LOWER MOKELUMNE RIVER FISHERIES MONITORING PROGRAM 1998–1999

Administered by:

East Bay Municipal Utility District
Fisheries and Wildlife Division
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A Technical Report on

Downstream Migration Monitoring at Woodbridge Dam
During December 1998 through July 1999

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EXECUTIVE SUMMARY

The objective of the East Bay Municipal Utility District's Lower Mokelumne River Fisheries Monitoring Program (monitoring program) is collection of information on the ecology and management of anadromous salmonids and other fishes inhabiting the lower Mokelumne River. This report provides summary data for fishes captured, assessments of the downstream migration of juvenile fall-run chinook salmon and steelhead, and numbers of wild fall-run chinook salmon coded-wire tagged at Woodbridge Dam during 1998-99.

Two rotary screw traps were fished between December 15, 1998 and July 31, 1999 at Woodbridge Dam. Juvenile chinook salmon were the most abundant species captured. Non-native cyprinids (minnows) and centrarchids (sunfishes) and native juvenile Pacific lampreys were the next most abundant fishes. Young-of-the-year fall-run chinook salmon emigration pattern was bimodal with a distinct peak for fry in February and an extended emigration of smolts from April through June. Fry numbers diminished by mid-March. Most fry passing Woodbridge Dam were recently "buttoned-up" (with fully absorbed yolk-sac). The estimated abundance of naturally produced chinook salmon (fry and smolts) was among the highest observed during the past ten years, estimated at 1,535,439 (95% C.I. : 1,143,989 - 2,318,804). Approximately 80% emigrated as fry and 20% as fingerling smolts.

Of 674 steelhead smolts (age 1+) captured from December 1998 through July 1999, 65% were adipose fin clipped. Over 90% of smolt-sized steelhead were captured within one month of the MRFI steelhead smolt release made in December. One hundred sixty-two YOY steelhead were captured from April to July, mostly from June to July. An abundance estimate for YOY steelhead migrating in June and July was approximated at 2,231 (95% C.I.: 1,595 - 4,474). Sixty-one juvenile kokanee salmon, presumed to have passed by Pardee and Camanche Dams, were captured from April to June 1999.

River flows at Woodbridge Dam were about 500 cfs from December 1998 through January 1999. Flood control releases increased flows to a peak of about 2,800 cfs during February followed by a gradual decline to about 1,000 to 1,200 cfs by mid-March. Flows remained at these levels until mid-June then stepped down to around 500 cfs by early July. Daily water temperatures at Woodbridge Dam through the rearing and emigration season varied from 8°C early in the year to 18.5°C in June and July. No distinct associations were observed between the abundance of juvenile salmon emigrants and the range of river flows and water temperatures experienced in 1999. Peak catches of fry were associated with storms and increased turbidity. Fry abundance was coincident with the expected timing of their emergence from the redds peaking in late-January/early-February. Fingerling-sized salmon smolts were observed in the traps after mid-March as in past years. Smolts were abundant from late April through June, with peaks each month during waxing and waning moon phases. During the peak migration period, salmon smolts migrated mostly during the night. Little flow variation occurred during the smolt emigration and no specific conditions appeared to be associated with the patterns of migration.

From January 29 to July 31, 1999, 55,819 naturally produced chinook salmon were captured, coded-wire tagged, and released at Woodbridge Dam. Approximately 35,000 of these were tagged and released as fry or parr and 21,000 as smolts.

I. OBJECTIVES

This report addresses two objectives of East Bay Municipal Utility District's (EBMUD) 1998–99 Lower Mokelumne River Fisheries Monitoring Program:

- Monitor abundance and emigration timing of juvenile fall-run chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), and other fish species within the lower Mokelumne River.

- Coded-wire tag wild chinook salmon fry and smolts migrating past Woodbridge Dam.

These objectives are integral to the ongoing collection of information on the ecology and management of anadromous salmonids in the lower Mokelumne River (Figure 1). Specific tasks performed in support of these program objectives during 1998-99 were:

- Monitor the daily abundance and downstream migration patterns of naturally produced juvenile anadromous salmonids passing the Woodbridge Irrigation District Dam (WIDD).

- Monitor size and condition of emigrating juvenile anadromous salmonids and determine the proportions of juvenile salmon emigrating as fry and as smolts.

- Evaluate juvenile anadromous salmonid emigration patterns related to environmental factors (i.e., stream flow, water temperature, lunar phase, precipitation, water turbidity, and time of day).

- Coded-wire tag (CWT) naturally produced chinook salmon smolts for ongoing assessments of population-level responses to management actions and fishery recruitment of the Mokelumne River fall-run chinook salmon stock.

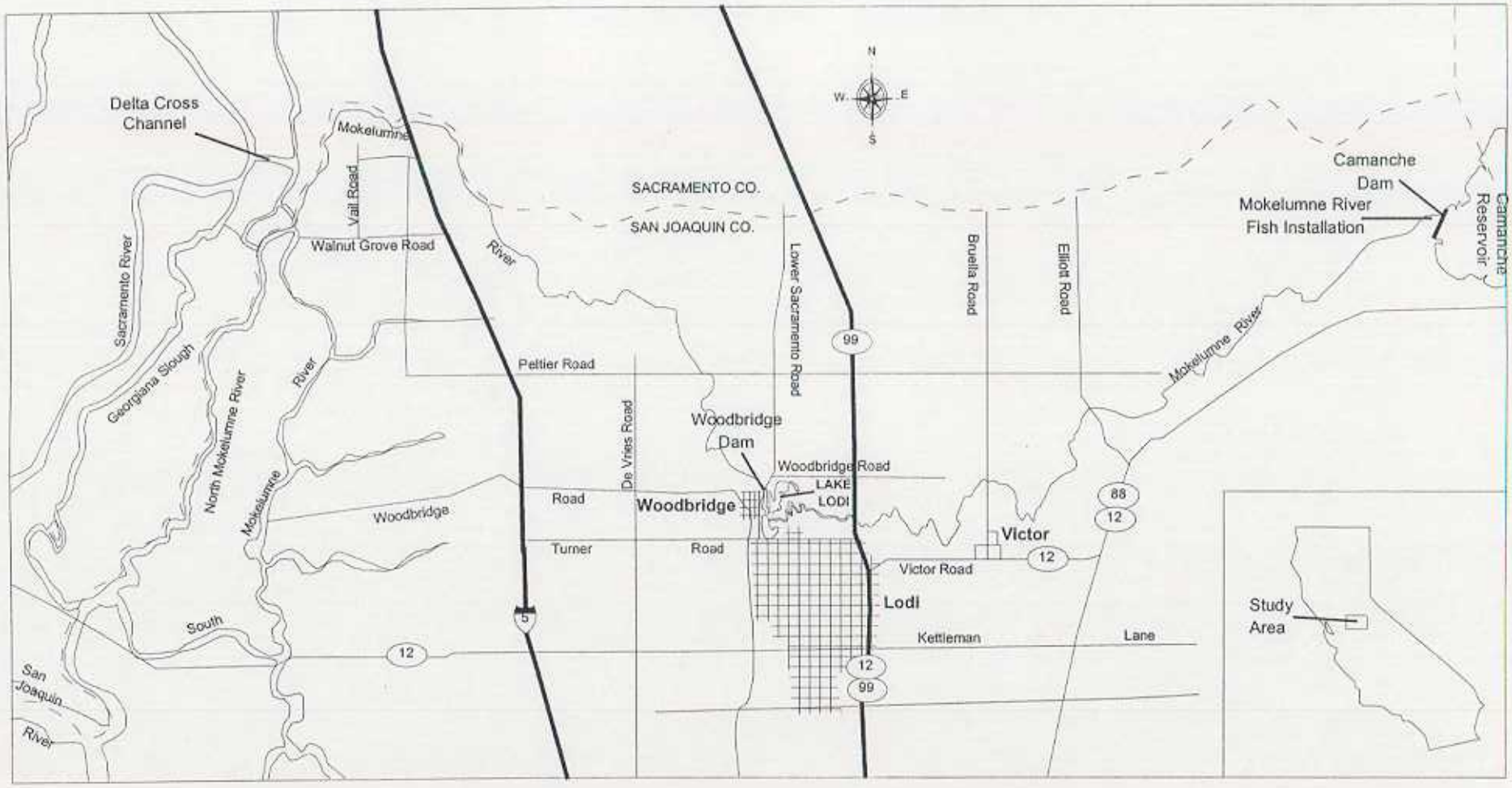

Figure 1. The Mokelumne River from Camanche Dam to its confluence with the San Joaquin River.

II. METHODS

2.1 Downstream Migrant Trapping at Woodbridge Dam

2.1.1 Rotary Screw Fish Traps

Woodbridge Dam has been used as a trapping site for downstream migrant salmonids since inception of EBMUD's Mokelumne River Fisheries Monitoring Program in 1990. This site, about midway between the Delta and Camanche Dam, is downstream of the principal spawning grounds (J. Setka, EBMUD, personal communication). During December 15, 1998 until July 31, 1999, two 2.4-m-diameter rotary screw fish traps were fished in tandem immediately downstream from Woodbridge Dam (Figure 2). The two traps were rigidly connected side by side. The trap suspension and operation system at Woodbridge Dam was similar to that described by Vogel and Marine (1994). When feasible, traps were positioned where the trapping cone rotation could be maintained at a minimum of 4 revolutions per minute.

2.1.2 Fish Handling and Measurements

The fish traps were tended at least twice daily. This was generally done early in the morning and late in the afternoon. During periods of high riverine debris loads and/or large catches of fish, the traps were attended more frequently throughout the day. Fish captured were transferred from the trap live boxes with dip nets to 20-liter (L) buckets filled with fresh river water. To facilitate longer holding times (>15 minutes), aeration was supplied to each bucket by an electric air pump through airstones. Water temperatures were maintained during fish processing by partially immersing buckets in a 100-L fiberglass flow-through holding tank with a flow rate of about 30-L per minute. Fish were sedated in aerated river water with 30 to 50 mg/L of tricaine methane sulfonate[1] buffered *w/w* with sodium bicarbonate. This formulation was selected for rapid and short-term induction of a moderate level of sedation for most of the species captured (Summerfelt and Smith 1990). All fish were identified to species (when possible) and enumerated.

Up to 60 of each salmonid species captured during each trapping period were randomly sampled for measurements of total length (TL) and fork length (FL) in millimeters (mm) and weighed in grams (g) on an Ohaus CT1200 portable balance. Weighing was done in tared beakers of fresh water set on the balance pan. Individual sedated fish were gently blotted on a moist sponge to remove excess water before weighing to ensure measurement of true wet weight. These measurements were recorded along with observations of external disease and injury. All adipose fin-clipped salmon (indicating CWT implants) and salmon otherwise marked that were observed among the fish counted or measured were recorded. After counting and measuring, fish were

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[1]"Finquel" formulation, sold by Argent Chemical Laboratories, Redmond, Washington.

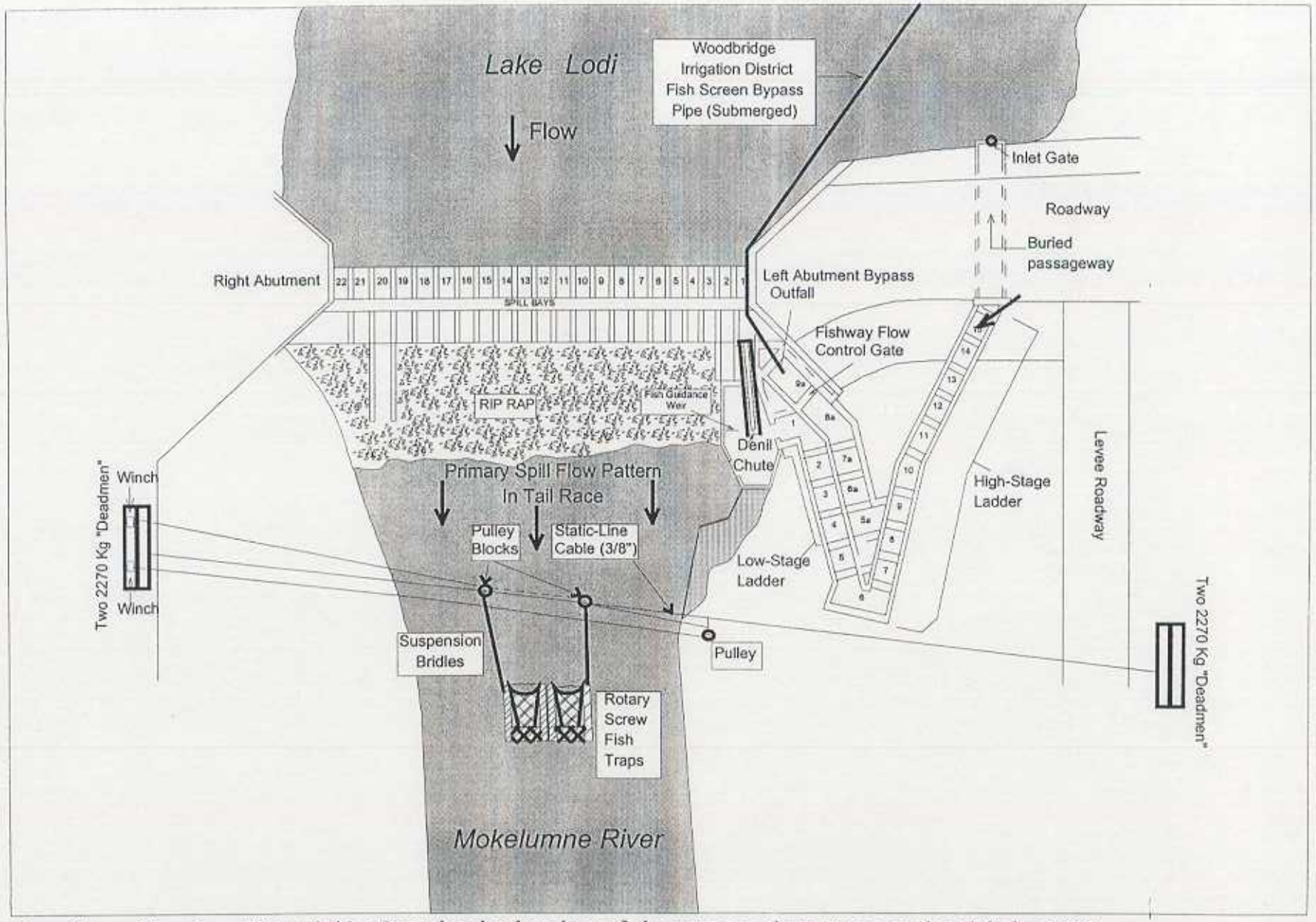

Figure 2. Plan view of Woodbridge Dam showing locations of downstream migrant traps employed during 1999.

gently placed in a 20-L bucket of fresh, aerated river water or in a live car placed in the flow-through tank to recover from sedation before being released downstream of the traps. Total processing time for individual fish from sedation and measurement to recovery and release was generally 15 to 30 minutes.

Surface water temperature was measured with a mercury-filled thermometer, water clarity was measured with a secchi disk, and turbidity samples were collected at the trapping site each time traps were attended. Any other relevant biological or environmental conditions potentially affecting trap performance or fish behavior (*e.g.*, incidence of predators, incidence of poaching, debris loads in traps, changes in river flow, or spill configurations at Woodbridge Dam) were recorded when observed.

2.1.3 Trap Maintenance and Debris Management

A floating debris deflecting boom was installed approximately 4 to 6 meters upstream of the traps in March 1999 after flood risks subsided. Prior to this, tree limbs, floating lumber, and other debris larger than about 40 cm long and 10 cm in diameter entrained into a screw trap usually stopped rotation of the trap. These occurrences required increased trap inspection frequencies and were most common during the stormy winter season and during increases in discharges from Camanche Dam or adjustment of flashboards in Woodbridge Dam. Discarded monofilament fishing line was also a periodic problem especially during episodes of illegal fishing in the vicinity of the dam and traps during the spring and summer months. All debris and fishing line were cleared from the trap at least twice daily and up to four times daily during heavy accumulations.

Algal growth on the perforated rotating cone of the traps was removed by brushing all surfaces as often as twice daily. This algal growth occurred predominantly during the late spring and summer months.

Seals between the interior of the live boxes and the moving parts of the traps were inspected regularly to ensure proper fit and sealing. A vegetable oil-based lubricant was periodically applied to nylon bushings that bear the rotating axle shaft of the trap.

2.1.4 Trap Calibrations for Abundance Estimates

Fish capture efficiency of the rotary screw trap system was measured at twenty-four intervals during the monitoring period to encompass the range of changes in fish sizes, river stage, turbidity, and Woodbridge Dam spill conditions. Hatchery-reared (Mokelumne River origin) and wild juvenile salmon were used for 23 of these mark-recapture tests. Hatchery-reared steelhead (from MRFI) were used in one test. All hatchery-reared fish used were marked with a caudal fin clip. Wild fish used for this assessment were subsampled from those adipose fin-clipped and coded-wire tagged for another task of this investigation. Caudal fin clips were made by excising a small portion (≤1mm) of the upper or lower lobe of the caudal fin while the fish were sedated

(*ca.* 70 to 100 mg/L tricaine solution). Fish were allowed to recover in cylindrical 25-L PVC live cars (30 cm diameter, 40 cm long with soft nylon 2-mm Delta mesh covered ends) placed in a protected refuge in the low-stage fishway for 6 to 24 hours before their release for the tests. A sample of 30 to 50 fish from each release group was measured for FL and examined for mark quality before release.

Paired test releases, one during daylight (1-hour after sunrise to 1-hour before sunset) and one during night time (½-hour after sunset to ½-hour before sunrise), were generally made for each trap efficiency measurement interval. Marked fish were released at the crest of the spill over flashboards on Woodbridge Dam, or near the fishway discharge (Figure 2). Fish released into the spill crest were liberated on the spill crest's falling portion so that none escaped upstream into Lake Lodi. These release groups were divided into four or five groups of approximately equal sublots and released across the entire width of the dam's spillway. The hydraulic head differential between the upstream and downstream side of the dam ranged from zero to about 2.5m. We assumed that the release distance from the trap and the spill configuration of the dam's discharge allowed fish to seek a preferred portion, or natural migration route, or to mix to a homogeneous distribution within the river flow before encountering the traps.

Standard mark-recapture ratios, m/M, where m = number of marked fish recaptured, and M = number of marked fish released, were used as measurements of trapping efficiency (TE).

2.2 Abundance and Timing of Emigration

The numbers of each salmonid species within each age class captured were stratified by day and night and compiled daily. Morning (night) and afternoon (day) trap capture numbers were combined to provide daily totals. Daily counts were compiled into weekly totals for several analyses. Outmigrant young-of-year (YOY) chinook salmon and steelhead abundance estimates were generated from trapping efficiency results. Diurnal (A_d)and nocturnal (A_n)abundances were estimated daily using the day and night trap efficiency rates, respectively, and summed to produce daily total abundances (A_T) as follows:

$$A_d = C_d/TE_d \text{ and; } A_n = C_n/TE_n$$

where, C_d and C_n are day and night trap catches, respectively; and, TE_d and TE_n are day and night trap efficiency estimates, respectively.

So,

$$A_T = A_d + A_n.$$

For each day, nocturnal abundance estimates included fish passing during the full darkness and the crepuscular periods (dusk and dawn) of the preceding night; and, diurnal abundance estimates included fish passing during full daylight, generally 1 to 2 hours after sunrise until 1 to 3 hours before sunset.

Confidence intervals for each day and night abundance estimate were generated using the upper and lower 95% confidence limits approximated from a binomial distribution for each trap efficiency used. Ninety-five percent confidence limits for trapping efficiency estimates were computed as,

lower 95% confidence limit for $TE_{(p)}$, $(LCL_{(p)}) = TE_{(p)} - 1.96\sqrt{[TE_{(p)}(1-TE_{(p)})/M_{(p)})]}$; and

upper 95% confidence limit for $TE_{(p)}$, $(UCL_{(p)}) = TE_{(p)} + 1.96\sqrt{[TE_{(p)}(1-TE_{(p)})/M_{(p)})]}$,

where, *estimated variance of* $TE_{(p)} = [TE_{(p)}(1-TE_{(p)})/M_{(p)})]$;

the subscript p notation refers to a specific diel period, day or night. Therefore, low and high values of the confidence interval for each abundance estimate were computed as,

$$A_{low(p)} = C_{(p)}/UCL_{(p)} \text{ and; } A_{high(p)} = C_{(p)}/LCL_{(p)}, \text{ respectively.}$$

Rotary trap abundance estimates were summed with the numbers of salmon captured in the fishway-installed downstream migrant traps to generate daily abundance estimates for years when these traps were operated.

2.3 Fish Size and Condition

Sizes (FL, TL) and weights of fish were obtained from subsamples of up to 60 for salmonids and 15 for non-salmonids each day. Fulton's Condition Factor, given as (100 x weight/TL^3) by Bagenal and Tesch (1978), where weight is in grams and TL is in millimeters, was computed for the salmonids. Daily and weekly averages for FL, TL, weight, and condition factors were computed and analyzed. Salmon fry were classified as those with FL≤50 mm based on a general size criterion for ocean-type chinook salmon throughout their range (Healy 1991). Classification of other juvenile life stages generally followed that provided by CVPIA's Comprehensive Assessment and Monitoring Program draft protocols (USFWS 1997). The parr stage was characterized as salmon between about 50 mm and 70 mm FL with distinctive parr markings and robust body form. Smolt stage salmon were characterized as salmon greater than 50 mm FL with a distinct silvery appearance, faint or indistinct parr markings, easily dislodged scales, and a more slender body form than the parr. Steelhead life stages were similarly characterized as to appearance, but within the following size ranges: FL ≤50 mm for fry, 50 mm<FL≤200 mm for parr, and FL≥150 mm for smolts. Discrimination between parr and smolts within their overlapping size ranges was made using the external morphological characteristics.

Injuries on trapped fish were described, recorded, and compiled daily, as well as the numbers of dead fish found in the traps. Incidents of injury and mortality were examined with regard to effects of predators, debris fouling of the traps, and other conditions that may have contributed to their occurrence.

2.4 Physical Environmental Data

Daily environmental data for the period December 1998 through July 1999 were obtained from the following sources:

- River Flow passing Woodbridge Dam: U.S. Geological Survey (USGS) gauging station (11325500) on the Mokelumne River located downstream of Woodbridge Dam near River Kilometer 60.

- WID's Canal Diversions: USGS gauging station (11325000) located in the canal near the point of diversion at Woodbridge, California.

- Local Watershed Precipitation: National Weather Service field data collection station at Camanche Dam, San Joaquin County, California; and a Campbell Scientific Instruments meteorological datalogger[2] at Woodbridge, California.

- River Temperature at Woodbridge Dam: Ryan Model RTM 2000 thermograph[3] installed in pool No. 6a of the low-stage fishway or pool No.15 of the high-stage fishway and surface temperatures generally measured twice daily, in the morning and in the afternoon, with a mercury-filled thermometer.

- Water Turbidity: Secchi depth visibility measured twice daily in the river channel off downstream end of screw traps, or in Lake Lodi immediately upstream from spillbay 1 at Woodbridge Dam. Turbidity, in nephelometric tubidity units (NTU), was measured using a Hach® turbidimeter on water samples collected twice daily at Woodbridge Dam.

- Lunar Age and Regional Sunrise/Sunset Timing: *1998/1999 Old Farmer's Almanac*, Yankee Publishing Inc., Dublin, New Hampshire.

- Sacramento-San Joaquin Delta Water Conditions: U.S. Bureau of Reclamation, Central Valley Operations Coordinating Office, Sacramento, California and California Department of Water Resources, Sacramento, California.

2.5 Coded-Wire Tagging of Wild Juvenile Salmon at Woodbridge Dam Trap Site

Naturally produced juvenile salmon >36 mm FL captured in the traps were coded wire tagged from January 25 through July, 1999. A 3-meter long Wells Cargo® trailer outfitted with two

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[2]Campbell Scientific Instruments, Inc., Logan, Utah

[3]Ryan Instruments Inc., Redmond, Washington

marking stations, each with a NMT[4] Mark IV tagging machine, quality control device (QCD), and recirculating anesthetic bath, and a flow-through fiberglass holding tank supplied with pumped river water was stationed at the trapping site. Fish were tagged with 1 mm (full tag) or ½ mm (half tag) binary CWTs (microtags) injected by the tagging machine into the head cartilage and marked by excision of the adipose fin using Miltex® fine-tipped surgical scissors. Fish were handled, as previously described for fish handling and measurement, with the additional procedures of injecting CWTs, excision of the adipose fin, and passing fish through a QCD or field microtag detector to ensure tag implantation before their placement into a recovery tank of fresh, flowing river water. After recovery, fish were released approximately 100 m downstream from the trap.

The quality of tagging and latent mortality associated with handling during tagging were assessed at eleven intervals. Approximately, 30 tagged fish were placed in 25 L PVC live cars (previously described) at densities of about 10 fish per live car and held in a protected area of the fishway for 5 to 7 days. The live cars were checked daily for mortalities. At the end of the holding period, all fish were mildly sedated with tricaine (*ca.* 30 to 50 mg/l), examined for quality of the adipose fin clip, and passed through the microtag detector to confirm tag retention. After this procedure, all fish were released as previously described.

2.6 Coded-Wire Tag Summaries and Assessment

Data for wild tagged fish included initial numbers of fish tagged, tag retention, post-tagging mortality, size of fish at time of release, dates of release and release objectives. These data were submitted to CDFG in their reporting format during August 1999. Tagging data for wild salmon marked as part of Task 2 are presented in this report.

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[4]Northwest Marine Technologies, Shaw Island, Washington.

III. RESULTS AND DISCUSSION

3.1 Fish Abundances Monitored at Woodbridge Dam

3.1.1 Numbers of Fish Trapped

Trapping was conducted from December 15, 1998 until July 31, 1999 at Woodbridge Dam. Appendices A and B provide daily records of traps used, trapping effort, and the numbers of juvenile fall-run chinook salmon and steelhead captured. Table 1 shows the monthly frequencies for thirty-two species captured at Woodbridge Dam. Juvenile chinook salmon were the most abundant species. Non-native cyprinids (minnow family) and centrarchids (sunfish family), and native Pacific lamprey (*Lampetra tridentata*) and prickly sculpin (*Cottus asper*), were the most abunadant non-salmonid species. In general, juveniles of the species captured dominated the catch. But, some adults of the smaller sized species, such as prickly sculpin, golden shiner (*Notemigonus crysoleucas*), and the smaller sunfishes were also frequently captured. Relatively large numbers of age 1+ steelhead were captured during December after MRFI made releases downstream of Woodbridge Dam. Few age 1+ steelhead were captured after December. Sixty-five percent of all yearling steelhead captured had clipped adipose fins indicating their hatchery origin.

Trapping mortality of salmon fry was high (20 to 50%) on several days in February during rising river flows and excessive debris accumulations in the traps (Appendix A). Overall, trapping mortality was typically less than 1%.

3.1.2 Abundance Estimates for Downstream Migrant Juvenile Salmonids

Abundance estimates for YOY fall-run chinook salmon were based on 23 trap calibration intervals during the season (Table 2). Sixteen of nineteen paired day and night trap efficiency tests resulted in significantly different (Chi-square, 1 *df*, $\alpha \leq 0.05$) day versus night trap efficiencies. When diel efficiencies were different, traps were more efficient during the day for fry (FL$\leq$50mm) and during the night for smolts (FL>50mm). So, daily abundance estimates were stratified by day and night time periods for computations.

Abundance of YOY steelhead was estimated for June and July based on a modest increase in the numbers trapped during these months. Trapping efficiency for YOY steelhead was tested once in July using hatchery reared steelhead from MRFI (Table 2). Similar to salmon for this period, trap efficiency for steelhead was signficantly greater at night. However, the efficiency values for steelhead were significantly different from those for salmon (Chi-square, 1 *df*, $\alpha \leq 0.05$). Therefore, daily steelhead abundance estimates for June and July were based on its species specific trap efficiency and stratified by day and night.

Table 1. Numbers of each fish species captured at the Woodbridge Dam trap site from December 16, 1998 through July 31, 1999.

Species	Life Stage	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Chinook Salmon (*Oncorhynchus tshawytscha*)	YOY	59	862	40,295	9,655	3,706	9,320	3,579	104
	Age 1+	3	7	2	5	3	0	0	0
Rainbow Trout/Steelhead (*Oncorhynchus mykiss*)	YOY	0	0	0	0	2	8	95	57
	Age 1+	545	72	15	6	21	8	5	2
	adipose-fin clipped	354	63	10	1	5	1	1	1
Kokanee (*Oncorhynchus nerka kennerlyi*)	Juvenile	0	0	0	0	24	32	5	0
Brook Trout (*Salvelinus fontinalis*)	Adult	0	1	0	0	0	0	0	0
Pacific Lamprey (*Lampetra tridentata*)	Juvenile	2	22	1,463	90	64	31	8	3
	Adult	0	0	0	0	4	6	4	2
Sacramento Sucker (*Catostomus occidentalis*)	Juvenile	1	1	1	1	0	0	1	2
Bluegill (*Lepomis macrochirus*)	Juvenile	15	8	29	267	5	3	2	0
	Adult	17	10	8	16	22	15	8	7
Largemouth Bass (*Micropterus salmoides*)	Juvenile	0	0	0	0	0	16	16	0
	Adult	1	1	0	0	2	1	0	1
Striped Bass (*Morone saxatilis*)	Juvenile	0	0	0	0	0	0	0	1
	Adult	0	0	0	0	0	1	8	0
Spotted Bass (*Micropterus punctulatus*)	Juvenile	4	4	6	3	0	54	417	142
	Adult	2	1	0	0	0	2	0	0
Redear Sunfish (*Lepomis microlophus*)	Juvenile	1	0	1	0	0	0	1	0
	Adult	3	0	0	1	7	15	4	1
Green Sunfish (*Lepomis cyanellus*)	Juvenile	0	0	0	1	0	0	0	0
	Adult	0	0	0	1	0	0	1	0
Prickly Sculpin (*Cottus asper*)	Juvenile	9	38	43	167	70	102	1,531	214
	Adult	11	29	33	90	24	6	1	0
Black Crappie (*Pomoxis nigromaculatus*)	Juvenile	12	16	9	6	0	0	0	0
	Adult	2	2	0	1	1	1	1	0

Table 1. Numbers of each fish species captured at the Woodbridge Dam trap site from December 16, 1998 through July 31, 1999 (continued).

Species	Life Stage	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Channel Catfish (*Ictalurus punctatus*)	Juvenile	1	0	0	1	1	0	1	0
White Catfish (*Ameiurus catus*)	Juvenile	0	0	1	3	2	1	1	2
	Adult	0	0	0	0	1	0	0	0
Brown Bullhead (*Ameiurus nebulosus*)	Juvenile	0	0	0	0	0	1	0	0
	Adult	0	0	0	1	0	0	0	0
Black Bullhead (*Ameiurus melas*)	Juvenile	0	1	0	0	0	0	0	0
Carp (*Cyprinus carpio*)	Juvenile	2	5	0	1	0	0	10	3
	Adult	0	1	1	0	0	0	0	0
Golden Shiner (*Notemigonus crysoleucas*)	Juvenile	31	44	15	5	10	1	2	8
	Adult	2	9	6	0	2	3	1	1
Hitch (*Lavinia exilicauda*)	Juvenile	22	159	23	3	8	1	2	38
	Adult	2	2	3	1	0	0	5	0
Sacramento Blackfish (*Orthodon microlepidotus*)	Adult	0	0	0	0	1	0	0	0
Threadfin Shad (*Dorosoma petenense*)	Juvenile	0	0	3	0	0	0	0	0
	Adult	0	0	0	0	1	1	0	0
Bigscale Logperch (*Percina macrolepida*)	Adult	0	1	0	1	0	0	0	0
Tule Perch (*Hysterocarpus traski*)	Juvenile	0	0	0	1	0	1	0	0
	Adult	1	1	0	5	2	3	3	0
Mosquitofish (*Gambusia affinis*)	Juvenile	1	0	1	1	0	0	0	0
	Adult	0	0	3	1	0	0	0	0
Unknown Smelt (*Hypomesus sp.*)	Adult	1	0	1	6	0	0	0	0

Table 2. Trap efficiency test results for tandem rotary screw traps fished at Woodbridge Dam during December 1998 through July 1999.

Date of Test	Purpose	Numbers of Marked Fish-Day		Numbers of Marked Fish-Night		Chi-Square	Avg. Fork Length	Trap Efficiency		River Flow	Water Temp.	Turbidity	No. Traps
		Released	Recaptured	Released	Recaptured	day vs. night	(mm)	Day	Night	(cfs)	(deg. C)	(NTU)	
01/07/99	D/N differential	490	177	459	96	26.8 (p<0.001)	37.2	0.361	0.209	550	8.4	3.68	2
01/09/99	D/N differential	430	164	439	101	23.4 (p<0.001)	38.4	0.381	0.230	544	8.3	3.00	2
01/22/99	D/N differential	329	72	397	127	9.4 (p<0.01)	36.8	0.219	0.320	455	10.1	3.17	2
02/04/99	D/N wild fish	543	80	646	43	20.9 (p<0.001)	36.5	0.147	0.067	712	9.3	5.37	2
02/13/99	D/N differential	507	37	498	9	17.2 (p<0.001)	39.0	0.073	0.018	2,830	9.3	7.47	2
02/23/99	D/N differential	659	26	549	17	0.6 (NS)	43.9	0.039	0.031	2,840	9.4	10.27	2
03/18/99	D/N differential	400	102	399	43	29.3 (p<0.001)	51.6	0.255	0.108	1,180	10.3	5.08	2
03/26/99	D/N differential	415	90	417	48	15.6 (p<0.001)	53.0	0.217	0.115	1,150	10.8	4.29	2
04/02/99	D/N differential	412	55	407	37	3.7 (p<0.05)	53.2	0.133	0.091	1,110	10.9	3.12	2
04/22/99	D/N differential	414	54	407	32	5.9 (p<0.025)	73.4	0.130	0.079	1,000	13.0	3.41	2
05/04/99	(N) wild@fishway	n/a	n/a	*(192)*	*7*	n/a	78.3	n/a	***0.036***	994	11.8	5.01	2
05/07/99	D/N differential	418	51	428	38	2.5 (NS)	72.6	0.122	0.089	976	13.5	3.82	2
05/09/99	D/N @fishway	***224***	***3***	*(214)*	*1*	0.9 (NS)	85.8	***0.013***	***0.005***	967	13.1	2.75	2
05/15/99	D/N differential	414	28	415	15	4.1 (p<0.05)	84.0	0.068	0.036	907	13.4	2.48	2
05/19/99	D/N differential	416	21	417	42	7.6 (p<0.01)	88.4	0.050	0.101	904	14.1	3.13	2
05/21/99	(N) fishway differentia	*(205)*	*4*	411	28	***6.6 (p<0.01)***	91.8	***0.020***	0.068	910	13.9	3.16	2
05/26/99	(N) fishway differentia	*(209)*	*14*	365	35	***1.4 (NS)***	94.7	***0.067***	0.096	909	14.7	3.06	2
06/03/99	(N) fishway differentia	*(218)*	*27*	444	54	***0.01 (NS)***	78.0	***0.124***	0.122	909	14.4	2.90	2
06/10/99	D/N differential	358	11	415	53	23.7 (p<0.001)	82.4	0.031	0.128	928	14.8	2.87	2
06/17/99	D/N differential	397	2	414	41	35.6 (p<0.001)	86.0	0.005	0.099	697	15.8	3.05	2
06/24/99	D/N differential	416	0	409	40	43.0 (p<0.001)	91.3	0.000	0.098	644	17.1	2.19	2
07/04/99	D/N differential	427	1	435	10	7.1 (p<0.01)	94.5	0.002	0.023	494	16.4	2.47	2
07/05/99	STH verification	421	7	426	38	22.2 (p<0.001)	61.3	0.017	0.089	505	15.8	2.48	2
07/19/99	D/N differential	393	1	423	42	38.1 (p<0.001)	118.9	0.003	0.099	469	16.1	2.25	2

Notes: Abbreviations: (D) - Day, (N) - Night, STH - steelhead, p - statistical probability, (NS) - statistical nonsignificance
Recapture period includes two trapping intervals following release (approximately 24h).
Average turbidity, water temperatures, and stream flows at Woodbridge Dam are for the 24h period following the marked fish release.
Test dates and results shown in bold italics include non-standard marked fish releases at the fishway discharge. Releases in bold italics and parentheses were made at night in the fishway discharge, including those shown for 5/21, 5/26, and 6/03 under the "Day" columns. Chi-square tests for these dates compare fishway vs. spillway passage results at night. Tests evaluated fish distribution assumptions and allowed for trap position adjustments.

Average trapping efficiencies for YOY salmon were computed for relatively homogeneous time intervals when multiple tests were performed. A time interval was considered homogeneous when river flow, turbidity, spill configuration, fish size, number of traps in service, and observations of predators did not change appreciably. Trap efficiency tests were applied as shown in Table 3.

Table 3. Monitoring intervals and 95% confidence limits for trap efficiencies used to estimate abundance of YOY fall-run chinook salmon and steelhead emigrating from the Mokelumne River during December 1998 through July 1999.

Trapping Period	Test Nos. Used	Overall Trapping Efficiencies (95% C.I.)		River Flows (cfs)
		Day	Night	
Chinook Salmon				
12/15/98 - 02/02/99	1, 2, 3	0.331 (0.305-0.357)	0.250 (0.226-0.274)	439 - 608
02/03/99 - 02/08/99	4	0.147 (0.117-0.177)	0.067 (0.048-0.086)	624 - 860
02/09/99 - 03/10/99	5, 6	0.054 (0.041-0.067)	0.025 (0.016-0.034)	1,670 - 2,900
03/11/99 - 03/31/99	7, 8	0.236 (0.207-0.265)	0.112 (0.090-0.134)	1,000 - 1,820
04/01/99 - 04/11/99	9	0.133 (0.100-0.166)	0.091 (0.063-0.119)	1,000 - 1,120
04/12/99 - 05/13/99	10, 12	0.126 (0.103-0.149)	0.084 (0.065-0.103)	923 - 1,110
05/14/99 - 05/31/99	14, 15, 16(n), 17(n)	0.059 (0.051-0.067)	0.074 (0.067-0.081)	897 - 918
06/01/99 - 06/15/99	18(n), 19	0.031 (0.013-0.049)	0.125 (0.118-0.132)	688 - 934
06/16/99 - 06/30/99	20, 21	0.002 (<0.001-0.005)	0.098 (0.078-0.118)	640 - 700
07/01/99 - 07/31/99	20, 21, 22(d), 24	0.002 (<0.001-0.004)	0.099 (0.082-0.116)	452 - 644
Steelhead				
06/01/99 - 07/31/99	23	0.017 (0.005-0.029)	0.089 (0.062-0.116)	452 - 934
(n) - night only values used; (d) - day only values used.				

Each day's diurnal and nocturnal abundance estimates and associated 95% confidence intervals were summed to produce daily total juvenile salmonid abundances and confidence intervals. The daily diurnal and nocturnal estimates of abundance, associated mean trap efficiencies, and periods of estimation used to compute the overall abundance estimates are provided in Appendices C-1 and C-2. Daily abundance estimates should be considered indices of relative abundance for salmon and steelhead outmigrating past Woodbridge Dam (versus passing the rotary trap location), since all trap efficiencies are determined from marked fish released along the spill and fishway discharge of the dam.

From December 16, 1998 through July 31, 1999, an estimate of 1,535,439 naturally produced YOY chinook salmon passed the Woodbridge Dam trap site. The 95% confidence interval for

this abundance estimate ranged from 1,143,989 to 2,318,804. Young-of-year steelhead were observed infrequently and in low numbers from April through May; however, numbers increased modestly during June and July allowing estimates of their abundance. Approximately, 2,231 (95% C.I.: 1,595 - 4,474) YOY steelhead were estimated to migrate past Woodbridge Dam during June and July 1999 (Appendix C-2).

3.2 Timing of the Downstream Migration of Juvenile Salmonids

Juvenile fall-run chinook salmon (BY98) exhibited a bimodal pattern of emigration in the lower Mokelumne River during 1999 (Figures 3 and 4). Fry (FL≤50mm) migrated in substantial numbers past Woodbridge Dam during February and early March followed by relatively few fish from mid-March through April. Larger juvenile salmon were observed to start emigrating around the first of April. These juvenile salmon were composed almost exclusively of smolts (FL>50mm, very silver in coloration with fading parr markings) suggesting the beginning of a purposeful smolt emigration (Figure 5). This rapid switch from fry to smolt migrants in early April has been observed for Mokelumne River fall-run chinook salmon during recent years (Vogel and Marine 1994, 1996, 1998a,b, 1999a,b).

Abundance estimates indicate that about 80 percent of the BY98 natural production emigrated as fry during 1999. Similar proportions of fry emigrants were observed in 1997 and 1998. Prior to 1997, proportions of outmigrating fry were lower (Vogel and Marine 1999)[5]. The fry migration period, occurring principally during the latter part of January through March, was comparable to that observed in previous years (Vogel and Marine 1999a,b). It is common to observe some proportion of a juvenile chinook salmon population to disperse downstream from the spawning grounds shortly after emergence (Healey 1991, Kjelson *et al.* 1982). Temporally bimodal fry-smolt emigration patterns are characteristic of ocean-type chinook salmon populations, especially in rivers with productive estuaries (Healey 1991). Hydrologic conditions have been observed to have a great influence on the magnitude of the fry emigration in the Sacramento River with a greater proportion of fry emigrating from upstream river reaches during wet winters with high river flows than during drier years (Vogel *et al.* 1988). However, the destiny of these early migrating fry varies among populations, according to Healey (1991); while some migrate directly to estuaries, others may simply relocate to other suitable freshwater habitat along the river's length.

Yearling-sized chinook salmon were captured and observed at Woodbridge Dam during December 1998 through April 1999, although not in any significant abundance (Table 1). These fish all appeared to be residualized hatchery reared fall-run chinook salmon that were released in October 1999. Juvenile *O. mykiss* (steelhead/rainbow trout) were not very common at any time during the season except during a one month period following the release of hatchery-reared

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[5]Downstream migrant trapping has begun on different dates among years. However, since traps were operating by mid-January in most years, and fry are not very abundant until after mid-January in years with early trapping data, we believe comparisons of relative fry abundance between most years can be made with appropriate qualification.

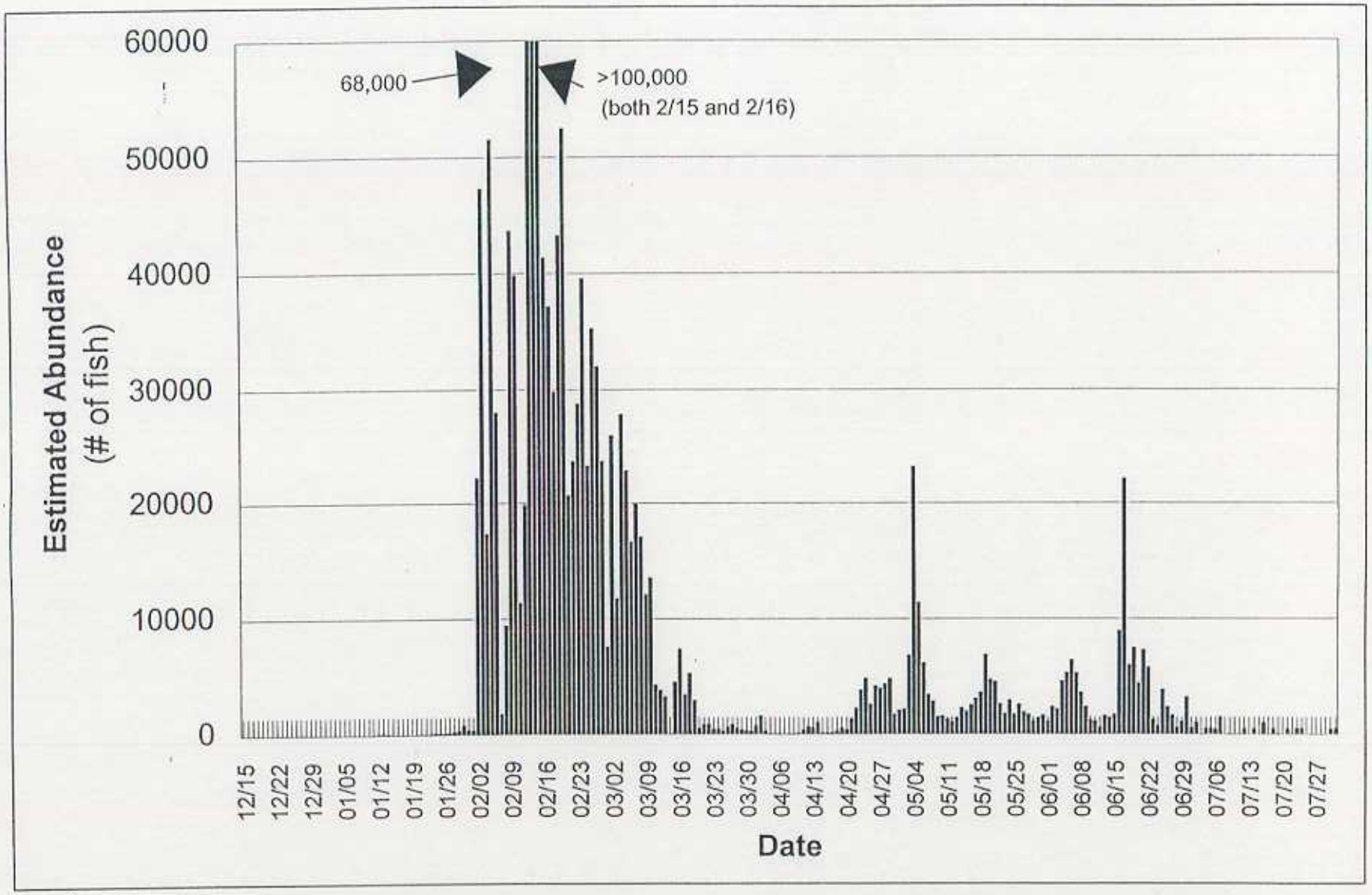

Figure 3. Estimated daily abundance of YOY fall-run chinook salmon passing Woodbridge Dam from December 16, 1998 through July 31, 1999.

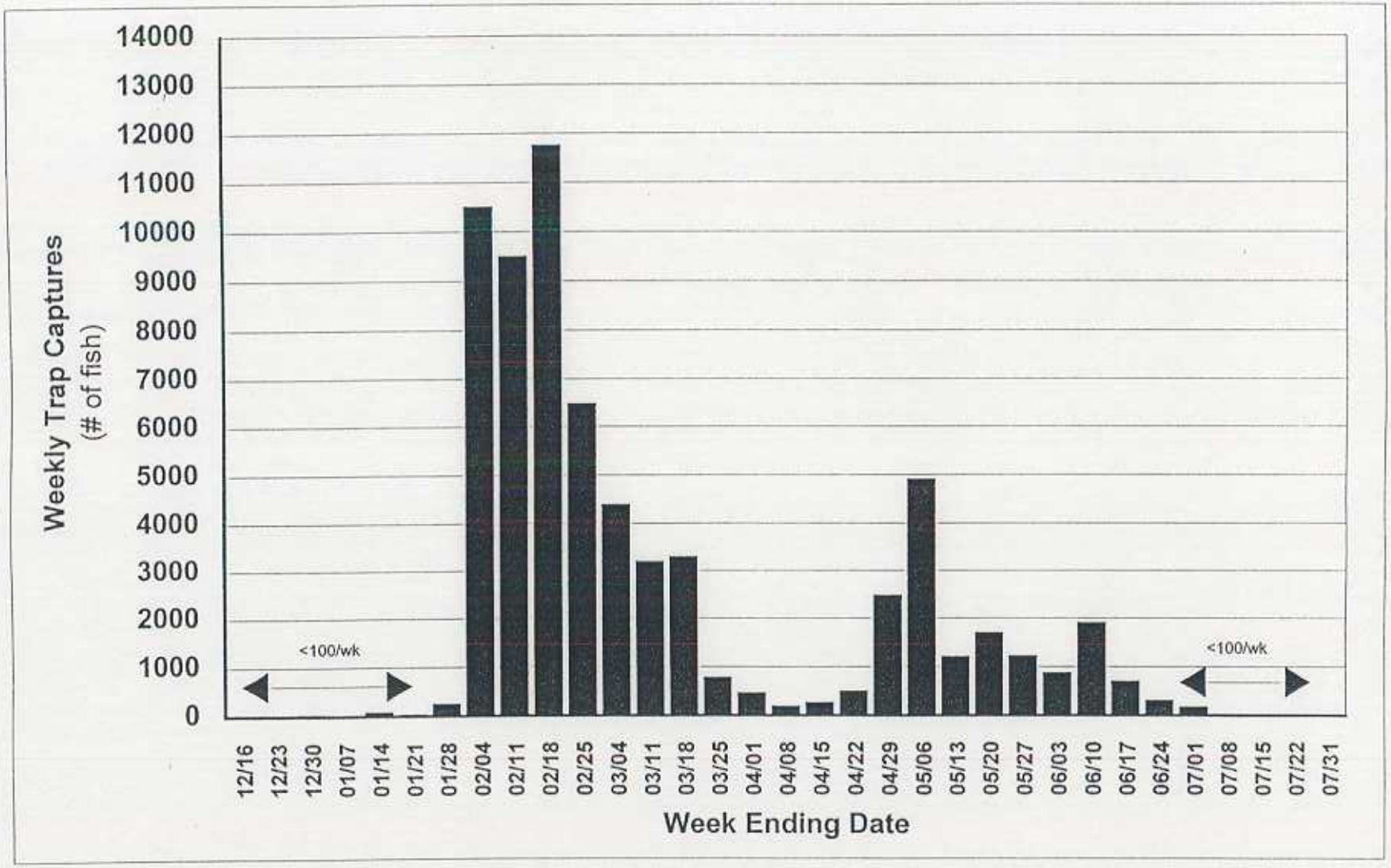

Figure 4. Weekly counts of YOY fall-run chinook salmon trapped in rotary screw fish traps at Woodbridge Dam on the Mokelumne River from December 16, 1998 through July 31, 1999.

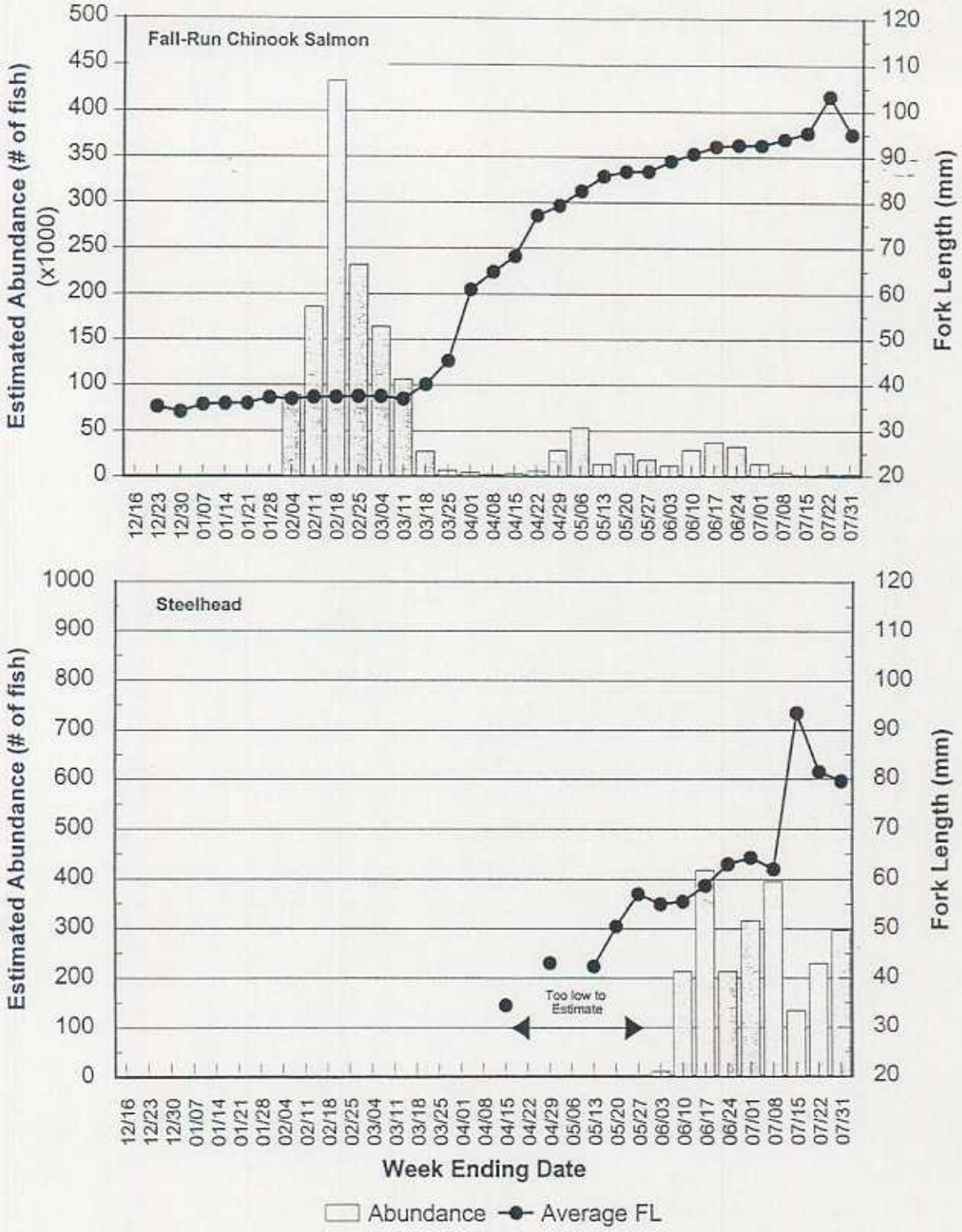

Figure 5. Estimated weekly abundance and average size of YOY fall-run chinook salmon and steelhead passing Woodbridge Dam from December 16, 1998 through July 31, 1999.

steelhead smolts at New Hope Landing in December 1998 (Table 1). YOY *O. mykiss* fry were first captured in low numbers in April (Table 1). The abundance of parr-sized *O. mykiss* increased modestly in June and July 1999 (Figure 5, Appendices B and C-2).

3.3 Size and Condition of Downstream Migrant Salmonids

Daily records of average TL, FL, weight, and condition factor, as well as the range of lengths and weights of salmonids captured at Woodbridge Dam are provided in Appendix D-1 and D-2. Figure 6 shows the mean and range of total lengths for YOY fall-run chinook salmon based on sampling from December 16,1998 to July 31, 1999. Approximately 80 percent of BY98 production emigrated past Woodbridge Dam as fry and 20 percent as smolt-sized salmon (Figure 5 and Figure 6). As in past years (Vogel and Marine 1994, 1996, 1998a,b, 1999a), the number of smolt-sized subyearling salmon increased abruptly after mid-March, signaling the onset of the smolt emigration. Smolt-size salmon predominated catches from the week nearest April 1 through the end of season, although small numbers of fry were observed through the end of April. The size of smolts increased gradually for the duration of the season after the onset of this phase of the emigration.

The condition factor of emigrating salmon fry ranged from about 5.1×10^{-4} to 9.0×10^{-4}, with the vast majority ranging from about 6.0×10^{-4} to 6.5×10^{-4} (Figure 7). Yolk-sac fry less than 40mm FL occurred among the earliest emigrants in January and February. Most fry captured during March were post-absorptive (i.e., little to no yolk-sac remaining) fry/parr dominated by fish between 40mm and 50mm FL characterized by increasing condition factors. The abrupt occurrence of large parr and smolt sized salmon in the traps affected increases in the means and the ranges of size and condition measurements during March (Appendix D-1). The size of smolts migrating by Woodbridge Dam increased throughout the smolt migration. Average condition factor varied, but generally increased over the duration of fry and smolt emigrations (Figure 7). An exception to this trend was a moderate decline in condition factor during April and early May that coincided with increased captures of smolt-sized salmon. This event was followed by a slow but continuous increase in condition factor during the remainder of the season. This pattern of change in condition factor between the fry/parr and smolt life stages of anadromous salmonids is observed annually in the Mokelumne River and widely throughout their range. The rather abrupt reduction in "plumpness" characterized by declining condition factor is thought to reflect a change in overall bioenergetic balance associated with the metabolic rigors of salmonid smoltification, as well as, adaptive morphologic changes for life in the ocean (Hoar 1988).

Of 162 YOY *O. mykiss* captured, approximately 20% were fry (FL<50mm) captured from April through June. And, the majority of YOY *O. mykiss*, which were captured from June through July were classified as parr ranging from 50mm to 100mm FL (Appendix D-2).

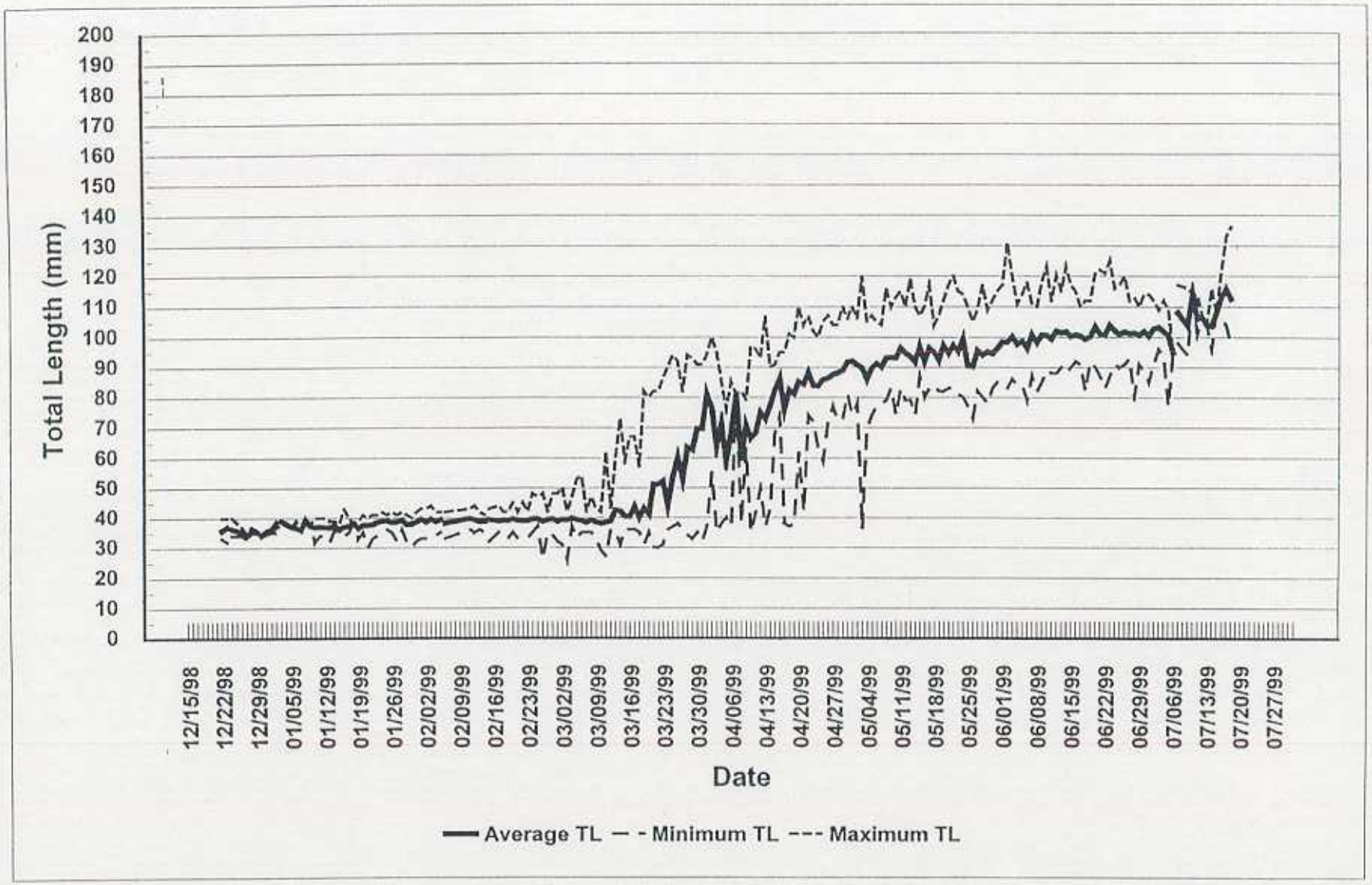

Figure 6. Daily average, minimum, and maximum total lengths of YOY fall-run chinook salmon captured at Woodbridge Dam on the Mokelumne River from December 16, 1998 through July 31, 1999.

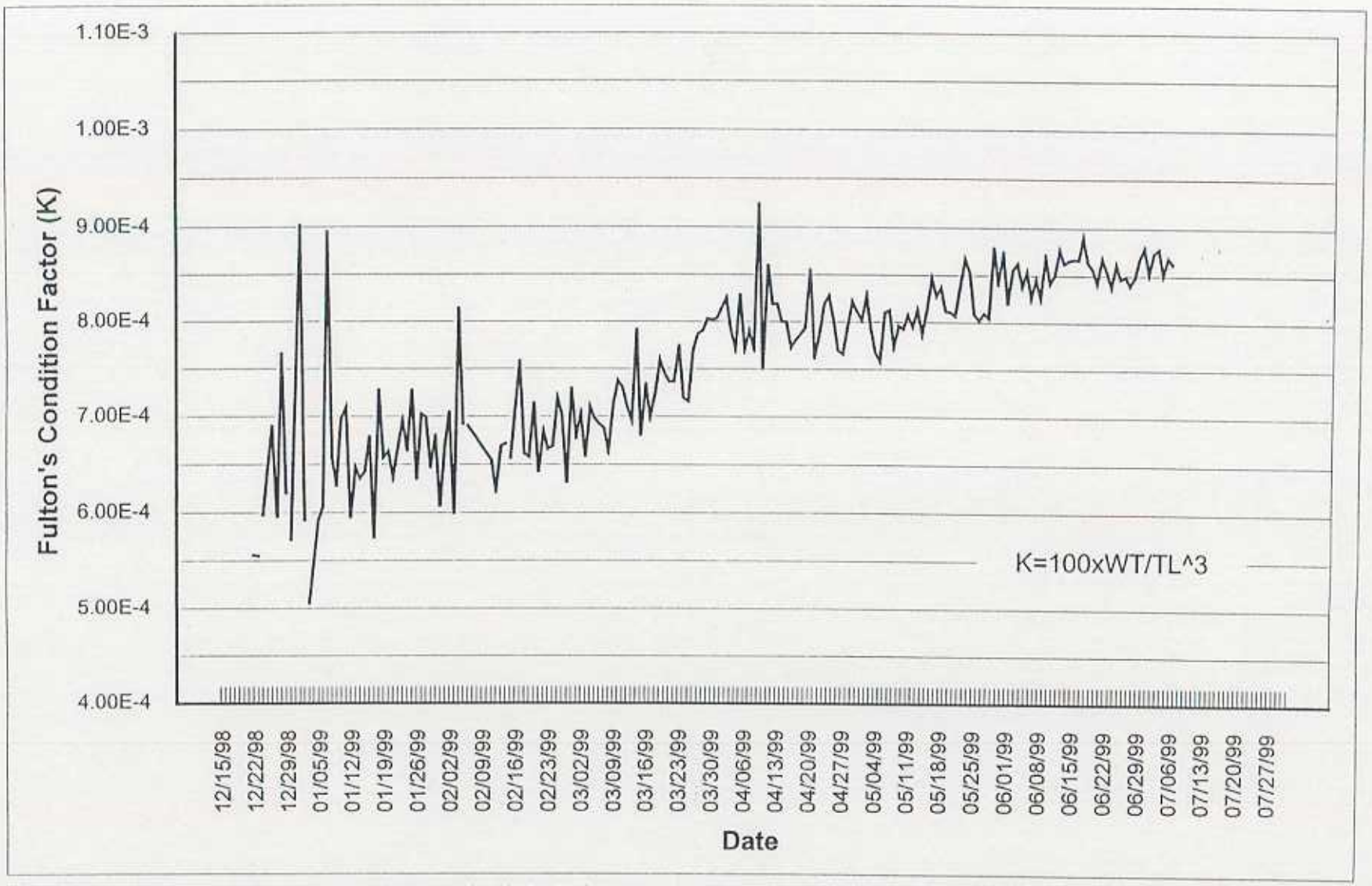

Figure 7. Daily average condition factor (K) of YOY fall-run chinook salmon captured at Woodbridge Dam on the Mokelumne River from December 16, 1998 through July 31, 1999.

3.4 Effects of Physical Environmental Conditions on Downstream Migrants

3.4.1 Diel Periodicity of Fish Migration Past Woodbridge Dam

The diel migration patterns of juvenile chinook salmon and steelhead passing Woodbridge Dam are shown in Figure 8. The majority of fish emigrated at night during peaks of migration for both species. Day time migration abundance dominated, however, during June and July for both species. However, this pattern may be an artifact of low total daily fish numbers and low trap efficiencies during these later months. Crepuscular peaks in passage have been documented during diel synoptic surveys conducted in past years (Bianchi et al. 1992, Vogel and Marine 1998b, 1999a,b), and fish passing during these hours are included in the night time passage in Figure 8.

3.4.2 Water Temperature, River Flow, Rainfall, Turbidity, and Lunar Phase

Daily average river flow, water clarity and turbidity, and water temperatures for the Woodbridge Dam trap site are provided in Appendix E. Daily rainfall at Camanche Dam, rainfall and barometric pressure at Woodbridge, California, lunar phase and times of sunrise and sunset are included in Appendix E.

Figure 9 shows the daily river flow, Woodbridge Canal diversions, periods of rainfall and turbidity, and barometric pressure at Woodbridge Dam. River flow levels were primarily related to changes in releases from Camanche Dam. Turbidities varied with transient increases during periods of rainfall and river stage changes. January and February storms were associated with the highest turbidities.

Figure 10 shows the hourly water temperatures recorded at the trapping site. Diel fluctuations in water temperatures varied through the season from less than 0.5 °C in December and January increasing to about 2°C in June and July. We computed mean daily water temperatures for comparison with the abundance of downstream migrating salmon (Appendix E).

Some researchers have reported that juvenile salmon emigrations tend to occur in multiphasic peaks or pulses; these pulses may correspond to changes in flow, increased turbidity, and other hydrologic and ecologic conditions (Kjelson *et al.* 1982, McKeown 1984, Vogel 1989, Healey 1991). We examined potential migratory responses to river flow, turbidity, water temperature, lunar phase, and precipitation in Figures 11 and 12. As in past years, no general associations of migration abundance corresponding to specific individual factors were apparent. Nor were any environmental thresholds for migratory responses identified. Peak daily catches of fry were frequently, but not always, associated with storm events and increased turbidity. However, the magnitudes of rainfall and increased turbidity were not associated with the magnitude of fish abundance. Most changes in migrant abundance appeared to be associated with season or size.

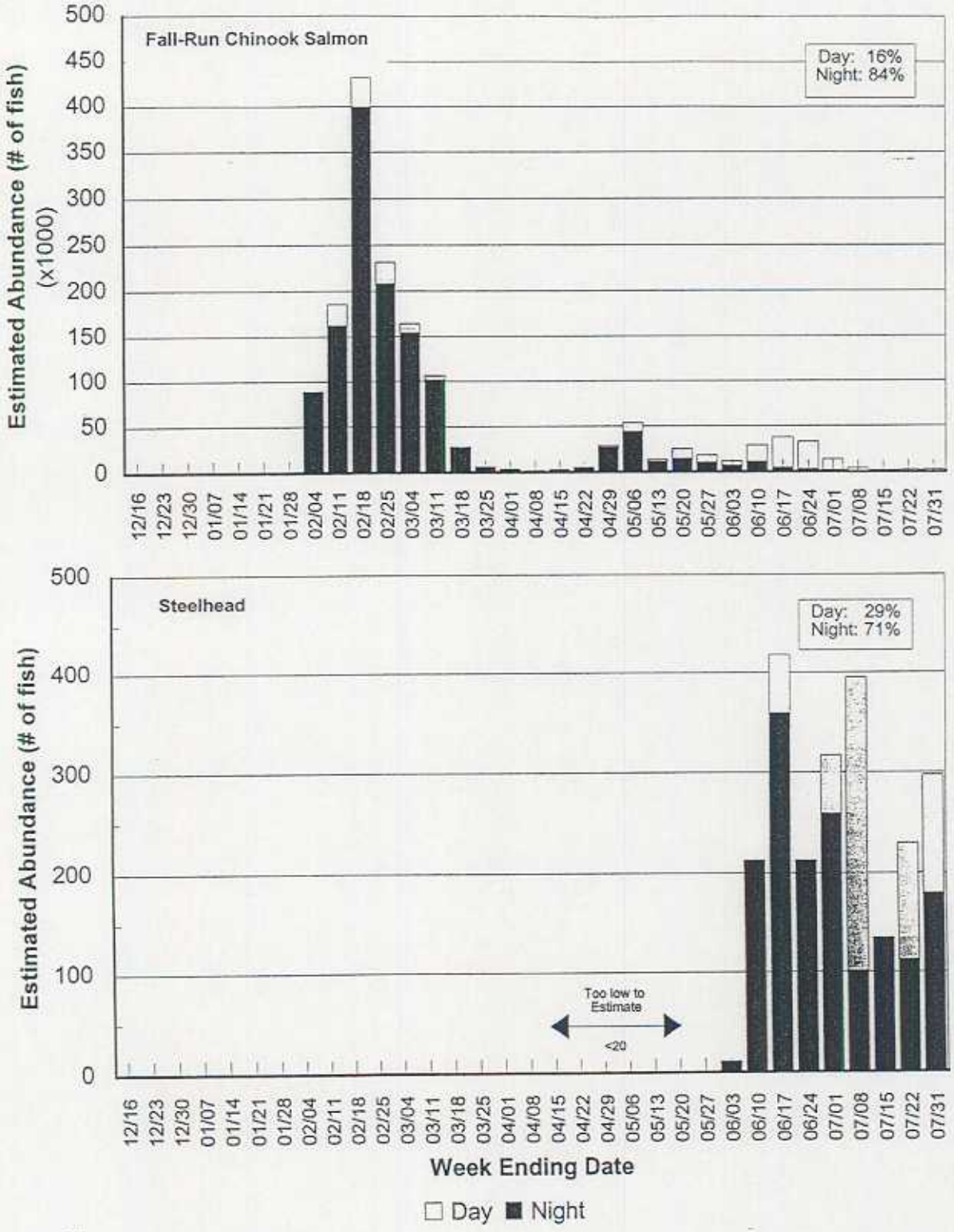

Figure 8. Weekly diel abundance distributions for YOY fall-run chinook salmon and steelhead emigrating by Woodbridge Dam from December 16, 1998 through July 31, 1999.

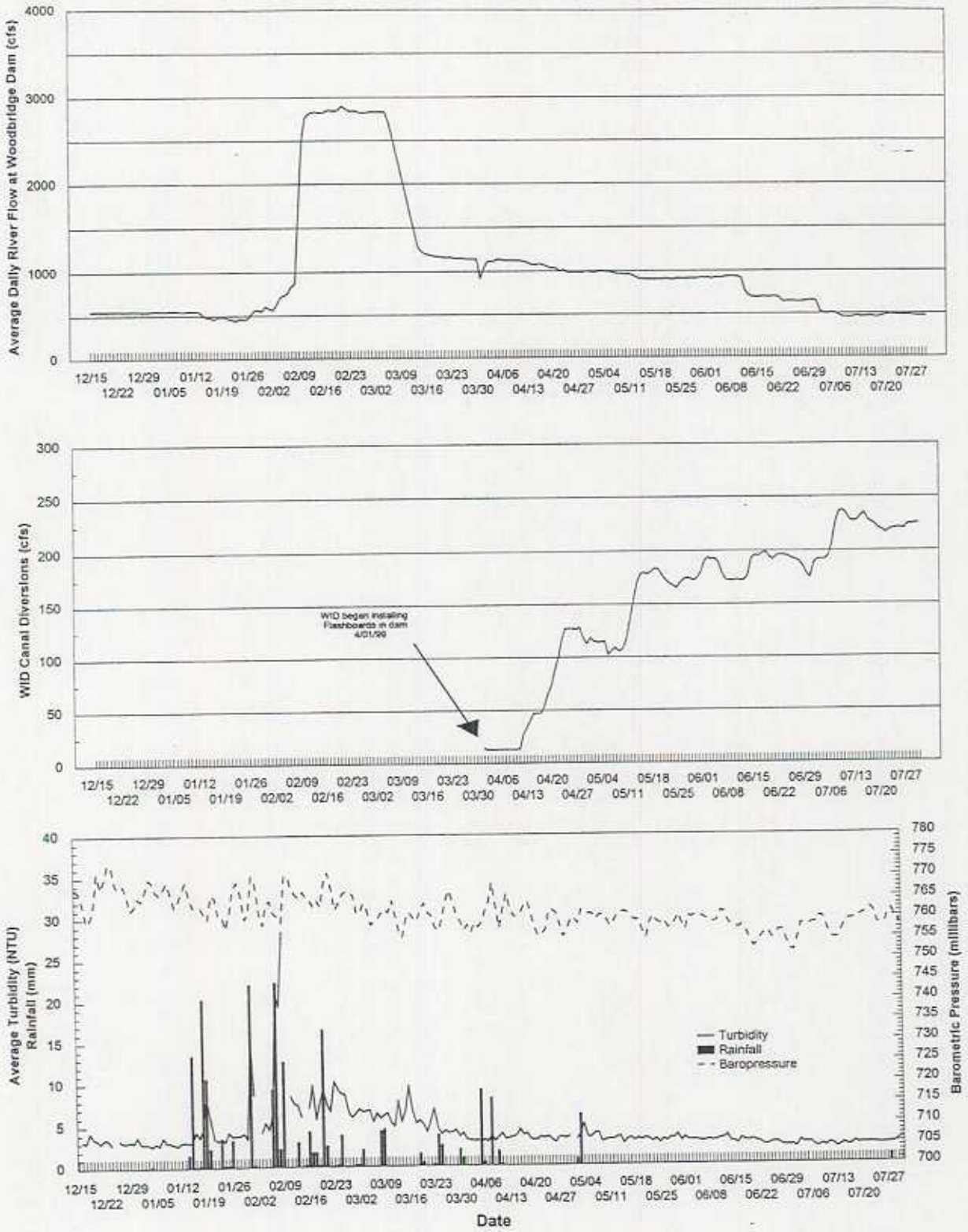

Figure 9. River flow passing Woodbridge Dam, WID canal diversions, daily average turbidity, barometric pressure and rainfall at Woodbridge Dam trap site from December 15, 1998 to July 31, 1999.

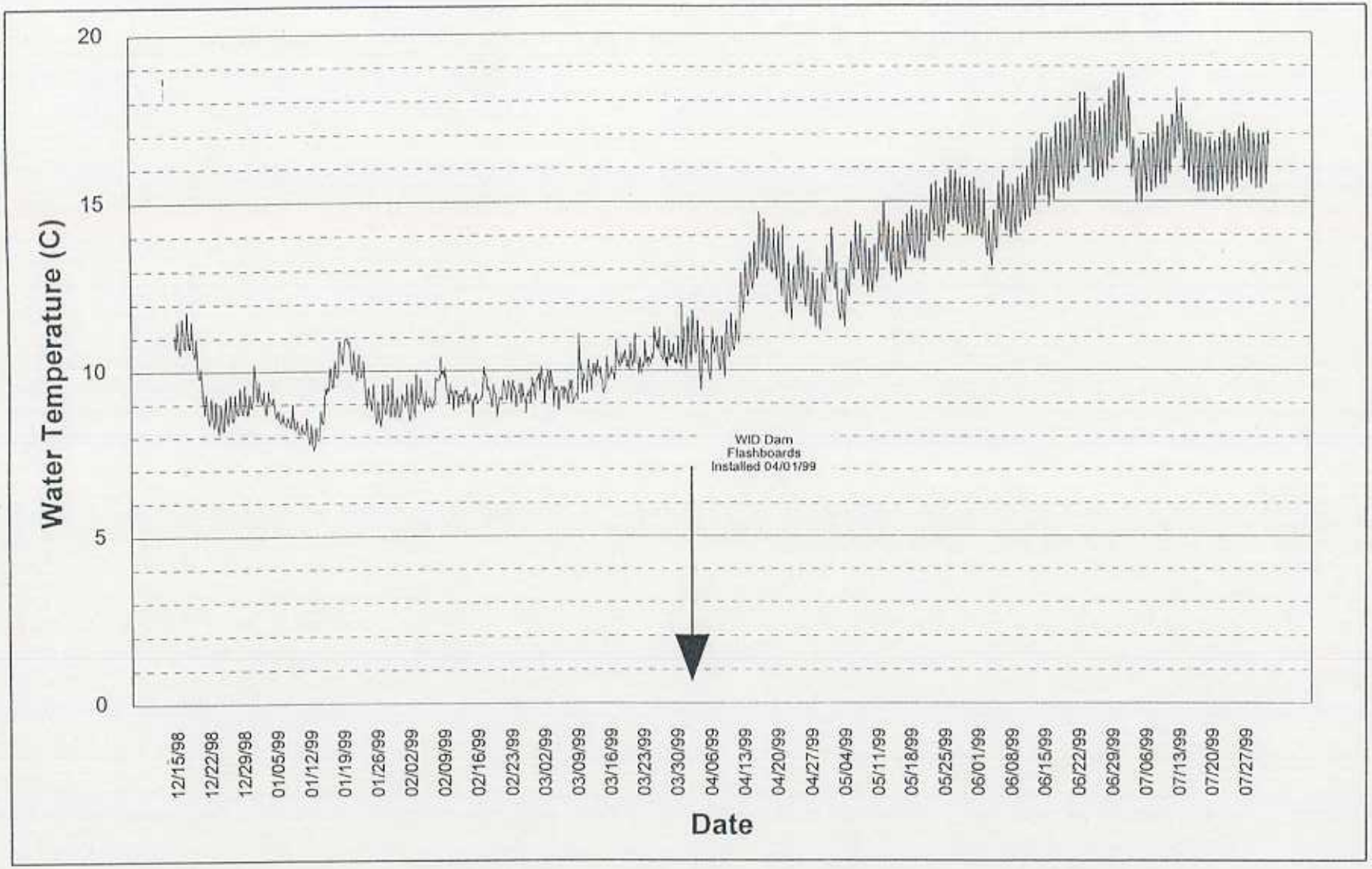

Figure 10. Hourly water temperatures recorded at Woodbridge Dam from December 15, 1998 through July 31, 1999.

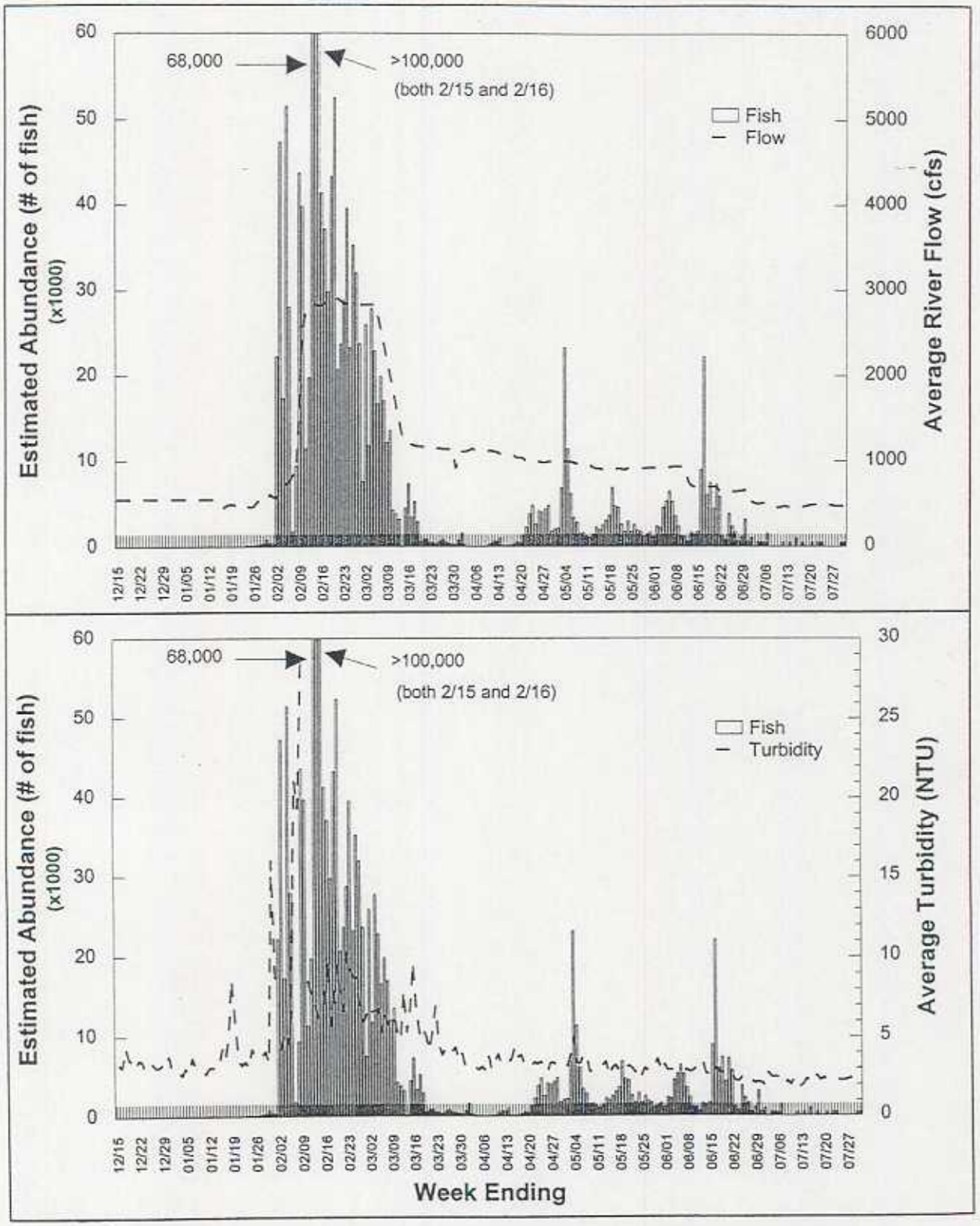

Figure 11. Estimated daily abundance of YOY fall-run chinook salmon passing Woodbridge Dam compared with average daily river flows passing Woodbridge Dam and water turbidity from December 15, 1998 through July 31, 1999. (Abundance values that exceed scale are presented in numeric form).

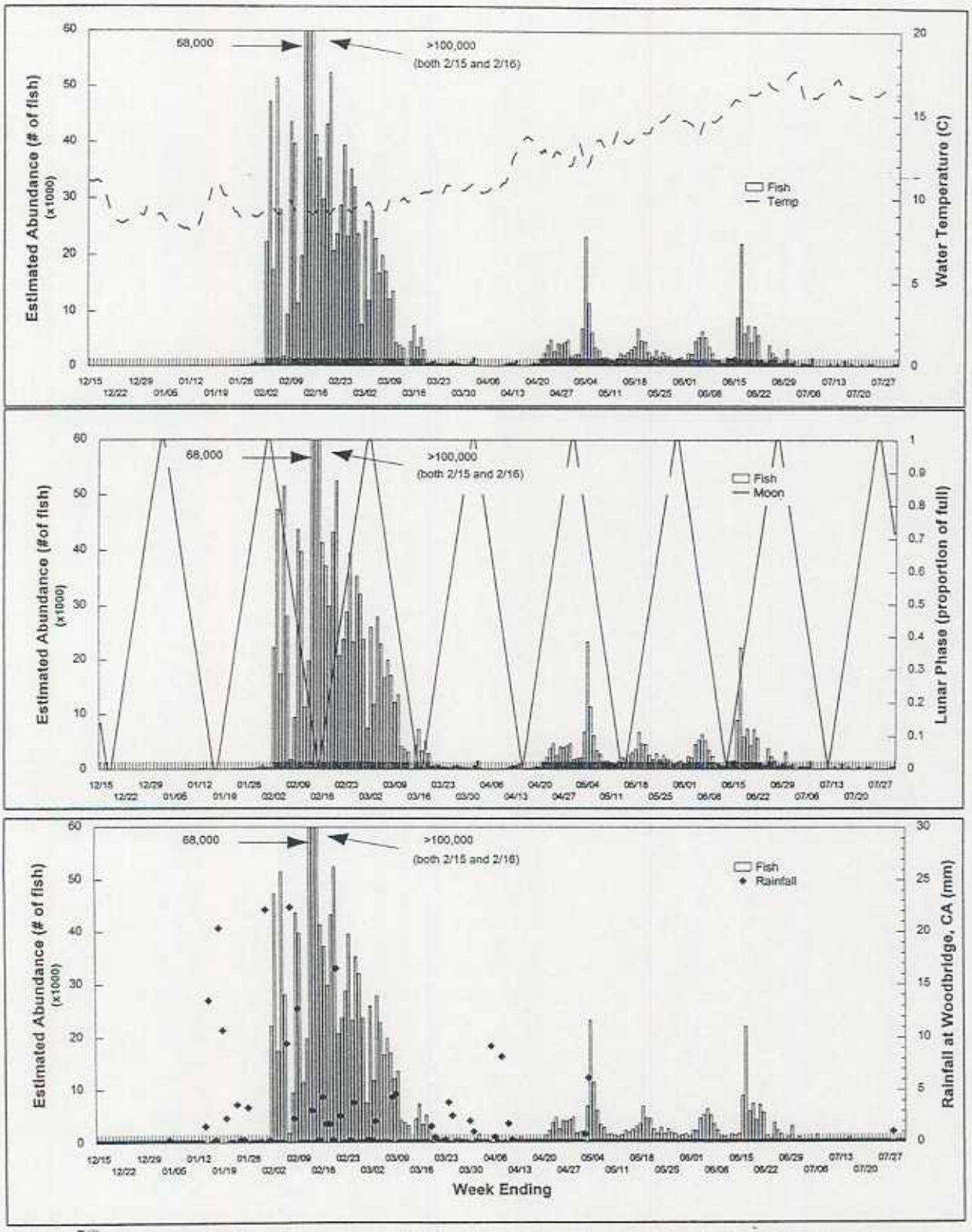

Figure 12. Estimated daily abundance of YOY fall-run chinook salmon passing Woodbridge Dam compared with daily water temperatures, lunar cycle, and daily rainfall measured from December 15, 1998 through July 31, 1999 (Abundance values that exceed scale are presented in numeric form).

The relative importance of fish size, or life stage, on emigration is illustrated by the apparent size threshold response denoting the abrupt onset of migrating smolts in April (Figure 5). This "threshold response" is supported by observations of increasing numbers of smolt-sized salmon during April with relatively few intermediate sized salmon (40 - 50 mm FL) occurring in the traps after the subsidence of fry emigration in March. The relative influence of size (FL) on migration patterns of subyearling chinook salmon has also been noted for the mid-Columbia River, where size was found to be the most important determinant of migration rate among several likely factors including river discharge, water temperature, and season (Giorgi et al. 1997).

3.5 Comparison of Annual Juvenile Fall-Run Chinook Salmon Downstream Migrations During 1990-1999

Data from ten consecutive monitoring seasons for juvenile chinook salmon emigrating from the Mokelumne River have been compiled for 1990 -1999. Outmigration monitoring methods have changed and have been refined over the years. Outmigration is monitored solely through the fishways under low flow conditions, with use of rotary fish traps when flows are higher, and with combinations of the two methods at intermediate flows. During 1990 -1992, only the fishway traps were used for smolt monitoring. During 1993 - 1999, rotary traps were used for all or portions of the season. And in 1994 and 1997, the fishway traps were fished during portions of the season, at times in combination with the rotary traps. Because of these differences in methodologies between years, direct comparisons among years must be made with some qualifications. However, certain generalized comparisons between years are possible.

The timing of juvenile chinook salmon emigrating past Woodbridge Dam for each year since 1990 is presented in Figures 13 through 15. Downstream migrant monitoring was started in mid-December during the 1997-98 and 1998-99 seasons. This was approximately 3 to 6 weeks earlier than in most other seasons, except for 1993-94 when monitoring started in October 1993. Salmon fry were intermittently observed in small numbers as early as mid-December in 1997-98 and 1998-99 with fry numbers increasing after mid-January in both years. This pattern contrasts with 1993-94 when outmigration monitoring was continuous from October through July. Few fry at all were captured migrating by Woodbridge Dam during that year (Figure 14). If the patterns for 1994 (a dry year), 1999 (a normal to above normal year), and 1998 (a wet year) reflect a normal range of fry emigration in the Mokelumne River, then past years with monitoring start dates by the third week in January may be compared for juvenile fall-run chinook salmon emigration timing and relative abundance.

Although fry emigrant abundance varies, it has dominated that of smolts for each year since 1995. This pattern differs from the emigration timing exhibited in 1993 and 1994 (Figure 14). The onset of smolt emigration begins during late March to early April. The peak of smolt emigration varies within about ±2-3 weeks during May and June, but the duration of this migration period varies between years. River flows during 1990, 1991, 1992, and 1994 were substantially lower during the principal migratory period than river flows in 1993 and 1995 to 1999 (Bianchi *et. al.* 1992, Vogel and Marine 1994,1996, 1998, 1999a,b). Water temperatures

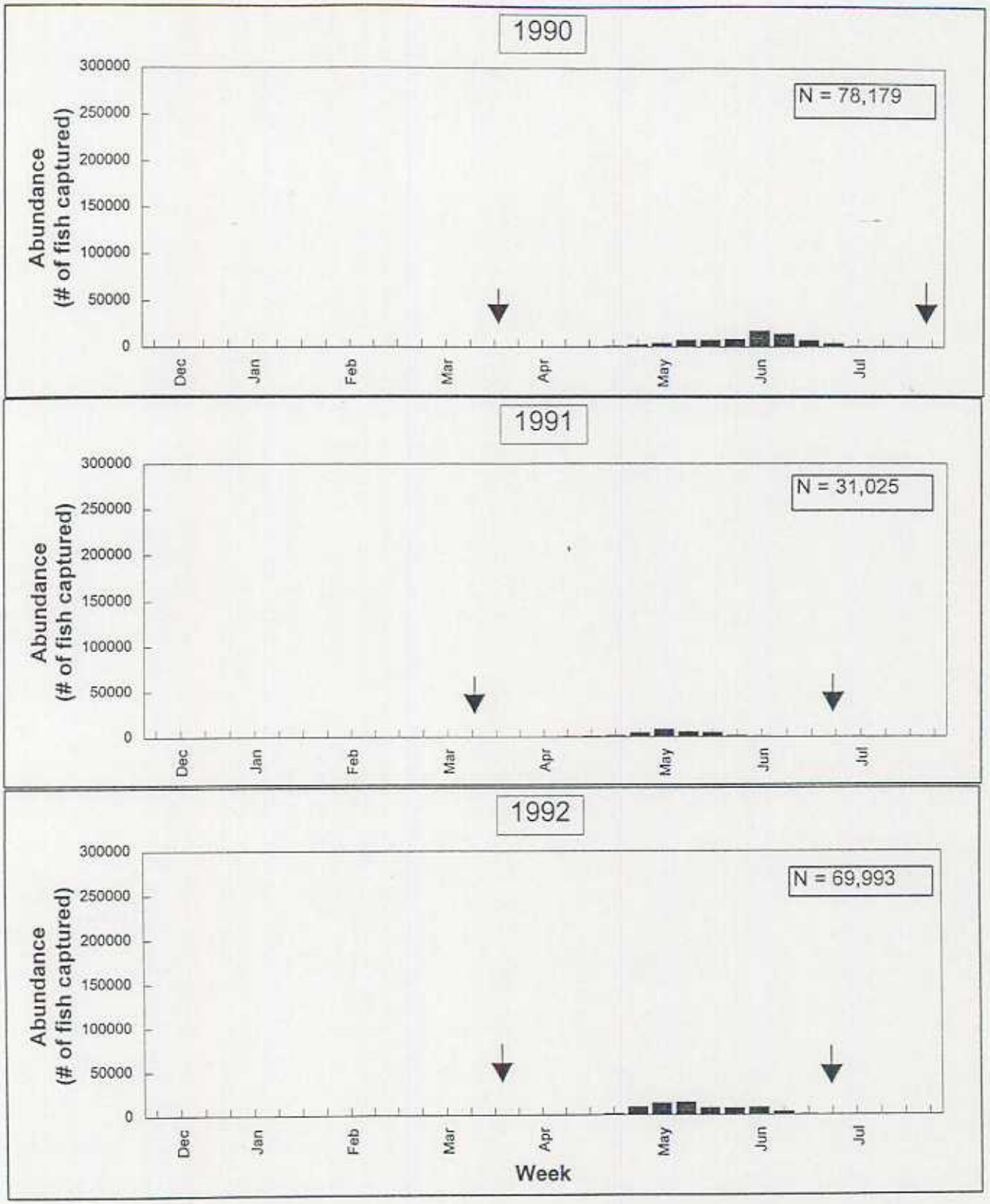

Figure 13. Weekly abundance of downstream migrant fall-run chinook salmon at Woodbridge Dam for 1990-1992. (Abundance for 1990-1992 was determined by capturing fish in fishway traps with nearly 100% of river flow passing through fishways) Month labels are on middle week of each month. Arrows indicate the beginning and end of annual monitoring periods.

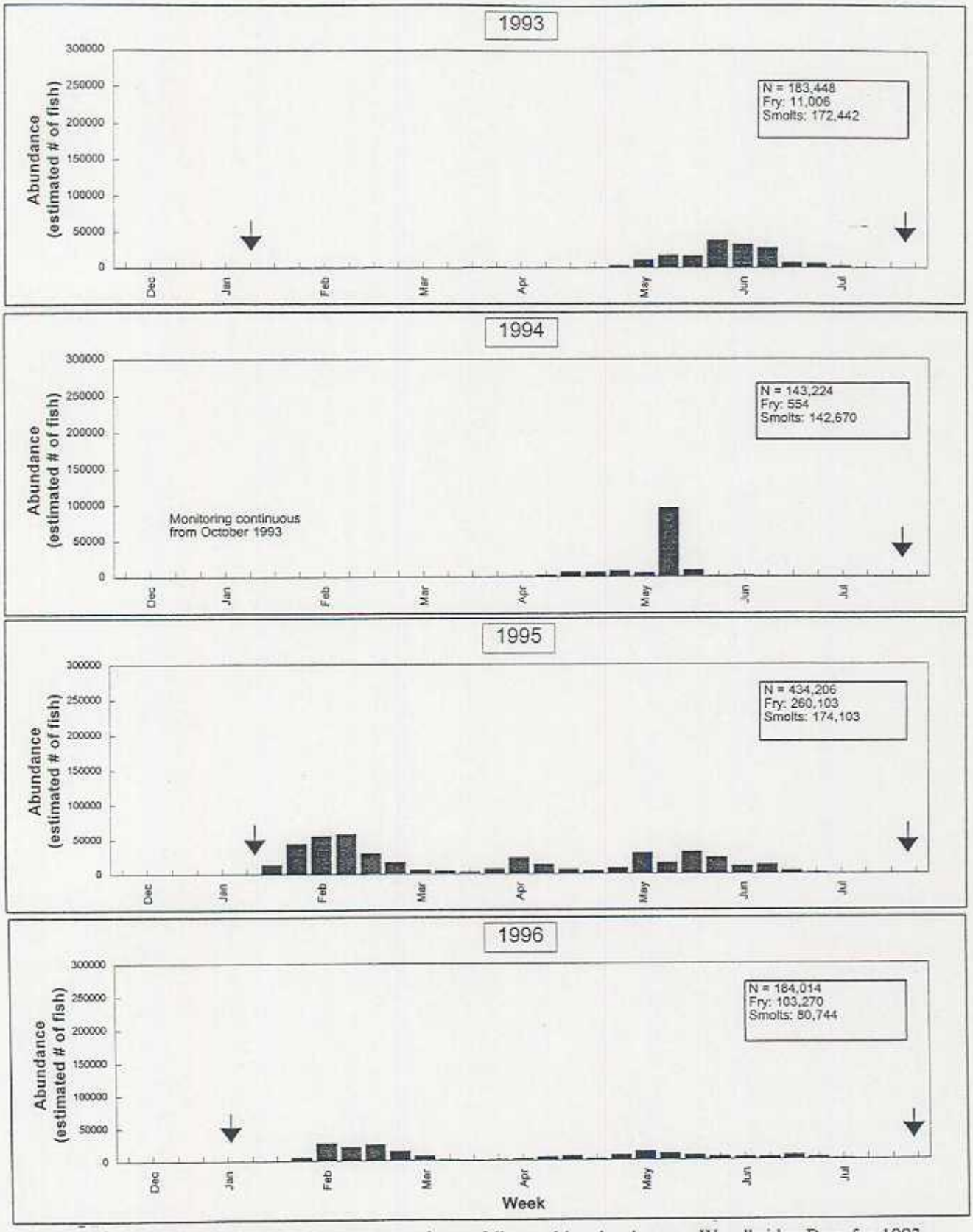

Figure 14. Weekly abundance of downstream migrant fall-run chinook salmon at Woodbridge Dam for 1993-1996. (Abundance was determined using experimentally -derived capture probabilities for rotary traps [and adding fishway trap captures in '94]). Month labels are on the middle week of each month. Arrows indicate the beginning and end of annual monitoring periods.

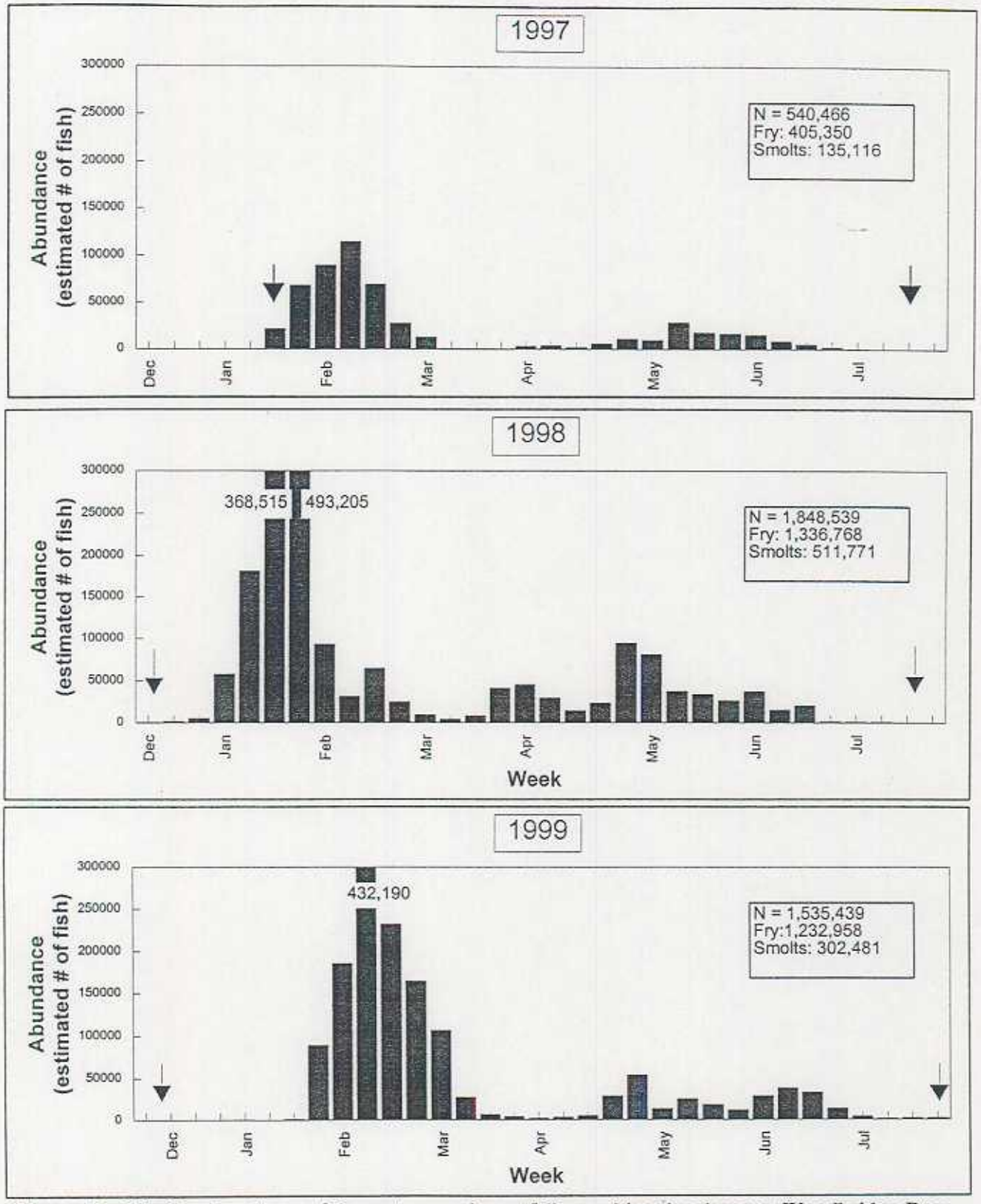

Figure 15. Weekly abundance of downstream migrant fall-run chinook salmon at Woodbridge Dam for 1997-1999. (Abundance was determined using experimentally-derived capture probabilities [and adding fishway trap captures in '97]). Month labels are on the middle week of each month. Arrows indicate the beginning and end of annual monitoring periods. Abundance values that exceed scale are presented as text.

recorded in 1991 and 1992 at Woodbridge Dam were approximately 0.5 to 3 °C higher than during comparable periods in later years (Bianchi *et. al.* 1992) . Water temperature data for 1990 were not available. Higher daily water temperatures during the early part of the smolt migration period may partially account for the earlier smolt-sized salmon outmigrations observed in 1991 and 1994 (data in Bianchi *et. al.* 1992, Vogel and Marine 1994, 1996, 1998a,b, 1999a,b).

Natural production of BY98 juvenile fall-run chinook salmon emigrating from the Mokelumne River, estimated at 1,535,439 (~1,232,958 fry and ~302,481 smolts), was the second highest production estimate since BY89. The past ten years of data are sufficient to suggest that the timing of fry and smolt emigrations is fairly consistent but the magnitude of the numbers of fry migrants varies to a greater extent than that of smolts. This phenomenon is observed elsewhere in the range of chinook salmon, such as the Big Qualicum River on Vancouver Island where numbers of emigrating fry may vary by as much as 100-fold annually but emigrating smolts by only as much as 10-fold (Lister and Walker 1966).

3.6 Wild Chinook Salmon Smolts Coded-Wire Tagged at Woodbridge Dam

Appendix A provides a daily record of the numbers of wild fall-run chinook salmon fry/parr and smolts captured, coded-wire tagged, and released at Woodbridge Dam. Additional relevant data are provided in Table 4. Fish were tagged from Janauary 29 until July 31, 1999. Six microtag codes were used during the season to tag 55,819 fish (Table 4). We marked and released approximately 35,000 fry/parr from January until April and 21,000 smolts from March through July.

Latent post-tagging mortality ranged from 0% to 4% with 8 fish out of 430 held that died in 11 separate tests (1 to7 days long). On most days, post-tagging survival was 98% or better throughout the season. Tag retention efficiency ranged from 94% to 100% during these tests. Tagging reports were submitted to the CDFG in August 1999.

Table 4. Coded-wire tag data for wild Mokelumne River fall-run chinook salmon marked and released at Woodbridge Dam - January through July 1999.

Code ID	Egg Lot No.	Brood Year	Release Location	Date Released		Rearing Type	Purpose	Total No. Tagged	Estimated Tag Loss and Mortality Before Release %[1]	No. Tagged Fish Released[2]	Quality Control Days	No./lb at Release[3]	Avg. FL (mm)[3]	Rearing Location	Stock of Release Group
				First	Last										
06-01-13-01-13	Wild	1998	Woodbridge Dam	01/29/99	02/07/99	wild	survival & fishery	11,250	0.0	11,250	7	1,136	37	Mokelumne River	MOK98
06-01-13-02-04	Wild	1998	Woodbridge Dam	02/08/99	02/15/99	wild	survival & fishery	9,733	0.0	9,733	7	1,136	37	Mokelumne River	MOK98
06-01-13-02-05	Wild	1998	Woodbridge Dam	02/15/99	03/01/99	wild	survival & fishery	11,088	0.0	11,088	7	1,136	37	Mokelumne River	MOK98
06-01-13-02-06	Wild	1998	Woodbridge Dam	03/02/99	04/29/99	wild	survival & fishery	10,829	0.053	10,251	7	98 - 380	44 - 75	Mokelumne River	MOK98
06-02-42	Wild	1998	Woodbridge Dam	04/30/99	06/04/99	wild	survival & fishery	10,067	0.088	9,179	7	67	86	Mokelumne River	MOK98
06-02-43	Wild	1998	Woodbridge Dam	06/05/99	07/31/99	wild	survival & fishery	2,852	0.028	2,772	7	52 - 54	91 - 96	Mokelumne River	MOK98

[1] Tag retention checked after 6 to 7day post-tagging holding periods. These checks were replicated for each tag group.

[2] Adjusted for estimated shed tags and prerelease mortality.

[3] Range in average size for entire time interval over which tag code was used.

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ACRONYMS

Acronym/Abreviation	Definition
CDFG	California Department of Fish and Game
cfs	cubic feet per second (1cfs = 0.03 cms)
cm	centimeter
CVPIA	Central Valley Project Improvement Act
CWT	coded-wire tagged
DO	dissolved oxygen
EBMUD	East Bay Municipal Utility District
FL	fork length
K	average condition factor
km	kilometer
L	Liter
m	meters
ml	milliliter
mm	millimeter
MRFI	Mokelumne River Fish Installation
NRS	Natural Resource Scientists, Inc.
NTU	Nephelometric turbidity units
PVC	polyvinyl chloride
QCD	quality control device
SD	standard deviation
TL	total length
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VAMP	Vernalis Adaptive Management Plan
WID	Woodbridge Irrigation District
WIDD	Woodbridge Irrigation District Dam
w/w	formulation made by combination on a dry weight to dry weight ratio
YOY	young-of-year

REFERENCES

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

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

Giorgi, A.E., T.W. Hillman, J.R. Stevenson, S.G. Hays, and C.M. Pevin. 1997. Factors that influence the downstream migration rates of juvenile salmon and steelhead through the hydroelectric system in the mid-Columbia River Basin. *North American Journal of Fisheries Management* 17: 268-282.

Healey, M.C. 1991. Life history of chinook salmon (*Oncorhynchus tshawytscha*). Pages 311-384 in C. Groot and L. Margolis (editors). *Pacific Salmon Life Histories*. University of British Columbia Press. Vancouver, British Columbia, Canada.

Hoar, W.S. 1988. The physiology of smolting salmonids. Pages 275-343 in W.S. Hoar and D.L. Randall (editors). *Fish Physiology*. Academic Press, San Diego, California.

Kjelson, M. A., P.F. Raquel, and F.W. Fisher. 1982. Life history of fall-run juvenile chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento-San Joaquin estuary, California. Pages 393-411 in V.S. Kennedy (editor), *Estuarine Comparisons*. Academic Press, New York.

Lister, D.B. and C.E. Walker. 1966. The effect of flow control on freshwater survival of chum, coho, and chinook salmon in the Big Qualicum River. *Canadian Fish Culturist* 37: 3-25.

McKeown, B.A. 1984. *Fish Migration*. Timber Press. Portland, Oregon. 224 pp.

Neter, J. and W. Wasserman. 1974. Applied linear statistical models. Richard Irwin, Incorporated, Homewood, IL.

Piper, R.G., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, and J.R. Leonard. 1982. *Fish Hatchery Management*. U.S. Department of the Interior. Fish and Wildlife Service. Washington, D.C. 517 pp.

Summerfelt, R.C. and L.S. Smith. 1990. Anesthesia, surgery, and related techniques. Pages 213-334 in C.B. Schreck and P.B. Moyle (editors). *Methods for Fish Biology*. American Fisheries Society. Bethesda, Maryland.

USFWS. 1997. Draft CVPIA Comprehensive Assessment and Monitoring Program Standard Protocol for Rotary Screw Trap Sampling. U.S. Fish and Wildlife Service. Sacramento, California.

Vogel, D.A. 1989. Tehama-Colusa Canal Diversion and Fishery Problems Study. Final Report. U.S. Fish and Wildlife Service Report No. AFF/FAO-89-06. April 1989. 33 pp. with appendices.

Vogel, D.A. 1992. Assessment of the Fish Passage Facilities at Lake Lodi in the Mokelumne River. Vogel Environmental Services. 42 pp.

Vogel, D.A., K.R. Marine, and J.G. Smith. 1988. Fish Passage Action Program for Red Bluff Diversion Dam: Final report on Fishery Investigations. US Fish and Wildlife Service Report No. FR1/FAO-88-1. October 1988. 77 pp. with appendices.

Vogel, D.A. and K.R. Marine. 1994. Evaluation of the downstream migration of juvenile chinook salmon and steelhead in the lower Mokelumne River and the Sacramento-San Joaquin Delta (January through July 1993). A Report Prepared for East Bay Municipal Utility District, Orinda, California. Vogel Environmental Services. 59p. plus 8 appendices.

Vogel, D.A. and K.R. Marine. 1996. Evaluation of the downstream migration of juvenile chinook salmon and steelhead in the lower Mokelumne River and the Sacramento-San Joaquin Delta (January through July 1994). A Report Prepared for East Bay Municipal Utility District, Orinda, California. Vogel Environmental Services. 66p. plus 10 appendices.

Vogel, D.A. and K.R. Marine. 1998a. Evaluation of the downstream migration of juvenile chinook salmon and steelhead in the lower Mokelumne River and the Sacramento-San Joaquin Delta (January through July 1995). A Report Prepared for East Bay Municipal Utility District, Orinda, California. Vogel Environmental Services. 55p. plus appendices.

Vogel, D.A. and K.R. Marine. 1998b. Evaluation of the downstream migration of juvenile chinook salmon and steelhead in the lower Mokelumne River and the Sacramento-San Joaquin Delta (January through July 1996). A Technical Report Prepared for East Bay Municipal Utility District, Orinda, California. Natural Resource Scientists, Inc. 43p. plus appendices.

Vogel, D.A. and K.R. Marine. 1999a. Evaluation of the downstream migration of juvenile chinook salmon and steelhead in the lower Mokelumne River and the Sacramento-San Joaquin Delta (January through July 1997). A Technical Report Prepared for East Bay Municipal Utility District, Orinda, California. Natural Resource Scientists, Inc. 44p. plus appendices.

Vogel, D.A. and K.R. Marine. 1999b. Evaluation of the downstream migration of juvenile chinook salmon and steelhead in the lower Mokelumne River and the Sacramento-San Joaquin Delta (December 1997 through July 1998). A Technical Report Prepared for East Bay Municipal Utility District, Orinda, California. Natural Resource Scientists, Inc. 43p. plus appendices.

APPENDICES

Appendix A. Daily trapping abundance of YOY fall-run chinook salmon: December 16, 1998 -- July 31, 1999.

	Nocturnal				Diurnal				Daily Totals**				Trap Operations Data			
Date	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
12/16/98	--	--	--	--	--	--	--	--	0	0	0	0	2	--	--	21:00
12/17/98	--	--	--	--	--	--	--	--	0	0	0	0	2	--	--	24:05
12/18/98	--	--	--	--	--	--	--	--	0	0	0	0	2	--	--	22:40
12/19/98	--	--	--	--	--	--	--	--	1	1	0	0	2	--	--	23:55
12/20/98	--	--	--	--	--	--	--	--	1	1	0	0	2	--	--	24:05
12/21/98	--	--	--	--	--	--	--	--	0	0	0	0	2	--	--	24:20
12/22/98	--	--	--	--	--	--	--	--	0	0	0	0	2	--	--	23:30
12/23/98	13	0	0	0	--	--	--	--	13	0	0	0	2	17:25	--	--
12/24/98	--	--	--	--	0	0	0	0	11	1	0	0	2	--	06:00	24:00
12/25/98	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	Fished until 12/26/98
12/26/98	--	--	--	--	--	--	--	--	5	0	0	0	2	--	--	41:55
12/27/98	--	--	--	--	--	--	--	--	8	0	1	0	2	--	--	23:55
12/28/98	--	--	--	--	--	--	--	--	3	0	0	0	2	--	--	24:05
12/29/98	--	--	--	--	--	--	--	--	10	1	0	0	2	--	--	23:40
12/30/98	--	--	--	--	--	--	--	--	4	0	0	0	2	--	--	24:05
12/31/98	--	--	--	--	--	--	--	--	3	0	0	0	2	--	--	23:50
01/01/99	--	--	--	--	--	--	--	--	1	1	0	0	2	--	--	24:30
01/02/99	--	--	--	--	--	--	--	--	3	0	0	0	2	--	--	23:35
01/03/99	--	--	--	--	--	--	--	--	12	0	0	0	2	--	--	24:05
01/04/99	--	--	--	--	--	--	--	--	2	0	0	0	2	--	--	24:20
01/05/99	--	--	--	--	--	--	--	--	0	0	0	0	2	--	--	23:40
01/06/99	--	--	--	--	0	0	0	0	1	0	0	0	2	--	07:10	24:05
01/07/99	7	0	2	0	--	--	--	--	7	0	2	0	2	17:10	--	--
01/08/99	--	--	--	--	--	--	--	--	5	0	0	0	2	--	--	23:20
01/09/99	--	--	--	--	--	--	--	--	3	0	1	0	2	--	--	25:00
01/10/99	--	--	--	--	--	--	--	--	3	0	0	0	2	--	--	23:20
01/11/99	--	--	--	--	--	--	--	--	10	0	1	0	2	--	--	24:15
01/12/99	--	--	--	--	--	--	--	--	28	1	0	0	2	--	--	24:10
01/13/99	--	--	--	--	--	--	--	--	33	0	3	0	2	--	--	23:45
01/14/99	--	--	--	--	--	--	--	--	18	1	0	0	2	--	--	24:25
01/15/99	--	--	--	--	--	--	--	--	8	0	0	0	2	--	--	23:20
01/16/99	--	--	--	--	--	--	--	--	6	0	0	0	2	--	--	24:55
01/17/99	--	--	--	--	--	--	--	--	6	0	1	0	2	--	--	23:10
01/18/99	--	--	--	--	--	--	--	--	6	0	0	0	2	--	--	24:10
01/19/99	--	--	--	--	--	--	--	--	1	0	0	0	2	--	--	24:10
01/20/99	--	--	--	--	--	--	--	--	7	0	0	0	2	--	--	24:40
01/21/99	--	--	--	--	--	--	--	--	13	0	0	0	2	--	--	23:15
01/22/99	--	--	--	--	--	--	--	--	16	0	0	0	2	--	--	25:00
01/23/99	--	--	--	--	--	--	--	--	19	11	0	0	2	--	--	23:10
01/24/99	--	--	--	--	--	--	--	--	41	20	0	0	2	--	--	23:50

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	Nocturnal				Diurnal				Daily Totals**				Trap Operations Data			
Date	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
01/25/99	--	--	--	--	--	--	--	--	34	0	0	0	2	--	--	24:00
01/26/99	--	--	--	--	--	--	--	--	29	0	0	0	2	--	--	23:50
01/27/99	--	--	--	--	--	--	--	--	51	0	0	0	2	--	--	23:55
01/28/99	--	--	--	--	--	--	--	--	74	0	0	0	2	--	--	24:10
01/29/99	--	--	--	--	--	--	--	--	103	2	0	98	2	--	--	24:15
01/30/99	--	--	--	--	--	--	--	--	211	2	0	209	2	--	--	24:25
01/31/99	--	--	--	--	--	--	--	--	111	0	0	111	2	--	--	23:40
02/01/99	--	--	--	--	6	0	0	6	108	1	0	107	2	--	06:55	24:00
02/02/99	5483	157	0	5024	102	0	0	100	5585	157	0	5124	2	17:30	07:10	--
02/03/99	3135	24	1	2692	82	5	0	0	3217	29	1	2692	2	18:55	04:45	--
02/04/99	1150	1	0	0	31	1	0	0	1181	2	0	0	2	18:55	05:24	--
02/05/99	3373	612	0	924	176	16	0	0	3549	628	0	924	2	17:51	06:05	--
02/06/99	1668	10	0	1516	457	11	0	380	2125	21	0	1896	2	15:55	07:38	--
02/07/99	98	2	0	89	52	2	0	0	150	4	0	89	2	16:47	06:45	--
02/08/99	467	5	0	460	364	4	0	360	831	9	0	820	2	18:50	05:40	--
02/09/99	--	--	--	--	--	--	--	--	1191	15	0	1173	2	--	--	23:55
02/10/99	952	704	0	237	92	3	0	89	1044	707	0	326	2	16:35	07:10	--
02/11/99	Traps pulled overnight due to debris loads				617	1	0	614	617	1	0	614	2	--	09:00	--
02/12/99	419	97	0	265	164	12	0	152	583	109	0	417	2	16:15	06:45	--
02/13/99	1494	50	21	1778	448	11	0	0	1942	61	21	1778	2	18:00	06:00	--
02/14/99	2864	62	44	2184	531	10	0	734	3395	72	44	2918	2	17:50	06:10	--
02/15/99	2697	125	0	2557	198	5	0	191	2895	130	0	2748	2	17:50	06:30	--
02/16/99	929	72	0	755	227	13	0	0	1156	85	0	755	2	17:10	07:15	--
02/17/99	903	52	0	860	58	1	0	74	961	53	0	934	2	17:45	05:30	--
02/18/99	677	7	1	647	149	5	0	102	826	12	1	749	2	18:00	05:15	--
02/19/99	1008	63	0	516	160	1	0	0	1168	64	0	516	2	18:30	06:00	--
02/20/99	1241	39	22	802	154	3	0	0	1395	42	22	802	2	17:45	06:20	--
02/21/99	451	4	1	634	146	3	0	0	597	7	1	634	2	17:35	06:25	--
02/22/99	500	20	4	467	200	7	1	225	700	27	5	692	2	18:20	05:15	--
02/23/99	625	53	2	581	204	6	0	204	829	59	2	785	2	18:00	06:30	--
02/24/99	892	21	0	856	210	3	0	191	1102	24	0	1047	2	17:10	06:15	--
02/25/99	484	21	2	480	213	1	0	228	697	22	2	708	2	18:00	05:50	--
02/26/99	781	14	0	754	220	4	0	198	1001	18	0	952	2	17:30	06:50	--
02/27/99	770	12	0	709	68	0	0	42	838	12	0	751	2	17:30	06:30	--
02/28/99	577	13	1	530	35	2	0	31	612	15	1	561	2	17:50	06:50	--
03/01/99	154	5	1	141	78	1	0	77	232	6	1	218	2	16:30	06:20	--
03/02/99	628	9	0	614	45	1	0	43	673	10	0	657	2	19:20	05:00	--
03/03/99	280	5	1	267	34	1	0	32	314	6	1	299	2	18:30	06:20	--
03/04/99	662	10	2	629	73	2	2	65	735	12	4	694	2	16:40	07:00	--
03/05/99	549	14	1	474	50	0	0	50	599	14	1	524	2	17:00	07:00	--

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	Nocturnal				Diurnal				Daily Totals**				Trap Operations Data			
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03/06/99	402	7	2	383	32	1	1	30	434	8	3	413	2	17:10	07:10	--
03/07/99	469	11	1	445	62	2	0	58	531	13	1	503	2	17:05	07:50	--
03/08/99	410	13	2	379	37	2	0	35	447	15	2	414	2	16:05	06:40	--
03/09/99	286	6	0	239	39	3	0	35	325	9	0	274	2	16:50	07:15	--
03/10/99	325	20	1	297	31	0	0	29	356	20	1	326	2	17:45	06:25	--
03/11/99	452	10	4	434	58	2	0	54	510	12	4	488	2	17:25	07:30	--
03/12/99	416	8	0	396	26	0	0	26	442	8	0	422	2	16:45	06:50	--
03/13/99	354	7	0	335	20	1	0	19	374	8	0	354	2	16:25	06:45	--
03/14/99	6	0	0	6	5	1	0	4	11	1	0	10	2	19:40	04:05	--
03/15/99	473	8	0	464	69	1	0	0	542	9	0	464	2	18:10	07:00	--
03/16/99	808	11	0	271	41	2	0	0	849	13	0	271	2	16:30	06:45	--
03/17/99	360	15	0	0	53	0	0	0	413	15	0	0	2	16:50	08:30	--
03/18/99	510	7	0	197	165	3	0	0	675	10	0	197	2	15:50	06:35	--
03/19/99	327	11	2	308	5	0	0	4	332	11	2	312	2	17:55	07:05	--
03/20/99	67	2	1	63	1	0	0	0	68	2	1	63	2	16:50	05:55	--
03/21/99	86	4	0	81	32	2	0	32	118	6	0	113	2	17:55	06:40	--
03/22/99	94	1	1	89	18	0	0	18	112	1	1	107	2	16:30	07:05	--
03/23/99	55	3	0	51	6	0	0	5	61	3	0	56	2	17:05	07:05	--
03/24/99	54	1	1	52	7	0	0	7	61	1	1	59	2	17:15	06:40	--
03/25/99	36	1	0	27	5	1	0	4	41	2	0	31	2	17:15	06:40	--
03/26/99	73	1	0	56	8	1	0	8	81	2	0	64	2	17:20	06:35	--
03/27/99	101	6	2	93	3	0	0	2	104	6	2	95	2	17:20	07:25	--
03/28/99	67	1	0	63	2	0	0	2	69	1	0	65	2	16:55	06:40	--
03/29/99	46	0	1	46	11	2	0	9	57	2	1	55	2	16:55	06:50	--
03/30/99	34	0	1	34	12	0	0	12	46	0	1	46	2	17:05	06:35	--
03/31/99	28	1	0	28	15	0	1	0	43	1	1	28	2	17:20	07:15	--
04/01/99	65	8	2	48	9	0	0	0	74	8	2	53	2	16:45	06:25	--
04/02/99	146	3	1	142	4	0	0	0	150	3	1	146	2	17:40	07:15	--
04/03/99	28	0	0	27	1	0	0	0	29	0	0	28	2	16:25	07:30	--
04/04/99	6	0	0	4	0	0	0	0	6	0	0	4	2	16:25	06:45	--
04/05/99	4	0	0	4	1	0	0	0	5	0	0	5	2	17:25	07:10	--
04/06/99	4	0	0	4	1	0	0	0	5	0	0	5	2	16:55	08:15	--
04/07/99	0	0	0	0	2	1	0	1	2	1	0	1	2	15:40	08:10	--
04/08/99	2	0	0	2	0	0	0	0	2	0	0	2	2	15:30	07:00	--
04/09/99	3	0	0	3	0	0	0	0	3	0	0	3	2	17:30	06:30	--
04/10/99	13	0	0	13	1	0	0	0	14	0	0	13	2	17:25	07:05	--
04/11/99	36	0	0	23	4	0	0	0	40	0	0	27	2	16:50	07:00	--
04/12/99	56	0	0	55	5	0	0	0	61	0	0	60	2	16:40	08:15	--
04/13/99	52	0	1	51	4	1	0	1	56	1	1	52	2	15:55	06:50	--
04/14/99	86	0	0	85	1	1	0	1	87	1	0	85	2	16:55	07:05	--

Appendix A. Daily trapping abundance of YOY fall-run chinook salmon: December 16, 1998 -- July 31, 1999.

	Nocturnal				Diurnal				Daily Totals**				Trap Operations Data			
Date	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
04/15/99	13	0	0	13	4	1	0	1	17	1	0	15	2	17:10	07:30	--
04/16/99	13	1	1	9	1	0	0	0	14	1	1	9	2	16:35	06:55	--
04/17/99	13	1	0	12	3	0	0	0	16	1	0	15	2	17:15	06:30	--
04/18/99	24	0	0	22	7	0	0	0	31	0	0	29	2	17:00	07:05	--
04/19/99	45	0	1	44	8	0	0	0	53	0	1	52	2	16:55	07:10	--
04/20/99	32	0	4	29	10	0	0	0	42	0	4	39	2	17:15	07:05	--
04/21/99	104	0	2	102	19	0	0	0	123	0	2	121	2	16:45	07:15	--
04/22/99	112	0	0	112	120	0	0	0	232	0	0	232	2	16:50	06:55	--
04/23/99	306	0	0	305	25	0	0	0	331	0	0	330	2	17:00	07:45	--
04/24/99	401	2	0	395	7	0	1	0	408	2	1	400	2	16:30	07:55	--
04/25/99	184	1	0	179	55	0	0	0	239	1	0	234	2	15:55	07:25	--
04/26/99	344	0	4	313	12	0	0	0	356	0	4	325	2	16:30	06:55	--
04/27/99	325	6	5	316	15	0	0	0	340	6	5	331	2	16:50	07:15	--
04/28/99	326	0	4	324	62	2	0	2	388	2	4	383	2	16:45	06:30	--
04/29/99	363	0	1	362	64	0	0	0	427	0	1	426	2	17:35	07:00	--
04/30/99	140	53	0	84	15	0	0	0	155	53	0	98	2	17:20	07:00	--
05/01/99	159	1	0	154	24	0	0	24	183	1	0	178	2	16:50	07:00	--
05/02/99	151	0	0	150	50	0	0	50	201	0	0	200	2	17:00	06:45	--
05/03/99	379	2	2	371	297	0	0	297	676	2	2	668	2	17:05	06:55	--
05/04/99	1756	1	7	1749	291	1	0	291	2047	2	7	2040	2	17:10	07:05	--
05/05/99	719	0	5	717	361	4	0	357	1080	4	5	1074	2	17:00	06:55	--
05/06/99	412	3	1	409	160	0	0	160	572	3	1	569	2	17:00	07:55	--
05/07/99	247	3	0	238	61	2	0	55	308	5	0	293	2	16:20	06:55	--
05/08/99	206	0	1	206	50	1	0	47	256	1	1	253	2	16:45	07:10	--
05/09/99	108	0	0	108	33	1	0	32	141	1	0	140	2	16:50	06:55	--
05/10/99	122	0	0	121	20	1	0	19	142	1	0	140	2	16:50	06:55	--
05/11/99	84	0	0	64	43	0	0	42	127	0	0	106	2	17:05	07:25	--
05/12/99	80	0	0	77	17	0	0	17	97	0	0	94	2	16:55	06:35	--
05/13/99	90	1	0	89	52	0	0	51	142	1	0	140	2	17:15	07:05	--
05/14/99	128	1	4	125	33	0	0	33	161	1	4	158	2	17:00	07:00	--
05/15/99	85	0	0	85	51	0	0	51	136	0	0	136	2	17:10	06:35	--
05/16/99	105	0	0	105	67	0	1	66	172	0	1	171	2	17:20	06:40	--
05/17/99	97	0	0	97	105	1	0	104	202	1	0	201	2	17:20	06:45	--
05/18/99	139	0	4	139	103	0	0	102	242	0	4	241	2	17:25	06:50	--
05/19/99	313	0	1	311	157	0	0	157	470	0	1	468	2	17:20	07:25	--
05/20/99	203	8	3	194	118	1	0	117	321	9	3	311	2	17:00	06:35	--
05/21/99	230	1	0	229	85	0	0	85	315	1	0	314	2	17:00	07:20	--
05/22/99	99	1	1	99	77	0	0	77	176	1	1	176	2	16:35	07:15	--
05/23/99	45	0	1	45	71	0	0	71	116	0	1	116	2	16:40	07:20	--
05/24/99	97	0	1	97	96	0	0	96	193	0	1	193	2	16:45	08:10	--

Appendix A. Daily trapping abundance of YOY fall-run chinook salmon: December 16, 1998 -- July 31, 1999.

	Nocturnal				Diurnal				Daily Totals**				Trap Operations Data			
Date	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
05/25/99	76	0	2	76	44	0	0	44	120	0	2	120	2	15:45	07:10	--
05/26/99	116	0	0	116	59	0	0	58	175	0	0	174	2	16:55	06:50	--
05/27/99	85	1	1	83	48	0	0	48	133	1	1	131	2	17:10	07:05	--
05/28/99	86	0	5	84	34	0	0	34	120	0	5	118	2	16:50	07:10	--
05/29/99	55	1	0	54	27	0	0	27	82	1	0	81	2	17:05	07:00	--
05/30/99	68	0	0	68	32	0	0	32	100	0	0	100	2	16:40	07:05	--
05/31/99	78	0	0	78	36	0	0	36	114	0	0	114	2	17:05	07:25	--
06/01/99	88	0	0	88	15	0	0	15	103	0	0	103	2	16:45	07:05	--
06/02/99	129	0	0	128	42	0	0	42	171	0	0	170	2	17:25	07:10	--
06/03/99	162	1	0	161	29	0	0	29	191	1	0	190	2	16:05	07:05	--
06/04/99	197	1	1	194	94	0	0	94	291	1	1	288	2	16:55	06:50	--
06/05/99	198	3	2	193	116	0	0	115	314	3	2	308	2	17:40	07:10	--
06/06/99	211	1	0	209	147	0	0	147	358	1	0	356	2	16:45	07:05	--
06/07/99	248	0	1	247	103	0	0	103	351	0	1	350	2	16:40	07:00	--
06/08/99	241	4	1	235	52	1	0	51	293	5	1	286	2	17:00	07:10	--
06/09/99	164	0	1	162	34	0	0	34	198	0	1	196	2	16:50	07:25	--
06/10/99	93	0	0	93	16	0	0	15	109	0	0	108	2	16:40	07:10	--
06/11/99	65	0	4	63	20	0	0	20	85	0	4	83	2	16:25	06:35	--
06/12/99	24	0	1	24	15	0	0	15	39	0	1	39	2	18:30	06:10	--
06/13/99	72	1	0	71	33	0	0	33	105	1	0	104	2	17:05	07:40	--
06/14/99	125	0	2	123	15	0	0	15	140	0	2	138	2	16:35	07:00	--
06/15/99	93	0	0	92	31	0	0	31	124	0	0	123	2	16:50	07:20	--
06/16/99	97	0	1	97	16	0	0	16	113	0	1	113	2	16:35	06:55	--
06/17/99	65	0	1	64	43	1	0	41	108	1	1	105	2	17:05	06:45	--
06/18/99	52	0	0	52	11	0	2	9	63	0	2	61	2	17:30	07:05	--
06/19/99	47	1	1	46	14	0	0	14	61	1	1	60	2	16:40	06:50	--
06/20/99	42	0	1	42	8	0	0	8	50	0	1	50	2	17:05	07:00	--
06/21/99	29	0	0	29	14	0	0	14	43	0	0	43	2	17:20	07:35	--
06/22/99	28	0	0	11	11	0	0	11	39	0	0	22	2	16:30	06:40	--
06/23/99	30	0	0	30	2	0	0	2	32	0	0	32	2	17:00	07:05	--
06/24/99	30	0	0	30	1	0	0	1	31	0	0	31	2	16:50	07:00	--
06/25/99	36	0	3	36	7	0	0	7	43	0	3	43	2	17:15	07:20	--
06/26/99	38	1	0	37	4	0	0	4	42	1	0	41	2	16:30	06:55	--
06/27/99	20	0	0	20	3	0	0	3	23	0	0	23	2	17:10	06:50	--
06/28/99	16	0	0	16	1	0	0	1	17	0	0	17	2	16:55	07:05	--
06/29/99	14	0	0	14	2	0	0	2	16	0	0	16	2	17:00	07:00	--
06/30/99	20	0	0	20	6	0	1	5	26	0	1	25	2	17:15	06:50	--
07/01/99	15	0	0	15	1	0	0	1	16	0	0	16	2	17:05	07:00	--
07/02/99	5	0	0	5	2	0	0	2	7	0	0	7	2	16:55	06:55	--
07/03/99	3	0	0	3	0	0	0	0	3	0	0	3	2	17:30	07:40	--

Appendix A. Daily trapping abundance of YOY fall-run chinook salmon: December 16, 1998 -- July 31, 1999.

	Nocturnal				Diurnal				Daily Totals**				Trap Operations Data			
Date	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Captured	Mortality***	Injury	CWT	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
07/04/99	6	0	0	6	1	0	0	1	7	0	0	7	2	16:00	08:10	--
07/05/99	6	0	0	6	1	0	0	1	7	0	0	7	2	15:30	07:10	--
07/06/99	0	0	0	0	1	0	0	1	1	0	0	1	2	17:05	06:55	--
07/07/99	3	0	0	1	3	0	0	3	6	0	0	4	2	17:25	06:45	--
07/08/99	0	0	0	0	0	0	0	0	0	0	0	0	2	16:45	07:30	--
07/09/99	8	0	0	8	0	0	0	0	8	0	0	8	2	16:45	06:45	--
07/10/99	2	1	0	0	0	0	0	0	2	1	0	0	2	17:45	06:50	--
07/11/99	5	1	0	3	0	0	0	0	5	1	0	3	2	17:25	05:55	--
07/12/99	1	0	0	0	1	0	0	0	2	0	0	0	2	17:40	07:20	--
07/13/99	1	0	0	0	0	0	0	0	1	0	0	0	2	16:45	06:20	--
07/14/99	2	0	0	0	1	0	0	1	3	0	0	1	2	17:15	07:15	--
07/15/99	1	0	0	0	0	0	0	0	1	0	0	0	2	16:45	06:55	--
07/16/99	3	0	0	0	2	0	0	0	5	0	0	0	2	17:00	06:55	--
07/17/99	3	0	0	0	0	0	0	0	3	0	0	0	2	17:15	07:05	--
07/18/99	2	0	0	0	1	1	0	1	3	1	0	1	2	16:45	07:00	--
07/19/99	6	0	0	6	0	0	0	0	6	0	0	6	2	17:20	06:55	--
07/20/99	0	0	0	0	0	0	0	0	0	0	0	0	2	16:45	07:10	--
07/21/99	0	0	0	0	1	0	0	1	1	0	0	1	2	16:50	07:05	--
07/22/99	0	0	0	0	0	0	0	0	0	0	0	0	2	16:45	06:45	--
07/23/99	3	1	0	2	1	0	0	1	4	1	0	3	2	17:20	07:00	--
07/24/99	3	0	0	3	1	0	0	0	4	0	0	3	2	17:15	06:50	--
07/25/99	2	0	1	2	0	0	0	0	2	0	1	2	2	17:05	06:55	--
07/26/99	1	0	0	1	0	0	0	0	1	0	0	1	2	17:05	06:55	--
07/27/99	1	0	0	1	0	0	0	0	1	0	0	1	2	17:00	07:15	--
07/28/99	2	0	0	2	0	0	0	0	2	0	0	2	2	16:30	07:25	--
07/29/99	0	0	0	0	0	0	0	0	0	0	0	0	2	16:50	07:20	--
07/30/99	0	0	0	0	1	0	1	1	1	0	1	1	2	16:40	07:00	--
07/31/99	1	0	0	1	1	1	0	0	2	1	0	1	2	17:00	06:35	--
TOTALS	54893	2553	211	45591	10493	181	11	8178	67580	2792	229	55896				

* Trap checked once daily or every other day without regard to diel (day/night) intervals.

** Daily totals include fish captured during nocturnal, diurnal, and non-diel specific periods. Therefore, sum of nocturnal and diurnal counts will not always equal daily total if non-diel specific captures occur.

*** Includes mortality observed in traps only.

Appendix B. Daily trapping abundance of juvenile steelhead: December 16, 1998 -- July 31, 1999.

Date	Nocturnal			Diurnal			Daily Totals**			Trap Operations Data			
	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
12/16/98	--	--	--	--	--	--	0	136	49	2	--	--	21:00
12/17/98	--	--	--	--	--	--	0	187	96	2	--	--	24:05
12/18/98	--	--	--	--	--	--	0	39	35	2	--	--	22:40
12/19/98	--	--	--	--	--	--	0	46	44	2	--	--	23:55
12/20/98	--	--	--	--	--	--	0	42	42	2	--	--	24:05
12/21/98	--	--	--	--	--	--	0	20	19	2	--	--	24:20
12/22/98	--	--	--	--	--	--	0	0	0	2	--	--	23:30
12/23/98	0	19	19	--	--	--	0	19	19	2	17:25	--	--
12/24/98	--	--	--	0	0	0	0	13	13	2	--	06:00	24:00
12/25/98	--	--	--	--	--	--	0	0	0	2	--	--	lshed until 12/26/98
12/26/98	--	--	--	--	--	--	0	10	10	2	--	--	41:55
12/27/98	--	--	--	--	--	--	0	12	12	2	--	--	23:55
12/28/98	--	--	--	--	--	--	0	5	0	2	--	--	24:05
12/29/98	--	--	--	--	--	--	0	3	3	2	--	--	23:40
12/30/98	--	--	--	--	--	--	0	5	4	2	--	--	24:05
12/31/98	--	--	--	--	--	--	0	8	8	2	--	--	23:50
01/01/99	--	--	--	--	--	--	0	6	6	2	--	--	24:30
01/02/99	--	--	--	--	--	--	0	2	2	2	--	--	23:35
01/03/99	--	--	--	--	--	--	0	1	1	2	--	--	24:05
01/04/99	--	--	--	--	--	--	0	3	1	2	--	--	24:20
01/05/99	--	--	--	--	--	--	0	4	4	2	--	--	23:40
01/06/99	--	--	--	0	0	0	0	4	4	2	--	07:10	24:05
01/07/99	0	2	2	--	--	--	0	2	2	2	17:10	--	--
01/08/99	--	--	--	--	--	--	0	1	1	2	--	--	23:20
01/09/99	--	--	--	--	--	--	0	1	0	2	--	--	25:00
01/10/99	--	--	--	--	--	--	0	0	0	2	--	--	23:20
01/11/99	--	--	--	--	--	--	0	0	0	2	--	--	24:15
01/12/99	--	--	--	--	--	--	0	6	6	2	--	--	24:10
01/13/99	--	--	--	--	--	--	0	2	0	2	--	--	23:45
01/14/99	--	--	--	--	--	--	0	0	0	2	--	--	24:25
01/15/99	--	--	--	--	--	--	0	2	2	2	--	--	23:20
01/16/99	--	--	--	--	--	--	0	2	2	2	--	--	24:55
01/17/99	--	--	--	--	--	--	0	3	3	2	--	--	23:10
01/18/99	--	--	--	--	--	--	0	3	3	2	--	--	24:10
01/19/99	--	--	--	--	--	--	0	3	2	2	--	--	24:10
01/20/99	--	--	--	--	--	--	0	2	1	2	--	--	24:40
01/21/99	--	--	--	--	--	--	0	1	1	2	--	--	23:15
01/22/99	--	--	--	--	--	--	0	0	0	2	--	--	25:00
01/23/99	--	--	--	--	--	--	0	8	7	2	--	--	23:10
01/24/99	--	--	--	--	--	--	0	5	5	2	--	--	23:50
01/25/99	--	--	--	--	--	--	0	1	1	2	--	--	24:00
01/26/99	--	--	--	--	--	--	0	3	2	2	--	--	23:50
01/27/99	--	--	--	--	--	--	0	2	2	2	--	--	23:55
01/28/99	--	--	--	--	--	--	0	0	0	2	--	--	24:10

Appendix B. Daily trapping abundance of juvenile steelhead: December 16, 1998 -- July 31, 1999.

Date	Nocturnal			Diurnal			Daily Totals**			Trap Operations Data			
	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
01/29/99	--	--	--	--	--	--	0	0	0	2	--	--	24:15
01/30/99	--	--	--	--	--	--	0	1	1	2	--	--	24:25
01/31/99	--	--	--	--	--	--	0	4	4	2	--	--	23:40
02/01/99	--	--	--	0	0	0	0	4	2	2	--	06:55	24:00
02/02/99	0	0	0	0	0	0	0	0	0	2	17:30	07:10	--
02/03/99	0	0	0	0	0	0	0	0	0	2	18:55	04:45	--
02/04/99	0	1	0	0	0	0	0	1	0	2	18:55	05:24	--
02/05/99	0	3	3	0	1	1	0	4	4	2	17:51	06:05	--
02/06/99	0	1	1	0	0	0	0	1	1	2	15:55	07:38	--
02/07/99	0	1	1	0	0	0	0	1	1	2	16:47	06:45	--
02/08/99	0	1	0	0	1	1	0	2	1	2	18:50	05:40	--
02/09/99	--	--	--	--	--	--	0	0	0	2	--	--	23:55
02/10/99	0	0	0	0	0	0	0	0	0	2	16:35	07:10	--
02/11/99	--	--	--	0	0	0	0	0	0	2	--	09:00	--
02/12/99	0	0	0	0	0	0	0	0	0	2	16:15	06:45	--
02/13/99	0	0	0	0	1	0	0	1	0	2	18:00	06:00	--
02/14/99	0	0	0	0	0	0	0	0	0	2	17:50	06:10	--
02/15/99	0	0	0	0	0	0	0	0	0	2	17:50	06:30	--
02/16/99	0	0	0	0	0	0	0	0	0	2	17:10	07:15	--
02/17/99	0	0	0	0	0	0	0	0	0	2	17:45	05:30	--
02/18/99	0	0	0	0	0	0	0	0	0	2	18:00	05:15	--
02/19/99	0	0	0	0	0	0	0	0	0	2	18:30	06:00	--
02/20/99	0	0	0	0	0	0	0	0	0	2	17:45	06:20	--
02/21/99	0	0	0	0	0	0	0	0	0	2	17:35	06:25	--
02/22/99	0	0	0	0	0	0	0	0	0	2	18:20	05:15	--
02/23/99	0	1	1	0	0	0	0	1	1	2	18:00	06:30	--
02/24/99	0	0	0	0	0	0	0	0	0	2	17:10	06:15	--
02/25/99	0	0	0	0	0	0	0	0	0	2	18:00	05:50	--
02/26/99	0	0	0	0	0	0	0	0	0	2	17:30	06:50	--
02/27/99	0	0	0	0	0	0	0	0	0	2	17:30	06:30	--
02/28/99	0	0	0	0	0	0	0	0	0	2	17:50	06:50	--
03/01/99	0	0	0	0	0	0	0	0	0	2	16:30	06:20	--
03/02/99	0	0	0	0	0	0	0	0	0	2	19:20	05:00	--
03/03/99	0	0	0	0	0	0	0	0	0	2	18:30	06:20	--
03/04/99	0	0	0	0	0	0	0	0	0	2	16:40	07:00	--
03/05/99	0	0	0	0	0	0	0	0	0	2	17:00	07:00	--
03/06/99	0	0	0	0	0	0	0	0	0	2	17:10	07:10	--
03/07/99	0	0	0	0	0	0	0	0	0	2	17:05	07:50	--
03/08/99	0	0	0	0	0	0	0	0	0	2	16:05	06:40	--
03/09/99	0	0	0	0	0	0	0	0	0	2	16:50	07:15	--
03/10/99	0	0	0	0	0	0	0	0	0	2	17:45	06:25	--
03/11/99	0	0	0	0	0	0	0	0	0	2	17:25	07:30	--
03/12/99	0	0	0	0	0	0	0	0	0	2	16:45	06:50	--
03/13/99	0	0	0	0	0	0	0	0	0	2	16:25	06:45	--

Appendix B. Daily trapping abundance of juvenile steelhead: December 16, 1998 -- July 31, 1999.

Date	Nocturnal			Diurnal			Daily Totals**			Trap Operations Data			
	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
03/14/99	0	0	0	0	0	0	0	0	0	2	19:40	04:05	--
03/15/99	0	0	0	0	0	0	0	0	0	2	18:10	07:00	--
03/16/99	0	0	0	0	0	0	0	0	0	2	16:30	06:45	--
03/17/99	0	0	0	0	0	0	0	0	0	2	16:50	08:30	--
03/18/99	0	0	0	0	0	0	0	0	0	2	15:50	06:35	--
03/19/99	0	1	1	0	0	0	0	1	1	2	17:55	07:05	--
03/20/99	0	0	0	0	0	0	0	0	0	2	16:50	05:55	--
03/21/99	0	0	0	0	0	0	0	0	0	2	17:55	06:40	--
03/22/99	0	0	0	0	0	0	0	0	0	2	16:30	07:05	--
03/23/99	0	0	0	0	0	0	0	0	0	2	17:05	07:05	--
03/24/99	0	0	0	0	0	0	0	0	0	2	17:15	06:40	--
03/25/99	0	0	0	0	0	0	0	0	0	2	17:15	06:40	--
03/26/99	0	1	0	0	0	0	0	1	0	2	17:20	06:35	--
03/27/99	0	2	0	0	0	0	0	2	0	2	17:20	07:25	--
03/28/99	0	1	0	0	0	0	0	1	0	2	16:55	06:40	--
03/29/99	0	0	0	0	0	0	0	0	0	2	16:55	06:50	--
03/30/99	0	1	0	0	0	0	0	1	0	2	17:05	06:35	--
03/31/99	0	0	0	0	0	0	0	0	0	2	17:20	07:15	--
04/01/99	0	1	1	0	0	0	0	1	1	2	16:45	06:25	--
04/02/99	0	1	1	0	0	0	0	1	1	2	17:40	07:15	--
04/03/99	0	0	0	0	1	1	0	1	1	2	16:25	07:30	--
04/04/99	0	0	0	0	0	0	0	0	0	2	16:25	06:45	--
04/05/99	0	0	0	0	0	0	0	0	0	2	17:25	07:10	--
04/06/99	0	0	0	0	0	0	0	0	0	2	16:55	08:15	--
04/07/99	0	1	1	0	0	0	0	1	1	2	15:40	08:10	--
04/08/99	0	0	0	0	1	0	0	1	0	2	15:30	07:00	--
04/09/99	0	0	0	0	0	0	0	0	0	2	17:30	06:30	--
04/10/99	0	0	0	0	0	0	0	0	0	2	17:25	07:05	--
04/11/99	0	0	0	0	0	0	0	0	0	2	16:50	07:00	--
04/12/99	0	1	0	0	0	0	0	1	0	2	16:40	08:15	--
04/13/99	0	0	0	0	0	0	0	0	0	2	15:55	06:50	--
04/14/99	0	1	0	0	1	0	0	2	0	2	16:55	07:05	--
04/15/99	0	0	0	0	0	0	0	0	0	2	17:10	07:30	--
04/16/99	0	1	0	0	0	0	0	1	0	2	16:35	06:55	--
04/17/99	0	0	0	0	0	0	0	0	0	2	17:15	06:30	--
04/18/99	2	1	0	0	0	0	2	1	0	2	17:00	07:05	--
04/19/99	0	0	0	0	0	0	0	0	0	2	16:55	07:10	--
04/20/99	0	0	0	0	1	1	0	1	1	2	17:15	07:05	--
04/21/99	0	2	0	0	0	0	0	2	0	2	16:45	07:15	--
04/22/99	0	0	0	0	1	0	0	1	0	2	16:50	06:55	--
04/23/99	0	2	0	0	0	0	0	2	0	2	17:00	07:45	--
04/24/99	0	0	0	0	0	0	0	0	0	2	16:30	07:55	--
04/25/99	0	0	0	0	0	0	0	0	0	2	15:55	07:25	--
04/26/99	0	1	0	0	0	0	0	1	0	2	16:30	06:55	--

Appendix B. Daily trapping abundance of juvenile steelhead: December 16, 1998 -- July 31, 1999.

Date	Nocturnal			Diurnal			Daily Totals**			Trap Operations Data			
	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
04/27/99	0	0	0	0	1	0	0	1	0	2	16:50	07:15	--
04/28/99	0	0	0	0	2	0	0	2	0	2	16:45	06:30	--
04/29/99	0	1	0	0	0	0	0	1	0	2	17:35	07:00	--
04/30/99	0	0	0	0	0	0	0	0	0	2	17:20	07:00	--
05/01/99	0	0	0	0	0	0	0	0	0	2	16:50	07:00	--
05/02/99	0	0	0	0	1	0	0	1	0	2	17:00	06:45	--
05/03/99	1	0	0	0	1	0	1	1	0	2	17:05	06:55	--
05/04/99	0	0	0	0	0	0	0	0	0	2	17:10	07:05	--
05/05/99	0	0	0	0	0	0	0	0	0	2	17:00	06:55	--
05/06/99	0	0	0	0	0	0	0	0	0	2	17:00	07:55	--
05/07/99	0	0	0	0	0	0	0	0	0	2	16:20	06:55	--
05/08/99	0	0	0	0	0	0	0	0	0	2	16:45	07:10	--
05/09/99	0	0	0	0	0	0	0	0	0	2	16:50	06:55	--
05/10/99	0	0	0	0	0	0	0	0	0	2	16:50	06:55	--
05/11/99	0	1	0	0	0	0	0	1	0	2	17:05	07:25	--
05/12/99	0	1	0	0	0	0	0	1	0	2	16:55	06:35	--
05/13/99	0	0	0	0	0	0	0	0	0	2	17:15	07:05	--
05/14/99	1	0	0	0	0	0	1	0	0	2	17:00	07:00	--
05/15/99	0	0	0	0	0	0	0	0	0	2	17:10	06:35	--
05/16/99	1	1	0	0	0	0	1	1	0	2	17:20	06:40	--
05/17/99	0	0	0	0	0	0	0	0	0	2	17:20	06:45	--
05/18/99	0	0	0	0	0	0	0	0	0	2	17:25	06:50	--
05/19/99	1	0	0	0	0	0	1	0	0	2	17:20	07:25	--
05/20/99	0	0	0	0	0	0	0	0	0	2	17:00	06:35	--
05/21/99	1	0	0	0	0	0	1	0	0	2	17:00	07:20	--
05/22/99	0	0	0	0	0	0	0	0	0	2	16:35	07:15	--
05/23/99	1	0	0	0	0	0	1	0	0	2	16:40	07:20	--
05/24/99	0	0	0	0	0	0	0	0	0	2	16:45	08:10	--
05/25/99	0	0	0	0	0	0	0	0	0	2	15:45	07:10	--
05/26/99	0	0	0	0	0	0	0	0	0	2	16:55	06:50	--
05/27/99	2	0	0	0	0	0	2	0	0	2	17:10	07:05	--
05/28/99	0	1	1	0	0	0	0	1	1	2	16:50	07:10	--
05/29/99	0	0	0	0	0	0	0	0	0	2	17:05	07:00	--
05/30/99	0	0	0	0	0	0	0	0	0	2	16:40	07:05	--
05/31/99	0	1	0	0	1	0	0	2	0	2	17:05	07:25	--
06/01/99	0	0	0	0	0	0	0	0	0	2	16:45	07:05	--
06/02/99	0	0	0	0	0	0	0	0	0	2	17:25	07:10	--
06/03/99	1	0	0	0	0	0	1	0	0	2	16:05	07:05	--
06/04/99	1	0	0	0	0	0	1	0	0	2	16:55	06:50	--
06/05/99	4	0	0	0	0	0	4	0	0	2	17:40	07:10	--
06/06/99	3	0	0	0	0	0	3	0	0	2	16:45	07:05	--
06/07/99	3	0	0	0	0	0	3	0	0	2	16:40	07:00	--
06/08/99	0	2	0	0	0	0	0	2	0	2	17:00	07:10	--
06/09/99	5	1	1	0	0	0	5	1	1	2	16:50	07:25	--

Appendix B. Daily trapping abundance of juvenile steelhead: December 16, 1998 -- July 31, 1999.

	Nocturnal			Diurnal			Daily Totals**			Trap Operations Data			
Date	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
06/10/99	3	0	0	0	0	0	3	0	0	2	16:40	07:10	--
06/11/99	6	0	0	0	0	0	6	0	0	2	16:25	06:35	--
06/12/99	2	0	0	0	0	0	2	0	0	2	18:30	06:10	--
06/13/99	7	0	0	0	0	0	7	0	0	2	17:05	07:40	--
06/14/99	2	2	0	1	0	0	3	2	0	2	16:35	07:00	--
06/15/99	6	0	0	0	0	0	6	0	0	2	16:50	07:20	--
06/16/99	6	0	0	0	0	0	6	0	0	2	16:35	06:55	--
06/17/99	3	0	0	0	0	0	3	0	0	2	17:05	06:45	--
06/18/99	5	0	0	0	0	0	5	0	0	2	17:30	07:05	--
06/19/99	3	0	0	0	0	0	3	0	0	2	16:40	06:50	--
06/20/99	2	0	0	0	0	0	2	0	0	2	17:05	07:00	--
06/21/99	1	0	0	0	0	0	1	0	0	2	17:20	07:35	--
06/22/99	2	0	0	0	0	0	2	0	0	2	16:30	06:40	--
06/23/99	3	0	0	0	0	0	3	0	0	2	17:00	07:05	--
06/24/99	3	0	0	0	0	0	3	0	0	2	16:50	07:00	--
06/25/99	7	0	0	0	0	0	7	0	0	2	17:15	07:20	--
06/26/99	3	0	0	0	0	0	3	0	0	2	16:30	06:55	--
06/27/99	2	0	0	0	0	0	2	0	0	2	17:10	06:50	--
06/28/99	5	0	0	0	0	0	5	0	0	2	16:55	07:05	--
06/29/99	2	0	0	1	0	0	3	0	0	2	17:00	07:00	--
06/30/99	3	0	0	0	0	0	3	0	0	2	17:15	06:50	--
07/01/99	1	0	0	0	0	0	1	0	0	2	17:05	07:00	--
07/02/99	3	0	0	3	0	0	6	0	0	2	16:55	06:55	--
07/03/99	0	0	0	0	0	0	0	0	0	2	17:30	07:40	--
07/04/99	2	0	0	0	0	0	2	0	0	2	16:00	08:10	--
07/05/99	0	0	0	1	0	0	1	0	0	2	15:30	07:10	--
07/06/99	2	0	0	0	0	0	2	0	0	2	17:05	06:55	--
07/07/99	2	1	1	1	0	0	3	1	1	2	17:25	06:45	--
07/08/99	0	0	0	0	0	0	0	0	0	2	16:45	07:30	--
07/09/99	1	0	0	0	0	0	1	0	0	2	16:45	06:45	--
07/10/99	1	0	0	0	0	0	1	0	0	2	17:45	06:50	--
07/11/99	3	0	0	0	0	0	3	0	0	2	17:25	05:55	--
07/12/99	2	0	0	0	0	0	2	0	0	2	17:40	07:20	--
07/13/99	2	0	0	0	0	0	2	0	0	2	16:45	06:20	--
07/14/99	2	0	0	0	0	0	2	0	0	2	17:15	07:15	--
07/15/99	1	0	0	0	0	0	1	0	0	2	16:45	06:55	--
07/16/99	1	0	0	0	0	0	1	0	0	2	17:00	06:55	--
07/17/99	1	0	0	1	0	0	2	0	0	2	17:15	07:05	--
07/18/99	0	0	0	0	0	0	0	0	0	2	16:45	07:00	--
07/19/99	1	0	0	1	0	0	2	0	0	2	17:20	06:55	--
07/20/99	3	0	0	0	0	0	3	0	0	2	16:45	07:10	--
07/21/99	2	1	0	0	0	0	2	1	0	2	16:50	07:05	--
07/22/99	2	0	0	0	0	0	2	0	0	2	16:45	06:45	--
07/23/99	2	0	0	0	0	0	2	0	0	2	17:20	07:00	--

Appendix B. Daily trapping abundance of juvenile steelhead: December 16, 1998 -- July 31, 1999.

Date	Nocturnal			Diurnal			Daily Totals**			Trap Operations Data			
	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	YOY	Age 1+	Age 1+ Ad-clip	Number Fished	Nocturnal (Hours)	Diurnal (Hours)	Non-Diel Specific* (Hours)
07/24/99	3	0	0	1	0	0	4	0	0	2	17:15	06:50	--
07/25/99	2	0	0	0	0	0	2	0	0	2	17:05	06:55	--
07/26/99	2	0	0	0	0	0	2	0	0	2	17:05	06:55	--
07/27/99	1	0	0	0	0	0	1	0	0	2	17:00	07:15	--
07/28/99	0	0	0	0	0	0	0	0	0	2	16:30	07:25	--
07/29/99	1	0	0	0	0	0	1	0	0	2	16:50	07:20	--
07/30/99	2	0	0	0	0	0	2	0	0	2	16:40	07:00	--
07/31/99	3	0	0	1	0	0	4	0	0	2	17:00	06:35	--
TOTALS	151	60	34	11	14	4	162	674	436				

* Trap checked once daily or every other day without regard to diel (day/night) intervals.

** Daily totals include fish captured during nocturnal, diurnal, and non-diel specific periods. Therefore, sum of nocturnal and diurnal counts will not always equal daily total if non-diel specific captures occur.

Appendix C-1. Estimated daily abundance of downstream migrant fall-run chinook salmon: December 16, 1998 - July 31, 1999.

Note: Differences in totals may be attributable to rounding.
n/a - indicates that separate diel census data and estimates for day and night passage abundance is not available.

Date	YOY# Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est No. YOY Total	95% Confidence Interval Hi	Lo
12/16/98	n/a	n/a	0.331	0.250	n/a	n/a	0	0	0
12/17/98	n/a	n/a	0.331	0.250	n/a	n/a	0	0	0
12/18/98	n/a	n/a	0.331	0.250	n/a	n/a	0	0	0
12/19/98	n/a	n/a	0.331	0.250	n/a	n/a	4	4	4
12/20/98	n/a	n/a	0.331	0.250	n/a	n/a	4	4	4
12/21/98	n/a	n/a	0.331	0.250	n/a	n/a	0	0	0
12/22/98	n/a	n/a	0.331	0.250	n/a	n/a	0	0	0
12/23/98	n/a	13	0.331	0.250	n/a	52	52	58	47
12/24/98	0	11	0.331	0.250	0	44	44	49	40
12/25/98	n/a	n/a	0.331	0.250	n/a	n/a	n/a	n/a	n/a
12/26/98	n/a	n/a	0.331	0.250	n/a	n/a	20	22	18
12/27/98	n/a	n/a	0.331	0.250	n/a	n/a	32	35	29
12/28/98	n/a	n/a	0.331	0.250	n/a	n/a	12	13	11
12/29/98	n/a	n/a	0.331	0.250	n/a	n/a	40	44	36
12/30/98	n/a	n/a	0.331	0.250	n/a	n/a	16	18	15
12/31/98	n/a	n/a	0.331	0.250	n/a	n/a	12	13	11
01/01/99	n/a	n/a	0.331	0.250	n/a	n/a	4	4	4
01/02/99	n/a	n/a	0.331	0.250	n/a	n/a	12	13	11
01/03/99	n/a	n/a	0.331	0.250	n/a	n/a	48	53	44
01/04/99	n/a	n/a	0.331	0.250	n/a	n/a	8	9	7
01/05/99	n/a	n/a	0.331	0.250	n/a	n/a	0	0	0
01/06/99	0	1	0.331	0.250	n/a	4	4	4	4
01/07/99	n/a	7	0.331	0.250	n/a	28	28	31	26
01/08/99	n/a	n/a	0.331	0.250	n/a	n/a	20	22	18
01/09/99	n/a	n/a	0.331	0.250	n/a	n/a	12	13	11
01/10/99	n/a	n/a	0.331	0.250	n/a	n/a	12	13	11
01/11/99	n/a	n/a	0.331	0.250	n/a	n/a	40	44	36
01/12/99	n/a	n/a	0.331	0.250	n/a	n/a	112	124	102
01/13/99	n/a	n/a	0.331	0.250	n/a	n/a	132	146	120
01/14/99	n/a	n/a	0.331	0.250	n/a	n/a	72	80	66
01/15/99	n/a	n/a	0.331	0.250	n/a	n/a	32	35	29
01/16/99	n/a	n/a	0.331	0.250	n/a	n/a	24	27	22
01/17/99	n/a	n/a	0.331	0.250	n/a	n/a	24	27	22
01/18/99	n/a	n/a	0.331	0.250	n/a	n/a	24	27	22
01/19/99	n/a	n/a	0.331	0.250	n/a	n/a	4	4	4
01/20/99	n/a	n/a	0.331	0.250	n/a	n/a	28	31	26
01/21/99	n/a	n/a	0.331	0.250	n/a	n/a	52	58	47
01/22/99	n/a	n/a	0.331	0.250	n/a	n/a	64	71	58
01/23/99	n/a	n/a	0.331	0.250	n/a	n/a	76	84	69
01/24/99	n/a	n/a	0.331	0.250	n/a	n/a	164	181	150
01/25/99	n/a	n/a	0.331	0.250	n/a	n/a	136	150	124
01/26/99	n/a	n/a	0.331	0.250	n/a	n/a	116	128	106
01/27/99	n/a	n/a	0.331	0.250	n/a	n/a	204	226	186
01/28/99	n/a	n/a	0.331	0.250	n/a	n/a	296	327	270
01/29/99	n/a	n/a	0.331	0.250	n/a	n/a	412	456	376
01/30/99	n/a	n/a	0.331	0.250	n/a	n/a	844	934	770
01/31/99	n/a	n/a	0.331	0.250	n/a	n/a	444	491	405
02/01/99	6	102	0.331	0.250	18	408	426	471	389
02/02/99	102	5483	0.331	0.250	308	21932	22240	24595	20297
02/03/99	82	3135	0.147	0.067	558	46791	47349	66013	36917
02/04/99	31	1150	0.147	0.067	211	17164	17375	24223	13547
02/05/99	176	3373	0.147	0.067	1197	50343	51541	71775	40215
02/06/99	457	1668	0.147	0.067	3109	24896	28004	38656	21977
02/07/99	52	98	0.147	0.067	354	1463	1816	2486	1433

Appendix C-1. Estimated daily abundance of downstream migrant fall-run chinook salmon: December 16, 1998 - July 31, 1999.

Note: Differences in totals may be attributable to rounding.
n/a - indicates that separate diel census data and estimates for day and night passage abundance is not available.

Date	YOY# Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est No. YOY Total	95% Confidence Interval Hi	Lo
02/08/99	364	467	0.147	0.067	2476	6970	9446	12840	7487
02/09/99	184	1007	0.054	0.025	3404	40288	43691	67433	32367
02/10/99	92	952	0.054	0.025	1704	38080	39784	61744	29373
02/11/99	617	n/a	0.054	0.025	11426	n/a	11426	15049	9209
02/12/99	164	419	0.054	0.025	3037	16760	19797	30188	14771
02/13/99	448	1494	0.054	0.025	8296	59760	68056	104302	50628
02/14/99	531	2864	0.054	0.025	9833	114560	124393	191951	92161
02/15/99	198	2697	0.054	0.025	3667	107880	111547	173392	82279
02/16/99	227	929	0.054	0.025	4204	37160	41364	63599	30712
02/17/99	58	903	0.054	0.025	1074	36120	37194	57852	27424
02/18/99	149	677	0.054	0.025	2759	27080	29839	45947	22136
02/19/99	160	1008	0.054	0.025	2963	40320	43283	66902	32035
02/20/99	154	1241	0.054	0.025	2852	49640	52492	81319	38799
02/21/99	146	451	0.054	0.025	2704	18040	20744	31748	15444
02/22/99	200	500	0.054	0.025	3704	20000	23704	36128	17691
02/23/99	204	625	0.054	0.025	3778	25000	28778	44038	21427
02/24/99	210	892	0.054	0.025	3889	35680	39569	60872	29370
02/25/99	213	484	0.054	0.025	3944	19360	23304	35445	17414
02/26/99	220	781	0.054	0.025	4074	31240	35314	54178	26254
02/27/99	68	770	0.054	0.025	1259	30800	32059	49784	23662
02/28/99	35	577	0.054	0.025	648	23080	23728	36916	17493
03/01/99	78	154	0.054	0.025	1444	6160	7604	11527	5694
03/02/99	45	628	0.054	0.025	833	25120	25953	40348	19142
03/03/99	34	280	0.054	0.025	630	11200	11830	18329	8743
03/04/99	73	662	0.054	0.025	1352	26480	27832	43155	20560
03/05/99	50	549	0.054	0.025	926	21960	22886	35532	16893
03/06/99	32	402	0.054	0.025	593	16080	16673	25905	12301
03/07/99	62	469	0.054	0.025	1148	18760	19908	30825	14719
03/08/99	37	410	0.054	0.025	685	16400	17085	26527	12611
03/09/99	39	286	0.054	0.025	722	11440	12162	18826	8994
03/10/99	31	325	0.054	0.025	574	13000	13574	21069	10022
03/11/99	58	452	0.236	0.112	246	4036	4281	5302	3592
03/12/99	26	416	0.236	0.112	110	3714	3824	4748	3203
03/13/99	20	354	0.236	0.112	85	3161	3245	4030	2717
03/14/99	5	6	0.236	0.112	21	54	75	91	64
03/15/99	69	473	0.236	0.112	292	4223	4516	5589	3790
03/16/99	41	808	0.236	0.112	174	7214	7388	9176	6185
03/17/99	53	360	0.236	0.112	225	3214	3439	4256	2887
03/18/99	165	510	0.236	0.112	699	4554	5253	6464	4429
03/19/99	5	327	0.236	0.112	21	2920	2941	3657	2459
03/20/99	1	67	0.236	0.112	4	598	602	749	504
03/21/99	32	86	0.236	0.112	136	768	903	1110	763
03/22/99	18	94	0.236	0.112	76	839	916	1131	769
03/23/99	6	55	0.236	0.112	25	491	516	640	433
03/24/99	7	54	0.236	0.112	30	482	512	634	429
03/25/99	5	36	0.236	0.112	21	321	343	424	288
03/26/99	8	73	0.236	0.112	34	652	686	850	575
03/27/99	3	101	0.236	0.112	13	902	914	1137	765
03/28/99	2	67	0.236	0.112	8	598	607	754	508
03/29/99	11	46	0.236	0.112	47	411	457	564	385
03/30/99	12	34	0.236	0.112	51	304	354	436	299
03/31/99	15	28	0.236	0.112	64	250	314	384	266
04/01/99	9	65	0.133	0.091	68	714	782	1122	600
04/02/99	4	146	0.133	0.091	30	1604	1634	2357	1251

Appendix C-1. Estimated daily abundance of downstream migrant fall-run chinook salmon: December 16, 1998 - July 31, 1999.

Note: Differences in totals may be attributable to rounding.
n/a - indicates that separate diel census data and estimates for day and night passage abundance is not available.

Date	YOY# Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est No. YOY Total	95% Confidence Interval Hi	Lo
04/03/99	1	28	0.133	0.091	8	308	315	454	241
04/04/99	0	6	0.133	0.091	0	66	66	95	50
04/05/99	1	4	0.133	0.091	8	44	51	73	40
04/06/99	1	4	0.133	0.091	8	44	51	73	40
04/07/99	2	0	0.133	0.091	15	0	15	20	12
04/08/99	0	2	0.133	0.091	0	22	22	32	17
04/09/99	0	3	0.133	0.091	0	33	33	48	25
04/10/99	1	13	0.133	0.091	8	143	150	216	115
04/11/99	4	36	0.133	0.091	30	396	426	611	327
04/12/99	5	56	0.126	0.084	40	667	706	910	577
04/13/99	4	52	0.126	0.084	32	619	651	839	532
04/14/99	1	86	0.126	0.084	8	1024	1032	1333	842
04/15/99	4	13	0.126	0.084	32	155	187	239	153
04/16/99	1	13	0.126	0.084	8	155	163	210	133
04/17/99	3	13	0.126	0.084	24	155	179	229	146
04/18/99	7	24	0.126	0.084	56	286	341	437	280
04/19/99	8	45	0.126	0.084	63	536	599	770	491
04/20/99	10	32	0.126	0.084	79	381	460	589	378
04/21/99	19	104	0.126	0.084	151	1238	1389	1784	1137
04/22/99	120	112	0.126	0.084	952	1333	2286	2888	1893
04/23/99	25	306	0.126	0.084	198	3643	3841	4950	3139
04/24/99	7	401	0.126	0.084	56	4774	4829	6237	3940
04/25/99	55	184	0.126	0.084	437	2190	2627	3365	2156
04/26/99	12	344	0.126	0.084	95	4095	4190	5409	3420
04/27/99	15	325	0.126	0.084	119	3869	3988	5146	3256
04/28/99	62	326	0.126	0.084	492	3881	4373	5617	3581
04/29/99	64	363	0.126	0.084	508	4321	4829	6206	3954
04/30/99	15	140	0.126	0.084	119	1667	1786	2299	1460
05/01/99	24	159	0.126	0.084	190	1893	2083	2679	1705
05/02/99	50	151	0.126	0.084	397	1798	2194	2809	1802
05/03/99	297	379	0.126	0.084	2357	4512	6869	8714	5673
05/04/99	291	1756	0.126	0.084	2310	20905	23214	29841	19002
05/05/99	361	719	0.126	0.084	2865	8560	11425	14566	9403
05/06/99	160	412	0.126	0.084	1270	4905	6175	7892	5074
05/07/99	61	247	0.126	0.084	484	2940	3425	4392	2807
05/08/99	50	206	0.126	0.084	397	2452	2849	3655	2336
05/09/99	33	108	0.126	0.084	262	1286	1548	1982	1270
05/10/99	20	122	0.126	0.084	159	1452	1611	2071	1319
05/11/99	43	84	0.126	0.084	341	1000	1341	1710	1104
05/12/99	17	80	0.126	0.084	135	952	1087	1396	891
05/13/99	52	90	0.126	0.084	413	1071	1484	1889	1223
05/14/99	33	128	0.059	0.074	559	1730	2289	2558	2073
05/15/99	51	85	0.059	0.074	864	1149	2013	2269	1811
05/16/99	67	105	0.059	0.074	1136	1419	2555	2881	2296
05/17/99	105	97	0.059	0.074	1780	1311	3090	3507	2765
05/18/99	103	139	0.059	0.074	1746	1878	3624	4094	3253
05/19/99	157	313	0.059	0.074	2661	4230	6891	7750	6207
05/20/99	118	203	0.059	0.074	2000	2743	4743	5344	4267
05/21/99	85	230	0.059	0.074	1441	3108	4549	5100	4108
05/22/99	77	99	0.059	0.074	1305	1338	2643	2987	2371
05/23/99	71	45	0.059	0.074	1203	608	1811	2064	1615
05/24/99	96	97	0.059	0.074	1627	1311	2938	3330	2630
05/25/99	44	76	0.059	0.074	746	1027	1773	1997	1595
05/26/99	59	116	0.059	0.074	1000	1568	2568	2888	2313

Appendix C-1. Estimated daily abundance of downstream migrant fall-run chinook salmon: December 16, 1998 - July 31, 1999.

Note: Differences in totals may be attributable to rounding.
n/a - indicates that separate diel census data and estimates for day and night passage abundance is not available.

Date	YOY# Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est No. YOY Total	95% Confidence Interval Hi	Lo
05/27/99	48	85	0.059	0.074	814	1149	1962	2210	1766
05/28/99	34	86	0.059	0.074	576	1162	1738	1950	1569
05/29/99	27	55	0.059	0.074	458	743	1201	1350	1082
05/30/99	32	68	0.059	0.074	542	919	1461	1642	1317
05/31/99	36	78	0.059	0.074	610	1054	1664	1870	1500
06/01/99	15	88	0.031	0.125	484	704	1188	1900	973
06/02/99	42	129	0.031	0.125	1355	1032	2387	4324	1834
06/03/99	29	162	0.031	0.125	935	1296	2231	3604	1819
06/04/99	94	197	0.031	0.125	3032	1576	4608	8900	3411
06/05/99	116	198	0.031	0.125	3742	1584	5326	10601	3867
06/06/99	147	211	0.031	0.125	4742	1688	6430	13096	4598
06/07/99	103	248	0.031	0.125	3323	1984	5307	10025	3981
06/08/99	52	241	0.031	0.125	1677	1928	3605	6042	2887
06/09/99	34	164	0.031	0.125	1097	1312	2409	4005	1936
06/10/99	16	93	0.031	0.125	516	744	1260	2019	1031
06/11/99	20	65	0.031	0.125	645	520	1165	2089	901
06/12/99	15	24	0.031	0.125	484	192	676	1357	488
06/13/99	33	72	0.031	0.125	1065	576	1641	3149	1219
06/14/99	15	125	0.031	0.125	484	1000	1484	2213	1253
06/15/99	31	93	0.031	0.125	1000	744	1744	3173	1337
06/16/99	16	97	0.002	0.098	8000	990	8990	17244	4022
06/17/99	43	65	0.002	0.098	21500	663	22163	43833	9151
06/18/99	11	52	0.002	0.098	5500	531	6031	11667	2641
06/19/99	14	47	0.002	0.098	7000	480	7480	14603	3198
06/20/99	8	42	0.002	0.098	4000	429	4429	8538	1956
06/21/99	14	29	0.002	0.098	7000	296	7296	14372	3046
06/22/99	11	28	0.002	0.098	5500	286	5786	11359	2437
06/23/99	2	30	0.002	0.098	1000	306	1306	2385	654
06/24/99	1	30	0.002	0.098	500	306	806	1385	454
06/25/99	7	36	0.002	0.098	3500	367	3867	7462	1705
06/26/99	4	38	0.002	0.098	2000	388	2388	4487	1122
06/27/99	3	20	0.002	0.098	1500	204	1704	3256	769
06/28/99	1	16	0.002	0.098	500	163	663	1205	336
06/29/99	2	14	0.002	0.098	1000	143	1143	2179	519
06/30/99	6	20	0.002	0.098	3000	204	3204	6256	1369
07/01/99	1	15	0.002	0.099	500	152	652	1183	379
07/02/99	2	5	0.002	0.099	1000	51	1051	2061	543
07/03/99	0	3	0.002	0.099	0	30	30	37	26
07/04/99	1	6	0.002	0.099	500	61	561	1073	302
07/05/99	1	6	0.002	0.099	500	61	561	1073	302
07/06/99	1	0	0.002	0.099	500	0	500	1000	250
07/07/99	3	3	0.002	0.099	1500	30	1530	3037	776
07/08/99	0	0	0.002	0.099	0	0	0	0	0
07/09/99	0	8	0.002	0.099	0	81	81	98	69
07/10/99	0	2	0.002	0.099	0	20	20	24	17
07/11/99	0	5	0.002	0.099	0	51	51	61	43
07/12/99	1	1	0.002	0.099	500	10	510	1012	259
07/13/99	0	1	0.002	0.099	0	10	10	12	9
07/14/99	1	2	0.002	0.099	500	20	520	1024	267
07/15/99	0	1	0.002	0.099	0	10	10	12	9
07/16/99	2	3	0.002	0.099	1000	30	1030	2037	526
07/17/99	0	3	0.002	0.099	0	30	30	37	26
07/18/99	1	2	0.002	0.099	500	20	520	1024	267
07/19/99	0	6	0.002	0.099	0	61	61	73	52

Appendix C-1. Estimated daily abundance of downstream migrant fall-run chinook salmon: December 16, 1998 - July 31, 1999.

Note: Differences in totals may be attributable to rounding.
n/a - indicates that separate diel census data and estimates for day and night passage abundance is not available.

Date	YOY# Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est No. YOY Total	95% Confidence Interval Hi	Lo
07/20/99	0	0	0.002	0.099	0	0	0	0	0
07/21/99	1	0	0.002	0.099	500	0	500	1000	250
07/22/99	0	0	0.002	0.099	0	0	0	0	0
07/23/99	1	3	0.002	0.099	500	30	530	1037	276
07/24/99	1	3	0.002	0.099	500	30	530	1037	276
07/25/99	0	2	0.002	0.099	0	20	20	24	17
07/26/99	0	1	0.002	0.099	0	10	10	12	9
07/27/99	0	1	0.002	0.099	0	10	10	12	9
07/28/99	0	2	0.002	0.099	0	20	20	24	17
07/29/99	0	0	0.002	0.099	0	0	0	0	0
07/30/99	1	0	0.002	0.099	500	0	500	1000	250
07/31/99	1	1	0.002	0.099	500	10	510	1012	259
TOTAL:	10677	56014			240607	1291275	1535439	2318804	1143989

Appendix C-2. Estimated daily abundance of downstream migrant YOY steelhead: June 1, 1999 - July 31, 1999.

Note: Differences in totals may be attributable to rounding.

Date	YOY# Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est No. YOY Total	95% Confidence Interval Hi	Lo
06/01/99	0	0	0.017	0.089	0	0	0	0	0
06/02/99	0	0	0.017	0.089	0	0	0	0	0
06/03/99	0	1	0.017	0.089	0	11	11	16	9
06/04/99	0	1	0.017	0.089	0	11	11	16	9
06/05/99	0	4	0.017	0.089	0	45	45	65	34
06/06/99	0	3	0.017	0.089	0	34	34	48	26
06/07/99	0	3	0.017	0.089	0	34	34	48	26
06/08/99	0	0	0.017	0.089	0	0	0	0	0
06/09/99	0	5	0.017	0.089	0	56	56	81	43
06/10/99	0	3	0.017	0.089	0	34	34	48	26
06/11/99	0	6	0.017	0.089	0	67	67	97	52
06/12/99	0	2	0.017	0.089	0	22	22	32	17
06/13/99	0	7	0.017	0.089	0	79	79	113	60
06/14/99	1	2	0.017	0.089	59	22	81	232	52
06/15/99	0	6	0.017	0.089	0	67	67	97	52
06/16/99	0	6	0.017	0.089	0	67	67	97	52
06/17/99	0	3	0.017	0.089	0	34	34	48	26
06/18/99	0	5	0.017	0.089	0	56	56	81	43
06/19/99	0	3	0.017	0.089	0	34	34	48	26
06/20/99	0	2	0.017	0.089	0	22	22	32	17
06/21/99	0	1	0.017	0.089	0	11	11	16	9
06/22/99	0	2	0.017	0.089	0	22	22	32	17
06/23/99	0	3	0.017	0.089	0	34	34	48	26
06/24/99	0	3	0.017	0.089	0	34	34	48	26
06/25/99	0	7	0.017	0.089	0	79	79	113	60
06/26/99	0	3	0.017	0.089	0	34	34	48	26
06/27/99	0	2	0.017	0.089	0	22	22	32	17
06/28/99	0	5	0.017	0.089	0	56	56	81	43
06/29/99	1	2	0.017	0.089	59	22	81	232	52
06/30/99	0	3	0.017	0.089	0	34	34	48	26
07/01/99	0	1	0.017	0.089	0	11	11	16	9
07/02/99	3	3	0.017	0.089	176	34	210	648	129
07/03/99	0	0	0.017	0.089	0	0	0	0	0
07/04/99	0	2	0.017	0.089	0	22	22	32	17
07/05/99	1	0	0.017	0.089	59	0	59	200	34
07/06/99	0	2	0.017	0.089	0	22	22	32	17
07/07/99	1	2	0.017	0.089	59	22	81	232	52
07/08/99	0	0	0.017	0.089	0	0	0	0	0
07/09/99	0	1	0.017	0.089	0	11	11	16	9
07/10/99	0	1	0.017	0.089	0	11	11	16	9
07/11/99	0	3	0.017	0.089	0	34	34	48	26
07/12/99	0	2	0.017	0.089	0	22	22	32	17
07/13/99	0	2	0.017	0.089	0	22	22	32	17
07/14/99	0	2	0.017	0.089	0	22	22	32	17
07/15/99	0	1	0.017	0.089	0	11	11	16	9
07/16/99	0	1	0.017	0.089	0	11	11	16	9
07/17/99	1	1	0.017	0.089	59	11	70	216	43
07/18/99	0	0	0.017	0.089	0	0	0	0	0
07/19/99	1	1	0.017	0.089	59	11	70	216	43
07/20/99	0	3	0.017	0.089	0	34	34	48	26
07/21/99	0	2	0.017	0.089	0	22	22	32	17
07/22/99	0	2	0.017	0.089	0	22	22	32	17
07/23/99	0	2	0.017	0.089	0	22	22	32	17

Appendix C-2. Estimated daily abundance of downstream migrant YOY steelhead: June 1, 1999 - July 31, 1999.

Note: Differences in totals may be attributable to rounding.

Date	YOY# Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est No. YOY Total	95% Confidence Interval Hi	Lo
07/24/99	1	3	0.017	0.089	59	34	93	248	60
07/25/99	0	2	0.017	0.089	0	22	22	32	17
07/26/99	0	2	0.017	0.089	0	22	22	32	17
07/27/99	0	1	0.017	0.089	0	11	11	16	9
07/28/99	0	0	0.017	0.089	0	0	0	0	0
07/29/99	0	1	0.017	0.089	0	11	11	16	9
07/30/99	0	2	0.017	0.089	0	22	22	32	17
07/31/99	1	3	0.017	0.089	59	34	93	248	60
TOTAL:	11	141			647	1584	2231	4474	1595

Appendix D-1. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: December 16, 1998 - July 31, 1999.

Date	Avg TL, mm	StDev TL, mm	Min TL, mm	Max TL, mm	Avg FL, mm	StDev FL, mm	Min FL, mm	Max FL, mm	Avg WT, g	StDev WT, g	Min WT, g	Max WT, g	Avg K	StDev K	Min K	Max K	N
12/16/98																	
12/17/98																	
12/18/98																	
12/19/98																	
12/20/98																	
12/21/98																	
12/22/98	36	2.0	33	40	35	1.9	32	39	0.3	0.07	0.2	0.4	5.56E-004	1.73E-004	3.95E-004	9.33E-004	13
12/23/98	37	2.4	32	40	36	2.4	31	39	0.3	0.10	0.2	0.5	5.55E-004	1.53E-004	3.13E-004	7.81E-004	10
12/24/98	36	2.1	34	40	35	2.1	33	39	0.3	0.07	0.2	0.4	5.98E-004	2.25E-004	3.95E-004	1.02E-003	5
12/25/98																	
12/26/98	35	1.2	34	37	34	1.3	33	36	0.3	0.07	0.2	0.4	6.91E-004	1.80E-004	3.95E-004	9.33E-004	8
12/27/98	34	0.8	33	35	33	0.8	32	34	0.2	0.05	0.2	0.3	5.95E-004	1.24E-004	4.66E-004	7.63E-004	3
12/28/98	35	0.8	34	37	34	0.8	33	36	0.3	0.07	0.3	0.5	7.67E-004	1.04E-004	6.43E-004	9.87E-004	9
12/29/98	35	1.3	33	36	34	1.3	32	35	0.3	0.04	0.2	0.3	6.21E-004	3.74E-005	5.57E-004	6.43E-004	4
12/30/98	34	0.5	34	35	33	0.5	33	34	0.2	0.05	0.2	0.3	5.72E-004	9.00E-005	5.09E-004	7.00E-004	3
12/31/98																	
01/01/99	36	0.9	35	37	35	0.9	34	36	0.4	0.05	0.4	0.5	9.03E-004	8.33E-005	7.90E-004	9.87E-004	3
01/02/99	37	1.4	35	39	36	1.1	34	37	0.3	0.08	0.2	0.4	5.93E-004	1.35E-004	3.95E-004	8.57E-004	11
01/03/99	39	0.0	39	39	38	0.0	38	38	0.3	0.00	0.3	0.3	5.06E-004	0.00E+000	5.06E-004	5.06E-004	1
01/04/99																	
01/05/99	37	0.0	37	37	36	0.0	36	36	0.3	0.00	0.3	0.3	5.92E-004	0.00E+000	5.92E-004	5.92E-004	1
01/06/99	37	1.0	36	39	36	1.0	35	38	0.3	0.05	0.2	0.4	6.06E-004	1.07E-004	4.29E-004	7.90E-004	7
01/07/99	36	0.9	35	37	35	0.9	34	36	0.4	0.07	0.3	0.5	8.96E-004	1.34E-004	7.00E-004	1.07E-003	5
01/08/99	39	0.5	39	40	38	0.5	38	39	0.4	0.00	0.4	0.4	6.58E-004	2.32E-005	6.25E-004	6.74E-004	3
01/09/99	37	0.9	36	38	36	0.9	35	37	0.3	0.09	0.2	0.4	6.29E-004	1.42E-004	4.29E-004	7.29E-004	3
01/10/99	37	2.1	32	40	36	2.1	31	39	0.4	0.07	0.2	0.4	6.98E-004	1.33E-004	4.29E-004	9.16E-004	10
01/11/99	37	1.6	34	40	36	1.5	33	38	0.4	0.06	0.3	0.5	7.09E-004	1.10E-004	5.06E-004	9.33E-004	27
01/12/99	37	1.6	34	40	36	1.3	33	38	0.3	0.08	0.2	0.5	5.94E-004	1.12E-004	4.29E-004	7.90E-004	33
01/13/99	37	1.9	32	39	36	1.9	31	38	0.3	0.09	0.2	0.5	6.47E-004	2.37E-004	3.64E-004	1.22E-003	17
01/14/99	38	1.0	36	39	36	0.7	35	37	0.3	0.07	0.2	0.4	6.36E-004	1.10E-004	3.95E-004	7.90E-004	8
01/15/99	36	1.3	34	38	35	1.3	33	37	0.3	0.06	0.2	0.4	6.43E-004	1.11E-004	4.29E-004	7.63E-004	6
01/16/99	37	3.5	34	43	36	3.2	33	41	0.4	0.10	0.2	0.5	6.80E-004	1.01E-004	5.09E-004	7.90E-004	6
01/17/99	37	1.7	35	40	36	1.5	34	38	0.3	0.08	0.2	0.4	5.73E-004	1.04E-004	4.29E-004	7.29E-004	6
01/18/99	38	0.0	38	38	36	0.0	36	36	0.4	0.00	0.4	0.4	7.29E-004	0.00E+000	7.29E-004	7.29E-004	1
01/19/99	37	1.8	33	39	35	1.9	32	38	0.3	0.10	0.2	0.5	6.58E-004	2.39E-004	3.64E-004	1.07E-003	7
01/20/99	38	1.4	35	41	37	1.4	34	40	0.4	0.10	0.2	0.5	6.64E-004	1.66E-004	3.64E-004	9.11E-004	13
01/21/99	38	2.8	30	40	36	2.1	31	39	0.3	0.09	0.2	0.5	6.37E-004	1.67E-004	3.64E-004	1.11E-003	16
01/22/99	38	2.0	33	41	36	1.6	33	39	0.4	0.08	0.2	0.5	6.69E-004	9.96E-005	5.06E-004	9.11E-004	19
01/23/99	38	1.5	34	41	37	1.2	33	39	0.4	0.10	0.2	0.8	6.96E-004	1.85E-004	4.69E-004	1.71E-003	41
01/24/99	39	1.6	35	42	38	1.6	34	41	0.4	0.08	0.2	0.6	6.66E-004	1.65E-004	3.95E-004	1.17E-003	34
01/25/99	39	1.4	36	41	38	1.2	35	40	0.4	0.11	0.3	0.8	7.28E-004	1.95E-004	4.69E-004	1.25E-003	29
01/26/99	38	1.6	35	42	37	1.3	34	40	0.4	0.07	0.2	0.5	6.34E-004	9.65E-005	4.29E-004	8.57E-004	47
01/27/99	39	2.1	32	41	37	1.7	32	39	0.4	0.07	0.3	0.5	7.03E-004	1.80E-004	5.06E-004	1.39E-003	34
01/28/99	39	1.6	36	42	37	1.4	35	40	0.4	0.06	0.3	0.5	7.00E-004	8.31E-005	5.80E-004	8.57E-004	30
01/29/99	38	2.6	32	41	36	2.2	31	39	0.4	0.09	0.2	0.5	6.49E-004	1.14E-004	3.95E-004	9.11E-004	37
01/30/99	38	2.4	30	40	36	2.0	30	38	0.4	0.09	0.2	0.5	6.80E-004	8.95E-005	4.66E-004	8.43E-004	39
01/31/99	39	2.6	32	42	37	2.4	31	40	0.4	0.10	0.1	0.5	6.07E-004	1.39E-004	2.78E-004	9.16E-004	41

Appendix D-1. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: December 16, 1998 - July 31, 1999.

Date	Avg TL, mm	StDev TL, mm	Min TL, mm	Max TL, mm	Avg FL, mm	StDev FL, mm	Min FL, mm	Max FL, mm	Avg WT, g	StDev WT, g	Min WT, g	Max WT, g	Avg K	StDev K	Min K	Max K	N
02/01/99	39	1.8	33	43	38	1.8	31	41	0.4	0.07	0.2	0.6	6.69E-004	1.14E-004	4.69E-004	1.18E-003	66
02/02/99	39	1.9	33	43	37	1.9	31	41	0.4	0.07	0.3	0.6	7.05E-004	9.54E-005	5.06E-004	9.33E-004	62
02/03/99	40	2.4	33	44	38	2.2	32	42	0.4	0.09	0.2	0.5	5.99E-004	1.22E-004	2.90E-004	7.90E-004	30
02/04/99	39	1.9	34	42	37	1.5	33	40	0.5	0.13	0.3	0.8	8.15E-004	1.58E-004	5.06E-004	1.16E-003	30
02/05/99	39	2.0	35	42	37	1.8	33	40	0.4	0.07	0.3	0.5	6.93E-004	7.94E-005	4.69E-004	8.43E-004	30
02/06/99	38	2.0	33	42	36	1.8	32	40	0.4	0.08	0.2	0.5	6.90E-004	1.22E-004	5.06E-004	1.07E-003	30
02/07/99																	
02/08/99																	
02/09/99																	
02/10/99																	
02/11/99	40	1.6	36	43	38	1.5	35	41	0.4	0.08	0.2	0.6	6.55E-004	8.70E-005	3.37E-004	7.90E-004	30
02/12/99	39	2.3	35	44	38	2.0	33	42	0.4	0.09	0.2	0.6	6.23E-004	9.78E-005	4.29E-004	8.57E-004	60
02/13/99	39	1.5	36	42	37	1.3	35	40	0.4	0.05	0.3	0.5	6.70E-004	8.23E-005	4.69E-004	8.57E-004	30
02/14/99	39	1.2	35	41	37	1.1	34	39	0.4	0.06	0.2	0.5	6.72E-004	7.31E-005	4.66E-004	7.90E-004	30
02/15/99	39	2.3	32	43	38	2.1	31	41	0.4	0.09	0.2	0.5	6.57E-004	7.06E-005	4.29E-004	7.81E-004	30
02/16/99																	
02/17/99	39	1.5	35	44	37	1.4	34	42	0.4	0.10	0.3	0.9	7.60E-004	1.55E-004	4.69E-004	1.41E-003	60
02/18/99	39	1.5	35	42	37	1.2	34	40	0.4	0.06	0.3	0.5	6.62E-004	7.67E-005	5.06E-004	7.90E-004	30
02/19/99	39	2.2	33	42	37	1.8	32	40	0.4	0.08	0.2	0.5	6.58E-004	6.60E-005	5.06E-004	7.90E-004	30
02/20/99	40	2.2	35	45	38	2.4	33	45	0.4	0.08	0.3	0.7	7.15E-004	8.49E-005	5.47E-004	8.71E-004	30
02/21/99	39	2.2	33	42	37	1.8	32	40	0.4	0.06	0.2	0.5	6.42E-004	7.52E-005	4.69E-004	8.57E-004	30
02/22/99	39	2.4	33	45	37	2.4	31	43	0.4	0.09	0.2	0.7	6.84E-004	9.84E-005	3.95E-004	8.43E-004	30
02/23/99	39	1.8	33	42	37	1.7	32	40	0.4	0.07	0.2	0.5	6.66E-004	7.48E-005	5.06E-004	8.43E-004	30
02/24/99	40	2.3	35	48	38	2.1	34	45	0.4	0.10	0.3	0.8	6.69E-004	7.77E-005	5.06E-004	8.43E-004	30
02/25/99	40	2.0	37	47	38	1.9	35	44	0.5	0.08	0.3	0.7	7.19E-004	6.41E-005	5.92E-004	8.71E-004	30
02/26/99	39	4.5	26	48	37	4.1	25	46	0.4	0.13	0.1	0.9	7.01E-004	1.36E-004	3.62E-004	1.14E-003	30
02/27/99	39	1.6	35	42	38	1.3	34	40	0.4	0.08	0.2	0.5	6.31E-004	9.30E-005	4.29E-004	7.81E-004	30
02/28/99	40	3.2	34	48	38	2.9	32	44	0.5	0.13	0.2	0.7	7.31E-004	1.47E-004	3.37E-004	1.07E-003	30
03/01/99	39	2.8	32	48	37	2.7	31	46	0.4	0.10	0.2	0.7	6.80E-004	7.67E-005	5.09E-004	8.43E-004	30
03/02/99	39	3.2	31	50	37	2.9	30	47	0.4	0.11	0.1	0.8	7.03E-004	8.97E-005	3.36E-004	8.57E-004	30
03/03/99	39	2.8	26	42	37	2.6	25	40	0.4	0.08	0.1	0.5	6.58E-004	9.14E-005	5.06E-004	8.57E-004	30
03/04/99	40	2.4	37	47	38	2.5	35	47	0.5	0.09	0.4	0.8	7.10E-004	6.03E-005	6.25E-004	8.10E-004	30
03/05/99	39	3.1	33	53	38	2.8	31	50	0.4	0.13	0.2	1.0	6.98E-004	6.78E-005	5.57E-004	7.90E-004	30
03/06/99	39	3.3	35	54	37	2.9	34	50	0.4	0.16	0.3	1.2	6.92E-004	6.77E-005	5.47E-004	8.43E-004	30
03/07/99	38	1.5	35	42	36	1.5	33	40	0.4	0.06	0.3	0.5	6.88E-004	7.60E-005	5.06E-004	7.90E-004	30
03/08/99	39	2.3	35	47	37	2.1	33	44	0.4	0.11	0.2	0.8	6.64E-004	9.06E-005	4.66E-004	9.11E-004	30
03/09/99	38	2.0	33	43	37	1.7	32	41	0.4	0.07	0.2	0.5	7.13E-004	8.01E-005	5.57E-004	8.43E-004	30
03/10/99	38	2.8	29	42	36	2.5	28	40	0.4	0.09	0.2	0.6	7.37E-004	1.08E-004	3.95E-004	9.87E-004	30
03/11/99	38	5.5	27	62	37	5.1	25	58	0.5	0.31	0.1	2.0	7.31E-004	1.52E-004	4.35E-004	1.25E-003	30
03/12/99	39	1.7	36	43	37	1.7	34	41	0.4	0.07	0.3	0.6	7.11E-004	9.20E-005	5.06E-004	9.87E-004	30
03/13/99	43	8.6	35	60	41	7.7	34	56	0.6	0.46	0.3	1.8	6.96E-004	1.22E-004	4.69E-004	8.57E-004	10
03/14/99	42	9.5	31	73	41	8.7	30	68	0.7	0.68	0.3	2.9	7.93E-004	1.37E-004	5.80E-004	1.34E-003	30
03/15/99	40	4.6	36	59	38	4.1	34	63	0.4	0.69	0.2	1.9	6.80E-004	9.03E-005	3.95E-004	8.06E-004	30
03/16/99	40	6.3	36	67	38	5.8	34	63	0.5	0.39	0.3	2.1	7.33E-004	7.54E-005	6.25E-004	8.76E-004	30
03/17/99	44	8.8	36	67	42	8.2	34	63	0.7	0.57	0.3	2.3	7.00E-004	9.11E-005	5.47E-004	8.71E-004	30
03/18/99	40	4.5	35	57	38	4.1	33	54	0.5	0.24	0.3	1.5	7.24E-004	1.00E-004	5.06E-004	8.71E-004	30
03/19/99	43	11.6	31	82	41	10.8	30	77	0.8	0.96	0.3	4.7	7.59E-004	1.63E-004	5.06E-004	1.34E-003	30

Appendix D-1. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: December 16, 1998 - July 31, 1999.

Date	Avg TL, mm	StDev TL, mm	Min TL, mm	Max TL, mm	Avg FL, mm	StDev FL, mm	Min FL, mm	Max FL, mm	Avg WT, g	StDev WT, g	Min WT, g	Max WT, g	Avg K	StDev K	Min K	Max K	N
03/20/99	41	10.3	35	80	39	9.3	33	75	0.7	0.88	0.3	4.5	7.45E-004	8.70E-005	5.47E-004	9.33E-004	30
03/21/99	51	15.3	30	82	48	13.7	29	75	1.3	1.25	0.2	4.7	7.37E-004	7.29E-005	5.47E-004	8.64E-004	30
03/22/99	51	15.3	30	82	48	13.7	29	75	1.3	1.25	0.2	4.7	7.37E-004	7.29E-005	5.47E-004	8.64E-004	30
03/23/99	52	17.6	31	86	49	15.9	29	80	1.6	1.67	0.2	5.5	7.75E-004	1.04E-004	5.57E-004	9.18E-004	30
03/24/99	45	14.7	36	90	42	13.2	34	84	1.0	1.58	0.3	6.8	7.19E-004	1.18E-004	5.06E-004	9.38E-004	30
03/25/99	54	21.3	37	94	50	19.0	35	86	2.0	2.40	0.3	7.3	7.16E-004	1.18E-004	4.69E-004	9.16E-004	30
03/26/99	60	20.5	38	92	56	18.3	36	84	2.4	2.18	0.3	6.4	7.70E-004	8.90E-005	5.06E-004	9.25E-004	30
03/27/99	53	14.8	36	82	50	13.3	35	76	1.5	1.22	0.3	4.5	7.87E-004	8.47E-005	5.40E-004	9.38E-004	30
03/28/99	63	20.4	34	94	59	18.6	33	87	2.7	2.25	0.3	7.0	7.91E-004	8.11E-005	5.06E-004	8.99E-004	30
03/29/99	63	20.8	33	93	58	19.1	31	85	2.7	2.31	0.3	7.0	8.04E-004	1.41E-004	5.47E-004	1.39E-003	30
03/30/99	70	18.5	35	91	64	16.6	33	84	3.4	2.10	0.3	6.5	8.02E-004	9.34E-005	5.80E-004	1.03E-003	30
03/31/99	70	15.5	32	91	65	14.1	31	84	3.1	1.59	0.4	6.1	8.04E-004	1.05E-004	6.25E-004	1.22E-003	26
04/01/99	81	14.6	37	94	74	13.0	35	85	4.8	1.97	0.3	7.3	8.15E-004	7.26E-005	5.92E-004	9.69E-004	30
04/02/99	77	11.7	55	100	71	10.8	51	92	4.0	1.71	1.5	6.9	8.25E-004	7.06E-005	6.80E-004	1.05E-003	30
04/03/99	64	21.0	35	95	60	18.7	34	88	2.8	2.21	0.3	7.7	7.92E-004	7.83E-005	6.25E-004	9.11E-004	25
04/04/99	71	19.4	38	85	66	16.8	37	78	3.4	1.86	0.4	5.1	7.72E-004	5.67E-005	7.16E-004	8.60E-004	4
04/05/99	59	16.6	40	76	55	14.9	38	71	2.0	1.25	0.4	3.3	8.30E-004	2.23E-004	6.25E-004	1.21E-003	4
04/06/99	68	19.0	37	85	64	17.6	35	80	3.2	1.89	0.3	5.0	7.71E-004	1.04E-004	5.92E-004	8.52E-004	4
04/07/99	81	0.0	81	81	73	0.0	73	73	4.2	0.00	4.2	4.2	7.90E-004	0.00E+000	7.90E-004	7.90E-004	1
04/08/99	60	22.0	38	82	55	19.0	36	74	2.5	2.05	0.4	4.5	7.73E-004	4.36E-005	7.29E-004	8.16E-004	2
04/09/99	71	6.5	63	79	66	6.6	59	75	3.3	0.87	2.4	4.5	9.25E-004	2.46E-005	9.04E-004	9.60E-004	3
04/10/99	67	33.5	35	156	62	29.6	34	141	4.5	7.47	0.2	30.8	7.50E-004	1.13E-004	4.29E-004	8.90E-004	15
04/11/99	68	11.7	42	96	64	10.5	39	88	3.0	1.52	0.4	6.9	8.62E-004	8.26E-005	5.40E-004	9.69E-004	30
04/12/99	75	10.1	50	93	70	8.8	48	86	3.6	1.26	1.0	6.1	8.19E-004	7.16E-005	7.06E-004	1.01E-003	30
04/13/99	73	12.3	37	107	68	11.4	35	100	3.5	1.78	0.1	10.8	8.19E-004	1.33E-004	1.97E-004	1.01E-003	31
04/14/99	77	9.5	43	90	71	8.7	40	83	3.8	1.22	0.6	5.8	8.01E-004	4.31E-005	7.23E-004	8.85E-004	30
04/15/99	82	6.4	68	91	76	5.4	64	83	4.5	0.99	2.6	6.2	8.00E-004	3.41E-005	7.48E-004	8.76E-004	13
04/16/99	86	8.0	74	95	78	7.1	67	87	5.0	1.28	2.9	6.6	7.73E-004	4.45E-005	7.11E-004	8.43E-004	9
04/17/99	76	15.2	38	95	70	13.5	36	87	3.7	1.41	0.5	5.8	7.81E-004	6.36E-005	6.76E-004	9.11E-004	9
04/18/99	82	13.9	37	101	76	12.2	36	92	4.7	1.92	0.4	8.7	7.87E-004	5.80E-005	7.00E-004	1.01E-003	30
04/19/99	81	13.7	38	100	75	12.3	36	91	4.6	1.62	0.4	8.2	7.94E-004	6.28E-005	6.81E-004	9.91E-004	44
04/20/99	85	11.6	62	110	78	10.7	57	103	5.5	2.46	1.9	12.4	8.57E-004	1.34E-004	5.90E-004	1.26E-003	32
04/21/99	84	12.1	42	104	77	11.1	40	95	5.0	2.25	0.4	11.4	7.64E-004	1.79E-004	8.76E-005	1.37E-003	31
04/22/99	88	7.4	74	107	81	6.7	67	96	5.5	1.58	3.1	10.6	7.87E-004	5.31E-005	6.79E-004	9.03E-004	30
04/23/99	84	7.7	72	102	78	6.9	68	95	5.0	1.63	3.0	9.3	8.20E-004	1.08E-004	6.46E-004	1.30E-003	30
04/24/99	84	8.1	63	100	77	7.3	58	93	4.9	1.35	2.6	9.0	8.28E-004	9.32E-005	7.39E-004	1.20E-003	30
04/25/99	86	8.6	59	105	79	7.8	54	95	5.2	1.47	1.7	9.3	8.02E-004	2.82E-005	7.46E-004	8.63E-004	30
04/26/99	86	7.9	72	107	79	6.4	66	95	5.1	1.55	2.7	10.6	7.70E-004	5.24E-005	6.76E-004	9.01E-004	30
04/27/99	88	7.3	77	104	80	6.7	72	97	5.3	1.62	3.2	8.9	7.66E-004	4.14E-005	6.81E-004	8.39E-004	30
04/28/99	88	6.7	72	104	80	5.9	65	95	5.6	1.63	3.0	11.7	7.95E-004	7.40E-005	6.46E-004	1.10E-003	30
04/29/99	89	8.2	73	110	82	7.5	68	103	5.9	1.83	3.2	12.1	8.22E-004	3.95E-005	7.59E-004	9.09E-004	30
04/30/99	92	6.9	81	106	84	6.0	74	97	6.3	1.39	4.0	10.2	8.12E-004	8.06E-005	6.05E-004	1.03E-003	30
05/01/99	92	8.3	74	110	85	7.8	69	103	6.4	1.76	3.6	11.6	8.03E-004	6.48E-005	7.09E-004	1.02E-003	30
05/02/99	91	6.8	78	106	84	6.4	72	100	6.3	1.38	4.1	9.7	8.29E-004	4.84E-005	7.46E-004	9.06E-004	30
05/03/99	90	12.1	36	120	82	10.6	35	108	5.9	1.95	0.6	14.0	7.92E-004	9.65E-005	6.67E-004	1.29E-003	31
05/04/99	86	8.0	70	105	78	7.1	64	95	5.0	1.34	2.7	8.6	7.68E-004	6.34E-005	7.14E-004	1.08E-003	30
05/05/99	90	8.0	74	107	82	7.3	68	97	5.6	1.64	2.6	9.3	7.59E-004	7.29E-005	4.89E-004	9.03E-004	30

Appendix D-1. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: December 16, 1998 - July 31, 1999.

Date	Avg TL, mm	StDev TL, mm	Min TL, mm	Max TL, mm	Avg FL, mm	StDev FL, mm	Min FL, mm	Max FL, mm	Avg WT, g	StDev WT, g	Min WT, g	Max WT, g	Avg K	StDev K	Min K	Max K	N
05/06/99	91	6.6	77	105	84	6.1	71	98	6.2	1.42	3.7	10.4	8.10E-004	5.27E-005	7.52E-004	9.57E-004	30
05/07/99	90	6.7	78	104	83	6.1	72	95	6.0	1.34	3.7	9.1	8.13E-004	5.58E-005	7.38E-004	9.96E-004	30
05/08/99	93	7.9	79	116	85	7.1	73	105	6.4	1.83	3.7	13.2	7.75E-004	4.01E-005	6.79E-004	8.79E-004	30
05/09/99	93	6.2	83	110	86	6.2	75	104	6.6	1.77	4.6	13.4	7.96E-004	6.01E-005	6.57E-004	1.01E-003	30
05/10/99	93	8.2	74	113	85	7.4	69	103	6.6	1.77	3.5	11.4	7.93E-004	4.40E-005	7.22E-004	8.82E-004	30
05/11/99	96	6.9	83	115	88	6.1	76	104	7.3	1.49	4.5	11.5	8.08E-004	4.04E-005	7.32E-004	8.98E-004	30
05/12/99	95	8.2	79	110	87	7.4	74	100	6.9	1.77	4.0	10.8	7.96E-004	6.30E-005	5.33E-004	8.90E-004	30
05/13/99	94	7.3	79	119	86	6.7	72	110	6.8	1.66	3.9	13.0	8.13E-004	4.82E-005	7.19E-004	9.03E-004	30
05/14/99	92	7.2	74	110	84	6.9	67	100	6.2	1.42	3.3	10.9	7.89E-004	4.91E-005	7.01E-004	8.96E-004	30
05/15/99	97	5.5	87	107	89	5.1	80	99	7.5	1.58	5.3	12.3	8.13E-004	5.99E-005	7.17E-004	1.00E-003	30
05/16/99	92	6.8	80	110	85	6.1	74	101	6.7	1.65	4.5	11.4	8.47E-004	5.68E-005	7.23E-004	9.85E-004	30
05/17/99	96	8.7	83	117	88	7.8	78	107	7.6	2.23	4.5	13.1	8.28E-004	5.80E-005	7.46E-004	9.93E-004	30
05/18/99	95	5.4	84	104	87	5.4	77	97	7.2	1.33	5.2	9.7	8.37E-004	1.20E-004	7.06E-004	1.42E-003	30
05/19/99	93	6.3	82	107	85	5.9	75	98	6.5	1.39	4.3	9.2	8.12E-004	9.35E-005	6.58E-004	1.16E-003	30
05/20/99	97	8.2	82	112	88	7.1	75	100	7.6	1.93	4.2	11.1	8.11E-004	4.91E-005	7.11E-004	9.05E-004	30
05/21/99	95	8.3	83	117	87	7.8	75	109	7.0	2.12	4.1	13.3	8.07E-004	4.84E-005	7.16E-004	9.22E-004	30
05/22/99	97	8.6	83	120	89	8.1	76	110	7.9	2.36	5.0	15.3	8.38E-004	4.70E-005	7.45E-004	9.20E-004	30
05/23/99	95	7.6	81	115	88	7.0	74	107	7.6	1.83	4.7	13.1	8.68E-004	3.56E-005	7.97E-004	9.39E-004	30
05/24/99	99	9.2	80	114	91	8.5	74	105	8.6	2.54	4.4	13.7	8.54E-004	5.91E-005	7.70E-004	9.88E-004	30
05/25/99	91	8.2	77	110	83	7.1	70	98	6.1	1.62	4.0	10.8	8.09E-004	7.35E-005	5.48E-004	9.15E-004	30
05/26/99	90	6.5	73	105	83	6.4	67	96	6.0	1.31	3.0	9.1	8.03E-004	7.43E-005	5.53E-004	1.00E-003	30
05/27/99	95	7.7	82	109	87	6.9	75	100	7.2	1.70	4.5	11.1	8.10E-004	4.85E-005	7.41E-004	9.28E-004	30
05/28/99	94	7.7	80	117	85	7.2	73	107	6.9	1.89	4.3	13.2	8.05E-004	4.88E-005	7.33E-004	9.12E-004	30
05/29/99	95	7.3	78	109	87	6.8	72	101	7.7	1.65	4.4	11.2	8.81E-004	4.92E-005	8.05E-004	1.02E-003	30
05/30/99	95	7.8	83	112	87	7.0	76	100	7.3	1.84	5.0	11.1	8.43E-004	4.66E-005	7.43E-004	9.57E-004	30
05/31/99	96	7.7	85	115	89	7.0	78	105	8.0	2.24	5.4	14.8	8.74E-004	6.17E-005	7.58E-004	1.00E-003	30
06/01/99	96	7.3	85	117	90	6.7	79	107	7.9	2.00	4.5	13.3	8.22E-004	1.00E-004	3.38E-004	9.38E-004	30
06/02/99	98	9.8	83	131	90	8.8	77	120	8.3	2.56	5.2	17.3	8.56E-004	5.13E-005	7.70E-004	9.87E-004	30
06/03/99	100	9.0	86	120	92	8.5	78	110	8.9	2.54	5.4	15.2	8.63E-004	4.13E-005	7.94E-004	9.68E-004	30
06/04/99	98	7.2	84	111	90	6.9	77	103	8.0	1.93	5.0	12.2	8.39E-004	4.83E-005	7.63E-004	9.42E-004	30
06/05/99	99	8.4	84	114	90	7.4	77	104	8.4	2.13	5.0	13.0	8.54E-004	5.23E-005	6.69E-004	9.49E-004	30
06/06/99	96	8.0	79	118	88	7.7	72	108	7.6	2.23	4.2	15.3	8.27E-004	4.62E-005	7.09E-004	9.31E-004	30
06/07/99	101	6.4	87	111	93	5.6	80	102	8.8	1.77	5.1	12.2	8.46E-004	4.40E-005	7.18E-004	9.32E-004	30
06/08/99	98	7.8	82	110	90	6.8	75	103	8.0	1.67	4.4	11.0	8.27E-004	5.03E-005	7.16E-004	9.79E-004	30
06/09/99	101	8.0	85	118	93	7.5	77	109	9.1	2.29	4.9	14.1	8.69E-004	3.99E-005	7.98E-004	9.51E-004	30
06/10/99	101	7.4	89	123	92	6.8	80	111	8.7	2.13	5.7	14.4	8.42E-004	4.70E-005	7.56E-004	9.61E-004	30
06/11/99	100	6.7	88	112	91	6.3	80	104	8.5	1.78	5.8	12.8	8.51E-004	4.76E-005	7.41E-004	9.33E-004	30
06/12/99	102	7.6	88	120	94	6.8	82	110	9.5	2.28	5.9	15.8	8.77E-004	4.50E-005	7.84E-004	9.61E-004	30
06/13/99	102	5.7	90	115	93	5.1	83	103	9.1	1.42	6.7	12.0	8.63E-004	4.24E-005	7.89E-004	9.78E-004	30
06/14/99	102	7.6	88	123	93	7.0	79	110	9.3	2.20	6.0	16.6	8.67E-004	4.95E-005	7.76E-004	9.64E-004	30
06/15/99	100	5.6	90	117	92	5.1	82	106	8.9	1.62	5.9	13.6	8.68E-004	4.28E-005	7.91E-004	9.46E-004	30
06/16/99	101	6.0	92	115	92	5.6	83	106	9.0	2.15	6.0	14.9	8.67E-004	1.55E-004	6.04E-004	1.63E-003	30
06/17/99	100	5.4	91	110	92	5.1	83	101	9.1	1.28	6.8	11.7	8.90E-004	5.26E-005	7.66E-004	1.05E-003	30
06/18/99	99	6.8	82	112	91	6.4	74	100	8.6	1.75	4.8	12.2	8.65E-004	4.37E-005	7.82E-004	9.80E-004	30
06/19/99	100	5.4	92	112	91	4.8	84	102	8.7	1.39	6.8	12.0	8.57E-004	4.41E-005	7.76E-004	9.80E-004	30
06/20/99	103	6.4	90	121	94	6.2	83	112	9.4	2.02	6.4	15.0	8.43E-004	5.43E-005	6.37E-004	9.40E-004	30
06/21/99	101	8.9	87	122	92	8.1	80	111	9.2	2.61	6.0	16.1	8.66E-004	4.72E-005	7.17E-004	9.57E-004	31

Appendix D-1. Daily average size of YOY fall-run chinook salmon captured at Woodbridge Dam: December 16, 1998 - July 31, 1999.

Date	Avg TL, mm	StDev TL, mm	Min TL, mm	Max TL, mm	Avg FL, mm	StDev FL, mm	Min FL, mm	Max FL, mm	Avg WT, g	StDev WT, g	Min WT, g	Max WT, g	Avg K	StDev K	Min K	Max K	N
06/22/99	101	7.2	83	121	92	6.6	76	110	8.9	1.89	5.0	15.3	8.56E-004	3.97E-005	7.80E-004	9.38E-004	38
06/23/99	104	7.2	87	125	95	6.5	80	112	9.6	2.18	5.6	16.6	8.39E-004	4.65E-005	7.08E-004	9.49E-004	32
06/24/99	102	6.3	91	116	93	5.4	83	106	9.3	1.72	6.7	13.7	8.62E-004	3.76E-005	7.54E-004	9.42E-004	31
06/25/99	101	5.1	90	117	92	4.5	82	107	8.8	1.20	6.5	12.1	8.47E-004	4.53E-005	7.26E-004	9.14E-004	30
06/26/99	102	6.0	91	120	93	5.4	83	109	9.1	1.85	6.4	15.4	8.49E-004	4.72E-005	7.67E-004	9.61E-004	34
06/27/99	101	5.5	93	112	92	5.0	84	102	8.8	1.62	5.8	11.9	8.40E-004	3.54E-005	7.21E-004	9.09E-004	23
06/28/99	101	7.4	80	113	93	6.7	75	105	9.0	2.01	4.0	12.3	8.49E-004	6.22E-005	7.14E-004	9.50E-004	17
06/29/99	101	5.3	91	110	92	4.4	84	100	8.9	1.19	6.6	10.9	8.69E-004	7.58E-005	5.94E-004	9.55E-004	16
06/30/99	102	5.6	89	114	93	4.6	85	105	9.3	1.47	7.0	13.2	8.79E-004	7.90E-005	6.19E-004	9.93E-004	25
07/01/99	101	6.6	85	114	93	6.4	77	105	8.8	2.13	4.9	13.0	8.54E-004	1.35E-004	5.90E-004	1.20E-003	16
07/02/99	103	6.4	91	112	94	6.1	83	103	9.7	2.03	6.3	12.4	8.74E-004	3.93E-005	8.29E-004	9.58E-004	7
07/03/99	103	5.4	96	109	95	3.7	90	99	9.7	1.08	8.2	10.7	8.78E-004	4.11E-005	8.26E-004	9.27E-004	3
07/04/99	102	6.2	94	112	93	6.3	85	105	9.2	1.77	6.9	12.4	8.52E-004	3.20E-005	7.95E-004	8.83E-004	6
07/05/99	101	10.4	77	109	92	9.0	72	100	9.2	2.52	3.8	11.2	8.69E-004	4.14E-005	8.14E-004	9.24E-004	7
07/06/99	95	0.0	95	95	87	0.0	87	87	7.4	0.00	7.4	7.4	8.63E-004	0.00E+000	8.63E-004	8.63E-004	1
07/07/99	108	7.5	98	117	99	6.2	90	105	11.0	2.17	8.3	14.2	8.66E-004	5.69E-005	7.62E-004	9.34E-004	5
07/08/99																	
07/09/99	104	7.4	94	116	93	2.9	87	97	9.3	0.79	8.3	10.6	8.46E-004	1.11E-004	6.51E-004	9.99E-004	8
07/10/99	114	0.0	114	114	105	0.0	105	105									1
07/11/99	106	5.7	101	114	98	5.0	94	105	10.5	1.76	9.0	13.0	8.77E-004	2.15E-006	8.74E-004	8.79E-004	3
07/12/99	107	0.5	106	107	99	0.0	99	99	10.7	0.10	10.6	10.8	8.86E-004	4.20E-006	8.82E-004	8.90E-004	2
07/13/99	104	0.0	104	104	95	0.0	95	95	10.4	0.00	10.4	10.4	9.25E-004	0.00E+000	9.25E-004	9.25E-004	1
07/14/99	104	8.8	96	116	94	7.4	87	104	9.6	2.92	7.0	13.7	8.38E-004	3.57E-005	7.91E-004	8.78E-004	3
07/15/99	108	0.0	108	108	99	0.0	99	99	11.2	0.00	11.2	11.2	8.89E-004	0.00E+000	8.89E-004	8.89E-004	1
07/16/99	113	6.4	106	121	102	6.0	96	110	12.7	2.51	10.3	15.9	8.73E-004	3.96E-005	7.95E-004	9.03E-004	5
07/17/99	116	12.5	104	133	106	13.8	94	125	13.4	4.41	9.2	19.5	8.37E-004	1.97E-005	8.18E-004	8.64E-004	3
07/18/99	113	16.7	98	136	103	17.9	87	128	12.9	6.88	6.9	22.5	8.15E-004	6.59E-005	7.33E-004	8.94E-004	3
07/19/99	113	9.9	98	130	104	9.2	92	120	12.9	3.69	8.6	19.6	8.81E-004	3.89E-005	8.26E-004	9.32E-004	6
07/20/99																	
07/21/99	111	0.0	111	111	101	0.0	101	101	13.4	0.00	13.4	13.4	9.80E-004	0.00E+000	9.80E-004	9.80E-004	1
07/22/99																	
07/23/99	101	4.9	95	107	92	4.9	86	98	8.9	1.99	6.9	11.6	8.38E-004	7.86E-005	7.63E-004	9.47E-004	3
07/24/99	107	4.0	104	113	98	3.6	95	103	9.8	1.53	7.8	11.5	7.88E-004	7.34E-005	6.93E-004	8.72E-004	3
07/25/99	108	2.5	105	110	98	2.5	95	100	10.4	0.90	9.5	11.3	8.35E-004	1.42E-005	8.21E-004	8.49E-004	2
07/26/99	86	0.0	86	86	79	0.0	79	79	4.9	0.00	4.9	4.9	7.70E-004	0.00E+000	7.70E-004	7.70E-004	1
07/27/99	146	0.0	146	146	134	0.0	134	134	27.1	0.00	27.1	27.1	8.71E-004	0.00E+000	8.71E-004	8.71E-004	1
07/28/99	119	13.0	106	132	110	12.0	98	122	17.1	5.05	12.0	22.1	9.84E-004	2.33E-005	9.61E-004	1.01E-003	2
07/29/99																	
07/30/99	105	0.0	105	105	98	0.0	98	98	11.4	0.00	11.4	11.4	9.85E-004	0.00E+000	9.85E-004	9.85E-004	1
07/31/99	93	22.6	76	125	87	19.9	71	115	9.0	5.85	4.6	17.3	1.01E-003	8.99E-005	8.86E-004	1.10E-003	3

Appendix D-2. Daily average size of YOY steelhead captured at Woodbridge Dam:
April 1, 1999 - July 31, 1999.

Date	Avg TL, mm	StDev TL, mm	Min TL, mm	Max TL, mm	Avg FL, mm	StDev FL, mm	Min FL, mm	Max FL, mm	Avg WT, g	StDev WT, g	Min WT, g	Max WT, g	Avg K	StDev K	Min K	Max K	N
04/01/99																	
04/02/99																	
04/03/99																	
04/04/99																	
04/05/99																	
04/06/99																	
04/07/99																	
04/08/99																	
04/09/99																	
04/10/99																	
04/11/99																	
04/12/99																	
04/13/99																	
04/14/99																	
04/15/99																	
04/16/99																	
04/17/99																	
04/18/99	36	1.5	34	37	35	1.5	33	36	0.4	0.05	0.3	0.4	8.05E-004	2.13E-004	5.92E-004	1.02E-003	2
04/19/99																	
04/20/99																	
04/21/99																	
04/22/99																	
04/23/99																	
04/24/99																	
04/25/99																	
04/26/99																	
04/27/99																	
04/28/99																	
04/29/99																	
04/30/99																	
05/01/99																	
05/02/99																	
05/03/99	45	0.0	45	45	43	0.0	43	43	0.7	0.00	0.7	0.7	7.68E-004	0.00E+000	7.68E-004	7.68E-004	1
05/04/99																	
05/05/99																	
05/06/99																	
05/07/99																	
05/08/99																	
05/09/99																	
05/10/99																	
05/11/99																	
05/12/99																	
05/13/99																	
05/14/99	49	0.0	49	49	47	0.0	47	47	1.2	0.00	1.2	1.2	1.02E-003	0.00E+000	1.02E-003	1.02E-003	1
05/15/99																	
05/16/99	40	0.0	40	40	38	0.0	38	38	0.6	0.00	0.6	0.6	9.38E-004	0.00E+000	9.38E-004	9.38E-004	1
05/17/99																	

Appendix D-2. Daily average size of YOY steelhead captured at Woodbridge Dam: April 1, 1999 - July 31, 1999.

Date	Avg TL, mm	StDev TL, mm	Min TL, mm	Max TL, mm	Avg FL, mm	StDev FL, mm	Min FL, mm	Max FL, mm	Avg WT, g	StDev WT, g	Min WT, g	Max WT, g	Avg K	StDev K	Min K	Max K	N
05/18/99																	
05/19/99	44	0.0	44	44	42	0.0	42	42	0.6	0.00	0.6	0.6	7.04E-004	0.00E+000	7.04E-004	7.04E-004	1
05/20/99																	
05/21/99	51	0.0	51	51	50	0.0	50	50	1.4	0.00	1.4	1.4	1.06E-003	0.00E+000	1.06E-003	1.06E-003	1
05/22/99																	
05/23/99	55	0.0	55	55	52	0.0	52	52	1.5	0.00	1.5	1.5	9.02E-004	0.00E+000	9.02E-004	9.02E-004	1
05/24/99																	
05/25/99																	
05/26/99																	
05/27/99	53	16.0	37	69	50	15.0	35	65	1.7	1.25	0.4	2.9	8.36E-004	4.65E-005	7.90E-004	8.83E-004	2
05/28/99																	
05/29/99																	
05/30/99																	
05/31/99																	
06/01/99																	
06/02/99																	
06/03/99	62	0.0	62	62	57	0.0	57	57	2.3	0.00	2.3	2.3	9.65E-004	0.00E+000	9.65E-004	9.65E-004	1
06/04/99	69	0.0	69	69	65	0.0	65	65	3.2	0.00	3.2	3.2	9.74E-004	0.00E+000	9.74E-004	9.74E-004	1
06/05/99	59	4.0	54	64	57	3.3	53	61	2.2	0.31	1.7	2.5	1.04E-003	8.04E-005	9.16E-004	1.13E-003	4
06/06/99	49	11.4	39	65	47	11.0	37	62	1.3	0.87	0.6	2.5	9.34E-004	5.61E-005	8.80E-004	1.01E-003	3
06/07/99	60	11.9	46	75	57	11.0	44	71	2.3	1.34	0.9	4.1	9.41E-004	2.21E-005	9.25E-004	9.72E-004	3
06/08/99	51	1.5	49	52	48	1.0	47	49	1.2	0.20	1.0	1.4	9.23E-004	7.28E-005	8.50E-004	9.96E-004	2
06/09/99	61	8.3	50	72	57	7.9	47	67	2.5	1.42	1.1	5.0	1.02E-003	1.71E-004	8.73E-004	1.34E-003	5
06/10/99	58	5.4	52	65	56	5.4	50	63	1.9	0.50	1.4	2.6	9.89E-004	3.23E-005	9.47E-004	1.02E-003	3
06/11/99	56	8.6	49	74	53	8.1	47	70	1.7	0.85	1.1	3.5	9.19E-004	4.47E-005	8.53E-004	9.74E-004	6
06/12/99	63	11.0	52	74	61	10.5	50	71	2.5	1.05	1.4	3.5	9.30E-004	6.60E-005	8.64E-004	9.96E-004	2
06/13/99	54	10.2	41	70	51	9.8	39	67	1.7	0.79	0.8	3.1	1.03E-003	1.87E-004	8.80E-004	1.45E-003	7
06/14/99	53	14.3	38	74	51	13.1	37	70	1.7	1.50	0.2	4.2	8.39E-004	2.67E-004	3.13E-004	1.04E-003	5
06/15/99	56	7.4	43	68	53	6.5	42	64	1.8	0.76	0.8	3.3	9.17E+000	2.05E+001	9.02E-004	5.50E+001	6
06/16/99	72	12.0	55	90	68	11.1	53	85	3.6	1.74	1.5	6.6	9.07E-004	2.41E-005	8.79E-004	9.47E-004	6
06/17/99	57	4.8	53	64	55	4.6	50	61	1.8	0.66	1.2	2.7	8.92E-004	9.83E-005	8.06E-004	1.03E-003	3
06/18/99	56	2.2	54	60	53	2.4	51	58	1.7	0.29	1.4	2.2	9.57E-004	7.67E-005	8.41E-004	1.02E-003	5
06/19/99	67	10.2	54	79	63	8.7	52	73	2.8	1.23	1.4	4.4	8.93E-004	3.55E-006	8.89E-004	8.98E-004	3
06/20/99	70	0.5	69	70	67	1.5	65	68	3.1	0.10	3.0	3.2	9.23E-004	9.86E-006	9.13E-004	9.33E-004	2
06/21/99	51	0.0	51	51	50	0.0	50	50	1.2	0.00	1.2	1.2	9.05E-004	0.00E+000	9.05E-004	9.05E-004	1
06/22/99	65	14.5	50	79	62	13.5	48	75	2.9	1.55	1.3	4.4	9.66E-004	7.38E-005	8.92E-004	1.04E-003	2
06/23/99	60	11.9	50	77	58	11.0	48	73	1.4	0.25	1.1	1.6	6.32E-004	4.50E-004	0.00E+000	1.02E-003	3
06/24/99	63	21.4	39	91	60	19.4	38	85	3.1	2.53	0.7	6.6	1.01E-003	1.27E-004	8.76E-004	1.18E-003	3
06/25/99	61	16.3	36	82	58	15.4	35	78	2.7	1.75	0.5	5.3	1.06E-003	1.14E-004	9.54E-004	1.31E-003	7
06/26/99	74	12.3	58	88	70	11.0	56	83	4.0	1.76	1.9	6.2	9.36E-004	2.74E-005	9.10E-004	9.74E-004	3
06/27/99	72	15.5	56	87	68	13.5	54	81	1.9	0.25	1.6	2.1	6.15E-004	2.96E-004	3.19E-004	9.11E-004	2
06/28/99	62	12.5	48	85	58	11.7	45	80	2.4	1.49	1.1	5.3	9.35E-004	6.38E-005	8.63E-004	1.03E-003	5
06/29/99	54	29.0	33	95	51	26.2	32	88	3.0	3.80	0.3	8.4	9.44E-004	7.88E-005	8.35E-004	1.02E-003	3
06/30/99	77	16.4	58	98	73	15.5	55	93	5.1	2.93	2.1	9.1	1.00E-003	5.41E-005	9.57E-004	1.08E-003	3
07/01/99	98	0.0	98	98	93	0.0	93	93	8.3	0.00	8.3	8.3	8.82E-004	0.00E+000	8.82E-004	8.82E-004	1
07/02/99	67	12.1	46	80	64	11.3	44	76	3.2	1.37	1.1	5.0	9.85E-004	7.22E-005	8.92E-004	1.13E-003	6
07/03/99																	

Appendix D-2. Daily average size of YOY steelhead captured at Woodbridge Dam: April 1, 1999 - July 31, 1999.

Date	Avg TL, mm	StDev TL, mm	Min TL, mm	Max TL, mm	Avg FL, mm	StDev FL, mm	Min FL, mm	Max FL, mm	Avg WT, g	StDev WT, g	Min WT, g	Max WT, g	Avg K	StDev K	Min K	Max K	N
07/04/99	50	14.0	36	64	49	13.5	35	62	1.6	1.20	0.4	2.8	9.63E-004	1.05E-004	8.57E-004	1.07E-003	2
07/05/99	84	0.0	84	84	79	0.0	79	79	5.4	0.00	5.4	5.4	9.11E-004	0.00E+000	9.11E-004	9.11E-004	1
07/06/99	80	1.5	78	81	76	1.0	75	77	5.0	0.35	4.6	5.3	9.83E-004	1.40E-005	9.69E-004	9.97E-004	2
07/07/99	67	9.0	60	80	63	9.3	55	76	3.1	1.34	2.1	5.0	9.57E-004	2.42E-005	9.23E-004	9.77E-004	3
07/08/99																	
07/09/99	77	0.0	77	77	73	0.0	73	73	4.2	0.00	4.2	4.2	9.20E-004	0.00E+000	9.20E-004	9.20E-004	1
07/10/99	74	0.0	74	74	70	0.0	70	70	3.8	0.00	3.8	3.8	9.38E-004	0.00E+000	9.38E-004	9.38E-004	1
07/11/99	58	10.2	44	67	54	9.5	41	62	1.9	0.82	0.8	2.7	9.05E-004	2.57E-005	8.77E-004	9.39E-004	3
07/12/99	56	5.5	50	61	53	4.5	48	57	1.7	0.80	1.1	2.3	9.47E-004	6.67E-005	8.80E-004	1.01E-003	2
07/13/99	73	8.0	65	81	69	7.5	61	76	3.9	1.45	2.4	5.3	9.36E-004	8.17E-005	8.74E-004	9.97E-004	2
07/14/99	60	18.0	42	78	57	17.5	39	74	2.2	1.70	0.5	3.9	7.48E-004	7.35E-005	6.75E-004	8.22E-004	2
07/15/99	88	0.0	88	88	83	0.0	83	83	6.5	0.00	6.5	6.5	9.54E-004	0.00E+000	9.54E-004	9.54E-004	1
07/16/99	97	0.0	97	97	90	0.0	90	90	8.3	0.00	8.3	8.3	9.09E-004	0.00E+000	9.09E-004	9.09E-004	1
07/17/99	75	0.5	74	75	70	1.0	69	71	3.9	0.60	3.3	4.5	9.41E-004	1.26E-004	8.14E-004	1.07E-003	2
07/18/99																	
07/19/99	76	0.5	75	76	72	1.5	70	73	3.8	0.15	3.6	3.9	8.71E-004	1.75E-005	8.53E-004	8.88E-004	2
07/20/99	75	3.9	70	79	71	3.6	66	74	4.1	0.52	3.4	4.6	9.63E-004	2.38E-005	9.33E-004	9.91E-004	3
07/21/99	73	6.0	67	79	70	4.3	62	75	4.8	1.90	2.9	6.7	1.16E-003	1.97E-004	9.64E-004	1.36E-003	3
07/22/99	87	6.0	81	93	81	6.0	75	87	6.6	1.60	5.0	8.2	9.80E-004	3.93E-005	9.41E-004	1.02E-003	2
07/23/99	80	0.0	80	80	77	0.0	77	77	5.4	0.00	5.4	5.4	1.05E-003	0.00E+000	1.05E-003	1.05E-003	1
07/24/99	91	14.2	75	114	86	12.6	71	106	7.9	4.01	3.8	14.5	9.50E-004	3.22E-005	9.01E-004	9.79E-004	4
07/25/99	72	2.0	70	74	69	1.5	67	70	3.8	0.35	3.4	4.1	1.00E-003	1.03E-005	9.91E-004	1.01E-003	2
07/26/99	80	3.5	76	83	75	4.0	71	79	4.5	0.20	4.3	4.7	9.01E-004	7.88E-005	8.22E-004	9.80E-004	2
07/27/99	99	0.0	99	99	94	0.0	94	94	8.9	0.00	8.9	8.9	9.17E-004	0.00E+000	9.17E-004	9.17E-004	1
07/28/99																	
07/29/99	100	0.0	100	100	94	0.0	94	94	10.1	0.00	10.1	10.1	1.01E-003	0.00E+000	1.01E-003	1.01E-003	1
07/30/99	70	4.0	66	74	65	4.5	60	69	3.4	0.40	3.0	3.8	9.91E-004	5.29E-005	9.38E-004	1.04E-003	2
07/31/99	96	3.3	92	100	90	3.4	85	93	8.0	0.84	6.9	8.9	8.97E-004	5.98E-005	8.30E-004	9.75E-004	3

APPENDIX E: Daily environmental conditions at Woodbridge Dam: December 1998 – July 1999

Date	River Flow (cfs)	Canal Flow (cfs)	Water Temp (C)			Secchi Depth (cm)			Turbidity (NTUs)			Rainfall (mm)		Baropress (millibars)	Moon Age (days)	Sunrise	Sunset
			Avg	Max	Min	AM	PM	Avg	AM	PM	Avg	Camanche	Woodbridge				
12/01/98	307	n/a	12.9	13.3	12.6	60.0	70.0	65.0	16.15	7.77	11.96	25.4	0.0	764.3	13	705	1645
12/02/98	288	n/a	12.9	13.3	12.5	160.0	180.0	170.0	3.12	2.54	2.83	0.3	0.0	765.1	14	706	1645
12/03/98	298	n/a	13.0	13.2	12.8	180.0	90.0	135.0	2.30	7.87	5.09	0.0	6.6	760.6	15	707	1645
12/04/98	297	n/a	11.9	12.7	11.2	170.0	160.0	165.0	2.59	2.25	2.42	0.0	0.0	763.6	16	708	1645
12/05/98	424	n/a	10.8	11.2	10.3	200.0	********	********	2.81	3.47	3.14	7.1	2.5	764.3	17	709	1645
12/06/98	455	n/a	10.9	11.4	10.4	190.0	180.0	185.0	3.61	3.19	3.40	0.0	0.0	766.6	18	710	1645
12/07/98	457	n/a	10.8	11.1	10.4	180.0	220.0	200.0	2.67	2.89	2.78	2.5	0.0	771.1	19	711	1645
12/08/98	463	n/a	11.1	11.7	10.7	180.0	190.0	185.0	3.14	2.80	2.97	0.0	0.8	771.1	20	712	1645
12/09/98	528	n/a	11.0	11.4	10.7	150.0	150.0	150.0	3.43	4.02	3.73	0.0	0.0	770.3	21	712	1645
12/10/98	540	n/a	10.9	11.5	10.5	160.0	180.0	170.0	3.12	3.89	3.51	0.0	0.0	771.8	22	713	1645
12/11/98	542	n/a	11.0	11.6	10.7	150.0	180.0	165.0	2.93	4.00	3.47	0.0	0.0	770.3	23	714	1645
12/12/98	544	n/a	11.0	11.5	10.6	170.0	180.0	175.0	3.42	3.83	3.63	0.0	0.0	768.1	24	715	1645
12/13/98	548	n/a	11.2	11.5	10.9	150.0	170.0	160.0	4.13	3.49	3.81	0.0	1.3	763.6	25	715	1645
12/14/98	549	n/a	11.3	11.8	11.0	150.0	150.0	150.0	2.67	3.79	3.23	5.1	0.0	767.3	26	716	1646
12/15/98	549	n/a	11.0	11.5	10.7	********	********	********	********	********	********	0.0	0.0	767.3	27	717	1646
12/16/98	550	n/a	11.0	11.6	10.5	160.0	********	********	3.13	3.32	3.23	0.0	0.0	766.6	28	718	1646
12/17/98	551	n/a	11.1	11.8	10.7	150.0	130.0	140.0	2.49	3.60	3.05	0.0	0.0	763.6	29	718	1646
12/18/98	551	n/a	11.0	11.5	10.7	130.0	130.0	130.0	4.81	3.85	4.33	0.0	0.0	759.1	0	719	1647
12/19/98	548	n/a	10.6	11.0	10.0	170.0	170.0	170.0	3.61	3.61	3.61	0.0	0.0	759.8	1	719	1647
12/20/98	551	n/a	9.8	10.1	9.3	190.0	180.0	185.0	3.57	3.20	3.39	0.0	0.0	762.8	2	720	1648
12/21/98	551	n/a	9.0	9.3	8.7	150.0	150.0	150.0	3.00	2.97	2.99	0.0	0.0	771.1	3	720	1648
12/22/98	551	n/a	8.8	9.2	8.4	150.0	150.0	150.0	3.24	3.79	3.52	0.0	0.0	767.3	4	721	1649
12/23/98	552	n/a	8.6	9.1	8.3	160.0	150.0	155.0	3.35	3.54	3.45	0.0	0.0	769.6	5	721	1649
12/24/98	549	n/a	8.5	9.0	8.1	170.0	180.0	175.0	3.10	2.52	2.81	0.0	0.0	773.3	6	722	1650
12/25/98	549	n/a	8.6	9.2	8.2	********	********	********	********	********	********	0.0	0.0	772.6	7	722	1650
12/26/98	550	n/a	8.8	9.3	8.4	160.0	150.0	155.0	3.43	3.20	3.32	0.0	0.0	768.1	8	723	1651
12/27/98	548	n/a	8.8	9.3	8.5	150.0	150.0	150.0	3.03	3.08	3.06	0.0	0.0	767.3	9	723	1652
12/28/98	549	n/a	9.0	9.5	8.7	150.0	170.0	160.0	3.01	3.05	3.03	0.0	0.0	768.1	10	723	1652
12/29/98	546	n/a	9.1	9.6	8.7	150.0	180.0	165.0	3.53	2.92	3.23	0.0	0.0	765.8	11	724	1653
12/30/98	545	n/a	8.9	9.3	8.7	170.0	160.0	165.0	3.24	2.82	3.03	0.0	0.0	762.1	12	724	1654
12/31/98	547	n/a	9.5	10.2	8.9	160.0	170.0	165.0	3.64	3.90	3.77	0.0	0.0	762.8	13	724	1655
01/01/99	550	n/a	9.4	9.7	9.1	160.0	160.0	160.0	3.08	2.71	2.90	0.0	0.0	765.1	14	724	1655
01/02/99	551	n/a	9.1	9.4	8.8	170.0	190.0	180.0	2.63	3.02	2.83	0.0	0.0	764.3	15	724	1656
01/03/99	549	n/a	9.0	9.4	8.7	140.0	180.0	160.0	3.06	2.68	2.87	0.0	0.0	766.6	16	724	1657
01/04/99	548	n/a	9.0	9.2	8.9	150.0	150.0	150.0	2.19	2.90	2.55	0.0	0.3	769.6	17	724	1658
01/05/99	549	n/a	8.7	8.8	8.5	160.0	150.0	155.0	3.08	2.89	2.99	0.5	0.0	768.8	18	725	1659
01/06/99	551	n/a	8.5	8.7	8.4	180.0	180.0	180.0	2.44	2.94	2.69	0.3	0.0	766.6	19	725	1700
01/07/99	550	n/a	8.4	8.6	8.3	170.0	170.0	170.0	3.70	3.65	3.68	0.3	0.0	765.8	20	724	1701
01/08/99	545	n/a	8.5	9.0	8.3	170.0	170.0	170.0	3.16	2.93	3.05	0.0	0.0	767.3	21	724	1702
01/09/99	544	n/a	8.3	8.5	8.1	170.0	180.0	175.0	3.23	2.77	3.00	0.0	0.0	768.8	22	724	1702
01/10/99	547	n/a	8.2	8.4	8.1	180.0	180.0	180.0	2.77	2.85	2.81	0.0	0.0	765.8	23	724	1703
01/11/99	550	n/a	8.2	8.6	8.1	170.0	160.0	165.0	2.58	2.77	2.68	0.0	0.0	762.8	24	724	1704
01/12/99	549	n/a	8.0	8.4	7.8	160.0	170.0	165.0	3.48	2.58	3.03	0.0	0.0	764.3	25	724	1705
01/13/99	549	n/a	7.9	8.3	7.6	160.0	170.0	165.0	3.13	3.04	3.09	0.0	0.0	766.6	26	724	1706
01/14/99	511	n/a	8.3	8.8	7.9	160.0	160.0	160.0	2.60	3.34	2.97	0.0	1.5	768.8	27	723	1707
01/15/99	479	n/a	8.9	9.5	8.4	180.0	170.0	175.0	3.21	2.96	3.09	1.3	13.5	765.1	28	723	1708

APPENDIX E: Daily environmental conditions at Woodbridge Dam: December 1998 – July 1999

	River Flow	Canal Flow	Water Temp (C)			Secchi Depth (cm)			Turbidity (NTUs)			Rainfall (mm)		Baropress	Moon Age		
Date	(cfs)	(cfs)	Avg	Max	Min	AM	PM	Avg	AM	PM	Avg	Camanche	Woodbridge	(millibars)	(days)	Sunrise	Sunset
01/16/99	482	n/a	9.7	10.1	9.4	140.0	160.0	150.0	4.88	3.68	4.28	14.0	0.0	762.8	29	723	1709
01/17/99	455	n/a	9.8	10.3	9.5	160.0	140.0	150.0	3.93	3.19	3.56	0.5	0.3	762.8	0	722	1710
01/18/99	484	n/a	10.7	10.9	10.4	150.0	100.0	125.0	3.80	5.92	4.86	2.5	20.3	762.8	1	722	1712
01/19/99	490	n/a	10.6	11.0	10.2	90.0	120.0	105.0	10.85	6.40	8.63	2.5	10.7	761.3	2	721	1713
01/20/99	488	n/a	10.8	11.0	10.4	140.0	140.0	140.0	6.70	5.21	5.96	12.2	2.3	759.8	3	721	1714
01/21/99	463	n/a	10.2	10.6	9.9	150.0	150.0	150.0	3.82	3.20	3.51	7.1	0.0	765.8	4	720	1715
01/22/99	455	n/a	10.1	10.5	9.7	160.0	160.0	160.0	3.13	3.21	3.17	0.8	0.0	765.1	5	720	1716
01/23/99	439	n/a	10.0	10.3	9.5	180.0	150.0	165.0	3.39	3.49	3.44	10.2	3.6	760.6	6	718	1717
01/24/99	465	n/a	9.2	9.5	8.9	170.0	150.0	160.0	2.90	3.23	3.07	4.3	0.3	760.6	7	718	1718
01/25/99	457	n/a	9.1	9.6	8.8	140.0	150.0	145.0	3.97	4.55	4.26	0.8	0.3	757.6	8	717	1719
01/26/99	461	n/a	8.7	9.1	8.4	140.0	140.0	140.0	4.07	3.31	3.69	2.5	3.3	761.3	9	716	1720
01/27/99	510	n/a	8.8	9.6	8.3	150.0	140.0	145.0	3.95	3.71	3.83	6.4	0.0	767.3	10	716	1721
01/28/99	561	n/a	9.0	9.6	8.7	150.0	140.0	145.0	3.43	4.12	3.78	0.8	0.0	768.8	11	715	1723
01/29/99	562	n/a	9.0	9.8	8.6	150.0	140.0	145.0	3.08	5.10	4.09	0.0	0.0	765.8	12	714	1724
01/30/99	548	n/a	8.8	9.2	8.6	140.0	150.0	145.0	3.61	3.12	3.37	0.0	0.0	759.8	13	714	1725
01/31/99	608	n/a	8.9	9.3	8.6	70.0	80.0	75.0	17.50	14.60	16.05	13.7	22.1	761.3	14	713	1726
02/01/99	576	n/a	9.2	9.6	8.9	110.0	90.0	100.0	6.93	10.31	8.62	8.6	0.3	770.3	15	712	1727
02/02/99	559	n/a	9.0	9.6	8.5	130.0	********	********	3.35	********	********	0.5	0.0	768.8	16	711	1728
02/03/99	624	n/a	9.2	9.9	8.6	110.0	120.0	115.0	3.86	4.53	4.20	0.0	0.0	761.3	17	710	1729
02/04/99	712	n/a	9.3	9.8	9.0	120.0	120.0	120.0	6.13	4.61	5.37	0.0	0.0	758.3	18	709	1730
02/05/99	732	n/a	9.0	9.4	8.8	110.0	115.0	112.5	5.03	4.00	4.52	0.3	0.0	763.6	19	708	1731
02/06/99	749	n/a	9.0	9.2	8.9	130.0	120.0	125.0	4.61	8.56	6.59	23.1	9.4	764.3	20	707	1733
02/07/99	834	n/a	9.4	9.8	8.9	65.0	50.0	57.5	11.80	30.30	21.05	3.8	22.4	761.3	21	706	1734
02/08/99	860	n/a	9.9	10.4	9.7	50.0	70.0	60.0	25.75	12.80	19.28	21.8	2.3	760.6	22	705	1737
02/09/99	1670	n/a	9.8	10.1	9.4	40.0	40.0	40.0	35.40	21.60	28.50	2.5	12.7	759.1	23	704	1738
02/10/99	2490	n/a	9.3	9.6	9.0	40.0	40.0	40.0	********	17.65	********	0.0	0.0	770.3	24	703	1739
02/11/99	2770	n/a	9.2	9.4	8.8	50.0	70.0	60.0	10.75	6.30	8.53	0.0	0.0	770.3	25	702	1740
02/12/99	2810	n/a	9.2	9.4	8.9	70.0	90.0	80.0	5.38	9.78	7.58	0.0	0.0	767.3	26	701	1741
02/13/99	2830	n/a	9.3	9.4	9.0	70.0	70.0	70.0	6.09	8.85	7.47	0.0	3.0	765.8	27	700	1742
02/14/99	2830	n/a	9.2	9.5	9.0	60.0	70.0	65.0	5.93	6.10	6.02	1.0	0.0	765.1	28	659	1743
02/15/99	2820	n/a	9.0	9.2	8.6	70.0	80.0	75.0	********	10.10	********	0.0	0.3	766.6	0	658	1744
02/16/99	2820	n/a	9.1	9.3	9.0	80.0	80.0	80.0	7.70	6.42	7.06	0.8	4.3	765.1	1	656	1746
02/17/99	2850	n/a	9.6	10.1	9.1	80.0	90.0	85.0	9.70	10.00	9.85	8.9	1.8	764.3	2	655	1747
02/18/99	2850	n/a	9.5	9.9	9.2	90.0	90.0	90.0	4.27	7.01	5.64	0.8	1.8	762.8	3	654	1748
02/19/99	2840	n/a	9.2	9.6	8.9	100.0	70.0	85.0	6.64	8.64	7.64	5.8	0.3	764.3	4	653	1749
02/20/99	2850	n/a	9.0	9.3	8.6	100.0	90.0	95.0	9.65	9.37	9.51	0.0	16.5	762.8	5	652	1750
02/21/99	2900	n/a	9.4	9.7	9.1	90.0	90.0	90.0	7.92	7.07	7.50	21.1	2.5	768.8	6	650	1751
02/22/99	2870	n/a	9.4	9.7	9.1	90.0	70.0	80.0	6.13	7.00	6.57	0.0	0.0	771.1	7	649	1752
02/23/99	2840	n/a	9.4	9.7	9.0	100.0	100.0	100.0	11.20	9.34	10.27	0.0	0.0	767.3	8	648	1753
02/24/99	2840	n/a	9.3	9.5	8.9	100.0	80.0	90.0	9.47	9.11	9.29	0.0	0.3	762.1	9	646	1754
02/25/99	2840	n/a	9.3	9.6	9.0	110.0	100.0	105.0	8.39	9.10	8.75	4.8	3.8	763.6	10	645	1755
02/26/99	2820	n/a	9.1	9.4	8.7	100.0	100.0	100.0	8.55	8.85	8.70	0.0	0.0	765.8	11	644	1756
02/27/99	2820	n/a	9.4	9.8	9.0	100.0	100.0	100.0	6.40	6.77	6.59	0.0	0.0	766.6	12	642	1757
02/28/99	2820	n/a	9.5	9.8	9.1	110.0	100.0	105.0	5.45	6.35	5.90	0.0	0.0	765.8	13	641	1758
03/01/99	2830	n/a	9.8	10.1	9.4	80.0	120.0	100.0	5.94	6.73	6.34	0.0	0.3	765.8	14	640	1759
03/02/99	2830	n/a	9.5	9.9	9.0	90.0	100.0	95.0	6.82	6.99	6.91	0.0	0.3	761.3	15	638	1800

APPENDIX E: Daily environmental conditions at Woodbridge Dam: December 1998 – July 1999

Date	River Flow (cfs)	Canal Flow (cfs)	Water Temp (C)			Secchi Depth (cm)			Turbidity (NTUs)			Rainfall (mm)		Baropress (millibars)	Moon Age (days)	Sunrise	Sunset
			Avg	Max	Min	AM	PM	Avg	AM	PM	Avg	Camanche	Woodbridge				
03/03/99	2830	n/a	9.8	10.0	9.4	100.0	100.0	100.0	6.83	6.29	6.56	7.1	2.0	761.3	16	637	1801
03/04/99	2830	n/a	9.3	9.6	8.9	110.0	100.0	105.0	6.80	6.50	6.65	0.3	0.0	763.6	17	635	1802
03/05/99	2830	n/a	9.2	9.5	8.8	110.0	120.0	115.0	6.87	6.66	6.77	0.0	0.0	762.1	18	634	1803
03/06/99	2720	n/a	9.4	9.5	9.1	130.0	120.0	125.0	4.89	5.63	5.26	0.0	0.0	758.3	19	632	1804
03/07/99	2540	n/a	9.4	9.7	9.0	120.0	100.0	110.0	6.13	6.80	6.47	0.0	0.0	759.1	20	631	1805
03/08/99	2360	n/a	9.3	9.7	9.0	130.0	130.0	130.0	4.61	6.86	5.74	0.0	4.3	759.8	21	630	1806
03/09/99	2180	n/a	9.9	11.1	9.1	140.0	110.0	125.0	6.00	6.22	6.11	5.8	4.6	761.3	22	628	1807
03/10/99	2000	n/a	9.8	10.2	9.3	110.0	140.0	125.0	6.39	6.37	6.38	0.0	0.0	762.1	23	627	1808
03/11/99	1820	n/a	9.8	10.3	9.3	110.0	100.0	105.0	4.76	5.70	5.23	0.0	0.0	761.3	24	625	1809
03/12/99	1630	n/a	9.8	10.2	9.4	100.0	120.0	110.0	4.54	5.01	4.78	0.0	0.0	764.3	25	623	1810
03/13/99	1450	n/a	10.0	10.3	9.8	120.0	90.0	105.0	7.84	7.94	7.89	0.0	0.0	760.6	26	621	1811
03/14/99	1280	n/a	9.7	10.1	9.3	130.0	120.0	125.0	4.95	5.55	5.25	0.0	0.0	756.8	27	620	1812
03/15/99	1230	n/a	9.8	10.4	9.4	********	100.0	********	5.10	7.96	6.53	0.0	0.0	755.3	28	618	1813
03/16/99	1200	n/a	9.9	10.1	9.7	80.0	70.0	75.0	9.22	10.05	9.64	0.0	0.0	759.8	29	617	1814
03/17/99	1190	n/a	10.2	10.9	9.7	100.0	90.0	95.0	6.08	7.22	6.65	0.0	0.0	761.3	0	615	1815
03/18/99	1180	n/a	10.3	10.5	10.1	150.0	140.0	145.0	4.94	5.21	5.08	0.0	0.0	759.8	1	614	1815
03/19/99	1170	n/a	10.4	10.6	10.1	100.0	110.0	105.0	5.03	6.04	5.54	0.0	1.5	759.1	2	612	1816
03/20/99	1170	n/a	10.3	10.8	10.0	120.0	140.0	130.0	5.20	4.81	5.01	3.8	0.5	762.1	3	611	1818
03/21/99	1160	n/a	10.4	11.1	10.1	140.0	150.0	145.0	3.60	4.56	4.08	1.5	0.0	763.6	4	609	1819
03/22/99	1160	n/a	10.1	10.4	9.9	150.0	150.0	150.0	4.93	5.97	5.45	0.3	0.0	761.3	5	608	1820
03/23/99	1160	n/a	10.3	10.9	10.0	110.0	110.0	110.0	7.01	6.84	6.93	0.6	0.3	760.6	6	606	1821
03/24/99	1150	n/a	10.3	10.4	10.1	160.0	170.0	165.0	5.08	3.93	4.51	0.3	3.8	757.6	7	605	1822
03/25/99	1150	n/a	10.8	11.3	10.3	160.0	170.0	165.0	3.66	4.00	3.83	0.0	2.5	756.8	8	603	1823
03/26/99	1150	n/a	10.8	11.3	10.5	170.0	180.0	175.0	4.61	3.97	4.29	0.0	0.0	759.8	9	601	1824
03/27/99	1140	n/a	10.5	11.0	10.3	210.0	150.0	180.0	3.55	4.34	3.95	0.0	0.0	764.3	10	600	1825
03/28/99	1140	n/a	10.4	10.9	10.1	150.0	190.0	170.0	4.39	3.76	4.08	0.0	0.0	766.6	11	558	1826
03/29/99	1140	n/a	10.5	10.8	10.2	152.0	170.0	161.0	4.51	4.19	4.35	0.0	0.0	763.6	12	557	1827
03/30/99	1140	n/a	10.4	11.0	10.2	130.0	190.0	160.0	3.47	3.53	3.50	0.0	2.0	760.6	13	555	1828
03/31/99	910	n/a	10.6	12.0	10.1	180.0	180.0	180.0	3.53	4.43	3.98	8.4	1.0	759.1	14	554	1828
04/01/99	1040	14	10.8	11.6	10.0	180	210	195	3.12	3.15	3.14	0.0	0.0	756.9	15	551	1829
04/02/99	1110	13	10.9	11.8	10.2	190	200	195	3.02	3.22	3.12	0.0	0.0	758.2	16	550	1830
04/03/99	1110	13	10.8	11.5	10.1	210	170	190	2.86	3.08	2.97	0.0	0.0	756.4	17	548	1831
04/04/99	1120	13	10.3	11.3	9.4	210	260	235	3.15	3.03	3.09	0.0	0.0	758.6	18	647	1932
04/05/99	1140	13	10.3	10.6	10.0	220	170	195	2.76	3.01	2.89	0.0	9.1	757.7	19	645	1934
04/06/99	1130	13	10.4	11.3	9.7	170	230	200	3.59	2.67	3.13	15.5	0.5	758.7	20	644	1935
04/07/99	1120	13	10.7	11.0	10.4	240	210	225	2.91	2.86	2.89	0.0	0.0	761.6	21	642	1936
04/08/99	1130	13	10.4	11.0	10.0	200	150	175	3.53	4.04	3.79	8.6	8.1	763.6	22	641	1937
04/09/99	1120	13	10.6	11.5	9.8	210	230	220	2.81	3.01	2.91	0.3	0.0	768.3	23	640	1938
04/10/99	1120	13	10.9	11.7	10.4	230	180	205	3.29	3.54	3.42	0.0	1.8	762.8	24	638	1939
04/11/99	1120	13	11.0	11.5	10.6	190	200	195	4.74	3.11	3.93	1.0	0.3	757.4	25	637	1939
04/12/99	1110	27	11.8	12.9	10.8	210	220	215	3.02	3.33	3.18	0.0	0.0	762.0	26	635	1940
04/13/99	1100	33	12.5	13.2	11.7	190	210	200	3.35	3.28	3.32	0.0	0.0	765.7	27	634	1941
04/14/99	1080	40	12.8	13.5	12.2	210	210	210	3.16	3.67	3.42	0.0	0.0	762.4	28	632	1942
04/15/99	1070	47	13.1	13.8	12.4	200	190	195	3.54	3.64	3.59	0.0	0.0	760.2	0	631	1943
04/16/99	1080	47	13.5	14.7	12.7	n/a	220	n/a	3.27	5.52	4.40	0.0	0.0	760.2	1	630	1944
04/17/99	1060	47	13.7	14.5	13.2	220	190	205	3.93	3.48	3.71	0.0	0.0	761.1	2	628	1945

APPENDIX E: Daily environmental conditions at Woodbridge Dam: December 1998 – July 1999

	River Flow	Canal Flow	Water Temp (C)			Secchi Depth (cm)			Turbidity (NTUs)			Rainfall (mm)		Baropress	Moon Age		
Date	(cfs)	(cfs)	Avg	Max	Min	AM	PM	Avg	AM	PM	Avg	Camanche	Woodbridge	(millibars)	(days)	Sunrise	Sunset
04/18/99	1060	53	13.5	14.2	13.0	200	200	200	3.60	4.11	3.86	0.0	0.0	763.0	3	627	1946
04/19/99	1040	65	13.4	14.2	12.9	190	220	205	3.08	3.26	3.17	0.0	0.0	763.7	4	625	1947
04/20/99	1040	73	13.3	14.1	12.7	180	200	190	3.06	3.11	3.09	0.0	0.0	760.6	5	624	1948
04/21/99	1030	88	12.7	14.3	12.2	180	250	215	3.03	3.16	3.10	0.0	0.0	757.6	6	623	1949
04/22/99	1000	99	13.0	13.5	12.2	210	230	220	3.17	3.64	3.41	0.0	0.0	755.4	7	621	1950
04/23/99	1010	116	12.3	13.2	11.7	190	220	205	3.66	2.90	3.28	0.0	0.0	755.9	8	620	1951
04/24/99	988	127	12.3	13.1	11.5	210	190	200	3.26	3.61	3.44	0.0	0.0	757.0	9	619	1951
04/25/99	983	127	12.8	13.7	12.1	200	230	215	3.15	2.95	3.05	0.0	0.0	761.6	10	618	1952
04/26/99	993	127	12.8	13.5	12.3	200	200	200	2.60	2.84	2.72	0.0	0.0	761.6	11	616	1953
04/27/99	983	126	12.4	13.1	11.9	220	220	220	3.50	3.23	3.37	0.0	0.0	761.0	12	615	1954
04/28/99	983	128	12.2	12.9	11.6	190	500	345	3.45	3.26	3.36	0.0	0.0	758.1	13	614	1955
04/29/99	992	118	12.0	12.7	11.3	190	220	205	3.04	3.36	3.20	0.0	0.0	755.2	14	613	1956
04/30/99	989	112	12.0	12.9	11.2	200	240	220	3.12	3.80	3.46	0.0	0.0	757.0	15	611	1957
05/01/99	985	116	12.8	13.7	12.0	170	190	180	n/a	3.04	n/a	0.0	0.0	759.2	16	610	1958
05/02/99	985	115	13.3	14.2	12.6	190	210	200	2.87	3.37	3.12	0.0	0.8	759.7	17	609	1959
05/03/99	1000	114	12.6	13.2	11.9	200	220	210	4.89	2.66	3.78	7.6	6.1	758.3	18	608	2000
05/04/99	994	114	11.8	12.4	11.5	200	230	215	6.45	3.57	5.01	0.5	0.0	761.7	19	605	2001
05/05/99	991	115	12.2	13.0	11.3	220	220	220	3.26	3.47	3.37	0.0	0.0	761.0	20	604	2002
05/06/99	988	102	13.0	13.8	12.2	200	200	200	3.07	3.51	3.29	0.0	0.0	760.7	21	603	2002
05/07/99	976	106	13.5	14.4	12.7	220	210	215	4.79	2.85	3.82	0.0	0.0	760.9	22	602	2003
05/08/99	965	109	13.6	14.3	13.0	180	230	205	3.84	3.94	3.89	0.0	0.0	759.3	23	601	2004
05/09/99	967	105	13.1	13.9	12.5	190	230	210	2.72	2.78	2.75	0.0	0.0	760.4	24	600	2005
05/10/99	953	107	12.9	13.6	12.3	220	215	218	3.00	2.90	2.95	0.0	0.0	760.6	25	559	2006
05/11/99	962	116	13.0	13.7	12.3	220	220	220	2.76	3.31	3.05	0.0	0.0	759.4	26	558	2007
05/12/99	947	133	13.5	14.4	12.6	190	190	190	2.61	3.41	3.01	0.0	0.0	757.6	27	557	2008
05/13/99	923	153	14.1	15.0	13.5	170	190	180	3.37	3.02	3.20	0.0	0.0	758.8	28	556	2009
05/14/99	904	170	13.7	14.4	13.2	200	210	205	3.68	3.21	3.45	0.0	0.0	760.3	29	555	2010
05/15/99	907	178	13.4	14.2	12.8	180	210	195	2.67	2.29	2.48	0.0	0.0	761.0	0	554	2011
05/16/99	900	180	13.3	14.1	12.6	190	200	195	2.78	3.27	3.03	0.0	0.0	761.4	1	553	2012
05/17/99	901	178	13.4	14.4	12.7	210	230	220	2.94	3.47	3.21	0.0	0.0	760.9	2	552	2013
05/18/99	899	181	13.8	14.6	13.0	210	210	210	2.72	3.02	2.87	0.0	0.0	759.7	3	552	2014
05/19/99	904	184	14.1	14.9	13.4	235	235	235	3.28	2.97	3.13	0.0	0.0	759.1	4	551	2015
05/20/99	899	183	13.9	14.8	13.3	200	215	208	2.99	2.86	2.93	0.0	0.0	759.2	5	550	2016
05/21/99	910	177	13.9	14.8	13.3	200	240	220	3.24	3.08	3.16	0.0	0.0	756.4	6	549	2017
05/22/99	902	173	13.9	14.6	13.2	250	230	240	2.78	3.30	3.04	0.0	0.0	754.9	7	549	2017
05/23/99	897	170	14.5	15.5	13.8	170	200	185	2.52	2.92	2.72	0.0	0.0	758.6	8	548	2018
05/24/99	910	168	14.8	15.6	14.1	195	210	203	3.02	3.12	3.07	0.0	0.0	760.1	9	547	2019
05/25/99	909	165	14.6	15.4	13.9	240	230	235	2.38	2.71	2.55	0.0	0.0	758.7	10	547	2020
05/26/99	909	170	14.7	15.7	13.8	210	220	215	3.26	2.85	3.06	0.0	0.0	758.3	11	546	2020
05/27/99	909	173	15.0	15.9	14.3	220	250	235	2.66	2.95	2.81	0.0	0.0	758.9	12	546	2021
05/28/99	913	175	15.1	15.9	14.4	220	230	225	3.10	3.22	3.16	0.0	0.0	757.5	13	547	2022
05/29/99	910	174	15.0	15.7	14.3	230	240	235	2.99	3.31	3.15	0.0	0.0	757.2	14	547	2023
05/30/99	914	172	14.8	15.7	14.2	230	220	225	3.52	3.72	3.62	0.0	0.0	758.6	15	546	2023
05/31/99	918	175	14.7	15.6	14.0	220	200	210	2.43	3.09	2.76	0.0	0.0	760.4	16	546	2024
06/01/99	917	180	14.7	15.7	14.0	200	200	200	3.18	3.33	3.26	0.0	0.0	758.2	17	546	2025
06/02/99	916	190	14.6	15.4	14.0	200	210	205	2.86	2.90	2.88	1.3	0.0	756.8	18	543	2025

APPENDIX E: Daily environmental conditions at Woodbridge Dam: December 1998 – July 1999

Date	River Flow (cfs)	Canal Flow (cfs)	Water Temp (C)			Secchi Depth (cm)			Turbidity (NTUs)			Rainfall (mm)		Baropress (millibars)	Moon Age (days)	Sunrise	Sunset
			Avg	Max	Min	AM	PM	Avg	AM	PM	Avg	Camanche	Woodbridge				
06/03/99	909	194	14.4	15.4	13.9	210	220	215	2.70	3.10	2.90	1.3	0.0	760.1	19	543	2026
06/04/99	922	192	13.8	14.4	13.4	190	240	215	2.69	3.12	2.91	1.8	0.0	759.9	20	543	2027
06/05/99	913	193	13.9	14.8	13.1	220	210	215	2.54	3.18	2.86	0.0	0.0	760.4	21	542	2027
06/06/99	922	189	14.5	15.6	13.6	230	200	215	2.65	2.79	2.72	0.0	0.0	760.1	22	542	2028
06/07/99	931	179	15.0	15.9	14.3	230	240	235	2.63	2.99	2.81	0.0	0.0	759.9	23	542	2028
06/08/99	934	173	14.7	15.5	14.1	230	250	240	2.77	3.07	2.92	0.0	0.0	759.4	24	542	2029
06/09/99	933	172	14.6	15.5	13.9	230	240	235	2.93	2.58	2.76	0.0	0.0	758.6	25	542	2030
06/10/99	928	172	14.8	15.7	14.0	220	250	235	2.56	3.17	2.87	0.0	0.0	758.7	26	541	2030
06/11/99	915	173	15.0	15.8	14.2	210	240	225	3.21	2.87	3.04	0.0	0.0	758.9	27	541	2030
06/12/99	759	172	15.2	16.0	14.4	220	220	220	2.60	3.55	3.08	0.0	0.0	761.3	28	541	2031
06/13/99	709	172	15.4	16.6	14.5	210	200	205	3.44	3.49	3.47	0.0	0.0	761.1	0	541	2031
06/14/99	694	176	15.7	16.8	14.8	210	240	225	3.17	2.17	2.67	0.0	0.0	758.8	1	541	2032
06/15/99	698	193	16.0	17.0	15.2	230	230	230	2.64	2.65	2.65	0.0	0.0	757.7	2	541	2032
06/16/99	696	198	15.9	16.9	15.2	250	240	245	2.10	2.71	2.41	0.0	0.0	757.5	3	541	2033
06/17/99	697	195	15.8	16.9	14.9	230	230	230	2.96	3.14	3.05	0.0	0.0	757.2	4	541	2033
06/18/99	695	198	16.2	17.3	15.1	240	220	230	2.73	2.87	2.80	0.0	0.0	757.8	5	541	2033
06/19/99	695	199	16.3	17.3	15.4	220	240	230	2.50	2.89	2.70	0.0	0.0	758.8	6	541	2033
06/20/99	700	194	16.3	17.3	15.4	210	230	220	2.65	3.19	2.92	0.0	0.0	754.3	7	542	2034
06/21/99	692	192	16.2	17.4	15.3	230	260	245	2.78	2.63	2.71	0.0	0.0	752.7	8	542	2034
06/22/99	640	196	16.4	17.6	15.6	260	260	260	2.93	2.32	2.63	0.0	0.0	753.2	9	542	2034
06/23/99	643	196	16.8	18.2	15.8	260	240	250	2.26	2.26	2.26	0.0	0.0	754.8	10	542	2034
06/24/99	644	196	17.1	18.2	16.2	230	250	240	2.04	2.34	2.19	0.0	0.0	755.9	11	542	2034
06/25/99	641	195	16.8	17.7	16.0	270	270	270	2.22	2.64	2.43	0.0	0.0	756.4	12	543	2035
06/26/99	639	193	16.6	17.7	15.7	260	270	265	2.40	2.72	2.56	0.0	0.0	754.8	13	543	2035
06/27/99	638	192	16.6	17.8	15.6	270	260	265	2.46	2.59	2.53	0.0	0.0	755.3	14	544	2035
06/28/99	646	190	16.7	17.9	15.7	300	290	295	2.05	2.38	2.22	0.0	0.0	756.7	15	544	2035
06/29/99	651	186	17.0	18.3	15.9	310	300	305	2.01	2.21	2.11	0.0	0.0	756.5	16	544	2035
06/30/99	657	178	17.3	18.6	16.2	300	280	290	1.90	2.41	2.16	0.0	0.0	754.1	17	545	2035
07/01/99	644	175	17.6	18.8	16.5	n/a	310	155	1.91	2.38	2.15	0.0	0.0	751.9	18	546	2035
07/02/99	523	189	17.7	18.8	16.8	290	310	300	2.20	1.63	1.92	0.0	0.0	751.6	19	546	2034
07/03/99	503	192	17.4	18.1	16.6	360	310	335	2.55	2.93	2.74	0.0	0.0	754.6	20	546	2034
07/04/99	494	192	16.4	17.1	15.7	290	240	265	2.27	2.67	2.47	0.0	0.0	758.1	21	547	2034
07/05/99	505	192	15.8	16.6	15.0	280	260	270	2.35	2.60	2.48	0.0	0.0	757.9	22	547	2034
07/06/99	504	195	15.9	16.8	15.0	260	280	270	2.46	2.47	2.47	0.0	0.0	757.7	23	548	2034
07/07/99	481	206	16.1	17.0	15.3	320	290	305	1.90	2.16	2.03	0.0	0.0	758.4	24	548	2033
07/08/99	460	226	16.1	16.9	15.3	300	320	310	1.75	2.17	1.96	0.0	0.0	758.3	25	549	2033
07/09/99	455	236	16.3	17.3	15.4	320	280	300	2.14	2.33	2.24	0.0	0.0	760.0	26	550	2033
07/10/99	452	237	16.4	17.6	15.5	340	270	305	1.95	1.96	1.96	0.0	0.0	759.7	27	550	2032
07/11/99	456	234	16.4	17.2	15.5	310	290	300	2.41	2.41	2.41	0.0	0.0	757.1	28	551	2032
07/12/99	473	228	16.7	17.6	15.8	300	270	285	2.03	2.45	2.24	0.0	0.0	755.1	0	552	2032
07/13/99	460	227	17.1	18.3	16.2	280	300	290	1.85	1.82	1.84	0.0	0.0	754.5	1	552	2031
07/14/99	458	228	17.2	17.9	16.7	320	290	305	1.95	2.16	2.06	0.0	0.0	754.6	2	553	2031
07/15/99	461	232	16.7	17.3	15.9	330	300	315	2.39	2.33	2.36	0.0	0.0	756.5	3	554	2030
07/16/99	470	235	16.5	17.1	15.7	300	250	275	1.81	2.32	2.07	0.0	0.0	758.2	4	555	2030
07/17/99	455	228	16.3	17.0	15.5	300	270	285	2.03	2.2	2.12	0.0	0.0	759.2	5	555	2029
07/18/99	457	226	16.1	17.0	15.3	330	300	315	2.63	2.48	2.56	0.0	0.0	759.0	6	556	2029

APPENDIX E: Daily environmental conditions at Woodbridge Dam: December 1998 -- July 1999

	River Flow	Canal Flow	Water Temp (C)			Secchi Depth (cm)			Turbidity (NTUs)			Rainfall (mm)		Baropress	Moon Age		
Date	(cfs)	(cfs)	Avg	Max	Min	AM	PM	Avg	AM	PM	Avg	Camanche	Woodbridge	(millibars)	(days)	Sunrise	Sunset
07/19/99	469	224	16.1	16.9	15.3	300	300	300	2.11	2.39	2.25	0.0	0.0	760.0	7	556	2028
07/20/99	480	220	16.1	16.9	15.3	290	280	285	2.61	2.19	2.40	0.0	0.0	760.0	8	557	2027
07/21/99	485	219	16.0	16.8	15.3	300	290	295	2.06	2.58	2.32	0.0	0.0	760.4	9	558	2027
07/22/99	487	216	16.0	16.9	15.2	290	290	290	2.39	2.32	2.36	0.0	0.0	760.9	10	559	2026
07/23/99	483	219	16.2	17.1	15.3	300	290	295	2.13	2.63	2.38	0.0	0.0	761.9	11	600	2025
07/24/99	484	220	16.3	17.0	15.5	280	280	280	2.3	2.39	2.35	0.0	0.0	761.1	12	601	2025
07/25/99	480	221	16.2	16.9	15.3	280	280	280	2.28	2.22	2.25	0.0	0.0	758.1	13	601	2024
07/26/99	484	221	16.4	17.2	15.4	310	320	315	2.09	2.43	2.26	0.0	0.0	757.8	14	602	2023
07/27/99	478	220	16.5	17.3	15.6	300	310	305	2.64	1.95	2.30	0.0	0.0	758.1	15	603	2022
07/28/99	474	224	16.4	17.1	15.7	280	270	275	2.34	2.38	2.36	0.0	1.0	760.3	16	604	2021
07/29/99	472	224	16.3	17.0	15.5	270	320	295	2.32	2.44	2.38	0.0	0.0	761.5	17	604	2020
07/30/99	472	225	16.2	17.0	15.4	240	250	245	2.6	2.83	2.72	0.0	0.0	759.6	18	605	2019
07/31/99	468	225	16.3	17.0	15.4	290	250	270	3.64	2.46	3.05	0.0	0.0	758.2	19	606	2018

Mokelumne River flow data from U.S.G.S. gaging station #11325500 at Woodbridge, CA. (operated by EBMUD) - Expressed in commonly used English units of water flow (cfs)

Water temperatures were recorded hourly with a Ryan TM2000 submersible thermograph installed in pool #15 of the high-stage fishway or pool #6a of low-stage fishway.

Average temperature on these dates (*) are computed from a morning and an afternoon "grab sample" hand held thermometer measurements.

Secchi depth measured twice daily in pool #6a of low-stage fishway or from screw trap platform located about mid-channel below Woodbridge Dam.

Rainfall measured by National Weather Service station at Camanche Reservoir N., San Joaquin Co., CA and by EBMUD approximately 0.5miles downstream from WIDD.

Barepressure measured (mm Hg, or millibars) at 15 minute intervals and average daily value computed from a Campbell Scientific Instruments meteorological datalogger (w/Vaisala PTA 427A pressure transducer) deployed near Woodbridge, CA

Lunar and solar data compiled from tables in the Old Farmer's Almanac, 1998 and 1999 western editions, Yankee Publishing, Dublin, NH

Appendix F. Delta outflow (in cfs): December 1998 -- July 1999.

December 1998

Date	Sacramento River At Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation District	Delta Outflow Index
1	34,831	208	2,996	0	99	1,316	0	43,206
2	37,267	209	3,094	0	97	1,736	0	45,887
3	43,293	211	3,194	0	103	1,880	0	47,681
4	49,549	212	3,156	0	95	1,991	0	54,512
5	54,755	213	3,245	0	98	1,955	0	59,396
6	58,346	214	3,608	0	97	1,997	0	61,125
7	60,704	216	3,925	0	96	1,993	0	63,919
8	61,872	217	4,085	0	96	2,001	0	66,073
9	62,296	217	4,266	0	97	1,991	0	65,930
10	61,948	217	4,263	0	96	1,908	0	64,946
11	60,683	217	4,342	0	209	1,787	0	62,238
12	59,400	217	4,608	0	296	1,908	0	61,004
13	57,624	217	4,842	0	265	1,952	0	59,407
14	55,695	217	4,859	0	300	1,985	0	57,812
15	54,218	217	4,786	0	297	1,992	0	56,274
16	53,075	217	4,735	0	298	2,045	0	55,030
17	51,919	217	4,753	0	299	3,619	0	52,107
18	49,264	217	4,847	0	290	4,674	0	48,364
19	45,219	217	4,781	0	287	2,814	0	45,900
20	42,125	217	4,574	0	289	1,301	0	44,019
21	40,035	217	4,351	440	241	1,309	0	41,325
22	38,482	217	4,374	292	176	463	0	40,847
23	36,365	217	4,748	0	114	3,180	0	36,738
24	34,072	217	4,690	0	144	3,167	0	34,369
25	31,414	217	4,520	0	255	2,216	0	32,434
26	28,935	217	3,876	0	254	822	0	30,729
27	26,909	217	3,667	0	251	2,714	0	26,639
28	25,612	217	3,590	0	251	1,832	0	26,133
29	24,868	217	3,509	0	249	1,989	0	25,194
30	24,265	217	3,479	303	223	1,698	0	24,630
31	23,528	217	3,465	0	152	1,961	0	24,036
AVERAGE	44,793	216	4,104	33	197	2,071	0	47,029

Appendix F. Delta outflow (in cfs): December 1998 -- July 1999.

January 1999

Date	Sacramento River At Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation District	Delta Outflow Index
1	22,403	217	3,422	0	169	1,810	0	23,099
2	21,548	218	3,437	0	169	2,011	0	22,110
3	21,146	220	3,395	0	170	1,995	0	21,735
4	21,005	221	3,362	0	170	1,153	0	22,447
5	20,694	223	3,339	0	168	935	0	22,379
6	20,524	224	3,316	1,469	146	271	0	21,441
7	20,271	226	3,270	2,046	87	115	0	20,841
8	20,149	227	3,146	2,018	92	193	0	20,560
9	19,681	227	2,970	1,974	93	30	0	20,142
10	19,127	227	2,808	197	91	204	0	19,305
11	18,417	227	2,777	1,982	87	208	0	18,550
12	17,975	227	2,764	1,961	86	203	0	18,169
13	17,922	227	2,741	3,714	87	180	0	16,361
14	18,011	227	2,722	4,431	95	2,579	0	13,367
15	19,721	227	2,724	4,132	104	2,823	0	13,441
16	17,495	227	2,729	4,098	107	2,497	0	16,449
17	17,671	227	2,784	4,069	96	2,496	0	16,751
18	18,486	227	2,997	4,077	103	2,498	0	17,957
19	20,274	227	3,100	4,093	195	2,498	0	24,403
20	23,769	227	3,281	3,924	252	3,002	0	33,375
21	36,611	227	3,473	3,965	266	2,505	0	45,772
22	56,755	227	4,112	4,019	267	2,497	0	66,332
23	61,659	227	4,553	4,019	273	2,492	0	71,369
24	63,094	227	5,638	4,039	267	2,491	0	72,295
25	66,648	227	6,847	4,373	244	2,691	0	72,585
26	67,454	227	7,741	4,365	267	2,939	0	72,343
27	65,727	227	7,748	4,320	211	45	0	72,254
28	63,710	227	7,844	4,408	135	120	0	69,992
29	60,196	227	7,940	4,224	91	168	0	65,166
30	56,222	227	7,707	4,300	91	200	0	60,822
31	51,991	227	7,319	4,265	89	195	0	55,998
AVERAGE	33,695	226	4,258	2,976	154	1,421	0	36,381

Appendix F. Delta outflow (in cfs): December 1998 -- July 1999.

February 1999

Date	Sacramento River At Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation District	Delta Outflow Index
1	48,767	227	7,107	4,285	92	297	0	57,006
2	44,977	229	6,635	4,325	93	222	0	52,538
3	41,607	230	6,211	4,372	97	218	0	48,370
4	37,907	232	5,728	4,404	100	317	0	43,871
5	34,812	233	5,675	4,382	99	197	0	40,797
6	33,925	235	5,950	4,372	100	197	0	35,859
7	35,361	236	6,081	4,307	93	200	0	40,284
8	48,319	238	5,992	4,166	91	200	0	64,708
9	60,247	238	6,007	4,280	86	849	0	76,782
10	69,252	238	6,861	4,279	92	829	0	117,835
11	83,044	238	8,659	4,353	98	1,386	0	154,620
12	85,351	238	10,099	4,338	91	1,352	0	157,006
13	82,521	238	11,378	4,331	90	563	0	146,539
14	78,680	238	12,799	4,297	97	1,112	0	127,458
15	75,223	238	13,626	4,323	104	527	0	110,769
16	72,425	238	13,539	4,315	101	321	0	101,328
17	71,225	238	14,769	4,195	100	71	0	97,974
18	74,911	238	14,836	4,292	90	75	0	114,393
19	86,652	238	13,740	4,306	92	0	0	147,150
20	85,536	238	13,981	4,302	89	79	0	154,190
21	81,372	238	14,127	4,306	96	0	0	156,767
22	79,972	238	14,320	4,320	94	519	0	158,458
23	79,336	238	15,063	4,324	44	1,397	0	156,343
24	76,622	238	15,578	4,332	11	2,552	0	147,525
25	74,046	238	14,964	4,297	12	2,994	0	129,818
26	72,621	238	13,766	4,310	11	3,401	0	112,348
27	71,907	238	12,787	4,326	12	4,006	0	103,859
28	71,299	238	12,227	4,335	6	2,396	0	100,506
AVERAGE	66,354	236	10,804	4,313	78	938	0	105,539

Appendix F. Delta outflow (in cfs): December 1998 -- July 1999.

March 1999

Date	Sacramento River At Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation District	Delta Outflow Index
1	71,062	238	11,933	4,321	5	2,373	0	98,732
2	71,817	236	11,612	4,404	0	2,217	0	102,921
3	73,368	234	11,050	4,379	0	1,793	0	110,665
4	74,017	232	10,689	4,367	0	3,204	0	115,714
5	74,727	231	10,333	4,373	10	3,478	0	118,076
6	74,719	229	9,970	4,373	1	3,999	0	114,795
7	74,588	227	9,647	4,359	1	4,274	0	111,425
8	72,905	225	9,176	4,356	5	3,111	9	105,892
9	71,324	225	8,663	4,347	1	3,146	1	99,020
10	70,583	225	8,512	4,349	41	2,042	0	99,545
11	69,261	225	8,664	4,355	100	3,292	0	92,399
12	68,232	225	8,951	4,355	95	3,245	0	87,189
13	67,727	225	9,226	4,360	90	4,677	0	80,114
14	66,601	225	9,349	4,352	90	5,176	0	73,413
15	65,603	225	9,071	4,363	87	3,395	0	70,330
16	63,946	225	8,852	4,347	90	3,562	0	68,222
17	61,019	225	8,563	4,353	173	2,978	0	65,883
18	57,248	225	8,223	4,337	297	2,693	0	62,693
19	53,046	225	7,995	4,486	285	2,678	0	57,892
20	49,564	225	7,851	4,386	293	1,669	0	54,865
21	46,218	225	7,791	4,447	292	2,474	0	49,732
22	43,500	225	7,832	4,354	268	1,431	15	48,095
23	40,847	225	7,622	4,407	237	1,666	0	44,540
24	38,223	225	7,381	4,438	230	2,247	0	40,971
25	35,743	225	7,137	4,393	232	2,009	0	40,786
26	33,934	225	6,913	3,818	232	1,888	0	42,908
27	35,973	225	6,449	3,460	236	1,886	0	44,707
28	41,406	225	6,155	3,460	232	2,755	0	48,737
29	43,198	225	6,120	3,001	148	4,237	0	49,135
30	43,134	225	6,054	2,230	75	3,946	0	48,803
31	41,356	225	5,802	1,927	81	3,859	0	46,048
AVERAGE	57,900	227	8,503	4,105	127	2,948	1	74,008

Appendix F. Delta outflow (in cfs): December 1998 -- July 1999.

April 1999

Date	Sacramento River At Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation District	Delta Outflow Index
1	38,281	225	5,673	1,723	75	4,093	0	42,848
2	34,332	222	5,481	1,574	74	3,596	0	37,605
3	31,449	218	5,248	1,577	74	5,088	0	32,169
4	29,888	215	4,967	1,517	76	4,647	0	30,938
5	28,503	211	4,901	1,644	72	5,189	12	28,036
6	27,611	208	4,831	1,659	79	3,237	6	31,507
7	27,605	204	4,850	1,661	89	3,022	0	32,138
8	27,268	201	5,102	1,683	82	4,057	0	31,017
9	27,474	201	5,519	2,342	85	4,427	0	31,873
10	28,157	201	5,747	2,710	83	5,081	0	32,040
11	28,338	201	5,938	2,707	79	5,072	0	29,769
12	29,405	201	6,392	2,704	96	5,342	0	33,146
13	30,780	201	6,592	2,017	97	3,794	0	37,619
14	34,436	201	6,650	1,756	107	2,822	0	40,747
15	36,545	201	6,520	1,961	85	3,837	0	40,358
16	35,723	201	6,330	2,572	88	4,336	0	36,495
17	34,941	201	6,337	2,318	81	1,315	0	38,926
18	34,649	201	6,324	2,061	92	1,591	0	38,899
19	34,617	201	6,468	1,685	79	981	27	40,081
20	34,897	201	6,638	1,766	94	933	33	40,517
21	34,303	201	6,668	1,305	98	2,173	20	39,006
22	33,569	201	6,597	993	105	1,848	19	38,738
23	33,117	201	6,617	987	95	1,896	42	38,143
24	31,737	201	6,754	980	100	2,748	0	35,808
25	29,888	201	6,933	986	103	2,389	0	34,365
26	28,619	201	6,926	989	104	2,338	41	33,085
27	27,585	201	6,759	988	112	2,349	62	31,913
28	27,005	201	6,633	990	104	2,101	79	31,447
29	26,806	201	6,586	1,675	98	1,446	86	31,073
30	26,103	201	7,061	1,732	105	1,441	109	30,723
AVERAGE	31,121	204	6,135	1,709	90	3,106	18	35,034

Appendix F. Delta outflow (in cfs): December 1998 -- July 1999.

May 1999

Date	Sacramento River At Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation District	Delta Outflow Index
1	25,514	201	7,284	1,840	118	2,142	0	29,411
2	24,980	200	7,126	1,842	106	1,845	0	29,110
3	24,803	200	6,931	1,841	110	1,193	126	29,585
4	24,394	199	7,257	1,832	111	2,094	83	29,861
5	24,796	199	7,330	2,576	136	686	31	30,946
6	24,375	198	7,279	2,231	145	1,499	55	29,845
7	23,752	198	7,181	1,903	53	1,752	71	29,226
8	22,445	197	7,044	1,978	0	950	0	28,585
9	21,231	197	6,913	1,979	0	1,647	81	25,466
10	21,300	197	7,163	1,947	0	1,996	106	25,405
11	21,176	197	7,184	1,558	0	1,291	72	26,262
12	20,489	197	7,008	860	0	3,000	44	24,230
13	19,399	197	6,800	252	0	3,490	66	23,099
14	18,814	197	6,951	0	0	3,000	77	23,373
15	18,199	197	7,254	1,349	0	1,591	63	23,027
16	18,239	197	7,312	2,015	0	997	50	22,946
17	17,545	197	7,034	2,021	2	1,010	120	21,933
18	16,987	197	6,056	1,353	0	1,995	154	20,060
19	16,578	197	5,060	1,687	0	2,300	160	17,971
20	16,642	197	4,530	2,038	0	1,962	105	17,353
21	16,916	197	4,346	2,035	0	1,483	150	17,906
22	16,892	197	4,322	2,047	0	1,491	151	17,795
23	16,521	197	4,252	2,044	0	1,493	152	17,332
24	17,250	197	4,223	2,052	91	1,497	81	17,837
25	18,341	197	4,204	2,050	117	1,493	103	18,890
26	18,407	197	3,965	1,807	159	1,499	128	18,914
27	17,944	197	3,686	1,623	187	1,291	123	18,587
28	17,807	197	3,621	1,500	190	1,292	87	18,446
29	17,764	197	3,637	1,506	188	1,297	126	18,345
30	18,708	197	3,542	1,507	188	795	126	19,620
31	18,942	197	3,358	1,497	189	793	126	19,537
AVERAGE	19,908	198	5,802	1,702	67	1,641	91	22,932

Appendix F. Delta outflow (in cfs): December 1998 -- July 1999.

June 1999

Date	Sacramento River At Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation District	Delta Outflow Index
1	19,781	197	3,395	1,700	315	780	71	19,906
2	19,846	196	3,232	2,339	377	722	83	19,136
3	19,403	196	3,227	3,350	384	816	86	17,518
4	19,965	195	3,304	3,758	385	830	99	17,606
5	20,070	195	3,323	3,765	384	845	50	17,531
6	21,066	194	3,353	3,765	385	847	50	18,385
7	21,621	194	3,352	3,764	386	783	53	18,918
8	21,337	193	3,353	3,246	368	805	75	19,066
9	20,257	193	3,338	2,821	386	837	76	18,302
10	18,669	193	3,349	2,827	305	851	133	16,812
11	17,592	193	3,350	2,786	336	217	129	16,358
12	16,419	193	3,283	2,761	338	844	126	14,383
13	16,308	193	3,259	2,772	337	817	50	14,040
14	15,749	193	3,303	2,709	204	846	113	13,654
15	15,691	193	3,357	2,638	157	812	113	13,784
16	15,065	193	3,305	2,741	176	793	115	12,965
17	15,145	193	3,304	2,767	176	850	129	12,923
18	15,024	193	3,272	2,773	170	843	101	12,706
19	15,008	193	3,070	2,761	177	833	101	12,468
20	14,989	193	2,990	2,762	180	849	63	12,258
21	14,688	193	3,080	3,020	171	841	123	11,794
22	14,811	193	3,240	3,418	154	850	59	11,415
23	14,764	193	3,130	3,886	164	844	117	10,768
24	14,576	193	3,124	4,292	184	853	127	10,207
25	14,550	193	2,958	4,435	202	60	140	10,669
26	14,970	193	2,781	4,429	199	2,500	126	8,450
27	15,488	193	2,706	4,422	185	2,500	126	8,908
28	15,813	193	2,734	4,423	159	3,075	163	8,813
29	17,154	193	2,781	4,434	129	3,110	144	10,069
30	19,124	193	2,628	4,441	106	3,290	164	11,700
AVERAGE	17,165	194	3,163	3,333	253	1,125	104	14,050

Appendix F. Delta outflow (in cfs): December 1998 -- July 1999.

July 1999

Date	Sacramento River At Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation District	Delta Outflow Index
1	20,665	193	2,536	4,447	212	6,675	157	9,690
2	20,927	194	2,466	4,437	196	4,979	156	11,482
3	20,922	195	2,349	4,423	191	6,174	151	10,092
4	20,521	196	2,352	4,418	191	6,032	151	9,813
5	20,660	196	2,570	4,446	190	5,992	151	10,100
6	20,255	197	2,660	4,447	211	6,576	151	9,154
7	20,306	198	2,532	4,455	211	6,012	80	9,531
8	20,575	199	2,458	4,393	199	6,095	130	9,750
9	20,533	199	2,380	4,431	208	6,141	118	9,496
10	21,016	199	2,293	4,434	208	6,207	116	9,841
11	21,355	199	2,299	4,418	160	6,631	101	9,848
12	21,344	199	2,300	4,418	170	6,185	98	10,260
13	21,421	199	2,384	4,421	217	6,618	110	9,929
14	21,558	199	2,276	4,316	222	6,644	117	10,042
15	21,523	199	2,270	4,452	224	6,680	126	9,843
16	22,120	199	2,181	4,430	228	5,602	132	11,455
17	22,192	199	2,106	4,402	225	5,417	126	11,594
18	22,408	199	2,218	4,408	227	5,835	101	11,479
19	22,770	199	2,249	4,413	220	6,679	111	11,045
20	22,963	199	2,156	4,413	226	6,662	146	11,259
21	23,607	199	1,958	4,416	233	6,672	166	11,604
22	23,737	199	1,975	4,417	230	6,679	136	11,650
23	23,716	199	2,012	4,425	221	6,670	124	11,594
24	23,162	199	1,924	4,415	231	6,677	126	11,074
25	23,284	199	1,874	4,411	234	6,675	126	11,267
26	23,260	199	1,946	4,426	227	6,680	38	11,240
27	23,463	199	2,015	4,445	220	6,678	77	11,546
28	23,659	199	1,928	4,455	222	5,959	72	12,426
29	23,761	199	1,961	4,448	224	5,472	68	12,932
30	23,908	199	1,951	4,424	225	6,122	70	12,344
31	23,686	199	1,942	4,411	226	6,465	66	11,815
AVERAGE	22,106	198	2,210	4,423	214	6,277	116	10,813