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BUTTE AND BIG CHICO CREEKS
SPRING-RUN CHINOOK SALMON, *ONCORYHNCHUS TSHAWYTSCHA*
LIFE HISTORY INVESTIGATION
1998-2000

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Sacramento Valley – Central Sierra Region

Inland Fisheries

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ABSTRACT

This report covers spring-run chinook salmon (*Oncorhynchus tshawytscha*) monitoring and life history evaluations in Butte and Big Chico Creeks from October 1998 until September 2000.

For Butte Creek during the 1998-1999 sampling year, 410,115 juvenile chinook salmon were captured near Chico, and 128,386 in the Sutter Bypass. There were 111,352 of the fish captured near Chico that were coded-wire tagged, and 421 of the tagged fish were recaptured in the Sutter Bypass traps. Additionally 60 coded-wire tagged fish were captured in the Sutter Bypass traps that were tagged and released in the upper Sacramento River by the USFWS. For Big Chico Creek during the 1998-1999 sampling season, there were 404 juvenile chinook salmon captured near Chico.

For Butte Creek during the 1999-2000 sampling year, 255,104 juvenile chinook salmon were captured near Chico, and 94,058 in the Sutter Bypass. There were 58,854 of the fish captured near Chico that were coded-wire tagged, and 172 of the tagged fish recaptured in the Sutter Bypass traps. Additionally 19 coded-wire tagged fish were captured in the Sutter Bypass traps that were tagged and released in the upper Sacramento River by the USFWS. For Big Chico Creek during the 1999-2000 sampling season, there were 110 juvenile salmon captured near Chico.

Average Butte Creek residency time of Butte Creek salmon marked near Chico and recaptured in the Sutter Bypass was 56 days for the 1998-1999 trapping season, and 71 days for the 1999-2000 trapping season. Tagged fish released in the upper Sacramento River prior to capture in the Sutter Bypass were at large from 32 days to 89 days for the 1998-1999 and 1999-2000 trapping seasons.

Adult escapement estimates for Butte Creek during 1999 and 2000 were 3,679 and 4,118 fish respectively. Adult escapement estimates for Big Chico Creek during 1999 and 2000 were 27 fish during both years. Tag recoveries from three adults captured in the ocean commercial /sport fishery during 1998 and one carcass recovered in Butte Creek during 1999, suggest that some proportion of Butte Creek spring run salmon return to spawn as age four fish.

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INTRODUCTION

Spring-run chinook salmon (SRCS), *Oncorhynchus tshawytscha*, are listed as threatened under both the California and Federal Endangered Species Acts. Butte and Big Chico Creeks produce SRCS. Butte Creek is one of three remaining streams that form a basis for population trends of SRCS in the Central Valley of California. The other two are nearby Deer and Mill Creeks, located to the north in Tehama County. Big Chico Creek currently exhibits only a remnant non-sustaining population of SRCS and is not used as a population trend indicator at this time. Adult escapement is used to indicate population trends for Butte Creek SRCS. The recovery status of SRCS is determined, in part, by this escapement trend. This project has developed adult escapement estimates on Butte Creek for 1995 through 2000, and on Big Chico Creek for 1998 through 2000.

Adult SRCS leave the ocean to begin their upstream migration in late January to early February. Butte Creek spring-run return to their natal stream beginning in late February, ending in June. SRCS are sexually immature during the freshwater migration to the natal stream. Within the natal stream, SRCS seek deep holding pools to over-summer. The pools provide adequate cover and cool water temperatures enabling the salmon to conserve energy for gonad maturation and future spawning. In mid-September, when water temperatures begin to cool, spawning commences. The length of time for egg incubation and hatching is dependant upon average daily water temperatures. Juvenile emergence from the gravel occurs as early as late-November. Various studies have shown that most Butte Creek SRCS emigrate as fry or fingerlings (young-of-the-year [YOY]) (CDFG, 1998; Hill and Webber, 1999). A small portion of juveniles over-summer and emigrate as yearlings the next fall. Once SRCS leave the spawning area, their emigration course is loosely defined. SRCS enter the Sacramento River either through the Butte Slough Outfall or through the Sutter Bypass. From the Sacramento River, they traverse the Delta and San Francisco Bay entering the ocean.

This study was initiated to define basic life history characteristics of Butte and Big Chico Creek SRCS. During the 1998 trapping season, Big Chico Creek was added to the project. The project has 1) developed adult escapement estimates for Butte and Big Chico Creeks, 2) monitored outmigration timing and relative abundance of age 0+ juvenile SRCS within Big Chico Creek and Butte Creek, including the Sutter Bypass, 3) documented the outmigration of yearling SRCS, and 4) documented relative growth of juvenile SRCS in the Butte Creek system, including the Sutter Bypass, through coded-wire tagging of juvenile salmon collected at Parrott-Phelan Diversion Dam (PPDD). Other research projects will assist in tracking coded-wire tagged Butte Creek SRCS juveniles as they emigrate downstream through the mainstem Sacramento River and the Delta. Tagged salmon will also be recovered in the ocean fishery to determine how and where Butte Creek SRCS contribute to the ocean harvest. Additionally, recovery of returning tagged adults to Butte Creek will provide information on survival and age structure.

Butte Creek Watershed and Hydrology

Butte Creek is located in Butte and Sutter Counties. The headwaters of Butte Creek originate in the Lassen National Forest, within the Jonesville Basin. This area is approximately 2,137 m (7,000 ft) in elevation. The watershed is approximately 2,103 km² (809 mi²) and has an unimpaired average annual yield of approximately 300,000 cubic decameters (dam³) (243,000

acre-feet) (Hillaire, 1993). Butte Creek enters the mainstem Sacramento River at two locations, the Butte Slough Outfall gates and the downstream end of the Sutter Bypass near the confluence of the Feather River with the Sacramento River (Figure 1). When flows are greater than approximately 595 cubic meters per second (m^3/s) (21,000 cubic feet per second (cfs)) at Wilkins Slough in the Sacramento River, part of the Sacramento River flows into lower Butte Creek and the Sutter Bypass through the Tisdale Weir (Figure 1). Moulton and Colusa weirs are upstream of Tisdale Weir and are staged to spill when the flow in the Sacramento River reaches approximately 1,274 m^3/s (45,000 cfs) and 1,841 m^3/s (65,000 cfs), respectively. The capacity of the Sacramento River channel downstream of the Tisdale Weir at Wilkins Slough is approximately 850 m^3/s (30,000 cfs). These weirs have a combined capacity to pass approximately 3,766 m^3/s (133,000 cfs) into the Sutter Bypass (Dept. of the Army, 1975). When water is bypassed, outmigrating salmonids from the upper Sacramento River mix with SRCS from Butte Creek.

Big Chico Creek Watershed and Hydrology

Big Chico Creek is located within Butte and Tehama Counties. The headwaters of Big Chico Creek originate from the southwest slope of Colby Mountain at an elevation of approximately 1,646 m (5,400 ft), and encompass a watershed area of approximately 116 km^2 (72 mi^2). The creek is approximately 45 miles (72 km) in length entering the Sacramento River, west of the City of Chico. The unimpaired average annual yield is approximately 66,600 dam^3 (54,000 acre-feet). The watershed also encompasses three smaller drainages to the north including Sycamore, Mud, and Rock creeks.

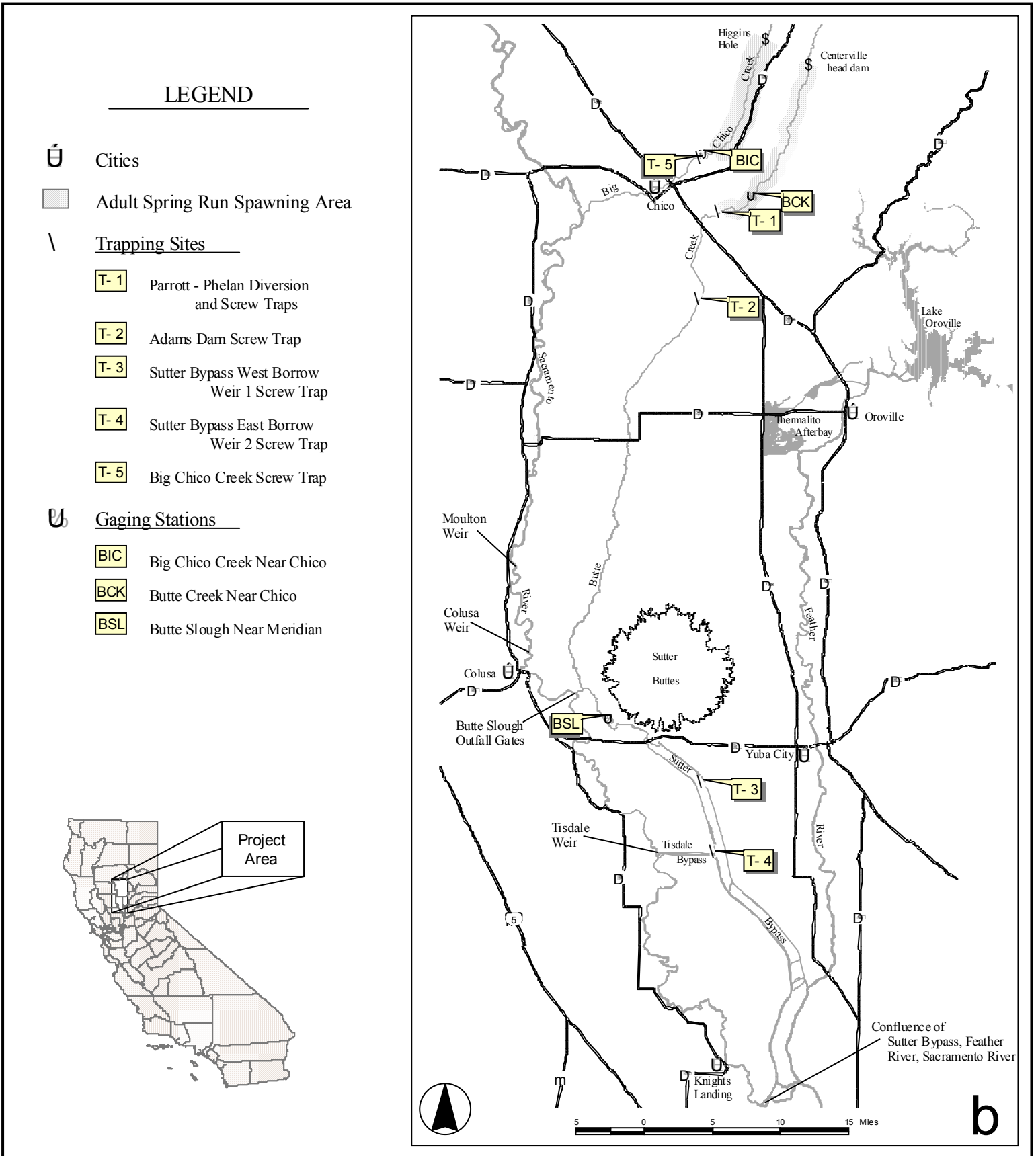


FIGURE 1. Butte Creek watershed indicating trapping sites

MATERIALS AND METHODS

Butte Creek Trapping Sites

Fish were trapped at three locations along Butte Creek (Figure 1). The PPDD is the uppermost site (Figure 1, site T-1). This site is directly downstream of the SRCS spawning habitat and upstream of the fall-run chinook salmon (FRCS) spawning habitat, although periodically some FRCS spawn above this site. The second trapping site is located at the Sutter Bypass West Borrow Weir 1, approximately 98 km (61 mi) downstream of PPDD (Figure 1, site T-3). The third trapping site is located at the Sutter Bypass East Borrow Weir 2, approximately 94 km (58 miles) downstream of PPDD (Figure 1, site T-4). Both Sutter Bypass locations are adjacent to the Sutter National Wildlife Refuge west of Yuba City, California. Each site was sampled with a 2.4 m (8 ft) rotary screw trap manufactured by EG Solutions (Eugene, Oregon). During the peak SRCS emigration period of the 1999/2000 trapping season, two 2.4m (8 ft) rotary screw traps were fished in tandem at the Sutter Bypass West Borrow Weir 1 site to maximize coded-wire tag recovery. Each rotary screw trap was connected to an upstream stationary object, dam or weir, by use of steel cable 0.6 cm (1/4 in.) in diameter. Placement was adjusted regularly to allow for safe operation and access as well as to maximize the efficiency of sampling. In addition to the rotary screw trap at PPDD, the diversion canal had an off-stream fish fitted with a trap box 1.2 m x 0.9 m x 2.1 m (4 ft x 3 ft x 7 ft). All traps were fished 24 hours a day, seven days a week, except during extraordinarily high water flows or during periods of excessive debris.

Big Chico Creek Trapping Site

Fish were trapped at the Bidwell Park Municipal Golf Course (Figure 1, site T-5). The site was sampled using a 1.5 m (5 ft) rotary screw trap manufactured by EG Solutions (Eugene, Oregon). Steel cable 0.6 cm (1/4 in.) in diameter connected the screw trap to the crossing bridge over Big Chico Creek. The trap was adjusted periodically to assure maximum trapping efficiency without jeopardizing safety. The trap was fished 24 hours per day, seven days a week, except during extraordinarily high water flows or during periods of excessive debris.

Physical Measurements

Four physical measurements were taken daily at each trapping site. Water velocity in meters per second (m/s) was measured at the mouth of the screw trap cone with a Marsh-McBirney Flo-Mate, Model 2000. The velocity sensor was attached to a graduated staff and submersed to a depth of 0.61m (2ft) directly below the shaft of the screw trap cone. Each velocity reading was based upon a preset 45-second averaging period and recorded as the velocity reading for the entire 24 hr period. Additionally, screw-trap cone revolutions were recorded through the use of a mechanical counter (Reddington Counters Inc., Model 1-2936). Total revolutions for the 24 hr period were recorded and the counter reset each day. Water temperature (Celsius) was measured in the live box of each trap using a hand held Enviro-Safe Thermometer. Turbidity was recorded daily using a Hach Model 2100P Portable Turbidimeter. A representative sample of water was collected directly besides the rotary screw trap and the resultant measurement in Nephelometric Turbidity Units (NTU's) recorded on the daily data sheet.

Processing Captured Fish

The methods used for processing fish were the same for both Butte and Big Chico creeks. The Big Chico Creek study does not include the procedures for the coded-wire tagging elements. Similar methods for processing fish were used from 1998 through 2000 as in the previous report for 1995 through 1998 (Hill and Webber, 1999). All fish were netted from the live-boxes and immediately placed into a shallow tub of fresh river water. Juvenile chinook salmon were sorted from other species and transferred swiftly with small aquarium nets into buckets equipped with portable aerators to be transported to shore for processing. The first 10 of each non-salmonid fish species were measured to the nearest mm fork length (FL) and released. The remainder were counted and released. Other species captured were recorded (Appendix E).

A random sub-sample of 50 salmon juveniles was placed into a bucket containing a weak, standardized solution of tricaine methanesulfonate (MS-222) and anaesthetized (6.3 g of MS-222 powder dissolved in 1 liter of fresh distilled water to create a stock solution, which is then used at a dilution of 8-9 ml stock solution/ 1 liter of fresh river water). Upon immobilization, juveniles were individually placed onto a wetted plexiglass measuring board and measured to the nearest mm FL. Thirty salmon of this group that measured greater than 40mm were then transferred to a wetted container on an Ohaus electronic scale and weighed to the nearest 0.01 g. All salmon caught in the Sutter Bypass traps were examined for an adipose fin clip. Salmon with a clipped adipose fin were sacrificed and preserved for future coded-wire tag (CWT) recovery and decoding. Each fish was individually bagged and given a tag having a unique numeric code identifying the date of capture, fork length and capture location. Unclipped fish were placed into a bucket of fresh aerated river water for recovery. After full recovery, all unmarked salmon were released downstream of the trap.

Juvenile SRCS captured at the PPDD trapping site were measured as above. Instead of releasing these salmon at the site, they were held in net holding pens for subsequent coded-wire tagging. All fish were saved for tagging, unless daily trap numbers were extremely high making processing time extremely long (> 10 days). On days with large numbers of salmon, a sub-sample was held for the tagging process. The rest were released at the trapping site.

Salmon were transported via aerated buckets to the Baldwin Construction Yard, approximately 1 mile downstream of the PPDD site. This was the site for the coded-wire tagging program for the 1998/1999 and the 1999/2000 seasons. Fish were tagged using a Northwest Marine Technology Tag Injector Model MKIV and Model MKIV Quality Control Device (QCD). Initially, injectors were fitted with a 1,200-fish/lb head mold. Head molds were changed periodically to accommodate for growth. Fish were anaesthetized in MS-222, adipose fin clipped, then tagged with a half-length (0.5 mm) tag in the rostrum and placed through the QCD. Any miss-tagged or rejected fish were retagged. All but a group of 100 tagged fish were recovered in fresh water and released. The remaining fish were held for 24 hours and re-run through the QCD to obtain a 24-hour tag shedding rate and then released. Yearling SRCS were not included in the sample tagged, except in 1999 when a group of 393 yearling SRCS was tagged. Tag codes were changed every fourteen days or after use of an entire 10,000 coded-wire tag spool throughout the outmigration period.

Juvenile Outmigration

Yearling SRCS are fish that emigrate in the fall, approximately one year after emergence. These fish are the only salmon to emigrate before salmon from the newly spawned brood year emerge. When both year classes are in the stream, yearlings are much larger than YOY. By examining length-frequency distributions of fish captured at PPDD, yearlings can generally be identified (Appendix B, Figure 1 and 2). Outmigration of YOY SRCS is described by examining catches of salmon trapped at PPDD and from tagged fish recovered in the Sutter Bypass.

Growth

An estimate of relative growth was determined using information from tagged salmon recoveries at the Sutter Bypass sites. Data collected was used to determine how long juvenile salmon remained in the system and growth was expressed in millimeters per day. The mean FL was calculated for each tag group, except for the 1998-1999 season. That season, the first seven tag groups released had a calculated mean. The last seven tag groups released could not be used due to incomplete information. The release of a tag code extended over a number of days. A median release date was used for calculating mean growth. Growth was determined by subtracting the mean release size from the individual capture size. Growth rate was calculated by dividing the difference between mean size at release (FL_{Release}) and size at recovery (FL_{Recovery}) by the difference in the number of days (d) between median release date and recovery date ($(FL_{\text{Recovery}} - FL_{\text{Release}}) / (d_{\text{Recovery}} - \text{Release})$).

Juvenile Relative Abundance

Comparing juvenile catches at the PPDD for the 1998 and 1999 brood years was used as a measure of juvenile relative abundance.

Adult Escapement

Each summer an adult SRCS count is determined by conducting a snorkel survey. Adults are counted while they are holding in deep pools, prior to spawning. On Butte Creek the snorkel survey extended from the Centerville Head Dam to PPDD, while on Big Chico Creek the survey was from Higgins Hole to Iron Canyon (Figure 1). The survey was conducted over four days, each covering a discrete reach on Butte Creek, and on one day with two distinct reaches on Big Chico Creek. As in past years, three to five experienced personnel swam abreast downstream through each pool. At the end of each pool, survey personnel compared numbers of adults counted, and if greater than a 20% discrepancy between individual counts, the survey was repeated. If less than a 20% discrepancy, all counts were recorded with the lowest and highest values for all pools summed for reporting a minimum and maximum range of total escapement. Counts were used for most pools; however in some cases estimates were used when large numbers of salmon in a pool precluded an actual count. Numbers were reported by reach. The total escapement for the year was a summation of the reaches surveyed for each creek.

RESULTS

Butte Creek
1998-1999 Trapping Season

The 1998-1999 trapping season began at the PPDD when the diversion trap was installed on October 1, 1998. The rotary screw trap was installed on October 14, 1998. Both traps were operated until July 7, 1999. During the trapping season, there were occasions when one or both of the traps were removed due to high stream flows or excessive debris. A total of 410,115 juvenile salmon, including yearlings, were captured in both traps; 194,623 in the diversion screen trap and 215,492 in the screw trap (Tables 1-3). Of the total captured, 111,352 were tagged and released at the Baldwin Construction Yard (Table 4). Since the diversion screen trap was located off-stream in the diversion canal, the trapping data continue to demonstrate the benefit of the PPDD fish screen; any fish captured in the trap would have been lost into the canal if the structure did not exist.

Approximately 337,000 (82%) juvenile SRCS (Table 3) of the entire PPDD salmon catch occurred during January 1999. Trapping was suspended for various periods of time in January and February (Tables 1 and 2) because of high flows (Appendix A, Figure 1).

Table 1. Bi-weekly catch summary of spring-run chinook salmon caught in the screen trap at Parrott-Phelan Diversion Dam from October 1, 1998 to July 7, 1999; yearling captures are included.

Trapping period		Mean FL(mm)	Standard deviation	Range FL (mm)		Total no. captured	No.trapping days
10/1/98	10/15/98	113	12.4	100	128	5	15
10/16/98	10/31/98	122	11.2	106	142	10	16
11/1/98	11/15/98	-	-	-	-	-	15
11/16/98	11/30/98	31	2.2	26	37	975	12
12/1/98	12/15/98	32	1.9	27	38	2,791	15
12/16/98	12/31/98	34	3.2	29	115	8,034	16
1/1/99	1/15/99	35	4.7	32	122	20,392	15
1/16/99	1/31/99	35	1.4	32	43	144,261	9
2/1/99	2/15/99	35	1.5	32	47	10,531	11
2/16/99	2/29/99	34	1.8	30	45	1,055	13
3/1/99	3/15/99	37	5.3	31	77	323	15
3/16/99	3/31/99	37	3.3	33	72	1,395	16
4/1/99	4/15/99	42	14.2	31	167	424	15
4/16/99	4/30/99	45	13.8	32	88	63	15
5/1/99	5/15/99	64	35.2	35	96	1,559	7
5/16/99	5/31/99	64	8.2	45	89	2,058	15
6/1/99	6/15/99	71	6.0	42	87	629	15
6/16/99	6/30/99	77	7.3	58	94	115	15
7/1/99	7/15/99	80	8.4	70	85	3	7
Total:						194,623	257

Table 2. Bi-weekly catch summary of spring-run chinook salmon caught in the screw trap at Parrott-Phelan Diversion Dam from October 14, 1998 to July 7, 1999; yearling captures are included.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no. captured	No. trapping days
10/16/98	10/31/98	-	-	-	-	-	16
11/1/98	11/15/98	-	-	-	-	-	15
11/16/98	11/30/98	32	6.2	27	117	397	12
12/1/98	12/15/98	34	3.7	27	114	3,216	11
12/16/98	12/31/98	34	6.2	29	131	12,590	16
1/1/99	1/15/99	35	8.1	31	133	32,675	15
1/16/99	1/31/99	36	7.7	32	124	140,522	9
2/1/99	2/15/99	35	1.8	32	50	14,736	5
2/16/99	2/29/99	35	5.0	30	123	1,641	5
3/1/99	3/15/99	37	5.8	31	135	1,583	11
3/16/99	3/31/99	38	4.3	30	90	2,908	16
4/1/99	4/15/99	38	7.1	31	77	649	15
4/16/99	4/30/99	43	11.7	30	97	219	15
5/1/99	5/15/99	61	9.7	32	98	1,585	15
5/16/99	5/31/99	64	8.3	44	113	1,967	15
6/1/99	6/15/99	71	8.0	33	95	694	14
6/16/99	6/30/99	75	4.7	65	89	110	15
7/1/99	7/15/99	-	-	-	-	-	7
Total:						215,492	227

Table 3. Bi-weekly catch summary of spring-run chinook salmon combining the catch of the screen trap and the screw trap at Parrott-Phelan Diversion Dam from October 1, 1998 to July 7, 1999; yearling captures are included.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no. captured	No. trapping days
10/1/98	10/15/98	113	12.4	100	128	5	15
10/16/98	10/31/98	122	11.2	106	142	10	16
11/1/98	11/15/98	-	-	-	-	-	15
11/16/98	11/30/98	32	4.4	26	117	1,372	12
12/1/98	12/15/98	33	2.9	27	114	6,007	15
12/16/98	12/31/98	34	5.0	29	131	20,624	16
1/1/99	1/15/99	35	6.6	31	133	53,067	15
1/16/99	1/31/99	35	5.1	32	124	284,783	9
2/1/99	2/15/99	35	1.7	32	50	25,267	11
2/16/99	2/29/99	35	3.5	30	123	2,696	13
3/1/99	3/15/99	37	7.3	31	135	1,906	15
3/16/99	3/31/99	37	3.9	30	90	4,303	16
4/1/99	4/15/99	39	10.2	31	167	1,073	15
4/16/99	4/30/99	44	12.2	30	97	282	15
5/1/99	5/15/99	62	10.1	32	98	3,144	15
5/16/99	5/31/99	64	8.2	44	113	4,025	15
6/1/99	6/15/99	71	6.8	33	95	1,323	15
6/16/99	6/30/99	76	6.4	58	94	225	15
7/1/99	7/15/99	70	8.4	70	85	3	7
Total:						410,115	265

Table 4. Summary of coded-wire tagged spring-run chinook salmon released at Baldwin Construction Yard from December 10, 1998 to May 27, 1999.

Tag code	Release date range		Mean FL (mm)	Range FL (mm)		Total released
06-01-12-02-08	12/10/98	12/22/98	34	31	36	1,149
06-01-12-02-09	12/29/98	01/15/99	35	30	41	6,782
06-01-12-02-10	01/13/99	01/20/99	35	32	39	11,096
06-01-12-02-11	01/19/99	01/26/99	35	32	37	14,179
06-01-12-02-12	01/19/99	01/22/99	34	32	38	12,586
06-01-12-02-13	01/20/99	01/29/99	35	32	43	13,012
06-01-12-02-14	01/25/99	02/01/99	35	32	43	10,941
06-01-12-02-15	02/01/99	02/27/99	-	-	-	5,429
06-01-12-03-01	02/01/99	02/27/99	-	-	-	5,871
06-01-12-03-02	03/02/99	03/18/99	-	-	-	7,345
06-01-12-03-03	03/02/99	03/20/99	-	-	-	9,591
06-01-12-03-04	03/22/99	04/16/99	-	-	-	8,679
06-01-12-03-05	04/29/99	05/14/99	-	-	-	1,592
06-01-12-03-06	05/19/99	05/27/99	-	-	-	3,100
					Total:	111,352

The Sutter Bypass sampling began on January 4, 1999 at the West Borrow Weir 1 site. The Weir 1 trap fished until June 27, 1999. A total of 125,385 juvenile chinook salmon was captured at that site (Table 5). The bypass was flooded from trap installation through mid-March. As the water began to recede in mid-March, the salmon capture increased significantly. A second Sutter Bypass trap was installed on May 1, 1999 at the East Borrow, Weir 2 site. The Weir 2 trap fished until June 27, 1999. A total of 3,001 juvenile chinook salmon was captured at this site (Table 6). The first CWT recapture, from either trap, was on January 21, 1999, the last on June 12, 1999 (Table 7 and 8; Appendix C, Table 1 and 2). There were a total of 412 and 9 Butte Creek CWT recaptures in the Weir 1 and Weir 2 traps respectively. Additionally, there were 60 CWT recaptures of fish released at Coleman National Fish Hatchery between March 4, 1999 and April 18, 1999, including 34 winter-run chinook salmon (WRCS), 8 late fall-run chinook salmon (LFRCS) and 18 fall-run chinook salmon (FRCS) (Appendix D, Table 1). Sampling by the U.S. Fish and Wildlife Service at Chipps Island recovered 8 additional tagged Butte Creek fish from April 2, 1999 to May 1, 1999 (Table 9). All fish were from brood year 1998, captured and tagged at the PPDD between January 13, and February 1, 1999.

Table 5. Bi-weekly catch summary of juvenile chinook salmon caught in the screw trap in the Sutter Bypass at West Borrow Weir 1 from January 4, 1999 to June 27, 1999. Fish captured at this location cannot be identified as spring-run chinook salmon because of the mixing of juvenile salmon of other races from the Sacramento River.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no captured	No. trapping days
1/1/99	1/15/99	82	23.0	34	132	100	11
1/16/99	1/31/99	46	29.3	31	137	7,815	16
2/1/99	2/15/99	40	8.7	33	139	9,489	11
2/16/99	2/29/99	44	10.3	34	124	476	5
3/1/99	3/15/99	58	22.7	33	150	186	15
3/16/99	3/31/99	75	14.0	35	140	22,641	13
4/1/99	4/15/99	77	9.8	40	106	54,870	13
4/16/99	4/30/99	74	11.8	38	155	23,477	15
5/1/99	5/15/99	72	8.4	35	99	4,743	15
5/16/99	5/31/99	69	6.8	46	95	1,216	16
6/1/99	6/15/99	70	7.0	54	93	372	13
6/16/99	6/30/99	-	-	-	-	-	12
Total:						125,385	144

Table 6. Bi-weekly catch summary of juvenile chinook salmon caught in the screw trap in the Sutter Bypass at East Borrow Weir 2 from March 23, 1999 to June 27, 1999. Fish captured at this location cannot be identified as spring-run chinook salmon because of the mixing of juvenile salmon of other races from the Sacramento River.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no captured	No. trapping days
3/16/99	3/31/99	-	-	-	-	-	9
4/1/99	4/15/99	-	-	-	-	-	15
4/16/99	4/30/99	-	-	-	-	-	15
5/1/99	5/15/99	71	5.2	56	92	753	15
5/16/99	5/31/99	67	7.9	51	120	1,899	15
6/1/99	6/15/99	69	6.4	52	95	349	14
6/16/99	6/30/99	-	-	-	-	-	12
Total:						3,001	95

Table 7. Recaptures of SRCS bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1 (See Appendix C, Table 1 for detail). All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag Code	Total no. captured	Average FL (mm)	Average d at large	Average mm/d
06-01-12-02-08	1	-	-	-
06-01-12-02-09	15	75	83	0.45
06-01-12-02-10	47	77	73	0.55
06-01-12-02-11	85	62	50	0.48
06-01-12-02-12	90	67	58	0.51
06-01-12-02-13	58	64	51	0.53
06-01-12-02-14	52	63	46	0.58
06-01-12-02-15	16	70	59	-
06-01-12-03-01	8	73	91	-
06-01-12-03-02	14	65	51	-
06-01-12-03-03	14	68	54	-
06-01-12-03-04	9	67	46	-
06-01-12-03-05	2	64	14	-
06-01-12-03-06	1	75	9	-
Total	412			

Table 8. Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass East Borrow Weir 2 (See Appendix C, Table 2 for detail). All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998

Tag Code	Total no. captured	Average FL (mm)	Average d at large	Average mm/d
06-01-12-03-02	1	76	64	-
06-01-12-03-03	3	69	62	-
06-01-12-03-04	1	67	40	-
06-01-12-03-05	3	65	24	-
06-01-12-03-06	1	80	1	-
Total	9			

Table 9. Recaptures of spring-run chinook salmon bearing coded-wire tags from other research projects. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code	Recovery Date	Recovery FL (mm)	mm/d	Recapture location	d at large
06-01-12-02-10	4/10/99	95	0.71	Chipps Is.	84
06-01-12-02-10	4/13/99	74	0.45	Chipps Is.	87
06-01-12-02-10	5/1/99	85	0.48	Chipps Is.	105
06-01-12-02-11	4/5/99	73	0.53	Chipps Is.	73
06-01-12-02-11	4/9/99	80	0.60	Chipps Is.	77
06-01-12-02-11	4/13/99	84	0.62	Chipps Is.	81
06-01-12-02-11	4/15/99	91	0.69	Chipps Is.	83
06-01-12-02-14	4/2/99	77	0.67	Chipps Is.	63

Butte Creek
1999-2000 Trapping Season

The 1999-2000 trapping season began at the PPDD when the diversion trap and screw trap were installed on October 4, 1999. Both traps were in operation until June 29, 2000. During the trapping season, there were occasions when one or both of the traps were pulled due to high stream flows or excessive debris (Table 10-12, Appendix A, Figure 2). A total of 255,104 juvenile salmon, including yearlings, was captured; 110,787 in the diversion screen trap and 144,317 in the rotary screw trap (Tables 10-12). Of the total captured, 58,854 were tagged and released at the Baldwin Construction Yard (Table 13).

Approximately 236,000 (93%) of the entire PPDD juvenile SRCS catch occurred during January 2000 and the first 15 days of February (Table 12). Trapping was suspended for various periods of time in January and February because of high flows (Tables 10 and 11, Appendix A, Figure 2).

Table 10. Bi-weekly catch summary of spring-run chinook salmon caught in the screen trap at Parrott-Phelan Diversion Dam from October 4, 1999 to June 29, 2000; yearling captures are included.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no. captured	No. trapping days
10/1/99	10/15/99	113	9.5	90	142	144	11
10/16/99	10/31/99	111	10.0	85	155	303	16
11/1/99	11/15/99	101	9.6	84	115	9	15
11/16/99	11/30/99	65	37.7	30	140	85	15
12/1/99	12/15/99	39	12.2	30	120	990	15
12/16/99	12/31/99	41	17.1	34	133	5,884	16
1/1/00	1/15/00	40	13.8	31	130	14,055	14
1/16/00	1/31/00	39	6.6	33	114	42,932	14
2/1/00	2/15/00	38	3.9	31	115	44,078	10
2/16/00	2/29/00	38	4.6	30	61	149	9
3/1/00	3/15/00	37	3.9	30	146	117	15
3/16/00	3/31/00	40	8.4	30	135	459	16
4/1/00	4/15/00	39	12.4	30	147	138	15
4/16/00	4/30/00	74	34.8	34	170	30	15
5/1/00	5/15/00	72	13.1	31	111	553	15
5/16/00	5/31/00	70	7.9	34	106	705	16
6/1/00	6/15/00	75	7.2	42	91	150	15
6/16/00	6/30/00	81	18.0	61	115	6	14
Total:						110,787	256

Table 11. Bi-weekly catch summary of spring-run chinook salmon caught in the screw trap at Parrott-Phelan Diversion Dam from October 4, 1999 to June 29, 2000; yearling captures are included.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no. captured	No. Trapping days
10/1/99	10/15/99	112	8.3	98	129	22	11
10/16/99	10/31/99	109	11.0	88	131	29	16
11/1/99	11/15/99	92	32.6	34	114	5	15
11/16/99	11/30/99	39	17.3	30	119	117	15
12/1/99	12/15/99	38	9.8	30	115	850	15
12/16/99	12/31/99	37	2.6	32	98	4,027	16
1/1/00	1/15/00	38	5.6	33	114	40,025	15
1/16/00	1/31/00	38	6.6	32	118	45,547	15
2/1/00	2/15/00	38	1.7	32	55	49,336	10
2/16/00	2/29/00	39	6.6	30	115	532	8
3/1/00	3/15/00	37	5.2	30	68	996	13
3/16/00	3/31/00	37	4.9	29	79	805	16
4/1/00	4/15/00	40	10.9	30	83	152	15
4/16/00	4/30/00	59	12.1	34	82	34	15
5/1/00	5/15/00	70	11.4	32	113	1,199	15
5/16/00	5/31/00	69	7.4	36	114	561	16
6/1/00	6/15/00	72	7.0	53	86	67	15
6/16/00	6/30/00	70	17.6	51	117	13	14
Total:						144,317	255

Table 12. Bi-weekly catch summary of spring-run chinook salmon combining the catch of the screen trap and the screw trap at Parrott-Phelan Diversion Dam from October 4, 1999 to June 29, 2000; yearling captures are included.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no. captured	No. trapping days
10/1/99	10/15/99	113	9.3	90	142	166	11
10/16/99	10/31/99	111	10.1	34	155	332	16
11/1/99	11/15/99	98	20.2	34	115	14	15
11/16/99	11/30/99	47	27.1	30	140	202	15
12/1/99	12/15/99	39	11.1	30	120	1,840	15
12/16/99	12/31/99	39	11.9	32	133	9,911	16
1/1/00	1/15/00	39	10.7	31	130	54,080	15
1/16/00	1/31/00	38	6.6	32	118	88,479	14
2/1/00	2/15/00	38	3.0	31	115	93,414	10
2/16/00	2/29/00	39	6.1	30	115	681	9
3/1/00	3/15/00	37	6.4	30	146	1,113	15
3/16/00	3/31/00	38	6.8	29	135	1,264	16
4/1/00	4/15/00	39	11.6	30	147	290	15
4/16/00	4/30/00	65	26.0	34	170	64	15
5/1/00	5/15/00	70	12.2	31	113	1,752	15
5/16/00	5/31/00	70	7.7	34	114	1,266	16
6/1/00	6/15/00	74	7.2	42	91	217	15
6/16/00	6/30/00	74	18.1	51	117	19	14
Total:						255,104	257

Table 13. Summary of coded-wire tagged spring-run chinook salmon released at Baldwin Construction Yard from October 15, 1999 to March 31, 2000.

Tag code	Release date range		Mean FL (mm)	Range FL (mm)		Total released
06-01-12-03-07	10/15/99	10/26/99	109	85	142	393
06-01-12-03-08	12/6/99	12/29/99	37	33	41	4,962
06-01-12-03-09	12/29/99	1/10/00	37	33	40	9,675
06-01-12-03-10	1/10/00	1/19/00	38	34	44	11,508
06-01-12-03-11	1/19/00	1/28/00	37	33	40	10,081
06-01-12-03-12	1/27/00	2/7/00	37	34	42	10,050
06-01-12-03-13	2/7/00	2/25/00	37	34	40	9,237
06-01-12-03-14	2/22/00	3/31/00	38	31	66	3,341
Total:						58,854

The Sutter Bypass sampling began November 8, 1999 at the West Borrow Weir 1 site (Figure 1, site T-3). The Weir 1 trap fished until June 14, 2000. A second rotary screw trap was installed March 23, 2000, to increase juvenile salmon captures at the site. The two traps were fished in

tandem. A total of 73,167 juvenile chinook salmon were captured (Table 14). The Sutter Bypass was flooded at various times from late January through mid-March. As the water began to recede in mid-March, salmon captures increased significantly. A third Sutter Bypass trap was installed January 7, 2000 at the East Borrow Weir 2 site (Figure 1, site T-4). The Weir 2 trap fished until June 14, 2000. A total of 20,891 juvenile chinook salmon was captured at that site (Table 15). The first recapture of a Butte Creek CWT fish, from either trap site, was on March 20, 2000 and the last on May 21, 2000 (Table 16 and 17, Appendix C, Figures 3 and 4). There was a total of 146 and 26 Butte Creek CWT recaptures in the Weir 1 and Weir 2 traps respectively. Additionally, there were 19 Coleman National Fish Hatchery CWT recaptures between March 23, and April 22, 2000. The CNFH CWT recaptures in the Weir 1 traps included 4 WRCS, and 11 FRCS. The 4 CNFH CWT recaptures in the Weir 2 trap were all FRCS (Appendix D, Table 2). Sampling by the U.S. Fish and Wildlife Service at Chipps Island recovered 3 additional Butte Creek CWT fish from April 5, to April 29, 2000 (Table 18). All fish were from brood year 1999 captured and tagged at the PPDD between December 29, 1999 and February 25, 2000.

Table 14. Bi-weekly catch summary of juvenile chinook salmon caught in both screw traps in the Sutter Bypass at West Borrow Weir 1 from November 8, 1999 to June 14, 2000. Fish captured at this location cannot be identified as spring-run chinook salmon because of the mixing of juvenile salmon of other races from the Sacramento River.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no. captured	No. trapping days
11/1/99	11/15/99	-	-	-	-	-	7
11/16/99	11/31/99	-	-	-	-	-	15
12/1/99	12/15/99	103	31.2	71	132	14	15
12/16/99	12/31/99	79	14.4	70	114	8	16
1/1/00	1/15/00	65	48.5	37	156	7	15
1/16/00	1/31/00	39	9.0	31	125	1,118	14
2/1/00	2/15/00	44	44.5	33	125	464	15
2/16/00	2/29/00	40	6.7	31	70	87	8
3/1/00	3/15/00	42	9.1	28	121	255	13
3/16/00	3/31/00	84	13.2	42	136	25,273	16
4/1/00	4/15/00	75	8.9	24	110	31,152	15
4/16/00	4/30/00	78	7.7	52	110	9,251	15
5/1/00	5/15/00	73	7.8	52	104	4,434	15
5/16/00	5/31/00	72	6.4	58	102	1,086	16
6/1/00	6/15/00	75	5.5	59	83	18	14
Total:						73,167	209

Table 15. Bi-weekly catch summary of juvenile chinook salmon caught in the screw trap in the Sutter Bypass at East Borrow Weir 2 from January 7, 1999 to June 14, 2000. Fish captured at this location cannot be identified as spring-run chinook salmon because of the mixing of juvenile salmon of other races from the Sacramento River.

Trapping period		Mean FL (mm)	Standard deviation	Range FL (mm)		Total no. captured	No. trapping days
1/1/00	1/15/00	38	1.1	35	41	181	7
1/16/00	1/31/00	38	5.1	31	145	1,029	16
2/1/00	2/15/00	44	6.8	35	105	391	15
2/16/00	2/29/00	-	-	-	-	-	0
3/1/00	3/15/00	-	-	-	-	-	0
3/16/00	3/31/00	-	-	-	-	-	0
4/1/00	4/15/00	77	8.1	51	106	11,924	13
4/16/00	4/30/00	77	8.0	51	107	6,083	15
5/1/00	5/15/00	73	8.1	51	104	1,043	15
5/16/00	5/31/00	73	7.7	56	101	221	16
6/1/00	6/15/00	72	13.4	25	89	19	14
Total:						20,891	111

Table 16. Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1 (See Appendix C, Table 3 and 4 for detail). All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1999.

Tag Code	Total no. captured	Average FL (mm)	Average d at large	Average mm/d
06-01-12-03-08	3	91	103	0.52
06-01-12-03-09	18	92	85	0.65
06-01-12-03-10	32	89	74	0.68
06-01-12-03-11	24	86	68	0.73
06-01-12-03-12	36	82	71	0.65
06-01-12-03-13	26	77	60	0.69
06-01-12-03-14	7	67	53	0.59
Total	146			

Table 17. Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass East Borrow Weir 2 (See Appendix C, Table 3 and 4 for detail). All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1999.

Tag Code	Total no. captured	Average FL (mm)	Average d at large	Average mm/d
06-01-12-03-09	2	81	102	0.44
06-01-12-03-10	5	83	82	0.51
06-01-12-03-11	1	75	73	0.52
06-01-12-03-12	5	76	69	0.66
06-01-12-03-13	11	70	59	0.68
06-01-12-03-14	2	76	52	0.89
Total	26			

Table 18. Recaptures of spring-run chinook salmon bearing coded wire tags from other research projects. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1999.

Tag code	Recovery Date	Recovery FL (mm)	mm/d	Recapture location	d at large
06-01-12-03-09	4/5/00	84	0.52	Chipps Is.	91
06-01-12-03-09	4/14/00	91	0.54	State Fish Fac.	100
06-01-13-03-13	4/4/00	84	0.98	Chipps Is.	48
06-01-13-03-13	4/29/00	80	0.59	Chipps Is.	73

Butte Creek
Juvenile Outmigration 1998-2000

As in the previous evaluation (Hill and Webber, 1999), YOY and yearling juvenile SRCS outmigrants were documented based upon the length of juvenile salmon captured at PPDD. During the evaluation period (October 1998 through June 2000), the majority of Butte Creek SRCS that were captured migrated as fry during high flows between mid-November and mid-February (Tables 3 and 12). As in the previous evaluation, some YOY remain to rear in Butte Creek above PPDD, outmigrating later in the spring and early summer. During the entire two-year evaluation period, 676 yearling SRCS were detected. Yearling SRCS were seen as early as October 5, 1999 and the last on April 18, 2000 at a length of 170 mm FL (Table 3 & 12; Appendix B, Figure 1 and 2). Length-frequency distributions for the entire period (Appendix B) show a bimodal, and sometimes trimodal distribution that generally appear to delineate yearling SRCS. During the 1999-2000 trapping season, 393 yearling SRCS captured at the PPDD between October 15, and October 26, 1999 were tagged and released at the Baldwin Construction Yard (Table 13). Yearling tagging ceased after October 26, 1999 as the result of a storm and a brief period of increased flows, after which yearling captures significantly decreased.

Butte Creek
Growth 1998-2000

Fish tagged at PPDD and recovered in the Sutter Bypass again provided a basis for determining mean growth. Growth calculations were based upon recoveries from 6 tag groups released during the period December 29, 1998 through February 1, 1999 (Table 7; Appendix C, Table 1 and 2), and from 7 tag groups released during the period December 6, 1999 through March 31, 2000 (Table 16 and 17; Appendix C, Table 3 and 4). Fish recovered from the 6 (1998-1999) tag groups varied in length from 34 mm FL to 125 mm FL and averaged 66 mm FL. Fish recovered from the 7 (1999-2000) tag groups varied in length from 60 mm FL to 105 mm FL and averaged 83 mm FL. Fish recovered from all tag groups for 1998-1999 were at large an average of 56 days, while fish recovered from all tag groups for 1999-2000 were at large an average of 73 days.

Growth calculations for this project as previously reported (Hill and Webber, 1999) were based upon tag groups released over a large and varying number of days (22 – 52 days), which affected the precision of growth rate calculations. During this evaluation period (1998-2000) the interval

during which a specific tag code was used was reduced. For the 6 (1998-1999) tag groups for which growth rates were calculated, the average duration of use for each tag code was 9 days and varied from 4 days to 18 days. For the 7 (1999-2000) tag groups for which growth were calculated, the average duration of use for each tag code was 18 days and varied from 10 days to 39 days. During the 1998-1999 tagging season the size of the fish used for the 6 tag groups varied from 31 mm FL to 43 mm FL. The variation in size of fish for the 7 (1999-2000) tag groups was 31mm FL to 66 mm FL. The growth calculation was based upon the mean FL of a measured subsample (30 fish) for each tag group.

Butte Creek
Relative Abundance (1998-2000)

Estimates of relative abundance of juveniles trapped at the PPDD were based solely upon the total catch for each year with no attempt to expand for non-trapping periods. During the 1998-1999 trapping season there were 410,115 juvenile SRCS (including yearlings) captured at the PPDD (Table 3), while during the 1999-2000 trapping season there were 255,104 fish (Table 12). To date, there is no effective means of standardizing effort on an annual basis, particularly during periods of very high flows and debris.

Butte Creek
Adult Escapement

Table 19. Estimates of adult spring-run salmon escapement in Butte Creek from snorkel surveys taken annually from 1994 through 2000.

Year	Estimate	Survey dates
1994	474	June 29 – July 1, 1994
1995	7,480	July 24 – July 27, 1995
1996	1,400	August 19 – August 23, 1996
1997	635	August 18 – August 21, 1997
1998	20,259	August 18 – August 24, 1998
1999	3,679	August 23 – August 31, 1999
2000	4,118	August 25 – September 1, 2000

Four marked adult Butte Creek brood year 1995 SRCS were recovered, 3 from the ocean sport/troll sampling and 1 from a limited project related sampling of carcasses in Butte Creek (Table 20). While ocean sampling maintains a standardized effort and expansion factors are applied, no standardized carcass recovery effort was implemented for Butte Creek.

Table 20. Recoveries of Butte Creek adult spring-run chinook salmon bearing coded wire tags. All fish were tagged at Parrott-Phelan Diversion Dam. All fish were from brood year 1995.

Tag code	Release Date	Recovery Date	Recovery FL (mm)	Recovery Expansion	Recapture location	Recapture Method
B6-12-01	01/25/96	05/98	678	3	Point Sur-CA/Mex. Bor	Ocean troll
B6-12-02	03/16/96	04/98	594	2.5	Fort Ross-Pigeon Pt.	Ocean sport
B6-12-02	03/16/96	04/98	555	2.5	Fort Ross-Pigeon Pt.	Ocean sport
B6-12-01	01/25/96	10/13/99	-	-	Butte Cr.- Centerville PH	Inland carcass

Big Chico Creek
1998-1999 Trapping Season

The 1998-1999 trapping season began February 22, 1999. The 1.5 m (5ft.) rotary screw trap was installed near the Bidwell Park Municipal Golf Course. This season is the first year Big Chico Creek has been sampled with a rotary screw trap. The trap fished until May 28, 1999. A total of 404 juvenile salmon was captured (Table 21).

Table 21. Bi-weekly catch summary of juvenile chinook salmon fishing the screw trap at Bidwell Municipal Golf Course from 22 February 1999 to 28 May 1999.

Trapping period		Mean FL(mm)	Standard deviation	Range FL (mm)		Total no. captured	No. trapping days
2/16/99	2/28/99	37	1.6	33	43	93	6
3/1/99	3/15/99	37	3.3	31	55	124	12
3/16/99	3/31/99	37	4.0	30	51	24	15
4/1/99	4/15/99	41	13.9	33	81	33	15
4/16/99	4/30/99	54	21.2	32	90	64	15
5/1/99	5/15/99	71	8.6	45	90	48	15
5/16/99	5/31/99	72	10.2	48	87	18	13
Total:						404	91

Big Chico Creek
1999-2000 Trapping Season

The 1999-2000 trapping season began November 23, 1999. The 1.5 m (5ft.) rotary screw trap was again installed near the Bidwell Park Municipal Golf Course. The trap fished until May 24, 2000. A total of 110 juvenile salmon was captured (Table 22).

Table 22. Bi-weekly catch summary of juvenile chinook salmon fishing the screw trap at Bidwell Municipal Golf Course from November 23, 1999 to May 24, 2000.

Trapping period		Mean FL(mm)	Standard deviation	Range FL (mm)		Total no. captured	No. trapping days
11/16/99	11/31/99	-	-	-	-	-	9
12/1/99	12/15/99	34	0	34	34	2	15
12/16/99	12/31/99	121	0	121	121	1	14
1/1/00	1/15/00	41	4.95	37	44	2	15
1/16/00	1/31/00	39	4.43	37	49	7	11
2/1/00	2/15/00	38	1.34	35	45	46	10
2/16/00	2/29/00	-	-	-	-	-	8
3/1/00	3/15/00	49	16.82	31	72	15	3
3/16/00	3/31/00	75	5.29	67	80	8	16
4/1/00	4/15/00	74	8.88	58	87	8	15
4/16/00	4/30/00	77	15.18	35	94	13	15
5/1/00	5/15/00	57	25.13	34	86	7	15
5/16/00	5/31/00	108	0	108	108	1	9
Total:						110	155

Big Chico
Adult Escapement

Table 23. Estimates of adult spring-run salmon escapement in Big Chico Creek from snorkel surveys taken annually for 1998, 1999 and 2000.

Year	Estimate	Survey date
1998	369	August 1998
1999	27	September 10, 1999
2000	27	August 8, 2000

DISCUSSION

Refinement of sampling gear and methods that were used in the previous evaluation (Hill and Webber, 1999), resulted in a more robust sampling effort during the period of this evaluation (1998-2000). Emphasis was placed upon trapping and tagging juvenile SRCS at the PPDD. Periodic elevated uncontrolled flows and sporadic periods of high debris load required the cessation of sampling (Appendix A, Figures 1-6) as with the previous evaluations, to protect gear and personnel. The juvenile trapping effort at the PPDD was suspended a total of 15 days out of

the 280 day trapping season during the 1998-1999 season, and 12 days out of 269 days during the 1999-2000 trapping season. As an example of the effect, during the period from January 9 - 15, 1998, Butte Creek flows averaged 237 cfs, while daily trap catches averaged 4,284 juvenile SRCS. Storm induced creek flows increased over the next three days to 819 cfs, at which time fishing of both traps was halted. During the three-day period, juvenile SRCS captures were 18,500 fish, 12,917 fish, and an estimated 200,000 fish respectively. Trapping was then halted for 8 days until reduced flows and debris allowed both traps to be reinstalled on January 26, 1999. No estimate of fish passing the site during the non-trapping period could be made, however based upon the increase from 4,284 fish per day to the estimated 200,000 fish on the day the traps were removed, the numbers were likely significant. Similar events occurred at the PPDD site during January and February 2000, with the likely result that large numbers of fish moved past the site at a time when traps could not be fished.

Juvenile Outmigration

Trapping data from the PPDD continue to support the previous conclusion (Hill and Webber, 1999) that most Butte Creek SRCS begin migration as YOY fry or fingerlings. During the current evaluation (1998-2000), 96.3% of all SRCS captured at PPDD migrated during the period December 1 through January 31 at an average length of 36 mm FL (Table 3 and 12). During the previous evaluation (Hill and Webber, 1999), for the three sampling seasons (1995-1998) 98.2% of all SRCS captured at PPDD migrated during the period December 1 through January 31, also at an average length of 36 mm FL. Fry were first captured at PPDD during the current evaluation (1998-2000) on November 11, 1998 and on November 9, 1999. Recently emerged fry were captured at PPDD every month from November through mid-June during both trapping seasons in the current evaluation period (1998-2000) (Appendix B, Tables 1&2). As with the previous evaluation (Hill and Webber, 1999), recently emerged fry captured at PPDD beginning in early April (Appendix B, Figure 1&2) were assumed to be LFRCS using Fisher's length criteria (Johnson et al., 1992). Anecdotal reports from local residents suggest that LFRCS spawn in Butte Creek above the PPDD; however there has been no official documentation. In nearby Big Chico Creek however, salmon were observed spawning in early January 1998, while recently emerged fry were subsequently captured during May 1998 (Brown, 1998). According to Fisher's length criteria, recently emerged fry during the period December through March are classified as FRCS. Fisher's criteria were however based upon evaluation of juvenile chinook salmon captured in the mainstem Sacramento River, in the reach from Hamilton City to Redding. Later emergence of spring run salmon fry during the period January through March has been documented for Deer and Mill Creeks (CDFG, 1998), and is directly influenced by water temperatures. While fall run salmon have been observed spawning above the PPDD diversion site, the numbers are generally small and thus fry captured at the site from November through March are assumed to be SRCS.

There were 676 SRCS captured at the PPDD during the entire 1998-2000 evaluation period that were identified as yearlings. During the 1998-1999 trapping season there were 37 fish identified as SRCS yearlings captured at the site from October 10, 1998 with the last on May 29, 1999. The majority of yearling SRCS (84%) were captured from early October 1998 through January 1999. During the 1999-2000 trapping season, there were 639 fish identified as SRCS yearlings captured at the site from October 5, 1999 through April 18, 2000. The majority (77%) was captured during October, with a significant decline after a storm, which occurred on October 27-28, 1999. Butte Creek flows as measured at the Butte Creek Near Chico Gage (Figure 1),

located upstream of the PPDD diversion, averaged 114 cfs for the three days prior to the storm, increased to 337 cfs on October 28, 2000, and then receded. During the same period, turbidity measurements taken at the site increased from an average of 0.73 NTU's to 25.2 NTU's and then again decreased after the storm. Yearling SRCS captures increased from an average of 7 fish per day for the three-day period preceding the storm, to 31 fish on October 28, and then to zero fish on the days immediately following the storm. The yearling SRCS tagging operation, which had marked 393 fish prior to the storm, was halted because of the lack of sufficient numbers of fish after the storm. Large numbers of yearling salmon were observed upstream of the PPDD during the summer adult escapement survey. Of the 676 fish captured during the entire 1998-2000 evaluation period that were classified as yearling SRCS, 7.5% (46 fish) fell within the Fisher length criteria for WRCS. There are no recorded observations of WRCS spawning in Butte Creek, as water temperatures are too high for incubation.

A total of 616 fish was CWT marked at PPDD and subsequently recaptured in traps fished within the Sutter Bypass during the two-year evaluation period (1998-2000). During the 1998-1999 trapping season, 409 of the fish marked at PPDD were recaptured in the Sutter Bypass West Borrow trap at Weir 1 (Figure 1), while 9 fish marked at PPDD were captured in the Sutter Bypass East Borrow trap at Weir 2. The earliest recapture for the 1998-1999 trapping season occurred on January 21, 1999 when a 34 mm FL SRCS (tag code 06-01-12-02-09) released between December 29, 1998 and January 15, 1999 was captured in the Weir 1 trap. The latest recapture was on June 4, 1999, when a 70 mm FL SRCS (tag code 06-01-12-03-04) released between March 22, 1999 and April 16, 1999, was captured in the Weir 1 trap.

The average number of days at large calculated for all fish marked at PPDD and recaptured in the Sutter Bypass Weir 1 trap for the 1998-1999 trapping season was 56 days (Table 7). The average number of days at large calculated for all fish marked at PPDD and recaptured in the Sutter Bypass Weir 2 trap for the 1998-1999 trapping season was 54 days (Table 8). During the 1999-2000 trapping season, 146 of the fish marked at PPDD were recaptured in the Sutter Bypass West Borrow trap at Weir 1, while 26 fish marked at PPDD were capture in the Sutter Bypass East Borrow trap at Weir 2. During the 1999-2000 trapping season, the earliest recapture occurred on March 23, 2000 when a 91 mm FL SRCS (tag code 06-01-12-03-09) released between December 29, 1999 and January 10, 2000 was captured in the Weir 1 trap. The latest recapture during the 1999-2000 trapping season occurred on May 21, 2000 when a 61 mm FL (tag code 06-01-12-03-14) released between February 22, 2000 and March 31, 2000 was captured in the Weir 1 trap. The average number of days at large calculated for fish marked at PPDD and recaptured in the Sutter Bypass Weir 1 trap for the 1999-2000 season was 71 days (Table 16). The average number of days at large calculated for fish marked at PPDD and recaptured in the Sutter Bypass Weir 2 trap for the 1999-2000 season was 69 days (Table 17).

Sutter Bypass trapping and CWT recaptures for the 1998-2000 evaluation period support the suggestion that the Sutter Bypass is a major nursery area (Hill and Webber, 1999). During the entire evaluation period a total of 222,444 chinook salmon was captured in all traps fished within the Sutter Bypass. There were 198,552 captured in the West Borrow at Weir 1, and 23,892 in the East Borrow at Weir 2. Significantly more effort was expended at the West Borrow Weir 1 site for the entire 1998-2000 evaluation period, with one screw trap fishing for 353 days, and a second fishing in tandem for 84 days. The Sutter Bypass East Borrow Weir 2 site was sampled with one screw trap for 206 days for the entire 1998-2000 evaluation period. During the entire evaluation period the Sacramento River overflowed into the Sutter Bypass at either or both the

Colusa and Tisdale Weirs a total of 45 days during the 1998-1999 trapping season, and 49 days during the 1999-2000 trapping season (Appendix A, Figures 3 and 4). During the 1998-1999 trapping season, the Sacramento River first overflowed into the Sutter Bypass via the Colusa/Tisdale Weirs on December 1, 1998 and for the last time on March 27, 1999. During the 1999-2000 trapping season the first overflow from the Sacramento River did not occur until January 25, 2000, while the last occurrence was on March 19, 2000. During the entire two-year evaluation there were a total of 79 recaptures of CWT fish from the upper Sacramento River marked by the USFWS (Appendix D, Tables 1 and 2). During the 1998-1999 trapping season, 8 LFRCS marked at CNFH, and released as surrogates for yearling SRCS, were captured at Weir 1 between March 15, and March 29, 1999. Average time at large for the group from date of release to date of recapture was 89 days. During the same trapping season (1998-1999), 34 WRCS marked at Livingston Stone National Fish Hatchery (LSNFH), released at Lake Redding Park, were recaptured at Weir 1 between March 14, and March 31, 1999. Average time at large for the WRCS from date of release to date of recapture was 58 days. Additionally, 13 wild FRCS captured and marked at RBDD, were recaptured at Weir 1 between March 4, 1999 and April 18, 1999. Average time at large using a median release date for fish marked and released over the period January 27, 1999 to March 12, 1999, was 51 days. A group of 5 CNFH FRCS was recaptured at Weir 1 between March 25, 1999 and April 9, 1999. Average time at large was 32 days. Based upon the days at large for the various groups it appears that upper Sacramento River fish that are entrained into the Sutter Bypass tend to reside and rear until the bypass drains, which occurred during late March 1999. A review of all Sutter Bypass captures during the two-year evaluation suggests that most fish exit by mid-May as was seen in the previous evaluation (Hill and Webber, 1999).

Twelve CWT recaptures of fish marked during the two-year evaluation period (1998-2000) were from other sampling efforts below the Sutter Bypass (Table 9 & 18). Eleven of the fish were captured by the USFWS at Chipps Island, while one fish was captured at the state pumping facility in the south Delta. All recaptures occurred from early April to early May. Average time at large from release at PPDD to recapture in the Delta and at Chipps Island was 72 days, while the fish ranged in size from 73 mm FL to 95 mm FL. The number of days at large is only slightly longer than the average time at large from PPDD to the Sutter Bypass trap, suggesting that fish that exit the Sutter Bypass move rapidly downstream and do not use the mainstem Sacramento River for rearing.

As previously reported (Hill and Webber, 1999), it is possible that a small proportion of the fish tagged as SRCS may have actually been FRCS as the result of some FRCS adults spawning above the PPDD.

Growth

The results of the two year evaluation confirm the value of the area above PPDD for rearing of yearling SRCS, while also demonstrating that most Butte Creek SRCS migrate as fry and rear below PPDD (Tables 1,2,3,10,11,12).

CWT recaptures from the Sutter Bypass further substantiate the value of the Bypass as a rearing area. Fish tagged at PPDD at an average size of 37 mm FL were recovered in the Sutter Bypass at an average of 72 mm FL. Average growth rate for 6 groups of fish tagged at PPDD during 1999 (Table 7) was 0.52 mm per day, and ranged from 0.45 mm per day to 0.58 mm per day.

During 2000, the average growth rate of 7 groups of fish tagged a PPDD (Tables 16 and 17) was 0.66 mm per day, with a range from 0.44 mm per day to 0.89 mm per day. These growth rates are less than those observed in the previous evaluation (Hill and Webber, 1999), however are comparable to those found by Kjelson et al. (1982). Kjelson et al. (1982) found growth rates for fish that reared in the Delta that averaged 0.86 mm/d (range 0.57 to 1.23) in 1980 and 0.53 mm/d (range 0.40. to 0.69) in 1981. During 1981, they found growth rates that averaged 0.33 mm/d for fish that reared in the upper Sacramento River. A growth model (Johnson et al., 1992) developed for the upper Sacramento River predicted a growth rate of approximately 0.33 mm/d for fish rearing in the mainstem during the period march 24, 1996 to March 30, 1996.

Relative Abundance

As previously discussed (Hill and Webber, 1999), a goal of this study was to develop an estimate of the relative abundance of SRCS outmigration. Physical factors affecting fish trapping, including high flows and debris, frequently required that trapping operations cease to protect personnel and gear. As was previously discussed, these constraints on trapping frequently occur during periods of elevated migration of SRCS juveniles. This was the case during the period January 9-15, 1998 when flows increased from 237 cfs to 819 cfs, at which time the trap was removed. Fish captures had increased from an average of 4,284 fish per day to an estimated 200,000 the day the trap was removed and trapping was halted for the next eight days. An examination of juvenile SRCS captures in the traps at PPDD suggests some correlation to the corresponding adult escapement. As described above however, as an example the adult escapement estimate for 1998 was 20,259, while the subsequent juvenile captures were 410,000 fish. Juvenile trapping was suspended as the result of high flows and debris at a time when juvenile recaptures had increased to 200,000 fish per day.

We conclude, as did Hill and Webber (1999) that based upon an inability to effectively trap during the entire juvenile emigration period, estimates of relative abundance are of questionable value as a metric for comparison between and among years. Additionally, the inability to trap under all conditions corresponding with an inability to determine trap efficiencies under these same conditions make estimates of total abundance of even less value.

Adult Escapement

Adult escapement estimates were based upon snorkel surveys of the entire summer holding areas (Table 19). Since snorkel surveys generally underestimate salmon abundance (Shardlow, et al. 1987), escapement estimates as developed by this study are based upon the highest count, as opposed to reporting the range of the counts. The 1998 escapement estimate was 20,259, the highest ever recorded for Butte Creek. That record adult escapement was probably due to the 1995 adult escapement of 7,480 and to favorable outflow in Butte Creek during the winter and spring of 1995-1996, when most of the 1995 brood year juveniles were outmigrating. The 1999 and 2000 escapement estimates (3,679 and 4,118 adults respectively) are significantly lower, however based upon adults returning as three year olds, reflect cohort replacement rates of 2.63 and 6.5 respectively.

There were 4 recoveries of Butte Creek SRCS adults that were tagged as fry (BY 95) at PPDD during 1996 (Table 20). Three of the recoveries were from the ocean fishery, 1 fish was caught in the ocean commercial fishery during May 1998, while the other 2 were caught in the ocean

sport fishery during April 1998. During September and October 1999, a limited carcass survey of the Butte Creek SRCS spawning area was conducted. One marked fish was found on October 13, 1999. Since the 3 ocean-caught fish were taken during April and May 1998, it appears that they would not have entered fresh water until 1999 at age 4. The 1 Butte Creek carcass recovery was a four-year-old fish, which seems to suggest that some proportion of Butte Creek SRCS return at age 4. Cramer and Demko (1997) found that 80% to 90% of Feather River Hatchery SRCS released as smolts matured at age 4, although it was also concluded that up to 85% of those fish were taken in the ocean harvest by the time they reached age 4. Fisher (1994) however suggested that based upon observations at Red Bluff Diversion Dam, 87% of spring-run adults returned at age three. Future Butte Creek evaluations will include expanded sampling of carcasses to recover tagged Butte Creek SRCS to better define age structure, and to identify straying from other watersheds including SRCS from the Feather River Fish Hatchery.

Hill and Webber (1999) reported that there was concern that Butte Creek FRCS were overlapping the SRCS spawning area. This was again the case during 1999 and 2000, as some FRCS were observed ascending the PPDD ladder and FRCS spawning was recorded as far upstream as Helltown (Figure 1).

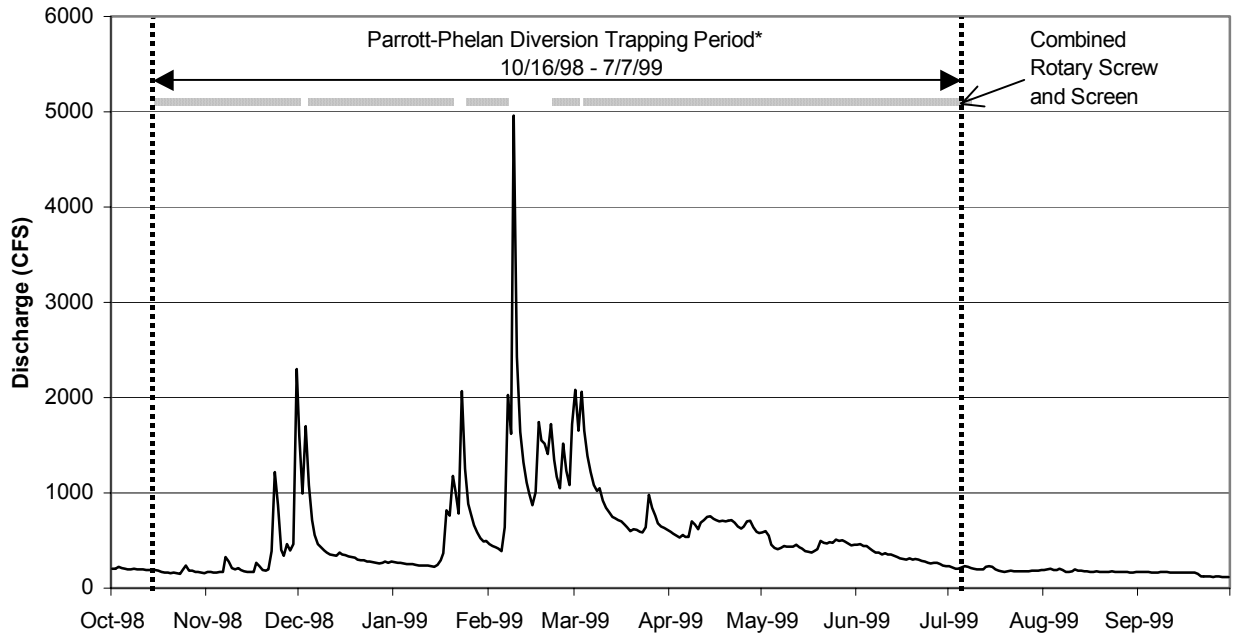
ACKNOWLEDGMENTS

This project was supported by funding provided by the U.S. Fish and Wildlife Service, Central Valley Anadromous Fish Restoration Program and by the Federal Aid in Sport Fish Restoration Act, in partnership with the California Department of Fish and Game.

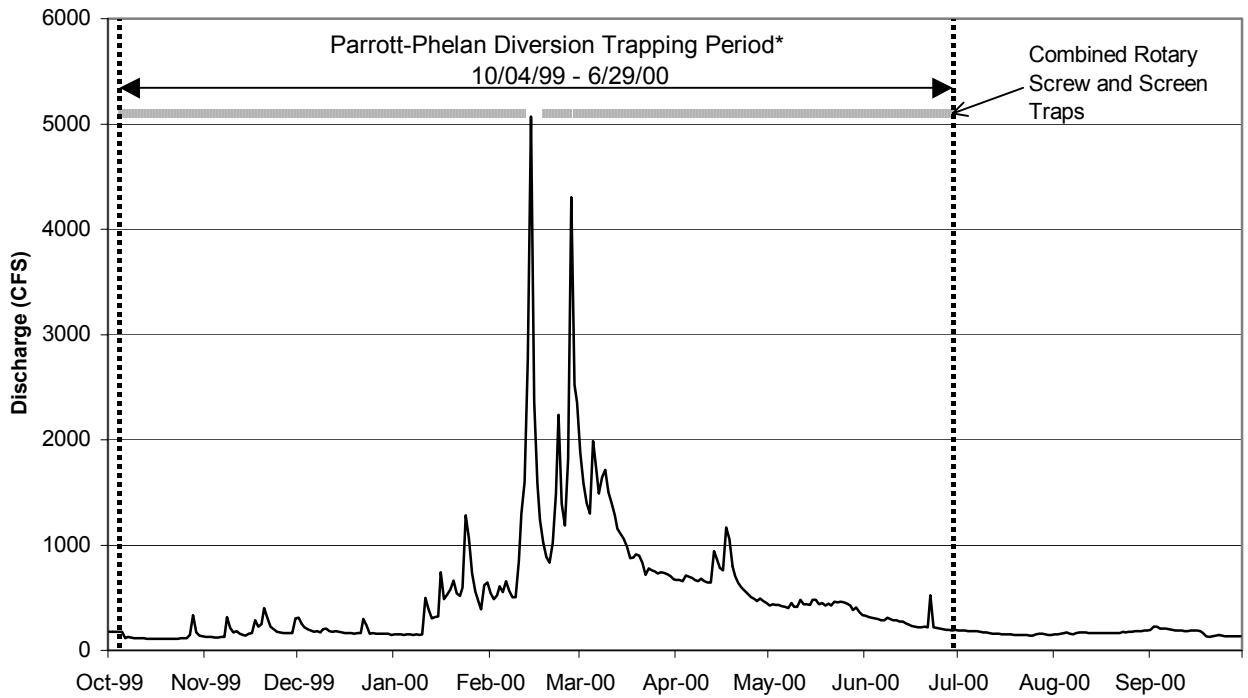
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APPENDIX A, FIGURE 1. Butte Creek flow at Butte Creek Near Chico Gage (USGS - #11390000), water year 1998-99, with trapping period shown.

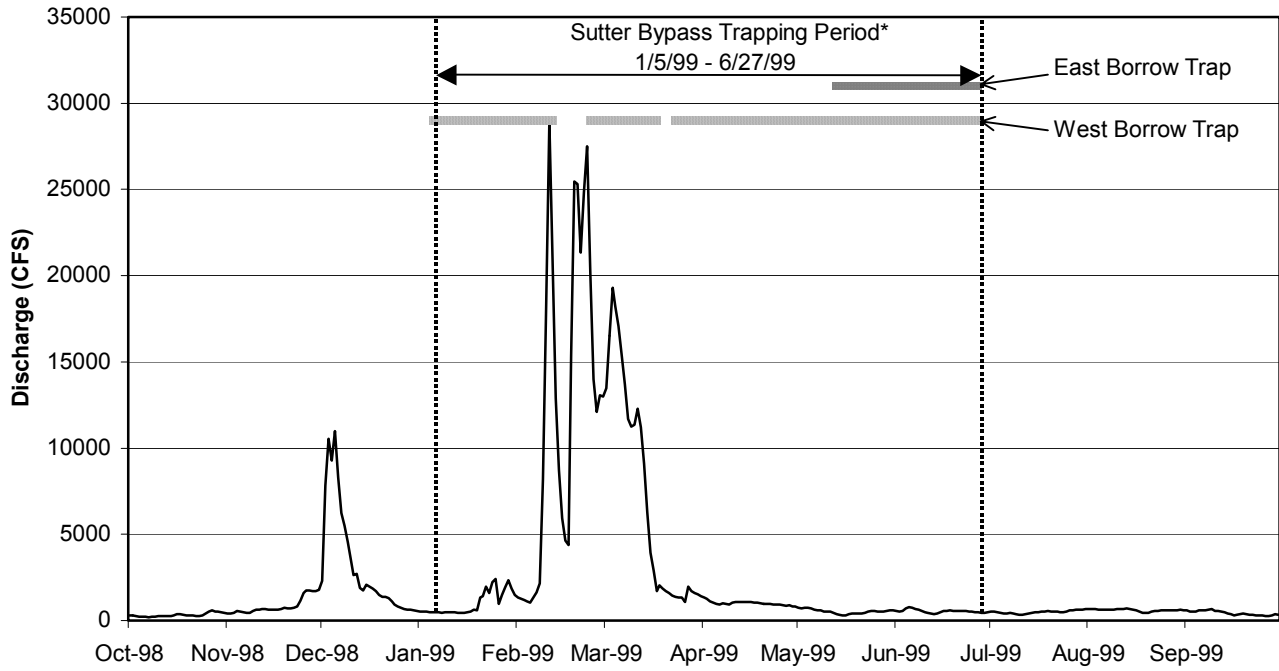


APPENDIX A, FIGURE 2. Butte Creek flow at Butte Creek Near Chico Gage (USGS - #11390000), water year 1999-00, with trapping period shown. Flow data are provisional and subject to revision

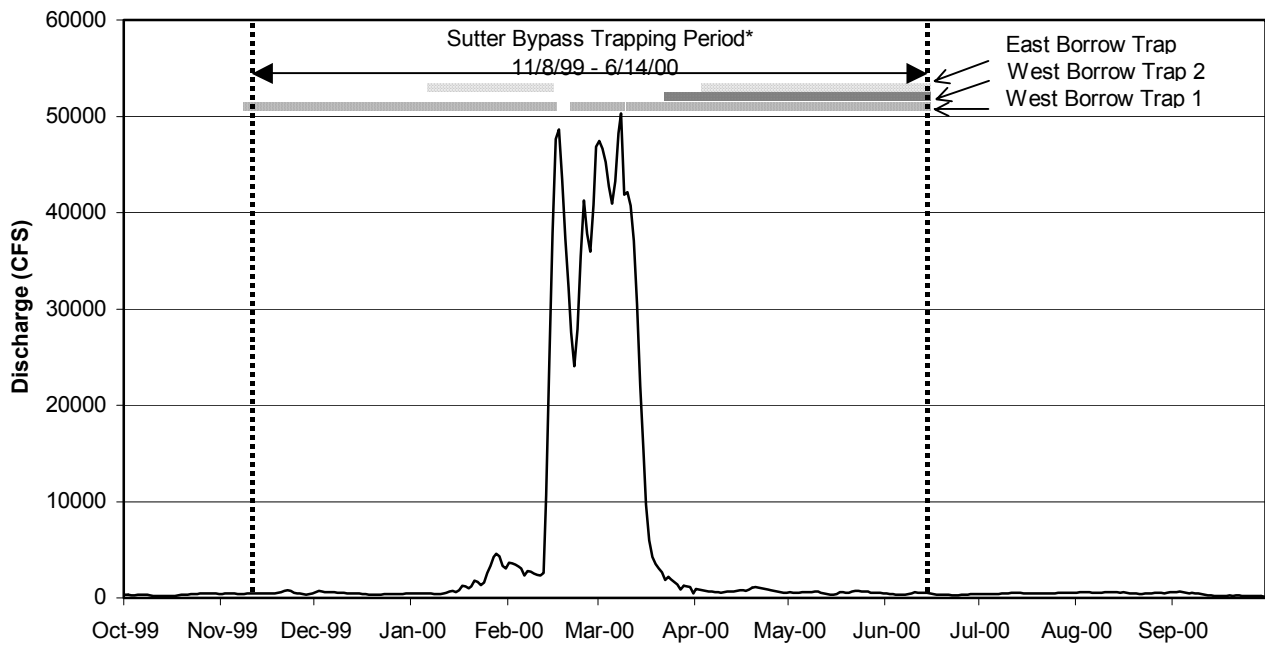


* Breaks in horizontal line indicate period of time when trap was not fishing.

APPENDIX A, FIGURE 3. Butte Creek flow at Sutter Bypass Butte Slough near Meridian Gage (DWR #A20972), water year 1998-99, with trapping period shown.

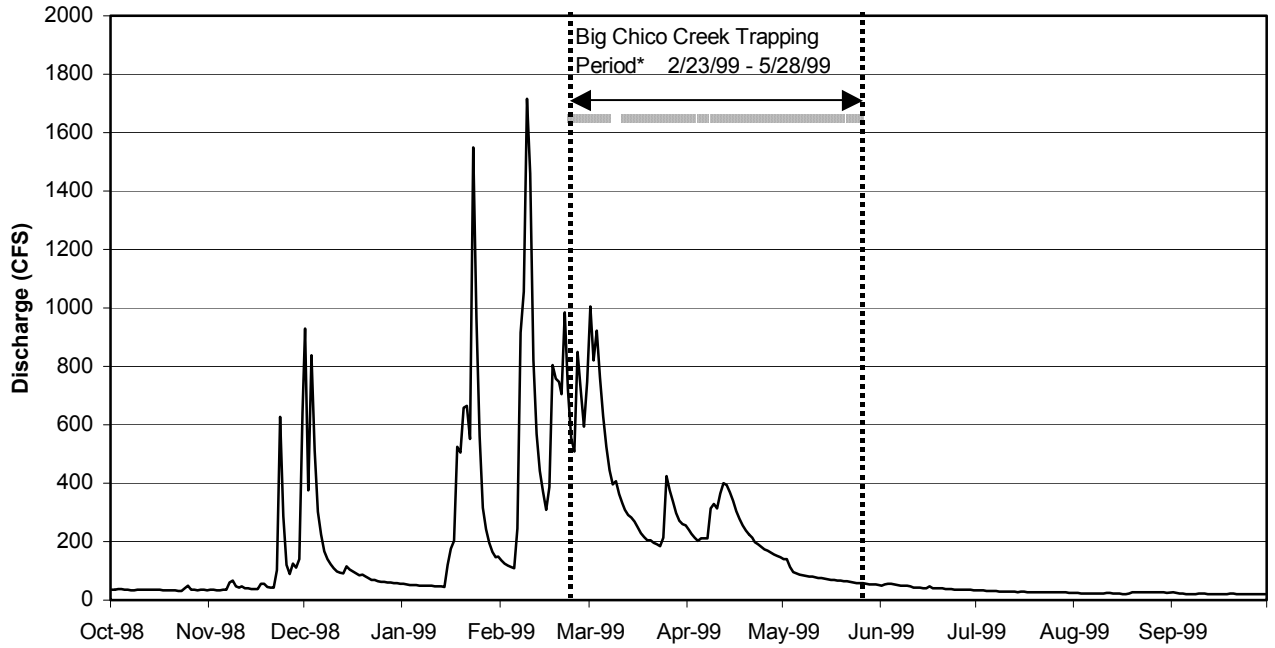


APPENDIX A, FIGURE 4. Butte Creek flow at Sutter Bypass Butte Slough near Meridian Gage (DWR A20972), water year 1999-00, with trapping period shown. Flow data are provisional and subject to revision.

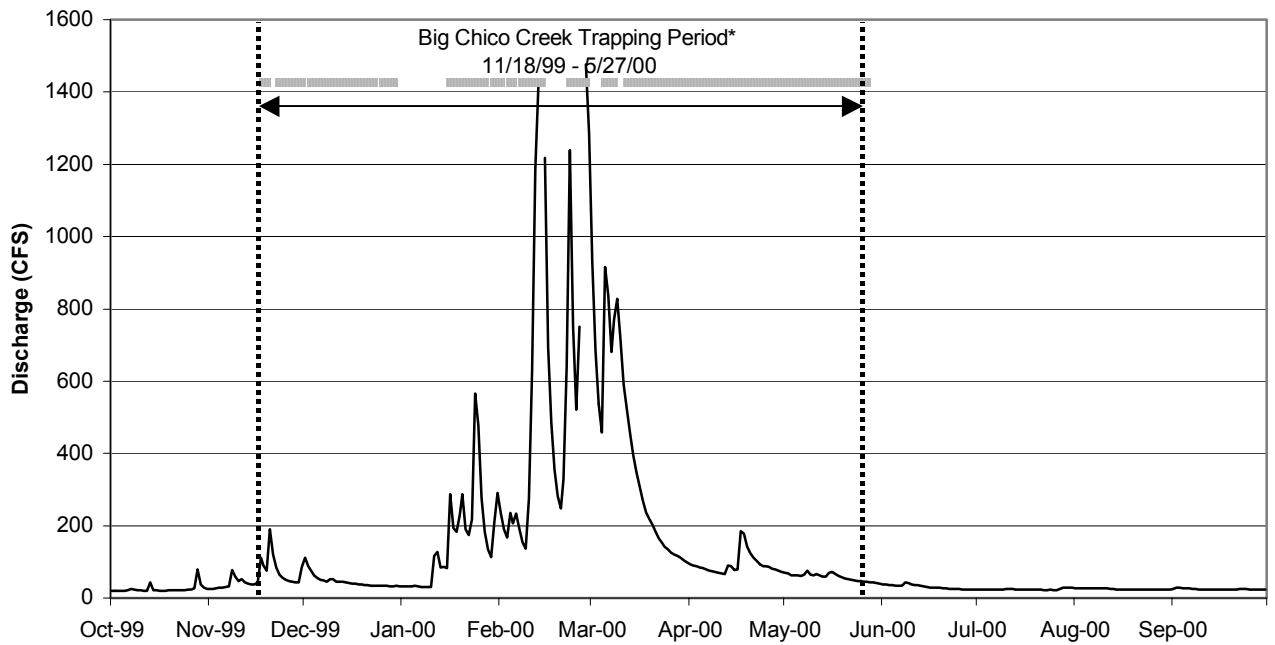


*Breaks in horizontal line indicate periods of time when the trap(s) were not fishing

APPENDIX A, FIGURE 5. Big Chico Creek flow at Big Chico Creek Near Chico Gage (DWR #42105), water year 1998-99, with trapping period shown.

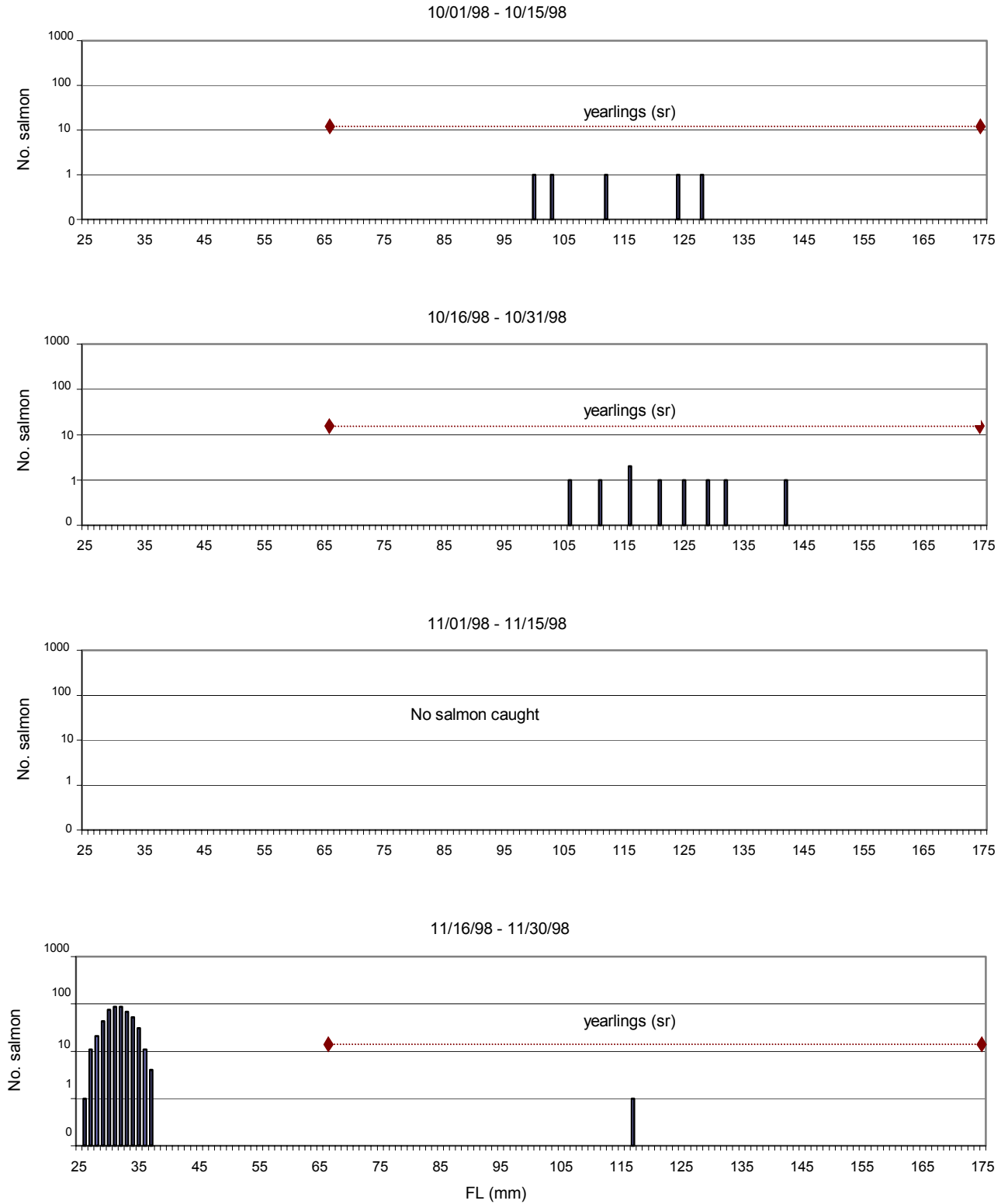


APPENDIX A, FIGURE 6. Big Chico Creek flow at Big Chico Creek Near Chico Gage (DWR #42105), water year 1999-00, with trapping period shown

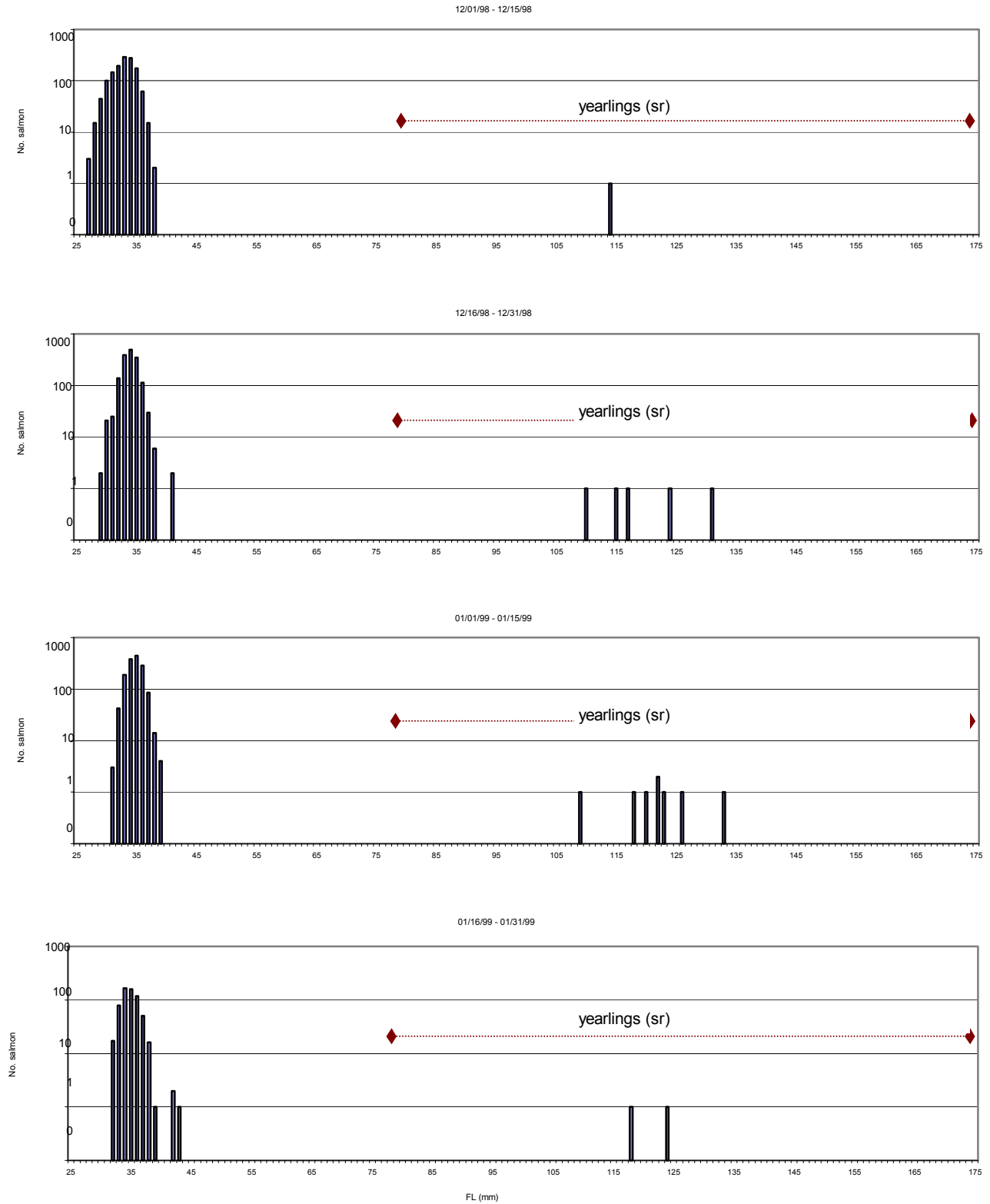


*Breaks in horizontal line indicate periods of time when the trap(s) were not fishing

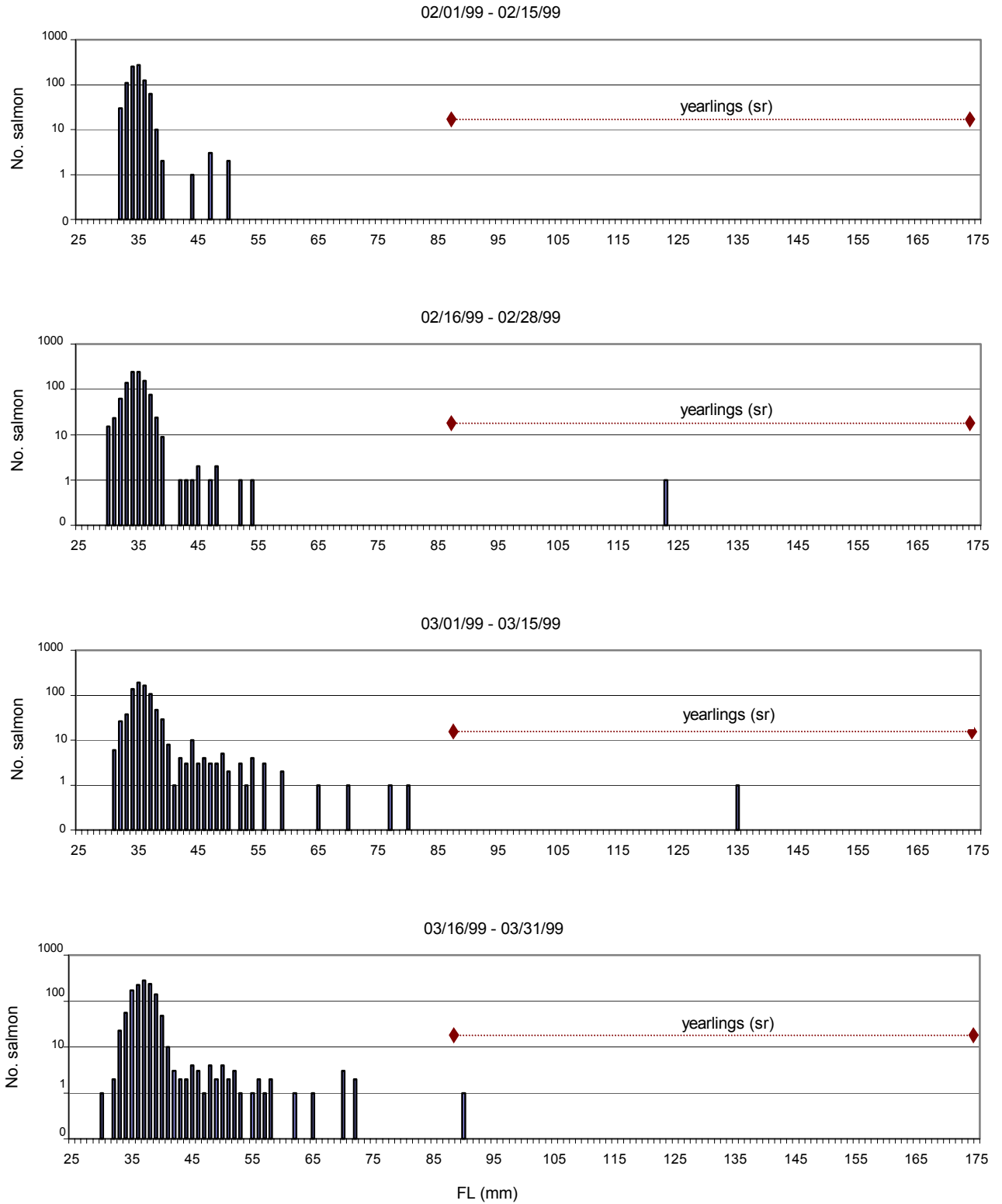
APPENDIX B, FIGURE 1. Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1998 through June 30, 1999. All fish are assumed to be spring-run chinook salmon except where indicated.



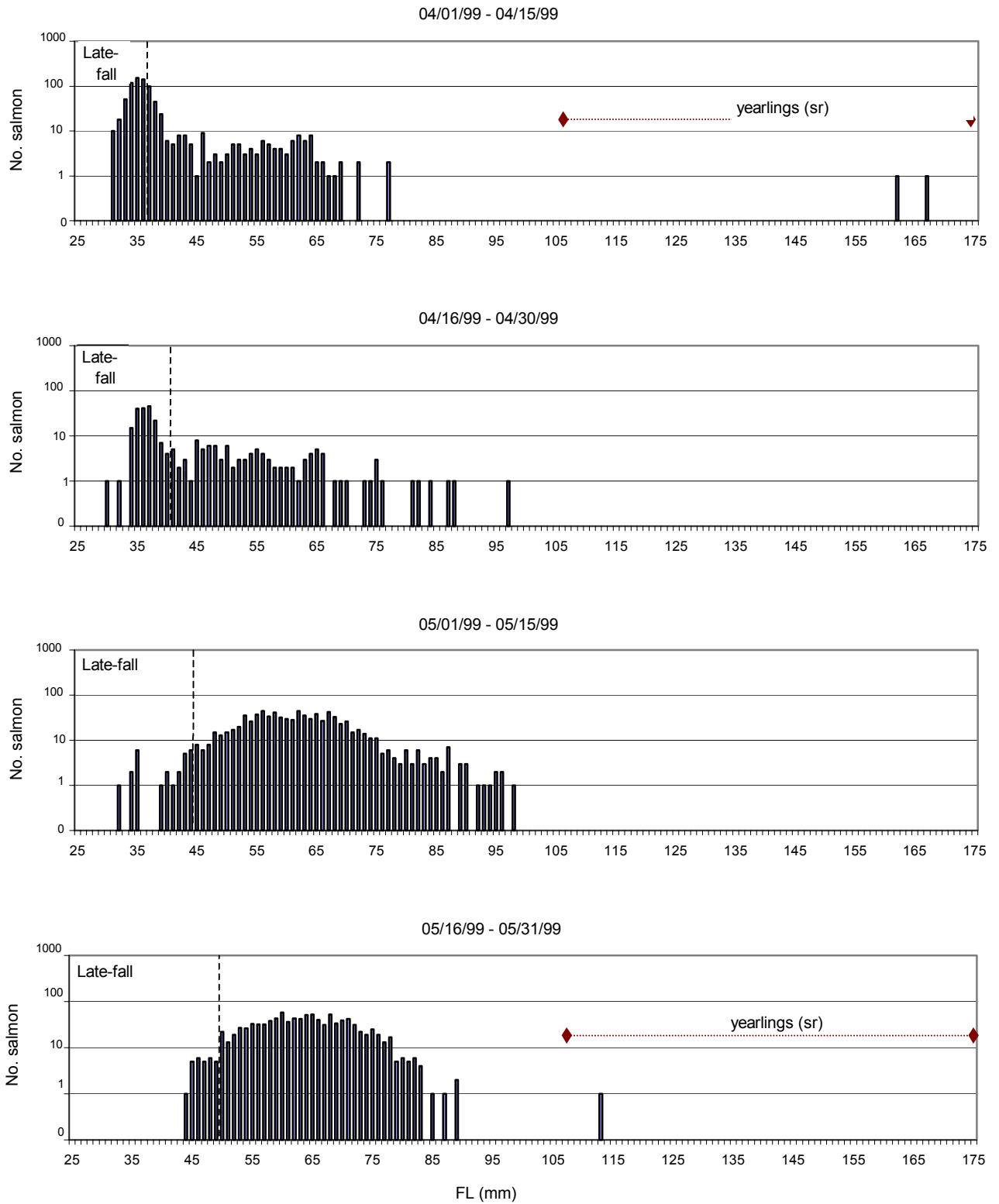
APPENDIX B, FIGURE 1. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1998 through June 30, 1999. All fish are assumed to be spring-run chinook salmon except where indicated.



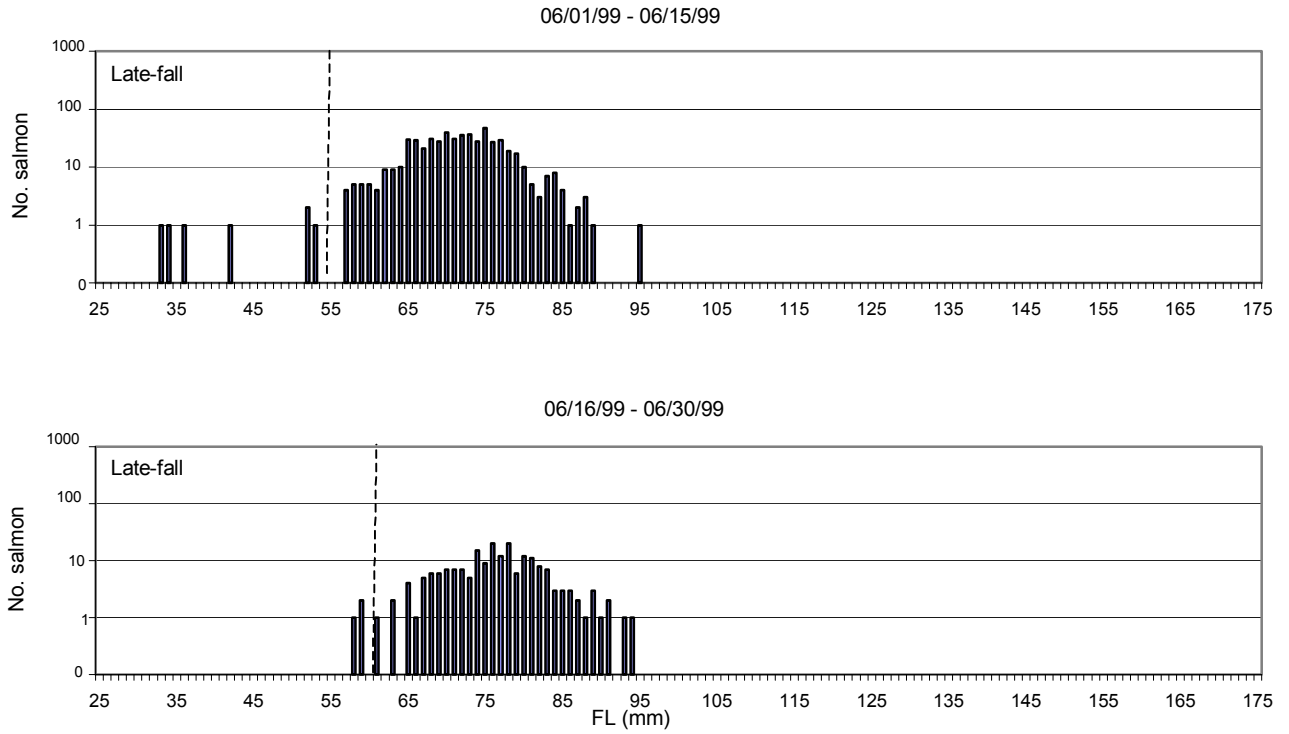
APPENDIX B, FIGURE 1. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1998 through June 30, 1999. All fish are assumed to be spring-run chinook salmon except where indicated.



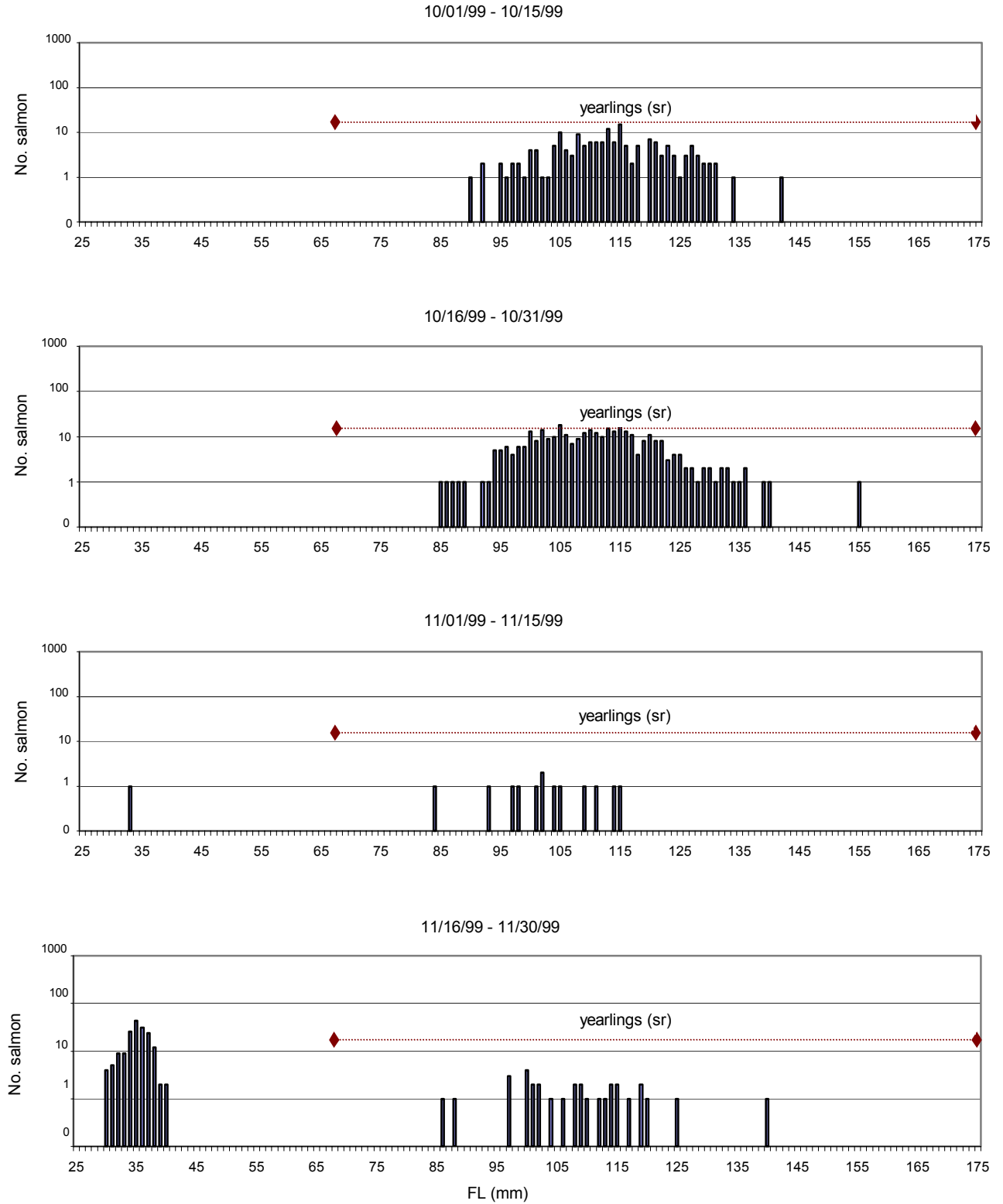
APPENDIX B, FIGURE 1. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1998 through June 30, 1999. All fish are assumed to be spring-run chinook salmon except where indicated.



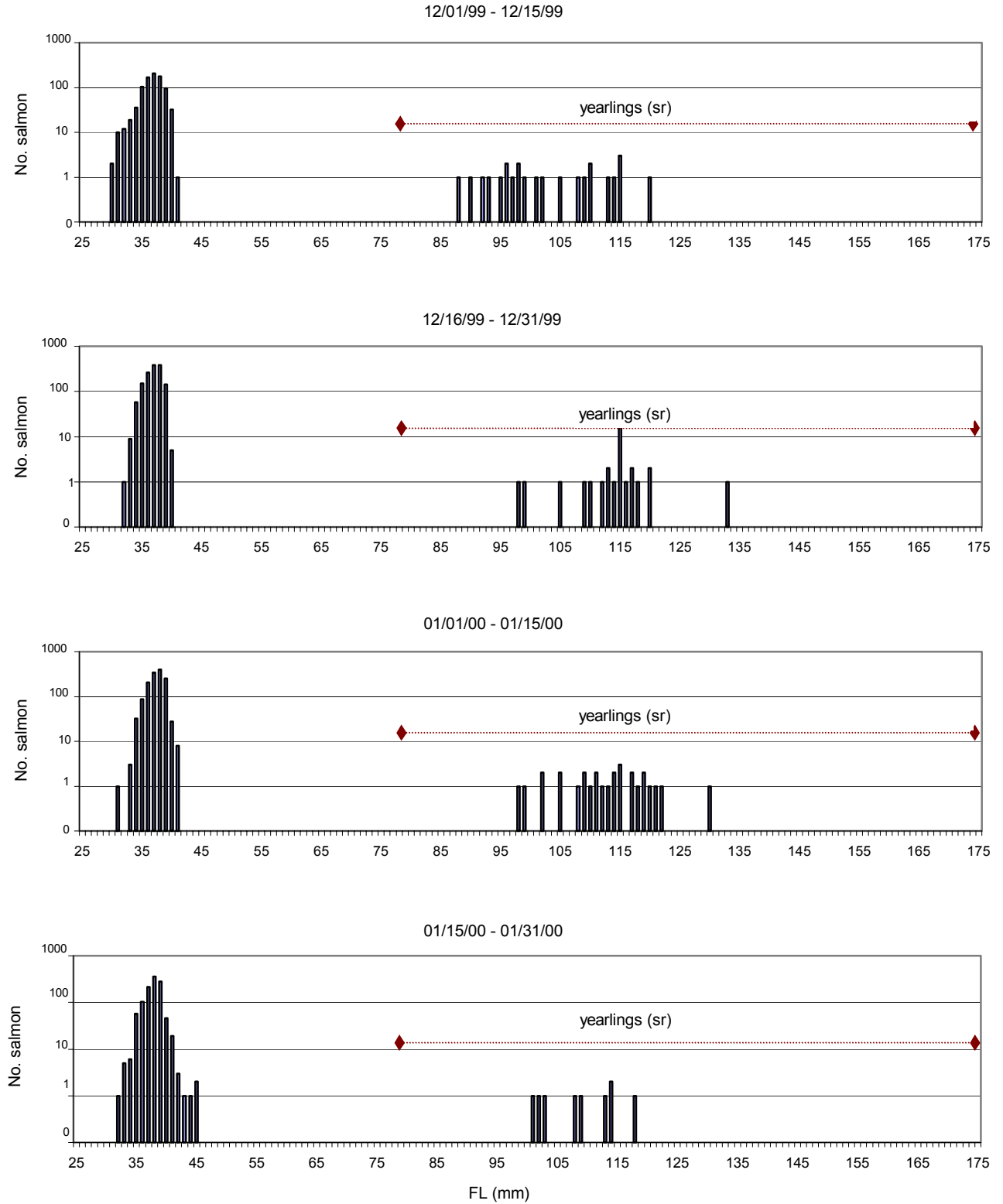
APPENDIX B, FIGURE 1. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1999 through June 30, 1999. All fish are assumed to be spring-run chinook salmon except where indicated.



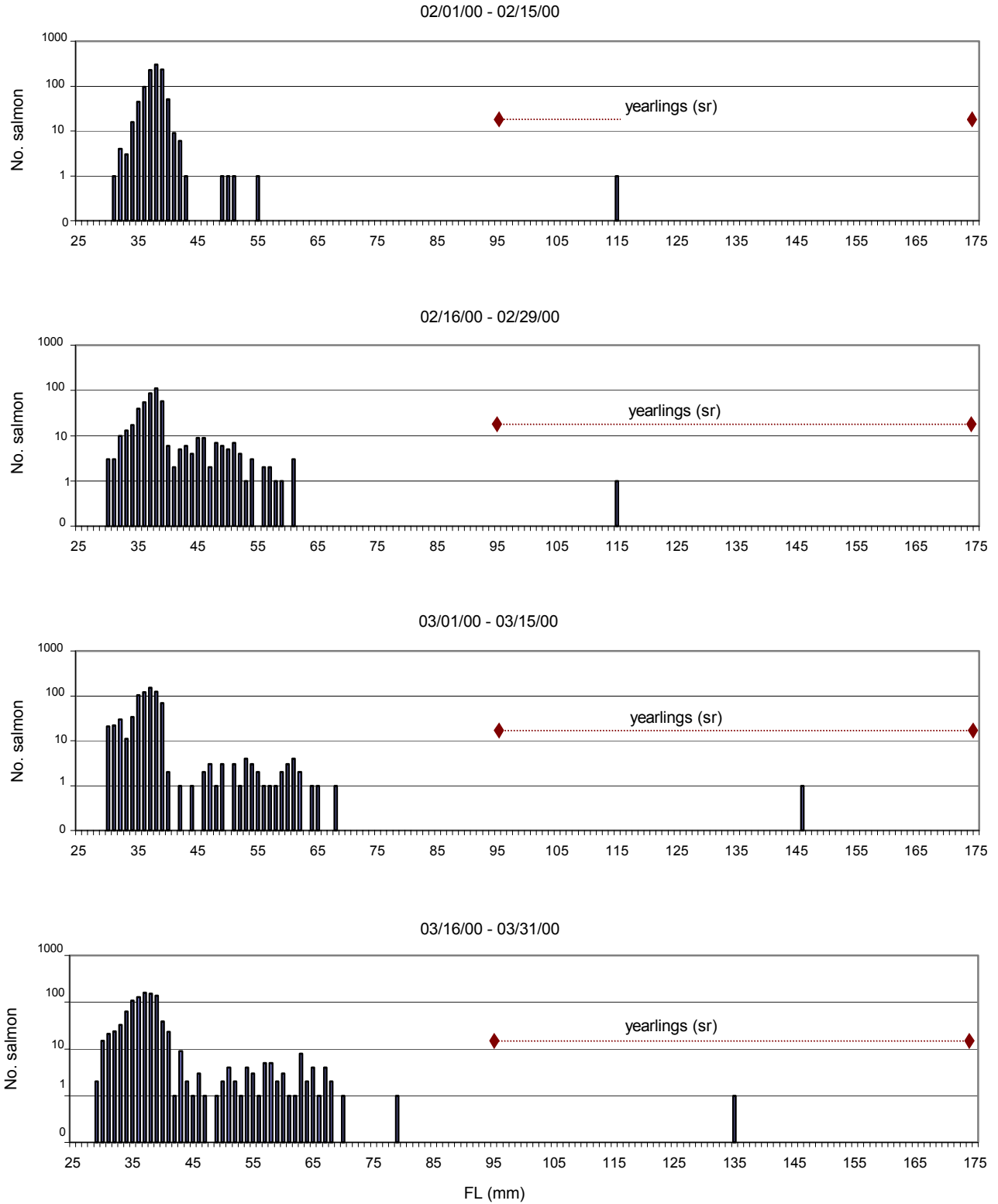
APPENDIX B, FIGURE 2. Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1999 through June 30, 2000. All fish are assumed to be spring-run chinook salmon except where indicated.



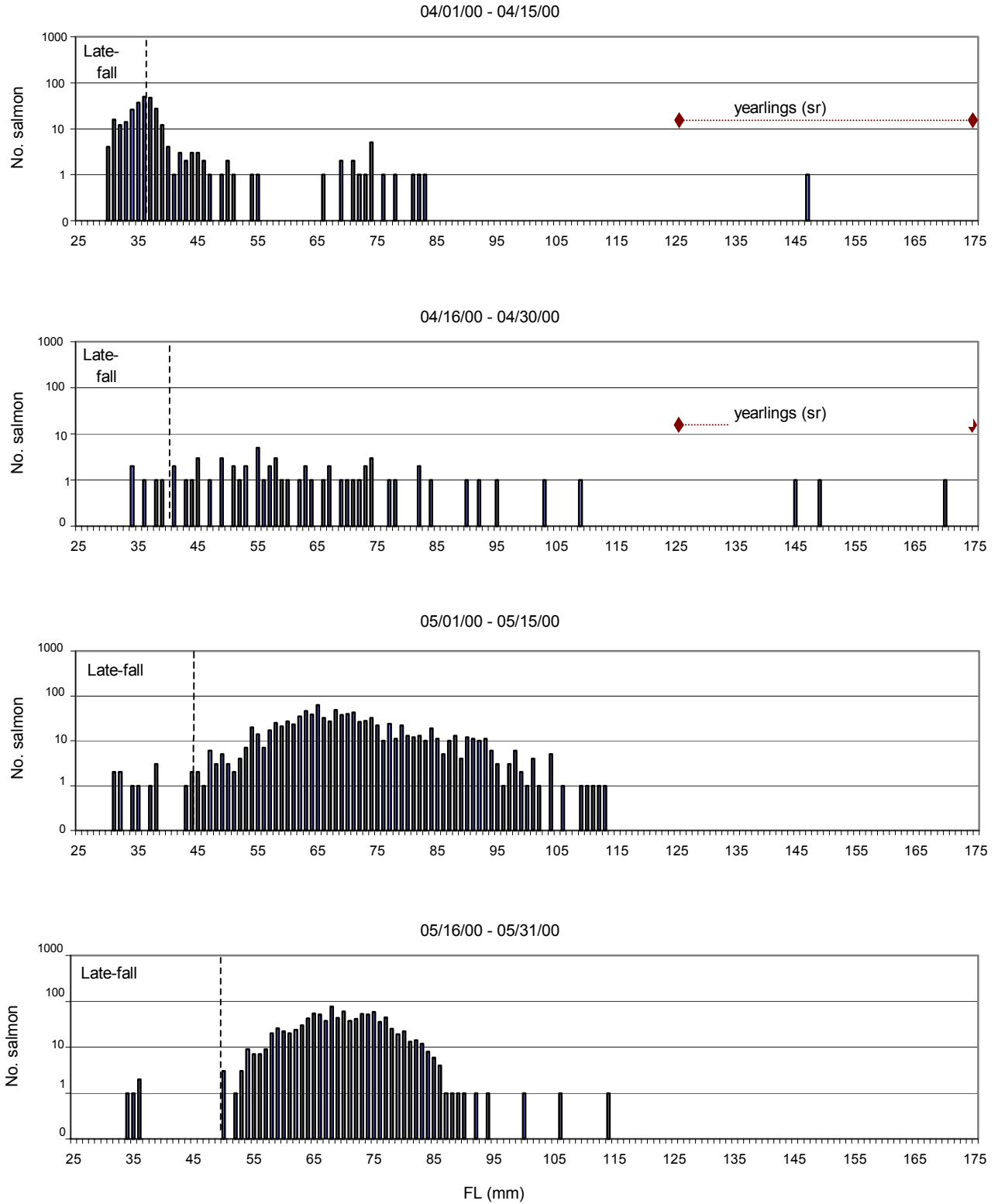
APPENDIX B, FIGURE 2. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1999 through June 30, 2000. All fish are assumed to be spring-run chinook salmon except where indicated.



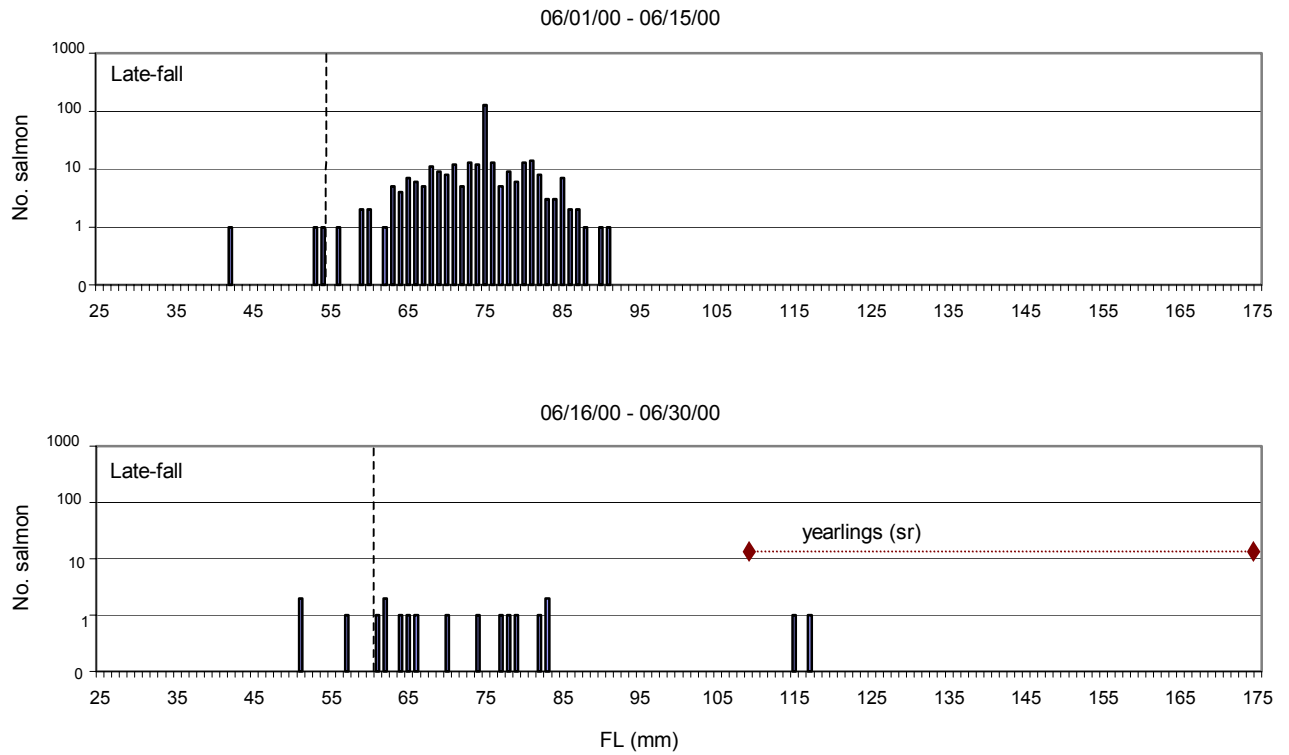
APPENDIX B, FIGURE 2. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1999 through June 30, 2000. All fish are assumed to be spring-run chinook salmon except where indicated.



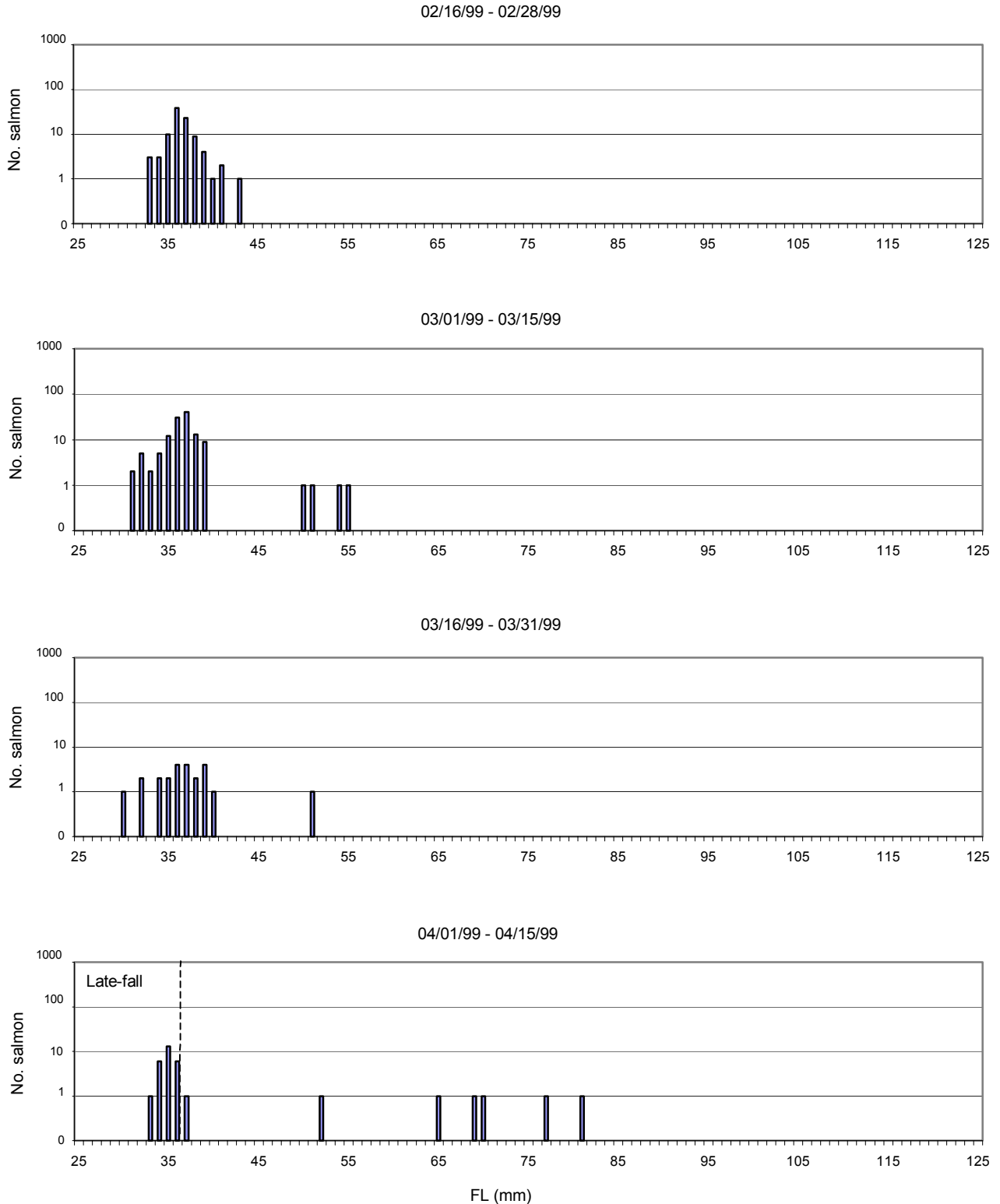
APPENDIX B, FIGURE 2. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1999 through June 30, 2000. All fish are assumed to be spring-run chinook salmon except where indicated.



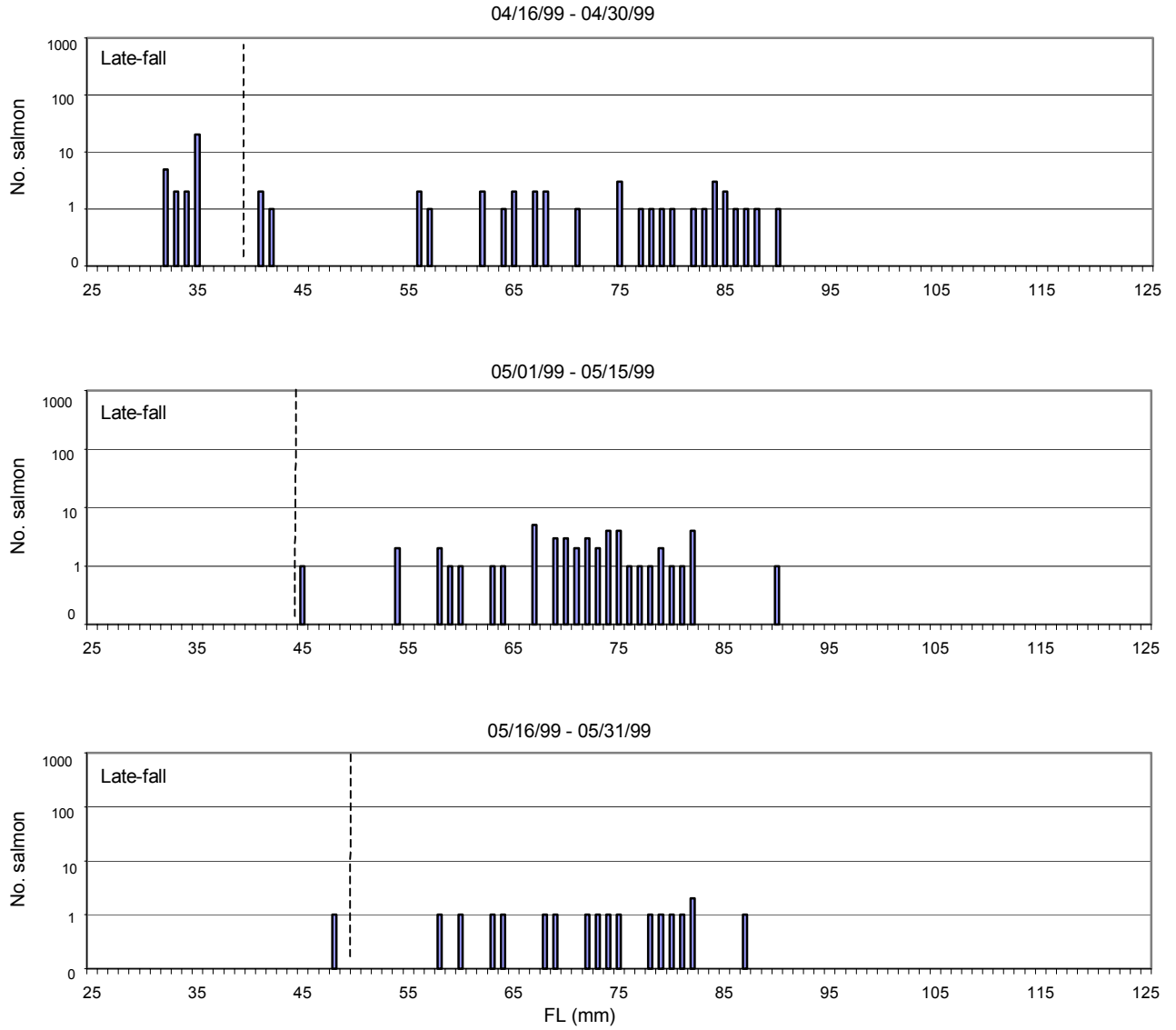
APPENDIX B, FIGURE 2. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released at Parrott-Phelan Diversion Dam from October 1, 1999 through June 30, 2000. All fish are assumed to be spring-run chinook salmon except where indicated.



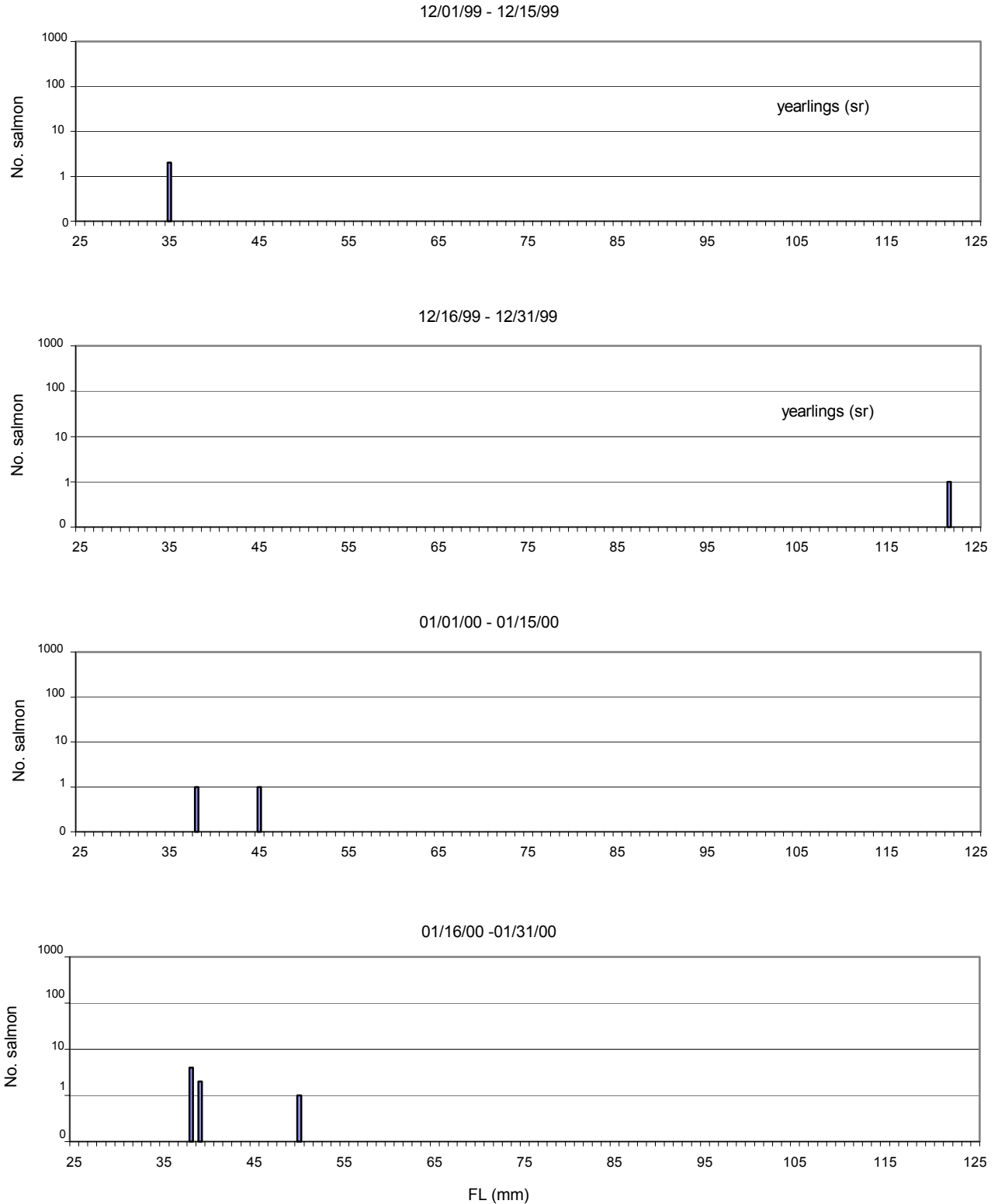
APPENDIX B, FIGURE 3. Frequency distribution of lengths of juvenile chinook salmon caught and released in Big Chico Creek from February 16, 1999 through May 31, 1999. All fish are assumed to be spring-run chinook salmon except where indicated.



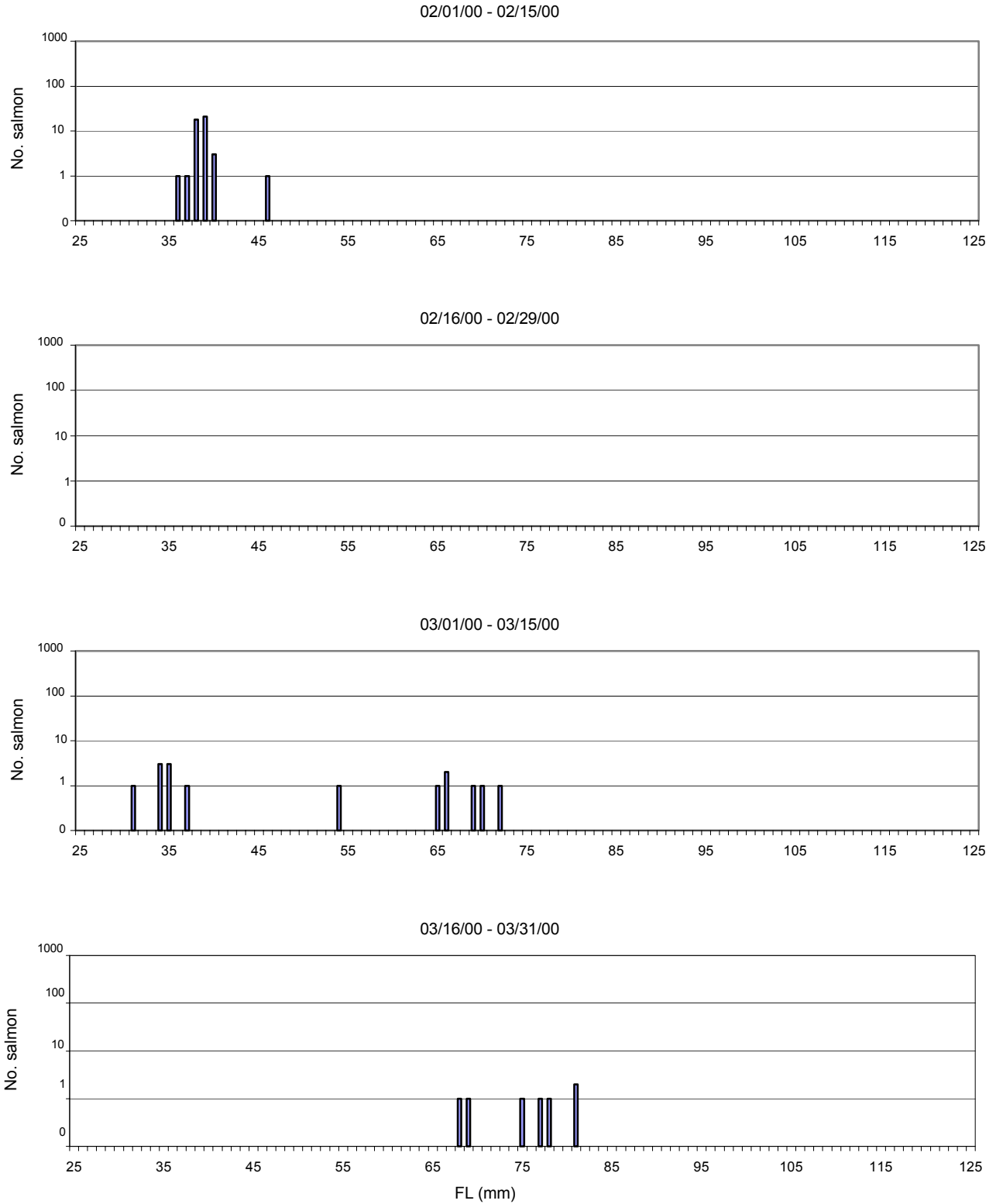
APPENDIX B, FIGURE 3. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released in Big Chico Creek from February 16, 1999 through May 31, 1999. All fish are assumed to be spring-run chinook salmon except where indicated.



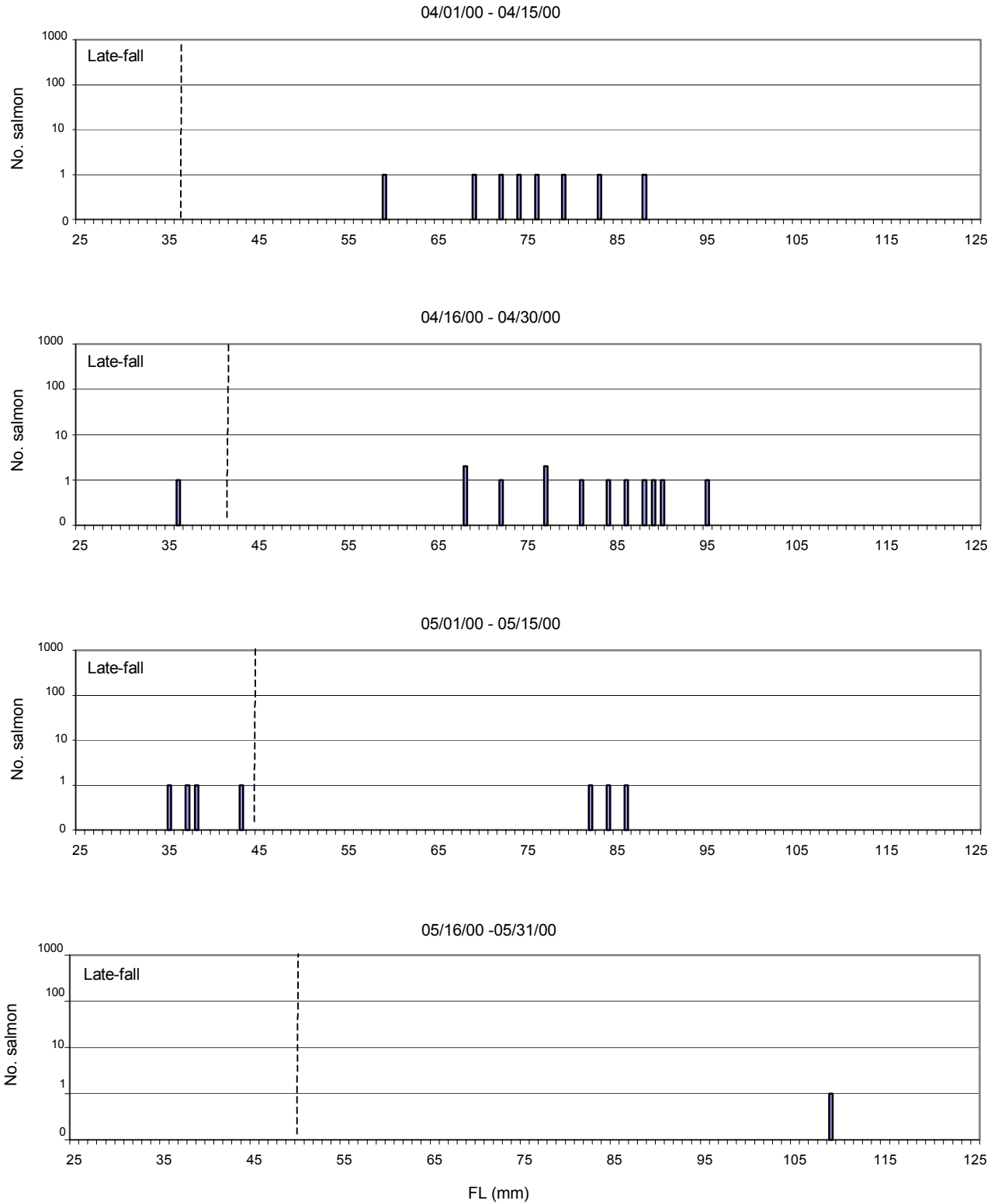
APPENDIX B, FIGURE 4. Frequency distribution of lengths of juvenile chinook salmon caught and released in Big Chico Creek from December 1, 1999 through May 31, 2000. All fish are assumed to be spring-run chinook salmon except where indicated..



APPENDIX B, FIGURE 4. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released in Big Chico Creek from December 1, 1999 through May 31, 2000. All fish are assumed to be spring-run chinook salmon except where indicated.



APPENDIX B, FIGURE 4. (continued) Frequency distribution of lengths of juvenile chinook salmon caught and released in Big Chico Creek from December 1, 1999 through May 31, 2000. All fish are assumed to be spring-run chinook salmon except where indicated.



APPENDIX C, TABLE 1. Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code 06-01-12-02-08							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
2/5/99	36	20	0.15				

Tag code 06-01-12-02-09							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
1/21/99	34	15	0.07	4/2/99	82	86	0.55
2/6/99	48	31	0.42	4/6/99	91	90	0.62
3/24/99	75	77	0.52	4/8/99	88	92	0.58
3/25/99	82	78	0.60	4/20/99	70	104	0.34
3/28/99	74	81	0.48	4/25/99	79	109	0.40
3/29/99	72	82	0.45	4/29/99	82	113	0.42
3/29/99	63	82	0.34	5/11/99	85	125	0.40
3/30/99	98	83	0.76				

Tag code 06-01-12-02-10							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
1/22/99	35	6	0.00	4/5/99	89	79	0.68
1/28/99	40	12	0.42	4/6/99	95	80	0.75
1/28/99	37	12	0.17	4/6/99	82	80	0.59
2/6/99	41	21	0.29	4/6/99	89	80	0.68
2/6/99	40	21	0.24	4/7/99	79	81	0.54
3/24/99	80	67	0.67	4/7/99	89	81	0.67
3/24/99	75	67	0.60	4/7/99	91	81	0.69
3/24/99	81	67	0.69	4/8/99	84	82	0.60
3/25/99	72	68	0.54	4/8/99	52	82	0.21
3/26/99	81	69	0.67	4/9/99	80	83	0.54
3/26/99	74	69	0.57	4/9/99	89	83	0.65
3/28/99	56	71	0.30	4/9/99	74	83	0.47
3/30/99	86	73	0.70	4/10/99	80	84	0.54
3/30/99	79	73	0.60	4/10/99	85	84	0.60
3/31/99	90	74	0.74	4/11/99	84	85	0.58
3/31/99	94	74	0.80	4/12/99	88	86	0.62
4/1/99	98	75	0.84	4/13/99	82	87	0.54
4/1/99	76	75	0.55	4/14/99	76	88	0.47
4/1/99	84	75	0.65	4/14/99	72	88	0.42
4/1/99	82	75	0.63	4/18/99	87	92	0.57
4/2/99	87	76	0.68	4/27/99	84	101	0.49
4/3/99	87	77	0.68	4/29/99	80	103	0.44
4/3/99	89	77	0.70	5/7/99	83	111	0.43
4/4/99	78	78	0.55				

APPENDIX C, TABLE 1(continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code 06-01-12-02-11							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
1/23/99	35	1	0	3/29/99	78	66	0.65
1/24/99	-	2	-	3/29/99	83	66	0.73
1/26/99	37	4	0.50	3/31/99	73	68	0.56
1/26/99	38	4	0.75	4/1/99	69	69	0.49
1/27/99	39	5	0.80	4/2/99	75	70	0.57
1/27/99	38	5	0.60	4/2/99	87	70	0.74
1/27/99	39	5	0.80	4/3/99	78	71	0.61
1/28/99	36	6	0.17	4/5/99	76	73	0.56
1/28/99	34	6	-0.17	4/5/99	79	73	0.60
1/28/99	35	6	0	4/5/99	93	73	0.79
1/30/99	38	8	0.38	4/6/99	74	74	0.53
2/1/99	38	10	0.30	4/6/99	77	74	0.57
2/1/99	39	10	0.40	4/6/99	73	74	0.51
2/2/99	40	11	0.45	4/7/99	77	75	0.56
2/2/99	38	11	0.27	4/7/99	78	75	0.57
2/3/99	40	12	0.42	4/7/99	84	75	0.65
2/3/99	37	12	0.17	4/8/99	79	76	0.58
2/3/99	37	12	0.17	4/8/99	82	76	0.62
2/3/99	38	12	0.25	4/9/99	78	77	0.56
2/4/99	38	13	0.23	4/9/99	86	77	0.66
2/4/99	38	13	0.23	4/10/99	62	78	0.35
2/4/99	35	13	0	4/10/99	83	78	0.62
2/4/99	35	13	0	4/10/99	82	78	0.60
2/4/99	41	13	0.46	4/11/99	76	79	0.52
2/5/99	40	14	0.36	4/11/99	84	79	0.62
2/5/99	39	14	0.29	4/11/99	86	79	0.65
2/5/99	37	14	0.14	4/12/99	78	80	0.54
2/5/99	38	14	0.21	4/13/99	97	81	0.77
2/6/99	38	15	0.20	4/14/99	78	82	0.52
2/6/99	42	15	0.47	4/14/99	87	82	0.63
2/6/99	38	15	0.20	4/16/99	81	83	0.55
2/6/99	36	15	0.70	4/17/99	60	84	0.30
2/6/99	42	15	0.47	4/17/99	82	84	0.56
2/7/99	40	16	0.31	4/18/99	95	85	0.71
3/23/99	58	60	0.38	4/20/99	72	87	0.43
3/24/99	81	61	0.75	4/20/99	70	87	0.40
3/26/99	90	63	0.87	4/21/99	-	88	-
3/27/99	74	64	0.61	4/21/99	-	88	-
3/28/99	92	65	0.88	4/22/99	79	89	0.49
3/28/99	82	65	0.72	4/22/99	93	89	0.65
3/29/99	73	66	0.58	4/30/99	85	97	0.52
3/29/99	65	66	0.45	5/3/99	68	101	0.33
3/29/99	64	66	0.44				

APPENDIX C, TABLE 1(continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code 06-01-12-02-12							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
1/26/99	37	6	0.50	4/2/99	100	72	0.92
1/26/99	36	6	0.33	4/2/99	91	72	0.79
1/26/99	37	6	0.50	4/3/99	86	73	0.71
1/28/99	38	8	0.50	4/5/99	81	75	0.63
1/28/99	37	8	0.38	4/5/99	83	75	0.65
1/28/99	33	8	0.13	4/5/99	88	75	0.72
1/29/99	36	9	0.22	4/6/99	75	76	0.54
1/30/99	38	10	0.40	4/6/99	78	76	0.58
1/30/99	38	10	0.40	4/6/99	89	76	0.72
1/30/99	35	10	0.10	4/6/99	82	76	0.63
1/31/99	37	11	0.27	4/7/99	95	77	0.79
1/31/99	35	11	0.09	4/7/99	84	77	0.65
2/1/99	38	12	0.33	4/7/99	86	77	0.68
2/1/99	38	12	0.33	4/8/99	58	78	0.31
2/2/99	36	13	0.15	4/8/99	60	78	0.33
2/3/99	37	14	0.21	4/8/99	78	78	0.56
2/3/99	38	14	0.29	4/9/99	81	79	0.59
2/4/99	41	15	0.47	4/9/99	85	79	0.65
2/4/99	37	15	0.20	4/9/99	88	79	0.68
2/4/99	41	15	0.47	4/9/99	74	79	0.51
2/4/99	37	15	0.20	4/9/99	76	79	0.53
2/6/99	36	17	0.12	4/9/99	71	79	0.47
2/6/99	37	17	0.18	4/9/99	78	79	0.56
2/6/99	38	17	0.24	4/10/99	89	80	0.69
2/6/99	39	17	0.29	4/10/99	75	80	0.51
2/7/99	39	18	0.28	4/10/99	81	80	0.59
3/23/99	71	62	0.60	4/11/99	91	81	0.70
3/24/99	78	63	0.70	4/11/99	92	81	0.72
3/24/99	70	63	0.57	4/11/99	71	81	0.46
3/25/99	79	64	0.70	4/11/99	78	81	0.54
3/25/99	70	64	0.56	4/11/99	95	81	0.75
3/25/99	62	64	0.44	4/14/99	94	84	0.71
3/25/99	81	64	0.73	4/15/99	90	85	0.66
3/28/99	64	67	0.45	4/15/99	83	85	0.58
3/28/99	80	67	0.69	4/15/99	78	85	0.52
3/28/99	65	67	0.46	4/16/99	98	86	0.74
3/28/99	79	67	0.67	4/18/99	61	88	0.31
3/28/99	85	67	0.76	4/19/99	83	89	0.55
3/28/99	80	67	0.69	4/20/99	77	90	0.48
3/28/99	80	67	0.69	4/20/99	71	90	0.41
3/29/99	78	68	0.65	4/20/99	84	90	0.56
3/29/99	59	68	0.37	4/20/99	65	90	0.34
3/30/99	73	69	0.57	4/22/99	79	92	0.49
3/31/99	75	70	0.59	4/22/99	88	92	0.59
4/1/99	82	71	0.68	5/4/99	-	104	-

APPENDIX C, TABLE 1(continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code 06-01-12-02-13							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
1/27/99	34	3	0.00	3/30/99	70	65	0.55
1/27/99	35	3	0.33	4/1/99	88	67	0.81
1/27/99	38	3	1.33	4/2/99	84	68	0.74
1/28/99	34	4	0.00	4/2/99	85	68	0.75
1/29/99	37	5	0.60	4/3/99	85	69	0.74
1/29/99	36	5	0.40	4/3/99	91	69	0.83
1/30/99	37	6	0.50	4/5/99	77	71	0.61
1/30/99	33	6	0.17	4/5/99	93	71	0.83
1/30/99	37	6	0.50	4/5/99	87	71	0.75
1/31/99	39	7	0.71	4/7/99	95	73	0.84
2/1/99	35	8	0.13	4/7/99	84	73	0.68
2/3/99	36	10	0.20	4/8/99	88	74	0.73
2/4/99	38	11	0.36	4/8/99	80	74	0.62
2/4/99	37	11	0.27	4/8/99	74	74	0.54
2/4/99	39	11	0.45	4/9/99	74	75	0.53
2/5/99	37	12	0.25	4/9/99	80	75	0.61
2/5/99	37	12	0.25	4/11/99	67	77	0.43
2/6/99	38	13	0.31	4/11/99	82	77	0.62
2/6/99	37	13	0.23	4/12/99	79	78	0.58
2/7/99	40	14	0.43	4/12/99	74	78	0.51
3/23/99	80	58	0.79	4/13/99	78	79	0.56
3/24/99	79	89	0.51	4/15/99	69	81	0.43
3/26/99	70	61	0.59	4/15/99	75	81	0.51
3/26/99	69	61	0.57	4/18/99	79	84	0.54
3/27/99	82	62	0.77	4/20/99	83	86	0.57
3/27/99	68	62	0.55	4/22/99	78	88	0.50
3/28/99	71	63	0.59	4/22/99	83	88	0.56
3/29/99	62	64	0.44	4/23/99	78	89	0.49
3/30/99	83	65	0.75	5/8/99	-	104	-

APPENDIX C, TABLE 1(continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code 06-01-12-02-14							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
1/29/99	39	1	4.00	4/3/99	75	63	0.63
1/30/99	37	2	1.00	4/4/99	69	64	0.53
1/31/99	37	3	0.67	4/5/99	76	65	0.63
2/1/99	34	4	0.25	4/6/99	80	66	0.68
2/1/99	36	4	0.25	4/6/99	60	66	0.38
2/2/99	35	5	0.00	4/6/99	74	66	0.59
2/3/99	39	6	0.67	4/6/99	80	66	0.68
2/4/99	36	7	0.14	4/7/99	73	67	0.57
2/4/99	35	7	0.00	4/7/99	72	67	0.55
2/4/99	37	7	0.29	4/8/99	92	68	0.84
2/4/99	36	7	0.14	4/9/99	85	69	0.72
2/5/99	36	8	0.13	4/10/99	80	70	0.64
2/5/99	37	8	0.25	4/10/99	80	70	0.64
2/6/99	36	9	0.11	4/11/99	63	71	0.39
2/6/99	39	9	0.44	4/11/99	77	71	0.59
2/7/99	40	10	0.50	4/12/99	63	72	0.39
2/7/99	41	10	0.60	4/12/99	78	72	0.60
2/7/99	40	10	0.50	4/13/99	66	73	0.42
2/7/99	37	10	0.20	4/14/99	99	74	0.86
3/21/99	80	51	0.88	4/17/99	71	77	0.47
3/23/99	58	53	0.43	4/21/99	-	81	-
3/25/99	86	55	0.93	4/22/99	75	82	0.49
3/27/99	81	56	0.82	4/22/99	79	82	0.54
3/28/99	79	57	0.77	4/23/99	98	83	0.76
3/29/99	77	58	0.72	4/26/99	86	86	0.59
4/3/99	86	63	0.81	5/5/99	83	95	0.51

Tag code 06-01-12-02-15							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
2/8/99	36	-	-	4/14/99	88	59	-
3/25/99	44	39	-	4/16/99	87	61	-
3/25/99	69	39	-	4/21/99	-	66	-
3/30/99	55	44	-	4/25/99	73	70	-
3/30/99	70	44	-	4/26/99	85	71	-
4/5/99	79	50	-	4/28/99	69	73	-
4/8/99	79	53	-	5/2/99	65	77	-
4/11/99	75	56	-	5/11/99	71	86	-

APPENDIX C, TABLE 1(continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code 06-01-12-03-01							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
3/28/99	56	70	-	4/17/99	91	90	-
4/11/99	74	84	-	4/22/99	77	95	-
4/13/99	76	86	-	4/30/99	68	103	-
4/15/99	68	88	-	5/7/99	77	110	-

Tag code 06-01-12-03-02							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
3/29/99	49	19	-	5/4/99	-	55	-
4/12/99	60	33	-	5/11/99	68	62	-
4/17/99	44	38	-	5/11/99	74	62	-
4/20/99	49	41	-	5/13/99	76	64	-
4/21/99	-	42	-	5/15/99	73	66	-
4/22/99	70	43	-	5/16/99	75	67	-
4/28/99	70	49	-	5/25/99	72	76	-

Tag code 06-01-12-03-03							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
4/9/99	53	28	-	5/9/99	65	58	-
4/18/99	70	36	-	5/10/99	73	59	-
5/4/99	-	53	-	5/10/99	66	59	-
5/4/99	-	53	-	5/10/99	65	59	-
5/5/99	64	54	-	5/11/99	79	60	-
5/9/99	70	58	-	5/13/99	72	62	-
5/9/99	67	58	-	5/13/99	76	62	-

Tag code 06-01-12-03-04							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
5/2/99	-	29	-	5/25/99	61	52	-
5/5/99	76	32	-	5/25/99	69	52	-
5/10/99	54	37	-	5/26/99	70	53	-
5/11/99	68	38	-	6/4/99	70	62	-
5/11/99	65	38	-				

Tag code 06-01-12-03-05							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
5/15/99	70	8	-	5/26/99	58	19	-

APPENDIX C, TABLE 1(continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code 06-01-12-03-06							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
6/1/99	75	9	-				

APPENDIX C, Table 2. Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass East Borrow Weir 2. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1998.

Tag code 06-01-12-03-02							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
5/13/99	76	64	-				

Tag code 06-01-12-03-03							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
5/13/99	77	62	-	5/13/99	72	62	-
5/13/99	59	62	-				

Tag code 06-01-12-03-04							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
5/13/99	67	40	-				

Tag code 06-01-12-03-05							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
5/24/99	72	17	-	6/12/99	62	36	-
5/26/99	61	19	-				

Tag code 06-01-12-03-06							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
5/24/99	80	1	-				

APPENDIX C, TABLE 3. Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1999.

Tag code 06-01-12-03-08							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
3/24/00	96	98	0.60	4/6/00	85	111	0.43
3/26/00	91	100	0.54				

Tag code 06-01-12-03-09							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
3/23/00	91	80	0.68	3/25/00	95	82	0.71
3/24/00	99	81	0.77	3/25/00	94	82	0.70
3/24/00	95	81	0.72	3/27/00	83	84	0.55
3/24/00	96	81	0.73	3/27/00	92	84	0.65
3/24/00	97	81	0.74	3/28/00	92	85	0.65
3/25/00	93	82	0.68	3/28/00	82	85	0.53
3/25/00	93	82	0.68	4/6/00	79	94	0.45
3/25/00	95	82	0.71	4/9/00	85	97	0.49
3/25/00	98	82	0.74	4/23/00	93	111	0.50

Tag code 06-01-12-03-10							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
3/23/00	92	69	0.78	3/25/00	96	71	0.82
3/23/00	95	69	0.83	3/26/00	97	72	0.82
3/23/00	95	69	0.83	3/26/00	79	72	0.57
3/24/00	90	70	0.74	3/26/00	81	72	0.60
3/24/00	94	70	0.80	3/26/00	93	72	0.76
3/24/00	93	70	0.79	3/27/00	81	73	0.59
3/24/00	84	70	0.66	3/27/00	96	73	0.79
3/24/00	92	70	0.77	3/27/00	91	73	0.73
3/24/00	105	70	0.96	3/27/00	90	73	0.71
3/24/00	97	70	0.84	3/30/00	86	76	0.63
3/25/00	58	71	0.28	4/1/00	94	78	0.72
3/25/00	93	71	0.33	4/5/00	84	82	0.56
3/25/00	89	71	0.72	4/6/00	79	83	0.49
3/25/00	95	71	0.80	4/7/00	85	84	0.56
3/25/00	92	71	0.76	4/12/00	76	89	0.43
3/25/00	90	71	0.73	4/21/00	84	98	0.47

APPENDIX C, TABLE 3 (continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1999.

Tag code 06-01-12-03-11							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
3/24/00	85	61	0.79	3/27/00	80	64	0.67
3/24/00	84	61	0.75	3/28/00	76	65	0.60
3/24/00	91	61	0.87	3/28/00	88	65	0.78
3/24/00	85	61	0.79	3/28/00	68	65	0.48
3/25/00	86	62	0.79	3/29/00	94	66	0.86
3/25/00	88	62	0.82	3/29/00	89	66	0.79
3/25/00	84	62	0.76	4/6/00	92	74	0.74
3/25/00	94	62	0.92	4/13/00	90	81	0.65
3/25/00	97	62	0.97	4/13/00	85	81	0.59
3/26/00	82	63	0.71	4/13/00	81	81	0.54
3/26/00	81	63	0.70	4/23/00	90	91	0.58
3/26/00	89	63	0.83	4/27/00	95	95	0.61

Tag code 06-01-12-03-12							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
3/20/00	84	48	0.98	4/8/00	86	67	0.73
3/23/00	98	51	1.20	4/8/00	78	67	0.64
3/25/00	76	53	0.74	4/8/00	80	67	0.64
3/26/00	78	54	0.76	4/8/00	82	67	0.67
3/27/00	76	55	0.71	4/9/00	90	68	0.78
3/27/00	85	55	0.87	4/10/00	73	69	0.52
3/28/00	82	56	0.80	4/11/00	84	70	0.67
3/29/00	78	57	0.72	4/12/00	99	71	0.87
3/29/00	79	57	0.74	4/13/00	90	72	0.74
4/1/00	79	60	0.70	4/13/00	80	72	0.60
4/1/00	77	60	0.67	4/13/00	77	72	0.56
4/5/00	71	64	0.53	4/13/00	74	72	0.51
4/5/00	88	64	0.80	4/14/00	79	73	0.58
4/5/00	90	64	0.83	4/15/00	82	74	0.61
4/5/00	84	64	0.73	4/17/00	78	76	0.54
4/6/00	74	65	0.57	4/23/00	103	82	0.80
4/6/00	83	65	0.71	4/25/00	82	84	0.54
4/7/00	73	66	0.55	5/10/00	73	99	0.36

APPENDIX C, TABLE 3 (continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass West Borrow Weir 1. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1999.

Tag code 06-01-12-03-13							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
4/5/00	75	50	0.76	4/13/00	85	58	0.83
4/5/00	66	50	0.58	4/15/00	72	60	0.58
4/5/00	80	50	0.86	4/16/00	76	61	0.64
4/5/00	80	50	0.86	4/17/00	78	62	0.66
4/5/00	62	50	0.50	4/19/00	75	64	0.59
4/6/00	74	51	0.73	4/23/00	86	68	0.72
4/6/00	82	51	0.88	4/23/00	81	68	0.65
4/7/00	86	52	0.94	4/23/00	78	68	0.60
4/8/00	76	53	0.74	4/23/00	73	68	0.53
4/8/00	81	53	0.83	4/24/00	80	69	0.62
4/8/00	77	53	0.75	4/24/00	73	69	0.52
4/11/00	74	56	0.66	4/27/00	81	72	0.61
4/12/00	82	57	0.79	4/30/00	80	75	0.57

Tag code 06-01-12-03-14							
Recovery date	Recovery FL (mm)	d at large	mm/d	Recovery date	Recovery FL (mm)	d at large	mm/d
4/6/00	60	27	0.81	5/9/00	75	60	0.62
4/11/00	62	32	0.75	5/18/00	73	69	0.51
5/5/00	75	56	0.66	5/21/00	61	72	0.32
5/6/00	64	57	0.46				

APPENDIX C, TABLE 4. Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass East Borrow Weir 2. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1999.

Tag code 06-01-12-03-09							
Recovery date	Recovery FL(mm)	d at large	mm/d	Recovery date	Recovery FL(mm)	d at large	mm/d
4/5/00	79	93	0.45	4/22/00	83	110	0.42

Tag code 06-01-12-03-10							
Recovery date	Recovery FL(mm)	d at large	mm/d	Recovery date	Recovery FL(mm)	d at large	mm/d
4/4/00	75	81	0.46	4/5/00	77	82	0.48
4/5/00	71	82	0.40	4/5/00	89	82	0.62
4/5/00	86	82	0.59				

APPENDIX C, TABLE 4 (continued). Recaptures of spring-run chinook salmon bearing coded-wire tags in the Sutter Bypass East Borrow Weir 2. All fish were tagged at Baldwin Construction Yard. All fish were from brood year 1999.

Tag code 06-01-12-03-11							
Recovery date	Recovery FL(mm)	d at large	mm/d	Recovery date	Recovery FL(mm)	d at large	mm/d
4/5/00	75	73	0.52				

Tag code 06-01-12-03-12							
Recovery date	Recovery FL(mm)	d at large	mm/d	Recovery date	Recovery FL(mm)	d at large	mm/d
4/5/00	79	64	0.66	4/8/00	74	67	0.55
4/6/00	80	65	0.66	4/22/00	78	81	0.51
4/8/00	98	67	0.91				

Tag code 06-01-12-03-13							
Recovery date	Recovery FL(mm)	d at large	mm/d	Recovery date	Recovery FL(mm)	d at large	mm/d
4/5/00	68	50	0.62	4/14/00	85	59	0.81
4/5/00	68	50	0.62	4/22/00	77	67	0.60
4/5/00	67	50	0.60	4/25/00	78	70	0.59
4/5/00	75	50	0.76	4/27/00	65	72	0.39
4/6/00	94	51	1.12	4/29/00	75	74	0.51
4/7/00	84	52	0.90				

Tag code 06-01-12-03-14							
Recovery date	Recovery FL(mm)	d at large	mm/d	Recovery date	Recovery FL(mm)	d at large	mm/d
4/13/00	83	34	1.32	5/18/00	69	69	0.45

APPENDIX D, TABLE 1. 1998-1999 Season. Recovery of juvenile chinook salmon tagged and released by USFWS. Salmon were recovered in the Sutter Bypass at Weir 1.

Tag code	Race ¹	Source ⁴	Release Site ⁴	Release date	Avg. FL at release	Recovery date	FL at recovery	Age at large
05-23-16	LFR ²	CNFH	CNFH	12/15/1998	125	3/28/1999	116	104
05-23-17	LFR ²	CNFH	CNFH	12/15/1998	123	3/15/1999	117	91
05-23-17	LFR ²	CNFH	CNFH	12/15/1998	123	3/29/1999	119	105
05-23-10	LFR ²	CNFH	CNFH	1/04/1999	129	3/24/1999	127	80
05-23-13	LFR ²	CNFH	CNFH	1/04/1999	125	3/28/1999	120	84
05-23-15	LFR ²	CNFH	CNFH	1/04/1999	124	3/23/1999	123	79
05-23-15	LFR ²	CNFH	CNFH	1/04/1999	124	3/28/1999	117	84
05-23-18	LFR ²	CNFH	CNFH	1/04/1999	119	3/29/1999	114	85
05-01-02-04-08	FR ³	Wild	RBDD	2/08/1999 to 3/12/1999	38	3/27/1999	71	16-48
05-01-02-04-08	FR ³	Wild	RBDD	2/08 to 3/12/1999	38	3/29/1999	73	18-50
05-01-02-04-08	FR ³	Wild	RBDD	2/08 to 3/12/1999	38	3/04/1999	36	-25
05-01-02-04-08	FR ³	Wild	RBDD	2/08 to 3/12/1999	38	4/12/1999	66	32-64
05-01-02-04-08	FR ³	Wild	RBDD	2/08 to 3/12/1999	38	4/18/1999	81	40-72
05-01-02-04-09	FR ³	Wild	RBDD	1/27/1999 to 2/12/1999	38	3/28/1999	72	45-60
05-01-02-04-09	FR ³	Wild	RBDD	1/27/1999 to 2/12/1999	38	3/30/1999	82	47-62
05-01-02-04-09	FR ³	Wild	RBDD	1/27/1999 to 2/12/1999	38	4/02/1999	77	50-65
05-01-02-04-09	FR ³	Wild	RBDD	1/27/1999 to 2/12/1999	38	4/06/1999	76	54-69
05-01-02-04-09	FR ³	Wild	RBDD	1/27/1999 to 2/12/1999	38	4/06/1999	75	54-69
05-01-02-04-09	FR ³	Wild	RBDD	1/27/1999 to 2/12/1999	38	4/06/1999	86	54-69
05-01-02-04-09	FR ³	Wild	RBDD	1/27/1999 to 2/12/1999	38	4/08/1999	77	56-71
05-01-02-04-09	FR ³	Wild	RBDD	1/27/1999 to 2/12/1999	38	4/16/1999	90	64-79
05-01-02-08-12	WR	LSNFH	LRP	1/28/1999	70	3/25/1999	90	57
05-01-02-08-12	WR	LSNFH	LRP	1/28/1999	70	3/31/1999	97	63
05-01-02-08-15	WR	LSNFH	LRP	1/28/1999	82	3/28/1999	113	60
05-01-02-08-15	WR	LSNFH	LRP	1/28/1999	82	3/28/1999	107	60
05-01-02-09-01	WR	LSNFH	LRP	1/28/1999	76	3/24/1999	97	56
05-01-02-09-01	WR	LSNFH	LRP	1/28/1999	76	3/25/1999	110	57
05-01-02-09-02	WR	LSNFH	LRP	1/28/1999	75	3/23/1999	101	55
05-01-02-09-04	WR	LSNFH	LRP	1/28/1999	88	3/24/1999	123	56
05-01-02-09-04	WR	LSNFH	LRP	1/28/1999	88	3/29/1999	122	61
05-01-02-09-07	WR	LSNFH	LRP	1/28/1999	70	3/14/1999	88	46
05-01-02-09-07	WR	LSNFH	LRP	1/28/1999	70	3/17/1999	85	49
05-01-02-09-07	WR	LSNFH	LRP	1/28/1999	70	3/24/1999	95	56

APPENDIX D, TABLE 1 (continued). 1998-1999 Season. Recovery of juvenile chinook salmon tagged and released by USFWS. Salmon were recovered in the Sutter Bypass at Weir 1.

Tag code	Race ¹	Source ⁴	Release Site ⁴	Release date	Avg. FL at release	Recovery date	FL at recovery	d at large
05-01-02-09-08	WR	LSNFH	LRP	1/28/1999	70	3/26/1999	35	58
05-01-02-09-11	WR	LSNFH	LRP	1/28/1999	74	3/25/1999	100	57
05-01-02-09-13	WR	LSNFH	LRP	1/28/1999	91	3/28/1999	118	60
05-01-02-09-13	WR	LSNFH	LRP	1/28/1999	91	3/29/1999	104	61
05-01-02-09-14	WR	LSNFH	LRP	1/28/1999	89	3/28/1999	113	60
05-01-02-09-14	WR	LSNFH	LRP	1/28/1999	89	3/28/1999	109	60
05-01-02-10-01	WR	LSNFH	LRP	1/28/1999	87	3/28/1999	107	60
05-01-02-08-11	WR	LSNFH	LRP	1/28/1999	82	3/24/1999	104	56
05-01-02-08-11	WR	LSNFH	LRP	1/28/1999	82	3/24/1999	104	56
05-01-02-08-11	WR	LSNFH	LRP	1/28/1999	82	3/25/1999	109	57
05-01-02-08-13	WR	LSNFH	LRP	1/28/1999	74	3/25/1999	109	57
05-01-02-08-13	WR	LSNFH	LRP	1/28/1999	74	3/29/1999	99	61
05-01-02-08-13	WR	LSNFH	LRP	1/28/1999	74	3/29/1999	108	61
05-01-02-08-13	WR	LSNFH	LRP	1/28/1999	74	3/29/1999	105	61
05-01-02-09-05	WR	LSNFH	LRP	1/28/1999	84	3/29/1999	117	61
05-01-02-09-06	WR	LSNFH	LRP	1/28/1999	84	3/24/1999	100	56
05-01-02-09-06	WR	LSNFH	LRP	1/28/1999	84	3/29/1999	102	61
05-01-02-09-09	WR	LSNFH	LRP	1/28/1999	73	3/29/1999	100	61
05-01-02-09-09	WR	LSNFH	LRP	1/28/1999	73	3/29/1999	105	61
05-01-02-09-10	WR	LSNFH	LRP	1/28/1999	84	3/23/1999	125	55
05-01-02-09-10	WR	LSNFH	LRP	1/28/1999	84	3/25/1999	112	57
05-01-02-09-15	WR	LSNFH	LRP	1/28/1999	87	3/28/1999	110	60
05-01-02-10-06	FR	CNFH		3/03/1999	52	3/25/1999	64	23
05-01-02-10-06	FR	CNFH		3/03/1999	52	3/28/1999	62	26
05-01-02-10-06	FR	CNFH		3/03/1999	52	4/05/1999	79	35
05-01-02-10-06	FR	CNFH		3/03/1999	52	4/07/1999	64	37
05-01-02-10-06	FR	CNFH		3/03/1999	52	4/09/1999	77	39

¹ Race designation, LFR = late-fall run chinook salmon, FR = fall run chinook salmon, WR = winter run chinook salmon.

² Released as surrogates for yearling spring run chinook salmon.

³ Fish captured at RBDD in rotary screw trap, marked and released below RBDD.

⁴ Represent various sources of fish and release sites including Coleman National Fish Hatchery on Battle Creek (CNFH), Livingston Stone National Fish Hatchery (LSNFH) on the Sacramento River near Shasta Dam, Red Bluff Diversion Dam (RBDD) on the Sacramento River at Red Bluff, and Lake Redding Park (LRP) on the Sacramento River at Redding.

APPENDIX D, TABLE 2. 1999-2000 Season. Recovery of juvenile chinook salmon tagged and released by USFWS. Salmon were recovered in the Sutter Bypass at Weir #1 except as noted.

Tag code	Race ²	Source ³	Release Site ³	Release date	Avg. FL at release	Recovery date	FL at recovery	d at large
05-01-02-12-06	WR	LSNFH		1/27/2000	74	3/23/2000	103	55
05-01-02-12-15	WR	LSNFH		1/27/2000	96	3/23/2000	122	55
05-01-02-13-02	WR	LSNFH		1/27/2000	98	3/25/2000	114	55
05-01-02-13-05	WR	LSNFH		1/27/2000	89	3/20/2000	114	52
05-01-02-13-08	FR	Wild	RBDD	1/21-28/2000	38	3/25/2000	68	64-57
05-01-02-13-10	FR	Wild	RBDD	2/07-11/2000	38	4/01/2000	66	50-54
05-01-02-13-10 ¹	FR	Wild	RBDD	2/07-11/2000	38	4/04/2000	67	50-54
05-01-02-13-10 ¹	FR	Wild	RBDD	2/07-11/2000	38	4/05/2000	81	53-57
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	3/23/2000	73	18
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	3/24/2000	75	19
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	3/25/2000	68	20
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	3/25/2000	68	20
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	3/25/2000	69	20
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	3/28/2000	82	23
05-01-02-01-01 ¹	FR	CNFH	RBDD	3/06/2000	57	4/11/2000	68	37
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	4/11/2000	84	37
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	4/14/2000	89	40
05-01-02-01-01	FR	CNFH	RBDD	3/06/2000	57	4/14/2000	84	40
05-01-02-14-01 ¹	FR	CNFH	CNFH	4/14/2000	77	4/22/2000	69	9

¹ Salmon recovered at Sutter Bypass Weir #2.

² Race designation, WR = winter run chinook salmon, FR = fall run chinook salmon,

³ Represent various sources of fish and release sites including Coleman National Fish Hatchery on Battle Creek (CNFH), Livingston Stone National Fish Hatchery (LSNFH) on the Sacramento River near Shasta Dam, Red Bluff Diversion Dam (RBDD) on the Sacramento River at Red Bluff, and Lake Redding Park (LRP) on the Sacramento River at Redding.

APPENDIX E. TABLE 1. Butte Creek Species Inventory - Parrott-Phelan Diversion Dam.

Catostomidae

Sacramento sucker (*Catostomus occidentalis*)

Centrarchidae

Bluegill (*Lepomis macrochirus*)

Geen sunfish (*Lepomis cyanellus*)

Largemouth bass (*Micropterus salmoides*)

Redear sunfish (*Lepomis microlophus*)

Smallmouth bass (*Micropterus dolomieu*)

Cottidae

Riffle sculpin (*Cottus gulosus*)

Cyprinidae

California roach (*Hesperoleucus symmetricus*)

Golden shiner (*Notemigonus crysoleucas*)

Hardhead (*Mylopharodon conocephalus*)

Sacramento pikeminnow (*Ptychocheilus grandis*)

Speckled dace (*Rhinichthys osculus*)

Embiotocidae

Tule perch (*Hysterocarpus traski*)

Ictaluridae

Brown bullhead (*Ameiurus nebulosus*)

Petromyzontidae

Pacific lamprey (*Lampetra tridentata*)

River lamprey (*Lampetra ayresi*)

Salmonidae

Chinook salmon (*Oncorhynchus tshawytscha*)

Brown trout (*Salmo trutta*)

Rainbow trout (*Oncorhynchus mykiss*)

APPENDIX E. TABLE 2. Butte Creek Species Inventory - Sutter Bypass

Acipenseridae

Splittail (*Pogonichthys macrolepidotus*)

White sturgeon, (*Acipenser transmontanus*)

Atherinidae

Embiotocidae

Inland silverside (*Menidia beryllina*)

Tule perch (*Hysterocarpus traski*)

Catostomidae

Ictaluridae

Sacramento sucker (*Catostomus occidentalis*)

Black bullhead (*Ameiurus melas*)

Brown bullhead (*Ameiurus nebulosus*)

Channel catfish, (*Ictalurus punctatus*)

White catfish (*Ameiurus catus*)

Yellow bullhead (*Ameiurus natalis*)

Centrarchidae

Black crappie (*Pomoxis nigromaculatus*)

Bluegill (*Lepomis macrochirus*)

Largemouth bass (*Micropterus salmoides*)

Smallmouth bass (*Micropterus dolomieu*)

Green sunfish, (*Lepomis cyanellus*)

Pumpkinseed (*Lepomis gibbosus*)

Redear sunfish, (*Lepomis microlophus*)

Warmouth (*Lepomis gulosus*)

White crappie (*Pomoxis annularis*)

Osmeridae

Wakasagi (*Hypomesus nipponensis*)

Percichthyidae

Striped bass (*Morone saxatilis*)

Clupeidae

Percidae

American shad (*Alosa sapidissima*)

Threadfin shad (*Dorosoma petenense*)

Logperch (*Percina caprodes*)

Cottidae

Petromyzontidae

Sculpin (*Cottus spp.*)

Pacific lamprey (*Lampetra tridentata*)

River lamprey (*Lampetra ayresi*)

Cyprinidae

Poeciliidae

Sacramento blackfish (*Orthodon microlepidotus*)

Western mosquitofish (*Gambusia affinis*)

Carp (*Cyprinus carpio*)

Salmonidae

Fathead minnow (*Pimephales promelas*)

Goldfish (*Carassius auratus*)

Chinook salmon (*Oncorhynchus tshawytscha*)

Golden shiner (*Notemigonus crysoleucas*)

Rainbow trout (*Oncorhynchus mykiss*)

Hitch (*Lavinia exilicauda*)

Red shiner, (*Cyprinella lutrensis*)

Sacramento pikeminnow (*Ptychocheilus grandis*)