YUBA RIVER JUVENILE CHINOOK SALMON, *ONCORHYNCHUS TSHAWYTSHA*, AND JUVENILE CENTRAL VALLEY STEELHEAD TROUT, *ONCORHYNCHUS MYKISS*, LIFE HISTORY SURVEY, ANNUAL DATA REPORT 2005-2006

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Introduction

The Yuba River, a tributary of the Feather River, drains a watershed of 3,468 kilometers^2 (1,339 miles^2), originating in the higher elevations of the west slope of the Sierra Nevada. The lower Yuba River is drained by the North, Middle, and South Yuba Rivers. The three tributaries converge near, and are impounded by the U.S. Army Corps of Engineers' (ACOE) Englebright Dam, approximately 39 kilometers (24 river miles) east of the city of Marysville. Englebright Dam represents the upper limits of anadromous fish migration and spawning (Drury 2003; Massa 2006, 2007). The lower Yuba River provides spawning habitat for adult spring-, fall-, and late fall-run Chinook salmon, as well as Central Valley steelhead trout (CDFG 1991, 1998). In addition, the river below Daguerre Point Dam supports other anadromous species including American shad, green sturgeon, and striped bass. Over the years, lower Yuba River anadromous salmonid populations have been adversely affected by water and land use practices; such as mining, dam construction, and water diversions that have impacted available spawning habitat through non-natural flow regimes, unsuitable water temperatures, and an overall loss of available spawning gravel substrates. These practices have affected adult Chinook salmon populations through losses to crucial habitat during essential rearing, migration and spawning periods.

Historically, the spring-run Chinook salmon were considered the most abundant run of salmon in the Central Valley of California, with yearly escapements in the Sacramento River estimated to have reached 600,000 spawners (Yoshiyama 2001). Fall- and late-fall Chinook salmon also occurred in all major tributaries in the Sacramento – San Joaquin systems (Moyle 2002). Spring-run were also known to occur in the Yuba River (Yoshiyama 2001). Currently, spring-run Chinook salmon are listed as Threatened under both the Federal and State Endangered Species acts, while Central Valley steelhead trout are listed as Threatened under the Federal Endangered Species Act.

Limited life history information on juvenile salmonids (spring-, fall-, and late fall-run Chinook salmon and Central Valley steelhead trout) in the lower Yuba River exists, but additional studies are needed to manage for these species. This study was conducted to continue development of baseline information for the Central Valley Project Improvement Act's (CVPIA), Anadromous Fish Restoration Program (AFRP) for juvenile salmon and steelhead trout life history strategies on the lower Yuba River. Data were collected to determine and document the timing of downstream movement, the duration of downstream movement, to determine abundance and/or relative abundance, and to monitor the condition and size of downstream migrants. Emigrating juvenile salmon were coded-wire tagged (CWT) in an effort to enumerate and determine the relative contribution to the adult escapement on the Yuba River by differing life history strategies employed by Yuba River Chinook salmon.

Methods

Trap Location

Juvenile Chinook salmon and steelhead trout were captured using two rotary screw traps (RSTs) equipped with an eight-foot diameter cone, manufactured by E.G. Solutions in Corvallis, Oregon. Both RSTs were located on the Yuba River, approximately ten kilometers east of the city of Marysville, adjacent to the south end of Hallwood Boulevard. The sampling site was downstream of most available salmon and steelhead spawning habitat. The RSTs were tethered by an earth anchor situated at the downstream terminus of a large gravel bar. The site allowed for a wide range of flexibility in the RSTs' orientation to, and their location in the river channel for optimum sampling during most flows, except during extraordinarily high water flows or during periods of excessive debris.

Data Collection

All fish were netted daily from each RST live box and immediately placed in five-gallon buckets equipped with portable aerators and fresh river water. Juvenile Chinook salmon and steelhead trout were separated from other species and transferred with small aquarium nets into additional five-gallon buckets equipped with portable aerators and held for processing. A sub-sample containing a minimum of 100 juvenile Chinook salmon, or 10% of the total captured (whichever number was greatest) was anesthetized in a shallow tub containing a weak solution (2/3 gram per liter of water) of tricaine methanesulfonate (MS-222). Upon immobilization, each fish was measured to the nearest millimeter (mm) in fork length (FL), weighed to the nearest tenth of a gram, and assigned a race designation. Chinook salmon race was determined by size-at-capture criteria (Fisher 1992). Although the Fisher size-at-capture criteria do not apply to most Central Valley streams, they do provide some measure for Chinook salmon on the Yuba River during periods of emigration for incidental take monitoring. All remaining salmon were individually counted. If the number of salmon remaining was too great to efficiently count individually (> 8,000 fish), then volumetric estimation was used in lieu of an exact enumeration. This was accomplished by filling a standardized container to the half-full mark with water and adding a documented number of fish until a complete volume was reached without the loss of any water. This process was repeated three times to produce an average number of fish for the known volume. Following RST work up, all juvenile Chinook salmon were held in holding pens placed in the river channel until such a number had been accrued to facilitate coded-wire tagging.

In order to obtain a relative measure of trapping efficiency, semi-monthly calibrations were conducted every two weeks using a sub-sample of no less than 300 Chinook salmon. The sub-sample was marked using a solution of Bismark brown and fresh river water (8 grams Bismark brown per 380 liters of water). Salmon were held for 24-hours to ensure all marked fish exhibited normal behavior and to assess any mortality that may have been caused by the marking process. The group was then released approximately

0.5 kilometers upstream from the trapping location, and was spread across a cross-section of the river to allow for random dispersal. The number of Chinook salmon recaptured in subsequent sampling was recorded on a daily basis and was used to develop trap efficiencies for differing flow regimes and salmon size classes for each trap. Additional calibration tests were conducted in addition to the semi-monthly tests if the flows or average fish size was determined to have changed substantially between the normal calibration frequency.

All juvenile steelhead trout were individually measured using the protocol employed for juvenile Chinook salmon. In addition, a juvenile steelhead trout life-stage rating protocol (smolt index) based on ontogenetic characteristics was utilized to provide information on smolt development over time and space (Table 1) (Snider and Titus 1995). In this rating system, each individual steelhead trout was given a numeric code that represented a particular smolting stage. All steelhead trout were released approximately 100 meters (m) downstream of the rotary screw traps.

Table 1. Juvenile Steelhead trout life-stage descriptive index based on ontogenetic characteristics observed at date of capture.

Numeric Code	Abbreviation	Description
1	YSF	Yolk Sac Fry - newly emerged with visible yolk sac.
2	FRY	Fry - recently emerged with yolk sac absorbed, pigmentation undeveloped.
3	PAR	Parr - darkly pigmented with distinct parr marks, no silvery coloration, and scales firmly set.
4	SPR	Silvery Parr - parr marks visible but faded, intermediate degree of silvering.
5	SMT	Smolt - parr marks highly faded or absent, bright silver or nearly white coloration, and scales easily shed (deciduous).

Coded-Wire Tagging

Captured salmon were transported via aerated buckets to the tagging facility located immediately downstream of the RST. Fish were tagged using three Northwest Marine Technology Tag Injectors, Model MKIV and Model MKIV Quality Control Devices (QCD). Injectors were initially fitted with a 1,100-fish/lb head mold and were changed periodically to accommodate for growth later in the season. Fish were anaesthetized in a weak solution (2/3 gram per liter of water) of MS-222, adipose-fin clipped, then tagged with a half-length (0.5 mm) decimal coded tag in the rostrum. All tagged fish were held for observation for 24 hours. A sub-sample (10% or greater) of the held fish were re-run through the QCD to obtain a 24-hour tag shedding rate and then released approximately 100 meters downstream of the RST. New tag codes were issued every 14 days or sooner if the use of an entire CWT spool occurred before each two-week period.

Abiotic Measurements

Ambient river water temperature was monitored using an Onset Model WTA032 temperature data logger. The Onset data logger was placed inside the RST live box

within a 2"x 6" long, perforated steel pipe and suspended by ¼" steel cable. Data loggers were set for 1-hour interval readings and were downloaded monthly.

Water velocities were measured at the anterior end of the RST, directly in front of the rotating cone with a Marsh-McBirney Flo-Mate, Model 2000. The velocity probe was attached to a graduated aluminum staff and was submerged to a depth of 0.61m below the water surface. Each velocity measurement was taken at a preset averaged period of ten seconds, and was recorded as the velocity reading for the entire 24-hr period.

Turbidity was recorded daily using a Hach, Model 2100P, portable turbidity meter. A representative sample of water was collected directly adjacent to the RSTs. All turbidity measurements were recorded in nephelometric turbidity units (ntu).

RST cone revolutions were recorded through the use of a Reddington Counters Inc., model 1-2936 mechanical counter. Total revolutions for the 24-hr period were recorded and the counter was reset each day.

Flows were monitored at the Marysville gage through the California Department of Water Resources' (DWR) online California Data Exchange Center (CDEC).

Results

RST 1 was installed on October 7, 2005. The trap was fished continuously from October 7, 2005 to June 13, 2006, unless periods of high flow and/or heavy debris required field crews to cease operations until flows and debris loading returned to lower levels. RST 1 was not fished during several periods in December 2005, as well as March, April and May 2006 due to high flows, excessive debris and dangerous conditions. In total RST 1 operated normally 192 days and was inoperable 58 days during the trapping season.

RST 2 was installed adjacent to RST 1 on February 17, 2006. RST 2 was fished in tandem with RST 1 from February 17, 2006 to April 22, 2006 in an attempt to increase the capture of smolt-sized Chinook salmon for coded-wire tagging. RST 2 was not fished after April 22, 2006 due to damage received from debris loading during a high flow event. In total, RST 2 operated normally 41 days and was inoperable during 24 days of the tandem period of operation.

Twenty-four species of fish were captured in both traps during the sampling period (Table 2), including a total of 58,951 juvenile Chinook salmon (Table 3). For comparison, 285,034 juvenile Chinook salmon were captured during the 2004-2005 sampling season. Semi-monthly length-frequency summaries of the 2005-2006 Chinook salmon catch are reported in Appendix A.

Steelhead trout were captured less frequently in both traps and totaled 177 fish during the October 2005 – June 2006 trapping period (Table 4). For comparison, during the 2004-

2005 sampling season 614 juvenile steelhead trout were captured. Semi-monthly length-frequency summaries of steelhead trout catch are reported in Appendix B.

Table 2. Common and scientific names of species captured during the 2005-2006 season.

Common Name	Species
American shad	*Alosa sapidissima*
Bluegill sunfish	*Lepomis macrochirus*
Brown bullhead	*Ameiurus nebulosus*
California roach	*Hesperoleucus symmetricus*
Chinook salmon	*Oncorhynchus tshawytscha*
Golden shiner	*Notemigonus crysoleucas*
Green sunfish	*Lepomis cyanellus*
Hardhead	*Mylopharodon conocephalus*
Largemouth bass	*Micropterus salmoides*
Mosquitofish	*Gambusia affinis*
Pacific lamprey	*Lampetra tridentata*
Prickly sculpin	*Cottus asper*
Steelhead trout	*Oncorhynchus mykiss*
Redear sunfish	*Lepomis microlophus*
Riffle sculpin	*Cottus gulosus*
River lamprey	*Lampetra ayresi*
Sacramento pikeminnow	*Ptychocheilus grandis*
Sacramento sucker	*Catostomus occidentalis*
Smallmouth bass	*Micropterus dolomieu*
Speckled dace	*Rhinichthys osculus*
Tule perch	*Hysterocarpus traskii*
White catfish	*Ameiurus catus*
White crappie	*Pomoxis annularis*
Warmouth	*Lepomis gulosus*

Table 3. Semi-monthly summary of Chinook salmon captures on the Yuba River near Hallwood Blvd., October 1, 2005 to June 30, 2006.

Trapping Period		Mean FL (mm)	Range FL (mm)		Total Captured
10/01/05	10/15/05	98	80	123	4
10/16/05	10/31/05	110	94	125	2
11/01/05	11/15/05	66	32	104	6
11/16/05	11/30/05	36	28	144	1,546
12/1/05	12/15/05	36	29	156	20,135
12/16/05	12/31/05	36	30	97	34,521
01/01/06	01/15/06	43	29	58	88
01/16/06	01/31/06	44	32	118	259
02/01/06	02/15/06	43	34	135	274
02/16/06[1/]	02/28/06	38	31	90	1,011
03/01/06[1/]	03/15/06	44	32	84	276
03/16/06[1/]	03/31/06	49	33	113	502
04/01/06[1/]	04/15/06	47	34	86	45
04/16/06[1/]	04/30/06	73	33	95	36
05/01/06	05/15/06	65	33	111	17
05/16/06	05/31/06	60	33	96	112
06/01/06	06/15/06	75	34	109	117
06/16/06	06/30/06	n/a	n/a	n/a	n/a

[1/] includes captures from RST 1 and RST 2

Total monthly juvenile Chinook salmon captures for January through June 2006 were extremely low in comparison to previous data due to an inability to safely fish the RSTs during the winter and spring months. Peak captures of Chinook salmon fry this season were observed in December before high flows hindered the ability to safely fish the RSTs. Monitoring conducted at the same site from 1999 through 2002 revealed that peak catch occurs between January and March of each year (Drury 2003). Current

observations of emigrating fry captured in the RST in December were similar to those described by Drury (2003) (Appendix A, Figures A-5, A-6).

Table 4. Semi-monthly summary of steelhead trout captures on the Yuba River near Hallwood Blvd., October 1, 2005 to June 30, 2006.

Trapping Period		Mean FL (mm)	Range FL (mm)		Total Captured
10/01/05	10/15/05	101	68	169	17
10/16/05	10/31/05	107	75	155	44
11/01/05	11/15/05	119	69	298	46
11/16/05	11/30/05	110	78	166	19
12/1/05	12/15/05	100	79	121	9
12/16/05	12/31/05	98	78	120	3
01/01/06	01/15/06	109	101	117	2
01/16/06	01/31/06	218	99	337	2
02/01/06	02/15/06	244	176	377	3
02/16/06[1/]	02/28/06	214	109	319	3
03/01/06[1/]	03/15/06	85	69	100	2
03/16/06[1/]	03/31/06	93	78	108	2
04/01/06[1/]	04/15/06	n/a	n/a	n/a	0
04/16/06[1/]	04/30/06	140	140	140	1
05/01/06	05/15/06	n/a	n/a	n/a	0
05/16/06	05/31/06	72	46	178	8
06/01/05	06/15/06	58	46	77	16
06/16/06	06/30/06	n/a	n/a	n/a	n/a

[1/] includes captures from RST 1 and RST 2.

RST calibrations were conducted to assess trap efficiency under varying flows. Fry were utilized primarily, as smolt-sized Chinook salmon were not captured in sufficient numbers. Only four calibrations were completed between December 09, 2005 and March 29, 2006 (Table 5), as heavy flows often precluded field crews from conducting normal RST monitoring and calibration exercises (Figure 1). Only two calibrations were conducted during the period that RST 2 was fishing due to low overall Chinook salmon catch totals and due to the high flows that forced field crews to cease trapping operations at several times during the season. Aside from the difficulties surrounding the exceptionally high flow year, the calibrations provided a relative measure to assess the number of emigrating juvenile salmon moving downstream of the RST site. RST efficiency during the calibration period (December 2005 – March 2006) ranged from 0.00% to 6.09% (Table 5). Calibration values during the previous sampling season (0.95% - 7.74%) were difficult to compare to those observed during the 2005-2006 study.

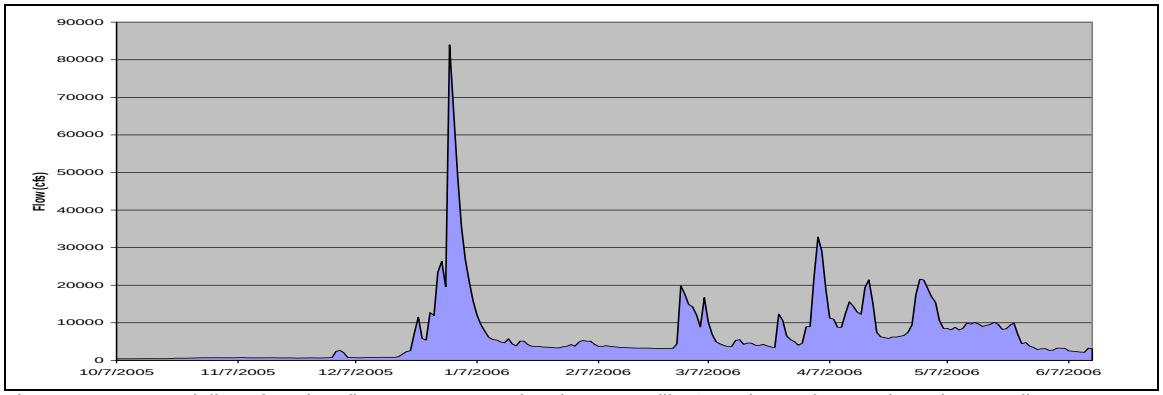

Figure 1. Average daily Yuba River flows as measured at the Marysville Gage located approximately one mile downstream of the RSTs at Hallwood Blvd., October 7, 2005 to June 13, 2006.

Table 5. Summary of RST efficiency calibrations from December 09, 2005 to March 29, 2006.

Date of Release	Release Number	Recaptures				Total Recaptures	Trap Efficiency
		Day 1	Day2	Day 3	Day 4		
12/9/2005	476	29	0	0	0	29	6.09%
1/28/2006	199	0	0	0	0	0	0.00%
2/23/2006[1/]	572	16	0	0	0	16	2.80%
3/29/2006[1/]	250	1	0	0	0	1	0.40%

[1/] includes recaptures from RST 1 and RST 2.

With only four data points for reference, analytical inferences can be difficult to ascertain. RST efficiency values indicated that the peak captures of juvenile Chinook salmon observed from late January 2006 through early March 2006 corresponded with the lowest RST efficiencies observed during the same period, suggesting that captures during this period could potentially represent a much smaller fraction of the total emigrating juvenile salmon at the RST site.

Three runs of Chinook salmon (spring-, fall-, and late-fall run) were identified through analysis and identification of modal capture distributions at the RSTs (Appendix A). Ongoing Chinook salmon monitoring projects (redd surveys, escapement surveys, juvenile monitoring and real-time adult passage monitoring at Daguerre Dam) also support and suggest that the three runs inhabit and utilize the lower Yuba River. Length-at-date capture criteria developed for run identification on the Sacramento River at Red Bluff (Fisher 1992) were referenced to provide further support, as well as real-time monitoring of incidental take of threatened spring-run Chinook salmon, as the capture criteria generally fit the modal distributions of the runs reasonably well.

Juvenile Chinook salmon were first observed on November 6, 2005. These early emigrating fish are presumably spring-run due to timing and a general agreement with size-at-date capture criteria; however, no true demarcation can be made between spring- and fall-run Chinook salmon emigrations due to overlaps in spawning, rearing and emigration periods. In contrast, a distinction is evident between fall and late- fall run Chinook salmon, as the latter are marked by a distinct and separate modal peak, generally beginning in early to late April (Appendix A, Figures A-13 – A-17), and continuing through project commencement in June. The 2005 late-fall brood year was difficult to detect and sample due to high flows and heavy debris loading during their migration period, but were observed consistently, most notably during the May 15-31, 2006 trapping period (Appendix A, Figure A-16). Fall-run Chinook salmon represented the majority of juveniles captured in the lower Yuba River, whereas the spring- and late-fall runs were captured less frequently. This pattern of catch during the 2005-2006 sampling season closely resembles that observed during both previous seasons of trapping (2003-2004, 2004-2005).

Coded-wire tagging operations were implemented from December 07, 2005 through December 22, 2005. The CWT effort was prematurely concluded due to exceptionally high flows during late December that persisted through the remainder of the sampling period. Of the 58,951 total juvenile Chinook salmon captured in RST 1, 44,269 were injected with a CWT and adipose-fin-clipped for later identification. Of that total, 43,729

juvenile Chinook salmon were successfully tagged and released (Table 6) The remaining 540 tagged fish either shed their tag (225) or perished (315) during the tagging process. For comparison, 183,305 juvenile Chinook salmon were successfully tagged during the 2003-2004 season, and 248,194 were tagged and released during the 2004-2005 season.

Table 6. Summary of coded-wire tagged Chinook salmon released to the lower Yuba River near Hallwood, December 7, 2005 to December 22, 2005.

Tag Code	Dates Tagged		Mean FL (mm)	Total Released	Shed Rate (%)
06-01-03-06-06	12/13/2005	12/15/2005	35	5,362	0.28
06-01-03-06-07	12/13/2005	12/15/2005	35	5,423	0.24
06-01-03-06-08	12/21/2005	12/22/2005	35.5	6,023	0.26
06-01-03-07-05	12/7/2005	12/13/2005	35	3,058	1.90
06-01-03-07-06	12/7/2005	12/13/2005	35	2,960	2.26
06-01-03-08-07	12/22/2005	12/22/2005	36	2,637	0.23
06-01-03-08-08	12/22/2005	12/22/2005	36	2,190	0.23
06-01-03-08-09	12/21/2005	12/22/2005	35.5	16,076	0.25

Water temperature data were recorded from October 25, 2005 to June 13, 2006 (Figure 2). Measured average daily temperatures observed remained between 7.5°C and 11°C during the winter months, whereas maximum daily temperatures on the Yuba River slightly exceeded the accepted thermal limit of 15°C (Hinze 1959; Boles 1988; CDFG 1998; Ward 2004) for Chinook salmon from June 02, 2006 through the end of monitoring activities on June 13, 2006. This observation is of concern, as temperatures above 15.6°C significantly increase the risk of mortality in juvenile Chinook salmon (McCullough 1999), and the optimum range for juvenile growth as reported by Boles was 12 - 14°C (1988).

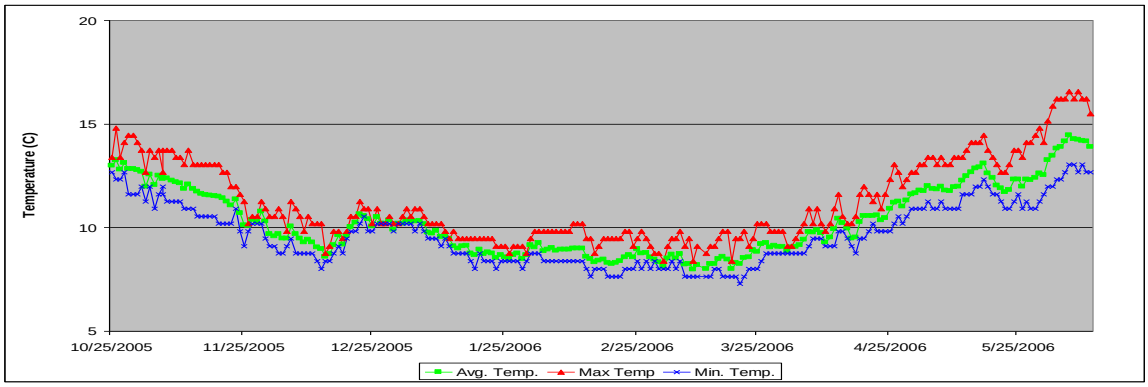

Figure 2. Yuba River water temperatures as recorded by Onset temperature probes placed in RST 1 near Hallwood Blvd. from October 25, 2005 to June 13, 2006.

Water velocities measured at the RST 1 cone ranged from 1.6 ft/s to 6.19 ft/s with a mean value of 4.08 ft/s (Appendix C, Table C-1). Daily turbidity measured at the RST ranged from 0.47 ntu to 72.1 ntu around a mean value of 14.12 ntu (Figure 3).

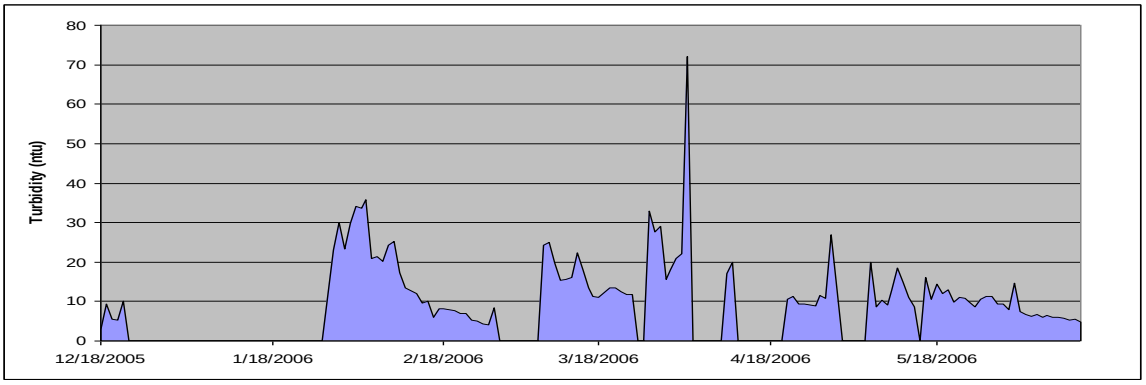

Figure 3. Turbidity measured at the lower Yuba River RSTs at Hallwood from December 21, 2005 to June 13, 2006.

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Appendix A:

Chinook Salmon (*Oncorhynchus tshawytscha*) Semi-monthly Catch 2005-2006

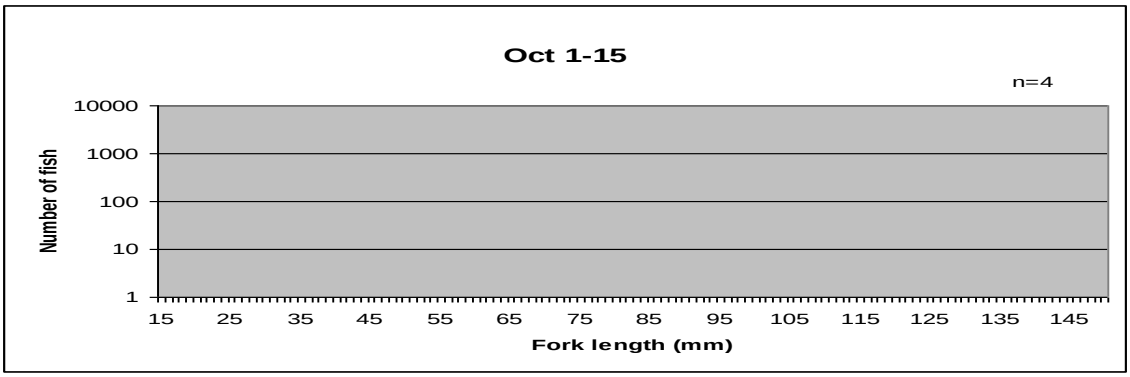

Figure A-1. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, October 1-15, 2005.

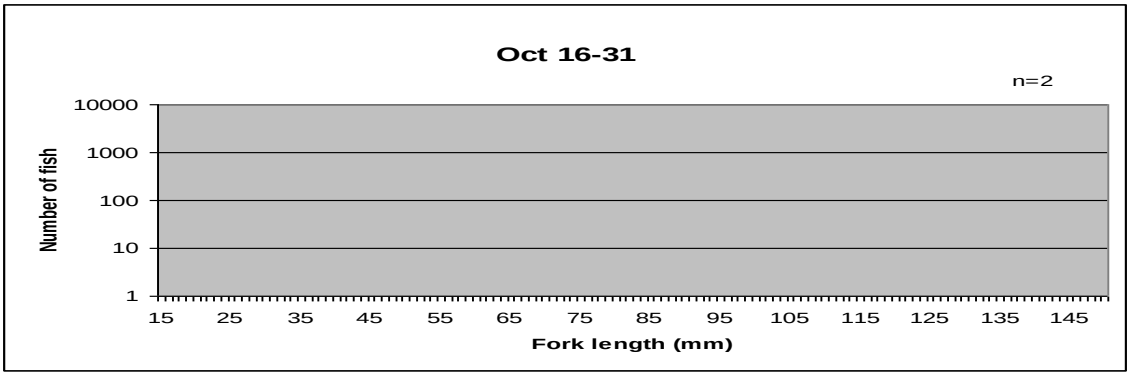

Figure A-2. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, October 16 -31, 2005

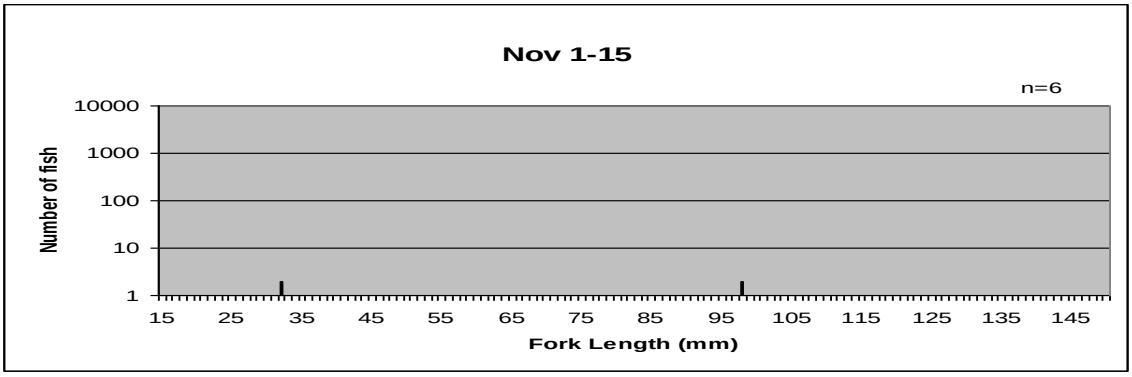

Figure A-3. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, November 1 – 15, 2005

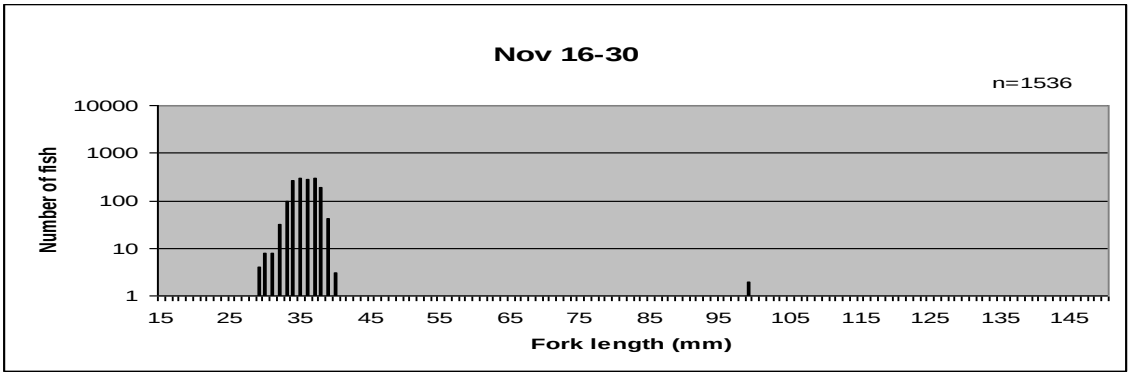

Figure A-4. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, November 16 – 30, 2005

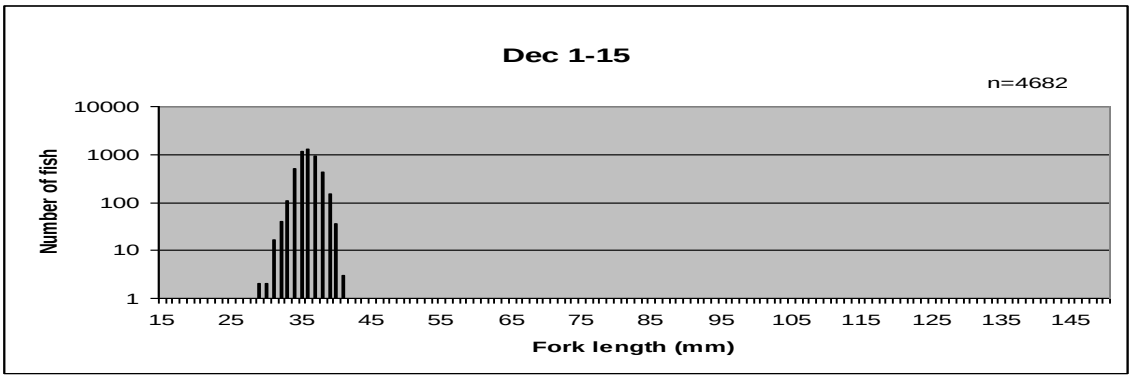

Figure A-5. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, December 1 – 15, 2005.

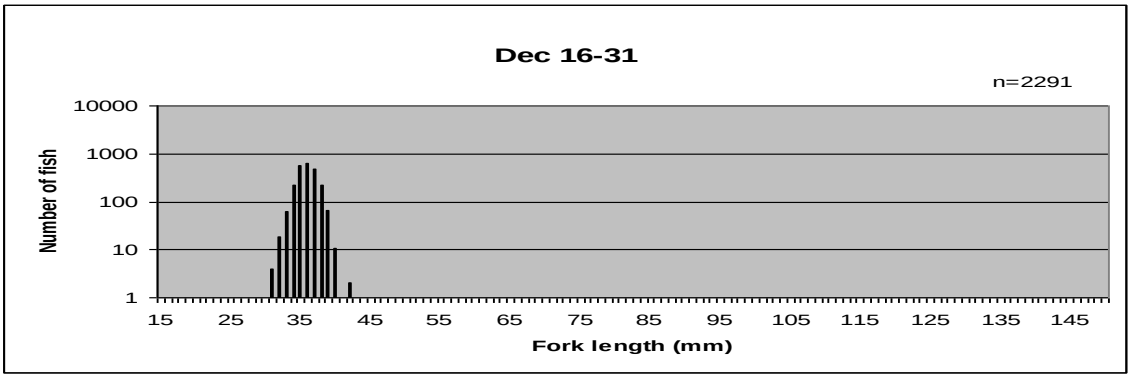

Figure A-6. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, December 16 – 31, 2005.

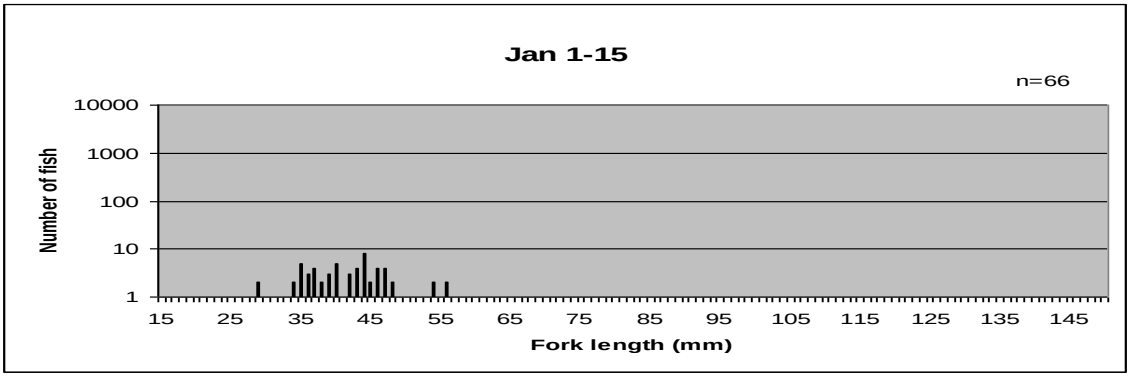

Figure A-7. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, January 1 – 15, 2006.

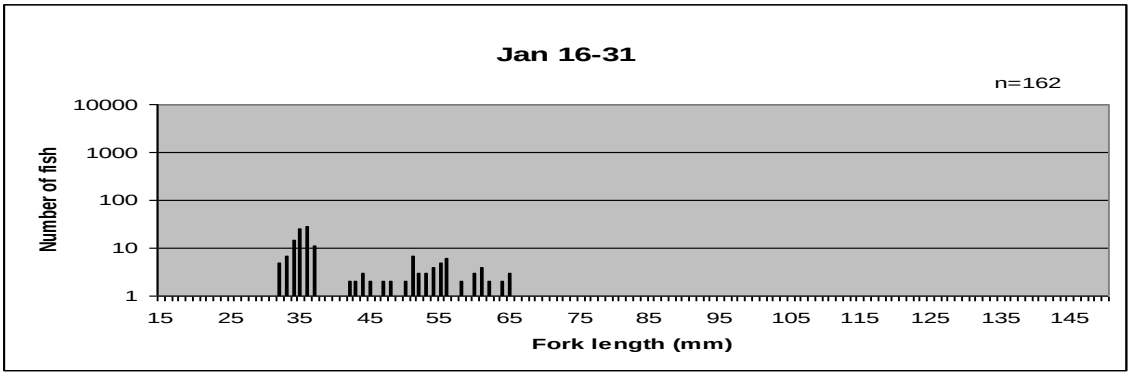

Figure A-8. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, January 16 – 31, 2006.

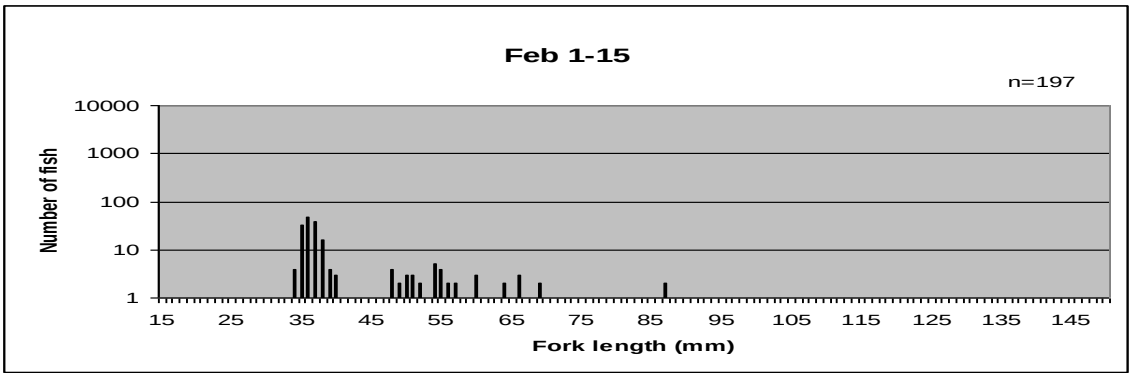

Figure A-9. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, February 1 – 15, 2006.

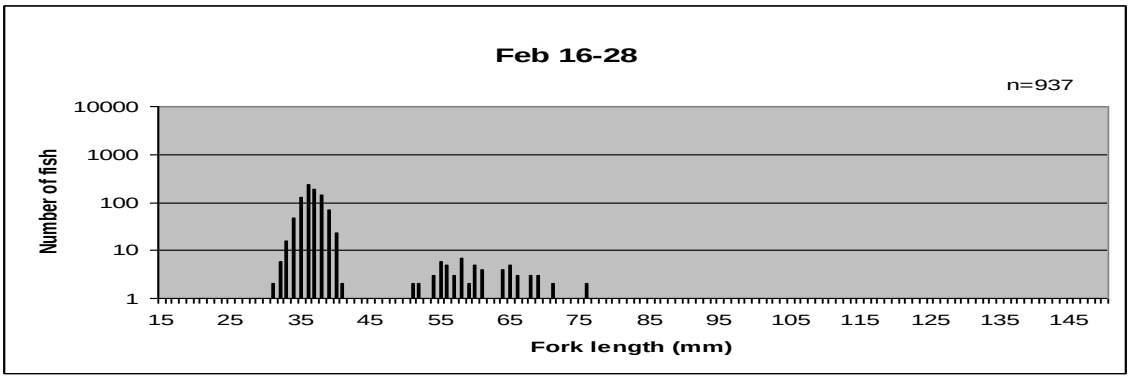

Figure A-10. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, February 16 – 28, 2006.

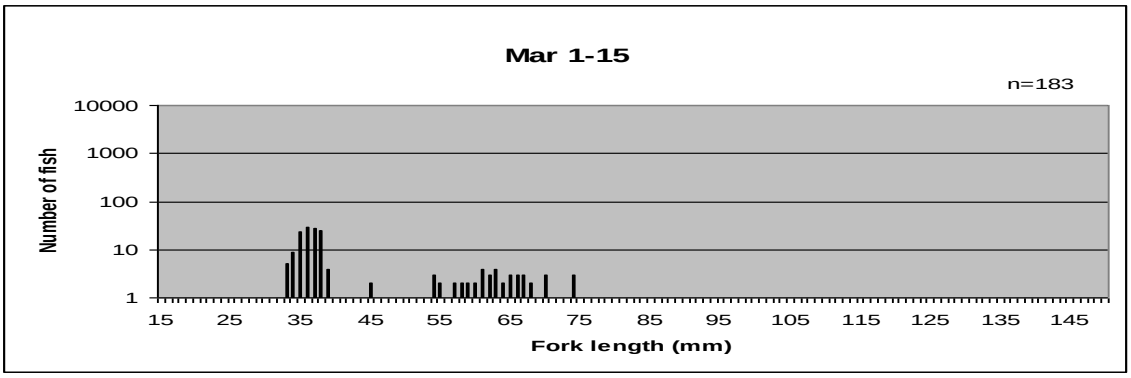

Figure A-11. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, March 1 – 15, 2006.

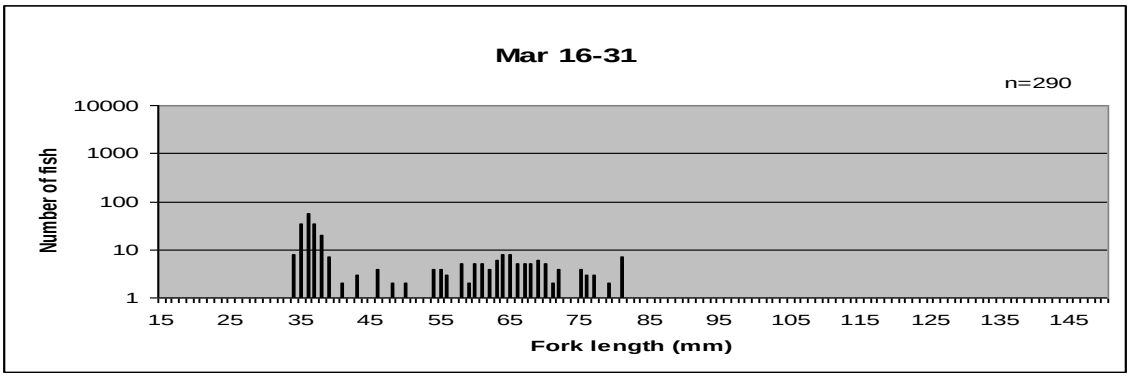

Figure A-12. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, March 16 – 31, 2006.

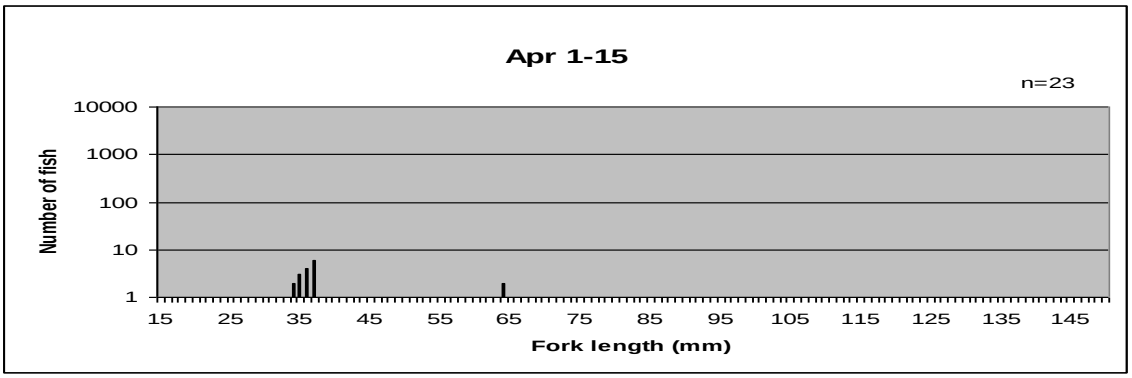

Figure A-13. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, April 1 – 15, 2006.

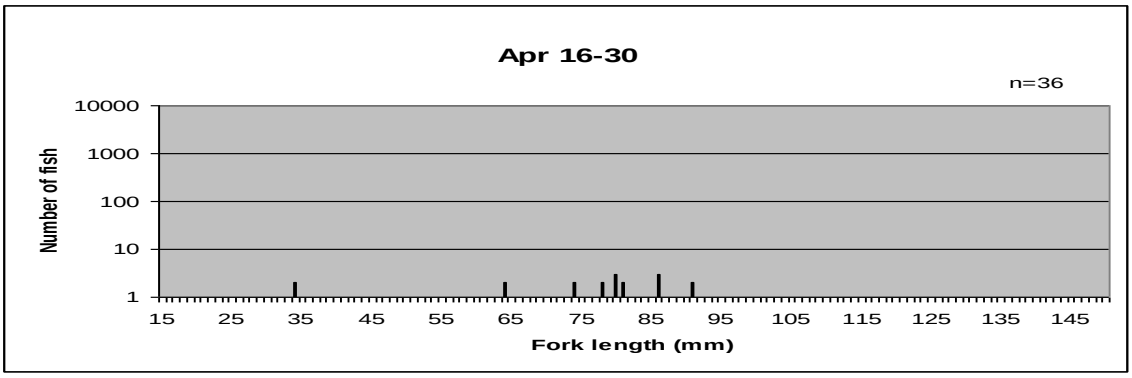

Figure A-14. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, April 16 – 30, 2006.

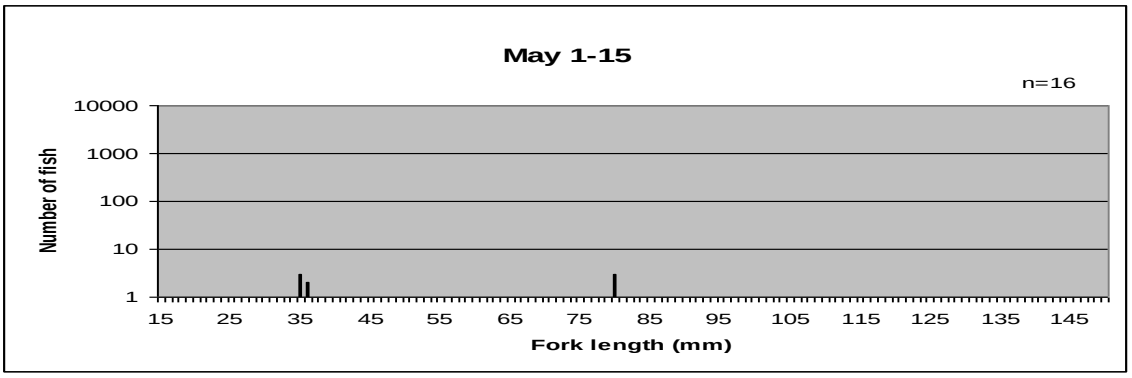

Figure A-15. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, May 1 – 15, 2006.

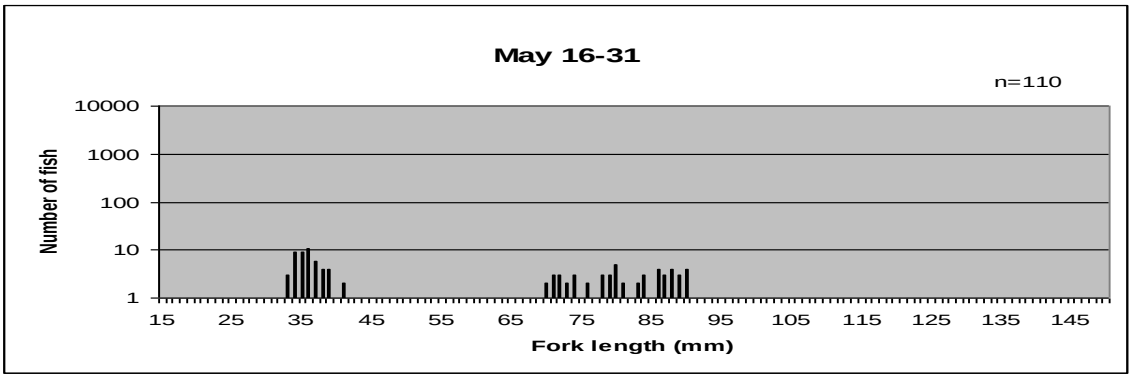

Figure A-16. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, May 16 – 31, 2006.

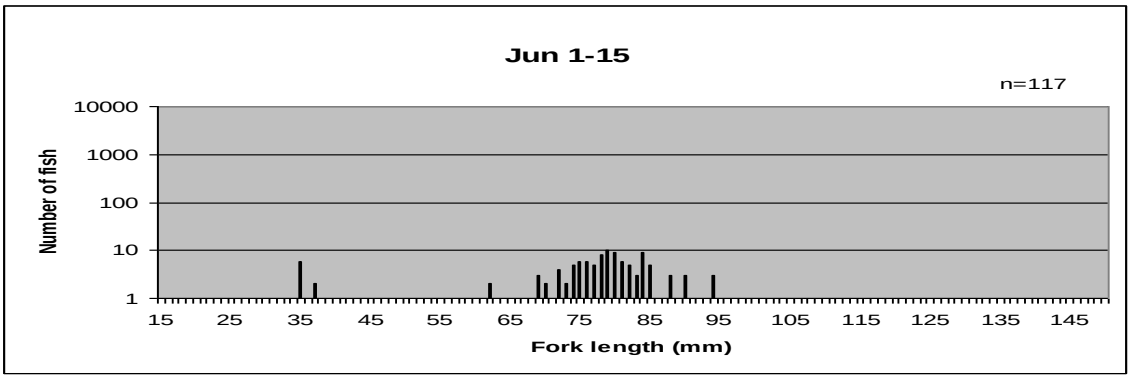

Figure A-17. Semi-monthly catch of juvenile Chinook salmon at the Yuba River RST, June 1 – 15, 2006.

Appendix B:

Steelhead Trout (*Oncorhynchus mykiss*) Semi-monthly Catch 2005-2006

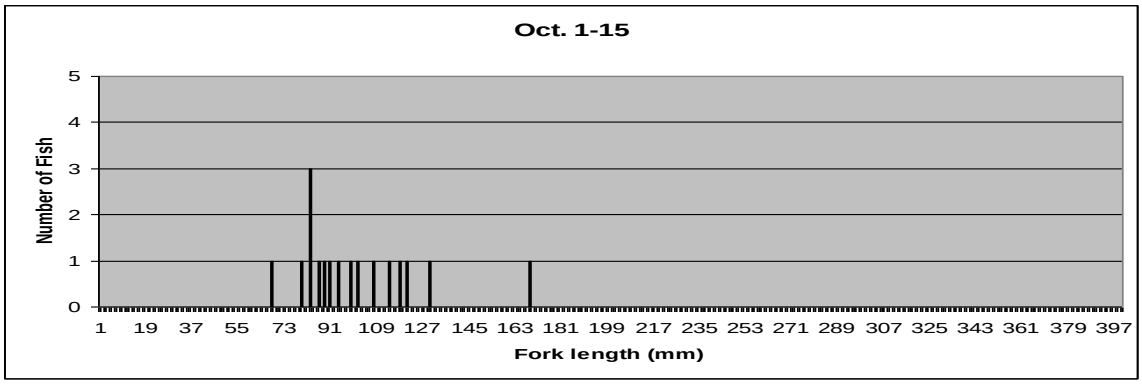

Figure B-1. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, Oct 1 – 15, 2005.

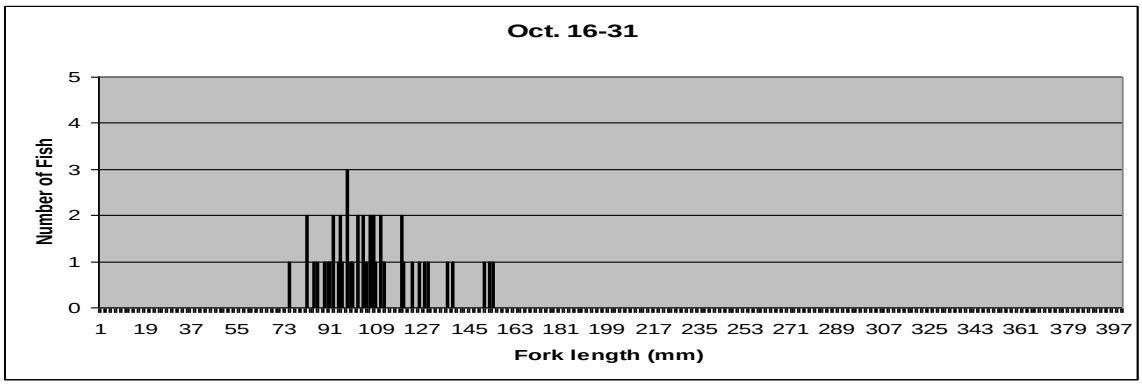

Figure B-2. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, Oct 16 – 31, 2005.

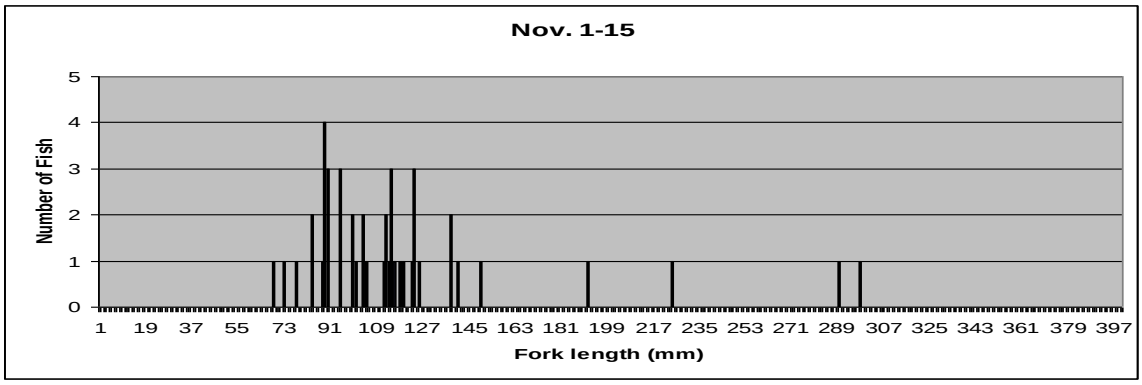

Figure B-3. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, November 1 – 15, 2005.

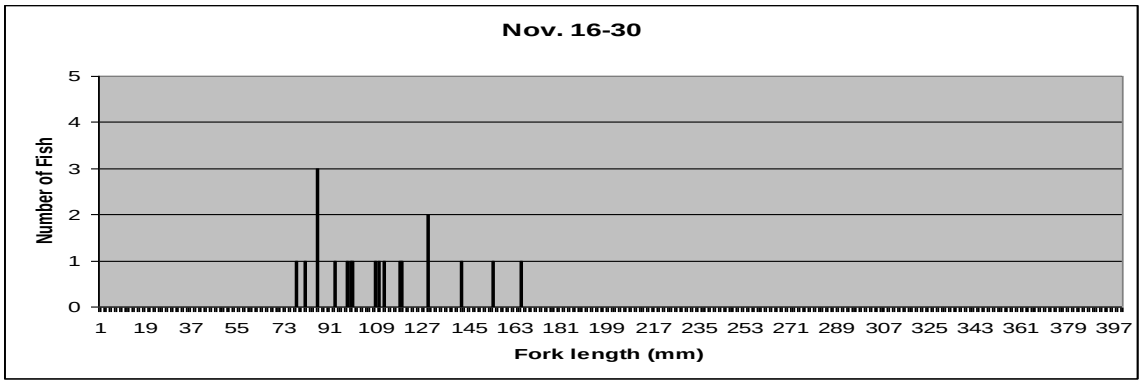

Figure B-4. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, November 16 – 30, 2005.

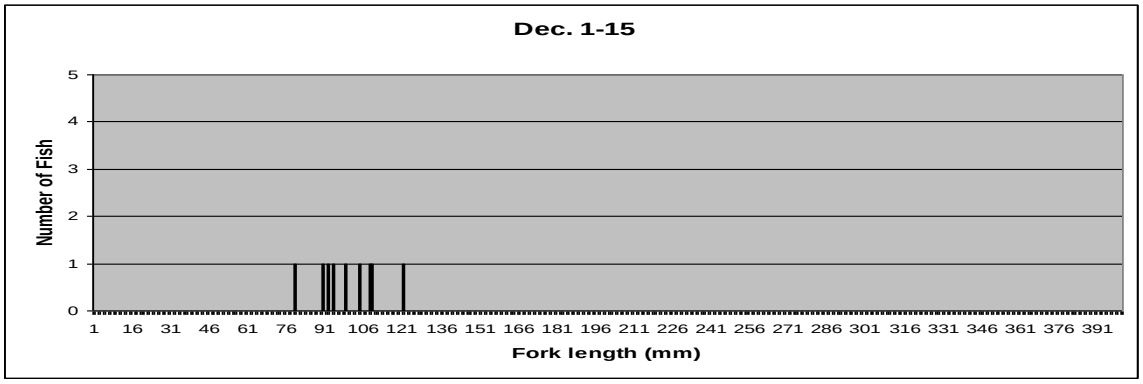

Figure B-5. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, December 1 - 15, 2005.

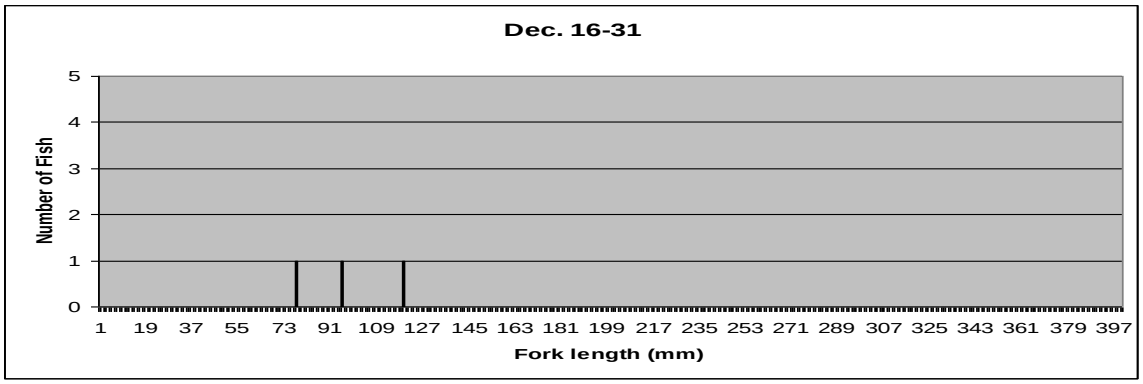

Figure B-6. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, December 16 – 31, 2005.

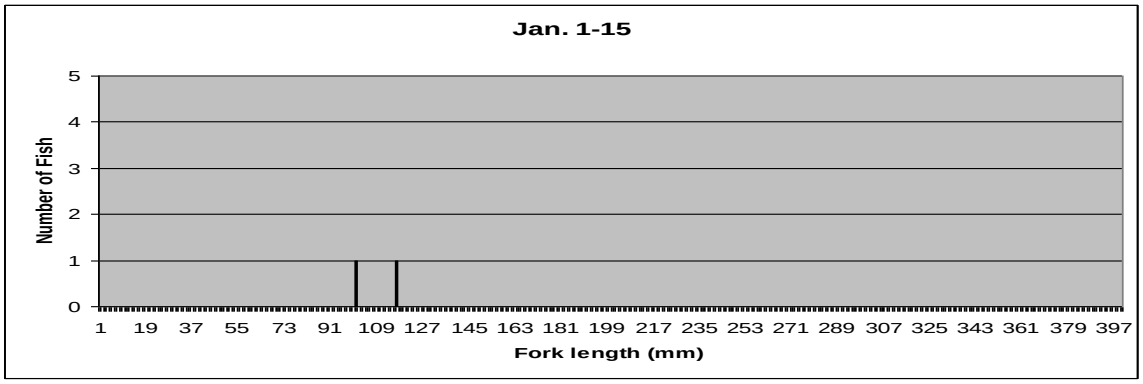

Figure B-7. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, January 1 – 15, 2006.

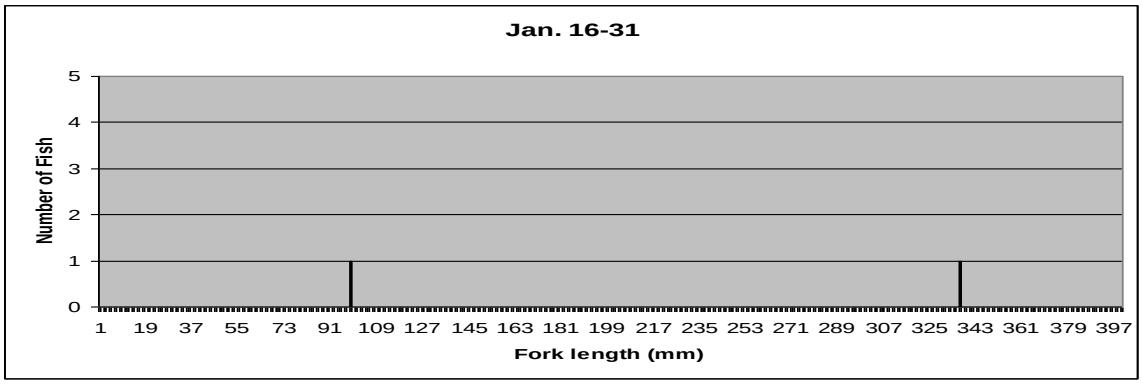

Figure B-8. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, January 16 – 31, 2006.

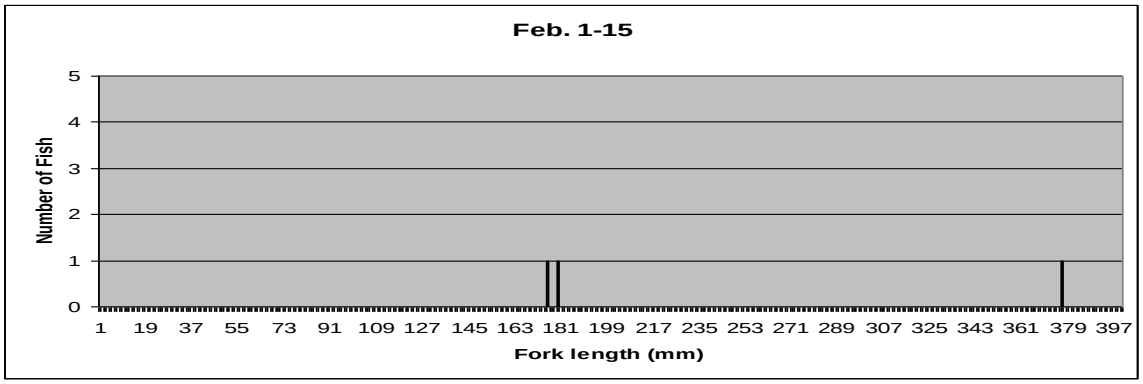

Figure B-9. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, February 1 – 15, 2006.

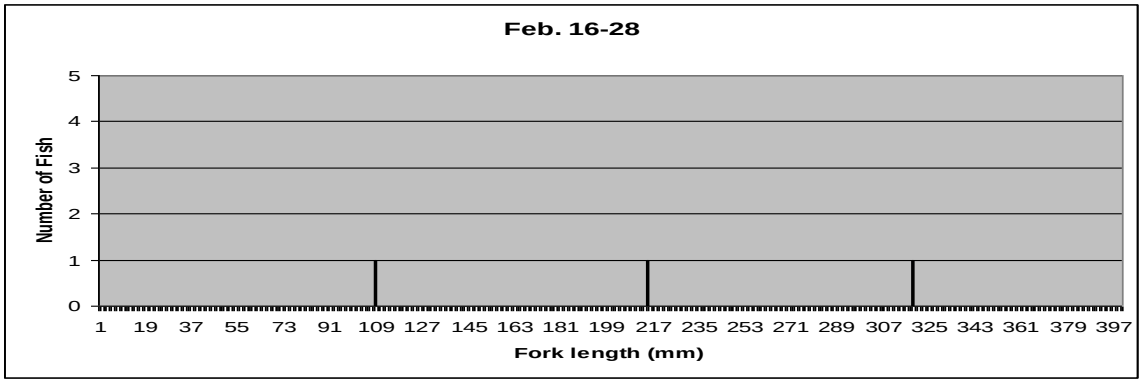

Figure B-10. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, February 16 – 28, 2006.

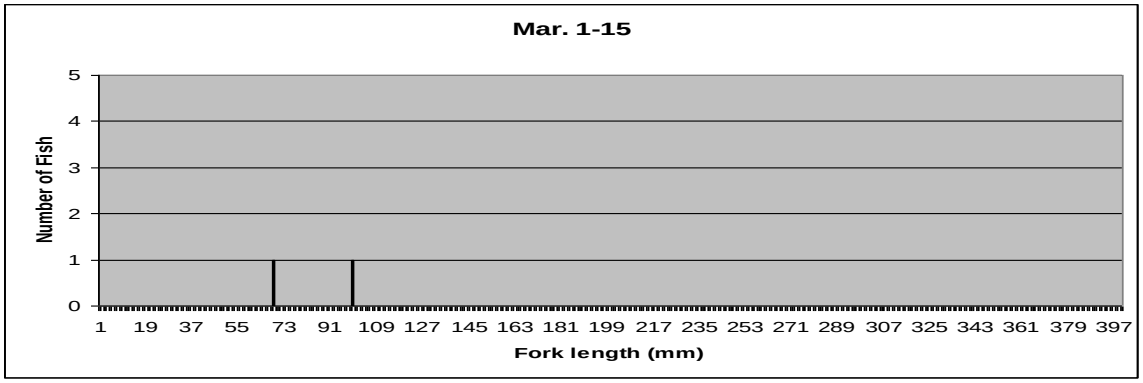

Figure B-11. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, March 1 – 15, 2006.

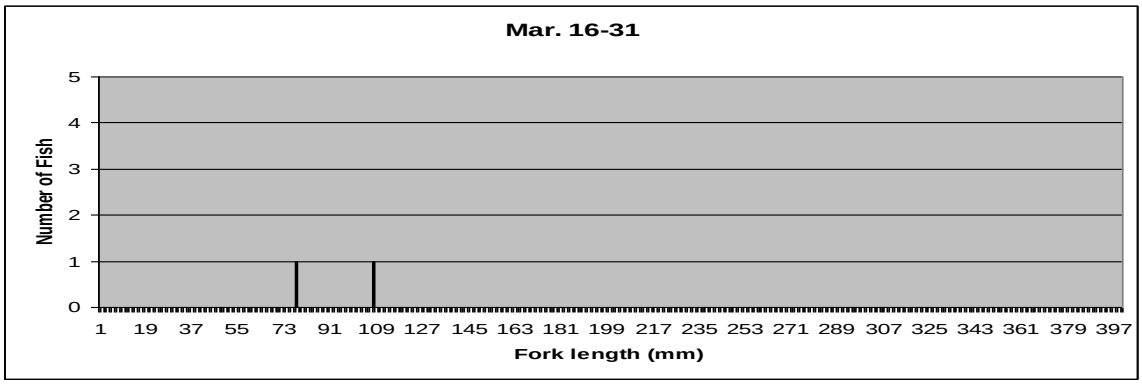

Figure B-12. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, March 16 – 31, 2006.

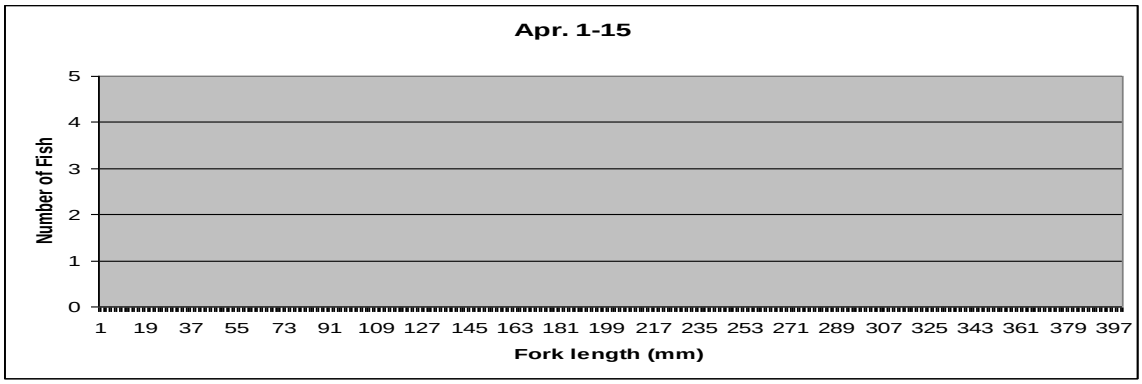

Figure B-13. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, April 1 – 15, 2006.

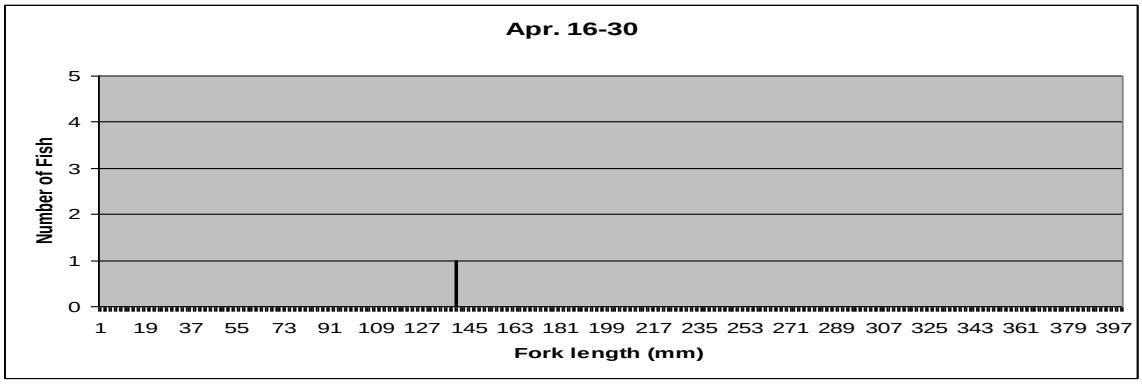

Figure B-14. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, April 16 – 30, 2006.

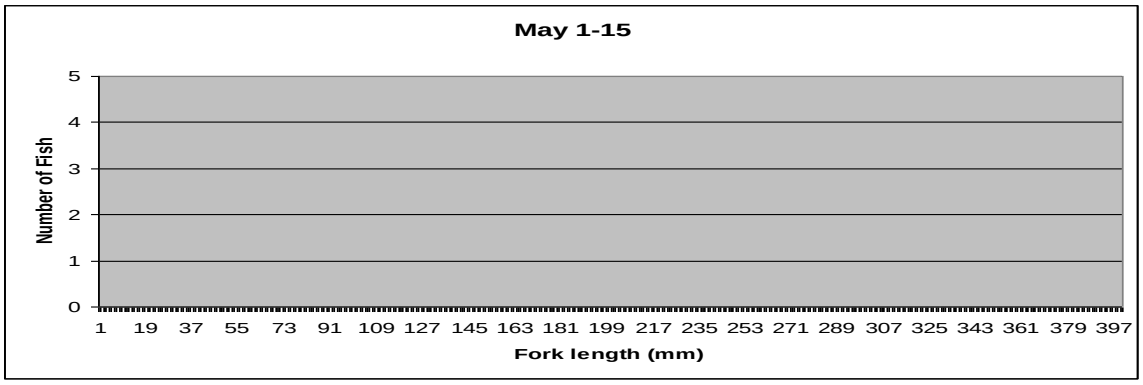

Figure B-15. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, May 1 – 15, 2006.

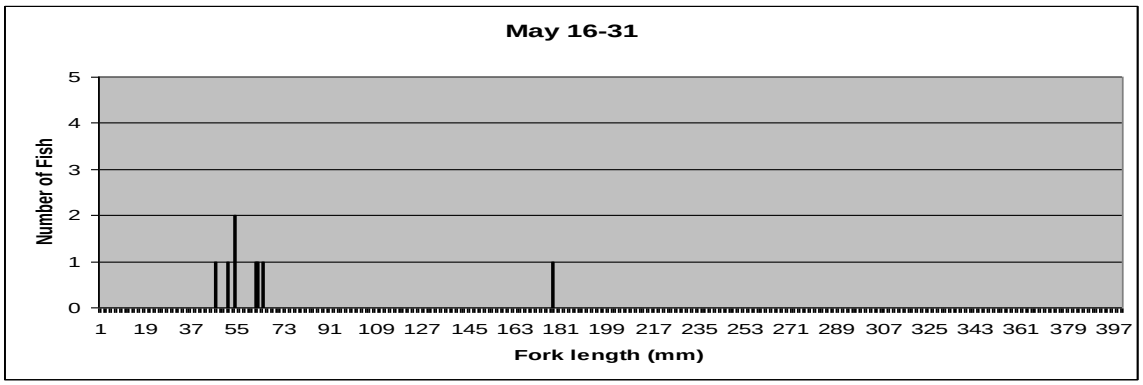

Figure B-16. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, May 16 – 31, 2006.

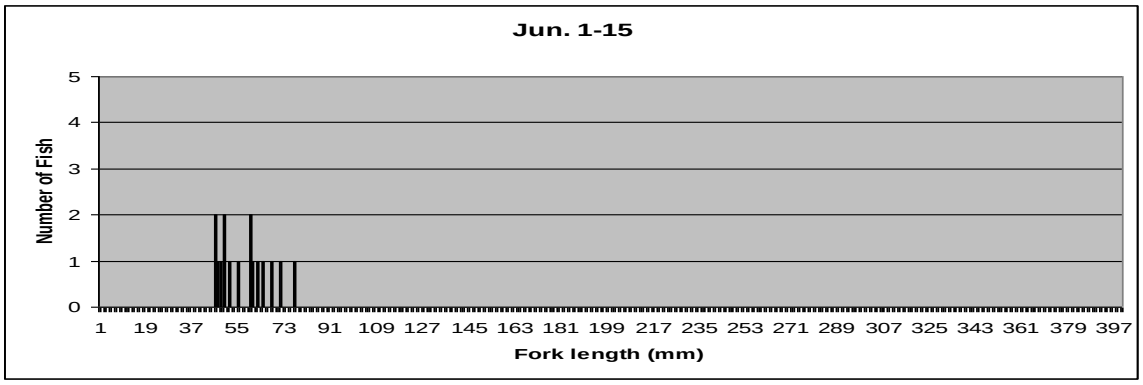

Figure B-17. Semi-monthly catch of juvenile Steelhead trout at the Yuba River RST, June 1 – 15, 2006.

Appendix C:

Flow Velocities Measured at the Lower Yuba River RST at Hallwood

Table C-1. Water velocities as measured at the lower Yuba River RST at Hallwood from October 8, 2005 to June 13, 2006.

Date	ft/s	Date	ft/s	Date	ft/s	Date	ft/s	Date	ft/s	Date	ft/s
10/8/2005	2.85	11/12/2005	5.6	12/17/2005	2.76	2/10/2006	3.3	3/28/2006	3.29	5/30/2006	5.1
10/9/2005	3.69	11/13/2005	5.75	12/18/2005	3.49	2/11/2006	4.17	3/29/2006	3.14	5/31/2006	3.78
10/10/2005	3.71	11/14/2005	5.86	12/19/2005	4.24	2/12/2006	3.73	3/30/2006	3.13	6/1/2006	4.81
10/11/2005	3.84	11/15/2005	6.08	12/20/2005	6.19	2/13/2006	3.31	3/31/2006	2.37	6/2/2006	4.61
10/12/2005	3.8	11/16/2005	6.03	12/22/2005	4.15	2/14/2006	3.39	4/1/2006	2.32	6/3/2006	4.54
10/13/2005	4.09	11/17/2005	5.72	1/10/2006	4.74	2/15/2006	3.66	4/2/2006	2.22	6/4/2006	4.71
10/14/2005	3.94	11/18/2005	5.8	1/11/2006	3.94	2/16/2006	3.05	4/3/2006	n/a	6/5/2006	4.59
10/15/2005	3.94	11/19/2005	4.59	1/13/2006	3.33	2/17/2006	3.21	4/22/2006	3.54	6/6/2006	4.61
10/16/2005	3.87	11/20/2005	4.99	1/14/2006	3.76	2/18/2006	3.58	4/23/2006	4.44	6/7/2006	4.68
10/17/2005	4.1	11/21/2005	5.21	1/15/2006	4.68	2/19/2006	3.71	4/24/2006	4.11	6/8/2006	5.28
10/18/2005	4.25	11/22/2005	5.31	1/16/2006	4.03	2/20/2006	3.76	4/25/2006	4.13	6/9/2006	4.81
10/19/2005	4.31	11/23/2005	5.23	1/17/2006	3.98	2/21/2006	3.9	4/26/2006	3.87	6/10/2006	4.53
10/20/2005	4.24	11/24/2005	5.34	1/18/2006	3.54	2/22/2006	3.89	4/27/2006	4.01	6/11/2006	4.97
10/21/2005	4.8	11/25/2005	5.53	1/19/2006	3.66	2/23/2006	3.87	4/28/2006	3.83	6/12/2006	3.85
10/23/2005	4.17	11/26/2005	5.31	1/20/2006	3.71	2/24/2006	4.39	4/29/2006	2.47	6/13/2006	4.76
10/24/2005	4.97	11/27/2005	1.6	1/21/2006	3.96	2/25/2006	3.57	5/7/2006	3.17		
10/25/2005	5.05	11/28/2005	5.51	1/22/2006	4.55	2/26/2006	4.21	5/8/2006	3.21		
10/26/2005	5.22	11/29/2005	5.5	1/23/2006	4.13	2/27/2006	4.49	5/9/2006	4.03		
10/27/2005	5.5	11/30/2005	5.94	1/24/2006	3.47	3/9/2006	3.29	5/10/2006	4.12		
10/28/2005	5.55	12/1/2005	6.02	1/25/2006	3.95	3/10/2006	2.26	5/11/2006	3.34		
10/29/2005	5.89	12/2/2005	n/a	1/26/2006	3.88	3/11/2006	2.09	5/12/2006	2.46		
10/30/2005	5.18	12/4/2005	3.91	1/27/2006	3.79	3/12/2006	4.41	5/13/2006	4.29		
10/31/2005	5.84	12/5/2005	2.08	1/29/2006	3.9	3/13/2006	4.14	5/17/2006	3.5		
11/1/2005	5.93	12/6/2005	2.61	1/30/2006	3.34	3/14/2006	3.09	5/18/2006	3.98		
11/2/2005	5.85	12/7/2005	2.77	1/31/2006	4.05	3/15/2006	2.99	5/19/2006	3.05		
11/3/2005	5.66	12/8/2005	2.81	2/1/2006	3.9	3/16/2006	2.88	5/20/2006	3.04		
11/4/2005	5.7	12/9/2005	2.88	2/2/2006	3.78	3/17/2006	3.29	5/21/2006	4.26		
11/5/2005	5.11	12/10/2005	2.91	2/3/2006	3.55	3/18/2006	2.37	5/22/2006	3.55		
11/6/2005	5.11	12/11/2005	2.87	2/4/2006	3.73	3/20/2006	3.28	5/23/2006	3.62		
11/7/2005	5.83	12/12/2005	2.91	2/5/2006	3.89	3/21/2006	2.68	5/25/2006	3.33		
11/8/2005	5.82	12/13/2005	2.99	2/6/2006	3.73	3/22/2006	2.88	5/26/2006	4.87		
11/9/2005	6.02	12/14/2005	3.09	2/7/2006	3.82	3/23/2006	3.02	5/27/2006	4.2		
11/10/2005	5.99	12/15/2005	3.24	2/8/2006	3.33	3/24/2006	2.88	5/28/2006	3.7		
11/11/2005	5.62	12/16/2005	3.3	2/9/2006	3.57	3/27/2006	3.09	5/29/2006	4.82		