YUBA RIVER JUVENILE CHINOOK SALMON, *ONCORHYNCHUS TSHAWYTSHA*, AND JUVENILE CENTRAL VALLEY STEELHEAD TROUT, *ONCORHYNCHUS MYKISS*, LIFE HISTORY SURVEY, ANNUAL DATA REPORT 2003-2004

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Introduction

The Yuba River, a tributary of the Feather River, drains a watershed of 1,339 square miles, 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 Forks. The North, Middle and South Yuba rivers converge near, and are impounded by the U.S. Army Corps of Engineers' (ACOE) Englebright Dam (approximately 24 river miles east of the city of Marysville), which represents the upper limits of anadromous fish migration. The lower Yuba River below Englebright Dam provides spawning and rearing habitat for adult and juvenile spring-, fall-, and late fall-run Chinook salmon (*Oncorhynchus tshawytscha*), as well as Central Valley steelhead trout (*Oncorhynchus mykiss*) (Drury, 2003). In addition, the river supports other anadromous species including American shad and striped bass below Daguerre Point Dam (approximately 12 river miles below Englebright Dam). 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 and rearing habitat through non-natural flow manipulation, fluctuating water temperatures, and an overall loss of available spawning gravel substrates (DFG, 1991). These practices affect both adult immigrations and juvenile emigrations, as well as create losses in crucial habitat during essential migration and spawning periods. Historically, the spring-run Chinook salmon was 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. The historic spring-run was also a major component of the Yuba River fishery. 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 strategies employed by juvenile Chinook salmon.

Methods

Trap Location

Juvenile Chinook salmon and steelhead trout were captured using a rotary screw trap (RST) equipped with an eight-foot diameter cone, manufactured by E.G. Solutions in Corvallis, Oregon. The RST was located on the Yuba River, approximately 6 miles 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 RST was 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 RST's orientation to, and the location in the river channel for optimum sampling during all flows. Except during extraordinarily high water flows or during periods of excessive debris, the trap was fished 24-hours-per-day, seven-days-a-week from October 15, 2003 through June 17, 2004.

Data Collection

All fish were netted daily from the 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 to race. Chinook salmon race was determined by size-at-capture criteria (Fisher, 1992). Although the Fisher size-at-capture criteria do not apply to all Central Valley streams, they do provide a good measure for Chinook salmon on the Yuba River during some periods of emigration. 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 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 trap efficiency, bi-monthly trap calibrations were conducted using a sub-sample of no less than 300 Chinook salmon. The sub-sample was

marked in five-gallon buckets using a solution of Bismark brown and fresh river water (8 grams Bismark brown per 380 liters of water). The marked salmon were held for 24-hours to insure all marked fish exhibited normal behavior and to assess any mortalities that may have been caused by the staining process. The marked group was then released approximately ½ mile upstream from the trap location, and was spread across a cross-section of the river to allow for random dispersement. Recaptured Chinook salmon were tallied during the following days sampling and were used to develop trap efficiencies for differing flow regimes and salmon size classes. Additional calibration tests were conducted in addition to the bi-monthly tests if it was determined that flows or average fish size had changed substantially between the normal test frequency.

All juvenile steelhead trout were individually measured using the same 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 trap.

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 a Northwest Marine Technology Tag Injector Model MKIV and Model MKIV Quality Control Device (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. Tag codes were changed every 14 days or after use of an entire CWT spool, whichever was more frequent.

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 for all measurements. 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 RST. 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

The RST was installed at the Hallwood site on October 1, 2003 and began fishing on October 15, 2003. The trap was generally fished continuously through June 17, 2004. The RST was not fished from January 15, 2004 to January 22, 2004, as the project was nearing the allowable incidental lethal take of spring-run Chinook salmon allocated for the season and was required to cease monitoring activities during the NOAA Fisheries' consultation process. The trap resumed fishing on January 23, 2004 when additional methods were developed to reduce the mortalities associated with the previous protocol.

Twenty-one species of fish were captured in the RST (Table 2), including a total of 307,397 juvenile Chinook salmon captured during the sampling period. Bi-weekly summaries of Chinook salmon catch are reported in Appendix A. Steelhead trout were captured less frequently and totaled 590 fish during the October – June trapping period. Bi-weekly summaries of Steelhead trout catch are reported in Appendix B.

Table 2. Common and scientific names of species captured in the RST.

Common Name	**Species**
American shad	*Alosa sapidissima*
Bluegill sunfish	*Lepomis macrochirus*
Brown bullhead	*Ameiurus nebulosus*
California roach	*Lavinia 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 tridentatus*
Prickly sculpin	*Cottus asper*
Steelhead trout	*Oncorhynchus mykiss*
Riffle sculpin	*Cottus gulosus*
Sacramento pikeminnow	*Ptychocheilus grandis*
Sacramento sucker	*Catostomus occidentalis*
Smallmouth bass	*Micropterus dolomieui*
Speckled dace	*Rhinichthys osculus*
Tule perch	*Hysterocarpus traski*
White catfish	*Ameiurus catus*
White crappie	*Pomoxis annularis*

Peak captures of Chinook salmon fry were observed earlier than recorded in previous sampling. Monitoring conducted from 2001 through 2002 revealed that peak catches occur between January and March of each year (Drury, 2003). Current observations saw peak catches of early emigrating fry captured in the RST present between December 2003 and March 2004, approximately one month earlier than observed during previous monitoring efforts (Figures A-5, A-6). Over 67,000 juvenile Chinook salmon were captured during the first two weeks of December 2003 (Table A-1). Daily captures remained high until approximately mid-March 2004. Juvenile Chinook salmon captures in January and February totaled 63,590 fish and 69,315 fish, respectively. March captures began to decrease, as a total of 21,396 juvenile Chinook salmon were captured in the RST.

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. The calibrations have provided a relative measure to assess the number of emigrating juvenile salmon moving downstream at the RST site. Seven calibrations were completed during the October 2003 – June 2004 trapping period (Table 3). No calibrations were conducted in October, November, May, or June, as juvenile Chinook salmon were not captured in adequate numbers to conduct a mark and recapture study. RST efficiency during the calibration period (December 2003 – April 2004) ranged from 1.42% to 7.36%, with the majority of calibration values falling between 1.42% and 2.85%. Peak juvenile Chinook salmon emigration in December 2003 corresponded with the highest calibration value observed during the study (7.36%). Calibration values changed with varying average daily flows for the capture period. Efficiency values associated with lower flows were generally higher than those observed during periods of higher flows. RST efficiency values indicated that although peak captures of juvenile Chinook salmon occurred in December 2003, peak emigration occurred in January 2004, as the lower RST efficiencies observed during the relatively higher flows recorded in January 2004 showed that captures during this month represented a smaller fraction of the total emigrating salmon at the RST site.

Table 3. Summary of RST efficiency calibrations from December 19, 2003 to April 3, 2004.

Date of Release	Release Size	Recaptures				Total	Efficiency
		Day 1	Day2	Day 3	Day 4		
12/19/03	611	39	6			45	7.36%
1/31/04	2,388	28	5	1		34	1.42%
2/13/04	1,837	35				35	1.91%
2/28/04	3,110	63	1			64	2.06%
3/13/04	988	17				17	1.72%
3/20/04	561	15	1			16	2.85%
4/3/04	626	12	3		1	16	2.56%

Three runs of Chinook salmon (spring-, fall-, and late-fall run) were identified through analysis and identification of modal distributions of captures at the RST (Appendix A). Length-at-date capture criteria developed for run identification on the Sacramento River

at Red Bluff were referenced to provide real-time monitoring of incidental take of threatened spring-run Chinook salmon, as the capture criteria generally fit the modal distributions of the three runs reasonable well (Fisher, 1992). Ongoing Chinook salmon monitoring projects (redd surveys, escapement surveys, juvenile monitoring and real-time adult passage monitoring at Daguerre Dam) further suggest that three runs exist on the lower Yuba River. Spring-run Chinook salmon were first observed on November 1, 2003, whereas fall-run Chinook salmon fry were not observed until December 2003. Late-fall run Chinook salmon fry were observed in the RST during mid-April and were represented in daily sampling until project commencement in late June. 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.

Tagging began on November 26, 2003 and ended on June 15, 2004. The majority of juvenile Chinook salmon were tagged during the observed peak emigration period between December 9, 2003 and March 18, 2004. Of the 307,397 total juvenile Chinook salmon captured in the RST, 185,515 were injected with a CWT and adipose-fin-clipped for later identification. Of that total, 183,305 juvenile Chinook salmon were correctly tagged and released (Table E-1), whereas the remaining 2,210 tagged fish either shed their tag or perished during the tagging process.

Water temperature data were recorded from December 4, 2003 to June 16, 2004 (Figure C-1). The optimum range for holding and rearing salmonids has an accepted upper thermal limit of 15^{o}C (Hinze, 1959; Boles, 1988; CDFG, 1998; Ward, 2004). Temperatures observed remained between 7^{o}C and 9^{o}C during the winter months. Maximum daily temperatures exceeded 15^{o}C on April 10, 2004 and mean daily temperature exceeded the accepted upper thermal limit for holding and rearing Chinook salmon of 15^{o}C from June 1, 2004 through the end of trapping on June 17, 2004 (Figure C-1).

Water velocities measured at the RST cone ranged from 1.1 ft/s to 6.2 ft/s with a mean value of 2.9 ft/s (Figure F-1). Daily turbidity measured at the RST ranged from 0.62 nephelometric turbidity units (ntu) to 16.4 ntu around a mean value of 2.81 ntu (Figure G-1).

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Appendix A:

Chinook Salmon (*Oncorhynchus tshawytscha*) Bi-weekly Catch 2003-2004

Table A-1. Bi-weekly summary of Chinook salmon captures on the Yuba River near Hallwood Blvd., October 1, 2003 to June 17, 2004.

Trapping Period		Mean FL (mm)	Range FL (mm)		Total Captured
10/01/03	10/15/03	89	36	121	6
10/16/03	10/31/03	83	73	93	7
11/01/03	11/15/03	41	22	110	148
11/16/03	11/30/03	36	30	132	991
12/1/03	12/15/03	37	30	120	67,168
12/16/03	12/31/03	37	29	99	78,231
01/01/04	01/15/04	37	29	60	23,122
01/16/04	01/31/04	38	29	138	40,468
02/01/04	02/15/04	38	30	67	52,867
02/16/04	02/29/04	39	28	70	16,448
03/01/04	03/15/04	41	17	130	17,811
03/16/04	03/31/04	44	29	101	3,585
04/01/04	04/15/04	49	29	90	1,677
04/16/04	04/30/04	55	32	97	2,908
05/01/04	05/15/04	56	30	97	815
05/16/04	05/31/04	63	30	91	416
06/01/04	06/15/04	70	33	111	648
06/16/04	06/17/04	74	40	105	81

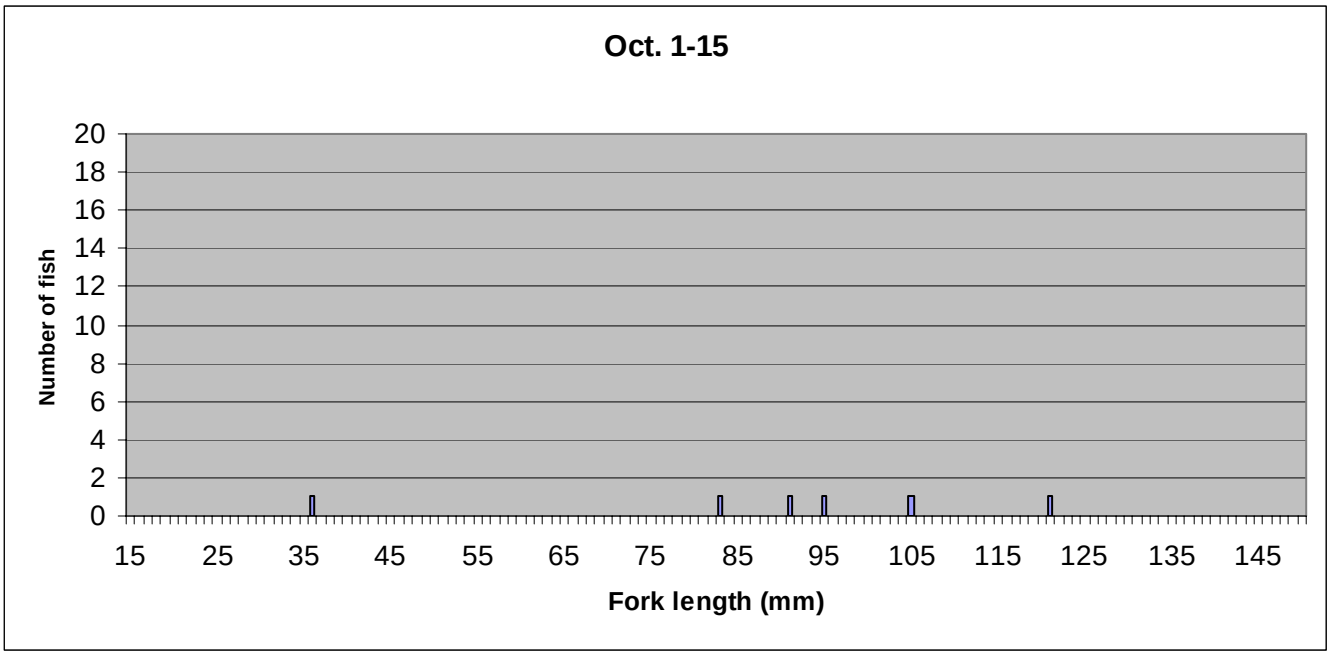

Figure A-1. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, October 1-15, 2003.

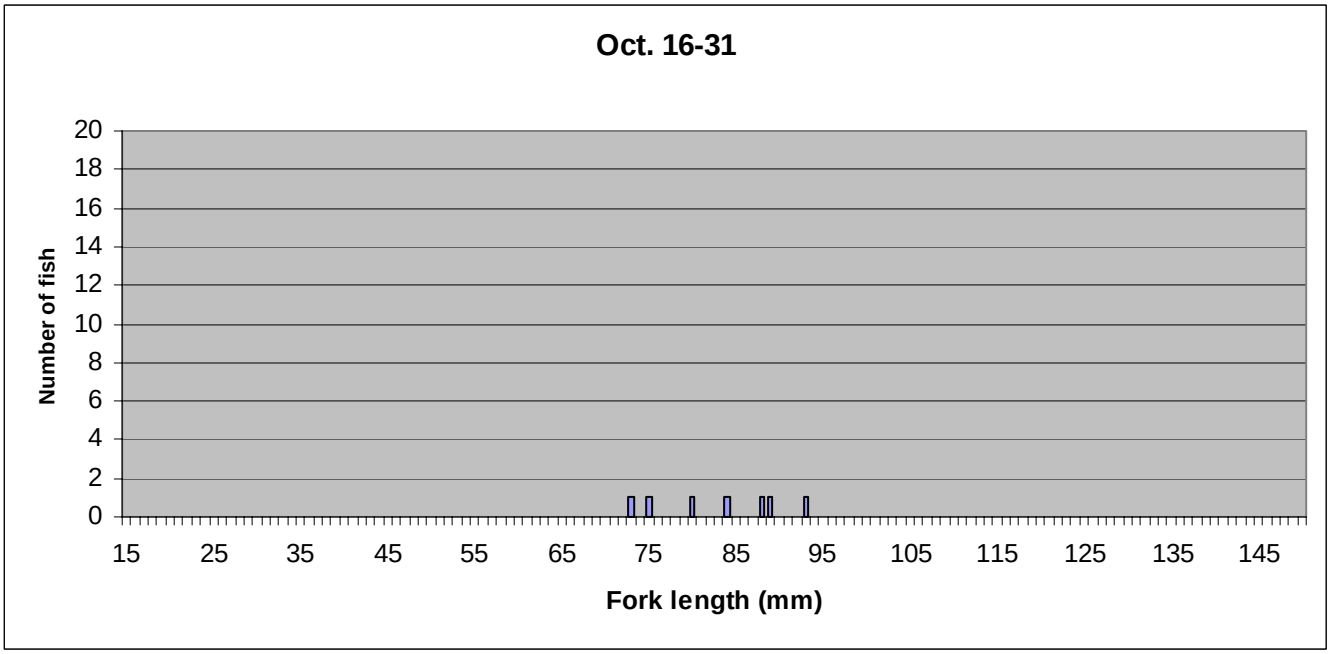

Figure A-2. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, October 16 -31, 2003.

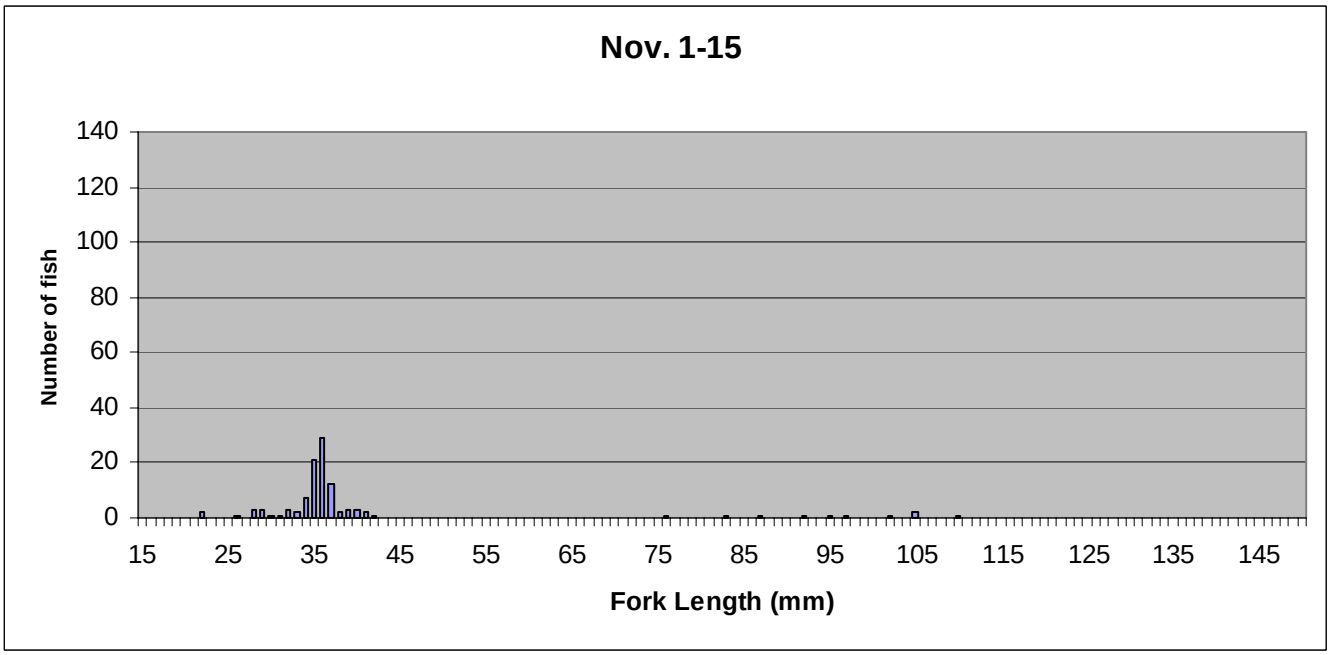

Figure A-3. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, November 1 – 15, 2003.

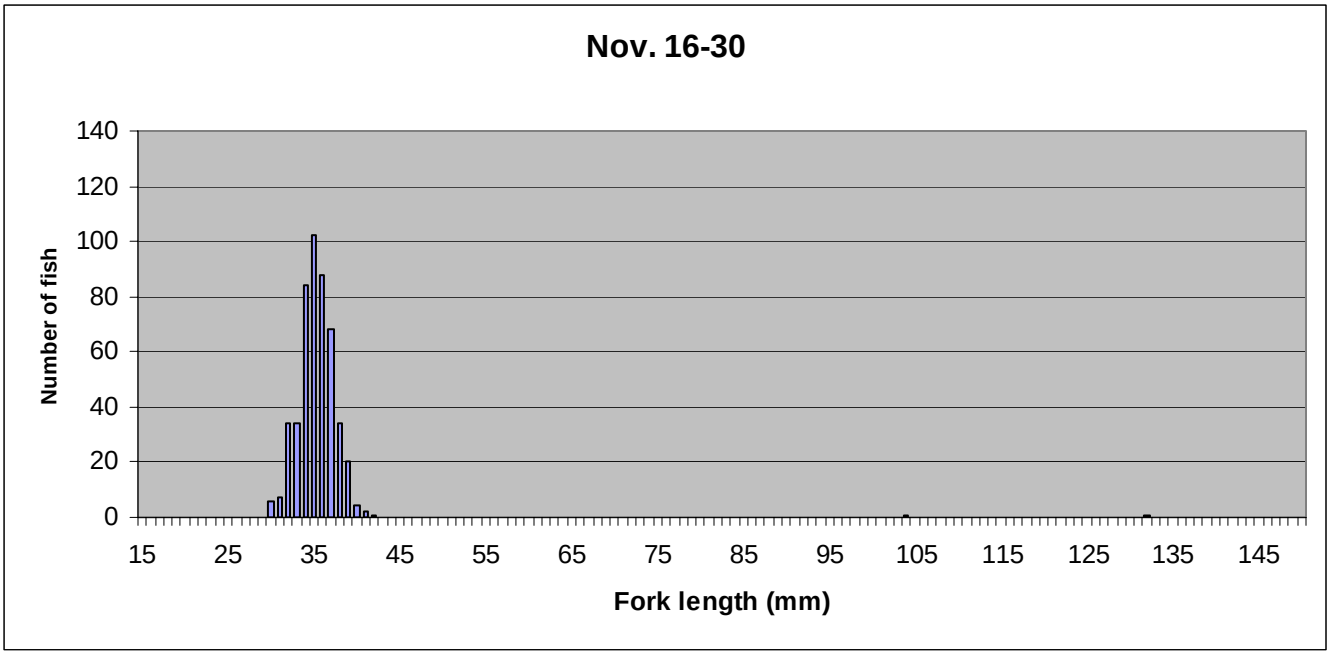

Figure A-4. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, November 16 – 30, 2003.

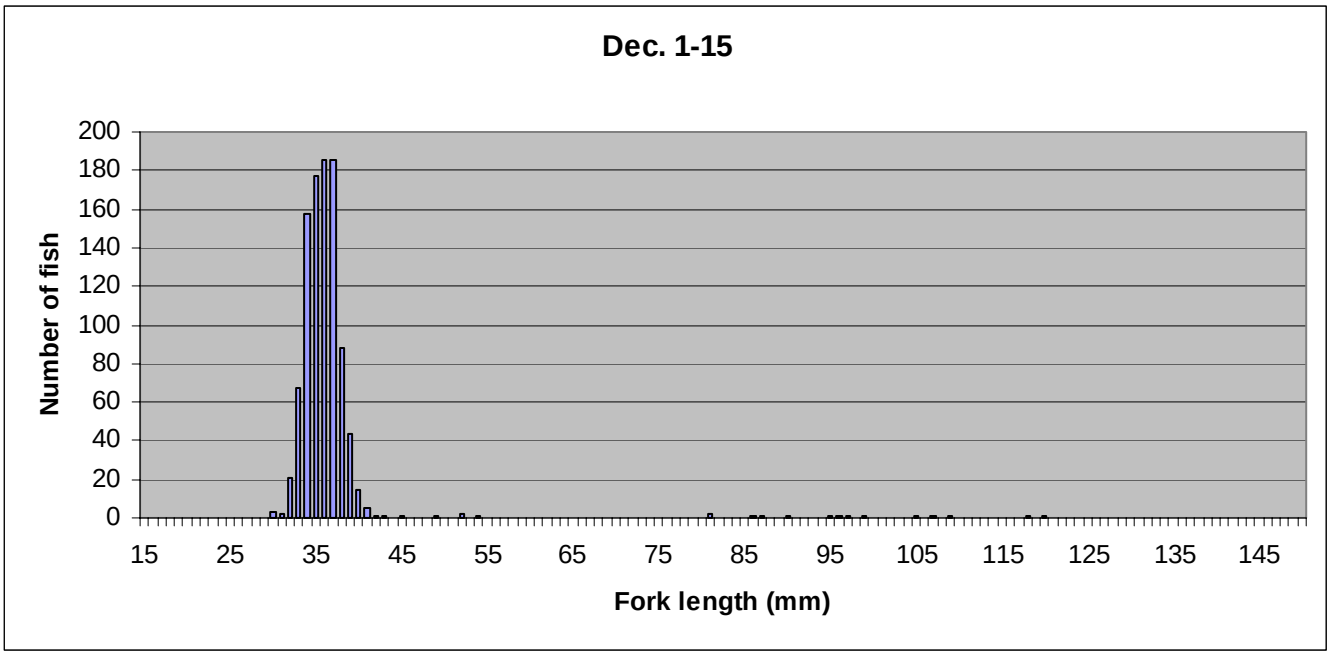

Figure A-5. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, December 1 – 15, 2003.

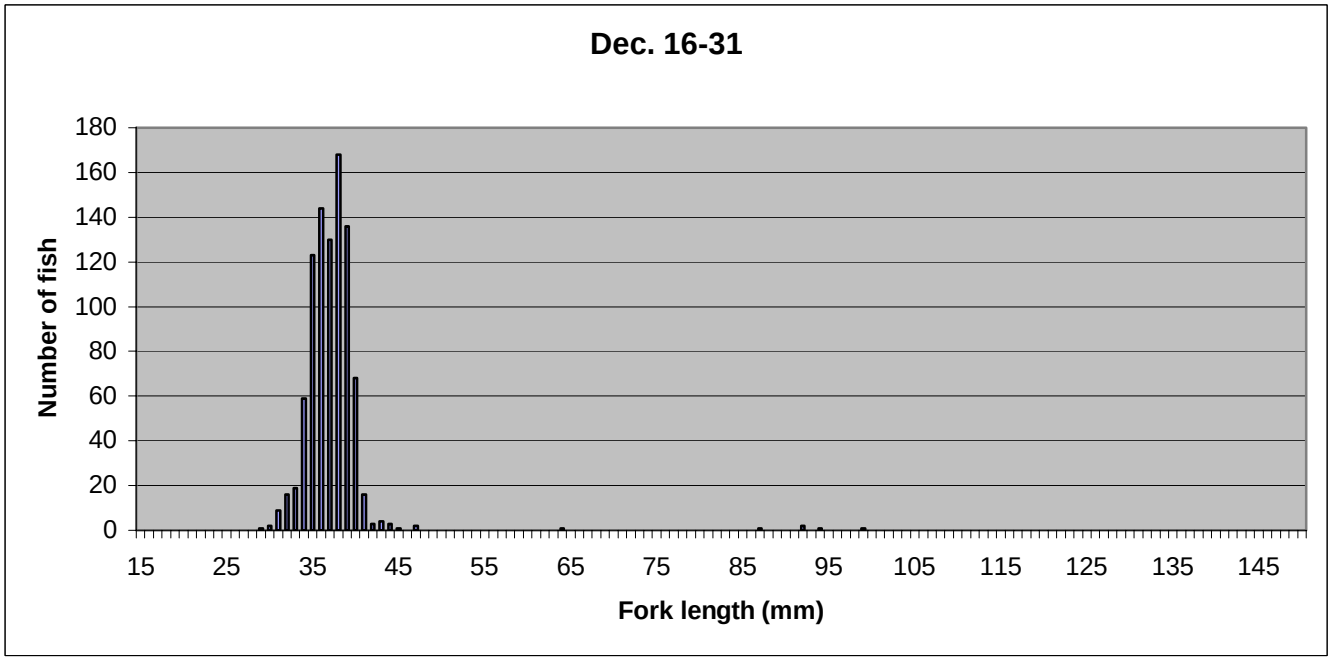

Figure A-6. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, December 16 – 31, 2003.

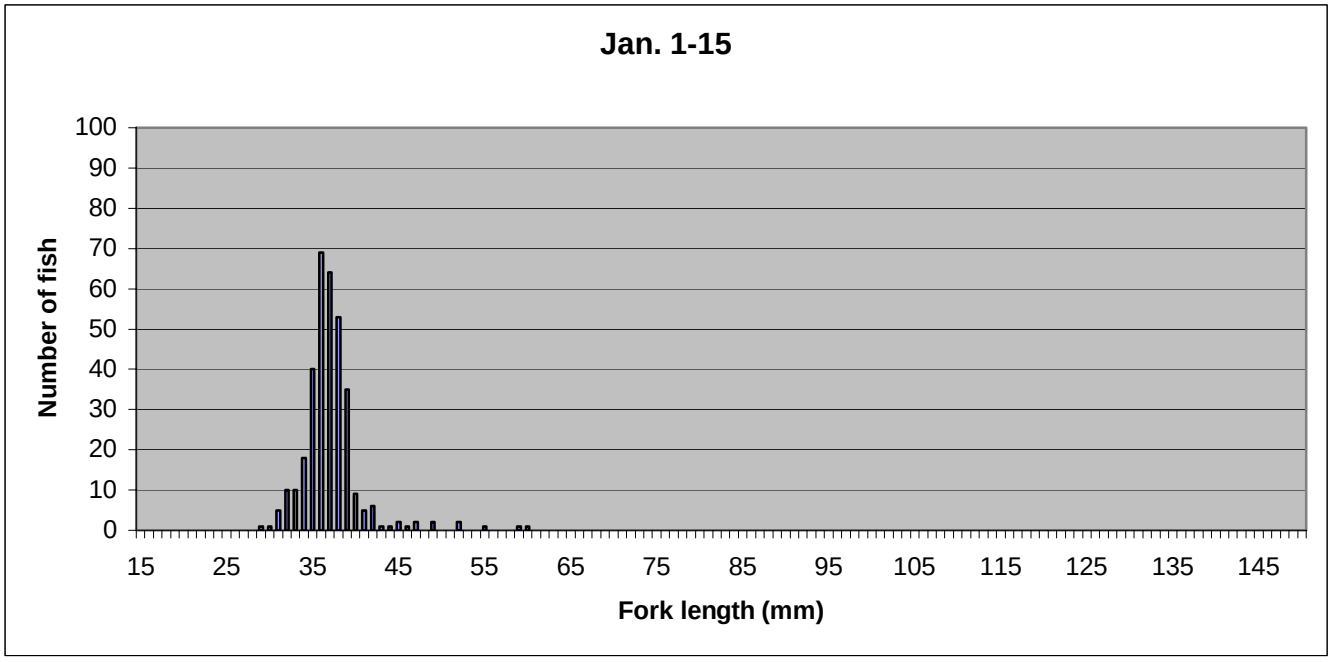

Figure A-7. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, January 1 – 15, 2004.

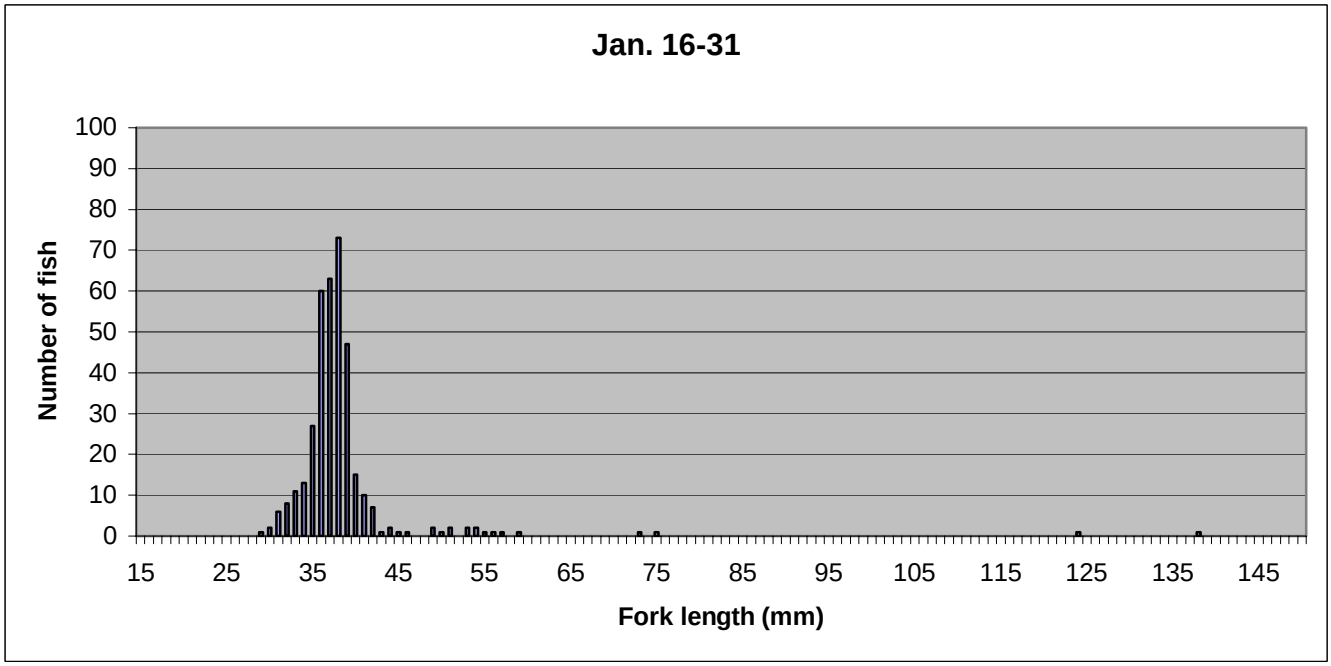

Figure A-8. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, January 16 – 31, 2004.

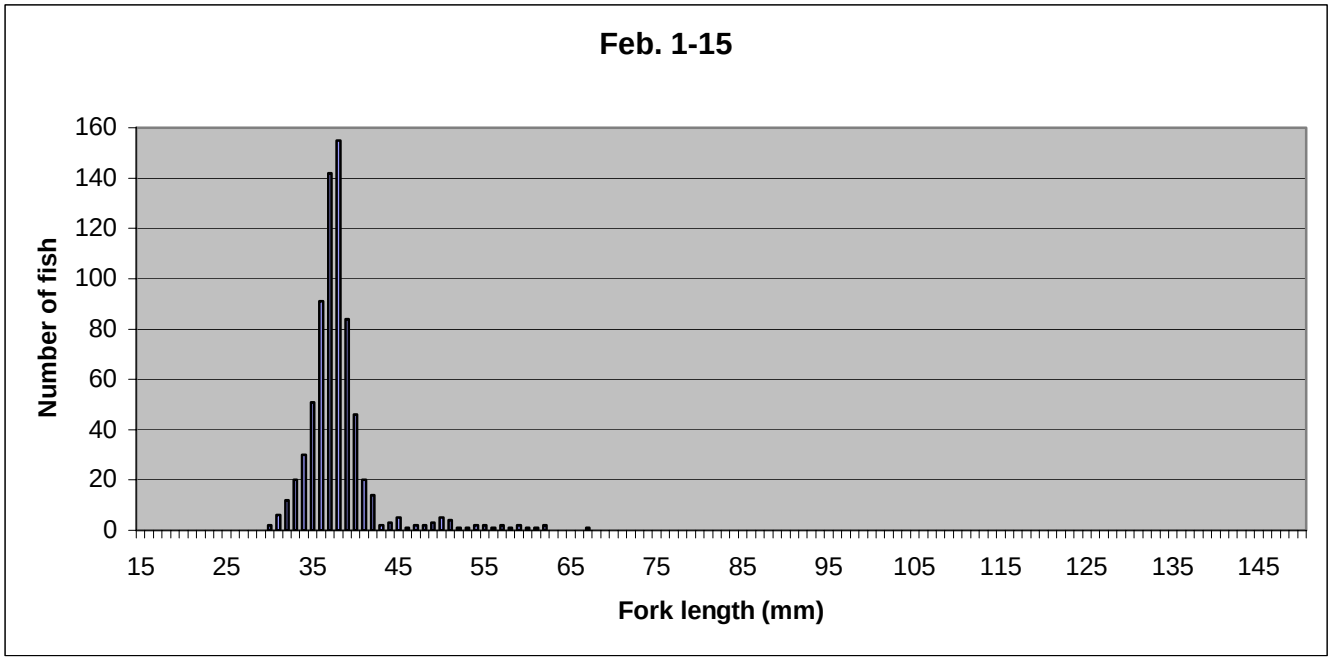

Figure A-9. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, February 1 – 15, 2004.

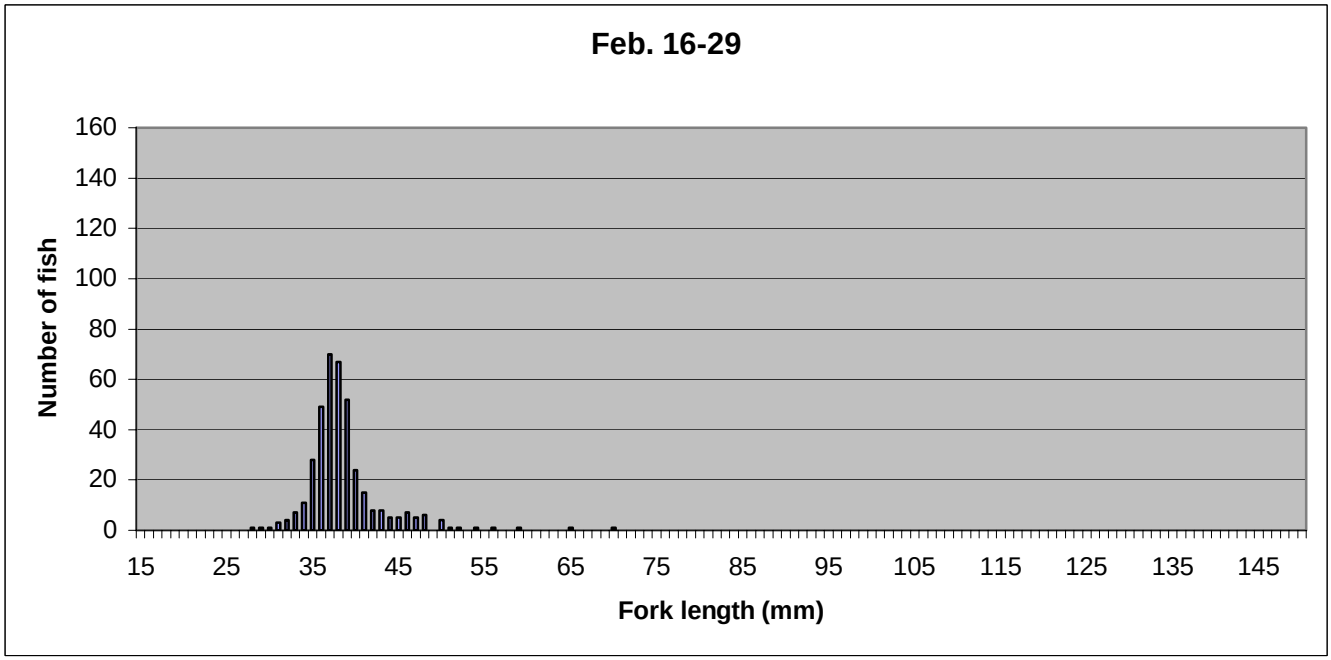

Figure A-10. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, February 16 – 29, 2004.

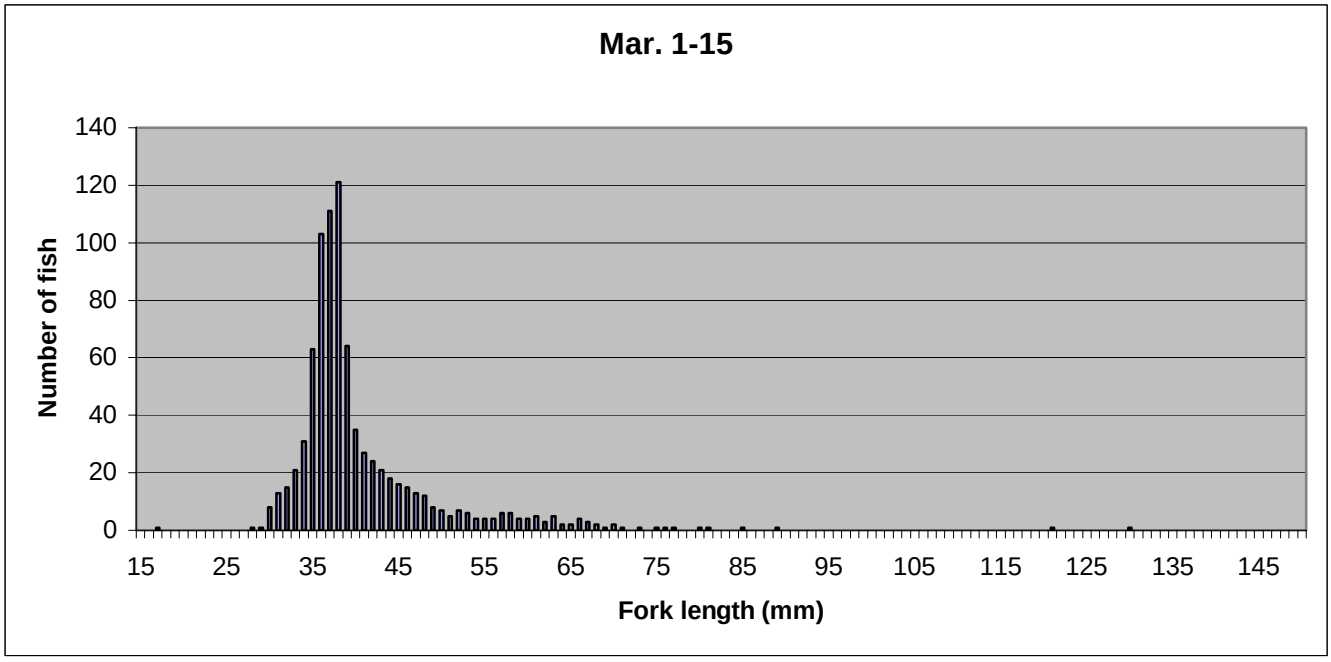

Figure A-11. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, March 1 – 15, 2004.

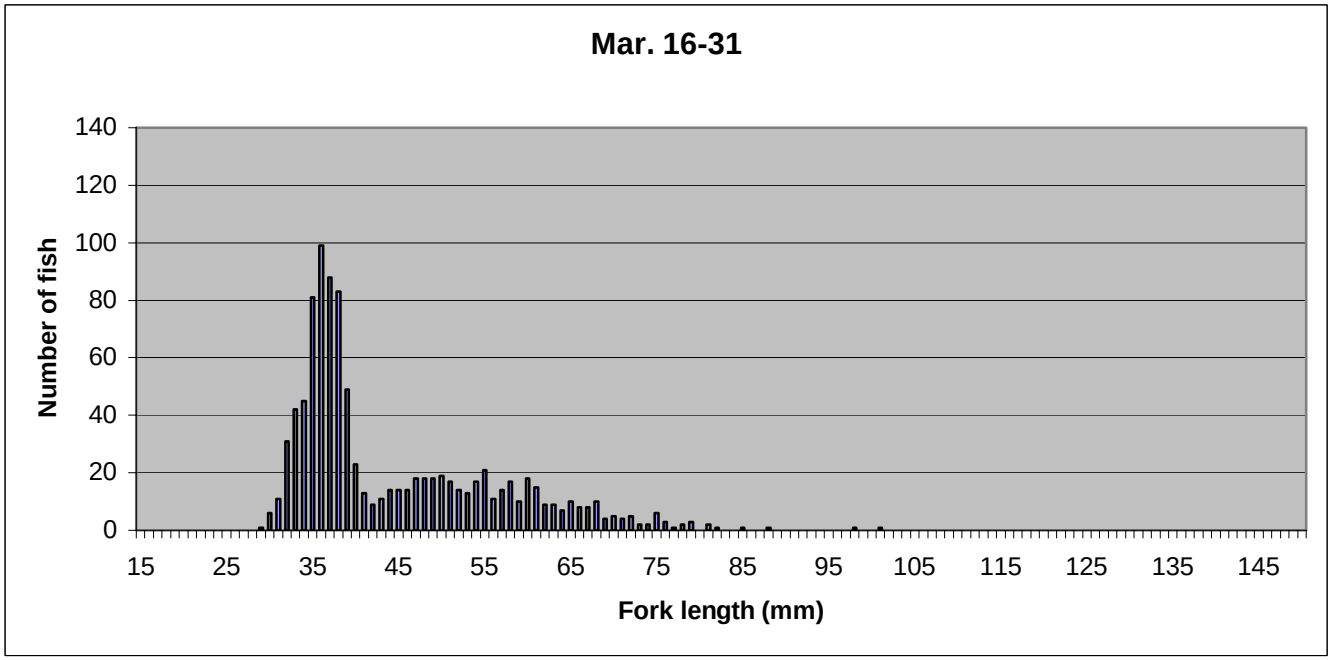

Figure A-12. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, March 16 – 31, 2004.

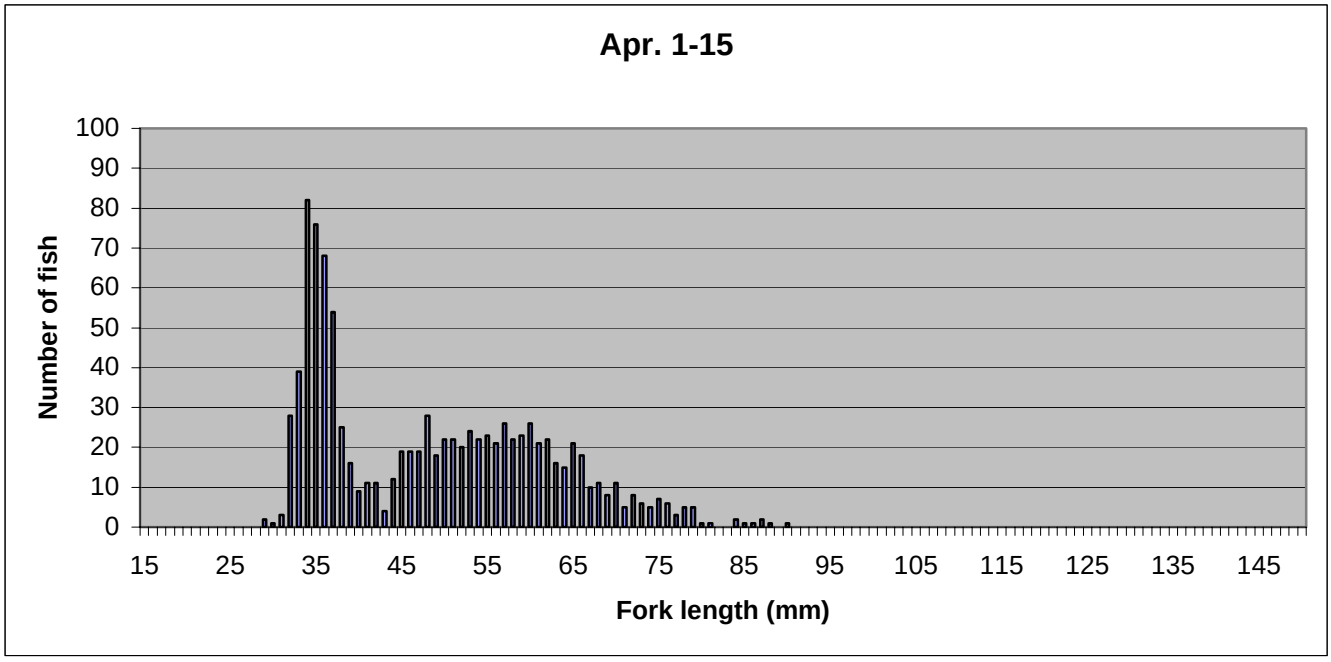

Figure A-13. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, April 1 – 15, 2004.

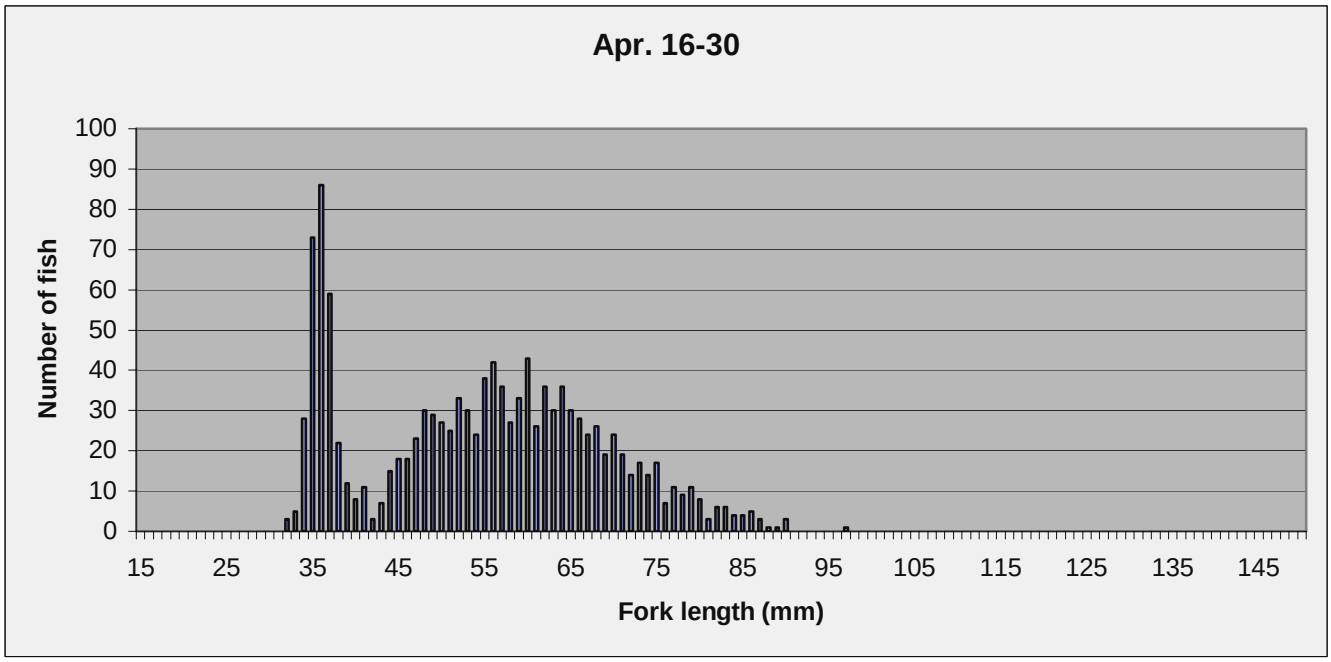

Figure A-14. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, April 16 – 30, 2004.

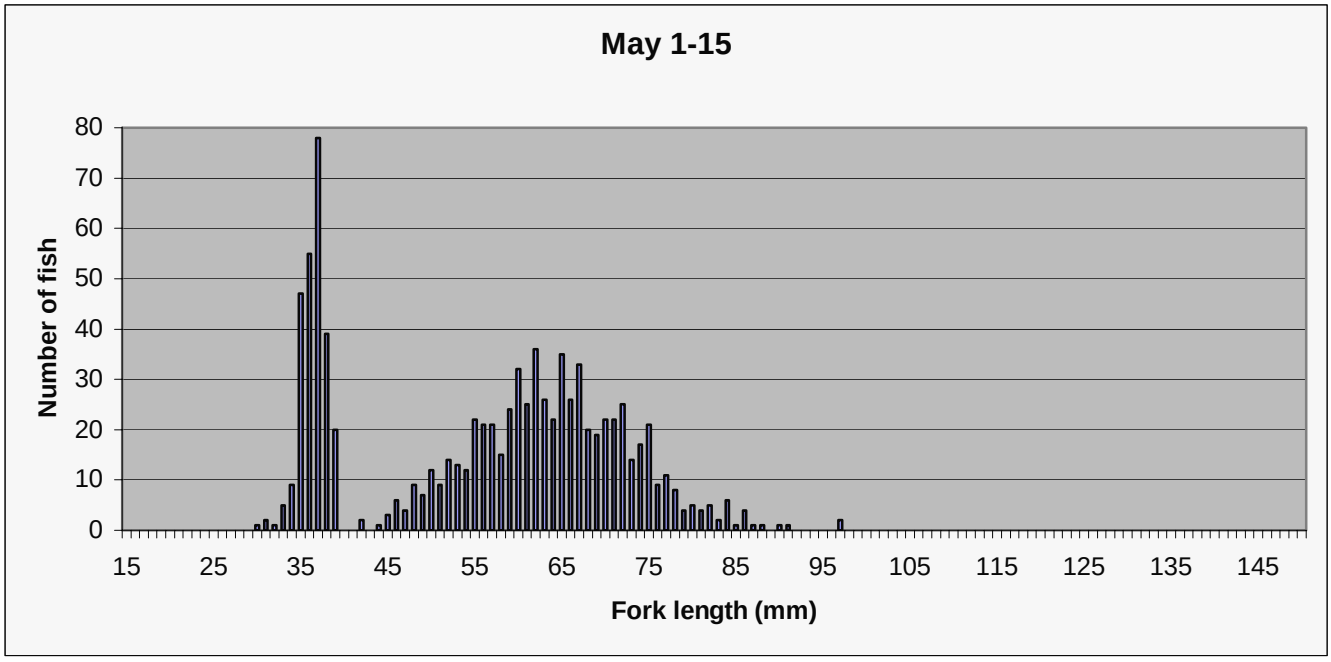

Figure A-15. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, May 1 – 15, 2004.

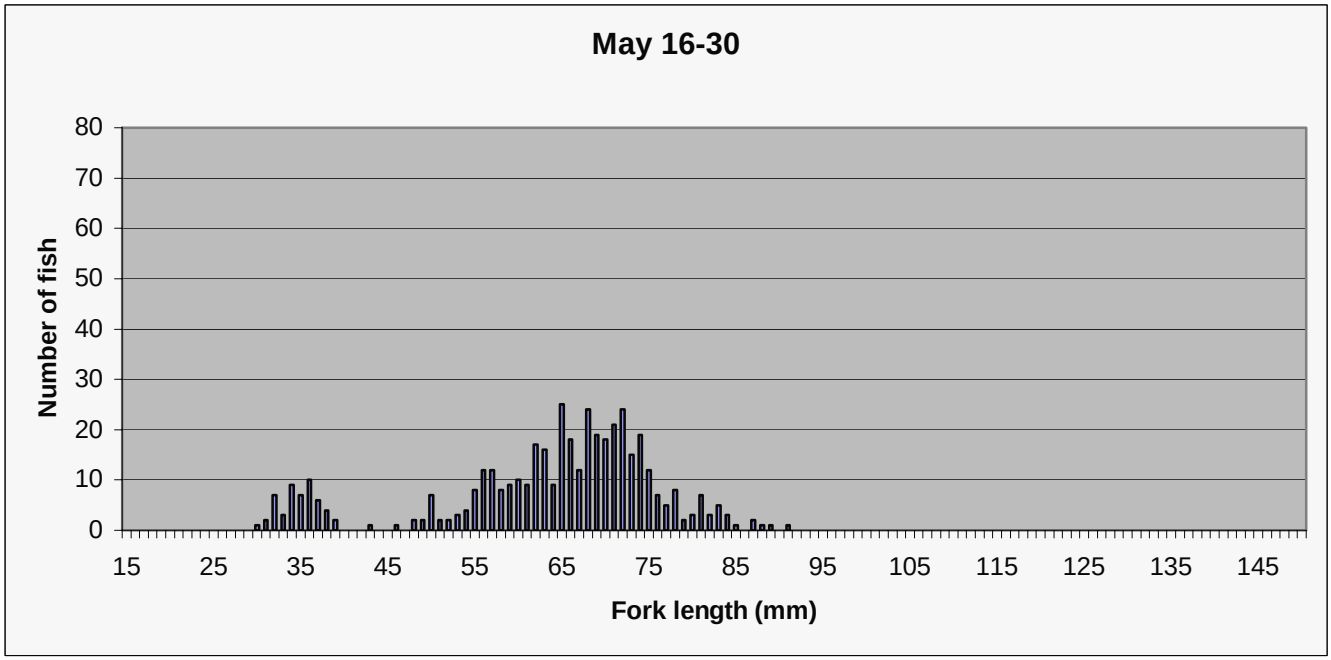

Figure A-16. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, May 16 – 30, 2004

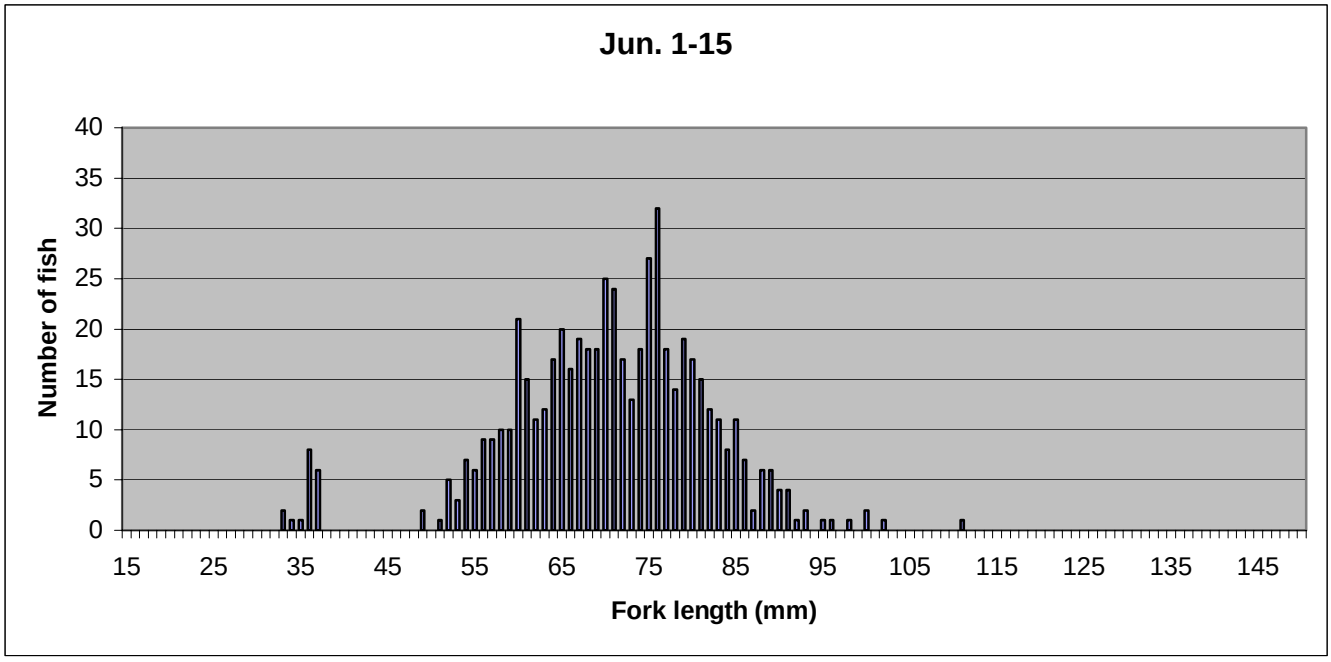

Figure A-17. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, June 1 – 15, 2004.

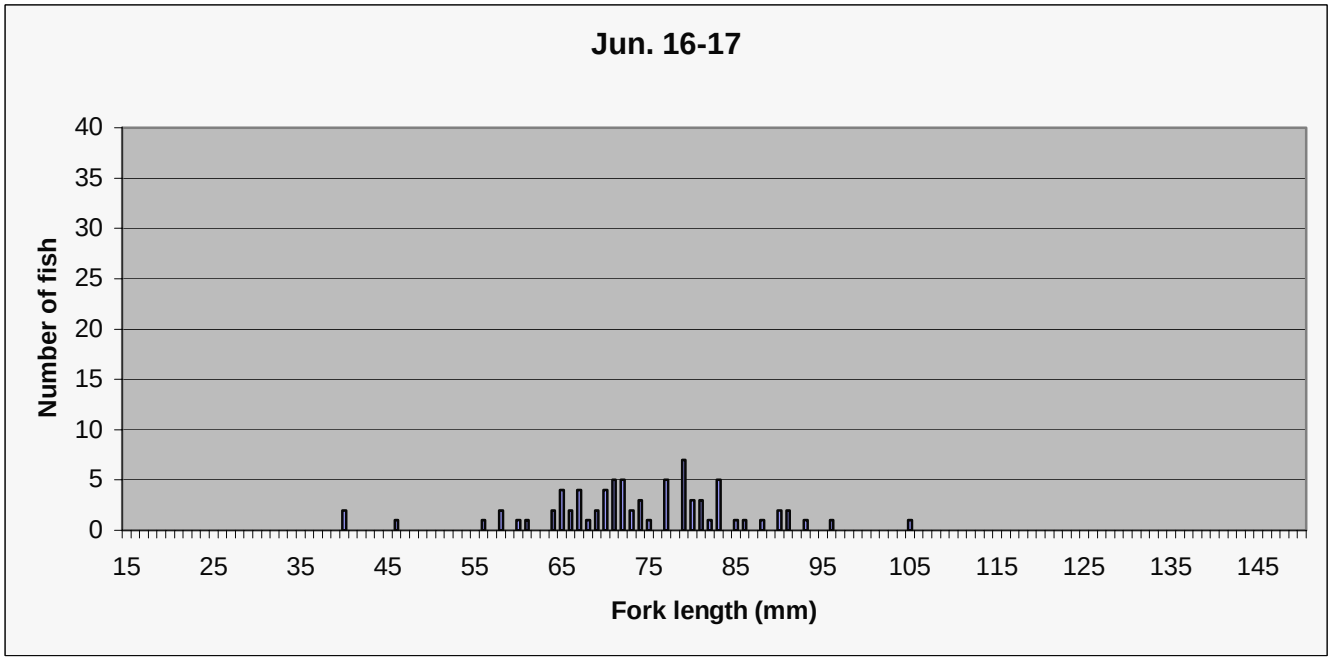

Figure A-18. Bi-weekly catch of juvenile Chinook salmon at the Yuba River RST, June 16 – 17, 2004.

Appendix B:

Steelhead Trout (*Oncorhynchus mykiss*) Bi-weekly Catch 2003-2004

Table B-1. Bi-weekly summary of steelhead trout captures on the Yuba River near Hallwood Blvd., October 1, 2003 to June 17, 2004.

Trapping Period		Mean FL (mm)	Range FL (mm)		Total Captured
10/01/03	10/15/03	93	75	129	5
10/16/03	10/31/03	78	35	160	15
11/01/03	11/15/03	103	55	165	43
11/16/03	11/30/03	84	52	122	17
12/1/03	12/15/03	88	60	133	57
12/16/03	12/31/03	80	55	125	46
01/01/04	01/15/04	86	70	109	9
01/16/04	01/31/04	117	92	151	3
02/01/04	02/15/04	97	71	135	7
02/16/04	02/29/04	97	69	168	10
03/01/04	03/15/04	88	50	236	100
03/16/04	03/31/04	89	38	268	30
04/01/04	04/15/04	92	38	229	31
04/16/04	04/30/04	85	43	108	39
05/01/04	05/15/04	96	50	384	32
05/16/04	05/31/04	77	48	94	27
06/01/04	06/15/04	63	30	211	92
06/16/04	06/17/04	59	43	71	27

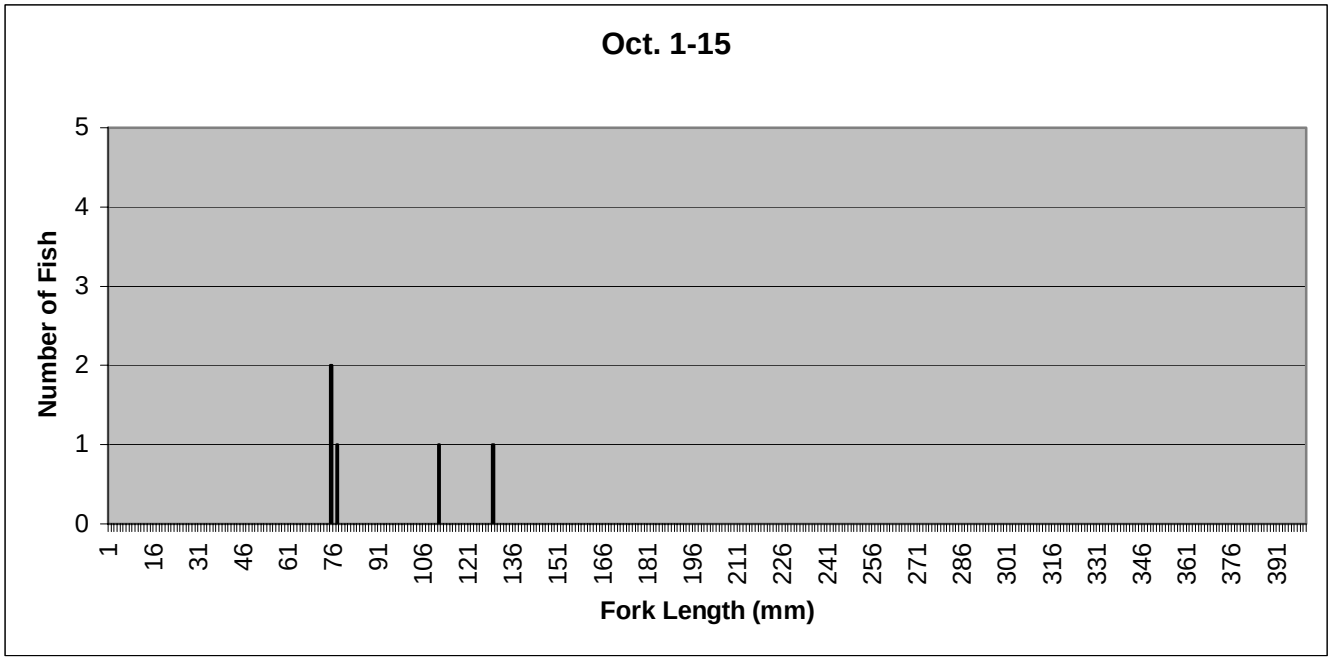

Figure B-1. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, Oct 1 – 15, 2003.

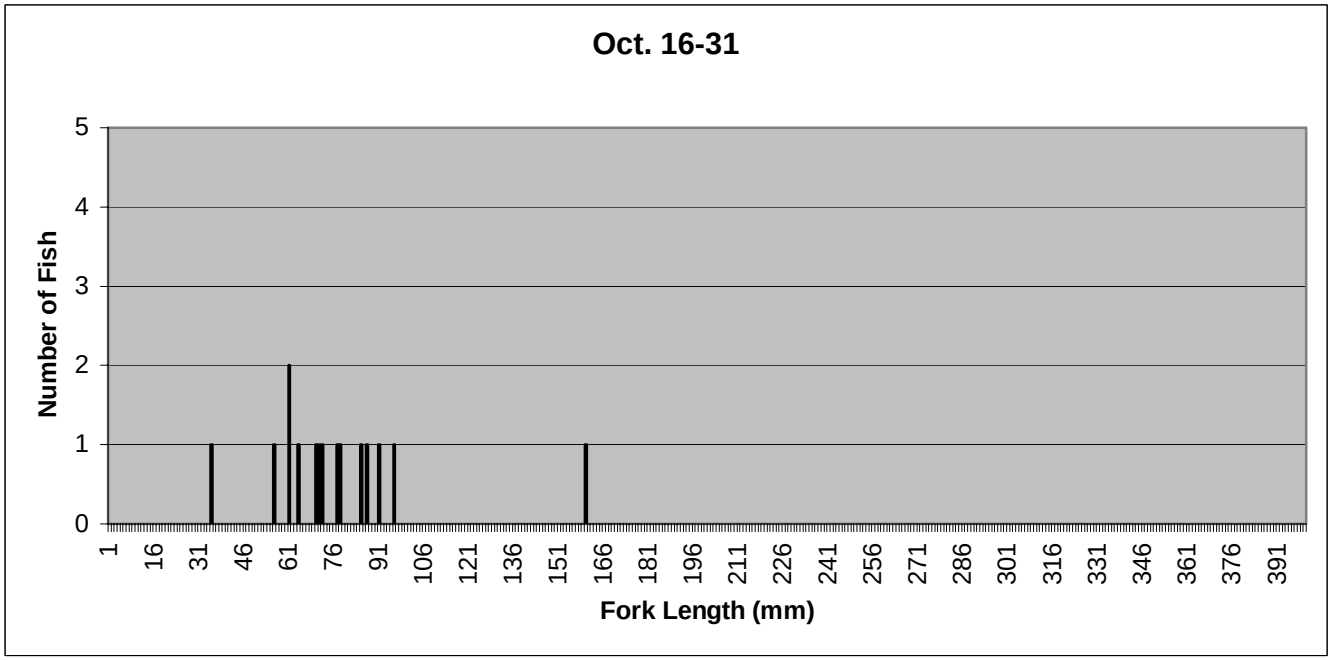

Figure B-2. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, Oct 16 – 31, 2003.

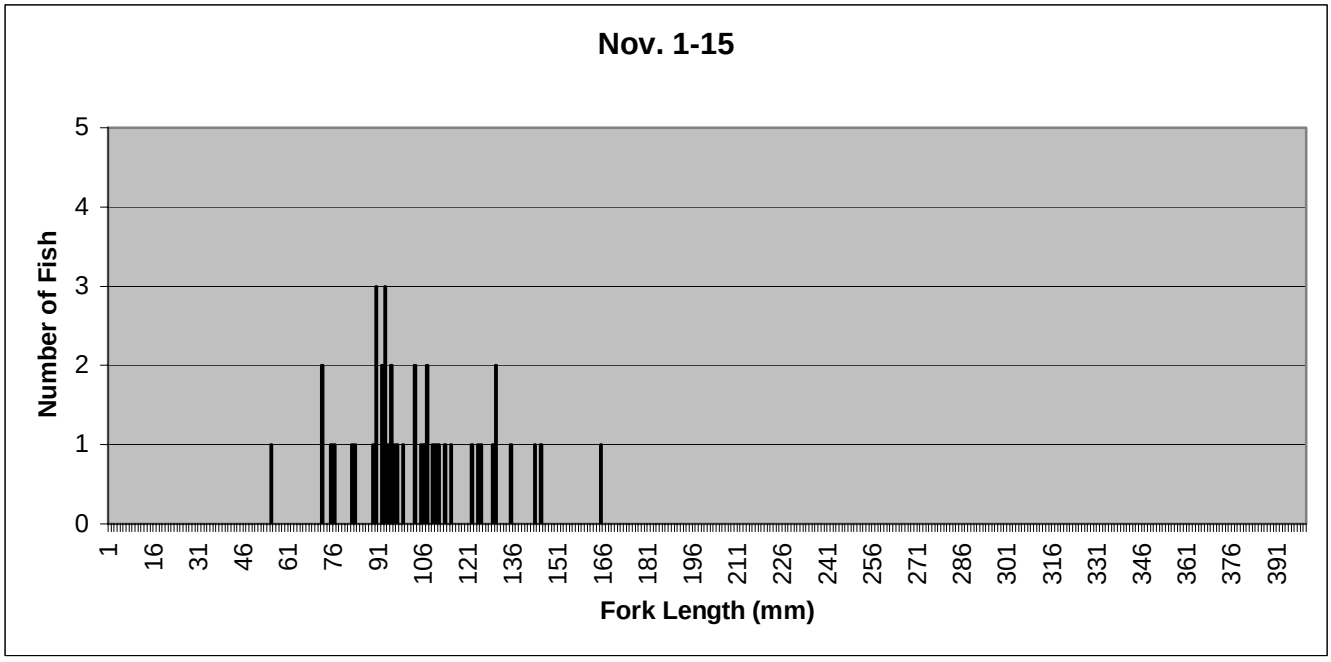

Figure B-3. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, November 1 – 15, 2003.

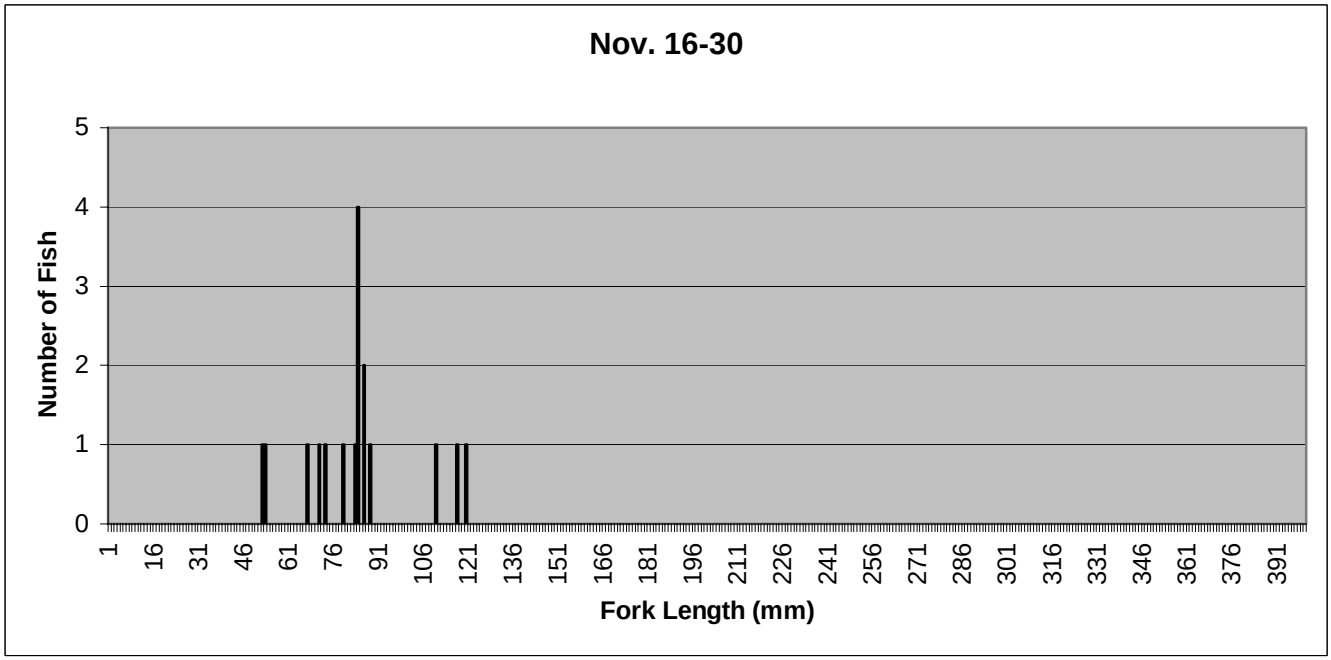

Figure B-4. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, November 16 – 30, 2003.

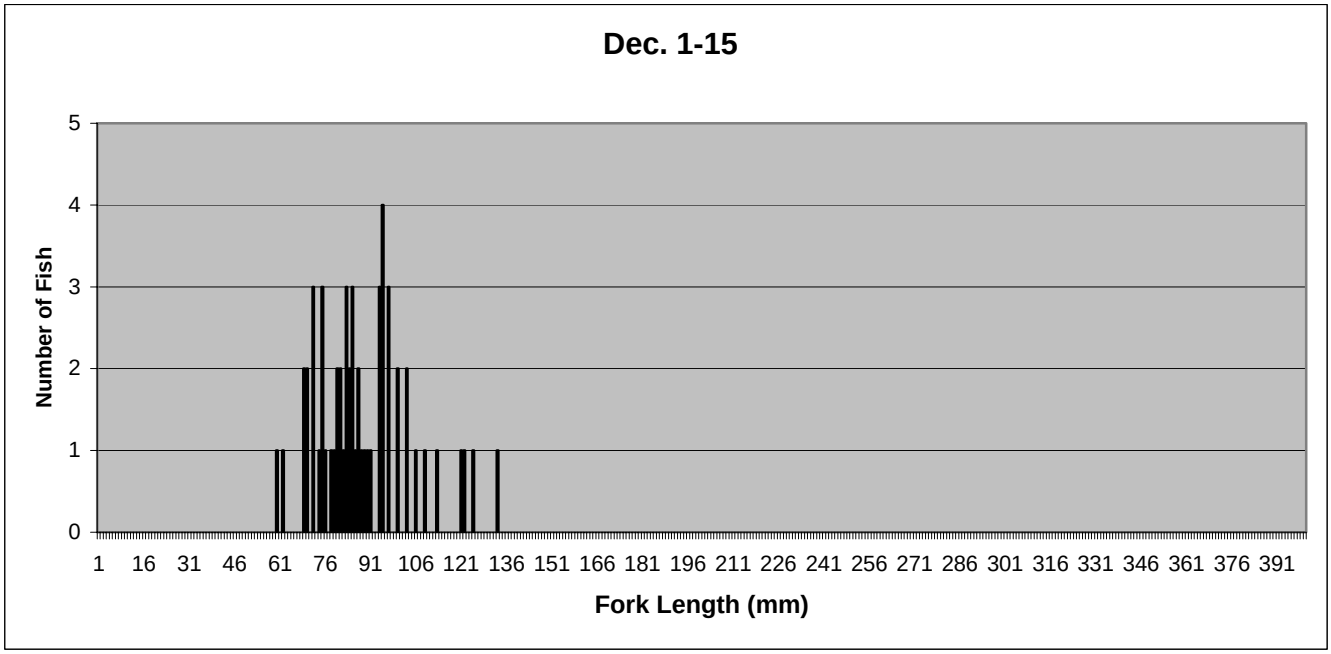

Figure B-5. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, December 1 -15, 2003.

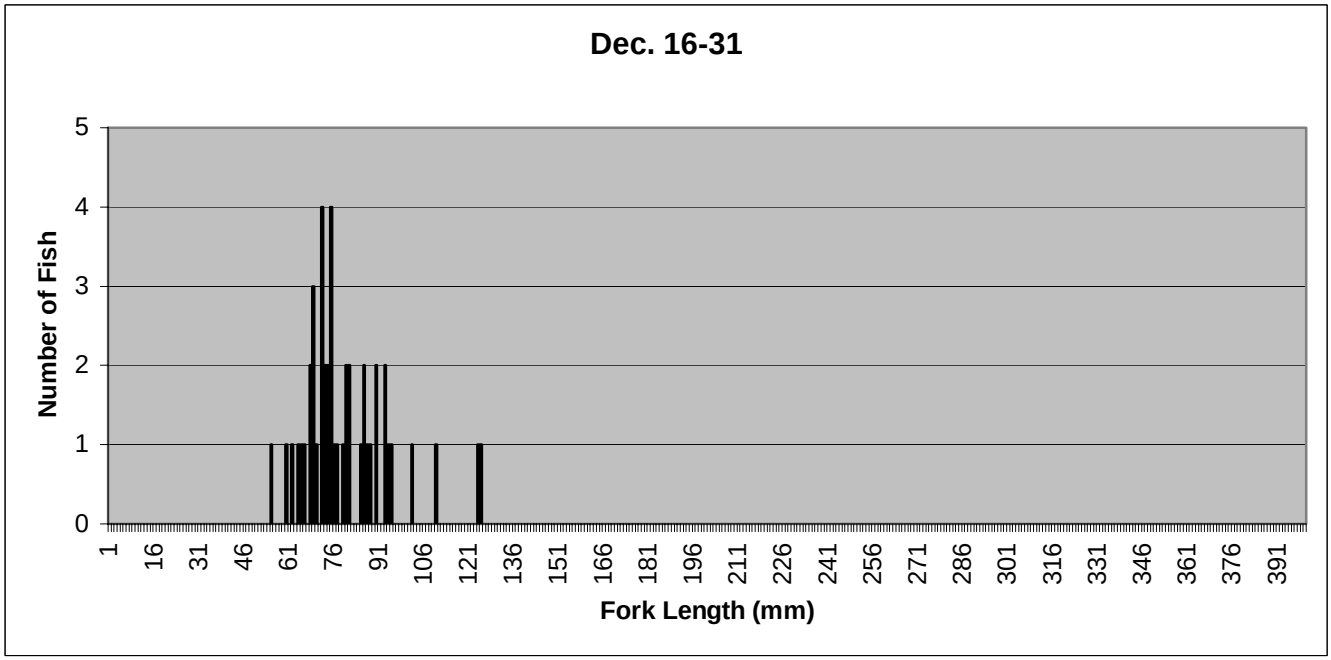

Figure B-6. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, December 16 – 31, 2003.

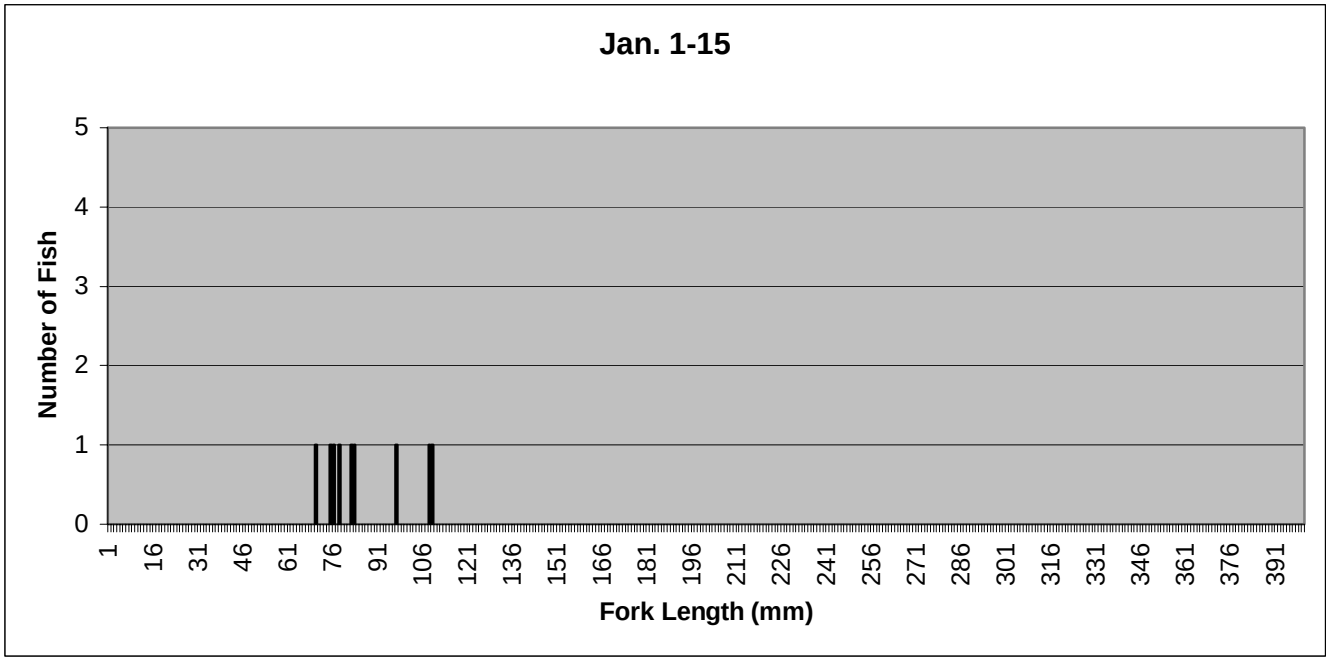

Figure B-7. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, January 1 – 15, 2004.

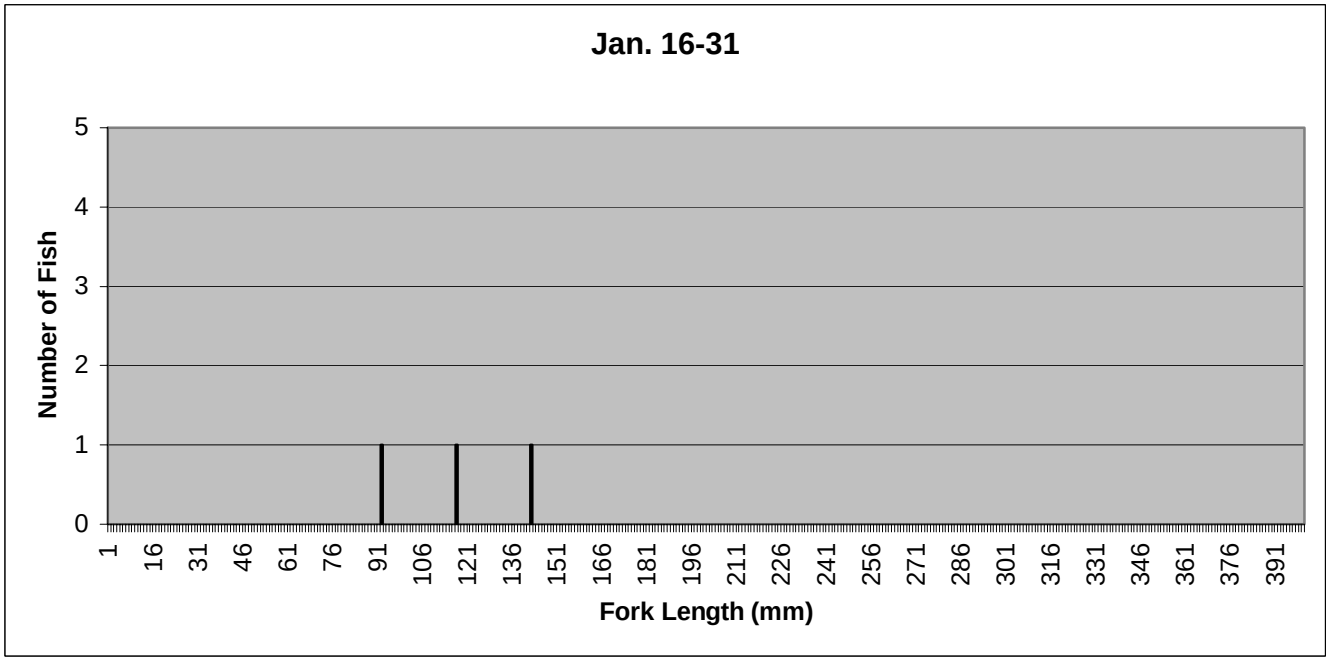

Figure B-8. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, January 16 – 31, 2004.

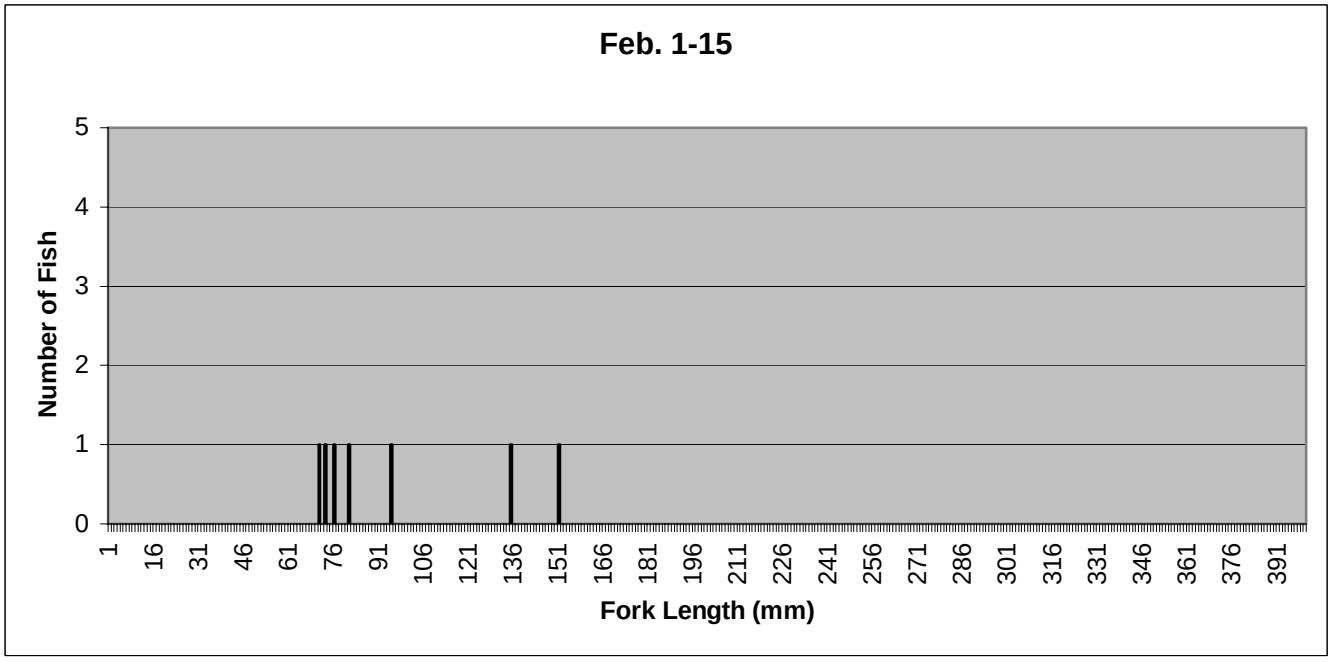

Figure B-9. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, February 1 – 15, 2004.

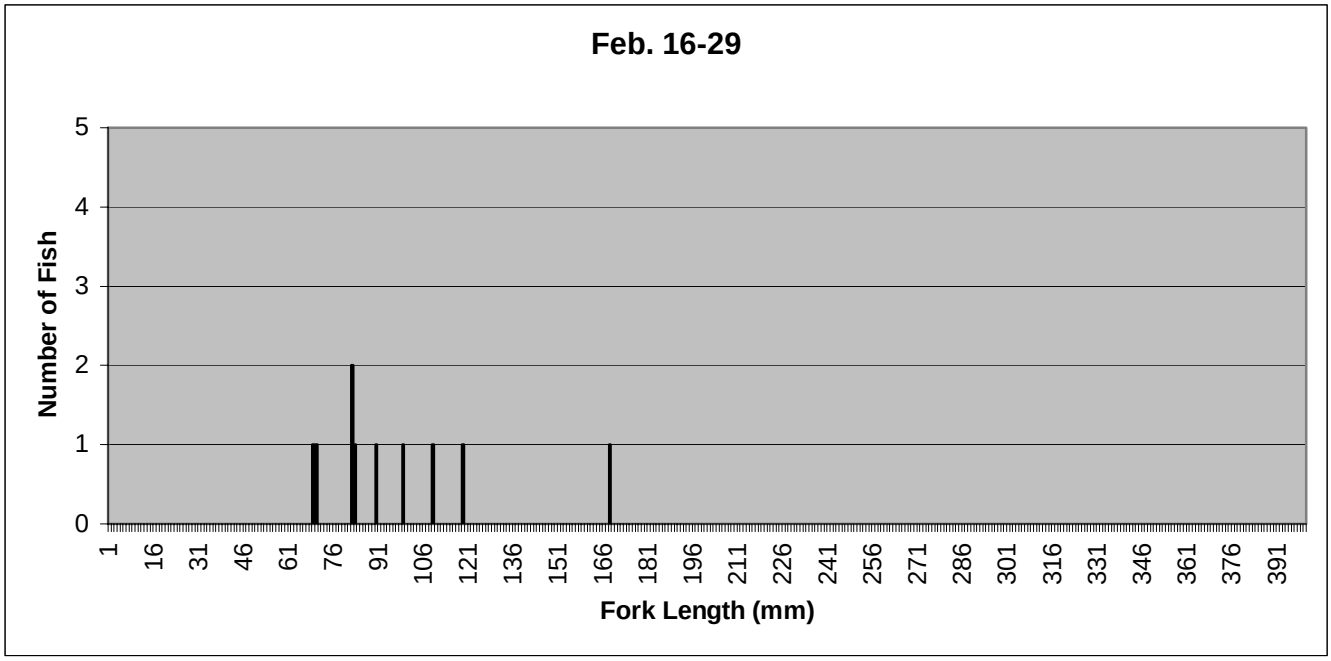

Figure B-10. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, February 16 – 29, 2004.

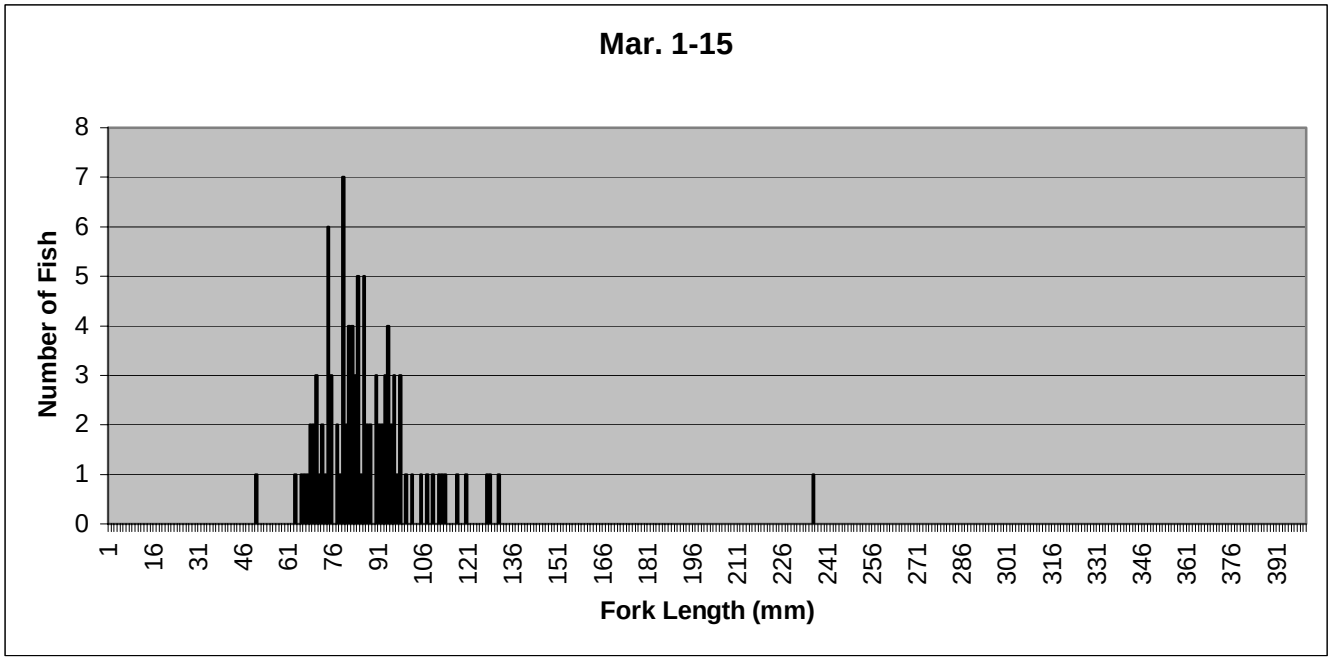

Figure B-11. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, March 1 – 15, 2004.

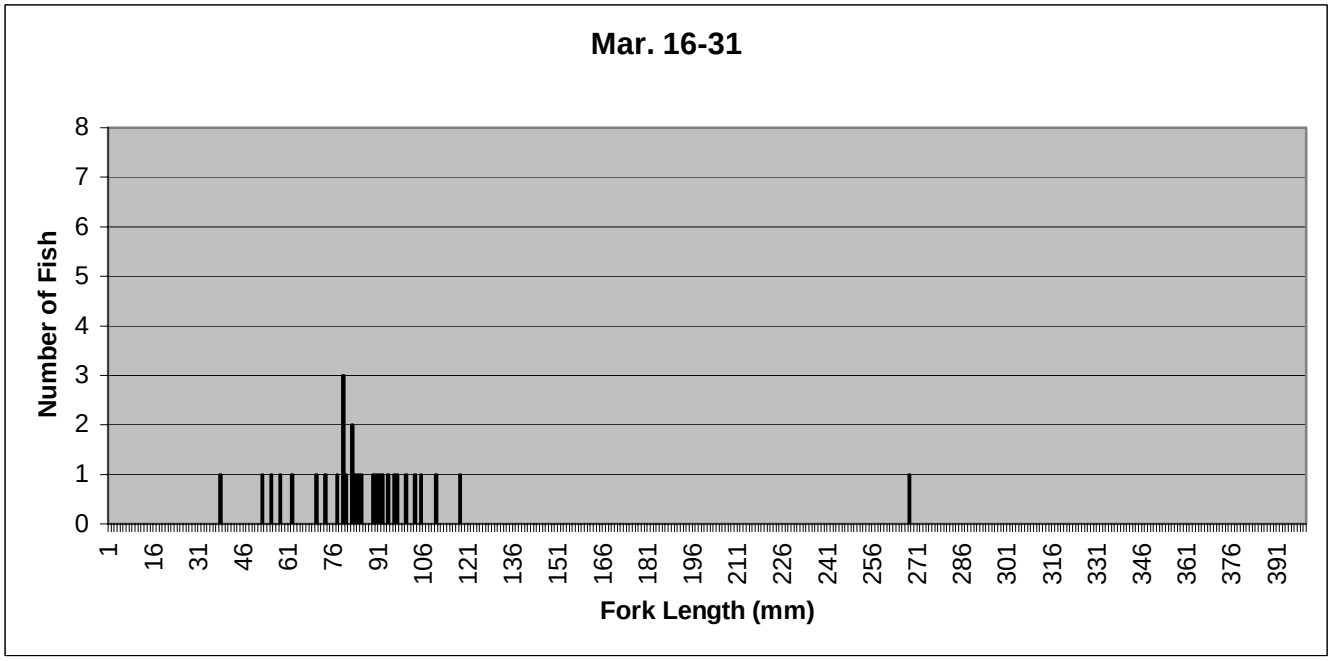

Figure B-12. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, March 16 – 31, 2004.

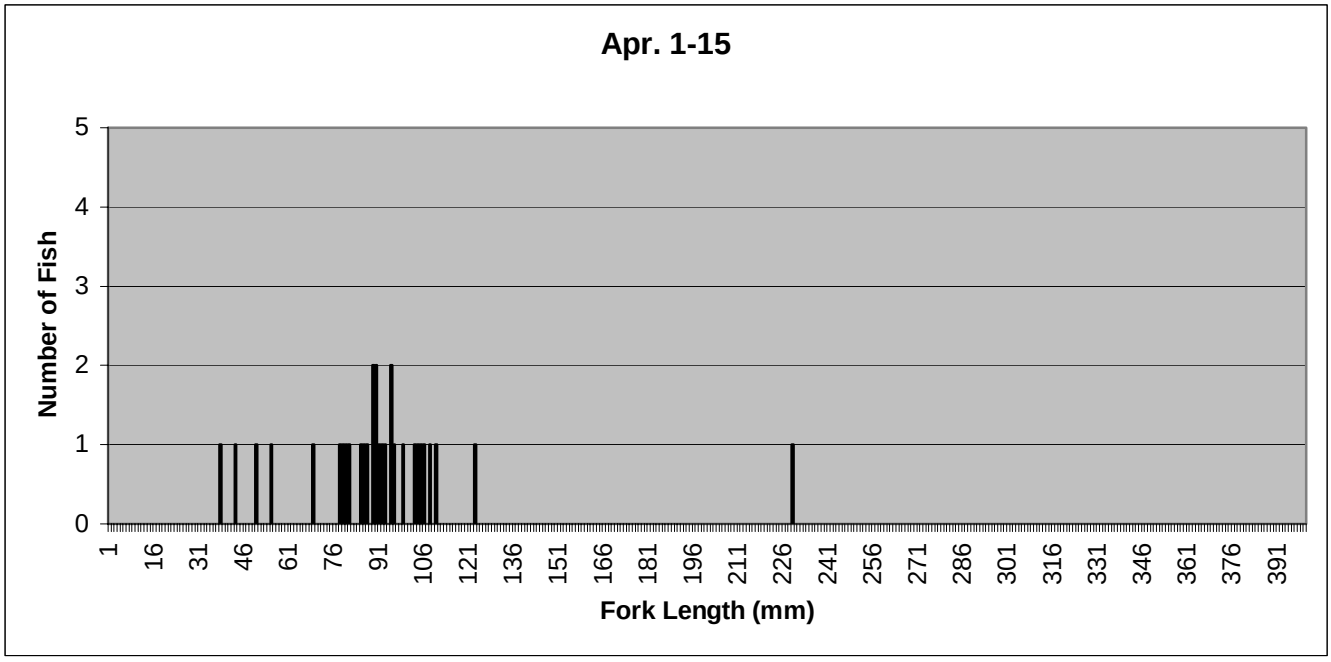

Figure B-13. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, April 1 – 15, 2004.

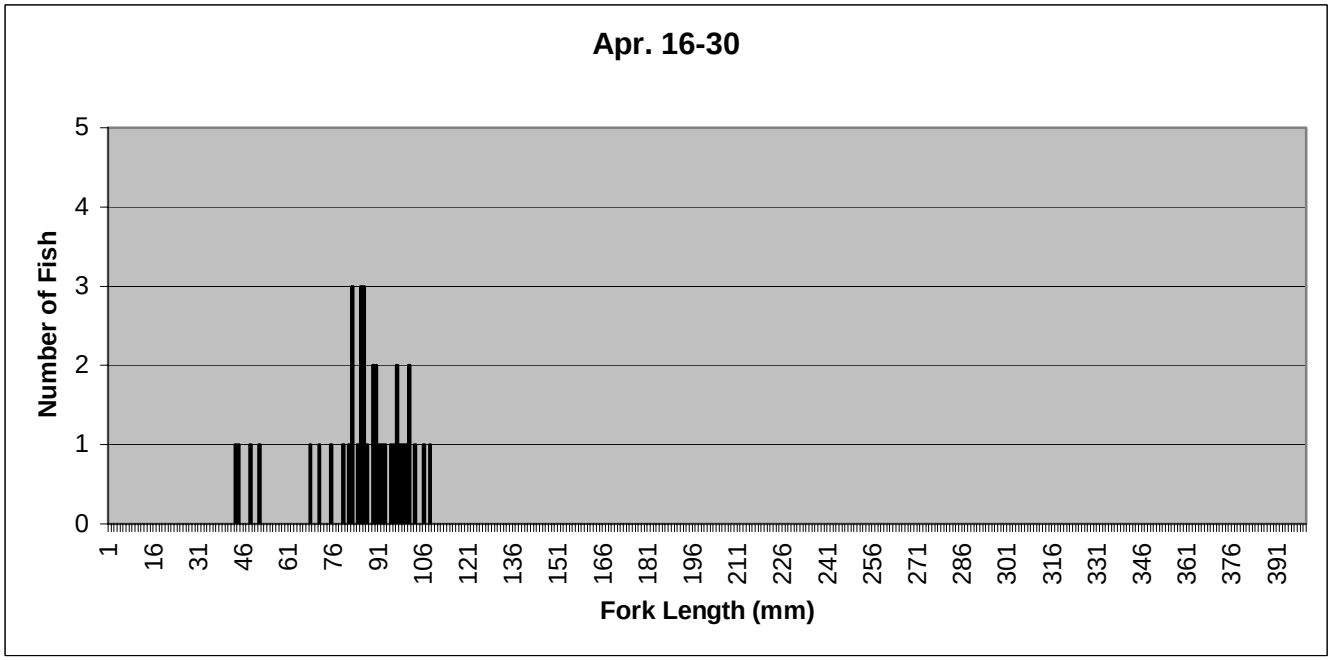

Figure B-14. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, April 16 – 30, 2004.

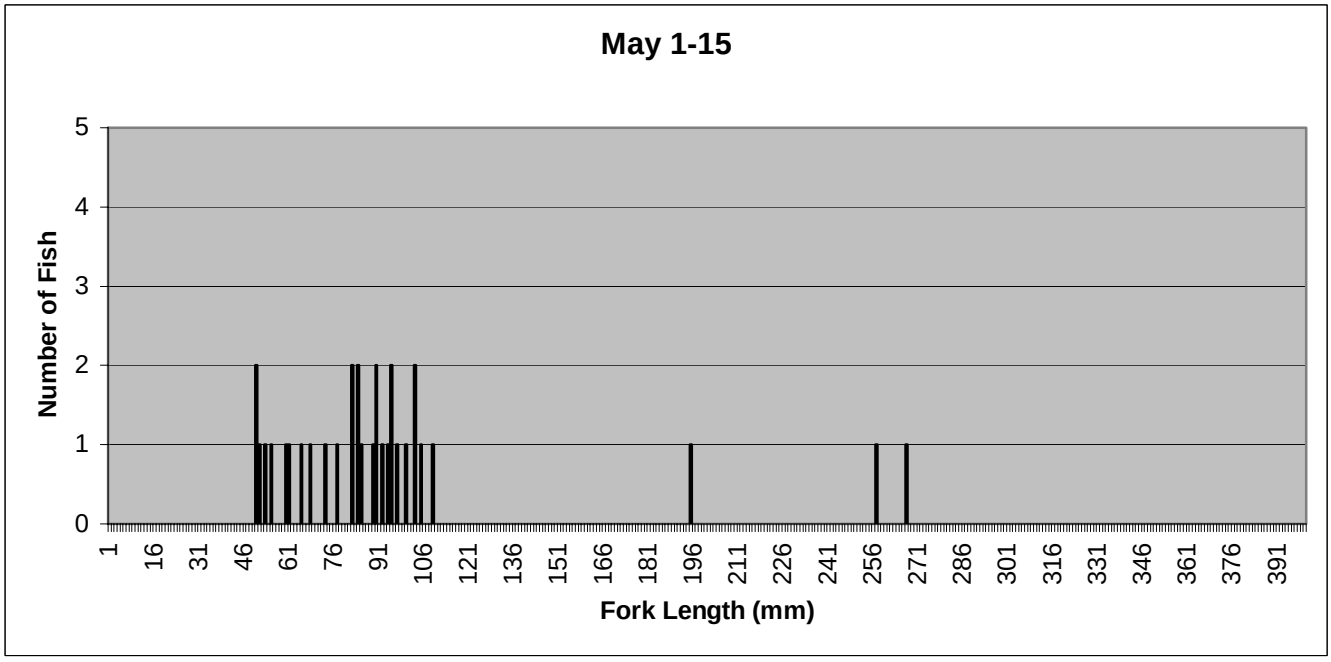

Figure B-15. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, May 1 – 15, 2004.

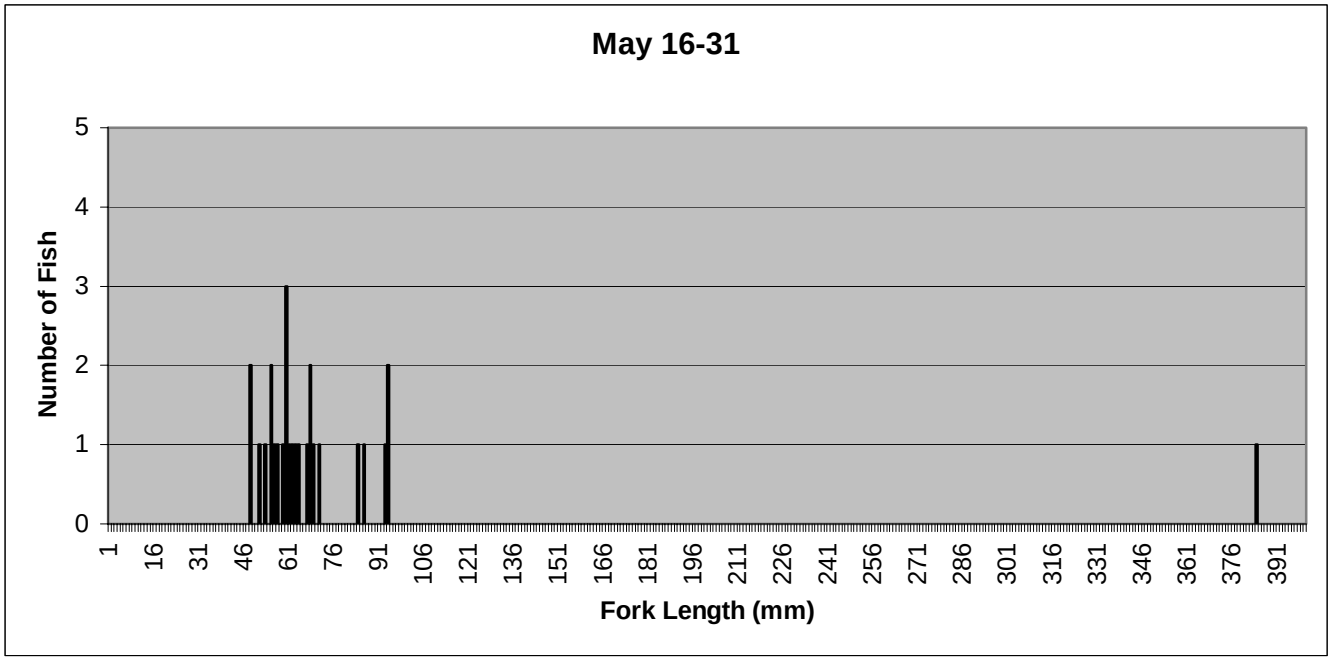

Figure B-16. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, May 16 – 31, 2004.

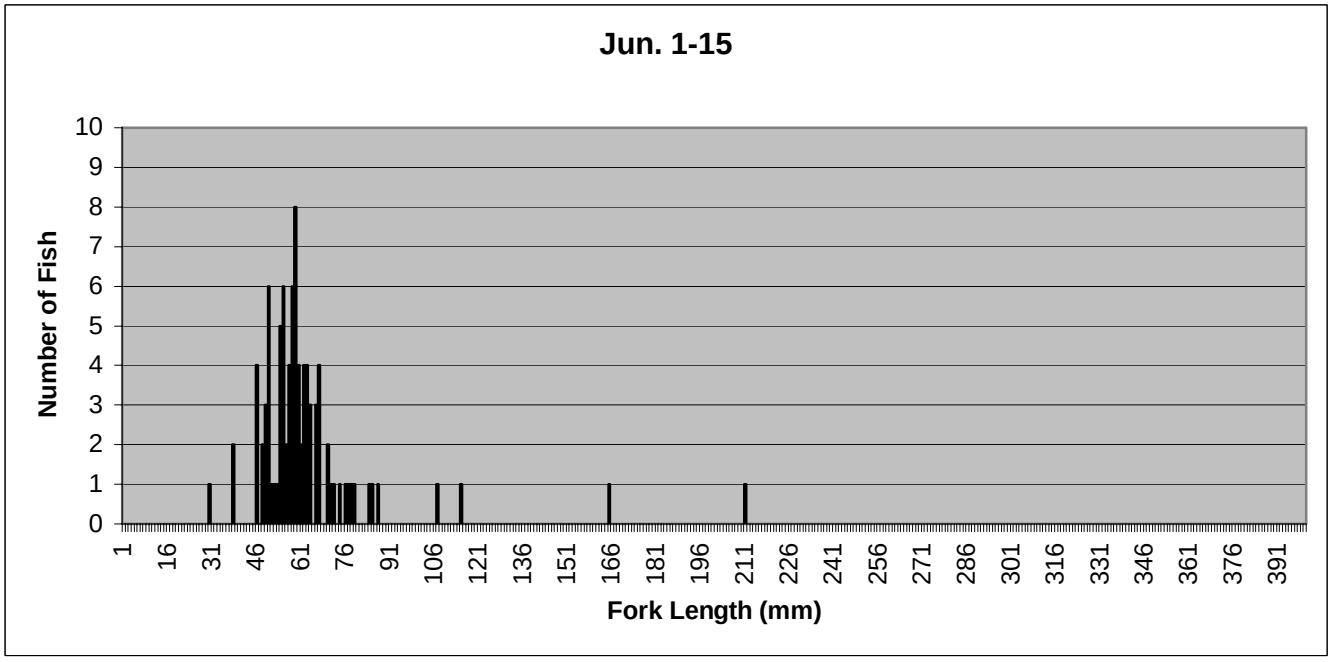

Figure B-17. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, June 1 – 15, 2004.

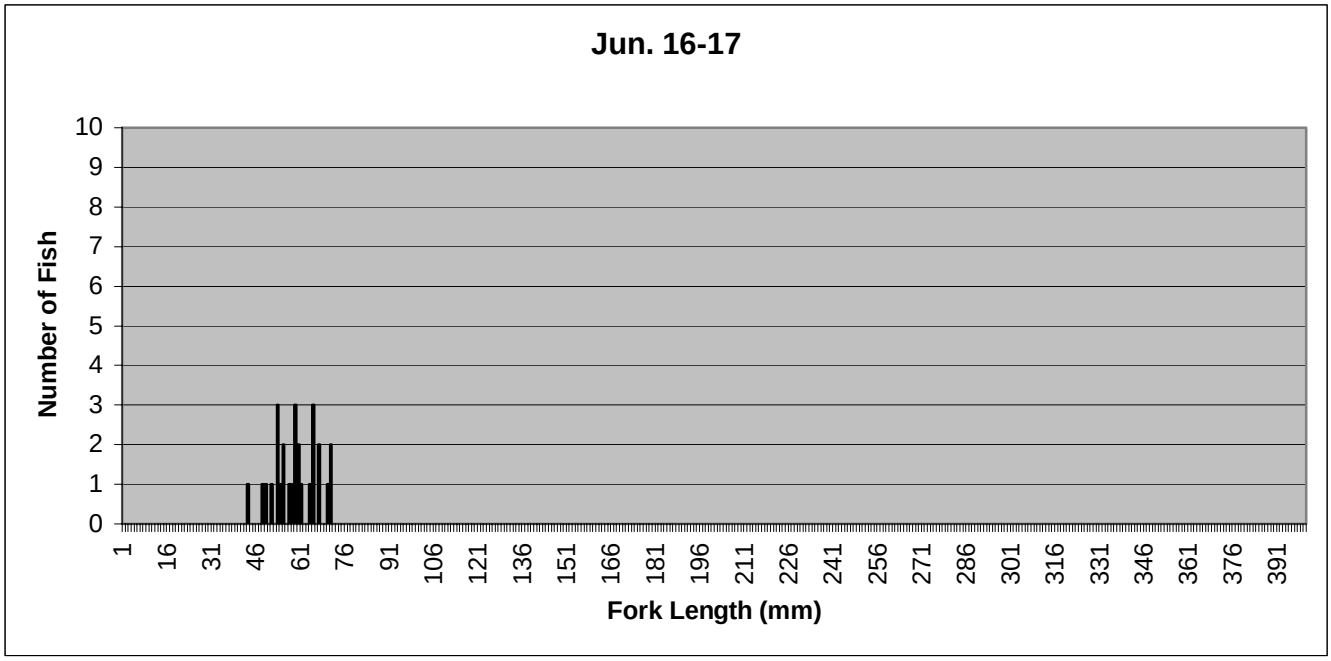

Figure B-18. Bi-weekly catch of juvenile Steelhead trout at the Yuba River RST, June 16 – 17, 2004.

Appendix C:

Lower Yuba River Temperatures at the Hallwood Rotary Screw Trap

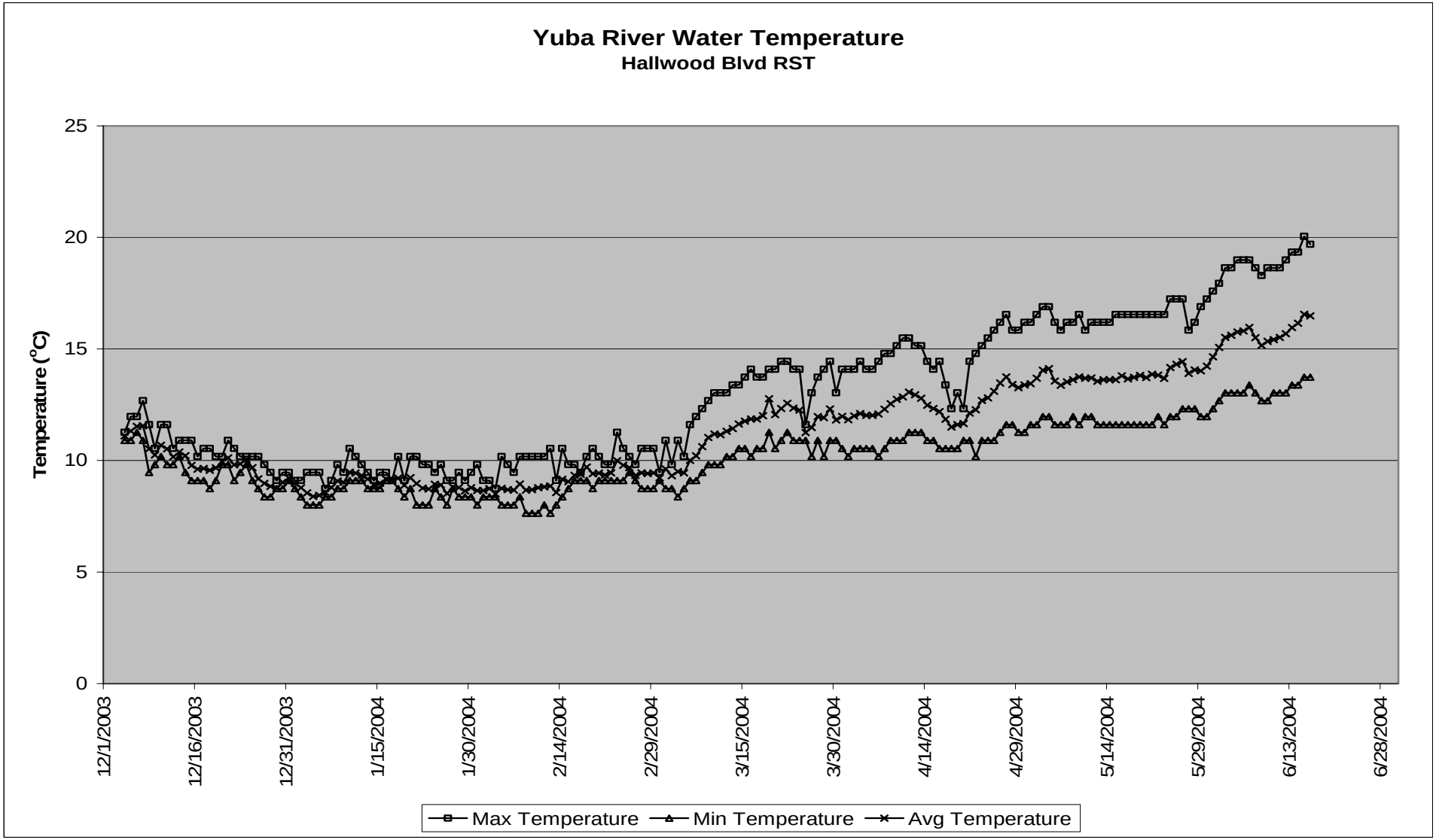

Figure C-1. Yuba River water temperatures as recorded by Onset temperature probes placed in the RST near Hallwood Blvd., December 1, 2003 to June 17, 2004.

Appendix D:

Lower Yuba River Flows at Marysville Gage

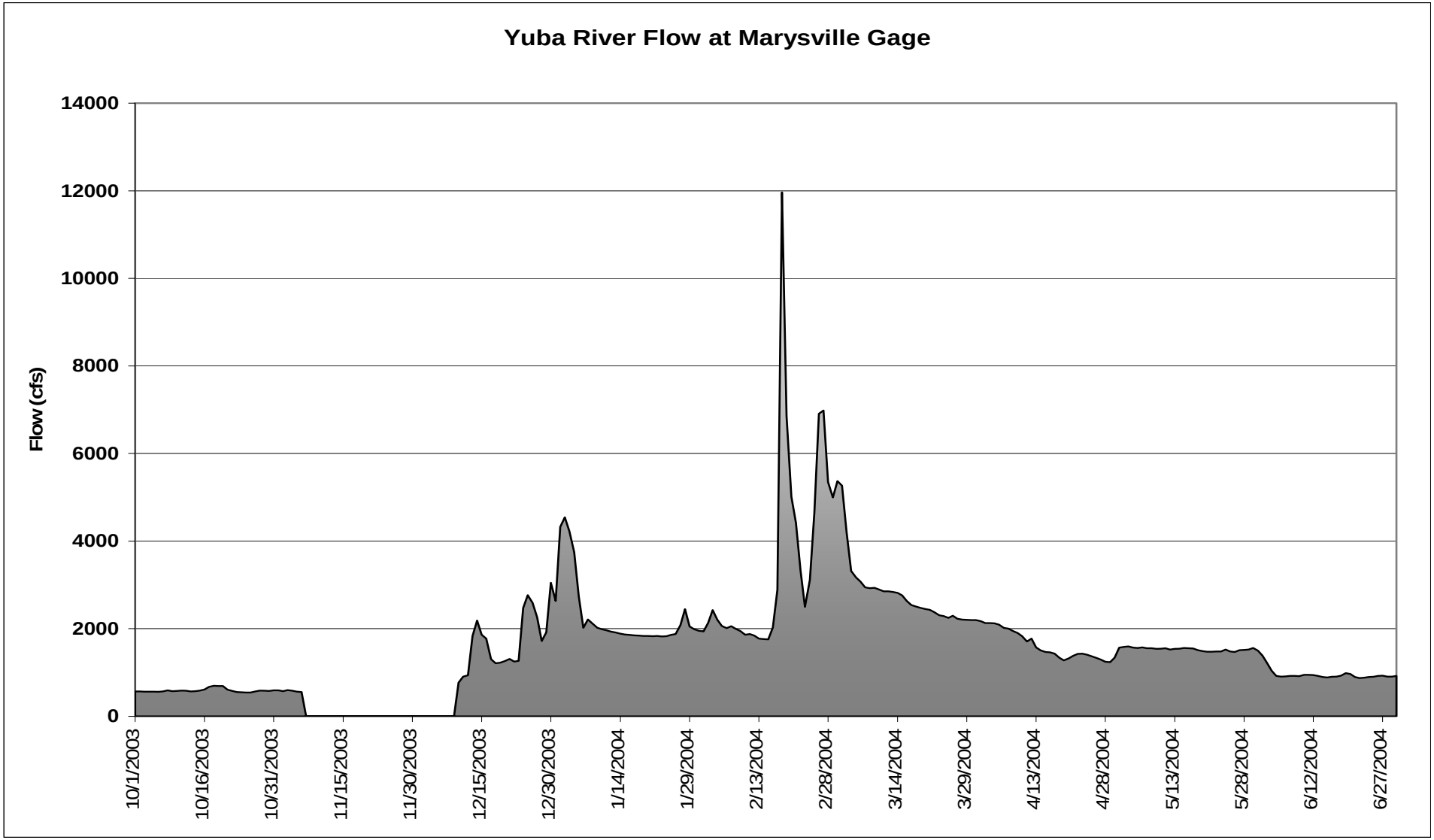

Figure D-1. Average daily Yuba River flows as measured at the Marysville Gage located approximately one mile downstream of the RST at Hallwood Blvd., October 1, 2003 to June 30, 2004.

Appendix E:

Coded-Wire Tagged Chinook Salmon Released to the Lower Yuba River

Table E-1. Summary of coded-wire tagged Chinook salmon released to the lower Yuba River near Hallwood, November 26, 2003 to June 15, 2004.

Tag Code	Date	Mean FL (mm)	Total Released	Shed Rate (%)
06-01-03-00-00	11/26/03 – 12/05/03	36	1,572	8.7
06-01-03-00-01	12/04/03 – 12/10/03	36	1,632	0
06-01-03-00-02	12/01/03 – 12/12/03	36.5	506	41.1
06-01-03-00-03	12/05/03 – 12/09/03	36	1,647	2.6
06-01-03-00-04	12/09/03 – 12/17/03	37	936	2.6
06-01-03-00-05	12/10/03 – 12/10/03	93	2	0
06-01-03-00-06	03/18/04 – 04/06/04	35	2,858	2.3
06-01-03-00-07	04/09/04 – 04/23/04	62	1,207	5.1
06-01-03-00-08	03/14/04 – 04/07/04	73	54	1.9
06-01-03-00-09	03/19/04 – 04/07/04	57	841	3.1
06-01-03-01-00	02/06/04 – 02/12/04	38	11,231	0.3
06-01-03-01-01	02/13/04 – 02/17/04	38	11,590	0.2
06-01-03-01-02	12/09/03 – 12/17/03	37	2,900	1.2
06-01-03-01-03	12/23/03 – 01/16/04	37	17,333	1.8
06-01-03-01-04	12/23/03 – 01/03/04	36	17,004	1.2
06-01-03-01-05	01/16/04 – 02/12/04	37	17,489	1.4
06-01-03-01-06	12/29/03 – 02/05/04	37	17,295	1.4
06-01-03-01-07	12/22/03 – 12/29/03	36	11,943	0
06-01-03-01-08	01/02/04 – 01/31/04	37	17,345	0.7
06-01-03-01-09	02/02/04 – 02/14/04	38	11,105	0.3
06-01-03-02-00	02/14/04 – 03/18/04	37	18,175	0.6
06-01-03-02-01	02/14/04 – 03/18/04	38	16,730	0.9
06-01-03-02-02	04/09/04 – 04/23/04	41	1,016	4.6
06-01-03-02-03	04/09/04 – 04/22/04	84	14	7.1
06-01-03-02-04	04/29/04 – 05/04/04	89	19	0
06-01-03-02-05	04/29/04 – 05/07/04	37	221	0.9
06-01-03-02-06	04/29/04 – 05/07/04	59	977	3.4
06-01-03-02-07	04/29/04 – 05/07/04	72	355	3.1
06-01-03-02-08	05/11/04 – 05/21/04	58	257	1.9
06-01-03-02-09	05/11/04 – 05/21/04	60	252	2.8
06-01-03-03-00	05/11/04 – 05/18/04	37	100	0
06-01-03-03-01	05/14/04 – 05/14/04	109	1	0
06-01-03-03-02	05/24/04 – 06/06/04	74	241	3.3
06-01-03-03-03	05/24/04 – 06/06/04	62	173	4
06-01-03-03-04	05/04/04 – 05/04/04	92	1	0
06-01-03-03-07	06/11/04 – 06/15/04	62	276	1.4
06-01-03-03-08	06/11/04 – 06/15/04	77	217	0.5

Appendix F:

Flow Velocities Measured at the Lower Yuba River RST at Hallwood

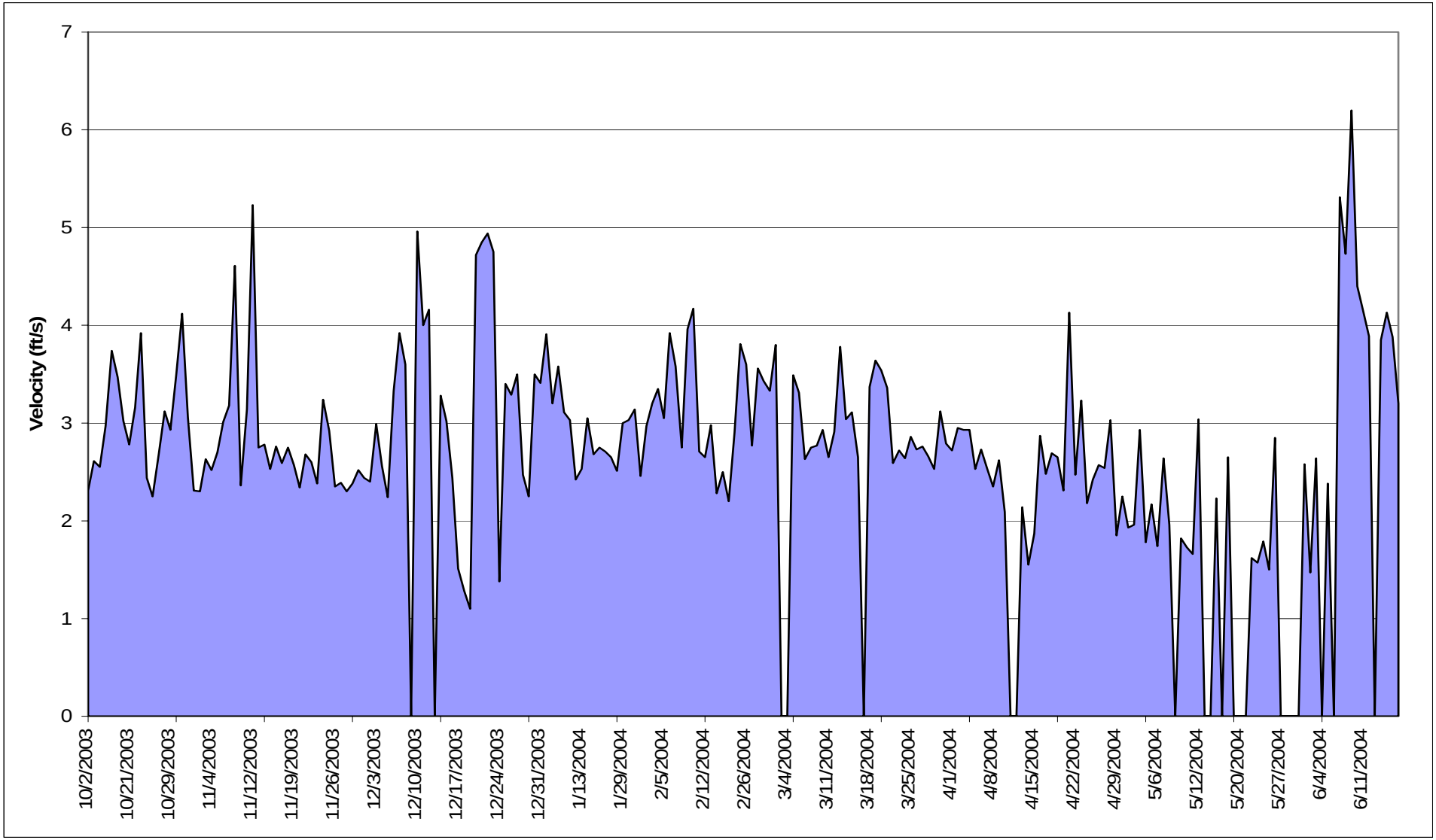

Figure F-1. Lower Yuba river water velocities as measured at the lower Yuba River RST at Hallwood from October 2, 2003 to June 17, 2004.

Appendix G:

Turbidity Measured at the Lower Yuba River RST at Hallwood

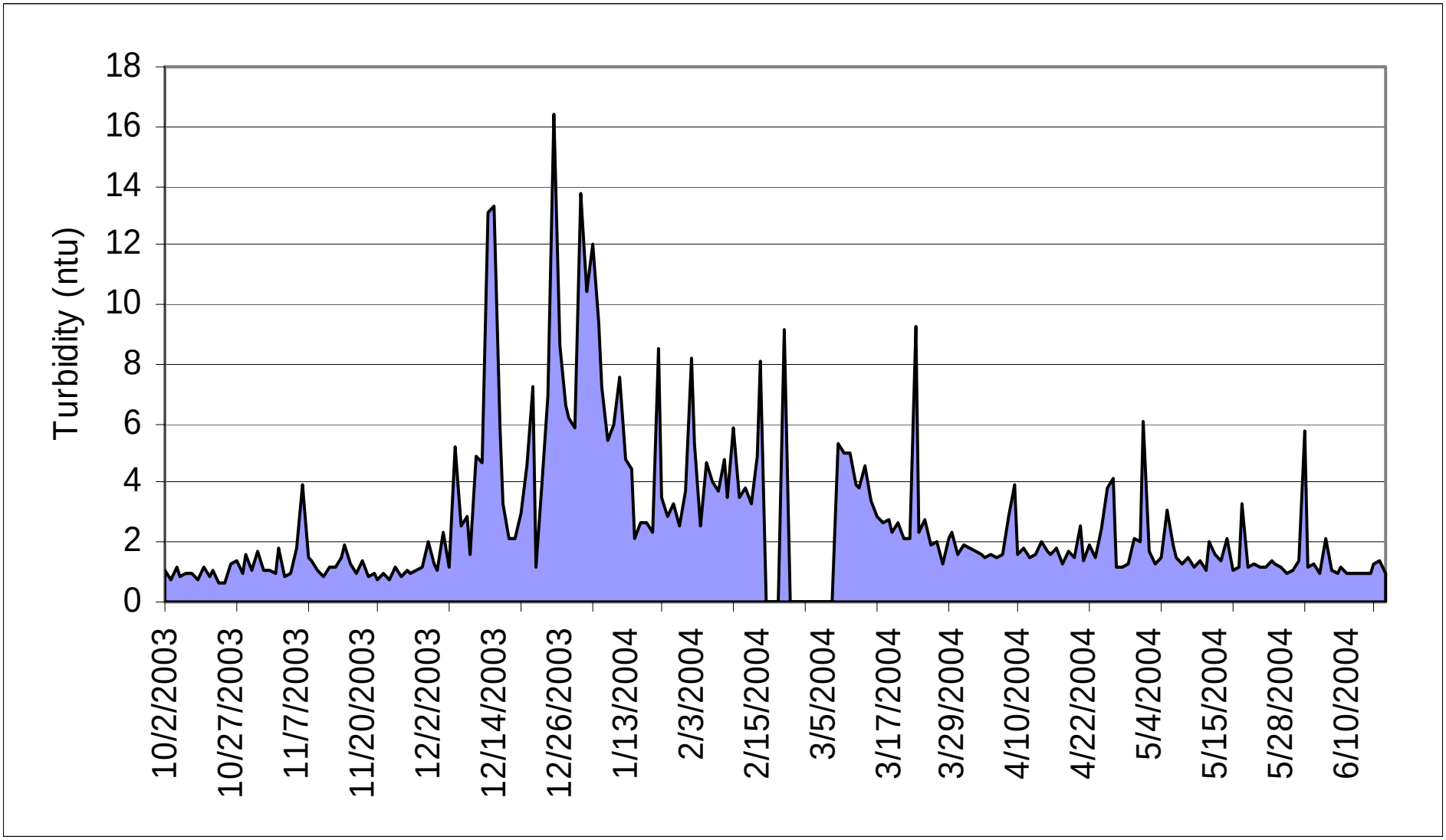

Figure G-1. Turbidity measured at the lower Yuba River RST at Hallwood from October 2, 2003 to June 17, 2004.