MOKELUMNE RIVER
CHINOOK SALMON AND STEELHEAD
MONITORING PROGRAM
1994–1995

Administered by:

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

A Technical Report on

Evaluation of the Downstream Migration of Juvenile Chinook Salmon and Steelhead in the Lower Mokelumne River and the Sacramento-San Joaquin Delta (January Through July 1995)

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EXECUTIVE SUMMARY

The East Bay Municipal Utility District has developed the Mokelumne River Chinook Salmon and Steelhead Monitoring Program (monitoring program) as part of the Lower Mokelumne River Management Plan. The objective of the monitoring program is the collection of information on the ecology and management of anadromous salmonids and other fishes inhabiting the lower Mokelumne River. This report provides data on, and assessment summaries of, the downstream migration of juvenile fall-run chinook salmon and steelhead, physiological smolt indices, physical injury to juvenile salmon passing the Woodbridge Dam spillbays, movement of radio-tagged juvenile salmon in Lake Lodi, and mark-recapture experiments of hatchery-reared juvenile salmon migrating through the Sacramento-San Joaquin Delta.

Two rotary screw traps were fished for 184 days between January 25 and July 28, 1995 immediately downstream of Woodbridge Dam. Juvenile chinook salmon were the most abundant species captured followed by several species of sunfishes (Centrarchidae). Juvenile salmon emigrated throughout the monitoring period exhibiting a bimodal emigration pattern with distinct peaks for fry in February and for smolts during April through May. Fry were captured in diminishing numbers during March and April. Abundance of naturally produced chinook salmon for the monitoring period was estimated at 434,000 (95% C.I.: 287,000 - 1,100,000). Approximately 60% were estimated to have emigrated as fry and 40% as smolts. Juvenile salmon abundance in 1995 (BY94) was the greatest reported since beginning the monitoring program in 1990. It was about 2.4 times as great as the next highest abundance, 183,448, reported in 1993 (BY92).

Fifty-three yearling chinook salmon were captured from January through April. Forty-six steelhead smolts were captured from January through July. One hundred steelhead fry were captured from April through July. The first occurrence of kokanee salmon in the lower Mokelumne River was reported this season with 74 juveniles captured during June and July. The kokanee are presumed to have passed by Pardee and Camanche Dams.

River flows during the monitoring season ranged from about 800cfs in February and early March, to a sustained range between 2800 and 3500cfs from mid-March through mid-July, declining through the end of July to 1100cfs. Water temperatures varied over the course of the monitoring period from 49°F to 64°F gradually increasing through the period. Patterns of emigration showed no distinct associations with rainfall, river flow, turbidity, water temperature, or lunar phase. Diel patterns of salmon smolt emigration were evaluated during three 24-hour surveys in May and June. Smolts migrated throughout the day and night. Larger numbers migrated during the day than at night in May. This pattern reversed in June with higher numbers migrating at night. Notable increases in smolt migrants were observed near dawn and dusk during all three diel surveys. The reason for the difference in diel migration pattern between May and June could not be determined. It is hypothesized that differences in day and night temperatures between these two months may potentially relate to the observed differences of migration behavior.

Six tests of potential physical injury to young salmon passing in spillbays 11, 12, and 14 of Woodbridge Dam revealed no significant injury or latent mortality. This result was consistent with tests performed in spillbays 2 and 3 in 1994, but contrasted with the injury and mortality detected for fish passing in spillbays 9, 14, and 15 in 1993. Factors potentially influencing young salmon passing Woodbridge Dam are varied and complex due to the circuitous route fish may take upon passing in the spill. However, differences in spillbay configurations and tailwater elevations observed between our tests may account for the different results. Spillbays 2 and 3 transition over a smooth concrete apron into the dam's tailwater compared to the rip-rap apron in spillbays 9, 14, and 15. And, the tailwater inundated the base of the spillbays and rip-rap apron during 1995 tests. Such conditions may improve passage fish conditions.

Approximately 197,000 hatchery young-of-year chinook salmon were coded-wire tagged and released in the Mokelumne River confluence with the Delta in two replicated experimental groups during mid- and late-April 1995. Both experimental groups exhibited statistically similar survival migrating through the Delta to Chipps Island, with mean survival indices of 0.475 for the early release and 0.485 for the later release.

From April 7 to July 28, 1995, 4,777 naturally produced chinook salmon captured and released at Woodbridge Dam were coded-wire tagged. These tagged fish will be used to track future contributions to the fisheries and spawning escapement of Mokelumne River salmon stock.

Thirty yearling chinook salmon were radio-tagged and released at the head of Lake Lodi to assess their migratory behavior under conditions existing during April through June. Twenty-three fish were tracked to Woodbridge Dam and seven were lost track of due to excessive radio interference during their release. River flows ranged from 2750 to 3600cfs during releases. All fish tracked to the dam passed with no delay. Migration rates through Lake Lodi ranged from 0.5 to 1.0 miles per hour.

Water quality (temperature, dissolved oxygen, pH, specific conductance, reduction-oxidation potential) was monitored in Lake Lodi and the lower Mokelumne River from May 30 to July 25, 1995. Water quality did not vary significantly among locations or over time. All water quality parameters were well within ranges suitable for rearing juvenile salmonids.

Physiological smolt development was monitored at Woodbridge Dam and on the upstream rearing grounds. Differences in condition factor and gill Na^+/K^+ ATPase, an enzyme involved in regulating salt and water balance, between fish at these two locations were observed during the monitoring period. Fish migrating by Woodbridge Dam, in general, exhibited a lower condition factor, a characteristic of smolting salmonids, compared to fish on the rearing grounds. A trend toward elevated gill Na^+/K^+ ATPase activity in fish migrating by the dam compared to fish on the rearing grounds was observed but was not statistically significant. Variation in these smolt indices were observed but no association with environmental conditions could be determined. These data reveal that smolts migrating past Woodbridge Dam are likely to be undergoing active smoltification. However, additional data collected under different hydrological conditions are required to assess whether these smolt indices can be used as management tools.

I. OBJECTIVES

This report addresses four objectives of East Bay Municipal Utility District's (EBMUD) 1994–95 Mokelumne River Chinook Salmon (*Oncorhynchus tshawytscha*) and Steelhead (*Oncorhynchus mykiss*) Monitoring Program:

- Monitor downstream migrant salmonids within the Mokelumne River
- Evaluate potential physical injury to downstream migrant salmonids passing over spillbays at Woodbridge Dam
- Evaluate movement patterns of juvenile salmonids migrating through Lake Lodi
- Conduct mark-recapture experiments to determine survival of hatchery-reared chinook salmon smolts migrating through the Sacramento-San Joaquin Delta (Delta).

These objectives continue the ongoing collection of information on the ecology and management of juvenile anadromous salmonids in the lower Mokelumne River (Figure 1). Task objectives and approaches of the 1994–95 investigation were modified and refined from those of previous years to address "wet water year" hydrological conditions, as well as investigate some specific aspects of the behavior of downstream migrant juvenile salmonids under those conditions. Specific objectives of the 1994-95 program were to:

- Monitor the daily abundance and downstream migratory movement of naturally produced juvenile anadromous salmonids passing Woodbridge Irrigation District Dam (WIDD)
- Monitor size and condition of emigrating juvenile anadromous salmonids and determine the proportions of juvenile salmon emigrating as fry and as smolt-sized salmon
- Evaluate juvenile anadromous salmonid emigration patterns related to environmental factors (stream flow, water temperature, lunar phase, precipitation, water turbidity, and time of day)
- Assess some effects of passage in Woodbridge Dam spill to migrating juvenile chinook salmon
- Evaluate some aspects of specific migratory behavior, as measured by radio-telemetry, for monitoring juvenile salmonid responses to environmental conditions in the lower Mokelumne River
- Evaluate the use of a physiological indicator of salmonid smoltification, gill sodium-potassium activated adenosine triphosphatase (gill Na^+/K^+ ATPase) activity, for monitoring juvenile salmonid responses to environmental conditions in the lower Mokelumne River
- Coded-wire tag (CWT) naturally produced chinook salmon smolts for later assessments of population-level responses to management actions and fishery recruitment
- Assess the relative survival of CWT Mokelumne River Fish Installation (MRFI)-reared salmon smolts migrating through the Delta under various hydrological conditions
- Evaluate the results of the preceding tasks in the context of resource monitoring activities and management recommendations/actions for the lower Mokelumne River.

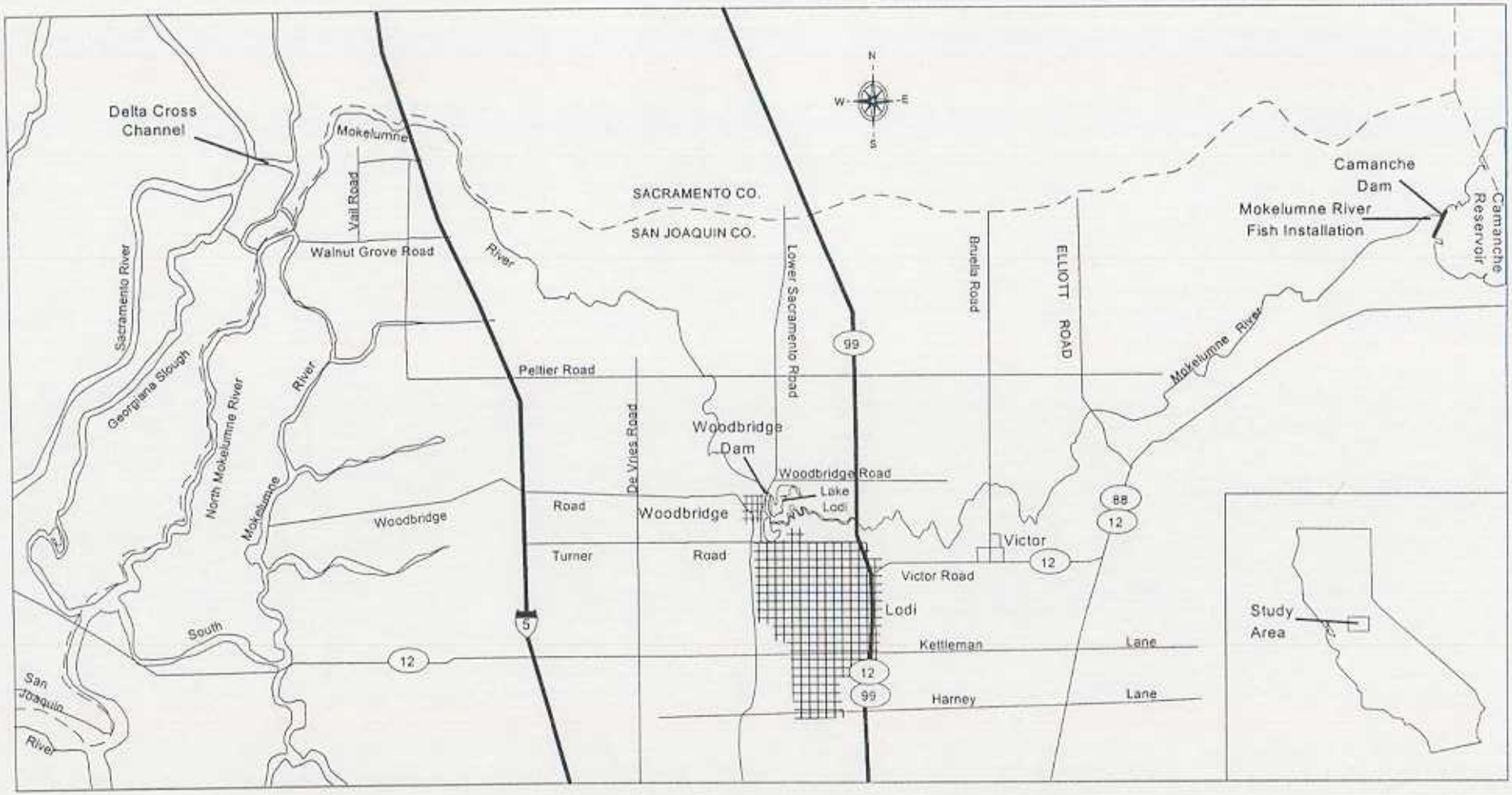

Figure 1. The Mokelumne River from Camanche Dam to the confluence of the San Joaquin River.

II. METHODS

2.1 Downstream Migrant Trapping at Woodbridge Dam

2.1.1 Rotary Screw Fish Traps

Woodbridge Dam has been used as a trapping site for downstream migrant salmonids since inception of the Mokelumne River Fishery Monitoring Program in 1990. During January 25 to July 28, 1995, two 2.4-m-diameter rotary screw fish traps were fished in tandem immediately downstream from Woodbridge Dam (Figure 2). The two traps were rigidly connected side by side by inserting 1.2-m-long pieces of 3-cm^2 Unistrut through the ends of the tubular fore and aft cross members of both screw traps. These Unistrut "connectors" were bolted into place with the cross members to the traps' pontoons. The trap suspension and operation system at Woodbridge Dam was similar to that described by Vogel and Marine (1994). When feasible, traps were positioned where the trapping cone rotation could be maintained at a minimum of 3 to 4 revolutions per minute.

2.1.2 Fish Handling and Measurements

The fish traps were tended twice daily. This was generally done early in the morning and late in the afternoon. During periods of high riverine debris loads and/or large catches of fish, the traps were attended two to three additional times daily, near mid-day and/or mid-evening. Fish captured were transferred from the trap live boxes with dip nets to 20-liter buckets filled with fresh river water to which 30 to 50 mg/l of tricaine methane sulfonate[1] was added for rapid and short-term induction of a moderate level of sedation for most of the species captured (Summerfelt and Smith 1990). All fish were identified to species (when possible) and enumerated.

Up to 30 of each salmonid species captured in each trap during each trapping period were randomly sampled for measurements of total length (TL) and fork length (FL) in millimeters (mm) and weighed in grams (g) on an Ohaus CT1200 portable balance. Weighing was done in tared beakers of fresh water set on the balance pan. Individual sedated fish netted in a small dip net were gently blotted on a moist sponge to remove excess water before weighing to ensure measurement of true wet weight. These measurements were recorded along with observations of external disease and injury. All adipose fin-clipped salmon (indicating CWT implants) and salmon otherwise marked that were observed among the fish counted or measured were recorded. After counting and measuring, fish were gently placed in a 20-liter bucket of fresh river water or live car placed in a flow-through tank with pumped-in river water to recover from sedation before being released downstream from the traps. Total processing time for individual fish from sedation and measurement to recovery and release was generally 5 to 30 minutes. Fish were distributed among several buckets or live cars to avoid overcrowding and depletion of dissolved

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

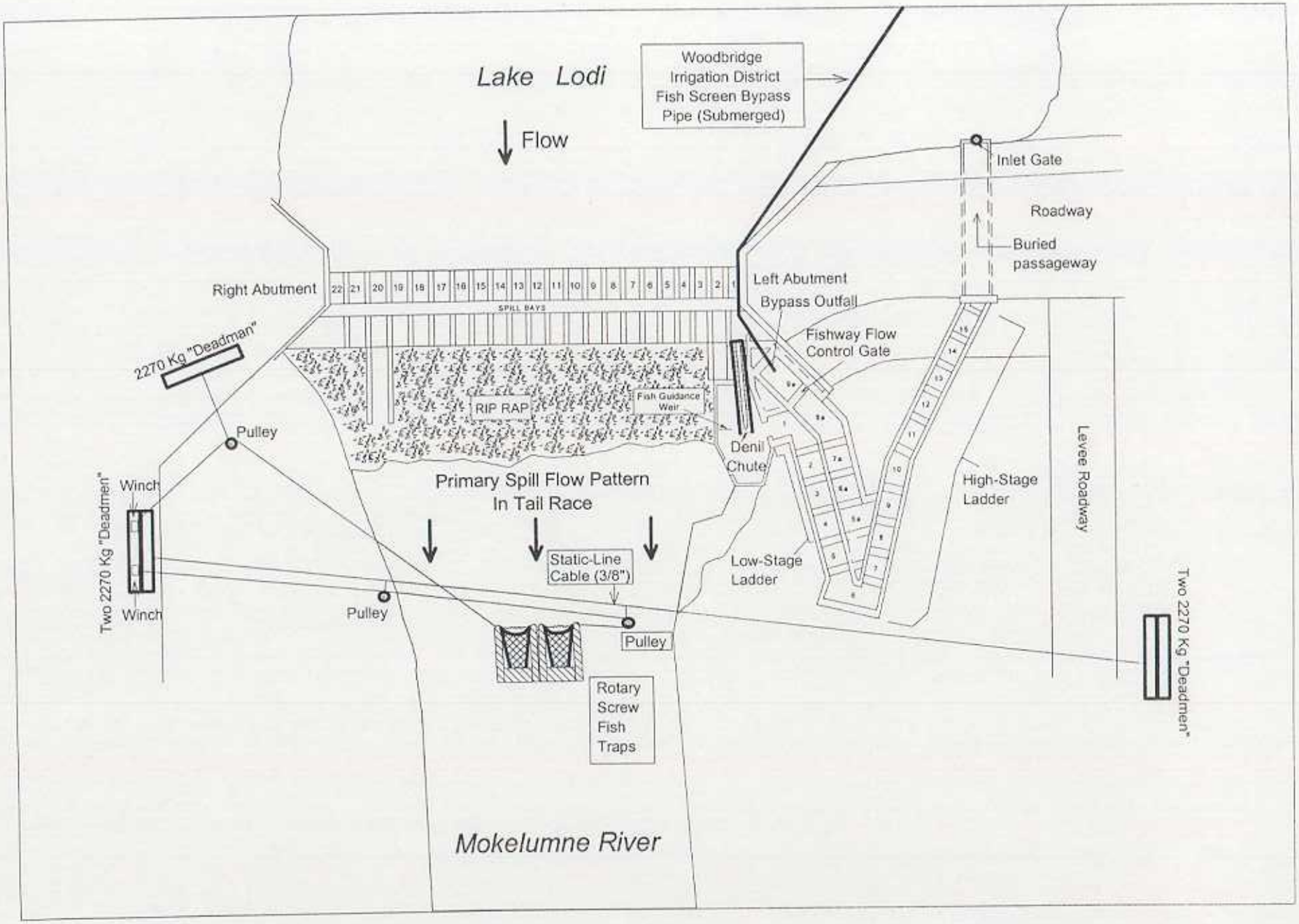

Figure 2. Plan view of Woodbridge Dam showing location of downstream migrant rotary screw traps employed during 1995.

oxygen (DO) during the processing procedures. To ensure DO remained at sufficient levels in holding buckets, water was exchanged at regular intervals (about every 5 to 10 minutes).

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

2.1.3 Trap Maintenance and Debris Management

Riverine and urban-generated debris was periodically problematic during operation of the rotary screw traps downstream from Woodbridge Dam. 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 rotation of the trap. These occurrences required increased trap inspection frequencies and were most common during the stormy winter season and during increases in discharges from Camanche Dam or adjustment of flashboards in Woodbridge Dam. Discarded and tangled monofilament fishing line was also a periodic problem especially during episodes of illegal fishing in the vicinity of the dam and traps during the spring and summer months. Fishing line wrapped around the main shaft of the rotating cone and the central axle of the live box drum screen resulted in wear and tear on moving parts and nylon bushing components.

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 predominantly during the late spring and summer months.

Seals between the interior of the live boxes and the moving parts of the traps were inspected regularly to ensure proper fit and sealing. No seal failures or escape of fish from the live boxes were reported over the course of the season.

2.1.4 Trap Calibrations for Abundance Estimates

Fish capture efficiency of the rotary screw trap system was measured at nine intervals during the monitoring period to encompass the range of changes in fish sizes and river stage and turbidity conditions. All juvenile salmon used for these mark-recapture tests were obtained from MRFI and were of Mokelumne River or Feather River origin. A fin clip or immersion stain (bismark brown) were used to mark fish for these assessments. Fin clips were made by excising either the right or left pelvic fin or by excision of a small but distinct portion of the upper or lower lobe of the caudal fin while the fish were anesthetized (*ca.* 70 to 100 mg/l tricaine solution). Stain marking of salmon fry was performed by immersing groups of about 300 to 400 fry in an aerated solution of bismark brown (*ca.* 20 mg/l solution) for about 15 to 30 minutes. Fish marked by either method were allowed to recover in cylindrical 25-liter PVC live cars (30 cm diameter, 40 cm long with soft nylon 2-mm Delta mesh covered ends) placed in a protected refuge in the low-

stage fishway for 8 to 24 hours before their release for the tests. A sample of 30 to 50 fish from each release group was measured for FL and examined for mark quality before release. Postmarking survival was generally 99 to 100 percent.

Paired test releases, one during daylight (½-hour after sunrise to ½-hour before sunset) and one during night time (1-hour after sunset to 1-hour before sunrise), were made for each trap efficiency measurement interval. Marked fish were released at the crest of the spill over flashboards on Woodbridge Dam. Fish were carefully released into the spill crest so that none escaped upstream into Lake Lodi. The release groups were divided into four or five groups of approximately equal sublots and released across the entire width of the dam's spillway. The hydraulic head differential between the upstream and downstream side of the dam ranged from about 0.25 to about 2.0 m. We assumed that the release distance from the trap and the spill configuration of the dam's discharge issuing toward the traps allowed fish to seek a preferred portion, or natural migration route, in the dam's discharge or to mix to a homogeneous distribution within the river flow before encountering the traps.

2.2 Abundance and Timing of Emigration

The numbers of each species and each age class of salmonids captured were compiled daily. The age 1+ size criteria for fall-run chinook salmon were based on previous years' juvenile salmonid monitoring results and were as follows:

Time Period	Age 1+ Size Criterion
January 1 through February 28, 1995	> 75 mm TL
March 1 through May 31, 1995	>130 mm TL
June 1 through July 28, 1995	>150 mm TL

Morning and afternoon trap capture numbers were combined to provide daily totals. Daily counts were compiled into weekly totals for several analyses. Outmigrant abundance estimates were generated from trapping efficiency results.

2.3 Fish Size and Condition

The size (FL, TL) and weight obtained from subsamples of each day's young-of-year (YOY) and yearling salmon catches for samples of up to 60 fish per trap were compiled. 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 millimeters, 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 YOY and yearling salmon were computed and compiled for analysis.

Injuries on trapped fish were described, recorded, and compiled daily, as well as the numbers of dead fish found in the traps. These incidents of injury and mortality were examined with regard

to effects of predators, debris fouling of the traps, and other conditions that may have contributed to their occurrence.

2.4 Physical Environmental Data

Daily environmental data for the period January through July 1995 were obtained from the following sources:

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

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

- Local Watershed Precipitation: National Weather Service field data collection station at Camanche Dam, San Joaquin County, California.

- River Temperature at Woodbridge Dam: Ryan Model RTM 2000 thermograph[2] installed in pool No. 6a of the low-stage fishway 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 in the river channel off downstream end of screw traps, or in Lake Lodi immediately upstream from spillbay 1 at Woodbridge Dam.

- Lunar Age and Regional Sunrise/Sunset Timing: *1994 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.

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[2]Ryan Instruments Inc., Redmond, Washington

2.5 Diel Migration Pattern Surveys

Diel patterns of the migration behavior of chinook salmon smolts were assessed during the height of the smolt emigration period. These diel surveys were conducted at the Woodbridge Dam trap site on March 16–17, May 16–17, May 31–June 1, and June 21–22, 1995. On the first survey date, the traps were tended at 1- to 2-hour intervals throughout the evening hours until 0300h. On all subsequent diel surveys, traps were tended hourly for a 24-hour cycle using the previously described fish handling and trap tending protocols. Numbers of juvenile salmon captured during each of the diel surveys were compiled on an hourly basis over the course of the survey. Trap efficiencies for applicable diurnal and nocturnal periods were applied to hourly trap captures to compute and compare hourly estimated abundance of downstream migrant fall chinook salmon smolts during the survey periods.

2.6 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 and into the dam spillbays. Experimental groups of approximately 500 to 1000 juvenile chinook salmon (obtained from MRFI) were released directly into spillbays on top of Woodbridge Dam. Immediately before release, these fish were transferred from an oxygenated holding tank positioned adjacent to the left abutment of the dam into five 5-gal. buckets for each release group, hand carried to the release location, then poured into a 12-in. diameter PVC pipe (7 ft 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 that released fish did not escape upstream into Lake Lodi but instead passed over the spill on the dam and into the spillbays.

Experimental fish were recaptured downstream of the dam by positioning the rotary fish trap (previously described) into the flow emanated from spillbays 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-in.-diameter, 16-in.-long PVC pipe with both ends covered with 1/8-in. knotless, nylon Delta mesh). All fish remained in water continuously following removal from the rotary trap. Each live car was placed in a protected area of the fishway (pool No. 15) where fish were monitored daily for mortalities over a 7-day period.

For each experimental group of fish released into a spillbay, a control group of approximately 25 to 50 fish was released into the rotary trap for comparative purposes. After each experimental group of fish was released, recaptured, and placed into the 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-gal. bucket. These fish were then transferred out to the rotary trap where they were released directly into the rotary trap entrance. Estimated time the fish remained in the transfer bucket was approximately the same as for the comparable experimental fish group. The

The quality of tagging and latent mortality associated with handling during tagging were assessed at four different times. Samples ranging from 19 to 52 tagged fish were placed in 25-liter PVC live cars (previously described) at densities of about 15 fish per live car and held in a protected area of high-stage fishway (pool No. 5) for 5 to 7 days[4]. The live cars were checked daily for mortalities. At the end of the holding period, all fish were mildly sedated with tricaine (*ca.* 30 to 50 mg/l), examined for quality of the adipose fin clip, and passed through the microtag detector to confirm tag retention. After this procedure, all fish were released as previously described.

2.8 Coded-Wire Tagging of Hatchery Smolts and Delta Survival Experiments

California Department of Fish and Game (CDFG) provided a trailer outfitted with CWT equipment for our use in tagging chinook salmon smolts reared at the MRFI 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 quality control device (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 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 by gravity through a return manifold pipe for reconditioning.

The tagging procedure was as follows. Fish were loaded directly from the hatchery raceway into the trailer's holding trough from which fish tagging technicians netted groups of fish to be tagged. In netted groups of about 50 to 60, the fish were mildly anesthetized in aerated, salted (0.7–0.9 percent), buffered tricaine methane sulfonate solutions (*ca.* 70 to 90 mg/l, 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 CWT 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

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[4]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.

the QCD to double check the rejection and retagged if necessary. 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 was 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.

Approximately 216,000 smolts at a size of 80 to 90 fish per pound were tagged for the 1995 Delta survival study. These fish were of Mokelumne River origin incubated, hatched, and reared at MRFI. Four tag codes assigned to EBMUD were used during March 20 to April 3, 1995 to tag these fish. The tag codes were allocated to four groups of about 54,000 fish each. The initial experimental design was a fully duplicated release design with two independent groups paired as replicates in each of two experimental releases. Two replicated experimental releases were scheduled to occur during different spring-time Delta water export conditions. Because of space and manpower constraints, CDFG has not been able to hold and release the fish as designed; each of the paired replicate CWT groups were reared, loaded, and transported together to the release site by CDFG. This latter condition violates the original experimental design requirement for independent replication groups and has resulted in pseudo-replicated releases consisting of two sublots for each experiment (see Hurlbert 1984 for a discussion of pseudo-replication). The resulting CWT release groups were as follows:

Experimental Group	Tag Codes
Early Season Release	6-02-11 and 6-02-12 mixed
Late Season Release	6-02-13 and 6-02-14 mixed

The main impact to the original experimental design of the mixed sublot releases has been a limitation of the resulting release design's capability to generate statistical estimates for refined survival estimates. However, the duplicated sublot releases allow for limited estimation of within group sampling variance for assessing reliability of survival estimates for each experimental release.

During the prerelease holding period, CDFG maintained records of all mortalities in each of the tag code groups. Each of the tag groups were checked for tag retention 21 to 26 days after being tagged. Samples of about 250 to 300 fish for each of the tag groups were mildly sedated in a 50 mg/l solution of tricaine and individually 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 number originally tagged (F. Fisher, CDFG, Red Bluff, California, personal communication). Two days before release of each of the composite groups, a sample of 70 to 80 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, 6-02-11/12 on April 18, 1995 and 6-02-13/14 on April 25, 1995. Fish were released at New Hope Landing at the confluence of the mainstem Mokelumne River and the central Delta. Recapture of the marked experimental release groups was conducted through June 1994 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, California, personal communication). USFWS processed recaptured fish and identified CWT samples. Reports of incidental recoveries at the Central Valley Project/State Water Project (CVP/SWP) diversion's fish salvage facilities and other Interagency Ecological Program sampling projects were obtained as well.

2.9 Coded-Wire Tag Summaries and Assessment

CWT 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 submitted to CDFG in their reporting format during July and August 1995. Tagging data for wild and hatchery release groups are 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.

2.10 Radio-Telemetry: Assessment of Yearling Fall-Run Chinook Salmon Migration Behavior

Individual juvenile chinook salmon behavior in the Lake Lodi reach of the Mokelumne River was assessed using radio-telemetry. All yearling salmon used for this assessment were obtained from the Merced River Fish Hatchery. An 1.8 g "smolt-sized" radio transmitter tag[5] was externally harnessed to each fish.

External attachment utilized a tag harness constructed of a small plastic plate (2 cm x 0.4 cm) with a piece of 3/0 surgical stainless steel suture wire bent in a U-shape with the ends of the wire passed through small holes in either end of the plastic plate. The plastic plate and suture wire assembly was firmly attached to the transmitter so that the ends of the wire protruded about 10 cm perpendicularly from the harness and tag. Heat-shrink tubing cut to fit the length of the plate and transmitter and cyanoacrylate adhesive were used to secure the harness assembly to the transmitter . A second plastic plate identical in dimensions and in location of the holes to that previously described was used as a back plate to externally secure the transmitter harness assembly to the fish.

Fish were radio-tagged at the hatchery where water temperature was cooler than at Woodbridge Dam and transport stresses could be avoided before tagging. Fish were anesthetized individually

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[5]Advanced Telemetry Systems, Inc., Isanti, MN

in aerated solutions containing 100 mg/l 2,2,2 tricaine methane sulfonate buffered with sodium bicarbonate, 2 ml of PolyAqua, and about 9 g/l (0.9 percent) NaCl. Water temperature of the anesthetic solution was monitored and maintained within 2 °F.

Upon sedation, fish were placed dorsum up in a foam tagging cradle that supported the entire body of the fish and was saturated with a recovery solution containing river water, PolyAqua, and 0.9 percent NaCl. All surgical equipment and the tag-harness suture wire were disinfected with a Betadine solution and rinsed with sterile physiological saline before radio-tagging each fish. Two 20-gauge hypodermic needles (spaced 1.7 cm apart) were pushed through the dorsal musculature approximately 1.0 cm ventral to the insertion of the dorsal fin. The ends of the suture wire protruding from the tag-harness assembly were threaded through the bore of the hypodermic needles and the needles were then withdrawn leaving the suture wire-harness-transmitter assembly in place (antenna running posteriorly alongside the fish). A neoprene pad, followed by the plastic back plate, were threaded on the ends of the wires, snugged gently against the body of the fish, and the ends of the wires were twisted (8–10x) to secure and complete the external attachment of the transmitter to the fish. The fish's buccal cavity (mouth and gills) was irrigated with the anaesthetic solution at 10- to 15-second intervals with a common meat basting syringe throughout the attachment procedure. After tagging, the fish was placed in a 20-liter recovery bucket containing an aerated solution of river water, PolyAqua, and about 0.9 percent NaCl. The entire tagging procedure from removal of the fish from the anesthetic solution to placing the fish in the recovery solution took from 30 to 60 seconds.

Fish were transported to Woodbridge Dam 1 to 2 hours after recovery in a 500-liter insulated fish transport tank with bottled oxygen aeration (5–10 liters/minute). River water obtained at the hatchery, with approximately 0.7–0.9 percent salt (NaCl added), PolyAqua, and ice to control temperature, was used as the transportation medium to minimize osmotic and handling stress during transport. Upon arrival at the dam, fish were acclimatized to the river water temperature by tempering at a rate of 2 °F per 15 minutes. Fish were placed three fish to a 25-liter cylindrical PVC live car and held overnight in the refuge area located in high-stage fishway pool No.15. After overnight acclimation to the water quality at Woodbridge Dam, fish were transported (as previously described) and released at various locations within Lake Lodi (Figure 3).

Radio-tagged juvenile chinook salmon movements were monitored using mobile reconnaissance and a fixed-station located at Woodbridge Dam. Both techniques utilized Advanced Telemetry Systems, Inc. scan receivers (model ATS R2100). Mobile reconnaissance was conducted from a boat and from shore using a directional loop antenna to locate radio-tagged fish. Radio reconnaissance surveys were conducted intensively immediately after release for 4 to 10 hours and one to four times daily thereafter, when radio-tagged fish were at large after release. Each time a radio-tagged fish was located during a reconnaissance survey, radio frequency identification number, location, time, and any relevant biological and behavioral observations were recorded on aerial photographic representations of the Lake Lodi reach of the river.

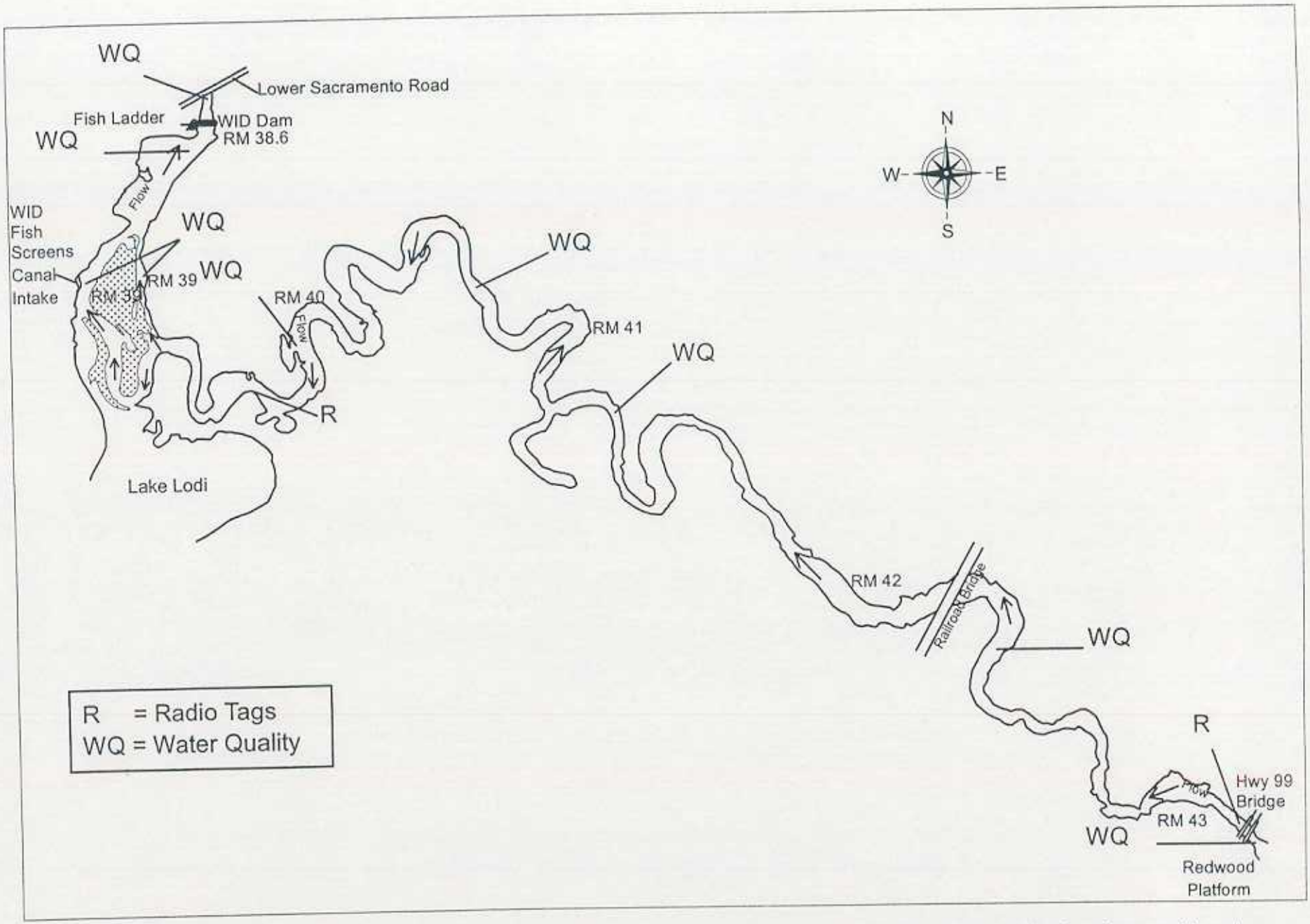

Figure 3. Topographical view of the Mokelumne River and Lake Lodi depicting release sites of radio-tagged chinook salmon and locations of water quality sampling sites.

Fixed station monitoring was conducted using a scan receiver connected to an ATS DCC II datalogger (Advanced Telemetry Systems, Inc.). The receiver-datalogger system scanned radio tag frequencies programmed into the datalogger and recorded their reception/occurrence when tagged fish entered a specified and limited area within about 100 m upstream of Woodbridge Dam. To control the size of the desired radio reception area, a directional Yagi antenna was used in combination with a tuning/test transmitter (located in 2 m of water at the farthest radius of the desired reception region) and the gain/range controls of the scanning receiver.

2.11 Water Quality Monitoring in Lake Lodi and the Mokelumne River

Water quality monitoring occurred at various locations in Lake Lodi and the Mokelumne River on one day in the afternoon during each week from May 30 to July 24, 1995. Nine monitoring sites were established from river mile 43.25 to river mile 38.5 (Figure 3). Each site was located one river mile or less from adjacent sites. Measurements were taken at the same locations each week using a Hydrolab[6] H20 Multiparameter Water Quality Data Transmitter and Surveyor 3 Display Logger. Water quality parameters monitored included: DO (mg/l), temperature (°F), specific conductance (conductivity), redox, and pH. At each location where sufficient water depth occurred, measurements were taken at the surface and every 3 ft in depth to the river bottom to obtain water column profile data. Calibration, postcalibration, maintenance, and data recovery from the instruments were conducted as described in the Hydrolab instrument operating manual.

2.12 Pilot- Level Physiological Monitoring of Smoltification of Fall Chinook Salmon

This task assessed the usefulness of gill Na^+/K^+ ATPase measurements from field-collected, naturally produced chinook salmon to characterize an aspect of the smoltification process and for detecting fish responses to environmental conditions. At 2-week intervals from February through July 1995, YOY fall-run chinook salmon were collected from the rearing habitat, nominally between State Highway 99 bridge to the Public Day Use Area near MRFI and at Woodbridge Dam. Collections from both reaches were made within no more than 2 days to minimize any temporal variations in measured parameters between groups collected in the different river reaches. Fish collected from the rearing habitat were assumed to be primarily in the rearing "parr" life stage; while fish collected at Woodbridge Dam were assumed to be actively migrating smolts. Collections in the rearing reach were made by beach seining with a 20 m x 1.5 m x 2 mm Delta mesh nylon seine. Collections at Woodbridge Dam were from fish captured in the downstream migrant traps. Up to 10 fish were sampled from each location on each collection date. Fish were individually euthanized using a 200 to 250 mg/l solution of tricaine buffered with bicarbonate. Fish were measured and weighed as previously described. Gill filaments were excised from all right-side-gill arches and placed in a 2 ml vial of a fixative solution of sucrose, EDTA, and imidazole buffered to pH 7.2, and frozen on dry ice. Samples

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[6]Hydrolab Corporation, Austin Texas

were kept frozen at -18 to - 25 °F until shipped to a laboratory for processing[7]. The samples were homogenized and analyzed using the whole tissue homogenate method for determining Na^+/K^+ ATPase activity (Johnson *et al.* 1977). The resulting data were subjected to analysis of variance (Neter and Wasserman 1974) to assess spatial and temporal differences and changes in gill Na^+/K^+ ATPase activity profiles among the groups of fish sampled.

[7]BioTech Research and Consulting, Inc., Corvallis, Oregon.

III. RESULTS AND DISCUSSION

3.1 Fish Abundances Monitored at Woodbridge Dam

3.1.1 Numbers of Fish Trapped

Trapping was conducted for 184 days between January 25 and July 28, 1995 at Woodbridge Dam. Appendices A and B provide daily records of trapping effort and the numbers of YOY and yearling fall-run chinook salmon captured. Table 1 shows that juvenile chinook salmon were the most abundant species captured throughout the monitored period. The most abundant nonsalmonid species were comprised of several introduced centrarchid fish (sunfish family) and the native prickly sculpin (*Cottus asper*). Nine smelt (*Hypomesus spp.*) were captured during January through March, the same period during which smelt were captured in 1994 (Vogel and Marine 1996). No differentiation of these smelt between wakasagi and Delta smelt were performed in the field and they were carefully released alive when captured. Seventy-four juvenile kokanee (*Oncorhynchus nerka kennerlyi*) were captured during June and July. This was the first recorded incidence of this species in the lower Mokelumne River. These fish presumably escaped in the spill from Pardee and Camanche reservoirs. In general, the life stages of all species captured (e.g., centrarchids, sculpins, striped bass, shad) were juveniles and subadults.

3.1.2 Abundance Estimate for Downstream Migrant Juvenile Chinook Salmon

Trap efficiency recovery rates for each test interval were computed for the day and night releases (Table 2). Based on a chi-square analyses, distinct differences ($P<0.05$) were obtained for the day and night releases, except for the April 14–15 and June 25 measurement intervals. In general, during the 1995 monitoring season, diurnal trap efficiencies were greater than nocturnal efficiencies for fry-sized salmon (FL$\leq$ 50 mm). Conversely, nocturnal trap efficiencies were greater than diurnal efficiencies for smolt-sized salmon (FL>50 mm). Abundance estimates were subsequently stratified by day and night time periods to improve resolution of the overall abundance estimate. Similar differences in diel capture probabilities of rotary fish traps for downstream migrant chinook salmon have been reported for the South Fork Umpqua River by Roper and Scarnecchia (1996).

Table 1. Numbers of each species captured at the Woodbridge Dam trap site (January through July 1995).

Species		Jan	Feb	Mar	Apr	May	June	July
Chinook Salmon (*Oncorhynchus tshawytscha*)	Age YOY:	986	15,805	1,938	1,332	2,289	1,451	110
	Age 1+ :	13	34	5	1	0	0	0
Pacific Lamprey (*Lampetra tridentata*)		9	3	2	0	2	0	1
Sacramento Sucker (*Catostomus occidentalis*)		0	0	0	1	0	0	3
Bluegill (*Lepomis macrochirus*)		83	57	34	24	49	52	106
Largemouth Bass (*Micropterus salmoides*)		3	0	0	3	1	0	0
Striped Bass (*Morone saxatilis*)		0	0	0	0	0	0	2
Spotted Bass (*Micropterus punctulatus*)		0	0	2	0	246	30	111
Redear Sunfish (*Lepomis microlophus*)		0	2	1	17	28	20	13
Green Sunfish (*Lepomis cyanellus*)		0	0	2	1	0	3	3
Prickly Sculpin (*Cottus asper*)		38	160	113	0	6	119	1,385
White Crappie (*Pomoxis annularis*)		2	5	3	1	0	0	1
Black Crappie (*Pomoxis nigromaculatus*)		2	4	8	3	3	1	0
White Catfish (*Ameiurus catus*)		0	3	1	0	1	1	9
Brown Bullhead (*Ameiurus nebulosus*)		0	0	2	12	0	0	2
Carp (*Cyprinus carpio*)		1	2	0	3	120	473	749
Hardhead (*Mylopharodon conocephalus*)		0	0	0	0	0	0	36
Golden Shiner (*Notemigonus crysoleucas*)		22	23	15	3	1	3	1

Table 1. Numbers of each species captured at the Woodbridge Dam trap site (January through July 1995) (continued).

Species		Jan	Feb	Mar	Apr	May	June	July
Hitch (*Lavinia exilicauda*)		0	0	0	1	2	2	1
Sacramento Squawfish (*Ptychocheilus grandis*)		0	3	12	7	3	2	6
Rainbow Trout/Steelhead (*Oncorhynchus mykiss*)	Age YOY:	0	0	0	8	21	10	61
	Age 1+/2+:	1	10	28	5	1	0	1
Threadfin Shad (*Dorosoma Petenense*)		10	46	0	0	0	0	0
Bigscale Logperch (*Percina macrolepida*)		1	0	0	0	0	0	0
Tule Perch (*Hysterocarpus traski*)		0	1	1	0	0	1	3
Smelt (*Hypomesus spp.*)		1	7	1	0	0	0	0
Kokanee (*Oncorhynchus nerka kennerlyi*)		0	0	0	0	0	27	47
Mosquitofish (*Gambusia affinis*)		0	0	4	1	1	0	5
Goldfish (*Carassius auratus*)		0	3	1	0	0	0	0

Table 2. Trap efficiency test results for tandem rotary screw fish trap system at Woodbridge Dam during February through June 1995.

	Release Group Info				Recapture Group Info				Water Temp (F)		WID	No. of Rotary
Date	Time	M	Avg. FL, mm	R, 24h	Avg. FL, mm	R(24h)/M	Chi-Sq., day-night	Secchi, cm	deg F.	River Q, cfs	Canal Q, cfs	Traps Fishing
02/08/95	1332	408	39 (s=2)	113	--	0.277	64.8***	60	49.1	832	0	2
02/09/95	**2015**	**381**	**40 (s=2)**	**23**	**40**	**0.060**		63	48.7	816	0	2
02/23/95	1000	542	40 (s=2)	96	40	0.177	15.9***	85	50.2	826	0	2
02/24/95	**1830**	**447**	**41 (s=2)**	**40**	**40**	**0.089**		80	49.9	830	0	2
03/03/95	952	658	36 (s=1)	104	36	0.158	16.9***	45	52.1	752	0	2
03/02/95	**1821**	**910**	**36 (s=1)**	**82**	**37**	**0.090**		45	52.1	752	0	2
03/18/95	1045	515	41 (s=2)	24	40	0.047	9.04**	30	51.4	2900	0	2
03/16/95	**2000**	**498**	**40 (s=1)**	**7**	**41**	**0.014**		--	51.8	2890	0	2
03/28/95	1000	812	--	42	51	0.052	36.5***	--	51.4	2900	0	2
03/28/95	**1930**	**847**	**48 (s=4)**	**3**	**54**	**0.004**		40	51.2	2900	0	2
04/15/95	1100	887	--	35	64	0.039	0.008 (NS)	52	52.0	2870	50	2
04/14/95	**2015**	**370**	**71 (s=7)**	**15**	**63**	**0.041**		52	52.0	2870	50	2
05/10/95	1015	690	82 (s=7)	10	80	0.014	8.5**	100	54.1	2750	104	2
05/09/95	**2035**	**644**	**85 (s=7)**	**26**	**85**	**0.040**		103	54.2	2750	96	2
05/23/95	1130	929	90 (s=5)	9	80	0.010	5.05*	95	55.2	3170	145	2
05/23/95	**2100**	**624**	**90 (s=7)**	**15**	**85**	**0.024**		95	55.1	3170	145	2
06/25/95	1100	782	111 (s=10)	32	111	0.041	1.62 (NS)	105	59.2	3570	235	2
06/25/95	**2140**	**572**	**107 (s=9)**	**16**	**107**	**0.028**		108	59.3	3580	232	2

Notes: The mark-recapture notation of Ricker (1958) is used with R = #'s of marked fish recaptured and M = #'s of marked fish released.
R(24h) denotes the recapture of marked fish during two trapping periods following their release.
Average secchi depths, water temperatures, and stream flows at Woodbridge Dam are for the 24 hour period immediately following marked fish release.
Day time recapture-release data in normal font - - - **night time recapture-release data in bold type.**
Chi-square analysis results levels of significance are indicated by *(P<0.05), **(P<0.01), ***(P<0.001), NS(not significant).

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

Trapping Period	Test Nos. Applied[8]	River Flow (cfs)	Trap Type (No.)
1/27/95 – 3/10/95	1, 2, 3	643 – 837	Rotary Screw (2)
3/11/95 – 4/11/95	4, 5	1350 – 3090	Rotary Screw (2)
4/12/95 – 4/30/95	6	2750 – 2870	Rotary Screw (2)
5/01/95 – 5/19/95	7	2730 – 3060	Rotary Screw (2)
5/20/95 – 6/05/95	8	3160 – 3190	Rotary Screw (2)
6/06/95 – 6/30/95	9	3280 – 3610	Rotary Screw (2)
7/01/95 - 7/28/95	None Applied[9]	1130 – 3470	Rotary Screw (2)

Diurnal and nocturnal abundances were estimated daily using the day and night trap efficiency rates, respectively, for the applicable period. Abundance was estimated using the calculation:

$$[\textit{number of salmon captured}] \div [\textit{trap efficiency for applicable period}]$$

Each day's diurnal and nocturnal abundance estimates were summed to produce daily abundances. The daily diurnal and nocturnal estimates of abundance, associated mean trap efficiencies, and the periods of estimation used to compute the overall abundance estimate are provided in Appendix C.

From January 25 through July 28, 1995, an estimate of approximately 434,000 naturally produced YOY chinook salmon passed the Woodbridge Dam trap site. The 95% confidence interval for this abundance estimate ranged from 287,000 to 1.1 million juvenile salmon. Based on the stratified diurnal/nocturnal trapping efficiencies, it was estimated that about 46,000 (day) and 388,000 (night) YOY salmon passed Woodbridge Dam.

These abundance estimates should be considered as an index of relative temporal abundance for salmon migrating past the spill bays of Woodbridge Dam (versus passing the trap location). And, these estimates are not necessarily firm estimates of population size. The reason for these caveats is that the estimates do not quantify potential fish losses between the spill bays and the trap location. Actual fish losses between the spill bays, where trap calibration fish are released, and the traps, where trap calibration fish are recaptured, (e.g., attributable to predation) are not known and cannot be quantified with these indices.

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[8]Refer to Table 1 for trap efficiency test dates and specific parameters for each test release used.

[9]Low numbers of migrants observed during this period, substantial ramped changes in river flow, and unavailability of test fish limited opportunity for trap efficiency measurements.

3.2 Timing of the Downstream Migration of Juvenile Salmonids

The 1994 brood (BY94) of fall-run chinook salmon exhibited a distinctly bimodal pattern of emigration from the lower Mokelumne River during 1995 (Figure 4). Substantial numbers of fry-sized fish migrated past Woodbridge Dam during January through early March followed by a period of relatively few fish passing the dam. Increases in numbers of larger juvenile salmon were observed beginning in the second and third week of April. The increased trap capture numbers after the beginning of April were composed almost exclusively of smolt-sized fish (Figure 5). As observed in past years (Vogel and Marine 1994, 1996), this appeared to signal the beginning of a purposeful downstream smolt migration.

Large numbers of fry-sized (FL≤50 mm) salmon were captured passing Woodbridge Dam and abundance estimates indicated that nearly 60 percent of the BY94 natural production emigrated as fry during 1995. It is common to observe some proportion of a juvenile chinook salmon population to disperse downstream from the spawning grounds shortly after emergence (Healey 1991, Kjelson *et al.* 1982). Hydrologic conditions have been observed to have a great influence on the magnitude of the fry emigration in the Sacramento River with a greater proportion of fry emigrating from upstream river reaches during wet winters with high river flows than during drier years (Vogel *et al.* 1988). However, the destiny of these early migrating fry varies among populations, according to Healey (1991); while some migrate directly to estuaries, others may simply relocate to other suitable freshwater rearing habitat along the river's length.

Figure 6 provides the weekly trap counts of YOY and yearling chinook salmon during January through July 1995. No estimates of abundance for yearling salmon were made because no yearling salmon were available at this time of year for conducting trap efficiency tests. Observations of yearling salmon in the traps were possible and they were present through the week of April 23, but not in great numbers. Juvenile steelhead were not very numerous at any time during the season (Table 1). Yearling and older (probably age 2+ based on size) juvenile steelhead were observed in traps during nearly every month. YOY steelhead first appeared in the traps during April and continued to increase in incidence through the end of monitoring in July (Table 1).

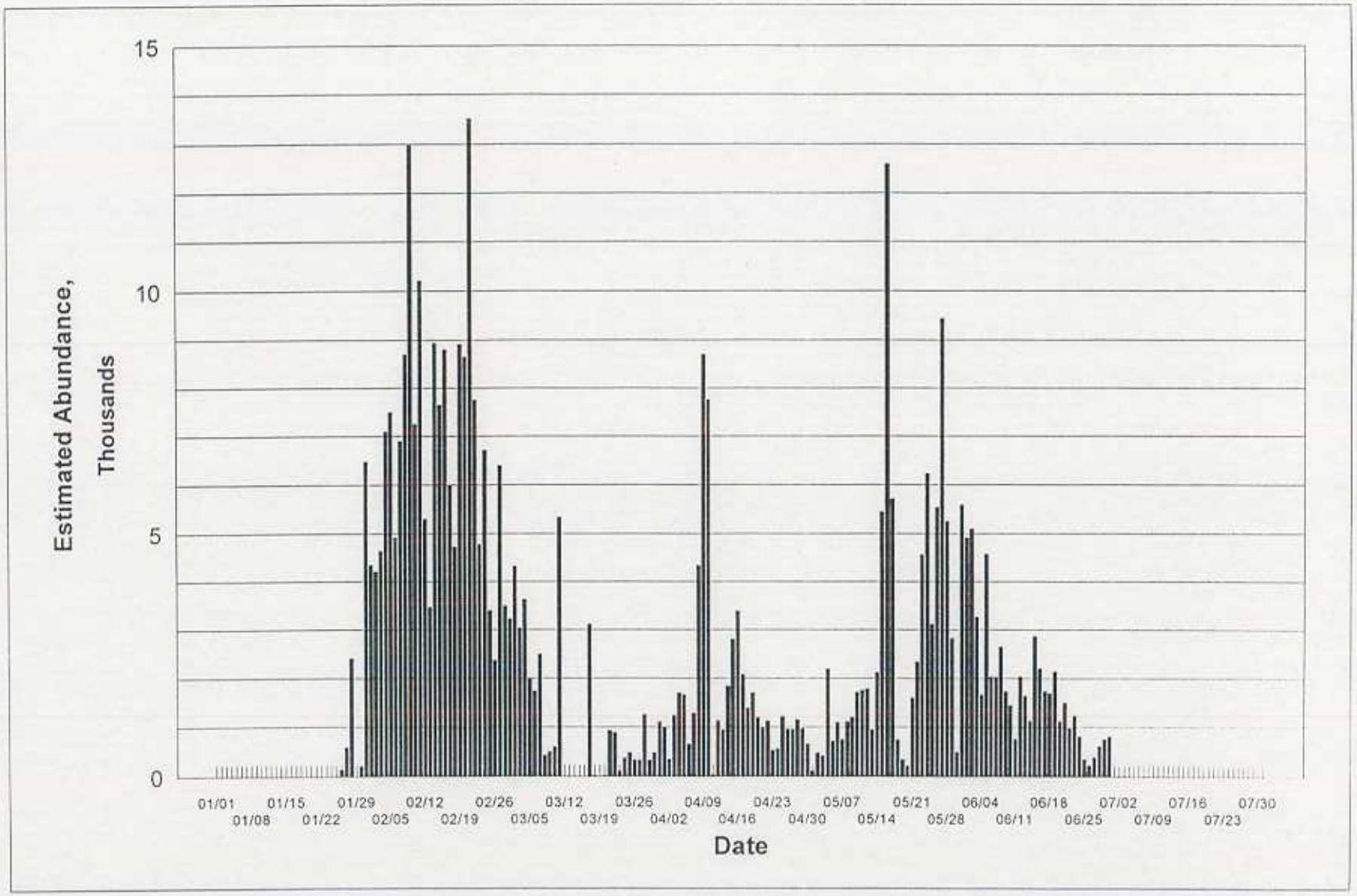


Figure 4. Estimated daily abundance of YOY chinook salmon passing Woodbridge Dam during January through July 1995.

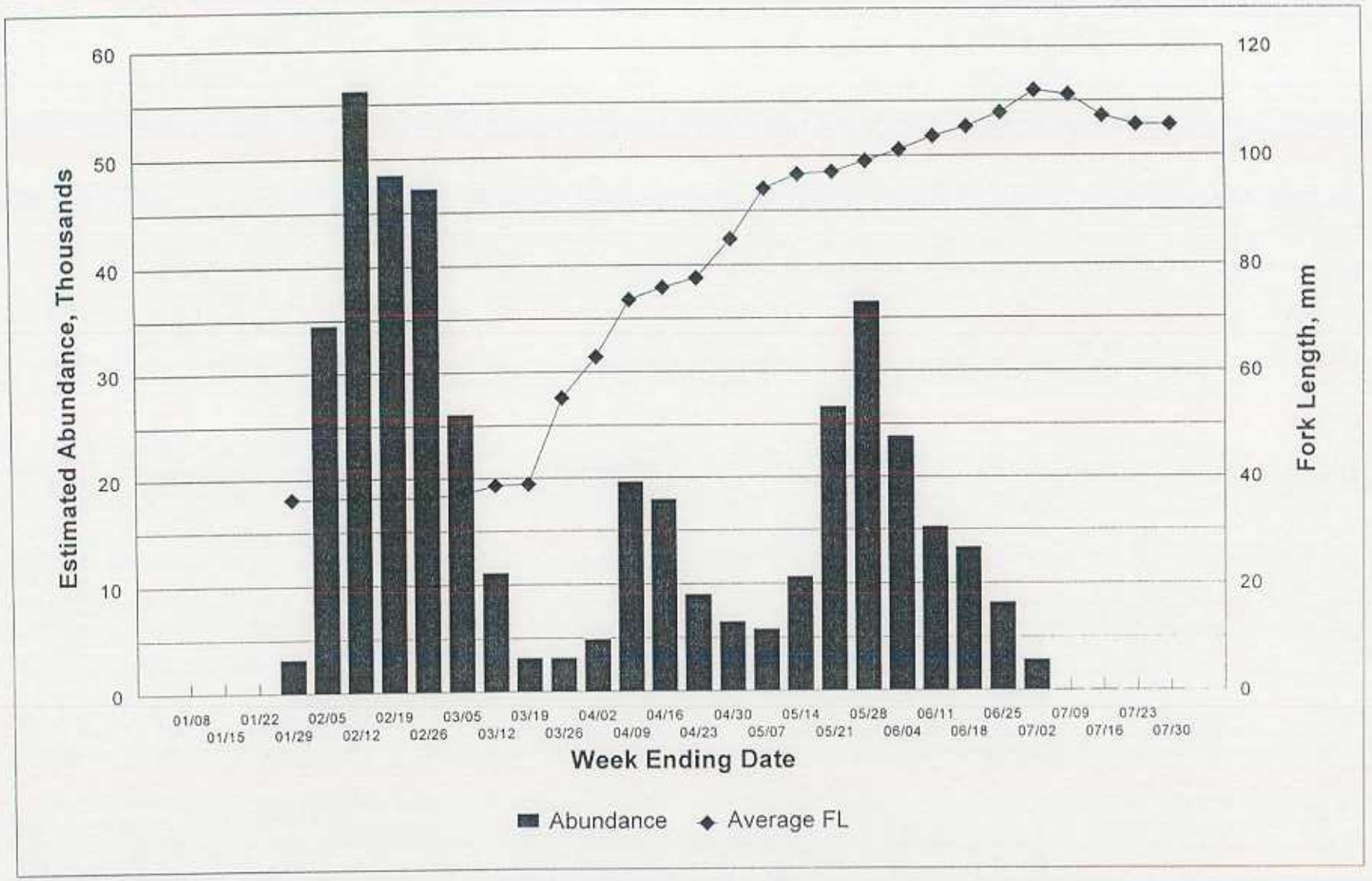
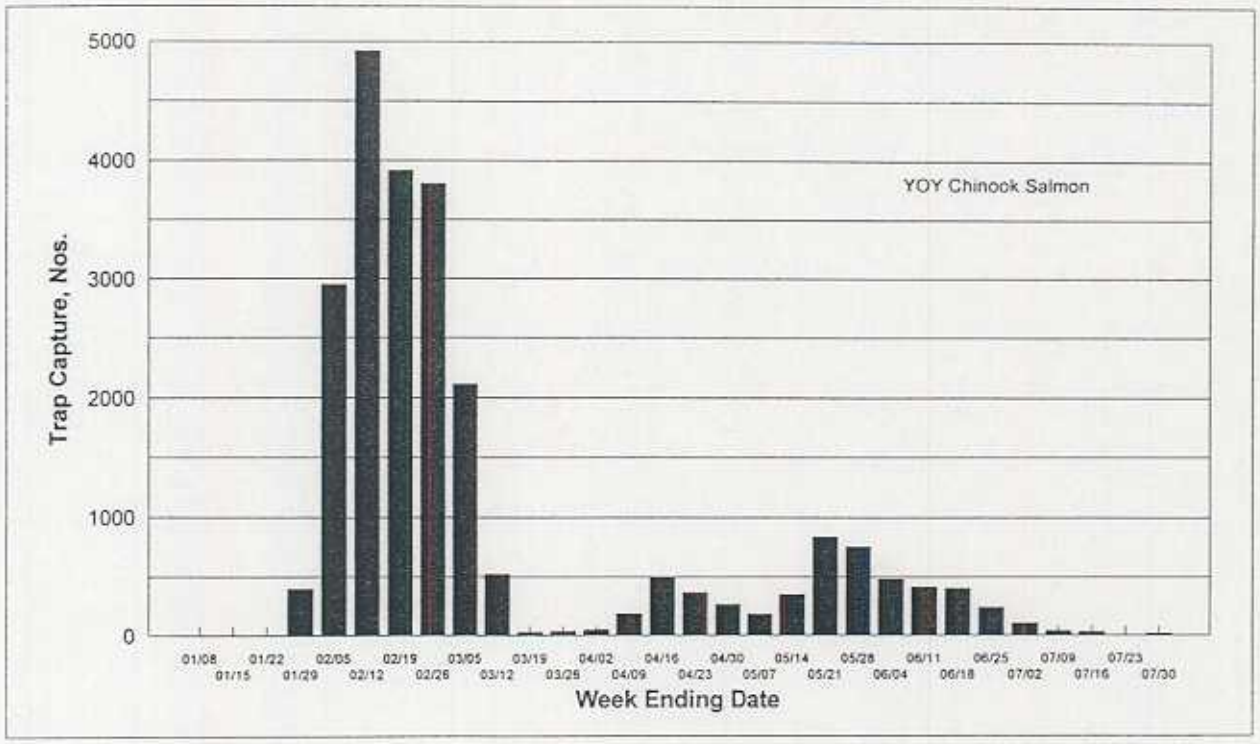


Figure 5. Estimated weekly abundance and mean size of YOY chinook salmon passing Woodbridge Dam during January through July 1995.



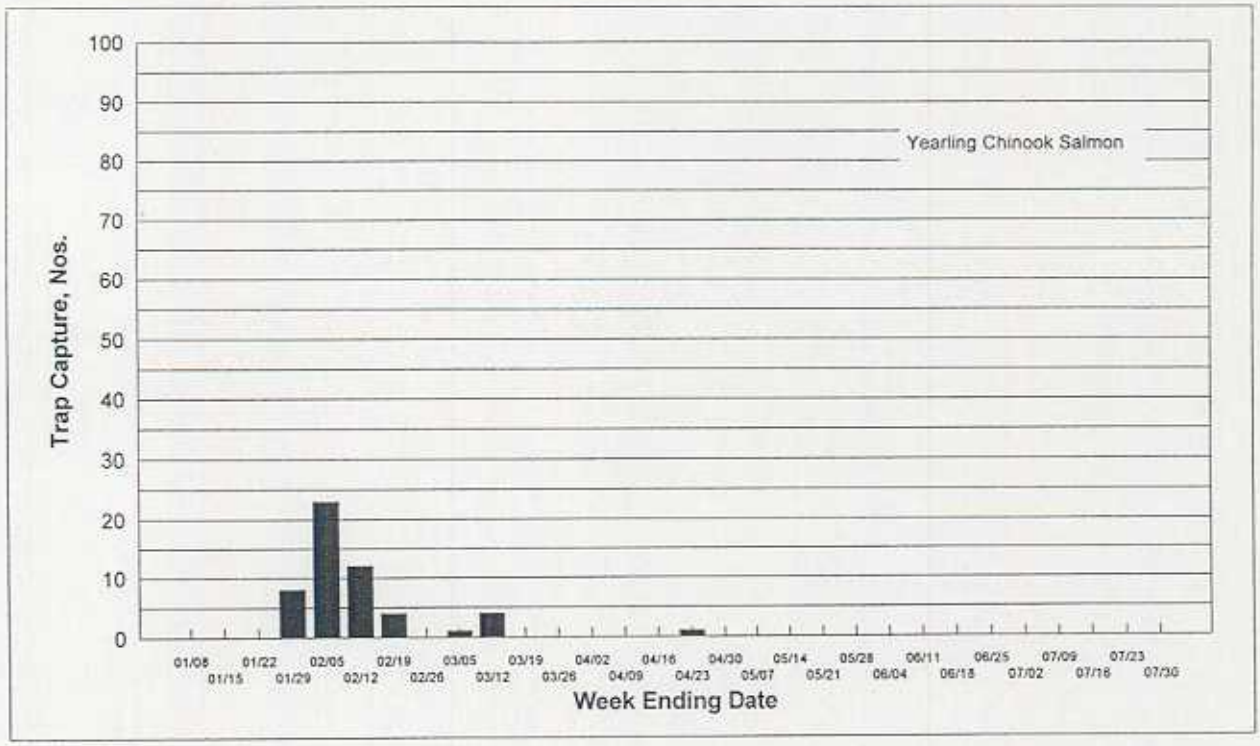


Figure 6. Weekly counts of YOY and yearling fall-run chinook salmon trapped in rotary screw fish traps downstream of Woodbridge Dam on the Mokelumne River during January through July 1995.

3.3 Size and Condition of Downstream Migrant Salmon

Daily records of average TL, FL, weight, and condition factor, as well as the range in length and weight of YOY and yearling salmon captured at Woodbridge Dam are provided in Appendices D and E. Figures 7 and 8 show the means and ranges of fish lengths over the course of the season for YOY and yearling salmon. Approximately 60 percent of the YOY salmon captured at Woodbridge Dam were fry and 40 percent were smolt sized salmon. The 50 mm FL size criterion for separating fry and smolt chinook salmon is based on generalized size at smoltification observed for the species throughout its range reviewed by Healey (1991); none exists specifically for the Mokelumne River fall chinook salmon stock. As in past years (Vogel and Marine 1994, 1996), the size and number of YOY salmon increased abruptly during the first half of April, signaling the onset of the smolt emigration; however, some fry were observed emigrating into May. The size of smolts increased gradually for the duration of the season after the onset of emigration. The daily mean size of yearling salmon observed passing Woodbridge Dam ranged from 150 mm TL to 220 mm TL, with a range of individual fish size between 112 mm to 220 mm TL.

The condition factor of emigrating juvenile salmon ranged from about 5×10^{-4} to 7.5×10^{-4} (Figure 9). The abrupt occurrence of smolts in the traps affected increases in the averages and the variation in size measurements during the later half of March (Appendices D). The weight of smolts migrating by Woodbridge Dam generally increased throughout the smolt migration. Average condition factor varied, generally increasing through the fry and smolt emigration, exhibiting a variable but slight decline for smolts near the beginning of their emigration [early-April] until the height of the emigration [mid-May] (Figure 9). During June and July, a variable but decreasing trend was observed in the condition factors of migrating smolts.

3.4 Effects of Physical Environmental Conditions on Downstream Migrants

3.4.1 Diel Periodicity of Fish 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 hourly patterns of migration of smolt-sized chinook salmon passing Woodbridge Dam were documented on three occasions during May and June 1995 at the height of the smolt emigration. These results are shown in Figure 10. Patterns of diel migration were similar during the first two surveys. Chinook salmon smolts migrated nearly continuously throughout the day and night during this period, with abundance of migrants greatest during the daylight hours. The third survey, performed after mid-June, differed in this respect with the greatest numbers of fish occurring during the night. Notable increases in migrants passing the dam were detected during or near the crepuscular periods during all three surveys. Patterns of diel migration abundance observed in past years indicated that migration abundance was distinctly greatest at night (Vogel and Marine 1994, 1996).

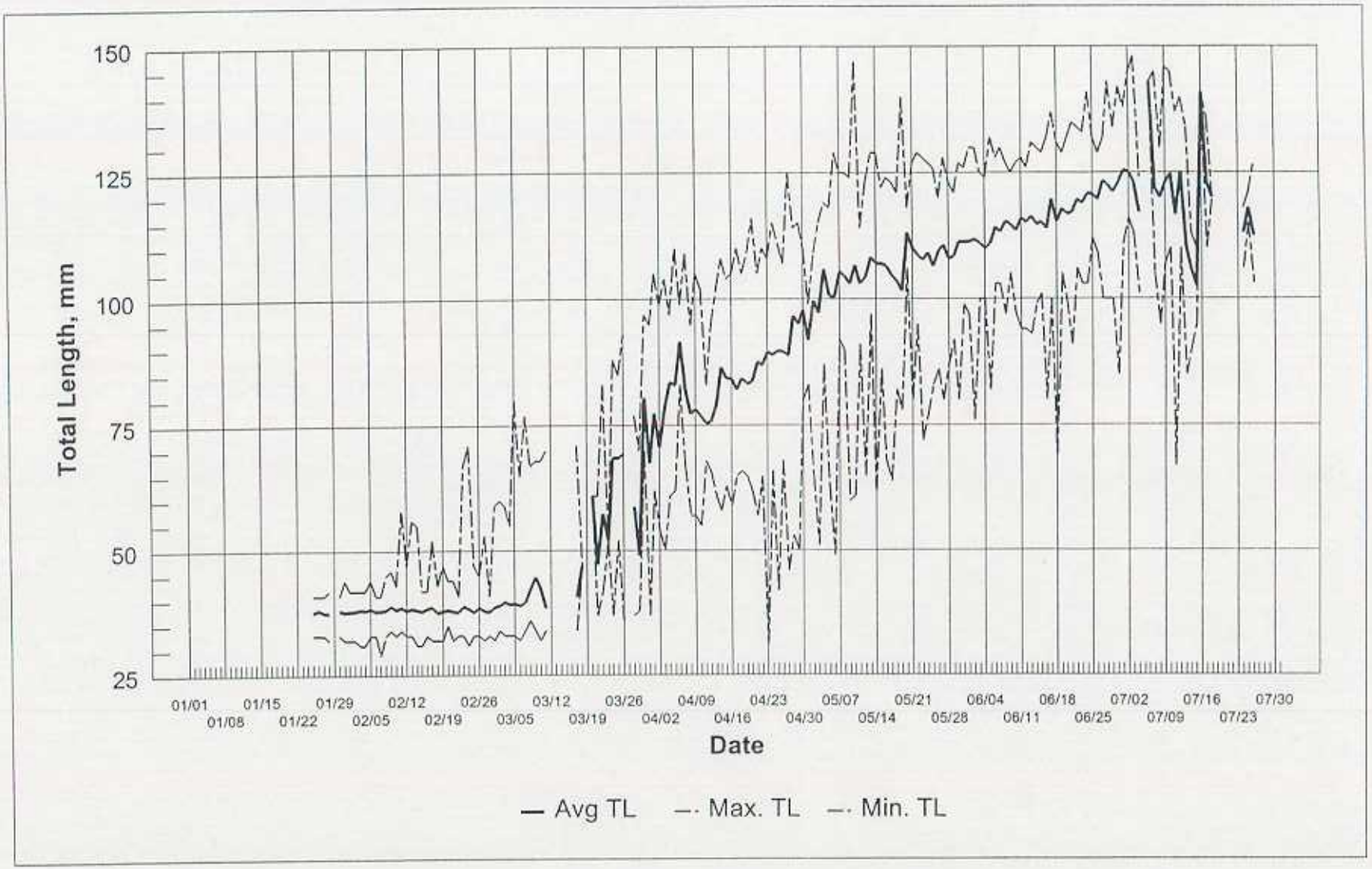


Figure 7. Daily average, maximum, and minimum total lengths of YOY chinook salmon captured in rotary screw fish traps downstream of Woodbridge Dam on the Mokelumne River during January through July 1995.

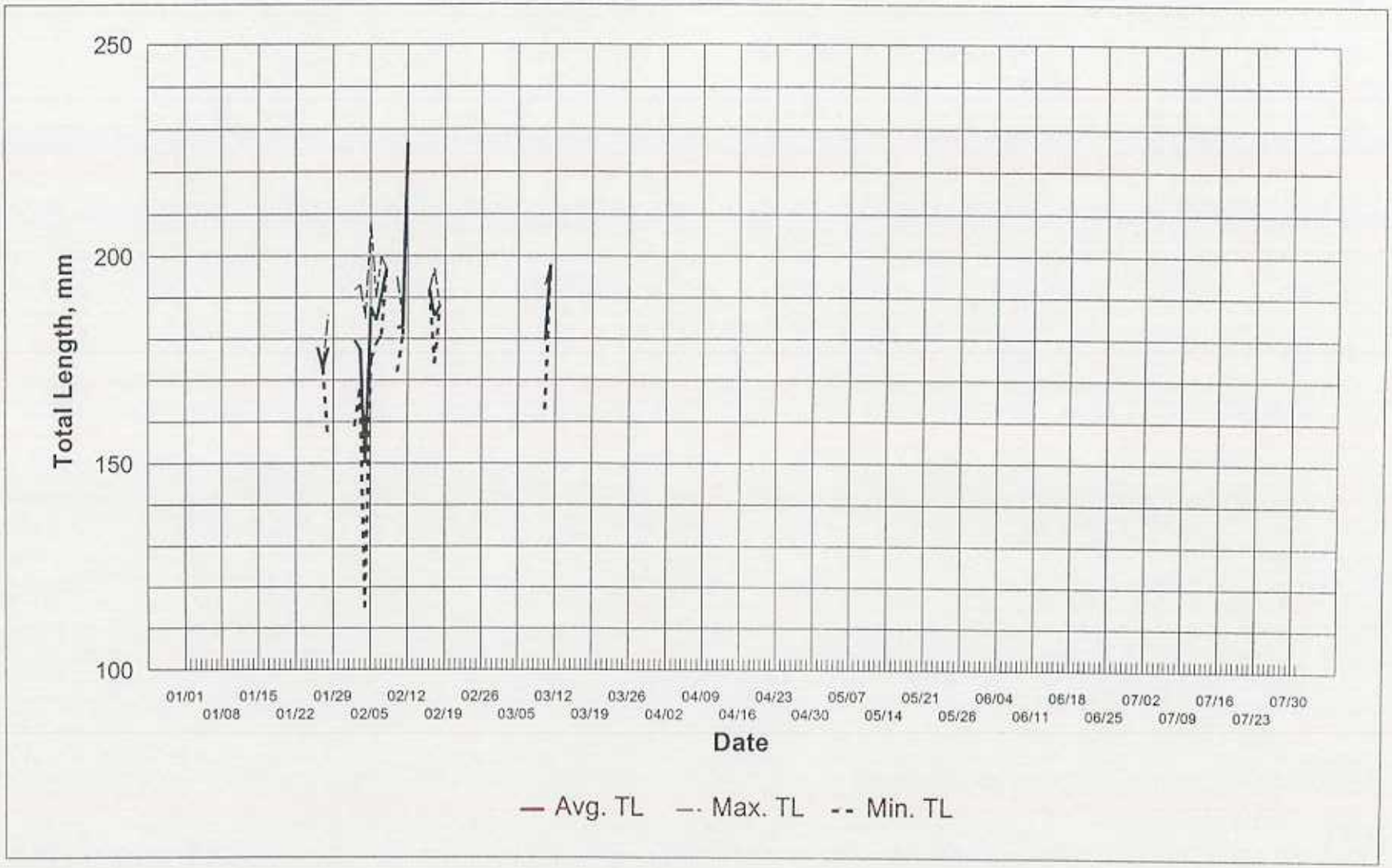


Figure 8. Daily average, maximum, and minimum total lengths for yearling fall-run chinook salmon captured in rotary screw fish traps downstream of Woodbridge Dam during January through July 1995.

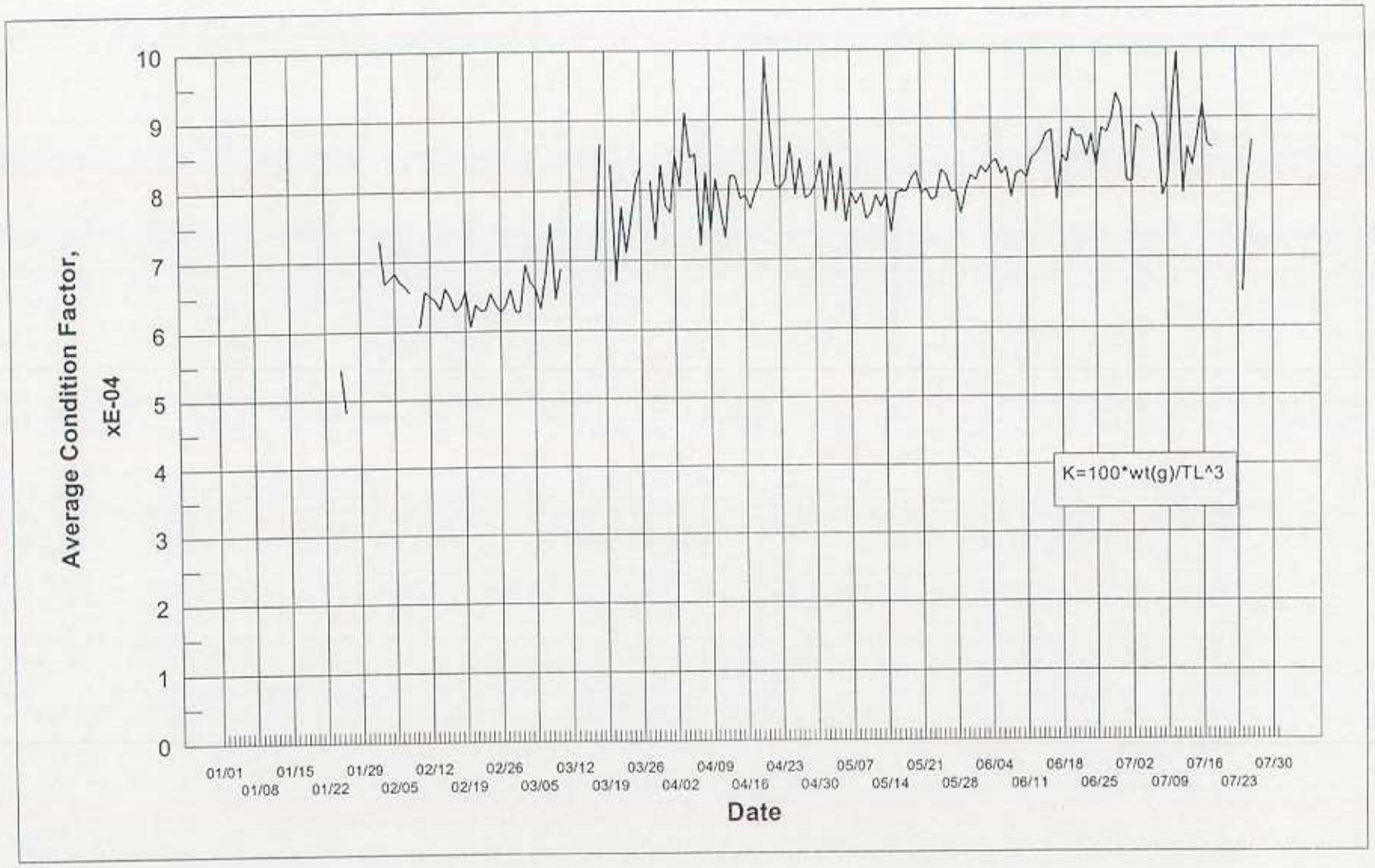


Figure 9. Daily average conditon factor (K) of YOY chinook salmon captured in rotary screw fish traps downstream of Woodbridge Dam on the Mokelumne River during January through July 1995.

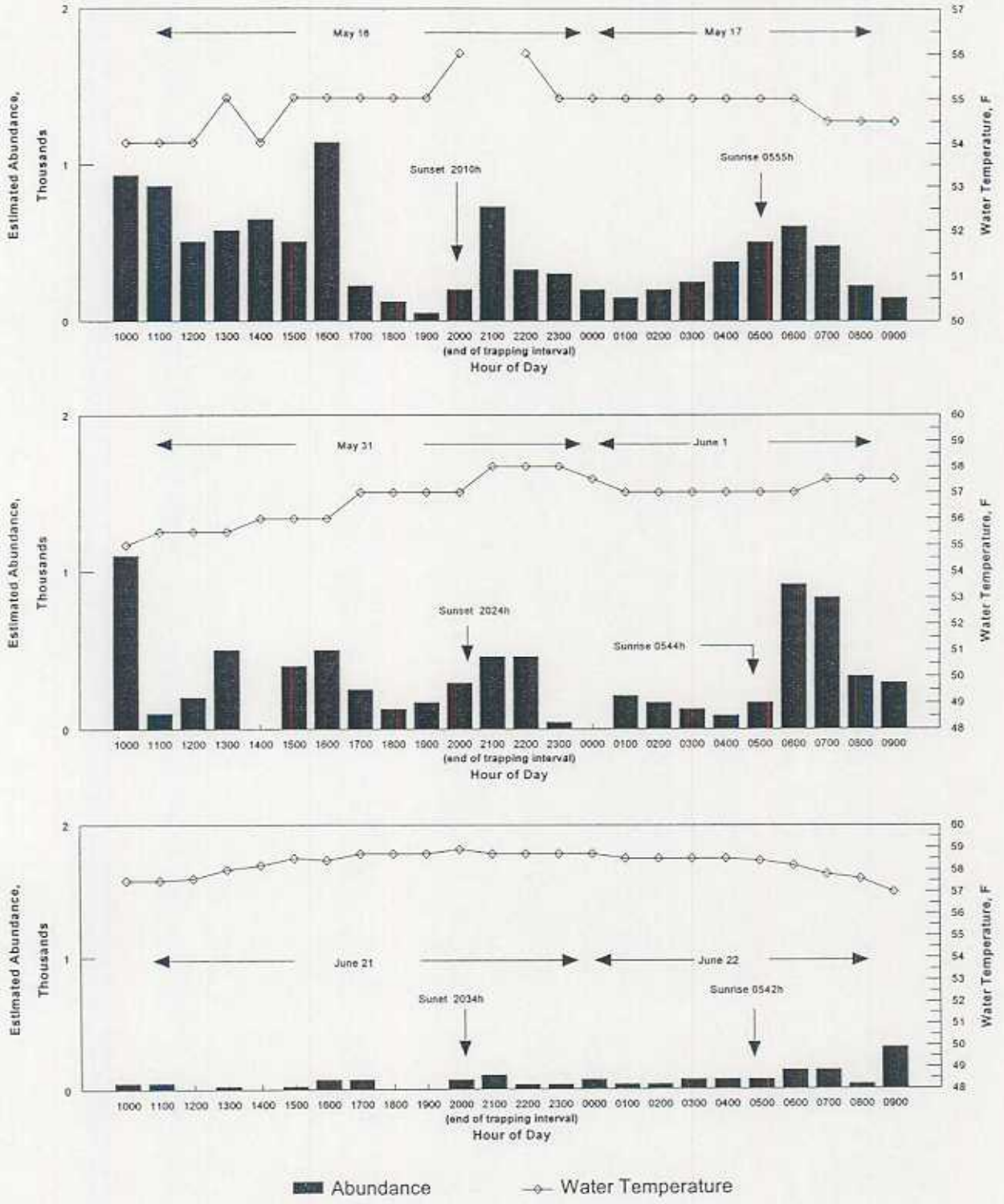


Figure 10. Abundance estimates and water temperatures during diel surveys of YOY fall-run chinook salmon migrating by Woodbridge Dam during May and June 1995. (Temperature data for 2100h on May 21 is missing).

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

Daily average river flow, water turbidity, and surface water temperatures for the Woodbridge Dam trap site are provided in Appendix F. Daily rainfall measured at Camanche Dam by the National Weather Service is included in the appendix tables.

Figure 11 shows the daily river flow, Woodbridge Canal diversions, periods of rainfall, and turbidity at Woodbridge Dam. Changes in river flow were primarily related to changes in releases from Camanche Dam. The resulting hydrograph exhibited periods of relatively constant flows punctuated by relatively rapid changes in flow occurring over the course of 2 to 5 days. Rainfall caused transient, low magnitude increases in river flow generally lasting less than 2 or 3 days. The effects of rainfall at Woodbridge Dam are somewhat accentuated by accretions caused by urban drainage from the city of Lodi (Jim Burgess, EBMUD, personal communication). Turbidity fluctuated widely over the season. Periods of rainfall and subsequent runoff caused transient increases in turbidity as did the pulsed, increased releases from Camanche Dam.

Figure 12 shows the hourly water temperatures recorded at the trapping site. Diel changes in water temperatures were very noticeable from the hourly readings logged at the site, and ranged over about 1 to 2 °F each day. We computed mean daily water temperatures for comparisons with the daily numbers of outmigrant salmon.

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 salmon corresponding to increased river flows and turbidity. We examined potential migratory responses to these environmental parameters and the potential influence of water temperature, lunar phase, and precipitation. In each case, no general trend or cause-and- effect relationship was apparent (Figures 13 and 14). And, although several daily peaks in downstream migrant abundance (in particular for fry in February) were noted to correspond with notable changes in flow and/or turbidity, most changes in migrant abundance appeared to be associated with seasonal or size-related phenomena. This latter pattern is illustrated by the apparent size threshold response denoting the abrupt onset of migrating smolts after mid-March (Figure 5). This "threshold response" is supported by the observation of increasing numbers of smolt sized salmon in mid to late March with relatively few salmon of intermediate size (40 - 50 mm FL) occurring in the traps after subsidence of the fry emigration in late February.

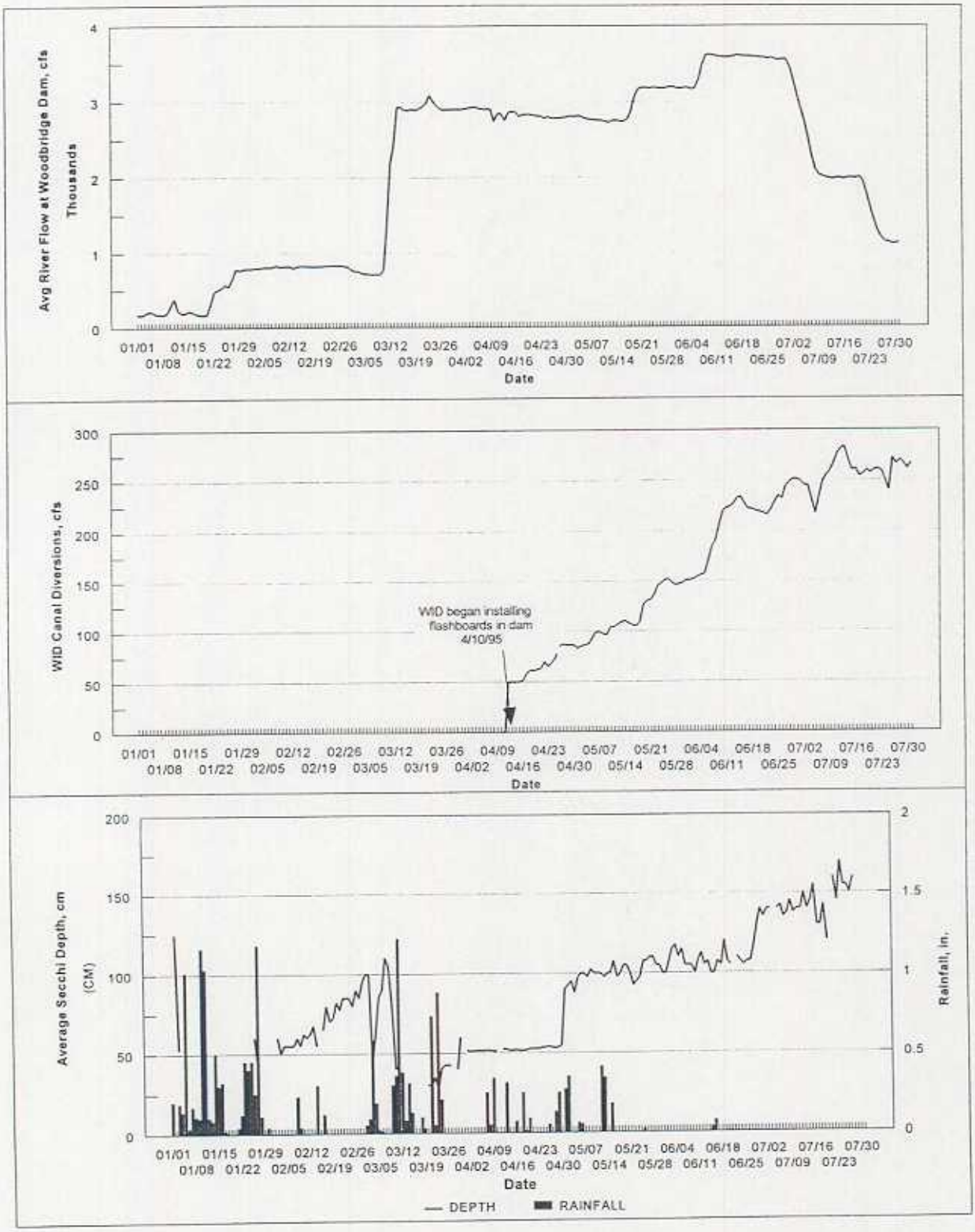


Figure 11. River flow passing Woodbridge Dam, WID canal diversions, daily average turbidity (as measured by Secchi visibility), and rainfall at Woodbridge Dam trap site (RM 39) during January through July 1995.

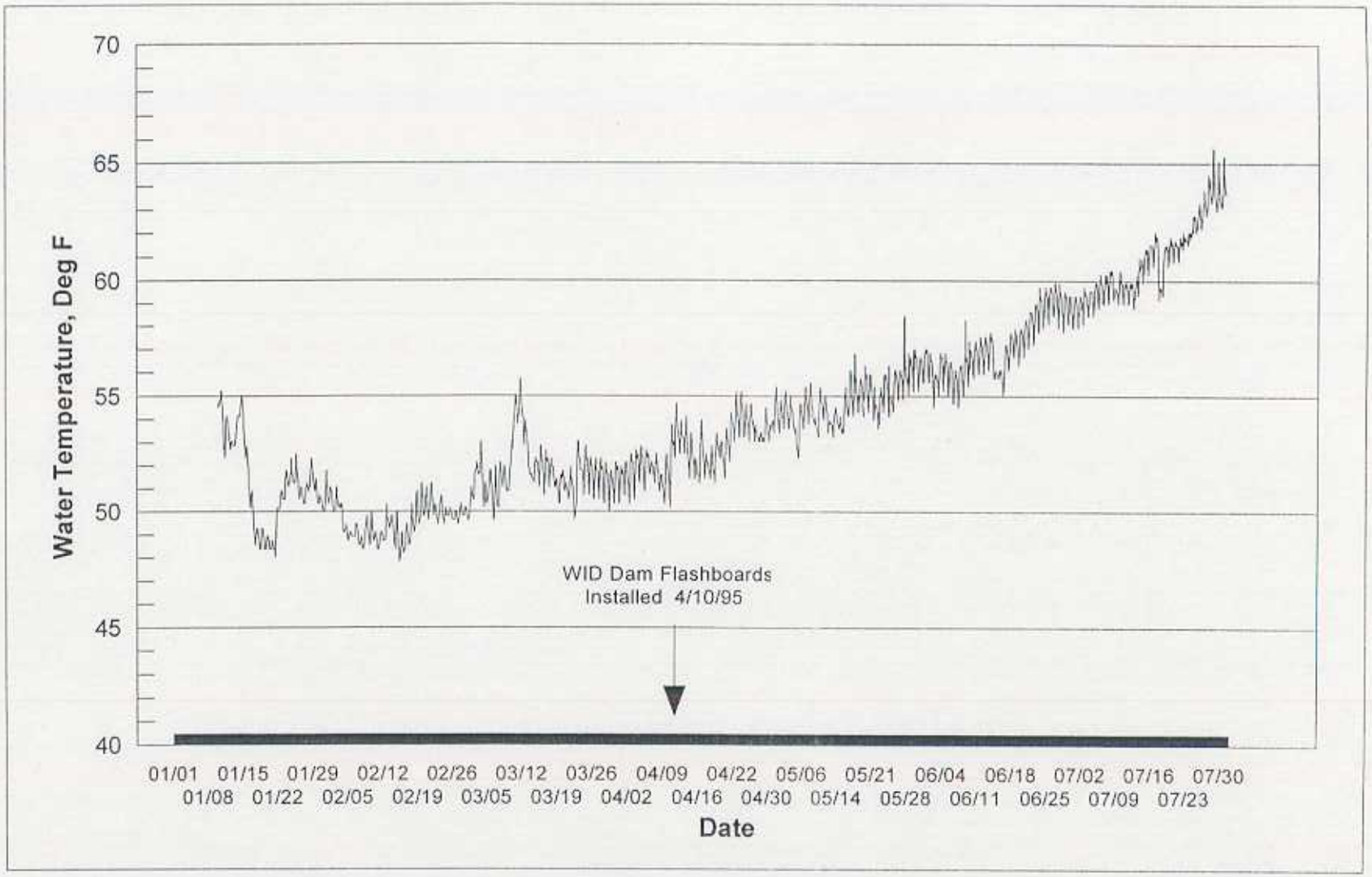


Figure 12. Hourly water temperatures recorded at Woodbridge Dam during January through July 1995.

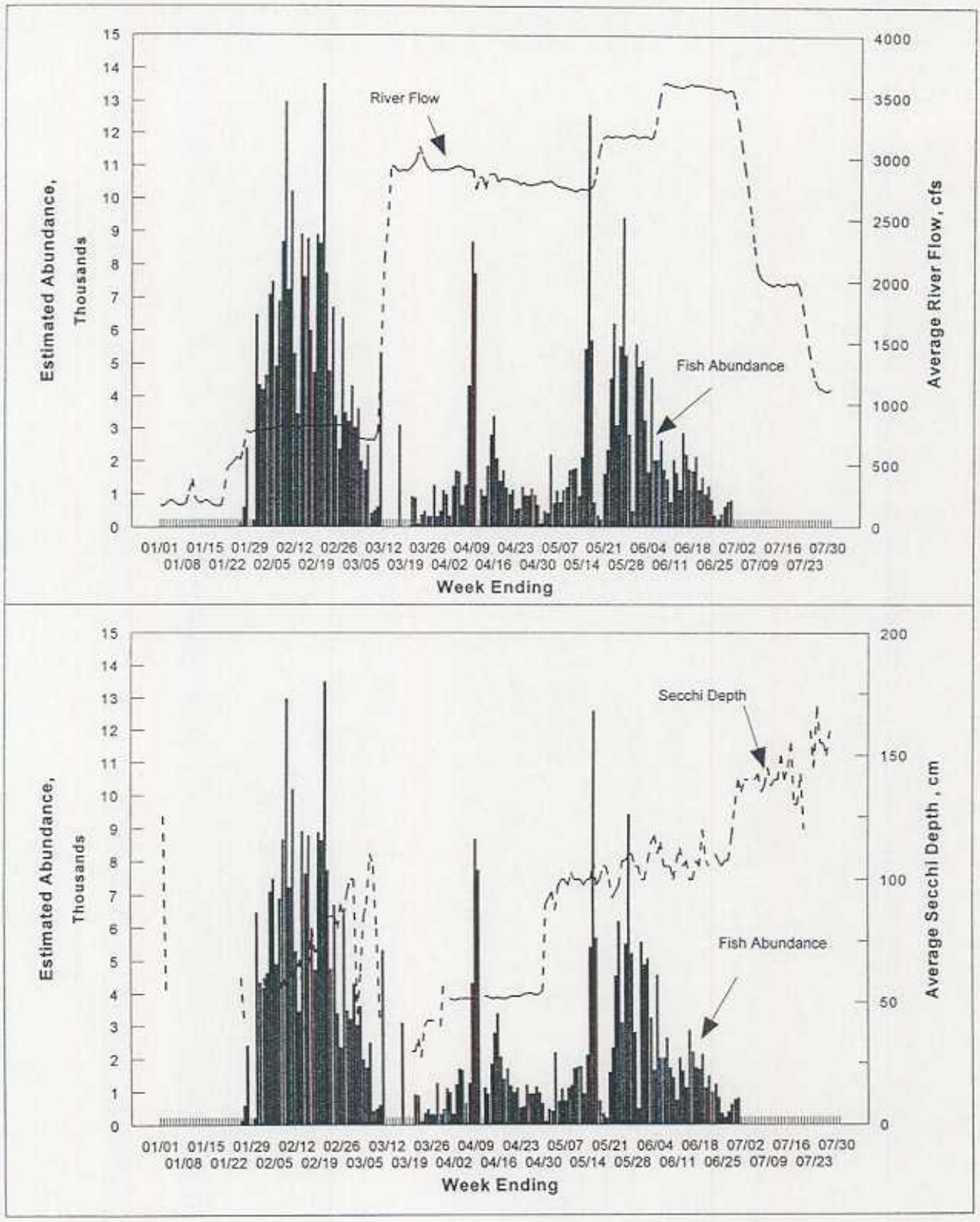


Figure 13. Estimated daily abundance of YOY chinook salmon passing Woodbridge Dam compared with average daily river flows passing Woodbridge Dam and water clarity (measured as Secchi depth) during January through July 1995.

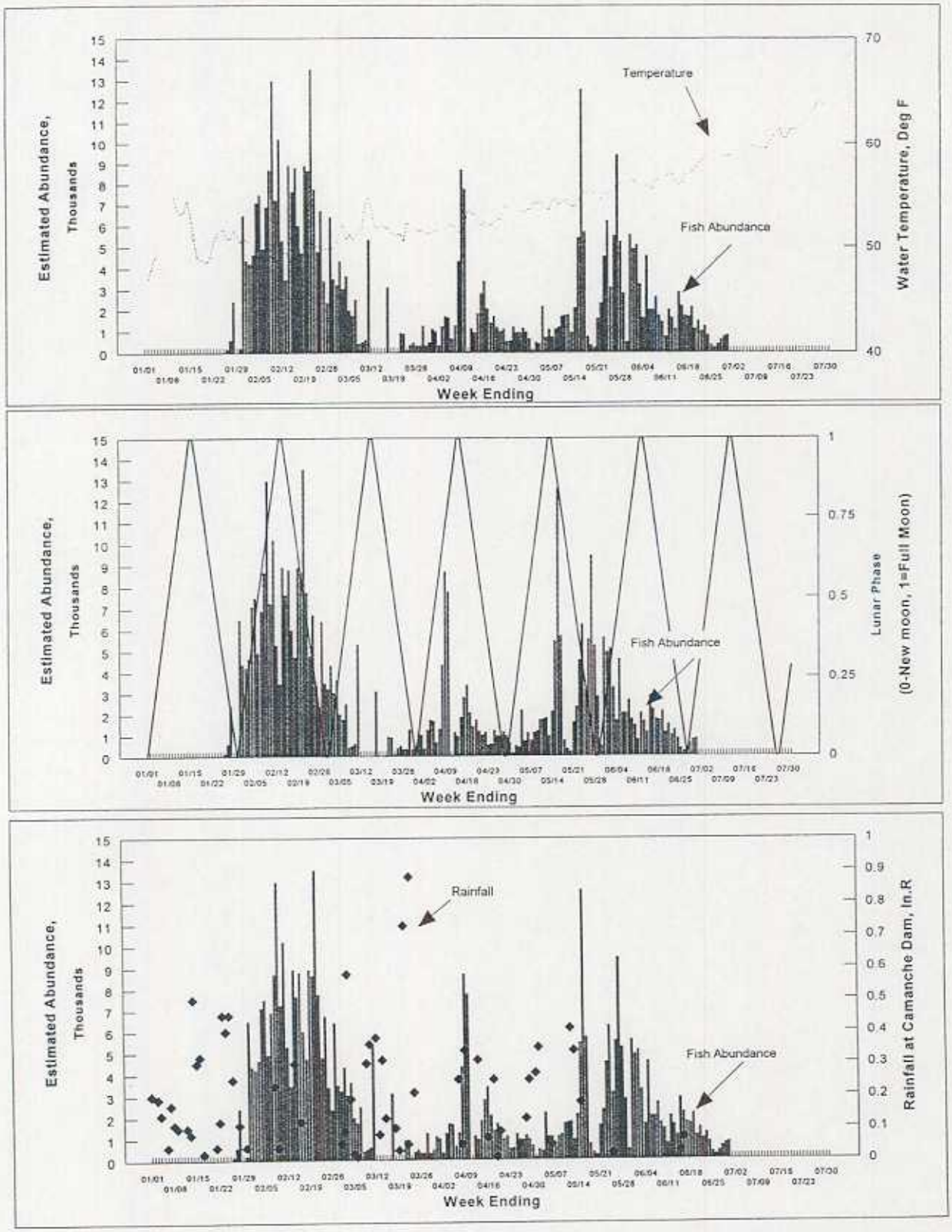


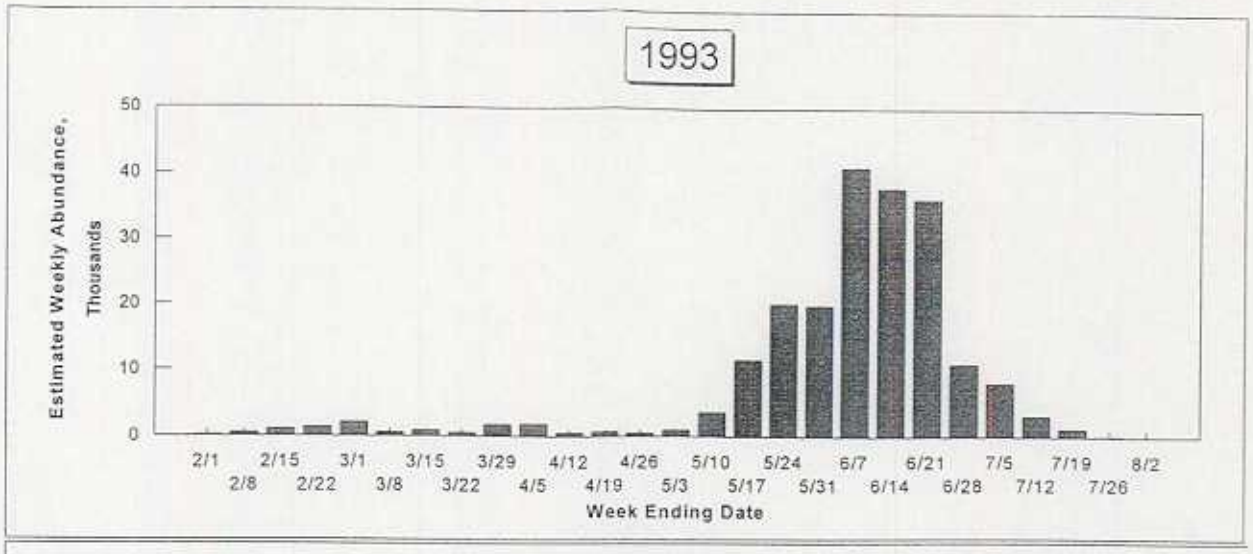
Figure 14. Estimated daily abundance of YOY chinook salmon passing Woodbridge Dam compared with daily water temperatures, lunar cycle, and daily rainfall measured during January through July 1995.

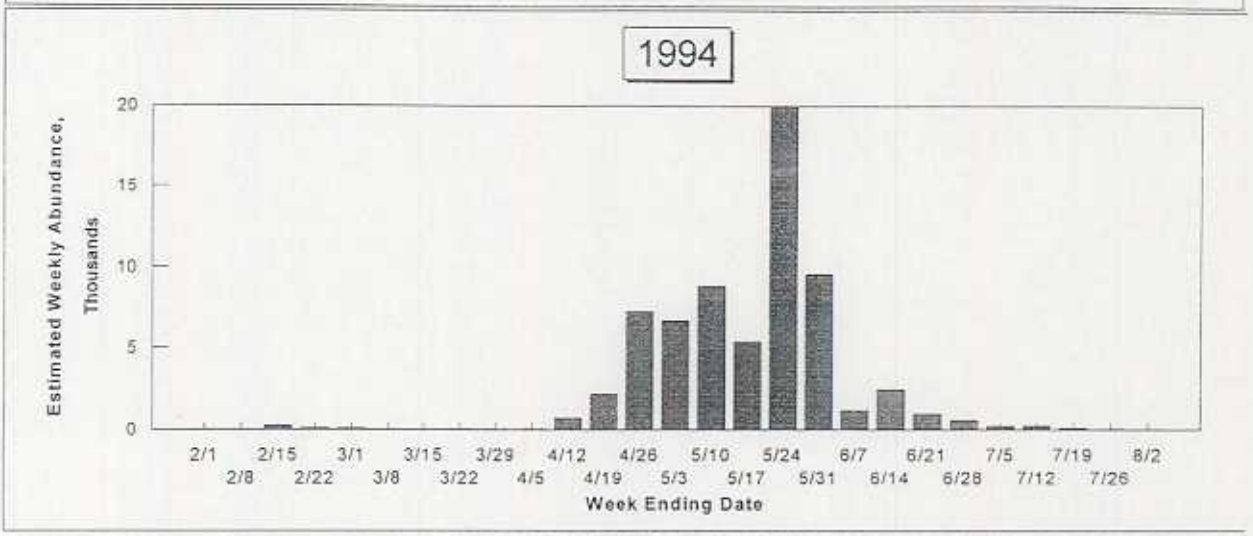
3.5 Comparison of Annual Juvenile Salmonid Downstream Migration During 1990-1995

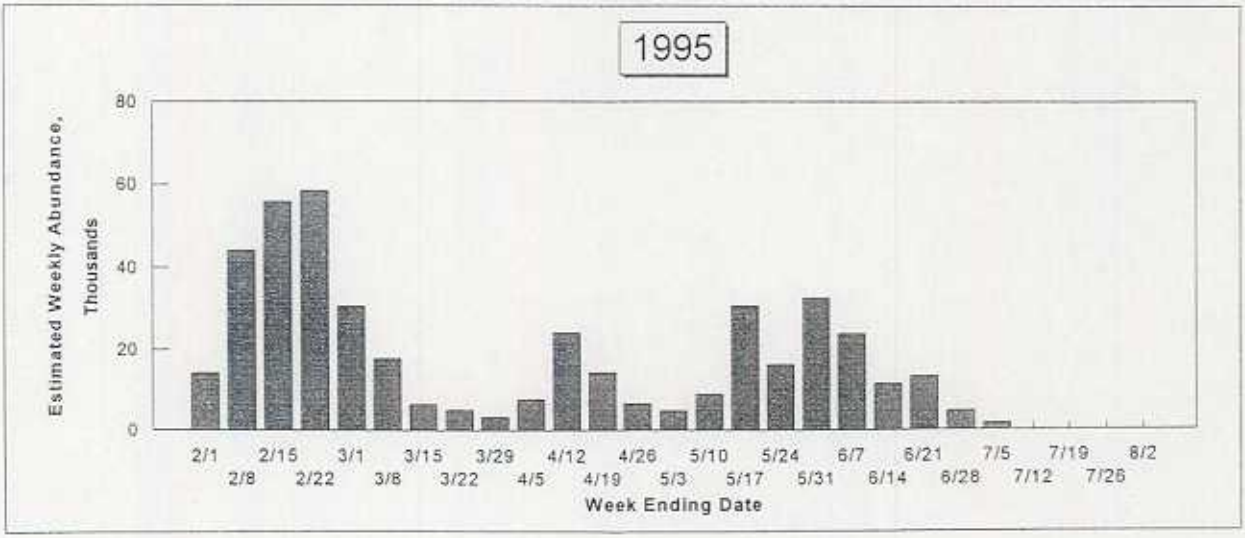
Monitoring of juvenile salmon outmigration in the Mokelumne River has been conducted since 1990. Prior to 1993, monitoring of outmigration at Woodbridge Dam relied on downstream migrant traps installed in the two fishways (due to lower flow conditions). Because the monitoring methodologies were not the same, direct comparisons of some data between years are not possible. However, there are some comparisons between years that may be made.

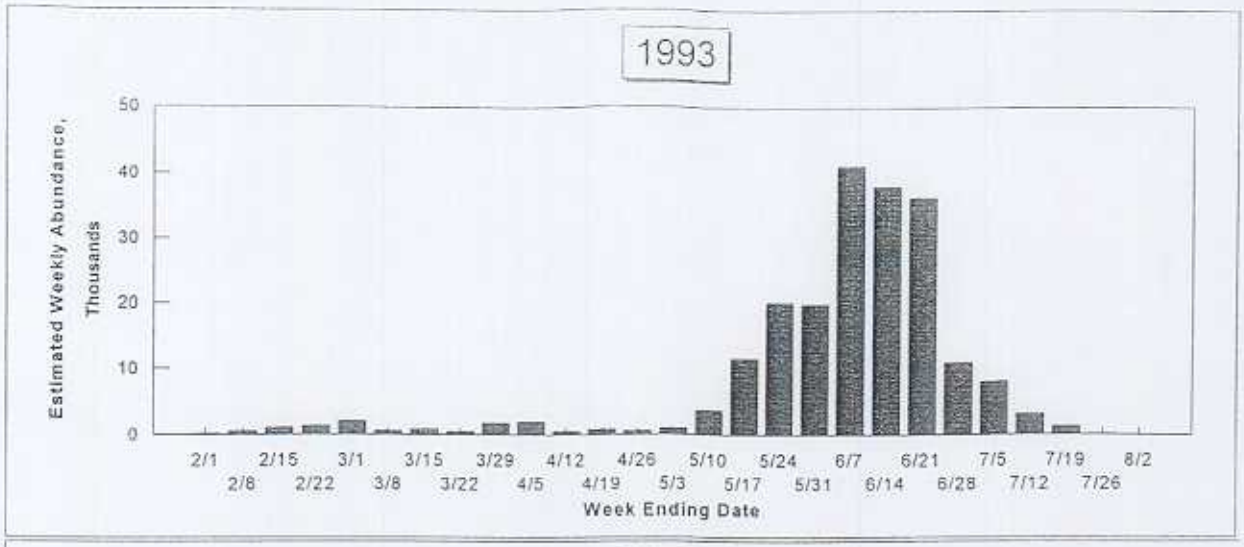
The extreme diel periodicity of migratory behavior observed during 1990–1994 was not apparent in 1995. Bianchi *et al.* (1992) reported for 1990 to 1992 that the greatest migration was seen during the morning twilight hours, but did not strongly correspond to changes in water temperature. Vogel and Marine (1994, 1996) observed during 1993 and 1994 that diel migration patterns varied during the season with some correlation with diel fluctuation in water temperature. The differences between these years may have been affected by operational conditions at the WID fish screens, where considerable debris built up in the fish bypasses in the earlier years (Vogel 1992). Also, the 1990 to 1992 diel studies were all conducted in the month of May when daily water temperature fluctuations were not more than about 2°F and the influence of temperature may not have been important. So, the role of environmental cues affecting emigration of Mokelumne River juvenile salmon cannot be deduced at this time. However, a hierarchy of environmental cues prompting migration of Atlantic salmon (*Salmo salar*) smolts down release ladders proposed by Greenstreet (1992) as, "...spate (rain storm) > light intensity > water temperature", may provide a hypothetical framework for examining future data.

The timing of juvenile chinook salmon emigration past Woodbridge Dam during 1995 was considerably different from that reported for previous years (Figure 15). The primary difference was that outmigration of fry exceeded that of smolt-sized salmon in 1995. In both 1990 and 1993, the peak emigration of smolts occurred during early June through mid June whereas in 1991, 1992, and 1994 the greatest majority of fish had migrated past Woodbridge Dam before June 1 (Figure 15). During 1995, the smolt outmigration was protracted and nearly completed by June. River flows during 1990, 1991, 1992, and 1994 were substantially lower during the principal migratory period than river flows in 1993 and 1995 (Bianchi *et. al.* 1992, Vogel and Marine 1994,1996). Based on graphic presentations of the Bianchi *et. al.* (1992) data, it appears that water temperatures recorded in 1991 and 1992 at Woodbridge Dam were approximately 1 to 5 °F higher than during comparable periods in 1993 and 1995. This may account for some of the differences in migration timing between years. Water temperature data for 1990 were not available for direct comparison with other years. Higher daily water temperatures during the early part of the smolt migration period may partially account for the earlier outmigrations observed in 1991, 1992, and 1994 (data in Bianchi *et. al.* 1992, Vogel and Marine 1994,1996).


1993
Estimated Weekly Abundance, Thousands
50
40
30
20
10
0
2/1 2/8 2/15 2/22 3/1 3/8 3/15 3/22 3/29 4/5 4/12 4/19 4/26 5/3 5/10 5/17 5/24 5/31 6/7 6/14 6/21 6/28 7/5 7/12 7/19 7/26 8/2
Week Ending Date


1994
Estimated Weekly Abundance, Thousands
20
15
10
5
0
2/1 2/8 2/15 2/22 3/1 3/8 3/15 3/22 3/29 4/5 4/12 4/19 4/26 5/3 5/10 5/17 5/24 5/31 6/7 6/14 6/21 6/28 7/5 7/12 7/19 7/26 8/2
Week Ending Date


1995
Estimated Weekly Abundance, Thousands
80
60
40
20
0
2/1 2/8 2/15 2/22 3/1 3/8 3/15 3/22 3/29 4/5 4/12 4/19 4/26 5/3 5/10 5/17 5/24 5/31 6/7 6/14 6/21 6/28 7/5 7/12 7/19 7/26 8/2
Week Ending Date


1993
Estimated Weekly Abundance, Thousands
0
10
20
30
40
50
2/1
2/8
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3/8
3/15
3/22
3/29
4/5
4/12
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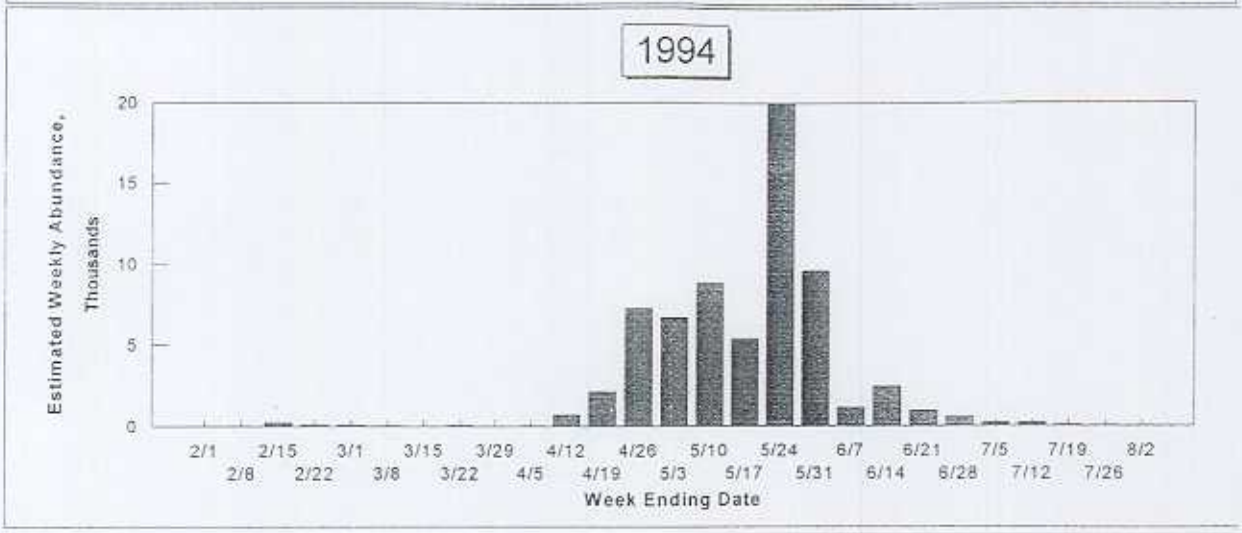
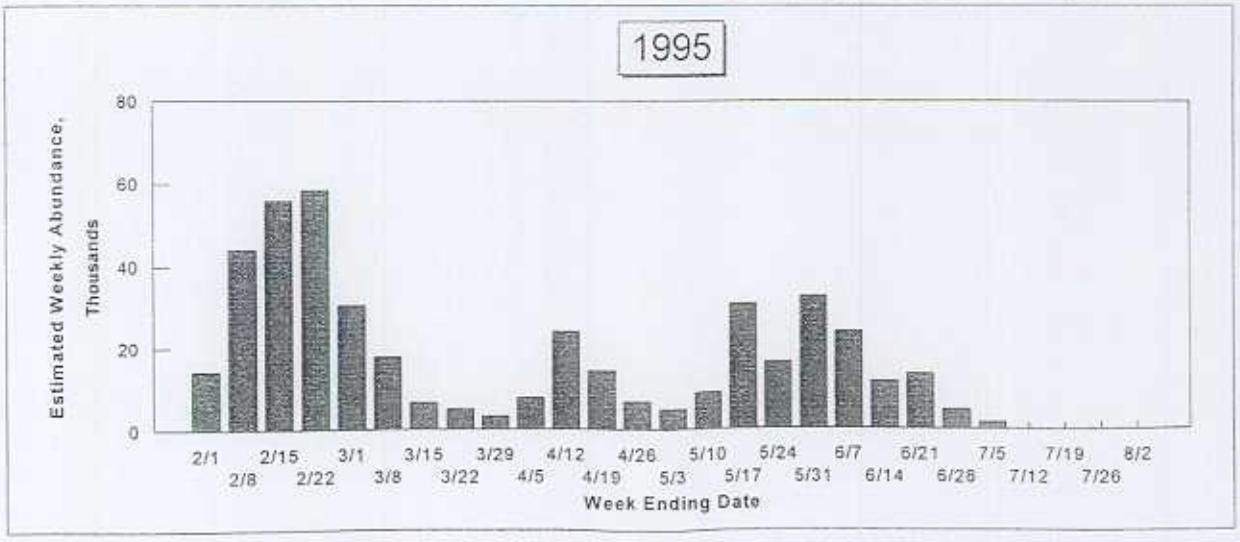
6/28
7/5
7/12
7/19
7/26
8/2
Week Ending Date


1994
Estimated Weekly Abundance, Thousands
0
5
10
15
20
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
5/3
5/10
5/17
5/24
5/31
6/7
6/14
6/21
6/28
7/5
7/12
7/19
7/26
8/2
Week Ending Date


1995
Estimated Weekly Abundance, Thousands
0
20
40
60
80
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
5/3
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7/5
7/12
7/19
7/26
8/2
Week Ending Date

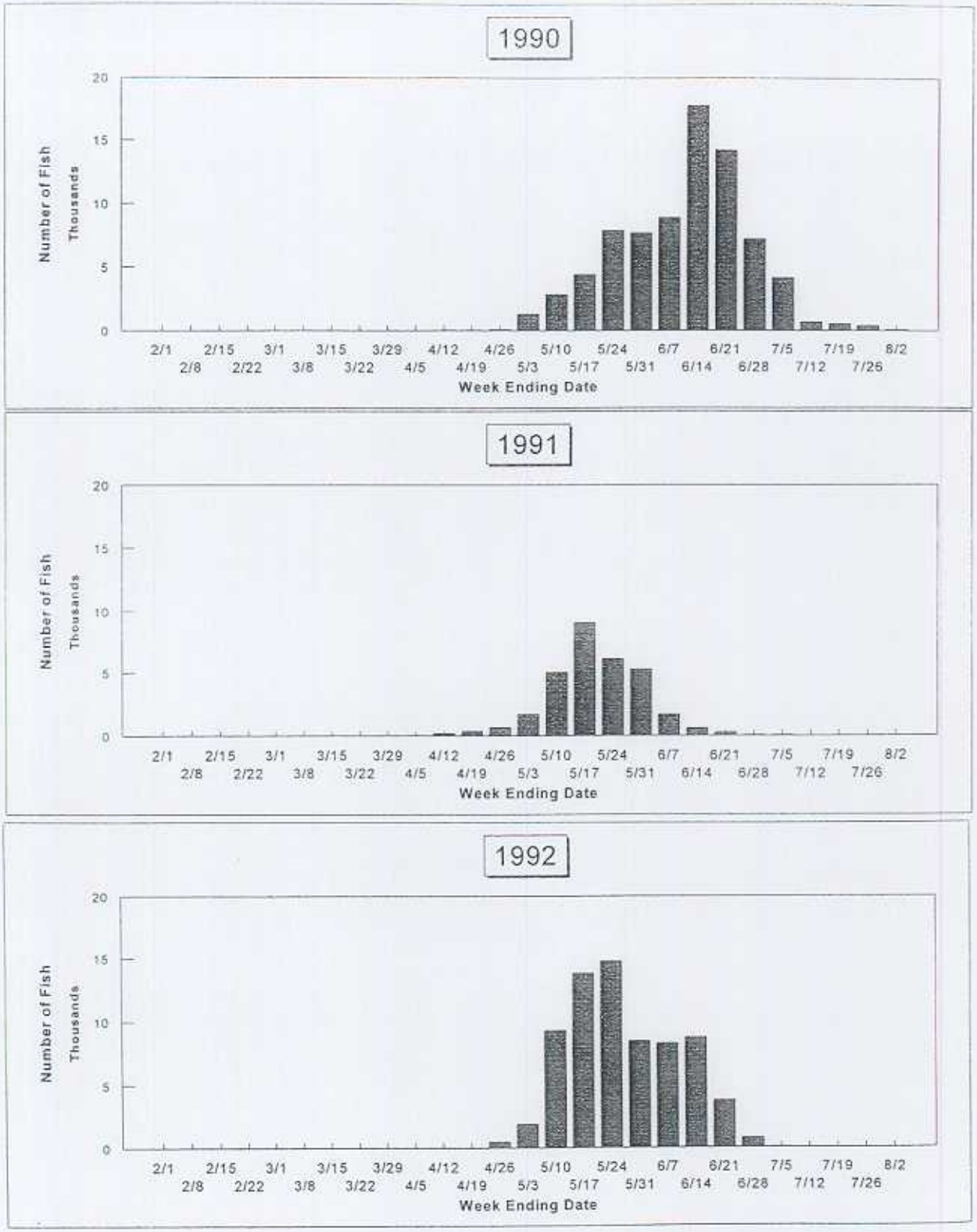

Figure 15. Weekly counts of downstream migrant chinook salmon at Woodbridge Dam for 1990, 1991, and 1992, and weekly abundance estimates of young chinook salmon at Woodbridge Dam for 1993, 1994, and 1995. (Although data are different comparisons of abundance, the patterns are roughly comparable).

Natural production of juvenile fall-run chinook salmon emigrating from the Mokelumne River during 1995 (BY94), estimated at 434,000 (about 174,000 smolts), was the greatest observed since the beginning of the monitoring program. Abundance index estimates for previous years were: 1990 (78,179), 1991 (31,025), 1992 (69,993), 1993 (183,448), and 1994 (143,224). Caution should be used in direct comparisons between years because of differences in sampling methods and some differences between sampling periods.

3.6 Assessment of Physical Injury of Juvenile Chinook Salmon Passing Woodbridge Dam

Six tests on potential physical injury to young chinook salmon passing over Woodbridge Dam were performed during June 8 and 9, 1995. Of the 22 spillbays on Woodbridge Dam (Figure 2), tests were conducted in bay numbers 11, 12, and 14. Results of these tests are given in Table 3. We hypothesized that there would be no significant differences in the proportion of dead to live fish in comparable control and experimental groups of fish after 7 days. We treated each comparison of mortality in control and experimental groups of fish independent from other tests (*i.e.*, data were not pooled).

After 7 days, only one of the six tests showed any mortality among the experimental or control groups of fish. In this case, one experimental group fish died and no control fish died. Based on these results, we could not detect any consistent, significant measurable mortality resulting from physical injury for fish passing over spillbays 11, 12, or 14 on Woodbridge Dam.

This year's test results were consistent with 1994 tests in spillbays 2 and 3 where no detectable mortality attributable to passage in those spillbays was determined, but contrasted with conditions and results of 1993 tests when significant differences between experimental and control groups were determined for spillbays 9, 14, and 15. In 1993, 8 of 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 (Vogel and Marine 1994, 1996).

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 spillbays on the dam (*i.e.*, bays 4–22) 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 spillbay are different between bays. This latter circumstance is attributable to the size, shape, configuration, and distribution of the riprap material (mostly varying sizes of broken-up concrete) downstream of each spillbay. It would be very difficult to quantify those specific differences between spillbays because of the highly circuitous routes fish may pass over or through the riprap material. However, unlike bay numbers 4 through 22, water flowing over bays 1, 2, and 3 primarily passes onto smooth concrete downstream of the dam and into the dam's tailwater pool. This smoother route of passage for fish may account for the absence of physical-injury-related mortality noted in the 1994 tests. The 1993 tests where significant mortality occurred were performed in spillbays 9, 14, and 15 that pass flow into riprap downstream of the dam when tailwater stage is

Table 3. Results of physical injury tests conducted on juvenile chinook salmon at Woodbridge Dam during the spring of 1995.

Test Group	Bay No. From Left Side Facing Downstream	Test Date	Approximate No. of Fish Released	No. of Fish Captured	Cumulative Mortality (Number of Fish) Following Recapture							Total No. of Dead Fish	Total No. 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						
13A-Experimental 7A-Control	11 and 12	6/8/95	1000 30	35 48	0 0	1 0	0 0	0 0	0 0	0 0	0 0	1 0	34 48	95 0	94 91	2.9 0.0	2.9
14B-Experimental 9B-Control	11 and 12	6/8/95	800 20	19 34	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	19 34	0 0	90 96	0.0 0.0	0.0
2A-Experimental 1A-Control	12 and 14	6/8/95	800 20	19 22	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	19 22	0 0	92 98	0.0 0.0	0.0
2B-Experimental 8B-Control	11 and 12	6/9/95	1050 20	20 29	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	20 29	0 0	92 88	0.0 0.0	0.0
7B-Experimental 13B-Control	11 and 12	6/9/95	1000 20	17 31	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	17 31	0 0	85 88	0.0 0.0	0.0
8A-Experimental 14A-Control	11 and 12	6/9/95	1000 25	27 33	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	27 33	0 0	89 89	0.0 0.0	0.0

low. A significantly higher tailwater stage during 1995 tests may have partially improved passage conditions near the base of the dam by inundating the riprap below spillbays 4 through 22.

3.7 Assessment of Survival of Juvenile Chinook Salmon Migrating Through the Sacramento-San Joaquin Delta During the Spring of 1995.

3.7.1 MRFI Chinook Salmon

Table 4 provides the release and recovery data for the approximately 197,000 hatchery fall-run chinook salmon CWT at MRFI and released during the spring of 1995. Table 5 gives specific release data for each of the tag groups.

Table 4. Release and recovery information for four groups of Mokelumne River Fish Installation CWT juvenile fall-run chinook salmon captured at the Chipps Island USFWS trawling station, Spring 1995.

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
6-02-11[A]	4-18-95	48,345	4-25-95	5-18-95	25	24	4,620	0.13	0.50
6-02-12[A]	4-18-95	49,531	4-26-95	5-21-95	23	27	5,220	0.13	0.45
6-02-13[B]	4-25-95	49,837	5-2-95	5-17-95	24	16	3,020	0.13	0.48
6-02-14[B]	4-25-95	49,625	5-1-95	5-20-95	25	20	3,820	0.13	0.49

[A]both tag groups treated as sublots of one experimental early season release
[B]both tag groups treated as sublots of one experimental late season release

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, personal communication). A calculated value of 1 would represent 100-percent survival.

Table 5. CWT release information for Mokelumne River fall-run chinook salmon, spring 1995.

Code ID	Egg Lot No.	Brood Year	Release Location	Date Released		Rearing Type	Purpose	Total No. Tagged	Estimated Tag Loss and Mortality Before 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										
6-02-11 *	Mixed	1994	New Hope Landing-Mok. R.	4/18/95	4/18/95	Hatchery	Delta Mortality Estimate	53,243	9.2	48,345	26	77	80.0	Mokelumne River Fish Installation	Mokelumne River
6-02-12 *	Mixed	1994	New Hope Landing-Mok. R.	4/18/95	4/18/95	Hatchery	Delta Mortality Estimate	54,550	9.2	48,531	21	77	80.0	Mokelumne River Fish Installation	Mokelumne River
6-02-13 *	Mixed	1994	New Hope Landing-Mok. R.	4/25/95	4/25/95	Hatchery	Delta Mortality Estimate	54,348	8.3	49,837	25	66	83.0	Mokelumne River Fish Installation	Mokelumne River
6-02-14 *	Mixed	1994	New Hope Landing-Mok. R.	4/25/95	4/25/95	Hatchery	Delta Mortality Estimate	54,117	8.3	49,625	21	66	83.0	Mokelumne River Fish Installation	Mokelumne River
6-1-13-1-06	Wild	1994	Woodbridge Dam	4/7/95	7/28/95	Wild	Survival and Contrib.	4,777	1.5	4,569	6-8[2]	79[3]	90	Mokelumne River Wild	Mokelumne River Wild
6-02-10	Mixed	1994	NewHope Landing-Mok. R.	6/15/96	6/19/96	Hatchery	Mitigation	53,221	2.3	51,762	18	41	--	Mokelumne River Fish Installation	Mokelumne River
6-02-07	Mixed	1994	Crockett San Pablo Bay	4/12/96	5/22/96	Hatchery	Enhance	51,675	3.7	49,763	27	52	93	Mokelumne River Fish Installation	Feather River
6-02-08	Mixed	1994	Crockett San Pablo Bay	4/12/96	5/22/96	Hatchery	Enhance	51,681	3.7	49,769	25	52	93	Mokelumne River Fish Installation	Feather River
6-02-09	Mixed	1994	Crockett San Pablo Bay	4/12/96	5/22/96	Hatchery	Enhance	51,082	3.7	49,192	21	52	93	Mokelumne River Fish Installation	Feather River

* These groups were mixed prior to trucking and tag shed check . Paired replicate groups treated as a single composite group with regard to tag shedding, mortality, and size.

1 Adjusted for estimated shed tags and prerelease mortality.

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

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

For each 1995 Delta survival study group released, recoveries by the USFWS at their Chipps Island trawling station were very low. These low recovery rates are a consistent result experienced for all prior years' Delta survival studies (Bianchi *et al.* 1992, Vogel and Marine 1994, 1996). Survival indexes were consistent among the replicated groups ranging from 0.45 to 0.50 for both early and late season releases. "Within group" variation was low with coefficients of variation ranging from 7.4 percent for the early release groups to 1.4 percent for the late release groups. Such low and consistent within group sampling variation suggests that sampling was relatively random and capture probabilities were consistent during the period of passage of each release group by the trawling station. Delta hydrologic conditions varied somewhat during the periods following the release of fish but the Delta outflow index generally exceeded 60,000 cfs (Appendix G). 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.

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

Appendix B provides a daily record of the numbers of wild fall-run chinook salmon smolts captured and CWT at Woodbridge Dam. Additional relevant data are provided in Table 6. Tagging was initiated on April 7, 1995 when a substantial increase in the numbers of smolt-sized salmon was observed in the traps. One tag code, 6-1-13-1-6 (0.5 mm microtag), was used during the season. This tag code was applied to 4,777 smolts ranging in size from 70–130 mm FL through July 28, 1995.

Overall, a 2.9 percent latent mortality (N=137) was observed during four 6 to 8-day post-tagging observation periods beginning on the following dates, 4/14/95, 5/3/95, 5/22/95, and 6/16/95. A 98.5 percent tag retention rate was obtained for fish surviving at least 6 days during each of the four holding periods (N=133). Tagging reports with all the preceding information were submitted to the CDFG during July and August 1995.

None of these tagged wild chinook salmon were reported as captured by the USFWS at their trawling station near Chipps Island. Because the numbers released were relatively small, no inferences can be made as to survival rates for these fish migrating through the Delta.

3.8 Radio-Telemetry Assessment of the Migratory Behavior of Juvenile Salmonids Through Lake Lodi

Thirty age 1+ (BY93) hatchery-reared fall-run chinook salmon obtained from Merced River Hatchery were radio tagged and released in Lake Lodi at two different locations from April through June 1995. The results of these telemetry observations are summarized in Table 6.

Of the 30 radio-tagged salmon released, 23 were confirmed to have passed Woodbridge Dam. The seven radio-tagged fish that were not confirmed to have passed the dam were part of the last release in June when excessive radio interference impaired reception of tag transmitters. Five fish in this release were detected passing the dam and the initial direction of movement of all fish in this release group, including the seven undetected fish, was downstream. The first two

Table 6. Summary of the migration behavior of 30 individual radio-tagged yearling fall chinook salmon released and tracked through Lake Lodi, Mokelumne River, California during April through June 1995.

Tag Freq., MHz	Pulse Rate of Tag, No./Min	FL, mm	Weight, gm	Date Tagged	Date of Release	Time of Release	Release Location	Time of Passage at RM41.5, Housing Inlet	Elapsed Time for Migration to RM41.5, hrs:min	Time of Passage at RM39.3, Island near Park	Elapsed Time for Migration to RM39.3, hrs:min	Date of Arrival at WIDD, RM38.6	Time of Arrival at WIDD, RM38.6	Elapsed Time for Migration to WIDD, hrs:min	Date Last Observed in Spill Basin	Time Last Detected by Datalogger in Dam/Basin Area
48.87	55	218	123	04/27/95	04/28/95	20:05	RM39.7	A	N/A	D	N/A	04/28/95	20:45	00:40	04/28/95	G
48.77	60	220	120	04/27/95	04/28/95	20:05	RM39.7	A	N/A	D	N/A	04/28/95	20:40	00:35	04/28/95	G
48.73	59	245	200	04/27/95	04/28/95	20:05	RM39.7	A	N/A	D	N/A	04/28/95	21:10	01:05	04/28/95	G
48.59	54	217	123	04/27/95	04/28/95	20:05	RM39.7	A	N/A	D	N/A	04/28/95	21:12	01:07	04/28/95	G
48.83	N/A	214	115	04/27/95	04/28/95	20:05	RM39.7	A	N/A	D	N/A	04/28/95	21:30	01:25	04/28/95	G
48.75	55	217	114	04/27/95	04/28/95	20:05	RM39.7	A	N/A	D	N/A	04/28/95	22:00	01:55	F	G
48.61	54	216	115	05/04/95	05/05/95	19:55	RM39.7	A	N/A	21:10	01:15	B	B	N/A	N/A	G
48.57	56	222	129	05/04/95	05/05/95	19:55	RM39.7	A	N/A	20:35	00:40	05/05/95	21:54	01:59	05/05/95	G
48.85	56	216	117	05/04/95	05/05/95	19:55	RM39.7	A	N/A	20:37	00:42	C	C	N/A	N/A	G
48.63	54	203	99	05/04/95	05/05/95	19:55	RM39.7	A	N/A	N/A	N/A	05/05/95	21:00	01:05	05/08/95	G
48.67	54	222	122	05/04/95	05/05/95	19:55	RM39.7	A	N/A	N/A	N/A	05/05/95	21:23	01:28	05/05/95	G
48.69	54	222	110	05/04/95	05/05/95	19:55	RM39.7	A	N/A	20:37	00:42	05/05/95	22:42	02:47	05/07/95	G
48.51	60	225	138	05/14/95	05/15/95	14:02	RM42.8	15:42	01:40	N/A	N/A	05/16/95	03:51	13:49	05/19/95	05:28
48.53	58	214	107	05/14/95	05/15/95	14:02	RM42.8	N/A	N/A	N/A	N/A	E	E	N/A	N/A	N/A
48.55	54	245	162	05/14/95	05/15/95	14:02	RM42.8	15:38	01:36	N/A	N/A	05/15/95	18:40	04:38	05/15/95	18:40
48.71	54	221	136	05/14/95	05/15/95	14:02	RM42.8	17:25	03:23	N/A	N/A	05/15/95	21:03	07:01	05/17/95	02:20
48.79	54	230	125	05/14/95	05/15/95	14:02	RM42.8	N/A	N/A	N/A	N/A	05/15/95	21:56	07:54	05/18/95	01:51
48.81	56	243	169	05/14/95	05/15/95	14:02	RM42.8	N/A	N/A	N/A	N/A	05/15/95	19:35	05:33	05/16/95	02:13
49.47	60	277	236	06/15/95	06/16/95	16:20	RM42.8	N/A	N/A	N/A	N/A	H	H	N/A	N/A	N/A
49.39	60	225	190	06/15/95	06/16/95	16:20	RM42.8	17:15	00:55	N/A	N/A	H	H	N/A	N/A	N/A
49.43	60	250	173	06/15/95	06/16/95	16:20	RM42.8	17:29	01:09	N/A	N/A	06/17/95	04:37	12:17	06/17/95	23:14
49.45	60	246	177	06/15/95	06/16/95	16:20	RM42.8	17:37	01:17	N/A	N/A	H	H	N/A	N/A	N/A
49.59	60	248	153	06/15/95	06/16/95	16:20	RM42.8	17:38	01:18	N/A	N/A	H	H	N/A	N/A	N/A
49.63	60	284	238	06/15/95	06/16/95	16:20	RM42.8	N/A	N/A	N/A	N/A	06/16/95	22:15	05:55	06/16/95	22:15
49.65	60	248	189	06/15/95	06/16/95	16:20	RM42.8	N/A	N/A	N/A	N/A	H	H	N/A	N/A	N/A
49.827	60	220	126	06/15/95	06/16/95	16:20	RM42.8	N/A	N/A	N/A	N/A	H	H	N/A	N/A	N/A
49.889	60	236	153	06/15/95	06/16/95	16:20	RM42.8	N/A	N/A	N/A	N/A	H	H	N/A	N/A	N/A
49.917	60	250	192	06/15/95	06/16/95	16:20	RM42.8	N/A	N/A	N/A	N/A	06/16/95	21:41	05:21	06/16/95	22:07
49.963	60	259	192	06/15/95	06/16/95	16:20	RM42.8	N/A	N/A	N/A	N/A	06/16/95	22:46	06:26	06/16/95	22:59
49.995	60	237	138	06/15/95	06/16/95	16:20	RM42.8	N/A	N/A	N/A	N/A	06/16/95	21:05	04:45	06/17/95	08:50

Notes:

A- Fish released downstream of this point; B- Fish last detected at 21:46h near RM39.3, no location the following day; C- Fish last detected at 20:47h near RM38.8, suspect fish moved rapidly downstream between radio scans;

D- Receiver malfunction, only had 1 receiver to track fish and missed several location plot opportunities; E- Fish not detected at all after release; F- Fish last detected at 22:25h on 4/28/95 immediately below WID;

G- Datalogger not deployed during these trials in order to use both receivers in field for specific locations; H-Considerable radio interference during this trial may have masked weak radio signals and required long datalogger scan intervals which may have missed arrivals.

N/A indicates missing or no data blocks.

releases (N=12) made on April 28 and May 5 were released about 1 mile upstream from Woodbridge Dam. All fish in these two groups passed the dam with no delay, and elapsed migration times through this reach ranged from 0.5 to 2.75 hours. River flows past Woodbridge Dam during this period were about 2,800 cfs. The latter two releases (N=18) were performed on May 15 and June 16, 1995 and were made about 4 miles upstream of the dam near the head of Lake Lodi (RM 42.8). These fish exhibited migration rates through Lake Lodi ranging from about 4.5 to 13.8 hours. River flows past Woodbridge Dam during this latter period ranged from 2,750 to 3,600 cfs. Rates of passage for radio-tagged yearling fall chinook salmon through the Lake Lodi reach of the Mokelumne River ranged from an average of about 0.5 to 1.0 miles per hour during river flows ranging from 2,750 to 3,600 cfs with no detected delay in passage at Woodbridge Dam. These results were comparable to those obtained for radio-tagged yearling fall-run chinook salmon migrating in the upper Sacramento River near Red Bluff Diversion Dam (Vogel *et al.* 1988).

3.9 Lake Lodi Water Quality Monitoring

Appendix H provides data for water quality monitoring from May 30 through July 25, 1995 in Lake Lodi and the Mokelumne River. Figure 16 shows that water temperature increased only slightly throughout Lake Lodi from upstream to downstream ends of the reservoir. Little thermal stratification in Lake Lodi was evident throughout the 1995 monitoring period. Water was generally cooler at river mile 39.0 in the right channel (facing downstream) as compared to the left channel near the WID screens (Figure 3), presumably because of the deeper water in the right channel. The pH, a measure of the hydrogen ion concentration of the water, ranged between 6.8 to 7.2. Throughout the monitoring period at all stations pH was homogeneous through the water column with little variation between stations. All measured pH values were near neutrality indicating a well-buffered, acid-base balanced water quality condition. DO levels during the season varied from 9.3 mg/l to 10.5 mg/l. These values are well within satisfactory ranges of fish. Specific conductance, which is an indirect measurement of total dissolved solids, ranged from 34 to 45μs/cm. These values varied very little over the season and between locations. Overall, water quality in Lake Lodi during the spring and early summer of 1995 were well within ranges suitable for juvenile salmonid rearing (Piper *et al.* 1982).

3.10 Physiological Assessment of Smolt Development of Fall Chinook Salmon

The temporal development of gill Na^+/K^+ ATPase activity has been used successfully to characterize one of the many physiological metamorphoses that salmon undergo preparatory to their transition from an early life stage in freshwater to their ocean life stage (Hoar 1988). The underlying physiological processes reflected by changes in gill Na^+/K^+ ATPase have also been demonstrated to be affected by environmental factors such as photoperiod, water chemistry, and water temperature, as well as, biological factors such as disease, social interactions, and nutrition (Ewing *et al.* 1979, Lorz and McPherson 1977, Schreck *et al.* 1985, Wedemeyer *et al.* 1980, Zaugg 1982).

Smolt development was monitored in downstream migrant salmon collected in the downstream migrant traps at Woodbridge Dam and in samples of fish collected on the rearing grounds in the river upstream from Woodbridge Dam. Data for physiological measurements are provided in Appendix I and Table 7 provides a summary of these results.

Size of fish sampled at both locations generally increased throughout the season. Fish migrating by Woodbridge Dam were significantly larger in length and weight (α=0.05, ANOVA) than fish collected on the rearing grounds, except during the first two and last sampling periods. Condition factor of fish on the rearing grounds was generally greater than that of fish migrating past Woodbridge Dam during the peak of the smolt emigration in April through June. This difference in condition factor between fish on the rearing grounds and those passing Woodbridge Dam was also observed during 1993 and 1994 (Vogel and Marine 1994, 1996) and was attributed to morphological changes (fish become less plump)that occur during smoltification for several species of salmonids (Hoar 1988, McKeown 1984, Woo *et al.* 1978).

Gill Na^+/K^+ ATPase activity also reflected potential differences in the smolt status of juvenile salmon as they rear in the lower Mokelumne River. Specific activity of gill Na^+/K^+ ATPase was generally higher throughout the season in fish migrating past Woodbridge Dam than in fish collected from the rearing grounds (Figure 17). However, these differences were not statistically significant (P>0.05). Moderate peaks of gill Na^+/K^+ ATPase activity for fish collected in the rearing habitats and migrating past Woodbridge Dam during April and May (Figure 17) occurred near the new moons and may indicate cyclic recurrence of smoltification or bimodality of smolt development within the Mokelumne population of fall chinook salmon. No such cyclicity was observed during 1994 (Vogel and Marine 1996). Lack of distinct cyclic changes in gill Na^+/K^+ ATPase activity in wild coho salmon compared to that observed for hatchery-reared salmon was noted by Rodgers *et al.* (1987); so, periodicity of this smolt index should not necessarily be expected in samples from wild fish.

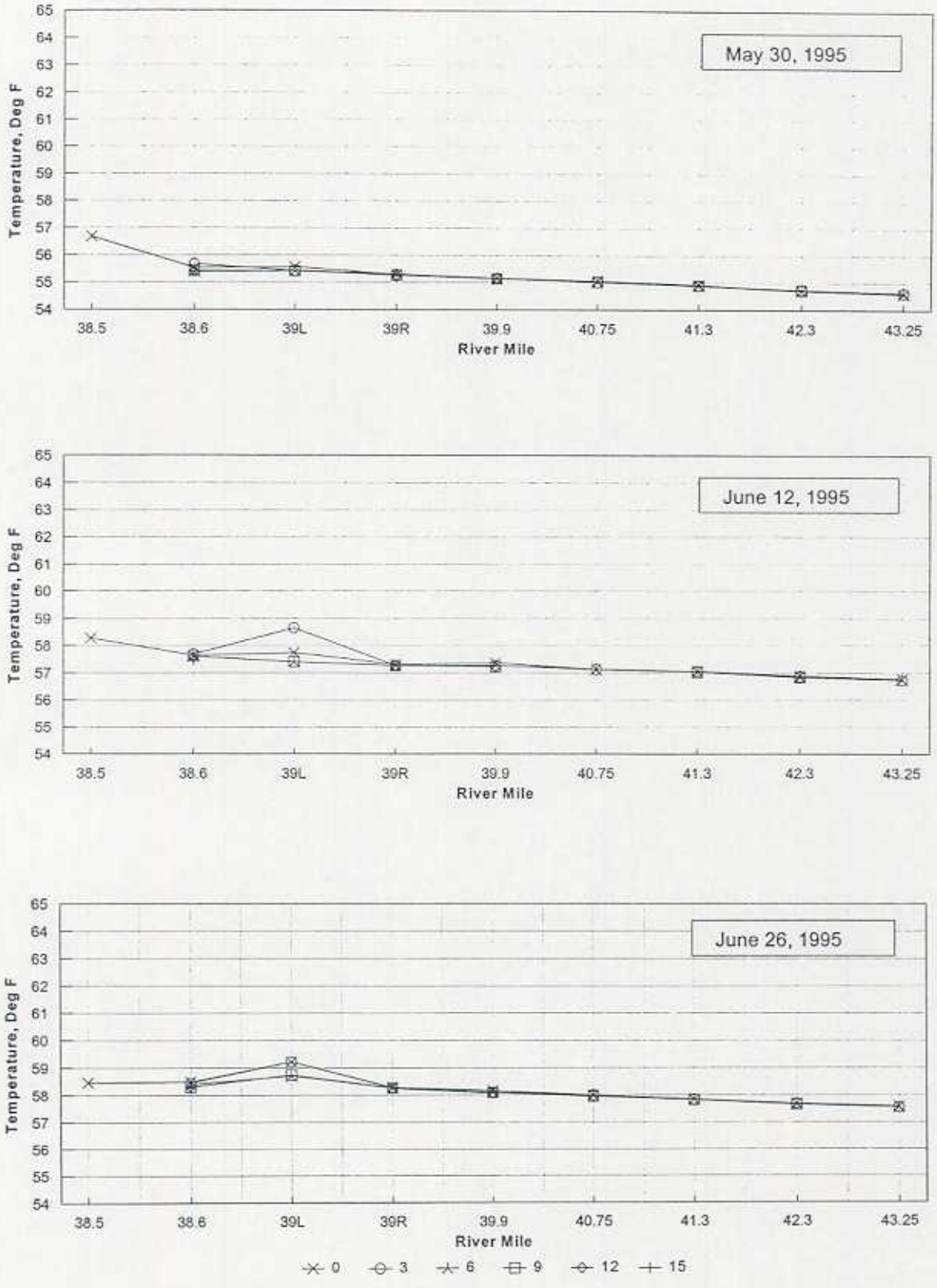

Figure 16. Water temperatures in Lake Lodi and the Mokelumne River.

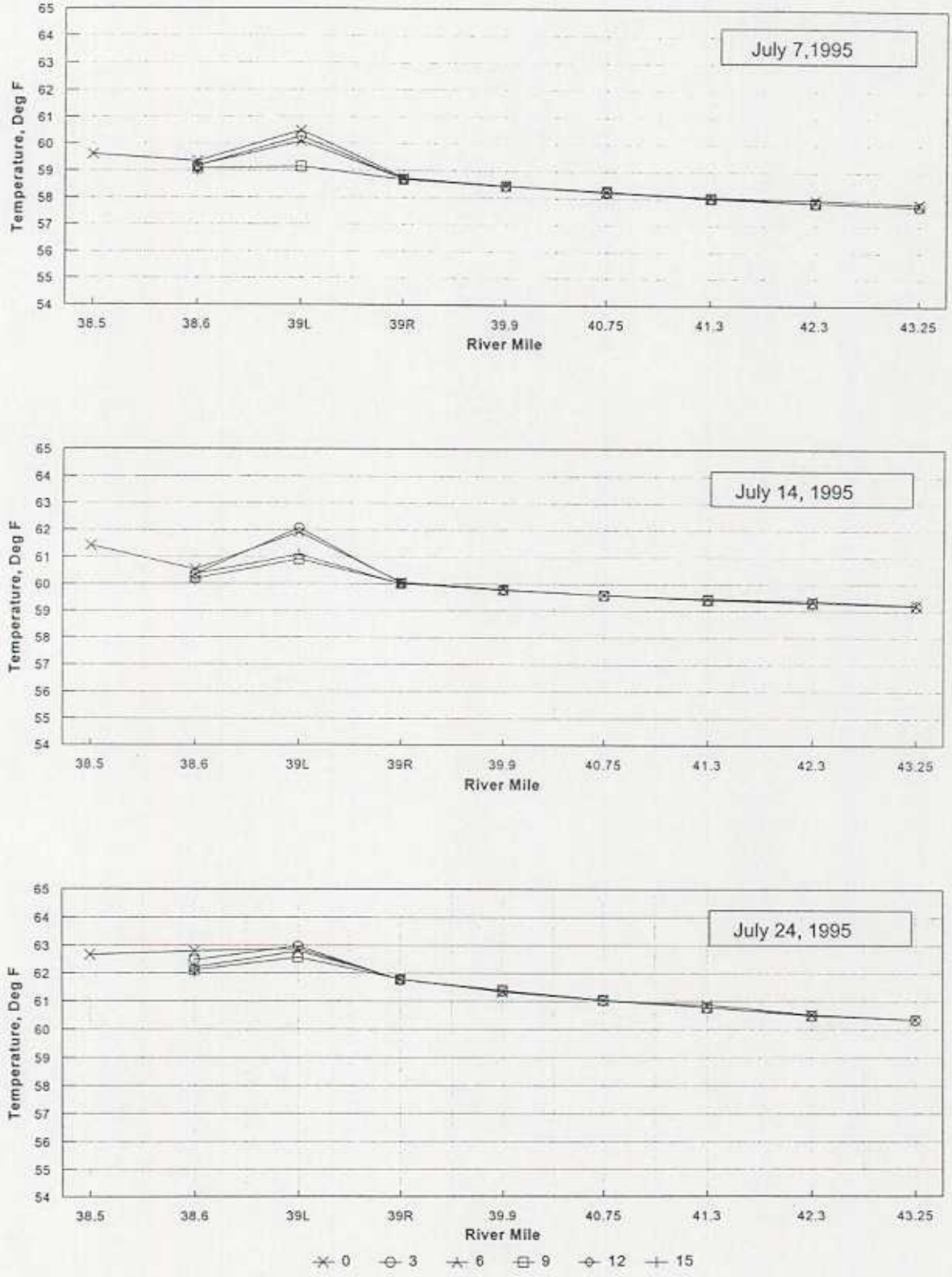

Figure 16 (continued). Water temperatures for Lake Lodi and the Mokelumne River.

Table 7. **Size, condition factor (K), gill Na^+/K^+ ATPase specific activity of YOY chinook salmon collected at Woodbridge Dam and in the rearing reaches of the Mokelumne River during February through July 1995 (values are means with standard deviations in parentheses).**

Date	Upstream Habitat					Woodbridge Dam				
	N	TL, mm	Wt, g	K	Na+/K+ ATPase, um P/mgProt./hr	N	TL, mm	Wt, g	K	Na+/K+ ATPase, um P/mgProt./hr
2/17/95	31	41 (3.7)	0.48 (0.17)	698068E-(.118431E-03)	3.3 (0.80)	6	41 (5.9)	0.5 (0.26)	673034E-03 (.801761E-04)	3.7 (0.50)
3/4/95	10	39 (2.0)	0.43 (0.11)	724902E-03 (.145820E-03)	2.3 (1.02)					
3/5/95						10	39 (5.56)	.49 (0.32)	.786619E-03 (.114478E-03)	2.6 (1.71)
3/19/95 & 3/20/95	10	40 (4.4)	0.54 ((0.15)	822591E-03 (.131376E-03)	2.9 (0.66)					
3/20/95						11	63 (10.55)	2.23 (1.07)	.825585E-03 (.857996E-04)	3.6 (0.85)
3/31/95						10	68 (19.19)	3.06 (2.24)	.778538E-03 (.942853E-04)	4.6 (1.53)
4/1/95 & 4/3/95	8	42 (5.7)	0.52 (0.29)	695728E-03 (.136874E-03)	3.16 (1.27)					
4/18/95						10	85 (9.7)	5.20 (1.87)	.808072E-03 (.120201E-03)	2.7 (1.12)
4/19/95	6	71 (7.11)	3.32 (0.99)	.895834E-03 (.812606E-04)	2.18 (0.71)					
5/1/95 & 5/2/95						6	94 (7.6)	7.1 (2.16)	.840854E-03 (.869428E-04)	2.6 (0.66)
5/2/95	7	81 (8.2)	5.0 (1.83)	.891096E-03 (.711235E-04)	1.9 (0.97)					
5/16/95						10	109 (4.12)	10.7 (1.06)	.829031E-03 (.678336E-04)	2.3 (1.26)
5/18/95	7	96 (5.90)	7.66 (1.15)	.866094E-03 (.466038E-04)	3.5 (0.94)					
5/31/95						9	114 (7.37)	12.2 (2.52)	.813208E-03 (.487461E-04)	3.38 (1.29)
6/5/95	10	101 (10.99)	8.9 (3.32)	827966E-03 (.883967E-04)	3.13 (1.14)					
6/13/95						10	114 (5.56)	11.6 (1.91)	.773772E-03 (.287110E-04)	2.02 (0.66)
6/19/95	1	111	13	950549E-03	0.71					
6/27/95						7	127 (3.69)	18.3 (1.46)	.882122E-03 (.393751E-04)	2.89 (0.83)
7/12/95 & 7/14/95						12	116 (17.28)	14.1 (5.96)	.839075E-03 (.592350E-04)	4.48 (1.85)

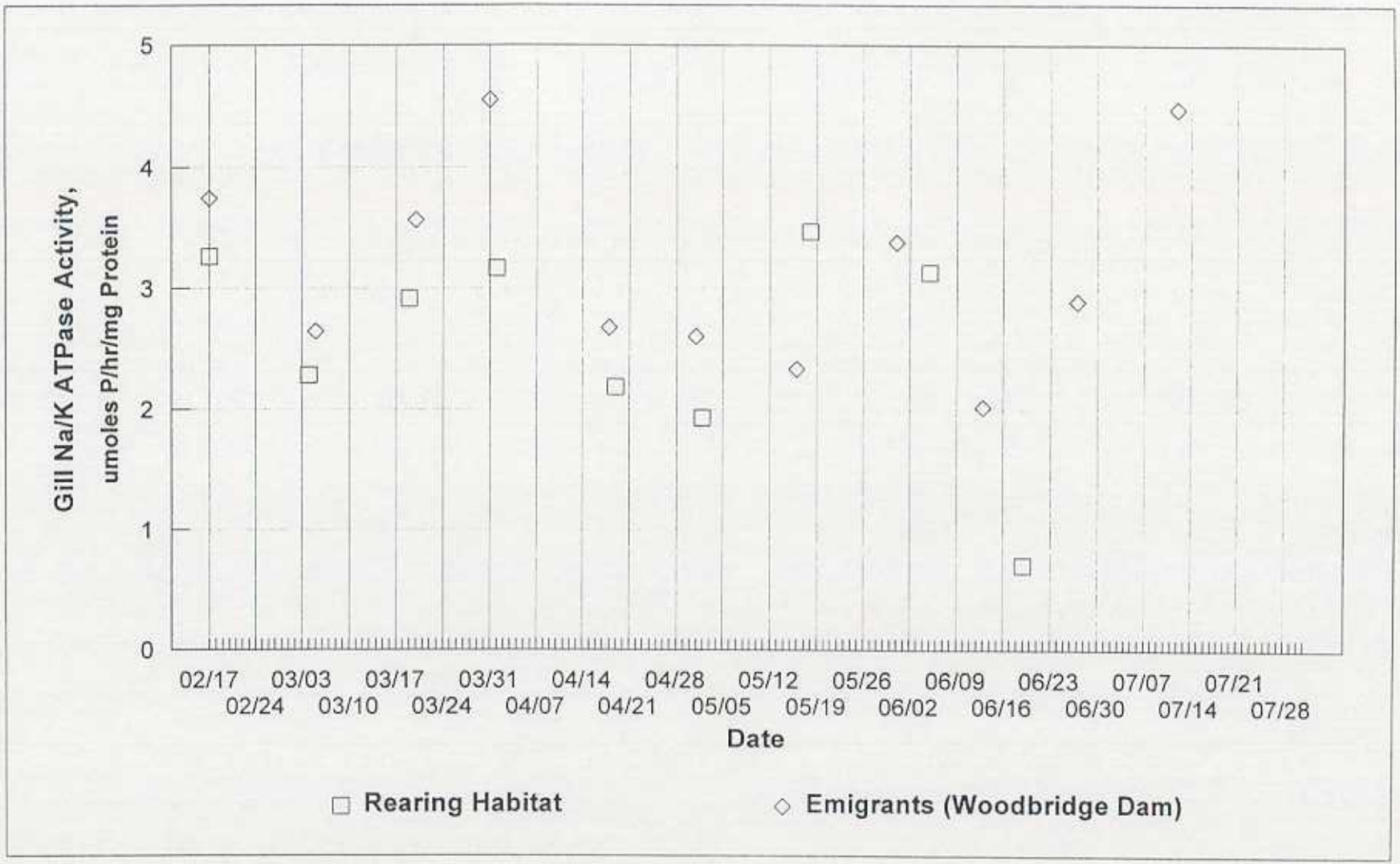

Figure 17. Temporal profile of mean gill Na+K+ATPase specific activity from samples of YOY fall chinook salmon collected in the rearing reaches and as emigrants passing Woodbridge Dam on the Mokelumne River during February through July 1995.

Gill Na^+/K^+ ATPase activity exhibited moderate variability for fish samples collected at Woodbridge Dam during June and July. Few fish remained on the rearing grounds during June and July and only 11 fish were collected there during those months despite persistent efforts to collect them. While gill Na^+/K^+ ATPase activity varied at both locales during the latter part of the season, it appeared to decline for fish collected on the rearing grounds but this pattern was based on only a few fish. As was observed in 1994 (Vogel and Marine 1996), the specific nature of this decline in gill Na^+/K^+ ATPase activity late in the season is not specifically revealed by the data set.

Gill Na^+/K^+ ATPase activities, along with other indices of smolt development such as condition factor, of YOY fall chinook salmon passing Woodbridge Dam indicate that these fish are likely undergoing active smoltification preparatory to their transition to life in seawater. Monitoring data collected during 1995 substantiates the data obtained in 1994 indicating that this approach may allow detection spatiotemporal differences in gill Na^+/K^+ ATPase activity of actively migrating and rearing salmon.

Additional data collected under several differing hydrologic year types with different water temperature regimes will be required to fully evaluate this approach for its application as a management tool. Resolution of competing hypotheses for explaining different patterns of smolt development under these contrasting water year types may provide for improved interpretation of smolt production response patterns under differing water management scenarios.

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ACRONYMS

Acronym/Abreviation	Definition
CDFG	California Department of Fish and Game
cfs	cubic feet per second
cm	centimeter
CVP	Central Valley Project
CWT	coded-wire tagged
DO	dissolved oxygen
EBMUD	East Bay Municipal Utility District
FL	fork length
K	average condition factor
m	meters
ml	milliliter
mm	millimeter
MRFI	Mokelumne River Fish Installation
NRS	Natural Resource Scientists, Inc.
PVC	poly vinyl chloride
QCD	quality control device
RM	river mile
SD	standard deviation
SWP	State Water Project
TBS	to be supplied
TL	total length
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VCR	video camera recorder
WID	Woodbridge Irrigation District
WIDD	Woodbridge Irrigation District Dam
WQ	water quality
YOY	young-of-year

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APPENDICES

Appendix A. Daily yearling chinook salmon trap capture record at Woodbridge Dam: January -- July 1995.

Date	Nocturnal Capture	Diurnal Capture	Total			No. Screw Traps	Time Fished		
			Capture	Adclip	Pelvic Clip		Nocturnal	Dirunal	Total
01/01/95	0	0	0	0	0	0	0.00	0.00	0.00
01/02/95	0	0	0	0	0	0	0.00	0.00	0.00
01/03/95	0	0	0	0	0	0	0.00	0.00	0.00
01/04/95	0	0	0	0	0	0	0.00	0.00	0.00
01/05/95	0	0	0	0	0	0	0.00	0.00	0.00
01/06/95	0	0	0	0	0	0	0.00	0.00	0.00
01/07/95	0	0	0	0	0	0	0.00	0.00	0.00
01/08/95	0	0	0	0	0	0	0.00	0.00	0.00
01/09/95	0	0	0	0	0	0	0.00	0.00	0.00
01/10/95	0	0	0	0	0	0	0.00	0.00	0.00
01/11/95	0	0	0	0	0	0	0.00	0.00	0.00
01/12/95	0	0	0	0	0	0	0.00	0.00	0.00
01/13/95	0	0	0	0	0	0	0.00	0.00	0.00
01/14/95	0	0	0	0	0	0	0.00	0.00	0.00
01/15/95	0	0	0	0	0	0	0.00	0.00	0.00
01/16/95	0	0	0	0	0	0	0.00	0.00	0.00
01/17/95	0	0	0	0	0	0	0.00	0.00	0.00
01/18/95	0	0	0	0	0	0	0.00	0.00	0.00
01/19/95	0	0	0	0	0	0	0.00	0.00	0.00
01/20/95	0	0	0	0	0	0	0.00	0.00	0.00
01/21/95	0	0	0	0	0	0	0.00	0.00	0.00
01/22/95	0	0	0	0	0	0	0.00	0.00	0.00
01/23/95	0	0	0	0	0	0	0.00	0.00	0.00
01/24/95	0	0	0	0	0	0	0.00	0.00	0.00
01/25/95	0	0	0	0	0	2	0.00	2.75	2.75
01/26/95	1	0	1	0	1	2	15.50	5.25	20.75
01/27/95	0	1	1	0	1	2	16.00	5.50	21.50
01/28/95	6	0	6	0	4	2	16.25	0.00	16.25
01/29/95	0	0	0	0	0	0	0.00	0.00	0.00
01/30/95	0	0	0	0	0	2	0.00	4.00	4.00
01/31/95	5	0	5	2	1	2	17.00	5.00	22.00
02/01/95	0	0	0	0	0	2	21.75	0.00	21.75
02/02/95	4	2	6	1	2	2	16.50	4.50	21.00
02/03/95	3	1	4	0	3	2	16.00	2.75	18.75
02/04/95	0	2	2	0	1	2	15.00	5.00	20.00
02/05/95	5	1	6	1	1	2	16.00	8.50	24.50
02/06/95	2	0	2	0	1	2	16.00	6.25	22.25
02/07/95	2	0	2	1	1	2	15.75	5.50	21.25
02/08/95	1	0	1	1	0	2	16.25	5.50	21.75
02/09/95	0	0	0	0	0	2	16.00	5.50	21.50
02/10/95	4	0	4	3	1	2	15.75	6.00	21.75
02/11/95	2	0	2	1	1	2	16.25	5.25	21.50
02/12/95	0	1	1	1	0	2	16.00	6.25	22.25
02/13/95	0	0	0	0	0	2	16.50	5.50	22.00
02/14/95	0	0	0	0	0	2	17.50	0.00	17.50
02/15/95	0	0	0	0	0	1	17.50	0.00	17.50
02/16/95	1	0	1	1	0	1	8.50	3.50	12.00

Appendix A. Daily yearling chinook salmon trap capture record at Woodbridge Dam: January -- July 1995.

Date	Nocturnal Capture	Diurnal Capture	Total			No. Screw Traps	Time Fished		
			Capture	Adclip	Pelvic Clip		Nocturnal	Dirunal	Total
02/17/95	2	0	2	1	1	1	8.50	3.38	11.88
02/18/95	1	0	1	0	1	2	8.25	6.50	14.75
02/19/95	0	0	0	0	0	2	18.38	5.50	23.88
02/20/95	0	0	0	0	0	2	17.13	6.25	23.38
02/21/95	0	0	0	0	0	2	17.63	6.00	23.63
02/22/95	0	0	0	0	0	2	17.88	6.63	24.50
02/23/95	0	0	0	0	0	2	17.88	6.38	24.25
02/24/95	0	0	0	0	0	2	18.13	8.25	26.38
02/25/95	0	0	0	0	0	2	15.38	7.00	22.38
02/26/95	0	0	0	0	0	2	17.00	6.13	23.13
02/27/95	0	0	0	0	0	2	17.50	5.50	23.00
02/28/95	0	0	0	0	0	2	17.50	6.50	24.00
03/01/95	0	0	0	0	0	2	17.50	5.88	23.38
03/02/95	0	0	0	0	0	2	17.25	8.50	25.75
03/03/95	0	0	0	0	0	2	15.88	6.75	22.63
03/04/95	1	0	1	0	0	2	17.00	6.50	23.50
03/05/95	0	0	0	0	0	2	17.88	6.13	24.00
03/06/95	0	0	0	0	0	2	17.63	6.25	23.88
03/07/95	0	0	0	0	0	2	17.38	5.88	23.25
03/08/95	0	0	0	0	0	2	17.75	6.38	24.13
03/09/95	0	0	0	0	0	2	17.50	6.75	24.25
03/10/95	3	0	3	1	1	2	17.63	6.50	24.13
03/11/95	1	0	1	0	0	2	18.25	0.00	18.25
03/12/95	0	0	0	0	0	0	0.00	0.00	0.00
03/13/95	0	0	0	0	0	0	0.00	0.00	0.00
03/14/95	0	0	0	0	0	2	0.00	2.50	2.50
03/15/95	0	0	0	0	0	0	0.00	0.00	0.00
03/16/95	0	0	0	0	0	0	0.00	0.00	0.00
03/17/95	0	0	0	0	0	2	12.25	0.00	12.25
03/18/95	0	0	0	0	0	2	0.00	8.50	8.50
03/19/95	0	0	0	0	0	0	0.00	0.00	0.00
03/20/95	0	0	0	0	0	2	0.00	7.00	7.00
03/21/95	0	0	0	0	0	2	8.50	5.88	14.38
03/22/95	0	0	0	0	0	2	17.75	6.50	24.25
03/23/95	0	0	0	0	0	2	17.38	6.75	24.13
03/24/95	0	0	0	0	0	2	17.88	7.13	25.00
03/25/95	0	0	0	0	0	2	17.13	6.13	23.25
03/26/95	0	0	0	0	0	2	17.25	6.38	23.63
03/27/95	0	0	0	0	0	0	17.25	6.75	24.00
03/28/95	0	0	0	0	0	2	17.38	9.25	26.63
03/29/95	0	0	0	0	0	2	14.75	6.88	21.63
03/30/95	0	0	0	0	0	2	17.13	6.63	23.75
03/31/95	0	0	0	0	0	2	17.25	0.00	17.25
04/01/95	0	0	0	0	0	2	20.38	7.25	27.63
04/02/95	0	0	0	0	0	2	17.00	6.75	23.75
04/03/95	0	0	0	0	0	2	17.88	6.38	24.25
04/04/95	0	0	0	0	0	2	17.00	7.00	24.00

Appendix A. Daily yearling chinook salmon trap capture record at Woodbridge Dam: January -- July 1995.

Date	Nocturnal Capture	Diurnal Capture	Total			No. Screw Traps	Time Fished		
			Capture	Adclip	Pelvic Clip		Nocturnal	Dirunal	Total
05/22/95	0	0	0	0	0	2	16.63	6.88	23.50
05/23/95	0	0	0	0	0	2	17.63	6.38	24.00
05/24/95	0	0	0	0	0	2	17.63	10.25	27.88
05/25/95	0	0	0	0	0	2	14.38	6.25	20.63
05/26/95	0	0	0	0	0	2	17.75	6.25	24.00
05/27/95	0	0	0	0	0	2	17.25	6.75	24.00
05/28/95	0	0	0	0	0	2	17.25	6.00	23.25
05/29/95	0	0	0	0	0	2	18.00	6.00	24.00
05/30/95	0	0	0	0	0	2	0.00	6.50	6.50
05/31/95	0	0	0	0	0	2	17.25	7.25	24.50
06/01/95	0	0	0	0	0	2	17.00	0.00	17.00
06/02/95	0	0	0	0	0	2	24.75	5.75	30.50
06/03/95	0	0	0	0	0	2	17.75	6.75	24.50
06/04/95	0	0	0	0	0	2	18.00	6.00	24.00
06/05/95	0	0	0	0	0	2	17.75	5.50	23.25
06/06/95	0	0	0	0	0	2	17.50	6.75	24.25
06/07/95	0	0	0	0	0	2	17.50	6.75	24.25
06/08/95	0	0	0	0	0	2	17.75	8.25	26.00
06/09/95	0	0	0	0	0	2	15.00	7.00	22.00
06/10/95	0	0	0	0	0	2	18.25	5.75	24.00
06/11/95	0	0	0	0	0	2	17.50	6.50	24.00
06/12/95	0	0	0	0	0	2	17.50	6.75	24.25
06/13/95	0	0	0	0	0	2	18.00	6.50	24.50
06/14/95	0	0	0	0	0	2	16.50	6.75	23.25
06/15/95	0	0	0	0	0	2	18.50	6.50	25.00
06/16/95	0	0	0	0	0	2	16.38	6.50	22.88
06/17/95	0	0	0	0	0	2	17.50	6.63	24.13
06/18/95	0	0	0	0	0	2	17.50	6.50	24.00
06/19/95	0	0	0	0	0	2	18.25	5.50	23.75
06/20/95	0	0	0	0	0	2	17.25	6.75	24.00
06/21/95	0	0	0	0	0	2	16.25	8.00	24.25
06/22/95	0	0	0	0	0	2	16.00	0.00	16.00
06/23/95	0	0	0	0	0	2	25.25	7.00	32.25
06/24/95	0	0	0	0	0	2	18.25	5.50	23.75
06/25/95	0	0	0	0	0	2	17.00	5.75	22.75
06/26/95	0	0	0	0	0	2	18.25	6.50	24.75
06/27/95	0	0	0	0	0	2	16.75	7.25	24.00
06/28/95	0	0	0	0	0	2	18.00	6.25	24.25
06/29/95	0	0	0	0	0	2	17.25	6.25	23.50
06/30/95	0	0	0	0	0	2	17.25	6.75	24.00
07/01/95	0	0	0	0	0	2	17.75	6.25	24.00
07/02/95	0	0	0	0	0	2	16.75	7.25	24.00
07/03/95	0	0	0	0	0	2	17.50	6.50	24.00
07/04/95	0	0	0	0	0	2	17.75	0.00	17.75
07/05/95	0	0	0	0	0	2	24.00	6.25	30.25
07/06/95	0	0	0	0	0	2	17.25	6.75	24.00
07/07/95	0	0	0	0	0	2	17.25	6.75	24.00

Appendix A. Daily yearling chinook salmon trap capture record at Woodbridge Dam: January -- July 1995.

Date	Nocturnal Capture	Diurnal Capture	Total			No. Screw Traps	Time Fished		
			Capture	Adclip	Pelvic Clip		Nocturnal	Dirunal	Total
07/08/95	0	0	0	0	0	2	17.75	6.25	24.00
07/09/95	0	0	0	0	0	2	18.25	5.75	24.00
07/10/95	0	0	0	0	0	2	18.00	5.75	23.75
07/11/95	0	0	0	0	0	2	18.50	6.25	24.75
07/12/95	0	0	0	0	0	2	16.75	6.25	23.00
07/13/95	0	0	0	0	0	2	18.75	6.25	25.00
07/14/95	0	0	0	0	0	2	17.75	5.75	23.50
07/15/95	0	0	0	0	0	2	17.50	6.75	24.25
07/16/95	0	0	0	0	0	2	18.25	5.50	23.75
07/17/95	0	0	0	0	0	2	17.50	6.50	24.00
07/18/95	0	0	0	0	0	2	17.00	7.00	24.00
07/19/95	0	0	0	0	0	2	17.75	6.00	23.75
07/20/95	0	0	0	0	0	2	14.50	8.75	23.25
07/21/95	0	0	0	0	0	2	14.00	0.00	14.00
07/22/95	0	0	0	0	0	2	27.75	6.00	33.75
07/23/95	0	0	0	0	0	2	17.75	6.25	24.00
07/24/95	0	0	0	0	0	2	17.00	7.00	24.00
07/25/95	0	0	0	0	0	2	17.25	6.75	24.00
07/26/95	0	0	0	0	0	2	17.75	6.25	24.00
07/27/95	0	0	0	0	0	2	18.00	5.75	23.75
07/28/95	0	0	0	0	0	2	18.00	4.75	22.75
07/29/95	0	0	0	0	0	0	0.00	0.00	0.00
07/30/95	0	0	0	0	0	0	0.00	0.00	0.00
07/31/95	0	0	0	0	0	0	0.00	0.00	0.00

Appendix B. Daily YOY chinook salmon trap capture record at Woodbridge Dam: January -- July 1995.

Date	Nocturnal Capture	Diurnal Capture	Total				No. Screw Traps	Time Fished		
			Capture	Mortality	Injuries	CWT		Nocturnal	Diurnal	Total
01/01/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/02/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/03/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/04/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/05/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/06/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/07/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/08/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/09/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/10/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/11/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/12/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/13/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/14/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/15/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/16/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/17/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/18/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/19/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/20/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/21/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/22/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/23/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/24/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/25/95	0	10	10	0	0	0	2	0.00	2.75	2.75
01/26/95	130	13	143	0	0	0	2	15.50	5.25	20.75
01/27/95	44	9	53	0	0	0	2	16.00	5.50	21.50
01/28/95	193	0	193	4	1	0	2	16.25	0.00	16.25
01/29/95	0	0	0	0	0	0	0	0.00	0.00	0.00
01/30/95	0	43	43	1	0	0	2	0.00	4.00	4.00
01/31/95	502	42	544	2	0	0	2	17.00	5.00	22.00
02/01/95	348	0	348	0	0	0	2	21.75	0.00	21.75
02/02/95	315	56	371	0	1	0	2	16.50	4.50	21.00
02/03/95	352	49	401	1	0	0	2	16.00	2.75	18.75
02/04/95	546	57	603	2	1	0	2	15.00	5.00	20.00
02/05/95	572	71	643	1	0	0	2	16.00	8.50	24.50
02/06/95	384	25	409	0	0	0	2	16.00	6.25	22.25
02/07/95	531	53	584	2	0	0	2	15.75	5.50	21.25
02/08/95	646	126	772	1	0	0	2	16.25	5.50	21.75
02/09/95	983	139	1122	5	0	0	2	16.00	5.50	21.50
02/10/95	510	179	689	2	0	0	2	15.75	6.00	21.75
02/11/95	793	60	853	1	0	0	2	16.25	5.25	21.50
02/12/95	379	114	493	0	0	0	2	16.00	6.25	22.25
02/13/95	272	14	286	0	0	0	2	16.50	5.50	22.00
02/14/95	712	6	718	5	0	0	2	17.50	0.00	17.50
02/15/95	612	0	612	3	0	0	1	17.50	0.00	17.50
02/16/95	702	4	706	1	0	0	1	8.50	3.50	12.00
02/17/95	474	15	489	3	0	0	1	8.50	3.38	11.88
02/18/95	374	12	386	0	1	0	2	8.25	6.50	14.75
02/19/95	709	9	718	0	0	0	2	18.38	5.50	23.88
02/20/95	690	6	696	0	0	0	2	17.13	6.25	23.38
02/21/95	1078	9	1087	1	2	0	2	17.63	6.00	23.63
02/22/95	616	11	627	1	0	0	2	17.88	6.63	24.50

Appendix B. Daily YOY chinook salmon trap capture record at Woodbridge Dam: January -- July 1995.

Date	Nocturnal Capture	Diurnal Capture	Total				No. Screw Traps	Time Fished		
			Capture	Mortality	Injuries	CWT		Nocturnal	Diurnal	Total
02/23/95	380	6	386	1	0	0	2	17.88	6.38	24.25
02/24/95	534	8	542	2	0	0	2	18.13	8.25	26.38
02/25/95	270	4	274	2	1	0	2	15.38	7.00	22.38
02/26/95	187	7	194	1	0	0	2	17.00	6.13	23.13
02/27/95	510	4	514	2	0	0	2	17.50	5.50	23.00
02/28/95	277	5	282	0	0	0	2	17.50	6.50	24.00
03/01/95	256	5	261	0	0	0	2	17.50	5.88	23.38
03/02/95	340	14	354	0	0	0	2	17.25	8.50	25.75
03/03/95	239	11	250	0	0	0	2	15.88	6.75	22.63
03/04/95	288	5	293	0	1	0	2	17.00	6.50	23.50
03/05/95	159	1	160	2	0	0	2	17.88	6.13	24.00
03/06/95	139	1	140	0	0	0	2	17.63	6.25	23.88
03/07/95	198	4	202	0	1	0	2	17.38	5.88	23.25
03/08/95	33	4	37	5	0	0	2	17.75	6.38	24.13
03/09/95	38	6	44	0	0	0	2	17.50	6.75	24.25
03/10/95	47	4	51	0	0	0	2	17.63	6.50	24.13
03/11/95	48	0	48	0	0	0	2	18.25	0.00	18.25
03/12/95	0	0	0	0	0	0	0	0.00	0.00	0.00
03/13/95	0	0	0	0	0	0	0	0.00	0.00	0.00
03/14/95	0	0	0	0	0	0	2	0.00	2.50	2.50
03/15/95	0	0	0	0	0	0	0	0.00	0.00	0.00
03/16/95	0	0	0	0	0	0	0	0.00	0.00	0.00
03/17/95	28	0	28	1	0	0	2	12.25	0.00	12.25
03/18/95	0	1	1	0	0	0	2	0.00	8.50	8.50
03/19/95	0	0	0	0	0	0	0	0.00	0.00	0.00
03/20/95	0	1	1	0	0	0	2	0.00	7.00	7.00
03/21/95	8	2	10	1	0	0	2	8.50	5.88	14.38
03/22/95	8	0	8	0	0	0	2	17.75	6.50	24.25
03/23/95	1	0	1	0	0	0	2	17.38	6.75	24.13
03/24/95	3	2	5	0	0	0	2	17.88	7.13	25.00
03/25/95	4	2	6	1	1	0	2	17.13	6.13	23.25
03/26/95	3	0	3	0	0	0	2	17.25	6.38	23.63
03/27/95	3	0	3	0	0	0	0	17.25	6.75	24.00
03/28/95	11	2	13	0	0	0	2	17.38	9.25	26.63
03/29/95	3	0	3	0	0	0	2	14.75	6.88	21.63
03/30/95	4	2	6	0	1	0	2	17.13	6.63	23.75
03/31/95	10	0	10	0	0	0	2	17.25	0.00	17.25
04/01/95	9	0	9	1	0	0	2	20.38	7.25	27.63
04/02/95	3	1	4	0	1	0	2	17.00	6.75	23.75
04/03/95	11	1	12	0	0	0	2	17.88	6.38	24.25
04/04/95	15	2	17	0	2	0	2	17.00	7.00	24.00
04/05/95	15	0	15	0	0	0	2	17.13	6.38	23.50
04/06/95	6	0	6	0	0	0	2	17.38	6.88	24.25
04/07/95	11	3	14	1	1	12	2	17.38	6.50	23.88
04/08/95	39	0	39	0	0	37	2	17.50	6.13	23.63
04/09/95	77	7	84	0	4	81	2	17.63	6.38	24.00
04/10/95	66	21	87	1	0	64	2	17.25	7.50	24.75
04/11/95	0	2	2	0	0	0	2	0.00	3.13	3.13
04/12/95	38	8	46	0	0	0	2	8.25	3.50	11.75
04/13/95	39	0	39	2	1	0	2	17.13	7.00	24.13
04/14/95	61	14	75	1	1	73	2	17.13	8.50	25.63
04/15/95	76	37	113	3	1	110	2	15.75	6.88	22.63
04/16/95	122	16	138	5	4	132	2	17.00	6.75	23.75

Appendix B. Daily YOY chinook salmon trap capture record at Woodbridge Dam: January -- July 1995.

Date	Nocturnal Capture	Diurnal Capture	Total				No. Screw Traps	Time Fished		
			Capture	Mortality	Injuries	CWT		Nocturnal	Diurnal	Total
04/17/95	63	21	84	3	3	81	2	15.75	8.88	24.63
04/18/95	28	28	56	1	3	44	2	15.50	7.75	23.25
04/19/95	48	21	69	0	2	68	2	17.38	7.38	24.75
04/20/95	49	0	49	0	3	48	2	16.63	7.88	24.50
04/21/95	41	0	41	2	0	38	2	16.50	6.63	23.13
04/22/95	45	1	46	1	0	45	2	17.00	6.50	23.50
04/23/95	22	0	22	0	2	21	2	18.25	5.50	23.75
04/24/95	17	6	23	0	0	23	2	18.00	7.13	25.13
04/25/95	50	0	50	1	2	48	2	16.88	7.50	24.38
04/26/95	32	7	39	3	2	35	2	16.38	6.75	23.13
04/27/95	35	4	39	2	1	37	2	17.50	6.75	24.25
04/28/95	39	8	47	1	1	46	2	18.75	5.50	24.25
04/29/95	39	1	40	1	1	39	2	17.13	6.50	23.63
04/30/95	22	5	27	2	1	25	2	17.00	6.75	23.75
05/01/95	5	0	5	0	0	0	2	17.25	6.88	24.13
05/02/95	8	4	12	0	0	9	2	17.63	6.38	24.00
05/03/95	17	0	17	0	0	16	2	17.38	6.63	24.00
05/04/95	42	16	58	1	1	57	2	18.75	6.25	25.00
05/05/95	29	0	29	1	1	28	2	17.25	9.25	26.50
05/06/95	24	7	31	0	1	30	2	14.50	6.50	21.00
05/07/95	30	0	30	0	3	30	2	17.75	6.50	24.25
05/08/95	39	2	41	0	1	41	2	17.75	6.75	24.50
05/09/95	34	5	39	5	5	34	2	17.75	7.88	25.63
05/10/95	43	9	52	1	1	49	2	14.38	7.38	21.75
05/11/95	53	6	59	0	0	56	2	16.88	6.75	23.63
05/12/95	57	5	62	1	3	61	2	17.75	6.38	24.13
05/13/95	21	6	27	1	1	26	2	17.25	6.25	23.50
05/14/95	65	7	72	0	1	72	2	18.25	6.38	24.63
05/15/95	155	22	177	3	1	174	2	17.00	6.88	23.88
05/16/95	298	72	370	12	4	358	2	17.25	6.75	24.00
05/17/95	203	9	212	2	2	199	2	16.75	7.25	24.00
05/18/95	27	1	28	2	1	26	2	17.75	6.00	23.75
05/19/95	11	1	12	2	1	10	2	17.88	6.38	24.25
05/20/95	3	1	4	0	0	4	2	17.00	6.88	23.88
05/21/95	29	4	33	1	1	32	2	17.75	6.00	23.75
05/22/95	37	8	45	0	2	45	2	16.63	6.88	23.50
05/23/95	47	26	73	0	2	72	2	17.63	6.38	24.00
05/24/95	92	24	116	3	2	113	2	17.63	10.25	27.88
05/25/95	63	5	68	2	0	66	2	14.38	6.25	20.63
05/26/95	121	5	126	0	1	126	2	17.75	6.25	24.00
05/27/95	193	14	207	5	2	202	2	17.25	6.75	24.00
05/28/95	114	5	119	3	2	116	2	17.25	6.00	23.25
05/29/95	63	2	65	50	0	15	2	18.00	6.00	24.00
05/30/95	0	5	5	0	0	5	2	0.00	6.50	6.50
05/31/95	67	28	95	0	1	95	2	17.25	7.25	24.50
06/01/95	118	0	118	2	0	106	2	17.00	0.00	17.00
06/02/95	72	21	93	2	0	90	2	24.75	5.75	30.50
06/03/95	64	6	70	1	0	69	2	17.75	6.75	24.50
06/04/95	28	5	33	0	2	33	2	18.00	6.00	24.00
06/05/95	81	12	93	0	3	93	2	17.75	5.50	23.25
06/06/95	53	6	59	0	0	59	2	17.50	6.75	24.25
06/07/95	46	16	62	0	0	61	2	17.50	6.75	24.25
06/08/95	55	28	83	0	1	83	2	17.75	8.25	26.00

Appendix B. Daily YOY chinook salmon trap capture record at Woodbridge Dam: January -- July 1995.

Date	Nocturnal Capture	Diurnal Capture	Total				No. Screw Traps	Time Fished		
			Capture	Mortality	Injuries	CWT		Nocturnal	Diurnal	Total
06/09/95	46	4	50	0	2	50	2	15.00	7.00	22.00
06/10/95	37	5	42	0	2	42	2	18.25	5.75	24.00
06/11/95	16	8	24	0	3	24	2	17.50	6.50	24.00
06/12/95	51	9	60	0	0	60	2	17.50	6.75	24.25
06/13/95	40	9	49	0	3	39	2	18.00	6.50	24.50
06/14/95	25	10	35	0	0	35	2	16.50	6.75	23.25
06/15/95	64	24	88	0	3	88	2	18.50	6.50	25.00
06/16/95	53	13	66	2	4	64	2	16.38	6.50	22.88
06/17/95	42	10	52	0	2	52	2	17.50	6.63	24.13
06/18/95	38	14	52	0	2	52	2	17.50	6.50	24.00
06/19/95	58	3	61	1	2	60	2	18.25	5.50	23.75
06/20/95	29	4	33	0	1	32	2	17.25	6.75	24.00
06/21/95	27	22	49	0	0	49	2	16.25	8.00	24.25
06/22/95	28	0	28	1	0	27	2	16.00	0.00	16.00
06/23/95	32	4	36	0	0	36	2	25.25	7.00	32.25
06/24/95	23	0	23	0	1	23	2	18.25	5.50	23.75
06/25/95	10	0	10	0	0	10	2	17.00	5.75	22.75
06/26/95	6	1	7	0	0	7	2	18.25	6.50	24.75
06/27/95	9	3	12	1	0	4	2	16.75	7.25	24.00
06/28/95	16	2	18	0	4	18	2	18.00	6.25	24.25
06/29/95	20	2	22	0	0	22	2	17.25	6.25	23.50
06/30/95	22	1	23	1	2	22	2	17.25	6.75	24.00
07/01/95	11	2	13	0	0	13	2	17.75	6.25	24.00
07/02/95	11	0	11	0	1	11	2	16.75	7.25	24.00
07/03/95	10	0	10	0	0	10	2	17.50	6.50	24.00
07/04/95	5	0	5	0	2	5	2	17.75	0.00	17.75
07/05/95	0	0	0	0	0	0	2	24.00	6.25	30.25
07/06/95	1	0	1	0	0	1	2	17.25	6.75	24.00
07/07/95	11	0	11	0	0	11	2	17.25	6.75	24.00
07/08/95	6	0	6	0	0	5	2	17.75	6.25	24.00
07/09/95	5	0	5	2	0	3	2	18.25	5.75	24.00
07/10/95	7	0	7	0	0	7	2	18.00	5.75	23.75
07/11/95	7	0	7	0	0	6	2	18.50	6.25	24.75
07/12/95	5	1	6	0	0	0	2	16.75	6.25	23.00
07/13/95	3	0	3	0	0	0	2	18.75	6.25	25.00
07/14/95	4	0	4	0	0	0	2	17.75	5.75	23.50
07/15/95	2	0	2	0	0	2	2	17.50	6.75	24.25
07/16/95	1	0	1	0	0	1	2	18.25	5.50	23.75
07/17/95	1	1	2	0	0	2	2	17.50	6.50	24.00
07/18/95	0	1	1	0	0	1	2	17.00	7.00	24.00
07/19/95	0	0	0	0	0	0	2	17.75	6.00	23.75
07/20/95	0	0	0	0	0	0	2	14.50	8.75	23.25
07/21/95	0	0	0	0	0	0	2	14.00	0.00	14.00
07/22/95	2	0	2	0	0	2	2	27.75	6.00	33.75
07/23/95	0	0	0	0	0	0	2	17.75	6.25	24.00
07/24/95	2	0	2	0	0	2	2	17.00	7.00	24.00
07/25/95	2	0	2	0	0	2	2	17.25	6.75	24.00
07/26/95	2	1	3	0	1	3	2	17.75	6.25	24.00
07/27/95	0	0	0	0	0	0	2	18.00	5.75	23.75
07/28/95	6	0	6	0	2	6	2	18.00	4.75	22.75
07/29/95	0	0	0	0	0	0	0	0.00	0.00	0.00
07/30/95	0	0	0	0	0	0	0	0.00	0.00	0.00
07/31/95	0	0	0	0	0	0	0	0.00	0.00	0.00

Appendix C. Estimated daily abundance of downstream migrant salmon at Woodbridge Dam: January -- July 1995.

Note: Differences in totals may be attributable to rounding

Date	YOY # Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est. No. YOY Total
01/01/95	--	--	--	--	--	--	--
01/02/95	--	--	--	--	--	--	--
01/03/95	--	--	--	--	--	--	--
01/04/95	--	--	--	--	--	--	--
01/05/95	--	--	--	--	--	--	--
01/06/95	--	--	--	--	--	--	--
01/07/95	--	--	--	--	--	--	--
01/08/95	--	--	--	--	--	--	--
01/09/95	--	--	--	--	--	--	--
01/10/95	--	--	--	--	--	--	--
01/11/95	--	--	--	--	--	--	--
01/12/95	--	--	--	--	--	--	--
01/13/95	--	--	--	--	--	--	--
01/14/95	--	--	--	--	--	--	--
01/15/95	--	--	--	--	--	--	--
01/16/95	--	--	--	--	--	--	--
01/17/95	--	--	--	--	--	--	--
01/18/95	--	--	--	--	--	--	--
01/19/95	--	--	--	--	--	--	--
01/20/95	--	--	--	--	--	--	--
01/21/95	--	--	--	--	--	--	--
01/22/95	--	--	--	--	--	--	--
01/23/95	--	--	--	--	--	--	--
01/24/95	--	--	--	--	--	--	--
01/25/95	10	--	--	--	10	--	10
01/26/95	13	130	--	--	13	130	143
01/27/95	9	44	0.204	0.080	44	550	594
01/28/95	0	193	0.204	0.080	0	2413	2413
01/29/95	0	0	0.204	0.080	0	0	0
01/30/95	43	0	0.204	0.080	211	0	211
01/31/95	42	502	0.204	0.080	206	6275	6481
02/01/95	0	348	0.204	0.080	0	4350	4350
02/02/95	56	315	0.204	0.080	275	3938	4212
02/03/95	49	352	0.204	0.080	240	4400	4640
02/04/95	57	546	0.204	0.080	279	6825	7104
02/05/95	71	572	0.204	0.080	348	7150	7498
02/06/95	25	384	0.204	0.080	123	4800	4923
02/07/95	53	531	0.204	0.080	260	6638	6897
02/08/95	126	646	0.204	0.080	618	8075	8693
02/09/95	139	983	0.204	0.080	681	12288	12969
02/10/95	179	510	0.204	0.080	877	6375	7252
02/11/95	60	793	0.204	0.080	294	9913	10207
02/12/95	114	379	0.204	0.080	559	4738	5296
02/13/95	14	272	0.204	0.080	69	3400	3469

Appendix C. Estimated daily abundance of downstream migrant salmon at Woodbridge Dam: January -- July 1995.

Note: Differences in totals may be attributable to rounding

Date	YOY # Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est. No. YOY Total
02/14/95	6	712	0.204	0.080	29	8900	8929
02/15/95	0	612	0.204	0.080	0	7650	7650
02/16/95	4	702	0.204	0.080	20	8775	8795
02/17/95	15	474	0.204	0.080	74	5925	5999
02/18/95	12	374	0.204	0.080	59	4675	4734
02/19/95	9	709	0.204	0.080	44	8863	8907
02/20/95	6	690	0.204	0.080	29	8625	8654
02/21/95	9	1078	0.204	0.080	44	13475	13519
02/22/95	11	616	0.204	0.080	54	7700	7754
02/23/95	6	380	0.204	0.080	29	4750	4779
02/24/95	8	534	0.204	0.080	39	6675	6714
02/25/95	4	270	0.204	0.080	20	3375	3395
02/26/95	7	187	0.204	0.080	34	2338	2372
02/27/95	4	510	0.204	0.080	20	6375	6395
02/28/95	5	277	0.204	0.080	25	3463	3487
03/01/95	5	256	0.204	0.080	25	3200	3225
03/02/95	14	340	0.204	0.080	69	4250	4319
03/03/95	11	239	0.204	0.080	54	2988	3041
03/04/95	5	288	0.204	0.080	25	3600	3625
03/05/95	1	159	0.204	0.080	5	1988	1992
03/06/95	1	139	0.204	0.080	5	1738	1742
03/07/95	4	198	0.204	0.080	20	2475	2495
03/08/95	4	33	0.204	0.080	20	413	432
03/09/95	6	38	0.204	0.080	29	475	504
03/10/95	4	47	0.204	0.080	20	588	607
03/11/95	0	48	0.049	0.009	0	5333	5333
03/12/95	0	0	0.049	0.009	0	0	0
03/13/95	0	0	0.049	0.009	0	0	0
03/14/95	0	0	0.049	0.009	0	0	0
03/15/95	0	0	0.049	0.009	0	0	0
03/16/95	0	0	0.049	0.009	0	0	0
03/17/95	0	28	0.049	0.009	0	3111	3111
03/18/95	1	0	0.049	0.009	20	0	20
03/19/95	0	0	0.049	0.009	0	0	0
03/20/95	1	0	0.049	0.009	20	0	20
03/21/95	2	8	0.049	0.009	41	889	930
03/22/95	0	8	0.049	0.009	0	889	889
03/23/95	0	1	0.049	0.009	0	111	111
03/24/95	2	3	0.049	0.009	41	333	374
03/25/95	2	4	0.049	0.009	41	444	485
03/26/95	0	3	0.049	0.009	0	333	333
03/27/95	0	3	0.049	0.009	0	333	333
03/28/95	2	11	0.049	0.009	41	1222	1263
03/29/95	0	3	0.049	0.009	0	333	333

Appendix C. Estimated daily abundance of downstream migrant salmon at Woodbridge Dam: January -- July 1995.

Note: Differences in totals may be attributable to rounding

Date	YOY # Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est. No. YOY Total
03/30/95	2	4	0.049	0.009	41	444	485
03/31/95	0	10	0.049	0.009	0	1111	1111
04/01/95	0	9	0.049	0.009	0	1000	1000
04/02/95	1	3	0.049	0.009	20	333	354
04/03/95	1	11	0.049	0.009	20	1222	1243
04/04/95	2	15	0.049	0.009	41	1667	1707
04/05/95	0	15	0.049	0.009	0	1667	1667
04/06/95	0	6	0.049	0.009	0	667	667
04/07/95	3	11	0.049	0.009	61	1222	1283
04/08/95	0	39	0.049	0.009	0	4333	4333
04/09/95	7	77	0.049	0.009	143	8556	8698
04/10/95	21	66	0.049	0.009	429	7333	7762
04/11/95	2	0	0.049	0.009	41	0	41
04/12/95	8	38	0.039	0.041	205	927	1132
04/13/95	0	39	0.039	0.041	0	951	951
04/14/95	14	61	0.039	0.041	359	1488	1847
04/15/95	37	76	0.039	0.041	949	1854	2802
04/16/95	16	122	0.039	0.041	410	2976	3386
04/17/95	21	63	0.039	0.041	538	1537	2075
04/18/95	28	28	0.039	0.041	718	683	1401
04/19/95	21	48	0.039	0.041	538	1171	1709
04/20/95	0	49	0.039	0.041	0	1195	1195
04/21/95	0	41	0.039	0.041	0	1000	1000
04/22/95	1	45	0.039	0.041	26	1098	1123
04/23/95	0	22	0.039	0.041	0	537	537
04/24/95	6	17	0.039	0.041	154	415	568
04/25/95	0	50	0.039	0.041	0	1220	1220
04/26/95	7	32	0.039	0.041	179	780	960
04/27/95	4	35	0.039	0.041	103	854	956
04/28/95	8	39	0.039	0.041	205	951	1156
04/29/95	1	39	0.039	0.041	26	951	977
04/30/95	5	22	0.039	0.041	128	537	665
05/01/95	0	5	0.014	0.040	0	125	125
05/02/95	4	8	0.014	0.040	286	200	486
05/03/95	0	17	0.014	0.040	0	425	425
05/04/95	16	42	0.014	0.040	1143	1050	2193
05/05/95	0	29	0.014	0.040	0	725	725
05/06/95	7	24	0.014	0.040	500	600	1100
05/07/95	0	30	0.014	0.040	0	750	750
05/08/95	2	39	0.014	0.040	143	975	1118
05/09/95	5	34	0.014	0.040	357	850	1207
05/10/95	9	43	0.014	0.040	643	1075	1718
05/11/95	6	53	0.014	0.040	429	1325	1754
05/12/95	5	57	0.014	0.040	357	1425	1782

Appendix C. Estimated daily abundance of downstream migrant salmon at Woodbridge Dam: January -- July 1995.

Note: Differences in totals may be attributable to rounding

Date	YOY # Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est. No. YOY Total
05/13/95	6	21	0.014	0.040	429	525	954
05/14/95	7	65	0.014	0.040	500	1625	2125
05/15/95	22	155	0.014	0.040	1571	3875	5446
05/16/95	72	298	0.014	0.040	5143	7450	12593
05/17/95	9	203	0.014	0.040	643	5075	5718
05/18/95	1	27	0.014	0.040	71	675	746
05/19/95	1	11	0.014	0.040	71	275	346
05/20/95	1	3	0.010	0.024	100	125	225
05/21/95	4	29	0.010	0.024	400	1208	1608
05/22/95	8	37	0.010	0.024	800	1542	2342
05/23/95	26	47	0.010	0.024	2600	1958	4558
05/24/95	24	92	0.010	0.024	2400	3833	6233
05/25/95	5	63	0.010	0.024	500	2625	3125
05/26/95	5	121	0.010	0.024	500	5042	5542
05/27/95	14	193	0.010	0.024	1400	8042	9442
05/28/95	5	114	0.010	0.024	500	4750	5250
05/29/95	2	63	0.010	0.024	200	2625	2825
05/30/95	5	0	0.010	0.024	500	0	500
05/31/95	28	67	0.010	0.024	2800	2792	5592
06/01/95	0	118	0.010	0.024	0	4917	4917
06/02/95	21	72	0.010	0.024	2100	3000	5100
06/03/95	6	64	0.010	0.024	600	2667	3267
06/04/95	5	28	0.010	0.024	500	1167	1667
06/05/95	12	81	0.010	0.024	1200	3375	4575
06/06/95	6	53	0.041	0.028	146	1893	2039
06/07/95	16	46	0.041	0.028	390	1643	2033
06/08/95	28	55	0.041	0.028	683	1964	2647
06/09/95	4	46	0.041	0.028	98	1643	1740
06/10/95	5	37	0.041	0.028	122	1321	1443
06/11/95	8	16	0.041	0.028	195	571	767
06/12/95	9	51	0.041	0.028	220	1821	2041
06/13/95	9	40	0.041	0.028	220	1429	1648
06/14/95	10	25	0.041	0.028	244	893	1137
06/15/95	24	64	0.041	0.028	585	2286	2871
06/16/95	13	53	0.041	0.028	317	1893	2210
06/17/95	10	42	0.041	0.028	244	1500	1744
06/18/95	14	38	0.041	0.028	341	1357	1699
06/19/95	3	58	0.041	0.028	73	2071	2145
06/20/95	4	29	0.041	0.028	98	1036	1133
06/21/95	22	27	0.041	0.028	537	964	1501
06/22/95	0	28	0.041	0.028	0	1000	1000
06/23/95	4	32	0.041	0.028	98	1143	1240
06/24/95	0	23	0.041	0.028	0	821	821
06/25/95	0	10	0.041	0.028	0	357	357

Appendix C. Estimated daily abundance of downstream migrant salmon at Woodbridge Dam: January -- July 1995.

Note: Differences in totals may be attributable to rounding

Date	YOY # Day	YOY # Night	Trap Eff Day	Trap Eff Night	Est No. YOY Day	Est No. YOY Night	Est. No. YOY Total
06/26/95	1	6	0.041	0.028	24	214	239
06/27/95	3	9	0.041	0.028	73	321	395
06/28/95	2	16	0.041	0.028	49	571	620
06/29/95	2	20	0.041	0.028	49	714	763
06/30/95	1	22	0.041	0.028	24	786	810
07/01/95	2	11	--	--	2	11	13
07/02/95	0	11	--	--	0	11	11
07/03/95	0	10	--	--	0	10	10
07/04/95	0	5	--	--	0	5	5
07/05/95	0	0	--	--	0	0	0
07/06/95	0	1	--	--	0	1	1
07/07/95	0	11	--	--	0	11	11
07/08/95	0	6	--	--	0	6	6
07/09/95	0	5	--	--	0	5	5
07/10/95	0	7	--	--	0	7	7
07/11/95	0	7	--	--	0	7	7
07/12/95	1	5	--	--	1	5	6
07/13/95	0	3	--	--	0	3	3
07/14/95	0	4	--	--	0	4	4
07/15/95	0	2	--	--	0	2	2
07/16/95	0	1	--	--	0	1	1
07/17/95	1	1	--	--	1	1	2
07/18/95	1	0	--	--	1	0	1
07/19/95	0	0	--	--	0	0	0
07/20/95	0	0	--	--	0	0	0
07/21/95	0	0	--	--	0	0	0
07/22/95	0	2	--	--	0	2	2
07/23/95	0	0	--	--	0	0	0
07/24/95	0	2	--	--	0	2	2
07/25/95	0	2	--	--	0	2	2
07/26/95	1	2	--	--	1	2	3
07/27/95	0	0	--	--	0	0	0
07/28/95	0	6	--	--	0	6	6
07/29/95	0	0	--	--	0	0	0
07/30/95	0	0	--	--	0	0	0
07/31/95	0	0	--	--	0	0	0
TOTAL	**1994**	**21917**			**45655**	**388551**	**434206**

Appendix D. Daily average size of YOY salmon captured at Woodbridge Dam - Traps 1 and 2: January -- July 1995.

DATE	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Std K	Max TL, mm	Min TL, mm	Max Wt, g	Min Wt, (g)	N
01/01/95													
01/02/95													
01/03/95													
01/04/95													
01/05/95													
01/06/95													
01/07/95													
01/08/95													
01/09/95													
01/10/95													
01/11/95													
01/12/95													
01/13/95													
01/14/95													
01/15/95													
01/16/95													
01/17/95													
01/18/95													
01/19/95													
01/20/95													
01/21/95													
01/22/95													
01/23/95													
01/24/95													
01/25/95	38	36	0.3	5.46E-04	2.4	2.4	0.09	8.49E-05	41	33	0.5	0.2	10
01/26/95	38	36	0.3	4.82E-04	2.0	1.7	0.06	1.76E-04	41	33	0.4	0.2	73
01/27/95	38	36		0.00E+00	1.9	1.7		0.00E+00	41	33			50
01/28/95	38	36			2.1	2.0			42	32			60
01/29/95													
01/30/95	38	36			2.0	2.0			41	33			42
01/31/95	38	36	0.4	6.58E-04	2.6	2.4	0.07	9.56E-05	44	32	0.5	0.2	102
02/01/95	38	36			2.6	2.5			42	32			60
02/02/95	38	36	0.4	7.30E-04	2.4	2.2	0.08	8.73E-05	42	32	0.6	0.2	104
02/03/95	38	36	0.4	6.69E-04	1.7	1.6	0.06	7.23E-05	42	31	0.5	0.2	98
02/04/95	38	36	0.4	6.76E-04	2.3	2.1	0.08	8.34E-05	42	31	0.5	0.2	107
02/05/95	38	36	0.4	6.84E-04	1.9	1.9	0.07	9.01E-05	44	33	0.6	0.2	112
02/06/95	38	36	0.4	6.71E-04	2.3	2.2	0.08	1.15E-04	41	33	0.5	0.2	85
02/07/95	38	36	0.4	6.65E-04	2.3	2.1	0.09	8.73E-05	41	29	0.6	0.2	113
02/08/95	38	36	0.4	6.56E-04	2.1	2.0	0.09	9.43E-05	45	33	0.6	0.2	120
02/09/95	39	37			2.2	2.1			46	34			95
02/10/95	38	36	0.3	6.07E-04	2.1	1.9	0.11	1.57E-04	43	33	0.6	0.1	68
02/11/95	39	37	0.4	6.57E-04	2.9	2.7	0.14	8.92E-05	58	34	1.5	0.2	111
02/12/95	38	36	0.4	6.50E-04	2.7	2.4	0.10	8.45E-05	47	33	0.8	0.2	102
02/13/95	38	36	0.4	6.45E-04	3.4	3.2	0.12	1.15E-04	56	33	0.7	0.2	74
02/14/95	38	36	0.4	6.32E-04	4.2	3.9	0.17	9.41E-05	55	31	1.2	0.2	40
02/15/95	38	36	0.4	6.62E-04	2.5	2.2	0.10	9.92E-05	42	31	0.6	0.2	30
02/16/95	38	36	0.4	6.49E-04	2.4	2.3	0.07	9.82E-05	42	33	0.5	0.2	33
02/17/95	39	37	0.4	6.30E-04	3.6	3.4	0.16	1.10E-04	52	32	1.0	0.2	45
02/18/95	38	36	0.3	6.37E-04	2.5	2.2	0.08	7.51E-05	43	32	0.6	0.2	42
02/19/95	38	36	0.4	6.58E-04	2.8	2.6	0.10	9.70E-05	47	32	0.7	0.2	59
02/20/95	38	36	0.3	6.07E-04	2.1	2.0	0.09	1.01E-04	44	35	0.6	0.2	56
02/21/95	38	36	0.4	6.39E-04	2.5	2.3	0.09	1.01E-04	44	32	0.6	0.2	59
02/22/95	38	36	0.3	6.30E-04	2.0	1.9	0.08	9.07E-05	41	33	0.5	0.2	61
02/23/95	39	37	0.4	6.31E-04	5.2	4.7	0.30	1.01E-04	67	33	2.3	0.2	56
02/24/95	38	37	0.4	6.54E-04	4.9	4.5	0.29	9.12E-05	71	31	2.5	0.2	58
02/25/95	38	36	0.3	6.38E-04	2.7	2.5	0.09	8.09E-05	47	33	0.7	0.2	54
02/26/95	39	37	0.4	6.28E-04	2.3	2.1	0.09	9.89E-05	45	33	0.7	0.2	57
02/27/95	38	36	0.4	6.38E-04	2.8	2.5	0.13	9.58E-05	53	32	1.1	0.2	54
02/28/95	38	36	0.4	6.60E-04	1.8	1.7	0.07	7.55E-05	41	33	0.5	0.2	55
03/01/95	39	37	0.4	6.28E-04	3.6	3.1	0.08	8.04E-05	59	32	0.6	0.2	55
03/02/95	39	37	0.4	6.28E-04	4.3	3.9	0.24	9.15E-05	60	34	1.7	0.2	64
03/03/95	40	38	0.5	6.95E-04	5.6	5.2	0.34	9.66E-05	59	33	1.9	0.2	61
03/04/95	39	37	0.4	6.70E-04	4.4	4.0	0.24	9.99E-05	55	33	1.3	0.2	55
03/05/95	39	37	0.5	6.62E-04	6.9	6.7	0.60	1.32E-04	80	33	4.3	0.2	51
03/06/95	39	37	0.4	6.32E-04	5.7	5.1	0.31	9.75E-05	65	32	2.0	0.2	51
03/07/95	40	38	0.5	6.80E-04	6.5	5.9	0.47	1.06E-04	77	34	3.7	0.2	54
03/08/95	42	40	0.7	7.54E-04	9.5	8.7	0.76	1.37E-04	67	36	3.2	0.3	30

Appendix D. Daily average size of YOY salmon captured at Woodbridge Dam - Traps 1 and 2: January -- July 1995.

DATE	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Std K	Max TL, mm	Min TL, mm	Max Wt, g	Min Wt, (g)	N
03/09/95	45	42	0.7	6.45E-04	10.8	10.2	0.60	7.93E-05	68	34	2.5	0.3	38
03/10/95	42	40	0.6	6.89E-04	8.8	7.7	0.50	8.25E-05	66	32	2.3	0.2	48
03/11/95	38	36			5.1	4.2			70	34			47
03/12/95													
03/13/95													
03/14/95													
03/15/95													
03/16/95													
03/17/95	41	39	0.5	7.01E-04	7.1	6.2	0.51	7.82E-05	71	34	2.9	0.3	26
03/18/95	47	44	0.9	8.67E-04					47	47	0.9	0.9	1
03/19/95													
03/20/95	61	57	1.9	8.37E-04					61	61	1.9	1.9	1
03/21/95	47	44	0.8	6.70E-04	9.5	8.7	0.64	1.28E-04	61	37	1.9	0.3	9
03/22/95	57	54	1.8	7.77E-04	14.6	13.2	1.46	5.65E-05	83	42	4.7	0.6	8
03/23/95	52	49	1.0	7.11E-04					52	52	1.0	1.0	1
03/24/95	69	63	3.1	7.60E-04	20.1	18.2	2.22	1.26E-04	88	37	5.7	0.3	5
03/25/95	69	64	2.9	8.09E-04	12.7	12.3	1.75	8.45E-05	85	52	5.6	1.2	5
03/26/95	69	65	4.2	8.34E-04	29.7	27.5	3.90	1.83E-04	93	36	8.1	0.3	3
03/27/95													
03/28/95	59	55	1.9	8.14E-04	12.8	11.2	1.08	8.56E-05	77	37	3.5	0.4	13
03/29/95	49	46	1.2	7.30E-04	18.2	16.5	1.33	5.64E-05	70	38	2.7	0.4	3
03/30/95	81	75	4.6	8.36E-04	10.4	9.6	1.84	6.25E-05	97	70	7.7	2.6	6
03/31/95	68	64	3.1	7.79E-04	19.2	17.7	2.24	9.43E-05	95	37	7.1	0.3	10
04/01/95	77	71	3.9	7.68E-04	13.3	11.6	2.46	4.85E-05	105	62	9.6	1.7	8
04/02/95	71	66	3.5	8.49E-04	19.5	16.9	2.98	1.21E-04	99	54	7.9	1.6	4
04/03/95	79	72	4.3	8.05E-04	14.5	12.9	2.21	6.58E-05	104	50	9.2	0.9	12
04/04/95	84	77	6.3	9.10E-04	9.5	8.5	0.00	6.54E-05	97	61	6.3	6.3	16
04/05/95	83	76	5.1	8.47E-04	13.6	11.3	2.25	4.65E-05	110	62	9.8	2.1	15
04/06/95	92	83	6.7	8.51E-04	6.6	6.8	1.80	1.00E-04	99	83	9.0	4.4	5
04/07/95	82	75	4.2	7.21E-04	14.2	12.7	2.50	1.84E-04	109	67	9.8	2.0	13
04/08/95	77	71	4.1	8.25E-04	10.0	8.4	1.82	9.77E-05	95	57	9.0	1.4	27
04/09/95	78	72	3.9	7.45E-04	12.3	11.0	2.11	1.32E-04	105	57	9.2	1.0	56
04/10/95	77	71	4.0	8.16E-04	11.2	10.3	2.29	1.40E-04	102	55	17.0	1.2	71
04/11/95	76	70	3.4	7.74E-04	10.6	9.9	1.27	3.04E-05	83	68	4.3	2.5	2
04/12/95	76	70	3.3	7.31E-04	8.8	7.9	1.39	3.63E-05	95	66	6.5	2.2	8
04/13/95	79	74	4.3	8.20E-04	11.2	10.2	1.95	6.47E-05	102	61	9.5	1.5	36
04/14/95	86	80	5.6	8.19E-04	12.7	11.3	2.34	1.01E-04	108	58	11.3	1.6	63
04/15/95	84	78	4.9	7.88E-04	10.5	9.6	1.92	1.36E-04	104	63	10.6	1.8	97
04/16/95	84	77	5.0	7.92E-04	10.8	9.9	2.01	1.11E-04	105	59	10.4	1.9	76
04/17/95	82	75	4.5	7.73E-04	10.3	9.0	1.83	7.18E-05	110	65	10.5	2.0	75
04/18/95	84	77	0.0	7.97E-04	11.3	10.5	2.12	1.06E-04	105	66	9.7	2.2	55
04/19/95	83	77	4.9	8.15E-04	11.4	10.2	2.08	1.05E-04	109	65	10.7	1.9	51
04/20/95	84	76	7.1	9.91E-04	13.3	12.1	14.21	1.09E-03	116	62	101.0	2.1	47
04/21/95	88	80	6.3	8.90E-04	11.1	9.8	2.31	1.07E-04	105	57	10.4	1.5	39
04/22/95	87	80	5.7	8.05E-04	15.0	13.4	2.86	4.67E-05	110	65	11.2	2.1	45
04/23/95	89	82	6.3	8.03E-04	16.4	15.1	2.36	6.63E-05	108	31	10.3	0.2	22
04/24/95	89	81	5.9	8.14E-04	11.1	9.9	2.27	1.09E-04	115	66	12.9	2.9	23
04/25/95	90	82	6.6	8.68E-04	13.9	12.4	2.83	1.37E-04	111	42	15.5	1.0	43
04/26/95	90	83	6.0	7.93E-04	9.6	9.0	1.88	7.18E-05	107	68	10.4	2.8	36
04/27/95	89	82	6.2	8.44E-04	13.4	12.2	2.79	2.67E-04	125	46	17.5	0.7	37
04/28/95	97	88	7.4	7.88E-04	11.0	9.8	2.23	3.98E-05	114	53	11.9	1.2	46
04/29/95	95	87	7.1	7.91E-04	11.4	10.1	2.15	4.40E-05	115	50	11.7	0.9	39
04/30/95	98	90	7.7	8.09E-04	7.5	7.2	1.89	5.16E-05	110	80	11.3	4.4	25
05/01/95	92	85	6.7	8.41E-04	7.2	7.4	2.20	9.72E-05	99	83	9.5	4.3	5
05/02/95	100	92	8.2	7.69E-04	12.1	11.0	2.60	1.77E-04	109	65	10.5	0.7	11
05/03/95	97	89	8.5	8.52E-04	14.1	12.1	2.85	1.37E-04	115	51	14.4	0.5	17
05/04/95	106	97	9.2	7.68E-04	7.3	6.5	2.03	7.33E-05	119	87	14.0	4.8	57
05/05/95	101	92	8.7	8.30E-04	11.4	10.2	2.45	7.27E-05	118	63	13.5	1.9	28
05/06/95	100	92	8.3	7.54E-04	15.5	13.8	3.40	8.64E-05	129	49	17.4	0.6	31
05/07/95	105	97	9.5	7.96E-04	7.4	6.4	2.32	4.60E-05	125	92	17.4	6.3	30
05/08/95	105	95	9.1	7.79E-04	8.1	7.3	2.27	5.54E-05	125	90	16.2	5.5	41
05/09/95	103	94	9.0	7.94E-04	11.7	10.5	2.87	6.63E-05	124	60	15.4	1.4	34
05/10/95	107	98	9.6	7.57E-04	12.2	10.7	2.93	9.49E-05	147	61	20.2	0.6	50
05/11/95	103	94	8.6	7.66E-04	9.4	8.2	2.39	6.34E-05	114	91	10.9	5.1	6
05/12/95	104	95	9.2	7.92E-04	11.5	10.2	2.89	1.57E-04	123	65	15.0	1.2	54
05/13/95	108	99	9.9	7.75E-04	6.7	5.9	2.13	4.07E-05	129	97	17.5	7.1	26
05/14/95	107	99	9.8	7.93E-04	11.5	9.4	2.48	1.35E-04	129	62	16.5	1.5	48

Appendix D. Daily average size of YOY salmon captured at Woodbridge Dam - Traps 1 and 2: January -- July 1995.

DATE	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Std K	Max TL, mm	Min TL, mm	Max Wt, g	Min Wt, (g)	N
05/15/95	107	98	9.1	7.39E-04	7.4	6.8	2.10	7.24E-05	122	86	14.8	5.3	82
05/16/95	106	97	9.8	7.94E-04	8.3	7.4	2.27	7.63E-05	124	68	16.0	1.6	131
05/17/95	105	96	9.5	7.97E-04	11.4	10.1	2.86	8.52E-05	123	64	16.0	1.6	83
05/18/95	104	95	9.1	7.97E-04	9.2	8.3	2.72	6.86E-05	121	82	15.3	3.7	26
05/19/95	102	93	9.3	8.15E-04	16.8	15.0	5.23	1.63E-04	140	78	22.2	2.8	10
05/20/95	113	104	12.0	8.25E-04	5.3	6.0	1.79	2.50E-05	118	106	13.9	9.6	4
05/21/95	110	101	10.8	7.93E-04	8.4	7.4	2.44	4.38E-05	127	80	16.3	3.4	32
05/22/95	109	99	10.4	8.00E-04	7.1	6.4	2.12	3.03E-05	129	95	17.5	7.0	45
05/23/95	108	98	9.9	7.84E-04	8.0	7.2	2.16	5.18E-05	128	72	15.8	2.3	73
05/24/95	109	99	10.4	7.88E-04	8.0	7.3	2.39	4.86E-05	127	77	15.9	2.9	81
05/25/95	106	97	10.1	8.26E-04	8.0	7.4	2.48	5.85E-05	126	83	17.2	4.2	52
05/26/95	109	100	10.8	8.19E-04	5.5	5.2	1.85	5.85E-05	120	86	16.1	4.4	65
05/27/95	111	101	10.9	7.95E-04	6.6	6.0	2.01	7.19E-05	128	80	16.6	3.6	74
05/28/95	108	98	10.2	7.97E-04	7.0	6.3	2.17	5.08E-05	123	87	15.0	4.7	65
05/29/95	108	99	9.9	7.64E-04	7.5	6.7	2.47	9.08E-05	121	92	14.9	6.5	15
05/30/95	111	102	11.8	7.98E-04	18.7	17.1	5.14	5.58E-05	127	80	16.7	3.8	5
05/31/95	111	101	11.6	8.19E-04	6.0	5.5	2.11	1.17E-04	126	99	16.8	6.0	65
06/01/95	111	101	11.3	8.11E-04	5.9	5.5	2.14	8.01E-05	130	97	17.0	3.5	65
06/02/95	112	101	11.7	8.31E-04	7.8	6.8	2.33	6.14E-05	130	76	18.5	3.0	60
06/03/95	111	101	11.3	8.22E-04	5.5	5.2	1.74	4.97E-05	125	100	15.6	8.1	53
06/04/95	110	100	11.2	8.35E-04	5.7	5.3	2.04	5.05E-05	124	100	16.4	7.8	33
06/05/95	111	101	11.6	8.41E-04	8.1	7.4	2.50	6.63E-05	132	82	20.1	4.0	66
06/06/95	114	104	12.3	8.20E-04	5.2	4.9	2.13	6.53E-05	128	103	19.1	8.5	55
06/07/95	113	103	12.1	8.30E-04	5.6	5.2	2.05	4.94E-05	130	103	19.3	8.5	51
06/08/95	115	105	12.2	7.88E-04	6.2	5.7	2.13	6.26E-05	127	97	16.5	6.8	80
06/09/95	115	104	12.5	8.21E-04	4.9	4.7	1.90	6.12E-05	125	105	16.3	9.4	41
06/10/95	113	103	12.1	8.25E-04	6.2	5.7	2.11	6.02E-05	127	97	17.7	8.2	42
06/11/95	116	105	12.8	8.15E-04	7.5	6.6	2.52	6.21E-05	128	94	18.8	7.7	24
06/12/95	115	105	13.0	8.43E-04	6.7	5.9	2.46	5.82E-05	126	94	18.1	6.5	55
06/13/95	116	106	13.5	8.49E-04	6.5	6.1	2.34	5.14E-05	131	93	20.6	6.9	39
06/14/95	115	105	13.2	8.60E-04	7.7	6.7	2.73	4.84E-05	130	99	18.7	7.5	35
06/15/95	115	105	13.5	8.79E-04	6.5	5.8	2.28	6.29E-05	129	101	20.8	9.4	79
06/16/95	114	103	13.1	8.83E-04	8.2	7.1	2.29	5.74E-05	132	80	19.1	6.2	65
06/17/95	120	109	13.6	7.84E-04	8.4	7.6	3.04	6.04E-05	137	100	21.0	8.0	53
06/18/95	115	105	13.3	8.47E-04	8.9	8.1	2.91	8.59E-05	131	69	20.3	1.5	52
06/19/95	118	107	13.8	8.37E-04	5.8	5.2	2.15	5.55E-05	129	105	20.0	10.0	50
06/20/95	117	106	14.3	8.85E-04	8.2	7.4	2.94	6.49E-05	132	100	21.8	8.1	33
06/21/95	117	107	14.2	8.73E-04	9.3	8.2	3.38	7.21E-05	135	91	21.4	6.8	42
06/22/95	120	109	15.2	8.74E-04	7.4	6.7	3.06	5.38E-05	134	106	21.6	8.7	19
06/23/95	119	109	14.4	8.45E-04	7.9	7.4	2.95	4.95E-05	133	103	21.5	9.2	36
06/24/95	121	110	15.8	8.77E-04	9.9	9.1	3.97	5.19E-05	141	103	24.5	8.9	23
06/25/95	121	110	14.8	8.30E-04	6.9	6.3	2.98	4.35E-05	132	112	20.2	11.3	10
06/26/95	120	109	15.4	8.86E-04	8.5	7.6	3.27	5.87E-05	129	109	19.8	11.5	7
06/27/95	123	112	16.7	8.79E-04	9.8	8.8	3.44	6.68E-05	132	100	19.7	9.3	11
06/28/95	123	111	16.8	8.99E-04	12.5	9.9	4.80	1.28E-04	143	100	26.0	9.6	18
06/29/95	121	111	16.7	9.35E-04	8.2	7.4	2.89	7.33E-05	134	100	22.4	10.1	22
06/30/95	123	113	17.5	9.15E-04	12.2	10.8	4.76	8.73E-05	142	85	26.0	4.6	22
07/01/95	125	114	18.1	8.10E-04	6.7	6.5	2.60	3.65E-05	138	111	21.1	10.4	13
07/02/95	125	114	16.2	8.09E-04	8.5	7.7	4.51	9.83E-05	145	116	25.6	8.9	11
07/03/95	123	112	16.9	8.89E-04	9.9	9.0	4.64	5.87E-05	148	113	28.7	12.7	10
07/04/95	117	106	14.4	8.81E-04	9.4	8.6	3.49	6.02E-05	124	101	16.6	8.3	5
07/05/95									143	143	26.5	26.5	1
07/06/95	143	130	26.5	9.06E-04					145	105	24.4	10.1	11
07/07/95	122	111	16.5	8.87E-04	11.6	11.1	4.53	4.32E-05	130	95	20.1	6.0	5
07/08/95	120	110	14.3	7.69E-04	14.3	13.7	5.82	1.65E-04	146	107	30.0	8.5	3
07/09/95	123	111	16.8	8.09E-04	20.4	18.1	11.54	1.39E-04	145	110	27.9	11.4	7
07/10/95	125	114	18.3	9.21E-04	13.2	11.5	5.86	7.01E-05	137	67	21.7	4.7	6
07/11/95	117	106	15.7	9.94E-04	24.9	23.7	5.77	2.80E-04	140	110	23.8	7.5	6
07/12/95	125	114	16.4	7.92E-04	12.0	11.6	6.20	1.23E-04	134	85	20.1	4.7	3
07/13/95	110	99	12.7	8.58E-04	24.5	21.5	7.72	1.05E-04	113	90	12.3	6.2	4
07/14/95	106	96	10.0	8.31E-04	10.6	9.6	2.65	2.62E-05	110	95	10.9	8.0	2
07/15/95	103	94	9.5	8.76E-04	10.6	9.2	2.05	8.07E-05	141	141	25.8	25.8	1
07/16/95	141	127	25.8	9.20E-04					136	110	23.7	10.4	2
07/17/95	123	112	17.1	8.62E-04	18.4	17.7	9.40	1.14E-04	120	120	14.8	14.8	1
07/18/95	120	109	14.8	8.56E-04									
07/19/95													
07/20/95													

Appendix D. Daily average size of YOY salmon captured at Woodbridge Dam - Traps 1 and 2: January -- July 1995.

DATE	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Std K	Max TL, mm	Min TL, mm	Max Wt, g	Min Wt, (g)	N
07/21/95													
07/22/95	108	98	9.6	7.67E-04	3.5	4.2	1.98	8.35E-05	110	105	11.0	8.2	2
07/23/95													
07/24/95	113	103	9.2	6.50E-04	6.2	4.6	1.07	1.54E-04	118	106	9.9	8.0	3
07/25/95	118	108	13.3	8.05E-04	4.2	3.5	2.40	5.94E-05	121	115	15.0	11.6	2
07/26/95	112	102	12.7	8.66E-04	12.9	11.2	4.75	4.70E-05	127	103	18.0	8.9	3
07/27/95													
07/28/95	118	108	14.3	8.41E-04	14.4	13.7	5.50	4.00E-05	140	97	23.6	7.3	6
07/29/95													
07/30/95													
07/31/95													

Appendix E. Daily average size of yearling salmon captured at Woodbridge Dam - Traps 1 and 2: January -- July 1995.

DATE	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Std K	Max TL, mm	Min TL, mm	Max Wt, g	Min Wt, (g)	N
01/01/95													
01/02/95													
01/03/95													
01/04/95													
01/05/95													
01/06/95													
01/07/95													
01/08/95													
01/09/95													
01/10/95													
01/11/95													
01/12/95													
01/13/95													
01/14/95													
01/15/95													
01/16/95													
01/17/95													
01/18/95													
01/19/95													
01/20/95													
01/21/95													
01/22/95													
01/23/95													
01/24/95													
01/25/95													
01/26/95	178	162	36.5	6.47E-04					178	178	36.5	36.5	1
01/27/95	173	160							173	173			1
01/28/95	178	166			11.2	10.0			186	156			6
01/29/95													
01/30/95													
01/31/95	190	177	54.7	8.02E-04	5.7	6.1	4.90	4.40E-05	195	182	59.6	49.2	5
02/01/95													
02/02/95	180	167	43.4	7.35E-04	13.3	13.8	10.34	3.26E-05	192	159	53.6	29.2	6
02/03/95	178	170	45.2	7.91E-04	11.0	14.2	15.76	1.95E-04	193	168	59.2	29.7	4
02/04/95	150	141	28.3	7.73E-04	49.5	52.3	21.43	1.24E-04	185	115	43.4	13.1	2
02/05/95	188	175	49.8	7.45E-04	13.6	15.0	10.43	6.73E-05	208	175	63.3	37.9	5
02/06/95	185	171	49.0	7.75E-04	7.8	7.1	8.91	4.37E-05	190	179	55.3	42.7	2
02/07/95	191	177	48.6	7.11E-04	13.4	12.0	1.41	1.29E-04	200	181	49.6	47.6	2
02/08/95	197	188	57.3	7.49E-04					197	197	57.3	57.3	1
02/09/95													
02/10/95	183	171	40.7	6.56E-04	10.3	13.3	9.81	6.03E-05	195	172	50.7	29.2	4
02/11/95	183	172	45.0	7.35E-04	2.8	0.0	0.14	3.18E-05	185	181	45.1	44.9	2
02/12/95	227	210	89.2	7.63E-04						227		89.2	1
02/13/95													
02/14/95													
02/15/95													
02/16/95	192	181	54.5	7.70E-04					192	192	54.5	54.5	1
02/17/95	186	173	46.2	7.13E-04	16.3	14.8	13.29	2.03E-05	197	174	55.6	36.8	2
02/18/95	188	175	47.2	7.10E-04					188	188	47.2	47.2	1
02/19/95													
02/20/95													
02/21/95													
02/22/95													
02/23/95													
02/24/95													
02/25/95													
02/26/95													
02/27/95													
02/28/95													
03/01/95													
03/02/95													
03/03/95													

Appendix E. Daily average size of yearling salmon captured at Woodbridge Dam - Traps 1 and 2: January -- July 1995.

DATE	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Std K	Max TL, mm	Min TL, mm	Max Wt, g	Min Wt, (g)	N
03/04/95	225	213	99.4	8.73E-04					225	225	99.4	99.4	1
03/05/95													
03/06/95													
03/07/95													
03/08/95													
03/09/95													
03/10/95	180	165	47.5	8.01E-04	15.3	16.3	14.11	5.25E-05	193	163	61.9	33.7	3
03/11/95	198	190							198	198			1
03/12/95													
03/13/95													
03/14/95													
03/15/95													
03/16/95													
03/17/95													
03/18/95													
03/19/95													
03/20/95													
03/21/95													
03/22/95													
03/23/95													
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03/26/95													
03/27/95													
03/28/95													
03/29/95													
03/30/95													
03/31/95													
04/01/95													
04/02/95													
04/03/95													
04/04/95													
04/05/95													
04/06/95													
04/07/95													
04/08/95													
04/09/95													
04/10/95													
04/11/95													
04/12/95													
04/13/95													
04/14/95													
04/15/95													
04/16/95													
04/17/95	225	215	105.2	9.24E-04					225	225	105.2	105.2	1
04/18/95													
04/19/95													
04/20/95													
04/21/95													
04/22/95													
04/23/95													
04/24/95													
04/25/95													
04/26/95													
04/27/95													
04/28/95													
04/29/95													
04/30/95													
05/01/95													
05/02/95													
05/03/95													
05/04/95													

Appendix E. Daily average size of yearling salmon captured at Woodbridge Dam - Traps 1 and 2: January -- July 1995.

DATE	Avg TL, mm	Avg FL, mm	Avg Wt, g	Avg K	Std TL	Std FL	Std Wt	Std K	Max TL, mm	Min TL, mm	Max Wt, g	Min Wt, (g)	N
05/05/95													
05/06/95													
05/07/95													
05/08/95													
05/09/95													
05/10/95													
05/11/95													
05/12/95													
05/13/95													
05/14/95													
05/15/95													
05/16/95													
05/17/95													
05/18/95													
05/19/95													
05/20/95													
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05/22/95													
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05/24/95													
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05/27/95													
05/28/95													
05/29/95													
05/30/95													
05/31/95													
06/01/95													
06/02/95													
06/03/95													
06/04/95													
06/05/95													
06/06/95													
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06/12/95													
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06/15/95													
06/16/95													
06/17/95													
06/18/95													
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06/24/95													
06/25/95													
06/26/95													
06/27/95													
06/28/95													
06/29/95													
06/30/95													
07/01/95													
07/02/95													
07/03/95													
07/04/95													
07/05/95													

Appendix F. Daily environmental conditions at Woodbridge Dam: October 1994 -- July 1995.

Date	Avg River Q	WID Canal Q	Water Temp (F)			Secchi Depth, cm			Rainfall	Baropress	Moon Age	Sunrise	Sunset
			Avg*	Max	Min	AM	PM	Avg					
10/01	42										26	702	1849
10/02	41										27	703	1847
10/03	40										28	704	1846
10/04	50										0	705	1844
10/05	70										1	706	1843
10/06	49										2	707	1841
10/07	41		68.1	68.6	67.5				0.00	29.99	3	708	1840
10/08	45		67.4	69.4	65.8	140	150	145.0	0.00	30.01	4	709	1838
10/09	44		68.4	71.2	66.2	110	130	120.0	0.00	29.91	5	709	1838
10/10	43		68.3	70.1	66.9	100	100	100.0	0.00	29.84	6	710	1836
10/11	42		66.6	67.5	65.4	110	100	105.0	0.00	29.90	7	711	1835
10/12	41		66.3	67.7	65.2	110	100	105.0	0.00	29.85	8	712	1834
10/13	41		65.0	65.6	64.2	100	100	100.0	0.00	29.73	9	713	1832
10/14	41		65.0	66.2	64.2	115	100	107.5	0.00	29.61	10	715	1831
10/15	48		63.8	64.8	63.2	100	110	105.0	0.00	29.70	11	716	1829
10/16	94		62.5	63.0	62.0	105	125	115.0	0.00	29.12	12	717	1828
10/17	148		61.7	62.6	60.8	130	120	125.0	0.00	29.97	13	718	1827
10/18	135		60.8	62.8	59.7	140	150	145.0	0.00	29.93	14	719	1825
10/19	128		59.6	60.5	58.7	195	185	190.0	0.00	29.96	15	720	1826
10/20	470		59.0	60.0*	58*	165	125	145.0	0.00	30.05	16	721	1825
10/21	360		58.2	59.0*	58*				0.00	30.04	17	722	1823
10/22	160		58.7	59.5	57.4	55	50	52.5	0.00	29.94	18	723	1822
10/23	141		58.8	59.5	57.8	60	70	65.0	0.00	29.95	19	724	1821
10/24	144		59.8	61.0	58.7	70	70	70.0	0.00	30.02	20	725	1819
10/25	143		60.1	60.6	59.1	65	70	67.5	0.00	30.03	21	726	1818
10/26	136		59.7	60.3	58.6	70	70	70.0	0.00	30.10	22	727	1817
10/27	133		60.1	60.8	59.3	75	75	75.0	0.00	30.12	23	728	1816
10/28	135		60.3	61.0	59.5	70	70	70.0	0.00	30.01	24	729	1815
10/29	135		59.3	60.6	58.4	75	75	75.0	0.00	29.99	25	730	1813
10/30	134		57.1	58.4	56.3	95	80	87.5	0.00	30.08	26	731	1812
10/31	135		56.1	56.7	54.9	100	90	95.0	0.00	30.09	27	732	1811
11/01	136		56.1	56.5	55.4	85	85	85.0	0.00	29.89	28	632	1705
11/02	153		55.6	56.1	55.0	80	80	80.0	0.02	29.87	29	634	1703
11/03	151		53.2	54.9	52.2	115	110	112.5	0.00	29.99	0	635	1702
11/04	155		52.0	52.7	51.1	160	110	135.0	0.00	30.08	1	636	1701
11/05	166		53.0	53.8	52.5	125	80	102.5	0.00	29.93	2	637	1701
11/06	174		54.9	55.8	54.0	75	70	72.5	0.43	29.94	3	639	1700
11/07	164		56.9	58.2	55.9	70	70	70.0	0.18	29.98	4	640	1658
11/08	159		56.5	57.6	55.8	50	70	60.0	0.00	30.06	5	641	1703
11/09	174		55.3	56.5	54.7	100	100	100.0	0.00	29.84	6	642	1702
11/10	180		54.3	54.5	54.0	55	50	52.5	0.77	29.82	7	644	1701
11/11	177		53.6	54.1	52.7	70	80	75.0	0.00	29.86	8	645	1700
11/12	175		53.7	54.0	53.2	120	105	112.5	0.00	29.91	9	646	1659
11/13	174		53.1	53.6	52.7	130	100	115.0	0.00	30.20	10	647	1658
11/14	174		51.9	52.7	51.0	110	100	105.0	0.00	30.20	11	649	1657
11/15	180		51.7	52.2	51.1	145	105	125.0	0.00	30.00	12	650	1656
11/16	176		52.1	53.1	51.5	85	85	85.0	0.26	30.08	13	651	1656
11/17	173		52.8	53.1	52.4	90	80	85.0	0.00	29.99	14	652	1655
11/18	172		51.1	52.5	50.1	120	140	130.0	0.00	30.10	15	654	1654
11/19	175		49.0	49.9	48.2	140	110	125.0	0.00	30.28	16	655	1653
11/20	173		49.2	50.1	48.5	155	110	132.5	0.00	30.25	17	656	1652
11/21	174		51.2	52.2	50.3	110	105	107.5	0.01	30.21	18	657	1652
11/22	175		51.2	52.0	50.6	90	90	90.0	0.00	30.34	19	658	1651
11/23	175		49.9	50.8	49.2	90	100	95.0	0.00	30.28	20	700	1650
11/24	175		50.0	50.6	49.6	100		100.0	0.00	30.10	21	701	1650
11/25	190		51.4	52.0	50.6	95	80	87.5	0.27	30.01	22	702	1649
11/26	179		51.5	52.0	50.8	80	100	90.0	0.06	30.18	23	703	1649
11/27	176		49.9	50.6	49.4	140	130	135.0	0.00	30.31	24	659	1648
11/28	175		50.3	51.0	49.8	150	135	142.5	0.00	30.31	25	700	1648
11/29	171		50.1	50.6	49.4	130	110	120.0	0.00	30.32	26	701	1647
11/30	173		49.4	49.9	48.7	130	110	120.0	0.00	30.20	27	703	1647
12/01	175		49.4	49.8	49.1	120	100	110.0	0.00	30.04	28	704	1647
12/02	177		50.1	50.4	49.8	100	80	90.0	0.05	29.99	0	705	1646
12/03	190		50.9	51.3	50.4	90	90	90.0	0.26	29.88	1	706	1646
12/04	188		51.5	51.7	51.1	90	70	80.0	0.40	29.91	2	707	1646
12/05	179		50.9	51.5	50.4	115	90	102.5	0.12	29.98	3	708	1646
12/06	176		50.0	50.4	49.6	135	110	122.5	0.00	30.13	4	709	1646
12/07	175		49.4	50.1	49.1	140	110	125.0	0.03	30.34	5	710	1646
12/08	174		48.0	49.2	47.2	150	100	125.0	0.00	30.38	6	711	1646
12/09	172		46.3	47.2	45.7	120	135	127.5	0.00	30.30	7	711	1646
12/10	176		46.0	46.4	45.4	130	125	127.5	0.00	30.15	8	712	1646
12/11	177		46.9	47.9	46.4	130	110	120.0	0.00	30.07	9	713	1646

Appendix F. Daily environmental conditions at Woodbridge Dam: October 1994 -- July 1995.

Date	Avg River Q	WID Canal Q	Water Temp (F) Avg*	Max	Min	Secchi Depth, cm AM	PM	Avg	Rainfall	Baropress	Moon Age	Sunrise	Sunset
12/12	192		48.8	49.6	48.0	100	100	100.0	0.25	30.00	10	714	1646
12/13	168		49.3	49.6	48.9	80	100	90.0	0.10	30.10	11	715	1646
12/14	184		48.3	49.2	47.9	130	90	110.0	0.02	30.09	12	716	1646
12/15	177		48.2	48.7	47.9	75	110	92.5	0.12	30.21	13	716	1646
12/16	177		48.6	48.9	48.4	140	120	130.0	0.00	30.25	14	717	1647
12/17	176		48.2	48.5	48.0	125		125.0	0.00	30.16	15	718	1647
12/18	174		48.4	48.9	48.0	140	100	120.0	0.00	30.22	16	718	1647
12/19	174		49.2	49.6	48.9	150	100	125.0	0.00	30.25	17	719	1648
12/20	173		49.5	49.6	49.4	170	100	135.0	0.00	30.15	18	720	1648
12/21	174		48.9	49.4	48.5	150	120	135.0	0.00	30.13	19	720	1648
12/22	173		47.9	48.5	47.7	130	140	135.0	0.00	30.09	20	721	1649
12/23	174		47.4	47.7	47.2	145	140	142.5	0.00	29.90	21	721	1650
12/24	177		47.6	48.0	47.2	130	120	125.0	0.22	29.90	22	721	1650
12/25	177		47.8	48.2	47.2	140	120	130.0	0.24	30.06	23	722	1651
12/26	175		47.8	48.4	47.2	130	120	125.0	0.00	30.19	24	722	1651
12/27	174		47.7	48.2	47.2	150	150	150.0	0.00	30.11	25	723	1652
12/28	174		48.6	49.4	48.0	140	130	135.0	0.13	30.10	26	723	1653
12/29	174		48.1	49.2	47.4	120	120	120.0	0.03	30.04	27	723	1654
12/30	173		46.0	47.2	45.4	145	130	137.5	0.00	30.09	28	723	1654
12/31	174		45.4	45.9	45.2	130	160	145.0	0.00	30.10	29	723	1655
01/01	174	0				n/a	n/a		0.20	30.11	0	724	1656
01/02	173	0	**47.0**	**47.0**	**47.0**	130	120	125.0	0.00	29.97	1	724	1657
01/03	193	0	**48.0**	**48.5**	**47.5**	50	55	52.5	0.19	29.91	2	724	1658
01/04	219	0	**49.0**	**49.0**	**49.0**	n/a	n/a		0.14	29.58	3	724	1659
01/05	212	0	**49.5**	**50.0**	**49.0**	n/a	n/a		1.01	29.84	4	724	1700
01/06	184	0				n/a	n/a		0.04	29.90	5	724	1701
01/07	178	0				n/a	n/a		0.17	29.87	6	723	1702
01/08	179	0				n/a	n/a		0.11	29.92	7	723	1703
01/09	194	0				n/a	n/a		0.10	29.76	8	723	1704
01/10	289	0	54.8	55.2	54.1	n/a	n/a		1.16	29.64	9	723	1705
01/11	386	0	53.4	54.1	52.3	n/a	n/a		1.03	29.85	10	723	1706
01/12	229	0	53.1	53.8	52.7	n/a	n/a		0.10	29.95	11	722	1707
01/13	197	0	53.3	54.1	52.9	n/a	n/a		0.08	30.00	12	722	1708
01/14	196	0	54.5	55.0	54.1	n/a	n/a		0.50	29.88	13	721	1709
01/15	221	0	52.9	54.3	52.0	n/a	n/a		0.30	29.93	14	721	1710
01/16	212	0	50.8	52.0	50.2	n/a	n/a		0.32	30.01	15	721	1712
01/17	182	0	49.1	50.0	48.6	n/a	n/a		0.02	30.17	16	720	1713
01/18	175	0	48.8	49.3	48.4	n/a	n/a		0.00	30.22	17	720	1714
01/19	171	0	48.7	49.1	48.4	n/a	n/a		0.00	30.07	18	719	1715
01/20	172	0	48.5	48.9	48.4	n/a	n/a		0.00	29.89	19	718	1716
01/21	318	0	49.0	50.2	48.0	n/a	n/a		0.04	30.00	20	718	1718
01/22	478	0	50.5	50.9	50.0	n/a	n/a		0.12	29.88	21	717	1719
01/23	506	0	51.1	51.8	50.5	n/a	n/a		0.45	29.82	22	721	1720
01/24	528	0	51.5	52.3	51.1	n/a	n/a		0.40	29.72	23	720	1721
01/25	571	0	51.7	52.5	51.3	n/a	50		0.45	29.79	24	720	1723
01/26	543	0	50.8	51.3	50.5	60	60	60.0	0.25	30.08	25	719	1724
01/27	643	0	50.8	51.3	50.4	50	35	42.5	1.18	30.18	26	718	1725
01/28	778	0	51.6	52.3	50.9	35	n/a		0.11	30.25	27	717	1727
01/29	764	0	51.0	51.6	50.4	n/a	n/a		0.00	30.26	28	716	1728
01/30	779	0	50.4	50.7	50.0	n/a	50		0.04	30.27	0	715	1729
01/31	789	0	50.7	51.8	50.0	60	60	60.0	0.00	30.24	1	714	1731
02/01	787	0	50.7	51.1	50.2	50	n/a		0.00	30.21	2	713	1732
02/02	791	0	50.4	51.1	50.0	60	60	60.0	0.00	30.19	3	712	1733
02/03	794	0	50.1	50.4	49.3	50	50	50.0	0.00	30.24	4	711	1734
02/04	802	0	49.1	49.5	48.7	50	60	55.0	0.00	30.21	5	710	1736
02/05	804	0	49.0	49.1	48.7	50	60	55.0	0.00	30.18	6	709	1737
02/06	805	0	49.1	49.5	48.7	50	60	55.0	0.00	30.08	7	708	1738
02/07	805	0	48.6	48.9	48.4	60	50	55.0	0.00	29.99	8	707	1740
02/08	832	0	49.1	49.8	48.4	60	60	60.0	0.23	30.00	9	705	1734
02/09	814	0	49.2	50.0	48.6	60	50	55.0	0.04	30.11	10	704	1735
02/10	816	0	48.7	49.1	48.4	65	60	62.5	0.00	30.07	11	703	1737
02/11	818	0	48.9	49.1	48.4	60	60	60.0	0.00	29.94	12	702	1738
02/12	820	0	49.3	50.4	48.7	65	60	62.5	0.00	29.83	13	700	1739
02/13	792	0	49.5	49.8	49.3	60	75	67.5	0.00	29.71	14	659	1740
02/14	823	0	49.1	50.0	48.4	50	60	55.0	0.30	29.80	15	658	1742
02/15	826	0	48.4	49.1	47.8	60	n/a		0.00	30.00	16	656	1743
02/16	825	0	48.8	49.5	48.2	70	60	65.0	0.12	30.15	17	655	1744
02/17	822	0	49.3	50.4	48.6	65	95	80.0	0.00	30.27	18	653	1746
02/18	820	0	49.9	50.9	49.1	70	70	70.0	0.00	30.30	19	652	1747
02/19	820	0	50.3	51.3	49.5	65	80	72.5	0.00	30.25	20	651	1748
02/20	822	0	50.3	51.1	49.8	85	80	82.5	0.00	30.11	21	649	1749
02/21	823	0	50.5	51.3	49.6	70	85	77.5	0.00	30.02	22	648	1751

Appendix F. Daily environmental conditions at Woodbridge Dam: October 1994 -- July 1995.

Date	Avg River Q	WID Canal Q	Water Temp (F) Avg*	Max	Min	Secchi Depth, cm AM	PM	Avg	Rainfall	Baropress	Moon Age	Sunrise	Sunset
02/22	824	0	50.0	50.4	49.6	80	90	85.0	0.00	30.05	23	646	1752
02/23	826	0	50.2	50.7	49.5	80	90	85.0	0.00	30.11	24	645	1753
02/24	837	0	49.8	50.2	49.5	80	90	85.0	0.00	30.10	25	643	1754
02/25	830	0	49.9	50.2	49.6	80	80	80.0	0.00	30.04	26	642	1756
02/26	828	0	49.8	50.0	49.6	70	110	90.0	0.00	30.05	27	640	1757
02/27	822	0	49.9	50.4	49.5	100	70	85.0	0.00	30.07	28	638	1758
02/28	815	0	49.9	50.2	49.6	90	100	95.0	0.00	30.05	29	637	1759
03/01	775	0	50.3	51.1	49.6	90	110	100.0	0.05	29.92	0	635	1801
03/02	748	0	51.3	52.2	50.5	90	110	100.0	0.09	29.81	1	634	1802
03/03	752	0	52.1	53.1	51.6	60	30	45.0	0.58	29.96	2	632	1803
03/04	723	0	50.7	51.3	50.2	50	75	62.5	0.19	30.01	3	630	1804
03/05	716	0	51.2	51.8	50.4	80	90	85.0	0.02	29.89	4	629	1805
03/06	712	0	50.7	52.0	49.6	90	90	90.0	0.01	30.01	5	627	1807
03/07	708	0	51.0	52.2	50.2	110	110	110.0	0.00	30.05	6	625	1808
03/08	711	0	51.4	52.0	50.9	110	100	105.0	0.00	29.88	7	624	1809
03/09	704	0	51.7	53.1	50.9	80	80	80.0	0.30	29.70	8	622	1810
03/10	769	0	54.1	55.0	52.7	40	40	40.0	0.36	29.52	9	620	1811
03/11	1350	0	54.7	55.8	53.9	10	n/a		1.22	29.68	10	619	1813
03/12	2180	0	53.6	54.3	52.9	10	n/a		0.38	30.07	11	623	1814
03/13	2440	0	51.9	53.1	51.4	10	n/a		0.08	30.18	12	621	1815
03/14	2930	0	51.8	52.3	51.3	30	n/a		0.31	30.13	13	620	1816
03/15	2930	0	52.0	52.9	51.1	n/a	n/a		0.13	30.15	14	618	1817
03/16	2890	0	51.8	52.7	50.7	n/a	n/a		0.00	30.02	15	616	1818
03/17	2890	0	51.8	52.3	51.1	35	n/a		0.00	30.05	16	614	1820
03/18	2900	0	51.4	52.0	51.1	30	30	30.0	0.10	30.20	17	613	1821
03/19	2890	0	51.1	51.6	50.4	30	n/a		0.03	30.09	18	611	1822
03/20	2910	0	51.2	51.8	50.9	30	30	30.0	0.00	29.79	19	609	1817
03/21	2940	0	51.2	52.0	50.5	30	30	30.0	0.73	29.82	20	608	1818
03/22	2980	0	50.5	52.5	49.6	35	35	35.0	0.05	29.74	21	606	1819
03/23	3090	0	52.3	53.1	51.8	30	25	27.5	0.88	29.84	22	604	1820
03/24	3010	0	51.9	52.9	50.7	40	40	40.0	0.21	30.10	23	602	1822
03/25	2950	0	51.8	52.3	50.7	40	45	42.5	0.00	30.15	24	601	1823
03/26	2910	0	51.6	52.3	50.5	40	45	42.5	0.00	30.20	25	559	1824
03/27	2890	0	51.6	52.3	50.5	40	45	42.5	0.00	30.13	26	557	1825
03/28	2900	0	51.4	52.2	50.4	50	n/a		0.00	30.04	27	555	1826
03/29	2900	0	51.2	51.8	50.0	40	40	40.0	0.00	30.01	28	554	1827
03/30	2900	0	51.4	52.2	50.4	60	60	60.0	0.00	30.02	0	552	1828
03/31	2900	0	51.4	52.0	50.4	50	n/a		0.00	30.07	1	550	1830
04/01	2900	0	51.6	52.2	50.7	51	52	51.5	0.00	30.02	2	554	1831
04/02	2910	0	51.6	52.5	50.4	50	52	51.0	0.00	30.00	3	653	1932
04/03	2920	0	51.8	52.7	50.5	50	52	51.0	0.00	30.07	4	651	1933
04/04	2930	0	52.2	52.9	51.3	51	52	51.5	0.00	30.00	5	649	1934
04/05	2930	0	52.0	52.7	50.9	51	52	51.5	0.00	29.88	6	648	1929
04/06	2910	0	52.1	52.5	51.6	51	52	51.5	0.00	29.87	7	646	1930
04/07	2900	0	51.9	52.5	51.3	51	52	51.5	0.25	29.98	8	644	1931
04/08	2900	0	51.4	51.8	50.9	51	52	51.5	0.05	30.18	9	643	1933
04/09	2900	0	51.4	52.5	50.4	50	52	51.0	0.34	30.15	10	641	1934
04/10	2740	0	52.0	53.8	50.2	50	52	51.0	0.00	30.07	11	639	1935
04/11	2840	0	53.5	54.7	52.3	n/a	52		0.00	30.01	12	638	1936
04/12	2840	e50	53.2	54.0	52.5	52	53	52.5	0.00	29.94	13	636	1937
04/13	2750	e50	53.2	54.1	52.5	52	53	52.5	0.31	30.04	14	635	1938
04/14	2860	e50	52.4	53.4	51.4	51	52	51.5	0.00	30.08	15	634	1939
04/15	2870	50	52.0	52.3	51.4	51	52	51.5	0.00	29.88	16	632	1940
04/16	2870	51	52.4	54.0	51.3	51	53	52.0	0.07	29.81	17	630	1942
04/17	2800	58	52.2	52.9	51.4	51	52	51.5	0.00	30.09	18	629	1943
04/18	2830	61	52.1	52.9	51.4	51	52	51.5	0.25	29.89	19	627	1944
04/19	2830	61	52.3	53.4	51.3	51	52	51.5	0.01	29.96	20	626	1945
04/20	2830	62	52.7	53.1	52.3	52	53	52.5	0.09	29.98	21	624	1946
04/21	2820	63	52.5	53.6	51.4	52	53	52.5	0.00	30.08	22	623	1947
04/22	2810	70	53.3	54.3	52.2	52	53	52.5	0.00	30.10	23	621	1948
04/23	2810	65	54.1	55.2	53.1	53	52	52.5	0.00	30.03	24	620	1949
04/24	2780	69	54.2	55.2	53.2	53	54	53.5	0.00	29.94	25	618	1951
04/25	2800	74	54.0	54.7	53.2	53	54	53.5	0.00	29.92	26	617	1952
04/26	2780	85	53.9	54.7	53.1	53	55	54.0	0.05	29.87	27	615	1953
04/27	2780	87	53.6	54.0	53.1	53	54	53.5	0.00	29.87	28	614	1954
04/28	2780	86	53.2	53.4	53.1	53	53	53.0	0.13	29.94	29	612	1955
04/29	2790	86	53.5	54.5	53.1	53	54	53.5	0.25	29.90	0	611	1956
04/30	2790	86	53.6	53.8	53.1	54	55	54.5	0.00	29.96	1	609	1957
05/01	2810	83	54.3	55.4	53.4	90	90	90.0	0.27	29.88	2	607	1958
05/02	2800	85	54.2	54.9	53.4	90	95	92.5	0.35	29.97	3	606	1959
05/03	2810	86	54.4	55.2	53.6	100	90	95.0	0.00	29.92	4	604	2001
05/04	2810	87	54.3	55.0	53.6	85	90	87.5	0.00	29.84	5	610	2002

Appendix F. Daily environmental conditions at Woodbridge Dam: October 1994 -- July 1995.

Date	Avg River Q	WID Canal Q	Water Temp (F) Avg*	Max	Min	Secchi Depth, cm AM	PM	Avg	Rainfall	Baropress	Moon Age	Sunrise	Sunset
05/05	2760	93	53.7	54.3	53.1	100	95	97.5	0.06	29.86	6	609	2003
05/06	2770	99	53.5	54.7	52.3	100	100	100.0	0.05	29.86	7	607	2004
05/07	2760	99	54.5	55.4	53.6	100	100	100.0	0.00	29.86	8	606	2005
05/08	2760	97	54.7	55.6	53.8	100	95	97.5	0.00	29.98	9	605	2006
05/09	2750	96	54.1	54.7	53.6	105	100	102.5	0.00	30.07	10	604	2007
05/10	2750	104	54.2	55.4	53.2	100	100	100.0	0.00	30.06	11	603	2008
05/11	2730	104	54.6	55.0	54.0	110	90	100.0	0.00	29.96	12	602	2009
05/12	2730	107	53.9	54.3	53.4	100	100	100.0	0.41	29.82	13	600	2010
05/13	2750	109	53.9	54.5	53.2	90	105	97.5	0.34	29.65	14	559	2011
05/14	2750	110	53.9	54.1	53.6	100	100	100.0	0.00	29.83	15	558	2012
05/15	2740	108	54.2	55.4	53.4	100	100	100.0	0.18	29.90	16	557	2008
05/16	2740	106	55.0	56.1	54.1	100	115	107.5	0.00	29.87	17	556	2010
05/17	2770	105	55.3	56.8	54.1	95	100	97.5	0.00	29.93	18	555	2011
05/18	2870	109	55.1	55.8	54.3	100	100	100.0	0.00	29.95	19	554	2012
05/19	3060	126	55.4	56.3	54.1	105	105	105.0	0.00	29.88	20	553	2013
05/20	3160	130	55.3	55.9	54.3	105	105	105.0	0.00	29.89	21	552	2014
05/21	3180	131	54.7	55.4	54.0	95	105	100.0	0.00	29.94	22	552	2015
05/22	3180	136	54.5	55.4	53.6	90	95	92.5	0.00	29.90	23	551	2015
05/23	3170	145	55.2	55.9	54.3	90	100	95.0	0.00	29.85	24	550	2016
05/24	3180	148	55.1	56.3	54.1	95	100	97.5	0.00	29.82	25	549	2017
05/25	3180	151	55.3	56.1	54.3	105	110	107.5	0.02	29.88	26	548	2018
05/26	3170	152	55.6	56.1	54.9	105	110	107.5	0.00	29.95	27	548	2019
05/27	3170	148	56.2	58.5	54.9	110	110	110.0	0.00	29.95	28	547	2020
05/28	3180	146	55.9	56.8	55.0	110	110	110.0	0.00	29.90	29	546	2021
05/29	3190	147	56.3	57.0	55.2	100	110	105.0	0.00	29.89	0	546	2022
05/30	3190	148	56.2	56.7	55.2	110	100	105.0	0.00	29.93	1	545	2023
05/31	3170	151	56.4	57.0	55.6	100	100	100.0	0.00	29.88	2	545	2024
06/01	3170	151	56.4	57.0	55.6	100	100	100.0	0.00	29.79	3	544	2024
06/02	3180	152	55.7	56.5	54.5	100	115	107.5	0.00	29.91	4	544	2025
06/03	3180	154	56.0	56.8	55.0	110	120	115.0	0.00	29.92	5	543	2025
06/04	3160	156	56.2	56.8	55.2	115	120	117.5	0.00	29.96	6	543	2026
06/05	3170	157	56.0	56.5	55.0	110	110	110.0	0.00	30.03	7	542	2027
06/06	3280	170	55.6	56.1	54.7	110	120	115.0	0.00	29.94	8	542	2027
06/07	3480	184	55.6	56.3	54.5	100	110	105.0	0.00	29.74	9	542	2028
06/08	3610	190	56.4	63.7	55.0	110	100	105.0	0.00	29.89	10	542	2029
06/09	3620	206	56.5	57.4	55.4	100	110	105.0	0.00	30.03	11	542	2030
06/10	3610	220	56.6	57.4	55.8	100	100	100.0	0.00	30.05	12	541	2030
06/11	3600	223	56.8	57.6	55.9	105	110	107.5	0.00	30.02	13	541	2031
06/12	3590	224	56.8	57.6	55.9	110	115	112.5	0.00	29.97	14	541	2031
06/13	3590	227	57.1	57.7	56.1	110	100	105.0	0.00	29.90	15	541	2032
06/14	3580	233	56.4	57.4	55.8	100	115	107.5	0.00	29.89	16	541	2032
06/15	3590	234	56.0	56.1	55.8	100	100	100.0	0.03	29.72	17	541	2033
06/16	3600	227	56.1	57.2	55.0	100	100	100.0	0.07	29.83	18	541	2033
06/17	3610	222	56.9	57.7	56.1	105	110	107.5	0.00	30.01	19	541	2033
06/18	3600	222	57.4	57.9	56.7	105	105	105.0	0.00	30.04	20	541	2034
06/19	3600	220	57.2	57.9	56.3	110	130	120.0	0.00	30.01	21	541	2034
06/20	3600	219	57.6	58.3	56.7	105	110	107.5	0.00	29.93	22	541	2034
06/21	3590	218	58.1	58.6	57.0	90	120	105.0	0.00	29.90	23	541	2034
06/22	3590	216	58.3	59.0	57.2	105	n/a		0.00	29.91	24	542	2035
06/23	3580	221	58.8	59.7	57.7	110	110	110.0	0.00	29.90	25	542	2035
06/24	3580	228	58.9	59.7	57.9	105	110	107.5	0.00	29.81	26	542	2035
06/25	3570	235	59.2	59.7	58.1	100	110	105.0	0.00	29.69	27	542	2035
06/26	3580	232	59.3	59.9	58.5	105	110	107.5	0.00	29.71	28	543	2035
06/27	3560	244	59.0	59.9	57.9	105	110	107.5	0.00	29.82	0	543	2035
06/28	3550	248	58.8	59.5	57.7	115	120	117.5	0.00	29.82	1	544	2035
06/29	3560	251	58.9	59.4	58.1	130	130	130.0	0.00	29.83	2	544	2035
06/30	3560	251	58.8	59.4	57.9	140	140	140.0	0.00	29.88	3	544	2035
07/01	3470	249	58.8	59.4	57.9	130	140	135.0	0.00	29.89	4	545	2035
07/02	3290	245	59.0	59.7	58.1	140	140	140.0	0.00	29.92	5	545	2035
07/03	3110	245	59.2	59.5	58.5	140	140	140.0	0.00	29.89	6	546	2035
07/04	2920	231	59.3	59.9	58.5	130	n/a		0.00	29.86	7	547	2035
07/05	2750	217	59.6	60.3	58.8	140	140	140.0	0.00	29.87	8	547	2034
07/06	2520	235	59.7	60.3	59.0	145	140	142.5	0.00	29.93	9	548	2034
07/07	2290	249	59.9	60.4	59.0	130	140	135.0	0.00	29.93	10	548	2033
07/08	2100	255	59.8	60.4	59.2	135	140	137.5	0.00	29.89	11	549	2033
07/09	2030	259	59.7	60.4	59.0	150	140	145.0	0.00	29.97	12	550	2033
07/10	2010	267	59.6	59.9	59.0	135	140	137.5	0.00	29.95	13	550	2032
07/11	1990	276	59.6	59.9	59.0	140	140	140.0	0.00	29.94	14	551	2030
07/12	1980	281	59.5	59.9	58.8	120	160	140.0	0.00	30.00	15	552	2031
07/13	1970	283	60.2	61.0	59.4	150	150	150.0	0.00	29.90	16	553	2031
07/14	1990	270	60.7	61.3	59.9	130	150	140.0	0.00	29.83	17	554	2030
07/15	1980	260	61.1	61.5	60.3	130	160	145.0	0.00	29.81	18	554	2029

Appendix F. Daily environmental conditions at Woodbridge Dam: October 1994 -- July 1995.

Date	Avg River Q	WID Canal Q	Water Temp (F)			Secchi Depth, cm			Rainfall	Baropress	Moon Age	Sunrise	Sunset
			Avg*	Max	Min	AM	PM	Avg					
07/16	1970	261	61.4	62.1	60.6	150	160	155.0	0.00	29.83	19	555	2029
07/17	1990	254	60.5	61.9	59.2	130	130	130.0	0.00	29.90	20	556	2028
07/18	1990	256	60.5	61.5	59.4	120	140	130.0	0.00	29.85	21	557	2027
07/19	1980	260	61.3	61.9	60.6	140	145	142.5	0.00	29.92	22	558	2027
07/20	2000	257	61.4	61.7	60.8	80	160	120.0	0.00	29.98	23	559	2026
07/21	1960	260	61.4	61.9	60.8	n/a	n/a		0.00	29.98	24	600	2025
07/22	1800	261	61.6	62.1	61.3	160	160	160.0	0.00	30.00	25	600	2024
07/23	1620	259	61.8	62.1	61.5	140	150	145.0	0.00	29.98	26	601	2023
07/24	1440	250	62.3	62.8	61.9	170	170	170.0	0.00	29.95	27	602	2022
07/25	1290	240	62.7	63.3	62.1	160	150	155.0	0.00	29.87	28	603	2021
07/26	1200	272	63.0	63.9	62.2	160	150	155.0	0.00	29.84	29	604	2026
07/27	1140	266	63.7	64.6	62.8	140	160	150.0	0.00	29.83	0	605	2025
07/28	1130	270	64.1	65.7	63.3	160	160	160.0	0.00	29.85	1	606	2024
07/29	1110	267	63.7	65.1	63.0	n/a	n/a		0.00	29.91	2	607	2022
07/30	1110	261	64.0	65.3	63.1	n/a	n/a		0.00	29.80	3	608	2021
07/31	1120	267				n/a	n/a		0.00	29.77	4	609	2020

Notes:
Mokelumne River flow data from U.S.G.S. gaging station #11325500 at Woodbridge, CA. (operated by EBMUD)
Woodbridge Irrigation District canal flow data from U.S.G.S. gaging station #11325000 at Woodbridge, CA.
* Average temperature on these dates are computed from a morning and an afternoon "grab sample" hand held thermometer measurements;
Water temperatures were recorded hourly with a Ryan TM2000 submersible thermograph installed in pool #6a of low-stage fishway.
Secchi depth measured twice daily in pool #9a of low-stage fishway or from screw trap platform located about mid-channel below Woodbridge Dam.
Rainfall measured by National Weather Service station at Camanche Reservoir N., San Joaquin Co., CA.
Barometric pressure measured hourly and average daily value computed by National Weather Service station at Stockton, CA.
Lunar and solar data compiled from tables in the Old Farmer's Almanac, 1994 and 1995 editions, Yankee Publishing, Dublin, NH.
Temperatures in bold were taken manually.
e = estimated value
n/a = data not available

Appendix G. Delta outflow (in cfs): January -- July 1995.

JANUARY 1995

Date	Sacramento River at Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation Dist.	Delta Outflow Index
1	14,493	227	1,324	4,212	122	6,017	0	5,430
2	13,704	227	1,318	4,235	120	5,930	0	4,600
3	13,816	227	1,377	4,149	123	6,043	0	3,860
4	14,836	227	1,442	4,195	121	5,936	0	4,110
5	20,327	227	1,586	4,110	112	5,741	0	5,880
6	28,680	227	1,645	4,014	106	6,470	0	13,190
7	30,266	227	1,803	3,966	99	7,302	0	20,760
8	33,102	227	2,104	3,907	99	7,290	0	22,130
9	44,008	227	2,471	4,061	95	7,339	0	30,130
10	66,336	227	3,040	3,988	87	7,445	0	54,380
11	87,883	227	4,041	4,267	67	7,475	0	99,480
12	95,364	227	5,120	4,157	66	8,054	0	176,710
13	91,265	227	4,398	4,173	73	8,348	0	176,900
14	85,778	227	3,994	4,144	73	8,046	0	170,480
15	82,415	227	3,988	4,166	79	8,054	0	169,710
16	80,203	227	4,466	4,187	80	8,049	0	169,310
17	78,172	227	5,215	3,975	83	8,153	0	160,260
18	76,718	227	4,763	4,224	61	8,454	0	177,730
19	74,458	227	4,391	4,231	71	8,275	0	151,760
20	72,554	227	4,007	4,204	80	8,153	0	116,600
21	70,511	227	3,863	4,217	90	8,055	0	96,370
22	70,544	227	3,718	4,219	82	7,995	0	86,860
23	70,577	227	3,820	4,258	82	7,320	0	85,040
24	70,858	227	4,216	4,246	94	7,602	0	90,110
25	71,924	227	5,536	4,171	98	7,870	0	94,690
26	73,303	227	8,193	4,134	99	8,243	0	110,540
27	76,473	227	8,604	4,124	103	8,344	0	127,550
28	91,361	227	9,441	4,137	99	7,861	0	144,630
29	82,637	227	11,614	4,134	92	8,261	0	166,790
30	74,321	227	11,437	4,154	97	8,209	0	148,670
31	73,692	227	10,620	4,225	89	7,991	0	133,780
TOTAL	1,930,579	7,037	143,555	128,584	2,842	234,322	0	3,018,440
AVERAGE	62,277	227	4,631	4,148	92	7,559	0	97,369

Appendix G. Delta outflow (in cfs): January -- July 1995.

FEBRUARY 1995

Date	Sacramento River at Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation Dist.	Delta Outflow Index
1	67,788	238	10,146	4,269	91	8,051	0	134,850
2	69,574	238	9,652	4,267	87	7,823	0	126,510
3	75,280	238	8,966	4,243	89	7,879	0	134,110
4	75,121	238	7,443	4,246	89	7,555	0	152,520
5	74,934	238	7,279	4,243	93	7,907	0	160,140
6	73,439	238	7,348	4,244	90	7,721	0	151,220
7	71,775	238	7,305	4,257	86	5,208	0	135,920
8	72,231	238	7,231	4,269	93	4,491	0	120,630
9	71,388	238	7,085	4,265	86	4,282	0	108,280
10	70,473	238	6,885	4,262	84	4,194	0	99,730
11	68,813	238	6,757	4,267	84	4,024	0	94,840
12	67,168	238	6,730	4,157	86	3,773	0	88,640
13	65,682	238	6,581	4,132	84	4,008	0	81,740
14	65,074	238	6,580	4,283	83	1,637	0	78,040
15	61,669	238	6,630	4,257	79	4,021	0	72,650
16	62,705	238	6,427	4,243	86	4,239	0	65,870
17	60,080	238	6,724	4,224	86	4,799	0	64,790
18	56,188	238	6,645	4,207	85	4,010	0	63,000
19	51,718	238	6,208	4,177	86	6,042	0	56,890
20	47,740	238	5,723	4,174	90	4,973	0	52,110
21	44,180	238	5,467	4,184	87	4,524	0	47,730
22	41,672	238	5,415	4,199	90	3,617	0	44,740
23	38,272	238	5,478	4,214	88	1,059	0	44,570
24	36,739	238	5,722	4,210	92	795	0	41,430
25	34,842	238	5,410	4,205	88	2,611	0	36,820
26	33,814	238	5,126	4,203	99	2,613	0	34,600
27	32,856	238	5,003	4,208	81	3,522	0	32,390
28	32,014	238	4,987	4,200	0	3,527	0	31,350
TOTAL	1,623,229	6,664	186,933	118,308	2,367	128,903	0	2,356,110
AVERAGE	57,972	238	6,676	4,225	85	4,604	0	84,147

Appendix G. Delta outflow (in cfs): January -- July 1995.

MARCH 1995

Date	Sacramento River at Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation Dist.	Delta Outflow Index
1	31,616	225	4,947	4,230	0	2,984	0	30,960
2	32,235	225	4,677	4,234	0	2,635	0	30,760
3	34,638	225	3,988	4,243	65	3,031	0	30,880
4	46,975	225	3,528	4,237	94	1,972	0	36,940
5	53,290	225	3,559	4,237	99	1,969	0	47,620
6	51,101	225	3,553	4,238	99	1,951	0	52,980
7	46,758	225	3,470	4,211	92	1,441	0	50,800
8	45,379	225	3,398	4,227	89	644	0	47,000
9	49,858	225	3,403	4,015	77	0	0	48,120
10	79,788	225	3,631	1,748	65	0	0	67,320
11	99,303	225	8,149	0	72	0	0	131,640
12	99,454	225	12,895	0	72	0	0	289,470
13	96,317	225	14,253	0	75	0	0	333,410
14	88,041	225	13,265	0	72	0	0	327,980
15	85,721	225	12,537	0	74	0	0	319,460
16	84,439	225	13,610	534	66	0	0	290,220
17	84,605	225	17,444	1,390	66	0	0	262,020
18	80,849	225	22,171	2,471	62	0	0	253,350
19	80,028	225	24,870	2,838	58	0	0	243,090
20	80,269	225	25,856	2,850	61	0	0	234,550
21	83,757	225	25,069	2,854	62	0	0	238,840
22	85,341	225	23,632	2,848	54	0	0	241,910
23	87,520	225	21,822	1,983	53	0	0	237,760
24	86,708	225	22,001	893	58	0	0	241,060
25	85,372	225	20,802	897	59	(11)	0	231,080
26	85,518	225	20,161	898	63	0	0	208,990
27	81,886	225	21,375	2,193	62	0	0	188,790
28	71,750	225	23,157	2,864	63	0	0	167,040
29	70,785	225	24,599	2,864	66	0	0	147,700
30	70,870	225	25,191	2,853	63	0	0	133,000
31	69,188	225	25,109	2,823	69	0	0	124,410
TOTAL	2,229,359	6,975	456,122	73,676	2,028	16,616	0	5,289,150
AVERAGE	71,915	225	14,714	2,377	65	536	0	170,618

Appendix G. Delta outflow (in cfs): January -- July 1995.

APRIL 1995

Date	Sacramento River at Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation Dist.	Delta Outflow Index
1	67,630	201	24,693	2,845	81	0	0	114,990
2	62,670	201	24,403	2,715	74	0	0	108,130
3	65,327	201	22,400	2,828	94	0	0	98,440
4	62,278	201	22,648	2,828	111	0	0	96,280
5	60,185	201	21,145	2,868	109	0	0	91,230
6	60,473	201	21,604	2,894	108	0	0	87,260
7	58,235	201	21,305	2,895	106	0	0	87,880
8	58,457	201	21,287	2,890	99	0	0	86,200
9	52,476	201	21,270	2,884	96	0	0	87,510
10	65,225	201	21,095	2,907	101	0	0	90,530
11	69,778	201	20,604	2,899	99	0	0	99,900
12	71,516	201	20,225	2,866	95	0	0	106,470
13	71,996	201	19,728	3,389	94	0	0	107,530
14	71,273	201	19,176	3,649	106	3,173	23	105,410
15	71,010	201	18,889	3,662	98	0	44	107,500
16	70,522	201	18,618	3,663	88	0	0	106,010
17	70,731	201	18,735	3,676	92	0	0	104,460
18	69,974	201	18,610	3,684	79	66	0	102,230
19	69,209	201	18,393	3,653	97	48	57	98,360
20	67,653	201	18,166	3,675	72	48	45	93,060
21	65,736	201	17,941	3,665	100	57	0	87,600
22	61,898	201	18,229	3,665	99	0	0	84,550
23	58,113	201	18,570	3,665	109	0	196	81,050
24	53,800	201	18,658	3,680	103	0	298	77,650
25	48,696	201	18,804	3,700	102	150	57	72,930
26	44,009	201	18,644	3,685	98	172	65	67,780
27	40,647	201	18,397	3,695	98	190	46	62,870
28	38,730	201	17,749	3,641	106	141	64	60,400
29	43,688	201	17,094	3,593	96	156	64	57,260
30	58,266	201	16,854	3,589	97	225	61	62,010
TOTAL	1,830,201	6,030	593,934	99,951	2,908	4,426	1,019	2,693,480
AVERAGE	61,007	201	19,798	3,332	97	148	34	89,783

Appendix G. Delta outflow (in cfs): January -- July 1995.

MAY 1995

Date	Sacramento River at Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation Dist.	Delta Outflow Index
1	69,327	197	16,886	3,156	98	428	47	78,810
2	78,435	197	17,359	2,890	97	692	36	98,690
3	84,163	197	17,834	2,892	90	836	51	138,100
4	85,573	197	18,876	2,877	92	689	27	170,850
5	87,852	197	20,939	2,904	93	899	40	174,370
6	88,522	197	21,743	2,864	95	894	0	170,020
7	85,518	197	22,217	2,847	97	1,288	25	165,580
8	83,982	197	22,354	2,865	99	940	93	147,950
9	82,147	197	22,360	2,264	96	0	49	136,370
10	79,296	197	22,588	2,615	87	1,527	55	124,960
11	77,181	197	22,899	2,614	102	1,996	51	113,810
12	76,513	197	22,851	2,703	106	1,870	60	107,630
13	74,044	197	22,826	2,746	102	1,827	51	102,590
14	72,740	197	22,919	2,750	111	1,827	51	97,820
15	70,434	197	22,843	2,797	116	0	51	98,120
16	67,081	197	22,818	2,885	106	0	73	95,470
17	62,193	197	22,990	3,387	123	0	83	91,090
18	56,503	197	23,121	3,638	117	0	94	86,030
19	51,348	197	23,191	3,630	128	2,026	162	78,390
20	47,760	197	23,063	3,643	126	2,016	152	73,330
21	46,398	197	23,419	3,633	122	2,018	101	69,720
22	43,251	197	23,416	2,784	103	2,020	68	69,530
23	42,820	197	23,410	2,048	126	1,272	56	67,700
24	41,632	197	23,491	2,726	115	0	53	67,740
25	41,484	197	23,422	3,016	125	1,004	49	65,130
26	43,500	197	23,095	3,062	133	1,006	89	64,420
27	46,086	197	23,061	3,041	135	2,819	61	64,190
28	46,629	197	23,146	3,043	142	2,920	76	66,530
29	47,327	197	23,121	3,508	149	2,517	81	66,990
30	47,467	197	22,849	3,529	157	2,534	95	67,530
31	46,921	197	22,379	3,345	154	2,045	41	67,960
TOTAL	1,974,127	6,107	687,486	92,706	3,542	39,910	2,019	3,087,420
AVERAGE	63,682	197	22,177	2,991	114	1,287	65	99,594

Appendix G. Delta outflow (in cfs): January -- July 1995.

JULY 1995

Date	Sacramento River at Freeport	Sacramento Treatment Plant	San Joaquin River Near Vernalis	Tracy Pump	Contra Costa Pump	Clifton Court Forebay Inflow	Byron-Bethany Irrigation Dist.	Delta Outflow Index
1	38,361	199	5,950	4,441	175	5,938	94	36,050
2	36,007	199	5,900	4,439	158	5,266	76	36,070
3	35,848	199	6,948	4,484	162	3,976	73	34,680
4	33,885	199	6,948	4,488	151	4,579	76	34,670
5	32,640	199	7,961	4,457	146	4,213	62	32,840
6	32,400	199	8,807	4,447	159	4,399	70	32,200
7	31,540	199	9,685	4,444	155	4,863	89	32,010
8	29,297	199	10,283	4,461	156	7,265	88	29,430
9	26,882	199	11,632	4,461	157	6,687	88	28,160
10	28,021	199	12,675	4,468	163	5,619	42	28,070
11	29,257	199	13,823	4,495	171	6,267	84	29,400
12	29,248	199	15,763	4,495	173	6,952	78	31,100
13	27,036	199	17,150	4,493	169	6,724	66	33,210
14	26,056	199	18,060	4,495	104	6,491	99	32,750
15	24,927	199	18,786	4,473	179	6,636	76	32,520
16	22,957	199	18,304	4,483	181	6,722	96	32,030
17	30,491	199	17,299	4,434	192	6,724	79	29,540
18	46,559	199	16,212	4,515	195	6,724	83	36,000
19	44,890	199	13,797	4,478	196	5,370	104	52,410
20	40,365	199	11,118	4,577	184	6,663	70	46,870
21	37,762	199	9,113	4,554	179	6,526	59	39,800
22	34,467	199	8,397	4,544	131	6,455	75	35,140
23	30,828	199	8,364	4,522	184	6,686	76	30,610
24	29,835	199	8,210	4,498	180	6,666	53	26,700
25	27,196	199	7,605	4,520	178	6,725	59	25,390
26	25,692	199	6,942	4,538	184	6,058	60	22,510
27	24,177	199	6,132	4,548	191	6,428	88	20,230
28	32,122	199	5,245	3,816	187	5,888	53	19,160
29	22,000	199	4,404	4,519	183	5,650	52	16,770
30	22,000	199	4,104	4,501	190	6,554	101	14,100
31	20,176	199	3,597	4,516	194	4,783	54	15,410
TOTAL	952,922	6,169	319,214	138,608	5,308	186,501	2,322	945,830
AVERAGE	30,739	199	10,297	4,471	171	6,016	75	30,511

Appendix H. Water quality parameters measured in Mokelumne River and Lake Lodi: May 30 through July 24, 1995.

River Mile, Depth	Date, mm/dd/yy	Time, hh/mm	Temp, Deg F	pH, units	SpCond, uS/cm	DO, mg/l	Redox, mV
RM38.5-S	05/30/95	1235	56.7	7.18	43.4	10.35	395
RM38.6-S	05/30/95	1225	55.5	7.09	43.4	9.96	398
-3	05/30/95	1225	55.7	7.06	43.4	9.91	399
-6	05/30/95	1225	55.4	7.05	43.4	9.9	399
-9	05/30/95	1225	55.4	7.05	43.4	9.91	398
-12	05/30/95	1225	55.4	7.06	43.4	9.9	399
-15	05/30/95	1225	55.4	7.8	43.3	9.89	398
RM39.0L-S	05/30/95	1218	55.6	7.08	43.3	9.9	402
-3	05/30/95	1218	55.4	7.06	43.3	9.91	402
-6	05/30/95	1218	55.4	7.05	43.2	9.92	403
-9	05/30/95	1218	55.4	7.06	43.3	9.91	402
RM39.0R-S	05/30/95	1210	55.3	7.12	43.2	9.92	403
-3	05/30/95	1210	55.3	7.09	43.3	9.89	404
-6	05/30/95	1210	55.3	7.05	43.3	9.9	404
-9	05/30/95	1210	55.3	7.06	43.2	9.89	405
-12	05/30/95	1210	55.3	7.07	43.2	9.88	406
-15	05/30/95	1210	55.2	7.07	43.3	9.9	405
RM39.9-S	05/30/95	1200	55.1	7.12	43.2	9.9	412
-3	05/30/95	1200	55.1	7.09	43.3	9.9	412
-6	05/30/95	1200	55.1	7.08	43.1	9.91	413
-9	05/30/95	1200	55.1	7.09	43.1	9.91	413
-12	05/30/95	1200	55.1	7.09	43.2	9.9	412
RM40.75-S	05/30/95	1153	55.1	7.17	43.2	9.93	432
-3	05/30/95	1153	55.0	7.13	43.2	9.89	431
-6	05/30/95	1153	55.0	7.09	43.3	9.92	429
-9	05/30/95	1153	55.0	7.09	43.2	9.91	430
RM41.3-S	05/30/95	1145	54.9	7.19	43.2	9.94	425
-3	05/30/95	1145	54.9	7.15	43.2	9.92	424
-6	05/30/95	1145	54.9	7.12	43.1	9.93	423
-9	05/30/95	1145	54.9	7.11	43.1	9.93	420
RM42.3-S	05/30/95	1140	54.7	7.11	43.2	10.08	406
-3	05/30/95	1140	54.7	7.12	43.2	9.94	405
-6	05/30/95	1140	54.7	7.08	43.1	9.95	404
-9	05/30/95	1140	54.7	7.08	43.1	9.95	402

Appendix H. **Water quality parameters measured in Mokelumne River and Lake Lodi: May 30 through July 24, 1995.**

River Mile, Depth	Date, mm/dd/yy	Time, hh/mm	Temp, Deg F	pH, units	SpCond, uS/cm	DO, mg/l	Redox, mV
RM43.25-S	05/30/95	1130	54.6	7.25	42.8	10.2	405
-3	05/30/95	1130	54.6	7.14	43.1	10.19	404
-6	05/30/95	1130	54.6	7.12	43.1	10.06	406
RM38.5-S	06/12/95	1711	58.3	7.05	45.1	10.45	387
RM38.6-S	06/12/95	1708	57.7	6.97	44.1	10.09	387
-3	06/12/95	1708	57.7	6.87	44.9	9.99	390
-6	06/12/95	1708	57.6	6.87	44.9	9.92	389
-9	06/12/95	1708	57.6	6.87	44.9	9.97	388
-12	06/12/95	1708	57.6	6.87	44.8	9.9	387
-15	06/12/95	1708	57.5	6.88	44.8	9.92	387
RM39.0L-S	06/12/95	1657	57.7	6.93	45.1	10.17	387
-3	06/12/95	1657	58.7	6.9	45	10.13	387
-6	06/12/95	1657	57.4	6.93	45.1	10	387
-9	06/12/95	1657	57.4	6.97	44.9	9.91	388
RM39.0R-S	06/12/95	1645	57.3	6.92	45.1	10.03	391
-3	06/12/95	1645	57.3	6.85	44.9	9.97	392
-6	06/12/95	1645	57.3	6.85	44.9	9.94	390
-9	06/12/95	1645	57.3	6.88	44.9	9.87	389
-12	06/12/95	1645	57.3	6.87	44.8	9.88	389
RM39.9-S	06/12/95	1635	57.4	6.92	44.9	10.12	389
	06/12/95	1645	57.3	6.9	44.9	10.06	390
-3	06/12/95	1645	57.3	6.89	44.7	9.99	390
-6	06/12/95	1645	57.2	6.94	45.3	10.01	389
-9	06/12/95	1645	57.2	6.91	45	9.94	389
RM40.75-S	06/12/95	1630	57.1	6.87	44.9	10.1	390
-3	06/12/95	1630	57.1	6.85	44.9	9.96	389
	06/12/95	1630	57.1	6.85	44.9	9.89	387
RM41.3-S	06/12/95	1624	57.1	6.9	44.8	10.11	386
-3	06/12/95	1624	57.1	6.85	44.7	9.97	391
-6	06/12/95	1624	57.0	6.87	44.7	9.95	390
-9	06/12/95	1624	57.0	6.88	44.7	9.95	388
RM42.3-S	06/12/95	1619	56.9	6.93	45	10.12	409
-3	06/12/95	1619	56.9	6.88	44.7	10	407
-6	06/12/95	1619	56.8	6.88	44.7	10.04	403
-9	06/12/95	1619	56.8	6.89	44.7	9.97	399

Appendix H. **Water quality parameters measured in Mokelumne River and Lake Lodi: May 30 through July 24, 1995.**

River Mile, Depth	Date, mm/dd/yy	Time, hh/mm	Temp, Deg F	pH, units	SpCond, uS/cm	DO, mg/l	Redox, mV
RM43.25-S	06/12/95	1613	56.8	6.99	44.7	10.28	432
-3	06/12/95	1613	56.7	6.93	44.6	10.08	430
-6	06/12/95	1613	56.7	6.92	44.6	10.02	427
RM38.5-S	06/26/95	1210	58.5	6.83	38.4	10.59	380
RM38.6-S	06/26/95	1152	58.5	6.82	38.3	10.16	391
-3	06/26/95	1152	58.4	6.82	38.4	10.15	389
-6	06/26/95	1152	58.4	6.83	38.3	10.16	388
-9	06/26/95	1152	58.3	6.85	38.3	10.18	386
-12	06/26/95	1152	58.3	6.86	38.3	10.16	386
-15	06/26/95	1152	58.3	6.87	38.2	10.15	385
RM39.0L-S	06/26/95	1149	59.2	6.84	38.5	10.16	397
-3	06/26/95	1149	59.2	6.84	38.5	10.16	397
-6	06/26/95	1149	58.7	6.83	35.4	10.22	396
-9	06/26/95	1149	58.7	6.85	38.4	10.13	394
RM39.0R-S	06/26/95	1144	58.3	6.83	38.4	10.21	405
-3	06/26/95	1144	58.3	6.85	38.4	10.19	402
-6	06/26/95	1144	58.3	6.85	38.4	10.17	401
-9	06/26/95	1144	58.3	6.85	38.3	10.17	397
-12	06/26/95	1144	58.2	6.86	38.1	10.18	399
-15	06/26/95	1144	58.3	6.85	38.2	10.19	401
RM39.9-S	06/26/95	1140	58.2	6.88	38.2	10.2	422
-3	06/26/95	1140	58.1	6.84	38.2	10.19	421
-6	06/26/95	1140	58.1	6.85	38	10.19	419
-9	06/26/95	1140	58.1	6.85	38.1	10.2	418
-12	06/26/95	1140	58.1	6.86	38	10.19	419
RM40.75-S	06/26/95	1135	58.0	6.86	33.8	10.21	417
-3	06/26/95	1135	58.0	6.85	38	10.24	418
-6	06/26/95	1135	58.0	6.86	38	10.23	411
-9	06/26/95	1135	57.9	6.87	38.1	10.23	413
RM41.3-S	06/26/95	1130	57.8	6.92	37.9	10.26	424
-3	06/26/95	1130	57.8	6.89	37.9	10.27	423
-6	06/26/95	1130	57.8	6.87	37.9	10.26	418
-9	06/26/95	1130	57.8	8.88	37.8	10.27	419
RM42.3-S	06/26/95	1122	57.7	6.93	37.7	10.3	431

Appendix H. **Water quality parameters measured in Mokelumne River and Lake Lodi: May 30 through July 24, 1995.**

River Mile, Depth	Date, mm/dd/yy	Time, hh/mm	Temp, Deg F	pH, units	SpCond, uS/cm	DO, mg/l	Redox, mV
-3	06/26/95	1122	57.7	6.94	37.9	10.28	427
-6	06/26/95	1122	57.7	6.93	37.6	10.29	423
-9	06/26/95	1122	57.7	6.94	37.8	10.28	423
RM43.25-S	06/26/95	1115	57.6	7.04	37.7	10.26	413
-3	06/26/95	1115	57.5	7.03	37.6	10.27	411
-6	06/26/95	1115	57.5	7.02	37.7	10.26	409
RM38.5-S	07/07/95	1100	59.6	7.38	41.5	10.13	442
RM38.6-S	07/07/95	1231	59.3	7.17	41.6	9.76	398
-3	07/07/95	1231	59.2	7.04	41.2	9.7	402
-6	07/07/95	1231	59.2	7.03	41.2	9.67	403
-9	07/07/95	1231	59.1	7.03	41	9.65	403
-12	07/07/95	1231	59.1	6.99	40.1	9.71	400
-15	07/07/95	1231	58.9	7.03	41.2	9.63	398
RM39.0L-S	07/07/95	1225	60.5	7.09	41.8	9.84	400
-3	07/07/95	1225	60.3	7.03	41.3	9.67	401
-6	07/07/95	1225	60.1	7.02	41.1	9.64	401
-9	07/07/95	1225	59.1	7.03	40.6	9.55	401
RM39.0R-S	07/07/95	1220	58.7	7.2	41.3	9.74	410
-3	07/07/95	1220	58.7	7.03	40.6	9.7	412
-6	07/07/95	1220	58.7	7.01	40.6	9.65	412
-9	07/07/95	1220	58.7	7	40	9.61	412
-12	07/07/95	1220	58.7	7	39.9	9.58	411
-15	07/07/95	1220	58.7	7.01	40.2	9.55	410
RM39.9-S	07/07/95	1208	58.4	7.13	40.1	9.8	405
-3	07/07/95	1208	58.4	7.04	40	9.66	408
-6	07/07/95	1208	58.4	7	40	9.61	409
-9	07/07/95	1208	58.4	6.99	39.9	9.59	409
-12	07/07/95	1208	58.4	7	40.1	9.63	404
RM40.75-S	07/07/95	1159	58.2	7.12	39.8	9.76	403
-3	07/07/95	1159	58.2	7.05	39.5	9.7	405
-6	07/07/95	1159	58.2	7	39.5	9.64	406
-9	07/07/95	1159	58.2	6.97	39.8	9.61	407
RM41.3-S	07/07/95	1149	58.1	7.13	39.9	9.79	404
-3	07/07/95	1149	58.0	7.01	39.3	9.61	408
-6	07/07/95	1149	58.0	7.02	39.4	9.6	408

Appendix H. Water quality parameters measured in Mokelumne River and Lake Lodi: May 30 through July 24, 1995.

River Mile, Depth	Date, mm/dd/yy	Time, hh/mm	Temp, Deg F	pH, units	SpCond, uS/cm	DO, mg/l	Redox, mV
-9	07/07/95	1149	58.0	6.98	40.2	9.56	407
RM42.3-S	07/07/95	1139	58.0	7.2	40.7	9.73	405
-3	07/07/95	1139	57.9	7.05	40.3	9.7	410
-6	07/07/95	1139	57.9	7.01	40.1	9.64	410
-9	07/07/95	1139	57.8	7	39.9	9.59	405
RM43.25-S	07/07/95	1128	57.8	7.17	40.2	9.63	416
-3	07/07/95	1128	57.7	7.07	39.8	9.61	419
-6	07/07/95	1128	57.7	7.05	39.8	9.56	418
RM-38.5-S	07/14/95	1442	61.4	7.05	38.4	10.07	419
RM-38.6-S	07/14/95	1434	60.5	6.93	38.6	9.75	408
-3	07/14/95	1434	60.4	6.82	38.2	9.68	410
-6	07/14/95	1434	60.4	6.8	38.1	9.65	409
-9	07/14/95	1434	60.2	6.8	38.1	9.62	409
-12	07/14/95	1434	60.2	6.81	38	9.62	408
-15	07/14/95	1434	60.1	6.8	38	9.62	408
RM-39.0L-S	07/14/95	1427	61.9	6.83	38.8	9.8	410
-3	07/14/95	1427	62.1	6.83	39.1	9.8	409
-6	07/14/95	1427	61.1	6.83	38.3	9.66	409
-9	07/14/95	1427	60.9	6.81	38.2	9.62	408
RM-39.0R-S	07/14/95	1418	60.1	6.88	38.5	9.7	406
-3	07/14/95	1418	60.0	6.81	38.4	9.64	407
-6	07/14/95	1418	60.0	6.79	38.1	9.61	407
-9	07/14/95	1418	60.0	6.79	38.1	9.59	407
-12	07/14/95	1418	60.0	6.79	38	9.58	406
-15	07/14/95	1418	60.0	6.79	38.2	9.57	404
RM39.9S	07/14/95	1404	59.8	6.86	38.4	9.64	418
-3	07/14/95	1404	59.8	6.79	38.1	9.6	412
-6	07/14/95	1404	59.8	6.77	38.1	9.6	412
-9	07/14/95	1404	59.8	6.77	38	9.59	412
-12	07/14/95	1404	59.8	6.77	38	9.58	411
RM40.75-S	07/14/95	1356	59.6	6.87	37.9	9.69	415
-3	07/14/95	1356	59.6	6.79	37.8	9.56	413
-6	07/14/95	1356	59.6	6.77	37.7	9.45	412
-9	07/14/95	1356	59.6	6.78	37.9	9.58	408

Appendix H. Water quality parameters measured in Mokelumne River and Lake Lodi: May 30 through July 24, 1995.

River Mile, Depth	Date, mm/dd/yy	Time, hh/mm	Temp, Deg F	pH, units	SpCond, uS/cm	DO, mg/l	Redox, mV
RM-41.3-S	07/14/95	1347	59.5	6.84	37.8	9.73	408
-3	07/14/95	1347	59.4	6.79	37.9	9.67	407
-6	07/14/95	1347	59.4	6.78	37.7	9.64	405
-9	07/14/95	1347	59.4	6.79	37.6	9.59	404
RM-42.3-S	07/14/95	1334	59.4	6.91	38	9.73	376
-3	07/14/95	1334	59.3	6.85	38	9.64	376
-6	07/14/95	1334	59.3	6.82	37.8	9.53	370
-9	07/14/95	1334	59.3	6.8	37.7	9.49	370
RM-43.25-S	07/14/95	1325	59.2	7.12	38.4	9.78	392
-3	07/14/95	1325	59.2	7.04	37.9	9.71	398
-6	07/14/95	1325	59.2	7	37.8	9.67	399
RM-38.5-S	07/24/96	1516	62.7	7.1	38.7	9.89	428
RM-38.6-S	07/24/96	1500	62.8	7.03	38.8	9.43	387
-3	07/24/96	1500	62.5	6.96	38.5	9.35	388
-6	07/24/96	1500	62.2	6.94	38.4	9.35	389
-9	07/24/96	1500	62.1	6.93	38.2	9.34	389
-12	07/24/96	1500	62.1	6.92	38.1	9.33	389
-15	07/24/96	1500	62.0	6.92	38.3	9.34	389
RM-39.0L-S	07/24/96	1442	62.9	6.91	38.5	9.47	379
-3	07/24/96	1442	63.0	6.91	38.4	9.49	379
-6	07/24/96	1442	62.8	6.91	38.6	9.44	380
-9	07/24/96	1442	62.6	6.91	38.4	9.41	380
RM-39.0R-S	07/24/96	1431	61.8	6.99	38.6	9.43	381
-3	07/24/96	1431	61.8	6.93	38.3	9.38	383
-6	07/24/96	1431	61.8	6.89	38.3	9.34	383
-9	07/24/96	1431	61.8	6.89	38.3	9.31	383
-12	07/24/96	1431	61.8	6.9	38.3	9.29	383
-15	07/24/96	1442	61.8	6.9	38.3	9.3	382
RM-39.9-S	07/24/96	1422	61.4	7.03	38.8	9.48	379
-3	07/24/96	1422	61.4	6.89	38.3	9.41	386
-6	07/24/96	1422	61.3	6.89	38.2	9.37	386
-9	07/24/96	1422	61.4	6.91	38.3	9.4	384
RM-40.75-S	07/24/96	1415	61.0	6.96	38.5	9.48	384
-3	07/24/96	1415	61.0	6.88	38.2	9.34	388
-6	07/24/96	1415	61.0	6.85	38.1	9.31	389

Appendix H. Water quality parameters measured in Mokelumne River and Lake Lodi: May 30 through July 24, 1995.

River Mile, Depth	Date, mm/dd/yy	Time, hh/mm	Temp, Deg F	pH, units	SpCond, uS/cm	DO, mg/l	Redox, mV
-9	07/24/96	1415	61.1	6.85	38.1	9.3	389
RM-41.3-S	07/24/96	1401	60.9	6.92	37.8	9.39	396
-3	07/24/96	1401	60.8	6.85	37.6	9.36	398
-6	07/24/96	1401	60.8	6.85	37.7	9.34	398
-9	07/24/96	1401	60.8	6.85	37.7	9.29	397
RM-42.3-S	07/24/96	1345	60.5	6.91	37.9	9.48	422
-3	07/24/96	1345	60.5	6.86	37.9	9.37	423
-6	07/24/96	1345	60.5	6.86	37.6	9.32	423
-9	07/24/96	1345	60.5	6.83	37.6	9.32	424
RM-43.25-S	07/24/96	1337	60.4	7.02	37.8	9.51	438
-3	07/24/96	1337	60.4	6.9	37.5	9.43	442
-6	07/24/96	1337	60.4	6.88	37.4	9.36	441

Appendix I. Fall chinook smolt physiology data: 1995.

Location	Date	Fish No.	FL, mm	TL, mm	WT, g	K	Sp Act.
UPSHAB	02/17/95	1	38	40	0.5	7.81E-04	3.92
UPSHAB	02/17/95	2	37	39	0.3	5.06E-04	3.38
UPSHAB	02/17/95	3	38	40	0.5	7.81E-04	3.10
UPSHAB	02/17/95	4	38	40	0.5	7.81E-04	2.35
UPSHAB	02/17/95	5	40	42	0.4	5.40E-04	2.44
UPSHAB	02/17/95	6	33	35	0.2	4.66E-04	4.37
UPSHAB	02/17/95	7	41	43	0.6	7.55E-04	
UPSHAB	02/17/95	8	38	40	0.5	7.81E-04	
UPSHAB	02/17/95	9	50	52	1.0	7.11E-04	
UPSHAB	02/17/95	10	38	40	0.3	4.69E-04	
UPSHAB	02/17/95	11	42	44	0.6	7.04E-04	
UPSHAB	02/17/95	12	37	39	0.4	6.74E-04	
UPSHAB	02/17/95	13	38	39	0.5	8.43E-04	
UPSHAB	02/17/95	14	48	50	0.9	7.20E-04	
UPSHAB	02/17/95	15	38	40	0.5	7.81E-04	
UPSHAB	02/17/95	16	41	44	0.6	7.04E-04	
UPSHAB	02/17/95	17	42	44	0.6	7.04E-04	
UPSHAB	02/17/95	18	38	40	0.4	6.25E-04	
UPSHAB	02/17/95	19	37	39	0.5	8.43E-04	
UPSHAB	02/17/95	20	37	39	0.4	6.74E-04	
UPSHAB	02/17/95	21	33	35	0.4	9.33E-04	
UPSHAB	02/17/95	22	35	37	0.4	7.90E-04	
UPSHAB	02/17/95	23	41	43	0.5	6.29E-04	
UPSHAB	02/17/95	24	39	41	0.6	8.71E-04	
UPSHAB	02/17/95	25	37	39	0.4	6.74E-04	
UPSHAB	02/17/95	26	43	45	0.7	7.68E-04	
UPSHAB	02/17/95	27	37	39	0.4	6.74E-04	
UPSHAB	02/17/95	28	36	38	0.3	5.47E-04	
UPSHAB	02/17/95	29	37	39	0.3	5.06E-04	
UPSHAB	02/17/95	30	36	38	0.4	7.29E-04	
UPSHAB	02/17/95	31	37	39	0.4	6.74E-04	
WIDD	02/17/95	1	37	39	0.4	6.74E-04	4.22
WIDD	02/17/95	2	49	52	1.0	7.11E-04	3.47
WIDD	02/17/95	3	38	40	0.4	6.25E-04	4.42
WIDD	02/17/95	4	38	40	0.5	7.81E-04	3.82
WIDD	02/17/95	5	37	35	0.3	7.00E-04	3.34
WIDD	02/17/95	6	36	38	0.3	5.47E-04	3.19
UPSHAB	03/04/95	1	42	40	0.5	7.81E-04	0.94
UPSHAB	03/04/95	2	38	40	0.4	6.25E-04	3.20
UPSHAB	03/04/95	3	40	38	0.4	7.29E-04	1.78
UPSHAB	03/04/95	4	38	40	0.3	4.69E-04	1.96
UPSHAB	03/04/95	5	38	41	0.4	5.80E-04	2.56
UPSHAB	03/04/95	6	37	35	0.4	9.33E-04	3.26
UPSHAB	03/04/95	7	40	38	0.4	7.29E-04	4.22
UPSHAB	03/04/95	8	45	42	0.7	9.45E-04	1.93
UPSHAB	03/04/95	9	40	38	0.4	7.29E-04	1.12
UPSHAB	03/04/95	10	40	38	0.4	7.29E-04	1.85
WIDD	03/05/95	1	40	38	0.5	9.11E-04	3.66
WIDD	03/05/95	2	38	36	0.4	8.57E-04	3.55
WIDD	03/05/95	3	40	38	0.4	7.29E-04	6.00
WIDD	03/05/95	4	58	54	1.4	8.89E-04	1.03
WIDD	03/05/95	5	38	36	0.3	6.43E-04	0.29
WIDD	03/05/95	6	40	38	0.4	7.29E-04	2.87
WIDD	03/05/95	7	38	36	0.3	6.43E-04	2.62
WIDD	03/05/95	8	41	39	0.4	6.74E-04	3.45
WIDD	03/05/95	9	38	36	0.4	8.57E-04	0.54
WIDD	03/05/95	10	37	35	0.4	9.33E-04	2.44
UPSHAB	03/19/95	1	44	46	0.6	6.16E-04	2.65

Appendix I. Fall chinook smolt physiology data: 1995.

Location	Date	Fish No.	FL, mm	TL, mm	WT, g	K	Sp Act.
UPSHAB	03/19/95	2	45	47	0.9	8.67E-04	2.21
UPSHAB	03/19/95	3	42	45	0.6	6.58E-04	3.04
UPSHAB	03/19/95	4	36	34	0.4	1.02E-03	4.47
UPSHAB	03/19/95	5	42	40	0.5	7.81E-04	2.27
UPSHAB	03/20/95	6	42	40	0.6	9.38E-04	2.63
UPSHAB	03/20/95	7	39	37	0.4	7.90E-04	3.30
UPSHAB	03/20/95	8	39	37	0.5	9.87E-04	3.18
UPSHAB	03/20/95	9	42	40	0.5	7.81E-04	2.54
UPSHAB	03/20/95	10	39	37	0.4	7.90E-04	2.87
WIDD	03/18/95	1	44	47	0.9	8.67E-04	2.13
WIDD	03/20/95	2	57	61	1.9	8.37E-04	3.14
WIDD	03/20/95	3	68	74	3.3	8.14E-04	3.41
WIDD	03/20/95	4	67	71	3.7	1.03E-03	3.35
WIDD	03/20/95	5	61	65	2.3	8.38E-04	4.73
WIDD	03/20/95	6	56	62	1.7	7.13E-04	4.34
WIDD	03/20/95	7	57	61	1.9	8.37E-04	4.12
WIDD	03/20/95	8	55	58	1.6	8.20E-04	2.20
WIDD	03/20/95	9	42	44	0.6	7.04E-04	3.46
WIDD	03/20/95	10	65	70	2.8	8.16E-04	4.07
WIDD	03/20/95	11	72	78	3.8	8.01E-04	4.24
UPSHAB	04/01/95	1	35	36	0.3	6.43E-04	1.64
UPSHAB	04/01/95	2	36	38	0.5	9.11E-04	2.26
UPSHAB	04/01/95	3	39	41	0.5	7.25E-04	2.29
UPSHAB	04/01/95	4	50	53	1.2	8.06E-04	3.19
UPSHAB	04/01/95	5	39	40	0.4	6.25E-04	4.99
UPSHAB	04/03/95	6	44	47	0.5	4.82E-04	3.90
UPSHAB	04/03/95	7	35	37	0.3	5.92E-04	4.81
UPSHAB	04/03/95	8	38	40	0.5	7.81E-04	2.24
WIDD	03/31/95	1	55	59	1.4	6.82E-04	1.91
WIDD	03/31/95	2	82	90	6.0	8.23E-04	5.36
WIDD	03/31/95	3	37	39	0.4	6.74E-04	2.93
WIDD	03/31/95	4	60	64	2.3	8.77E-04	4.80
WIDD	03/31/95	5	61	65	2.2	8.01E-04	5.10
WIDD	03/31/95	6	73	79	4.1	8.32E-04	3.50
WIDD	03/31/95	7	35	37	0.3	5.92E-04	4.99
WIDD	03/31/95	8	68	73	3.2	8.23E-04	7.54
WIDD	03/31/95	9	87	95	7.1	8.28E-04	4.87
WIDD	03/31/95	10	69	75	3.6	8.53E-04	4.50
UPSHAB	04/19/95	1	65	71	3.7	1.03E-03	2.18
UPSHAB	04/19/95	2	69	75	3.7	8.77E-04	2.43
UPSHAB	04/19/95	3	75	81	4.5	8.47E-04	1.31
UPSHAB	04/19/95	4	57	63	2.0	8.00E-04	2.27
UPSHAB	04/19/95	5	69	74	3.8	9.38E-04	1.59
UPSHAB	04/19/95	6	59	63	2.2	8.80E-04	3.33
WIDD	04/18/95	1	77	84	6.0	1.01E-03	2.94
WIDD	04/18/95	2	85	93	8.0	9.95E-04	2.32
WIDD	04/18/95	3	72	78	4.0	8.43E-04	2.32
WIDD	04/18/95	4	74	80	4.0	7.81E-04	3.39
WIDD	04/18/95	5	79	86	4.0	6.29E-04	2.21
WIDD	04/18/95	6	94	102	8.0	7.54E-04	0.89
WIDD	04/18/95	7	86	95	6.0	7.00E-04	1.54
WIDD	04/18/95	8	66	72	3.0	8.04E-04	2.88
WIDD	04/18/95	9	82	90	6.0	8.23E-04	3.31
WIDD	04/18/95	10	69	74	3.0	7.40E-04	4.96
UPSHAB	05/02/95	1	86	92	7.9	1.01E-03	0.81
UPSHAB	05/02/95	2	83	89	6.8	9.65E-04	1.20
UPSHAB	05/02/95	3	70	75	3.5	8.30E-04	2.47
UPSHAB	05/02/95	4	80	87	5.5	8.35E-04	2.14

Appendix I. Fall chinook smolt physiology data: 1995.

Location	Date	Fish No.	FL, mm	TL, mm	WT, g	K	Sp Act.
UPSHAB	05/02/95	5	71	78	4.0	8.43E-04	1.05
UPSHAB	05/02/95	6	72	77	4.0	8.76E-04	2.25
UPSHAB	05/02/95	7	64	70	3.0	8.75E-04	3.57
WIDD	05/01/95	1	91	99	8.3	8.55E-04	2.89
WIDD	05/01/95	2	84	91	6.6	8.76E-04	2.21
WIDD	05/01/95	3	81	87	4.9	7.44E-04	3.02
WIDD	05/01/95	4	93	99	9.5	9.79E-04	1.52
WIDD	05/01/95	5	75	83	4.3	7.52E-04	3.39
WIDD	05/02/95	6	94	102	8.9	8.39E-04	2.58
UPSHAB	05/18/95	1	81	88	6.3	9.24E-04	1.95
UPSHAB	05/18/95	2	93	101	8.8	8.54E-04	4.38
UPSHAB	05/18/95	3	84	90	6.7	9.19E-04	4.12
UPSHAB	05/18/95	4	93	101	8.1	7.86E-04	3.36
UPSHAB	05/18/95	5	92	101	8.9	8.64E-04	2.43
UPSHAB	05/18/95	6	90	99	8.4	8.66E-04	3.88
UPSHAB	05/18/95	7	84	91	6.4	8.49E-04	4.16
WIDD	05/16/95	1	101	111	11.0	8.04E-04	0.84
WIDD	05/16/95	2	101	111	10.2	7.46E-04	2.29
WIDD	05/16/95	3	90	100	7.9	7.90E-04	2.48
WIDD	05/16/95	4	99	108	10.8	8.57E-04	2.78
WIDD	05/16/95	5	99	108	10.9	8.65E-04	5.24
WIDD	05/16/95	6	104	114	11.7	7.90E-04	3.14
WIDD	05/16/95	7	100	111	11.3	8.26E-04	1.76
WIDD	05/16/95	8	101	111	11.0	8.04E-04	1.73
WIDD	05/16/95	9	100	111	11.1	8.12E-04	0.91
WIDD	05/16/95	10	95	104	11.2	9.96E-04	2.17
UPSHAB	06/05/95	1	79	84	4.5	7.59E-04	2.49
UPSHAB	06/05/95	2	100	110	12.0	9.02E-04	3.81
UPSHAB	06/05/95	3	80	84	4.7	7.93E-04	4.76
UPSHAB	06/05/95	4	89	97	6.5	7.12E-04	5.14
UPSHAB	06/05/95	5	96	106	11.4	9.57E-04	1.98
UPSHAB	06/05/95	6	85	92	5.9	7.58E-04	2.39
UPSHAB	06/05/95	7	102	113	11.7	8.11E-04	1.99
UPSHAB	06/05/95	8	99	109	12.0	9.27E-04	3.63
UPSHAB	06/05/95	9	100	111	12.5	9.14E-04	2.81
UPSHAB	06/05/95	10	92	101	7.7	7.47E-04	2.32
WIDD	05/31/95	1	102	112	11.4	8.11E-04	3.30
WIDD	05/31/95	2	98	108	9.2	7.30E-04	2.45
WIDD	05/31/95	3	100	110	11.1	8.34E-04	4.83
WIDD	05/31/95	4	111	123	15.5	8.33E-04	1.27
WIDD	05/31/95	5	101	111	10.6	7.75E-04	4.08
WIDD	05/31/95	6	100	110	11.1	8.34E-04	5.16
WIDD	05/31/95	7	101	110	11.0	8.26E-04	3.01
WIDD	05/31/95	8	103	113	13.0	9.01E-04	4.15
WIDD	05/31/95	9	118	130	17.0	7.74E-04	2.14
WIDD	06/27/95	1	115	127	17.6	8.59E-04	3.09
WIDD	06/27/95	2	118	130	19.6	8.92E-04	3.70
WIDD	06/27/95	3	116	127	18.4	8.98E-04	3.64
WIDD	06/27/95	4	111	121	15.3	8.64E-04	2.24
WIDD	06/27/95	5	120	132	19.2	8.35E-04	1.96
WIDD	06/27/95	6	114	125	18.7	9.57E-04	1.92
WIDD	06/27/95	7	118	130	19.1	8.69E-04	3.68
UPSHAB	06/19/95	1	102	111	13.0	9.51E-04	0.71
WIDD	06/13/95	1	100	110	10.0	7.51E-04	1.71
WIDD	06/13/95	2	102	112	10.4	7.40E-04	1.50
WIDD	06/13/95	3	105	117	12.7	7.93E-04	1.47
WIDD	06/13/95	4	102	112	11.6	8.26E-04	1.65
WIDD	06/13/95	5	110	120	13.6	7.87E-04	1.65

Appendix I. Fall chinook smolt physiology data: 1995.

Location	Date	Fish No.	FL, mm	TL, mm	WT, g	K	Sp Act.
WIDD	06/13/95	6	113	124	14.7	7.71E-04	2.26
WIDD	06/13/95	7	100	111	10.3	7.53E-04	2.18
WIDD	06/13/95	8	100	110	10.5	7.89E-04	3.39
WIDD	06/13/95	9	109	120	13.7	7.93E-04	1.46
WIDD	06/13/95	10	98	107	9.0	7.35E-04	2.89
WIDD	07/12/95	1	119	130	19.7	8.97E-04	4.15
WIDD	07/12/95	2	128	140	23.8	8.67E-04	3.78
WIDD	07/12/95	3	101	111	10.2	7.46E-04	7.12
WIDD	07/12/95	4	100	110	11.0	8.26E-04	7.07
WIDD	07/12/95	5	119	130	18.1	8.24E-04	3.21
WIDD	07/12/95	6	120	131	18.8	8.36E-04	4.60
WIDD	07/13/95	7	120	134	20.1	8.35E-04	2.43
WIDD	07/13/95	8	77	85	4.7	7.65E-04	2.08
WIDD	07/13/95	9	100	111	13.3	9.72E-04	2.84
WIDD	07/14/95	10	103	113	12.3	8.52E-04	6.77
WIDD	07/14/95	11	100	110	10.6	7.96E-04	6.20
WIDD	07/14/95	12	82	90	6.2	8.50E-04	3.48