PT. ANTIOCH	Trawl CHIPPS	"adult" OCEAN CATCH	"adult" SPAWN	Averages: Trawl average	Adj. Trawl	Pump average	Adult average	Avg. of all using adj. Mossdale
1986	6,600	6,600			0.93	1.00		1.48	0.99	1.18	1.48	1.48	0.97	1.09	1.12
1987	560	563	0.42	0.35	0.11	0.67		0.28	0.29	0.29	0.35	0.32	0.39	0.29	0.33
1995	7,700	8,217	0.80	0.82	1.35	0.75		1.14	1.02	0.70	0.97	0.98	1.05	0.86	0.96
1996	2,600	2,816	0.31	0.35	1.57	0.73		0.57	0.65	0.75	0.44	0.46	1.15	0.70	0.77
1998	6,400	4,050	1.03	1.17		1.13	0.71	0.63	1.90	1.65	0.79	0.84	1.13	1.78	1.20
1999	2,000	1,960	0.18	0.34	0.83	0.70	0.39	0.24	0.95	0.70	0.27	0.32	0.77	0.83	0.59
2000	3,800	2,982	0.30	0.50	0.41		0.28	0.84	0.55	0.53	0.47	0.54	0.41	0.54	0.52
2001	640	634	0.17	0.27			0.20	0.21	0.24	0.16	0.19	0.23		0.20	0.22
2002	1,300	1,300	0.53	0.53	1.32		2.36	0.61	1.90		1.17	1.17	1.32	1.90	1.35
2005	4,000	4,000			0.93	0.49	1.54	1.24			1.39	1.39	0.71		1.05

	adj. LG	Trawl average	Adj. Trawl	Pump average	Adult average	Avg. of all using adj. Mossdale
Avg. adj. high flow (1986, 1995, 1998, 2005)	**5,717**	1.16	1.17	0.96	1.24	1.08
Avg. adj. med. flow (1996, 99, 00, 02)	**2,265**	0.59	0.62	0.91	0.99	0.81
Avg. adj. low flow (1987, 2001)	**599**	0.27	0.27	0.20	0.25	0.27

Note: 2002 Index at Mossdale uses 1st lower group only