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# Results of 1988 Striped Bass Egg and Larva Study near the State Water Project and Central Valley Project Facilities in the Sacramento-San Joaquin Delta

Stephani A. Spaar
Department of Water Resources

Technical Report 25
June 1990

## Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary

A Cooperative Study By:

California Department of Water Resources
State Water Resources Control Board
U.S. Fish and Wildlife Service
California Department of Fish and Game
U.S. Bureau of Reclamation
U.S. Geological Survey

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# Abstract

A striped bass (*Morone saxatilis*) egg and larva sampling program was conducted from April 4 to July 11, 1988, in the southern Sacramento-San Joaquin Delta, near the intakes of the State Water Project and Central Valley Project. Entrainment losses of striped bass eggs were estimated to be 9.16 million at the SWP and 25.76 million at the CVP. Entrainment losses of larvae (fish <21 mm standard length, SL) were estimated to be 125.58 million at the SWP and 108.97 million at the CVP. The highest entrainment at both intakes was in the 36 mm SL size group. Striped bass yearling equivalent losses for fish less than 21 mm SL were 59,625 for the SWP and 51,085 for the CVP. Sampling conducted over 24- and 48-hour periods indicates that changes in larval densities (3-20 mm SL) tended to follow the tidal cycle as measured by fluctuations in water surface elevation and were also affected by SWP gate operations. At the SWP site, larval densities generally peaked, followed by a rapid decline, after opening of the SWP gates, especially on the ebb of a high-high tide. Replicate sampling indicated that densities could vary moderately from tow to tow and may be more variable during moderate to higher diversions when the SWP gates are open.

# Contents

Abstract . . . . . *iii*

Introduction . . . . . 1

Methods and Materials . . . . . 2

Special Studies . . . . . 5

Tidal Cycle Sampling . . . . . 5

Replicate Sampling . . . . . 5

Results . . . . . 6

State Water Project . . . . . 6

Central Valley Project . . . . . 7

Resident Fish and Other Species . . . . . 7

Tidal Cycle Sampling . . . . . 9

Replicate Sampling . . . . . 9

Discussion . . . . . 12

Recommendations . . . . . 15

Literature Cited . . . . . 17

## Appendixes

A Daily SWP Inflow and CVP Export, April 1 through July 11, 1988 . . . 19

B Laboratory Quality Control Program . . . . . 21

C Total Striped Bass Densities, by Size Group and Sample Site, Collected by South Delta Striped Bass Egg and Larva Survey, 1988 . . . . . 23

D Total Fish Densities, by Type and Sample Site, Collected by the South Delta Striped Bass Egg and Larva Survey, 1988 . . . . . 31

E Total Fish Densities for Striped Bass and Other Species, by Size Group, for the SWP and CVP Sites During 24- and 48-Hour Tidal Studies, May 17-18 and May 31-June 2, 1988 . . . . 39

## Figures


1 South Delta Striped Bass Egg and Larva Sampling Stations and State Water Project and Central Valley Project Diversion Sites 1988 . . . . . 3

2 Diurnal Variability in Striped Bass Densities and Water Surface Elevation near the SWP Intake, May 17-18, 1988 . . . . . 10

3 Diurnal Variability in Striped Bass Densities and Water Surface Elevation near the CVP Intake, May 17-18, 1988 . . . . . 10

4 Diurnal Variability in Striped Bass Densities and Water Surface Elevation near the SWP Intake, May 31-June 2, 1988 . . . . . 10

5 Diurnal Variability in Striped Bass Densities and Water Surface Elevation near the CVP Intake, May 31-June 2, 1988 . . . . . 10

6 Densities of Striped Bass Larvae for Replicated Tows near the SWP Intake, June 1988


## Tables


1 Striped Bass Egg and Larval Mean Density and Entrainment Estimates for the State Water Project Intake, 1988 . . . . . 6

2 Bimonthly Average of Environmental Parameters and Export Rates near Intakes to the SWP and CVP, April 1 through July 11, 1988 . . . 7

3 Striped Bass Yearling Equivalent Loss at SWP and CVP Export Facilities Based on Densities near the Intakes . . . . . 7

4 Striped Bass Egg and Larval Mean Density and Entrainment Estimates for the Central Valley Project Intake, 1988 . . . . . 8

5 Larval Fishes Collected at All Sites in the Southern Delta During the Striped Bass Egg and Larva Survey, 1988 . . . . . 8

6 Period of Highest Density and Entrainment of Striped Bass Eggs and Larvae at the SWP and CVP Intakes for 1985-1988 . . . . . 12

7 Striped Bass Egg and Larval Entrainment Estimates for the SWP and CVP Intakes, April through July 1985-1988 . . . . . 13

# Introduction

Water is exported south from the Sacramento-San Joaquin Delta by the State Water Project and the Federal Central Valley Project pumping plants in the southern Delta. Louver screens at the project intakes are not efficient for fish less than 20 mm SL, thus striped bass eggs and larvae are entrained with this water. Egg and larva loss estimates are based on density estimates of eggs and larvae near the project intakes and the amount of water diverted by the SWP and CVP facilities. The Department of Fish and Game had conducted this survey in previous years[1]. In 1988, the survey was conducted by the Department of Water Resources in cooperation with DFG. Sampling was also conducted in other channels near the diversion sites to determine the source of eggs and larvae transported toward the pumps.

1 P.F. Raquel. 1987. *Estimated Entrainment of Striped Bass Eggs and Larvae at State Water Project and Central Valley Project Facilities in the Sacramento-San Joaquin Delta, 1985 and 1986.* Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 13. 27 pp.
and
_____. 1988. *Estimated Entrainment of Striped Bass Eggs and Larvae at State Water Project and Central Valley Project Facilities in the Sacramento-San Joaquin Delta, 1987.* Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 15. 15 pp.

# Methods and Materials

An egg and larva survey was conducted from April 4 to July 11, 1988, at seven locations in the southern Delta (Figure 1):

- Station 91 (ROLD 38) is about 1/2 mile upstream of the Highway 4 bridge on Old River.
- Station 92 (DHWST 0) is on West Canal about 650 feet downstream of the intake to Clifton Court Forebay.
- Station 93 is on Old River about 2 miles upstream of the confluence of Old River and the CVP intake.
- Station 94 is on Grant Line Canal 2-1/8 miles upstream of the confluence of Grant Line Canal and Old River.
- Station 95 (CHNRT 0) is on North Canal about 300 feet downstream of the confluence of North Canal and Old River (where the canal becomes straight).
- Station 96 (ROLD 47) is on Old River about 1,300 feet downstream of the intake to the CVP.
- Station 98 (CHGRL 11) is on Grant Line Canal near the mouth of Salmon Slough.

These were the same sites monitored by the 1987 DFG survey. Stations 92 and 96 were used to determine entrainment estimates for the SWP and CVP, respectively.

The 1988 survey was conducted in the same manner as in previous years. Sampling was conducted at each station every other day from April 4 to July 11, 1988. Samples were collected by making a 10-minute oblique tow at each station, regardless of tidal stage, using an egg and larva net mounted on a towing frame with skis. When heavy blooms of filamentous algae occurred, 5-minute tows were necessary to reduce net clogging. Boat speed was adjusted to maintain a towing cable angle declination of about 71 degrees. A cone-shaped net 76 cm in diameter at the opening and 3 meters long, made of 505-micron mesh Nitex netting was used. The actual opening of the net when attached to the towing frame is D-shaped. A 32-ounce plastic collecting jar, screened with 470-micron mesh bolting cloth, was attached at the cod end.

At the end of each tow, contents of the net were rinsed into the collecting jar, and the sample preserved in 5 percent buffered formalin. Rose bengal dye was added to make the eggs and larvae more visible. The sampling methods are essentially the same as those used by DFG in its Delta striped bass egg and larva sampling program. The methods have been thoroughly described by Fusfeld-Low and Miller[2].

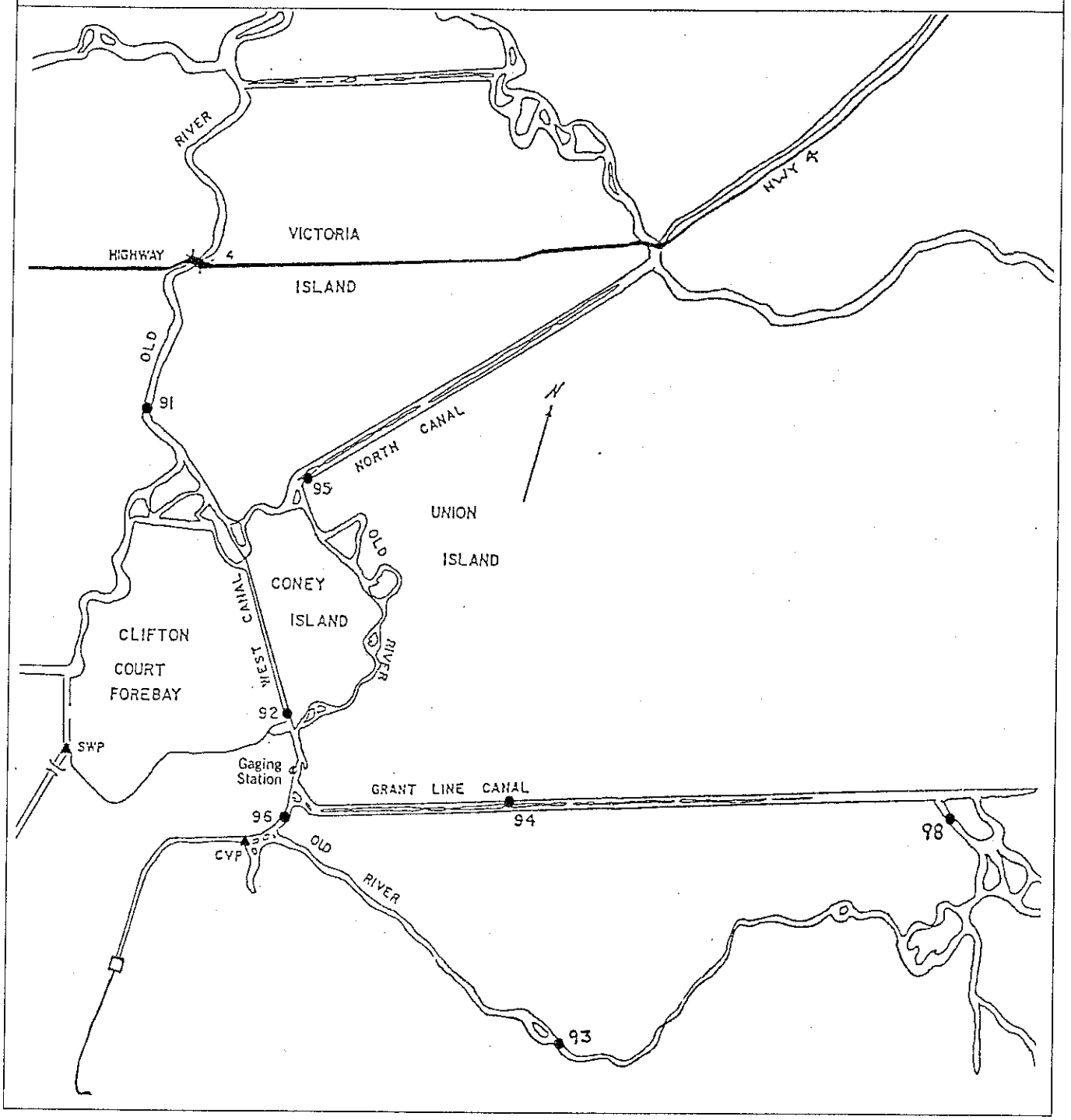
A digital flowmeter (Oceanics Model 2030), mounted in the net mouth, was used to estimate water flow through the net. The flow data were subsequently used to compute the cubic meters of water sampled. At the end of the sampling season, the flowmeter was calibrated in a flow tank at different velocities for a specific amount of time[3]. The difference in rotor counts observed was divided by the number of seconds the flowmeter was in the water. A calibration curve was generated by linear regression for the flowmeter.

Physical data were collected at each sampling station. Surface water temperature (degrees Fahrenheit) was measured with a mercury thermometer. A secchi disk was used to measure water transparency (cm). Specific conductance ($\mu$S/cm) was measured by collecting a water sample at the surface and analyzing it in the laboratory on a Beckman conductivity bridge (Model RC-19).

2 A. Fusfeld-Low and L.W. Miller. 1986. *1984 Striped Bass Egg and Larva Study in the Sacramento-San Joaquin Estuary*. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 11. 41 pp.

3 General Oceanics, Inc. 1983. *Digital Flowmeter Manual*. Miami, FL. 13 pp.

Figure 1
SOUTH DELTA STRIPED BASS EGG AND LARVA SAMPLING STATIONS
AND
STATE WATER PROJECT AND CENTRAL VALLEY PROJECT DIVERSION SITES
1988



The amount of water diverted by the SWP and CVP is monitored by each facility on a daily basis. The daily inflow (acre-feet) into Clifton Court Forebay for the SWP and the daily export (acre-feet) for the CVP for April through July were obtained from daily operation summaries for each facility[4] (Appendix A).

The Department of Water Resources contracted with a consultant, Johnson C.S.Wang, for the sorting, identification, and enumeration. In the laboratory, samples were rinsed thoroughly with water through a No. 50 sieve (300-micron mesh) to remove formalin, excess dye, and algae. Each sample was sorted under a magnifying illuminator and all fish eggs and larvae were removed and counted. Sample processing was subject to a strict quality control program (Appendix B).

Eggs were identified to species, where possible, and counted; striped bass eggs were further classified as dead, 0-8 hours old, or 9-36 hours old. Fish larvae were classified to family and, in some cases, to species. Striped bass larvae were measured to the nearest millimeter standard length (SL). About 5 percent of the identifications were reworked for quality control.

Estimates of numbers of striped bass eggs and larvae entrained by the SWP and CVP were derived from the density estimates (eggs or larvae per cubic meter) of eggs and larvae at the sample sites (Stations 92 and 96) just upstream of the intake of each facility and the amount of water diverted by each facility. Densities were calculated for all sizes of striped bass for each sample site, by day, and organized into size groups (eggs, 3-6 mm, 7-10 mm, 11-14 mm, 15-18 mm, and 19-20 mm SL larvae). Daily inflow into Clifton Court Forebay for the SWP and daily export by the CVP were multiplied by the appropriate density of eggs and larvae to estimate entrainment losses. Losses of yearling equivalents were estimated for each size range by multiplying the number of eggs or larvae entrained by the survival rates to age 1 for each size group. Survival rates were calculated by Ecological Analysts[5].

For days when no samples were taken, densities from the previous day were used to calculate entrainment. If a scheduled sample day or station was missed, the density estimate for the prior or nearest sampling day at that station was used to estimate entrainment losses for that day. For larger gaps in the sampling data, this method was used for the first and last scheduled sample day in the gap. Any other scheduled samples were estimated by interpolating between the prior and next actual sample days.

In 1988, the method used to measure the area of the net opening was changed to improve the estimate of the amount of water sampled. The old method measured the area of the net opening before it was attached to the towing frame. The area of the net opening is now measured as the actual open area of the net after it is attached to the frame. Estimates for 1985-1987 used in this report have been adjusted for the correct area of the net opening to be comparable with 1988 results. The correction factor applied to previous years increased those estimates by about 5 percent.

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4 California Department of Water Resources. 1988. *Dispatchers Daily Report, April 1 - July 31, 1988.* Operations and Maintenance Section.

5 Ecological Analysts. 1981. *Contra Costa Power Plant Cooling Water Intake Structures - 316(b) Demonstration,* prepared for Pacific Gas and Electric Company, 60-G-1.

The special studies were conducted to examine two areas of concern to striped bass egg and larva sampling methods. The routine egg and larva survey is conducted by making one tow at each station every other day at about the same time of day. There is some question as to whether taking one sample at each site is representative of actual egg and larva densities at that site during the time of the sample and throughout the day. Densities over a 24-hour period may be influenced by opening the gates at Clifton Court Forebay, the CVP pumping rate, the tidal cycle, and day and night. These concerns could apply to the Delta-wide survey as well, and information gained by the South Delta survey may help in evaluating technical adequacy of the broad survey.

## Tidal Cycle Sampling

The tidal sampling study was conducted to examine variations in egg and larva densities over 1-2 day sampling periods. Sampling began on a high or low tide the day before a regularly scheduled sampling day. Only sites 92 and 96 were sampled, with one tow per station at a minimum of 1.5-hour intervals. One 48-hour study (May 31-June 2) over two tidal cycles and one 24-hour study (May 17-18) over one tidal cycle were conducted. Routine sampling was integrated into the tidal sampling schedule. Changes in the tidal cycle were monitored at the DWR gaging station (B95340) in Old River at Clifton Court Ferry (Figure 1). Water surface elevation (in feet) from sea level (zero elevation) was measured at 15-minute intervals.

## Replicate Sampling

The replicate sampling study was conducted to measure variation in sample densities at the same site over a short time. Sampling was incorporated into regularly scheduled sampling days. Site 92 was sampled with four back-to-back tows per station in the least time possible at the end of the sample day. Replicate samples were taken on June 7, 13, 15, and 17.

# Results

Total estimated entrainment of striped bass eggs and larvae (SL < 21 mm) in 1988 was 134.74 million by the SWP and 134.73 million by the CVP. Total SWP inflow to Clifton Court Forebay during the survey period was 694,810 acre-feet. Total CVP exports were 700,076 acre-feet. Additional results on striped bass densities, by size group and sample site, are included in Appendix C.

## State Water Project

Striped bass eggs were first observed near the SWP intake on April 24, 1988. The 2-week period of highest mean density was May 1-15, with 0.0236 eggs per cubic meter (Table 1). No eggs were collected at this site after May 20, 1988.

Striped bass larvae were first collected on April 16 — before the first eggs were seen at this site. May 16-31 was the period of highest mean density for 3-20 mm larvae, with 0.4044 larvae per cubic meter.

SWP export rates and several environmental parameters were also averaged bimonthly (Table 2). Intake rates at the SWP were greatest during April 16-30, with a daily average of 10,620 acre-feet diverted.

Total estimated entrainment of striped bass eggs and larvae was 134.74 million (Table 1) — 9.16 million eggs and 125.58 million larvae. The highest entrainment at the SWP was for 3-6 mm larvae, with entrainment estimated at 68.36 million. The estimate decreased with each successive size group.

Estimates of entrainment losses for striped bass eggs and larvae were converted to an equivalent number of age 1 fish by multiplying the entrainment estimates by the survival rates to

Table 1
STRIPED BASS EGG AND LARVAL MEAN DENSITY AND ENTRAINMENT ESTIMATES FOR THE STATE WATER PROJECT INTAKE, 1988

| | Size Groups | | | | | | |
|---|---|---|---|---|---|---|---|
| | Eggs | 3-6 mm | 7-10 mm | 11-14 mm | 15-18 mm | 19-20 mm | 3-20 mm |
| **Density*** *(Fish per Cubic Meter)* | | | | | | | |
| April 1-15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| April 16-30 | 0.0140 | 0.0493 | 0.0139 | 0 | 0 | 0 | 0.0632 |
| May 1-15 | 0.0236 | 0.0443 | 0.0776 | 0 | 0 | 0 | 0.1219 |
| May 16-31 | 0.0130 | 0.3077 | 0.0908 | 0.0058 | 0 | 0 | 0.4044 |
| June 1-15 | 0 | 0.1630 | 0.1758 | 0.0166 | 0.0007 | 0 | 0.3561 |
| June 16-30 | 0 | 0.0213 | 0.0462 | 0.0212 | 0.0087 | 0.0032 | 0.1007 |
| July 1-15 | 0 | 0.0043 | 0.0195 | 0.0076 | 0.0055 | 0.0014 | 0.0383 |
| **Entrainment*** | | | | | | | |
| April 1-15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| April 16-30 | 2895531 | 9542192 | 2845007 | 0 | 0 | 0 | 12387199 |
| May 1-15 | 4351681 | 7493540 | 14295471 | 0 | 0 | 0 | 21789011 |
| May 16-31 | 1909129 | 32563256 | 9371679 | 197722 | 0 | 0 | 42132657 |
| June 1-15 | 0 | 15641648 | 17013499 | 1556556 | 85092 | 0 | 34296794 |
| June 16-30 | 0 | 2728333 | 4854243 | 2434570 | 1081918 | 367322 | 11466387 |
| July 1-15 | 0 | 393163 | 1738033 | 686592 | 537328 | 152545 | 3507662 |
| Total | 9156342 | 68362134 | 50117931 | 4875440 | 1704338 | 519868 | 125579711 |
| Grand Total | | | | | | | 134,736,053 |

* Includes estimated values for May 4 to 11, 1988, for sample days missed due to sampling gear problems.

age 1 for each size group. Striped bass yearling equivalent loss for the SWP was 59,625 fish (Table 3). Highest SWP losses in terms of yearling equivalents occurred in the 7-10 mm size group.

## Central Valley Project

Striped bass eggs were first observed near the CVP intake on April 20. The 2-week period of highest mean egg density was May 1-15, with an estimated 0.1104 eggs per cubic meter (Table 4). No eggs were found at this site after May 24.

Striped bass larvae were first collected near the CVP intake on April 6. May 16-31 was the period of highest mean density for 3-20 mm larvae, with 0.5147 larvae per cubic meter.

Intake rates at the CVP were greatest during July 1-11, with a daily average of 8,727 acre-feet diverted (Table 2).

Total estimated entrainment of striped bass eggs and larvae was 134.73 million (Table 4) – 25.76 million eggs and 108.97 million larvae. The larval group with highest entrainment losses was the 3-6 mm group, with 71.55 million entrained. Again, entrainment estimates decreased as the larval size group increased.

Estimates of entrainment losses for striped bass eggs and larvae were converted to an equivalent number of age 1 fish by multiplying the entrainment estimates by the survival rates to age 1 for each size group. Striped bass yearling equivalent loss for the CVP was 51,085 fish (Table 4). CVP losses in terms of yearling equivalents were highest for the 11-14 mm size group.

## Resident Fish and Other Species

Many species of fish other than striped bass are found in the southern Delta. The 1989 survey collected 14 varieties of larval fish (Table 5).

Prickly sculpin, striped bass, and threadfin shad, the most abundant fishes in the catches, accounted for 91 percent of the total catch. Chameleon goby and Delta smelt were moderately low in abundance and comprised less than 2 percent of the total catch. Splittail, yellowfin goby, and longfin smelt were less than 0.5 percent of the total catch. Densities of resident fish and other species at each station are listed in Appendix D.

Table 2
BIMONTHLY AVERAGE OF ENVIRONMENTAL PARAMETERS AND EXPORT RATES NEAR INTAKES TO THE SWP AND CVP, APRIL 1 THROUGH JULY 11, 1988

| | Specific Conductance (µS/cm) | Secchi Disk (cm) | Temperature (°F) | Export (ac-ft) |
|---|---|---|---|---|
| **SWP** | | | | |
| April 1-15 | 559 | 94 | 61 16C | 6,683 |
| April 16-30 | 358 | 63 | 62 | 10,620 |
| May 1-15* | 372 | 60 | 64 | 8,266 |
| May 16-31 | 395 | 44 | 67 | 4,484 |
| June 1-15 | 466 | 31 | 68 | 5,216 |
| June 16-30 | 484 | 34 | 74 | 5,832 |
| July 1-11 | 548 | 38 | 75 | 6,709 |
| **CVP** | | | | |
| April 1-15 | 595 | 75 | 61 | 8,055 |
| April 16-30 | 414 | 57 | 62 | 8,100 |
| May 1-15* | 361 | 54 | 63 | 6,163 |
| May 16-31 | 435 | 40 | 67 | 5,640 |
| June 1-15 | 473 | 31 | 68 | 6,003 |
| June 16-30 | 551 | 34 | 73 | 5,870 |
| July 1-11 | 610 | 34 | 75 | 8,727 |

* No data available for May 4 to May 11, 1988 because of missed sample days due to sampling gear problem.

Table 3
STRIPED BASS YEARLING EQUIVALENT LOSS AT SWP AND CVP EXPORT FACILITIES BASED ON DENSITIES NEAR THE INTAKES AND ON WATER EXPORTS APRIL 4 THROUGH JULY 11, 1988

| | Survival Rate to Age 1* | SWP | CVP |
|---|---|---|---|
| Eggs | 0.000047 | 430 | 1,211 |
| 3-6 mm | 0.000124 | 8,477 | 8,872 |
| 7-10 mm | 0.000338 | 16,940 | 10,459 |
| 11-14 mm | 0.002509 | 12,232 | 11,392 |
| 15-18 mm | 0.006415 | 10,933 | 9,346 |
| 19-20 mm | 0.020414 | 10,613 | 9,805 |
| Total | | 59,625 | 51,085 |

* Survival rates to age 1 for different size groups were calculated by Ecological Analysts, 1981. Egg survival rate was estimated by calculating the potential number of eggs spawned compared to the estimated number of age 1 fish in the estuary.

Table 4
STRIPED BASS EGG AND LARVAL MEAN DENSITY AND
ENTRAINMENT ESTIMATES FOR THE CENTRAL VALLEY PROJECT INTAKE, 1988

| | Eggs | Size Groups 3-6 mm | 7-10 mm | 11-14 mm | 15-18 mm | 19-20 mm | 3-20 mm |
|---|---|---|---|---|---|---|---|
| **DENSITY*** *(Fish per Cubic Meter)* | | | | | | | |
| April 1-15 | 0 | 0.0008 | 0 | 0 | 0 | 0 | 0.0008 |
| April 16-30 | 0.0131 | 0.0402 | 0.0014 | 0 | 0 | 0 | 0.0417 |
| May 1-15 | 0.1104 | 0.0719 | 0.0221 | 0 | 0 | 0 | 0.0940 |
| May 16-31 | 0.0922 | 0.3954 | 0.1193 | 0 | 0 | 0 | 0.5147 |
| June 1-15 | 0 | 0.0871 | 0.0752 | 0.0160 | 0.0008 | 0.0003 | 0.1794 |
| June 16-30 | 0 | 0.0174 | 0.0472 | 0.0193 | 0.0123 | 0.0028 | 0.0991 |
| July 1-15 | 0 | 0.0096 | 0.0272 | 0.0065 | 0.0007 | 0.0015 | 0.0455 |
| **ENTRAINMENT*** | | | | | | | |
| April 1-15 | 0 | 89799 | 0 | 0 | 0 | 0 | 89799 |
| April 16-30 | 1963163 | 6039378 | 213661 | 0 | 0 | 0 | 6253039 |
| May 1-15 | 12770508 | 8318698 | 2593242 | 0 | 0 | 0 | 10911940 |
| May 16-31 | 11026832 | 45216688 | 11940158 | 0 | 0 | 0 | 57156846 |
| June 1-15 | 0 | 9068477 | 8497931 | 1798964 | 92468 | 25989 | 19483828 |
| June 16-30 | 0 | 1928881 | 4920558 | 2055786 | 1301913 | 295300 | 10502438 |
| July 1-15 | 0 | 883130 | 2777064 | 685740 | 62531 | 159036 | 4567501 |
| Total | 25760504 | 71545053 | 30942613 | 4540490 | 1456912 | 480325 | 108965391 |
| Grand Total | | | | | | | 134,725,895 |

* Includes estimated values for May 6 to 11, 1988, for sample days missed due to sampling gear problems.

Table 5
LARVAL FISHES COLLECTED
AT ALL SITES IN THE
SOUTHERN DELTA DURING THE
STRIPED BASS EGG AND LARVA SURVEY, 1988

| Species | Type* | Total Catch** | % of Total Catch |
|---|---|---|---|
| Prickly sculpin | F-E | 6,874 | 39 |
| Striped bass | E | 5,951 | 34 |
| Threadfin shad | E | 3,114 | 18 |
| Cyprinidae | F | 637 | 4 |
| Lepomis spp. | F | 293 | <2 |
| Chameleon goby | E | 291 | <2 |
| Bigscale logperch | F | 144 | <1 |
| Delta smelt | E | 101 | <1 |
| Splittail | E | 26 | <0.5 |
| Ictalurus spp. | F | 26 | <0.5 |
| Sacramento sucker | F | 19 | <0.5 |
| Inland silverside | F-E | 15 | <0.5 |
| Yellowfin goby | E-M | 4 | <0.5 |
| Longfin smelt | E | 1 | <0.5 |
| Total | | 17,496 | |

* E = Estuarine, F = Freshwater, M = Marine.
** Actual number of fish caught.

## Tidal Cycle Sampling

The tidal sampling study examined variations in sample densities at the SWP and CVP stations over 24- and 48-hour periods. The following results are based on data from only one survey season and should be replicated before implementing any changes in the sampling program. Striped bass densities, by size group, and densities for other species are listed in Appendix E.

Density of striped bass larvae varied over the 24-hour study (May 17-18) at both the SWP and CVP sites (Figures 2 and 3). Density patterns of 3-20 mm larvae near the SWP were generally very similar to those near the CVP. The majority of larvae collected were 3-6 mm, with a few at 7-10 mm.

During the low-high tide on the night of May 17, a small increase in density of 3-20 mm larvae (from 0.1865 to 0.5379 larvae per cubic meter) occurred near the CVP between 2006 and 2130 hours. At the SWP site, the density decreased during about the same period (2031 to 2158 hours) from 0.1770 to 0.0373 larvae per cubic meter, probably due to the opening of the SWP gates. The gates were open for about 6.5 hours during this time. Total diversions for the day were 7,934 acre-feet at the SWP and 6,389 acre-feet at the CVP.

In general, densities were fairly low and stable until after the peak in water surface elevation with a high-high tide on May 18. At both sites, larval densities increased rapidly and peaked about 2 hours after the peak in water surface elevation and within about 1 hour of the opening of the SWP gates. After this peak, densities declined rapidly with the decline in water surface elevation on the outgoing tide and the diversion of flow to the SWP. The SWP gates were open for about 4 hours during this time. Total diversions for the day were 7,141 acre-feet at the SWP and 6,405 acre-feet at the CVP.

Results from the SWP and CVP sites during the 48-hour study (May 31-June 2) are not as similar to each other as were the 24-hour results (Figures 4 and 5). Again, 3-6 mm larvae were the most abundant, followed by 7-10 mm larvae. Larvae 11-14 mm in size were more abundant in these samples than in the 24-hour study.

In general, SWP densities appeared to be related to fluctuations of the water surface elevation and SWP gate operations. Except for May 31, however, SWP densities did not follow water surface elevation in exactly the same way as during the 24-hour study (Figures 2 and 4). Peaks in density usually occurred after the opening of the SWP gates, but some peaks also occurred when the gates were closed and water surface elevation was rising, such as at 0400 on June 1 and 0430 on June 2.

At the CVP site, striped bass densities seemed to be more randomly distributed with changes in water surface elevation. Peaks in densities at low water surface elevations could be due to fish being drafted toward the CVP on ebb tides from upstream in Old River (Station 93). Total daily diversions (in acre-feet) were:

| | SWP | CVP |
|---|---|---|
| May 31 | 3,233 | 4,840 |
| June 1 | 6,157 | 4,824 |
| June 2 | 7,466 | 4,826 |

## Replicate Sampling

The replicate sampling study looked at variation in sample densities near the SWP intake (Station 92) with back-to-back tows. The following results are based on data from only one survey season and should be replicated before implementing any changes in the sampling program. The following striped bass densities are the results of these tows (* indicates SWP gates were open):

| | Larvae per Cubic Meter | | | |
|---|---|---|---|---|
| | June 7 | June 13 | June 15 | June 17 |
| Tow 1 | 0.0368* | 0.6018* | 0.1896 | 0.0116* |
| Tow 2 | 0.2240* | 0.7098* | 0.3025 | 0.1023 |
| Tow 3 | 0.0839* | 0.4681* | 0.1913 | 0.1126 |
| Tow 4 | 0.2062* | 0.2263 | 0.2372 | 0.1512 |
| Mean | 0.1377 | 0.5015 | 0.2302 | 0.0944 |
| SD | 0.0917 | 0.2084 | 0.0530 | 0.0591 |
| 95% Confidence Limits: | | | | |
| Low | -0.0082 | 0.1699 | 0.1459 | 0.0004 |
| High | 0.2836 | 0.8331 | 0.3145 | 0.1884 |
| SWP Diversions (acre-feet): | | | | |
| | 4,224 | 5,246 | 1,507 | 1,542 |

Figure 2
DIURNAL VARIABILITY IN STRIPED BASS DENSITIES AND WATER SURFACE ELEVATION (- - -) NEAR THE SWP INTAKE, MAY 17-18, 1988

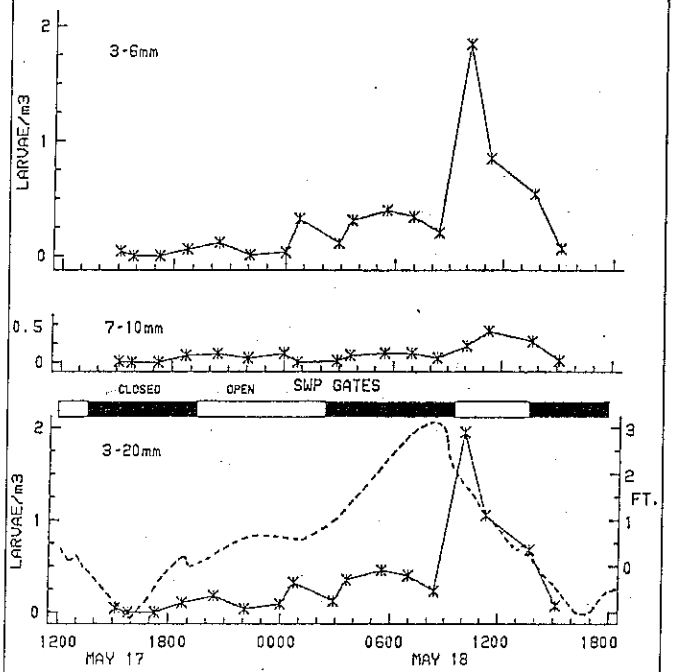



Figure 3
DIURNAL VARIABILITY IN STRIPED BASS DENSITIES AND WATER SURFACE ELEVATION (- - -) NEAR THE CVP INTAKE, MAY 17-18, 1988

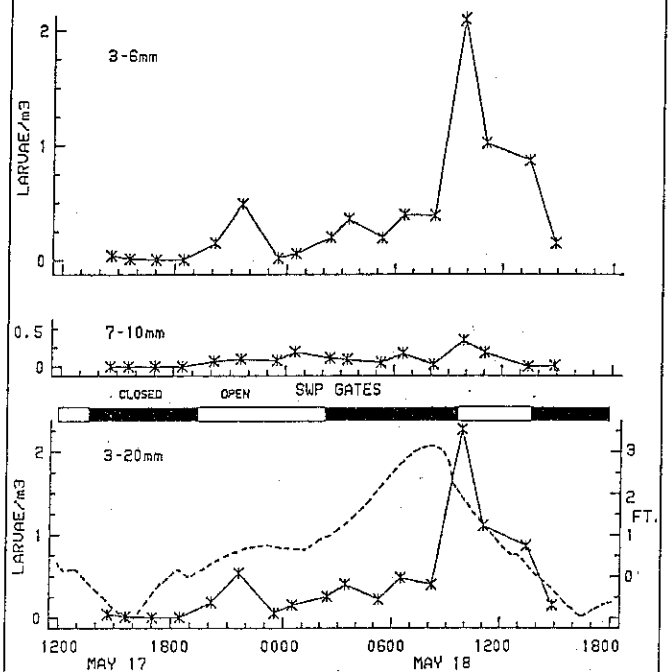



Figure 4
DIURNAL VARIABILITY IN STRIPED BASS DENSITIES AND WATER SURFACE ELEVATION (- - -) NEAR THE SWP INTAKE, MAY 31-JUNE 2, 1988

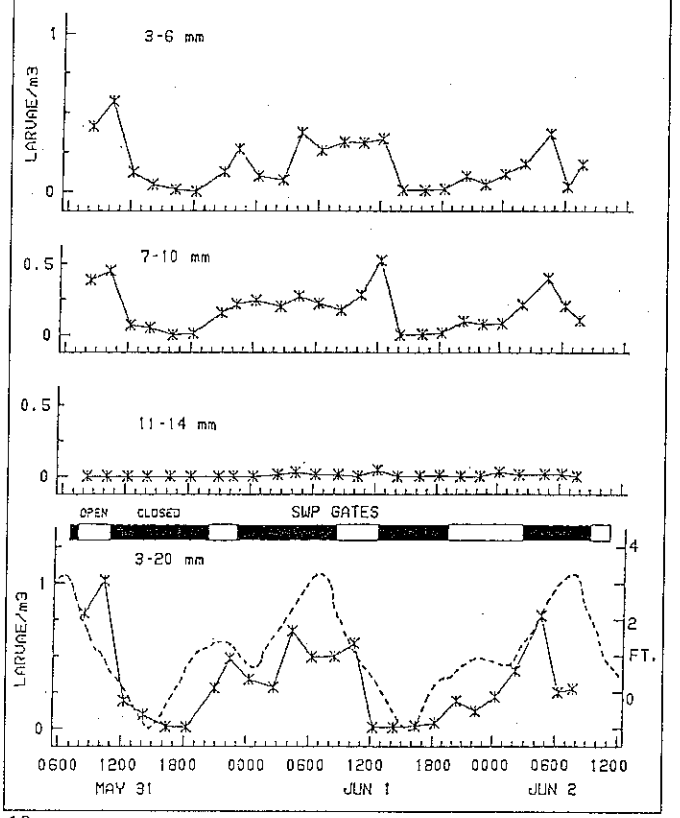
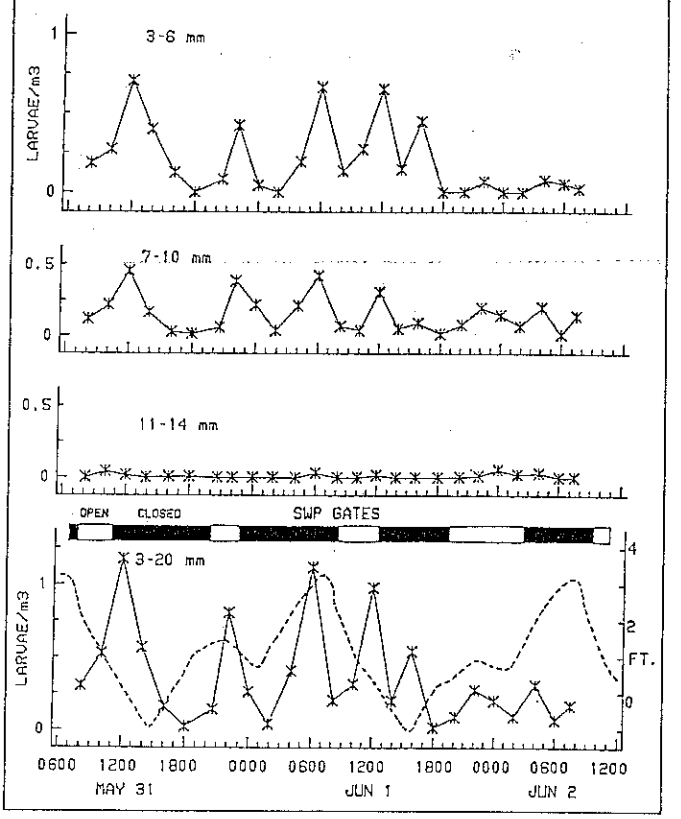



Figure 5
DIURNAL VARIABILITY IN STRIPED BASS DENSITIES AND WATER SURFACE ELEVATION (- - -) NEAR THE CVP INTAKE, MAY 31-JUNE 2, 1988



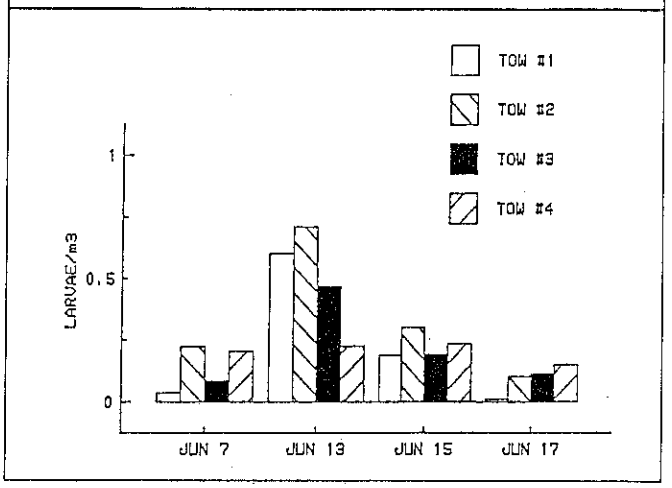
In general, the density of striped bass larvae (3-20 mm) varied moderately from tow to tow (Figure 6). The amount of variability between tows was not very consistent from day to day. Days when diversion rates were higher and the SWP gates were open during most tows (June 7 and 13) showed more variability between tows than days of lower diversions and closed gates. In addition, confidence limits of the means were wider on June 7 and 13. Based on variation in densities observed in the tidal study, the variation between tows may be due to effects of the tidal cycle and SWP gate operations, in conjunction with the time lag between the four tows. The variation between tows could also indicate a patchy nature in distribution of larvae in the channel.

Effects of variation in larval densities between tows on entrainment estimates were based on daily minimum, maximum, and mean densities and on confidence limits of the means, as given below:

| | Number of Larvae Entrained | | | |
|---|---|---|---|---|
| | June 7 | June 13 | June 15 | June 17 |
| Minimum | 191,738 | 3,029,023 | 352,442 | 22,064 |
| Maximum | 1,167,099 | 4,593,037 | 562,308 | 287,589 |
| Mean | 717,453 | 3,245,151 | 427,912 | 179,553 |
| Lower Limit | 0 | 1,099,396 | 271,021 | 761 |
| Upper Limit | 1,477,619 | 5,390,856 | 584,610 | 358,342 |

In most cases, entrainment estimates based on mean density were substantially different than estimates based on maximum and minimum densities for that day and those based on confidence limits.

Figure 6
DENSITIES OF STRIPED BASS LARVAE (3-20 mm) FOR REPLICATED TOWS NEAR THE SWP INTAKE, JUNE 1988




The total estimated number of larvae entrained for the four days was compared based on 4-day totals by tow number and the daily mean, as follows:

| | |
|---|---|
| Tow 1 | 4,460,425 |
| Tow 2 | 6,517,023 |
| Tow 3 | 4,035,936 |
| Tow 4 | 3,267,231 |
| Mean | 4,570,069 |

In this case the entrainment estimate based on the first tow was fairly close to that of the mean, but estimates based on the other tows were not as accurate.

# Discussion

In the spring and summer of 1988, entrainment losses of striped bass eggs and larvae were estimated from measurements of egg and larva densities near the SWP and CVP diversions and the volume of water exported by these pumping plants. It appears that the 1988 survey was largely successful in monitoring the start of the spawning period and entrainment season, since few eggs or larvae were collected near the pumping plants within the first six sample days. According to results for 1985-1988, eggs and larvae are generally first observed during the April 1-15 period and are more abundant by the April 16-30 period[6].

The peak period of egg density in 1988, May 1-15, was similar in timing to 1985 at both the SWP and CVP intakes and to 1986 at the SWP site (Table 6). In 1987, the spawn was early, probably due to higher than normal spring water temperatures during the drought year.

The peak period of larval density is usually directly after the peak period of egg density. In 1988, this peak occurred during the last half of May at both the SWP and CVP sites, which is similar to the 1985 and 1986 surveys (Table 6).

Timing of peak egg and larva densities generally varies between the two sites. These yearly

Table 6
PERIOD OF HIGHEST DENSITY *(Fish per Cubic Meter)* AND ENTRAINMENT OF STRIPED BASS EGGS AND LARVAE AT THE SWP AND CVP INTAKES FOR 1985-1988*

| YEAR** | PERIOD | EGGS | PERIOD | LARVAE | SIZE |
|---|---|---|---|---|---|
| SWP DENSITY | | | | | |
| 1985 | May 1-15 | 0.6372 | May 1-15 | 0.6359 | 3-6 mm |
| 1986 | May 1-15 | 0.0291 | May 16-31 | 0.1640 | 3-6 mm |
| 1987 | April 16-30 | 0.0156 | May 1-15 | 0.3687 | 7-10 mm |
| 1988 | May 1-15 | 0.0236 | May 16-31 | 0.3077 | 3-6 mm |
| CVP DENSITY | | | | | |
| 1985 | May 1-15 | 0.5079 | May 16-31 | 0.9199 | 3-6 mm |
| 1986 | May 16-31 | 0.0660 | May 16-31 | 0.1049 | 3-6 mm |
| 1987 | April 1-15 | 0.0365 | May 1-15 | 0.2843 | 7-10 mm |
| 1988 | May 1-15 | 0.1104 | May 16-31 | 0.3954 | 3-6 mm |
| SWP ENTRAINMENT | | | | | |
| 1985 | May 1-15 | 76,450,153 | May 16-31 | 139,771,863 | 3-6 mm |
| 1986 | May 1-15 | 3,074,258 | May 16-31 | 21,351,538 | 3-6 mm |
| 1987 | April 16-30 | 1,561,477 | May 1-15 | 27,968,618 | 7-10 mm |
| 1988 | May 1-15 | 4,351,681 | May 16-31 | 32,563,256 | 3-6 mm |
| CVP ENTRAINMENT | | | | | |
| 1985 | May 1-15 | 55,833,079 | May 16-31 | 113,146,696 | 3-6 mm |
| 1986 | May 16-31 | 7,742,859 | May 16-31 | 12,523,276 | 3-6 mm |
| 1987 | May 1-15 | 3,152,186 | April 16-30 | 44,796,461 | 3-6 mm |
| 1988 | May 1-15 | 12,770,508 | May 16-31 | 45,216,688 | 3-6 mm |

* Density and entrainment estimates for 1985-1987 have been corrected for differences in methodology used to calculate the area of the net opening.
** Used correction factor = 1.0508, 5.08% for years prior to 1988.

6 Raquel, op. cit.

variations may be due to factors such as the actual difference in distribution and timing of spawning fish; the volume, frequency, and origin of diversions at each site; Delta outflow; and sampling variability during the special study surveys.

In comparison to past surveys, the peak periods of entrainment of striped bass eggs and larvae at the SWP and CVP are usually similar in timing to the peak density periods (Table 6). Occasionally, entrainment may peak before or after the peak in density, which reflects a larger volume of water being diverted during that period.

The entrainment estimates of striped bass eggs and larvae since 1985 are as follows[7]:

| Year | SWP | CVP |
|---|---|---|
| 1985 | 463,553,003 | 370,365,411 |
| 1986 | 54,546,357 | 50,141,951 |
| 1987 | 99,105,518 | 145,522,754 |
| 1988 | 134,736,053 | 134,725,895 |

The size distribution of entrained larvae seems to be fairly similar from year to year (Table 7). The 3-6 mm larvae usually experience greatest entrainment with decreasing losses as size increases. In 1985, distribution was unusual in comparison to 1986-1988. No larvae were collected in the 15-18 mm and 19-20 mm groups, which may have been due to the poor survival of smaller larvae in 1985[8].

A comparison of yearling equivalent entrainment losses of striped bass since 1985 follows[9].

| Year | SWP | CVP | Total |
|---|---|---|---|
| 1985 | 68,488 | 46,360 | 114,848 |
| 1986 | 37,109 | 52,976 | 90,085 |
| 1987 | 43,846 | 71,958 | 115,804 |
| 1988 | 59,625 | 51,085 | 110,710 |

In comparison to past surveys, yearling equivalent losses for 1988 were the second highest on record for the SWP and were moderate for the CVP.

Table 7
STRIPED BASS EGG AND LARVAL ENTRAINMENT ESTIMATES FOR THE SWP AND CVP INTAKES, APRIL THROUGH JULY 1985-1988*

| SIZE GROUP | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|
| STATE WATER PROJECT | | | | |
| Eggs | 90,241,186 | 3,963,747 | 2,190,700 | 9,156,342 |
| 3-6 mm | 322,833,324 | 28,445,267 | 49,665,161 | 68,362,134 |
| 7-10 mm | 47,183,359 | 14,936,299 | 39,618,702 | 50,117,931 |
| 11-14 mm | 3,295,136 | 5,901,138 | 6,338,811 | 4,875,440 |
| 15-18 mm | 0 | 928,287 | 1,292,144 | 1,704,338 |
| 19-20 mm | 0 | 371,616 | 0 | 519,868 |
| TOTAL | 463,553,004 | 54,546,355 | 99,105,518 | 134,736,053 |
| CENTRAL VALLEY PROJECT | | | | |
| Eggs | 89,174,102 | 9,743,141 | 7,183,033 | 25,760,504 |
| 3-6 mm | 256,531,417 | 14,494,769 | 77,204,548 | 71,545,053 |
| 7-10 mm | 23,727,476 | 16,047,375 | 48,253,507 | 30,942,613 |
| 11-14 mm | 932,416 | 7,559,537 | 10,516,885 | 4,540,490 |
| 15-18 mm | 0 | 1,614,753 | 2,066,161 | 1,456,912 |
| 19-20 mm | 0 | 782,376 | 298,622 | 480,325 |
| TOTAL | 370,365,411 | 50,241,950 | 145,522,755 | 134,725,895 |

* 1985-1987 multiplied by correction factor = 1.0508.

7 Raquel, op. cit.

8 R.L. Brown (Compiler). 1987. *1985-1986 Report of the Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary.* AR-15/87. 143 pp.

9 Raquel, op. cit.

Special studies in 1988 focused on two areas of striped bass egg and larva sampling: variation in densities throughout the day and variation during the time of the sample. Since results from these studies are based on data from only one survey season, the studies should be replicated before implementing any changes in the sampling program.

Tidal sampling provided a good indication of the diurnal variation in striped bass densities. It did not appear that daylight or darkness had a detectable effect on densities, since high and low density levels were found at both day and night.

The most visible effects on larval densities were the variation through the tidal cycle and when the SWP gates were open. Variation in densities over the 24-hour study at the SWP and CVP sites and the 48-hour study at the SWP site tended to follow the tidal changes in water surface elevation and were generally increased at higher elevations and decreased at lower elevations. In addition, a peak in densities followed by a rapid decline generally occurred after the opening of the SWP gates, especially on the ebb of a high-high tide. CVP densities over the 48-hour study did not appear to follow this pattern as closely, and they fluctuated more randomly due to some as yet unidentified mechanism.

The difference in density patterns may be due to the difference in pumping plant operations at the SWP and CVP. The CVP pumps water continuously throughout the day, whereas SWP intake operations are based on the tidal cycle, with the radial gates generally opening on the backside of a high tide.

Information from the tidal study brings up some points to be considered in estimating striped bass egg and larva entrainment at the SWP and CVP intakes. Routinely these sites are sampled in mid-morning regardless of tidal stage or SWP gate operations.

In regard to SWP entrainment estimates, if sampling is conducted when the gates are closed, then entrainment would generally be underestimated. More specifically, when a high-high tide occurs during afternoon, evening, or early morning, then the peak period of striped bass egg and larva abundance would be missed, resulting in an underestimate of entrainment for the day. The underestimation may not be of the same magnitude for a low-high tide, because the abundance of eggs and larvae appears to be much lower and similar to abundance when the SWP gates are closed.

A better estimate of SWP entrainment could be obtained by sampling when the gates are open. Due to the rather long period between the opening of the gates during a day, it might seem less expensive and labor intensive to sample only on the fall of a high-high tide, when abundance appears to be highest. However, if these densities were used to estimate entrainment during the diversion period of the low-high tide, then losses during this diversion period would likely be overestimated.

These considerations would apply to the CVP entrainment estimates as well. Because the CVP diverts water continuously over a 24-hour day and striped bass abundances fluctuate over this period, the present sampling scheme produces only a gross estimate of striped bass entrainment at the CVP. Entrainment estimates could be over- or under-estimated for the day, depending on whether the sample was taken on or near a high or low tide. Since there is no compensation at this time from the Federal Government for striped bass eggs and larvae lost to CVP pumping plant operations, the data at this site are basically for research purposes, and it might not be as necessary to derive more than a general estimate of losses.

The replicate sampling study indicated that densities at a site could vary moderately from tow to tow over a relatively short time. The variation between tows could be due to tidal effects and SWP gate operations, as indicated in the tidal study, or to a patchy nature in the distribution of larvae in the channel. The variation in this study indicates that making one tow per station is probably fairly representative of striped bass densities when the SWP gates are closed and diversion rates are low. When the SWP gates are open and diversion rates are higher, one tow does not appear to provide as good a representation of larval densities.

# Recommendations

Although results of the special studies are based on only one season of data and need to be replicated before changing the sampling program, these studies do indicate that the sampling program could be examined to improve estimates of entrainment to the State and Federal pumping plants in the southern Delta.

If larval densities are related to the tidal cycle and SWP gate operations divert water in relation to the tidal cycle, then sampling should be in relation to this. The best estimate of entrained striped bass eggs and larvae at the SWP site would be provided by sampling when the SWP gates are open and water is being diverted into Clifton Court Forebay. Since larval densities appear to vary over the period when the gates are open, samples should be taken at intervals or continually over this period.

# References


Brown, R.L. (Compiler). 1987. *1985-1986 Report of the Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary.* AR-15/87. 143 pp.

California Department of Water Resources. 1988. *Dispatchers Daily Report, April 1 - July 31, 1988.* Operations and Maintenance Section.

Ecological Analysts. 1981. *Contra Costa Power Plant Cooling Water Intake Structures - 316(b) Demonstration.* Prepared for Pacific Gas and Electric Company, 60-G-1.

Fusfeld-Low, A. and L.W. Miller. 1986. *1984 Striped Bass Egg and Larva Study in the Sacramento-San Joaquin Estuary.* Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 11 (FS/BIO-4ATR/87-11). 41 pp.

General Oceanics, Inc. 1983. *Digital Flowmeter Manual.* Miami, FL. 13 pp.

Raquel, P.F. 1987. *Estimated Entrainment of Striped Bass Eggs and Larvae at State Water Project and Central Valley Project Facilities in the Sacramento-San Joaquin Delta, 1985 and 1986.* Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 13. (FF/BIO-4ATR/87-13). 27 pp.

Raquel, P.F. 1988. *Estimated Entrainment of Striped Bass Eggs and Larvae at State Water Project and Central Valley Project Facilities in the Sacramento-San Joaquin Delta, 1987.* Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary. Technical Report 15 (FF/BIO-4ATR/88-15). 15 pp.

Appendix A. Daily SWP Inflow and CVP Export (acre-feet) April 1 through July 11, 1988 (California Department of Water Resources 1988).

| | SWP | | | | CVP | | | |
|---|---|---|---|---|---|---|---|---|
| DAY | APRIL | MAY | JUNE | JULY | APRIL | MAY | JUNE | JULY |
| 1 | 4353 | 4040 | 6157 | 7015 | 8109 | 8087 | 4824 | 6036 |
| 2 | 4354 | 4639 | 7466 | 6930 | 8144 | 6890 | 4826 | 6566 |
| 3 | 4359 | 4775 | 6445 | 5742 | 7737 | 6370 | 5960 | 8480 |
| 4 | 4360 | 3860 | 4284 | 4562 | 8098 | 6382 | 6441 | 9275 |
| 5 | 4546 | 4944 | 3996 | 6377 | 8131 | 5422 | 6435 | 9265 |
| 6 | 6925 | 8727 | 4351 | 8661 | 7476 | 5005 | 6422 | 9366 |
| 7 | 8472 | 9552 | 4224 | 7453 | 8186 | 4982 | 6392 | 9328 |
| 8 | 5524 | 8934 | 4180 | 7618 | 8140 | 5020 | 6349 | 9414 |
| 9 | 6744 | 9418 | 6395 | 7339 | 8103 | 6020 | 6314 | 9420 |
| 10 | 7001 | 10444 | 6740 | 7339 | 8130 | 6347 | 6386 | 9490 |
| 11 | 7141 | 10890 | 7331 | 4760 | 8125 | 6404 | 6349 | 9352 |
| 12 | 8317 | 11032 | 6446 | | 8128 | 6425 | 6390 | |
| 13 | 8529 | 10540 | 5246 | | 8140 | 6305 | 6367 | |
| 14 | 9304 | 10814 | 3479 | | 8080 | 6380 | 5582 | |
| 15 | 10313 | 11382 | 1507 | | 8094 | 6400 | 5006 | |
| 16 | 10096 | 10755 | 1003 | | 8081 | 6400 | 4995 | |
| 17 | 10109 | 7934 | 1542 | | 8092 | 6389 | 6011 | |
| 18 | 9520 | 7141 | 3755 | | 8125 | 6405 | 6395 | |
| 19 | 8823 | 6743 | 8419 | | 8110 | 6420 | 6365 | |
| 20 | 9917 | 8092 | 7735 | | 8145 | 6390 | 6375 | |
| 21 | 11100 | 6349 | 5971 | | 8136 | 6406 | 6380 | |
| 22 | 11644 | 7127 | 6144 | | 8124 | 6398 | 6330 | |
| 23 | 11688 | 4604 | 5535 | | 8089 | 6375 | 6344 | |
| 24 | 12763 | 3611 | 6517 | | 8065 | 5290 | 6359 | |
| 25 | 9710 | 580 | 7931 | | 8073 | 4825 | 6490 | |
| 26 | 11900 | 996 | 7967 | | 8076 | 4827 | 6260 | |
| 27 | 12891 | 1413 | 9760 | | 8091 | 4825 | 4935 | |
| 28 | 11983 | 1219 | 6269 | | 8081 | 4835 | 4934 | |
| 29 | 10364 | 1196 | 3603 | | 8104 | 4862 | 4931 | |
| 30 | 6791 | 756 | 5335 | | 8109 | 4746 | 4943 | |
| 31 | | 3233 | | | | 4840 | | |
| TOTAL | 259541 | 195740 | 165733 | 73796 | 243322 | 182672 | 178090 | 95992 |
| GRAND TOTAL | | | | 694,810 | | | | 700,076 |

## Appendix B

### Laboratory Quality Control Program

The first 10 samples that a sorter completes are re-sorted by the quality control supervisor. An accuracy rate of 90 percent must be maintained. After successful completion of the first 10 samples, one sample is chosen at random for rework. If the 90 percent accuracy rate is maintained, the 10 percent rework mode continues. If a sample fails the Q.C. check, all of the following samples are reworked until 10 consecutive samples pass, whereupon the sorter returns to the 1 in 10 mode.

All fish larvae will be identified to species or the lowest taxonomic level practicable and counted. Mutilated larvae representing more than 50 percent of total body length will be counted as whole fish.

A variable-magnification (10x - 70x) dissecting microscope with an ocular micrometer will be used for all identifications. Approximately 5 percent of the identifications are reworked.

Appendix C. Total Striped Bass Densities by Size Group and Sample Site Collected by South Delta Striped Bass Egg and Larva Survey, 1988.

STATION 91 STRIPED BASS DENSITIES (fish/m3)

| | | | SIZE GROUP | | | | |
|---|---|---|---|---|---|---|---|
| DATE | STA# | EGGS | 3-6 mm | 7-10 mm | 11-14mm | 15-18mm | 19-20 mm |
| 04-Apr-88 | 91 | 0 | 0 | 0 | 0 | 0 | 0 |
| 06-Apr-88 | 91 | 0 | 0.0040 | 0 | 0 | 0 | 0 |
| 08-Apr-88 | 91 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12-Apr-88 | 91 | 0 | 0.0205 | 0 | 0 | 0 | 0 |
| 14-Apr-88 | 91 | 0 | 0.0042 | 0 | 0 | 0 | 0 |
| 16-Apr-88 | 91 | 0 | 0.0259 | 0 | 0 | 0 | 0 |
| 18-Apr-88 | 91 | 0 | 0.0348 | 0 | 0 | 0 | 0 |
| 20-Apr-88 | 91 | 0 | 0.0119 | 0.0039 | 0 | 0 | 0 |
| 22-Apr-88 | 91 | 0 | 0.0864 | 0 | 0 | 0 | 0 |
| 24-Apr-88 | 91 | 0 | 0.0794 | 0 | 0 | 0 | 0 |
| 26-Apr-88 | 91 | 0 | 0.1312 | 0.0039 | 0 | 0 | 0 |
| 28-Apr-88 | 91 | 0.0073 | 0.0913 | 0.0036 | 0 | 0 | 0 |
| 30-Apr-88 | 91 | 0 | 0.0035 | 0.0070 | 0 | 0 | 0 |
| 02-May-88 | 91 | 0 | 0.0263 | 0 | 0 | 0 | 0 |
| 12-May-88 | 91 | 0.0406 | 0.1446 | 0.0045 | 0 | 0 | 0 |
| 14-May-88 | 91 | 0 | 0.2471 | 0 | 0 | 0 | 0 |
| 16-May-88 | 91 | 0.0497 | 0.4623 | 0.1067 | 0 | 0 | 0 |
| 18-May-88 | 91 | 0 | 1.1162 | 0.1841 | 0 | 0 | 0 |
| 20-May-88 | 91 | 0 | 2.3894 | 0.0696 | 0 | 0 | 0 |
| 22-May-88 | 91 | 0.0378 | 0.2652 | 0 | 0 | 0 | 0 |
| 24-May-88 | 91 | 0.0303 | 0.1214 | 0.0303 | 0 | 0 | 0 |
| 26-May-88 | 91 | 0 | 0.4685 | 0.3123 | 0 | 0 | 0 |
| 28-May-88 | 91 | 0 | 0.6684 | 0.6521 | 0 | 0 | 0 |
| 30-May-88 | 91 | 0 | 0.7772 | 0.3681 | 0 | 0 | 0 |
| 01-Jun-88 | 91 | 0 | 0.7224 | 0.2549 | 0 | 0 | 0 |
| 03-Jun-88 | 91 | 0 | 0.4525 | 0.5940 | 0 | 0 | 0 |
| 05-Jun-88 | 91 | 0 | 0.4872 | 0.3950 | 0.0131 | 0 | 0 |
| 07-Jun-88 | 91 | 0 | 0.2950 | 0.0885 | 0.0147 | 0 | 0 |
| 09-Jun-88 | 91 | 0 | 0.1401 | 0.4074 | 0.0481 | 0.0131 | 0 |
| 11-Jun-88 | 91 | 0 | 0.4224 | 0.1730 | 0.0152 | 0 | 0 |
| 13-Jun-88 | 91 | 0 | 0.1415 | 0.2144 | 0.0214 | 0.0085 | 0.0042 |
| 15-Jun-88 | 91 | 0 | 0.0161 | 0.0808 | 0.0202 | 0 | 0 |
| 17-Jun-88 | 91 | 0 | 0.0151 | 0.0453 | 0.0188 | 0 | 0 |
| 19-Jun-88 | 91 | 0 | 0.0043 | 0.0696 | 0.0261 | 0.0130 | 0 |
| 21-Jun-88 | 91 | 0 | 0.0076 | 0.0344 | 0.0191 | 0.0114 | 0.0038 |
| 23-Jun-88 | 91 | 0 | 0.0041 | 0.0289 | 0.0206 | 0.0041 | 0 |
| 25-Jun-88 | 91 | 0 | 0.0862 | 0.0538 | 0.0107 | 0 | 0.0035 |
| 27-Jun-88 | 91 | 0 | 0.0994 | 0.0596 | 0.0119 | 0.0119 | 0 |
| 29-Jun-88 | 91 | 0 | 0.0202 | 0.0162 | 0.0040 | 0.0040 | 0 |
| 01-Jul-88 | 91 | 0 | 0.0299 | 0.0299 | 0.0112 | 0.0074 | 0 |
| 03-Jul-88 | 91 | 0 | 0.0390 | 0.0426 | 0.0071 | 0 | 0 |
| 05-Jul-88 | 91 | 0 | 0 | 0.0120 | 0.0080 | 0.0080 | 0.0080 |
| 07-Jul-88 | 91 | 0 | 0 | 0 | 0 | 0.0044 | 0 |
| 11-Jul-88 | 91 | 0 | 0 | 0 | 0 | 0 | 0 |

APPENDIX C (Cont.)

STATION 93 STRIPED BASS DENSITIES (fish/m3)

| DATE | STA# | EGGS | SIZE GROUP 3-6 mm | 7-10 mm | 11-14 mm | 15-18 mm | 19-20 mm |
|---|---|---|---|---|---|---|---|
| 04-Apr-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 |
| 06-Apr-88 | 93 | 0 | 0.0044 | 0 | 0 | 0 | 0 |
| 08-Apr-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12-Apr-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14-Apr-88 | 93 | 0.0838 | 0 | 0 | 0 | 0 | 0 |
| 16-Apr-88 | 93 | 0 | 0.0131 | 0 | 0 | 0 | 0 |
| 18-Apr-88 | 93 | 0 | 0.0596 | 0 | 0 | 0 | 0 |
| 20-Apr-88 | 93 | 0 | 0.0775 | 0 | 0 | 0 | 0 |
| 22-Apr-88 | 93 | 0 | 0.0042 | 0 | 0 | 0 | 0 |
| 24-Apr-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26-Apr-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28-Apr-88 | 93 | 0.0045 | 0 | 0 | 0 | 0 | 0 |
| 30-Apr-88 | 93 | 0 | 0.0037 | 0 | 0 | 0 | 0 |
| 02-May-88 | 93 | 0 | 0.0264 | 0.0151 | 0 | 0 | 0 |
| 04-May-88 | 93 | 0.0842 | 0.0093 | 0 | 0 | 0 | 0 |
| 12-May-88 | 93 | 0.0438 | 0 | 0.0048 | 0 | 0 | 0 |
| 14-May-88 | 93 | 0.3387 | 0.1669 | 0.0429 | 0 | 0 | 0 |
| 16-May-88 | 93 | 0.2519 | 0.2432 | 0.1129 | 0 | 0 | 0 |
| 18-May-88 | 93 | 0 | 0.0233 | 0 | 0 | 0 | 0 |
| 20-May-88 | 93 | 1.0646 | 0.2475 | 0.1114 | 0 | 0 | 0 |
| 22-May-88 | 93 | 0.0207 | 0.0789 | 0.0415 | 0 | 0 | 0 |
| 24-May-88 | 93 | 0 | 0 | 0.0039 | 0 | 0 | 0 |
| 26-May-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28-May-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30-May-88 | 93 | 0 | 0.0041 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 93 | 0 | 0.0127 | 0.0298 | 0.0042 | 0 | 0 |
| 03-Jun-88 | 93 | 0.1802 | 0.0212 | 0.2120 | 0.0212 | 0 | 0 |
| 05-Jun-88 | 93 | 0 | 0.0314 | 0.0865 | 0.0472 | 0 | 0 |
| 07-Jun-88 | 93 | 0 | 0 | 0.0307 | 0.0230 | 0.0038 | 0 |
| 09-Jun-88 | 93 | 0 | 0.0044 | 0.0178 | 0.0222 | 0 | 0 |
| 11-Jun-88 | 93 | 0 | 0.0184 | 0.0368 | 0.0046 | 0.0046 | 0 |
| 13-Jun-88 | 93 | 0 | 0.0891 | 0.0891 | 0.0247 | 0.0099 | 0 |
| 15-Jun-88 | 93 | 0 | 0.1097 | 0.0970 | 0.0211 | 0 | 0 |
| 17-Jun-88 | 93 | 0 | 0.0079 | 0.0079 | 0.0118 | 0 | 0 |
| 21-Jun-88 | 93 | 0 | 0.0044 | 0 | 0 | 0.0044 | 0 |
| 23-Jun-88 | 93 | 0 | 0 | 0 | 0.0327 | 0.0245 | 0.0122 |
| 25-Jun-88 | 93 | 0 | 0.0039 | 0.0039 | 0.0119 | 0.0079 | 0.0079 |
| 27-Jun-88 | 93 | 0 | 0.0078 | 0.0392 | 0.0078 | 0.0039 | 0.0039 |
| 29-Jun-88 | 93 | 0 | 0.1072 | 0.1646 | 0.0076 | 0.0038 | 0 |
| 01-Jul-88 | 93 | 0 | 0.0237 | 0.0158 | 0 | 0.0039 | 0 |
| 03-Jul-88 | 93 | 0 | 0.0042 | 0.0420 | 0.0084 | 0.0084 | 0 |
| 05-Jul-88 | 93 | 0 | 0 | 0.0198 | 0.0198 | 0.0039 | 0.0079 |
| 07-Jul-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0.0041 |
| 11-Jul-88 | 93 | 0 | 0 | 0 | 0 | 0 | 0 |

APPENDIX C (Cont.)

STATION 95 STRIPED BASS DENSITIES (fish/m3)

| DATE | STA# | EGGS | SIZE GROUP 3-6 mm | 7-10 mm | 11-14 mm | 15-18 mm | 19-20 mm |
|---|---|---|---|---|---|---|---|
| 04-Apr-88 | 95 | 0 | 0 | 0 | 0 | 0 | 0 |
| 06-Apr-88 | 95 | 0 | 0 | 0 | 0 | 0 | 0 |
| 08-Apr-88 | 95 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12-Apr-88 | 95 | 0 | 0.0085 | 0 | 0 | 0 | 0 |
| 14-Apr-88 | 95 | 0 | 0.0127 | 0.0042 | 0 | 0 | 0 |
| 16-Apr-88 | 95 | 0 | 0.0290 | 0 | 0 | 0 | 0 |
| 18-Apr-88 | 95 | 0 | 0.0311 | 0 | 0 | 0 | 0 |
| 20-Apr-88 | 95 | 0 | 0.1260 | 0.0033 | 0 | 0 | 0 |
| 22-Apr-88 | 95 | 0 | 0.1519 | 0 | 0 | 0 | 0 |
| 24-Apr-88 | 95 | 0 | 0.0351 | 0 | 0 | 0 | 0 |
| 26-Apr-88 | 95 | 0 | 0.0126 | 0 | 0 | 0 | 0 |
| 28-Apr-88 | 95 | 0 | 0.0276 | 0 | 0 | 0 | 0 |
| 30-Apr-88 | 95 | 0 | 0.0043 | 0 | 0 | 0 | 0 |
| 02-May-88 | 95 | 0 | 0.0322 | 0.0040 | 0 | 0 | 0 |
| 12-May-88 | 95 | 0 | 0.0767 | 0.0239 | 0 | 0 | 0 |
| 16-May-88 | 95 | 0.2662 | 0.5058 | 0.1065 | 0 | 0 | 0 |
| 18-May-88 | 95 | 0 | 0.3343 | 0.0222 | 0 | 0 | 0 |
| 20-May-88 | 95 | 0 | 0.2406 | 0.0240 | 0 | 0 | 0 |
| 22-May-88 | 95 | 0 | 0.5077 | 0.0491 | 0 | 0 | 0 |
| 24-May-88 | 95 | 0 | 0.9329 | 0.2188 | 0 | 0 | 0 |
| 26-May-88 | 95 | 0 | 0.6032 | 0.4485 | 0.0154 | 0 | 0 |
| 28-May-88 | 95 | 0 | 0.1247 | 0.2183 | 0 | 0 | 0 |
| 30-May-88 | 95 | 0 | 0.9616 | 0.3351 | 0 | 0 | 0 |
| 01-Jun-88 | 95 | 0 | 0.1404 | 0.1532 | 0.0127 | 0 | 0 |
| 03-Jun-88 | 95 | 0 | 0.1812 | 0.1115 | 0 | 0 | 0 |
| 05-Jun-88 | 95 | 0 | 0.0868 | 0.0868 | 0.0521 | 0.0173 | 0 |
| 07-Jun-88 | 95 | 0 | 0.0404 | 0.0808 | 0 | 0 | 0 |
| 09-Jun-88 | 95 | 0 | 0.3528 | 0.2543 | 0.0410 | 0.0082 | 0 |
| 11-Jun-88 | 95 | 0 | 0.2487 | 0.1411 | 0.0537 | 0.0134 | 0 |
| 13-Jun-88 | 95 | 0 | 0.1640 | 0.1342 | 0.0671 | 0 | 0 |
| 15-Jun-88 | 95 | 0 | 0.1511 | 0.1247 | 0.0188 | 0 | 0 |
| 17-Jun-88 | 95 | 0 | 0.1907 | 0.0381 | 0.0114 | 0 | 0 |
| 19-Jun-88 | 95 | 0 | 0.0226 | 0.0317 | 0.0362 | 0.0090 | 0 |
| 21-Jun-88 | 95 | 0 | 0.1333 | 0.0862 | 0.0274 | 0.0117 | 0 |
| 23-Jun-88 | 95 | 0 | 0.0685 | 0.0266 | 0.0152 | 0.0038 | 0 |
| 25-Jun-88 | 95 | 0 | 0.0430 | 0.0323 | 0 | 0 | 0 |
| 27-Jun-88 | 95 | 0 | 0.0210 | 0.0490 | 0.0035 | 0.0035 | 0 |
| 29-Jun-88 | 95 | 0 | 0 | 0.0038 | 0 | 0 | 0 |
| 01-Jul-88 | 95 | 0 | 0.0232 | 0.0657 | 0 | 0 | 0 |
| 03-Jul-88 | 95 | 0 | 0.0197 | 0.0906 | 0.0039 | 0 | 0.0039 |
| 05-Jul-88 | 95 | 0 | 0 | 0.0124 | 0.0083 | 0.0041 | 0 |
| 07-Jul-88 | 95 | 0 | 0 | 0.0075 | 0 | 0 | 0 |
| 11-Jul-88 | 95 | 0 | 0 | 0 | 0 | 0 | 0 |

APPENDIX C (Cont.)

STATION 98

STRIPED BASS DENSITIES (fish/m3)

| DATE | STA# | EGGS | SIZE GROUP 3-6 mm | 7-10 mm | 11-14 mm | 15-18 mm | 19-20 mm |
|---|---|---|---|---|---|---|---|
| 04-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 06-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 08-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26-Apr-88 | 98 | 0.0039 | 0 | 0 | 0 | 0 | 0 |
| 28-Apr-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30-Apr-88 | 98 | 0 | 0.0031 | 0 | 0 | 0 | 0 |
| 02-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 04-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12-May-88 | 98 | 0 | 0.0044 | 0 | 0 | 0 | 0 |
| 14-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24-May-88 | 98 | 0 | 0.0125 | 0 | 0 | 0 | 0 |
| 28-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30-May-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 98 | 0 | 0 | 0.0037 | 0 | 0 | 0 |
| 03-Jun-88 | 98 | 0 | 0.0211 | 0 | 0 | 0 | 0 |
| 05-Jun-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 07-Jun-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 09-Jun-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11-Jun-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13-Jun-88 | 98 | 0 | 0.0043 | 0 | 0 | 0 | 0 |
| 15-Jun-88 | 98 | 0 | 0 | 0 | 0.0040 | 0.0040 | 0 |
| 17-Jun-88 | 98 | 0 | 0.0038 | 0 | 0 | 0 | 0 |
| 19-Jun-88 | 98 | 0 | 0.0079 | 0 | 0 | 0 | 0 |
| 21-Jun-88 | 98 | 0 | 0.0037 | 0 | 0 | 0 | 0 |
| 23-Jun-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25-Jun-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27-Jun-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29-Jun-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jul-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 03-Jul-88 | 98 | 0 | 0.0037 | 0 | 0 | 0 | 0 |
| 05-Jul-88 | 98 | 0 | 0 | 0 | 0 | 0.0037 | 0 |
| 07-Jul-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11-Jul-88 | 98 | 0 | 0 | 0 | 0 | 0 | 0 |

Appendix D. Total Fish Densities by Type and Sample Site Collected by the South Delta Striped Bass Egg and Larva Survey, 1988.

STATION 91 FISH DENSITY (fish per cubic meter)

| MON | DAY | YR | THREADFIN SHAD | DELTA SMELT | PRICKLY SCULPIN | CYPRINID | CENTRARCHID | YELLOWFIN GOBY | INLAND SILVERSIDE | BIGSCALE LOGPERCH | ICTALURUS | SPLITTAIL | SACRAMENTO SUCKER | CHAMELEON GOBY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4 | 88 | 0 | 0.0237 | 0.3091 | 0 | 0 | 0 | 0 | 0.0039 | 0 | 0 | 0 | 0 |
| 4 | 6 | 88 | 0 | 0.0244 | 0.3090 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 8 | 88 | 0 | 0.0203 | 0.3255 | 0 | 0 | 0 | 0 | 0.0040 | 0 | 0 | 0 | 0 |
| 4 | 12 | 88 | 0 | 0.0123 | 0.1850 | 0 | 0 | 0 | 0 | 0.0041 | 0 | 0 | 0 | 0 |
| 4 | 14 | 88 | 0 | 0 | 0.1986 | 0 | 0.0042 | 0 | 0 | 0.0042 | 0 | 0 | 0 | 0 |
| 4 | 16 | 88 | 0 | 0 | 0.2334 | 0 | 0.0043 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 18 | 88 | 0.0034 | 0.0069 | 0.2368 | 0 | 0.0034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 20 | 88 | 0 | 0.0079 | 0.2421 | 0 | 0.0039 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 22 | 88 | 0 | 0.0617 | 0.0041 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0041 | 0 | 0 |
| 4 | 24 | 88 | 0 | 0.0083 | 0.0919 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 26 | 88 | 0 | 0 | 0.1591 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0039 | 0 | 0 |
| 4 | 28 | 88 | 0 | 0 | 0.1643 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 30 | 88 | 0.0106 | 0.0035 | 0.1949 | 0 | 0 | 0 | 0 | 0.0035 | 0 | 0 | 0 | 0 |
| 5 | 2 | 88 | 0.0113 | 0 | 0.2260 | 0 | 0.0037 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 12 | 88 | 0 | 0 | 0.1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 14 | 88 | 0.0117 | 0 | 0.0882 | 0 | 0 | 0 | 0 | 0.0117 | 0 | 0 | 0 | 0 |
| 5 | 16 | 88 | 0 | 0 | 0.0284 | 0.0142 | 0 | 0 | 0 | 0.0071 | 0 | 0 | 0 | 0 |
| 5 | 18 | 88 | 0 | 0 | 0 | 0.0115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 20 | 88 | 0 | 0 | 0.0298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 22 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 24 | 88 | 0 | 0 | 0.0151 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 26 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 28 | 88 | 0.0163 | 0 | 0.0163 | 0.0163 | 0.0326 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 30 | 88 | 0 | 0 | 0.0136 | 0.0136 | 0.0272 | 0 | 0 | 0.0136 | 0 | 0 | 0 | 0 |
| 6 | 1 | 88 | 0 | 0 | 0.0566 | 0 | 0.0141 | 0 | 0 | 0.0141 | 0 | 0 | 0 | 0 |
| 6 | 3 | 88 | 0.0424 | 0 | 0 | 0.0282 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 5 | 88 | 0.0131 | 0 | 0 | 0.0263 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 7 | 88 | 0 | 0 | 0 | 0 | 0.0147 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 9 | 88 | 0.0043 | 0 | 0 | 0.1927 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 11 | 88 | 0 | 0 | 0 | 0.0254 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0050 |
| 6 | 13 | 88 | 0.0042 | 0 | 0 | 0.0128 | 0 | 0 | 0 | 0 | 0.0042 | 0 | 0 | 0.0042 |
| 6 | 15 | 88 | 0 | 0 | 0 | 0.0040 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 17 | 88 | 0 | 0 | 0 | 0.0151 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 19 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 21 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 23 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 25 | 88 | 0.0035 | 0 | 0 | 0 | 0.0071 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0035 |
| 6 | 27 | 88 | 0.0039 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0039 |
| 6 | 29 | 88 | 0.0121 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0162 |
| 7 | 1 | 88 | 0 | 0 | 0 | 0.0037 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0411 |
| 7 | 3 | 88 | 0.0248 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2166 |
| 7 | 5 | 88 | 0.0040 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 7 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0044 | 0 | 0 | 0 |
| 7 | 11 | 88 | 0.0066 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.2298 |

APPENDIX D (Cont.)

STATION 93

FISH DENSITY (fish per cubic meter)

| MON | DAY | YR | THREADFIN SHAD | DELTA SMELT | PRICKLY SCULPIN | CYPRINID | CENTRARCHID | YELLOWFIN GOBY | INLAND SILVERSIDE | BIGSCALE LOGPERCH | ICTALURUS | SPLITTAIL | SACRAMENTO SUCKER | CHAMELEON GOBY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4 | 88 | 0 | 0.0086 | 1.1936 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 6 | 88 | 0 | 0.0223 | 0.7961 | 0 | 0 | 0.0044 | 0 | 0.0044 | 0 | 0 | 0 | 0 |
| 4 | 8 | 88 | 0 | 0 | 0.8460 | 0 | 0 | 0.0038 | 0 | 0.0155 | 0 | 0 | 0 | 0 |
| 4 | 12 | 88 | 0 | 0 | 0.8516 | 0 | 0 | 0 | 0 | 0.0086 | 0 | 0 | 0 | 0 |
| 4 | 14 | 88 | 0 | 0.0049 | 0.0986 | 0 | 0 | 0 | 0 | 0.0049 | 0 | 0 | 0 | 0 |
| 4 | 16 | 88 | 0 | 0 | 0.1314 | 0 | 0 | 0 | 0 | 0.0131 | 0 | 0 | 0 | 0 |
| 4 | 18 | 88 | 0.0039 | 0.0039 | 0.4413 | 0 | 0.0039 | 0 | 0 | 0.0198 | 0 | 0 | 0 | 0 |
| 4 | 20 | 88 | 0 | 0 | 0.2670 | 0 | 0 | 0 | 0 | 0.0172 | 0 | 0 | 0 | 0 |
| 4 | 22 | 88 | 0 | 0 | 0.5180 | 0 | 0 | 0 | 0 | 0.0171 | 0 | 0 | 0 | 0 |
| 4 | 24 | 88 | 0.0046 | 0 | 0.1533 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 26 | 88 | 0.0041 | 0 | 0.0656 | 0 | 0 | 0 | 0 | 0.0041 | 0 | 0 | 0 | 0 |
| 4 | 28 | 88 | 0 | 0 | 0.0588 | 0 | 0.0045 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 30 | 88 | 0.0037 | 0 | 0.2899 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 2 | 88 | 0 | 0 | 0.2153 | 0 | 0 | 0 | 0 | 0.0075 | 0 | 0 | 0 | 0 |
| 5 | 4 | 88 | 0.0093 | 0 | 0.1123 | 0 | 0.0031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 12 | 88 | 0 | 0 | 0.0195 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 14 | 88 | 0 | 0.0143 | 0.1860 | 0.0047 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 16 | 88 | 0 | 0 | 0.0217 | 0.0173 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 18 | 88 | 0.7849 | 0 | 0.1126 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 20 | 88 | 0 | 0 | 0 | 0.0742 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 22 | 88 | 0.1039 | 0 | 0.1080 | 0.0124 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 24 | 88 | 0.1388 | 0 | 0 | 0 | 0.0039 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 26 | 88 | 0.0947 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 28 | 88 | 0.0788 | 0 | 0.0087 | 0.0087 | 0.0043 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 30 | 88 | 0.2718 | 0 | 0 | 0.0247 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 1 | 88 | 0.1491 | 0 | 0 | 0 | 0.2130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 3 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 5 | 88 | 0.1652 | 0 | 0 | 0.0157 | 0.0786 | 0 | 0.0078 | 0 | 0 | 0 | 0 | 0.0078 |
| 6 | 7 | 88 | 0.1344 | 0 | 0 | 0.0384 | 0.0076 | 0 | 0.0038 | 0 | 0 | 0 | 0 | 0.0038 |
| 6 | 9 | 88 | 0.0044 | 0 | 0 | 0.0178 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0044 |
| 6 | 11 | 88 | 0.1059 | 0 | 0 | 0.0184 | 0 | 0 | 0 | 0.0046 | 0 | 0 | 0 | 0 |
| 6 | 13 | 88 | 0.0148 | 0 | 0 | 0.0148 | 0.0099 | 0 | 0.0049 | 0 | 0 | 0 | 0 | 0 |
| 6 | 15 | 88 | 0.0253 | 0 | 0 | 0.0084 | 0 | 0 | 0 | 0 | 0.0042 | 0 | 0 | 0 |
| 6 | 17 | 88 | 0.1027 | 0 | 0 | 0 | 0 | 0 | 0.0039 | 0 | 0 | 0 | 0 | 0.0039 |
| 6 | 21 | 88 | 0.5486 | 0 | 0 | 0 | 0.0178 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 23 | 88 | 0.2004 | 0 | 0 | 0.0818 | 0.1349 | 0 | 0.0040 | 0 | 0 | 0 | 0 | 0 |
| 6 | 25 | 88 | 0.2632 | 0 | 0 | 0.0039 | 0.0199 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0039 |
| 6 | 27 | 88 | 0.1412 | 0 | 0 | 0.0117 | 0.0117 | 0 | 0.0039 | 0 | 0 | 0 | 0 | 0.0039 |
| 6 | 29 | 88 | 0.0306 | 0 | 0 | 0 | 0.0038 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0765 |
| 7 | 1 | 88 | 0.0079 | 0 | 0 | 0 | 0.0079 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0079 |
| 7 | 3 | 88 | 0.0378 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0252 |
| 7 | 5 | 88 | 0.1744 | 0 | 0 | 0.0039 | 0.0039 | 0 | 0.0039 | 0 | 0 | 0 | 0 | 0.0039 |
| 7 | 7 | 88 | 0.2579 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0041 |
| 7 | 11 | 88 | 0.0160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0040 |

APPENDIX D (Cont.)

STATION 95 FISH DENSITY (fish per cubic meter)

| MON | DAY | YR | THREADFIN SHAD | DELTA SMELT | PRICKLY SCULPIN | CYPRINID | CENTRARCHID | YELLOWFIN GOBY | INLAND SILVERSIDE | BIGSCALE LOGPERCH | ICTALURUS | SACRAMENTO SPLITTAIL | SUCKER | CHAMELEON GOBY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4 | 88 | 0 | 0.0081 | 1.6859 | 0 | 0 | 0 | 0 | 0.0121 | 0 | 0 | 0 | 0 |
| 4 | 6 | 88 | 0 | 0.0047 | 0.4502 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 8 | 88 | 0 | 0.0119 | 1.3160 | 0 | 0 | 0 | 0 | 0.0039 | 0 | 0 | 0 | 0 |
| 4 | 12 | 88 | 0 | 0.0042 | 0.4284 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 14 | 88 | 0 | 0 | 0.3493 | 0 | 0 | 0 | 0 | 0.0085 | 0 | 0 | 0 | 0 |
| 4 | 16 | 88 | 0 | 0.0041 | 0.2409 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 18 | 88 | 0 | 0.0077 | 0.4976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 20 | 88 | 0 | 0.0066 | 0.1061 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 22 | 88 | 0 | 0 | 0.1646 | 0 | 0 | 0 | 0 | 0.0042 | 0 | 0 | 0 | 0 |
| 4 | 24 | 88 | 0 | 0 | 0.0835 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 26 | 88 | 0 | 0 | 0.2091 | 0 | 0 | 0 | 0 | 0.0190 | 0 | 0 | 0 | 0 |
| 4 | 28 | 88 | 0.0039 | 0 | 0.2134 | 0 | 0 | 0 | 0 | 0.0039 | 0 | 0 | 0 | 0 |
| 4 | 30 | 88 | 0.0086 | 0 | 0.3079 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 2 | 88 | 0.0080 | 0.0040 | 0.4723 | 0 | 0 | 0 | 0 | 0.0080 | 0 | 0 | 0 | 0 |
| 5 | 12 | 88 | 0 | 0.0047 | 0.3357 | 0 | 0 | 0 | 0 | 0.0047 | 0 | 0 | 0 | 0 |
| 5 | 16 | 88 | 0 | 0 | 0.0621 | 0 | 0 | 0 | 0 | 0.0177 | 0 | 0 | 0 | 0 |
| 5 | 18 | 88 | 0 | 0 | 0.0111 | 0.0222 | 0 | 0 | 0 | 0.0111 | 0 | 0 | 0 | 0 |
| 5 | 20 | 88 | 0 | 0 | 0.0240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 22 | 88 | 0.0163 | 0 | 0 | 0.0163 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 24 | 88 | 0 | 0 | 0.0575 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 26 | 88 | 0 | 0 | 0.0154 | 0.0154 | 0 | 0 | 0 | 0.0154 | 0 | 0 | 0 | 0 |
| 5 | 28 | 88 | 0 | 0 | 0.0155 | 0.0155 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0155 |
| 5 | 30 | 88 | 0.0291 | 0 | 0.0291 | 0.0437 | 0.0145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 1 | 88 | 0 | 0 | 0 | 0.0127 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 3 | 88 | 0 | 0 | 0 | 0.0557 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 5 | 88 | 0 | 0 | 0.0173 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 7 | 88 | 0 | 0 | 0 | 0.0202 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 9 | 88 | 0.0164 | 0 | 0 | 0.1230 | 0.0082 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 11 | 88 | 0.0336 | 0 | 0 | 0.0470 | 0 | 0 | 0 | 0.0134 | 0 | 0 | 0 | 0 |
| 6 | 13 | 88 | 0.0149 | 0 | 0 | 0.0074 | 0.0074 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 15 | 88 | 0.0604 | 0 | 0 | 0.0226 | 0.0037 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0075 |
| 6 | 17 | 88 | 0.0648 | 0 | 0 | 0.0381 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 19 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 21 | 88 | 0.1568 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0039 | 0 | 0 | 0 | 0.0352 |
| 6 | 23 | 88 | 0.0799 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 25 | 88 | 0.1938 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0358 |
| 6 | 27 | 88 | 0.0175 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0070 |
| 6 | 29 | 88 | 0.0458 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 1 | 88 | 0.0309 | 0 | 0 | 0.0038 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0348 |
| 7 | 3 | 88 | 0.0118 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0039 |
| 7 | 5 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 7 | 88 | 0.0150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0113 |
| 7 | 11 | 88 | 0.0448 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0207 |

APPENDIX D (Cont.)

STATION 98

FISH DENSITY (fish per cubic meter)

| MON | DAY | YR | THREADFIN SHAD | DELTA SMELT | PRICKLY SCULPIN | CYPRINID | CENTRARCHID | YELLOWFIN GOBY | INLAND SILVERSIDE | BIGSCALE LOGPERCH | ICTALURUS | SPLITTAIL | SACRAMENTO SUCKER | CHAMELEON GOBY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4 | 88 | 0 | 0 | 0.1754 | 0 | 0 | 0 | 0 | 0.0042 | 0 | 0 | 0 | 0 |
| 4 | 6 | 88 | 0 | 0 | 0.1146 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 8 | 88 | 0 | 0 | 0.1262 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0037 | 0 |
| 4 | 12 | 88 | 0 | 0 | 0.0573 | 0 | 0 | 0 | 0 | 0.0038 | 0 | 0 | 0 | 0 |
| 4 | 14 | 88 | 0.0108 | 0 | 0.0973 | 0.0054 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0054 | 0 |
| 4 | 16 | 88 | 0 | 0 | 0.0046 | 0.0046 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0046 | 0 |
| 4 | 18 | 88 | 0 | 0 | 0.0298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 20 | 88 | 0 | 0 | 0.0757 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 22 | 88 | 0 | 0 | 0.0334 | 0.0041 | 0.0041 | 0 | 0 | 0 | 0 | 0 | 0.0041 | 0 |
| 4 | 24 | 88 | 0.0039 | 0 | 0.0199 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0039 | 0.0039 | 0 |
| 4 | 26 | 88 | 0 | 0 | 0.0273 | 0 | 0 | 0 | 0 | 0.0039 | 0 | 0.0156 | 0 | 0 |
| 4 | 28 | 88 | 0 | 0 | 0.0044 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 30 | 88 | 0.0094 | 0 | 0.0125 | 0 | 0 | 0 | 0 | 0.0094 | 0 | 0.0031 | 0 | 0 |
| 5 | 2 | 88 | 0.0290 | 0 | 0.0249 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 4 | 88 | 0.0072 | 0 | 0.0253 | 0 | 0.0036 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 12 | 88 | 0.0089 | 0 | 0.0134 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0089 | 0 | 0 |
| 5 | 14 | 88 | 0.0416 | 0 | 0.0096 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 16 | 88 | 0.1365 | 0 | 0.0179 | 0.0898 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 18 | 88 | 0.0451 | 0 | 0.0246 | 0.1067 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0041 | 0 |
| 5 | 20 | 88 | 0 | 0 | 0.0109 | 0.0072 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 22 | 88 | 0.0568 | 0 | 0.0035 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 24 | 88 | 0.0166 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0041 | 0 |
| 5 | 28 | 88 | 0.1626 | 0 | 0 | 0.1161 | 0 | 0 | 0 | 0.0038 | 0 | 0 | 0 | 0 |
| 5 | 30 | 88 | 0.0789 | 0 | 0 | 0.0236 | 0.0236 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 1 | 88 | 0.0568 | 0 | 0 | 0.0151 | 0.1213 | 0 | 0 | 0 | 0 | 0 | 0.0037 | 0 |
| 6 | 3 | 88 | 0.0281 | 0 | 0.0070 | 0 | 0.0211 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 5 | 88 | 0.1086 | 0 | 0 | 0.0070 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0035 | 0 |
| 6 | 7 | 88 | 0.1272 | 0 | 0 | 0.0079 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 9 | 88 | 0.0076 | 0 | 0 | 0.0570 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0038 | 0 |
| 6 | 11 | 88 | 0.0082 | 0 | 0 | 0.0370 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 13 | 88 | 0.2056 | 0 | 0 | 0.0087 | 0.0087 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 15 | 88 | 0.4685 | 0 | 0 | 0 | 0.0040 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 17 | 88 | 0.2846 | 0 | 0 | 0.0269 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 19 | 88 | 0.0711 | 0 | 0 | 0.1264 | 0.0079 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 21 | 88 | 0.2156 | 0 | 0 | 0.0074 | 0.0260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 23 | 88 | 0.1835 | 0 | 0 | 0.0224 | 0.0037 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 25 | 88 | 0.0683 | 0 | 0 | 0.1452 | 0 | 0 | 0 | 0 | 0.0128 | 0 | 0 | 0 |
| 6 | 27 | 88 | 0.2965 | 0 | 0 | 0.0203 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0040 | 0 |
| 6 | 29 | 88 | 0.3069 | 0 | 0 | 0.0073 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 1 | 88 | 0.0959 | 0 | 0 | 0.0076 | 0.0038 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 3 | 88 | 0.3298 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0037 | 0 | 0 | 0.0037 |
| 7 | 5 | 88 | 0.1016 | 0 | 0 | 0.0075 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 7 | 88 | 0.4290 | 0 | 0 | 0.1053 | 0.0039 | 0 | 0 | 0 | 0.0117 | 0 | 0 | 0 |
| 7 | 11 | 88 | 0.2680 | 0 | 0 | 0.0121 | 0.0040 | 0 | 0 | 0 | 0.0040 | 0 | 0 | 0 |

Appendix E. Total Fish Densities for Striped Bass and Other Species by Size Group for the SWP (Station 92) and CVP (Station 96) Sites During 24- and 48-hour Tidal Studies, May 17-18 and May 31-June 2, 1988.

STATION 92 - TIDAL STUDY STRIPED BASS DENSITIES (fish/m3)

| | | | SIZE GROUP | | | | | |
|---|---|---|---|---|---|---|---|---|
| DATE | TIME | EGGS | 3-6 mm | 7-10 mm | 11-14 mm | 15-18 mm | 19-20 mm | 3-20 mm |
| 17-May-88 | 1504 | 0 | 0.0405 | 0.0050 | 0 | 0 | 0 | 0.0455 |
| 17-May-88 | 1550 | 0.0046 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17-May-88 | 1716 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17-May-88 | 1847 | 0.0376 | 0.0601 | 0.0451 | 0 | 0 | 0 | 0.1052 |
| 17-May-88 | 2031 | 0 | 0.1170 | 0.0561 | 0.0046 | 0 | 0 | 0.1777 |
| 17-May-88 | 2158 | 0 | 0.0093 | 0.0280 | 0 | 0 | 0 | 0.0373 |
| 18-May-88 | 2400 | 0 | 0.0314 | 0.0584 | 0 | 0 | 0 | 0.0898 |
| 18-May-88 | 0047 | 0.0104 | 0.3224 | 0 | 0 | 0 | 0 | 0.3224 |
| 18-May-88 | 0253 | 0 | 0.1127 | 0.0093 | 0 | 0 | 0 | 0.1220 |
| 18-May-88 | 0343 | 0 | 0.3086 | 0.0467 | 0 | 0 | 0 | 0.3553 |
| 18-May-88 | 0534 | 0 | 0.3972 | 0.0611 | 0 | 0 | 0 | 0.4583 |
| 18-May-88 | 0701 | 0.0342 | 0.3426 | 0.0599 | 0 | 0 | 0 | 0.4025 |
| 18-May-88 | 0826 | 0 | 0.2031 | 0.0290 | 0 | 0 | 0 | 0.2321 |
| 18-May-88 | 1008 | 0 | 1.8422 | 0.1078 | 0 | 0 | 0 | 1.9500 |
| 18-May-88 | 1119 | 0 | 0.8448 | 0.2045 | 0 | 0 | 0 | 1.0493 |
| 18-May-88 | 1343 | 0 | 0.5373 | 0.1386 | 0 | 0 | 0 | 0.6759 |
| 18-May-88 | 1505 | 0.1241 | 0.0620 | 0.0103 | 0 | 0 | 0 | 0.0723 |
| 31-May-88 | 0821 | 0 | 0.4112 | 0.3829 | 0 | 0 | 0 | 0.7941 |
| 31-May-88 | 1025 | 0 | 0.5698 | 0.4486 | 0 | 0 | 0 | 1.0184 |
| 31-May-88 | 1208 | 0 | 0.1224 | 0.0680 | 0 | 0 | 0 | 0.1904 |
| 31-May-88 | 1413 | 0 | 0.0441 | 0.0514 | 0 | 0 | 0 | 0.0955 |
| 31-May-88 | 1614 | 0.0040 | 0.0122 | 0 | 0 | 0 | 0 | 0.0122 |
| 31-May-88 | 1814 | 0 | 0 | 0.0095 | 0 | 0 | 0 | 0.0095 |
| 31-May-88 | 2047 | 0 | 0.1240 | 0.1551 | 0 | 0 | 0 | 0.2791 |
| 31-May-88 | 2215 | 0 | 0.2686 | 0.2148 | 0 | 0 | 0 | 0.4834 |
| 01-Jun-88 | 0017 | 0 | 0.0967 | 0.2419 | 0 | 0 | 0 | 0.3386 |
| 01-Jun-88 | 0240 | 0 | 0.0714 | 0.2001 | 0.0142 | 0 | 0 | 0.2857 |
| 01-Jun-88 | 0416 | 0 | 0.3726 | 0.2722 | 0.0286 | 0 | 0 | 0.6734 |
| 01-Jun-88 | 0615 | 0 | 0.2596 | 0.2207 | 0.0129 | 0 | 0 | 0.4932 |
| 01-Jun-88 | 0828 | 0 | 0.3118 | 0.1732 | 0.0115 | 0 | 0 | 0.4965 |
| 01-Jun-88 | 1013 | 0 | 0.3081 | 0.2801 | 0 | 0 | 0 | 0.5882 |
| 01-Jun-88 | 1210 | 0 | 0.3329 | 0.5218 | 0.0449 | 0.0089 | 0 | 0.9085 |
| 01-Jun-88 | 1411 | 0 | 0.0083 | 0 | 0 | 0 | 0 | 0.0083 |
| 01-Jun-88 | 1613 | 0 | 0.0087 | 0.0043 | 0.0043 | 0 | 0 | 0.0173 |
| 01-Jun-88 | 1812 | 0 | 0.0150 | 0.0150 | 0.0075 | 0 | 0 | 0.0375 |
| 01-Jun-88 | 2024 | 0 | 0.0952 | 0.0952 | 0 | 0 | 0 | 0.1904 |
| 01-Jun-88 | 2217 | 0 | 0.0441 | 0.0736 | 0 | 0 | 0 | 0.1177 |
| 02-Jun-88 | 0021 | 0 | 0.1087 | 0.0777 | 0.0310 | 0 | 0 | 0.2174 |
| 02-Jun-88 | 0216 | 0 | 0.1739 | 0.2111 | 0.0124 | 0 | 0 | 0.3974 |
| 02-Jun-88 | 0430 | 0 | 0.3654 | 0.3971 | 0.0158 | 0 | 0 | 0.7783 |
| 02-Jun-88 | 0618 | 0 | 0.0311 | 0.2026 | 0.0155 | 0 | 0 | 0.2492 |
| 02-Jun-88 | 0745 | 0 | 0.1714 | 0.1028 | 0 | 0 | 0 | 0.2742 |

APPENDIX E (Cont.)

STATION 92 - TIDAL STUDY

FISH DENSITY (fish per cubic meter)

| DATE | TIME | THREADFIN SHAD | DELTA SMELT | PRICKLY SCULPIN | CYPRINID | CEN-TRARCHID | INLAND SILVERSIDE | BIGSCALE LOGPERCH | ICTALURUS | SPLITTAIL | SACRAMENTO SUCKER | CHAMELEON GOBY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-May-88 | 1504 | 0 | 0 | 0.0506 | 0.0506 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17-May-88 | 1550 | 0.0468 | 0 | 0.0280 | 0.0421 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17-May-88 | 1716 | 0.0599 | 0 | 0.0257 | 0.0428 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17-May-88 | 1847 | 0 | 0 | 0.0150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17-May-88 | 2031 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17-May-88 | 2158 | 0 | 0 | 0 | 0.0093 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 2400 | 0.0044 | 0 | 0.0134 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 0047 | 0 | 0 | 0.0832 | 0.0104 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 0253 | 0 | 0 | 0.0187 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 0343 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 0534 | 0 | 0 | 0.0611 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 0701 | 0 | 0.0085 | 0.0342 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 0826 | 0 | 0 | 0.0145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 1008 | 0 | 0 | 0.0746 | 0.0082 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 1119 | 0.0088 | 0 | 0.0177 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 1343 | 0 | 0.0086 | 0.0086 | 0.0086 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18-May-88 | 1505 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31-May-88 | 0821 | 0.0141 | 0 | 0 | 0.0709 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31-May-88 | 1025 | 0 | 0 | 0 | 0.0363 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31-May-88 | 1208 | 0.0136 | 0 | 0.0136 | 0.0272 | 0.0680 | 0 | 0.0408 | 0 | 0 | 0 | 0 |
| 31-May-88 | 1413 | 0.0955 | 0 | 0 | 0.0220 | 0.0735 | 0 | 0.0073 | 0 | 0 | 0 | 0 |
| 31-May-88 | 1614 | 0.0775 | 0 | 0 | 0.0081 | 0.0775 | 0 | 0.0040 | 0 | 0 | 0 | 0 |
| 31-May-88 | 1814 | 0 | 0 | 0 | 0.0095 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31-May-88 | 2047 | 0.0155 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31-May-88 | 2215 | 0 | 0 | 0 | 0 | 0.0179 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 0017 | 0 | 0 | 0 | 0.0161 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 0240 | 0 | 0 | 0 | 0.0142 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 0416 | 0 | 0 | 0 | 0 | 0.0143 | 0 | 0.0429 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 0615 | 0.0259 | 0 | 0.0129 | 0.0389 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 0828 | 0.0115 | 0 | 0 | 0.0346 | 0.0115 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 1013 | 0 | 0 | 0 | 0.0420 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 1210 | 0.0089 | 0 | 0 | 0.0359 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 1411 | 0.0249 | 0 | 0 | 0 | 0.0499 | 0.0083 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 1613 | 0.0565 | 0 | 0 | 0.0174 | 0.1479 | 0 | 0.0043 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 1812 | 0.0901 | 0 | 0.0075 | 0 | 0.0901 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 2024 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 01-Jun-88 | 2217 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 02-Jun-88 | 0021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 02-Jun-88 | 0216 | 0 | 0 | 0.0124 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 02-Jun-88 | 0430 | 0.0635 | 0 | 0 | 0.0317 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 02-Jun-88 | 0618 | 0 | 0 | 0 | 0.0155 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 02-Jun-88 | 0745 | 0 | 0 | 0.0171 | 0.0171 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |