**Downstream Fish Migration Monitoring on the Lower Mokelumne River from January 8, 2008 through May 29, 2008**

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## SUMMARY

Two rotary screw traps were operated on the lower Mokelumne River during East Bay Municipal Utility District's 2008 downstream fish migration monitoring season. The downstream trap was located in reach 2 at river kilometer 61.8 (river mile 38.4) and was operational from January 8 through May 29. The upstream trap was located in reach 5 at river kilometer 87.4 (river mile 54.3) and was operational from January 8 through April 25.

The first juvenile Chinook salmon (*Oncorhynchus tshawytscha*) were captured at the downstream and upstream traps on January 29 and January 8, respectively. Total trap captures for naturally produced juvenile Chinook salmon was 601 at the downstream trap and 14,092 at the upstream trap. Estimated abundance for the monitoring period was 18,347 at the downstream trap (95% CI: 14,513-25,152) and 1,117,451 at the upstream trap (95% CI: 798,895-7,184,950).

The first juvenile steelhead (*Oncorhynchus mykiss*) were captured at the downstream and upstream traps on February 6 and January 10, respectively. Total trap captures for naturally produced juvenile steelhead was 21 at the downstream trap and 312 at the upstream trap. Estimated abundance for the monitoring period based on salmon trap calibrations was 783 at the downstream trap (95% CI: 611-1,086) and 49,717 at the upstream trap (95% CI: 27,904-1,784,002).

Camanche Reservoir release during the monitoring period ranged from 6.4 cubic meters per second (226 cubic feet per second) to 16.5 cubic meters per second (581 cubic feet per second).

## INTRODUCTION

East Bay Municipal Utility District (EBMUD) has been monitoring the lower Mokelumne River (LMR) juvenile salmonid emigration since 1990 (Bianchi et al. 1992; Marine 2000). Salmonid spawning on the LMR occurs primarily in the first 16 river kilometers (10 miles) downstream of Camanche Dam. The rotary screw traps (RST) are operated to assess juvenile salmonid emigration. The objectives of this study are to monitor the abundance and emigration patterns of juvenile salmonids in the LMR. This report presents the monitoring results for RST operations from January 8, 2008 through May 29, 2008.

## METHODS

*Rotary Screw trap*

Two 2.4-m diameter (8 ft) RST's (EG Solutions, Inc.) were operated on the LMR. One trap was operated below Woodbridge Irrigation District Dam (WIDD) and one upstream of Elliott Road, at the lower end of the spawning reach. The downriver RST, also referred to as the Golf RST, was placed downstream of Lower Sacramento Road approximately 195 m (640 ft) downstream of WIDD. The location is the same as the location used from 2005 through 2007 (Workman 2007) and approximately 195 m (640 ft) downstream of the location used from 1993 through 2003 (Workman 2002). The upstream RST, also referred to as the Vino Farms RST, was placed 1.1 km (0.7 miles) upstream of Elliott Road (Figure 1). The cone of each RST was lowered Monday morning and operational from Monday through Friday morning. The cones were raised after each trap check on Friday morning. Therefore, trapping days were Tuesday through Friday and non-trapping days were Saturday through Monday. The only deviation from this operational schedule was during holidays. Each RST was checked once daily from Tuesday through Friday. Daily trap catch estimates were generated for non-trapping days by averaging the daily trap catch (and rounding to the nearest one fish) for three days before and after non-trapping periods. The non-trapping periods are represented by shaded areas in Appendix A and are included in total estimates but not included in total catch. Efforts were made to operate each RST to maintain a rotational speed of two rotations per minute (RPM) or greater (U.S. Fish and Wildlife Service [USFWS] 1997). RPM was recorded during each trap check by using a stopwatch to record the amount of time it took the RST cone to make three full rotations. Trap bridle cables were adjusted to optimize rotations. The downstream RST was checked between the hours of 0800-1130 and the upstream RST was checked between the hours of 0830-1300. Cone rotations since the previous trap check were read off of a Redington® mechanical counter mounted on side rails near the mouth of the cone and the counter was reset to zero immediately after all fish were removed from the live box. Turbidity samples were collected by submerging a sample jar to a depth of 0.3 m (1 ft) and allowing it to fill with water. Water temperature, dissolved oxygen and turbidity samples were taken at the downstream end of each RST during each trap check. Turbidities were determined in the lab using a Hach ®P1000 turbidimeter. RST's were cleared of debris and fish were offloaded into 19 liter (5 gallon) buckets at the conclusion of each trap check. All captured fish were transported approximately 0.4 kilometers (0.25 miles) downstream of the capture sight and released. Pontoons, cones, live boxes and decks were scrubbed each day to reduce algal build up and maintain trap rotation. Cables, pulleys, counters and cones were inspected daily to ensure proper function.

*Estimate Calculations and Equations*

Daily trap catch estimates were generated for non-trapping days by averaging the daily trap catch (and rounding to the nearest one fish) for three days before and after non-trapping periods. Trap efficiencies (see *Calibrations* section) were applied to daily non-trapping period catch estimates and daily actual catch numbers to produce trap efficiency corrected daily abundance estimates. Daily abundance estimates were calculated as:

$$DA = \frac{C}{TE}, \text{ where}$$

DA = daily abundance estimate,
C = daily trap catch or daily trap catch estimate (non-trap days),
TE = trap efficiency.

Annual abundance estimates were calculated by summing the daily abundance estimates. Daily confidence intervals were generated for each daily abundance estimate using the upper and lower 95% confidence limits approximated from a binomial distribution for each trap efficiency. Ninety-five percent confidence intervals for each trap efficiency were calculated as:

$$LCL = TE - 1.96\sqrt{TE\frac{(1-TE)}{M}}, \text{ and}$$

$$UCL = TE + 1.96\sqrt{TE\frac{(1-TE)}{M}}, \text{ where}$$

LCL = trap efficiency lower 95% confidence limit,
UCL = trap efficiency upper 95% confidence limit,
TE = trap efficiency,
M = number of marked fish released,
$TE\frac{(1-TE)}{M}$ = estimated variance of TE.

Daily confidence intervals for daily abundance estimates were calculated as follows:

$$DCI_{low} = \frac{C}{UCL}, \text{ and}$$

$$DCI_{high} = \frac{C}{LCL}, \text{ where}$$

$DCI_{low}$ = daily abundance lower 95% confidence limit,
$DCI_{high}$ = daily abundance upper 95% confidence limit,
C = daily trap catch or daily trap catch estimate (non-trap days),
UCL = trap efficiency upper 95% confidence limit,
LCL = trap efficiency lower 95% confidence limit.

Annual confidence intervals for annual abundance estimates were calculated by summing the daily abundance confidence intervals.

*Fish Handling and Condition Calculations*

Fish at the downstream trap were processed on the north bank of the river. Fish at the upstream trap were processed in a Wells Cargo™ trailer equipped with a flow-through water supply and a recirculating anesthetic bath. Tricaine methanesulfonate (MS-222) was used to anesthetize fish. Electric aerators (air stones) were used to maintain oxygen concentrations. The first 50 Chinook salmon and the first 20 of other species recovered from the traps were weighed to the nearest 0.1 gram with an Ohaus® Scout portable scale and measured to the nearest millimeter. Life stage of each fish and any observations of marks, injuries or anomalies were recorded. Fish were allowed to recover in oxygenated water, transported by canoe (downstream trap) or vehicle (upstream trap), via 19 liter (5 gallon) buckets equipped with battery operated aerators, approximately 0.4 kilometers (0.25 miles) downstream of the capture site and released.

Condition factor was calculated for all captured salmonids that were both measured and weighed. Fulton's Condition Factor (Bagenal and Tesh 1978) was calculated as:

$$\mathrm{K} = \left(\frac{W}{FL^3}\right) * 100{,}000, \text{ where}$$

K = Fulton's Condition Factor,
W = weight in grams,
FL = fork length in mm.

*Calibrations*

Calibration tests using hatchery produced Chinook salmon were conducted to assess the proportion of emigrating Chinook being caught by each RST. Calibration tests were conducted four times at the downstream RST and three times at the upstream RST during the survey period. Each calibration test at each RST consisted of one daytime release of marked hatchery fish. Calibration fish were marked using caudal fin clips or Bismark® brown chemical stain. Calibrations were conducted approximately once per month or when changes in flow or length of captured fish had the potential to alter capture efficiencies. Standard mark-recapture ratios were used as measurements of trap efficiency and calculated as follows:

$$TE = \frac{m}{M}, \text{ where}$$

TE = trap efficiency,
m = number of marked fish recaptured,
M = number of marked fish released.

Calibration fish were obtained from the Mokelumne River Fish Hatchery (MRFH). Approximately 1,000 juvenile Chinook salmon were marked for each calibration test for each RST. Downstream calibration fish were marked using Bismark® brown chemical stain. The stain was applied by soaking fish in a solution of water and stain for approximately one hour. Upstream calibration fish were marked with an upper caudal fin clip for the first and third calibration test and a lower caudal fin clip for the second calibration test. Mark retention and mortality rates were determined before releasing test fish. Releases were conducted after the morning RST check (between 0845 and 1200). Downstream calibration fish were released below WIDD and distributed proportionally to the flow along the face of the dam. Upstream calibration fish were released approximately 0.4 km (0.25 miles) upstream of the trap location and distributed proportionally to the flow.

*Coded Wire Tagging*

Coded wire tags (CWT) were implanted on-site at the upstream RST in each juvenile Chinook salmon that was completely buttoned-up and measuring $\geq$38 mm total length (TL) from January 8 through February 5 and $\geq$43 mm TL from February 6 through April 25. Two Northwest Marine Technologies, Inc. Mark IV tagging machines with QC devices were used to implant CWT's in juvenile Chinook salmon. One numeric CWT code was used during the survey period. Standard coded-wire tagging methods for juvenile salmon were followed (Vogel and Marine 1999).

**RESULTS**

*Chinook Salmon*

During rotary screw trap monitoring 601 naturally produced juvenile Chinook salmon were captured at the downstream RST and 14,092 at the upstream RST. Daily non-trapping period catch estimates and daily actual catch totals were summed to produce total catch estimates of 1,087 at the downstream RST and 28,495 at the upstream RST. Trap efficiencies were applied to daily non-trapping period catch estimates and daily actual catch totals to produce trap efficiency corrected daily abundance estimates (Figure 2 and Figure 3). Daily abundance estimates were summed to calculate annual abundance estimates. The annual abundance estimate at the downstream RST (January 8 through May 29) was 18,347 (95% CI: 14,513-25,152) and 1,117,451 (January 8 through April 25) at the upstream RST (95% CI: 798,895-7,184,950). Actual catch at the downstream RST consisted of 4.2% fry, 1.3% parr, 4.2% silvery parr and 90.3% smolt. Actual catch at the upstream RST consisted of 93.7% fry, 5.3% parr, 0.7% silvery parr and 0.3% smolt. Fry, parr, silvery parr and smolt were first captured at the downstream RST on January 29, February 14, March 4 and April 3, respectively. Fry, parr, silvery parr and smolt were first captured at the upstream RST on January 8, January 23, February 14 and April 9, respectively.

A subsample of juvenile Chinook salmon was weighed, measured and described to life stage based on appearance as fry, parr, silvery parr or smolt (Table 1). Average fork length (FL) of measured fry, parr, silvery parr and smolt at the downstream RST was 36.9 mm (34-39 mm, n=25), 45.7 mm (39-63 mm, n=7), 70.0 mm (56-105 mm, n=25) and 88.3 mm (68-136 mm, n=521), respectively (Figure 4). Average FL of measured fry, parr, silvery parr and smolt at the upstream RST was 36.7 mm (29-41 mm, n=2,117), 40.2 mm (36-58 mm, n=151), 67.4 mm (46-134 mm, n=60) and 80.4 mm (66-89 mm, n=37), respectively (Figure 5). Average condition factor (K) of measured and weighed fry, parr, silvery parr and smolt at the downstream RST was 0.66 (0.47-0.79, n=25), 0.88 (0.55-1.20, n=7), 1.03 (0.66-1.37, n=25) and 1.05 (0.69-1.52, n=520), respectively (Figure 6). Average condition factor (K) of measured and weighed fry, parr, silvery parr and smolt at the upstream RST was 0.64 (0.25-1.34, n=2,116), 0.73 (0.43-1.17, n=151), 0.98 (0.68-1.73, n=60) and 1.03 (0.79-1.31, n=37), respectively (Figure 7).

The minimum and maximum recorded rotational speeds for the downstream RST during the 97 days of trap operation were 0.4 RPM and 3.2 RPM ($\bar{X}$ =2.2), and for the upstream RST during the 75 days of operation were 2.1 RPM and 3.5 RPM($\bar{X}$ =2.8). The Comprehensive Assessment and Monitoring Program protocol (USFWS 1997) recommends a minimum RST rotation of 2

RPM. Daily RPM at the downstream RST fell below 2 RPM during 16.5 percent (16 days) of sample days. Daily RPM at the upstream RST remained above 2 RPM throughout the sample period.

Flows at the Golf gauging station (located approximately 0.6 km [0.4 mile] downstream of the downstream RST) during the monitoring period ranged from 4.5 $m^3$/s to 6.6 $m^3$/s (158 cfs to 234 cfs) and averaged 5.0 $m^3$/s (176 cfs) (Figure 8). Flows at the Elliott gauging station (located approximately 1.1 km [0.7 mile] downstream of the upstream RST) during the monitoring period ranged from 5.5 $m^3$/s to 14.7 $m^3$/s (195 cfs to 518 cfs) and averaged 6.8 $m^3$/s (239 cfs) (Figure 9). Flows below Camanche Dam at the McIntire gauging station (located approximately 1.5 km [0.9 mile] downstream of Camanche Powerhouse) during the monitoring period ranged from 6.4 $m^3$/s to 16.5 $m^3$/s (226 cfs to 581 cfs) and averaged 8.5 $m^3$/s (301 cfs) (Figure 10 and Figure 11). Simple linear regression showed that flow accounted for a small percentage of the variation in daily abundance estimates. However, corresponding p-values generally showed a linear relationship. Results from regression analyses are shown in Table 2.

Water velocities at the downstream and upstream RST's at the start of each trap check ranged from 0.51 m/s to 0.90 m/s (1.67 ft/s to 2.95 ft/s) and 0.85 m/s to 2.52 m/s (2.79 ft/s to 8.27 ft/s), and averaged 0.72 m/s (2.36 ft/s) and 1.01 m/s (3.31 ft/s), respectively. Simple linear regression showed that 1.7% and 0.6% of the variation in daily abundance estimates was accounted for by water velocity at the downstream and upstream RST's, respectively. Corresponding p-values showed a non-linear relationship at the upstream and downstream RST's ($p=0.21$ and $p=0.52$, respectively).

Average daily water temperature at the Golf gauging station during the monitoring period (Figure 12) ranged from 7.7°C (45.9°F) to 20.0°C (68.0°F) and averaged 12.7°C (54.9°F). Average daily water temperature at the Elliott gauging station (Figure 13) ranged from 8.4°C (47.1°F) to 13.4°C (56.1°F) and averaged 10.6°C (51.1°F). Average daily water temperature below Camanche Dam at the McIntire gauging station (Figure 14 and Figure 15) ranged from 8.9°C (48.0°F) to 13.1°C (55.6°F) and averaged 10.9°C (51.6°F). Simple linear regression showed that water temperature accounted for a small percentage of the variation in daily abundance estimates. However, corresponding p-values generally showed a linear relationship. Results from regression analyses are shown in Table 2.

Water turbidity in NTU's at the downstream and upstream RST's ranged from 1.6 to 12.0 ($\bar{X}$ = 4.2) and 1.8 to 13.7 ($\bar{X}$ = 2.8). Values exceeded 5 on 23 days and 3 days at the downstream and upstream RST's, respectively (Figure 16 and Figure 17). Simple linear regression showed that 17.7% and 0.3% of the variation in daily abundance estimates was accounted for by water turbidity at the downstream and upstream RST's, respectively. Corresponding p-values showed a linear relationship at the downstream RST ($p<0.01$) and a non-linear relationship at the upstream RST ($p=0.67$).

Overall, simple linear regression explained little of the total variation in daily abundance estimates as a function of the environmental variables examined.

*Calibrations*

Rotary screw trap efficiency tests for Chinook salmon were conducted four times at the downstream RST and three times at the upstream RST (Table 3). The number of calibration fish released during efficiency tests at the downstream and upstream RST ranged from 993-1,015 and

990-1,017, respectively. Trap efficiencies at the downstream and upstream RST ranged from 0.035-0.089 and 0.004-0.040, respectively. Chinook salmon daily catch numbers and associated calibration coefficients (trap efficiencies) are presented in Appendix A.

*Coded Wire Tagging*

Coded wire tags were implanted in naturally produced juvenile Chinook salmon captured at the upstream RST. The first and last CWT's were implanted on January 30, 2008 and April 25, 2008, respectively. One tag code (06-01-05-02-02) was used to tag 322 juvenile Chinook salmon. Tagged fish ranged in size from 38 mm FL to 94 mm FL and averaged 59.8 mm FL.

*Steelhead*

During rotary screw trap monitoring 21 naturally produced juvenile steelhead were captured at the downstream RST and 312 at the upstream RST. Daily non-trapping period catch estimates and daily actual catch totals were summed to produce total catch estimates of 39 at the downstream RST and 577 at the upstream RST. Trap efficiencies, based on Chinook salmon calibrations, were applied to daily non-trapping period catch estimates and daily actual catch totals to produce trap efficiency corrected daily abundance estimates. Daily abundance estimates were summed to calculate annual abundance estimates. The annual steelhead abundance estimate at the downstream RST was 783 (95% CI: 611-1,086) and 49,717 at the upstream RST (95% CI: 27,904-1,784,002). Actual catch at the downstream RST consisted of 4.8% fry, 28.6% parr, 9.5% silvery parr and 57.1% smolt. One fry was captured at the downstream RST and it measured 29.0 mm FL, parr averaged 46.7 mm FL (33-64 mm FL, n=9), silvery parr averaged 215.0 mm FL (212-218 mm FL, n=2) and smolt averaged 246.3 mm FL (210-299 mm FL, n=12). Fry at the upstream RST averaged 26.1 mm FL (20-36 mm FL, n=242), parr averaged 53.1 mm FL (25-168 mm FL, n=39), silvery parr averaged 171 mm FL (165-177 mm FL, n=2) and smolt averaged 203.7 mm FL (177-232 mm FL, n=3). Actual catch at the upstream RST consisted of 85.6% fry, 12.5% parr, 0.6% silvery parr and 1.3% smolt. Fry, parr, silvery parr and smolt were first captured at the downstream RST on April 23, April 25, February 8 and February 6, respectively. Fry, parr, silvery parr and smolt were first captured at the upstream RST on February 20, January 16, January 10 and February 15, respectively.

Sixty six adipose-fin clipped steelhead were captured in the downstream RST (65 smolt, 1 adult). The first and last adipose fin clipped steelhead was captured on January 30 and May 23, respectively. Average length was 256 mm FL (185-411 mm FL, n=66). Fifteen adipose-fin clipped steelhead were captured in the upstream RST (1 silvery parr, 14 smolt). The first and last adipose fin-clipped steelhead was captured on April 8 and April 23, respectively. Average length was 221 mm FL (191-269 mm FL, n=15).

MRFH planted 27,067 steelhead in the LMR on April 7. All fish were pumped from raceways and released just below the fish ladder entrance. Sixty five of the 66 adipose-fin clipped steelhead captured at the downstream RST were captured between April 9 and May 23. All 15 of the adipose-fin clipped steelhead captured at the upstream RST were captured between April 8 and April 23.

*Incidental Species*

Twenty four fish species were captured in the RST's during the monitoring period. Eight native species and 16 non-native species were captured in the downstream trap with the most abundant species being black bass, prickly sculpin, Chinook salmon, and common carp (Appendix C). In certain instances juvenile black bass were only identified to genus. In the upstream trap eight native species and nine non-native species were captured with the most abundant being Chinook salmon, steelhead, Pacific lamprey, and hitch (Appendix D).

## DISCUSSION

EBMUD began monitoring juvenile salmonids in 1990. During most years, various types of traps, including rotary screw traps, were utilized within or slightly downstream of WIDD facilities to capture juvenile salmonids. Rotary screw traps have been placed upstream of WIDD once prior to the 2008 season and that was during the 1993 monitoring season. The 1993 location was river kilometer 85.3 (river mile 53) just downstream of Elliott Road. Low water velocities at the site were believed to have contributed to low captures when compared to the downstream location and moving the RST further upstream was recommended for future surveys. The 2008 location was river kilometer 87.4 (river mile 54.3). Water velocities and trap RPM's remained high during the monitoring period and trap captures were high when compared to the downstream location. In addition, EBMUD relations with adjacent landowners are good and the site is easily accessible.

The upstream sites proximity to spawning habitat lends itself to high capture rates of fry. Juvenile salmonids grow as they move downstream and typically are smolt sized by the time they reach the downstream trapping location. Ninety percent of the total catch at the downstream RST were classified as smolt (4% were classified as fry) and 94% of the total catch at the upstream RST were classified as fry (0.3% were classified as smolt). Due to differences in proximity to spawning habitat and primary life stage available for capture, upstream estimates are more reflective of instream production and emergence timing while downstream estimates are more reflective of the number of smolt passing WIDD and emigration timing. For this reason comparison of abundance estimates should be made with caution.

Estimated abundance was much higher from the upstream RST than from the downstream RST. Many factors likely account for the differences including proximity to spawning habitat, length of sampling period, predation, effects from Lake Lodi, effects from WIDD and trapping efficiency. Spawning habitat in the LMR primarily is available in reach 6 and the upper reaches of reach 5. The upstream RST was located just downstream from where spawning habitat becomes largely unavailable. A very high percentage of the total catch at the upstream RST was classified as fry. The fry life stage accounts for the highest number of fish available for capture. Cumulative mortality through time from both natural and unnatural sources reduces the number of fish available for capture with distance downstream. Therefore, higher catches would be expected at the upstream RST. Water management changes scheduled for June 1 required removal of the downstream RST on May 29. Total catch at the downstream RST increased significantly in May and remained high through the month. Seventy seven percent of captures at the downstream RST occurred in May. Results from EBMUD's juvenile monitor efforts from 1990 through 2007 indicate emigration continues through July with highest captures usually occurring in May and June. Also, during low flow years peak downstream movement past the downstream site typically occurs later during the emigration time period. The downstream RST may have been removed prior to the passage of a significant percentage of outmigrating juvenile Chinook salmon which may, in part, account for the low abundance estimate at the downstream RST. Predation likely contributed to the differences in abundance estimates as well. Approximately 16 miles of river separate the upstream and downstream locations exposing fish to many species of predators. Results from EBMUD's fish community surveys indicate high densities of Sacramento pikeminnow, largemouth bass, spotted bass, redeye bass and the occasional striped bass within that reach of the LMR (EBMUD unpublished data). In addition, predatory birds including great blue heron, green heron, black crowned night heron, double-crested cormorant, common merganser and belted kingfisher are numerous throughout the LMR. Although the magnitude of predation occurring between RST locations is unknown, predation likely decreased the number of fish available for capture and was a contributing factor to the low abundance estimate at the downstream RST. Other possible contributing factors include Lake Lodi and WIDD. Lake Lodi may offer sufficient shallow, slow moving and food rich water providing juvenile salmonids an option for rearing possibly causing delayed downstream movements. Facilities at WIDD include a bladder operated dam, several fish ladders and a fish screen that diverts fish from Woodbridge canal through a bypass pipe and back into the LMR below the dam. Survival through the dam and fish ladders, effectiveness of the fish screen and level of predation associated with the facilities are unknown. Trap calibrations were conducted at each RST approximately once per month. Trap efficiencies at the upstream RST were low when compared to the downstream RST (Table 3). The Comprehensive Assessment and Monitoring Program protocol (USFWS 1997) recommends releasing efficiency test fish a minimum of 402 m (0.25 miles) upstream of the RST location. Release fish at the upstream location were released approximately 402 m (0.25 miles) upstream. However, release fish at the downstream location were released approximately 195 m (0.12 miles) due to proximity to WIDD. Differences in release distances may have influenced trap efficiencies and the resulting abundance estimates.

The upstream RST site is an excellent location in terms of functionality and accessibility. Ample room exists on the adjacent bank for our CWT trailer, unlike the downstream RST site. Continued concurrent use of both locations is recommended. Each location provides different types of equally important information. The 2008 data from the upstream RST should be considered a baseline estimate of instream production. Future use of the site would facilitate evaluation of the effectiveness of habitat restoration and water temperature and flow management efforts. In addition, concurrent use of both locations would provide for future studies designed to assess survival, residence time and growth of juvenile salmonids in the LMR.

From 1993 through 2008, first captures at the downstream location occurred in mid-December during seven sample years with the earliest occurring on December 15. A conservative start date for future monitoring would be December 1 because captures at the upstream location would be expected to occur earlier than at the downstream location. Adequate flows are needed at both locations for properly functioning RST's. Water management operations influence use of the downstream location but not the upstream location. Minimum release flows even during the dries years are sufficient to maintain a properly functioning RST at the upstream location. During those occasions when flows are too low at the downstream location to provide functional conditions, a strategically placed fyke net could be used as an alternative to maintain downstream sampling throughout the survey time period.

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## LITERATURE CITED

Bagenal, T. B. and F. W. Tesch. 1978. Age and growth. Pages 101-136 *in* T. B. Bagenal (editor). Methods for Assessment of Fish Production in Fresh Waters. IBP Handbook No. 3. Blackwell Scientific Publications. Oxford, England.

Bianchi, E. W., W. Walsh, and C. Marzuola. 1992. Task reports of fisheries studies on the Mokelumne River 1990-1992. (Appendix A of the lower Mokelumne River Management Plan). Report to East Bay Municipal Utility District, Oakland, California. BioSystems Analysis, Inc., Tiburon, California.

Marine, K. 2000. Lower Mokelumne River fisheries monitoring program 1999-2000. Downstream migration monitoring at Woodbridge Dam during December 1999 through July 2000. Natural Resource Scientists, Inc. 41pp + appendices.

USFWS. 1997. CVPIA Comprehensive Assessment and Monitoring Program (CAMP). Standard protocol for rotary screw trap sampling of outmigrating juvenile salmonids. U.S. Fish and Wildlife Service, Sacramento, California.

Vogel, D. A. and K. R. Marine. 1999. Evaluation of the downstream migration of juvenile Chinook salmon and steelhead in the lower Mokelumne River and the Sacramento-San Joaquin Delta (January through July 1997). A technical report prepared for EBMUD, Orinda, California. Natural Resources Scientists, Inc. 44pp + appendices.

Workman, M. L. 2002. Downstream migration monitoring at Woodbridge Dam on the lower Mokelumne River, Ca. December 2001 through July 2002. EBMUD unpublished report. 23pp + appendices.

Workman, M. L. 2007. Downstream fish migration monitoring at Woodbridge Irrigation District Dam. Lower Mokelumne River, December 2006 through July 2007. EBMUD unpublished report. 19pp + appendices.

**Table 1. Life stage, lengths and weights of juvenile Chinook salmon captured on the lower Mokelumne River during the 2008 rotary screw trap surveys, January 8, 2008 through May 29, 2008.**

| Life Stage | RST | Fork Length (mm) | | | Weight (g) | | |
|---|---|---|---|---|---|---|---|
| | | Ave | Range | n | Ave | Range | n |
| Fry | Downstream | 36.9 | 34-39 | 25 | 0.3 | 0.3-0.4 | 25 |
| | Upstream | 36.7 | 29-41 | 2117 | 0.3 | 0.1-0.6 | 2116 |
| Parr | Downstream | 45.7 | 39-63 | 7 | 1 | 0.4-3.0 | 7 |
| | Upstream | 40.2 | 36-58 | 151 | 0.5 | 0.2-1.9 | 151 |
| Silvery Parr | Downstream | 70.0 | 56-105 | 25 | 3.9 | 1.5-11.6 | 25 |
| | Upstream | 67.4 | 46-134 | 60 | 3.4 | 0.7-23.4 | 60 |
| Smolt | Downstream | 88.3 | 68-136 | 521 | 7.3 | 3.6-26.1 | 520 |
| | Upstream | 80.4 | 66-89 | 37 | 5.5 | 2.9-7.7 | 37 |

**Table 2. Simple linear regression results for abundance estimates, flow and water temperature for rotary screw traps fished on the lower Mokelumne River, January 8, 2008 through May 29, 2008.**

| Estimate | Gauging Station | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Golf | | | | Elliott | | | | McIntire | | | |
| | Flow | | Temperature | | Flow | | Temperature | | Flow | | Temperature | |
| | $R^2$ | $P$ | $R^2$ | $P$ | $R^2$ | $P$ | $R^2$ | $P$ | $R^2$ | $P$ | $R^2$ | $P$ |
| **Downstream** | 0.066 | <0.01 | 0.288 | <0.01 | N/A | N/A | N/A | N/A | 0.348 | <0.01 | 0.347 | <0.01 |
| **Upstream** | N/A | N/A | N/A | N/A | 0.007 | 0.395 | 0.184 | <0.01 | 0.013 | 0.246 | 0.362 | <0.01 |

**Table 3. Trap efficiency test results for rotary screw traps fished on the lower Mokelumne River, January 8, 2008 through May 29, 2008.**

| Date | RST | Release Site | Released | Recaptured | Trap Efficiency | Ave. Daily Flow (CFS)[1] | Ave. Size Released (FL mm) | Ave. Size Captured (FL mm)[2] |
|---|---|---|---|---|---|---|---|---|
| 2/05/08 | Downstream | WIDD Basin | 1015 | 53 | 0.052 | 190 | 37.8 | 35.1 |
| 2/05/08 | Upstream | ¼ Mile Upstream | 1017 | 26 | 0.026 | 224 | 38.0 | 36.4 |
| 3/03/08 | Downstream | WIDD Basin | 993 | 54 | 0.054 | 175 | 39.9 | 38.8 |
| 3/03/08 | Upstream | ¼ Mile Upstream | 990 | 40 | 0.040 | 215 | 40.4 | 37.2 |
| 4/07/08 | Downstream | WIDD Basin | 999 | 35 | 0.035 | 173 | 42.7 | 70.3 |
| 4/07/08 | Upstream | ¼ Mile Upstream | 1001 | 4 | 0.004 | 213 | 43.5 | 44.6 |
| 5/05/08 | Downstream | WIDD Basin | 1000 | 89 | 0.089 | 173 | 62.4 | 85.5 |

1 Ave. daily flow was calculated for the time period between efficiency tests. For example, the average daily flow shown for 3/3/08 was calculated from 2/6/08 through 3/3/08.

2 Ave. size captured was calclulated for naturally produced fish captured during the time period between efficiency tests. For example, the average size captured shown for 3/3/08 was calculated from 2/6/08 through 3/3/08.

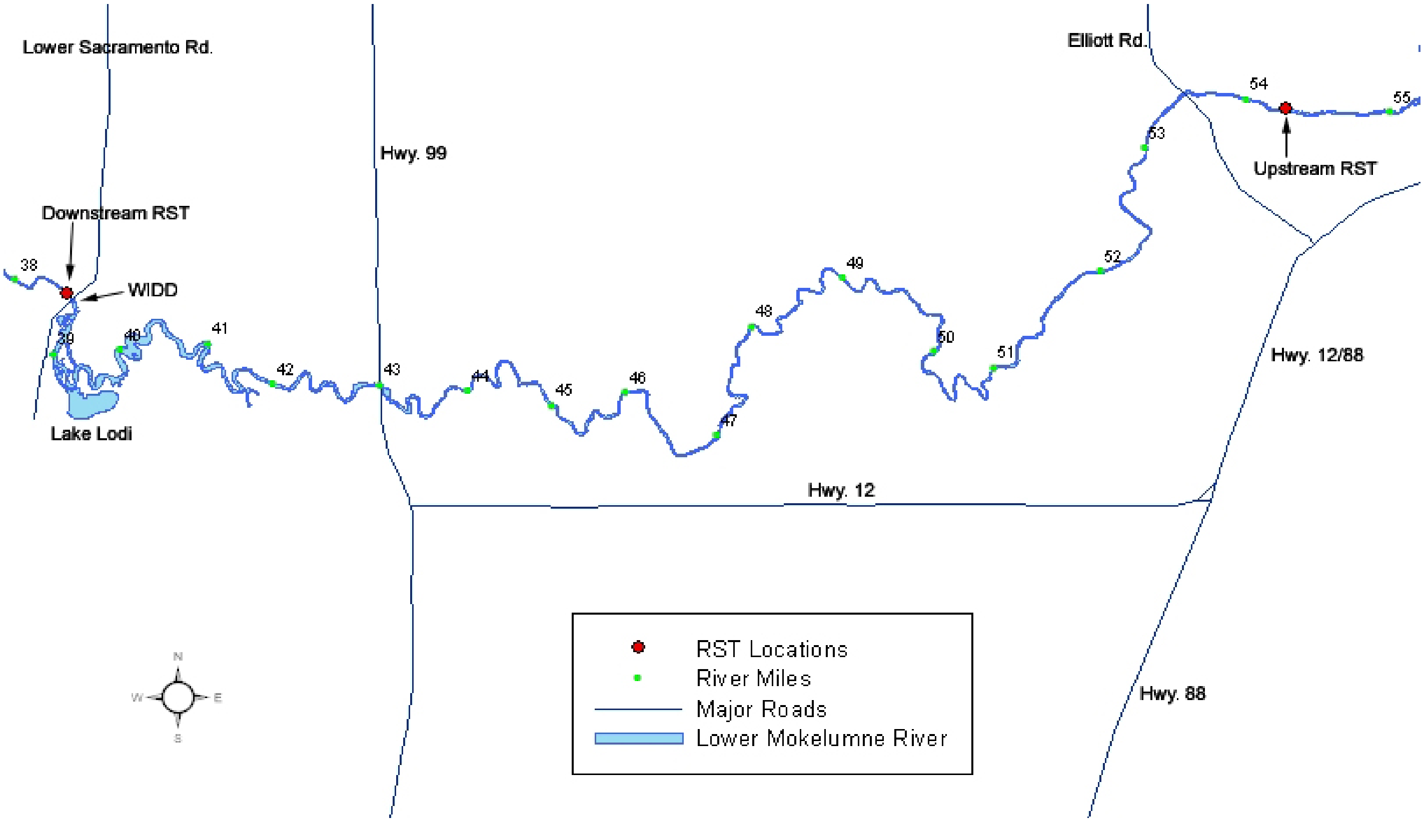


**Figure 1. Rotary screw trap locations**

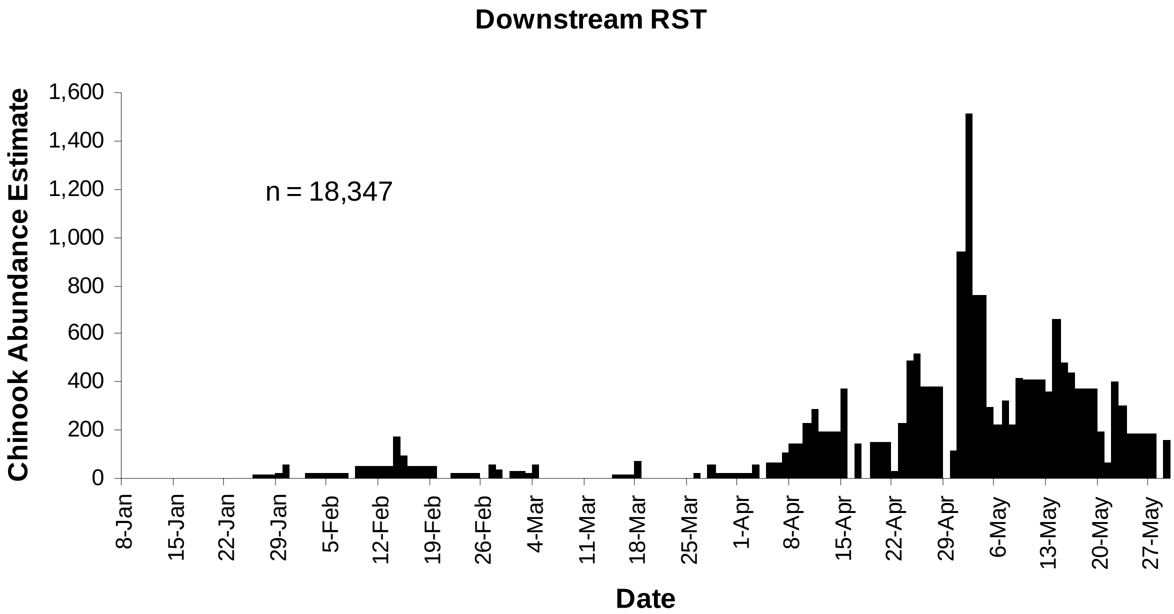


**Figure 2. Daily abundance estimates for juvenile Chinook salmon captured in the downstream rotary screw trap on the lower Mokelumne River from January 8, 2008 through May 29, 2008.**

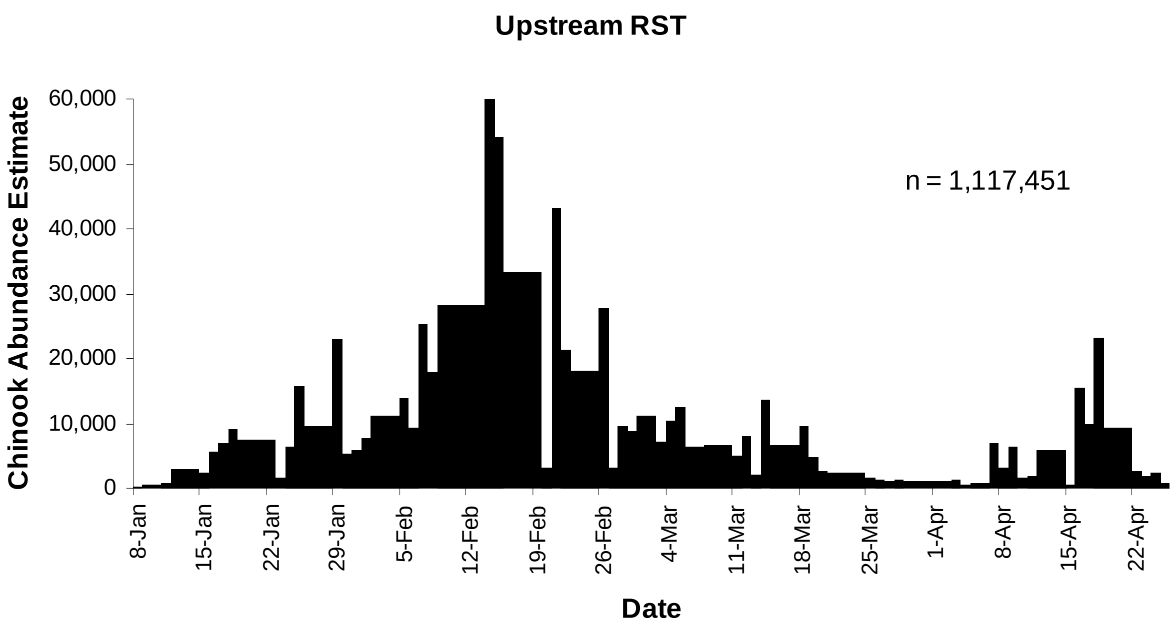


**Figure 3. Daily abundance estimate for juvenile Chinook salmon captured in the upstream rotary screw trap on the lower Mokelumne River from January 8, 2008 through April 25, 2008.**

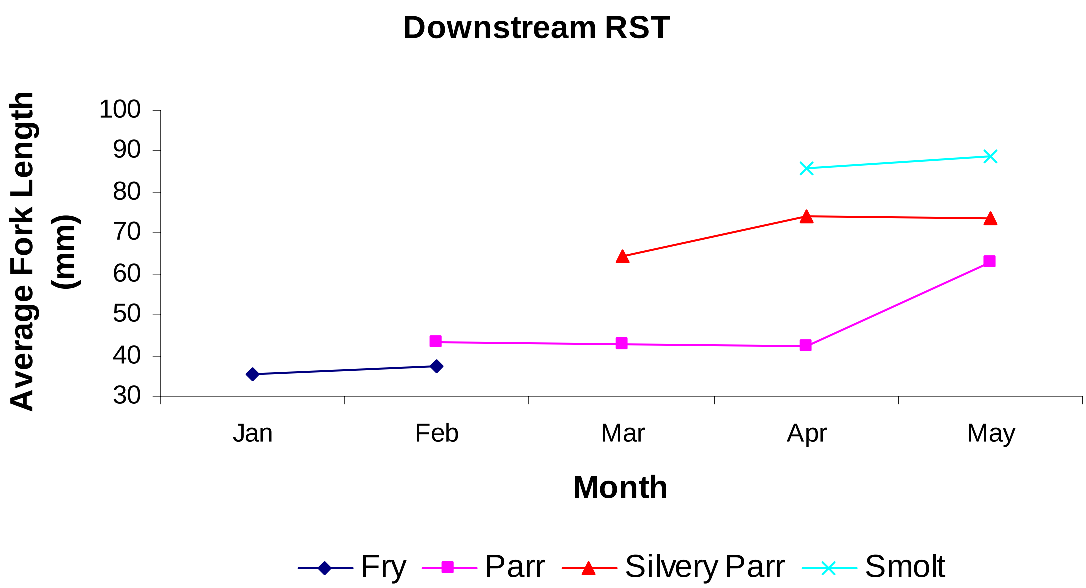


**Figure 4. Average fork length (mm) of juvenile Chinook salmon life stages by month captured in the downstream rotary screw trap on the lower Mokelumne River from January 8, 2008 through May 29, 2008.**

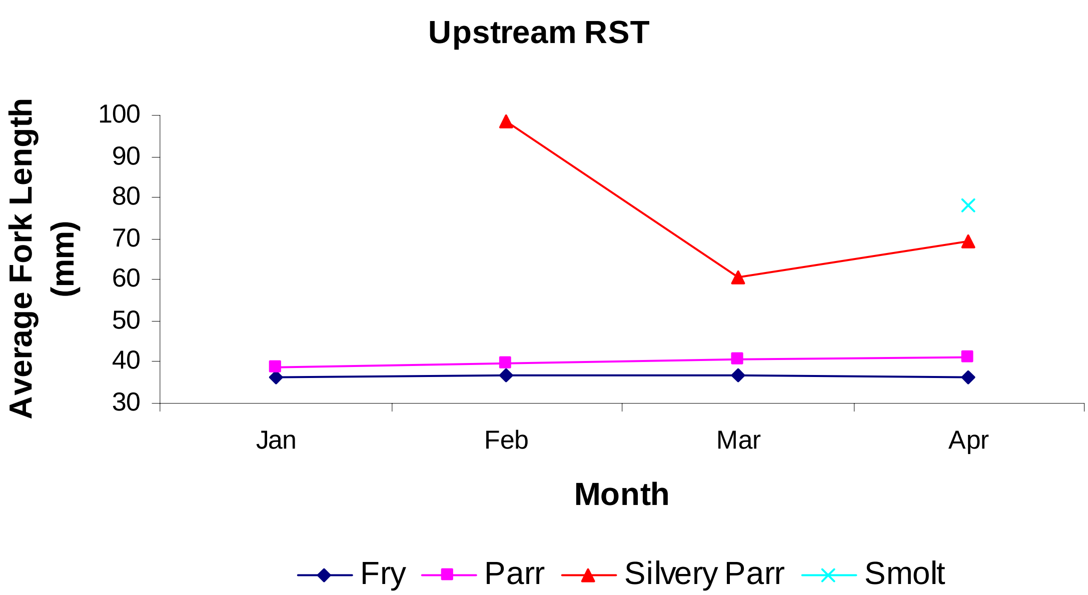


**Figure 5. Average fork length (mm) of juvenile Chinook salmon life stages by month captured in the upstream rotary screw trap on the lower Mokelumne River from January 8, 2008 through April 25, 2008.**

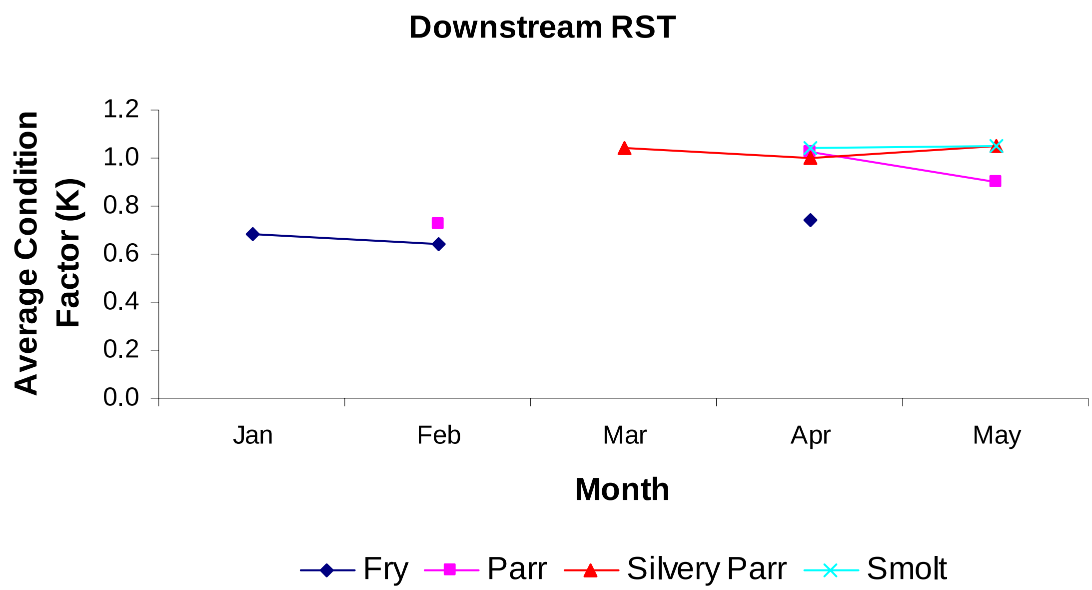


**Figure 6. Average condition factor (K) of juvenile Chinook salmon life stages by month captured in the downstream rotary screw trap on the lower Mokelumne River from January 8, 2008 through May 29, 2008.**

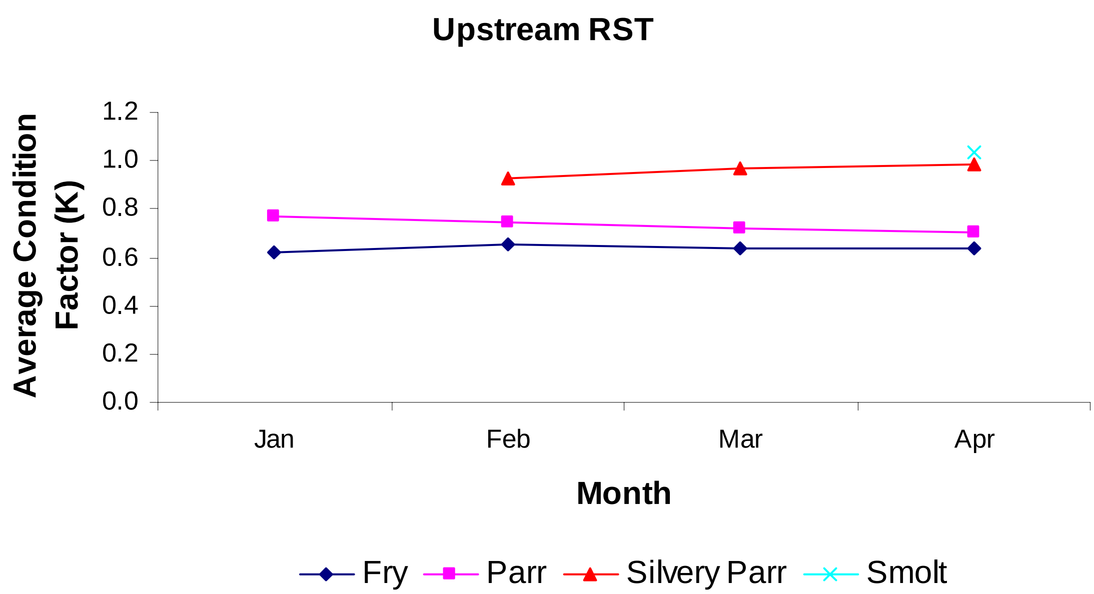


**Figure 7. Average condition factor (K) of juvenile Chinook salmon life stages by month captured in the upstream rotary screw trap on the lower Mokelumne River from January 8, 2008 through April 25, 2008.**

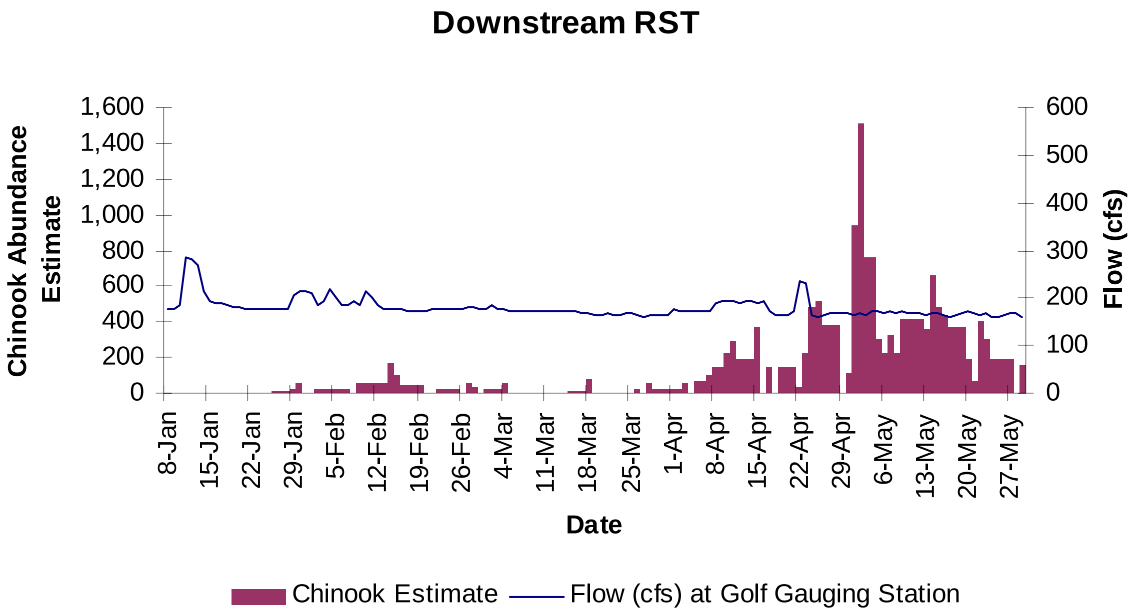


**Figure 8. Juvenile Chinook salmon daily abundance estimates at the downstream rotary screw trap and flow at the Golf gauging station on the lower Mokelumne River from January 8, 2008 through May 29, 2008.**

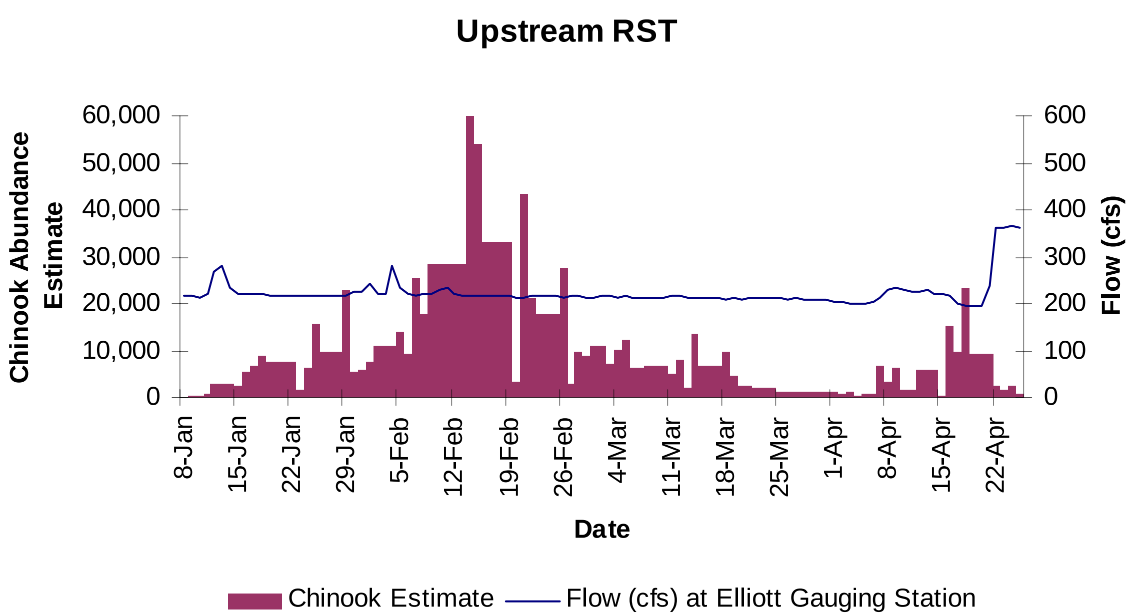


**Figure 9. Juvenile Chinook salmon daily abundance estimates at the upstream rotary screw trap and flow at the Elliott gauging station on the lower Mokelumne River from January 8, 2008 through April 25, 2008.**

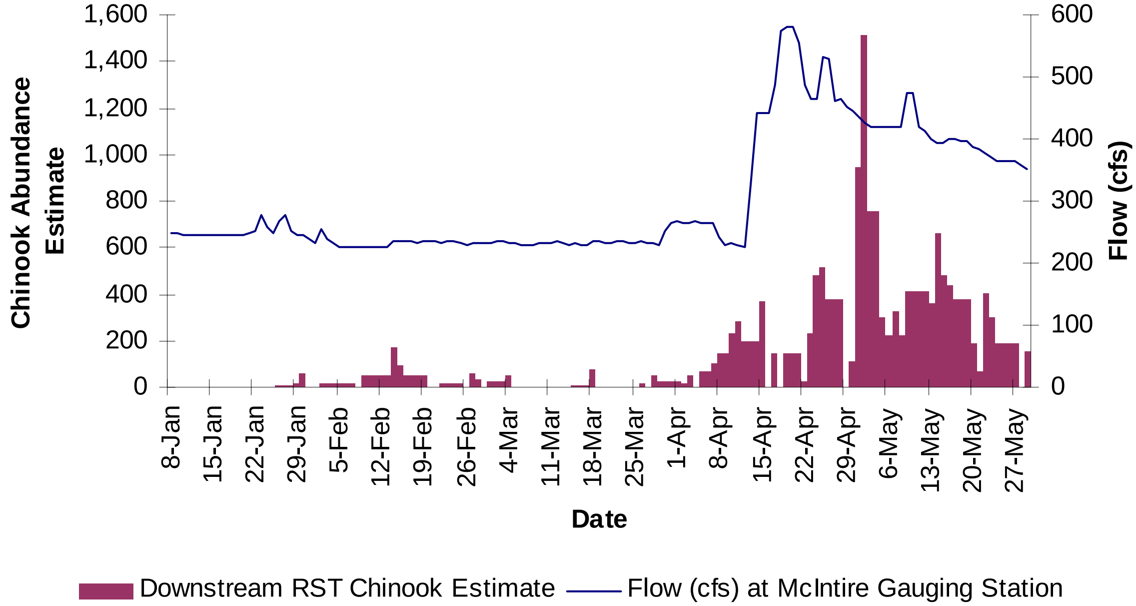


**Figure 10. Juvenile Chinook salmon daily abundance estimates at the downstream rotary screw trap and flow at the McIntire gauging station below Camanche Powerhouse on the lower Mokelumne River from January 8, 2008 through May 29, 2008.**

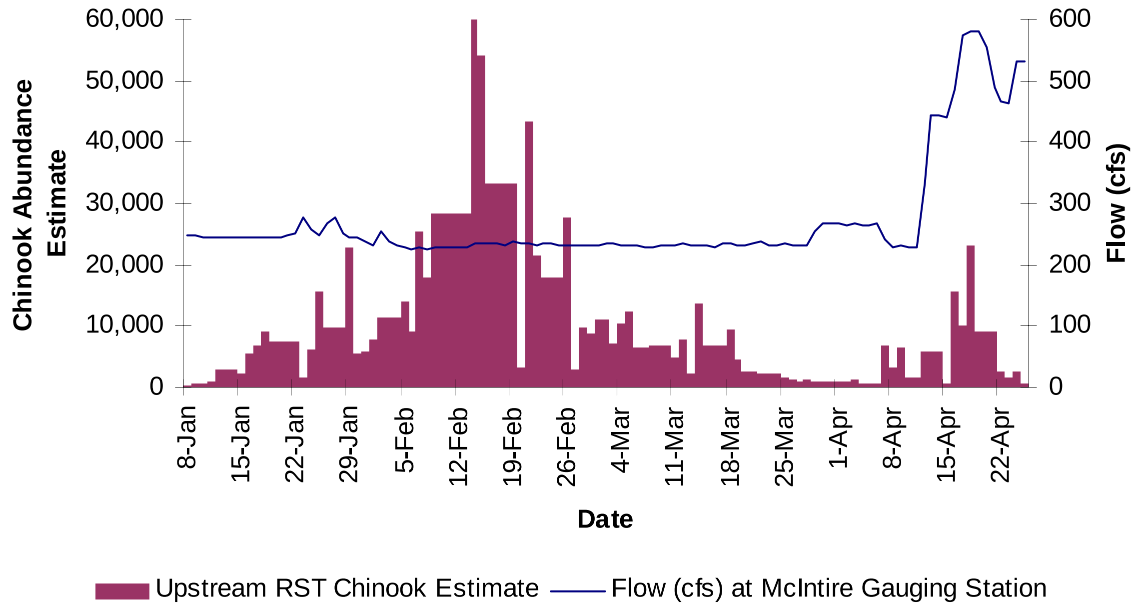


**Figure 11. Juvenile Chinook salmon daily abundance estimates at the upstream rotary screw trap and flow at the McIntire gauging station below Camanche Powerhouse on the lower Mokelumne River from January 8, 2008 through April 25, 2008.**

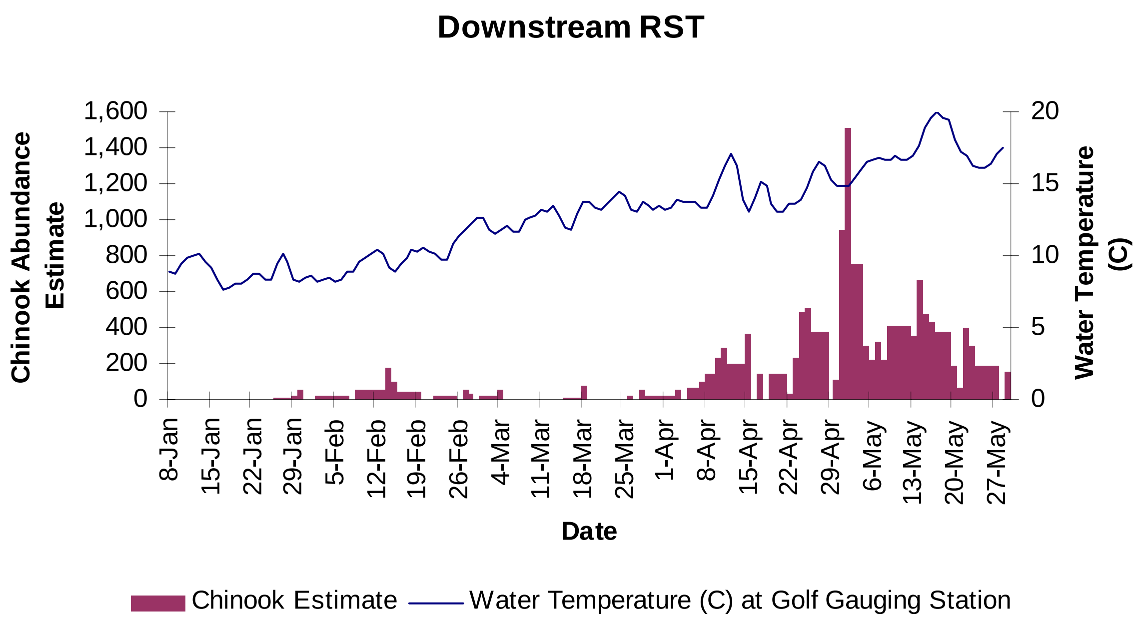


**Figure 12. Juvenile Chinook salmon daily abundance estimates at the downstream rotary screw trap and water temperature at the Golf gauging station on the lower Mokelumne River from January 8, 2008 through May 29, 2008.**

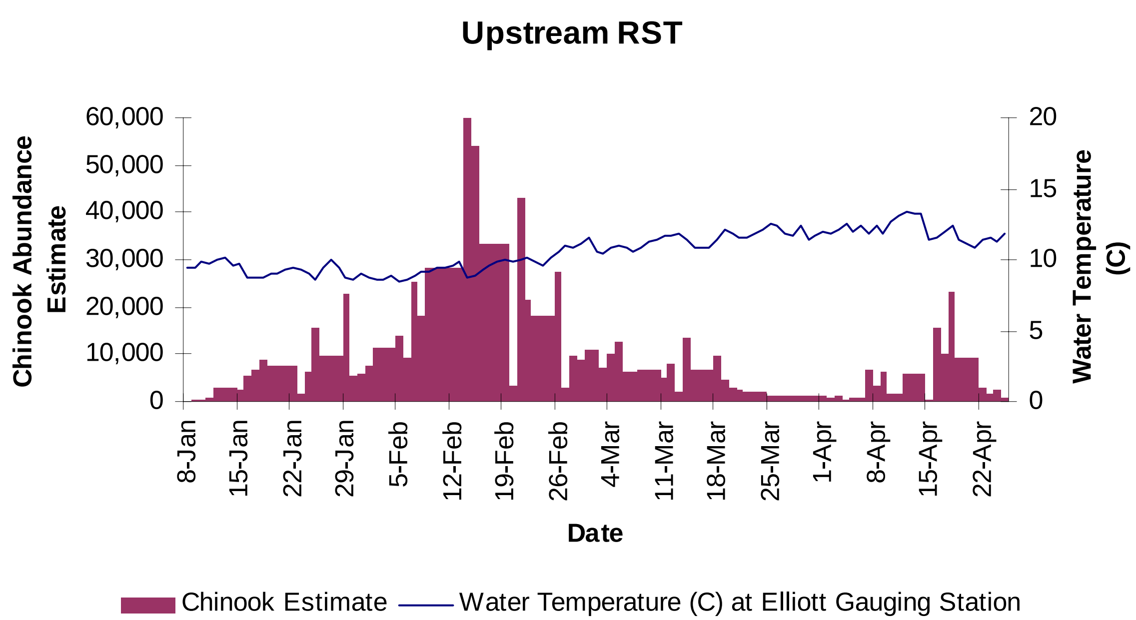


**Figure 13. Juvenile Chinook salmon daily abundance estimates at the upstream rotary screw trap and water temperature at the Elliott gauging station on the lower Mokelumne River from January 8, 2008 through April 25, 2008.**

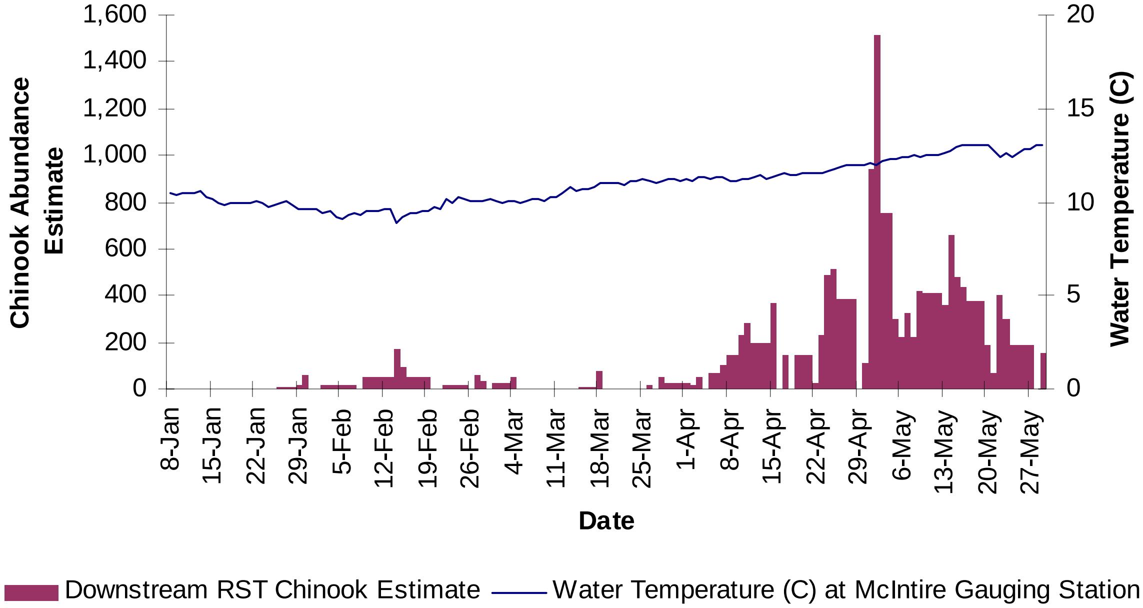


**Figure 14. Juvenile Chinook salmon daily abundance estimates at the downstream rotary screw trap and water temperature at the McIntire gauging station below Camanche Powerhouse on the lower Mokelumne River from January 8, 2008 through May 29, 2008.**

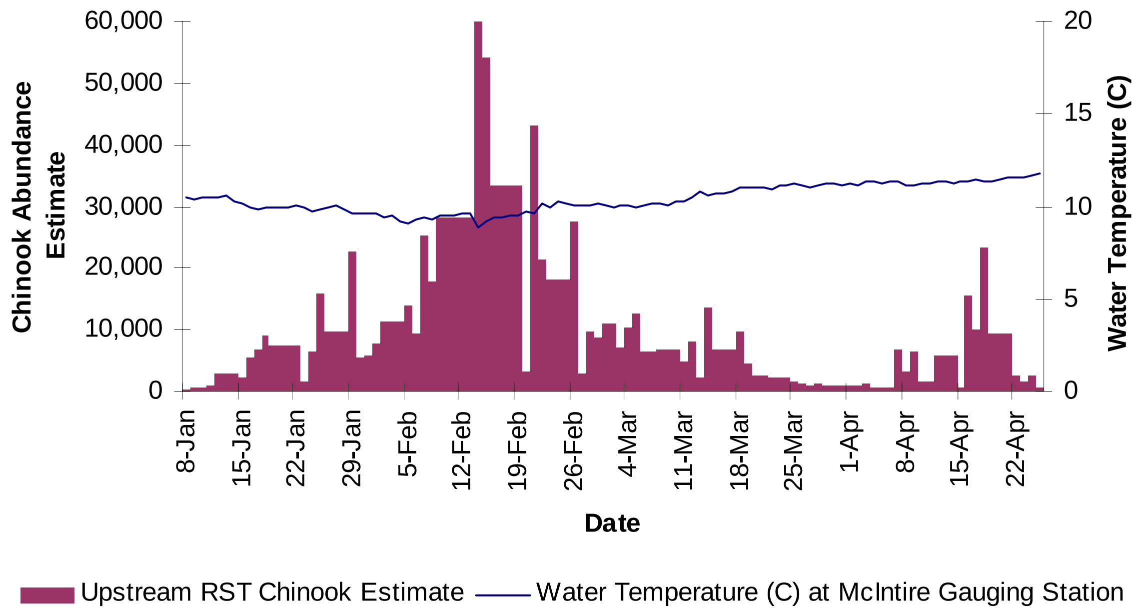


**Figure 15. Juvenile Chinook salmon daily abundance estimates at the upstream rotary screw trap and water temperature at the McIntire gauging station below Camanche Powerhouse on the lower Mokelumne River from January 8, 2008 through April 25, 2008.**

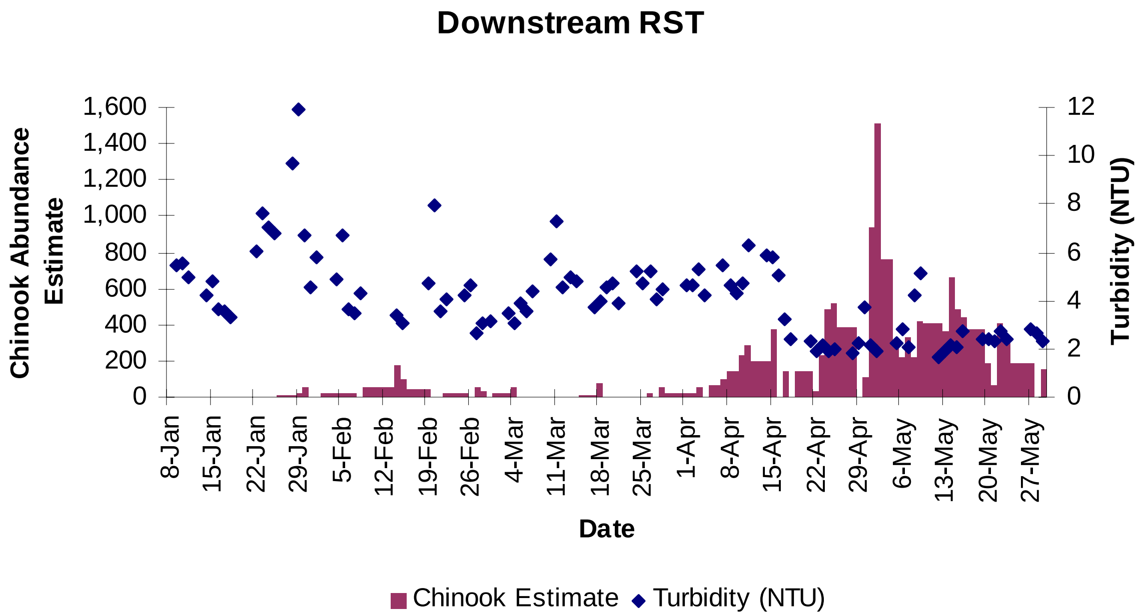


**Figure 16. Juvenile Chinook salmon daily abundance estimates at the downstream rotary screw trap and turbidity on the lower Mokelumne River from January 8, 2008 through May 29, 2008.**

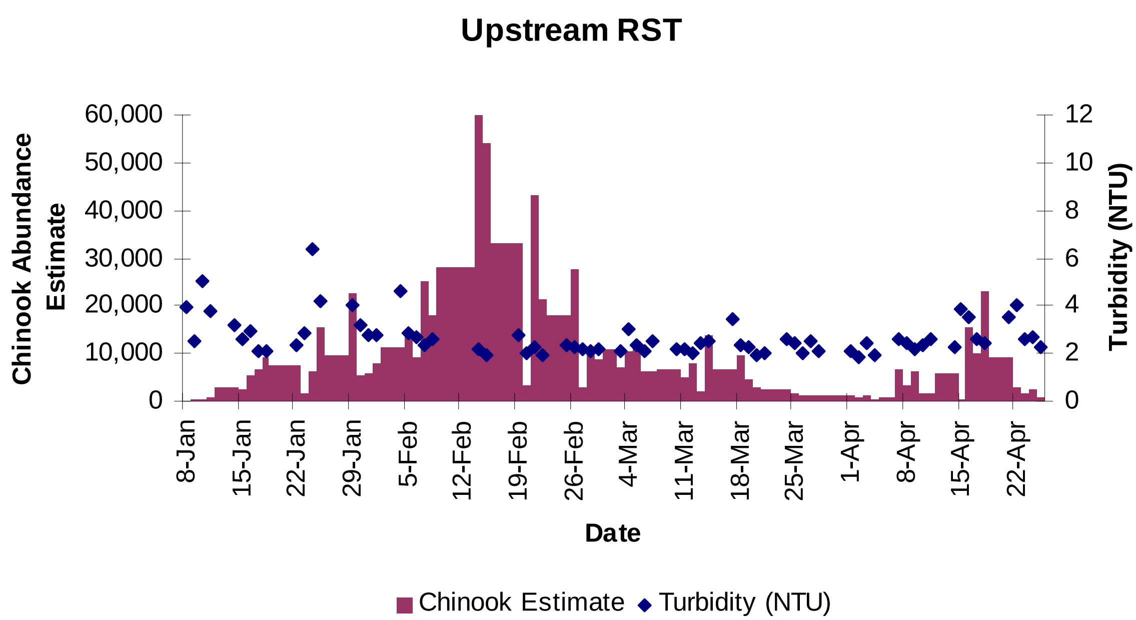


**Figure 17. Juvenile Chinook salmon daily abundance estimates at the upstream rotary screw trap and turbidity on the lower Mokelumne River from January 8, 2008 through April 25, 2008.**

**Appendix A. Trap catch, trap efficiency, abundance estimates and 95% confidence intervals of emigrating juvenile Chinook salmon in the lower Mokelumne River from January 8, 2008 through May 29, 2008. Shaded areas represent estimates for non-trapping periods.**

| | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| Date | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 1/8/2008 | 0 | 5 | 0.052 | 0.026 | 0 | 192 | 0 | 0 | 142 | 315 |
| 1/9/2008 | 0 | 15 | 0.052 | 0.026 | 0 | 577 | 0 | 0 | 425 | 945 |
| 1/10/2008 | 0 | 16 | 0.052 | 0.026 | 0 | 615 | 0 | 0 | 454 | 1009 |
| 1/11/2008 | 0 | 23 | 0.052 | 0.026 | 0 | 885 | 0 | 0 | 652 | 1450 |
| 1/12/2008 | 0 | 73 | 0.052 | 0.026 | 0 | 2821 | 0 | 0 | 2079 | 4622 |
| 1/13/2008 | 0 | 73 | 0.052 | 0.026 | 0 | 2821 | 0 | 0 | 2079 | 4622 |
| 1/14/2008 | 0 | 73 | 0.052 | 0.026 | 0 | 2821 | 0 | 0 | 2079 | 4622 |
| 1/15/2008 | 0 | 63 | 0.052 | 0.026 | 0 | 2423 | 0 | 0 | 1786 | 3971 |
| 1/16/2008 | 0 | 144 | 0.052 | 0.026 | 0 | 5538 | 0 | 0 | 4083 | 9077 |
| 1/17/2008 | 0 | 179 | 0.052 | 0.026 | 0 | 6885 | 0 | 0 | 5076 | 11283 |
| 1/18/2008 | 0 | 236 | 0.052 | 0.026 | 0 | 9077 | 0 | 0 | 6692 | 14876 |
| 1/19/2008 | 0 | 196 | 0.052 | 0.026 | 0 | 7545 | 0 | 0 | 5562 | 12365 |
| 1/20/2008 | 0 | 196 | 0.052 | 0.026 | 0 | 7545 | 0 | 0 | 5562 | 12365 |
| 1/21/2008 | 0 | 196 | 0.052 | 0.026 | 0 | 7545 | 0 | 0 | 5562 | 12365 |
| 1/22/2008 | 0 | 196 | 0.052 | 0.026 | 0 | 7545 | 0 | 0 | 5562 | 12365 |
| 1/23/2008 | 0 | 44 | 0.052 | 0.026 | 0 | 1692 | 0 | 0 | 1248 | 2773 |
| 1/24/2008 | 0 | 165 | 0.052 | 0.026 | 0 | 6346 | 0 | 0 | 4679 | 10400 |
| 1/25/2008 | 0 | 409 | 0.052 | 0.026 | 0 | 15731 | 0 | 0 | 11598 | 25780 |
| 1/26/2008 | 1 | 251 | 0.052 | 0.026 | 13 | 9654 | 10 | 17 | 7117 | 15821 |
| 1/27/2008 | 1 | 251 | 0.052 | 0.026 | 13 | 9654 | 10 | 17 | 7117 | 15821 |
| 1/28/2008 | 1 | 251 | 0.052 | 0.026 | 13 | 9654 | 10 | 17 | 7117 | 15821 |
| 1/29/2008 | 1 | 594 | 0.052 | 0.026 | 19 | 22846 | 15 | 26 | 16843 | 37441 |
| 1/30/2008 | 3 | 141 | 0.052 | 0.026 | 57 | 5423 | 46 | 78 | 3998 | 8888 |
| 1/31/2008 | 0 | 153 | 0.052 | 0.026 | 0 | 5885 | 0 | 0 | 4338 | 9644 |
| 2/1/2008 | 0 | 202 | 0.052 | 0.026 | 0 | 7769 | 0 | 0 | 5728 | 12733 |
| 2/2/2008 | 1 | 293 | 0.052 | 0.026 | 19 | 11263 | 15 | 26 | 8304 | 18458 |
| 2/3/2008 | 1 | 293 | 0.052 | 0.026 | 19 | 11263 | 15 | 26 | 8304 | 18458 |
| 2/4/2008 | 1 | 293 | 0.052 | 0.026 | 19 | 11263 | 15 | 26 | 8304 | 18458 |

**Appendix A continued.**

| Date | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 2/5/2008 | 1 | 361 | 0.052 | 0.026 | 19 | 13885 | 15 | 26 | 10236 | 22755 |
| 2/6/2008 | 1 | 241 | 0.052 | 0.026 | 19 | 9269 | 15 | 26 | 6834 | 15191 |
| 2/7/2008 | 1 | 659 | 0.052 | 0.026 | 19 | 25346 | 15 | 26 | 18687 | 41539 |
| 2/8/2008 | 0 | 467 | 0.052 | 0.026 | 0 | 17962 | 0 | 0 | 13242 | 29436 |
| 2/9/2008 | 3 | 736 | 0.052 | 0.026 | 51 | 28321 | 40 | 69 | 20879 | 46413 |
| 2/10/2008 | 3 | 736 | 0.052 | 0.026 | 51 | 28321 | 40 | 69 | 20879 | 46413 |
| 2/11/2008 | 3 | 736 | 0.052 | 0.026 | 51 | 28321 | 40 | 69 | 20879 | 46413 |
| 2/12/2008 | 3 | 736 | 0.052 | 0.026 | 51 | 28321 | 40 | 69 | 20879 | 46413 |
| 2/13/2008 | 3 | 736 | 0.052 | 0.026 | 51 | 28321 | 40 | 69 | 20879 | 46413 |
| 2/14/2008 | 9 | 1557 | 0.052 | 0.026 | 172 | 59885 | 137 | 234 | 44150 | 98142 |
| 2/15/2008 | 5 | 1410 | 0.052 | 0.026 | 96 | 54231 | 76 | 130 | 39982 | 88876 |
| 2/16/2008 | 3 | 867 | 0.052 | 0.026 | 48 | 33327 | 38 | 65 | 24570 | 54618 |
| 2/17/2008 | 3 | 867 | 0.052 | 0.026 | 48 | 33327 | 38 | 65 | 24570 | 54618 |
| 2/18/2008 | 3 | 867 | 0.052 | 0.026 | 48 | 33327 | 38 | 65 | 24570 | 54618 |
| 2/19/2008 | 3 | 867 | 0.052 | 0.026 | 48 | 33327 | 38 | 65 | 24570 | 54618 |
| 2/20/2008 | 0 | 84 | 0.052 | 0.026 | 0 | 3231 | 0 | 0 | 2382 | 5295 |
| 2/21/2008 | 0 | 1125 | 0.052 | 0.026 | 0 | 43269 | 0 | 0 | 31900 | 70912 |
| 2/22/2008 | 1 | 556 | 0.052 | 0.026 | 19 | 21385 | 15 | 26 | 15766 | 35046 |
| 2/23/2008 | 1 | 469 | 0.052 | 0.026 | 19 | 18051 | 15 | 26 | 13308 | 29583 |
| 2/24/2008 | 1 | 469 | 0.052 | 0.026 | 19 | 18051 | 15 | 26 | 13308 | 29583 |
| 2/25/2008 | 1 | 469 | 0.052 | 0.026 | 19 | 18051 | 15 | 26 | 13308 | 29583 |
| 2/26/2008 | 0 | 718 | 0.052 | 0.026 | 0 | 27615 | 0 | 0 | 20360 | 45257 |
| 2/27/2008 | 3 | 80 | 0.052 | 0.026 | 57 | 3077 | 46 | 78 | 2268 | 5043 |
| 2/28/2008 | 2 | 253 | 0.052 | 0.026 | 38 | 9731 | 30 | 52 | 7174 | 15947 |
| 2/29/2008 | 0 | 227 | 0.052 | 0.026 | 0 | 8731 | 0 | 0 | 6437 | 14308 |
| 3/1/2008 | 1 | 288 | 0.052 | 0.026 | 26 | 11090 | 20 | 35 | 8176 | 18174 |
| 3/2/2008 | 1 | 288 | 0.052 | 0.026 | 26 | 11090 | 20 | 35 | 8176 | 18174 |
| 3/3/2008 | 1 | 288 | 0.054 | 0.040 | 25 | 7208 | 19 | 33 | 5474 | 10247 |
| 3/4/2008 | 3 | 412 | 0.054 | 0.040 | 56 | 10300 | 44 | 74 | 7822 | 14642 |
| 3/5/2008 | 0 | 501 | 0.054 | 0.040 | 0 | 12525 | 0 | 0 | 9512 | 17805 |
| 3/6/2008 | 0 | 257 | 0.054 | 0.040 | 0 | 6425 | 0 | 0 | 4879 | 9133 |
| 3/7/2008 | 0 | 257 | 0.054 | 0.040 | 0 | 6425 | 0 | 0 | 4879 | 9133 |

**Appendix A continued.**

| | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| Date | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 3/8/2008 | 0 | 270 | 0.054 | 0.040 | 0 | 6738 | 0 | 0 | 5117 | 9578 |
| 3/9/2008 | 0 | 270 | 0.054 | 0.040 | 0 | 6738 | 0 | 0 | 5117 | 9578 |
| 3/10/2008 | 0 | 270 | 0.054 | 0.040 | 0 | 6738 | 0 | 0 | 5117 | 9578 |
| 3/11/2008 | 0 | 198 | 0.054 | 0.040 | 0 | 4950 | 0 | 0 | 3759 | 7037 |
| 3/12/2008 | 0 | 319 | 0.054 | 0.040 | 0 | 7975 | 0 | 0 | 6057 | 11337 |
| 3/13/2008 | 0 | 85 | 0.054 | 0.040 | 0 | 2125 | 0 | 0 | 1614 | 3021 |
| 3/14/2008 | 0 | 548 | 0.054 | 0.040 | 0 | 13700 | 0 | 0 | 10404 | 19475 |
| 3/15/2008 | 1 | 272 | 0.054 | 0.040 | 12 | 6800 | 10 | 17 | 5164 | 9667 |
| 3/16/2008 | 1 | 272 | 0.054 | 0.040 | 12 | 6800 | 10 | 17 | 5164 | 9667 |
| 3/17/2008 | 1 | 272 | 0.054 | 0.040 | 12 | 6800 | 10 | 17 | 5164 | 9667 |
| 3/18/2008 | 4 | 383 | 0.054 | 0.040 | 74 | 9575 | 58 | 99 | 7272 | 13611 |
| 3/19/2008 | 0 | 187 | 0.054 | 0.040 | 0 | 4675 | 0 | 0 | 3550 | 6646 |
| 3/20/2008 | 0 | 110 | 0.054 | 0.040 | 0 | 2750 | 0 | 0 | 2088 | 3909 |
| 3/21/2008 | 0 | 100 | 0.054 | 0.040 | 0 | 2500 | 0 | 0 | 1899 | 3554 |
| 3/22/2008 | 0 | 93 | 0.054 | 0.040 | 3 | 2313 | 2 | 4 | 1756 | 3287 |
| 3/23/2008 | 0 | 93 | 0.054 | 0.040 | 3 | 2313 | 2 | 4 | 1756 | 3287 |
| 3/24/2008 | 0 | 93 | 0.054 | 0.040 | 3 | 2313 | 2 | 4 | 1756 | 3287 |
| 3/25/2008 | 0 | 59 | 0.054 | 0.040 | 0 | 1475 | 0 | 0 | 1120 | 2097 |
| 3/26/2008 | 1 | 56 | 0.054 | 0.040 | 19 | 1400 | 15 | 25 | 1063 | 1990 |
| 3/27/2008 | 0 | 43 | 0.054 | 0.040 | 0 | 1075 | 0 | 0 | 816 | 1528 |
| 3/28/2008 | 3 | 51 | 0.054 | 0.040 | 56 | 1275 | 44 | 74 | 968 | 1812 |
| 3/29/2008 | 1 | 45 | 0.054 | 0.040 | 25 | 1121 | 19 | 33 | 851 | 1593 |
| 3/30/2008 | 1 | 45 | 0.054 | 0.040 | 25 | 1121 | 19 | 33 | 851 | 1593 |
| 3/31/2008 | 1 | 45 | 0.054 | 0.040 | 25 | 1121 | 19 | 33 | 851 | 1593 |
| 4/1/2008 | 1 | 45 | 0.054 | 0.040 | 25 | 1121 | 19 | 33 | 851 | 1593 |
| 4/2/2008 | 1 | 40 | 0.054 | 0.040 | 19 | 1000 | 15 | 25 | 759 | 1422 |
| 4/3/2008 | 3 | 58 | 0.054 | 0.040 | 56 | 1450 | 44 | 74 | 1101 | 2061 |
| 4/4/2008 | 0 | 21 | 0.054 | 0.040 | 0 | 525 | 0 | 0 | 399 | 746 |
| 4/5/2008 | 4 | 27 | 0.054 | 0.040 | 68 | 683 | 54 | 91 | 519 | 971 |
| 4/6/2008 | 4 | 27 | 0.054 | 0.040 | 68 | 683 | 54 | 91 | 519 | 971 |
| 4/7/2008 | 4 | 27 | 0.035 | 0.004 | 105 | 6833 | 79 | 155 | 3458 | 311483 |
| 4/8/2008 | 5 | 13 | 0.035 | 0.004 | 143 | 3250 | 108 | 212 | 1645 | 148144 |

**Appendix A continued.**

| | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| Date | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 4/9/2008 | 5 | 26 | 0.035 | 0.004 | 143 | 6500 | 108 | 212 | 3289 | 296289 |
| 4/10/2008 | 8 | 6 | 0.035 | 0.004 | 229 | 1500 | 172 | 339 | 759 | 68374 |
| 4/11/2008 | 10 | 7 | 0.035 | 0.004 | 286 | 1750 | 215 | 423 | 886 | 79770 |
| 4/12/2008 | 7 | 24 | 0.035 | 0.004 | 195 | 5958 | 147 | 289 | 3015 | 271598 |
| 4/13/2008 | 7 | 24 | 0.035 | 0.004 | 195 | 5958 | 147 | 289 | 3015 | 271598 |
| 4/14/2008 | 7 | 24 | 0.035 | 0.004 | 195 | 5958 | 147 | 289 | 3015 | 271598 |
| 4/15/2008 | 13 | 2 | 0.035 | 0.004 | 371 | 500 | 280 | 550 | 253 | 22791 |
| 4/16/2008 | 0 | 62 | 0.035 | 0.004 | 0 | 15500 | 0 | 0 | 7844 | 706535 |
| 4/17/2008 | 5 | 40 | 0.035 | 0.004 | 143 | 10000 | 108 | 212 | 5061 | 455829 |
| 4/18/2008 | 0 | 93 | 0.035 | 0.004 | 0 | 23250 | 0 | 0 | 11766 | 1059802 |
| 4/19/2008 | 5 | 37 | 0.035 | 0.004 | 148 | 9292 | 111 | 219 | 4702 | 423541 |
| 4/20/2008 | 5 | 37 | 0.035 | 0.004 | 148 | 9292 | 111 | 219 | 4702 | 423541 |
| 4/21/2008 | 5 | 37 | 0.035 | 0.004 | 148 | 9292 | 111 | 219 | 4702 | 423541 |
| 4/22/2008 | 1 | 11 | 0.035 | 0.004 | 29 | 2750 | 22 | 42 | 1392 | 125353 |
| 4/23/2008 | 8 | 7 | 0.035 | 0.004 | 229 | 1750 | 172 | 339 | 886 | 79770 |
| 4/24/2008 | 17 | 10 | 0.035 | 0.004 | 486 | 2500 | 366 | 719 | 1265 | 113957 |
| 4/25/2008 | 18 | 3 | 0.035 | 0.004 | 514 | 750 | 388 | 762 | 380 | 34187 |
| 4/26/2008 | 13 | | 0.035 | | 381 | | 287 | 564 | | |
| 4/27/2008 | 13 | | 0.035 | | 381 | | 287 | 564 | | |
| 4/28/2008 | 13 | | 0.035 | | 381 | | 287 | 564 | | |
| 4/29/2008 | 0 | | 0.035 | | 0 | | 0 | 0 | | |
| 4/30/2008 | 4 | | 0.035 | | 114 | | 86 | 169 | | |
| 5/1/2008 | 33 | | 0.035 | | 943 | | 711 | 1396 | | |
| 5/2/2008 | 53 | | 0.035 | | 1514 | | 1141 | 2243 | | |
| 5/3/2008 | 27 | | 0.035 | | 757 | | 571 | 1121 | | |
| 5/4/2008 | 27 | | 0.035 | | 757 | | 571 | 1121 | | |
| 5/5/2008 | 27 | | 0.089 | | 298 | | 248 | 371 | | |
| 5/6/2008 | 20 | | 0.089 | | 225 | | 188 | 280 | | |
| 5/7/2008 | 29 | | 0.089 | | 326 | | 272 | 406 | | |
| 5/8/2008 | 20 | | 0.089 | | 225 | | 188 | 280 | | |
| 5/9/2008 | 37 | | 0.089 | | 416 | | 347 | 519 | | |
| 5/10/2008 | 37 | | 0.089 | | 412 | | 344 | 514 | | |

**Appendix A continued.**

| Date | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 5/11/2008 | 37 | | 0.089 | | 412 | | 344 | 514 | | |
| 5/12/2008 | 37 | | 0.089 | | 412 | | 344 | 514 | | |
| 5/13/2008 | 32 | | 0.089 | | 360 | | 300 | 448 | | |
| 5/14/2008 | 59 | | 0.089 | | 663 | | 553 | 827 | | |
| 5/15/2008 | 43 | | 0.089 | | 483 | | 403 | 603 | | |
| 5/16/2008 | 39 | | 0.089 | | 438 | | 366 | 547 | | |
| 5/17/2008 | 33 | | 0.089 | | 375 | | 313 | 467 | | |
| 5/18/2008 | 33 | | 0.089 | | 375 | | 313 | 467 | | |
| 5/19/2008 | 33 | | 0.089 | | 375 | | 313 | 467 | | |
| 5/20/2008 | 17 | | 0.089 | | 191 | | 159 | 238 | | |
| 5/21/2008 | 6 | | 0.089 | | 67 | | 56 | 84 | | |
| 5/22/2008 | 36 | | 0.089 | | 404 | | 338 | 505 | | |
| 5/23/2008 | 27 | | 0.089 | | 303 | | 253 | 378 | | |
| 5/24/2008 | 17 | | 0.089 | | 187 | | 156 | 233 | | |
| 5/25/2008 | 17 | | 0.089 | | 187 | | 156 | 233 | | |
| 5/26/2008 | 17 | | 0.089 | | 187 | | 156 | 233 | | |
| 5/27/2008 | 17 | | 0.089 | | 187 | | 156 | 233 | | |
| 5/28/2008 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/29/2008 | 14 | | 0.089 | | 157 | | 131 | 196 | | |
| Total Catch | 601 | 14092 | | | | | | | | |
| Total Estimate | 3277 | 22868 | | | 42244 | 901022 | 33666 | 57205 | 639331 | 6830255 |

**Appendix B. Trap catch, trap efficiency, abundance estimates and 95% confidence intervals of emigrating juvenile steelhead in the lower Mokelumne River from January 8, 2008 through May 29, 2008. Shaded areas represent estimates for non-trapping periods.**

| | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| Date | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 1/8/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/9/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/10/08 | 0 | 1 | 0.052 | 0.026 | 0 | 38 | 0 | 0 | 28 | 63 |
| 1/11/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/12/08 | 0 | 1 | 0.052 | 0.026 | 0 | 38 | 0 | 0 | 28 | 63 |
| 1/13/08 | 0 | 1 | 0.052 | 0.026 | 0 | 38 | 0 | 0 | 28 | 63 |
| 1/14/08 | 0 | 1 | 0.052 | 0.026 | 0 | 38 | 0 | 0 | 28 | 63 |
| 1/15/08 | 0 | 3 | 0.052 | 0.026 | 0 | 115 | 0 | 0 | 85 | 189 |
| 1/16/08 | 0 | 2 | 0.052 | 0.026 | 0 | 77 | 0 | 0 | 57 | 126 |
| 1/17/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/18/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/19/08 | 0 | 0 | 0.052 | 0.026 | 0 | 13 | 0 | 0 | 9 | 21 |
| 1/20/08 | 0 | 0 | 0.052 | 0.026 | 0 | 13 | 0 | 0 | 9 | 21 |
| 1/21/08 | 0 | 0 | 0.052 | 0.026 | 0 | 13 | 0 | 0 | 9 | 21 |
| 1/22/08 | 0 | 0 | 0.052 | 0.026 | 0 | 13 | 0 | 0 | 9 | 21 |
| 1/23/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/24/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/25/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/26/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/27/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/28/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/29/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/30/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1/31/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2/1/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2/2/08 | 0 | 0 | 0.052 | 0.026 | 3 | 0 | 3 | 4 | 0 | 0 |
| 2/3/08 | 0 | 0 | 0.052 | 0.026 | 3 | 0 | 3 | 4 | 0 | 0 |
| 2/4/08 | 0 | 0 | 0.052 | 0.026 | 3 | 0 | 3 | 4 | 0 | 0 |

**Appendix B continued.**

| Date | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Downstream | | Upstream | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Low | High | Low | High |
| 2/5/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2/6/08 | 1 | 0 | 0.052 | 0.026 | 19 | 0 | 15 | 26 | 0 | 0 |
| 2/7/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2/8/08 | 1 | 0 | 0.052 | 0.026 | 19 | 0 | 15 | 26 | 0 | 0 |
| 2/9/08 | 0 | 0 | 0.052 | 0.026 | 6 | 6 | 5 | 9 | 5 | 11 |
| 2/10/08 | 0 | 0 | 0.052 | 0.026 | 6 | 6 | 5 | 9 | 5 | 11 |
| 2/11/08 | 0 | 0 | 0.052 | 0.026 | 6 | 6 | 5 | 9 | 5 | 11 |
| 2/12/08 | 0 | 0 | 0.052 | 0.026 | 6 | 6 | 5 | 9 | 5 | 11 |
| 2/13/08 | 0 | 0 | 0.052 | 0.026 | 6 | 6 | 5 | 9 | 5 | 11 |
| 2/14/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2/15/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2/16/08 | 0 | 0 | 0.052 | 0.026 | 3 | 13 | 3 | 4 | 9 | 21 |
| 2/17/08 | 0 | 0 | 0.052 | 0.026 | 3 | 13 | 3 | 4 | 9 | 21 |
| 2/18/08 | 0 | 0 | 0.052 | 0.026 | 3 | 13 | 3 | 4 | 9 | 21 |
| 2/19/08 | 0 | 0 | 0.052 | 0.026 | 3 | 13 | 3 | 4 | 9 | 21 |
| 2/20/08 | 0 | 1 | 0.052 | 0.026 | 0 | 38 | 0 | 0 | 28 | 63 |
| 2/21/08 | 0 | 1 | 0.052 | 0.026 | 0 | 38 | 0 | 0 | 28 | 63 |
| 2/22/08 | 0 | 0 | 0.052 | 0.026 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2/23/08 | 0 | 1 | 0.052 | 0.026 | 3 | 51 | 3 | 4 | 38 | 84 |
| 2/24/08 | 0 | 1 | 0.052 | 0.026 | 3 | 51 | 3 | 4 | 38 | 84 |
| 2/25/08 | 0 | 1 | 0.052 | 0.026 | 3 | 51 | 3 | 4 | 38 | 84 |
| 2/26/08 | 1 | 3 | 0.052 | 0.026 | 19 | 115 | 15 | 26 | 85 | 189 |
| 2/27/08 | 0 | 1 | 0.052 | 0.026 | 0 | 38 | 0 | 0 | 28 | 63 |
| 2/28/08 | 0 | 2 | 0.052 | 0.026 | 0 | 77 | 0 | 0 | 57 | 126 |
| 2/29/08 | 2 | 1 | 0.052 | 0.026 | 38 | 38 | 30 | 52 | 28 | 63 |
| 3/1/08 | 1 | 1 | 0.052 | 0.026 | 19 | 51 | 15 | 26 | 38 | 84 |
| 3/2/08 | 1 | 1 | 0.052 | 0.026 | 19 | 51 | 15 | 26 | 38 | 84 |
| 3/3/08 | 1 | 1 | 0.054 | 0.040 | 19 | 33 | 15 | 25 | 25 | 47 |
| 3/4/08 | 0 | 3 | 0.054 | 0.040 | 0 | 75 | 0 | 0 | 57 | 107 |
| 3/5/08 | 2 | 0 | 0.054 | 0.040 | 37 | 0 | 29 | 50 | 0 | 0 |
| 3/6/08 | 2 | 1 | 0.054 | 0.040 | 37 | 25 | 29 | 50 | 19 | 36 |
| 3/7/08 | 0 | 2 | 0.054 | 0.040 | 0 | 50 | 0 | 0 | 38 | 71 |

**Appendix B continued.**

| | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| Date | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 3/8/08 | 0 | 5 | 0.054 | 0.040 | 12 | 71 | 10 | 17 | 54 | 101 |
| 3/9/08 | 0 | 5 | 0.054 | 0.040 | 12 | 71 | 10 | 17 | 54 | 101 |
| 3/10/08 | 0 | 5 | 0.054 | 0.040 | 12 | 71 | 10 | 17 | 54 | 101 |
| 3/11/08 | 0 | 5 | 0.054 | 0.040 | 0 | 125 | 0 | 0 | 95 | 178 |
| 3/12/08 | 0 | 4 | 0.054 | 0.040 | 0 | 100 | 0 | 0 | 76 | 142 |
| 3/13/08 | 0 | 5 | 0.054 | 0.040 | 0 | 125 | 0 | 0 | 95 | 178 |
| 3/14/08 | 0 | 10 | 0.054 | 0.040 | 0 | 250 | 0 | 0 | 190 | 355 |
| 3/15/08 | 0 | 7 | 0.054 | 0.040 | 0 | 163 | 0 | 0 | 123 | 231 |
| 3/16/08 | 0 | 7 | 0.054 | 0.040 | 0 | 163 | 0 | 0 | 123 | 231 |
| 3/17/08 | 0 | 7 | 0.054 | 0.040 | 0 | 163 | 0 | 0 | 123 | 231 |
| 3/18/08 | 0 | 8 | 0.054 | 0.040 | 0 | 200 | 0 | 0 | 152 | 284 |
| 3/19/08 | 0 | 6 | 0.054 | 0.040 | 0 | 150 | 0 | 0 | 114 | 213 |
| 3/20/08 | 0 | 6 | 0.054 | 0.040 | 0 | 150 | 0 | 0 | 114 | 213 |
| 3/21/08 | 1 | 2 | 0.054 | 0.040 | 19 | 50 | 15 | 25 | 38 | 71 |
| 3/22/08 | 0 | 15 | 0.054 | 0.040 | 6 | 375 | 5 | 8 | 285 | 533 |
| 3/23/08 | 0 | 15 | 0.054 | 0.040 | 6 | 375 | 5 | 8 | 285 | 533 |
| 3/24/08 | 0 | 15 | 0.054 | 0.040 | 6 | 375 | 5 | 8 | 285 | 533 |
| 3/25/08 | 0 | 31 | 0.054 | 0.040 | 0 | 775 | 0 | 0 | 589 | 1102 |
| 3/26/08 | 0 | 32 | 0.054 | 0.040 | 0 | 800 | 0 | 0 | 608 | 1137 |
| 3/27/08 | 1 | 13 | 0.054 | 0.040 | 19 | 325 | 15 | 25 | 247 | 462 |
| 3/28/08 | 0 | 11 | 0.054 | 0.040 | 0 | 275 | 0 | 0 | 209 | 391 |
| 3/29/08 | 0 | 21 | 0.054 | 0.040 | 3 | 513 | 2 | 4 | 389 | 729 |
| 3/30/08 | 0 | 21 | 0.054 | 0.040 | 3 | 513 | 2 | 4 | 389 | 729 |
| 3/31/08 | 0 | 21 | 0.054 | 0.040 | 3 | 513 | 2 | 4 | 389 | 729 |
| 4/1/08 | 0 | 21 | 0.054 | 0.040 | 3 | 513 | 2 | 4 | 389 | 729 |
| 4/2/08 | 0 | 18 | 0.054 | 0.040 | 0 | 450 | 0 | 0 | 342 | 640 |
| 4/3/08 | 0 | 12 | 0.054 | 0.040 | 0 | 300 | 0 | 0 | 228 | 426 |
| 4/4/08 | 0 | 37 | 0.054 | 0.040 | 0 | 925 | 0 | 0 | 702 | 1315 |
| 4/5/08 | 0 | 17 | 0.054 | 0.040 | 6 | 392 | 5 | 8 | 297 | 557 |
| 4/6/08 | 0 | 17 | 0.054 | 0.040 | 6 | 392 | 5 | 8 | 297 | 557 |
| 4/7/08 | 0 | 17 | 0.035 | 0.004 | 10 | 3917 | 7 | 14 | 1982 | 178533 |
| 4/8/08 | 0 | 2 | 0.035 | 0.004 | 0 | 500 | 0 | 0 | 253 | 22791 |

**Appendix B continued.**

| Date | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 4/9/08 | 0 | 12 | 0.035 | 0.004 | 0 | 3000 | 0 | 0 | 1518 | 136749 |
| 4/10/08 | 2 | 13 | 0.035 | 0.004 | 57 | 3250 | 43 | 85 | 1645 | 148144 |
| 4/11/08 | 0 | 3 | 0.035 | 0.004 | 0 | 750 | 0 | 0 | 380 | 34187 |
| 4/12/08 | 1 | 8 | 0.035 | 0.004 | 14 | 2083 | 11 | 21 | 1054 | 94964 |
| 4/13/08 | 1 | 8 | 0.035 | 0.004 | 14 | 2083 | 11 | 21 | 1054 | 94964 |
| 4/14/08 | 1 | 8 | 0.035 | 0.004 | 14 | 2083 | 11 | 21 | 1054 | 94964 |
| 4/15/08 | 0 | 2 | 0.035 | 0.004 | 0 | 500 | 0 | 0 | 253 | 22791 |
| 4/16/08 | 0 | 14 | 0.035 | 0.004 | 0 | 3500 | 0 | 0 | 1771 | 159540 |
| 4/17/08 | 1 | 6 | 0.035 | 0.004 | 29 | 1500 | 22 | 42 | 759 | 68374 |
| 4/18/08 | 0 | 10 | 0.035 | 0.004 | 0 | 2500 | 0 | 0 | 1265 | 113957 |
| 4/19/08 | 0 | 8 | 0.035 | 0.004 | 10 | 1958 | 7 | 14 | 991 | 89266 |
| 4/20/08 | 0 | 8 | 0.035 | 0.004 | 10 | 1958 | 7 | 14 | 991 | 89266 |
| 4/21/08 | 0 | 8 | 0.035 | 0.004 | 10 | 1958 | 7 | 14 | 991 | 89266 |
| 4/22/08 | 0 | 6 | 0.035 | 0.004 | 0 | 1500 | 0 | 0 | 759 | 68374 |
| 4/23/08 | 1 | 8 | 0.035 | 0.004 | 29 | 2000 | 22 | 42 | 1012 | 91166 |
| 4/24/08 | 0 | 3 | 0.035 | 0.004 | 0 | 750 | 0 | 0 | 380 | 34187 |
| 4/25/08 | 2 | 12 | 0.035 | 0.004 | 57 | 3000 | 43 | 85 | 1518 | 136749 |
| 4/26/08 | 1 | | 0.035 | | 14 | | 11 | 21 | | |
| 4/27/08 | 1 | | 0.035 | | 14 | | 11 | 21 | | |
| 4/28/08 | 1 | | 0.035 | | 14 | | 11 | 21 | | |
| 4/29/08 | 0 | | 0.035 | | 0 | | 0 | 0 | | |
| 4/30/08 | 0 | | 0.035 | | 0 | | 0 | 0 | | |
| 5/1/08 | 0 | | 0.035 | | 0 | | 0 | 0 | | |
| 5/2/08 | 0 | | 0.035 | | 0 | | 0 | 0 | | |
| 5/3/08 | 0 | | 0.035 | | 0 | | 0 | 0 | | |
| 5/4/08 | 0 | | 0.035 | | 0 | | 0 | 0 | | |
| 5/5/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/6/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/7/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/8/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/9/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/10/08 | 0 | | 0.089 | | 2 | | 2 | 2 | | |
| 5/11/08 | 0 | | 0.089 | | 2 | | 2 | 2 | | |

**Appendix B continued.**

| | Catch | | Trap Efficiency | | Abundance Estimate | | 95% Confidence Interval | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Downstream | | Upstream | |
| Date | Downstream | Upstream | Downstream | Upstream | Downstream | Upstream | Low | High | Low | High |
| 5/12/08 | 0 | | 0.089 | | 2 | | 2 | 2 | | |
| 5/13/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/14/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/15/08 | 1 | | 0.089 | | 11 | | 9 | 14 | | |
| 5/16/08 | 1 | | 0.089 | | 11 | | 9 | 14 | | |
| 5/17/08 | 0 | | 0.089 | | 4 | | 3 | 5 | | |
| 5/18/08 | 0 | | 0.089 | | 4 | | 3 | 5 | | |
| 5/19/08 | 0 | | 0.089 | | 4 | | 3 | 5 | | |
| 5/20/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/21/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/22/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/23/08 | 1 | | 0.089 | | 11 | | 9 | 14 | | |
| 5/24/08 | 0 | | 0.089 | | 4 | | 4 | 6 | | |
| 5/25/08 | 0 | | 0.089 | | 4 | | 4 | 6 | | |
| 5/26/08 | 0 | | 0.089 | | 4 | | 4 | 6 | | |
| 5/27/08 | 0 | | 0.089 | | 4 | | 4 | 6 | | |
| 5/28/08 | 0 | | 0.089 | | 0 | | 0 | 0 | | |
| 5/29/08 | 1 | | 0.089 | | 11 | | 9 | 14 | | |
| Total Catch | 21 | 312 | | | | | | | | |
| Total Estimate | 39 | 577 | | | 783 | 49717 | 611 | 1086 | 27904 | 1784002 |

**Appendix C. Raw capture data for fish species captured during the 2007 downstream rotary screw trap survey on the lower Mokelumne River from January 8, 2008 through May 29, 2008. Native species are in bold.**

| Species | Life Stage | Jan | Feb | Mar | Apr | May | Total |
|---|---|---|---|---|---|---|---|
| Black Bullhead | Juvenile | 0 | 0 | 0 | 0 | 1 | 1 |
| *Ameiurus melas* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Black Crappie | Juvenile | 1 | 0 | 0 | 0 | 0 | 1 |
| *Pomoxis Nigromaculatus* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Bluegill | Juvenile | 4 | 2 | 3 | 9 | 5 | 23 |
| *Lepomis macrochirus* | Adult | 0 | 1 | 2 | 0 | 0 | 3 |
| **Chinook Salmon** | Juvenile | 4 | 23 | 11 | 98 | 465 | 601 |
| *Oncorhynchus tshawytscha* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Common Carp | Juvenile | 0 | 0 | 0 | 0 | 94 | 94 |
| *Cyprinus carpio* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Western Mosquitofish | Juvenile | 0 | 0 | 0 | 0 | 0 | 0 |
| *Gambusia affinis* | Adult | 0 | 0 | 0 | 1 | 1 | 2 |
| Golden Shiner | Juvenile | 3 | 4 | 0 | 1 | 0 | 8 |
| *Notemigonus crysoleucas* | Adult | 14 | 7 | 2 | 5 | 0 | 28 |
| Goldfish | Juvenile | 0 | 1 | 0 | 0 | 1 | 2 |
| *Carassius auratus* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Hitch** | Juvenile | 0 | 0 | 1 | 2 | 0 | 3 |
| *Lavinia exilicauda* | Adult | 1 | 1 | 3 | 1 | 0 | 6 |
| Inland Silverside | Juvenile | 0 | 0 | 0 | 0 | 0 | 0 |
| *Menidia beryllina* | Adult | 0 | 0 | 2 | 1 | 2 | 5 |
| Kokanee | Juvenile | 1 | 0 | 0 | 1 | 1 | 3 |
| *Oncorhynchus nerka* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Largemouth Bass | Juvenile | 1 | 1 | 1 | 0 | 0 | 3 |
| *Micropterus salmoides* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Pacific Lamprey** | Ammocoete | 3 | 0 | 0 | 1 | 0 | 4 |
| *Lampetra tridentata* | Juvenile | 17 | 4 | 2 | 11 | 1 | 35 |
|  | Adult | 0 | 1 | 2 | 2 | 4 | 9 |

**Appendix C continued.**

| Species | Life Stage | Jan | Feb | Mar | Apr | May | Total |
|---|---|---|---|---|---|---|---|
| **Prickly Sculpin** | Juvenile | 28 | 15 | 6 | 26 | 207 | 282 |
| *Cottus asper* | Adult | 317 | 148 | 68 | 14 | 6 | 553 |
| Redear Sunfish | Juvenile | 0 | 1 | 0 | 0 | 0 | 1 |
| *Lepomis microlophus* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Redeye Bass | Juvenile | 0 | 0 | 1 | 0 | 0 | 1 |
| *Micropterus coosae* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Sacramento Pikeminnow** | Juvenile | 0 | 1 | 0 | 0 | 1 | 2 |
| *Ptychocheilus grandis* | Adult | 0 | 0 | 1 | 0 | 0 | 1 |
| **Sacramento Sucker** | Juvenile | 0 | 0 | 0 | 1 | 28 | 29 |
| *Catostomus occidentalis* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Spotted Bass | Juvenile | 1 | 0 | 0 | 0 | 0 | 1 |
| *Micropterus punctulatus* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Steelhead** | Juvenile | 0 | 5 | 6 | 6 | 4 | 21 |
| *Oncorhynchus mykiss* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Steelhead Adclipped** | Juvenile | 0 | 0 | 0 | 42 | 23 | 65 |
| *Oncorhynchus mykiss* | Adult | 1 | 0 | 0 | 0 | 0 | 1 |
| Threadfin Shad | Juvenile | 0 | 0 | 0 | 0 | 0 | 0 |
| *Dorosoma petenense* | Adult | 1 | 0 | 0 | 0 | 0 | 1 |
| **Tule Perch** | Juvenile | 0 | 0 | 1 | 0 | 0 | 1 |
| *Hysterocarpus traski* | Adult | 0 | 1 | 9 | 14 | 0 | 24 |
| Warmouth | Juvenile | 0 | 0 | 0 | 1 | 1 | 2 |
| *Lepomis gulosus* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| White Catfish | Juvenile | 0 | 0 | 0 | 0 | 0 | 0 |
| *Ameiurus catus* | Adult | 0 | 0 | 0 | 1 | 2 | 3 |
| Unknown Black Bass | Juvenile | 0 | 0 | 0 | 0 | 807 | 807 |
| *Micropterus sp.* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |

**Appendix D. Raw capture data for fish species captured during the 2007 upstream rotary screw trap survey on the lower Mokelumne River from January 8, 2008 through May 29, 2008. Native species are in bold.**

| Species | Life Stage | Jan | Feb | Mar | Apr | May | Total |
|---|---|---|---|---|---|---|---|
| Bluegill | Juvenile | 3 | 1 | 0 | 1 | 0 | 5 |
| *Lepomis macrochirus* | Adult | 0 | 0 | 0 | 4 | 0 | 4 |
| **Chinook Salmon** | Juvenile | 2,187 | 7,940 | 3,566 | 399 | 0 | 14092 |
| *Oncorhynchus tshawytscha* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Common Carp | Juvenile | 1 | 0 | 0 | 0 | 0 | 1 |
| *Cyprinus carpio* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Western Mosquitofish | Juvenile | 0 | 0 | 0 | 0 | 0 | 0 |
| *Gambusia affinis* | Adult | 0 | 1 | 0 | 2 | 0 | 3 |
| Golden Shiner | Juvenile | 1 | 1 | 1 | 1 | 0 | 4 |
| *Notemigonus crysoleucas* | Adult | 16 | 8 | 1 | 1 | 0 | 26 |
| **Hitch** | Juvenile | 6 | 3 | 5 | 18 | 0 | 32 |
| *Lavinia exilicauda* | Adult | 9 | 5 | 3 | 12 | 0 | 29 |
| Kokanee | Juvenile | 1 | 1 | 1 | 18 | 0 | 21 |
| *Oncorhynchus nerka* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| Largemouth Bass | Juvenile | 1 | 0 | 0 | 0 | 0 | 1 |
| *Micropterus salmoides* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Pacific Lamprey** | Ammocoete | 2 | 3 | 2 | 1 | 0 | 8 |
| *Lampetra tridentata* | Juvenile | 97 | 6 | 4 | 14 | 0 | 121 |
| | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Prickly Sculpin** | Juvenile | 1 | 4 | 2 | 2 | 0 | 9 |
| *Cottus asper* | Adult | 16 | 11 | 8 | 15 | 0 | 50 |
| Redear Sunfish | Juvenile | 0 | 1 | 0 | 0 | 0 | 1 |
| *Lepomis microlophus* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Sacramento Pikeminnow** | Juvenile | 0 | 0 | 0 | 0 | 0 | 0 |
| *Ptychocheilus grandis* | Adult | 0 | 1 | 0 | 0 | 0 | 1 |
| **Sacramento Sucker** | Juvenile | 5 | 2 | 0 | 4 | 0 | 11 |
| *Catostomus occidentalis* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |

**Appendix D continued.**

| Species | Life Stage | Jan | Feb | Mar | Apr | May | Total |
|---|---|---|---|---|---|---|---|
| Spotted Bass | Juvenile | 1 | 0 | 0 | 0 | 0 | 1 |
| *Micropterus punctulatus* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Steelhead** | Juvenile | 3 | 12 | 139 | 158 | 0 | 312 |
| *Oncorhynchus mykiss* | Adult | 1 | 0 | 0 | 0 | 0 | 1 |
| **Steelhead Adclipped** | Juvenile | 0 | 0 | 0 | 15 | 0 | 15 |
| *Oncorhynchus mykiss* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |
| **Tule Perch** | Juvenile | 0 | 0 | 0 | 0 | 0 | 0 |
| *Hysterocarpus traski* | Adult | 1 | 0 | 1 | 0 | 0 | 2 |
| White Catfish | Juvenile | 0 | 0 | 0 | 1 | 0 | 1 |
| *Ameiurus catus* | Adult | 0 | 0 | 0 | 0 | 0 | 0 |