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1995 PILOT REAL-TIME MONITORING PROGRAM: EVALUATION AND RECOMMENDATIONS

Prepared by:

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Technical Report 47

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Interagency Ecological Program for the San Francisco Bay/Delta Estuary

A Cooperative Program of:

California Department of Water Resources
State Water Resources Control Board
U.S. Bureau of Reclamation
U.S. Army Corps of Engineers

California Department of Fish and Game
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S. Environmental Protection Agency

National Marine Fisheries Service

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SUMMARY

A Real-Time Monitoring Program to help protect target species from entrainment and other effects of State Water Project and Central Valley Project operations in the southern delta while providing operational flexibility to the projects was an element of the "Principles for Agreement on Bay-Delta Standards" signed December 15, 1994, by the State of California, the Federal Government, and many local and regional water agencies and public interest groups.

To test the feasibility of a sustained program involving daily sampling, with field data converted to useful management information within 24 to 48 hours, the Interagency Ecological Program conducted a 2-month field test in May and June 1995. The pilot study focused on chinook salmon, delta smelt, and splittail, and involved 15 boats staffed by crews from 5 agencies conducting daily monitoring at 11 sites. The program included salvage monitoring at SWP and CVP pumping facilities. Data were compiled and reviewed by a team consisting of a senior biologist and four biologists. Data were summarized at least weekly by a Data Summary Team consisting of agency staff biologists.

Results

The pilot study demonstrated that logistical problems associated with sustained, daily sampling throughout the delta can be solved and a real-time monitoring effort can be accomplished by the Interagency Program. There were, however, significant direct and indirect costs associated with this work. The estimated cost of the 2-month real-time monitoring in 1995 was about $470,000. In addition, diverting equipment and staff to the Real-Time Monitoring Program forced delay or cancellation of more than 20 other work items.

The Real-Time Monitoring Program provided valuable information on the species that were monitored. Key preliminary conclusions include:

- Despite high Sacramento River flow, many chinook salmon entered Georgiana Slough. Although most migrated out of the central delta via Jersey Point, some moved farther into the southern delta.
- Despite high San Joaquin River flow, more salmon smolts entered Old River rather than continuing down the San Joaquin River.
- The majority of the delta smelt population remained outside the delta during May and June, probably due to high outflow during the sampling period.
- Large numbers of young-of-the-year splittail migrated from the San Joaquin River. Reasonable relationships were developed between the

catch of YOY splittail from Mossdale and salvage at the State Water Project and Central Valley Project.

- For salmon, there was no apparent relationship between catch and salvage at either facility. There was also no consistency in the size of the peaks or the timing of peaks at different sampling sites.

Questions remain regarding the effectiveness and usefulness of real-time monitoring as a management tool. This 1995 program was not designed to target winter-run chinook salmon; however information obtained from fall-run Coleman Hatchery smolts may help us understand juvenile salmon movement in the delta (including winter-run). The applicability of this type of real-time monitoring for managing low-abundance races (for example, winter-run) must be evaluated further. The manner by which fish move through the delta made pulses of salmon and splittail difficult to track. The difficulty may have been caused by the high outflow, efficiency of the sampling equipment, biology of sampled species, or a number of other factors. Pulses of splittail could be followed into the delta from the San Joaquin River but not beyond the Fay Island and Bacon Island sites. No pulses of young-of-the-year splittail were detected in the Sacramento River.

The Interagency Ecological Program formed a Project Work Team to develop and carry out the 1996 Real-Time Monitoring Program. The team includes representatives from member agencies, as well as stakeholders representing the California Urban Water Agencies/Agricultural working group, and the environmental community.

Recommendations

Because many questions need to be addressed before the effectiveness of real-time monitoring is demonstrated under a variety of hydrologic conditions, we recommend another pilot effort in 1996. This sampling should start early in the year to include winter-run salmon. However, because winter-run densities are so low, detecting these fish will be difficult. In addition to trying to follow pulses of fish through selected sites, the 1996 program should incorporate presence/absence scenarios into the decision-making process regarding additional sampling sites, sampling frequency, and export facility operations (particularly for species that are few in number). A draft proposal for 1996 real-time monitoring is found in Appendix A.

In addition to the above, the following specific changes, discussed in greater detail in the report, are recommended for the 1996 program:

- Staff should be assigned specifically to real-time monitoring. Three permanent biologists should be assigned to the data synthesis and summary work as well as most of the logistic planning. Temporary

employees should be hired and trained for all of the general field crew and part of the crew leaders, to reduce scheduling problems.

- To address the shortage of qualified boat operators, agencies should authorize overtime for boat operators and/or hire additional operators.
- Real-time monitoring efforts should be coordinated with other sampling programs (winter-run work and overall salmon program) to the greatest extent possible. A system should be developed for allocating expenses between the Real-Time Monitoring Program and other programs.
- At least three good reserve boats should be acquired and available for rapid deployment on a 7-day-a-week operation.
- Boats should be designed and built specifically for their assigned duties (midwater trawl or Kodiak trawl).
- Cellular phones should be acquired and allocated to the Real-Time Monitoring Program because they allow us to solve equipment and scheduling problems in a timely manner.
- A budget and accounting system should be developed so that the cost of "borrowed" equipment, personnel, and supplies is accounted for.
- The program needs to be formulated, equipped, and staffed so that other high-priority programs are not impacted.
- Before instituting the 1996 program, permit conditions should be reviewed to resolve the dilemma of "take" during sampling versus reduced take at the SWP and CVP facilities. An adaptive sampling methodology similar to the 1995 program should be developed and implemented.
- The data processing aspect of the 1996 program should be completely revised, with new data file structures and applications programs.
- The need to fax everything to the entire No-Name Group should be re-examined in light of the availability of e-mail.
- Additional analytical efforts should be directed toward investigating the effect of tide and time of day on catch; the level of effort needed to identify peaks or pulses of fish; the relationship, if any, between fish and flow; and understanding which chinook salmon smolts comprised those collected in the central delta based on the coded-wire-tagged smolts caught there. Some of this work has been completed, and the rest is planned or in progress. A CUWA/Ag analyst has analyzed the within-day variance. The results will be used to develop the 1996 program and will be presented in the 1996 report.

ACKNOWLEDGMENT

Logistical considerations involved with the design and implementation of the pilot Real-Time Monitoring Program within the time constraints presented a formidable challenge to the staff. One of the major reasons the 1995 Real-Time Monitoring worked as well as it did was the diligence, dedication, and hard work of the field, maintenance, and data processing staff. The staff believed in the program, and their determination overcame the numerous problems encountered.

Chapter 1

INTRODUCTION

The "Principles for Agreement on Bay-Delta Standards" signed on December 15, 1994, by the State of California, the Federal Government, and a number of local and regional California water agencies and public interest groups identified real-time monitoring as a tool to be developed for use in making decisions regarding operational flexibility of the State Water Project and Central Valley Project. Under this agreement, an operations group (CALFED Ops Group) would be established by the CALFED agencies to use data from real-time monitoring to make decisions to protect chinook salmon, delta smelt, splittail, longfin smelt, and other fish species from entrainment and the indirect effects of SWP and CVP operations in the southern delta and provide for operational flexibility for the projects. In April 1995, a group of urban and agricultural water agencies requested that the Interagency Program develop a test program for implementation during the late spring and early summer of 1995. This test had two objectives:

- To determine if daily real-time monitoring could be conducted in a consistent manner over an extended period and to use data from the test to develop a long-term real-time monitoring program.
- To determine whether data collected on a continuous basis could be provided as reliable information to decision makers within 24-48 hours and to use data from the test to develop an effective program for processing field data and making results available to decision makers.

In addition, data from the real-time monitoring program (hereafter "RTM Program") were expected to shed light on several scientific issues, such as the relationship between outflow and the movement of various fish species and the distribution of target species.

If successful, real-time monitoring would serve the dual purposes of protecting targeted fish species while providing operational flexibility to the SWP and CVP. For example, export pumping could be reduced if monitoring detected high densities of targeted species in the channels leading toward these facilities. Reduced pumping levels could then result in take of fewer fish. Higher pumping levels could be resumed once monitoring indicated that the targeted species were no longer in an established "zone of influence". Further, if susceptibility of a target species to loss was greater at one facility, then export pumping could be shifted to the facility where there was less susceptibility, possibly resulting in greater protection of fish.

The test of real-time monitoring was conducted by a multi-agency team of Interagency scientists, with help from several private consultants, from late April through June 1995. The primary purpose was to determine if such a program could be carried out and if the information collected could be useful in making water project management decisions.

This report describes the RTM Program, summarizes the data collected, and evaluates the effectiveness of the 2-month

test and makes recommendations for the 1996 program. The report also documents costs of the field program and some of its impacts on other Interagency monitoring and study programs. Finally, the report presents some preliminary scientific analysis of datasets developed by the RTM Program. At this time, the monitoring program recommended for 1996 should be considered preliminary, pending review and comments from the Real-Time Monitoring Project Work Team, the Interagency Coordinators, the Management Advisory Group to the Interagency Program.

Chapter 2

FIELD PROGRAM LOGISTICS

The field program involved sampling at 11 sites in the delta (Figure 1; Table 1), plus salvage sampling at the Central Valley Project facilities near Tracy and the State Water Project facilities near Byron. Sampling was conducted using midwater trawl (three main channel sites; Table 1) and Kodiak trawl (remaining eight field sites). At some sites, intensity of sampling varied during the field program; intensity was decreased when target species were determined to have moved out of a sampling area and increased when concentrations of target species were determined to have moved into an area.

From May 1 through May 21, sampling targeted outmigrant chinook salmon, including about 10,000,000 unmarked smolts released from Coleman National Fish Hatchery on April 24 and 25 and 275,000 unmarked smolts released from Merced River Fish Facility on May 10. Trawling was also done before April 30 at Sherwood Harbor to make sure the initial group of smolts from Coleman was detected.

Between May 12 and May 20, Kodiak trawling was conducted at the head of Old River just downstream of the confluence with the San Joaquin River and in the San Joaquin River near Dos Reis to evaluate the relative density in the two channels and assess whether high numbers of salmon migrate down upper Old River.

On May 21, the focus of sampling shifted to delta smelt. All osmerids collected from stations other than Chipps Island and Georgiana Slough were retained for positive identification. Field crews were given instructions to help differentiate delta smelt from wakasagi.

After May 21, when the delta smelt survey for post-larval smelt (called the 20mm survey) showed that most of the delta smelt were outside the delta and a large 1995 year class of splittail was encountered in the San Joaquin River, emphasis was shifted to follow splittail. To look at patterns in the catch, splittail CPUE was plotted by location and sample date (Appendix C). Relationships between splittail CPUE at Mossdale and CPUE at other downstream locations were examined by plotting paired comparisons for same-day catches and for catches from 1 to 5 days afterward for the downstream locations. Linear regression statistics were calculated for each comparison, and coefficients of determination (r^2) were used to examine how well CPUE at one location could predict CPUE at another downstream location based on different transit times between locations.

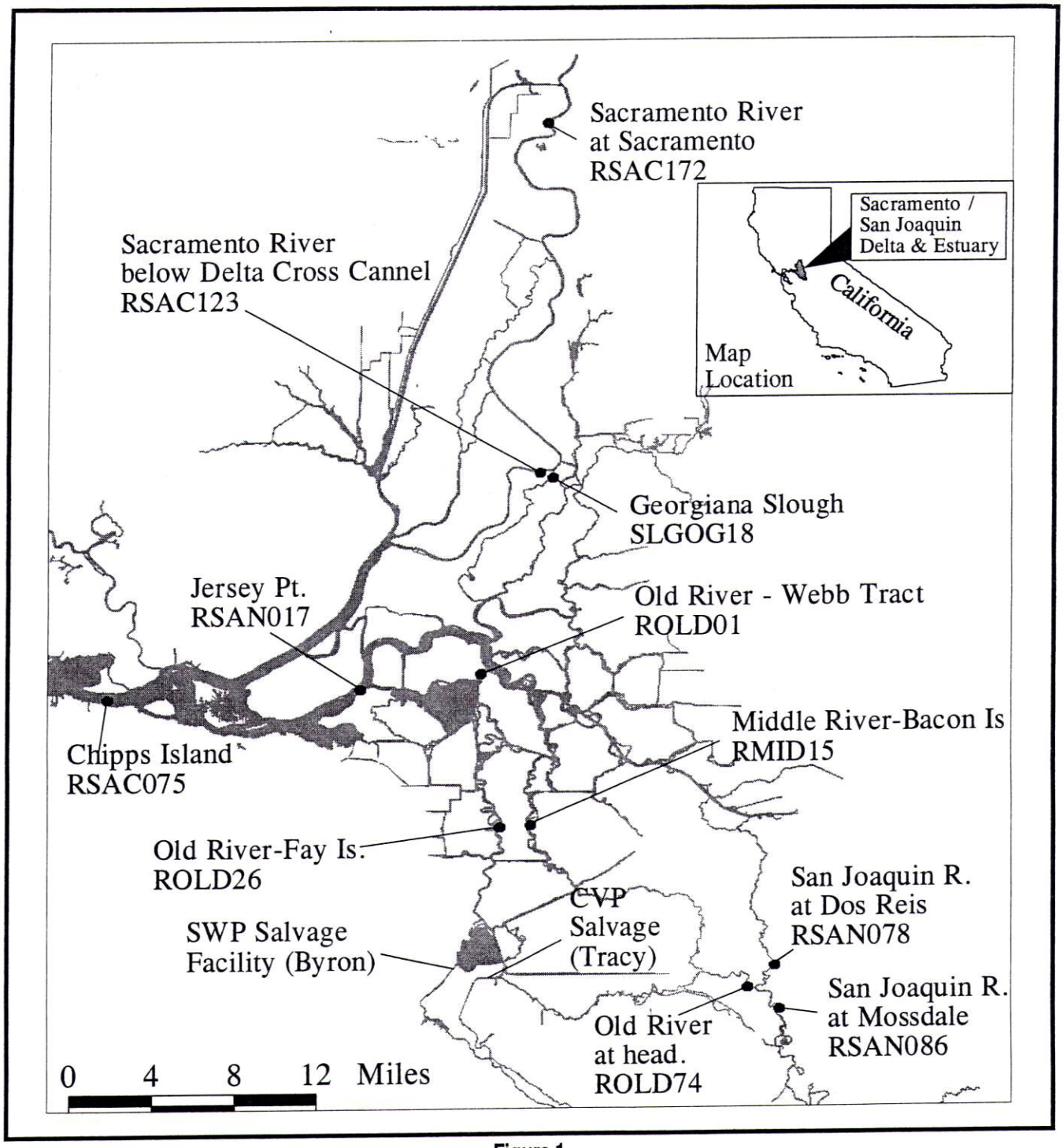

Figure 1
1995 REAL-TIME MONITORING SITES

Table 1
SUMMARY OF 1995 REAL-TIME MONITORING

Sampling Site	RKI	Gear	Dates	Frequency	Number Days	Number Tows	Comments
Sacramento River at Sherwood Marina	RSAC172	Small Midwater Trawl	5/1 - 5/21 5/22 - 6/30	Daily 3 days/week	39	384	Ten 20-minute tows per day
Sacramento River at Walnut Grove	RSAC123	Kodiak Trawl	5/1 - 6/30	4 days/week	35	318	Same crew as Georgiana Slough Nine 20-minute tows per day
Georgiana Slough	SLGOG81	Kodiak Trawl	5/1 - 6/30	4 days/week	35	319	Same crew as Walnut Grove Nine 20-minute tows per day
Jersey Point	RSAN017	Small Midwater Trawl	5/1 - 5/21	Daily	21	203	Ten 20-minute tows per day
Old River at Webb Tract	ROLD01	Kodiak Trawl	5/1 - 6/30	Daily	53	461	Ten 20-minute tows per day
Chipps Island	RSAC075	Large Midwater Trawl	5/1 - 6/30	Daily	59	582	Ten 20-minute tows per day
Old River at Fay Island	ROLD26	Kodiak Trawl	5/1 - 6/30	Daily	57	271	Same crew as Middle River Five 20-minute tows per day
Middle River at Bacon Island	RMID15	Kodiak Trawl	5/1 - 6/30	Daily	56	245	Same crew as Old River @ Fay Is. Five 20-minute tows per day
San Joaquin River at Mossdale	RSAN086	Kodiak Trawl	5/1 - 6/19 6/20 - 6/30	Daily 3 days/week	42	404	DFG Region 4 Ten 20-minute tows per day
San Joaquin River at Dos Reis	RSAN078	Kodiak Trawl	5/14 - 5/20	Daily	6	29	Same crew as head of Old River Five 20-minute tows per day
Head of Old River	ROLD74	Kodiak Trawl	5/14 - 5/20	Daily	7	31	Same crew as Dos Reis Five 20-minute tows per day

Personnel

Sampling at the midwater sites involved a single vessel; a midwater trawl (6x12 feet for Sacramento and Jersey Point and 15x30 feet at Chipps Island); and a crew consisting of an operator, crew leader, and 1 or 2 general crew members (Table 1). Sampling at the Kodiak trawl sites involved two boats, a main net boat, and a tow boat. Crews consisted of two operators, a crew leader, and two crew members.

In the May/June field effort, the 65 boat operators, crew leaders, and crew members represented:

- Department of Fish and Game: Bay-Delta — 29; Region Four — 5
- Department of Water Resources — 9
- U.S. Fish and Wildlife Service — 14
- U.S. Bureau of Reclamation — 4
- Consultants — 3
- Metropolitan Water District of Southern California — 1

USFWS personnel served mainly as crew leaders and trainers for crew leaders from other agencies. To avoid too heavy an

impact on any other study, DFG Bay-Delta field personnel were selected from every group within the Bay-Delta Division.

Staffing a full-time, 7-day-a-week operation in a year of high flows and the problems associated with such flows presented several problems. Knowledgeable, experienced boat operators are scarce and, for safety reasons, it is critical that all boat operators have a strong knowledge of the delta and of boat operations especially operations involving trawls. This problem was overcome by using experienced boat operators from DFG, USFWS, and DWR and allowing them to work overtime. Current State guidelines dictate that overtime accural be minimized. Overall, ten DFG Bay-Delta Division, five DWR, and four USFWS operators were used. In addition, operators were supplied by DFG Region 4 for the Mossdale work and by the State Water Contractors via Hanson Environmental for work at the lower San Joaquin River at Dos Reis and head of Old River, a short period for the Webb Tract work, and as half of the crew at Georgiana Slough. All DFG Bay-Delta personnel that could operate boats were used as operators. Some of the USFWS and all of the DWR boat operators had not towed a Kodiak trawl, but all performed well following a short training period.

Scheduling to accommodate crew personal needs, to minimize impacts on existing projects, to keep overtime to a minimum, and to be flexible enough to accommodate last-minute changes required the full-time attention of one DFG biologist and one USFWS biologist.

Equipment

The 15 boats used in the field program were provided by:

- Department of Fish and Game: Bay-Delta — 6; Region 4 — 2
- Contractors — 3
- U.S. Fish and Wildlife Service — 3
- Department of Water Resources — 1

When the RTM Program began, one of the required eight Kodiak trawl nets was a borrowed Georgiana Slough Project backup net. As new nets were received, the problems of field and backup gear were relieved. Damaged gear was repaired in a timely manner using DFG Bay-Delta staff. One Kodiak trawl net was snagged and lost. The head ropes of the Kodiak trawls were altered, which helped solve the problem of tangling the nets in propellers and outdrives during retrieval.

Field crews were transported using DFG vehicles and vehicles obtained from the State Garage. A concerted effort was made to carpool to reduce vehicle use. Cellular phones, borrowed from various projects, were assigned to each field crew and to the Data Review Team (DiRT). This allowed expeditious repairs; speedy solution of scheduling problems; and timely conference between office staff and field staff on identification, procedures, and data. Equipment such as flowmeters, measuring boards, buckets, boots, rain gear, and field forms was either bought, borrowed, or built.

The need for a second boat and larger crew at the Kodiak sites was one of the

more difficult problems. Boats were not taken from studies already in progress, and this limited the number of boats available from DFG, USFWS, and DWR. The boat shortage was exacerbated by the availability of reliable boats designed or modifiable for trawling. The study design adopted had four boats held in reserve. Due to the short lead time after program approval, one boat was quickly modified for Kodiak duty and maintenance on the steering system of another was deferred. Preparation of the DFG boats required that maintenance personnel work overtime and several permanent and seasonal employees dedicate their time to this task during March and April. Most of the boats completed the task without major problems, although they all required some work after the program was over.

Towing trawl gear full time is hard on boats, especially those with outdrives. Numerous problems arose during the program, and for the first month, two of the DFG backup boats were used. During the extra-sampling period at Dos Reis and head of Old River, all available boats were in use, leaving none in reserve. Maintenance personnel were fully occupied keeping the sampling boats operating, leaving boats needing repairs waiting. On average, at least one boat a week had problems severe enough to take it out of service for off-site repair. Both DFG Bay-Delta maintenance and DWR Mobile Equipment personnel worked considerable overtime and weekends to keep the fleet operating.

ESA Permits

Early in the planning process, the need for permits to take winter-run chinook salmon and delta smelt was recognized as a potentially serious problem. The RTM Program was considered a minor modification to the NMFS and USFWS biological opinions; therefore, no permitting or incidental take statements were required. However, an adaptive sampling strategy was developed to minimize take of these species (see sections 17 and 18 in Appendix B).

Take of winter-run chinook salmon was not considered a problem because the 1995 RTM Program began in May — later than the main period when winter-run chinook salmon smolts are known to be present. Take of delta smelt was also not considered a problem because most of the delta smelt were downstream in Suisun Bay, outside the sampling area.

Because 1995 was an extremely wet year, we did not have to address the issue of what would happen if the catch of listed species was such that sampling had to be curtailed. This issue remains unresolved and must be addressed before the 1996 program. There is a risk, particularly in above-normal through dry water year types, that the RTM Program could be prematurely shut down if the catch of listed species, particularly delta smelt, exceeds the allowable take. Therefore the take limit imposed on the sampling effort creates a dilemma — take limits for sampling could curtail monitoring required to protect the same species from significant take at CVP and SWP facilities.

Program Costs and Cost Accounting

Table 2 is a breakdown of costs, by agency and expense type. Estimates for personnel are based on hourly salary and number of hours worked; overtime is calculated at time-and-one-half. The total was increased by 28.25%, the amount currently used by DFG to account for benefits for permanent staff.

Our best estimate of the direct cost for the 1995 RTM Program is $468,000. Several elements, such as the acoustic barrier work, were budgeted and paid for separately. Direct cost is probably underestimated because of difficulties in separating RTM costs from other project costs. Also, due to differences in how participating agencies handle billings, it was not possible to trace all expenses or accurately tally the number of hours worked. Estimates of overtime have some ambiguity because of intra-agency differences in labor and agency work rules. Operating expenses include fuel, vehicles, berthing, supplies, and repairs but do not include purchases of trawls. Work at a number of the sampling sites was budgeted and accounted for under other programs. Using these sites resulted in a greater use of the data for a given expenditure, but it was difficult to allocate costs to the RTM Program and the other programs.

Table 2
DIRECT COSTS OF
1995 REAL-TIME MONITORING PROGRAM
(Dollars)

Agency	Personnel	Operating	Total
DFG	165,637	9,700	175,337
DWR	98,780	7,400	106,180
USFWS	63,735	13,050	76,785
USBR	8,161	567	8,728
Other	80,739	20,000	100,739
Total	417,052	50,717	467,769

Other Costs

Other costs include work not done, work delayed or backlogged, and adjustments to make the program work, all of which resulted in unquantifiable impacts on existing workload and assignments. Indirect costs and impacts to other programs identified to date include:

- A 2-week backlog in processing delta smelt egg and larval and 20-mm survey samples.
- A delay in processing south delta egg and larval samples.
- A 2-week delay in processing zooplankton samples.
- A 4-month backlog in processing shrimp samples for the Delta Outflow/San Francisco Bay Study.
- A 2-month curtailment of sampling at Oroville, Almanor, and Folsom reservoirs for various life stages of wakasagi.
- May-June cancellation of the delta smelt purse seine survey to assess habitat preference of delta smelt.

- Cancellation of the 24-hour delta smelt egg and larval study.
- A 1-week (40 hours) backlog in reviewing data sheets for the Bay Study.
- 80 hours of deferred boat maintenance on the *Longfin* and *Alosa*.
- Incomplete larval splittail sampling.
- A 4-week postponement of the tidal marsh survey.
- No April-June fyke net surveys for salmon smolt work.
- Cancellation of 15 days of salmon beach seining.
- Cancellation of the Kodiak and midwater comparison trawls at Sacramento.
- Delays in numerous reports, including splittail gill-net survey report, 1993 and 1994 Montezuma Slough salmon migration reports, longfin smelt paper, Bay Study fish bulletin, 1994 egg and larval annual report, 1994 delta agricultural diversion annual report, 1993-1994 delta agricultural diversion technical report, 1994 delta smelt annual report, 1994 North Bay Aqueduct report, 1994 delta smelt monitoring report, and USFWS 1994 annual report.
- 8-week delay in preparation of data files for IEP server.
- Reduction in frequency of south delta egg and larval sampling from every other day to once a week.
- A 4-week delay in the start of the 1995 agricultural diversion study. In addition, the study's concurrent channel sampling to estimate channel densities was not conducted due to transfer of boats and boat operators to the real-time program.
- A 6-week delay in Feather River study associated work (purchases of boats, trailers, and screw traps; obtaining permits; researching background material).
- Cancellation of trawling at Sacramento for comparison between day and night and other efficiency studies.
- A 4-month backlog in reading coded wire tags.
- Postponement of all non-RTM Program training.

Recommendations for the 1996 Program

Temporary employees should be hired and trained to serve as all of the general field crew and as part of the crew leaders to reduce scheduling problems.

At least three good reserve boats should be available for 7-day-a-week operations and capable of rapid deployment.

Boats used for should be designed and built for specific duty (midwater trawl or Kodiak trawl).

Cellular telephones should be considered basic field equipment for any future RTM effort.

A system should be developed and implemented to allocate and track expenses between the RTM Program and other programs.

The RTM program should have its own budget so that costs of "borrowed" equipment, personnel, and supplies are accounted for.

The RTM Program needs to be budgeted, equiped, and staffed so that other high-priority programs are not impacted.

Before instituting the RTM program in 1996, permit conditions should be reviewed to resolve the dilemma of take during sampling versus reduced take at the SWP and CVP facilities. An adaptive sampling methodology similar to that used for the 1995 program should be used.

Chapter 3

DATA PROCESSING

Field sheets (completed data forms) were returned to the DFG Stockton office each night. Exceptions were the Georgiana Slough and Mossdale sampling being carried out by non-RTM groups. Daily summaries of the field data from these sites were faxed to the Stockton office either the night following collection or the next morning. All data received before 10:00 am were key entered, proofed, edited, and transferred into the master data files by one lead biologist and two temporary employees. Initial problems with the data entry programs were solved and did not affect the success of the program. Initially, daily summaries from the Mossdale site were a problem because of an old fax machine, incomplete instructions, and some mis-communication between RTM staff and Region 4 personnel. Once these problems were identified, solutions were implemented and timely faxing of the daily catch summaries proceded routinely.

After the data files were edited, they were given to the Data Review Team (DiRT) consisting of one senior biologist and four biologists. The DiRT combined the various data files, calculated the catch per unit effort, summarized catch per unit effort by species, coalesced this information into a series of tables and figures, faxed these tables and summaries to the biologists sub-group (No-Name Group) of the CALFED Ops Group, and posted this information on the Bay-Delta home page available through the Internet. Faxing the material to the No-Name Group was time consuming, even using automated computer faxing. While planning the RTM, producing the summaries was assumed to be a somewhat routine task, taking 1 or 2 hours. In fact, producing the summaries took an average of 4 hours during the first several weeks and decreased to 3 hours by the end of June.

The last part of the data summary process was for a staff biologist to analyze the data and summarize the status of a given species. This was done at least once a week by a member of the Data Summary Team (DuST).

Problems

For the sake of expediency, existing data files and data entry routines used for other Interagency programs were used for the RTM program. This proved to be problematic because the files had different structures and formats and required significant programming to combine them and produce usable summaries. The problem was exacerbated by the short lead time to do the programming and to refine the reporting process.

The DiRT had to develop a concise, readable, understandable format for the summary tables and figures to present data for multiple species over all of the sites and times. Numerous variations were developed and evaluated; most were too complicated. The process continued throughout the project and will likely continue as part of any new RTM project.

Given the other commitments of the biologist who analyzed the data, weekly analysis efforts were all that could be managed.

Recommendations

- An entirely new data file structure designed specifically for real-time monitoring should be developed, along with a series of applications designed to expedite data entry, editing, report generation, updating of time series figures, and posting the material on the Interagency Program home page. Programmers should be given enough lead time to develop and thoroughly test these programs.
- The need to fax everything to each member of the No-Name Group should be re-examined in light of the availability of e-mail.
- Three biologists should be dedicated full time to the data summary/analysis process and given enough lead time to plan the most effective way to carry out their duties. These biologists would be responsible for analyzing what is happening in relation to various target species and relating that to flows, project operations, and species' biology. The analyses should be produced as often as needed.

The winter months before May and June 1995 provided above-average rainfall and snowpack. From April through June, the Delta Outflow Index averaged about 80,000 cubic feet per second. During the early part of May, outflow peaked to about 180,000 cfs due to increased releases for flood control following earlier storms. Combined SWP/CVP pumping averaged about 5,000 cfs in May through June because of low demand. The Delta Cross Channel gates were closed for flood control.

As shown in Table 3, Sacramento River flows were 34,300 to 88,500 cfs during May through June. San Joaquin River flows were 6,400 to 23,500 cfs during the same period. Interior delta flows were all net positive and moderately high.

Real-Time Monitoring for Chinook Salmon

Catch of salmon smolts peaked on May 1 at the Sacramento River monitoring sites at Sherwood Marina, Walnut Grove, and Georgiana Slough (Figure 2). It is unclear why peaks at the Walnut Grove and Georgiana Slough sites were at the same time as at Sherwood Marina, which is about 25 miles upstream. Many of the smolts in this inital peak appeared to move into the central delta via Georgiana Slough, but in general, relative density was similar in Georgiana Slough and the Sacramento River at Walnut Grove. It also appeared that most of the Sacramento smolts that moved into the central delta successfully migrated to the western delta via Jersey Point (Figure 3). This first group of smolts were most likely part of the 10,000,000 smolts released at Battle Creek on April 24 and 25. Additional evidence from the recovery at Jersey Point of coded-wire-tagged smolts released at Battle Creek, Feather River, Red Bluff, and Miller Park (Sacramento) shows that smolts originating from the Sacramento River moved into the central delta. Recoveries at Jersey Point of smolts released at Ryde indicate they may also have moved into the central delta via straying from the mainstem Sacramento River, via Georgiana Slough, Threemile Slough, or around the tip of Sherman Island (Table 4).

A second, smaller pulse of smolts was observed at the Sherwood, Walnut Grove, and Georgiana Slough sites between May 20 and 22 (Figure 2). Its unclear if this second pulse consisted of mostly hatchery released smolts. Both Sacramento pulses were followed by pulses at Jersey Point and Chipps Island (Figure 3).

Catches of smolts at Mossdale peaked on May 18, 26, and 31 (Figure 4). These smolts likely were part of the 275,000 hatchery smolts released at Merced River Fish Facility on May 10. Daily average CVP and SWP pumping was reduced from about 5,400-6,000 cfs to about 3,900-4,500 cfs between May 22 and May 27

Table 3
DELTA HYDROLOGY AND OPERATIONS, MAY AND JUNE 1995

(Flows are in cubic feet per second.)

Date	Sacramento River at I Street	Yolo Bypass	San Joaquin River at Vernalis	Total Delta Inflow	Clifton Court Intake	Banks Pumping Plant	Tracy Pumping Plant
5/01/95	58266	1787	16854	84465	425	84	3150
5/02/95	69327	7962	16886	104348	687	574	2885
5/03/95	78345	37076	17359	143782	830	1389	2887
5/04/95	84163	68907	17834	176538	684	1277	2872
5/05/95	85573	69289	18876	180293	893	1266	2899
5/06/95	87852	60757	20939	175973	888	1138	2859
5/07/95	88522	55244	21743	171878	1280	1135	2842
5/08/95	85518	40372	22217	153906	934	1111	2860
5/09/95	83982	28937	22354	140792	0	2054	2260
5/10/95	82147	21450	22360	131326	1517	2054	2611
5/11/95	79296	13496	22588	120655	1983	1553	2609
5/12/95	77181	9269	22899	114474	1857	1580	2698
5/13/95	76513	5073	22851	109487	1814	1742	2741
5/14/95	74044	2190	22826	104925	1814	2045	2745
5/15/95	72740	1741	22919	103339	0	1116	2793
5/16/95	70434	1806	22843	100746	0	0	2880
5/17/95	67081	1729	22818	96890	0	0	3381
5/18/95	62193	1711	22990	92069	0	0	3632
5/19/95	56503	1665	23121	86626	2013	0	3624
5/20/95	51348	1670	23191	81460	2003	1471	3637
5/21/95	47760	1670	23063	77947	2004	1696	3626
5/22/95	46398	1657	23419	76910	2006	1612	2779
5/23/95	43251	1665	23416	73690	1263	1207	2045
5/24/95	42820	1658	23410	73213	0	1119	2721
5/25/85	41632	1588	23491	71953	997	1109	3011
5/26/95	41484	1198	23422	71303	999	1451	3057
5/27/95	43500	1125	23095	72882	2800	1872	3036
5/28/95	46086	1078	23061	75372	2900	1967	3038
5/29/95	46629	1057	23146	75934	2500	1973	3502
5/30/95	47372	1040	23121	76604	2516	2355	3523
5/31/95	47467	1057	22849	76421	2031	1979	3340
6/01/95	46921	1253	22379	75572	2171	2102	3595
6/02/95	44902	1368	21744	73042	2169	3095	4350
6/03/95	47186	1235	21359	74764	6065	6049	4351
6/04/95	46792	1332	21067	74111	6099	6021	4350
6/05/95	45563	1380	20811	72625	3800	3702	4300
6/06/95	45477	1352	20314	72077	3110	3101	4383
6/07/95	46055	1348	19810	72202	4060	3996	4404
6/08/95	44709	1231	19055	69467	4061	3968	4284
6/09/95	42630	1180	18186	67035	3499	3378	4348
6/10/95	41103	1068	17598	64689	3500	3596	4352
6/11/95	39977	1364	17065	63200	591	6	2463
6/12/95	37453	1265	16380	60016	1370	1488	1659
6/13/95	36040	1184	15559	57743	1561	1504	1746
6/14/95	35745	1108	14838	56622	5136	4382	3656
6/15/95	35175	1207	14371	55691	5837	5349	4366
6/16/95	34845	1209	13690	55318	3832	3726	4346
6/17/95	37125	1192	13408	57250	3071	1620	4345
6/18/95	40425	972	12826	59264	3171	3126	4338
6/19/95	45702	787	12350	63799	1976	1969	4337
6/20/95	44394	743	12079	62142	3413	2832	4332
6/21/95	43291	703	11772	60620	3217	3304	4326
6/22/95	41938	848	11567	59211	2404	2362	4351
6/23/95	39801	1007	11161	56743	1399	1351	4352
6/24/95	38547	1029	10717	55072	1680	1644	4338
6/25/85	35579	1136	10121	51616	4305	4274	4344
6/26/95	34674	1183	9146	49775	3609	3545	4477
6/27/95	34374	1189	8082	48419	3923	3892	4477
6/28/95	37635	1177	7139	50692	4574	4495	4447
6/29/95	38417	1221	6521	50893	4560	4474	4457
6/30/95	39149	1230	6393	51476	4698	4593	4450

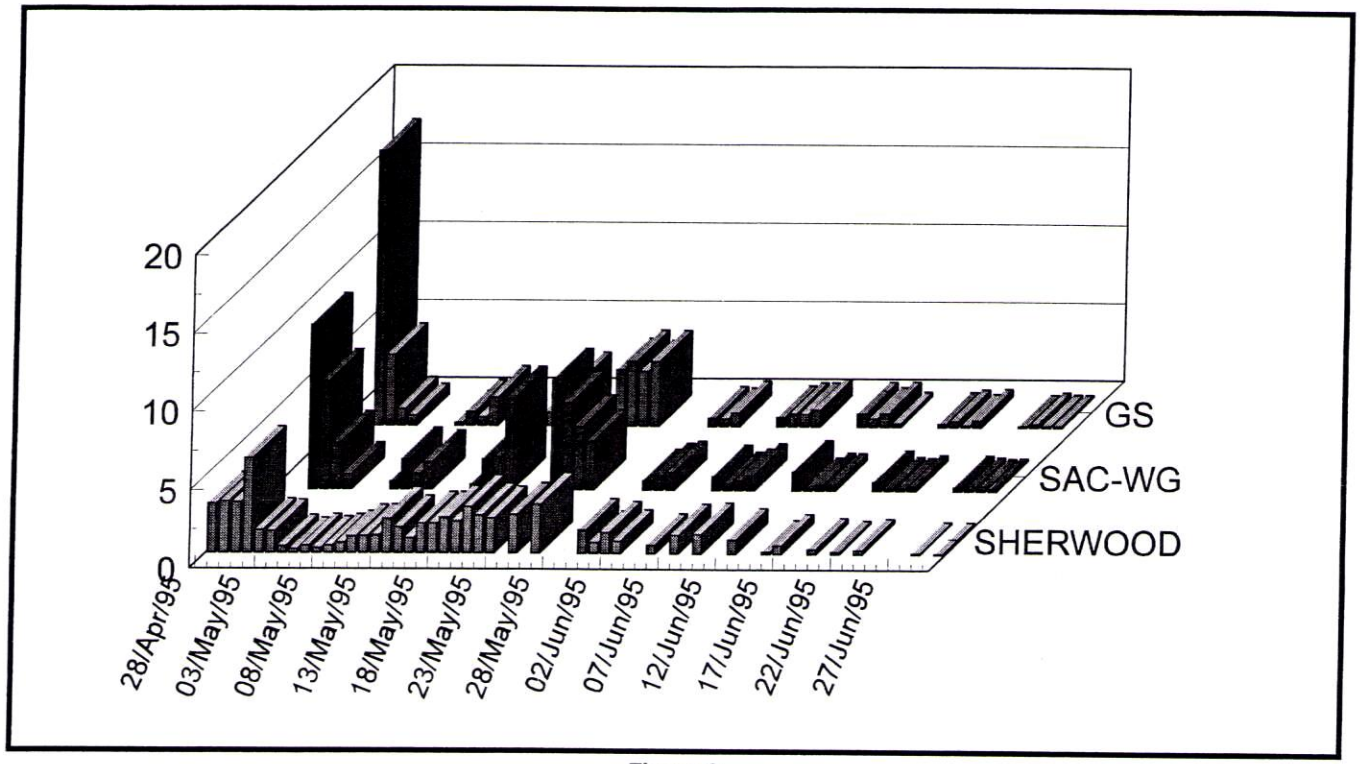

Figure 2
CHINOOK SALMON SMOLT CATCH PER ACRE-FOOT AT GEORGIANA SLOUGH, SACRAMENTO RIVER AT WALNUT GROVE, AND SACRAMENTO RIVER AT SHERWOOD MARINA

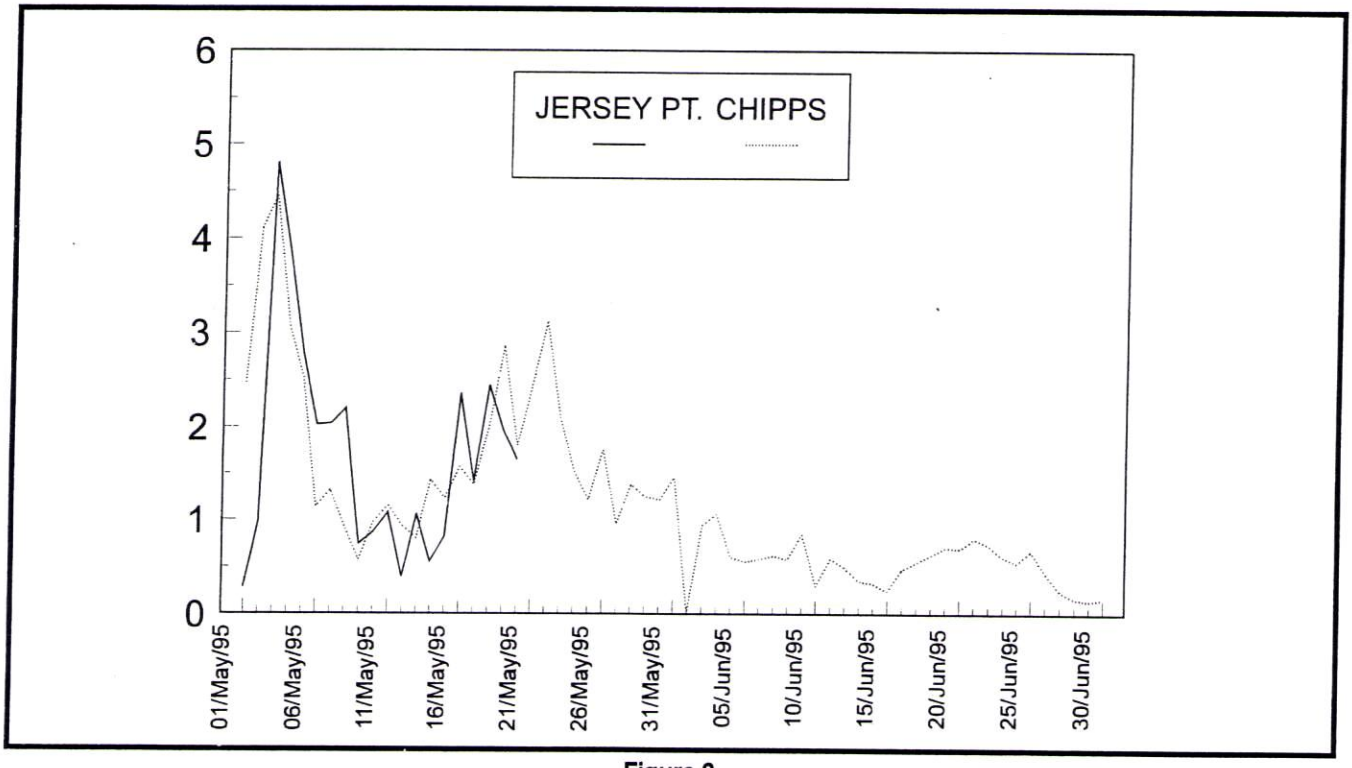

Figure 3
CHINOOK SALMON CATCH PER ACRE-FOOT AT JERSEY POINT AND CHIPPS ISLAND

Table 4
CODED-WIRE-TAGGED SMOLTS RECOVERED BY THE 1995 REAL-TIME MONITORING PROGRAM IN MAY AND JUNE

Release Site	Release Date	Number Released	Recovery Site: Jersey Point	Georgiana Slough	Sacramento River at Walnut Grove	Old River at Webb Tract	Middle River at Bacon Island	Old River at Fay Island	Head of Old River	San Joaquin River at Dos Reis
Upper Sacramento Fry Releases										
Red Bluff Diversion Dam	3/10/95	50410	1	1	2	0	0	0	0	0
Red Bluff Diversion Dam	3/10/95	45472	0	1	0	0	0	0	0	0
Upper Sacramento Smolt Releases										
Battle Creek	4/24/95	52442	5	1	1	1	0	0	0	0
Battle Creek	4/24/95	49636	6	2	3	1	0	0	0	0
Battle Creek	4/24/95	50109	3	5	6	0	0	0	0	0
Feather River Smolt Releases										
Feather River	4/3/95	54304	1	3	3	0	0	0	0	0
Feather River	4/3/95	52394	0	0	2	1	0	0	0	0
Feather River	4/3/95	51631	1	2	5	0	0	0	0	0
Feather River	4/3/95	38635	0	1	2	0	0	0	0	0
Yuba River										
Yuba City	5/18/95	52249	0	4	9	0	0	0	0	0
Yuba City	5/18/95	53398	0	10	9	0	0	0	0	0
Yuba City	5/18/95	53486	0	5	10	0	0	0	0	0
Yuba City	5/18/95	42525	0	5	6	0	0	0	0	0
Sacramento River Releases in Delta										
Koket	5/1/95	51597	10	0	0	0	0	0	0	0
Miller Park	5/1/95	50292	13	11	5	0	0	0	0	0
San Joaquin River Releases in Delta										
Mossdale	4/17/95	50120	7	0	0	3	35	56	1	0
Mossdale	4/17/95	50849	9	0	0	2	25	45	0	1
Dos Reis	4/17/95	50848	7	0	0	4	11	5	0	0
Jersey Point	4/19/95	50779	7	0	0	0	0	0	0	0
Mossdale	5/5/95	52297	6	0	0	0	64	24	2	3
Mossdale	5/5/95	50265	3	0	0	3	56	30	3	5
Dos Reis	5/5/95	52097	15	0	0	4	10	0	0	0
Mossdale	5/17/95	52703	1	0	0	0	41	41	12	2
Mossdale	5/17/95	51422	0	0	0	0	49	34	14	4
Dos Reis	5/17/95	51665	1	0	0	1	7	1	0	1
Mokelumne River Releases										
Thorton	5/15/95	51757	0	0	0	6	0	0	0	0
New Hope Landing	4/18/95	48345	13	0	0	5	1	0	0	0
New Hope Landing	4/18/95	49531	5	0	0	2	0	1	0	0
New Hope Landing	4/25/95	49837	16	0	0	4	0	0	0	0
New Hope Landing	4/25/95	49625	21	0	0	5	0	0	0	0
San Joaquin River Tributary Releases										
Upper Tuolumne	5/4/95	28055	0	0	0	0	0	0	0	
Upper Tuolumne	5/4/95	27062	2	0	0	0	1	4	3	2
Upper Tuolumne	5/4/95	28332	1	0	0	1	0	1	1	0
Lower Tuolumne	5/5/95	26007	0	0	0	0	0	2	0	3
Lower Tuolumne	5/5/95	27285	0	0	0	1	1	7	2	2
Merced Hatchery	5/3/95	28349	2	0	0	1	0	4	3	3
Merced Hatchery	5/3/95	27961	0	0	0	0	2	3	1	2
Merced Hatchery	5/3/95	26839	0	0	0	0	0	2	2	0
Merced Hatchery	5/3/95	28141	0	0	0	0	2	2	1	0
Lower Merced	5/4/95	27317	2	0	0	0	3	3	3	1
Lower Merced	5/4/95	29776	2	0	0	1	0	5	6	3
Lower Merced	5/4/95	29203	0	0	0	4	1	6	6	3

to facilitate movement of these smolts past the SWP and CVP facilities. The group collected at Mossdale most likely contained a large proportion of smolts released from Merced River hatchery, considering the few (4,200) adults that spawned naturally in the San Joaquin basin in fall 1994 and the fact that with the high flows many of the juveniles may have moved into the delta as fry.

With the exception of one sampling day, catch per acre-foot was always greater in Old River (ROLD74) than in the San Joaquin River downstream of the confluence with Old River (RSAN078, Figure 5). This demonstrates that in 1995, a wet year, many smolts moved toward the CVP and SWP pumping plants via upper Old River. Information from dry years indicates that survival is about two times greater for smolts that migrate to Chipps Island via the mainstem San Joaquin River (USFWS, 1991 Annual Report).

Smolts initially observed at Webb Tract, Old River (Fay Island), and Middle River sites appeared to be of Sacramento River origin that entered the southern delta via Georgiana Slough. Smolts recovered later (May 16-24) at these same sites could have originated from either the Sacramento or San Joaquin basins (Figures 4 and 7). This illustrates the difficulty of knowing the origin of smolts in the southern delta and vulnerable to the pumping plants. Since flows were relatively high during May in the southern and central delta and many San Joaquin smolts were observed migrating into upper Old River, some portion was likely of San Joaquin origin.

Preliminary data from reading the coded wire tags of marked smolts recovered at the real-time monitoring sites show that Mossdale, Tuolumne, and Merced River tagged fish were recovered at the Old River at Webb Tract, Old River at Fay Island, and Middle River sites (Table 4). In addition, marked smolts originating from Battle Creek, Feather River, and Mokelumne River (New Hope Landing and Thorton) were collected at Webb Tract, Old River at Fay Island, and Middle River at Bacon Island. This indicates that at least some smolts originating from the Sacramento River or central delta were present in the southern delta, providing evidence that smolts in the southern delta could be from either the Sacramento basin or the San Joaquin basin.

Recovery at the head of Old River and Dos Reis of smolts released May 17 at Mossdale also indicated that many smolts from the San Joaquin basin entered the southern delta via upper Old River and traveled north via Old River (Fay Island) and Middle River to Webb Tract, Jersey Point, and Chipps Island. Similar comparisons are not possible with the other marked Mossdale groups because sampling at upper Old River and Dos Reis did not start until May 12, after the previous two releases had been made at Mossdale.

Although no smolts released at Dos Reis were observed in upper Old River, some were recovered at Webb Tract, Old River (Fay Island), and Middle River sites. These smolts could have traveled to lower Old River and Middle River, Columbia Cut, Turner Cut, or Webb Tract.

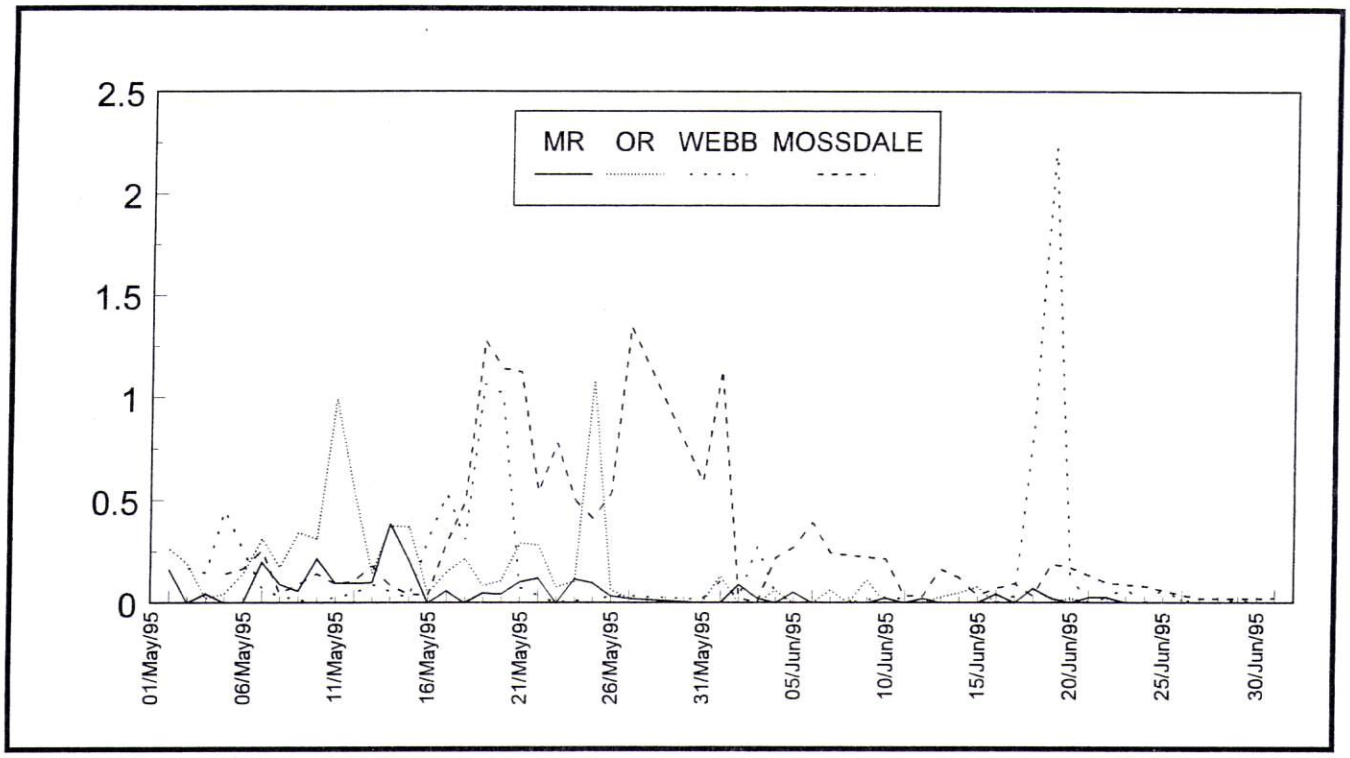

Figure 4
CHINOOK SALMON SMOLT CATCH PER ACRE-FOOT AT MIDDLE RIVER, OLD RIVER AT FAY ISLAND, OLD RIVER AT WEBB TRACT, AND MOSSDALE

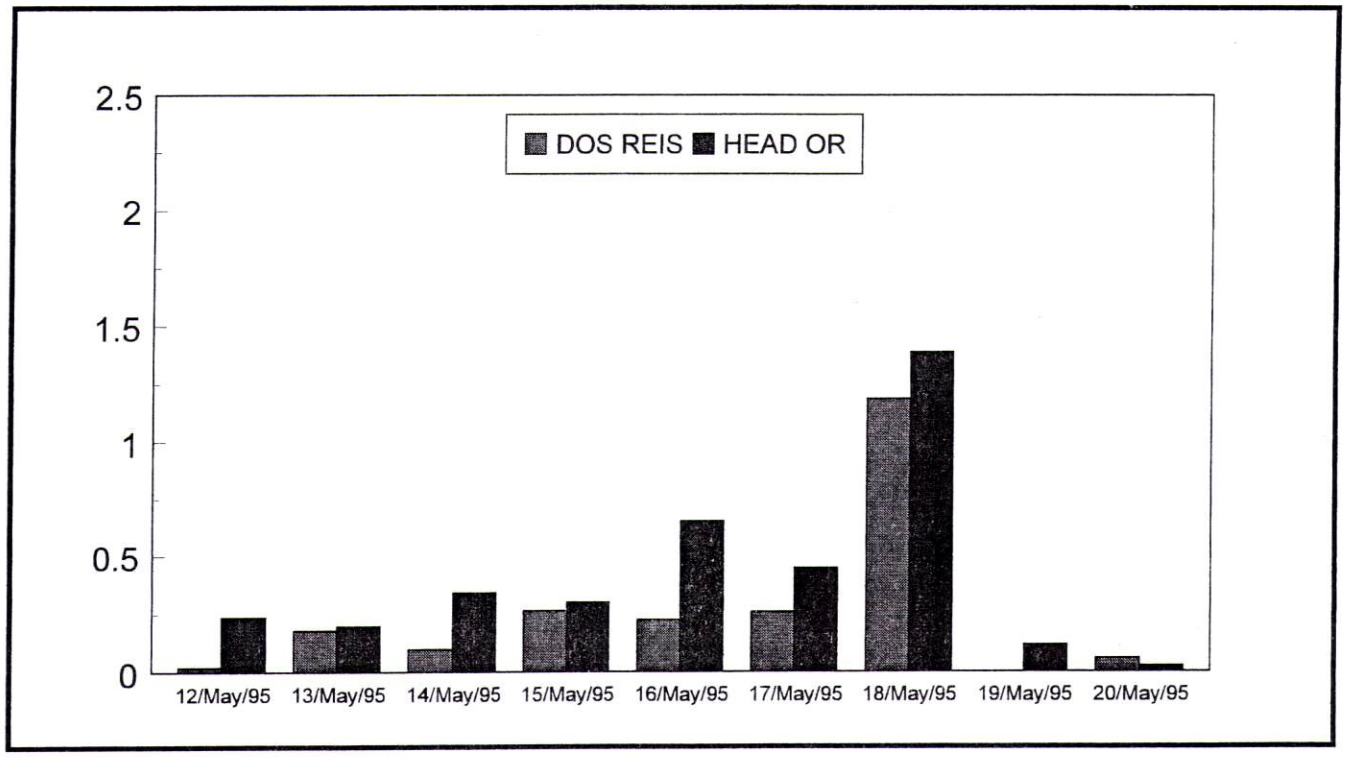

Figure 5
CHINOOK SALMON SMOLT CATCH PER ACRE-FOOT AT SAN JOAQUIN RIVER AT DOS REIS AND AT THE HEAD OF OLD RIVER

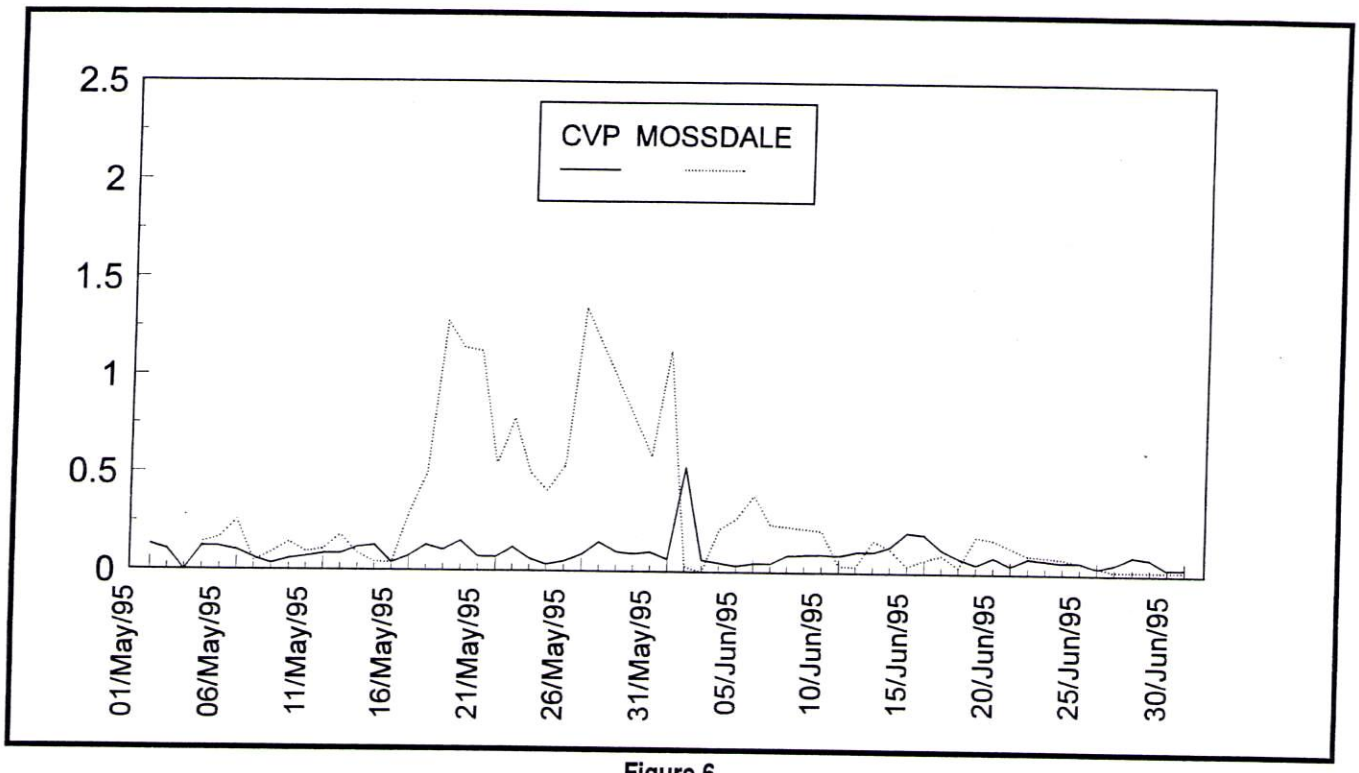

Figure 6
CHINOOK SALMON SMOLT CATCH PER ACRE-FOOT AT THE CENTRAL VALLEY PROJECT AND AT MOSSDALE

It is difficult to make valid comparisons between sites with the marked release groups because of the difference in timing of the sampling efforts and release dates. Continued evaluation of these data may give us additional insight regarding the composition and pathways of smolts in the southern delta.

In general, based on review of the juvenile salmon data generated from the real-time monitoring program, large numbers of smolts were observed entering and exiting the delta. Most of the juvenile salmon within the peaks were presumed to be of hatchery origin.

Problems

The peak of unmarked smolts immigrating into the delta from the Merced River hatchery release should have been relatively straightforward to track. What occurred was that the catches of smolts at Mossdale were quite variable, with the period during which the catch increased lasting about 15 days. This protracted period during which the catch increased and the appearance of several peaks in the catch during this period suggests that it may be difficult to determine in advance how long the peak will last and, therefore, the appropriate length of operations curtailment at CVP and SWP facilities for maximum protection of the immigrating fish.

Determining length of curtailment of CVP and SWP operations is further complicated by the lack of a reliable relationship between salvage at either facility and catch at any of the sampling sites (Figures 6, 8, 9). Considering that the Mossdale catch appears to be a reliable indicator (based on the fact that high catches followed the Merced River release) and that the CVP diversion takes water right off the migration route, it is surprising that CVP catch does not correlate with the Mossdale catch. Although adult production indices are significantly correlated to spring exports and flows 2½ years earlier (USFWS, SWRCB Exhibit 7, 1992), the lack of sound relationships between exports and catches at the real-time monitoring sites makes the benefit of short curtailments to outmigrating smolts unquantifiable.

The movement of salmon smolt pulses was difficult to interpret. Peaks observed at Mossdale, Sacramento River sites, Jersey Point, and Chipps Island were most likely of hatchery origin because peaks in the delta occurred shortly after hatchery releases. It was difficult to determine the origin and route of movement for smolts recovered at Webb Tract, Old River (Fay Island), and Middle River sites. Recovery of marked smolts did show smolts from both the Sacramento basin and San Joaquin basin were in the southern delta. Applicability of real-time monitoring to adjust project exports for the protection of naturally-spawned smolts is uncertain, because it is unclear whether wild smolts move into the delta in such obvious peaks.

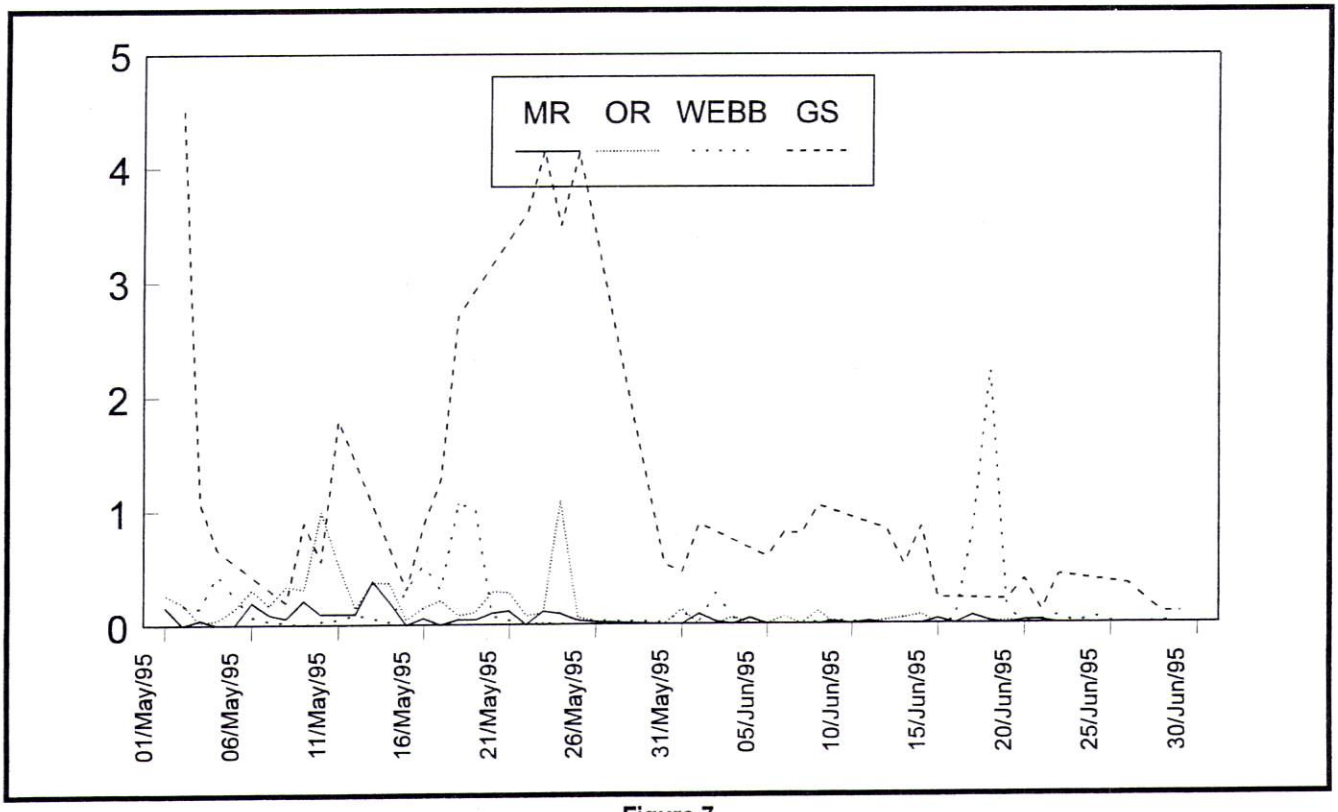

Figure 7
CHINOOK SALMON SMOLT CATCH PER ACRE-FOOT AT MIDDLE RIVER, OLD RIVER AT FAY ISLAND, OLD RIVER AT WEBB TRACT, AND GEORGIANA SLOUGH

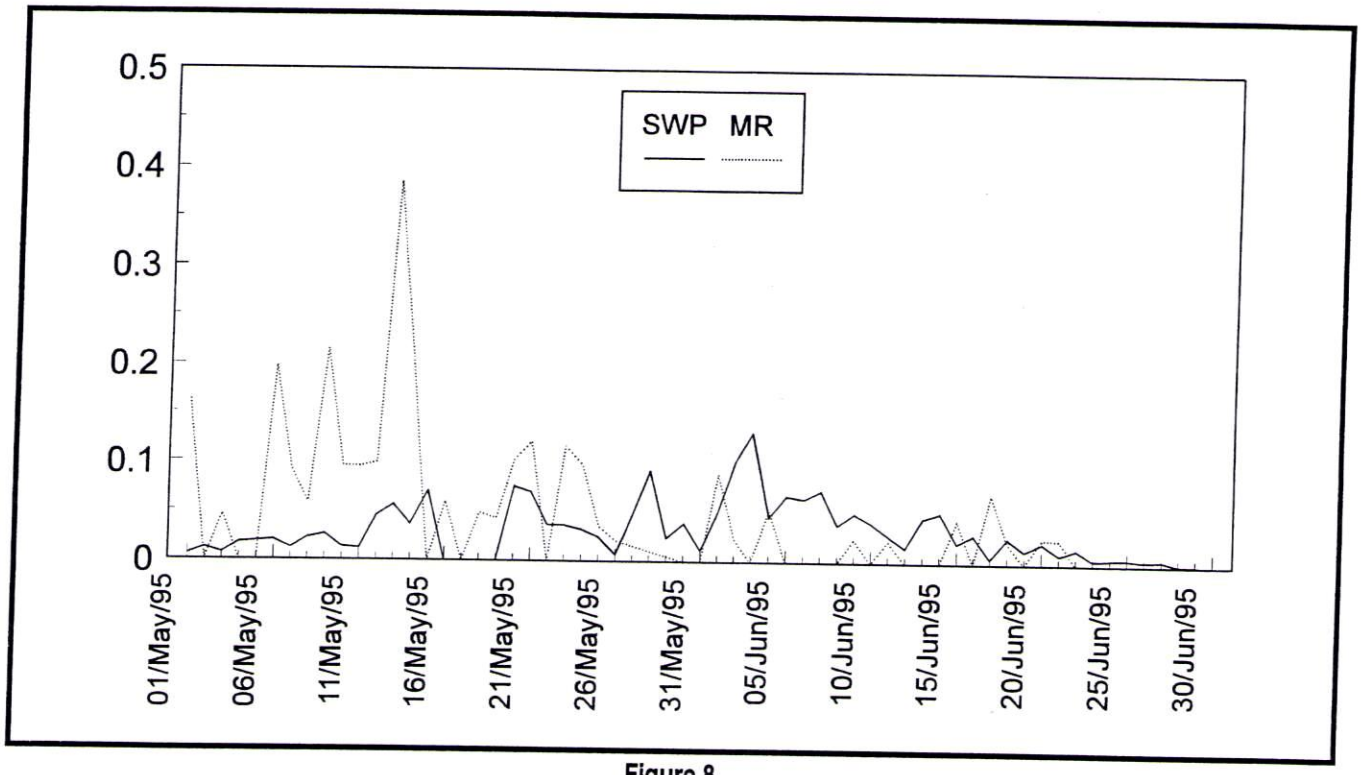

Figure 8
CHINOOK SALMON SMOLT CATCH PER ACRE-FOOT AT THE STATE WATER PROJECT AND AT THE MIDDLE RIVER SITE

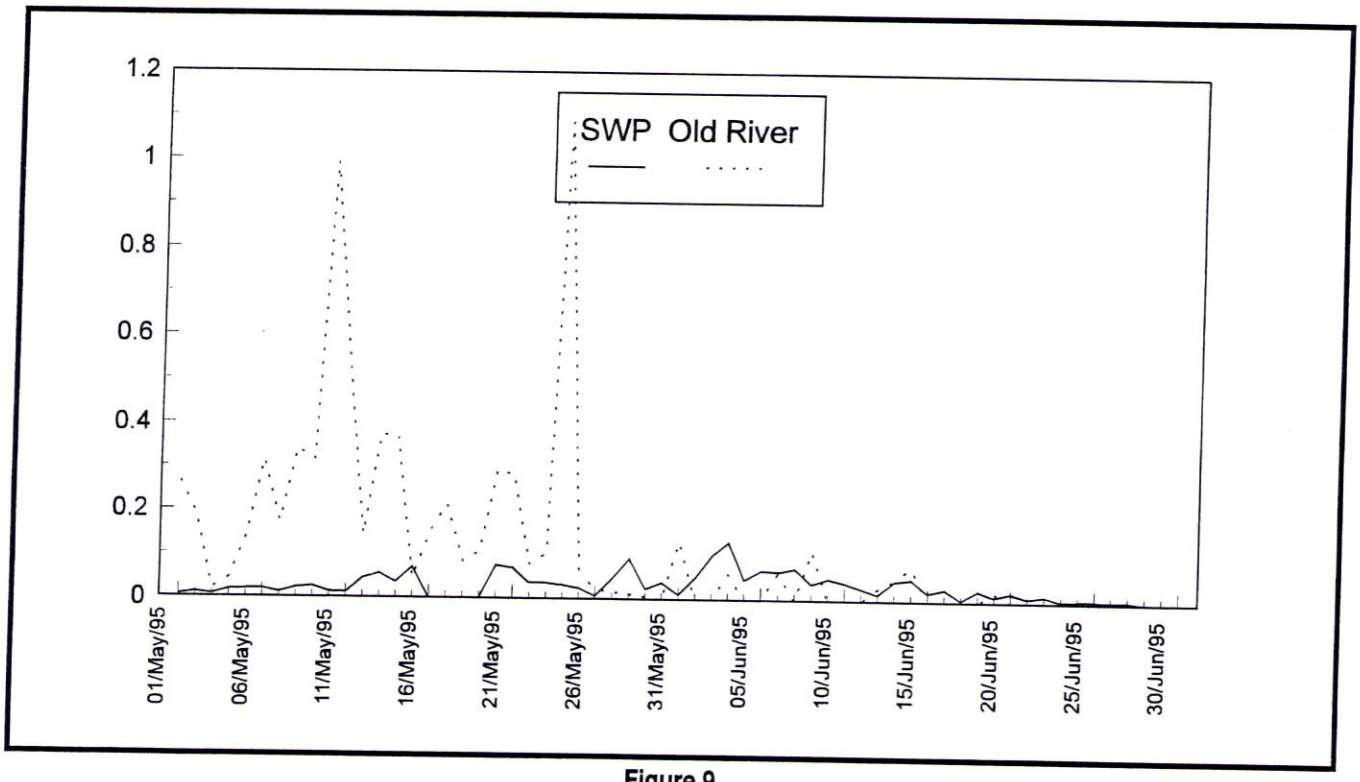

Figure 9
CHINOOK SALMON SMOLT CATCH PER ACRE-FOOT AT THE STATE WATER PROJECT AND AT OLD RIVER AT FAY ISLAND

Recommendations

- The real-time study should be repeated, preferrably in a dry year, with more marked smolts and broader sampling effort at Jersey Point, upper Old River, and Dos Reis.
- Further analysis of the relationships between hydrologic variables, CVP/SWP operations, and movement of outmigrating smolts will allow better definition of the benefits of SWP/CVP operations curtailments and enhance the ability to predict the period and conditions under which fish may be at risk from facility operations.

Real-Time Monitoring for Splittail

Data used in the analysis of the Mossdale catch presented here cover the period May 9 through June 30. Data for May 23, 1995, were estimated for several tows, and the data should be considered suspect.

Patterns in Splittail Catch per Unit Effort

Pulses of splittail young-of-the-year could be followed into the delta from the San Joaquin River side, but not beyond Fay Island and Bacon Island sites (Figure 10; Appendix C). There was no indication of pulses traveling between sites on the Sacramento River. Catch per unit effort at Chipps Island appears independent of CPUE farther up the Sacramento River and of the nearest site on the San Joaquin River, Webb Tract. The pulses of splittail from the San Joaquin River dampened considerably, and transit times may have increased through the delta due to tidal conditions, transit pathways, and fish behavior.

Catch per unit effort at Bacon and Fay peaked (May 26-30) higher than and coincident with the second increase in Mossdale numbers (>10 per acre-foot), but no similar increase was observed at either salvage facility. This suggested that in-delta spawning or recruitment to the net may have obscured transit-time relationships between river sites and delta sites. Moreover, CVP salvage density was higher than density at Mossdale until May 25, suggesting that splittail were initially moving down the shoreline (that is, not available to the Kodiak trawl), that early May salvage came from in-delta spawning, that salvage was capturing earlier migrants that had become resident in the area, or that salvage was more efficient in capturing splittail.

Potential Factors Related to Splittail Movement

Young-of-the-year splittail caught at Mossdale appeared to be moving with the flow, probably because they were too small to do otherwise through most of the season. Beach seine sampling during and after real-time monitoring indicates that some portion of the population was along the channel margins and suggests that they may not have been going with the flow but nonetheless may have been moving downstream. In 1995, some young-of-the-year remained upstream in the Sacramento and San Joaquin rivers at least into August.

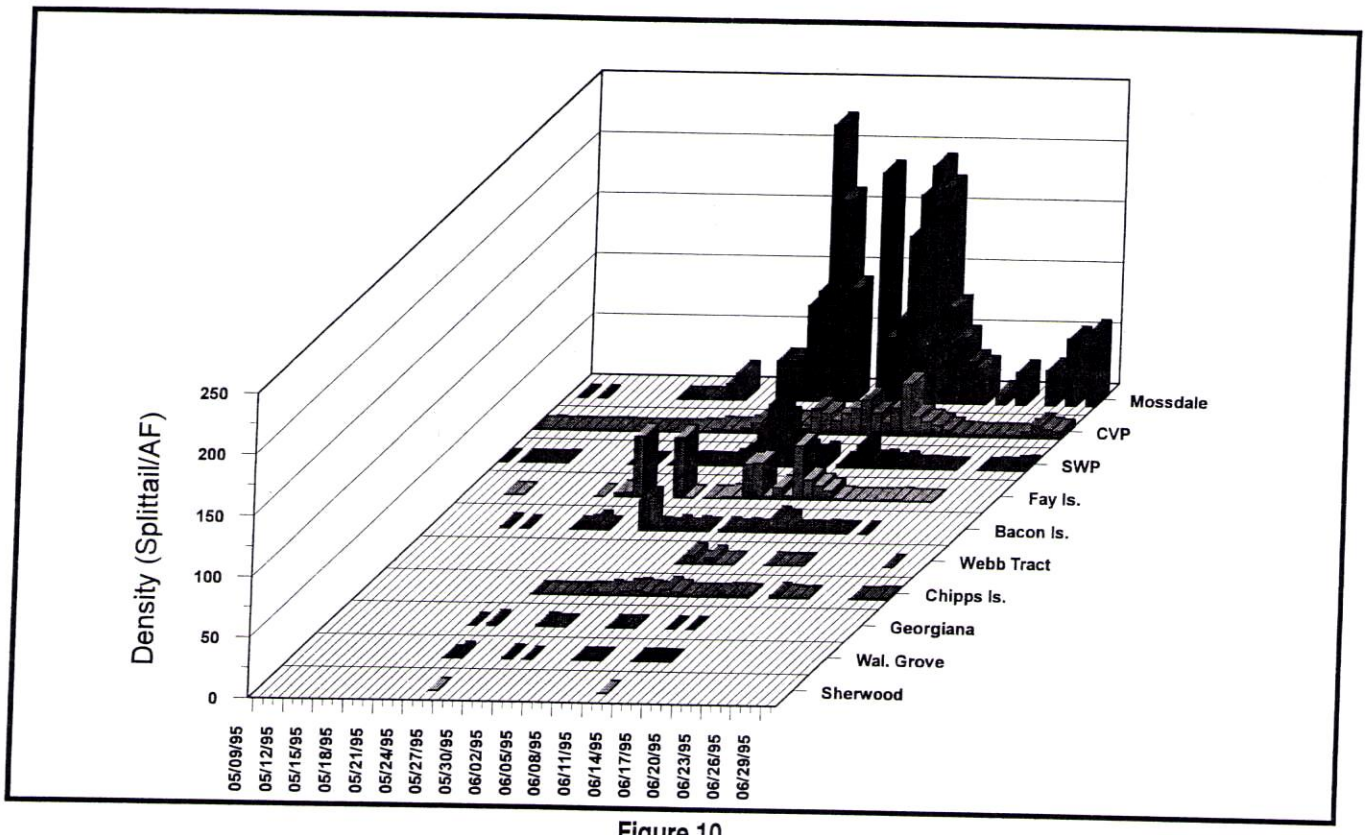

Figure 10
SPLITTAIL CATCH PER ACRE-FOOT, BY DATE AND LOCATION

Other factors also may have influenced splittail movement. Temperature did not appear directly related to numbers at Mossdale, but temperature may have triggered movement downstream that was not measured at Mossdale for some days afterward. Five days before the first major peak (June 4, 1995), water temperature increased from a low of about 62°F to a high of about 68°F. The second major peak (June 9) was after water temperature had declined to 64°F. These data do not reveal a relationship between temperature and splittail movement.

Splittail spawn between February and May. Historical larval data collected by DFG in 1988-1994 indicate peak larval abundance in April. Based on growth of 20 millimeters per month, the 30-60mm splittail caught at Mossdale from mid-May through mid-June were likely spawned in April. In early May, outflow began increasing, possibly reflooding areas isolated during decreasing flows in April. Peak May flows were similar to those of late March and early April, when much of the spawning probably took place (Figure 11). These flows may have allowed splittail that hatched and grew in isolated backwaters after early flows subsided to escape. It is unclear whether density, fish size, or some other environmental factor triggers emigration. It may be that water subsided below the flood plains and back into the channels, severely reducing habitat and increasing density, which led to emigration. Mossdale length data will allow investigation of whether size (length) may be related to emigration.

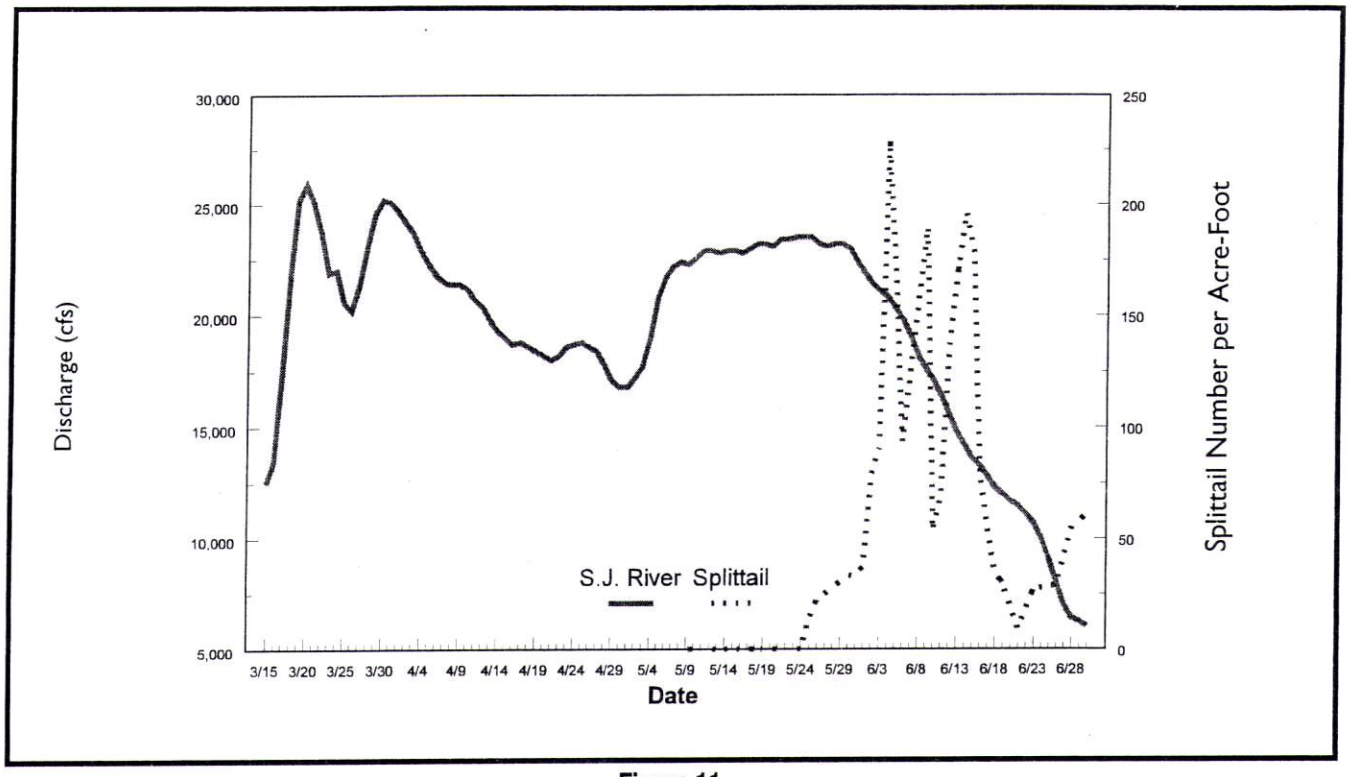

Figure 11
SPLITTAIL CATCH PER ACRE-FOOT AND SAN JOAQUIN RIVER FLOW

Relationships between Splittail CPUE at Different Sites

Since splittail were not marked, it was not possible to determine transit times for specific pulses of fish. If splittail move in response to large flows, the relatively large changes in discharge make it likely that there were large changes in transit times through the real-time sampling period. Attempting to predict times based on regression analyses produced somewhat incongruent results and, in general, poor relationships (r^2<0.30) between Mossdale and other real-time sites, except CVP and SWP.

Using data from May 9 through June 7, peak coefficients of determination (r^2) for Mossdale to CVP/SWP were 0.807 (n=25) using a 2-day lag and 0.956 (n=22) using a 1-day lag (Table 5). These coefficients are good, but offset times for the SWP would be expected to be the same as or higher than those for the CVP because of the slight added distance and operation of the Clifton Court Forebay gates. Due to gate operations, the day offset in the peak relationship between Mossdale and the SWP means the fish had to be drawn into Clifton Court Forebay on the same day as they were caught at Mossdale so they could show in the salvage the following day. At present, there is no way to reconcile this with the CVP data.

Relationships between CPUE at Mossdale and the locations with the next highest catches, Fay and Bacon islands, were weak. Coefficients of determination were 0.244 (n=23) for Fay Island and 0.079 (n=24) for Bacon Island (both for Mossdale+2 days). These predictions were too weak to provide any help in

Table 5
COEFFICIENTS OF DETERMINATION AND SAMPLE SIZES FOR LINEAR RELATIONSHIPS BETWEEN SPLITTAIL CATCH PER ACRE-FOOT AT CVP/MOSSDALE AND SWP/MOSSDALE, 1995 REAL-TIME MONITORING PROGRAM

Data do not include unidentified fish eventually determined to be splittail.

Sampling Day	CVP May 9 - June 7	CVP May 9 - June 30	SWP May 9 - June 7	SWP May 9 - June 30
Same Day	r^2=0.455, n=26	r^2 =0.483, n=42	r^2 =0.746, n=22	r^2=0.417, n=37
Day + 1	r^2=0.532, n=26	r^2 =0.572, n=41	r^2 =0.956, n=22	r^2=0.504, n=36
Day + 2	r^2=0.807, n=25	r^2 =0.688, n=41	r^2 =0.649, n=21	r^2=0.318, n=36
Day + 3	r^2=0.607, n=24	r^2 =0.470, n=40	r^2 =0.380, n=21	r^2=0.052, n=36
Day + 4	r^2 =0.943, n=22			
Day + 5	r^2 =0.782, n=22			

managing operations; however, they may incorporate a tidal effect that obscures the relationship.

Relationships between Mossdale and fish facility catches weakened when the complete dataset was used (Table 5). Since San Joaquin outflow dropped steadily through June, it is hypothesized that the difference between the time of the Mossdale catch and the time when the same fish reached the facilities changed over time, resulting in a weaker relationship.

Splittail CPUE at Georgiana Slough and Walnut Grove were strongly related (r^2=0.949, n=30) for samples taken on the same day (sampling period May 9-June 30). Comparisons with other sites were only made with Walnut Grove numbers. Walnut Grove catch was not predicted by catch at Sherwood. Neither site was on a 7-day-per-week sampling schedule and this limited sample sizes in the comparisons. There was not a significant relationship between Walnut Grove catch and that of Chipps Island.

Relationships between splittail salvage numbers and Chipps Island numbers were relatively strong (Table 6) and suggest that splittail trucked to the delta may have contributed significantly to the catch at Chipps Island.

Table 6
COEFFICIENTS OF DETERMINATION AND SAMPLE SIZES FOR LINEAR RELATIONSHIPS BETWEEN SPLITTAIL CATCH PER ACRE-FOOT AT CVP/CHIPPS ISLAND AND SWP/CHIPPS ISLAND, 1995 REAL-TIME MONITORING PROGRAM

Data do not include unidentified fish eventually determined to be splittail.

Sampling Day	CVP May 9 - June 30	SWP May 9 - June 30
Same Day	r^2=0.248, n=51	r^2 =0.508, n=46
Day + 1	r^2=0.193, n=50	r^2 =0.466, n=45
Day + 2	r^2=0.387, n=49	r^2 =0.459, n=44
Day + 3	r^2=0.283, n=48	r^2 =0.541, n=43
Day + 4	r^2 =0.170, n=48	r^2 =0.299, n=42

Problems

Although sampling for splittail every other day appears to adequately reveal patterns of increase and decrease at any site, it will not allow enough time to act upon data from the San Joaquin River before fish detected at Mossdale could be expected to reach CVP/SWP facilities. Sampling every other day would, therefore, be inconsistent with the RTM Program goal of reducing impacts at the pumps. Also, relationships between sites would be more difficult to determine because of fewer points for comparison.

Available data support the hypothesis that changes in outflow, tides, and pumping may affect splittail movement through the delta.

Recommendations

- Real-time monitoring for splittail should be conducted daily, particularly at San Joaquin River sites during periods of peak pulse movements.
- To effectively use real-time monitoring, the effects of outflow, tides, and pumping on splittail movement should be quantified. The high flows of 1995 will probably not be repeated in 1996, so a new set of transit relationships will result.

Real-Time Monitoring for Delta Smelt

During the real-time monitoring survey, 845 delta smelt were collected, with 694 (82%) collected at the Chipps Island site (RSAC075, Figure 12). Combined catch at Georgiana Slough (SLGOG18) and Walnut Grove (RSAC124) was 121 (14.3%); only 30 fish (3.6%) were caught at all other sites combined. Other sites where delta smelt were collected include: Webb Tract (ROLD01), Bacon Island (RMID12), Fay Island (ROLD22), and Jersey Point (RSAN017). No delta smelt were observed at Sherwood (RSAC142), Mossdale (RSAN-068), head of Old River (ROLD46), Dos Reis (RSAN051), the State Water Project, and the Central Valley Project.

The highest CPUE of delta smelt (0.31/acre-foot) was at Chipps Island on June 23. The highest CPUE per tow (1.21/acre-foot; 26 delta smelt/tow) was also at Chipps Island. Highest densities at other stations were: Walnut Grove (0.10/acre-foot on May 1); Georgiana Slough (0.056/acre-foot on May 2). CPUE at other stations did not exceed the 0.075/acre-foot per day recorded at Webb Tract on May 4.

In addition to young-of-the-year, adult delta smelt were also captured. To separate year classes, delta smelt less than 40mm were plotted separately. Figure 13 shows that most young-of-the-year were captured in June, and collection of adults was nearly continuous throughout the sampling period.

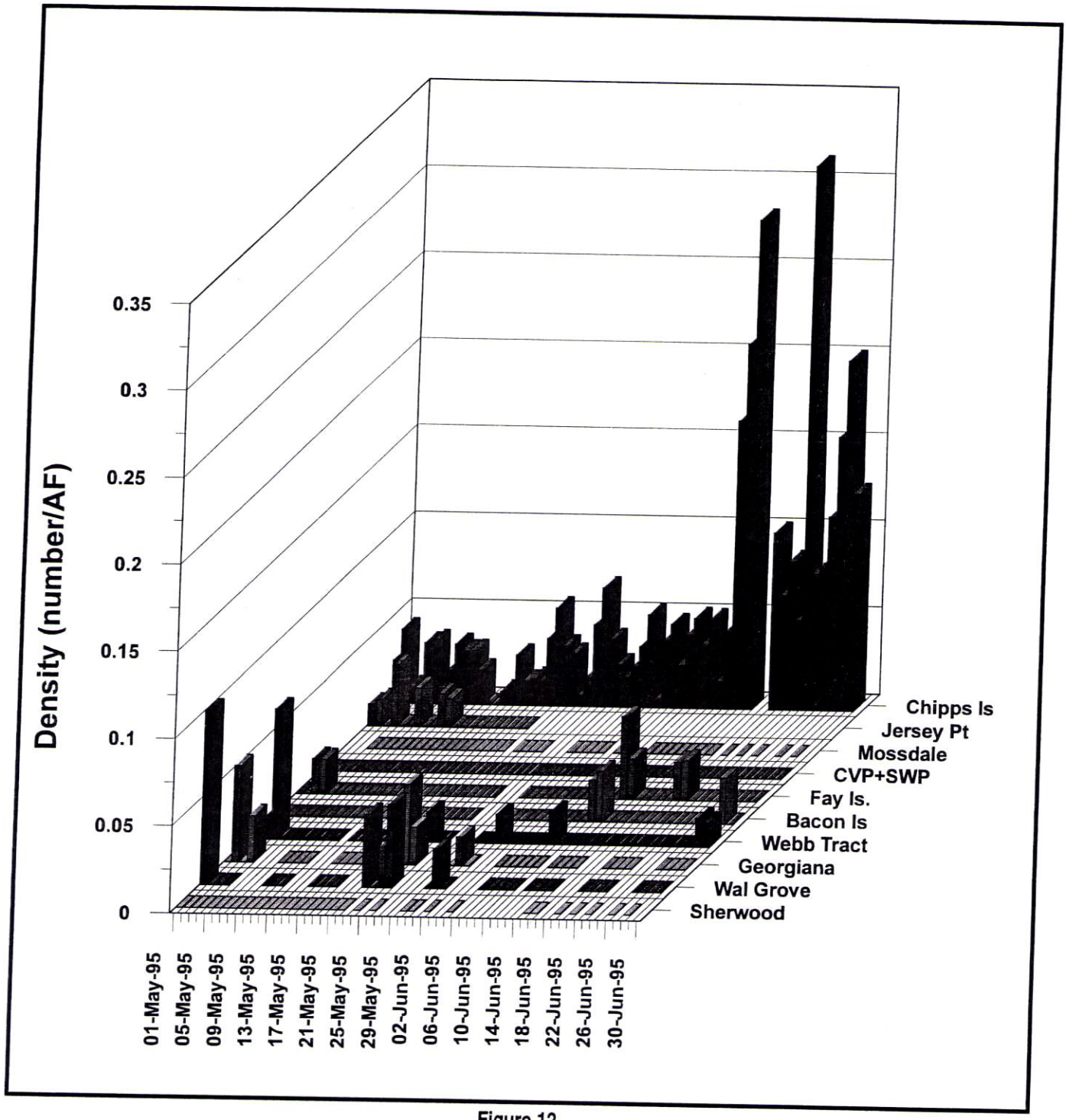

Figure 12
CATCH OF DELTA SMELT AT REAL-TIME MONITORING SITES
Zero catch is shown as a solid box. No sample is shown as an open box.

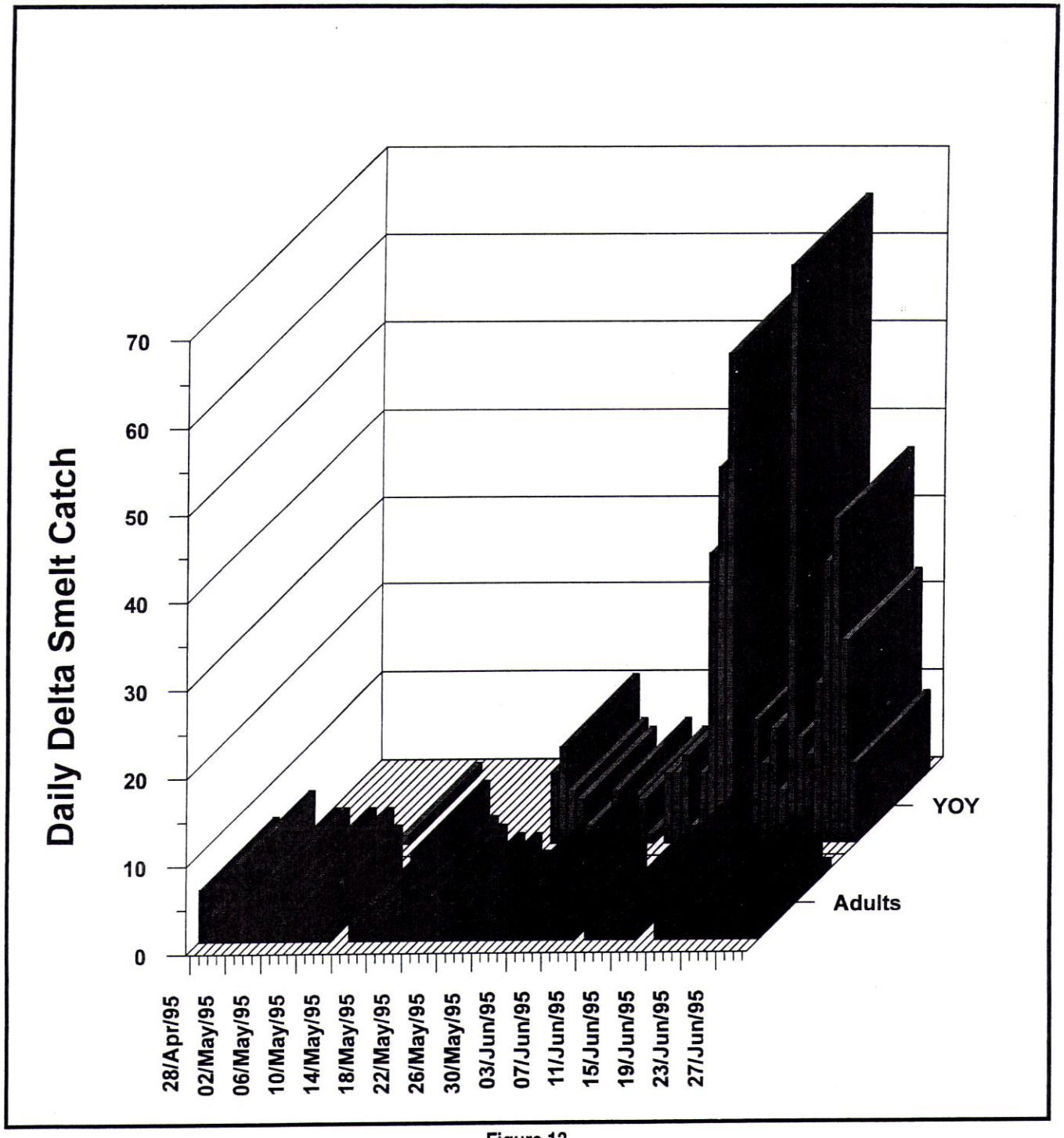

Figure 13
CATCH OF ADULT DELTA SMELT (>40mm) AND
YOUNG-OF-THE-YEAR DELTA SMELT (<40mm) AT CHIPPS ISLAND

Supplemental 20mm Survey for Delta Smelt

In addition to daily sampling at the RTM sites, a special 20mm survey was initiated in late April to give bimonthly information on the geographical distribution and relative abundance of young-of-the-year delta smelt about 15-50mm long at 35 sites throughout the estuary (Figure 14). These supplemental surveys were intended to provide twice-monthly information about the distribution and relative abundance of delta smelt throughout the estuary. Preliminary results are reported here to provide a backdrop for the RTM results.

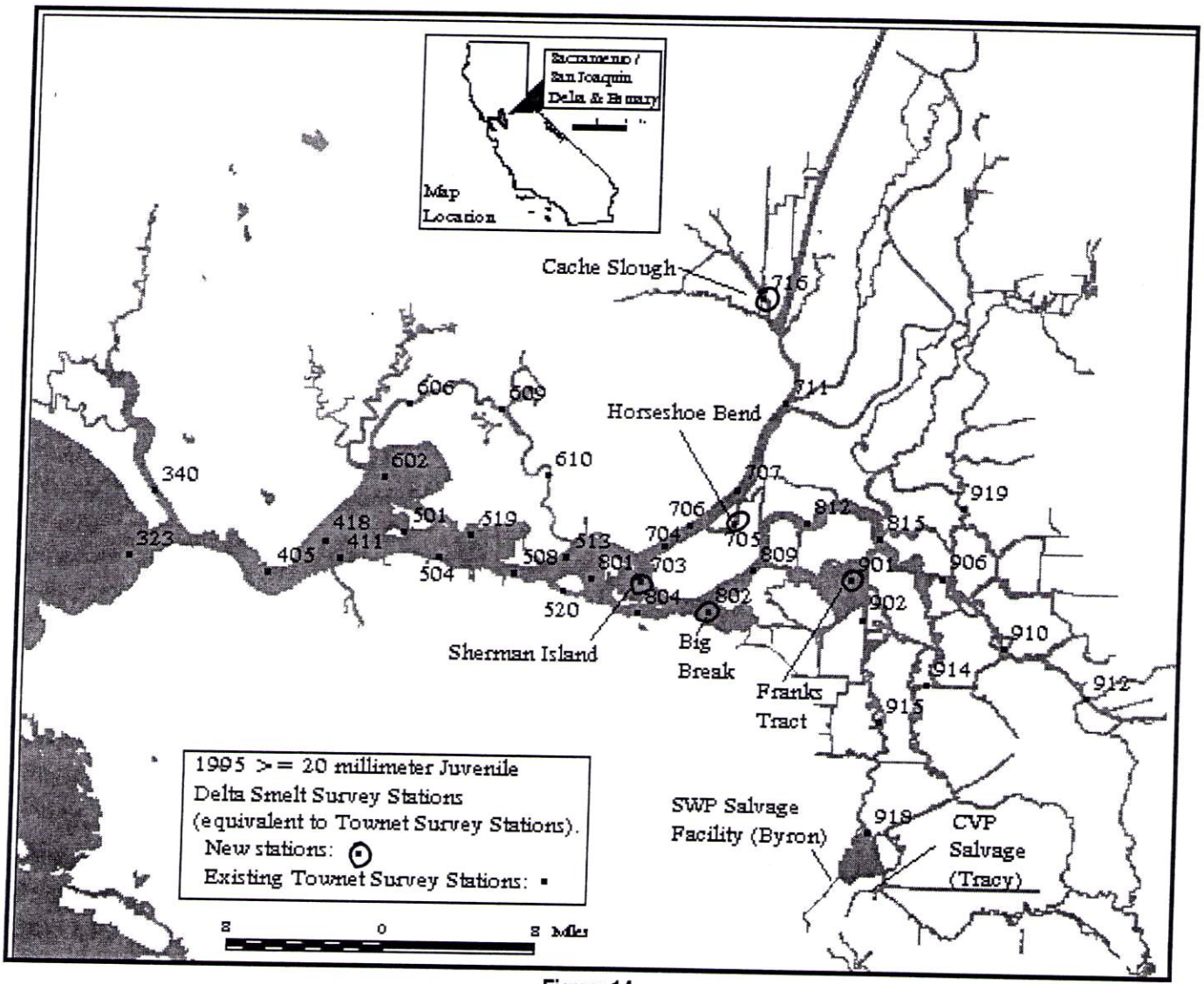

Figure 14
20-MILLIMETER DELTA SMELT SAMPLING SITES

Methods

To capture juvenile delta smelt for the 20mm survey, a 1600-micron plankton stretched-mesh net 5.1 meters long was mounted on a tow-net frame (a frame with skids, with a 1.5 m^2 mouth opening. The mesh size was based on the minimum width of a 20mm delta smelt reported by Griffin (pers. comm.) for screening purposes. A flowmeter, mounted across the mouth of the net, was used to estimate the volume of water sampled as the basis for calculating catch of smelt per unit volume of water sampled.

The 20mm survey was conducted every 14 days from April 24 through August 7 and was scheduled on neap tides:

Survey 1	April 24 - April 28
Survey 2	May 8 - May 12
Survey 3	May 22 - May 26
Survey 4	June 5 - June 9
Survey 5	June 19 - June 23
Survey 6	July 3 - July 7
Survey 7	July 17 - July 21
Survey 8	July 31 - August 7

Sampling sites roughly correspond to current summer tow-net sampling sites, with several added to sample shallow water habitats in Cache Slough, Horseshoe Bend, Franks Tract, Big Break, and Sherman Island, which may provide rearing habitat within the delta (Figure 14). These sites were chosen because they encompass the known range of delta smelt distribution, can be sampled in 5 days, and have been sampled before, which reduces the chances of losing nets due to hitting snags or debris. Three tows per station were conducted. This survey did not attempt to determine lateral distribution within channels.

The delta smelt larval survey sampling protocols were used with the tow-net tow schedule, which is an oblique tow. However, the tow schedules and boat towing speeds were modified because this net fishes differently than the tow net. Samples were preserved in 10% Formalin in quart jars (one quart jar per replicate, or smaller if possible). Large fish (>100mm) were identified in the field; all other fish were identified in the laboratory.

Results

The mean length of delta smelt collected in the first six surveys increased from 13.9mm during the last week of April to 30.5mm by the first week of July (Figure 15).

Throughout the real-time monitoring sampling period, the highest delta smelt catches per unit effort were recorded outside the delta, from the lower reaches of the Sacramento River to the mouth of the Napa River (Table 7). Within this general area, based on a comparison of CPUE at the various sampling sites, there were apparent shifts in distribution from sampling period to sampling period. Areas with the highest CPUE were:

- Survey 1 (catch = 11): Hastings Slough to Pittsburg and adjacent areas to Montezuma Slough
- Survey 2 (catch = 25): Pittsburg and adjacent areas in Montezuma Slough to the east end of San Pablo Bay, including Napa River
- Survey 3 (catch = 92): Decker Island in the Sacramento River to the mouth of the Napa River

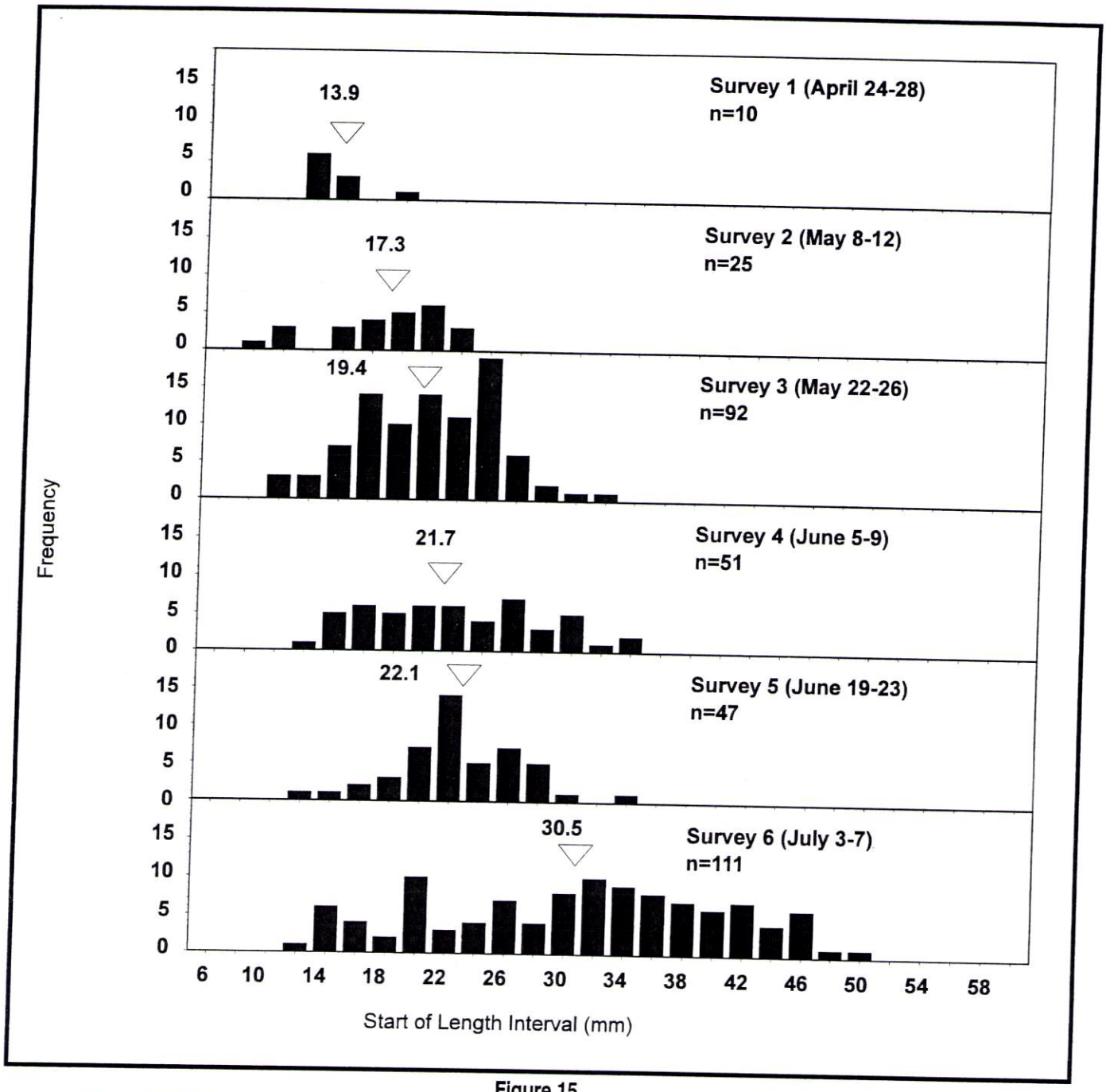

Figure 15
DELTA SMELT LENGTH FREQUENCY DISTRIBUTION FROM THE FIRST SIX 20-MILLIMETER SURVEYS
Bars represent the start of each length interval. Triangles represent the average length for each survey.

- Survey 4 (catch = 51): Sherman Island to Napa River, and adjacent areas in Montezuma Slough
- Survey 5 (catch = 47): Broad Slough to Napa River, and adjacent areas of Montezuma Slough
- Survey 6 (catch = 111): Cache Slough to Napa River, and adjacent areas of Montezuma Slough

These results are in substantial agreement with results of the summer tow-net survey, which found highest densities of delta smelt in Suisun and Honker bays. The distribution of delta smelt was generally consistent with the hypothesis that delta smelt are associated with areas of intermediate salinity.

A thorough discussion of the 1995 delta smelt 20mm survey will be presented in a separate report.

Table 7
MEAN CATCH PER UNIT EFFORT OF DELTA SMELT IN THE 20-MILLIMETER SURVEY

	Survey					
Area	1	2	3	4	5	6
Southern and Central Delta	0.000	0.000	0.000	0.000	0.000	0.000
Lower Sacramento River and Lower San Joaquin River	0.000	0.002	0.007	0.005	0.003	0.029
Confluence and Sherman Island	0.025	0.005	0.000	0.014	0.062	0.061
Suisun Bay, Honker Bay, and Montezuma Slough	0.017	0.028	0.114	0.108	0.049	0.148
San Pablo Bay including Napa River	0.000	0.080	0.199	0.056	0.019	0.0

Appendix A

PROPOSED 1996 REAL-TIME MONITORING PROGRAM

This draft of the proposed 1996 Real-Time Monitoring Program is being refined by the Project Work Team in a manner that will derive the maximum benefit of the sampling using available resources.

Proposed Real-Time Monitoring Program — October 24, 1995

November	December	January	February	March	April	May	June
Sacramento River at Sacramento (Sherwood Marina)							
Proposed salmon program with some additional help from RTM							
kt: 5d/wk **+2d** bs: 5d/wk **+2d** rst:5d/wk **+2d** *1 *2	kt: 5d/wk **+2d** bs: 5d/wk **+2d** rst:5d/wk **+2d** *1 *2	kt: 5d/wk **+2d** bs: 5d/wk **+2d** rst:5d/wk **+2d** *1 *2	kt: 5d/wk bs: 5d/wk	kt: 5d/wk bs: 5d/wk	mwt1: 5d/wk**+2d** *1	mwt1: 5d/wk**+2d** *1	mwt1: 5d/wk **+2d/wk 6/1-6/15** *1
San Joaquin River at Mossdale							
Either Region 4 or IEP will do sampling							
			kt: 3d/wk Starting date based on SJR tributary rst catches.	**kt: 3d/wk** Starting date based on SJR tributary rst catches.	**kt: 7d/wk**	**kt: 7d/wk**	**kt: 3d/wk**
Georgiana Slough and Sacramento River at Walnut Grove							
No expansion over planned Acoustic Barrier studies							
					kt: 4d/wk **kt: +3d/wk while Coleman fish are present**	kt: 4d/wk	kt: 4d/wk
San Joaquin River at Jersey Point							
Starting date will be established when planting date for Coleman fish is decided (4/7-6/1)							
					mwt1: 7d/wk See note for starting date.	**mwt1: 7d/wk**	
Turner Cut and Middle River at Columbia Cut							
Sites are sampled if barrier is installed at head of Old River (4/7-6/1)							
					kt: 7d/wk If barrier is in place and if delta smelt appear in the salvage.	**kt: 7d/wk** If delta smelt are collected in the central delta by the 20mm survey.	**kt: 7d/wk** If delta smelt are collected in the central delta by the 20mm survey.

*1 The "+2" indicates 2 additional days/week of sampling beyond planned salmon program.
*2 The rotary screw trap is in the Delta Cross Channel, not in the Sacramento River at Sherwood Marina.

Items in bold print indicate work being done by the Real-Time Monitoring Program
kt = kodiak trawl, mwt1 = small midwater trawl, mwt2 = large midwater trawl, bs = beach seine, rst = rotary screw trap

November	December	January	February	March	April	May	June
False River and Old River at Webb Tract							
Starting date will be established when planting date for Coleman fish is decided (4/7-6/1)							
			kt: 7d/wk Started if delta smelt are caught at Chipps Island.	**kt: 7d/wk** If done in February or if delta smelt are caught at Chipps Island.	**kt: 7d/wk** See note for starting date.	**kt: 7d/wk**	**kt: 7d/wk**
Old River at Bacon Island and Middle River at Fay Island							
Sampled only if 20mm survey delta smelt catch at Turner Cut, False River, Columbia Cut, or Old River at Webb Tract goes above a predetermined threshold.							
			kt: 7d/wk Started only if delta smelt are caught at False River or Old River at Webb Tract.	**kt: 7d/wk** If done in February or if delta smelt are caught at False River or Old River at Webb Tract.	**kt: 7d/wk** If done in March or if delta smelt are caught at False River or Old River at Webb Tract.	**kt: 7d/wk**	**kt: 7d/wk**
Cache Slough							
To be sampled only in a wet year when the bypasses flood							
						kt: 7d/wk	**kt: 7d/wk**

Possible Operation Options That Could Be Altered

November	December	January	February	March	April	May	June
Possible operation aspects that could be altered							
Close Delta Cross Channel.	Close Delta Cross Channel.	Close Delta Cross Channel.	Decision whether to go from 35% to 45%. "Take" may drive decision.	Pumping alterations.	Pumping alterations.	Reduce pumping. Close Delta Cross Channel after 5/22.	Reduce pumping. Close Delta Cross Channel.

*1 The "+2" indicates 2 additional days/week of sampling beyond planned salmon program.
*2 The rotary screw trap is in the Delta Cross Channel, not in the Sacramento River at Sherwood Marina.

Items in bold print indicate work being done by the Real-Time Monitoring Program
kt = kodiak trawl, mwt1 = small midwater trawl, mwt2 = large midwater trawl, bs = beach seine, rst = rotary screw trap

Concurrent Studies or Sampling Efforts Not Part of the 1995 Real-Time Monitoring Program

November	December	January	February	March	April	May	June
Delta Outflow/San Francisco Bay Study							
Once a month at 52 sites	Once a month at 52 sites	Once a month at 52 sites	Once a month at 52 sites	Once a month at 52 sites	Once a month at 52 sites	Once a month at 52 sites	Once a month at 52 sites
Delta Smelt 20mm Study							
					Twice a month at 43 sites	Twice a month at 43 sites	Twice a month at 43 sites
Midwater Trawl							
Once a month at 125 sites	Once a month at 125 sites	Once a month at 96 sites	Once a month at 96 sites	Once a month at 96 sites	Once a month at 96 sites		
USFWS Beach Seine Survey							
Lower Sacramento River - 9 sites; North Delta - 10 sites; Central Delta - 9 sites; South Delta - 12 sites							
2-4 days/month at each site	2-4 days/month at each site	2-4 days/month at each site	2-4 days/month at each site	2-4 days/month at each site	2-4 days/month at each site	2-4 days/month at each site	2-4 days/month at each site
Lower San Joaquin River - 7 sites							
		1 day/week at each site	1 day/week at each site	1 day/week at each site	1 day/week at each site	1 day/week at each site	1 day/week at each site
Chipps Island Salmon Trawl							
Part of proposed salmon program.							
mwt2: 4d/wk	mwt2: 4d/wk	mwt2: 7d/wk	mwt2: 4d/wk	mwt2: 4d/wk	mwt2: 7d/wk	mwt2: 7d/wk	mwt2: 7d/wk

Special Studies That Could Benefit Real-Time Monitoring or are Associated with Real-Time Monitoring

November	December	January	February	March	April	May	June
Head of Old River and San Joaquin River at Dos Reis							
Special study to determine split when no barrier is in at the head of Old River.							
					kt: 7d/wk starting 4/15	kt: 7d/wk until 5/15	

*1 The "+2" indicates 2 additional days/week of sampling beyond planned salmon program.
*2 The rotary screw trap is in the Delta Cross Channel, not in the Sacramento River at Sherwood Marina.

Items in bold print indicate work being done by the Real-Time Monitoring Program
kt = kodiak trawl, mwt1 = small midwater trawl, mwt2 = large midwater trawl, bs = beach seine, rst = rotary screw trap

Appendix B

INSTRUCTIONS TO REAL-TIME MONITORING CREWS

1995 IEP Real Time Monitoring Program

Instructions to Real Time Monitoring Crews
May 2, 1995

1. Safety is of primary importance. If the boat operator feels it is unsafe to work, then no work is done. If you have any questions regarding safety, speak with your crew leader, boat operator or call Chuck Armor, Mark Pierce, Rick Burmester or Jeff McLain.

2. If the presence of recreational boaters becomes such that safe operation is not possible, then trawling should cease for the day. In areas where recreational boaters pose problems, sampling should begin as early as possible in the day.

3. If a crew member feels that they can't do the job or can't do the job safely, they should notify the boat operator and designated crew leader.

4. For the first several weeks of the Real Time Monitoring survey, all field crews, except the Chipps Island crew, need to save all osmerids collected (delta smelt, wakasagi, and longfin smelt). These fish will be used in clarifying the identification of delta smelt and wakasagi. This procedure will be discontinued when sufficient smelt are collected. Osmerids from each tow shall be saved in whirl paks and kept on ice in a cooler chest along with the tagged (clipped) salmon and any other unidentified fish. Whirl paks as well as identification tags will be supplied. Please include: Date, Time, Station, Gear Type, Tow and initial identification of the osmerids (e.g. 7 ds, 1 wak) on the tag. Make sure that these fish are recorded on the original data sheets and noted with an asterisk (*). Samples need to be returned to Stockton at the end of the day and stored in the Sub-Zero Freezer (–60°C). If you go into this freezer make sure that the door is shut! If the alarm on the freezer goes off or the temperature rises to above -30°C, please notify Lisa Lynch immediately. It is possible that additional delta smelt will be needed for electrophoretic analyses. If so, procedures and dry ice will be provided.

5. Keep all fish which cannot be **positively** identified. Either make tentative identification or note as unidentified fish species A... and record them on the data sheet, and be sure to note these species on the data sheet using an asterisk (*). Place them in a plastic bag along with a tag indicating date, station, gear, tow number, species and length. Place the bag in the cooler chest and transfer to a freezer at the end of the day (see item 4).

6. Identify and measure all fish greater than 20 mm this includes the fish collected at Chipps Island.

7, Measure all fish using **fork length**, not total length or standard length.

8. **No fish may be kept for personal purposes**.

9. All data sheets shall be returned to the Stockton office at the end of each day. Exceptions to this is the work at Georgiana Slough and the work being done by DFG Region 4 at Mossdale where summary sheets will be faxed to the Stockton office at the end of the day or first thing in the morning.

10. Keep all chinook salmon that have a clipped adipose fin (ie. marked fish). Place each clipped (marked) salmon from each tow into a plastic bag along with a tag identifying the date, station, gear, tow number and length. Place the plastic bag in the cooler chest and place the specimens in the appropriate freezer upon returning to the Stockton office.

11. Each crew member is responsible for showing up at the designated locations at the time specified. Crew members should bring their lunch and any beverages they may want. Consumption of alcohol while on duty is prohibited.

12. All crew members are expected to act professionally while on duty or while in uniform.

13. If you are unable to work on an assigned day, call the person designated as the crew leader (this is indicated by the name being in bold face on the schedule) and inform them of your condition and when you will be able to return to work. If you can, make arrangements with one of the people listed as alternates for the day to take your place. If you cannot make arrangements for a replacement ask your crew leader to do so or contact the Study Contact Person [Chuck Armor (209) 948-7800 work or (209) xxx-xxxx home] and ask that an alternate be assigned.

14. PLEASE MAKE EVERY EFFORT TO CONTACT EITHER THE DESIGNATED CREW LEADER OR STUDY CONTACT PERSON AS SOON AS POSSIBLE IF YOU ARE NOT ABLE TO WORK ON AN ASSIGNED DAY. Making crew changes in the morning before sampling is to start is difficult on everyone.

15. Cellular phones are for business or emergency use only.

16. All sampling is to follow the protocols set forth in the USFWS document. A copy is included in each clipboard.

17. If the catch of delta smelt exceeds a total of 35 in any day or the catch of winter run size salmon exceeds 7 in any day, call the member of the Data Review Team at cell phone 209-xxx-xxxx and inform them of the situation. If there is no answer call the Stockton DFG office at 209-948-7800 and speak with one of the members of the Data Review Team (Kevin Fleming, Jenni Lott, Jane Arnold, Jim Starr, or Kevin Urquhart). The Data Review Team member will contact the Data Summary Team who have the responsibility to decide if the next days sampling effort will need to be reduced at that site, how much it will be reduced and how long the reduced effort will be in effect. This information will be communicated to the appropriate designated crew leaders.

18. If the catch of delta smelt exceeds 45 in any day or the catch of winter run size salmon exceeds 10 in any day, cease sampling for the day and call the member of the Data Review Team at cell phone 209-xxx-xxxx and inform them of the situation. If there is no answer, call the Stockton DFG office at 209-948-7800 and speak with one of the members of the Data Review Team (Kevin Fleming, Jenni Lott, Jane Arnold, Jim Starr or Kevin Urquhart). A decision will be made by the Data Summary Team as to resumption of sampling the following day and the appropriate field crew(s) will be notified.

19. **It is the duty of the designated crew leaders for each site to make sure the crew leader for the following day at that site is notified of any important information such as crew status, boat status, etc. and the location of the cellular telephone.**

20. If you have any questions about scheduling contact Mark Pierce, Rick Burmester or Chuck Armor.

Appendix C

SPLITTAIL CATCH PER ACRE-FOOT

Date	Sacramento River at Sherwood	Sacramento River at Walnut Grove	Georgiana Slough	Chipps Island	Old River at Webb Tract	Middle River at Bacon Island	Old River at Fay Island	State Water Project	Central Valley Project	San Joaquin River at Mossdale
05/09/95	0	0	0	0.0158	0	0	0	0.2942	0.2999	0
05/10/95	0	0	0.0276	0	0	0	0	0.0857	1.168	0.1087
05/11/95	0	0	0	0	0	0	0	0.2694	0.5959	0.032
05/12/95	0			0.0126	0	0	0	0.3529	0.7154	0.192
05/13/95	0			0	0	0	0.1855	0.3333	0.7059	0
05/14/95	0			0	0	0	0.1582	0.3174	0.5598	0
05/15/95	0	0	0	0.0076	0	0	0	0.5348	0.6911	0
05/16/95	0	0	0	0	0	1.5018	0.0956		0.916	0
05/17/95	0	0	0	0	0	0.0384	0		0.9466	0.0465
05/18/95	0	0	0	0.0046	0	0.2911	0		0.2482	0.0072
05/19/95	0			0	0	0.023	0		0.1536	0.0398
05/20/95	0			0.0047	0	0	0	0.0486	0.1331	0.1711
05/21/95	0			0.0092	0	0.0273	0	0.0725	0.1351	0.1319
05/22/95	0.0212	0	0.0241	0.0056	0	0.0505	0.2058	0.1094	0.3809	0.581
05/23/95		0.0625	0.1457	0.0053	0	0.1089	0.0806	0.177	0.4379	0.1316
05/24/95	0	0.1586	0.0744	0.0041	0	1.3987	3.1392	0.1081	0.4714	0.2105
05/25/95		3.1393	2.413	0.0301	0	5.3388	4.0089	0.0977	1.3061	13.5641
05/26/95	0.1266			0.1228	0	0.6687	49.8374	0.1212	1.0074	22.3685
05/27/95				0.3506				0.6536	2.9532	
05/28/95				0.1117				1.6959	2.5131	
05/29/95				0.2269				1.2496	2.4325	
05/30/95	0	1.5124	1.4717	0.2632	0	25.1714	49.2074	1.2007	4.4242	33.2273
05/31/95	0	0.061	0.1482	0.6621	0.0356	0.8908	0.3463	0.7557	8.5688	33.1952
06/01/95	0	0.1218	0.1733	0.5537	0.0181	0.1237	0.0452	3.8683	6.9593	37.3335
06/02/95	0			2.5682	0.0273	2.6911	0.3295	8.6522	15.4324	79.0381
06/03/95				0.8543	0	0.2198	0.618	15.0907	9.1679	90.9064
06/04/95				3.4358	0	2.3778	1.8212	31.1656	8.9666	228.3344
06/05/95	0.0219	0.0996	0	4.2135		1.2543	1.3639	51.0328	7.6808	166.4664
06/06/95		0.3559	0.5506	2.784	0.2607		28.5808	39.1502	21.0849	93.4077
06/07/95	0	0.5237	0.3208	1.6919	7.139	1.6932	29.7679	20.6579	16.8701	0
06/08/95		0.4683	0.6263	5.8765	0.7928	0.2089	2.2087	12.2227	11.4097	0
06/09/95	0.083			3.5852	5.391	1.0538	9.8833	8.6267	17.6584	189.1983
06/10/95				0.9504	0.3991	0.309	3.2346	11.1253	21.962	53.7565
06/11/95				0.9061	0.7361	0.1475	44.3713		29.1783	69.006
06/12/95	0.3773	0.3472	0.2548	0.6332	0.0302	11.0549	16.3423	2.7158	18.1204	137.5255
06/13/95		0.4719	0.048	0.7904	0.0613	8.8206	11.5243	6.96	9.9694	171.6359
06/14/95		0.3059	0.1459	1.6257	0.0823	0.1972	7.7988	19.1881	22.4446	195.9199
06/15/95	0	0.1053	0	1.7189	0.4141	0.3754	1.1513	4.5843	42.4873	177.9204
06/16/95	0			1.1779	0.3042	0.181	0.281	5.7698	15.9056	79.4896
06/17/95					0.1648	0.9968	0.3336	2.7738	11.9499	54.6082
06/18/95					0.2309	0.4842	0.3878	4.5403	9.1241	34.634
06/19/95	0	0.0208	0.0827	2.2565	0.053	0.1565	0.4091	1.0335	5.4874	30.0228
06/20/95		0	0	0.8165	0	0.0213	0.9264	1.2643	2.5391	
06/21/95	0	0	0	0.2813	0	0.1126	1.1806	0.6811	2.0571	9.4413
06/22/95		0.022	0	0.3389	0.0163	0.0247	0.2241	0.1308	1.5031	
06/23/95	0.0179			0.0931	0	0	0.2612	0.1654	1.7044	27.0043
06/24/95				0.0349	0	0.0217	0.1594	0.0528	1.7195	
06/25/95				0.0165	0.0314	0.039	0.0847	0.0884	1.5002	
06/26/95	0	0.023	0.024	0.0604	0	0.0226	0.0979	0.1308	1.5031	29.0705
06/27/95		0.0464	0	0.2075	0.1037	0.1008	0	0.8629	5.5527	
06/28/95	0.0208	0.0264	0.0256	0.1284	0.0464	0	0.0471	0.7431	10.4163	55.3968
06/29/95		0.0226	0.0259	0.7402	0.0538	0	0	2.4511	7.2489	
06/30/95	0			0.8684	0			2.7811	5.8382	61.3093