THE MOKELUMNE RIVER CHINOOK SALMON AND STEELHEAD MONITORING PROGRAM 1992-1993

Administered by:

East Bay Municipal Utility District
Watershed and Recreation Division
500 San Pablo Dam Road
Orinda, California 94563

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)

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TASK OBJECTIVES

This report addresses two related tasks of the 1992-93 Mokelumne River Chinook Salmon (*Oncorhynchus tshawytscha*) and Steelhead (*Oncorhynchus mykiss*) Monitoring Program:

- Monitoring of downstream-migrant salmonids within the Mokelumne River
- Mark-recapture experiments to determine survival of hatchery-reared chinook salmon smolts migrating through the Sacramento-San Joaquin Delta (Delta).

The purpose of these two tasks was to continue the development of information begun during the years of 1990, 1991, and 1992 on juvenile anadromous salmonids in the lower Mokelumne River (Figure 1). Task objectives and approaches of this investigation were modified and refined from those of previous years' to address differences in climatological and riverine conditions. Specific objectives of this year's program were as follows:

1) To monitor the daily abundance and movement of naturally produced juvenile anadromous salmonids passing two locations:

   A) Immediately downstream from the major salmon spawning reach
   B) Woodbridge Irrigation District's (WID) dam (Woodbridge Dam)

2) To monitor size and condition of emigrating juvenile anadromous salmonids and determine the proportions of juvenile salmon emigrating as fry and as smolt-sized salmon.

3) To evaluate juvenile anadromous salmonid emigration patterns related to environmental factors (stream flow, water temperature, lunar phase, precipitation, water turbidity, and time of day).

4) To assess the effects of juvenile chinook salmon passage over Woodbridge Dam.

5) To coded-wire tag naturally produced chinook salmon smolts for later assessments of survival and fishery recruitment.

6) To assess the relative survival of coded-wire tagged Mokelumne River Fish Hatchery (MRFH)-reared salmon smolts migrating through the Delta under two water diversion scenarios.

7) To evaluate the results of the preceding tasks as related to resource monitoring activities and management recommendations/actions for the lower Mokelumne River.

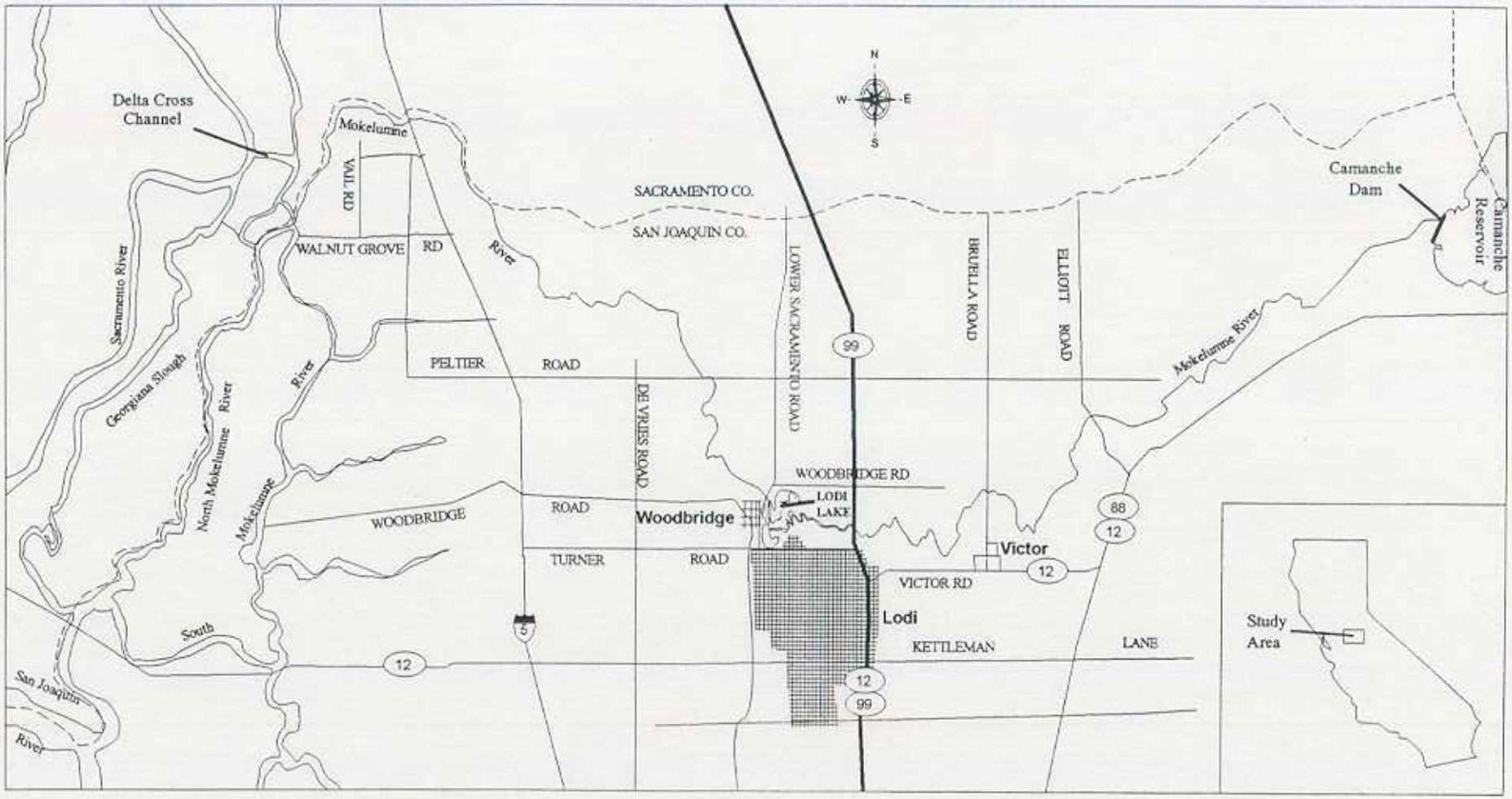

Figure 1. Map of the Mokelumne River from Camanche Dam to the confluence of the San Joaquin River.

METHODS

Downstream Migrant Fish Traps

Dramatically higher sustained river flows occurred during the winter and spring seasons as compared to previous study years because of above-normal precipitation. The higher flow conditions required use of downstream migrant fish trapping methodologies different from those employed in the past. Rotary screw fish traps[1] were selected for their "state-of-the-art" design characteristics[2]. Vogel Environmental Services' (VES) and East Bay Municipal Utility District's (EBMUD) biologists identified two trapping sites for deployment of the screw traps which would address the objectives of this study (Figure 2). California Department of Fish and Game (CDFG) biologists concurred on the adequacy of these sites (M. Fjeldstad and J. Nelson, CDFG, pers. comm.). One site was located just downstream from the Elliott Road bridge at river mile 53, which was the downstream limit of the major salmon spawning reach in 1992 (Hartwell 1993) and 1990 and 1991 (Bianchi *et al.* 1992). The other trapping site was located at Woodbridge Dam at river mile 39, which was used for downstream migrant trapping in previous years (Bianchi *et al.* 1992). A fyke trap was used to monitor juvenile salmonid emigration at Woodbridge Dam during the initial trapping period prior to deployment of the screw trap.

Elliott Road Trapping Site

The upriver site near Elliott Road (Figure 2) was selected based on several criteria important for meeting the monitoring program objectives. This site needed to be located near the downstream-most salmon spawning area to attempt to evaluate timing and abundance of salmon fry moving from the spawning grounds to downstream areas. The site also needed to possess stream channel configuration and stream flow characteristics to optimize fish capture efficiencies. Additionally, the site had to be secure and accessible to field crews seven days a week and twenty-four hours a day. The Soil Conservation Service's Plant Materials Center near Lockeford, California, located immediately downstream from the Elliott Road bridge and fronting the river on the south bank for a distance of about one mile, provided an ideal site fulfilling these criteria.

A 2.4-meter (m) diameter x 6.7-m long screw trap near Elliott Road was assembled and deployed by VES and EBMUD crews and was operated from January 29 through July 23, 1993. Figure 3 provides a schematic of the suspension and pulley system used to position the screw trap at this site. The static-line pulley system allowed the trap to be moved across the

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[1] E.G. Solutions, Inc., Corvallis, Oregon.

[2] A rotary trap is self-powered, self-cleaning, captures fast swimming fishes such as juvenile salmonids, operates effectively in wide ranges of water velocities from one to eight feet per second, and does not injure fish.

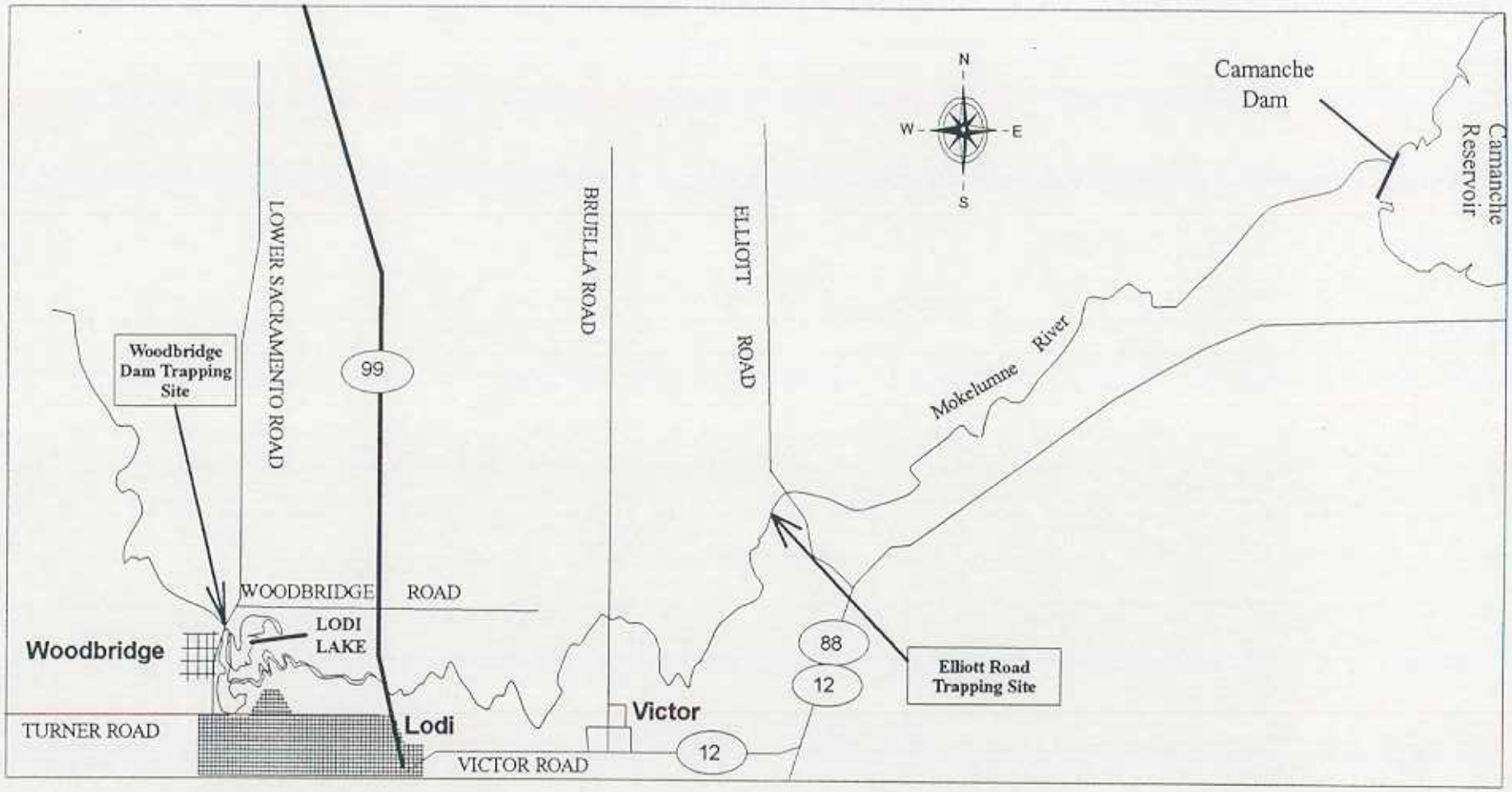

Figure 2. Map Depicting Detailed Trap Sites (Camanche Dam to Woodbridge Dam).

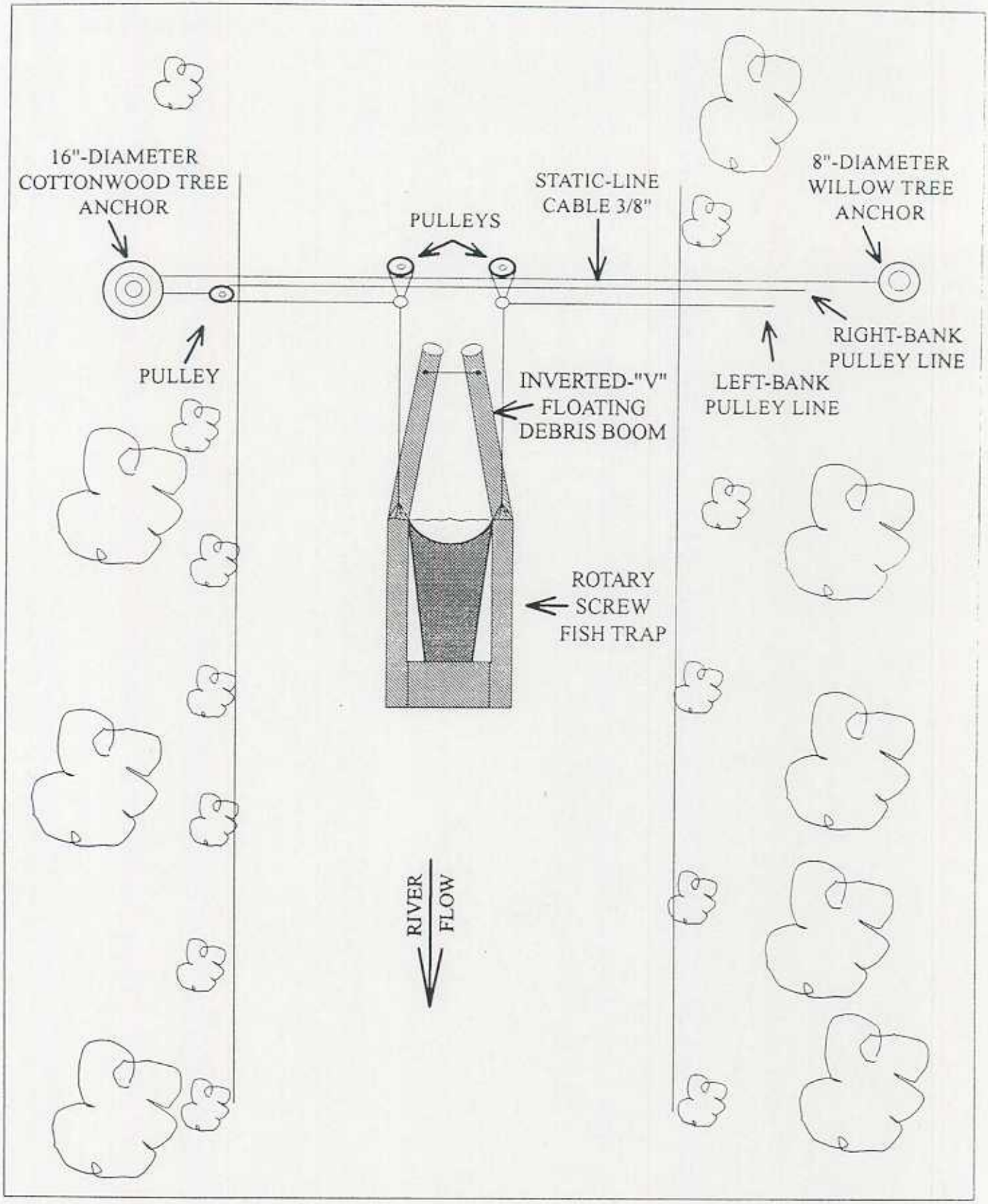

Figure 3. Schematic perspective view of rotary screw trap system at Elliott Road trap site (River Mile 53).

entire width of the river channel. The lengths of two bridles running from the static-line pulleys to the trap could be adjusted to provide for limited longitudinal positioning of the trap within the channel. The suspension system was designed to allow the trap to be pulled by hand to the left bank (facing downstream) so it could be easily tended. Highly visible warning signs notifying river users of the trap's location and directing them to safe passage were posted 200 m upstream from the trap and on the suspension cable. The suspension cable was made very visible by attaching brightly colored plastic marking ribbon along its length.

Woodbridge Dam Trapping Site

Woodbridge Dam has been used as a trapping site for downstream migrant salmonids since inception of the Mokelumne River Fishery Monitoring Program in 1990. During the previous study seasons, river flows were low enough that nearly the entire river flow passed through the fishways and fish bypass system at Woodbridge Dam where traps were installed to capture most downstream migrant fishes (Bianchi *et al.* 1992). However during early 1993, the majority of the flow passing Woodbridge Dam passed over the dam's flashboards because of the higher sustained river flows. This condition, combined with an anticipated return of a spring chinook salmon spawning run and the need to maintain the fishways clear for their passage (M. Fjeldstad, CDFG, pers. comm.), precluded use of the previously used trapping system in the fishways.

Initial trapping at this site was conducted in the low-stage fishway during the period from January 19 through March 31, 1993 using a modified fyke trap installed in pool 6a (Figure 4). This trap utilized a 0.9-m wide x 0.6-m high x 1.8-m long fyke net with a 2 millimeter (mm) mesh that tapered to a 10.5 centimeter (cm) diameter by 1.8-m long polyvinylchloride (PVC) reinforced flex hose that terminated in a perforated (1.6-mm diameter holes) and baffled aluminum live box (0.6-m x 0.6-m x 1-m high). This trap was installed so as not to impede migration of upstream migrant fish in pool 6a but to capture a portion of the flow entering the pool. The mouth of the trap was positioned about 0.5 m downstream from the orifice entering pool 6a from pool 7a and 0.3 m from the bottom of the pool, effectively filtering about half the discharge entering the pool through the 0.6-m x 0.6-m underwater orifice. The fyke netting and flex hose guided captured fish to the live box which was securely attached to the downstream corner of the pool away from the orifice entering pool 6a from pool 5a. The trap was serviced by briefly (5-15 minutes) reducing the flow in the fishway by partially closing the fishway flow control gate between pools 9a and 8a.

Releases from Camanche Dam were projected to dramatically increase during April 1993 increasing river flows passing Woodbridge Dam. The fyke trap installed in the low-stage fishway at Woodbridge Dam would be neither effective nor serviceable under those conditions. Therefore, a 2.4-m diameter screw trap borrowed from CDFG was assembled and deployed by VES, EBMUD, and CDFG crews on April 1, 1993. Figure 4 shows the location and a schematic of the suspension and pulley system used to position this trap in the tailwater

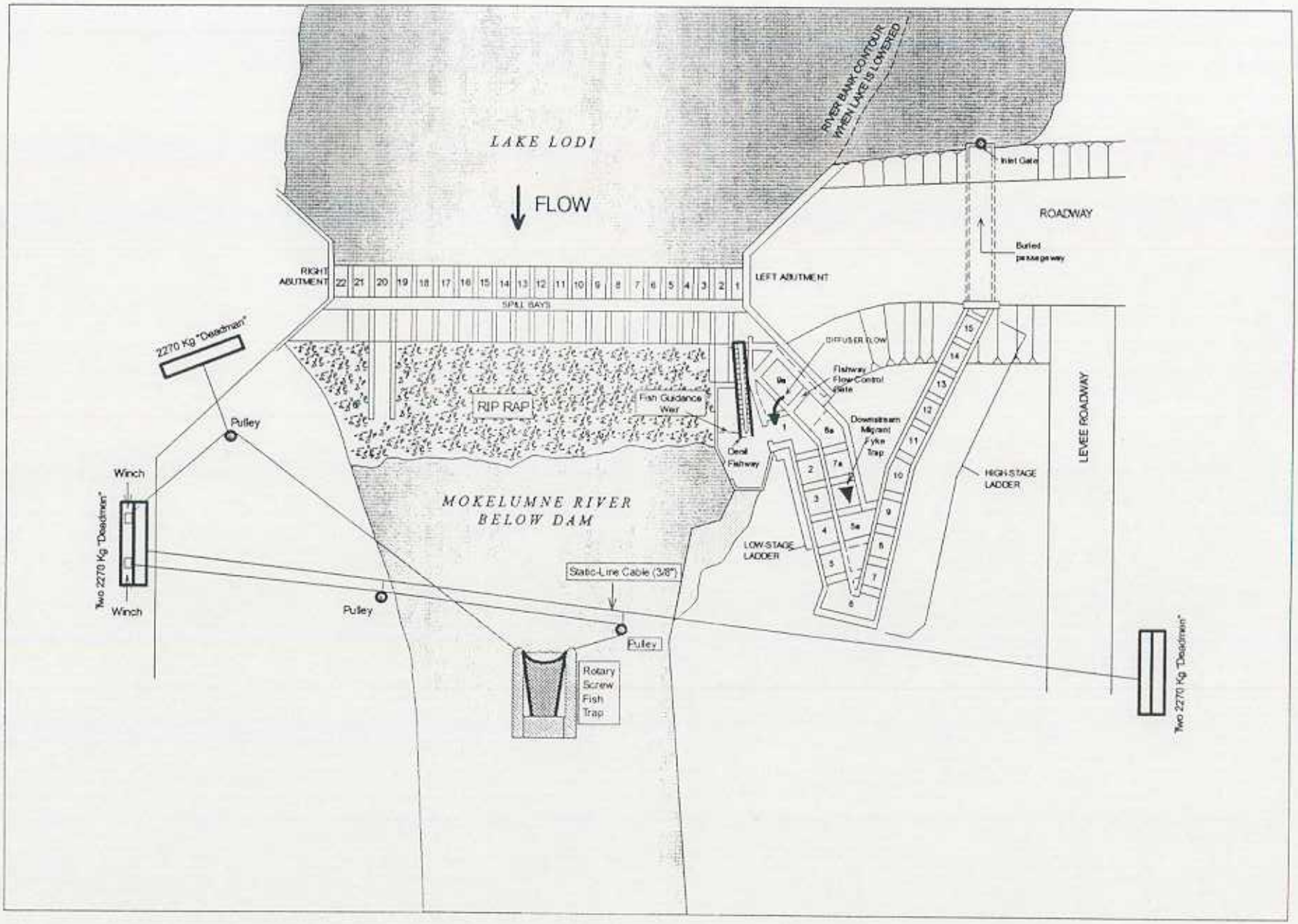

Figure 4. Schematic perspective view of downstream migrant fish traps used at Woodbridge Dam site (River Mile 39).

immediately downstream from the dam. The suspension system was anchored by two 2,270-kilogram concrete anchors on both sides of the river. The pulley system was operated by two electric winches powered by a 12-volt deep cycle automotive battery. This suspension system allowed the trap to be fished across approximately two-thirds of the river channel from the right bank out beyond mid-channel. This was the most effective sampling location in the channel because an eddy, in which the trap would not operate, occurred along the left bank out into the channel for about one-third of its width. The longitudinal position of the screw trap in the channel could be adjusted to a limited extent by adjusting the lengths of the pulley cables. The trap was tended by pulling it to the right bank.

A new, 2.4-m diameter by 6.7-m long screw trap purchased by EBMUD was deployed, replacing the screw trap on loan from CDFG, on May 11, 1993. This trap was operated through July 29, 1993.

Downstream Migrant Fish Trap Monitoring Protocol

Fish Handling and Measurements

Rotary screw traps, and the Woodbridge Dam fyke trap when in service, were regularly tended twice each day. 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 two to three additional times each day, near mid-day and/or mid-evening. Fishes captured were transferred from the trap live boxes with dip nets to 20-liter buckets filled with fresh river water to which tricaine methane sulfonate[3] was added at *ca.* 30-50 milligrams/liter for rapid and short-term induction of moderate sedation for most of the species captured (Summerfelt and Smith 1990). All fishes were identified to species (when possible) and enumerated.

Up to 50 of each salmonid species captured during each trapping period were randomly sampled for measurements of total length (TL) and fork length (FL) (in mm) and weighed (in grams) on an Ohaus CT1200 portable balance. Weighing was done in tared beakers of fresh water set on the balance pan. Individual sedated fish netted in a small dip net were gently blotted on a moist sponge to remove excess water prior to weighing to ensure measurement of true wet weight. During several short periods (<2 weeks), the electronic scale was not available and weights were estimated by placing individual fish in a 100 milliliter graduated cylinder. It was assumed that 1 milliliter of displaced water equaled 1 gram wet weight of fish. These measurements were recorded along with observations of disease and injury. All adipose fin-clipped salmon (indicating coded-wire tag implants) and salmon otherwise marked that were observed among the fish counted or measured were recorded. Upon completion of counting and measuring fish, fish were gently placed in another 20-liter bucket of fresh river

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[3] "Finquel" formulation, sold by Argent Chemical Laboratories, Redmond, WA.

water to recover from sedation prior to being released downstream from the traps. Total processing time for individual fish from sedation and measurement to recovery and release was generally 5 to 15 minutes.

Surface water temperature was measured with a mercury filled thermometer and water clarity was measured with a secchi disk at each trapping site each time the 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, changes in river flow or spill configurations at Woodbridge Dam) were recorded when observed.

Trap Maintenance and Debris Management

Riverine and urban-generated debris was periodically problematic in the operation of the downstream migrant traps at both sites. Of particular importance were large tree limbs and floating lumber. Tree limbs and floating lumber larger than about 40 cm long and 10 cm in diameter entrained into a screw trap usually lodged to stop the 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.

At the Elliott Road trap site, we experimented with a technique for reducing debris problems at the trap. Floating debris entrainment was reduced and managed by a floating, inverted V-shaped log boom (3-m long x 15-cm diameter) installed on the upstream side of the trap with the apex of the boom pointed upstream. This boom deflected most flotsam away from the trap entrance. All trap calibration trials with recovery of marked and released fish were conducted with the boom in place. The boom also provided an additional safeguard for swimmers, canoeists, and other river users to grab if floating toward the trap opening.

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

Trap Calibrations for Abundance Estimates

Fish capture efficiencies of the traps at each site were measured several times throughout the monitoring period. Table 1 provides the dates, river flows, numbers, and mean sizes of marked fish used to measure trapping efficiencies. All juvenile salmon used for these mark-recapture tests were obtained from MRFH, except for 272 wild salmon fry captured at Elliott Road and used at the Woodbridge Dam trap on February 26, 1993. Fish were anesthetized (*ca.* 70 to 100 milligrams/liter tricaine methane sulfonate solution) and marked by excision of either the right or left pelvic fin. These fish were measured for FL and TL, and allowed to recover in a large live car (1.0 m x 0.8 m x 1.2 m with 2-mm "Nitex" plastic mesh) placed in the river near Elliott Road for 1 to 2 days prior to their release for the tests.

Table 1. Trapping Efficiency Test Parameters for Woodbridge Dam and Elliott Road Trap Sites - January through July 1993.							
Date of Test	**Wood-bridge Dam Site**	**River Flow at Wood-bridge Dam**	**Elliott Road Site**	**River Flow at Victor**	**# Day Release**	**# Night Release**	**Mean TL(mm)± S.D.**
2/26/93	test	182	no test	--	189 (w) 243 (h)	83 (w) 301 (h)	36±2 (w) 53±5 (h)
3/5/93	no test	--	test	590	251	255	54±12
3/10/93	no test	--	test	595	282	297	55±4
4/10/93	test	432	no test	--	181	173	76±8
4/28/93	test	969	test	1190	310(WD) 317(ER)	298(WD) 315(ER)	94±12
5/12/93	no test	--	test	1140	487	392	78±
6/5/93	no test	--	test	1250	329	330	100±6
Notations: (w) & (h) - wild & hatchery - Wild fish were used to partially comprise these release groups. (WD) & (ER) - Woodbridge Dam Site & Elliott Road Site.							

Paired test releases, one during daylight and one during night time, were made on each test date at the trap sites. Fish releases were made approximately 200 m upstream from the Elliott Road trap and at the top of the spill bays at the Woodbridge Dam trap site for the screw trap and approximately 200 m upstream from the dam for the fishway fyke trap. Fish were released from 20-liter buckets or 25-liter cylindrical PVC live cars (30-cm diameter x 40 cm long with 2 mm nylon mesh ends). The release groups were divided into three approximately equal sublots and released in the right one-third, middle one-third, and left one-third of the river channel at each site. We assumed that the release distance from the trap and the flow configuration at each site allowed fish to seek a preferred portion, or natural migration route, in the channel or to mix to a homogeneous distribution within the channel prior to encountering the traps.

Live box retention efficiency at each trap site was measured twice during the monitoring period on May 17-18 and July 13-14, 1993 at the Woodbridge Dam site and on May 1 and

July 12-13, 1993 at the Elliott Road site. For each retention test, a right or left pelvic fin or upper lobe of caudal fin was excised from each fish (group size = 10-100 per test) as described for trap efficiency tests. Use of the combinations of fin-clip marks was coordinated with all other mark-recapture experiments (*e.g.*, trap efficiency releases) to avoid conflicting purposes between tests. Fish were placed in the live boxes of the traps after 2 to 24 hours recovery from the fin removal procedure. Fish were left in the live box until the following trap check (7-16 hours) when they were counted, measured for FL and TL, and released downstream from the trap.

Abundance and Timing of Emigration

The numbers of each species and each age class of salmonids captured were compiled on a daily basis. The age 1+ size criteria for chinook salmon were based on previous years' juvenile salmonid monitoring results as substantiated by the sizes of adipose-clipped salmon released at age 1+ during the fall of 1992 and captured during each of the following time periods:

Time Period	Age 1+ Size Criterion
January through April 14, 1993	>100 mm TL
April 15 through April 25, 1993	>110 mm TL
April 25 through April 30, 1993	>120 mm TL
May 1 through July 29, 1993	>130 mm TL.

Morning and afternoon trap capture numbers were combined to provide daily totals for each trap site. Daily counts were compiled into weekly totals for several analyses.

Outmigrant abundance estimates were generated from trapping efficiency results. The abundance estimates should be considered as an index of relative abundance and not as a population estimate. Only those estimates for the Woodbridge Dam trap site are considered reasonably reliable indices for the entire season. Several instances of low recovery and no recovery of marked fished, particularly for smolt-sized salmon (>70 mm TL), at the Elliott Road trap site made it undesirable for abundance estimations (Table 2). Average trap efficiency recovery rates for each of the Woodbridge Dam site test dates were computed from the paired day and night releases (Table 3). This was done because recoveries of marked fish for each of the releases occurred over protracted periods, including both daylight and night time, and thus made it difficult to distinguish any differences between day and night trap efficiencies. Treatment of the paired day and night releases as replicates allowed estimation of a trapping variance and generation of a confidence interval for the abundance estimate. The average trapping efficiency for each test date was applied to each respective period for

which it was representative in terms of river flow, fish size, and trap equipment as follows:

Applicable Period	Test Date Applied	River Flow	Trap Type
1/19/93-3/31/93	2/26/93	141-531 cfs	Fyke
4/1/93-4/13/93	4/10/93	412-655 cfs	Rotary Screw
4/14/93-7/29/93	4/28/93	894-1100 cfs	Rotary Screw

Each day's total trap capture abundance was divided by the average trap efficiency rate applicable to the period in which it occurred to calculate an estimated index of total fish passage by Woodbridge Dam. The individual daily abundance estimates were summed to produce abundance estimates for various time periods.

Table 2. Trap Efficiency Test Results for the Elliott Road Trap Site.

Date	River Flow (cfs)	Trap Efficiency (%) (R/M)[1]		Avg. Trap Efficiency[2] (%) (S.D.)	Avg. Fish Size (TL in mm) (S.D.)
		Day Release	Night Release		
3/5/93	590	1.99 (5/251)	3.53 (9/255)	2.76 (s=1.09)	54 (s=12.0)
3/10/93	595	1.06 (3/282)	1.68 (5/297)	1.37 (s=0.44)	55 (s=4.0)
4/28/93	1190	0 (0/317)	0 (0/315)	0	92 (s=10.5)
5/12/93	1140	0.21 (1/487)	0.26 (1/392)	0.24 (s=0.04)	83 (s=7.4)
6/5/93	1250	0 (0/329)	0 (0/330)	0	100 (s=6.0)

[1] The Mark-Recapture notation of Ricker (1958) is used with R = #'s marked fish recaptured and M = #'s marked fish released.

[2] Fish released during daytime and nighttime were recaptured over protracted time periods which precluded making definitive inferences regarding differences between day and night trap efficiencies; so, each of the paired day-night releases are considered as single duplicated trap efficiency tests and the average result presented.

Table 3. Trap Efficiency Test Results for the Woodbridge Dam Trap Site.

Date	River Flow (cfs)	Trap Efficiency (%) (R/M)[2]		Avg. Trap Efficiency[3] (%) (S.D.)	Avg. Fish Size (TL in mm) (S.D.)
		Day Release	Night Release		
2/26/93[1]	182	2.55 (11/432)	3.91 (15/384)	3.23 (s=0.96)	36 (s=2.0)w 53 (s=5.0)h
4/10/93	432	12.71 (23/181)	9.83 (17/173)	11.27 (s=2.04)	76 (s=8.0)h
4/28/93	969	7.74 (24/310)	13.42 (40/298)	10.58 (s=4.02)	94 (s=12.0)h

[1] The results for the 2/26/93 test are applied to the time period when a fyke trap was fished in the low-stage fishway (1/19/93 through 3/31/93).

[2] The Mark-Recapture notation of Ricker (1958) is used with R = #'s marked fish recaptured and M = #'s marked fish released.

[3] Fish released during daytime and nighttime were recaptured over protracted time periods which precluded making definitive inferences regarding differences between day and night trap efficiencies; so, each of the paired day-night releases are considered as single duplicated trap efficiency tests and the average result presented.

Fish Size and Condition

The size parameters of FL, TL, and weight measured on subsamples of each day's Y-O-Y salmon catches for samples of up to 100 fish each day at each trap site were compiled on a daily basis. Fulton's Condition Factor, given as ($100 \times \text{weight}/TL^3$) by Bagenal and Tesch (1978), where weight is in grams and TL is in mm, were computed for each fish for which TL and weight measurements were obtained. Daily and weekly averages for FL, TL, weight, and condition factor of Y-O-Y salmon were computed and compiled for analysis.

Observations of injuries on trapped fish were described, recorded, and compiled on a daily basis, as well as the numbers of dead fish found in the traps during each day. These incidents of injury and mortality were examined with regard to effects of predaceous species, debris fouling of the traps, and other conditions which may have contributed to their occurrence.

Physical Environmental Data

Daily environmental data for the period of January through July 1993 were obtained from the following sources:

- River Flow at Victor, California: EBMUD gauging station on the Mokelumne River near River Mile 51.

- River Flow passing Woodbridge Dam: U.S. Geological Survey (USGS) gauging station (#11325500) on the Mokelumne River located downstream of Woodbridge Dam near River Mile 37.

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

- Local Precipitation: USDA - Soil Conservation Service Plant Materials Center near Lockeford, California (located about midway between Camanche Dam and Woodbridge Dam) maintains daily climatological data series.

- River Temperature at Woodbridge Dam: Ryan Model RTM 2000 thermograph (Ryan Instruments Inc., Redmond, Washington) installed in pool #6a of the low-stage fishway and surface temperatures generally measured twice daily during morning and afternoon with a mercury filled thermometer.

- River Temperature at Elliott Road Site: Ryan Model RTM 2000 thermograph installed in the live box of rotary screw trap at site and surface temperatures generally measured twice daily during morning and afternoon with a mercury filled thermometer.

- Water Turbidity Index (Secchi Depth): Generally measured twice daily at each trap site in the river channel off downstream end of screw traps.

- Lunar Age and Regional Sunrise/Sunset Timing: *1993 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.

Diel Migration Pattern Surveys

Diel patterns of the migration behavior of chinook salmon smolts were assessed on three dates during the height of the emigration period. These diel surveys were conducted at the Woodbridge Dam trap site on May 19-20, June 2-3, and June 29-30, 1993. On these dates,

the trap was tended hourly for a full 24-hour cycle using the same previously described fish handling and trap tending protocols, except that the trap was tended by boating over to its fishing position in the channel rather than pulling it to shore. This trap tending procedure allowed the trap to operate continuously during the entire diel survey period. Numbers of juvenile salmon captured during each of the three diel surveys were compiled on an hourly basis over the course of the 24 hours of survey for each date.

Water Velocity Profiles near Elliott Road

Water velocity profiles were taken on two occasions at the fish sampling site downstream of Elliott Road (approximately one-half mile downstream of the bridge). Velocities were measured to determine flow characteristics in the immediate vicinity of the rotary fish trap and within the adjacent river channel during Camanche Reservoir releases of approximately 600 cfs and 1300 cfs. Measurements were taken on March 22, 1993 (600 cfs) and May 26, 1993 (1300 cfs). Water velocities were measured with a Price AA flow meter at 20 % and 80 % of the water depth at each of 22 verticals across the river channel on March 22 and at each of 26 verticals on May 26.

Physical Injury Tests at Woodbridge Dam

Tests were conducted at Woodbridge Dam to assess the potential for fish mortality attributable to young chinook salmon passing over the top of Woodbridge Dam, into the dam spill bays, and through the riprap downstream of the dam. Tests were conducted during two different flow conditions in the Mokelumne River (Camanche Reservoir releases near 600 cfs and 1300 cfs).

Experimental groups of juvenile chinook salmon (obtained from MRFH) in lots ranging from approximately 200 to 1000 fish each were released directly into spill bays on top of Woodbridge Dam. Immediately prior to release, these fish were transferred from an oxygenated holding tank positioned adjacent to the left abutment of the dam into five 5-gallon buckets for each release group, hand carried to the release location, then poured into a 12-inch diameter PVC pipe (7 feet long) with its end positioned directly over the lip of the spill passing over the Woodbridge Dam flashboards. Positioning of the end of the PVC pipe was critical to ensure released fish did not escape upstream into Lake Lodi but instead passed over the spill on the dam and into the spill bays.

Experimental fish were recaptured downstream of the dam by positioning the rotary fish trap (previously described) into the flow emanated from spill bays where experimental fish were released. After approximately 15 minutes following the experimental fish release, all salmon captured within the rotary trap were removed. It was assumed that the capture of any wild fish during the 15-minute sampling period was minimal and would not significantly influence study results. Recaptured experimental fish were transferred to shore in a live car (12-inch diameter, 16-inch long PVC pipe with both ends covered with 1/8-inch knotless, nylon Delta

mesh). All fish remained in water continuously following removal from the rotary trap. Each live car was placed in the high-stage fishway where fish were monitored daily for mortalities over a seven-day period.

For each experimental group of fish released into a spill bay, a control group of approximately 100 fish was released into the rotary trap for comparative purposes. After each experimental group of fish was released, recaptured, and placed into the high-stage fishway, a control group of fish was removed from the oxygenated holding tank positioned adjacent to the left abutment of the dam and placed into a 5-gallon bucket. These fish were then transferred out to the rotary trap (via a rowboat) where they were released directly into the rotary trap entrance. The estimated time the fish remained in the transfer bucket was approximately the same as for the comparable experimental fish group. The control group of fish remained in the rotary trap for approximately 15 minutes and were removed and transferred in a live car to the high-stage fishway as previously described for experimental groups of fish. All attempts were made to treat experimental and control groups of fish the same, except for the experimental fish group's passage over the spill bays and through the riprap prior to recapture in the rotary trap. The numbers of fish within each group were purposefully not individually enumerated prior to release to minimize handling stress and potential physical injury attributable to handling. The numbers within each group were visually estimated solely to attempt relative similarities in fish densities between experimental and control groups after recapture. The intent was to minimize any differences in mortality that could be attributed to differences in densities of fish held in the same sized live cars during subsequent monitoring after recapture. Fish were not fed during the seven-day monitoring period, but they had some limited ability to fed on water-borne natural feed because riverine water could freely pass through their live car. Any observed differential mortality between the experimental and control groups over the seven-day monitoring period was assumed to be primarily attributable to factors affecting fish after release into the dam spill and recapture in the rotary trap.

Coded-Wire Tagging of Wild Smolts

Tagging of juvenile salmon with coded-wire tags was initiated upon a dramatic increase in the number and size of juvenile salmon (≥75 mm TL) being captured at the Woodbridge Dam trap. Beginning on May 5, 1993 and continuing through the monitoring season until July 29, 1993, all juvenile chinook salmon captured at the Woodbridge Dam site were tagged by injecting 1-mm binary coded-wire tags into their head cartilage using a NMT[4] Mark IV tagging machine and marked by excision of the adipose fin with Mitex fine surgical scissors. Fish were handled as previously described for fish handling and measurement with the additional procedures of injecting tag wire, passing fish through a quality control device (QCD) to insure tag implantation, and excising adipose fins prior to their placement into a

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

recovery tank of fresh flowing river water. A single tagging machine with QCD provided by EBMUD was set up daily on the grate covering pool #15 of the high-stage fishway. Water was pumped from the fishway to operate the hydraulic controls of the QCD and to provide cool flowing water to a 120-liter plastic tank used as a recovery bath for the fish. A shade fabric (60% light reduction) was installed over the entire work area to control sun heating of equipment and fish. Upon recovery, fish were placed in 20-liter buckets at densities of no more than about 60 fish per bucket and hauled approximately 100 m downstream from the trap where they were released. Total time in transit was one to three minutes.

Two tag codes assigned to EBMUD were used for tagging naturally produced chinook salmon captured at Woodbridge Dam during 1993:

Tag Code	Time Period
6-63-45	May 5 through June 7, 1993
6-63-46	June 8 through July 29, 1993.

The use of two codes allocated to these two periods will allow some inferences to be made regarding the survival and fishery contributions of early and late emigrating naturally produced smolts when analyzing later tag returns.

The quality of tagging and latent mortality associated with handling during tagging were assessed at two different times for each tag code. Samples of 25 to 50 tagged fish were placed in 25-liter PVC live cars (previously described) at densities of about 25 fish per live car and held in a protected area of high-stage fishway pool #15 for 7 to 10 days[5]. The live cars were checked daily for mortalities. And, at the end of the holding period, all fish were mildly sedated with tricaine methane sulfonate (*ca.* 30 to 50 milligrams per liter), examined for quality of the adipose fin clip, and passed through the QCD to detect tag retention. After this procedure, all fish were released as previously described.

Coded-Wire Tagging of Hatchery Smolts and Delta Survival Experiments

CDFG provided a trailer outfitted with coded-wire tagging equipment for our use in tagging chinook salmon smolts reared at the MRFH for mark and recapture experiments of smolt survival in the Sacramento-San Joaquin Delta. The trailer was equipped with six marking stations each with a NMT Mark IV tagging machine, a QCD, and a stainless steel anesthetic bath pan. A stainless steel trough running along the length of an interior wall of the trailer was supplied with continuously flowing water pumped from a hatchery water supply for

[5] Note: CDFG holds tagged hatchery fish for a minimum of 21 days for quality control assessment; however, this was not practicable under field conditions at the Woodbridge Dam site.

loading and holding fish in the trailer prior to being tagged. A PVC return pipe manifold system that ran the length of the trailer's floor passing beneath each station served to collect and carry tagged fish back outside to a receiving raceway. Each station was plumbed to receive water pumped from the hatchery water supply. This plumbing system provided water to operate the QCD's hydraulic sorting switches, which separated correctly tagged from untagged fish, and to carry tagged fish through the return pipe system. The trailer was also equipped with a recirculating anesthetic system consisting of a 120-liter plastic barrel head tank, copper chilling coil, aerator, and submersible pump for pumping anesthetic solution through a PVC distribution manifold to each station. Anesthetic solution returned to the head tank for reconditioning by gravity through a return manifold pipe.

The tagging procedure was as follows. Fish were loaded directly from the hatchery raceway into the trailer's holding trough from which workers netted groups of fish to be tagged. In netted groups of about 50 to 60, the fish were mildly anesthetized in aerated, buffered tricaine methane sulfonate solutions (*ca.* 70 to 90 milligrams per liter, with 1:1 sodium bicarbonate as buffer). The temperature of the anesthetic solution at each station was monitored regularly by each worker or a supervisor. The anesthetic solution was changed regularly at 2 to 3 hour intervals or more frequently if the time for induction of anesthesia increased to more than about 1.5 to 2 minutes. Once the fish were anesthetized, a 1-mm binary coded-wire tag was injected into the head cartilage of each fish using the tagging machine, the adipose fin was excised with a pair of fine-pointed surgical scissors, and the fish was passed through the QCD. Those fish which the QCD detected as untagged were automatically directed to a recovery bucket and the QCD issued a warning tone to the operator. These fish were passed back through the QCD to double check the rejection and re-tagged if necessary. The efficiency of tagging, proper operation of QCD's, and tag placement for each operator and tagging machine was checked two to three times daily during tagging operations. Samples of 25 to 100 fish were collected from each station's QCD outflow and passed back through another QCD for confirmation of tagging efficiency and QCD operation. A subsample of 3 to 10 of these fish were dissected to confirm proper placement of the tags and the tagging machines were adjusted if necessary. Machine cleaning and major repair or adjustments were conducted at the end of each tagging day.

A total of approximately 200,000 smolts at a size of 100 fish per pound were tagged for the 1993 Delta survival study. These fish were Feather River fall chinook salmon transferred and incubated as eggs, hatched, and reared at MRFH. Four tag codes assigned to EBMUD were used during April 13 to April 22, 1993 to tag these fish. The tag codes were allocated to four groups of about 50,000 fish each. It was originally intended that these groups be used in a fully duplicated release design with two groups paired as replicates in each of two experimental releases. However, two of three divider screens installed by CDFG to keep all four tagged groups separate in the hatchery raceway until their scheduled releases in May 1993 failed because of excessive debris loading on the screens. This resulted in mixing of two tagged groups on both sides of the screen that remained standing which effectively eliminated the replication and created two single groups each composed of two tag codes,

referred to as sublots of the same release group. The resulting coded-wire tagged release groups were as follows:

Experimental Group	Tag Codes
Early Season Release	6-63-41 & 6-63-42 mixed
Late Season Release	6-63-43 & 6-63-44 mixed

During the pre-release holding period, CDFG maintained records of all mortalities in each of the two mixed tag code groups. Each of the two mixed tag groups, 6-63-41/42 and 6-63-43/44, were checked for tag retention 18 days and 13 days, respectively, after being tagged. Samples of about 1000 fish for each of the two composite groups were mildly sedated in a 50 milligrams per liter solution of tricaine methane sulfonate and singly passed through a QCD set up alongside the raceway. Then following the procedure outlined by CDFG, the proportion of fish detected without tags for each sample was used to adjust for total numbers of fish retaining tags after subtracting mortalities from the composite groups (F. Fisher, CDFG, Red Bluff, CA, personal communication). Mortalities in each composite group were assumed to be evenly contributed by each sublot when making computations for each sublot. Two days prior to release of each of the composite groups, a sample of 100 to 300 fish were measured for FL and TL and weighed and their condition factors were calculated.

CDFG transported and released each of the composite tagged groups of fish, 6-63-41/42 on May 6, 1993 and 6-63-43/44 on May 20, 1993. Fish were released at New Hope Landing at the confluence of the Mokelumne River and the central Delta. Subsequent recapture of the marked experimental release groups was conducted through June 1993 by the U.S. Fish and Wildlife Service's (USFWS) Sacramento-San Joaquin Estuary Fishery Resource Office using a standardized, routine trawl sampling program at the western outflow of the Delta near Chipps Island (P.L. Brandes, USFWS, Stockton, CA, pers. comm.). USFWS processed recaptured fish and identified coded-wire tag samples.

Coded-Wire Tag Summaries and Assessment

Coded-wire tagging data for both wild and hatchery reared groups were compiled to indicate initial numbers of fish tagged, tag retention, post-tagging mortality, size of fish at time of release, and dates of release and release objectives. These data were previously submitted to CDFG in their reporting format during July and August 1993. Tagging data for both wild and hatchery release groups are also presented in this report. Tag recovery data for the Delta survival experimental releases were compiled by USFWS. USFWS provided preliminary computed survival indices (S_T) for each of the tag codes recovered during their surveys.

RESULTS AND DISCUSSION

Abundance of Downstream Migrant Juvenile Salmonids

Trapping was conducted for a total of 186 days between January 19 and July 29, 1993 at Woodbridge Dam and for a total of 176 days between January 29 and July 23, 1993 near Elliott Road. Trapping was essentially continuous at the Elliott Road site, but was suspended for a total of 6 days during the course of the season at Woodbridge Dam. The reasons for suspension of trapping were due to repair work on the low-stage fishway in February and due to trap replacement activities, debris interference, flow changes, and studies of physical injury to migrating smolts at Woodbridge Dam which required use of the rotary screw trap. Appendices 1 and 2 provide complete daily records of trapping effort and capture numbers of juvenile anadromous salmonids for each trap site. The overall trapping numbers of juvenile salmonids during the 1993 monitoring season are presented in Table 4. Juvenile chinook salmon were by far the most abundant species captured at either trap site. The most abundant nonsalmonid species were comprised of several introduced centrarchid fishes (sunfish family) and introduced cyprinids (minnow family). The monthly trapping numbers of these species and others captured at each site are shown in Tables 5 and 6.

Table 4. Total Numbers of Juvenile Anadromous Salmonids Trapped at the Woodbridge Dam and Elliott Road Trap Sites During January through July 1993.

Elliott Road Site			
Fall-Run Chinook Salmon		Steelhead	
YOY	1+	YOY	1+
8,111	6	8	38
Woodbridge Dam Site			
Fall-Run Chinook Salmon		Steelhead	
YOY	1+	YOY	1+
18,725	135	12	9

The comparatively lower catches of juvenile salmon near Elliott Road was indicative of the lower capture efficiency of the trap at this site as previously discussed (see Table 2). This result was contrary to initial expectations for the site because the channel was comparatively narrow, the river flow was centered on the trap's location in the channel, and the site was near the spawning grounds where we expected to catch many juvenile salmon. However, the water

Table 5. Monthly Capture of Incidental Species at the Woodbridge Dam Trap Site.

Species	Jan	Feb	Mar	Apr	May	June	July
Pacific Lamprey (*Lampetra tridentata*)	3	100	21	98	14	0	0
Sacramento Sucker (*Catostomus occidentalis*)	8	7	0	0	0	0	0
Bluegill (*Lepomis macrochirus*)	13	16	8	78	63	30	24
Largemouth Bass (*Micropterus salmoides*)	12	1	3	0	1	0	1
Smallmouth Bass (*Micropterus dolomieui*)	0	0	1	2	0	0	0
Redear Sunfish (*Lepomis microlophus*)	0	0	6	115	31	25	22
Green Sunfish (*Lepomis cyanellus*)	0	0	0	0	1	1	0
Unknown Centrarchid Centrarchidae	13	0	4	25	7	8	1
Sculpin Cottidae	0	0	2	1	66	0	0
White Crappie (*Pomoxis annularis*)	0	8	5	12	0	0	0
Black Crappie (*Pomoxis nigromaculatus*)	0	0	0	2	0	0	0
Channel Catfish (*Ictalurus punctatus*)	0	9	1	1	0	3	0
Brown Bullhead (*Ameiurus nebulosus*)	0	1	0	2	5	3	1
White Catfish (*Ameiurus catus*)	0	1	0	0	0	0	0
Unknown Catfish Ictaluridae	3	0	0	0	0	3	0
Striped Bass (*Morone saxatilis*)	0	0	0	0	3	12	5

Table 5. (Continued)

Species	Jan	Feb	Mar	Apr	May	June	July
Carp (*Cyprinus carpio*)	27	11	1	7	0	59	0
Goldfish (*Carassius auratus*)	0	1	0	0	0	0	0
Hardhead (*Mylopharodon conocephalus*)	1	0	0	0	0	0	0
Golden Shiner (*Notemigonus crysoleucas*)	1	20	8	10	1	1	0
Hitch (*Lavinia exilicauda*)	0	2	0	2	0	0	0
Sacramento Squawfish (*Ptychocheilus grandis*)	0	0	1	12	3	0	0
California Roach (*Hesperoleucus symmetricus*)	0	0	0	2	0	0	0
Unknown Cyprinid Cyprinidae	0	4	0	0	0	0	0
Topsmelt (*Atherinops affinis*)	0	0	0	1	1	0	0
Shad Clupeidae	0	0	0	2	2	0	0

Table 6. Monthly Capture of Incidental Species at the Elliott Road Trap Site.							
Species	Jan	Feb	Mar	Apr	May	June	July
Pacific Lamprey (*Lampetra tridentata*)	0	1	1	2	0	0	0
Sacramento Sucker (*Catostomus occidentalis*)	0	2	0	0	1	1	0
Bluegill (*Lepomis macrochirus*)	0	14	8	1	1	1	0
Largemouth Bass (*Micropterus salmoides*)	0	0	0	0	1	12	0
Redear Sunfish (*Lepomis microlophus*)	0	4	10	4	0	1	0
Green Sunfish (*Lepomis cyanellus*)	0	2	0	0	0	0	0
Sculpin Cottidae	1	33	3	2	0	0	0
Channel Catfish (*Ictalurus punctatus*)	0	1	0	0	0	0	0
Brown Bullhead (*Ameiurus nebulosus*)	0	0	0	1	1	0	0
Unknown Catfish Ictaluridae	0	0	0	0	0	0	4
Carp (*Cyprinus carpio*)	0	0	0	0	0	520	1
Golden Shiner (*Notemigonus crysoleucas*)	0	26	5	0	0	0	0
Sacramento Squawfish (*Ptychocheilus grandis*)	0	0	0	1	0	1	0
Unknown Cyprinid Cyprinidae	0	1	2	0	0	0	0
Brown Trout (*Salmo trutta*)	0	0	0	1	0	0	0
Brook Trout (*Salvelinus fontinalis*)	0	0	0	0	1	0	0

velocity was slow, generally less than 1.25 feet per second under all river flow conditions experienced throughout the season, and this is near the minimum effective velocity of 1 foot per second for the rotary screw trap (Mark Wade, E.G. Solutions, Inc., pers. comm.). Larger-sized juvenile salmon (>70 mm TL) were least vulnerable to the trap at this site. This was probably due to their well developed swimming capability at this size and larger, so they could avoid the slow turning screw trap. Therefore, it was not possible to generate with any confidence an estimate for total abundance of juvenile salmon passing this trap site. It may be desirable to relocate the upstream trap site in future years if a secure site with higher velocities can be found, or experiment with guidance devices and wing nets to improve trap efficiencies in this low gradient reach of the river.

A total abundance index for Y-O-Y chinook salmon passing Woodbridge Dam was possible based on the results of trap efficiency tests previously described for this site (see Table 3). From January 19 through July 29, 1993 an estimated 183,448 naturally produced Y-O-Y chinook salmon passed the Woodbridge Dam trap site. A 95% confidence interval for the estimate is 120,835 - 382,738. The week-by-week estimates of abundance, associated mean trap efficiencies and standard deviations, and the periods of estimation used to construct the 95% confidence interval are provided in Appendix 3. Figures 5 and 6 display the temporal distribution of daily estimated abundance and aggregated weekly estimates of abundance for Y-O-Y salmon passing the Woodbridge Dam trap site.

Water Velocity Profiles near Elliott Road

Figure 7 shows the water velocity measurements taken in the immediate vicinity of the Elliott Road fish sampling site during Camanche Reservoir releases of 600 cfs and 1300 cfs. Water depth increased substantially with the increased reservoir releases (>7 feet maximum to >11 feet maximum). The maximum observed water velocity increased from 2.2 ft/s to 2.92 ft/s. Water velocities in front of the rotary fish trap increased by approximately 1 ft/s.

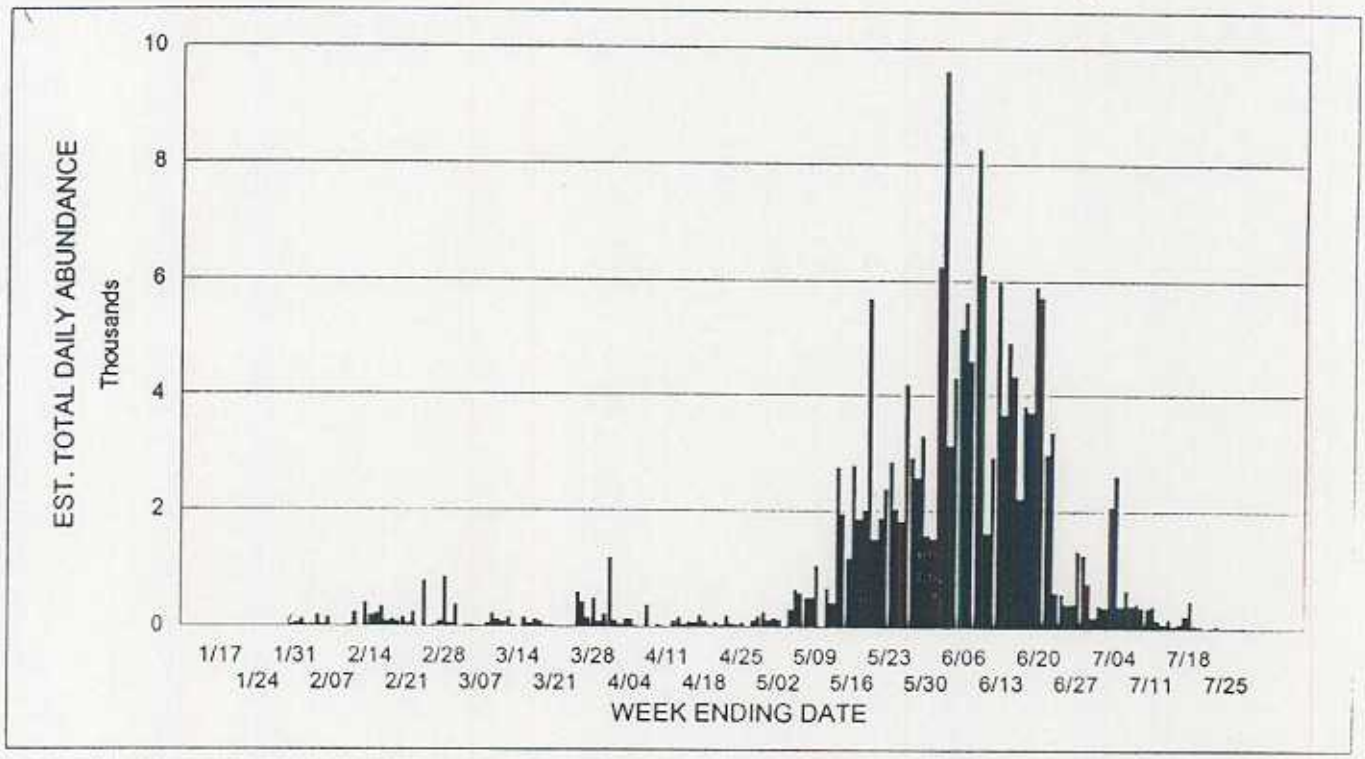


Figure 5. Estimated Total Daily Abundance of Young-of-Year Chinook Salmon Passing Woodbridge Dam During January through July 1993.

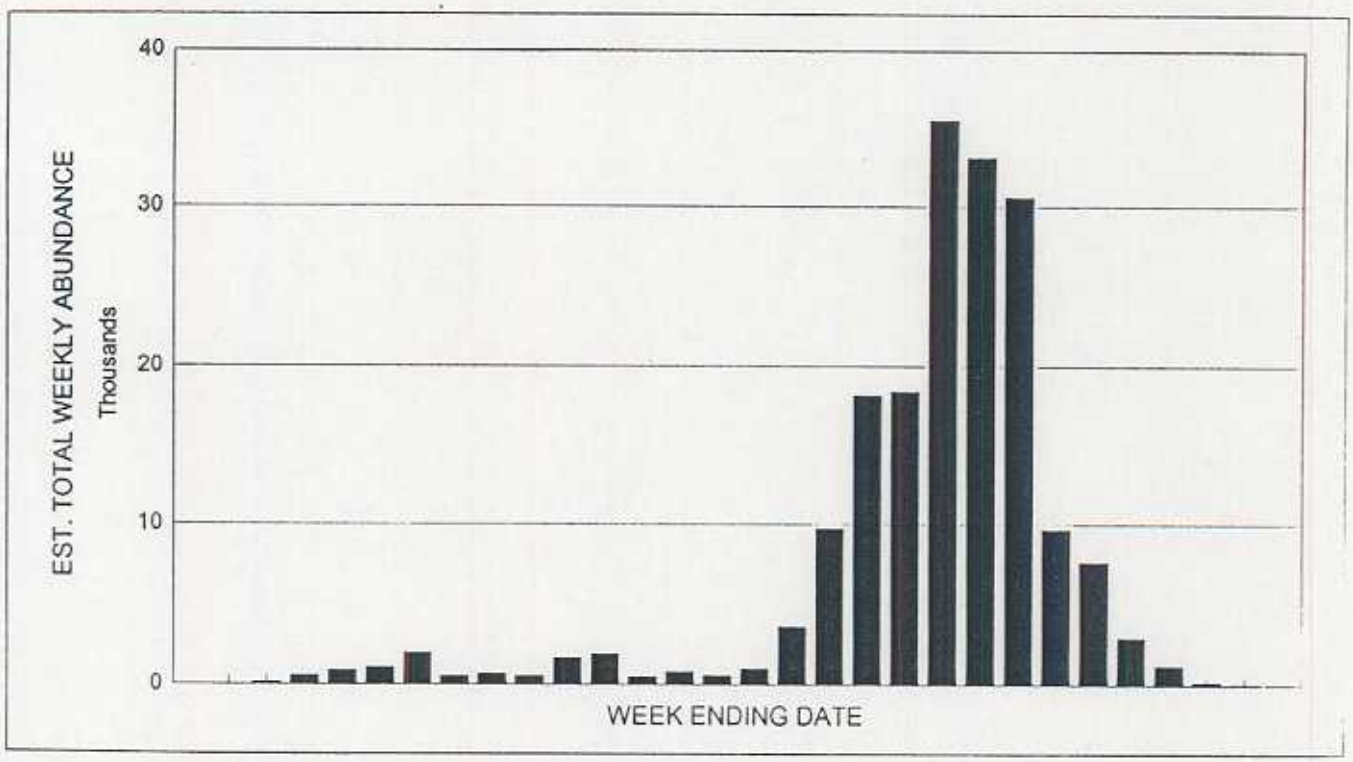


Figure 6. Estimated Total Weekly Abundance of Young-of-Year Chinook Salmon Passing Woodbridge Dam During January through July 1993.

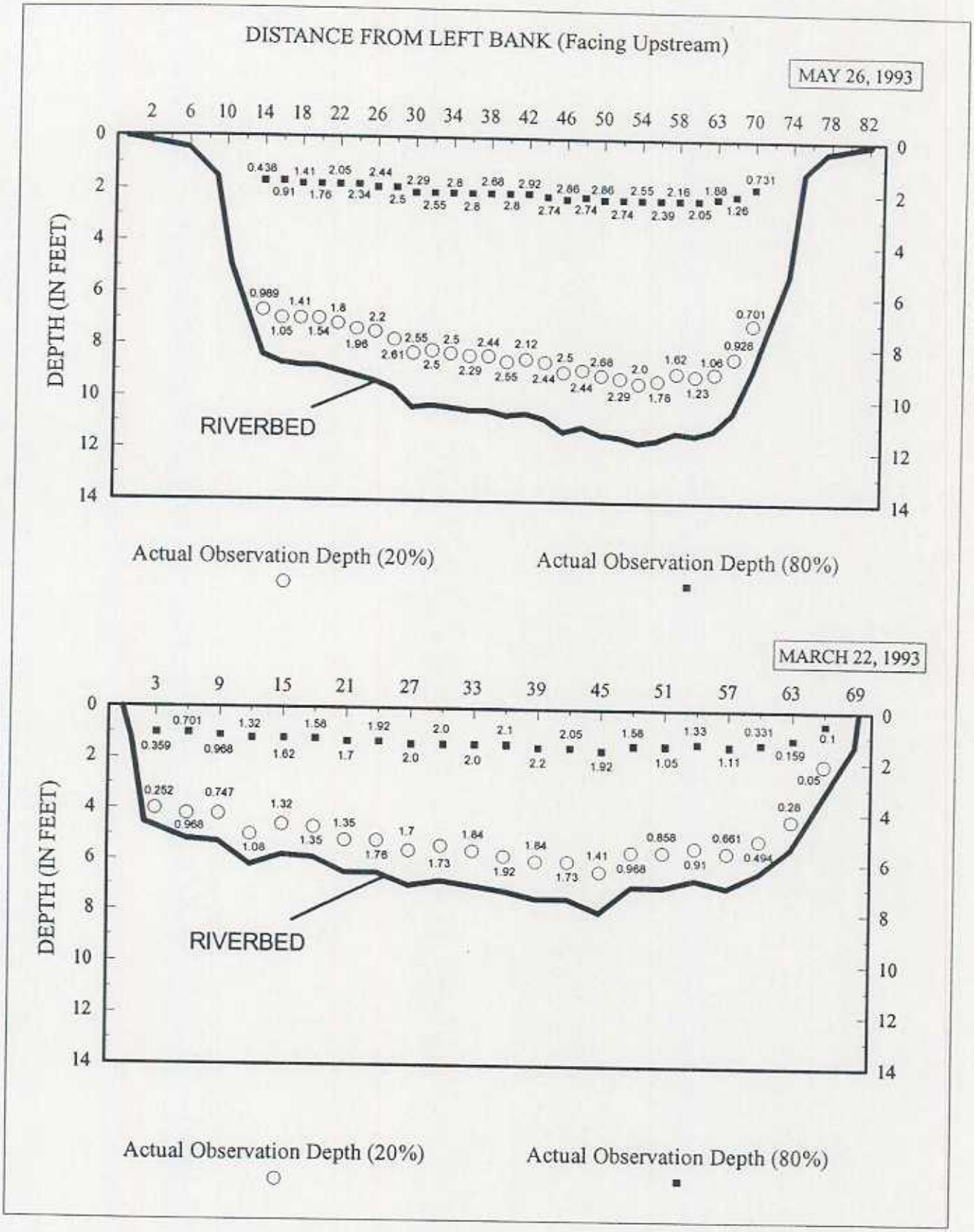


Figure 7. Velocity distribution (in feet per second) at Elliott Road rotary fish trap sampling site. Data collected on March 22 (Camanche release of 576 cfs) and May 26, 1993 (Camanche release of 1,340 cfs).

Timing of the Downstream Migration of Juvenile Salmonids

As Figures 5 and 6 show, the majority of the 1992 brood of fall chinook salmon emigrated from the lower Mokelumne River during the months of May through June in 1993. Dramatic increases in daily counts at Woodbridge Dam were observed beginning in the second week of May when daily captures of Y-O-Y salmon doubled from those of previous weeks'. In fact, successive daily counts nearly doubled each day during that week. This obviously signalled the beginning of a purposeful downstream smolt migration. This conclusion is substantiated by the rapid increase in the mean size of juvenile salmon captured at the Woodbridge Dam trap site just preceding and during this same time interval (Figure 8).

A comparison of the timing of Y-O-Y salmon migration at the Woodbridge Dam and Elliott Road trap sites is of interest, but must be made with caution given the previously described inadequacies in trap efficiency near Elliott Road. Figure 9 shows the timing of weekly trap counts of migrating juvenile salmonids at the two sites. The most significant apparent difference is the relatively greater passage of juvenile salmon by the Elliott Road site early in the season compared to that at Woodbridge Dam. It is difficult to make comparisons later in the season due to the trap's reduced efficiency for larger sized juvenile salmon at the Elliott Road site. However, an increase in Y-O-Y salmon migration, as measured by a slight increase in trap catches, was detected at the Elliott Road site which corresponded with increased passage at Woodbridge Dam during late May and June. This bimodal movement pattern detected at the upstream trap site is typical of most populations of chinook salmon in the Central Valley and elsewhere throughout their range where there is an extensive downstream dispersal of fry from the spawning grounds soon after emergence; a portion of the population takes up residence on or near the spawning grounds where they rear until smolting then emigrate to the river's estuary (Healey 1991, Kjelson *et al.* 1982). 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 rearing habitat along the river's length. From the estimates of the weekly abundance of Y-O-Y salmon passing Woodbridge Dam shown in Figure 8, it can be seen that only a small proportion of the annual natural production (6% through the week of April 11) moved below Woodbridge Dam and potentially to the estuary during this early fry migration. Therefore, a considerable number of Y-O-Y salmon likely reared in the river reach between Elliott Road and Woodbridge Dam.

Figures 10 and 11 also provide the weekly counts of age 1+ chinook salmon and both Y-O-Y and age 1+ steelhead at the two trap sites. No estimates of total abundance for age 1+ salmon were made because no age 1+ salmon were available at this time of year for conducting trap efficiency tests. Observations on yearling salmon occurrence in the traps were possible and they were present at both trap sites through the week of May 2; however, not in great numbers. Steelhead were not numerous at either trap site. Yearling and some potentially age 2+ steelhead (>200 mm TL) were captured early in the season at both sites.

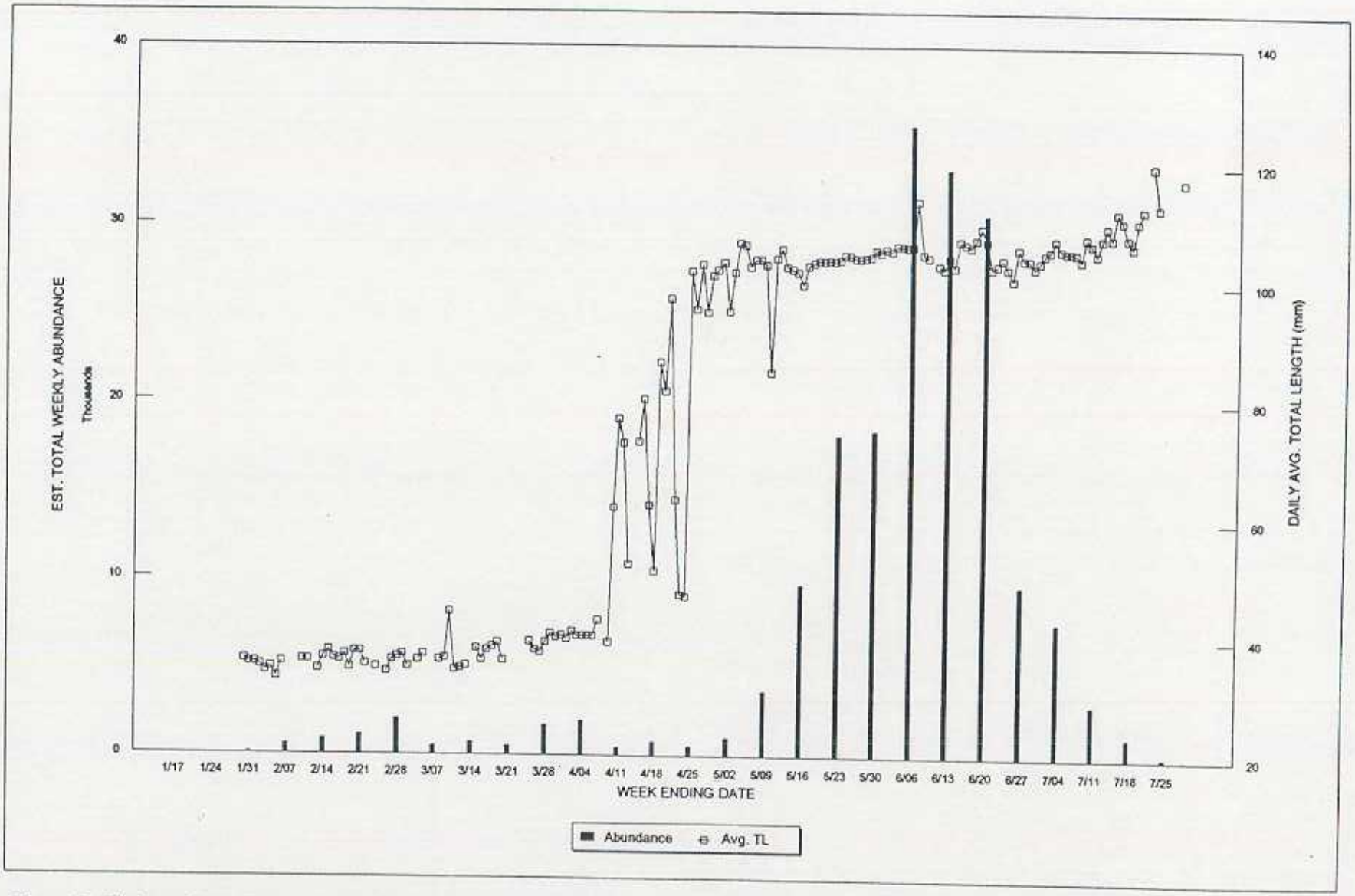


Figure 8. Timing of Total Estimated Weekly Abundance and Size of Downsream Migrant Young-of-Year Chinook Salmon Passing Woodbridge Dam During January through July 1993.

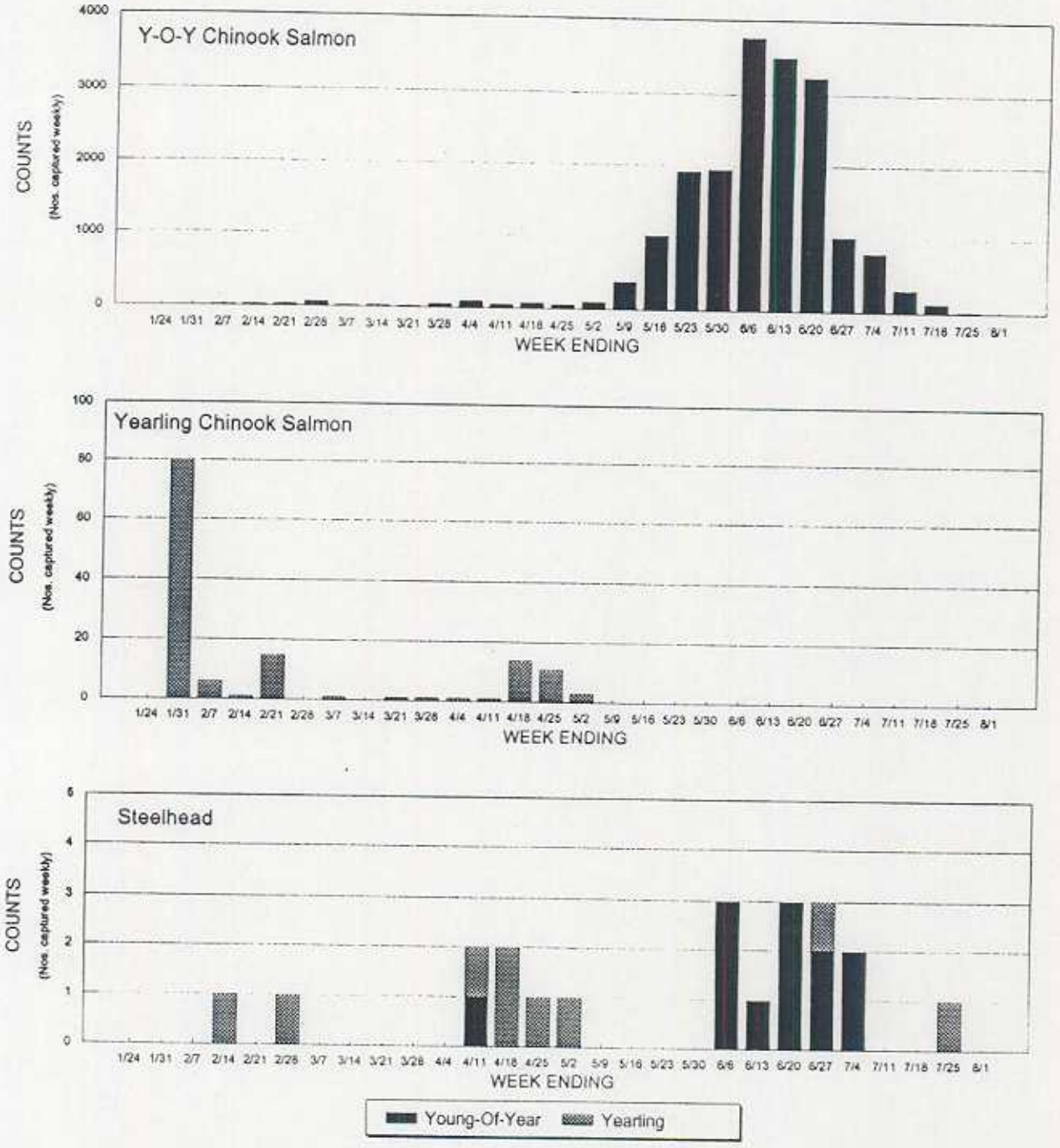


Figure 10. Weekly Counts of Juvenile Chinook Salmon and Steelhead Trapped at the Woodbridge Dam Site During January through July 1993.

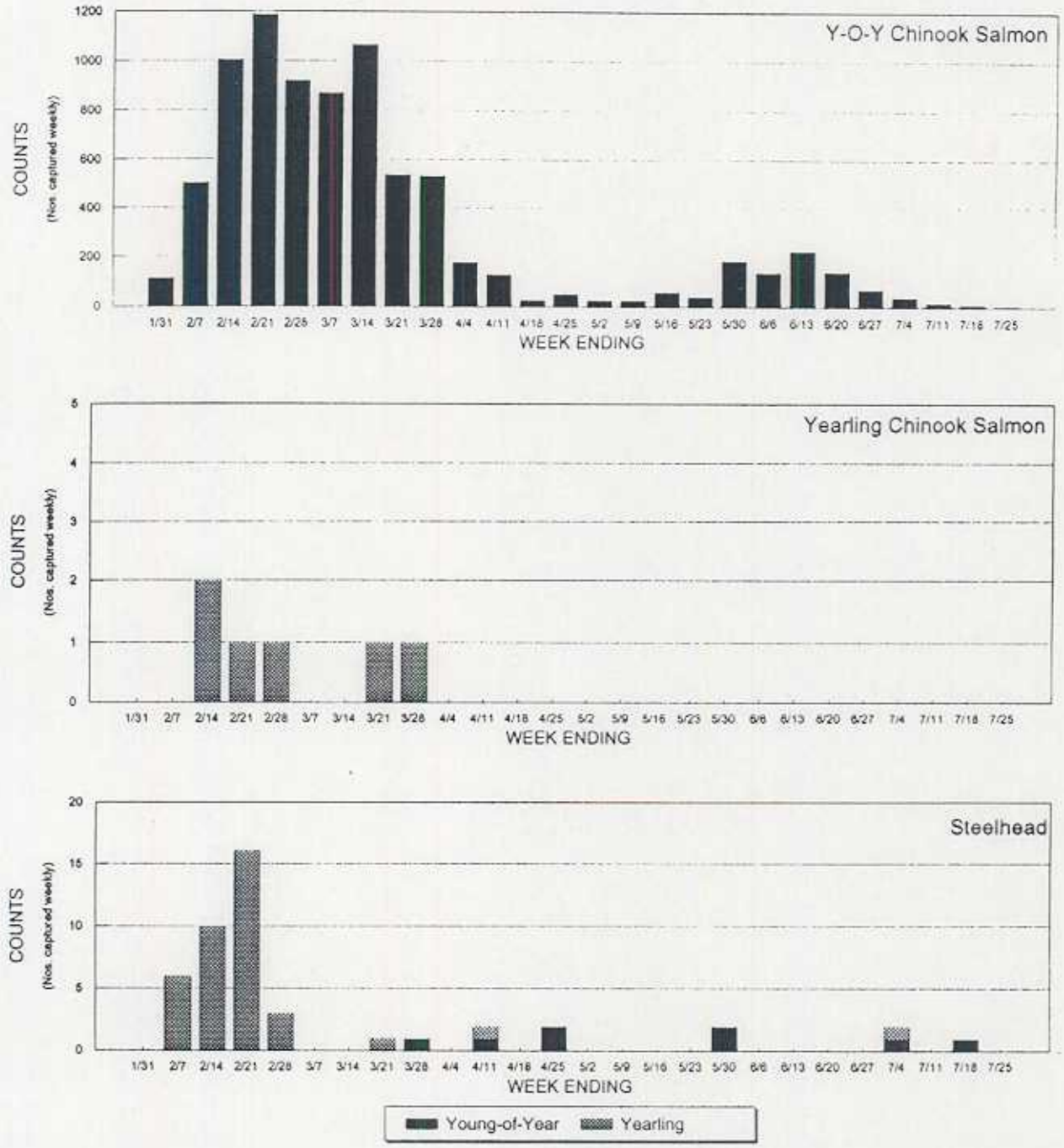


Figure 11. Weekly Counts of Juvenile Chinook Salmon and Steelhead Trapped at the Elliott Road Site During January through July 1993.

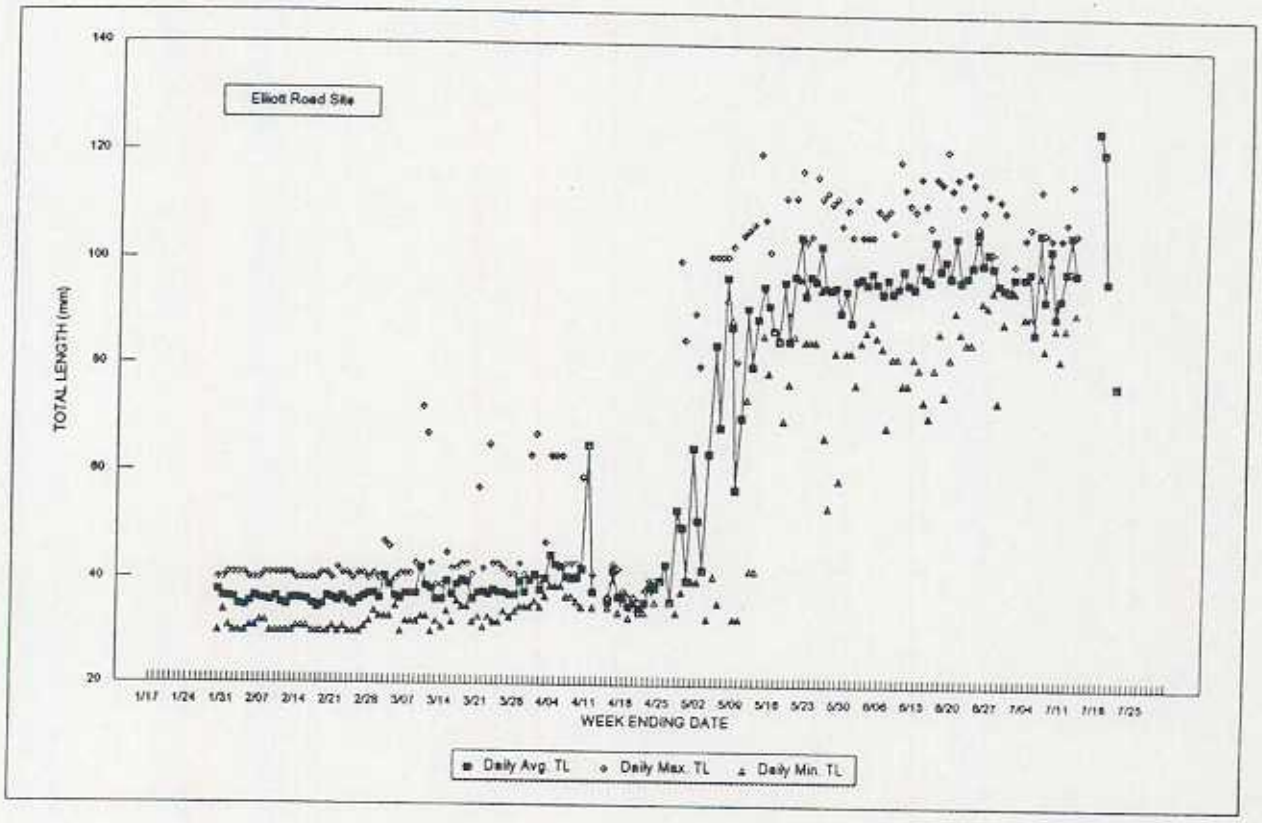
Y-O-Y steelhead were first observed during the end of March near Elliott Road and at both sites occasionally during the remainder of the monitoring season.

Size and Condition of Young-of-Year Downstream Migrant Salmon

Daily records of average TL, FL, weight, and condition factor, as well as the range in size measurements of Y-O-Y salmon captured at Woodbridge Dam and Elliott Road are provided in Appendices 4 and 5. Figure 12 shows that the majority of juvenile salmon captured near Elliott Road were captured as fry (≤50 mm TL) while the majority at Woodbridge Dam were captured as smolt-sized salmon (>50 mm TL). These size criteria are based on size at smoltification data for chinook salmon reviewed by Healey (1991); none exists specifically for the Mokelumne River fall chinook salmon stock. Based on the abundance estimates for downstream migrants passing Woodbridge Dam, approximately 6% emigrated as fry and 94% as smolts. Recently emerged chinook salmon fry, those less than about 40 mm TL, dominated the catch near Elliott Road until May (Figure 12). Figure 12 also shows that recently emerged fry dominated in the daily catches at Woodbridge Dam until the first week in April when larger-sized fish began appearing in the daily catches and the average size began increasing rapidly on a daily basis. The small, recently emerged fry were observed at both sites through the second week in May, after which the size of the smallest fish in the daily catches increased rapidly (Figure 12). The observation of fry migrating well into May indicates that the emergence period was quite protracted, especially since the last observations of salmon spawning by EBMUD biologists occurred during the first or second week in January (Hartwell 1993). Investigations by Fisher (1976) at the WID fish screens during 1974 also noted the presence of chinook fry late in the season (*i.e.*, early to mid-May).

The size of captured downstream migrant salmon increased abruptly at both sites, during the latter half of April at Woodbridge Dam and during the first half of May near Elliott Road. The change is revealed in Figure 12 by the increases in average size during these respective periods. However, this change in average size was a result of an increase in capture of relatively large smolt-sized fish with fry in the traps rather than a uniform increase in fish size over this period (Figure 12). Tables 7 and 8 also reveal this phenomenon based on the increased standard deviations of the average TL's during these same time periods. This abrupt change in the size and numbers of migrating juvenile salmon signalled the beginning of a smolt migration in the lower Mokelumne River (Figure 12).

The weight and condition factor of migrating juvenile salmon captured at both trap sites followed a similar pattern to that of changes in TL (Tables 7 and 8). Weight and condition factor increased slightly during the fry migration ranging from 0.2 to 0.6 grams in average weight with average condition factors ranging from 4.4×10^{-4} to 6.9×10^{-4}. The abrupt occurrence of smolts in the traps affected increases in averages and standard deviations for weight and condition factor as it did for TL. The weight and condition factor of smolts migrating by Woodbridge Dam generally increased throughout the smolt migration, except for a two-week period (May 24 to June 6) at the beginning of the smolt migration when average



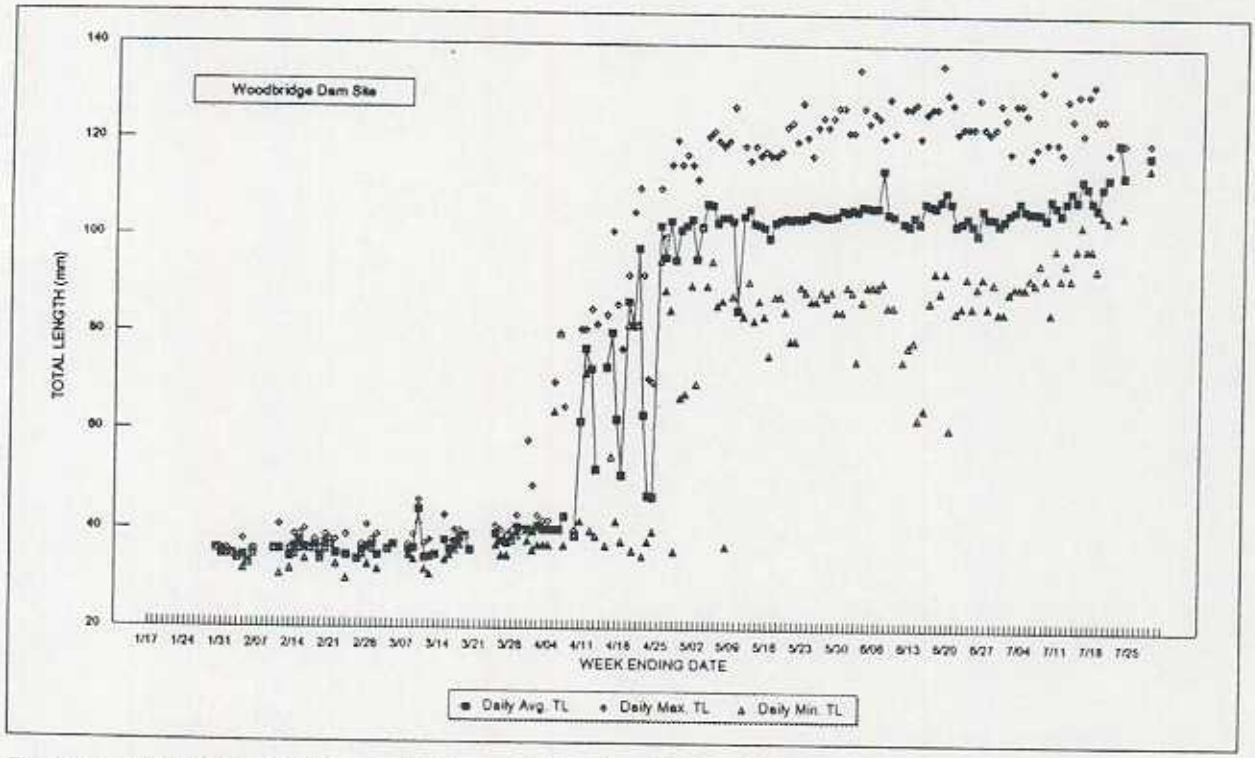


Figure 12. Daily Average, Maximum and Minimum total Lengths of Young-of-Year Chinook Salmon Captured at the Elliott Road and Woodbridge Dam trap Sites During January through July 1993.

Table 7. Weekly Average Total Length, Weight and Condition Factor for Y-O-Y Chinook Salmon Captured at Woodbridge Dam During January through July 1993.

Date	TL(mm)	SD	WT(g)	SD	K	SD	N*
1/31	36	0.5	0.2	0.15	4.38E-04	2.90E-04	3 (2)
2/07	35	1.3	0.3	0.16	6.92E-04	2.15E-05	18 (11)
2/14	35	2.0					25 (0)
2/21	37	1.4	0.3	0.00	5.92E-04	0.00E+00	33 (4)
2/28	36	2.0	0.3	0.07	6.12E-04	1.14E-04	63 (54)
3/07	35	2.5	0.3	0.08	6.26E-04	6.37E-05	16
3/14	37	2.3	0.3	0.07	6.18E-04	7.26E-05	21
3/21	38	2.3	0.3	0.07	6.13E-04	6.47E-05	16
3/28	39	1.2	0.4	0.04	6.50E-04	5.58E-05	53
4/04	40	3.0	0.4	0.17	6.35E-04	6.10E-05	96
4/11	44	6.3	0.6	0.40	5.86E-04	1.24E-04	86
4/18	63	14.7	2.1	1.25	7.11E-04	1.36E-04	78
4/25	72	19.0	3.8	2.05	7.45E-04	1.35E-04	60
5/02	100	13.5	8.0	2.79	7.90E-04	1.54E-04	105
5/09	104	8.0	9.1	1.90	7.85E-04	6.48E-05	309 (308)
5/16	102	7.8	8.3	1.67	7.71E-04	1.17E-04	437 (436)
5/23	104	7.0	8.6	1.75	7.60E-04	6.77E-05	1070
5/30	105	6.9	7.8	1.70	6.74E-04	7.02E-05	647
6/06	106	7.0	6.8	1.76	5.67E-04	8.83E-05	1088 (888)
6/13	106	37.6	9.6	3.23	8.54E-04	1.70E-04	600 (200)
6/20	107	8.0	10.1	2.41	7.93E-04	3.44E-04	691
6/27	104	8.3	9.7	2.37	8.54E-04	5.51E-05	380
7/04	105	7.9	10.1	2.39	8.55E-04	5.15E-05	368
7/11	106	6.5	10.2	1.92	8.56E-04	5.12E-05	290
7/18	108	7.5	11.1	2.36	8.74E-04	5.45E-05	126
7/25	113	7.3	13.0	2.31	8.99E-04	6.80E-05	15
8/01	118	2.5	14.7	1.45	9.00E-04	3.20E-05	2

* Differing sample sizes for length and weight data are indicated by placing sample sizes for weight and condition factors in parentheses.

Table 8. **Weekly Average Total Length, Weight, and Condition Factor for Y-O-Y Chinook Salmon Captured Near Elliott Road During January through July 1993.**

Date	TL(mm)	SD	WT(g)	SD	K	SD	N*
1/31	37	2.0	0.3	0.08	6.39E-04	1.24E-04	102
2/07	36	2.3	0.3	0.10	6.89E-04	1.87E-04	392
2/14	36	3.0	0.3	0.08	5.92E-04	1.15E-04	557
2/21	36	2.7	0.3	0.08	5.84E-04	1.11E-04	586
2/28	36	2.5	0.3	0.08	6.08E-04	9.76E-05	574
3/07	38	2.8	0.3	0.08	6.10E-04	7.45E-05	354
3/14	38	4.7	0.4	0.26	6.28E-04	8.68E-05	519
3/21	38	2.4	0.4	0.08	6.24E-04	6.72E-05	406
3/28	38	2.6	0.3	0.08	6.32E-04	9.23E-05	400
4/04	40	4.4	0.5	0.27	6.42E-04	8.08E-05	178
4/11	42	4.1	0.5	0.44	6.61E-04	1.38E-04	131
4/18	38	2.1	0.3	0.06	5.81E-04	4.32E-05	27
4/25	36	1.0	0.3	0.07	6.20E-04	1.42E-04	53
5/02	53	21.6	1.8	2.43	7.07E-04	9.81E-05	26
5/09	77	24.3	5.1	3.27	7.80E-04	1.80E-04	27
5/16	87	18.1	5.9	2.62	7.83E-04	1.13E-04	61
5/23	96	7.9	7.3	1.42	8.33E-04	1.46E-04	42
5/30	96	8.8	6.4	1.57	7.15E-04	8.16E-05	185
6/06	95	9.8	5.7	0.97	7.11E-04	1.02E-04	141 (27)
6/13	97	7.7					225 (0)
6/20	100	8.9	7.7	1.95	7.78E-04	1.16E-04	141
6/27	99	7.2	8.7	2.00	8.79E-04	6.60E-05	70
7/04	97	7.9	8.2	1.70	9.08E-04	9.55E-05	40
7/11	96	8.0	8.1	1.80	8.84E-04	9.96E-05	15
7/18	106	9.9	9.6	2.84	7.68E-04	1.43E-04	9
7/25	87	10.0	6.0	0.10	9.80E-04	3.12E-04	2

* Differing sample sizes for length and weight data are indicated by placing sample sizes for weight and condition factors in parentheses.

weight and condition factor declined (Table 7). This may have corresponded to morphological changes and loss of weight, which can affect condition factor, and have been observed during smoltification for several species of anadromous salmonids (Hoar 1988, McKeown 1984, Woo *et al.* 1978). Otherwise condition factors increased throughout the season indicating gains in "plumpness" or robustness of the fish.

Effects of Physical Environmental Conditions on Downstream Migrants

Diel Periodicity of Migration Past Woodbridge Dam

The effects of photoperiod (day length) on the physiology of salmonid smoltification and salmonid migration behavior, particularly at passage obstacles such as dams, are well documented (Banks 1969, Greenstreet 1992, Hoar 1988, Long 1959, McKeown 1984, Vogel *et al.* 1988). The diel patterns of migration of smolt-sized chinook salmon passing Woodbridge Dam were documented on three occasions during the height of the smolt emigration. These results are shown in Figure 13. The temporal patterns of diel migration were similar during the May and early June dates. During these times, the greatest movements of chinook salmon smolts occurred in the morning daylight hours with smaller but distinct peaks in movement occurring during the two crepuscular periods (twilight hours of dawn and dusk) of each day. The crepuscular movement was similarly observed during the late June date but a greater proportion of the smolts migrated by the dam at night.

The difference in diel movement patterns may be partially explained by differences in water temperature during these times. Average daily temperature was higher in late June than earlier in the month and in May. Daily water temperatures during the periods ranged as follows: May 19-20 (14°-17°C), June 2-3 (14°-16°C), and June 29-30 (15°-17°C). Generally, the coolest temperatures were experienced near sunrise and early daylight morning hours on the first two dates and during the night time hours on the late June date. So, the magnitude and temporal distribution of temperature fluctuations may partly explain the differences in observed patterns between these two periods.

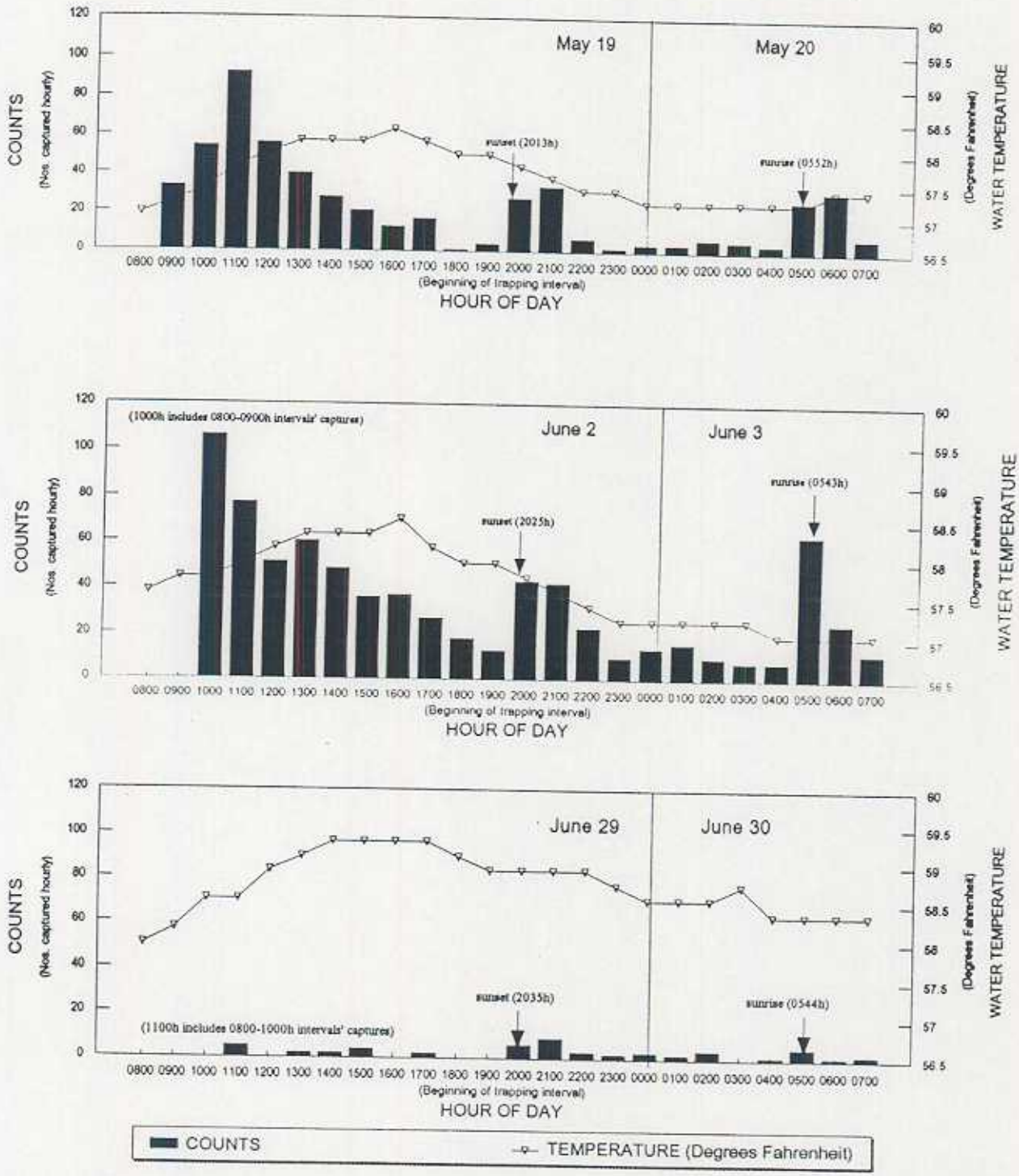


Figure 13. Hourly Counts and Corresponding Water Temperature (in Degrees Fahrenheit) of Y-O-Y Chinook Salmon Migrating Past Woodbridge Dam During Diel Trapping Surveys - May and June 1993

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

Daily average river flow, water turbidity, and surface water temperatures are provided in Appendices 6 and 7 for Woodbridge Dam and Elliott Road trap sites. Daily rainfall was measured near the Elliott Road trap site and is included in Appendix 7.

Figures 14 and 15 show the daily river flow and turbidity at each trap site. Changes in river flow were primarily related to increased releases from Camanche Dam. The resulting hydrograph exhibited periods of relatively constant flows punctuated by large, rapid increases in flow occurring over the course of one or two days. Rainfall caused transient, low magnitude increases in river flow at both sites generally lasting less than three days. The effects of rainfall were more noticeable at Woodbridge Dam due to accretions caused by urban drainage from the city of Lodi (Jim Burgess, EBMUD, personal communication). Turbidity fluctuated over the season at both sites. Periods of rainfall and subsequent runoff caused transient increases in turbidity as did the pulsed, increased releases from Camanche Dam. Turbidity also could have been a function of algal production in Camanche Reservoir and Lake Lodi that subsequently moves in river discharges at their outlets.

Figures 16, 17, and 18 show the water temperatures recorded at the fish sampling sites. It was interesting to note that diel changes in water temperatures were very noticeable from the hourly reading recorded at each site, but was particularly pronounced at Woodbridge Dam (Figures 16 and 17). We converted hourly readings or early morning and late afternoon readings to mean daily water temperatures to allow for graphical comparisons between sites (Figure 18) and comparisons to the daily numbers of outmigrant salmon. In nearly all instances, the mean daily water temperatures observed at Woodbridge Dam were higher than that recorded near Elliott Road. The water temperature differences between the sites became considerably more pronounced later in the season (Figure 18).

Researchers elsewhere have noted that salmon emigrations tend to occur in groups and pulses; these pulses may correspond to increased flow events. For example, USFWS salmon research by Kjelson *et al.* (1982) and Vogel (1989) reported increased downstream movements of fry chinook corresponding to increase river flows and turbidity, respectively. We examined potential migratory responses to these environmental parameters and the potential influence of water temperature, lunar phase, and precipitation. In each case, no cause and effect relationship was apparent (Figures 19 through 22).

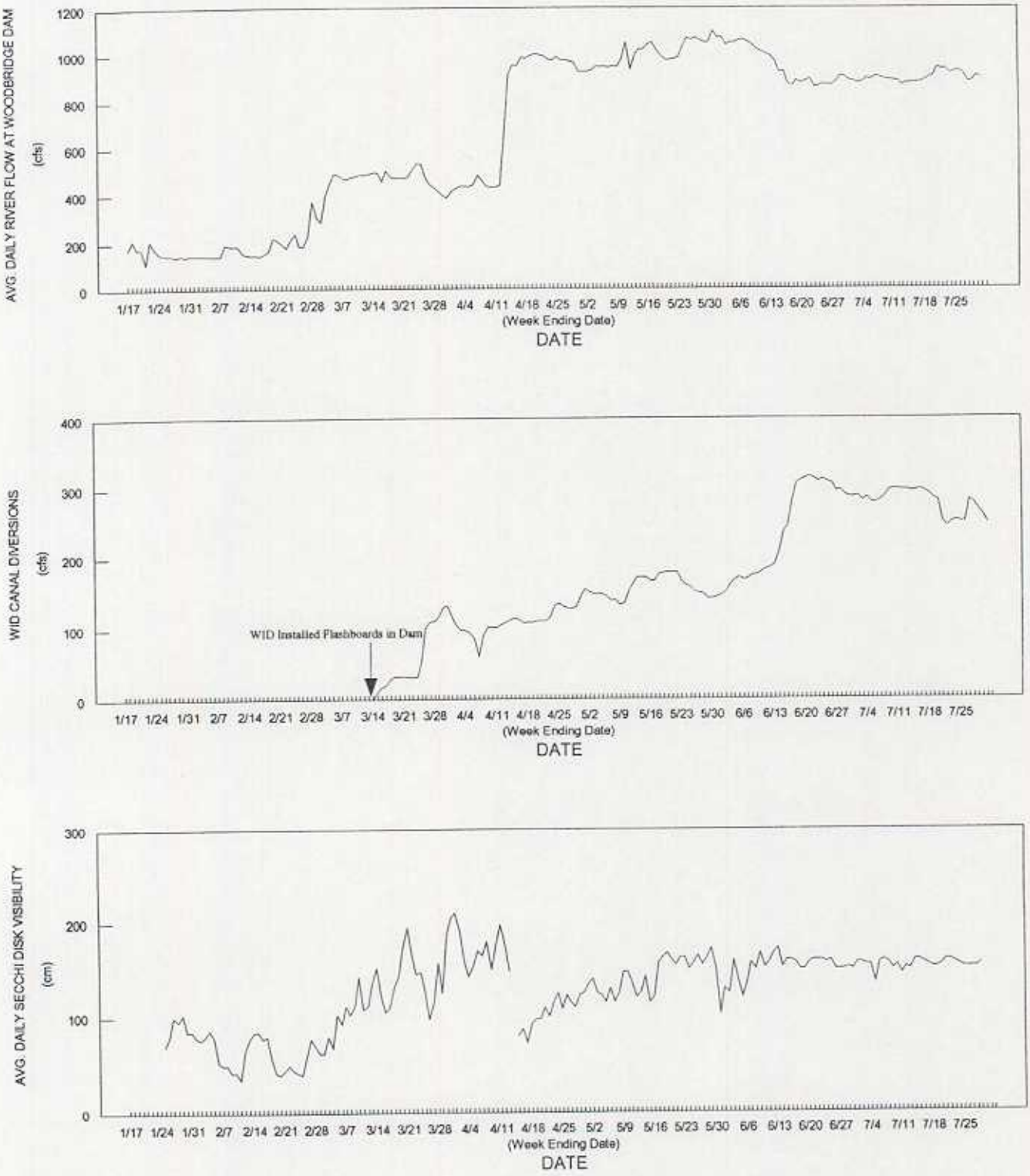


Figure 14. River Flow Passing Woodbridge Dam, WID Canal Diversions, and Daily Average Turbidity (as measured by Secchi visibility) at Woodbridge Dam Trap Site (RM 39) During January through July 1993.

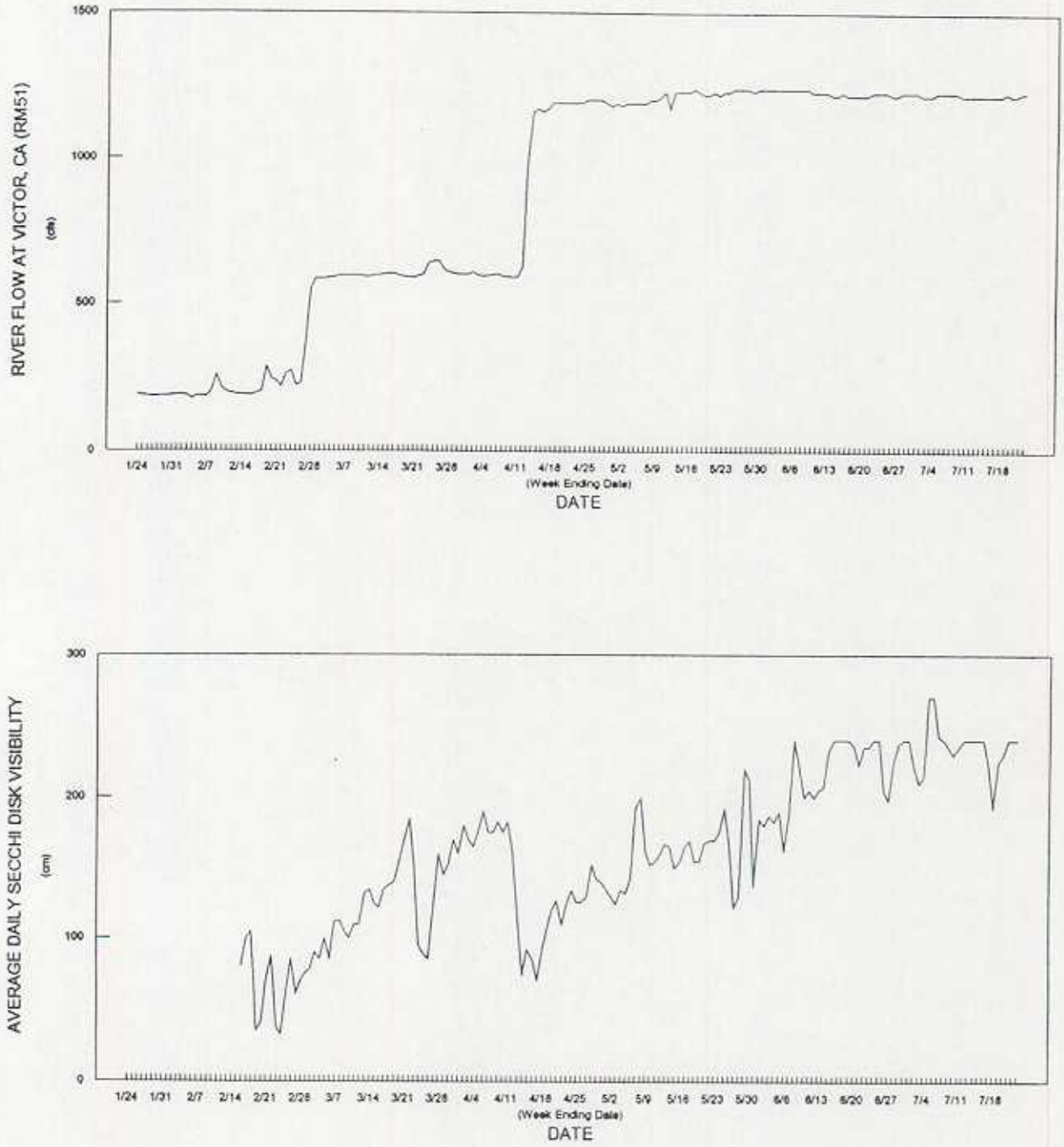


Figure 15. Daily River Flow and Turbidity (measured as Secchi visibility) at the Elliott Road Trap Site During January through July 1993.

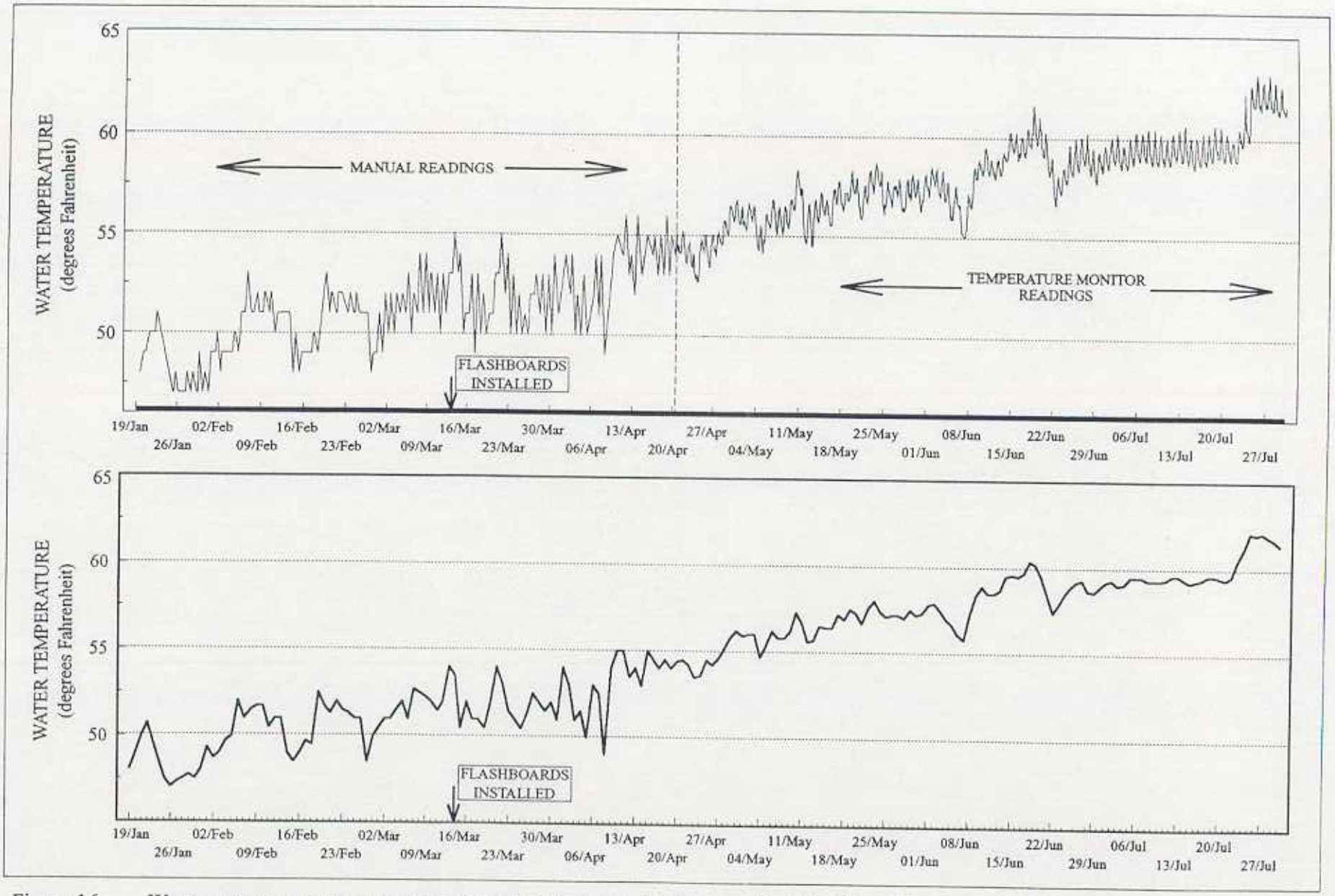


Figure 16. Water temperatures recorded at the Woodbridge Dam site (January 19 - July 30, 1993). Top graph depicts temperatures taken manually (a.m. and p.m.) or using electronic monitoring equipment (hourly). Bottom graph depicts average daily temperatures.

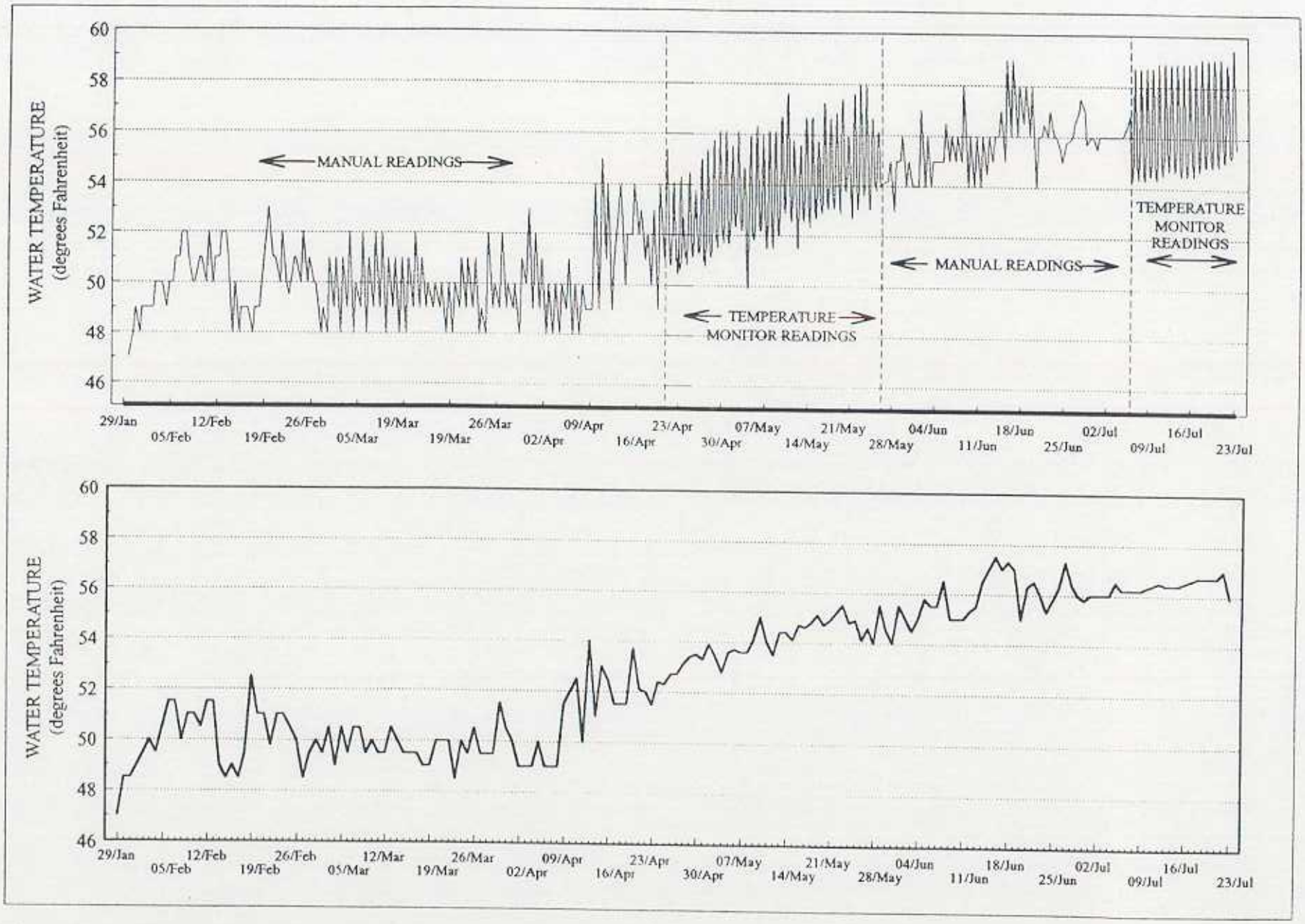


Figure 17. Water temperatures recorded at the Elliott Road trap site (January 29 - July 23, 1993). Top graph depicts temperatures taken manually (a.m. and p.m.) or using electronic monitoring equipment (hourly). Bottom graph depicts average daily temperatures.

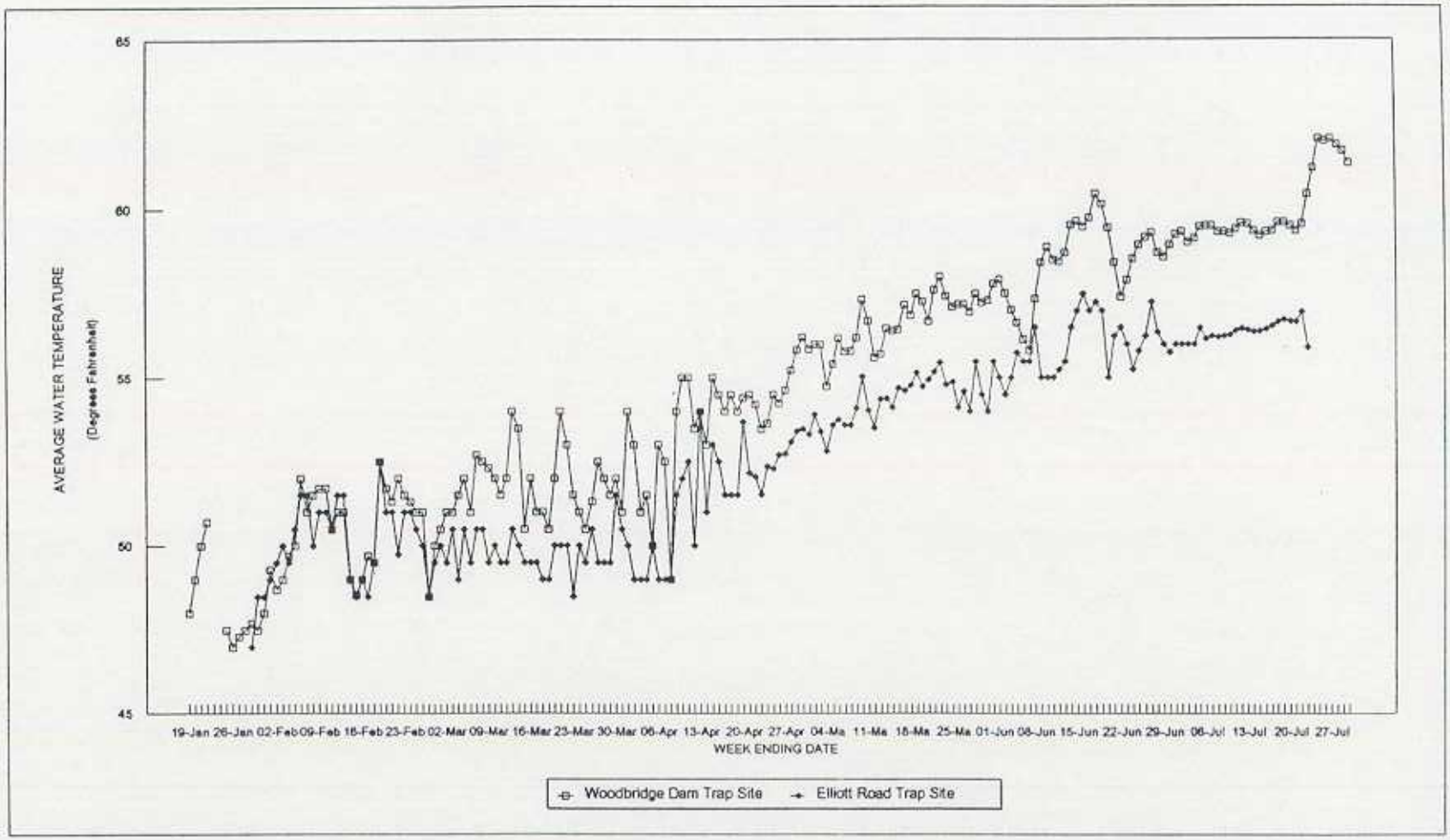


Figure 18. Average Daily Water Temperatures (in Degrees Fahrenheit) Recorded at the Woodbridge Dam and Elliot Road Trap Sites During January through July 1993.

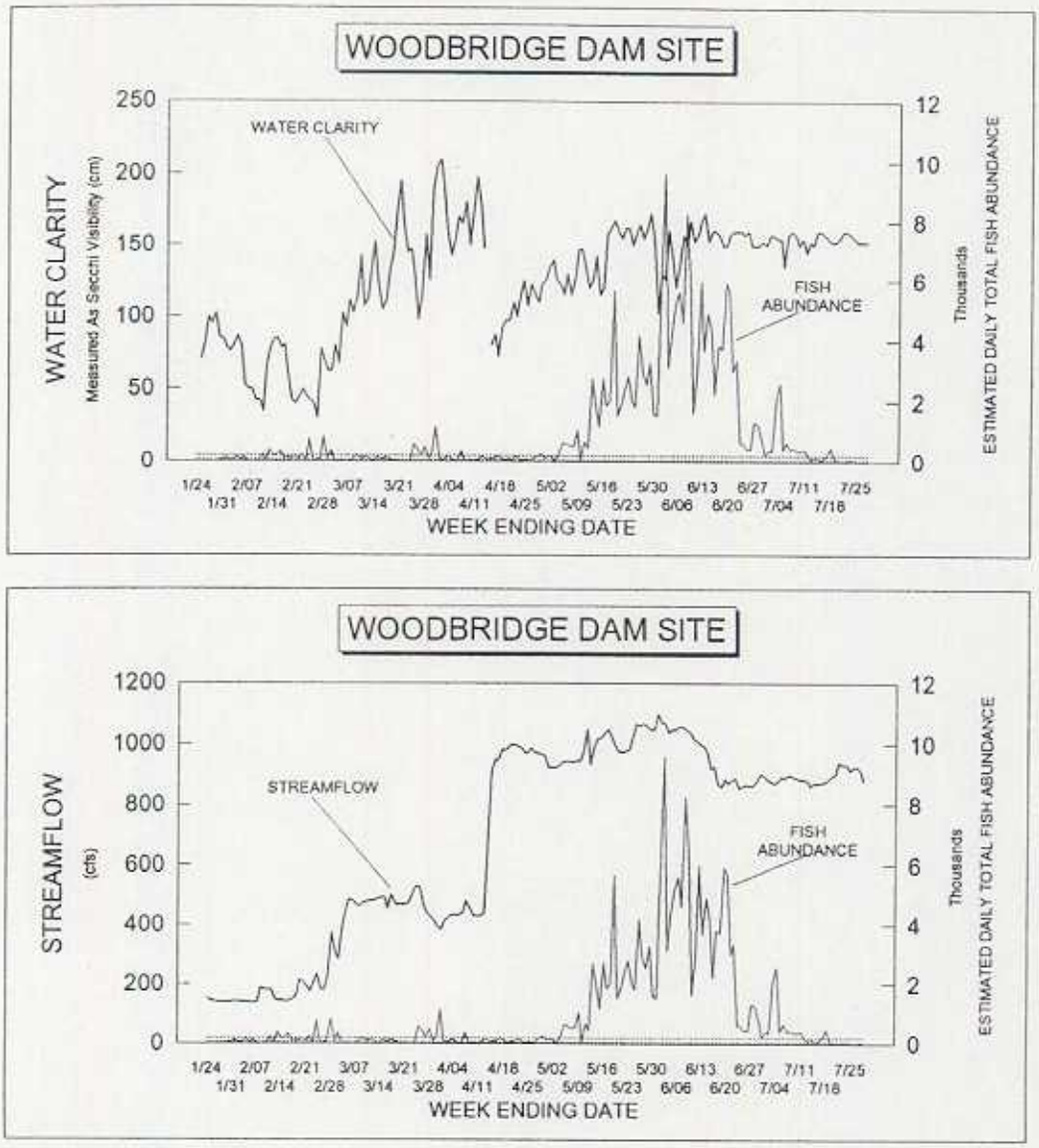


Figure 19. Comparison of Estimated Daily Total Abundance of Young-of-Year Chinook Salmon Passing Woodbridge Dam with Water Clarity (measured as Secchi visibility) and Streamflow (Woodbridge Dam outflow) During January through July 1993.

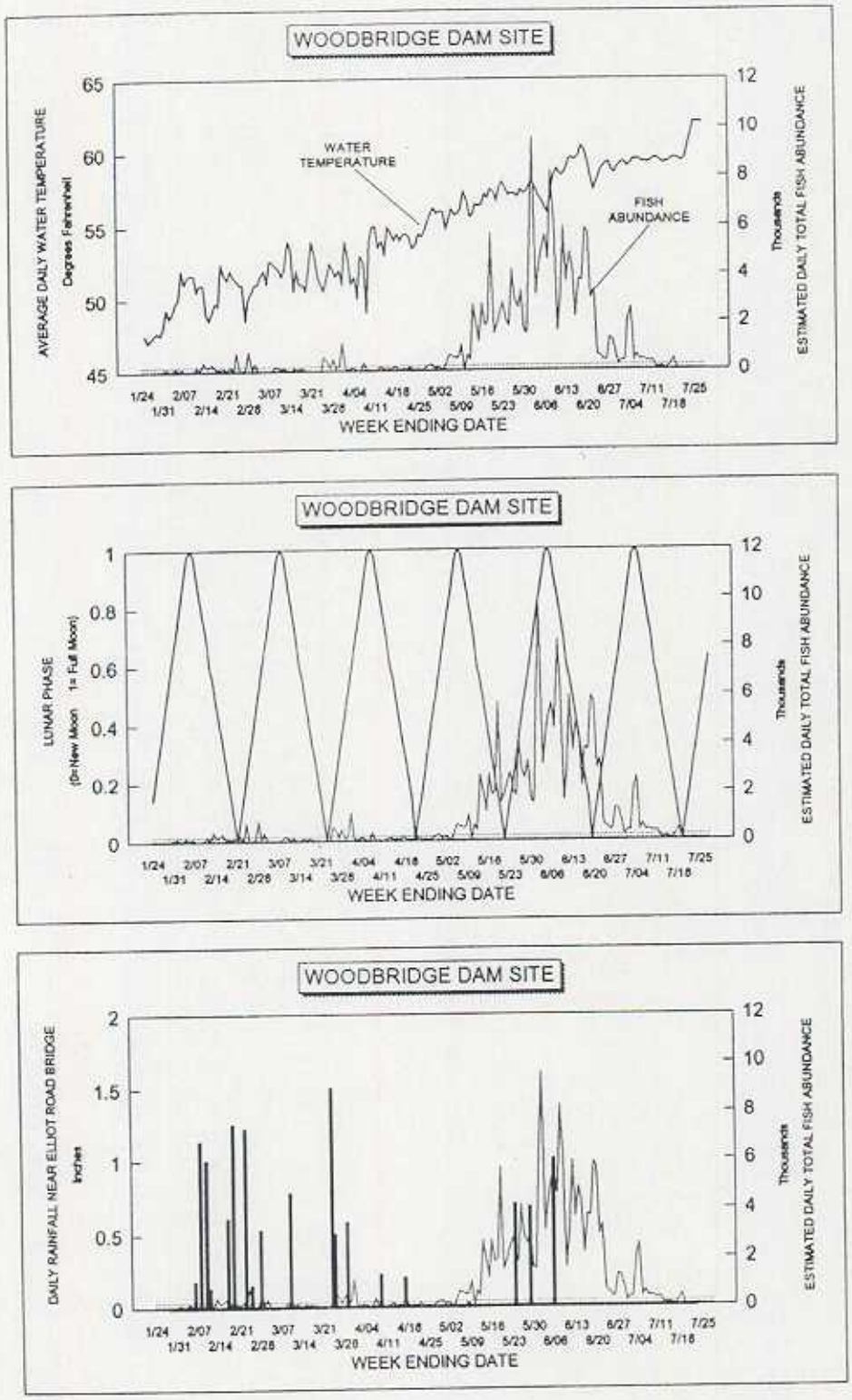


Figure 20. Comparison of Estimated Daily Total Abundance of Young-of-Year Chinook Salmon Passing Woodbridge Dam with Daily Water Temperatures, Lunar Phase and Rainfall Measured During January through July 1993.

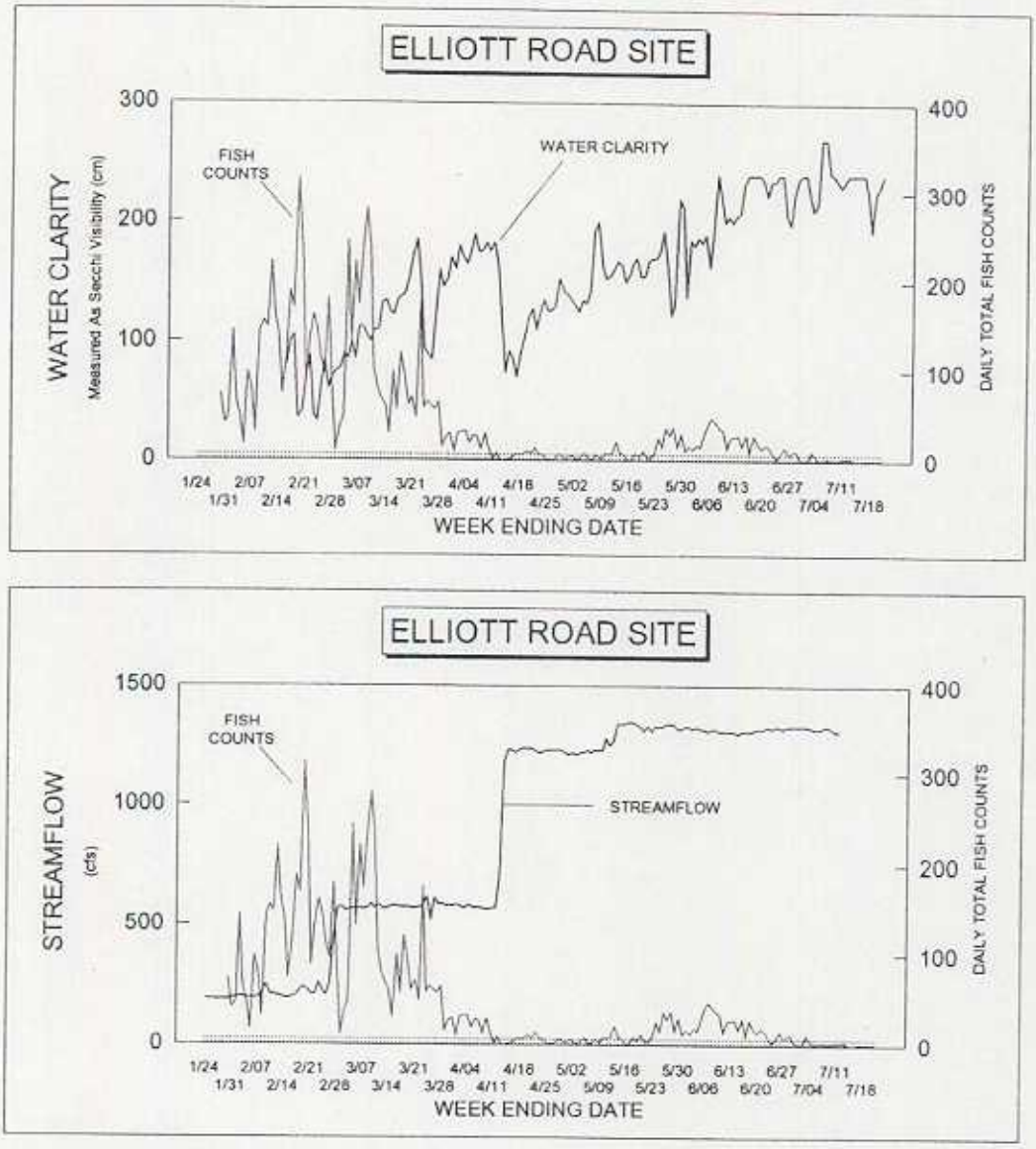


Figure 21. Comparison of Daily Total Counts of Young-of-Year Chinook Salmon Passing the Elliott Road Trap Site (not expanded for estimated abundance) with Water Clarity (measured as Secchi visibility) and Streamflow (Camanche Dam outflow) During January through July 1993.

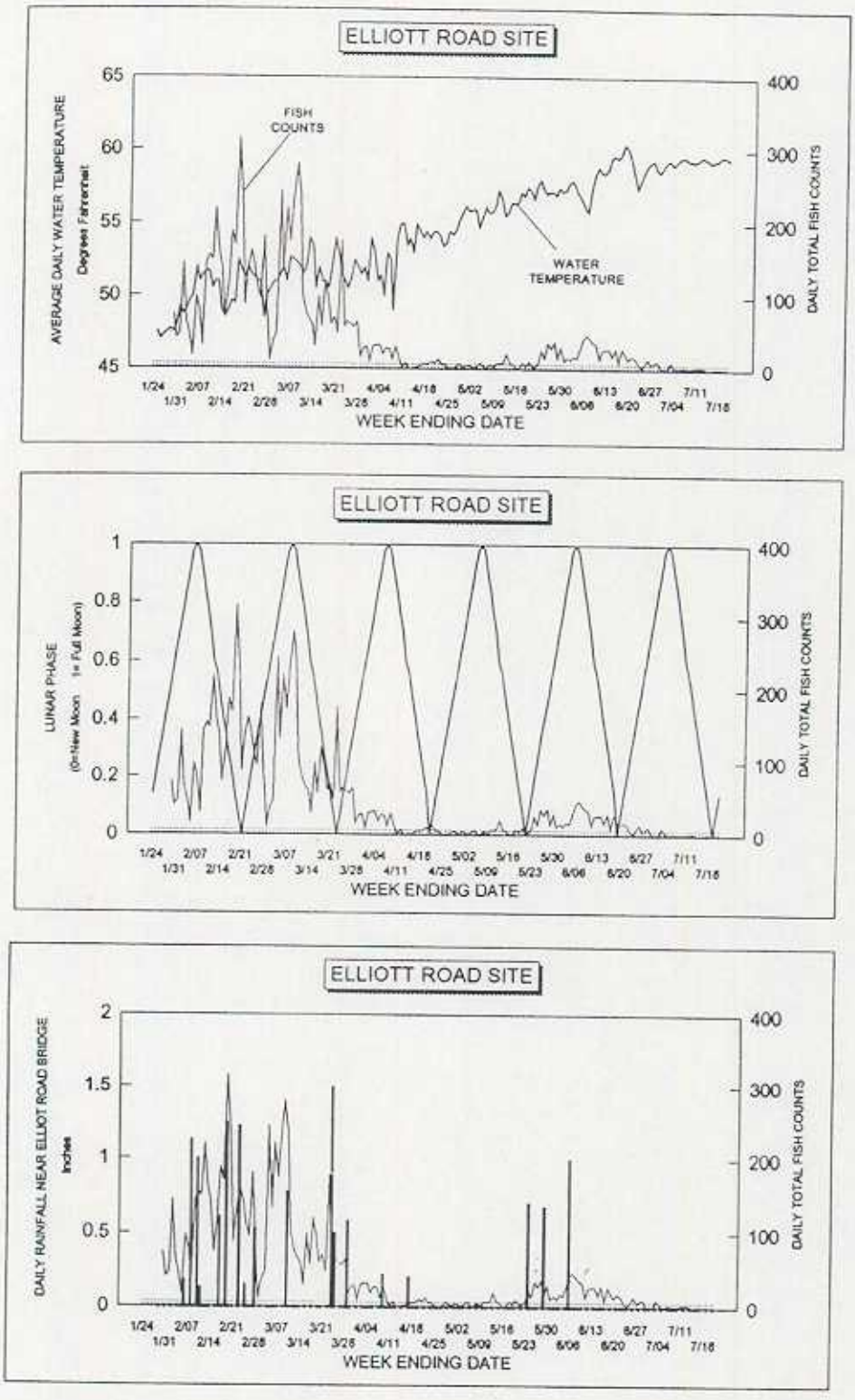


Figure 22. Comparison of Daily Total Counts of Young-of-Year Chinook Salmon Passing the Elliott Road Trap Site (not expanded for estimated abundance) with Daily Water Temperatures, Lunar Phase and Rainfall Measured During January through July 1993.

Comparison of Juvenile Salmonid Downstream Migration During 1990-1993

Monitoring of juvenile salmon outmigration in the Mokelumne River was conducted during the spring of 1990, 1991, and 1992. The purposes for this monitoring were to determine the age, size and physical condition of the migrants and to identify the environmental variables influencing the migration patterns (Bianchi *et al.* 1992). Unlike the monitoring conducted during 1993, prior years monitoring of outmigration at Woodbridge Dam relied on downstream migrant traps installed in the two fishways (due to lower flow conditions). Because the monitoring methodologies were not the same, direct comparisons of some data between years is not possible. However, there are some useful comparisons between years which may be made.

During diel sampling conducted during 1993 a migratory response during the crepuscular periods was observed. This crepuscular response pattern was also observed in 1990, 1991, and 1992 by Bianchi *et al.* (1992) in that the greatest movement was seen during the morning twilight hours; however, they did not notice any potential effect of temperature. Their results may have also been affected by conditions at the WID fish screens (Vogel 1992). The 1990 to 1992 studies were all conducted in the month of May when daily water temperature fluctuations were not more than 1.5°C and the influence of temperature may not be as acute. In fact, Greenstreet (1992) proposed a hierarchy of environmental cues eliciting migration of Atlantic salmon (*Salmo salar*) smolts down release ladders as spate (rain storm) > light intensity > water temperature. This hierarchy may be dynamic as critical thresholds for each of these factors may interact in eliciting migrational behavior of smolting salmonids.

The timing of smolt emigration past Woodbridge Dam during 1993 was similar to that observed in 1990 but dissimilar to migration observed during 1991 and 1992 (Figure 23). In both 1990 and 1993, the peak emigration of smolts occurred during early June through mid June whereas in 1991 and 1992, the greatest majority of fish had migrated past Woodbridge Dam prior to June 1 (Figure 23). River flows during 1990 - 1992 were substantially lower during the principal migratory period than the river flow during the spring of 1993. Based on graphical presentations of their data, it appears that water temperatures recorded in 1991 and 1992 at Woodbridge Dam were approximately 1 to 2 degrees Fahrenheit higher during comparable periods in 1993 which may account for some of the differences in migration timing between years. Water temperature data for 1990 were not available for direct comparison with 1993.

The total number of young salmon estimated to have past Woodbridge Dam during April through July was substantially greater than during a similar time period in 1990, 1991, and 1992. Based on abundance index estimates in 1993, 175,522 salmon emigrated past Woodbridge Dam during April through July whereas only 78,179, 31,025, and 69,993 salmon were capture during a similar period in 1990, 1991, and 1992, respectively. Caution should be used in direct comparisons between years because of differences in sampling methods.

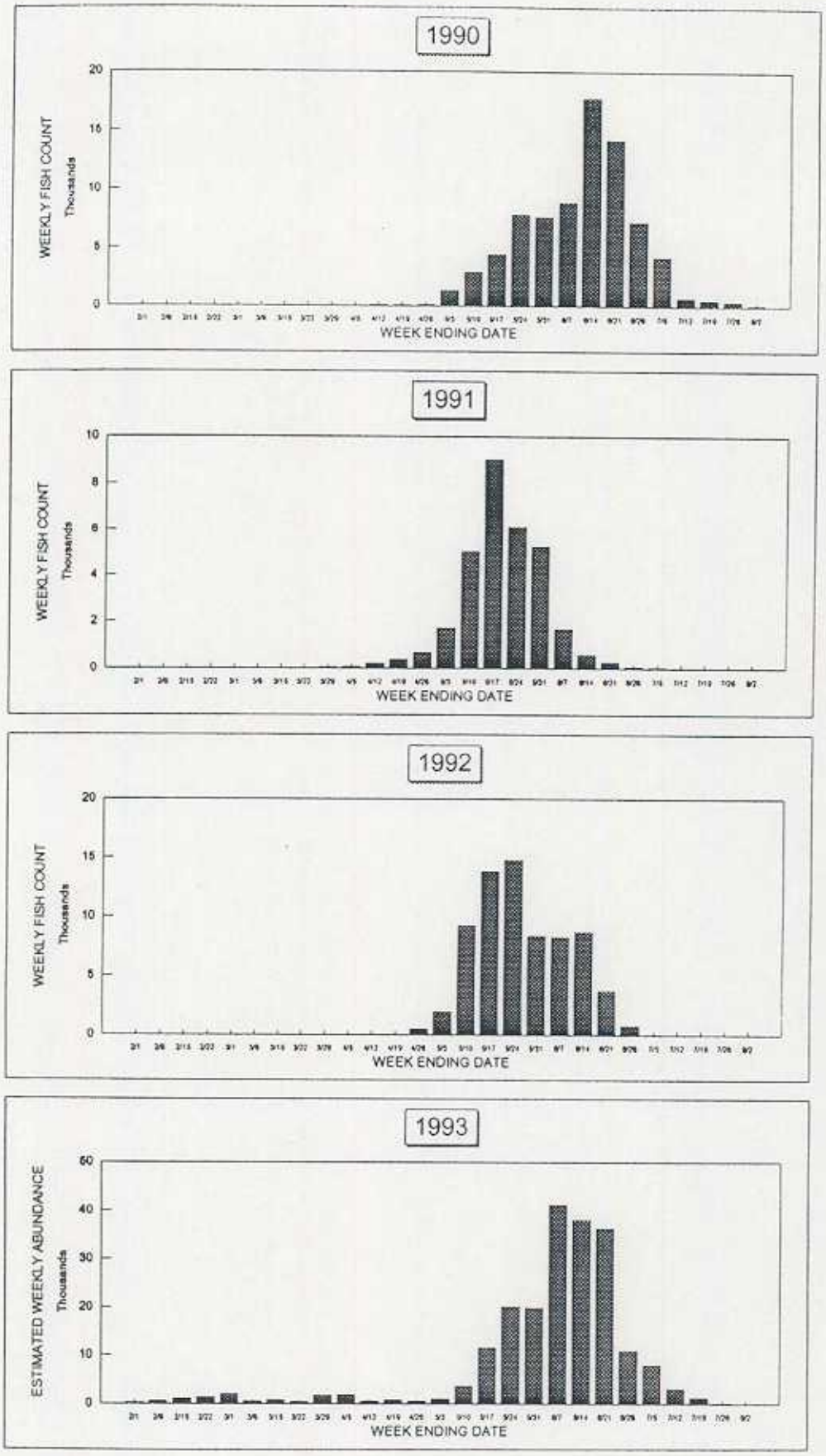


Figure 23. Comparison of Weekly Counts of Downstream Migrant Chinook Salmon at Woodbridge Dam for 1990, 1991 and 1992 with Weekly Abundance of Young Chinook Salmon at Woodbridge Dam for 1993.

Assessment of Physical Injury of Juvenile Chinook Salmon Passing Woodbridge Dam

Fourteen tests on potential physical injury to young chinook salmon passing over Woodbridge Dam were performed during April 8 and 9, and June 10 and 11, 1993. Of the 22 spill bays on Woodbridge Dam (Figure 4), tests were conducted in bay numbers 5, 7, 8, 9, 14, and 15. Results of these tests are given in Table 9. Two of the 14 tests did not show any measurable difference between mortalities observed in control and experimental groups of fish. Twelve of the 14 tests showed a higher mortality in experimental groups of fish as compared to control groups of fish.

Although there was an evident trend in mortality among those fish passing over Woodbridge Dam (as compared to control fish), we performed analyses of the data to determine if the levels of mortality were statistically significant. Our null hypothesis tested was that there would be no significant differences in the proportion of dead to live fish in comparable control and experimental groups of fish after seven days. We treated each comparison of mortality in control and experimental groups of fish independent from other tests (*i.e.*, data were not pooled).

As stated earlier, fish were not enumerated prior to release to minimize handling stress and potential physical injury attributable to handling. Although attempts were made to approximate densities of comparable experimental and control groups of fish during the seven-day monitoring period (to minimize potential density-dependent differences in mortality), it was not possible to ensure that the numbers of fish within test groups would be identical. This was considered as a preferable alternative to risks associated with the potential for physical injuries from handling the fish which could have confounded results from the tests. Examination of test results revealed that there was no apparent relationship of mortalities in control or experimental groups of fish and densities in their respective groups. On an overall basis, 12 mortalities occurred among 1,862 control fish held for observation over seven days (0.6 percent average mortality). One hundred-twenty-two mortalities occurred among 1,980 experimental fish held for observation over seven days (6.2 percent average mortality). These results supported our hypothesis that relatively small differences between fish densities in the live cars would not significantly influence study results.

Fifty-seven percent of the mortalities observed in the experimental groups of fish occurred within the first three days following test releases. This same percentage was evident for all 14 groups combined as well as those eight tests where statistically significant differences (discussed below) in mortalities were observed. Following the first three days, there was a general trend of reduced mortalities among experimental fish during the middle of the seven-day monitoring period and an increased level of mortality toward the end of the seven-day monitoring period. The level of mortality among control fish was too low to note any significant trends.

Table 9. Results of Physical Injury Tests Conducted on Juvenile Chinook Salmon at Woodbridge Dam During the Spring of 1993.

TEST GROUP	BAY # FROM LEFT SIDE FACING D/S	TEST DATE	APPROX. # OF FISH RELEASED	# OF FISH CAPTURED	CUMULATIVE MORTALITY (NUMBER OF FISH) FOLLOWING RECAPTURE							TOTAL # OF DEAD FISH	TOTAL # OF LIVE FISH	MEAN FL DEAD FISH (mm)	MEAN FL LIVE FISH (mm)	MORTALITY (%)	ADJ. DIFF. MORTALITY (%)
					1 DAY	2 DAYS	3 DAYS	4 DAYS	5 DAYS	6 DAYS	7 DAYS						
1A-EXPERIMENTAL 1B-CONTROL	8	4/8/93	500 100	63 99	0 0	0 0	0 0	0 0	2 0	0 0	0 0	2 0	61 99	68 –	68 73	3.2 0.0	3.2
2A-EXPERIMENTAL 2B-CONTROL	8	4/8/93	500 100	85 96	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	85 96	– –	69 71	0.0 0.0	0.0
3A-EXPERIMENTAL 3B-CONTROL	7	4/8/93	200 80	75 39	1 1	0 0	0 0	0 0	1 0	0 0	0 0	2 1	73 38	74 72	73 71	2.7 2.6	0.1
4A-EXPERIMENTAL 4B-CONTROL	9	4/9/93	500 100	57 122	0 0	0 0	0 0	0 0	0 0	2 1	0 0	2 1	55 121	73 66	72 73	3.5 0.8	2.7
5A-EXPERIMENTAL 5B-CONTROL	9	4/9/93	500 100	51 140	0 0	0 0	0 0	1 1	0 0	4 0	1 0	6 1	45 139	68 63	72 73	11.8 0.7	11.1
6A-EXPERIMENTAL 6B-CONTROL	5	4/9/93	375 100	68 96	0 0	0 0	0 0	0 0	0 0	1 3	0 2	1 5	67 91	80 72	70 73	1.5 5.2	(-3.7)
7A-EXPERIMENTAL 7B-CONTROL	15	6/10/93	1000 150	171 146	0 0	2 0	4 0	2 0	1 0	0 0	1 0	10 0	161 146	96 –	97 98	5.8 0.0	5.8
8A-EXPERIMENTAL 8B-CONTROL	15	6/10/93	1000 150	214 170	0 0	2 0	3 0	0 0	0 0	0 0	0 0	5 0	209 170	88 –	96 95	2.3 0.0	2.3
9A-EXPERIMENTAL 9B-CONTROL	15	6/10/93	1000 150	236 166	0 0	2 0	4 0	0 0	0 0	1 1	10 0	17 1	219 165	95 82	93 93	7.2 0.6	6.6
10A-EXPERIMENTAL 10B-CONTROL	15	6/10/93	1000 150	199 197	0 0	0 0	11 0	0 0	0 0	0 0	0 0	11 0	188 197	90 –	90 92	5.5 0.0	5.5
11A-EXPERIMENTAL 11B-CONTROL	14	6/11/93	1000 150	177 108	3 0	4 0	0 0	1 0	1 0	3 1	5 1	17 2	160 106	88 86	95 95	9.6 1.9	7.7
12A-EXPERIMENTAL 12B-CONTROL	14	6/11/93	1000 150	166 165	0 0	6 0	0 0	0 0	2 0	0 0	3 0	11 0	155 165	79 –	93 89	6.6 0.0	6.6
13A-EXPERIMENTAL 13B-CONTROL	14	6/11/93	1000 150	191 167	10 0	5 0	0 0	0 0	0 0	0 0	3 0	18 0	173 167	84 –	91 90	9.4 0.0	9.4
14A-EXPERIMENTAL 14B-CONTROL	14	6/11/93	1000 200	227 151	5 0	7 0	0 0	0 0	2 1	2 0	4 0	20 1	207 150	90 83	90 91	8.8 0.7	8.1

To test if there was a statistically significant difference (P<0.05) in the proportion of dead and live fish in each group, the Pearson chi-square statistical test for independence was used which is also a test for the equality of proportions (Wilkinson *et al.* 1992). However, the very low mortalities observed among control groups of fish resulted in sparse data for statistical comparisons which can cause tests and measures to be suspect. We therefore chose the more conservative statistical tests of Fisher's exact test and Yates' corrected chi-square test which can be more appropriately used for small samples (Wilkinson *et al.* 1992). Results of these tests are given in Table 10. Eight of the 14 fish release tests demonstrated highly significant differences in the proportion of dead fish in experimental releases over the dam as compared to their corresponding control groups. Although four of the remaining six tests also exhibited higher mortalities among experimental fish, the results for those tests were not statistically significant.

Table 10. Statistical Significance of Results from Fish Physical Injury Tests Conducted at Woodbridge Dam. Tests Showing a Significant Difference (P<0.05) Between Mortality in Experimental and Control Groups of Fish are Shown in Bold, Italicized Letters.

Test Number	Pearson's Chi-Square and Probability	Fisher's Exact Test Probability	Yates Corrected Chi-Square and Probability
1	3.182, P=0.074	0.150	1.111, P=0.292
2	N.A.	N.A.	N.A.
3	0.001, P=0.974	1.000	0.000, P=1.000
4	1.705, P=0.192	0.238	0.463, P=0.496
5	***12.929, P<0.0005***	***0.002***	***9.989, P=0.002***
6	N.A.	N.A.	N.A.
7	***8.816, P=0.003***	***0.002***	***7.006, P=0.008***
8	***4.024, P=0.045***	0.069	2.412, P=0.120
9	***9.928, P=0.002***	***0.001***	***8.445, P=0.004***
10	***11.201, P=0.001***	***0.001***	***9.247, P=0.002***
11	***6.479, P=0.011***	***0.013***	***5.293, P=0.021***
12	***11.310, P=0.001***	***0.001***	***9.341, P=0.002***
13	***16.571, P<0.0005***	***<0.0005***	***14.657, P<0.005***
14	***11.465, P=0.001***	***<0.0005***	***9.974, P=0.002***

Factors potentially influencing young salmon passing over the top of Woodbridge Dam and through the riprap immediately downstream of the dam are varied and complex. Most of the 22 spill bays on the dam are somewhat different in their physical and hydraulic configurations. The physical and hydraulic conditions fish are exposed to during their passage through or over the riprap downstream of each spill bay are dramatically different between bays. This latter circumstance is attributable to the non-uniform size, irregular shape, configuration, and distribution of the riprap material (mostly varying sizes of broken-up concrete) downstream of each spill bay. It would be very difficult to quantify those specific differences between spill bays because of the highly circuitous routes fish may pass over or through the riprap material. The river flows and elevation of Lake Lodi during the June fish releases were higher than during the tests conducted during May (Table 11). It was originally hypothesized that increased flows over the dam may reduce adverse conditions for fish by raising the dam's tailwater which causes partial inundation of the riprap material. However, it was noted that, even during high flows past the dam, a substantial amount of riprap material was not covered by the tailwater. Increased Lake Lodi water surface elevations caused a slightly greater fall for salmon passing over the top of the stoplogs in Woodbridge Dam which may partially explain the observed higher levels of mortality. Additional tests are planned during the spring of 1994 which may provide further insight into potential sources of mortality.

Table 11. Parameters Relevant to Physical Injury Tests Conducted on Young Chinook Salmon at Woodbridge Dam During the Spring of 1993.

Date	Camanche Dam Release	Flow past Woodbridge Dam	Lake Lodi Elevation	Water Temperature
April 8, 1993	567 cfs	457 cfs	39.03 feet	49 °F
April 9, 1993	565 cfs	433 cfs	38.98 feet	54 °F
June 10, 1993	1310 cfs	1020 cfs	39.80 feet	59 °F
June 11, 1993	1310 cfs	1010 cfs	39.78 feet	58 °F

Assessment of Survival of Juvenile Chinook Salmon Migrating Through the Sacramento-San Joaquin Delta During the Spring of 1993.

MRFH Chinook Salmon

Table 12 gives the release and recovery data for the 200,000 hatchery fall-run chinook salmon coded-wire tagged at MRFH and released during the spring of 1993. Table 13 gives specific release data for each of the tag groups.

Table 12. Release and Recovery Information for Four Groups of Mokelumne River Fish Hatchery Coded-Wire Tagged Juvenile Fall-Run Chinook Salmon Captured at the Chipps Island USFWS Trawling Station, Spring 1993.

Tag Code	Release Date	Number of Fish Tagged	Date of First Catch	Date of Last Catch	Number of Fish Recovered	Days at Large	Minutes Sampled	Fraction of Time Sampled	Estimated Survival
6-63-41	5-6-93	50,402	5-13-93	5-27-93	15	15	3,000	0.138889	0.278560
6-63-42	5-6-93	50,038	5-14-93	6-4-93	13	22	4,200	0.132576	0.254754
6-63-43	5-20-93	49,542	5-28-93	6-2-93	4	6	1,000	0.115741	0.090686
6-63-44	5-20-93	49,719	5-27-93	6-2-93	6	7	1,200	0.119048	0.131780

The USFWS formula for calculating estimated fish survival based on recoveries of tagged fish in trawling samples collected by the USFWS near Chipps Island is as follows.

Estimated Survival = R / [(M) (30 feet / 3900 feet) (Proportion of Time Sampled)]

where R = number of tagged fish recovered and M = number of fish tagged (Mark Pierce, USFWS, Stockton, pers. comm.). A calculated value of 1 would represent 100 percent survival.

Table 13. Coded-Wire Tag Release Information for Mokelumne River Fall-Run Chinook Salmon, Spring 1993.

Code ID	Egg Lot No.	Brood Year	Release Location	Date Released		Rearing Type	Purpose	Total No. Tagged	Estimated Mortalities Prior to Release	No. Tagged Fish Released[1/]	Quality Control Days	No./lb. at Release	Avg. Length in FL (mm)	Rearing Location	Stock of Release Group
				First	Last										
6-63-41 *	5	1992	New Hope Landing-Mok. R.	5/6/93	5/6/93	Hatchery	Delta Mortality Estimate	52,367	225	50,402	18-until chk 20-until rel.	94	78 N=300	Mokelumne River Fish Facility	Feather River
6-63-42 *	5	1992	New Hope Landing-Mok. R.	5/6/93	5/6/93	Hatchery	Delta Mortality Estimate	51,990	224	50,038	18-until chk 20-until rel.	94	78	Mokelumne River Fish Facility	Feather River
6-63-43 **	5	1992	New Hope Landing-Mok. R.	5/20/93	5/20/93	Hatchery	Delta Mortality Estimate	51,798	199	49,542	13-until chk 29-until rel.	64	87 N=156	Mokelumne River Fish Facility	Feather River
6-63-44 **	5	1992	New Hope Landing-Mok. R.	5/20/93	5/20/93	Hatchery	Delta Mortality Estimate	51,983	200	49,719	13-until chk 29-until rel.	64	87	Mokelumne River Fish Facility	Feather River
6-63-45	Wild	1992	Woodbridge Dam	5/5/93	6/7/93	Wild	Survival & Contrib.	9,254	0/60=0	9,254	8-10[2/]	53.5[3/]	95.7 N=3,310	Mokelumne River Wild	Mokelumne River Wild
6-63-46	Wild	1992	Woodbridge Dam	6/8/93	7/28/93	Wild	Survival & Contrib.	8,260	0/87=0	8,260	7[2/]	44.1[3/]	97.9 N=2,387	Mokelumne River Wild	Mokelumne River Wild

* These groups were accidentally mixed prior to trucking and tag shed check . 6-63-41 and 6-63-42 treated as a single composite group with regard to tag shedding, mortality and size.

** Tag groups 6-63-43 and 6-63-44 were combined (as a result of mixing of tag groups 6-63-41 and 6-63-42) and treated as a single composite group with regard to tag shedding, mortality and size.

1/ Adjusted for estimated shed tags and pre-release mortality.

2/ Quality control based on two holding periods. Only small sample sizes kept for these checks.

3/ Average size for entire time interval over which tag code was used.

For all tagged groups released, recoveries by the USFWS at their Chipps Island trawling station and their estimated survival rates were very low. Similarly low recovery rates on prior year's MRFH coded-wire tagged fall-run chinook were also evident (Bianchi *et al.* 1992). Water exports from the Delta were substantially higher during and following the release of the late May fish release (approximately 4,000 - 6,000 cfs) than water exports during the early May release (<1,800 cfs) (Appendix 8). If the estimated survival rates for each tagged group accurately reflect overall survival for each group, the high export rates may partially explain the lower survival for the late May release group. However, because the numbers of tagged fish recovered for all tagged groups were very small, we do not believe that specific conclusions can be derived from these data at this time. Tag recoveries in the ocean sport and commercial fisheries and in adult fish returning to the river systems during the next two to four years will provide better information concerning the tagged fish released during 1993.

Wild Chinook Salmon Smolts Coded-Wire Tagged at Woodbridge Dam

Appendix 1 provides a daily record of the numbers of wild fall chinook salmon smolts captured and coded-wire tagged at Woodbridge Dam. Additional relevant data are provided in Table 13. Tagging was initiated on May 5, 1993 when a dramatic increase in the numbers of smolt-sized salmon (>50 mm TL) was observed in the traps. Two tag codes were used during the season. These two codes were allocated to essentially the first and second halves of the total migration of smolts as follows:

Dates of Application	Tag Code	Nos. Tagged	Avg. Size of Fish
5/5/93 to 6/7/93	06-63-45	9,254	106 mm TL
6/8/93 to 7/28/93	06-63-46	8,260	108 mm TL

No tag shedding or latent mortality was observed in the samples of fish retained for tagging quality control. Two samples of 25 to 50 fish were held for 7 to 10 days during each of the two tag code periods. Tagging reports with all the preceding information was submitted to CDFG during August 1993.

None of these tagged wild chinook salmon were captured by the USFWS at their trawling station near Chipps Island (Mark Pierce, USFWS, Stockton, pers. comm.). Because the numbers released were relatively small, no inferences can be made at to survival rates for these fish migrating through the Delta. As discussed for the MRFH hatchery coded-wire salmon, tag recoveries in the ocean sport and commercial fisheries and in adult fish returning to the river systems are expected to provide better information concerning these two groups of fish.

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APPENDICES

APPENDIX 1
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Daily Abundance at the Woodbridge Dam Trap Site

	Fall Chinook Salmon									Steelhead/Rainbow Trout						Trap Effort (hours fished) /1		
	YOY						Yearlings			YOY			1+			Over		
DATE	Night Counts	Diurnal Counts	Total Counts	Trap Mortalities	Number Tagged	Predation Injuries	Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Night Effort	Diurnal Effort	Total Effort
01-Jan-93																		
02-Jan-93																		
03-Jan-93																		
04-Jan-93																		
05-Jan-93																		
06-Jan-93																		
07-Jan-93																		
08-Jan-93																		
09-Jan-93																		
10-Jan-93																		
11-Jan-93																		
12-Jan-93																		
13-Jan-93																		
14-Jan-93																		
15-Jan-93																		
16-Jan-93																		
17-Jan-93																		
18-Jan-93																		
19-Jan-93	0	0	0				0	0	0	0	0	0	0	0	0		5.7	5.7
20-Jan-93	0	0	0				0	0	0	0	0	0	0	0	0	14.8	8.7	23.5
21-Jan-93	0	0	0				0	0	0	0	0	0	0	0	0	14.7	8.4	23.1
22-Jan-93	0	0	0				0	0	0	0	0	0	0	0	0	14.5	8.5	23
23-Jan-93	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0
24-Jan-93	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0
25-Jan-93	0	0	0				0	0	0	0	0	0	0	0	0	0	8.7	8.7
26-Jan-93	0	0	0				0	6	6	0	0	0	0	0	0	14.7	8.5	23.2
27-Jan-93	0	0	0				6	1	7	0	0	0	0	0	0	14.2	9	23.2
28-Jan-93	0	0	0				15	2	17	0	0	0	0	0	0	14.7	8.7	23.4
29-Jan-93	0	0	0				27	1	28	0	0	0	0	0	0	14.7	8.5	23.2
30-Jan-93	1	0	1				15	1	16	0	0	0	0	0	0	15	9	24
31-Jan-93	2	0	2				6	0	6	0	0	0	0	0	0	14.5	8	22.5
01-Feb-93	3	1	4				0	0	0	0	0	0	0	0	0	15	8.5	23.5
02-Feb-93	1	0	1				0	1	1	0	0	0	0	0	0	14.5	9.5	24
03-Feb-93	1	0	1				0	0	0	0	0	0	0	0	0	14.5	9.5	24
04-Feb-93	6	0	6				3	0	3	0	0	0	0	0	0	14.5	10.5	25
05-Feb-93	1	0	1				0	0	0	0	0	0	0	0	0	13	9.5	22.5
06-Feb-93	5	0	5				0	2	2	0	0	0	0	0	0	15	9	24
07-Feb-93	0	0	0				0	0	0	0	0	0	0	0	0	15	9	24
08-Feb-93	0	0	0				0	0	0	0	0	0	0	0	0	15.5	8	23.5
09-Feb-93	0	0	0				0	1	1	0	0	0	0	0	0	16	9	25
10-Feb-93	0	1	1				0	0	0	0	0	0	0	0	0	14.5	9.5	24
11-Feb-93	8	0	8				0	0	0	0	0	0	0	0	0	15	8.5	23.5
12-Feb-93	0	0	0				0	0	0	0	0	0	0	0	0	15.5	8.5	24
13-Feb-93	13	0	13				0	0	0	0	0	0	0	1	1	15.5	8.5	24
14-Feb-93	5	1	6				0	0	0	0	0	0	0	0	0	15.5	8.5	24
15-Feb-93	7	0	7				3	1	4	0	0	0	0	0	0	15.5	9	24.5
16-Feb-93	11	0	11				0	0	0	0	0	0	0	0	0	15	9	24
17-Feb-93	3	0	3				0	0	0	0	0	0	0	0	0	15	8.5	23.5
18-Feb-93	4	0	4				0	0	0	0	0	0	0	0	0	15.5	8.5	24
19-Feb-93	3	0	3				0	0	0	0	0	0	0	0	0	15.5	8.5	24
20-Feb-93	3	2	5				0	5	5	0	0	0	0	0	0	15	9.5	24.5
21-Feb-93	2	0	2				4	2	6	0	0	0	0	0	0	15.5	8	23.5
22-Feb-93	8	0	8				0	0	0	0	0	0	0	1	1	15.5	0.72	15.5
23-Feb-93	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0 /2
24-Feb-93	25	0	25				0	0	0	0	0	0	0	0	0	15.5	3	18.5
25-Feb-93	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0 /2
26-Feb-93	1	0	1				0	0	0	0	0	0	0	0	0	0	0	0 /2
27-Feb-93	2	1	3				0	0	0	0	0	0	0	0	0	15.5	7.5	23
28-Feb-93	25	2	27				0	0	0	0	0	0	0	0	0	16.5	8	24.5
01-Mar-93	2	0	2				1	0	1	0	0	0	0	0	0	16	8.5	24.5
02-Mar-93	11	1	12				0	0	0	0	0	0	0	0	0	15.5	8	23.5
03-Mar-93	0	0	0				0	0	0	0	0	0	0	0	0	16	9	25
04-Mar-93	1	0	1				0	0	0	0	0	0	0	0	0	15	8.5	23.5
05-Mar-93	0	1	1				0	0	0	0	0	0	0	0	0	16	8.5	24.5
06-Mar-93	0	0	0				0	0	0	0	0	0	0	0	0	15	8.5	23.5
07-Mar-93	0	0	0				0	0	0	0	0	0	0	0	0	15.5	8	23.5
08-Mar-93	0	2	2				0	0	0	0	0	0	0	0	0	16	8.5	24.5
09-Mar-93	2	5	7				0	0	0	0	0	0	0	0	0	15.5	8.5	24
10-Mar-93	4	0	4				0	0	0	0	0	0	0	0	0	15.5	8	23.5
11-Mar-93	3	0	3				0	0	0	0	0	0	0	0	0	16	8.5	24.5
12-Mar-93	2	3	5				0	0	0	0	0	0	0	0	0	15	9	24
13-Mar-93	1	0	1				0	0	0	0	0	0	0	0	0	15.5	8	23.5
14-Mar-93	0	0	0				0	0	0	0	0	0	0	0	0	16	8	24
15-Mar-93	2	3	5				0	0	0	0	0	0	0	0	0	16	8.5	22.5
16-Mar-93	2	0	2				0	0	0	0	0	0	0	0	0	17.5	8	25.5
17-Mar-93	3	1	4				0	0	0	0	0	0	0	0	0	16	8.5	24.5
18-Mar-93	0	3	3				0	0	0	0	0	0	0	0	0	15	9.5	24.5
19-Mar-93	1	0	1				0	0	0	0	0	0	0	0	0	13.5	10	23.5
20-Mar-93	1	0	1				0	0	0	0	0	0	0	0	0	15	8	23
21-Mar-93	0	0	0				1	0	1	0	0	0	0	0	0	16	8.5	22.5
22-Mar-93	0	0	0				0	0	0	0	0	0	0	0	0	17.5	8.5	26
23-Mar-93	0	0	0				0	0	0	0	0	0	0	0	0	15.5	9	24.5
24-Mar-93	0	0	0				0	0	0	0	0	0	0	0	0	15.5	7.5	23
25-Mar-93	19	0	19				1	0	1	0	0	0	0	0	0	16	8	24

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	Fall Chinook Salmon										Steelhead/Rainbow Trout						Trap Effort (hours fished) (1)		
	YOY						Yearlings				YOY			1+			Over		
DATE	Night Counts	Diurnal Counts	Total Counts	Trap Mortalities	Number Tagged	Predation Injuries	Night Counts	Diurnal Counts	Total Counts		Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Night Effort	Diurnal Effort	Total Effort
26-Mar-93	10	4	14				0	0	0		0	0	0	0	0	0	15	9.5	24.5
27-Mar-93	5	0	5				0	0	0		0	0	0	0	0	0	15.5	8	23.5
28-Mar-93	16	0	16				0	0	0		0	0	0	0	0	0	16	7.5	23.5
29-Mar-93	3	0	3				0	0	0		0	0	0	0	0	0	16	9	25
30-Mar-93	7	0	7				0	0	0		0	0	0	0	0	0	15.5	8	23.5
31-Mar-93	38	0	38				0	0	0		0	0	0	0	0	0	17.5	0 /3	17.5
01-Apr-93	13	0	13				1	0	1		0	0	0	0	0	0	15	-	15
02-Apr-93	4	1	5				0	0	0		0	0	0	0	0	0	20	6	26
03-Apr-93	14	1	15	1			0	0	0		0	0	0	0	0	0	16.5	6.5	23
04-Apr-93	11	4	15	1			0	0	0		0	0	0	0	0	0	17.5	7.5	25
05-Apr-93	0	2	2	0			0	0	0		0	0	0	0	0	0	16.8	2.3 /6	19.1
06-Apr-93	1	0	1	0			0	0	0		0	0	0	0	0	0	16.5	8	24.5
07-Apr-93	36	6	42	3			0	0	0		1	0	1	0	0	0	15.5	8.5	24
08-Apr-93	0	0	0	0			0	0	0		0	0	0	0	0	0	0	0	0 /4
09-Apr-93	5	0	5	0			0	0	0		0	0	0	0	0	0	15.5	0 /4	15.5
10-Apr-93	0	2	2	1			0	0	0		0	0	0	1	0	1	18	7	25
11-Apr-93	0	0	0	0			1	0	1		0	0	0	0	0	0	12	8	20
12-Apr-93	11	0	11	0			1	0	1		0	0	0	0	0	0	16	7.5	23.5
13-Apr-93	15	4	19	0			0	2	2		0	0	0	0	0	0	16	7.5	23.5
14-Apr-93	5	0	5	4			4	0	4		0	0	0	0	0	0	21	0 /5	21
15-Apr-93	10	0	10	0			2	0	2		0	0	0	0	0	0	21	0 /5	21
16-Apr-93	7	1	8	1			0	0	0		0	0	0	0	0	0	24.5	4.5	29
17-Apr-93	19	2	21	0			0	0	0		0	0	0	1	1	2	16	11	27
18-Apr-93	8	3	11	0			5	0	5		0	0	0	0	0	0	14	10	24
19-Apr-93	2	1	3	0			1	1	2		0	0	0	0	1	1	14.5	7.5	22
20-Apr-93	9	1	10	4			4	0	4		0	0	0	0	0	0	17	7	24
21-Apr-93	4	0	4	0			1	3	4		0	0	0	0	0	0	17.2	5.8	23
22-Apr-93	21	0	21	0			0	0	0		0	0	0	0	0	0	16	8	24
23-Apr-93	7	0	7	0			0	0	0		0	0	0	0	0	0	17	7.5	24.5
24-Apr-93	5	0	5	1			0	0	0		0	0	0	0	0	0	15.5	8	23.5
25-Apr-93	8	0	8	0			1	0	1		0	0	0	0	0	0	18	6.5	24.5
26-Apr-93	2	0	2	0			2	0	2		0	0	0	0	0	0	15.5	8.5	24
27-Apr-93	11	1	12	0			1	0	1		0	0	0	0	0	0	15.5	8	23.5
28-Apr-93	16	4	20	0			0	0	0		0	0	0	0	0	0	16	8	24
29-Apr-93	24	4	28	0			0	0	0		0	0	0	0	0	0	16	8.5	24.5
30-Apr-93	10	3	13	0			0	0	0		0	0	0	1	0	1	15.5	8	23.5
01-May-93	17	0	17	0			0	0	0		0	0	0	0	0	0	16	10.5	26.5
02-May-93	12	2	14	4			0	0	0		0	0	0	0	0	0	13	11	24
03-May-93	1	0	1	1			0	0	0		0	0	0	0	0	0	15.8	6.2	22
04-May-93	25	8	33	0			0	0	0		0	0	0	0	0	0	17	7	24
05-May-93	61	7	68	0	67		0	0	0		0	0	0	0	0	0	17.5	6.5	24
06-May-93	57	5	62	0	62		0	0	0		0	0	0	0	0	0	15.5	8	23.5
07-May-93	52	2	54	0	54		0	0	0		0	0	0	0	0	0	16	8	24
08-May-93	51	4	55	0	55		0	0	0		0	0	0	0	0	0	18	5.5	23.5
09-May-93	106	6	112	0	112		0	0	0		0	0	0	0	0	0	16.5	8	24.5
10-May-93	0	1	1	0	0		0	0	0		0	0	0	0	0	0	17.5	7	24.5
11-May-93	70	0	70	0	69		0	0	0		0	0	0	0	0	0	15.5	0 /3	15.5
12-May-93	30	15	45	1	44		0	0	0		0	0	0	0	0	0	14	7	21
13-May-93	202	87	289	16	239		0	0	0		0	0	0	0	0	0	17.5	6	23.5
14-May-93	148	58	206	1	204		0	0	0		0	0	0	0	0	0	18	6	24
15-May-93	125	0	125	2	123		0	0	0		0	0	0	0	0	0	17.5	0	17.5
16-May-93	229	63	292	6	286		0	0	0		0	0	0	0	0	0	23.5	7	30.5
17-May-93	121	75	196	0	196		0	0	0		0	0	0	0	0	0	18	6.5	24.5
18-May-93	128	84	212	0	203		0	0	0		0	0	0	0	0	0	17	7	24
19-May-93	171	430	601	3	570	15	0	0	0		0	0	0	0	0	0	15	15	30
20-May-93	92	69	161	6	155	7	0	0	0		0	0	0	0	0	0	12	9	21
21-May-93	125	73	198	0	198	0	0	0	0		0	0	0	0	0	0	16.5	7.5	24
22-May-93	81	169	250	10	228	5	0	0	0		0	0	0	0	0	0	16.5	7	23.5
23-May-93	173	126	299	3	296	8	0	0	0		0	0	0	0	0	0	16	8	24
24-May-93	109	106	215	4	211	10	0	0	0		0	0	0	0	0	0	16.5	8.5	25
25-May-93	25	168	193	0	198	0	0	0	0		0	0	0	0	0	0	17.5 /6	7	24.5
26-May-93	334	109	443	17	426	0	0	0	0		0	0	0	0	0	0	18.5	4.5	23
27-May-93	131	176	307	11	295	7	0	0	0		0	0	0	0	0	0	15.5	7.5	23
28-May-93	149	122	271	4	267	2	0	0	0		0	0	0	0	0	0	17.5	6.5	24
29-May-93	131	217	348	19	329	9	0	0	0		0	0	0	0	0	0	18.5	6.5	25
30-May-93	145	23	168	12	156	13	0	0	0		0	0	0	0	0	0	15.5	8.5	24
31-May-93	75	87	162	3	159	6	0	0	0		0	0	0	0	0	0	16.5	7.5	24
01-Jun-93	401	259	660	2	658	27	0	0	0		0	0	0	0	0	0	16.5	7	23.5
02-Jun-93	424	591	1015	4	1010	71	0	0	0		0	0	0	0	0	0	16	12	28
03-Jun-93	156	174	330	3	327	4	0	0	0		0	0	0	0	0	0	12	9	21
04-Jun-93	317	138	455	3	452	12	0	0	0		1	0	1	0	0	0	15.5	8	23.5
05-Jun-93	354	193	547	8	539	4	0	0	0		1	0	1	0	0	0	17.5	7	24.5
06-Jun-93	472	123	595	7	588	0	0	0	0		1	0	1	0	0	0	16.5	7.5	24
07-Jun-93	325	162	487	9	478	3	0	0	0		0	0	0	0	0	0	17.5	8	25.5
08-Jun-93	635	238	873	11	862	0	0	0	0		1	0	1	0	0	0	17.5	7	24.5
09-Jun-93	514	133	647	5	642	0	0	0	0		0	0	0	0	0	0	17	7	24
10-Jun-93	172	0	172	0	94	0	0	0	0		0	0	0	0	0	0	16	0 /4	16
11-Jun-93	163	146	309	11	302	13	0	0	0		0	0	0	0	0	0	16	4.5	20.5
12-Jun-93	449	182	631	11	620	24	0	0	0		0	0	0	0	0	0	15.5	8.5	24
13-Jun-93	254	134	388	9	379	0	0	0	0		0	0	0	0	0	0	16	6.5	22.5
14-Jun-93	397	123	520	10	510	0	0	0	0		0	0	0	0	0	0	16.5	8	24.5
15-Jun-93	321	138	459	10	449	0	0	0	0		2	0	2	0	0	0	17	7.5	24.5
16-Jun-93	151	83	234	10	224	0	0	0	0		1	0	1	0	0	0	16.5	7	23.5
17-Jun-93	363	41	404	7	398	0	0	0	0		0	0	0	0	0	0	17.5	6.5	24

APPENDIX 1
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Daily Abundance at the Woodbridge Dam Trap Site

	Fall Chinook Salmon										Steelhead/Rainbow Trout						Trap Effort (hours fished) /1		
	YOY						Yearlings				YOY			1+			Over		
DATE	Night Counts	Diurnal Counts	Total Counts	Trap Mortalities	Number Tagged	Predation Injuries	Night Counts	Diurnal Counts	Total Counts		Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Night Effort	Diurnal Effort	Total Effort
18-Jun-93	244	148	392	12	385	3	0	0	0		0	0	0	0	0	0	17	7	24
19-Jun-93	397	228	625	13	612	2	0	0	0		0	0	0	0	0	0	16	8	24
20-Jun-93	478	126	604	9	595	8	0	0	0		0	0	0	0	0	0	16.5	7.5	24
21-Jun-93	294	20	314	10	304	0	0	0	0		0	0	0	1	0	1	17.5	6.5	24
22-Jun-93	321	34	355	45	310	0	0	0	0		0	0	0	0	0	0	17.5	6.5	24
23-Jun-93	82	3	85	2	83	0	0	0	0		0	0	0	0	0	0	17.5	6.5	24
24-Jun-93	56	7	63	0	63	0	0	0	0		2	0	2	0	0	0	17.5	7	24.5
25-Jun-93	31	13	44	0	44	0	0	0	0		0	0	0	0	0	0	17	9	26
26-Jun-93	33	11	44	1	43	0	0	0	0		0	0	0	0	0	0	15	6	21
27-Jun-93	121	18	139	3	121	0	0	0	0		0	0	0	0	0	0	18	6	24
28-Jun-93	124	8	132	3	129	0	0	0	0		1	0	1	0	0	0	18	6	24
29-Jun-93	46	35	81	0	81	0	0	0	0		0	0	0	0	0	0	16	16	32
30-Jun-93	18	2	20	0	20	0	0	0	0		0	0	0	0	0	0	8	8.5	16.5
01-Jul-93	38	4	42	0	42	2	0	0	0		0	0	0	0	0	0	17.5	6	23.5
02-Jul-93	31	7	38	0	38	0	0	0	0		1	0	1	0	0	0	18	5	23
03-Jul-93	209	11	220	2	218	0	0	0	0		0	0	0	0	0	0	18.5	6.5	25
04-Jul-93	257	18	275	3	272	0	0	0	0		0	0	0	0	0	0	18	6	24
05-Jul-93	32	9	41	15	26	0	0	0	0		0	0	0	0	0	0	16.5	7.5	24
06-Jul-93	58	11	69	1	68	2	0	0	0		0	0	0	0	0	0	18	6	24
07-Jul-93	39	3	42	0	42	0	0	0	0		0	0	0	0	0	0	18	6	24
08-Jul-93	40	5	45	0	45	0	0	0	0		0	0	0	0	0	0	18	6	24
09-Jul-93	31	7	38	0	38	0	0	0	0		0	0	0	0	0	0	18	6	24
10-Jul-93	30	7	37	0	37	0	0	0	0		0	0	0	0	0	0	18	6	24
11-Jul-93	37	4	41	0	41	0	0	0	0		0	0	0	0	0	0	18	6	24
12-Jul-93	14	1	15	0	15	0	0	0	0		0	0	0	0	0	0	18	6	24
13-Jul-93	9	0	9	0	9	0	0	0	0		0	0	0	0	0	0	17.5	7	24.5
14-Jul-93	12	4	16	0	16	0	0	0	0		0	0	0	0	0	0	17	7	24
15-Jul-93	3	2	5	0	5	0	0	0	0		0	0	0	0	0	0	15.5	8	23.5
16-Jul-93	8	0	8	0	8	0	0	0	0		0	0	0	0	0	0	16.5	9	25.5
17-Jul-93	12	11	23	0	23	0	0	0	0		0	0	0	0	0	0	15.5	7.5	23
18-Jul-93	47	3	50	0	50	0	0	0	0		0	0	0	0	0	0	17.5	6	23.5
19-Jul-93	5	0	5	0	5	0	0	0	0		0	0	0	0	0	0	18	7	25
20-Jul-93	4	0	4	0	4	1	0	0	0		0	0	0	0	0	0	16.5	7	23.5
21-Jul-93	0	0	0	0	0	0	0	0	0		0	0	0	1	0	1	15.5	8.5	24
22-Jul-93	1	0	1	0	1	0	0	0	0		0	0	0	0	0	0	15.5	8	23.5
23-Jul-93	4	1	5	0	5	0	0	0	0		0	0	0	0	0	0	16.5	7.5	24
24-Jul-93	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	16	7.5	23.5
25-Jul-93	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	17	7.5	24.5
26-Jul-93	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	16.5	8.5	25
27-Jul-93	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	15	9	24
28-Jul-93	2	0	2	0	2	0	0	0	0		0	0	0	0	0	0	15.5	8.5	24
29-Jul-93	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0			
30-Jul-93																			
31-Jul-93																			
01-Aug-93																			
Totals:	**12743**	**5962**	**18725**	**375**	**17514**	**256**	**106**	**29**	**135**		**12**	**0**	**12**	**7**	**2**	**9**			

CWT Subtotals: Tag Code 6-63-45: 9254
Tag Code 6-63-46: 8260

/1 Due to variation in trap tending times, effort may overlap several days resulting in total effort exceeding 24 hours. However, the total effort is the total time interval that trap was fished associated with a day's total fish count.
/2 Fishway repairs; no trapping.
/3 Replaced trap; partial day's trapping effort.
/4 Physical injury studies at WID dam in progress; usurped regular trapping effort.
/5 Flows too high to access trap from shore; longer intervals between trap tending.
/6 Partial interval count; debris interference stopped trap rotation during interval.

APPENDIX 2
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Daily Abundance at the Elliott Road Trap Site

	Fall Chinook Salmon							Steelhead/Rainbow Trout						Trap Effort (hours fished) /1		
	YOY				1+			YOY			1+					
DATE	Night Counts	Diurnal Counts	Total Counts	Trap Mortalities	Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Over Night Effort	Diurnal Effort	Total Effort
01-Jan-93																
02-Jan-93																
03-Jan-93																
04-Jan-93																
05-Jan-93																
06-Jan-93																
07-Jan-93																
08-Jan-93																
09-Jan-93																
10-Jan-93																
11-Jan-93																
12-Jan-93																
13-Jan-93																
14-Jan-93																
15-Jan-93																
16-Jan-93																
17-Jan-93																
18-Jan-93																
19-Jan-93																
20-Jan-93																
21-Jan-93																
22-Jan-93																
23-Jan-93																
24-Jan-93																
25-Jan-93																
26-Jan-93																
27-Jan-93																
28-Jan-93																
29-Jan-93	0	0	0	0	0	0	0	0	0	0	0	0	0		3.5	3.5
30-Jan-93	63	11	74	0	0	0	0	0	0	0	0	0	0	17.5	5	22.5
31-Jan-93	38	3	41	0	0	0	0	0	0	0	0	0	0	17	4	21
01-Feb-93	30	17	47	5	0	0	0	0	0	0	0	2	2	17	7	24
02-Feb-93	76	69	145	10	0	0	0	0	0	0	0	0	0	17	7	24
03-Feb-93	56	9	65	3	0	0	0	0	0	0	2	0	2	17	7	24
04-Feb-93	31	18	49	6	0	0	0	0	0	0	0	0	0	16.5	10	26.5
05-Feb-93	13	4	17	0	0	0	0	0	0	0	1	0	1	13	7.5	20.5
06-Feb-93	95	4	99	0	0	0	0	0	0	0	0	0	0	17	7	24
07-Feb-93	66	16	82	0	0	0	0	0	0	0	1	0	1	17	6	23
08-Feb-93	30	1	31	0	0	0	0	0	0	0	0	0	0	17.5	6	23.5
09-Feb-93	88	56	144	0	0	0	0	0	0	0	3	1	4	18	6.5	24.5
10-Feb-93	131	25	156	3	2	0	2	0	0	0	0	1	1	17	7.5	24.5
11-Feb-93	113	36	149	0	0	0	0	0	0	0	0	0	0	17	7	24
12-Feb-93	144	77	221	0	0	0	0	0	0	0	2	0	2	17	7	24
13-Feb-93	121	40	161	0	0	0	0	0	0	0	3	0	3	17	6.5	23.5
14-Feb-93	116	25	141	0	0	0	0	0	0	0	0	0	0	17.5	6.5	24
15-Feb-93	57	17	74	1	0	0	0	0	0	0	3	0	3	18	5.5	23.5
16-Feb-93	74	40	114	0	0	0	0	0	0	0	2	0	2	18	6.5	24.5
17-Feb-93	143	46	189	2	0	0	0	0	0	0	0	0	0	17.5	6.5	24
18-Feb-93	109	61	170	0	0	0	0	0	0	0	1	0	1	18	6.5	24.5
19-Feb-93	263	53	316	0	0	0	0	0	0	0	10	0	10	17	7	24
20-Feb-93	220	16	236	1	1	0	1	0	0	0	0	0	0	16.5	7	23.5
21-Feb-93	71	17	88	0	0	0	0	0	0	0	0	0	0	18	6	24
22-Feb-93	92	45	137	0	0	0	0	0	0	0	0	0	0	17.5	8	25.5
23-Feb-93	132	31	163	1	0	0	0	0	0	0	0	1	1	16.5	6	22.5
24-Feb-93	109	36	145	0	0	0	0	0	0	0	2	0	2	17.5	6.5	24
25-Feb-93	100	13	113	0	0	0	0	0	0	0	0	0	0	17.5	6.5	24
26-Feb-93	63	33	96	0	0	0	0	0	0	0	0	0	0	16.5	7	23.5
27-Feb-93	136	45	181	0	0	0	0	0	0	0	0	0	0	18.5	7	25.5
28-Feb-93	64	23	87	0	0	1	1	0	0	0	0	0	0	17	5.5	22.5
01-Mar-93	4	7	11	2	0	0	0	0	0	0	0	0	0	18.3	6.3	24.6
02-Mar-93	33	4	37	0	0	0	0	0	0	0	0	0	0	17.5	6.5	24
03-Mar-93	47	1	48	0	0	0	0	0	0	0	0	0	0	17.5	7.5	25
04-Mar-93	214	31	245	0	0	0	0	0	0	0	0	0	0	16.5	7	23.5
05-Mar-93	128	5	133	0	0	0	0	0	0	0	0	0	0	17.5	7	24.5
06-Mar-93	211	11	222	0	0	0	0	0	0	0	0	0	0	16.5	6.5	23
07-Mar-93	163	11	174	0	0	0	0	0	0	0	0	0	0	18	5.5	23.5
08-Mar-93	177	60	237	0	0	0	0	0	0	0	0	0	0	18	6	24
09-Mar-93	217	64	281	0	0	0	0	0	0	0	0	0	0	17	6.5	23.5
10-Mar-93	203	35	238	0	0	0	0	0	0	0	0	0	0	17.5	6	23.5
11-Mar-93	83	19	102	0	0	0	0	0	0	0	0	0	0	18	6.5	24.5
12-Mar-93	66	13	79	0	0	0	0	0	0	0	0	0	0	17	7	24
13-Mar-93	67	1	68	0	0	0	0	0	0	0	0	0	0	18	5.5	23.5
14-Mar-93	60	1	61	0	0	0	0	0	0	0	0	0	0	18.5	5.5	24
15-Mar-93	21	9	30	0	0	0	0	0	0	0	0	0	0	18	5	23
16-Mar-93	81	19	100	0	0	0	0	0	0	0	0	0	0	19	6	25
17-Mar-93	53	4	57	0	0	0	0	0	0	0	0	0	0	18	6	24
18-Mar-93	97	24	121	1	0	0	0	0	0	0	1	0	1	18	8	26
19-Mar-93	76	21	97	0	0	0	0	0	0	0	0	0	0	15	7.5	22.5
20-Mar-93	56	5	61	0	0	0	0	0	0	0	0	0	0	18	5.5	23.5
21-Mar-93	68	3	71	0	1	0	1	0	0	0	0	0	0	18.5	4.5	23

APPENDIX 2
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Daily Abundance at the Elliott Road Trap Site

	Fall Chinook Salmon							Steelhead/Rainbow Trout						Trap Effort (hours fished) /1		
	YOY				1+			YOY			1+					
DATE	Night Counts	Diurnal Counts	Total Counts	Trap Mortalities	Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Over Night Effort	Diurnal Effort	Total Effort
22-Mar-93	41	7	48	0	0	0	0	0	0	0	0	0	0	20.2	7.8	28
23-Mar-93	150	27	177	1	0	0	0	1	0	1	0	0	0	15.5	6.5	22
24-Mar-93	55	3	58	0	0	0	0	0	0	0	0	0	0	17.8	6.2	24
25-Mar-93	59	6	65	1	1	0	1	0	0	0	0	0	0	17.8	4.5	22.3
26-Mar-93	55	6	61	0	0	0	0	0	0	0	0	0	0	16.8	7.2	24
27-Mar-93	52	5	57	0	0	0	0	0	0	0	0	0	0	18	5.5	23.5
28-Mar-93	59	6	65	0	0	0	0	0	0	0	0	0	0	18.5	5	23.5
29-Mar-93	14	1	15	1	0	0	0	0	0	0	0	0	0	18	7.5	25.5
30-Mar-93	25	2	27	0	0	0	0	0	0	0	0	0	0	17	6.5	23.5
31-Mar-93	24	6	30	0	0	0	0	0	0	0	0	0	0	16.5	7	23.5
01-Apr-93	8	2	10	0	0	0	0	0	0	0	0	0	0	17	8	25
02-Apr-93	29	2	31	0	0	0	0	0	0	0	0	0	0	16.5	7	23.5
03-Apr-93	23	9	32	0	0	0	0	0	0	0	0	0	0	16.5	8.5	25
04-Apr-93	19	14	33	0	0	0	0	0	0	0	0	0	0	15.5	7.5	23
05-Apr-93	11	8	19	0	0	0	0	0	0	0	0	0	0	16	8	24
06-Apr-93	21	7	28	0	0	0	0	0	0	0	0	0	0	15.5	8.5	24
07-Apr-93	23	4	27	0	0	0	0	0	0	0	0	0	0	15	11	26
08-Apr-93	12	0	12	0	0	0	0	0	0	0	0	0	0	14	--	14
09-Apr-93	29	1	30	0	0	0	0	0	0	0	0	0	0	--	8.5	32
10-Apr-93	11	3	14	0	0	0	0	0	0	0	0	0	0	16	11	27
11-Apr-93	1	0	1	0	0	0	0	1	0	1	1	0	1	16	5	21
12-Apr-93	9	0	9	0	0	0	0	0	0	0	0	0	0	17	7.5	24.5
13-Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	--	--	21.5
14-Apr-93	0	0	0	0	0	0	0	0	0	0	0	0	0	18.5	8	26.5
15-Apr-93	2	0	2	0	0	0	0	0	0	0	0	0	0	17	7	24
16-Apr-93	3	0	3	0	0	0	0	0	0	0	0	0	0	15.5	9.5	25
17-Apr-93	6	1	7	0	0	0	0	0	0	0	0	0	0	16	8.5	24.5
18-Apr-93	4	2	6	0	0	0	0	0	0	0	0	0	0	14	9	23
19-Apr-93	7	0	7	0	0	0	0	0	0	0	0	0	0	15	7.5	22.5
20-Apr-93	6	5	11	0	0	0	0	0	0	0	0	0	0	17	7.5	24.5
21-Apr-93	7	0	7	0	0	0	0	0	0	0	0	0	0	16.5	8	24.5
22-Apr-93	14	0	14	0	0	0	0	2	0	2	0	0	0	15	8	23
23-Apr-93	6	0	6	0	0	0	0	0	0	0	0	0	0	16	9	25
24-Apr-93	7	0	7	0	0	0	0	0	0	0	0	0	0	15.5	8	23.5
25-Apr-93	1	0	1	0	0	0	0	0	0	0	0	0	0	17.5	7	24.5
26-Apr-93	0	1	1	0	0	0	0	0	0	0	0	0	0	16.5	7.5	24
27-Apr-93	1	0	1	0	0	0	0	0	0	0	0	0	0	17.5	6	23.5
28-Apr-93	7	0	7	0	0	0	0	0	0	0	0	0	0	18.5	6	24.5
29-Apr-93	3	2	5	0	0	0	0	0	0	0	0	0	0	19	5	24
30-Apr-93	2	0	2	0	0	0	0	0	0	0	0	0	0	18.5	7.5	26
01-May-93	6	0	6	0	0	0	0	0	0	0	0	0	0	16	8	24
02-May-93	4	0	4	0	0	0	0	0	0	0	0	0	0	16	8	24
03-May-93	1	0	1	0	0	0	0	0	0	0	0	0	0	15.5	6.5	22
04-May-93	5	0	5	0	0	0	0	0	0	0	0	0	0	16.5	8	24.5
05-May-93	7	1	8	0	0	0	0	0	0	0	0	0	0	17	6	23
06-May-93	2	0	2	0	0	0	0	0	0	0	0	0	0	18.5	5.5	24
07-May-93	2	0	2	0	0	0	0	0	0	0	0	0	0	17	7.5	24.5
08-May-93	7	0	7	0	0	0	0	0	0	0	0	0	0	16.5	7.5	24
09-May-93	2	0	2	0	0	0	0	0	0	0	0	0	0	16	7.5	23.5
10-May-93	6	2	8	0	0	0	0	0	0	0	0	0	0	17	7.5	24.5
11-May-93	7	0	7	0	0	0	0	0	0	0	0	0	0	18	--	18
12-May-93	8	1	9	0	0	0	0	0	0	0	0	0	0	--	--	34.5
13-May-93	20	1	21	0	0	0	0	0	0	0	0	0	0	12	7	19
14-May-93	8	0	8	0	0	0	0	0	0	0	0	0	0	17	7	24
15-May-93	7	0	7	0	0	0	0	0	0	0	0	0	0	17	--	17
16-May-93	1	0	1	0	0	0	0	0	0	0	0	0	0	--	--	31.5
17-May-93	1	0	1	0	0	0	0	0	0	0	0	0	0	17	6.5	23.5
18-May-93	9	0	9	0	0	0	0	0	0	0	0	0	0	17	7	24
19-May-93	4	0	4	0	0	0	0	0	0	0	0	0	0	17.5	--	17.5
20-May-93	11	0	11	0	0	0	0	0	0	0	0	0	0	--	--	27
21-May-93	4	0	4	0	0	0	0	0	0	0	0	0	0	20.5	7.5	28
22-May-93	4	0	4	0	0	0	0	0	0	0	0	0	0	--	--	21
23-May-93	9	0	9	0	0	0	0	0	0	0	0	0	0	--	--	25
24-May-93	26	0	26	0	0	0	0	0	0	0	0	0	0	18.5	7.5	26
25-May-93	14	0	14	0	0	0	0	2	0	2	0	0	0	16.5	7	23.5
26-May-93	36	0	36	0	0	0	0	0	0	0	0	0	0	17	--	17
27-May-93	28	0	28	0	0	0	0	0	0	0	0	0	0	--	--	31.5
28-May-93	37	0	37	0	0	0	0	0	0	0	0	0	0	16.5	7.5	24
29-May-93	13	1	14	0	0	0	0	0	0	0	0	0	0	16.5	7.5	24
30-May-93	27	3	30	0	0	0	0	0	0	0	0	0	0	15.5	8.5	24
31-May-93	10	1	11	0	0	0	0	0	0	0	0	0	0	16.5	7.5	24
01-Jun-93	15	1	16	0	0	0	0	0	0	0	0	0	0	16.5	7.5	24
02-Jun-93	12	0	12	0	0	0	0	0	0	0	0	0	0	--	--	26.5
03-Jun-93	14	4	18	0	0	0	0	0	0	0	0	0	0	14	8	22
04-Jun-93	15	0	15	0	0	0	0	0	0	0	0	0	0	16.5	6.5	23
05-Jun-93	28	0	28	0	0	0	0	0	0	0	0	0	0	17.5	6.5	24
06-Jun-93	41	0	41	0	0	0	0	0	0	0	0	0	0	17	7	24
07-Jun-93	46	1	47	0	0	0	0	0	0	0	0	0	0	17	7	24
08-Jun-93	41	1	42	0	0	0	0	0	0	0	0	0	0	17	7	24
09-Jun-93	33	3	36	0	0	0	0	0	0	0	0	0	0	17.5	7.5	25

APPENDIX 2
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Daily Abundance at the Elliott Road Trap Site

	Fall Chinook Salmon							Steelhead/Rainbow Trout						Trap Effort (hours fished) /1		
	YOY				1+			YOY			1+					
DATE	Night Counts	Diurnal Counts	Total Counts	Trap Mortalities	Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Night Counts	Diurnal Counts	Total Counts	Over Night Effort	Diurnal Effort	Total Effort
10-Jun-93	34	0	34	0	0	0	0	0	0	0	0	0	0	16	8.5	24.5
11-Jun-93	12	1	13	0	0	0	0	0	0	0	0	0	0	15	9.5	24.5
12-Jun-93	25	1	26	0	0	0	0	0	0	0	0	0	0	15	8.5	23.5
13-Jun-93	24	3	27	0	0	0	0	0	0	0	0	0	0	15.5	8.5	24
14-Jun-93	26	2	28	1	0	0	0	0	0	0	0	0	0	15.5	7	22.5
15-Jun-93	16	0	16	1	0	0	0	0	0	0	0	0	0	17	8	25
16-Jun-93	29	0	29	0	0	0	0	0	0	0	0	0	0	16	7	23
17-Jun-93	9	0	9	0	0	0	0	0	0	0	0	0	0	17	7.5	24.5
18-Jun-93	26	0	26	1	0	0	0	0	0	0	0	0	0	16.5	7.5	24
19-Jun-93	17	2	19	0	0	0	0	0	0	0	0	0	0	17.5	7.5	25
20-Jun-93	13	0	13	0	0	0	0	0	0	0	0	0	0	15	9	24
21-Jun-93	18	0	18	0	0	0	0	0	0	0	0	0	0	15.5	7	22.5
22-Jun-93	15	0	15	2	0	0	0	0	0	0	0	0	0	17	7	24
23-Jun-93	8	0	8	0	0	0	0	0	0	0	0	0	0	17	7	24
24-Jun-93	2	0	2	0	0	0	0	0	0	0	0	0	0	17	7.5	24.5
25-Jun-93	7	1	8	0	0	0	0	0	0	0	0	0	0	16.5	6.5	23
26-Jun-93	12	3	15	0	0	0	0	0	0	0	0	0	0	17	6.5	23.5
27-Jun-93	6	0	6	0	0	0	0	0	0	0	0	0	0	17.5	6	23.5
28-Jun-93	10	0	10	1	0	0	0	0	0	0	0	0	0	17.5	6.5	24
29-Jun-93	11	0	11	0	0	0	0	0	0	0	0	0	0	19.5	7.5	27
30-Jun-93	1	0	1	0	0	0	0	1	0	1	0	0	0	15.5	7	22.5
01-Jul-93	2	0	2	0	0	0	0	0	0	0	1	0	1	16	7	23
02-Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	17	6.5	23.5
03-Jul-93	11	0	11	0	0	0	0	0	0	0	0	0	0	17.5	5.5	23
04-Jul-93	5	0	5	0	0	0	0	0	0	0	0	0	0	18	6.5	24.5
05-Jul-93	1	0	1	0	0	0	0	0	0	0	0	0	0	20.5	2.5	23
06-Jul-93	2	0	2	0	0	0	0	0	0	0	0	0	0	18.5	6.5	25
07-Jul-93	3	0	3	0	0	0	0	0	0	0	0	0	0	17.5	7.5	25
08-Jul-93	2	0	2	0	0	0	0	0	0	0	0	0	0	16.5	6.5	23
09-Jul-93	2	0	2	0	0	0	0	0	0	0	0	0	0	17.5	7	24.5
10-Jul-93	2	0	2	0	0	0	0	0	0	0	0	0	0	17	7	24
11-Jul-93	3	0	3	0	0	0	0	0	0	0	0	0	0	17.5	6	23.5
12-Jul-93	3	0	3	0	0	0	0	0	0	0	0	0	0	17.75	6.15	23.9
13-Jul-93	4	0	4	0	0	0	0	0	0	0	0	0	0	17.5	6.5	24
14-Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	17.5	7	24.5
15-Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	16	8.5	24.5
16-Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	15.5	7	22.5
17-Jul-93	1	0	1	0	0	0	0	1	0	1	0	0	0	18	6	24
18-Jul-93	1	0	1	0	0	0	0	0	0	0	0	0	0	17	7	24
19-Jul-93	1	0	1	0	0	0	0	0	0	0	0	0	0	17	6.5	23.5
20-Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	17.5	7.5	25
21-Jul-93	1	0	1	0	0	0	0	0	0	0	0	0	0	16.5	9	25.5
22-Jul-93	0	0	0	0	0	0	0	0	0	0	0	0	0	16	7.5	23.5
23-Jul-93	0		0	0	0		0	0		0	0		0	16		16
24-Jul-93																
25-Jul-93																
26-Jul-93																
27-Jul-93																
28-Jul-93																
29-Jul-93																
30-Jul-93																
31-Jul-93																
01-Aug-93																
Totals:	6713	1398	8111	44	6	1	6	8	0	8	33	5	38			

/1 Due to variation in trap tending times effort may overlap several days resulting in total effort exceeding 24 hours. However, the total effort is the total time interval that trap was fished associated with a day's total fish count.

Appendix 3
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Estimated Weekly Abundance at Woodbridge Dam

Week Ending	Trap Capture #	Trap Effic. (%)	StDev of Trap Effic.(%)	Estimated Abundance
01/24/93	0	3.23	0.96	0
01/31/93	3	3.23	0.96	93
02/07/93	18	3.23	0.96	557
02/14/93	28	3.23	0.96	867
02/21/93	35	3.23	0.96	1084
02/28/93	64	3.23	0.96	1981
03/07/93	16	3.23	0.96	495
03/14/93	22	3.23	0.96	681
03/21/93	16	3.23	0.96	495
03/28/93	54	3.23 & 11.27	0.96 & 2.04	1672
04/04/93	96	11.27	2.14	1912
04/11/93	52	11.27	2.04	461
04/18/93	85	11.27&10.58	2.04 & 4.02	786
04/25/93	58	10.58	4.02	548
05/02/93	106	10.58	4.02	1002
05/09/93	385	10.58	4.02	3639
05/16/93	1028	10.58	4.02	9716
05/23/93	1917	10.58	4.02	18119
05/30/93	1945	10.58	4.02	18384
06/06/93	3764	10.58	4.02	35577
06/13/93	3507	10.58	4.02	33147
06/20/93	3238	10.58	4.02	30605
06/27/93	1024	10.58	4.02	9679
07/04/93	808	10.58	4.02	7637
07/11/93	313	10.58	4.02	2958
07/18/93	126	10.58	4.02	1191
07/25/93	15	10.58	4.02	142
08/01/93	2	10.58	4.02	19
Totals:	18725			183448

95%CI:	PERIOD OF CAPTURE	ESTVALUE	HIGH	LOW
	1/19-3/31	9412	16004	6666
	4/1-4/13	1154	1540	922
	4/14-7/29	172883	365194	113247
	Cumulative	**183448**	**382738**	**120835**

APPENDIX 4
MOKELUMNE RIVER FISHERIES MONITORING PROGRAM OF THE EAST BAY M.U.D.-1993
Juvenile Salmonid Downstream Migrant Monitoring
Size and Condition Database
Daily Average Size of Y-O-Y Salmon Captured at the Woodbridge Dam Trap Site

DATE	AVGTL (mm)	AVGFL (mm)	AVGWT (g)	AVGK	STDTL	STDFL	STDWT	STDK	N	MAXTL (mm)	MINTL (mm)	MAXWT (g)	MINWT (g)
01/01													
01/02													
01/03													
01/04													
01/05													
01/06													
01/07													
01/08													
01/09													
01/10													
01/11													
01/12													
01/13													
01/14													
01/15													
01/16													
01/17													
01/18													
01/19									0				
01/20									0				
01/21									0				
01/22									0				
01/23									0				
01/24									0				
01/25									0				
01/26									0				
01/27									0				
01/28									0				
01/29									0				
01/30	36.0	34.0			0.00	0.00			1	36	36		
01/31	35.5	34.0	0.2	6.43E-04	0.50	0.00	0.15	0	2	36	35	0.3	0.1
02/01	35.5	34.0			0.50	0.00	0.00		4	36	35		
02/02	35.0	34.0			0.00	0.00	0.00		1	35	35		
02/03	34.0	33.0			0.00	0.00	0.00		1	34	34		
02/04	34.7	33.7	0.3	7.09E-04	1.89	1.89	0.17	0.000014	6	38	32	0.4	0.3
02/05	33.0	32.0			0.00	0.00	0.00		1	33	33		
02/06	35.8	34.6	0.3	6.71E-04	0.49	0.49	0.15	0.000028	5	36	35	0.3	0.3
02/07									0				
02/08									0				
02/09									0				
02/10	36.0	35.0			0.00	0.00	0.00		1	36	36		
02/11	36.0	34.0			3.22	2.61			5	41	31		
02/12									0				
02/13	34.5	33.3			1.15	1.14			13	36	32		
02/14	36.5	35.5			1.50	1.50			6	39	35		
02/15	37.7	36.7			0.94	0.94			6	39	36		
02/16	36.4	34.9			2.01	1.98			11	40	34		
02/17	36.0	35.0			0.00	0.00			3	36	36		
02/18	37.0	36.0			0.71	0.71			4	38	36		
02/19	34.7	33.7			0.94	0.94			3	36	34		
02/20	37.5	36.5	0.3	5.92E-04	1.12	1.12	0.00	0	4	39	36	0.3	0.3
02/21	37.5	36.5			0.50	0.50			2	38	37		
02/22	35.3	34.8			1.48	1.30			8	38	33		
02/23									0				
02/24	34.6	34.0	0.3	6.31E-04	2.17	2.18	0.08	0.000114	25	39	30	0.4	0.1
02/25									0				
02/26	34.0	33.0			0.00	0.00			1	34	34		
02/27	36.0	35.0	0.3	6.45E-04	0.82	0.82	0.00	0.000044	3	37	35	0.3	0.3
02/28	36.5	35.4	0.3	5.90E-04	1.91	1.84	0.07	0.000119	26	41	33	0.4	0.2
03/01	37.0	36.0	0.4	6.86E-04	1.00	1.00	0.05	0.000043	2	38	36	0.4	0.3
03/02	34.8	33.8	0.3	6.17E-04	2.27	2.27	0.08	0.000065	12	39	32	0.4	0.2
03/03									0				
03/04	36.0	35.0	0.3	6.43E-04	0.00	0.00	0.00	0	1	36	36	0.3	0.3
03/05	37	36	0.3	0.000592	0.00	0.00	0.00	0	1	37	37	0.3	0.3
03/06									0				
03/07									0				
03/08	36.0	35.0	0.3	6.46E-04	1.00	1.00	0.00	0.000054	2	37	35	0.3	0.3
03/09	36.3	35.3	0.3	6.54E-04	2.05	2.05	0.07	0.000094	6	39	34	0.4	0.2
03/10	44.3	42.5	0.5	5.73E-04	1.48	1.12	0.07	0.000031	4	46	42	0.6	0.4
03/11	34.3	33.3	0.2	5.70E-04	2.05	2.05	0.05	0.000044	3	37	32	0.3	0.2
03/12	34.6	33.6	0.3	6.13E-04	2.94	2.94	0.08	0.00008	5	38	31	0.4	0.2
03/13	35.0	34.0	0.3	7.00E-04	0.00	0.00	0.00	0	1	35	35	0.3	0.3
03/14									0				
03/15	38.0	36.8	0.3	5.67E-04	3.03	2.71	0.10	0.000059	5	43	34	0.5	0.2
03/16	36.0	35.0	0.3	6.46E-04	1.00	1.00	0.00	0.000054	2	37	35	0.3	0.3
03/17	37.8	36.8	0.4	6.51E-04	1.48	1.48	0.05	0.000088	4	40	36	0.4	0.3
03/18	38.3	37.3	0.3	5.88E-04	1.25	1.25	0.05	0.000032	3	40	37	0.4	0.3
03/19	39.0	38.0	0.4	6.74E-04	0.00	0.00	0.00	0	1	39	39	0.4	0.4
03/20	36.0	35.0	0.3	6.43E-04	0.00	0.00	0.00	0	1	36	36	0.3	0.3
03/21									0				
03/22									0				

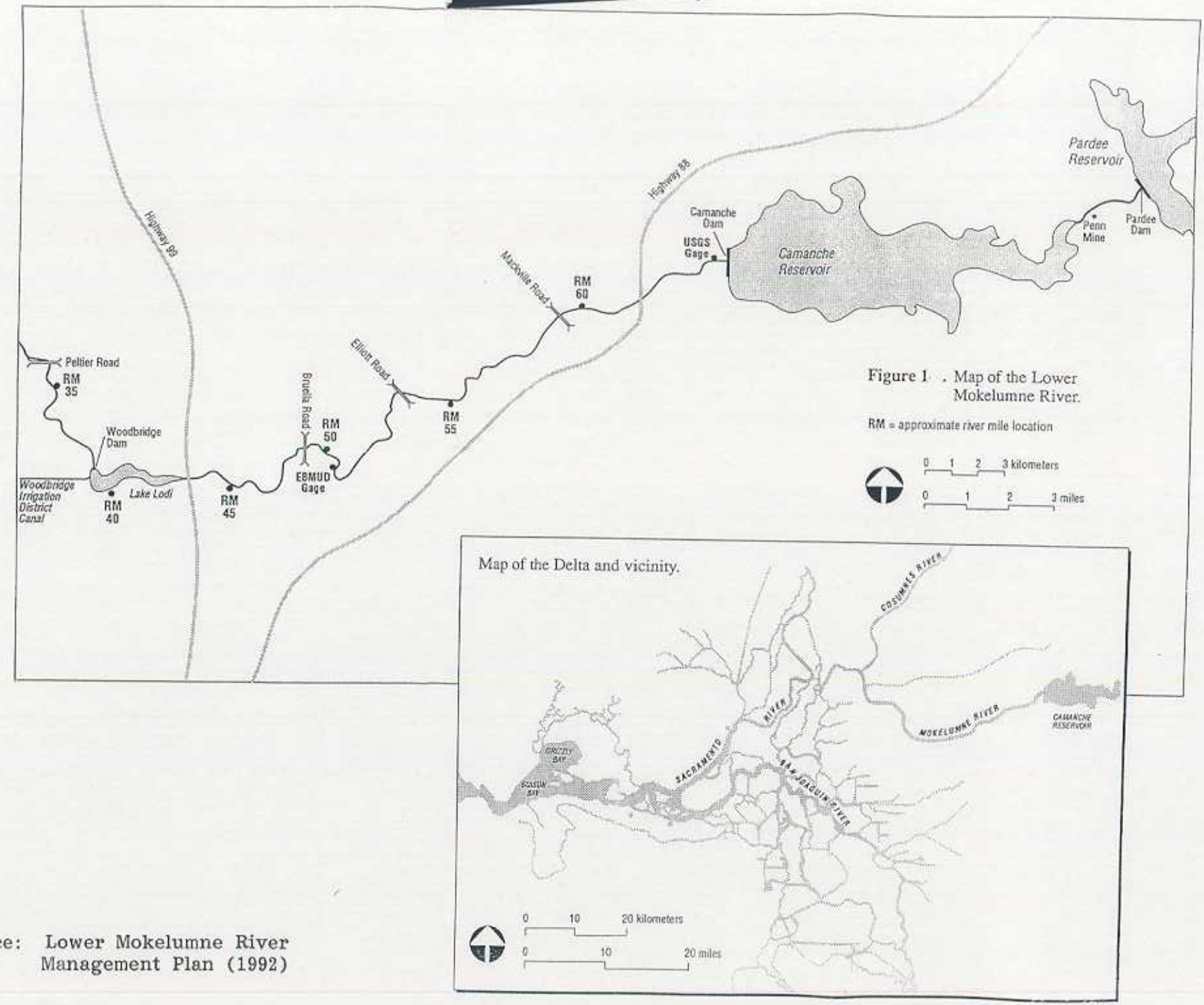

Figure 1 . Map of the Lower Mokelumne River.

RM = approximate river mile location

Source: Lower Mokelumne River Management Plan (1992)

APPENDIX 4
MOKELUMNE RIVER FISHERIES MONITORING PROGRAM OF THE EAST BAY M.U.D.-1993
Juvenile Salmonid Downstream Migrant Monitoring
Size and Condition Database
Daily Average Size of Y-O-Y Salmon Captured at the Woodbridge Dam Trap Site

DATE	AVGTL (mm)	AVGFL (mm)	AVGWT (g)	AVGK	STDTL	STDFL	STDWT	STDK	N	MAXTL (mm)	MINTL (mm)	MAXWT (g)	MINWT (g)
03/23									0				
03/24									0				
03/25	39.3	38.0	0.4	6.43E-04	0.85	0.79	0.03	0.000038	19	41	37	0.4	0.3
03/26	37.9	36.6	0.4	6.42E-04	1.81	1.78	0.05	0.000047	14	40	35	0.4	0.3
03/27	37.4	36.4	0.3	6.48E-04	1.36	1.36	0.05	0.000068	5	39	35	0.4	0.3
03/28	39.1	38.1	0.4	6.66E-04	0.72	0.68	0.05	0.000075	15	40	38	0.5	0.3
03/29	40.7	38.7	0.4	6.43E-04	1.70	1.25	0.05	0.000022	3	43	39	0.5	0.4
03/30	40.0	39.0	0.4	6.25E-04	0.00	0.00	0.00	5.3E-23	7	40	40	0.4	0.4
03/31	40.3	39.1	0.4	6.45E-04	4.10	3.68	0.25	0.000081	38	56	38	1.6	0.3
04/01	39.8	38.5	0.4	6.74E-04	2.91	2.47	0.11	0.00005	13	49	36	0.8	0.3
04/02	41.0	39.6	0.4	6.03E-04	2.10	1.85	0.07	0.000046	5	43	37	0.5	0.3
04/03	40.2	39.2	0.4	6.27E-04	1.38	0.86	0.03	0.000046	15	42	37	0.5	0.4
04/04	40.2	39.1	0.4	5.99E-04	1.22	1.06	0.03	0.000039	15	42	37	0.4	0.3
04/05	40.2	39.2	0.4	6.27E-04	1.38	0.86	0.03	0.000046	15	70	64	2.4	2
04/06	40.2	39.1	0.4	5.99E-04	1.22	1.06	0.03	0.000039	15	80	80	3.9	3.9
04/07	43.0	40.6	0.6	6.42E-04	6.43	5.03	0.54	0.000161	42	85	37	2.9	0.3
04/08									0				
04/09	39.2	37.0			0.45	0.00			5	40	39		
04/10	62.0	58.2			16.20	16.60			5	81	42	3.2	0.5
04/11	77.0	71.3	2.3	5.12E-04	3.24	3.34	0.12	0.000093	4	81	72	2.5	2.2
04/12	72.9	69.5	3.5	6.27E-04	11.39	10.65	1.18	0.000109	11	85	40	4.9	0.4
04/13	52.4	49.8	1.2	6.99E-04	14.24	13.22	1.01	0.000206	19	82	39	3.3	0.3
04/14									10	84	37		
04/15	73.2	69.0			12.83	13.52			6	101	55	8.4	1.5
04/16	80.3	75.0	4.6	8.00E-04	14.92	13.42	2.32	0.000125	21	86	42	3.8	0.5
04/17	62.5	58.8	1.9	8.54E-04	17.21	15.85	1.23	0.00009	11	77	38	2.9	0.3
04/18	51.3	48.1	1.1	6.77E-04	13.33	12.36	0.91	0.000069	3	92	82	6	3
04/19	86.7	83.7	4.6	7.39E-04	4.11	3.68	1.24	0.000251	12	105	36	7	0.3
04/20	81.8	77.3	4.1	8.47E-04	25.78	23.31	2.52	0.000111	4	110	82	18.7	4.2
04/21	97.5	90.0	7.5	7.79E-04	10.04	8.83	2.16	0.000035	21	92	35	8.3	0.2
04/22	83.3	59.6	3.0	8.07E-04	22.30	20.56	2.35	0.000178	7	71	38	2.9	0.4
04/23	47.3	44.9	0.9	7.32E-04	10.44	9.28	0.84	0.000074	5	70	40	0.6	0.4
04/24	47.0	45.0	0.5	7.04E-04	11.56	10.53	0.10	0.000081	8	110	95	12.3	5.8
04/25	102.1	95.4	8.1	7.54E-04	6.24	7.36	1.73	0.000058	3	100	89	9.8	6.8
04/26	95.7	95.7	8.0	9.10E-04	4.76	3.68	1.30	0.000088	12	115	85	11.5	2.5
04/27	103.3	94.6	8.1	7.13E-04	9.42	7.47	2.19	0.00012	20	120	36	11.4	0.4
04/28	95.2	88.9	6.7	7.58E-04	22.22	20.56	3.68	0.000117	26	115	67	17.6	1.9
04/29	101.4	95.2	8.8	8.21E-04	11.70	10.90	3.51	0.00024	13	117	68	11.3	2.2
04/30	102.4	94.0	8.5	7.74E-04	12.07	10.38	2.19	0.000105	17	115	90	11.4	6.6
05/01	103.6	96.8	8.7	7.86E-04	5.88	5.58	1.19	0.00007	14	112	70	11.5	4.1
05/02	95.4	89.9	7.2	8.40E-04	11.37	10.97	2.15	0.000139	1	102	102		
05/03	102.0	96.0			0.00	0.00			33	121	90	12.9	5.3
05/04	106.9	99.1	9.7	7.87E-04	7.89	7.23	1.94	0.00004	57	122	95	14.8	6.9
05/05	106.6	100.1	9.7	7.98E-04	6.09	6.17	1.65	0.00005	55	120	88	13.8	1.6
05/06	102.9	95.6	8.7	7.92E-04	6.65	6.26	1.98	0.000105	52	119	87	12.3	5.2
05/07	104.1	96.1	8.9	7.79E-04	6.98	5.91	1.74	0.000037	55	120	37	14.1	0.2
05/08	104.1	95.8	8.8	7.56E-04	11.15	10.11	2.07	0.000071	56	127	88	16.2	5.3
05/09	103.3	96.0	8.9	7.98E-04	7.87	7.27	1.99	0.000051	1	85	85		
05/10	85.0				0.00				50	119	84	13.8	4.4
05/11	104.3	97.5	8.6	7.43E-04	7.16	6.61	1.85	0.000043	45	116	91	12.2	5.2
05/12	105.9	97.4	8.9	7.43E-04	5.70	5.41	1.41	0.000042	91	119	83	13.8	4.9
05/13	102.9	95.2	8.4	7.55E-04	7.14	6.49	1.82	0.000054	100	117	87	14.4	4.8
05/14	102.5	94.1	8.1	7.45E-04	6.95	5.76	1.70	0.000062	50	118	84	12.1	4.4
05/15	102.0	94.4	7.9	7.39E-04	6.90	6.06	1.55	0.000049	100	117	76	11.7	4.4
05/16	99.9	92.0	8.3	8.55E-04	10.32	9.59	1.55	0.000224	100	117	88	12.7	4.2
05/17	103.1	94.5	8.4	7.54E-04	6.57	6.04	1.75	0.000073	100	118	88	12.4	5
05/18	103.6	95.0	8.1	7.24E-04	6.58	5.83	1.61	0.000058	426	123	85	15	4.7
05/19	104.0	95.4	8.6	7.55E-04	6.82	6.25	1.76	0.000056	144	124	79	15.6	4.4
05/20	103.8	95.5	9.0	7.95E-04	7.68	6.87	1.96	0.000086	100	120	79	15.6	4.9
05/21	104.0	95.9	9.8	8.67E-04	8.61	7.69	1.86	0.000111	100	128	90	14.5	5.3
05/22	103.9	95.2	8.2	7.21E-04	6.62	6.02	1.65	0.000044	100	121	89	12.4	4.7
05/23	104.1	95.3	8.0	7.04E-04	6.50	5.79	1.52	0.000049	100	117	87	11.6	4.4
05/24	104.9	95.6	7.8	6.73E-04	6.12	5.52	1.46	0.000048	75	123	87	14.8	4.2
05/25	104.8	95.9	7.8	6.68E-04	7.17	6.48	1.80	0.00005	100	125	89	12.6	4.5
05/26	104.5	94.9	7.5	6.55E-04	5.66	5.34	1.40	0.000056	100	123	88	12.7	4.5
05/27	104.3	95.5	7.7	6.64E-04	6.93	6.16	1.74	0.000042	100	125	89	12.4	5.4
05/28	104.5	96.0	8.5	7.40E-04	7.15	6.66	1.67	0.000062	100	127	85	13.3	3.8
05/29	104.7	95.7	8.0	6.85E-04	7.38	6.64	1.97	0.0001	72	127	85	13.9	4.1
05/30	105.8	96.7	7.4	6.17E-04	7.77	6.91	1.84	0.000111	100	122	90	11.9	4.1
05/31	105.4	96.0	6.6	5.60E-04	5.22	4.50	1.20	0.000051	80	122	89	10.3	1.7
06/01	106.0	95.7	6.8	5.65E-04	7.65	6.64	1.61	0.000085	406	135	75	14.2	2.3
06/02	105.6	95.9	7.2	6.05E-04	6.72	6.44	2.01	0.000116	202	127	87	11.5	3.5
06/03	106.8	96.2	6.3	5.27E-04	7.52	6.63	1.69	0.000047	100	124	90	9.5	4
06/04	106.5	95.8	6.2	5.01E-04	7.32	6.63	1.37	0.000033	100	126	90		
06/05	106.2	96.2			7.15	6.56			100	125	90		
06/06	106.4	96.3			7.52	6.73			100	121	91		
06/07	114.1	95.2			69.09	6.20			100	129	86		
06/08	105.1	94.5			8.52	11.53			100	122	86		
06/09	104.6	94.8			6.84	6.18			0				
06/10									100	127	75		
06/11	103.3	91.7			11.50	16.16							

APPENDIX 4
MOKELUMNE RIVER FISHERIES MONITORING PROGRAM OF THE EAST BAY M.U.D.-1993
Juvenile Salmonid Downstream Migrant Monitoring
Size and Condition Database
Daily Average Size of Y-O-Y Salmon Captured at the Woodbridge Dam Trap Site

DATE	AVGTL (mm)	AVGFL (mm)	AVGWT (g)	AVGK	STDTL	STDFL	STDWT	STDK	N	MAXTL (mm)	MINTL (mm)	MAXWT (g)	MINWT (g)
06/12	102.6	93.5	9.6	9.05E-04	13.21	11.94	3.40	0.000196	100	127	78	18	6
06/13	104.5	94.6	9.4	8.03E-04	11.13	10.07	3.05	0.00014	100	128	79	18	5
06/14	103.0	110.3	9.2	7.74E-04	8.89	112.06	2.21	0.000084	100	121	63	19	5
06/15	107.4	97.5	9.5	7.46E-04	8.46	8.80	2.31	0.000174	100	126	65	14	1
06/16	106.9	96.6	9.4	7.45E-04	7.58	7.22	1.84	0.000084	100	127	87	14	6
06/17	106.4	96.4	11.2	8.72E-04	8.60	8.16	2.35	0.000865	91	127	93	18	5
06/18	107.8	97.8	9.6	7.52E-04	7.87	6.84	2.63	0.0002	100	136	89	20	5
06/19	109.7	99.6	11.1	8.30E-04	7.57	7.21	2.69	0.000057	100	130	93	19.9	6.8
06/20	107.4	97.7	10.4	8.38E-04	8.84	6.90	2.52	0.000221	100	128	81	18.4	1.8
06/21	102.7	93.4	9.5	8.63E-04	7.87	7.05	2.27	0.000062	69	122	85	14.8	5.6
06/22	103.3	93.3	9.7	8.59E-04	8.68	7.87	2.53	0.000063	80	123	86	17.5	5.8
06/23	104.4	94.0	9.5	8.24E-04	8.90	8.07	1.93	0.00004	53	123	92	15	6.6
06/24	102.8	92.8	9.4	8.50E-04	7.77	6.84	2.27	0.000067	57	123	86	16.2	5.4
06/25	100.9	91.7	8.7	8.32E-04	8.62	7.17	2.50	0.000035	28	129	90	17.5	6.1
06/26	106.1	96.2	10.5	8.64E-04	8.11	7.50	2.35	0.000046	43	123	92	15.2	6.5
06/27	104.3	94.6	10.2	8.77E-04	9.78	8.77	2.69	0.000048	50	122	86	15.2	5.6
06/28	104.2	94.6	9.9	8.64E-04	7.81	7.18	2.16	0.000049	58	123	91	15.5	6.8
06/29	102.9	94.0	9.4	8.53E-04	7.77	7.08	2.17	0.000053	79	128	85	19.1	5.8
06/30	103.9	94.7	10.2	8.89E-04	9.22	8.18	2.58	0.000061	22	125	85	17.5	5
07/01	105.1	93.3	9.6	8.21E-04	8.70	14.20	1.81	0.000054	42	118	89	13.4	5.2
07/02	105.8	96.1	10.3	8.53E-04	7.50	6.81	2.42	0.00005	38	126	90	18.4	6.2
07/03	107.7	95.9	11.0	8.82E-04	8.32	13.24	2.66	0.000051	61	128	90	18.1	6.4
07/04	106.0	96.1	10.4	8.57E-04	8.09	7.47	2.57	0.000047	68	128	90	17.7	6.5
07/05	105.8	96.6	10.0	8.49E-04	5.92	5.52	1.64	0.000072	28	117	92	14.5	7.2
07/06	105.6	96.5	10.0	8.40E-04	5.89	5.50	1.73	0.00005	61	119	91	13.6	6.3
07/07	105.5	95.9	10.2	8.66E-04	6.61	5.90	1.91	0.000056	42	131	95	17.2	7
07/08	104.3	94.7	9.8	8.56E-04	7.68	6.93	2.12	0.000044	45	120	92	14.4	6.2
07/09	108.1	99.3	11.2	8.74E-04	7.98	7.42	2.68	0.000053	38	135	85	23.1	6.1
07/10	106.9	98.1	10.8	8.65E-04	5.63	5.27	1.81	0.000046	37	120	98	14	7.4
07/11	105.2	95.9	10.0	8.53E-04	5.60	5.26	1.53	0.000042	41	118	92	13.4	6.9
07/12	107.6	98.3	11.3	8.86E-04	8.48	8.08	2.77	0.000038	15	129	95	18.2	7.9
07/13	109.9	100.8	11.7	8.62E-04	8.80	8.47	2.70	0.000015	9	125	92	16.7	8.7
07/14	108.0	98.5	10.8	8.50E-04	7.97	7.22	2.49	0.000064	16	130	96	18.9	7.8
07/15	112.4	101.0	12.4	8.71E-04	6.65	6.39	2.06	0.000062	5	122	103	15.4	10.3
07/16	110.9	101.0	12.0	8.76E-04	9.68	8.79	2.41	0.000089	8	130	98	17.4	9.4
07/17	108.0	98.0	10.7	8.38E-04	8.13	7.49	2.63	0.000051	23	132	98	18.5	7.9
07/18	106.5	96.4	10.9	8.97E-04	6.17	5.54	1.99	0.000054	50	125	94	17.8	7.6
07/19	110.8	101.4	12.4	8.95E-04	7.22	6.92	3.02	0.000064	5	125	105	18	9.5
07/20	112.8	103.5	13.5	9.38E-04	5.36	5.12	2.07	0.000068	4	118	104	16.2	10.4
07/21									0				
07/22	120.0	111.0	13.4	7.75E-04	0.00	0.00	0.00	0	1	120	120	13.4	13.4
07/23	113.2	103.4	13.0	8.97E-04	5.64	5.08	1.51	0.000071	5	120	105	14.4	10.1
07/24									0				
07/25									0				
07/26									0				
07/27									0				
07/28	117.5	107.6	14.7	9.00E-04	2.50	2.50	1.45	0.000032	2	120	115	16.1	13.2
07/29									0				
07/30													
07/31													

APPENDIX 5
MOKELUMNE RIVER FISHERIES MONITORING PROGRAM OF THE EAST BAY M.U.D.-1993
Juvenile Salmonid Downstream Migrant Monitoring
Size and Condition Database
Daily Average Size of Y-O-Y Salmon Captured Near the Elliott Road Trap Site

DATE	AVGTL (mm)	AVGFL (mm)	AVGWT (g)	AVGK	STDTL	STDFL	STDWT	STDK	N	MAXTL (mm)	MINTL (mm)	MAXWT (g)	MINWT (g)
01/01													
01/02													
01/03													
01/04													
01/05													
01/06													
01/07													
01/08													
01/09													
01/10													
01/11													
01/12													
01/13													
01/14													
01/15													
01/16													
01/17													
01/18													
01/19													
01/20													
01/21													
01/22													
01/23													
01/24													
01/25													
01/26													
01/27													
01/28													
01/29													
01/30	37.8	36.4	0.3	6.21E-04	1.95	1.83	0.08	0.000106	61	40	30	0.5	0.2
01/31	36.6	35.5	0.3	6.67E-04	1.96	1.78	0.09	0.000144	41	40	34	0.5	0.2
02/01	36.4	35.2	0.4	7.30E-04	2.29	1.98	0.10	0.000144	47	41	31	0.5	0.2
02/02	36.4	35.3	0.4	7.18E-04	2.35	2.27	0.08	0.000088	100	41	30	0.5	0.1
02/03	35.1	34.0	0.3	7.41E-04	2.45	2.41	0.08	0.00009	59	41	30	0.5	0.2
02/04	34.9	33.7	0.3	6.38E-04	2.45	2.41	0.12	0.000245	49	41	30	0.5	0.2
02/05	35.7	34.4	0.3	6.11E-04	2.80	2.55	0.09	0.00018	17	40	31	0.4	0.1
02/06	36.7	35.7	0.3	7.26E-04	2.32	2.32	0.15	0.000357	54	40	31	0.5	0.2
02/07	36.3	35.2	0.3	5.95E-04	1.41	1.35	0.07	0.000138	66	40	32	0.4	0.1
02/08	36.1	35.0	0.3	6.44E-04	1.91	1.79	0.07	0.000107	31	41	32	0.4	0.1
02/09	35.9	34.8	0.3	6.15E-04	2.11	2.08	0.07	0.000109	100	41	30	0.4	0.1
02/10	36.6	35.4	0.3	5.67E-04	3.36	3.23	0.09	0.000129	75	41	30	0.5	0.1
02/11	35.5	34.2	0.3	6.21E-04	2.43	2.44	0.07	0.000107	66	41	30	0.4	0.1
02/12	35.1	34.1	0.3	5.83E-04	2.88	2.87	0.07	0.000111	100	41	30	0.4	0.1
02/13	36.2	35.3	0.3	5.58E-04	4.03	4.00	0.09	0.000111	90	41	30	0.4	0.1
02/14	36.4	35.3	0.3	5.84E-04	2.91	2.87	0.09	0.000127	75	40	31	0.4	0.1
02/15	36.3	35.2	0.3	5.93E-04	2.00	1.92	0.09	0.00012	67	40	31	0.5	0.1
02/16	36.2	35.2	0.3	5.82E-04	2.49	2.49	0.07	0.000112	90	40	31	0.4	0.1
02/17	35.4	34.4	0.3	5.78E-04	2.84	2.84	0.09	0.000114	96	40	30	0.4	0.1
02/18	34.5	33.4	0.3	6.25E-04	3.08	3.08	0.09	0.000131	100	40	30	0.4	0.1
02/19	35.1	34.1	0.3	6.32E-04	3.40	3.40	0.09	0.000105	100	41	30	0.4	0.1
02/20	36.8	35.8	0.3	5.00E-04	2.18	2.13	0.06	0.000084	66	41	30	0.4	0.1
02/21	36.4	35.4	0.3	5.38E-04	2.15	2.15	0.07	0.000099	67	40	31	0.4	0.1
02/22	35.9	34.9	0.3	6.06E-04	2.57	2.59	0.08	0.00013	95	42	30	0.4	0.1
02/23	36.7	35.7	0.3	5.71E-04	2.47	2.46	0.08	0.000082	80	41	31	0.4	0.1
02/24	35.8	34.8	0.3	5.98E-04	2.49	2.49	0.08	0.0001	85	41	30	0.4	0.1
02/25	35.2	34.2	0.3	6.18E-04	2.74	2.79	0.08	0.000103	83	40	30	0.4	0.1
02/26	36.2	35.2	0.3	6.05E-04	2.85	2.85	0.08	0.000082	83	41	30	0.4	0.1
02/27	36.8	35.8	0.3	6.26E-04	2.41	2.40	0.07	0.000086	95	41	31	0.4	0.1
02/28	37.1	36.1	0.3	6.33E-04	1.70	1.70	0.06	0.000066	73	40	32	0.4	0.1
03/01	37.4	36.4	0.3	6.48E-04	1.72	1.72	0.15	0.000073	11	41	34	0.4	0.2
03/02	36.4	35.4	0.3	6.21E-04	2.54	2.54	0.08	0.000085	37	40	33	0.4	0.2
03/03	40.5	39.5	0.4	6.25E-04	3.40	3.40	0.09	0.000056	48	47	33	0.6	0.3
03/04	39.0	38.0	0.4	6.07E-04	3.16	3.14	0.10	0.000062	61	46	33	0.6	0.2
03/05	36.8	35.8	0.3	5.97E-04	1.34	1.30	0.05	0.000095	55	40	35	0.4	0.2
03/06	36.4	35.4	0.3	5.97E-04	3.62	3.60	0.09	0.000065	61	41	30	0.4	0.1
03/07	37.3	36.3	0.3	6.15E-04	1.58	1.58	0.06	0.000084	61	41	32	0.4	0.2
03/08	37.4	36.3	0.3	6.30E-04	1.90	1.97	0.06	0.000075	100	41	32	0.4	0.2
03/09	37.3	36.3	0.3	6.18E-04	2.59	2.55	0.08	0.000073	100	43	32	0.5	0.2
03/10	42.1	40.7	0.6	6.54E-04	9.51	8.77	0.55	0.000102	85	72	33	2.7	0.2
03/11	38.9	37.6	0.4	6.13E-04	5.39	4.97	0.30	0.000066	69	67	33	2.1	0.2
03/12	38.3	37.1	0.3	6.00E-04	2.94	2.78	0.09	0.000063	63	43	30	0.5	0.1
03/13	36.2	35.2	0.3	6.37E-04	1.50	1.50	0.07	0.000106	51	39	32	0.4	0.1
03/14	36.3	35.3	0.3	6.45E-04	1.73	1.61	0.07	0.00011	51	39	31	0.4	0.1
03/15	39.7	38.4	0.4	6.22E-04	2.60	2.32	0.07	0.00006	30	45	34	0.5	0.3
03/16	37.3	36.2	0.3	6.13E-04	2.57	2.53	0.08	0.000076	69	42	32	0.4	0.1
03/17	39.1	38.0	0.4	6.18E-04	1.67	1.52	0.05	0.000053	54	42	36	0.5	0.3
03/18	39.9	38.7	0.4	6.15E-04	2.21	2.00	0.06	0.000049	74	43	35	0.5	0.3
03/19	39.6	38.5	0.4	6.26E-04	2.30	2.13	0.06	0.00005	71	43	35	0.5	0.3
03/20	36.4	35.4	0.3	6.42E-04	1.86	1.86	0.07	0.000082	55	41	32	0.5	0.1
03/21	37.5	36.4	0.3	6.37E-04	3.15	3.00	0.14	0.000092	53	57	33	1.2	0.1
03/22	37.8	36.4	0.3	5.94E-04	2.50	2.23	0.09	0.000111	48	42	31	0.6	0.2

APPENDIX 5
MOKELUMNE RIVER FISHERIES MONITORING PROGRAM OF THE EAST BAY M.U.D.-1993
Juvenile Salmonid Downstream Migrant Monitoring
Size and Condition Database
Daily Average Size of Y-O-Y Salmon Captured Near the Elliott Road Trap Site

DATE	AVGTL (mm)	AVGFL (mm)	AVGWT (g)	AVGK	STDTL	STDFL	STDWT	STDK	N	MAXTL (mm)	MINTL (mm)	MAXWT (g)	MINWT (g)
06/12	95.4	87.3			7.03	6.13			28	110	82		
06/13	99.9	91.2			7.70	6.71			27	116	80		
06/14	97.4	89.0	7.6	8.26E-04	8.81	7.80	2.14	0.000071	27	111	74	12	4
06/15	98.7	86.9	7.4	8.67E-04	8.43	8.99	2.32	0.000231	16	107	71	10	0
06/16	104.3	94.6	7.5	6.59E-04	8.63	8.24	1.63	0.000083	29	116	80	10	4
06/17	98.9	89.0	7.7	7.83E-04	9.04	8.16	1.89	0.000084	9	115	87	11	5
06/18	100.7	91.4	8.9	7.00E-04	9.73	9.05	2.23	0.000102	28	121	75	12	0
06/19	97.5	88.1	8.6	9.35E-04	9.57	7.78	1.54	0.000126	19	114	82	11.5	5.6
06/20	105.1	95.5	9.0	7.73E-04	8.63	6.22	1.54	0.000068	13	116	91	12.6	7.1
06/21	96.7	88.0	8.5	9.20E-04	6.72	5.75	2.47	0.000092	16	111	87	14.6	5.4
06/22	97.7	87.8	9.0	9.43E-04	9.31	7.96	2.61	0.000047	13	117	85	15	5.8
06/23	99.6	89.9	8.5	8.51E-04	10.56	9.85	2.13	0.000062	8	115	85	12.2	5.3
06/24	106.0	95.5	9.7	8.14E-04	1.00	0.50	0.50	0.000019	2	107	105	10.2	9.2
06/25	100.0	89.9	8.9	8.86E-04	5.52	5.42	1.12	0.00007	8	110	93	11.4	7.7
06/26	102.2	92.1	8.8	8.18E-04	5.86	5.36	1.30	0.000038	15	113	92	11.5	6.6
06/27	99.5	90.3	8.1	8.16E-04	2.36	1.89	0.60	0.000011	6	102	95	8.8	7
06/28	96.3	87.0	8.4	9.56E-04	12.26	11.52	2.35	0.000147	10	112	74	11.4	5.2
06/29	95.5	86.6	8.4	9.55E-04	5.84	5.30	1.56	0.000087	11	110	89	11.5	6.3
06/30	95.0	87.0	8.3	9.68E-04	0.00	0.00	0.00	0	1	95	95	8.3	8.3
07/01	97.5	87.5	8.7	9.39E-04	2.50	2.50	0.40	0.000029	2	100	95	9.1	8.3
07/02									0				
07/03	97.5	88.6	7.8	8.30E-04	4.83	4.50	1.33	0.000051	11	105	90	10.8	6
07/04	96.6	89.6	8.3	8.58E-04	5.71	5.00	1.27	0.000053	5	107	90	10.5	7
07/05	87.0	79.0	5.4	8.20E-04	0.00	0.00	0.00	0	1	87	87	5.4	5.4
07/06	106.0	97.0	10.2	8.81E-04	8.00	8.00	1.05	0.000105	2	114	98	11.2	9.1
07/07	93.3	84.7	7.5	8.78E-04	9.29	7.59	2.91	0.000078	3	106	84	11.5	4.6
07/08	103.0	93.5	9.9	9.06E-04	2.00	1.50	0.40	0.000016	2	105	101	10.3	9.5
07/09	90.0	81.5	6.2	8.43E-04	2.00	1.50	0.35	8.2E-06	2	92	88	6.5	5.8
07/10	93.5	86.5	8.5	1.07E-03	11.50	9.50	1.35	0.000221	2	105	82	9.8	7.1
07/11	98.7	90.3	7.9	8.18E-04	8.22	8.18	1.70	0.00006	3	108	88	10.2	6.1
07/12	105.7	96.3	8.7	7.08E-04	8.80	6.34	3.18	0.000117	3	115	99	13.1	5.6
07/13	98.5	89.3	8.2	8.26E-04	5.85	4.82	2.59	0.000157	4	106	91	11.3	4.2
07/14									0				
07/15									0				
07/16									0				
07/17	125.0	115.0	13.4	6.86E-04	0.00	0.00	0.00	0	1	125	125	13.4	13.4
07/18	121.0	111.0	14.1	7.96E-04	0.00	0.00	0.00	0	1	121	121	14.1	14.1
07/19	97.0	89.0	6.1	6.68E-04	0.00	0.00	0.00	0	1	97	97	6.1	6.1
07/20									0				
07/21	77.0	71.0	5.9	1.29E-03	0.00	0.00	0.00	0	1	77	77	5.9	5.9
07/22									0				
07/23									0				
07/24													
07/25													
07/26													
07/27													
07/28													
07/29													
07/30													
07/31													

APPENDIX 6
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Environmental Conditions at the Woodbridge Dam Trap Site

	Physical Environmental Data				Solar & Lunar Data			Stream Flow	
	Surface Temp	Secchi Depth (cm)							
DATE	* Daily Avg Temp. (F)	Night Avg. Secchi	Diurnal Avg. Secchi	Daily Avg. Secchi	Sunrise Time	Sunset Time	Lunar Phase (age)	Woodbridge Q (cfs)	WID CanalQ (cfs)
01-Jan-93					07:24	16:56	9	133	0
02-Jan-93					07:24	16:57	10	125	0
03-Jan-93					07:24	16:58	11	113	0
04-Jan-93					07:24	16:59	12	109	0
05-Jan-93					07:24	17:00	13	107	0
06-Jan-93					07:24	17:01	14	113	0
07-Jan-93					07:23	17:02	15	167	0
08-Jan-93					07:23	17:03	16	192	0
09-Jan-93					07:23	17:04	17	162	0
10-Jan-93					07:23	17:05	18	138	0
11-Jan-93					07:23	17:06	19	123	0
12-Jan-93					07:22	17:07	20	130	0
13-Jan-93					07:22	17:08	21	209	0
14-Jan-93					07:22	17:10	22	239	0
15-Jan-93					07:21	17:11	23	160	0
16-Jan-93					07:21	17:12	24	134	0
17-Jan-93					07:20	17:13	25	171	0
18-Jan-93					07:20	17:14	26	211	0
19-Jan-93	48.0				07:19	17:16	27	171	0
20-Jan-93	49.0				07:18	17:17	28	174	0
21-Jan-93	50.0				07:18	17:18	29	108	0
22-Jan-93	50.7				07:22	17:19	0	208	0
23-Jan-93					07:21	17:21	1	176	0
24-Jan-93					07:20	17:22	2	154	0
25-Jan-93	47.5	70	70	70	07:20	17:23	3	147	0
26-Jan-93	47.0	80	80	80	07:19	17:24	4	145	0
27-Jan-93	47.3	100	100	100	07:18	17:26	5	143	0
28-Jan-93	47.5	100	90	95	07:17	17:27	6	141	0
29-Jan-93	47.7	110	95	102.5	07:16	17:28	7	142	0
30-Jan-93	47.5	90	80	85	07:15	17:30	8	141	0
31-Jan-93	48.0	90	80	85	07:14	17:31	9	144	0
01-Feb-93	49.3	80	77	78.5	07:13	17:32	10	144	0
02-Feb-93	48.7	75	77	76	07:12	17:33	11	144	0
03-Feb-93	49.0	75	85	80	07:11	17:35	12	143	0
04-Feb-93	49.7	90	82.5	86.25	07:10	17:36	13	142	0
05-Feb-93	50.0	85	72.5	78.75	07:09	17:37	14	140	0
06-Feb-93	52.0	55	50	52.5	07:08	17:39	15	141	0
07-Feb-93	51.0	50	50	50	07:07	17:33	16	141	0
08-Feb-93	51.5	50	50	50	07:05	17:34	17	190	0
09-Feb-93	51.7	45	40	42.5	07:04	17:36	18	184	0
10-Feb-93	51.7	40	45	42.5	07:03	17:37	19	184	0
11-Feb-93	50.5	35	35	35	07:02	17:38	20	184	0
12-Feb-93	51.0	60	70	65	07:00	17:39	21	153	0
13-Feb-93	51.0	75	80	77.5	06:59	17:41	22	147	0
14-Feb-93	49.0	85	82.5	83.75	06:58	17:42	23	146	0
15-Feb-93	48.5	85	85	85	06:56	17:43	24	145	0
16-Feb-93	49.0	80	75	77.5	06:55	17:45	25	144	0
17-Feb-93	49.7	75	85	80	06:53	17:46	26	151	0
18-Feb-93	49.5	65	50	57.5	06:52	17:47	27	163	0
19-Feb-93	52.5	45	40	42.5	06:51	17:48	28	215	0
20-Feb-93	51.7	40	40	40	06:49	17:50	29	209	0
21-Feb-93	51.3	45	45	45	06:48	17:51	0	192	0
22-Feb-93	52.0	50		50	06:46	17:52	1	176	0
23-Feb-93	51.5	50	40	45	06:45	17:53	2	207	0
24-Feb-93	51.3	45	40	42.5	06:43	17:55	3	236	0
25-Feb-93	51.0	40		40	06:41	17:56	4	185	0
26-Feb-93	51.0		60	30	06:40	17:57	5	182	0
27-Feb-93	48.5	70	85	77.5	06:38	17:58	6	226	0
28-Feb-93	50.0	80	60	70	06:37	18:00	7	374	0
01-Mar-93	50.5	60	65	62.5	06:35	18:01	8	305	0
02-Mar-93	51.0	60	65	62.5	06:34	18:02	9	285	0
03-Mar-93	51.0	80	80	80	06:32	18:03	10	392	0
04-Mar-93	51.5	70	65	67.5	06:30	18:05	11	445	0
05-Mar-93	52.0	95	110	102.5	06:29	18:06	12	487	0
06-Mar-93	51.0	95	90	92.5	06:27	18:07	13	484	0
07-Mar-93	52.7	110	112.5	111.25	06:25	18:08	14	471	0
08-Mar-93	52.5	100	105	102.5	06:24	18:09	15	464	0
09-Mar-93	52.3	105	120	112.5	06:22	18:10	16	475	0
10-Mar-93	52.0	150	135	142.5	06:20	18:12	17	479	0
11-Mar-93	51.5	105	110	107.5	06:25	18:13	18	483	0
12-Mar-93	52.0	115	107.5	111.25	06:23	18:14	19	483	0
13-Mar-93	54.0	125	145	135	06:21	18:15	20	488	0
14-Mar-93	53.5	150	155	152.5	06:19	18:16	21	495	0
15-Mar-93	50.5	130	110	120	06:18	18:17	22	495	11
16-Mar-93	52.0	105	105	105	06:16	18:19	23	455	18

* Manual recordings (a.m./p.m.) in BOLD; others are electronically recorded

APPENDIX 6
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Environmental Conditions at the Woodbridge Dam Trap Site

	Physical Environmental Data				Solar & Lunar Data			Stream Flow	
	Surface Temp	Secchi Depth (cm)							
DATE	* Daily Avg Temp (F)	Night Avg Secchi	Diurnal Avg Secchi	Daily Avg Secchi	Sunrise Time	Sunset Time	Lunar Phase (age)	Woodbridge Q (cfs)	WID CanalQ (cfs)
17-Mar-93	51.0	100	120	110	06:14	18:20	24	502	20
18-Mar-93	51.0	135	130	132.5	06:13	18:21	25	473	30
19-Mar-93	50.5	145	140	142.5	06:11	18:18	26	470	33
20-Mar-93	52.0	160	185	172.5	06:09	18:17	27	472	33
21-Mar-93	54.0	190	200	195	06:07	18:18	28	469	33
22-Mar-93	53.0	185	145	165	06:06	18:20	29	476	32
23-Mar-93	51.5	125	165	145	06:04	18:21	0	507	31
24-Mar-93	51.0	150	145	147.5	06:02	18:22	1	531	32
25-Mar-93	50.5	145	105	125	06:00	18:23	2	530	57
26-Mar-93	51.3	100	95	97.5	05:59	18:24	3	470	102
27-Mar-93	52.5	105	125	115	05:57	18:25	4	443	110
28-Mar-93	52.0	150	165	157.5	05:55	18:26	5	429	110
29-Mar-93	51.5	135	115	125	05:53	18:27	6	415	117
30-Mar-93	52.0	165	210	187.5	05:52	18:29	7	395	131
31-Mar-93	51.0	205		205	05:50	18:30	8	385	132
01-Apr-93	54.0		210	210	05:54	18:31	9	412	118
02-Apr-93	53.0	200	180	190	05:53	18:32	10	426	104
03-Apr-93	51.0	165	150	157.5	05:51	18:33	11	435	98
04-Apr-93	51.5	140	145	142.5	06:49	19:26	12	436	98
05-Apr-93	50.0	155		155	06:47	19:29	13	433	94
06-Apr-93	53.0	180	160	170	06:46	19:30	14	442	85
07-Apr-93	52.5	155	175	165	06:44	19:32	15	482	60
08-Apr-93	49.0	180		180	06:42	19:33	16	457	91
09-Apr-93	54.0	130	170	150	06:41	19:34	17	433	102
10-Apr-93	55.0	175		175	06:39	19:35	18	432	102
11-Apr-93	55.0	190	205	197.5	06:37	19:36	19	431	101
12-Apr-93	53.5	190	165	177.5	06:36	19:37	20	437	106
13-Apr-93	54.0	150	145	147.5	06:34	19:38	21	655	108
14-Apr-93	53.0				06:32	19:39	22	910	113
15-Apr-93	55.0		80	80	06:31	19:41	23	952	114
16-Apr-93	54.5	85	90	87.5	06:29	19:42	24	950	113
17-Apr-93	54.0	80	65	72.5	06:28	19:43	25	985	108
18-Apr-93	54.5	80	105	92.5	06:26	19:44	26	981	109
19-Apr-93	54.0	95	100	97.5	06:24	19:45	27	994	109
20-Apr-93	54.4	100	95	97.5	06:23	19:46	28	1000	110
21-Apr-93	54.5	110	110	110	06:21	19:47	0	996	111
22-Apr-93	54.2	100	100	100	06:20	19:48	1	991	110
23-Apr-93	53.5	115	115	115	06:18	19:50	2	977	115
24-Apr-93	53.6	125	125	125	06:17	19:51	3	971	132
25-Apr-93	54.5	110	105	107.5	06:15	19:52	4	966	136
26-Apr-93	54.2	120	125	122.5	06:14	19:53	5	974	131
27-Apr-93	54.6	115	115	115	06:12	19:54	6	973	129
28-Apr-93	55.2	110	110	110	06:11	19:55	7	969	128
29-Apr-93	55.8	120	125	122.5	06:10	19:56	8	963	130
30-Apr-93	56.2	125	125	125	06:08	19:57	9	924	144
01-May-93	55.9	135	135	135	06:07	19:59	10	924	155
02-May-93	56.0	140	140	140	06:06	20:00	11	924	152
03-May-93	56.0	125	125	125	06:11	20:01	12	928	148
04-May-93	54.7	130	115	122.5	06:10	20:02	13	945	148
05-May-93	55.4	115	115	115	06:09	20:03	14	945	146
06-May-93	56.2	120	140	130	06:07	20:04	15	944	145
07-May-93	55.8	120	110	115	06:06	20:05	16	942	139
08-May-93	55.8	120	130	125	06:05	20:06	17	946	140
09-May-93	56.2	145	150	147.5	06:04	20:07	18	945	133
10-May-93	57.3	150	145	147.5	06:03	20:08	19	977	135
11-May-93	56.7	135		135	06:01	20:09	20	1050	151
12-May-93	55.6	120	120	120	06:00	20:10	21	933	162
13-May-93	55.7	115	135	125	05:59	20:12	22	992	171
14-May-93	56.5	160	135	142.5	05:58	20:08	23	1020	171
15-May-93	56.4	115		115	05:57	20:09	24	1020	171
16-May-93	56.4	110	130	120	05:56	20:10	25	1040	166
17-May-93	57.2	155	160	157.5	05:55	20:11	26	1050	167
18-May-93	56.9	160	165	162.5	05:54	20:12	27	1020	176
19-May-93	57.5	165	170	167.5	05:53	20:13	28	994	177
20-May-93	57.3		160	160	05:52	20:14	29	976	178
21-May-93	56.7	160	150	155	05:51	20:15	0	976	178
22-May-93	57.6	155	170	162.5	05:51	20:16	1	979	178
23-May-93	58.0	165	160	162.5	05:50	20:17	2	983	167
24-May-93	57.4	150	150	150	05:49	20:17	3	1030	160
25-May-93	57.1	150	165	157.5	05:48	20:18	4	1070	158
26-May-93	57.2	167.5	162.5	165	05:48	20:19	5	1060	152
27-May-93	57.2	155	155	155	05:47	20:20	6	1070	150
28-May-93	57.0	160	165	162.5	05:46	20:21	7	1060	148
29-May-93	57.5	170	175	172.5	05:46	20:20	8	1050	142
30-May-93	57.2	155	150	152.5	05:45	20:23	9	1050	142

* Manual recordings (a.m./p.m.) in BOLD; others are electronically recorded

APPENDIX 8
Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
Juvenile Salmonid Downstream Migrant Monitoring
Environmental Conditions at the Woodbridge Dam Trap Site

	Physical Environmental Data				Solar & Lunar Data			Stream Flow	
	Surface Temp.	Secchi Depth (cm)							
DATE	* Daily Avg. Temp. (F)	Night Avg. Secchi	Diurnal Avg. Secchi	Daily Avg. Secchi	Sunrise Time	Sunset Time	Lunar Phase (age)	Woodbridge Q (cfs)	WID CanalQ (cfs)
31-May-93	57.3	120	85	102.5	05:45	20:24	10	1100	144
01-Jun-93	57.8	120	140	130	05:44	20:24	11	1070	146
02-Jun-93	57.9	125		125	05:44	20:25	12	1070	151
03-Jun-93	57.5	160	160	160	05:43	20:26	13	1040	161
04-Jun-93	57.0	155	125	140	05:43	20:27	14	1050	167
05-Jun-93	56.7	110	130	120	05:42	20:27	15	1050	171
06-Jun-93	56.1	135	137.5	136.25	05:42	20:28	16	1060	168
07-Jun-93	55.8	145	170	157.5	05:42	20:28	17	1060	169
08-Jun-93	57.3	150	150	150	05:42	20:29	18	1050	174
09-Jun-93	58.4	165	170	167.5	05:42	20:30	19	1040	174
10-Jun-93	58.9	155	150	152.5	05:41	20:30	20	1020	178
11-Jun-93	58.5	155	160	157.5	05:41	20:31	21	1010	183
12-Jun-93	58.5	155	170	167.5	05:41	20:31	22	1000	185
13-Jun-93	58.7	180	165	172.5	05:41	20:32	23	993	189
14-Jun-93	59.5	150	155	152.5	05:41	20:32	24	971	207
15-Jun-93	59.6	160	160	160	05:41	20:33	25	920	236
16-Jun-93	59.5	160	160	160	05:41	20:33	26	925	245
17-Jun-93	59.7	160	155	157.5	05:41	20:33	27	872	280
18-Jun-93	60.4	155	145	150	05:41	20:34	28	859	306
19-Jun-93	60.2	145	155	150	05:41	20:34	0	887	310
20-Jun-93	59.5	155	160	157.5	05:41	20:34	1	871	314
21-Jun-93	58.4	160	160	160	05:41	20:34	2	883	316
22-Jun-93	57.4	160	160	160	05:42	20:35	3	891	313
23-Jun-93	57.9	160	160	160	05:42	20:35	4	858	309
24-Jun-93	58.5	160	155	157.5	05:42	20:35	5	860	312
25-Jun-93	58.9	155	165	160	05:42	20:35	6	867	308
26-Jun-93	59.2	155	145	150	05:43	20:35	7	865	307
27-Jun-93	59.3	150	150	150	05:43	20:35	8	863	295
28-Jun-93	58.7	150	150	150	05:44	20:35	9	878	296
29-Jun-93	58.6	155	150	152.5	05:44	20:35	10	903	290
30-Jun-93	58.9	150	150	150	05:44	20:35	11	899	287
01-Jul-93	59.2	155	160	157.5	05:45	20:35	12	884	287
02-Jul-93	59.3	160	155	157.5	05:46	20:35	13	881	288
03-Jul-93	59.0	155	155	155	05:46	20:34	14	871	281
04-Jul-93	59.1	155	155	155	05:47	20:34	15	877	286
05-Jul-93	59.5	120	150	135	05:47	20:34	16	894	278
06-Jul-93	59.5	155	160	157.5	05:48	20:34	17	889	276
07-Jul-93	59.5	160	160	160	05:48	20:33	18	901	282
08-Jul-93	59.3	160	155	157.5	05:49	20:33	19	896	287
09-Jul-93	59.3	150	150	150	05:50	20:33	20	890	296
10-Jul-93	59.3	155	155	155	05:50	20:33	21	887	298
11-Jul-93	59.4	145	145	145	05:51	20:32	22	884	298
12-Jul-93	59.6	155	150	152.5	05:52	20:31	23	883	296
13-Jul-93	59.6	145	155	150	05:53	20:31	24	864	296
14-Jul-93	59.4	160	160	160	05:54	20:30	25	871	294
15-Jul-93	59.2	160	160	160	05:54	20:29	26	872	295
16-Jul-93	59.3	160	155	157.5	05:55	20:29	27	873	298
17-Jul-93	59.4	155	155	155	05:56	20:28	28	875	294
18-Jul-93	59.6	150	155	152.5	05:57	20:27	29	883	290
19-Jul-93	59.6	155	150	152.5	05:58	20:27	0	895	284
20-Jul-93	59.5	150	160	155	05:59	20:26	1	902	281
21-Jul-93	59.4	160	160	160	06:00	20:25	2	941	251
22-Jul-93	59.6	160	160	160	06:01	20:24	3	932	244
23-Jul-93	60.5	160	155	157.5	06:02	20:23	4	935	250
24-Jul-93	61.2	155	155	155	06:02	20:22	5	914	252
25-Jul-93	62.1	155	150	152.5	06:03	20:26	6	922	251
26-Jul-93	62.0	150	155	152.5	06:04	20:25	7	926	251
27-Jul-93	62.1	155	150	152.5	06:05	20:24	8	912	282
28-Jul-93	61.9	150	155	152.5	06:06	20:23	9	878	277
29-Jul-93	61.7	160	155	157.5	06:07	20:22	10	883	269
30-Jul-93	61.4				06:08	20:21	11	904	261
31-Jul-93					06:09	20:20	12	891	248
01-Aug-93									

* Manual recordings (a.m./p.m.) in BOLD; others are electronically recorded

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Mokelumne River Fisheries Monitoring Program of the East Bay MUD - 1993
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	Physical Environmental Data						
	Surface Temp. (F)	Secchi Depth (cm)				Stream Flow	
DATE	* Daily Avg. Temp.	Night Avg. Secch	Diurnal Avg. Secch	Daily Avg. Secchi	Rainfall (in.)	Victor Q (cfs)	CamancheQ (cfs)
01-Jan-93						167	174
02-Jan-93						170	164
03-Jan-93						160	163
04-Jan-93						158	163
05-Jan-93						158	164
06-Jan-93						159	165
07-Jan-93						203	233
08-Jan-93						235	214
09-Jan-93						198	180
10-Jan-93						171	174
11-Jan-93						164	167
12-Jan-93						162	179
13-Jan-93						282	284
14-Jan-93						230	183
15-Jan-93						177	167
16-Jan-93						174	188
17-Jan-93						215	250
18-Jan-93						260	220
19-Jan-93						201	197
20-Jan-93						196	213
21-Jan-93						245	234
22-Jan-93						249	228
23-Jan-93						205	196
24-Jan-93						192	189
25-Jan-93						188	189
26-Jan-93						186	188
27-Jan-93						184	187
28-Jan-93						185	189
29-Jan-93	47.0				0	186	189
30-Jan-93	48.5				0	187	185
31-Jan-93	48.5				0	188	195
01-Feb-93	49.0				0	189	196
02-Feb-93	49.5				0	189	200
03-Feb-93	50.0				0	188	198
04-Feb-93	49.5				0	177	194
05-Feb-93	50.5				0	186	196
06-Feb-93	51.5				0.18	186	195
07-Feb-93	51.5				0	185	197
08-Feb-93	50.0				1.13	204	210
09-Feb-93	51.0				0	258	248
10-Feb-93	51.0				1	211	211
11-Feb-93	50.5				0.13	198	210
12-Feb-93	51.5				0	196	205
13-Feb-93	51.5				0	191	203
14-Feb-93	49.0				0	191	195
15-Feb-93	48.5				0	189	195
16-Feb-93	49.0	80		80	0	190	197
17-Feb-93	48.5	90	110	100	0.61	196	204
18-Feb-93	49.5	110	100	105	0	202	225
19-Feb-93	52.5	55	15	35	1.25	285	240
20-Feb-93	51.0	30	50	40	0	243	228
21-Feb-93	51.0	65	75	70	0	236	210
22-Feb-93	49.8	85	90	87.5	0	217	210
23-Feb-93	51.0	55	20	37.5	1.22	260	256
24-Feb-93	51.0	25	40	32.5	0	270	222
25-Feb-93	50.5	55	70	62.5	0.15	220	205
26-Feb-93	50.0	85	85	85	0	229	250
27-Feb-93	48.5	65	55	60	0	364	452
28-Feb-93	49.5	65	75	70	0.53	553	569
01-Mar-93	50.0	75	75	75	0	585	576
02-Mar-93	49.5	75	80	77.5	0	585	581
03-Mar-93	50.5	90	90	90	0	585	566
04-Mar-93	49.0	85	85	85	0	589	567
05-Mar-93	50.5	100	100	100	0	590	567
06-Mar-93	49.5	85	85	85	0	595	568
07-Mar-93	50.5	105	120	112.5	0	596	568
08-Mar-93	50.5	115	110	112.5	0	595	568
09-Mar-93	49.5	105	105	105	0	595	588
10-Mar-93	50.0	95	105	100	0.78	595	568
11-Mar-93	49.5	115	105	110	0	593	585
12-Mar-93	49.5	110	110	110	0	593	567
13-Mar-93	50.5	125	140	132.5	0	597	568

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	Physical Environmental Data						
	Surface Temp. (F)	Secchi Depth (cm)				Stream Flow	
DATE	* Daily Avg. Temp.	Night Avg. Secch	Diurnal Avg. Secch	Daily Avg. Secchi	Rainfall (in.)	Victor Q (cfs)	CamancheQ (cfs)
14-Mar-93	50.0	135	135	135	0	597	575
15-Mar-93	49.5	130	120	125	0	602	582
16-Mar-93	49.5	120	125	122.5	0	603	578
17-Mar-93	49.5	130	140	135	0	603	576
18-Mar-93	49.0	140	135	137.5	0	596	575
19-Mar-93	49.0	140	140	140	0	593	575
20-Mar-93	50.0	150	160	155	0	591	571
21-Mar-93	50.0	165	175	170	0	588	571
22-Mar-93	50.0	185	185	185	0	595	576
23-Mar-93	48.5	155	145	150	0	599	581
24-Mar-93	50.0	125	65	95	1.5	640	617
25-Mar-93	49.5	85	92.5	88.75	0.5	647	522
26-Mar-93	50.5	85	85	85	0	646	612
27-Mar-93	49.5	105	140	122.5	0	619	586
28-Mar-93	49.5	155	165	160	0	609	588
29-Mar-93	49.5	145	145	145	0.58	605	582
30-Mar-93	51.5	155	150	152.5	0	602	581
31-Mar-93	50.5	170	170	170	0	601	584
01-Apr-93	50.0	155	165	160	0	602	586
02-Apr-93	49.0	175	185	180	0	608	576
03-Apr-93	49.0	180	160	170	0	598	572
04-Apr-93	49.0	160	170	165	0	594	587
05-Apr-93	50.0	170	180	175	0	595	573
06-Apr-93	49.0	190	190	190	0	600	575
07-Apr-93	49.0	180	170	175	0	601	573
08-Apr-93	49.0	175		175	0	594	567
09-Apr-93	51.5	185	180	182.5	0.22	592	565
10-Apr-93	52.0	175	175	175	0	591	570
11-Apr-93	52.5	180	185	182.5	0	591	571
12-Apr-93	50.0	170	155	162.5	0	624	702
13-Apr-93	54.0	117.5		117.5	0	994	1180
14-Apr-93	51.0	72.5	75	73.75	0	1160	1230
15-Apr-93	53.0	85	100	92.5	0	1170	1230
16-Apr-93	52.5	95	75	85	0	1160	1220
17-Apr-93	51.5	70	70	70	0.2	1170	1230
18-Apr-93	51.5	85	95	90	0	1190	1240
19-Apr-93	51.5	100	110	105	0	1190	1240
20-Apr-93	53.7	110	130	120	0	1190	1240
21-Apr-93	52.1	120	135	127.5	0	1190	1230
22-Apr-93	52.0	115	105	110	0	1190	1220
23-Apr-93	51.5	125	125	125	0	1190	1220
24-Apr-93	52.4	130	140	135	0	1190	1230
25-Apr-93	52.3	130	122.5	126.25	0	1200	1230
26-Apr-93	52.7	127.5	125	126.25	0	1200	1230
27-Apr-93	52.7	125	135	130	0	1200	1230
28-Apr-93	53.1	150	155	152.5	0	1200	1230
29-Apr-93	53.4	145	140	142.5	0	1190	1220
30-Apr-93	53.5	140	140	140	0	1180	1210
01-May-93	53.3	135	135	135	0	1190	1220
02-May-93	53.9	130	130	130	0	1180	1210
03-May-93	53.4	125	125	125	0	1190	1220
04-May-93	52.8	130	140	135	0	1190	1220
05-May-93	53.6	140	125	132.5	0	1190	1230
06-May-93	53.7	125	160	142.5	0	1190	1220
07-May-93	53.6	195	190	192.5	0	1190	1230
08-May-93	53.6	195	205	200	0.02	1200	1230
09-May-93	54.1	175	150	162.5	0	1200	1230
10-May-93	55.0	150	155	152.5	0	1210	1280
11-May-93	54.0	155		155	0	1230	1250
12-May-93	53.5	160		160	0	1170	1270
13-May-93	54.4	160	175	167.5	0	1230	1340
14-May-93	54.4	180	150	165	0	1230	1340
15-May-93	54.1	150	150	150	0	1230	1340
16-May-93	54.7	155		155	0	1230	1350
17-May-93	54.6	160	170	165	0	1240	1350
18-May-93	54.8	175	165	170	0	1230	1340
19-May-93	55.1	155		155	0	1220	1330
20-May-93	54.7	155		155	0	1220	1310
21-May-93	54.9	160	175	167.5	0	1230	1330
22-May-93	55.2	170		170	0	1220	1310
23-May-93	55.5	170		170	0	1230	1330
24-May-93	54.8	170	180	175	0.7	1230	1330

* Manual recordings (a.m./p.m.) in BOLD; others are electronically recorded

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	Physical Environmental Data						
	Surface Temp. (F)	Secchi Depth (cm)				Stream Flow	
DATE	* Daily Avg. Temp.	Night Avg. Secch	Diurnal Avg. Secch	Daily Avg. Secchi	Rainfall (in.)	Victor Q (cfs)	CamancheQ (cfs)
25-May-93	54.9	200	185	192.5	0	1240	1330
26-May-93	54.1	165		165	0	1240	1340
27-May-93	54.8	135	110	122.5	0	1240	1340
28-May-93	54.0	125	135	130	0	1240	1340
29-May-93	55.5	195	245	220	0.68	1230	1320
30-May-93	54.5	225	200	212.5	0	1240	1320
31-May-93	54.0	155	120	137.5	0	1240	1330
01-Jun-93	55.5	160	210	185	0	1240	1330
02-Jun-93	55.0	180		180	0	1240	1320
03-Jun-93	54.5	180	195	187.5	0	1240	1330
04-Jun-93	55.0	180	185	182.5	0	1240	1320
05-Jun-93	55.8	200	180	190	0	1240	1320
06-Jun-93	55.5	160	165	162.5	1	1240	1310
07-Jun-93	55.5	180	195	187.5	0	1240	1320
08-Jun-93	56.5	225	255	240	0	1240	1320
09-Jun-93	55.0	235	205	220	0	1240	1310
10-Jun-93	55.0	200	200	200	0	1230	1310
11-Jun-93	55.0	205	205	205	0	1230	1310
12-Jun-93	55.3	200	200	200	0	1230	1310
13-Jun-93	55.5	205	205	205	0	1230	1310
14-Jun-93	56.5	205	210	207.5	0	1220	1300
15-Jun-93	57.0	225	240	232.5	0	1220	1310
16-Jun-93	57.5	240	240	240	0	1230	1310
17-Jun-93	57.0	240	240	240	0	1220	1310
18-Jun-93	57.3	240	240	240	0	1220	1310
19-Jun-93	57.0	240	240	240	0	1220	1320
20-Jun-93	55.0	235	235	235	0	1220	1320
21-Jun-93	56.3	225	220	222.5	0	1220	1320
22-Jun-93	56.5	235	235	235	0	1230	1330
23-Jun-93	56.0	235	235	235	0	1230	1320
24-Jun-93	55.3	240	240	240	0	1230	1330
25-Jun-93	55.8	240	240	240	0	1230	1330
26-Jun-93	56.3	215	195	205	0	1220	1320
27-Jun-93	57.3	200	195	197.5	0	1220	1330
28-Jun-93	56.4	215	235	225	0	1230	1330
29-Jun-93	56.0	235	240	237.5	0	1230	1330
30-Jun-93	55.8	240	240	240	0	1230	1330
01-Jul-93	56.0	240	240	240	0	1230	1330
02-Jul-93	56.0	235	210	222.5	0	1220	1330
03-Jul-93	56.0	205	215	210	0	1220	1330
04-Jul-93	56.0	215	215	215	0	1220	1320
05-Jul-93	56.5	250	290	270	0	1230	1320
06-Jul-93	56.2	280	260	270	0	1230	1320
07-Jul-93	56.2	245	240	242.5	0	1230	1330
08-Jul-93	56.2	240	240	240	0	1230	1330
09-Jul-93	56.2	240	230	235	0	1230	1320
10-Jul-93	56.3	230	230	230	0	1220	1310
11-Jul-93	56.4	240	230	235	0	1220	1310
12-Jul-93	56.5	235	245	240	0	1220	
13-Jul-93	56.4	240	240	240	0	1220	
14-Jul-93	56.4	240	240	240	0	1220	
15-Jul-93	56.4	240	240	240	0	1220	
16-Jul-93	56.5	240	240	240	0	1220	
17-Jul-93	56.6	240	205	222.5	0	1220	
18-Jul-93	56.7	185	200	192.5	0	1220	
19-Jul-93	56.7	220	230	225	0	1230	
20-Jul-93	56.7	225	235	230	0	1220	
21-Jul-93	56.7	240	240	240	0	1220	
22-Jul-93	57.0	240	240	240	0	1230	
23-Jul-93	55.9	240		240	0	1230	
24-Jul-93						1220	
25-Jul-93						1220	
26-Jul-93						1220	
27-Jul-93						1220	
28-Jul-93						1220	
29-Jul-93						1220	
30-Jul-93						1220	
31-Jul-93						1220	
01-Aug-93							
Totals:					12.38		

* Manual recordings (a.m./p.m.) in BOLD; others are electronically recorded

Appendix 8. Delta Outflow (in CFS), January-July, 1993

JANUARY 1993

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TOTAL COLUMNS 1, 2 & 3	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	TOTAL EXPORT	NET CONSUMPTIV USE	TOTAL DEMAND	TOTAL OUTFLOW INDEX
1	14,725	195	978	15,898	4,207	83	6,492	0	10,782	(600)	10,182	5,716
2	13,833	195	1,048	15,074	4,048	76	6,497	0	10,621	(700)	9,921	5,153
3	22,149	195	1,078	23,422	4,089	76	3,997	0	8,162	(800)	7,362	16,060
4	34,551	195	1,127	35,873	4,128	86	5,290	0	9,504	(800)	8,704	27,169
5	34,513	195	1,209	35,917	3,907	81	5,801	0	9,789	(900)	8,889	27,028
6	29,113	195	1,243	30,551	3,995	86	6,497	0	10,578	(900)	9,678	20,873
7	23,659	195	1,255	25,109	4,028	79	7,327	0	11,434	(900)	10,534	14,575
8	26,086	195	1,358	27,639	4,021	85	6,491	0	10,597	(900)	9,697	17,942
9	29,727	195	1,951	31,873	4,031	84	6,495	0	10,610	(900)	9,710	22,163
10	38,029	195	2,841	41,065	4,021	79	6,499	0	10,599	(900)	9,699	31,366
11	39,566	195	3,130	42,891	4,005	82	7,089	0	11,176	(1,000)	10,176	32,715
12	33,235	195	4,070	37,500	3,958	90	7,793	0	11,841	(1,000)	10,841	26,659
13	34,056	195	3,598	37,849	3,966	77	7,872	0	11,915	(1,000)	10,915	26,934
14	34,602	195	4,277	39,074	3,856	70	8,088	0	12,014	(1,000)	11,014	28,060
15	42,083	195	6,320	48,598	3,767	88	7,351	0	11,206	(1,000)	10,206	38,392
16	46,688	195	6,721	53,604	3,953	89	8,758	0	12,800	(1,000)	11,800	41,804
17	51,717	195	6,150	58,062	3,959	91	9,999	0	14,049	(1,000)	13,049	45,013
18	58,175	195	6,310	64,680	3,909	86	8,039	0	12,034	(1,000)	11,034	53,646
19	63,390	195	8,994	72,579	4,032	87	8,267	0	12,406	(1,000)	11,406	61,173
20	60,928	195	9,582	70,705	4,043	4	9,897	0	13,944	(1,000)	12,944	57,761
21	59,021	195	7,381	66,597	3,941	25	9,154	0	13,120	(900)	12,220	54,377
22	68,102	195	6,646	74,943	3,955	50	8,898	0	12,903	(900)	12,003	62,940
23	76,822	195	6,497	83,514	3,979	49	8,835	0	12,863	(900)	11,963	71,551
24	80,030	195	6,230	86,455	3,982	51	8,743	0	12,776	(900)	11,876	74,579
25	79,172	195	5,459	84,826	4,013	57	8,497	0	12,567	(900)	11,667	73,159
26	77,114	195	4,880	82,189	3,932	57	8,299	0	12,286	(900)	11,386	70,801
27	71,529	195	4,344	76,068	4,010	58	8,099	0	12,167	(900)	11,267	64,801
28	67,502	195	3,704	71,401	4,059	57	7,900	0	12,016	(900)	11,116	60,285
29	61,809	195	3,223	65,227	4,132	58	7,692	0	11,882	(900)	10,982	54,245
30	51,446	195	2,914	54,555	4,116	55	7,600	0	11,771	(900)	10,871	43,684
31	42,653	195	2681	45,529	4,154	55	6,182	0	10,391	(900)	9,491	36,038
TOTAL	1,466,025	6,045	127,199	1,599,267	124,196	2,151	234,458	0	360,805	(28,200)	332,605	1,266,662
AVERAGE	47,291	195	4,151	51,589	4,006	69	7,563	0	11,639	(910)	10,729	40,860

Appendix 8. Delta Outflow (in CFS), January-July, 1993

FEBRUARY 1993

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TOTAL COLUMNS 1, 2 & 3	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	TOTAL EXPORT	NET CONSUMPTIV USE	TOTAL DEMAND	TOTAL OUTFLOW INDEX
1	40,547	195	2,457	43,199	4,161	55	5,294	0	9,510	(900)	8,610	34,589
2	35,608	195	2,368	38,191	4,147	56	4,000	0	8,203	(800)	7,403	30,788
3	35,050	195	2,183	37,428	3,806	52	4,594	0	8,452	(800)	7,652	29,776
4	31,530	195	2,062	33,787	3,448	57	4,308	0	7,813	(800)	7,013	26,774
5	28,801	195	1,972	30,968	3,497	46	3,306	0	6,849	(800)	6,049	24,919
6	27,221	195	1,910	29,326	3,018	45	3,094	0	6,157	(800)	5,357	23,969
7	26,232	195	1,849	28,276	3,135	57	3,410	0	6,602	(800)	5,802	22,474
8	25,388	195	1,903	27,486	3,996	76	5,895	0	9,969	(800)	9,169	18,317
9	26,649	195	2,729	29,573	4,096	92	7,587	0	11,775	(800)	10,975	18,598
10	31,995	195	4,051	36,241	4,052	86	7,664	0	11,804	(700)	11,104	25,137
11	43,628	195	4,344	48,167	4,181	83	8,096	0	12,360	(700)	11,660	36,507
12	49,304	195	3,731	53,230	4,214	81	8,113	0	12,408	(700)	11,708	41,522
13	51,979	195	3,660	55,834	4,198	86	8,009	0	12,293	(700)	11,593	44,241
14	52,794	195	3,361	56,350	4,206	85	7,796	0	12,089	(700)	11,389	44,961
15	52,822	195	2,971	55,988	4,225	83	7,666	0	11,974	(700)	11,274	44,714
16	48,826	195	2,713	51,734	4,232	85	7,592	0	11,909	(600)	11,309	40,425
17	44,513	195	2,533	47,241	4,221	85	7,490	0	11,796	(600)	11,196	36,045
18	43,888	195	2,359	46,442	4,172	80	7,400	0	11,652	(600)	11,052	35,390
19	43,606	195	2,849	46,650	4,077	78	7,700	0	11,855	(600)	11,255	35,395
20	48,217	195	3,660	52,072	4,075	81	7,889	0	12,045	(600)	11,445	40,627
21	58,758	195	3,867	62,820	4,179	77	7,001	0	11,257	(600)	10,657	52,163
22	67,470	195	3,510	71,175	4,212	80	4,849	0	9,141	(600)	8,541	62,634
23	70,686	195	3,309	74,190	4,174	77	4,947	0	9,196	(500)	8,698	65,492
24	73,752	195	3,206	77,153	4,192	74	2,028	0	6,294	(500)	5,794	71,359
25	75,364	195	3,196	78,755	4,195	76	0	0	4,271	(500)	3,771	74,984
26	73,385	195	3,325	76,905	4,202	73	0	0	4,275	(500)	3,775	73,130
27	68,424	195	3,976	72,595	4,202	79	0	0	4,281	(500)	3,781	68,814
28	64,431	195	4,219	68,845	4,195	74	0	0	4,269	(500)	3,769	65,076
29							0	0	0			
30							0	0	0			
31							0	0	0			
TOTAL	1,340,868	5,460	84,293	1,430,621	112,710	2,061	145,730	0	260,501	(18,700)	241,801	1,188,820
AVERAGE	47,886	195	3,010	51,094	4,025	74	4,701	0	8,403	(668)	8,636	42,458

Appendix 8. Delta Outflow (in CFS), January-July, 1993

MARCH 1993

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TOTAL COLUMNS 1, 2 & 3	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	TOTAL EXPORT	NET CONSUMPTIV USE	TOTAL DEMAND	TOTAL OUTFLOW INDEX
1	59,713	195	4,381	64,289	4,206	82	0	0	4,290	(400)	3,890	60,399
2	52,739	195	4,295	57,229	4,180	80	0	0	4,260	(400)	3,860	53,369
3	45,124	195	4,116	49,435	4,193	82	0	0	4,275	(400)	3,875	45,560
4	39,360	195	3,793	43,348	4,189	73	0	0	4,262	(400)	3,862	39,486
5	35,819	195	3,447	39,461	4,173	67	0	0	4,240	(400)	3,840	35,621
6	33,526	195	3,087	36,808	4,169	62	0	0	4,231	(300)	3,931	32,877
7	31,371	195	2,776	34,342	4,180	64	0	0	4,244	(300)	3,944	30,398
8	29,717	195	2,548	32,460	4,124	69	0	0	4,193	(300)	3,893	28,567
9	29,483	195	2,373	32,051	3,999	60	500	0	4,559	(300)	4,259	27,792
10	28,235	195	2,241	30,671	3,979	61	2,079	0	6,119	(300)	5,819	24,852
11	26,210	195	2,140	28,545	4,193	64	2,019	0	6,276	(300)	5,976	22,569
12	25,178	195	2,048	27,421	4,169	72	2,168	0	6,409	(300)	6,109	21,312
13	26,600	195	1,985	28,780	4,170	79	2,314	0	6,563	(200)	6,363	22,417
14	26,641	195	1,957	28,793	4,171	70	2,327	0	6,568	(200)	6,368	22,425
15	26,282	195	1,924	28,401	4,191	75	2,327	0	6,593	(200)	6,393	22,008
16	26,246	195	1,883	28,324	4,190	72	2,214	0	6,476	(200)	6,276	22,048
17	26,819	195	1,849	28,863	4,195	71	2,565	0	6,831	(200)	6,631	22,232
18	27,207	195	1,849	29,251	3,906	70	2,138	0	6,114	(200)	5,914	23,337
19	35,441	195	1,782	37,418	3,906	66	2,283	0	6,255	(100)	6,155	31,263
20	52,123	195	1,762	54,080	4,095	67	2,262	0	6,424	(100)	6,324	47,756
21	61,055	195	1,775	63,025	4,049	65	2,294	0	6,408	(100)	6,308	56,717
22	68,165	195	1,931	70,291	4,043	67	2,275	0	6,385	(100)	6,285	64,006
23	83,560	195	2,006	85,761	4,040	57	2,330	0	6,427	(100)	6,327	79,434
24	73,869	195	2,132	76,196	4,034	59	2,341	0	6,434	(100)	6,334	69,862
25	77,969	195	2,321	80,485	4,035	58	3,474	0	7,567	0	7,567	72,918
26	80,616	195	2,594	83,405	3,959	56	3,322	0	7,337	0	7,337	76,068
27	79,519	195	3,078	82,792	3,958	54	3,413	0	7,425	0	7,425	75,367
28	80,654	195	3,930	84,779	3,950	56	3,355	0	7,361	100	7,461	77,318
29	82,613	195	3,857	86,665	3,948	58	3,184	0	7,190	100	7,290	79,375
30	79,944	195	3,893	84,032	3,926	58	3,294	0	7,278	200	7,478	76,554
31	76,916	195	3939	81,050	4,004	61	3,296	0	7,361	300	7,661	73,389
TOTAL	1,528,714	6,045	83,692	1,618,451	126,526	2,055	57,774	0	186,355	(5,200)	181,155	1,437,296
AVERAGE	49,313	195	2,658	52,208	4,081	66	1,864	0	6,011	(168)	5,844	46,364

Appendix 8. Delta Outflow (in CFS), January-July, 1993

APRIL 1993

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TOTAL COLUMNS 1, 2 & 3	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	TOTAL EXPORT	NET CONSUMPTIV USE	TOTAL DEMAND	TOTAL OUTFLOW INDEX
1	74,559	195	3,821	78,575	3,941	59	3,468	0	7,468	400	7,868	70,707
2	71,178	195	3,588	74,961	3,970	61	3,385	0	7,416	500	7,916	67,045
3	73,286	195	3,325	76,806	3,937	59	3,377	0	7,373	600	7,973	68,833
4	72,088	195	3,129	75,412	3,767	59	3,383	0	7,209	700	7,909	67,503
5	67,751	195	3,112	71,058	3,917	67	3,274	0	7,258	800	8,058	63,000
6	64,990	195	3,012	68,197	3,926	73	3,281	0	7,280	800	8,080	60,117
7	63,359	195	2,840	66,394	3,923	79	3,041	0	7,043	900	7,943	58,451
8	62,174	195	2,946	65,315	3,934	73	3,248	0	7,255	900	8,155	57,160
9	58,681	195	3,299	62,175	3,947	78	3,202	0	7,227	900	8,127	54,048
10	54,822	195	3,248	58,265	3,957	77	3,134	0	7,168	1,000	8,168	50,097
11	51,058	195	3,325	54,578	3,960	76	2,960	0	6,996	1,000	7,996	46,582
12	46,423	195	3,500	50,118	3,406	86	3,181	0	6,673	1,000	7,673	42,445
13	43,460	195	3,525	47,180	2,969	107	3,233	0	6,309	1,000	7,309	39,871
14	41,589	195	3,500	45,284	3,428	109	3,345	0	6,882	1,000	7,882	37,402
15	40,018	195	3,544	43,757	3,914	116	3,190	0	7,222	1,100	8,322	35,435
16	38,512	195	3,482	42,189	3,680	116	3,175	0	6,973	1,100	8,073	34,116
17	37,666	195	3,500	41,361	3,509	109	3,473	0	7,091	1,100	8,191	33,170
18	36,596	195	3,597	40,388	3,523	105	3,230	0	6,858	1,100	7,958	32,430
19	28,384	195	3,430	32,009	3,543	104	3,230	0	6,877	1,200	8,077	23,932
20	30,277	195	3,282	33,754	2,438	100	3,357	0	5,895	1,200	7,095	26,659
21	32,657	195	3,137	35,989	1,795	107	3,220	0	5,122	1,200	6,322	29,667
22	33,552	195	3,045	36,792	1,797	117	3,217	0	5,131	1,200	6,331	30,461
23	31,534	195	2,970	34,699	1,797	105	2,270	0	4,172	1,300	5,472	29,227
24	31,080	195	2,970	34,245	1,792	98	2,076	0	3,966	1,300	5,266	28,979
25	30,416	195	3,037	33,648	1,794	97	2,213	0	4,104	1,300	5,404	28,244
26	28,526	195	3,129	31,850	965	96	966	0	2,027	1,300	3,327	28,523
27	27,985	195	3,793	31,973	642	107	767	83	1,433	1,400	2,833	29,140
28	26,587	195	4,276	31,058	772	114	822	85	1,623	1,400	3,023	28,035
29	25,685	195	4,535	30,415	760	129	834	114	1,609	1,400	3,009	27,406
30	26,087	195	4,564	30,846	749	131	761	129	1,512	1,500	3,012	27,834
TOTAL	1,350,980	5,850	102,461	1,459,291	86,452	2,818	82,313	411	171,172	31,600	202,772	1,256,519
AVERAGE	45,033	195	3,415	48,643	2,882	94	2,744	14	5,706	1,053	6,759	41,884

Appendix 8. Delta Outflow (in CFS), January-July, 1993

MAY 1993

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TOTAL COLUMNS 1, 2 & 3	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	TOTAL EXPORT	NET CONSUMPTIV USE	TOTAL DEMAND	TOTAL OUTFLOW INDEX
1	24,716	195	4,478	29,389	768	129	885	101	1,681	1,500	3,181	26,208
2	29,238	195	4,555	33,968	761	120	737	126	1,492	1,500	2,992	30,996
3	26,638	195	4,555	31,588	757	131	805	99	1,594	1,500	3,094	28,494
4	24,206	195	4,750	29,151	776	150	872	154	1,644	1,600	3,244	25,907
5	23,276	195	4,662	28,133	748	156	819	109	1,614	1,600	3,214	24,919
6	24,562	195	4,740	29,497	729	140	750	146	1,473	1,600	3,073	26,424
7	25,143	195	4,780	30,118	757	136	867	145	1,615	1,700	3,315	26,803
8	25,309	195	4,594	30,098	786	137	900	75	1,748	1,700	3,448	26,650
9	26,496	195	4,672	31,363	783	138	772	76	1,617	1,700	3,317	28,046
10	24,426	195	4,613	29,234	786	133	873	117	1,675	1,800	3,475	25,759
11	24,852	195	3,949	28,996	778	134	822	131	1,603	1,800	3,403	25,593
12	23,015	195	3,730	26,940	782	133	880	77	1,718	1,800	3,518	23,422
13	25,658	195	3,730	29,583	788	136	843	127	1,640	1,900	3,540	26,043
14	25,785	195	3,623	29,603	572	136	916	102	1,522	1,900	3,422	26,181
15	24,290	195	3,544	28,029	788	137	859	101	1,683	1,900	3,583	24,446
16	24,262	195	3,447	27,904	783	136	860	101	1,678	2,000	3,678	24,226
17	22,423	195	3,342	25,960	782	131	3,012	114	3,811	2,000	5,811	20,149
18	19,358	195	3,062	22,615	1,999	133	3,389	122	5,399	2,000	7,399	15,216
19	21,891	195	2,680	24,766	2,957	132	3,096	117	6,068	2,100	8,168	16,598
20	19,845	195	2,426	22,466	2,745	140	3,249	116	6,018	2,100	8,118	14,348
21	21,233	195	2,533	23,961	2,755	163	3,102	116	5,904	2,100	8,004	15,957
22	19,744	195	2,720	22,659	2,744	162	3,098	116	5,888	2,200	8,088	14,571
23	20,183	195	2,728	23,106	2,753	159	3,102	116	5,898	2,200	8,098	15,008
24	21,631	195	2,736	24,562	2,756	155	2,839	101	5,649	2,200	7,849	16,713
25	24,329	195	2,696	27,220	2,765	158	3,097	97	5,923	2,300	8,223	18,997
26	26,958	195	2,784	29,937	2,773	155	3,063	63	5,928	2,300	8,228	21,709
27	31,236	195	2,872	34,303	2,238	151	2,437	63	4,763	2,300	7,063	27,240
28	32,115	195	2,921	35,231	1,908	155	2,068	44	4,067	2,400	6,487	28,744
29	30,775	195	2,848	33,818	1,973	154	2,024	50	4,101	2,400	6,501	27,317
30	30,992	195	2,848	34,035	1,961	149	1,993	50	4,073	2,500	6,573	27,462
31	30,222	195	2,824	33,241	1,966	145	1,983	63	4,031	2,500	6,531	26,710
TOTAL	775,007	6,045	110,442	891,494	47,237	4,424	55,012	3,135	103,538	61,100	164,638	726,856
AVERAGE	25,000	195	3,563	28,758	1,524	143	1,775	101	3,340	1,971	5,311	23,447

Appendix 8. Delta Outflow (in CFS), January-July, 1993

JUNE 1993

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TOTAL COLUMNS 1, 2 & 3	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	TOTAL EXPORT	NET CONSUMPTIV USE	TOTAL DEMAND	TOTAL OUTFLOW INDEX
1	28,909	195	2,995	32,099	1,975	149	2,974	43	5,055	2,500	7,555	24,544
2	33,586	195	2,872	36,653	1,907	137	2,524	40	4,528	2,600	7,128	29,525
3	39,221	195	2,816	42,232	2,289	141	2,421	92	4,759	2,600	7,359	34,873
4	41,222	195	2,625	44,042	2,268	144	2,415	134	4,693	2,700	7,393	36,649
5	42,897	195	2,688	45,780	1,980	140	2,096	134	4,082	2,700	6,782	38,998
6	43,398	195	2,784	46,377	1,970	130	2,071	134	4,037	2,800	6,837	39,540
7	44,534	195	2,657	47,386	1,967	132	2,076	73	4,102	2,800	6,902	40,484
8	47,446	195	2,548	50,189	1,973	137	2,171	65	4,216	2,800	7,016	43,173
9	48,739	195	2,464	51,398	1,969	135	1,954	79	3,979	2,900	6,879	44,519
10	47,976	138	2,464	50,578	1,971	140	1,942	90	3,963	2,900	6,863	43,715
11	45,715	138	2,594	48,447	1,957	137	1,980	88	3,986	3,000	6,986	41,461
12	41,032	138	2,649	43,819	1,976	142	2,004	76	4,046	3,000	7,046	36,773
13	37,030	138	2,571	39,739	1,955	150	1,999	76	4,028	3,100	7,128	32,611
14	33,775	138	2,680	36,593	1,963	152	1,941	73	4,003	3,100	7,103	29,490
15	30,706	138	2,618	33,462	1,970	163	2,019	79	4,073	3,200	7,273	26,189
16	28,962	138	2,433	31,533	1,919	173	1,929	116	3,905	3,200	7,105	24,428
17	27,681	138	2,299	30,118	1,826	179	1,916	129	3,792	3,300	7,092	23,026
18	25,851	138	2,307	28,296	1,810	198	1,800	119	3,689	3,300	6,989	21,307
19	24,217	138	2,277	26,632	1,792	196	1,830	119	3,699	3,400	7,099	19,533
20	23,411	138	2,183	25,732	1,798	200	1,887	119	3,766	3,500	7,266	18,466
21	22,759	138	2,292	25,189	1,766	203	1,762	39	3,712	3,500	7,212	17,977
22	22,293	138	2,161	24,592	1,409	201	1,736	103	3,243	3,500	6,743	17,849
23	22,398	138	2,041	24,577	1,389	203	1,750	153	3,189	3,600	6,789	17,788
24	21,395	138	1,769	23,302	1,753	205	1,747	148	3,557	3,600	7,157	16,145
25	19,861	138	1,703	21,702	1,889	211	1,753	136	3,717	3,700	7,417	14,285
26	19,486	138	1,677	21,301	2,271	206	2,500	147	4,832	3,700	8,532	12,769
27	18,343	138	1,690	20,171	2,471	208	2,500	91	5,068	3,800	8,868	11,283
28	17,765	138	1,671	19,574	2,474	208	2,462	117	5,027	3,800	8,827	10,747
29	18,024	138	1,632	19,794	2,475	212	2,461	131	5,017	3,800	8,817	10,977
30	18,995	138	1,551	20,684	2,518	228	2,535	129	5,152	3,900	9,052	11,632
31				0					0		0	0
TOTAL	937,627	4,653	69,711	1,011,991	59,690	5,162	63,155	3,072	124,935	96,300	221,235	790,756
AVERAGE	31,254	155	2,324	32,645	1,990	172	2,105	102	4,030	3,210	7,137	25,508

Appendix 8. Delta Outflow (in CFS), January-July, 1993

JULY 1993

DATE	SACRAMENTO RIVER AT FREEPORT	SACRAMENTO TREATMENT PLANT	SAN JOAQUIN RIVER NEAR VERNALIS	TOTAL COLUMNS 1, 2 & 3	TRACY PUMP	CONTRA COSTA PUMP	CLIFTON COURT FOREBAY INFLOW	BYRON-BETHANY IRRIGATION DIST.	TOTAL EXPORT	NET CONSUMPTIV USE	TOTAL DEMAND	TOTAL OUTFLOW INDEX
1	18,868	138	1,532	20,538	3,329	232	3,583	113	7,031	4,000	11,031	9,507
2	20,002	138	1,526	21,666	4,373	220	4,042	125	8,510	4,000	12,510	9,156
3	18,609	138	1,435	20,182	4,363	197	4,264	50	8,774	4,000	12,774	7,408
4	16,845	138	1,508	18,491	4,360	204	4,200	64	8,680	4,100	12,780	5,711
5	16,839	138	1,671	18,648	4,357	203	4,231	50	8,741	4,100	12,841	5,807
6	17,983	138	1,690	19,811	4,258	203	4,277	115	8,623	4,100	12,723	7,088
7	20,000	138	1,626	21,764	4,217	207	2,222	131	6,515	4,100	10,615	11,149
8	22,000	138	1,684	23,822	4,362	203	3,008	139	7,434	4,200	11,634	12,188
9	22,665	138	1,671	24,474	4,313	200	4,795	128	9,180	4,200	13,380	11,094
10	20,369	138	1,594	22,101	4,375	202	4,872	126	9,323	4,200	13,523	8,578
11	20,701	138	1,538	22,377	4,345	204	4,893	136	9,306	4,300	13,606	8,771
12	20,830	138	1,609	22,577	4,352	200	4,012	123	8,441	4,300	12,741	9,836
13	20,960	138	1,526	22,624	4,358	193	4,000	134	8,417	4,300	12,717	9,907
14	20,016	138	1,441	21,595	4,328	181	3,998	135	8,370	4,300	12,670	8,925
15	20,555	138	1,417	22,110	4,376	171	4,069	140	8,496	4,400	12,896	9,214
16	20,514	138	1,394	22,046	4,354	155	4,133	117	8,525	4,400	12,925	9,121
17	20,244	138	1,411	21,793	4,337	148	4,067	116	8,436	4,400	12,836	8,957
18	19,914	138	1,465	21,517	4,308	179	3,998	116	8,369	4,400	12,769	8,748
19	19,884	138	1,520	21,542	4,323	186	3,956	102	8,363	4,500	12,863	8,679
20	20,089	138	1,514	21,741	4,333	195	3,998	114	8,412	4,500	12,912	8,829
21	20,389	138	1,453	21,980	4,275	204	4,331	69	8,741	4,500	13,241	8,739
22	19,087	138	1,429	20,654	4,334	202	4,205	98	8,643	4,500	13,143	7,511
23	20,170	138	1,405	21,713	4,271	213	4,111	94	8,501	4,500	13,001	8,712
24	20,811	138	1,388	22,337	4,377	212	4,528	76	9,041	4,600	13,641	8,696
25	21,383	138	1,417	22,938	4,341	208	4,757	101	9,205	4,600	13,805	9,133
26	21,600	138	1,453	23,191	4,353	210	4,944	86	9,421	4,600	14,021	9,170
27	21,740	138	1,465	23,343	4,370	213	5,313	118	9,778	4,600	14,378	8,965
28	22,100	138	1,563	23,801	4,370	216	5,299	59	9,826	4,600	14,426	9,375
29	22,413	138	1,545	24,096	4,359	216	5,064	64	9,575	4,600	14,175	9,921
30	22,867	138	1,652	24,657	4,336	226	5,051	94	9,519	4,600	14,119	10,538
31	23,610	138	1,664	25,412	4,237	231	5,268	101	9,635	4,600	14,235	11,177
TOTAL	634,057	4,278	47,206	685,541	133,344	6,234	133,507	3,254	269,831	135,100	404,931	280,610
AVERAGE	20,453	138	1,523	22,114	4,301	201	4,307	105	8,704	4,358	13,062	9,052