ADDENDUM 1 to APPENDIX C1

EFFECTS OF THERMAL DISCHARGES ON PLANKTON, MACROINVERTEBRATES, AND FISH

ADDENDUM TO
APPENDIX C1

ECOLOGICAL STUDIES FOR THE OYSTER CREEK NUCLEAR GENERATING STATION

EFFECTS OF THERMAL DISCHARGES ON PLANKTON, MACROINVERTEBRATES, AND FISH

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This Addendum uses OCGS as the acronym for the Oyster Creek Nuclear Generating Station.

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INTRODUCTION

Since 8 September 1975, Ichthyological Associates, Inc. (I.A.) has conducted studies to determine and to assess the biological impact of the Oyster Creek Generating Station (OCGS) and its discharges, and I.A. has implemented an ecological survey of fin- and shellfish populations in Barnegat Bay, Oyster Creek, and Forked River. Samples were taken primarily in the central and western portion of Barnegat Bay from Cedar Creek in the north to Double Creek in the south. The central and western Bay is relatively deep and ranges from 1.2 to 3.7 m (National Oceanic and Atmospheric Administration, NOAA 1976). Some specimens were also collected in the eastern portion of the Bay which contains extensive shoal areas (depth 0.2 to 0.9 m). Life history studies of fishes and macroinvertebrates designated as important by the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Environmental Protection Agency (EPA) were conducted.

Data collected from September 1975 through August 1976 were reported in Appendix C1. This addendum summarizes information collected from September 1976 through August 1977 as a part of many continuing studies. Data from individual collections in the Bay, Oyster Creek, and Forked River from September 1976 through February 1977 were reported by I.A. (1977), and these data from March through August 1977 were reported in Tatham et al. (1978a,b). Whenever possible, this addendum summarizes and compares data from the 2 years of study. The common and scientific names of fishes and invertebrates used in this report are given in Tables C1-142 through C1-144.

In addition to fisheries samples, collections were taken in Oyster Creek and Forked River to determine the effect of the heated discharge on macrozoo- and ichthyoplankton. Macrozooplankton (i.e., planktonic invertebrates > 500 microns) included organisms that were planktonic during their entire life cycle (holoplankton) and those that occurred in the plankton only periodically or during a portion of their life cycle (meroplankton). Emphasis was placed on forms designated as important species by the NRC or the EPA. Important macrozooplankton were the ctenophores *Mnemiopsis leidyi* and *Beroe* spp., the arrowworms *Sagitta elegans* and *Sagitta* spp., the sand shrimp *Crangon septemspinosa*, grass shrimp *Palaemonetes* spp., the mysids *Neomysis americana* and *Mysidopsis bigelowi*, polychaete epitokes and individuals less than 1 mm, and blue crab zoeae and megalopae. Important ichthyoplankton were the eggs and larvae of the Atlantic menhaden, bay anchovy, threespine stickleback, northern pipefish, striped bass, bluefish, weakfish, northern kingfish, summer flounder, winter flounder, and northern puffer.

Introduction

Water temperature, salinity, pH, dissolved oxygen, and water clarity were taken with each biological collection. Total chlorine was determined for plankton samples taken at the OCGS discharge. These data were used to describe the physicochemical regime at four stations in western Barnegat Bay (Fig. C1-15) and at the intake to the OCGS cooling-water system from September 1976 through August 1977. Thirteen stations (Fig. C1-16) in the south branch of Forked River (intake canal) and in Oyster Creek (discharge canal) were sampled from March 1976 through March 1977 to evaluate the physicochemical parameters associated with fisheries collections in the OCGS thermal discharge.

Materials and Methods

Water temperature and dissolved oxygen were measured with a YSI dissolved oxygen meter (Model 57A), and salinity was determined with an American Optical hand refractometer. The pH was measured with either a Photovolt pH meter (Model 126A) or a Corning pH meter (Model 610A). Total chlorine was measured with a Fischer-Porter amperometric titrator. For all biological collections (except seine collections) taken during the day, water transparency was measured with a 20-cm Secchi disc. Procedures for use and calibration of these instruments were presented previously (I. A. 1976).

Surface and bottom water chemistries were taken with all trawl and gill net collections and with impingement and entrainment (plankton) collections at the intake to the OCGS cooling-water system. Bottom water samples were obtained with either a 1.7- or 5-liter Niskin bottle. Only surface chemistry was taken with seine collections. Because water at the OCGS discharge was thoroughly mixed, only surface chemistry was taken with entrainment collections at the discharge. During impingement sampling, a bottom chemistry was taken only with the first and last collection of the day because surface and bottom chemistries were similar.

In the Bay, water chemistries were generally taken between replicate collections or, for unreplicated sets of a gill net, at the beginning of the collection. Chemistries associated with impingement and entrainment samples were usually taken during or near the end of the collection period. To determine instrument variability, the first and last chemistries of any sampling date were replicated by taking a second reading from the same water sample. A paired t-test was performed on various physicochemical parameters taken in the Bay from February 1976 through August 1977 and at OCGS from September 1975 through August 1977 to determine if significant ($P \leq 0.05$) differences occurred between replicates. A paired t-test was also used to examine differences between surface and bottom samples.

Results and Discussion

The mean monthly water temperature, salinity, pH, dissolved oxygen concentration, and Secchi disc reading for stations at the mouth of

Cedar Creek, Forked River, Oyster Creek, and Double Creek and within the intake and discharge canal are summarized in Tables C1-146 through C1-149 and C1-152 through C1-158. Physicochemical data examined were taken with individual fisheries collections within Forked River and Oyster Creek from March 1976 through March 1977, at the OCGS cooling-water intake from September 1975 through August 1976, and at four stations in the Bay from September 1976 through August 1977.

Oyster Creek was divided into an area east (Sta. 15, 28, 29, 30) and west (26 and 27) of U.S. Route 9 to compare the physicochemical parameters in the vicinity of the OCGS discharge with those in the lower portion of Oyster Creek. No samples were taken at Cedar Creek, Double Creek, Forked River, and in the lagoon off Oyster Creek during January and February because of ice cover.

The temperature regime in western Barnegat Bay in 1976-77 was more accurately described from data recorded daily by JCP&L monitoring equipment (accuracy of 1.1 C) maintained at the intake to the cooling-water system. Although these data may be biased by occasional (4 to 22%) recirculation of 0.9 to 1.7 C from the thermal discharge in Oyster Creek, this daily record provided a better description of the temperature patterns in the Bay than water chemistries taken on 1 day a month at the mouths of the three creeks. While the mean monthly temperature based on Bay and intake temperatures may differ slightly, the same seasonal patterns were found.

Similarly, the mean monthly increase in the temperature of water circulated through OCGS (delta T) was determined from JCP&L's daily

records of temperature at the intake and discharge of the cooling-water system rather than from the seven or eight values determined from 4 or 5 days of entrainment sampling during a month. Since the delta T was calculated only for days that OCGS operated, the values reported by Tatham (1977a) were recalculated.

Water Temperature

OCGS Discharge

When OCGS operated, the largest mean delta T (Table C1-145) occurred in August (11.0 C) and the smallest in September (8.2). The mean yearly delta T during periods of OCGS operation in 1976-77 (9.4 C) was slightly higher than that in 1975-76 (9.2). The lowest mean monthly intake (0.1 C) and discharge (10.0 and 10.1) temperatures occurred in December and January. The maximum mean monthly intake (26.6 C) and discharge (37.6) temperatures were in August.

Western Barnegat Bay

The coldest mean monthly surface (2.2 C) and bottom (2.4) temperatures in the Bay were recorded in December; however, no temperatures were taken during January and February at stations unaffected by the heated discharge because these stations were covered with ice (Table C1-146). During the previous year, the coldest Bay temperature (-1.5 C) occurred during January (Tatham 1977a). The warmest mean monthly temperature (29.7 C) in the Bay occurred in July. When OCGS was in operation, the mean monthly surface and bottom water temperatures at the mouth of Oyster Creek averaged 3.0 C (range of 1.1 to 4.0 C) and 3.3 C (1.4 to

4.4), respectively warmer than the combined mean temperature of the other creek mouths. When OCGS was shut down from May through July, the mean temperatures at the mouth of Oyster Creek and at the other three creeks were similar.

As in 1975-76 (Tatham 1977a), thermal stratification occurred frequently at Double Creek. From April through August, the bottom water was cooler than the surface water, but from October through March, the bottom water was usually warmer. At other stations, stratification occurred sporadically. Stratification in Barnegat Bay can be caused by long wave infrared atmospheric heating or cooling, short wave solar radiation, back-radiation of surface water, and density differences that prevent complete mixing (Lawler et al. 1978).

Forked River and Oyster Creek

The mean monthly water temperatures at stations in Forked River followed the seasonal pattern in the Bay except for a decrease in water temperature from April to May that was caused by generally lower air temperatures (Table C1-148). Highest mean monthly temperatures were recorded from Forked River (27.6 C) and from Oyster Creek (29.8) in June. Lowest temperatures were found in January in both Forked River (1.7 C) and Oyster Creek (4.7).

Due to cooling and dilution, water temperatures decreased from the immediate vicinity of the OCGS discharge to the mouth of Oyster Creek. Because water in the vicinity of the OCGS discharge (Sta. 26) was relatively undiluted by ambient temperature water from the dilution pumps, the mean temperatures at stations in Oyster Creek west of Route 9

averaged 2.0 C warmer at the surface and 1.7 C warmer at the bottom than those in the Creek east of Route 9. In May 1976, however, the temperature in the immediate vicinity of the OCGS discharge was less than temperatures recorded elsewhere in Oyster Creek because OCGS shut down minutes before the sample was taken. The temperature of the discharge water was therefore about ambient. Temperatures in Oyster Creek, however, were still 4 C above ambient for several hours after shutdown because the cessation of dilution pumping immediately after shutdown increased the residence time of heated water in Oyster Creek. Due to restricted circulation, the temperature of water in the lagoon (Sta. 30) off Oyster Creek remained above ambient for several hours after the water in the Creek had cooled.

Surface temperatures were often warmer than bottom temperatures in the immediate vicinity of the OCGS discharge (Sta. 26) because the heated water discharged from OCGS overrides ambient temperature water from the dilution pump (M. B. Roche, personal communication). Little difference was found between surface and bottom temperatures at the other stations in Oyster Creek.

OCGS Cooling-Water Intake

The mean monthly surface and bottom water temperatures at the intake to the OCGS cooling-water system ranged from 1.2 C in January to 25.7 C in July and August (Table C1-149). A paired t-test indicated that the bottom water temperature was significantly greater than the surface temperature in 1976-77 but not in 1975-76 (Table C1-150).

The seasonal variation of the mean monthly temperatures at the OCGS cooling-water intake was similar to that of the three thermally unaffected

creek mouths. However, water temperatures cooled more rapidly in the fall of 1976 than in the previous year. In 1976, the temperature had decreased to 5 C by mid-November, while in 1975, 5 C was not reached until mid-December. As a result of the earlier cooling of the Bay in 1976, the mean yearly water temperature (substituting the mean water temperature of the creek mouths for June) at the OCGS cooling-water intake was 1.6 C lower in 1976-77 (13.3 C) than in the previous year (14.9). The National Weather Service reported that the winter of 1976-77 was the coldest winter in weather bureau records (Darling 1977).

Salinity

Western Barnegat Bay

The lowest mean monthly salinities were always recorded at Cedar Creek, the northernmost station, while the highest mean monthly salinities were usually (8 of 9 months) found at Double Creek, the southernmost station (Table C1-147). The same trend was found in 1975-76 (Tatham 1977a). The mean yearly salinity was 20.9 ppt at Cedar Creek, 24.5 ppt at Forked River, 23.7 ppt at Oyster Creek, and 25.3 ppt at Double Creek. The mean yearly salinity at each station was higher in 1976-77 than in 1975-76 even though slightly more rainfall was recorded the second year (953 mm) than the first (899 mm, Table C1-151). During the year, salinities were generally highest during September and October 1976 and in August 1977 due, in part, to the cumulative effects of higher evaporation rates and less runoff during the summer. Lowest salinities occurred in December and April.

Mean monthly surface and bottom salinities at the mouth of Forked River were slightly higher than those at the mouth of Oyster Creek in 8 of 10 months; this phenomenon was also noted by Tatham (1977a) during 1975-76. Freshwater from the three branches of Forked River and from Oyster Creek drained into Forked River and Oyster Creek between the stations at the mouths of the two creeks. This freshwater input apparently contributed to lower salinities at the mouth of Oyster Creek.

Forked River and Oyster Creek

The mean surface and bottom salinities in Forked River (23.5 and 23.6 ppt, respectively) and Oyster Creek (23.1 and 23.3) were similar for this period (Table C1-152). The slightly lower salinities in Oyster Creek may be attributed, in part, to freshwater input from the south branch of Forked River (discharge of 0.06 m^3/sec) and from Oyster Creek (0.71 m^3/sec). Seasonal fluctuations in salinities were also similar between the two areas except for relatively minor differences from January through March 1977. Lowest mean salinity (20.4 ppt) in both areas occurred in April and the highest values (27.0) in July. The 4-ppt decrease in salinity from July to August was due to precipitation from Hurricane Belle on 9 August. Tatham (1977a) reported a similar reduction in salinity in other parts of Barnegat Bay during August 1976. At most stations, the mean monthly bottom salinity was slightly higher than the surface salinity.

OCGS Cooling-Water Intake

The mean monthly salinity at the OCGS cooling-water intake ranged from 21.5 ppt in April to 25.5 ppt in August with an average value of

23.9 ppt for the year (Table C1-149). During both 1975-76 and 1976-77, salinity was significantly greater at the bottom than the surface (Table C1-150).

pH

Western Barnegat Bay

The mean yearly pH value ranged from 8.1 at the mouth of Oyster Creek to 8.3 at the mouth of Cedar Creek (Table C1-153). Although the pH values were similar to those reported for Barnegat Bay by Makai (1973), they were approximately 0.4 units higher (i.e., more basic) than those reported by Tatham (1977a) at the same stations in 1975-76. The lowest monthly values were recorded in December (7.8) and the highest (8.4) in November and August, but no seasonal trends in pH were apparent.

Forked River and Oyster Creek

From March 1976 through March 1977, the mean pH in both Forked River and Oyster Creek was 7.9 (Table C1-155), although differences in pH occurred between canals in some months. The largest difference was found in June when the mean pH in Forked River (7.6) was 0.3 units more basic than that in the discharge canal (7.3). No seasonal trends in pH were evident.

OCGS Cooling-Water Intake

The mean monthly pH values at the OCGS screens ranged from 7.8 in October to 8.1 in August and were similar to those at stations in Forked River (Table C1-149). Although the mean yearly pH was the same (8.0)

for both surface and bottom samples, a paired t-test based on individual values indicated that the pH of bottom samples was significantly higher (i.e., more basic) than that of surface samples (Table C1-150).

Dissolved Oxygen

Western Barnegat Bay

Mean monthly dissolved oxygen concentrations ranged from 6.8 ppm in July to 12.0 ppm in December and January (Table C1-154), and they were similar to those reported for Barnegat Bay by Makai (1973) and Tatham (1977a). The mean yearly dissolved oxygen concentrations at the mouths of Cedar Creek, Oyster Creek, and Forked River averaged 9.2 to 9.3 ppm at the surface and 9.5 to 9.6 ppm at the bottom. However, the mean yearly surface (9.7 ppm) and bottom (10.1) dissolved oxygen values at the mouth of Double Creek were slightly higher than those at the other stations. These higher values were probably due to the proximity of Double Creek to cooler, ocean water entering the Bay from Barnegat Inlet.

Forked River and Oyster Creek

The seasonal variation in dissolved oxygen concentration at the 13 stations in Forked River and Oyster Creek was similar to that at other stations in Barnegat Bay (Table C1-156). Highest values occurred from November through February (8.6 to 12.4 ppm) and the lowest values in July (5.4 to 6.7). For the period, the mean dissolved oxygen concentration at all stations in Oyster Creek (8.6 ppm) was slightly lower than those at stations in Forked River (9.3).

OCGS Cooling-Water Intake

The mean surface and bottom dissolved oxygen concentrations ranged from 5.8 ppm in July to 12.2 ppm during January and averaged 9.3 ppm for the year (Table C1-149). The seasonal pattern of dissolved oxygen concentration was similar to those from stations in the Bay. Although the dissolved oxygen concentration at the surface was significantly greater than at the bottom in October and November, no significant differences were found during the other 10 months.

Water Clarity

Western Barnegat Bay

The mean yearly Secchi disc readings were similar (103 to 111 cm) at all four stations (Table C1-157). The highest Secchi disc readings were recorded in March (mean value of all stations of 183 cm) and the lowest in August (56 cm). Water clarity increased from October through March and then steadily decreased through August. During the previous year, Secchi disc readings were also highest during late fall and winter and lowest in the summer (Tatham 1977a). Similar findings were reported by Mountford (1971) in his study of plankton in Barnegat Bay. He found that water transparency decreased during the summer as a result of phytoplankton blooms. Greater clarity in the fall and spring was associated with nutrient depletion and consequently low chlorophyll (i.e., phytoplankton) concentrations.

Forked River and Oyster Creek

Although samples in these two areas were not taken during the same time period as those in western Barnegat Bay, similar trends in water clarity were evident. The lowest mean Secchi disc readings were recorded in July and the highest values in February (Table C1-158). Water clarity steadily increased from July through February and then decreased after spring. The mean yearly Secchi disc reading for Forked River (126 cm) was comparable to that of Oyster Creek (125), and month-to-month variation in transparency in the two areas was similar. The large decrease in transparency from May to June may have been due to an increase in phytoplankton.

Replicate Chemistries

Paired t-tests of replicate bottom water chemistries taken in the Bay and of replicate surface and bottom water chemistries taken at the intake to the OCGS cooling-water system showed no significant differences in temperature, dissolved oxygen, salinity, and pH between the two replicates. Significant differences were found for dissolved oxygen and pH values between replicate surface samples in the Bay, but the reason for these differences is not known.

C1.17 EFFECTS OF THE OCGS HEATED DISCHARGE ON FISHES AND MACROINVERTEBRATES

Introduction

The effects of the OCGS heated discharge on the distribution of fishes, the sand shrimp, and blue crab were examined. Collections were made in Oyster Creek (the discharge canal) and in the unheated south branch of Forked River (the intake canal); both areas had similar flow, bathymetry, and salinity. The distribution and abundance of organisms in Oyster Creek and in corresponding areas of Forked River were analyzed from collections taken from March 1976 through March 1977. Samples were also taken from 31 May through 2 June and on 15 and 16 July during a shutdown of OCGS (23 April through 4 August) and on 18 and 19 August during the subsequent operational period to determine differences in catch in Oyster Creek before and after the addition of heat.

In addition to collections in Oyster Creek and Forked River, data were collected at the mouth of Oyster Creek, Forked River, Cedar Creek, and Double Creek from September 1976 through August 1977. These data were used to determine the species composition and relative abundance of fishes, the sand shrimp, and blue crab in western Barnegat Bay and the effect of the heated discharge on the distribution of these organisms at the mouth of Oyster Creek. Although one station was influenced by the OCGS thermal discharge, these data were the most representative of the nearshore fish community in western Barnegat Bay and therefore were used

to describe that community. This study is a continuation of studies conducted during 1975-76 (Danila 1977b).

Materials and Methods

Collections in western Barnegat Bay

The stations at the mouth of Cedar Creek, Forked River, Oyster Creek, and Double Creek were sampled once a month by trawl and seine (Tables C1-159, C1-160; Fig. C1-15). Collections at all four stations were made from October through December and from March through August. Before a plan for continuing studies was adopted in October, trawl and seine collections were taken only at the mouth of Oyster Creek and only seine collections were made at the mouth of Forked River in September. Only one haul of the 45.7-m seine was made during the day at each station. In January and February, samples could be taken only at the mouth of Oyster Creek due to ice cover at the other three stations.

Two consecutive 5-min hauls of a 4.9-m semiballoon otter trawl were made at each station during daylight and were repeated at night (beginning 1 h after sunset) at the mouth of Oyster Creek and Forked River. The trawl had a 4.9-m headrope, 5.8-m footrope, and 61.0 x 30.5-cm doors. It had a 3.8-cm nylon stretch mesh body and a 3.2-cm stretch mesh codend fitted with a 1.3-cm stretch mesh inner liner. It was hauled at 1,600 rpm from a 6.4-m MonArk work boat, and an average haul covered 771.75 m^2. The boat returned to the starting point to take the second haul as soon as the first collection was processed.

Two hauls of a 45.7 x 2.4-m nylon seine (1.3-cm stretch mesh), with a 2.4-m bag in the center, were made at each station. One collection was made before and one after two consecutive hauls of a 12.2 x 1.5-m nylon seine (0.6-cm stretch mesh). The 45.7-m seine was set in a semicircle from a 4.3-m Starcraft with both ends at or near shore when the net was fully deployed, and it was then hauled onto the beach by hand. An average haul covered approximately 3,300 m^2 ($0.5\pi[45.7]m^2$). The 12.2-m seine was set by holding one brail stationary at the water's edge and sweeping the fully extended net through the water in a semicircle. The maximum area covered was 233 m^2 ($0.5\pi[12.2]m^2$). The 45.7-m seine captured primarily larger fishes and macroinvertebrates found in shallow water within about 50 m from shore while the 12.2-m seine took smaller organisms found from shore out to about 12 m. Samples were taken at each station during daylight and again at night at the mouth of Oyster Creek and Forked River.

At times, schools of small American eel elvers and young (age 0+) Atlantic silverside were observed in front of the 12.2-m seine, but most escaped through the mesh of the net because of their small size. In order to record the time and location of occurrence of these small fishes without biasing catch statistics, two relative estimates of abundance were used. The abundance of these small fish was recorded as occasional (few specimens) and numerous (many specimens) according to subjective estimates made by the biologists. This escapement generally occurred only for a short period in spring because young Atlantic silverside grew rapidly and elvers of the American eel moved from the shore zone.

In trawl collections with large amounts of detritus and macroalgae, an estimate of abundant organisms was made by counting their number in a known volume of the sample. The number in this subsample was multiplied by the total volume of the sample to estimate the total number of these organisms. Fish tangled in the net were removed by hand, counted, and added to the estimated total. Prior to subsampling for abundant organisms, the entire collection was examined, and all other organisms were removed.

All individuals of important species or a representative subsample of at least 50 individuals from each station were initially preserved in buffered 10% formalin. Fishes other than important species were identified, counted, and discarded; uncommon species were preserved for the voucher collection.

Invertebrates other than the sand shrimp or blue crab were identified in the field to the lowest practical taxon. Their numbers were counted or estimated, and their relative abundance was categorized as rare (1 to 10 individuals or colonies), occasional (11 to 100), common (101 to 1,000), or abundant (> 1,000).

Collections in Forked River and Oyster Creek

Samples with trawl, seine, and gill net were taken at 13 stations in Oyster Creek and Forked River (Tables C1-159 through C1-161, Fig. C1-16). Swift currents and extensive rip-rap on the banks prevented use of the gill net in all areas west of U.S. Route 9 except in the immediate vicinity of the OCGS discharge (Sta. 26). Although this station had no comparable station in Forked River, it was sampled because many fishes

occurred in this area of maximum OCGS discharge temperature (Danila 1977b). One seine station (Sta. 28) in Oyster Creek was not comparable to any station in Forked River, but the data were used in conjunction with the catch at the station (29) in the mouth of Oyster Creek to provide information on the distribution of shore zone fishes in the heated discharge.

Fifteen sets of collections were taken from March 1976 through March 1977. Sampling was conducted during daylight once a month usually over a 2 or 3-day period. An additional set of collections was taken in August and September 1976 to collect more data on the distribution of organisms during the period of highest water temperatures. In January and February, only two stations east of Route 9 in Oyster Creek (Sta. 15 and 50) could be sampled because of extensive ice on the Bay, portions of Forked River, and the lagoons off Oyster Creek. In 1977, additional sets of collections were made in May-June and in July when OCGS was shut down and again in August, several weeks after OCGS resumed operation. After March 1977, the seine station in Forked River (Sta. 47) was relocated (Sta. 53) because construction activities prevented sampling at the original station.

A 4.9-m trawl (see page C1-363) was used at three stations in Oyster Creek (Sta. 15, 30, 50) and in Forked River (6, 45, 46). At most stations, two consecutive 5-min hauls were made in the direction of the current, but in the short lagoons (Sta. 30 and 46), only a 2.5-min haul could be made.

West of Route 9, two stations in Forked River (Sta. 48, 49) and in Oyster Creek (26, 27) near OCGS were sampled with a 2.7-m semiballoon

otter trawl. The trawl was towed at a standard throttle setting from a 4.3-m Starcraft powered with an outboard motor because the areas west of Route 9 were not accessible to the larger MonArk. This trawl had a 2.7-m headrope, 3.4-m footrope, and 40.6 x 26.7-cm doors. The nylon body was 3.8-cm stretch mesh, and the codend had an inner liner of 0.6-cm stretch mesh. Two consecutive 3-min tows were made at the easternmost stations (Sta. 27, 48) and two consecutive 1-min tows were taken at the westernmost stations (26, 49).

Although duration of tows of the 2.7 and 4.9-m trawls varied between the gear and between stations for the same gear, data were not adjusted to equalize tow duration. Chittenden and Van Engle (1972) found no significant differences in the catch of blue crab or in the catch of haddock (data from Clark 1973) from trawl hauls of different duration. They believed that the relation of catch by trawl to tow duration was not linear and suggested that a linear relationship between catch and tow duration should not be assumed to adjust for unequal sampling time.

A 61.0-m gill net was used at the same stations as the 4.9-m trawl and in the immediate vicinity of the OCGS discharge (Sta. 26). It consisted of two, 30.5 x 2.4-m panels of 38- and 89-mm monofilament stretch mesh. The net was anchored and fished either at the surface or, in shallow water, from surface to bottom. It was retrieved after 1 h, but in the immediate vicinity of the OCGS discharge it was sometimes set for a shorter duration because many specimens were collected. The total catch of the gill net was the number of fish collected and the number of fish that were seen to fall from the net. A 91.4 x 1.8-m gill net

was used on several occasions at various stations because a 61.0-m net was not available. The larger net was similar in construction to the 61.0-m net but had an additional 30.5-m panel of 70-mm monofilament stretch mesh. From June through August 1977, this net was used in the main channels of Oyster Creek and Forked River and a 61.0-m net was used in the lagoons.

One haul of a 45.7-m seine was made at three stations (Sta. 28, 29, 47 or 53). Prior to the use of this seine in April 1976, a 76.2 x 3.0-m seine (1.3-cm stretch mesh) was used at all stations in March.

The catch of the 15 sets of paired trawl and gill net collections from the creeks was divided into 5 consecutive seasonal groups. These periods were spring (29 March to 5 May), early to mid-summer (17 June to 13 August), late summer (19 August to 23 September), fall (18 October to 8 December), and winter (5 January to 9 March). A Hewlett-Packard 9830A programmable calculator was used for data compilation and for some statistical analyses.

A balanced two-way (station x date) analysis of variance (ANOVA) was used to examine the spatial and temporal distribution of the most numerous species with a particular gear. Since the data had to be equally distributed among stations, data after December was not used because some stations were not sampled in January or February. Data were transformed by a ln (x+1) transformation in order to reduce skewness, approximate normality, and make variances homogeneous (Sokal and Rohlf 1969). If the ANOVA indicated significant variation of a main effect

mean ($P \leq 0.05$), then significant differences among means were determined by the Student-Newman-Keuls (SNK) multiple range test (Sokal and Rohlf 1969). Mean values were plotted when significant interaction effects occurred, and the ANOVA was considered invalid if the ordering among these mean values varied considerably. Some interaction effects may have been significant because of large main effects. A significant interaction that is much smaller than the main effects may imply minor variation between the main effects at different levels (Steel and Torrie 1960).

The length (nearest 1 mm) and weight (nearest 0.1 g) of selected specimens of important fishes taken in Oyster Creek and Forked River were recorded in the laboratory. Sufficient data existed to determine the allometric condition factor (weight/length^b, Ricker 1975) for individuals of the Atlantic menhaden, bay anchovy, bluefish, weakfish, and winter flounder from these two areas. The exponent b, the slope of geometric mean regression of length and weight, for each species was taken from life history studies conducted in 1975-76 (Tatham et al. 1977a). Because condition is a measure of the relative robustness of a fish (i.e., for specimens of the same length, larger condition values are found for heavier fish), the condition of fishes in Oyster Creek and Forked River was compared by a one-way ANOVA or t-test to evaluate the effect of the heated discharge on these specimens. Sufficient data also existed for the Atlantic menhaden and bay anchovy to compare those fish found in the lagoons (i.e., area of slow current) with those found in the main channel of the creeks (moderate to fast current). Monthly

differences in condition of the Atlantic menhaden that overwintered in the immediate vicinity of the OCGS discharge were also examined.

Everhart et al. (1975) noted that sex, season, stage of maturity, and size influenced the condition of an individual, and these parameters should be as similar as possible when comparisons are made. Therefore, condition data for all fishes were grouped by length, and data were chosen to eliminate months when a species was not taken in all areas. Individuals over a large size range were examined only if the length distribution of specimens was similar between areas. These standardizations eliminated some problems in the comparison of condition data, but resulted in the elimination of many data (especially for the Atlantic menhaden, bluefish, and weakfish) from the analyses. Sex was not determined, but it was assumed that sex ratios and maturity did not vary significantly among stations.

An unbalanced one-way ANOVA or a t-test ($P \leq 0.05$) was used to determine differences in condition of species among stations. Various combinations of stations, dates, and lengths were used either to have sufficient data for analyses or to meet the constraints of the Hewlett-Packard 9830A computer which limited the number of observations for a particular group of stations to less than 255.

Results and Discussion

Collections in western Barnegat Bay

September 1976 through August 1977

Some 16,476 fish, 10,573 sand shrimp, and 833 blue crab were taken from September 1976 through August 1977 (Table C1-162). The sand shrimp

was the most numerous organism collected (37.9% of total catch) and was taken in every month. Most sand shrimp were taken in December and from March through May. The blue crab was most common from September through November and from May through August. The greatest number of fishes was taken in October (45 species) and September (28), while the fewest fishes were collected in January (8) and February (6). Most fish were taken from May through August, and the fewest specimens were collected in January and February when most of the Bay was ice covered and samples were taken only at the mouth of Oyster Creek. However, few fish are usually caught in New Jersey estuaries during winter regardless of ice conditions (Danila 1977b, Danila and Howells 1977).

Five fishes made up 83.8% of the total catch of fish: bay anchovy (35.8%), Atlantic silverside (27.0%), winter flounder (8.0%), blueback herring (6.6%), and spot (6.4%). Although the blueback herring was the fourth most abundant fish, it did not occur frequently; 96.4% of the specimens (n = 1,055) were taken in one set of the 45.7-m seine in December. An additional 9.7% of the catch was comprised of the Atlantic needlefish, oyster toadfish, northern pipefish, bluefish, Atlantic menhaden, mummichog, striped killifish, and crevalle jack. The remaining 6.5% was made up of 56 other fishes.

The abundance and distribution of fishes and macroinvertebrates were determined through catches by several collection gears. Each gear effectively collected certain species and, sometimes, only specific sizes of some species. A more complete record of the fish community was determined when the catch from several gears was examined. Since each gear was selective, bias was introduced into the catch statistics.

Behavioral differences among many species also resulted in differential catch by gear. For example, young weakfish were rarely found in the shore zone, and therefore, few were taken by seine although many were collected by trawl. Diel differences in behavior of many species as well as improved gear efficiencies resulted in larger catches at night.

The catch by trawl was dominated by the bay anchovy (76.6% of trawl catch of fish); the winter flounder (8.7%) and spot (6.8%) were also common (Table C1-163). Few fish were taken by trawl from January through April, and most individuals were collected from May through August. The sand shrimp made up most of the catch by trawl in December, March, and April, and it was also abundant in May.

The Atlantic silverside (34.5%), blueback herring (18.1%), winter flounder (10.5%), spot (9.3%), bay anchovy (5.7%), and Atlantic needlefish (4.3%) comprised 82.3% of the catch of fish by 45.7-m seine (Table C1-164). Most fishes were taken in October (33 species) and the fewest in January (4) and February (3). Most fish were taken in December (n = 1,569) and March (1,133) with the blueback herring (68.1% of December catch of fish) and Atlantic silverside (79.1% of March catch of fish) comprising most of the fish caught in these months. The monthly catches during October and November and from May through August were similar in number (n = 410 to 659). Two-thirds of the sand shrimp were taken in December, and one-third of the blue crab were collected in July.

The catch of fish by 12.2-m seine (Table C1-165) was dominated by the Atlantic silverside (62.2%) and secondarily by bay anchovy (12.0%).

Although not enumerated, elvers of the American eel were observed to be occasional to numerous in May, and young of the Atlantic silverside were numerous in June. Few fish were taken in January (n = 5) and February (11), and the most in July (924) and August (957). The sand shrimp was most abundant in December (40.1% of the total catch of sand shrimp), and it was also common from March through May and during August. Relatively few blue crab were taken. Although both the 45.7 and 12.2-m seines were fished at the same locations in a similar manner, catches were markedly different because of differences in the size and mesh of the seines and differences in the area and depth sampled. Larger fish such as the Atlantic needlefish, bluefish, spot, and mullets were common in the 45.7-m seine while the smaller seine took mostly Atlantic silverside, bay anchovy, killifishes, and other small forage fishes. The larger seine was more effective in capturing larger fish because it sampled a much larger bottom area and deeper water. Although the bay anchovy, Atlantic silverside, and sand shrimp were relatively common in catches by 45.7-m seine, most specimens were large individuals that were retained by the larger mesh of that seine. Many smaller individuals escaped through the mesh of the net while it was in the water. The 12.2-m seine caught mostly small individuals found closer to shore, although some smaller fish and invertebrates also passed through the mesh.

More fish were taken during the night (53.2%) than the day (46.8%) at the mouth of Oyster Creek and Forked River (Table C1-66). Elimination of the one large collection of blueback herring made during the day increased the proportion of the catch at night to 58.7%. The Atlantic

menhaden (66.0% of diel catch), oyster toadfish (88.6%), striped cusk-eel (100.0%), Atlantic silverside (71.6%), weakfish (94.7%), spot (58.8%), winter flounder (79.3%), sand shrimp (95.0%), and blue crab (59.6%) were taken primarily at night. The bay anchovy (68.4%) and the mullets (79.1%) were mostly taken during the day. As in 1975-76 (Danila 1977b), more bay anchovy were taken in deeper water by trawl during the day and in the shore zone by seine during the night.

Catches at the mouth of Forked River, Cedar Creek, and Double Creek were generally similar in number and species composition (Table C1-167). Fewest fishes were taken at the latter station perhaps because it was the smallest and shallowest of the three creeks. The largest differences in catch and species composition among the stations occurred between Oyster Creek and the other stations during most months, and this difference usually reflected the attraction or avoidance of organisms to the heated discharge. In October, the Atlantic needlefish, bluefish, and jacks were most common at Oyster Creek mouth. The catch at the mouth of Forked River consisted primarily of more temperate fishes such as the Atlantic silverside and black sea bass, although the spot was also common. An attraction of organisms to the heated discharge was also evident in November and December when most blueback herring, Atlantic menhaden, Atlantic needlefish, Atlantic silverside, spot, sand shrimp, and blue crab were taken at the mouth of Oyster Creek. Similarly, the increased catches at Oyster Creek mouth in March and April were probably due to the attraction of species such as the bay anchovy, Atlantic silverside, and blue crab. The sand shrimp probably avoided Oyster

Creek in August. Catches of other organisms were not consistent enough to confirm attraction or avoidance.

When OCGS did not discharge heat from 23 April to 4 August, the catches at the mouth of Oyster Creek declined and were similar to or less than those at the other stations. The bay anchovy, spot, and winter flounder were common at all stations, although the total catch of the latter declined considerably at all stations during August.

Some 89.9% (n = 5,297) of the bay anchovy were collected from May through August, and most (89.2%) of these were taken by trawl. Only seven specimens were taken from November through March. The bay anchovy was less common at the mouth of Oyster Creek than at the other stations when OCGS was shut down.

Almost all of the Atlantic silverside were taken by 12.2-m seine (52.8% of all Atlantic silverside) and 45.7-m seine (46.8%). Over one-third of the specimens were captured in March (n = 1,556) when several large catches were made at the mouth of Oyster Creek at night. It was common throughout the Bay in July (n = 829), December (569), and August (567), but very few were taken in January (5), February (10), and June (18). Catches of Atlantic silverside by the 45.7-m seine were largest in December and from March through May; most specimens were adults. In contrast the largest catches of the smaller mesh 12.2-m seine were in July and August, and most of these fish were young.

The spot was most common in July (44.0% of all spot, n = 463), but few were collected from December through June (3.8%, 40). It was primarily taken by 4.9-m trawl (42.7%) and 45.7-m seine (53.5%), and it was most common at the mouth of Forked River and Oyster Creek.

The winter flounder was common in May (12.9% of all winter flounder, n = 170), June (54.5%, 718), and July (20.5%, 270), but only one specimen was taken in August. All of these fish were young. Adults comprised most of the winter flounder collected in December (n = 36), March (52), and April (38). Most specimens were captured by 45.7-m seine (48.1%) and 4.9-m trawl (43.7%). Young were most common at Forked River, and the fewest were taken at Double Creek. The catch at the mouth of Oyster Creek and Forked River was comparable, but OCGS was not in operation when young were most abundant.

Most sand shrimp were taken in December (40.1%, n = 4,240), March (15.1%, 1,600), April (10.0%; 1,061), and May (15.2%; 1,608). Although relatively uncommon during January (0.8%, n = 80) and February (2.6%, 276), it was still the most numerous organism taken in those months. Most specimens (51.5%) were taken by 12.2-m seine. It appeared to be attracted to Oyster Creek in December and generally avoided the heated discharge in August.

Relatively few blue crab were taken by trawl; most (51.7%) were taken by 45.7-m seine. It was most common in October (17.0%, n = 142), July (22.4%, 187), and August (15.8%, 132). Few were taken from December through April (8.9%, n = 74) with most of these collected at the mouth of Oyster Creek.

Comparison Between Years

The fish community in Barnegat Bay in 1975-76 and from 1966 through 1972 (Marcellus 1972, McClain 1973) was discussed by Danila (1977b).

Although the catch in 1976-77 generally was dominated by the same few fishes as in 1975-76, major changes in the abundance of some species occurred between these 2 years. Some increases in abundance (e.g., Atlantic needlefish, jacks) and decreases in abundance (e.g., Atlantic menhaden) were due, in part, to the change in sampling gear from a gill net in 1975-76 to a 45.7-m seine in 1976-77. In addition, the number of stations and sampling frequency decreased from the first to the second year. These differences were considered when comparisons of the catch of a species were made between years. However, the increased abundance of winter flounder and the decreased abundance of the Atlantic silverside, fourspine stickleback, and blue crab from 1975-76 to 1976-77 represented actual differences in the abundance of these species. Many fish populations have large annual fluctuations in abundance, and Marcellus (1972) reported highly variable catches of the Atlantic silverside and other fishes in Barnegat Bay during his 4-year study.

Many of the changes in abundance during 1976-77 were probably attributable to environmental factors. Large year-to-year variations in population of many fishes (e.g., spot) are probably due to environmental fluctuations that influence spawning success (Joseph 1972). The large number of young winter flounder produced in 1977 was probably a result of the cold winter of 1976-77. In Narragansett Bay, Rhode Island, Jeffries and Johnson (1974) found that 78% of the variation in the abundance of the winter flounder population was attributable to climatic trends during the reproductive period. Substantial reproductive success occurred in cold winters, while the reproductive success was poor during

mild winters. The winter of 1976-77, in which a substantial number of young was produced in Barnegat Bay, was much colder than several previous winters (Darling 1977). Although many young were produced, predation by bluefish and perhaps other predators (e.g., summer flounder and weakfish) may have substantially reduced their numbers in August.

The severe winter of 1976-77 probably was also the most significant factor in the reduction of the numbers of resident species such as the Atlantic silverside, fourspine stickleback, and blue crab. However, most individuals of common, seasonally present fishes, (e.g., Atlantic menhaden, bluefish, and spot) emigrated from the Bay and nearshore ocean in fall and were locally not affected by the cold winter.

Collections in Forked River and Oyster Creek

March 1976 through March 1977

The surface water temperature was usually about 5 C warmer in Oyster Creek than in Forked River and the largest difference in temperature between the areas (7.9 C) occurred in April (Table C1-168, Fig. C1-17). The largest difference in temperature between adjacent stations occurred between the station in the immediate vicinity of the OCGS discharge (Sta. 26) and the station with the mixed flow of OCGS discharge and ambient water (Sta. 27) during November and February (7.6 and 7.5 C, respectively).

From March to April 1976, mean surface water temperature increased from 12.9 to 21.8 C in Forked River and from 15.8 to 29.7 C in Oyster Creek, but these temperatures declined to 15.2 and 17.2 C, respectively,

from April to May. Most sampling in May was done when OCGS had shutdown briefly, and therefore some temperatures in Oyster Creek were near ambient while others remained above ambient, The mean temperature increased to 26.9 C in Forked River and 32.8 C in Oyster Creek from May to June and remained warm (> 23 C) through September. A rapid decrease occurred thereafter until the minimum temperature was recorded in Forked River (1.5 C) and in Oyster Creek (4.8) during January.

The combined catch by 2.7- and 5.9-m trawl and by gill net included 189 collections in Oyster Creek and 177 in Forked River (Table C1-169). The discrepancy in sampling effort was caused by ice cover in portions of Forked River during January and February. Since only five specimens were taken at the stations sampled in January and February, the total catch for the two areas was compared directly without correction for dissimilar effort. Specimens taken by gill net in the vicinity of OCGS discharge (Sta. 26) were not included in the total catch because no station in Forked River was comparable. Similarly, data from the seine collections were not included because two stations (Sta. 28, 29) were sampled in Oyster Creek but only one (47) in Forked River. Data from these stations are discussed separately.

Based on total catch by trawl and gill net (Table C1-169), over 1,500 more fish were taken in Oyster Creek (n = 7,045; 36 species) than Forked River (5,501; 31), and twice as many blue crab were taken in Oyster Creek (1,401) than Forked River (650). However, more than five times as many sand shrimp were taken in Forked River (1,792) than Oyster Creek (336). The largest differences among fishes were in the catch of

the Atlantic menhaden, spot, and winter flounder; at least twice as many specimens of each species were taken in Oyster Creek. The bay anchovy and bluefish were also more abundant in Oyster Creek, and almost all herrings, white perch, and jacks were taken there. In contrast, four times as many weakfish and more oyster toadfish, fourspine stickleback, and tautog were taken in Forked River. Other fishes were taken too infrequently for comparisons or were equally abundant in both areas.

The abundance of the catch by station and gear was also examined seasonally to determine periods of either attraction or avoidance (Tables C1-170 through C1-184), and the catch of the most numerous species was summarized by season, gear, and area (Table C1-185). During spring (Table C1-186) and late summer (Table C1-187), the total catch from Forked River was larger than that from Oyster Creek. In spring, the much larger number of sand shrimp caught in Forked River accounted for most of this difference; the catch of fish, primarily the bay anchovy, was similar between the two areas. In late summer, more Atlantic menhaden, bay anchovy, weakfish, and sand shrimp were collected in Forked River. However during early and mid-summer (Table C1-188), fall (Table C1-189), and winter (Table C1-190), the total catch was larger in Oyster Creek with the Atlantic menhaden, bay anchovy, spot, and blue crab more numerous there than in Forked River. The bluefish was more common in Oyster Creek during fall, and the winter flounder was more abundant there in winter.

Most collections with the 45.7-m seine were dominated by one or two species (Tables C1-191 through C1-195). The dominance of the Atlantic

silverside during spring and the collection of the Atlantic needlefish and mullets in Oyster Creek were the greatest differences in catch between the seine and the trawls.

Fewer specimens were taken by 45.7-m seine at the station in Forked River than at either station in Oyster Creek, and differences between the two areas were largest in fall. Attraction to Oyster Creek was demonstrated by the larger number of the Atlantic menhaden, crevalle jack, spot, mullets, and blue crab taken there. In late summer, however, the bay anchovy, winter flounder, and sand shrimp appeared to avoid Oyster Creek. Few organisms were taken at any station in winter.

Catches by gill net near the OCGS discharge (Sta. 26) were not directly comparable over time because a 91.4-m gill net was used on the first four sampling dates and the sampling duration differed. However, the data demonstrated the species composition and relative abundance of fishes in the warmest area of the heated discharge (Table C1-196). The Atlantic menhaden and bluefish were most common, and they were most abundant in fall and winter. A few large catches of the spot and blue crab were made in July and August, but few other fishes were taken then.

May through August 1977

Samples were taken at all stations from 31 May through 2 June and on 18 and 19 July when OCGS was not in operation. Samples were again taken on 15 and 16 August about 2 weeks after OCGS resumed operation. Water temperature was similar in the two areas in May-June and July (Table C1-168, Fig. C1-17). Although the mean temperature in Oyster

Creek during August was 4.3 C warmer than that in Forked River, the ambient water temperature was higher in July (29.1 C) than August (26.2). Consequently, the water temperature in Oyster Creek was similar in July (29.5 C) and August (30.5).

A summary of the catches of the most numerous species taken by 4.9-m trawl, 2.7-m trawl, and gill net indicated that differences between the shutdown and operational periods varied for individual species (Table C1-197). More Atlantic menhaden were taken in Oyster Creek regardless of OCGS operation. The large number of sand shrimp (n = 78) and blue crab (48) taken in Forked River during July by 2.7-m trawl was biased by one large collection of these organisms (78 sand shrimp, 26 blue crab) in a haul made very close to the rip-rap on the bank rather than in the main channel. A few sand shrimp were taken in Oyster Creek in May and June, but none were collected afterwards. The catch of the bay anchovy in May-June and July was similar between areas, but twice as many bay anchovy were taken in Forked River than Oyster Creek in August. More young of the winter flounder were taken by trawl in Forked River (n = 40) than Oyster Creek (19) from May through July, but more were taken by 45.7-m seine at one station (Sta. 29) in Oyster Creek (n = 106) than at Sta. 53 in Forked River (20). None were taken at any station in August.

The spot showed the greatest change in distribution when OCGS began operation. When OCGS was shut down in July, a few more were taken in Forked River (n = 110) than in Oyster Creek (87), but a larger number was taken in Oyster Creek (81) than Forked River (11) in August. This

difference was apparent in the immediate vicinity of the OCGS discharge (Sta. 26) where more were taken by 2.7-m trawl in August (n = 68, bottom water temperature of 32.3 C) than July (29, 28.6 C).

Large differences in catch by gill net (Table C1-196) occurred in the vicinity of the OCGS discharge (Sta. 26). Although 33 bluefish and 15 blue crab were taken in July (surface water temperature of 28.5 C), only 1 bluefish was captured in August (34.1 C).

The water temperatures at stations sampled with the 45.7-m seine during July (28.4 to 29.5 C) and August (30.0) were similar, but catches were much different. This difference in catch may be attributed, in part, to differences in current. A large catch of the spot, white mullet, winter flounder, and blue crab was made at the mouth of Oyster Creek (Sta. 29) in July (29.5 C). However, in August (30.0 C) when the current was substantial at this station, most spot and white mullet were taken upstream (Sta. 28) in an area with less current (30.0 C).

Effect of the OCGS discharge on abundant organisms

The distribution and abundance of the most numerous species with respect to the OCGS heated discharge are discussed below (Tables C1-198, C1-199). The conditon of selected fishes was also examined (Table C1-200). Most data used in the analyses are from collections made in Oyster Creek and Forked River from March 1976 through March 1977. However, data from collections made in western Barnegat Bay, particularly from the stations at the mouth of Oyster Creek and Forked River, are used when appropriate to further illustrate either attraction to or avoidance of the heated discharge.

The distribution of important species by the surface water temperature (nearest whole degree) at which they were collected was expressed as the total number collected at a particular temperature divided by the number of collections at that temperature. Distribution by temperature throughout the year and during four monthly periods was examined to determine periods of possible attraction to or avoidance of the heated discharge (Tables C1-201 through C1-205). For comparative purposes, specimens taken by gill net in the immediate vicinity of the OCGS discharge (Sta. 26) were not included because no comparable station existed in Forked River. However, this station had the warmest water temperatures of any station sampled, and the catch there was examined separately to help determine temperatures of avoidance and attraction.

The Atlantic menhaden was one of the most numerous fishes collected in the heated discharge, and it was taken in all months. More were taken in Oyster Creek and Forked River by gill net (n = 254) than by either 4.9-m trawl (126) or 2.7-m trawl (80). Although no significant differences were found in the gill net catch of Atlantic menhaden among stations or by date, individuals were attracted to the heated discharge, and about twice as many were taken in Oyster Creek than Forked River. Similarly, collections in western Barnegat Bay indicated that many more Atlantic menhaden were taken at the mouth of Oyster Creek (n = 158) than at the mouth of Forked River (4), Cedar Creek (1), and Double Creek (2).

Seasonal differences in the distribution of Atlantic menhaden within Oyster Creek were apparent. Atlantic menhaden that returned to the Bay during late March and April were attracted to the OCGS discharge.

The number of individuals in the immediate vicinity of the OCGS discharge decreased after May, but Atlantic menhaden were abundant in the lower portion of the Creek and in the dilution pump discharge. The catch of Atlantic menhaden in Oyster Creek east of Route 9 was comparable to similar areas of Forked River during early summer, but more specimens were taken in Forked River during late summer as many fish avoided temperatures above 30 C. However, a few Atlantic menhaden were taken in the immediate vicinity of the OCGS discharge at 36 C. After September, almost all Atlantic menhaden were collected in Oyster Creek as the heated discharge attracted fish emigrating from the Bay. From November through early March, most specimens that overwintered were taken in the immediate vicinity of the OCGS discharge by gill net. The largest catch was an estimated 1,348 Atlantic menhaden on 11 February.

Length-frequency distributions of Atlantic menhaden for which condition was determined are given in Tables C1-206 and C1-207. For small (91 to 130 mm) Atlantic menhaden taken from June through December, significant differences were found among four stations east of Route 9. Individuals examined from Oyster Creek were in better condition than those at comparable stations in Forked River, and in both areas, specimens collected in the main channel were in better condition than those in the adjacent lagoon. Large (221 to 280 mm) Atlantic menhaden taken in Oyster Creek from March through November were in better condition at the mouth of Oyster Creek (Sta. 50) than those taken either in the upper Creek (15) or near the OCGS discharge (26). No difference was found between the condition of specimens 111 to 310 mm in length collected

from the upper Creek and near the OCGS discharge from March through December.

Condition of Atlantic menhaden which overwintered near the OCGS discharge was examined from January through March. Although ANOVA indicated significant differences for large (211 to 260 mm) Atlantic menhaden, no difference in the mean condition was detected by the SNK multiple range test. The mean monthly condition factors were not ordered in any specific pattern, and differences among the months were small. However, small (101 to 120 mm) fish were in significantly better condition in January than during either February or early March.

The bay anchovy was the most abundant fish taken in Oyster Creek and Forked River. Almost all were collected by 4.9-m trawl, and the largest catches occurred in spring. The largest mean catch occurred at the Forked River lagoon (Sta. 46), an area of little current. Landry and Strawn (1974) stated that the bay anchovy preferred areas of low current.

The bay anchovy was attracted to the heated discharge in Oyster Creek during March and April upon its return to the Bay. Despite the attraction to and the earlier collection of this fish in Oyster Creek, a similar number was taken there (n = 3,785) and in Forked River (3,523) during spring. The bay anchovy was more common in Oyster Creek during early to mid-summer (n = 1,204) than in Forked River (457), but it apparently avoided the heated discharge in August and September when the catch was larger in Forked River (404) than Oyster Creek (78). Catches declined in fall, and no specimens were collected in winter. Although

collections in Oyster Creek did not indicate that a large number of the bay anchovy was attracted to and resided in Oyster Creek during winter, some dead individuals were observed there in December 1976.

Most bay anchovy were taken at a temperature from 12 to 31 C, and individuals may have avoided areas of Oyster Creek above 31 C in late summer. Marcellus (1972) noted that his catch of young bay anchovy decreased at the mouth of Oyster Creek after OCGS commenced operation, and he attributed this decrease to increased temperature and current. Chung (1977) listed the bay anchovy as a very heat sensitive fish. Based on its abundance in trawl and seine collections, Gallaway and Strawn (1974) concluded that the bay anchovy preferred temperatures of 24.5 to 32.5 C although some were taken at 37.0 C.

Condition was calculated for bay anchovy 51 to 60 mm and 61 to 70 mm in length which were collected from March through August at all trawl stations and at the seine station (Sta. 47) in Forked River (Table C1-208). Data from seine collections in Oyster Creek were sparse and were combined with data from trawl collections at adjacent stations. Condition was not significantly different among most stations, but bay anchovy taken in Forked River were in better condition than those from Oyster Creek. The smallest mean condition values were found for the Oyster Creek lagoon (Sta. 30) and the largest at the seine station (47) in Forked River.

The bluefish was attracted to and collected almost exclusively in Oyster Creek during May and from November through January. Most specimens were taken by gill net. The bluefish was most abundant from June through

September when it was collected in similar numbers in Forked River and in all areas of Oyster Creek except in the immediate vicinity of the OCGS discharge. Many individuals also were found in the immediate vicinity of the OCGS discharge during most of the year although they were rare at a temperature above 32 C. The largest collections in the OCGS discharge occurred from October through January as many individuals overwintered in this area.

The distribution of bluefish in Oyster Creek and Forked River limited analysis of condition because large individuals were taken only in the vicinity of the OCGS discharge and no bluefish were taken in Forked River after September. Data from all stations (except Sta. 26) in each area were combined; the condition of 150 to 190-mm bluefish collected in Oyster Creek and in Forked River from July through September was not significantly different.

The jacks (primarily crevalle jack with some blue runner, lookdown, and bigeye scad) were attracted to and taken almost exclusively in Oyster Creek from July to October. Although many specimens remained in Oyster Creek in fall, most probably died during winter when the temperature declined below about 9 C. Mortalities of jacks were noted during OCGS shutdowns in November 1975 (ambient Bay temperature of about 7.8 C, Tatham and Metzger 1976) and in October 1977 (11.7 C). Hoff (1971) reported mortality of the crevalle jack in the Slocum River, Massachusetts when the ambient water temperature decreased to 7.4 to 9.0 C; live fish were collected in an adjacent area at a temperature of 9.8 to 10.9 C.

Weakfish, mostly young, were taken primarily in late summer in Forked River. Most were collected by 4.9-m trawl, and they were collected in Forked River at a temperature of 20.9 to 28.6 C. Young may have avoided the higher water temperature in Oyster Creek (25.4 to 33.3 C) at this time, and most were taken there at a temperature of 31 C or less. However, larger individuals, mostly adults, were occasionally taken in the heated discharge by gill net and were observed in Oyster Creek and near the OCGS discharge from late April through early December. One specimen was taken by 2.7-m trawl near the OCGS discharge at a surface temperature of 36.1 C and a bottom temperature 34.3 C. Some adults were attracted to Oyster Creek in October, and although no fish were collected at temperatures less than 12 C, some weakfish apparently overwintered as mortality of a few individuals was noted in December and January.

Condition data from juvenile weakfish (45 to 215 mm) taken throughout Oyster Creek from August through October were compared with those in Forked River east (Sta. 6, 45, 46, 47) and west (48 and 49) of Route 9. No significant differences were found.

The spot was attracted to the OCGS heated discharge to a greater extent than most other fishes. Over the year, some 1,199 spot were taken in Oyster Creek as compared to 463 individuals in Forked River. Catch by 4.9-m trawl was nearly equal in Oyster Creek (n = 384) and Forked River (388), and the catch by gill net was not significantly different among the stations in both areas. The substantial difference in catch between the two areas therefore was attributed to differences

in catch with the 2.7-m trawl west of Route 9. Most of the 721 spot taken by trawl in this area of Oyster Creek were collected near the OCGS discharge (Sta. 26) as compared to only 37 individuals taken in Forked River west of Route 9. Most individuals collected near the OCGS discharge were taken from June through September, and this indicated an attraction to the immediate vicinity of the OCGS discharge despite the fast current there. In Forked River, the mean catch was largest in the lagoon (Sta. 46) and smallest at the stations with the greatest current (6 and 45).

Collections in western Barnegat Bay further illustrated the attraction of the spot to the OCGS discharge. Although more individuals were taken at the mouth of Forked River (n = 480) than at the mouth of Oyster Creek (412), the spot was taken at Oyster Creek mouth in all months except February and March while it was collected only from June through November at Forked River mouth. In addition, about half of the spot taken at the mouth of Forked River were collected in July 1977 when OCGS was shut down and no specific attraction to Oyster Creek was noted. A large number of spot were attracted to and collected at the mouth of Oyster Creek when OCGS resumed operations in August.

Although common in Oyster Creek during summer, the spot may have avoided temperatures above about 33.5 C. Landry (1977) found it was one of the two fishes to establish a well defined resident population in the heated discharge of the P. H. Robinson Generating Station near Galveston, Texas. He reported that many individuals left the discharge canal when the water temperature exceeded 32 C, and some dead or stressed individuals were taken at temperatures of 35 to 40 C.

Few spot were taken in Forked River when the water temperature was below 12 C. Pacheco (1959) reported that the spot left Chesapeake Bay when the temperature fell below 10 C. Some overwintering individuals were taken in Oyster Creek at a temperature of 4 to 12 C during December and January. Spot have been taken in southern estuaries at a temperature as low as 5 C (Dawson 1958, Perret et al. 1971, Christmas and Waller 1973).

The winter flounder was collected in Oyster Creek during all months, and its attraction to and avoidance of the heated discharge varied with season and life stage. Adults were numerous near OCGS (Sta. 26 and 27) from December through March. Although one large collection of adults was made at a water temperature of 14.6 C, adults were most common in Oyster Creek at a water temperature of 5 to 10 C, and none were collected above 15 C. McCracken (1963) reported that older winter flounder preferred a temperature of 12 to 15 C. Mature winter flounder emigrated from the Bay in April.

Most young winter flounder apparently avoided Oyster Creek in July and August 1976 when OCGS was in operation and the water temperature exceeded 24 C. However, other factors (e.g., current) may have been more important then temperature in the distribution of young. Young were taken in the Bay at a temperature as high as 30.4 C and in Oyster Creek at a temperature as high as 30.0 C in July 1977 when OCGS was not in operation and current was reduced. These temperatures were greater than the reported avoidance temperature for young (about 26.7 C) and age 1+ winter flounder (24.1 C) during summer, and they were just below the avoidance breakdown temperature of young (30.6 to 31.1 C, Gift and Westman 1971).

Condition of young and small adult (90 to 210 mm) winter flounder was analyzed for specimens taken in Oyster Creek east (Sta. 15, 28, 29, 30, 50) and west (26, 27) of Route 9 and in Forked River near OCGS (48, 49) from October through March. No significant differences were found.

The sand shrimp was usually more common in Forked River than Oyster Creek. The largest differences in abundance occurred in the areas west of Route 9 where significantly fewer shrimp were taken by 2.7-m trawl in Oyster Creek (n = 58) than Forked River (714). Other factors besides water temperature may have affected the distribution of the sand shrimp as it was also more common in Forked River when OCGS was not in operation.

The largest catches occurred in spring when 1,405 sand shrimp were taken in Forked River and 285 individuals in Oyster Creek. The sand shrimp apparently avoided Oyster Creek during summer when water temperatures were above 28 C, and only four specimens were taken there from June through September. Some 329 sand shrimp were taken in Forked River during the same period. Large catches of the sand shrimp were made at the mouth of Oyster Creek in December when ambient Bay temperatures were low, and these large collections may have indicated attraction to the heated discharge.

The blue crab was taken by all gear from late March through December. The attraction of this species to Oyster Creek was illustrated by the significantly greater number of crabs taken by 2.7-m trawl near the OCGS discharge (Sta. 26) and by 4.7-m trawl and gill net in the upper Creek (15) than at corresponding stations in Forked River and at other stations in Oyster Creek.

Mean monthly catch of blue crab by 2.7-m trawl was similar in the two areas from May through October, but catch by 4.9-m trawl declined from August through December. None were taken by gill net after September. This decline in abundance during fall indicated a reduction in activity as many individuals burrowed into bottom sediment to overwinter. The blue crab was rare at temperatures below 12 C in Oyster Creek, and apparently none remained active in the OCGS discharge during winter regardless of the discharge temperature.

The blue crab was tolerant of high temperature and was collected at a temperature as great as 36 C. Chung (1977) reported that the blue crab was very heat tolerant. Based on collections in the discharge canal of the P. H. Robinson Generating Station near Galveston, Texas, Margraf (1977) found that the upper lethal temperature of the blue crab was 40.0 C, but he noted that most specimens were taken at a temperature less than 37.5 C. In studies conducted in Great Bay, New Jersey, Gift and Westman (1971) found that the upper avoidance breakdown temperature of adults was 39.2 C and that of juveniles was 40.0 C. Several instances of OCGS-induced mortalities were observed, but the number of blue crab killed was relatively small.

Observations of Mortalities

All but one specimen of the dead or stressed organisms observed either in collection gear, in the water, or along the shore were found in Oyster Creek (Table C1-209). Although mortalities of 15 species were noted, the mortality of most species was limited to a few specimens. Mortalities of the bay anchovy and blue crab were observed most frequently.

Although some indiviudals died from temperature shock associated with the operation of OCGS, some specimens collected in the immediate vicinity of the OCGS discharge (Sta. 26 and 27) may have died from impingement on either the OCGS screens (Appendix D1, Section D1.11) or the condenser tube sheet and then were released into Oyster Creek.

On 21 and 22 April 1976, mortality of five species of fish and two crabs was noted throughout Oyster Creek. Several thousand dead blue crab were estimated along the banks of Oyster Creek. Although only a few dead fish were collected, many gulls were observed feeding on fish floating on the surface. However, many live bay anchovy were taken in Oyster Creek east of Route 9, and live northern pipefish, sand shrimp, and blue crab were relatively common. Only a few live blue crab were taken west of Route 9 where it was usually common during most other months (Tables C1-175 through C1-178).

It was possible that some of the observed mortalities were due to heat shock from the increase in the water temperature in Oyster Creek from 17 to 20 April. This increase resulted from the combination of a rapid rise in ambient temperature and an abrupt decrease in dilution flow. From 17 to 20 April, ambient Bay temperature increased from 15.6 to 21.1 C (D. R. Weigle, personal communication), and corresponding increases were observed in the OCGS discharge (21.7 to 29.4 C) and at the Route 9 bridge in Oyster Creek (16.1 to 22.8 C). On 19 April, one of the two dilution pumps in operation was shut off in accordance with normal OCGS operating procedures (Fig. C1-18), and the associated temperature increase may have been as great as 1.3 C (Lawler et al. 1978).

The total increase in temperature from 17 April until the shutdown of the one dilution pump on 19 April was 6.7 C.

When OCGS shut down briefly on the morning of 4 May 1976 (Fig C1-18), the temperature in the OCGS discharge dropped from 24 C to 15 C in about 30 min. However, the heated water discharged just prior to the shutdown remained in Oyster Creek (19.5 C) when collections were made east of Route 9 (Sta. 15, 30, and 50) later in the morning. By afternoon, temperatures throughout Oyster Creek had declined to about 15 C although it was 19.9 C in the lagoon (Sta. 30). No mortalities were noted in sampling on 4 and 5 May, but the mobility of blue crab taken during sampling was reduced considerably.

Low water temperature may have caused mortality of an unestimated number of bay anchovy that were observed in the shore zone of Oyster Creek in early December 1976. Ambient temperatures in the Bay were near 0 C in the first week of December, and temperatures in Oyster Creek were below 10 C. The LT_{50} of bay anchovy acclimated to 10.0 C was calculated to be 6.4 C (Table C1-211).

Observations were made throughout Oyster Creek and adjacent lagoons on 26 and 27 April 1977 after a scheduled OCGS shutdown on 23 April. The average OCGS discharge temperature decreased from 26.1 C on 22 April to 21.1 C on 23 April, and it was 18.3 C on 25 April. The temperature at the Route 9 bridge decreased from 21.1 to 16.1 C during the same period, and the ambient temperature ranged from 20.6 to 16.1 C (D. R. Weigle, personal communication). Approximately 80 dead blue crab were observed along the shoreline at the mouth of Oyster Creek. Throughout

the Creek, gulls were observed feeding on fish (possibly Atlantic menhaden) that floated or swam sluggishly near the surface. The total number of stressed or dead fish could not be estimated, but it did not appear large.

Other mortalities were observed but no obvious cause was found. Eleven dead and decomposing bluefish and one dead blue crab were taken in the vicinity of the OCGS discharge on 15 August 1977 but the source of these specimens was unknown. One dead weakfish was observed in Oyster Creek on both 7 December and 11 January. Both individuals were attracted to and remained in Oyster Creek during fall instead of emigrating from the Bay. Since OCGS operated throughout this period, it is doubtful that a sudden cold shock was responsible for this mortality. As with jacks, the temperature of the heated discharge may have declined below the lower lethal temperature of these individuals.

Summary

A major emphasis of this study was to examine the distribution of fishes, blue crab, and sand shrimp in Oyster Creek and to determine their interaction with the heated discharge. When OCGS was in operation, more fish and blue crab were taken in Oyster Creek than in comparable areas of Forked River over the year. Largest differences occurred in spring, fall, and winter and were attributed to attraction of organisms to the heated discharge. The Atlantic menhaden, bay anchovy, Atlantic needlefish, bluefish, jacks, spot, and winter flounder were the most abundant fishes attracted to Oyster Creek. The temperature, time, and degree of attraction to Oyster Creek varied by species. Other factors

such as current and habitat preference also seemed to influence relative abundance of some species (e.g., winter flounder, sand shrimp) between Oyster Creek and Forked River. In addition, many fish and macroinvertebrates introduced into Oyster Creek after either impingement on the OCGS screens (Appendix D1, Section D1.11) or passage through the dilution pumps (Appendix D1, Section D1.12) may have remained in Oyster Creek.

Attraction usually occurred upon the return of a species to the Bay or, in the case of the blue crab, upon emergence from the bottom sediment. During the year, many fishes returning to the Bay were first collected in or at the mouth of Oyster Creek. Some fishes, such as the Atlantic needlefish, jacks, and mullets, were taken almost exclusively in Oyster Creek. The attraction of resident fishes, such as the Atlantic silverside and killifishes, was noted by Marcellus (1972). Observations of many individuals of these fishes were made during this study, but few were captured because of their distribution in the shore zone, their small size, and the gear used in this study. Two other resident fishes, the fourspine stickleback and northern pipefish, were evidently not attracted to Oyster Creek.

Attraction was greatest in spring, fall, and winter when most species preferred the water temperature in Oyster Creek. Attraction in fall caused some fish that migrate to remain in Oyster Creek. The Atlantic menhaden, bluefish, jacks, weakfish, spot and probably bay anchovy were the most numerous fishes attracted. Apparently only the Atlantic menhaden, bluefish, and spot successfully overwintered because no evidence existed that any bay anchovy, jacks, or a substantial number

of weakfish were present during spring even when OCGS operated throughout the winter. Even with the addition of a heated discharge (delta T of 9 to 10 C), temperatures from December 1976 through February 1977 averaged 6.7 C at the Route 9 bridge and 11.5 C in the immediate vicinity of the OCGS discharge. However, except for the undiluted OCGS discharge, the temperature in most of Oyster Creek may be below the thermal tolerances of some fishes. Residence in the heated discharge during winter has caused mortalities of some fish during OCGS shutdown, but the cessation of dilution pumping during winter shutdowns apparently mitigated these mortalities (Tatham and Metzger 1976).

In 1976, most avoidance of Oyster Creek occurred in late summer when water temperatures were warmest, and more individuals of many species were found in Forked River at that time. When OCGS was not in operation, however, the catch in both areas was generally similar. Sand shrimp and young weakfish avoided Oyster Creek to the greatest extent in summer, but the absence of individuals of some other species may be attributable to other factors. Predation may have been important, to some extent, in reducing the number of sand shrimp in Oyster Creek.

Few fourspine stickleback and northern pipefish were found in Oyster Creek, but the lack of vegetation also may have been an important factor contributing to their low abundance.

When water temperatures in the immediate vicinity of the OCGS discharge were maximum, most Atlantic menhaden, bay anchovy, bluefish, spot, and blue crab avoided the warmest portions of Oyster Creek. Avoidance temperatures of several species determined from field collections

were similar to those reported by other workers. For most fishes the avoidance temperature was approximately 31.0 to 33.5 C.

Winter flounder adults were attracted to Oyster Creek in late fall upon their return to the Bay, and they remained throughout winter. In spring adults left Oyster Creek when water temperatures exceeded 14 or 15 C. Based on field collections, young apparently avoided Oyster Creek in the summer of 1976 when OCGS was in operation and the temperature was about 24 C, but young were found there in warmer ambient water (30.0 C) during the summer of 1977 when OCGS was shut down. Therefore, other factors (e.g., current) may also have been important to the distribution of young.

Residence in the heated discharge may affect the condition or relative well-being of fish found there. Marcy (1976) found that changes in condition and rate of growth of fishes that resided in thermal discharges varied among species and geographical location. Different physiological responses to water temperature, current, availability of food, competition, and other factors probably interact to determine the condition of an individual fish. In the OCGS heated discharge, no significant differences in the condition of small bluefish, weakfish, and winter flounder were found between Oyster Creek and Forked River, and small Atlantic menhaden were in significantly better condition in Oyster Creek than comparable stations in Forked River. Although bay anchovy taken in Forked River tended to be in better condition than those in Oyster Creek, this difference was not significant. Fish found in the immediate vicinity of the OCGS discharge generally were in similar

condition to those downstream. The condition of large Atlantic menhaden that overwintered in the heated discharge did not change although the condition of smaller individuals decreased through the winter.

C1.18 EFFECT OF SUDDEN TEMPERATURE CHANGES ON FISHES AND MACROINVERTEBRATES

Introduction

The heated water discharged by OCGS has several direct effects on fin- and shellfish in Barnegat Bay. Organisms impinged on the traveling screens or passed through the dilution pumps are introduced into ambient temperature water in the discharge of the dilution pumps (Fig. C1-19). This water and the heated water discharged from OCGS remain fairly discrete in the upper 60 m of the discharge canal, and therefore, organisms introduced into the dilution pump discharge may not be exposed to the maximum discharge temperature. However, the only route by which organisms can leave the area of the dilution pump discharge is via the mixed flow of ambient and heated water. With two dilution pumps in operation, the temperature of this partially mixed water averages 4.5 C (range of 2.0 to 7.5 C) above ambient temperature (M. B. Roche, personal communication). Since OCGS began operation in 1969, two incidences of heat-shock mortality have been reported, but these were under unusual operating or natural conditions.

Fishes attracted to and residing in the heated discharge from October through March may be subject to cooler, ambient temperature water if OCGS shuts down. From January 1972 to February 1975, the winter shutdowns of OCGS and the subsequent rapid cooling of the water

in Oyster Creek have resulted in mortality of fishes, primarily the Atlantic menhaden. However, recent operational changes (i.e., cessation of dilution pumping immediately after shutdown) have apparently decreased mortality of fishes from cold shock during winter shutdowns.

The objectives of this study was to determine the effect of a sudden increase or decrease in temperature (delta T) on important fishes and macroinvertebrates acclimated to rising or relatively constant water temperature in Barnegat Bay. Heat-shock temperatures lethal to 50% of the organisms (LT_{50}) were determined for some species at ambient temperatures of 5.0, 10.0, 15.0, 20.0, and 25.0 C, and cold-shock $LT_{50's}$ were determined for some species at ambient temperatures at 5.0, 10.0, and 15.0 C.

From February through August 1977, $LT_{50's}$ were determined at the Oyster Creek Experimental Laboratory in a closed system with relatively good temperature control. Prior to September 1976, heat-shock bioassays were conducted in a flow-through system at the fluctuating temperature of the water discharged from OCGS (Powers 1977).

Materials and Methods

The 15.2 x 3.0-m mobile experimental laboratory located at OCGS was designed to test the heat and cold shock of organisms acclimated to a water temperature from 5.0 to 30.0 C. The laboratory was divided into a holding facility and three (heat-shock, cold-shock, and control) test facilities (Fig. C1-20). Water for the experimental systems was initially obtained from the discharge of the dilution pumps at the OCGS. Water used to replenish the systems came either from this area or was fresh water that had cured for at least 48 h prior to addition to the system.

Each test facility had an independent water system which included a mechanical-biological stack filter. Each filter consisted of a 79 x 66 x 94-cm filter box and 37 x 66 x 94-cm temperature control box. The filter box contained an upper layer of 5 to 20-mm pebbles, a middle layer of 1 to 2-mm dolomite particles, and a lower layer of fine silica sand. Water entered the filter box, percolated through the various layers, and drained into the temperature control box where the temperature was controlled by either a YSI model 73 RC (± 0.6 C) or model 71 A (± 0.5 C) temperature controller. The controller operated 2, 1,000-watt Vycor immersion heaters and either a 0.5 or 1.0-hp Frigid Unit or a 0.75-hp Forma Scientific refrigeration unit.

Water was pumped from the temperature control box of the filter to either the holding facility or the three test facilities. The holding facility contained 2, 900-liter circular and 6, 200-liter oval fiberglass tanks. Each test facility consisted of 3, 76.2 x 66.0 x 76.2-cm test chambers. Each chamber contained 2, 56-liter aquaria which were covered with either a plastic grate or plastic mesh screen. Water from the chambers overflowed through standpipes and was gravity returned to the appropriate filter.

The temperature in the control chamber of a test facility was the temperature to which the organisms were acclimated. Each temperature-shock facility had water at three different temperatures. The water in the temperature control box of each test facility was set to the greatest cold-shock or the smallest heat-shock temperature to be tested, and the other two test temperatures were produced by two step-up baths between

the temperature control box and the test chambers (Fig. C1-20). Each 61.0 x 30.5 x 55.9-cm step-up bath was divided in half, and each half had two series of vertical baffles. One-third of the water from the temperature control box bypassed the bath and went to one of the three test chambers. The other two-thirds were diverted into the two halves of the step-up bath, and in each half of the bath, the other two test temperatures were obtained by heating the water with a series of 4, 1,000-watt Vycor immersion heaters. The last heater in each side of the bath was regulated by a YSI model 73 RC temperature controller and a 1,000-watt rheostat which was used either alone or in conjunction with the other heaters to maintain the desired temperature. Water from each half of the bath went to the other two chambers of the test facility. The temperature in the test chamber was continuously monitored for the duration of the test by a Leeds and Northrup Speedomax W Recorder.

Specimens were collected with a 4.9-m semiballoon trawl with the codend modified to reduce collection stress, a 12.2 x 1.5-m beach seine, a 1.1 x 1.1 x 1.2-m pit sampler with 10.7-mm wire mesh, a 1.5-m cast net, or a 1-m diameter lift net. All specimens were brought to the laboratory in either a 56-liter insulated cooler or a 1,000-liter transport box. The relatively large volume of water in the transportation vessels minimized temperature changes during transport, and air was supplied when transport time exceeded 5 min.

In the holding facility, organisms were slowly acclimated (temperature changes of $\leq$ 3 C/h) from the temperature at which they were collected to

the acclimation temperature. Temperature in the holding facility was approximately the same temperature at which organisms were collected. Organisms were maintained in the holding facility at least 36 h prior to testing.

Lighting in the test facility was provided by cool-white flourescent lights and an automatic timer which coincided with the natural photoperiod. Specimens in the holding facility were maintained at ambient light levels under natural photoperiod.

Organisms were fed preferentially on a variety of foods: chopped fish, brine shrimp, and commercially-prepared flake (Tetramin) or pellet (Purina #4 floater) food. Organisms were not fed during or 24 h prior to a test.

For all species, handling during collection and testing was minimized. A scoop made from a 4-liter plastic bottle was used to transport organisms from the collection gear to coolers and from the holding tank to the test aquarium. Individuals showing stress were not tested.

Organisms from the holding facility were placed directly into either the control or the experimental aquaria. Although the number of specimens per aquarium varied with the size and availability of organisms, an attempt was made to place an equal number of specimens in each aquarium. One chamber (two aquaria) in the control facility served as a control for the heat-shock test and a second chamber as a control for the cold-shock test. The temperature at which 50% of the organisms died (LT_{50}, American Public Health Assoc. et al. 1971) was calculated by the following

formulae:

$$M = \frac{Y_1 - Y_2}{X_1 - X_2}$$

$$LT_{50} = \frac{50 - Y_1 + MX_1}{M}$$

Y_1 = smallest mortality (%) greater than 50%.
Y_2 = greatest mortality (%) less than 50%.
X_1 = mean temperature at which Y_1 occurred.
X_2 = mean temperature at which Y_2 occurred.

Heat-shock tests were conducted for 48 h and cold-shock tests for 96 h. Observations were made continuously for the first hour; hourly to 4 h; at 6, 8, and 24 h; and three times daily to the end of the test. Mortality, loss of equilibrium, and any other significant event were noted at each observation. Mortality was defined as either lack of opercular movement for 5 min or no reaction when probed vigorously with a glass rod. The inability of an organism to maintain its normal orientation was considered loss of equilibrium. A test was invalid if more than 20% of the organisms in the control died for reasons other than mechanical failure of the system, and invalid data were not presented. Temperature (at the first hourly observation and at every observation thereafter), dissolved oxygen level, salinity, pH, and hydrogen sulfide level were determined daily throughout the test to insure that the water quality was similar between the test facilities.

Length of most specimens was measured to the nearest 0.1 mm with dial calipers. Fishes larger than 185 mm were measured to the nearest 1 mm on a blocked measuring board. The length of all fishes was measured

from the snout to the proximal portion of the central rays of the caudal fin. The carapace width (distance between the ends of the anterolateral spines) of the blue crab and total length (distance from the anterior end of the spine on the antennal scale to the posterior tip of the telson) of the sand shrimp were determined to the nearest 0.1 mm. Individuals were weighed to the nearest 0.1 g with an Ohaus Autogram or Dial-O-Gram balance. Specimens of the sand shrimp were weighed to the nearest 0.01 g on an Ohaus Cent-O-Gram balance.

Results

Heat-shock and cold-shock studies conducted from March through August 1977 are summarized in Table C1-210 and C1-211. This summary includes only tests for which LT_{50}'s were determined, but data from all valid, individual tests are also presented (Tables C1-212 through C1-225).

Heat Shock

Nine heat-shock tests were conducted with the sand shrimp at acclimation temperatures of 5.0, 10.0, and 15.0 C (Table C1-212). At 5.0 and 10.0 C, little ($\leq$10%) mortality occurred at the greatest delta T's (17.0 and 14.6 C, respectively). However at an acclimation temperature of 15.0 C, 100% of the organisms exposed to a delta T of 14.2 C were dead at 48 h although no mortalities occurred at a delta T of 11.0 C. The LT_{50} for sand shrimp acclimated to 15.0 C was 27.6 C.

The blue crab acclimated to 19.0 or 20.0 C had little heat-shock mortality at a shock temperature of 34.9 C or less, and those acclimated

to 25.0 C had little mortality at 36.0 C or less (Table C1-213). At both acclimation temperatures, mortality was observed at the lowest test temperature (29.2 and 33.0 C, respectively), but this mortality was attributed to cannabalism. Complete (100%) mortality occurred at both acclimation temperatures when the test temperature exceeded 38.0 C. The LT_{50} value for organisms acclimated to 20.0 and 25.0 C was 34.9 and 36.7 C, respectively.

Atlantic menhaden (57.4 to 181.6 mm) were tested at acclimation temperatures from 10.0 to 24.0 C (Table C1-214). At an acclimation temperature of 10.0 C and test temperatures from 20.9 to 26.9 C, mortality was 50% or greater. When Atlantic menhaden acclimated to 14.0 C were subjected to a delta T of 17.0 C, all fish died within 0.5 hours; the LT_{50} for this acclimation temperature was 29.7 C. Young of the Atlantic menhaden were acclimated to 20.0 C and were exposed to temperatures from 26.2 to 31.5 C; the LT_{50} (29.6 C) was similar to that of fish acclimated to 14.0 C. Young Atlantic menhaden acclimated to 24.0 C and exposed to a temperature from 29.0 to 33.0 C had an LT_{50} of 32.0 C.

Heat-shock tests of bay anchovy 18.7 to 78.9 mm in length were conducted at an acclimation temperature of 10.0, 16.0, and 25.0 C (Table C1-215). The LT_{50} of fish (44.6 to 73.8 mm) acclimated to 10.0 C was 23.9 C, and it was 27.1 C for individuals (42.7 to 78.9 mm) acclimated to 16.0 C. At an acclimation temperature of 25.0 C, young of the bay anchovy (18.7 to 29.9 mm) had an LT_{50} of 32.0 C.

The Atlantic silverside was tested at acclimation temperatures of 10.0, 15.0, 21.0, 22.0, and 25.0 C; both young and adults were tested at

21.0 and 22.0 C (Table C1-216). Atlantic silverside (68.9 to 101.5 mm) acclimated to 10.0 C had an LT_{50} of 24.5 C, and 69.1 to 114.7-mm individuals acclimated to 15.0 C had an LT_{50} of 29.8 C. Adults (48.4 to 108.8 mm) acclimated to 21.0 C had an LT_{50} of 28.9 C, and young (13.7 to 21.7 mm) acclimated to 22.0 C had an LT_{50} of 28.3 C. The highest LT_{50} (33.2 C) was calculated for 33.1 to 64.4-mm fish acclimated to 25.0 C.

Adult northern pipefish (114.5 to 239 mm) were tested at an acclimation temperature of 15.0 and 19.0 C (Table C1-217). At 15.0 C, no mortality occurred at test temperatures as high as 29.1 C (delta T of 14.1 C). However, fish acclimated to 19.0 C had 20% mortality at a test temperature of 29.0 C and 80% mortality at 32.0 C; the LT_{50} was 30.5 C.

Young of the bluefish acclimated to 20.0 C had no mortality at a test temperature as high as 30.0 C (Table C1-218). However, bluefish acclimated to 21.0 C had 100% mortality at a test temperature of 32.0 C, and the LT_{50} was 29.2 C. At an acclimation temperature of 25.0 C, the LT_{50} was calculated as 31.3 C.

Winter flounder (73.7 to 158.5 mm) acclimated to 5.0 C and subjected to a test temperature of 24.9 and 27.9 C had 100% mortality in 4 h and 0.2 h, respectively; the LT_{50} was 22.7 C (Table C1-219). Winter flounder (103.7 to 181.0 mm) acclimated to 15.0 C had a LT_{50} of 27.4 C. All young of the winter flounder (29.6 to 65.1 mm) acclimated to 20.0 C had 100% mortality at a temperature of 28.2 C or above; the LT_{50} was 27.0 C.

Cold Shock

Cold-shock tests on sand shrimp acclimated to 5.0 and 10.0 C produced no mortality after 96 h (Table C1-220). These organisms were tested at

a temperature of 1.5 C (10.0 C acclimation temperature) and 2.3 C (5.0 C), and these were the lowest temperatures that could be produced in the cold-shock facilities.

Atlantic menhaden (115.5 to 143.5 mm) acclimated to 10.0 C and subjected to a test temperature of 3.9 C experienced 10% mortality at 3 h, 90% mortality at 24 h, and 100% mortality at 32 h (Table C1-221). Individuals (118.6 to 141.2 mm) acclimated to 14.0 C and exposed to test temperatures of 5.3 and 9.2 C had 100% mortality (at 28 h) and 10% mortality (96 h), respectively. The LT_{50} for these fish was 7.5 C. Young Atlantic menhaden acclimated to 20.0 C had 100% mortality after 48 h at a test temperature of 9.2 C; the LT_{50} was 11.1 C.

Individuals of the bay anchovy (46.9 to 67.0 mm) acclimated to 10.0 C had an LT_{50} of 6.4 C (Table C1-222). Although six tests were conducted at acclimation temperatures of 14.0 to 16.0 C, no LT_{50} was determined. At an acclimation temperature of 14.0 C, the lowest test temperature (10.0 C) produced 26.3% mortality after 96 h. At an acclimation temperature of 15.0 C and a test temperature of 10.5 C, 9.1% mortality occurred after 72 h, and a power failure terminated the test at that time. At an acclimation temperature of 16.0 C and test temperature of 6.4 and 9.3 C, mortality was 100% (at 24 h) and 73.7% (at 96 h), respectively.

When acclimated to 10.0 C, individuals of the Atlantic silverside (66.3 to 106.4 mm) subjected to test temperatures of 3.1 and 6.0 C had 36.4% mortality at both temperatures (Table C1-223). At an acclimation temperature of 15.0 C, Atlantic silverside (74.0 to 102.1 mm) subjected

to 7.2 and 11.2 C had little ($\leq$ 10%) mortality. Young of the Atlantic silverside (17.1 to 39.2 mm) acclimated to 21.0 C had less than 27.4% mortality at test temperatures from 12.7 to 16.8 C with the greatest mortality at the lowest temperature. Young acclimated to 22.0 C and exposed to 6.3 C had 100% mortality after 4 h; fish tested at 11.2 C had 50% mortality after 4 h and 100% mortality at 24 h.

Northern pipefish (108.0 to 213 mm) acclimated to 15.0 C had less than 6% mortality at test temperatures of 7.1 and 10.9 C (Table C1-224). One of the 20 individuals tested at 10.9 C died.

Adult and young winter flounder acclimated to 6.0 and 20.0 C had no loss of equilibrium or mortality at test temperatures from 1.0 to 11.2 C (Table C1-225).

Discussion

The highest LT_{50} value calculated for the fishes tested was 33.2 C for Atlantic silverside acclimated to 25.0 C. No fish survived more than 24 h when subjected to a temperature above 33.9 C regardless of acclimation temperature, and as acclimation temperatures increased, the delta T needed to cause an LT_{50} decreased. de Sylva (1969) noted that most marine fish do not survive at temperatures above 35.0 C.

The LT_{50} values determined for Atlantic menhaden in this study were higher than the temperatures that Powers (1977) reported as lethal. Only 20% of the Atlantic menhaden acclimated to 24.0 C and tested at 31.1 C died; the LT_{50} of these fish was 32.0 C. Powers (1977) reported that temperatures exceeding 31.0 C were lethal to all Atlantic menhaden that he tested under flow-through conditions. On three occasions in

this study, some individuals survived through 48 h when the shock temperature exceeded 31.0 C.

Meldrim et al. (1977) found that the avoidance temperature of the Atlantic menhaden was directly related to acclimation temperature but inversely related to size. Wyllie (1976) reported that 110 to 195-mm Atlantic menhaden acclimated from 10.0 to 24.0 C avoided temperatures from 28.4 to 32.2 C during periods of decreasing ambient temperatures. A comparison of avoidance temperatures and LT_{50}'s to the average monthly temperature predicted for Oyster Creek indicated that the Atlantic menhaden should avoid Oyster Creek from June through August (Table C1-226).

The LT_{50} for bay anchovy acclimated to 10.0 and 25.0 C (LT_{50} of 23.9 and 32.0 C, respectively) were greater than avoidance temperatures reported by Meldrim (1977) for similar acclimation temperatures. Meldrim (1977) reported that bay anchovy acclimated to 12.0 C avoided temperatures of 21.0 to 22.0 C while those acclimated to 28.0 C avoided temperatures of 29.0 to 32.0 C. The LT_{50} at an acclimation temperature of 16.0 C (LT_{50} of 27.1 C) was in the range of avoidance temperatures presented by Terpin et al. (1977) for fish acclimated to 15.0 C. They recorded avoidance temperatures of 26.6 to 28.1 C at an acclimation temperature of 15.0 C although their organisms showed low thermal response during several of these tests. Avoidance temperatures and LT_{50}'s indicated that the bay anchovy should avoid some part of the thermal plume from April through September when the average monthly temperature predicted for Oyster Creek ranged from 18.9 to 33.2 C (Table C1-226).

As with the Atlantic menhaden, the LT_{50} values of the bay anchovy were greater than the temperatures that Powers (1977) found were often lethal. Powers (1977) reported substantial (>50%) mortality of the bay anchovy in 24 h when ambient temperature exceeded 15.7 C, shock temperature exceeded 25.2 C, and the delta T was greater than 5.1 C. However, he found that the determination of well defined limits of mortality was hampered by excessive control mortality.

At least 50% of the Atlantic silverside did not survive a temperature of 33.2 C or a delta T greater than 15.0 C. An inverse relationship existed between acclimation temperature and LT_{50}; the lower the acclimation temperature the greater the delta T necessary to effect an LT_{50}. The LT_{50} of 33.2 C for Atlantic silverside acclimated to 25.0 C was just below the mean avoidance breakdown temperature (34.3 C), but it was above the mean avoidance temperature (30.0 C) of this species (Gift and Westman 1971).

Terpin et al. (1977) reported an avoidance temperature of 32.2 to 34.4 C for 150 to 190-mm bluefish acclimated at 20.0 C which was greater than the LT_{50} (31.0 C) calculated for smaller (79.5 to 110.5-mm) bluefish acclimated to 21.0 C. Similarly, based on the regression equation presented by Terpin et al. (1977), the avoidance temperature calculated for an acclimation temperature of 21.0 (avoidance temperature of 33.3 C) and 25.0 C (34.1) were inconsistent with the LT_{50}'s determined in this study for acclimation temperatures of 21.0 (LT_{50} of 29.2 C) and 25.0 C (31.3). However, the coefficient of determination for the regression equation was relatively low (0.42) which indicated the limitations of

this equation in the prediction of the avoidance temperature. At comparable acclimation temperatures, the LT_{50} data presented in this study were within the range of temperatures that Powers (1977) reported as lethal to young bluefish. He reported mortality greater than 85% for 35.2 to 185.4-mm bluefish held at a temperature from 19.0 to 35.5 C and exposed to a test temperature of 27.9 to 37.3 C.

Young of the winter flounder were very tolerant of sudden increases in temperature during the colder months. Powers (1977) also reported that young (age 0+) winter flounder were very temperature tolerant during these months; fish held from 0.0 to 7.6 C had less than 8% mortality at a delta T of 16.0 C. Young of the winter flounder remain in the Bay through the year, but they should avoid lethal temperatures in the OCGS discharge during the summer months. The avoidance temperature of young acclimated to 19.6 C (24.4 C, Gift and Westman 1971) was below the LT_{50} (27.0 C) for fish acclimated to 20.0 C.

The blue crab survived a substantially higher test temperature than the fishes tested, and total mortality occurred only when test temperature exceeded 38.0 C. Chung (1977) found that the temperature at which 50% of the blue crab survived for 180 min varied from 37.0 to 40.0 C at acclimation temperatures of 20.0 and 30.8 C and at delta T's of 9.5 to 18.0 C. In the OCGS discharge canal, the blue crab was collected at a temperature as high as 36.1 C (see Section C1.17), and catches of the blue crab in nature generally were relatively large at temperatures as high as 37 C (Margraf 1977). Gift and Westman (1971) reported an avoidance temperature of 34.3 C and an avoidance breakdown temperature of 39.2 C

for mature and large immature individuals acclimated to 20.0 C. They found that immature blue crab had a slightly higher avoidance temperature (37.5 C) and avoidance breakdown temperature (40.0 C) than adults. Some portion of the OCGS discharge canal west of Rt. 9 may be avoided during July and August (Table C1-226).

Heat-shock data indicated that the LT_{50} generally was above the temperature at which most species would avoid the OCGS heated discharge. Therefore, most fishes and blue crab attracted to the heated discharge should avoid lethal temperatures. Those fish and macroinvertebrates introduced into the discharge canal after impingement on the OCGS screens were probably not exposed to the maximum temperatures or delta T's reported by Powers (1977) because of the relocation of the OCGS screen wash sluiceway discharge into the dilution pump discharge. It is still possible that some organisms washed from the OCGS screens or passed through the dilution pumps may be exposed to lethal temperatures in the OCGS discharge. However, most organisms should utilize the area of mixed OCGS discharge water and dilution flow, and the subsequent temperature increase would not be as great as that which occurred prior to the diversion of the sluiceway.

Two documented incidents of heat shock have occurred in the past; both were related to unusual natural or operating conditions. The unexpected shutdown of the only operating dilution pump in August 1973 resulted in a rapid increase in temperature in the immediate vicinity of the OCGS discharge. The temperature reached 41.1 C and even some blue crab died. In April 1976 (see Section C1.17), rapidly increasing Bay

temperatures and a reduction in dilution flow caused the temperature at OCGS discharge to increase from 21.7 to 29.4 C from 17 to 19 April, and mortality of some blue crab and bay anchovy was observed.

Based on data reported in this study and by Powers (1977), the probable heat-shock mortality observed during April 1976 should not have affected all individuals of the bay anchovy and blue crab in Oyster Creek. Bay anchovy acclimated to 16.0 C and exposed to a 10.0 C delta T (shock temperature of 26.0 C) experienced 26.3% mortality in 48 h (Table C1-215). When the bay anchovy was acclimated to 20.3 C, 32% mortality was noted at 48 h at a delta T of 9.7 C (shock temperature of 30.0 C), but preliminary data collected in 1978 indicated no mortality of individuals acclimated to 20.0 C and tested at shock temperatures of 24.5 and 27.0 C. At an acclimation temperature of 25.0 C and test temperatures of 29.0 and 31.1 C, mortality was less than or equal to 25% (Table C1-215). Data collected by Powers (1977) indicated that no mortalities occurred at OCGS discharge temperatures of 26.5 to 29.8 C. However on 21 April, the temperature in the dilution discharge decreased from 26.0 to 21.0 C in a 2-h period. This temperature decrease may partially account for some of the mortalities noted in this area on that date and on 22 April.

From January 1972 through February 1975, the shutdown of OCGS during winter months and the subsequent cooling of the water in Oyster Creek resulted in the mortality of overwintering fishes, particularly the Atlantic menhaden. The sand shrimp was also collected in Oyster Creek during winter, but it did not appear to be susceptible to cold

shock when subject to sudden temperature decreases as great as 8.5 C or temperatures as low as 1.5 C. Cold shock of the sand shrimp in Oyster Creek has not been documented.

Cold-shock data for young Atlantic menhaden agreed with Reintjes (1975) report that a water temperature of 3.0 C and below was lethal to young and that a temperature of 5.0 to 7.0 C killed young acclimated to a temperature of 15.0 C or above. Meldrim (1977) found that cold-shock mortality of young Atlantic menhaden was greatest when the temperature decrease exceeded 7.0 C or when the temperature fell below 10.0 C.

Since November 1975, the pumping of dilution water ceased during OCGS winter shutdowns, and the canal cooled more slowly than during previous shutdowns. Abell and Burton (1977) reported that the likelihood of mortality (to 120 h) of the Atlantic menhaden acclimated to 15.0 C was substantially reduced when a temperature decrease of 10.0 C occurred over a 6-h period. Substantial mortality of the Atlantic menhaden was not observed during two OCGS shutdowns in December 1975 (Bay temperature of about 3.0 C, Tatham and Metzger 1976).

Meldrim's (1977) data indicated that most cold-shock mortality of the bay anchovy occurred at temperatures below 10.0 C, and the LT_{50} calculated for the bay anchovy acclimated to 10.0 C was 6.4 C in this study. Some 73.7% to 100% mortality occurred for fish acclimated at 16.0 C and tested at a temperature from 6.4 to 9.3 C. Cold-shock mortalities were documented in January 1973 (JCP&L 1978) and in December 1976 (see Section C1.17).

The elevated temperatures in the heated discharge may lead to the formation of gas bubbles in fishes due to supersaturation of gases in the heated water. Powers (1977) reported these effects for northern pipefish tested in his experimental studies at OCGS; his experimental work was conducted with heated water directly from the OCGS discharge. Younger (1974) reported gas bubble disease for Atlantic silverside collected in the discharge canal. However, fishes tested in the closed-cycle experimental system did not exhibit loss of equilibrium or mortality due to gas bubble disease.

C1.19 LIFE HISTORY STUDIES

Introduction

Life history studies were undertaken for 12 fishes, the sand shrimp, and blue crab. The Atlantic menhaden, bay anchovy, northern pipefish, winter flounder, and blue crab were designated as important species by the NRC. Additionally, the threespine stickleback, striped bass, bluefish, weakfish, northern kingfish, summer flounder, northern puffer, and sand shrimp were designated as representative, important species (RIS) by the EPA. The life history of the Atlantic silverside was also studied because it was an abundant forage fish in Barnegat Bay. Procedures common to all studies are given below. All data were compiled and analyzed with a Hewlett-Packard 9830A programmable calculator.

A representative sample of specimens was examined from five areas: the vertical traveling water screens at OCGS, the immediate vicinity of the OCGS discharge (Sta. 26), Oyster Creek, the south branch of Forked River, and the mouth of Cedar and Double creeks (creek mouths). All physical anomalies, injuries, external parasites, and diseases were noted.

Length of specimens was measured to the nearest 1 mm on a blocked measuring board or with dial calipers. The length of all fishes was measured from the snout to the distal portion of the central rays of the caudal fin. The distance between the end of the anterolateral spines of

the carapace of the blue crab was measured to the nearest 1 mm, and the length from the anterior end of the spine on the antennal scale to the posterior tip of the telson of the sand shrimp was determined to the nearest 0.1 mm.

Selected individual fish and blue crab were weighed to the nearest 0.1 g with an Ohaus Autogram or Dial-O-Gram balance. Specimens of the sand shrimp were weighed to the nearest 0.01 g on a Ohaus Cent-O-Gram balance.

The length-weight relationship was determined by a geometric mean regression (Ricker 1975), and the confidence interval ($P \leq 0.05$) of the regression coefficient was also determined (Simpson et al. 1960).

The age of selected Atlantic menhaden and striped bass, and of most bluefish and weakfish larger than 180 mm was determined by examination of scales for annuli. Scales were removed from specimens, cleaned, and stored in labeled envelopes. Scale impressions were made on acetate slides and were read on an EPOI LP-6 Profile Projector at either 10 or 20X magnification.

Otoliths (left and right sagitta) were used to age winter flounder and summer flounder according to the methodology of Poole (1966) and Smith (1969), respectively. Otoliths were removed, cleaned, and stored either in 3% sodium phosphate (winter flounder) or dry (summer flounder). In most cases the left sagitta was used for ageing. It was immersed in glycerin in a 0.5-mm deep culture slide and examined under 10X magnification with a binocular microscope. The otolith-body length relationship was determined and length at each year was calculated from annual measurements (Tesch 1968).

The age and growth of the bay anchovy, Atlantic silverside, and northern pipefish were determined by the change in the length-frequency distribution through time. The growth of some bluefish and weakfish was also determined by changes in the length-frequency distribution. Age of the northern puffer was determined from stained vertebrae according to the methodology of Laroche and Davis (1973).

The allometric condition factor (weight/length^b) was determined for the Atlantic menhaden, bay anchovy, bluefish, summer flounder, winter flounder, and ovigerous sand shrimp. The exponent b was the regression coefficient of the geometric mean regression equation (Ricker 1975). Conclusions based on the condition data reported here can be compared to those reported in the section discussion the effects of the heated discharge on fishes, but a comparison of the absolute values of the condition factors reported in these two sections is not valid. In computing the condition factor of various species in the preceding section, the exponent b was taken from the geometric mean regression equation calculated for specimens examined from 1975-76 (Tatham et al. 1977a). Even though the difference between the regression coefficients for each of the 2 years was small and in some cases not significant, these slight differences are exaggerated as exponents, and therefore large differences in the absolute value of the condition factor can occur. In addition, some specimens included in the analysis in the preceding section were collected before September 1976 and, therefore, were not included in condition determinations reported in the following sections.

A t-test or one-way ANOVA was used to test for the difference between mean lengths, mean weights, annuli measurements, condition factors, and regression coefficients (Simpson et al. 1960). When significant differences were indicated among the main effects of the ANOVA, the Student-Newman-Kuels (SNK) multiple range test was used to determine significant differences among the means (Sokal and Rohlf 1969). A chi-square test was used to test for differences in sex ratios and between day and night catches. The significance level for all statistical tests was the 95% level ($P \leq 0.05$).

Food habits were studied to determine the diet of weakfish and bluefish in Oyster Creek in relation to individuals in Barnegat Bay. After the stomach was removed, the contents were identified to the lowest possible taxon, and the volume displacement of food items was measured with either a 10- or 50-ml graduated cylinder. In addition to identifiable food items, the volume of unidentified fish (fish fragments), unidentified invertebrates (invertebrate fragments), plant matter, and organic debris was also recorded.

ATLANTIC MENHADEN

Introduction

The Atlantic menhaden supports a major commercial fishery along the Atlantic coast from northern Florida to the Gulf of Maine (Nicholson 1975), and in 1976 about 68 million kg, valued at $4.3 million, were landed in New Jersey (U.S. Dept. of Commerce 1977). It also comprises a large portion of the diet of sport fish such as the bluefish and weakfish (Bigelow and Schroeder 1953). The Atlantic menhaden is a planktivore, and its diet consists mainly of diatoms, unicellular plants, and copepods (Hildebrand 1964).

Atlantic menhaden reproduce primarily in the ocean (Hildebrand 1964). The time of spawning varies with location, but Reintjes (1969) reported that most spawning in the mid-Atlantic probably occurred in March and April and during September and October. Most fish mature by age 3, and females produce from 38,000 to 631,000 eggs, depending upon their size (Higham and Nicholson 1964).

Larvae and older Atlantic menhaden enter mid-Atlantic estuaries in spring although the time of arrival varies with location (Hettler 1976). Larvae transform into juveniles (30 to 40 mm in length) in low salinity water (June and Chamberlin 1959, Reintjes 1969), and both young (age 0+) and juveniles remain in estuaries during summer. In fall, the Atlantic

menhaden migrates southward, and during winter it is found from Cape Hatteras to the south (Kroger and Guthrie 1973).

Materials and Methods

Sex and gonad condition were determined by examination of the gonads under a dissecting microscope. Fish were considered immature when their gonads occupied a small portion of the posterior body cavity and the GSI (Gonado-somatic Index; i.e., ratio of gonad weight to total body weight) was small. Gonads of mature fish were considered at rest, enlarged, ripe, or spent. Each of the first three stages of maturity occupied a progressively larger portion of the posterior body cavity and had a larger GSI value. Females with gonads at rest had small but noticeable egg cells in the ovary, but the testes of males showed no sign of convolutions. Mature fish with enlarged ovaries had many 0.3- to 0.6-mm eggs, and testes showed some convolutions. Egg cells in ripe ovaries exceeded 0.8 mm in size, and ripe testes were fully convoluted. Gonads were considered spent when they became flaccid and showed a decrease in size and GSI value. Spent gonads were larger than gonads at rest, but convolutions in the testes and egg-cell diameters in the ovaries were reduced from the ripe stage.

Age and rate of growth were determined from scales. When possible, scales were removed from the left side of the specimen in the area between the tip of the flexed pectoral fin and the insertion of the

dorsal fin (June and Roithmayr 1960). Age was determined by counting the annuli on each scale, and a Helios caliper was used to measure the distance from the centrum to each annulus and to the edge of the scale. The body-scale relationship was determined and lengths at various ages were calculated from the annulus measurements.

Since allometric condition factor varies with the size of the fish (Everhart et al. 1975), only the condition of 90 to 109-mm Atlantic menhaden was examined because this was the only size-group of fish that and enough specimens for analysis. The condition of specimens from three areas from September through November and from December through February and of individuals from two areas from March through May were compared.

Results

The Atlantic menhaden was collected in all areas from September 1976 through August 1977, although none were taken at the OCGS screens from 14 May through 11 July because OCGS did not circulate water during this period. Most (93.8%) individuals were collected at the OCGS screens (Table C1-227). Since only three Atlantic menhaden were collected from the mouth of Cedar Creek and Double Creek, these areas were not considered in most analyses. Most (85.1%) Atlantic menhaden collected from Oyster Creek, Forked River, and the immediate vicinity of the OCGS discharge were taken by gill net. However, few individuals were taken in these three areas during April and May because sampling with a gill net ended in March and only a few gill net collections were taken in Oyster Creek and Forked River from June through August.

Impingement of the Atlantic menhaden at the OCGS screens increased in fall, and maximum impingement occurred in November at a water temperature of 9 to 11 C (Appendix D1, Table D1-63). Few Atlantic menhaden were taken in January when water temperatures were coldest (mean monthly temperature of 0.1 C), but substantial impingement occurred during March when the temperature at OCGS averaged 9.5 C.

A total of 2,031 Atlantic menhaden (32 to 364 mm in length) was examined. Young (age 0+) comprised 78.0% (n = 1,353) of the 1,735 specimens that were aged (Table C1-228). Age 1+ fish comprised 4.5% of the fish examined, age 2+ fish 3.3%, age 3+ individuals 9.7%, and age 4+ specimens 3.5%. Few (n = 17) age 5+ through 8+ specimens (1.0%) were collected.

Since many specimens under 150 mm in length were difficult to sex, the sex of only 50.6% of the specimens was determined. Although females (n = 587) significantly outnumbered males (441) for the year, the ratio of males to females varied with age. The sex ratio was not significantly different from a 1:1 ratio for age 1+ and 2+ fish, but young males significantly outnumbered females (Table C1-229). However for age 3+ and 4+ fish, females significantly outnumbered males. In comparisons by month and area, significant differences in sex ratios were found in only 4 of 16 instances (Table C1-230). When data were pooled for all months, females significantly outnumbered males in Oyster Creek and at the OCGS screens but not at the other areas. In a comparison of months regardless of area, significantly more females were found in October, April, and August.

No significant difference in mean length between males and females was found for young through age 2+ specimens. The mean length of all young was 115 mm, age 1+ fish 150 mm, and age 2+ individuals 214 mm. The mean length of age 3+ females was significantly greater than that of males while age 4+ males were significantly larger than age 4+ females (Table C1-231).

The mean length of all Atlantic menhaden in each age-class was determined, regardless of sex, to examine differences in length among areas (Table C1-232). The mean length of young from Forked River and the OCGS screens was the same (111 mm), and it was similar to that of fish from Oyster Creek (103) and the immediate vicinity of the OCGS discharge (108). However,the mean length of age 1+ fish from the OCGS screens (167 mm) was greater than that of specimens collected from Oyster Creek (132). Age 2+ through age 4+ Atlantic menhaden collected in the immediate vicinity of the OCGS discharge were slightly larger than those collected at the OCGS screens, but this difference decreased with older fish.

The mean length of both males and females at ages 1 through 5 was calculated from annulus measurements (Table C1-233). The regression of the scale radius to body length was body length = 47.643 + 37.137 (scale radius), and the coefficient of correlation for this relationship was high (0.912). The intercept of the regression was used as a correction factor in the calculation of growth (Tesch 1968). Annulus formation of Atlantic menhaden collected in Barnegat Bay occurred in late spring because the smallest mean distance from the last annulus to the edge of

the scale occurred in June of 1976 (Kurtz 1977a) and April of 1977. No significant difference was found between the mean length calculated for age 1 through 3 males and females at time of annulus formation (Table C1-234), but 4-year old males were significantly larger than age 4 females. Calculated mean lengths of fish at a given age was less than the mean length of all specimens in each age-class because the calculated length was determined at the time of annulus formation and the mean length of each age-class included fish that had grown after annulus formation.

The length-weight relationship was curvilinear and the logarithmic regression of this relationship was determined for both male and female Atlantic menhaden (Table C1-235). Because a t-test indicated no significant difference between the regression coefficients of the two equations, the data were pooled to generate a single equation: log weight = -4.8919 + 3.0437 (log length) with a confidence interval of $\pm$ 0.020 on the regression coefficient. The regression coefficient of the pooled regression from 1975-76 (Kurtz 1977a) was compared to that of 1976-77, and no significant difference was found.

Gonad condition was determined for 815 of the 2,031 (40.1%) Atlantic menhaden examined. Immature fish composed the largest percentage (67.2%) of the specimens that were aged and sexed. Since the gonads of many young fish were not examined because they could not be sexed, the percentage of the Bay population that was immature was greater than 67.2%. Among mature fish, 56.0% of the gonads (n = 150) were at rest, 28.7% (77) enlarged, 4.5% (12) ripe, and 10.8% (29) spent (Table C1-236).

All young and most (98.7%) age 1+ fish were immature, but only 36.8% of all age 2+ fish, 7.7% of age 3+ fish, and 1.7% of age 4+ individuals were immature. Most (10 of 12) ripe specimens were males. The two ripe females contained eggs which were 1.0 mm or larger in diameter.

Specimens (90 to 109 mm in length) taken in Oyster Creek from September through November were in significantly better condition than those taken from either the OCGS screens or Forked River (Table C1-237). The mean condition of fish from the OCGS screens was greater than but not significantly different from that of individuals from Forked River. Atlantic menhaden taken in the lower portion of Oyster Creek and in the immediate vicinity of the OCGS discharge from December through February were in similar condition, and specimens from both areas were in significantly better condition than individuals from the OCGS screens. However from March through May, the condition of specimens taken at the OCGS screens was not significantly different than the condition of fish near the OCGS discharge.

Analysis of condition through time was limited due to the availability of specimens from comparable areas during each season (Table C1-237). In the immediate vicinity of the OCGS discharge, mean condition decreased slightly from 18.09 in winter (December through February) to 17.77 in spring (March through May). Condition of Atlantic menhaden in Oyster Creek decreased from 19.87 in fall (September through November) to 18.91 in winter (December through February). The condition value of individuals collected at the OCGS screens improved slightly from fall (16.52) to winter (16.89) but decreased during spring (15.76) and summer (11.84).

All specimens were examined for physical anomalies, injuries, external parasites, and disease. Individuals with scale loss were the most common (62.4%). Lernaeenicus radiatus, a parasitic copepod, was found on 28.4% (n = 577) of all specimens, and Olencira praegustator, a parasitic isopod, was found on 4.6% (94) of all individuals (Table C1-238). Most (91.5%) specimens infested with O. praegustator had evidence of gill erosion, and similar gill erosion was seen on 23 other fish although no O. praegustator were found. Gill erosion may be a better indicator of this parasite because these parasites often detach from the host after capture (Kroger and Guthrie 1972). Based on the number of specimens with gill erosion, the infestation rate of O. praegustator may have been as high as 5.8%.

The percentage of unaffected Atlantic menhaden in each area (Table C1-239) indicated a lower percentage of unaffected Atlantic menhaden (8.0%) at the OCGS screens than in Oyster Creek (35.7%), the immediate vicinity of the OCGS discharge (49.1%), or Forked River (51.6%). This large difference occurred because mechanically damaged fish were more common at the OCGS screens (86.0%) than at other areas (13.7% to 34.8%). The percentage of diseased and parasitized Atlantic menhaden was similar among the four areas (31.0% to 38.9%).

Discussion

Barnegat Bay serves primarily as a nursery and feeding area for a small segment of the Atlantic menhaden population along the mid-Atlantic coast. No spawning occurs in the Bay, and few individuals with ripe

gonads were collected in either 1975-76 (0.5% of all specimens aged and sexed, Kurtz 1977a) or 1976-77 (0.8%). Most spawning occurs in the ocean (Hildebrand 1964).

This species was present seasonally in the Bay when the water temperature was above 10 C, and this generally agreed with the reported temperature at which it occurred in other areas in the mid-Atlantic. Bigelow and Schroeder (1953) reported that the Atlantic menhaden first appeared in the Gulf of Maine at a water temperature of 10 C. However, the temperature at which it emigrated from Barnegat Bay during the fall of both 1975 and 1976 may be lower than that reported by Reintjes (1969). The temperature at which impingement of the Atlantic menhaden substantially increased in the fall was used as an indication of the temperature of emigration of a large number of individuals in the Bay. Impingement at OCGS appeared to correspond with the movement of fish within the Bay rather than their occurrence in the Bay. The increase in impingement of Atlantic menhaden at OCGS occurred at a water temperature of 9 to 11 C, and this temperature was lower than the 15 C Reintjes (1969) reported as the emigration temperature of Atlantic menhaden in the Bay.

The Atlantic menhaden was more abundant in the Bay during 1976-77 (1.21/trawl collection, Table C1-163) than 1975-76 (0.04, Danila 1977b), and greater numbers of individuals were impinged at OCGS from September through December of 1976 (an estimated 89,387 individuals) than in comparable months in 1975 (9,133; Appendix D1, Table D1-47). However, the water velocities in front of the OCGS screens during these months in 1975 (3 circulating water pumps in operation, mean velocity of 0.06 to

0.12 m/sec) were lower than those in 1976 (4 pumps, 0.18 to 0.20 m/sec), and this difference may account for some of the greater impingement during 1976.

The increase in abundance during 1976-77 was attributed primarily to the large 1976 year-class of young Atlantic menhaden. Young comprised 78.0% of all specimens in 1976-77 but only 27.7% of those in 1975-76. This larger year-class of young also explained why the percentage of young to age 2+ fish in 1976-77 (85.8%) was greater than this percentage in 1975-76 (67.3%, Kurtz 1977a). Elimination of young and adjustment for the 1 year of growth from 1975-76 to 1976-77 indicated that the percentage of age 1+ and 2+ Atlantic menhaden in the Bay during 1975-76 (13.9% and 40.8%, respectively) was similar to that of age 2+ and 3+ fish (15.1%, 44.2%) the following year. However, the percentage of age 3+ fish in 1975-76 (33.2%) was larger than that of age 4+ fish in 1976-77 (15.8%), and this decrease may result from either natural mortality or the harvest of these individuals by the commercial fishery. Few age 1+ fish were collected in either 1975-76 (10.1% of all fish aged) or 1976-77 (4.5%), but age 1+ Atlantic menhaden are uncommon in central and northern New Jersey (Nicholson 1972).

Most aspects of the life history of the Atlantic menhaden in Barnegat Bay were similar during 1975-76 (Kurtz 1977a) and 1976-77. The gonad condition of young, age 1+, and age 4+ Atlantic menhaden during 1975-76 and 1976-77 were similar. However, the age 2+ (1974 year-class) and 3+ (1973) Atlantic menhaden in 1976-77 had a higher percentage of mature gonads than age 2+ (1973) and 3+ (1972) fish examined in 1975-76.

During 1975-76, only 1.5% of the specimens from the 1973 year-class (age 2+) were mature from September through December 1975, and a similar percentage of these gonads were mature from March through May 1976. In comparison, a much larger percentage of the 1974 year-class (age 2+) had mature gonads from September through December 1975 (50.0%) and from February through April 1977 (91.7%). Similarly, most (81.1%) of the Atlantic menhaden from the 1972 year-class (age 3+) collected from September through December 1975 were immature, but by March through May 1976, 66.2% were mature. However from September through December 1976, most (73.9%) of the 1973 year-class (age 3+) had mature gonads, and all were mature by January 1977.

The later maturation of the 1972 and 1973 year-classes, in comparison to the 1973 and 1974 year-classes, respectively, may reflect yearly fluctuations in environmental conditions. The later date for annulus formation in 1976 (June) than in 1977 (April) also suggested slower development for the 1972 and 1973 year-classes. June and Roithmayr (1960) stated that annulus formation occurred from late winter to late spring. Data from 1976-77 were in closer agreement with the literature than 1975-76 data. Higham and Nicholson (1964) stated that many female Atlantic menhaden reached maturity during their second year, and Nicholson (1972) found that all age 3+ females were mature by fall.

Several discrepancies between mean length and calculated length at the time of annulus formation were found from year-to-year. Although the calculated length of females at age 2 was significantly larger than that of males in 1975-76 (Kurtz 1977a), this difference was not found in

1976-77. Reintjes (1969) found little difference in the length of males and females at the time of annulus formation through 6 years of age, and therefore this difference was probably of little significance.

The mean length of age 2+ through 4+ Atlantic menhaden was similar in both years. The mean lengths of age 1+ Atlantic menhaden examined during 1976-77 (mean length of males was 152 mm, females 149 mm) was substantially smaller than those examined during 1975-76 (185, 189; Kurtz 1977a), but this difference was attributed to the time of collection. Most (67%) age 1+ fish examined in 1975-76 were collected between November and April, and most individuals (70%) examined from 1976-77 were collected from June through August. Since annulus formation occurred from April through June, most Atlantic menhaden examined in 1976-77 were younger and therefore smaller than those examined the previous year.

During both 1975-76 and 1976-77, significantly more females than males were taken on the OCGS screens. The ratio of females to males during 1975-76 (1.4:1, Kurtz 1977a) was similar to the ratio during 1976-77 (1.3:1) and probably reflected the sex ratio of the Bay population. These values exceeded the approximately equal sex ratio (1.02:1.00) reported by Reintjes (1969) for young to age 3+ Atlantic menhaden.

The reported condition of fish residing in heated discharges varied with species and geographic area. Although fish (i.e., brown bullhead) in the heated discharge of the Connecticut Yankee Atomic Plant were in poorer condition than those in the Connecticut River (Marcy 1976), Atlantic menhaden in Oyster Creek were often in better condition than individuals from other areas. Similarly, Atlantic menhaden taken in

Oyster Creek were in significantly better condition than those from the OCGS screens and in Forked River (see page C1-385). Bennett (1972) reported that black crappie in a heated discharge in South Carolina were in better condition than those from ambient waters. Residence near the OCGS discharge from November 1976 through March 1977 caused small (90 to 130 mm) Atlantic menhaden to lose weight, but this loss did not occur in larger (211 to 260 mm) specimens (see page C1-386).

The incidence of Lernaeenicus radiatus increased substantially from 9.8% in 1975-76 (Kurtz 1977a) to 28.4% in 1976-77. The reason for this increase was not known, but it probably represented natural variation. The incidence of Olencira praegustator infestation in 1976-77 (4.6%) also increased over that found in 1975-76 (0.8%). The actual rate of O. praegustator infestation may have been higher in both years because this parasite may detach from the host (Kroger and Guthrie 1972). However, the rate of O. praegustator infestation in Barnegat Bay was substantially lower than that reported in Virginia (39.3%) and Maryland (34.4%) by Kroger and Guthrie (1972). This lower rate of infestation in Barnegat Bay may occur because the Bay is near the northern limit of O. praegustator's range. Although the overall rate of disease and parasitic infection on specimens was greater in 1976-77 than the previous year, this increase was not apparently related to the OCGS heated discharge.

BAY ANCHOVY

Introduction

The bay anchovy is the most abundant fish along the Atlantic Coast of the United States (McHugh 1967), and it was the most numerous fish collected in the Bay from September 1975 through August 1976 (Danila 1977b). Marcellus (1972) and McClain (1973) reported that it was the second most abundant fish collected in the Bay from 1966-70 and during 1971-72, respectively. Its diet is primarily copepods, megalopae, and zoeae (Stevenson 1958). The bay anchovy is important forage for many sport and commercial fishes such as the striped bass (Schaefer 1970), weakfish (Thomas 1971), and summer flounder (Smith 1969).

The life span of the bay anchovy appears to be relatively short, probably not more than 2 or 3 years (Stevenson 1958), and it matures at 1 year of age. Reproduction occurs from May through August in Barnegat Bay (Tatham et al. 1977b), and larvae grow rapidly to juveniles. Juveniles and some adults remain in the estuary until November or December before they emigrate to the ocean. The bay anchovy returns to inshore waters in spring, and it returned to the Bay during 1976 in March (Kurtz 1977b).

Materials and Methods

Sex was determined by examination of the gonads under a dissecting microscope. Testes were thin at the edges and leaf-like while ovaries were rounded and bag-like (Stevenson 1958). Six stages of maturity were used to distinguish gonad condition. Gonads were considered immature if they were small and the egg cells in the ovaries were small or indistinguishable. Gonads of mature specimens were categorized as at rest, enlarged, ripe, partially spent, or spent. The size of mature gonads increased progressively from at rest to ripe and then progressively decreased in size. Ovaries at rest had a granular consistency, and most eggs were small (< 0.1 mm). Testes at rest had thin edges, a firm texture, and no visible convolutions. Enlarged ovaries contained numerous 0.2- to 0.4-mm egg cells, and enlarged testes had some convolutions. Ripe ovaries contained many transparent eggs larger than 0.5 mm, and ripe testes were soft and highly convoluted. Partially spent gonads of both sexes were somewhat flaccid. Fewer eggs larger than 0.5 mm were present in ovaries, and testes were less convoluted. Spent gonads were flaccid; ovaries had few egg cells over 0.4 mm while testes contained few or no convolutions. The sex of most specimens under 30 mm was not determined because the gonads were indistinguishable.

Age and growth were determined by the length-frequency distribution of specimens because scales, otoliths, and vertebrae were unsatisfactory for age determination (Stevenson 1958). Length-frequency histograms (5-mm increments) were often bimodal, and the mean length of each mode was determined. If the two modes were not completely separated, they were arbitrarily separated at the intermediate size-categories with the

fewest specimens. When two, contiguous intermediate size-categories contained the same number of specimens, the modes were divided between the size-categories.

Since the allometric condition factor varies with length of fish and season (Everhart et al. 1975), condition was determined for several size-groups taken from September through November, March through May, and June through August.

Results

A total of 3,297 bay anchovy was examined. Males ranged in length from 25 to 89 mm and females from 21 to 89 mm. The smallest specimen examined was 16 mm, but sex could not be determined. Most bay anchovy smaller than 35 mm were immature, and most specimens larger than 40 mm were mature.

The length-frequency distribution from each month was examined to ascertain age and growth of the population. Data from July and August 1976 (Kurtz 1977b) was used with that from September through December 1976 to determine growth of young (age 0+). A single mode of lengths was found from April through June 1977, and the mean length decreased each month from April (74 mm) to May (63) and June (62). A bimodal distribution of length was found from July through December 1976 and also in July and August 1977 (Table C1-240). The mean length of the larger mode in July was 57 mm and these were individuals found in the Bay from April through June. In 1976, the mean size of the smaller mode increased from July (27 mm) to August (34) to September (40), but from

September through December the mean length was generally similar (36 to 43) with the smallest mean length (36) during November. The mean length of the larger mode from September through December ranged from 67 to 70 mm. The mean length of each of the two modes in July and August of 1977 was similar to the mean length of these modes in July and August 1976. The estimated growth rate of young bay anchovy from mid-July through mid-October 1976 was 0.16 mm/day.

The relationship between length and weight was curvilinear, and a logarithmic regression of this relationship was generated for both sexes (Table C1-241). No significant difference in regression coefficients existed between males and females. The data were pooled to generate a single regression equation: log weight = -5.2179 + 3.0747 (log length) with a confidence interval of $\pm$ 0.039 on the regression coefficient.

The mean condition of 35 to 44-mm bay anchovy collected from September through November at the mouth of Cedar and Double creeks and from the mouth of Oyster Creek was not significantly different, and these fish were in significantly better condition than those impinged on the OCGS screens and those collected in Forked River (Table C1-242). Fish from Forked River were in significantly better condition than those from the OCGS screens. In spring (March through May), 60 to 69-mm bay anchovy from Cedar Creek, Double Creek, Forked River, and Oyster Creek were in significantly better condition than those from the OCGS screens. Bay anchovy collected in Oyster Creek during June and July were not affected by OCGS because it did not discharge heat during that period. During these months, 25 to 34-mm bay anchovy from the creek mouths, Forked

River, and Oyster Creek were not in significantly different condition. Larger fish (60 to 69 mm) taken at the creek mouths and Oyster Creek were in significantly better condition than those from Forked River and the OCGS screens, and those in Forked River were in significantly better condition than those from the OCGS screens (Table C1-242).

The sex of 2,988 bay anchovy was determined. Over the entire period, females significantly outnumbered males in all areas except at the creek mouths. Females outnumbered males during September and from June through August (Table C1-243), but the sex ratio was not significantly different from a 1:1 ratio from October through December and during April and May.

All fish examined from April through June were in some state of maturity (Table C1-244). The sex of most immature fish examined from July and August could not be determined. From September through December, most fish had gonads that were either immature or at rest. Fish with enlarged gonads were first collected in April from Oyster Creek, but specimens with enlarged gonads were taken in all areas by May.

Ripe and partially spent gonads were more common in males than females; the gonads of most mature females were either enlarged or spent. The few ripe females occurred primarily in July. The gonads of most males were enlarged in May, ripe in June, partially spent in July, and either spent or at rest in August. The largest percentage of spent females was in July, but the largest percentage of spent males was in August.

All specimens were examined for physical anomalies, injuries, external parasites, and disease (Table C1-245). Lernaeenicus spp., a parasitic copepod, was attached on 7.1% of all specimens, and it was most common in October and November. Scales were missing from most (96.4%) fish, and this condition accounted for most of the mechanically damaged specimens.

Few (0.1% to 2.2%) unaffected specimens were found in each area (Table C1-246). The percentage of diseased and parasitized bay anchovy collected from the OCGS screens was approximately four to six times greater than that from other areas. The percentage of diseased and parasitized fish was similar among the other three areas. Most (97.8 to 99.4%) fish examined from all areas were mechanically damaged.

Discussion

The bay anchovy emigrated from the Bay in December and returned in March and April. This was similar to the seasonal occurrence reported for the Bay by Kurtz (1977b), Marcellus (1972), and McClain (1973). The estimated number of the bay anchovy impinged during 1976-77 was much smaller than that reported for 1975-76. The estimated number of individuals impinged at OCGS for 7 comparable months in 1976-77 was significantly ($P \leq 0.2$) less than the numbers that were taken during these months in 1975-76 (Appendix D1, Table D1-47). Apparently the number of the bay anchovy which returned to the Bay in 1977 was much smaller than the large population which entered the Bay during 1976. In April 1976 an estimated 1,084,658 bay anchovy were impinged, but only 38,315 individuals

were impinged in April 1977 (Appendix D1, Table D1-66). The catch by trawl (63.6 n/coll) and seine (40.8) in 1975-76 (Danila 1977b) was also greater than these catches in 1976-77 (42.4, 3.67; Tables C1-163, C1-165).

The unimodal length-frequency distribution found from April through June and the bimodal distribution from July through December were similar to those found in the Bay in 1975-76 (Kurtz 1977b). Perlmutter (1939) reported a similar length-frequency distribution for bay anchovy from Long Island and concluded that the modes represented age 0+ and age 1+ fish. Specimens larger than 80 mm in spring were uncommon and may have been age 2+, although Stevenson (1958) reported that older bay anchovy tended to remain at sea.

This estimated growth of 0.16 mm/day was similar to the growth rate of 0.18 mm/day reported for bay anchovy in Barnegat Bay by Marcellus (1972) and to the 0.15 mm/day reported by Kurtz (1977b). Relatively small fluctuations in growth rate from year-to-year probably reflected various environmental factors such as food supply, water temperature, and year-class strength. The logarithmic regression of length and weight was similar between the 2 years.

The predominance of females during both 1975-76 (Kurtz 1977b) and 1976-77 was also reported for bay anchovy populations in Delaware Bay (Stevenson 1958). However, Stevenson (1958) found that the sex ratio was nearly equal during the spawning season (May through August). Although no significant difference in the sex ratio of the bay anchovy in Barnegat Bay was found in May 1976 (Kurtz 1977b) and May 1977, females

significantly outnumbered males during the remainder of the spawning season (June through August) in both years.

As in 1975-76, bay anchovy from the OCGS screens were in poorer condition than individuals collected elsewhere in the Bay. Prolonged swimming in the current near the OCGS screens may have utilized body reserves and consequently lowered the condition factor, or individuals in poorer condition may have been selectively impinged on the OCGS screens.

Heated discharges have been found to be detrimental to the condition of certain species (e.g., brown bullhead, Marcy 1976) but beneficial to others (e.g., black crappie, Bennett 1972). Although no significant reduction in the condition of bay anchovy at the mouth of Oyster Creek was noted in comparison to the condition of individuals from the creek mouths, individuals collected from the creek mouths had the largest mean condition values. However, trends in the condition of the bay anchovy collected in Oyster Creek and Forked River from March 1976 through March 1977 indicated that fish in the heated discharge may be in poorer condition than those in Forked River (see page C1-387). OCGS discharged heat from March through August 1976 and bay anchovy (61 to 70 mm) collected in Forked River were in better condition than those from Oyster Creek; at some stations these differences were significant. In the present study, 60 to 69-mm bay anchovy examined from March through May 1977 were in slightly better condition in Forked River than in Oyster Creek but these differences were not significant. OCGS operated during most (2 of 3 months) of this period. Individuals from Oyster Creek were in significantly

better condition than those from Forked River from June through August 1977, but OCGS was shut down during most (2 of 3 months) of this period.

The incidence of bay anchovy with disease and parasites was similar between 1975-76 (5.8%, Kurtz 1977b) and 1976-77 (7.1%). Most parasitized fish were infested with Lernaeenicus spp. in both years. The incidence of Lernaeenicus spp. was greatest in the fall (October and November) and coincided with the poorest condition of specimens from most areas.

The increase in the number of specimens with mechanical damage (primarily scale loss) from 63.6% during 1975-76 (Kurtz 1977b) to 96.5% during 1976-77 resulted primarily from more rigorous criteria in the examination for scale loss during the second year. Since the high scale loss occurred in specimens from all areas, it is impossible to determine how much of the scale loss of specimens collected at the OCGS screens was attributable to impingement and how much to collection technique. However, scales are easily lost (Bigelow and Schroeder 1953), and scale loss among impinged fish was probably high.

ATLANTIC SILVERSIDE

Introduction

The Atlantic silverside is an important and abundant forage fish in estuarine and marine waters along the Atlantic coast (Bayliff 1950). In Barnegat Bay, it ranked second in abundance in seine collections (27% of total catch) from September 1976 through August 1977 (Table C1-165). In previous studies in the Bay, the Atlantic silverside ranked first (51%) in seine collections from 1966-70 (Marcellus 1972), and first (57%) in seine collections taken in 1971-72 (McClain 1973). It also was the most abundant fish (53%) in seine collections from the nearby Mullica River-Great Bay estuary from 1972 to 1974 (Bieder and Howells 1977). Bigelow and Schroeder (1953) reported that the Atlantic silverside was forage for many commercial and sport fishes such as the bluefish, striped bass, weakfish, and summer flounder, and it was found in the stomachs of weakfish and bluefish in Barnegat Bay in 1976-77.

Materials and Methods

A life history study of this species was not conducted by Tatham et al. (1977a) in 1975-76, and specimens collected during 1976 were included in this study. Specimens examined were collected from January through August 1976 in four areas: the traveling screens

at OCGS; Oyster Creek and the Bay off its mouth; Forked River and the Bay off its mouth; and in the Bay and at the mouth of Cedar, Stouts, and Double creeks.

Sex and gonad condition were determined by examination of the gonads under a dissecting microscope. Testes were long, thin, leaf-like structures while ovaries were rounded and sack-like. Mature gonads were categorized as at rest, enlarged, ripe, partially spent, and spent. Mature testes at rest were thin, elongated, and firm with no convolutions. Ovaries at rest were small, contained eggs 0.1 to 0.2 mm in diameter, and were coarse internally. Enlarged testes were partially convoluted and filled a larger portion of the body cavity than testes at rest. Enlarged ovaries had many 0.3 to 0.9-mm opaque eggs and a few large (0.9 to 1.2 mm) translucent eggs. Ripe testes were fully convoluted and soft while ripe ovaries had many large translucent eggs and a few smaller opaque eggs. Partially spent ovaries occupied a smaller area of the body cavity than ripe ovaries and contained about 25% to 50% of the translucent eggs found in ripe ovaries. Partially spent testes were soft and occupied a larger area of the body cavity than spent testes. Spent ovaries contained mostly dead or arrested eggs with a few translucent eggs while spent testes were soft, flaccid, and disintegrated easily when probed.

Results

A total of 36,395 Atlantic silverside was collected from January 1976 through August 1977; 59% were taken at OCGS, 25% from Oyster Creek,

11% from the Bay, and 5% from Forked River (Table C1-247). Most Atlantic silverside were taken during March and April in 1976 (57% of all fish taken in 1976) and 1977 (79%). Few specimens (< 2%) were collected during January and February in either year.

A total of 3,475 specimens was examined from January 1976 through August 1977. Overall, the mean length of females (93 mm) was significantly greater than that of males (81). The mean length of both males (90 mm) and females (98) taken from OCGS was greater than that of males (78) and females (91) taken from all other areas, but this difference was significant only for males (Table C1-248). At the seven stations (Sta. 1, 2, 20, 21, 22, 23, 24; Danila 1977b) in the Bay, the mean length of fish was generally similar. However, Atlantic silverside captured at the mouth of Oyster Creek from March through June 1976 (99 mm) were larger than individuals from Forked River (90) and the Bay (92), but the difference was not significant.

Length-frequency histograms for each sex were examined by month to determine age and growth of the population. A bimodal distribution of length was found from June through August, and the two modes represented age 1+ and young (age 0+) fish. Nine fish from 132 to 140 mm in length were collected in Barnegat Bay from January through April, and these fish may represent a few older age 1+ fish which may spawn as age 2+ fish in the spring.

Young were first taken by seine in May of 1976 and June of 1977. The mean length of young increased rapidly from May (28 mm) through August (62) 1976 and from June (32) through August (65) 1977 (Table C1-249).

The growth of young from 28 May through 31 August 1976 (0.36 mm/day) was similar to that of young collected from 6 June through 31 August 1977 (0.38 mm/day). Most young reached 75 mm in length by October. The mean length of age 1+ fish decreased each successive month from October through April.

The sex of some 2,997 Atlantic silverside (86% of all fish examined) was determined (Table C1-250). Although females (60% of all fish sexed) significantly outnumbered males, the sex ratio varied seasonally. In January and February of both years and in December of 1976, males significantly outnumbered females; most (69%) males were collected at the mouth of Oyster Creek, Cedar Creek, and Double Creek. However, significantly more females were taken from March through August 1976 and 1977. In 1976, the percentage of fish that were male increased from 47% in September to 56% in November, but the difference in the sex ratio was not significantly different from a 1:1 ratio (Table C1-250).

The sex of most Atlantic silverside smaller than 50 mm was undeterminable. These specimens and the few individuals larger than 50 mm that were immature (13% of the total examined) were captured from May through November. The sex ratio of larger (50 to 70 mm) immature fish was not significantly different from 1:1 (Tables C1-251, C1-252).

From March through June 1976, 97% of all mature Atlantic silverside were in some stage of reproductive development (Table C1-251). Enlarged gonads were prevalent in March (91% of mature specimens during March) and April (53%). Specimens with ripe gonads were common in April (26%) and May (7%). During May and June, most of the fish had spent (59%) or

partially spent (33%) gonads while 22% of the adults in July had spent gonads.

In 1977, specimens with enlarged gonads were again predominant in March (26% of mature specimens in March) and April (63%, Table C1-252). Ripe specimens were also most common in April (36%) and May (62%), but the portion of the population that was ripe was larger in 1977 (46%) than in 1976 (15%). Specimens with partially spent gonads were taken primarily in May (27%) and June (46%) while spent fish were taken most frequently in June (23%) and July (16%).

Nixon and Oviatt (1971) found larval Atlantic silverside to be the predominant fish in eelgrass beds in southern New England, and the beds of eelgrass and widgeon grass in the eastern portion of Barnegat Bay may also be important to this fish. The Atlantic silverside spawns near and attaches its eggs to vegetation (Fowler 1918, Bayliff 1950). Many (n = 8,009) larval Atlantic silverside (mean length of 6.5 mm, range of 5.4 to 10.3 mm) were collected with a 20-cm bongo sampler on 18 May 1977 in the shallow eastern portion of the Bay between Toms River and Barnegat Inlet. More larvae were collected in three tows (average of 2,065 larvae n/coll) parallel to shore in shallow water (depth <1 m, approximately 100 m from shore) than in nine tows (201 larvae n/coll) in deeper (>1 m) water further from shore. Many young (mean length of 45 mm) also were collected with a 2.7-m trawl on 8 July 1977 in this area of the Bay.

Most (89.9%) of the fish examined had no parasites, diseases, or abnormalities (Table C1-253). The parasitic copepod Lernaeenicus spp. was found on 1.1% of all specimens, and only three fish (0.1%) had the

parasitic isopod Lironeca ovalis. Overall, fish taken in Forked River had a higher incidence of disease or parasites (2.7%) than Atlantic silverside from either Oyster Creek (0.6%) or the Bay (1.1%, Table C1-254). Mechanical damage was noted for only 1.6% of the fish captured in the Bay, Oyster Creek, and Forked River, but 20% of the Atlantic silverside collected from the OCGS screens had mechanical damage, primarily loss of scales or abrasions. Six fish were found with vertebral deformities.

Discussion

The Atlantic silverside is resident in New Jersey estuaries. It was collected year-round in Barnegat Bay and the Mullica River-Great Bay estuary (Thomas and Milstein 1973), but during winter it may leave the shore zone for deeper water in the Bay or nearby ocean (Milstein 1973). In mid-winter, fish were uncommon in seine hauls in Chesapeake Bay (Bayliff 1950) and in southern New England (Warfel and Merriman 1944).

In Barnegat Bay, males significantly outnumbered females only in winter. Bayliff (1950) found significantly more females than males (2:1) in Chesapeake Bay in summer, but he reported that the ratio was approximately equal in spring. In Barnegat Bay, females significantly outnumbered males by a ratio of 2:1 from March through August.

Young Atlantic silverside grew rapidly. The increase in mean length from June through August of 1976 (0.36 mm/day) and 1977 (0.38 mm/day) was similar to that reported by Marcellus (1972) for young in Barnegat Bay (0.4 mm/day) during the summer. Bayliff (1950) also reported that the growth of Atlantic silverside was rapid in Chesapeake Bay and that most young reached the size of adults by winter. Merriman

(1944) found that the growth rate of Atlantic silverside in Connecticut was much slower than that of individuals in Chesapeake Bay, and he stated that fish in Connecticut matured in 2 years.

The bimodal distributions of length from June through October indicated the presence of two age-classes, young (age 0+) and adults (1+). However, after August few age 1+ fish were collected. Bayliff (1950) reported that adults (age 1+) from Chesapeake Bay died soon after spawning, while Merrimen (1944) believed that the slower growing Atlantic silverside in Connecticut lived beyond 2 years.

The Atlantic silverside population may experience substantial fluctuations in abundance from year to year. Marcellus (1972) found large, statistically significant fluctuations in the population of Atlantic silverside in Barnegat Bay from 1966-69. Bieder and Howells (1977) noted a general decline in abundance of the Atlantic silverside in seine collections in the Great Bay-Mullica River estuary from 1972 (241.9 n/coll) through 1973 (88.6) and 1974 (81.8). The collection of only 21 fish in 160 seine hauls in April 1977 and the decrease in the seine catch from 1975-76 (38.6 n/coll) to 1976-77 (19.0) may have indicated a large mortality of Atlantic silverside in Barnegat Bay during the severe winter of 1976-77.

THREESPINE STICKLEBACK

On the eastern coast of North America, the threespine stickleback ranges from Hudson Bay and Baffin Island in Canada to Chesapeake Bay (Leim and Scott 1966). It occurs primarily near shore and is found from fresh water to the ocean (Bigelow and Schroeder 1953). In estuaries, its diet consists of copepods, isopods, euphausiids, and other small invertebrates (Leim and Scott 1966).

Adults of the threespine stickleback enter the shore zone in the spring to spawn. In the Gulf of Maine, the threespine stickleback spawns in brackish estuaries during May and June (Bigelow and Schroeder 1953). Adults leave the shallow portion of estuaries in summer and spend the winter in deeper water (Bigelow and Schroeder 1953). However, young (age 0+) were found in the Bay during the summer months.

All 59 threespine stickleback collected were examined. Most (96.6%) specimens were taken in February and March, but one individual was collected during April and another in June. One specimen was taken by seine at the mouth of Forked River; all others were collected from the OCGS screens. Most (79.7%) specimens were taken at night, and neither physical abnormalities nor parasites were noted on any specimen.

Specimens ranged in length from 22 to 68 mm with a mean length of 59 mm (Table C1-255). One individual (22 mm) was young, and the others were older juveniles or adults. No distinct modes in the length-

frequency distribution of the specimens were evident, and therefore, age could not be determined. In Europe, the threespine stickleback attained 40 to 50 mm when 2 years old and 50 to 55 mm at 3 years (Bigelow and Schroeder 1953).

The threespine stickleback is a nest builder and spawns in shallow areas where rooted aquatic plants are abundant (Lippson and Moran 1974). In Maine, fish were sexually mature at 2 years (Bigelow and Schroeder 1953). The male guards the nest until the eggs hatch and the young leave the nest (Hubbs and Lagler 1958). In Great Bay, New Jersey, adults spawned in early spring in marsh tide pools (Thomas 1974). However in Barnegat Bay, most of the reproduction probably occurred in the eastern Bay because most of the vegetation was found there. Spawning coloration was evident on some specimens.

The threespine stickleback apparently was not as abundant in the Bay during 1975-77 as it has been in other years. Marcellus (1972) collected 219 specimens in 1966-68, but only 25 fish in 1969-70. McClain (1973) reported only eight threespine stickleback taken by seine and trawl in the upper Bay from December 1971 to November 1972. Only one young individual was taken in trawl, seine, and push net collections in the Bay in 1975-1977.

Although the cause of this decline in abundance is unknown, part of this apparent decrease may reflect changes in the habitat at the sampling stations in the western Bay rather than an actual decrease in the abundance of this species. Marcellus (1972) did not completely describe the amount of vegetation at these stations, but it appeared that vegetation was more abundant there in 1966-69 than in 1975-77. This possible

decrease in vegetation may account for part of the decline in the catch of this species at these stations because vegetation is an important factor affecting its distribution.

NORTHERN PIPEFISH

Introduction

The northern pipefish is found in brackish and oceanic waters from the Gulf of St. Lawrence to offshore of Texas (Leim and Scott 1966). Bigelow and Schroeder (1953) and Hildebrand and Schroeder (1928) discussed its distribution, food habits, and reproductive behavior. The eelgrass beds in Barnegat Bay provide a preferred habitat for this species. Although the northern pipefish has no sport or commercial importance, individuals have been found in the stomachs of the striped bass (Hoff 1974), summer flounder (Poole 1964), and bluefish.

Materials and Methods

In addition to individuals collected from the four areas, specimens were collected and measured from a series of 5-min hauls of a 2.7-m trawl on the eastern side of Barnegat Bay about 0.5 km northeast of Sedge Island.

Sex was determined by the presence of the marsupium in males. When sex was difficult to determine externally, the gonads were examined under a dissecting microscope. Sex could not be determined for specimens less than 100 mm in length. The reproductive condition of males was recorded as immature (marsupium closely attached to the body), mature

(flap of marsupium easily separated from the body), or gravid (eggs present in the marsupium). The reproductive condition of females was not determined.

Results and Discussion

A total of 246 northern pipefish was collected in the Bay from September 1976 through August 1977 by 4.9-m trawl (14% of all individuals), 12.2-m seine (29%), and 45.7-m seine (57%, Table C1-256). It was the eighth most abundant fish taken in collections in the Bay. Most northern pipefish (86%) were taken from April through August while only one individual was collected from December through March (Table C1-257). Although the sampling effort during January and February was limited because Oyster Creek was the only area that remained free of ice, fewer specimens were usually taken during the colder months (Moore 1977a). Bigelow and Schroeder (1953) observed the northern pipefish in a torpid state and sometimes partially imbedded in the bottom sediments during winter. More specimens were taken in collections at night at Oyster Creek and Forked River (59%) than during the day (Table C1-258).

Some avoidance of Oyster Creek was apparent. When OCGS was in operation, a similar number of specimens was taken in collections during the day from the mouths of Forked River (n = 38), Cedar Creek (43), and Double Creek (51), but fewer (25) individuals were taken in Oyster Creek. However, an approximately equal number of northern pipefish was taken in collections in Oyster Creek (n = 40) and Forked River (42) from May through July when OCGS did not operate and the differences in monthly

mean water temperature between these two areas were less than 1.5 C. In August the temperature was 3.6 C warmer at the mouth of Oyster Creek, and only about one-fourth as many specimens were collected there (n = 8) than at Forked River (35). No attraction to or avoidance of Oyster Creek was evident in collections made from September 1975 through August 1976 (Moore 1977a).

Samples taken in a population survey of the central Bay during July and August showed that the northern pipefish was concentrated in the shallow, heavily vegetated eastern section of Barnegat Bay (0.68 individuals/m^2 of bottom area) with relatively few in the deeper portions of the western Bay ($< 0.01/m^2$) where vegetation was sparse (Appendix D1, Table D1-99). Joseph (1957) felt that the association between the Gulf pipefish (Syngnathus scovelli) and turtle grass (Thalassia sp.) beds was so great that many of the ecological requirements considered essential for the Gulf pipefish were, in reality, requirements for the turtle grass.

The northern pipefish ranked tenth in abundance among all fishes impinged, and an estimated 11,220 $\pm$ 1,412 individuals were impinged on the OCGS screens in about 10 months of sampling. Most specimens were impinged in November (28%) and April (26%), and 86% of all individuals were taken at night.

While significantly more northern pipefish were impinged during the 7 comparable months in 1975-76 (n = 29,379 $\pm$ 4,425) than 1976-77 (8,780 $\pm$ 1,204), the reasons for the difference are not known (Appendix D1, Table D1-47). In contrast to the impingement totals, the estimated population in the Bay was substantially larger during the second year,

although the survey in 1977 was conducted approximately 4 weeks later in the summer than during 1976, and recruitment into the population contributed, in part, to the higher estimate. Over the year, the number of specimens per seine and trawl collections for Oyster Creek (0.47 n/coll) and Forked River (0.64) were similar to these values (0.51, 0.45 respectively) reported for 1975-76 (Moore 1977a).

A total of 1,102 specimens was examined from the creek mouths (8%), Forked River (8%), Oyster Creek (6%), and the OCGS screens (78%). As in 1975-76 (Moore 1977a), significantly more females (72%, n = 763) were collected than males (28%, 300), and the mean length of all females (171 mm) was significantly larger than that of males (155 mm, Table C1-259). Females may be more common than males because of the greater stress imposed on the egg-carrying male. For the Gulf pipefish, Joseph (1957) suggested that spawning stress may have resulted in a higher mortality rate of males.

Few young (age 0+) individuals were collected; they comprised only 8.3% (20 of 242) of the individuals collected in the Bay and 2.2% (19 of 860) of those impinged at OCGS during 1976-77. The small number of young collected in the Bay reflected the relative inefficiency of the gear at collecting these small individuals. An estimated 10.3 $\pm$ 4.5 million small northern pipefish were entrained through OCGS during 1976-77 (Appendix D1, Table D1-111) as compared to the 11,220 larger individuals impinged on the OCGS screens. The greater percentage of young in seine and trawl collections indicated that the gear selectivity was probably not as great as that found at the OCGS screens. The selectivity of the OCGS screens for larger specimens was also indicated by the fact that

those taken there in 1976-77 were significantly larger (mean length of 163 mm) than those taken by trawl and seine (147). Fish collected from OCGS from September 1975 through August 1976 tended to be larger than those collected elsewhere, but the difference was not significant (Moore 1977a).

More males were gravid (n = 177) than either mature (109) or immature (14). Gravid males (88%) were taken primarily from May through August with most taken in May (34%, n = 60). In 1976, a few gravid males were also taken in September. Mercer (1973) found most gravid males during May and June in the York River, Virginia, and in 1976 the greatest number of gravid males was taken from OCGS in May and June (Moore 1977a). Because of the OCGS shutdown in 1977, fewer gravid males (n = 21) were collected during May and June 1977 than during this period in 1976 (133).

The relationship between length and weight was computed, but the calculated relationship was not considered valid because of large variations in weight among specimens of similar length. These variations occurred primarily with smaller individuals whose weight apparently was near the accuracy of the balance. The large variations in weight may account for the fact that the regression coefficients Moore (1977a) reported for males (3.5125 ± 0.1271) and females (3.1980 ± 0.1658) were substantially different than 3.0, the value generally accepted for isometric growth (Ricker 1975). Therefore, the length-weight relationship reported by Moore (1977a) was probably invalid.

The rate of growth and age-structure of the population were difficult to determine from length-frequency distributions because spawning was

protracted (April through September), growth was rapid, and smaller fish were not collected in proportion to their abundance. The frequency and mean length of the 194 northern pipefish collected from the eastern portion of Barnegat Bay indicated that most specimens probably were young (age 0+) spawned in 1977, although some larger individuals may have been produced from late spawns of the previous year (Fig. C1-21). A few age 1+ specimens were also found in June and July. This age-structure more closely reflected the age-structure of the Bay population than that found in sampling at the OCGS screens or by trawl and seine.

Growth of young was approximated from the 72-mm increase in mean length in the 91 days from 24 June to 23 September 1977. This increase (0.79 mm/day) was less than the growth rate of 0.96 mm/day determined from aquarium raised individuals which grew from 11 to 70 mm in 2 months (Bigelow and Schroeder 1953).

In Barnegat Bay, the length of northern pipefish ranged from about 85 to 165 mm in mid-August, and most of these were probably young. Although Mercer (1973) did not separate specimens by sex, her length-frequency histograms suggested that at the end of the first summer, young in the York River, Virginia ranged from 50 to 125 mm. These fish probably made up a large percentage of the reproductive population in the following year. She noted the disappearance of larger individuals in July, and this phenomenon was also found in collections made in eastern Barnegat Bay.

No parasites were found on the 1,102 northern pipefish examined, and only two types of abnormalities were noted. The tails of four specimens were shortened and severely disfigured, and caudal fin rot occurred on two individuals.

STRIPED BASS

The striped bass is a valuable commercial and sport fish that occurs on the Atlantic Coast from the Gulf of St. Lawrence to Florida (Raney 1952). In 1976, 62,392 kg valued at $102,053 were landed commercially in New Jersey (U. S. Dept. of Commerce 1977). The area of Barnegat Bay in and around Barnegat Inlet has supported a limited sport fishery (Porch 1977b), and Halgren (1973) estimated that 2,688 fish were caught in the upper Bay by sport fishermen in 1972. McHugh (1977) estimated that the total sport catch for the North and mid-Atlantic in 1970 was 6.5 times the reported commercial catch.

The striped bass is anadromous and spawns in fresh or brackish water (Hildebrand and Schroeder 1928). Some striped bass spawned in the Mullica River, New Jersey during April and May of 1975 (Hoff 1976), but coastal New Jersey estuaries are relatively unimportant in the reproduction of the striped bass on the Atlantic coast of the United States (Raney 1952). Most individuals captured along the New Jersey coast were produced in Chesapeake Bay and its tributaries (Austin and Custer 1977).

Striped bass age 2+ and older migrate seasonally along the mid-Atlantic coast. They leave coastal estuaries in late winter and spring and move northward to Long Island and New England (Raney 1952). Few individuals, primarily juveniles, are found in New Jersey estuaries during the summer. From mid-September through November, striped bass

leave areas near Long Island and New England, and they migrate southward to spend the winter in various coastal estuaries (Merriman 1941). Some overwintered in the Mullica River and Great Bay, New Jersey (Hoff 1974).

A total of seven striped bass were collected from September 1976 through August 1977. Four individuals were impinged on the OCGS screens, two were collected from the trash racks which precede these screens, and one was taken by gill net. One specimen was collected in November and the others were taken during March and April. Individuals ranged in length from 305 to 810 mm with a mean length of 461 mm. One striped bass was age 2+, three were age 3+, one was age 4+, and one was age 9+ (Table C1-260).

Two females age 4+ and 9+, and one male age 3+ were sexually mature. Merriman (1941) reported that approximately 25% of female striped bass matured when 4 years old, about 75% at age 5, and 95% by age 6. Some males matured at age 2+, and most were mature at age 3+. The number of eggs produced by a mature female varied with size. Worth (1904) reported as few as 14,000 eggs in a 1.4-kg fish and as many as 3.2 million in a 22.7-kg individual.

Physical anomalies, disease, and parasitism were noted in three specimens. One fish had fin rot and also had lost some scales, probably from passage through the trash racks and impingement on the OCGS screens. The 810-mm specimen had extensive caudal fin damage which had healed. The parasitic cestode Pomphorhyncus rocci was found on the intestines of the 490-mm fish. Paperna and Zwerner (1975) found that 67% of age 3+ striped bass in lower Chesapeake Bay were infected with this parasite.

The striped bass may have been more common in the vicinity of OCGS than collections indicated. Most large individuals cannot pass through the trash racks and, therefore, few were impinged at OCGS. Striped bass usually avoid trawls, and none were taken by this gear. A small school of about six individuals was seen in the immediate vicinity of the OCGS discharge canal on 17 November 1976, and on 22 and 23 April 1977, four striped bass (280 to 421 mm in length) were taken by rod and reel in the immediate vicinity of the OCGS discharge. On several occasions in late March and April, striped bass were observed near the trash racks in front of the OCGS screens.

BLUEFISH

Introduction

The bluefish is migratory and regularly occurs along the Atlantic Coast from Cape Cod to Florida and occasionally in the Gulf of Maine (Bigelow and Schroeder 1953). It is present in New Jersey waters from May through November (Milstein 1974, Metzger 1977a).

The bluefish is one of the most abundant sport and commercial fishes in the mid-Atlantic. In 1974, 84% of the commercial landings of the bluefish on the Atlantic coast were from the mid-Atlantic (Gusey 1976). From September 1976 through August 1977, 175,142 kg of bluefish valued at $70,909 were landed commercially in Ocean County (U.S. Dept. of Commerce 1977). Young of the bluefish were the most abundant finfish caught by sport fishermen in western Barnegat Bay near Oyster Creek from September 1975 through August 1977 (Hillman 1977d, Table C1-325). In 1972, an estimated 19,144 bluefish were caught by sport fishermen in upper Barnegat Bay (Halgren 1973).

Materials and Methods

The sex of specimens was determined by examination of the gonads under a dissecting microscope. Reproductive condition was recorded as

either immature or mature. Specimens smaller than 180 mm in length were assumed to be young (Bigelow and Schroeder 1953, Richards 1976), but the age of all other fish was determined by examination of the scales.

Condition was computed for individuals within age-classes 1+ through 3+, and an analysis of condition among areas was made when a sufficient number of specimens was collected in each area. Analysis of condition of individuals within each age-class was limited to specimens with a similar (± 10 mm) mean length because the allometric condition varies with the size of the fish (Everhart et al. 1975).

Results

A total of 900 bluefish was examined from September 1976 through August 1977. The bluefish was taken in Oyster Creek and in the immediate vicinity of the OCGS discharge from September through January, but it was collected in the Bay and Forked River only from September through November. No specimens were collected from any area from February through May, but they were taken again in most areas from June through August. The OCGS screens accounted for 57.2% (n = 515) of the specimens examined, Oyster Creek 16.2% (146), the immediate vicinity of the OCGS discharge 14.0% (126), the creek mouths 6.4% (58), and Forked River 6.1% (55). The number, and the mean length and weight of bluefish examined during various periods and for the several areas are presented in Tables C1-261 and C1-262.

Bluefish taken in Forked River from September and October (mean length of 175 mm) were significantly larger than those collected at the

OCGS screens from September through November (133 mm), but bluefish taken from these two areas (102, 98 mm respectively) during July and August were similar in length (Table C1-261). Although bluefish collected in Oyster Creek were larger than those taken from all other areas of the Bay during all months except August, these differences were not significant. Bluefish from the immediate vicinity of the OCGS discharge were significantly larger than fish from all other areas from September through November and during July and August (Table C1-261).

The age of 893 bluefish was determined (Tables C1-263, C1-264). Young (age 0+) accounted for 94.1% (n = 840) of the fish examined, age 1+ specimens 4.3% (38), age 2+ fish 1.1% (10) and age 3+ individuals 0.6% (5). Most (36 of 38) age 1+ and all age 2+ and 3+ bluefish were taken in either the immediate vicinity of the OCGS discharge or Oyster Creek from October through January. All fish collected in the other three areas from September through November and from June through August were young.

Young ranged in length from 80 mm in September 1976 to 323 mm in January 1977, and those examined from July and August 1977 ranged from 33 to 210 mm. The length-frequency distribution of young collected in July revealed a bimodal distribution similar to that found in 1976 (Metzger 1977a). The smaller of the two size-groups had a mean length of 63 mm and the larger fish had a mean length of 142 mm. Small young (mean length of 38 mm) also were collected in August and probably resulted from a spawn in the ocean off New Jersey.

The mean length for bluefish collected in each age-class was 304 mm for age 1+ individuals, 334 mm for age 2+ fish, and 443 mm for age 3+ fish (Table C1-263). The lengths of all male and female bluefish collected for the year were similar. Males ranged in length from 80 to 452 mm with a mean length of 174 mm while the length of females ranged from 89 mm to 465 mm with a mean of 172 mm.

Young of the bluefish that were attracted to and overwintered in the OCGS heated discharge probably grew during at least part of the winter. Young collected in the immediate vicinity of the OCGS discharge in January (mean length of 266 mm) were substantially larger than young collected in this area in November (183) and approached the mean length of age 1+ fish taken in November (295).

The length-weight relationship for males (n = 379) was log weight = -5.8718 + 3.4165 (log length). The confidence limits on the regression coefficient were $\pm$ 0.084. For females (n = 275), the regression was log weight = -5.8181 + 3.3919 (log length) with confidence limits of $\pm$ 0.109. The regression coefficients of the two equations were not significantly different, and the subsequent length-weight equation for all specimens, including fish which were not sexed, was log weight = -5.7432 + 3.3859 (log length). The confidence limits on the regression coefficient were $\pm$ 0.040.

All 654 specimens sexed were immature. Generally, specimens under 100 mm in length could not be sexed due to undeveloped gonads. All bluefish taken in June were small, and sex could not be determined.

Significantly more young males were collected than young females for the year. More young males were taken in all months except August, but this difference was significant only in September (Table C1-263). Neither sex showed a preference for a particular area (Tables C1-265, C1-266). Although too few fish from age-classes 1+ through 3+ were collected to make statistical comparisons of the sex ratio of males to females during each month, significantly more age 1+ and age 2+ males were taken for the year. Only five age 3+ bluefish were taken, and four were females.

Condition of similar sized (mean length of $\pm$ 10 mm) bluefish from all areas was computed during months when a sufficient number of specimens was taken in these areas (Table C1-267). The condition of bluefish from Oyster Creek (mean condition of 1.76) and Forked River (1.80) during July was not significantly different, but in November bluefish from Oyster Creek (1.44) were in significantly better condition than those (1.36) collected from the OCGS screens. Individuals (mean condition of 1.92) taken at the creek mouths in July also were in significantly better condition than those from the OCGS screens (1.61). The lower condition values of specimens taken at the OCGS screens may reflect the greater vulnerability of fish in relatively poor condition to impingement. The condition of young taken in the immediate vicinity of the OCGS discharge could not be compared to young from other areas because young taken near the OCGS discharge were consistently larger than those from other areas. The condition of similar size fish taken in the immediate vicinity of the OCGS discharge did not change significantly from September through January.

Some 222 (24.7% of those examined) bluefish were diseased, parasitized, mechanically damaged, or had a physical anomaly (Table C1-268). Various types of mechanical damage were noted on 75 specimens, and missing scales and flesh or damaged fins were the most common. Most damaged fish were collected from the OCGS screens and in the Bay by gill net. The parasitic isopod Lironeca ovalis (135 fish) and the copepod Lernaeenicus spp. (7) were found on 15.8% of all specimens examined. Pugheadedness, a rare osteological deformity (Dawson 1964, 1966, 1971), was observed in two young collected at the OCGS screens, but they appeared healthy and their feeding ability did not seem affected.

The largest percentage of anomalies occurred in fish examined from Oyster Creek (30.2%) and in Forked River (29.0%), and it was slightly higher than that of individuals collected at either the OCGS screens (24.6%) or in the immediate vicinity of the OCGS discharge (24.6%). The smallest percent of anomalous fish (6.8%) occurred at the creek mouths. L. ovalis was found on fish from all areas. Bluefish from Forked River had the highest rate of infestation (23.6%) followed by specimens from Oyster Creek (20.5%), the immediate vicinity of the OCGS discharge (19.0%), the OCGS screens (12.8%), and the creek mouths (3.4%). Two L. ovalis (one in each gill) were found in 16.4% of the parasitized specimens, and most of the specimens with two isopods were taken from September to January in Oyster Creek.

Of the 856 stomachs examined, 411 (48.0%) were empty (Table C1-269). Exclusive of fish fragments, the most numerous fishes in the diet of the bluefish from all areas over the year were silversides, anchovies, and

various other small fishes. Generally, the stomach contents of bluefish were similar among areas, but some small variations were found. For example, young of the winter flounder were heavily preyed upon at the creek mouths during July, and both mysids and sand shrimp were numerous in the stomachs of bluefish taken in Oyster Creek during November. The diet of bluefish taken from the immediate vicinity of the OCGS discharge was generally similar to that of bluefish from other areas. Stomachs of specimens taken near the OCGS discharge had more fish fragments by volume than were found in the stomachs of bluefish from the other areas. Fishes attracted to the heated discharge or introduced there after impingement on the OCGS screens may be prey for bluefish near the OCGS discharge.

Discussion

The movements and migration of juvenile and adult bluefish are largely correlated to water temperature (Freeman and Turner 1976). Lund and Maltezos (1970) and Backus (1962) reported that bluefish arrived in Long Island waters in spring when the water temperature was from 12 to 15 C. These temperatures were similar to the ocean temperature offshore of Barnegat Bay when bluefish were first collected in the Bay during May 1976 at a mean bottom temperature of 17.5 C (Metzger 1977c). In 1977, bluefish were not collected in the Bay until June but the mean bottom temperature at the creek mouths during that month (16.5 to 17.5 C) was similar to the temperature at which they were first collected in May 1976.

Young bluefish in Barnegat Bay probably originated from several areas in the mid-Atlantic. The first young (30 to 70 mm in length, Metzger 1977a) collected in the Bay during May and June were probably from a spawn during early spring off North Carolina. Ripe bluefish are taken off North Carolina in the spring (Bigelow and Schroeder 1953), but ripe individuals did not occur off New York until late June (Deuel et al. 1966). Bluefish 1.4 to 4.5 kg in weight resided off the coast of New Jersey in July (Freeman and Turner 1976) and probably produced the small young taken in Barnegat Bay during August and September. Thomas (1974) reported larval bluefish were taken off Little Egg Inlet, New Jersey from July through September. The age at which bluefish mature is not known, but all age 3+ bluefish taken in Barnegat Bay during fall showed no evidence of maturation.

When OCGS operated during the summer, bluefish apparently avoided areas of Oyster Creek at a water temperature above 32 C (Table C1-201). Only one bluefish was taken in the immediate vicinity of the OCGS discharge in August when water temperature (mean temperature 36.3 C) exceeded 35 C, the temperature that Terpin et al. (1977) reported as lethal to the bluefish. Bluefish from 90 to 221 mm in length that were acclimated to 22 C had 20% mortality when exposed to a temperature increase (delta T) of 10 C, but complete mortality resulted in 0.1 h when the delta T was increased to 13 C (Terpin et al. 1977). During August bluefish were taken in Oyster Creek east of U.S. Route 9 at a water temperature of 30.4 to 30.6 C, and these temperatures were lower than the mean avoidance temperature (33 C) determined by Terpin et al. (1977).

The bluefish was attracted to the heated discharge in Oyster Creek from September through January, and significantly more were collected in Oyster Creek and in the immediate vicinity of the OCGS discharge than in Forked River and the Bay during this period. During these months, most bluefish were found near OCGS discharge; relatively few individuals were taken in Oyster Creek east of Route 9. The similar condition of young taken in the immediate vicinity of the OCGS discharge from September through January suggested that these individuals did not lose weight as a result of residence there.

The size-distribution and age-composition of bluefish taken in 1976-77 were generally similar to those reported by Metzger (1977a) for 1975-76 although young comprised a greater percentage of the population during 1977. However, this may reflect differences in gear because most age 1+ and 2+ fish taken in May 1976 were captured by gill net, and regular gill net collections were not taken after March 1977. For example, 49 age 1+ and 2+ bluefish were taken in Oyster Creek during May of 1976 while only young bluefish were taken there during this period in 1977. In addition, OCGS did not discharge heated water from 23 April through 4 August and older bluefish in the Bay may not have been attracted to and collected in Oyster Creek.

In the fall, most young and all but one of the older bluefish were captured in the OCGS discharge after most of the population had emigrated from the Bay. Many of these fishes, particularly young and age 1+ individuals, were larger than bluefish of a similar age taken in the fall of 1976. Too few age 2+ and 3+ specimens were collected to determine growth of these fish. Richards (1976) reported that bluefish almost

doubled in length during its second year, and that age 3+ fish had a length range that completely overlapped that of age 2+ fish.

In general the diet of young bluefish in Barnegat Bay was similar to that of fish from Long Island (Richards 1976) and Delaware (Grant 1962) in that they utilized seasonally abundant forage fishes. Grant (1962) analyzed the stomachs of 262 specimens from Indian River, Delaware and found that 86% of the forage fish were the Atlantic menhaden, bay anchovy, mummichog, Atlantic silverside, and tidewater silverside. Richards (1976) reported that the stomachs of most bluefish examined from Long Island contained locally common species such as squid, the Atlantic menhaden, anchovies, and butterfish. In Barnegat Bay, the most common fishes identified in bluefish stomachs were silversides and the bay anchovy, fishes that were common to abundant in collections from the Bay in 1976-77. In July, bluefish taken from the Bay fed heavily on young winter flounder which were abundant then in the Bay (Table C1-164, C1-165).

The overall rate of infestation of Lironeca ovalis, the most common parasite, was 15.0%, and this rate was similar to that reported for bluefish from the Delaware River (19.5%, Lindsay and Moran 1976) and in the vicinity of Little Egg Inlet, New Jersey (14%, Swiecicki 1974). However, more bluefish in Barnegat Bay had two isopods (one in each gill) than reported by Lindsay and Moran (1976). They found only 1% of their specimens contained two L. ovalis as compared to 16.4% of the parasitized bluefish from Barnegat Bay from 1976-77 and 29.8% in 1975-76 (Metzger 1977a). Since most of the instances of parasitism occurred in bluefish attracted to Oyster Creek in the fall and winter, the concentration of these overwintering fish may have contributed to their greater infestation.

WEAKFISH

Introduction

The weakfish is an important predator that is found primarily from Florida to Massachusetts Bay with strays reported as far north as the Bay of Fundy (Bigelow and Schroeder 1953). The area of greatest abundance for this fish is centered around Chesapeake Bay (Thomas 1971). The weakfish is important to both the sport and commercial fishery from New Jersey to North Carolina although the sport catch in 1970 was twice the reported commercial catch (McHugh 1977). It was one of the most abundant fish taken by anglers in New Jersey from 1972 through 1976 (Milstein et al. 1977, Figley 1977). From September 1976 through August 1977, it was the third most important fish (83,640 kg) landed in Ocean County, New Jersey (U.S. Dept. of Commerce 1977).

Materials and Methods

Weakfish less than 180 mm in length were considered young (age 0+) and were not sexed because it was difficult to accurately determine the sex of these small fish. For all individuals larger than 180 mm, sex was determined by inspection of the gonads, and the age of these larger specimens was determined by examination of scales taken from the juncture of the spinous and soft dorsal fins. Annuli on scales were most easily

counted when the scale was held between two acetate slides at 10X magnification.

Results

A total of 8,186 weakfish was collected from September 1976 through August 1977 (Table C1-270), but no fish were taken from December through June. Most (97.0%) individuals were captured at the OCGS screens. In the Bay, more specimens were collected by trawl (n = 228) than seine (5) because the weakfish generally avoided the shore zone. Most (92.8%) large weakfish collected by gill net were taken in the immediate vicinity of the OCGS discharge. About 10% (n = 812) of the weakfish collected were examined.

Most (97.7%) of the specimens were young. Scales were taken to determine the age of the 99 specimens larger than 180 mm, but the age of 14 fish could not be determined as the scales were unreadable. Some 77.6% (n = 66) of these larger fish were young (age 0+) that ranged in length from 181 to 221 mm. No age 1+ or 2+ fish were collected; the other 19 fish were age 3+ through 7+ (Table C1-271). The mean length of age 3+ fish (n = 3) was 398 mm, age 4+ (6) was 502 mm, age 5+ (5) was 525 mm, age 6+ (4) was 536 mm, and one age 7+ fish was 681 mm. Most (14 of 19) of the older weakfish were collected from the immediate vicinity of the OCGS discharge in September (n = 11) and November (3). The remaining fish were collected at the OCGS screens, the mouth of Oyster Creek, or Forked River mouth.

In 1976, the mean length of young weakfish increased from July (53 mm, Hillman 1977a) to October (134) but decreased in November (112,

Table C1-272). The length-frequency distribution of young weakfish showed that two size-groups were present in August 1977, but only one group was found in July 1977 and from September through November 1976. In August the mean length for 208 small young was 51 mm, while the mean length of 16 larger young was 108 mm.

The mean length of young taken from Oyster Creek in September (156 mm) and October (184) was larger than that of young from Forked River (125, 135 respectively) and the OCGS screens (119, 133). Bottom water temperatures in Oyster Creek (17.0 to 25.6 C) were warmer than those in Forked River (13.5 to 24.6) during those months.

The length-weight relationship for 47 females was similar to that for 38 males (Table C1-273). Since the difference in the regression coefficient between sexes was not significant, all specimens, including young, were pooled to generate a single regression equation: log weight = -5.3337 + 3.1205 (log length) with confidence limits of $\pm$ 0.027.

The gonads of all fish examined were either immature or mature at rest, and no significant difference was found between the number of males (n = 38) and females (47).

The stomachs from 492 weakfish were examined; most (n = 481) were taken from young. Some 358 young examined were taken at the OCGS screens, 94 from Forked River, 29 from Oyster Creek, and 1 from Cedar Creek. The dominant identified food items were anchovies, silversides, young of the weakfish, mysids, grass shrimp, and sand shrimp (Table C1-274). By volume, the diet of young weakfish consisted primarily of fishes (92.0%) rather than invertebrates (8.0%). Among adults, fish occurred in all

stomachs, and the overall percentage of fish in the diet of all weakfish was 99.9% (Table C1-275). Unidentified fish (fish fragments) was the most common item found (55.1% of total volume), and most of the fragments were of small forage fishes. Anchovies were the most abundant fish that could be identified; they occurred in 18.2% of the stomachs with food and ranked third (16.0%) in volume displacement (Table C1-274). Two large young of the weakfish were found in the stomachs of two adults taken in the vicinity of the OCGS discharge (Table C1-275). Invertebrate fragments, the second most numerous food item, were found in 27.3% of stomachs with food, and mysid shrimp were the most numerous identified invertebrate (22.3% of all identified invertebrates).

Analysis of the food habits of fish in Oyster Creek was limited to September through November because few individuals were collected in other months. In Oyster Creek, silversides (27.5% of total volume) were more important than anchovies (10.5%) as the dominant identifiable food (Table C1-276). In contrast, relatively few silversides were found in the stomachs of weakfish from either Forked River (3.2%, Table C1-277) or the OCGS screens (3.6%, Table C1-278). Several trends in food habits were evident by area and through time. Mysids were found in more weakfish stomachs from Forked River (40.3%) than in those in Oyster Creek (29.6%) or at OCGS (11.6%). Anchovies declined in relative importance in the diet of individuals taken at OCGS during the fall; in September they ranked first (57.0% of total volume) in the stomach contents, but in November they accounted for only 7.7% of the volume. The steady decline of anchovies in weakfish stomachs throughout the Bay from September

through November reflected the emigration of anchovies from the Bay during fall.

Some 3.3% (n = 27) of all weakfish examined were diseased or parasitized (Table C1-279). Twelve fish (1.5% of all specimens examined) had fin rot, 11 (1.4%) were infested with the isopod Lironeca ovalis, and 4 fish (0.5%) had at least one parasitic copepod Lernaeenicus spp. attached.

Some 52.7% (n = 428) of all weakfish had external mechanical damage. A higher incidence of mechanical damage was noted among fish collected at the OCGS condenser discharge (71.4%) than in other areas. The damage to these fish was probably due to impingement on the OCGS screens or damage during collection by gill net.

Discussion

The weakfish was present in Barnegat Bay from spring through late fall. The failure to collect weakfish until July in 1977 was due to the shutdown of OCGS from 14 May through 11 July rather than the absence of the fish in the Bay. During 1976, Hillman (1977a) first reported weakfish at the OCGS screens at the end of April and during May. He also found that the heated discharge attracted weakfish during spring (primarily in May) and fall. However, OCGS did not discharge heat from 23 April through 4 August 1977, and during this period weakfish were not attracted to or collected in Oyster Creek.

Barnegat Bay was unimportant to the reproduction of the weakfish. Relatively few older, mature individuals were captured; their gonads were at rest. Tatham et al. (1974) collected most weakfish larvae in

the ocean near Great Bay, New Jersey, and they concluded that spawning occurred in the ocean, primarily during June. The large number of young in Barnegat Bay indicated that they entered the Bay and used it primarily as a nursery. Thomas (1971) noted that the lower Delaware River was important as a nursery for young.

The bimodal length distribution of young during August 1977 probably reflected weakfish spawned in two different areas. Hildebrand and Cable (1934) reported a protracted spawn of weakfish in Virginia and North Carolina waters from May through August. These fish probably represented the larger young in Barnegat Bay while the smaller young were spawned off the New Jersey coast (Tatham et al. 1974). Hillman (1977a) also found a bimodal distribution of young in Barnegat Bay in 1975-76. Although two size-classes were present in Barnegat Bay in August, these two size-classes could not be distinguished from September through November. Thomas (1971) found that mortality of late-spawned fish in the Delaware River was high and that most of these fish did not contribute to the adult population.

Other information on the life history of weakfish from Barnegat Bay in 1975-76 (Hillman 1977a) and 1976-77 generally was similar to that reported for other mid-Atlantic estuaries. The ratio of males to females found in this study was not significantly different from 1:1, and an equal sex ratio was also reported for weakfish in the Delaware River (Thomas 1971). The low incidence of Lironeca ovalis on weakfish from Barnegat Bay (1.4%) was similar to the 0.8% infestation rate reported from the Delaware River by Thomas (1971) and the 2.8% rate found there by Lindsay and Moran (1976).

Studies from numerous areas of the mid-Atlantic have demonstrated that weakfish collected from different geographic areas had great flexibility in prey selection (Merriner 1975), and they utilized a wide variety of available food items. In Barnegat Bay, fish were the single most important prey of the weakfish, although the amount of fish consumed varied somewhat by location, date, and size of the individual. Hildebrand and Schroeder (1928) found that anchovies, silversides, and mysids dominated stomach contents of weakfish from Chesapeake Bay. However in Delaware Bay, the diet of young consisted primarily of mysid shrimp and sand shrimp (de Sylva et al. 1962). In the Delaware River, mysid shrimp and the amphipods Gammarus spp. were most important (Thomas 1971).

Apparent differences in diet between areas may be attributed to size of the fish rather than different feeding habits. Thomas (1971) found that small (60 to 120 mm) weakfish from the Delaware River had a greater percentage of mysids in their diet than larger individuals (120 to 180) which ate more fish. The greater percentage of mysids found in the stomachs of fish from Forked River (40.3%) as compared to Oyster Creek (29.6%) from September through November may be, in part, related to size. The mean length of the young weakfish examined from Forked River (125 mm) was considerably smaller than that of individuals from Oyster Creek (161). The greater percentage of mysids in the stomachs of weakfish from Forked River may also be related to the greater density of mysids in Forked River.

NORTHERN KINGFISH

The northern kingfish ranges from southern Florida to Casco Bay, Maine, but it is most numerous from Chesapeake Bay to New York (Bigelow and Schroeder 1953). In Long Island, New York, the northern kingfish first appears in late April to early May and remains until late autumn (Schaeffer 1965). Although the area in which the northern kingfish spends the winter is unknown, Schaeffer (1965) speculated that it was offshore in deeper water.

In the mid-Atlantic, the northern kingfish is more important to the sport fishery than the commercial fishery (McHugh 1977). In 1970, the recreational catch from New Jersey to North Carolina was 3.5 times greater than the reported commercial landings. It was the seventh most abundant finfish taken by anglers in upper Barnegat Bay from December 1971 through November 1972 (Halgren 1973), but the recent catch has declined.

A total of 35 northern kingfish was examined (Table C1-280). Most (n=32) were taken from September through mid-November, and 65.7% (23) were collected from the OCGS screens. Sex was determined for 14 individuals; seven were males and seven were females. Sex could not be determined for most fish less than 135 mm in length because of the relatively small size of the gonads. No physical anomalies or parasites were noted for any specimens. The collection of small young (age 0+) off North Carolina (Hildebrand and Cable 1934), in Delaware Bay (de Sylva

et al. 1962), and in the ocean and surf near Little Egg Inlet, New Jersey (Milstein et al. 1977) suggested that the northern kingfish spawns primarily in the ocean. In New Jersey spawning began in June and terminated in August (Welsh and Breder 1923), but neither eggs nor larvae were found in Barnegat Bay during 1976 (Tatham et al. 1977b).

The northern kingfish has rapid growth. Welsh and Breder (1923) found that northern kingfish reached a modal length of 120 mm by the first winter, 250 mm by the second, and 350 mm by the third. However in New York, Schaeffer (1965) found that individuals hatched in May or early June attained a modal length of 250 mm by October. Specimens collected in the Bay during 1976-77 ranged in length from 18 to 310 mm with a mean length of 105 mm. All but the largest specimen (310 mm, age 1+) were young, and all fish were immature. Metzger (1977b) reported that most of 16 specimens taken in the Bay from September 1975 through August 1976 were young; their length ranged from 26 to 280 mm (mean length of 161 mm).

The northern kingfish has not been abundant in Barnegat Bay in recent years. From 1929 to 1933, it ranked ninth in numerical abundance in trawl collections made in Barnegat Bay and near the mouth of Forked River by the Bingham Oceanographic Institute (Thomas and Milstein 1973). Marcellus (1972) collected a total of 416 specimens from 1966 to 1970; the number collected each year declined from 220 in 1966-67 to 59 in 1969-70. From December 1971 through November 1972, McClain (1973) collected only seven northern kingfish by seine in the Bay. Only five northern kingfish were reported by anglers in the Bay near OCGS from

September 1975 to September 1977 (Hillman 1977c, Table C1-325). Commercial landings of the northern kingfish in New Jersey have declined from a mean of 25,409 kg from 1966 through 1970 to 5,000 kg from 1971 through 1975 (U. S. Dept. of Commerce 1966-76); in 1976 commercial fishermen landed only 92 kg (U. S. Dept. of Commerce 1977).

Fluctuations in abundance and age-class structure of northern kingfish populations are common. Bean (1903) reported that from 1884 to 1898 young were abundant in Great South Bay, New York, but only one adult was collected. However, large fish were common in 1901 but only two young were taken. In Corson's Inlet, New Jersey, Phillips (1914) reported that northern kingfish were abundant for 1 or 2 years but then gradually decreased in number. Schaeffer (1965) concluded that because the northern kingfish is short-lived the abundance and size-distribution of the population were dependent upon the success of individual year-classes.

SUMMER FLOUNDER

Introduction

The summer flounder ranges from Maine to Florida (Freeman and Turner 1976). It migrates inshore to coastal and estuarine waters in spring and moves offshore to the continental shelf in fall. Spawning occurs in the ocean during the fall migration and it may extend into March (Murawski 1963, Smith 1969). Festa (1975) suggested that larvae and young (age 0+) of the summer flounder entered New Jersey estuaries from October through March.

The summer flounder is important to both commercial and recreational fishermen of the mid-Atlantic. From 1951 to 1974, commercial fishermen in the mid-Atlantic annually landed between 0.9 and 4.1 million kg (Gusey 1976), and annual recreational catches have been as high as 17.7 million kg (National Marine Fisheries Service 1974). The commercial value of the summer flounder is high ($0.91/kg in 1975, U. S. Dept. of Commerce 1976) and often exceeds that of most commercially-harvested flatfishes (Freeman and Turner 1976). Halgren (1973) estimated that 31,730 summer flounder were taken by sport fishermen in Barnegat Bay from December 1971 through November 1972.

Materials and Methods

Sex was determined by visual inspection of the gonads, but maturation was not determined because most females were less than 4 years old, the age at which the summer flounder matured (Richards 1970). The gonads of some females were enlarged, and it was assumed they were approaching maturity.

Ageing was done by examination of the otoliths. Prior to examination, they were soaked in 5% hydrochloric acid, dried, and submerged in glycerol on a depression slide. The material comprising the outermost zone of the otolith was recorded as either opaque or hyaline. Generally, the left otolith was used for age determination, but if it was either damaged or difficult to read, then the right otolith was used. Vertical measurements (to nearest 0.1 mm) were taken from the otolith core to each annulus. The first of December was considered the birthdate of a summer flounder (Festa 1974), and if specimens taken at that date had no clear annulus and a wide hyaline band, 1 year was added to their age.

Results

A total of 498 summer flounder was examined from September 1976 through August 1977, and specimens were collected during all months except January through March. Most (92.2%, n = 459) were taken at the OCGS screens; 4.0% (20) were taken in Oyster Creek and 2.8% (14) in Forked River. Only three specimens were taken at the creek mouths, one was collected in the immediate vicinity of the OCGS discharge, and one was taken at the OCGS dilution discharge.

Females taken at the OCGS screens ranged in length from 115 to 425 mm with a mean length of 273 mm. Males ranged in length from 160 to

382 mm and had a mean length of 248 mm (Table C1-281). For the year, females were significantly longer and heavier than males. Although females were larger than males during each month, the differences in length and weight were small in each month from April through August. The difference in length between sexes was only significant in October.

The relationship between length and weight was not significantly different for males and females. A pooled regression for all specimens (n = 498), including a few individuals of undetermined sex, was log weight = -5.2231 + 3.0782 (log length), and the confidence limits were $\pm$ 0.115 (Table C1-282).

A total of 386 summer flounder were aged. The mean length and weight of fish in the five age-classes (age 0+ to 4+) are given in Table C1-283. Age 2+ fish were most abundant and represented 59.1% (n = 228) of all fish aged. Age 1+ fish accounted for 17.4% (n = 67), and age 3+ fish comprised 18.1% (70). Only two young (age 0+) summer flounder were taken.

The accuracy of ageing by otoliths was indicated by a strong correlation coefficient (males = 0.904, females = 0.936) between otolith measurements and length of specimens. The regression of the otolith width to body length for males had intercepts of 14.08 for males and 11.18 for females. These intercepts were used as a correction factor in the calculation of growth (Tesch 1968). At age 1 through 3, no significant difference was found between the calculated mean length of male and female summer flounder (Table C1-284). Mean length for males age 1 through 3 were 101, 182, and 257 mm, respectively. Corresponding females

were 102, 186, and 266 mm in length. Although the calculated mean length of age 4 females (319 mm) was greater than males (297), the difference was not tested because few specimens were collected.

Growth was calculated using annulus measurements of 361 summer flounder (Table C1-284; Figs. C1-22, C1-23). Within the five age-classes examined, growth was greatest during the first year and was similar for males (annual growth of 101 mm) and females (102). Growth slowed as the summer flounder became older, and by the fourth year, yearly growth was reduced to 41 mm for males and 53 mm for females. The annual growth increment for females was larger than that of males for each age-class.

Most summer flounder collected from July through December had otoliths with wide hyaline edges while those taken in April had otoliths with either opaque edges or a very fine hyaline band at the edge of the otolith. Otoliths taken from the two young specimens were composed almost entirely of an opaque core.

Some 484 fish were sexed, and significantly more females (n = 272) than males (212) were taken for the year. However by age-class, the only significant difference between a 1:1 ratio of females to males was among age 4+ fish where 89.5% (17 of 19) of the individuals were females (Table C1-283). At OCGS, significantly more females (n = 256) than males (195) were taken for the year (Table C1-281), and significantly more females than males were taken in November and April (Table C1-285). In November, the ratio of females to males was 3:1 (n = 28) and during April it was 2.9:1 (35). Too few specimens were taken in other areas for comparisons.

All summer flounder collected were considered immature. However, three age 3+ females (380 to 422 mm in length) had slightly enlarged ovaries (5 to 10 g in weight), and they were considered to be in the stage of development described by Festa (1974) as prespawning.

Condition factors were computed for the year for age 1+ through 3+ males and females collected at OCGS (Table C1-286); too few age 4+ males were collected for comparisons. The small number of specimens collected from areas other than OCGS prevented a comparison of condition among areas. Condition was not significantly different between males and females in each of the three age-classes tested.

Physical anomalies were noted on specimens from each area (Table C1-287). Some 51.4% (n = 237) of the summer flounder examined from OCGS had some anomaly, primarily mechanical damage (e.g., scale or flesh missing, fins damaged) incurred from impingement on the OCGS screens. No parasites were found on any of the summer flounder examined; one fish had fin rot.

Three types of genetic anomalies were found among 10 specimens at OCGS. One pugheaded male (168 mm) was captured in October; it was probably age 1+. Two instances of ambicoloration (dark pigmentation on both dorsal and ventral surfaces) and seven instances of staining (small patches of pigment on the ventral surface) were found.

Discussion

The summer flounder was common in Barnegat Bay from April to November, and a few specimens were also taken in December. Although a few specimens

first appeared in Oyster Creek in April, the summer flounder apparently neither avoided nor preferred Oyster Creek during the year. This apparent lack of interaction with the thermal discharge may be attributed, in part, to the local distribution of summer flounder. Hillman (1977d) found that most summer flounder caught by sport fishermen in the Bay near OCGS were taken near the Inlet. The eastern portion of Barnegat Bay, especially near the Inlet, is preferred habitat for the summer flounder because this area generally has a hard sandy bottom with some eelgrass beds and mud. Ginsburg (1952) and Bigelow and Schroeder (1953) reported that the summer flounder preferred hard sandy bottoms although it was also found on muddy or grassy bottoms. In contrast, the western Bay has primarily a mud bottom and, therefore, the number of summer flounder (n = 31) taken there probably did not reflect the overall population in the Bay.

The population of the summer flounder in Barnegat Bay and other major estuaries in the mid-Atlantic (Eldridge 1962, Murawski 1963, Festa 1975) were comprised primarily of immature individuals. Generally, older mature individuals remain just offshore during summer and rarely enter lower salinity estuaries (Freeman and Turner 1976).

The summer flounder usually matures at age 4, but some individuals may mature as early as age 3 (Eldridge 1962, Murawski 1963, Smith 1969). Three age 3+ females taken in the Bay in October and November had ovaries which contained enlarged eggs similar to those found by Murawski (1963) in females just prior to spawning. These larger females probably would have spawned during the fall emigration to the ocean.

The life history of the summer flounder in Barnegat Bay during 1976-77 generally was similar to that from the Bay in 1975-76 (Hillman 1977b) and from other mid-Atlantic estuaries (Poole 1961, Eldridge 1962, Smith 1969). Although Hillman (1977b) found no significant difference in the number of males and females at OCGS in 1975-76, significantly more females than males were taken at OCGS during 1976-77. More females than males also were collected in the Delaware River (Smith 1969) and in Great South Bay, New York (Poole 1961), but the statistical significance of the differences was not mentioned.

The age-structure of the summer flounder population in Barnegat Bay during 1976-77 was similar to that found in 1975-76 in that five age-classes (ages 0+ to 4+) were present. During both years, the dominant age-class was 2+, but during 1976-77 few young (age 0+, 1976 year-class) fish were taken. Hillman (1977b) reported that young comprised 10.1% of the summer flounder in Barnegat Bay during 1975-76.

The absence of young summer flounder during 1976-77 probably resulted from natural fluctuations in reproductive success. Festa (1974) reported that significant fluctuations in the summer flounder population have occurred off New Jersey in the past 20 years. From 1962 through 1971, the reduced inshore fishery reflected, primarily, the decrease in the abundance of age 1+ summer flounder, the predominant age-class of the fishery. Beginning in 1972, the summer flounder population began to increase, and this increase coincided with an increase of age 1+ summer flounder. The absence of young summer flounder in 1977 may affect the inshore fishery in 1978 since Festa (1974) reported that this fishery is highly dependent on age 1+ fish.

The anoxic water mass off New Jersey from July to mid-October 1976 may have altered the normal migration of the summer flounder and had some effect on spawning success (Festa 1976). During late August and early September, Festa (1976) reported few summer flounder in Great Bay, but on 20 September large catches of summer flounder were reported there. The presence of individuals in the Bay at this time suggested an interruption of the offshore migration by the anoxic ocean water. Mortality of a portion of the spawning population may also have affected the spawning success during 1976. Festa (1976) reported at least 500 dead summer flounder in Little Egg Inlet on 22 July during an incursion of anoxic ocean water into the Inlet.

The mean length of summer flounder taken in Barnegat Bay in both 1975-76 (Hillman 1977b) and in 1976-77 corresponded to the calculated mean length reported for individuals off North Carolina (Powell and Schwartz 1977); in Delaware Bay (Smith 1969); in Great South Bay, New York (Poole 1961); and in Virginia (Eldridge 1962). Hildebrand and Schroeder (1928) reported that about 1 year after hatching, summer flounder from Chesapeake Bay attained a length of 120 to 180 mm and at age 2+ were about 280 mm; these lengths also were similar to those of individuals in Barnegat Bay.

Unlike the mean length of summer flounder, the calculated mean length of age 1 to age 4 summer flounder from Barnegat Bay was smaller than that of fish from Delaware Bay (Smith 1969), Virginia (Eldridge 1962), and Great South Bay, New York (Poole 1961). This difference may be attributed, in part, to variation in growth, such as the 30 to 40-mm

variation in growth Festa (1975) found in age 2+ summer flounder taken in Great Bay, New Jersey during 1972 and 1973. Substantial differences were evident among the growth rates of age 1 and age 2 summer flounder from Barnegat Bay and other mid-Atlantic estuaries. The abundance of age 2+ fish in 1975 may have caused increased competition and reduced growth rates among these fish, but the calculated annual growth rates of 3 and 4 year old summer flounder in Barnegat Bay was similar to those of fish from other mid-Atlantic estuaries (Table C1-288; Figs. C1-22, C1-23). Since the growth rates of age 3 and 4 individuals were similar to those of summer flounder in other estuaries, this difference in growth rate at annulus formation for age 1 and age 2 fish may also be partially attributed to variation in spawning time.

Although the length-weight relationship of males and females in Barnegat Bay was not significantly different in 1975-76 (Hillman 1977b) or 1976-77, females generally were larger and heavier than males of the same age because females apparently grew faster than males. Smith (1969) found no significant difference either in the length-weight relation of males and females or between the lengths and weights of male and female summer flounder in Delaware Bay, but females were slightly longer and heavier than males. However, Smith (1969) found that females were significantly ($P \leq 0.05$) longer than males at the predicted maximum attainable length determined by Walford's growth transformation.

Although no parasites were found, nearly half of the specimens taken at OCGS had some physical damage which was probably caused by impingement on the OCGS screens. Mechanical damage among specimens from

other areas was relatively uncommon (10.0%) and was probably caused by the collection gear.

Ambicoloration, a developmental anomaly probably caused by genetic or environmental conditions prior to metamorphosis (Dawson 1962), was found in two fish. Twenty-two ambicolored individuals were found in the Bay in 1975-76 (Hillman 1977b), and this anomaly also has been reported in North Carolina (Dawson 1962, White and Moss 1964). The occurrence of this abnormality in specimens from Barnegat Bay was unrelated to the operation of OCGS because metamorphosis occurs in the ocean.

WINTER FLOUNDER

Introduction

The winter founder is an important sport fish in the New York Bight, and in the mid-Atlantic the recreational catch reported in 1970 was 43 times larger than the relatively minor commercial landings (McHugh 1977). Some individuals of this species are found in estuarine waters throughout the year. Adults return to their natal estuaries in late fall, spawn in winter, and migrate offshore in spring, but young (age 0+) and immature winter flounder remain in estuaries year-round. Due to its estuarine-dependent life cycle and its value to the sport and commercial fishery of Barnegat Bay, a study of the life history of the winter flounder was initiated in September 1975 (Danila 1977c) and completed in August 1977.

Materials and Methods

The sex of most specimens was determined, and reproductive condition was characterized as immature (gonads small in size, ovarian cells small), enlarged (gonads swollen prior to spawning), partially spent (ovaries partially emptied of eggs), spent (gonads flaccid), and mature (gonads at rest and reduced in size; ovaries devoid of large eggs,

testes firm). Many young males became ripe in their first winter, but after February it was difficult to distinguish between testes of young that were mature and the testes of those that remained immature. Therefore, young males collected after February were classified as maturity undetermined. Total gonad weight (nearest 0.1 g) was taken for most specimens; weights less than 0.1 g were recorded as zero.

Most individuals of the 1976 and 1977 year-classes were classified as young based on their small size (i.e., non-overlapping length frequencies). Annuli formed on otoliths of older specimens were used to determine age and to calculate the rate of growth (Tesch 1968). Danila (1977c) demonstrated and discussed the validity of the otolith for ageing winter flounder from Barnegat Bay. The left and right sagitta were removed, stored in 3% sodium phosphate, and transferred to 100% glycerin for at least one week before examination. Annuli appeared as thin brown lines under reflected light (Poole 1966), and measurements (to nearest 0.05 mm) from the center of the otolith core to the right margin of the left otolith were made with an ocular micrometer. The right otolith was usually more asymmetric and was not used for ageing except when the left otolith was lost or broken. March 1 was considered the birthday of winter flounder in the Bay; specimens that had not formed an annulus by that date had 1 year added to their age (i.e., number of visible annuli) and the measurement to the edge of the otolith was used as the last annulus measurement. All adults could not be aged as some otoliths were not clear enough to distinguish annuli.

Results

A total of 7,725 winter flounder was collected from September 1976 through August 1977 (Table C1-289), and 27.3% (n = 2,111) of these were examined. The largest number of individuals (38.4%, n = 2,967) was taken in December. Very few (n = 5) were collected in August, and this was a substantial decrease from the 485 specimens collected in July. Significantly more winter flounder were taken at night than during the day on the OCGS screens (93.4%) and by trawl and seine (79.3%) at the mouths of Oyster Creek and Forked River.

Most winter flounder (78.1%, n = 6,030) were taken from the OCGS screens, and 48.2% of these were collected in December after the return of adults to the Bay. The winter flounder was also common at OCGS in November (11.8%), January (14.8%), February (9.6%), and March (9.8%). Larger adult males first appeared in late October and adult females in mid-November. Adults were collected until late April when most had emigrated from the Bay. An estimated 18,618 $\pm$ 6,385 winter flounder that weighed 1,400 $\pm$ 370 kg were impinged during the year although the OCGS screens did not operate from 14 May through 11 July (Appendix D1, Table D1-49).

For the year, a similar number of winter flounder was collected in Oyster Creek (n = 680) and Forked River (708). More were collected in Oyster Creek (n = 209) than Forked River (56) from December through March because they were attracted to the OCGS heated discharge and because of limited sampling in Forked River during January and February. Although OCGS did not discharge heat from 23 April through 4 August,

more winter flounder were taken in Forked River (n = 613) than Oyster Creek (428) during this period. Most of this difference was due to a larger catch of young in Forked River, especially in May. Adult winter flounder apparently avoided the heated discharge in Oyster Creek before OCGS shut down. Few age 1+ winter flounder were taken in Oyster Creek during April and May, and no age 2+ or older specimens were taken there after March.

Almost all (92.8%) of the 307 winter flounder collected at the creek mouths were young taken in June and July. On 18 July, 146 young were taken in two hauls of the 4.9-m trawl at the mouth of Cedar Creek at a bottom water temperature of 30.4 C. This was the highest temperature at which young were collected in the Bay.

Examination of the catch of winter flounder during the blue crab and northern pipefish population survey in late July and early August revealed that more young were found in the Bay near the Inlet. Very few young were taken in the deeper water of the northern Bay where the water temperature ranged from 24.0 to 26.0 C. Some fish were caught in the central Bay (21.0 to 23.3 C), but individuals were most common near the Inlet (19.0 to 21.0 C).

The mean length of male and female winter flounder taken in the four areas by month indicated that specimens taken at the OCGS screens from September through April and during July were usually larger than specimens from the other three areas (Table C1-290). Winter flounder tended to be similar in size in Oyster Creek and Forked River. The lengths of young taken from the four areas from June through August were examined with a one-way ANOVA. In June, the mean length of young taken

at the creek mouths (n = 97) was significantly larger (57 mm) than that of individuals taken in Oyster Creek (n = 118, 49 mm) and Forked River (137, 48 mm). Young collected from the OCGS screens (n = 62, 69 mm) and at the creek mouths (85, 68 mm) in July and August also were significantly larger than those from Oyster Creek (25, 59 mm) and Forked River (89, 58 mm).

Some 1,914 winter flounder were aged (Table C1-291). The specimens were tabulated by year-class because they entered the next age-class in March, and therefore they were included in two age-classes during the year. Consequently, only 6 months of growth by the 1977 year-class occurred during the study. Most specimens were in the youngest age-classes, and winter flounder of the 1975 and older year-classes comprised only 11.7% of the specimens examined.

The number of fish examined and the mean length and weight of winter flounder by age were summarized for various months (Tables C1-292, C1-293). No significant differences in length and weight were found between young males and females except during November when males were significantly longer (120 mm) and heavier (20.7 g) than females (111 mm, 15.3 g). However, females age 2+ and older were always longer and heavier than males. Except for specimens of the 1976 and 1977 year-classes, females were significantly larger than males (Table C1-291).

High correlations between otolith width and total body length (Figs. C1-24, C1-25) were found in both years, and these correlations indicated that the measurement to each annulus (Table C1-294) did not change as the fish grew (coefficient of variation $\leq$ 11.4%). The significantly greater annulus width in females from age 2 through 5 probably was related to faster growth of females.

A regression of otolith width to total body length had an intercept of -56.2 for males and -82.3 for females, and these were used as a correction factor in the calculation of growth (Tesch 1968). Only fish with at least one annulus were used in the regression because "calculated lengths are determined only down to the length of a fish at its first annulus...the shape of the curve below that length is of no consequence" (Tesch 1968). Without this correction factor, calculated growth may be underestimated if the intercept is positive or overestimated if it is negative. Because Danila (1977c) did not use a correction factor when calculating growth of the winter flounder from 1975-76, these data were recalculated. Recalculation of the 1975-76 data showed that the best regression equation for males had an intercept of -34.9 ($r = 0.874$). Recalculation of growth for males indicated that only the length at age 1 was markedly overestimated, and the corrected growth decreased from the reported 161 mm to 151 mm. The plot of otolith width to body length of females taken in 1975-76 was more scattered, and the correlation was not as strong ($r = 0.815$) as in 1976-77 (0.935). The intercept of the regression was 0.95, and this very small value would not substantially change the reported growth. However, due to the relatively poor correlation of the data for the first year, the accuracy of these calculated growth estimates was considered less accurate than during the second year; the largest error in calculated growth occurred at age 1. The reason for the large difference between years for females is unknown, but it may be related to the particular specimens examined.

For 1976-77, calculated growth at each year of life indicated that females were significantly larger than males except at age 1 (Table C1-295).

Growth attained by individual year-classes may be compared with the calculated mean length in March. At age 1 (March 1977), the measured mean length of males (125 mm) and females (128) of the abundant 1976 year-class was smaller (Table C1-292) than the calculated growth of males (152) and females (155) from all year-classes at age 1 (Table C1-295). This slower growth of the abundant 1976 year-class in comparison to that of the less abundant year-classes was an indication of density-dependent growth.

The logarithmic relationship of length and weight was calculated for both males and females (Table C1-296). Gonad weight was subtracted from total body weight before calculation of the regression because the gonads of gravid females often weighed as much as 25% of the total body weight. The regression coefficient for females (3.2012 $\pm$ 0.019) was significantly greater than that of males (3.1592 $\pm$ 0.020).

A large difference occurred in the estimated number of winter flounder impinged on the OCGS screens in comparable months during 1975-76 and 1976-77 (Table C1-297; Appendix D1, Table D1-47). The largest portion of this difference between the years was in the impingement of young. Very few young of the small 1975 year-class were impinged from November 1975 through May 1976 (5.1% of all impinged winter flounder, n = 18), but in 1976-77, 78.7% (n = 796) of the winter flounder examined were young of the abundant 1976 year-class. Substantially more age 1+ and older individuals were also taken in 1976-77. In 5 comparable months (November, December, March, April, and May), more age 1+ and older males (n = 552) and females (493) were estimated to have been

taken in 1976-77 than in 1975-76 (231 males, 90 females) with the 1974 year-class particularly abundant in both years.

Significantly more females than males of the 1976 year-class were taken on the OCGS screens in November, December, and for the year, but significantly more young males than females were taken in January (Table C1-298). No significant difference was found in each month from February through May. The ratio of age 1+ and older males to females was not significantly different from a 1:1 ratio from November 1976 through April 1977 even though females outnumbered males during February and March.

Condition of winter flounder was examined to determine if differences existed between individuals impinged on the OCGS screens during the day and night (Table C1-299). Although various-sized winter flounder taken at OCGS from November through April had larger mean condition values during the day, no significant differences were found between individuals impinged during the day and at night.

When a sufficient number of specimens was available, condition was also examined among areas by month to determine if fish impinged at OCGS or collected in the heated discharge were in different condition than individuals in other areas (Table C1-300). No significant difference was found between 60 to 159-mm winter flounder taken in Oyster Creek and at OCGS in December. However, in January winter flounder from Oyster Creek were in significantly better condition than those taken at OCGS because the mean condition factor of specimens in Oyster Creek increased substantially from December (4.45) to January (5.09). In March and April, the condition of winter flounder in Oyster Creek decreased (4.42)

and although it was significantly less than that of specimens at OCGS (4.71), it was not significantly different than that of winter flounder from Forked River and the creek mouths (4.63). OCGS did not discharge heat during June, and young taken at the creek mouths, Oyster Creek, and Forked River then did not differ significantly in condition. Young taken at OCGS during July and August were in significantly better condition (5.13) than those at the other three areas (4.54 to 4.62).

Adult males began to ripen in October, and all mature specimens had enlarged testes in November (Table C1-301). Mean weight of enlarged gonads was largest in December and decreased thereafter (Fig. C1-26). Although a few fish in spawning condition were taken in March, most were spent. Most fish taken after April were immature.

A large number of young males (1976 year-class) matured in their first winter; some 60.6% of these young had enlarged gonads from November through February. All older males were mature except for one age 2+ specimen that had a deformed jaw and was in poor condition.

Ovaries of females began to ripen in November, and the mean weight of enlarged gonads increased each month through February (Fig. C1-27). Spent individuals were taken in February, and most females had spawned by March although one female with enlarged ovaries was taken in April. All females of the 1976 and 1977 year-classes were immature. Only 1 of the 21 females of the 1975 year-class was immature, and all older females were mature.

The sex ratio of young (1977 year-class) and of winter flounder from the 1974 and older year-classes was not significantly different

from 1:1. However, significantly more females (n = 633) than males (523) of the 1976 year-class were taken. For the 1975 year-class, significantly more males (n = 40) than females (21) were found. The largest differences in the sex ratio, regardless of year-class, occurred in November, December, March, and April. In January, males outnumbered females but the difference was not significant.

All specimens were examined for injuries, parasites, and anomalies (Table C1-302). Because most (92.7%) mechanical damage was found in fish taken on the OCGS screens and because this damage should have been independent of other abnormalities, the occurrence of parasites and physical anomalies was examined regardless of mechanical injury.

Very few winter flounder were diseased or parasitized (1.9%, n = 41), and most of these specimens were lightly infected. A 2.7% rate of infection was found for fish taken on the OCGS screens, and the light degree of infestation probably did not increase the rate of impingement of these individuals. Fin rot was the most common disease but it occurred in only 0.9% (n = 18) of all specimens examined. Eleven of these were adult females. Ten individuals (7 adult males) had lymphocystis. Eight fish (seven young) had either leeches attached or scars from previous attachment. Five individuals were infected with the microsporidian *Nosema* (*Glugea*) *stephani* (Stunkard and Lux 1965, Sindermann 1970, Lom 1970), but only one of these specimens was severely infected.

Some 153 winter flounder taken from the OCGS screens (13.9% of those examined from OCGS) had some mechanical damage; split fins and missing scales or abrasions were the most frequent damage. Mechanically

damaged winter flounder were also taken in Oyster Creek (2.3%), and some of these individuals may have been introduced there after impingement at OCGS. Very few damaged fish were collected at Forked River (0.7%), and none were taken at the creek mouths. Injuries believed to have been caused by preservation and handling were disregarded, and only injuries apparently sustained prior to collection were recorded.

Four individuals taken by trawl in the immediate vicinity of the OCGS discharge and 15 specimens taken on the OCGS screens had impressions of the OCGS condenser tubes on their bodies. Two of the four specimens taken near the OCGS discharge were dead at capture. Thirteen of the 15 fish collected at OCGS were collected from one screen wash. Individuals taken at the OCGS screens probably were flushed from the OCGS water box and were transported in front of the screens through the tunnel which recirculated water from the discharge tunnel to the OCGS intake structure (M. B. Roche, personal communication). Three specimens were 249 to 275 mm in length, and the other fish ranged from 102 to 153 mm. Since most specimens with condenser tube markings were small, few larger fish may be able to get around or under the OCGS screens.

Genetic or developmental abnormalities were rare except for staining. This pigment anomaly is characterized by scattered patches of dark pigment on the unpigmented side of the body (Norman 1934), and it was found on 2.5% of all specimens examined. Fifty of these specimens were aged, and 52.0% of the winter flounder with staining were from the 1976 year-class (2.2% of total year-class examined, n = 26).

Three specimens of the 1976 year-class were reversed (i.e., the right eye migrated to the left side and the left side was fully pigmented).

Two winter flounder were ambicolored. An adult male, probably from the 1975 year-class, was completely ambicolored in that pigment covered the entire left side and the left eye had not fully migrated to the right side (Norman 1934). Although not taken in regular sampling (Table C1-302), one partially albino young was taken in June near the mouth of Oyster Creek during the collection of specimens for temperature-shock studies. It was devoid of pigment except for very small scattered patches of melanophores between the eyes, on the chin, and on both sides of the caudal peduncle.

Two individuals with caudal fin abnormalities and one specimen with a deformed jaw were also found. The deformity of the latter specimen probably reduced successful feeding because it weighed considerably less than other fish of the same size and sex, and its sexual maturation was retarded. Nine specimens were found with healed wounds or scars; some of these injuries (e.g., regenerated caudal fins) may have been caused by predators.

Discussion

The occurrence of the winter flounder in Barnegat Bay in 1976-77 was similar to that in 1975-76 (Danila 1977c) as adults entered the Bay about November and remained until April before moving offshore. Many winter flounder were attracted to Oyster Creek during these months. Age 1+ winter flounder were collected in the heated discharge during April at a temperature as high as 18 C, but larger adults apparently left Oyster Creek after March when the temperature was between 10 and 15 C. A similar movement was noted in early April 1976 when the water temperature

in Oyster Creek warmed to greater than 15 C (Danila 1977c). McCracken (1963) determined that adult winter flounder preferred a temperature of 12 to 15 C. South of Cape Cod, adults generally moved from bays to the ocean in summer because their upper lethal temperature is 20.2 C, regardless of acclimation temperature (McCracken 1963). However, Olla et al. (1969) observed some adults in Great South Bay, New York at temperatures up to 24 C.

Young and older immature fish remain in estuaries for most of the year. Young were taken at Cedar Creek in July at 30.4 C, a temperature at the upper end of the range of lethal temperatures (29.3 to 30.4 C) reported for young in Nova Scotia by Huntsman and Sparks (1924). However, the local popultion probably was more heat tolerant than that northern population. This temperature of natural occurrence was also near the avoidance breakdown temperature (30.6 to 31.1 C) determined by Gift and Westman (1971) for young winter flounder from Great Bay, New Jersey. They reported exposure to these temperatures for 1 h or less caused loss of equilibrium and death. Although the temperature in the bottom sediments may be somewhat lower than the bottom water temperature, young of the winter flounder in Barnegat Bay may occur near their upper thermal limits.

Young of the winter flounder were found in Oyster Creek in July at a temperature as high as 29.8 C, but OCGS did not operate during that month. When OCGS was in operation from May through August 1976, few young were taken in Oyster Creek, in comparison to Forked River, even though the water temperature was usually less than 29.8 C. With OCGS in

operation, few young were usually taken in Oyster Creek above 24 C (Danila 1977c). Therefore, other factors (e.g., current) may have also affected its distribution there.

The large difference in abundance between 1975-76 and 1976-77 was attributed to variable reproductive success during recent years. Populations of winter flounder had declined in Barnegat Bay and other southern New Jersey estuaries during the past few years (Danila 1977c, Milstein et al. 1977). However, the 1976 year-class was larger than the very small 1975 year-class and comprised most of the specimens taken on the OCGS screens in 1976-77. The 1977 year-class was even more abundant (12.7 n/trawl and 2.6 n/seine from June through August in 1977) than the 1976 year-class (0.9, 1.4 respectively) was in comparable months during 1976, and it accounted for most of the winter flounder taken from May through July of 1977.

Variable abundance of year-classes was probably related to environmental effects, particularly water temperature (Jeffries and Johnson 1974). They found a relationship between decreasing catches and increasing water temperatures in Rhode Island during a 7-year period. The relationship between water temperature and the abundance of year-classes suggested a complex interaction between time of spawning, length of incubation period, metamorphosis of larvae, and presence of predators and prey. Cushing (1973) noted that "successful correlations between year-class strength and climatic factors is probably the match or mismatch of larval production to that of larval food, because it is the only means by which recruitment can be modulated by the weather." In addition,

Laurence (1977) presented evidence of a critical period for mortality of larval winter flounder, and the density of their planktonic prey was one of the most important factors that affected survival during this period.

Although Pearcy (1962) found that the hydromedusa Sarsia tubulosa preyed heavily upon larval winter flounder in the Mystic River, Connecticut, no evidence was found that it regulated the number of larvae. Similarly, no evidence exists that Sarsia spp. regulated the number of winter flounder larvae in Barnegat Bay. Although Sarsia spp. were common in the plankton in the Bay when larval winter flounder were present in 1976 and 1977, Sarsia spp. were more abundant in 1977 when more young winter flounder were produced.

Older young also may suffer severe losses due to predation (Pearcy 1962). Predation on young may explain, in part, the large decrease in the number of young taken from July to August 1977. Many young bluefish were found in the Bay during late summer, and young winter flounder frequently were found in their stomachs. Howe et al. (1976) reported that the highest natural mortality and incidence of wounded juvenile winter flounder occurred when young bluefish were abundant.

Fewer young were found in the northern and western portions of the Bay during a population survey, and if this distribution was the result of movement in response to water temperature, it may also have explained some of the decrease in catch in the western Bay from July to August. However, the large catches of young in July were made just prior to the warmest daily mean temperature (28.9 C) recorded in the cooling-water intake at OCGS (Fig. C1-28). Furthermore, the population survey in late

July and early August was during a period of cooler water temperature (23.3 to 25.6 C), and it seems unlikely that a movement in response to water temperature occurred. A preliminary analysis of the catch of fishes after August 1977 indicated that winter flounder remained uncommon in September and October after the water temperature in the Bay had cooled. Consequently, the decline in number may have been primarily due to predation or other natural causes of mortality rather than movement from the western Bay.

Young taken at the creek mouths apparently grew faster than those from either Forked River or Oyster Creek. Similarly, Pearcy (1962) noted large differences in growth of young winter flounder among his stations in the Mystic River, Connecticut estuary. He suggested that intraspecific competition may have accounted for these differences because growth was much greater at lower population densities. He also noted that most young tended to remain within the same area in summer, so differences among stations were not due to influxes of larger fish from other areas. Although differences in growth may occur between stations in Barnegat Bay, the number of individuals taken at all stations and the condition factor of these individuals were comparable.

The growth of winter flounder in Barnegat Bay was similar to that found in the Bay during 1975-76 (Danila 1977c) and in other estuaries in the northeastern United States (Berry et al. 1965, Poole 1966). Most specimens were from the youngest age-classes although individuals, especially females, from the 1975 year-class were uncommon. Females of the 1975 year-class were also outnumbered by males in 1975-76 (Danila

1977c). Winter flounder older than age 3 were rare, and growth for the most part had slowed.

Berry et al. (1965), Poole (1966), and Lux (1973b) also reported that females age 2 and older were always significantly longer and heavier than males. Females were also heavier per unit length than males. Likewise, Lux (1969) reported that females 300 mm and larger were generally heavier than males of the same size.

The regression coefficients of the length-weight relationship for both males and females in 1976-77 were significantly greater than the values reported for each sex by Danila (1977c) in 1975-76. He was in error in reporting that the regressions for males and females were not significantly different, and the sexes should not have been combined for a pooled regression. Ricker (1975) noted that marked differences can exist between populations of a species or for the same population from year to year, and these differences may be associated with varying nutrition.

The number, age, and sex ratios of winter flounder taken on the OCGS screens differed between 1975-76 and 1976-77. Danila (1977c) reported that significantly more males than females were taken on the OCGS screens in 1975-76 and that males (mean length of 225 mm) were significantly smaller than females (265 mm). He suggested that this difference was due to lower sustained swimming speeds of the smaller males or sexual differences in activity patterns. A larger proportion of the catch in 1976-77 was comprised of young from the abundant 1976 year-class, but adults of older age-classes also were more abundant.

This increased number of adults impinged may have resulted from increased water velocity through the screens or a reduction in sustained swimming speed of individuals because of lower water temperature which would make them more susceptible to impingement. Impingement, in part, was related to the velocity of the water through the screens, and this was related to the number of circulating-water pumps and screens in operation. A larger number of circulating pumps in operation in conjunction with a smaller number of screens would increase the mean water velocity at the intake structure. In 5 comparable months (November, December, March, April, and May) between the 2 years, a smaller mean number of screens (5.25) and a greater mean number of circulating water pumps (3.72) were in daily operation at OCGS in 1976-77 than 1975-76 (5.90 screens, 3.37 pumps). Although actual current measurements before the screens were taken only once during each month, they reflected the greater flow of water through the OCGS screens in the 5 comparable months in 1976-77 (mean velocity of 0.30 m/sec) than 1975-76 (0.15 m/sec, J. J. Vouglitois, personal communication). In addition, the mean monthly water temperature at OCGS for November and December was considerably less in 1976 (6.8 and 0.1 C, respectively) than in 1975 (12.7, 4.7 C), and colder water temperatures lowered the sustained swimming speeds of fishes (Terpin et al. 1977). Beamish (1966) also found that the winter flounder has greater endurance with increased water temperature.

The relative number of age 1+ and older males impinged was much greater in 1975-76 (2.6 males:1 female) than in 1976-77 (0.8:1). The increase in mean intake velocity and the reduction in swimming speed at

the colder water temperatures during 1976-77 may have increased the impingement of larger females and thereby lowered the ratio of males to females in impingement collections. Significant monthly differences were also found in the sex ratios of young taken at the OCGS screens, but these differences were due to one or two collections during each month in which one sex greatly predominated. This phenomenon was also noted in collections by trawl and seine, but the reason for the apparent segregation by sex in young is not known.

Significantly more specimens were impinged at night even though the winter flounder is usually active only during the day. Olla et al. (1969) observed that individuals were quiescent at night and moved very little, even when disturbed. Therefore, many winter flounder were probably less able to avoid the OCGS screens at night. Condition was probably not a factor in this diel difference as no differences in condition were found between fish impinged during the day or night. Similarly, the OCGS screens did not selectively impinge individuals that were in poorer physical condition. Individuals collected at the OCGS screens were usually (3 of 4 instances) in similar or better condition than individuals taken elsewhere.

The time of reproduction in 1976-77 was similar to that of 1975-76, and during both years winter flounder in Barnegat Bay, especially males, matured at a relatively early age in comparison to males from some other areas. Berry (1959) noted that some males in Rhode Island matured in their first winter, but Perlmutter (1947) reported fish from Long Island were mature at 2 to 3 years of age. More northerly populations matured

at older ages (Kennedy and Steele 1971, Dunn and Tyler 1969, Lux 1973b), and this phenomenon of later maturity in higher latitudes has been found for many fishes (Nikolsky 1963). Nikolsky (1963) also noted that abundance of food influenced age of maturity and that accelerated maturation was often observed in populations reduced by natural conditions. Accelerated maturity may be evidence of the recent natural decline in the population of winter flounder in Barnegat Bay and other New Jersey estuaries.

Mean gonad weights of females taken in 1976-77 were considerably larger than those found in 1975-76 (Danila 1977c), but this was probably due to the size of females examined. In 1975-76, 58.1% of the females with enlarged ovaries were between 250 and 300 mm in length and 26.7% were between 200 and 250 mm. However in 1976-77, 59.5% of the females with enlarged ovaries were between 300 and 350 mm and 36.5% were between 250 and 300 mm. The largest females usually had the heaviest ovaries.

As in 1975-76, few specimens were diseased or parasitized. Fin rot, the most common disease, was not severe in any of the infected specimens. Although fin rot is caused by bacteria and may be associated with gross domestic and industrial pollution (Mahoney et al. 1973), most of the affected specimens were large adults, and the source of the infection is difficult to ascertain because of their movements within and outside of the Bay during the year.

Lymphocystis, a viral disease consisting of multiple nodules in the dermis of the skin and fins, was recently reported for winter flounder in Casco Bay, Maine and the New York Bight (Murchelano and Bridges 1976). They noted that the response of winter flounder to lymphocystis

was minimal in that lesions were small and were mostly confined to the fins. Similarly, individuals from Barnegat Bay had minor infections. Since infection can consist of only one nodule, some instances of minor lymphocystis infection may have been overlooked in the examination of specimens.

Mechanical damage occurred most frequently at the OCGS screens, but the percentage of damaged fish (13.9%) was less than the estimated percentage of dead and damaged fish (55.3%) recorded at the OCGS screens (Appendix D1, Table D1-57). Since fish exhibiting abnormal behavior were also considered damaged for the latter estimate, it would appear that much of the damage caused by the OCGS screens was behavioral.

Pigmentation anomalies were probably caused by environmental factors during development (e.g., subnormal temperature) and were common in specific year-classes in certain areas (Lux 1973a). Individuals from seven year-classes in the Bay had the pigmentation anomaly of staining, but ambicoloration and partial albinism, other color anomalies, were rare. These pigmentation anomalies may be associated with wounds or adverse environmental factors during development (Dawson 1967). Reversal may be common in some flatfishes (Norman 1934), but it has not been reported often for the winter flounder.

NORTHERN PUFFER

Introduction

The northern puffer is a seasonal resident of inshore waters from Newfoundland to Florida (Shipp and Yerger 1969), but it moves to deeper water to spend the winter on the bottom (Bigelow and Schroeder 1953). The time of spawning appears to be variable and occurs from May through August in Long Island Sound (Wheatland 1956). Although of limited commercial importance, it is a desirable sport fish. Halgren (1973) estimated that over 30,000 individuals (12.4% of sport catch of fish) were caught by Barnegat Bay sport fishermen in 1972. Only 13 specimens were taken in all seine and trawl collections in the Bay from September 1976 through August 1977, and another 13 northern puffer (0.6% of sport catch of fish) were reported by sport fishermen in a portion of the Bay during 1975-77 (Hillman 1977c, Table C1-325).

Materials and Methods

The sex and reproductive condition of small specimens were determined by examination of the gonads under a dissecting microscope. Reproductive condition was considered immature if the gonads were small, closely attached to the dorsal surface of the body cavity, and weighed less than 0.5 g.

The gonads of mature fish weighed more than 0.5 g and were categorized as at rest (gonads reduced in size but cells visible in ovaries), enlarged (gonads many times larger than the resting stage, cells tightly grouped in ovaries), ripe (gonads of maximum size, darker in color, and eggs loosely grouped), and spent (gonads flaccid).

Age was determined from the annuli on the vertebrae according to the technique of Laroche and Davis (1973). The first seven vertebrae were removed from each specimen and stained in a 4 to 8% solution of potassium hydroxide and alizarin red S. When the connective tissues were soft enough to disarticulate the bones, the fourth and fifth vertebrae were removed and sliced lengthwise. Under a dissecting microscope, the number of annuli were counted and the distance from the centrum to the distal edge of each annulus was measured with an ocular micrometer. Vertebrae with false or unclear annuli were discarded, and those specimens were not aged.

Results and Discussion

An estimated 1,585 northern puffer were impinged on the OCGS screens from September 1976 through August 1977 (Table C1-303), and about 77% of these were impinged during September and October 1976. In 1975-76, most northern puffer were impinged during May, June, and August 1976; few were impinged at OCGS from September through November 1975 (Moore 1977b). The impingement of more northern puffer at OCGS during the fall of 1976 than in the fall of 1975 reflected their greater abundance in 1976. No specimens were impinged during May and June of 1977 because OCGS was shut down from 14 May through 11 July.

A total of 352 northern puffer was examined from the OCGS screens and 13 were collected by seine and trawl from Oyster Creek (n = 5) and Forked River (8). An additional 24 specimens were taken with a 2.7-m trawl in the eastern portion of the Bay during June. Most (98%) of the specimens examined were collected from September, October, July, and August (Table C1-304).

Sex could not be determined for about 8% (n = 29) of the specimens, and males (178) outnumbered females (158) among the remaining specimens although this difference was not significant. From September 1975 through August 1976, males also outnumbered females with three times as many males as females taken on the OCGS screens (Moore 1977b). In Chesapeake Bay, Laroche and Davis (1973) reported that females were more abundant than males during all months except May and November when the sex ratio was approximately equal.

Few northern puffer with enlarged, ripe, or spent gonads were taken primarily because OCGS was shut down during most of the reproductive season. During 1976, most (91%) of the specimens with enlarged or ripe gonads were impinged in May and July (Moore 1977b), but in 1977 OCGS was either shut down (14 May through 11 July) or withdrawing relatively small amounts of water (23 April through 13 May and 12 July through 4 August) during these months. Two northern puffer impinged at OCGS from 23 April through 4 August; both were males with enlarged gonads. Spawning occurred in either the Bay or near-shore ocean because young (age 0+) northern puffer (mean length of 22 mm) were collected from the eastern side of the Bay in June.

The length-weight relationship was not significantly different between males and females (Table C1-305), and these relationships were not significantly different than those previously reported for individuals from the Bay (Moore 1977b). The pooled regression equation for northern puffer, including those of undetermined sex, was log weight = -4.9135 + 3.1341 (log length) with confidence limits of $\pm$ 0.044 on the regression coefficient.

Both mature and immature males were slightly smaller than corresponding females, but these differences were not significant. Moore (1977b) found that females were significantly larger than males collected at OCGS in May 1976. Laroche and Davis (1973) and Welsh and Breder (1922) also reported that females were larger than males, but this difference was significant only during the first year. In Chesapeake Bay, females exhibited a significantly faster growth rate during the first season (Laroche and Davis 1973).

Annuli measurements were used to calculate the lengths of northern puffer taken in September and October (Table C1-306). The regression equation of body length (L) to vertebrae length (V) was L = 85.04 + 18.23 V, and it was substantially different than the regression equation that Laroche and Davis (1973) reported for northern puffer from Chesapeake Bay: L = 27.52 + 32.8 V. The intercept of the regression was used as a correction factor in the calculation of growth (Tesch 1968).

In Barnegat Bay the calculated mean length of males at age 1 (149 mm, n = 56) was significantly smaller than that of females (158 mm, 35); males at age 2 (178 mm, 9) were also significantly smaller than females (196 mm, 9).

The calculated mean length of both male and female northern puffer from Chesapeake Bay at age 1 was significantly smaller than that of fish from Barnegat Bay (Table C1-306). However at age 2, the mean length of specimens from Barnegat Bay was not significantly different than that of fish from Chesapeake Bay. This difference may be attributable to either the limited number of specimens examined from Barnegat Bay or natural year-to-year variation in growth.

The length-frequency distribution of specimens taken in September and October indicated three age-classes of northern puffer (Fig. C1-29). Most young ranged from 45 to 65 mm in length and comprised 75% of all specimens examined. Older individuals ranged from 165 to 245 mm with age 1+ fish comprising 20% and age 2+ fish 5% of the specimens examined. Although age 2+ northern puffer were taken in Barnegat Bay in 1975-76, no age 3+ specimens were found in 1976-77. Since only 5% of all specimens examined in 1976-77 were age 2+, specimens age 3+ were not expected to occur frequently. Laroche and Davis (1973) reported 4 year-classes of males and females in Chesapeake Bay.

While groups of age 1+ and 2+ females were indicated by the length-frequency histograms (Fig. C1-29), the age 1+ and 2+ males could not be differentiated. The weighted mean length of age 1+ and 2+ male northern puffer from Barnegat Bay (196 mm, n = 58) was similar to the weighted mean length of specimens of the same age from Chesapeake Bay (188 mm, 278; Table C1-307). Given the considerable differences between the number of specimens examined in the two studies, an 8-mm difference was not substantial.

No external parasites or physical anomalies were found on any specimen examined. Unlike most other fishes impinged on the OCGS screens, the northern puffer suffered little mechanical damage because its tough, leathery skin was resistant to abrasion.

The population of northern puffer in Barnegat Bay and other New Jersey estuaries has undergone a pronounced decline during the last 10 years. In a 4-year study of the fishes of Barnegat Bay, Marcellus (1972) found that the northern puffer ranked fourth in abundance during 1966-67; the catch-per-unit-effort by seine was 8.4 n/coll. The number of the northern puffer taken declined each successive year through 1969-70 when it ranked 10th in abundance (0.3 n/coll). Fewer than 0.1 n/coll were taken in seine collections during 1975-76 (Danila 1977b) and during 1976-77 (Table C1-165). Although the northern puffer comprised 66% of the sport fishing catch of boat fishermen in nearby Great Bay, New Jersey in 1969, its population had declined to low levels by 1972 (Hamer 1972, Thomas and Milstein 1973). In July 1978, many young individuals were impinged at OCGS, and this large number of fish may indicate an increase in the northern puffer population in the Bay.

SAND SHRIMP

Introduction

The sand shrimp ranges from Baffin Bay in Canada to eastern Florida and is found from inshore water to 450 m (Whitely 1948). This common caridean shrimp is a year-round resident of Barnegat Bay. However, many adults move out of the shore zone and shallow areas of the Bay to deeper water during both summer and winter to avoid extreme temperatures. The sand shrimp was one of the most abundant organisms taken in the Bay by seine and trawl and impinged on the OCGS screens. Richards (1963) found that the sand shrimp was forage for more than half the fishes in Long Island Sound, and it was common in the diet of bluefish, weakfish, and summer flounder collected from Barnegat Bay. The pelagic larvae are also forage for many planktivores (Fish and Johnson 1937).

Materials and Methods

The sex of individuals larger than 25 mm was determined by the dimorphic endopodite of the first pleopod (Price 1962), and ovigerous (egg-bearing) shrimp were also noted. When no sexual dimorphism was observed, the sex of the specimen was recorded as undetermined, and it was considered a juvenile.

Results

The sand shrimp was the most abundant organism impinged on the OCGS screens (an estimated 596,471 ± 100,860), collected in the dilution pump sampler (127,261), and taken in either Forked River (n = 4,240) or Oyster Creek (6,053). Most sand shrimp were taken on the OCGS screens (43%) and from Oyster Creek mouth (61%) during December, from Forked River mouth during April and May, and from the other creek mouths in October (Table C1-308). Some 9% of the 3,444 individuals examined were from the creek mouths, 30% from Forked River, 27% from Oyster Creek, and 34% from the OCGS screens (Table C1-312). Most (95%) of the sand shrimp taken in seine and trawl collections (Table C1-309) and in collections at OCGS (99%) were caught at night (Appendix D1, Table D1-56).

From March 1976 through March 1977, additional samples were collected in Oyster Creek and Forked River both east and west of U.S. Route 9 and in a lagoon off Oyster Creek and Forked River (Fig. C1-16). Overall, more sand shrimp were taken in Forked River (n = 1,939) than Oyster Creek (930, Table C1-310). Nearly 13 times more sand shrimp were taken in Forked River west of Route 9 (n = 714) than from a similar portion of Oyster Creek (56). This large difference in abundance of the sand shrimp west of Route 9 may be attributed to predation by fishes in Oyster Creek.

The attraction of sand shrimp to the thermal plume at the mouth of Oyster Creek was obvious during December when 88% of the sand shrimp taken by seine and trawl were collected there (Table C1-308). However, most of these shrimp apparently were not present throughout the winter

because the number collected in January (n = 86) and February (276) was small.

Avoidance response to the heated discharge was apparent in August 1977 when 573 individuals were collected at Forked River mouth but only 32 sand shrimp from Oyster Creek mouth. Similarly from May through August 1976, more than twice as many sand shrimp were taken at Forked River mouth (n = 900) than Oyster Creek mouth (422).

A relationship between length and weight was calculated for males, females, and ovigerous females (Table C1-311). While non-ovigerous females were significantly heavier than males of the same length, the difference between ovigerous and non-ovigerous females was not significant.

The mean length of specimens impinged at OCGS (48 mm) was significantly larger than that of shrimp collected from other areas (weighted mean of 34 mm). Many of the smaller individuals collected in the Bay by seine and trawl passed through the larger mesh of the OCGS screens (Moore 1977c). Because the OCGS screens selected larger shrimp, no size comparisons were made with other areas. Males comprised 31% of all specimens from the OCGS screens and females 69%. About 40% (n = 320) of the females from the OCGS screens were gravid. No juveniles were taken because they passed through the screens (Table C1-312).

In the Bay, significantly more females than males were collected from all areas. Some 61% of the adult sand shrimp examined from the mouth of Forked River, Cedar Creek, and Double Creek were females, and nearly 28% of these females were ovigerous (Table C1-312). While the difference between the percentage of gravid females in Forked River (33%

of all females) and Oyster Creek (27%) was not considerable, nearly three times as many juveniles were taken in Forked River.

More than 75% of females examined from the OCGS traveling screens in October and November, and from March through June were gravid. The mean length of ovigerous females increased from October (48 mm) to February (55) and decreased from February through May (47).

Enough specimens were collected from Cedar Creek, Double Creek, and Forked River from March through May to determine the age-structure of the population based on the length-frequency distribution by sex during each month. During these months, 15% of the population were juveniles, 33% were males, and 52% were females. The relatively few juveniles may have resulted from the loss of these small individuals through the mesh of the collection gear and, therefore, they may have comprised a larger percentage of the population (Fig. C1-30). Juveniles first appeared in February but were most common in March (mean length of 22 mm, n = 27) and April (20 mm, 33). They decreased in number during May and June (17 mm, 12) and became common again in July (21 mm, 40) and August (19 mm, 65; Table C1-312). Although one group of males was found in March (31 mm, n = 41) and May (29 mm, 96), two size-groups (age-groups) were taken in April (26 mm, 36; 38 mm, 19). The distribution of females was bimodal in March (34 mm, n = 35; 49 mm, 35) and April (34 mm, 140; 54 mm, 11).

The mean condition of sand shrimp of the same sex collected during similar time periods at Forked River, Oyster Creek, and the creek mouths was compared (Table C1-313). Because the OCGS screens selected for

larger specimens, no comparisons were made with other stations. At the Bay stations, no trends in condition were apparent. Although males taken from Forked River during October and November were in significantly poorer condition than males from Oyster Creek and the creek mouths, no significant differences were found for either males or females collected in these areas during April and May.

Discussion

The sand shrimp was significantly more abundant during 1975-76 than 1976-77. While an estimated 1,740,571 $\pm$ 422,778 specimens were impinged from September through December and during March, April, and August of 1975-76, only 526,618 $\pm$ 95,758 sand shrimp were impinged during these months in 1976-77 (Appendix D1, Table D1-47). Similarly, the entrainment estimate for the same period was nearly six times greater in 1975-76 than 1976-77.

The severe winter of 1976-77 and anoxic water off the New Jersey coast from August through October 1976 may have reduced the population in the Bay and, thereby, lowered the estimated number of sand shrimp impinged and entrained. The severity of the winter of 1976-77 may have affected the abundance of the sand shrimp in the Bay by excluding individuals from the Bay for a longer period of time. No mortality of the sand shrimp was documented from anoxic water off Barnegat Inlet, but many individuals from the Bay population emigrated from the estuary to cooler ocean waters during the summer months. These sand shrimp may have been susceptible to the lethal, anoxic bottom water.

Modlin (1976) suggested that the sand shrimp is a marine species which uses estuarine waters as a nursery. Migration related to reproduction has been documented for other species of Crangon by Israel (1936) and Allen (1960). Although zoeae of the sand shrimp are taken in plankton collections throughout the year (Sandine et al. 1977), sand shrimp reproduced in Barnegat Bay primarily during October and November and from March through May. In the Mystic River estuary, Connecticut, the sand shrimp moved into shallow water to reproduce during April and May (Modlin 1976). Similarly, most ovigerous sand shrimp appeared at the mouth of Forked River from April through June. As in Barnegat Bay, Modlin (1976) also found a number of smaller ovigerous females in October and November.

Modlin (1976) attributed the spring spawning period in the Mystic River estuary to 2 and 3-year old females and a fall spawn to smaller, age 1+ females. In Delaware Bay, larger ovigerous females were the first individuals in the population to spawn (Price 1962), and collections taken from the OCGS screens indicated that the mean length of ovigerous females collected at the beginning of the spring reproductive period (March) was larger than that of ovigerous females taken during the remainder of this reproductive period and in October and November. The juveniles taken in the Bay from March through May and during July and August may represent a fall and a spring hatch, respectively.

The sand shrimp was not common in the Bay during extreme summer and winter temperatures. Haefner (1972) reported a probable migration from shallow embayments at Lamoine, Maine, when water temperatures decreased

to 5 to 6 C. In the York River-Chesapeake Bay estuary, the maximum number of sand shrimp occurred when the bottom temperature was from 5 to 11 C with fewer individuals taken when the temperature exceeded 15 C (Haefner 1976). Nearly 80% of all specimens from Oyster Creek and Forked River were collected at a temperature of 6.0 to 16.9 C.

Because the sand shrimp avoids extreme temperatures, attraction to and avoidance of the OCGS thermal discharge occurred. Some sand shrimp that would have emigrated from the Bay during winter were attracted to the heated discharge in November and December 1976, and individuals returning to the Bay during spring were attracted to the warmer water in Oyster Creek during March 1977. Avoidance of the OCGS discharge was apparent in August, and during the summer few shrimp were collected in Oyster Creek at a temperature greater than 28 C (Table C1-201). Sand shrimp avoided relatively small (1 to 2 C) temperature differences. Meldrim (unpublished data) reported that sand shrimp acclimated to 25 C avoided 26 C. Some 189 sand shrimp were taken in seine collections at Forked River mouth during June 1978 (water temperature of 24.8 C), but only 15 individuals were taken at Oyster Creek mouth (26.5 C).

The number of specimens taken at night greatly exceeded the number taken during the day. Welsh (1970) reported that the sand shrimp was significantly more active after the onset of darkness except at low temperatures. Since most night collections at Oyster Creek and Forked River were made within several hours of sunset, the number of sand shrimp collected then probably represented the maximum number of this epibenthic shrimp which migrated off the bottom.

The life history of the sand shrimp in Barnegat Bay was similar to that reported for other estuaries in the mid-Atlantic. The predominance of females in the population was similar to the sex ratio of sand shrimp collected by trawl in the York River-Chesapeake Bay estuary (Haefner 1976) and collected by seine in the Delaware River estuary (Price 1962). However, bias of the sampling gear or behavior of the sand shrimp may account, in part, for some of these reported differences in the sex ratio. The larger females were more likely to be selected by the sampling gear than the smaller males. Price (1962) sampled primarily in the shore zone, and he felt that these collections may have biased the sex ratio because a large portion of the spawning population (i.e., females) was in the shore zone.

Unlike specimens collected from Chesapeake Bay during March and April, males and non-ovigerous females examined from Barnegat Bay during the year had significantly different regression coefficients for the length-weight relationship. The regression coefficient for ovigerous sand shrimp from Delaware Bay (Price 1962) was larger than that of specimens from Barnegat Bay, but not significantly so. Little difference occurred between the regression coefficients of ovigerous females taken from Barnegat Bay in March and April of either 1976 or 1977.

An insufficient number of sand shrimp of the same size range and sex were collected from the same locations for several consecutive months to accurately estimate the growth rate of individuals in Barnegat Bay. Other workers have found that the growth of the sand shrimp was mostly dependent on water temperature and age. In Rhode Island, Wilcox

and Jeffries (1973) found that the growth of individuals from 20 to 30 mm in length was less than 0.4 mm/week in winter (5 C) but greater than 1.1 mm/week in summer (20 C). They also reported that smaller shrimp grew faster than larger specimens.

The age-structure of the sand shrimp population of Barnegat Bay was similar to that of the Delaware Bay population (Price 1962). From March through May, two year-classes of mature females, two year-classes of mature males and one group of juveniles were present in Barnegat Bay. Price (1962) also found two age-classes of males but reported three year-classes of females.

BLUE CRAB

Introduction

The blue crab is a swimming crab that is a year-round resident in Barnegat Bay. It is generally active in the Bay from April through December and burrows into the sediment during the other months. This crab ranges from Nova Scotia to northern Argentina and is common from shallow water to depths of 35 m (Oesterling 1976). The blue crab was the second most abundant species impinged at the OCGS screens during 1975-76 and 1976-77, and it accounted for the greatest estimated biomass impinged at OCGS in both years.

The blue crab is important to the local sport and commercial fisheries. Commercial landings of 1.2 million kg of blue crab, valued at $830,806, were made in New Jersey during 1976; 59,581 kg ($40,283) were landed in Ocean County (U. S. Dept. of Commerce 1977). The blue crab comprised 65.9% of the sport fishery catch in the western Bay near OCGS from September 1976 through August 1977 (Table C1-325) and 83.3% of this catch from September 1975 through August 1976 (Hillman 1977d). The blue crab made up 65.3% of the sport catch in upper Barnegat Bay in 1972 (Halgren 1973).

Materials and Methods

49 The sex and reproductive condition of the blue crab were determined by the shape of the abdomen. From the first crab stage, the male has an inverted, T-shaped abdomen (Oesterling 1976). The abdomen of the immature male is firmly attached to the body, but in the mature male it is loosely connected to and easily separated from the body. The immature female has a triangular-shaped abdomen that becomes broadly rounded at maturity. Females bearing eggs and the stage of egg development were recorded.

Results

From September 1976 through August 1977, an estimated 230,691 ± 33,337 blue crab were impinged at the OCGS screens. Some 45,704 were actually collected from all areas, and 3,160 of these were examined. Most (84.2%, n = 2,662) of the blue crab examined were taken at the OCGS screens, 10.4% (n = 329) were from Oyster Creek, 3.7% (119) from Forked River, and 1.6% (50) from the creek mouths (Tables C1-314, C1-315).

The blue crab was collected throughout the year, but most (99.0%) were taken from September through November and from March through August. During 24-h sampling at the OCGS screens (Appendix D1, Table D1-56), significantly more individuals were collected at night (85.1%) than during the day (14.9%). More blue crab were also collected at night (59.6%) by trawl and seine in Forked River and Oyster Creek (Table C1-166).

The blue crab did not avoid the heated discharge in Oyster Creek from March through August, and it was collected at a temperature as high as 36.1 C (Table C1-201). For the year, significantly more blue crab were collected in Oyster Creek than in Forked River. Although a large number of blue crab did not remain active in Oyster Creek in winter, a

few were collected in Oyster Creek in December and January (bottom temperature of 5.9 to 4.7 C) when they were not found elsewhere in the Bay (1.5 C).

Males of the blue crab ranged in length from 9 to 199 mm and females from 11 to 161 mm. Males ranged in weight from 0.1 to 238.2 g and females from 0.1 to 230.0 g (Tables C1-316, C1-317). Exclusive of the few individuals collected from December through February, the mean monthly length of immature males ranged from 43 mm in March to 70 mm in August while the mean length of immature females ranged from 45 mm in March to 75 mm in August (Table C1-318). The largest immature male was 128 mm and the largest immature female 122 mm. For the year, the mean lengths of immature males collected at the creek mouths (53 mm), Forked River (50), Oyster Creek (50), and at the OCGS screens (57) were similar. The mean lengths of females from these four areas (68, 63, 57, and 61 mm respectively) were also similar. Immature females taken from all areas were larger than males, but this difference was significant only during September and July.

The mean lengths of mature males collected from the creek mouths (115 mm), Forked River (110), Oyster Creek (111), and the OCGS screens (115) were significantly less than that of females from these areas (131, 129, 131, and 128 mm respectively). The smallest mature male (79 mm) was collected in May and the smallest mature female (78) in September (Table C1-319).

The length-weight regression equation for males (n = 1,520) was log weight = -3.8119 + 2.8167 (log length), and the confidence limits on the

regression coefficient were $\pm$ 0.052. For non-gravid females (n = 1,640), the length-weight relationship was log weight = -3.6411 + 2.7019 (log length) with confidence limits of $\pm$ 0.059. The regression coefficients for the equations were significantly different; males were significantly heavier than females at a given length (Table C1-320).

Some 82.1% of all blue crab examined were immature, and they dominated collections in all months. Overall, the ratio of immature males to females was not significantly different from a 1:1 ratio, but some seasonal differences in the sex ratio were found (Table C1-321). Significantly more immature females were collected at the OCGS screens during September, and significantly more immature males were taken in May. During the period from March through May, significantly more immature male blue crab were taken in Oyster Creek, and from June through August significantly more immature females were taken at the creek mouths, Forked River, and Oyster Creek (Table C1-318).

Seasonal differences in the ratio of mature male and female crabs were also found. Significantly more mature females were collected at OCGS during September, October, April, and May, and significantly more males during August (Table C1-319). No significant difference was found in the ratio of mature male and female blue crab taken from the creek mouths, Forked River, and Oyster Creek for the year.

For comparative purposes, Miller et al. (1975) separated the catch of blue crab in the vicinity of the Chesapeake and Delaware Canal into three size-groups: recruitment ($\leq$ 59 mm), growth (60 to 119 mm), and mature ($\geq$ 120 mm). Classification of the blue crab taken in 1975-76

(Newcomb 1977) and 1976-77 according to these categories revealed a marked shift in the age-structure of the population from 1976 to 1977. From March through August 1976, recruitment-size blue crab comprised 81.6% of the population in Barnegat Bay. Substantially fewer blue crab of recruitment-size were collected during the same period in 1977 (47.2%). From March through August 1977, growth-size blue crab represented 49.3% of those examined, but during the same period in 1976, they accounted for only 30.2% (Table C1-322).

In 1976, most egg-bearing females were present during June and July (Newcomb 1977), but relatively few gravid females were collected in 1977 because no collections were taken at the OCGS screens from 14 May through 11 July.

Discussion

The estimated number of blue crab impinged at the OCGS screens during 7 comparable months (September through December, March, April, and August) decreased from an estimated 1,526,862 $\pm$ 478,070 during 1975-76 to 212,995 $\pm$ 31,538 during 1976-77 (Appendix D1, Table D1-47). Although fewer blue crab were taken in 1976-77, the composition of the catch was generally similar between years with the population in the Bay comprised of young (age 0+), age 1+, and age 2+ individuals. Immature specimens dominated the catch during both years, although the percentage of the population that was immature during 1975-76 (91.5%) was greater than that during 1976-77 (82.1%). Immature and mature females were larger than males in both years, but this difference between sexes was significant only for mature crabs during the second year.

The size of mature female blue crab differed between 1975-76 and 1976-77. For the year, the mean length of females taken in all areas in 1975-76 (135 mm) was larger than that of females in 1976-77 (128). The difference was not substantial and may be due to year-to-year variation in growth. The length of males of the blue crab collected during both years was nearly equal (115 mm in 1975-76, 114 mm in 1976-77).

Immature females taken from all areas were larger than males during both years (61 vs 55 mm in 1976-77; 50 vs 41 mm in 1975-76). The mean length of immature individuals of both sexes taken in 1976-77 (58 mm) was considerably larger than that of immature crabs taken the previous year (46).

The severe winter of 1976-77 apparently caused high mortality of blue crab, particularly those of recruitment-size ($\leq$ 59 mm). During a trawl survey throughout the Bay in March, an estimated 42,000 $\pm$ 14,000 dead blue crab were estimated to have been on the bottom of the Bay. However, this figure was probably a gross underestimate of dead individuals as most blue crab killed during the winter probably remained buried in the sediment and were passed over by the trawl. The effect of this mortality was demonstrated by the substantial decrease in the catch of blue crab at the OCGS screens during 7 comparable months of 1976-77 as compared to 1975-76 (Appendix D1, Fig. D1-16). The loss of many small individuals also was reflected in the decrease of the percentage of the population that was immature, the increase in the mean size of immature blue crab, and the decrease in the percentage of recruitment-size crabs in the population.

The general life history and movements of the blue crab in Barnegat Bay corresponded closely with those of other studies along the eastern coast of the United States (Churchill 1917, Van Engel 1958, Fishler and Walburg 1962, Miller et al. 1975, Oesterling 1976). After growth in lower salinity waters, females mature and mate during the spring or summer of their second year (Norse 1977). Two to 9 months after mating, they migrate offshore or to high salinity water to spawn (Van Engel 1958). A female mates only once in her lifetime; however, some females may spawn a second time as the sperm remains viable for more than a year (Van Engel 1958).

After hatching, the young crab passes through a zoea and megalopa larval stage. Zoeae require salinities greater than 20 ppt to develop (Fishler and Walburg 1962); relatively few were found in the central Bay from Cedar Beach to Gulf Point (Appendix D1, Section D1.17). Megalopae were found primarily in the Bay near Barnegat Inlet. The megalopa returns to less saline waters and metamorphoses into the first, small (3.2 mm) crab (Sandifer 1975). Recruitment and growth-size crabs were predominant throughout the Bay, and this is characteristic of blue crab nursery areas (Miller et al. 1975).

The seasonal differences in the sex ratio of immature blue crab in the Bay during 1975-76 (Newcomb 1977) and 1976-77 were evidence of differences in spatial distribution among immature blue crab. Miller et al. (1975) suggested that differences in the sex ratio among small crabs may be due to differences in migratory behavior between the sexes at an early age. They found that males were predominant in the low salinity

waters of the Chesapeake and Delaware Canal during summer. If immature males migrated to lower salinity areas of Barnegat Bay during the summer, this would explain the greater number of immature females in the higher salinity area (20 to 25 ppt) of the Bay that was regularly sampled.

The blue crab exhibits rapid growth and is short-lived. Van Engel (1958) reported that blue crab spawned in June attained a length of 63 mm by the end of November and usually matured in 12 to 18 months. The blue crab generally lives 2 or, rarely, 3 years, but Pearson (1948) reported that individuals older than 2 years probably contributed little to the reproductive population.

During population surveys of the blue crab in the past 2 years (Appendix D1, Table D1-98), most mature and gravid females were taken in the higher salinity areas near the Inlet. The movement of mature females to these areas from the central area of the Bay may account, in part, for the significantly greater number of mature females impinged at OCGS in both 1975-76 and 1976-77. Mature males probably remained in low salinity areas although they may have exhibited some movement to higher salinity water during the winter. In South Carolina, the blue crab left estuaries during winter months but remained in adjacent coastal areas (Fishler and Walburg 1962). In Barnegat Bay, the overwintering of blue crab in the sediment of the Bay was evidenced from the substantial (28,636 kg) commercial dredge fishery for the blue crab from December 1975 to March 1976 (Hillman 1977c).

C1.20 SPORT FISHERIES

Introduction

Sport fisheries data for western Barnegat Bay, the south branch of Forked River, and Oyster Creek were collected from September 1976 through August 1977 to determine the species composition of the recreational catch, the relative abundance of each species, and the effect of the OCGS heated discharge on the local sport fishery.

Materials and Methods

A creel census was conducted in four areas of Barnegat Bay (Figs. C1-31, C1-32). Zone 1 encompassed an area of the western Bay from Cedar Creek to the lagoon between Forked River and Oyster Creek. It included Forked River from its mouth to FL "19" and the south branch of the River from FL "19" to the U.S. Route 9 bridge. Zone 2 was located in the western Bay from the lagoon between Forked River and Oyster Creek to Waretown Creek, and it included Oyster Creek from its mouth to the Route 9 bridge. The eastern boundary of zones 1 and 2 was the Intracoastal Waterway (Fig. C1-31). Zone 5 included three areas on the south branch of Forked River: the north bank near Route 9, the walkway along the Route 9 bridge, and the beach on the south bank around the Beach Blvd. bridge (Fig. C1-32). Zone 4 included three areas in Oyster Creek: the north bank near Route 9, the walkway along the Route 9 bridge, and the bulkheaded area on the north bank near the mouth. A creel census of

fishermen in each zone was conducted on a randomly-chosen day from Monday through Friday, and additionally twice a month on a randomly-chosen weekend day beginning in April. Fishermen in boats in zones 1 and 2 and on the banks and bridges in zones 4 and 5 were censused. The number of fishermen, hours fished, fishing rods and crab traps used, and fishes and blue crab taken were recorded. Surface water temperature and salinity were recorded in each zone.

The catch per individual (c/i) and catch per hour (c/h) were computed for each zone, and catch per boat (c/b) was computed for zones 1 and 2. Fishermen were defined as those participating in the sport fishery; anglers were individuals using only fishing rods; and crabbers were those using only crab traps and hand lines. Fishermen who used fishing rods and crab traps simultaneously were included separately as anglers and crabbers. The catch per individual crabber and angler and the catch per hour of crabbers and anglers were computed for each zone.

Results

Zones 4 and 5 were censused more frequently (56 times) than zones 1 and 2 (21 times) because they were more accessible during inclement weather. No one fished in any zone during January and February because of cold weather.

A total of 930 fishermen caught 2,719 specimens of 17 taxa (Table C1-323), and the overall c/h and c/i were 1.6 and 2.9, respectively (Table C1-324). Although the c/h was slightly larger for boat fishermen (1.7) than for bank fishermen (1.5), the c/i was greater for bank fishermen

(3.2) than for fishermen in boats (2.6, Table C1-324). The blue crab (n = 1,792), bluefish (569), spot (173), and winter flounder (92) accounted for 96.6% of the catch. The American eel, scup, summer flounder, white perch, and nine other fishes comprised the remainder of the catch (Table C1-325).

Although anglers (n = 567) outnumbered crabbers (529), crabbers landed 65% of the total catch (1,780) while expending 53% (1,077.75 h) of the total effort (Table C1-323). Some 61% of the crabbers were recorded in zone 1 (n = 172) and zone 2 (151), but the smallest c/i of crabs (<3.0) were in these zones. The 138 crabbers on the banks of Oyster Creek (zone 4) had the largest catch (n = 687) and the greatest c/i (5.0) because they expended the most effort (433.25 h, Table C1-324). The c/h of crabs in this zone (1.5) was slightly lower than that in either zone 1 (1.9) or 2 (1.9). Some 54.9% (n = 978) of the blue crab were taken in August, and zone 1 had the largest monthly landings (420) of blue crab during that month (Table C1-323).

Anglers expended less effort (937.75 h) than crabbers and landed fewer specimens (n = 939). The largest number of anglers (n = 291) expended the greatest amount of effort (564.0 h) in zone 4, and 80% of those anglers fished near the Route 9 bridge (Table C1-323). The largest mean c/i and c/h were in Forked River (zone 5) near the Beach Blvd. bridge, but these large values were attributed to an unusually large catch by a few anglers. Zone 1 and the area of zone 4 near the mouth of Oyster Creek also had a relatively better angler catch (c/i and c/h). The catch of anglers was smallest in zone 2 (Table C1-324). Most fish (34.5% of all fish) were taken by anglers in August (Table C1-323).

The census in the Bay (zones 1 and 2) was limited by inclement weather, ice cover from mid-December through late February, and the seasonal fluctuation in the number of fishermen. Only one angler was seen in the Bay from September through mid-December. When OCGS was in operation from September through April and during August, crabbers in zone 2 had a larger c/i (9.5) than those in zone 1 (3.1) although the c/h was greater in zone 1 (Table C1-326). The blue crab was more predominant (90.3% of the catch) in the catch in zone 2 than in zone 1 (75.8%). The angler catch (c/i and c/h) was greater in zone 1 than zone 2 regardless of OCGS operation (Table C1-326), and overall more fishes were taken in zone 1 than in zone 2 (Table C1-325).

Fishermen from the banks of Forked River (zone 5) had the smallest c/h (1.5) and c/i (2.7) of all zones even though the largest monthly c/h (8.3) and c/i (11.6) occurred here in September (Table C1-324). The fewest fishermen (n = 141) were found in this zone.

Although fishermen from the banks of Oyster Creek (zone 4) had the same mean c/h (1.5) as fishermen from the banks of Forked River, the largest c/i (3.4, Table C1-324) was found in Oyster Creek because the greatest effort (836 h) was expended there (Table C1-323). The largest monthly c/i for crabbers (15.4) and anglers (11.3) during the year was in some portion of Oyster Creek, and fish were taken in every month but January and February. In Forked River, fish were taken only during 8 months.

Differences in effort and catch were found for the area around the Route 9 bridge in Oyster Creek and Forked River. In this area of Oyster

Creek, 270 fishermen expended 582.25 h of effort as compared to 98 fishermen (195.5 h) in this area of Forked River (Table C1-323). Over four times as many specimens were harvested from Oyster Creek (n = 877) than Forked River (219), but this was primarily a result of the greater effort in Oyster Creek. The species composition also differed between areas; fishermen took 15 species of fish in Oyster Creek, but only 4 species were taken in Forked River (Table C1-325).

Although this area of Forked River had a larger monthly c/h and c/i for fishermen than the comparable area of Oyster Creek during September, a larger c/h and c/i were consistently made in Oyster Creek throughout the year (Table C1-324). Over the year, the mean c/i in Oyster Creek was 3.3 as compared to 2.2 in Forked River. Although the mean angler c/i in Forked River (0.9) was slightly larger than that in Oyster Creek (0.6), the crabber c/i in Oyster Creek (4.9) exceeded that in Forked River (4.1). The c/h for both anglers and crabbers was greater in Oyster Creek (1.3 and 1.6, respectively) than Forked River (0.7 and 1.4).

The Beach Blvd. area of Forked River had little fishing activity (43 fishermen, 65 h) until August (Table C1-323). Although fishermen in this area had the largest mean c/h (2.6) and c/i (3.9) over the year, 58% of the total catch was taken in 1 day (6 h) by four individuals. As a result of this large catch of bluefish, this was the only area where fish outnumbered blue crab in the catch.

Fishermen around the bulkhead near the mouth of Oyster Creek had the same mean c/h (1.5) as those near Route 9, but the c/i (3.9) was

larger because the average individual near the bulkhead fished for about 0.5 h more than an individual near Route 9 (Table C1-324). The largest c/i (5.1) for crabbers for the year and 14% of the total catch of blue crab were taken in this area.

The blue crab (65.9% of total catch) was the most numerous species taken (Table C1-325). All were taken from May through September, but the largest catches were made in July and August (Table C1-323). The mean c/i for crabbers was 3.4 and the largest number was taken from the banks of Oyster Creek (n = 699), in zone 1 (478), and in zone 2 (408). The greatest overall c/i was also in Oyster Creek, but the largest c/h was in zones 1 and 2 (Table C1-324).

The bluefish was the most numerous fish taken. It comprised 20.9% of the total catch and 61.4% of all fish caught (Table C1-325). It was taken in September and October 1976 and during July and August 1977. Largest catches of the bluefish (n = 243) were made in Oyster Creek near the Route 9 bridge.

Spot comprised 6.4% of the total catch and 18.7% of all fish taken (Table C1-325). All were taken in September and October 1976 and during April and from June through August 1977. About half of the spot were taken near the Route 9 bridge in Oyster Creek, but none were caught from the banks of Forked River.

The winter flounder accounted for 3.4% of the total catch and 9.9% of all fish taken (Table C1-325). It was taken in November, December, and from March through May. The lack of any catch in January and February reflected the severe weather and subsequent lack of fishing. Most

(85.9%) winter flounder were taken in Oyster Creek, but relatively little fishing activity was observed in the Bay during March and April.

Over the year, the sport fishery in the zones associated with the heated discharge of OCGS (zones 2 and 4) differed very little from the fishing in similar areas unaffected by the heated discharge (zones 1 and 5). The yearly mean c/h (1.5) and c/i (2.9) for fishermen in zones 2 and 4 were similar to those in zones 1 and 5 (1.8, 3.0, respectively; Table C1-327). Although the harvest in zones 2 and 4 was 40% larger than that of the other zones, more effort was expended in zones 2 and 4.

The shutdown of OCGS from 23 April through 4 August had several effects on the sport fishery. More species of fish were caught in zones 2 and 4 during the summer of 1977 than in 1976. With OCGS in operation from May through July 1976, only 1 summer flounder, 1 oyster toadfish, and 14 bluefish were taken, but 9 species were taken in Oyster Creek during these months in 1977 when OCGS was shut down. The spot (18.2% of total catch during the shutdown), bluefish (4.7%), summer flounder (4.2%), and American eel (2.0%) comprised most of the fishes taken.

During the OCGS shutdown, the angler c/h was similar in zones 1 and 5 (0.5) and in zones 2 and 4 (0.5). The crabber c/h in zones 2 and 4 (1.2) was slightly greater than in zones 1 and 5 (0.9, Table C1-327). The greater c/i in zones 2 and 4 during the shutdown again reflected the greater effort expended in this area. The number of fishermen and fishing effort expended in the Route 9 area of zone 4 increased 28.3% and 73.3%, respectively, from 1976 (Hillman 1977d), but most individuals censused were unaware that OCGS was shut down.

Discussion

The effect of the heated discharge from OCGS and from other electric generating stations on the local sport fishery is well documented. Hillman (1977d) found that c/i and c/h were greater in zones associated with the heated discharge of OCGS than in similar unaffected areas. Elsner (1965) concluded that a warm-water discharge substantially increased the catch/trip of anglers in the Potomac River, and both Spigarelli and Thommes (1976) and Marcy (1976) reported increased catch-per-unit-effort in the heated discharge of nuclear power plants. Although c/i was greater in zones affected by the OCGS heated discharge in 1976-77, the c/h during this period was similar to that in other areas, primarily because OCGS did not discharge heat during much of the summer, the peak of the fishing season in the Bay. When OCGS was in operation during August, the crabber c/h was greater in areas affected by the heated discharge, but the angler c/h was less.

The difference in harvest between zones associated with the heated discharge of OCGS (zones 2 and 4) and unaffected zones (1 and 5) reflected the difference in effort expended within these zones. Although the harvest in zones 2 and 4 was larger than that in zones 1 and 5, the average individual fished about 0.5 h more in zones 2 and 4 than in zones 1 and 5. From December 1971 through November 1972, Halgren (1973) found more bank fishermen on Oyster Creek than any other area of the Bay censused.

During the year, the most notable effect of the heated discharge was to extend the sport fishery season in Oyster Creek. Although no fishermen were seen in any zone during January and February, fishing

activity and catch occurred in Oyster Creek in the other 10 months. Fishing occurred in the other zones during only 8 months of the year.

The most notable effect of the OCGS shutdown from April through August 1977 was the greater number of fishes taken in Oyster Creek than during the previous summer. The decrease in the fin- and shellfish harvest during the shutdown, as compared to 1975-76 (Hillman 1977d), reflected the overall decrease of catch, especially shellfish, throughout the Bay in 1976-77.

Hillman (1977d) reported that the blue crab (82.0% of the total catch), bluefish (12.1%), summer flounder (2.0%), black sea bass (1.3%), and spot (1.3%) comprised most of the catch in a study of the sport fishery in basically the same area from September 1975 through August 1976. The area of the Bay near Oyster Creek Channel (zone 3) was the only area of his survey that was not included in this study. From September 1976 through August 1977, blue crab comprised only 65.9% of the catch while bluefish (20.9%), spot (6.4%), winter flounder (3.4%), and American eel (1.0%) accounted for most of the remaining catch. The decrease in the catch of the summer flounder and black sea bass was primarily attributed to the elimination of zone 3 because 98% of the summer flounder and 77% of the black sea bass taken in 1975-76 were caught in this zone.

The decline in the catch of the blue crab from 1975-76 to 1976-77 was probably due to a large mortality during the winter of 1976-77. Birnbaum (1977) reported that commercial landings of the blue crab in late July 1977 had decreased as much as 50% from Cambridge, Maryland to

Georgia. The estimated number of blue crab in the Bay in 1976 was about five times greater than the number in 1977 (Appendix D1, Section D1.15). The recreational crab catch (c/h and c/i) in 1976-77 (1.6 and 2.9, respectively) declined substantially from these values in 1975-76 (3.0, 6.1).

Halgren (1973) found that the blue crab (65.3% of total catch), winter flounder (7.3%), weakfish (5.9%), bluefish (5.7%), summer flounder (4.5%), and northern puffer (4.3%) were the most numerous fishes taken in a creel census of upper Barnegat Bay from December 1971 through November 1972. Few weakfish and summer flounder were recorded in the 1976-77 survey because the areas censused were not the best fishing areas for these species. The northern puffer population has declined along the New Jersey coast in recent years (Hamer 1972, Thomas and Milstein 1973). The spot had shown large increases in population size in recent years and has been taken more commonly in the sport catch.

C1.21 EFFECTS OF THE OCGS HEATED DISCHARGE ON PLANKTON IN OYSTER CREEK

Introduction

The species composition, abundance, and distribution of macrozoo- and ichthyoplankton collected in Oyster Creek (the discharge canal) east of U. S. Route 9 and in the south branch of Forked River (intake canal) east of Route 9 from March 1976 through March 1977 were examined to determine the effect of the thermal plume from OCGS on primarily and secondarily entrained forms. Forked River generally was similar to Oyster Creek except for water temperature. Because organisms were introduced into Oyster Creek after secondary entrainment through the dilution pumps, all organisms in Oyster Creek did not experience the maximum OCGS discharge temperature. With two dilution pumps in operation, water entrained through these pumps remained somewhat discrete from the heated discharge until about 60 m below the OCGS discharge, and at that point the temperature of the mixed flow averaged 4.5 C (range of 2.0 to 7.5 C) above ambient.

Materials and Methods

Macrozoo- and ichthyoplankton were taken at three stations (Sta. 45, 46, 6) in Forked River and at three stations (50, 30, 14) in Oyster Creek (Fig. C1-33). In each area stations were located at the mouth,

just east of the Route 9 bridge, and in a lagoon off the main channel. Stations generally were sampled sequentially (i.e., upstream in Forked River and downstream in Oyster Creek) in an attempt to sample the same water mass. Each station was sampled once a month from March 1976 through March 1977 although no collections could be made in either Forked River or the lagoon off Oyster Creek (Sta. 30) in January and February because of ice cover in these areas and in the Bay. An additional set of collections was taken in July and in August 1976 to examine the plankton in Oyster Creek during the period of the highest discharge temperatures.

A 20-cm bongo sampler (505-micron mesh) was used to collect samples. The gear was attached to a wire approximately 30 to 38 cm above a 17-kg depressor. It was deployed and retrieved with a hand winch and boom on the port side of a 6.4-m Monark workboat. Each tow began at the surface, and the wire angle was maintained at approximately 45 degrees from the vertical throughout the tow. The wire was deployed at a constant rate until the depressor touched the bottom and was then retrieved in a similar manner. The gear traversed the water column at least twice during each tow.

Sampling began 0.5 h after sunset and two consecutive tows were made at each station. The volume of water sampled was determined by a digital flowmeter (General Oceanics Model 2030) located in the mouth of the sampler. Tow time was from 4 to 6 min, but it was shortened if excessive clogging of the net occurred. Collections were preserved in the field in buffered 5% formalin. When ctenophores were abundant, a

50% solution of glacial acetic acid saturated with potassium dichromate was used as a preservative.

The laboratory procedures for the sorting, enumeration, and identification of plankton samples were presented in Appendix D1, Section D1.16. Most macrozooplankton were identified to the lowest possible taxon although all amphipods, except Corophium and Ampelisca, were grouped as unidentified Amphipoda and mud crab zoeae were grouped as Xanthidae zoeae. A Hewlett-Packard 9830A programmable calculator was used for data compilation and most statistical analyses.

The differences in the density of macrozoo- and ichthyoplankton among stations in Oyster Creek and Forked River were initially examined statistically ($P \leq 0.05$) with a two-way (date x station) ANOVA. The densities were transformed by the ln (X + 1) transformation in an attempt to normalize the data. Since all stations could not be sampled in January and February, these months were excluded in the statistical analysis. ANOVA were computed for the four stations in the main channel; the stations in the lagoons were excluded because of their dissimilarity to the main channel stations. Data from the lagoon stations indicated that densities were inconsistent between stations in the lagoon and the other stations and, therefore, the lagoon stations were not considered representative of the affected biota.

The presence of interactions in the ANOVA also confounded analyses. When interactions occurred, the mean densities were plotted to examine the effect of the interaction on the analysis. In most cases, the ordering of the densities at the stations was not consistent through

time (i.e., the density at one station was not always greater than or less than the density at another station), and, therefore, most ANOVA were invalid (William H. Swallow, personal communication).

Since the parametric ANOVA could not be consistently used to examine the differences in density of forms in Oyster Creek and Forked River, the non-parametric Wilcoxon rank sum test ($P \leq 0.05$) was used to determine difference in density between the uppermost station in Forked River (Sta. 6) and the station in the mouth of Oyster Creek (Sta. 50). Since substantial reproduction of some forms may occur in Forked River and some forms may originate from the north and central branches of Forked River, the uppermost station in Forked River was the best estimate of the density of forms introduced into Oyster Creek. However, since additional reproduction of some forms (e.g., the sand shrimp, gobies) may occur between this station and OCGS, this estimate may still have been low. Since dead plankton settles to the bottom (Carpenter et al. 1974, Marcy 1976, Tatham et al. 1977b), organisms collected at the mouth of Oyster Creek were considered live. The density of a form at this station was considered the best estimate of density of forms in Oyster Creek after primary and secondary entrainment and passage down Oyster Creek.

In addition to statistical analyses, the effect of the OCGS heated discharge was also examined as the difference between the mean density of a form at the uppermost station in Forked River (Sta. 6) and at the mouth of Oyster Creek (50). The percentage difference in the mean density of a form between the two stations was determined by dividing

the smaller mean density by the larger and subtracting that value from 100. During the summer of 1976, OCGS operated at less than its full-rated capacity (640 MWe) during June (mean daily electrical output of 548 MWe), July (526), August (569), and September (580). Because organisms were introduced into Oyster Creek by both entrainment through the OCGS cooling-water system and secondary entrainment through the dilution pumps, decreases in abundance at the mouth of Oyster Creek could not be attributed solely to primary entrainment. Reproduction of forms in Oyster Creek at times may introduce eggs and larvae into the Creek and, thereby, mask some entrainment losses.

Results and Discussion

Macrozooplankton

The macrozooplankton community in Forked River was characterized by one assemblage at ambient water temperatures below 18 C (cold period) and another assemblage above 18 C (warm period; Table C1-328). The dominant (> 5% of the community) macrozooplankton during the cold period (March 1976 and October 1976 through March 1977) were the mysid *Neomysis americana* (35% of all macrozooplankton collected then), the hydromedusae *Sarsia* spp. (21%) and *Rathkea octopunctata* (19%), zoeae of the sand shrimp *Crangon septemspinosa* (9%), and amphipods (5%). The dominant forms during the warm period (April through September) were mud crab (Xanthidae) zoeae (47%), amphipods (16%), *N. americana* (13%), and sand shrimp zoeae (6%). All of the dominant forms were estuarine and marine (Jeffries 1967).

N. americana and amphipods were the only dominant forms collected during all months. *N. americana* was abundant (> $100/m^3$) from February

through June and during August and September, and it was common (1-100/m^3) in all months. Amphipods were common in all months and were most abundant from May through October 1976. The dominant amphipods, based on collections from the OCGS discharge for the period September 1975 through August 1976 were Ampelisca spp. (30% of all identified amphipods), Jassa falcata (26%), Microdeutopus gryllotalpa (16%), and Corophium spp. (8%, Sandine et al. 1977). From September through March 1977, 76% of all identified Corophium spp. were C. tuberculatum, 20% were C. acherusicum, 4% were C. bonelli, and less than 1% was C. insidiosum.

Zoeae of the sand shrimp were common from March through July and again during November. Mud crab zoeae occurred from April through September but they were abundant only from May through July. Based on collections from the OCGS discharge during this period (Sandine et al. 1977), the most numerous mud crab zoeae were those of Neopanope texana (67% of all mud crab zoeae) and Panopeus herbstii(32%). R. octopunctata occurred from November through April and Sarsia spp. from February through April.

The species composition of macrozooplankton was similar in both Forked River and Oyster Creek (Table C1-329). Although the species composition of macrozooplankton collected at the lagoons was generally similar to that of stations in the main channel, the densities of most macrozooplankton were often substantially lower in the lagoons. For a planktonic form whose horizontal movement was due primarily to the movement of water rather than its swimming (e.g., most larvae), the chance of entering a lagoon was small due to the minimal exchange of

water between the lagoon and the main channel. However, larger forms (e.g., mysids, shrimp) capable of lateral movement may have entered a lagoon at a rate independent of water exchange. At times the abundance of mysids was greater in the lagoon than in the main channel.

A comparison of the density of macrozooplankton from Forked River (Sta. 6) and Oyster Creek (50) showed that some losses apparently occurred in Oyster Creek because total macrozooplankton were significantly more abundant in Forked River (Table C1-330). Only on 1 of 13 sampling dates was the density of total macrozooplankton greater in Oyster Creek. The greater density in Oyster Creek on that date resulted from a large number of mud crab and grass shrimp zoeae there.

For the cold period, the density of 10 of 13 common or important forms was less in Oyster Creek, and this difference was significant for 2 of the 8 forms tested (Table C1-330). During the warm period, the density of 16 of 19 common or important forms was less in Oyster Creek, and the difference was significant for 11 of the 13 forms tested. The mean density of zoeae of the sand shrimp ($4.3/m^3$ in Forked River, $1.7/m^3$ at the mouth of Oyster Creek); the mud crabs Neopanope texana, Panopeus herbstii, and Rhithropanopeus harrisii ($88.2/m^3$, $49.5/m^3$); Hippolyte spp. ($0.11/m^3$, $0.01/m^3$); Upogebia affinis ($0.54/m^3$, $0.08/m^3$); hermit crabs Pagurus spp. ($0.32/m^3$, $0.08/m^3$); and spider crabs Libinia spp. ($0.18/m^3$, $0.03/m^3$) was greater in Forked River than in Oyster Creek (Table C1-331). However, zoeae of the grass shrimp were more abundant in Oyster Creek ($8.6/m^3$) than in Forked River ($2.0/m^3$). Of the above zoeae, the difference was significant for mud crabs and the grass shrimp

(Table C1-330). Zoeae of Hippolyte spp., U. affinis, Pagurus spp., and Libinia spp. were tested collectively since they occurred on three or less sampling dates, and the difference for this group was also significant (Table C1-330).

These decreases in the density of many macrozooplankton from Forked River to Oyster Creek were similar to the decreases in density in Oyster Creek reported by Hoffman et al. (1978). Decreases in density in Oyster Creek may be attributed to mortality of organisms exposed to elevated temperatures during passage down Oyster Creek, latent mortality of entrained forms, or behavioral changes which altered their distribution in the water column and, thereby, apparently made them less abundant in Oyster Creek. Swain et al. (1975) found that the freshwater mysid Mysis relicta moved down through the water column when exposed to elevated temperatures, even if a lower level of the water column was warmer than the water that caused the avoidance reaction. They suggested that this avoidance reaction was instinctive, and they termed this movement negative thermotaxis. Herman (1963) reported a similar negative thermotaxis for estuarine mysids. On the other hand, reproduction of some forms (i.e., grass shrimp, mud crabs, and Nereis spp.) in Oyster Creek, at times, may have introduced larvae and eggs into the Creek and, thereby, masked some losses from entrainment. Hatching of grass shrimp zoeae probably accounted for the greater number of total macrozooplankton in Oyster Creek on one sampling date.

No data were available on mortality of secondarily-entrained macrozooplankton introduced into Oyster Creek after passage through the dilution

pumps. Therefore, temperature-tolerance data for adults and juveniles of the sand shrimp, grass shrimp, amphipods, and N. americana; epitokes of Nereis spp.; and blue crab megalopae exposed to the OCGS discharge temperature for 15 min were used to evaluate the effects of secondary entrainment. At OCGS, most entrainment mortality was related to temperature, and therefore, these data were valid indicators of temperature tolerance. In addition, these data generally agreed with temperature-tolerance data in the literature. For zoeae of mud crabs, grass shrimp, and sand shrimp, data from laboratory studies were used to evaluate secondary entrainment because no quantitative data were available from OCGS discharge collections.

N. americana was significantly more abundant in Forked River during both the warm and cold periods, but the mean percentage difference between the two areas was greater during the warm period (Table C1-330). The decrease in density of N. americana in Oyster Creek during both periods was generally larger than that expected from temperature shock alone. Exposure of N. americana to temperatures above 35.0 C, from 32.5 to 35.0 C, and from 30.0 to 32.5 C resulted in a mean percent mortality of 94%, 82%, and 36%, respectively (Appendix D1, Section D1.16). Below 30.0 C, mortality generally did not exceed 10%. From October through March, the temperature in Oyster Creek did not exceed 27 C, and therefore, the decrease in abundance in Oyster Creek from temperature shock should not have exceeded about 10%. However, the mean percent difference in density between Forked River and Oyster Creek during this period was 65% (Table C1-330), and this difference may reflect either latent mortality or negative thermotaxis (Swain et al. 1975, see page C1-555).

Sand shrimp zoeae were significantly more abundant in Forked River during the cold period; they were also more abundant there during the warm period but not significantly so (Table C1-330). The form was most abundant from March through June. Qualitative observations of sand shrimp zoeae collected at the OCGS discharge indicated abnormal swimming at discharge temperatures above 30 C. Regnault and Costlow (1970) reported that these zoeae did not survive a 24-h exposure to a cyclic temperature of 25 to 30 C. The percent difference in density of sand shrimp zoeae between Forked River and Oyster Creek during both the cold and warm periods was similar to the percentage of the water from Forked River that passed through OCGS. This suggested that most individuals passed through the OCGS cooling-water system were affected and that individuals secondarily entrained were not generally affected when the temperature in Oyster Creek was below 30 C. During the warm period, sand shrimp zoeae were common only in May and June when the temperature in the Creek exceeded 30 C. The average density of this zoea was $0.5/m^3$ in Forked River and $0.04/m^3$ in Oyster Creek during this period.

Adult and juvenile sand shrimp were significantly more abundant in Forked River during the warm period (Table C1-330). They were also more abundant there during the cold period but not significantly so. Adult and juvenile sand shrimp had 75% mortality at OCGS discharge temperatures above 35.0 C, 78% from 32.5 to 35.0 C, and 53% from 30 to 32.5 C. At temperatures from 27.5 to 30.0 C, the average mortality was 23%, and below 27.5 C it generally was less than 10%. The decrease in density of

this form in Oyster Creek was generally greater than that expected from the above mortality data. During the cold period, latent mortality may not account for the decreased density in Oyster Creek because sand shrimp acclimated to 15 C had about a 50% survival when exposed to 28 C for 24 h (Mihursky and Kennedy 1967). Therefore, the lower densities in Oyster Creek may have resulted, in part, from a behavioral change of individuals (Swain et al. 1975) and predation by fishes (see page C1-447).

Zoeae of the grass shrimp Palaemonetes spp. were apparently thermally tolerant, and they were significantly more abundant in Oyster Creek (Table C1-330). Qualitative observations of OCGS discharge collections indicated that grass shrimp zoeae were relatively unaffected by temperatures as high as 35 C. Chase (1977) found 100% survival of grass shrimp zoeae after an exposure of 180 min to temperatures of 36.0 to 37.2 C. Since no collections in Oyster Creek were made at a temperature above 35 C, no adverse effect from temperature shock would be expected for secondarily entrained individuals. On six of seven sampling dates from May through September, grass shrimp zoeae were also more abundant at the lower station in Oyster Creek (Sta. 50) than at the upper station (14). The difference was greatest on two dates in July when the density at the upper station was $4.4/m^3$ and $0.0/m^3$ while at the mouth it was $42.2/m^3$ and $2.5/m^3$, respectively. These data indicated that grass shrimp reproduction occurred in the Creek. Furthermore, the heated discharge apparently stimulated an earlier hatching of the eggs of females in the Creek because grass shrimp zoeae were not collected at the upper station in Forked River in May, but they were taken at the mouth of Oyster Creek.

Adult and juvenile grass shrimp tended to be more abundant in Oyster Creek than Forked River during the warm period and less abundant there during the cold period (Table C1-330), but the differences in density between the areas was not significant. At OCGS discharge temperatures above 35 C, mortality of this form averaged 89%, and below 35 C it did not exceed 33%.

Mud crab zoeae were significantly more abundant in Forked River during the warm period. These zoeae were collected in Oyster Creek during April but not in Forked River, and this indicated that the eggs of gravid mud crabs in Oyster Creek hatched earlier than those of females in Forked River. Qualitative observations indicated that few mud crab zoeae were affected by entrainment through OCGS at temperatures below 35.0 C. Zoeae of the mud crabs Neopanope texana, Panopeus herbstii, and Rhithropanopeus harrisii have been reared successfully at 30.0 C by Chamberlain (1961) and Costlow et al. (1962, 1966). R. harrisii zoeae had better survival over the cyclic temperature range of 30.0 to 35.0 C than at a constant temperature of either 30.0 or 35.0 C (Costlow and Bookhout 1971). Exposure of R. harrisii zoeae to temperatures of 37 C or below for 180 min produced no mortality although exposure to 38 C and above produced 100% mortality (Chase 1977). Mud crab zoeae occurred from April into September and the temperature in Oyster Creek did not exceed 32.5 C. Therefore, no mortality of secondary entrained individuals should have occurred due to temperature shock, and the lower density of mud crab zoeae in Oyster Creek (Table C1-330) may have resulted from mortality of zoeae passed through OCGS or behavioral changes.

Blue crab megalopae were collected in the two areas from late August to early November, and they were more abundant in Forked River (Table C1-330). Megalopae of the blue crab are very temperature tolerant, and therefore, this decrease in density probably did not represent mortality from temperature shock. Chase (1977) found no mortality of blue crab megalopae collected from a discharge canal at temperatures below 38 C and no mortality when this form was exposed in the laboratory for 180 min to temperatures below 38 C. Only 4 of the 376 blue crab megalopae collected at OCGS in 1975 and 1976 and examined after entrainment through OCGS at temperatures above 30 C were dead. Qualitatively, however, some blue crab megalopae were observed to remain on the bottom of the examination pan and did not display the active swimming behavior of individuals collected from the OCGS intake. This difference in behavior may account for some of the apparent differences in density between Forked River and Oyster Creek.

Epitokes of Nereis spp. were significantly more abundant in Forked River during the warm period (Table C1-330). However, in April these epitokes were collected only in Oyster Creek where they were most abundant at the lower Creek station. The source of these epitokes appeared to be from adult Nereis in Oyster Creek which entered the reproductive stage earlier than the rest of the Bay population. This earlier reproduction was probably due to the elevated water temperature in Oyster Creek.

Epitokes of Nereis spp. appeared relatively tolerant of the temperatures it encountered during primary and secondary entrainment. Mortality was about 65% at temperatures from 27.5 to 30.0 C in April and May, but

from June through September, mortality did not exceed 25% at temperatures from 27.5 to 37.5 C (Sandine et al. 1977). Therefore, the lower densities of epitokes in Oyster Creek probably were not attributable to mortality from temperature shock. Since Nereis epitokes die soon after release of gametes (Pettibone 1963), the decrease in density in Oyster Creek may be due, in part, to natural mortality.

Ichthyoplankton

The species composition and relative abundance of ichthyoplankton were similar in both Forked River and Oyster Creek (Table C1-332). The common ichthyoplankton (> 1% of all larvae and juveniles collected) were winter flounder larvae (53%), larvae and juveniles of the bay anchovy (21%), goby larvae (11%), sand lance larvae (10%), and juveniles of the northern pipefish (2%). The eggs of the bay anchovy comprised 98% of the eggs taken; eggs of the tautog, cunner, and hogchoker accounted for most of the remainder (Table C1-332). The abundance and species composition of ichthyoplankton were characterized by cold season forms (December through April) and warm season forms (May through September), and the period of occurrence for a form was similar to that found in Barnegat Bay (Tatham et al. 1977).

The cold season was dominated by larvae of the winter flounder (82% of the larvae and juveniles collected from December through April) and sand lance (15%), but few eggs were collected (Table C1-332). Larvae of the sand lance appeared in March 1976 ($1.3/m^3$ mean monthly density). They also occurred from mid-December through March 1977 and were most

abundant in March 1977 ($1.9/m^3$). Winter flounder larvae occurred in March 1976 ($2.1/m^3$) and again during February and March 1977 with maximum abundance in March 1977 ($15.8/m^3$).

The warm season was dominated by the eggs of the bay anchovy (98% of all eggs during the period) and larvae and juveniles of the bay anchovy (57% of all larvae and juveniles) and gobies (31%, Table C1-332). Northern pipefish juveniles (6.4%) and atherinid larvae (1.8%) were common, but neither species had a well-defined period of maximum abundance. Eggs of the tautog, cunner, and hogchoker were also collected. Bay anchovy eggs were first collected in May, and the maximum mean monthly density ($137.5/m^3$) occurred then. After May, the mean monthly density gradually decreased, and most spawning ceased by September. Bay anchovy larvae were first taken in May, and maximum abundance ($3.4/m^3$) occurred in July. Larvae remained abundant through early August but decreased in abundance during September as they grew to juveniles. Goby (Gobiosoma spp.) larvae were first collected in May, were most abundant (mean monthly density of $1.0/m^3$) in July, and gradually became less abundant through September.

The Wilcoxon rank sum test indicated that the densities of larvae of the winter flounder, sand lance, and goby; juveniles of the northern pipefish; and eggs, larvae, and juveniles of the bay anchovy were not significantly different between the upper station in Forked River (Sta. 6) and the station at the mouth of Oyster Creek (50). Only the density of all larvae and juveniles combined was significantly greater in Forked River than in Oyster Creek. Most larvae were abundant on only a few

dates, and therefore, statistical tests were not always sensitive enough to detect apparent differences between the two areas. Despite the results of statistical tests, all forms showed a decrease in density at the mouth of Oyster Creek as compared to the upper station in Forked River (Table C1-333). This decrease ranged from 42% for goby larvae to 86% for juvenile northern pipefish.

The decreased densities of most ichthyoplankton between Forked River and Oyster Creek may have been attributable, in part, to entrainment losses at OCGS. Some 47% of the water in Oyster Creek passed through the OCGS cooling-water system. Therefore, a decrease of about 50% in the density of a form at the mouth of Oyster Creek may have been due to primary entrainment losses. Statistically significant mortality of larvae immediately after entrainment through OCGS has been found (Appendix D1, Section D1.16). Losses from primary entrainment were expected to exceed those from secondary entrainment because organisms passed through the OCGS cooling-system were exposed to a higher temperature and to greater mechanical effects than those secondarily entrained. Decreases greater than 50% may represent additional losses from secondary entrainment between the two areas. Some apparent differences in abundance may also have been caused by the large natural variation in plankton populations (Heinle 1977); this was particularly true for forms that were present in low densities. In addition, the six stations in the two areas were sampled sequentially over an interval of about 4 h, and some differences in density between the stations may be due to variability from vertical migration and unequal distribution (patchiness) of organisms.

The lack of a significant difference in the density of bay anchovy eggs between Forked River and Oyster Creek may be due to either spawning in Oyster Creek or a high survival rate after entrainment. Decreased survival of secondarily entrained bay anchovy eggs was not expected because the temperature in Oyster Creek was below 33.5 C. In laboratory tests at a salinity of 12 ppt, Meldrim (unpublished) reported that 84% of the bay anchovy eggs exposed to 33.5 C for 1 h hatched, and this percentage was not substantially different than the 90% of the eggs which hatched at ambient temperature.

Summary

The macrozooplankton community of Forked River and Oyster Creek was characterized by one assemblage at an ambient water temperature below 18 C and another assemblage above 18 C, but the species composition in the two areas was similar. The lagoon stations were generally areas of lower abundance with the Oyster Creek lagoon having the lowest mean density of all stations. On 12 of 13 sampling dates, densities of common and important macrozooplankton were greater in Forked River; the zoeae of the grass shrimp were an exception to this pattern. Because many forms showed lower densities in Oyster Creek when the OCGS discharge temperature was below the temperature that caused immediate mortality, other factors such as behavioral changes (i.e., negative thermotaxis), predation, and latent mortality may have caused these apparent differences in abundance. Some forms also reproduced earlier in Oyster Creek.

Although most ichthyoplankton did not have a significant decrease in density between Forked River and Oyster Creek, a consistent decrease in density of all forms occurred between the upper station in Forked River and the station at the mouth of Oyster Creek. These decreases may be attributed to mortality from entrainment, latent mortality, and behavioral effects.

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Table C1-142. Alphabetical listing by common name of all vertebrates collected by fish and impingement programs from September 1976 through August 1977.

Alewife - Alosa pseudoharengus
American eel - Anguilla rostrata
American shad - Alosa sapidissima
Atlantic croaker - Micropogon undulatus
Atlantic herring - Clupea harengus
Atlantic menhaden - Brevoortia tyrannus
Atlantic moonfish - Vomer setapinnis
Atlantic needlefish - Strongylura marina
Atlantic silverside - Menidia menidia
Atlantic spadefish - Chaetodipterus faber
Bay anchovy - Anchoa mitchilli
Bigeye scad - Selar crumenophthalmus
Black sea bass - Centropristis striata
Blackcheek tonguefish - Symphurus plagiusa
Blueback herring - Alosa aestivalis
Bluefish - Pomatomus saltatrix
Blue runner - Caranx crysos
Bluespotted cornetfish - Fistularia tabacaria
Bluntnose stingray - Dasyatis sayi
Butterfish - Peprilus triacanthus
Chain pickerel - Esox niger
Chain pipefish - Syngnathus louisianae
Cobia - Rachycentron canadum
Conger eel - Conger oceanicus
Crevalle jack - Caranx hippos
Cunner - Tautogolabrus adspersus
Diamondback terrapin - Malaclemys terrapin
Feather blenny - Hypsoblennius hentzi
Flying gurnard - Dactylopterus volitans
Fourspine stickleback - Apeltes quadracus
Fowler's toad - Bufo fowleri
Gag - Mycteroperca microlepis
Gizzard shad - Dorosoma cepedianum
Golden shiner - Notemigonus crysoleucas
Gray snapper - Lutjanus griseus
Grubby - Myoxocephalus aenaeus
Halfbeak - Hyporhamphus unifasciatus
Hogchoker - Trinectes maculatus
Inshore lizardfish - Synodus foetens
Lined seahorse - Hippocampus erectus
Lookdown - Selene vomer
Mummichog - Fundulus heteroclitus
Naked goby - Gobiosoma bosci
Northern kingfish - Menticirrhus saxatilis
Northern pipefish - Syngnathus fuscus
Northern puffer - Sphoeroides maculatus
Northern searobin - Prionotus carolinus
Northern sennet - Sphyraena borealis
Northern stargazer - Astroscopus guttatus
Orange filefish - Aluterus schoepfi
Oyster toadfish - Opsanus tau
Permit - Trachinotus falcatus
Planehead filefish - Monacanthus hispidus
Pumpkinseed - Lepomis gibbosus
Rainwater killifish - Lucania parva
Red hake - Urophycis chuss
Rough silverside - Membras martinica
Sand lance - Ammodytes sp.
Scup - Stenotomus chrysops
Seaboard goby - Gobiosoma ginsburgi
Sheepshead minnow - Cyprinodon variegatus
Silver anchovy - Engraulis eurystole
Silver perch - Bairdiella chrysura
Smallmouth flounder - Etropus microstomus
Smooth dogfish - Mustelus canis
Smooth trunkfish - Lactophrys triqueter
Spiny dogfish - Squalus acanthias
Spot - Leiostomus xanthurus
Spotfin butterflyfish - Chaetodon ocellatus
Spotted hake - Urophycis regius
Striped anchovy - Anchoa hepsetus
Striped bass - Morone saxatilis
Striped blenny - Chasmodes bosquianus
Striped burrfish - Chilomycterus schoepfi
Striped cusk-eel - Rissola marginata
Striped killifish - Fundulus majalis
Striped mullet - Mugil cephalus
Striped searobin - Prionotus evolans
Summer flounder - Paralichthys dentatus
Tautog - Tautoga onitis
Threespine stickleback - Gasterosteus aculeatus
Tidewater silverside - Menidia beryllina
Weakfish - Cynoscion regalis
White mullet - Mugil curema
White perch - Morone americana
Windowpane - Scophthalmus aquosus
Winter flounder - Pseudopleuronectes americanus

Table C1-143. Alphabetical listing by scientific name of all vertebrates collected by fish and impingement programs from September 1976 through August 1977.

Alosa aestivalis - Blueback herring
Alosa pseudoharengus - Alewife
Alosa sapidissima - American shad
Aluterus schoepfi - Orange filefish
Ammodytes sp. - Sand lance
Anchoa hepsetus - Striped anchovy
Anchoa mitchilli - Bay anchovy
Anguilla rostrata - American eel
Apeltes quadracus - Fourspine stickleback
Astroscopus guttatus - Northern stargazer
Bairdiella chrysura - Silver perch
Brevoortia tyrannus - Atlantic menhaden
Bufo fowleri - Fowler's toad
Caranx crysos - Blue runner
Caranx hippos - Crevalle jack
Centropristis striata - Black sea bass
Chaetodipterus faber - Atlantic spadefish
Chaetodon ocellatus - Spotfin butterflyfish
Chasmodes bosquianus - Striped blenny
Chilomycterus schoepfi - Striped burrfish
Clupea harengus - Atlantic herring
Conger oceanicus - Conger eel
Cynoscion regalis - Weakfish
Cyprinodon variegatus - Sheepshead minnow
Dactylopterus volitans - Flying gurnard
Dasyatis sayi - Bluntnose stingray
Dorosoma cepedianum - Gizzard shad
Engraulis eruystole - Silver anchovy
Esox niger - Chain pickerel
Etropus microstomus - Smallmouth flounder
Fistularia tabacaria - Bluespotted cornetfish
Fundulus heteroclitus - Mummichog
Fundulus majalis - Striped killifish
Gasterosteus aculeatus - Threespine stickleback
Gobiosoma bosci - Naked goby
Gobiosoma ginsburgi - Seaboard goby
Hippocampus erectus - Lined seahorse
Hyporhamphus unifasciatus - Halfbeak
Hypsoblennius hentzi - Feather blenny
Lactophys triqueter - Smooth trunkfish
Leiostomus xanthurus - Spot
Lepomis gibbosus - Pumpkinseed
Lucania parva - Rainwater killifish
Lutjanus griseus - Gray snapper
Malaclemys terrapin - Diamondback terrapin
Membras martinica - Rough silverside
Menidia beryllina - Tidewater silverside
Menidia menidia - Atlantic silverside
Menticirrhus saxatilis - Northern kingfish
Micropogon undulatus - Atlantic croaker
Monacanthus hispidus - Planehead filefish
Morone americana - White perch
Morone saxatilis - Striped bass
Mugil cephalus - Striped mullet
Mugil curema - White mullet
Mustelus canis - Smooth dogfish
Mycteroperca microlepis - Gag
Myoxocephalus aenaeus - Grubby
Notemigonus crysoleucas - Golden shiner
Opsanus tau - Oyster toadfish
Paralichthys dentatus - Summer flounder
Peprilus triacanthus - Butterfish
Pomatomus saltatrix - Bluefish
Prionotus carolinus - Northern searobin
Prionotus evolans - Striped searobin
Pseudopleuronectes americanus - Winter flounder
Rachycentron canadum - Cobia
Rissola marginata - Striped cusk-eel
Scophthalmus aquosus - Windowpane
Selar crumenophthalmus - Bigeye scad
Selene vomer - Lookdown
Sphoeroides maculatus - Northern puffer
Sphyraena borealis - Northern sennet
Squalus acanthias - Spiny dogfish
Stenotomus chrysops - Scup
Strongylura marina - Atlantic needlefish
Symphurus plagiusa - Blackcheek tonguefish
Syngnathus fuscus - Northern pipefish
Syngnathus louisianae - Chain pipefish
Synodus foetens - Inshore lizardfish
Tautog onitis - Tautog
Tautogolabrus adspersus - Cunner
Trachinotus falcatus - Permit
Trinectes maculatus - Hogchoker
Urophycis chuss - Red hake
Urophycis regius - Spotted hake
Vomer setapinnis - Atlantic moonfish

Table C1-144. Alphabetical listing by scientific names of all macroinvertebrate taxa collected by fish and impingement programs from September 1976 through August 1977.

Actiniaria (order) - sea anemones	Nosema stephani - a microsporidian parasite
Aequorea spp. - a hydromedusa	Olencira praegustator - a parasitic isopod
Callinectes sapidus - blue crab	Ovalipes ocellatus - a lady crab
Callinectes similis - lesser blue crab	Pagurus longicarpus - long-armed hermit crab
Cancer irroratus - rock crab	Palaemonetes pugio - grass shrimp
Carcinus maenus - green crab	Palaemonetes vulgaris - grass shrimp
Crangon septemspinosa - sand shrimp	Panopeus herbstii - a mud crab
Cyanea capillata - lion's mane jellyfish	Penaeus aztecus - brown shrimp
Ensis directus - Atlantic jackknife clam	Penaeus setiferus - white shrimp
Lernaeenicus spp. - parasitic copepods	Piscicolidae (family) - marine leeches
Libinia dubia - spider crab	Polychaeta (class) - bristle worms
Limulus polyphemus - horseshoe crab	Porifera (phylum) - sponges
Lironeca ovalis - a parasitic isopod	Portunus gibbesi - a portunid crab
Loliginidae (family) - squids	Portunus spinimanus - a portunid crab
Loligo pealei - Atlantic long-finned squid	Procambarus blandingi - Blanding's crayfish
Lolliguncula brevis - brief squid	Scyphozoa (class) - true jellyfishes
Mercenaria mercenaria - hard clam, northern quahog	Squilla empusa - mantis shrimp
Mytilus edulis - blue mussel	Urosalpinx cinereus - Atlantic oyster drill
Nemertea (phylum) - ribbon worms	Xanthidae (family) - mud crabs
Neopanope texana - a mud crab	

Table CI-148. Mean monthly water temperature (C) in the OCGS condenser intake and the condenser discharge and the difference between these temperatures (ΔT) during plant operation and shutdown from September 1975 through August 1977.

Month	Days		1976-76 Mean Temp. of Condenser Intake		Mean Temp. of Condenser Discharge		ΔT		Days		1976-77 Mean Temp. of Condenser Intake		Mean Temp. of Condenser Discharge		ΔT	
	Operating	Shutdown	Operating	Shutdown	Operating	Shutdown	Operating	Shutdown	Operating	Shutdown	Operating	Shutdown	Operating	Shutdown	Operating	Shutdown
September	23	7	20.4	19.2	31.1	21.4	10.7	2.2	30	-	23.3	-	31.5	-	8.2	-
October	31	-	16.4	-	22.8	-	6.4	-	31	-	14.9	-	23.7	-	8.8	-
November	24	6	12.8	7.8	24.5	9.0	11.7	1.2	30	-	6.8	-	16.6	-	9.8	-
December	25	6	4.7	3.4	15.8	4.7	11.1	1.3	31	-	0.1	-	10.0	-	9.9	-
January	-	31	-	0.8	-	1.2	-	0.6	31	-	0.1	-	10.1	-	10.0	-
February	-	29	-	4.1	-	4.4	-	0.3	28	-	2.1	-	12.2	-	10.1	-
March	21	10	9.7	7.5	16.8	7.4	7.1	-0.1	31	-	8.8	-	17.1	-	8.6	-
April	30	-	14.3	-	22.5	-	8.2	-	22	8	13.3	16.2	21.8	17.7	8.5	1.5
May	31	-	20.0	-	28.7	-	8.7	-	-	31	-	18.4	-	19.8	-	1.4
June	30	-	25.8	-	35.4	-	9.6	-	-	30	-	20.2	-	22.7	-	2.5
July	28	3	26.7	25.7	35.7	26.8	9.0	1.1	-	31	-	25.6	-	27.0	-	1.2
August	31	-	26.6	-	36.3	-	9.7	-	27	4	26.6	25.3	37.6	27.0	11.0	1.7
						Mean ΔT =	9.2							Mean ΔT =	9.4	

Table C1-146. Mean surface (S) and bottom (B) water temperatures at thermally unaffected and affected stations in western Barnegat Bay from September 1976 through August 1977.

Location (Station No.)		September	October	November	December	January	February	March	April	May	June	July	August	Yearly Mean
Thermally unaffected:														
Mouth of Cedar Creek (1)	S	-	13.6	6.2	1.6	Ice	Ice	6.9	15.6	16.5	20.8	29.4	27.0	15.3
	B	-	13.2	7.6	1.5	Ice	Ice	8.6	13.3	16.5	20.2	30.4	26.7	15.3
Mouth of Forked River (4)	S	24.1	13.5	7.4	2.4	Ice	Ice	6.9	14.8	16.5	20.6	28.6	27.2	16.3
	B	24.6	14.0	7.8	3.9	Ice	Ice	7.3	13.4	16.4	18.2	28.3	26.0	16.0
Mouth of Double Creek (23)	S	-	9.4	6.0	2.7	Ice	Ice	7.5	19.0	18.2	23.9	30.8	29.3	16.3
	B	-	12.1	6.5	1.8	Ice	Ice	8.1	14.6	16.4	19.8	30.3	25.0	14.9
Mean	S	24.1	12.3	6.5	2.3	Ice	Ice	7.1	16.5	17.1	21.4	29.7	28.0	16.5
	B	24.6	13.1	7.3	2.4	Ice	Ice	8.0	13.8	16.4	19.3	29.7	25.9	16.0
Thermally affected:														
Mouth of Oyster Creek (17)	S	26.8	16.2	10.4	6.2	3.7	7.4	9.8	17.6	17.0	21.7	28.9	30.6	16.4
	B	26.0	17.3	10.6	5.9	4.7	7.2	10.6	17.2	16.8	19.1	29.2	30.3	16.2

Table C1-147. Mean surface (S) and bottom (B) salinities (ppt) at thermally unaffected and affected stations in western Barnegat Bay from September 1976 through August 1977.

Location (Station No.)		September	October	November	December	January	February	March	April	May	June	July	August	Yearly Mean
Thermally unaffected:														
Mouth of Cedar Creek (1)	S	-	24.5	21.0	17.7	Ice	Ice	20.0	17.8	19.9	21.8	19.9	25.2	20.9
	B	-	22.0	18.0	20.5	Ice	Ice	21.8	16.5	19.4	20.5	22.5	26.3	20.8
Mouth of Forked River (4)	S	25.8	26.3	24.0	21.0	Ice	Ice	21.9	22.3	22.8	24.7	26.1	27.3	24.2
	B	26.0	26.5	23.9	22.4	Ice	Ice	22.5	22.3	24.3	26.7	26.9	26.4	24.7
Mouth of Double Creek (23)	S	-	26.4	25.3	21.7	Ice	Ice	23.4	23.8	25.4	26.7	21.7	27.6	24.7
	B	-	26.5	26.0	24.0	Ice	Ice	24.0	24.5	25.6	27.0	28.3	26.0	25.8
Mean	S	25.8	25.8	23.4	20.1	Ice	Ice	21.8	21.3	22.6	24.4	22.6	26.8	23.5
	B	26.0	25.0	22.8	22.3	Ice	Ice	22.8	21.1	23.1	24.7	25.7	26.3	24.0
Thermally affected:														
Mouth of Oyster Creek (17)	S	25.7	25.8	23.1	21.5	24.0	23.3	22.1	21.9	21.6	23.9	24.7	26.8	23.7
	B	25.8	25.8	23.3	22.0	23.0	23.5	22.8	21.5	21.0	24.7	24.6	25.6	23.6

Table C1-148. Mean surface (S) and bottom (B) water temperature in Forked River (intake canal) and Oyster Creek (discharge canal) from March 1976 through March 1977.

Location (Station No.)		1976 March	April	May	June	July	August	September	October	November	December	1977 January	February	March	Yearly Mean
THERMALLY UNAFFECTED:															
Forked River, just east of Rt. 9 bridge (6)	S	11.8	22.1	14.6	26.3	24.5	24.4	23.2	13.7	7.5	3.0	ice	ice	6.9	16.2
	B	11.5	22.5	14.6	26.4	24.5	24.5	23.1	13.7	7.6	3.1	ice	ice	7.1	16.2
Forked River, south branch, east of Beach Blvd. bridge (46)	S	12.3	22.0	14.5	27.1	23.9	25.3	23.3	13.4	8.0	2.1	ice	ice	6.6	16.2
	B	12.3	22.2	14.9	27.2	23.9	25.3	23.4	13.5	8.3	2.2	ice	ice	6.7	16.4
Forked River, lagoon off north bank of south branch (46)	S	13.5	20.9	15.4	26.2	24.7	25.2	23.6	12.8	7.0	1.6	ice	ice	6.7	16.1
	B	13.0	20.6	15.7	25.9	24.8	24.9	22.7	12.8	6.9	2.7	ice	ice	6.7	16.1
Forked River, beach at end of Kanoohe Ave. (47)	S	14.0	21.5	17.7	25.2	23.9	26.7	25.2	15.5	8.0	2.1	ice	4.5	6.1	15.9
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intake Canal, just west of Rt. 9 bridge (48)	S	13.5	23.0	15.5	28.0	24.0	24.5	22.7	13.2	6.0	3.0	1.4	3.6	9.1	14.4
	B	13.5	22.7	15.5	28.0	24.0	24.5	23.0	13.4	-	3.2	1.5	3.3	9.6	15.2
Intake Canal, just east of security fence (49)	S	13.5	23.5	15.5	31.2	23.8	24.4	23.4	12.6	6.0	3.0	1.6	3.6	8.4	14.7
	B	13.5	23.0	15.3	31.5	24.2	24.6	22.7	13.4	-	3.5	2.2	3.4	9.4	15.6
Mean	S	13.1	22.2	15.5	27.3	24.1	25.1	23.4	13.5	7.1	2.5	1.5	3.9	7.5	14.4
	B	12.8	22.2	15.2	27.6	24.3	24.8	23.0	13.4	7.6	2.9	1.9	3.4	7.9	14.4
THERMALLY AFFECTED															
Immediate vicinity of OCGS condenser discharge (26)	S	19.7	30.0	15.1	34.5	31.0	31.8	30.5	21.9	16.4	10.7	4.9	12.1	13.7	20.9
	B	19.8	30.6	15.0	33.9	31.1	31.6	28.5	21.6	16.9	8.2	7.9	13.1	13.6	20.9
Discharge Canal between railroad trestle and Rt. 9 bridge (27)	S	18.0	27.5	16.2	34.2	29.0	29.4	27.4	18.9	8.6	8.0	6.6	6.8	11.6	18.6
	B	15.0	27.5	15.7	32.8	28.5	28.8	27.0	16.2	9.0	6.6	6.3	7.1	11.4	17.8
Mean	S	18.9	28.8	15.7	34.4	30.0	30.6	29.0	20.4	12.6	9.4	5.8	9.5	12.7	19.8
	B	17.4	29.1	15.4	33.4	29.8	30.2	27.8	18.9	13.0	7.4	7.1	10.1	12.5	19.4
Oyster Creek, east of Rt. 9 bridge (15)	S	14.5	26.9	17.3	30.6	28.6	29.1	27.9	17.5	10.8	8.3	4.5	5.1	10.5	17.8
	B	14.8	24.6	17.3	30.7	28.6	29.1	27.8	17.5	10.3	8.5	4.5	7.0	10.9	17.8
Oyster Creek, south bank, across from L.A. dock (28)	S	15.0	25.0	18.0	28.8	27.0	30.0	27.9	18.6	12.7	6.3	6.5	8.2	8.6	17.9
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oyster Creek, south shore, just upstream from mouth (29)	S	15.2	25.0	19.2	29.0	26.8	30.2	28.5	18.2	11.8	5.5	4.0	8.2	9.1	17.7
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oyster Creek, easternmost lagoon (30)	S	15.0	23.3	19.6	29.3	27.5	28.5	26.9	16.1	10.9	6.5	ice	ice	10.1	19.4
	B	15.0	23.0	19.8	28.7	27.1	28.2	26.8	16.3	10.4	7.2	ice	ice	10.4	19.4
Oyster Creek, from easternmost lagoon to mouth (50)	S	15.4	26.8	16.6	30.3	27.9	29.5	27.3	17.4	11.2	8.0	4.5	7.8	10.6	17.9
	B	15.4	26.9	16.6	30.2	28.1	29.6	27.4	17.3	10.7	8.1	4.5	7.2	11.0	17.9
Mean	S	15.0	25.4	18.1	29.6	27.6	29.5	27.7	17.6	11.8	6.9	4.9	7.3	9.8	17.8
	B	15.1	25.0	17.9	29.9	27.9	29.0	27.3	17.0	10.5	7.9	4.5	7.1	10.8	17.7

Table C1-149. Mean monthly surface (S) and bottom (B) temperatures, salinities, dissolved oxygen concentrations, pH and Secchi disc measurements at the cooling-water intake from September 1976 through August 1977.

		September	October	November	December	January	February	March	April	May	June[a]	July	August	Yearly Mean
Temperature (C)	S	22.1	14.0	6.0	2.0	1.0	3.2	9.3	12.9	15.6	-	25.9	25.2	12.6
	B	22.2	14.1	6.3	2.3	1.3	3.4	9.5	14.2	15.8	-	26.2	26.4	12.8
Salinity (ppt)	S	24.6	24.4	23.8	24.5	23.7	24.4	22.0	21.4	22.5	-	25.4	25.4	23.8
	B	24.6	24.3	23.8	24.2	24.0	24.6	22.1	21.5	22.5	-	25.4	25.6	23.9
Oxygen (ppm):	S	7.0	9.3	11.1	11.7	12.0	12.2	9.8	8.8	8.4	-	5.9	6.6	9.3
	B	7.1	9.0	11.0	11.3	12.3	12.2	9.8	8.8	8.4	-	5.6	6.6	9.3
pH	S	7.9	7.8	7.9	7.9	8.0	8.1	8.0	8.0	8.0	-	8.0	8.1	8.0
	B	7.9	7.8	8.0	7.9	8.0	8.0	8.0	8.0	8.0	-	8.0	8.1	8.0
Secchi (cm)		64.8	70.5	114.9	108.7	150.7	183.7	169.5	107.5	131.0	-	91.3	58.6	111.0

[a] OCGS shutdown.

Table C1-150. Results of paired t-tests for comparison of surface and bottom water chemistries taken at OCGS from September 1975 through August 1977.

	TEMPERATURE	SALINITY	DISSOLVED OXYGEN	pH
October - November	NS[a]	NS	NS	Surface > Bottom *
December	Surface > Bottom *	NS	NS	NS
OCGS Shutdown	-	-	-	-
March - May	Bottom > Surface *	NS	NS	NS
June - August	Bottom > Surface *	NS	NS	NS
September 1975 - August 1976[b]	NS	Bottom > Surface *	NS	NS
October - November	Bottom > Surface **	NS	Surface > Bottom *	Bottom > Surface **
December - February	Bottom > Surface **	Bottom > Surface *	NS	NS
March - May	Bottom > Surface **	NS	NS	NS
OCGS Shutdown	-	-	-	-
July - August	Bottom > Surface **	NS	NS	Bottom > Surface **
September 1976 - August 1977[c]	Bottom > Surface **	Bottom > Surface *	NS	Bottom > Surface **

[a] NS = not significant
* = achieved significance at $P < 0.05$
** = achieved significance at $P \leq 0.01$
[b] No samples taken at OCGS from 24 December 1975 through 7 March 1976.
[c] No samples taken at OCGS from 14 May through 12 July 1977.

Table C1-151. Total precipitation at the Oyster Creek site area from September 1975 through August 1977.[a]

Month	1975-76		1976-77	
	(inches)	(mm)	(inches)	(mm)
September	5.60	142.2	1.19	30.2
October	2.28	57.9	7.27	184.7
November	3.25	82.6	0.60	15.2
December	2.19	55.6	2.14	54.4
January	3.59	91.2	2.38	60.5
February	1.77	45.0	2.15	54.6
March	1.13	28.7	3.60	91.4
April	1.68	42.7	2.61	66.3
May	2.39	60.7	1.25	31.8
June	1.02	25.9	2.99	75.9
July	3.06	77.7	3.59	91.2
August	7.45	189.2	7.73	196.3
Total	35.41	899.4	37.50	952.5

[a] Data from OCGS meteorological tower (D. R. Weigle, personal communication).

Table C1-152. Mean surface (S) and bottom (B) salinities (ppt) in Forked River (intake canal) and Oyster Creek (discharge canal) from March 1976 through March 1977.

Location (Station No.)		1976 March	April	May	June	July	August	September	October	November	December	1977 January	February	March	Yearly Mean
THERMALLY UNAFFECTED:															
Forked River, just east of Rt. 9 bridge (6)	S	22.4	20.2	21.5	25.0	26.6	23.0	25.6	25.7	23.0	23.0	Ice	Ice	22.7	23.5
	B	22.8	20.2	22.0	25.0	26.9	22.9	25.6	26.0	23.0	23.0	Ice	Ice	22.5	23.6
Forked River, south branch, east of Beach Blvd. bridge (45)	S	23.0	20.3	21.0	24.6	27.0	22.4	25.0	26.3	23.5	22.3	Ice	Ice	21.9	23.4
	B	23.3	20.1	21.6	24.5	26.7	23.1	25.2	25.3	24.0	22.7	Ice	Ice	22.1	23.5
Forked River, lagoon off north bank of south branch (46)	S	21.8	20.5	21.3	25.0	27.0	22.6	25.2	24.8	23.8	21.7	Ice	Ice	22.0	23.2
	B	22.3	20.8	21.7	24.5	27.5	22.8	24.8	25.3	23.9	22.7	Ice	Ice	22.3	23.5
Forked River, beach at end of Kanoche Ave. (47)	S	22.0	22.0	20.0	24.0	27.5	23.9	23.7	25.0	24.0	22.8	Ice	22.0	22.5	23.4
	B	-	-	-	-	-	-	-	-	-	-	Ice	-	-	-
Intake Canal, just west of Rt. 9 bridge (48)	S	22.0	20.0	22.5	24.0	27.5	21.8	24.8	25.5	23.5	23.0	25.0	23.0	22.0	23.4
	B	22.0	20.5	22.5	24.0	27.5	22.3	24.8	25.5	-	23.0	25.0	23.0	22.0	23.5
Intake Canal, just east of security fence (49)	S	22.0	19.8	22.5	24.0	27.5	21.8	24.8	26.0	23.5	23.0	25.0	23.0	21.5	23.4
	B	22.0	19.8	22.5	24.0	27.5	22.0	24.8	26.0	-	23.0	26.0	23.0	21.6	23.5
Mean	S	22.2	20.5	21.5	24.4	27.2	22.6	24.9	25.6	23.6	22.6	25.0	23.0	22.1	23.5
	B	22.5	20.3	22.1	24.4	27.2	22.6	25.0	25.6	23.6	22.9	25.5	23.0	22.1	23.6
THERMALLY AFFECTED:															
Immediate vicinity of OCGS condenser discharge (26)	S	22.0	20.1	21.5	24.0	26.4	22.1	24.8	25.5	23.0	25.0	24.7	25.0	22.0	23.5
	B	22.0	20.4	21.5	24.0	27.1	21.9	24.8	25.5	24.0	25.0	24.7	25.0	22.0	23.7
Discharge Canal between railroad trestle and Rt. 9 bridge (27)	S	22.0	20.0	21.0	24.0	27.5	22.0	25.0	25.5	23.5	22.0	25.0	25.0	21.0	23.3
	B	22.0	20.0	21.0	24.5	27.5	22.0	25.5	25.5	23.5	22.0	25.0	25.0	21.0	23.4
Mean	S	22.0	20.1	21.3	24.0	27.0	22.1	24.9	25.5	23.3	23.5	24.9	25.0	21.5	23.5
	B	22.0	20.2	21.3	24.3	27.3	22.0	25.2	25.5	23.8	23.5	24.9	25.0	21.5	23.6
Oyster Creek, east of Rt. 9 bridge (15)	S	22.2	20.3	21.0	24.5	27.1	22.0	25.1	25.7	23.4	22.3	23.3	23.0	21.9	23.3
	B	22.0	20.5	20.9	24.8	26.9	22.1	25.1	25.3	23.3	22.0	22.7	23.0	21.9	23.1
Oyster Creek, south bank, across from L.A. dock (28)	S	21.0	21.0	20.8	24.0	25.0	22.4	18.8	24.0	24.0	22.5	22.5	23.5	20.5	22.3
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oyster Creek, south shore, just upstream from mouth (29)	S	21.5	21.5	20.5	24.0	26.5	22.5	25.0	24.0	24.0	23.5	23.0	23.5	20.5	23.1
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oyster Creek, easternmost lagoon (30)	S	22.0	20.2	20.3	24.7	27.2	22.0	24.8	25.0	23.7	21.0	Ice	Ice	21.7	23.0
	B	22.0	20.0	21.0	25.0	26.8	22.1	24.8	24.3	23.7	22.3	Ice	Ice	21.7	23.1
Oyster Creek, from easternmost lagoon to mouth (50)	S	22.0	20.3	21.0	24.8	27.0	22.4	25.4	25.6	23.3	22.3	22.2	24.0	22.5	23.3
	B	21.8	19.8	21.2	25.0	26.8	21.7	25.3	26.0	23.7	22.4	22.2	24.0	22.3	23.2
Mean	S	21.7	20.7	20.7	24.4	26.6	22.3	23.8	24.9	23.7	22.3	22.3	23.5	21.4	22.9
	B	21.9	20.1	21.0	24.9	26.8	22.0	25.1	25.2	23.6	22.2	22.5	23.5	22.0	23.1

Table C1-153. Mean surface (S) and bottom (B) pH at thermally unaffected and affected stations in western Barnegat Bay from September 1976 through August 1977.

Location (Station No.)		September	October	November	December	January	February	March	April	May	June	July	August	Yearly Mean
Thermally unaffected:														
Mouth of Cedar Creek (1)	S	-	8.1	8.3	8.1	Ice	Ice	8.2	-	-	-	8.1	8.1	8.2
	B	-	8.1	8.7	8.1	Ice	Ice	8.1	-	-	-	8.1	8.5	8.3
Mouth of Forked River (4)	S	8.3	8.2	8.3	7.8	Ice	Ice	8.2	-	-	8.0	8.0	8.3	8.1
	B	8.4	8.2	8.5	7.8	Ice	Ice	8.2	-	-	8.0	8.1	8.4	8.2
Mouth of Double Creek (23)	S	-	8.2	8.3	7.8	Ice	Ice	7.9	-	-	-	8.2	8.5	8.1
	B	-	8.2	8.8	7.7	Ice	Ice	8.0	-	-	-	8.2	8.6	8.2
Mean	S	8.3	8.2	8.3	7.7	Ice	Ice	8.1	-	-	8.0	8.1	8.3	8.1
	B	8.4	8.1	8.8	7.8	Ice	Ice	8.1	-	-	8.0	8.1	8.5	8.2
Thermally affected:														
Mouth of Oyster Creek (17)	S	8.2	8.1	8.3	7.6	8.0	8.1	8.2	-	-	7.8	8.0	8.3	8.1
	B	7.9	8.1	8.5	7.7	7.6	8.2	8.1	-	-	7.8	7.9	8.3	8.0

Table C1-154. Mean monthly surface (S) and bottom (B) oxygen concentration (ppm) at thermally unaffected and affected stations in western Barnegat Bay from September 1976 through August 1977.

Location (Station No.)		September	October	November	December	January	February	March	April	May	June	July	August	Yearly Mean
Thermally unaffected:														
Mouth of Cedar Creek (1)	S	-	10.0	10.7	12.2	Ice	Ice	11.6	9.5	8.1	7.5	6.9	6.8	9.3
	B	-	9.3	12.2	12.2	Ice	Ice	11.1	10.7	8.4	7.0	7.8	8.0	9.6
Mouth of Forked River (4)	S	8.0	10.6	11.2	11.7	Ice	Ice	10.6	9.7	8.8	8.5	6.4	7.6	9.3
	B	8.9	9.0	12.3	12.7	Ice	Ice	11.4	11.2	8.5	8.7	6.9	8.8	9.6
Mouth of Double Creek (23)	S	-	10.2	11.4	11.5	Ice	Ice	10.3	9.1	8.9	7.3	7.6	10.8	9.7
	B	-	9.3	12.8	12.6	Ice	Ice	11.0	10.5	9.3	7.5	7.9	10.2	10.1
Mean	S	8.0	10.3	11.1	11.8	Ice	Ice	11.6	9.4	8.6	7.9	6.6	8.5	9.4
	B	8.9	9.2	12.4	12.5	Ice	Ice	11.2	10.8	8.7	7.7	7.5	9.0	9.8
Thermally affected:														
Mouth of Oyster Creek (17)	S	7.5	10.1	10.9	11.7	12.0	10.3	8.9	9.3	8.4	7.4	6.1	7.6	9.2
	B	8.7	9.3	12.0	11.6	12.0	11.3	10.9	10.4	8.0	7.4	8.1	7.7	9.5

Table C1-155. Mean surface (S) and bottom (B) pH in Forked River (intake canal) and Oyster Creek (discharge canal) from March 1976 through March 1977.

Location (Station No.)		1976 March	April	May	June	July	August	September	October	November	December	1977 January	February	March	Yearly Mean
THERMALLY UNAFFECTED:															
Forked River, just east of Rt. 9 bridge (6)	S	8.0	7.9	8.0	7.3	7.4	8.1	8.1	8.4	8.0	7.9	Ice	Ice	7.9	7.9
	B	8.0	7.9	7.9	7.4	7.5	8.2	8.1	8.3	8.0	7.8	Ice	Ice	7.8	7.9
Forked River, south branch, east of Beach Blvd. bridge (45)	S	7.9	7.0	8.0	7.4	7.6	7.9	8.1	8.4	8.2	8.5	Ice	Ice	8.1	7.9
	B	7.9	7.1	8.0	7.4	7.6	7.9	8.2	8.4	8.2	8.4	Ice	Ice	8.1	7.9
Forked River, lagoon off north bank of south branch (46)	S	7.8	7.8	7.9	6.7	7.9	7.7	8.2	8.4	8.2	8.2	Ice	Ice	7.8	7.9
	B	7.8	7.9	7.8	6.8	7.9	7.9	8.1	8.5	8.3	8.2	Ice	Ice	7.8	7.9
Forked River, beach at end of Kanoahe Ave. (47)	S	-	-	7.8	7.6	8.1	8.3	7.9	7.9	8.1	8.3	Ice	8.0	8.0	8.0
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intake Canal, just west of Rt. 9 bridge (48)	S	8.0	7.6	8.0	8.2	8.5	7.9	8.1	7.9	-	7.2	7.9	8.1	7.6	7.7
	B	8.1	7.6	8.0	8.2	8.6	7.9	8.0	7.9	-	7.2	8.1	8.1	7.7	7.7
Intake Canal, just east of security fence (49)	S	8.0	7.7	8.0	8.2	-	7.9	8.1	8.0	-	7.2	7.9	8.1	7.7	7.9
	B	8.1	7.8	8.0	8.1	-	7.8	8.1	8.0	-	7.2	7.8	8.1	7.7	7.9
Mean	S	7.9	7.8	8.0	7.6	7.9	8.0	8.1	8.2	8.1	7.9	7.9	8.1	7.9	7.9
	B	8.0	7.7	7.9	7.5	7.2	7.9	8.1	8.2	8.2	7.8	8.0	8.1	7.8	7.8
THERMALLY AFFECTED															
Immediate vicinity of OCGS condenser discharge (26)	S	8.0	7.8	8.1	8.0	-	7.8	7.7	7.4	-	7.3	7.9	8.0	7.9	7.8
	B	8.0	7.7	8.0	8.0	-	7.8	7.8	7.4	-	7.3	7.9	8.0	8.0	7.8
Discharge Canal between railroad trestle and Rt. 9 bridge (27)	S	8.0	7.7	8.0	7.9	-	7.8	7.9	7.9	-	7.4	8.0	8.1	8.3	7.9
	B	8.0	7.7	8.0	8.0	-	7.8	7.9	7.9	-	7.3	8.0	8.1	8.3	7.9
Mean	S	8.0	7.8	8.1	8.0	-	7.8	7.8	7.7	-	7.4	8.0	8.1	8.1	7.9
	B	8.0	7.7	8.0	8.0	-	7.8	7.9	7.7	-	7.3	8.0	8.1	8.2	7.9
Oyster Creek, east of Rt. 9 bridge (15)	S	8.0	7.9	7.8	7.2	7.9	7.9	8.0	8.3	8.5	8.0	-	8.2	8.0	8.0
	B	8.0	7.9	7.8	6.8	7.9	7.9	8.1	8.3	8.4	7.9	-	8.2	8.0	7.9
Oyster Creek, south bank, across from L.A. dock (28)	S	-	-	7.6	7.6	8.1	8.1	8.0	7.8	8.0	8.5	-	8.0	8.0	8.0
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oyster Creek, south shore, just upstream from mouth (29)	S	-	-	7.7	7.6	7.2	8.2	8.1	7.9	8.0	8.5	-	8.0	8.1	7.9
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oyster Creek, easternmost lagoon (30)	S	7.6	8.0	7.7	6.9	7.8	8.1	7.9	7.8	8.4	8.0	Ice	8.1	8.0	7.9
	B	7.5	8.0	7.8	6.6	7.8	8.1	7.9	7.8	8.4	8.0	Ice	8.1	8.0	7.8
Oyster Creek, from easternmost lagoon to mouth (50)	S	7.7	7.9	7.7	6.8	7.6	8.0	8.2	8.2	8.3	8.0	Ice	8.2	7.9	7.9
	B	7.9	7.9	7.8	6.7	7.6	8.1	8.1	8.2	8.1	8.0	Ice	8.2	8.0	7.9
Mean	S	7.8	7.9	7.7	7.2	7.7	8.1	8.0	8.0	8.2	8.2	-	8.1	8.0	7.9
	B	7.8	7.9	7.8	6.7	7.8	8.0	8.0	8.1	8.3	8.0	-	8.2	8.0	7.8

Table C1-156. Mean surface (S) and bottom (B) dissolved oxygen (ppm) concentration in Forked River (intake canal) and Oyster Creek (discharge canal) from March 1976 through March 1977.

Location (Station No.)		1976 March	April	May	June	July	August	September	October	November	December	January	February	March	Yearly Mean
THERMALLY UNAFFECTED:															
Forked River, just east of Rt. 9 bridge (6)	S	10.6	7.5	8.3	7.0	6.4	6.6	7.3	8.6	11.3	12.2	Ice	Ice	11.4	8.8
	B	10.6	7.5	8.3	7.0	6.6	6.7	7.2	8.4	11.3	12.0	Ice	Ice	11.0	8.8
Forked River, south branch, east of Beach Blvd. bridge (45)	S	10.8	7.6	9.2	7.4	6.7	7.1	7.2	8.2	11.1	12.3	Ice	Ice	10.3	8.9
	B	10.7	7.5	9.3	7.2	6.5	7.1	7.1	8.0	11.2	12.3	Ice	Ice	10.1	8.8
Forked River, lagoon off north bank of south branch (46)	S	10.6	7.6	8.2	7.9	6.8	8.2	7.5	8.3	11.5	12.0	Ice	Ice	10.3	9.0
	B	10.6	7.6	8.1	6.8	6.7	7.5	7.2	8.3	11.3	12.2	Ice	Ice	10.6	8.8
Forked River, beach at end of Kanosha Ave. (47)	S	11.2	8.9	9.2	8.9	7.1	7.5	7.2	8.5	10.4	13.2	Ice	8.2	12.6	9.2
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intake Canal, just west of Rt. 9 bridge (48)	S	8.4	7.4	9.3	7.7	6.5	7.0	7.8	8.7	-	11.4	11.4	12.8	10.5	9.0
	B	8.4	7.4	9.2	7.5	6.6	6.9	7.7	8.6	-	12.2	11.4	12.6	9.0	8.9
Intake Canal, just east of security fence (49)	S	8.4	7.4	9.2	7.5	6.0	7.0	8.0	9.2	-	11.3	11.6	12.6	10.2	9.0
	B	8.4	7.6	9.3	7.4	5.7	7.0	7.7	8.3	-	12.2	10.8	12.8	10.3	9.0
Mean	S	10.0	7.7	8.9	7.2	6.4	7.2	7.5	8.6	11.1	12.1	11.5	11.2	10.9	9.3
	B	9.7	7.5	8.8	7.2	6.2	7.0	7.4	8.3	11.2	12.2	11.1	12.7	10.2	9.2
THERMALLY AFFECTED															
Immediate vicinity of OCGS condenser discharge (26)	S	10.1	6.8	8.3	7.5	5.6	5.5	7.0	8.1	10.3	12.0	11.3	12.2	9.1	8.7
	B	10.2	6.8	8.2	8.1	5.6	5.5	7.7	8.2	10.0	12.0	10.6	11.7	9.1	8.7
Discharge Canal between railroad trestle and Rt. 9 bridge (27)	S	8.8	7.0	8.6	7.2	5.6	6.6	7.3	9.0	10.1	12.0	11.0	13.4	9.7	8.9
	B	9.2	6.9	9.0	7.1	5.2	6.3	7.1	8.8	10.4	12.4	10.4	12.0	9.6	8.8
Mean	S	9.5	6.9	8.6	7.4	5.5	6.0	7.2	8.6	10.2	12.0	11.2	12.8	9.4	8.9
	B	9.7	6.9	8.6	7.6	5.4	5.9	7.4	8.5	10.2	12.2	10.5	11.9	9.4	8.8
Oyster Creek, east of Rt. 9 bridge (15)	S	10.1	5.7	8.0	6.5	6.4	6.6	7.4	9.2	11.0	10.4	10.2	8.6	10.7	8.5
	B	9.7	5.7	8.2	6.2	6.2	6.5	7.3	9.1	9.8	10.5	10.5	8.4	10.3	8.3
Oyster Creek, south bank, across from L.A. dock (28)	S	10.6	7.0	9.2	5.7	6.0	6.5	6.4	8.6	9.2	13.7	11.6	7.8	10.6	8.8
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oyster Creek, south shore, just upstream from mouth (29)	S	10.6	7.0	9.2	5.9	7.2	7.1	8.8	8.3	9.8	12.8	14.4	7.8	11.5	9.1
	B	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oyster Creek, easternmost lagoon (30)	S	10.2	6.1	7.5	6.9	6.4	7.7	7.8	9.4	10.6	10.5	Ice	Ice	9.7	8.4
	B	10.0	6.5	7.5	6.3	6.0	7.1	6.9	9.2	10.0	11.0	Ice	Ice	9.3	8.2
Oyster Creek, from easternmost lagoon to mouth (50)	S	9.7	6.0	7.8	6.3	6.4	6.7	7.5	9.4	11.2	10.9	10.2	9.4	10.1	8.6
	B	9.6	5.7	7.7	6.1	6.4	6.4	7.3	9.3	9.4	11.1	10.3	9.0	10.0	8.3
Mean	S	10.3	6.4	8.3	6.3	6.7	7.0	7.2	9.0	10.4	11.6	11.6	8.4	10.5	8.7
	B	9.8	6.0	7.8	6.2	6.2	6.7	7.2	9.2	9.7	10.9	10.4	8.7	9.9	8.4

Table C1-157. Mean monthly Secchi disc readings (cm) at thermally unaffected and affected stations in western Barnegat Bay from September 1976 through August 1977.

Location (Station No.)	September	October	November	December	January	February	March	April	May	June	July	August	Yearly Mean
Thermally unaffected stations:													
Mouth of Cedar Creek (1)	-	80	-	120	Ice	Ice	140	110	140	120	65	50	108
Mouth of Forked River (4)	60	70	110	110	Ice	Ice	220	180	120	90	90	55	111
Mouth of Double Creek (23)	-	55	-	85	Ice	Ice	180	160	140	110	70	70	109
Mean	60	68	110	105	Ice	Ice	180	150	133	107	75	58	106
Thermally affected station:													
Mouth of Oyster Creek (23)	73	60	90	95	175	180	190	110	180	70	60	50	111

Table C1-158. Mean Secchi disc readings (cm) for Forked River (FR) and Oyster Creek (OC) from March 1976 through March 1977.

Location (Station No.)	March	April	May	June	July	August	September	October	November	December	January	February	March	Mean
THERMALLY UNAFFECTED														
Forked River, just east of Rt. 9 bridge (6)	100	112	120	100	63	58	73	93	115	150	Ice	Ice	270	95
Forked River, south branch, east of Beach Blvd. bridge (45)	90	113	115	70	60	65	64	88	110	123	Ice	Ice	220	101
Forked River, lagoon off north bank of south branch (46)	80	132	120	70	62	58	79	70	72	107	Ice	Ice	177	93
Forked River, beach at end of Kanoche Ave. (47)	90	80	120	80	40	65	73	80	60	220	190	340	190	123
Intake Canal, just west of Rt. 9 bridge (48)	90	90	120	80	40	60	73	80	60	220	190	340	190	124
Mean	90	105	119	70	51	60	72	79	83	164	190	340	209	126
THERMALLY AFFECTED														
Oyster Creek, east of Rt. 9 bridge (15)	93	108	133	60	58	56	72	70	93	133	185	170	230	112
Immediate vicinity of OCGS condenser discharge (26)	83	95	110	45	38	54	79	80	100	205	175	350	165	121
Discharge Canal between railroad trestle and Rt. 9 bridge (27)	110	100	120	50	40	50	68	75	85	190	210	345	160	123
Oyster Creek, easternmost lagoon (30)	80	155	107	60	62	70	65	67	93	133	-	-	247	104
Oyster Creek, from easternmost lagoon to mouth (50)	95	120	103	50	57	63	69	65	93	143	175	180	220	110
Mean	92	116	115	53	51	59	71	71	93	161	186	261	202	125

Table C1-159. Description of trawl stations regularly sampled during Oyster Creek Generating Station Ecological Studies.

Station 01: Cedar Creek Mouth

Area Sampled:	Navigation channel in mouth of Cedar Creek, west of Intracoastal Waterway can buoy C "63"; tow is made in mid-channel between flashing light FL "1" and the third black channel marker inside Cedar Creek.
Depth Sampled:	1.5 to 2.1 m.
Current:	Very slight, dependent on tide.
Clarity:	Clear to tannic brown.
Aquatic Vegetation:	*Zostera marina* attached and detrital, *Agardhiella*, and *Ulva* occasional to abundant.

Station 04: Forked River Mouth

Area Sampled:	Mouth of Forked River, west of Intracoastal Waterway mid-channel marker BW N "D1"; tow is made in north approach channel between buoys 5 and 6 outside of mouth and buoys 9 and 10 inside of mouth.
Depth Sampled:	1.5 to 2.1 m.
Current:	Slight to moderate, westerly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Detritus (*Zostera marina*) none to abundant; *Ulva* and *Codium* none to occasional.

Station 06: Forked River, east of Route 9 Bridge

Area Sampled:	South branch of Forked River, west of Beach Blvd. bridge and east of Route 9 bridge; tow is made east to west beginning at last house on north bank and ending near Route 9 bridge.
Depth Sampled:	2.1 to 2.4 m.
Current:	Moderate, westerly due to influence of OCGS.
Clarity:	Clear to turbid.

Station 15: Oyster Creek, east of Route 9 Bridge

Area Sampled:	Oyster Creek, approximately 0.5 miles west of Route 9 bridge; tow is made in the channel west to east beginning approximately 180 m west of the bulkheaded pond on the north bank.
Depth Sampled:	1.2 to 2.4 m.
Current:	Moderate, easterly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	*Ulva*, *Zostera*, detritus and woody debris none to occasional.

Station 17: Oyster Creek Mouth

Area Sampled:	Mouth of Oyster Creek, due west of Intracoastal Waterway mid-channel marker BW N "E1"; tow is made west to east beginning at second black channel stake located just west of bulkhead on north bank and ending in vicinity of first channel marker can and nun.
Depth Sampled:	1.8 to 3.7 m.
Current:	Slight to moderate, easterly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Detritus (*Zostera marina*) rare to common; *Zostera* and *Codium fragile* none to occasional; shellhash occasional.

Station 23: Double Creek Mouth

Area Sampled:	Mouth of Double Creek, southwest of Intracoastal Waterway flashing light FL R "68"; tow is made in mid-channel between the fourth black channel stake inside Double Creek and the flashing light FL R "2".
Depth Sampled:	2.1 to 3.7 m.
Current:	Slight, dependent on tide.
Clarity:	Usually clear.
Aquatic Vegetation:	*Zostera marina* and detritus, occasional to abundant; *Ulva* and *Codium fragile* occasional to common.

Table C1-159. (cont.)

Station 26: Discharge Canal at OCGS

Area Sampled:	Discharge Canal from bulkhead at L.A. trailers to railroad bridge; tow made along north bulkhead in condenser discharge.
Depth Sampled:	3.7 to 4.3 m.
Current:	Strong easterly due to OCGS.
Clarity:	Usually clear, sometimes turbid.
Aquatic Vegetation:	Usually none, occasionally some detritus.

Station 27: Discharge Canal at OCGS

Area Sampled:	Discharge Canal, approximately 100 m downstream from railroad bridge towards Route 9 bridge; tow made in mid-channel.
Depth Sampled:	3.7 to 4.3 m.
Current:	Strong easterly due to OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Usually none, occasionally some detritus.

Station 30: Oyster Creek, first lagoon

Area Sampled:	First lagoon west of mouth on south side of Oyster Creek; tow is made from bulkhead at southern end to juncture with Oyster Creek.
Depth Sampled:	1.5 to 3.1 m.
Current:	Usually none.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Detritus (*Zostera marina*), *Ulva* and *Codium fragile* occasional to common.

Station 45: Forked River, east of Beach Blvd. Bridge

Area Sampled:	South Branch of Forked River, from its juncture with the Middle Branch to 100 m east of the Beach Blvd. Bridge; tow is made in mid-channel.
Depth Sampled:	1.8 to 3.1 m.

Table C1-159. (cont.)

Current:	Slight to moderate, predominantly westerly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Detritus, Zostera marina, Ulva, Codium fragile, and woody debris occasional to common

Station 46: Forked River, lagoon

Area Sampled:	Lagoon off north side of the South Branch of Forked River just east of the Beach Blvd. Bridge; tow is made from easternmost side channel westwards towards entrance from Forked River.
Depth Sampled:	1.5 to 2.8 m.
Current:	Usually none.
Clarity:	Usually clear, sometimes turbid.
Aquatic Vegetation:	Detritus (Zostera marina), Ulva, and Codium fragile occasional to common.

Station 48: Intake Canal at OCGS.

Area Sampled:	Intake Canal, from first bend west of Route 9 to security fence tow made in mid-channel.
Depth Sampled:	3.7 to 4.3 m.
Current:	Strong westerly due to OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Usually none, occasionally some detritus.

Station 49: Intake Canal at OCGS

Area Sampled:	Intake Canal, from security fence to 50 m east of log boom.
Depth Sampled:	3.7 to 4.3 m.
Current:	Strong westerly due to OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Usually none, occasionally some detritus.

Table C1-159. (cont.)

Station 50: Oyster Creek, from first lagoon to mouth

Area Sampled:	Mouth of Oyster Creek, from juncture with first lagoon on south side to juncture with Bay; tow is made in mid-channel.
Depth Sampled:	1.8 to 3.7 m.
Current:	Slight to moderate, easterly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Detritus (*Zostera marina*) occasional to common; *Zostera* and *Codium fragile* none to occasional; shellhash occasional.

Table C1-160. Description of seine stations regularly sampled during Oyster Creek Generating Station Ecological Studies.

Station 01: Cedar Creek Mouth

Area Sampled:	Off the easternmost peninsula of the north bank of Cedar Creek Mouth, area sampled is approximately 60 m of a narrow (5 m) sandy beach on the south side of the peninsular tip.
Beach and Bottom Composition:	Hard-packed sand and gravel; slope very gentle.
Depth Sampled:	0 to 1 m; during extremely high tides entire beach is submerged to vegetation zone.
Current:	Slight, dependent on tide.
Clarity:	Normally clear, turbid with surf.
Aquatic Vegetation:	None attached in immediate sampling area; small amounts of floating *Zostera marina* and detritus sometimes encountered.

Station 04: Forked River Mouth

Area Sampled:	At the easternmost point of the South bank of Forked River Mouth; area sampled is approximately 60 m of a narrow (5 m) sandy beach in the cove on the north side of the point.
Beach and Bottom Composition:	Soft sand throughout sampling area with frequent patches of mud; slope gentle.
Depth Sampled:	0 to 1.1 m.
Current:	Slight, westerly due to influence of OCGS.
Clarity:	Normally clear.
Aquatic Vegetation:	Occasional patches of *Zostera marina*; floating *Zostera*, *Ulva* and detritus, occasional to common.

Station 17: Oyster Creek Mouth

Area Sampled:	North bank of Oyster Creek Mouth, opposite Sands Point. Area sampled is approximately 60 m of a narrow (5 m) sandy beach immediately east of the bulkhead at the mouth of Oyster Creek.

Table C1-160. (cont.)

Beach and Bottom Composition:	Hard sand and coarse gravel from shore to a depth of about 0.6 m, becoming soft sand and mud to edge of sampling area; slope steep.
Depth Sampled:	0 to 1.2 m.
Current:	Slight to moderate, easterly due to influence of OCGS.
Clarity:	Normally clear, turbid with surf.
Aquatic Vegetation:	None attached in immediate sampling area; occasional floating Zostera marina, Ulva, Codium, and detritus.

Station 23: Double Creek Mouth

Area Sampled:	North bank of mouth of Double Creek, area sampled is approximately 60 m of a narrow (5 m) sandy beach, located between two groin bulkheads immediately northwest of Double Creek flashing light FL R "2".
Beach and Bottom Composition:	Firm sand throughout with some gravel to edge of sampling area; slope gentle.
Depth Sampled:	0 to 1.1 m.
Current:	None to slight.
Clarity:	Clear to turbid.
Aquatic Vegetation:	None attached in sampling area; floating Zostera marina occasional to abundant, Codium fragile and detritus occasional to common; beach often completely covered with a layer of dead Zostera up to 30 cm thick.

Station 28: Oyster Creek, south shore, across from L. A. dock

Area Sampled:	South bank of Oyster Creek, across from bulkheaded area of Baywood Farm and between bulkheaded, fenced area and boat docks. Area sampled is approximately 20 m of a narrow sandy beach.
Beach and Bottom Composition:	Hard sand and coarse gravel from shore to a depth of about 0.6 m, becoming soft sand and mud to edge of sampling area; slope gentle.
Depth Sampled:	0 to 1.2 m.
Current:	Slight to moderate, predominantly easterly due to influence of OCGS.

Table C1-160. (cont.)

Clarity:	Clear to turbid.
Aquatic Vegetation:	None attached in sampling area; occasional floating Zostera marine, Ulva, Codium, and detritus.

Station 29: Oyster Creek, south shore, near mouth

Area Sampled:	South bank of Oyster Creek, upstream of and across from bulkheaded area at mouth. Area sampled is approximately 50 m of a narrow (5 m) sandy beach.
Beach and Bottom Composition:	Hard sand and gravel from shore to a depth of about 0.5 m, becoming soft sand and mud. Slope moderate until edge of dredged channel where depth increases sharply.
Depth Sampled:	0 to 1.8 m.
Current:	Slight to moderate, predominantly easterly due to influence of OCGS.
Clarity:	Clear to trubid.
Aquatic Vegetation:	None attached in sampling area; occasional floating Zostera marina, Ulva, Codium, and detritus.

Station 47: Forked River at Kanoehe Avenue

Area Sampled:	South bank of Forked River near eastern end of the South Branch at a narrow (1 m) and short (3 m) beach at the end of Kanoehe Avenue.
Beach and Bottom Composition:	Soft sand and mud bottom, slope moderate. Beach comprised of sand and debris with grass, weeds, and shrubs.
Depth Sampled:	0 to 1.5 m.
Current:	Slight to moderate, predominantly westerly due to influence of OCGS
Clarity:	Clear to turbid.
Aquatic Vegetation:	None attached in sampling area; occasional floating Zostera marina, Ulva, Codium, and detritus.

Table C1-160. (cont.)

Station 53: Forked River at Waikiki Avenue

Area Sampled:	South bank of Forked River near eastern end of the South Branch at a boat launching ramp at the end of Waikiki Avenue.
Beach and Bottom Composition:	Soft sand and mud bottom, depth drops off rapidly from bank. Beach and edge composed of Spartina, grass, and weeds.
Depth Sampled:	0 to 1.5 m.
Current:	Slight to moderate, predominantly westerly due to influence of OCGS.
Clarity:	Clear
Aquatic vegetation:	Occasional Ulva and detritus. Spartina and other rooted vegetation attached on shore.

Table C1-161. Description of gill net stations regularly sampled during Oyster Creek Generating Station Ecological Studies.

Station 06: Forked River, east of Route 9 Bridge

Area Sampled:	South branch of Forked River, west of Beach Blvd. bridge and east of Route 9 bridge; just west of last house on north bank of River.
Depth:	1.5 to 2.1 m near banks, 2.7 m in mid-channel.
Direction of Set:	Northeast to southwest, from River bank toward OCGS.
Current:	Moderate, westerly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Occasional to common *Zostera marina*, *Ulva*, and detritus.

Station 15: Oyster Creek, east of Route 9 bridge

Area Sampled:	Oyster Creek, east of Route 9 bridge, approximately 1 mile upstream of the Creek mouth.
Depth:	1.8 to 2.0 m near banks, 3.5 m in mid-channel.
Direction of Set:	Northeast to southwest, bank to bank, approximately 180 m west of bulkheaded pond on north bank.
Current:	Moderate, easterly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	None to occasional, mostly *Zostera marina* and detritus.

Station 26: Discharge Canal at OCGS

Area Sampled:	Discharge Canal at condenser discharge.
Depth:	Approximately 3.7 m.
Direction of Set:	Gill net set in semicircle from bulkhead on north bank to bulkhead by I.A. trailers in condenser discharge.
Current:	Strong due to OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Usually none.

Table C1-161. (cont.)

Station 30: Oyster Creek, first lagoon

Area Sampled:	First lagoon west of mouth on south side of Oyster Creek, midway from ends.
Depth:	1.5 to 2.8 m.
Direction of Set:	North to South, parallel to banks.
Current:	Clear to turbid.
Aquatic Vegetation:	Usually none; occasionally some detritus and Ulva.

Station 45: Forked River, east of Beach Blvd. Bridge

Area Sampled:	South Branch of Forked River, in channel next to cove on south side formed by entrances to lagoons east of the Beach Blvd. Bridge.
Depth:	1.8 to 3.1 m.
Direction of Set:	The net was set perpendicular to the main channel, but generally dragged anchors due to soft bottom and currents and eventually fished from east to west, parallel to channel.
Current:	Moderate, westerly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Occasional to common, Zostera marina, Ulva, and detritus.

Station 46: Forked River, lagoon

Area Sampled:	Lagoon off north side of the south Branch of Forked River just east of the Beach Blvd. Bridge, 50 m west of easternmost side channel.
Depth:	1.5 to 2.8 m.
Direction of Set:	East to west, parallel to banks.
Current:	Usually none.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Usually none, occasionally some detritus and Ulva.

Table C1-161. (cont.)

Station 50: Oyster Creek, from first lagoon to mouth

Area Sampled:	Midway between first lagoon on side south of Oyster Creek to juncture with Bay, on south side of channel.
Depth:	1.8 to 3.7 m.
Direction of Set:	East to west, parallel to banks.
Current:	Slight to moderate, easterly due to influence of OCGS.
Clarity:	Clear to turbid.
Aquatic Vegetation:	Occasional detritus (*Zostera marina*) and *Ulva*.

TABLE C1-162. TOTAL NUMBER OF SPECIMENS TAKEN BY TRAWL AND SEINE FROM SEPTEMBER 1976 THROUGH AUGUST 1977 AT THE MOUTH OF CEDAR CREEK, FORKED RIVER, OYSTER CREEK, AND DOUBLE CREEK.

SPECIES	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTALS
ANGUILLA ROSTRATA	7	2	-	1	-	-	1	8	10	12	8	8	57
CONGER OCEANICUS	-	-	-	2	-	-	-	-	-	-	-	-	2
ALOSA AESTIVALIS	-	-	-	1069	1	-	10	1	9	1	3	-	1094
ALOSA PSEUDOHARENGUS	-	-	-	1	-	-	8	1	9	-	1	-	20
ALOSA SAPIDISSIMA	-	-	-	-	-	-	-	1	-	-	-	-	1
BREVOORTIA TYRANNUS	7	6	69	48	20	9	2	-	1	-	-	3	165
ANCHOA HEPSETUS	41	1	1	-	-	-	-	-	-	-	-	-	43
ANCHOA MITCHILLI	172	307	6	1	-	-	-	109	1648	1313	1402	934	5892
SYNODUS FOETENS	1	1	-	-	-	-	-	-	-	-	-	-	2
OPSANUS TAU	18	22	3	-	-	-	2	1	4	4	36	175	265
RISSOLA MARGINATA	-	20	7	2	2	-	-	-	5	1	1	-	38
STRONGYLURA MARINA	39	24	198	-	-	-	-	-	-	7	1	6	275
CYPRINODON VARIEGATUS	-	2	2	8	-	-	-	3	-	-	-	-	15
FUNDULUS HETEROCLITUS	-	41	10	9	2	2	19	60	5	1	9	2	160
FUNDULUS MAJALIS	-	3	9	39	4	-	1	97	-	-	-	-	153
LUCANIA PARVA	-	1	-	-	-	-	-	-	-	-	-	-	1
MEMBRAS MARTINICA	-	-	-	-	-	-	-	-	-	1	1	-	2
MENIDIA BERYLLINA	1	70	-	-	2	1	6	29	-	-	-	-	109
MENIDIA MENIDIA	36	118	317	569	5	10	1556	214	217	18	829	567	4456
APELTES QUADRACUS	-	-	1	13	-	-	11	4	5	-	5	20	59
GASTEROSTEUS ACULEATUS	-	-	-	-	-	-	-	-	-	1	-	-	1
FISTULARIA TABACARIA	-	1	-	-	-	-	-	-	-	-	-	-	1
HIPPOCAMPUS ERECTUS	-	-	-	-	-	-	-	-	-	-	-	1	1
SYNGNATHUS FUSCUS	5	23	5	1	-	-	-	18	65	27	34	68	246
MORONE AMERICANA	1	4	5	5	-	2	3	5	3	1	-	-	29
CENTROPRISTIS STRIATA	12	30	5	-	-	-	-	-	-	-	-	-	47
POMATOMUS SALTATRIX	9	50	13	-	-	-	-	-	-	46	41	24	183
CARANX CRYSOS	-	5	-	-	-	-	-	-	-	-	-	-	5
CARANX HIPPOS	5	139	-	-	-	-	-	-	-	-	1	3	148
SELAR CRUMENOPHTHALMUS	-	17	-	-	-	-	-	-	-	-	-	-	17
SELENE VOMER	8	4	-	-	-	-	-	-	-	-	1	10	23
TRACHINOTUS FALCATUS	4	3	-	-	-	-	-	-	-	-	1	-	8
STENOTOMUS CHRYSOPS	-	2	-	-	-	-	-	-	-	1	-	-	3
BAIRDIELLA CHRYSURA	9	13	16	-	-	-	-	-	-	-	-	10	48
CYNOSCION REGALIS	3	6	2	-	-	-	-	-	-	-	-	85	96
LEIOSTOMUS XANTHURUS	41	171	149	26	-	-	-	8	4	2	463	188	1052
MENTICIRRHUS SAXATILIS	7	5	1	-	-	-	-	-	-	-	-	1	14
MICROPOGON UNDULATUS	-	6	4	1	-	-	-	-	-	-	-	-	11
CHAETODON OCELLATUS	-	2	-	-	-	-	-	-	-	-	-	-	2
TAUTOGA ONITIS	8	19	6	2	-	-	-	1	2	9	3	4	54
MUGIL CEPHALUS	3	5	-	-	-	-	-	-	-	-	-	68	76
MUGIL CUREMA	6	15	-	-	-	-	-	7	2	16	-	42	88
SPHYRAENA BOREALIS	-	2	-	-	-	-	-	-	-	-	-	-	2
ASTROSCOPUS GUTTATUS	-	1	-	-	-	-	-	-	-	-	-	-	1
CHASMODES BOSQUIANUS	3	3	1	-	-	-	-	-	-	-	-	-	7
HYPSOBLENNIUS HENTZI	-	13	-	1	-	-	-	-	-	1	-	-	15
GOBIOSOMA BOSCI	-	5	-	3	-	-	-	-	1	1	-	2	12
GOBIOSOMA GINSBURGI	-	-	1	-	-	-	1	-	-	-	-	-	2
PEPRILUS TRIACANTHUS	-	1	-	-	-	-	-	-	-	1	-	-	2
PRIONOTUS EVOLANS	7	3	2	-	-	-	-	-	-	-	1	2	15
ETROPUS MICROSTOMUS	-	21	13	13	-	-	-	-	-	-	-	-	47
PARALICHTHYS DENTATUS	-	-	-	-	-	-	-	2	3	6	16	6	33
SCOPHTHALMUS AQUOSUS	-	-	-	-	-	-	-	2	5	2	-	-	9
PSEUDOPLEURONECTES AMERICANUS	4	9	15	36	2	2	52	38	170	718	270	1	1317
TRINECTES MACULATUS	4	7	2	-	-	-	-	5	2	3	6	7	36
SYMPHURUS PLAGIUSA	-	-	-	1	-	-	-	-	-	-	-	-	1
LACTOPHRYS TRIQUETER	-	1	-	-	-	-	-	-	-	-	-	-	1
SPHOEROIDES MACULATUS	2	-	-	-	-	-	-	-	-	2	3	6	13
CHILOMYCTERUS SCHOEPFI	-	-	-	-	-	-	-	-	-	-	1	-	1
CRANGON SEPTEMSPINOSA	26	188	248	4240	80	276	1600	1061	1608	238	400	608	10573
CALLINECTES SAPIDUS	92	142	64	13	-	3	22	36	55	87	187	132	833
CALLINECTES SIMILIS	-	-	-	-	-	-	-	-	-	-	-	1	1
TOTAL SPECIMENS	581	1534	1175	6104	118	305	3294	1711	3833	2520	3724	2984	27883
TOTAL TAXA	30	47	29	24	9	8	15	23	22	27	26	29	62
TOTAL COLLECTIONS	14	36	36	36	12	12	36	36	36	36	36	36	362

TABLE C1-163. TOTAL NUMBER OF SPECIMENS TAKEN BY 4.9-M TRAWL FROM SEPTEMBER 1976 THROUGH AUGUST 1977 AT THE MOUTH OF CEDAR CREEK, FORKED RIVER, OYSTER CREEK, AND DOUBLE CREEK.

SPECIES	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTALS
ANGUILLA ROSTRATA	-	-	-	1	-	-	-	5	8	2	1	3	20
CONGER OCEANICUS	-	-	-	1	-	-	-	-	-	-	-	-	1
ALOSA AESTIVALIS	-	-	-	-	1	-	-	-	-	1	-	-	2
ALOSA PSEUDOHARENGUS	-	-	-	1	-	-	-	1	-	-	-	-	2
BREVOORTIA TYRANNUS	7	4	54	48	20	9	2	-	-	-	-	1	145
ANCHOA MITCHILLI	64	299	2	-	-	-	-	-	1620	1089	1346	672	5092
SYNODUS FOETENS	-	1	-	-	-	-	-	-	-	-	-	-	1
OPSANUS TAU	4	4	2	-	-	-	1	1	3	1	13	20	49
MISSOLA MARGINATA	-	2	-	1	2	-	-	-	-	-	1	-	6
FUNDULUS HETEROCLITUS	-	1	-	-	-	-	-	-	-	-	-	-	1
MENIDIA MENIDIA	-	1	6	-	1	-	-	-	-	4	3	-	15
APELTES QUADRACUS	-	-	-	4	-	-	7	-	-	-	-	-	11
SYNGNATHUS FUSCUS	-	2	2	1	-	-	-	4	10	10	5	1	35
MORONE AMERICANA	-	1	2	2	-	-	1	-	-	-	-	-	6
CENTROPRISTIS STRIATA	-	2	4	-	-	-	-	-	-	-	-	-	6
POMATOMUS SALTATRIX	-	-	6	-	-	-	-	-	-	3	2	1	12
CARANX HIPPOS	-	1	-	-	-	-	-	-	-	-	1	2	4
SELENE VOMER	4	-	-	-	-	-	-	-	-	-	-	-	4
STENOTOMUS CHRYSOPS	-	2	-	-	-	-	-	-	-	1	-	-	3
BAIRDIELLA CHRYSURA	-	4	-	-	-	-	-	-	-	-	-	-	4
CYNOSCION REGALIS	1	6	2	-	-	-	-	-	-	-	-	85	94
LEIOSTOMUS XANTHURUS	10	101	23	21	-	-	-	7	1	-	224	62	449
MICROPOGON UNDULATUS	-	5	1	-	-	-	-	-	-	-	-	-	6
CHAETODON OCELLATUS	-	2	-	-	-	-	-	-	-	-	-	-	2
TAUTOGA ONITIS	-	2	2	2	-	-	-	1	2	5	-	3	17
SPHYRAENA BOREALIS	-	1	-	-	-	-	-	-	-	-	-	-	1
CHASMODES BOSQUIANUS	-	-	1	-	-	-	-	-	-	-	-	-	1
HYPSOBLENNIUS HENTZI	-	1	-	1	-	-	-	-	-	1	-	-	3
GOBIOSOMA BOSCI	-	4	-	3	-	-	-	-	-	-	-	-	7
GOBIOSOMA GINSBURGI	-	-	1	-	-	-	1	-	-	-	-	-	2
PEPRILUS TRIACANTHUS	-	1	-	-	-	-	-	-	-	1	-	-	2
PRIONOTUS EVOLANS	1	2	1	-	-	-	-	-	-	-	-	2	6
ETROPUS MICROSTOMUS	-	2	4	8	-	-	-	-	-	-	-	-	14
PARALICHTHYS DENTATUS	-	-	-	-	-	-	-	-	3	3	3	4	13
SCOPHTHALMUS AQUOSUS	-	-	-	-	-	-	-	-	1	-	-	-	1
PSEUDOPLEURONECTES AMERICANUS	-	1	4	19	1	1	39	27	26	258	200	-	576
TRINECTES MACULATUS	4	7	2	-	-	-	-	1	2	3	3	7	29
SPHOEROIDES MACULATUS	-	-	-	-	-	-	-	-	-	2	1	2	5
CRANGON SEPTEMSPINOSA	-	16	41	697	39	17	817	247	1007	193	46	100	3220
CALLINECTES SAPIDUS	23	35	20	1	-	3	17	20	13	18	28	40	218
TOTAL SPECIMENS	118	510	180	811	64	30	885	314	2696	1595	1877	1005	10085
TOTAL TAXA	9	28	20	16	6	4	8	10	12	17	15	16	40
TOTAL COLLECTIONS	4	12	12	12	4	4	12	12	12	12	12	12	120

TABLE C1-164. TOTAL NUMBER OF SPECIMENS TAKEN BY 45.7-M SEINE FROM SEPTEMBER 1976 THROUGH AUGUST 1977 AT THE MOUTH OF CEDAR CREEK, FORKED RIVER, OYSTER CREEK, AND DOUBLE CREEK.

SPECIES	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTALS
ANGUILLA ROSTRATA	-	2	-	-	-	-	1	2	1	10	6	4	26
ALOSA AESTIVALIS	-	-	-	1069	-	-	10	-	9	-	3	-	1091
ALOSA PSEUDOHARENGUS	-	-	-	-	-	-	8	-	9	-	1	-	18
ALOSA SAPIDISSIMA	-	-	-	-	-	-	-	1	-	-	-	-	1
BREVOORTIA TYRANNUS	-	2	15	-	-	-	-	-	1	-	-	1	19
ANCHOA HEPSETUS	-	1	1	-	-	-	-	-	-	-	-	-	2
ANCHOA MITCHILLI	-	3	-	-	-	-	-	86	24	183	24	25	345
SYNODUS FOETENS	1	-	-	-	-	-	-	-	-	-	-	-	1
OPSANUS TAU	1	17	1	-	-	-	1	-	1	3	3	48	75
BISSOLA MARGINATA	-	14	5	1	-	-	-	-	2	1	-	-	23
STRONGYLURA MARINA	31	24	197	-	-	-	-	-	-	2	-	6	260
CYPRINODON VARIEGATUS	-	2	2	4	-	-	-	-	-	-	-	-	8
FUNDULUS HETEROCLITUS	-	6	2	2	1	-	2	9	1	-	2	1	26
FUNDULUS MAJALIS	-	1	2	17	4	-	-	15	-	-	-	-	39
MEMBRAS MARTINICA	-	-	-	-	-	-	-	-	-	1	1	-	2
MENIDIA BERYLLINA	-	2	-	-	-	-	-	-	-	-	-	-	2
MENIDIA MENIDIA	-	55	72	444	2	2	1096	161	185	12	29	28	2086
APELTES QUADRACUS	-	-	-	1	-	-	-	2	5	-	1	1	10
FISTULARIA TABACARIA	-	1	-	-	-	-	-	-	-	-	-	-	1
SYNGNATHUS FUSCUS	-	18	2	-	-	-	-	12	45	15	13	35	140
MORONE AMERICANA	-	3	3	3	-	2	2	3	3	1	-	-	20
CENTROPRISTIS STRIATA	3	28	1	-	-	-	-	-	-	-	-	-	32
POMATOMUS SALTATRIX	8	50	7	-	-	-	-	-	-	32	38	22	157
CARANX CRYSOS	-	5	-	-	-	-	-	-	-	-	-	-	5
CARANX HIPPOS	5	137	-	-	-	-	-	-	-	-	-	1	143
SELAR CRUMENOPHTHALMUS	-	17	-	-	-	-	-	-	-	-	-	-	17
SELENE VOMER	-	4	-	-	-	-	-	-	-	-	1	9	14
BAIRDIELLA CHRYSURA	7	9	13	-	-	-	-	-	-	-	-	2	31
CYNOSCION REGALIS	1	-	-	-	-	-	-	-	-	-	-	-	1
LEIOSTOMUS XANTHURUS	23	64	125	5	-	-	-	1	3	2	216	122	561
TAUTOGA ONITIS	7	17	4	-	-	-	-	-	-	4	3	1	36
MUGIL CEPHALUS	3	5	-	-	-	-	-	-	-	-	-	67	75
MUGIL CUREMA	1	9	-	-	-	-	-	-	-	-	-	42	52
SPHYRAENA BOREALIS	-	1	-	-	-	-	-	-	-	-	-	-	1
ASTROSCOPUS GUTTATUS	-	1	-	-	-	-	-	-	-	-	-	-	1
CHASMODES BOSQUIANUS	3	2	-	-	-	-	-	-	-	-	-	-	5
HYPSOBLENNIUS HENTZI	-	12	-	-	-	-	-	-	-	-	-	-	12
GOBIOSOMA BOSCI	-	1	-	-	-	-	-	-	-	1	-	-	2
PRIONOTUS EVOLANS	-	-	-	-	-	-	-	-	-	-	1	-	1
ETROPUS MICROSTOMUS	-	12	9	5	-	-	-	-	-	-	-	-	26
PARALICHTHYS DENTATUS	-	-	-	-	-	-	-	2	-	3	13	2	20
SCOPHTHALMUS AQUOSUS	-	-	-	-	-	-	-	2	4	2	-	-	8
PSEUDOPLEURONECTES AMERICANUS	3	5	10	17	1	1	13	10	137	387	49	1	634
TRINECTES MACULATUS	-	-	-	-	-	-	-	4	-	-	3	-	7
SYMPHURUS PLAGIUSA	-	-	-	1	-	-	-	-	-	-	-	-	1
SPHOEROIDES MACULATUS	1	-	-	-	-	-	-	-	-	-	2	3	6
CHILOMYCTERUS SCHOEPFI	-	-	-	-	-	-	-	-	-	-	1	-	1
CRANGON SEPTEMSPINOSA	-	5	17	1266	9	16	249	233	61	18	2	31	1907
CALLINECTES SAPIDUS	33	45	25	11	-	-	4	10	25	51	142	85	431
CALLINECTES SIMILIS	-	-	-	-	-	-	-	-	-	-	-	1	1
TOTAL SPECIMENS	131	580	513	2846	17	21	1386	553	516	728	554	538	8383
TOTAL TAXA	16	35	20	14	5	4	10	16	17	18	22	23	50
TOTAL COLLECTIONS	2	12	12	12	4	4	12	12	12	12	12	12	118

TABLE C1-165. TOTAL NUMBER OF SPECIMENS TAKEN BY 12.2-M SEINE FROM SEPTEMBER 1976 THROUGH AUGUST 1977 AT THE MOUTH OF CEDAR CREEK, FORKED RIVER, OYSTER CREEK, AND DOUBLE CREEK.

SPECIES	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	TOTALS
ANGUILLA ROSTRATA	7	-	-	-	-	-	-	1	1	-	1	1	11
CONGER OCEANICUS	-	-	-	1	-	-	-	-	-	-	-	-	1
ALOSA AESTIVALIS	-	-	-	-	-	-	-	1	-	-	-	-	1
BREVOORTIA TYRANNUS	-	-	-	-	-	-	-	-	-	-	-	1	1
ANCHOA HEPSETUS	41	-	-	-	-	-	-	-	-	-	-	-	41
ANCHOA MITCHILLI	108	5	4	1	-	-	-	23	4	41	32	237	455
OPSANUS TAU	13	1	-	-	-	-	-	-	-	-	20	107	141
RISSOLA MARGINATA	-	4	2	-	-	-	-	-	3	-	-	-	9
STRONGYLURA MARINA	8	-	1	-	-	-	-	-	-	5	1	-	15
CYPRINODON VARIEGATUS	-	-	-	4	-	-	-	3	-	-	-	-	7
FUNDULUS HETEROCLITUS	-	34	8	7	1	2	17	51	4	1	7	1	133
FUNDULUS MAJALIS	-	2	7	22	-	-	1	82	-	-	-	-	114
LUCANIA PARVA	-	1	-	-	-	-	-	-	-	-	-	-	1
MENIDIA BERYLLINA	1	68	-	-	2	1	6	29	-	-	-	-	107
MENIDIA MENIDIA	36	62	239	125	2	8	460	53	32	2	797	539	2355
APELTES QUADRACUS	-	-	1	8	-	-	4	2	-	-	4	19	38
GASTEROSTEUS ACULEATUS	-	-	-	-	-	-	-	-	-	1	-	-	1
HIPPOCAMPUS ERECTUS	-	-	-	-	-	-	-	-	-	-	-	1	1
SYNGNATHUS FUSCUS	5	3	1	-	-	-	-	2	10	2	16	32	71
MORONE AMERICANA	1	-	-	-	-	-	-	2	-	-	-	-	3
CENTROPRISTIS STRIATA	9	-	-	-	-	-	-	-	-	-	-	-	9
POMATOMUS SALTATRIX	1	-	-	-	-	-	-	-	-	11	1	1	14
CARANX HIPPOS	-	1	-	-	-	-	-	-	-	-	-	-	1
SELENE VOMER	4	-	-	-	-	-	-	-	-	-	-	1	5
TRACHINOTUS FALCATUS	4	3	-	-	-	-	-	-	-	-	1	-	8
BAIRDIELLA CHRYSURA	2	-	3	-	-	-	-	-	-	-	-	8	13
CYNOSCION REGALIS	1	-	-	-	-	-	-	-	-	-	-	-	1
LEIOSTOMUS XANTHURUS	8	6	1	-	-	-	-	-	-	-	23	4	42
MENTICIRRHUS SAXATILIS	7	5	1	-	-	-	-	-	-	-	-	1	14
MICROPOGON UNDULATUS	-	1	3	1	-	-	-	-	-	-	-	-	5
TAUTOGA ONITIS	1	-	-	-	-	-	-	-	-	-	-	-	1
MUGIL CEPHALUS	-	-	-	-	-	-	-	-	-	-	-	1	1
MUGIL CUREMA	5	6	-	-	-	-	-	7	2	16	-	-	36
CHASMODES BOSQUIANUS	-	1	-	-	-	-	-	-	-	-	-	-	1
GOBIOSOMA BOSCI	-	-	-	-	-	-	-	-	1	-	-	2	3
PRIONOTUS EVOLANS	6	1	1	-	-	-	-	-	-	-	-	-	8
ETROPUS MICROSTOMUS	-	7	-	-	-	-	-	-	-	-	-	-	7
PSEUDOPLEURONECTES AMERICANUS	1	3	1	-	-	-	-	1	7	73	21	-	107
LACTOPHRYS TRIQUETER	-	1	-	-	-	-	-	-	-	-	-	-	1
SPHOEROIDES MACULATUS	1	-	-	-	-	-	-	-	-	-	-	1	2
CRANGON SEPTEMSPINOSA	26	167	190	2277	32	243	534	581	540	27	352	477	5446
CALLINECTES SAPIDUS	36	62	19	1	-	-	1	6	17	18	17	7	184
TOTAL SPECIMENS	332	444	482	2447	37	254	1023	844	621	197	1293	1441	9415
TOTAL TAXA	24	22	16	10	4	4	7	15	11	11	14	19	42
TOTAL COLLECTIONS	8	12	12	12	4	4	12	12	12	12	12	12	124

TABLE C1-166. TOTAL NUMBER OF SPECIMENS TAKEN DURING DAY-NIGHT COLLECTIONS BY TRAWL AND SEINE AT OYSTER CREEK AND FORKED RIVER.

	SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
SPECIES	DAY	NITE	DAY	NITE	DAY	NITE	DAY	NITE
ANGUILLA ROSTRATA	-	7	-	2	-	-	1	-
CONGER OCEANICUS	-	-	-	-	-	-	-	2
ALOSA AESTIVALIS	-	-	-	-	-	-	1064	5
ALOSA PSEUDOHARENGUS	-	-	-	-	-	-	1	-
BREVOORTIA TYRANNUS	-	7	2	2	53	16	-	48
ANCHOA HEPSETUS	2	39	-	1	1	-	-	-
ANCHOA MITCHILLI	68	104	24	36	-	4	-	1
SYNODUS FOETENS	-	-	1	-	-	-	-	-
OPSANUS TAU	-	17	2	16	-	1	-	-
MISSOLA MARGINATA	-	-	-	20	-	7	-	2
STRONGYLURA MARINA	-	8	7	17	172	26	-	-
CYPRINODON VARIEGATUS	-	-	1	1	1	-	1	6
FUNDULUS HETEROCLITUS	-	-	20	13	-	10	1	7
FUNDULUS MAJALIS	-	-	-	-	-	8	4	33
MENIDIA BERYLLINA	-	1	8	-	-	-	-	-
MENIDIA MENIDIA	9	27	35	69	125	190	454	111
APELTES QUADRACUS	-	-	-	-	1	-	-	9
FISTULARIA TABACARIA	-	-	1	-	-	-	-	-
SYNGNATHUS FUSCUS	3	2	3	5	-	3	1	-
MORONE AMERICANA	-	1	2	1	-	5	-	5
CENTROPRISTIS STRIATA	2	7	5	24	-	4	-	-
POMATOMUS SALTATRIX	-	1	13	37	5	8	-	-
CARANX CRYSOS	-	-	-	5	-	-	-	-
CARANX HIPPOS	-	-	83	56	-	-	-	-
SELAR CRUMENOPHTHALMUS	-	-	17	-	-	-	-	-
SELENE VOMER	4	4	1	3	-	-	-	-
TRACHINOTUS FALCATUS	-	4	3	-	-	-	-	-
STENOTOMUS CHRYSOPS	-	-	2	-	-	-	-	-
BAIRDIELLA CHRYSURA	-	2	3	9	-	16	-	-
CYNOSCION REGALIS	1	1	4	2	-	2	-	-
LEIOSTOMUS XANTHURUS	10	8	51	98	3	146	5	21
MENTICIRRHUS SAXATILIS	7	-	4	1	-	1	-	-
MICROPOGON UNDULATUS	-	-	-	2	-	3	-	-
CHAETODON OCELLATUS	-	-	2	-	-	-	-	-
TAUTOGA ONITIS	1	-	2	8	2	4	1	1
MUGIL CEPHALUS	-	-	1	4	-	-	-	-
MUGIL CUREMA	-	5	15	-	-	-	-	-
SPHYRAENA BOREALIS	-	-	1	1	-	-	-	-
ASTROSCOPUS GUTTATUS	-	-	1	-	-	-	-	-
HYPSOBLENNIUS HENTZI	-	-	1	12	-	-	1	-
GOBIOSOMA BOSCI	-	-	-	-	-	-	-	3
GOBIOSOMA GINSBURGI	-	-	-	-	1	-	-	-
PEPRILUS TRIACANTHUS	-	-	1	-	-	-	-	-
FRIONOTUS EVOLANS	3	4	-	3	-	2	-	-
ETROPUS MICROSTOMUS	-	-	3	17	1	12	4	9
PSEUDOPLEURONECTES AMERICANUS	1	-	2	6	-	14	7	27
TRINECTES MACULATUS	-	4	-	7	1	1	-	-
SYMPHURUS PLAGIUSA	-	-	-	-	-	-	-	1
LACTOPHRYS TRIQUETER	-	-	-	1	-	-	-	-
SPHOEROIDES MACULATUS	1	-	-	-	-	-	-	-
CRANGON SEPTEMSPINOSA	-	26	15	57	14	185	161	4074
CALLINECTES SAPIDUS	24	35	37	53	1	50	-	13
TOTAL SPECIMENS	136	314	373	589	381	718	1706	4378
TOTAL TAXA	14	22	35	33	14	24	14	19
TOTAL COLLECTIONS	6	6	12	12	12	12	12	12

TABLE C1-166. (CONT.)

SPECIES	JANUARY DAY	JANUARY NITE	FEBRUARY DAY	FEBRUARY NITE	MARCH DAY	MARCH NITE	APRIL DAY	APRIL NITE
ANGUILLA ROSTRATA	-	-	-	-	-	1	-	8
ALOSA AESTIVALIS	-	1	-	-	1	9	-	1
ALOSA PSEUDOHARENGUS	-	-	-	-	1	7	-	-
ALOSA SAPIDISSIMA	-	-	-	-	-	-	-	1
BREVOORTIA TYRANNUS	-	20	-	9	-	2	-	-
ANCHOA MITCHILLI	-	-	-	-	-	-	-	109
OPSANUS TAU	-	-	-	-	1	-	-	1
RISSOLA MARGINATA	-	2	-	-	-	-	-	-
CYPRINODON VARIEGATUS	-	-	-	-	-	-	3	-
FUNDULUS HETEROCLITUS	1	1	1	1	-	14	26	2
FUNDULUS MAJALIS	-	4	-	-	-	1	3	-
MENIDIA BERYLLINA	-	2	1	-	1	5	23	-
MENIDIA MENIDIA	-	5	10	-	19	1535	13	160
APELTES QUADRACUS	-	-	-	-	-	3	2	-
SYNGNATHUS FUSCUS	-	-	-	-	-	-	5	5
MORONE AMERICANA	-	-	-	2	-	3	1	4
LEIOSTOMUS XANTHURUS	-	-	-	-	-	-	-	8
TAUTOGA ONITIS	-	-	-	-	-	-	-	1
PARALICHTHYS DENTATUS	-	-	-	-	-	-	1	1
SCOPHTHALMUS AQUOSUS	-	-	-	-	-	-	-	2
PSEUDOPLEURONECTES AMERICANUS	-	2	-	2	10	37	12	22
TRINECTES MACULATUS	-	-	-	-	-	-	-	5
CRANGON SEPTEMSPINOSA	2	78	49	227	17	1558	174	820
CALLINECTES SAPIDUS	-	-	-	3	-	22	11	21
TOTAL SPECIMENS	3	115	61	244	50	3197	274	1171
TOTAL TAXA	2	9	4	6	7	13	12	17
TOTAL COLLECTIONS	6	6	6	6	12	12	12	12

TABLE C1-166. (CONT.)

	MAY		JUNE		JULY		AUGUST	
SPECIES	DAY	NITE	DAY	NITE	DAY	NITE	DAY	NITE
ANGUILLA ROSTRATA	-	10	6	4	-	5	4	3
ALOSA AESTIVALIS	-	9	1	-	1	2	-	-
ALOSA PSEUDOHARENGUS	-	9	-	-	-	-	-	-
BREVOORTIA TYRANNUS	-	1	-	-	-	-	-	2
ANCHOA MITCHILLI	509	229	856	87	275	122	259	226
OPSANUS TAU	1	1	-	2	3	19	20	153
RISSOLA MARGINATA	-	5	-	1	-	1	-	-
STRONGYLURA MARINA	-	-	2	-	-	-	2	2
FUNDULUS HETEROCLITUS	2	1	-	-	-	4	2	-
MEMBRAS MARTINICA	-	-	-	-	-	1	-	-
MENIDIA MENIDIA	29	155	8	5	206	166	63	40
APELTES QUADRACUS	1	-	-	-	1	3	1	19
GASTEROSTEUS ACULEATUS	-	-	1	-	-	-	-	-
HIPPOCAMPUS ERECTUS	-	-	-	-	-	-	-	1
SYNGNATHUS FUSCUS	22	17	10	10	4	18	14	29
MORONE AMERICANA	-	3	-	-	-	-	-	-
POMATOMUS SALTATRIX	-	-	12	2	17	1	5	4
CARANX HIPPOS	-	-	-	-	1	-	-	2
SELENE VOMER	-	-	-	-	1	-	-	10
TRACHINOTUS FALCATUS	-	-	-	-	-	1	-	-
STENOTOMUS CHRYSOPS	-	-	-	1	-	-	-	-
BAIRDIELLA CHRYSURA	-	-	-	-	-	-	1	9
CYNOSCION REGALIS	-	-	-	-	-	-	-	84
LEIOSTOMUS XANTHURUS	-	4	1	1	179	175	47	112
MENTICIRRHUS SAXATILIS	-	-	-	-	-	-	-	1
TAUTOGA ONITIS	-	2	4	1	2	1	4	-
MUGIL CEPHALUS	-	-	-	-	-	-	27	3
MUGIL CUREMA	2	-	1	1	-	-	26	6
HYPSOBLENNIUS HENTZI	-	-	1	-	-	-	-	-
GOBIOSOMA BOSCI	-	1	-	1	-	-	-	2
PEPRILUS TRIACANTHUS	-	-	1	-	-	-	-	-
PRIONOTUS EVOLANS	-	-	-	-	-	1	-	2
PARALICHTHYS DENTATUS	-	3	4	1	-	15	-	5
SCOPHTHALMUS AQUOSUS	1	4	-	2	-	-	-	-
PSEUDOPLEURONECTES AMERICANUS	5	156	134	442	29	63	1	-
TRINECTES MACULATUS	-	2	2	1	-	3	-	7
SPHOEROIDES MACULATUS	-	-	-	2	1	2	1	5
CHILOMYCTERUS SCHOEPFI	-	-	-	-	1	-	-	-
CRANGON SEPTEMSPINOSA	59	1533	8	206	11	389	5	600
CALLINECTES SAPIDUS	8	42	35	21	74	52	51	43
CALLINECTES SIMILIS	-	-	-	-	-	-	-	1
TOTAL SPECIMENS	639	2187	1087	791	806	1044	533	1371
TOTAL TAXA	11	20	18	19	16	21	18	26
TOTAL COLLECTIONS	12	12	12	12	12	12	12	12

Table C1-167. Summary of the number of fish, sand shrimp, and blue crab taken at Oyster Creek, Forked River, Cedar Creek, and Double Creek by 4.9-m trawl, 45.7-m seine, and 12.2-m seine from September 1976 through August 1977.

	September			October			November			December			January			February		
	F[a]	SS	BC	F	SS	BC	F	SS	BC	F	SS	BC	F	SS	BC	F	SS	BC
4.9-m trawl - Day																		
Oyster Creek	76	-	2	5	-	3	50	-	1	5	32	-	-	-	-	-	-	-
Forked River	NS	NS	NS	63	-	-	7	1	-	2	5	-	NS	NS	NS	NS	NS	NS
Cedar Creek	NS	NS	NS	106	7	18	7	22	7	1	-	-	NS	NS	NS	NS	NS	NS
Double Creek	NS	NS	NS	161	7	10	4	18	6	2	1	-	NS	NS	NS	NS	NS	NS
Night																		
Oyster Creek	19	-	21	17	-	3	33	-	4	97	485	1	25	39	-	10	17	3
Forked River	NS	NS	NS	107	2	1	9	-	2	6	174	-	NS	NS	NS	NS	NS	NS
45.7-m seine - Day																		
Oyster Creek	50	-	22	161	1	13	218	-	-	1492	60	-	1	-	-	2	-	-
Forked River	48	-	11	39	1	2	4	2	-	-	-	-	NS	NS	NS	NS	NS	NS
Cedar Creek	NS	NS	NS	51	1	9	2	-	-	1	2	-	NS	NS	NS	NS	NS	NS
Double Creek	NS	NS	NS	4	1	-	1	2	-	6	-	-	NS	NS	NS	NS	NS	NS
Night																		
Oyster Creek	NS	NS	NS	136	-	9	234	11	26	69	1067	11	7	9	-	3	16	-
Forked River	NS	NS	NS	140	1	12	12	-	-	1	-	-	NS	NS	NS	NS	NS	NS
12.2-m seine - Day																		
Oyster Creek	12	-	11	21	1	18	77	6	-	46	64	-	-	2	-	10	49	-
Forked River	34	-	11	38	12	1	1	5	1	-	-	-	NS	NS	NS	NS	NS	NS
Cedar Creek	NS	NS	NS	17	82	2	-	-	-	1	2	-	NS	NS	NS	NS	NS	NS
Double Creek	NS	NS	NS	65	8	13	-	7	-	4	-	-	NS	NS	NS	NS	NS	NS
Night																		
Oyster Creek	102	-	10	25	5	24	94	130	19	109	2013	1	5	1	30	1	194	-
Forked River	132	26	4	55	49	4	101	42	-	9	198	-	NS	NS	NS	NS	NS	NS

	March			April			May			June			July			August			Total		
	F	SS	BC	F	SS	BC	F	SS	BC	F	SS	BC	F	SS	BC	F	SS	BC	F	SS	BC
4.9-m trawl - Day																					
Oyster Creek	2	-	-	5	21	2	4	6	1	281	2	5	46	-	2	29	-	2	512	83	18
Forked River	5	6	-	3	53	2	510	35	2	473	3	3	295	-	1	167	1	1	1825	103	9
Cedar Creek	1	1	-	1	10	1	105	14	3	103	1	3	679	-	1	358	1	2	1361	56	35
Double Creek	6	14	-	3	16	-	817	-	1	280	3	-	543	-	-	96	-	2	1912	59	19
Night																					
Oyster Creek	18	359	17	18	38	10	25	73	4	61	33	4	47	25	9	55	10	32	425	1079	108
Forked River	19	438	-	17	109	5	215	577	2	186	161	3	193	21	15	160	88	1	912	1860	29
45.7-m seine - Day																					
Oyster Creek	23	3	-	6	6	3	7	1	-	80	1	14	73	-	15	33	-	29	2146	72	90
Forked River	2	-	-	14	25	1	40	3	1	182	2	10	84	-	82	100	3	21	512	36	98
Cedar Creek	3	-	-	10	-	-	27	-	-	61	1	9	87	-	46	64	-	29	306	4	87
Double Creek	6	1	-	42	1	3	35	1	1	85	-	7	41	-	13	73	-	8	273	6	92
Night																					
Oyster Creek	1095	182	4	228	101	3	61	6	12	160	6	8	86	-	12	71	1	5	2149	1401	89
Forked River	4	63	-	10	100	-	260	48	11	111	8	3	39	2	4	80	27	5	657	388	35
12.2-m seine - Day																					
Oyster Creek	-	9	-	19	42	3	2	9	3	40	8	7	198	1	-	45	-	2	670	191	44
Forked River	1	-	-	42	27	-	9	3	1	37	-	4	26	10	4	103	1	2	274	58	23
Cedar Creek	3	-	-	9	-	-	1	-	-	10	-	4	323	-	1	337	1	1	701	95	9
Double Creek	3	9	-	130	40	-	1	1	-	16	-	-	140	-	-	111	1	1	470	68	14
Night																					
Oyster Creek	477	406	1	56	58	3	10	341	12	45	8	3	58	35	6	136	21	-	1120	3243	79
Forked River	4	110	-	1	414	-	41	186	1	4	11	-	180	306	6	223	459	-	750	1795	15

[a] F = all fish
SS = sand shrimp
BC = blue crab
NS = not sampled

Table C1-168. Mean surface water temperature (C) in Oyster Creek and Forked River, New Jersey from March 1976 through August 1977.

Month	Mean Temperature			Difference
	Oyster Creek	Forked River		
March	15.8	12.9		2.9
April	29.7	21.8		7.9
May	17.2	15.2		2.0
June	32.8	26.9		5.9
July	28.4	24.3		4.1
August	29.4	24.8		4.6
September	27.7	23.2		4.5
October	17.8	13.5		4.3
November	11.7	7.3		4.4
December	7.5	2.5		5.0
January [a]	4.8	1.5		3.3
Feburary [a]	7.9	3.9		4.0
March	10.5	7.3		3.2
			Mean difference	4.3
May-June [b]	21.8	21.0		0.8
July [b]	29.5	29.1		0.4
August	30.5	26.2		4.3

[a] Most Forked River stations not sampled in January and Feburary due to ice.

[b] OCGS not in operation May through July.

TABLE C1-169.A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY TRAWL AND GILL NET FROM MARCH 1976 THROUGH MARCH 1977 IN OYSTER CREEK (STA. 15, 26, 27, 30, AND 50) AND FORKED RIVER (6, 45, 46, 48, AND 49).

		OYSTER CREEK	FORKED RIVER
TEMPERATURE:	AIR	-2.5 - 30.5	-1.0 - 32.0
	SURFACE	3.6 - 36.1	1.4 - 31.3
	BOTTOM	4.5 - 34.6	1.5 - 31.5
SALINITY:	SURFACE	20.0 - 27.5	19.5 - 27.5
	BOTTOM	19.5 - 28.0	19.5 - 28.0
OXYGEN:	SURFACE	5.0 - 14.4	5.5 - 14.0
	BOTTOM	5.1 - 13.6	5.6 - 13.6
PH:	SURFACE	6.4 - 8.6	5.5 - 8.7
	BOTTOM	6.6 - 8.5	5.6 - 8.6
SECCHI (CM)		35.0 - 360.0	40.0 - 350.0

SPECIES	NO.	NO.
ANGUILLA ROSTRATA	9	13
ALOSA AESTIVALIS	24	-
ALOSA PSEUDOHARENGUS	14	3
BREVOORTIA TYRANNUS	261	128
CLUPEA HARENGUS	7	-
ANCHOA HEPSETUS	-	1
ANCHOA MITCHILLI	5103	4498
SYNODUS FOETENS	1	-
OPSANUS TAU	18	38
UROPHYCIS REGIUS	3	4
RISSOLA MARGINATA	1	2
STRONGYLURA MARINA	-	1
FUNDULUS HETEROCLITUS	1	-
MENIDIA MENIDIA	15	11
APELTES QUADRACUS	8	24
SYNGNATHUS FUSCUS	35	23
MORONE AMERICANA	39	2
CENTROPRISTIS STRIATA	-	3
POMATOMUS SALTATRIX	58	32
CARANX HIPPOS	10	-
SELENE VOMER	17	-
STENOTOMUS CHRYSOPS	-	1
BAIRDIELLA CHRYSURA	1	-
CYNOSCION REGALIS	35	142
LEIOSTOMUS XANTHURUS	1199	463
MICROPOGON UNDULATUS	1	1
CHAETODON OCELLATUS	2	-
TAUTOGA ONITIS	7	22
TAUTOGOLABRUS ADSPERSUS	-	1
CHASMODES BOSQUIANUS	1	3
HYPSOBLENNIUS HENTZI	2	2
GOBIOSOMA BOSCI	2	8
GOBIOSOMA GINSBURGI	1	1
PEPRILUS TRIACANTHUS	1	-
PRIONOTUS EVOLANS	11	11
ETROPUS MICROSTOMUS	8	4
PARALICHTHYS DENTATUS	7	3
SCOPHTHALMUS AQUOSUS	1	-
PSEUDOPLEURONECTES AMERICANUS	132	48
TRINECTES MACULATUS	8	7
SPHOEROIDES MACULATUS	2	1
CRANGON SEPTEMSPINOSA	336	1792
CALLINECTES SAPIDUS	1401	650
TOTAL SPECIMENS	8782	7943
TOTAL COLLECTIONS	189	177

TABLE C1-170. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 4.9-m TRAWL FROM 29 MARCH THROUGH 5 MAY 1976 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	13.0 - 21.0	17.5 - 20.0	16.0 - 20.0	18.0 - 20.0	6.0 - 19.0	19.0 - 20.0
SURFACE	14.0 - 27.2	15.0 - 26.9	15.0 - 23.2	12.5 - 22.0	12.5 - 21.5	14.0 - 20.6
BOTTOM	14.5 - 23.0	15.0 - 27.1	15.0 - 22.9	12.0 - 22.0	12.5 - 22.0	13.0 - 20.4
SALINITY: SURFACE	20.0 - 23.0	20.0 - 22.5	20.0 - 22.0	20.0 - 22.5	19.5 - 23.5	20.5 - 22.5
BOTTOM	20.0 - 22.5	19.5 - 22.5	20.0 - 22.0	20.0 - 23.0	20.0 - 24.0	21.0 - 23.0
OXYGEN: SURFACE	5.5 - 10.6	5.6 - 10.4	5.4 - 10.6	7.2 - 11.0	7.4 - 11.5	7.1 - 11.1
BOTTOM	5.4 - 10.1	5.5 - 10.2	6.2 - 10.4	7.1 - 10.9	7.3 - 11.5	6.9 - 11.1
PH: SURFACE	7.8 - 7.8	7.7 - 7.7	7.7 - 7.7	8.0 - 8.0	8.0 - 8.0	7.9 - 7.9
BOTTOM	7.8 - 7.8	7.8 - 7.8	7.8 - 7.8	7.9 - 7.9	8.0 - 8.0	7.8 - 7.8
SECCHI (CM)	85.0 - 130.0	105.0 - 130.0	60.0 - 160.0	90.0 - 150.0	75.0 - 130.0	75.0 - 140.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
ALOSA AESTIVALIS	5	1	-	-	-	-
ALOSA PSEUDOHARENGUS	1	-	3	-	-	1
CLUPEA HARENGUS	-	-	7	-	-	-
ANCHOA MITCHILLI	1746	1817	206	82	2801	638
OPSANUS TAU	-	2	1	5	1	-
UROPHYCIS REGIUS	-	-	2	-	-	2
MENIDIA MENIDIA	-	8	7	-	1	-
APELTES QUADRACUS	1	-	5	2	-	21
SYNGNATHUS FUSCUS	12	9	-	7	4	2
TAUTOGA ONITIS	1	2	-	3	-	-
GOBIOSOMA BOSCI	-	1	-	2	-	1
PARALICHTHYS DENTATUS	3	1	-	-	-	-
PSEUDOPLEURONECTES AMERICANUS	2	-	-	2	1	1
TRINECTES MACULATUS	1	-	-	-	-	-
CRANGON SEPTEMSPINOSA	100	61	95	240	390	348
CALLINECTES SAPIDUS	43	19	13	30	22	12
TOTAL SPECIMENS	1915	1921	339	373	3220	1026
TOTAL COLLECTIONS	6	6	6	6	6	6

TABLEC1-171.A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 4.9-m TRAWL FROM 17 JUNE THROUGH 13 AUGUST 1976 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	21.5 - 30.0	20.5 - 29.0	21.0 - 29.0	20.0 - 25.5	21.0 - 28.0	21.0 - 28.5
SURFACE	29.5 - 30.5	28.0 - 30.8	27.7 - 29.4	24.6 - 25.7	24.0 - 26.2	24.8 - 25.9
BOTTOM	29.0 - 30.7	28.0 - 30.4	27.3 - 28.7	24.7 - 25.8	24.0 - 26.0	25.0 - 25.7
SALINITY: SURFACE	22.5 - 27.5	22.5 - 27.5	22.0 - 27.5	23.5 - 27.5	22.5 - 27.5	22.5 - 27.0
BOTTOM	22.5 - 27.0	20.6 - 27.0	22.0 - 27.0	23.0 - 28.0	23.5 - 27.5	22.5 - 27.5
OXYGEN: SURFACE	6.2 - 6.6	6.3 - 6.5	6.3 - 8.4	5.6 - 6.8	6.3 - 7.0	6.6 - 8.4
BOTTOM	6.0 - 6.4	6.0 - 6.4	5.9 - 7.0	5.8 - 7.1	6.0 - 6.6	6.8 - 8.3
PH: SURFACE	6.7 - 6.7	6.4 - 6.4	6.5 - 6.5	7.2 - 7.2	7.1 - 7.1	6.2 - 6.2
BOTTOM	6.7 - 6.8	6.7 - 6.7	6.6 - 6.6	7.2 - 7.3	7.1 - 7.1	6.4 - 6.4
SECCHI (CM)	55.0 - 60.0	50.0 - 70.0	60.0 - 70.0	55.0 - 100.0	60.0 - 90.0	60.0 - 70.0

SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
ANGUILLA ROSTRATA	1	-	1	1	1	2
BREVOORTIA TYRANNUS	1	1	45	-	-	2
ANCHOA MITCHILLI	537	24	643	16	151	290
OPSANUS TAU	2	1	-	5	2	-
UROPHYCIS REGIUS	-	-	1	-	-	-
MENIDIA MENIDIA	-	-	-	-	-	1
APELTES QUADRACUS	-	-	-	-	1	-
SYNGNATHUS FUSCUS	-	-	-	-	1	-
POMATOMUS SALTATRIX	1	-	1	1	-	1
CARANX HIPPOS	3	-	-	-	-	-
CYNOSCION REGALIS	-	2	-	-	1	1
LEIOSTOMUS XANTHURUS	27	38	54	7	37	84
TAUTOGA ONITIS	2	-	-	6	-	-
HYPSOBLENNIUS HENTZI	-	1	-	-	-	-
GOBIOSOMA BOSCI	-	-	1	1	-	-
PEPRILUS TRIACANTHUS	-	-	1	-	-	-
PARALICHTHYS DENTATUS	-	-	-	-	1	-
PSEUDOPLEURONECTES AMERICANUS	-	-	-	-	-	2
TRINECTES MACULATUS	2	-	-	-	-	-
SPHOEROIDES MACULATUS	-	1	-	-	-	-
CRANGON SEPTEMSPINOSA	-	1	2	5	30	13
CALLINECTES SAPIDUS	34	65	12	30	39	21
TOTAL SPECIMENS	610	134	761	72	264	417
TOTAL COLLECTIONS	6	6	6	6	6	6

TABLE C1-172. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 4.9-m TRAWL FROM 19 AUGUST THROUGH 23 SEPTEMBER 1976 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	22.0 - 24.0	22.0 - 25.5	23.0 - 25.0	20.0 - 25.5	20.0 - 25.0	20.0 - 25.0
SURFACE	26.9 - 28.0	25.8 - 28.0	25.6 - 27.7	21.0 - 22.9	20.9 - 23.1	21.7 - 23.0
BOTTOM	27.0 - 28.3	25.9 - 28.5	25.6 - 27.4	21.1 - 22.9	21.1 - 23.0	21.8 - 23.5
SALINITY: SURFACE	21.5 - 25.5	21.5 - 26.5	22.0 - 25.0	22.0 - 26.5	22.0 - 25.5	23.0 - 25.5
BOTTOM	21.5 - 25.5	21.5 - 25.5	22.0 - 25.0	22.0 - 26.0	22.0 - 26.0	22.5 - 25.0
OXYGEN: SURFACE	7.0 - 7.7	7.0 - 7.8	7.0 - 8.6	7.0 - 7.7	6.3 - 7.7	6.9 - 7.7
BOTTOM	6.8 - 7.6	7.1 - 7.7	6.2 - 7.7	7.0 - 7.8	6.7 - 7.6	7.1 - 7.7
PH: SURFACE	7.9 - 7.9	8.0 - 8.4	7.5 - 8.2	8.0 - 8.3	7.8 - 8.4	7.9 - 8.4
BOTTOM	7.9 - 8.2	8.0 - 8.2	7.5 - 8.2	8.0 - 8.3	8.0 - 8.4	7.9 - 8.3
SECCHI (CM)	50.0 - 80.0	55.0 - 80.0	60.0 - 75.0	45.0 - 80.0	50.0 - 70.0	60.0 - 80.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
ANGUILLA ROSTRATA	2	-	1	2	1	2
BREVOORTIA TYRANNUS	-	1	5	-	-	1
ANCHOA HEPSETUS	-	-	-	-	-	1
ANCHOA MITCHILLI	3	70	4	10	79	313
OPSANUS TAU	4	3	1	6	8	1
SYNGNATHUS FUSCUS	1	-	-	1	-	1
CENTROPRISTIS STRIATA	-	-	-	1	-	-
POMATOMUS SALTATRIX	2	-	-	-	-	-
CARANX HIPPOS	1	-	-	-	-	-
SELENE VOMER	9	5	2	-	-	-
STENOTOMUS CHRYSOPS	-	-	-	-	1	-
CYNOSCION REGALIS	9	8	7	4	56	50
LEIOSTOMUS XANTHURUS	76	16	110	29	73	112
TAUTOGA ONITIS	-	-	-	3	-	-
TAUTOGOLABRUS ADSPERSUS	-	-	-	1	-	-
CHASMODES BOSQUIANUS	1	-	-	-	1	-
HYPSOBLENNIUS HENTZI	-	-	-	1	-	-
GOBIOSOMA BOSCI	-	-	-	2	-	-
PRIONOTUS EVOLANS	5	2	-	-	6	1
PSEUDOPLEURONECTES AMERICANUS	-	-	-	1	1	-
TRINECTES MACULATUS	2	-	2	-	4	2
SPHOEROIDES MACULATUS	1	-	-	-	-	-
CRANGON SEPTEMSPINOSA	-	-	-	6	23	-
CALLINECTES SAPIDUS	42	29	9	10	28	7
TOTAL SPECIMENS	158	134	141	77	281	491
TOTAL COLLECTIONS	6	6	6	6	6	6

TABLE C1-173. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 4.9-m TRAWL FROM 18 OCTOBER THROUGH 8 DECEMBER 1976 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	5.5 - 13.0	5.0 - 14.0	7.0 - 14.0	6.0 - 11.5	7.0 - 10.0	6.0 - 11.0
SURFACE	9.0 - 17.4	9.0 - 17.5	7.0 - 16.2	2.4 - 14.5	1.6 - 14.1	1.4 - 13.0
BOTTOM	9.2 - 17.4	8.6 - 17.6	7.0 - 16.4	2.5 - 14.5	1.7 - 14.2	2.2 - 13.0
SALINITY: SURFACE	22.0 - 25.0	21.0 - 26.0	21.5 - 25.0	22.0 - 26.0	21.5 - 27.0	22.0 - 24.5
BOTTOM	21.5 - 25.5	21.5 - 26.0	22.0 - 24.0	22.0 - 26.0	22.0 - 25.5	22.0 - 24.5
OXYGEN: SURFACE	8.5 - 9.4	8.8 - 9.8	9.6 - 9.7	8.4 - 11.5	8.2 - 11.5	8.1 - 11.8
BOTTOM	9.0 - 9.4	9.4 - 9.8	9.8 - 10.1	8.2 - 11.5	7.6 - 11.6	8.1 - 11.6
PH: SURFACE	8.0 - 8.3	8.1 - 8.3	8.0 - 8.3	7.2 - 8.5	8.2 - 8.7	8.0 - 8.4
BOTTOM	8.0 - 8.3	7.9 - 8.3	8.0 - 8.3	7.1 - 8.5	8.2 - 8.5	8.2 - 8.5
SECCHI (CM)	70.0 - 140.0	60.0 - 150.0	70.0 - 140.0	90.0 - 160.0	90.0 - 120.0	55.0 - 120.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
ALOSA PSEUDOHARENGUS	-	-	1	-	-	-
BREVOORTIA TYRANNUS	2	51	7	3	4	-
ANCHOA MITCHILLI	2	-	34	-	5	109
SYNODUS FOETENS	1	-	-	-	-	-
OPSANUS TAU	2	1	-	3	2	1
FUNDULUS HETEROCLITUS	-	-	1	-	-	-
MENIDIA MENIDIA	-	-	-	-	-	9
SYNGNATHUS FUSCUS	4	-	1	1	1	-
MORONE AMERICANA	1	-	7	-	-	-
CENTROPRISTIS STRIATA	-	-	-	1	1	-
POMATOMUS SALTATRIX	7	4	3	-	-	-
CARANX HIPPOS	1	-	2	-	-	-
SELENE VOMER	1	-	-	-	-	-
BAIRDIELLA CHRYSURA	-	-	1	-	-	-
CYNOSCION REGALIS	4	-	2	-	3	1
LEIOSTOMUS XANTHURUS	28	5	30	8	22	16
MICROPOGON UNDULATUS	-	-	1	-	-	1
CHAETODON OCELLATUS	-	2	-	-	-	-
TAUTOGA ONITIS	-	1	-	1	4	-
CHASMODES BOSQUIANUS	-	-	-	2	-	-
HYPSOBLENNIUS HENTZI	-	-	-	1	-	-
GOBIOSOMA BOSCI	-	-	-	1	-	-
GOBIOSOMA GINSBURGI	1	-	-	-	-	1
PRIONOTUS EVOLANS	2	-	-	-	-	-
ETROPUS MICROSTOMUS	1	1	1	-	2	-
PSEUDOPLEURONECTES AMERICANUS	2	-	-	-	-	4
TRINECTES MACULATUS	-	-	1	-	-	1
CRANGON SEPTEMSPINOSA	12	-	-	4	6	7
CALLINECTES SAPIDUS	14	4	1	9	6	4
TOTAL SPECIMENS	85	69	93	34	56	154
TOTAL COLLECTIONS	6	6	6	6	6	6

TABLE C1-174. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 4.9-m TRAWL FROM 5 JANUARY THROUGH 9 MARCH 1977 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	0.0 - 9.0	0.0 - 9.0	8.0 - 8.0	7.0 - 7.0	8.0 - 8.0	8.0 - 8.0
SURFACE	4.5 - 10.9	4.5 - 10.4	9.9 - 9.9	6.8 - 6.8	6.4 - 6.4	6.6 - 6.6
BOTTOM	4.5 - 11.0	4.5 - 11.0	10.4 - 10.4	7.0 - 7.0	6.2 - 6.2	6.5 - 6.5
SALINITY: SURFACE	22.5 - 23.5	22.0 - 24.0	21.5 - 21.5	23.0 - 23.0	22.5 - 22.5	22.0 - 22.0
BOTTOM	22.0 - 23.0	22.0 - 24.0	21.5 - 21.5	23.0 - 23.0	23.0 - 23.0	22.5 - 22.5
OXYGEN: SURFACE	8.6 - 11.4	9.4 - 10.2	9.6 - 9.6	11.8 - 11.8	10.3 - 10.3	10.4 - 10.4
BOTTOM	8.4 - 11.4	9.0 - 10.3	9.4 - 9.4	11.5 - 11.5	10.2 - 10.2	10.8 - 10.8
PH: SURFACE	8.0 - 8.2	7.9 - 8.1	8.0 - 8.0	7.9 - 7.9	8.2 - 8.2	7.9 - 7.9
BOTTOM	8.0 - 8.2	8.0 - 8.1	8.0 - 8.0	7.7 - 7.7	8.1 - 8.1	7.9 - 7.9
SECCHI (CM)	170.0 - 220.0	175.0 - 190.0	230.0 - 230.0	230.0 - 230.0	230.0 - 230.0	200.0 - 200.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
ALOSA AESTIVALIS	-	-	18	-	-	-
ALOSA PSEUDOHARENGUS	-	-	4	-	-	-
BREVOORTIA TYRANNUS	-	-	4	-	-	-
MORONE AMERICANA	-	-	1	-	1	-
PSEUDOPLEURONECTES AMERICANUS	-	2	1	-	-	2
CRANGON SEPTEMSPINOSA	5	-	2	3	3	-
TOTAL SPECIMENS	5	2	30	3	4	2
TOTAL COLLECTIONS	6	6	2	2	2	2

TABLE C1-175. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 2.7-m TRAWL FROM 29 MARCH THROUGH 5 MAY 1976 IN OYSTER CREEK (STA. 26 AND 27) AND FORKED RIVER (48 AND 49).

LOCATION	26	27	49	48
TEMPERATURE: AIR	12.0 - 22.0	16.0 - 22.0	15.0 - 23.0	15.0 - 23.0
SURFACE	15.1 - 30.2	16.2 - 27.5	13.5 - 23.5	13.5 - 23.0
BOTTOM	15.0 - 31.1	15.0 - 27.5	13.5 - 23.0	13.5 - 22.7
SALINITY: SURFACE	20.0 - 22.0	20.0 - 22.0	19.5 - 22.5	20.0 - 22.5
BOTTOM	20.5 - 22.0	20.0 - 22.0	19.5 - 22.5	20.5 - 22.5
OXYGEN: SURFACE	6.9 - 10.2	7.0 - 8.8	7.3 - 9.3	7.4 - 9.3
BOTTOM	6.9 - 10.4	6.9 - 9.2	7.6 - 9.3	7.4 - 9.2
PH: SURFACE	7.7 - 8.1	7.7 - 8.0	7.7 - 8.0	7.6 - 8.0
BOTTOM	7.6 - 8.0	7.7 - 8.0	7.8 - 8.1	7.8 - 8.1
SECCHI (CM)	80.0 - 110.0	100.0 - 120.0	90.0 - 120.0	80.0 - 120.0
SPECIES	NO.	NO.	NO.	NO.
ANGUILLA ROSTRATA	1	-	2	1
ANCHOA MITCHILLI	16	-	-	2
UROPHYCIS REGIUS	-	-	-	1
APELTES QUADRACUS	2	-	-	-
SYNGNATHUS FUSCUS	1	-	-	2
MORONE AMERICANA	3	-	-	-
PARALICHTHYS DENTATUS	2	-	1	1
PSEUDOPLEURONECTES AMERICANUS	1	-	1	1
CRANGON SEPTEMSPINOSA	24	5	265	162
CALLINECTES SAPIDUS	51	13	16	39
TOTAL SPECIMENS	101	18	285	209
TOTAL COLLECTIONS	6	6	6	6

TABLE C1-176. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 2.7-m TRAWL FROM 17 JUNE THROUGH 13 AUGUST 1976 IN OYSTER CREEK (STA. 26 AND 27) AND FORKED RIVER (48 AND 49).

LOCATION	26	27	49	48
TEMPERATURE: AIR	22.5 - 24.0	21.0 - 26.0	21.0 - 30.0	21.0 - 28.0
SURFACE	31.8 - 36.1	29.0 - 34.2	23.8 - 31.3	24.0 - 28.0
BOTTOM	28.1 - 34.3	28.5 - 32.8	24.2 - 31.5	24.0 - 28.0
SALINITY: SURFACE	23.0 - 26.0	22.0 - 27.5	22.0 - 27.5	22.0 - 27.5
BOTTOM	23.0 - 28.0	22.0 - 27.5	22.0 - 27.5	22.5 - 27.5
OXYGEN: SURFACE	5.0 - 7.8	5.5 - 7.2	5.9 - 7.6	5.5 - 7.7
BOTTOM	5.1 - 8.8	5.2 - 7.1	5.7 - 7.4	5.6 - 7.5
PH: SURFACE	7.8 - 8.0	7.9 - 7.9	7.9 - 8.2	5.5 - 8.2
BOTTOM	7.8 - 8.0	7.8 - 8.0	7.9 - 8.2	5.6 - 8.2
SECCHI (CM)	35.0 - 60.0	40.0 - 60.0	40.0 - 75.0	40.0 - 75.0

SPECIES	NO.	NO.	NO.	NO.
ANGUILLA ROSTRATA	-	3	-	-
BREVOORTIA TYRANNUS	2	2	-	-
OPSANUS TAU	-	-	-	1
UROPHYCIS REGIUS	-	-	-	1
RISSOLA MARGINATA	-	1	2	-
SYNGNATHUS FUSCUS	1	-	1	-
CYNOSCION REGALIS	1	-	-	-
LEIOSTOMUS XANTHURUS	456	10	7	15
TAUTOGA ONITIS	-	1	-	-
GOBIOSOMA BOSCI	-	-	-	1
CRANGON SEPTEMSPINOSA	-	-	129	13
CALLINECTES SAPIDUS	301	115	30	108
TOTAL SPECIMENS	761	132	169	139
TOTAL COLLECTIONS	6	6	6	6

TABLE C1-177. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 2.7-m TRAWL FROM 19 AUGUST THROUGH 23 SEPTEMBER 1976 IN OYSTER CREEK (STA. 26 AND 27) AND FORKED RIVER (48 AND 49).

LOCATION	26	27	49	48
TEMPERATURE: AIR	19.5 - 22.0	20.0 - 25.0	21.0 - 24.0	21.0 - 24.0
SURFACE	29.3 - 32.1	26.3 - 28.5	21.1 - 23.7	21.3 - 24.0
BOTTOM	26.0 - 30.4	25.4 - 28.5	21.4 - 24.0	21.6 - 24.3
SALINITY: SURFACE	22.0 - 26.0	22.0 - 25.0	21.5 - 25.0	21.5 - 25.0
BOTTOM	21.0 - 26.0	22.0 - 26.0	22.0 - 25.0	22.0 - 25.0
OXYGEN: SURFACE	6.3 - 7.1	7.0 - 7.5	7.3 - 8.2	7.2 - 8.0
BOTTOM	6.2 - 7.1	6.9 - 7.1	7.2 - 7.9	7.1 - 7.7
PH: SURFACE	7.7 - 7.8	7.7 - 8.0	7.8 - 8.2	7.9 - 8.1
BOTTOM	7.8 - 7.9	7.8 - 8.0	7.7 - 8.1	7.8 - 8.0
SECCHI (CM)	40.0 - 70.0	40.0 - 70.0	45.0 - 80.0	45.0 - 80.0

SPECIES	NO.	NO.	NO.	NO.
BREVOORTIA TYRANNUS	2	-	-	-
ANCHOA MITCHILLI	1	-	1	1
OPSANUS TAU	-	-	1	2
SYNGNATHUS FUSCUS	3	-	-	-
MORONE AMERICANA	21	-	-	-
CYNOSCION REGALIS	1	-	6	10
LEIOSTOMUS XANTHURUS	155	9	2	7
PRIONOTUS EVOLANS	1	1	1	3
SPHOEROIDES MACULATUS	-	-	-	1
CRANGON SEPTEMSPINOSA	-	1	57	53
CALLINECTES SAPIDUS	213	123	27	97
TOTAL SPECIMENS	397	134	95	174
TOTAL COLLECTIONS	6	6	6	6

TABLE C1-178. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 2.7-m TRAWL FROM 18 OCTOBER THROUGH 8 DECEMBER 1976 IN OYSTER CREEK (STA. 26 AND 27) AND FORKED RIVER (48 AND 49).

LOCATION	26	27	49	48
TEMPERATURE: AIR	4.0 - 8.5	4.0 - 8.5	2.5 - 10.0	2.5 - 10.0
SURFACE	10.0 - 22.6	8.0 - 18.9	3.0 - 12.6	3.0 - 13.2
BOTTOM	5.0 - 23.0	6.6 - 16.2	3.5 - 13.4	3.2 - 13.4
SALINITY: SURFACE	23.0 - 25.5	22.0 - 25.5	23.0 - 26.0	23.0 - 26.0
BOTTOM	24.0 - 25.5	22.0 - 25.5	23.0 - 26.0	23.0 - 26.0
OXYGEN: SURFACE	7.8 - 12.0	9.0 - 12.0	9.2 - 11.3	8.7 - 11.4
BOTTOM	8.1 - 12.3	8.8 - 12.4	8.3 - 12.2	8.6 - 12.2
PH: SURFACE	7.4 - 7.4	7.4 - 7.9	7.2 - 8.0	7.2 - 7.9
BOTTOM	7.3 - 7.4	7.3 - 7.9	7.2 - 8.0	7.2 - 7.9
SECCHI (CM)	80.0 - 220.0	70.0 - 190.0	60.0 - 220.0	60.0 - 220.0
SPECIES	NO.	NO.	NO.	NO.
BREVOORTIA TYRANNUS	-	2	-	-
SYNGNATHUS FUSCUS	-	1	-	1
MORONE AMERICANA	-	1	-	-
POMATOMUS SALTATRIX	-	1	-	-
CYNOSCION REGALIS	-	-	3	6
LEIOSTOMUS XANTHURUS	55	29	-	6
TAUTOGA ONITIS	-	-	-	1
ETROPUS MICROSTOMUS	-	3	1	1
SCOPHTHALMUS AQUOSUS	-	1	-	-
PSEUDOPLEURONECTES AMERICANUS	2	9	3	1
CRANGON SEPTEMSPINOSA	2	18	14	2
CALLINECTES SAPIDUS	38	46	5	20
TOTAL SPECIMENS	97	111	26	38
TOTAL COLLECTIONS	6	6	6	6

TABLE C1-179. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 2.7-m TRAWL FROM 5 JANUARY THROUGH 9 MARCH 1977 IN OYSTER CREEK (STA. 26 AND 27) AND FORKED RIVER (48 AND 49).

LOCATION	26	27	49	48
TEMPERATURE: AIR	-1.0 - 12.0	0.0 - 12.0	0.0 - 14.0	0.0 - 14.0
SURFACE	3.6 - 14.1	6.6 - 11.6	1.6 - 9.5	1.4 - 9.1
BOTTOM	8.1 - 14.6	6.3 - 11.4	2.2 - 9.4	1.5 - 9.6
SALINITY: SURFACE	21.0 - 25.0	21.0 - 25.0	21.0 - 25.0	22.0 - 25.0
BOTTOM	21.0 - 25.0	21.0 - 25.0	21.1 - 26.0	22.0 - 25.0
OXYGEN: SURFACE	9.4 - 12.4	9.7 - 14.4	10.2 - 12.6	10.5 - 12.8
BOTTOM	9.5 - 11.6	9.6 - 12.0	10.2 - 12.8	9.0 - 12.6
PH: SURFACE	7.8 - 8.1	8.0 - 8.3	7.6 - 8.1	7.6 - 8.1
BOTTOM	7.8 - 8.1	8.0 - 8.3	7.6 - 8.1	7.7 - 8.1
SECCHI (CM)	160.0 - 340.0	150.0 - 350.0	190.0 - 340.0	190.0 - 340.0
SPECIES	NO.	NO.	NO.	NO.
SYNGNATHUS FUSCUS	-	-	-	1
MORONE AMERICANA	3	-	-	-
POMATOMUS SALTATRIX	1	-	-	-
LEIOSTOMUS XANTHURUS	7	-	-	-
HYPSOBLENNIUS HENTZI	-	1	-	-
ETROPUS MICROSTOMUS	2	-	-	-
PSEUDOPLEURONECTES AMERICANUS	94	19	17	10
CRANGON SEPTEMSPINOSA	3	5	11	8
CALLINECTES SAPIDUS	1	1	-	2
TOTAL SPECIMENS	111	26	28	21
TOTAL COLLECTIONS	6	6	6	6

TABLE C1-180. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 61.0-m GILL NET FROM 29 MARCH THROUGH 5 MAY 1976 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	10.0 - 22.0	9.0 - 23.0	9.0 - 21.0	12.0 - 22.0	13.0 - 21.0	13.0 - 22.0
SURFACE	15.5 - 26.6	15.8 - 26.6	15.0 - 23.4	11.0 - 22.4	12.0 - 22.4	12.6 - 21.6
BOTTOM	15.5 - 26.2	15.8 - 26.6	15.0 - 23.3	11.0 - 23.4	12.0 - 22.4	12.9 - 21.0
SALINITY: SURFACE	20.5 - 22.0	21.0 - 22.0	20.5 - 22.0	20.5 - 22.5	20.5 - 22.5	20.5 - 22.0
BOTTOM	21.0 - 22.0	20.0 - 22.0	20.0 - 22.0	20.5 - 22.5	20.0 - 22.5	20.5 - 21.0
OXYGEN: SURFACE	5.9 - 9.0	6.8 - 9.2	7.5 - 9.8	7.6 - 10.6	7.6 - 10.9	7.2 - 10.5
BOTTOM	5.9 - 9.3	6.0 - 9.2	7.2 - 9.4	7.5 - 10.6	7.6 - 11.0	7.1 - 10.4
PH: SURFACE	7.8 - 8.0	7.5 - 7.9	7.6 - 8.0	7.9 - 8.0	6.9 - 7.9	7.8 - 7.8
BOTTOM	7.8 - 8.0	7.8 - 7.9	7.5 - 8.0	7.9 - 8.0	7.1 - 8.0	7.8 - 7.9
SECCHI (CM)	85.0 - 140.0	85.0 - 100.0	110.0 - 145.0	95.0 - 120.0	95.0 - 120.0	90.0 - 120.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
ALOSA PSEUDOHARENGUS	1	-	-	-	-	2
BREVOORTIA TYRANNUS	19	22	1	-	-	8
MORONE AMERICANA	-	-	-	1	-	-
TAUTOGA ONITIS	-	-	-	2	1	-
PARALICHTHYS DENTATUS	-	1	-	-	-	-
CALLINECTES SAPIDUS	20	1	-	12	4	-
TOTAL SPECIMENS	40	24	1	15	5	10
TOTAL COLLECTIONS	3	3	3	3	3	3

TABLE C1-181. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 61.0-m GILL NET FROM 17 JUNE THROUGH 13 AUGUST 1976 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	23.5 - 29.0	23.3 - 29.0	23.0 - 30.5	23.5 - 28.0	23.5 - 32.0	23.5 - 32.0
SURFACE	27.7 - 31.0	27.7 - 30.7	27.2 - 30.3	24.0 - 27.5	23.7 - 28.0	24.6 - 27.7
BOTTOM	28.2 - 30.0	27.7 - 30.7	26.8 - 29.7	24.0 - 27.5	23.7 - 28.4	24.4 - 27.0
SALINITY: SURFACE	23.0 - 27.0	24.0 - 26.5	23.0 - 26.5	24.0 - 26.0	24.0 - 26.0	23.0 - 27.0
BOTTOM	23.0 - 27.0	23.0 - 26.5	23.0 - 26.5	24.5 - 26.0	24.0 - 25.0	24.0 - 27.5
OXYGEN: SURFACE	6.6 - 7.0	6.5 - 6.5	6.5 - 7.4	7.0 - 7.5	7.4 - 7.8	7.2 - 9.9
BOTTOM	6.2 - 6.7	6.0 - 6.5	6.3 - 6.8	7.0 - 7.2	7.4 - 7.8	6.3 - 7.5
PH: SURFACE	7.7 - 7.9	7.6 - 7.7	7.6 - 7.8	7.4 - 7.6	7.6 - 7.8	7.6 - 7.9
BOTTOM	7.9 - 7.9	7.6 - 7.6	7.8 - 7.8	7.6 - 7.7	7.6 - 7.6	7.5 - 7.9
SECCHI (CM)	60.0 - 60.0	60.0 - 60.0	55.0 - 65.0	50.0 - 60.0	60.0 - 65.0	55.0 - 65.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
ANGUILLA ROSTRATA	-	-	-	-	1	-
BREVOORTIA TYRANNUS	-	-	19	-	-	7
POMATOMUS SALTATRIX	-	-	13	2	2	5
CARANX HIPPOS	2	-	-	-	-	-
LEIOSTOMUS XANTHURUS	-	2	14	3	1	15
PSEUDOPLEURONECTES AMERICANUS	-	-	-	-	-	1
CALLINECTES SAPIDUS	133	11	8	28	14	8
TOTAL SPECIMENS	135	13	54	33	18	36
TOTAL COLLECTIONS	3	3	3	3	3	3

TABLE C1-182. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 61.0-m GILL NET FROM 19 AUGUST THROUGH 23 SEPTEMBER 1976 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	21.0 - 25.0	24.0 - 26.0	23.0 - 25.0	21.0 - 31.0	19.0 - 32.0	19.0 - 32.0
SURFACE	28.0 - 28.5	28.0 - 29.0	26.8 - 28.0	24.4 - 25.5	25.0 - 25.7	23.7 - 28.6
BOTTOM	27.8 - 28.5	28.1 - 29.0	26.8 - 27.9	24.0 - 25.6	24.7 - 26.5	23.0 - 24.0
SALINITY: SURFACE	20.5 - 25.0	21.5 - 25.0	21.0 - 25.0	22.5 - 26.0	21.0 - 25.0	21.5 - 25.0
BOTTOM	21.5 - 25.0	20.5 - 25.0	21.5 - 25.0	22.5 - 26.0	22.5 - 25.0	22.5 - 24.5
OXYGEN: SURFACE	6.2 - 7.5	6.6 - 7.6	6.7 - 7.9	6.8 - 7.8	6.9 - 7.6	7.0 - 8.8
BOTTOM	6.1 - 7.3	6.3 - 7.3	5.5 - 7.8	6.6 - 7.7	6.9 - 7.5	6.0 - 7.4
PH: SURFACE	7.8 - 8.3	7.9 - 8.3	7.9 - 8.4	7.6 - 8.4	7.5 - 8.4	7.4 - 8.4
BOTTOM	7.8 - 8.3	7.9 - 8.3	7.9 - 8.1	7.6 - 8.4	7.8 - 8.4	7.4 - 8.4
SECCHI (CM)	55.0 - 80.0	50.0 - 70.0	65.0 - 80.0	60.0 - 80.0	50.0 - 70.0	40.0 - 80.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
BREVOORTIA TYRANNUS	1	-	20	4	25	70
OPSANUS TAU	1	-	-	-	-	-
STRONGYLURA MARINA	-	-	-	1	-	-
SYNGNATHUS FUSCUS	-	-	2	-	-	-
POMATOMUS SALTATRIX	11	1	8	1	2	18
CARANX HIPPOS	-	1	-	-	-	-
CYNOSCION REGALIS	-	1	-	-	-	-
LEIOSTOMUS XANTHURUS	13	1	1	-	-	14
CALLINECTES SAPIDUS	34	3	4	14	6	2
TOTAL SPECIMENS	60	7	35	20	33	104
TOTAL COLLECTIONS	3	3	3	3	3	3

TABLE C1-183. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 61.0-m GILL NET FROM 18 OCTOBER THROUGH 8 DECEMBER 1976 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	-2.0 - 13.0	-2.5 - 13.0	-2.5 - 12.0	0.0 - 11.0	-1.0 - 12.0	-1.0 - 9.0
SURFACE	7.0 - 17.6	7.0 - 17.2	5.4 - 16.0	3.5 - 12.0	3.1 - 12.0	2.1 - 12.5
BOTTOM	7.0 - 17.6	7.5 - 17.0	7.5 - 16.0	3.6 - 12.0	3.3 - 12.1	3.8 - 12.5
SALINITY: SURFACE	23.0 - 27.0	23.0 - 26.0	20.0 - 25.0	24.0 - 25.0	23.5 - 25.0	21.0 - 25.0
BOTTOM	23.0 - 25.0	23.0 - 26.5	23.0 - 25.0	24.0 - 26.0	24.0 - 25.0	24.0 - 26.0
OXYGEN: SURFACE	8.9 - 14.2	8.9 - 13.0	8.9 - 12.4	9.1 - 13.0	8.3 - 14.0	8.5 - 13.6
BOTTOM	8.4 - 13.6	8.8 - 12.6	8.0 - 12.8	8.7 - 12.8	8.9 - 13.6	8.5 - 13.3
PH: SURFACE	7.9 - 8.6	7.8 - 8.4	7.5 - 8.6	8.3 - 8.5	8.1 - 8.2	8.3 - 8.5
BOTTOM	7.8 - 8.5	7.8 - 8.4	7.5 - 8.5	7.9 - 8.6	8.1 - 8.2	8.2 - 8.6
SECCHI (CM)	70.0 - 120.0	70.0 - 135.0	60.0 - 120.0	70.0 - 140.0	70.0 - 130.0	70.0 - 90.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
ALOSA PSEUDOHARENGUS	-	-	4	-	-	-
BREVOORTIA TYRANNUS	18	1	29	1	3	-
MORONE AMERICANA	1	-	1	-	-	-
POMATOMUS SALTATRIX	1	-	4	-	-	-
CYNOSCION REGALIS	-	-	-	-	1	-
LEIOSTOMUS XANTHURUS	8	-	55	-	5	-
TAUTOGA ONITIS	-	-	-	-	1	-
TOTAL SPECIMENS	28	1	93	1	10	0
TOTAL COLLECTIONS	3	3	3	3	3	3

TABLE C1-184. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 61.0-m GILL NET FROM 5 JANUARY THROUGH 9 MARCH 1977 IN OYSTER CREEK (STA. 15, 30, AND 50) AND FORKED RIVER (6, 45, AND 46).

LOCATION	15	50	30	6	45	46
TEMPERATURE: AIR	0.0 - 12.0	0.0 - 10.0	10.0 - 10.0	9.5 - 9.5	5.5 - 5.5	7.0 - 7.0
SURFACE	4.5 - 10.0	4.5 - 11.1	10.5 - 10.5	7.2 - 7.2	6.8 - 6.8	7.0 - 7.0
BOTTOM	4.5 - 10.8	4.5 - 11.0	10.4 - 10.4	7.2 - 7.2	7.2 - 7.2	7.0 - 7.0
SALINITY: SURFACE	21.0 - 23.5	21.5 - 22.0	22.0 - 22.0	22.0 - 22.0	21.0 - 21.5	22.0 - 22.0
BOTTOM	21.0 - 23.0	21.0 - 22.0	22.2 - 22.2	21.5 - 21.5	21.0 - 21.5	22.0 - 22.0
OXYGEN: SURFACE	8.6 - 10.2	9.4 - 10.3	9.8 - 9.8	10.5 - 10.5	10.2 - 10.2	10.0 - 10.0
BOTTOM	8.4 - 10.6	9.0 - 10.8	9.0 - 9.0	10.0 - 10.0	10.0 - 10.0	10.2 - 10.2
PH: SURFACE	8.0 - 8.2	8.0 - 8.1	7.9 - 7.9	7.8 - 7.8	7.9 - 8.0	7.7 - 7.7
BOTTOM	8.0 - 8.2	8.0 - 8.1	7.9 - 7.9	7.9 - 7.9	8.0 - 8.0	7.7 - 7.7
SECCHI (CM)	170.0 - 240.0	175.0 - 280.0	280.0 - 280.0	350.0 - 350.0	210.0 - 210.0	130.0 - 130.0
SPECIES	NO.	NO.	NO.	NO.	NO.	NO.
BREVOORTIA TYRANNUS	-	5	1	-	-	-
TOTAL SPECIMENS	0	5	1	0	0	0
TOTAL COLLECTIONS	3	3	1	1	1	1

Table C1-185. Summary of the catches of the most numerous species taken in Oyster Creek and Forked River, New Jersey from March 1976 through March 1977.

	29 March - 5 May						17 June - 13 August						19 August - 23 September					
	Oyster Creek			Forked River			Oyster Creek			Forked River			Oyster Creek			Forked River		
	4.9[a]	2.7[b]	GN[c]	4.9	2.7	GN	4.9	2.7	GN	4.9	2.7	GN	4.9	2.7	GN	4.9	2.7	GN
Brevoortia tyrannus	-	-	42	-	-	8	47	4	19	2	-	7	6	2	21	1	-	99
Anchoa mitchilli	3769	16	-	3521	2	-	1206	-	-	457	-	-	77	1	-	402	2	-
Pomatomus saltatrix	-	-	-	-	-	-	2	-	13	2	-	9	2	-	20	-	-	21
Cynoscion regalis	-	-	-	-	-	-	2	1	-	2	-	-	24	1	1	110	16	-
Leiostomus xanthurus	-	-	-	-	-	-	119	466	16	128	22	19	202	164	15	214	9	14
Pseudopleuronectes americanus	2	1	-	4	2	-	-	-	-	2	-	1	-	-	-	2	-	-
Crangon septemspinosa	256	29	-	978	427	-	3	-	-	48	142	-	-	1	-	29	110	-
Callinectes sapidus	75	64	21	64	55	16	111	416	152	90	138	50	80	336	41	45	124	22

	18 October - 8 December						5 January - 9 March					
	Oyster Creek			Forked River			Oyster Creek			Forked River		
	4.9	2.7	GN	4.9	2.7	GN	4.9	2.7	GN	4.9	2.7	GN
Brevoortia tyrannus	60	2	48	7	-	4	4	-	6	-	-	-
Anchoa mitchilli	36	-	-	114	-	-	-	-	-	-	-	-
Pomatomus saltatrix	14	1	5	-	-	-	-	1	-	-	-	-
Cynoscion regalis	6	-	-	4	9	1	-	-	-	-	-	-
Leiostomus xanthurus	63	84	63	46	6	5	-	7	-	-	-	-
Pseudopleuronectes americanus	2	11	-	4	4	-	3	113	-	2	27	-
Crangon septemspinosa	12	20	-	17	16	-	7	8	-	6	19	-
Callinectes sapidus	19	34	-	19	25	-	-	2	-	-	2	-

[a] 4.9-m trawl at stations 15, 30, and 50 in Oyster Creek and 6, 45, and 46 in Forked River.
[b] 2.7-m trawl at stations 26, and 27 in Oyster Creek and 48, and 49 in Forked River.
[c] 61.0-m gill net at stations 15, 30, and 50 in Oyster Creek and 6, 45, and 46 in Forked River.

TABLE C1-186. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY TRAWL AND GILL NET FROM 29 MARCH THROUGH 5 MAY 1976 IN OYSTER CREEK (STA. 15, 26, 27, 30 AND 50) AND FORKED RIVER (6, 45, 46, 48, AND 49).

	OYSTER CREEK	FORKED RIVER
TEMPERATURE: AIR	9.0 - 23.0	6.0 - 23.0
SURFACE	14.0 - 30.2	11.0 - 23.5
BOTTOM	14.5 - 31.1	11.0 - 23.4
SALINITY: SURFACE	20.0 - 23.0	19.5 - 23.5
BOTTOM	19.5 - 22.5	19.5 - 24.0
OXYGEN: SURFACE	5.4 - 10.6	7.1 - 11.5
BOTTOM	5.4 - 10.4	6.9 - 11.5
PH: SURFACE	7.5 - 8.1	6.9 - 8.0
BOTTOM	7.5 - 8.0	7.1 - 8.1
SECCHI (CM)	60.0 - 160.0	75.0 - 150.0

SPECIES	NO.	NO.
ANGUILLA ROSTRATA	1	3
ALOSA AESTIVALIS	6	-
ALOSA PSEUDOHARENGUS	5	3
BREVOORTIA TYRANNUS	42	8
CLUPEA HARENGUS	7	-
ANCHOA MITCHILLI	3785	3523
OPSANUS TAU	3	6
UROPHYCIS REGIUS	2	3
MENIDIA MENIDIA	15	1
APELTES QUADRACUS	8	23
SYNGNATHUS FUSCUS	22	15
MORONE AMERICANA	3	1
TAUTOGA ONITIS	3	6
GOBIOSOMA BOSCI	1	3
PARALICHTHYS DENTATUS	7	2
PSEUDOPLEURONECTES AMERICANUS	3	6
TRINECTES MACULATUS	1	-
CRANGON SEPTEMSPINOSA	285	1405
CALLINECTES SAPIDUS	160	135
TOTAL SPECIMENS	4359	5143
TOTAL COLLECTIONS	39	39

TABLE C1-187. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY TRAWL AND GILL NET FROM 17 JUNE THROUGH 13 AUGUST 1976 IN OYSTER CREEK (STA. 15, 26, 27, 30, AND 50) AND FORKED RIVER (6, 45, 46, 48, AND 49).

		OYSTER CREEK	FORKED RIVER
TEMPERATURE:	AIR	20.5 - 30.5	20.0 - 32.0
	SURFACE	27.2 - 36.1	23.7 - 31.3
	BOTTOM	26.8 - 34.6	23.7 - 31.5
SALINITY:	SURFACE	22.0 - 27.5	22.0 - 27.5
	BOTTOM	20.6 - 28.0	22.0 - 28.0
OXYGEN:	SURFACE	5.0 - 8.4	5.5 - 9.9
	BOTTOM	5.1 - 8.8	5.6 - 8.3
PH:	SURFACE	6.4 - 8.0	5.5 - 8.2
	BOTTOM	6.6 - 8.0	5.6 - 8.2
SECCHI (CM)		35.0 - 70.0	40.0 - 100.0

SPECIES	NO.	NO.
ANGUILLA ROSTRATA	5	5
BREVOORTIA TYRANNUS	70	9
ANCHOA MITCHILLI	1204	457
OPSANUS TAU	3	8
UROPHYCIS REGIUS	1	1
RISSOLA MARGINATA	1	2
MENIDIA MENIDIA	-	1
APELTES QUADRACUS	-	1
SYNGNATHUS FUSCUS	1	2
POMATOMUS SALTATRIX	15	11
CARANX HIPPOS	5	-
CYNOSCION REGALIS	3	2
LEIOSTOMUS XANTHURUS	601	169
TAUTOGA ONITIS	3	6
HYPSOBLENNIUS HENTZI	1	-
GOBIOSOMA BOSCI	1	2
PEPRILUS TRIACANTHUS	1	-
PARALICHTHYS DENTATUS	-	1
PSEUDOPLEURONECTES AMERICANUS	-	3
TRINECTES MACULATUS	2	-
SPHOEROIDES MACULATUS	1	-
CRANGON SEPTEMSPINOSA	3	190
CALLINECTES SAPIDUS	679	278
TOTAL SPECIMENS	2600	1148
TOTAL COLLECTIONS	39	39

TABLE C1-188. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY TRAWL AND GILL NET FROM 19 AUGUST THROUGH 23 SEPTEMBER 1976 IN OYSTER CREEK (STA. 15, 26, 27, 30 AND 50) AND FORKED RIVER (6, 45, 46, 48, AND 49).

		OYSTER CREEK	FORKED RIVER
TEMPERATURE:	AIR	17.0 - 26.0	19.0 - 32.0
	SURFACE	25.6 - 33.3	20.9 - 28.6
	BOTTOM	25.4 - 33.2	21.1 - 26.5
SALINITY:	SURFACE	20.5 - 26.5	21.0 - 26.5
	BOTTOM	20.5 - 26.0	22.0 - 26.0
OXYGEN:	SURFACE	5.0 - 8.6	6.3 - 8.8
	BOTTOM	5.3 - 7.8	6.0 - 7.9
PH:	SURFACE	7.5 - 8.4	7.4 - 8.4
	BOTTOM	7.5 - 8.3	7.4 - 8.4
SECCHI (CM)		40.0 - 100.0	40.0 - 80.0

SPECIES	NO.	NO.
ANGUILLA ROSTRATA	3	5
BREVOORTIA TYRANNUS	29	100
ANCHOA HEPSETUS	-	1
ANCHOA MITCHILLI	78	404
OPSANUS TAU	9	18
STRONGYLURA MARINA	-	1
SYNGNATHUS FUSCUS	6	2
MORONE AMERICANA	21	-
CENTROPRISTIS STRIATA	-	1
POMATOMUS SALTATRIX	22	21
CARANX HIPPOS	2	-
SELENE VOMER	16	-
STENOTOMUS CHRYSOPS	-	1
CYNOSCION REGALIS	26	126
LEIOSTOMUS XANTHURUS	381	237
TAUTOGA ONITIS	-	3
TAUTOGOLABRUS ADSPERSUS	-	1
CHASMODES BOSQUIANUS	1	1
HYPSOBLENNIUS HENTZI	-	1
GOBIOSOMA BOSCI	-	2
PRIONOTUS EVOLANS	9	11
PSEUDOPLEURONECTES AMERICANUS	-	2
TRINECTES MACULATUS	4	6
SPHOEROIDES MACULATUS	1	1
CRANGON SEPTEMSPINOSA	1	139
CALLINECTES SAPIDUS	457	191
TOTAL SPECIMENS	1066	1275
TOTAL COLLECTIONS	39	39

TABLE C1-189. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY TRAWL AND GILL NET FROM 18 OCTOBER THROUGH 8 DECEMBER 1976 IN OYSTER CREEK (STA. 15, 26, 27, 30, AND 50) AND FORKED RIVER (6, 45, 46, 48, AND 49).

		OYSTER CREEK	FORKED RIVER
TEMPERATURE:	AIR	-2.5 - 14.0	-1.0 - 12.0
	SURFACE	5.4 - 22.6	1.4 - 14.5
	BOTTOM	5.0 - 23.0	1.7 - 14.5
SALINITY:	SURFACE	20.0 - 27.0	21.0 - 27.0
	BOTTOM	21.5 - 26.5	22.0 - 26.0
OXYGEN:	SURFACE	7.8 - 14.2	8.1 - 14.0
	BOTTOM	8.0 - 13.6	7.6 - 13.6
PH:	SURFACE	7.2 - 8.6	7.2 - 8.7
	BOTTOM	7.2 - 8.5	7.1 - 8.6
SECCHI (CM)		60.0 - 220.0	55.0 - 220.0

SPECIES	NO.	NO.
ALOSA PSEUDOHARENGUS	5	-
BREVOORTIA TYRANNUS	110	11
ANCHOA MITCHILLI	36	114
SYNODUS FOETENS	1	-
OPSANUS TAU	3	6
FUNDULUS HETEROCLITUS	1	-
MENIDIA MENIDIA	-	9
SYNGNATHUS FUSCUS	6	3
MORONE AMERICANA	11	-
CENTROPRISTIS STRIATA	-	2
POMATOMUS SALTATRIX	20	-
CARANX HIPPOS	3	-
SELENE VOMER	1	-
BAIRDIELLA CHRYSURA	1	-
CYNOSCION REGALIS	6	14
LEIOSTOMUS XANTHURUS	210	57
MICROPOGON UNDULATUS	1	1
CHAETODON OCELLATUS	2	-
TAUTOGA ONITIS	1	7
CHASMODES BOSQUIANUS	-	2
HYPSOBLENNIUS HENTZI	-	1
GOBIOSOMA BOSCI	-	1
GOBIOSOMA GINSBURGI	1	1
PRIONOTUS EVOLANS	2	-
ETROPUS MICROSTOMUS	6	4
SCOPHTHALMUS AQUOSUS	1	-
PSEUDOPLEURONECTES AMERICANUS	13	8
TRINECTES MACULATUS	1	1
CRANGON SEPTEMSPINOSA	32	33
CALLINECTES SAPIDUS	103	44
TOTAL SPECIMENS	577	319
TOTAL COLLECTIONS	39	39

TABLE C1-190. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY TRAWL AND GILL NET FROM 5 JANUARY THROUGH 9 MARCH 1977 IN OYSTER CREEK (STA. 15, 26, 27, 30, AND 50) AND FORKED RIVER (6, 45, 46, 48, AND 49).

		OYSTER CREEK	FORKED RIVER
TEMPERATURE:	AIR	-1.0 - 12.0	0.0 - 14.0
	SURFACE	3.6 - 14.1	1.4 - 9.5
	BOTTOM	4.5 - 14.6	1.5 - 9.6
SALINITY:	SURFACE	21.0 - 25.0	21.0 - 25.0
	BOTTOM	21.0 - 25.0	21.0 - 26.0
OXYGEN:	SURFACE	8.6 - 14.4	10.0 - 12.8
	BOTTOM	8.4 - 12.0	9.0 - 12.8
PH:	SURFACE	7.7 - 8.3	7.6 - 8.2
	BOTTOM	7.8 - 8.3	7.6 - 8.1
SECCHI (CM)		150.0 - 360.0	130.0 - 350.0

SPECIES	NO.	NO.
ALOSA AESTIVALIS	18	-
ALOSA PSEUDOHARENGUS	4	-
BREVOORTIA TYRANNUS	10	-
SYNGNATHUS FUSCUS	-	1
MORONE AMERICANA	4	1
POMATOMUS SALTATRIX	1	-
LEIOSTOMUS XANTHURUS	7	-
HYPSOBLENNIUS HENTZI	1	-
ETROPUS MICROSTOMUS	2	-
PSEUDOPLEURONECTES AMERICANUS	116	29
CRANGON SEPTEMSPINOSA	15	25
CALLINECTES SAPIDUS	2	2
TOTAL SPECIMENS	180	58
TOTAL COLLECTIONS	33	21

TABLE C1-191. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 45.7-m SEINE FROM 29 MARCH THROUGH 5 MAY 1976 IN OYSTER CREEK (STA. 28 AND 29) AND FORKED RIVER (47).

LOCATION	28	29	47
TEMPERATURE: AIR	12.0 - 20.0	13.0 - 20.0	13.0 - 20.0
SURFACE	15.0 - 25.0	15.2 - 25.0	14.0 - 21.5
BOTTOM	- - -	- - -	- - -
SALINITY: SURFACE	20.5 - 21.0	20.5 - 21.5	20.0 - 22.5
BOTTOM	- - -	- - -	- - -
OXYGEN: SURFACE	7.0 - 10.6	7.0 - 10.8	8.9 - 11.2
BOTTOM	- - -	- - -	- - -
PH: SURFACE	7.6 - 7.6	7.7 - 7.7	7.8 - 7.8
BOTTOM	- - -	- - -	- - -
SECCHI (CM)	- - -	- - -	- - -

SPECIES	NO.	NO.	NO.
ALOSA AESTIVALIS	-	-	18
BREVOORTIA TYRANNUS	-	21	-
ANCHOA MITCHILLI	14	12	35
OPSANUS TAU	-	-	4
STRONGYLURA MARINA	2	1	-
FUNDULUS HETEROCLITUS	12	4	-
MENIDIA MENIDIA	114	1	56
APELTES QUADRACUS	-	1	-
SYNGNATHUS FUSCUS	-	-	1
MORONE AMERICANA	3	-	-
TAUTOGA ONITIS	-	-	1
GOBIOSOMA BOSCI	-	1	-
TRINECTES MACULATUS	1	1	-
CRANGON SEPTEMSPINOSA	327	243	95
CALLINECTES SAPIDUS	79	32	32
TOTAL SPECIMENS	552	317	242
TOTAL COLLECTIONS	3	3	3

TABLE C1-192. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 45.7-m SEINE FROM 17 JUNE THROUGH 13 AUGUST 1976 IN OYSTER CREEK (STA. 28 AND 29) AND FORKED RIVER (47).

LOCATION	28	29	47
TEMPERATURE: AIR	23.5 - 28.0	23.5 - 33.0	23.5 - 33.0
SURFACE	27.0 - 30.6	26.8 - 31.2	23.9 - 28.0
BOTTOM	- - -	- - -	- - -
SALINITY: SURFACE	23.0 - 25.0	23.0 - 26.5	8.0 - 27.0
BOTTOM	- - -	- - -	- - -
OXYGEN: SURFACE	5.7 - 6.9	5.9 - 7.2	5.8 - 26.5
BOTTOM	- - -	- - -	- - -
PH: SURFACE	7.6 - 8.1	7.2 - 7.9	7.5 - 8.1
BOTTOM	- - -	- - -	- - -
SECCHI (CM)	- - -	- - -	- - -

SPECIES	NO.	NO.	NO.
ANGUILLA ROSTRATA	2	2	-
BREVOORTIA TYRANNUS	-	58	6
ANCHOA MITCHILLI	5	15	88
OPSANUS TAU	-	-	15
STRONGYLURA MARINA	3	23	-
FUNDULUS HETEROCLITUS	1	1	1
MENIDIA BERYLLINA	-	-	1
MENIDIA MENIDIA	4	2	3
MORONE AMERICANA	1	-	-
POMATOMUS SALTATRIX	4	7	5
CARANX HIPPOS	19	17	-
CYNOSCION REGALIS	-	-	1
LEIOSTOMUS XANTHURUS	207	187	17
MUGIL CEPHALUS	10	19	-
MUGIL CUREMA	28	1	-
PRIONOTUS EVOLANS	-	1	-
PSEUDOPLEURONECTES AMERICANUS	-	-	20
TRINECTES MACULATUS	-	22	-
CRANGON SEPTEMSPINOSA	-	2	49
CALLINECTES SAPIDUS	37	233	62
TOTAL SPECIMENS	321	590	268
TOTAL COLLECTIONS	3	3	3

TABLE C1-193. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 45.7-m SEINE FROM 19 AUGUST THROUGH 23 SEPTEMBER 1976 IN OYSTER CREEK (STA. 28 AND 29) AND FORKED RIVER (47).

LOCATION	28	29	47
TEMPERATURE: AIR	19.0 - 21.5	21.0 - 25.0	21.5 - 23.0
SURFACE	27.6 - 29.4	28.4 - 29.1	24.6 - 25.5
BOTTOM	- - -	- - -	- - -
SALINITY: SURFACE	12.0 - 25.0	22.0 - 25.0	23.0 - 25.0
BOTTOM	- - -	- - -	- - -
OXYGEN: SURFACE	6.3 - 6.9	6.6 - 7.5	7.2 - 7.3
BOTTOM	- - -	- - -	- - -
PH: SURFACE	7.7 - 8.3	7.9 - 8.4	7.7 - 8.4
BOTTOM	- - -	- - -	- - -
SECCHI (CM)	- - -	- - -	- - -

SPECIES	NO.	NO.	NO.
ANGUILLA ROSTRATA	-	1	-
BREVOORTIA TYRANNUS	2	-	-
ANCHOA MITCHILLI	-	-	79
OPSANUS TAU	-	-	2
STRONGYLURA MARINA	-	2	-
FUNDULUS MAJALIS	-	2	-
MENIDIA MENIDIA	8	-	6
APELTES QUADRACUS	-	-	1
SYNGNATHUS FUSCUS	-	3	3
CENTROPRISTIS STRIATA	-	-	2
POMATOMUS SALTATRIX	-	3	-
CARANX HIPPOS	7	4	-
LEIOSTOMUS XANTHURUS	31	7	-
MUGIL CEPHALUS	33	7	-
MUGIL CUREMA	-	2	-
GOBIOSOMA BOSCI	-	-	1
PRIONOTUS EVOLANS	-	-	2
PSEUDOPLEURONECTES AMERICANUS	-	-	1
TRINECTES MACULATUS	-	2	-
CRANGON SEPTEMSPINOSA	-	-	1
CALLINECTES SAPIDUS	124	81	9
CALLINECTES SIMILIS	-	1	-
TOTAL SPECIMENS	205	115	107
TOTAL COLLECTIONS	3	3	3

TABLE C1-194. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 45.7-m SEINE FROM 18 OCTOBER THROUGH 8 DECEMBER 1976 IN OYSTER CREEK (STA. 28 AND 29) AND FORKED RIVER (47).

LOCATION	28	29	47
TEMPERATURE: AIR	0.0 - 19.0	-2.0 - 21.0	-1.5 - 19.0
SURFACE	6.3 - 18.6	5.5 - 18.2	2.1 - 15.5
BOTTOM	- - -	- - -	- - -
SALINITY: SURFACE	22.5 - 24.0	23.5 - 24.0	22.5 - 25.0
BOTTOM	- - -	- - -	- - -
OXYGEN: SURFACE	8.5 - 13.7	8.3 - 12.3	8.5 - 13.2
BOTTOM	- - -	- - -	- - -
PH: SURFACE	7.8 - 8.5	7.9 - 8.5	7.9 - 8.3
BOTTOM	- - -	- - -	- - -
SECCHI (CM)	- - -	- - -	- - -

SPECIES	NO.	NO.	NO.
ANGUILLA ROSTRATA	-	-	1
BREVOORTIA TYRANNUS	96	2	1
ANCHOA MITCHILLI	-	-	7
STRONGYLURA MARINA	2	1	-
CYPRINODON VARIEGATUS	35	8	-
FUNDULUS HETEROCLITUS	10	-	-
LUCANIA PARVA	2	-	-
MENIDIA MENIDIA	22	21	6
SYNGNATHUS FUSCUS	-	-	1
MORONE AMERICANA	-	1	-
CENTROPRISTIS STRIATA	-	-	3
POMATOMUS SALTATRIX	14	1	-
CARANX HIPPOS	7	6	-
CYNOSCION REGALIS	-	-	1
LEIOSTOMUS XANTHURUS	12	15	-
MUGIL CEPHALUS	14	27	-
MUGIL CUREMA	5	7	-
HYPSOBLENNIUS HENTZI	-	-	1
PRIONOTUS EVOLANS	2	-	1
PSEUDOPLEURONECTES AMERICANUS	-	14	-
TRINECTES MACULATUS	1	2	-
SYMPHURUS PLAGIUSA	2	-	-
CRANGON SEPTEMSPINOSA	2	10	3
CALLINECTES SAPIDUS	27	38	16
TOTAL SPECIMENS	253	153	43
TOTAL COLLECTIONS	3	3	3

TABLE C1-195. A COMPARISON OF THE TOTAL SPECIMENS TAKEN BY 45.7-m SEINE FROM 5 JANUARY THROUGH 9 MARCH 1977 IN OYSTER CREEK (STA. 28 AND 29) AND FORKED RIVER (47).

LOCATION	28	29	47
TEMPERATURE: AIR	1.0 - 13.0	0.5 - 10.0	5.5 - 8.5
SURFACE	6.5 - 8.6	4.0 - 9.1	4.5 - 6.1
BOTTOM	- - -	- - -	- - -
SALINITY: SURFACE	20.5 - 23.5	20.5 - 23.5	22.5 - 23.0
BOTTOM	- - -	- - -	- - -
OXYGEN: SURFACE	7.8 - 11.6	7.8 - 14.4	8.2 - 12.6
BOTTOM	- - -	- - -	- - -
PH: SURFACE	8.0 - 8.0	8.0 - 8.1	8.0 - 8.0
BOTTOM	- - -	- - -	- - -
SECCHI (CM)	- - -	- - -	- - -

SPECIES	NO.	NO.	NO.
ALOSA AESTIVALIS	1	-	-
CYPRINODON VARIEGATUS	-	3	-
FUNDULUS HETEROCLITUS	-	1	-
FUNDULUS MAJALIS	1	-	-
MENIDIA MENIDIA	5	-	1
PSEUDOPLEURONECTES AMERICANUS	1	5	-
CRANGON SEPTEMSPINOSA	18	2	2
TOTAL SPECIMENS	26	11	3
TOTAL COLLECTIONS	3	3	2

Table C1-196. Number of fishes and blue crab taken by gill net at Station 26, Discharge Canal at OCGS, from March 1976 through August 1977.

SPECIES	DATE																	
	29 March[a]	22 April	4 May	18 June	23 July	13 August	20 August	10 September	23 September	18 October	8 November	6 December	6 January	11 February	8 March	31 May	18 July	15 August
Alosa pseudoharengus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-
Brevoortia tyrannus	23	220	114	-	2	1	-	1	5	-	31	43	63	1,348	167	1	7	-
Clupea harengus	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anchoa mitchilli	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strongylura marina	-	-	-	-	-	-	-	-	3	5	-	-	-	-	-	2	-	-
Morone americana	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-
Morone saxatilis	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Pomatomus saltatrix	-	-	2	1	2	1	5	5	1	15	27	31	23	-	-	-	33	1
Caranx hippos	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
Cynoscion regalis	-	-	1	-	-	-	-	-	1	7	3	-	-	-	-	-	-	-
Leiostomus xanthurus	-	-	-	-	197	3	-	27	-	-	-	1	-	-	-	1	5	-
Mugil cephalus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Callinectes sapidus	-	2	-	2	-	100	35	4	5	1	-	-	-	-	-	2	15	-
Duration of sample (min)	60	40	45	60	60	60	60	60	60	60	60	50	60	60	30	60	60	60
Total specimens	23	238	156	3	206	105	40	40	15	29	62	75	87	1,349	167	7	62	1
Taxa	1	4	3	2	4	4	2	7	5	5	4	3	3	2	1	5	5	1

[a] A 91.4-m gill net from March through June 1976 and a 61.0-m gill net used from July 1976 through August 1977.

Table CI-197. Summary of the catches of the most numerous species taken in Oyster Creek and Forked River, New Jersey from May through August 1977.

	31 May - 2 June						18-19 July						15-16 August					
	Oyster Creek			Forked River			Oyster Creek			Forked River			Oyster Creek			Forked River		
	4.9[a]	2.7[b]	GN[c]	4.9	2.7	GN	4.9	2.7	GN	4.9	2.7	GN	4.9	2.7	GN	4.9	2.7	GN
Brevoortia tyrannus	11	-	40	1	-	16	28	1	9	1	-	2	9	-	5	1	-	3
Anchoa mitchilli	948	-	-	1075	-	-	407	48	-	431	-	-	94	-	-	199	-	-
Leiostomus xanthurus	-	2	2	-	-	3	49	38	-	65	25	20	11	69	1	6	4	1
Pseudopleuronectes americanus	4	3	-	16	-	-	11	1	-	18	6	-	-	-	-	-	-	-
Crangon septemspinosa	20	-	-	168	-	-	-	-	-	4	78	-	-	-	-	-	42	-
Callinectes sapidus	3	6	-	9	1	1	5	9	3	5	48	3	6	8	3	6	7	4

[a] 4.9-m trawl at stations 15, 30, and 50 in Oyster Creek and 6, 45, and 46 in Forked River.
[b] 2.7-m trawl at stations 26 and 27 in Oyster Creek and 48 and 49 in Forked River.
[c] 61.0 or 91.4-m gill net at stations 15, 30, and 50 in Oyster Creek and 6, 45, and 46 in Forked River.

Table C1-198. Summary of results of two-way analysis of variance applied to trawl, seine, and gill net collections from March 1976 through March 1977.

Species	Time Period	Gear	Replicate[a]	Station	Date	Station x Date Interaction
Anchoa mitchilli	March-November	4.9-m trawl	NS	**	**	**
Leiostomus xanthurus	June-November	4.9-m trawl	NS	**	**	NS
Crangon septemspinosa	March-May	4.9-m trawl	* (2>1)	**	NS	**
Callinectes sapidus	March-December	4.9-m trawl	NS	**	**	**
Leiostomus xanthurus	July-January	2.7-m trawl	NS	**	**	*
Pseudopleuronectes americanus	December-March	2.7-m trawl	NS	**	**	*
Crangon septemspinosa	March-August	2.7-m trawl	NS	**	**	NS
Callinectes sapidus	March-November	2.7-m trawl	NS	**	**	NS
Brevoortia tyrannus	March-December	61.0-m gill net	-	NS	NS	-
Leiostomus xanthurus	July-December	61.0-m gill net	-	NS	NS	-
Callinectes sapidus	April-September	61.0-m gill net	-	**	**	-
Callinectes sapidus	March-December	45.7-m seine	-	NS	NS	-

[a] NS = not significant
** = achieved significance at $P \leq 0.01$
* = achieved significance at $P \leq 0.05$
Largest mean replicate indicated where significant
Significant differences among stations and dates given on following table.

Table C1-199. Results of the Student-Newman-Kuels Multiple Range test applied to main effect means from two-way analysis of variance. Means underlined are not significantly different.

Anchoa mitchilli	station	46	45	30	15	50	6					
March - November	mean[a]	3.135	2.204	2.068	1.704	1.535	0.738					
4.9-m trawl												
	date	April	May	June	July	September 2	March	August 2	August 1	September 1	November	October
	mean[b]	4.128	3.104	3.034	2.478	1.851	1.276	1.194	1.162	1.065	0.842	0.775
Leiostomus xanthurus	station	46	30	15	45	50	6					
June - November	mean	2.386	2.070	1.810	1.529	1.070	0.925					
4.9-m trawl												
	date	August 2	July	September 2	September 1	October	June	August 1	November			
	mean	2.404	2.376	2.083	1.883	1.776	1.101	0.986	0.448			
Crangon septemspinosa	station	45	46	6	50	15	30					
March - May	mean	3.764	3.330	3.226	2.630	2.168	1.535					
4.9-m trawl												
Callinectes sapidus	station	15	50	45	6	46	30					
March - December	mean	1.503	1.283	1.278	1.173	0.777	0.648					
4.9-m trawl												
	date	June	August 2	July	May	April	August 1	March	October	September 1	September 2	November	December
	mean	1.820	1.744	1.722	1.682	1.148	1.124	1.099	0.886	0.847	0.582	0.498	0.173
Leiostomus xanthurus	station	26	27	48	49							
July - January	mean	2.660	0.690	0.605	0.227							
2.7-m trawl												
	date	July	August 1	August 2	October	September 1	September 2	December	November	January		
	mean	2.193	1.589	1.289	1.139	1.074	1.018	1.610	0.288	0.260		
Pseudopleuronectes americanus	station	28	27	48	49							
December - March	mean	2.183	0.964	0.708	0.585							
2.7-m trawl												
	date	January	March	December	February							
	mean	1.582	1.474	0.900	0.484							

Table C1-199. (cont.)

Crangon septemspinosa	station	49	48	27	28							
March - August	mean	2.573	1.770	0.256	0.230							
2.7-m trawl												
	date	March	May	August 2	April	July	June	August 1				
	mean	2.152	1.721	1.472	1.321	1.209	0.489	0.087				
Callinectes sapidus	station	26	27	48	49							
March - November	mean	2.839	2.116	2.109	1.210							
2.7-m trawl												
	date	July	September 1	August 2	August 1	June	September 2	October	May	April	March	November
	mean	2.847	2.778	2.697	2.586	2.584	2.457	2.325	2.143	1.298	0.607	0.433
Callinectes sapidus	station	15	6	45	50	30	46					
April - September	mean	2.845	1.741	1.210	0.842	0.721	0.554					
61.0-m gill net												
	date	July	August 1	June	August 2	September 2	May	September 1	April			
	mean	2.173	1.737	1.696	1.305	1.133	1.015	0.992	0.499			

[a] Means from ln (x + 1) transformed data.
[b] 1 and 2 refer to first and second sampling dates in August and September.

Table C1-200. Summary of results of one-way ANOVA or t-test and SNK multiple range test applied to condition data.

Species	Results of ANOVA or t-test[a]		Results of SNK multiple range test[b]						
Brevoortia tyrannus	$F_{9,\ 187} = 114.86$	Sta	50	45	30	48			
91-130 mm	**	K	14.56	11.98	10.76	8.58			
June - December		n	(53)	(26)	(71)	(41)			
Brevoortia tyrannus	$F_{2,\ 129} = 11.88$	Sta	50	15	26				
221-280 mm	**	K	14.51	12.92	12.56				
March - November		n	(18)	(23)	(91)				
Brevoortia tyrannus	$t_{224} = 0.83$	Sta	26	15					
111-310 mm	NS	K	12.86	12.62					
March - December		n	(187)	(39)					
Brevoortia tyrannus (Sta. 26)	$F_{2,\ 80} = 14.59$	date	Jan	Feb	Mar				
101-120 mm	**	K	13.36	11.84	11.80				
January - March		n	(19)	(30)	(34)				
Brevoortia tyrannus (Sta. 26)	$F_{4,\ 121} = 3.02$	date	Mar	Dec	Feb	Jan	Nov		
211-260 mm	*	K	13.87	13.84	13.14	13.12	13.06		
November - March		n	(35)	(28)	(19)	(26)	(18)		
Anchoa mitchilli	$F_{8,\ 533} = 3.13$	Sta	47	45	6	46	15,28	50,29	30
51-60 mm	**	K	5.98	5.76	5.75	5.56	5.50	5.47	5.36
March - August		n	(27)	(132)	(52)	(81)	(93)	(42)	(113)
Anchoa mitchilli	$F_{6,\ 409} = 7.87$	Sta	47	46	6	45	15,28	50,29	30
61-70 mm	**	K	5.96	5.94	5.56	5.49	5.35	5.32	5.02
March - August		n	(54)	(53)	(38)	(63)	(86)	(70)	(42)
Pomatomus saltatrix	$t_{46} = 1.47$	Sta	OC	FR					
150-190 mm	NS	K	1.63	1.48					
July - September		n	(28)	(20)					
Cynoscion regalis	$F_{2,111} = 0.68$	Sta	48,49	OC	FR				
45-215 mm	NS	K	4.23	4.18	4.09				
August - October		n	(22)	(27)	(65)				

Table C1-200. (cont.)

Species	Results of ANOVA or t-test[a]		Results of SNK multiple range test[b]		
Pseudopleuronectes americanus	$F_{2, 157} = 1.45$	Sta	28,27	OC	48,49
90-210 mm	NS	K	7.34	7.27	6.97
October - March		n	(108)	(24)	(27)

[a] NS = not significant
* = achieved significance at $P \leq 0.05$
** = achieved significance at $P \leq 0.01$

[b] Station or station group, mean condition (K) and number of observations (n) given. Means underlined are not significantly different.

Table C1-201. Number per collection by temperature* of selected fishes and macroinvertebrates in Oyster Creek and Forked River, New Jersey from March 1976 through March 1977.

	No. Collections		Brevoortia tyrannus		Anchoa mitchilli		Pomatomus saltatrix		Cynoscion regalis		Leiostomus xanthurus		Pseudopleuronectes americanus		Crangon septemspinosa		Callinectes sapidus	
Temp. (C)	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR
36	2	0	1	-	-	-	-	-	1	-	-	-	-	-	-	-	29	-
35	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	2	0	-	-	-	-	-	-	-	-	1	-	-	-	-	-	16	-
33	3	0	-	-	-	-	-	-	-	-	101	-	-	-	-	-	31	-
32	4	0	-	-	-	-	-	-	-	-	47	-	-	-	-	-	54	-
31	12	2	-	-	34	-	-	-	-	-	11	-	-	-	-	2	23	8
30	12	0	1	-	12	-	1	-	-	-	5	-	-	-	-	-	15	-
29	19	1	-	16	23	-	-	3	-	-	21	2	-	-	-	-	26	-
28	27	8	2	2	9	7	-	1	1	-	7	1	-	-	-	1	7	6
27	14	1	6	-	197	-	1	1	-	-	6	-	-	-	8	-	3	4
26	6	14	1	2	11	24	-	-	-	-	8	4	-	-	-	2	8	5
25	2	17	-	-	9	10	-	-	-	-	-	4	-	1	17	3	12	6
24	0	17	-	3	-	4	-	1	-	-	-	4	-	-	-	10	-	10
23	5	18	-	-	12	12	-	-	-	5	1	9	-	-	4	10	6	6
22	0	10	-	-	-	202	-	-	-	2	-	4	-	-	-	8	-	2
21	0	10	-	-	-	16	-	-	-	1	-	2	-	-	-	8	-	4
20	7	0	1	-	20	-	-	-	-	-	-	-	-	-	6	-	5	-
19	4	0	6	-	-	-	-	-	-	-	10	-	-	-	-	-	16	-
18	7	1	-	-	1	34	-	-	-	-	3	-	-	-	4	4	6	-
17	3	0	-	-	-	-	1	-	1	-	8	-	-	-	-	-	1	-
16	9	7	4	-	-	78	-	-	-	-	4	-	-	-	-	19	2	8
15	13	7	-	-	57	1	-	-	-	-	-	1	-	-	48	22	10	6
14	4	11	-	-	23	90	-	-	-	-	-	2	4	-	3	78	1	5
13	3	12	31	1	-	8	4	-	-	1	-	2	14	1	-	11	3	3
12	9	1	6	3	3	-	1	-	-	1	-	4	-	-	1	-	3	-
11	4	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
10	9	1	2	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
9	8	3	-	-	-	-	-	-	-	-	-	-	1	8	1	1	1	-
8	7	7	1	1	-	-	-	-	-	-	-	-	1	-	3	1	-	-
7	9	10	-	-	-	1	-	-	-	-	-	-	2	-	2	1	-	-
6	2	7	-	-	-	-	-	-	-	-	-	-	6	-	5	1	1	-
5	10	1	2	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
4	3	5	-	-	-	-	-	-	-	-	2	-	14	-	1	-	-	-
3	0	5	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	-
2	0	8	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
1	0	4	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-

* rounded to nearest whole n/coll and degree C.

Table C1-202. Number per collection by temperature* of selected fishes and macroinvertebrates taken in Oyster Creek and Forked River, New Jersey from March and April 1976.

Temp. (C)	No. Collections		Brevoortia tyrannus		Anchoa mitchilli		Pseudopleuronectes americanus		Crangon septemspinosa		Callinectes sapidus	
	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR
30	2	0	-	-	-	-	-	-	-	-	4	-
29	0	0	-	-	-	-	-	-	-	-	-	-
28	2	0	-	-	-	-	-	-	-	-	2	-
27	6	0	2	-	458	-	-	-	13	-	3	-
26	0	0	-	-	-	-	-	-	-	-	-	-
25	2	0	-	-	9	-	-	-	17	-	12	-
24	0	2	-	-	-	-	-	-	-	12	-	3
23	3	2	-	-	21	1	-	-	8	22	1	6
22	0	8	-	-	-	236	-	-	-	11	-	3
21	0	2	-	-	-	50	-	-	-	38	-	1
20	2	0	-	-	2	-	1	-	12	-	5	-
19	0	0	-	-	-	-	-	-	-	-	-	-
18	2	0	-	-	-	-	-	-	1	-	-	-
17	0	0	-	-	-	-	-	-	-	-	-	-
16	2	0	12	-	-	-	-	-	-	-	1	-
15	7	0	-	-	101	-	-	-	88	-	9	-
14	2	7	-	2	47	-	1	1	5	84	2	6
13	0	5	-	-	-	-	-	1	-	26	-	2
12	0	1	-	-	-	-	-	-	-	-	-	-
11	0	1	-	-	-	-	-	-	-	-	-	-

* rounded to nearest whole n/coll and degree C.

Table C1-203. Number per collection by temperature* of selected fishes and macroinvertebrates in Oyster Creek and Forked River, New Jersey for May 1976.

Temp. (C)	No. Collections OC	No. Collections FR	Brevoortia tyrannus OC	Brevoortia tyrannus FR	Anchoa mitchilli OC	Anchoa mitchilli FR	Crangon septemspinosa OC	Crangon septemspinosa FR	Callinectes sapidus OC	Callinectes sapidus FR
20	5	0	2	-	28	-	4	-	5	-
19	1	0	21	-	-	-	1	-	3	-
18	1	1	-	-	8	34	29	4	31	-
17	0	0	-	-	-	-	-	-	-	-
16	2	6	-	-	-	90	2	23	5	6
15	6	5	-	-	6	1	3	31	11	6
14	0	2	-	-	-	495	-	133	-	4

* rounded to nearest whole n/coll and degree C.

Table C1-204. Number per collection by temperature* of selected fishes and macroinvertebrates in Oyster Creek and Forked River, New Jersey from June through September 1976.

Temp. (C)	No. Collections		Brevoortia tyrannus		Anchoa mitchilli		Pomatomus saltatrix		Cynoscion regalis		Leiostomus xanthurus		Pseudopleuronectes americanus		Crangon septemspinosa		Callinectes sapidus	
	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR
36	2	0	1	-	-	-	-	-	1	-	-	-	-	-	-	-	29	-
35	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	2	0	-	-	-	-	-	-	-	-	1	-	-	-	-	-	16	-
33	3	0	-	-	-	-	-	-	-	-	101	-	-	-	-	-	31	-
32	4	0	-	-	-	-	-	-	-	-	47	-	-	-	-	-	54	-
31	12	2	-	-	34	-	-	-	-	-	11	-	-	-	-	2	23	8
30	10	0	1	-	15	-	1	-	-	-	6	-	-	-	-	-	17	-
29	17	1	-	16	25	-	1	3	-	-	23	2	-	-	-	-	28	-
28	25	8	4	2	9	7	-	1	1	-	7	1	-	-	-	1	7	6
27	8	1	9	-	1	-	2	1	1	-	11	-	-	-	-	-	4	4
26	6	14	1	2	11	24	-	-	-	-	8	4	-	-	-	2	8	5
25	0	18	-	-	-	10	-	-	-	-	-	4	-	1	-	3	-	6
24	0	15	-	4	-	4	-	1	-	-	-	5	-	-	-	10	-	11
23	0	16	-	-	-	13	-	-	-	6	-	10	-	-	-	9	-	6
22	0	2	-	-	-	66	-	-	-	11	-	19	-	-	-	-	-	-
21	0	3	-	-	-	8	-	-	-	1	-	2	-	-	-	-	-	5

* rounded to nearest whole n/coll and degree C.

Table C1-205. Number per collection by temperature* of selected fishes and macroinvertebrates taken in Oyster Creek and Forked River, New Jersey from October through December 1976.

	No. Collections		Brevoortia tyrannus		Anchoa mitchilli		Pomatomus saltatrix		Cynoscion regalis		Leiostomus xanthurus		Pseudopleuronectes americanus		Crangon septemspinosa		Callinectes sapidus	
Temp. (C)	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR	OC	FR
23	2	0	-	-	-	-	-	-	-	-	3	-	-	-	-	-	15	-
22	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	3	0	1	-	-	-	-	-	-	-	13	-	-	-	-	-	21	-
18	4	0	-	-	-	-	-	-	-	-	6	-	1	-	-	-	4	-
17	3	0	-	-	-	-	1	-	1	-	8	-	-	-	-	-	1	-
16	5	1	2	-	-	7	1	-	-	1	7	-	-	-	-	1	2	18
15	0	2	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	4
14	0	2	-	-	-	3	-	-	-	2	-	11	-	-	-	-	-	3
13	1	7	94	-	-	14	13	-	-	1	1	3	-	-	1	-	10	4
12	7	2	8	1	5	-	2	-	-	1	1	2	-	-	1	-	5	-
11	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	5	0	4	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-
9	6	0	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-
8	2	7	-	1	-	-	1	-	-	-	-	-	5	-	9	1	-	-
7	3	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1	-	1
6	2	4	-	-	-	-	-	-	-	-	-	-	5	-	5	1	1	-
5	1	0	24	-	-	-	-	-	-	-	54	-	-	-	-	-	-	-
4	0	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	0	5	-	-	-	-	-	-	-	-	-	-	-	1	-	3	-	-
2	0	6	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
1	0	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-

* rounded to nearest whole n/coll and degree C.

Table C1-206. Length frequency distribution of Atlantic menhaden measured for condition by station from March through December 1976.

	Station						
	Oyster Creek					Forked River	
Length (mm)	26	15	29	30	50	45	46
41-50	-	-	-	2	-	-	-
51-60	-	-	-	6	-	-	-
61-70	-	-	-	15	-	-	-
71-80	-	-	44	16	-	-	2
81-90	-	-	13	2	1	-	1
91-100	-	-	1	10	11	2	-
101-110	-	-	-	14	28	12	6
111-120	2	1	-	27	11	11	5
121-130	-	-	-	20	3	1	30
131-140	-	-	-	4	1	-	23
141-150	-	-	-	5	-	-	6
151-160	-	-	2	1	-	-	-
161-170	1	1	-	-	-	-	-
171-180	8	2	-	1	1	-	-
181-190	11	1	-	-	1	-	2
191-200	13	3	-	-	-	-	1
201-210	10	3	-	-	-	-	-
211-220	10	4	-	1	2	-	-
221-230	19	8	-	2	-	-	1
231-240	21	4	-	1	1	1	-
241-250	17	2	-	-	3	-	-
251-260	10	3	-	-	6	1	4
261-270	22	3	-	-	3	-	1
271-280	19	3	-	-	5	1	1
281-290	13	1	-	-	2	1	1
291-300	6	-	-	-	1	-	-
301-310	1	-	-	-	1	-	-
.							
.							
.							
341-350	2	-	-	-	-	-	-

Table C1-207. Length frequency distribution of Atlantic menhaden measured for condition at station 26, OCGS condenser discharge, from March 1976 through March 1977.

	1976					1977		
Length (mm)	March 29	April 22	May[a] 4	November 8	December 6	January 5	February 11	March 8
101-110	-	-	-	-	-	13	19	11
111-120	-	-	2	-	-	6	11	23
121-130	-	-	-	-	-	-	-	-
131-140	-	-	-	-	-	-	-	-
141-150	-	-	-	-	-	-	-	-
151-160	-	-	-	-	-	-	-	-
161-170	-	1	-	-	-	-	-	-
171-180	-	7	1	-	-	-	-	-
181-190	-	6	3	-	-	-	-	-
191-200	-	9	2	-	2	-	-	-
201-210	-	7	-	-	3	-	1	-
211-220	-	4	1	-	5	1	4	3
221-230	-	3	-	4	12	4	6	7
231-240	-	3	4	8	6	8	6	16
241-250	1	-	6	4	4	9	3	8
251-260	1	1	5	2	1	4	-	1
261-270	4	1	11	5	1	-	1	-
271-280	9	2	5	3	-	2	-	-
281-290	5	3	4	1	-	1	-	-
291-300	-	1	4	-	1	1	-	-
301-310	1	-	-	-	-	-	-	-
.								
.								
.								
341-350	2	-	-	-	-	-	-	-

[a] A total of 12 were taken on 5 dates from 18 June through 23 September and were not included in analyses.

Table C1-208. Length frequency distribution of bay anchovy measured for condition by station from March through November 1976.

	March - May									June - August									September - November						
	Oyster Creek					Forked River				Oyster Creek					Forked River				Oyster Creek			Forked River			
Length (mm)	15	50	30	28	29	6	45	46	47	15	50	30	28	29	6	45	46	47	15	50	30	6	45	46	47
21-25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-30	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	13	6	-	-	6	-	-	-	-
31-35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	10	21	-	1	10	-	-	6	-
36-40	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	4	13	39	-	15	8	-	1	9	2
41-45	-	4	4	2	1	-	3	5	-	-	-	4	-	-	1	1	10	21	1	28	4	-	7	28	5
46-50	5	6	10	-	-	-	21	11	-	6	-	23	-	1	2	6	15	2	-	17	2	-	11	31	2
51-55	8	10	23	2	3	19	40	16	-	32	3	28	1	1	7	28	15	-	-	3	2	1	1	23	2
56-60	19	17	27	-	3	21	36	15	7	30	3	35	1	5	5	30	19	4	-	-	1	-	2	6	-
61-65	31	23	18	4	2	29	32	10	8	18	12	8	1	3	2	14	32	16	-	-	-	-	1	3	-
66-70	19	17	14	3	2	4	10	5	9	8	4	2	2	6	3	7	26	21	-	-	-	-	-	3	1
71-75	15	11	2	-	2	7	4	1	5	5	4	1	-	-	-	2	22	16	-	-	-	-	-	7	-
76-80	9	8	2	3	-	1	2	1	2	-	1	1	-	-	-	-	10	5	-	-	3	-	-	6	-
81-85	4	13	-	-	-	-	2	1	4	-	-	-	-	-	-	-	1	2	-	-	-	-	-	1	1
86-90	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
91-95	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C1-209. Observations or collections of dead or stressed specimens in Oyster Creek and Forked River, New Jersey from March 1976 through August 1977.

Location	OC	OC	OC	OC	OC	OC	OC
Station	28	29	26	27	27	15	30
Date	21 April 76	21 April 76	22 April 76	22 April 76	22 April 76	22 April 76	22 April 76
Hour	1010	1045	1145	1159	1217	1240	1336
Air Temperature	19.0	18.0	22.0	22.0	22.0	21.0	20.0
Water Temperature, surface	25.0	25.0	30.2	27.5	27.5	27.2	23.2
bottom	-	-	31.1	27.5	27.5	23.0	22.9
Salinity, surface	21.0	21.5	20.0	20.0	20.0	20.0	20.0
bottom	-	-	20.5	20.0	20.0	20.0	20.0
Oxygen, surface	7.0	7.0	6.9	7.0	7.0	5.5	5.4
bottom	-	-	6.9	6.9	6.9	5.4	6.2
pH, surface	-	-	7.7	7.7	7.7	-	-
bottom	-	-	7.6	7.7	7.7	-	-
Brevoortia tyrannus	-	-	-	-	-	-	1
Anchoa mitchilli	-	-	4	5	3	-	-
Urophycis regius	-	-	-	-	-	-	1
Mugil curema	1	-	-	-	-	-	-
Cancer irroratus	-	-	-	-	-	1	-
Callinectes sapidus	1	many	-	-	-	-	-
Remarks:	Observed dead on beach	Observed dead on beach and in water	Dead and decomposing; in trawl	Dead and decomposing; in trawl	Dead and decomposing; in trawl	Observed dead on beach; possibly many dead fish on surface-many gulls observed feeding	Dead; in trawl

Table C1-209. (cont.)

Location	OC	OC	OC	OC	OC	OC	OC
Station	30	15	50	27	15	26	50
Date	22 April 76	4 May 76	23 June 76	12 August 76	13 August 76	6 December 76	7 December 76
Hour	1347	1340	1240	1057	900	930	948
Air Temperature	20.0	-	28.0	26.0	29.0	5.5	11.0
Water Temperature, surface	23.2	14.6	32.7	31.0	30.0	10.0	9.0
bottom	22.9	15.0	-	29.8	30.0	5.0	8.6
Salinity surface	20.0	20.5	24.5	22.0	23.5	25.5	22.0
bottom	20.0	20.0	-	22.0	23.0	25.5	22.0
Oxygen, surface	5.4	7.0	8.5	5.7	6.9	12.0	8.8
bottom	6.2	7.0	-	5.6	6.7	12.2	9.8
pH, surface	-	7.8	7.4	7.9	-	7.4	8.1
bottom	-	7.8	-	7.8	-	7.3	8.1
Anguilla rostrata	1	-	-	-	-	-	-
Morone saxatilis	-	-	-	-	1	-	-
Etropus microstomus	-	-	-	-	-	-	1
Pseudopleuronectes americanus	-	-	-	-	-	1	-
Limulus polyphemus	-	-	1	1	-	-	-
Callinectes sapidus	-	several	2	-	-	-	-
Remarks:	Dead; in trawl	Plant shut down this A.M., mobility of blue crabs greatly reduced	Dead; in trawl	Dead; in trawl	Observed dead on beach	Dead with condenser tube marks; in trawl	Dead and decomping; in trawl

Table C1-203. (cont.)

Location	OC	OC	OC	OC	OC	OC	OC
Station	15	26	50	27	50	28	26
Date	7 December 76	5 January 77	11 January 77	11 February 77	11 February 77	1 June 77	18 July 77
Hour	1101	950	1300	950	1200	930	1021
Air Temperature	9.0	-1.0	-	12.0	9.0	21.0	29.5
Water Temperature, surface	9.0	3.6	2.0	6.8	7.8	20.0	28.5
bottom	9.2	8.1	-	7.1	7.2	-	28.6
Salinity, surface	22.0	25.0	-	25.0	24.0	21.0	24.0
bottom	21.5	25.0	-	25.0	24.0	-	24.0
Oxygen, surface	8.5	11.4	-	14.4	9.4	7.8	4.9
bottom	9.0	10.6	-	12.0	9.0	-	4.1
pH, surface	8.0	7.8	-	8.0	8.1	-	8.1
bottom	8.0	7.8	-	8.1	8.1	-	8.1
Brevoortia tyrannus	-	-	-	1	-	-	-
Anchoa mitchilli	many	-	-	-	-	-	-
Morone americana	-	-	-	-	-	-	-
Poniatomus saltatrix	-	-	-	-	-	-	-
Cynoscion regalis	1	-	1	-	-	-	-
Scophthalmus aquosus	-	-	-	-	-	-	1
Pseudopleuronectes americanus	-	4	-	-	-	-	-
Callinectes sapidus	-	-	-	-	1	several	-
Remarks:	Dead and decomposing; in trawl and observed along shore	Dead (2 with condenser tube marks); in trawl	Dead adult (2.4 kg) found on beach	Dead and partially eaten; in trawl	Dead and decomposing; in trawl	Observed dead on beach	Dead and partially eaten; in trawl

Table C1-209. (cont.)

Location	FR	OC
Station	6	26
Date	19 July 77	15 August 77
Hour	1107	852
Air Temperature	31.0	28.0
Water Temperature, surface	30.0	34.1
bottom	30.5	32.3
Salinity, surface	26.5	25.0
bottom	26.5	25.0
Oxygen, surface	6.2	5.9
bottom	5.8	5.8
pH, surface	8.1	7.7
bottom	8.1	7.7
Brevoortia tyrannus	-	-
Anchoa mitchilli	-	-
Morone americana	1	-
Pomatomus saltatrix	-	11
Cynoscion regalis	-	-
Scophthalmus aquosus	-	-
Pseudopleuronectes americanus	-	-
Callinectes sapidus	-	1
Remarks:	Dead and decomposing; in gill net	Dead and decomposing; in gill net

Table C1-210. Summary of heat shock studies for fishes and macroinvertebrates during a period of rising ambient water temperature from February through August 1977. Only studies which produced a LT_{50} are listed.

Date	Temperature (C) Acclimation	Temperature (C) Shock[a]	Delta T C	Experimental Mortality Percent	Experimental Mortality Time (h)[b]	Experimental LT50 (C)	Experimental Mean Length (mm)
			Sand Shrimp				
27 April	15.0	26.0	11.0	0.0	48.0	27.6	37.2
	15.0	29.2	14.2	100.0	48.0		38.9
	15.0	32.0	17.0	100.0	0.5		37.1
			Blue crab				
25 July	20.0	29.2	9.2	12.5[c]	48.0	34.9	58.1
	20.0	31.9	11.9	10.0	48.0		62.3
	20.0	34.9	14.9	0.0	48.0		59.4
28 July	19.0	38.7	19.7	100.0	2.0		70.9
19 August	25.0	33.0	8.0	33.3[c]	48.0	36.7	95.5
	25.0	36.0	11.0	20.0	48.0		69.7
	25.0	38.0	13.0	100.0	24.0		104.3
			Atlantic menhaden				
18 April	14.0	25.9	11.9	0.0	48.0	29.7	132.7
	14.0	29.0	15.0	20.0	48.0		132.6
	14.0	31.0	17.0	100.0	0.5		138.4

a Mean temperature of all observations.
b Time from start of test.
c Some experimental mortality due to cannabalism, data not used to determine LT_{50}.

Table C1-210. (cont.)

Date	Temperature (C) Acclimation	Temperature (C) Shock[a]	Delta T C	Experimental Mortality Percent	Experimental Mortality Time (h)[b]	Experimental LT_{50} (C)	Experimental Mean Length (mm)
			Atlantic menhaden (cont.)				
11 July	20.0	26.2	6.2	0.0	48.0	29.6	65.8
	20.0	29.0	9.0	33.3	48.0		65.6
	20.0	31.5	11.5	100.0	24.0		66.9
2 August	24.0	29.0	5.0	0.0	48.0	32.0	86.2
	24.0	31.1	7.1	20.0	48.0		77.7
	24.0	33.0	9.0	80.0	48.0		78.7
			Bay anchovy				
2 May	10.0	18.0	8.0	17.6	48.0	23.9	54.0
	10.0	21.0	11.0	9.5	48.0		51.4
	10.0	23.9	13.9	50.0	48.0		53.0
24 May	16.0	26.0	10.0	26.3	48.0	27.1	57.6
	16.0	28.9	12.9	90.5	48.0		53.4
	16.0	32.0	16.0	100.0	0.3		58.2
11 August	25.0	29.0	4.0	20.0	48.0	32.0	22.6
	25.0	31.1	6.1	25.0	48.0		23.0
	25.0	33.9	8.9	100.0	24.0		22.5
			Atlantic silverside				
16 March	10.0	20.9	10.9	0.0	48.0	24.5	27.0
	10.0	23.9	13.9	37.5	48.0		26.5
	10.0	27.0	17.0	100.0	3.0		26.5
19 May	15.0	26.0	11.0	12.5	48.0	29.8	97.2
	15.0	28.9	13.9	30.0	48.0		100.7
	15.0	32.0	17.0	100.0	2.0		91.8
17 July	21.0	28.1	7.1	40.0	48.0	28.9	78.6
	21.0	29.4	8.3	10.0	48.0		91.6
	21.0	31.9	10.9	90.0	48.0		87.2

Table C1-210. (cont.)

Date	Temperature (C) Acclimation	Temperature (C) Shock[a]	Delta T C	Experimental Mortality Percent	Experimental Mortality Time (h)[b]	Experimental LT_{50} (C)	Experimental Mean Length (mm)
			Atlantic silverside (cont.)				
29 June	22.0	26.0	4.0	40.0	48.0	28.3	18.0
	22.0	28.9	6.9	30.0	48.0		19.2
	22.0	32.1	10.1	66.7	48.0		18.7
8 August	25.0	29.0	4.0	0.0	48.0	33.2	51.7
	25.0	32.0	7.0	15.0	48.0		49.8
	25.0	35.0	10.0	100.0	8.0		50.0
			Northern pipefish				
27 July	19.0	29.0	10.0	20.0	48.0	30.5	165.0
	19.0	32.0	13.0	80.0	48.0		164.0
	19.0	35.0	16.0	100.0	1.0		179.2
			Bluefish				
21 July	21.0	26.4	5.4	0.0	48.0	29.2	90.8
	21.0	32.0	11.0	100.0	48.0		88.1
25 August	25.0	31.0	6.0	40.0	48.0	31.3	144.6
17 August	25.0	32.7	7.7	100.0	24.0		127.3
			Winter flounder				
24 March	5.0	21.4	16.4	20.0	48.0	22.7	113.6
	5.0	24.9	19.9	100.0	48.0		122.7
	5.0	27.9	22.9	100.0	0.2		112.2
25 April	15.0	25.9	10.9	0.0	48.0	27.4	134.5
	15.0	28.9	13.9	100.0	3.0		129.2
	15.0	32.1	17.1	100.0	0.1		130.7
16 June	20.0	26.0	6.0	11.1	48.0	27.0	42.6
	20.0	28.2	8.2	100.0	24.0		41.5
	20.0	31.7	11.7	100.0	0.5		40.6

Table C1-211. Summary of cold shock studies of fishes during a period of rising ambient water temperature from February through August 1977. Only studies which produced a LT_{50} are listed.

Date	Temperature (C)		Delta T C	Experimental			
				Mortality			
	Acclimation	Shock[a]		Percent	Time (h)[b]	LT50 (C)	Length (mm)
			Atlantic menhaden				
18 April	14.0	9.2	-4.8	10.0	96.0	7.5	132.3
	14.0	5.3	-8.7	100.0	28.0		130.2
5 July	20.0	13.0	-7.0	0.0	96.0	11.1	64.3
	20.0	9.2	-12.8	100.0	48.0		62.8
			Bay anchovy				
2 May	10.0	7.2	-2.9	29.4	96.0	6.4	53.8
	10.0	4.6	-5.4	100.0	24.0		54.5

a. Mean temperature of all observations.
b. Time from start of test.

Table C1-212. The effects of sudden temperature increases at rising ambient water temperature on sand shrimp from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
29 Mar 77	20.2	38.2	29.0	5	5.6	16.6	11	0.0	11	-	-	-
								24.0	10	1	0	9.1
								32.0	9	2	0	18.2
								48.0	9	2	0	18.2
29 Mar 77	23.6	33.7	29.0	5	5.6	19.1	11	0.0	10	-	-	-
								24.0	9	1	0	10.0
								32.0	8	2	0	20.0
								48.0	7	3	0	30.0
29 Mar 77	23.9	44.9	29.0	5	5.6	22.0	11	0.0	10	-	-	-
								48.0	9	1	0	10.0
11 Apr 77	40.1	57.6	29.0	10	10.2	18.1	10	0.0	10	-	-	-
								24.0	9	1	0	10.0
								48.0	8	2	0	20.0
11 Apr 77	45.4	60.2	29.0	10	10.2	21.6	10	0.0	10	-	-	-
								48.0	10	0	0	0.0
11 Apr 77	41.0	58.6	29.0	10	10.2	24.6	10	0.0	10	-	-	-
								6.0	9	1	0	10.0
								48.0	9	1	0	10.0
27 Apr 77	33.1	42.1	29.4	15	14.9	26.0	10	0.0	10	-	-	-
								48.0	10	0	0	0.0

a. Loss of equilibrium.

Table C1-212. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
27 Apr 77	34.6	46.0	29.4	15	14.9	29.2	10	0.0	11	-	-	-
								3.0	9	2	0	18.2
								4.0	6	5	0	45.5
								6.0	5	6	0	54.5
								24.0	1	10	0	90.9
								48.0	0	11	0	100.0
27 Apr 77	33.5	42.2	28.5	15	14.9	32.0	10	0.0	10	-	-	-
								0.0	10	0	2	0.0
								0.1	3	7	2	70.0
								0.3	2	8	2	80.0
								0.4	1	9	1	90.0
								0.5	0	10	-	100.0

Table C1-213. The effects of sudden temperature increases at rising ambient water temperature on blue crab from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
28 Jul 77	56.3	80.7	31.0	19	20.0	38.7	10	0.0	10	-	-	-
								0.0	10	0	10	0.0
								0.8	6	4	4	40.0
								0.9	4	6	3	60.0
								1.3	1	9	1	90.0
								2.0	0	10	-	100.0
25 Jul 77	42.3	73.2	31.2	20	19.9	29.2	11	0.0	8	-	-	-
								32.0	7	1	0	12.5
								48.0	7	1	0	12.5
25 Jul 77	46.0	76.0	31.0	20	19.9	31.9	11	0.0	10	-	-	-
								48.0	9	1	0	10.0
25 Jul 77	48.3	75.2	31.0	20	19.9	34.9	11	0.0	10	-	-	-
								48.0	10	0	0	0.0
19 Aug 77	67.7	121.0	32.0	25	24.9	33.0	9	0.0	9	-	-	-
								24.0	8	1	0	11.1
								48.0	6	3	0	33.3
19 Aug 77	55.0	84.2	23.0	25	24.9	36.0	9	0.0	10	-	-	-
								1.0	9	1	0	10.0
								6.0	8	2	0	20.0
								48.0	8	2	0	20.0
19 Aug 77	78.6	133.4	32.0	25	24.9	38.0	9	0.0	9	-	-	-
								0.2	9	0	1	0.0
								4.0	9	0	1	0.0
								6.0	7	2	1	22.2
								8.0	7	2	1	22.2
								24.0	0	9	0	100.0

a. Loss of equilibrium

Table C1-214. The effects of sudden temperature increases at rising ambient water temperature on Atlantic menhaden from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
9 Mar 77	102.4	181.6	25.8	10	10.0	20.9	10	0.0	9	-	-	-
								0.2	9	0	1	0.0
								3.0	8	1	1	11.1
								6.0	7	2	2	22.2
								24.0	4	5	0	55.6
								48.0	4	5	0	55.6
9 Mar 77	105.4	128.8	25.8	10	10.0	23.8	10	0.0	10	-	-	-
								0.1	10	0	1	0.0
								2.0	9	1	1	10.0
								3.0	8	2	0	20.0
								24.0	6	4	0	40.0
								48.0	5	5	0	50.0
9 Mar 77	114.4	141.2	25.8	10	10.0	26.9	10	0.0	10	-	-	-
								0.1	10	0	6	0.0
								1.0	3	7	0	70.0
								3.0	2	8	1	80.0
								4.0	1	9	0	90.0
								24.0	0	10	0	100.0
2 Mar 77	116.8	137.5	25.8	12	12.0	19.9	10	0.0	9	-	-	-
								0.1	9	0	1	0.0
								48.0	9	0	0	0.0
2 Mar 77	119.2	134.9	25.8	12	12.0	22.9	10	0.0	10	-	-	-
								0.1	10	0	1	0.0
								24.0	10	0	1	0.0
								48.0	10	0	0	0.0

a. Loss of equilibrium.

Table C1-214. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
2 Mar 77	99.0	139.0	26.0	12	12.0	25.8	10	0.0	10	-	-	-
								0.0	10	0	10	0.0
								0.7	9	1	2	10.0
								2.0	7	3	0	30.0
								48.0	7	3	0	30.0
18 Apr 77	126.6	141.6	27.2	14	14.2	25.9	10	0.0	9	-	-	-
								48.0	9	0	0	0.0
18 Apr 77	119.6	142.1	27.2	14	14.2	29.0	10	0.0	10	-	-	-
								0.1	10	0	1	0.0
								1.5	9	1	0	10.0
								8.0	8	2	0	20.0
								48.0	8	2	0	20.0
18 Apr 77	121.5	154.5	26.5	14	14.2	31.0	10	0.0	10	-	-	-
								0.1	10	0	10	0.0
								0.3	4	6	4	60.0
								0.5	0	10	0	100.0
11 Jul 77	59.4	74.2	30.1	20	20.0	26.2	19	0.0	20	-	-	-
								48.0	20	0	0	0.0
11 Jul 77	59.6	70.2	30.1	20	20.0	29.0	19	0.0	18	-	-	-
								0.8	17	1	0	5.6
								3.0	16	2	0	11.1
								6.0	15	3	0	16.7
								24.0	12	6	0	33.3
								48.0	12	6	0	33.3

Table C1-214. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	# ALIVE	EXPERIMENTAL # DEAD	# WITH L.O.E.	PERCENT MORT
11 Jul 77	57.4	75.6	29.8	20	20.0	31.5	19	0.0	20	-	-	-
								0.4	19	1	0	5.0
								2.0	14	6	0	30.0
								3.0	10	10	0	50.0
								4.0	5	15	0	75.0
								24.0	0	20	0	100.0
13 Jul 77	118.5	130.8	30.7	20	20.0	29.0	13	0.0	13	-	-	-
								48.0	13	0	0	0.0
29 Jun 77	105.2	126.3	28.8	22	20.0	31.9	21	0.0	20	-	-	-
								1.0	19	1	0	5.0
								4.0	17	3	0	15.0
								6.0	12	8	0	40.0
								24.0	5	15	0	75.0
								48.0	4	16	0	80.0
2 Aug 77	69.1	93.5	31.0	24	25.0	29.0	8	0.0	9	-	-	-
								48.0	9	0	0	0.0
2 Aug 77	66.8	83.4	31.0	24	25.0	31.1	8	0.0	10	-	-	-
								6.0	9	1	0	10.0
								8.0	8	2	0	20.0
								48.0	8	2	0	20.0
2 Aug 77	71.4	89.0	31.0	24	25.0	33.0	8	0.0	10	-	-	-
								3.0	6	4	1	40.0
								4.0	4	6	0	60.0
								6.0	2	8	0	80.0
								48.0	2	8	0	80.0

Table C1-215. The effects of sudden temperature increases at rising ambient water temperature on bay anchovy from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
2 May 77	44.6	73.8	28.9	10	10.6	18.0	19	0.0	17	-	-	-
								6.0	17	0	1	0.0
								8.0	17	0	1	0.0
								24.0	14	3	0	17.6
								48.0	14	3	0	17.6
2 May 77	45.1	56.6	28.4	10	10.6	21.0	19	0.0	21	-	-	-
								1.0	21	0	1	0.0
								2.0	20	1	1	4.8
								3.0	19	2	0	9.5
								48.0	19	2	0	9.5
2 May 77	44.8	58.1	28.2	10	10.6	23.9	19	0.0	14	-	-	-
								1.0	14	0	5	0.0
								2.0	13	1	1	7.1
								3.0	12	2	1	14.3
								6.0	9	5	2	35.7
								24.0	7	7	1	50.0
24 May 77	44.0	78.9	28.9	16	15.2	26.0	24	0.0	19	-	-	-
								6.0	18	1	0	5.3
								24.0	15	3	1	15.8
								28.0	14	5	0	26.3
								48.0	14	5	0	26.3
24 May 77	43.3	64.7	28.9	16	15.2	28.9	24	0.0	21	-	-	-
								0.1	21	0	2	0.0
								1.0	16	5	1	23.8
								2.0	10	11	1	52.4
								3.0	7	14	0	66.7
								48.0	2	19	0	90.5

a. Loss of equilibrium.

Table C1-215. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
24 May 77	42.7	74.5	28.9	16	15.2	32.0	24	0.0	23	-	-	-
								0.1	23	0	23	0.0
								0.3	0	23	-	100.0
11 Aug 77	19.5	29.9	32.0	25	24.9	29.0	28	0.0	15	-	-	-
								0.8	14	1	0	6.7
								24.0	13	2	0	13.3
								48.0	12	3	0	20.0
11 Aug 77	18.7	26.8	32.0	25	24.9	31.1	28	0	24	-	-	-
								0.3	23	1	1	4.2
								0.4	22	2	0	8.3
								4.0	21	3	0	12.5
								28.0	20	4	0	16.7
								48.0	18	6	0	25.0
11 Aug 77	19.5	28.1	32.0	25	24.9	33.9	28	0.0	20	-	-	-
								0.1	19	1	3	5.0
								0.8	11	9	0	45.0
								1.0	10	10	0	50.0
								3.0	5	15	0	75.0
								24.0	0	20	0	100.0

Table C1-216. The effects of sudden temperature increases at rising ambient water temperature on Atlantic silverside from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
16 Mar 77	83.4	103.4	27.0	10	10.0	20.9	9	0.0	10	-	-	-
								1.0	10	0	0	0.0
								32.0	10	0	1	0.0
								48.0	10	0	0	0.0
16 Mar 77	77.5	101.5	26.5	10	10.0	23.9	9	0.0	8	-	-	-
								1.5	7	1	0	12.5
								4.0	7	1	1	12.5
								8.0	7	1	1	12.5
								24.0	5	3	0	37.5
								48.0	5	3	0	37.5
16 Mar 77	68.9	89.5	26.5	10	10.0	27.0	9	0.0	10	-	-	-
								0.1	10	-	2	0.0
								0.4	6	4	1	40.0
								0.6	5	5	2	50.0
								1.0	4	6	1	60.0
								3.0	0	10	0	100.0
6 Apr 77	70.2	98.9	29.0	15	14.9	22.9	10	0.0	10	-	-	-
								1.0	10	0	0	0.0
								48.0	10	0	0	0.0
16 May 77	87.3	104.3	28.5	15	15.0	23.0	9	0.0	10	-	-	-
								0.1	10	0	2	0.0
								0.3	10	0	0	0.0
								48.0	10	0	0	0.0
6 Apr 77	6[illegible].1	[illegible]	29.0	15	14.9	26.0	10	0.0	10	-	-	-
								1.0	10	0	0	0.0
								48.0	10	0	0	0.0

a. Loss of equilibrium.

Table C1-216. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
19 May 77	83.9	101.9	27.5	15	14.9	26.0	10	0.0	8	-	-	-
								0.3	8	0	1	0.0
								2.0	7	1	0	12.5
								48.0	7	1	0	12.5
16 May 77	84.1	95.4	28.5	15	15.0	26.1	9	0.0	10	-	-	-
								0.1	10	0	0	0.0
								48.0	10	0	0	0.0
6 Apr 77	69.8	84.7	29.0	15	14.9	28.9	10	0.0	8	-	-	-
								48.0	6	2	0	25.0
19 May 77	92.4	114.7	27.5	15	14.9	28.9	10	0.0	10	-	-	-
								0.1	10	0	2	0.0
								0.2	9	1	0	10.0
								0.3	8	2	0	20.0
								48.0	7	3	0	30.0
16 May 77	75.9	99.1	28.5	15	15.0	29.2	9	0.0	10	-	-	-
								1.0	9	1	0	10.0
								2.0	7	3	0	30.0
								48.0	7	3	0	30.0
19 May 77	82.3	104.7	26.9	15	14.9	32.0	10	0.0	10	-	-	-
								0.1	10	0	10	0.0
								0.2	5	5	5	50.0
								0.3	3	7	3	70.0
								1.0	1	9	1	90.0
								2.0	0	10	-	100.0

Table C1-216. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
25 Jun 77	13.7	21.7	29.0	21	19.8	26.0	10	0.0	10	-	-	-
								0.2	9	1	0	10.0
								24.0	8	2	0	20.0
								28.0	7	3	0	30.0
								48.0	7	3	0	30.0
17 Jul 77	48.4	98.9	29.8	21	19.9	28.1	9	0.0	10	-	-	-
								4.0	10	0	1	0.0
								6.0	9	1	1	10.0
								8.0	8	2	0	20.0
								24.0	7	3	0	30.0
								32.0	6	4	0	40.0
25 Jun 77	15.0	21.3	29.0	21	19.8	29.2	10	0.0	9	-	-	-
								1.0	9	0	1	0.0
								2.0	8	1	0	11.1
								48.0	8	1	0	11.1
17 Jul 77	57.6	108.8	30.0	21	19.9	29.4	9	0.0	10	-	-	-
								28.0	9	1	0	10.0
								48.0	9	1	0	10.0
25 Jun 77	14.4	19.2	29.0	21	19.8	30.3	10	0.0	10	-	-	-
								1.0	9	1	0	10.0
								2.0	8	2	0	20.0
								32.0	7	3	0	30.0
								48.0	7	3	0	30.0

Table C1-216. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
17 Jul 77	54.7	102.1	29.8	21	19.9	31.9	9	0.0	10	-	-	-
								1.0	9	1	0	10.0
								3.0	8	2	0	20.0
								8.0	8	2	1	20.0
								24.0	3	7	0	70.0
								48.0	1	9	0	90.0
29 Jun 77	14.4	23.4	28.8	22	19.9	26.0	10	0.0	10	-	-	-
								2.0	9	1	0	10.0
								6.0	8	2	0	20.0
								8.0	7	3	0	30.0
								48.0	6	4	0	40.0
29 Jun 77	14.4	29.5	28.8	22	19.9	28.9	10	0.0	10	-	-	-
								6.0	9	1	0	10.0
								24.0	7	3	0	30.0
								48.0	7	3	0	30.0
29 Jun 77	16.5	22.5	28.8	22	19.9	32.1	10	0.0	9	-	-	-
								8.0	8	1	0	11.1
								24.0	6	3	0	33.3
								48.0	3	6	0	66.7
8 Aug 77	35.9	64.4	31.0	25	25.0	29.0	20	0.0	17	-	-	-
								48.0	17	0	0	0.0
8 Aug 77	33.1	62.7	31.0	25	25.0	32.0	20	0.0	20	-	-	-
								6.0	19	1	0	5.0
								24.0	17	3	0	15.0
								48.0	17	3	0	15.0
8 Aug 77	40.1	61.4	31.0	25	25.0	35.0	20	0.0	22	-	-	-
								0.5	21	1	0	4.5
								2.0	15	7	0	31.8
								3.0	12	10	1	45.5
								4.0	8	14	1	63.6
								8.0	0	22	-	100.0

Table C1-217. The effects of sudden temperature increases at rising ambient water temperature on northern pipefish from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
10 May 77	137.0	210.5	29.4	15	15.0	23.0	10	0.0	10	-	-	-
								0.1	10	0	0	0.0
								48.0	10	0	0	0.0
10 May 77	114.5	215.0	29.4	15	15.0	26.1	10	0.0	10	-	-	-
								0.1	10	0	0	0.0
								48.0	10	0	0	0.0
10 May 77	152.0	191.5	29.4	15	15.0	29.1	10	0.0	10	-	-	-
								0.1	10	0	7	0.0
								0.3	10	0	1	0.0
								48.0	10	0	0	0.0
27 Jul 77	116.0	216.0	31.5	19	20.0	29.0	10	0.0	10	-	-	-
								0.2	10	0	1	0.0
								0.5	9	1	0	10.0
								48.0	8	2	0	20.0
27 Jul 77	121.0	202.0	31.5	19	20.0	32.0	10	0.0	10	-	-	-
								0.3	9	1	0	10.0
								0.4	8	2	0	20.0
								24.0	6	4	2	40.0
								28.0	4	6	0	60.0
								48.0	2	8	2	80.0
27 Jul 77	125.0	239.0	31.5	19	20.0	35.0	10	0.0	9	-	-	-
								0.0	9	0	7	0.0
								0.1	4	5	3	55.6
								0.2	3	6	2	66.7
								0.8	1	8	1	88.9
								1.0	0	9	0	100.0

a. Loss of equilibrium.

Table C1-218. The effects of sudden temperature increases at rising ambient water temperature on bluefish from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
30 Jul 77	91.3	133.6	30.0	20	19.9	27.9	10	0.0	9	-	-	-
								48.0	9	0	0	0.0
30 Jul 77	97.5	138.3	30.0	20	19.9	30.0	10	0.0	9	-	-	-
								48.0	9	0	0	0.0
21 Jul 77	79.7	100.6	30.8	21	19.9	26.4	5	0.0	5	-	-	-
								48.0	5	0	0	0.0
21 Jul 77	79.8	110.5	30.8	21	19.9	32.0	5	0.0	5	-	-	-
								0.4	4	1	0	20.0
								0.6	3	2	0	40.0
								2.0	2	3	0	60.0
								3.0	1	4	0	80.0
								48.0	0	5	0	100.0
25 Aug 77	116.0	166.0	30.4	25	24.8	31.0	10	0.0	10	-	-	-
								1.0	10	0	1	0.0
								1.5	9	1	1	10.0
								6.0	8	2	2	20.0
								8.0	7	3	2	30.0
								24.0	6	4	2	40.0
18 Aug 77	106.2	148.3	32.5	25	24.6	32.7	10	0.0	10	-	-	-
								1.3	9	1	0	10.0
								4.0	7	3	0	30.0
								6.0	5	5	1	50.0
								8.0	2	8	0	80.0
								24.0	0	10	0	100.0

a. Loss of equilibrium.

Table C1-219. The effects of sudden temperature increases at rising ambient water temperature on winter flounder from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
24 Mar 77	91.2	145.7	28.0	5	5.1	21.4	10	0.0	10	-	-	-
								24.0	8	2	0	20.0
								48.0	8	2	0	20.0
24 Mar 77	78.2	158.5	27.5	5	5.1	24.9	10	0.0	10	-	-	-
								0.2	9	1	0	10.0
								2.0	5	5	1	50.0
								3.0	4	6	0	60.0
								4.0	0	10	0	100.0
24 Mar 77	73.7	146.0	27.5	5	5.1	27.9	10	0.0	10	-	-	-
								0.1	10	0	6	0.0
								0.2	0	10	0	100.0
21 Mar 77	83.8	149.0	27.5	6	5.3	16.0	10	0.0	11	-	-	-
								1.0	11	0	0	0.0
								48.0	11	0	0	0.0
21 Mar 77	84.6	127.7	27.5	6	5.3	19.0	10	0.0	10	-	-	-
								1.0	10	0	0	0.0
								48.0	10	0	0	0.0
21 Mar 77	93.5	155.8	27.5	6	5.3	22.0	10	0.0	10	-	-	-
								1.0	10	0	0	0.0
								24.0	7	3	0	30.0
								48.0	7	3	0	30.0

a. Loss of equilibrium.

Table C1-219. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
25 Apr 77	103.7	181.0	28.9	15	15.0	25.9	10	0.0	10	-	-	-
								48.0	10	0	0	0.0
25 Apr 77	110.4	143.4	29.0	15	15.0	28.9	10	0.0	10	-	-	-
								1.0	6	4	1	40.0
								2.0	1	9	1	90.0
								3.0	0	10	-	100.0
25 Apr 77	112.2	163.0	29.0	15	15.0	32.1	10	0.0	10	-	-	-
								0.1	0	10	0	100.0
12 Jun 77	31.8	55.3	32.3	20	20.0	26.0	10	0.0	10	-	-	-
								4.0	9	1	0	10.0
								24.0	6	4	0	40.0
								32.0	5	5	0	50.0
								48.0	5	5	0	50.0
16 Jun 77	38.0	50.7	32.6	20	20.0	26.0	15	0.0	18	-	-	-
								24.0	17	1	0	5.6
								48.0	16	2	0	11.1
16 Jun 77	33.3	54.1	32.5	20	20.0	28.2	15	0.0	20	-	-	-
								6.0	19	1	0	5.0
								24.0	0	20	0	100.0
12 Jun 77	36.2	53.4	32.3	20	20.0	29.1	10	0.0	10	-	-	-
								2.0	10	0	1	0.0
								4.0	7	3	1	30.0
								6.0	0	10	0	100.0

Table C1-219. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	# ALIVE	EXPERIMENTAL # DEAD	# WITH L.O.E.	PERCENT MORT
16 Jun 77	29.6	50.3	32.5	20	20.0	31.7	15	0.0	20	-	-	-
								0.1	20	0	4	0.0
								0.2	19	1	10	5.0
								0.3	3	17	4	85.0
								0.4	1	19	1	95.0
								0.5	0	20	0	100.0
12 Jun 77	32.0	48.4	32.3	20	20.0	32.0	10	0.0	10	-	-	-
								0.1	10	0	2	0.0
								0.3	6	4	4	40.0
								0.3	3	7	3	70.0
								0.4	0	10	0	100.0

Table C1-220. The effects of sudden temperature decreases at rising ambient water temperature on sand shrimp from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
28 Mar 77	18.8	42.0	24.2	5	5.5	1.5	11	0.0	11	-	-	-
								0.0	11	0	0	0.0
								48.0	11	0	0	0.0
11 Apr 77	41.1	65.6	25.1	10	10.1	2.3	10	0.0	10	-	-	-
								1.0	10	0	1	0.0
								2.0	10	0	1	0.0
								96.0	10	0	0	0.0

a. Loss of equilibrium

Table C1-221. The effects of sudden temperature decreases at rising ambient water temperature on Atlantic menhaden from Feburary through August 1977. Times listed were of significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
9 Mar 77	115.5	143.5	24.0	10	10.0	3.9	10	0.0	10	-	-	-
								0.1	10	0	7	0.0
								3.0	9	1	6	10.0
								24.0	1	9	1	90.0
								32.0	0	10	0	100.0
18 Apr 77	125.5	141.2	23.6	14	14.2	9.2	10	0.0	10	-	-	-
								72.0	10	0	1	0.0
								76.0	9	1	0	10.0
								96.0	9	1	1	10.0
18 Apr 77	118.6	140.7	24.0	14	14.2	5.3	10	0.0	10	-	-	-
								0.1	10	0	8	0.0
								2.0	10	0	6	0.0
								4.0	10	0	4	0.0
								24.0	1	9	1	90.0
								28.0	0	10	-	100.0
5 Jul 77	57.0	76.4	22.7	20	20.0	13.0	20	0.0	20	-	-	-
								96.0	20	0	0	0.0
5 Jul 77	55.5	77.0	22.8	20	20.0	9.2	20	0.0	20	-	-	-
								8.0	20	0	1	0.0
								24.0	14	6	6	30.0
								28.0	10	10	4	50.0
								32.0	8	12	7	60.0
								48.0	0	20	0	100.0

a. Loss of equilibrium

Table C1-222. The effects of sudden temperature decreases at rising ambient water temperature on bay anchovy from February through August 1977. Times listed were of significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
2 May 77	46.9	58.8	23.6	10	10.3	7.2	19	0.0	17	-	-	-
								8.0	17	0	1	0.0
								28.0	17	0	3	0.0
								32.0	17	0	3	0.0
								48.0	12	5	3	29.4
								96.0	12	5	0	29.4
2 May 77	48.5	67.0	23.5	10	10.3	4.6	19	0.0	14	-	-	-
								1.0	14	0	7	0.0
								3.0	14	0	7	0.0
								4.0	13	1	9	7.1
								6.0	9	5	9	35.7
								24.0	0	14	0	100.0
6 Jun 77	45.2	62.3	23.2	14	14.9	13.1	23	0.0	14	-	-	-
								3.0	14	0	1	0.0
								24.0	13	1	0	7.1
								96.0	13	1	1	7.1
6 Jun 77	44.0	72.0	23.2	14	14.9	10.0	23	0.0	19	-	-	-
								2.0	19	0	1	0.0
								8.0	18	1	3	5.3
								24.0	16	3	0	15.8
								76.0	14	5	0	26.3
								96.0	14	5	1	26.3
31 May 77	46.8	73.1	23.0	15	15.1	12.4	21	0.0	20	-	-	-
								6.0	20	0	1	0.0
								28.0	19	1	0	5.0
								72.0	19	1	0	5.0

a. Loss of equilibrium.

Table C1-222. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
31 May 77	45.2	71.9	23.0	15	15.1	10.5	21	0.0	22	-	-	-
								0.2	22	0	1	0.0
								8.0	22	0	2	0.0
								28.0	20	2	0	9.1
								72.0	20	2	0	9.1
24 May 77	44.0	72.0	23.9	16	15.1	9.3	24	0.0	19	-	-	-
								1.0	19	0	2	0.0
								6.0	16	3	2	15.8
								24.0	11	8	3	42.1
								32.0	8	11	0	57.9
								96.0	5	14	0	73.7
24 May 77	43.8	67.8	24.5	16	15.1	6.4	24	0.0	18	-	-	-
								0.2	18	0	1	0.0
								4.0	17	1	6	5.6
								6.0	13	5	4	27.8
								8.0	13	5	9	27.8
								24.0	0	18	-	100.0

Table C1-223. The effects of sudden temperature decreases at rising ambient water temperature on Atlantic silverside from February through August 1977. Times listed were at significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
14 Mar 77	66.3	106.4	24.0	10	10.0	6.0	10	0.0	11	-	-	-
								0.1	11	0	3	0.0
								1.0	10	1	9	9.1
								3.0	9	2	0	18.2
								28.0	8	3	0	27.3
								72.0	7	4	0	36.4
14 Mar 77	66.5	96.3	24.0	10	10.0	3.1	10	0.0	11	-	-	-
								0.1	11	0	11	0.0
								24.0	10	1	8	9.1
								28.0	9	2	3	18.2
								72.0	8	3	1	27.3
								96.0	7	4	2	36.4
16 May 77	76.8	102.1	24.1	15	15.1	11.2	10	0.0	10	-	-	-
								48.0	9	1	0	10.0
								96.0	9	1	0	10.0
16 May 77	74.0	101.7	24.1	15	15.1	7.2	10	0.0	10	-	-	-
								0.1	10	0	0	0.0
								96.0	10	0	0	0.0
18 Jul 77	18.4	39.2	22.8	21	20.0	16.8	10	0.0	10	-	-	-
								0.8	9	1	0	10.0
								4.0	9	1	1	10.0
								8.0	9	1	1	10.0
								24.0	8	2	0	20.0
								96.0	8	2	0	20.0

a. Loss of equilibrium.

Table C1-223. (cont.)

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME(hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.	PERCENT MORT
18 Jul 77	17.6	34.1	22.8	21	20.0	14.1	10	0.0	10	-	-	-
								1.0	10	0	1	0.0
								2.0	9	1	0	10.0
								8.0	9	1	1	10.0
								24.0	8	2	1	20.0
								96.0	8	2	1	20.0
18 Jul 77	17.1	33.0	22.8	21	20.0	12.7	10	0.0	11	-	-	-
								4.0	10	1	4	9.1
								8.0	9	2	3	18.2
								24.0	8	3	1	27.3
								52.0	8	3	1	27.3
								96.0	8	3	0	27.3
29 Jun 77	12.8	26.0	22.8	22	19.9	11.2	10	0.0	10	-	-	-
								3.0	6	4	1	40.0
								4.0	5	5	1	50.0
								6.0	3	7	1	70.0
								8.0	1	9	1	90.0
								24.0	0	10	0	100.0
29 Jun 77	15.2	22.9	22.5	22	19.9	6.3	10	0.0	10	-	-	-
								0.1	9	1	5	10.0
								1.0	6	4	6	40.0
								2.0	3	7	3	70.0
								3.0	1	9	1	90.0
								4.0	0	10	0	100.0

Table C1-224. The effects of sudden temperature decreases at rising ambient water temperature on northern pipefish from February through August 1977. Times listed were of significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
9 May 77	120.0	213.0	23.3	15	15.0	10.9	20	0.0	20	-	-	-
								52.0	19	1	0	5.0
								96.0	19	1	0	5.0
9 May 77	108.0	196.0	23.3	15	15.0	7.1	20	0.0	20	-	-	-
								72.0	20	0	1	0.0
								96.0	20	0	0	0.0

a. Loss of equilibrium.

Table C1-225. The effects of sudden temperature decreases at rising ambient water temperature on winter flounder from February through August 1977. Times listed were of significant events although they may reflect a summation of events from one time period to another.

DATE	RANGE LENGTH (mm) MIN	MAX	SALINITY (ppt)	ACCL TEMP (C)	CONT TEMP (C)	EXP TEMP (C)	CONT # ORG TESTED	TIME (hrs) FRM START OF TEST	EXPERIMENTAL # ALIVE	# DEAD	# WITH L.O.E.[a]	PERCENT MORT
21 Mar 77	98.6	156.2	23.6	6	5.2	1.0	10	0.0	10	-	-	-
								1.0	10	0	0	0.0
								96.0	10	0	0	0.0
25 Apr 77	96.5	160.2	23.3	15	14.9	1.0	10	0.0	10	-	-	-
								1.0	10	0	10	0.0
								3.0	10	0	8	0.0
								8.0	10	0	7	0.0
								24.0	10	0	1	0.0
								96.0	10	0	0	0.0
25 Jun 77	34.0	47.2	23.0	20	20.0	11.2	20	0.0	16	-	-	-
								96.0	16	0	0	0.0
25 Jun 77	34.0	47.8	23.0	20	20.0	5.7	20	0.0	18	-	-	-
								1.0	18	0	3	0.0
								2.0	18	0	2	0.0
								3.0	18	0	1	0.0
								96.0	18	0	0	0.0

a. Loss of equilibrium.

Table C1-226. Nearfield and farfield temperature in the Oyster Creek Generating Station discharge canal and Barnegat Bay under various operating regimes for the Oyster Creek and Forked River Generating Stations.

Season	Predicted Plume[b]	Month	Bay Temp. (C)[a]	Nearfield Temp. (C)				Farfield Temp. (C), by isotherm								
				A[b]	B	C	D	4.4	3.9	3.3	2.8	2.2	1.7	1.1	0.3	0.6
Non-summer	LMST07	Jan	2.8	10.6	10.2	10.1	10.1	-	6.7	6.1	5.6	5.0	4.5	3.9	3.6	3.4
		Feb	3.9	11.7	11.3	11.2	11.2	-	7.8	7.2	6.7	6.1	5.6	5.0	4.7	4.5
		Mar	6.1	13.9	13.5	13.4	13.4	-	10.0	9.4	8.9	8.3	7.8	7.2	6.9	6.7
		Apr	11.1	18.9	18.5	18.4	18.4	-	15.0	14.4	13.9	13.3	12.8	12.2	11.9	11.7
		May	17.8	25.6	25.2	25.1	25.1	-	21.7	21.1	20.6	20.0	19.5	18.9	18.6	18.4
		Oct	15.5	23.3	22.9	22.8	22.8	-	19.4	18.8	18.3	17.7	17.2	16.6	16.3	16.1
		Nov	10.0	17.8	17.4	17.3	17.3	-	13.9	13.3	12.8	12.2	11.7	11.1	10.8	10.6
		Dec	5.0	12.8	12.4	12.3	12.3	-	8.9	8.3	7.8	7.2	6.7	6.1	5.8	5.6
Summer	LMST06	One dilution pump														
		Jun	23.8	31.1	30.7	30.8	30.6	-	27.2	26.6	26.1	25.5	25.0	24.4	24.1	23.9
		Jul	26.7	34.5	34.1	34.0	34.0	-	30.6	30.0	29.5	28.9	28.4	27.8	27.5	27.3
		Aug	26.7	34.5	34.1	34.0	34.0	-	30.6	30.0	29.5	28.9	28.4	27.8	27.5	27.3
		Sep	22.2	30.2	29.8	29.7	29.7	-	26.1	25.5	25.0	24.4	23.9	23.3	23.0	22.8
	LMST03	Two dilution pumps														
		Jun	23.3	29.8	29.5	29.5	29.4	27.7	27.2	26.6	26.1	25.5	25.0	24.4	24.1	23.9
		Jul	26.7	33.2	32.9	32.9	32.8	31.1	30.6	30.0	29.5	28.9	28.4	27.8	27.5	27.3
		Aug	26.7	33.2	32.9	32.9	32.8	31.1	30.6	30.0	29.5	28.9	28.4	27.8	27.5	27.3
		Sep	22.2	28.7	28.4	28.4	28.3	26.6	26.1	25.5	25.0	24.4	23.9	23.3	23.0	22.8

Season	Predicted Plume[b]	Month	Farfield, Area ($10^6 m^3$) per isotherm								
			3.3	2.8	2.2	1.7	1.1	0.3	0.6
Summer	LMST06	One dilution pump							
		Jun	-	0.76	1.37	1.98	3.66	5.64	10.82	16.15	25.45
		Jul	-	0.76	1.37	1.98	3.66	5.64	10.82	16.15	25.45
		Aug	-	0.76	1.37	1.98	3.66	5.64	10.82	16.15	25.45
		Sep	-	0.76	1.37	1.98	3.66	5.64	10.82	16.15	25.45
	LMST03	Two dilution pumps									
		Jun	0.46	1.22	2.29	3.81	4.27	5.79	10.21	14.94	24.08
		Jul	0.46	1.22	2.29	3.81	4.27	5.79	10.21	14.94	24.08
		Aug	0.46	1.22	2.29	3.81	4.27	5.79	10.21	14.94	24.08
		Sep	0.46	1.22	2.29	3.81	4.24	5.79	10.21	14.94	24.08

[a] Average Bay temperature from Burns and Roe, Inc. (1974).
[b] See Lawler, Matusky, and Skelly Engineers (1977).

Table C1-227. Total number and percent of Atlantic menhaden collected from Barnegat Bay, New Jersey by area from September 1976 through August 1977.

	NUMBER												
	September	October	November	December	January	February	March	April	May	June	July	August	Total
Creek Mouths	-	2	-	-	-	-	-	-	-	-	-	1	3
Forked River	74	5	8	2	-	-	-	-	-	3	3	5	100
Oyster Creek	44	19	234	73	20	14	4	-	1	39	36	10	494
OCGS Screens	297	11,761	18,564	2,279	37	125	578	110	2	-	377	890	35,020
OCGS Condenser Discharge	7	6	31	43	114	1,348	167	-	-	-	7	-	1,723
Total	422	11,793	18,817	2,397	171	1,487	749	110	3	42	423	906	37,340

Table C1-227. (cont.).

	PERCENT											
	September	October	November	December	January	February	March	April	May	June	July	August
Creek Mouths	-	-	-	-	-	-	-	-	-	-	-	0.1
Forked River	17.5	0.1	+	0.1	-	-	-	-	-	7.1	0.7	0.6
Oyster Creek	10.4	0.2	1.2	3.0	11.7	1.0	0.5	-	33.3	92.9	8.5	1.1
OCGS Screens	70.4	99.7	98.6	95.1	21.6	8.4	77.2	100.0	66.7	-	89.1	98.2
OCGS Condenser Discharge	1.7	0.1	0.2	1.8	66.7	90.6	22.3	-	-	-	1.7	-
Total	100.0	100.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table C1-228. Number and percent of Atlantic menhaden in each age class for specimens examined from September 1976 through August 1977.

Age	No. Specimens	%
0	1353	78.0
1	78	4.5
2	58	3.3
3	169	9.7
4	60	3.5
5	13	0.7
6	2	0.1
7	1	0.1
8	1	0.1
Total	1735	100.0

Table C1-229. Number and percent of Atlantic menhaden by sex in each age class for specimens examined from September 1976 through August 1977.

Age	Number		%		X^2	Significance ($P \leq 0.05$)
	Male	Female	Male	Female		
0	242	196	55.3	44.7	4.83	M > F
1	37	38	50.7	49.3	0.03	NS
2	26	32	44.8	55.2	0.62	NS
3	71	98	42.0	58.0	4.31	F > M
4	21	39	35.0	65.0	5.40	F > M
5	9	4	-	-	-	-
6	1	1	-	-	-	-
7	1	0	-	-	-	-
8	0	1	-	-	-	-
Total	408	409				

Table C1-230. Number of male and female Atlantic menhaden examined from Barnegat Bay, New Jersey from September 1976 through August 1977.

	Creek Mouths		X^2 [a]	Forked River		X^2	Oyster Creek		X^2	OCGS Screens		X^2	OCGS Condenser Discharge		X^2	Totals		X^2
	Males	Females	test	Males	Females	test	Males	Females	test	Males	Females	test	Males	Females	test	Males	Females	test
September	0	0	-	6	12	-	4	9	-	25	35	NS	4	1	-	39	57	NS
October	0	1	-	0	1	-	2	5	-	23	56	* (F>M)	0	0	-	25	63	* (F>M)
November	0	0	-	4	0		20	25	NS	55	37	NS	5	22	* (F>M)	84	84	NS
December	0	0	-	0	1	-	17	12	NS	33	44	NS	13	22	NS	63	79	-
January	0	0	-	0	0	-	2	2	-	10	5	-	28	31	NS	40	38	NS
February	0	0	-	0	0	-	1	7	-	30	37	NS	25	16	NS	56	60	NS
March	0	0	-	0	0	-	3	3	-	31	40	NS	35	33	NS	69	76	NS
April	0	0	-	0	0	-	0	0	-	19	52	* (F>M)	0	0	-	19	52	* (F>M)
May	0	0	-	0	0	-	0	0	-	0	1	-	0	0	-	0	1	-
June	0	0	-	2	1		15	20	NS	0	0	-	0	0	-	17	21	-
July	0	0	-	0	2	-	1	8	-	4	2	-	3	4	-	8	16	-
August	0	0	-	1	0	-	3	4	-	17	36	* (F>M)	0	0	-	21	40	* (F>M)
Total	0	1		13	17		68	95		247	345		113	129		441	587	
				NS			* (F>M)			* (F>M)			NS			* (F>M)		

[a] NS = not significant
* = significant at $P \leq 0.05$
F > M = significantly more females than males

Table C1-231. Summary of comparisons of mean lengths of male and female Atlantic menhaden from Barnegat Bay, New Jersey by age class from September 1976 through August 1977.

Age		Number	Mean	Standard Deviation	Results[a]
0+	Male	243	113.8	13.8	$t_{437} = 1.04$ NS
	Female	196	115.2	14.2	
1+	Male	37	151.9	28.6	$t_{73} = 0.49$ NS
	Female	38	148.6	29.8	
2+	Male	26	217.1	10.1	$t_{56} = 1.16$ NS
	Female	32	211.6	22.5	
3+	Male	71	224.2	12.8	$t_{167} = 3.24$ **
	Female	98	231.8	16.5	
4+	Male	21	259.1	20.5	$t_{58} = 2.24$ *
	Female	39	246.5	20.9	

[a] NS = not significant
* = achieved significance at $P \leq 0.05$
** = achieved significance at $P \leq 0.01$

Table C1-232. Number and mean length of Atlantic menhaden by age examined from Forked River, Oyster Creek, OCGS traveling screens, and OCGS condenser discharge from September 1976 through August 1977.[a]

Age		Forked River	Oyster Creek	OCGS Screens	OCGS Condenser Discharge
0^+	number	77	246	844	184
	mean	111	103	111	108
1^+	number	-	40	32	-
	mean	-	132	167	-
2^+	number	-	-	40	13
	mean	-	-	214	222
3^+	number	-	-	102	57
	mean	-	-	227	232
4^+	number	-	-	25	26
	mean	-	-	252	254

[a] means calculated when 10 or more specimens taken in an area.

Table C1-233. Lengths of Atlantic menhaden examined from September 1976 through August 1977 as calculated from annulus measurements.

Age	Number Examined	Calculated Lengths Min	Max	Mean	Standard Deviation	Standard Error	95% Confidence Interval	
Males								
1	165	90	178	126	18.6	1.5	123	129
2	130	141	227	178	17.2	1.5	175	181
3	104	172	255	212	17.3	1.7	209	215
4	32	184	285	247	22.5	4.0	239	255
5	11	233	287	265	16.9	5.1	254	276
Females								
1	216	85	194	125	18.8	1.3	123	128
2	175	132	228	178	19.6	1.5	175	181
3	143	163	273	213	20.5	1.7	210	217
4	45	194	301	236	22.5	3.4	230	243
5	6	229	200	271	26.6	10.9	243	299

Table C1-234. Results of t-tests between calculated mean lengths of male and female Atlantic menhaden from September 1976 through August 1977.

Age	Results[a]
1	$t_{379} = 0.52$ NS
2	$t_{303} = 0.00$ NS
3	$t_{245} = 0.40$ NS
4	$t_{75} = 2.11$ * (M>F)

[a] NS = Not Significant at $P \leq .05$
* = Significant at $P \leq .05$
M > F = Males significantly larger than females.

Table C1-235. The length-weight relationship of Atlantic menhaden taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Males	Slope	2.9420
	95% Confidence Interval	0.039
	Intercept	-4.666
	Number Examined	505
Females	Slope	2.9998
	95% Confidence Interval	0.044
	Intercept	-4.7873
	Number Examined	588
Pooled	Slope	3.0437
	95% Confidence Interval	0.020
	Intercept	-4.8919
	Number Examined	2031

Table C1-236. Gonad condition of male and female Atlantic menhaden examined from Barnegat Bay, New Jersey from September 1976 through August 1977.

	Gonad Condition											
	Immature		Mature		Enlarged		Ripe		Spent		Total	
Age	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0	242	196	-	-	-	-	-	-	-	-	242	196
1	36	38	1	-	-	-	-	-	-	-	37	38
2	12	9	8	15	5	5	-	-	1	3	26	32
3	10	3	32	53	18	28	8	2	3	12	71	98
4	1	-	12	19	5	13	2	-	1	7	21	39
5	-	-	6	3	2	1	-	-	1	-	9	4
6	-	-	1	-	-	-	-	-	-	1	1	1
Total	301	246	60	90	30	47	10	2	6	23	407	408

Percentage of specimens for each gonad condition

	Gonad Condition											
	Immature		Mature		Enlarged		Ripe		Spent		Total	
Age	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0	59.5	48.0	-	-	-	-	-	-	-	-	59.5	48.0
1	8.9	9.3	0.2	-	-	-	-	-	-	-	9.1	9.3
2	3.0	2.2	2.0	3.7	1.2	1.2	-	-	0.2	0.7	6.4	7.8
3	2.5	0.7	7.9	13.0	4.4	6.9	2.0	0.5	0.7	2.9	17.5	24.0
4	0.2	-	2.9	4.7	1.2	3.2	0.5	-	0.2	1.7	5.0	9.6
5	-	-	1.5	0.7	0.5	0.2	-	-	0.2	-	2.2	0.9
6	-	-	0.2	-	-	-	-	-	-	0.2	0.2	0.2
Total	74.1	60.2	14.7	22.1	7.3	11.5	2.5	0.5	1.3	5.5	99.9	99.8

Percentage of specimens in each gonad condition by age class

	Gonad Condition											
	Immature		Mature		Enlarged		Ripe		Spent		Total	
Age	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
0	100.0	100.0	-	-	-	-	-	-	-	-	100.0	100.0
1	97.3	100.0	2.7	-	-	-	-	-	-	-	100.0	100.0
2	46.1	28.1	30.8	46.9	19.2	15.6	-	-	3.8	9.4	99.9	100.0
3	14.1	3.1	45.1	54.1	25.4	28.6	11.3	2.0	4.2	12.2	100.1	100.0
4	4.8	-	57.1	48.7	23.8	33.3	9.5	-	4.8	17.9	100.0	99.9
5	-	-	66.7	75.0	22.2	25.0	-	-	11.1	-	100.0	100.0
6	-	-	100.0	-	-	-	-	-	-	100.0	100.0	100.0

Table C1-237. Summary of results of one-way ANOVA or t-test and SNK multiple range test applied to condition data for Atlantic menhaden examined from September 1976 through August 1977.

Length (mm)	Months	Results of ANOVA t-test[a]		Results of SNK multiple range test[b]		
90 - 109	Sept-Nov	$F_{2,205}$ = 25.32 *	STA	Oyster Creek	OCGS Screens	Forked River
			K	19.87	16.52	14.78
			N	140	46	22
					Condenser	
90 - 109	Dec-Feb	$F_{2,256}$ = 18.29 *	STA	Oyster Creek	OCGS Discharge	OCGS Screens
			K	18.91	18.09	16.89
			N	56	77	126
				Condenser		
90 - 109	Mar-May	t_{37} = 1.56 NS	STA	OCGS Discharge	OCGS Screens	
			K	17.77	15.76	
			N	20	19	
90 - 109	Jun-Aug	-	STA	OCGS Screens		
			K	11.84		
			N	83		

a * = achieved significance at $P \leq .05$
NS - not significant

b Station group, mean condition (K), and number of specimens examined (N) are given. Means underlined are not significantly different.

Table C1-238. The number and percent by category of Atlantic menhaden from Barnegat Bay, New Jersey with abnormalities examined from September 1976 through August 1977.

	Number	% of Each Category	% of All Specimens Examined
Disease or parasite only:			
Lernaeenicus spp.	236	88.4	11.6
Olencira praegustator	22	8.2	1.1
Fin Rot	4	1.5	0.2
Lernaeenicus spp. and *O. praegustator*	5	1.9	0.2
	267	100.0	13.1
Mechanical damage only:			
Probably dead at time of capture	3	0.3	0.1
Scales missing	813	90.6	40.1
Scales and flesh missing	34	3.8	1.7
Fin damaged	10	1.1	0.5
Eye damaged	3	0.3	0.1
Scales missing and fin damage	34	3.8	1.7
	897	99.9	44.2
Genetic only:			
Fin abnormality	4	100.0	0.2
Miscellaneous only:			
Scar present	3	100.0	0.1
Multiple trauma:			
Probably dead at time of capture and *Lernaeenicus* spp.	3	0.7	0.1
Scales missing and *Lernaeenicus* spp.	259	61.7	12.7
Scales missing and *O. praegustator*	42	10.0	2.1
Scales missing and fin rot	7	1.7	0.3
Scales missing, *Lernaeenicus* spp., and *O. praegustator*	11	2.6	0.5
Scales and flesh missing and *Lernaeenicus* spp.	13	3.1	0.6
Scales and flesh missing and *O. praegustator*	2	0.5	0.1
Scales and flesh missing, *Lernaeenicus* spp. and *O. praegustator*	7	1.7	0.3
Fin damaged and *Lernaeenicus* spp.	3	0.7	0.1
Fin damaged, *Lernaeenicus* spp. and *O. praegustator*	1	0.2	0.1
Eye damaged and *Lernaeenicus* spp.	2	0.5	0.1
Scales missing and fin damage	15	3.6	0.7
Scales missing, fin damaged, and *Lernaeenicus* spp.	4	1.0	0.2
Scales missing, fin damaged, and *O. praegustator*	4	1.0	0.2
Fin abnormality and *Lernaeenicus* spp.	1	0.2	0.1
Fin abnormality and scales missing	9	2.1	0.4
Scar and *Lernaeenicus* spp.	15	3.6	0.7
Scar and scales missing	4	1.0	0.2
Scar, scales missing, and *Lernaeenicus* spp.	10	2.4	0.5
Scar, fin damaged, and *Lernaeenicus* spp.	7	1.7	0.3
	419	100.0	20.3
Normal:	441	100.0	21.7
Total	2031		99.6

Table C1-239. Number and percent[a] of all normal and abnormal Atlantic menhaden examined from Barnegat Bay, New Jersey from September 1976 through August 1977.

	Number Normal	Diseased and Parasites	Mechanically Damaged	Genetic Abnormalities	Miscellaneous Abnormalities	Number Examined
Forked River	49	37	13	0	0	95
Oyster Creek	121	113	118	3	5	339
OCGS Screens	100	425	1,076	10	9	1,251
OCGS Condenser Discharge	168	106	96	1	19	342
Totals	438	681	1,303	14	33	2,027

	% Normal	% Diseased and Parasites	% Mechanically Damaged	% Genetic Abnormalities	% Miscellaneous Abnormalities
Forked River	51.6	38.9	13.7	-	-
Oyster Creek	35.7	33.3	34.8	0.9	1.5
OCGS Screens	8.0	34.0	86.0	0.8	0.7
OCGS Condenser Discharge	49.1	31.0	28.1	0.3	5.6

[a] Because of multiple trauma, total percentage will exceed 100%.

Table C1-240. Number, mean length and standard deviation for each mode of bimodal frequency distribution of bay anchovy examined from July 1976 through December 1976 and July and August 1977 from Barnegat Bay, New Jersey.

	July		August		September		October	
Number	9	675	181	369	208	85	145	200
Mean	27	57	34	64	40	67	42	70
Standard Deviation	1.9	5.5	5.1	6.1	5.3	4.2	6.6	6.1

	November		December		July		August	
Number	51	39	5	22	37	610	334	425
Mean	36	70	43	69	25	65	32	66
Standard Deviation	8.9	6.0	6.0	4.3	4.4	6.8	4.6	5.9

Table C1-241. The length-weight relationship of bay anchovy taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Males	Slope	3.1105
	95% Confidence Interval	0.049
	Intercept	-5.2834
	Number Examined	1318
Females	Slope	3.1170
	95% Confidence Interval	0.035
	Intercept	-5.2825
	Number Examined	1671
Pooled	Slope	3.0747
	95% Confidence Interval	0.039
	Intercept	-5.2179
	Number Examined	3294

Table C1-242. Summary of results of one-way ANOVA and SNK multiple range test applied to condition data for bay anchovy examined from September 1976 through August 1977.

Length (mm)	Months	Results of ANOVA[a]		Results of SNK multiple range test[b]			
38 - 44	Sept-Nov	$F_{2,229} = 7.98$ *	STA	Creek Mouths	Oyster Creek	Forked River	OCGS Screens
			K	5.07	4.82	4.45	3.96
			N	23	78	97	35
60 - 69	Mar-May	$F_{2,123} = 6.23$ *	STA	Forked River	Creek Mouths	Oyster Creek	OCGS Screens
			K	5.84	5.58	5.36	4.88
			N	34	42	35	26
26 - 34	Jun-Aug	$F_{2,212} = 2.38$ NS	STA	Creek Mouths	Oyster Creek	Forked River	
			K	6.98	6.59	6.25	
			N	23	94	129	
60 - 69	Jun-Aug	$F_{3,730} = 16.91$ *	STA	Creek Mouths	Oyster Creek	Forked River	OCGS Screens
			K	5.74	5.68	5.49	5.28
			N	168	161	220	185

[a] * = achieved significance at $P \leq 0.01$
NS = not significant

[b] Station group, mean condition (K), and number of specimens examined (N) are given. Means underlined are not significantly different.

Table C1-243. Number of male and female bay anchovy examined from Barnegat Bay, New Jersey from September 1976 through August 1977.

	Creek Mouths		X^2 [a]	Forked River		X^2	Oyster Creek		X^2	OCGS Screens		X^2	All Specimens		X^2
	Males	Females	test	Males	Females	test	Males	Females	test	Males	Females	test	Males	Females	test
September	-	-	-	25	40	NS	28	48	NS	50	71	NS	113	158	S (F>M)
October	20	19	NS	40	38	NS	12	11	NS	90	92	NS	162	160	NS
November	-	1	-	5	1	-	8	7	-	83	92	NS	96	102	NS
December	-	-	-	-	-	-	1	-	-	13	14	NS	14	14	NS
January	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	16	35	S (F>M)	91	80	NS	107	115	NS
May	64	50	NS	55	97	S (F>M)	37	47	NS	24	24	NS	180	218	NS
June	56	71	NS	56	71	NS	43	85	S (F>M)	-	-	-	154	227	S (F>M)
July	49	53	NS	82	109	NS	82	103	NS	64	79	S (F>M)	287	344	S (F>M)
August	44	80	S (F>M)	46	101	S (F>M)	50	48	NS	84	109	NS	224	338	S (F>M)
Total	232	274		319	457		277	378		490	561		1318	1670	
	NS			S (F>M)			S (F>M)			S (F>M)			S (F>M)		

[a] NS = not significant
S = significant at $P \leq 0.05$
F>M = significantly more females than males

Table C1-244. Number of male and female bay anchovy examined from Barnegat Bay, New Jersey by gonad condition from September 1976 through August 1977.

		Creek Mouths[a]						Forked River						Oyster Creek						OCGS Screens					
		I	M	E	R	PS	S	I	M	E	R	PS	S	I	M	E	R	PS	S	I	M	E	R	PS	S
September	Male	-	-	-	-	-	-	20	15	-	-	-	-	25	3	-	-	-	-	8	39	-	-	-	3
	Female	-	-	-	-	-	-	25	16	-	-	-	-	33	9	-	-	-	-	10	60	-	-	-	1
October	Male	6	14	-	-	-	-	12	26	-	-	-	-	5	7	-	-	-	-	1	88	-	-	-	1
	Female	8	11	-	-	-	-	16	21	-	-	-	1	3	6	-	-	-	-	3	89	-	-	-	-
November	Male	-	-	-	-	-	-	-	5	-	-	-	-	6	2	-	-	-	-	-	88	-	-	-	1
	Female	-	1	-	-	-	-	-	1	-	-	-	-	7	-	-	-	-	-	-	91	-	-	-	1
December	Male	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	13	-	-	-	-
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	1
January	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	11	5	-	-	-	-	91	-	-	-	-
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	34	1	-	-	-	-	80	-	-	-	-
May	Male	-	14	46	4	-	-	-	3	42	10	-	-	-	7	20	10	-	-	-	8	13	3	-	-
	Female	-	29	21	-	-	-	-	51	46	-	-	-	-	9	38	-	-	-	-	18	6	-	-	-
June	Male	-	-	18	36	1	-	-	1	31	23	1	-	-	1	13	29	-	-	-	-	-	-	-	-
	Female	-	2	68	-	1	-	-	4	58	3	5	1	-	6	77	1	1	-	-	-	-	-	-	-
July	Male	-	-	-	11	34	4	-	1	2	11	55	13	-	2	4	14	47	15	-	-	-	5	39	10
	Female	-	-	11	-	4	38	1	2	26	16	7	57	-	5	19	15	8	56	-	22	15	1	3	38
August	Male	1	9	-	-	14	20	12	22	-	-	5	7	11	3	15	-	20	1	2	29	-	1	18	34
	Female	10	19	-	-	6	45	37	49	1	1	10	3	18	18	4	-	8	-	8	78	-	1	7	15

[a] I = immature, M = mature, E = enlarged, R = ripe, PS = partially spent, S = spent

Table C1-245. The number and percent by category of bay anchovy from Barnegat Bay, New Jersey with abnormalities examined from September 1976 through August 1977.

	Number	% of Each Category	% of All Specimens Examined
Disease or parasite only:			
Lernaeenicus spp.	3	75.0	0.1
Fin Rot	1	25.0	< 0.1
	4	100.0	0.1
Mechanical damage only:			
Probably dead at time of capture	47	1.6	1.4
Scales missing	2880	95.5	87.4
Scales and flesh missing	24	0.8	0.7
Fin damaged	1	< 0.1	< 0.1
Eye damaged	22	0.7	0.7
Scales missing and fin damaged	42	1.4	1.3
	3016	100.0	91.5
Multiple trauma:			
Probably dead at time of capture and *Lernaeenicus* spp.	3	1.3	0.1
Scales missing and *Lernaeenicus* spp.	221	93.6	6.7
Scales missing and eye damage	3	1.3	0.1
Scales and flesh missing and *Lernaeenicus* spp.	1	0.4	< 0.1
Scales missing, fin damaged, and *Lernaeenicus* spp.	7	3.0	0.2
Vertebral deformity and scales missing	1	0.4	< 0.1
	236	100.0	7.1
Normal:	41	100.0	1.2
Total	3297	-	99.9

Table C1-246. Number and percent[a] of all normal and abnormal bay anchovy examined from Barnegat Bay, New Jersey from September 1976 through August 1977.

	Number Normal	Diseased and Parasites	Mechanically Damaged	Total No. Examined Each Area
Creek Mouths	3	12	531	534
Forked River	20	37	893	913
Oyster Creek	9	26	767	778
OCGS Screens	9	164	1,061	1,072
Totals	41	239	3,252	3,297

	% Normal	% Diseased and Parasites	% Mechanically Damaged
Creek Mouths	0.5	2.2	99.4
Forked River	2.2	4.1	97.8
Oyster Creek	1.2	3.3	98.6
OCGS Screens	0.8	15.3	99.0

[a] Because of multiple trauma, percentages will exceed 100%.

Table C1-247. Total number and percent by area of Atlantic silverside collected by area in Barnegat Bay, New Jersey from January 1976 through August 1977.

Number

	1976												1977								
	Jan[a]	Feb[a]	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May[a]	June[a]	July[a]	Aug	Total
Bay	53	51	353	350	278	407	1,504	44	-	28	2	9	-	-	2	41	33	5	458	464	4,092
Forked River	6	8	388	37	78	82	198	109	68	181	153	-	-	1	4	18	163	8	148	41	1,656
Oyster Creek	43	61	1,749	3,303	26	61	194	55	22	31	226	1,162	10	13	1,554	156	21	10	224	62	8,984
OCGS Screens	-	-	7,992	1,290	1,061	103	1	-	5	263	3,817	1,451	61	68	3,057	2,327	5	-	63	99	21,663
Total	102	120	10,482	4,990	1,443	623	1,897	208	95	503	4,200	2,622	71	82	4,617	2,541	222	18	893	666	36,395

Percent

	1976												1977								
	Jan[a]	Feb[a]	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May[a]	June[a]	July[a]	Aug	Total
Bay	51.9	42.5	3.4	7.2	19.3	65.3	79.3	21.2	-	5.6	0.1	0.3	-	-	0.1	1.6	14.8	27.8	51.3	69.7	11.2
Forked River	5.8	6.7	3.7	0.7	5.4	8.3	10.4	52.4	71.6	36.0	3.6	-	-	1.2	0.1	0.7	73.4	16.7	16.6	6.2	4.6
Oyster Creek	42.2	50.8	16.6	66.1	1.8	9.8	10.2	26.4	23.2	6.2	5.2	44.3	14.1	15.8	33.6	6.1	9.5	55.6	25.0	9.3	24.7
OCGS Screens	-	-	76.3	26.0	73.5	16.6	0.1	-	5.2	52.3	91.1	55.3	85.9	82.9	66.2	91.6	2.3	-	7.1	14.8	59.5

[a] OCGS shutdown for all or part of month.

Table C1-248. Mean length of male, female, and undetermined Atlantic silverside examined by area in Barnegat Bay, New Jersey from January 1976 through August 1977.

	Bay			Forked River			Oyster Creek			OCGS Screens					
	Undet.	Male	Female	Undet.	Male	Female	Undet.	Male	Female	Undet.	Male	Female	All Fish	Young[a]	Adults[a]
January 1976	58.0	76.4	89.0	-	-	-	62.0	74.1	86.0	-	-	-	78.1	-	-
February	77.0	83.9	91.2	-	-	109.0	48.5	75.1	81.1	-	-	-	79.7	-	-
March	-	-	-	-	-	-	-	99.9	102.1	78.5	98.5	108.0	100.6	-	-
April	-	84.1	90.9	-	88.8	96.1	-	88.6	102.6	-	90.6	97.8	93.3	-	-
May	-	92.3	96.1	28.2	86.9	96.7	-	90.5	112.0	-	92.2	102.5	96.8	28.2	98.5
June	-	91.0	98.3	-	-	-	38.6	-	105.0	-	98.0	107.7	89.4	38.6	98.9
July	59.9	73.8	87.0	57.5	60.2	65.0	53.6	-	-	-	-	-	64.9	57.7	101.5
August	52.2	66.4	71.4	46.4	63.7	72.4	48.7	58.4	62.1	-	-	-	63.1	61.8	99.4
September	-	-	-	46.3	77.9	82.1	48.0	57.4	71.4	-	-	91.0	66.0	65.5	108.0
October	39.0	77.3	99.0	61.0	82.8	93.0	46.0	82.7	79.2	68.7	92.1	97.3	90.2	-	-
November	-	98.0	-	61.1	73.7	85.0	59.0	72.9	98.5	71.8	87.7	92.5	83.4	65.7	95.4
December	61.0	87.5	103.0	-	-	-	56.7	76.0	92.7	73.0	83.9	88.2	82.8	-	-
January 1977	-	-	-	-	-	-	-	78.0	95.0	-	79.0	88.1	86.4	-	-
February	-	-	-	-	-	102.0	-	76.4	109.0	-	92.8	97.0	94.7	-	-
March	-	-	-	-	-	-	-	85.6	100.4	-	90.7	97.4	94.2	-	-
April	-	83.6	104.1	-	83.5	98.2	-	92.3	99.3	-	90.1	98.6	95.4	-	-
May	-	88.0	108.7	-	97.0	105.2	-	100.9	108.0	-	96.0	102.0	104.4	-	-
June	32.3	-	112.0	-	-	112.5	29.3	98.5	109.7	-	-	-	48.9	31.7	108.8
July	52.8	77.0	105.9	54.7	71.5	77.5	58.5	79.6	83.6	55.3	65.0	68.8	64.5	58.5	109.8
August	57.4	72.5	70.2	53.6	67.4	70.2	58.2	69.5	72.8	56.7	66.0	75.1	66.2	64.9	113.3
Total	50.6	78.5	88.1	53.6	78.9	91.4	51.4	77.2	93.8	65.8	89.8	97.8	-	-	-

[a] Means given for months when bimodal frequency distribution found.

Table C1-249. Number and mean length for each mode of bimodal frequency distribution of Atlantic silverside examined from May through September 1976 and June through August 1977.

	May		June		July		August	
Number	7	283	10	54	105	19	239	9
Mean	28	99	39	99	58	102	62	99
Standard Deviation	2.4	9.2	5.2	8.5	6.6	6.4	10.7	7.6

	September		June		July		August	
Number	74	1	45	13	150	20	217	6
Mean	66	108	32	109	59	110	65	113
Standard Deviation	14.9	-	5.6	8.6	8.7	6.2	8.2	6.1

Table C1-250. Number of male and female Atlantic silverside examined from Barnegat Bay, New Jersey from January 1976 through August 1977.

	Creek Mouths		X^2[a]	Forked River		X^2	Oyster Creek		X^2	OCGS Screens		X^2	Totals		X^2
	Males	Females	test	Males	Females	test	Males	Females	test	Males	Females	test	Males	Females	test
1976															
January	28	11	* (M>F)	-	-	-	24	8	* (M>F)	-	-	-	82	19	* (M>F)
February	24	16	NS	-	1	-	41	10	* (M>F)	-	-	-	65	26	* (M>F)
March	-	-	-	-	-	-	10	41	* (F>M)	39	115	* (F>M)	49	156	* (F>M)
April	28	58	* (F>M)	6	16	-	26	46	* (F>M)	40	84	* (F>M)	100	204	* (F>M)
May	16	30	* (F>M)	13	9	NS	2	10	-	57	146	* (F>M)	88	195	* (F>M)
June	1	47	* (F>M)	-	-	-	-	1	-	2	3	-	3	51	* (F>M)
July	11	27	* (F>M)	4	4	-	-	-	-	-	-	-	15	31	* (F>M)
August	34	82	* (F>M)	12	21	* (F>M)	11	14	NS	-	-	-	57	117	* (F>M)
September	-	-	-	11	8	-	17	20	NS	-	3	-	28	32	NS
October	9	2	-	42	36	NS	3	4	-	41	60	NS	95	102	NS
November	1	-	-	42	22	* (M>F)	73	75	NS	47	33	NS	163	130	NS
December	2	1	-	-	-	-	82	35	* (M>F)	40	54	NS	124	90	* (M>F)
1977															
January	-	-	-	-	-	-	1	3	-	4	7	-	5	10	-
February	-	-	-	-	1	-	5	3	-	25	39	NS	30	42	NS
March	-	-	-	-	-	-	40	42	NS	97	135	* (F>M)	137	177	* (F>M)
April	18	11	* (M>F)	6	6	NS	13	45	* (F>M)	50	94	* (F>M)	87	156	* (F>M)
May	2	31	* (F>M)	20	65	* (F>M)	9	12	NS	1	2	-	32	110	* (F>M)
June	-	2	-	-	2	-	2	7	-	-	-	-	2	11	-
July	3	7	-	8	14	NS	9	15	-	1	4	-	21	40	* (F>M)
August	16	30	* (F>M)	10	12	NS	15	38	* (F>M)	8	16	* (F>M)	49	96	* (F>M)
Total	193	354	* (F>M)	174	217	* (F>M)	383	429	NS	452	795	* (F>M)	1202	1795	* (F>M)

[a] NS = not significant
* = significant at $P \leq 0.05$
F M = significantly more females than males
M>F = significantly more males than females

Table C1-251. Number of male and female Atlantic silverside examined from Barnegat Bay, New Jersey by gonad condition from January through December 1976.

		Bay[a]						Forked River						Oyster Creek						OCGS Screens						
		I	M	E	R	PS	S	I	M	E	R	PS	S	I	M	E	R	PS	S	I	M	E	R	PS	S	Total
January	Male	1	26	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	47
	Female	-	11	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	19
February	Male	-	24	-	-	-	-	-	-	-	-	-	-	-	35	-	-	-	-	-	-	-	-	-	-	59
	Female	-	15	-	-	-	-	-	1	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	25
March	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	1	9	-	-	-	-	7	32	-	-	-	49
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	-	-	-	-	10	105	-	-	-	156
April	Male	-	-	28	-	-	-	-	-	3	-	-	-	-	-	16	10	1	-	-	-	18	18	3	3	97
	Female	-	-	55	3	-	-	-	-	7	6	3	-	-	1	19	22	4	-	-	-	17	19	27	20	203
May	Male	-	-	-	-	13	9	-	-	-	3	8	5	-	-	1	-	-	1	-	-	3	3	23	29	91
	Female	-	-	-	7	13	10	-	-	1	3	2	3	-	-	-	1	1	8	-	-	-	4	31	111	195
June	Male	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	3
	Female	-	-	-	2	17	28	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	2	51
July	Male	8	2	-	-	3	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
	Female	11	4	-	-	4	8	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	34
August	Male	6	26	-	-	-	-	8	4	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	56
	Female	7	76	-	-	-	-	4	17	-	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	117
September	Male	-	-	-	-	-	-	1	9	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-	27
	Female	-	-	-	-	-	-	-	8	-	-	-	-	16	4	-	-	-	-	-	-	-	-	-	-	28
October	Male	1	8	-	-	-	-	4	38	-	-	-	-	-	2	-	-	-	-	1	40	-	-	-	-	94
	Female	-	2	-	-	-	-	2	34	-	-	-	-	1	3	-	-	-	-	-	60	-	-	-	-	102
November	Male	-	1	-	-	-	-	27	15	-	-	-	-	1	72	-	-	-	-	-	47	-	-	-	-	163
	Female	-	-	-	-	-	-	6	16	-	-	-	-	-	75	-	-	-	-	-	33	-	-	-	-	130
December	Male	-	2	-	-	-	-	-	-	-	-	-	-	16	66	-	-	-	-	-	40	-	-	-	-	124
	Female	-	1	-	-	-	-	-	-	-	-	-	-	6	29	-	-	-	-	-	54	-	-	-	-	90
Totals	Male	14	91	28	-	16	4	44	86	3	3	8	5	45	196	25	10	1	1	1	135	51	20	26	33	826
	Female	18	108	55	12	34	46	18	77	8	9	5	3	37	129	60	23	5	8	-	158	122	23	58	136	1150
	Combined	32	199	83	12	50	50	59	143	11	12	13	8	82	325	85	3	7	9	1	293	173	43	84	169	1976

[a] I = immature, M = mature, E = enlarged, R = ripe, PS = partially spent, S = spent

Table C1-282. Number of male and female Atlantic silverside examined from Barnegat Bay, New Jersey by gonad condition from January through August 1977.

		Bay[a]						Forked River						Oyster Creek						OCGS Screens						
		I	M	E	R	PS	S	I	M	E	R	PS	S	I	M	E	R	PS	S	I	M	E	R	PS	S	Total
January	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	4	-	-	-	-	5
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	7	-	-	-	-	10
February	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	25	-	-	-	-	30
	Female	-	-	-	-	-	-	-	-	1	-	-	-	-	3	-	-	-	-	-	38	1	-	-	-	43
March	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	39	1	-	-	-	-	62	35	-	-	-	137
	Female	-	-	-	-	-	-	-	-	-	-	-	-	-	42	0	-	-	-	-	89	46	-	-	-	177
April	Male	-	-	15	3	-	-	-	-	6	-	-	-	-	-	8	5	-	-	-	-	12	28	-	-	77
	Female	-	1	10	-	-	-	-	-	5	1	-	-	-	-	29	16	-	-	-	1	61	32	-	-	156
May	Male	-	-	-	2	-	-	-	-	2	17	1	-	-	-	-	8	1	-	-	-	-	1	-	-	32
	Female	-	-	-	17	14	-	-	-	15	39	15	-	-	-	-	4	8	-	-	-	-	2	-	-	114
June	Male	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
	Female	-	-	-	2	-	-	-	-	-	-	2	-	-	-	-	2	4	1	-	-	-	-	-	-	11
July	Male	2	-	-	-	-	1	7	-	-	-	1	-	6	1	-	-	1	1	1	-	-	-	-	-	21
	Female	1	-	-	-	2	4	10	-	-	-	2	2	10	2	-	-	1	2	4	-	-	-	-	-	40
August	Male	14	2	-	-	-	-	10	-	-	-	-	-	14	1	-	-	-	-	6	1	-	-	-	-	48
	Female	26	4	-	-	-	-	10	2	-	-	-	-	32	6	-	-	-	-	14	2	-	-	-	-	96
Totals	Male	16	2	15	5	-	1	17	-	8	17	2	-	20	47	9	13	2	3	7	92	47	29	-	-	352
	Female	27	5	10	19	16	4	20	2	21	40	19	2	42	56	29	22	13	3	18	137	108	34	-	-	647
	Combined	43	7	25	24	16	5	37	2	29	57	21	2	62	103	38	35	15	6	25	229	155	63	-	-	999

[a] I = immature, M = mature, E = enlarged, R = ripe, PS = partially spent, S = spent

Table C1-253. The number and percent by category of Atlantic silverside from Barengat Bay, New Jersey with abnormalities examined January 1976 through August 1977.

	Number	% of Each Category	% of All Specimens Examined
Disease or parasite only:			
Lernaeenicus spp.	39	90.6	1.1
Lironeca ovalis	3	6.9	0.1
Fin Rot	1	2.4	0.1
	43	99.9	1.3
Mechanical damage only:			
Probably dead at capture	48	15.8	1.4
Scales missing	88	29.0	2.5
Scales and flesh missing	36	11.9	1.0
Fin damaged	63	20.8	1.8
Eye damaged	30	9.9	0.8
Scales missing and fin damaged	15	4.9	0.4
Hemmorrhage	23	7.6	0.6
	303	-	8.5
Genetic:			
Vertebral deformity	6	100.0	0.1
Normal:	3123	100.0	89.8
Total	3475	-	99.7

Table C1-254. Number and percent of all normal and abnormal Atlantic silverside examined from Barnegat Bay, New Jersey from January 1976 through August 1977.

Area	Number Normal	Diseased and Parasites	Mechanically Damaged	Total
Bay	717	8	9	734
Forked River	507	14	6	527
Oyster Creek	907	6	21	934
OCGS Screens	1002	21	257	1280
Totals	3133	49	293	3475

Percentages Within Areas

Area	% Normal	% Diseased and Parasites	% Mechanically Damaged	Total Percent
Bay	97.7	1.1	1.2	100.0
Forked River	96.2	2.7	1.1	100.0
Oyster Creek	97.1	0.6	2.3	100.0
OCGS Screens	78.3	1.7	20.0	100.0

Table C1-255. Length-frequency distribution of threespine stickleback taken in the vicinity of OCGS from September 1976 through August 1977.

Length (mm)	Total	% Frequency
20-24	1	1.7
25-29	-	0.0
30-34	-	0.0
35-39	-	0.0
40-44	-	0.0
45-49	-	0.0
50-54	1	1.7
55-59	25	42.4
60-64	23	39.0
64-69	9	15.3

Table C1-256. Total number of northern pipefish taken by seine and trawl from September 1976 through August 1977.

	12.2-m seine	45.7-m seine	4.9-m trawl
September	5	-	-
October	3	18	2
November	1	2	2
December	-	-	1
January	-	-	-
February	-	-	-
March	-	-	-
April	2	12	4
May	10	45	10
June	2	15	10
July	16	13	5
August	32	35	1
Total	71	140	35

Table C1-257. Total number of northern pipefish taken by area in Barnegat Bay, New Jersey from September 1976 through August 1977.

	Creek Mouths	Forked River	Oyster Creek	OCGS[a] Traveling Screens
September	-	5	-	131
October	15	5	3	1,705
November	2	2	1	3,169
December	-	-	1	376
January	-	-	-	7
February	-	-	-	-
March	-	-	-	310
April	8	4	6	2,904
May	26	21	18	1,082
June	6	5	16	-
July	12	14	8	1,123
August	25	35	8	484
Total	94	91	61	11,220[b]

[a] Estimated number

[b] Estimated total reflects mean annual estimate (Appendix D-1, Table D1-49) and is not a sum of the monthly estimates.

Table C1-258. Number of northern pipefish taken in Oyster Creek and Forked River, New Jersey during the day and night from September 1976 through August 1977.

	Oyster Creek		Forked River	
	Day	Night	Day	Night
September	-	-	3	2
October	1	2	2	3
November	-	1	-	2
December	1	-	-	-
January	-	-	-	-
February	-	-	-	-
March	-	-	-	-
April	3	3	2	2
May	7	11	15	6
June	7	9	4	1
July	1	7	3	11
August	5	3	9	26
Total	25	36	38	53

Table C1-259. Number and mean length of northern pipefish taken by area in Barnegat Bay, New Jersey from September 1976 through August 1977.

	Creek Mouths										Forked River									
	Juvenile		Male Immature		Male Mature		Male Gravid		Female		Juvenile		Male Immature		Male Mature		Male Gravid		Female	
	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length
September	-	-	-	-	-	-	-	-	-	-	3	95	1	120	1	145	-	-	5	144
October	5	110	-	-	-	-	-	-	10	151	1	73	-	-	-	-	-	-	3	166
November	1	110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	160
December	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	157
January	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feburary	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	-	-	-	-	1	138	-	-	6	179	-	-	1	117	1	148	-	-	1	165
May	-	-	-	-	1	113	13	151	13	178	-	-	-	-	1	112	15	136	5	182
June	1	68	-	-	-	-	2	168	3	212	-	-	-	-	-	-	4	172	1	213
July	-	-	-	-	-	-	3	137	8	129	3	73	-	-	1	187	2	168	10	129
August	3	87	-	-	1	102	3	125	11	135	4	86	-	-	-	-	5	156	21	142
Total	8	96	-	-	3	118	21	133	51	158	11	84	2	119	4	148	26	148	48	148

Table C1-259. (cont.)

	Oyster Creek										OCGS Traveling Screens									
	Juvenile		Male Immature		Male Mature		Male Gravid		Female		Juvenile		Male Immature		Male Mature		Male Gravid		Female	
	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length
September	-	-	-	-	-	-	1	139	2	163	1	114	-	-	11	172	12	157	23	161
October	-	-	-	-	-	-	-	-	3	164	1	44	-	-	6	153	-	-	68	178
November	-	-	-	-	1	152	-	-	5	158	1	90	-	-	4	156	-	-	103	165
December	-	-	-	-	-	-	-	-	1	160	13	87	-	-	4	157	-	-	63	159
January	-	-	-	-	-	-	-	-	-	-	3	81	-	-	-	-	-	-	1	109
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-	-	-	-	9	141	12	151	-	-	70	185
April	-	-	-	-	-	-	-	-	6	153	-	-	3	137	23	142	8	147	133	181
May	-	-	1	92	-	-	11	145	6	182	-	-	-	-	-	-	21	145	67	191
June	1	61	-	-	-	-	13	175	2	220	-	-	-	-	-	-	-	-	-	-
July	-	-	-	-	-	-	3	155	3	153	-	-	-	-	24	167	32	168	54	169
August	-	-	-	-	-	-	3	163	6	157	-	-	-	-	17	157	26	165	49	167
Total	1	61	1	92	1	152	31	160	34	165	19	85	11	140	101	157	99	159	630	175

Table C1-260. Length, weight, age, sex, and maturity of striped bass taken at OCGS from September 1976 through September 1977.

Length (mm)	Weight (g)	Age	Sex	Maturity
305	341.2	2+	male	immature
345	537.3	3+	female	immature
384	777.5	3+	male	mature
390	562.9	3+	female	immature
490	1700.0	4+	female	mature
504	1250.0	--	female	immature
810	7700.0	9+	female	mature

Table C1-261. Number, mean length, and mean weight by area of bluefish taken in Barnegat Bay, New Jersey from September 1976 through August 1977.[a]

	September - November								
		Length				Weight			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	26	151	200	175.2	14.4	33.4	102.0	55.3	17.4
Oyster Creek	119	121	268	179.0	26.6	20.8	275.4	72.5	40.5
OCGS Screens	346	35	237	133.2	44.7	0.4	164.0	35.3	33.6
OCGS Condenser Discharge	45	138	465	304.1	65.8	28.3	2150.0	521.1	429.5

	December - January								
		Length				Weight			
	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	-	-	-	-	-	-	-	-	-
Forked River	-	-	-	-	-	-	-	-	-
Oyster Creek	-	-	-	-	-	-	-	-	-
OCGS Screens	-	-	-	-	-	-	-	-	-
OCGS Condenser Discharge	56	175	368	290.1	41.9	57.4	638.0	376.9	142.7

	July - August								
		Length				Weight			
	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	58	50	165	84.5	24.3	0.9	48.9	8.0	8.4
Forked River	29	53	151	101.5	34.6	1.1	43.2	15.6	13.7
Oyster Creek	27	51	216	109.3	43.2	1.1	115.9	22.5	25.3
OCGS Screens	169	33	210	97.8	37.2	0.2	127.3	13.5	19.4
OCGS Condenser Discharge	25	135	197	149.5	12.9	27.1	103.4	38.7	15.2

[a] No bluefish were collected from February through June.

Table C1-262. Total number, mean length, and mean weight of bluefish taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Location	Number	Length				Weight			
		Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	58	50	165	84.5	24.3	0.9	48.9	8.0	8.4
Forked River	55	53	200	134.4	44.1	1.1	102.0	34.4	25.3
Oyster Creek	146	51	268	166.3	40.6	1.1	275.4	63.3	42.7
OCGS Screens	515	33	237	121.6	45.5	0.2	164.0	28.1	31.4
OCGS Discharge Condenser	126	135	465	267.2	76.3	27.1	2150.1	361.3	322.5

Table C1-263. Number, mean length, and mean weight by age of bluefish taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

					September							
					Length				Weight			
Sex	%	Age	Number	%	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	68.6	0	83	100.0	80	286	152.8	44.4	5.2	314.7	50.2	46.8
		1	0	-	-	-	-	-	-	-	-	-
		2	0	-	-	-	-	-	-	-	-	-
Female	31.4	0	38	100.0	101	277	175.7	60.5	7.3	323.7	89.9	81.8
		1	0	-	-	-	-	-	-	-	-	-
		2	0	-	-	-	-	-	-	-	-	-

					October							
					Length				Weight			
Sex	%	Age	Number	%	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	52.8	0	125	94.7	90	297	150.1	41.3	8.0	433.2	49.5	57.8
		1	5	3.8	240	340	305.0	41.5	174.3	645.0	458.9	182.1
		2	1	0.7	435	435	435.0	-	1450.4	1450.4	1450.4	-
		3	1	0.7	452	452	452.0	-	1540.3	1540.3	1540.3	-
Female	47.2	0	112	94.9	89	286	149.0	39.1	3.6	263.8	45.7	41.0
		1	2	1.7	307	334	320.5	-	514.2	537.3	525.8	-
		2	0	-	-	-	-	-	-	-	-	-
		3	4	3.4	412	465	441.3	21.9	1144.2	2150.0	1513.4	451.3

					November							
					Length				Weight			
Sex	%	Age	Number	%	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	61.3	0	57	87.6	128	304	183.5	37.9	22.2	453.2	90.3	95.4
		1	5	7.7	268	318	292.0	20.5	295.7	518.2	428.7	92.6
		2	3	4.6	297	330	313.7	16.5	415.7	533.5	476.5	59.0
Female	38.7	0	38	92.7	121	288	184.1	34.1	19.4	362.8	84.4	70.0
		1	2	4.9	302	307	304.5	-	451.2	453.3	452.3	-
		2	1	2.4	325	325	325.0	-	553.4	553.4	553.4	-

Table C1-263. (cont.)

					December							
					Length				Weight			
Sex	%	Age	Number	%	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	72.0	0	8	44.4	190	294	243.6	35.8	87.2	393.9	224.2	107.1
		1	7	38.9	266	335	295.7	27.6	290.0	573.4	408.5	114.9
		2	3	16.7	300	350	322.0	25.5	406.0	638.0	514.7	116.6
Female	28.0	0	3	42.9	227	279	246.3	28.4	175.3	354.4	236.7	102.0
		1	3	42.9	272	329	300.0	28.5	308.2	514.8	406.8	103.6
		2	1	14.2	328	328	328.0	-	434.1	434.1	434.1	-

					January							
					Length				Weight			
Sex	%	Age	Number	%	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	57.7	0	7	46.6	195	323	274.9	56.2	88.2	460.6	318.5	159.4
		1	7	46.6	250	368	308.6	34.4	195.2	602.0	420.3	119.7
		2	1	6.8	343	343	343.0	-	554.9	554.9	554.9	-
Female	42.3	0	5	45.4	175	318	254.4	53.3	57.4	471.9	251.6	156.5
		1	6	54.6	296	340	316.7	18.5	368.2	573.0	482.1	73.0
		2	0	-	-	-	-	-	-	-	-	-

					July							
					Length				Weight			
Sex	%	Age	Number	%	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	59.3	0	32	100.0	103	178	137.1	19.6	8.4	57.6	30.6	13.4
		1	-	-	-	-	-	-	-	-	-	-
Female	40.7	0	22	100.0	112	164	138.5	13.0	9.9	48.9	31.0	9.2
		1	-	-	-	-	-	-	-	-	-	-

					August							
					Length				Weight			
Sex	%	Age	Number	%	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	49.3	0	35	100.0	101	210	139.3	33.0	8.5	127.3	34.9	31.4
		1	-	-	-	-	-	-	-	-	-	-
Female	50.7	0	38	100.0	103	216	130.9	25.2	8.2	115.9	26.0	21.5
		1	-	-	-	-	-	-	-	-	-	-

Table C1-264. Age composition by area of bluefish collected in Barnegat Bay, New Jersey from September 1976 through August 1977.

Location	Age 0	%	Age 1	%	Age 2	%	Age 3	%	Total	%
Creek Mouths	58	100.0	-	-	-	-	-	-	58	6.5
Forked River	55	100.0	-	-	-	-	-	-	55	6.2
Oyster Creek	145	99.3	1	0.7	-	-	-	-	146	16.3
OCGS Screens	513	99.8	1	0.2	-	-	-	-	514	57.6
Discharge Canal	69	57.5	36	30.0	10	8.3	5	4.2	120	13.4
Total	840	94.1	38	4.3	10	1.1	5	0.6	893	100.0

Table C1-265. Number, mean length, and mean weight by area and month of male bluefish taken in Barnegat Bay, New Jersey from September through August 1977.

	Creek Mouths								
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	0	-	-	-	-	-	-	-	-
October	0	-	-	-	-	-	-	-	-
November	0	-	-	-	-	-	-	-	-
December	0	-	-	-	-	-	-	-	-
January	0	-	-	-	-	-	-	-	-
July	5	104	142	116.0	15.7	12.2	37.1	18.6	10.4
August	3	110	165	132.0	29.1	13.1	48.9	26.4	19.6

	Forked River								
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	18	151	195	167.9	11.3	33.4	89.0	50.6	12.0
October	2	165	171	168.0	-	47.1	62.7	54.9	-
November	0	-	-	-	-	-	-	-	-
December	0	-	-	-	-	-	-	-	-
January	0	-	-	-	-	-	-	-	-
July	5	105	144	132.6	15.7	10.2	43.2	28.0	11.8
August	1	105	105	105.0	-	10.4	10.4	10.4	-

Table C1-265. (cont.)

	Oyster Creek								
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	16	151	210	174.3	20.5	31.1	118.6	60.9	26.4
October	36	130	268	180.9	30.9	24.1	275.4	78.0	49.6
November	18	128	231	171.7	24.1	22.4	158.3	61.0	31.0
December	0	-	-	-	-	-	-	-	-
January	0	-	-	-	-	-	-	-	-
July	6	113	163	135.3	18.1	15.0	57.6	32.2	15.3
August	5	119	170	141.8	19.3	19.0	58.6	34.7	15.4

	OCGS Screens								
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	42	80	219	133.2	46.4	5.2	135.2	36.5	34.9
October	86	90	220	134.7	33.3	8.0	118.0	31.4	28.3
November	33	131	206	173.8	20.1	22.2	94.4	61.2	20.6
December	0	-	-	-	-	-	-	-	-
January	0	-	-	-	-	-	-	-	-
July	3	103	178	133.7	39.3	8.4	56.6	26.7	26.1
August	24	101	210	137.5	35.0	8.5	127.3	33.1	33.3

Table CI-265. (cont.)

	OCGS Condenser Discharge								
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	4	138	286	223.8	63.2	28.3	314.7	168.3	124.3
October	8	274	452	342.9	66.3	314.3	1540.3	732.3	482.2
November	15	216	330	287.7	27.7	135.6	533.5	401.1	103.9
December	19	220	350	286.6	39.2	150.8	638.0	382.9	156.0
January	16	195	368	295.7	46.6	88.2	602.0	384.9	143.5
July	13	135	167	148.6	9.6	27.1	54.2	36.3	8.3
August	1	197	197	197.0	-	103.4	103.4	103.4	-

Table C1-268. Number, mean length, and mean weight by area and month of female bluefish taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

		Creek Mouths							
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	0	-	-	-	-	-	-	-	-
October	0	-	-	-	-	-	-	-	-
November	0	-	-	-	-	-	-	-	-
December	0	-	-	-	-	-	-	-	-
January	0	-	-	-	-	-	-	-	-
July	1	113	113	113.0	-	17.0	17.0	17.0	-
August	4	107	120	114.0	5.6	13.6	18.0	16.9	1.8

		Forked River							
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	5	153	200	179.2	21.9	38.2	87.4	63.3	22.8
October	1	195	195	195.0	-	102.0	102.0	102.0	-
November	0	-	-	-	-	-	-	-	-
December	0	-	-	-	-	-	-	-	-
January	0	-	-	-	-	-	-	-	-
July	4	132	140	136.5	3.4	29.9	35.6	32.1	2.4
August	3	136	151	144.7	7.8	24.4	35.3	30.6	5.6

		Oyster Creek							
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	12	149	258	194.6	33.5	32.6	250.4	97.1	62.2
October	20	131	216	181.3	22.0	24.4	127.2	74.8	29.9
November	17	121	198	173.7	21.7	20.8	91.1	64.3	19.9
December	0	-	-	-	-	-	-	-	-
January	0	-	-	-	-	-	-	-	-
July	2	130	131	130.5	-	26.0	26.9	26.5	-
August	1	216	216	216.0	-	116.9	116.9	116.9	-

Table C1-266. (cont.)

		OCGS Screens							
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	17	101	233	139.9	62.4	7.3	156.8	52.0	50.6
October	90	89	237	139.8	35.3	2.6	164.0	36.9	32.4
November	17	127	199	176.6	20.8	19.4	103.6	63.9	23.5
December	0	-	-	-	-	-	-	-	-
January	0	-	-	-	-	-	-	-	-
July	4	113	146	129.8	19.9	9.9	39.1	23.0	14.4
August	28	103	195	128.8	21.9	8.2	91.9	23.7	16.6

		OCGS Condenser Discharge							
		Length				Weight			
Month	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
September	4	258	277	266.3	8.9	195.0	325.7	262.1	69.9
October	7	286	465	384.6	73.7	263.8	2150.0	1052.7	663.1
November	7	222	325	281.7	36.6	149.1	553.4	354.9	147.4
December	8	227	335	287.8	42.6	175.3	539.3	363.0	137.3
January	12	175	340	289.4	45.9	57.4	573.0	364.8	146.5
July	11	139	164	146.3	7.3	29.0	48.9	35.7	6.3
August	0	-	-	-	-	-	-	-	-

Table c1-267. Condition of young bluefish taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

		September							
		Length				Condition Factor			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	23	151	200	170.4	14.4	1.0	1.5	1.28	0.13
Oyster Creek	28	149	258	183.0	28.2	1.1	1.7	1.35	0.16
OCGS Screens	99	41	233	116.3	60.5	1.0	2.3	1.52	0.35
OCGS Condenser Discharge	8	138	286	245.0	47.6	1.1	1.8	1.41	0.23

		October							
		Length				Condition Factor			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	3	165	195	177.0	15.9	1.3	1.7	1.49	0.25
Oyster Creek	55	130	268	180.0	26.9	0.5	1.9	1.43	0.22
OCGS Screens	197	45	237	132.0	38.1	0.9	2.8	1.47	0.26
OCGS Condenser Discharge	3	274	297	285.7	11.5	1.2	1.5	1.42	0.17

		November							
		Length				Condition Factor			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	0	-	-	-	-	-	-	-	-
Oyster Creek	35	121	231	172.7	22.7	1.1	1.8	1.44	0.18
OCGS Screens	50	127	206	174.7	20.1	1.0	1.7	1.36	0.15
OCGS Condenser Discharge	10	216	304	267.2	30.7	1.4	1.8	1.57	0.10

		December							
		Length				Condition Factor			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	0	-	-	-	-	-	-	-	-
Oyster Creek	0	-	-	-	-	-	-	-	-
OCGS Screens	0	-	-	-	-	-	-	-	-
OCGS Condenser Discharge	10	220	294	249.8	28.6	1.4	1.8	1.50	0.18

Table C1-267. (cont.)

		January							
		Length				Condition Factor			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	0	-	-	-	-	-	-	-	-
Oyster Creek	0	-	-	-	-	-	-	-	-
OCGS Screens	0	-	-	-	-	-	-	-	-
OCGS Condenser Discharge	13	175	323	268.5	51.8	1.2	2.0	1.45	0.21

		June							
		Length				Condition Factor			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	26	50	76	63.2	7.0	1.6	2.4	2.04	0.23
Forked River	10	59	87	68.5	9.7	1.8	2.6	2.11	0.32
Oyster Creek	9	51	72	59.3	6.4	1.4	2.7	2.04	0.40
OCGS Screens	3	82	90	86.0	5.7	1.7	1.7	1.70	0.02
OCGS Condenser Discharge	0	-	-	-	-	-	-	-	-

		July							
		Length				Condition Factor			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	23	77	142	96.5	16.1	1.3	2.4	1.92	0.27
Forked River	15	88	144	118.7	22.7	1.3	2.3	1.80	0.31
Oyster Creek	19	94	163	124.3	21.1	1.4	2.2	1.76	0.26
OCGS Screens	67	68	178	94.2	17.7	1.1	2.1	1.61	0.21
OCGS Condenser Discharge	24	135	167	147.5	8.5	1.2	1.8	1.47	0.15

		August							
		Length				Condition Factor			
Location	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	9	90	165	115.7	21.3	1.3	2.2	1.65	0.33
Forked River	4	105	151	134.8	20.8	1.3	1.6	1.40	0.13
Oyster Creek	4	119	216	154.2	34.9	1.4	1.6	1.46	0.07
OCGS Screens	108	33	210	100.1	45.7	0.8	2.5	1.66	0.36
OCGS Condenser Discharge	1	197	197	197	0.0	1.5	1.5	1.50	0.00

Table C1-268. The number and percent of occurrence by location of bluefish from Barnegat Bay, New Jersey with abnormalities examined from September 1976 through August 1977.

	Creek Mouths	%	Forked River	%	Oyster Creek	%	OCGS Screens	%	OCGS Condenser Discharge	%
Disease and Parasitism:										
L. ovalis	2	3.4	13	23.6	30	20.5	66	12.8	24	19.0
Lernaeenicus spp.	-	-	1	1.8	2	1.4	4	0.8	-	-
Fin rot	-	-	-	-	-	-	2	0.4	-	-
Mechanical Damage:										
Dead at capture	-	-	-	-	-	-	1	0.2	-	-
Scales missing or abrasions	1	1.7	-	-	1	0.7	9	1.7	1	0.8
Scales and flesh missing	-	-	-	-	9	6.2	27	5.2	3	2.4
Fin damage	-	-	-	-	-	-	11	2.1	2	1.6
Eye damage	-	-	-	-	-	-	1	0.2	-	-
Scales missing and fin damage	1	1.7	2	3.6	2	1.4	3	0.6	-	-
Hemorrhage	-	-	-	-	-	-	1	0.2	-	-
Genetic Abnormalities:										
Pusheaded	-	-	-	-	-	-	2	0.4	-	-
Fin abnormality	-	-	-	-	-	-	-	-	1	0.8
Total with abnormalities	4	6.8	16	29.0	44	30.2	127	24.7	31	24.6
Normal	54	93.2	39	71.0	102	69.8	388	75.3	95	75.4

Table C1-259. Stomach contents of bluefish taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Taxon	Creek Mouths					
	Frequency[a]	Number[b]	% Frequency[c]	Volume Displacement (ml)	% Volume	Average Number Per Stomach
Anguilla rostrata	1	1	1.7	-	-	1.0
Anchoa sp.	1	1	1.7	0.1	0.7	1.0
Anchoa mitchilli	1	1	1.7	0.2	1.4	1.0
Menidia sp.	14	57	24.1	1.2	8.2	4.1
Apeltes quadracus	2	2	3.4	0.1	0.7	1.0
Pseudopleuronectes americanus	7	13	12.1	6.3	42.9	1.9
Class Polychaeta	1	1	1.7	0.1	0.7	1.0
Family Mysidae	1	2	1.7	-	-	2.0
Family Palaemonidae	1	1	1.7	0.1	0.7	1.0
Crangon septemspinosa	3	12	5.2	1.0	6.8	4.0
Fish fragments	13	-	22.4	5.5	37.4	-
Plant matter	1	-	1.7	0.1	0.7	-
Number examined 58				14.7		
Number with food 41						
Number empty 17						

Taxon	Oyster Creek					
	Frequency	Number	% Frequency	Volume Displacement (ml)	% Volume	Average Number Per Stomach
Brevoortia tyrannus	2	2	1.5	14.5	13.7	1.0
Anchoa mitchilli	10	11	7.4	6.9	6.5	1.1
Cyprinodon variegatus	2	6	1.5	5.2	4.9	3.0
Fundulus heteroclitus	4	9	3.0	5.9	5.6	2.3
Menidia sp.	17	43	12.6	10.8	10.2	2.5
Menidia menidia	4	5	3.0	15.2	14.4	1.3
Pomatomus saltatrix	1	1	0.7	-	-	1.0
Bairdiella chrysura	1	1	0.7	-	-	1.0
Pseudopleuronectes americanus	1	2	1.4	-	-	2.0
Tenaeus aztecus	1	1	0.7	0.1	0.1	1.0
Palaemonetes vulgaris	3	4	2.2	1.2	1.1	1.3
Palaemonetes sp.	1	7	0.7	-	-	7.0
Crangon septemspinosa	13	43	9.6	7.0	6.6	3.3
Callinectes sapidus	1	1	0.7	-	-	1.0
Fish fragments	58	-	43.0	39.1	36.9	-
Inorganic matter	2	1	0.7	-	-	0.5
Invertebrate fragments	1	-	-	-	-	-
Number examined 135				105.9		
Number with food 100						
Number empty 35						

Table C1-269. (cont.)

Taxon	OCGS Condenser Discharge					
	Frequency	Number	% Frequency	Volume Displacement (ml)	% Volume	Average Number Per Stomach
Brevoortia tyrannus	1	2	0.8	45.0	11.4	2.0
Anchoa sp.	1	1	0.8	1.8	0.5	1.0
Anchoa mitchilli	6	9	4.8	5.5	1.4	2.7
Rissola marginata	3	3	2.4	41.2	10.4	1.0
Menidia menidia	2	2	1.6	1.9	0.5	1.0
Syngnathus fuscus	1	1	0.8	4.0	1.0	1.0
Pomatomus saltatrix	1	1	0.8	86.5	21.8	1.0
Caranx hippos	1	1	0.8	40.0	10.1	1.0
Leiostomus xanthurus	2	2	1.6	32.0	8.1	1.0
Prionotus sp.	1	1	0.8	-	-	1.0
Family Myxidae	2	83	1.6	1.1	0.3	41.5
Palaemonetes vulgaris	3	3	-	-	-	1.0
Palaemonetes sp.	1	2	0.8	0.2	0.1	2.0
Crangon septemspinosa	6	16	4.8	5.5	1.4	2.7
Fish fragments	41	-	32.5	131.3	33.2	-
Number examined 126				396.0		
Number with food 60						
Number empty 66						

Taxon	Forked River					
	Frequency	Number	% Frequency	Volume Displacement (ml)	% Volume	Average Number Per Stomach
Anchoa sp.	1	2	1.8	0.3	1.3	2.0
Anchoa mitchilli	4	8	7.1	3.1	13.8	2.0
Menidia sp.	9	21	16.1	3.7	16.4	2.3
Menidia menidia	1	1	1.8	0.1	0.4	1.0
Pseudopleuronectes americanus	2	5	3.6	4.4	19.6	2.5
Class Polychaeta	1	1	1.8	0.1	0.4	1.0
Palaemonetes vulgaris	1	13	1.8	-	-	13.0
Crangon septemspinosa	1	2	1.8	0.3	1.3	2.0
Fish fragments	14	-	25.0	10.5	46.7	-
Number examined 56				22.5		
Number with food 32						
Number empty 24						

Table C1-269. (cont.)

Taxon	OCGS Screens					
	Frequency	Number	% Frequency	Volume Displacement (ml)	% Volume	Average Number Per Stomach
Conger oceanicus	1	1	-	-	-	1.0
Anchoa sp.	4	65	0.9	1.6	1.9	16.3
Anchoa mitchilli	29	94	6.0	29.1	34.6	3.2
Menidia sp.	16	21	3.3	3.8	4.5	1.3
Menidia menidia	1	2	0.2	1.1	1.3	2.0
Pomatomus saltatrix	1	1	-	-	-	1.0
Phylum Annelida	2	16	0.4	1.1	1.3	8.0
Class Polychaeta	8	52	1.7	5.1	6.1	6.5
Family Mysidae	1	50	0.2	0.1	0.1	50.0
Suborder Natantia	1	1	-	-	-	1.0
Crangon septemspinosa	11	15	2.3	1.4	1.7	1.4
Fish fragments	143	-	29.7	40.7	48.5	-
Plant matter	2	-	-	-	-	-
Inorganic matter	1	-	-	-	-	-
Organic matter	4	-	-	-	-	-
				84.0		

Number examined 481
Number with food 212
Number empty 269

[a]Number of stomachs containing the food item.
[b]Total number of each food item found in stomachs.
[c]Percentage of stomachs examined containing particular food item.

Table C1-270. Number of weakfish collected and examined in Barnegat Bay, New Jersey from September 1976 through August 1977.

	Creek Mouths, Forked River, and Oyster Creek				OCGS Traveling Screens[a]			
	Number Collected			Number Examined	Number Collected	Number Examined	Total Collected	Total Examined
	Trawl	Seine	Gill net					
September	108	4	2	107	673	149	787	256
October	29	1	7	23	4,782	215	4,789	238
November	8	-	3	8	374	73	382	79
December	-	-	-	-	-	-	-	-
January	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-
June	-	-	-	-	-	-	-	-
July	1	-	-	1	12	10	13	11
August	85	-	-	50	2,130	178	2,215	228
Total	228	5	12	187	7,941	625	8,186	812

[a] OCGS shutdown from 14 May through 11 July.

Table C1-271. Mean length and weight by age of weakfish of undetermined sex and of males and females larger than 180 mm taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

	Length														
	Males					Females					Undetermined				
Age	Number	Min	Max	Mean	Standard Deviation	Number	Min	Max	Mean	Standard Deviation	Number	Min	Max	Mean	Standard Deviation
0	30	181	202	189.1	16.0	36	186	221	192.2	26.2	727	19	180	102.7	49.7
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	389	411	390.0	-	1	-	-	416.0	-	-	-	-	-	-
4	3	477	516	495.6	23.4	3	500	522	508.7	11.7	-	-	-	-	-
5	2	508	524	516.0	-	3	494	560	530.3	33.6	-	-	-	-	-
6	1	-	-	548.0	-	3	509	562	532.0	27.2	-	-	-	-	-
7	-	-	-	-	-	1	-	-	621.0	-	-	-	-	-	-

	Weight														
	Males					Females					Undetermined				
Age	Number	Min	Max	Mean	Standard Deviation	Number	Min	Max	Mean	Standard Deviation	Number	Min	Max	Mean	Standard Deviation
0	30	54.7	92.9	76.2	18.2	36	51.4	122.0	88.3	28.2	727	0.1	63.7	17.1	13.4
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	512.0	757.6	634.7	-	1	-	-	795.3	-	-	-	-	-	-
4	3	1140.0	1510.0	1274.2	224.7	3	1160.0	1500.0	1321.7	170.6	-	-	-	-	-
5	2	1140.0	1695.0	1417.5	-	3	1300.0	1700.0	1550.0	217.9	-	-	-	-	-
6	1	-	-	1520.0	-	3	1510.0	1678.0	1598.7	84.4	-	-	-	-	-
7	-	-	-	-	-	1	-	-	3350.0	-	-	-	-	-	-

Table C1-272. Number and mean length of young weakfish examined from Barnegat Bay, New Jersey from September 1976 through August 1977.

	Creek Mouths		Forked River		Oyster Creek		OCGS		Total	
	Number	Mean Length	Number	Mean Length	Number	Mean Length	Number	Mean Length	Number	Mean Length
September	0	-	75	125.3	20	155.5	149	119.4	244	124.2
October	0	-	17	134.7	6	184.2	214	132.8	237	134.2
November	0	-	0	-	3	150.0	73	110.7	76	112.3
July	1	105.0	0	-	0	-	10	105.7	11	105.6
August	0	-	43	47.0	7	39.6	178	60.6	228	57.4

Table C1-273. The length-weight relationship for weakfish collected in Barnegat Bay, New Jersey from September through August 1977.

Males	Slope	3.1140
	Confidence Limits	0.077
	Intercept	-5.2978
	No. of Pairs	38
Females	Slope	3.1351
	Confidence Limits	0.055
	Intercept	-5.3514
	No. of Pairs	47
Pooled	Slope	3.1205
	Confidence Limits	0.027
	Intercept	-5.3337
	No. of Pairs	812

Table C1-274. Stomach contents of 492 weakfish taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

		Frequency[a]	Total Number[b]	% Frequency[c]	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments		133	-	55.0	-	161.9	55.1
Cynoscion regalis		2	2	0.8	1.0	49.0	16.7
Anchoa sp.		44	104	18.2	2.4	47.1	16.0
Menidia sp.		17	25	7.0	1.5	12.4	4.2
Invertebrate fragments		66	-	27.3	-	9.0	3.1
Family Mysidae		54	673	22.3	12.4	6.5	2.2
Palaemonetes sp.		16	19	6.6	1.2	3.4	1.2
Crangon septemspinosa		8	12	3.3	1.5	1.6	0.5
Organic debris		10	-	4.1	-	1.0	0.3
Order Amphipoda		8	24	3.3	3.0	0.9	0.3
Plant matter		5	-	2.1	-	0.6	0.2
Lernaeopinna sp.		3	3	1.2	1.0	0.3	0.1
Class Polychaeta		2	2	0.8	1.0	0.2	0.1
Number examined	492					293.9	
Number with food	242						
Number empty	250						

[a] Number of stomachs containing the food item.
[b] Total number of each food item found in stomachs.
[c] Percentage of stomachs with food containing particular food item.

Table C1-275. Stomach contents of 9 adult weakfish taken by gill net in the OCGS condenser discharge from October and November 1976.

		Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments		8	-	100.0	-	84.1	62.3
Cynoscion regalis		2	2	25.0	1.0	49.0	36.3
Anchoa sp.		2	2	25.0	1.0	1.8	1.3
Palaemonetes sp.		1	1	12.5	1.0	0.1	0.1
Number examined	9					135.0	
Number with food	8						
Number empty	1						

Table C1-276. Stomach contents of 29 weakfish taken in Oyster Creek, New Jersey from September through November 1976.

September		Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Menidia sp.		8	15	42.1	1.9	7.8	44.6
Fish fragments		11	-	57.9	-	6.1	34.9
Anchoa sp.		2	9	10.5	4.5	2.3	13.1
Family Mysidae		5	66	26.3	13.6	0.6	3.4
Invertebrate fragments		4	-	21.0	-	0.5	2.9
Order Amphipoda		1	1	5.3	1.0	0.1	0.6
Organic debris		1	-	5.3	-	0.1	0.6
Number examined	20					17.5	
Number with food	19						
Number empty	1						

October		Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments		6	-	100.0	-	9.5	84.1
Anchoa sp.		1	1	16.7	1.0	0.8	7.1
Family Mysidae		3	44	50.0	14.7	0.6	5.3
Invertebrate fragments		2	-	33.0	-	0.2	1.8
Order Amphipoda		2	2	33.0	1.0	0.2	1.8
Number examined	6					11.3	
Number with food	6						
Number empty	0						

Table C1-278. (cont.)

November	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Menidia sp.	1	1	50.0	1.0	0.3	42.9
Palaemonetes sp.	1	2	50.0	2.0	0.3	42.9
Lernaeenicus sp.	1	1	50.0	1.0	0.1	14.3
Number examined 3					0.7	
Number with food 2						
Number empty 1						

Total	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments	17	-	63.0	-	15.6	52.9
Menidia sp.	9	16	33.3	1.8	8.1	27.5
Anchoa sp.	3	10	11.1	3.3	3.1	10.5
Family Mysidae	8	112	29.6	27.6	1.2	4.1
Invertebrate fragments	6	-	22.2	-	0.7	2.4
Order Amphipoda	3	3	11.1	1.0	0.3	1.0
Palaemonetes sp.	1	2	3.7	2.0	0.3	1.0
Lernaeenicus sp.	1	1	3.7	1.0	0.1	0.3
Organic debris	1	-	3.7	-	0.1	0.3
Number examined 29					29.5	
Number with food 27						
Number empty 2						

Table C1-277. Stomach contents of 95 weakfish taken in Forked River, New Jersey from September through November 1976.

September	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments	36	-	56.3	-	20.6	42.0
Anchoa sp.	16	37	25.0	2.3	17.6	35.9
Family Mysidae	31	500	48.4	16.1	3.9	7.9
Invertebrate fragments	26	-	40.6	-	3.2	6.5
Menidia sp.	5	6	7.8	1.2	2.6	5.3
Crangon septemspinosa	2	3	3.1	1.5	0.7	1.4
Palaemonetes sp.	2	2	3.1	1.0	0.3	0.6
Lernaeenicus sp.	1	1	1.6	1.0	0.1	0.2
Organic debris	1	-	1.6	-	0.1	0.2
Number examined 77					49.1	
Number with food 64						
Number empty 13						

October	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments	11	-	84.6	-	15.0	60.7
Anchoa sp.	4	12	30.8	3.0	9.5	38.5
Invertebrate fragments	2	-	15.4	-	0.2	0.8
Number examined 17					24.7	
Number with food 13						
Number empty 4						

Table C1-277. (cont.)

November	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments	1	-	100.0	-	8.4	100.0
Number examined 1					8.4	
Number with food 1						
Number empty 0						

Total	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments	48	-	62.3	-	44.0	53.5
Anchoa sp.	20	49	26.0	2.5	27.1	33.0
Family Mysidae	31	500	40.3	16.1	3.9	4.7
Invertebrate fragments	28	-	36.7	-	3.4	4.1
Menidia sp.	5	6	6.5	1.2	2.6	3.2
Crangon septemspinosa	2	3	2.6	1.5	0.7	0.8
Palaemonetes sp.	2	2	2.6	1.0	0.3	0.4
Lernaeenicus sp.	1	1	1.3	1.0	0.1	0.1
Organic debris	1	-	1.3	-	0.1	0.1
Number examined 96					82.2	
Number with food 77						
Number empty 18						

Table CI-278. Stomach contents of 358 weakfish taken at the OCGS traveling screens from September 1976 through August 1977.

September	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Anchoa sp.	10	28	23.3	2.8	11.0	57.0
Fish fragments	16	-	37.2	-	4.0	20.7
Invertebrate fragments	10	-	23.2	-	2.0	10.4
Menidia sp.	3	3	7.0	1.0	1.7	8.8
Family Mysidae	2	6	4.7	3.0	0.2	1.0
Class Polychaeta	2	2	4.7	1.0	0.2	1.0
Plant matter	1	-	2.3	-	0.1	0.5
Organic debris	2	-	4.7	-	0.1	0.5
Number examined 133					19.3	
Number with food 43						
Number empty 90						

October	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments	36	-	67.9	-	12.8	62.8
Anchoa sp.	5	8	9.4	1.6	2.6	12.8
Invertebrate fragments	17	-	32.0	-	2.4	11.8
Palaemonetes sp.	6	7	11.3	1.0	1.1	5.4
Crangon septemspinosa	5	5	9.4	1.0	0.8	4.0
Family Mysidae	5	15	9.4	3.0	0.4	2.0
Plant matter	3	-	5.7	-	0.2	1.0
Lernaeenicus spp.	1	1	1.9	1.0	0.1	0.5
Number examined 165					20.4	
Number with food 53						
Number empty 112						

Table C1-278. (cont.)

November	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments	6	-	30.0	-	1.3	33.3
Palaemonetes sp.	4	4	20.0	1.0	1.0	25.6
Family Mysidae	5	35	25.0	7.0	0.5	12.8
Invertebrate fragments	4	-	20.0	-	0.5	12.8
Anchoa sp.	1	1	5.0	1.0	0.3	7.7
Organic debris	3	-	15.0	-	0.2	5.1
Plant matter	1	-	5.0	-	0.1	2.6
Number examined 42					3.9	
Number with food 20						
Number empty 22						

July	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Anchoa sp.	2	5	22.2	2.5	0.7	38.9
Palaemonetes sp.	2	2	22.2	1.0	0.4	22.2
Order Amphipoda	3	9	33.3	3.0	0.3	16.7
Family Mysidae	1	1	11.1	1.0	0.1	5.6
Invertebrate fragments	1	-	11.1	-	0.1	5.6
Fish fragments	1	-	11.1	-	0.1	5.6
Organic debris	1	-	11.1	-	0.1	5.6
Number examined 11					1.8	
Number with food 9						
Number empty 2						

Table C1-278. (cont.)

August	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Anchoa sp.	1	3	16.7	3.0	0.5	35.7
Order Amphipoda	2	12	33.3	6.0	0.3	21.4
Family Mysidae	2	9	33.3	4.5	0.2	14.3
Organic matter	2	-	33.3	-	0.2	14.3
Fish fragments	1	-	16.7	-	0.1	7.1
Invertebrate fragments	1	-	16.7	-	0.1	7.1
Number examined 10					1.4	
Number with food 6						
Number empty 4						

Total	Frequency	Total Number	% Frequency	Average Number per Stomach	Volume Displacement (ml)	% Volume
Fish fragments	60	-	46.5	-	18.2	38.8
Anchoa sp.	19	43	14.7	2.3	15.1	32.2
Invertebrate fragments	32	-	24.8	-	4.9	10.5
Palaemonetes sp.	12	13	9.3	1.1	2.5	5.3
Menidia sp.	3	3	2.3	1.0	1.7	3.6
Family Mysidae	15	66	11.6	4.4	1.4	3.0
Crangon septemspinosa	5	5	3.9	1.0	0.8	1.7
Order Amphipoda	5	21	3.9	4.2	0.6	1.3
Plant matter	5	-	3.9	-	0.6	1.3
Organic debris	8	-	6.2	-	0.8	1.7
Class Polychaeta	2	2	1.5	1.0	0.2	0.4
Leptocheirus spp.	1	1	0.8	1.0	0.1	0.2
Number examined 358						
Number with food 129						
Number empty 229						

Table C1-279. The number and percent by category of weakfish from Barnegat Bay, New Jersey with abnormalities examined from September 1976 through August 1977.

	Number	% of each category	% of all specimens examined
Disease or parasite only:			
Lernaeenicus sp.	4	14.8	0.5
Lironeca ovalis	11	40.7	1.4
Fin rot	12	44.5	1.5
	27	100.0	3.4
Mechanical damage only:			
Probably dead at capture	43	10.0	5.3
Scales missing	297	69.4	36.6
Scales and flesh missing	60	14.0	7.4
Fin damaged	16	3.7	2.0
Eye damaged	4	0.9	0.5
Hemmorrhage	7	1.6	0.9
Scales missing and fin damaged	1	0.4	0.1
	428	100.0	52.8
Developmental:			
Pugheaded	1	100.0	0.1
Normal:	356	-	43.8
Total:	812	-	100.0

Table C1-280. Length-frequency distribution by sex of northern kingfish taken in Barnegat Bay from September 1976 through August 1977.

Length (mm)	Sex Undetermined	Male	Female	Total	% Frequency
1-50	7	-	-	7	20.0
51-100	9	-	-	9	25.7
101-150	5	5	4	14	40.0
151-200	0	1	2	3	8.5
201-250	0	0	1	1	2.9
251-300	0	0	0	0	0.0
301-350	0	1	0	1	2.9

Table C1-281 . Number and mean length and weight of summer flounder taken by area in Barnegat Bay, New Jersey from September 1976 through August 1977.

		Males							
		Length				Weight			
Area	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	1	296	296	296.0	-	240.4	240.4	240.4	-
Forked River	8	122	328	196.6	78.7	17.0	348.0	107.9	121.0
Oyster Creek	7	164	303	203.3	52.2	35.1	281.5	97.9	89.0
OCGS Screens	195	160	382	247.6	48.4	33.2	491.5	158.8	105.6
OCGS Condenser Discharge	1	310	310	310.0	-	278.9	278.9	278.9	-

		Females							
		Length				Weight			
Area	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Creek Mouths	2	157	178	167.5	-	27.6	51.6	39.6	-
Forked River	4	153	352	219.8	90.3	35.4	415.4	142.3	182.9
Oyster Creek	8	143	330	222.1	71.4	30.9	384.0	140.1	126.5
OCGS Screens	256	115	425	273.1	64.6	27.6	858.0	228.6	186.3
OCGS Condenser Discharge	-	-	-	-	-	-	-	-	-

Table C1-282. The length-weight relationship of summer flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Males	Slope	3.1420
	95% Confidence Interval	0.147
	Intercept	-5.3767
	Number Examined	212
Females	Slope	3.0430
	95% Confidence Interval	0.189
	Intercept	-5.1365
	Number Examined	272
Pooled	Slope	3.0782
	95% Confidence Interval	0.115
	Intercept	-5.2231
	Number Examined	498

Table C1-283. Number and mean length and weight of summer flounder by age collected in Barnegat Bay, New Jersey from September 1976 through August 1977.

		Sex Undetermined							
		Length				Weight			
Age	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
0+	1	90	90	90.0	-	7.3	7.3	7.3	-
1+	7	110	198	143.0	32.8	12.6	57.2	27.3	16.4
2+	1	219	219	219.0	-	80.6	80.6	80.6	-
3+	0	-	-	-	-	-	-	-	-
4+	0	-	-	-	-	-	-	-	-

		Males							
		Length				Weight			
Age	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
0+	1	122	122	122.0	-	17.0	17.0	17.0	-
1+	33	125	225	182.8	24.3	17.4	101.1	57.8	21.8
2+	111	167	344	244.8	31.4	45.7	394.6	142.5	63.3
3+	26	248	382	322.7	35.1	143.3	491.5	334.1	96.7
4+	2	351	359	355.0	-	398.6	471.7	435.2	-

		Females							
		Length				Weight			
Age	Number	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
0+	0	-	-	-	-	-	-	-	-
1+	27	143	238	184.6	25.6	27.6	115.1	59.0	24.8
2+	116	165	343	252.7	35.8	45.8	408.5	159.5	75.8
3+	44	218	425	332.9	56.2	78.5	824.3	383.7	195.7
4+	17	340	425	393.5	24.8	377.1	858.0	631.2	146.0

Table C1-284. Mean length of summer flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977 as calculated from otolith measurements.

Males								
					Standard	Standard	95% Confidence Interval	
Age	Number	Min	Max	Mean	Deviation	Error	Low	High
1	160	64	154	101	16.6	1.3	99	104
2	126	128	247	182	27.6	2.5	177	186
3	28	183	294	257	23.8	4.5	247	266
4	2	296	297	297	-	-	-	-

Females								
					Standard	Standard	95% Confidence Interval	
Age	Number	Min	Max	Mean	Deviation	Error	Low	High
1	200	58	155	102	17.8	1.2	100	105
2	173	127	277	186	29.4	2.2	182	190
3	64	221	344	266	28.3	3.6	259	274
4	19	259	369	319	29.0	6.6	305	333

Table C1-285. Number of male and female summer flounder taken at the OCGS traveling screens from September 1976 through August 1977.

Month	Males	%	Females	%
September	56	46.2	65	53.8
October	68	48.9	71	51.1
November	7	25	21	75
December	3	60	2	40
January	0	-	0	-
February	0	-	0	-
March	0	-	0	-
April	9	25.7	26	74.3
May[a]	0	-	0	-
June[a]	0	-	0	-
July	11	45.8	13	54.2
August	46	54.8	38	45.2

[a] OCGS shutdown from 14 May through 12 July 1977.

Table C1-286. Mean condition factor of age 1+, 2+, and 3+ summer flounder collected at OCGS from September 1976 through August 1977.

			Length				Condition			
	Number	Age	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	83	1	125	225	182.8	24.3	7.7	12.2	9.7	1.08
Female	27	1	143	238	184.6	25.6	7.6	11.3	9.4	0.85

			Length				Condition			
	Number	Age	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	107	2	171	344	246.4	30.3	7.8	12.9	9.9	1.0
Female	113	2	183	343	254.4	34.4	7.2	12.8	9.9	1.03

			Length				Condition			
	Number	Age	Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Male	26	3	248	382	322.7	35.2	9.1	11.8	10.5	0.7
Female	44	3	218	425	332.9	56.7	8.2	12.9	10.3	1.1

Table C1-287. The number and percent by category of summer flounder from Barnegat Bay, New Jersey with abnormalities examined by area from September 1976 through August 1977.

	Abnormality	Type	Number	% Occurrence
Creek Mouths				
	Mechanical damage	Scaled/abrasions	1	33.3
Total			1	33.3
Forked River				
	Mechanical damage	Scaled/abrasions	1	7.1
Total			1	7.1
Oyster Creek				
	Mechanical damage	Scaled/abrasions	1	5.0
		Hemorrhage	1	5.0
Total			2	10.0
OCGS Screens				
	Parasites/diseases	Fin rot	1	0.2
	Mechanical damage	Dead at capture	1	0.2
		Scaled/abrasions	192	41.6
		Scaled/flesh missing	8	1.7
		Fin damaged	4	0.8
		Scaled/fin damaged	7	1.5
		Hemorrhage	13	2.8
	Genetic	Pugheaded	1	0.2
		Ambicolored	2	0.4
		Staining	7	1.5
Total			236	51.2

Table C1-288. Comparison of calculated and actual mean lengths of summer flounder taken in Barnegat Bay, N. J. in 1976-77 with those taken in Delaware Bay (Smith 1969), and Virginia (Eldridge 1962).

CALCULATED LENGTH AT TIME OF ANNULUS FORMATION

	MALES					
	I	II	III	IV	V	VI
Smith (1969)	114	256	345	408	449	-
Eldridge (1962)[a]	170	240	319	357	381	399
Barnegat Bay (calculated length)	191	182	257	297	-	-
Barnegat Bay (measured length)	182	245	323	355	-	-

	FEMALES					
	I	II	III	IV	V	VI
Smith (1969)	127	279	387	460	512	568
Eldridge (1962)	170	240	377	424	471	518
Barnegat Bay (calculated length)	192	186	266	319	-	-
Barnegat Bay (measured length)	185	253	333	394	-	-

[a] Values taken from Smith (1969). Eldridge reported estimated length at time of annulus formation.

Table C1-289. Number of winter flounder collected and examined by sex and area in Barnegat Bay, New Jersey from September 1976 through August 1977.

	OCGS Traveling Screens					Oyster Creek					Forked River				
	Number Collected	Number Examined			% Examined	Number Collected	Number Examined			% Examined	Number Collected	Number Examined			% Examined
		Undet.	Male	Female			Undet.	Male	Female			Undet.	Male	Female	
September	4	-	2	2	100.0	8	-	4	4	100.0	8	1	4	2	87.5
October	25	-	18	4	88.0	7	-	3	4	100.0	7	-	4	3	100.0
November	714	-	82	133	30.1	15	-	6	6	93.3	3	-	1	2	100.0
December	2,906	-	94	116	7.2	53	-	23	29	98.1	8	-	2	4	100.0
January	891	-	113	79	21.5	67	-	30	32	92.5	4	-	1	3	100.0
February	579	-	40	54	16.2	14	-	3	11	100.0	-	-	-	-	-
March	590	1	71	87	26.9	75	-	29	43	96.0	46	-	25	21	100.0
April	216	-	64	78	65.7	13	-	6	7	100.0	21	-	10	11	100.0
May	-	-	-	-	-	10	-	2	3	50.0	144	-	33	49	56.9
June	-	-	-	-	-	312	16	46	60	39.1	368	74	28	40	38.6
July	101	5	29	29	62.7	106	-	11	14	23.6	100	-	47	43	90.0
August	4	-	2	1	75.0	-	-	-	-	-	1	-	-	1	100.0
Total	6,030	6	515	583	18.3	680	16	163	215	57.9	708	75	155	179	57.8

	Creek Mouths					Total					
	Number Collected	Number Examined			% Examined	Number Collected	Number Examined			Sexes Combined	% Examined
		Undet.	Male	Female			Undet.	Male	Female		
September	-	-	-	-	-	20	1	10	8	19	95.0
October	1	-	1	-	100.0	40	-	28	11	37	92.5
November	1	-	1	-	100.0	733	-	90	143	233	31.8
December	2	-	-	1	50.0	2,967	-	119	150	269	9.1
January	-	-	-	-	-	962	-	144	114	258	26.8
February	-	-	-	-	-	593	-	43	65	108	18.2
March	5	-	3	2	100.0	716	1	128	153	282	39.4
April	4	-	1	3	100.0	254	-	81	99	180	70.9
May	9	-	3	6	100.0	163	-	38	58	96	58.9
June	107	37	31	30	91.6	787	127	105	130	382	46.0
July	178	38	23	24	47.8	485	43	110	110	263	54.2
August	-	-	-	-	-	5	-	2	2	4	80.0
Total	307	15	63	66	56.4	7,725	172	896	1,043	2,111	27.3

Table C1-290. Number and mean length by location of winter flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Month	Location	Males (length in mm)					Females (length in mm)				
		Number	Min	Max	Mean	Standard Deviation	Number	Min	Max	Mean	Standard Deviation
September-October	OCGS traveling screens	20	88	175	212.1	60.7	6	75	324	124.7	97.9
	Oyster Creek	7	71	116	89.1	16.6	8	98	114	101.8	7.9
	Forked River	8	85	232	116.9	48.9	5	83	126	103.0	29.4
	Creek mouths	1	-	-	87.0	-	-	-	-	-	-
November	OCGS traveling screens	82	88	280	131.5	37.0	133	75	300	117.9	34.1
	Oyster Creek	6	95	204	121.5	42.1	8	96	115	102.4	7.2
	Forked River	1	-	-	127.0	-	2	79	138	108.5	-
	Creek mouths	1	-	-	103.0	-	-	-	-	-	-
December	OCGS traveling screens	94	81	343	165.6	79.6	116	74	390	156.5	84.6
	Oyster Creek	23	61	306	129.3	52.9	29	79	323	137.6	70.8
	Forked River	2	122	132	127.0	-	4	102	126	114.8	10.8
	Creek mouths	-	-	-	-	-	1	-	-	86.0	-
January	OCGS traveling screens	113	73	308	136.3	61.6	79	78	331	141.8	76.5
	Oyster Creek	30	98	294	161.8	63.7	32	90	294	135.8	43.3
	Forked River	1	-	-	292.0	-	3	101	381	201.3	156.0
	Creek mouths	-	-	-	-	-	-	-	-	-	-
February	OCGS traveling screens	40	80	291	140.4	52.5	54	79	365	216.8	95.1
	Oyster Creek	3	117	196	161.0	40.3	11	95	277	170.0	44.7
	Forked River	-	-	-	-	-	-	-	-	-	-
	Creek mouths	-	-	-	-	-	-	-	-	-	-
March	OCGS traveling screens	71	90	329	157.7	59.8	87	83	392	186.2	88.5
	Oyster Creek	29	99	228	131.5	26.6	43	87	285	143.5	36.0
	Forked River	25	77	258	122.0	35.2	21	89	298	125.9	42.5
	Creek mouths	3	113	156	128.0	24.3	2	100	224	162.0	-
April	OCGS traveling screens	64	98	316	159.7	56.2	78	91	370	167.7	71.3
	Oyster Creek	6	127	183	155.0	20.4	7	94	198	147.9	30.4
	Forked River	10	128	303	200.9	65.3	11	105	188	139.5	27.8
	Creek mouths	1	-	-	156.0	-	3	141	199	162.0	32.1
May	OCGS traveling screens	-	-	-	-	-	-	-	-	-	-
	Oyster Creek	2	138	148	143.0	7.1	3	165	177	169.3	6.7
	Forked River	33	31	161	57.7	43.7	49	30	180	53.0	41.5
	Creek mouths	3	156	168	162.0	6.0	6	33	188	150.8	58.2
June	OCGS traveling screens	-	-	-	-	-	-	-	-	-	-
	Oyster Creek	46	42	180	82.3	19.8	60	40	174	55.1	24.6
	Forked River	28	40	166	58.1	30.1	40	37	186	58.9	32.3
	Creek mouths	31	43	81	58.1	8.6	30	41	157	61.2	20.8
July-August	OCGS traveling screens	31	51	185	75.5	29.9	30	50	214	78.5	33.4
	Oyster Creek	11	46	81	60.5	9.8	14	42	83	57.3	11.3
	Forked River	47	39	98	59.9	16.3	44	39	155	59.8	24.4
	Creek mouths	23	52	81	65.5	8.0	24	55	90	70.1	8.3

Table C1-291. Length frequency distribution by year class and sex of winter flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Length (mm)	Year class:	MALES 1977[a]	1976	1975	1974	1973	1972	1971	1970	FEMALES 1977[a]	1976	1975	1974	1973	1972	1971	1970	1968
31-40		28	-	-	-	-	-	-	-	44	-	-	-	-	-	-	-	-
41-50		65	-	-	-	-	-	-	-	81	-	-	-	-	-	-	-	-
51-60		76	-	-	-	-	-	-	-	76	-	-	-	-	-	-	-	-
61-70		37	1	-	-	-	-	-	-	42	1	-	-	-	-	-	-	-
71-80		19	7	-	-	-	-	-	-	19	11	-	-	-	-	-	-	-
81-90		11	31	-	-	-	-	-	-	12	32	-	-	-	-	-	-	-
91-100		3	65	-	-	-	-	-	-	1	99	-	-	-	-	-	-	-
101-110		-	82	-	-	-	-	-	-	-	94	-	-	-	-	-	-	-
111-120		-	85	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-
121-130		-	102	-	-	-	-	-	-	-	99	-	-	-	-	-	-	-
131-140		-	82	-	-	-	-	-	-	-	73	-	-	-	-	-	-	-
141-150		-	51	-	-	-	-	-	-	-	58	-	-	-	-	-	-	-
151-160		-	28	-	-	-	-	-	-	-	34	-	-	-	-	-	-	-
161-170		-	15	-	-	-	-	-	-	-	17	-	-	-	-	-	-	-
171-180		-	4	-	-	-	-	-	-	-	14	-	-	-	-	-	-	-
181-190		-	2	1	-	-	-	-	-	-	4	-	-	-	-	-	-	-
191-200		-	1	3	-	-	-	-	-	-	2	-	-	-	-	-	-	-
201-210		-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
211-220		-	-	5	-	-	-	-	-	-	1	2	-	-	-	-	-	-
221-230		-	-	4	3	-	-	-	-	-	-	2	-	-	-	-	-	-
231-240		-	-	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-
241-250		-	-	3	9	2	-	-	-	-	-	2	-	-	-	-	-	-
251-260		-	-	4	18	3	-	-	-	-	-	2	-	-	-	-	-	-
261-270		-	-	4	10	2	-	-	-	-	-	3	3	1	-	-	-	-
271-280		-	-	1	4	2	-	1	-	-	-	4	7	-	-	-	-	-
281-290		-	-	2	4	3	1	-	-	-	-	2	10	2	-	-	-	-
291-300		-	-	-	1	3	1	2	1	-	-	1	12	-	-	-	-	-
301-310		-	-	-	2	-	4	1	-	-	-	3	13	7	-	-	-	-
311-320		-	-	1	-	-	-	-	-	-	-	-	11	5	1	1	-	-
321-330		-	-	-	-	1	-	1	-	-	-	-	4	4	1	-	1	-
331-340		-	-	-	-	-	-	-	-	-	-	-	1	1	1	2	1	-
341-350		-	-	-	-	-	-	-	1	-	-	-	-	-	1	2	-	-
351-360		-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
361-370		-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
371-380		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
381-390		-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-
391-400		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Total		239	523	40	53	16	6	5	2	275	633	21	61	21	6	7	3	1
Mean length		55.7	120.2	235.5	258.1	275.1	300.7	299.2	320.0	53.8	121.0	265.3	298.7	311.4	344.3	344.1	343.7	392.0

Number of males	896
Number of females	1028
Grand Total	1914

[a] An additional 170 specimens of the 1977 year-class not sexed (mean length of 53.6 mm).

Table C1-292. Number and mean length by age of winter flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Month	Age	Males (length in mm) Number	Min	Max	Mean	Standard Deviation	Females (length in mm) Number	Min	Max	Mean	Standard Deviation
September-October	0	19	71	128	94.8	15.2	16	63	126	99.2	17.6
	1	3	210	231	217.3	11.8	-	-	-	-	-
	2	11	223	275	248.0	15.3	1	-	-	324.0	-
November	0	81	88	156	119.8	17.5	138	76	156	111.4	15.9
	1	5	192	226	210.4	13.2	1	-	-	217.0	-
	2	3	225	260	247.7	19.7	4	269	300	281.3	13.3
	3	1	-	-	243.0	-	-	-	-	-	-
December	0	85	61	150	112.1	17.6	120	74	154	112.2	18.1
	1	4	188	246	227.5	26.7	4	249	269	261.3	9.3
	2	14	222	306	263.6	21.4	14	266	327	303.2	17.5
	3	8	260	327	281.3	20.7	7	302	329	313.9	10.2
	4	3	282	303	295.3	11.6	2	326	350	338.0	-
	5	2	300	310	305.0	-	3	336	390	356.7	29.1
	6	2	297	343	320.0	-	-	-	-	-	-
January	0	114	73	163	111.9	19.3	95	78	163	111.5	17.7
	1	6	195	261	228.2	23.1	1	-	-	241.0	-
	2	15	238	307	263.1	18.5	9	277	316	294.7	13.8
	3	4	247	295	264.5	21.0	2	266	315	290.5	-
	4	-	-	-	-	-	1	-	-	317.0	-
	5	3	292	308	298.0	8.7	-	-	-	-	-
	6	-	-	-	-	-	1	-	-	381.0	-
February	0	36	80	170	121.4	19.2	35	79	178	129.9	24.0
	1	2	196	207	201.5	-	3	210	273	237.7	32.2
	2	4	248	291	265.0	19.1	14	270	312	296.9	10.7
	3	1	-	-	264.0	-	5	289	331	310.6	16.9
	4	-	-	-	-	-	1	-	-	339.0	-
	5	-	-	-	-	-	4	314	365	339.8	21.2
	6	-	-	-	-	-	1	-	-	320.0	-
March	1	108	77	166	124.7	19.5	120	83	188	128.2	22.3
	2	9	228	283	248.4	18.4	9	223	309	278.1	26.8
	3	6	230	264	252.0	11.6	17	273	335	301.6	17.8
	4	1	-	-	295.0	-	4	305	325	312.0	9.2
	5	2	278	329	303.5	-	1	-	-	344.0	-
	9	-	-	-	-	-	1	-	-	392.0	-
April	1	63	98	192	136.5	19.2	84	91	199	137.3	21.2
	2	11	211	315	256.4	28.8	3	273	301	284.0	14.9
	3	3	253	269	259.7	8.3	2	275	317	296.0	-
	4	1	-	-	291.0	-	3	286	359	319.7	36.8
	5	1	-	-	303.0	-	1	-	-	370.0	-
	7	-	-	-	-	-	1	-	-	330.0	-
May	0	27	31	70	37.8	7.6	44	30	66	38.0	8.2
	1	11	129	168	150.5	11.5	14	137	188	167.1	13.3
June	0	102	40	81	52.2	7.2	123	37	75	51.6	7.5
	1	3	161	180	169.0	9.8	7	147	186	162.9	13.0
July-August	0	110	39	98	63.3	13.1	108	39	93	62.8	13.9
	1	2	178	185	181.5	-	4	150	214	171.8	29.2

Table C1-293. Number and mean weight by age of winter flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Month	Age	Males (weight in g)					Females (weight in g)				
		Number	Min	Max	Mean	Standard Deviation	Number	Min	Max	Mean	Standard Deviation
September-October	0	19	4.7	20.2	9.1	4.1	16	2.5	19.9	10.1	5.3
	1	3	96.4	163.3	122.6	35.7	-	-	-	-	-
	2	11	72.9	247.6	181.7	51.5	1	-	-	369.3	-
November	0	70	7.3	43.2	20.7	8.7	118	3.7	47.2	16.2	7.9
	1	5	64.0	145.5	103.3	31.3	1	-	-	119.3	-
	2	3	120.1	261.6	191.1	70.8	4	181.0	358.5	269.8	76.9
	3	1	-	-	196.1	-	-	-	-	-	-
December	0	85	2.3	34.6	16.1	7.5	120	3.6	42.9	15.4	8.5
	1	4	69.2	174.0	142.9	49.4	4	203.5	262.8	239.6	26.0
	2	14	150.8	342.0	216.5	53.1	14	239.8	463.4	375.7	73.9
	3	8	165.4	326.4	282.3	47.5	7	404.0	462.4	429.9	24.9
	4	3	271.2	336.8	306.1	33.0	2	463.2	554.6	508.9	-
	5	2	328.0	332.4	330.2	-	3	540.0	813.2	631.4	167.5
	6	2	320.0	585.0	452.5	-	-	-	-	-	-
January	0	79	3.1	55.9	17.1	10.7	65	4.4	47.2	18.0	10.5
	1	6	81.6	299.5	139.7	55.6	1	-	-	179.6	-
	2	15	151.0	355.3	209.9	55.4	9	257.5	427.5	340.4	59.7
	3	4	161.2	273.3	208.2	47.0	2	347.0	397.8	372.4	-
	4	-	-	-	-	-	1	-	-	478.8	-
	5	3	303.1	389.9	342.5	43.9	-	-	-	-	-
	6	-	-	-	-	-	1	-	-	824.1	-
February	0	36	4.4	61.6	19.2	11.0	35	4.5	65.0	25.2	15.2
	1	2	82.7	106.7	94.7	-	3	115.2	239.1	161.2	67.8
	2	4	182.0	299.9	229.9	53.8	14	231.1	482.2	338.2	68.1
	3	1	-	-	205.8	-	5	345.7	495.1	395.1	63.6
	4	-	-	-	-	-	1	-	-	388.9	-
	5	-	-	-	-	-	4	379.3	725.0	546.6	143.4
	6	-	-	-	-	-	1	-	-	437.0	-
March	1	108	6.3	46.0	21.1	10.2	110	5.2	70.0	25.7	18.7
	2	9	103.1	228.7	165.1	43.9	9	121.2	397.4	264.3	89.4
	3	6	105.9	198.7	177.9	35.7	17	169.2	475.9	307.5	84.7
	4	1	-	-	269.0	-	4	317.2	358.9	344.2	19.1
	5	2	237.0	356.0	296.5	-	1	-	-	488.2	-
	9	-	-	-	-	-	1	-	-	672.0	-
April	1	63	9.1	79.0	30.1	15.0	84	10.2	121.8	33.2	19.4
	2	11	94.4	362.5	190.3	77.3	3	248.0	299.8	279.8	27.8
	3	3	134.8	215.2	187.9	46.0	2	250.3	302.9	276.6	-
	4	1	-	-	246.0	-	3	279.6	696.8	455.0	216.4
	5	1	-	-	343.0	-	1	-	-	532.4	-
	7	-	-	-	-	-	1	-	-	365.0	-
May	0	27	0.1	3.6	0.5	0.7	44	0.1	3.4	0.6	0.7
	1	11	26.3	68.0	46.5	12.4	14	33.3	105.7	67.0	18.3
June	0	102	0.3	5.4	1.3	0.7	133	0.2	4.9	1.3	0.7
	1	3	56.2	70.2	61.5	7.6	7	30.8	85.2	55.8	15.1
July-August	0	110	0.3	10.7	2.7	2.3	108	0.3	8.1	2.8	2.0
	1	2	50.9	84.9	67.9	-	4	42.0	113.5	64.8	33.3

Table C1-294. Measurements to otolith annuli (in mm) by sex of winter flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

	Sex	Number	Mean	Standard Deviation	Coefficient of Variation
Annulus 1	male	151	0.90	0.08	9.4%
	female	156	0.92	0.10	11.4%
		female = male (t_{305} = 1.93, NS)			
Annulus 2	male	104	1.19	0.10	8.5%
	female	111	1.24	0.12	9.4%
		female > male (t_{213} = 3.31, $P \leq 0.01$)			
Annulus 3	male	37	1.27	0.10	7.6%
	female	57	1.39	0.13	9.2%
		female > male (t_{92} = 4.77, $p \leq 0.01$)			
Annulus 4	male	14	1.34	0.07	5.5%
	female	24	1.48	0.12	8.3%
		female > male (t_{36} = 3.54, $p \leq 0.01$)			
Annulus 5	male	10	1.44	0.09	6.5%
	female	13	1.58	0.14	8.8%
		female > male (t_{21} = 2.75, $p \leq 0.05$)			

Table C1-295. Mean lengths of winter flounder taken in Barnegat Bay, N. J. from September 1976 through August 1977 as calculated from otolith measurements.

Age	Number	Calculated Lengths Min.	Max.	Mean	Standard Deviation	Standard Error	95% Confidence Interval
Males							
1	150	99	205	152	23.5	1.9	149-156
2	104	166	281	225	23.2	2.3	220-229
3	37	207	300	247	19.8	3.3	240-253
4	14	240	290	267	17.1	4.6	258-277
5	10	263	315	287	15.7	5.0	276-299
Females							
1	156	58	229	155	30.6	2.5	150-160
2	111	139	297	243	29.2	2.8	238-249
3	57	197	335	281	29.4	3.9	273-289
4	24	234	359	305	29.3	6.0	293-318
5	13	277	376	328	29.2	8.1	311-346
6	4	306	356	333	24.8	12.4	293-372

Table C1-296. The length-weight[a] relationship of winter flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Males	Slope	3.1592
	95% Confidence Interval	0.020
	Intercept	-5.3390
	95% Confidence Interval	0.041
	Correlation Coefficient	0.996
	Number Examined	837
Females	Slope	3.2012
	95% Confidence Interval	0.019
	Intercept	-5.4155
	95% Confidence Interval	0.040
	Correlation Coefficient	0.995
	Number Examined	981

[a] Total weight minus gonad weight used in calculations.

Table C1-297. Number of winter flounder collected and examined from the traveling screens at OCGS from November through May in 1975-76 and 1976-77.

1975-76	Number Collected	Number Examined			% Examined	% Aged		1975 age class				Older age classes			
								Males		Females		Males		Females	
		Males	Females	Total		Males	Females	n	%	n	%	n	%	n	%
November	58	51	7	58	100.0	27.4	57.1	0	-	0	-	51	100.0	7	100.0
December	156	95	51	146	93.6	52.6	60.8	3	3.1	1	2.0	92	96.9	50	98.0
January[a]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	83	67	16	83	100.0	31.3	62.5	11	16.4	1	6.3	56	83.6	15	93.7
April-May	58	34	18	52	89.7	61.8	83.3	2	5.9	-	32	94.1		18	100.0

1976-77	Number Collected	Number Examined			% Examined	% Aged		1976 age class				Older age classes			
								Males		Females		Males		Females	
		Males	Females	Total		Males	Females	n	%	n	%	n	%	n	%
November	714	82	133	215	30.1	100.0	100.0	74	90.0	128	94.0	8	10.0	5	6.0
December	2096	94	216	210	7.2	98.9	100.0	63	67.0	90	77.6	31	33.0	26	22.4
January	891	113	79	192	21.5	100.0	97.5	92	81.4	64	81.0	21	18.6	15	19.0
February	579	40	54	94	16.2	100.0	98.1	34	85.0	26	48.1	6	15.0	28	51.9
March	590	71	87	158	26.9	98.6	98.9	54	76.1	58	66.7	17	23.9	29	33.3
April-May[a]	216	64	78	142	65.7	96.9	93.6	50	78.1	63	80.8	14	21.9	15	19.2

[a] OCGS not in operation from 24 December 1975 through 7 March 1976 and from 15 through 31 May 1977.

Table C1-298. Number and mean length by age of winter flounder taken on the traveling screens at OCGS from November through May in 1975-76 and 1976-77.

		MALES 1975-76						MALES 1976-77					
Month	Age	Year class	No.	Min.	Max.	Mean	Standard Deviation	Year class	No.	Min.	Max.	Mean	Standard Deviation
November	0	1975	0	-	-	-	-	1976	74	88	156	120.9	17.5
	1	1974	11	187	239	209.0	16.6	1975	4	192	226	212.0	14.7
	2	1973	3	257	267	261.3	5.1	1974	3	225	260	247.7	19.7
	3	1972	0	-	-	-	-	1973	1	-	-	243.0	-
December	0	1975	3	127	158	142.3	15.5	1976	63	81	150	111.8	17.3
	1	1974	30	188	264	222.1	17.3	1975	2	236	240	238.0	-
	2	1973	14	189	310	252.9	37.2	1974	13	222	287	260.3	18.4
	3	1972	2	263	290	276.5	-	1973	8	260	327	281.3	20.7
	4	1971	1	-	-	282.0	-	1972	3	282	303	295.3	11.6
	5	1970	0	-	-	-	-	1971	2	300	310	305.0	-
	6	1969	0	-	-	-	-	1970	2	297	343	320.0	-
January[a]	0	1975	0	-	-	-	-	1976	92	73	163	108.6	18.2
	1	1974	0	-	-	-	-	1975	5	195	261	222.6	25.4
	2	1973	0	-	-	-	-	1974	12	243	307	265.4	18.6
	3	1972	0	-	-	-	-	1973	3	247	295	266.0	25.5
	4	1971	0	-	-	-	-	1972	0	-	-	-	-
	5	1970	0	-	-	-	-	1971	1	-	-	308.0	-
February	0	1975	0	-	-	-	-	1976	34	80	161	120.1	17.8
	1	1974	0	-	-	-	-	1975	1	-	-	207.0	-
	2	1973	0	-	-	-	-	1974	4	248	291	265.0	19.1
	3	1972	0	-	-	-	-	1973	1	-	-	264.0	-
March	1	1975	6	118	186	144.3	24.5	1976	54	90	166	126.5	17.9
	2	1974	8	182	240	219.6	19.4	1975	7	230	283	252.0	19.0
	3	1973	6	215	315	267.2	36.8	1974	6	230	264	252.0	11.6
	4	1972	1	-	-	275.0	-	1973	1	-	-	295.0	-
	5	1971	0	-	-	-	-	1972	2	278	329	303.5	-
April-May[a]	1	1975	2	137	172	154.5	-	1976	50	98	171	131.9	16.4
	2	1974	14	181	270	224.4	25.4	1975	9	211	315	255.7	32.0
	3	1973	4	236	270	255.3	16.5	1974	2	253	257	255.0	-
	4	1972	0	-	-	-	-	1973	1	-	-	291.0	-
	5	1971	0	-	-	-	-	1972	0	-	-	-	-
	6	1970	1	-	-	275.0	-	1971	0	-	-	-	-

[a] OCGS not in operation from 24 December 1975 through 7 March 1976 and from 15 through 31 May 1977.

Table C1-298. (cont.)

		FEMALES 1975-76						FEMALES 1976-77					
Month	Age	Year class	No.	Min.	Max.	Mean	Standard Deviation	Year class	No.	Min.	Max.	Mean	Standard Deviation
November	0	1975	0	-	-	-	-	1976	128	76	156	112.1	15.9
	1	1974	1	-	-	232.0	-	1975	1	-	-	217.0	-
	2	1973	3	240	341	280.3	53.5	1974	4	269	300	281.3	13.3
December	0	1975	1	-	-	143.0	-	1976	90	74	154	112.6	17.1
	1	1974	13	222	285	250.0	21.4	1975	4	249	269	261.3	9.3
	2	1973	12	242	322	284.4	20.5	1974	11	266	327	305.2	17.0
	3	1972	3	284	305	292.7	11.0	1973	6	302	329	312.3	10.2
	4	1971	2	312	338	325.0	-	1972	2	326	350	338.0	-
	5	1970	0	-	-	-	-	1971	3	336	390	356.7	29.1
January[a]	0	1975	0	-	-	-	-	1976	64	78	141	106.0	15.6
	1	1974	0	-	-	-	-	1975	1	-	-	241.0	-
	2	1973	0	-	-	-	-	1974	9	277	316	294.7	13.8
	3	1972	0	-	-	-	-	1973	2	266	315	290.5	-
	4	1971	0	-	-	-	-	1972	1	-	-	317.0	-
February	0	1975	0	-	-	-	-	1976	26	79	157	121.7	18.1
	1	1974	0	-	-	-	-	1975	2	230	273	251.5	-
	2	1973	0	-	-	-	-	1974	14	270	312	296.9	10.7
	3	1972	0	-	-	-	-	1973	5	289	331	310.6	16.9
	4	1971	0	-	-	-	-	1972	1	-	-	339.0	-
	5	1970	0	-	-	-	-	1971	4	314	365	339.8	21.2
	6	1969	0	-	-	-	-	1970	1	-	-	320.0	-
March	1	1975	0	-	-	-	-	1976	58	83	174	125.9	21.1
	2	1974	6	232	325	261.3	34.4	1975	6	270	309	290.5	15.1
	3	1973	3	253	266	259.0	6.6	1974	16	273	335	301.9	18.3
	4	1972	1	-	-	281.0	-	1973	4	305	325	312.0	9.2
	5	1971	0	-	-	-	-	1972	1	-	-	344.0	-
	9	1967	0	-	-	-	-	1968	1	-	-	392.0	-
April-May[a]	1	1975	0	-	-	-	-	1976	63	91	170	134.5	17.5
	2	1974	13	227	295	270.8	20.5	1975	3	273	301	284.0	14.9
	3	1973	2	251	277	264.0	-	1974	2	275	317	296.0	-
	4	1972	0	-	-	-	-	1973	3	286	359	319.7	36.8
	5	1971	0	-	-	-	-	1972	1	-	-	370.0	-
	6	1970	0	-	-	-	-	1971	0	-	-	-	-
	7	1969	0	-	-	-	-	1970	1	-	-	330.0	-

[a] OCGS not in operation from 24 December 1975 through 7 March 1976 and from 15 through 31 May 1977.

Table C1-299. Comparison of the condition of winter flounder taken during the day and night from the OCGS traveling screens from November 1976 through April 1977.

	Day			Night			
Size Range (mm)	Number	Mean	Standard Deviation	Number	Mean	Standard Deviation	Results of t-test[a]
70-109	40	4.38	0.81	182	4.19	0.81	$t_{220} = 1.32$ NS
110-139	61	4.59	0.61	293	4.47	0.71	$t_{352} = 1.21$ NS
140-169	38	4.72	0.79	76	4.71	0.66	$t_{112} = 0.01$ NS
210-289	59	4.77	0.65	52	4.64	0.82	$t_{109} = 0.97$ NS
290-349	47	4.42	0.77	46	4.15	0.57	$t_{91} = 1.87$ NS

[a] NS = not significant

Table C1-300. Summary of results of one-way ANOVA or t-test and SNK multiple range test applied to condition data for winter flounder examined from December 1976 through August 1977.

Date	Size Range (mm)	Results of ANOVA or t-test[a]		Results of SNK multiple range test[b]			
December	60-159	$t_{196} = 1.42$ NS	sta	Oyster Creek	OCGS screens		
			k	4.45	4.28		
			n	45	153		
January	90-159	$t_{176} = 5.42$ **	sta	Oyster Creek	OCGS screens		
			k	5.09	4.50		
			n	51	127		
March - April	70-189	$F_{2,232} = 4.11$ *	sta	OCGS screens	Forked River/ Creek mouths	Oyster Creek	
			k	4.71	4.63	4.42	
			n	203	51	81	
June	30- 99	$F_{2,224} = 0.78$ NS	sta	Creek mouths	Oyster Creek	Forked River	
			k	4.34	4.20	4.19	
			n	61	102	64	
July - August	30- 99	$F_{2,205} = 5.73$ **	sta	OCGS screens	Oyster Creek	Creek mouths	Forked River
			k	5.13	4.62	4.56	4.54
			n	48	25	47	89

[a] NS = not significant
* = achieved significance at $P \leq 0.05$
** = achieved significance at $P \leq 0.01$
[b] station groups, mean condition (k), and number of observations (n) given. Means underlined are not significantly different.

Table C1-301. Gonad condition by age of winter flounder taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

		MALES										FEMALES									
		Immature		Mature		Enlarged		Spent		Undetermined		Immature		Mature		Enlarged		Partially Spent		Spent	
Month	Age	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
September–October	0	17	89	-	-	2	11	-	-	-	-	16	100	-	-	-	-	-	-	-	-
	1	-	-	3	75	1	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1	10	3	30	6	60	-	-	-	-	-	-	1	100	-	-	-	-	-	-
November	0	31	38	-	-	50	62	-	-	-	-	138	100	-	-	-	-	-	-	-	-
	1	-	-	1	20	4	80	-	-	-	-	-	-	-	-	1	100	-	-	-	-
	2	-	-	-	-	3	100	-	-	-	-	-	-	-	-	4	100	-	-	-	-
	3	-	-	-	-	1	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December	0	50	59	-	-	35	41	-	-	-	-	120	100	-	-	-	-	-	-	-	-
	1	-	-	-	-	4	100	-	-	-	-	-	-	-	-	4	100	-	-	-	-
	2	-	-	-	-	13	93	1	7	-	-	-	-	-	-	14	100	-	-	-	-
	3	-	-	-	-	8	100	-	-	-	-	-	-	-	-	7	100	-	-	-	-
	4	-	-	-	-	3	100	-	-	-	-	-	-	-	-	2	100	-	-	-	-
	5	-	-	-	-	2	100	-	-	-	-	-	-	-	-	3	100	-	-	-	-
	6	-	-	-	-	2	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
January	0	46	41	-	-	67	59	-	-	-	-	95	100	-	-	-	-	-	-	-	-
	1	-	-	-	-	8	100	-	-	-	-	-	-	-	-	1	100	-	-	-	-
	2	-	-	-	-	15	100	-	-	-	-	-	-	-	-	9	100	-	-	-	-
	3	-	-	-	-	4	100	-	-	-	-	-	-	-	-	2	100	-	-	-	-
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100	-	-	-	-
	5	-	-	-	-	3	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100	-	-	-	-
February	0	12	33	2	6	20	56	2	6	-	-	36	100	-	-	-	-	-	-	-	-
	1	-	-	1	50	1	50	-	-	-	-	1	33	-	-	2	67	-	-	-	-
	2	-	-	-	-	4	100	-	-	-	-	-	-	1	7	11	79	1	7	1	7
	3	-	-	-	-	1	100	-	-	-	-	-	-	-	-	5	100	-	-	-	-
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	100	-	-	-	-
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100	-	-	-	-
March	1	-	-	-	-	4	4	13	12	91	84	120	100	-	-	-	-	-	-	-	-
	2	-	-	4	44	1	11	4	44	-	-	-	-	3	33	2	22	-	-	4	44
	3	-	-	3	50	-	-	2	33	1	17	-	-	6	35	-	-	-	-	11	65
	4	-	-	-	-	-	-	1	100	-	-	-	-	2	50	1	25	1	25	-	-
	5	-	-	1	50	1	50	-	-	-	-	-	-	-	-	-	-	-	-	1	100
	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100
April	1	3	5	1	2	-	-	1	2	58	92	84	100	-	-	-	-	-	-	-	-
	2	-	-	11	100	-	-	-	-	-	-	-	-	3	100	-	-	-	-	-	-
	3	-	-	3	100	-	-	-	-	-	-	-	-	2	100	-	-	-	-	-	-
	4	-	-	1	100	-	-	-	-	-	-	-	-	2	67	1	33	-	-	-	-
	5	-	-	1	100	-	-	-	-	-	-	-	-	1	100	-	-	-	-	-	-
	7	-	-	-	-	-	-	-	-	-	-	-	-	1	100	-	-	-	-	-	-
May	0	27	100	-	-	-	-	-	-	-	-	44	100	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	1	9	10	91	14	100	-	-	-	-	-	-	-	-
June–August	0	212	100	-	-	-	-	-	-	-	-	231	100	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	5	100	11	100	-	-	-	-	-	-	-	-

Table C1-302 . The number and percent by category of winter flounder from Barnegat Bay, New Jersey with abnormalities examined by area from September 1976 through August 1977.

	No. Examined	Parasites/Diseases: Nosema stephani		Fin rot		Lymphocystis Disease		Leech (Piscicolidae)		Leech attachment scar		Mechanical: Dead at capture		Scaled or abrasions		Scales and flesh missing		Fin(s) damaged		Eye(s) damaged		Condenser tube markings		Fin and scale damage		Hemmorrhage		Head damaged	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
OCGS																													
Sept-Oct	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3.8	4	15.4	-	-	-	-	-	-	-	-	-	-
Nov	215	2	1.0	4	1.9	-	-	1	0.5	-	-	-	-	7	3.3	3	1.4	21	9.8	2	0.9	-	-	1	0.5	1	0.5	-	-
Dec	210	-	-	3	1.4	3	1.4	-	-	-	-	-	-	6	2.9	5	2.4	3	1.4	1	0.5	15	7.1	-	-	-	-	-	-
Jan	192	1	0.5	2	1.0	3	1.6	-	-	-	-	-	-	5	2.6	1	0.5	4	2.1	-	-	-	-	1	0.5	-	-	-	-
Feb	94	-	-	4	4.3	3	3.2	-	-	-	-	3	3.2	4	4.3	1	1.1	6	6.4	-	-	-	-	-	-	-	-	-	-
Mar	159	-	-	-	-	1	0.6	-	-	-	-	1	0.6	14	8.8	5	3.1	6	3.8	-	-	-	-	3	1.9	-	-	-	-
Apr	142	-	-	3	2.1	-	-	-	-	-	-	-	-	10	7.0	1	0.7	3	2.1	1	0.7	-	-	1	0.7	4	2.8	2	1.4
May	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-Aug	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4.5	1	1.5	-	-	-	-	-	-	1	1.5
Total	1104	3	0.3	16	1.4	10	0.9	1	0.1	-	-	4	0.4	46	4.2	17	1.5	52	4.7	5	0.5	15	1.4	6	0.5	5	0.5	3	0.3
Oyster Creek																													
Sept-Oct	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1.9	-	-	1	1.9	-	-	-	-	-	-
Jan	62	-	-	2	3.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4.8	-	-	-	-	-	-
Feb	14	-	-	-	-	-	-	-	-	-	-	-	-	1	7.1	-	-	1	7.1	-	-	-	-	-	-	-	-	-	-
Mar	73	-	-	-	-	-	-	-	-	-	-	-	-	1	1.4	-	-	1	1.4	-	-	-	-	-	-	-	-	-	-
Apr	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun	122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-Aug	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	394	-	-	2	0.5	-	-	-	-	-	-	-	-	2	0.5	-	-	3	0.8	-	-	4	1.0	-	-	-	-	-	-
Forked River																													
Sept-Oct	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2.2	-	-	-	-	-	-	-	-	-	-
Apr	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	9.5	-	-	-	-	-	-	-	-	-	-
May	82	1	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun	142	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-Aug	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	409	1	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.7	-	-	-	-	-	-	-	-	-	-
Creek Mouths																													
Sept-Oct	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nov	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dec	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar	5	1	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apr	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-Aug	85	-	-	-	-	-	-	-	-	7	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	204	1	0.5	-	-	-	-	-	-	7	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total	2111	5	0.2	19	0.9	10	0.5	1	<0.1	7	0.3	4	0.2	48	2.3	17	0.8	58	2.7	5	0.2	19	0.9	6	0.3	5	0.2	3	0.1

Table C1-302 (cont.)

	No. Examined	Genetic/Development: Fin abnormality		Ambicolored		Reversed		Staining		Jaw deformed		Miscellaneous: Healed wound or scar	
		n	%	n	%	n	%	n	%	n	%	n	%
OCGS													
Sept-Oct	26	-	-	-	-	-	-	-	-	1	3.8	-	-
Nov	215	1	0.5	-	-	-	-	11	5.1	-	-	-	-
Dec	210	-	-	-	-	1	0.5	13	6.2	-	-	1	0.5
Jan	198	1	0.5	-	-	1	0.5	4	2.1	-	-	1	0.5
Feb	94	-	-	-	-	1	1.1	6	6.4	-	-	3	3.2
Mar	139	-	-	1	0.6	-	-	2	1.3	-	-	-	-
Apr	142	-	-	-	-	-	-	2	1.4	-	-	1	0.7
May	0	-	-	-	-	-	-	-	-	-	-	-	-
Jun	0	-	-	-	-	-	-	-	-	-	-	-	-
Jul-Aug	88	-	-	-	-	-	-	3	4.5	-	-	-	-
Total	1104	2	0.2	1	0.1	3	0.3	41	3.7	1	0.1	6	0.5
Oyster Creek													
Sept-Oct	16	-	-	-	-	-	-	-	-	-	-	-	-
Nov	14	-	-	-	-	-	-	4	28.6	-	-	-	-
Dec	52	-	-	-	-	-	-	1	1.9	-	-	1	1.9
Jan	62	-	-	-	-	-	-	1	1.6	-	-	-	-
Feb	14	-	-	-	-	-	-	-	-	-	-	-	-
Mar	72	-	-	-	-	-	-	-	-	-	-	-	-
Apr	13	-	-	-	-	-	-	-	-	-	-	-	-
May	5	-	-	-	-	-	-	-	-	-	-	-	-
Jun	122	-	-	-	-	-	-	-	-	-	-	-	-
Jul-Aug	25	-	-	1	4.0	-	-	2	8.0	-	-	-	-
Total	394	-	-	1	0.3	-	-	8	2.0	-	-	1	0.3
Forked River													
Sept-Oct	14	-	-	-	-	-	-	-	-	-	-	-	-
Nov	3	-	-	-	-	-	-	-	-	-	-	-	-
Dec	6	-	-	-	-	-	-	-	-	-	-	-	-
Jan	4	-	-	-	-	-	-	-	-	-	-	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-	-	-
Mar	46	-	-	-	-	-	-	-	-	-	-	-	-
Apr	21	-	-	-	-	-	-	1	4.8	-	-	-	-
May	82	-	-	-	-	-	-	2	2.4	-	-	-	-
Jun	142	-	-	-	-	-	-	-	-	-	-	-	-
Jul-Aug	91	-	-	-	-	-	-	-	-	-	-	-	-
Total	409	-	-	-	-	-	-	3	0.7	-	-	-	-
Creek Mouths													
Sept-Oct	1	-	-	-	-	-	-	-	-	-	-	-	-
Nov	1	-	-	-	-	-	-	-	-	-	-	-	-
Dec	1	-	-	-	-	-	-	-	-	-	-	-	-
Jan	0	-	-	-	-	-	-	-	-	-	-	-	-
Feb	0	-	-	-	-	-	-	-	-	-	-	-	-
Mar	5	-	-	-	-	-	-	-	-	-	-	-	-
Apr	4	-	-	-	-	-	-	-	-	-	-	1	20.0
May	9	-	-	-	-	-	-	-	-	-	-	1	25.0
Jun	98	-	-	-	-	-	-	-	-	-	-	-	-
Jul-Aug	85	-	-	-	-	-	-	1	1.2	-	-	-	-
Total	204	-	-	-	-	-	-	1	0.5	-	-	2	1.0
Grand Total	2111	2	0.1	2	0.1	3	0.1	53	2.5	1	< 0.1	9	0.4

Table C1-303. Number of northern puffer taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

	OCGS[a] Traveling Screens	Oyster Creek	Forked River
September	179	1	1
October	1044	-	-
November	28	-	-
December	-	-	-
January	-	-	-
February	-	-	-
March	-	-	-
April	5	-	-
May	4	-	-
June	-	1	1
July	100	2	1
August	225	1	5
Total	1585	5	8

[a] Estimated number (Table).

Table C1-304. Number and mean length of northern puffer taken at the OCGS traveling screens from September 1976 through August 1977.

	UNDETERMINED		MALE						FEMALE			
			Immature		Mature		Enlarged		Immature		Mature	
	Number	Mean Length	Number	Mean Length	Number	Mean Length	Number	Mean Length	Number	Mean Length	Number	Mean Length
September	2	66	22	97	13	193	-	-	13	97	20	189
October	4	49	47	109	46	198	-	-	66	107	24	208
November	-	-	1	90	1	165	-	-	1	117	-	-
December	-	-	-	-	-	-	-	-	-	-	-	-
January	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	1	183	-	-	-	-
May	-	-	-	-	-	-	1	177	-	-	-	-
June	24[a]	22[a]	-	-	-	-	2	110	-	-	-	-
July	12	60	15	74	1	136	-	-	12	75	-	-
August	11	60	26	90	2	180	-	-	21	96	1	115
TOTAL	29	59	111	97	63	195	4	142	113	100	45	197

[a] taken in seven 5-min hauls from the east side of Barnegat Bay (not included in total)

Table C1-305 . The length-weight relationship of northern puffer taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

MALES	slope	3.1901
	95% confidence interval	0.069
	intercept	-5.0325
	number examined	179
FEMALES	slope	3.1105
	95% confidence interval	0.072
	intercept	-4.8615
	number examined	161
POOLED	slope	3.1341
	95% confidence interval	0.044
	intercept	-4.9135
	number examined	371

Table C1-306. Number and mean calculated length of northern puffer taken in Barnegat Bay, N. J. from September 1976 through August 1977 and in Chesapeake Bay from November 1969 through November 1970 (Laroche and Davis 1973).

	BARNEGAT BAY				CHESAPEAKE BAY			
	Male		Female		Male		Female	
Age	Number	Mean Length	Number	Mean Length	Number	Mean Length	Number	Mean Length
1	56	149	35	158	307	131	455	147
2	9	178	9	186	117	182	140	204
3	-	-	-	-	29	209	41	237
4	-	-	-	-	7	227	9	259

Table C1-307 . Number and mean length of northern puffer taken in Barnegat Bay, N. J. from September 1976 through August 1977 and in Chesapeake Bay from November 1969 through November 1970 (Laroche and Davis 1973).

	BARNEGAT BAY				CHESAPEAKE BAY			
	Male		Female		Male		Female	
Age	Number	Mean Length	Number	Mean Length	Number	Mean Length	Number	Mean Length
1+	49	194	26	213	190	181	315	200
	58	196[a]	-	-	278	188[a]	-	-
2+	9	209	9	231	88	204	99	235
3+	-	-	-	-	22	224	32	256
4+	-	-	-	-	7	236	9	274

[a] Weighted mean length of 1+ and 2+ males.

Table C1-308. Number of sand shrimp taken by area in Barnegat Bay, New Jersey from September 1976 through August 1977.

	Creek Mouths	Forked River	Oyster Creek	OCGS
September	-	26	-	21
October	116	65	7	1,295
November	49	52	147	97,958
December	5	514	3721	256,280
January	-	-	86	51,542
February	-	-	276	16,202
March	25	616	959	94,312
April	67	728	266	77,080
May	16	1152	440	1,763
June	5	175	58	-
July	-	339	61	11
August	3	573	32	7
TOTAL	286	4240	6047	596,471

Table C1-309. Number of sand shrimp taken in paired collections by day and night in Oyster Creek and Forked River, New Jersey from September 1976 through August 1977.

	September	October	November	December	January	February	March	April	May	June	July	August
Day	0	15	14	161	2	49	17	174	59	16	11	5
Night	26	57	185	4074	78	227	1558	820	1533	210	389	600

Table C1-310. Number of sand shrimp collected in Forked River and Oyster Creek, New Jersey from March 1976 through March 1977.

	West of Route 9		Between Route 9 and Barnegat Bay	
	Forked River	Oyster Creek	Forked River	Oyster Creek
March	242	26	471	623
April	66	-	160	126
May	119	3	439	67
June	13	-	76	5
July	128	-	20	-
August	111	1	31	-
September	-	-	-	-
October	-	-	2	-
November	3	-	11	7
December	13	18	7	19
January	16	5	-	16
February	1	3	-	1
March	2	-	8	10
TOTAL	714	56	1225	874

Table C1-311. The length-weight relationship of sand shrimp taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

MALES	slope	2.8827
	95% confidence interval	0.035
	intercept	-5.0522
	number examined	1143
FEMALES	slope	3.0731
	95% confidence interval	0.050
	intercept	-5.3076
	number examined	1366
OVIGEROUS FEMALES	slope	3.1128
	95% confidence interval	0.027
	intercept	-5.3044
	number examined	657

Table C1-312. Number and mean length of sand shrimp taken by area in Barnegat Bay, New Jersey from September 1976 through August 1977.

	Creek Mouths								Forked River							
	Juvenile		Male		Female		Ovigerous		Juvenile		Male		Female		Ovigerous	
	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length
September	-	-	-	-	-	-	-	-	9	21	9	28	8	31	-	-
October	2	23	27	31	48	34	-	-	15	23	26	32	30	38	3	41
November	-	-	24	38	23	37	1	45	2	27	16	34	32	41	1	41
December	-	-	-	-	4	39	-	-	6	21	30	36	31	38	2	52
January	-	-	-	-	-	-	-	-	-	-	7	30	4	40	-	-
February	1	20	4	36	10	39	3	55	-	-	-	-	-	-	-	-
March	5	20	7	33	11	37	1	44	22	23	34	31	43	39	16	53
April	25	20	18	31	21	30	9	47	8	20	37	32	49	35	73	49
May	-	-	12	28	45	31	7	40	10	16	84	29	51	32	48	38
June	-	-	2	39	-	-	3	9	2	20	27	31	9	34	27	38
July	-	-	-	-	-	-	-	-	40	21	28	27	39	33	1	26
August	-	-	1	30	1	28	-	-	65	19	56	24	46	28	-	-
Total	33	20	95	33	164	34	26	44	179	21	353	30	342	35	171	44

Table C1-312. (cont.)

	Oyster Creek								OCGS Traveling Screens							
	Juvenile		Male		Female		Ovigerous		Juvenile		Male		Female		Ovigerous	
	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length	No.	Mean Length
September	-	-	-	-	-	-	-	-	-	-	-	-	2	45	-	-
October	1	23	2	28	3	31	-	-	-	-	9	45	10	45	26	46
November	2	23	38	32	70	39	-	-	-	-	89	45	44	49	32	48
December	1	21	67	40	88	42	9	53	-	-	59	45	109	49	18	52
January	-	-	16	40	32	45	5	55	-	-	50	44	135	48	35	54
February	8	28	48	30	47	36	5	52	-	-	34	44	96	48	36	55
March	2	23	47	31	32	39	30	52	-	-	51	45	72	49	93	54
April	11	20	41	30	40	33	68	51	-	-	19	43	9	50	50	51
May	8	23	28	29	26	31	11	38	-	-	51	42	2	50	34	47
June	1	18	12	34	14	41	13	43	-	-	-	-	-	-	-	-
July	23	20	26	27	12	30	-	-	-	-	-	-	1	39	1	37
August	17	19	9	25	7	28	-	-	-	-	-	-	3	40	-	-
Total	66	22	339	33	377	38	141	49	-	-	355	44	483	48	320	51

Table C1-313. Summary of results of one-way ANOVA and SNK multiple range test applied to condition data for sand shrimp examined from September 1976 through August 1977.

Sex	Months	Results of ANOVA[a]	Results of SNK Multiple Range Test			
			STA	Creek Mouths	Oyster Creek	Forked River
Males	October - November	$F_{2,130} = 3.90$ *	K	9.35	9.32	8.76
			N	51	40	42
			STA	Oyster Creek	Forked River	Creek Mouths
Males	April	$F_{2,093} = 0.40$ NS	K	8.56	8.39	8.38
			N	18	37	41
			STA	Oyster Creek	Forked River	Creek Mouths
Females	April - May	$F_{2,107} = 0.75$ NS	K	4.90	4.87	4.73
			N	21	49	40

a * = achieved significance at $P \leq 0.05$
NS = not significant
Means underlined not significantly different

Table C1-314. Number and mean length and weight of male blue crab collected by season in Barnegat Bay from September 1976 through August 1977.

		September - November							
		Length				Weight			
Location	Number	Min	Max	Mean	S. Dev.	Min	Max	Mean	S. Dev.
Creek Mouths	31	12	106	47.5	25.1	0.1	78	12.1	17.8
Forked River	56	20	110	56.1	24.1	0.7	75	15.9	18.6
Oyster Creek	159	9	135	57.3	27.3	0.1	146.6	21.1	25.0
OCGS Screens	636	12	146	70.6	31.4	0.1	217.3	37.1	37.9

		December - February							
		Length				Weight			
Location	Number	Min	Max	Mean	S. Dev.	Min	Max	Mean	S. Dev.
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	0	-	-	-	-	-	-	-	-
Oyster Creek	17	12	131	46.4	41.7	0.1	160.1	25.9	49.5
OCGS Screens	7	18	89	37.1	24.9	0.6	51.5	10.1	18.5

		March - May							
		Length				Weight			
Location	Number	Min	Max	Mean	S. Dev.	Min	Max	Mean	S. Dev.
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	2	12	12	12.0	-	0.1	0.2	0.2	0.1
Oyster Creek	2	11	18	14.5	5.0	0.2	0.7	0.5	0.4
OCGS Screens[a]	374	11	199	51.2	25.9	0.1	138	16.2	18.2

		June - August							
		Length				Weight			
Location	Number	Min	Max	Mean	S. Dev.	Min	Max	Mean	S. Dev.
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	0	-	-	-	-	-	-	-	-
Oyster Creek	0	-	-	-	-	-	-	-	-
OCGS Screens[a]	236	27	154	75.1	27.8	1.9	238.2	42.8	41.7

[a] OCGS shutdown from 14 May through 12 July 1977.

Table CI-315. Number and mean length and weight of female blue crab collected by season in Barnegat Bay from September 1976 through August 1977.

		September - November							
		Length				Weight			
Location	Number	Min	Max	Mean	S.Dev.	Min	Max	Mean	S.Dev.
Creek Mouths	19	12	102	50.7	20.9	0.2	36.2	10.6	10.3
Forked River	58	16	155	74.7	31.4	0.3	142.3	33.4	34.3
Oyster Creek	144	16	142	68.5	34.0	0.1	136.3	30.4	36.7
OCGS Screens	841	13	161	80.0	36.0	0.1	230	45.0	42.9

		December - February							
		Length				Weight			
Location	Number	Min	Max	Mean	S.Dev.	Min	Max	Mean	S.Dev.
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	2	42	65	53.5	16.26	8.6	21.4	15.0	9.1
Oyster Creek	7	18	72	41.4	20.42	0.4	19.5	7.5	8.4
OCGS Screens	4	11	50	25.5	16.94	0.4	10	3.0	4.7

		March - May							
		Length				Weight			
Location	Number	Min	Max	Mean	S.Dev.	Min	Max	Mean	S.Dev.
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	1	18	18	18.0	-	1.2	1.2	1.2	-
Oyster Creek	0	-	-	-	-	-	-	-	-
OCGS Screens[a]	308	12	147	62.7	38.3	0.1	163	30.8	37.5

		June - August							
		Length				Weight			
Location	Number	Min	Max	Mean	S.Dev.	Min	Max	Mean	S.Dev.
Creek Mouths	0	-	-	-	-	-	-	-	-
Forked River	0	-	-	-	-	-	-	-	-
Oyster Creek	0	-	-	-	-	-	-	-	-
OCGS Screens[a]	256	21	158	83.4	32.3	0.5	184.6	50.0	41.1

[a] OCGS shutdown from 14 May through 12 July 1977.

Table C1-316. Total number and mean length and weight of male blue crab collected by area in Barengat Bay from September 1976 through August 1977.

Location	Number	Length				Weight			
		Min	Max	Mean	S.Dev.	Min	Max	Mean	S.Dev.
Creek Mouths	31	12	106	47.5	25.1	0.1	78	12.1	17.8
Forked River	58	12	110	54.5	25.0	0.1	75	15.4	18.5
Oyster Creek	178	9	135	55.8	29.2	0.1	160.1	21.3	28.7
OCGS Screens	1253	11	199	65.5	30.7	0.1	238.2	31.8	35.6

Table C1-317 Total number and mean length and weight of female blue crab collected by area in Barnegat Bay from September 1976 through August 1977.

Location	Number	Length				Weight			
		Min	Max	Mean	S.Dev.	Min	Max	Mean	S.Dev.
Creek Mouths	19	12	102	50.7	20.9	0.2	36.2	10.6	10.3
Forked River	61	16	155	73.1	31.8	0.3	142.3	32.3	33.8
Oyster Creek	151	16	142	67.2	34.0	0.1	136.3	29.3	36.2
OCGS Screens	1409	11	161	76.7	36.7	0.1	230	42.7	41.9

Table C1-31[illegible] Number and mean length and weight by month of immature blue crab taken in Barnegat Bay from September 1976 through August 1977.

MALE	Creek Mouths			Forked River			Oyster Creek			OCGS Screens[a]			Total	
	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length
September	-	-	-	19	54.4	14.3	32	60.0	21.9	322	61.0	24.2	373	60.6
October	23	40.4	6.5	27	48.0	9.1	54	45.1	10.0	134	60.7	24.3	238	53.8
November	6	49.6	9.7	3	42.0	8.2	47	50.4	12.4	46	39.6	8.2	101	45.2
December	-	-	-	-	-	-	11	21.7	1.0	2	27.0	2.0	13	22.5
January	-	-	-	-	-	-	1	100.0	54.1	1	49.0	10.0	2	74.5
February	-	-	-	-	-	-	2	43.5	6.3	3	23.7	2.0	5	31.0
March	-	-	-	-	-	-	12	51.6	-	55	40.5	10.6	67	42.5
April	1	62.0	-	3	14.0	0.1	10	50.6	-	168	46.3	12.3	182	46.0
May	2	55.5	-	7	49.9	-	15	37.9	-	133	54.6	16.7	157	52.8
June	8	66.4	-	6	57.8	-	8	56.1	-	-	-	-	22	60.3
July	7	68.7	-	21	49.4	-	12	44.0	-	150	62.0	23.8	190	59.7
August	4	67.3	-	8	61.5	-	19	70.1	-	71	70.4	17.7	102	69.5
Total	50	52.6	-	94	50.2	-	223	50.4	-	1085	56.5	-	1452	55.0

FEMALE	Creek Mouths			Forked River			Oyster Creek			OCGS Screens[a]			Total	
	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length
September	-	-	-	24	68.7	25.2	40	68.5	27.7	403	66.0	26.9	467	66.4
October	15	47.9	9.5	17	53.1	12.1	33	59.1	16.2	164	58.9	22.0	229	57.8
November	4	61.3	14.7	2	86.5	34.1	45	47.2	9.5	46	39.6	8.9	97	44.9
December	-	-	-	-	-	-	6	40.8	7.6	-	-	-	6	40.8
January	-	-	-	-	-	-	-	-	-	3	30.3	3.8	3	30.3
February	-	-	-	2	53.5	15.0	1	45.0	7.0	1	11.0	0.4	4	40.8
March	-	-	-	-	-	-	8	69.6	-	51	40.7	18.4	59	44.6
April	3	42.3	-	5	34.0	0.2	6	45.8	-	132	46.8	14.2	146	46.2
May	2	73.5	-	8	64.8	-	4	44.0	-	65	57.4	19.8	79	57.9
June	12	68.0	-	8	64.6	-	20	38.1	-	-	-	-	40	52.4
July	21	81.2	-	32	55.8	-	19	58.2	-	166	70.6	33.5	238	68.5
August	10	76.4	-	17	81.5	-	21	73.3	-	59	73.9	21.2	107	75.2
Total	67	67.5	-	115	62.6	-	203	56.7	-	1090	60.8	-	1475	60.6

[a] OCGS shutdown from 14 May through 12 July 1977.

Table C1-319. Number and mean length and weight by month of mature blue crab taken in Barnegat Bay from September 1976 through August 1977.

MALE	Creek Mouths			Forked River			Oyster Creek			OCGS Screens[a]			Total	
	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length
September	-	-	-	4	98.5	50.5	12	108.8	81.2	38	109.9	79.2	55	108.5
October	1	106.0	78.0	2	105.0	68.0	1	92.0	59.4	59	117.4	100.9	63	116.4
November	2	99.5	48.8	-	-	-	4	112.0	88.9	23	121.0	98.0	29	117.8
December	-	-	-	-	-	-	2	116.5	101.1	-	-	-	2	116.5
January	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	1	130.0	160.1	1	89.0	51.5	2	109.5
March	-	-	-	-	-	-	-	-	-	3	106.7	74.9	3	106.7
April	-	-	-	-	-	-	2	98.5	-	8	95.8	57.5	10	96.3
May	-	-	-	2	89.0	-	2	84.5	-	7	115.1	71.2	11	104.8
June	-	-	-	1	88.0	-	4	98.8	-	-	-	-	5	97.8
July	14	118.6	-	7	118.4	-	4	121.3	-	29	119.1	112.0	54	119.0
August	5	114.6	-	3	129.0	-	10	120.7	-	30	116.6	48.1	48	118.4
Total	22	114.8	-	19	109.8	-	43	110.9	-	198	115.2	-	282	114.1

FEMALE	Creek Mouths			Forked River			Oyster Creek			OCGS Screens[a]			Total	
	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length	Mean Weight	Number	Mean Length
September	-	-	-	10	130.1	97.7	16	131.5	109.6	56	127.6	98.3	81	128.6
October	-	-	-	1	100.0	55.5	2	126.0	92.6	120	130.8	105.3	123	130.5
November	-	-	-	-	-	-	3	130.0	96.1	30	128.8	105.2	33	128.9
December	-	-	-	-	-	-	-	-	-	-	-	-	-	-
January	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	2	117.5	-	6	123.7	93.9	8	122.2
April	-	-	-	-	-	-	4	129.8	-	28	123.1	93.3	32	123.9
May	-	-	-	1	125.0	-	-	-	-	26	120.5	94.6	27	120.7
June	2	119.5	-	-	-	-	1	128.0	-	-	-	-	3	122.3
July	-	-	-	3	134.3	-	1	145.0	-	28	128.2	110.3	32	129.3
August	1	155.0	-	1	141.0	-	1	155.0	-	12	124.3	86.1	15	129.5
Total	3	131.3	-	16	129.4	-	29	130.9	-	306	127.8	-	354	128.2

[a] OCGS shutdown from 14 May through 12 July 1977.

Table C1-32Q The length-weight relationship of blue crab taken in Barnegat Bay, New Jersey from September 1976 through August 1977.

Males	Slope	2.8167
	95% Confidence Interval	0.052
	Intercept	-3.8119
	Number Examined	1520
Females	Slope	2.7019
	95% Confidence Interval	0.059
	Intercept	-3.6411
	Number Examined	1640
Pooled	Slope	2.7468
	95% Confidence Interval	0.039
	Intercept	-3.7069
	Number Examined	3160

Table C1-321. Number and percent of mature and immature, male and female blue crab collected in Barnegat Bay from September 1976 through August 1977.

	Immature Male	%	Immature Female	%	Total Immature No.	%	Mature Male	%	Mature Female	%	Total Mature No.	%	Grand Total	%
September	373	38.2	447	47.8	840	86.1	55	5.6	81	8.3	136	13.9	976	27.4
October	238	36.4	229	35.1	467	71.5	63	9.6	123	18.8	186	28.5	653	18.3
November	101	38.8	97	37.3	198	76.2	29	11.2	33	12.7	62	23.8	260	7.3
December	13	61.9	6	28.6	19	90.5	2	9.5	0	-	2	9.5	21	0.6
January	2	40.0	3	60.0	5	100.0	0	-	0	-	0	-	5	0.1
February	5	45.5	4	36.4	9	81.8	2	18.2	0	-	2	18.2	11	0.3
March	67	48.9	59	43.1	126	92.0	3	2.2	8	5.8	11	8.0	137	3.8
April	182	49.2	146	39.5	328	88.6	10	2.7	32	8.6	42	11.4	370	10.4
May	157	57.3	79	28.8	236	86.1	11	4.0	27	9.9	38	13.9	274	7.7
June	22	31.4	40	57.1	62	88.6	5	7.1	3	4.3	8	11.4	70	2.0
July	190	37.0	238	46.3	428	83.3	54	10.5	32	6.2	86	16.7	514	14.4
August	102	37.5	107	39.3	209	76.8	48	17.6	15	5.5	63	23.2	272	7.6
Total	1452	40.8	1475	41.4	2927	82.1	282	7.9	354	9.9	636	17.9	3563	100.0

Table C1-322 Number and percent of recruitment (1-59 mm), growth (60-119 mm), and mature (> 120 mm) size classes of blue crab collected by season from December 1975 through August 1977.

	Dec 1975 - Feb 1976		Mar - May 1976		Jun - Aug 1976		Sept - Nov 1976	
	No.	%	No.	%	No.	%	No.	%
Recruitment (1-59 mm)	600	97.7	2333	83.2	3366	80.5	884	45.4
Growth (60-119 mm)	13	2.1	324	11.6	684	16.4	815	41.8
Mature (> 120 mm)	1	0.2	147	5.2	133	3.2	250	12.8

	Dec 1976 - Feb 1977		Mar - May 1977		Jun - Aug 1977	
	No.	%	No.	%	No.	%
Recuritment (1-59 mm)	29	78.4	451	56.9	319	33.5
Growth (60-119 mm)	6	16.2	295	37.3	534	56.0
Mature (> 120 mm)	2	5.4	46	5.8	100	10.5

Table C1-323. Sport fisheries catch and effort for all zones[a] from September 1976 through August 1977.

	Zone 1									Zone 2								
	No. fishers	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch	No. fishers	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch
September	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
November	-	-	-	-	-	-	-	-	-	1	1.25	-	1	1.25	-	-	-	-
December	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-	5	5.5	3	5	5.5	3	-	-	-
April	-	-	-	-	-	-	-	-	-	3	5.0	-	2	5.0	-	1	1.0	-
May	5	7.5	3	5	7.5	3	-	-	-	23	24.5	3	21	20.5	1	8	8.0	2
June	20	34.0	16	8	8.0	2	11	18.5	14	52	86.0	50	29	44.0	2	25	26.0	48
July	39	25.0	48	10	7.5	4	25	18.0	44	67	81.0	94	28	19.0	10	58	70.5	84
August	149	236.5	564	48	86.5	144	136	223.5	420	56	134.0	302	14	16.0	28	59	113.5	274
Total	207	293.0	631	71	109.5	153	172	257.0	478	217	337.25	452	101	111.25	44	151	219.0	408

	Zone 5 (Forked River)																	
	Route 9 Area									Beach Blvd Area								
	No. fishers	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch	No. fishers	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch
September	9	12.5	104	4	3.5	19	6	10.0	85	-	-	-	-	-	-	-	-	-
October	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
November	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December	1	3.0	2	1	3.0	2	-	-	-	-	-	-	-	-	-	-	-	-
March	6	8.5	3	6	8.5	3	-	-	-	2	3.0	1	2	3.0	1	-	-	-
April	28	44.5	6	28	44.5	6	-	-	-	3	2.5	-	3	2.5	-	-	-	-
May	4	14.0	5	5	9.0	5	4	8.0	-	4	3.0	2	2	1.0	-	2	2.0	2
June	4	3.0	-	4	3.0	-	-	-	-	4	7.0	4	4	7.0	2	2	5.0	2
July	26	90.0	62	8	10.5	9	20	84.0	53	6	5.0	7	6	5.0	4	4	4.0	3
August	15	20.0	37	7	8.0	15	9	16.5	22	24	44.5	153	24	44.5	113	21	41.0	40
Total	98	195.5	219	63	90.0	59	39	118.5	160	43	65.0	167	41	63.0	120	29	52.0	47

	Total of Zone 5								
	No. fishers	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch
September	9	12.5	104	4	3.5	19	6	10.0	85
October	-	-	-	-	-	-	-	-	-
November	-	-	-	-	-	-	-	-	-
December	1	3.0	2	1	3.0	2	-	-	-
March	8	11.5	4	8	11.5	4	-	-	-
April	31	47.0	6	31	47.0	6	-	-	-
May	13	17.0	7	7	10.0	5	6	10.0	2
June	8	10.0	4	8	10.0	2	2	5.0	2
July	32	95.0	49	14	15.5	13	24	88.0	56
August	39	64.5	190	31	52.5	128	30	57.5	62
Total	141	260.5	186	104	153.0	179	68	170.5	207

Table C1-323. (cont.)

Zone 4 (Oyster Creek)

	Route 9 Area									Bulkhead Area								
	No. fshrmn	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch	No. fshrmn	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch
September	32	59.25	173	30	58.25	96	5	31.00	77	6	12.75	69	4	5.75	45	2	7.0	24
October	39	80.25	146	39	80.25	122	2	7.25	24	10	20.00	39	10	20.00	39	3	5.0	-
November	30	64.75	72	30	64.75	48	3	6.50	24	2	2.00	3	2	2.00	3	-	-	-
December	13	23.50	15	13	23.50	15	-	-	-	-	-	-	-	-	-	-	-	-
March	9	15.00	2	9	15.00	2	-	-	-	10	8.00	5	10	8.00	5	-	-	-
April	23	33.50	27	23	33.50	27	-	-	-	20	54.50	37	20	54.50	37	2	2.0	-
May	19	24.00	17	13	18.00	4	17	23.50	13	4	7.00	2	4	7.00	-	2	6.0	2
June	33	66.00	68	27	56.00	23	10	20.00	45	8	29.00	51	2	5.00	-	8	26.0	51
July	36	133.00	185	30	82.00	73	23	112.50	82	20	93.50	123	3	2.50	-	17	91.0	123
August	37	83.00	202	19	28.50	24	31	69.00	178	15	27.00	44	3	2.50	-	14	26.5	44
Total	270	582.25	877	233	456.75	434	90	269.75	443	95	253.75	373	58	107.25	129	48	163.5	244

	Total of Zone 4									Grand Total								
	No. fshrmn	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch	No. fshrmn	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch
September	38	72.00	242	34	64.00	141	7	38.00	101	47	84.50	346	38	67.5	160	15	48.00	186
October	49	100.25	185	49	100.25	161	5	12.25	24	49	100.25	185	49	100.25	161	5	12.25	24
November	32	66.75	75	32	66.75	51	3	6.50	24	33	68.00	75	33	68.00	51	3	6.50	24
December	13	23.50	15	13	23.50	15	-	-	-	14	26.50	17	14	26.50	17	-	-	-
March	19	23.00	7	19	23.00	7	-	-	-	32	40.00	14	32	40.00	14	-	-	-
April	43	88.00	64	43	88.00	64	2	2.00	-	77	140.00	70	77	140.00	70	1	1.00	-
May	22	31.00	19	17	25.00	4	19	29.40	15	63	80.00	32	50	63.00	13	33	47.50	19
June	41	95.00	119	29	60.00	23	18	46.00	96	121	215.00	189	74	122.00	29	56	92.50	160
July	86	226.50	278	33	86.50	73	39	203.50	205	188	427.50	489	85	126.50	100	146	390.00	389
August	82	110.00	246	22	29.00	24	45	95.50	222	306	545.00	1302	115	184.00	324	270	490.00	978
Total	365	836.00	1250	291	564.00	563	138	433.25	887	930	1726.75	2719	567	937.75	939	529	1077.75	1780

[a] See Fig. C1-32 and C1-33.

Table C1-324. Sport fisheries catch/hour and catch/individual by zone[a] from September 1976 through August 1977.

Month[b]	Temperature range (C)	Catch/hour			Catch/individual			Catch/boat		
		Total	Finfish	Blue crab	Total	Finfish	Blue crab	Total	Finfish	Blue crab
Zone 1										
April	15.3-16.6	-	-	-	-	-	-	-	-	-
May	19.0-20.0	0.4	0.4	-	0.6	0.6	-	0.7	0.7	-
June	21.0-26.0	0.7	0.3	0.9	0.8	0.3	1.2	2.0	0.4	3.5
July	25.0-27.0	1.9	0.5	2.4	1.5	0.4	1.8	2.7	1.0	5.2
August	24.0-29.5	2.4	1.7	1.9	3.8	3.0	3.1	11.1	3.4	8.9
Total	15.3-29.5	2.2	1.4	1.9	3.1	2.2	2.8	9.9	2.9	8.0
Zone 2										
November	9.0	-	-	-	-	-	-	0.0	0.0	-
March	12.5	0.6	0.6	-	0.6	0.6	-	1.0	1.0	-
April	15.4-18.0	-	-	-	-	-	-	-	-	-
May	19.5-20.0	0.1	0.1	0.3	0.1	+[c]	0.3	0.5	0.2	1.0
June	20.0-26.0	0.6	0.1	1.9	1.0	0.1	1.9	2.5	0.2	4.8
July	25.0-27.0	1.2	0.5	1.2	1.4	0.4	1.5	4.5	1.0	4.9
August	26.0-28.5	2.3	1.8	2.4	4.6	2.0	4.6	13.1	1.9	13.1
Total	8.0-28.5	1.3	0.4	1.9	2.1	0.4	2.7	6.0	0.9	8.0
Zone 5 (Forked River Route 9 area)										
September	19.0-25.5	8.3	5.4	8.5	11.6	4.8	14.2			
October	11.0-20.0	-	-	-	-	-	-			
December	1.0-5.0	0.7	3.2	-	2.0	2.0	-			
March	6.0-13.0	0.4	0.4	-	0.5	0.5	-			
April	14.0-17.0	0.1	0.1	-	0.2	0.2	-			
May	13.0-24.0	0.4	0.6	-	0.6	0.6	-			
June	17.0-25.0	-	-	-	-	-	-			
July	23.5-27.0	0.7	0.9	0.6	2.4	1.1	2.7			
August	25.0-28.0	1.9	1.9	1.3	2.5	2.1	2.4			
Total	1.0-28.0	1.2	0.7	1.4	2.2	0.9	4.1			
Zone 5 (Forked River Beach Blvd area)										
March	6.0-12.0	0.3	0.3	-	0.5	0.5	-			
April	14.0-17.0	-	-	-	-	-	-			
May	21.0-24.0	0.7	-	1.0	0.5	-	1.0			
June	17.0-26.0	0.6	0.3	0.4	1.0	0.5	1.0			
July	25.0-28.0	1.4	0.8	0.8	1.2	0.7	0.8			
August	25.0-29.0	3.4	2.5	1.0	6.4	4.7	1.9			
Total	6.0-29.0	2.6	1.9	0.9	3.9	3.1	1.6			

Table C1-324 (cont.)

Month[b]	Temperature range (C)	Catch/hour			Catch/individual		
		Total	Finfish	Blue crab	Total	Finfish	Blue crab
Zone 4 (Oyster Creek Route 9 area)							
September	24.5-29.5	2.9	1.7	2.5	5.4	2.2	15.4
October	14.5-26.0	1.8	1.5	2.2	3.7	2.1	12.0
November	7.5-14.0	1.1	0.7	3.7	2.4	1.6	8.0
December	5.5-9.0	0.8	0.6	-	1.2	1.2	-
March	8.0-15.0	0.1	0.1	-	0.2	0.2	-
April	18.0-22.0	0.8	0.8	-	1.2	1.2	-
May	13.5-23.5	0.7	0.2	0.6	0.9	0.3	0.8
June	17.5-24.0	1.0	0.4	2.3	2.1	0.9	4.6
July	23.0-26.0	1.2	0.9	0.7	4.3	2.4	2.7
August	30.0-31.0	2.4	0.9	2.6	5.5	1.3	5.7
Total	5.5-31.0	1.5	1.3	1.6	3.3	0.6	4.9
Zone 4 (Oyster Creek Bulkhead area)							
September	24.5-29.5	5.4	7.5	3.4	11.5	11.3	12.0
October	14.5-26.0	2.0	2.0	-	3.9	3.9	-
November	7.5-14.0	1.5	1.5	-	1.5	1.5	-
March	10.0-15.0	0.6	0.6	-	0.5	0.5	-
April	18.0-19.0	0.7	0.7	-	1.9	1.9	-
May	20.0-24.0	0.3	-	0.3	0.5	-	1.0
June	17.5-26.0	1.8	-	2.0	6.4	-	6.4
July	25.0-29.0	1.3	-	1.4	6.2	-	7.2
August	28.0-31.0	1.6	-	1.7	3.0	-	3.1
Total	7.5-31.0	1.5	1.2	1.5	3.9	2.2	5.1
Total Catch							
September	19.0-29.5	4.5	2.4	3.9	7.4	1.7	14.3
October	11.0-26.0	1.9	1.6	2.0	3.5	3.3	4.8
November	7.5-14.0	1.1	3.7	3.7	2.3	1.6	8.0
December	1.0-9.0	0.8	-	-	1.2	1.2	-
March	6.0-15.0	0.4	-	-	0.4	0.4	-
April	14.0-22.0	0.5	-	-	0.9	-	0.9
May	13.5-24.0	0.5	0.4	0.4	0.4	0.2	0.6
June	17.0-26.0	0.9	2.9	2.9	1.6	0.4	1.7
July	23.0-29.0	1.1	1.0	1.0	2.9	1.7	2.7
August	24.0-31.0	2.3	2.0	2.0	4.3	2.8	3.6
Total	1.0-31.0	1.6	1.7	1.7	2.9	1.7	3.4

[a] see Fig. C1-32 and C1-33.
[b] Only months during which sport fishermen were present are indicated.
[c] - = less than 0.1%

Table C1-325 Sport fisheries catch in western Barnegat Bay by species and zone[a] from September 1976 through August 1977.

	Zone 1		Zone 2		Zone 3 (Forked River)						Zone 4 (Oyster Creek)							
					Rt. 9 area		Beach Blvd area		Total		Rt. 9 area		Bulkhead area		Total		Total Catch	
Species	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Blue crab	478	75.8	408	90.3	160	73.1	47	25.1	207	53.6	441	50.1	258	87.6	699	55.9	1792	65.9
Bluefish	91	14.4	21	4.6	40	18.3	109	58.3	149	38.6	243	27.7	65	17.4	308	25.6	568	20.9
Spot	51	8.1	7	1.5	-	-	-	-	-	-	88	10.1	26	7.0	115	9.2	173	6.4
Winter flounder	-	-	3	0.7	9	4.1	1	0.6	10	2.6	51	5.8	28	7.5	79	6.3	92	3.4
American eel	9	1.3	4	0.9	8	3.7	1	0.6	9	2.3	5	0.6	-	-	5	0.4	26	1.0
Scup	1	0.2	1	0.2	-	-	-	-	-	-	20	2.3	-	-	20	1.6	22	0.8
Summer flounder	-	-	2	0.4	-	-	-	-	-	-	9	1.0	-	-	9	0.7	11	0.4
White perch	-	-	-	-	2	0.9	4	2.4	6	1.6	2	0.2	1	0.3	3	0.2	9	0.3
Northern puffer	1	0.2	5	1.1	-	-	-	-	-	-	1	0.1	-	-	1	0.1	7	0.3
Black sea bass	-	-	-	-	-	-	1	0.6	1	0.3	3	0.3	-	-	3	0.2	4	0.1
Oyster toadfish	1	0.2	-	-	-	-	2	1.2	2	0.5	1	0.1	-	-	1	0.1	4	0.1
Striped sea robin	-	-	-	-	-	-	2	1.2	2	0.5	1	0.1	-	-	1	0.1	3	0.1
Tautog	-	-	1	0.2	-	-	-	-	-	-	1	0.1	-	-	1	0.1	2	0.1
Northern kingfish	-	-	-	-	-	-	-	-	-	-	2	0.2	-	-	2	0.2	2	0.1
Silver perch	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-	1	0.1	1	+[b]
Smooth dogfish	-	-	-	-	-	-	-	-	-	-	1	0.1	-	-	1	0.1	1	+
Atlantic needlefish	-	-	-	-	-	-	-	-	-	-	-	-	1	0.3	1	0.1	1	+

[a] see Fig. C1-32 and C1-33.

[b] + = less than 0.1%

Table C1-337. Sport fisheries catch and effort for areas associated with the thermal plume (zones 2 and 4) and unaffected areas (zones 1 and 5) from September 1976 through August 1977.

		Zones 1 and 5																	
										Catch/hour			Catch/individual			Catch/boat[b]		
Month[a]	Temperature range (C)	No. fishers	Hrs. fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch	Total	Angler	Crabber	Total	Angler	Crabber	Total	Angler	Crabber
September	19.0 - 25.5	9	12.5	104	4	3.5	19	8	10.0	85	8.3	5.4	8.5	11.6	4.8	14.2	-	-	-
October	11.0 - 20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
November	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December	1.0 - 5.0	1	2.0	2	1	2.0	2	-	-	-	0.7	0.7	-	2.0	2.0	-	-	-	-
March	6.0 - 13.0	8	11.5	4	8	11.5	4	-	-	-	0.4	0.4	-	0.5	0.5	-	-	-	-
April	14.0 - 17.0	21	47.0	6	21	47.0	6	-	-	-	0.1	0.1	-	0.2	0.2	-	-	-	-
May	13.8 - 24.0	18	24.5	10	12	17.5	8	6	10.0	2	0.4	0.5	0.2	0.6	0.7	0.3	0.7	0.7	-
June	17.0 - 26.0	28	34.0	20	16	16.0	4	12	20.5	16	0.6	0.2	0.8	0.7	0.3	1.2	2.0	0.4	3.5
July	23.5 - 27.0	58	120.0	117	24	23.0	17	49	106.0	100	1.0	0.7	0.9	2.1	0.7	2.0	2.7	1.0	5.3
August	24.0 - 29.5	188	301.0	754	79	139.0	273	168	281.0	482	2.5	2.0	1.7	4.0	3.4	2.9	11.1	3.4	8.9
Total	1.0 - 29.5	338	553.5	1017	175	262.5	332	240	427.5	685	1.8	1.3	1.8	3.0	1.9	2.9	9.9	2.9	8.0
OCGS in operation[c]	1.0 - 29.5	237	375.0	870	123	204.0	303	173	291.0	567	2.3	1.5	2.0	3.7	2.5	3.3	11.0	2.8	8.2
OCGS shutdown	13.8 - 27.0	101	178.5	147	52	58.5	29	68	136.5	118	0.8	0.5	0.9	1.5	0.6	1.7	2.9	0.4	2.4

		Zones 2 and 4																	
										Catch/hour			Catch/individual			Catch/boat[b]		
	Temperature range (C)	No. fishers	Hrs fished	Catch	No. anglers	Hrs. fished	Catch	No. crabbers	Hrs. fished	Catch	Total	Angler	Crabber	Total	Angler	Crabber	Total	Angler	Crabber
September	24.5 - 29.5	38	72.00	242	34	64.00	141	7	38.00	101	3.4	2.2	2.7	6.4	4.2	14.4	-	-	-
October	14.5 - 26.0	49	100.25	185	49	100.25	161	5	12.25	24	1.9	1.6	2.0	3.8	3.3	4.8	-	-	-
November	7.5 - 14.0	33	68.00	75	33	68.00	51	3	6.50	24	1.1	0.8	3.7	2.3	1.6	8.0	0.0	0.0	-
December	5.5 - 9.0	13	23.50	15	13	23.50	15	-	-	-	0.5	0.6	-	1.2	1.3	-	-	-	-
March	8.0 - 15.0	24	28.50	10	24	28.50	10	-	-	-	0.4	0.4	-	0.4	0.4	-	1.0	1.0	-
April	15.0 - 22.0	46	93.00	64	45	93.00	64	3	3.00	-	0.7	0.7	0.0	1.4	1.4	0.0	-	-	-
May	13.8 - 24.0	40	49.50	7	38	45.50	5	27	37.50	17	0.1	0.1	0.5	0.2	0.1	0.6	0.5	0.2	4.8
June	17.5 - 26.0	81	181.00	169	58	104.00	25	45	72.00	144	0.9	0.2	2.0	2.1	0.2	3.4	2.5	0.2	4.8
July	25.0 - 29.0	123	307.00	372	61	103.5	83	97	274.00	289	1.2	0.8	1.1	3.0	0.8	3.0	4.5	1.0	4.9
August	26.0 - 31.0	118	244.0	548	36	45.0	32	106	209.00	496	2.3	1.2	2.4	4.6	1.4	4.8	13.1	1.9	13.1
Total	5.5 - 31.0	582	1173.25	1702	392	675.25	607	299	652.25	1095	1.5	0.9	1.7	2.9	1.8	3.8	6.0	0.9	8.0
OCGS in operation[c]	5.5 - 31.0	338	635.75	1154	235	422.75	494	122	268.75	645	1.8	1.2	2.4	3.4	2.1	5.3	10.5	1.1	9.5
OCGS shutdown	13.8 - 29.0	244	537.50	548	157	252.5	113	167	383.5	450	1.0	0.5	1.2	2.3	0.7	2.7	3.1	0.3	2.9

[a] Months listed only when sport fishermen were present.

[b] c/b computed only in zones 1 and 2.

[c] OCGS operated from September 1976 through April 1977, and resumed operation in August 1977.

Table C1-328. The mean density of the dominant (> 5%) forms of macrozooplankton in the intake canal to the Oyster Creek Generating Station at water temperatures below 18 C (October through March) and above 18 C (April through September) from March 1976 through March 1977.

	Mouth South Branch of Forked River	Route 9 Bridge
	Below 18 C	
Neomysis americana	44,056	38,893
Sarsia spp.	26,050	23,328
Rathkea octopunctata	20,553	23,326
Crangon septemspinosa (zoeae)	11,104	9,296
Total Macrozooplankton	120,387	117,388

	Mouth South Branch of Forked River	Route 9 Bridge
	Above 18 C	
Xanthidae zoeae	46,355	88,153
Amphipoda	18,906	26,120
Crangon septemspinosa (zoeae)	11,073	4,305
Neomysis americana	10,398	22,087
Total Macrozooplankton	109,404	169,700

TABLE C1-329. YEARLY MEAN DENSITIES (n/1000m^3) OF MACROZOOPLANKTON THAT COMPRISED 95% OF THE SPECIES COMPOSITION AT EACH OF THE THREE STATIONS IN FORKED RIVER AND AT EACH OF THE THREE STATIONS IN OYSTER CREEK FROM MARCH 1976 THROUGH MARCH 1977.

FORKED RIVER MOUTH (45)

SPECIES	LIFESTAGE	FREQUENCY	YEARLY MEAN	STD DEV	% COMPOSITION
TOTAL		26	118112.70		
NEOMYSIS AMERICANA	NO DETERM.	26	28779.40	10395.80	24.37
FAMILY XANTHIDAE	ZOEAL	12	21190.20	6804.28	17.94
SARSIA SPP	NO DETERM.	5	14208.90	869.40	12.03
CRANGON SEPTEMSPINOSA	ZOEAL	19	13065.70	5958.66	11.06
RATHKEA OCTOPUNCTATA	NO DETERM.	4	11210.50	1058.05	9.49
UNIDENTIFIED AMPHIPODA	NO DETERM.	24	9206.90	13812.90	7.80
OXYUROSTYLIS SMITHI	NO DETERM.	17	2866.21	2622.30	2.43
AMPELISCA SPP.	NO DETERM.	7	2333.81	5663.65	1.98
MYSIDOPSIS BIGELOWI	NO DETERM.	14	1767.81	1511.01	1.50
CLASS POLYCHAETA	LARVAL	11	1718.81	1650.47	1.46
BARNACLE CYPRIS	LARVAL	2	1698.00	4148.01	1.44
PALAEMONETES SPP	ZOEAL	9	1339.20	4540.64	1.13
SAGITTA ELEGANS	NO DETERM.	2	879.95	1041.00	0.75
ORDER CAPRELLIDEA	NO DETERM.	17	846.39	743.29	0.72
LEUCON AMERICANUS	NO DETERM.	22	805.70	587.08	0.68
FAMILY SYLLIDAE	NO DETERM.	9	700.95	695.37	0.59

FORKED RIVER ROUTE 9 BRIDGE (6)

SPECIES	LIFESTAGE	FREQUENCY	YEARLY MEAN	STD DEV	% COMPOSITION
TOTAL		26	146792.44		
FAMILY XANTHIDAE	ZOEAL	14	45806.50	16616.80	31.20
NEOMYSIS AMERICANA	NO DETERM.	25	30101.00	25712.10	20.51
SARSIA SPP	NO DETERM.	4	12724.30	8206.41	8.67
RATHKEA OCTOPUNCTATA	NO DETERM.	6	12723.30	16788.60	8.67
UNIDENTIFIED AMPHIPODA	NO DETERM.	26	10226.60	6084.46	6.97
CRANGON SEPTEMSPINOSA	ZOEAL	21	7729.95	2077.78	5.27
AMPELISCA SPP.	NO DETERM.	5	5294.04	11025.20	3.61
OXYUROSTYLIS SMITHI	NO DETERM.	20	4094.20	1962.86	2.79
CLASS POLYCHAETA	LARVAL	10	3212.59	4334.53	2.19
BARNACLE CYPRIS	LARVAL	2	2902.45	5445.95	1.98
SAGITTA ELEGANS	NO DETERM.	2	1781.45	2090.20	1.21
MYSIDOPSIS BIGELOWI	NO DETERM.	13	1302.45	2213.26	0.89
LEUCON AMERICANUS	NO DETERM.	23	1238.15	773.45	0.84
ORDER CAPRELLIDEA	NO DETERM.	19	1198.29	715.10	0.82

FORKED RIVER LAGOON (46)

SPECIES	LIFESTAGE	FREQUENCY	YEARLY MEAN	STD DEV	% COMPOSITION
TOTAL		25	73351.64		
NEOMYSIS AMERICANA	NO DETERM.	25	44431.80	52699.10	60.57
RATHKEA OCTOPUNCTATA	NO DETERM.	4	7678.50	3720.93	10.47
FAMILY XANTHIDAE	ZOEAL	14	2775.44	1303.64	3.78
SARSIA SPP	NO DETERM.	6	2675.90	724.06	3.65
CRANGON SEPTEMSPINOSA	ZOEAL	17	2641.01	2272.33	3.60
MYSIDOPSIS BIGELOWI	NO DETERM.	15	2630.70	3868.74	3.59
UNIDENTIFIED AMPHIPODA	NO DETERM.	16	1370.31	2385.26	1.87
LEUCON AMERICANUS	NO DETERM.	18	1277.09	1506.26	1.74
CLASS OLIGOCHAETA	NO DETERM.	1	1233.00	0.00	1.68
CLASS POLYCHAETA	LARVAL	6	1124.40	2922.27	1.53
AMPELISCA SPP.	NO DETERM.	6	970.95	533.72	1.32
BARNACLE CYPRIS	LARVAL	2	757.27	614.87	1.03
MNEMIOPSIS LEIDYI	NO DETERM.	6	527.34	1084.21	0.72

TABLE C1-329. (CONT.)

SPECIES	LIFESTAGE	FREQUENCY	YEARLY MEAN	STD DEV	% COMPOSITION
OYSTER CREEK MOUTH (50)					
TOTAL		26	56401.58		
FAMILY XANTHIDAE	ZOEAL	16	20211.20	38655.20	35.83
NEOMYSIS AMERICANA	NO DETERM.	26	8344.85	2192.66	14.80
SARSIA SPP	NO DETERM.	4	5564.90	5585.19	9.87
CRANGON SEPTEMSPINOSA	ZOEAL	16	3806.01	2022.84	6.75
PALAEMONETES SPP	ZOEAL	15	3288.53	7023.60	5.83
SAGITTA ELEGANS	NO DETERM.	2	3229.95	3100.14	5.73
UNIDENTIFIED AMPHIPODA	NO DETERM.	24	3160.88	1635.56	5.60
RATHKEA OCTOPUNCTATA	NO DETERM.	6	2155.59	1568.74	3.82
NEREIS SPP	EPITOKES	12	1053.38	1942.75	1.87
LEUCON AMERICANUS	NO DETERM.	21	782.30	453.37	1.39
OXYUROSTYLIS SMITHI	NO DETERM.	13	637.18	318.63	1.13
CLASS POLYCHAETA	LARVAL	10	630.52	764.22	1.12
ORDER CAPRELLIDEA	NO DETERM.	12	386.68	668.22	0.69
MYSIDOPSIS BIGELOWI	NO DETERM.	16	360.70	389.79	0.64
OYSTER CREEK LAGOON (30)					
TOTAL		26	33006.54		
FAMILY XANTHIDAE	ZOEAL	14	9469.54	13853.20	28.69
NEOMYSIS AMERICANA	NO DETERM.	26	7259.15	3264.10	21.99
SARSIA SPP	NO DETERM.	4	6742.77	4917.27	20.43
CRANGON SEPTEMSPINOSA	ZOEAL	17	3007.09	609.09	9.11
MYSIDOPSIS BIGELOWI	NO DETERM.	17	1265.83	912.34	3.84
UNIDENTIFIED AMPHIPODA	NO DETERM.	25	1212.92	1415.96	3.67
PALAEMONETES SPP	ZOEAL	14	1020.24	1606.44	3.09
SAGITTA ELEGANS	NO DETERM.	2	525.59	107.67	1.59
LEUCON AMERICANUS	NO DETERM.	15	252.64	429.67	0.77
RATHKEA OCTOPUNCTATA	NO DETERM.	4	221.73	445.82	0.67
NEREIS SPP	EPITOKES	5	203.00	210.04	0.62
OXYUROSTYLIS SMITHI	NO DETERM.	13	146.36	232.19	0.44
BARNACLE CYPRIS	LARVAL	2	127.77	97.43	0.39
OYSTER CREEK ROUTE 9 BRIDGE (14)					
TOTAL		26	80194.43		
FAMILY XANTHIDAE	ZOEAL	13	28640.50	19858.80	35.71
NEOMYSIS AMERICANA	NO DETERM.	26	16059.90	5845.56	20.03
AMPELISCA SPP.	NO DETERM.	4	7911.49	7058.36	9.87
CRANGON SEPTEMSPINOSA	ZOEAL	15	4336.59	1617.81	5.41
UNIDENTIFIED AMPHIPODA	NO DETERM.	26	4116.79	1245.44	5.13
SARSIA SPP	NO DETERM.	4	3992.90	3626.79	4.98
RATHKEA OCTOPUNCTATA	NO DETERM.	4	3575.27	786.30	4.46
SAGITTA ELEGANS	NO DETERM.	2	1899.04	861.97	2.37
PALAEMONETES SPP	ZOEAL	12	1555.20	822.14	1.94
OXYUROSTYLIS SMITHI	NO DETERM.	16	1250.12	996.03	1.56
LEUCON AMERICANUS	NO DETERM.	20	740.11	450.96	0.92
BARNACLE CYPRIS	LARVAL	2	739.32	142.63	0.92
CLASS POLYCHAETA	LARVAL	7	720.39	813.41	0.90
MYSIDOPSIS BIGELOWI	NO DETERM.	14	687.25	476.55	0.86

Table C1-330. Comparison of the mean density of common and important macrozooplankton between Forked River (Sta. 6) and Oyster Creek (50) from March 1976 through March 1977.

	Ambient Temperature[a]	Mean Density (n/1000m³) Forked River	Oyster Creek	Percent Difference	Difference Between Canals Significant[b]	Number of Dates Density at 6 > 50
Neomysis americana	Below 18 C	38,893	13,683	-65	Y	6 of 6
	Above 18 C	25,087	1,806	-92	Y	6 of 7
Mysidopsis bigelowi	"	919	319	-65	NT[c]	3 of 4
	"	2,107	550	-74	Y	4 of 6
Unidentified Amphipoda	"	2,721	3,164	+14	N	2 of 6
	"	18,156	3,643	-80	Y	6 of 7
Crangon septemspinosa	"	113	22	-80	N	3 of 4
	"	134	10	-93	Y	6 of 6
C. septemspinosa (zoeae)	"	9,296	4,950	-47	Y	6 of 6
	"	4,305	1,746	-59	N	4 of 5
Edotea triloba	"	101	169	+40	N	1 of 3
	"	1,886	295	-84	Y	7 of 7
Palaemonetes spp.	"	77	26	-66	N	5 of 6
	"	87	134	+35	N	4 of 7
Polychaete larvae	"	4,830	1,029	-79	NT	2 of 4
	"	922	114	-88	NT	3 of 5
Caprellidae	"	98	15	-85	NT	4 of 4
	"	3,024	933	-69	NT	6 of 7
Oxyurostylis smithi	"	1,098	87	-92	N	3 of 6
	"	6,429	1,118	-83	Y	7 of 7
Leucon americanus	"	596	595	0	N	2 of 6
	"	2,263	1,097	-52	Y	6 of 7
Sarsia spp.	"	23,928	10,202	-56	NT	2 of 2
	"	-	-	-	-	-
Rathkea octopunctata	"	23,326	3,952	-83	NT	2 of 3
	"	-	-	-	-	-
Xanthidae (zoeae)	"	-	-	-	-	-
	"	88,153	49,488	-44	Y	5 of 7
Palaemonetes spp. (zoeae)	"	-	-	-	-	-
	"	1,994	8,600	+67	Y	1 of 7
Other zoeae[d]	"	-	-	-	-	-
	"	1,562	338	-78	Y	6 of 6
Callinectes sapidus (megalopae)	"	-	-	-	-	-
	"	223	64	-71	NT	3 of 3
Nereis spp. (epitokes)	"	-	-	-	-	-
	"	353	107	-70	Y	6 of 7
Ampelisca spp.	"	-	-	-	-	-
	"	7,964	580	-93	NT	2 of 4
Mnemiopsis leidyi	"	-	-	-	-	-
	"	430	136	-68	NT	2 of 3
Beroe ovata	"	-	-	-	-	-
	"	87	29	-67	NT	1 of 2
Total Macrozooplankton	"	117,388	48,794	-58	Y	6 of 6
	"	189,700	72,480	-57	Y	6 of 7

a Below 18 C, March 1976 and October through March; above 18 C, April through September
b Wilcoxon "T" test
c Not tested
d Includes Hippolyte spp., Upogebia spp., Pagurus spp., and Libinia spp.

TABLE C1-331. MEAN DENSITIES (n/1000m^3) OF MACROZOOPLANKTON COLLECTED AT STATIONS IN FORKED RIVER AND OYSTER CREEK FROM MAY THROUGH SEPTEMBER 1976 (WATER TEMPERATURE ABOVE 18C).

	ROUTE 9 BRIDGE											
	FORKED RIVER (6)						OYSTER CREEK (14)					
SPECIES	FREQ	MEAN	MIN	MAX	SDEV	CVAR	FREQ	MEAN	MIN	MAX	SDEV	CVAR
LIFE STAGE: NO DETERMINATION												
CLASS HYDROZOA	1	83	1164	1164	311	374	0	-	-	-	-	-
TURRITOPSIS NUTRICOLA	8	575	133	3148	881	153	3	171	150	1667	458	267
ORDER ACTINIARIA	0	-	-	-	-	-	3	28	63	184	60	217
PHYLUM CTENOPHORA	1	130	1813	1813	485	374	1	5	75	75	20	374
MNEMIOPSIS LEIDYI	5	430	159	3256	890	207	4	156	84	1078	346	222
BEROE SPP	2	87	133	1087	290	333	3	14	54	75	29	201
CLASS BIVALVIA	1	18	250	250	67	374	0	-	-	-	-	-
ENSIS DIRECTUS	0	-	-	-	-	-	1	3	40	40	11	374
CLASS POLYCHAETA	3	52	36	500	139	267	4	73	36	635	174	238
FAMILY PHYLLODOCIDAE	2	26	48	318	85	325	2	14	46	149	41	293
FAMILY SYLLIDAE	4	198	192	1164	387	196	4	106	217	574	192	181
NEREIS SPP	4	81	33	500	170	210	3	13	46	72	26	203
FAMILY CAPITELLIDAE	3	116	192	1115	303	261	1	2	34	34	9	374
SCOLECOLEPIDES VIRIDIS	1	3	35	35	9	374	0	-	-	-	-	-
DIOPATRA CUPREA	5	126	33	1106	305	242	2	10	46	100	29	274
CLASS OLIGOCHAETA	0	-	-	-	-	-	1	41	574	574	153	374
SUBPHYLUM PYCNOGONIDA	7	576	192	3005	939	163	8	289	168	1111	368	127
ORDER CUMACEA	1	11	159	159	42	374	0	-	-	-	-	-
CYCLASPIS VARIANS	4	152	290	769	279	184	1	16	217	217	58	374
LEUCON AMERICANUS	13	2263	192	5333	1699	75	13	1114	250	2867	700	63
OXYUROSTYLIS SMITHI	11	6429	580	28546	9636	150	12	2172	140	9176	2832	130
COROPHIUM SPP	2	485	385	6400	1706	352	3	125	168	1085	308	246
ORDER CAPRELLIDEA	13	3024	558	6667	2176	72	12	1490	542	5378	1502	101
UNIDENTIFIED MYSIDS	1	34	476	476	127	374	1	12	168	168	45	374
MYSIDOPSIS BIGELOWI	9	2107	769	7143	2308	110	9	1028	840	2909	918	89
NEOMYSIS AMERICANA	13	25087	36	156000	44875	179	14	6331	1111	20313	6053	96
PALAEMONETES VULGARIS	2	10	67	73	25	254	1	8	108	108	29	374
PALAEMONETES SPP	7	77	34	577	152	197	6	119	39	778	251	210
CRANGON SEPTEMSPINOSA	9	134	36	688	209	156	6	33	36	125	45	135
SAGITTA SPP	1	10	133	133	36	374	0	-	-	-	-	-
LEPTOSYNAPTA SPP	4	13	34	63	22	171	2	6	42	46	16	255
SUBORDER DORIDACEA	1	27	376	376	100	374	1	24	336	336	90	374
INVERTEBRATE FRAGMENTS	0	-	-	-	-	-	2	24	149	184	61	256
SCOLOPLOS SPP	3	11	40	71	23	209	0	-	-	-	-	-
PECTINARIA GOULDII	1	80	1115	1115	298	374	0	-	-	-	-	-
PODARKE OBSCURA	5	69	73	592	157	227	6	43	34	336	89	208
GLYCERA SPP	2	10	40	96	27	278	0	-	-	-	-	-
LIRONECA OVALIS	3	10	33	73	22	217	4	47	46	479	127	271
IDOTEA BALTICA	5	33	33	238	66	198	7	295	34	1600	510	173
EDOTEA TRILOBA	12	1886	192	5575	1831	97	7	325	217	1008	389	120
ERICHSONELLA SP	2	80	48	1067	284	357	1	12	168	168	45	374
UNIDENTIFIED AMPHIPODA	15	18156	1400	52571	15375	85	14	6413	1147	12218	3326	52
AMPELISCA SPP.	4	7964	6690	73143	19765	248	4	12507	563	103051	32018	256
LIFE STAGE: JUVENILES												
CALLINECTES SAPIDUS	7	133	63	946	248	187	7	90	42	574	159	176
CALLINECTES SPP.	3	65	48	801	213	325	2	11	39	109	30	285
	14	70858					14	33172				

TABLE C1-331. (CONT.)

SPECIES	ROUTE 9 BRIDGE											
	FORKED RIVER (6)						OYSTER CREEK (14)					
	FREQ	MEAN	MIN	MAX	SDEV	CVAR	FREQ	MEAN	MIN	MAX	SDEV	CVAR
LIFE STAGE: GRAVID												
CLASS POLYCHAETA	1	159	2230	2230	596	374	1	16	217	217	58	374
FAMILY SYLLIDAE	4	271	533	1746	515	190	4	131	299	750	236	180
SUBPHYLUM PYCNOGONIDA	1	11	159	159	42	374	0	-	-	-	-	-
COROPHIUM SPP	1	152	2133	2133	570	374	0	-	-	-	-	-
NEOMYSIS AMERICANA	1	71	1000	1000	267	374	0	-	-	-	-	-
PALAEMONETES VULGARIS	1	3	36	36	10	374	1	5	72	72	19	374
PALAEMONETES SPP	2	5	33	35	12	254	0	-	-	-	-	-
CRANGON SEPTEMSPINOSA	1	2	34	34	9	374	0	-	-	-	-	-
IDOTEA BALTICA	3	11	40	67	23	205	0	-	-	-	-	-
UNIDENTIFIED AMPHIPODA	4	459	36	3148	990	216	4	109	63	737	235	216
AMPELISCA SPP.	0	-	-	-	-	-	2	237	1147	2170	635	268
LIFE STAGE: LARVAL												
CLASS POLYCHAETA	4	922	192	10592	2822	306	1	16	217	217	58	374
LIFE STAGE: ZOEAL												
ORDER DECAPODA	1	11	159	159	42	374	0	-	-	-	-	-
PALAEMONETES SPP	9	1994	133	7467	2632	132	12	3027	479	6984	2847	94
HIPPOLYTE SPP.	4	108	159	582	196	181	2	125	149	1600	426	341
CRANGON SEPTEMSPINOSA	9	4305	376	26760	8549	199	4	1379	84	9176	3131	227
UPOGEBIA AFFINIS	7	537	192	3148	893	166	5	365	168	2909	848	233
PAGURUS SP	7	317	133	1746	491	155	4	137	217	582	240	175
LIBINIA SPP	3	180	192	1746	478	266	1	78	1085	1085	290	374
FAMILY XANTHIDAE	14	88153	192	406893	127722	145	12	53708	5217	247104	74945	140
UCA SPP.	2	92	290	1000	272	296	1	31	435	435	116	374
INFRAORDER BRACHYURA	2	190	376	2286	611	322	4	571	168	3797	1303	228
LIFE STAGE: MEGALOPAL												
CALLINECTES SAPIDUS	3	223	750	1600	482	216	4	65	140	299	111	171
INFRAORDER BRACHYURA	4	281	192	2133	607	216	3	97	420	500	193	199
LIFE STAGE: EPITOKES												
NEREIS SPP	11	383	105	938	323	84	9	155	40	380	153	99
	14	98842					14	60249				

TABLE C1-331. (CONT.)

SPECIES	MOUTH											
	FORKED RIVER (45)						OYSTER CREEK (50)					
	FREQ	MEAN	MIN	MAX	SDEV	CVAR	FREQ	MEAN	MIN	MAX	SDEV	CVAR
LIFE STAGE: NO DETERMINATION												
TURRITOPSIS NUTRICOLA	4	269	160	2963	786	293	6	212	138	1296	367	173
ORDER ACTINIARIA	0	-	-	-	-	-	1	11	147	147	39	374
MNEMIOPSIS LEIDYI	6	312	337	1204	414	133	4	136	338	608	235	172
BEROE SPP	3	57	160	374	120	212	3	29	74	207	63	219
CLASS GASTROPODA	1	30	419	419	112	374	0	-	-	-	-	-
ORDER NUDIBRANCHIA	1	11	153	153	41	374	0	-	-	-	-	-
CLASS BIVALVIA	2	95	209	1123	301	316	1	3	39	39	10	374
ENSIS DIRECTUS	2	88	43	1185	316	360	0	-	-	-	-	-
LOLIGO PEALEI	0	-	-	-	-	-	1	5	69	69	18	374
CLASS POLYCHAETA	1	39	539	539	144	374	1	14	193	193	52	374
FAMILY PHYLLODOCIDAE	5	120	35	1199	324	270	2	8	39	71	21	266
FAMILY SYLLIDAE	6	1130	37	8927	2706	239	2	25	147	202	64	258
FAMILY NEREIDAE	1	24	336	336	90	374	0	-	-	-	-	-
NEREIS SPP	7	169	37	1116	306	181	2	6	36	48	15	257
FAMILY CAPITELLIDAE	3	138	70	1714	456	329	1	45	623	623	167	374
FAMILYNIDAE SPIONIDAE	1	54	750	750	200	374	0	-	-	-	-	-
DIOPATRA CUPREA	8	310	36	1778	573	185	2	48	286	392	125	258
SUBPHYLUM PYCNOGONIDA	9	472	37	2424	701	149	2	94	455	860	252	268
CYCLASPIS VARIANS	2	42	153	428	118	285	2	24	138	193	61	258
LEUCON AMERICANUS	12	1188	160	3529	992	84	11	1097	138	3416	1194	109
OXYUROSTYLIS SMITHI	9	5062	160	30215	9291	184	9	1118	242	5385	1754	157
MICRODEUTOPUS GRYLLOTALPA	1	171	2397	2397	641	374	0	-	-	-	-	-
COROPHIUM SPP	1	204	2857	2857	764	374	3	94	202	894	242	259
FAMILY GAMMARIDAE	1	86	1199	1199	320	374	0	-	-	-	-	-
JASSA FALCATA	0	-	-	-	-	-	1	22	311	311	83	374
MELITA NITIDA	0	-	-	-	-	-	1	45	623	623	167	374
FAMILY STENOTHOIDAE	1	86	1199	1199	320	374	0	-	-	-	-	-
ORDER CAPRELLIDEA	10	1863	640	5657	2068	111	10	933	256	4040	1316	141
MYSIDOPSIS BIGELOWI	8	1210	523	5562	1773	147	11	550	59	2020	641	117
NEOMYSIS AMERICANA	14	10398	356	23529	8002	77	14	1806	441	4638	1451	80
ORDER DECAPODA	0	-	-	-	-	-	1	41	580	580	155	374
PALAEMONETES VULGARIS	1	8	107	107	29	374	1	18	254	254	68	374
PALAEMONETES SPP	11	272	43	1213	351	129	8	116	64	605	165	142
HIPPOLYTE SPP.	1	9	131	131	35	374	0	-	-	-	-	-
CRANGON SEPTEMSPINOSA	6	57	37	250	85	149	3	10	36	54	20	202
LEPTOSYNAPTA SPP	2	9	35	84	24	278	1	41	571	571	153	374
SUBORDER DORIDACEA	3	89	209	613	194	218	0	-	-	-	-	-
SUBORDER AEOLIDACEA	2	18	37	209	56	319	0	-	-	-	-	-
INVERTEBRATE FRAGMENTS	2	14	70	131	38	268	1	11	147	147	39	374
HYDROIDES DIANTHUS	1	33	460	460	123	374	0	-	-	-	-	-
SCOLOPLOS SPP	5	283	160	1393	494	175	1	3	36	36	10	374
PODARKE OBSCURA	8	84	43	428	118	141	4	37	36	374	99	267
STAURONEREIS RUDOLPHI	0	-	-	-	-	-	1	10	138	138	37	374
GLYCERA SPP	1	6	80	80	21	374	0	-	-	-	-	-
ORDER ISOPODA	1	5	74	74	20	374	0	-	-	-	-	-
LIRONECA OVALIS	5	22	36	160	43	194	3	17	36	147	41	244
CHIRIDOTEA NIGRESCENS	0	-	-	-	-	-	1	2	32	32	9	374
IDOTEA BALTICA	7	191	34	1259	366	192	7	230	59	1779	480	209
EDOTEA TRILOBA	8	844	160	3556	1300	154	9	295	143	1212	353	119
ERICHSONELLA SP	3	35	35	303	87	249	2	9	59	71	24	255
UNIDENTIFIED AMPHIPODA	13	14996	1920	74464	21682	145	12	3643	298	13786	4308	118
AMPELISCA SPP.	6	3534	672	28071	7832	222	7	580	48	3551	1028	177
LIFE STAGE: JUVENILES												
OVALIPES OCELLATUS	0	-	-	-	-	-	1	3	36	36	10	374
CALLINECTES SAPIDUS	8	158	35	857	275	174	6	96	39	761	213	221
CALLINECTUS SPP.	2	11	75	77	28	254	0	-	-	-	-	-
FAMILY XANTHIDAE	0	-	-	-	-	-	1	48	676	676	181	374

TABLE C1-331. (CONT.)

	MOUTH											
	FORKED RIVER (45)						OYSTER CREEK (50)					
SPECIES	FREQ	MEAN	MIN	MAX	SDEV	CVAR	FREQ	MEAN	MIN	MAX	SDEV	CVAR
LIFE STAGE: GRAVID												
FAMILY SYLLIDAE	4	92	153	480	166	180	2	33	54	414	110	330
CYCLASPIS VARIANS	0	-	-	-	-	-	1	18	256	256	68	374
LEUCON AMERICANUS	0	-	-	-	-	-	2	123	580	1143	332	270
OXYUROSTYLIS SMITHI	0	-	-	-	-	-	1	3	48	48	13	374
COROPHIUM SPP	1	41	571	571	153	374	1	45	623	623	167	374
MYSIDOPSIS BIGELOWI	0	-	-	-	-	-	1	3	48	48	13	374
NEOMYSIS AMERICANA	2	5	35	37	13	254	0	-	-	-	-	-
PALAEMONETES VULGARIS	1	3	36	36	10	374	1	3	36	36	10	374
IDOTEA BALTICA	1	6	84	84	22	374	1	3	47	47	13	374
UNIDENTIFIED AMPHIPODA	2	141	153	1821	485	344	3	128	32	1714	457	356
AMPELISCA SPP.	1	72	1008	1008	269	374	1	4	51	51	14	374
LIFE STAGE: LARVAL												
ORDER NUDIBRANCHIA	1	13	178	178	48	374	0	-	-	-	-	-
CLASS POLYCHAETA	4	296	178	2060	616	208	3	114	143	934	274	241
LIFE STAGE: ZOEAL												
PALAEMONETES SPP	9	3941	178	34556	9246	235	14	8600	147	45143	14489	168
HIPPOLYTE SPP.	1	22	307	307	82	374	1	14	202	202	54	374
CRANGON SEPTEMSPINOSA	7	11073	336	69614	21304	192	5	1746	215	8492	3119	179
FAMILY CALLIANASSIDAE	1	11	153	153	41	374	0	-	-	-	-	-
UPOGEBIA AFFINIS	8	755	419	3556	1097	145	2	81	569	571	207	254
PAGURUS SP	6	175	131	766	256	147	4	83	138	571	165	198
LIBINIA SPP	2	107	307	1185	321	301	2	25	143	202	64	258
FAMILY XANTHIDAE	12	46355	8107	138105	47315	102	14	49488	588	275464	77849	157
UCA SPP.	2	90	428	838	244	269	0	-	-	-	-	-
INFRAORDER BRACHYURA	5	549	571	4310	1159	211	3	201	808	1143	405	202
LIFE STAGE: MEGALOPAL												
CALLINECTES SAPIDUS	5	690	336	2995	1117	162	4	64	138	374	118	184
INFRAORDER BRACHYURA	5	329	178	2139	622	189	3	60	179	386	126	210
LIFE STAGE: EPITOKES												
NEREIS SPP	9	338	80	1148	403	119	10	107	39	544	148	139
	14	65103					14	60947				

TABLE C1-331. (CONT.)

SPECIES	LAGOON											
	FORKED RIVER (46)						OYSTER CREEK (30)					
	FREQ	MEAN	MIN	MAX	SDEV	CVAR	FREQ	MEAN	MIN	MAX	SDEV	CVAR
LIFE STAGE: NO DETERMINATION												
CLASS HYDROIDA	0	-	-	-	-	-	1	35	485	485	130	374
TURRITOPSIS NUTRICOLA	3	90	252	709	205	227	6	59	105	185	73	123
PHYLUM CTENOPHORA	0	-	-	-	-	-	1	4	62	62	17	374
MNEMIOPSIS LEIDYI	6	1657	53	8817	3158	191	6	168	265	648	223	132
BEROE SPP	3	39	76	284	88	225	2	47	146	513	140	297
CLASS BIVALVIA	0	-	-	-	-	-	1	3	38	38	10	374
CLASS POLYCHAETA	2	38	243	284	96	255	3	38	86	300	87	230
FAMILY PHYLLODOCIDAE	3	29	53	258	72	246	1	3	38	38	10	374
AUTOLYTUS FASCIATUS	0	-	-	-	-	-	1	0	6	6	2	-
FAMILY CAPITELLIDAE	0	-	-	-	-	-	1	18	247	247	66	374
FAMILYNIDAE SPIONIDAE	1	70	976	976	261	374	0	-	-	-	-	-
DIOPATRA CUPREA	0	-	-	-	-	-	3	19	52	158	45	232
CLASS OLIGOCHAETA	1	969	13563	13563	3625	374	1	107	1498	1498	400	374
SUBPHYLUM PYCNOGONIDA	1	15	206	206	55	374	2	76	171	895	240	315
ORDER CUMACEA	1	28	395	385	103	374	0	-	-	-	-	-
CYCLASPIS VARIANS	4	138	284	745	252	182	3	56	121	342	121	216
LEUCON AMERICANUS	10	2176	774	8302	2498	115	8	558	6	3333	963	173
OXYUROSTYLIS SMITHI	4	266	206	1584	556	209	10	353	6	1875	517	147
COROPHIUM SPP	0	-	-	-	-	-	1	86	1199	1199	320	374
ORDER CAPRELLIDEA	5	193	303	1031	312	161	9	208	146	625	207	100
MYSIDOPSIS BIGELOWI	10	6505	1212	27302	7576	116	10	2708	986	9684	2770	102
NEOMYSIS AMERICANA	14	23454	850	69161	21401	91	14	3010	141	11364	3938	131
PALAEMONETES SPP	4	92	71	619	204	223	8	217	123	1368	359	165
CRANGON SEPTEMSPINOSA	0	-	-	-	-	-	1	9	123	123	33	374
SUBORDER DORIDACEA	1	18	248	248	66	374	0	-	-	-	-	-
SUBORDER AEOLIDACEA	0	-	-	-	-	-	1	13	185	185	49	374
INFRAORDER BRACHYURA	0	-	-	-	-	-	1	17	242	242	65	374
SCOLOPLOS SPP	1	18	258	258	69	374	1	0	6	6	2	-
FAMILY AMPHARETIDAE	3	74	41	792	214	288	1	21	300	300	80	374
GLYCERA CAPITATA	1	31	430	430	115	374	0	-	-	-	-	-
PODARKE OBSCURA	0	-	-	-	-	-	6	24	6	104	36	146
FAMILY HESIONIDAE	0	-	-	-	-	-	2	19	53	208	56	302
ORDER ISOPODA	1	15	212	212	57	374	0	-	-	-	-	-
LIRONECA OVALIS	5	47	41	303	92	198	6	81	35	449	146	180
IDOTEA BALTICA	4	28	53	152	49	180	5	44	52	309	86	194
EDOTEA TRILOBA	4	103	142	792	221	214	6	123	141	421	164	133
UNIDENTIFIED AMPHIPODA	14	2879	426	11887	3465	120	14	2219	123	10208	2994	135
AMPELISCA SPP.	4	1156	792	6235	2291	198	2	163	485	1798	488	299
LIFE STAGE: JUVENILES												
CALLINECTES SAPIDUS	0	-	-	-	-	-	8	39	38	105	39	99
	14	40127					14	10545				

TABLE C1-331. (CONT.)

	LAGOON											
	FORKED RIVER (46)						OYSTER CREEK (30)					
SPECIES	FREQ	MEAN	MIN	MAX	SDEV	CVAR	FREQ	MEAN	MIN	MAX	SDEV	CVAR
LIFE STAGE: GRAVID												
FAMILY SYLLIDAE	1	10	142	142	38	374	2	21	141	146	52	254
LEUCON AMERICANUS	0	-	-	-	-	-	2	59	202	625	172	290
COROPHIUM SPP	1	3	41	41	11	374	0	-	-	-	-	-
MYSIDOPSIS BIGELOWI	0	-	-	-	-	-	3	54	121	421	122	229
NEOMYSIS AMERICANA	6	354	152	1818	552	156	3	249	970	1474	506	203
IDOTEA BALTICA	0	-	-	-	-	-	1	6	86	86	23	374
UNIDENTIFIED AMPHIPODA	1	57	792	792	212	374	2	25	140	208	65	260
AMPELISCA SPP.	0	-	-	-	-	-	1	21	300	300	80	374
LIFE STAGE: LARVAL												
CLASS POLYCHAETA	0	-	-	-	-	-	1	5	64	64	17	374
LIFE STAGE: ZOEAL												
PALAEMONETES SPP	8	798	303	3093	1071	134	13	2238	141	8090	2419	108
HIPPOLYTE SPP.	0	-	-	-	-	-	1	0	6	6	2	-
CRANGON SEPTEMSPINOSA	7	1717	206	9756	3421	199	6	1778	208	9333	3257	183
UPOGEBIA AFFINIS	2	125	774	976	320	256	8	233	64	1094	368	158
PAGURUS SP	2	26	152	206	66	258	4	41	62	242	80	198
LIBINIA SPP	1	15	206	206	55	374	4	86	121	421	158	183
FAMILY XANTHIDAE	12	5622	248	17935	6604	117	14	22033	439	70260	21777	99
INFRAORDER BRACHYURA	1	64	891	891	238	374	2	67	202	741	201	299
LIFE STAGE: MEGALOPAL												
CALLINECTES SAPIDUS	2	95	426	909	260	273	3	57	185	423	125	219
INFRAORDER BRACHYURA	6	783	430	4546	1322	169	5	169	128	1026	321	189
LIFE STAGE: EPITOKES												
NEREIS SPP	9	223	63	810	294	132	3	16	38	121	36	225
	14	9889					14	27159				

TABLE C1-332. Monthly mean densities (n/m^3) and biomass (mg/m^3) of ichthyoplankton collected at three stations (14, 30, 50) in Oyster Creek east of the Route 9 bridge and three stations (45, 46, 6) in Forked River east of Route 9 bridge from March 1976 through March 1977.

MONTH	MARCH											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	1.0 - 1.0		0.0 - 0.0		1.0 - 1.0		0.0 - 0.0		1.0 - 1.0		0.0 - 1.0	
SURFACE	8.2 - 8.2		11.3 - 11.3		8.8 - 8.8		9.5 - 9.5		8.0 - 8.0		11.5 - 11.5	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
SALINITY: SURFACE	22.0 - 22.5		21.5 - 22.0		21.0 - 21.0		20.0 - 20.0		22.0 - 22.0		22.0 - 22.0	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
OXYGEN: SURFACE	11.6 - 11.6		11.0 - 11.0		11.0 - 11.0		10.8 - 10.8		11.2 - 11.2		10.9 - 10.9	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
PH: SURFACE	7.5 - 7.5		7.4 - 7.4		7.5 - 7.5		7.4 - 7.4		7.5 - 7.5		7.5 - 7.5	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
ALOSA AESTIVALIS	-	-	0.024	-	-	-	-	-	-	-	-	-
LARVAE												
ANGUILLA ROSTRATA	0.198	-	0.330	-	0.391	-	0.233	-	0.122	-	0.324	-
BREVOORTIA TYRANNUS	-	-	0.047	-	0.040	-	-	-	-	-	-	-
CLUPEA HARENGUS	0.024	0.5	0.024	-	0.039	-	-	-	-	-	-	-
FAMILY ATHERINIDAE	-	-	0.024	-	-	-	-	-	-	-	-	-
AMMODYTES SP.	2.125	-	1.364	-	0.816	-	0.868	-	0.654	-	2.071	-
PSEUDOPLEURONECTES AMERICANUS	1.257	0.1	1.716	0.4	1.926	-	3.073	-	2.597	0.0	2.070	0.3
EGGS												
UNIDENTIFIED FISH	-	-	-	-	-	-	-	-	0.101	-	-	-
TOTAL LARVAE & JUVENILES	3.603	0.6	3.527	0.4	3.211	0.0	4.173	0.0	3.373	0.0	4.465	0.3
TOTAL EGGS	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.101	0.0	0.000	0.0
TOTAL COLLECTIONS	2		2		2		2		2		2	

TABLE C1-332. (CONT.)

MONTH	APRIL											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	22.0 - 22.0		17.0 - 17.0		19.5 - 20.0		17.0 - 17.0		19.0 - 19.0		18.0 - 18.0	
SURFACE	21.0 - 21.0		25.5 - 26.0		21.5 - 21.5		22.5 - 22.5		20.5 - 20.5		25.7 - 25.7	
BOTTOM	21.0 - 21.0		25.5 - 26.0		20.5 - 20.5		17.5 - 17.5		20.9 - 20.9		25.5 - 25.5	
SALINITY: SURFACE	22.5 - 22.5		22.0 - 22.0		21.0 - 21.0		21.0 - 21.0		22.0 - 22.0		21.5 - 21.5	
BOTTOM	22.0 - 22.0		21.5 - 22.0		22.0 - 22.0		21.5 - 21.5		22.0 - 22.0		22.0 - 22.0	
OXYGEN: SURFACE	9.7 - 9.8		7.6 - 7.8		10.0 - 10.0		8.6 - 8.6		9.3 - 9.3		8.6 - 8.6	
BOTTOM	9.6 - 9.6		7.6 - 7.8		10.0 - 10.0		6.6 - 6.6		8.8 - 8.8		8.2 - 8.2	
PH: SURFACE	7.9 - 7.9		8.0 - 8.0		8.1 - 8.1		8.1 - 8.1		8.0 - 8.0		- - -	
BOTTOM	7.9 - 7.9		8.0 - 8.0		7.5 - 7.5		7.6 - 7.6		8.1 - 8.1		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE												
ANGUILLA ROSTRATA	-	-	0.146	-	-	-	0.352	-	0.093	-	0.139	-
BREVOORTIA TYRANNUS	-	-	-	-	0.027	5.0	-	-	-	-	-	-
EGGS												
ANCHOA MITCHILLI	-	-	-	-	-	-	-	-	-	-	0.109	-
TAUTOGA ONITIS	-	-	-	-	0.121	-	-	-	-	-	0.055	-
TOTAL LARVAE & JUVENILES	0.000	0.0	0.146	0.0	0.027	5.0	0.352	0.0	0.093	0.0	0.139	0.0
TOTAL EGGS	0.000	0.0	0.000	0.0	0.121	0.0	0.000	0.0	0.000	0.0	0.163	0.0
TOTAL COLLECTIONS	2		2		2		2		2		2	

TABLE C1-332. (CONT.)

MONTH	MAY											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	9.5 - 9.5		10.0 - 10.0		10.0 - 10.0		8.0 - 9.0		9.0 - 9.0		8.0 - 9.0	
SURFACE	20.0 - 20.0		25.5 - 25.5		19.5 - 19.5		24.0 - 24.0		19.5 - 19.5		24.0 - 24.0	
BOTTOM	18.0 - 18.0		- - -		18.5 - 18.5		21.0 - 22.0		18.0 - 18.0		21.0 - 22.0	
SALINITY: SURFACE	22.5 - 23.5		22.5 - 22.5		22.5 - 22.5		22.5 - 22.5		24.0 - 24.0		22.5 - 22.5	
BOTTOM	22.5 - 23.0		- - -		24.0 - 24.0		22.5 - 22.5		24.0 - 24.0		22.0 - 22.5	
OXYGEN: SURFACE	8.2 - 8.9		- - -		- - -		- - -		- - -		- - -	
BOTTOM	8.0 - 8.0		- - -		- - -		- - -		- - -		- - -	
PH: SURFACE	- - -		- - -		- - -		- - -		- - -		- - -	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
SYNGNATHUS FUSCUS	1.089	-	0.097	-	-	-	-	-	0.145	-	-	-
POMATOMUS SALTATRIX	-	-	-	-	-	-	0.018	-	-	-	-	-
LARVAE												
ANGUILLA ROSTRATA	-	-	-	-	-	-	-	-	0.018	-	-	-
ANCHOA MITCHILLI	-	-	0.040	-	-	-	-	-	-	-	-	-
FUNDULUS HETEROCLITUS	-	-	-	-	-	-	0.019	-	-	-	-	-
FAMILY ATHERINIDAE	-	-	0.254	-	0.041	-	-	-	0.075	-	-	-
FAMILY BLENNIIDAE	-	-	-	-	-	-	0.038	-	-	-	-	-
FAMILY GOBIIDAE	2.232	-	0.685	-	-	-	1.170	-	1.123	-	0.759	-
EGGS												
ANCHOA MITCHILLI	243.972	-	50.176	-	23.077	-	29.841	-	435.615	-	42.592	-
TAUTOGA ONITIS	1.089	-	-	-	-	-	-	-	0.600	-	0.623	-
TAUTOGOLABRUS ADSPERSUS	-	-	-	-	-	-	-	-	-	-	0.312	-
TRINECTES MACULATUS	2.232	-	0.318	-	-	-	1.049	-	-	-	0.224	-
UNIDENTIFIED FISH	2.232	-	1.588	-	-	-	2.907	-	-	-	1.118	-
TOTAL LARVAE & JUVENILES	3.320	0.0	1.076	0.0	0.041	0.0	1.244	0.0	1.361	0.0	0.759	0.0
TOTAL EGGS	249.522	0.0	52.081	0.0	23.077	0.0	33.796	0.0	436.214	0.0	44.867	0.0
TOTAL COLLECTIONS	2		2		2		2		2		2	

TABLE C1-332. (CONT.)

MONTH	JUNE											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	14.5 - 14.5		13.5 - 13.5		13.5 - 13.5		13.5 - 13.5		14.0 - 14.0		13.5 - 13.5	
SURFACE	18.5 - 18.5		23.5 - 23.5		19.1 - 19.1		22.1 - 22.1		18.1 - 18.1		23.1 - 23.1	
BOTTOM	18.5 - 18.5		24.0 - 24.0		19.0 - 19.0		22.2 - 22.2		18.2 - 18.2		23.0 - 23.0	
SALINITY: SURFACE	22.0 - 22.0		22.0 - 22.0		22.5 - 22.5		22.5 - 22.5		22.0 - 22.0		22.0 - 22.0	
BOTTOM	22.0 - 22.5		22.0 - 22.0		23.0 - 23.0		22.5 - 22.5		22.0 - 22.0		22.0 - 22.0	
OXYGEN: SURFACE	9.1 - 9.3		8.8 - 8.8		9.5 - 9.5		8.9 - 8.9		8.9 - 8.9		8.6 - 8.6	
BOTTOM	8.0 - 8.6		8.1 - 8.1		9.0 - 9.0		8.1 - 8.1		8.0 - 8.0		7.7 - 7.7	
PH: SURFACE	8.1 - 8.4		8.0 - 8.0		7.9 - 7.9		7.5 - 7.5		7.9 - 7.9		7.8 - 7.8	
BOTTOM	8.1 - 8.1		7.9 - 7.9		8.0 - 8.0		7.8 - 7.8		7.9 - 7.9		7.9 - 7.9	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
ANGUILLA ROSTRATA	0.035	-	-	-	-	-	-	-	0.022	-	-	-
SYNGNATHUS FUSCUS	1.224	-	0.089	-	0.136	-	0.092	-	0.726	-	0.281	-
LARVAE												
FAMILY ATHERINIDAE	-	-	0.017	-	0.056	-	0.031	-	0.018	-	0.105	-
APELTES QUADRACUS	-	-	-	-	-	-	-	-	0.022	-	-	-
FAMILY BLENNIIDAE	-	-	-	-	0.031	-	0.274	-	-	-	0.290	-
FAMILY GOBIIDAE	0.576	-	2.285	-	0.252	-	0.793	-	0.022	-	0.291	-
EGGS												
ANCHOA MITCHILLI	84.419	-	216.285	-	47.636	-	53.152	-	345.113	-	42.864	-
TAUTOGA ONITIS	0.558	-	1.131	-	-	-	0.031	-	-	-	-	-
TAUTOGOLABRUS ADSPERSUS	-	-	-	-	0.396	-	0.062	-	0.857	-	-	-
TRINECTES MACULATUS	-	-	6.168	-	-	-	0.031	-	-	-	2.826	-
UNIDENTIFIED FISH	-	-	0.287	-	-	-	-	-	-	-	0.257	-
TOTAL LARVAE & JUVENILES	1.835	0.0	2.390	0.0	0.473	0.0	1.189	0.0	0.809	0.0	0.966	0.0
TOTAL EGGS	84.976	0.0	223.871	0.0	48.032	0.0	53.276	0.0	345.970	0.0	45.947	0.0
TOTAL COLLECTIONS	2		2		2		2		2		2	

TABLE C1-332. (CONT.)

MONTH	JULY											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	21.0 - 23.0		20.0 - 23.0		21.0 - 23.0		20.0 - 23.0		21.0 - 23.0		20.0 - 23.0	
SURFACE	27.5 - 28.0		29.7 - 31.8		26.2 - 27.0		26.8 - 29.2		26.9 - 27.7		29.4 - 31.7	
BOTTOM	27.2 - 28.0		30.5 - 32.0		26.3 - 27.3		27.0 - 28.5		27.6 - 27.7		30.4 - 31.5	
SALINITY: SURFACE	27.0 - 28.0		26.5 - 27.5		26.0 - 28.0		26.0 - 27.5		26.0 - 28.0		26.5 - 27.0	
BOTTOM	27.0 - 27.5		26.5 - 27.0		27.5 - 30.0		26.0 - 27.5		27.0 - 28.0		27.0 - 27.5	
OXYGEN: SURFACE	6.1 - 7.2		6.0 - 6.6		6.9 - 8.4		6.8 - 7.0		6.1 - 7.3		6.1 - 6.6	
BOTTOM	5.4 - 7.0		5.8 - 6.7		5.2 - 7.6		6.1 - 7.5		6.5 - 7.1		6.0 - 6.6	
PH: SURFACE	- - -		- - -		- - -		- - -		- - -		- - -	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
ANGUILLA ROSTRATA	0.008	-	-	-	-	-	-	-	-	-	-	-
ANCHOA MITCHILLI	-	-	0.058	-	-	-	-	-	0.038	-	-	-
STRONGYLURA MARINA	-	-	-	-	-	-	-	-	-	-	0.009	-
MEMBRAS MARTINICA	-	-	0.021	-	-	-	-	-	-	-	-	-
MENIDIA MENIDIA	-	-	0.021	-	-	-	-	-	-	-	-	-
SYNGNATHUS FUSCUS	0.055	-	0.025	-	0.042	-	0.026	-	0.217	-	0.027	-
CARANX HIPPOS	0.008	-	-	-	-	-	-	-	-	-	-	-
CYNOSCION REGALIS	0.008	-	-	-	-	-	-	-	-	-	-	-
MUGIL CUREMA	-	-	-	-	-	-	-	-	0.009	-	-	-
HYPSOBLENNIUS HENTZI	-	-	-	-	0.013	-	-	-	-	-	-	-
GOBIOSOMA BOSCI	-	-	0.011	-	-	-	-	-	-	-	0.026	-
GOBIOSOMA GINSBURGI	-	-	0.023	-	-	-	-	-	-	-	-	-
LARVAE												
ANCHOA MITCHILLI	2.794	-	1.575	-	7.157	-	4.196	-	2.395	-	2.058	-
FUNDULUS HETEROCLITUS	0.017	-	-	-	-	-	-	-	-	-	-	-
FAMILY ATHERINIDAE	0.093	-	-	-	0.013	-	-	-	0.019	-	0.054	-
CYNOSCION REGALIS	0.010	-	-	-	-	-	-	-	-	-	-	-
ASTROSCOPUS GUTTATUS	-	-	-	-	-	-	0.013	-	-	-	-	-
FAMILY BLENNIIDAE	-	-	-	-	-	-	-	-	0.019	-	0.098	-
FAMILY GOBIIDAE	0.453	-	0.775	-	1.657	-	0.978	-	1.376	-	0.786	-
TRINECTES MACULATUS	-	-	-	-	-	-	-	-	-	-	0.072	-
UNIDENTIFIED FISH	-	-	-	-	-	-	-	-	0.010	-	-	-
EGGS												
ANCHOA MITCHILLI	14.138	-	32.014	-	15.326	-	17.962	-	144.784	-	13.733	-
TRINECTES MACULATUS	0.333	-	-	-	-	-	0.158	-	0.113	-	1.588	-
UNIDENTIFIED FISH	0.512	-	-	-	-	-	-	-	0.073	-	-	-
TOTAL LARVAE & JUVENILES	3.447	0.0	2.507	0.0	8.882	0.0	5.213	0.0	4.082	0.0	3.129	0.0
TOTAL EGGS	14.983	0.0	32.014	0.0	15.326	0.0	18.120	0.0	144.970	0.0	15.321	0.0
TOTAL COLLECTIONS	4		4		4		4		4		4	

TABLE C1-332. (CONT.)

MONTH	AUGUST											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	25.0 - 25.0		25.0 - 25.0		25.0 - 25.0		25.0 - 25.0		26.0 - 26.0		25.0 - 25.0	
SURFACE	24.8 - 28.6		28.5 - 32.6		25.5 - 27.6		28.5 - 30.7		24.8 - 28.6		28.0 - 31.6	
BOTTOM	28.5 - 28.5		32.6 - 32.6		25.0 - 26.6		28.0 - 29.5		24.9 - 28.6		28.0 - 31.6	
SALINITY: SURFACE	22.0 - 25.0		22.0 - 25.0		22.0 - 25.0		22.0 - 25.0		22.0 - 25.0		22.0 - 25.0	
BOTTOM	25.0 - 25.0		25.0 - 25.0		22.0 - 25.0		21.5 - 24.0		22.5 - 25.0		22.0 - 25.0	
OXYGEN: SURFACE	7.6 - 7.7		6.0 - 7.5		6.0 - 9.4		6.2 - 7.0		6.2 - 7.9		5.8 - 7.3	
BOTTOM	5.8 - 5.8		5.6 - 5.6		5.0 - 8.2		5.5 - 7.0		5.8 - 7.7		5.5 - 5.5	
PH: SURFACE	- - -		- - -		- - -		- - -		- - -		- - -	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
ANCHOA MITCHILLI	0.128	-	0.044	-	0.386	-	-	-	0.061	-	0.010	-
MEMBRAS MARTINICA	0.012	-	-	-	-	-	-	-	0.014	-	-	-
SYNGNATHUS FUSCUS	0.036	-	-	-	0.062	-	0.016	-	0.013	-	-	-
LARVAE												
ANCHOA MITCHILLI	5.296	-	1.618	-	3.040	-	1.772	-	1.883	-	1.182	-
FAMILY ATHERINIDAE	0.086	-	0.014	-	0.081	-	0.087	-	0.069	-	0.027	-
FAMILY GOBIIDAE	1.013	-	0.638	-	0.643	-	0.653	-	0.407	-	0.473	-
EGGS												
ANCHOA MITCHILLI	0.564	-	0.449	-	0.054	-	0.855	-	1.399	-	1.060	-
UNIDENTIFIED FISH	-	-	-	-	-	-	-	-	-	-	0.142	-
TOTAL LARVAE & JUVENILES	6.571	0.0	2.314	0.0	4.212	0.0	2.528	0.0	2.446	0.0	1.693	0.0
TOTAL EGGS	0.564	0.0	0.449	0.0	0.054	0.0	0.855	0.0	1.399	0.0	1.201	0.0
TOTAL COLLECTIONS	4		4		4		4		4		4	

TABLE C1-332. (CONT.)

MONTH	SEPTEMBER											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	- - -		- - -		22.0 - 22.0		- - -		- - -		- - -	
SURFACE	24.6 - 24.6		28.7 - 28.7		24.9 - 24.9		27.0 - 27.0		25.9 - 25.9		29.0 - 29.0	
BOTTOM	24.6 - 24.6		28.7 - 28.7		24.9 - 24.9		25.7 - 25.7		25.5 - 25.5		29.0 - 29.0	
SALINITY: SURFACE	25.0 - 25.0		25.0 - 25.0		25.0 - 25.0		25.0 - 25.0		25.0 - 25.0		25.0 - 25.0	
BOTTOM	25.0 - 25.0		25.0 - 25.0		25.0 - 25.0		25.0 - 25.0		25.0 - 25.0		25.0 - 25.0	
OXYGEN: SURFACE	7.9 - 7.9		7.4 - 7.4		9.4 - 9.4		7.6 - 7.6		8.2 - 8.2		7.4 - 7.4	
BOTTOM	7.9 - 7.9		7.4 - 7.4		9.4 - 9.4		7.6 - 7.6		8.2 - 8.2		7.4 - 7.4	
PH: SURFACE	8.1 - 8.1		8.3 - 8.3		8.0 - 9.4		8.3 - 8.3		8.0 - 8.0		8.3 - 8.3	
BOTTOM	8.1 - 8.1		8.3 - 8.3		8.0 - 9.4		8.3 - 8.3		8.0 - 8.0		8.3 - 8.3	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
ANCHOA MITCHILLI	-	-	-	-	0.299	-	0.107	-	0.066	-	-	-
MEMBRAS MARTINICA	0.048	-	-	-	-	-	-	-	-	-	-	-
SYNGNATHUS FUSCUS	-	-	-	-	0.036	-	-	-	-	-	-	-
LARVAE												
ELOPS SAURUS	-	-	-	-	-	-	0.037	-	-	-	-	-
ANCHOA MITCHILLI	0.581	-	0.329	-	0.625	-	0.929	-	0.368	-	0.326	-
FAMILY ATHERINIDAE	0.048	-	-	-	-	-	0.072	-	-	-	-	-
FAMILY BLENNIIDAE	0.507	-	0.255	-	0.294	-	0.141	-	0.216	-	0.210	-
FAMILY GOBIIDAE	0.618	-	0.327	-	0.074	-	0.212	-	0.305	-	0.141	-
EGGS												
ANCHOA MITCHILLI	0.034	-	-	-	-	-	-	-	0.053	-	-	-
TOTAL LARVAE & JUVENILES	1.802	0.0	0.910	0.0	1.326	0.0	1.496	0.0	0.955	0.0	0.676	0.0
TOTAL EGGS	0.034	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.053	0.0	0.000	0.0
TOTAL COLLECTIONS	2		2		2		2		3		2	

TABLE C1-332. (CONT.)

MONTH	OCTOBER											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	14.0 - 14.0		16.0 - 16.0		14.0 - 14.0		16.0 - 16.0		14.0 - 14.0		16.0 - 16.0	
SURFACE	13.0 - 13.0		17.0 - 17.0		12.0 - 12.0		16.0 - 16.0		13.0 - 13.0		17.0 - 17.0	
BOTTOM	13.0 - 13.0		17.0 - 17.0		12.0 - 12.0		16.0 - 16.0		13.0 - 13.0		- - -	
SALINITY: SURFACE	23.5 - 23.5		24.0 - 24.0		24.0 - 24.0		24.0 - 24.0		24.0 - 24.0		24.0 - 24.0	
BOTTOM	24.5 - 24.5		24.0 - 24.0		23.5 - 23.5		24.0 - 24.0		25.0 - 25.0		- - -	
OXYGEN: SURFACE	10.0 - 10.0		10.4 - 10.4		9.0 - 9.0		9.5 - 9.5		9.8 - 9.8		10.0 - 10.0	
BOTTOM	9.9 - 9.9		10.0 - 10.0		9.1 - 9.1		8.2 - 8.2		10.0 - 10.0		- - -	
PH: SURFACE	7.8 - 7.8		7.8 - 7.8		7.9 - 7.9		7.6 - 7.6		7.8 - 7.8		7.8 - 7.8	
BOTTOM	7.8 - 7.8		7.9 - 7.9		7.5 - 7.5		7.8 - 7.8		7.8 - 7.8		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
ANCHOA MITCHILLI	0.649	-	0.138	-	0.700	-	0.297	-	0.254	-	0.112	-
POMATOMUS SALTATRIX	-	-	-	-	-	-	-	-	0.017	-	-	-
LARVAE												
ANCHOA MITCHILLI	-	-	0.023	-	-	-	0.049	-	-	-	-	-
MICROPOGON UNDULATUS	0.019	-	-	-	-	-	0.025	-	-	-	-	-
FAMILY GOBIIDAE	0.018	-	0.023	-	0.021	-	0.025	-	-	-	-	-
TOTAL LARVAE & JUVENILES	0.685	0.0	0.184	0.0	0.721	0.0	0.395	0.0	0.271	0.0	0.112	0.0
TOTAL EGGS	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
TOTAL COLLECTIONS	2		2		2		2		2		2	

TABLE C1-332. (CONT.)

MONTH	NOVEMBER											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	- - -		- - -		- - -		- - -		- - -		- - -	
SURFACE	4.0 - 4.0		8.0 - 8.0		4.0 - 4.0		7.7 - 7.8		4.0 - 4.2		8.0 - 8.1	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
SALINITY: SURFACE	20.0 - 22.0		22.5 - 22.5		22.5 - 22.5		22.0 - 22.0		22.0 - 22.0		22.5 - 22.5	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
OXYGEN: SURFACE	11.2 - 11.4		11.0 - 11.1		11.2 - 11.3		10.8 - 10.8		10.9 - 11.4		11.0 - 11.1	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
PH: SURFACE	8.1 - 8.1		8.1 - 8.2		8.0 - 8.1		8.1 - 8.2		7.6 - 7.8		8.2 - 8.2	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
ANCHOA MITCHILLI	-	-	-	-	-	-	0.033	-	-	-	-	-
SYNGNATHUS FUSCUS	-	-	-	-	-	-	0.065	-	0.020	-	-	-
LARVAE												
MICROPOGON UNDULATUS	0.065	-	-	-	0.040	-	0.033	-	0.038	-	-	-
SCOPHTHALMUS AQUOSUS	-	-	-	-	-	-	0.033	-	-	-	-	-
TOTAL LARVAE & JUVENILES	0.065	0.0	0.000	0.0	0.040	0.0	0.163	0.0	0.058	0.0	0.000	0.0
TOTAL EGGS	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
TOTAL COLLECTIONS	2		2		2		2		2		2	

TABLE C1-332. (CONT.)

MONTH	DECEMBER											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	1.5 - 1.5		1.5 - 1.5		2.0 - 2.0		2.0 - 2.0		1.0 - 1.0		2.0 - 2.0	
SURFACE	3.6 - 3.6		8.0 - 8.0		2.0 - 2.0		4.7 - 4.7		4.0 - 4.0		8.0 - 8.0	
BOTTOM	3.8 - 3.8		7.8 - 7.8		3.0 - 3.0		6.0 - 6.0		4.0 - 4.0		7.6 - 7.8	
SALINITY: SURFACE	22.0 - 22.0		22.0 - 22.0		21.0 - 21.0		20.0 - 20.0		22.0 - 22.0		22.0 - 22.0	
BOTTOM	22.0 - 22.0		22.0 - 22.0		21.0 - 21.0		23.0 - 23.0		22.0 - 22.0		21.0 - 22.0	
OXYGEN: SURFACE	11.6 - 11.6		12.2 - 12.2		11.5 - 11.5		11.8 - 11.8		11.0 - 11.0		11.6 - 11.6	
BOTTOM	11.8 - 11.8		11.6 - 11.6		11.8 - 11.8		11.6 - 11.6		11.6 - 11.6		11.3 - 11.3	
PH: SURFACE	7.7 - 7.7		7.7 - 7.7		7.7 - 7.7		7.7 - 7.7		7.7 - 7.7		7.7 - 7.7	
BOTTOM	7.7 - 7.7		7.7 - 7.7		7.7 - 7.7		7.7 - 7.7		7.7 - 7.7		7.7 - 7.7	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES												
ANCHOA MITCHILLI	-	-	-	-	0.041	-	-	-	-	-	-	-
SYNGNATHUS FUSCUS	0.020	-	-	-	-	-	-	-	-	-	-	-
LARVAE												
AMMODYTES SP.	0.039	-	0.037	-	-	-	-	-	-	-	-	-
EGGS												
UNIDENTIFIED FISH	-	-	-	-	-	-	-	-	-	-	0.179	-
TOTAL LARVAE & JUVENILES	0.059	0.0	0.037	0.0	0.041	0.0	0.000	0.0	0.000	0.0	0.000	0.0
TOTAL EGGS	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.179	0.0
TOTAL COLLECTIONS	2		2		2		2		2		2	

TABLE C1-332. (CONT.)

MONTH	JANUARY											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	- - -		1.0 - 1.0		- - -		- - -		- - -		0.0 - 0.0	
SURFACE	- - -		3.0 - 3.0		- - -		- - -		- - -		3.0 - 3.0	
BOTTOM	- - -		5.5 - 5.5		- - -		- - -		- - -		4.5 - 4.5	
SALINITY: SURFACE	- - -		22.5 - 23.0		- - -		- - -		- - -		22.5 - 22.5	
BOTTOM	- - -		22.0 - 22.5		- - -		- - -		- - -		23.0 - 23.0	
OXYGEN: SURFACE	- - -		12.4 - 12.4		- - -		- - -		- - -		13.0 - 13.0	
BOTTOM	- - -		13.0 - 13.0		- - -		- - -		- - -		13.2 - 13.2	
PH: SURFACE	- - -		- - -		- - -		- - -		- - -		- - -	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE												
AMMODYTES SP.	-	-	0.187	-	-	-	-	-	-	-	0.232	-
TOTAL LARVAE & JUVENILES	0.000[a]	0.0	0.187	0.0	0.000[a]	0.0	0.000[a]	0.0	0.000[a]	0.0	0.232	0.0
TOTAL EGGS	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
TOTAL COLLECTIONS	0		2		0		0		0		2	

TABLE C1-332. (CONT.)

MONTH	FEBRUARY											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	- - -		5.0 - 5.0		- - -		2.0 - 2.0		- - -		2.0 - 2.0	
SURFACE	- - -		9.0 - 9.0		- - -		7.0 - 7.0		- - -		7.0 - 7.0	
BOTTOM	- - -		8.2 - 8.2		- - -		6.2 - 6.2		- - -		7.0 - 7.0	
SALINITY: SURFACE	- - -		- - -		- - -		- - -		- - -		- - -	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
OXYGEN: SURFACE	- - -		8.0 - 8.0		- - -		8.7 - 8.7		- - -		8.5 - 8.5	
BOTTOM	- - -		8.0 - 8.0		- - -		9.8 - 9.8		- - -		8.5 - 8.5	
PH: SURFACE	- - -		8.0 - 8.0		- - -		8.0 - 8.0		- - -		8.0 - 8.0	
BOTTOM	- - -		8.0 - 8.0		- - -		8.0 - 8.0		- - -		8.0 - 8.0	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE												
AMMODYTES SP.	-	-	0.118	-	-	-	0.242	-	-	-	-	-
PSEUDOPLEURONECTES AMERICANUS	-	-	0.354	-	-	-	0.968	-	-	-	-	-
EGGS												
AMMODYTES SP.	-	-	0.027	-	-	-	-	-	-	-	-	-
PSEUDOPLEURONECTES AMERICANUS	-	-	0.643	-	-	-	-	-	-	-	-	-
TOTAL LARVAE & JUVENILES	0.000[a]	0.0	0.472	0.0	0.000[a]	0.0	1.210	0.0	0.000[a]	0.0	0.000	0.0
TOTAL EGGS	0.000	0.0	0.670	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
TOTAL COLLECTIONS	0		2		0		2		0		2	

TABLE C1-332. (CONT.)

MONTH	MARCH											
LOCATION	6		14		46		30		45		50	
TEMPERATURE: AIR	7.0 - 7.0		7.0 - 7.0		7.0 - 7.0		6.5 - 6.5		7.0 - 7.0		6.5 - 6.5	
SURFACE	8.2 - 8.2		11.3 - 11.3		8.4 - 8.4		11.0 - 11.0		8.4 - 8.4		11.4 - 11.4	
BOTTOM	8.3 - 8.3		11.3 - 11.3		8.2 - 8.2		10.4 - 10.4		8.2 - 8.2		11.4 - 11.4	
SALINITY: SURFACE	23.5 - 23.5		23.0 - 23.0		23.5 - 23.5		22.5 - 22.5		23.0 - 23.0		22.5 - 22.5	
BOTTOM	24.0 - 24.0		23.5 - 23.5		24.0 - 24.0		22.5 - 22.5		23.0 - 23.0		22.5 - 22.5	
OXYGEN: SURFACE	12.6 - 12.6		12.6 - 12.6		12.4 - 12.4		12.4 - 12.4		12.6 - 12.6		12.4 - 12.4	
BOTTOM	12.4 - 12.4		12.2 - 12.2		12.6 - 12.6		12.2 - 12.2		12.4 - 12.4		12.0 - 12.0	
PH: SURFACE	- - -		- - -		- - -		- - -		- - -		- - -	
BOTTOM	- - -		- - -		- - -		- - -		- - -		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE												
ANGUILLA ROSTRATA	0.032	-	0.086	-	0.027	-	-	-	0.068	-	0.104	-
AMMODYTES SP.	3.609	-	0.900	-	1.140	-	1.831	-	2.796	-	1.107	-
PSEUDOPLEURONECTES AMERICANUS	27.059	-	5.405	-	23.001	-	17.255	-	15.228	-	6.718	-
TOTAL LARVAE & JUVENILES	30.700	0.0	6.390	0.0	24.168	0.0	19.086	0.0	18.092	0.0	7.929	0.0
TOTAL EGGS	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
TOTAL COLLECTIONS	2		2		2		2		2		2	

[a]No Samples Taken--stations were iced in.

Table C1-333. Comparison of mean density of common and important ichthyoplankton between the intake canal (sta. 6) and discharge canal (50) from March 1976 through March 1977.

Form	Months Analysed	Mean Density (n/m^3) Intake Canal	Discharge Canal	Percent Difference
Pseudopleuronectes americanus larvae	March 1976, March 1977	14.158	4.394	-69
Ammodytes sp. larvae	"	2.867	1.589	-45
Anchoa mitchilli eggs	May through August 1976	59.632	19.174	-68
Anchoa mitchilli larvae and juveniles	July through October 1976	2.750	1.156	-58
Gobiidae larvae	May through September 1976	0.908	0.530	-42
Syngnathus fuscus juveniles	"	0.357	0.048	-86
Atherinidae larvae and juveniles	"	0.068	0.038	-44

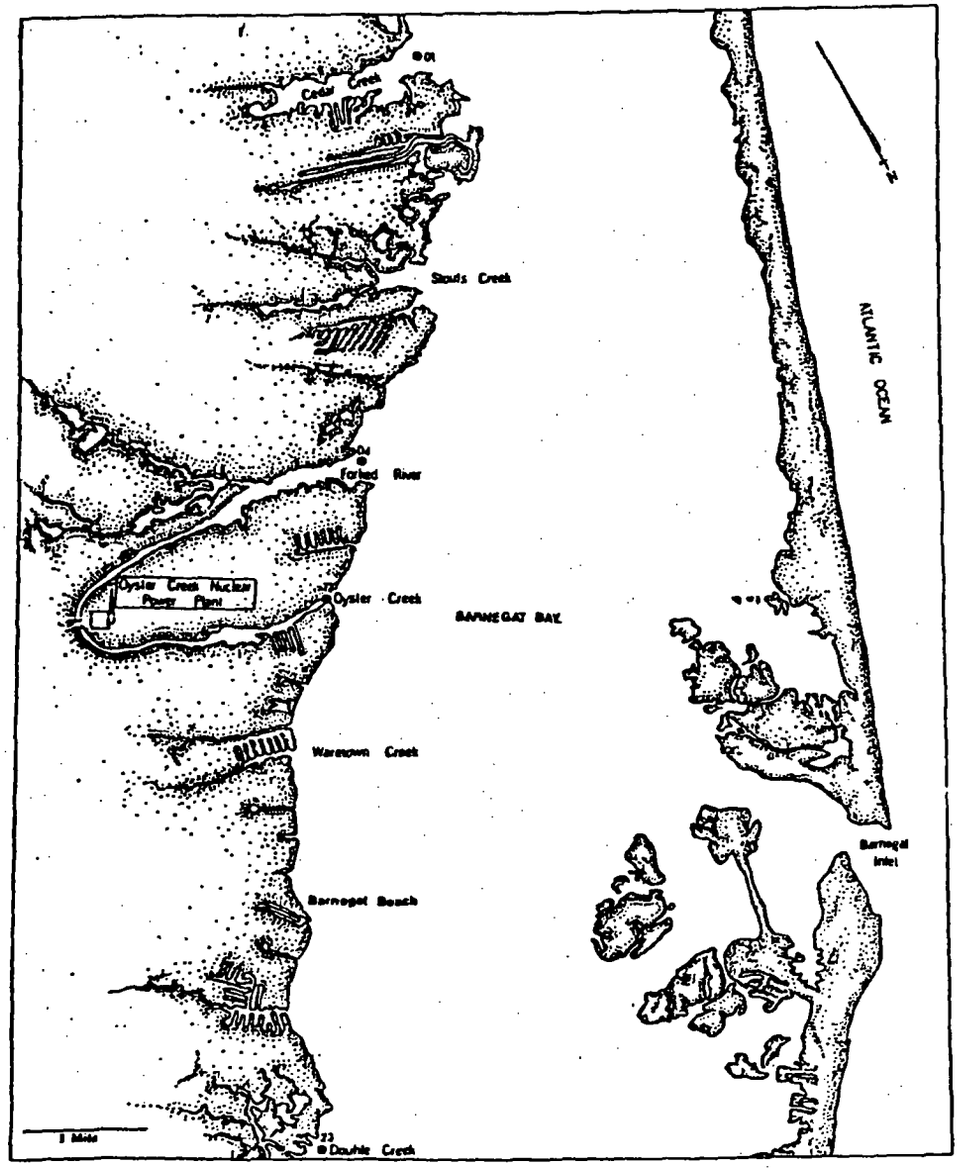


Fig. C1-15. Sampling locations for biological collections taken for the OCGS ecological study.

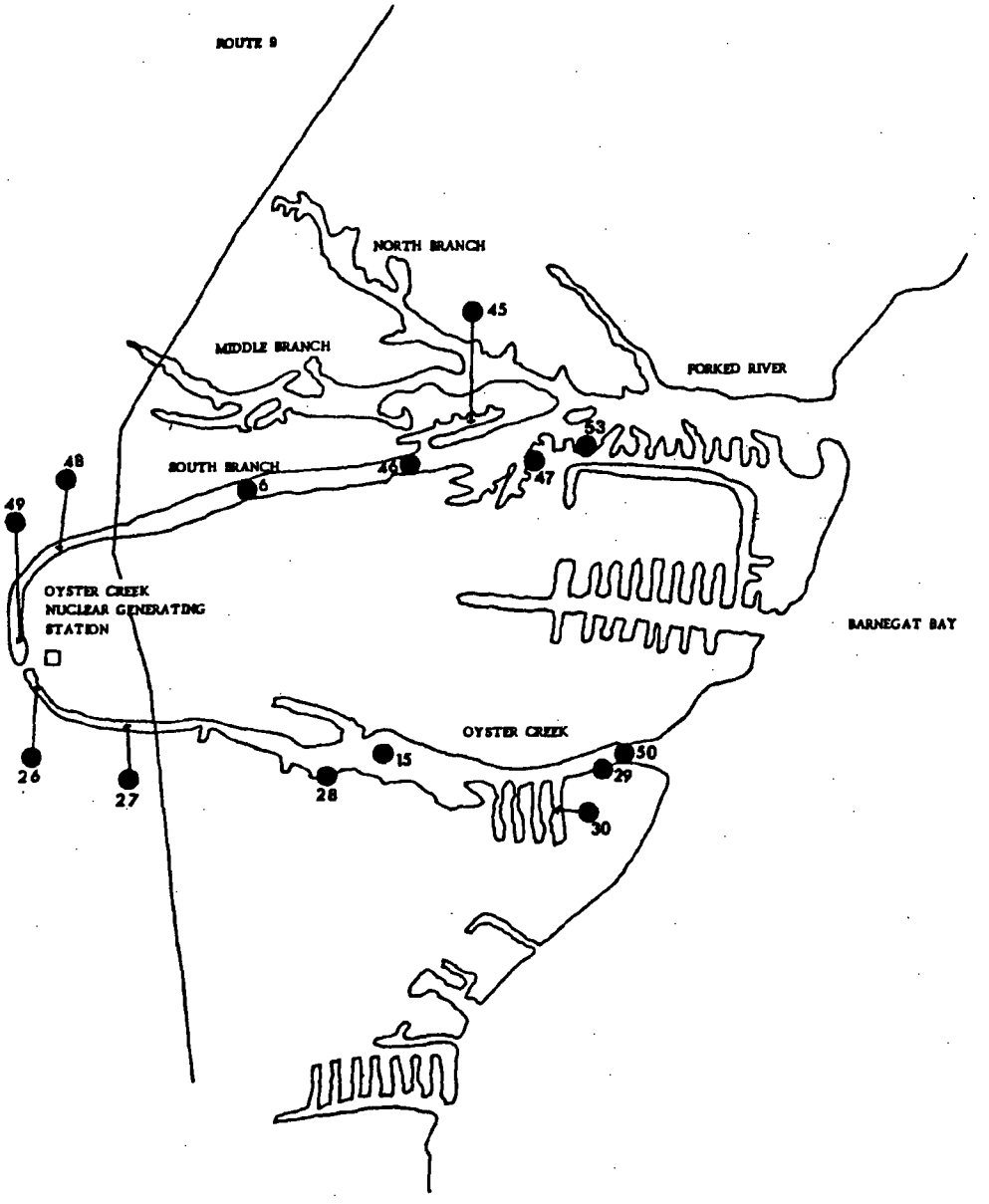


Fig. C1-16. Sampling locations for biological collections for OCGS thermal effects studies from March 1976 through March 1977.

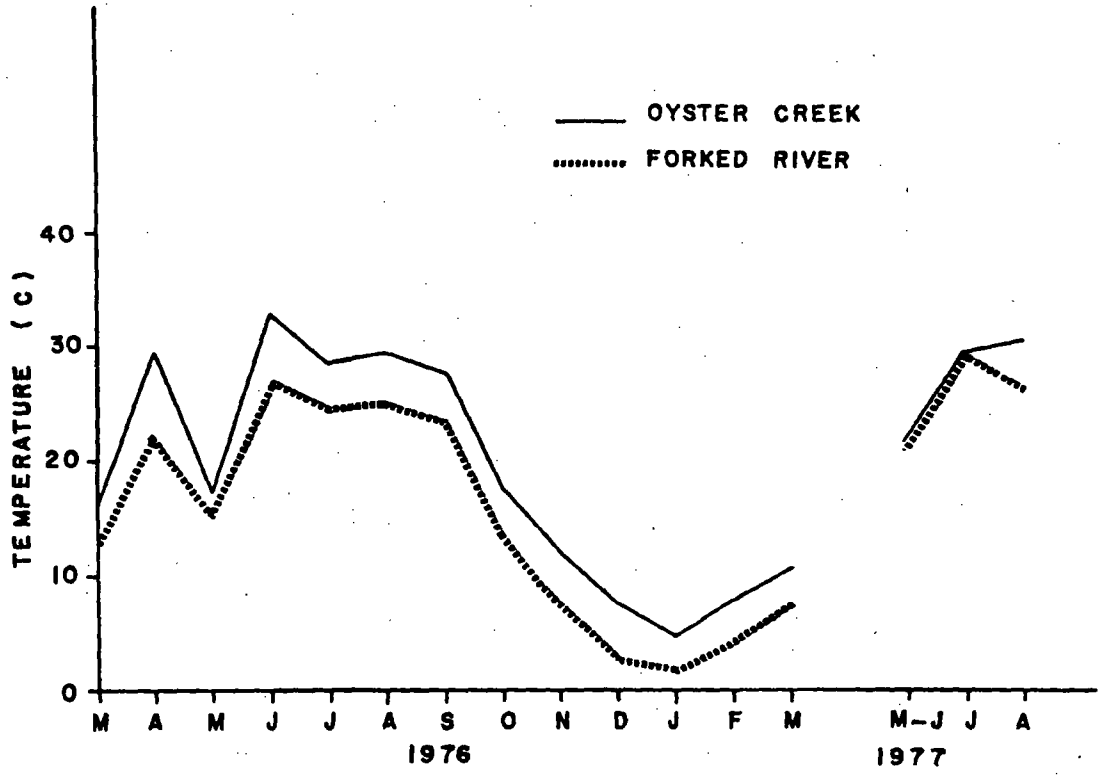


Fig. C1-17. Monthly mean surface water temperature in Oyster Creek and Forked River from March 1976 through March 1977 and May-June 1977 through August 1977.

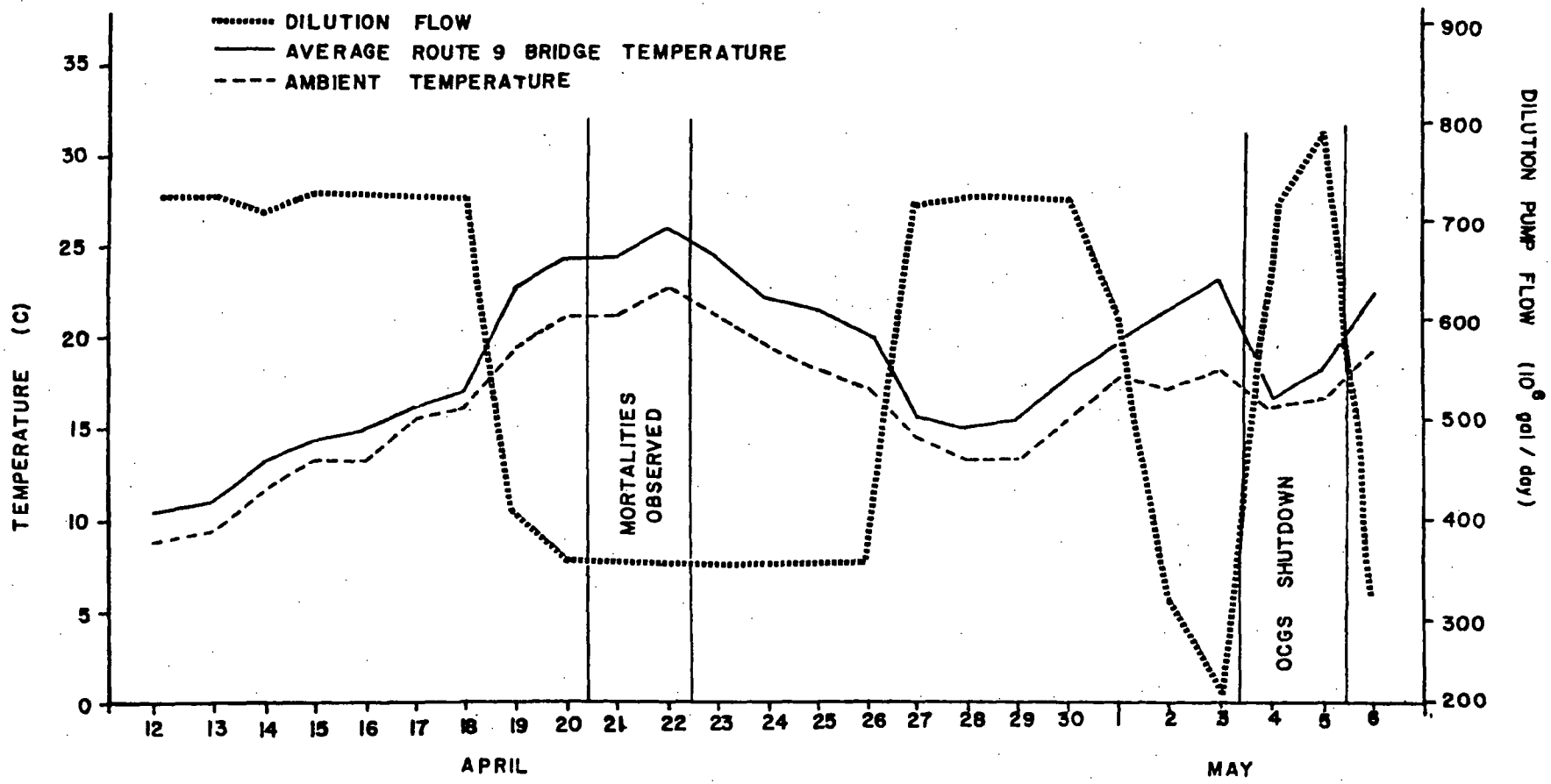


Fig. C1-18. Daily mean ambient water temperature, water temperature at the U.S. Rt. 9 bridge, and dilution flow from 12 April through 6 May 1977.

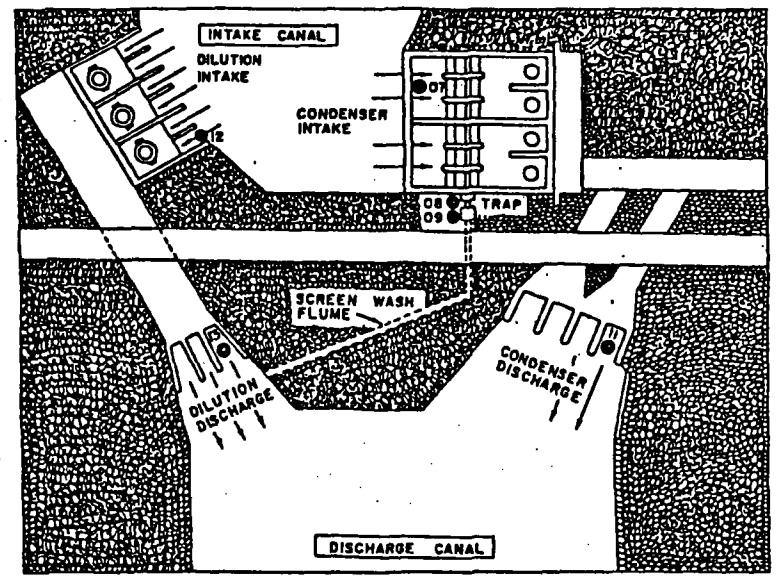


Fig. C1-19. Diagram of the intake and discharge of the circulating water system and the dilution pumps at the Oyster Creek Generating Station.

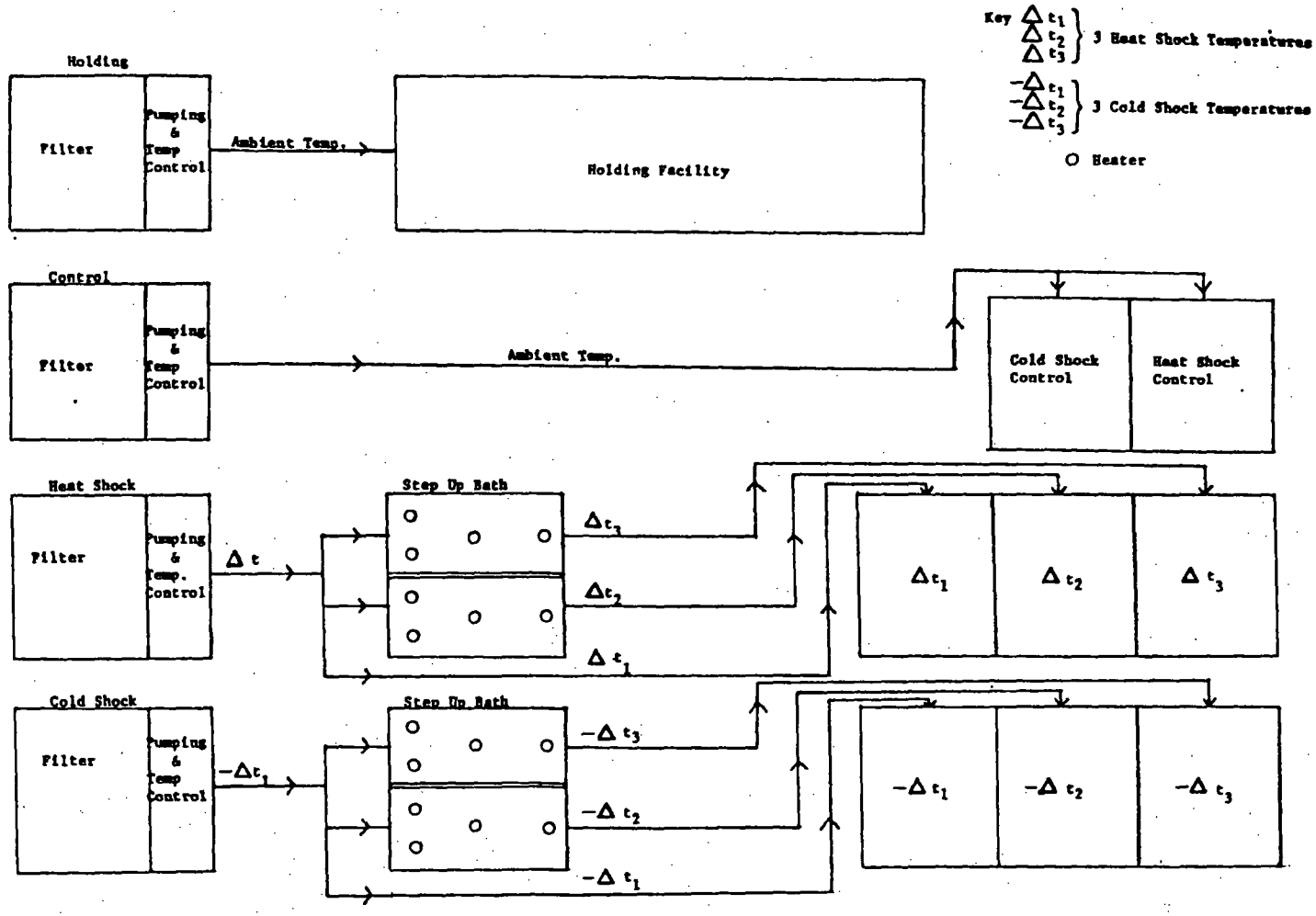


Fig. C1-20. Schematic diagram of heat and cold shock facilities at Oyster Creek Experimental Laboratory.

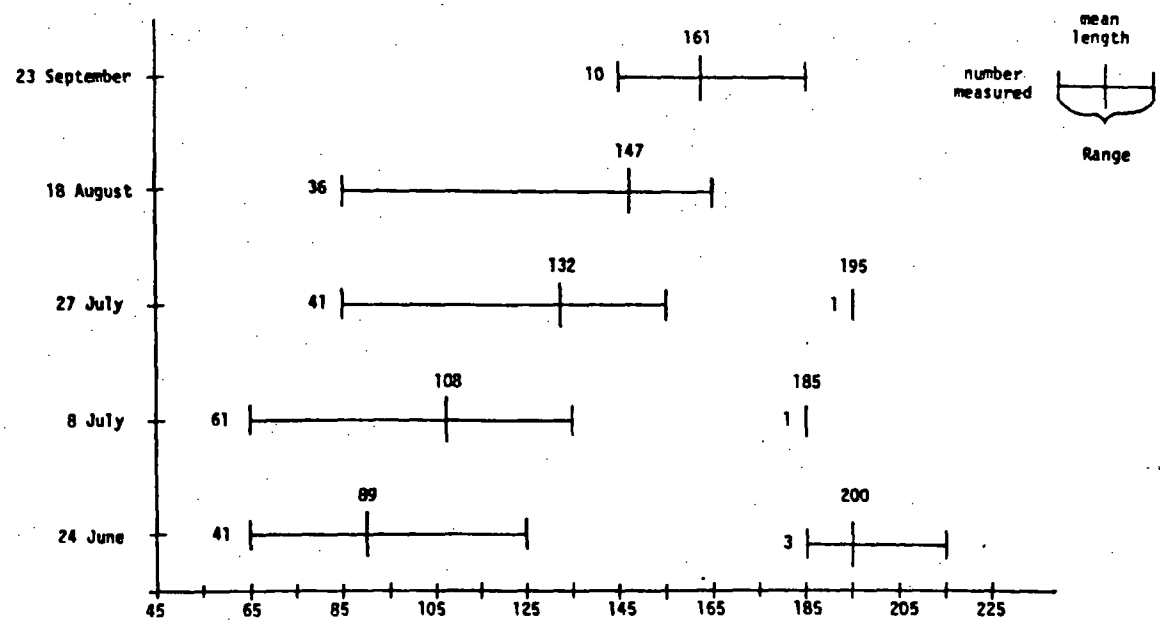


Fig. C1-21. Number and length of northern pipefish taken by 2.7-m trawl from the east side of Barnegat Bay, New Jersey from 24 June through 23 September 1977.

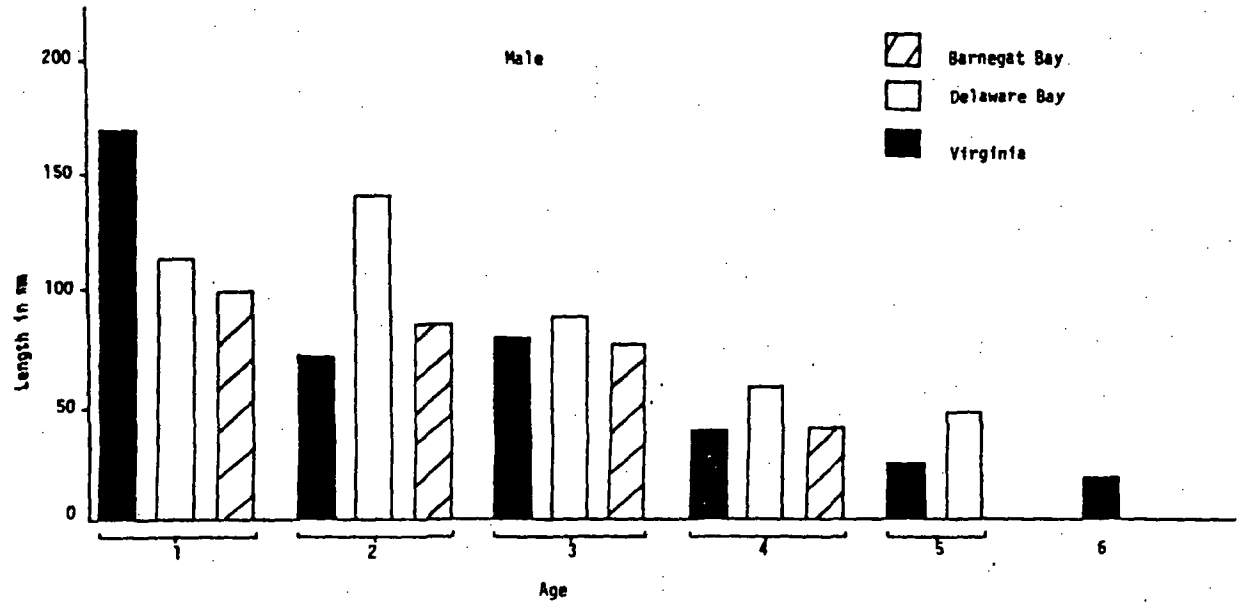


Fig. C1-22. Mean annual growth increments of male summer flounder taken in Barnegat Bay, N.J., Delaware Bay (Smith 1969), and Virginia (Eldridge 1962) as calculated at the time of annulus formation.

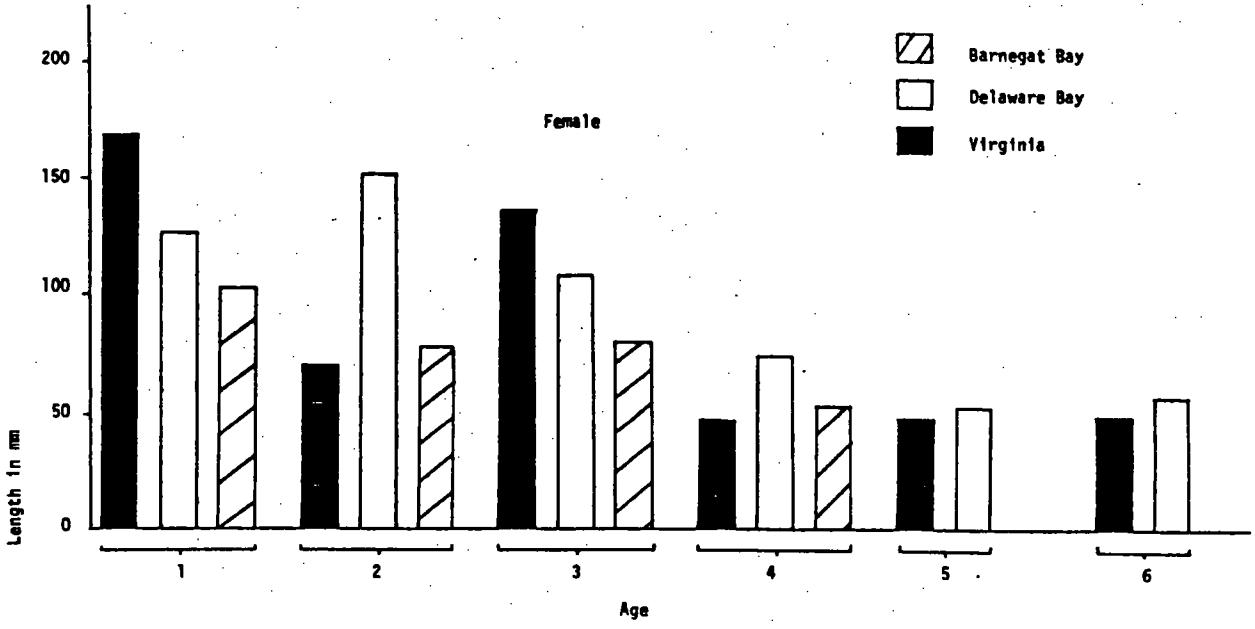


Fig. C1-23. Mean annual growth increments of female summer flounder taken in Barnegat Bay, N.J., Delaware Bay (Smith 1969), and Virginia (Eldridge 1962) as calculated at the time of annulus formation.

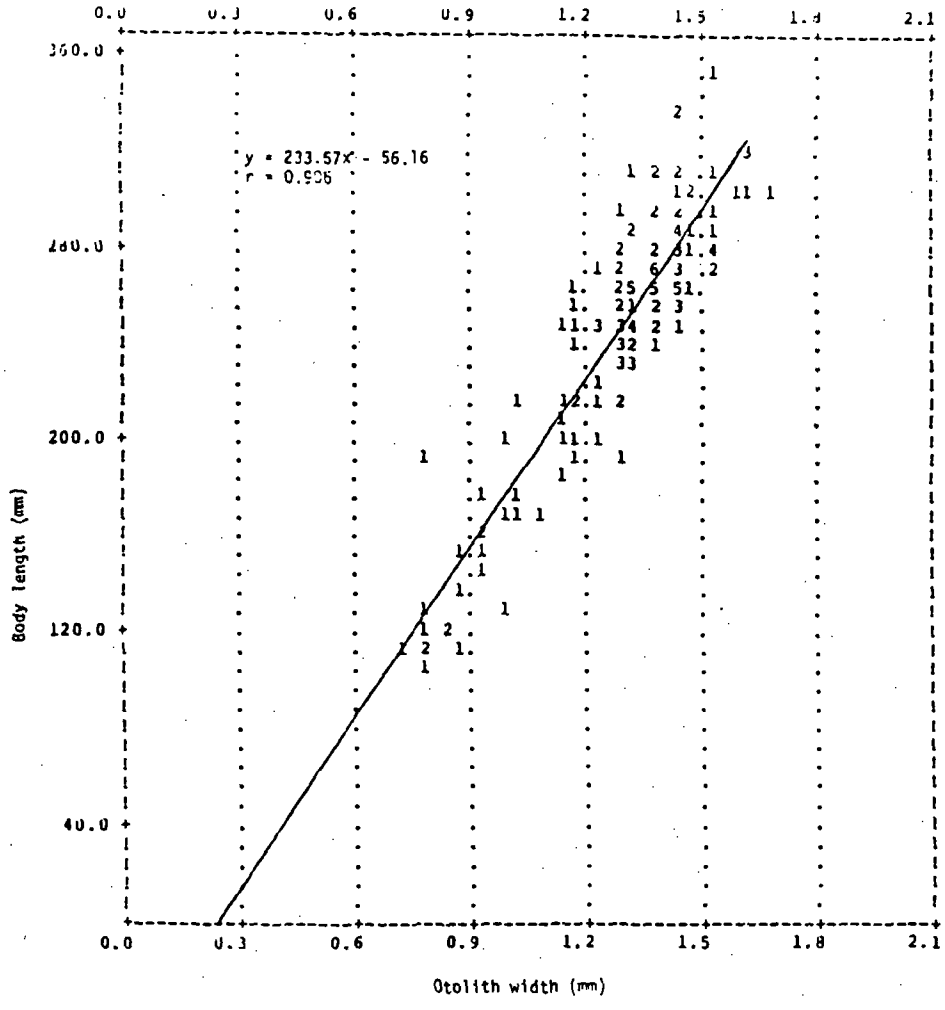


Fig. C1-24. The otolith-body length relationship of male winter flounder taken in Barnegat Bay from September 1976 through August 1977. Digits indicate number of data points plotted.

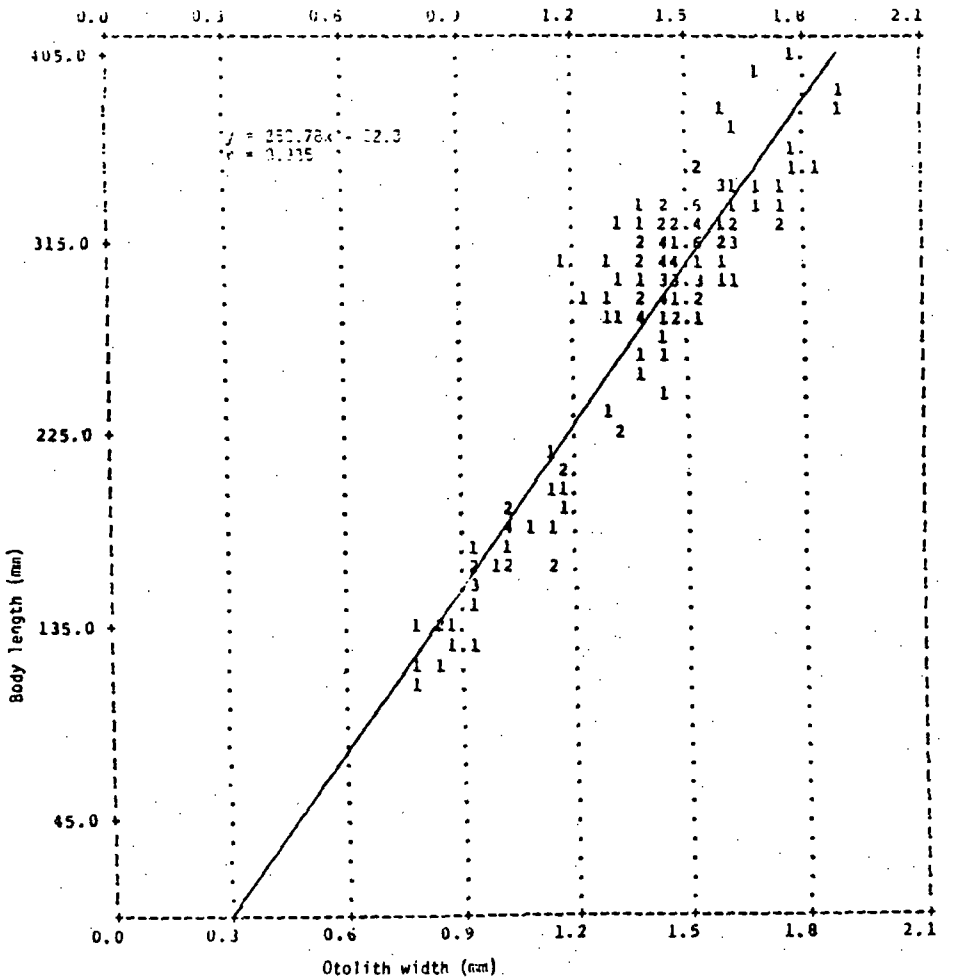


Fig. C1-25. The otolith-body length relationship of female winter flounder taken in Barnegat Bay, N.J. from September 1976 through August 1977. Digits indicate number of data points plotted.

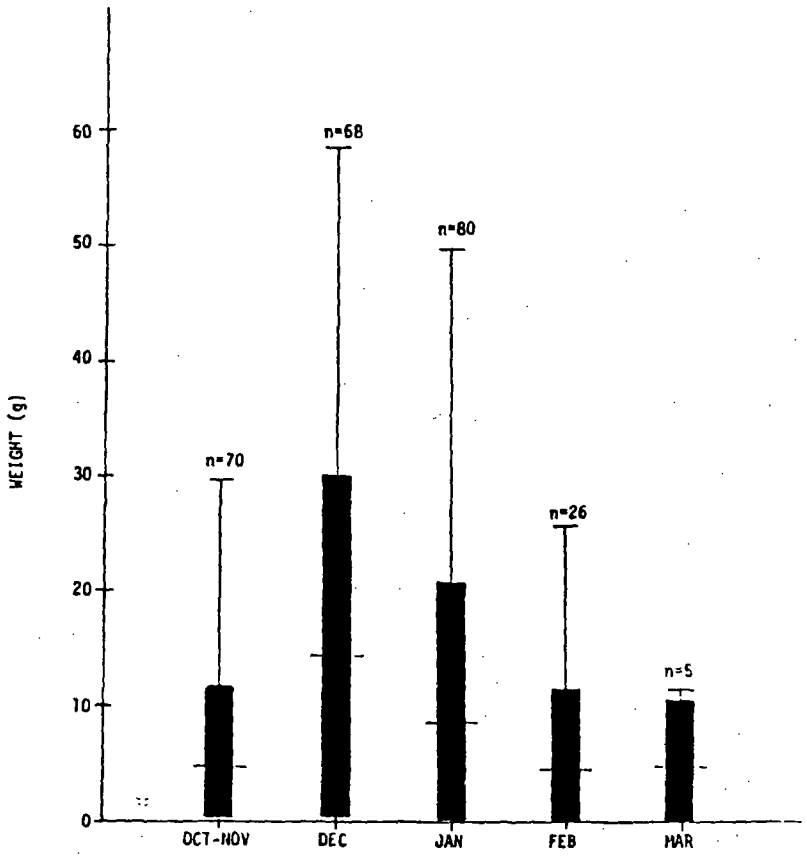


Fig. C1-26. The total enlarged gonad weights of male winter flounder taken in Barnegat Bay, N. J. from October 1976 through March 1977. The range, mean, and one standard deviation from the mean are illustrated.

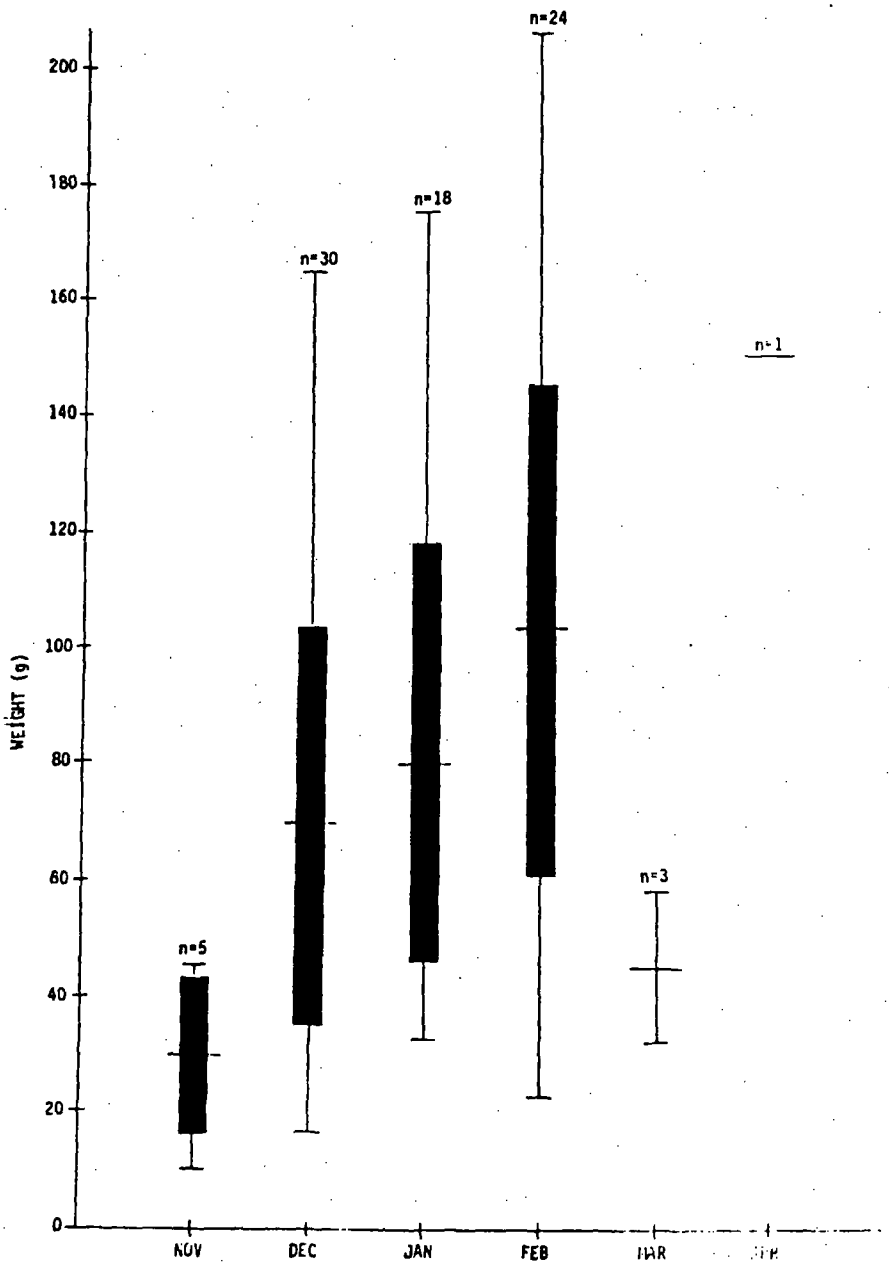


Fig. C1-27. The total enlarged gonad weights of female winter flounder taken in Barnegat Bay, N. J. from November 1976 through April 1977. The range, mean, and one standard deviation from the mean are illustrated.

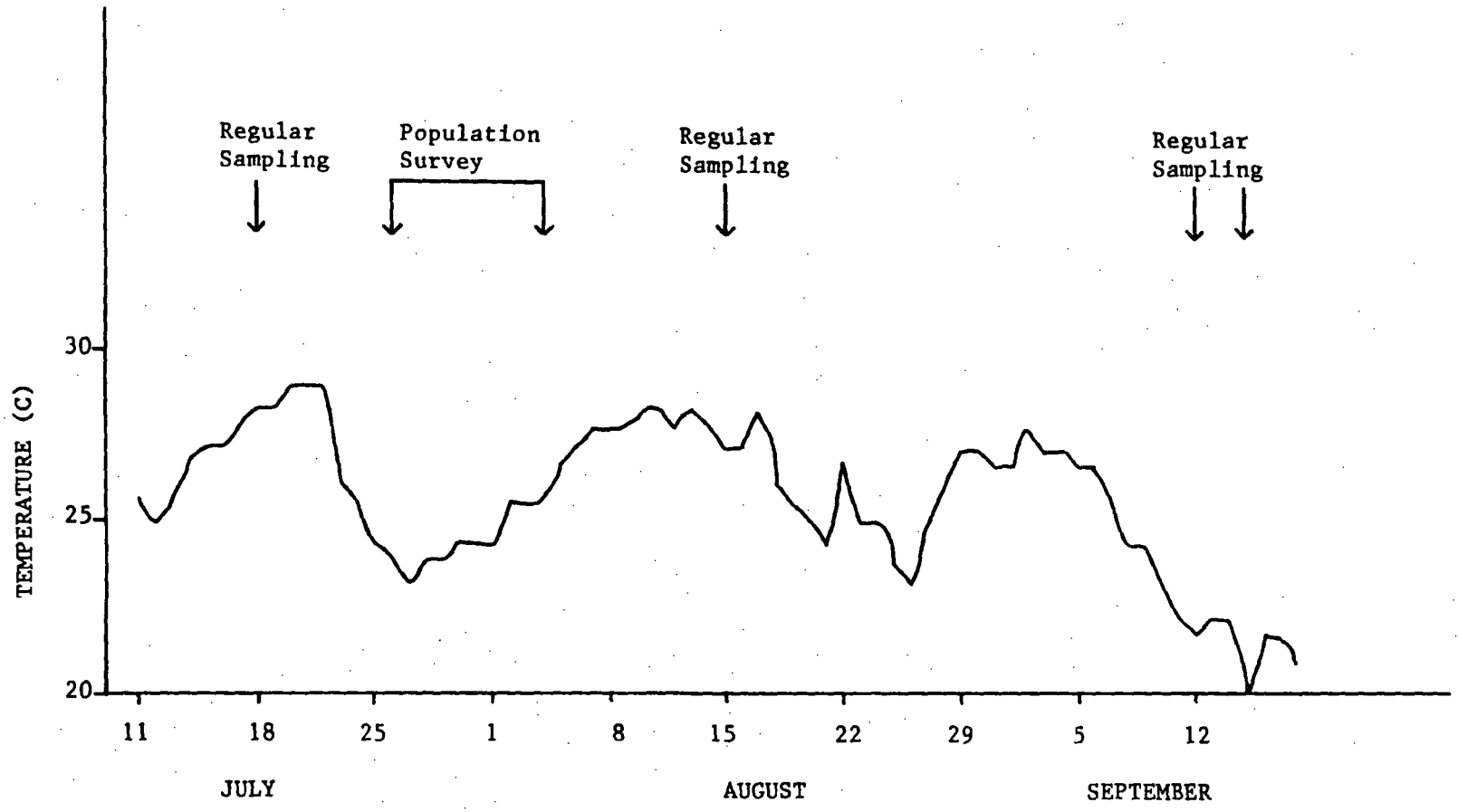
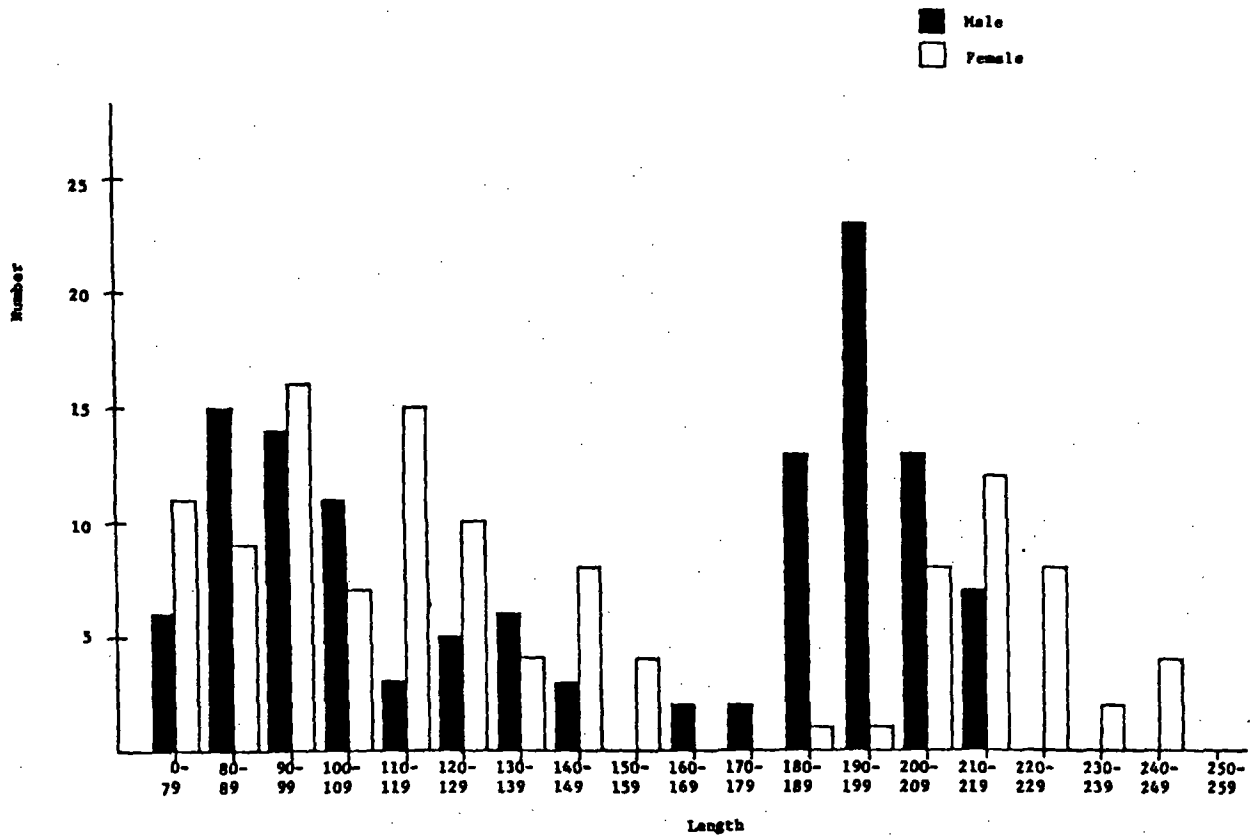


Fig. C1-28. Daily mean ambient temperature (C) as recorded at OCGS from 11 July through 18 September 1977. Dates of the regular sampling from July through September and the July-August population survey are indicated.



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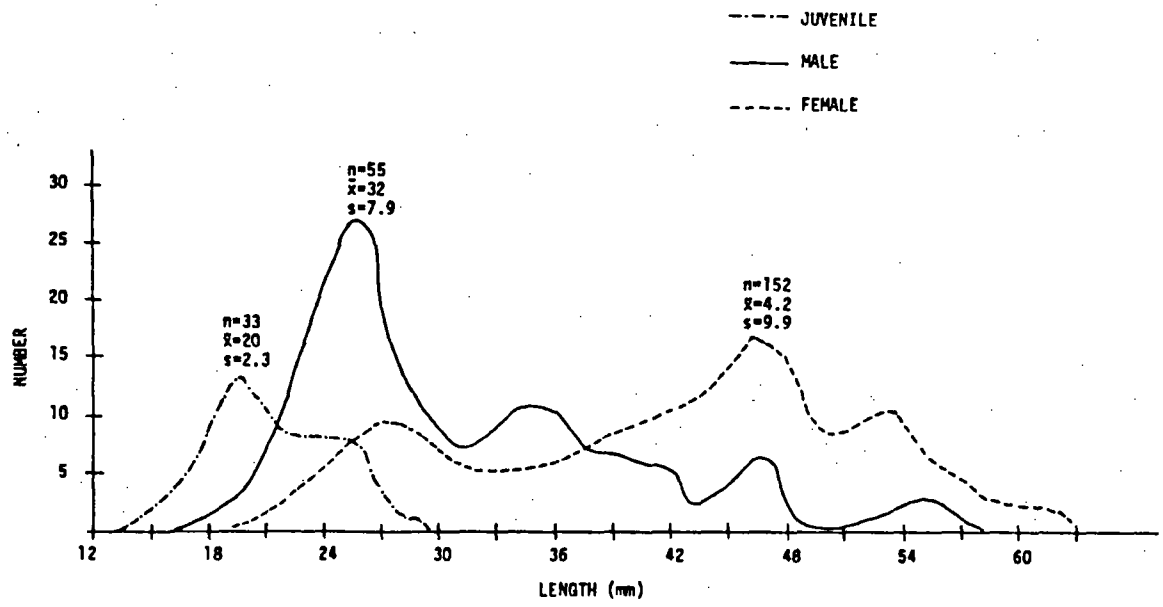

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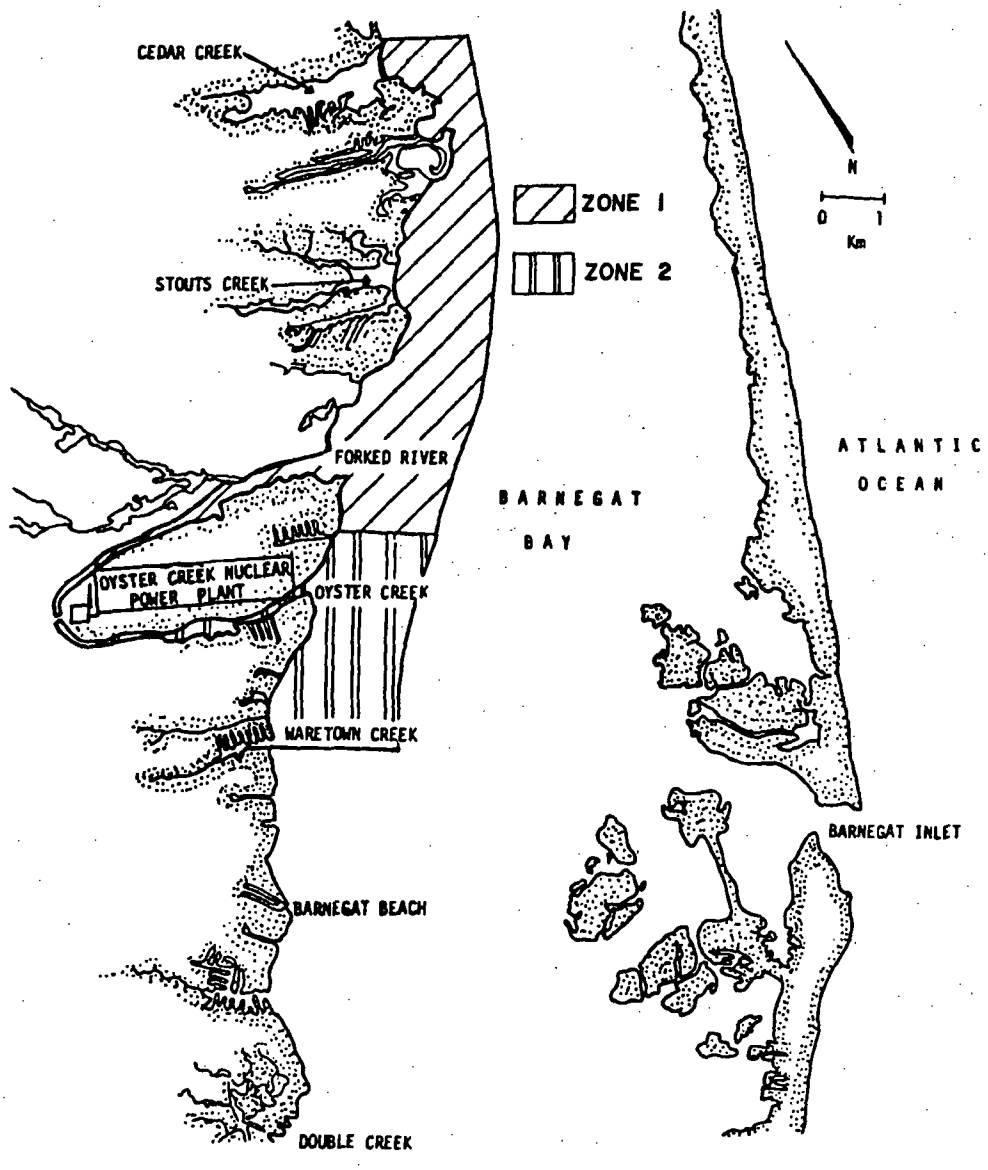

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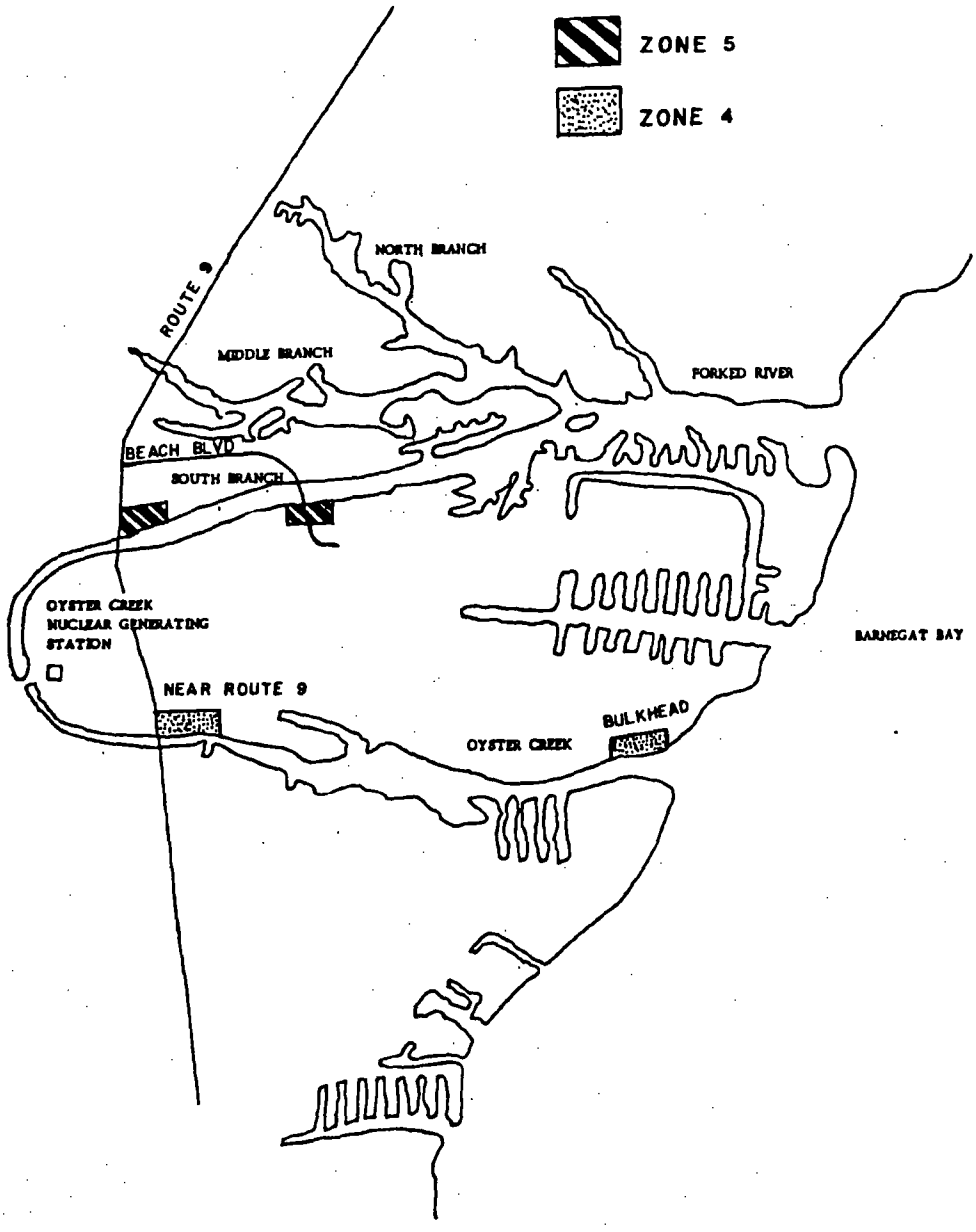

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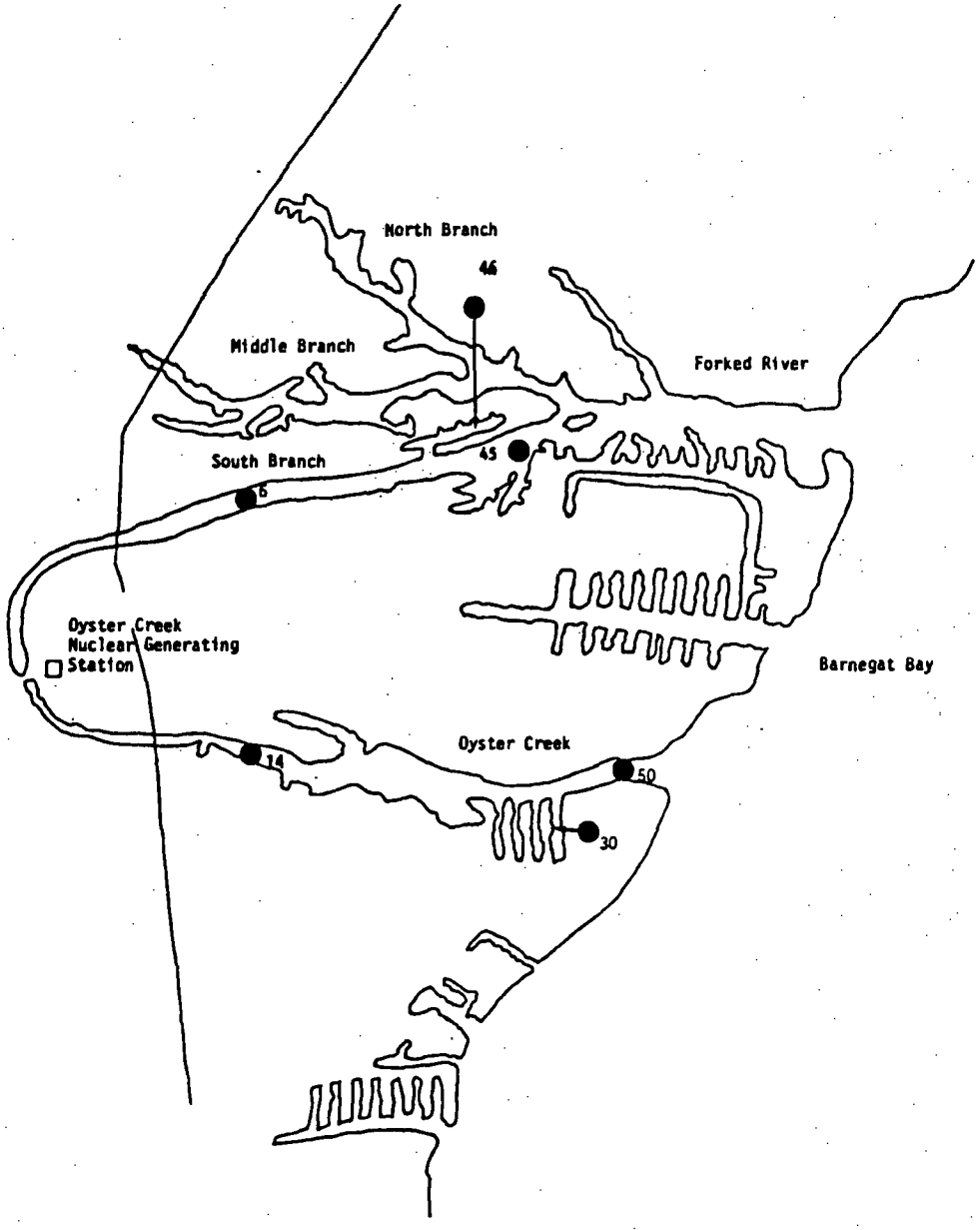

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ADDENDUM 1 to APPENDIX D1

EFFECTS OF IMPINGEMENT AND ENTRAINMENT AT THE OYSTER CREEK NUCLEAR GENERATING STATION ON PLANKTON, MACROINVERTEBRATES, AND FISH

ADDENDUM TO
APPENDIX D1

ECOLOGICAL STUDIES FOR THE OYSTER
CREEK NUCLEAR GENERATING STATION

EFFECTS OF IMPINGEMENT AND ENTRAINMENT AT THE OYSTER CREEK NUCLEAR GENERATING STATION* ON PLANKTON, MACROINVERTEBRATES, AND FISH

BY
JERSEY CENTRAL POWER & LIGHT COMPANY

SEPTEMBER 1978

*This Appendix uses OCGS as the acronym for the Oyster Creek Nuclear Generating Station.

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D1.10 INTRODUCTION

Since 8 September 1975, Ichthyological Associates, Inc. (I.A.) has conducted studies to determine and to assess the biological impact of the Oyster Creek Generating Station (OCGS), and I.A. has implemented a general ecological survey of Barnegat Bay, Oyster Creek, and Forked River. Samples were taken primarily in the middle portion of Barnegat Bay from Good Luck Point in the north to Gulf Point in the south (volume of 118,774,000 m^3). The eastern part of the study area contains extensive shoal areas (depth 0.2 to 0.9 m), but the central and western Bay is deeper (1.2 to 3.7 m).

Data collected from September 1975 through August 1976 were reported in Appendices C1 and D1. This addendum to Appendix D1 summarizes information collected from September 1975 through August 1976 as a part of many continuing studies. Data from individual collections at OCGS and in Barnegat Bay were presented by I.A. (1977) and Tatham et al. (1978a,b). Life history information on impinged fishes, the sand shrimp, and the blue crab were presented in Section C1.19 in Appendix C1; the references cited in this addendum were included in Section C1.22. Some data from 1975-76 were analyzed further in this addendum, and some data were reevaluated or recalculated in light of either additional data collected during 1976-77 or a statistical critique of the 1975-76 data.

In addition to fin- and shellfishes, collections were taken at the OCNGS and in the bay to determine the magnitude and effect of entrainment losses. Microzooplankton was defined as planktonic invertebrates (< 500 microns in length) that were retained in an 80-micron mesh net. Macrozooplankton was defined as planktonic invertebrates larger than 500

microns. Micro- and macrozooplankton included organisms that were planktonic during their entire life cycle (holoplankton) and those that occurred in the plankton only periodically or during a portion of their life cycle (meroplankton). Emphasis was placed on forms designated as important species by the U.S. Nuclear Regulatory Commission (NRC) or the U.S. Environmental Protection Agency (EPA). Important microzooplankton were the larvae of bivalves, particularly the northern quahog (*Mercenaria mercenaria*), and polychaetes. Important macrozooplankton were the ctenophores *Mnemiopsis leidyi* and *Beroe* spp., the arrowworms *Sagitta elegans* and *Sagitta* spp., the sand shrimp *Crangon septemspinosa*, grass shrimp *Palaemonetes* spp., the mysids *Neomysis americana* and *Mysidopsis bigelowi*, polychaete epitokes and polychaete larvae greater than 1 mm, crab zoeae and megalopae. Important ichthyoplankton were the eggs and larvae of the Atlantic menhaden, bay anchovy, threespine stickleback, northern pipefish, striped bass, bluefish, weakfish, northern kingfish, summer flounder, winter flounder, and northern puffer. The common and corresponding scientific names for fishes and some invertebrates are given in Tables D1-44 through D1-46.

D1.11 IMPINGEMENT OF FISHES AND MACROINVERTEBRATES ON THE TRAVELING SCREENS

Introduction

Ichthyological Associates, Inc. has studied the effect of the impingement of organisms on the vertical traveling screens which protect the intake to the OCGS cooling-water system since September 1975. Miller (1977) reported impingement data from 8 September 1975 through 4 September 1976, and Tatham (1977b) evaluated the effect of these losses. Data presented here are a continuation of those studies and include collections from 5 September 1976 through 2 September 1977. The objectives of these studies were to determine the species composition of organisms impinged on the OCGS screens, their abundance, and their survival rate when returned to the Bay. The evaluation of these losses on the populations in Barnegat Bay was discussed by JCP&L (1978).

Materials and Methods

Samples of impinged organisms were taken from the sluiceway after the last traveling screen and from the sluiceway pit (Fig. D1-10). A 45.7 x 50.8 x 61.0-cm wire basket (10.7-mm mesh) was used to collect organisms from the sluiceway (Sta. 8) to determine their condition (Fig. D1-11). A 101.6 x 101.6 x 121.9-cm wire basket (10.7-mm mesh) was used to collect organisms from the sluiceway pit (Fig. D1-11).

Samples were taken during two to four periods a day, 3 days a week. Period 1 was from sunrise to 6 h before sunset; period 2 was from 6 h before sunset to sunset; period 3 was from sunset to 6 h after sunset; and period 4 was from 6 h after sunset to sunrise. Early in the week, periods 1 and 3 or, on alternate weeks, periods 2 and 3 were sampled. In the middle of the week, all periods were sampled consecutively during a 24-h period, and late in the week, periods 3 and 4 were sampled. Occasionally, periods 3 and 4 were sampled early in the week and either periods 1 and 3 or periods 2 and 3 were sampled late in the week. On 30 November and 12 December, additional collections were taken to determine the condition of organisms impinged during continuous rotation of the screens.

After the screens were washed at the beginning of the sampling period, the pit sampler was lowered into place. Subsequently, the screens washed automatically either every 2 h or when the pressure differential across the screens reached a critical level. The screen wash usually involved one complete rotation of the screens and lasted from 10 to 11 min. However, after the automatic timer was replaced in early February, screen washes initiated by the timer involved about two complete rotations of the screens and lasted for approximately 20 min. Screen washes triggered by differential pressure still lasted for only 10 to 11 min.

After the screens had washed for 1 min, the sluiceway sampler was inserted. After 1 min or less, depending on the mass of organisms present, it was removed and the organisms were placed on a 3.9-m^2

sorting table. The sluiceway sampler was replaced, and the procedure repeated until a maximum of six, 10-min samples was taken during each screen wash. For 20-min screen washes, the sluiceway sampler was used only during the first 11 min of the wash.

Collections from the sluiceway sampler were rapidly processed on the sorting table. Fishes were placed into water in insulated coolers, and crabs were placed into 10-liter plastic buckets. The condition (live/dead/ damaged) of the organisms was determined 5 to 10 min after the last sluiceway sample was taken. Live denoted a specimen which had no apparent damage and which was swimming normally. Damaged specimens were alive (opercular movement in fishes) but had external damage or abnormal behavior. Dead fishes showed no opercular movement, and dead invertebrates showed no movement of appendages. The difference in the condition of organisms impinged during the day (Periods 1 and 2) and at night (3 and 4) was determined by the binomial proportion test (Snedecor and Cochran 1967).

Organisms washed from the screens and not collected in the sluiceway sampler passed into the pit sampler; at the end of the screen wash this sampler was removed and the specimens were processed. The number and weight of abundant species were estimated volumetrically. After all other species were removed from the sample, the remaining debris and abundant organisms were thoroughly mixed and a known volume removed. The number and weight of the abundant species in this subsample were determined and were used to estimate the number and weight of these species in the total sample. Physicochemical parameters were recorded

with each collection and an analysis of these parameters was presented in Appendix C1, Section C1-16.

All specimens, or a representative subsample, of important fishes and the sand shrimp were preserved for life history studies. A representative subsample of the blue crab was analyzed immediately after collection for length, weight, sex, and stage of maturity; all crabs were then released.

When the screens washed frequently or continuously, it was not always possible to collect all organisms impinged because the screen wash overflowed the pit sampler. When this occurred, the pit sampler was removed before it overflowed, and some portion of the screen wash was missed. The total impingement during a period was then extrapolated from collections taken during the portion of the period that was sampled.

For a week, estimated impingement during a period (W_a) was calculated by the formula:

$$W_a = \frac{P_a \cdot 7}{s}$$

P_a = actual or extrapolated number of specimens impinged during a period.

s = number of times a period was sampled during the week.

The sum of the estimated weekly impingement during each of the four periods was the total weekly impingement estimate. A Hewlett-Packard 9830A programmable calculator was used for data compilation and statistical analyses.

To determine if fish impinged on the OCGS screens were in poorer physical condition than fish in other areas, the allometric condition

factor (Ricker 1975) was determined for some fishes collected at the OCGS screens, Forked River, Oyster Creek, and the mouth of Cedar and Double creeks. The methodology and limitations of this analysis are presented in Appendix C1, Section C1.19, and the results of the analysis for individual species are reported in the appropriate life history section.

The mean immediate mortality of a species after impingement differed slightly from the percentage of the estimated number of specimens lost immediately after impingement during the 2 years because each percentage was estimated differently. The mean immediate mortality for 1976-77, for 7 comparable months between the 2 years, and for the 2 years combined was calculated as the number of dead specimens collected during a time period divided by the total number of specimens examined during that time period. The percentage of the estimated number of specimens lost immediately after impingement (Y) during the 2 years was determined by the formula:

$$Y = \sum M_m \cdot N_m$$

M_m = monthly mortality rate

N_m = estimated number of individuals impinged during the month.

The total number of live and damaged individuals that suffered delayed mortality was estimated from data collected in 1975-76 (Rode and Boyle 1977b) and 1976-77 (Table D1-86).

Continuation of the impingement program depended on the statistical predictability of the data collected from 1975 through 1977. The program

would not continue beyond March 1978 unless the estimated number of impinged organisms that were killed during the first two 12-month periods were significantly ($P \leq 0.2$) different (JCP&L 1976).

The comparison of the total impingement loss during the 2 years was examined by comparing the estimated number of organisms impinged during each year. Because OCGS was shut down during January and February 1976 and from May into July 1977, the data from 7 months (September through December, March, April, and August) were used to compare the two 12-month periods. Use of the abundance data for this evaluation of total loss was valid because the difference ($P \leq 0.05$) between the percent mortality of 7 of 11 abundant species impinged, as determined by the binomial proportion test (Sokal and Rohlf 1969), was not significant during the 7 comparable months of the 2 years (Table D1-47).

Stratified sampling with optimal allocation (Snedecor and Cochran 1967) was used to estimate the total number of organisms and of various species impinged during the 7 comparable months and during all months sampled in a year. These estimates were not used for statistical comparisons but were used to demonstrate the magnitude of the difference in the total number impinged between the 2 years.

The methods that Miller (1977) used to estimate the number and weight of impinged organisms during the first year (8 September 1975 through 3 September 1976) differed from those used during the second year (4 September 1976 through 2 September 1977). The first year's estimates and the recalculated stratified estimates for that year which are reported here differed because the first method was an extrapolation

based on the sum of the estimated weekly impingement. The second method was a statistical estimator which also determined the variance and provided confidence limits for each estimate. The first year's estimate was within the confidence limits of the recalculated estimate for that year.

The mean number impinged during the 7 comparable months ($\overline{Y}_{st7}$) and for each year ($\overline{Y}_{st12}$) was estimated by the formula:

$$\overline{Y}_{st} = \sum\left(\left[N_a/N\right] \cdot \overline{Y}_a\right)$$

$\overline{Y}_a$ = sample mean in stratum a

N_a = number of sampling units in stratum a

N = number of sampling units in all strata

The strata were the four time periods sampled during a day. The sampling unit size was 1 h, and each sample mean was expressed as the number of specimens impinged per hour. This sample mean was derived by dividing the number of individuals taken from all samples collected during a time period by the total duration of these samples. This weighted mean of the number impinged per hour was used as a single sample because the duration of individual samples in a time period was unequal.

The total number of individuals impinged during the 7 months (Y_7) and for each year (Y_{12}) was computed by the formula:

$$Y = \overline{Y}_{st} \cdot D \cdot 24 \text{ h}$$

D = the number of days the OCGS screens operated during the 7 or 12 months of the year.

A three-way (year x month x time period) analysis of variance (ANOVA) was used to determine if the total number impinged was significantly

different ($P \leq 0.2$) between the two 7-month periods. The monthly stratified mean (Y_{stm}) for each year was estimated by the formula:

$$Y_{stm} = \sum \left(\left[N_{am} / N_m \right] \cdot Y_{am} \right)$$

Y_{am} = sample mean in stratum a during a month

N_{am} = number of sampling units in stratum a during a month

N_m = number of sampling units in all strata during a month

The stratum means were used as observations in the ANOVA because a balanced design was required for the Hewlett-Packard ANOVA program. In some cases the 7-month estimates were higher than the yearly estimates due to the seasonal presence and absence of particular species. A yearly estimate may have included more months in which the form was absent and, therefore, the 7-month estimate may exceed the yearly estimate.

For 13 of the 20 months sampled during the 2 years, OCGS had all four circulating-water pumps in operation. The mean velocity in front of the trash racks with six traveling screens in operation varied from 0.17 to 0.22 m/sec although the velocity at an individual location ranged from less than 0.01 to 0.67 m/sec. From September through December 1975, however, only three circulating-water pumps were in operation; both the mean velocity before the trash racks (0.06 to 0.21 m/sec) and the velocity at an individual location (0 to 0.27 m/sec) were considerably lower (M. B. Roche, personal communication).

Results

A total of 944 collections was taken from 5 September 1976 through 2 September 1977, and physicochemical parameters associated with each collection were summarized weekly (Table D1-48) and monthly (Appendix C1, Table C1-149). Water temperature, by month, was summarized in Fig. D1-12. No collections were taken from 14 May through 12 July because OCGS did not circulate water during this period. Some 352 collections were made during the day (170 in period 1, 182 in period 2) and 592 at night (356 in period 3, 236 in period 4). Each collection represented the organisms impinged for a duration of 20 min to 7 h 38 min.

An estimated 1,481,396 ± 132,597 specimens, weighing 27,500 ± 2,387 kg, of 122 taxa were impinged (Table D1-49), but only 487,178 specimens (Table D1-50) weighing 7,988 kg (Table D1-51) were actually collected. Invertebrates comprised 59% and fishes 41% of the estimated specimens impinged.

The most numerous fishes were the bay anchovy (25% of the estimated fish impinged), Atlantic menhaden (16%), spot (10%), smallmouth flounder (10%), and Atlantic silverside (6%). The most important fishes by weight were the Atlantic menhaden (34% of the estimated fish biomass impinged), spot (14%), winter flounder (10%), and summer flounder (4%). The most numerous invertebrates were the sand shrimp (68% of the estimated invertebrates impinged), blue crab (26%), and grass shrimp (3%), but the blue crab accounted for more biomass (84% of the estimated invertebrate biomass impinged) than the sand shrimp (5%).

Most of the organisms were impinged from fall into winter. About 68% of the estimated fish impinged and 68% of the estimated fish biomass were taken from 26 September through 27 November (Tables D1-52, D1-53). Most of these fish were the bay anchovy, Atlantic menhaden, spot, and smallmouth flounder. Few fish (0.3%) were impinged from 16 January through 19 February. A total of 69% of the estimated invertebrates were impinged from 5 September through 15 January; the sand shrimp and blue crab comprised most of these specimens.

The total weekly impingement estimate expressed as the number of specimens impinged per hour and per million gallons of cooling-water flow also indicated that most organisms were impinged during fall and that few were taken during late winter (Table D1-54). The most specimens (736) were collected per hour from 21 through 27 November and the least (15) from 30 January through 12 February. The average number per hour during the year was 217 specimens. The most specimens (29) collected per million gallons of cooling-water flow occurred from 12 through 18 December and the least (1) from 23 January through 12 February. Few specimens (1 to 2) also were collected from 24 April through 14 May when the number of circulating-water pumps in operation was reduced. The average number impinged per million gallons of cooling-water flow was nine specimens.

During 24 h samples, 50% of the fishes and invertebrates were impinged in the 6 h after sunset, and 41% from 6 h after sunset to dawn (Table D1-55). Most of the bay anchovy (86%), Atlantic menhaden (85%), sand shrimp (99%), and blue crab (79%) were impinged at night (Table D1-56).

Some 28,436 organisms were examined for condition; 41.7% were live, 29.6% damaged, and 28.7% dead (Table D1-57). Since the estimated mortality for 7 of the 11 most abundant fishes and macroinvertebrates was not significantly different between 7 comparable months for the 2 years (Table D1-58), data from the 2 years were pooled to generate a single estimate of condition for abundant species (Table D1-59). The significantly different mortality between years for the bay anchovy, Atlantic silverside, weakfish, and smallmouth flounder may reflect differences in either the physical condition of these fishes or operational characteristics associated with the OCGS screens. For the bay anchovy and Atlantic silverside, the difference in percent mortality between the 2 years was relatively small (< 10%), and for the other two fishes the pooled mortality estimate for these species approximated their mortality over both years.

Fishes with high (> 70%) survival and low mortality (< 15%) immediately after impingement included the northern pipefish (90% survival), oyster toadfish (85%), and fourspine stickleback (85%). Macroinvertebrates with hard exoskeletons, such as the blue crab (64%), sand shrimp (77%), and grass shrimp (87%), also passed from the screens with minimal damage and mortality (Table D1-59), but molting invertebrates were often dead. Although only 64% of the impinged blue crab were live and undamaged after impingement, few (7%) were dead. Most damaged crabs (29%) were missing one or more appendages, a condition which is not uncommon in nature and which probably did not affect the ultimate survival of these individuals.

The striped cusk-eel (41% survival), black sea bass (37%), striped searobin (55%), smallmouth flounder (36%), summer flounder (53%), and winter flounder (46%) had moderate immediate survival and low (<30%) immediate mortality (Table D1-59). Much of the damage to the flatfishes consisted of abrasions on the body and missing scales. Many damaged flatfishes and striped searobin also had split fins. The Atlantic silverside had moderate survival (34%) and mortality (38%). Striped cusk-eel and Atlantic silverside were often observed tangled in the mesh of the screens.

The immediate survival and mortality of three flatfishes showed a correlation between body size and survival rate. The smallmouth flounder (mean length about 70 mm) had lower survival and higher mortality than the larger summer flounder (255 mm) and winter flounder (161). The thicker musculature of the larger flatfishes may afford more protection to internal organs and hence increase survival of these fishes.

The alewife (12% survival), blueback herring (17%), Atlantic menhaden (8%), bay anchovy (7%), bluefish (20%), weakfish (15%), and spot (19%) had low (< 30%) immediate survival and usually more than 50% immediate mortality (Table D1-59). Although the mortality of the three clupeids was less than 50%, many (41% to 64%) fish were damaged, and these individuals were severely stressed. They displayed loss of equilibrium and frequently lay on the bottom of the cooler. Similarly stressed clupeids and bay anchovy were often observed at the discharge of the screenwash flume where they were prey for sea gulls.

Over the 2-year period, seasonal differences in immediate survival, damage, and mortality were evident for several species where data were sufficient to follow seasonal trends. The survival and mortality of the bay anchovy and blue crab followed seasonal changes in water temperature. Mortality of both species increased during the spring to a maximum during the summer and then decreased in the fall (Figs. D1-13, D1-14). Molting blue crabs were more common at warmer water temperatures, and many molting individuals were dead. The percentage of live blue crab and bay anchovy decreased during summer, and the lowest percentage of live individuals was found during this season. The substantial decrease in blue crab survival (i.e., live and undamaged crabs) during summer corresponded primarily to the large increase in damaged specimens rather than a large increase in dead individuals. The increased activity of crabs, both in nature and in the collecting device, during periods of warmer ambient temperatures probably accounted for the increased number of individuals which were damaged (i.e., missing appendages).

Monthly variation in immediate mortality also was apparent for other species (Table D1-60). Mortality of the Atlantic menhaden also followed water temperature with decreased mortality from September through December and increased mortality from March through May. Atlantic silverside mortality decreased from November to December and also from March to April. Sand shrimp mortality was greatest in December and January and least during March and April.

The diel difference in condition was examined from collections from September 1976 through August 1977 (Table D1-61). At OCGS, specimens

impinged during the day had slightly higher mortality (32%) than those impinged at night (28%), and specimens collected at night had better survival (43%) than those impinged during the day (31%). Fewer damaged specimens were impinged at night (29%) than during the day (37%). Although differences were found for several species, the trends were inconsistent. More live Atlantic silverside, bay anchovy, and grass shrimp were collected at OCGS at night and more dead or damaged individuals during the day. However, significantly more live Atlantic menhaden and spot were collected during the day and more dead individuals at night. The difference between the percentage of live, damaged, and dead blue crab and northern pipefish was not significant between day and night collections.

The allometric condition factor of the limited number of specimens examined indicated that impinged fishes often were in poorer condition than those from other areas. From September through November, March through May, and June through August, the condition factor for the bay anchovy taken from Oyster Creek, Forked River, and the other creek mouths was significantly better than that of individuals taken from the screens (Appendix C1, Table C1-242). From September through November, Atlantic menhaden from Oyster Creek had a significantly better condition factor than those impinged (Appendix C1, Table C1-237), and from December through February, individuals from Oyster Creek were in significantly better condition than those from the screens.

For some fishes, however, the condition of impinged organisms was similar to or greater than that of individuals from other areas. From

March through May, condition of Atlantic menhaden impinged at OCGS was not significantly different from that of individuals taken from the OCGS discharge (Appendix C1, Table C1-237). Similarly, the condition factor for winter flounder impinged during December was not significantly different from that of specimens taken from Oyster Creek (Appendix C1, Table C1-300). In January, winter flounder taken in Oyster Creek were in significantly better condition than those impinged. Individuals impinged from March through April were in significantly better condition than those taken in Oyster Creek, and impinged specimens from July through August were in significantly better condition than those from Oyster Creek, Forked River, and the other creek mouths. During November the condition of bluefish from Oyster Creek was significantly better than those from the screens, and bluefish collected from the creek mouths during July were in significantly better condition than individuals from the screens (Appendix C1, Table C1-267).

Although a limited number of specimens was examined, it appeared that continuous operation of the OCGS screens decreased immediate mortality and increased immediate survival of the Atlantic menhaden, Atlantic silverside, and winter flounder (Table D1-62). These differences were most dramatic for fishes which had relatively low survival under normal, intermittent screen operation. The immediate survival of the Atlantic menhaden impinged in November and December increased from 9% with intermittent screen rotation to 25% under continuous operation while mortality decreased from 23% to 9%. Similarly, the survival of the Atlantic silverside increased from 27% (intermittent operation) to 65%

(continuous operation), and mortality decreased from 43% to 14%. The apparent decrease in survival of the smallmouth flounder and sand shrimp under continuous screen operation was attributed to the very cold air temperatures on the nights that these samples were collected. Since these small organisms were often obscured by and hidden in detritus and vegetation, they often remained on the sorting table and exposed to the cold air longer than the larger, more visible fishes.

The estimated number of fishes and macroinvertebrates impinged at OCGS during the 7 comparable months in 1975-76 and 1976-77 varied widely (Table D1-47). The difference between the estimated number impinged was significant for the total number of organisms impinged and for 13 of the 16 species tested. Only the estimated number of the blueback herring, Atlantic silverside, and striped searobin was not significantly different between the 2 years.

From 4 September 1976 through 2 September 1977, nine species accounted for 87% of the estimated 1,481,396 specimens (27,500 kg) impinged, and for the 2 years, 98% of the estimated 12,967,509 specimens (94,896 kg) impinged were of 10 species (Table D1-49). The abundance, mortality rate, impingement in relation to water temperature (Table D1-63), diel occurrence, and differences in these parameters between 1975-76 and 1976-77 for these 10 species and for other species which were considered important by the NRC and EPA are discussed in order of their numerical abundance.

1. Sand shrimp

An estimated 600,278 sand shrimp (606 kg) were impinged during the second year (Table D1-49) with 68% of the specimens impinged from 21 November through 15 January (mean weekly temperatures of 6 to 0 C) and 22% from 20 March through 23 April (7 to 17 C). Although it was the most numerous organism collected in the second year (41% of all specimens), it accounted for only 2% of the biomass.

More sand shrimp were estimated to have been impinged the first year (3,342,143 shrimp; 2,883 kg) than the second year. More than three times as many sand shrimp were estimated to have been impinged during the 7 comparable months of 1975-76 (n = 1,740,571) than during 1976-77 (526,618). The sand shrimp was collected throughout both years, but few were impinged in August and September of either year. For the 2 years, 96% of the individuals were impinged at a water temperature of -1 to 20 C (Table D1-63). The increase in the impingement of the sand shrimp in the fall occurred earlier in 1976 (November) than in 1975 (December). Substantial impingement apparently occurred earlier (late March through April) in 1977 than in 1976 (May through June), but OCGS did not circulate water during half of May and in June of 1977 (Fig. D1-15). Most individuals were collected at night during both 1975-76 (94%) and 1976-77 (99%).

For the 7 comparable months, the percent immediate mortality during the first year (14% mortality) was not significantly different than that during the second (15%, Table D1-58). The mean immediate mortality for the 2 years was 14%, and during this period an estimated 840,053 sand

shrimp (21% of those impinged) experienced immediate (n = 391,770) and delayed (448,283) mortality (Table D1-64).

2. Blue crab

In both years, the blue crab accounted for the most biomass (51,399 kg the first year; 10,837 kg the second) impinged at OCGS even though the estimated number of crabs impinged during the second year (n = 230,691) was much less than the estimated 5,626,253 blue crab impinged during the first year (Table D1-49). This large difference in the number impinged was due in part to a substantial mortality of blue crab during the winter of 1976-77 (Appendix C1, Section C1.19) and to the 1977 OCGS shutdown from 14 May through 11 July, a period when crabs were most abundant in 1976. A similar percentage of crabs were impinged at night during both the first (83%) and second (79%) year.

In 1975-76, OCGS operated during all months that the blue crab was abundant with the most crabs impinged during June and July (Table D1-65). During the second year, 65% of the blue crab were impinged from 5 September through 6 November (mean weekly water temperature of 25 to 10 C) and 31% from 17 July through 3 September (24 to 28 C). During the 2 years, 99% of the crabs were taken at a water temperature of 9 to 29 C, and relatively few individuals were impinged from December through February. During 1975, the blue crab was common and infrequently abundant in impingement collections through December, but in 1976 they were abundant only until the beginning of November (Fig. D1-16). In 1976, blue crabs first became abundant in March, but they did not become abundant until April during 1977.

Immediate mortality of the blue crab was not significantly different between the 7 comparable months in the first (7% mortality) and second (6%) year (Table D1-47); the average mortality for the 2 years was 7%. An estimated 10% (n = 600,087) of those individuals impinged experienced either immediate (403,573) or delayed (196,514) mortality (Table D1-65).

3. Bay anchovy

The estimated 147,202 bay anchovy (477 kg) impinged during the second year comprised 10% of the specimens impinged but only 2% of the biomass. More bay anchovy (59% of all individuals impinged) were impinged during the fall of 1976 (12 September through 13 November; mean weekly water temperature of 25 to 7 C) than during the spring of 1977 (23% from 10 to 23 April; 13 to 17 C). During the first year, an estimated 1,811,550 bay anchovy (4,954 kg) were impinged; most (95%) of these specimens were impinged in the spring (21 March through 29 May, 11 to 21 C) of 1976. Although OCGS did not operate four circulating-water pumps from 23 April to 12 May and did not circulate water during the remainder of May in 1977, the difference in time of greatest impingement between the two 12-month periods was primarily explained by a larger number of bay anchovy in the Bay during 1976 than during either 1975 or 1977. The time of greatest impingement during each of the two, 12-month periods was during 1976.

The large number of bay anchovy impinged in March and April of 1976 and the shutdown of OCGS from 14 May through 11 July 1977 accounted, in part, for the greater number of bay anchovy impinged during the first

year (Table D1-49). Most bay anchovy were impinged in spring (March and April) and again in fall (October through December). During spring, most impingement occurred in March during 1976 but not until April in 1977 (Fig. D1-17). Few bay anchovy were collected from January through March during either year because they left the Bay during late fall and early winter (Table D1-66). Ninety-two percent of the bay anchovy were impinged at a water temperature of 9 to 22 C. The bay anchovy was impinged primarily at night during 1975-76 (61%) and 1976-77 (86%).

The immediate mortality of the bay anchovy was high during both the first (72% mortality) and second (81%) years, and during the 7 comparable months mortality was significantly greater during the second year (Table D1-58). The average mortality for the 2 years was 78%. Most (96%) of the bay anchovy impinged in the 2 years were lost due to immediate (n = 1,506,768) and delayed (366,341) mortality (Table D1-66).

4. Atlantic menhaden

Most (90%) of the estimated 94,960 Atlantic menhaden (5,003 kg) impinged during the second year were impinged from 17 October through 18 December when the mean weekly water temperature decreased from 13 to 0 C. Although the Atlantic menhaden comprised only 6% of the specimens impinged, it accounted for 18% of the biomass. Fewer (17,788 fish; 1,218 kg) Atlantic menhaden were estimated to have been impinged during the first year (Table D1-49). Although most of those impinged during the first year were also impinged in the fall, they were most abundant from 30 November through 27 December (Table D1-67, Fig. D1-18). About

87% of the individuals taken during the 2 years were impinged at a water temperature of 0 to 13 C. The Atlantic menhaden was impinged primarily at night during the first (71%) and the second (85%) year.

Mortality between years for the 7 comparable months was not significantly different for the first (27% mortality) and the second (25%) year (Table D1-58). The mean immediate mortality for the 2 years (28% mortality) was higher than the mortality for the 7 comparable months because the high mortality during July of the first (54%) and second (67%) year was not included in the estimated mortality for the 7 comparable months. Some 110,448 Atlantic menhaden (98% of those impinged) were lost due to immediate (n = 31,822) and delayed (78,626) mortality during the 2 years (Table D1-67).

5. Spot

Most (81%) of the estimated 61,573 spot (2,084 kg) impinged in the second year were impinged from 17 October through 27 November at a mean weekly water temperature of 13 to 5 C. During the second year, the spot comprised 4% of all specimens impinged.

During the first year an estimated 48,059 spot weighing 191 kg were impinged (Table D1-49). Few spot were impinged before June (Table D1-68), and most (91%) were taken from 13 June through 31 July when the mean weekly water temperature ranged from 26 to 29 C. Fewer spot were impinged in the fall on 1975 than the fall of 1976, and this may have been due to a smaller 1975 year-class (Fig. D1-19). During 7 comparable months, only an estimated 4,682 spot were impinged during the first year

while an estimated 60,153 were impinged during the second. Most of the spot were impinged at night during the first (91%) and second (81%) year. During the 2 years, 58% of the spot were impinged at a water temperature of 4 to 13 C and 28% at 23 to 29 C.

The mean immediate mortality for the 2 years was 48%. An estimated 47,789 spot (44% of those impinged) died immediately after impingement (Table D1-68). The lower percentage of the estimated number lost immediately after impingement was attributed to the lower mortality of the spot during October (32% mortality) and November (22%), months when this fish was most abundant.

6. Smallmouth flounder

The smallmouth flounder was substantially more abundant during the second year (an estimated 57,773 fish; 359 kg) than during the first year (8,022; 54 kg), and this difference was significant for the 7 comparable months (Table D1-49).

In both years, most smallmouth flounder (99.8%) were taken from late October through December with few taken in other months (Table D1-69, Fig. D1-20). A total of 99% of the specimens was impinged at a water temperature of -1 to 11 C. In 1975, the smallmouth flounder was abundant in impingement collections during November (mean monthly water temperature of 12 C), but it was abundant about a month earlier (October, 14 C) in 1976. Ninety-seven percent of the smallmouth flounder were impinged at night during the second year, and 86% were impinged at night during the first year.

Significantly more smallmouth flounder were killed during the 7 comparable months of the second year (29% mortality) than the first year

(17%, Table D1-58). Overall, the mean immediate mortality for the 2 years was 26%. An estimated 18,714 smallmouth flounder (28% of those impinged) were lost to immediate mortality (Table D1-69), and 81% of these fish were lost during November 1976.

7. Atlantic silverside

An estimated 35,051 Atlantic silverside (185 kg) were impinged during the second year as compared to 61,272 (314 kg) during the first year (Table D1-49). More Atlantic silverside were also impinged during the 7 comparable months of the first year (n = 56,567) than the second (33,766), but no signficant diffference occurred between years. Most fish were taken during November and December and again during March and April of both years (Table D1-70); 95% of the Atlantic silverside were taken at a water temperature of -1 to 14 C. During the second year, 41% of the Atlantic silverside were impinged from 7 November through 18 December (mean weekly water temperature of 7 to 0 C) and 46% from 14 March throgh 16 April (7 to 13 C). Atlantic silverside occurred mostly in December during the fall of 1975, although most specimens were collected during November in the fall of 1976. They occurred in March during both years but were taken longer (into May) in 1976 (Fig. D1-21). Fewer were impinged at night during the first year (55%) than the second (66%).

The mortality of the Atlantic silverside was significantly different for the 7 comparable months between the 2 years even though the mortality between the first (38% mortality) and second year (34%) differed by only 4% (Table D1-58). Overall, the mean mortality for the 2 years was 38%.

An estimated 53,395 Atlantic silverside (55% of those impinged) were lost due to immediate (n = 39,073) and delayed (14,322) mortality (Table D1-70).

8. Grass shrimp

An estimated 29,885 grass shrimp (18 kg) were impinged from 4 September 1976 through 2 September 1977. Some 39% of these individuals were collected from 6 March through 23 April (mean weekly temperature of 7 to 17 C). It comprised only 2% of the specimens impinged during the second year, but it ranked fourth in numerical abundance for both years combined because more grass shrimp were impinged during the first year (an estimated 373,288 shrimp; 241 kg) than the second (Table D1-49). Similarly during the 7 comparable months, more than 6 times as many grass shrimp were impinged the first year (n = 171,904) than the second (25,535).

Specimens were collected throughout the year, and 85% were impinged at a water temperature of -1 to 22 C (Table D1-63). Few individuals were taken in September (Table D1-71), and most grass shrimp were impinged in June of 1976. In the fall of 1975, the grass shrimp became abundant during November whereas in the fall of 1976 they first were abundant in impingement collections during October (Fig. D1-22). Ninety-four percent of the grass shrimp were impinged at night during 1975-76 and 96% during 1976-77.

No significant difference was found between the immediate mortality of the grass shrimp for the 7 comparable months (Table D1-58). Mortalities were similar during the first year (8% mortality) and the second (6%),

and the average mortality for the 2 years was 8%. Because the mortality of the grass shrimp impinged in June 1976 was only 5% and many individuals (n = 144,512) were impinged then, the percentage of the estimated number of specimens lost immediately after impingement during the 2 years (n=22,633; 6% of those impinged) was less than the average immediate mortality (Table D1-71).

9. Striped searobin

Most (87%) of the estimated 28,371 striped searobin (516 kg) impinged from 4 September 1976 through 2 September 1977 were impinged from 26 September through 30 October when the mean weekly water temperature decreased from 20 to 11 C. An approximately equal number of striped searobin was impinged during the first year (32,254 fish; 369 kg; Table D1-49). No significant difference was found between the abundance of the striped searobin for 7 comparable months during the first (n = 34,251) or second year (28,109, Table D1-47). During both years, most striped searobin were taken from August through November (Table D1-72, Fig. D1-23), and 83% were taken at a water temperature of 11 to 22 C. Some 97% were impinged at night during the first year and 95% during the second year.

No significant difference was found between mortalities of the striped searobin for 7 comparable months of the first year (12% mortality) and the second year (14%, Table D1-58). Some 16,096 striped searobin (27% of those impinged) experienced immediate mortality (Table D1-72), but no specimens were lost to delayed mortality. The mean immediate

mortality for the 2 years (18% mortality) was less than the percentage of the estimated number of fish lost immediately after impingement because many (n = 10,534) striped searobin were impinged during August 1976 when immediate mortality was 57%.

10. Blueback herring

An estimated 27,496 blueback herring (197 kg) were impinged in the second year, and 79% of these were impinged from 5 through 25 December when the mean water temperature was 0 C. The estimated 28,120 blueback herring (268 kg) impinged during the first year was similar to the number of individuals impinged during the second year (Table D1-49). No significant difference was found between the abundance of the blueback herring for 7 comparable months during the first (n = 26,070) or second (26,113) year. For 2 years, most blueback herring were impinged in December (68%) and from March through May (28%, Table D1-73). Some 94% of those impinged were collected at a temperature of -1 to 12 C. Although blueback herring were most abundant in December during both winters, they were more abundant in impingement collections during the early portion of December in 1976 (mean weekly water temperature 3 to 0 C) and during the later portion of the month in 1975 (7 to 1 C, Fig. D1-24). About 80% of the blueback herring were impinged at night during the first year and 85% during the second year.

Although the mortality during the 7 comparable months of the first year (43% mortality) was slightly higher than that during the second year (41%), the difference was not significant. The mean immediate

mortality for the 2 years was 42%, and an estimated 36,137 blueback herring (65% of those impinged) were lost from immediate (n = 23,104) and delayed (13,033) mortality (Table D1-73).

Other Fishes

Although the threespine stickleback, striped bass, northern kingfish, and northern puffer were designated by the EPA as important fishes for an evaluation of the thermal discharge from the OCGS, few individuals were impinged, and these species were not discussed. The impingement of other important fishes that were designated as important by the EPA or the NRC but which did not rank among the ten most numerous fishes and macroinvertebrates impinged are discussed below.

Northern pipefish

The estimated 11,220 northern pipefish (25 kg) that were impinged from 4 September 1976 through 2 September 1977 was substantially less than the 36,066 (86 kg) individuals impinged during the first year (Table D1-49). The abundance of the northern pipefish was significantly different between the first (n = 29,379) and second (8,780) years for the 7 comparable months. In the 2 years, most were collected from October through December and from March through June. However in the fall, the northern pipefish was most abundant in December (mean monthly temperature 4 C) of 1975 and in November (6 C) in 1976 (Table D1-74). In the spring, they were most abundant during March (9 C) in 1976 and during April (14 C) in 1977 (Fig. D1-25). For the 2 years, 84% of the

specimens were impinged at a water temperature of 4 to 17 C. More individuals were impinged at night during the first year (86%) than during the second year (75%).

The mean immediate mortality for the 2 years was 5%, and mortality was not significantly different in the 7 comparable months of the first (4% mortality) and second year (5%). Some 11,693 northern pipefish (25% of those impinged) were lost through immediate (n = 1,877) and delayed (9,816) mortality in the 2 years (Table D1-74).

Bluefish

Fewer bluefish (3,935 fish; 153 kg) were impinged during the second year than during the first (14,086, 64 kg; Table D1-49). However for the 7 comparable months, significantly fewer (n = 1,474) bluefish were impinged in the first year than the second (3,313). The shutdown of OCGS from 14 May through 11 July 1977 may have accounted for part of the apparent difference in the number of bluefish impinged between the 2 years. In 1976, most fish were taken in May (20% of all impinged bluefish in 1975-76; mean monthly water temperature 20 C), June (45%, 26 C), and October (11%, 14 C; Table D1-75, Fig. D1-26). For the 2 years, 78% of the bluefish were impinged at a temperature of 17 to 28 C. Only 62% of the bluefish were impinged at night during the first year while 79% of those impinged during the second year were taken at night.

The mean immediate mortality for the 2 years was 59%, and the immediate mortality during the first year (61% mortality) was similar to that during the second year (56%). An estimated total of 9,781 bluefish

(54% of those impinged) was lost to immediate mortality during both years (Table D1-75). The total percentage of the estimated number of fish lost immediately after impingement was lower than the mean percent mortality for 2 years because of relatively low mortality (46%) during October 1976.

Weakfish

An estimated 11,790 weakfish (185 kg) were impinged during the first year as compared to 27,297 individuals (559 kg) that were estimated to have been impinged during the second year (Table D1-49). During 7 comparable months, more than twice as many weakfish were impinged during the second year (n = 26,899) as compared to the first year (11,448); this difference was significant (Table D1-47). During the 2 years, most (99%) weakfish were collected from August through November (Table D1-76). It was not as abundant in the fall of 1975 as in the fall of 1976, and its greatest impingement occurred earlier in the fall of 1976 (October, mean monthly water temperature 14 C) than the fall of 1975 (November, 12 C; Fig. D1-27). A total of 70% of the estimated impingement occurred at night during the first year, but 86% occurred at night during the second. Some 83% of the weakfish were impinged at a water temperature of 11 to 26 C.

The immediate mortality rate of the weakfish was significantly greater for the 7 comparable months of the second year (60% mortality) than during the first year (44%, Table D1-58), and the mean immediate mortality for each of the 2 years was 59%. A total of 23,836 weakfish

(61% of those impinged) experienced immediate mortality during the 2 years (Table D1-76).

Summer flounder

More (4,266 fish; 908 kg) summer flounder were impinged during the first year than the second (2,380, 601 kg; Table D1-49). Similarly for the 7 comparable months, significantly more summer flounder were impinged the first year (n = 3,147) than the second year (2,273). Most summer flounder were impinged a month later in the fall of 1975 (November; mean monthly water temperature 12 C) than the fall of 1976 (October, 14 C; Table D1-77, Fig. D1-28). Sixty-three percent of the summer flounder were impinged at night the first year, but substantially more (85%) were taken at night the second year. Some 83% of impinged specimens were taken at a water temperature of 8 to 25 C. The mean immediate mortality of the summer flounder for the 2 years was 9%. A total of 543 summer flounder (8% of those impinged) experienced immediate mortality (Table D1-77).

Winter flounder

An estimated 18,618 winter flounder (1,400 kg) were impinged from 4 September 1976 through 2 September 1977, but only an estimated 3,908 winter flounder (368 kg) were impinged during the first year (Table D1-49). Significantly more winter flounder were impinged during 7 comparable months of the second year (n = 14,285) as compared to the first year

(1,214). In the 2 years, most were impinged from November through March and in June. The winter flounder entered the Bay in the fall, and they were taken on the screens earlier and in greater abundance in November 1976 (mean monthly water temperature 6 C) than in November 1975 (13 C; Table D1-78, Fig. D1-29). Most (87%) of the fish were impinged at a water temperature of -1 to 8 C. Young of the winter flounder were abundant in June 1976, but none were taken in 1977 because OCGS was shut down during this month (Fig. D1-29). Most (93%) of the winter flounder were taken at night during the second year, but only 81% were taken at night during the first year. The mean immediate mortality for the 2 years was 15%, and an estimated 5,070 winter flounder (23% of those impinged) were lost from immediate (n = 2,909) and delayed (2,161) mortality during the 2 years (Table D1-78).

Discussion

A multiple regression analysis of 1975-76 data indicated that water temperature was a factor affecting impingement and that most fishes were impinged when the water temperature was seasonally increasing or decreasing (Miller 1977). Changing water temperature influenced the movement of specimens either into, out of, or within the Bay, and most fishes were generally impinged during these periods of movement. The period of maximum abundance of an organism in the Bay did not correlate well with impingement. The bay anchovy, Atlantic menhaden, bluefish, Atlantic silverside, spot, and weakfish were present in the Bay throughout summer, but most individuals of these species were impinged during spring and

fall when these species were moving within or out of the Bay. Low water temperature, particularly from October through December, may also have reduced the ability of fishes to avoid impingement.

The correlation between water temperature and time of maximum impingement also was illustrated by the shift in the date when the greatest impingement occurred in the fall between the 2 years. The water temperature decreased more rapidly in the fall of 1976 than during the previous year. The mean water temperature by month was considerably lower during October (14.0 C in 1976, 16.4 C in 1975), November (6.0, 11.8), and December (2.0, 4.4) of 1976. This earlier cooling of the Bay was reflected in the earlier movement and impingement of the Atlantic menhaden, Atlantic silverside, northern pipefish, summer flounder, and winter flounder in the fall of 1976.

The survival of impinged organisms is an important parameter when these organisms are returned to the receiving body of water because it minimizes the impingement losses of these organisms. At OCGS, the recent rerouting of the screen-wash flume from the area of the OCGS heated discharge to the ambient temperature water in the dilution pump discharge insures that organisms returned live from the OCGS screens will not be subject to a temperature shock at the point of release. Furthermore, this area of ambient temperature water in the upper part of the discharge canal should provide an area for fishes and invertebrates to avoid the maximum discharge temperatures.

The rate of survival and mortality for impinged fishes and macro-invertebrates varied widely, and the impact of impingement must be

weighed on a species-by-species basis. Overall, organisms which have been traditionally regarded as hardy (e.g., blue crab and northern pipefish) had relatively good survival while fishes which are traditionally difficult to collect and handle in good condition (e.g., Atlantic menhaden, bay anchovy, and young weakfish) had poor survival. Organisms with a hard exoskeleton (e.g., blue crab), bony plates (e.g., fourspine stickleback, northern pipefish) or a defensive mechanism (e.g., northern puffer) had high immediate survival.

The survival rate of the bay anchovy and blue crab decreased during the summer, and seasonally variable injury rates (individuals obviously dead and damaged) were also reported by Landry and Strawn (1974). They reported that the injury rate of the bay anchovy was lowest in February (7.4%) and March (18.6%) and highest during August (64.8%) and September (75.9%). The injury rate of the Gulf menhaden increased from a low in February (0.1%) and March (2.3%) to a high in September (43.1%) and October (32.1%).

Seasonal variability in survival and mortality must also be considered in an evaluation of impact. At OCGS, the periods of maximum impingement of fishes were during seasonally increasing and decreasing water temperature. Immediate survival of the bay anchovy was at least 10% greater during spring and fall than during summer. However, the maximum mortality of blue crab was during summer, the time of its greatest impingement.

Landry and Strawn (1974) reported that injury rates (individuals obviously dead and damaged) of fishes impinged at the P. H. Robinson Power Plant in Texas depended on the time of collection. They found

that more injured fishes were collected during daylight. Although the overall trend in survival at OCGS was similar to that reported by Landry and Strawn (1974), the difference between the condition of individual species in day and night collections was inconsistent.

Continuous operation of vertical traveling screens appeared to increase survival and decrease mortality of fishes. At the P. H. Robinson Power Plant, Chase (1975) found that the percent of live blue crab impinged during a 20-min continuous rotation of the traveling screens (95% survival) was about 14% greater than the survival of blue crab impinged for 2 h (80.8%). He also found better survival of the Gulf menhaden during continuous rotation (20% survival) than during intermittent rotation of the screens every 2 h (2.6%). At the Bowline Point, Roseton, and Danskammer Point power plants on the Hudson River, King et al. (1978) reported that the survival of young white perch, Atlantic tomcod, and striped bass generally increased as the time between screen washes decreased. They also found that the highest probabilities for survival of young white perch and striped bass were during continuous operation of the screens.

The Ristroph screen, a modified traveling screen which dramatically increased the immediate survival of the blueback herring (90.4% survival), alewife (90.7%), Atlantic menhaden (94.9%), bay anchovy (82.0%), weakfish (59.2%), and summer flounder (97.4%) impinged at Virginia Electric and Power Co.'s Surry Power Station on the James River, Virginia (White and Brehmer 1977), was also operated continuously. Although it may not be practical to continuously rotate traveling screens at all times, continuous

rotation during periods of high impingement may substantially reduce the environmental impact of these screens.

Other factors may also affect survival of impinged organisms. Chase (1975) found that the survival of the blue crab and Gulf menhaden impinged on continuously rotating traveling screens with low volume flow (95% and 20% survival, respectively) was higher than survival of these species at screens with higher volume flows (64% and 13.7%, respectively). Anderson et al. (1975) also attributed higher impingement mortality at Unit 4 of the Salem Power Station in Massachusetts to greater intake velocity at that unit. Differences in flow and intake velocity immediately before the OCGS screens existed between 1975 and 1976 and may explain, in part, some differences in the mortality estimate of certain species between the 2 years. Physical condition of individuals also affects survival of impinged organisms and for a number of species the condition factor of individuals impinged at the OCGS screens was significantly less than that of individuals from other areas of Barnegat Bay.

A comparison of the number of specimens impinged per hour and the number of specimens impinged per million gallons of cooling-water indicated that most (736 per hour) specimens were impinged from 21 through 27 November 1976 and most (29) specimens per million gallons of cooling-water were impinged from 12 through 18 December 1976. During the first year, the most specimens (7,005 per hour and 254 per million gallons of cooling-water) were impinged from 13 to 19 June 1976. The difference in these periods of impingement between the 2 years was attributed to both the increased impingement of fishes in the fall of 1976 and the

decreased catch of the blue crab in 1977. This decrease in the catch of the blue crab reflected both its reduced abundance in the Bay in 1977 (Section D1.15) and the shutdown of OCGS from 14 May through 11 July.

Since the abundance and, therefore, loss of most (13 of 16 species) fishes and macroinvertebrates impinged at OCGS was significantly different between comparable months in 1975-1976 and 1976-1977, it was apparent that statistical predictability of the annual abundance and loss of impinged organisms has not been achieved. The significant difference in the number of impinged organisms was not surprising because the populations of estuarine species vary greatly from year to year. Marcellus (1972) reported 50 to 100% fluctuations in the abundance of various fishes from year-to-year. Populations of fishes (e.g., Sciaenidae) undergo natural cycles in abundance, and drastic changes in these populations can occur in a period of a few years (Joseph 1972).

D1.12 PASSAGE OF FISHES AND MACROINVERTEBRATES THROUGH THE DILUTION PUMPS

Introduction

The dilution pumps pass ambient temperature water from Forked River (the intake canal) to Oyster Creek (the discharge canal) to dilute the heated water discharged from OCGS. This ambient temperature water and water discharged from OCGS remain somewhat discrete in about the upper 60 m of the discharge canal, but they are effectively mixed near the bend in the discharge canal (Fig. D1-10). After mixing, the water in the discharge canal averaged about 4.5 C (range of 2.0 to 7.5 C) above ambient with two dilution pumps in operation (M. B. Roche, personal communication). The capacity of two dilution pumps (5.2×10^5 gallons per min, GPM) was slightly greater than that of the four circulating-water pumps (4.6×10^5 GPM).

The intake to the dilution pumps is preceded only by trash racks, and large fish and invertebrates pass through the pumps. The species, abundance, and condition of organisms immediately after passage through the dilution pumps were determined and compared with those of organisms impinged on the traveling screens that precede the intake to the OCGS circulating-water system. These studies were a continuation of the work begun in 1975 by Rode and Boyle (1977a). Delayed mortality of organisms passed through the dilution pumps was examined in a separate study.

Materials and Methods

The dilution pump sampler consisted of a steel frame (91 cm long) which opened from a 1.2-m^2 mouth to 1.5 m^2; a 3.3-m section of 38-mm stretch mesh netting; and a 97 x 128 x 97-cm aluminum live box with 9.5-mm mesh netting (Fig. D1-11). After November, the live box was replaced with a 78 x 87 x 92-cm box (6.3-mm mesh netting) because the larger box was in disrepair.

A boom was used to lower the sampler near the bottom of the discharge of dilution pump number three (Fig. D1-10), but the live box floated at the surface. After organisms were taken from the live box, crabs and fish were placed in separate, insulated coolers. All specimens were identified, and their condition was recorded as live, dead, or damaged.

Collections were taken once a week from sunset to 6 h after sunset (period 3) and were concurrent with sampling at the OCGS screens when OCGS was in operation. The duration of each collection was usually 1 h.

Half-hour samples were taken at the surface and bottom of the dilution pump discharge during five, 6-h periods from 10 through 24 October 1977 to determine differences in the vertical distribution of organisms discharged from the pumps. The significance of these vertical differences in distribution were determined with a Wilcoxon's Signed Rank Test ($P \leq 0.05$).

The estimated number of abundant fishes and macroinvertebrates passed through the dilution pumps was compared to the estimated number of specimens impinged on the OCGS screens during the same sampling

period. The estimated number of an organism passed through the dilution pumps was calculated from the number in each collection divided by the portion of the dilution flow that was sampled. Flow through the dilution pumps was determined from OCGS records, and volume sampled by the dilution pump sampler was calculated from the flow rate in the mouth of the sampler, the area of the sampler mouth, and the duration of each sample. Flow rate was not determined for each collection, but it was measured periodically with a digital flowmeter (General Oceanics Model 2030) mounted in the mouth of the sampler. Because flow rate changed with different numbers and combinations of pumps in operation, the flow rate was determined for each operating condition that was sampled. When the volume passed through the dilution pumps (two pumps in operation) was approximately the same as that passed through the OCGS cooling-water system (four pumps in operation), it was unnecessary to adjust the estimated number of organisms passed through the dilution pumps or impinged on the OCGS screens for the volume of water pumped at each location. When different configurations of pumps operated (8 of 27 times) adjustments were made to compensate for the different volume pumped.

Results and Discussion

From 7 September 1976 through 7 September 1977, 262 collections were taken, and 7,138 invertebrates of 10 taxa and 5,671 fish of 56 taxa were collected (Table D1-79). The number of collections per month ranged from 29 during November, June, and August to 5 during January when ice blockage at the intake of dilution pump number three forced the shutdown of this pump from 8 January to 14 February 1977.

The half-hour samples taken at the surface and bottom indicated that the distribution of the catch in the discharge varied by species. Although the number of the Atlantic silverside and blue crab collected in surface and bottom collections was not significantly different, significantly more bay anchovy and northern pipefish were collected in bottom samples (Table D1-80). Although the greater abundance of some organisms in bottom collections may have resulted in an overestimate in the abundance of these species, data were not adequate to adjust the catch on a species-by-species basis. In light of the magnitude of the difference for the bay anchovy (surface to bottom ratio of 1:1.4) and northern pipefish (1:1.6), these differences were not considered substantial enough to invalidate conclusions based on the unadjusted abundance data.

The spot (n = 1,503), bay anchovy (1,094), winter flounder (722), and Atlantic menhaden (386) comprised 70% of all fish taken (Table D1-79). The ten most abundant species comprised 93% of all fish collected. Many of the additional 378 Atlantic menhaden collected during March and April were not passed through the dilution pumps but were individuals attracted to and feeding in the discharge canal. Unlike Atlantic menhaden passed through the dilution pumps, many of the fish collected during March and April had little scale loss and were generally in better condition.

The immediate condition of common fishes passed through the dilution pumps varied by species (Tables D1-81, D1-82). Although only 9% of the bay anchovy collected were live (28% damaged), the percentage of other abundant fishes passed through the pumps undamaged was considerably higher. Some 74% of the smallmouth flounder, 83% of the spot, and 94%

of the striped cusk-eel were undamaged immediately after collection. Only 4% of the Atlantic menhaden passed through the pumps (all months except March and April) were dead and 30% were damaged. No winter flounder were dead immediately after collection, and only 1% of the specimens were damaged. The percentage of individuals which were passed through the dilution pumps undamaged was lower for less abundant fishes such as the bluefish (34%), weakfish (47%), and Atlantic silverside (59%).

The sand shrimp (n = 5,289) and blue crab (1,549) were the dominant macroinvertebrates and comprised 96% of all invertebrates collected (Table D1-79). Most sand shrimp were taken from November through June with the greatest number of individuals (61%) collected during December. Of the 3,051 sand shrimp examined, 6% were dead and 2% were damaged (Table D1-81). Most blue crab were taken from April through August, and 7% of the 770 specimens examined were dead and 25% damaged.

The estimates of immediate condition were considered to be fairly accurate because the dilution pump sampler and collection technique caused little additional mortality or damage to the organisms. Many of the Atlantic menhaden collected in March and April had not passed through the dilution pump. Although the Atlantic menhaden generally is considered a delicate species, none of these individuals were dead and less than 4% were damaged (Table D1-83).

The condition of the Atlantic menhaden, winter flounder, sand shrimp, and blue crab passed through the dilution pumps during 1975-76 (Rode and Boyle 1977a) was similar to the condition of those examined in

this study (Table D1-84). However in 1976-77, the percentage of dead and damaged striped cusk-eel decreased substantially over those reported for 1975-76. In contrast to the striped cusk-eel, the number of dead and damaged bay anchovy showed a marked increase from 1975-76 (54%) to 1976-77 (91%). The reason for these differences may be attributed, in part, to the relatively few individuals examined in 1975-76; the values for 1976-77 were considered to be a more realistic estimate because they were based on a larger sample.

The immediate condition of the sand shrimp, blue crab, and the ten most abundant fishes passed through the dilution pump was compared with the condition of those impinged on the OCGS screens (Table D1-81). For all 12 species, a greater percentage of live individuals was found in collections at the dilution pump discharge and a greater percentage of both dead and damaged individuals in collections from the OCGS screens. The differences in percent live were greatest for the Atlantic menhaden (66% of individuals from dilution pump collections, 9% of those collected at OCGS screens), striped cusk-eel (94%, 44%), spot (83%, 14%), and winter flounder (99%, 45%). Although the survival of the bay anchovy passed through the dilution pump (9%) was greater than that of specimens impinged at the OCGS screens (4%), this species had high mortality at both locations because it was very sensitive and easily damaged during handling. The percentages of blue crab that were live, dead, and damaged after impingement on the OCGS screens were similar to the percentages of those passed through the dilution pumps (Table D1-81). Overall, more than 69% of the ten comparable fishes and 87% of the blue crab and sand

shrimp taken from the dilution pump sampler were live in contrast to 20% of these fishes and 75% of the blue crab and sand shrimp examined from the OCGS screens.

The species composition of the catch of fishes and macroinvertebrates passed through the dilution pump was similar to that from collections at the OCGS screens. The sand shrimp and blue crab were the dominant invertebrates taken at each location. The bay anchovy, spot, and Atlantic menhaden were the most abundant fishes collected at the OCGS screens and they were among the four most abundant fishes taken in dilution pump samples.

The estimated number of sand shrimp, blue crab, and ten abundant fishes passed through the dilution pumps was compared with the number of those impinged on the OCGS screens during a comparable period (Table D1-85). More fish (80,746), sand shrimp (127,261), and blue crab (25,799) were estimated to have passed through the dilution pumps than were impinged on the OCGS screens (32,302 fish; 36,801 sand shrimp; 11,652 blue crab). The estimated number of bluefish (1,121 passed through the dilution pump, 275 impinged on the OCGS screens), spot (30,126, 7,929), and winter flounder (18,009, 2,884) passed through the dilution pumps were nearly four times greater than the estimated number impinged at OCGS. Operation of the dilution pumps also may reduce the number of organisms impinged on the OCGS screens. On several occasions, the number of organisms impinged at OCGS noticeably declined in the several hours after a second dilution pump was put into operation.

The difference between the larger mesh size of the OCGS screens (10.7 mm) and that of the dilution pump sampler live box (6.3 mm) probably introduced some bias, particularly for the smaller individuals of the bay anchovy, northern pipefish, and sand shrimp. These individuals would be more likely to pass through the OCGS screens and the impingement sampler, and this would result in a comparatively low estimate.

Different water velocities at the intake of the dilution pumps and circulating-water pumps may account, in part, for more organisms passed through the dilution pumps than were impinged at OCGS, even though a similar volume was pumped at each location. The velocity of water at the intake of the dilution pump was considerably greater than the velocity of water through the trash racks that precede the OCGS screens. On 1 April 1977, the one date that velocity measurements were available at each location, the mean velocity in front of the intake to the two operating dilution pumps (73 cm/sec) was twice the velocity in front of the OCGS trash racks (35 cm/sec) with three pumps and five screens in operation (J. J. Vouglitois, personal communication). Under normal operation (four pumps) at OCGS, this difference in velocity may be even greater. From May through November 1976, the mean velocities before the trash racks (17 to 20 cm/sec) with four circulating-water pumps and six traveling screens in operation were substantially lower than during April 1977.

Higher velocities at the intake to the dilution pumps may account for the greater number of most fishes passed through the pumps because individuals may be unable to escape these velocities. The critical

swimming speeds of young (age 0+) bluefish (65 to 72 cm/sec) at 23 C, young weakfish (35 to 70 cm/sec) at 12 to 22 C, young spot (48 cm/sec) at 15 C, and adult winter flounder (33 to 48 cm/sec) at 3.3 C, as reported by Wyllie et al. (1976) and Terpin et al. (1977), exceeded the intake velocity (17 to 20 cm/sec) at the OCGS screens under normal operation. However, the velocity at the dilution pump intake with two dilution pumps in operation (73 cm/sec) was greater than or approximately equal to the critical swim speeds of these fishes.

D1.13 DELAYED MORTALITY OF FISHES AND MACROINVERTEBRATES

Introduction

After impingement on the OCGS screens or passage through the dilution pumps, organisms are passed into the discharge of the dilution pumps. Although this water is at ambient temperature, the only route by which organisms can leave this area is through the mixed flow of heated and ambient water in Oyster Creek. This study was conducted to examine the latent effects of impingement, dilution pump passage, and exposure to increased temperature on fishes and macroinvertebrates. It is a continuation of the work reported by Rode and Boyle (1977b).

Materials and Methods

Live and damaged fishes and macroinvertebrates collected in the dilution pump discharge and during both normal (intermittent) and continuous washes of the OCGS screens were held for 48 h after collection. Organisms were held in either a 900-liter circular fiberglass tank or one of two 60 x 80 x 120-cm wooden holding tanks. Specimens were maintained under flow-through conditions in either ambient temperature water or heated water discharged from OCGS. Prior to January 1977, heated water was pumped to the holding facility from a point approximately 50 m from the OCGS discharge, but after January heated water was pumped directly from the OCGS discharge. Since

organisms are released in ambient temperature water, they are probably not subjected to the maximum holding temperatures used for testing.

The condition of fishes, the blue crab, and sand shrimp was recorded as live, dead, or damaged. Condition was determined immediately after collection and, thereafter, twice daily for 48 h. Specimens exhibiting loss of equilibrium were recorded as damaged.

Results and Discussion

OCGS screens - normal (intermittent) washes

Individuals of 26 taxa were held for delayed mortality studies. For the year, the greatest mortalities were among the herrings (*Alosa* spp.), Atlantic menhaden, bay anchovy, black sea bass, and weakfish (Table D1-86). Most (63.8%) of the organisms held for delayed mortality studies were damaged prior to testing.

The delayed mortality of herrings maintained in ambient water (42.4%, 14 of 33) was less than that of individuals held in heated water (58.3%, 14 of 24). Most of the bay anchovy held in either ambient (92.6%, 25 of 27) or heated (88.0%, 22 of 25) water were dead after 48 h, and most individuals were dead at the first observation. All bay anchovy were damaged at the beginning of the test. Both the bay anchovy and the herrings are generally considered delicate fish, and the method of collection and handling may have introduced stress which contributed to the delayed mortality.

Delayed mortality of some fishes was apparently unrelated to temperature because mortality of fishes held in ambient temperature water exceeded

that of organisms held in heated water. All 18 Atlantic menhaden held in ambient water died while only 9 of 16 specimens held in heated water were dead. Some 17 of 18 weakfish maintained at ambient temperature were dead, but only 10 of 15 individuals held in heated water were dead after 48 h. More mortality of the black sea bass also occurred in ambient (14 of 17 individuals) than in heated (5 of 13) water. Although relatively few individuals of the striped cusk-eel (27) and spot (16) were tested, a greater percentage of fish held in ambient water were dead at 48 h. All of these species were tested during decreasing ambient water temperature, and the heated water from the OCGS discharge may have mitigated, to some extent, the latent effect of impingement on these species.

The Atlantic silverside had relatively little delayed mortality although mortality was less in ambient (17.8%) than in heated (29.6%) water. The mortality of individuals held in the heated water was apparently related to the condition of the fish immediately after collection rather than the temperature increase (delta T) or absolute temperature (Table D1-87). All organisms that were live at the start of each test were live at 48 h, and all individuals dead at 48 h were damaged after collection.

Little (< 2.0%) delayed mortality occurred among the 45 striped searobin held at ambient temperature and the 41 specimens held in the heated discharge. Similarly, none of the five white perch or the six winter flounder tested were dead after 48 h regardless of the temperature at which they were held. Two of the 15 sand shrimp held at ambient

temperature and 4 of 15 shrimp held in the heated water were dead at 48 h.

Most fishes with high delayed mortality also had high mortality and damage immediately after impingement on the OCGS screens. Mortality determinations made immediately after impingement (Table D1-59) indicated substantial mortality of the bay anchovy (78%), and many individuals of the alewife (88%), blueback herring (83%), Atlantic menhaden (92%), and weakfish (85%) were either dead or damaged immediately after impingement. Organisms with relatively little delayed mortality also had lower rates of mortality and damage immediately after impingement: Atlantic silverside (66% immediate mortality and damage), striped searobin (45%), winter flounder (54%), and sand shrimp (23%).

OCGS screens - continuous washes

A total of 14 species collected during continuous screen washes on 30 November and 12 December were held for delayed mortality studies (Table D1-88). As with individuals collected during intermittent screen rotation, winter flounder (n = 33) had little mortality when held at either ambient (1 of 17) or heated discharge (1 of 16) temperatures. Similarly, the sand shrimp had little mortality in either ambient (4 of 30) or heated (6 of 37) water. The total number of sand shrimp that died in 48 h (10 of 67), regardless of temperature, was similar to the delayed mortaltiy of individuals impinged during intermittent screen washes (6 of 30). The mortality of the smallmouth flounder held for 48 h in the heated water (5 of 14) was slightly greater than that of

individuals held in ambient water (3 of 12). Overall, the delayed mortality of the smallmouth flounder (8 of 26) impinged during continuous washes of the OCGS screens was less than that of individuals impinged during intermittent screen washes (17 of 30).

OCGS Dilution Pump

The delayed mortality of organisms held at ambient and heated discharge temperatures was discussed for 8 of the 31 taxa tested. The bay anchovy, weakfish, Atlantic menhaden, and bluefish, species which had substantial delayed mortality after impingement on the OCGS screens, also had the greatest delayed mortality after passage through the dilution pumps. Although unequal numbers of specimens were tested, a greater percentage of mortalities was observed for individuals held at heated temperatures (Table D1-89). Relatively few weakfish were tested but delayed mortality was high for specimens held in both ambient (6 of 11) and heated (5 of 8) water. Two of 15 bluefish held in ambient water and two of five fish held in heated water died during the 48 h.

The delayed mortality of the Atlantic menhaden was less in ambient (20.0%, 7 of 35) than in heated (50.0%, 13 of 26) water. Rode and Boyle (1977b) found 45.7% mortality (16 of 35) for Atlantic menhaden held in ambient water and complete mortality of all 18 fish held in the heated discharge. During both years, most of the mortality of the Atlantic menhaden held in the heated water was noted at the first observation. The difference in the mortality of individuals held in the heated water during 1975-76 (Rode and Boyle 1977b) and 1976-77 was probably related

to temperature. Rode and Boyle (1977b) held specimens during June through August when the OCGS discharge temperature was high (31.5 to 37.0 C). The 11 individuals tested at 32.8 to 33.3 C during this study died, but only 2 of 15 held at 22.9 to 25.1 C died.

Most bay anchovy (73.9%, 51 of 69) held in ambient water and all four individuals held in heated water were dead at 48 h. Most (72 of 73) of the individuals were damaged after collection. Rode and Boyle (1977b) also reported high mortality of the bay anchovy held in ambient (88.0%) and heated (100%) water.

Although 17 of 30 spot (56.7%) held in heated water died, only 1 of 195 (0.5%) specimens tested in ambient temperature water was dead after 48 h. Spot held at a temperature in excess of 32 C or a delta T greater than 10 C showed the greatest mortality (Table D1-90). Little mortality (3.1%, 8 of 255 individuals) was noted in ambient water during both years, and this coincided with the highest mortality of the spot held in heated water. Powers (1977) reported that spot survived a maximum of 4 h when exposed to a discharge temperature of 34.6 to 36.2 C (delta T of 8.5 to 9.4 C). Rode and Boyle (1977b) reported 16.7% (12 of 72 individuals) mortality of spot passed through the dilution pumps and held at ambient temperatures and 52.5% mortality (42 of 80) of those held in heated water. All of these spot were tested from May through August 1976 when ambient water temperatures were rising.

Two fishes and the sand shrimp had little or no delayed mortality. One of 40 winter flounder tested was dead, and that individual was held

in the heated discharge. No mortalities were observed for the 36 striped cusk-eel or 17 sand shrimp maintained in either heated or ambient water. Rode and Boyle (1977b) also found high survival for the striped cusk-eel, winter flounder, and sand shrimp held in ambient water. Although they reported substantial mortality (91.0%) for the striped cusk-eel in heated water, their tests were conducted at discharge temperatures from 32.8 to 37.0 C while the OCGS discharge temperatures at which organisms were held in this study were considerably lower (22.9 to 25.1 C).

Individuals of several species that were passed through the dilution pumps and were maintained in either ambient or heated water had less delayed mortality than individuals impinged on the OCGS screens. At ambient temperatures, the mortalities were lower for the Atlantic menhaden (delayed mortality of 17 of 18 impinged fish, delayed mortality of 7 of 35 fish passed through the dilution pumps); weakfish (17 of 18, 6 of 11); striped cusk-eel (9 of 16, 0 of 34); and sand shrimp (2 of 13, 0 of 17). Individuals of the bay anchovy held in ambient temperature water had less delayed mortality after passage through the dilution pumps (73.9%) than after impingement on the OCGS screens (92.6%). The high mortality of the bay anchovy collected and tested from both locations suggested that stress from collection and handling may have contributed to these high delayed mortalities. For organisms held in ambient water, Rode and Boyle (1977b) reported less delayed mortality of Atlantic menhaden and bay anchovy passed through the dilution pumps than of those taken from the OCGS screens.

D1.14 COMMERCIAL FISHERIES IN BARNEGAT BAY AND OCEAN COUNTY

Introduction

Data were compiled to determine the magnitude of various commercial fisheries in Barnegat Bay and in Ocean County, New Jersey. Although commercial landings have value only as a relative index of the size of the population of a species, they may give some perspective to the biomass of fishes lost through impingement. These data are not estimates of absolute abundance because catches may not be accurately reported, fishes caught in one area may be landed in another, and fishing effort is selective and dependent on the current economic value of the fishes.

Materials and Methods

Commercial fisheries data for Barnegat Bay were obtained from the National Marine Fisheries Service (NMFS) in Toms River, New Jersey. The data were from 19 crabbers, 5 fyke netters, 3 eel potters, and 10 clam wholesalers who reported their catch in Barnegat Bay from Toms River to the Manahawkin Bridge. This represented all of the commercial fishermen in the Bay (E. LoVerde, personal communication). An individual was included in more than one category if he fished several types of gear.

Commercial fisheries data for Ocean County were obtained from the preliminary monthly New Jersey landings (U. S. Department of Commerce 1976, 1977), and any minor discrepancies between the catch reported in

Barnegat Bay and Ocean County probably occurred because of the preliminary nature of these data.

Results and Discussion

Commercial fishermen in Barnegat Bay landed 155,615 kg of fin- and shellfish valued at $338,545 from September 1976 through August 1977 (Table D1-91). Although the reported catch decreased 34% from the previous 12 months, the value of the catch decreased only 2% (Hillman 1977c). The decrease in catch was attributed to a large decrease in landings of the white perch, winter flounder, and blue crab. The value of the catch decreased only 2% between the 2 years because the price per kg increased 33% during the second year. August was the most productive month (26,869 kg, $67,998); the northern quahog, American eel, and blue crab were the predominant species taken during this month. Only 364 kg of the northern quahog were taken during January, the least productive month, because severe weather and extensive ice cover on the Bay limited fishing.

The extremely cold weather from early October through mid-February accounted, in part, for the decline in landings. Ice cover on the Bay limited the activity of fyke netters, clammers, and crab dredgers in January and February 1977; only 1,941 kg of the northern quahog were landed during these months. In January and February 1976, 24,310 kg of the northern quahog (22% of reported landings from September 1975 through August 1977); 10,946 kg of the blue crab (15%); 6,909 kg of the winter flounder (33%); and 7,187 kg of the white perch (39%) were landed from the Bay (Hillman 1977c).

The northern quahog accounted for 68.4% of the catch (106,562 kg) and 89.6% ($303,336) of the revenue (Table D1-91). It was taken by rake (56.2%), treading (24.2%), and tongs (19.5%). Some 50.8% of the northern quahog was landed from June through August when all three types of gear were in use (Fig. D1-30).

The blue crab accounted for the second largest landings and revenue; it accounted for 17.4% of all weight (27,086 kg) and 6.3% of all revenue ($21,217). The blue crab was taken by pot in September, October, July, and August and by dredge during March, November, and December, but the largest landings were reported from September through November (Fig. D1-30). No crabs were landed in January and February and from April through June. The blue crab averaged $0.75/kg, an increase of $.09/kg from the previous 12 months. The average price of the blue crab landed by pot ($0.80/kg) was more than that of crabs collected by dredge ($0.64/kg).

Blue crab landings decreased 68.2% from the previous 12 months (Hillman 1977c) because of substantial mortality of the blue crab during the winter of 1976-77 and of the inability to dredge for crabs during the winter. Many dead individuals were taken throughout the Bay by trawl in March (Section D1.15). Birnbaum (1977) attributed a 50% decrease in the commercial landings of the blue crab in upper Chesapeake Bay during late July 1977 to mortality during the previous winter.

The American eel accounted for the third greatest landings (10,156 kg) and revenue ($8,750). It was the most abundant (46.2%) finfish landed, and all were taken by eel pot. Landings in the Bay decreased 25% from the previous 12 months (Hillman 1977c). Largest catches were from April

through June, and none were landed from November through March. It accounted for 2.6% of the total income and averaged $0.86/kg, a substantial increase over the $0.68/kg for the previous 12 months.

All other finfish were taken by fyke net during the 6-month (from 13 October through 13 April) fyke net season. Landings from fyke nets accounted for 7.5% of all landings and 1.6% of total revenue.

The winter flounder accounted for the most weight (6,419 kg) and revenue ($2,629) taken by fyke net. It comprised 4.0% of the total landings and 29.2% of all finfish reported from the Bay. The reported landings were a 69.5% decrease from the previous 12 months (Hillman 1977c). The average price for the winter flounder was $0.41/kg.

The white perch comprised 2.8% of the total landings and 20.0% of all finfish landed in the Bay. The 4,392 kg reported was a 76.4% decrease from the previous 12 months. However, the average price ($0.57/kg) increased $0.02/kg during the second year.

Fyke net landings of the alewife (1,000 kg) were reported only in May, and this may be a delinquent report of fish taken during April. The alewife comprised 4.6% of all finfish landed in the Bay and averaged $0.11/kg.

A total of 1,263,813 kg of 9 species of fin- and shellfish valued at $1,724,552 was landed in Ocean County from September 1976 through August 1977 (Table D1-92). This was a 16.6% decrease in weight and a 1.9% decrease in value from the previous 12 months (Hillman 1977c). The bluefish and summer flounder were the only species to have larger landings from September 1976 through August 1977 than during the previous 12

months. The landings of all other species declined from 20.4% (northern quahog) to 76.4% (white perch).

The summer flounder and northern quahog dominated the commercial landings reported for Ocean County. The summer flounder accounted for 49.8% of the reported landings and 42.2% of the value. The northern quahog comprised the second largest weight (23.6% of reported landings), but accounted for 48.7% of the value. The bluefish (13.9%) and the weakfish (6.6%) accounted for most of the remainder of the catch. During the previous 12 months, the summer flounder (38.7% of the reported landings from September 1975 through August 1976), northern quahog (25.0%), weakfish (15.2%), and bluefish (10.5%) also accounted for most of the landings reported for Ocean County (Hillman 1977c).

The largest catch (160,255 kg) was reported in May. The smallest catch was in March (25,442 kg), but the landings in November (56,219 kg) and December (31,761 kg) were also small. The largest monthly values ($171,771 to $218,321) were reported from April through August, and the smallest value was in December ($48,516).

Barnegat Bay commercial landings comprised 12.3% of the weight and 19.6% of the value of the landings in Ocean County. While not all species landed in Ocean County were taken in Barnegat Bay, a substantial portion of the landings of the alewife (100% of Ocean County landings), white perch (100%), blue crab (100%), American eel (45.7%), northern quahog (35.7%), and winter flounder (29.6%) were from the Bay between Toms River and the Manahawkin Bridge.

D1.15 SURVEYS OF THE POPULATION OF SELECTED FISHES, THE SAND SHRIMP, AND THE BLUE CRAB IN BARNEGAT BAY

Introduction

Surveys were made to estimate the population of the bay anchovy, northern pipefish, winter flounder, sand shrimp, and blue crab in the central portion of Barnegat Bay. With the exception of the sand shrimp, similar surveys of these species were conducted from April through July 1976, and the estimated populations in the central Bay were reported by Danila (1977a). These estimates were used with other data to assess the effect of OCGS on these species. An evaluation of impingement losses on these populations was discussed by JCP&L (1978).

Although the threespine stickleback, striped bass, northern kingfish, summer flounder, and northern puffer were considered important by the EPA, they were relatively uncommon and no population estimates were made for them. The Atlantic menhaden, bluefish, and weakfish were relatively common, but they were able to avoid most collection gear and therefore, could not be sampled quantitatively. Attempts were made to estimate the population of the Atlantic silverside in both November and April, but few specimens were taken and the surveys were discontinued. The unusually small number of Atlantic silverside taken in April may have indicated that substantial mortality occurred during the severe winter of 1976-77.

Materials and Methods

Barnegat Bay from Goodluck Point to Gulf Point (19.2 km) was used as the survey area because the Bay between these two points is a basin somewhat constricted at both ends with OCGS roughly in the center. The shallow, eastern portion of the Bay was also sampled during surveys for the northern pipefish and blue crab.

Most samples were taken with a 4.9- and 2.7-m trawl; both gears were described previously (Appendix C1, Section C1.17). During an average 5-min tow, the 4.9-m trawl covered 771.75 m^2 and the 2.7-m trawl covered 157.5 m^2. These values were about 75% of those reported by Danila (1977a) because the effective fishing width of the trawls, as determined by the methodology of Loesch et al. (1976), was 0.5 rather than 0.67 times the length of the headrope. During the blue crab survey, a tickler chain was added to the 4.9-m trawl to increase its efficiency. Chittenden and Van Engel (1972) reported that the catch of blue crab by trawl in the York River nearly tripled with the addition of a tickler chain. The 4.9-m trawl was also modified to make collections at the surface (Trent 1967) during the blue crab survey because swimming blue crab may have avoided the bottom trawl in deeper areas of the Bay.

A stratified random sample model was employed for samples taken by trawl (Snedecor and Cochran 1967, Mackett 1973). Although the Bay was subdivided into strata based on the distribution of organisms during previous surveys of the Bay (Danila 1977a), strata were redefined after a survey if the distribution of the catch was substantially different than expected. The area of each stratum was calculated from a nautical

chart of the Bay (NOAA 1976) with a Lietz Polar Planimeter (Model 3651-30). The Bay was also subdivided into 0.9-km^2 grids, and the locations of samples within a stratum were determined using the grids and a random number table. Each tow was taken at a random location in a grid.

Population size and confidence limits were determined for species taken by trawl (Snedecor and Cochran 1967, Mackett 1973), but data were not transformed to approximate a normal distribution. Although transformations are valuable for comparative statistics, they are not desirable for estimates of abundance because estimates calculated with transformed data are based on the median rather than the mean of the sampling distribution and, therefore, are underestimates (W. Swallow, personal communication). Because Danila (1977a) based most of his population estimates on transformed catch data and overestimated the area covered in an average haul, population estimates of species surveyed in 1976 were recalculated.

A roller pushnet, similar to that described by Strawn (1954), was used to sample northern pipefish and blue crab in the shore zone. It was constructed of 6.3-mm mesh nylon netting over a tubular frame with a wooden roller just below the mouth of the net. The mouth of the net was 1 m wide, and the gear fished from surface to bottom in shallow water. It was pushed parallel to and about 3 to 7 m from shore for a distance of 15 m, and it sampled about 15 m^2 of bottom.

The pushnet was used at 10 locations in the eastern Bay from the Sedge Islands to the northern end of Island Beach State Park and at 20 locations in the western Bay from Berkeley Shores to Double Creek. Two of 10 samples were taken randomly at each location.

A 4.6 x 1.2-m nylon seine (3.2-mm mesh) was used for a survey of sand shrimp along the western shore of the Bay. Its operation was identical to that of the 12.2-m seine (Appendix C1, Section C1.17), and an average haul covered approximately 30 m^2. Samples were taken at night at eight locations from Cedar Creek to Double Creek. The number of hauls at each location varied from 7 to 30 and depended on the amount of the shore that could be sampled.

Catches by the pushnet and 4.6-m seine were adjusted to the density of specimens in 1 m^2 of bottom area (n/m^2) in the shore zone (0 to 10 m from shore). The number in the shore zone was estimated by multiplying the n/m^2 by the area of the shore zone surveyed.

Results and Discussion

Population estimates were biased to varying degrees because the efficiency and selectivity varied among the gear used and the species sampled. The large catches of the winter flounder and blue crab often made by sport fishermen suggested that the populations were grossly underestimated. Loesch et al. (1976) reported that large underestimates in biomass occurred in the measurement of the standing crop of selected fishes and macroinvertebrates by 4.9-m trawl. They reported that efficiency varied from 50% for the brown shrimp to 6% for the spot. Selectivity of gear for specific size-groups can also cause large differences in the species and number of fish caught (Pope et al. 1975). Inferences about the abundance of populations can be drawn from these estimates, but the estimates are relatively low (conservative) and of undetermined accuracy.

However, they can give perspective to the number of individuals that were impinged on the OCGS screens and from year-to-year will reflect gross changes in the abundance of a species.

The dates of the surveys, sampling gear used, and the number of samples taken are summarized in Table D1-93. The results of each survey are discussed below, and the recalculated population estimates of surveys from April through July 1976 are given with the appropriate species. Most of the recalculated estimates were substantially larger than reported by Danila (1977a).

Bay anchovy

Three strata were established based on the distribution of bay anchovy as determined from the catch during the survey (Fig. D1-31). The catch-frequency distribution was highly negatively skewed (i.e., few or no fish were taken in many hauls but several catches were very large), and this distribution was typical of schooling fishes such as the bay anchovy.

Most bay anchovy (61.4 n/coll) were found in the area of the Bay from just south of Cedar Creek to just south of Barnegat Inlet. Both Stouts Creek and Forked River were included in this stratum. Few individuals (3.3 n/coll) were taken along the western shoreline from Oyster Creek to Gulf Point, and the fewest fish (1.3 n/coll) were taken in the deeper portions of the Bay to the north and east. This distribution of the bay anchovy suggested a movement towards the deeper areas of the Bay prior to emigration to the ocean. The estimated population at the time of the survey was 2,617,000 $\pm$ 909,000 (Table D1-94).

The population estimate from the May 1976 survey (Fig. D1-32, Table D1-94) was recalculated as 5,270,000 ± 2,310,000. The previous estimate was 1,932,000 ± 755,000 (Danila 1977a).

Winter flounder

The 1977 survey was conducted in March before most adults had left the Bay. In 1976, data from the fourth sampling date (15 and 16 April) were not used in the population estimate because the number of fish collected on that date was substantially lower than the catch on the other three dates (6 to 8 April). This apparent decline was probably due to emigration of adults from the Bay during the week between 8 and 15 April (Danila 1977a). A one-way ANOVA ($P \leq 0.05$) indicated no significant difference in catch among the four dates sampled in 1977.

Strata used in the population estimate (Fig. D1-33) were nearly the same as those used in April 1976 (Danila 1977a), but about twice as many samples were taken in the north stratum in 1977. In 1976, most winter flounder were found in this stratum, and the increased sampling there was an attempt to reduce the sample variance in that stratum.

With the exception of a smaller catch in the inlet stratum, the distribution of winter flounder was similar to that in 1976. Catch in the inlet stratum in 1977 (0.3 n/coll) was less than that in 1976 (2.3 n/coll) possibly because more winter flounder were leaving the Bay at the time of the 1976 survey. However, some large catches were reported for sport fishermen near Barnegat Light at the time of the 1977 survey (Porch 1977a), and this indicated that a substantial number of winter flounder

were near Barnegat Inlet in 1977. Most fish (1.5 n/coll) were taken in the north stratum and the greatest densities were generally found near the Intracoastal Waterway. Few (0.6 n/coll) were taken in the south stratum. Although the largest mean catch (2.3 n/coll) was from the creeks stratum, only seven samples were taken there. Most fish were caught in Cedar Creek, adjacent to the north stratum.

The estimated population in March 1977 of 111,000 ± 23,000 winter flounder (Table D1-95) was less than the recalculated population (194,000 ± 43,000) for April 1976. The somewhat lower population estimate in 1977 was contrary to the increased number of winter flounder impinged on the OCGS screens from October through April of 1976-77 as compared to 1975-76 (Table D1-78). The increased catch at OCGS was probably more indicative of the actual abundance of the winter flounder population during the second year. It is not known why the 1977 population estimate was less than that in 1976 although it may be due, in part, to a boat breakdown which prevented the collection of 13 samples in an area of the north stratum where most of the largest catches occurred in 1976. If large catches had also been made there in 1977, the mean catch for that stratum and consequently the estimated population would have been larger.

The large difference in the number of winter flounder impinged between years was mostly attributed to the production of a large year-class in 1976 after a very small year-class in 1975 (Appendix C1, Section C1.19). The length-frequency distribution of winter flounder taken in the population surveys during both years reflected this difference (Fig. D1-34). Some 45% of the winter flounder taken in 1977 were age 1+

fish from the 1976 year-class but only 11% of the specimens taken in 1976 were age 1+ fish from the 1975 year-class. Thus, the age-structure of the population determined in the 1977 population survey was similar to that found for specimens taken at the OCGS screens and in the Bay during 1976-77, even though the estimated abundance was unexpectedly smaller than that of the previous year.

Sand shrimp

This population survey was conducted at night because significantly more sand shrimp were taken at night by seine and trawl (Danila 1977b). Because it was difficult to navigate in the Bay at night during spring and because of the unknown efficiency and larger mesh size (38-mm mesh body) of the trawl, a seine (3.2-mm mesh) was used at selected areas along the western shore. This technique precluded the estimation of the population throughout the central Bay, but it allowed an approximation of the number of sand shrimp in the shore zone (0 to 10 m from shore) of the western Bay.

Samples were taken at eight areas on three consecutive nights (Fig. D1-35). Because the catch at Waretown was not significantly different from the catch at Barnegat Beach and because the catches at Stouts and Cedar creeks were not significantly different, these data were combined and analyzed as Waretown/Barnegat Beach and Stouts Creek/Cedar Creek, respectively. Significant differences in the mean catch among locations were found with a one-way ANOVA ($P \leq 0.05$), and the Student-Newman-Kuels (SNK) multiple range test indicated two groups of locations

(Table D1-96). The mean catches for the locations were generally ordered geographically with the largest mean catches at Double Creek (41.8 n/coll) and Waretown/Barnegat Beach (29.7 n/coll). The second group was comprised of all four locations north of Sands Point Harbor, and the mean catch ranged from 7.6 to 13.3 n/coll.

The reason for the differences in catch was not clear. Except for Oyster Creek (water temperature of 15 to 17 C), water temperature was somewhat higher at the southern locations (15.5 to 18 C) than at the northern locations (13 to 16 C). Substrate preference also may have affected the abundance of sand shrimp although Whiteley (1948) reported it to be found on a variety of substrates. The substrate was mostly sand and pebbles at Double Creek and Waretown/Barnegat Beach. Bottom composition at other locations ranged from mostly mud at Stouts Creek, a mixture of sand and mud at Forked River, to mostly sand and gravel at Sands Point Harbor, Cedar Creek, and Oyster Creek.

To calculate the number of sand shrimp in the shore zone, the mean number/m^2 of bottom was determined for each group of locations. The length of the shore was approximately 5.6 km from Double Creek to Waretown Creek (shore zone area of 5.6×10^4 m^2) and 13.3 km from Waretown Creek to Cedar Creek (1.33×10^5 m^2). These distances and areas were underestimates because they did not account for either the many small irregularities in the shore or the shoreline of the numerous tributaries to the Bay. Therefore, the estimated population of approximately 112,000 sand shrimp in this shore zone area was considered an underestimate. The population in the central Bay was undoubtedly much larger than 112,000 because the

shore zone from Double Creek to Cedar Creek (1.89×10^5 m^2) was only about 0.2% of the total bottom area of the Bay from Good Luck Point to Gulf Point (86.08×10^6 m^2).

A comparison of the estimated number of sand shrimp in the shore zone to the estimated number impinged on the OCGS screens must consider the size of the individuals captured by each gear. The seine (3.2-mm mesh) captured most sand shrimp in the shore zone but only larger sand shrimp were collected at OCGS with various samplers (10.7-mm mesh). The mean length of individuals impinged at OCGS was larger than the mean length of those collected from other areas of the Bay (Appendix C1, Section C1.19). The length-frequency distribution of sand shrimp taken in the survey indicated that most (80%) individuals were from 23 to 40 mm in length (Table D1-96). Most sand shrimp impinged at OCGS were larger than 40 mm with very few individuals less than 23 mm. The percentage of the 23 to 40-mm sand shrimp that were impinged at OCGS was unknown, but it was probably small. If all sand shrimp larger than 40 mm in length and 10% of those 23 to 40 mm in length were impinged and retained by the OCGS screens, only about 10% of the individuals taken in the survey would have been impinged on the screens at OCGS.

Blue crab

The deeper western portion of the central Bay was sampled with a 4.9-m trawl (Fig. D1-36) and the shallow eastern portion with a 2.7-m trawl (Fig. D1-37). Strata were similar to those sampled in 1976 (Danila 1977a). However, two strata (south-central and south) sampled

with a 2.7-m trawl during 1976 and an additional 1-km^2 area were combined to form a single stratum (south) in 1977. The number of samples taken in 1977 was determined from the relative variances of the catch in 1976 and the relative areas of the strata (Mackett 1973).

A considerable decrease in the estimated population occurred from 1976 to 1977 (Table D1-97). The population in July-August 1977 was estimated to be 604,000 $\pm$ 234,000 in the eastern Bay (3,672,000 $\pm$ 570,000 in 1976), and 102,000 $\pm$ 43,000 in the western Bay (261,000 $\pm$ 70,000 in 1976). Catch by trawl, seine, and at the OCGS screens also decreased substantially from 1975-76 to 1976-77, and much of this decline probably resulted from the mortality of blue crab during the severe winter of 1976-77. The mean temperature in Philadelphia from December 1976 through February 1977 was the coldest in more than 150 years (Darling 1977). Many dead blue crab (mostly immature individuals) were taken by trawl during the winter flounder survey in March, and an estimated 42,000 $\pm$ 14,000 dead blue crab were on the bottom during the March survey. Many other dead specimens probably remained buried in bottom sediment or were passed over by the trawl.

In both years a considerably smaller number of blue crab was calculated for the larger western portion of the Bay. Although real differences in abundance probably existed between the eastern and western Bay, many blue crab may have avoided the 4.9-m trawl in the deeper, non-vegetated portion of the Bay. To determine if many individuals were swimming near the surface in the western Bay, 50 tows were made at the surface with a 4.9-m trawl. Only seven blue crab were taken; five were adults and six

of the seven individuals were taken in the shallower areas sampled. Therefore, the number of blue crab not effectively sampled by bottom hauls of the 4.9-m trawl apparently was not substantial although individuals may have evaded both bottom and surface trawls.

Largest differences between the catch in the eastern and western Bay were probably due to differences in the efficiency of the two different trawls. Even with the addition of the tickler chain to the 4.9-m trawl, the 2.7-m trawl was probably the more efficient gear because it was towed more slowly and it fished from surface to bottom in heavily vegetated areas. However, the addition of the tickler chain to the 4.9-m trawl probably increased both the efficiency of and catch with this gear. The estimated number of blue crab taken in the population survey by 4.9-m trawl in 1977 was 39.1% of that taken in 1976. This decrease was less than the decrease in the population estimate determined with the 2.7-m trawl in 1977 (16.4% of 1976 population estimate) and the decrease in the estimated number of blue crab impinged on the OCGS screens in August 1977 (6.5% of the estimated number in August 1976). The smaller decrease in the western Bay was probably due to an increase in efficiency of the 4.9-m trawl in 1977.

A pushnet was used to estimate the number of blue crab that was in the shore zone and unavailable to the trawls (Fig. D1-37, Table D1-97). Mean catch was similar in the areas of either eelgrass or widgeon grass along the eastern ($0.050/m^2$) and western ($0.048/m^2$) shore, but few blue crab ($0.005/m^2$) were found in non-vegetated areas of the western shore. This difference in catch may represent either habitat preference or

increased efficiency of the pushnet in vegetation. All specimens taken were immature.

Since the total vegetated and non-vegetated areas of the western shore were unknown, an estimated number of blue crab in each area could not be calculated. The estimated number of blue crab in the shore zone along the western shore (5,800 $\pm$ 2,300) and eastern shore (8,900 $\pm$ 5,900) was large considering the area of the shore zone sampled (4.65×10^5 m^2) in relation to the area of the Bay (85.08×10^6 m^2). However, all these numbers are considered underestimates. The area determined for the shore zone was conservative because it did not consider small irregularities of the shore line and the shore line of numerous tributary creeks. Gear avoidance may have been considerable. For example, at one location on the eastern shore approximately 25 blue crab were observed in the water in front of the pushnet but none were collected.

A summary of the life history stages of the blue crab (Table D1-98) was consistent with that reported for 1976 (Danila 1977a) with several exceptions. The percentage of the population that was immature decreased from 90% in 1976 to 72% in 1977. This decrease probably resulted from differential mortality of mature and immature blue crab during the severe winter. More gravid females with eggs in a later stage of development (black eggs) were taken in 1977 (46% of all gravid females) than 1976 (29%) probably because the survey was conducted at a later date in 1977. All gravid females were taken near the Inlet. The apparent preference of mature males for the northern part of the central Bay was not as pronounced in 1977. The percentage of immature females (69%) to males

(31%) was similar to that of collections at the OCGS screens in July and August.

Northern pipefish

The northern pipefish survey was made in conjunction with the blue crab survey, and the gear used, number of samples taken, and strata sampled were the same (Figs. D1-36, D1-37; Table D1-99). As in 1976, most northern pipefish were taken from the eastern portion of the Bay where beds of eelgrass were common. However, the populations estimated for the eastern and western portion of the Bay were considerably larger in 1977 (1,758,000 $\pm$ 475,000 and 311,000 $\pm$ 450,000, respectively) than 1976 (514,000 $\pm$ 150,000; 61,000 $\pm$ 58,000). In 1977, the survey was conducted 3 to 4 weeks later than during 1976, and a large number of young had been recruited into the population in 1977.

Large standard errors produced large confidence intervals for the estimated population in the western Bay during both years. One very large catch (n = 77) was made in Double Creek Channel (south stratum) in one of the few areas of eelgrass sampled by 4.9-m trawl. Particularly large catches (mean catch of 33.2) by 2.7-m trawl also were made in the south stratum of the eastern Bay. The mean catch of northern pipefish in both the eastern and western Bay decreased from the south to the north.

Mean catch by pushnet was larger in eelgrass and widgeon grass on the eastern (0.132/m^2) and western (0.092) shore than in areas of the western shore without vegetation (0.010). Many northern pipefish were

estimated to be in the shore zone along both the western (12,100 ± 5,100) and eastern (23,400 ± 9,000) shore.

Most specimens were young, and the number in each collection was probably underestimated. Although the number of fish that were seen going through the 6.3-mm mesh of the pushnet was included in the catch, many others probably passed through the mesh of the pushnet and trawls unobserved. Most northern pipefish collected were smaller than the mean size (167 mm) of individuals impinged on the OCGS screens (Appendix C1, Section C1.19). An unknown but probably large percentage of the northern pipefish probably passed through the relatively large mesh (10.7 mm) of the OCGS samplers and through the intake screens (9.6 mm).

D1.16 ENTRAINMENT OF ORGANISMS THROUGH THE OCGS COOLING-WATER SYSTEM

Introduction

Zoo- and ichthyoplankton which pass through the cooling-water system of OCGS are subject to mechanical, hydraulic, thermal, and biocidal stresses. Studies to determine the species composition and abundance of entrained organisms and their survival immediately after passage through OCGS were begun in September 1975. Data collected from September 1975 through August 1976 were reported by Sandine et al. (1977), and this study is a continuation of that work. Assessment of the entrainment losses on invertebrate and fish populations was discussed in Section D1-17 and by Tatham (1977). A summary of the effect of entrainment losses on individual populations and on the invertebrate and fish communities was presented by JCP&L (1978). Possible effects of latent mortality are discussed in Appendix C1, Section C1-21.

Continuation of the entrainment program after August 1977 depended on the statistical predictability of the data from 1975 through 1977. This program would not continue beyond March 1978 unless the estimated number of entrained organisms that were killed during the first two 12-month periods was significantly ($P \leq 0.2$) different (JCP&L 1976). As part of this evaluation, an improved method of estimating the number of forms entrained at OCGS was used for the 1976-77 data and for recalculating

the September 1975 through August 1976 entrainment data. A preliminary analysis of the difference in annual entrainment mortality was reported by I. A. (1977).

Materials and Methods

In September and October 1976 and from March through August 1977, collections were taken twice a week, starting 2 h after dark (Period 3A), and every 2 weeks during four periods over a 24-h interval. Period 1 was from sunrise to 6 h before sunset, period 2 was from 6 h before sunset to sunset, period 3A was from 2 to 6 h after sunset, and period 4 was from 6 h after sunset to sunrise. From November through February, macrozoo-and ichthyoplankton collections were taken once every 2 weeks during period 3A and once a month over a 24-h interval. No microzooplankton collections were taken from December through February because no important forms were present during these months (Sandine et al. 1977).

Two consecutive oblique tows with a 36-cm bongo sampler (505-micron mesh) were taken to determine the species composition and abundance of macrozoo-and ichthyoplankton entrained at OCGS. Collections were taken at both the intake (Sta. 7) and discharge (11) of the OCGS cooling-water system (Fig. D1-10). Collections at the OCGS intake were used to estimate the mortality of macrozoo- and ichthyoplankton that was attributable to the collection technique, and this mortality was used as a control for the mortality of a form in collections at the OCGS discharge. When OCGS did not circulate water, collections were taken in the dilution pump discharge. The binomial proportion test (Snedecor and Cochran 1967) was

used to establish significant differences ($P \leq 0.05$) between intake and discharge mortalities.

Two consecutive oblique tows of a 12.5-cm Clarke-Bumpus (C-B) sampler with an 80-micron mesh net was used to determine the species composition and abundance of entrained microzooplankton. Collections were made in the OCGS intake and discharge in 1975-76 but only at the discharge in 1976-77. Mortality of microzooplankton was not determined. The small size of individuals and the large amounts of phytoplankton and detritus that were frequently in the water prevented the determination of mortality by direct observation.

The sampling gear was attached to a wire approximately 30 to 38 cm above a 27-kg weight, and it was deployed and retrieved with a boom and hand winch. Each oblique tow sampled the entire water column at least twice. The volume of water sampled was determined with either a digital flowmeter (General Oceanics Model 2030) centered in the mouth of one side of the bongo or a flowmeter integral in the C-B. Tow time was shortened if excessive clogging of the net occurred or if organisms were extremely abundant.

As the samplers were removed from the water, the outside of the nets was gently rinsed with either low pressure water from a pump or water poured from buckets. For bongo collections, the plankton buckets at the end of the nets were removed and immediately carried to a trailer for condition (live/dead/damaged) determination.

Organisms taken in bongo collections were placed in a glass dish in a water bath which maintained organisms near ($\pm$ 1 C) their collection

temperature. The condition of most macrozoo- and ichthyoplankton was determined by examination of organisms under a magnifying lens for 15 min. If organisms were abundant, one half of the collection was examined. Specimens were considered live if they showed normal motility or behavior and dead if they showed no motility even when stimulated. Damaged specimens showed some movement (e.g., respiration or muscle spasms) but not normal motility or behavior. Only qualitative estimates of condition could be determined for some macrozooplankton because of the limited time (15 min) available to examine collections, the presence of detritus which obscured small forms, and the difficulty in determining the mortality of some forms. Samples were subsequently preserved in buffered 5% formalin (2% formaldehyde), but ctenophores were identified and counted before preservation because they disintegrated in formalin.

Since the mortality of ichthyoplankton collected with the bongo sampler was high (Sandine et al. 1977), collections with a sampler designed to reduce collection mortality were taken in March and April. This sampler was a 12.5-cm C-B sampler with a modified cylinder-cone net (333-micron mesh) with a Dacron expansion cone (basal diameter of 20 cm, Fig. D1-38). A 500-ml plastic cup with a window of 250-micron netting was used as a collection bucket. The deployment of the sampler and the procedure for the determination of mortality were similar to those used for the bongo collections, but the tow time was reduced to 1 min or less depending on the amount of detritus in the water. In an effort to reduce stress on larvae, the codend was not rinsed; however, the nets were rinsed thoroughly between collections to prevent contamination of subsequent samples.

In the laboratory, microzooplankton collections were concentrated to a known volume and subsampled with a 1-ml Stempel pipette. The subsample was placed in a Sedgwick-Rafter cell, and organisms were identified and enumerated under a compound microscope. A minimum of two subsamples was processed. Identification of all forms was made by reference to pertinent literature and by use of a voucher collection maintained in the laboratory.

At the OCGS intake, only meroplankton were enumerated and identified. Identification was to the lowest possible taxon except for bivalves which were grouped as Bivalvia and classified as either the straight-hinge or umbo stage. Forms designated as the life stage "no determination" were adults and juveniles. In collections from the OCGS discharge, all microzooplankton were identified to the lowest possible taxon. The bivalves Argopecton (Aequipecten) irradians, Crassostrea virginica, Mercenaria mercenaria, Modiolus demissus, Mulinia lateralis, Tellina spp., and Teredinidae were identified as either the straight-hinge or umbo stage. Straight-hinge larvae less than 80 microns were not identified to species because of taxonomic difficulties. These small larvae and all other bivalves were designated as class Bivalvia and were identified to stage.

Bongo collections were stained with Rose Bengal dye and later rinsed to remove formalin. When a sample contained few forms and relatively little detritus, the entire sample was examined under a dissecting microscope, and all macrozoo- and ichthyoplankton were removed. When organisms or detritus were abundant, the sample was poured into a shallow pan and examined for forms that were easily seen and removed

(usually < 200 individuals). Large ctenophore fragments and pieces of detritus also were removed. The sample was then quantitatively divided with a Folsom Plankton Splitter, and a fraction of the sample was examined under a dissecting microscope. If a form of macrozooplankton was extremely abundant (> 1000 individuals), its number was estimated from a subsample drawn from the sample with a 10-ml Stemple pipette. A minimum of two subsamples were taken and at least 50 individuals of the form were drawn from the sample.

In collections from the OCGS discharge, macrozooplankton was identified to the lowest possible taxon. However at the OCGS intake, all amphipods were grouped as unidentified Amphipoda, mud crab zoeae were grouped as Xanthidae zoeae, and all mysids were designated unidentified mysids. All engraulid larvae were identified as the bay anchovy. Separation of larvae (< 15 mm) of the bay anchovy and striped anchovy was virtually impossible, but most (> 99%) of the engraulids collected in the Bay during 1975-76 were the bay anchovy (Danila 1977c). Juveniles of the bay anchovy were separated from larvae by the appearance of pelvic fin buds (usually > 15 mm standard length).

The density (log x) of microzooplankton in collections from the OCGS discharge was plotted against the water temperature at the OCGS intake structure. These plots were used to characterize the presence and abundance of a form in relation to temperature. Correlation and plotting of data were accomplished with a Hewlett-Packard 9830A programmable calculator and an impact printer.

The analysis of variance (ANOVA, Snedecor and Cochran 1976) was used to test for differences in density of forms between day and night collections and between the 7 comparable months in which OCGS operated between 1975-76 and 1976-77. In some cases the 7 month estimates may be higher than the yearly estimates due to the seasonal presence or absence of particular species. A yearly estimate may have included more months in which the form was absent and, therefore, the 7-month estimate may exceed the yearly estimate. Two-way (day-night x month) ANOVA were calculated for collections at the discharge of the dilution pumps (Sta. 13) and the OCGS discharge (11) during 24-h periods. The density of a form in collections from the OCGS intake (Sta. 7) and discharge (11) was not compared because flowmeter readings between the two sides of the bongo were inconsistent in collections from the OCGS intake and, therefore, these densities were questionable.

The comparison of the total entrainment loss during the two 12-month periods was examined by comparing the estimated number of organisms entrained during each period. Because the entrainment mortality of most forms, particularly microzoo- and ichthyoplankton, was generally not known, mortality was assumed to be the same for both periods and, therefore, abundance reflected mortality. If a significant difference in the number of entrained organisms occurred between the two periods, the total loss between these periods also was assumed to be different.

Because OCGS was shut down during January and February 1976 and from 14 May through 11 July 1977, only data from 7 months (September

through December, March, April, and August) were used to compare macrozoo- and ichthyoplankton entrainment between the two 12-month periods. No microzooplankton collections were made in December 1976 because no important forms were abundant during this month, and therefore, a comparison of the number of microzooplankton forms entrained during the two periods was limited to 6 comparable months.

Densities of a form were transformed via the ln (x + 1) transformation in an attempt to normalize the data. If significant interactions occurred among the main effects, the interactions were graphically examined. If the plots demonstrated a consistent relationship through time (i.e., densities during the day were always greater or less than densities at night), the ANOVA was considered valid, and Tukey's HSD multiple range test (Steel and Torrie 1960) was used to compare the main effects. However, if the plots were not consistent through time, Friedman's non-parametric analysis of variance (Conover 1971) was used on untransformed data. Statistical tests for day-night differences were analyzed at the 95% ($P \leq 0.05$) significance level, but ANOVA for the difference in abundance between the 7 comparable months was analyzed at the 80% ($P \leq 0.2$) significance level (JCP&L 1976).

The method that Sandine et al. (1977) used to estimate the number of forms entrained at OCGS during the first year (September 1975 through August 1976) differed from that used during the second year (September 1976 through August 1977). During the first year, the number of microzooplankton entrained per 24-h period during a month (E_m) was

estimated for each month by the formula:

$$E_m = \frac{(d_n \cdot V)}{n_n}$$

d_n = density of a form in samples collected in the OCGS discharge during Period 3A.

V = volume of water entrained at OCGS in 24 h on the date the samples were collected.

n_n = number of samples collected during Period 3A in the month.

Only samples collected during Period 3A were used for the estimate because most of the samples were collected during this period. All data were not used because no computer program existed to calculate an unbiased weighted mean which included all of the samples. For months when OCGS was not in operation, samples from the discharge of the dilution pump were used to estimate the number of a form that would have been entrained at OCGS during that month. The number of microzooplankton entrained during the year (E_y) was estimated by the formula:

$$E_y = \sum E_m \cdot K$$

K = number of days in a given month.

During the first year, the estimated number of macrozoo- and ichthyoplankton entrained at OCGS per 12-h period of daylight (E_d) and of darkness (E_n) in a month were estimated as:

$$E_d = \frac{(D_d \cdot V_h)}{n_d} \quad \text{and} \quad E_n = \frac{(d_n \cdot V_h)}{n_n}$$

$d_{d \text{ or } n}$ = density of form in day (d_d) or night (d_n) samples collected during a month.

V_h = volume of water entrained at OCGS in 12 h on the date the samples were collected.

$n_{d \text{ or } n}$ = number of day (n_d) or night (n_n) samples collected during a month.

It was necessary to compute the density of a form during the day and at night because these densities often were substantially different (Sandine et al. 1977). The number of the form entrained during the year (E_a) was estimated by the formula:

$$E_a = \sum (E_d + E_n)/2 \cdot K$$

K = number of days in a given month.

In calculating E_a for macrozooplankton during 1975-76, the density of a form at either the OCGS intake or the discharge, depending on the form, was used. For ichthyoplankton, E_a was calculated using combined data from both the OCGS intake and discharge.

During the second year, the number of a form entrained at OCGS was estimated using stratified sampling with optimal allocation (Snedecor and Cochran 1967). The number entrained during the first year was recalculated using this same technique. The mean number entrained per hour for the year ($\overline{Y}_{st}$) was estimated by the formula:

$$\overline{Y}_{st} = \frac{\sum (N_p \cdot \overline{Y}_p)}{N}$$

N_p = number of sampling units in stratum p.

$\overline{Y}_p$ = mean density of a form in stratum p.

N = number of sampling units in all strata.

A sample was the mean density of all the individual tows collected in a stratum multiplied by the volume of water pumped through OCGS in 1 h on the sampling date. Each sampling unit was 1 h, and each sample was expressed as the number of a form entrained per hour because the duration of the individual tows was unequal. The total number entrained during the year (E) was estimated by the formula:

$$E = \overline{Y}_{st} \cdot D \cdot 24 \text{ h}$$

D = number of days the OCGS circulating-water pumps operated during the year.

In calculating E for macrozooplankton (with the exception of ctenophores) and ichthyoplankton collected during 1976-77 and in recalculating E for 1975-76, only the density of forms at the OCGS discharge was used. Samples from the OCGS intake were not used because of the inconsistent and unexplained variation in the volume filtered between the two sides of the bongo sampler. These inequalities may have been attributable to variable patterns of current flow caused by the recirculation tunnel which precedes the OCGS trash racks. For months that OCGS did not circulate water, collections from the dilution pump discharge were used to estimate the number of a form that would have been entrained at OCGS during that month.

The first year's estimates (Sandine et al. 1977) and the recalculated stratified estimates for that year which are reported here differed because the calculations reported by Sandine et al. (1977) included dates when OCGS was not in operation and was really an estimate of the number that would have been entrained if OCGS had operated continuously

throughout the year. The stratified technique estimated only the number of a form that actually passed through the OCGS cooling-water system. Furthermore, the stratified estimate was a more accurate estimate because it utilized all of the data collected to obtain a weighted mean ($\overline{Y}_{st}$). The method used to estimate entrainment during the first year was less accurate because it did not include additional samples during a 24-h period and, therefore, it biased the estimate toward the densities from collections taken during period 3A.

Results and Discussion

Microzooplankton

A total of 239 microzooplankton collections was taken at the OCGS discharge and the dilution pump discharge from 7 September 1976 through 1 September 1977. An estimated $4.03 \times 10^{13} \pm 6.40 \times 10^{12}$ microzooplankton were entrained through the OCGS cooling-water system during the 304 days of OCGS operation as compared with an estimated $5.16 \times 10^{13} \pm 7.90 \times 10^{12}$ entrained organisms during 287 days in the previous year (Table D1-100). Although the estimated number of all entrained microzooplankton was similar between the 2 years, the estimated number entrained during 6 comparable months (September through November, March, April, and August) between the 2 years was significantly different for 15 of 18 forms (Table D1-101). Only the estimated numbers of rotifers, polychaete larvae, and total bivalve larvae were not significantly different between years.

The mean monthly density of entrained microzooplankton ranged from 25,409/m^3 in March to 124,562/m^3 during September 1976 and averaged

64,133/m^3 for the year (Table D1-102). Thirteen forms accounted for 95% of all microzooplankton collected (Table D1-103). Microzooplankton densities were highest in September when copepod nauplii (72,962/m^3) were numerous and in July when Oithona colcarva (31,059/m^3) and Oithona spp. copepodites (20,711/m^3) were abundant. In 1975-76, the density of microzooplankton averaged 73,302/m^3 for the year and were most abundant in April when large numbers of copepod nauplii (80,545/m^3) and barnacle larvae (43,781/m^3) were collected.

In 1976-77, holoplankton (mean annual density of 51,646/m^3) comprised 81% of all microzooplankton and consisted almost entirely (93%) of copepods (all developmental stages). Copepod nauplii comprised 52%, by density, of all holoplankton (42% of all microzooplankton) and averaged 26,723/m^3 for the year. Mean monthly densities ranged from 1,623/m^3 in November to 72,962/m^3 in September, but no definite seasonal trends in abundance were evident. The abundance (mean annual density of 30,294/m^3) and percent composition (54% of all holoplankton, 41% of all microzooplankton) of copepod nauplii in 1975-76 were comparable to those in 1976-77.

An estimated 1.21×10^{13} adult and copepodite-stage copepods were entrained (Table D1-100). The mean monthly density ranged from 1,807/m^3 in November to 68,174/m^3 in July, and the mean density for the year was 21,410/m^3. As in 1975-76, adult and copepodite-stage copepods were abundant ($>$ 10,000/m^3) in September 1976 and from April through August 1977, and common (1,000-10,000/m^3) in other months.

Oithona colcarva and Oithona spp. were the most numerous copepods collected and comprised 50% of all adult and copepodite-stage copepods as compared with 17% the previous year. They were common to abundant from late May through October and rare in other months (Figs. D1-39 through D1-42). O. colcarva and Oithona spp. averaged 2,992/m^3 (an estimated 1.51 x 10^{12} entrained) the first year and 10,770/m^3 (6.75 x 10^{12}) the second. Both O. colcarva and Oithona spp. were collected at ambient temperatures of 4 to 29 C; however, densities greater than 10,000/m^3 were found at temperatures above 16 C for O. colcarva and above 22 C for Oithona spp. copepodites. Although O. similis was occasionally collected in small numbers, most Oithona spp. copepodites were probably those of O. colcarva because the seasonal abundance of copepodites followed closely that of adult O. colcarva (Figs. D1-39 through D1-42).

Acartia clausi, A. tonsa, and Acartia spp. were the most numerous copepods collected during 1975-76 (63% of all adult and copepodite-stage copepods), but they accounted for only 37% of all copepods in 1976-77. The lower relative abundance of Acartia was due to a 27% decrease in the mean annual density from 1975-76 (10,934/m^3) to 1976-77 (7,960/m^3) and a substantial increase in Oithona spp.

A. clausi, a boreal-temperate species, was the most common winter-spring copepod entrained at OCGS. It was collected from November through June at temperatures of 4 to 23 C (Figs. D1-43, D1-44). Densities greater than 10,000/m^3 occurred in April and May at temperatures between 15 and 17 C. The upper temperature limit for reproduction of A. clausi is approximately 20 to 22 C (Jeffries 1962). An estimated 8.73 x 10^{11}

A. clausi were entrained, and the mean density of entrained A. clausi for the year was 1,610/m^3. A. clausi was more numerous during the first year (2,484/m^3) when an estimated 1.30 x 10^{12} specimens were entrained. A. clausi copepodites tended to be more numerous in night collections although the difference in density between day and night collections was not significant.

Sandine (1973) reported that A. clausi entrained at OCGS experienced 60% mortality in June when exposed to a discharge temperature of 30 to 31 C (delta T of 10 C) for 1.5 to 2.0 h. However, the abundance of A. clausi was rapidly decreasing in June, and densities were relatively low at these discharge temperatures.

In late May, the temperate-tropical species A. tonsa replaced A. clausi as the dominant species of Acartia. It was common to abundant through September and was present in small numbers from October through April (Figs. D1-45, D1-46). A similar seasonal succession was found in 1975-76 at OCGS and has been reported for other estuaries in the northeastern United States (Conover 1956; Deevey 1960; Jeffries 1962, 1967). Densities of A. tonsa greater than 1,000/m^3 were found at ambient water temperatures above 15 C and densities over 10,000/m^3 between 18 and 25 C. Although OCGS did not circulate water from 14 May through 11 July 1977, the mean annual density of A. tonsa (2,600/m^3) in 1976-77 was greater than in 1975-76 (1,782/m^3), and consequently more A. tonsa were estimated to have been entrained in the second year (1.02 x 10^{12}) than in the first (9.30 x 10^{11}).

Reeve and Cosper (1970) found that as populations of A. tonsa acclimated to progressively higher water temperatures through the spring and summer, survival of experimental temperature shocks increased until no more than 25% mortality occurred after a 6 h exposure to 36 C. The upper thermal limit for A. tonsa in these experiments appeared to be 37 C because survival after 3 h at this temperature was poor regardless of acclimation temperature. Sandine (1973) reported results of an earlier entrainment study at OCGS which were similar. He found less than 20% mortality of entrained A. tonsa after 1.5 to 2.0 h exposure to discharge temperatures up to 35 C. However, at a discharge temperature of 40.4 C, 80% mortality occurred after 15 min.

Acartia spp. copepodites included both immature A. clausi and A. tonsa, and they were collected throughout the year (Figs. D1-47, D1-48). They averaged 3,750/m^3 for the year and were most numerous between April and October with a maximum monthly density of 12,984/m^3 in September. An estimated 2.53×10^{12} Acartia spp. copepodites were entrained in 1976-77 as compared with 3.88×10^{12} (mean annual density of 6,668/m^3) during the previous year.

Rotifers accounted for 7% of all holoplankton (6% of all microzooplankton), and an estimated 1.21×10^{12} individuals were entrained. Rotifers were collected in all months, were most abundant in November (mean monthly density of 26,041/m^3) and were common during May, June, and September (Fig. D1-49). Since collections were not taken from December through February when rotifers were most numerous in 1975-76 (Sandine et al. 1977), the mean annual density (3,840/m^3) was lower than

in the previous year (7,943/m^3). A plot of the moving average of density by date indicated several peaks of abundance during the year (Fig. D1-50). Many rotifers are cyclically abundant and can be characterized as mono-, di-, or polycyclic (Pennak 1953). Because rotifers were not identified, it was not known if the periodicity found in OCGS collections was due to a single polycyclic population or a series of abundant, monocyclic species.

The estimated number of meroplankton entrained through the OCGS cooling-water system in 1976-77 (6.69×10^{12}) was similar to the number entrained during the previous 12 months (6.98×10^{12}). However, OCGS was shut down from 14 May through 11 July when meroplankton were abundant (Sandine et al. 1977), and the entrainment estimate for most meroplanktonic forms was lower than it would have been if OCGS had operated throughout the summer. Larvae of polychaetes (33% by density of all meroplankton), gastropods (23%), barnacles (15%), and bivalves (14%) were the most numerous meroplankton (mean annual density of 12,487/m^3).

The estimated 2.73×10^{12} polychaete larvae entrained during 1976-77 (mean annual density of 4,154/m^3) was similar to the estimated 4.34×10^{12} larvae entrained during the first year (4,019/m^3), and the estimated number entrained in the 6 comparable months between the 2 years was not significantly different (Table D1-101). Larvae were collected at temperatures of 4 to 29 C; densities greater than 1,000/m^3 first occurred in late March when the water temperature reached 7 C (Figs. D1-51, D1-52). Concentrations greater than 10,000/m^3 were found from mid-April through mid-May at temperatures of 14 to 21 C.

In April (mean monthly density of 15,124/m^3) and May (8,153/m^3), larvae of Polydora spp. accounted for 83% and 32%, respectively, of all polychaete larvae. Although they occurred from 4 to 28 C (Figs. D1-53, D1-54), densities greater than 1,000/m^3 were found from late March to early June at temperatures of 10 to 23 C. Maximum abundance (> 10,000/m^3) occurred from mid-April to mid-May at a temperature of 15 to 17 C. Jeffries (1964) noted that the initial and largest burst of polychaete reproductive activity (primarily of spionids such as Polydora spp.) occurred in Raritan Bay at approximately 11 C.

Gastropod larvae were collected in every month and over a wide range of temperatures (6 to 29 C). They were common to abundant from May through September (mean monthly densities of 1,729 to 10,157/m^3), but they were rare from mid-October to mid-April (Figs. D1-55, D1-56). Densities in excess of 1,000/m^3 occurred at temperatures above 15 C, and densities greater than 10,000/m^3 were found between 17 and 26 C. Although the mean annual density (2,781/m^3) was higher in 1976-77 than in the previous year (1,080/m^3), the estimated number of larvae entrained during 1976-77 (6.44×10^{11}) was slightly lower than in 1975-76 (8.61×10^{11}) because OCGS did not operate from mid-May through mid-July when larvae were numerous.

Barnacle larvae (nauplii and cyprids) were collected in every month and occurred at temperatures of 4 to 29 C. The average density for the year was 1,784/m^3, and maximum densities (> 10,000/m^3) were found from March through May at temperatures between 10 and 16 C (Figs. D1-57, D1-58). The estimated 1.48×10^{12} larvae entrained was less than the 7.31 x

10^{12} larvae that were estimated to have been entrained during the previous year. Although the difference in abundance between the 2 years may be explained, in part, by the shutdown of OCGS from mid-May through mid-July 1977, larvae were also less abundant during the second year. The mean annual density in 1975-76 (8,204/m^3) was greater than that in 1976-77, and the number entrained during the 6 comparable months was significantly greater during the first year than the second (Table D1-101). Young and Frame (1976) identified the barnacles Balanus improvisus, B. eburneus, B. balanoides, and B. crenatus on test panels in the OCGS intake and discharge canals. Intertidal forms such as barnacles are usually more tolerant of extreme temperatures than sublittoral organisms (Naylor 1965). At the P. H. Robinson and Cedar Bayou power plants in Texas, barnacle nauplii (probably B. eburneus) had more than 80% survival after entrainment at 38 C and more than 50% survival above 40 C (Schlicht 1977).

Fewer (9.46×10^{11}) straight-hinge and umbonate bivalve larvae were entrained through the OCGS cooling-water system in 1976-77 than in the previous year (1.40×10^{12}). This difference was attributed primarily to the shutdown of OCGS during part of the year rather than a difference in abundance between the 2 years because the annual mean density for 1976-77 (1,650/m^3) was similar to that of the previous year (1,902/m^3). In 1976-77, bivalve larvae were collected in all months and were generally common from April through November with maximum abundance (mean monthly density of 3,693/m^3) during September 1976 (Figs. D1-59, D1-60).

Larvae of the northern quahog were collected on 4 October 1976 (ambient temperature of 17 C, discharge temperature of 25 C) and from 31 May through 1 July 1977 (ambient temperatures of 19 to 25 C). An estimated 1.86×10^9 larvae were entrained at OCGS for the year, but they were all entrained on 4 October because OCGS did not circulate water from 14 May through 11 July when larvae were most common (Figs. D1-61, D1-62).

Larvae of the northern quahog comprised 2% by density of the identified bivalve larvae and less than 1% of all bivalve larvae. Only straight-hinge larvae were taken from 31 May to 6 June (ambient temperatures of 19 to 21 C) with the maximum density ($309/m^3$) taken on 6 June at an ambient temperature of 19 C. From 23 June through 1 July (ambient temperatures of 23 to 25 C), only umbonate larvae were collected; the greatest density of umbos ($247/m^3$) occurred on 1 July at an ambient temperature of 25 C.

Carriker (1961) noted that the northern quahog in Little Egg Harbor, New Jersey spawned at a water temperature of 22 to 30 C with maximum frequency from 24 to 26 C. At comparable temperatures in Barnegat Bay and an average delta T of 10 C, larvae would be subjected to a temperature from 32 to 40 C during passage through the OCGS cooling-water system and a 15-min residence in the undiluted discharge water. Most larvae would probably be entrained at OCGS discharge temperatures of 34 to 36 C. The effect of these temperature elevations on straight-hinge larvae should result in little or no mortality because Kennedy et al. (1974) found little (5%) mortality of these forms after a 30-min exposure to 40 C.

Cleavage-stage eggs and trochophore larvae of the northern quahog would also be entrained through the OCGS cooling-water system. However, no entrainment estimates or relative abundance data were available because these stages were either unidentifiable or too small to be retained by an 80-micron mesh net. Based on heat-shock experiments in the laboratory, these stages were less tolerant of temperature increases. Kennedy et al. (1974) estimated that cleavage-stage eggs (2 h old) would experience 10% mortality after a 20-min exposure to 32 C, 50% mortality at 33 C, and 90% at 35 C and above. The more temperature tolerant trochophore-stage larvae (10 to 11 h old) would suffer an estimated 10% mortality after a 20-min exposure at 35 C, 50% at 36 C, and 90% at 37 C.

The dwarf surf clam, Mulinia lateralis, was the most abundant bivalve in Barnegat Bay (M. J. Kennish, personal communication), and larvae of this species accounted for the greatest percentage of identified bivalves in 1975-76 (42%) and in 1976-77 (98%). It comprised a similar percentage of total bivalve larvae in 1975-76 (17%) and 1976-77 (12%). Larvae of the dwarf surf clam were found in September and October 1976 and from May through August 1977 (Figs. D1-63, D1-64). They were collected at ambient temperatures of 12 to 28 C (OCGS discharge temperatures of 15 to 36 C) with densities greater than 1,000/m^3 at ambient temperatures of 18 to 24 C. Although the estimated 1.93×10^{11} entrained larvae did not include those entrained from 14 May through 11 July, the entrainment estimate for the second year was only slightly less than in the previous

year (2.10×10^{11}) when OCGS operated throughout the summer. The mean yearly density ($203/m^3$) in 1976-77 was less than the density in the previous year ($331/m^3$).

At OCGS discharge temperatures of 32.5 C and above, mortality of larvae of the dwarf surf clam may occur. Calabrese (1969) suggested that 32.5 C was the upper limit of thermal tolerance for straight-hinge larvae. At temperatures from 12.5 to 27.5 C and salinities of 20 to 30 ppt, 83% of the embryos developed to the straight-hinge stage. However at a temperature of 32.5 C, this percentage was less than 32%.

Macrozooplankton

A total of 483 macrozooplankton collections was taken from 7 September 1976 through 31 August 1977. Monthly mean day and night densities of common and important macrozooplankton are presented in Table D1-104. During the year 19 forms accounted for 95% of the macrozooplankton collected at the OCGS discharge (Table D1-105). The most abundant forms were the hydromedusa Rathkea octopunctata (mean annual density of $37.0/m^3$) and Neomysis americana ($29.3/m^3$). Caprellids, sea spiders (Pycnogonida) and the larvae of polychaetes and barnacles are not discussed although they were abundant. Caprellids and sea spiders are usually collected in the plankton in association with debris as they are primarily benthic forms. Better estimates of polychaete and barnacle larvae are obtained from C-B collections, and these forms are discussed in the microzooplankton section. During the first year (1975-76) of this study, 34 forms constituted 95% of the macrozooplankton, and N. americana ($17.6/m^3$) and

the zoeae of the mud crab Neopanope texana ($7.2/m^3$) were the most abundant forms.

The mean annual density of all macrozooplankton for the second year (1976-77) was about two times greater ($114.5/m^3$) than that during the first year ($51.4/m^3$). This large difference between the years was due primarily to the substantial increase in the abundance of R. octopunctata during the second year (Table D1-105). The hydromedusae Sarsia spp. also were more abundant during the second year ($13.7/m^3$) than the first ($0.6/m^3$), and the difference between the mean annual density of both hydromedusae illustrated the large natural variation in abundance that can occur in a macrozooplankton population between years.

The number of macrozooplankton entrained during the 2 years was estimated only for common (mean annual density $> 1/m^3$) and important forms (Table D1-106). The estimated 9.98×10^{10} specimens entrained during the second year exceeded the estimated 4.25×10^{10} forms entrained during the first year. However, the annual entrainment estimates are not comparable because OCGS was shut down during different months of the 2 years and, therefore, statistical testing was limited to data from the 7 comparable months. Twelve of the 28 forms examined had significant interactions which precluded use of the ANOVA. For 13 of the 16 remaining forms and for total macrozooplankton, the difference in the estimated number entrained between the 2 years was significant (Table D1-107). Only the number of Edotea triloba, adult grass shrimp, and the zoeae of Panopeus herbstii was not significantly different between the 2 years. The forms which differed significantly between the 2 years differed from

those previously reported by I. A. (1977) because preliminary analyses for some forms were based on collections from the OCGS intake. Because of inequalities in flow between the two sides of the bongo sampler (see page D1-367), samples from the OCGS intake were not used to generate entrainment estimates in the analyses reported here. Ctenophores were an exception, however, as most specimens greater than 20 mm in length were fragmented during passage through the cooling-water system of OCGS. Despite year-to-year differences in abundance, the common forms generally had similar patterns of seasonal occurrence during the 2 years.

During the second year, the mysid Neomysis americana was the second most abundant form (mean annual density of $29.3/m^3$). It was the most frequently collected form, and it occurred in 282 of the 283 collections at the OCGS and dilution pump discharges (Table D1-105). N. americana was least abundant in January (mean monthly density of $9.0/m^3$) and most abundant in April ($62.7/m^3$, Table D1-108). The decrease in density of this form from October to January resulted from its emigration from the estuary during the period of decreasing water temperature. Its return to the estuary commenced after minimal water temperature had been reached (Allen 1978). In Barnegat Bay, this return of N. americana began in February. During 24-h sampling, N. americana was significantly more abundant in night collections (Table D1-109). This diel difference in abundance resulted from vertical migration at night; similar behavior has been reported for other estuaries (Herman 1963, Hopkins 1965) and coastal waters (Sandine and Swiecicki 1975).

Although N. americana was the most abundant form during the first year (mean annual density of $17.6/m^3$), it was less abundant than during the second year. Consequently, more were entrained during 1976-77 (an estimated 2.29×10^{10}) than in 1975-76 (1.19×10^{10}, Table D1-106), and it was significantly more abundant in the 7 comparable months of the second year (Table D1-107). The seasonal trends in abundance of N. americana were similar between the 2 years, although the form was more abundant in April and May of the second year (Table D1-104).

Collections during the second year indicated that exposure of N. americana to OCGS discharge temperatures above 35 C, from 32.5 to 35 C, and from 30 to 32.5 C resulted in a mean mortality of 100%, 83%, and 36% respectively. Below 30 C, mortality generally did not exceed 10%. Cannon et al. (1978) reported that N. americana acclimated to 24 C could tolerate 30 C for 30 min and 33 C for 10 min. Mortality estimates for 1976-77 were generally similar to those reported for mysids entrained at OCGS during 1975-76 (Sandine et al. 1977). The comparison between the 2 years was limited, however, because in the second year OCGS discharge temperatures above 30 C occurred only in September and August.

The mysid Mysidopsis bigelowi was the eighth most abundant form (mean annual density of $1.4/m^3$) during 1976-77, and it occurred in 66% of the collections. The form was common from July through December, and the maximum mean monthly density ($6.8/m^3$) was in August. It was rare or absent from January through June because M. bigelowi emigrated from estuarine waters during this period (Allen 1978). Because of diel migration, M. bigelowi was significantly more abundant in night collections (Table D1-109).

During 1975-76, M. bigelowi was the ninth most abundant form, and its mean annual density ($1.0/m^3$) was slightly less than that in the second year. More individuals were estimated to have been entrained during the second year (1.38×10^9) than the first (6.36×10^8, Table D1-106), and the estimate for the 7 comparable months was significantly greater during the second year (Table D1-107). The seasonal trend of occurrence and abundance were similar for the 2 years, but the form was substantially less abundant during the cold period of the second year (Table D1-104). Since the winter of 1976-77 was more severe and had a longer period of low temperatures than the previous winter, it may have delayed the return of M. bigelowi into the Bay.

M. bigelowi collected at OCGS discharge temperatures of 32.5 to 35 C and of 30 to 32.5 C had a mean percent mortality of 75% and 90% respectively. The apparent discrepancy of higher mortality at the lower temperature probably reflected a limited number of individuals examined at the higher temperatures. Mortality was generally less than 10% at discharge temperatures below 30 C except in December when mortalities as high as 47% were found. Since M. bigelowi has a more southern distribution than N. americana, those specimens collected in December may have been stressed by the low ambient temperatures and were less tolerant of the temperature increase at OCGS. Mortality estimates of M. bigelowi were generally similar to those obtained during the first year for mysids (Sandine et al. 1977).

Zoeae of the mud crab Neopanope texana were the fifth most abundant form of macrozooplankton collected during 1976-77 (mean annual density

of 6.5/m^3), and they occurred in 39% of the collections. Large numbers of N. texana zoeae were first collected in May when the Bay temperature exceeded 20 C, and this zoeal form remained abundant through July. Its monthly mean density exceeded 10/m^3 from May through July (Table D1-108), and it was collected into September (Table D1-104). N. texana zoeae were significantly more abundant in night collections. The greater abundance of this zoeae and other decapod zoeae at night was due to the tendency for the eggs of decapods to hatch at night (Christy 1978).

During 1975-76, N. texana zoeae were the second most abundant form, but the mean density for the year (7.2/m^3) was only slightly higher than that in 1976-77. The seasonal occurrence and densities of this form during the 2 years were quite similar (Table D1-104). More N. texana zoeae were entrained during the first year (Table D1-106), and the estimate for the 7 comparable months was significantly different for the 2 years (Table D1-107).

Zoeae of the mud crab Panopeus herbstii were the sixth most abundant form collected in 1976-77. They occurred in 29% of the collections, and the mean density for the year was 3.2/m^3. Zoeae first occurred in collections in early June, about two weeks after zoeae of N. texana, and they were collected into early September. The monthly mean density of P. herbstii zoeae exceeded 10/m^3 only in July (Table D1-108). P. herbstii zoeae were more abundant at night (Table D1-104).

In 1975-76, P. herbstii zoeae ranked 16th in OCGS entrainment collections when their mean annual density was 0.4/m^3 and they occurred in only 18% of the collections. This form was much less abundant in the

first year when its maximum monthly density did not exceed $10/m^3$ (Table D1-108). However, the period of occurrence was similar for the 2 years (Table D1-104). More P. herbstii zoeae were entrained the second year (Table D1-106), but the difference between the 2 years for the 7 comparable months was not significant.

No quantitative mortality data were obtained for the zoeae of any mud crab, but qualitative observations indicated that few mud crab zoeae were affected by entrainment at OCGS discharge temperatures below 35 C. Zoeae of the mud crabs N. texana, P. herbstii, and Rhithropanopeus harrisii have been reared successfully at 30.0 C by Chamberlain (1961) and Costlow et al. (1962, 1966). In addition, R. harrisii zoeae had a better survival over the cyclic temperature range of 30 to 35 C than at a constant temperature of either 30 or 35 C (Costlow and Bookhout 1971). R. harrisii zoeae survived 180-min exposure to temperatures of 37 or below, but at 38 C or above they died (Chase 1977).

Zoeae of the sand shrimp Crangon septemspinosa occurred in 58% of the collections, and they were the seventh most abundant macrozooplankter collected in 1976-77 ($2.3/m^3$, Table D1-105). They were collected in each month except January (Table D1-104), and significantly more were taken at night (Table D1-109).

In the first year, sand shrimp zoeae were the third most abundant form (Table D1-105), and the annual mean density ($4.6/m^3$) was twice as great as during the second year. Although the seasonal occurrence was similar between the 2 years, the mean monthly density was larger in 9 of the 12 months of the first year (Table D1-108). Annual entrainment

estimates for 1975-76 and 1976-77 were 4.34×10^9 and 6.98×10^8 respectively (Table D1-106). The decreased abundance of sand shrimp zoeae in the second year may have indicated a decrease in the adult population in the Bay during that year. The estimated number of adult and juvenile sand shrimp impinged on the OCGS screens during 7 comparable months was significantly greater in 1975-76 (1,740,571) than in 1976-77 (526,618; Table D1-47). Laboratory tests indicated that no sand shrimp zoeae survived a 24-h exposure to a temperature that varied from 25 to 30 C (Regnault and Costlow 1970). Qualitative observations of sand shrimp zoeae indicated abnormal swimming behavior of individuals entrained at a discharge temperature above 30 C.

The mean annual density of adult and juvenile sand shrimp was relatively low ($0.1/m^3$), and it was the 32nd most abundant form taken during 1976-77. Although they occurred in only 32% of the collections, they were collected in all months except November. Most sand shrimp were collected from December through April and again in August (Table D1-104), but the monthly mean density was greater than $0.5/m^3$ only in February. Sand shrimp were significantly more abundant in night collections (Table D1-109).

In 1975-76, the sand shrimp ranked 22nd in abundance, and the mean annual density ($0.2/m^3$) was greater than in 1976-77. In the first year, it was collected in all months except October and November, and the mean monthly density exceeded $0.5/m^3$ in December, February, March, and August. Consequently, more sand shrimp were estimated to have been entrained in 1975-76 (1.04×10^8) than in 1976-77 (6.37×10^7; Table D1-106), and the

entrainment estimates for the 7 comparable months were significantly different (Table D1-107).

During the second year, only two sand shrimp were collected from the OCGS discharge at a temperature between 32.5 and 35 C, and both individuals were dead. One of the three individuals collected at a temperature between 30 to 32.5 C was dead. In the first year, mortality of the sand shrimp was 75% (n = 115) at discharge temperatures above 35 C, 78% (33) from 32.5 to 35 C, and 53% (131) from 30 to 32.5 C. Generally little (< 10%) mortality occurred at discharge temperatures below 30 C in either year.

The hydromedusa Rathkea octopunctata was the most abundant (mean annual density of $37.0/m^3$) macrozooplankter collected in the second year; the maximum monthly density ($29.0/m^3$) was in April (Table D1-108). It occurred in 35% of the collections. R. octopunctata was first collected in November at a water temperature of about 6 C, occurred throughout the winter, and was not collected after the water temperature exceeded 17 C in late April. An estimated 4.20×10^{10} R. octopunctata were entrained during the year (Table D1-106). Qualitative observations indicated that most R. octopunctata were killed immediately after entrainment at an OCGS discharge temperature above 23 C.

Few R. octopunctata were collected in the first year of the study when it ranked 58th in abundance (mean annual density $0.04/m^3$) and occurred in only 5% of the collections. In 1975-76, it was collected from January into May with the maximum monthly density ($0.4/m^3$) in March. This large difference in abundance between years appeared to be

natural variation in abundance, but this variation was unusually large for a macrozooplankter in Barnegat Bay. This large variation in abundance was also reflected in the significant, three orders of magnitude difference between the number entrained in the 7 comparable months between the 2 years (Table D1-106). The annual entrainment estimate for the first year was 2.30×10^7.

The hydromedusae Sarsia spp. were the third most abundant macrozooplankters entrained in the second year (mean annual density of $13.7/m^3$). They occurred in 27% of the collections, and the greatest mean monthly density was in March ($77.2/m^3$). Sarsia spp. were first collected when the ambient temperature was about 1 C, and individuals were collected until May when the ambient temperature exceeded 17 C. Most Sarsia spp. exposed to an OCGS discharge temperature of about 23 C laid on the bottom of the examination pan and did not swim. However, most of these individuals resumed normal swimming when placed in water of 20 C or below.

The mean annual density of Sarsia spp. also increased substantially (21 times) from 1975-76 to 1976-77, and the difference between years was significant for the 7 comparable months (Table D1-107). For the first year, Sarsia spp. ranked 13th in abundance, occurred in 16% of the collections, and was collected only from February through April. Annual entrainment estimates for the first and second year were 4.11×10^8 and 1.52×10^{10} respectively (Table D1-106).

The amphipod Jassa falcata was the fourth most abundant form in the second year. It had a mean annual density of $8.0/m^3$. It was collected in all months (89% of all collections), and it was most abundant from

September through December when its mean monthly density exceeded $10/m^3$ (Table D1-108). No significant difference occurred between day and night collections (Table D1-109), but J. falcata tended to be most abundant in collections taken 6 h after sunset during the cold period (ambient water temperature < 18 C) and more abundant during the day during the warm period (> 18 C).

Although J. falcata ranked fifth in abundance during 1975-76, the mean annual density ($2.4/m^3$) was substantially lower than during the second year. It was collected in all months but the mean monthly density exceeded $10/m^3$ only in July and August. Over the 2 years, it appeared that the abundance of this species in entrainment collections was not related to water temperature because it was common to abundant for 13 consecutive months (June 1976 through July 1977) and it was generally rare to occasional during the remainder of the 2 years (Table D1-104). The annual entrainment estimate of J. falcata during the first year was 2.68×10^9 and 6.73×10^9 for the second year (Table D1-106).

Amphipods of the genus Ampelisca were the ninth most abundant form (mean annual density of $1.0/m^3$) during 1976-77 when they occurred in 49% of the collections. Ampelisca spp. were common from May through July (Table D1-108), and they were generally most abundant at temperatures above 20 C. They were occasional to absent during the remainder of the year. This amphipod was significantly more abundant in night collections, and maximum density generally occurred from 2 to 3 h after sunset (Table D1-109).

Ampelisca spp. were more abundant in 1975-76 (mean annual density $2.0/m^3$) when they were the sixth most abundant form and were taken in 70% of the collections. They were collected in all months of the year and were common over a longer period (March through July). More were estimated to have been entrained in 1975-76 (2.11×10^9) than in 1976-77 (1.70×10^8; Table D1-106), and the estimated number entrained during the 7 comparable months was significantly different between the 2 years (Table D1-107).

The 13th most numerous form collected at the OCGS and the dilution pump discharges during 1976-77 was the amphipod Microdeutopus gryllotalpa. It occurred in 40% of the collections and had a mean annual density of $0.7/m^3$. This amphipod was common from May through July (Table D1-108), and its density exceeded $1.0/m^3$ at ambient temperatures of 15 to 28 C; below 15 C, this species was relatively uncommon (Table D1-109).

The seasonal occurrence of M. gryllotalpa was similar during the 2 years. It ranked eighth in abundance during the first year, and it had a larger mean annual density ($1.2/m^3$) and frequency of occurrence (55% of the collections) than during the second year. Consequently, more M. gryllotalpa were estimated to have been entrained during the first year than the second (Table D1-106).

Amphipods of the genus Corophium were the 28th most abundant form (mean annual density of $0.3/m^3$) during 1976-77, and they occurred in 40% of the collections. From September 1977 through March 1978, 76% of all identified Corophium were C. tuberculatum, 20% were C. acherusicum, 4% were C. bonelli, and less than 1% was C. insidiosum. Individuals of the

genus were collected in all months except February and were abundant in December ($0.8/m^3$). The difference in day and night densities was not significant. However at water temperatures below 18 C, Corophium was generally most abundant in night collections while it was more abundant during the day when the water temperature was above 18 C (Table D1-109).

Corophium spp. were more abundant in 1975-76 (mean annual density of $0.8/m^3$) when they were 11th in abundance and occurred in 47% of the collections. They were collected in all months except March and were most abundant in July (mean monthly density was $3.2/m^3$). More Corphium were entrained in the first year (7.92×10^8) than the second (1.72×10^8, Table D1-106). The difference between the 7 comparable months for the 2 years was not tested because of a significant interaction effect.

During 1975-76, mortality of amphipods was determined for the group Amphipoda and not for individual species. In general, amphipods collected from April through July 1976 at an OCGS discharge temperature below 35 C had less than 10% mortality (Sandine et al. 1977). In 1976-77, the mortality of individual genera or species of amphipods was examined, and little immediate mortality generally occurred at discharge temperatures below 35 C. In September 1976, J. falcata had 13% mortality after entrainment at an OCGS discharge temperature of 30 to 32.5 C and 40% mortality from 32.5 to 35 C. Mortality was generally below 10% at temperatures below 30 C. Only 2 of 192 Ampelisca spp. examined at OCGS discharge temperatures below 35 C were dead. No immediate mortality occurred to the 12 M. gryllotalpa collected at OCGS discharge temperatures of 30 to 32.5 C, and only 1 of 500 individuals was dead at temperatures

below 30 C. No mortality of Corophium spp. was noted at OCGS discharge temperatures between 30 and 35 C, while only 1 of 516 individuals was dead at a temperature below 30 C. In 1975-76, Sandine et al. (1977) found greater mortality of amphipods when the OCGS discharge temperature exceeded 35 C in June and July (36% mortality) and during August at either 30 to 35 C (37%) or above 35 C (65%). Relatively few amphipods were collected at an OCGS discharge temperature of 35 C in 1976-77 primarily because OCGS was shut down from 14 May through 11 July.

The cumacean Leucon americanus ranked 20th in abundance during 1976-77 with a mean annual density of $0.4/m^3$. It was not collected in January and was only occasional in the other months. L. americanus occurred in 57% of the collections. It was significantly more abundant in night collections and generally was absent from collections taken during the day (Table D1-109). Mortality of cumaceans was not determined because they tended to remain motionless in collections from both the OCGS intake and discharge and because they were usually hidden by detritus.

During 1975-76, L. americanus occurred in 57% of the collections, ranked ninth in abundance, and had a mean annual density of $0.9/m^3$. A greater number was estimated to have been entrained in the first year than the second (Table D1-106), and this difference was significant for the 7 comparable months (Table D1-107).

Arrowworms were the 18th most abundant form entrained in 1976-77. Their mean annual density was $0.5/m^3$, and they occurred in 34% of all collections. Most individuals were collected from December into April at ambient temperatures of 1 to 15 C; Sagitta elegans, a cold-water

species, was the only arrowworm collected during this period. Based on the seasonal succession of Sagitta in coastal waters of the mid-Atlantic, arrowworms collected in September and October were probably S. serratodentata and S. enflata (Grant 1963).

Arrowworms were more abundant in the first year (mean annual density of $3.6/m^3$) when they ranked fourth in abundance, even though they occurred in only 20% of the collections. Thus, substantially more arrowworms were entrained in the first year (5.45×10^8) than in the second (2.79×10^8, Table D1-106), and the difference was significant between the 7 comparable months (Table D1-107).

Only a qualitative estimate of the condition of entrained arrowworms was obtained. In collections from both the OCGS intake and discharge, this form usually showed motility only after repeated contact with a probe, and this procedure was too time consuming to use in the 15-min examination period. Although more damaged individuals (i.e., bent bodies) were qualitatively observed in discharge collections than in intake collections, this damage may reflect net damage of these soft-bodied forms rather than an entrainment effect. The current velocity in the mouth of the sampler at the OCGS discharge (approximately 70 cm/sec) was greater than that at the intake (40 cm/sec). Cada and Hergennoder (1978) showed that net-induced sampling mortality of soft-bodied fish larvae was a function of water velocity in the nets.

Zoeae of grass shrimp (Palaemonetes spp.) ranked 10th in abundance in the second year with a mean annual density of $1.0/m^3$; they occurred in 33% of the collections. They were present during September and

October and from May through August, and were generally taken at ambient temperatures above 20 C. These zoeae were common in June and July (Table D1-108) at ambient temperatures of 23 to 29 C. They were significantly more abundant in night collections (Table D1-109).

In 1975-76, grass shrimp zoeae ranked 18th in abundance, had a mean annual density of $0.4/m^3$, and occurred in 35% of the collections. The period of occurrence of grass shrimp zoeae was similar between the 2 years (Table D1-104). Although they were less abundant in 1975-76, the estimated number entrained in the first year (4.15×10^8) was greater than in the second year (1.41×10^8, Table D1-106) because OCGS was shut down from 14 May through 11 July 1977, the period of maximum abundance. The difference between the comparable months for the 2 years was not significant (Table D1-107).

Qualitative observation of grass shrimp zoeae indicated no adverse effect at OCGS discharge temperatures below 35 C. Grass shrimp zoeae have been reared successfully at 30.6 ± 0.5 C (Sandifer 1973), and Chase (1977) found that they survived a 180-min exposure to temperatures as high as 37 C. However, at 38 C she reported that no zoeae survived.

Epitokes of Nereis spp. occurred in 14% of the collections in 1976-77 and had a mean annual density of $0.04/m^3$. They occurred in September and from May through August when ambient temperatures were 16 C or above. The form was significantly more abundant at night, and it was most abundant in collections from 2 to 3 h after sunset (Table D1-109).

The annual mean density of Nereis spp. epitokes was similar in 1975-76 ($0.05/m^3$), but they occurred more frequently (26% of all collections)

in the first year. The seasonal occurrence in the 2 years generally was similar, although the form first occurred one month earlier (April) in 1975-76. This earlier occurrence probably was due to the more rapid warming of the Bay in the spring of 1976. More Nereis spp. epitokes were estimated to have been entrained in the first year (Table D1-106).

In 1976-77, only 18 Nereis spp. epitokes were examined at OCGS discharge temperatures above 30 C, and four of these were dead. During April and May 1976, mortality of these epitokes was 65% at temperatures from 27.5 to 30 C and it did not exceed 20% below 27.5 C. However from June through September 1976 mortality did not exceed 25% at OCGS discharge temperatures from 27.5 to 37.5 C.

Based on collections taken at the OCGS intake, the ctenophore Mnemiopsis leidyi was not abundant in 1976-77; its mean annual density was only $0.03/m^3$ (Table D1-110). It occurred in 9% of all collections and was collected only in September and October 1976 and again in August 1977 when it reached a maximum monthly abundance of $0.3/m^3$. No obvious difference in abundance was noted between day and night collections.

M. leidyi was about 35 times more abundant in 1975-76 (mean annual density of $0.9/m^3$) when it ranked ninth in abundance and occurred in 40% of the collections at the OCGS intake. This ctenophore occurred in September and October 1975 and from May through August 1976 with the maximum monthly density ($7.9/m^3$) in August. Many more M. leidyi were estimated to have been entrained in the first year (9.79×10^8) than during the second (3.41×10^7, Table D1-106).

Most M. leidyi larger than 20 mm were fragmented after passage through the cooling-water system of OCGS while smaller individuals were usually collected without substantial damage. The fragmentation probably resulted from mechanical stresses of impact on the OCGS screens and passage through the cooling-water system. Bongers et al. (1975) also found fragmentation of ctenophores from entrainment at an electrical generating station on the Potomac River.

Based on collections taken at the OCGS intake, the ctenophore Beroe ovata had a mean annual density of $0.02/m^3$ in 1976-77 (Table D1-110). It occurred in 7% of the collections and was collected only during September and October 1976. B. ovata larger than about 20 mm were often fragmented after passage through the OCGS cooling-water system. In general, B. ovata was somewhat less subject to fragmentation than M. leidyi.

B. ovata was more abundant in 1975-76 (mean annual density of $0.06/m^3$) even though it occurred in a similar percentage (8%) of the collections. In 1975-76, it occurred from September into November and again in August. More B. ovata were entrained during the first year (2.83×10^7) than during the second one (2.00×10^7, Table D1-106).

Megalopae of the blue crab ranked 30th in abundance during 1976-77 (mean annual density of $0.1/m^3$), and they occurred in 16% of all collections. They were collected in September and October and again during August at ambient temperatures of 14 to 25 C (Table D1-104). These megalopae were most abundant in September ($0.9/m^3$) and least abundant in August ($0.05/m^3$). Although blue crab megalopae did not occur in enough collections for statistical analysis, they were more abundant at night (Table D1-109).

In the first year, blue crab megalopae had a mean annual density of $0.02/m^3$ and they occurred in 12% of all collections. The seasonal pattern of occurrence between the 2 years was similar although these megalopae were less abundant in October of 1975-76 than October of 1976-77 (Table D1-104). More blue crab megalopae were entrained during 1976-77 (1.89×10^8) than during 1975-76 (5.18×10^7, Table D1-106). The difference between the 7 comparable months was significant (Table D1-107).

Blue crab megalopae showed little mortality immediately after entrainment. Less than 1% of the 376 blue crab megalopae collected at an OCGS discharge temperature above 30 C was dead. Individuals collected at the OCGS intake were actively swimming, but those collected from the OCGS discharge at temperatures above 32 C usually remained on the bottom of the examination pan. However, these individuals resumed active swimming when the water cooled to ambient temperature. Chase (1977) found 100% survival of blue crab megalopae exposed to temperatures up to 38 C for 180 min, but 100% mortality occurred at temperatures above 39 C.

Ichthyoplankton

From 7 September 1976 through 31 August 1977, a total of 483 collections was taken at the intake and discharge of the OCGS cooling-water system and at the discharge of the dilution pumps. An estimated 2.22×10^9 larvae (annual mean density of $15.6/m^3$) and 9.09×10^8 eggs ($23.2/m^3$) were entrained during the year (Tables D1-111, D1-112).

The species composition and period of abundance of ichthyoplankton between 1975-76 (Tatham et al. 1977) and 1976-77 were similar although

substantial differences in abundance existed for some forms. In both 1975-76 and 1976-77, ichthyoplankton was most abundant from May through September and from January through April. For some forms, the difference in the estimated number entrained between the 2 years was due to the shutdown of OCGS either during January and February 1976 or from 14 May through 11 July 1977 (Table D1-111). However for 7 comparable months between the 2 years, the estimated number entrained was significantly different for larvae of the sand lance and winter flounder; the difference between the number entrained during the 2 years was not significant for seven other forms (Table D1-113).

From May through September, the dominant ichthyoplankton were the bay anchovy, gobies, northern pipefish, blennies, silversides, and northern puffer. During 1976-77, larvae of the bay anchovy comprised 37% of the larvae and juveniles entrained. They occurred in collections from May through August and reached their maximum monthly density in July (mean monthly density of $19.67/m^3$). Most juvenile bay anchovy were collected from July through October with maximum abundance (mean monthly density of $1.30/m^3$) in August (Table D1-114). The seasonal occurrence of larval and juvenile bay anchovy was similar between the 2 years. During 1975-76, larvae and juveniles of the bay anchovy comprised 56% of all larvae and juveniles entrained and were collected from September through December 1975 and from May through December 1976. Bay anchovy larvae comprised a larger percentage of the entrained ichthyoplankton in the first year than during the second because OCGS did not circulate water from 14 May through 11 July 1977, the period of maximum abundance

of bay anchovy larvae. Although maximum monthly density occurred in July during both years, this density was about twice as great in July 1977 than July 1976 ($7.13/m^3$).

Eggs of the bay anchovy accounted for 98% of the eggs entrained at OCGS in 1975-76 but only 47% of all eggs collected in 1976-77. Fewer eggs were entrained through OCGS in 1976-77 (4.30×10^8) than in 1975-76 (1.58×10^{10}) because OCGS was shut down during the period of maximum abundance in 1977 (Table D1-111). Eggs of the bay anchovy were collected from March through August 1977 with the maximum mean monthly density in July ($40.62/m^3$, Table D1-114). In 1976, eggs were collected during a similar period but maximum monthly mean density ($96.77/m^3$) occurred in June. The difference in the time of occurrence of maximum monthly density between the 2 years may be due, in part, to cooler water temperatures in June 1977 (mean monthly temperature at the OCGS intake of 20.2 C) than in June 1976 (25.8 C). Optimal spawning for the bay anchovy occurred when water temperatures were maximum (Dovel 1971).

Eggs of the tautog and cunner also were consistently taken from March through August. Hogchoker eggs followed a pattern of occurrence similar to the bay anchovy and also reached maximum abundance in July (Table D1-115).

Gobies (Gobiosoma spp.) comprised 7% of the larvae and juveniles collected during entrainment sampling from May through August 1977. They were the second most abundant (30% of entrained larvae and juveniles) ichthyoplankton collected during 1975-76. Maximum monthly density occurred in July during 1977 ($2.26/m^3$) and in June of 1976 ($3.98/m^3$).

Cooler water temperatures in June 1977 (mean monthly temperature at the OCGS intake of 20.2 C) than in June 1976 (25.8 C) may account, in part, for this 1-month difference in maximum abundance. No significant difference in the estimated number of larvae entrained occurred between the 7 comparable months in 1975-76 and 1976-77.

Other larvae and juveniles were consistently present in low densities from May through September of 1976 and 1977. Young of the northern pipefish and larvae of the blennies were taken throughout these months. Several species of blennies were probably taken because adults of the feather blenny and striped blenny were impinged on the OCGS screens. Larvae and juveniles of the atherinids were collected from April through September, and these ichthyoplankton probably represented individuals of the Atlantic silverside, tidewater silverside, and rough silverside. All three species have been collected as adults at OCGS although the Atlantic silverside is the most abundant. Larvae of the northern puffer were collected in May and June 1976 and from May through July 1977. Northern puffer were most abundant during June in each year, but the maximum mean monthly density in June 1976 ($0.007/m^3$) was somewhat less than that in June 1977 ($0.045/m^3$).

Little reproductive activity occurred in the Bay from October through December. Few eggs were collected, but larvae and juveniles spawned either in the ocean during fall (e.g., Atlantic croaker, windowpane) or in the Bay during summer (e.g., bay anchovy, gobies) were present. The density of these forms was relatively low (Table D1-114).

Winter flounder and sand lance larvae were the dominant ichthyoplankton collected at OCGS from January through April. Larvae of the sand lance represented 2% of the total larvae and juveniles entrained at OCGS in 1976 and 6% of these forms in 1977. The maximum monthly abundance of sand lance larvae occurred in January during 1976 ($1.93/m^3$) and during March ($1.07/m^3$, Table D1-114) in 1977. Winter flounder larvae represented 8% of all larvae in 1976 but 55% of all larvae in 1977. The maximum monthly density of larval winter flounder both in 1976 ($5.48/m^3$) and 1977 ($8.76/m^3$) was in March (Tatham et al. 1977, Table D1-114), and the mean annual density of winter flounder was greater in 1976-77 ($1.57/m^3$, Table D1-112) than 1975-76 ($0.23/m^3$, Tatham et al. 1977).

Significantly more sand lance and winter flounder were entrained during comparable months of 1976-77 than the previous year (Table D1-113). Although the shutdown of OCGS during early March 1976 may have accounted for some portion of this difference for winter flounder, the increase in density and survival rate during 1977 (see Section D1.17) may be due to a decrease of some predators (e.g., the arrowworm Sagitta); an increase in available food supply, primarily microzooplankton; and climatic changes. The higher salinity during January through March 1977 (mean salinity of 22.3 ppt) as compared to 1976 (19.5 ppt) also may have increased survival of embryos in 1977. Rogers (1976) stated that salinity seemed to have an inverse effect on the hatching rates of winter flounder eggs (i.e., the lower the salinity, the longer the hatching time).

Eggs of the winter flounder (71% of all eggs collected from January through April) and sand lance (5%) were found in bongo collections from

January and February with maximum abundance (mean monthly density of $8.08/m^3$ and $0.54/m^3$ respectively) in February. The eggs of these two fishes are demersal, and the eggs taken in entrainment collections were undoubtedly a small fraction of the sand lance and winter flounder eggs in the Bay. Eggs of the Atlantic menhaden (6% of all eggs collected from January through April), bay anchovy (<1%), tautog (4%), cunner (1%), and silversides (1%) were also collected during these months, primarily during April; an additional 11% of the eggs collected were unidentified.

A two-way (day/night x station) ANOVA was computed for all eggs and all larvae combined; bay anchovy larvae, juveniles, and eggs; northern pipefish juveniles; and larvae of gobies, the sand lance, and winter flounder. No significant day-night differences occurred for any forms except bay anchovy juveniles which were significantly more abundant at night. Most forms exhibited greater densities at night, although not significantly so, and this was also found for entrainment collections in 1975-76 (Tatham et al. 1977). This tendency toward higher densities of larvae and juveniles at night probably resulted from either decreased net avoidance or changes in location in the water column. Bridger (1956), Daiber (1963), and Isaacs (1964) reported an increase in size and density of ichthyoplankton collected at night due, in part, to these two reasons. The higher densities of bay anchovy eggs at night may result from the initiation of spawning behavior around sunset (Hildebrand and Cable 1930). Only the densities of winter flounder and sand lance larvae were not substantially greater at night. Pearcy (1962) and

Tatham et al. (1977) found no consistent day-night differences in catches of winter flounder larvae.

The mortality of larvae and juveniles entrained at OCGS varied by species and their size. Although larvae of the sand lance, winter flounder, and Atlantic croaker, and juveniles of the bay anchovy taken in the bongo sampler had significantly higher mortality at the OCGS discharge, relatively high mortality in collections at the OCGS intake prevented an accurate determination of immediate entrainment mortality. Sand lance had 52% mortality in intake collections and 90% mortality in discharge collections; larvae of the winter flounder had 67% and 92% mortality, respectively; the Atlantic croaker had 20% and 36% mortality; and juveniles of the bay anchovy had 8% and 21% mortality (Table D1-115). Mortality of bay anchovy larvae (65% mortality in intake collections, 84% from discharge collections), juvenile northern pipefish (65%, 77%), blenny larvae (97%, 99%), and goby larvae (88%, 90%) were high in collections from both areas, and the difference in mortality between the two locations was not significant.

The size of entrained larvae of the bay anchovy, sand lance, and winter flounder examined ranged from 3 to 20+ mm in length, and the binomial proportion test indicated that larvae less than 5 mm in length had significantly higher mortalities than larger larvae and juveniles. Bay anchovy larvae (5 to 15 mm) had 93% mortality while juveniles (usually > 15 mm) had 33% mortality. Similarly, larvae of the sand lance (3 to 7 mm) and winter flounder (3 to 5 mm) had greater mortalities (77% for both forms) than post larvae (> 7 mm) of these species (30% and 48%

respectively). The three winter flounder larvae greater than 9 mm survived entrainment.

A modified C-B sampler (Fig. D1-38) was used to determine the condition of entrained larvae from 18 March through 6 April due to high mortalities encountered with the 36-cm bongo. Mortality still occurred in intake collections, but it was lower than in bongo samples and enabled a more accurate estimate of immediate entrainment mortality. Although these collections indicated that the percent mortality of winter flounder larvae collected at the OCGS discharge (34%) still was significantly greater than that of larvae taken at the intake (23%), these immediate mortalities were considerably lower than those collected at the OCGS intake (65%) and the discharge (92%) in March with the 36-cm bongo. For the sand lance, immediate mortality at the intake (17%) and at the discharge (6%) was not significantly different. These mortalities also were considerably lower than those determined in March with the 36-cm bongo at the intake (38%) and at the discharge (88%). Too few collections were taken to determine the mortality for various size-groups of winter flounder and sand lance larvae. The shutdown of OCGS from 14 May through 11 July prevented the estimation of immediate entrainment mortality of ichthyoplankton entrained during the summer.

D1.17 SURVEYS OF THE POPULATION OF SELECTED ZOOPLANKTON AND ICHTHYOPLANKTON IN BARNEGAT BAY

Introduction

Although entrainment studies can estimate the magnitude of potential entrainment losses, they do not evaluate the significance of these losses to the populations of organisms in the Bay. Since the potential losses at OCGS are numerically large, surveys were conducted in central Barnegat Bay from Berkeley Shores to Gulf Point in an effort to estimate the population of important and abundant macrozoo- and ichthyoplankton in this area. These estimated populations in the Bay were then used to put the estimated number of a form entrained through the OCGS cooling-water system in perspective.

The portion of the population of a form that was entrained through OCGS depended primarily on its distribution in the central Bay in relation to Forked River (i.e., the intake canal). If a form was evenly distributed throughout the central Bay, the percentage of that form entrained at OCGS in 12 h should be approximately equal to 1.1%, the percentage of the water from the central Bay that is entrained at OCGS during that period. If the percentage entrained was consistently less than or greater than 1.1%, the form was probably not evenly distributed throughout the Bay. Forms which had a wide range in the percentage of the Bay population that was entrained had a variable and uneven distribution in the Bay.

Materials and Methods

During 1977, the number of various forms of macrozoo- and ichthyoplankton in central Barnegat Bay from Berkeley Shores to Gulf Point was determined by random sampling from 87, 0.4 x 0.4-km quadrates (Fig. D1-65). Collections with a 20-cm bongo sampler (505-micron mesh net) were taken within approximately 50 randomly chosen quadrates during the day. Sampling methodology was discussed in Appendix C1, Section C1.21.

The estimated number of a form entrained at OCGS was calculated from samples taken at either the OCGS discharge or the dilution pump discharge. Sampling methods were detailed on page D1-326.

Bias in the estimates of the number of a form in the Bay and the number entrained through OCGS may be introduced because the velocity of the flow through the sampler was different for collections at OCGS and in the Bay. Bias caused by different sized bongo samplers in the Bay (20-cm bongo) and at OCGS (36-cm bongo) were considered negligible because no significant difference occurred among the catches of various sized bongos (Bjorke et al. 1974). However, the velocity of the water, as determined from the digital flowmeter, was greater through the small bongos than the large bongos, and this may have increased the escapement of small forms through the net of the small bongos in the Bay collections. Differential escapement between the two samplers would result in an overestimate of the percentage entrained because the number of a form in the Bay would be underestimated. The first zoeal stage of the hermit crabs Pagurus spp., the fiddler crabs Uca spp., and the blue crab;

recently released mysids; and early larvae of the winter flounder and bay anchovy may have been susceptible to escapement.

Two surveys for larvae of the winter flounder were made in March. The hydromedusae Rathkea octopunctata and Sarsia spp., sand shrimp zoeae, and other abundant zooplankton were also enumerated. From May through July, five surveys for the eggs and larvae of the bay anchovy were made. Zoeae of the sand shrimp, grass shrimp, and mud crabs and other important and abundant macrozoo- and ichthyoplankton collected during these surveys were also enumerated.

During September two surveys were made at night in 20 quadrates to estimate the population of mysids and blue crab megalopae in the Bay. These collections were made at night because these forms were substantially more abundant in the water column at night (Sandine et al. 1977). Juveniles of the bay anchovy and other important and abundant forms in these collections were also enumerated. These surveys were limited to quadrates that were readily sampled at night. However, the quadrates sampled were considered representative of the Bay from Berkeley Shores to Gulf Point, and the estimates were calculated for this area of the Bay.

The volume of each quadrate sampled was estimated from the surface area of the quadrate as determined with a Lietz Polar Planimeter (Model 3651-30) and from the mean depth of the quadrate given on a nautical chart (National Oceanic and Atmospheric Administration 1976). The total volume of the 87 quadrates was 118,774,000 m^3. The estimated number in this area of the Bay was calculated from the mean volume filtered per

sample and the mean number of a form per sample (adjusted to the mean volume filtered) using Poole's (1974) stratified random sampling formulae. The daily population estimate was calculated by multiplying the mean number of a form per mean volume filtered by the total number of samples that could have been collected from the study area.

To evaluate the effect of potential entrainment losses at OCGS, the number of a form entrained at OCGS during a 12-h period was compared to the estimated number of a form in the central area of the Bay. Because the survey was taken either during daylight or at night and because significant day-night differences occurred in the density of a form in both entrainment and Bay collections (Tatham et al. 1977b), comparisons of daily population and entrainment estimates were limited to a 12-h period of either daylight or darkness.

During March, the estimated number of a form entrained through OCGS during a 12-h period of daylight was calculated from entrainment samples taken during daylight 4 to 7 days before the date of the survey. Afterwards, however, 7 to 10 samples were taken at the OCGS discharge on the same day or night that the samples were collected in the Bay, and this provided a more accurate estimate of the percentage of the Bay population entrained on a date. If less than four circulating-water pumps were in operation, the mean density (n/m^3) in collections from the OCGS discharge was multiplied by the volume of water that would have been pumped through OCGS in 12 h with four pumps in operation (1.25×10^6 m^3) to estimate the maximum number that would have been entrained. If OCGS did not circulate water on the date that the survey was conducted,

the mean density (n/m^3) of a form in collections from the dilution pump discharge was multiplied by 1.25×10^6 m^3 to estimate the number of a form that would have been entrained.

For winter flounder larvae and for eggs and larvae of the bay anchovy, the number of eggs or larvae that were produced in the central Bay during the reproductive season was estimated with a method slightly modified from the random sampling model of Houde (1977). He calculated the population estimate of each size-class of larvae separately and then summed those estimates to determine the total population of larvae. In this study, the estimated number of larvae in the central Bay on each sampling date was multiplied by the percentage of larvae in each size-class on that date to estimate the number of larvae in each size-class. The estimated number of larvae in each size-class and of bay anchovy eggs were multiplied by the number of days of the reproductive season that were represented by a survey to estimate the number of larvae or eggs in the Bay during those days. The number of days represented by each survey generally was half of the days after the previous survey and half of the days before the next survey. The duration of the reproductive season was determined by the presence of a form in collections at OCGS.

Population estimates of larvae for the portion of the reproductive season before the first and after the last survey were calculated from the mean density of the form in night collections from the OCGS discharge during this period. The mean density of a size-class of larvae in these collections was divided by the mean density of that size-class from the closest survey in the Bay. The resulting ratio was multiplied by the

estimated number of larvae in that size-class from the nearest survey to obtain a daily population estimate for this period. This daily estimate was then multiplied by the number of days (usually 7 or less) from the beginning or end of the reproductive season represented by the entrainment samples to estimate the population during this period. This technique partially corrects Houde's (1977) inherent error of overestimating abundance at the beginning and the end of the reproductive season.

This method was used for larvae of the winter flounder and bay anchovy because examination of the data showed no significant difference ($P \leq 0.05$) in either densities (t-test, Sokal and Rohlf 1969) or size-frequency distributions (Kolmogorov-Smirnov test, Sokal and Rohlf 1969) between collections at OCGS and in the Bay. The method was not used for bay anchovy eggs because the portion of the reproductive season affected was short and the densities of eggs during this period were very low compared to the remainder of the spawning period.

Abundance of larvae was probably underestimated due to escapement of small larvae through the meshes of the net and avoidance of the sampling gear by larger larvae. During both 1976 (Tatham et al. 1977b) and 1977, the catch of winter flounder larvae less than about 3.5 mm and of bay anchovy larvae less than 7.0 mm were apparently biased by escapement because the estimated number of larvae in these size-classes was less than that in larger size-classes. Therefore, the estimated number in the smaller size-classes were excluded from the exponential regression analysis.

Although daylight is only one factor that affects avoidance and some avoidance probably occurs during both day and night sampling, this aspect of avoidance can be partially corrected by determining the ratio of abundance of each size-class between day and night samples. No correction was made for avoidance of winter flounder larvae because Pearcy (1962) found no evidence that these larvae avoided his sampling gear during daylight and the night/day ratios of various size-classes of winter flounder larvae in OCGS collections did not indicate gear avoidance. Therefore, it was assumed that the size-frequency distribution of winter flounder larvae taken in the Bay during daylight was respresentative of the population.

Smith et al. (1977) found considerable net avoidance by larvae of the bay anchovy in collections taken during the day in the Bay, and the catch of this form was corrected for this avoidance. The ratio of larval abundance between night and day samples increased for each size-class of larvae from 6.0 to 15.9 mm. These ratios were used to derive the exponential relationship between standard length of larvae (L) and night/day ratios of abundance (R), and the function $R = 0.178e^{0.306L}$ was derived from the calculated ratios. Due to random variation in the size-frequency distribution of samples used to calculate these ratios, this function expressed the relationship between length and avoidance better than the empirical ratios. The estimated number in each size-class was adjusted by multiplying the number collected in that size-class by the R value for that size-class.

Since life-stages of long duration would be represented by a larger number of specimens than a life-stage of shorter duration, it is necessary to adjust the estimated abundance of each life stage for the duration of that stage. In order to estimate the abundance and mortality in relation to the age of each life-stage, the duration and mean age of each stage was determined from the growth rate reported in the literature. Growth data for winter flounder larvae was found in Pearcy (1962) and that for bay anchovy larvae in Saksena and Houde (1972). The duration of the egg-stage of the bay anchovy was determined by examining eggs for distinct embryonic stages; and it was estimated to be 3 days in May, 2 days in the first half of June, and 1 day from mid-June through August. For the entire reproductive season, a weighted mean duration of 1.5 days was used for this egg-stage.

The summation of the estimated number of a form (adjusted for avoidance) in each size class during the periods covered by each survey gave the seasonal estimate of the number in that size-class. This estimate was unadjusted for age and growth, and this adjustment to the seasonal population estimate for each size-class was accomplished by dividing the estimated number in each size-class by the duration of that size-class. The exponential regression of this adjusted seasonal abundance for each size-class on the estimated mean age of that size-class was used to estimate the number of larvae hatched during the reproductive season. This number had to be estimated because the estimated abundance of newly hatched larvae was biased by escapement.

The absolute value of the slope of the exponential regression provided an estimate of the instantaneous mortality coefficients, the daily mortality rates, and the resulting production of large larvae during each reproductive season. Significant differences ($P \leq 0.05$) between instantaneous mortality coefficients between the 2 years were tested with a t-test (Simpson et al. 1960). Since the volume of the study area in 1977 was 1.1 times larger than the study area in 1976 (Tighe et al. 1977), all abundance estimates from 1976 were multiplied by 1.1 to allow a direct comparison between the 2 years.

In order to evaluate the effect of OCGS on the Bay population of winter flounder larvae and of bay anchovy eggs and larvae throughout the reproductive season, population estimates were compared to seasonal entrainment estimates for each size-class, and the estimated number of larvae hatched was compared to the seasonal entrainment estimate of all larvae. In order to compare between size-classes of different duration, the percent of the population entrained for each size-class was divided by the duration of that size-class to give the percent of the population entrained per 24-h. Seasonal entrainment estimates were calculated by multiplying the monthly entrainment estimate of all larvae by the size-frequency distribution of larvae during that month. These monthly entrainment estimates of each size-class were summed to obtain the seasonal entrainment estimate of each size-class, and the total seasonal entrainment estimate was the sum of the seasonal estimates of all size classes.

Results and Discussion

Macrozooplankton

Zoeae of the sand shrimp were collected in seven surveys from March through July, and the maximum population estimate (3.12×10^8) occurred in early June (Table D1-116). This form was generally most abundant south of Stouts Creek where the salinity usually exceeded 20 ppt (Fig. D1-66 through D1-72). In Chesapeake Bay, Sandifer (1972) reported that this form occurred primarily at salinities of 20 to 30 ppt.

The percent of the sand shrimp zoeae in the central Bay that was entrained at OCGS per a 12-h period of daylight ranged from 0% to 8.4%; the percentage exceeded 5% on three of the seven dates. Data from trawl and seine collections indicated that adult sand shrimp were more abundant in Forked River than in the Bay from March through June (Danila 1976, 1977). In addition, 52% of the females collected in Forked River during these months were gravid as compared to only 21% of the females collected in the Bay (Appendix C1, Section C1.19). This concentration of gravid females, at times, may have produced a larger density of zoeae in Forked River than in the Bay. If this occurred on the date of a population survey, a relatively large estimate of the number of this form entrained at OCGS would have occurred. However, these zoeae also entered the Bay and were subject to collection and inclusion in the Bay estimates.

Zoeae of the grass shrimp (*Palaemonetes* spp.) were collected on four dates in June and July and generally were most abundant along the eastern side of the Bay in salinities from 20 to 30 ppt (Figs. D1-73 through D1-76). However, relatively few collections were taken at a

salinity below 20 ppt. In Chesapeake Bay, Sandifer (1972) reported that grass shrimp zoeae were most abundant at a salinity of 10 to 15 ppt with few larvae taken above 25 ppt.

The percent of grass shrimp zoeae in the central Bay that were entrained at OCGS in a 12-h period ranged from 0.4% to 3.0% (Table D1-116), but this percentage exceeded 2.0% only on 21 July. On that date, the density of this form at the OCGS discharge ($2.7/m^3$) substantially exceeded that at the mouth of Forked River ($0.3/m^3$). This difference indicated that hatching of grass shrimp eggs probably occurred in Forked River.

Zoeae of the mud crab Neopanope texana were collected on four dates in June and July, and they were generally most abundant in the southern half of the Bay where salinities usually exceeded 25 ppt (Figs. D1-77 through D1-80). The largest estimated number in the central Bay (5.91×10^9) was on 8 June, and it resulted from a dense patch of larvae (densities as great as $1,055/m^3$) in the southern end of the Bay (Fig. D1-77). In Chesapeake Bay, zoeae of this species were most abundant at a salinity between 20 and 25 ppt; few were collected at a salinity below 15 ppt (Sandifer 1972).

An estimated 0.1% to 6.3% of the N. texana zoeae in the Bay were entrained at OCGS during a 12-h period (Table D1-116). Although the density of this form at the mouth of Forked River and at the OCGS discharge were comparable on 8 June, the density at the OCGS discharge exceeded that at the mouth of Forked River by 2 to 30 times on the other three dates. Adult mud crabs were more abundant in trawl collections in Forked River than in trawl collections in the Bay.

Zoeae of the mud crab Panopeus herbstii were collected on four dates in June and July. On three of the four days, they were most abundant in the western portion of the Bay in salinities from 20 to 29 ppt (Figs. D1-81 through D1-84). Sandifer (1972) reported that this zoea was most abundant in Chesapeake Bay at salinities of 15 to 25 ppt with less than 5% of the zoeae collected at a salinity below 15 ppt.

The percent of the estimated number of P. herbstii zoeae in the central area of the Bay that was entrained at OCGS ranged from 1.1% to more than 100% (Table D1-104). The large estimated percentages of the population that were entrained at times most likely resulted from the large number of mud crabs in Forked River.

The maximum population estimates of zoeae of the hermit crabs Pagurus spp.; the spider crabs Libinia spp.; the mud shrimp Upogebia affinis; the mud crab Rhithropanopeus harrisii; the broken back shrimps Hippolyte spp.; the blue crab Callinectes sapidus; and fiddler crabs Uca spp. were at least an order of magnitude less than those of zoeae of the four previous forms (Table D1-116). Each of these forms had at least one entrainment percentage which exceeded 2% (2.7% to 39.4%) of the estimated population in the Bay. For Pagurus spp., Libinia spp., and Hippolyte spp. these higher percentages probably indicated that a dense patch of zoeae occurred off the mouth of Forked River on one of the sampling dates. A relatively large number of gravid R. harrisii may occur in the lower salinity sections of the north and middle branches of Forked River, and both fiddler crabs and U. affinis may be common along the banks of Forked River. Therefore, their higher entrainment percentages may be attributable to hatching of these forms in Forked River.

Although the estimated percentage of early-stage larvae (e.g., zoeae) in the Bay that were entrained at OCGS may, at times, be related to the number of gravid females in Forked River, the number of late-stage larvae entrained at OCGS should be unrelated to the number of gravid females in Forked River. Late-stage larvae have been in the plankton for some time and have dispersed from the site of hatching or spawning. Therefore, the percentage of the estimated populations of late-stage larvae of barnacles (cyprid stage) and of the blue crab and spider crab (megalopae) that were entrained at OCGS ranged from 0.1% to 1.9% (Table D1-116). Furthermore, on the survey dates, these forms were usually not concentrated in Forked River or the Bay off the mouth of Forked River. Similarly, the hydromedusae Rathkea octopunctata, Sarsia spp., and Turritopsis nutricola and the mysid Neomysis americana did not appear to be concentrated in or near Forked River during the days of sampling because the percentage of their populations that were entrained ranged from 0.2% to 1.9% (Table D1-116).

In the two surveys conducted at night during September, megalopae of the blue crab were distributed throughout the area sampled, but they generally were most abundant near the Inlet (Figs. D1-85, D1-86). This distribution resulted in the entrainment of only 0.2% and 0.3% of the estimated blue crab megalopae in the Bay at OCGS during a 12-h period. The estimated number of the later-stage megalopae of the blue crab exceeded those of the earlier stage zoeae (Table D1-116), and this indicated that most blue crab zoeae probably hatched in the nearshore ocean rather than in the Bay. Blue crab eggs hatch primarily in coastal

waters and in the lower reaches of estuaries in water near oceanic salinities; migration into the estuary occurs primarily at the megalopal stage (Williams 1971).

The estimated number of the mysids Neomysis americana and Mysidopsis bigelowi in the central Bay were also obtained from the two night surveys. N. americana accounted for most (>80%) of the mysid population. Although it generally was most abundant north of Oyster Creek (Figs. D1-87, D1-88), the percentage of the population in the central Bay that was entrained in 12 h was 1.6% and 0.8%. M. bigelowi generally was common throughout the central Bay on 19 September when 3.2% of the population was entrained (Fig. D1-89). However on 28 September, it was most abundant near the mouths of Forked River and Oyster Creek and in the southern part of the central Bay (Fig. D1-90), and a greater percentage (5.1%) of the estimated Bay population was entrained at OCGS.

In summary, the portion of the population of a form that was entrained through OCGS depended primarily on its distribution in the central Bay in relation to the mouth of Forked River. A value exceeding 1.1% (i.e., the percentage of the water from the central Bay that is entrained in 12 h at OCGS) indicated that a form was more abundant in or near Forked River. The range of these percentages for the common zoeae, such as sand shrimp (0% to 8.4%), grass shrimp (0.4% to 3.0%), N. texana (0.1% to 6.3%), and P. herbstii (1.1% to 100%), probably resulted from a large population of gravid females in Forked River. The percentage of late-stage larvae entrained ranged from 0.1% to 1.9%, and the percentage of the megalopae of the blue crab did not exceed 0.3%. The percentages of

the populations of mysids entrained were less for N. americana (0.8% and 1.6%) than M. bigelowi (3.3% and 5.1%).

Ichthyoplankton

Data for surveys to estimate the number of the winter flounder (larvae); bay anchovy (eggs, larvae, and juveniles); and other abundant ichthyoplankton (i.e., young of the northern pipefish and goby larvae) are presented in Table D1-117.

The estimated number of winter flounder larvae in the Bay was 1.53×10^9 on 11 March and 1.30×10^9 on 28 March, and the estimated number of these larvae entrained at OCGS per 12-h period was 1.1% and 1.0%, respectively (Table D1-117). Since the volume of the central Bay that was entrained at OCGS during a 12-h period (about 1.1%) was approximately equal to the percentage of the population entrained, winter flounder larvae were apparently evenly distributed in the Bay near OCGS. However, patches of high density occurred in the northern and central portions of the central Bay with an area of very low density in the shallow, eastern Bay on both survey dates.

The seasonal population estimates of each size-class of winter flounder larvae for the 1976 (Table D1-118) and 1977 (Table D1-119) reproductive season were compared to the seasonal entrainment estimates for each size-class. For the different size-classes, the percent of the larvae in the Bay that was entrained during 24 h ranged from 0.3% to 6.1% during 1976 and from 0.8% to 1.9% during 1977.

The estimated number of larvae that hatched in the Bay in 1976 (1.88×10^{10}) and 1977 (1.35×10^{10}) was about equal (Table D1-118, D1-119). However, 0.5% and 4.9% of the winter flounder larvae hatched in Barnegat Bay were entrained at OCGS in 1976 and 1977, respectively. The lower percentage entrained in 1976 was probably due to the high mortality rate during that year (i.e., many larvae died before they could be entrained at OCGS).

In the exponential regression analysis for winter flounder larvae (Table D1-122), the estimate of the instantaneous mortality coefficient was 0.2162 for the 1976 reproductive season and 0.0844 for the 1977 season, and these coefficients were significantly different. The corresponding daily natural mortality rate was also greater in 1976 (19.4%) than in 1977 (8.1%). Although the number of adults present (see Section D1.15) and the number of larvae hatched (Tables D1-118 and D1-119) in the Bay were similar for both years, the significantly different mortality rates resulted in approximately two orders of magnitude difference in the abundance of large (> 7.0 mm) larvae during 1977. This difference in mortality rates and survival of larvae between the 2 years was apparently not related to OCGS operation because OCGS operated during both reproductive seasons. OCGS actually entrained a greater percentage of the larvae during the year when the greater number of large larvae were produced.

The natural fluctuation in survival between the 2 years may have been due to differences in climatic conditions during the 2 years. Jeffries and Johnson (1974) found that a negative correlation between

warming climatic trends (i.e., temperatures in April) and trawl catch of adult winter flounder 2.5 years later accounted for 75% of the variation observed in their study. They felt that this correlation was due to ecological interactions caused by temperature because the temperature differences between years in their study were too small to substantially affect individual larvae or young (age 0+) of the winter flounder. A similar phenomena apparently occurred in Barnegat Bay with poor survival and production of large larvae during the relatively mild winter of 1976 followed by increased survival and production of large larvae during the severe (cold) winter of 1977.

The estimated daily population of bay anchovy eggs in the central Bay ranged from 4.94×10^8 on 8 June to 5.72×10^9 on 6 July (Table D1-117). If OCGS had circulated water during June and July, an estimated 0.3% to 1.5% of these eggs would have been entrained at OCGS during a 12-h period.

The seasonal estimate for eggs of the bay anchovy produced during the 1976 and 1977 reproductive season were compared to the estimated number entrained at OCGS during that season (Tables D1-120, D1-121). Although the number of eggs spawned during the 2 years was about equal, an estimated 3.6% of bay anchovy eggs spawned in the central Bay in 1976 were entrained by OCGS, but only 0.1% of these eggs were entrained in 1977. This difference between years was primarily due to the shutdown of OCGS during most of spawning period (June and July) in 1977.

Daily population estimates of larvae of the bay anchovy ranged from 7.47×10^6 on 8 June to 7.73×10^8 on 21 July (Table D1-117). If OCGS

had been circulating water, an estimated 1.1% to 15.3% of these larvae would have been entrained during a 12-h period. The large range of this percentage was probably due to the unequal (i.e., patchy) distribution of these larvae in the Bay. When larvae were relatively abundant near the mouth of Forked River, a higher percentage of those in the Bay were entrained; however on 3 of 4 days, this percentage was below 8%.

The estimated population of juveniles of the bay anchovy in the central Bay on the night of 19 September and 28 September was 5.63×10^7 and 1.77×10^7, respectively, and an estimated 0.5% to 0.6% of these were entrained at OCGS in a 12-h period (Table D1-117).

A comparison of the estimated number of larvae of the bay anchovy produced in the Bay during the year to the seasonal entrainment estimate showed that the percentage of the different size-classes that were entrained at OCGS per 24-h period ranged from 1.0% to 2.4% during 1976 and from 0.1% to 0.6% during 1977 (Tables D1-120, D1-121). A comparison of the estimated number of larvae hatched during the reproductive season with the total number of larvae entrained at OCGS during that season showed that 1.7% and 0.6% of the larvae hatched in the Bay were entrained at OCGS in 1976 and 1977, respectively. As for eggs, the percentages were lower during 1977 due to the shutdown of OCGS during June and July.

These seasonal percentages were considered to be underestimates because they were only slightly higher than the mean percentage entrained per 24 h. The percentage of the population entrained throughout the season should exceed the percentage entrained per 24 h because larvae

in the Bay would take about 25 days to grow to 15.9 mm (Houde 1974), the upper size limit used in the regression analysis. The inclusion of the estimated number of eggs in the regression analysis probably resulted in an overestimate in the number of larvae hatched because the regression model assumed equal mortality over the entire period, and mortality of eggs was higher than mortality of larvae (Houde 1977).

Another estimate of the percentage of the larvae in the Bay that was entrained at OCGS during the reproductive season was obtained by estimating the number of larvae hatched in the Bay from the exponential regression of the abundance of each size-class of 7.0 to 15.9-mm larvae on the mean age of these size-classes (Tables D1-120, D1-121). However, this method probably underestimated the number of larvae hatched because the mortality rate of early larvae was often greater than that of later stages, and the abundance of eggs and early larvae were not included in the regression analysis. Comparison of these estimates with the estimates of seasonal entrainment indicated that approximately 30.6% (1976) and 3.1% (1977) of the larvae hatched in the Bay were entrained at OCGS. The percentage in 1977 was lower due to the shutdown of OCGS during the peak of the reproductive season. These percentages were probably overestimates and the actual percentage entrained during each year was between the estimated percentage determined by the two regressions.

The exponential regression of eggs and larvae (Table D1-122) indicated that the instantaneous mortality coefficients were not significantly different in 1976 (0.2017) and in 1977 (0.2025). These instantaneous mortality coefficients corresponded to a daily mortality

rate of 18.3% in both 1976 and 1977. However, the instantaneous mortality coefficient for larvae 7 to 15 mm in length was significantly lower in 1976 (0.0600) than in 1977 (0.1227); these instantaneous mortality coefficients corresponded to daily mortality rates of 5.8% and 11.6%, respectively. The higher mortality rate in 1977 may have been due to an increase in the abundance of young (age 0+) bluefish which may have resulted in increased predation on young bay anchovy (Appendix C1, Section C1.19.

The shutdown of OCGS during the 1977 reproductive season apparently had little effect on the population dynamics of the eggs and larvae of the bay anchovy. The number of eggs spawned, the number of larvae hatched, the instantaneous mortality coefficients, and the resulting number of large (15.0 to 15.9 mm) larvae were not substantially different between the 2 years. The only difference between the 2 years was the difference in the mortality of larger larvae, and this was apparently not related to OCGS operation.

The estimated number of juvenile northern pipefish in the Bay was relatively constant from May through July (3.14×10^6 to 5.28×10^6), but the estimated percentage of juveniles entrained at OCGS during a 12-h period ranged from 1.2% to 22.3% (Table D1-117). As with larvae of the bay anchovy, the large range of this percentage was probably due to the variability in the distribution of juveniles in the Bay; however, on 4 of 5 days this percentage was less than 5%. The high estimate of the percentage entrained was found when they were relatively abundant near the mouth of Forked River. Juveniles were not abundant enough for a seasonal analysis.

Although the estimated population of goby larvae (2.28×10^5 to 1.76×10^6) in the Bay was relatively small, many goby larvae were entrained at OCGS. Estimates of the percentage entrained during a 12-h period ranged from 23.7% to more than 100% of the estimated number in the Bay (Table D1-117). However, these high percentages were probably due to the large number of gobies in Forked River near OCGS and did not reflect the effect of OCGS on local populations in the Bay. Because goby eggs are adhesive, high densities of larvae occur near the habitat of the adults. Therefore, the larvae produced by the large population in Forked River produced high estimates of the percentage of the Bay population that was entrained.

Although the number of larvae entrained at OCGS was large, the effect of OCGS on the ichthyoplankton populations in the Bay was probably a slight increase in the daily mortality rate. This increase was a function of the percentage of the population entrained per day and the mortality of these entrained eggs and larvae, and this increment would be difficult to estimate without more accurate measurements of these two parameters throughout the year. Any increase in the total daily mortality rate that was attributable to OCGS would probably be small when compared to the large annual fluctuations in the natural mortality rate.

Table D1-44. Alphabetical listing by common name of all vertebrates collected by fish and impingement programs from September 1976 through August 1977.

Alewife - Alosa pseudoharengus
American eel - Anguilla rostrata
American shad - Alosa sapidissima
Atlantic croaker - Micropogon undulatus
Atlantic herring - Clupea harengus
Atlantic menhaden - Brevoortia tyrannus
Atlantic moonfish - Vomer setapinnis
Atlantic needlefish - Strongylura marina
Atlantic silverside - Menidia menidia
Atlantic spadefish - Chaetodipterus faber
Bay anchovy - Anchoa mitchilli
Bigeye scad - Selar crumenophthalmus
Black sea bass - Centropristis striata
Blackcheek tonguefish - Symphurus plagiusa
Blueback herring - Alosa aestivalis
Bluefish - Pomatomus saltatrix
Blue runner - Caranx crysos
Bluespotted cornetfish - Fistularia tabacaria
Bluntnose stingray - Dasyatis sayi
Butterfish - Peprilus triacanthus
Chain pickerel - Esox niger
Chain pipefish - Syngnathus louisianae
Cobia - Rachycentron canadum
Conger eel - Conger oceanicus
Crevalle jack - Caranx hippos
Cunner - Tautogolabrus adspersus
Diamondback terrapin - Malaclemys terrapin
Feather blenny - Hypsoblennius hentzi
Flying gurnard - Dactylopterus volitans
Fourspine stickleback - Apeltes quadracus
Fowler's toad - Bufo fowleri
Gag - Mycteroperca microlepis
Gizzard shad - Dorosoma cepedianum
Golden shiner - Notemigonus crysoleucas
Gray snapper - Lutjanus griseus
Grubby - Myoxocephalus aenaeus
Halfbeak - Hyporhamphus unifasciatus
Hogchoker - Trinectes maculatus
Inshore lizardfish - Synodus foetens
Lined seahorse - Hippocampus erectus
Lookdown - Selene vomer
Mummichog - Fundulus heteroclitus
Naked goby - Gobiosoma bosci
Northern kingfish - Menticirrhus saxatilis
Northern pipefish - Syngnathus fuscus
Northern puffer - Sphoeroides maculatus
Northern searobin - Prionotus carolinus
Northern sennet - Sphyraena borealis
Northern stargazer - Astroscopus guttatus
Orange filefish - Aluterus schoepfi
Oyster toadfish - Opsanus tau
Permit - Trachinotus falcatus
Planehead filefish - Monacanthus hispidus
Pumpkinseed - Lepomis gibbosus
Rainwater killifish - Lucania parva
Red hake - Urophycis chuss
Rough silverside - Membras martinica
Sand lance - Ammodytes sp.
Scup - Stenotomus chrysops
Seaboard goby - Gobiosoma ginsburgi
Sheepshead minnow - Cyprinodon variegatus
Silver anchovy - Engraulis eurystole
Silver perch - Bairdiella chrysura
Smallmouth flounder - Etropus microstomus
Smooth dogfish - Mustelus canis
Smooth trunkfish - Lactophrys triqueter
Spiny dogfish - Squalus acanthias
Spot - Leiostomus xanthurus
Spotfin butterflyfish - Chaetodon ocellatus
Spotted hake - Urophycis regius
Striped anchovy - Anchoa hepsetus
Striped bass - Morone saxatilis
Striped blenny - Chasmodes bosquianus
Striped burrfish - Chilomycterus schoepfi
Striped cusk-eel - Rissola marginata
Striped killifish - Fundulus majalis
Striped mullet - Mugil cephalus
Striped searobin - Prionotus evolans
Summer flounder - Paralichthys dentatus
Tautog - Tautoga onitis
Threespine stickleback - Gasterosteus aculeatus
Tidewater silverside - Menidia beryllina
Weakfish - Cynoscion regalis
White mullet - Mugil curema
White perch - Morone americana
Windowpane - Scophthalmus aquosus
Winter flounder - Pseudopleuronectes americanus

Table D1-45. Alphabetical listing by scientific name of all vertebrates collected by fish and impingement programs from September 1976 through August 1977.

Alosa aestivalis - Blueback herring
Alosa pseudoharengus - Alewife
Alosa sapidissima - American shad
Aluterus schoepfi - Orange filefish
Ammodytes sp. - Sand lance
Anchoa hepsetus - Striped anchovy
Anchoa mitchilli - Bay anchovy
Anguilla rostrata - American eel
Apeltes quadracus - Fourspine stickleback
Astroscopus guttatus - Northern stargazer
Bairdiella chrysura - Silver perch
Brevoortia tyrannus - Atlantic menhaden
Bufo fowleri - Fowler's toad
Caranx crysos - Blue runner
Caranx hippos - Crevalle jack
Centropristis striata - Black sea bass
Chaetodipterus faber - Atlantic spadefish
Chaetodon ocellatus - Spotfin butterflyfish
Chasmodes bosquianus - Striped blenny
Chilomycterus schoepfi - Striped burrfish
Clupea harengus - Atlantic herring
Conger oceanicus - Conger eel
Cynoscion regalis - Weakfish
Cyprinodon variegatus - Sheepshead minnow
Dactylopterus volitans - Flying gurnard
Dasyatis sayi - Bluntnose stingray
Dorosoma cepedianum - Gizzard shad
Engraulis eruystole - Silver anchovy
Esox niger - Chain pickerel
Etropus microstomus - Smallmouth flounder
Fistularia tabacaria - Bluespotted cornetfish
Fundulus heteroclitus - Mummichog
Fundulus majalis - Striped killifish
Gasterosteus aculeatus - Threespine stickleback
Gobiosoma bosci - Naked goby
Gobiosoma ginsburgi - Seaboard goby
Hippocampus erectus - Lined seahorse
Hyporhamphus unifasciatus - Halfbeak
Hypsoblennius hentzi - Feather blenny
Lactophys triqueter - Smooth trunkfish
Leiostomus xanthurus - Spot
Lepomis gibbosus - Pumpkinseed
Lucania parva - Rainwater killifish
Lutjanus griseus - Gray snapper
Malaclemys terrapin - Diamondback terrapin
Membras martinica - Rough silverside
Menidia beryllina - Tidewater silverside
Menidia menidia - Atlantic silverside
Menticirrhus saxatilis - Northern kingfish
Micropogon undulatus - Atlantic croaker
Monacanthus hispidus - Planehead filefish
Morone americana - White perch
Morone saxatilis - Striped bass
Mugil cephalus - Striped mullet
Mugil curema - White mullet
Mustelus canis - Smooth dogfish
Mycteroperca microlepis - Gag
Myoxocephalus aenaeus - Grubby
Notemigonus crysoleucas - Golden shiner
Opsanus tau - Oyster toadfish
Paralichthys dentatus - Summer flounder
Peprilus triacanthus - Butterfish
Pomatomus saltatrix - Bluefish
Prionotus carolinus - Northern searobin
Prionotus evolans - Striped searobin
Pseudopleuronectes americanus - Winter flounder
Rachycentron canadum - Cobia
Rissola marginata - Striped cusk-eel
Scophthalmus aquosus - Windowpane
Selar crumenophthalmus - Bigeye scad
Selene vomer - Lookdown
Sphoeroides maculatus - Northern puffer
Sphyraena borealis - Northern sennet
Squalus acanthias - Spiny dogfish
Stenotomus chrysops - Scup
Strongylura marina - Atlantic needlefish
Symphurus plagiusa - Blackcheek tonguefish
Syngnathus fuscus - Northern pipefish
Syngnathus louisianae - Chain pipefish
Synodus foetens - Inshore lizardfish
Tautog onitis - Tautog
Tautogolabrus adspersus - Cunner
Trachinotus falcatus - Permit
Trinectes maculatus - Hogchoker
Urophycis chuss - Red hake
Urophycis regius - Spotted hake
Vomer setapinnis - Atlantic moonfish

Table D1-46. Alphabetical listing by scientific names of all macroinvertebrate taxa collected by fish and impingement programs from September 1976 through August 1977.

Actiniaria (order) - sea anemones	Nosema stephani - a microsporidian parasite
Aequorea spp. - a hydromedusa	Olencira praegustator - a parasitic isopod
Callinectes sapidus - blue crab	Ovalipes ocellatus - a lady crab
Callinectes similis - lesser blue crab	Pagurus longicarpus - long-armed hermit crab
Cancer irroratus - rock crab	Palaemonetes pugio - grass shrimp
Carcinus maenus - green crab	Palaemonetes vulgaris - grass shrimp
Crangon septemspinosa - sand shrimp	Panopeus herbstii - a mud crab
Cyanea capillata - lion's mane jellyfish	Penaeus aztecus - brown shrimp
Ensis directus - Atlantic jackknife clam	Penaeus setiferus - white shrimp
Lernaeenicus spp. - parasitic copepods	Piscicolidae (family) - marine leeches
Libinia dubia - spider crab	Polychaeta (class) - bristle worms
Limulus polyphemus - horseshoe crab	Porifera (phylum) - sponges
Lironeca ovalis - a parasitic isopod	Portunus gibbesi - a portunid crab
Loliginidae (family) - squids	Portunus spinimanus - a portunid crab
Loligo pealei - Atlantic long-finned squid	Procambarus blandingi - Blanding's crayfish
Lolliguncula brevis - brief squid	Scyphozoa (class) - true jellyfishes
Mercenaria mercenaria - hard clam, northern quahog	Squilla empusa - mantis shrimp
Mytilus edulis - blue mussel	Urosalpinx cinereus - Atlantic oyster drill
Nemertea (phylum) - ribbon worms	Xanthidae (family) - mud crabs
Neopanope texana - a mud crab	

Table D1-47. Estimated number with confidence interval ($P \leq 0.2$), and results of a three-way analysis of variance of selected fishes and macroinvertebrates impinged on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey during seven comparable months (September-December, March, April, and August) from 8 September 1975 through 2 September 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	1975 - 1976 Estimated Number		1976 - 1977 Estimated Number		Significant Difference ($P \leq 0.2$) Between Years
Alosa aestivalis	26,070 ±	9,564	26,113 ±	8,380	No
Alosa pseudoharengus	3,036 ±	726	3,767 ±	828	Yes
Brevoortia tyrannus	11,478 ±	3,616	91,614 ±	21,583	Yes
Anchoa mitchilli	1,275,132 ±	277,411	140,437 ±	26,276	Yes
Menidia menidia	56,567 ±	11,177	33,766 ±	5,239	No
Syngnathus fuscus	29,379 ±	4,425	8,780 ±	1,204	Yes
Pomatomus saltatrix	1,474 ±	433	3,313 ±	688	Yes
Cynoscion regalis	11,448 ±	2,610	26,899 ±	5,960	Yes
Leiostomus xanthurus	4,682 ±	1,605	60,153 ±	15,571	Yes
Prionotus evolans	34,251 ±	27,648	28,109 ±	8,985	No
Etropus microstomus	8,083 ±	2,916	57,074 ±	14,532	Yes
Paralichthys dentatus	3,147 ±	513	2,273 ±	497	Yes
Pseudopleuronectes americanus	1,214 ±	351	14,285 ±	6,235	Yes
Palemonetes vulgaris	171,904 ±	38,279	25,535 ±	4,071	Yes
Crangon septemspinosa	1,740,571 ±	422,778	526,618 ±	95,758	Yes
Callinectes sapidus	1,526,862 ±	487,070	212,995 ±	31,538	Yes
Total of all species	4,942,829 ±	715,802	1,355,903 ±	117,085	Yes

TABLE D1-68. PHYSICOCHEMICAL PARAMETERS TAKEN IN FRONT OF THE TRAVELING SCREENS DURING IMPINGEMENT SAMPLING AT OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM 5 SEPTEMBER 1976 THROUGH 3 SEPTEMBER 1977. NO SAMPLES WERE TAKEN 14 MAY THROUGH 12 JULY.

	SEPTEMBER 5 - 11	SEPTEMBER 12 - 18	SEPTEMBER 19 - 25	SEPTEMBER 26 - OCTOBER 2	OCTOBER 3 - 9
TEMPERATURE: AIR	14.0 - 30.0	18.0 - 29.0	6.0 - 22.0	8.0 - 28.0	14.0 - 21.0
SURFACE	21.0 - 25.6	22.0 - 25.4	18.5 - 24.4	17.5 - 22.8	16.5 - 20.0
BOTTOM	21.0 - 23.5	22.5 - 25.5	18.5 - 24.1	17.4 - 22.2	17.1 - 19.0
SALINITY: SURFACE	24.0 - 26.0	23.0 - 25.0	23.0 - 25.5	24.0 - 27.0	23.0 - 26.0
BOTTOM	24.0 - 26.0	23.0 - 25.0	23.0 - 25.5	24.0 - 26.0	22.0 - 26.0
OXYGEN: SURFACE	6.4 - 8.3	6.2 - 8.1	7.0 - 8.5	6.2 - 8.0	7.3 - 9.5
BOTTOM	6.8 - 8.1	6.1 - 7.6	7.0 - 7.8	6.6 - 7.7	7.6 - 9.0
PH: SURFACE	7.5 - 8.1	7.7 - 8.2	7.9 - 8.1	7.8 - 8.1	7.3 - 8.0
BOTTOM	7.5 - 8.1	7.6 - 8.2	7.7 - 8.0	7.9 - 8.0	7.3 - 8.3
SECCHI (CM)	50.0 - 80.0	50.0 - 80.0	68.0 - 68.0	65.0 - 72.0	50.0 - 70.0

	OCTOBER 10 - 16	OCTOBER 17 - 23	OCTOBER 24 - 30	OCTOBER 31 - NOVEMBER 6	NOVEMBER 7 - 13
TEMPERATURE: AIR	4.5 - 20.0	2.0 - 17.0	-4.0 - 13.8	0.0 - 15.0	-2.5 - 11.5
SURFACE	12.5 - 17.2	10.4 - 17.5	6.4 - 13.5	7.2 - 12.0	4.5 - 11.0
BOTTOM	12.5 - 16.8	10.6 - 15.3	7.2 - 13.3	6.9 - 11.5	5.2 - 8.5
SALINITY: SURFACE	22.5 - 25.0	24.0 - 26.0	23.0 - 26.0	22.0 - 25.5	24.0 - 26.0
BOTTOM	22.5 - 25.0	24.0 - 26.0	23.0 - 25.0	22.0 - 25.5	23.0 - 26.0
OXYGEN: SURFACE	7.7 - 11.2	7.6 - 12.4	8.2 - 13.2	9.6 - 16.0	9.6 - 12.6
BOTTOM	8.0 - 10.4	7.6 - 10.4	8.6 - 11.4	10.2 - 14.0	9.5 - 12.2
PH: SURFACE	7.7 - 8.2	7.4 - 8.0	7.4 - 8.1	7.6 - 8.0	7.6 - 8.1
BOTTOM	7.8 - 8.2	7.4 - 8.0	7.6 - 8.0	7.7 - 8.0	7.8 - 8.0
SECCHI (CM)	60.0 - 70.0	50.0 - 80.0	90.0 - 100.0	75.0 - 90.0	85.0 - 90.0

	NOVEMBER 14 - 20	NOVEMBER 21 - 27	NOVEMBER 28 - DECEMBER 4	DECEMBER 5 - 11	DECEMBER 12 - 18
TEMPERATURE: AIR	-1.0 - 15.0	-4.0 - 8.0	-12.0 - 4.5	-10.0 - 6.0	-7.5 - 9.0
SURFACE	3.2 - 8.5	-1.0 - 7.0	0.4 - 7.6	0.0 - 6.5	0.0 - 5.0
BOTTOM	3.4 - 6.0	1.0 - 5.8	0.4 - 7.6	0.0 - 7.5	1.0 - 4.0
SALINITY: SURFACE	21.0 - 24.0	24.0 - 26.0	22.5 - 25.0	23.0 - 30.0	22.0 - 25.0
BOTTOM	22.0 - 24.0	24.0 - 25.0	22.0 - 25.0	23.0 - 27.0	21.0 - 24.5
OXYGEN: SURFACE	9.6 - 12.4	7.9 - 13.6	10.0 - 14.7	7.2 - 13.8	9.3 - 16.8
BOTTOM	9.4 - 12.4	8.5 - 12.0	10.0 - 12.8	8.2 - 12.0	9.4 - 16.7
PH: SURFACE	7.6 - 8.4	7.8 - 8.5	7.5 - 8.2	7.4 - 8.2	7.5 - 8.3
BOTTOM	7.7 - 8.4	7.9 - 8.5	7.6 - 8.2	7.4 - 8.0	7.6 - 8.3
SECCHI (CM)	70.0 - 130.0	100.0 - 125.0	135.0 - 170.0	120.0 - 145.0	90.0 - 120.0

TABLE D1-48. (CONT.)

	DECEMBER 19 - 25	DECEMBER 26 - JANUARY 1	JANUARY 2 - 8	JANUARY 9 - 15	JANUARY 16 - 22
TEMPERATURE: AIR	-8.0 - 8.0	-12.0 - 1.0	-8.0 - 1.0	-14.0 - 3.0	-18.5 - -6.1
SURFACE	-1.0 - 7.5	-0.9 - 2.6	0.6 - 2.4	-0.6 - 1.8	0.0 - 1.6
BOTTOM	-0.5 - 6.2	-0.9 - 1.6	0.5 - 1.6	0.1 - 2.1	-0.5 - 2.5
SALINITY: SURFACE	22.0 - 26.0	24.0 - 28.0	23.0 - 26.0	19.0 - 25.0	23.0 - 24.0
BOTTOM	22.0 - 26.0	24.0 - 26.0	24.0 - 26.0	20.0 - 27.0	23.0 - 24.0
OXYGEN: SURFACE	10.8 - 12.6	10.2 - 13.3	10.2 - 12.5	11.2 - 13.0	11.0 - 12.6
BOTTOM	10.8 - 11.2	11.4 - 13.3	11.6 - 12.3	11.4 - 13.2	10.8 - 13.0
PH: SURFACE	7.7 - 8.2	7.7 - 8.2	7.8 - 8.1	7.7 - 8.1	7.7 - 8.2
BOTTOM	7.8 - 8.2	7.9 - 8.0	7.9 - 8.0	7.8 - 8.1	7.9 - 8.3
SECCHI (CM)	65.0 - 90.0	80.0 - 158.0	150.0 - 190.0	- - -	135.0 - 145.0

	JANUARY 23 - 29	JANUARY 30 - FEBRUARY 5	FEBRUARY 6 - 12	FEBRUARY 13 - 19	FEBRUARY 20 - 26
TEMPERATURE: AIR	-13.0 - 2.5	-8.0 - 3.0	-8.0 - 8.0	-11.0 - 10.2	-6.5 - 17.5
SURFACE	0.6 - 2.6	1.0 - 3.5	0.5 - 4.5	1.5 - 5.6	3.1 - 8.0
BOTTOM	1.0 - 2.8	1.4 - 3.5	1.0 - 4.1	2.4 - 6.0	2.8 - 7.0
SALINITY: SURFACE	23.0 - 26.0	22.0 - 26.0	24.0 - 26.0	24.0 - 26.0	19.5 - 26.0
BOTTOM	23.5 - 26.0	22.0 - 25.5	24.0 - 27.0	25.0 - 26.0	22.0 - 25.5
OXYGEN: SURFACE	11.4 - 12.9	10.4 - 14.4	10.8 - 14.4	11.4 - 12.8	10.1 - 12.7
BOTTOM	12.0 - 13.6	10.6 - 14.2	11.8 - 14.4	11.8 - 12.6	10.8 - 12.3
PH: SURFACE	7.8 - 8.2	7.9 - 8.1	8.0 - 8.1	8.0 - 8.3	8.0 - 8.2
BOTTOM	7.9 - 8.1	7.9 - 8.1	7.9 - 8.1	7.9 - 8.2	8.0 - 8.3
SECCHI (CM)	135.0 - 180.0	140.0 - 165.0	170.0 - 205.0	200.0 - 270.0	115.0 - 200.0

TABLE D1-48 (CONT.)

	27 FEBRUARY - 5 MARCH	6 - 12 MARCH	13 - 19 MARCH	20 - 26 MARCH	27 MARCH - 2 APRIL
TEMPERATURE: AIR	-2.0 - 7.0	2.0 - 16.8	3.0 - 17.5	-3.5 - 8.7	4.0 - 25.0
SURFACE	5.1 - 9.3	7.0 - 13.3	9.8 - 14.0	4.5 - 9.7	8.2 - 15.6
BOTTOM	5.0 - 9.0	7.1 - 13.3	10.0 - 11.0	6.6 - 10.0	8.6 - 14.8
SALINITY: SURFACE	21.0 - 24.0	20.5 - 24.0	22.0 - 26.0	20.0 - 24.0	19.0 - 22.0
BOTTOM	22.0 - 24.0	21.0 - 23.0	22.0 - 24.0	20.5 - 23.0	20.0 - 22.0
OXYGEN: SURFACE	10.0 - 12.4	8.8 - 10.8	8.9 - 9.6	9.3 - 10.9	8.6 - 10.2
BOTTOM	10.6 - 11.8	8.8 - 10.3	9.0 - 9.5	9.7 - 10.5	8.9 - 9.4
PH: SURFACE	8.0 - 8.3	7.8 - 8.2	7.8 - 8.1	7.7 - 8.1	7.9 - 8.1
BOTTOM	8.0 - 8.3	7.9 - 8.2	7.8 - 8.0	7.8 - 8.0	7.9 - 8.1
SECCHI (CM)	110.0 - 163.0	180.0 - 235.0	150.0 - 190.0	90.0 - 165.0	130.0 - 155.0

	3 - 9 APRIL	10 - 16 APRIL	17 - 23 APRIL	24 - 30 APRIL	1 - 7 MAY
TEMPERATURE: AIR	-2.2 - 10.0	7.0 - 30.5	5.5 - 20.0	1.7 - 12.5	11.0 - 22.6
SURFACE	8.4 - 11.9	11.4 - 16.7	14.6 - 17.6	14.2 - 17.1	15.5 - 17.4
BOTTOM	8.6 - 12.2	12.8 - 16.0	14.8 - 17.7	14.4 - 17.3	15.9 - 17.3
SALINITY: SURFACE	20.5 - 25.5	20.0 - 24.0	20.0 - 22.0	20.5 - 23.0	21.0 - 22.0
BOTTOM	20.5 - 23.5	20.0 - 22.0	20.0 - 22.0	21.0 - 23.0	21.0 - 22.5
OXYGEN: SURFACE	8.4 - 9.5	8.7 - 9.9	8.0 - 9.6	8.2 - 9.1	7.8 - 9.0
BOTTOM	8.4 - 9.5	8.8 - 9.4	8.0 - 9.2	8.4 - 9.1	7.5 - 8.8
PH: SURFACE	7.8 - 8.1	7.9 - 8.1	7.8 - 8.2	7.9 - 8.1	7.7 - 8.1
BOTTOM	7.8 - 8.1	7.9 - 8.1	7.9 - 8.1	7.9 - 8.1	7.8 - 8.1
SECCHI (CM)	70.0 - 105.0	45.0 - 155.0	90.0 - 140.0	120.0 - 150.0	105.0 - 160.0

TABLE D1-48. (CONT.)

	8 - 14 MAY	10 - 16 JULY	17 - 23 JULY	24 - 30 JULY	31 JULY - 6 AUGUST
TEMPERATURE: AIR	3.7 - 19.5	18.8 - 26.8	21.6 - 30.0	9.7 - 24.8	18.5 - 28.5
SURFACE	13.6 - 16.9	25.0 - 27.7	26.8 - 30.0	21.5 - 24.5	23.7 - 26.5
BOTTOM	13.6 - 16.9	25.2 - 28.0	27.8 - 31.0	21.8 - 24.0	23.8 - 25.9
SALINITY: SURFACE	22.0 - 25.0	24.0 - 26.0	23.0 - 26.0	25.0 - 28.0	25.0 - 28.0
BOTTOM	22.0 - 24.0	24.0 - 26.0	24.0 - 26.0	25.0 - 27.0	25.0 - 28.0
OXYGEN: SURFACE	7.9 - 8.7	5.3 - 6.6	4.4 - 7.6	4.2 - 6.8	5.3 - 8.0
BOTTOM	8.1 - 8.6	5.2 - 6.6	3.6 - 7.0	5.1 - 6.6	6.6 - 7.9
PH: SURFACE	7.9 - 8.1	7.9 - 8.2	7.7 - 8.2	7.7 - 8.3	8.0 - 8.3
BOTTOM	8.0 - 8.2	8.0 - 8.2	7.7 - 8.3	7.9 - 8.1	8.1 - 8.2
SECCHI (CM)	100.0 - 160.0	- - -	40.0 - 95.0	50.0 - 60.0	60.0 - 85.0

	7 - 13 AUGUST	14 - 20 AUGUST	21 - 27 AUGUST	28 AUGUST - 3 SEPTEMBER
TEMPERATURE: AIR	21.8 - 33.0	11.2 - 31.5	11.9 - 27.0	20.4 - 29.2
SURFACE	26.5 - 29.4	22.0 - 29.0	20.6 - 27.5	24.8 - 27.1
BOTTOM	26.4 - 28.0	23.0 - 27.0	21.5 - 27.8	25.0 - 27.5
SALINITY: SURFACE	26.0 - 27.0	24.0 - 26.5	24.0 - 26.0	24.0 - 26.0
BOTTOM	26.0 - 27.0	25.0 - 26.0	24.0 - 26.0	24.0 - 26.0
OXYGEN: SURFACE	4.2 - 7.5	5.6 - 9.0	4.1 - 8.4	4.0 - 7.3
BOTTOM	5.4 - 7.6	5.6 - 8.1	5.1 - 8.3	4.3 - 6.5
PH: SURFACE	7.7 - 8.2	7.8 - 8.4	7.7 - 8.3	7.7 - 8.4
BOTTOM	7.9 - 8.2	7.8 - 8.4	7.9 - 8.3	7.9 - 8.3
SECCHI (CM)	35.0 - 50.0	30.0 - 70.0	40.0 - 65.0	45.0 - 72.0

Table D1-49. Total estimated number and weight (kg), with 80% confidence interval of selected fishes and macroinvertebrates impinged on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from 8 September 1975 through 3 September 1976 and from 4 September 1976 through 2 September 1977. No samples were taken 24 December through 7 March 1976 and 14 May through 12 July 1977.

Species	8 September 1975 - 3 September 1976				4 September 1976 - 2 September 1977			
	Estimated Number		Estimated Weight		Estimated Number		Estimated Weight	
Alosa aestivalis	28,120 ±	9,511	268 ±	66	27,496 ±	8,584	197 ±	47
Alosa pseudoharengus	4,141 ±	772	301 ±	49	4,047 ±	857	142 ±	38
Brevoortia tyrannus	17,788 ±	4,023	1,218 ±	313	94,960 ±	22,275	5,003 ±	912
Anchoa mitchilli	1,811,550 ±	311,622	4,954 ±	868	147,202 ±	27,472	477 ±	100
Menidia menidia	61,272 ±	11,440	314 ±	57	35,051 ±	5,498	185 ±	31
Gasterosteus aculeatus	225 ±	61	.7 ±	.2	189 ±	55	.5 ±	.1
Syngnathus fuscus	36,066 ±	4,650	86 ±	10	11,220 ±	1,412	25 ±	3
Pomatomus saltatrix	14,086 ±	2,934	64 ±	14	3,935 ±	774	153 ±	51
Cynoscion regalis	11,790 ±	2,653	185 ±	60	27,297 ±	6,166	559 ±	145
Leiostomus xanthurus	48,059 ±	17,412	191 ±	50	61,573 ±	15,945	2,084 ±	546
Mentiocirrhus saxatilis	16 ±	12	2 ±	1	105 ±	52	4 ±	2
Prionotus evolans	32,254 ±	25,168	369 ±	137	28,371 ±	9,208	516 ±	192
Etropus microstomus	8,022 ±	2,838	54 ±	19	57,773 ±	14,980	359 ±	100
Paralichthys dentatus	4,266 ±	585	908 ±	136	2,380 ±	514	601 ±	132
Pseudopleuronectes americanus	8,908 ±	1,320	368 ±	113	18,618 ±	6,385	1,400 ±	370
Sphoeroides maculatus	3,313 ±	1,178	251 ±	97	1,516 ±	860	189 ±	170
Total of all Vertebrates	2,120,873 ±	311,958	11,135 ±	1,125	600,537 ±	76,935	14,586 ±	1,991
Palaemonetes vulgaris	373,288 ±	71,453	241 ±	49	29,885 ±	4,287	18 ±	2
Crangon septemspinosa	3,342,143 ±	687,672	2,883 ±	595	600,278 ±	100,860	606 ±	100
Callinectes sapidus	5,627,253 ±	1,264,146	51,399 ±	9,577	230,691 ±	33,337	10,837 ±	1,334
Total of all Invertebrates	9,365,228 +	1,681,865	56,261 +	9,767	879,842 ±	100,116	12,914 ±	1,332
Grand total of all species[a]	11,486,113 ±	1,749,394	67,396 ±	10,017	1,481,396 ±	132,597	27,500 ±	2,387

a Grand total of all species does not equal the total of all vertebrates and invertebrates because each total was a separate estimate.

TABLE D1-50. TOTAL NUMBER OF FISHES AND MACROINVERTEBRATES IMPINGED ON THE TRAVELING SCREENS AT THE OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM 5 SEPTEMBER 1976 THROUGH 3 SEPTEMBER 1977. NO SAMPLES WERE TAKEN FROM 14 MAY THROUGH 12 JULY.

SPECIES	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUL	AUG	TOTALS
MUSTELUS CANIS	-	27	3	1	-	-	-	-	-	-	-	31
SQUALUS ACANTHIAS	-	-	-	-	-	-	-	1	-	-	-	1
DASYATIS SAYI	14	4	-	-	-	-	-	-	-	-	13	31
ANGUILLA ROSTRATA	4	6	33	79	7	10	10	2	-	-	14	165
CONGER OCEANICUS	-	3	22	9	1	-	-	1	-	-	-	36
ALOSA AESTIVALIS	7	42	110	7628	20	146	610	524	13	145	65	9310
ALOSA PSEUDOHARENGUS	2	133	110	28	2	6	508	319	30	29	29	1196
ALOSA SAPIDISSIMA	1	-	1	-	-	-	-	-	-	-	-	2
BREVOORTIA TYRANNUS	331	8637	15399	2227	34	178	578	110	2	377	890	28763
CLUPEA HARENGUS	-	-	-	-	-	-	2	8	1	-	-	11
DOROSOMA CEPEDIANUM	-	12	7	3	-	-	-	-	-	-	-	22
ANCHOA HEPSETUS	82	53	20	-	-	-	-	-	-	-	8	163
ANCHOA MITCHILLI	5583	14219	2772	79	6	-	-	11194	91	1256	4488	39688
ENGRAULIS EURYSTOLE	1	-	1	-	-	-	-	-	-	-	-	2
ESOX NIGER	-	-	-	1	-	1	-	1	-	-	-	3
SYNODUS FOETENS	66	222	11	-	-	-	-	-	-	-	-	299
NOTEMIGONUS CRYSOLEUCAS	-	-	-	-	-	-	-	1	-	-	-	1
OPSANUS TAU	54	164	160	10	-	5	2	28	22	25	112	582
UROPHYCIS CHUSS	-	-	8	17	-	-	-	1	-	-	-	26
UROPHYCIS REGIUS	-	-	83	15	-	-	1	-	-	-	-	99
RISSOLA MARGINATA	13	3324	4527	366	-	1	8	1	-	2	1	8243
HYPORHAMPHUS UNIFASCIATUS	-	6	1	-	-	-	-	-	-	-	-	7
STRONGYLURA MARINA	7	40	2	-	-	-	-	-	-	105	178	332
CYPRINODON VARIEGATUS	-	12	89	40	-	1	4	1	-	-	-	147
FUNDULUS HETEROCLITUS	-	10	58	29	9	19	55	23	2	3	1	209
FUNDULUS MAJALIS	-	4	2	8	-	3	1	1	-	-	-	19
LUCANIA PARVA	-	-	-	-	1	2	1	-	-	-	-	4
MEMBRAS MARTINICA	4	-	1	-	-	1	-	-	-	-	14	20
MENIDIA SP.	-	-	-	-	1	-	-	-	-	-	-	1
MENIDIA BERYLLINA	-	1	-	3	1	1	-	-	-	1	2	9
MENIDIA MENIDIA	9	200	3207	1303	60	102	3096	2271	5	24	92	10369
APELTES QUADRACUS	-	-	3	18	7	4	13	4	1	-	1	51
GASTEROSTEUS ACULEATUS	-	-	-	-	-	24	34	1	-	-	-	59
FISTULARIA TABACARIA	8	69	-	-	-	-	-	-	-	-	-	77
HIPPOCAMPUS ERECTUS	1	7	15	3	-	-	-	-	-	-	-	26
SYNGNATHUS FUSCUS	41	421	1133	127	3	-	107	912	370	295	120	3529
SYNGNATHUS LOUISIANAE	-	-	-	-	-	-	-	-	-	-	1	1
MORONE AMERICANA	5	11	15	30	13	47	187	99	-	5	6	418
MORONE SAXATILIS	-	-	-	-	-	-	3	-	-	-	-	3
CENTROPRISTIS STRIATA	4	3353	3047	113	-	-	-	-	-	-	-	6517
MYCTEROPERCA MICROLEPIS	-	1	-	-	-	-	-	-	-	-	-	1
LEPOMIS GIBBOSUS	-	-	-	1	2	-	99	72	-	-	-	174
POMATOMUS SALTATRIX	132	483	105	-	-	-	-	2	-	163	196	1081
RACHYCENTRON CANADUM	-	-	-	-	-	-	-	-	-	-	6	6
CARANX CRYSOS	1	1	-	-	-	-	-	-	-	-	-	2
CARANX HIPPOS	28	670	1	-	-	-	-	-	-	24	98	821
SELAR CRUMENOPHTHALMUS	-	6	-	-	-	-	-	-	-	-	-	6
SELENE VOMER	112	203	-	-	-	-	-	-	-	91	452	858
VOMER SETAPINNIS	1	22	-	-	-	-	-	-	-	-	-	23
LUTJANUS GRISEUS	1	-	-	-	-	-	-	-	-	-	-	1

TABLE D1-50. (CONT.)

STENOTOMUS CHRYSOPS	-	23	326	3	-	-	-	-	-	-	-	352
BAIRDIELLA CHRYSURA	10	508	348	-	-	1	-	-	-	-	8	875
CYNOSCION REGALIS	799	4752	374	-	-	-	-	-	-	12	1664	7601
LEIOSTOMUS XANTHURUS	298	5674	9823	552	1	9	13	6	-	187	1360	17923
MENTICIRRHUS SAXATILIS	1	19	3	-	-	-	-	-	-	-	1	24
MICROPOGON UNDULATUS	-	2	9	8	1	-	-	-	-	-	1	21
CHAETODIPTERUS FABER	1	-	-	-	-	-	-	-	-	-	-	1
CHAETODON OCELLATUS	-	27	1	-	-	-	-	-	-	-	-	28
TAUTOGA ONITIS	1	40	409	115	3	-	9	11	1	1	2	592
TAUTOGOLABRUS ADSPERSUS	1	-	1	3	-	-	1	1	-	2	4	13
MUGIL CEPHALUS	1	-	11	5	8	3	4	-	-	-	-	32
MUGIL CUREMA	22	45	10	2	1	2	2	-	-	-	3	87
SPHYRAENA BOREALIS	-	72	-	-	-	-	-	-	-	-	-	72
ASTROSCOPUS GUTTATUS	2	133	111	3	-	-	-	-	-	-	-	249
CHASMODES BOSQUIANUS	2	13	5	7	4	-	-	-	-	-	-	31
HYPSOBLENNIUS HENTZI	10	553	807	68	19	-	-	-	2	1	2	1462
AMMODYTES SP.	-	-	-	4	8	1	13	8	-	-	-	34
GOBIOSOMA BOSCI	1	2	4	13	10	1	2	-	-	-	-	33
GOBIOSOMA GINSBURGI	-	1	1	2	-	-	-	-	-	-	-	4
PEPRILUS TRIACANTHUS	12	162	75	32	-	-	-	-	-	-	-	281
PRIONOTUS CAROLINUS	16	26	66	2	-	-	-	-	-	2	19	131
PRIONOTUS EVOLANS	1016	6242	605	15	-	-	-	-	-	1	21	7900
MYOXOCEPHALUS AENAEUS	-	-	1	4	1	4	1	-	-	-	-	11

TABLE D1-50. (CONT.)

SPECIES	SEP.	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	TOTALS
DACTYLOPTERUS VOLITANS	-	1	-	-	-	-	-	-	-	-	-	1
FAMILY BOTHIDAE	-	-	-	1	-	-	-	-	-	-	-	1
ETROPUS MICROSTOMUS	4	475	19140	2562	1	1	-	-	-	-	-	22183
PARALICHTHYS DENTATUS	80	408	35	7	-	-	-	37	-	26	98	691
SCOPHTHALMUS AQUOSUS	7	77	81	22	1	2	44	56	12	15	2	319
PSEUDOPLEURONECTES AMERICANUS	4	25	715	2906	891	579	590	219	-	101	4	6034
TRINECTES MACULATUS	23	65	27	1	-	-	9	21	4	3	25	178
SYMPHURUS PLAGIUSA	-	2	17	2	-	-	-	-	-	-	-	21
ALUTERUS SCHOEPFI	5	9	-	-	-	-	-	-	-	1	4	19
MONACANTHUS HISPIDUS	5	11	-	-	-	-	-	-	-	-	-	16
LACTOPHRYS TRIQUETER	-	1	-	-	-	-	-	-	-	-	-	1
SPHOEROIDES MACULATUS	50	217	6	-	-	-	-	1	1	39	61	375
CHILOMYCTERUS SCHOEPFI	3	2	-	-	-	-	-	-	-	4	1	10
FISH FRAGMENTS	-	-	-	-	-	1	1	-	-	-	-	2
BUFO FOWLERI	-	-	-	-	-	-	-	-	-	-	2	2
MALACLEMYS TERRAPIN	-	2	-	-	-	-	-	-	-	1	2	5
PHYLUM PORIFERA	-	-	-	-	-	-	-	-	-	-	1	1
AEQUOREA SPP	38	7	24	-	-	-	-	-	-	-	-	69
CLASS SCYPHOZOA	-	-	-	-	-	-	-	-	-	1	-	1
CYANEA CAPILLATA	-	-	74	25	-	-	-	-	452	-	-	551
ORDER ACTINIARIA	-	1	-	-	1	3	3	1	-	-	-	9
UROSALPINX CINEREUS	-	-	-	-	-	-	-	1	-	-	-	1
MYTILUS EDULIS	-	-	-	-	-	-	-	-	-	-	1	1
ENSIS DIRECTUS	-	-	2	-	-	-	-	-	-	-	-	2
LOLIGO PEALEI	-	-	-	-	-	4	-	-	-	-	-	4
LOLLIGUNCULA BREVIS	298	39	-	-	-	-	-	-	-	-	-	337
CLASS POLYCHAETA	2	6	162	53	28	310	50	65	1	1	2	680
LIMULUS POLYPHEMUS	1	9	5	2	-	-	2	4	-	2	6	31
SQUILLA EMPUSA	4	253	108	1	-	-	-	2	1	1	2	372
PENAEUS SETIFERUS	-	7	-	-	-	-	-	-	-	-	-	7
PENAEUS AZTECUS	209	929	46	1	-	-	-	-	-	-	-	1185
PALAEMONETES VULGARIS	3	862	1307	2196	769	481	3171	1609	119	97	38	10652
PALAEMONETES PUGIO	-	-	8	1	1	-	12	1	1	2	-	26
PALAEMONETES SPP	-	-	1	-	-	2	-	-	-	5	-	8
CRANGON SEPTEMSPINOSA	5	300	37705	102341	19698	6429	31678	24486	638	3	3	223286
PAGURUS LONGICARPUS	-	-	-	1	-	-	8	7	-	-	-	16
LIBINIA DUBIA	2	15	8	-	-	-	-	7	2	3	3	40
CARCINUS MAENAS	-	-	5	-	-	-	-	-	-	-	-	5
OVALIPES OCELLATUS	42	368	396	6	1	1	30	59	11	37	19	970
PORTUNUS GIBBESI	1	12	-	-	-	-	-	-	-	-	1	14
PORTUNUS SPINIMANUS	1	4	-	-	-	-	-	-	-	-	-	5
CALLINECTES SAPIDUS	32027	13221	366	8	3	5	209	1677	414	3862	14804	66596
CALLINECTES SIMILIS	413	111	-	-	-	-	-	-	-	36	398	958
FAMILY XANTHIDAE	-	2	-	-	-	-	-	-	-	-	-	2
PANOPEUS HERBSTII	2	1	-	1	-	-	-	-	1	-	-	5
NEOPANOPE TEXANA	1	6	6	12	1	1	12	27	5	12	4	87
INVERTEBRATE FRAGMENTS	-	-	-	-	-	-	-	-	-	-	-	0
PHYLUM NEMERTEA	-	21	77	26	-	4	42	28	-	-	1	199
PROCAMBARUS BLANDINGI	-	-	-	-	-	1	1	1	-	-	-	3
TOTAL SPECIMENS	41935	68129	104257	123151	21618	8396	41226	43912	2202	7003	25354	487183
TOTAL TAXA	67	83	74	62	36	39	43	47	26	43	56	121
TOTAL COLLECTIONS	75	90	91	104	91	89	108	93	42	53	110	946

TABLE D1-51. TOTAL WEIGHT (g) OF FISHES AND MACROINVERTEBRATES IMPINGED ON THE TRAVELING SCREENS AT THE OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM 5 SEPTEMBER 1976 THROUGH 3 SEPTEMBER 1977. NO SAMPLES WERE TAKEN FROM 14 MAY THROUGH 12 JULY.

SPECIES	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUL	AUG	TOTALS
MUSTELUS CANIS	-	18535	3381	51	-	-	-	-	-	-	-	21967
SQUALUS ACANTHIAS	-	-	-	-	-	-	-	110	-	-	-	110
DASYATIS SAYI	5950	2067	-	-	-	-	-	-	-	-	4970	12987
ANGUILLA ROSTRATA	1775	1412	8808	37866	1133	2311	1261	164	-	-	2253	56983
CONGER OCEANICUS	-	165	1095	505	37	-	-	15	-	-	-	1817
ALOSA AESTIVALIS	89	589	1262	32153	105	680	7061	17583	847	1893	755	63017
ALOSA PSEUDOHARENGUS	59	2293	1664	298	16	111	13646	19026	2469	353	404	40339
ALOSA SAPIDISSIMA	276	-	27	-	-	-	-	-	-	-	-	303
BREVOORTIA TYRANNUS	23967	399243	631219	348428	1599	8319	62030	21214	577	3224	13618	1513380
CLUPEA HARENGUS	-	-	-	-	-	-	177	1274	1	-	-	1452
DOROSOMA CEPEDIANUM	-	432	291	67	-	-	-	-	-	-	-	790
ANCHOA HEPSETUS	239	250	122	-	-	-	-	-	-	-	50	661
ANCHOA MITCHILLI	13601	48849	8536	321	6	-	-	39982	311	3520	12477	127603
ENGRAULIS EURYSTOLE	4	-	1	-	-	-	-	-	-	-	-	5
ESOX NIGER	-	-	-	127	-	33	-	21	-	-	-	181
SYNODUS FOETENS	4880	15391	669	-	-	-	-	-	-	-	-	20940
NOTEMIGONUS CRYSOLEUCAS	-	-	-	-	-	-	-	6	-	-	-	6
OPSANUS TAU	7920	31830	17691	818	-	83	76	7683	6708	2881	10999	86689
UROPHYCIS CHUSS	-	-	32	304	-	-	-	33	-	-	-	369
UROPHYCIS REGIUS	-	-	1678	1049	-	-	6	-	-	-	-	2733
RISSOLA MARGINATA	232	107486	108145	7259	-	43	140	16	-	121	42	223484
HYPORHAMPHUS UNIFASCIATUS	-	89	7	-	-	-	-	-	-	-	-	96
STRONGYLURA MARINA	203	1198	123	-	-	-	-	-	-	390	902	2816
CYPRINODON VARIEGATUS	-	26	161	86	-	2	7	2	-	-	-	284
FUNDULUS HETEROCLITUS	-	37	214	108	19	75	283	92	7	19	7	861
FUNDULUS MAJALIS	-	6	6	98	-	38	25	5	-	-	-	178
LUCANIA PARVA	-	-	-	-	1	3	5	-	-	-	-	9
MEMBRAS MARTINICA	16	-	11	-	-	1	-	-	-	-	30	58
MENIDIA SP.	-	-	-	-	1	-	-	-	-	-	-	1
MENIDIA BERYLLINA	-	2	-	5	1	1	-	-	-	2	4	15
MENIDIA MENIDIA	30	1070	15818	6153	230	507	17485	13736	36	60	214	55339
APELTES QUADRACUS	-	-	3	20	7	4	20	6	2	-	1	63
GASTEROSTEUS ACULEATUS	-	-	-	-	-	67	88	3	-	-	-	158
FISTULARIA TABACARIA	213	1543	-	-	-	-	-	-	-	-	-	1756
HIPPOCAMPUS ERECTUS	3	46	50	20	-	-	-	-	-	-	-	119
SYNGNATHUS FUSCUS	84	1030	2363	220	3	-	244	1932	1030	728	259	7893
SYNGNATHUS LOUISIANAE	-	-	-	-	-	-	-	-	-	-	6	6
MORONE AMERICANA	1543	2620	2654	7064	1696	7668	22122	9792	-	1525	772	57456
MORONE SAXATILIS	-	-	-	-	-	-	1599	-	-	-	-	1599
CENTROPRISTIS STRIATA	18	20078	28514	1232	-	-	-	-	-	-	-	49842
MYCTEROPERCA MICROLEPIS	-	25	-	-	-	-	-	-	-	-	-	25
LEPOMIS GIBBOSUS	-	-	-	5	6	-	164	187	-	-	-	362
POMATOMUS SALTATRIX	6273	24185	5849	-	-	-	-	6	-	1787	3236	41336
RACHYCENTRON CANADUM	-	-	-	-	-	-	-	-	-	-	17	17
CARANX CRYSOS	3	47	-	-	-	-	-	-	-	-	-	50
CARANX HIPPOS	630	34208	54	-	-	-	-	-	-	45	401	35338
SELAR CRUMENOPHTHALMUS	-	255	-	-	-	-	-	-	-	-	-	255
SELENE VOMER	1450	8968	-	-	-	-	-	-	-	340	2272	13030
VOMER SETAPINNIS	8	167	-	-	-	-	-	-	-	-	-	175
LUTJANUS GRISEUS	3	-	-	-	-	-	-	-	-	-	-	3
STENOTOMUS CHRYSOPS	-	1846	41701	292	-	-	-	-	-	-	-	43839
BAIRDIELLA CHRYSURA	106	2963	1813	-	-	74	-	-	-	-	11	4987
CYNOSCION REGALIS	11189	116812	18849	-	-	-	-	-	-	145	4635	151630
LEIOSTOMUS XANTHURUS	5462	184882	411435	11818	16	254	345	191	-	1117	14862	630382
MENTICIRRHUS SAXATILIS	17	878	18	-	-	-	-	-	-	-	2	915

TABLE D1-51.(CONT.)

SPECIES	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUL	AUG	TOTALS
MICROPOGON UNDULATUS	-	18	21	7	1	-	-	-	-	-	132	179
CHAETODIPTERUS FABER	1	-	-	-	-	-	-	-	-	-	-	1
CHAETODON OCELLATUS	-	223	14	-	-	-	-	-	-	-	-	237
TAUTOGA ONITIS	384	2198	25593	18848	340	-	3217	96	17	28	359	51080
TAUTOGOLABRUS ADSPERSUS	87	-	3	12	-	-	50	199	-	197	596	1144
MUGIL CEPHALUS	5	-	981	171	384	116	192	-	-	-	-	1849
MUGIL CUREMA	389	789	396	51	19	64	73	-	-	-	37	1818
SPHYRAENA BOREALIS	-	1837	-	-	-	-	-	-	-	-	-	1837
ASTROSCOPUS GUTTATUS	16	4411	11448	470	-	-	-	-	-	-	-	16345
CHASMODES BOSQUIANUS	12	82	30	45	12	-	-	-	-	-	-	181
HYPSOBLENNIUS HENTZI	83	3435	4751	553	128	-	-	-	44	5	9	9008
AMMODYTES SP.	-	-	-	15	27	5	132	109	-	-	-	288
GOBIOSOMA BOSCI	2	2	4	23	14	1	5	-	-	-	-	51
GOBIOSOMA GINSBURGI	-	1	1	2	-	-	-	-	-	-	-	4
PEPRILUS TRIACANTHUS	366	6228	3724	1986	-	-	-	-	-	-	-	12304
PRIONOTUS CAROLINUS	1539	2140	1705	3	-	-	-	-	-	176	2308	7871
PRIONOTUS EVOLANS	26719	110040	6701	131	-	-	-	-	-	315	2610	146516
MYOXOCEPHALUS AENAEUS	-	-	28	126	32	71	11	-	-	-	-	268
DACTYLOPTERUS VOLITANS	-	56	-	-	-	-	-	-	-	-	-	56
FAMILY BOTHIDAE	-	-	-	1	-	-	-	-	-	-	-	1
ETROPUS MICROSTOMUS	31	2704	123662	12242	2	5	-	-	-	-	-	138646
PARALICHTHYS DENTATUS	19247	107372	11590	3376	-	-	-	7278	-	3770	16596	169229
SCOPHTHALMUS AQUOSUS	700	6772	5374	2598	42	142	2890	3266	126	585	52	22547
PSEUDOPLEURONECTES AMERICANUS	215	4227	22436	230356	38255	108347	34531	18748	-	612	212	457939
TRINECTES MACULATUS	1493	2612	1951	37	-	-	463	1460	225	134	1145	9520
SYMPHURUS PLAGIUSA	-	8	43	2	-	-	-	-	-	-	-	53
ALUTERUS SCHOEPFI	452	1500	-	-	-	-	-	-	-	8	306	2266
MONACANTHUS HISPIDUS	213	526	-	-	-	-	-	-	-	-	-	739
LACTOPHRYS TRIQUETER	-	1	-	-	-	-	-	-	-	-	-	1
SPHOEROIDES MACULATUS	9035	27672	962	-	-	-	-	148	151	447	1318	39733
CHILOMYCTERUS SCHOEPFI	224	302	-	-	-	-	-	-	-	29	7	562
FISH FRAGMENTS	2003	4829	1818	149	3	20	80	82	2	771	1936	11693
BUFO FOWLERI	-	-	-	-	-	-	-	-	-	-	35	35
MALACLEMYS TERRAPIN	-	501	-	-	-	-	-	-	-	165	492	1158
PHYLUM PORIFERA	-	-	-	-	-	-	-	-	-	-	19	19
AEQUOREA SPP	765	125	549	-	-	-	-	-	-	-	-	1439
CLASS SCYPHOZOA	-	-	-	-	-	-	-	-	-	72	-	72
CYANEA CAPILLATA	-	-	22363	3913	-	-	-	-	141507	-	-	167783
ORDER ACTINIARIA	-	6	-	-	25	55	17	2	-	-	-	105
UROSALPINX CINEREUS	-	-	-	-	-	-	-	2	-	-	-	2
MYTILUS EDULIS	-	-	-	-	-	-	-	-	-	-	1	1
ENSIS DIRECTUS	-	-	3	-	-	-	-	-	-	-	-	3
LOLIGO PEALEI	-	-	-	-	-	95	-	-	-	-	-	95
LOLLIGUNCULA BREVIS	5300	477	-	-	-	-	-	-	-	-	-	5777
CLASS POLYCHAETA	2	17	442	113	62	1067	117	89	1	1	3	1914
LIMULUS POLYPHEMUS	1400	8736	5191	3200	-	-	2050	5226	-	1115	6112	33030
SQUILLA EMPUSA	55	4158	1683	19	-	-	-	97	21	26	49	6108
PENAEUS SETIFERUS	-	22	-	-	-	-	-	-	-	-	-	22
PENAEUS AZTECUS	3321	11858	466	7	-	-	-	-	-	-	-	15652
PALAEMONETES VULGARIS	3	409	824	1299	420	311	1887	1065	84	66	28	6396
PALAEMONETES PUGIO	-	-	6	1	1	-	12	1	1	1	-	23
PALAEMONETES SPP	-	-	1	-	-	1	-	-	-	3	-	5
CRANGON SEPTEMSPINOSA	5	388	34056	98843	19359	6726	34825	27746	621	2	2	222573
PAGURUS LONGICARPUS	-	-	-	3	-	-	24	13	-	-	-	40

TABLE D1-51. (CONT.)

LIBINIA DUBIA	263	2024	1026	-	-	-	-	921	182	351	604	5371
CARCINUS MAENAS	-	-	38	-	-	-	-	-	-	-	-	38
OVALIPES OCELLATUS	1117	4153	3007	30	2	2	355	373	104	888	498	10529
PORTUNUS GIBBESI	3	46	-	-	-	-	-	-	-	-	4	53
PORTUNUS SPINIMANUS	2	16	-	-	-	-	-	-	-	-	-	18
CALLINECTES SAPIDUS	1163290	509697	17586	132	21	58	3955	35066	10406	218727	1019780	2978670
CALLINECTES SIMILIS	857	334	-	-	-	-	-	-	-	55	1742	2988
FAMILY XANTHIDAE	-	11	-	-	-	-	-	-	-	-	-	11
PANOPEUS HERBSTII	20	11	-	7	-	-	-	-	35	-	-	73
NEOPANOPE TEXANA	3	23	21	41	3	2	67	136	102	62	13	473
INVERTEBRATE FRAGMENTS	142	23	2	8	-	-	7	23816	122007	-	39	146044
PHYLUM NEMERTEA	-	67	410	110	-	14	312	125	-	-	8	1046
PROCAMBARUS BLANDINGI	-	-	-	-	-	2	12	9	-	-	-	23
TOTAL SPECIMENS	1325750	1864240	1624910	835297	64028	137378	212068	259152	287624	246761	1130010	7987710
TOTAL TAXA	69	85	76	64	37	39	44	49	28	44	58	122
TOTAL COLLECTIONS	73	90	91	104	91	89	108	93	42	53	110	944

Table D1-42. Total estimated number of fishes and macroinvertebrates impinged on the traveling screens by week for taxa with more than 100 specimens taken from 5 September 1976 through 3 September 1977 at the Oyster Creek Generating Station, Forked River, New Jersey. No samples were taken 16 May through 12 July.

	September			October					November				December
	5-11	12-18	19-25	26-2	3-9	10-16	17-23	24-30	31-6	7-13	14-20	21-27	28-4
FISH													
Anguilla rostrata	4	-	7	9	4	-	11	9	5	33	36	50	58
Alosa aestivalis	-	2	5	3	21	11	47	87	127	152	35	68	278
Alosa pseudoharengus	-	2	-	-	20	211	96	147	164	115	29	24	24
Brevoortia tyrannus	281	242	209	231	721	927	6034	30048	7886	36095	4528	3975	2417
Anchoa hepsetus	52	106	45	69	-	30	135	50	83	-	-	-	-
Anchoa mitchilli	1399	8347	3631	15405	5324	8617	27396	8003	5364	3098	672	591	147
Synodus foetens	-	26	78	394	199	116	150	85	34	-	-	-	-
Opsanus tau	48	33	39	32	30	93	358	192	214	288	46	20	16
Risola marginata	4	15	16	62	95	97	4710	7716	4144	6375	3012	1199	809
Cyprinodon variegatus	-	-	-	-	-	-	15	44	75	81	80	67	25
Fundulus heteroclitus	-	-	-	-	-	-	9	29	118	47	25	14	12
Menidia menidia	4	-	2	29	94	103	284	410	714	5384	3088	2116	1994
Syngnathus fuscus	19	70	10	14	56	66	1007	899	883	2007	478	280	149
Centropristis striata	-	2	2	20	164	1282	5967	5258	1196	5537	2338	760	372
Pomatomus saltatrix	203	124	64	110	108	361	482	978	192	228	-	2	2
Caranx hippos	11	2	11	65	89	388	2535	6	4	-	-	-	-
Selene vomer	6	6	123	161	29	396	342	9	-	-	-	-	-
Stenotomus chrysops	-	-	-	-	-	4	11	78	80	875	101	101	11
Bairdiella chrysura	12	11	2	16	8	94	776	1289	854	370	125	36	-
Cynoscion regalis	622	595	285	983	2282	5621	8737	1449	968	290	28	25	2
Leiostomus xanthurus	192	213	87	207	279	1427	8141	12945	16004	12280	2481	2471	931
Tautoga onitis	-	-	2	-	-	-	11	142	231	596	300	147	131
Astroscopus guttatus	-	6	-	-	-	5	260	274	219	131	11	16	7
Hypsoblennius hentzi	25	-	7	11	4	12	485	1633	1084	1848	166	50	11
Peprilus triacanthus	10	4	16	9	21	95	466	100	44	123	27	33	107
Prionotus carolinus	8	8	9	15	17	5	49	23	20	153	51	28	4
Prionotus evolans	118	826	763	5284	2704	5614	11153	1367	513	959	287	200	76
Etropus microstomus	-	5	-	26	12	91	951	904	8919	25507	11791	10891	5203
Paralichthys dentatus	103	74	87	163	46	662	536	114	61	36	41	7	8
Scophthalmus aquosus	-	2	6	32	2	43	148	112	59	99	57	64	29
Pseudopleuronectes americanus	-	-	9	5	9	9	56	17	87	336	201	1429	591
Trinectes maculatus	4	13	30	61	41	46	89	36	47	26	8	9	4
Sphoeroides maculatus	14	18	14	686	152	93	89	12	28	-	-	-	-
Total of all species	3182	10796	5530	24274	12499	26747	82398	74466	50490	103375	30205	24810	13294
INVERTEBRATES													
Loligunculla brevis	434	259	146	96	27	68	16	7	-	-	-	-	-
Class Polychaeta	-	-	4	3	-	-	11	15	6	163	212	48	38
Squilla empusa	-	2	2	8	4	28	756	816	291	36	9	9	-
Penaeus aztecus	8	43	58	1170	303	601	2363	163	131	13	-	-	-
Palaemonetes vulgaris	2	-	2	81	40	137	3658	70	304	1164	1607	807	767
Crangon septemspinosa	-	6	7	9	6	69	1391	152	273	3233	8719	97742	65613
Ovalipes ocellatus	13	29	26	125	280	125	634	378	559	690	81	26	48
Callinectes sapidus	25429	26018	32231	21025	13697	10210	14121	1186	956	196	31	43	9
Callinectes similis	11	691	252	449	91	48	14	-	-	-	-	-	-
Phylum Nemertea	-	-	-	-	-	-	-	66	6	68	65	50	21
Total of all species	25897	27049	32943	22975	14529	11340	23008	2419	2576	5608	10893	98866	69512
Grand Total of all species	29079	37845	38473	47249	27028	38087	105406	76885	53066	108983	41098	123676	82806

Table D1-52. (Cont.)

	December			January					February			
	5-11	12-18	19-25	26-1	2-8	9-15	16-22	23-29	30-5	6-12	13-19	20-26
FISH												
Anguilla rostrata	117	52	34	20	-	9	2	7	22	-	-	17
Alosa aestivalis	11208	6473	4099	824	2	14	22	30	2	43	40	173
Alosa pseudoharengus	10	9	40	5	-	3	-	2	6	-	-	9
Brevoortia tyrannus	1721	2602	918	74	-	85	-	2	4	14	18	398
Anchoa hepsetus	-	-	-	-	-	-	-	-	-	-	-	-
Anchoa mitchilli	65	22	51	4	7	14	-	-	-	-	-	-
Synodus foetens	-	-	-	-	-	-	-	-	-	-	-	-
Opsanus tau	-	-	4	20	-	-	-	-	7	4	6	4
Rissola marginata	296	60	124	72	-	-	-	-	-	-	-	-
Cyprinodon variegatus	31	5	58	2	-	-	-	-	-	4	-	-
Fundulus heteroclitus	26	49	22	-	7	24	-	4	-	14	23	12
Menidia menidia	1011	1037	724	192	5	66	55	42	34	9	26	167
Syngnathus fuscus	90	126	88	36	2	2	-	2	-	-	-	-
Centropristis striata	20	17	6	2	-	-	-	-	-	-	-	-
Pomatomus saltatrix	-	-	-	-	-	-	-	-	-	-	-	-
Caranx hippos	-	-	-	-	-	-	-	-	-	-	-	-
Selene vomer	-	-	-	-	-	-	-	-	-	-	-	-
Stenotomus chrysops	-	-	-	-	-	-	-	-	-	-	-	-
Bairdiella chrysura	-	-	-	-	-	-	-	-	-	-	-	-
Cynoscion regalis	-	-	-	-	-	-	-	-	-	-	-	-
Leiostomus xanthurus	343	148	708	-	10	-	-	-	-	-	18	8
Tautoga onitis	150	80	33	9	8	7	-	-	-	-	-	-
Astroscopus guttatus	4	-	6	-	-	-	-	-	-	-	-	-
Hypsoblennius hentzi	39	28	47	114	18	17	20	4	-	-	-	-
Peprilus triacanthus	4	-	3	-	-	-	-	-	-	-	-	-
Prionotus carolinus	4	-	-	-	-	-	-	-	-	-	-	-
Prionotus evolans	9	7	7	-	-	-	-	-	-	-	-	-
Etropus microstomus	1951	678	303	70	10	-	-	-	-	-	-	2
Paralichthys dentatus	9	-	3	-	-	-	-	-	-	-	-	-
Scophthalmus aquosus	13	23	10	2	-	-	2	-	-	-	-	4
Pseudopleuronectes americanus	1607	6014	1199	2028	264	1825	270	132	419	160	225	858
Trinectes maculatus	-	-	-	-	-	-	-	-	-	-	-	-
Sphoeroides maculatus	-	-	-	-	-	-	-	-	-	-	-	-
Total of all species	18900	19542	8571	3949	359	2214	425	254	513	288	432	1721
INVERTEBRATES												
Loliguncula brevis	-	-	-	-	-	-	-	-	-	-	-	-
Class Polychaeta	5	94	45	9	12	83	22	-	12	12	56	901
Squilla empusa	-	7	-	-	-	-	-	-	-	-	-	-
Penaeus aztecus	-	7	-	-	-	-	-	-	-	-	-	-
Palaemonetes vulgaris	596	4014	1318	182	238	1277	355	271	661	191	258	120
Crangon septemspinosa	82304	87133	42251	21876	7606	34074	7398	3275	1345	1943	6369	8130
Ovalipes ocellatus	4	-	-	2	-	4	-	-	-	-	2	-
Callinectes sapidus	12	9	-	6	-	2	7	-	4	4	4	7
Callinectes similis	-	-	-	-	-	-	-	-	-	-	-	-
Phylum Nemertea	18	7	45	-	-	-	-	-	-	2	-	2
Total of all species	83043	91338	43678	22074	7856	35440	7782	3546	2022	2152	6719	9167
Grand Total of all species	101943	110880	52248	26023	8215	37654	8207	3800	2535	2440	7151	10888

Table D1-52. (cont.)

	March				April					May	
	27-5	6-12	13-19	20-26	27-2	3-9	10-16	17-23	24-30	1-7	8-14
VERTEBRATES											
Alosa aestivalis	484	128	190	1204	182	984	456	104	62	23	32
Alosa pseudoharengus	36	43	119	1296	184	545	292	96	50	37	64
Brevoortia tyrannus	412	382	33	1038	40	45	123	21	210	7	-
Anchoa mitchilli	-	-	-	-	-	2207	20730	11782	537	185	138
Opsanus tau	2	-	-	-	4	-	16	12	55	32	39
Menidia menidia	567	362	3126	4027	2196	5420	1536	812	111	18	6
Syngnathus fuscus	-	-	6	127	179	480	369	1197	731	745	342
Morone americana	350	88	82	120	40	244	84	19	4	-	-
Lepomis gibbosus	-	-	4	4	282	4	98	88	22	-	-
Lagodon rhomboides	12	10	6	16	-	10	17	-	-	-	-
Paralichthys dentatus	-	-	-	-	-	60	21	13	2	-	-
Scophthalmus aquosus	3	7	20	72	21	63	49	56	7	23	12
Pseudopleuronectes americanus	191	118	88	1261	118	388	110	125	46	-	-
Sphaeroides maculatus	-	-	-	-	-	-	-	-	7	-	8
Total of all species	2237	1215	3712	9394	3265	10540	23974	13837	1906	1098	660
INVERTEBRATES											
Cyanea capillata	-	-	-	-	-	-	-	-	-	466	1087
Class Polychaeta	77	26	9	40	20	12	136	9	10	2	-
Palaemonetes vulgaris	669	1795	1209	2443	2684	1230	1271	1725	238	110	204
Crangon septemspinosa	4708	5000	5098	71166	8846	14761	15156	35261	3708	997	756
Ovalipes ocellatus	5	4	32	8	40	82	25	42	18	17	12
Callinectes sapidus	9	27	98	5	304	181	2030	1805	977	662	549
Total of all species	5508	6899	6483	73707	12140	16368	18670	38898	4962	2264	2628
Grand Total of all species	7735	8114	10195	83021	15514	26908	42644	52735	6868	3356	3285

Table D1-52. (cont.)

	July			August			
	17-23	24-30	31-6	7-13	14-20	21-27	28-3
VERTEBRATES							
Alosa aestivalis	4	370	67	25	72	41	18
Alosa pseudoharengus	7	75	44	34	12	16	6
Brevoortia tyrannus	-	1062	1376	751	485	323	243
Anchoa mitchilli	21	3596	3140	3604	4320	3604	1713
Opsanus tau	8	50	76	137	110	52	56
Strongylura marina	4	317	485	117	47	9	5
Menidia menidia	-	64	215	61	25	15	12
Syngnathus fuscus	187	215	77	132	139	69	76
Morone americana	-	15	7	9	3	-	-
Lepomis gibbosus	-	-	-	-	-	-	-
Pomatomus saltatrix	-	455	429	106	82	78	26
Caranx hippos	-	64	34	-	99	190	25
Selene vomer	-	258	217	54	826	366	329
Cynoscion regalis	-	39	35	130	1110	3621	1104
Leiostomus xanthurus	5	432	2323	795	670	812	531
Paralichthys dentatus	-	71	95	159	54	43	7
Scophthalmus aquosus	32	12	-	8	-	-	-
Psuedopleuronectes americanus	292	-	-	15	-	4	-
Sphoeroides maculatus	4	92	23	119	49	30	-
Total of all species	573	7230	8735	6372	8235	9462	4229
INVERTEBRATES							
Cyanea capillata	-	-	-	-	-	-	-
Class Polychaeta	-	4	-	-	2	7	-
Palaemonetes vulgaris	14	44	15	7	34	58	7
Crangon septemspinosa	-	-	-	-	-	-	7
Ovalipes ocellatus	43	67	22	10	10	16	13
Callinectes sapidus	3672	7373	16604	14955	14350	7582	4633
Callinectes similis	-	95	552	437	202	96	108
Total of all species	3768	7594	17215	15413	14625	7776	4783
Grand Total of all species	4341	14824	25950	21785	22860	17238	9012

Table D1-63. Total estimated weight (kg) of fishes and macroinvertebrates impinged on the traveling screens by week for taxa with more than 100 specimens taken from 6 September 1976 through 3 September 1977 at the Oyster Creek Generating Station, Forked River, New Jersey. No samples were taken 14 May through 12 July.

	September			October					November				December
	5-11	12-18	19-25	26-2	3-9	10-16	17-23	24-30	31-6	7-13	14-20	21-27	28-4
FISH													
Anguilla rostrata	4.165	-	0.882	2.868	0.609	-	1.211	3.943	1.022	2.556	14.655	10.487	46.436
Alosa aestivalis	-	0.014	0.075	0.021	0.292	0.168	1.065	0.858	0.827	1.762	0.392	1.173	1.841
Alosa pseudoharengus	-	0.030	-	-	0.268	3.107	2.434	2.522	2.129	1.681	0.453	0.760	0.281
Brevoortia tyrannus	13.073	16.966	24.330	28.886	41.666	75.607	50.1165	1067.482	344.790	1354.620	238.089	179.839	105.730
Anchoa hepsetus	0.183	0.228	0.143	0.217	-	0.126	0.629	0.255	0.373	-	-	-	-
Anchoa mitchilli	3.480	14.836	10.163	61.298	17.318	28.654	95.417	24.070	18.498	9.378	2.101	2.021	0.608
Synodus foetens	-	1.896	6.199	31.655	12.543	8.099	9.472	4.427	2.107	-	-	-	-
Opsanus tau	6.686	3.598	4.566	5.311	6.556	21.203	61.689	37.700	32.351	18.045	6.739	1.150	1.722
Rimola marginata	0.060	0.172	0.377	1.179	2.302	2.747	153.726	241.403	95.137	150.929	75.898	26.197	12.223
Cyprinodon variegatus	-	-	-	-	-	-	0.037	0.090	0.150	0.140	0.148	0.151	0.053
Fundulus heteroclitus	-	-	-	-	-	-	0.015	0.109	0.364	0.197	0.098	0.086	0.046
Menidia menidia	0.007	-	0.012	0.165	0.016	0.484	1.540	2.390	3.525	28.466	15.444	10.449	9.711
Syngnathus fuscus	0.044	0.126	0.029	0.040	0.100	0.198	2.506	1.628	1.868	4.165	0.866	0.594	0.282
Centropristis striata	-	0.012	0.009	0.119	1.197	6.476	34.144	32.214	13.038	48.784	18.087	8.267	4.085
Pomatomus saltatrix	12.717	5.602	3.087	2.491	8.271	7.154	14.650	83.323	8.337	14.637	-	0.089	0.135
Caranx hippos	0.187	0.021	0.270	1.500	1.432	8.872	169.468	0.265	0.189	-	-	-	-
Selene vomer	0.146	0.063	2.269	4.123	0.768	18.690	20.020	0.460	-	-	-	-	-
Stenotomus chrysops	-	-	-	-	-	0.083	0.536	7.321	6.267	119.789	9.502	10.377	1.023
Bairdiella chrysura	0.063	0.130	0.026	0.291	0.102	1.436	5.288	4.657	4.668	1.747	0.379	0.120	-
Cynoscion regalis	9.616	9.299	4.345	18.334	48.931	116.168	246.081	51.925	55.135	8.155	0.270	0.327	0.056
Leiostomus xanthurus	3.950	4.831	2.389	4.731	7.196	36.263	249.300	461.724	468.965	534.316	172.310	151.067	19.845
Tautoga onitis	-	-	0.896	-	-	-	1.285	6.396	7.409	14.320	37.398	18.668	20.893
Astroscopus guttatus	-	0.047	-	-	-	0.063	9.815	8.877	35.527	3.313	0.421	0.692	0.238
Hypsoblennius hentzi	0.182	-	0.075	0.072	0.028	0.098	3.340	9.718	5.015	9.265	0.758	0.258	0.055
Peprilus triacanthus	0.178	0.049	0.364	0.406	0.042	1.903	19.725	4.445	1.874	5.781	2.078	1.804	6.063
Prionotus carolinus	0.612	0.881	0.660	1.395	1.006	0.614	3.727	1.304	1.078	3.031	0.992	0.396	0.004
Prionotus evolans	2.621	21.535	18.918	141.096	63.548	122.387	100.013	17.201	9.102	8.861	2.468	1.825	0.328
Etropus microstomus	-	0.012	-	0.135	0.032	0.446	4.999	5.772	55.818	170.386	75.492	66.615	27.232
Paralichthys dentatus	19.245	15.760	10.640	32.899	13.210	166.805	158.500	25.235	17.441	11.264	15.438	0.836	1.257
Scophthalmus aquosus	-	0.023	0.376	5.117	0.378	5.724	11.109	7.197	2.767	7.084	3.096	5.496	3.351
Pseudopleuronectes americanus	-	-	0.502	0.026	0.700	3.197	10.694	3.046	4.626	14.832	3.449	50.390	36.649
Trinectes maculatus	0.347	1.045	1.653	3.036	0.699	2.144	5.663	1.370	3.473	1.922	0.324	0.877	0.130
Sphoeroides maculatus	3.118	0.497	0.686	141.089	11.163	2.892	2.382	2.233	4.432	-	-	-	-
Total of all species	97.463	104.466	98.507	520.124	243.134	681.180	1961.770	2141.399	1226.770	2558.282	704.597	558.572	312.597
INVERTEBRATES													
Loliguncula brevis	7.512	4.758	2.656	1.438	0.379	0.790	0.210	0.084	-	-	-	-	-
Class Polychaeta	-	-	0.004	0.002	-	-	0.077	0.018	0.013	0.379	0.663	0.118	0.075
Squilla empusa	-	0.023	0.028	0.077	0.080	0.461	12.135	5.618	4.524	0.534	0.156	0.198	-
Penaeus setiferus	0.042	0.487	0.812	13.536	4.231	7.518	33.956	1.784	1.329	0.139	-	-	-
Palaemonetes vulgaris	0.002	-	0.002	0.081	0.035	0.090	1.657	0.049	0.218	0.750	0.938	0.510	0.436
Crangon septemspinosa	-	0.006	0.007	0.009	0.006	0.064	1.992	0.167	0.289	3.144	7.932	87.845	72.369
Ovalipes ocellatus	0.287	0.353	0.714	2.278	3.829	0.934	5.434	6.476	4.208	4.567	1.264	0.572	0.198
Callinectes sapidus	833.487	1120.974	994.499	761.709	658.715	425.243	468.992	71.509	49.952	10.465	1.870	0.715	0.270
Callinectes similis	0.014	1.088	0.446	1.445	0.239	0.107	0.025	-	-	-	-	-	-
Phylum Nemertea	-	-	-	-	-	-	-	0.206	0.091	0.385	0.287	0.287	0.190
Total of all species	841.443	1127.826	1007.428	781.644	670.826	448.329	538.278	98.375	76.606	24.767	66.719	109.315	30.820
Grand Total of all species	938.906	1232.292	1105.932	1301.768	913.960	1129.509	2520.048	2239.774	1303.376	2583.039	771.316	667.887	393.217

Table D1-53. (cont.)

	December			January					February			
	5-11	12-18	19-25	26-1	2-8	9-15	16-22	23-29	30-5	6-12	13-19	20-26
FISH												
Anguilla rostrata	44.223	8.112	16.362	14.174	-	1.139	0.002	2.569	2.638	-	-	4.996
Alosa aestivalis	49.402	36.657	13.582	1.860	0.009	0.145	0.064	0.135	0.012	0.137	0.158	0.852
Alosa pseudoharengus	0.145	0.079	0.342	0.092	-	0.029	-	0.016	0.127	-	-	0.189
Brevoortia tyrannus	180.482	665.210	236.967	18.645	-	3.386	-	0.530	0.056	0.452	1.281	21.644
Anchoa hepsetus	-	-	-	-	-	-	-	-	-	-	-	-
Anchoa mitchilli	0.242	0.072	0.158	0.004	0.007	0.014	-	-	-	-	-	-
Synodus foetens	-	-	-	-	-	-	-	-	-	-	-	-
Opsanus tau	-	-	2.884	0.180	-	-	-	-	0.280	0.042	0.071	0.035
Rissola marginata	5.748	1.135	2.400	1.388	-	-	-	-	-	-	-	-
Cyprinodon variegatus	0.074	0.007	0.124	0.008	-	-	-	-	-	0.007	-	-
Fundulus heteroclitus	0.085	0.172	0.885	-	0.014	0.048	-	0.011	-	0.084	0.088	0.034
Menidia menidia	4.707	4.689	2.278	0.703	0.018	0.253	0.271	0.187	0.144	0.040	0.137	0.862
Syngnathus fuscus	0.182	0.173	0.090	0.056	0.009	0.002	-	0.002	-	-	-	-
Centropristis striata	0.238	0.074	0.023	0.023	-	-	-	-	-	-	-	-
Pomatomus saltatrix	-	-	-	-	-	-	-	-	-	-	-	-
Caranx hippos	-	-	-	-	-	-	-	-	-	-	-	-
Selene vomer	-	-	-	-	-	-	-	-	-	-	-	-
Stenotomus chrysops	-	-	-	-	-	-	-	-	-	-	-	-
Bairdiella chrysura	-	-	-	-	-	-	-	-	-	-	-	0.259
Cynoscion regalis	-	-	-	-	-	-	-	-	-	-	-	-
Leiostomus xanthurus	8.776	3.227	16.050	-	0.159	-	-	-	-	-	0.310	0.299
Tautoga onitis	27.388	8.206	4.947	2.144	0.826	0.056	-	-	-	-	-	-
Astroscopus guttatus	1.484	-	0.149	-	-	-	-	-	-	-	-	-
Hypsoblennius hentzi	0.364	0.175	0.430	0.894	0.100	0.078	0.182	0.049	-	-	-	-
Peprilus triacanthus	0.469	-	0.466	-	-	-	-	-	-	-	-	-
Prionotus carolinus	0.007	-	-	-	-	-	-	-	-	-	-	-
Prionotus evolans	0.488	0.021	0.046	-	-	-	-	-	-	-	-	-
Etropus microstomus	8.437	2.571	1.419	0.262	0.020	-	-	-	-	-	-	0.012
Paralichthys dentatus	6.393	-	0.827	-	-	-	-	-	-	-	-	-
Scophthalmus aquosus	1.823	3.143	0.871	0.411	-	-	0.098	-	-	-	-	0.154
Pseudopleuronectes americanus	89.637	314.546	168.310	237.143	15.972	72.992	16.114	9.750	42.946	28.299	38.958	196.487
Trinectes maculatus	-	-	-	-	-	-	-	-	-	-	-	-
Sphoeroides maculatus	-	-	-	-	-	-	-	-	-	-	-	-
Total of all species	437.863	1054.460	473.668	278.111	17.770	79.501	19.868	14.246	50.911	31.001	44.438	232.781
INVERTEBRATES												
Lolliguncula brevis	-	-	-	-	-	-	-	-	-	-	-	-
Class Polychaeta	0.009	0.182	0.168	0.011	0.012	0.081	0.099	-	0.037	0.014	0.136	3.226
Squilla empusa	-	0.133	-	-	-	-	-	-	-	-	-	-
Penaeus aztecus	-	0.049	-	-	-	-	-	-	-	-	-	-
Palaemonetes vulgaris	0.554	2.433	0.654	0.124	0.150	0.611	0.209	0.184	0.466	0.111	0.154	0.092
Crangon septemspinosa	86.981	82.810	32.978	31.088	7.364	33.292	7.363	3.485	1.425	1.945	6.302	8.923
Ovalipes ocellatus	0.011	-	-	0.014	-	0.007	-	-	-	-	0.005	-
Callinectes sapidus	0.270	0.026	-	0.028	-	0.023	0.039	-	0.004	0.007	0.011	0.182
Callinectes similis	-	-	-	-	-	-	-	-	-	-	-	-
Phylum Nemertea	0.025	0.023	0.223	-	-	-	-	-	-	0.006	-	0.007
Total of all species	103.878	89.578	33.871	31.294	7.536	34.095	7.710	3.669	1.932	2.082	7.143	12.433
Grand Total of all species	541.741	1144.038	507.239	309.405	25.305	113.596	27.578	17.915	52.843	33.083	51.581	244.214

Table D1-53. (cont.)

	March				April					May	
	27-5	6-12	13-19	20-26	27-2	3-9	10-16	17-23	24-30	1-7	8-14
VERTEBRATES											
Alosa aestivalis	2.129	0.880	0.887	17.898	2.442	30.905	15.499	5.447	3.558	1.935	1.606
Alosa pseudoharengus	0.371	0.371	0.931	43.707	4.419	27.279	21.030	8.191	5.364	2.352	6.513
Brevoortia tyrannus	26.666	36.597	2.793	123.022	6.473	11.206	26.317	4.632	34.969	2.020	-
Anchoa mitchilli	-	-	-	-	-	9.235	74.490	41.296	1.737	0.646	0.435
Opsanus tau	0.009	-	-	-	0.252	-	0.543	2.766	19.821	10.590	10.919
Menidia menidia	2.826	1.819	17.486	22.540	12.559	31.999	8.097	2.948	0.901	0.107	0.044
Syngnathus fuscus	-	-	0.022	0.288	0.414	0.980	0.827	2.266	1.728	1.934	1.081
Morone americana	41.226	9.035	5.549	29.128	9.655	25.312	4.854	1.255	0.352	-	-
Lepomis gibbosus	-	-	0.007	0.011	0.463	0.007	0.369	0.139	0.062	-	-
Scophthalmus aquosus	0.272	0.441	2.081	8.728	0.268	7.082	3.527	0.971	0.035	0.254	0.100
Pseudopleuronectes americanus	34.542	9.693	6.448	69.999	7.296	35.126	7.298	13.532	1.668	-	-
Total of all species	99.516	62.811	39.400	329.892	47.750	195.172	174.153	89.424	72.359	20.506	22.337
INVERTEBRATES											
Cyanea capillata	-	-	-	-	-	-	-	-	-	166.307	339.322
Class Polychaeta	0.197	0.075	0.021	0.102	0.060	0.012	0.186	0.009	0.101	0.002	-
Palaemonetes vulgaris	0.420	0.923	0.729	1.586	1.560	0.760	1.039	1.003	0.156	0.079	0.148
Crangon septemspinosa	5.388	5.094	5.613	7.711	10.362	17.119	18.309	38.995	4.151	1.042	0.672
Ovalipes ocellatus	0.086	0.012	0.238	0.086	0.611	0.742	0.080	0.188	0.106	0.129	0.121
Callinectes sapidus	0.287	0.369	0.967	0.026	10.710	2.365	35.143	46.669	22.214	12.718	18.697
Total of all species	6.328	6.834	7.631	85.452	23.440	21.980	65.564	125.448	78.000	279.065	607.623
Grand total of all species	106.044	69.645	47.231	415.345	71.170	217.152	239.717	214.872	150.359	299.571	629.960

Table D1-53. (cont.)

	July 17-23	24-30	31-6	August 7-13	14-20	21-27	28-3
VERTEBRATES							
Alosa aestivalis	0.046	4.723	0.773	0.373	0.816	0.432	0.237
Alosa pseudoharengus	0.095	0.820	0.579	0.663	0.239	0.173	0.170
Brevoortia tyrannus	-	8.911	14.739	10.972	10.457	9.326	6.666
Anchoa mitchilli	0.055	10.086	8.424	10.965	12.780	8.642	3.894
Opsanus tau	0.564	6.624	9.766	12.522	8.695	4.667	7.859
Strongylura marina	0.004	1.132	1.986	0.807	0.440	0.040	0.058
Menidia menidia	-	0.159	0.433	0.184	0.060	0.045	0.037
Syngnathus fuscus	0.602	0.569	0.218	0.266	0.273	0.128	0.153
Morone americana	-	4.839	0.835	1.290	0.403	-	-
Lepomis gibbosus	-	-	-	-	-	-	-
Pomatomus saltatrix	-	4.865	4.216	1.823	2.144	2.852	0.898
Caranx hippos	-	0.117	0.061	-	0.126	1.252	0.039
Selene vomer	0.014	0.974	0.917	0.354	3.714	2.277	1.551
Cynoscion regalis	-	0.435	0.438	0.448	2.090	10.357	3.483
Leiostomus xanthurus	0.014	2.518	23.073	9.503	7.912	10.534	6.239
Paralichthys dentatus	-	12.211	19.519	29.251	6.641	4.396	1.209
Scophthalmus aquosus	1.329	0.394	-	0.201	-	-	-
Pseudopleuronectes americanus	1.516	-	-	0.561	-	0.500	-
Sphoeroides maculatus	0.196	0.958	0.203	2.961	1.101	0.520	-
Total of all species	5.571	64.854	97.394	92.854	72.068	82.612	37.180
INVERTEBRATES							
Cyanea capillata	-	-	-	-	-	-	-
Class Polychaeta	-	0.004	-	-	0.005	0.007	-
Palaemonetes vulgaris	0.014	0.028	0.011	0.007	0.028	0.038	0.005
Crangon septemspinosa	-	-	-	-	-	-	0.005
Ovalipes ocellatus	1.173	1.523	0.593	0.159	0.305	0.467	0.331
Callinectes sapidus	151.141	504.450	967.100	954.393	1180.297	555.053	419.028
Callinectes similis	-	0-.141	1.242	1.687	1.439	0.685	1.177
Total of all species	156.562	506.491	981.480	956.276	1189.616	556.812	422.381
Grand Total of all species	162.133	571.345	1078.874	1049.130	1261.684	639.424	459.561

Table D1-54 Total impingement estimate by week, with number of specimens impinged per hour, total intake cooling water flow, and total number impinged per million gallons of cooling water flow at Oyster Creek Generating Station, Forked River, New Jersey from 5 September 1976 through 3 September 1977. No samples were taken from 14 May through 12 July 1977.

Date		Weekly Estimated #	#/Hr	Weekly Gal x 10^6	#/Gal x 10^6
September	5 - 11	29,079	173	4637	6
	12 - 18	37,845	225	4637	8
	19 - 25	38,473	229	4637	8
	26 - Oct. 2	47,249	281	4637	10
October	3 - 9	27,028	161	4637	6
	10 - 16	38,087	227	4637	8
	17 - 23	105,406	627	4637	23
	24 - 30	76,885	458	4637	17
	31 - Nov. 6	53,065	316	4637	11
November	7 - 13	108,981	649	4637	24
	14 - 20	41,098	245	4637	9
	21 - 27	123,676	736	4596	27
	28 - Dec. 4	82,806	493	4637	18
December	5 - 11	101,943	607	4637	22
	12 - 18	110,880	660	3852	29
	19 - 25	52,243	310	4637	11
	26 - Jan. 1	35,323	210	4454	8
January	2 - 8	8,215	49	3907	2
	9 - 15	37,654	224	4205	9
	16 - 22	8,207	49	3478	2
	23 - 29	3,800	23	3478	1
	30 - Feb. 5	2,535	15	3478	1

Date		Weekly Estimated #	#/Hr	Weekly Gal x 10^6	#/Gal x 10^6
February	6 - 12	2,440	15	3478	1
	13 - 19	7,151	43	4239	2
	20 - 26	10,888	65	4637	2
	27 - Mar. 5	7,735	46	4637	2
March	6 - 12	8,114	48	4637	2
	13 - 19	10,195	61	4637	2
	20 - 26	83,031	494	4629	18
	27 - Apr. 2	15,514	92	4637	3
April	3 - 9	26,908	160	4637	6
	10 - 16	42,644	254	4637	9
	17 - 23	52,735	314	4601	11
	24 - 30	6,868	41	3560	2
May	1 - 7	3,356	20	2318	1
	8 - 14	3,285	20	1398	2
July	17 - 23	4,341	26	1424	3
	24 - 30	14,824	88	2623	6
	31 - Aug. 6	25,950	154	4381	6
August	7 - 13	21,785	130	4637	5
	14 - 20	22,860	136	4637	5
	21 - 27	17,238	103	4637	4
	28 - Sept. 3	9,012	54	4637	2
Totals		1,567,352	217	180024	9

TABLE D1-55 . TOTAL NUMBER OF ORGANISMS IMPINGED ON THE TRAVELING SCREENS DURING EACH TIME PERIOD OF A 24, CONSECUTIVE HOUR SAMPLE AT THE OYSTER CREEK GENERATING STATION FROM 5 SEPTEMBER 1976 THROUGH 3 SEPTEMBER 1977. NO SAMPLES WERE TAKEN 14 MAY THROUGH 12 JULY.

SPECIES	PERIOD 1[a]	PERIOD 2	PERIOD 3	PERIOD 4
MUSTELUS CANIS	6	4	3	2
DASYATIS SAYI	4	1	5	2
ANGUILLA ROSTRATA	12	14	20	33
CONGER OCEANICUS	1	2	7	4
ALOSA AESTIVALIS	331	311	1103	1907
ALOSA PSEUDOHARENGUS	89	65	211	139
ALOSA SAPIDISSIMA	-	-	-	1
BREVOORTIA TYRANNUS	1185	1013	4053	6448
CLUPEA HARENGUS	-	2	2	1
DOROSOMA CEPEDIANUM	-	2	2	2
ANCHOA HEPSETUS	8	5	21	34
ANCHOA MITCHILLI	1554	1584	7050	6541
ESOX NIGER	-	1	1	-
SYNODUS FOETENS	3	6	33	20
OPSANUS TAU	22	28	147	86
UROPHYCIS CHUSS	-	-	4	4
UROPHYCIS REGIUS	3	-	24	30
RISSOLA MARGINATA	93	127	2856	994
HYPORHAMPHUS UNIFASCIATUS	-	2	3	1
STRONGYLURA MARINA	22	20	112	46
CYPRINODON VARIEGATUS	7	13	11	23
FUNDULUS HETEROCLITUS	15	24	27	38
FUNDULUS MAJALIS	2	3	5	2
LUCANIA PARVA	-	1	-	-
MEMBRAS MARTINICA	3	2	8	4
MENIDIA SP.	-	-	1	-
MENIDIA BERYLLINA	2	-	1	-
MENIDIA MENIDIA	776	694	1144	1387
APELTES QUADRACUS	4	6	11	7
GASTEROSTEUS ACULEATUS	6	1	10	16
FISTULARIA TABACARIA	7	2	8	10
HIPPOCAMPUS ERECTUS	2	4	1	6
SYNGNATHUS FUSCUS	118	90	830	485
SYNGNATHUS LOUISIANAE	-	-	1	-
MORONE AMERICANA	21	25	54	61
MORONE SAXATILIS	-	-	2	-
CENTROPRISTIS STRIATA	76	153	2509	815
LEPOMIS GIBBOSUS	4	38	54	22
POMATOMUS SALTATRIX	61	47	197	123
RACHYCENTRON CANADUM	2	-	1	-
CARANX CRYSOS	-	-	-	1
CARANX HIPPOS	18	7	83	29
SELAR CRUMENOPHTHALMUS	-	-	-	1
SELENE VOMER	74	24	61	135
VOMER SETAPINNIS	3	-	8	-
STENOTOMUS CHRYSOPS	28	5	72	125
BAIRDIELLA CHRYSURA	72	17	132	147
CYNOSCION REGALIS	207	208	1274	988
LEIOSTOMUS XANTHURUS	612	560	2767	2022
MENTICIRRHUS SAXATILIS	3	1	3	2
MICROPOGON UNDULATUS	-	-	2	2
CHAETODIPTERUS FABER	-	-	1	-
CHAETODON OCELLATUS	1	-	6	11
TAUTOGA ONITIS	35	41	148	75

TABLE D1-55. (CONT.)

TAUTOGOLABRUS ADSPERSUS	2	1	3	1
MUGIL CEPHALUS	2	2	5	8
MUGIL CUREMA	1	2	9	23
SPHYRAENA BOREALIS	2	9	19	5
ASTROSCOPUS GUTTATUS	3	1	94	20
CHASMODES BOSQUIANUS	7	5	6	3
HYPSOBLENNIUS HENTZI	19	37	365	150
AMMODYTES SP.	4	4	10	1
GOBIOSOMA BOSCI	-	10	3	1
GOBIOSOMA GINSBURGI	-	-	2	-
PEPRILUS TRIACANTHUS	18	10	93	42
PRIONOTUS CAROLINUS	4	2	31	15
PRIONOTUS EVOLANS	68	141	1242	774
MYOXOCEPHALUS AENAEUS	-	-	3	2
DACTYLOPTERUS VOLITANS	-	-	1	-
ETROPUS MICROSTOMUS	176	145	6669	4771
PARALICHTHYS DENTATUS	18	24	127	54
SCOPHTHALMUS AQUOSUS	14	7	64	39
PSEUDOPLEURONECTES AMERICANUS	76	118	916	802
TRINECTES MACULATUS	5	4	39	20
SYMPHURUS PLAGIUSA	-	-	7	3
ALUTERUS SCHOEPPI	2	-	6	-
MONACANTHUS HISPIDUS	-	-	2	2
SPHOEROIDES MACULATUS	10	9	63	12
CHILOMYCTERUS SCHOEPPI	1	-	2	-
BUFO FOWLERI	-	-	2	-
MALACLEMYS TERRAPIN	-	-	1	1
PHYLUM PORIFERA	1	-	-	-
AEQUOREA SPP	29	4	6	9
CLASS SCYPHOZOA	-	-	1	-
CYANEA CAPILLATA	51	49	115	58
ORDER ACTINIARIA	1	-	1	3
UROSALPINX CINEREUS	1	-	-	-
MYTILUS EDULIS	1	-	-	-
ENSIS DIRECTUS	-	-	2	-
LOLIGO PEALEI	-	3	1	-
LOLLIGUNCULA BREVIS	8	17	64	48
CLASS POLYCHAETA	14	24	120	80
LIMULUS POLYPHEMUS	5	4	3	1
SQUILLA EMPUSA	3	7	178	66
PENAEUS SETIFERUS	-	-	1	-
PENAEUS AZTECUS	3	3	213	256
PALAEMONETES VULGARIS	72	106	2599	1790
PALAEMONETES PUGIO	-	-	2	1
CRANGON SEPTEMSPINOSA	583	462	47819	38645
PAGURUS LONGICARPUS	-	2	6	1
LIBINIA DUBIA	2	2	9	3

TABLE D1-55. (CONT.)

CARCINUS MAENAS	-	-	1	-
OVALIPES OCELLATUS	13	11	195	168
PORTUNUS GIBBESI	-	-	2	6
CALLINECTES SAPIDUS	3206	2628	10576	8169
CALLINECTES SIMILIS	17	13	179	71
PANOPEUS HERBSTII	-	-	3	-
NEOPANOPE TEXANA	2	13	16	9
INVERTEBRATE FRAGMENTS	-	-	-	-
PHYLUM NEMERTEA	1	-	34	17
PROCAMBARUS BLANDINGI	-	-	1	-
TOTALS	9937	9032	97020	78982
TAXA	78	74	103	86

[a]TIME PERIOD 1 = SUNRISE TO 6 H BEFORE SUNSET;
TIME PERIOD 2 = 6 H BEFORE SUNSET TO SUNSET;
TIME PERIOD 3 = SUNSET TO 6 H AFTER SUNSET;
TIME PERIOD 4 = 6 H AFTER SUNSET TO SUNRISE.

Table D1-56. Estimated number and percent of selected organisms impinged on the traveling screens during the day and night at the Oyster Creek Generating Station, Forked River, New Jersey from 5 September 1976 through 3 September 1977. No samples were taken 14 May through 12 July.

	Day		Night	
	Number	%	Number	%
Alosa aestivalis	4,499	15	25,363	85
Brevoortia tyrannus	15,804	15	90,178	85
Anchoa mitchilli	20,822	14	122,919	86
Menidia menidia	11,929	44	23,634	66
Syngnathus fuscus	1,593	14	9,469	86
Pomatomus saltatrix	833	21	3,204	79
Cynoscion regalis	3,918	14	23,988	86
Prionotus evolans	1,534	5	28,322	95
Paralichthys dentatus	359	15	2,075	85
Pseudopleuronectes americanus	1,353	7	19,260	93
Sphoeroides maculatus	152	11	1,286	89
Palaemonetes vulgaris	1,257	4	30,640	96
Crangon septemspinosa	9,113	1	650,259	99
Callinectes sapidus	46,747	21	174,479	79
Total of all specimens	147,480	9	1,419,872	91

TABLE D1-57. TOTAL NUMBER OF LIVE, DEAD, AND DAMAGED FISHES AND MACRO-INVERTEBRATES IMPINGED ON THE TRAVELING SCREENS AT OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM 5 SEPTEMBER 1976 THROUGH 3 SEPTEMBER 1977. NO SAMPLES WERE TAKEN 14 MAY THROUGH 12 JULY.

SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
MUSTELUS CANIS	4	3	-	1	-
DASYATIS SAYI	3	1	1	1	33
ANGUILLA ROSTRATA	22	5	1	16	5
CONGER OCEANICUS	3	1	-	2	-
ALOSA AESTIVALIS	1534	266	631	637	41
ALOSA PSEUDOHARENGUS	201	23	70	108	35
BREVOORTIA TYRANNUS	2388	193	656	1539	27
DOROSOMA CEPEDIANUM	2	-	-	2	-
ANCHOA HEPSETUS	31	-	28	3	90
ANCHOA MITCHILLI	3460	115	2819	526	81
ESOX NIGER	1	-	1	-	100
SYNODUS FOETENS	19	14	1	4	5
OPSANUS TAU	37	30	2	5	5
UROPHYCIS CHUSS	6	1	1	4	17
UROPHYCIS REGIUS	10	3	3	4	30
RISSOLA MARGINATA	404	178	43	183	11
HYPORHAMPHUS UNIFASCIATUS	1	-	1	-	100
STRONGYLURA MARINA	81	8	54	19	67
CYPRINODON VARIEGATUS	28	20	3	5	11
FUNDULUS HETEROCLITUS	47	22	7	18	15
FUNDULUS MAJALIS	4	3	-	1	-
MEMBRAS MARTINICA	2	1	1	-	50
MENIDIA BERYLLINA	2	1	1	-	50
MENIDIA MENIDIA	1701	573	589	539	35
APELTES QUADRACUS	10	9	-	1	-
GASTEROSTEUS ACULEATUS	16	9	1	6	6
FISTULARIA TABACARIA	10	3	5	2	50
HIPPOCAMPUS ERECTUS	10	8	-	2	-
SYNGNATHUS FUSCUS	477	400	28	49	6
MORONE AMERICANA	85	7	5	73	6
MORONE SAXATILIS	1	-	-	1	-
CENTROPRISTIS STRIATA	301	111	93	97	31
LEPOMIS GIBBOSUS	28	9	17	2	61
POMATOMUS SALTATRIX	149	13	83	53	56

TABLE D1-57. (CONT.)

CARANX HIPPOS	73	7	42	24	58
SELAR CRUMENOPHTHALMUS	1	-	1	-	100
SELENE VOMER	95	17	40	38	42
VOMER SETAPINNIS	2	-	-	2	-
STENOTOMUS CHRYSOPS	21	-	1	20	5
BAIRDIELLA CHRYSURA	84	12	47	25	56
CYNOSCION REGALIS	834	110	495	229	59
LEIOSTOMUS XANTHURUS	1290	177	385	728	30
MENTICIRRHUS SAXATILIS	3	2	1	-	33
MICROPOGON UNDULATUS	1	-	1	-	100
TAUTOGA ONITIS	45	31	1	13	2
MUGIL CEPHALUS	4	-	-	4	-
MUGIL CUREMA	17	-	8	9	47
SPHYRAENA BOREALIS	14	1	6	7	43
ASTROSCOPUS GUTTATUS	17	10	-	7	-
CHASMODES BOSQUIANUS	3	2	-	1	-
HYPSOBLENNIUS HENTZI	66	51	7	8	11
AMMODYTES SP.	4	1	2	1	50
GOBIOSOMA BOSCI	10	-	9	1	90
PEPRILUS TRIACANTHUS	33	4	12	17	36
PRIONOTUS CAROLINUS	18	11	2	5	11
PRIONOTUS EVOLANS	887	493	121	273	14
MYOXOCEPHALUS AENAEUS	1	-	-	1	-
ETROPUS MICROSTOMUS	1655	485	472	698	29
PARALICHTHYS DENTATUS	29	10	1	18	3
SCOPHTHALMUS AQUOSUS	43	26	3	14	7
PSEUDOPLEURONECTES AMERICANUS	617	276	85	256	14
TRINECTES MACULATUS	16	10	-	6	-
SYMPHURUS PLAGIUSA	5	2	-	3	-
ALUTERUS SCHOEPFI	3	1	-	2	-
MONACANTHUS HISPIDUS	3	-	-	3	-
SPHOEROIDES MACULATUS	63	57	2	4	3
CHILOMYCTERUS SCHOEPFI	2	2	-	-	-
AEQUOREA SPP	18	-	17	1	94
CYANEA CAPILLATA	5	1	-	4	-

TABLE D1-57. (CONT.)

ORDER ACTINIARIA	1	-	-	1	-
ILYANASSA OBSOLETA	1	-	-	1	-
LOLIGO PEALEI	1	-	1	-	100
LOLLIGUNCULA BREVIS	40	13	8	19	20
CLASS POLYCHAETA	101	55	17	29	17
LIMULUS POLYPHEMUS	5	3	-	2	-
SQUILLA EMPUSA	29	23	-	6	-
PENAEUS AZTECUS	86	78	3	5	3
PALAEMONETES VULGARIS	465	374	58	33	12
PALAEMONETES PUGIO	1	1	-	-	-
PALAEMONETES SPP	2	1	-	1	-
CRANGON SEPTEMSPINOSA	5442	4020	893	529	16
LIBINIA DUBIA	2	1	-	1	-
OVALIPES OCELLATUS	84	61	4	19	5
PORTUNUS GIBBESI	3	1	-	2	-
CALLINECTES SAPIDUS	4943	3280	254	1409	5
CALLINECTES SIMILIS	121	92	4	25	3
PANOPEUS HERBSTII	1	-	-	1	-
NEOPANOPE TEXANA	7	3	3	1	43
PHYLUM NEMERTEA	41	20	-	21	-
TOTALS	28436	11855	8151	8430	29

Table D1-58. Comparison of the estimated immediate mortality of selected fishes and macroinvertebrates impinged on the traveling screens at the Oyster Creek Generating Station, Forked River New Jersey during seven comparable months (September through December, March, April, and August) from 8 September 1975 through 2 September 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

No Significant Difference	1975-76	1976-77
Alosa aestivalis	43%	41%
Brevoortia tyrannus	27	25
Syngnathus fuscus	4	5
Prionotus evolans	12	14
Palaemonetes vulgaris	8	6
Crangon septemspinosa	14	15
Callinectes sapidus	7	6
Significant Difference		
Anchoa mitchilli	72%	81%
Menidia menidia	38	34
Cynoscion regalis	44	60
Etropus microstomus	17	29

Table D1-59. Survival and mortality of fishes and macroinvertebrates immediately and 48 h after impingement on the traveling screens at Oyster Creek Generating Station from September 1975 through August 1977.

	Immediate				Survival after 48 h	
	Number	% live	% damaged	% dead	Number	% live
Blueback herring	2,445	17	41	42		
Alewife	329	12	50	38		
Atlantic menhaden	3,165	8	64	28	38	5
Bay anchovy	13,854	7	15	78	128	9
Oyster toadfish	186	85	9	6		
Striped cusk-eel	633	47	41	12		
Atlantic silverside	5,133	34	28	38	141	35
Fourspine stickleback	92	85	10	5		
Northern pipefish	2,417	90	5	5	33	79
Black seabass	310	37	33	30		
Bluefish	433	20	21	59		
Weakfish	1,351	15	26	59		
Spot	2,367	19	33	48		
Striped searobin	1,335	55	27	18	45	98
Smallmouth flounder	2,213	36	38	26		
Summer flounder	159	53	38	9		
Winter flounder	686	46	39	15	12	67
Grass shrimp (*Palaemonetes vulgaris*)	2,259	87	5	8		
Sand shrimp (*Crangon septemspinosa*)	17,234	77	9	14	15	87
Blue crab (*Callinectes sapidus*)	21,669	64	29	7	149	79

TABLE D1-60. TOTAL NUMBER OF LIVE, DEAD, AND DAMAGED FISHES AND MACRO-INVERTEBRATES IMPINGED ON THE TRAVELING SCREENS, BY MONTH, AT OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM 5 SEPTEMBER 1976 THROUGH 3 SEPTEMBER 1977. NO SAMPLES WERE TAKEN 14 MAY THROUGH 12 JULY.

DATE	5 - 30 SEPTEMBER 1976				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
DASYATIS SAYI	2	1	1	-	50
ANGUILLA ROSTRATA	1	-	-	1	-
ALOSA AESTIVALIS	1	-	1	-	100
BREVOORTIA TYRANNUS	55	2	38	15	69
ANCHOA HEPSETUS	20	-	20	-	100
ANCHOA MITCHILLI	796	3	759	34	95
SYNODUS FOETENS	5	3	-	2	-
OPSANUS TAU	4	4	-	-	-
STRONGYLURA MARINA	2	1	1	-	50
MENIDIA MENIDIA	3	1	2	-	67
FISTULARIA TABACARIA	1	1	-	-	-
SYNGNATHUS FUSCUS	3	2	-	1	-
MORONE AMERICANA	2	-	2	-	100
POMATOMUS SALTATRIX	23	-	17	6	74
CARANX HIPPOS	6	-	4	2	67
SELENE VOMER	15	-	5	10	33
CYNOSCION REGALIS	115	25	70	20	61
LEIOSTOMUS XANTHURUS	28	3	17	8	61
TAUTOGA ONITIS	1	-	-	1	-
MUGIL CEPHALUS	1	-	-	1	-
MUGIL CUREMA	2	-	-	2	-
HYPSOBLENNIUS HENTZI	1	1	-	-	-
PEPRILUS TRIACANTHUS	2	-	2	-	100
PRIONOTUS CAROLINUS	3	3	-	-	-
PRIONOTUS EVOLANS	184	116	24	44	13
ETROPUS MICROSTOMUS	1	-	1	-	100
PARALICHTHYS DENTATUS	5	2	1	2	20
SCOPHTHALMUS AQUOSUS	2	2	-	-	-
TRINECTES MACULATUS	5	5	-	-	-
ALUTERUS SCHOEPFI	1	1	-	-	-
SPHOEROIDES MACULATUS	9	9	-	-	-
AEQUOREA SPP	14	-	14	-	100
LOLLIGUNCULA BREVIS	38	12	8	18	21
PENAEUS AZTECUS	28	28	-	-	-
PALAEMONETES VULGARIS	1	1	-	-	-
CRANGON SEPTEMSPINOSA	1	1	-	-	-
OVALIPES OCELLATUS	11	10	-	1	-
PORTUNUS GIBBESI	1	-	-	1	-
CALLINECTES SAPIDUS	1893	1214	133	546	7
CALLINECTES SIMILIS	26	22	-	4	-
NEOPANOPE TEXANA	1	1	-	-	-
TOTALS	3313	1474	1120	719	34

TABLE D1-60. (CONT.)

DATE	OCTOBER 1976				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
MUSTELUS CANIS	2	1	-	1	-
ANGUILLA ROSTRATA	1	-	-	1	-
ALOSA AESTIVALIS	6	-	1	5	17
ALOSA PSEUDOHARENGUS	18	1	10	7	56
BREVOORTIA TYRANNUS	670	51	170	449	25
ANCHOA HEPSETUS	5	-	5	-	100
ANCHOA MITCHILLI	1119	44	920	155	82
SYNODUS FOETENS	13	10	1	2	8
OPSANUS TAU	3	3	-	-	-
RISSOLA MARGINATA	65	33	6	26	9
STRONGYLURA MARINA	11	2	4	5	36
CYPRINODON VARIEGATUS	2	2	-	-	-
FUNDULUS HETEROCLITUS	1	1	-	-	-
MENIDIA MENIDIA	35	6	23	6	66
FISTULARIA TABACARIA	9	2	5	2	56
SYNGNATHUS FUSCUS	31	27	1	3	3
MORONE AMERICANA	1	-	-	1	-
CENTROPRISTIS STRIATA	92	38	41	13	45
POMATOMUS SALTATRIX	50	6	23	21	46
CARANX HIPPOS	52	1	31	20	60
SELAR CRUMENOPHTHALMUS	1	-	1	-	100
SELENE VOMER	17	1	5	11	29
VOMER SETAPINNIS	2	-	-	2	-
STENOTOMUS CHRYSOPS	2	-	-	2	-
BAIRDIELLA CHRYSURA	41	8	22	11	54
CYNOSCION REGALIS	615	60	373	182	61
LEIOSTOMUS XANTHURUS	471	58	149	264	32
MENTICIRRHUS SAXATILIS	2	1	1	-	50
MUGIL CUREMA	10	-	7	3	70
SPHYRAENA BOREALIS	14	1	6	7	43
ASTROSCOPUS GUTTATUS	9	7	-	2	-
HYPSOBLENNIUS HENTZI	17	13	3	1	18
PEPRILUS TRIACANTHUS	20	3	5	12	25
PRIONOTUS CAROLINUS	4	3	-	1	-

TABLE D1-60. (CONT.)

DATE	OCTOBER 1976 (CONT.)				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
PRIONOTUS EVOLANS	632	350	84	198	13
ETROPUS MICROSTOMUS	27	7	10	10	37
PARALICHTHYS DENTATUS	16	8	-	8	-
PSEUDOPLEURONECTES AMERICANUS	1	-	-	1	-
TRINECTES MACULATUS	1	-	-	1	-
ALUTERUS SCHOEPFI	1	-	-	1	-
MONACANTHUS HISPIDUS	3	-	-	3	-
SPHOEROIDES MACULATUS	31	30	-	1	-
AEQUOREA SPP	3	-	3	-	100
LOLLIGUNCULA BREVIS	2	1	-	1	-
LIMULUS POLYPHEMUS	2	2	-	-	-
SQUILLA EMPUSA	18	16	-	2	-
PENAEUS AZTECUS	57	49	3	5	5
PALAEMONETES VULGARIS	12	10	1	1	8
PALAEMONETES SPP	1	-	-	1	-
CRANGON SEPTEMSPINOSA	5	4	1	-	20
OVALIPES OCELLATUS	22	16	-	6	-
PORTUNUS GIBBESI	2	1	-	1	-
CALLINECTES SAPIDUS	891	547	36	308	4
CALLINECTES SIMILIS	11	9	1	1	9
TOTALS	5149	1433	1952	1764	38

TABLE D1-60. (CONT.)

DATE	NOVEMBER 1976				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	3	-	-	3	-
CONGER OCEANICUS	1	-	-	1	-
ALOSA AESTIVALIS	8	-	2	6	25
ALOSA PSEUDOHARENGUS	9	1	2	6	22
BREVOORTIA TYRANNUS	897	96	224	577	25
DOROSOMA CEPEDIANUM	1	-	-	1	-
ANCHOA HEPSETUS	5	-	2	3	40
ANCHOA MITCHILLI	238	11	169	58	71
SYNODUS FOETENS	1	1	-	-	-
OPSANUS TAU	10	7	-	3	-
UROPHYCIS REGIUS	6	3	1	2	17
RISSOLA MARGINATA	240	110	28	102	12
HYPORHAMPHUS UNIFASCIATUS	1	-	1	-	100
CYPRINODON VARIEGATUS	13	9	2	2	15
FUNDULUS HETEROCLITUS	8	8	-	-	-
MENIDIA MENIDIA	302	88	132	82	44
HIPPOCAMPUS ERECTUS	7	6	-	1	-
SYNGNATHUS FUSCUS	34	24	3	7	9
MORONE AMERICANA	1	-	-	1	-
CENTROPRISTIS STRIATA	175	66	43	66	25
POMATOMUS SALTATRIX	7	-	-	7	-
STENOTOMUS CHRYSOPS	19	-	1	18	5
BAIRDIELLA CHRYSURA	43	4	25	14	58
CYNOSCION REGALIS	28	2	11	15	39
LEIOSTOMUS XANTHURUS	482	62	107	313	22
MENTICIRRHUS SAXATILIS	1	1	-	-	-
MICROPOGON UNDULATUS	1	-	1	-	100
TAUTOGA ONITIS	20	19	-	1	-
MUGIL CUREMA	2	-	1	1	50
ASTROSCOPUS GUTTATUS	6	3	-	3	-
CHASMODES BOSQUIANUS	1	1	-	-	-
HYPSOBLENNIUS HENTZI	27	25	1	1	4
GOBIOSOMA BOSCI	1	-	1	-	100
PEPRILUS TRIACANTHUS	4	1	2	1	50

TABLE D1-60. (CONT.)

DATE	NOVEMBER 1976 (CONT.)				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
PRIONOTUS CAROLINUS	9	4	2	3	22
PRIONOTUS EVOLANS	66	24	13	29	20
ETROPUS MICROSTOMUS	1051	305	319	427	30
PARALICHTHYS DENTATUS	1	-	-	1	-
SCOPHTHALMUS AQUOSUS	4	3	-	1	-
PSEUDOPLEURONECTES AMERICANUS	34	24	2	8	6
TRINECTES MACULATUS	2	1	-	1	-
SYMPHURUS PLAGIUSA	4	2	-	2	-
SPHOEROIDES MACULATUS	2	1	-	1	-
AEQUOREA SPP	1	-	-	1	-
CYANEA CAPILLATA	4	-	-	4	-
ILYANASSA OBSOLETA	1	-	-	1	-
CLASS POLYCHAETA	16	9	3	4	19
SQUILLA EMPUSA	11	7	-	4	-
PENAEUS AZTECUS	1	1	-	-	-
PALAEMONETES VULGARIS	25	21	1	3	4
CRANGON SEPTEMSPINOSA	601	418	97	86	16
OVALIPES OCELLATUS	21	16	-	5	-
CALLINECTES SAPIDUS	7	2	-	5	-
PHYLUM NEMERTEA	8	4	-	4	-
TOTALS	4471	1390	1196	1885	27

DATE	DECEMBER 1976				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
MUSTELUS CANIS	1	1	-	-	-
ANGUILLA ROSTRATA	11	3	1	7	9
CONGER OCEANICUS	2	1	-	1	-
ALOSA AESTIVALIS	1186	207	533	446	45
ALOSA PSEUDOHARENGUS	8	-	4	4	50
BREVOORTIA TYRANNUS	370	14	70	286	19
DOROSOMA CEPEDIANUM	1	-	-	1	-
ANCHOA MITCHILLI	26	-	19	7	73
OPSANUS TAU	3	1	1	1	33
UROPHYCIS CHUSS	6	1	1	4	17
UROPHYCIS REGIUS	4	-	2	2	50
RISSOLA MARGINATA	96	34	7	55	7
CYPRINODON VARIEGATUS	12	8	1	3	8
FUNDULUS HETEROCLITUS	6	1	3	2	50
FUNDULUS MAJALIS	2	1	-	1	-
MENIDIA BERYLLINA	2	1	1	-	50
MENIDIA MENIDIA	266	64	109	93	41
APELTES QUADRACUS	5	5	-	-	-
HIPPOCAMPUS ERECTUS	3	2	-	1	-
SYNGNATHUS FUSCUS	26	14	4	8	15
MORONE AMERICANA	8	-	1	7	13
CENTROPRISTIS STRIATA	34	7	9	18	26
LEIOSTOMUS XANTHURUS	127	21	14	92	11
TAUTOGA ONITIS	20	12	-	8	-
ASTROSCOPUS GUTTATUS	2	-	-	2	-
CHASMODES BOSQUIANUS	2	1	-	1	-
HYPSOBLENNIUS HENTZI	20	12	2	6	10
AMMODYTES SP.	2	-	1	1	50
GOBIOSOMA BOSCI	5	-	4	1	80
PEPRILUS TRIACANTHUS	7	-	3	4	43
PRIONOTUS EVOLANS	2	1	-	1	-
ETROPUS MICROSTOMUS	575	173	142	260	25
SCOPHTHALMUS AQUOSUS	4	3	-	1	-
PSEUDOPLEURONECTES AMERICANUS	350	180	52	118	15
SYMPHURUS PLAGIUSA	1	-	-	1	-
CYANEA CAPILLATA	1	1	-	-	-
CLASS POLYCHAETA	6	2	1	3	17
PALAEMONETES VULGARIS	15	15	-	-	-
CRANGON SEPTEMSPINOSA	1609	1184	288	137	18
CALLINECTES SAPIDUS	2	1	1	-	50
PHYLUM NEMERTEA	12	9	-	3	-
TOTALS	4840	1980	1274	1586	26

TABLE D1-60. (CONT.)

DATE	JANUARY 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	1	-	-	1	-
ALOSA AESTIVALIS	4	-	2	2	50
ALOSA PSEUDOHARENGUS	1	-	-	1	-
BREVOORTIA TYRANNUS	15	-	1	14	7
FUNDULUS HETEROCLITUS	1	-	1	-	100
MENIDIA MENIDIA	13	5	3	5	23
MORONE AMERICANA	2	-	-	2	-
TAUTOGA ONITIS	1	-	1	-	100
MUGIL CEPHALUS	2	-	-	2	-
MUGIL CUREMA	1	-	-	1	-
HYPSOBLENNIUS HENTZI	1	-	1	-	100
AMMODYTES SP.	1	-	1	-	100
GOBIOSOMA BOSCI	4	-	4	-	100
SCOPHTHALMUS AQUOSUS	1	-	-	1	-
PSEUDOPLEURONECTES AMERICANUS	60	24	5	31	8
CLASS POLYCHAETA	5	-	2	3	40
PALAEMONETES VULGARIS	49	31	11	7	22
CRANGON SEPTEMSPINOSA	1025	681	198	146	19
TOTALS	1187	741	230	216	19

TABLE D1-60. (CONT.)

DATE	FEBRUARY 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ALOSA AESTIVALIS	46	5	16	25	35
ALOSA PSEUDOHARENGUS	2	-	2	-	100
BREVOORTIA TYRANNUS	42	8	4	30	10
ESOX NIGER	1	-	1	-	100
FUNDULUS HETEROCLITUS	6	1	-	5	-
FUNDULUS MAJALIS	2	2	-	-	-
MENIDIA MENIDIA	25	9	8	8	32
APELTES QUADRACUS	1	1	-	-	-
GASTEROSTEUS ACULEATUS	6	2	1	3	17
MORONE AMERICANA	16	2	-	14	-
LEIOSTOMUS XANTHURUS	3	-	-	3	-
MYOXOCEPHALUS AENAEUS	1	-	-	1	-
SCOPHTHALMUS AQUOSUS	1	-	-	1	-
PSEUDOPLEURONECTES AMERICANUS	40	20	4	16	10
LOLIGO PEALEI	1	-	1	-	100
CLASS POLYCHAETA	44	39	3	2	7
PALAEMONETES VULGARIS	48	26	15	7	31
PALAEMONETES SPP	1	1	-	-	-
CRANGON SEPTEMSPINOSA	637	447	106	84	17
OVALIPES OCELLATUS	1	1	-	-	-
CALLINECTES SAPIDUS	1	-	1	-	100
PHYLUM NEMERTEA	1	-	-	1	-
TOTALS	926	564	162	200	17

TABLE D1-60. (CONT.)

DATE	MARCH 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	3	-	-	3	-
ALOSA AESTIVALIS	162	44	29	89	18
ALOSA PSEUDOHARENGUS	103	17	19	67	18
BREVOORTIA TYRANNUS	122	8	16	98	13
RISSOLA MARGINATA	2	-	2	-	100
FUNDULUS HETEROCLITUS	18	7	2	9	11
MENIDIA MENIDIA	791	317	236	238	30
APELTES QUADRACUS	4	3	-	1	-
GASTEROSTEUS ACULEATUS	10	7	-	3	-
SYNGNATHUS FUSCUS	23	18	1	4	4
MORONE AMERICANA	38	2	-	36	-
MORONE SAXATILIS	1	-	-	1	-
LEPOMIS GIBBOSUS	14	7	5	2	36
LEIOSTOMUS XANTHURUS	3	-	1	2	33
TAUTOGA ONITIS	1	-	-	1	-
MUGIL CEPHALUS	1	-	-	1	-
MUGIL CUREMA	2	-	-	2	-
AMMODYTES SP.	1	1	-	-	-
ETROPUS MICROSTOMUS	1	-	-	1	-
SCOPHTHALMUS AQUOSUS	12	6	2	4	17
PSEUDOPLEURONECTES AMERICANUS	78	21	-	57	-
TRINECTES MACULATUS	1	-	-	1	-
ORDER ACTINIARIA	1	-	-	1	-
CLASS POLYCHAETA	13	3	-	10	-
LIMULUS POLYPHEMUS	1	-	-	1	-
PALAEMONETES VULGARIS	198	175	14	9	7
CRANGON SEPTEMSPINOSA	761	617	96	48	13
OVALIPES OCELLATUS	8	6	1	1	13
CALLINECTES SAPIDUS	60	49	2	9	3
NEOPANOPE TEXANA	1	-	1	-	100
PHYLUM NEMERTEA	18	5	-	13	-
TOTALS	2452	1313	427	712	17

TABLE D1-60. (CONT.)

DATE	APRIL 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
MUSTELUS CANIS	1	1	-	-	-
ALOSA AESTIVALIS	62	10	14	38	23
ALOSA PSEUDOHARENGUS	30	2	15	13	50
BREVOORTIA TYRANNUS	14	1	6	7	43
ANCHOA MITCHILLI	677	41	438	198	65
OPSANUS TAU	1	-	1	-	100
CYPRINODON VARIEGATUS	1	1	-	-	-
FUNDULUS HETEROCLITUS	6	4	1	1	17
MENIDIA MENIDIA	242	80	61	101	25
SYNGNATHUS FUSCUS	122	112	2	8	2
MORONE AMERICANA	13	3	-	10	-
LEPOMIS GIBBOSUS	14	2	12	-	86
LEIOSTOMUS XANTHURUS	1	-	-	1	-
PARALICHTHYS DENTATUS	1	-	-	1	-
SCOPHTHALMUS AQUOSUS	12	6	1	5	8
PSEUDOPLEURONECTES AMERICANUS	12	4	1	7	8
TRINECTES MACULATUS	4	2	-	2	-
CLASS POLYCHAETA	16	2	7	7	44
PALAEMONETES VULGARIS	32	28	2	2	6
PALAEMONETES PUGIO	1	1	-	-	-
CRANGON SEPTEMSPINOSA	637	542	72	23	11
OVALIPES OCELLATUS	8	6	-	2	-
CALLINECTES SAPIDUS	121	103	-	18	-
PHYLUM NEMERTEA	1	1	-	-	-
TOTALS	2029	952	633	444	31

TABLE D1-60. (CONT.)

DATE	1-14 MAY 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ALOSA AESTIVALIS	7	-	4	3	57
ALOSA PSEUDOHARENGUS	15	1	5	9	33
BREVOORTIA TYRANNUS	1	-	-	1	-
ANCHOA MITCHILLI	23	-	20	3	87
OPSANUS TAU	3	2	-	1	-
MENIDIA MENIDIA	2	1	1	-	50
SYNGNATHUS FUSCUS	122	104	11	7	9
TAUTOGA ONITIS	1	-	-	1	-
SCOPHTHALMUS AQUOSUS	3	3	-	-	-
PALAEMONETES VULGARIS	42	30	10	2	24
CRANGON SEPTEMSPINOSA	165	126	34	5	21
LIBINIA DUBIA	1	1	-	-	-
OVALIPES OCELLATUS	3	2	-	1	-
CALLINECTES SAPIDUS	123	69	7	47	6
NEOPANOPE TEXANA	3	2	-	1	-
TOTALS	514	341	92	81	18

TABLE D1-60. (CONT.)

DATE	JULY 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ALOSA AESTIVALIS	48	-	26	22	54
ALOSA PSEUDOHARENGUS	11	-	11	-	100
BREVOORTIA TYRANNUS	121	4	81	36	67
ANCHOA MITCHILLI	306	4	260	42	85
OPSANUS TAU	2	2	-	-	-
RISSOLA MARGINATA	1	1	-	-	-
STRONGYLURA MARINA	34	4	17	13	50
MENIDIA MENIDIA	12	-	8	4	67
SYNGNATHUS FUSCUS	106	91	6	9	6
MORONE AMERICANA	4	-	2	2	50
POMATOMUS SALTATRIX	45	4	23	18	51
CARANX HIPPOS	8	3	4	1	50
SELENE VOMER	31	6	19	6	61
CYNOSCION REGALIS	5	-	5	-	100
LEIOSTOMUS XANTHURUS	48	5	36	7	75
TAUTOGA ONITIS	1	-	-	1	-
PRIONOTUS CAROLINUS	1	-	-	1	-
PARALICHTHYS DENTATUS	3	-	-	3	-
SCOPHTHALMUS AQUOSUS	4	3	-	1	-
PSEUDOPLEURONECTES AMERICANUS	42	3	21	18	50
TRINECTES MACULATUS	1	-	-	1	-
ALUTERUS SCHOEPFI	1	-	-	1	-
SPHOEROIDES MACULATUS	18	14	2	2	11
CHILOMYCTERUS SCHOEPFI	2	2	-	-	-
CLASS POLYCHAETA	1	-	1	-	100
PALAEMONETES VULGARIS	41	35	4	2	10
CRANGON SEPTEMSPINOSA	1	-	1	-	100
LIBINIA DUBIA	1	-	-	1	-
OVALIPES OCELLATUS	7	2	3	2	43
CALLINECTES SAPIDUS	449	280	29	140	6
CALLINECTES SIMILIS	18	12	1	5	6
NEOPANOPE TEXANA	1	-	1	-	100
TOTALS	1374	475	561	338	41

TABLE D1-60. (CONT.)

DATE	AUGUST 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
DASYATIS SAYI	1	-	-	1	-
ANGUILLA ROSTRATA	2	2	-	-	-
ALOSA AESTIVALIS	4	-	3	1	75
ALOSA PSEUDOHARENGUS	4	1	2	1	50
BREVOORTIA TYRANNUS	78	8	44	26	56
ANCHOA HEPSETUS	1	-	1	-	100
ANCHOA MITCHILLI	265	10	227	28	86
OPSANUS TAU	8	8	-	-	-
STRONGYLURA MARINA	34	1	32	1	94
FUNDULUS HETEROCLITUS	1	-	-	1	-
MEMBRAS MARTINICA	2	1	1	-	50
MENIDIA MENIDIA	10	2	6	2	60
SYNGNATHUS FUSCUS	8	7	-	1	-
POMATOMUS SALTATRIX	24	3	20	1	83
CARANX HIPPOS	7	3	3	1	43
SELENE VOMER	32	10	11	11	34
CYNOSCION REGALIS	66	22	32	12	48
LEIOSTOMUS XANTHURUS	124	27	61	36	49
PRIONOTUS CAROLINUS	1	1	-	-	-
PRIONOTUS EVOLANS	2	1	-	1	-
PARALICHTHYS DENTATUS	3	-	-	3	-
TRINECTES MACULATUS	2	2	-	-	-
SPHOEROIDES MACULATUS	3	3	-	-	-
LIMULUS POLYPHEMUS	2	1	-	1	-
PALAEMONETES VULGARIS	2	2	-	-	-
OVALIPES OCELLATUS	3	2	-	1	-
CALLINECTES SAPIDUS	1306	940	42	324	3
CALLINECTES SIMILIS	65	48	2	15	3
NEOPANOPE TEXANA	1	-	1	-	100
PHYLUM NEMERTEA	1	1	-	-	-
TOTALS	2062	1104	488	468	24

TABLE D1-60. (CONT.)

DATE	1-2 SEPTEMBER 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
BREVOORTIA TYRANNUS	3	1	2	-	67
ANCHOA MITCHILLI	10	2	7	1	70
OPSANUS TAU	3	3	-	-	-
SYNGNATHUS FUSCUS	2	1	-	1	-
CYNOSCION REGALIS	5	1	4	-	80
LEIOSTOMUS XANTHURUS	3	1	-	2	-
PRIONOTUS EVOLANS	1	1	-	-	-
CALLINECTES SAPIDUS	90	75	3	12	3
CALLINECTES SIMILIS	1	1	-	-	-
PANOPEUS HERBSTII	1	-	-	1	-
TOTALS	119	86	16	17	13

TABLE D1-61. TOTAL NUMBER AND PERCENT LIVE, DEAD, AND DAMAGED FISHES AND MACROINVERTEBRATES, IMPINGED ON THE TRAVELING SCREENS AT THE OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM 3 SEPTEMBER 1976 THROUGH 3 SEPTEMBER 1977. NO SAMPLES WERE TAKEN 14 MAY THROUGH 12 JULY.

	PERIOD 1[a]				PERIOD 2			
WEEK	NO.	LIVE	DEAD	DAMG	NO.	LIVE	DEAD	DAMG
5 - 11 SEPTEMBER	57	49	33	18	114	61	11	27
12 - 18 SEPTEMBER	124	44	22	35	47	60	11	30
19 - 25 SEPTEMBER	59	34	53	14	84	38	48	14
26 - 2 OCTOBER	116	35	27	38	55	55	22	24
3 - 9 OCTOBER	87	22	53	25	133	32	38	31
10 - 16 OCTOBER	96	24	43	33	86	15	50	35
17 - 23 OCTOBER	85	15	59	26	157	23	32	45
24 - 30 OCTOBER	208	12	27	61	177	8	16	76
31 - 6 NOVEMBER	103	20	39	41	253	31	21	49
7 - 13 NOVEMBER	80	26	25	49	91	37	27	35
14 - 20 NOVEMBER	71	31	34	35	99	33	26	40
21 - 27 NOVEMBER	23	-	39	61	113	17	43	40
28 - 4 DECEMBER	81	25	43	32	49	29	39	33
5 - 11 DECEMBER	35	6	11	83	87	33	24	43
12 - 18 DECEMBER	36	44	31	25	21	19	14	67
19 - 25 DECEMBER	16	6	25	69	119	19	17	64
26 - 1 JANUARY	22	27	27	45	19	42	16	42
2 - 8 JANUARY	-	-	-	-	-	-	-	-
9 - 15 JANUARY	3	33	33	33	4	25	75	-
16 - 22 JANUARY	5	-	20	80	1	100	-	-
23 - 29 JANUARY	1	-	-	100	-	-	-	-
30 - 5 FEBRUARY	-	-	-	-	2	100	-	-
6 - 12 FEBRUARY	-	-	-	-	-	-	-	-
13 - 19 FEBRUARY	4	-	75	25	6	-	50	50
20 - 26 FEBRUARY	4	25	25	50	-	-	-	-
27 - 5 MARCH	16	31	13	56	26	38	12	50
6 - 12 MARCH	36	33	25	42	3	100	-	-
13 - 19 MARCH	-	-	-	-	48	60	40	-
20 - 26 MARCH	118	41	22	37	97	20	25	56
27 - 2 APRIL	1	100	-	-	123	28	30	41
3 - 9 APRIL	36	44	25	31	2	100	-	-
10 - 16 APRIL	83	17	51	33	87	14	66	21
17 - 23 APRIL	112	21	56	23	11	64	9	27
24 - 30 APRIL	2	100	-	-	9	44	22	33
1 - 7 MAY	19	53	21	26	3	67	33	-
8 - 14 MAY	9	22	44	33	15	87	7	7
10 - 16 JULY	-	-	-	-	-	-	-	-
17 - 23 JULY	11	45	27	27	8	63	13	25
24 - 30 JULY	36	42	44	14	78	38	37	24
31 - 6 AUGUST	163	33	46	21	23	39	43	17
7 - 13 AUGUST	48	54	25	21	15	67	-	33
14 - 20 AUGUST	61	46	25	30	27	85	-	15
21 - 27 AUGUST	34	65	15	21	55	67	22	11
28 - 3 SEPTEMBER	13	54	23	23	11	64	-	36
TOTALS	2114	29	35	35	2358	33	28	39

TABLE D1-61. (CONT.)

WEEK	PERIOD 3 NO.	PERIOD 3 LIVE	PERIOD 3 DEAD	PERIOD 3 DAMG	PERIOD 4 NO.	PERIOD 4 LIVE	PERIOD 4 DEAD	PERIOD 4 DAMG
5 - 11 SEPTEMBER	322	63	20	17	166	40	32	28
12 - 18 SEPTEMBER	485	50	23	27	219	34	54	12
19 - 25 SEPTEMBER	332	41	43	15	322	30	54	16
26 - 2 OCTOBER	728	43	35	22	201	62	14	23
3 - 9 OCTOBER	677	33	31	36	396	46	23	30
10 - 16 OCTOBER	802	34	43	24	295	24	46	30
17 - 23 OCTOBER	884	28	45	27	174	37	34	29
24 - 30 OCTOBER	601	15	47	37	173	6	34	60
31 - 6 NOVEMBER	365	22	31	47	255	27	23	51
7 - 13 NOVEMBER	360	14	43	43	280	11	40	49
14 - 20 NOVEMBER	706	44	19	37	378	38	13	48
21 - 27 NOVEMBER	785	37	26	38	163	5	42	53
28 - 4 DECEMBER	769	57	14	29	523	41	24	35
5 - 11 DECEMBER	834	32	40	28	406	19	43	38
12 - 18 DECEMBER	317	52	13	35	284	36	28	36
19 - 25 DECEMBER	581	39	26	35	310	36	30	33
26 - 1 JANUARY	466	62	15	23	211	71	10	19
2 - 8 JANUARY	236	68	19	12	179	72	13	15
9 - 15 JANUARY	154	45	27	28	35	37	60	3
16 - 22 JANUARY	226	66	12	22	70	69	7	24
23 - 29 JANUARY	224	61	21	18	47	66	30	4
30 - 5 FEBRUARY	1	100	-	-	16	44	25	31
6 - 12 FEBRUARY	54	52	41	7	31	55	23	23
13 - 19 FEBRUARY	276	73	17	10	126	51	20	29
20 - 26 FEBRUARY	239	72	10	19	46	78	9	13
27 - 5 MARCH	235	46	17	38	78	51	15	33
6 - 12 MARCH	233	53	15	32	23	9	22	70
13 - 19 MARCH	317	61	21	18	101	62	15	23
20 - 26 MARCH	400	54	11	35	144	43	10	47
27 - 2 APRIL	483	63	19	18	115	81	10	9
3 - 9 APRIL	270	50	11	39	155	61	14	25
10 - 16 APRIL	332	31	44	25	114	31	44	25
17 - 23 APRIL	374	62	26	12	147	61	26	14
24 - 30 APRIL	221	56	29	14	52	81	15	4
1 - 7 MAY	162	69	19	12	62	68	21	11
8 - 14 MAY	210	68	14	18	34	53	26	21
10 - 16 JULY	69	72	7	20	66	76	14	11
17 - 23 JULY	86	51	21	28	34	44	32	24
24 - 30 JULY	732	27	46	27	254	24	52	24
31 - 6 AUGUST	319	42	40	18	93	60	24	16
7 - 13 AUGUST	317	53	28	19	166	70	7	22
14 - 20 AUGUST	267	48	18	34	110	71	5	25
21 - 27 AUGUST	162	64	14	22	65	51	17	32
28 - 3 SEPTEMBER	192	65	15	20	40	75	10	15
TOTALS	16805	45	28	27	7159	41	28	30

TABLE D1-61. (CONT.)

WEEK	TOTALS NO.	LIVE	DEAD	DAMG
5 - 11 SEPTEMBER	659	56	23	22
12 - 18 SEPTEMBER	875	46	30	24
19 - 25 SEPTEMBER	797	36	49	15
26 - 2 OCTOBER	1100	46	30	24
3 - 9 OCTOBER	1293	36	31	33
10 - 16 OCTOBER	1279	29	44	27
17 - 23 OCTOBER	1300	28	43	29
24 - 30 OCTOBER	1159	12	37	51
31 - 6 NOVEMBER	976	25	27	48
7 - 13 NOVEMBER	811	17	38	45
14 - 20 NOVEMBER	1254	41	19	41
21 - 27 NOVEMBER	1084	29	30	41
28 - 4 DECEMBER	1422	48	20	31
5 - 11 DECEMBER	1362	27	39	33
12 - 18 DECEMBER	658	43	21	36
19 - 25 DECEMBER	1026	36	26	38
26 - 1 JANUARY	718	63	14	23
2 - 8 JANUARY	415	70	17	13
9 - 15 JANUARY	196	43	34	23
16 - 22 JANUARY	302	66	11	24
23 - 29 JANUARY	272	61	22	16
30 - 5 FEBRUARY	19	53	21	26
6 - 12 FEBRUARY	85	53	34	13
13 - 19 FEBRUARY	412	64	19	17
20 - 26 FEBRUARY	289	72	10	18
27 - 5 MARCH	355	46	16	39
6 - 12 MARCH	295	48	17	36
13 - 19 MARCH	466	61	21	17
20 - 26 MARCH	759	45	14	40
27 - 2 APRIL	722	60	20	20
3 - 9 APRIL	463	54	13	34
10 - 16 APRIL	616	27	48	25
17 - 23 APRIL	644	55	31	14
24 - 30 APRIL	284	61	26	13
1 - 7 MAY	246	67	20	13
8 - 14 MAY	268	65	16	18
10 - 16 JULY	135	74	10	16
17 - 23 JULY	139	50	24	27
24 - 30 JULY	1100	28	47	25
31 - 6 AUGUST	598	42	39	19
7 - 13 AUGUST	546	59	21	21
14 - 20 AUGUST	465	55	15	30
21 - 27 AUGUST	316	62	16	22
28 - 3 SEPTEMBER	256	66	14	20
TOTALS	28436	42	29	30

[a]Time Period 1 - Sunrise to 6 h before sunset
Time Period 2 - 6h before sunset to sunset
Time Period 3 - Sunset to 6 h after sunset
Time Period 4 - 6 h after sunset to sunrise

Table D1-62. Comparison of the condition of fishes and macroinvertebrates impinged during continuous and intermittent rotation of the OCGS traveling screens in November and December 1976.

	% Dead			% Live		
	Continuous	Intermittent		Continuous	Intermittent	
		Nov.	Dec.		Nov.	Dec.
Brevoortia tyrannus	9	25	19	25	11	4
Menidia menidia	14	44	41	65	29	24
Etropus microstomus	26	30	25	13	29	30
Pseudopleuronectes americanus	2	6	15	90	71	51
Crangon septemspinosa	19	16	18	62	70	73

TABLE D1-63. CATCH FREQUENCY (NUMBER PER COLLECTION) BY TEMPERATURE FOR SELECTED FISHES AND MACROINVERTEBRATES IMPINGED ON THE TRAVELING SCREENS AT THE OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM 8 SEPTEMBER 1975 THROUGH 2 SEPTEMBER 1977. NO SAMPLES WERE TAKEN FROM 24 DECEMBER 1975 THROUGH 7 MARCH 1976 AND FROM 14 MAY THROUGH 12 JULY 1977.

TEMPERATURE	FREQUENCY	CALLINECTES SAPIDUS	CRANGON SEPTEMSPINOSA	BREVOORTIA TYRANNUS	ANCHOA MITCHILLI	MENIDIA MENIDIA	SYNGNATHUS FUSCUS	POMATOMUS SALTATRIX	CYNOSCION REGALIS	PSEUDOPLEURONECTES AMERICANUS
31	2	81	2	1	6		2	1		1
30	7	158	2		8		2			1
29	32	544	63	1	9		1	1		1
28	49	873	147	2	20		2	2	1	3
27	76	787	93	4	21		3	2	6	1
26	81	920	26	5	20		1	2	10	
25	75	1268	19	4	36		1	3	10	
24	75	1199	2	9	49	1	1	4	7	
23	61	1138	26	8	82		1	4	7	
22	59	1150	170	5	485	1	1	4	12	
21	30	459	100	3	699	2	1	2	10	
20	60	558	728	2	473	2	1	2	4	
19	80	721	513	1	756	3	2	4	2	
18	56	315	164	6	411	2	2	3	8	
17	92	367	889	3	328	2	6	2	11	
16	101	162	114	1	334	2	6		4	
15	68	99	55	4	208	3	8	1	13	
14	61	170	120	5	538	11	5		4	1
13	45	283	387	14	720	15	8	1	23	
12	44	238	435	11	487	33	14		2	3
11	75	178	576	19	299	26	10		11	2
10	61	190	160	18	286	25	13		4	

TABLE D1-63. (Cont.)

TEMPERATURE	FREQUENCY	CALLINECTES SAPIDUS	CRANGON SEPTENSPINOSA	BREVOORTIA TYRANNUS	ANCHOA MITCHILLI	MENIDIA MENIDIA	SYNGNATHUS FUSCUS	POMATOMUS SALTATRIX	CYNOSCION REGALIS	PSEUDOPLEURONECTES AMERICANUS
9	58	226	602	34	429	18	15	1	5	1
8	61	39	323	19	99	23	13	1	7	6
7	58	6	1446	77	170	23	24	3	3	2
6	55	2	387	165	12	26	22	1	1	9
5	55		1423	55	5	38	24	1	1	5
4	57	2	1303	26	5	82	23			6
3	53		647	21	1	28	5			10
2	74		1418	16	1	32	3			9
1	79		1260	20		33	4			9
0	37		2433	13		20	2			55
-1	5		1855	8	1	26	2			46
TOTAL	1882	12130	17887	578	7001	476	229	42	165	169

TEMPERATURE	FREQUENCY	PARALICHTHYS DENTATUS	SPHOEROIDES MACULATUS	ALOSA AESTIVALIS	ALOSA PSEUDOHARENGUS	LEIOSTOMUS XANTHURUS	ETROPUS MICROSTOMUS	PRIONOTUS EVOLANS	RISSOLA MARGINATA	PALAEMONETES VULGARIS
31	2					5			1	1
30	7					3				1
29	32					13			1	59
28	49	1				27			4	58
27	76	1				15			3	62
26	81	1				12		1	2	12
25	75	1	1			17		2	2	11
24	75	1	1	1		20		6	1	
23	61	1	1	1	1	12		2	2	8
22	59	1	1	1	1	6		34	1	23
21	30	1		1	1	3		2		8

Table D1-63. (cont.)

TEMPERATURE	FREQUENCY	PARALICHTHYS DENTATUS	SPHOEROIDES MACULATUS	ALOSA AESTIVALIS	ALOSA PSEUDOHARENGUS	LEIOSTOMUS XANTHURUS	ETROPUS MICROSTOMUS	PRIONOTUS EVOLANS	RISSOLA MARGINATA	PALAEMONETES VULGARIS
20	60			1	1	1		19		36
19	80	1	1	1	1			4		42
18	56	1	3	1	1	4	3	25	5	19
17	92	2	1	2	1	1		15		18
16	101	1		1	1			7		10
15	68	2	2	1	1	6		13	6	11
14	61	1		3	2	6		3	1	50
13	45	3		3	2	15		26	3	80
12	44	2		11	5	6	2	2	3	147
11	75	1		10	3	20	26	14	9	111
10	61	1		3	2	12	6	5	4	56
9	58	1		4	2	35	7	4	27	102
8	61	1		5	2	35	13	2	9	60
7	58	1		6	2	40	41	4	21	123
6	55			5	3	45	119	5	23	25
5	55			28	1	19	93	2	21	62
4	57			23	1	14	53	1	8	75
3	53			34		8	35		6	25
2	74			27		3	12		1	12
1	79	1		41		2	11			26
0	37			88		2	7		1	33
-1	5			29		11	61		2	27
TOTAL	1882	25	9	330	32	418	489	198	164	1394

Table DI-[illegible]. Total estimated number, weight (g), and total mortality (immediate and delayed) of *Crangon septemspinosa* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Mortality: Number, Immediate	Mortality: Number, Delayed[a]	Mortality: Weight, Immediate	Mortality: Weight, Delayed[a]	Mortality: Total, Number	Mortality: Total, Weight
September 1975	0	0	-	-	-	-	-	-	-
October	299	297	14[b]	42	33	42	33	75	75
November	13,371	15,550	16	2,407	1,425	2,799	1,658	3,832	4,457
December	1,184,278	1,005,568	15	177,642	130,863	160,835	111,115	308,505	261,950
March 1976	174,143	153,147	10	17,414	20,375	15,315	17,918	37,789	33,233
April	317,298	282,943	9	28,587	37,536	25,465	33,472	66,093	58,937
May	772,904	638,258	5	38,645	95,454	31,913	78,825	134,099	110,738
June	779,717	695,673	4	31,189	97,309	27,827	86,820	128,498	114,647
July	1,603	1,191	14[b]	224	179	167	133	403	300
August	18	16	14[b]	3	2	2	2	5	4
September	21	21	14[b]	3	2	3	2	5	5
October	1,295	1,833	14[b]	181	145	257	205	326	462
November	97,958	88,304	16	15,673	10,697	14,129	9,643	26,370	23,772
December	256,290	249,859	18	48,130	27,320	44,975	26,635	75,450	71,610
January 1977	51,542	50,735	19	9,793	5,427	9,640	5,342	15,220	14,982
February	16,202	16,936	17	2,754	1,748	2,879	1,827	4,502	4,706
March	94,312	104,129	13	12,261	10,667	13,537	11,777	22,928	25,314
April	77,080	88,209	11	8,479	8,918	9,703	10,206	17,397	19,909
May	1,763	1,727	21	370	181	363	177	551	540
July	11	8	14[b]	2	1	1	1	3	2
August	7	4	14[b]	1	1	1	0	2	1
Total	3,810,102[c]	3,394,404[c]	14[b]	391,770	448,283	349,853	395,791	840,053	745,644

[a] Delayed mortality estimate from October 1975 through August 1977 for specimens held in ambient water was 13%.
[b] Estimate from 8 September 1975 through 2 September 1977.
[c] Total number and weight does not equal the total for 2 years (Table DI-47) because each total was a separate estimate (see page DI-294).

Table D1-[illegible]. Total estimated number, weight (g), and total mortality (immediate and delayed) of *Callinectes sapidus* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Mortality					
				Number		Weight		Total	
				Immediate	Delayed[a]	Immediate	Delayed[a]	Number	Weight
September 1975	28,901	920,399	12	3,468	1,017	110,448	32,398	4,485	142,846
October	44,101	1,167,239	9	3,989	1,605	105,052	42,487	5,574	147,539
November	25,970	154,998	3	779	1,008	4,650	6,014	1,787	10,664
December	5,731	8,208	4	229	220	328	315	449	643
March 1976	85,462	124,707	1	855	2,592	1,247	4,938	3,247	6,185
April	204,571	730,908	0	0	8,183	0	29,236	8,183	29,236
May	562,810	3,315,428	8	33,769	21,162	198,926	124,660	54,931	323,586
June	2,093,695	12,998,376	7	146,559	77,885	909,888	483,540	224,444	1,393,428
July	1,094,193	13,170,511	8	98,417	39,829	1,185,348	479,407	138,308	1,664,753
August	920,410	13,661,551	11	101,245	32,787	1,502,771	486,351	134,012	1,989,122
September	135,960	4,318,544	7	9,517	5,058	302,158	160,575	14,575	462,733
October	52,129	1,985,090	4	2,085	2,002	78,604	75,459	4,087	154,063
November	1,151	57,172	7[b]	81	43	4,002	2,127	124	6,129
December	21	320	7[b]	1	1	22	12	2	34
January 1977	8	58	7[b]	1	0	4	2	1	6
February	24	386	7[b]	2	1	27	14	3	41
March	583	10,719	3	17	23	322	418	40	738
April	5,460	115,816	0	0	218	0	4,633	218	4,633
May	1,231	30,712	6	74	46	1,843	1,155	120	2,998
July	14,142	814,918	6	849	532	48,895	30,641	1,381	79,536
August	59,855	4,199,114	3	1,796	2,322	125,973	162,926	4,118	288,899
Total	5,318,408[c]	57,763,172[c]	7[b]	403,573	196,514	4,580,504	2,127,306	600,087	6,707,810

[a] Delayed mortality estimate from October 1975 through August 1977 for specimens held in ambient water was 4%.

[b] Estimate from 8 September 1975 through 2 September 1977.

[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table D1-46. Total estimated number, weight (g), and total mortality (immediate and delayed) of *Anchoa mitchilli* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Mortality					
				Number		Weight		Total	
				Immediate	Delayed[a]	Immediate	Delayed[a]	Number	Weight
September 1975	2,250	5,762	91	2,048	182	5,243	467	2,230	5,710
October	12,502	40,510	79	9,877	2,363	32,003	7,656	12,240	39,659
November	2,435	8,633	51	1,242	1,074	4,403	3,807	2,316	8,210
December	657	1,984	54	355	272	1,071	822	627	1,893
March 1976	38,420	108,238	68	26,128	11,065	73,600	31,172	37,191	104,772
April	1,084,658	3,045,787	73	791,800	263,372	2,223,425	740,126	1,055,372	2,963,551
May	364,044	1,466,908	89	301,999	55,841	1,305,548	145,224	357,840	1,450,772
June	36,949	76,679	90	33,254	3,326	69,011	6,901	36,580	75,912
July	6,207	12,518	98	6,083	112	12,268	225	6,195	12,493
August	12,882	29,601	99	12,753	118	29,305	266	12,869	29,571
September	18,871	44,595	96	18,116	680	42,811	1,606	18,796	44,417
October	62,116	216,372	82	50,935	10,063	177,425	35,052	60,998	212,477
November	9,660	29,524	71	6,859	2,521	20,962	7,706	9,380	28,668
December	244	945	78[b]	190	49	736	186	239	922
January 1977	20	20	78[b]	16	4	16	4	20	20
February	0	0	-	-	-	-	-	-	-
March	0	0	-	-	-	-	-	-	-
April	38,315	137,190	65	24,905	12,069	89,174	43,214	36,974	132,388
May	310	1,032	78[b]	242	61	805	204	303	1,009
July	4,402	12,424	85	3,742	594	10,560	1,678	4,336	12,238
August	18,867	53,163	86	16,226	2,377	45,720	6,699	18,603	52,419
Total	1,913,896[c]	5,291,881[c]	78[b]	1,506,768	366,341	4,144,086	1,033,015	1,873,109	5,177,101

[a] Delayed mortality estimate from October 1975 through August 1977 for specimens held in ambient water was 90%.

[b] Estimate from 8 September 1975 through 2 September 1977.

[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table D1-47. Total estimated number, weight (g), and total mortality (immediate and delayed) of *Brevoortia tyrannus* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Mortality					
				Number		Weight		Total	
				Immediate	Delayed[a]	Immediate	Delayed[a]	Number	Weight
September 1975	27	4,594	28[b]	8	18	1,286	3,143	26	4,429
October	16	945	28[b]	4	11	265	646	15	911
November	98	18,028	28[b]	27	67	5,048	12,331	94	17,379
December	8,992	812,258	26	2,338	6,321	159,187	430,417	8,659	589,604
March 1976	34	27,070	28[b]	26	65	7,580	18,516	91	26,096
April	1,153	179,179	28[b]	323	789	50,170	122,559	1,112	172,729
May	904	109,769	28[b]	253	618	30,735	75,082	871	105,817
June	651	77,453	28[b]	182	446	21,687	52,978	628	74,665
July	4,584	47,545	54	2,475	2,004	25,674	20,777	4,479	46,451
August	952	39,800	28[b]	267	651	11,144	27,223	918	38,367
September	1,031	81,165	73	753	264	59,250	20,819	1,017	80,069
October	36,145	1,635,647	25	9,038	25,754	408,912	1,165,398	34,790	1,574,310
November	45,448	1,868,832	25	11,382	32,382	467,208	1,331,543	43,744	1,798,751
December	6,763	1,108,977	19	1,283	5,204	210,706	853,357	6,489	1,064,063
January 1977	94	4,353	28[b]	26	65	1,219	2,977	91	4,196
February	530	25,481	28[b]	148	363	7,135	17,429	511	24,564
March	1,745	187,513	13	227	1,442	24,377	154,979	1,669	179,356
April	454	86,953	28[b]	127	311	24,347	59,476	438	83,823
May	6	1,857	28[b]	2	4	520	1,270	6	1,790
July	1,254	10,848	67	840	393	7,134	3,338	1,233	10,472
August	3,643	55,329	58	2,113	1,454	32,207	22,158	3,567	54,353
Total	114,584[c]	6,181,596[c]	28[b]	31,822	78,626	1,555,791	4,398,414	110,448	5,952,205

[a] Delayed mortality estimate from October 1975 through August 1977 for specimens held in ambient water was 95%.

[b] Estimate from 8 September 1975 through 2 September 1977.

[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table D1-68. Total estimated number, weight (g), and immediate mortality[a] of Leiostomus xanthurus impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Immediate Mortality Number	Immediate Mortality Weight
September 1975	2	137	48[b]	1	66
October	0	0	-	-	-
November	45	2,575	48[b]	22	1,236
December	12	1,295	48[b]	6	622
March 1976	0	0	-	-	-
April	0	0	-	-	-
May	0	0	-	-	-
June	27,488	73,965	77	21,166	56,953
July	11,313	55,303	57	6,448	31,523
August	4,079	39,512	64	2,611	25,288
September	792	16,094	48[b]	380	7,725
October	22,588	733,033	32	7,228	234,571
November	32,193	1,285,402	22	7,082	282,788
December	1,777	38,415	11	195	4,226
January 1977	12	198	48[b]	6	95
February	32	997	48[b]	15	479
March	44	1,136	48[b]	21	545
April	25	827	48[b]	12	397
May	0	0	-	-	-
July	531	3,163	48[b]	255	1,518
August	4,777	52,546	49	2,341	25,748
Total	105,710[c]	2,304,598[c]	48[b]	47,789	673,780

a No delayed mortality estimate due to an insufficient number of specimens.
b Estimate from 8 September 1975 through 2 September 1977.
c Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table D1-69. Total estimated number, weight (g), and immediate mortality[a] of Etropus microstomus impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Immediate Mortality	
				Number	Weight
September 1975	2	19	26[b]	1	5
October	5	76	26[b]	1	20
November	1,308	9,702	18	235	1,746
December	7,537	48,610	17	1,281	8,264
March 1976	4	30	26[b]	1	8
April	25	111	26[b]	7	29
May	7	65	26[b]	2	17
June	0	0	-	-	-
July	0	0	-	-	-
August	5	51	26[b]	1	13
September	22	126	26[b]	6	33
October	1,835	10,469	26[b]	477	2,722
November	50,351	324,022	30	15,105	97,207
December	6,373	30,153	25	1,593	7,538
January 1977	12	25	26[b]	3	7
February	2	12	26[b]	1	3
March	0	0	-	-	-
April	0	0	-	-	-
May	0	0	-	-	-
July	0	0	-	-	-
August	0	0	-	-	-
Total	67,488[c]	423,471[c]	26[b]	18,714	117,612

[a] No delayed mortality estimate due to an insufficient number of specimens.

[b] Estimate from 8 September 1975 through 2 September 1977.

[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table DI-70. Total estimated number, weight (g), and total mortality (immediate and delayed) of *Menidia menidia* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Mortality: Number, Immediate	Mortality: Number, Delayed[a]	Mortality: Weight, Immediate	Mortality: Weight, Delayed[a]	Mortality: Total, Number	Mortality: Total, Weight
September 1975	2	6	38[b]	1	0	2	1	1	3
October	42	154	38[b]	16	7	59	26	23	85
November	759	2,869	38[b]	288	127	1,098	484	415	1,582
December	19,835	87,091	30	8,951	3,749	26,127	16,460	9,700	42,587
March 1976	26,119	138,625	61	13,321	3,455	70,699	18,340	16,776	89,039
April	5,724	35,505	61	3,492	603	21,658	3,739	4,095	25,397
May	4,745	30,109	61	3,843	244	24,383	1,544	4,087	25,927
June	292	1,821	38[b]	111	49	692	305	160	997
July	9	35	38[b]	3	2	13	6	5	19
August	0	0	-	-	-	-	-	-	-
September	24	78	38[b]	9	4	30	13	13	43
October	849	4,543	38[b]	323	142	1,726	761	465	2,487
November	10,402	50,552	44	4,577	1,573	22,243	7,643	6,150	29,886
December	4,248	19,778	41	1,742	677	8,109	3,151	2,419	11,260
January 1977	215	789	38[b]	82	36	300	132	118	432
February	401	1,972	38[b]	152	67	749	330	219	1,079
March	9,861	54,737	30	2,958	1,864	16,421	10,345	4,822	26,766
April	8,148	46,758	25	2,037	1,650	12,189	9,873	3,687	22,062
May	19	124	38[b]	7	3	47	21	10	68
July	79	193	38[b]	30	13	73	32	43	105
August	341	828	38[b]	130	57	314	138	187	452
Total	92,114[c]	478,376[c]	38[b]	39,073	14,322	206,932	73,344	53,395	280,276

[a] Delayed mortality estimate from October 1975 through August 1977 for specimens held in ambient water was 27%.

[b] Estimate from 8 September 1975 through 2 September 1977.

[c] Total number and weight does not equal the total for 2 years (Table DI-47) because each total was a separate estimate (see page DI-294).

Table D1-71. Total estimated number, weight (g), and immediate mortality[a] of *Palaemonetes vulgaris* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Immediate Mortality	
				Number	Weight
September 1975	15	10	8[b]	1	1
October	115	66	8[b]	9	5
November	4,817	3,052	8	385	244
December	37,258	22,229	9	3,353	2,001
March 1976	75,034	44,446	7	5,252	3,111
April	40,376	25,398	2	808	508
May	37,751	30,231	8[b]	3,020	2,418
June	144,512	94,610	5	7,226	4,731
July	3,411	2,485	8[b]	273	199
August	18	18	8[b]	1	1
September	7	7	8[b]	1	1
October	3,538	1,686	8[b]	283	135
November	3,376	2,120	8[b]	270	170
December	5,407	3,364	8[b]	433	269
January 1977	2,294	1,242	8[b]	184	99
February	1,270	829	8[b]	102	66
March	8,188	4,826	7	573	338
April	5,020	3,333	8[b]	402	267
May	317	230	8[b]	25	18
July	275	188	8[b]	22	15
August	124	92	8[b]	10	7
Total	373,123[c]	240,462[c]	8[b]	22,633	14,604

[a] No delayed mortality estimate due to an insufficient number of specimens.
[b] Estimate from 8 September 1975 through 2 September 1977.
[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table D1-72. Total estimated number, weight (g), and total mortality[a] of Prionotus evolans impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Number	Weight	Immediate Mortality (%)	Immediate and Total Mortality	
				Number	Weight
September 1975	394	4,050	18[b]	71	729
October	2,197	32,141	14	308	4,500
November	1,562	30,333	6	94	1,820
December	302	6,433	18[b]	54	1,158
March 1976	0	0	-	-	-
April	13	973	18[b]	2	175
May	156	36,741	18[b]	28	6,613
June	222	29,457	18[b]	40	5,302
July	34	7,579	18[b]	6	1,364
August	18,480	152,549	57	10,534	86,953
September	5,824	101,731	23	1,340	23,398
October	24,858	431,607	13	3,232	56,109
November	1,833	21,437	20	367	4,287
December	43	676	18[b]	8	122
January 1977	0	0	-	-	-
February	0	0	-	-	-
March	0	0	-	-	-
April	0	0	-	-	-
May	0	0	-	-	-
July	2	738	18[b]	0	133
August	68	8,160	18[b]	12	1,469
Total	55,988[c]	864,605[c]	18[b]	16,096	194,132

[a] Delayed mortality estimate from October 1975 through August 1977 for specimens held in ambient water was 0%.
[b] Estimate from 8 September 1975 through 2 September 1977.
[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table D1-73. Total estimated number, weight (g), and total mortality (immediate and delayed) of *Alosa aestivalis* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1976 through August 1977. No samples were taken 24 December 1976 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Mortality					
				Number		Weight		Total	
				Immediate	Delayed[a]	Immediate	Delayed[a]	Number	Weight
September 1976	29	423	42[b]	12	7	178	103	19	281
October	27	603	42[b]	11	7	253	147	18	400
November	89	2,219	42[b]	37	22	932	541	59	1,473
December	16,044	63,185	49	7,862	3,436	30,951	13,530	11,298	44,481
March 1976	7,100	67,824	34	2,414	1,966	22,992	18,745	4,382	41,737
April	2,071	69,308	42[b]	870	504	29,109	16,883	1,374	45,992
May	1,934	43,777	42[b]	812	471	18,386	10,664	1,283	29,050
June	525	9,589	42[b]	221	128	4,027	2,336	349	6,363
July	3	18	42[b]	1	1	6	4	2	10
August	13	119	42[b]	6	4	50	29	10	79
September	9	108	42[b]	4	2	45	26	6	71
October	163	2,324	42[b]	69	40	976	566	108	1,542
November	340	3,880	42[b]	143	83	1,630	945	226	2,575
December	20,809	86,418	45	9,364	4,807	38,888	19,903	14,171	58,851
January 1977	66	337	42[b]	28	16	142	82	44	224
February	421	1,935	42[b]	177	102	813	471	279	1,284
March	1,917	23,240	18	345	660	4,183	8,004	1,005	12,187
April	1,860	63,350	23	428	601	14,571	20,487	1,029	35,058
May	54	3,293	42[b]	23	13	1,383	802	36	2,185
July	406	5,132	42[b]	171	99	2,185	1,250	270	3,405
August	254	2,896	42[b]	107	62	1,216	706	169	1,922
Total	54,136[c]	449,753[c]	42[b]	23,104	13,033	172,886	116,284	36,137	289,170

[a] Delayed mortality estimate from October 1975 through August 1977 for *Alosa* spp. held in ambient water was 42%.

[b] Estimate from 8 September 1975 through 2 September 1977.

[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table DI-74. Total estimated number, weight (g), and total mortality (immediate and delayed) of *Synagnathus fuscus* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Mortality					
				Number		Weight		Total	
				Immediate	Delayed[a]	Immediate	Delayed[a]	Number	Weight
September 1975	29	126	3[b]	1	6	6	25	7	31
October	118	432	3[b]	6	24	22	86	30	108
November	3,924	7,881	4	157	791	318	1,589	948	1,904
December	10,557	21,654	4	422	2,128	868	4,365	2,550	5,231
March 1976	8,200	16,231	4	328	1,653	729	3,675	1,981	4,404
April	5,463	14,117	3	164	1,113	424	2,876	1,277	3,300
May	3,686	11,990	3	111	751	360	2,442	862	2,802
June	2,576	7,246	3[b]	129	614	362	1,445	643	1,807
July	486	1,221	3[b]	24	462	61	244	486	305
August	81	370	3[b]	4	16	19	74	20	93
September	131	276	3[b]	7	124	14	55	131	69
October	1,705	4,208	3[b]	85	340	210	840	426	1,050
November	3,169	6,602	3[b]	158	632	330	1,317	790	1,647
December	376	635	3[b]	19	75	32	106	94	138
January 1977	7	7	3[b]	0	1	0	1	1	1
February	0	0	-	-	-	-	-	-	-
March	310	726	3[b]	16	62	36	145	78	181
April	2,904	6,229	2	58	598	125	6,104	656	6,229
May	1,082	2,973	9	97	207	268	568	304	838
July	1,123	2,692	6	67	222	162	531	289	693
August	484	1,016	3[b]	24	97	51	203	121	254
Total	46,410[c]	108,831[c]	3[b]	1,877	9,816	4,392	26,691	11,693	31,053

[a] Delayed mortality estimate from October 1976 through August 1977 for specimens held in ambient water was 21%.
[b] Estimate from 8 September 1975 through 2 September 1977.
[c] Total number and weight does not equal the total for 2 years (Table DI-47) because each total was a separate estimate (see page DI-294).

Table D1-75. Total estimated number, weight (g), and immediate mortality[a] of Pomatomus saltatrix impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Immediate Mortality Number	Immediate Mortality Weight
September 1975	79	2,758	59[b]	47	1,627
October	77	2,717	59[b]	45	1,603
November	161	9,456	59[b]	95	5,579
December	24	2,571	59[b]	14	1,517
March 1976	0	0	-	-	-
April	0	0	-	-	-
May	3,354	3,065	58	1,945	1,778
June	7,645	12,873	60	4,587	7,724
July	693	6,099	59[b]	409	3,598
August	818	19,215	59[b]	483	11,337
September	551	23,993	59[b]	325	14,156
October	1,919	97,765	46	883	44,972
November	339	18,088	59[b]	200	10,672
December	0	0	-	-	-
January 1977	0	0	-	-	-
February	0	0	-	-	-
March	0	0	-	-	-
April	10	30	59[b]	6	18
May	0	0	-	-	-
July	555	5,925	59[b]	327	3,496
August	704	11,956	59[b]	415	7,054
Total	16,929[c]	216,511[c]	59[b]	9,781	115,131

a No delayed mortality estimate due to an insufficient number of specimens.

b Estimate from 8 September 1975 through 2 September 1977.

c Total number and weight does not equal the total for 2 years (Table D1-47) because each table was a separate estimate (see page D1-294).

Table D1-76. Total estimated number, weight (g), and immediate mortality[a] of Cynoscion regalis impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Immediate Mortality	
				Number	Weight
September 1975	713	16,014	59[b]	421	9,448
October	1,360	16,767	51	694	8,551
November	2,758	84,630	38	1,048	32,159
December	88	1,886	59[b]	52	1,113
March 1976	0	0	-	-	-
April	3	2,069	59[b]	2	1,221
May	5	295	59[b]	3	174
June	265	4,504	59[b]	156	2,657
July	185	34,803	59[b]	109	20,534
August	6,229	28,671	80	4,983	22,937
September	2,521	39,030	64	1,613	24,979
October	18,183	460,789	61	11,092	281,081
November	1,289	70,988	59[b]	761	41,883
December	0	0	-	-	-
January 1977	0	0	-	-	-
February	0	0	-	-	-
March	0	0	-	-	-
April	0	0	-	-	-
May	0	0	-	-	-
July	36	420	59[b]	21	248
August	6,002	17,166	48	2,881	8,240
Total	39,637[c]	778,032[c]	59[b]	23,836	455,225

[a] No delayed mortality estimate due to an insufficient number of specimens.
[b] Estimate from 8 September 1975 through 2 September 1977.
[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table D1-77. Total estimated number, weight (g), and immediate mortality[a] of *Paralichthys dentatus* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Immediate Mortality	
				Number	Weight
September 1975	120	15,227	9[b]	11	1,370
October	572	101,291	9[b]	51	9,116
November	1,248	207,620	2	25	4,152
December	508	18,030	9[b]	46	1,623
March 1976	45	5,055	9[b]	4	455
April	148	29,488	9[b]	13	2,654
May	446	131,292	9[b]	40	11,816
June	451	129,694	9[b]	41	11,672
July	193	62,547	9[b]	17	5,629
August	713	222,547	9[b]	64	20,029
September	367	80,833	9[b]	33	7,275
October	1,502	415,834	9[b]	135	37,425
November	120	37,706	9[b]	11	3,394
December	21	8,937	9[b]	2	804
January 1977	0	0	-	-	-
February	0	0	-	-	-
March	0	0	-	-	-
April	124	25,734	9[b]	11	2,316
May	0	0	-	-	-
July	80	13,558	9[b]	7	1,220
August	353	60,382	9[b]	32	5,434
Total	7,011[c]	1,565,775[c]	9[b]	543	126,384

[a] No delayed mortality estimate due to an insufficient number of specimens.
[b] Estimate from 8 September 1975 through 2 September 1977.
[c] Total number and weight does not equal the total for 2 years (Table D1-47) because each total was a separate estimate (see page D1-294).

Table DI-78. Total estimated number, weight (g), and total mortality (immediate and delayed) of *Pseudopleuronectes americanus* impinged by month on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

	Total Number	Total Weight	Immediate Mortality (%)	Mortality: Number, Immediate	Mortality: Number, Delayed[a]	Mortality: Weight, Immediate	Mortality: Weight, Delayed[a]	Mortality: Total, Number	Mortality: Total, Weight
September 1975	0	0	-	-	-	-	-	-	-
October	3	440	15[b]	0	0	66	30	0	96
November	172	28,244	15[b]	26	12	4,237	1,921	38	6,158
December	376	80,756	15[b]	56	26	12,115	5,491	82	17,604
March 1976	282	49,130	15[b]	42	19	7,370	3,341	61	10,711
April	118	64,522	15[b]	18	8	9,676	4,388	26	14,066
May	258	71,034	15[b]	39	18	10,655	4,830	57	15,485
June	3,131	50,481	15[b]	320	145	7,572	3,433	465	11,005
July	122	509	15[b]	18	8	76	35	26	111
August	119	894	15[b]	18	8	104	47	26	151
September	16	550	15[b]	2	1	83	37	3	120
October	94	16,101	15[b]	14	6	2,415	1,095	20	3,510
November	1,676	62,407	15[b]	281	128	9,361	4,244	409	13,605
December	9,873	719,316	15	1,481	671	107,897	48,914	2,152	156,811
January 1977	2,449	118,225	8	196	180	9,458	8,701	376	18,159
February	1,506	289,483	15[b]	226	102	43,422	19,685	328	63,107
March	1,747	112,026	0	0	140	0	8,962	140	8,962
April	781	66,404	15[b]	117	664	9,961	4,515	781	14,476
May	0	0	-	-	-	-	-	-	-
July	948	2,011	15[b]	52	24	302	137	76	439
August	19	1,114	15[b]	3	1	167	76	4	243
Total	22,290[c]	1,733,447[c]	15[b]	2,909	2,161	234,937	119,882	5,070	354,819

[a] Delayed mortality estimate from October 1975 through August 1977 for specimens held in ambient water was 8%.
[b] Estimate from 8 September 1975 through 2 September 1977.
[c] Total number and weight does not equal the total fro 2 years (Table DI-47) because each total was a separate estimate (see page DI-294).

Table III-19. Total number of fishes and macroinvertebrates collected in the discharge of the dilution pump by month at Oyster Creek Generating Station, Forked River, New Jersey from 7 September 1976 through 7 September 1977.

	September	October	November	December	January	February	March	April	May	June	July	August	September	Totals
Fish														
Elops saurus	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Anguilla rostrata	1	4	8	13	2	-	-	7	2	6	5	7	2	57
Conger oceanicus	-	1	1	-	-	-	-	-	-	-	-	-	-	2
Alosa aestivalis	-	1	-	16	-	-	4	7	-	2	1	2	2	35
Alosa pseudoharengus	-	1	1	-	-	-	2	2	-	2	8	1	-	17
Brevoortia tyrannus	55	110	46	2	-	3	163	216	17	3	9	135	6	764
Clupea harengus	-	14	-	-	-	-	-	-	-	-	-	-	-	14
Anchoa hepsetus	-	-	1	-	-	-	-	-	-	-	-	-	1	2
Anchoa mitchilli	33	49	14	-	-	-	-	261	158	180	201	72	126	1094
Synodus foetens	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Opsanus tau	-	4	1	-	-	-	-	-	-	-	1	-	-	6
Urophycis regius	-	-	2	-	-	-	-	-	-	-	-	-	-	2
Urophycis tenuis	-	-	-	2	-	-	-	-	-	-	-	-	-	2
Rissola marginata	-	14	53	6	-	-	-	-	-	155	76	63	-	367
Strongylura marina	1	-	1	-	-	-	-	-	-	1	-	2	1	6
Fundulus heteroclitus	-	1	-	2	-	6	2	5	-	-	-	-	-	16
Menidia beryllina	-	-	-	-	-	-	-	-	-	-	-	2	-	2
Menidia menidia	-	-	-	1	-	-	-	1	-	-	-	-	1	3
Apeltes quadracus	1	-	14	58	-	4	17	19	1	2	16	11	1	144
Gasterosteus aculeatus	-	-	1	11	2	-	1	1	-	-	-	-	-	16
Fistularia tabacaria	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Syngnathus fuscus	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Morone americana	-	2	14	5	-	-	4	46	21	12	51	4	-	159
Centropristis striata	-	2	8	1	-	4	10	35	1	1	-	1	-	61
Pomatomus saltatrix	-	9	14	-	-	-	-	-	-	-	-	2	-	25
Caranx hippos	11	19	2	1	-	-	-	-	-	22	26	12	1	94
Selene vomer	-	3	-	-	-	-	-	-	-	-	1	3	-	7
Stenotomus chrysops	2	1	-	-	-	-	-	-	-	-	1	1	-	5
Bairdiella chrysura	-	-	3	-	-	-	-	-	-	-	-	1	-	4
Cynoscion regalis	-	3	-	-	-	-	-	-	-	-	-	-	-	3
Leiostomus xanthurus	11	39	4	-	-	-	-	-	-	-	3	46	9	112
Menticirrhus saxatilis	45	144	203	-	-	1	7	8	126	31	150	778	10	1503
Micropogon undulatus	-	1	-	-	-	-	-	-	-	-	-	1	-	2
Chaetodon ocellatus	-	-	-	3	-	-	-	-	-	-	-	-	-	3
Tautoga onitis	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Tautogolabrus adspersus	-	-	10	7	-	-	-	-	-	-	1	-	-	18
Mugil cephalus	-	-	-	2	-	-	-	-	-	-	-	-	-	2
Mugil curema	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Astroscopus guttatus	-	1	-	-	-	-	-	-	-	1	-	-	-	2
Chasmodes bosquianus	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Hypsoblennius hentzi	-	-	2	-	-	-	-	-	-	-	-	-	-	2
Ammodytes sp.	-	2	21	-	-	-	-	-	-	-	-	-	-	23
Peprilus triacanthus	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Prionotus carolinus	-	1	-	-	-	-	-	-	-	-	-	-	-	1
Prionotus evolans	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Myoxocephalus octodecemspinosus	10	39	11	-	-	-	-	-	-	-	-	-	-	60
Etropus microstomus	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Paralichthys dentatus	-	1	226	29	-	-	-	-	-	-	-	-	-	256
Paralichthys oblongus	3	10	2	-	-	-	-	1	1	-	-	4	-	21
Scophthalmus aquosus	-	3	-	-	-	-	-	-	-	-	-	-	-	3
Pseudopleuronectes americanus	-	-	1	5	-	-	2	1	1	-	1	-	-	11
Trinectes maculatus	-	-	127	466	31	80	6	9	-	3	-	-	-	722
Symphurus plagiusa	1	1	1	-	-	-	-	1	-	3	-	-	-	7
Monacanthus hispidus	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Sphoeroides maculatus	-	-	-	-	-	-	-	-	-	-	1	-	-	1
Fish fragments	-	2	-	-	-	-	-	-	-	1	1	-	-	4
Totals	1	-	2	-	1	-	1	4	2	1	-	-	-	12
Taxa	176	485	795	632	36	99	219	623	330	428	553	1149	100	5671
	13	32	31	20	3	7	11	16	9	16	18	21	11	56

Table D1-79. (cont.)

	September	October	November	December	January	February	March	April	May	June	July	August	September	Totals
Invertebrates														
Cyanea capillata	-	-	-	-	-	-	-	-	11	-	-	-	-	11
Lolliguncula brevis	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Class Polychaeta	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Penaeus aztecus	-	6	-	-	-	-	-	-	-	-	-	-	-	6
Palaemonetes vulgaris	-	-	-	36	5	11	44	78	41	34	12	2	-	263
Crangon septemspinosa	-	-	131	3245	71	91	147	1186	246	165	7	1	-	5289
Libinia dubia	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Ovalipes ocellatus	1	1	-	-	-	-	-	2	-	5	-	-	1	10
Callinectes sapidus	779	144	1	-	-	-	1	34	26	196	190	155	23	1549
Callinectes similis	-	3	-	-	-	-	-	-	-	-	-	2	2	7
Invertebrate fragments	-	-	-	-	-	-	-	-	2	-	-	-	-	2
Totals	781	154	132	3281	76	103	192	1300	325	401	209	160	26	7136
Taxa	3	4	2	2	2	3	2	4	4	5	3	4	2	10
Grand Totals	957	639	927	3013	112	202	411	1923	655	827	762	1309	186	12826
Taxa	16	36	33	22	5	10	14	20	13	21	21	25	14	56

Table D1-80. Results of Wilcoxon's Signed-Rank Test for the catch of abundant fishes and macroinvertebrates in surface and bottom collections in the dilution pump discharge at Oyster Creek Generating Station, Forked River, New Jersey from 10 through 24 October 1977.

	Number of Pairs	Results of Test ($P \leq 0.05$)
Anchoa mitchilli	27	B > S
Menidia menidia	11	N. S.
Syngnathus fuscus	16	B > S
Callinectes sapidus	27	N. S.

Table D1-41. Comparison of live, dead, and damaged fishes and macroinvertebrates passed through the dilution pump and impinged on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey, from 4 October 1976 through 7 September 1977.

Species	Dilution Pump				Impingement			
	Number	% Live	% Damaged	% Dead	Number	% Live	% Damaged	% Dead
Brevoortia tyrannus	332[a]	66	30	4	2388	9	64	27
Anchoa mitchilli	768	9	28	63	3460	4	15	81
Rissola marginata	309	94	5	1	404	44	45	11
Menidia menidia	141	59	30	11	1701	33	32	35
Syngnathus fuscus	158	96	2	2	477	84	10	6
Pomatomus saltatrix	75	34	41	25	149	8	38	54
Cynoscion regalis	78	47	24	29	834	14	27	59
Leiostomus xanthurus	854	83	13	4	1290	14	56	30
Etropus microstomus	228	74	24	2	1655	29	42	29
Pseudopleuronectes americanus	720	99	1	0	617	45	41	14
Crangon septemspinosa	3051	92	2	6	5442	83	1	16
Callinectes sapidus	770	68	25	7	4943	66	29	5

[a] All months except March and April.

TABLE D1-82. TOTAL NUMBER OF LIVE, DEAD, AND DAMAGED FISHES AND MACROINVERTEBRATES COLLECTED IN THE DISCHARGE OF THE DILUTION PUMP AT AT OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM OCTOBER 1976 THROUGH 7 SEPTEMBER 1977.

SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	56	44	1	11	2
CONGER OCEANICUS	2	2	-	-	-
ALOSA AESTIVALIS	35	13	4	18	11
ALOSA PSEUDOHARENGUS	17	8	4	5	24
BREVOORTIA TYRANNUS	659	529	13	117	2
ANCHOA HEPSETUS	2	-	2	-	100
ANCHOA MITCHILLI	768	70	480	218	63
SYNODUS FOETENS	1	1	-	-	-
OPSANUS TAU	6	6	-	-	-
UROPHYCIS REGIUS	2	2	-	-	-
RISSOLA MARGINATA	309	290	2	17	1
STRONGYLURA MARINA	5	-	3	2	60
FUNDULUS HETEROCLITUS	16	14	1	1	6
MEMBRAS MARTINICA	2	1	-	1	-
MENIDIA BERYLLINA	3	2	1	-	33
MENIDIA MENIDIA	141	83	16	42	11
APELTES QUADRACUS	16	15	1	-	6
GASTEROSTEUS ACULEATUS	1	1	-	-	-
FISTULARIA TABACARIA	1	-	1	-	100
SYNGNATHUS FUSCUS	158	151	3	4	2
MORONE AMERICANA	61	49	3	9	5
CENTROPRISTIS STRIATA	19	16	-	3	-
POMATOMUS SALTATRIX	75	25	19	31	25
CARANX HIPPOS	6	5	-	1	-
SELENE VOMER	3	1	-	2	-
STENOTOMUS CHRYSOPS	4	4	-	-	-
BAIRDIELLA CHRYSURA	3	3	-	-	-
CYNOSCION REGALIS	79	37	23	19	29
LEIOSTOMUS XANTHURUS	854	710	36	108	4
MENTICIRRHUS SAXATILIS	2	1	1	-	50
MICROPOGON UNDULATUS	3	2	1	-	33
CHAETODON OCELLATUS	1	1	-	-	-
TAUTOGA ONITIS	19	17	-	2	-
TAUTOGOLABRUS ADSPERSUS	2	2	-	-	-
MUGIL CUREMA	2	2	-	-	-
ASTROSCOPUS GUTTATUS	1	1	-	-	-
CHASMODES BOSQUIANUS	2	2	-	-	-
HYPSOBLENNIUS HENTZI	23	20	-	3	-
AMMODYTES SP.	1	-	-	1	-
PEPRILUS TRIACANTHUS	1	1	-	-	-
PRIONOTUS CAROLINUS	1	1	-	-	-
PRIONOTUS EVOLANS	50	42	2	6	4
MYOXOCEPHALUS OCTODECEMSPINOSUS	1	1	-	-	-
ETROPUS MICROSTOMUS	226	165	5	56	2

TABLE D1-82. (CONT.)

PARALICHTHYS DENTATUS	19	14	-	5	-
PARALICHTHYS OBLONGUS	3	3	-	-	-
SCOPHTHALMUS AQUOSUS	11	6	-	5	-
PSEUDOPLEURONECTES AMERICANUS	720	707	3	10	0
TRINECTES MACULATUS	6	6	-	-	-
SYMPHURUS PLAGIUSA	1	-	-	1	-
MONACANTHUS HISPIDUS	1	1	-	-	-
SPHOEROIDES MACULATUS	4	4	-	-	-
FISH FRAGMENTS	1	1	-	-	-
CLASS POLYCHAETA	1	1	-	-	-
PENAEUS AZTECUS	6	6	-	-	-
PALAEMONETES VULGARIS	257	231	22	4	9
CRANGON SEPTEMSPINOSA	3051	2818	170	63	6
LIBINIA DUBIA	1	1	-	-	-
OVALIPES OCELLATUS	9	5	-	4	-
CALLINECTES SAPIDUS	770	530	51	189	7
CALLINECTES SIMILIS	8	7	-	1	-
TOTALS	8508	6681	868	959	10

TABLE D1-83. TOTAL NUMBER OF LIVE, DEAD, AND DAMAGED FISHES AND MACROINVERTEBRATES COLLECTED IN THE DISCHARGE OF THE DILUTION PUMP BY MONTH AS OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM OCTOBER 1976 THROUGH 7 SEPTEMBER 1977.

MONTH	OCTOBER 1976				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	4	3	1	-	25
CONGER OCEANICUS	1	1	-	-	-
ALOSA AESTIVALIS	1	1	-	-	-
ALOSA PSEUDOHARENGUS	1	-	-	1	-
BREVOORTIA TYRANNUS	124	90	3	31	2
ANCHOA MITCHILLI	49	7	31	11	63
SYNODUS FOETENS	1	1	-	-	-
OPSANUS TAU	4	4	-	-	-
RISSOLA MARGINATA	14	13	-	1	-
FUNDULUS HETEROCLITUS	1	1	-	-	-
FISTULARIA TABACARIA	1	-	1	-	100
SYNGNATHUS FUSCUS	2	2	-	-	-
MORONE AMERICANA	2	1	-	1	-
CENTROPRISTIS STRIATA	9	9	-	-	-
POMATOMUS SALTATRIX	19	12	1	6	5
CARANX HIPPOS	3	3	-	-	-
SELENE VOMER	1	1	-	-	-
BAIRDIELLA CHRYSURA	3	3	-	-	-
CYNOSCION REGALIS	39	25	6	8	15
LEIOSTOMUS XANTHURUS	144	138	1	5	1
MENTICIRRHUS SAXATILIS	1	1	-	-	-
CHAETODON OCELLATUS	1	1	-	-	-
MUGIL CUREMA	1	1	-	-	-
HYPSOBLENNIUS HENTZI	2	2	-	-	-
PEPRILUS TRIACANTHUS	1	1	-	-	-
PRIONOTUS EVOLANS	39	37	2	-	5
ETROPUS MICROSTOMUS	1	-	-	1	-
PARALICHTHYS DENTATUS	10	8	-	2	-
PARALICHTHYS OBLONGUS	3	3	-	-	-
TRINECTES MACULATUS	1	1	-	-	-
SPHOEROIDES MACULATUS	2	2	-	-	-
PENAEUS AZTECUS	6	6	-	-	-
OVALIPES OCELLATUS	1	1	-	-	-
CALLINECTES SAPIDUS	144	98	9	37	6
CALLINECTES SIMILIS	3	2	-	1	-
TOTALS	639	479	55	105	9

TABLE D1-83. (CONT.)

MONTH	NOVEMBER 1976				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	8	7	-	1	-
CONGER OCEANICUS	1	1	-	-	-
ALOSA PSEUDOHARENGUS	1	1	-	-	-
BREVOORTIA TYRANNUS	46	25	7	14	15
ANCHOA HEPSETUS	1	-	1	-	100
ANCHOA MITCHILLI	14	-	9	5	64
OPSANUS TAU	1	1	-	-	-
UROPHYCIS REGIUS	2	2	-	-	-
RISSOLA MARGINATA	53	41	1	11	2
STRONGYLURA MARINA	1	-	-	1	-
MENIDIA MENIDIA	14	8	3	3	21
APELTES QUADRACUS	1	-	1	-	100
SYNGNATHUS FUSCUS	14	13	-	1	-
MORONE AMERICANA	6	4	-	2	-
CENTROPRISTIS STRIATA	8	6	-	2	-
POMATOMUS SALTATRIX	2	2	-	-	-
STENOTOMUS CHRYSOPS	3	3	-	-	-
CYNOSCION REGALIS	4	3	-	1	-
LEIOSTOMUS XANTHURUS	204	186	6	12	3
TAUTOGA ONITIS	11	10	-	1	-
ASTROSCOPUS GUTTATUS	1	1	-	-	-
CHASMODES BOSQUIANUS	2	2	-	-	-
HYPSOBLENNIUS HENTZI	21	18	-	3	-
PRIONOTUS CAROLINUS	1	1	-	-	-
PRIONOTUS EVOLANS	11	5	-	6	-
ETROPUS MICROSTOMUS	196	153	4	39	2
PARALICHTHYS DENTATUS	3	2	-	1	-
SCOPHTHALMUS AQUOSUS	1	1	-	-	-
PSEUDOPLEURONECTES AMERICANUS	127	126	-	1	-
TRINECTES MACULATUS	1	1	-	-	-
SYMPHURUS PLAGIUSA	1	-	-	1	-
FISH FRAGMENTS	1	1	-	-	-
CRANGON SEPTEMSPINOSA	132	115	14	3	11
CALLINECTES SAPIDUS	1	1	-	-	-
TOTALS	894	740	46	108	5

TABLE D1-83. (CONT.)

MONTH	DECEMBER 1976				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	13	9	-	4	-
ALOSA AESTIVALIS	16	4	1	11	6
BREVOORTIA TYRANNUS	2	-	1	1	50
RISSOLA MARGINATA	8	5	1	2	13
FUNDULUS HETEROCLITUS	2	2	-	-	-
MENIDIA BERYLLINA	1	1	-	-	-
MENIDIA MENIDIA	58	31	-	27	-
APELTES QUADRACUS	11	11	-	-	-
SYNGNATHUS FUSCUS	5	5	-	-	-
MORONE AMERICANA	1	1	-	-	-
POMATOMUS SALTATRIX	1	-	-	1	-
MICROPOGON UNDULATUS	3	2	1	-	33
TAUTOGA ONITIS	7	7	-	-	-
TAUTOGOLABRUS ADSPERSUS	2	2	-	-	-
AMMODYTES SP.	1	-	-	1	-
MYOXOCEPHALUS OCTODECEMSPINOSUS	1	1	-	-	-
ETROPUS MICROSTOMUS	29	12	1	16	3
SCOPHTHALMUS AQUOSUS	5	-	-	5	-
PSEUDOPLEURONECTES AMERICANUS	466	457	2	7	0
PALAEMONETES VULGARIS	36	27	6	3	17
CRANGON SEPTEMSPINOSA	1833	1724	73	36	4
TOTALS	2501	2301	86	114	3

TABLE D1-83. (CONT.)

MONTH	JANUARY 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	2	1	-	1	-
APELTES QUADRACUS	2	2	-	-	-
PSEUDOPLEURONECTES AMERICANUS	31	31	-	-	-
PALAEMONETES VULGARIS	5	3	2	-	40
CRANGON SEPTEMSPINOSA	71	51	20	-	28
TOTALS	111	88	22	1	20

MONTH	FEBRUARY 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
BREVOORTIA TYRANNUS	3	2	-	1	-
FUNDULUS HETEROCLITUS	6	6	-	-	-
MENIDIA MENIDIA	4	3	-	1	-
GASTEROSTEUS ACULEATUS	1	1	-	-	-
MORONE AMERICANA	4	3	-	1	-
LEIOSTOMUS XANTHURUS	1	-	-	1	-
PSEUDOPLEURONECTES AMERICANUS	78	77	1	-	1
CLASS POLYCHAETA	1	1	-	-	-
PALAEMONETES VULGARIS	11	11	-	-	-
CRANGON SEPTEMSPINOSA	91	79	10	2	11
TOTALS	200	183	11	6	6

TABLE D1-83. (CONT.)

MONTH	MARCH 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ALOSA AESTIVALIS	4	3	-	1	-
ALOSA PSEUDOHARENGUS	2	2	-	-	-
BREVOORTIA TYRANNUS	163	155	-	8	-
FUNDULUS HETEROCLITUS	2	1	1	-	50
MENIDIA MENIDIA	17	15	2	-	12
APELTES QUADRACUS	1	1	-	-	-
SYNGNATHUS FUSCUS	4	4	-	-	-
MORONE AMERICANA	10	7	1	2	10
LEIOSTOMUS XANTHURUS	7	6	-	1	-
SCOPHTHALMUS AQUOSUS	2	2	-	-	-
PSEUDOPLEURONECTES AMERICANUS	6	4	-	2	-
PALAEMONETES VULGARIS	44	33	11	-	25
CRANGON SEPTEMSPINOSA	147	110	20	17	14
CALLINECTES SAPIDUS	1	1	-	-	-
TOTALS	410	344	35	31	9

TABLE D1-83. (CONT.)

MONTH	APRIL 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	7	5	-	2	-
ALOSA AESTIVALIS	7	5	-	2	-
ALOSA PSEUDOHARENGUS	2	2	-	-	-
BREVOORTIA TYRANNUS	155	150	-	5	-
ANCHOA MITCHILLI	202	12	65	125	32
FUNDULUS HETEROCLITUS	5	4	-	1	-
MENIDIA BERYLLINA	1	1	-	-	-
MENIDIA MENIDIA	19	16	-	3	-
APELTES QUADRACUS	1	1	-	-	-
SYNGNATHUS FUSCUS	46	46	-	-	-
MORONE AMERICANA	35	31	2	2	6
LEIOSTOMUS XANTHURUS	8	8	-	-	-
PARALICHTHYS DENTATUS	1	-	-	1	-
SCOPHTHALMUS AQUOSUS	1	1	-	-	-
PSEUDOPLEURONECTES AMERICANUS	9	9	-	-	-
TRINECTES MACULATUS	1	1	-	-	-
PALAEMONETES VULGARIS	75	74	-	1	-
CRANGON SEPTEMSPINOSA	459	438	20	1	4
OVALIPES OCELLATUS	2	1	-	1	-
CALLINECTES SAPIDUS	34	26	2	6	6
TOTALS	1070	831	89	150	8

TABLE D1-83. (CONT.)

MONTH	MAY 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	2	2	-	-	-
BREVOORTIA TYRANNUS	17	14	-	3	-
ANCHOA MITCHILLI	158	37	88	33	56
MENIDIA MENIDIA	1	-	-	1	-
SYNGNATHUS FUSCUS	21	20	1	-	5
MORONE AMERICANA	1	1	-	-	-
LEIOSTOMUS XANTHURUS	126	126	-	-	-
PARALICHTHYS DENTATUS	1	1	-	-	-
SCOPHTHALMUS AQUOSUS	1	1	-	-	-
PALAEMONETES VULGARIS	41	41	-	-	-
CRANGON SEPTEMSPINOSA	245	234	9	2	4
CALLINECTES SAPIDUS	26	15	1	10	4
TOTALS	640	492	99	49	15

TABLE D1-83. (CONT.)

MONTH	JUNE 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	6	4	-	2	-
ALOSA AESTIVALIS	2	-	2	-	100
ALOSA PSEUDOHARENGUS	2	-	-	2	-
BREVOORTIA TYRANNUS	3	1	-	2	-
ANCHOA MITCHILLI	159	12	134	13	84
RISSOLA MARGINATA	155	153	-	2	-
STRONGYLURA MARINA	1	-	1	-	100
MENIDIA MENIDIA	2	1	1	-	50
SYNGNATHUS FUSCUS	11	8	1	2	9
MORONE AMERICANA	1	1	-	-	-
POMATOMUS SALTATRIX	22	5	8	9	36
LEIOSTOMUS XANTHURUS	31	23	3	5	10
MUGIL CUREMA	1	1	-	-	-
PSEUDOPLEURONECTES AMERICANUS	3	3	-	-	-
TRINECTES MACULATUS	3	3	-	-	-
SPHOEROIDES MACULATUS	1	1	-	-	-
PALAEMONETES VULGARIS	33	30	3	-	9
CRANGON SEPTEMSPINOSA	70	64	4	2	6
LIBINIA DUBIA	1	1	-	-	-
OVALIPES OCELLATUS	5	3	-	2	-
CALLINECTES SAPIDUS	196	139	6	51	3
TOTALS	708	453	163	92	23

TABLE D1-83. (CONT.)

MONTH	JULY 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	5	4	-	1	-
ALOSA AESTIVALIS	1	-	-	1	-
ALOSA PSEUDOHARENGUS	7	3	3	1	43
BREVOORTIA TYRANNUS	6	3	1	2	17
ANCHOA MITCHILLI	134	1	109	24	81
OPSANUS TAU	1	1	-	-	-
RISSOLA MARGINATA	51	50	-	1	-
MENIDIA MENIDIA	14	4	5	5	36
SYNGNATHUS FUSCUS	51	49	1	1	2
POMATOMUS SALTATRIX	20	5	8	7	40
CARANX HIPPOS	1	1	-	-	-
SELENE VOMER	1	-	-	1	-
CYNOSCION REGALIS	3	-	1	2	33
LEIOSTOMUS XANTHURUS	116	78	12	26	10
TAUTOGA ONITIS	1	-	-	1	-
SCOPHTHALMUS AQUOSUS	1	1	-	-	-
MONACANTHUS HISPIDUS	1	1	-	-	-
SPHOEROIDES MACULATUS	1	1	-	-	-
PALAEMONETES VULGARIS	10	10	-	-	-
CRANGON SEPTEMSPINOSA	2	2	-	-	-
CALLINECTES SAPIDUS	190	137	12	41	6
TOTALS	617	351	152	114	25

TABLE D1-83. (CONT.)

MONTH	AUGUST 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	7	7	-	-	-
ALOSA AESTIVALIS	2	-	-	2	-
ALOSA PSEUDOHARENGUS	2	-	1	1	50
BREVOORTIA TYRANNUS	134	85	1	48	1
ANCHOA MITCHILLI	50	1	43	6	86
RISSOLA MARGINATA	28	28	-	-	-
STRONGYLURA MARINA	2	-	2	-	100
MEMBRAS MARTINICA	2	1	-	1	-
MENIDIA MENIDIA	11	5	4	2	36
SYNGNATHUS FUSCUS	4	4	-	-	-
MORONE AMERICANA	1	-	-	1	-
CENTROPRISTIS STRIATA	2	1	-	1	-
POMATOMUS SALTATRIX	10	1	2	7	20
CARANX HIPPOS	2	1	-	1	-
SELENE VOMER	1	-	-	1	-
STENOTOMUS CHRYSOPS	1	1	-	-	-
CYNOSCION REGALIS	28	8	13	7	46
LEIOSTOMUS XANTHURUS	211	139	14	58	7
MENTICIRRHUS SAXATILIS	1	-	1	-	100
PARALICHTHYS DENTATUS	4	3	-	1	-
PALAEMONETES VULGARIS	2	2	-	-	-
CRANGON SEPTEMSPINOSA	1	1	-	-	-
CALLINECTES SAPIDUS	155	92	21	42	14
CALLINECTES SIMILIS	2	2	-	-	-
TOTALS	663	382	102	179	15

TABLE DI-83. (CONT.)

MONTH	SEPTEMBER 1977				
SPECIES	NUMBER	LIVE	DEAD	DAMAGED	% DEAD
ANGUILLA ROSTRATA	2	2	-	-	-
ALOSA AESTIVALIS	2	-	1	1	50
BREVOORTIA TYRANNUS	6	4	-	2	-
ANCHOA HEPSETUS	1	-	1	-	100
ANCHOA MITCHILLI	2	-	1	1	50
STRONGYLURA MARINA	1	-	-	1	-
MENIDIA BERYLLINA	1	-	1	-	100
MENIDIA MENIDIA	1	-	1	-	100
POMATOMUS SALTATRIX	1	-	-	1	-
CYNOSCION REGALIS	5	1	3	1	60
LEIOSTOMUS XANTHURUS	6	6	-	-	-
OVALIPES OCELLATUS	1	-	-	1	-
CALLINECTES SAPIDUS	23	21	-	2	-
CALLINECTES SIMILIS	3	3	-	-	-
TOTALS	55	37	8	10	15

Table D1-84. Comparison of the condition of selected fishes and macroinvertebrates passed through the dilution pumps at Oyster Creek Generating Station, Forked River, New Jersey from September 1975 to August 1976 and from September 1976 to August 1977.

	September 1975 - August 1976				September 1976 - August 1977			
	Number	% Live	% Damaged	% Dead	Number	% Live	% Damaged	% Dead
Brevoortia tyrannus	52	58	27	15	160[a]	64	33	2
Anchoa mitchilli	145	46	15	39	768	9	28	63
Rissola marginata	42	55	38	7	309	94	5	1
Pseudopleuronectes americanus	39	97	3	0	720	99	1	-
Crangon septemspinosa	493	96	2	2	3051	92	2	6
Callinectes sapidus	73	73	23	4	770	68	25	7

[a] number collected from 1 May through 31 August 1977 (See page D1-328).

Table D1-85. Total number of selected fishes and macroinvertebrates passed through the dilution pump and impinged on the traveling screens, from sunset to 6 h after sunset once each week, at Oyster Creek Generating Station, Forked River, New Jersey. No samples were taken 14 May through 12 July 1977.

	Dilution Pumps in operation			Brevoortia tyrannus		Anchoa mitchilli		Menidia menidia		Syngnathus fuscus		Pomatomus saltatrix		Cynoscion regalis		Leiostomus xanthurus		Pseudopleuronectes americanus		Crangon septemspinosa		Callinectes sapidus	
	1	2	3	D. Pump	Imping.	D. Pump	Imping.	D. Pump	Imping.	D. Pump	Imping.	D. Pump	Imping.	D. Pump	Imping.	D. Pump	Imping.	D. Pump	Imping.	D. Pump	Imping.	D. Pump	Imping.
7 Sept 76	X	-	X	600	12	26	22	-	-	-	1	78	10	26	48	313	13	-	-	-	-	3651	920
13 Sept 76	X	-	X	574	10	443	58	-	-	-	-	78	8	130	32	365	4	-	-	-	-	3860	1280
20 Sept 76	X	-	X	235	11	261	133	26	-	-	-	130	2	130	14	417	3	-	2	-	-	5816	2420
27 Sept 76	-	-	X	18	11	80	133	-	2	-	-	-	3	-	20	48	2	-	-	-	-	4269	614
4 Oct 76	-	-	X	96	56	239	694	-	2	-	4	32	10	127	226	112	10	-	2	-	2	1116	1463
12 Oct 76	-	X	X	1638	24	199	317	-	3	-	3	177	4	243	86	575	16	-	1	-	3	1239	686
21 Oct 76	X	-	X	704	438	287	1033	-	22	26	45	52	18	443	759	2373	667	-	2	-	148	391	420
25 Oct 76	X	-	X	78	624	365	365	-	9	26	13	183	3	78	126	522	606	-	2	-	-	78	142
1 Nov 76	X	-	X	391	1437	318	699	26	65	-	137	52	62	104	144	4747	4097	26	-	-	21	26	48
8 Nov 76	X	-	X	156	3973	-	357	130	653	156	26	-	80	-	56	443	1527	238	36	-	212	-	55
15 Nov 76	X	-	X	78	656	26	2	52	510	156	67	-	-	-	1	-	603	1460	30	704	1021	-	-
22 Nov 76	X	-	X	522	101	26	51	52	26	52	14	-	1	-	3	52	47	1539	10	1904	1067	-	2
29 Nov 76	X	-	X	52	60	-	4	104	15	-	6	-	1	-	1	52	32	52	18	808	787	-	2
6 Dec 76	X	-	X	-	6	-	2	156	19	26	6	-	-	-	-	-	28	2399	90	20708	3933	-	1
13 Dec 76	X	-	X	-	18	-	-	1330	231	52	14	26	-	-	-	-	4	7694	2441	51352	12586	-	-
20 Dec 76	X	-	X	52	12	-	1	26	7	26	3	-	-	-	-	-	8	939	11	1330	1116	-	-
27 Dec 76	-	-	X	-	-	-	-	-	12	26	3	-	-	-	-	-	-	887	117	9232	2663	-	-
3 Jan 77	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	494	31	1131	581	-	-
14 Feb 77	-	-	X	-	-	-	-	-	1	-	2	-	-	-	-	-	-	303	10	462	821	-	-
21 Feb 77	X	-	X	-	-	-	-	-	1	-	-	-	-	-	-	26	-	1121	9	1252	923	-	-
28 Feb 77	X	-	X	-	56	78	55	104	8	-	-	-	-	-	-	-	2	469	11	365	154	-	-
10 Mar 77	X	-	X	-	14	704	10	52	12	-	-	-	-	-	-	130	1	26	2	626	183	-	2
14 Mar 77	X	-	X	-	3	313	3	26	751	-	-	-	-	-	-	20	1	78	2	104	77	-	2
21 Mar 77	X	-	X	-	4	782	4	183	59	-	4	-	-	-	-	-	1	26	4	1356	1081	-	2
28 Mar 77	X	-	X	-	4	2452	4	183	193	104	32	-	-	-	-	26	-	26	3	1747	1089	28	3
4 Apr 77	X	-	X	-	3	1304	4	391	547	496	7	-	-	-	-	-	1	235	46	9102	935	26	4
11 Apr 77	X	-	X	443	2002	3443	3	78	14	209	33	-	-	-	-	209	1	-	2	3234	1444	156	456
18 Apr 77	X	-	X	5920	1485	678	1	-	16	391	121	-	-	-	-	-	-	-	2	18021	5348	574	166
25 Apr 77	-	-	X	271	15	112	5	16	3	64	39	-	-	-	-	-	-	-	1	350	371	80	97
4 May 77	-	-	X	701	8	112	-	-	-	80	28	-	-	-	-	16	-	-	-	271	30	112	65
9 May 77	-	-	X	605	5	48	-	16	1	159	72	-	-	-	-	16	-	-	-	3186	210	159	68
25 Jul 77	-	-	X	510	39	16	2	96	1	16	17	32	4	48	-	191	-	-	-	-	-	701	282
1 Aug 77	-	-	X	350	229	430	106	64	27	-	3	-	50	-	9	478	73	-	-	16	-	462	846
8 Aug 77	X	-	X	574	145	52	40	26	5	-	3	52	7	-	2	15231	25	-	-	-	-	939	345
18 Aug 77	X	-	X	235	192	313	24	26	-	26	8	52	9	469	48	913	58	-	-	-	-	1017	594
25 Aug 77	-	X	X	310	186	44	29	89	-	66	7	22	-	553	189	558	88	-	-	-	-	332	433
29 Aug 77	-	X	X	111	105	2036	13	22	2	-	5	155	5	88	117	2302	12	-	-	-	-	797	234
Total				18019	7732	12295	8345	3274	3417	2157	721	1121	275	2369	1880	30138	7929	18009	2884	127261	36801	25799	11652

Table D1-86. Condition (live, dead, damaged) of fishes and macroinvertebrates held for delayed mortality studies after impingement on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1976 through August 1977.

	Test Temperature	Condition	September-December 1976[a]			March-August 1977			September 1976-August 1977		
			Live	Dead	Damaged	Live	Dead	Damaged	Live	Dead	Damaged
Alosa spp.	..	Immediate				11	-	46	11	-	46
	Ambient	Delayed				7	14	12	7	14	12
	Heated	Delayed				4	14	6	4	14	6
Brevoortia tyrannus		Immediate	1	-	33				1	-	33
	Ambient	Delayed	0	18	0				0	18	0
	Heated	Delayed	7	9	0				7	9	0
Anchoa mitchilli		Immediate	0	-	6	0	-	46	0	-	52
	Ambient	Delayed	0	1	1	0	24	1	0	25	2
	Heated	Delayed	0	1	3	0	21	0	0	22	3
Synodus foetens		Immediate	7	-	0				7	-	0
	Ambient	Delayed	0	0	3				0	0	3
	Heated	Delayed	2	1	0				2	1	0
Riasola marginata		Immediate	1	-	26				1	-	26
	Ambient	Delayed	1	9	6				1	9	6
	Heated	Delayed	0	2	9				0	2	9
Fistularia tabacaria		Immediate	1	-	1				1	-	1
	Ambient	Delayed	0	0	1				0	0	1
	Heated	Delayed	0	1	0				0	1	0
Menidia menidia		Immediate	1	-	14	38	-	91	39	-	105
	Ambient	Delayed	0	5	4	25	11	45	25	16	49
	Heated	Delayed	0	4	2	13	12	23	13	16	25
Syngnathus fuscus		Immediate	2	-	0	7	-	0	9	-	0
	Ambient	Delayed	0	1	0	4	0	0	4	1	0
	Heated	Delayed	1	0	0	3	0	0	4	0	0
Morone americana		Immediate	0	-	1	0	-	4	0	-	5
	Ambient	Delayed	0	0	1	0	0	2	0	0	3
	Heated	Delayed	-	-	-	0	0	2	0	0	2

Table D1-86. (cont.)

	Test Temperature	Condition	September-December 1976[a] Live	Dead	Damaged	March-August 1977 Live	Dead	Damaged	September 1976-August 1977 Live	Dead	Damaged
Centropristis striata		Immediate	1	-	29				1	-	29
	Ambient	Delayed	1	14	2				1	14	2
	Heated	Delayed	0	5	8				0	5	8
Pomatomus saltatrix		Immediate	0	-	1				0	-	1
	Ambient	Delayed	0	1	0				0	1	0
	Heated	Delayed	-	-	-				-	-	-
Caranx hippos		Immediate	0	-	1				0	-	1
	Ambient	Delayed	0	1	0				0	1	0
	Heated	Delayed	-	-	-				-	-	-
Trachinotus carolinus		Immediate	0	-	2				0	-	2
	Ambient	Delayed	0	0	1				0	0	1
	Heated	Delayed	0	0	1				0	0	1
Cynoscion regalis		Immediate	2	-	32				2	-	32
	Ambient	Delayed	0	17	1				0	17	1
	Heated	Delayed	4	10	1				4	10	1
Leiostomus xanthurus		Immediate	2	-	14				2	-	14
	Ambient	Delayed	1	5	3				1	5	3
	Heated	Delayed	1	1	5				1	1	5
Mugil curema		Immediate	0	-	1				0	-	1
	Ambient	Delayed	0	1	0				0	1	0
	Heated	Delayed	-	-	-				-	-	-
Sphyraena borealis		Immediate	1	-	0				1	-	0
	Ambient	Delayed	0	1	0				0	1	0
	Heated	Delayed	-	-	-				-	-	-
Hypsoblennius hentzi		Immediate	2	-	0				2	-	0
	Ambient	Delayed	0	1	0				0	1	0
	Heated	Delayed	1	0	0				1	0	0

Table D1-86. (cont.)

	Test Temperature	Condition	September-December 1976[a] Live	Dead	Damaged	March-August 1977 Live	Dead	Damaged	September 1976-August 1977 Live	Dead	Damaged
Prionotus evolans		Immediate	88	-	0				88	-	0
	Ambient	Delayed	44	0	1				44	0	1
	Heated	Delayed	40	1	0				40	1	0
Etropus microstomus		Immediate	0	-	30				0	-	30
	Ambient	Delayed	0	7	8				0	7	8
	Heated	Delayed	0	6	9				0	6	9
Paralichthys dentatus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	-	-	-				-	-	-
	Heated	Delayed	1	0	0				1	0	0
Pseudopleuronectes americanus		Immediate				5	-	1	5	-	1
	Ambient	Delayed				3	0	1	3	0	1
	Heated	Delayed				2	0	0	2	0	0
Sphoeroides maculatus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	-	-	-				-	-	-
Peneaus aztecus		Immediate	12	-	0				12	-	0
	Ambient	Delayed	6	1	0				6	1	0
	Heated	Delayed	2	0	0				2	0	0
Crangon septemspinosa		Immediate				30	-	0	30	-	0
	Ambient	Delayed				13	2	0	13	2	0
	Heated	Delayed				11	4	0	11	4	0
Callinectes sapidus		Immediate				9	-	5	9	-	5
	Ambient	Delayed				-	-	-	-	-	-
	Heated	Delayed				2	2	2	2	2	2

a. From Ichthyological Associates, Inc., 1977. Table 40.

Table D1-87. Mortality by temperature of Atlantic silverside held at ambient and at OCGS discharge temperatures for 48 hours after impingement on the traveling screens at Oyster Creek Generating Station, Forked River, New Jersey from November 1976 through April 1977.

	Salinity Range		Time[a]	Temperature		Condition					
	Heated	Ambient		Heated	Ambient	Heated			Ambient		
						Live	Dead	Damaged	Live	Dead	Damaged
6 November 76	23.5-24.0	23.5-24.0	I	25.3	17.1	-	-	-	0	1	0
			II	-	-	-	-	-	-	-	-
			III	26.1	17.8	-	-	-	-	-	-
			IV	-	-	-	-	-	-	-	-
8 March 77	22.0-23.5	21.5-23.5	I	14.5	10.1	0	1	19	0	1	19
			II	16.5	12.1	0	2	16	0	2	17
			III	18.8	14.8	0	2	14	0	3	14
			IV	18.8	14.8	0	1	13	0	0	14
22 March 77	20.5-22.0	20.0-22.0	I	14.3	8.6	7	0	5	10	0	4
			II	14.6	14.6	7	0	5	10	0	4
			III	13.5	8.5	7	1	4	10	1	3
			IV	12.5	8.1	7	0	4	10	0	3
29 March 77	18.5-20.5	18.5-21.5	I	16.8	11.0	6	2	8	5	1	11
			II	20.6	16.6	6	1	7	5	0	11
			III	20.7	15.7	6	2	5	5	1	10
			IV	20.1	16.5	6	0	5	5	0	10
4 April 77	-	19.5-24.0	I	-	10.9	-	-	-	10	2	14
			II	-	11.4	-	-	-	10	0	14
			III	-	10.6	-	-	-	10	0	14
			IV	-	12.3	-	-	-	10	0	14
13 April 77	20.5-25.0	21.0-24.0	I	20.1	16.6	0	0	2	0	0	4
			II	22.6	18.7	0	0	2	0	0	4
			III	21.9	18.7	0	0	2	0	0	4
			IV	23.0	19.0	0	0	2	0	0	4

a. I - The morning observation the first day after collection.
II - The afternoon observation the first day after collection.
III - The morning observation the second day after collection.
IV - The afternoon observation the second dat after collection.

Table D1-88. Condition (live, dead, damaged) of fishes and macroinvertebrates held for delayed mortality after continuous screen washing of the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey during November and December 1976.

			Ambient		Heated	Ambient		Heated			
Date of Collection			30 November			12 December			TOTAL		
Time of Collection			1805			1700-1900					
Air Temperature (C)			-6.5			-					
Test Temperature (C)			6.4,12.0			9.8-10.8,14.3-15.5					
Test Salinity (ppt)			-			22.6-22.5					
Test Oxygen (ppm)			11.0,10.4			10.9,10.6					
Test pH			7.8			7.9					
Species	Test Temperature	Condition	Live	Dead	Damaged	Live	Dead	Damaged	Live	Dead	Damaged
Anguilla rostrata		Immediate				1	-	0	1	-	0
	Ambient	Delayed				-	-	-	-	-	-
	Heated	Delayed				1	0	0	1	0	0
Alosa aestivalis		Immediate	3	-	1				3	-	1
	Ambient	Delayed	0	1	0				0	1	0
	Heated	Delayed	0	3	0				0	3	0
Brevoortia tyrannus		Immediate	3	-	5	0	-	1	3	-	6
	Ambient	Delayed	1	0	1	-	-	-	1	0	1
	Heated	Delayed	0	4	2	-	-	-	0	4	2
Rissola marginata		Immediate	8	-	4	1	-	0	9	-	4
	Ambient	Delayed	2	0	2	-	-	-	2	0	2
	Heated	Delayed	1	5	2	1	0	0	2	5	2
Menidia menidia		Immediate	10	-	4	0	-	1	10	-	5
	Ambient	Delayed	7	0	1	-	-	-	7	0	1
	Heated	Delayed	3	0	3	0	1	0	3	1	3
Centropristis striata		Immediate	2	-	0				2	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	1	0	0				1	0	0
Leiostomus xanthurus		Immediate	0	-	4				0	-	4
	Ambient	Delayed	1	1	0				1	1	0
	Heated	Delayed	0	0	2				0	0	2

Table D1-88. (cont.)

			Ambient		Heated	Ambient		Heated			
Date of Collection			30 November			12 December			TOTAL		
Time of Collection			1805			1700-1900					
Air Temperature (C)			-6.5			-					
Test Temperature (C)			6.4,12.0			9.8-10.8,14.3-15.5					
Test Salinity (ppt)			-			22.0-22.5					
Test Oxygen (ppm)			11.0,10.4			10.9,10.6					
Test pH			7.8			7.9					
Species	Test Temperature	Condition	Live	Dead	Damaged	Live	Dead	Damaged	Live	Dead	Damaged
Tautoga onitis		Immediate	1	-	0				1	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	-	-	-				-	-	-
Peprilus triacanthus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	-	-	-				-	-	-
	Heated	Delayed	1	0	0				1	0	0
Prionotus sp.		Immediate	0	-	1				0	-	1
	Ambient	Delayed	0	0	1				0	0	1
	Heated	Delayed	-	-	-				-	-	-
Etropus microstomus		Immediate	9	-	9	0	-	8	9	-	17
	Ambient	Delayed	5	3	0	0	0	4	5	3	4
	Heated	Delayed	5	3	2	0	2	2	5	5	4
Scophthalmus aquosus		Immediate				0	-	1	0	-	1
	Ambient	Delayed				-	-	-	-	-	-
	Heated	Delayed				1	0	0	1	0	0
Pseudopleuronectes americanus		Immediate	2	-	1	30	-	0	32	-	1
	Ambient	Delayed	1	0	1	14	1	0	15	1	1
	Heated	Delayed	1	0	0	12	1	2	13	1	2
Crangon septemspinosa		Immediate	20	-	7	40	-	0	60	-	7
	Ambient	Delayed	8	2	0	18	2	0	26	4	0
	Heated	Delayed	9	4	4	18	2	0	27	6	4

Table D1-89. Condition (live, dead, damaged) of fishes and macroinvertebrates held for delayed mortality studies after passage through the dilution pump at the Oyster Creek Generating Station, Forked River, New Jersey from September 1976 through August 1977.

	Test Temperature	Condition	September-December 1976[a]			February-August 1977			September 1976-August 1977		
			Live	Dead	Damaged	Live	Dead	Damaged	Live	Dead	Damaged
Anguilla rostrata		Immediate	2	-	0				2	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	0	1	0				0	1	0
Alosa spp.		Immediate	1	-	0				1	-	0
	Ambient	Delayed	0	1	0				0	1	0
	Heated	Delayed	-	-	-				-	-	-
Brevoortia tyrannus		Immediate	50	-	5	5	-	1	55	-	6
	Ambient	Delayed	20	5	4	2	2	2	22	7	6
	Heated	Delayed	12	13	1	-	-	-	12	13	1
Anchoa mitchilli		Immediate	1	-	7	0	-	65	1	-	72
	Ambient	Delayed	0	4	0	0	47	18	0	51	18
	Heated	Delayed	0	4	0	-	-	-	0	4	0
Opsanus tau		Immediate	4	-	0				4	-	0
	Ambient	Delayed	3	0	0				3	0	0
	Heated	Delayed	1	0	0				1	0	0
Rissola marginata		Immediate	3	-	1	32	-	0	35	-	1
	Ambient	Delayed	0	0	2	32	0	0	32	0	2
	Heated	Delayed	1	0	1	-	-	-	1	0	1
Fundulus sp.		Immediate	1	-	0				1	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	-	-	-				-	-	-
Menidia menidia		Immediate				1	-	0	1	-	0
	Ambient	Delayed				1	0	0	1	0	0
	Heated	Delayed				-	-	-	-	-	-
Syngnathus fuscus		Immediate	1	-	0	2	-	0	3	-	0
	Ambient	Delayed	-	-	-	2	0	0	2	0	0
	Heated	Delayed	1	0	0	-	-	-	1	0	0
Morone americana		Immediate	1	-	0	8	-	0	9	-	0
	Ambient	Delayed	1	0	0	6	0	0	7	0	0
	Heated	Delayed	-	-	-	2	0	0	2	0	0

Table D1-89. (cont.)

	Test Temperature	Condition	September-December 1976[a] Live	Dead	Damaged	February-August 1977 Live	Dead	Damaged	September 1976-August 1977 Live	Dead	Damaged
Centropristis striata		Immediate	5	-	0				5	-	0
	Ambient	Delayed	2	1	0				2	1	0
	Heated	Delayed	1	0	1				1	0	1
Pomatomus saltatrix		Immediate	9	-	7	5	-	0	14	-	7
	Ambient	Delayed	6	2	2	5	0	0	11	2	2
	Heated	Delayed	2	2	1	-	-	-	2	2	1
Selene vomer		Immediate	1	-	0				1	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	-	-	-				-	-	-
Cynoscion regalis		Immediate	13	-	6				13	-	6
	Ambient	Delayed	4	6	1				4	6	1
	Heated	Delayed	2	5	1				2	5	1
Leiostomus xanthurus		Immediate	60	-	0	165	-	1	225	-	1
	Ambient	Delayed	27	1	2	163	0	2	190	1	4
	Heated	Delayed	12	17	0	0	0	1	12	17	1
Menticirrhus saxatilis		Immediate	1	-	0				1	-	0
	Ambient	Delayed	-	-	-				-	-	-
	Heated	Delayed	1	0	0				1	0	0
Chaetodon ocellatus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	-	-	-				-	-	-
Tautogolabrus adspersus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	-	-	-				-	-	-
	Heated	Delayed	1	0	0				1	0	0
Mugil sp.		Immediate	4	-	1				4	-	1
	Ambient	Delayed	-	-	-				-	-	-
	Heated	Delayed	4	1	0				4	1	0
Hypsoblennius hentzi		Immediate	1	-	0				1	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	-	-	-				-	-	-
Peprilus triacanthus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	0	0	1				0	0	1
	Heated	Delayed	-	-	-				-	-	-

Table D1-89. (cont.)

	Test Temperature	Condition	September-December 1976[a] Live	Dead	Damaged	February-August 1977 Live	Dead	Damaged	September 1976-August 1977 Live	Dead	Damaged
Prionotus sp.		Immediate	14	-	2				14	-	2
	Ambient	Delayed	7	2	1				7	2	1
	Heated	Delayed	2	3	1				2	3	1
Paralichthys dentatus		Immediate	4	-	0	2	-	0	6	-	0
	Ambient	Delayed	0	0	2	2	0	0	2	0	2
	Heated	Delayed	1	1	0	-	-	-	1	1	0
Pseudopleuronectes americanus		Immediate	1	-	0	39	-	0	40	-	0
	Ambient	Delayed	1	0	0	19	0	0	20	0	0
	Heated	Delayed	-	-	-	19	1	0	19	1	0
Trinectes maculatus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	-	-	-				-	-	-
	Heated	Delayed	1	0	0				1	0	0
Sphoeroides maculatus		Immediate	1	-	0	3	-	0	4	-	0
	Ambient	Delayed	-	-	-	3	0	0	3	0	0
	Heated	Delayed	1	0	0	-	-	-	1	0	0
Limulus polyphemus		Immediate				0	-	1	0	-	1
	Ambient	Delayed				0	0	1	0	0	1
	Heated	Delayed				-	-	-	-	-	-
Penaeus aztecus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	-	-	-				-	-	-
Crangon septemspinosa		Immediate				15	-	2	15	-	2
	Ambient	Delayed				8	0	0	8	0	0
	Heated	Delayed				7	0	2	7	0	2
Ovalipes ocellatus		Immediate	1	-	0				1	-	0
	Ambient	Delayed	1	0	0				1	0	0
	Heated	Delayed	-	-	-				-	-	-
Callinectes sapidus		Immediate	18	-	0	20	-	9	38	-	9
	Ambient	Delayed	10	0	0	6	1	2	16	1	2
	Heated	Delayed	8	0	0	-	-	-	8	0	0

a. From Ichthyological Associates, Inc., 1977. Table 42.

Table D1-90. Mortality by temperature of spot held at ambient and OCGS discharge temperatures for 48 hours after passage through the dilution pump at Oyster Creek Generating Station, Forked River, New Jersey from June 1976 through July 1977.

	Salinity Range		Time[a]	Temperature		Condition					
						Heated			Ambient		
	Heated	Ambient		Heated	Ambient	Live	Dead	Damaged	Live	Dead	Damaged
14 June 76	24.0	24.0	I	31.5	22.6	5	0	1	4	0	1
			II	31.5	22.4	5	0	1	1	3	1
			III	32.4	22.6	5	0	1	1	0	1
			IV	31.8	22.6	5	1	0	1	0	1
28 June 76	24.5-26.0	24.5-26.0	I	37.0	26.0	0	6	0	7	1	2
			II	37.0	26.2	-	-	-	7	0	2
			III	36.9	26.5	-	-	-	7	1	1
			IV	37.2	26.5	-	-	-	7	0	1
6 July 76	26.0-27.0	26.0-27.0	I	36.4	26.1	0	14	0	10	0	0
			II	37.1	27.0	-	-	-	8	2	0
			III	34.8	25.0	-	-	-	8	0	0
			IV	36.0	26.0	-	-	-	8	0	0
19 July 76	27.0-27.5	27.0-27.5	I	33.9	23.9	17	2	0	16	0	2
			II	34.2	24.6	6	11	0	16	1	1
			III	35.0	24.9	6	0	0	16	0	1
			IV	35.1	24.8	6	0	0	16	0	1
10 August 76	22.0-23.5	22.0-23.5	I	32.6	25.0	22	7	0	26	0	0
			II	32.8	25.1	22	0	0	26	0	0
			III	34.4	27.0	20	2	0	26	0	0
			IV	34.8	27.6	20	0	0	26	0	0
23 August 76	22.5-23.5	22.5-23.5	I	35.5	25.6	2	2	2	3	0	0
			II	37.8	27.4	0	4	0	3	0	0
			III	35.8	25.6	-	-	-	3	0	0
			IV	37.2	27.1	-	-	-	3	0	0

Table D1-90. (cont.)

	Salinity Range		Time[a]	Temperature		Condition					
	Heated	Ambient		Heated	Ambient	Heated			Ambient		
						Live	Dead	Damaged	Live	Dead	Damaged
13 September 76	25.0	25.0	I	33.0	26.4	1	4	0	5	0	0
			II	33.3	26.6	1	0	0	5	0	0
			III	32.8	26.1	1	0	0	5	0	0
			IV	-	-	1	0	0	5	0	0
27 September 76	25.0-27.0	26.0-27.0	I	28.9	20.7	1	0	0	1	0	0
			II	29.4	21.5	1	0	0	1	0	0
			III	27.5	21.7	1	0	0	1	0	0
			IV	28.8	22.0	1	0	0	1	0	0
13 October 76	23.5-25.0	23.5-25.0	I	23.5	15.0	13	1	1	12	0	1
			II	25.1	17.1	12	1	1	12	0	1
			III	22.9	17.0	12	0	1	12	0	1
			IV	24.0	17.5	10	3	0	12	0	1
14 March 77	20.5-23.5	22.0-23.0	I	16.1	10.6	1	0	0	-	-	-
			II	17.0	14.0	0	0	1	-	-	-
			III	18.6	13.0	0	0	1	-	-	-
			IV	20.1	14.7	0	0	1	-	-	-
3 May 77	-	21.0-21.5	I	-	16.3	-	-	-	20	0	0
			II	-	16.5	-	-	-	20	0	0
			III	-	15.8	-	-	-	19	0	1
			IV	-	16.1	-	-	-	19	0	1
10 May 77	-	22.5-24.0	I	-	12.2	-	-	-	20	0	0
			II	-	13.5	-	-	-	20	0	0
			III	-	12.8	-	-	-	20	0	0
			IV	-	14.7	-	-	-	20	0	0

Table D1-90. (cont.)

	Salinity Range		Time[a]	Temperature		Condition					
	Heated	Ambient		Heated	Ambient	Heated			Ambient		
						Live	Dead	Damaged	Live	Dead	Damaged
17 May 77	-	21.0-22.0	I	-	18.4	-	-	-	35	0	0
			II	-	19.9	-	-	-	35	0	0
			III	-	18.9	-	-	-	35	0	0
			IV	-	19.3	-	-	-	35	0	0
5 July 77	-	25.0-26.0	I	-	25.7	-	-	-	26	0	0
			II	-	26.5	-	-	-	26	0	0
			III	-	25.2	-	-	-	26	0	0
			IV	-	25.2	-	-	-	26	0	0
12 July 77	-	22.5-26.0	I	-	24.2	-	-	-	63	0	1
			II	-	26.7	-	-	-	63	0	1
			III	-	26.0	-	-	-	63	0	1
			IV	-	27.4	-	-	-	63	0	1

a. I - The morning observation the first day after collection.
II - The afternoon observation the first day after collection.
III - The morning observation the second day after collection.
IV - The afternoon observation the second day after collection.

Table D1-91. Commercial fisheries landings reported from the waters between Toms River and the Manahawkin Bridge, New Jersey from September 1976 through August 1977.

Species	September			October			November			December		
	Kg	Value ($)	Gear[a]	Kg	Value ($)	Gear	Kg	Value ($)	Gear	Kg	Value ($)	Gear
White perch	-	-	-	546	360	310	182	120	310	68	45	310
Winter flounder	-	-	-	818	270	310	955	315	310	318	140	310
American eel	505	388	340	736	567	340	-	-	-	-	-	-
Blue crab	3,727	2,870	330	6,564	4,693	330	4,073	2,688	805	3,636	2,000	805
Northern quahog (meats)	3,032	7,501	845	2,605	6,440	845	1,973	5,095	845	1,077	2,967	845
Northern quahog (meats)	5,050	12,502	855	4,832	11,960	855	4,596	11,889	855	2,518	6,992	855
Northern quahog (meats)	2,018	5,000	955	-	-	-	-	-	-	-	-	-
Total	14,332	28,261		16,101	24,290		11,779	20,107		7,617	12,144	

Species	January			February			March			April		
	Kg	Value ($)	Gear	Kg	Value ($)	Gear	Kg	Value ($)	Gear	Kg	Value ($)	Gear
White perch	-	-	-	-	-	-	1,205	663	310	1,409	775	310
Winter flounder	-	-	-	-	-	-	1,782	784	310	1,364	600	310
American eel	-	-	-	-	-	-	-	-	-	1,818	1,400	340
Blue crab	-	-	-	-	-	-	1,982	1,526	805	-	-	-
Northern quahog (meats)	146	477	845	550	1,822	845	1,223	3,704	845	2,427	7,343	845
Northern quahog (meats)	218	715	855	1,027	3,383	855	2,859	8,641	855	5,664	17,134	855
Northern quahog (meats)	-	-	-	-	-	-	-	-	-	-	-	-
Total	364	1,192		1,577	5,205		9,051	15,318		12,682	27,252	

Table D1-91. (cont.)

Species	May			June			July		
	Kg	Value ($)	Gear	Kg	Value ($)	Gear	Kg	Value ($)	Gear
Alewife	1,000	110	310	-	-	-	-	-	-
White perch	982	540	310	-	-	-	-	-	-
Winter flounder	1,182	520	310	-	-	-	-	-	-
American eel	2,823	3,105	340	1,955	1,505	340	1,273	980	340
Blue crab	-	-	-	-	-	-	2,558	3,440	330
Northern quahog (meats)	2,641	7,702	845	2,046	5,627	845	964	2,913	845
Northern quahog (meats)	7,400	21,566	855	9,550	26,257	855	7,705	23,304	855
Northern quahog (meats)	527	1,541	955	2,046	5,626	955	10,591	32,042	955
Total	16,555	35,084		15,597	39,015		23,091	62,679	

Species	August			Totals		
	Kg	Value ($)	Gear	Kg	Value ($)	Gear
Alewife	-	-	-	1,000	110	310
White perch	-	-	-	4,392	2,503	310
Winter flounder	-	-	-	6,419	2,629	310
American eel	1,046	805	340	10,156	8,750	340
Blue crab	4,546	4,000	330	17,395	15,003	330
Blue crab	-	-	-	9,691	6,214	805
Northern quahog (meats)	2,127	6,319	845	20,811	57,910	845
Northern quahog (meats)	8,509	25,277	855	59,928	169,620	855
Northern quahog (meats)	10,641	31,597	955	25,823	75,806	955
Total	26,869	67,998		155,615	338,545	

[a] 310 - Fyke net
330 - Crab pots
340 - Eel pots
805 - Crab dredge
845 - Clam tongs
855 - Clam rake
955 - Clam by tread

Table D1-92. Commercial fisheries landings reported from Ocean County, New Jersey from September 1976 through August 1977.

Species	September		October		November		December	
	Kg	Value ($)	Kg	Value ($)	Kg	Value ($)	Kg	Value ($)
Bluefish	36,381	8,843	22,940	5,560	6,625	2,819	522	298
American eel[1]	1,709	1,316	1,668	1,285	-	-	-	-
Winter flounder[2]	239	98	1,138	437	2,223	793	791	378
Summer flounder[3]	33,400	27,413	12,062	10,993	16,795	20,244	12,326	9,674
Weakfish[4]	24,099	8,092	26,199	6,569	4,421	1,935	2,432	3,158
White perch	-	-	546	360	182	120	68	45
Blue crab[5]	3,727	2,870	6,564	4,693	4,073	2,688	3,636	2,000
Northern quahog (meats)[6]	40,409	100,013	29,736	73,598	21,900	56,612	11,986	32,963
Total	139,964	148,645	100,853	103,495	56,219	85,211	31,761	48,516

Species	January		February		March		April	
	Kg	Value ($)	Kg	Value ($)	Kg	Value ($)	Kg	Value ($)
American eel	-	-	-	-	-	-	5,273	4,060
Winter flounder	738	365	85	46	1,782	784	1,364	600
Summer flounder	115,616	157,459	132,146	137,755	-	-	111,566	142,074
Weakfish	46	28	66	43	68	41	4,440	1,189
White perch	-	-	-	-	1,205	663	1,409	465
Blue crab	-	-	-	-	1,982	1,526	-	-
Northern quahog (meats)	1,446	4,770	7,886	26,025	20,405	61,724	23,118	69,933
Total	117,846	162,622	140,183	163,869	25,442	64,738	147,170	218,321

Table D1-92 (cont.)

Species	May		June		July		August		Totals	
	Kg	Value ($)	Kg	Value ($)	Kg	Value ($)	Kg	Value ($)	Kg	Value ($)
Alewife	1,000	110	-	-	-	-	-	-	1,000	110
Bluefish	1,173	387	17,026	7,869	56,781	23,244	33,694	21,889	175,142	70,909
American eel	5,505	6,055	3,023	2,328	2,773	2,135	2,286	1,761	22,237	18,940
Winter flounder	10,182	3,829	2,341	801	836	570	-	-	21,719	8,701
Summer flounder	113,759	107,328	54,240	64,798	18,269	33,766	8,585	16,666	628,764	728,170
Weakfish	1,201	409	3,695	2,200	6,986	4,047	9,987	7,261	83,640	34,972
White perch	982	540	-	-	-	-	-	-	4,392	2,193
Blue crab	-	-	-	-	3,909	3,440	4,546	4,000	28,437	21,217
Northern quahog (meats)	26,423	77,022	34,100	93,775	38,518	116,518	42,555	126,387	298,482	839,340
Total	160,225	195,680	114,425	171,771	128,072	183,720	101,653	177,964	1,263,813	1,724,552

[1] Reported as eels, common
[2] Reported as flounder, blackback
[3] Reported as flounder, fluke
[4] Reported as seatrout, grey
[5] Reported as crabs, blue, hard
[6] Reported as clams, hard

Table D1-93. Summary of population surveys conducted during 1976-77.

Survey	Dates Sampled	Gear Used	Total Area Surveyed (km^2)	Number of Samples Taken
Bay anchovy	22, 25, 28, 29 October	4.9-m trawl[b]	61.23	157
Winter flounder	14 - 16, 21 March	4.9-m trawl[b]	88.97	147
Sand shrimp	18 - 20 April	4.6-m seine	0.189	160
Northern pipefish and blue crab[a]	26 - 29 July, 2, 4, 5 August	4.9-m trawl[b]	60.38	80
		4.9-m trawl[c]	60.38	50
		2.7-m trawl[b]	25.70	75
		roller pushnet	0.465	130

[a] Surveys conducted simultaneously
[b] Rigged for bottom tows
[c] Rigged for surface tows

Table D1-94. Results of the bay anchovy population surveys conducted in 1976 in Barnegat Bay, New Jersey.

Stratum	October 1976				May 1976			
	North and East	Central	Southwest	Total	North	West	South	Total
Area ($x10^6$ m^2)	20.29	32.01	8.93	61.23	16.09	4.27	14.33	34.69
Number of samples taken	41	85	31	157	24	28	40	90
Sample mean within stratum [a]	3.29	61.36	8.25		18.54	49.77	102.53	
Stratified sample mean	32.96				73.89			
Standard error of mean	5.84				16.53			
95% confidence interval	11.45				32.39			
Population estimate	2,617,000				5,270,000			
95% confidence limits of population estimate	± 909,000				± 2,310,000			

[a] Mean number per 4.9-m trawl haul that covered 771.75m^2 of bottom.

Table D1-95. Results of the winter flounder population surveys conducted in 1976 and 1977 in Barnegat Bay, New Jersey.

Stratum	March 1977					April 1976				
	North	South	Inlets	Creeks	Total	North	South	Inlets	Creeks	Total
Area ($x10^6$ m^2)	34.01	24.60	2.48	7.88	68.97	39.99	28.62	2.48	7.88	68.97
Number of samples taken	80	46	14	7	147	47	47	9	17	120
Sample mean within stratum[a]	1.51	0.64	0.29	2.29		3.40	1.21	2.33	0.94	
Stratified sample mean	1.24					2.17				
Standard error of mean	0.13					0.25				
95% confidence interval	0.26					0.48				
Population estimate	111,000					194,000				
95% confidence limits of population estimate	± 23,000					± 43,000				

[a] Mean number per 4.9 m trawl haul that covered 771.75m^2 of bottom.

Table D1-96. Results of the sand shrimp population survey conducted in April 1977 in Barnegat Bay, New Jersey.

A. Catch by 4.6-m seine

Location	Double Creek	Waretown/Barnegat Beach	Sands Point Harbor	Oyster Creek	Stouts Creek/Cedar Creek	Forked River
Number of hauls	25	25	30	30	25	25
Mean catch per area[a]	41.8	29.7	13.3	8.4	8.3	7.6
Combined mean catch	35.8		9.6			
Mean number per m^2	1.21		0.33			
Standard error of mean	0.12		0.41			
Area of shore zone (m^2)	56,000		133,000			
Population estimate	68,000		44,000			
95% confidence limits of population estimate	± 12,000		± 107,000			

B. Length frequency distribution of catch

Location	< 23 mm		23 - 40 mm		> 40 mm		Total
	n	%	n	%	n	%	n
Double Creek	32	34	63	66	-	-	95
Waretown	7	13	44	80	4	7	55
Sands Point	30	21	109	77	3	2	142
Oyster Creek	7	11	56	85	3	4	66
Stouts Creek	5	8	54	89	2	3	61
Forked River	6	8	69	90	2	2	77
Total	87	17	395	80	14	3	496

[a] Means underlined not significantly different

Table D1-97. Results of the blue crab population surveys conducted in 1976 and 1977 in Barnegat Bay, New Jersey.

A. East side of Bay (2.7-m trawl samples)

Stratum	July - August 1977					July 1976					
	North	Central	South	Inlet	Total	North	North Central	South Central	Inlet	South	Total
Area ($x10^6$ m^2)	10.57	3.65	9.19	2.29	25.70	10.57	3.65	6.43	2.29	1.76	24.70
Number of samples taken	16	27	8	24	75	32	14	20	9	5	80
Sample mean within stratum[a]	3.94	4.44	3.25	3.21		22.25	29.93	18.40	39.11	16.40	
Stratified sample mean	3.70					23.41					
Standard error of mean	0.73					1.88					
95% confidence interval	1.44					3.64					
Population estimate	604,000					3,872,000					
95% confidence limits of population estimate	± 234,000					± 570,000					

B. West side of Bay (4.9-m trawl samples)

Stratum	July - August 1977					July 1976				
	North	North Central	South Central	South	Total	North	North Central	South Central	South	Total
Area ($x10^6$ m^2)	11.35	8.47	17.71	22.85	60.38	11.35	8.47	17.71	22.85	60.38
Number of samples taken	7	23	40	10	80	8	12	20	20	80
Sample mean within stratum[b]	2.00	3.00	1.10	0.50		2.63	7.83	3.35	1.65	
Stratified sample mean	1.21					3.33				
Standard error of mean	0.28					0.46				
95% confidence interval	0.55					0.90				
Population estimate	102,000					261,000				
95% confidence limits of population estimate	± 43,000					± 70,000				

C. Shore Zone (pushnet samples)

Location	July - August 1977				July 1976
	Western Shore			Eastern Shore	
	No Vegetation	Vegetation	Total	Vegetation	
Number of samples taken	58	32	90	40	
Mean number per m^2	0.005	0.048	0.020	0.050	
Standard error of mean	0.002	0.010	0.004	0.017	
Area of shore zone (m^2)	-	-	288,000	177,000	Not Used
Population estimate	-	-	5,800	8,900	
95% confidence limits of population estimate	-	-	± 2,300	± 6,900	

[a] Mean number per 2.7-m haul that covered 157.5 m^2 of bottom.
[b] Mean number per 4.9-m haul that covered 771.75 m^2 of bottom.

Table D1-98. Summary of the life history stages of the blue crab taken during the population survey in Barnegat Bay from 26 July to 5 August 1977.

	Number of hauls	Mature male	Mature female	Mature male paper shell	Mature female paper shell	Mature male molting	Mature female molting	Gravid female orange eggs	Gravid female black eggs	Immature male	Immature female	Immature male paper shell	Immature female paper shell	Immature female molting
A. 2.7-m trawl														
North	16	8	3	-	1	-	1	-	-	16	32	-	2	-
Central	27	16	4	-	1	-	1	-	-	30	67	1	-	-
South	8	3	1	-	-	-	-	-	-	10	12	-	-	-
Inlet	24	20	3	-	-	1	-	5	6	11	30	-	1	-
subtotal	75	47	11	0	2	1	2	5	6	67	141	1	3	0
B. 4.9-m trawl														
North	7	2	3	1	-	-	-	-	-	-	8	-	-	-
North central	23	14	3	2	-	-	-	-	-	11	37	1	-	1
South central	40	5	7	-	-	-	-	2	-	13	17	-	-	-
South	10	1	2	-	-	-	-	-	-	-	2	-	-	-
subtotal	80	22	15	3	0	0	0	2	0	24	64	1	0	1
Totals		69	26	3	2	1	2	7	6	91	205	2	3	1

Ratios

All immature 0.72
All mature 0.28

All mature male 0.68
All mature female 0.32

All immature male 0.31
All immature female 0.69

Mature paper shell 0.11
Mature molting 0.07
Mature hard shell 0.82

Immature paper shell 0.02
Immature molting <0.01
Immature hard shell 0.98

Mature females 0.69
Gravid females 0.31
Orange eggs 0.54
Black eggs 0.46

Table D1-99. Results of the northern pipefish population surveys conducted in 1976 and 1977 in Barnegat Bay, New Jersey.

A. East side of Bay (2.7-m trawl samples)

Stratum	July - August 1977					July 1976		
	North	North Central	South Central	South	Total	East	Inlet/Sand	Total
Area ($x10^6$ m^2)	10.57	3.65	9.19	2.29	25.70	22.12	14.19	36.31
Number of samples taken	16	27	8	24	75	67	14	81
Sample mean within stratum[a]	4.44	9.74	12.88	33.21		1.64	3.14	
Stratified sample mean	10.77					2.23		
Standard error of mean	1.48					0.33		
95% confidence interval	2.91					0.65		
Population estimate	1,758,000					514,000		
95% confidence limits of population estimate	± 476,000					± 150,000		

B. West side of Bay (4.9-m trawl samples)

Stratum	July - August 1977					July 1976		
	North	North Central	South Central	South	Total	Central	West	Total
Area ($x10^6$ m^2)	11.35	8.47	17.71	22.85	60.38	56.10	5.80	61.90
Number of samples taken	7	23	40	10	80	34	5	39
Sample mean within stratum[b]	0.43	1.30	0.78	8.00		0.79	0.20	
Stratified sample mean	3.98					0.76		
Standard error of mean	2.94					0.37		
95% confidence interval	5.76					0.72		
Population estimate	311,000					61,000		
95% confidence limits of population estimate	± 450,000					± 58,000		

C. Shore Zone (pushnet samples)

Location	July - August 1977				July 1976
	Western Shore			Eastern Shore	
	No Vegetation	Vegetation	Total	Vegetation	
Number of samples taken	58	32	90	40	
Mean number per m^2	0.910	0.092	0.042	0.132	
Standard error of mean	0.004	0.020	0.009	0.026	
Area of shore zone (m^2)	-	-	288,000	177,000	Not Used
Population estimate	-	-	12,100	23,400	
95% confidence limits of population estimate	-	-	± 8,100	± 9,000	

[a] Mean number per 2.7-m haul that covered 157.5m^2 of bottom.
[b] Mean number per 4.9-m haul that covered 771.75m^2 of bottom.

Table D1-100. Estimated entrainment, with confidence interval, of common and important microzooplankton at the OCGS from September 1975 through August 1977.

Form	September 1975 through August 1976	September 1976 through August 1977
Total Microzooplankton	$5.16 \times 10^{13} \pm 7.90 \times 10^{12}$	$4.03 \times 10^{13} \pm 6.40 \times 10^{12}$
Total Meroplankton	$6.98 \times 10^{12} \pm 1.14 \times 10^{12}$	$6.69 \times 10^{12} \pm 1.53 \times 10^{12}$
Total Holoplankton	$4.17 \times 10^{13} \pm 6.80 \times 10^{12}$	$3.36 \times 10^{13} \pm 5.80 \times 10^{12}$
Total Copepods	$9.01 \times 10^{12} \pm 1.79 \times 10^{12}$	$1.21 \times 10^{13} \pm 2.80 \times 10^{12}$
Copepod nauplii	$2.21 \times 10^{13} \pm 4.60 \times 10^{12}$	$1.98 \times 10^{13} \pm 4.00 \times 10^{12}$
Acartia clausi	$1.30 \times 10^{12} \pm 5.90 \times 10^{11}$	$8.73 \times 10^{11} \pm 4.47 \times 10^{11}$
Acartia tonsa	$9.30 \times 10^{11} \pm 2.20 \times 10^{11}$	$1.02 \times 10^{12} \pm 3.00 \times 10^{11}$
Acartia spp.	$3.88 \times 10^{12} \pm 7.50 \times 10^{11}$	$2.53 \times 10^{12} \pm 7.10 \times 10^{11}$
Oithona colcarva	$4.73 \times 10^{11} \pm 1.54 \times 10^{11}$	$3.67 \times 10^{12} \pm 1.44 \times 10^{12}$
Oithona spp.	$1.04 \times 10^{12} \pm 4.00 \times 10^{11}$	$3.08 \times 10^{12} \pm 9.20 \times 10^{11}$
Paracalanus crassirostris	$1.77 \times 10^{11} \pm 6.50 \times 10^{10}$	$2.76 \times 10^{11} \pm 1.05 \times 10^{11}$
Rotifers	$4.81 \times 10^{12} \pm 1.26 \times 10^{12}$	$1.21 \times 10^{12} \pm 5.90 \times 10^{11}$
Total Bivalve larvae	$1.40 \times 10^{12} \pm 3.50 \times 10^{11}$	$9.46 \times 10^{11} \pm 2.44 \times 10^{11}$
Mercenaria mercenaria larvae	$1.14 \times 10^{11} \pm 9.70 \times 10^{10}$	$1.86 \times 10^{9} \pm 4.22 \times 10^{9}$
Mulinia lateralis	$2.10 \times 10^{11} \pm 5.90 \times 10^{10}$	$1.93 \times 10^{11} \pm 1.07 \times 10^{11}$
Barnacle larvae	$7.31 \times 10^{12} \pm 2.32 \times 10^{12}$	$1.48 \times 10^{12} \pm 4.20 \times 10^{11}$
Polychaete larvae	$4.34 \times 10^{12} \pm 8.00 \times 10^{11}$	$2.73 \times 10^{12} \pm 1.17 \times 10^{12}$
Polydora spp. larvae	$6.98 \times 10^{9} \pm 4.42 \times 10^{9}$	$1.26 \times 10^{12} \pm 1.12 \times 10^{12}$
Gastropod larvae	$8.61 \times 10^{11} \pm 1.89 \times 10^{11}$	$6.44 \times 10^{11} \pm 1.69 \times 10^{11}$

Table D1-101. Estimated entrainment, with confidence interval, and results of analysis of variance ($P \leq 0.2$) of common and important microzooplankton at OCGS during six comparable months (September through November, March, April, and August).

	8 September 1975-3 September 1976 Entrainment Estimate	4 September 1976-30 August 1977 Entrainment Estimate	Significance ($P \leq 0.2$)
Total Microzooplankton	$3.03 \times 10^{13} \pm 7.10 \times 10^{12}$	$2.87 \times 10^{13} \pm 4.8 \times 10^{12}$	Yes
Total Meroplankton	$3.88 \times 10^{12} \pm 7.70 \times 10^{11}$	$4.84 \times 10^{12} \pm 1.22 \times 10^{12}$	Yes
Total Holoplankton	$2.44 \times 10^{13} \pm 6.10 \times 10^{12}$	$2.39 \times 10^{13} \pm 4.40 \times 10^{12}$	Yes
Total Copepods	$5.81 \times 10^{12} \pm 1.26 \times 10^{12}$	$8.10 \times 10^{12} \pm 2.05 \times 10^{12}$	Yes
Copepod nauplii	$1.32 \times 10^{13} \pm 4.10 \times 10^{12}$	$1.45 \times 10^{13} \pm 3.00 \times 10^{12}$	Yes
Acartia clausi	$1.12 \times 10^{12} \pm 6.00 \times 10^{11}$	$6.08 \times 10^{11} \pm 3.22 \times 10^{11}$	Yes
Acartia tonsa	$5.34 \times 10^{11} \pm 1.24 \times 10^{11}$	$6.94 \times 10^{11} \pm 2.21 \times 10^{11}$	Yes
Acartia spp.	$2.69 \times 10^{12} \pm 6.70 \times 10^{11}$	$1.72 \times 10^{12} \pm 5.50 \times 10^{11}$	Yes
Oithona colcarva	$2.35 \times 10^{11} \pm 7.50 \times 10^{10}$	$2.32 \times 10^{12} \pm 1.05 \times 10^{12}$	Yes
Oithona spp.	$5.11 \times 10^{11} \pm 7.90 \times 10^{10}$	$2.01 \times 10^{12} \pm 6.60 \times 10^{11}$	Yes
Paracalanus crassirostris	$7.62 \times 10^{10} \pm 2.81 \times 10^{10}$	$1.50 \times 10^{11} \pm 4.80 \times 10^{10}$	Yes
Rotifers	$2.29 \times 10^{12} \pm 5.60 \times 10^{11}$	$8.91 \times 10^{11} \pm 4.46 \times 10^{11}$	No
Total Bivalve larvae	$9.49 \times 10^{11} \pm 3.25 \times 10^{11}$	$7.04 \times 10^{11} \pm 1.89 \times 10^{11}$	No
Mercenaria mercenaria larvae	$1.09 \times 10^{11} \pm 1.04 \times 10^{11}$	$1.29 \times 10^{9} \pm 6.40 \times 10^{8}$	Yes
Barnacle larvae	$4.28 \times 10^{12} \pm 2.05 \times 10^{12}$	$1.08 \times 10^{12} \pm 3.2 \times 10^{11}$	Yes
Polychaete larvae	$2.32 \times 10^{12} \pm 4.60 \times 10^{11}$	$2.02 \times 10^{12} \pm 9.40 \times 10^{11}$	No
Polydora spp. larvae	$6.68 \times 10^{9} \pm 4.64 \times 10^{9}$	$9.62 \times 10^{11} \pm 9.02 \times 10^{11}$	Yes
Gastropod larvae	$3.79 \times 10^{11} \pm 7.50 \times 10^{10}$	$4.37 \times 10^{11} \pm 1.28 \times 10^{11}$	Yes

Table D1-102. Mean monthly densities (n/m^3) and percent composition of numerous and important microzooplankton collected at the Oyster Creek Generating Station discharge from September 1975-September 1976 (year one) and from September 1976-September 1977 (year two).[a] NE = not enumerated.

Form	Year	September n/m^3	September %	October n/m^3	October %	November n/m^3	November %	December n/m^3	December %	March n/m^3	March %	April n/m^3	April %
Copepod nauplii	1	8,573	26	7,433	43	2,039	31	19,618	30	30,911	39	80,545	45
	2	72,962	59	22,343	59	1,623	5	NS	-	17,721	70	38,320	49
Total copepods	1	3,601	11	5,146	30	2,569	39	7,127	11	46,748	59	20,083	11
	2	40,083	32	9,892	26	1,807	5	NS	-	3,408	13	15,117	19
Acartia clausi	1	0	0	93	< 1	26	< 1	1,180	2	20,823	26	4,828	3
	2	0	0	0	0	215	1	NS	-	747	3	9,197	12
Acartia tonsa	1	710	2	1,472	9	769	12	1,715	3	557	1	124	< 1
	2	4,841	4	727	2	299	1	NS	-	70	< 1	32	< 1
Acartia spp.	1	585	2	2,280	13	937	14	2,866	4	18,803	24	13,056	7
	2	12,984	10	2,256	6	216	1	NS	-	493	2	2,874	4
Oithona colcarva	1	267	1	373	2	136	2	116	< 1	118	< 1	54	< 1
	2	5,146	4	1,416	4	226	1	NS	-	26	< 1	0	0
Oithona spp.	1	322	1	197	1	210	3	333	< 1	0	0	24	< 1
	2	12,893	10	3,885	10	94	< 1	NS	-	9	1	49	< 1
Paracalanus crassirostris	1	15	< 1	45	< 1	0	0	0	0	35	< 1	53	< 1
	2	620	< 1	205	< 1	86	< 1	NS	-	0	0	0	0
Rotifers	1	11,317	34	78	< 1	433	7	34,698	52	133	< 1	11,256	6
	2	1,439	1	80	< 1	26,041	76	NS	-	171	1	149	< 1
Total bivalve larvae	1	1,376	4	325	2	127	2	163	< 1	48	< 1	7,708	4
	2	3,693	3	1,753	5	2,067	6	NS	-	6	< 1	1,207	2
Mercenaria mercenaria larvae	1	0	0	0	0	0	0	6	< 1	0	0	1,249	1
	2	0	0	31	< 1	0	0	NS	-	0	0	0	0
Mulinia lateralis larvae	1	833	3	290	2	0	0	0	0	0	0	114	< 1
	2	1,380	1	316	1	0	0	NS	-	0	0	0	0
Polydora spp. larvae	1	NE	-	NE	-	NE	-	NE	-	NE	-	NE	-
	2	0		0		237	< 1	NS	-	117	< 1	12,511	16
Total polychaete larvae	1	2,131	6	746	4	172	3	442	1	247	< 1	12,840	7
	2	3,710	3	2,258	6	1,558	5	NS	-	406	2	15,124	19
Barnacle larvae	1	1,643	5	1,016	6	611	9	3,590	5	1,420	2	43,781	25
	2	651	< 1	595	2	225	1	NS	-	3,185	13	7,248	9
Gastropod larvae	1	1,582	5	544	3	171	3	69	< 1	15	< 1	381	< 1
	2	990	1	213	< 1	19	< 1	NS	-	23	< 1	200	1
Cyphonautes larvae	1	622	2	429	2	38	< 1	26	< 1	0	0	0	0
	2	58	< 1	46	< 1	25	< 1	NS	-	7	< 1	43	< 1
Trochophores	1	168	< 1	12	< 1	126	2	139	< 1	0	0	885	< 1
	2	699	< 1	282	1	726	2	NS	-	0	0	0	0
Total Microzooplankton	1	33,232	-	17,202	-	6,650	-	66,310	-	79,555	-	177,640	-
	2	124,562	-	37,689	-	34,223	-	NS	-	25,409	-	77,625	-

Table D1-102. (cont.)

Form	Year	May n/m³	May %	June n/m³	June %	July n/m³	July %	August n/m³	August %	September n/m³	September %	Mean n/m³	Mean %
Copepod nauplii	1	25,275	24	51,772	53	48,635	55	15,984	45	42,452	43	30,294	41
	2	20,932	36	34,010	45	36,733	30	13,648	26	8,918	26	26,723	42
Total copepods	1	5,702	5	18,136	19	30,204	34	9,743	27	42,185	43	17,386	24
	2	18,206	31	22,327	29	68,174	57	26,168	50	8,915	26	21,410	33
Acartia clausi	1	195	< 1	179	< 1	0	0	0	0	0	0	2,484	3
	2	5,757	10	43	< 1	0	0	0	0	140	< 1	1,610	3
Acartia tonsa	1	17	< 1	2,835	3	3,680	4	1,567	4	6,158	6	1,782	2
	2	1,802	3	7,148	9	5,449	5	1,924	4	3,711	11	2,600	4
Acartia spp.	1	1,732	2	6,925	7	6,938	8	3,572	10	15,658	16	6,668	9
	2	896	2	4,106	5	6,766	6	3,883	7	3,027	9	3,750	6
Oithona colcarva	1	49	< 1	546	1	3,221	4	941	3	2,512	3	757	1
	2	284	< 1	3,899	5	31,059	26	16,819	32	2,271	7	6,115	10
Oithona spp.	1	179	< 1	641	< 1	6,975	8	2,596	7	13,108	13	2,235	3
	2	395	1	2,930	4	20,711	17	4,799	9	784	2	4,865	6
Paracalanus crassirostris	1	26	< 1	877	1	840	1	48	< 1	1,992	2	357	< 1
	2	6	< 1	241	< 1	5,214	4	517	1	0	0	689	1
Rotifers	1	21,318	20	2,844	3	335	< 1	2,423	7	2,542	3	7,943	11
	2	2,199	4	1,413	2	138	< 1	490	1	6,280	18	3,840	6
Total bivalve larvae	1	3,350	3	1,971	2	792	< 1	1,842	5	3,215	3	1,902	3
	2	631	1	2,165	3	1,059	1	1,127	2	2,794	8	1,650	3
Mercenaria mercenaria	1	81	< 1	24	< 1	0	0	97	< 1	307	< 1	160	< 1
	2	3	< 1	15	< 1	6	< 1	0	0	0	0	8	-
Mulinia lateralis	1	1,051	1	215	< 1	190	< 1	297	< 1	644	< 1	331	< 1
	2	164	< 1	70	< 1	50	< 1	54	< 1	0	0	203	< 1
Polydora spp. larvae	1	NE	-	NE	-	NE	-	NE	-	NE	0	-	-
	2	2,639	13	391	-	116	< 1	15	< 1	0	0	1,602	3
Total polychaete larvae	1	12,136	12	8,601	9	2,890	3	2,256	6	3,245	3	4,154	6
	2	8,153	14	2,077	3	2,496	2	2,297	4	2,115	6	4,019	6
Barnacle larvae	1	28,321	27	8,956	9	735	< 1	170	< 1	0	0	8,204	11
	2	3,697	6	1,479	2	303	< 1	372	1	86	< 1	1,784	3
Gastropod larvae	1	3,288	3	1,487	2	2,316	3	1,416	4	641	< 1	1,080	1
	2	4,280	7	10,157	13	7,167	6	3,087	6	1,729	5	2,781	4
Cyphonautes larvae	1	0	0	21	< 1	76	< 1	108	< 1	0	0	120	< 1
	2	58	< 1	205	< 1	2,018	2	4,822	9	2,701	8	968	2
Trochophores	1	4,257	4	2,872	3	1,914	2	1,804	5	3,822	4	1,427	2
	2	3,449	6	1,383	2	1,816	2	54	< 1	0	0	841	1
Total Microzooplankton	1	104,827	-	98,054	-	88,562	-	35,838	-	98,448	-	73,301	-
	2	58,200	-	75,972	-	120,570	-	32,866	-	34,213	-	64,133	-

[a] Year one includes September-December and 2 March-September 1976; year two includes 9 September 1976-November 1976, 1 March-September 1977. During the second year, the dilution discharge was sampled instead of the condenser discharge from 16 May through 18 July when the plant was not in operation. Densities from the dilution discharge are included in the monthly and yearly totals.

Table D1-103. The average annual density (n/m^3) and percent composition of organisms which comprise 95% of all microzooplankton collected at the discharge of the Oyster Creek Generating Station, Forked River, New Jersey from 7 September 1976 through 1 September 1977 (no samples were taken from December-February, and in June.

Form	Mean Density (n/m^3)	Percent Composition
1. Copepod nauplii	26,723	41.67
2. *Oithona colcarva* (adults & copepodites)	6,115	9.53
3. *Oithona* spp. copepodites	4,655	7.26
4. Total Polychaete larvae	4,019	6.27
5. Rotifers	3,840	5.99
6. *Acartia* spp. copepodites	3,750	5.85
7. Gastropod larvae	2,781	4.34
8. *Acartia tonsa* (adults & copepodites)	2,600	4.05
9. Barnacle larvae	1,784	2.78
10. Total Bivalve larvae	1,650	2.57
11. *Acartia clausi* (adults & copepodites)	1,610	2.51
12. Cyphonaute larvae	968	1.51
13. *Paracalanus crassirostris*	718	1.12
Total Microzooplankton	61,213	-

Table D1-104. Monthly day and night mean densities (n/1000m^3) of common and important macrozooplankton collected at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1976 and from September 1976 through August 1977.

		September		October		November		December		January		February	
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Neomysis americana	1975/76	1153	12768	528	17701	2678	24953	2757	33744	180	12063	3071	42601
	1976/77	7769	36694	7150	31666	4061	29829	23408	85394	5654	12282	24808	62594
Mysidopsis bigelowi	1975/76	771	4320	47	4567	369	2867	174	1194	0	1632	59	479
	1976/77	232	2588	494	4329	153	2640	1661	1369	0	12	13	0
Crangon septemspinosa	1975/76	0	53	0	0	0	0	0	513	15	439	0	612
	1976/77	0	29	0	22	0	0	0	149	0	179	79	654
Jassa falcata	1975/76	25	8	50	121	40	191	228	130	1409	618	66	111
	1976/77	17082	16471	10806	18668	7954	15647	17629	10967	3324	2853	7457	4367
Microdeutopus gryllotalpa	1975/76	17	98	7	88	156	176	123	443	0	4	14	235
	1976/77	33	121	0	0	0	0	0	0	0	14	106	0
Ampelisca spp.	1975/76	40	1796	23	398	47	393	0	560	0	13	0	640
	1976/77	7	874	0	121	0	0	0	55	0	0	0	0
Leucon americanus	1975/76	2	191	0	336	0	319	18	253	0	21	0	171
	1976/77	14	879	0	699	63	675	0	240	0	0	156	236
Oxyurostylis smithi	1975/76	25	1936	0	279	23	92	0	225	0	16	0	41
	1976/77	32	160	0	60	0	21	0	15	0	0	50	26
Sarsia spp.	1975/76	0	0	0	0	0	0	0	0	0	0	221	709
	1976/77	0	0	0	0	0	0	0	0	0	16	12996	33149
Rathkea octopunctata	1975/76	0	0	0	0	0	0	0	0	5	0	111	0
	1976/77	33	0	0	0	76	71	562	849	4510	1966	18779	27390
Sagitta spp.	1975/76	0	0	0	0	0	0	0	12	10276	6614	33556	13632
	1976/77	704	409	39	108	0	0	1267	1658	1053	2356	1834	642
Neopanope texana (zoeae)	1975/76	1474	336	0	0	0	0	0	0	0	0	0	0
	1976/77	291	260	0	5	0	0	0	0	0	0	0	0
Crangon septemspinosa (zoeae)	1975/76	0	0	170	118	32	96	982	999	63	214	471	792
	1976/77	17	8	0	126	1210	1599	51	193	0	0	0	23
Panopeus herbstii (zoeae)	1975/76	2	0	0	0	0	0	0	0	0	0	0	0
	1976/77	0	16	0	0	0	0	0	0	0	0	0	0
Rhithropanopeus harrisi (zoeae)	1975/76	56	27	0	0	0	0	0	0	0	0	0	0
	1976/77	0	0	0	0	0	0	0	0	0	0	0	0
Palaemonetes spp. (zoeae)	1975/76	238	112	0	0	0	0	0	0	0	0	0	0
	1976/77	33	73	0	9	0	0	0	0	0	0	0	0
Upogebia affinis (zoeae)	1975/76	0	0	0	0	0	0	0	0	0	0	0	0
	1976/77	0	0	0	0	0	0	0	0	0	0	0	0
Hippolyte spp. (zoeae)	1975/76	21	43	0	0	0	0	0	0	0	0	0	0
	1976/77	523	283	12	0	0	0	0	0	0	0	0	0
Pagurus spp. (zoeae)	1975/76	206	94	0	0	0	0	0	0	0	0	0	0
	1976/77	211	295	0	10	0	0	0	0	0	0	0	0
Libinia spp. (zoeae)	1975/76	0	7	0	0	0	0	0	0	0	0	0	0
	1976/77	0	5	0	0	0	0	0	0	0	0	0	0
Callinectes sapidus (megalopae)	1975/76	61	1766	26	189	0	0	0	0	0	0	0	0
	1976/77	56	1775	157	1438	0	0	0	0	0	0	0	0

Table D1-104. (cont.)

		March		April		May		June		July		August	
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Neomysis americana	1975/76	30556	79928	679	11336	874	7422	3866	47390	3080	2712	2274	53701
	1976/77	9188	109273	6910	118493	648	43124	927	27578	2896	32015	4527	14201
Mysidopsis bigelowi	1975/76	182	284	31	23	0	1	0	396	98	3258	190	3508
	1976/77	0	4	0	0	0	0	0	30	208	6485	773	12849
Crangon septemspinosa	1975/76	206	722	0	154	0	208	0	154	0	236	11	731
	1976/77	0	317	0	282	0	64	0	26	0	6	31	182
Jassa falcata	1975/76	0	26	24	200	101	110	601	4909	13783	7805	14600	12762
	1976/77	2710	6328	7172	11451	6866	12254	1591	894	4031	4165	510	316
Microdeutopus gryllotalpa	1975/76	276	184	179	1300	2100	17364	1118	3082	864	1312	92	168
	1976/77	25	23	7	298	103	10033	128	2713	292	3271	259	243
Ampeliscа spp.	1975/76	103	3654	38	8108	131	10783	61	11175	197	7907	242	1261
	1976/77	0	290	104	843	0	1212	246	6896	63	12653	219	407
Leucon americanus	1975/76	63	564	0	341	0	573	0	10546	0	244	88	1669
	1976/77	0	379	0	548	0	128	0	197	33	922	148	1301
Oxyurostylis smithi	1975/76	84	824	40	890	0	2178	409	8658	875	2647	188	344
	1976/77	0	44	0	869	25	2433	42	1991	34	994	393	351
Sarsia spp.	1975/76	4851	7059	1415	1092	0	0	0	0	0	0	0	0
	1976/77	63036	91366	46732	82361	191	83	0	0	0	0	0	0
Rathkea octopunctata	1975/76	622	131	0	32	0	5	0	0	0	0	0	0
	1976/77	75978	176125	292315	288373	13	0	0	0	0	8	0	0
Sagitta spp.	1975/76	11122	10492	59	112	0	0	0	0	0	0	0	0
	1976/77	381	375	134	61	0	0	0	0	0	0	0	0
Neopanope texana (zoeae)	1975/76	0	0	0	13	2760	32926	14916	59698	8985	40458	2778	8779
	1976/77	0	0	0	0	6621	16151	4101	46572	16834	57328	2184	6044
Crangon septemspinosa (zoeae)	1975/76	7443	5750	8513	17558	6432	26537	13502	17467	2166	293	821	89
	1976/77	133	222	2071	9578	3324	12943	7194	10467	2067	3355	51	7
Panopeus herbstii (zoeae)	1975/76	0	0	8	0	0	896	1456	3836	405	2849	393	650
	1976/77	0	0	0	0	32	0	7551	7941	28714	22875	1101	8406
Rhithropanopeus harrisii (zoeae)	1975/76	0	0	0	0	574	1011	1042	1733	67	345	101	95
	1976/77	0	0	0	0	136	135	312	698	281	363	31	72
Palaemonetes spp. (zoeae)	1975/76	0	0	0	0	163	464	619	3584	140	2681	66	682
	1976/77	0	0	0	0	0	11	1185	7800	2900	9233	243	859
Upogebia affinis (zoeae)	1975/76	0	0	0	0	0	0	273	767	408	535	52	129
	1976/77	0	0	0	0	0	0	490	289	1222	800	148	56
Hippolyte spp. (zoeae)	1975/76	0	0	0	0	85	56	0	100	86	67	173	142
	1976/77	0	0	0	0	0	0	0	48	850	578	513	378
Pagurus spp. (zoeae)	1975/76	0	0	0	10	170	109	192	288	315	323	118	126
	1976/77	0	0	0	0	28	153	23	247	1004	337	258	121
Libinia spp. (zoeae)	1975/76	0	0	0	0	0	0	49	379	131	378	48	117
	1976/77	0	0	0	0	0	22	37	222	885	968	15	234

TABLE D1-105. YEARLY MEAN DENSITIES (n/1000m^3) OF MACROZOOPLANKTON THAT CONSTITUTED 95% OF THE ASSEMBLAGE COLLECTED AT THE OYSTER CREEK GENERATING STATION, FORKED RIVER, NEW JERSEY FROM SEPTEMBER 1976 THROUGH AUGUST 1977 AND FROM SEPTEMBER 1975 THROUGH AUGUST 1976.

SECOND YEAR - SEPTEMBER 1976 THROUGH AUGUST 1977

SPECIES	LIFESTAGE	FREQUENCY	YEARLY MEAN	STD DEV	% COMPOSITION
TOTAL		283	114478.33		
RATHKEA OCTOPUNCTATA	NO DETERM.	99	36959.70	100922.00	32.29
NEOMYSIS AMERICANA	NO DETERM.	282	29296.50	29322.60	25.59
SARSIA SPP	NO DETERM.	76	13745.80	34366.50	12.01
JASSA FALCATA	NO DETERM.	253	7979.95	5317.36	6.97
NEOPANOPE TEXANA	ZOEAL	112	6516.23	17543.60	5.69
PANOPEUS HERBSTII	ZOEAL	83	3193.09	8111.04	2.79
CRANGON SEPTEMSPINOSA	ZOEAL	165	2276.64	4241.61	1.99
MYSIDOPSIS BIGELOWI	NO DETERM.	121	1409.91	4115.46	1.23
AMPELISCA SPP.	NO DETERM.	139	999.63	3009.60	0.87
PALAEMONETES SPP	ZOEAL	93	971.91	1952.87	0.85
ORDER CAPRELLIDEA	NO DETERM.	215	926.72	2689.62	0.81
CLASS POLYCHAETA	LARVAL	123	812.98	2231.56	0.71
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	112	736.25	2647.25	0.64
BARNACLE CYPRIS	LARVAL	47	709.65	2474.31	0.62
JASSA FALCATA	GRAVID FE.	187	600.32	636.45	0.52
OBELIA SPP	NO DETERM.	33	556.42	2171.17	0.49
SUBPHYLUM PYCNOGONIDA	NO DETERM.	125	460.03	1576.94	0.40
SAGITTA SPP	NO DETERM.	95	459.10	749.39	0.40
FAMILY STENOTHOIDAE	NO DETERM.	147	429.96	288.36	0.38

FIRST YEAR - SEPTEMBER 1975 THROUGH AUGUST 1976

SPECIES	LIFESTAGE	FREQUENCY	YEARLY MEAN	STD DEV	% COMPOSITION
TOTAL		262	51361.21		
NEOMYSIS AMERICANA	NO DETERM.	259	17620.70	19132.00	34.31
NEOPANOPE TEXANA	ZOEAL	128	7213.88	16399.70	14.05
CRANGON SEPTEMSPINOSA	ZOEAL	172	4592.57	5396.92	8.94
SAGITTA ELEGANS	NO DETERM.	52	3587.33	3309.99	6.98
JASSA FALCATA	NO DETERM.	144	2413.20	3071.02	4.70
AMPELISCA SPP.	NO DETERM.	184	1977.70	4272.15	3.85
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	144	1220.30	2655.59	2.38
MYSIDOPSIS BIGELOWI	NO DETERM.	132	1017.91	1345.98	1.98
LEUCON AMERICANUS	NO DETERM.	150	930.73	2548.04	1.81
OXYUROSTYLIS SMITHI	NO DETERM.	163	834.63	1801.93	1.63
COROPHIUM SPP	NO DETERM.	124	805.23	1461.01	1.57
ORDER CAPRELLIDEA	NO DETERM.	153	764.19	1007.51	1.49
SARSIA SPP	NO DETERM.	43	639.49	1505.27	1.25
CLASS POLYCHAETA	LARVAL	117	637.69	1028.61	1.24
UNIDENTIFIED AMPHIPODA	NO DETERM.	130	604.97	1002.60	1.18
PANOPEUS HERBSTII	ZOEAL	49	428.83	1397.51	0.83
EDOTEA TRILOBA	NO DETERM.	124	378.48	386.38	0.74
PALAEMONETES SPP	ZOEAL	92	364.48	823.25	0.71
NEOMYSIS AMERICANA	GRAVID FE.	115	339.77	686.41	0.66
ORDER CERIANTHARIA	LARVAL	41	321.41	1046.02	0.63
ELASMOPUS LEVIS	NO DETERM.	129	273.61	340.98	0.53
RHITHROPANOPEUS HARRISI	ZOEAL	65	210.44	436.76	0.41
SUBPHYLUM PYCNOGONIDA	NO DETERM.	70	203.74	379.32	0.40
CRANGON SEPTEMSPINOSA	NO DETERM.	134	167.28	223.19	0.33
JASSA FALCATA	GRAVID FE.	57	160.69	419.98	0.31
STENOTHOE BREVICORNIS	NO DETERM.	57	151.07	463.73	0.25
FAMILY CAPITELLIDAE	NO DETERM.	61	139.83	368.75	0.27
MONOCULODES EDWARDSI	NO DETERM.	73	137.32	307.27	0.27
MICROPROTOPUS RANEYI	NO DETERM.	40	132.50	457.42	0.26
MNEMIOPSIS LEIDYI	NO DETERM.	31	129.17	708.71	0.25
FAMILY SYLLIDAE	NO DETERM.	64	122.90	330.95	0.24
INFRAORDER BRACHYURA	ZOEAL	30	114.32	314.40	0.22
IDOTEA BALTICA	NO DETERM.	74	113.61	229.81	0.22
FAMILY STENOTHOIDAE	NO DETERM.	32	111.05	352.28	0.22

Table D1-106. Annual estimate, with confidence interval ($P \leq 0.05$), of important and common macrozooplankton entrained at Oyster Creek Generating Station from 8 September 1975 through August 1977. Estimates were based on data obtained from collections taken at the condenser discharge, except for the estimates of B. ovata and M. leidyi, which were derived from data from collections taken at the condenser intakes.

	8 September 1975-3 September 1976	4 September 1976-30 August 1977
	Entrainment Estimate	Entrainment Estimate
Total Macrozooplankton	$4.25 \times 10^{10} \pm 4.61 \times 10^{9}$	$9.98 \times 10^{10} \pm 2.20 \times 10^{9}$
Polychaeta larvae	$3.28 \times 10^{8} \pm 7.20 \times 10^{7}$	$4.05 \times 10^{8} \pm 2.52 \times 10^{8}$
Palaemonetes spp. zoeae	$4.15 \times 10^{8} \pm 1.03 \times 10^{8}$	$1.41 \times 10^{8} \pm 5.00 \times 10^{7}$
Crangon septemspinosa zoeae	$4.34 \times 10^{9} \pm 8.40 \times 10^{8}$	$6.98 \times 10^{8} \pm 2.32 \times 10^{8}$
Panopeus herbstii	$4.81 \times 10^{8} \pm 1.54 \times 10^{8}$	$1.55 \times 10^{9} \pm 8.10 \times 10^{8}$
Neopanope texana	$8.11 \times 10^{9} \pm 1.91 \times 10^{9}$	$1.07 \times 10^{9} \pm 4.37 \times 10^{8}$
Rhithropanopeus harrisi	$2.24 \times 10^{8} \pm 6.50 \times 10^{7}$	$8.89 \times 10^{6} \pm 5.32 \times 10^{6}$
Callinectes sapidus megalopae	$5.18 \times 10^{7} \pm 2.78 \times 10^{8}$	$1.89 \times 10^{8} \pm 7.26 \times 10^{7}$
Other Brachyuran megalopae	$2.08 \times 10^{7} \pm 1.17 \times 10^{7}$	$2.42 \times 10^{8} \pm 7.84 \times 10^{7}$
Beroe ovata	$2.83 \times 10^{7} \pm 1.72 \times 10^{7}$	$2.00 \times 10^{7} \pm 1.63 \times 10^{7}$
Mnemiopsis leidyi	$9.79 \times 10^{8} \pm 3.83 \times 10^{8}$	$3.41 \times 10^{7} \pm 1.52 \times 10^{7}$
Sarsia spp.	$4.11 \times 10^{8} \pm 1.96 \times 10^{8}$	$1.52 \times 10^{10} \pm 5.06 \times 10^{9}$
Rathkea octopunctata	$2.30 \times 10^{7} \pm 2.08 \times 10^{7}$	$4.20 \times 10^{10} \pm 1.72 \times 10^{10}$
Nereis spp. epitokes	$3.83 \times 10^{7} \pm 1.11 \times 10^{7}$	$1.75 \times 10^{7} \pm 7.93 \times 10^{6}$
Leucon americanus	$1.07 \times 10^{9} \pm 3.09 \times 10^{8}$	$2.41 \times 10^{8} \pm 4.09 \times 10^{7}$
Oxyurostylis smithi	$8.62 \times 10^{8} \pm 2.16 \times 10^{8}$	$1.27 \times 10^{8} \pm 3.86 \times 10^{7}$
Edotea triloba	$4.01 \times 10^{8} \pm 7.79 \times 10^{7}$	$1.63 \times 10^{8} \pm 5.31 \times 10^{7}$
Ampelisca spp.	$2.11 \times 10^{9} \pm 4.42 \times 10^{8}$	$1.70 \times 10^{8} \pm 3.38 \times 10^{7}$
Microdeutopus gryllotalpa	$1.23 \times 10^{9} \pm 3.49 \times 10^{8}$	$1.01 \times 10^{8} \pm 4.27 \times 10^{7}$
Corophium spp.	$7.92 \times 10^{8} \pm 2.47 \times 10^{8}$	$1.72 \times 10^{8} \pm 5.30 \times 10^{7}$
Jassa falcata	$2.68 \times 10^{9} \pm 8.38 \times 10^{8}$	$6.73 \times 10^{9} \pm 9.43 \times 10^{8}$
Total Amphipoda	$1.96 \times 10^{9} \pm 3.53 \times 10^{8}$	$1.03 \times 10^{9} \pm 1.37 \times 10^{8}$
Mysidopsis bigelowi[a]	$6.36 \times 10^{8} \pm 1.11 \times 10^{8}$	$1.38 \times 10^{9} \pm 4.06 \times 10^{8}$
Mysidopsis bigelowi gravid	$4.21 \times 10^{6} \pm 2.12 \times 10^{6}$	$3.69 \times 10^{7} \pm 1.66 \times 10^{7}$
Neomysis americana[a]	$1.19 \times 10^{10} \pm 1.99 \times 10^{9}$	$2.29 \times 10^{10} \pm 3.24 \times 10^{9}$
Neomysis americana gravid	$2.98 \times 10^{8} \pm 7.63 \times 10^{7}$	$3.10 \times 10^{8} \pm 7.93 \times 10^{7}$
Palaemonetes spp.	$5.09 \times 10^{7} \pm 1.32 \times 10^{7}$	$2.75 \times 10^{7} \pm 8.49 \times 10^{6}$
Crangon septemspinosa	$1.04 \times 10^{8} \pm 1.97 \times 10^{7}$	$6.37 \times 10^{7} \pm 1.39 \times 10^{7}$
Sagitta spp.	$5.45 \times 10^{8} \pm 3.56 \times 10^{8}$	$2.79 \times 10^{8} \pm 8.33 \times 10^{7}$

[a] Adult males, non-gravid females, and juveniles.

Table D1-107. Estimated entrainment, with confidence interval ($P \leq 0.2$), and results of analysis of variance ($P \leq 0.2$) of important and common macrozooplankton at Oyster Creek Generating Station during seven comparable months (September through December, March, April, and August) from 8 September 1975 through 30 August 1977.

	8 September 1975-3 September 1976 Entrainment Estimate	4 September 1976-30 August 1977 Entrainment Estimate	Significance ($P \leq 0.2$)
Total Macrozooplankton	$2.67 \times 10^{10} \pm 3.29 \times 10^{9}$	$7.42 \times 10^{10} \pm 1.82 \times 10^{10}$	Yes
Polychaeta larvae	$3.34 \times 10^{8} \pm 8.40 \times 10^{7}$	$4.85 \times 10^{8} \pm 3.32 \times 10^{6}$	I[a]
Palaemonetes spp. zoeae	$3.85 \times 10^{8} \pm 1.01 \times 10^{8}$	$1.31 \times 10^{8} \pm 4.80 \times 10^{7}$	I
Crangon septemspinosa zoeae	$3.84 \times 10^{9} \pm 8.30 \times 10^{8}$	$7.09 \times 10^{8} \pm 2.44 \times 10^{8}$	I
Panopeus herbstii zoeae	$4.15 \times 10^{8} \pm 1.39 \times 10^{8}$	$1.04 \times 10^{9} \pm 4.50 \times 10^{8}$	No
Neopanope texana zoeae	$7.13 \times 10^{9} \pm 1.82 \times 10^{9}$	$8.66 \times 10^{8} \pm 3.26 \times 10^{8}$	Yes
Rhithropanopeus harissi zoeae	$1.60 \times 10^{8} \pm 4.73 \times 10^{7}$	$6.13 \times 10^{6} \pm 3.85 \times 10^{6}$	Yes
Callinectes sapidus megalopae	$3.57 \times 10^{7} \pm 1.87 \times 10^{7}$	$1.35 \times 10^{8} \pm 5.06 \times 10^{7}$	Yes
Other Brachyura megalopae	$1.39 \times 10^{7} \pm 7.80 \times 10^{6}$	$1.74 \times 10^{8} \pm 5.57 \times 10^{7}$	Yes
Beroe ovata	$2.29 \times 10^{7} \pm 1.56 \times 10^{7}$	$1.60 \times 10^{7} \pm 1.40 \times 10^{7}$	I
Mnemiopsis leidyi	$7.49 \times 10^{8} \pm 3.35 \times 10^{8}$	$2.42 \times 10^{7} \pm 1.06 \times 10^{7}$	I
Sarsia spp.	$3.48 \times 10^{8} \pm 1.86 \times 10^{8}$	$1.15 \times 10^{10} \pm 4.05 \times 10^{9}$	Yes
Rathkea octopunctata	$2.15 \times 10^{7} \pm 2.07 \times 10^{7}$	$3.29 \times 10^{10} \pm 1.45 \times 10^{10}$	Yes
Nereis spp. epitokes	$2.56 \times 10^{7} \pm 7.46 \times 10^{6}$	$1.35 \times 10^{7} \pm 6.31 \times 10^{6}$	I
Leucon americanus	$7.08 \times 10^{8} \pm 2.07 \times 10^{8}$	$1.66 \times 10^{8} \pm 2.85 \times 10^{7}$	Yes
Oxyurostylis smithi	$5.47 \times 10^{8} \pm 1.42 \times 10^{8}$	$9.08 \times 10^{7} \pm 2.87 \times 10^{7}$	Yes
Edotea triloba	$2.26 \times 10^{8} \pm 4.33 \times 10^{7}$	$1.23 \times 10^{8} \pm 4.72 \times 10^{7}$	No
Ampelisca spp.	$1.41 \times 10^{9} \pm 2.96 \times 10^{8}$	$1.21 \times 10^{8} \pm 2.43 \times 10^{7}$	Yes
Microdeutopus gryllotalpa	$7.22 \times 10^{8} \pm 2.25 \times 10^{8}$	$6.95 \times 10^{7} \pm 3.03 \times 10^{7}$	I
Corophium spp.	$3.15 \times 10^{8} \pm 8.18 \times 10^{7}$	$1.42 \times 10^{8} \pm 4.49 \times 10^{7}$	I
Jassa falcata	$1.60 \times 10^{9} \pm 6.70 \times 10^{8}$	$4.93 \times 10^{9} \pm 7.70 \times 10^{8}$	I
Total Amphipoda	$5.13 \times 10^{9} \pm 9.63 \times 10^{8}$	$6.02 \times 10^{9} \pm 8.66 \times 10^{8}$	I
Mysidopsis bigelowi[b]	$4.42 \times 10^{8} \pm 7.81 \times 10^{7}$	$9.78 \times 10^{8} \pm 2.83 \times 10^{8}$	Yes
Mysidopsis bigelowi gravid	$2.91 \times 10^{6} \pm 1.43 \times 10^{6}$	$2.58 \times 10^{7} \pm 1.15 \times 10^{7}$	I
Neomysis americana[b]	$8.17 \times 10^{9} \pm 1.58 \times 10^{9}$	$1.59 \times 10^{10} \pm 2.23 \times 10^{9}$	Yes
Neomysis americana gravid	$2.11 \times 10^{8} \pm 6.28 \times 10^{8}$	$2.17 \times 10^{8} \pm 5.51 \times 10^{7}$	I
Palaemonetes spp.	$3.65 \times 10^{7} \pm 1.03 \times 10^{7}$	$2.14 \times 10^{7} \pm 7.29 \times 10^{6}$	No
Crangon septemspinosa	$7.18 \times 10^{7} \pm 1.44 \times 10^{7}$	$4.33 \times 10^{7} \pm 9.60 \times 10^{6}$	Yes
Sagitta spp.	$6.89 \times 10^{8} \pm 5.11 \times 10^{8}$	$2.44 \times 10^{8} \pm 7.75 \times 10^{7}$	Yes

[a] Significant interaction

[b] Adult males, non-gravid females, and juveniles

TABLE D1-108. Mean monthly densities (n/1000^3) of those macrozooplankton that constituted 95% of the assemblage for the period September 1976 through August 1977 at the Oyster Creek Generating Station, Forked River, New Jersey. Data for Crangon septemspinosa and Palaemonetes spp. are also included.

MONTHLY MEAN DENSITY DURING SEP 76

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		30	55678.29		
RATHKEA OCTOPUNCTATA	NO DETERM.	1	16.69	33.37	0.03
NEOMYSIS AMERICANA	NO DETERM.	30	23231.70	25318.10	41.72
SARSIA SPP	NO DETERM.	0	0.00	0.00	0.00
JASSA FALCATA	NO DETERM.	30	16776.40	7959.19	30.13
NEOPANOPE TEXANA	ZOEAL	14	275.07	532.19	0.49
PANOPEUS HERBSTII	ZOEAL	1	7.91	37.10	0.01
CRANGON SEPTEMSPINOSA	ZOEAL	2	12.18	24.59	0.02
MYSIDOPSIS BIGELOWI	NO DETERM.	23	1409.72	1444.48	2.53
AMPELISCA SPP.	NO DETERM.	20	440.66	666.05	0.79
PALAEMONETES SPP	ZOEAL	6	53.41	92.24	0.10
ORDER CAPRELLIDEA	NO DETERM.	32	1209.13	506.57	2.17
CLASS POLYCHAETA	LARVAL	10	157.72	205.17	0.28
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	5	77.14	141.95	0.14
BARNACLE CYPRIS	LARVAL	0	0.00	0.00	0.00
JASSA FALCATA	GRAVID FE.	25	645.30	374.68	1.16
OBELIA SPP	NO DETERM.	0	0.00	0.00	0.00
SUBPHYLUM PYCNOGONIDA	NO DETERM.	28	656.94	272.30	1.18
SAGITTA SPP	NO DETERM.	19	556.40	743.51	1.00
FAMILY STENOTHOIDAE	NO DETERM.	29	1258.65	551.30	2.26

SUBTOTALS

CRANGON SEPTEMSPINOSA	14.68	0.00
PALAEMONETES SPP.	85.52	0.00

TOTAL NUMBER OF FORMS = 93

MONTHLY MEAN DENSITY DURING OCT 76

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		28	44909.10		
RATHKEA OCTOPUNCTATA	NO DETERM.	0	0.00	0.00	0.00
NEOMYSIS AMERICANA	NO DETERM.	28	19417.70	12964.99	43.24
SARSIA SPP	NO DETERM.	0	0.00	0.00	0.00
JASSA FALCATA	NO DETERM.	28	14735.80	9101.62	32.81
NEOPANOPE TEXANA	ZOEAL	1	2.25	10.06	0.01
PANOPEUS HERBSTII	ZOEAL	0	0.00	0.00	0.00
CRANGON SEPTEMSPINOSA	ZOEAL	14	63.18	44.24	0.14
MYSIDOPSIS BIGELOWI	NO DETERM.	24	2411.22	2682.76	5.37
AMPELISCA SPP.	NO DETERM.	6	60.65	120.96	0.14
PALAEMONETES SPP	ZOEAL	1	4.73	21.13	0.01
ORDER CAPRELLIDEA	NO DETERM.	24	559.63	355.08	1.25
CLASS POLYCHAETA	LARVAL	6	44.86	71.87	0.10
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	0	0.00	0.00	0.00
BARNACLE CYPRIS	LARVAL	0	0.00	0.00	0.00
JASSA FALCATA	GRAVID FE.	23	834.94	781.49	1.86
OBELIA SPP	NO DETERM.	0	0.00	0.00	0.00
SUBPHYLUM PYCNOGONIDA	NO DETERM.	26	425.39	250.89	0.95
SAGITTA SPP	NO DETERM.	12	73.64	90.20	0.16
FAMILY STENOTHOIDAE	NO DETERM.	27	1190.75	564.07	2.65

SUBTOTALS

CRANGON SEPTEMSPINOSA	10.98	0.00
PALAEMONETES SPP.	47.93	0.00

TABLE D1-109. (CONT.)

MONTHLY MEAN DENSITY DURING NOV 76

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		12	36046.91		
RATHKEA OCTOPUNCTATA	NO DETERM.	5	73.79	65.75	0.20
NEOMYSIS AMERICANA	NO DETERM.	12	16954.90	5704.38	47.04
SARSIA SPP	NO DETERM.	0	0.00	0.00	0.00
JASSA FALCATA	NO DETERM.	12	11800.40	2026.32	32.74
NEOPANOPE TEXANA	ZOEAL	0	0.00	0.00	0.00
PANOPEUS HERBSTII	ZOEAL	0	0.00	0.00	0.00
CRANGON SEPTEMSPINOSA	ZOEAL	12	1404.70	590.17	3.90
MYSIDOPSIS BIGELOWI	NO DETERM.	12	1396.66	864.94	3.87
AMPELISCA SPP.	NO DETERM.	0	0.00	0.00	0.00
PALAEMONETES SPP	ZOEAL	0	0.00	0.00	0.00
ORDER CAPRELLIDEA	NO DETERM.	10	153.54	37.60	0.43
CLASS POLYCHAETA	LARVAL	9	337.88	54.69	0.94
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	0	0.00	0.00	0.00
BARNACLE CYPRIS	LARVAL	0	0.00	0.00	0.00
JASSA FALCATA	GRAVID FE.	12	710.25	108.35	1.97
OBELIA SPP	NO DETERM.	0	0.00	0.00	0.00
SUBPHYLUM PYCNOGONIDA	NO DETERM.	4	46.54	83.54	0.13
SAGITTA SPP	NO DETERM.	0	0.00	0.00	0.00
FAMILY STENOTHOIDAE	NO DETERM.	10	572.17	382.84	1.59
SUBTOTALS					
CRANGON SEPTEMSPINOSA			0.00		0.00
PALAEMONETES SPP.			46.46		0.00

TOTAL NUMBER OF FORMS = 47

MONTHLY MEAN DENSITY DURING DEC 76

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		12	79054.59		
RATHKEA OCTOPUNCTATA	NO DETERM.	11	705.58	392.64	0.89
NEOMYSIS AMERICANA	NO DETERM.	12	54400.90	5397.30	68.81
SARSIA SPP	NO DETERM.	0	0.00	0.00	0.00
JASSA FALCATA	NO DETERM.	12	14298.00	3658.32	18.09
NEOPANOPE TEXANA	ZOEAL	0	0.00	0.00	0.00
PANOPEUS HERBSTII	ZOEAL	0	0.00	0.00	0.00
CRANGON SEPTEMSPINOSA	ZOEAL	7	121.88	60.26	0.15
MYSIDOPSIS BIGELOWI	NO DETERM.	11	1514.75	865.12	1.92
AMPELISCA SPP.	NO DETERM.	1	27.33	66.95	0.03
PALAEMONETES SPP	ZOEAL	0	0.00	0.00	0.00
ORDER CAPRELLIDEA	NO DETERM.	3	76.21	38.48	0.10
CLASS POLYCHAETA	LARVAL	12	772.08	234.88	0.98
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	0	0.00	0.00	0.00
BARNACLE CYPRIS	LARVAL	0	0.00	0.00	0.00
JASSA FALCATA	GRAVID FE.	12	1134.12	542.34	1.43
OBELIA SPP	NO DETERM.	0	0.00	0.00	0.00
SUBPHYLUM PYCNOGONIDA	NO DETERM.	2	83.75	0.00	0.11
SAGITTA SPP	NO DETERM.	12	1462.37	1096.88	1.85
FAMILY STENOTHOIDAE	NO DETERM.	11	727.63	245.66	0.92
SUBTOTALS					
CRANGON SEPTEMSPINOSA			74.46		0.00
PALAEMONETES SPP.			64.67		0.00

TOTAL NUMBER OF FORMS = 41

TABLE D1-108. (CONT.)

MONTHLY MEAN DENSITY DURING JAN 77

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		14	19059.56		
RATHKEA OCTOPUNCTATA	NO DETERM.	14	3232.52	934.67	16.96
NEOMYSIS AMERICANA	NO DETERM.	14	8967.97	7706.55	47.05
SARSIA SPP	NO DETERM.	2	8.20	25.93	0.04
JASSA FALCATA	NO DETERM.	14	3088.51	656.14	16.20
NEOPANOPE TEXANA	ZOEAL	0	0.00	0.00	0.00
PANOPEUS HERBSTII	ZOEAL	0	0.00	0.00	0.00
CRANGON SEPTEMSPINOSA	ZOEAL	0	0.00	0.00	0.00
MYSIDOPSIS BIGELOWI	NO DETERM.	2	6.20	19.61	0.03
AMPELISCA SPP.	NO DETERM.	0	0.00	0.00	0.00
PALAEMONETES SPP	ZOEAL	0	0.00	0.00	0.00
ORDER CAPRELLIDEA	NO DETERM.	3	42.43	52.34	0.22
CLASS POLYCHAETA	LARVAL	5	589.90	1790.32	3.10
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	2	6.85	13.52	0.04
BARNACLE CYPRIS	LARVAL	0	0.00	0.00	0.00
JASSA FALCATA	GRAVID FE.	13	215.99	82.11	1.13
OBELIA SPP	NO DETERM.	0	0.00	0.00	0.00
SUBPHYLUM PYCNOGONIDA	NO DETERM.	3	20.95	15.40	0.11
SAGITTA SPP	NO DETERM.	14	1703.81	2120.08	8.94
FAMILY STENOTHOIDAE	NO DETERM.	13	432.11	189.18	2.27
SUBTOTALS					
CRANGON SEPTEMSPINOSA			89.72		0.00
PALAEMONETES SPP.			2.10		0.00

TOTAL NUMBER OF FORMS = 44

MONTHLY MEAN DENSITY DURING FEB 77

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		12	102461.58		
RATHKEA OCTOPUNCTATA	NO DETERM.	12	23084.40	20290.56	22.53
NEOMYSIS AMERICANA	NO DETERM.	12	43700.90	28051.84	42.65
SARSIA SPP	NO DETERM.	12	23072.30	28563.49	22.52
JASSA FALCATA	NO DETERM.	12	5906.93	711.55	5.77
NEOPANOPE TEXANA	ZOEAL	0	0.00	0.00	0.00
PANOPEUS HERBSTII	ZOEAL	0	0.00	0.00	0.00
CRANGON SEPTEMSPINOSA	ZOEAL	1	11.56	32.70	0.01
MYSIDOPSIS BIGELOWI	NO DETERM.	1	6.25	0.00	0.01
AMPELISCA SPP.	NO DETERM.	0	0.00	0.00	0.00
PALAEMONETES SPP	ZOEAL	0	0.00	0.00	0.00
ORDER CAPRELLIDEA	NO DETERM.	6	130.31	13.91	0.13
CLASS POLYCHAETA	LARVAL	8	334.06	35.04	0.33
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	2	53.13	0.00	0.05
BARNACLE CYPRIS	LARVAL	2	519.13	1468.31	0.51
JASSA FALCATA	GRAVID FE.	7	102.56	44.77	0.10
OBELIA SPP	NO DETERM.	1	79.75	0.00	0.08
SUBPHYLUM PYCNOGONIDA	NO DETERM.	2	53.13	0.00	0.05
SAGITTA SPP	NO DETERM.	9	1237.81	567.83	1.21
FAMILY STENOTHOIDAE	NO DETERM.	10	423.81	76.74	0.41
SUBTOTALS					
CRANGON SEPTEMSPINOSA			366.63		0.00
PALAEMONETES SPP.			0.00		0.00

TOTAL NUMBER OF FORMS = 42

TABLE D1-108. (CONT.)

MONTHLY MEAN DENSITY DURING MAR 77

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		30	280563.07		
RATHKEA OCTOPUNCTATA	NO DETERM.	30	126051.00	125345.92	44.93
NEOMYSIS AMERICANA	NO DETERM.	30	59230.40	44488.76	21.11
SARSIA SPP	NO DETERM.	30	77202.10	48667.34	27.52
JASSA FALCATA	NO DETERM.	28	4518.78	2203.27	1.61
NEOPANOPE TEXANA	ZOEAL	0	0.00	0.00	0.00
PANOPEUS HERBSTII	ZOEAL	0	0.00	0.00	0.00
CRANGON SEPTEMSPINOSA	ZOEAL	14	177.30	196.04	0.06
MYSIDOPSIS BIGELOWI	NO DETERM.	1	2.05	9.59	0.00
AMPELISCA SPP.	NO DETERM.	12	145.07	254.52	0.05
PALAEMONETES SPP	ZOEAL	0	0.00	0.00	0.00
ORDER CAPRELLIDEA	NO DETERM.	16	161.57	111.65	0.06
CLASS POLYCHAETA	LARVAL	9	323.03	593.48	0.12
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	3	24.10	44.90	0.01
BARNACLE CYPRIS	LARVAL	28	6873.66	8248.92	2.45
JASSA FALCATA	GRAVID FE.	26	515.36	442.45	0.18
OBELIA SPP	NO DETERM.	12	2235.41	3070.98	0.80
SUBPHYLUM PYCNOGONIDA	NO DETERM.	3	25.76	46.33	0.01
SAGITTA SPP	NO DETERM.	24	378.03	367.31	0.13
FAMILY STENOTHOIDAE	NO DETERM.	1	4.09	19.19	0.00
SUBTOTALS					
CRANGON SEPTEMSPINOSA			158.73		0.00
PALAEMONETES SPP.			14.02		0.00

TOTAL NUMBER OF FORMS = 53

MONTHLY MEAN DENSITY DURING APR 77

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		26	446182.95		
RATHKEA OCTOPUNCTATA	NO DETERM.	24	290343.00	325729.95	65.07
NEOMYSIS AMERICANA	NO DETERM.	26	62701.70	77357.81	14.05
SARSIA SPP	NO DETERM.	25	64541.40	104825.57	14.47
JASSA FALCATA	NO DETERM.	26	9311.35	4294.00	2.09
NEOPANOPE TEXANA	ZOEAL	0	0.00	0.00	0.00
PANOPEUS HERBSTII	ZOEAL	0	0.00	0.00	0.00
CRANGON SEPTEMSPINOSA	ZOEAL	26	5824.79	6721.35	1.31
MYSIDOPSIS BIGELOWI	NO DETERM.	0	0.00	0.00	0.00
AMPELISCA SPP.	NO DETERM.	16	473.62	399.91	0.11
PALAEMONETES SPP	ZOEAL	0	0.00	0.00	0.00
ORDER CAPRELLIDEA	NO DETERM.	18	440.59	409.53	0.10
CLASS POLYCHAETA	LARVAL	12	470.01	801.49	0.11
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	6	152.51	446.39	0.03
BARNACLE CYPRIS	LARVAL	15	1112.37	1807.19	0.25
JASSA FALCATA	GRAVID FE.	24	1434.38	619.77	0.32
OBELIA SPP	NO DETERM.	11	4276.85	6859.42	0.96
SUBPHYLUM PYCNOGONIDA	NO DETERM.	1	4.03	17.09	0.00
SAGITTA SPP	NO DETERM.	5	97.19	151.32	0.02
FAMILY STENOTHOIDAE	NO DETERM.	1	11.44	48.55	0.00
SUBTOTALS					
CRANGON SEPTEMSPINOSA			140.97		0.00
PALAEMONETES SPP.			21.14		0.00

TOTAL NUMBER OF FORMS = 58

TABLE D1-108. (CONT.)

MONTHLY MEAN DENSITY DURING MAY 77

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		32	63150.22		
RATHKEA OCTOPUNCTATA	NO DETERM.	1	6.71	16.43	0.01
NEOMYSIS AMERICANA	NO DETERM.	31	21885.90	19743.23	34.66
SARSIA SPP	NO DETERM.	7	127.13	254.59	0.20
JASSA FALCATA	NO DETERM.	33	9560.06	11106.48	15.14
NEOPANOPE TEXANA	ZOEAL	11	11385.90	30950.49	18.03
PANOPEUS HERBSTII	ZOEAL	1	15.88	38.89	0.03
CRANGON SEPTEMSPINOSA	ZOEAL	31	8133.81	10277.40	12.88
MYSIDOPSIS BIGELOWI	NO DETERM.	0	0.00	0.00	0.00
AMPELISCA SPP.	NO DETERM.	15	606.10	1597.83	0.96
PALAEMONETES SPP	ZOEAL	8	594.47	1334.27	0.94
ORDER CAPRELLIDEA	NO DETERM.	23	743.23	2436.94	1.18
CLASS POLYCHAETA	LARVAL	10	45.70	41.15	0.07
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	26	5067.67	8876.42	8.02
BARNACLE CYPRIS	LARVAL	1	6.79	16.64	0.01
JASSA FALCATA	GRAVID.FE.	24	1203.55	1716.35	1.91
OBELIA SPP	NO DETERM.	3	5.38	14.73	0.01
SUBPHYLUM PYCNOGONIDA	NO DETERM.	19	116.57	94.77	0.18
SAGITTA SPP	NO DETERM.	0	0.00	0.00	0.00
FAMILY STENOTHOIDAE	NO DETERM.	13	116.87	186.41	0.19

SUBTOTALS

CRANGON SEPTEMSPINOSA	32.38	0.00
PALAEMONETES SPP.	24.15	0.00

TOTAL NUMBER OF FORMS = 78

MONTHLY MEAN DENSITY DURING JUN 77

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		27	73525.18		
RATHKEA OCTOPUNCTATA	NO DETERM.	0	0.00	0.00	0.00
NEOMYSIS AMERICANA	NO DETERM.	27	14252.40	10023.77	19.38
SARSIA SPP	NO DETERM.	0	0.00	0.00	0.00
JASSA FALCATA	NO DETERM.	25	1242.62	731.16	1.69
NEOPANOPE TEXANA	ZOEAL	27	25336.40	45764.07	34.46
PANOPEUS HERBSTII	ZOEAL	23	7745.72	7518.79	10.53
CRANGON SEPTEMSPINOSA	ZOEAL	27	8830.67	7448.02	12.01
MYSIDOPSIS BIGELOWI	NO DETERM.	1	15.05	67.31	0.02
AMPELISCA SPP.	NO DETERM.	24	3571.31	3843.14	4.86
PALAEMONETES SPP	ZOEAL	27	4392.57	5687.09	5.97
ORDER CAPRELLIDEA	NO DETERM.	25	556.91	557.83	0.76
CLASS POLYCHAETA	LARVAL	4	21.64	31.38	0.03
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	25	1420.65	1186.36	1.93
BARNACLE CYPRIS	LARVAL	1	3.85	17.22	0.01
JASSA FALCATA	GRAVID FE.	10	71.69	120.36	0.10
OBELIA SPP	NO DETERM.	2	12.00	24.00	0.02
SUBPHYLUM PYCNOGONIDA	NO DETERM.	6	21.64	55.13	0.03
SAGITTA SPP	NO DETERM.	0	0.00	0.00	0.00
FAMILY STENOTHOIDAE	NO DETERM.	10	73.66	116.65	0.10

SUBTOTALS

CRANGON SEPTEMSPINOSA	12.50	0.00
PALAEMONETES SPP.	11.35	0.00

TABLE D1-108. (CONT.)

MONTHLY MEAN DENSITY DURING JUL 77

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		30	124371.17		
RATHKEA OCTOPUNCTATA	NO DETERM.	1	4.00	18.76	0.00
NEOMYSIS AMERICANA	NO DETERM.	30	17455.30	10922.27	14.03
SARSIA SPP	NO DETERM.	0	0.00	0.00	0.00
JASSA FALCATA	NO DETERM.	21	4108.10	5221.59	3.30
NEOPANOPE TEXANA	ZOEAL	30	37081.20	24969.98	29.81
PANOPEUS HERBSTII	ZOEAL	29	25794.50	26569.47	20.74
CRANGON SEPTEMSPINOSA	ZOEAL	29	2710.74	3037.43	2.18
MYSIDOPSIS BIGELOWI	NO DETERM.	21	3346.36	9791.41	2.69
AMPELISCA SPP.	NO DETERM.	24	6358.15	9520.28	5.11
PALAEMONETES SPP	ZOEAL	30	6066.68	3358.17	4.88
ORDER CAPRELLIDEA	NO DETERM.	25	461.40	351.93	0.37
CLASS POLYCHAETA	LARVAL	20	4298.61	6228.36	3.46
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	28	1781.71	1904.77	1.43
BARNACLE CYPRIS	LARVAL	0	0.00	0.00	0.00
JASSA FALCATA	GRAVID FE.	10	302.37	500.51	0.24
OBELIA SPP	NO DETERM.	2	5.64	17.96	0.00
SUBPHYLUM PYCNOGONIDA	NO DETERM.	7	46.63	81.47	0.04
SAGITTA SPP	NO DETERM.	0	0.00	0.00	0.00
FAMILY STENOTHOIDAE	NO DETERM.	8	151.42	217.98	0.12

SUBTOTALS

CRANGON SEPTEMSPINOSA	2.89	0.00
PALAEMONETES SPP.	11.31	0.00

TOTAL NUMBER OF FORMS = 97

MONTHLY MEAN DENSITY DURING AUG 77

SPECIES	LIFESTAGE	FREQUENCY	MONTHLY MEAN	STD DEV	% COMPOSITION
TOTAL		30	48750.44		
RATHKEA OCTOPUNCTATA	NO DETERM.	0	0.00	0.00	0.00
NEOMYSIS AMERICANA	NO DETERM.	30	9363.80	5289.38	19.21
SARSIA SPP	NO DETERM.	0	0.00	0.00	0.00
JASSA FALCATA	NO DETERM.	12	412.81	486.01	0.85
NEOPANOPE TEXANA	ZOEAL	29	4114.00	4160.32	8.44
PANOPEUS HERBSTII	ZOEAL	29	4753.17	5195.89	9.75
CRANGON SEPTEMSPINOSA	ZOEAL	2	29.18	53.84	0.06
MYSIDOPSIS BIGELOWI	NO DETERM.	25	6810.88	9827.99	13.97
AMPELISCA SPP.	NO DETERM.	21	312.73	218.44	0.64
PALAEMONETES SPP	ZOEAL	21	551.20	596.07	1.13
ORDER CAPRELLIDEA	NO DETERM.	30	6585.73	8936.82	13.51
CLASS POLYCHAETA	LARVAL	18	2360.35	4081.31	4.84
MICRODEUTOPUS GRYLLOTALPA	NO DETERM.	15	251.24	218.05	0.52
BARNACLE CYPRIS	LARVAL	0	0.00	0.00	0.00
JASSA FALCATA	GRAVID FE.	1	33.31	66.62	0.07
OBELIA SPP	NO DETERM.	2	62.00	290.81	0.13
SUBPHYLUM PYCNOGONIDA	NO DETERM.	24	4019.06	5447.54	8.24
SAGITTA SPP	NO DETERM.	0	0.00	0.00	0.00
FAMILY STENOTHOIDAE	NO DETERM.	14	196.93	168.94	0.40

SUBTOTALS

CRANGON SEPTEMSPINOSA	91.30	0.00
PALAEMONETES SPP.	75.35	0.00

TOTAL NUMBER OF FORMS = 101

Table D1-109. Comparison of day and night mean densities (n/m^3) of common and important macrozooplankton collected at the Oyster Creek Generating Station, Forked River, New Jersey from January 1976 through August 1977. Results are given for the intervals October through March (water temperature below 18C) and April through September (above 18C). Collections were taken in the morning and afternoon and 2-h and 6-h after sunset during a 24-h period.

	October through April					May through September				
	Morning	Afternoon	2-h after Sunset	6-h after Sunset	Significant[a] Difference	Morning	Afternoon	2-h after Sunset	6-h after Sunset	Significant Difference
Neomysis americana	7.812	2.921	33.282	50.971	yes	2.324	1.582	17.927	26.248	yes
Mysidopsis bigelowi	0.191	0.076	0.306	0.599	yes	0.164	0.088	1.080	1.228	yes
Crangon septemspinosa	0.030	0.028	0.306	0.226	yes	0.008	0	0.085	0.094	yes
Leucon americanus	0.019	0.020	0.206	0.362	yes	0.069	0.044	1.269	0.834	yes
Oxyurostylis smithi	0.019	0.006	0.138	0.164	yes	0.153	0.184	0.883	1.003	yes
C. septemspinosa (zoeae)	9.778	0.917	1.107	1.030	no	2.421	2.068	1.766	3.420	yes[b]
Jassa falcata	3.918	3.542	3.980	4.986	no	2.322	2.437	2.251	1.466	no
Corophium spp.	0.109	0.113	0.190	0.126	no	0.663	0.598	0.526	0.329	no
Ampelisca spp.	-	-	-	-		0.089	0.116	3.236	1.637	yes
Nereis spp. (epitokes)	-	-	-	-		0.022	0.007	0.103	0.028	yes
Neopanope texana (zoeae)	-	-	-	-		4.528	2.901	11.227	9.129	yes
Panopeus herbstii (zoeae)	-	-	-	-		1.176	1.167	2.063	1.505	no
Palaemonetes spp. (zoeae)	-	-	-	-		0.480	0.407	1.172	1.848	yes
Callinectes sapidus (megalopae)	-	-	-	-		0.011	0.012	0.068	0.080	NT[c]

[a]Difference significant between all day and night collections unless otherwise indicated.
[b]Only for collections taken 6 h after sunset.
[c]Not tested.

Table D1-110. Mean yearly densities (n/1000m^3) of the ctenophores Mnemiopsis leidyi and Beroe ovata collected at the condenser intake of the Oyster Creek Generating Station, Forked River, New Jersey from September 1976 through August 1977 and from September 1975 through August 1976.

	Second Year September 1976 through August 1977		First Year September 1975 through August 1976	
	Frequency	Yearly Mean	Frequency	Yearly Mean
Total Macrozooplankton	266	157081.85	253	66507.71
Mnemiopsis leidyi	25	25.61	101	906.53
Beroe ovata	18	20.98	19	62.76

Table D1-111. Estimated yearly entrainment, with confidence interval of important and common ichthyoplankton at the Oyster Creek Generating Station from 8 September 1975 through 2 September 1977.

Species	Life Stage	8 September 1975-3 September 1976 Entrainment Estimate	4 September 1976-2 September 1977 Entrainment Estimate
Anchoa mitchilli	eggs	$1.58 \times 10^{10} \pm 4.54 \times 10^{9}$	$4.30 \times 10^{8} \pm 3.50 \times 10^{8}$
Anchoa mitchilli	larvae and juveniles	$1.13 \times 10^{9} \pm 2.90 \times 10^{8}$	$8.26 \times 10^{8} \pm 3.48 \times 10^{8}$
Atherinidae	larvae and juveniles	$1.42 \times 10^{7} \pm 5.89 \times 10^{6}$	$6.35 \times 10^{6} \pm 2.50 \times 10^{6}$
Syngnathus fuscus	juveniles	$5.12 \times 10^{7} \pm 1.51 \times 10^{7}$	$1.03 \times 10^{7} \pm 4.53 \times 10^{6}$
Ammodytes sp.	larvae	$3.42 \times 10^{7} \pm 1.61 \times 10^{7}$	$1.26 \times 10^{8} \pm 4.91 \times 10^{7}$
Gobiidae	larvae	$6.00 \times 10^{8} \pm 1.43 \times 10^{8}$	$1.48 \times 10^{8} \pm 6.26 \times 10^{7}$
Pseudopleuronectes americanus	larvae	$1.63 \times 10^{8} \pm 8.62 \times 10^{7}$	$1.22 \times 10^{9} \pm 4.68 \times 10^{8}$
Total	eggs	$1.62 \times 10^{10} \pm 4.57 \times 10^{9}$	$9.09 \times 10^{8} \pm 3.92 \times 10^{8}$
Total	larvae	$2.01 \times 10^{9} \pm 3.75 \times 10^{8}$	$2.22 \times 10^{9} \pm 5.51 \times 10^{8}$

Table D1-112. Mean densities (n/m^3) and biomass (mg/m^3) of ichthyoplankton by year collected at the Oyster Creek Generating Station, Forked River, New Jersey from September 1976 through August 1977.

LOCATION	7		11		13	
TEMPERATURE: AIR	-8.5 - 32.0		-9.0 - 33.0		12.5 - 27.5	
SURFACE	1.0 - 28.6		10.6 - 37.4		15.5 - 29.2	
BOTTOM	0.0 - 28.0		11.5 - 30.5		18.8 - 23.6	
SALINITY: SURFACE	20.0 - 27.0		19.5 - 28.0		20.0 - 26.5	
BOTTOM	19.5 - 27.0		20.0 - 28.0		20.0 - 22.5	
OXYGEN: SURFACE	4.2 - 13.3		4.7 - 13.8		5.5 - 8.6	
BOTTOM	4.8 - 13.2		7.2 - 12.3		6.6 - 7.0	
PH: SURFACE	7.2 - 8.5		7.2 - 8.4		7.7 - 8.2	
BOTTOM	7.2 - 8.4		7.4 - 8.2		7.7 - 7.8	
	DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES						
ANCHOA MITCHILLI	0.346	-	0.286	-	0.062	-
STRONGYLURA MARINA	-	-	-	-	0.000	-
MEMBRAS MARTINICA	0.001	-	0.002	-	0.000	-
MENIDIA MENIDIA	-	-	-	-	0.013	-
HIPPOCAMPUS ERECTUS	0.000	-	0.001	-	-	-
SYNGNATHUS FUSCUS	0.024	-	0.017	-	0.223	-
CYNOSCION REGALIS	0.001	-	0.001	-	-	-
LEIOSTOMUS XANTHURUS	-	-	-	-	0.001	-
FAMILY GOBIIDAE	0.000	-	-	-	-	-
GOBIOSOMA BOSCI	0.000	-	0.001	-	0.006	-
GOBIOSOMA GINSBURGI	0.002	-	0.001	-	-	-
PRIONOTUS EVOLANS	0.000	-	-	-	-	-
LARVAE						
ANGUILLA ROSTRATA	0.016	-	0.008	-	0.002	-
ANCHOA MITCHILLI	0.718	2.3	1.141	1.7	5.681	-
STRONGYLURA MARINA	-	-	-	-	0.001	-
FAMILY ATHERINIDAE	0.011	-	0.011	-	0.105	-
MEMBRAS MARTINICA	0.001	-	0.001	-	-	-
MENIDIA MENIDIA	-	-	0.000	-	0.007	-
CYNOSCION REGALIS	0.005	-	0.003	-	-	-
MICROPOGON UNDULATUS	0.018	-	0.012	-	-	-
FAMILY BLENNIIDAE	0.041	-	0.044	-	0.032	-
AMMODYTES SP.	0.271	-	0.171	-	-	-
FAMILY GOBIIDAE	0.271	-	0.235	-	1.014	-
SCOPHTHALMUS AQUOSUS	0.001	-	0.000	-	-	-
PSEUDOPLEURONECTES AMERICANUS	3.216	-	1.572	-	-	-
TRINECTES MACULATUS	-	-	0.001	-	-	-
SPHOEROIDES MACULATUS	-	-	-	-	0.026	-
EGGS						
BREVOORTIA TYRANNUS	0.070	-	0.031	-	-	-
ANCHOA MITCHILLI	0.452	0.0	0.479	-	19.796	-
MERLUCCIUS BILINEARIS	0.000	-	-	-	-	-
MENIDIA SP.	0.023	-	-	-	-	-
TAUTOGA ONITIS	0.075	-	0.057	-	0.494	-
TAUTOGOLABRUS ADSPERSUS	0.014	-	0.017	-	0.751	-
AMMODYTES SP.	0.003	-	0.030	-	-	-
PRIONOTUS SP.	-	-	-	-	0.001	-
PSEUDOPLEURONECTES AMERICANUS	0.051	-	0.473	-	-	-
TRINECTES MACULATUS	0.001	-	0.005	-	0.118	-
UNIDENTIFIED FISH	0.069	-	0.145	-	0.003	-
TOTAL LARVAE & JUVENILES	4.944	2.3	3.509	1.7	7.172	0.0
TOTAL EGGS	0.760	0.0	1.238	0.0	21.163	0.0
TOTAL COLLECTIONS	202		218		66	

Table D1-113. Estimated entrainment, with confidence interval, and results of analysis of variance ($P \leq 0.2$) of important and common ichthyoplankton at the Oyster Creek Generating Station during seven comparable months (September through December, March, April, and August) from 8 September 1975 through 2 September 1977.

Species	Life Stage	8 September 1975-3 September 1976 Entrainment Estimate	4 September 1976-2 September 1977 Entrainment Estimate	($P \leq 0.2$) Significance
Anchoa mitchilli	eggs	$1.04 \times 10^{10} \pm 2.79 \times 10^{9}$	$4.48 \times 10^{8} \pm 4.55 \times 10^{8}$	No
Anchoa mitchilli	larvae and juveniles	$9.71 \times 10^{8} \pm 2.48 \times 10^{8}$	$6.29 \times 10^{8} \pm 1.84 \times 10^{8}$	No
Atherinidae	larvae and juveniles	$1.42 \times 10^{7} \pm 5.90 \times 10^{6}$	$5.46 \times 10^{6} \pm 2.23 \times 10^{6}$	No
Syngnathus fuscus	juveniles	$4.41 \times 10^{7} \pm 1.36 \times 10^{7}$	$9.11 \times 10^{6} \pm 4.68 \times 10^{6}$	No
Ammodytes sp.	larvae	$4.39 \times 10^{7} \pm 2.17 \times 10^{7}$	$1.30 \times 10^{8} \pm 5.39 \times 10^{7}$	Yes
Gobiidae	larvae	$5.43 \times 10^{8} \pm 1.40 \times 10^{8}$	$1.61 \times 10^{8} \pm 8.05 \times 10^{7}$	No
Pseudopleuronectes americanus	larvae	$2.08 \times 10^{8} \pm 1.18 \times 10^{8}$	$1.39 \times 10^{9} \pm 5.73 \times 10^{8}$	Yes
Total	eggs	$1.06 \times 10^{10} \pm 2.83 \times 10^{9}$	$8.32 \times 10^{8} \pm 4.77 \times 10^{8}$	No
Total	larvae	$1.85 \times 10^{9} \pm 3.40 \times 10^{8}$	$2.21 \times 10^{9} \pm 5.80 \times 10^{8}$	No

Table D1-114. Monthly mean densities (n/m^3) and biomass (mg/m^3) of Ichthyoplankton collected at the Oyster Creek Generating Station, Forked River, New Jersey from September 1976 through August 1977.

MONTH	SEPTEMBER			
LOCATION	7		11	
TEMPERATURE: AIR	16.0 - 26.0		16.0 - 26.5	
SURFACE	18.0 - 25.4		26.4 - 34.4	
BOTTOM	18.4 - 25.5		29.0 - 30.5	
SALINITY: SURFACE	23.0 - 26.0		23.0 - 26.0	
BOTTOM	23.0 - 26.0		25.0 - 25.5	
OXYGEN: SURFACE	6.4 - 8.1		6.5 - 8.3	
BOTTOM	6.3 - 8.0		7.2 - 7.7	
PH: SURFACE	7.6 - 8.2		7.6 - 8.2	
BOTTOM	7.5 - 8.2		8.0 - 8.0	
	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES				
ANCHOA MITCHILLI	0.179	-	0.065	-
HIPPOCAMPUS ERECTUS	0.002	-	0.004	-
SYNGNATHUS FUSCUS	0.033	-	0.009	-
GOBIOSOMA BOSCI	0.002	-	-	-
GOBIOSOMA GINSBURGI	0.002	-	0.003	-
LARVAE				
ANCHOA MITCHILLI	1.467	15.2	1.032	12.3
FAMILY ATHERINIDAE	0.014	-	0.007	-
CYNOSCION REGALIS	0.002	-	-	-
MICROPOGON UNDULATUS	0.039	-	0.045	-
FAMILY BLENNIIDAE	0.194	-	0.275	-
FAMILY GOBIIDAE	1.352	-	0.819	-
SCOPHTHALMUS AQUOSUS	0.004	-	-	-
EGGS				
ANCHOA MITCHILLI	0.278	0.0	0.157	-
UNIDENTIFIED FISH	-	-	0.006	-
TOTAL LARVAE & JUVENILES	3.289	15.2	2.258	12.3
TOTAL EGGS	0.278	0.0	0.163	0.0
TOTAL COLLECTIONS	30		30	

Table D1-114. (cont.)

MONTH	OCTOBER			
LOCATION	7		11	
TEMPERATURE: AIR	1.0 - 24.0		1.5 - 24.0	
SURFACE	8.0 - 19.5		15.0 - 28.5	
BOTTOM	8.8 - 19.5		20.2 - 26.4	
SALINITY: SURFACE	23.0 - 26.0		22.0 - 26.0	
BOTTOM	23.0 - 26.0		24.0 - 28.0	
OXYGEN: SURFACE	7.6 - 11.6		8.1 - 12.0	
BOTTOM	7.6 - 11.2		8.4 - 11.2	
PH: SURFACE	7.6 - 7.9		7.6 - 8.0	
BOTTOM	7.8 - 8.0		7.4 - 8.0	
	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES				
ANCHOA MITCHILLI	0.242	-	0.211	-
SYNGNATHUS FUSCUS	0.009	-	0.006	-
GOBIOSOMA BOSCI	0.002	-	-	-
GOBIOSOMA GINSBURGI	-	-	0.002	-
PRIONOTUS EVOLANS	0.002	-	-	-
LARVAE				
ANCHOA MITCHILLI	0.126	-	0.129	-
MICROPOGON UNDULATUS	0.054	-	0.043	-
FAMILY BLENNIIDAE	0.070	-	0.011	-
FAMILY GOBIIDAE	0.028	-	0.024	-
SCOPHTHALMUS AQUOSUS	-	-	0.002	-
EGGS				
ANCHOA MITCHILLI	0.012	-	0.005	-
TAUTOGA ONITIS	0.001	-	-	-
UNIDENTIFIED FISH	0.003	-	-	-
TOTAL LARVAE & JUVENILES	0.533	0.0	0.428	0.0
TOTAL EGGS	0.016	0.0	0.005	0.0
TOTAL COLLECTIONS	28		28	

Table D1-114. (cont.)

MONTH	NOVEMBER			
LOCATION	7		11	
TEMPERATURE: AIR	-1.5 - 7.0		-2.0 - 7.0	
SURFACE	3.4 - 6.2		13.0 - 15.0	
BOTTOM	3.4 - 5.9		- - -	
SALINITY: SURFACE	22.0 - 25.0		22.0 - 25.0	
BOTTOM	22.0 - 24.0		- - -	
OXYGEN: SURFACE	9.6 - 12.6		10.2 - 13.8	
BOTTOM	9.2 - 13.2		- - -	
PH: SURFACE	7.2 - 8.2		7.2 - 8.2	
BOTTOM	7.2 - 8.2		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES				
ANCHOA MITCHILLI	0.051	-	0.032	-
FAMILY GOBIIDAE	0.006	-	-	-
GOBIOSOMA GINSBURGI	0.028	-	0.007	-
LARVAE				
ANCHOA MITCHILLI	-	-	0.008	-
MICROPOGON UNDULATUS	0.073	-	0.015	-
SCOPHTHALMUS AQUOSUS	0.004	-	-	-
TOTAL LARVAE & JUVENILES	0.161	0.0	0.062	0.0
TOTAL EGGS	0.000	0.0	0.000	0.0
TOTAL COLLECTIONS	12		12	

Table D1-114. (cont.)

MONTH	DECEMBER			
LOCATION	7		11	
TEMPERATURE: AIR	-1.0 - 9.0		-1.5 - 8.0	
SURFACE	2.8 - 7.1		14.5 - 18.6	
BOTTOM	3.0 - 6.3		- - -	
SALINITY: SURFACE	22.0 - 24.0		22.0 - 24.0	
BOTTOM	22.0 - 22.5		- - -	
OXYGEN: SURFACE	9.2 - 10.8		8.9 - 11.4	
BOTTOM	9.5 - 9.5		- - -	
PH: SURFACE	7.8 - 8.1		7.8 - 8.0	
BOTTOM	7.8 - 7.9		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE				
ANCHOA MITCHILLI	-	-	0.012	-
MICROPOGON UNDULATUS	0.014	-	-	-
TOTAL LARVAE & JUVENILES	0.014	0.0	0.012	0.0
TOTAL EGGS	0.000	0.0	0.000	0.0
TOTAL COLLECTIONS	12		12	

Table D1-114. (cont.)

MONTH	JANUARY			
LOCATION	7		11	
TEMPERATURE: AIR	-8.5 - 1.5		-9.0 - 2.0	
SURFACE	1.0 - 1.7		10.6 - 11.5	
BOTTOM	0.0 - 1.4		11.5 - 11.5	
SALINITY: SURFACE	23.5 - 24.0		22.0 - 24.0	
BOTTOM	23.5 - 24.0		24.0 - 24.0	
OXYGEN: SURFACE	11.6 - 13.3		11.4 - 12.8	
BOTTOM	11.6 - 13.1		11.4 - 11.4	
PH: SURFACE	7.8 - 8.2		7.8 - 8.1	
BOTTOM	7.8 - 8.2		8.0 - 8.0	
	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE				
AMMODYTES SP.	0.263	-	0.159	-
PSEUDOPLEURONECTES AMERICANUS	-	-	0.006	-
EGGS				
PSEUDOPLEURONECTES AMERICANUS	0.123	-	0.443	-
UNIDENTIFIED FISH	-	-	0.003	-
TOTAL LARVAE & JUVENILES	0.263	0.0	0.165	0.0
TOTAL EGGS	0.123	0.0	0.446	0.0
TOTAL COLLECTIONS	12		14	

Table D1-114. (cont.)

MONTH	FEBRUARY			
LOCATION	7		11	
TEMPERATURE: AIR	-0.8 - 11.0		-0.5 - 17.0	
SURFACE	4.4 - 8.0		12.9 - 15.6	
BOTTOM	4.4 - 7.6		12.6 - 13.9	
SALINITY: SURFACE	22.0 - 25.0		19.5 - 25.0	
BOTTOM	22.0 - 25.0		20.5 - 25.0	
OXYGEN: SURFACE	11.0 - 12.6		11.0 - 12.4	
BOTTOM	11.1 - 12.7		11.0 - 12.3	
PH: SURFACE	7.9 - 8.2		7.9 - 8.3	
BOTTOM	7.9 - 8.2		7.9 - 8.2	
	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE				
ANGUILLA ROSTRATA	-	-	0.008	-
AMMODYTES SP.	0.736	-	0.275	-
PSEUDOPLEURONECTES AMERICANUS	2.615	-	1.667	-
EGGS				
AMMODYTES SP.	0.053	-	0.542	-
PSEUDOPLEURONECTES AMERICANUS	0.734	-	8.079	-
TOTAL LARVAE & JUVENILES	3.351	0.0	1.950	0.0
TOTAL EGGS	0.787	0.0	8.621	0.0
TOTAL COLLECTIONS	12		12	

Table D1-114. (cont.)

MONTH	MARCH			
LOCATION	7		11	
TEMPERATURE: AIR	-1.2 - 18.5		-1.0 - 19.0	
SURFACE	5.8 - 14.0		13.3 - 20.6	
BOTTOM	7.9 - 13.5		15.0 - 19.6	
SALINITY: SURFACE	20.0 - 24.0		20.0 - 24.0	
BOTTOM	20.0 - 24.0		20.5 - 22.0	
OXYGEN: SURFACE	9.0 - 11.2		8.7 - 11.4	
BOTTOM	8.6 - 11.4		8.0 - 10.2	
PH: SURFACE	7.8 - 8.2		7.8 - 8.2	
BOTTOM	7.8 - 8.2		7.7 - 8.2	
	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE				
ANGUILLA ROSTRATA	0.045	-	0.018	-
AMMODYTES SP.	1.070	-	0.839	-
PSEUDOPLEURONECTES AMERICANUS	16.901	-	8.762	-
EGGS				
BREVOORTIA TYRANNUS	0.008	-	0.011	-
ANCHOA MITCHILLI	0.008	-	-	-
TAUTOGA ONITIS	-	-	0.009	-
UNIDENTIFIED FISH	0.439	-	0.978	-
TOTAL LARVAE & JUVENILES	18.016	0.0	9.618	0.0
TOTAL EGGS	0.455	0.0	0.998	0.0
TOTAL COLLECTIONS	30		30	

Table D1-114. (cont.)

MONTH	APRIL			
LOCATION	7		11	
TEMPERATURE: AIR	7.0 - 22.0		7.0 - 23.0	
SURFACE	11.5 - 17.4		16.8 - 24.4	
BOTTOM	11.5 - 17.5		18.6 - 24.0	
SALINITY: SURFACE	20.0 - 22.0		19.5 - 22.0	
BOTTOM	19.5 - 22.0		20.0 - 22.0	
OXYGEN: SURFACE	8.0 - 10.4		8.0 - 10.2	
BOTTOM	8.0 - 10.5		7.8 - 9.8	
PH: SURFACE	7.8 - 8.1		7.7 - 8.0	
BOTTOM	7.4 - 8.1		7.8 - 8.0	
	DENSITY	BIOMASS	DENSITY	BIOMASS
LARVAE				
ANGUILLA ROSTRATA	0.068	-	0.036	-
FAMILY ATHERINIDAE	0.022	-	-	-
AMMODYTES SP.	0.408	-	0.255	-
PSEUDOPLEURONECTES AMERICANUS	4.280	-	2.297	-
EGGS				
BREVOORTIA TYRANNUS	0.536	-	0.250	-
ANCHOA MITCHILLI	-	-	0.010	-
MENIDIA SP.	0.183	-	-	-
TAUTOGA ONITIS	0.243	-	0.254	-
TAUTOGOLABRUS ADSPERSUS	0.043	-	0.136	-
UNIDENTIFIED FISH	0.020	-	0.029	-
TOTAL LARVAE & JUVENILES	4.778	0.0	2.588	0.0
TOTAL EGGS	1.025	0.0	0.679	0.0
TOTAL COLLECTIONS	26		26	

Table D1-114. (cont.)

MONTH		MAY					
LOCATION		7		11		13	
TEMPERATURE:	AIR	4.0 - 21.5		4.0 - 23.9		13.5 - 27.2	
	SURFACE	14.6 - 17.4		15.2 - 17.2		16.1 - 23.6	
	BOTTOM	15.9 - 17.3		16.2 - 16.2		16.8 - 23.6	
SALINITY:	SURFACE	21.5 - 23.0		22.0 - 23.0		20.0 - 25.0	
	BOTTOM	21.5 - 22.0		22.0 - 22.0		20.0 - 22.5	
OXYGEN:	SURFACE	8.2 - 9.1		7.2 - 8.6		6.7 - 8.6	
	BOTTOM	8.1 - 8.8		7.8 - 7.8		6.6 - 7.0	
PH:	SURFACE	8.0 - 8.1		7.8 - 8.1		7.7 - 8.1	
	BOTTOM	8.0 - 8.0		8.0 - 8.0		7.7 - 7.8	
		DENSITY	BIOMASS	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES							
MENIDIA MENIDIA		-	-	-	-	0.001	-
SYNGNATHUS FUSCUS		-	-	-	-	0.096	-
LARVAE							
ANGUILLA ROSTRATA		0.007	-	0.015	-	0.004	-
ANCHOA MITCHILLI		-	-	-	-	0.190	-
STRONGYLURA MARINA		-	-	-	-	0.001	-
FAMILY ATHERINIDAE		-	-	0.011	-	0.045	-
MENIDIA MENIDIA		-	-	0.005	-	0.022	-
FAMILY BLENNIIDAE		-	-	-	-	0.005	-
FAMILY GOBIIDAE		-	-	-	-	0.139	-
SPHAEROIDES MACULATUS		-	-	-	-	0.014	-
EGGS							
ANCHOA MITCHILLI		0.366	-	0.247	-	4.545	-
MERLUCCIUS BILINEARIS		0.008	-	-	-	-	-
TAUTOGA ONITIS		0.739	-	0.455	-	1.516	-
TAUTOGOLABRUS ADSPERSUS		0.145	-	0.022	-	0.052	-
PRIONOTUS SP.		-	-	-	-	0.002	-
TRINECTES MACULATUS		-	-	-	-	0.071	-
UNIDENTIFIED FISH		0.011	-	0.092	-	-	-
TOTAL LARVAE & JUVENILES		0.007	0.0	0.031	0.0	0.517	0.0
TOTAL EGGS		1.269	0.0	0.816	0.0	6.186	0.0
TOTAL COLLECTIONS		12		12		20	

Table D1-114. (cont.)

MONTH		JUNE
LOCATION		13
TEMPERATURE:	AIR	12.5 - 25.5
	SURFACE	15.5 - 25.1
	BOTTOM	- - -
SALINITY:	SURFACE	22.0 - 26.5
	BOTTOM	- - -
OXYGEN:	SURFACE	6.3 - 7.8
	BOTTOM	- - -
PH:	SURFACE	7.8 - 8.2
	BOTTOM	- - -

	DENSITY	BIOMASS
JUVENILES		
ANCHOA MITCHILLI	0.001	-
MENIDIA MENIDIA	0.028	-
SYNGNATHUS FUSCUS	0.163	-
LEIOSTOMUS XANTHURUS	0.001	-
LARVAE		
ANGUILLA ROSTRATA	0.001	-
ANCHOA MITCHILLI	0.610	-
FAMILY ATHERINIDAE	0.133	-
FAMILY BLENNIIDAE	0.043	-
FAMILY GOBIIDAE	0.840	-
SPHOEROIDES MACULATUS	0.045	-
EGGS		
ANCHOA MITCHILLI	17.308	-
TAUTOGA ONITIS	0.079	-
TAUTOGOLABRUS ADSPERSUS	1.732	-
TRINECTES MACULATUS	0.062	-
TOTAL LARVAE & JUVENILES	1.864	0.0
TOTAL EGGS	19.180	0.0
TOTAL COLLECTIONS	28	

Table D1-114. (cont.)

MONTH	JULY			
LOCATION	11		13	
TEMPERATURE: AIR	19.0 - 24.0		22.0 - 27.5	
SURFACE	23.7 - 27.3		24.6 - 29.2	
BOTTOM	- - -		- - -	
SALINITY: SURFACE	26.0 - 28.0		24.5 - 26.0	
BOTTOM	- - -		- - -	
OXYGEN: SURFACE	5.3 - 7.0		5.5 - 7.6	
BOTTOM	- - -		- - -	
PH: SURFACE	7.9 - 8.2		8.0 - 8.2	
BOTTOM	- - -		- - -	
	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES				
ANCHOA MITCHILLI	1.272	-	0.225	-
STRONGYLURA MARINA	-	-	0.001	-
MEMBRAS MARTINICA	0.024	-	0.001	-
MENIDIA MENIDIA	-	-	0.003	-
SYNGNATHUS FUSCUS	0.130	-	0.457	-
LEIOSTOMUS XANTHURUS	-	-	0.001	-
GOBIOSOMA BOSCI	0.022	-	0.022	-
LARVAE				
ANGUILLA ROSTRATA	0.003	-	0.003	-
ANCHOA MITCHILLI	12.485	-	19.671	-
STRONGYLURA MARINA	-	-	0.001	-
FAMILY ATHERINIDAE	0.101	-	0.129	-
CYNOSCION REGALIS	0.019	-	-	-
FAMILY BLENNIIDAE	0.065	-	0.043	-
FAMILY GOBIIDAE	1.113	-	2.256	-
TRINECTES MACULATUS	0.026	-	-	-
SPHOEROIDES MACULATUS	-	-	0.010	-
EGGS				
ANCHOA MITCHILLI	2.714	-	40.615	-
TAUTOGA ONITIS	-	-	0.006	-
TRINECTES MACULATUS	0.078	-	0.259	-
UNIDENTIFIED FISH	-	-	0.011	-
TOTAL LARVAE & JUVENILES	15.258	0.0	22.823	0.0
TOTAL EGGS	2.791	0.0	40.890	0.0
TOTAL COLLECTIONS	12		18	

Table D1-114. (cont.)

MONTH		AUGUST	
LOCATION		7	11
TEMPERATURE:	AIR	14.5 - 32.0	14.5 - 33.0
	SURFACE	22.5 - 28.6	24.8 - 37.4
	BOTTOM	22.5 - 28.0	- - -
SALINITY:	SURFACE	23.5 - 27.0	23.5 - 28.0
	BOTTOM	24.0 - 27.0	- - -
OXYGEN:	SURFACE	4.2 - 8.3	4.7 - 8.3
	BOTTOM	4.8 - 8.2	- - -
PH:	SURFACE	8.0 - 8.5	8.0 - 8.4
	BOTTOM	8.0 - 8.4	- - -

	DENSITY	BIOMASS	DENSITY	BIOMASS
JUVENILES				
ANCHOA MITCHILLI	2.039	-	1.296	-
MEMBRAS MARTINICA	0.004	-	0.003	-
SYNGNATHUS FUSCUS	0.131	-	0.060	-
CYNOSCION REGALIS	0.006	-	0.005	-
GOBIOSOMA BOSCI	-	-	0.001	-
LARVAE				
ANCHOA MITCHILLI	3.480	-	2.139	-
FAMILY ATHERINIDAE	0.044	-	0.030	-
MEMBRAS MARTINICA	0.004	-	0.004	-
CYNOSCION REGALIS	0.035	-	0.015	-
FAMILY BLENNIIDAE	0.021	-	0.006	-
FAMILY GOBIIDAE	0.479	-	0.424	-
EGGS				
ANCHOA MITCHILLI	2.788	-	2.130	-
TRINECTES MACULATUS	0.006	-	0.005	-
UNIDENTIFIED FISH	-	-	0.006	-
TOTAL LARVAE & JUVENILES	6.243	0.0	3.982	0.0
TOTAL EGGS	2.794	0.0	2.140	0.0
TOTAL COLLECTIONS	28		30	

Table D1-115. Monthly totals of live, dead, and damaged ichthyoplankton collected at the discharge (11) and intake (7) at OCGS from September 1976 through August 1977.[a]

Month	September 1976						September 1976						October 1976						October 1976					
Location	11						7						11						7					
Temperature: (C), air	18.0-28.5						18.0-25.0						1.5-24.0						1.0-24.0					
surface	26.4-34.4						18.0-25.4						15.0-28.5						8.0-19.5					
bottom	29.0-30.5						18.4-25.5						20.2-26.4						8.5-19.5					
Salinity: (ppt), surface	23.0-26.0						23.0-26.0						22.0-26.0						23.0-26.0					
bottom	25.0-25.5						23.0-26.0						24.0-26.0						23.0-26.0					
Oxygen: (ppm), surface	6.5-8.3						6.4-8.1						8.1-12.0						7.6-11.6					
bottom	7.2-7.7						6.3-8.0						8.4-11.2						7.6-11.2					
pH: surface	7.6-8.2						7.6-8.2						7.6-8.0						7.6-7.9					
bottom	8.0-8.0						7.5-8.2						7.4-8.0						7.8-8.0					
	Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
JUVENILES																								
Anchoa mitchilli	6	23.1	20	76.9	0	0	77	91.7	6	7.1	1	1.2	109	90.9	10	8.3	1	0.8	135	86.0	12	7.6	10	6.4
Hippocampus erectus	1	100.0	0	0	0	0	1	100.0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Syngnathus fuscus	0	0	2	66.7	1	33.3	3	25.0	8	66.7	1	8.3	1	25.0	3	75.0	0	0	3	42.9	4	57.1	0	0
Gobiosoma bosci	-	-	-	-	-	-	1	100.0	0	0	0	0	-	-	-	-	-	-	1	100.0	0	0	0	0
Gobiosoma ginsburgi	0	0	1	100.0	0	0	1	100.0	0	0	0	0	1	100.0	0	0	0	0	-	-	-	-	-	-
Prionotus evolans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	100.0	0	0	0	0
LARVAE																								
Anchoa mitchilli	18	7.5	222	92.5	0	0	37	8.0	414	89.4	12	2.6	27	38.6	40	57.1	3	4.3	37	48.0	30	39.0	10	13.0
Atherinidae	1	50.0	1	50.0	0	0	0	0	4	100.0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Cynoscion regalis	-	-	-	-	-	-	0	0	1	100.0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Micropogon undulatus	9	60.0	6	40.0	0	0	16	76.2	5	23.8	0	0	14	63.6	8	36.4	0	0	24	64.9	9	24.3	4	10.8
Sciaenidae	1	1.0	101	99.0	0	0	2	2.9	67	97.1	0	0	0	0	6	100.0	0	0	0	0	45	100.0	0	0
Gobiidae	14	7.4	171	90.0	5	2.6	33	9.2	320	88.9	7	1.9	4	30.8	8	61.5	1	7.7	10	52.6	9	47.4	0	0
Scophthalmus aquosus	-	-	-	-	-	-	0	0	2	100.0	0	0	1	100.0	0	0	0	0	-	-	-	-	-	-

Table D1-115. (cont.)

Month		November 1976	November 1976	December 1976	December 1976
Location		11	7	11	7
Temperature: (C),	air	-2.0-7.0	-1.5-7.0	-1.5-8.0	-1.0-9.0
	surface	13.0-18.0	3.4-6.2	14.5-18.6	2.6-7.1
	bottom	- -	3.4-5.9	- -	3.0-6.3
Salinity: (ppt),	surface	22.0-25.0	22.0-25.0	22.0-24.0	22.0-24.0
	bottom	- -	22.0-24.0	- -	22.0-22.5
Oxygen: (ppm),	surface	10.2-13.8	9.6-12.8	8.9-11.4	9.2-10.8
	bottom	- -	9.2-13.2	- -	9.5-9.5
pH	surface	7.2-8.2	7.2-8.2	7.8-8.0	7.8-8.1
	bottom	- -	7.2-8.2	- -	7.8-7.9

	Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
JUVENILES																								
Anchoa mitchilli	6	75.0	2	25.0	0	0	9	90.0	0	0	1	10.0	-	-	-	-	-	-	-	-	-	-	-	-
Gobiidae	-	-	-	-	-	-	2	100.0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Gobiosoma ginsburgi	2	100.0	0	0	0	0	2	100.0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
LARVAE																								
Anchoa mitchilli	1	50.0	1	50.0	0	0	-	-	-	-	-	-	0	0	0	0	1	100.0	-	-	-	-	-	-
Micropogon undulatus	4	80.0	1	20.0	0	0	11	100.0	0	0	0	0	-	-	-	-	-	-	1	100.0	0	0	0	0
Scophthalmus aquosus	-	-	-	-	-	-	1	100.0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-

Table D1-115. (cont.)

Month		January 1977	January 1977	February 1977	February 1977
Location		11	7	11	7
Temperature: (C),	air	-9.0-2.0	-8.5-1.5	-0.5-17.0	-0.8-11.0
	surface	10.8-11.5	1.0-1.7	12.9-15.8	4.4-8.0
	bottom	11.5-11.5	0.0-1.4	12.6-13.9	4.4-7.6
Salinity: (ppt),	surface	22.0-24.0	23.5-24.0	19.5-25.0	22.0-25.0
	bottom	24.0-24.0	23.5-24.0	20.5-25.0	22.0-25.0
Oxygen: (ppm),	surface	11.4-12.8	11.6-13.3	11.0-12.4	11.0-12.6
	bottom	11.4-11.4	11.6-13.1	11.0-12.3	11.1-12.7
pH:	surface	7.8-8.1	7.8-8.2	7.9-8.3	7.9-8.2
	bottom	8.0-8.0	7.8-8.2	7.9-8.2	7.9-8.2

	Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
LARVAE																								
Anguilla rostrata	-	-	-	-	-	-	-	-	-	-	-	-	0	0	1	100.0	0	0	-	-	-	-	-	-
Ammodytes sp.	1	1.7	57	95.0	2	3.3	15	30.6	34	69.4	0	0	0	0	38	100.0	0	0	9	11.2	71	88.8	0	0
Pseudopleuronectes americanus	0	0	2	100.0	0	0	-	-	-	-	-	-	0	0	185	100.0	0	0	18	6.9	243	93.1	0	0

Table D1-115. (cont.)

Month		March 1977	March 1977	April 1977	April 1977
Location		11	7	11	7
Temperature: (C),	air	-1.0-19.0	-1.2-18.5	7.0-23.0	7.0-22.0
	surface	13.3-20.6	5.6-14.0	18.3-24.4	11.5-17.4
	bottom	15.0-19.6	7.9-13.5	18.6-24.0	11.5-17.5
Salinity: (ppt),	surface	20.0-24.0	20.0-24.0	19.5-22.0	20.0-22.0
	bottom	20.5-22.0	20.0-24.0	20.0-22.0	19.5-22.0
Oxygen: (ppm),	surface	8.7-11.4	9.0-11.2	8.0-10.2	8.0-10.4
	bottom	8.0-10.2	8.6-11.4	7.8-9.8	8.0-10.5
pH:	surface	7.8-8.2	7.8-8.2	7.7-8.0	7.8-8.1
	bottom	7.7-8.2	7.8-8.2	7.8-8.0	7.4-8.1

	March 1977						March 1977						April 1977						April 1977					
	Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
LARVAE																								
Anguilla rostrata	4	100.0	0	0	0	0	8	88.9	1	11.1	0	0	6	85.7	1	14.3	0	0	12	100.0	0	0	0	0
Atherinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	20.0	4	80.0	0	0
Ammodytes sp.	21	10.1	182	87.5	5	2.4	106	53.3	76	38.2	17	8.5	10	23.3	27	62.8	6	13.9	31	53.4	19	32.8	8	13.8
Pseudopleuronectes americanus	114	5.5	1910	92.0	52	2.5	723	26.4	1770	64.6	248	9.0	79	25.7	201	65.5	27	8.8	309	66.0	118	25.2	41	8.8

Table D1-115. (cont.)

Month		July 1977[b]	August 1977	August 1977
Location		11	11	7
Temperature: (C),	air	19.0-24.0	14.5-33.0	14.5-32.0
	surface	23.7-27.3	24.8-37.4	22.5-28.6
	bottom	- -	- -	22.5-28.0
Salinity: (ppt),	surface	26.0-28.0	23.5-28.0	23.5-27.0
	bottom	- -	- -	24.0-27.0
Oxygen: (ppm),	surface	5.3-7.0	4.7-8.3	4.2-8.3
	bottom	- -	- -	4.8-8.2
pH:	surface	7.9-8.2	8.0-8.4	8.0-8.6
	bottom	- -	- -	8.0-8.4

	Alive		Dead		Damaged		Alive		Dead		Damaged		Alive		Dead		Damaged	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
JUVENILES																		
Anchoa mitchilli	-	-	-	-	-	-	2	100.0	0	0	0	0	-	-	-	-	-	-
Syngnathus fuscus	-	-	-	-	-	-	-	-	-	-	-	-	1	100.0	0	0	0	0
LARVAE																		
Anchoa mitchilli	8	24.2	25	75.8	0	0	4	25.0	12	75.0	0	0	-	-	-	-	-	-
Cynoscion regalis	1	100.0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Blennidae	-	-	-	-	-	-	-	-	-	-	-	-	1	100.0	0	0	0	0
Gobiidae	1	33.3	2	66.7	0	0	2	66.7	1	33.3	0	0	1	100.0	0	0	0	0

[a] Mortality studies were not taken in May and June. Plant was shutdown.
[b] Plant not discharging heated water-ambient temperatures. Condenser intake not sampled; Pumps not up to full operative capacities.

Table D1-115. Comparison of estimated populations of selected macrozooplankton in Barnegat Bay with estimated number entrained per 12-h period at the Oyster Creek Generating Station from 11 March 1977 through 28 September 1977.

	Date	Population Estimate ± C.L.	12-h Entrainment Estimate ± C.L.	Percent of Population Entrained
Rathkea octopunctata	11 Mar	$7.22 \times 10^{9} \pm 2.81 \times 10^{9}$	$1.34 \times 10^{6} \pm 3.58 \times 10^{7}$	1.9
	28 Mar	$2.11 \times 10^{10} \pm 0.55 \times 10^{10}$	$6.41 \times 10^{7} \pm 3.32 \times 10^{7}$	0.3
Sarsia sp.	11 Mar	$1.33 \times 10^{10} \pm 0.36 \times 10^{10}$	$1.09 \times 10^{8} \pm 6.12 \times 10^{7}$	0.8
	28 Mar	$2.23 \times 10^{10} \pm 0.70 \times 10^{10}$	$1.67 \times 10^{8} \pm 3.33 \times 10^{7}$	0.7
Barnacle larvae (cypris)	11 Mar	$3.95 \times 10^{9} \pm 1.87 \times 10^{9}$	$4.88 \times 10^{6} \pm 4.76 \times 10^{6}$	0.1
	28 Mar	$1.89 \times 10^{8} \pm 0.69 \times 10^{8}$	$3.68 \times 10^{6} \pm 1.20 \times 10^{6}$	1.9
Crangon septemspinosa (zoeae)	11 Mar	$2.41 \times 10^{6} \pm 1.51 \times 10^{6}$	$2.03 \times 10^{5} \pm 2.30 \times 10^{5}$	8.4
	28 Mar	$4.42 \times 10^{7} \pm 1.43 \times 10^{7}$	$4.88 \times 10^{5} \pm 6.26 \times 10^{5}$	1.1
	18 May	$2.07 \times 10^{8} \pm 0.84 \times 10^{8}$	$6.51 \times 10^{6} \pm 2.53 \times 10^{6}$	3.1
	8 Jun	$3.12 \times 10^{8} \pm 0.97 \times 10^{8}$	$1.28 \times 10^{7} \pm 3.40 \times 10^{5}$	4.1
	22 Jun	$1.19 \times 10^{8} \pm 0.47 \times 10^{8}$	$8.11 \times 10^{6} \pm 1.38 \times 10^{6}$	6.8
	6 Jul	$4.69 \times 10^{7} \pm 1.86 \times 10^{7}$	$3.39 \times 10^{6} \pm 9.30 \times 10^{5}$	7.2
	21 Jul	$9.15 \times 10^{6} \pm 4.45 \times 10^{6}$	0	0
Palaemonetes spp. (zoeae)	8 Jun	$2.08 \times 10^{8} \pm 1.48 \times 10^{8}$	$8.12 \times 10^{5} \pm 3.67 \times 10^{5}$	0.4
	22 Jun	$1.88 \times 10^{8} \pm 1.12 \times 10^{8}$	$7.65 \times 10^{5} \pm 4.15 \times 10^{5}$	0.4
	6 Jul	$7.95 \times 10^{7} \pm 2.96 \times 10^{7}$	$1.52 \times 10^{6} \pm 1.05 \times 10^{6}$	1.9
	21 Jul	$1.15 \times 10^{8} \pm 0.35 \times 10^{8}$	$3.45 \times 10^{6} \pm 1.06 \times 10^{6}$	3.0
Neopanope texana (zoeae)	8 Jun	$5.91 \times 10^{9} \pm 6.14 \times 10^{9}$	$1.07 \times 10^{6} \pm 7.90 \times 10^{5}$	0.1
	22 Jun	$1.81 \times 10^{9} \pm 1.13 \times 10^{9}$	$1.63 \times 10^{7} \pm 6.81 \times 10^{6}$	0.9
	6 Jul	$6.64 \times 10^{8} \pm 3.86 \times 10^{8}$	$3.08 \times 10^{7} \pm 9.24 \times 10^{6}$	4.6
	21 Jul	$6.80 \times 10^{8} \pm 1.92 \times 10^{8}$	$4.27 \times 10^{7} \pm 8.50 \times 10^{6}$	6.3
Panopeus herbstii (zoeae)	8 Jun	$1.27 \times 10^{7} \pm 1.20 \times 10^{7}$	$2.45 \times 10^{7} \pm 8.82 \times 10^{6}$	> 100
	22 Jun	$1.21 \times 10^{8} \pm 1.34 \times 10^{8}$	$1.37 \times 10^{6} \pm 7.00 \times 10^{5}$	1.1
	6 Jul	$1.02 \times 10^{8} \pm 8.10 \times 10^{7}$	$1.14 \times 10^{7} \pm 8.10 \times 10^{6}$	11.2
	21 Jul	$1.64 \times 10^{8} \pm 0.73 \times 10^{8}$	$5.96 \times 10^{7} \pm 1.26 \times 10^{7}$	36.3
Pagurus spp. (zoeae)	8 Jun	$1.24 \times 10^{7} \pm 9.14 \times 10^{6}$	$1.36 \times 10^{5} \pm 8.91 \times 10^{5}$	1.1
	22 Jun	$7.38 \times 10^{6} \pm 3.60 \times 10^{6}$	$1.26 \times 10^{5} \pm 8.50 \times 10^{4}$	1.7
	6 Jul	$1.51 \times 10^{7} \pm 1.43 \times 10^{7}$	$1.59 \times 10^{6} \pm 7.73 \times 10^{5}$	10.5
	21 Jul	$4.74 \times 10^{7} \pm 2.93 \times 10^{7}$	$4.38 \times 10^{5} \pm 6.89 \times 10^{5}$	0.9
Libinia spp. (zoeae)	8 Jun	$2.91 \times 10^{6} \pm 1.53 \times 10^{6}$	$5.13 \times 10^{5} \pm 3.87 \times 10^{5}$	17.6
	22 Jun	$8.58 \times 10^{6} \pm 7.31 \times 10^{6}$	$2.38 \times 10^{5} \pm 2.49 \times 10^{5}$	2.7
	6 Jul	$9.22 \times 10^{7} \pm 7.92 \times 10^{7}$	$9.77 \times 10^{5} \pm 7.99 \times 10^{5}$	1.1
	21 Jul	$8.77 \times 10^{6} \pm 5.65 \times 10^{6}$	$2.50 \times 10^{5} \pm 3.42 \times 10^{5}$	2.9
Upogebia affinis (zoeae)	22 Jun	$3.76 \times 10^{7} \pm 2.30 \times 10^{7}$	$6.55 \times 10^{5} \pm 2.84 \times 10^{5}$	1.7
	6 Jul	$4.54 \times 10^{7} \pm 2.51 \times 10^{7}$	$3.74 \times 10^{6} \pm 1.30 \times 10^{6}$	8.2
	21 Jul	$4.51 \times 10^{7} \pm 1.30 \times 10^{7}$	$4.24 \times 10^{5} \pm 3.10 \times 10^{5}$	0.9
Rhithropanopeus harrisii (zoeae)	22 Jun	$2.44 \times 10^{7} \pm 1.74 \times 10^{7}$	$8.95 \times 10^{5} \pm 4.01 \times 10^{5}$	3.7
	21 Jul	$3.15 \times 10^{6} \pm 2.40 \times 10^{6}$	$1.24 \times 10^{6} \pm 1.00 \times 10^{6}$	39.4
Hippolyte spp. (zoeae)	22 Jun	$4.37 \times 10^{6} \pm 1.94 \times 10^{6}$	$8.63 \times 10^{4} \pm 5.85 \times 10^{4}$	2.0
	6 Jul	$5.81 \times 10^{6} \pm 4.47 \times 10^{5}$	$1.44 \times 10^{5} \pm 6.31 \times 10^{4}$	24.8
	21 Jul	$2.25 \times 10^{7} \pm 8.11 \times 10^{6}$	$3.05 \times 10^{5} \pm 2.96 \times 10^{5}$	1.4
	19 Sep	$2.63 \times 10^{7} \pm 1.17 \times 10^{7}$	$9.30 \times 10^{5} \pm 4.08 \times 10^{5}$	3.5
Callinectes sapidus (zoeae)	6 Jul	$1.48 \times 10^{6} \pm 1.61 \times 10^{6}$	$3.10 \times 10^{5} \pm 4.45 \times 10^{5}$	20.9
	21 Jul	$1.94 \times 10^{7} \pm 1.10 \times 10^{7}$	$5.31 \times 10^{5} \pm 5.61 \times 10^{5}$	2.7
Uca spp. (zoeae)	6 Jul	$2.99 \times 10^{6} \pm 3.14 \times 10^{6}$	$8.09 \times 10^{5} \pm 8.91 \times 10^{5}$	27.1
	21 Jul	$7.40 \times 10^{6} \pm 3.16 \times 10^{6}$	$5.25 \times 10^{5} \pm 9.34 \times 10^{5}$	7.1
Turritopsis nutricola	19 Sep	$6.53 \times 10^{8} \pm 7.65 \times 10^{8}$	$1.53 \times 10^{6} \pm 6.31 \times 10^{5}$	0.2
Neomysis americana	19 Sep	$1.09 \times 10^{9} \pm 5.47 \times 10^{8}$	$1.69 \times 10^{7} \pm 4.55 \times 10^{6}$	1.6
	28 Sep	$2.60 \times 10^{9} \pm 1.07 \times 10^{9}$	$2.10 \times 10^{7} \pm 4.32 \times 10^{6}$	0.8
Mysidopsis bigelowi	19 Sep	$2.76 \times 10^{8} \pm 1.07 \times 10^{8}$	$8.84 \times 10^{6} \pm 3.87 \times 10^{6}$	3.2
	28 Sep	$2.16 \times 10^{8} \pm 1.99 \times 10^{8}$	$1.10 \times 10^{7} \pm 5.58 \times 10^{6}$	5.1
Callinectes sapidus (megalopae)	19 Sep	$1.74 \times 10^{8} \pm 4.23 \times 10^{7}$	$7.11 \times 10^{5} \pm 6.82 \times 10^{5}$	0.2
	28 Sep	$1.01 \times 10^{8} \pm 5.86 \times 10^{7}$	$2.77 \times 10^{5} \pm 2.16 \times 10^{5}$	0.3
Libinia spp. (megalopae)	19 Sep	$4.67 \times 10^{7} \pm 3.31 \times 10^{7}$	$6.36 \times 10^{5} \pm 5.20 \times 10^{5}$	1.4
	28 Sep	$9.28 \times 10^{7} \pm 1.32 \times 10^{8}$	$2.27 \times 10^{5} \pm 1.71 \times 10^{5}$	0.8

Table D1-117. Comparison of estimated populations of abundant ichthyoplankton in Barnegat Bay with estimated number entrained per 12 h period at the Oyster Creek Generating Station from 11 March 1977 through 28 September 1977.

Organism	Date	Population Estimate ± C.L.	12 h Entrainment Estimate ± C.L.	% of Population Entrained
Pseudopleuronectes americanus larvae	11 March	$1.53 \times 10^9 \pm 7.85 \times 10^8$	$1.60 \times 10^7 \pm 6.50 \times 10^6$	1.1
	28 March	$1.30 \times 10^9 \pm 3.37 \times 10^8$	$1.29 \times 10^7 \pm 2.71 \times 10^6$	1.0
Anchoa mitchilli eggs	18 May	$9.76 \times 10^8 \pm 3.07 \times 10^8$	$1.03 \times 10^6 \pm 4.61 \times 10^5$	0.1
	8 June	$4.94 \times 10^8 \pm 9.95 \times 10^7$	$1.30 \times 10^6 \pm 4.06 \times 10^5$	0.3
	22 June	$5.88 \times 10^9 \pm 7.56 \times 10^8$	$1.84 \times 10^7 \pm 6.33 \times 10^6$	0.3
	6 July	$5.72 \times 10^9 \pm 1.71 \times 10^9$	$8.51 \times 10^7 \pm 2.72 \times 10^7$	1.5
	21 July	$5.08 \times 10^9 \pm 7.96 \times 10^8$	$1.46 \times 10^7 \pm 3.01 \times 10^6$	0.3
Anchoa mitchilli larvae	8 June	$7.47 \times 10^6 \pm 2.29 \times 10^6$	$1.21 \times 10^5 \pm 4.52 \times 10^4$	1.6
	22 June	$2.62 \times 10^7 \pm 1.19 \times 10^7$	$1.99 \times 10^6 \pm 3.34 \times 10^5$	7.6
	6 July	$1.09 \times 10^8 \pm 3.78 \times 10^7$	$1.67 \times 10^7 \pm 3.32 \times 10^6$	15.3
	21 July	$7.73 \times 10^8 \pm 1.08 \times 10^8$	$8.65 \times 10^6 \pm 1.69 \times 10^6$	1.1
Anchoa mitchilli juveniles	19 September	$5.63 \times 10^7 \pm 3.07 \times 10^7$	$3.28 \times 10^5 \pm 1.30 \times 10^5$	0.6
	28 September	$1.77 \times 10^7 \pm 5.18 \times 10^6$	$9.83 \times 10^4 \pm 5.96 \times 10^4$	0.5
Syngnathus fuscus juveniles	18 May	$4.17 \times 10^6 \pm 1.77 \times 10^6$	$9.76 \times 10^4 \pm 1.07 \times 10^5$	2.3
	8 June	$4.26 \times 10^6 \pm 2.11 \times 10^6$	$1.70 \times 10^5 \pm 5.09 \times 10^4$	4.0
	22 June	$5.06 \times 10^6 \pm 2.22 \times 10^6$	$1.68 \times 10^5 \pm 9.22 \times 10^4$	3.3
	6 July	$3.14 \times 10^6 \pm 2.01 \times 10^6$	$6.99 \times 10^5 \pm 2.83 \times 10^5$	22.3
	21 July	$5.26 \times 10^6 \pm 2.72 \times 10^6$	$6.38 \times 10^4 \pm 1.44 \times 10^5$	1.2
Gobiidae larvae	8 June	$2.28 \times 10^5 \pm 2.26 \times 10^5$	$1.34 \times 10^5 \pm 5.37 \times 10^4$	54.4
	22 June	$1.09 \times 10^6 \pm 1.21 \times 10^6$	$2.58 \times 10^5 \pm 8.38 \times 10^4$	23.7
	6 July	$1.39 \times 10^6 \pm 1.23 \times 10^6$	$3.71 \times 10^6 \pm 7.29 \times 10^5$	>100.0
	21 July	$1.76 \times 10^6 \pm 1.83 \times 10^6$	$6.34 \times 10^5 \pm 1.95 \times 10^5$	36.0

Table D1-118. Comparison of seasonal population estimates with seasonal entrainment estimates for winter flounder larvae for the 1976 breeding season.

Size Class	Duration of Size Class (Days)	Seasonal Population Estimate	Seasonal Entrainment Estimate[b]	Percent of Population Entrained	Percent of Population Entrained Per 24-h Day
2.5 - 3.7	7.3	1.62×10^9	3.72×10^7	2.3	0.3
3.8 - 4.0	1.6	2.48×10^9	3.04×10^7	1.2	0.8
4.1 - 4.3	1.5	2.06×10^9	1.54×10^7	0.7	0.5
4.4 - 4.6	1.4	1.40×10^9	8.09×10^6	0.6	0.4
4.7 - 4.9	1.3	6.58×10^8	2.65×10^6	0.4	0.3
5.0 - 5.2	1.2	4.78×10^8	2.82×10^6	0.6	0.5
5.3 - 5.5	1.15	2.61×10^8	1.57×10^6	0.6	0.5
5.6 - 5.8	1.1	1.91×10^8	7.51×10^5	0.4	0.4
5.9 - 6.1	1.0	1.64×10^8	7.11×10^5	0.4	0.4
6.2 - 6.4	1.0	4.70×10^7	4.76×10^5	1.0	1.0
6.5 - 6.7	3.3	8.78×10^6	4.21×10^5	4.8	1.5
6.8 - 7.0	3.15	3.60×10^6	2.19×10^5	6.1	1.9
7.0	6.0	1.29×10^6	4.76×10^5	36.9	6.1
Total		1.88×10^{10}[a]	1.01×10^8	0.5	

[a] Total number of larvae hatched estimated from the exponential regression of the seasonal abundance of each size class on the estimated age of each size class. Upper and lower 95% confidence limits of this estimate are 7.76×10^{10} and 1.33×10^{10}, respectively.

[b] Seasonal entrainment estimates were calculated by multiplying the monthly entrainment estimate of all larvae by the monthly size-frequency distribution and then adding the monthly entrainment estimates of each size class. The total seasonal entrainment estimate was calculated by adding the seasonal estimates of all size classes. This estimate differs from the annual entrainment estimate (Table D1-111).

Table D1-119. Comparison of seasonal population estimates with seasonal entrainment estimates for winter flounder larvae for the 1977 breeding season.

Size Class	Duration of Size Class (Days)	Seasonal Population Estimate	Seasonal Entrainment Estimate[b]	Percent of Population Entrained	Percent of Population Entrained Per 24-h Day
2.5 - 3.4	5.5	1.11×10^9	5.63×10^7	5.1	0.9
3.5 - 3.7	1.7	4.08×10^9	7.39×10^7	1.8	1.1
3.8 - 4.0	1.6	4.18×10^9	6.63×10^7	1.6	1.0
4.1 - 4.3	1.5	3.65×10^9	4.69×10^7	1.3	0.9
4.4 - 4.6	1.4	3.53×10^9	4.43×10^7	1.3	0.9
4.7 - 4.9	1.3	4.31×10^9	4.72×10^7	1.1	0.8
5.0 - 5.2	1.2	4.62×10^9	4.84×10^7	1.0	0.9
5.3 - 5.5	1.15	4.30×10^9	4.99×10^7	1.2	1.0
5.6 - 5.8	1.1	4.49×10^9	5.14×10^7	1.1	1.0
5.9 - 6.1	1.0	3.83×10^9	4.85×10^7	1.3	1.3
6.2 - 6.4	1.0	3.36×10^9	4.09×10^7	1.2	1.2
6.5 - 6.7	3.3	8.00×10^8	3.89×10^7	4.9	1.5
6.8 - 7.0	3.15	4.95×10^8	2.91×10^7	5.9	1.9
7.0	6.0	2.90×10^8	2.39×10^7	8.2	1.4
Total		1.35×10^{10}[a]	6.66×10^8	4.9	

[a] Total number of larvae hatched estimated from the exponential regression of the seasonal abundance of each size class on the estimated age of each size class. Upper and lower 95% confidence limits of this estimate are 3.10×10^{10} and 5.87×10^9, respectively.

[b] Seasonal entrainment estimates were calculated by multiplying the monthly entrainment estimate of all larvae by the monthly size-frequency distribution and then adding the monthly entrainment estimates of each size class. The total seasonal entrainment estimate was calculated by adding the seasonal estimates of all size classes. This estimate differs from the annual entrainment estimate (Table D1.111).

Table D1-120. Comparison of seasonal population estimates with seasonal entrainment estimates for eggs and larvae of the bay anchovy for the 1976 breeding season.

Size Class	Duration of Size Class (Days)	Seasonal Population Estimate	Seasonal Entrainment Estimate	Percent of Population Entrained	Percent of Population Entrained Per Day
Eggs	1.5	3.77×10^{11}	1.37×10^{10}	3.6	2.4
1.0 - 6.9	10.1	5.82×10^{9}	5.75×10^{8}	9.9	1.0
7.0 - 7.9	1.8	2.12×10^{9}	8.79×10^{7}	4.1	2.3
8.0 - 8.9	1.8	1.60×10^{9}	5.52×10^{7}	3.45	1.9
9.0 - 9.9	1.8	1.05×10^{9}	3.68×10^{7}	3.5	1.9
10.0 - 10.9	1.8	9.17×10^{8}	2.85×10^{7}	3.1	1.7
11.0 - 11.9	1.8	9.33×10^{8}	2.32×10^{7}	2.5	1.4
12.0 - 12.9	1.8	9.06×10^{8}	2.12×10^{7}	2.3	1.3
13.0 - 13.9	1.8	1.06×10^{9}	2.07×10^{7}	2.0	1.1
14.0 - 14.9	1.8	8.11×10^{8}	1.78×10^{7}	2.2	1.2
15.0 - 15.9	1.8	5.83×10^{8}	1.56×10^{7}	2.7	1.5
16.0	19.8	4.85×10^{8}	1.09×10^{8}	22.5	1.1
Total					
Egg		3.77×10^{11}	1.00×10^{10}	3.6	
Larvae		5.79×10^{10} [a]	9.91×10^{8}	1.7	
Larvae		3.24×10^{9} [b]	9.91×10^{8}	30.6	

[a] Total number of larvae at hatching (mean age 1.5 days) estimated from the exponential regression of the seasonal abundance of eggs and each size class of larvae (> 7.0 mm) on the estimated age of each size class. Upper and lower 95% confidence limits of estimate are 1.14×10^{12} and 2.95×10^{9}, respectively.

[b] Total number of larvae hatched estimated from the exponential regression of the seasonal abundance of each size class of larvae (> 7.0 mm) on the estimated age of each size class. Upper and lower 95% confidence limits of estimate are 6.11×10^{9} and 1.72×10^{9}, respectively.

Table D1-121. Comparison of seasonal population estimates with seasonal entrainment estimates for eggs and larvae of the bay anchovy for the 1977 breeding season.

Size Class	Duration of Size Class (Days)	Seasonal Population Estimate	Seasonal Entrainment Estimate	Percent of Population Entrained	Percent of Population Entrained Per Day
Eggs	1.5	3.39×10^{11}	3.46×10^{8}	0.1	0.1
1.0 - 6.9	10.1	1.79×10^{10}	3.75×10^{8}	2.1	0.2
7.0 - 7.9	1.8	7.26×10^{9}	6.98×10^{7}	1.0	0.5
8.0 - 8.9	1.8	4.57×10^{9}	4.39×10^{7}	1.0	0.5
9.0 - 9.9	1.8	2.95×10^{9}	2.54×10^{7}	0.9	0.5
10.0 - 10.9	1.8	2.09×10^{9}	1.62×10^{7}	0.8	0.4
11.0 - 11.9	1.8	2.11×10^{9}	1.57×10^{7}	0.7	0.4
12.0 - 12.9	1.8	1.76×10^{9}	1.28×10^{7}	0.7	0.4
13.0 - 13.9	1.8	1.24×10^{9}	9.32×10^{6}	0.8	0.4
14.0 - 14.9	1.8	8.70×10^{8}	9.04×10^{6}	1.0	0.6
15.0 - 15.9	1.8	1.02×10^{9}	9.07×10^{6}	0.9	0.5
16.0	19.8	7.82×10^{9}	9.29×10^{7}	1.2	0.1
Total					
Egg		3.39×10^{11}	3.46×10^{8}	0.1	
Larvae		1.10×10^{11} [a]	6.79×10^{8}	0.6	
Larvae		2.17×10^{10} [b]	6.79×10^{8}	3.1	

[a] Total number of larvae at hatching (mean age 1.5 days) estimated from the exponential regression of the abundance of eggs and each size class of larvae (> 7.0 mm) on the estimated age of each size class. Upper and lower 95% confidence limits of seasonal estimate are 5.87×10^{11} and 2.07×10^{10}, respectively.

[b] Total number of larvae hatched estimated from the exponential regression of the seasonal abundance of each size class of larvae (> 7.0 mm) on the estimated age of each size class. Upper and lower 95% confidence limits of estimate are 3.82×10^{10} and 1.24×10^{10}, respectively.

Table D1-122. Results of the exponential regression of adjusted seasonal abundance by size class on the estimated mean age of each size class for winter flounder larvae, and eggs and larvae of the bay anchovy.

Species	Breeding Season	Y-intercept	Slope	Regression Equation	Correlation Coefficient	Significance
Pseudopleuronectes americanus (larvae)	1976	1.88×10^{10}	-.2162	$N_t = (1.88 \times 10^{10})e^{-.2162t}$	.9750	.01
Pseudopleuronectes americanus (larvae)	1977	1.35×10^{10}	-.0844	$N_t = (1.35 \times 10^{10})e^{-.0844t}$	.8312	.01
Anchoa mitchilli (eggs and larvae)	1976	7.84×10^{10}	-.2017	$N_t = (7.84 \times 10^{10})e^{-.2017t}$	.8610	.01
Anchoa mitchilli (eggs and larvae)	1977	1.50×10^{11}	-.2025	$N_t = (1.50 \times 10^{11})e^{-.2025t}$	.9463	.01
Anchoa mitchilli (larvae only)	1976	3.24×10^{9}	-.0600	$N_t = (3.24 \times 10^{9})e^{-.0600t}$	.8713	.01
Anchoa mitchilli (larvae only)	1977	2.17×10^{10}	-.1227	$N_t = (2.17 \times 10^{10})e^{-.1227t}$	.9669	.01

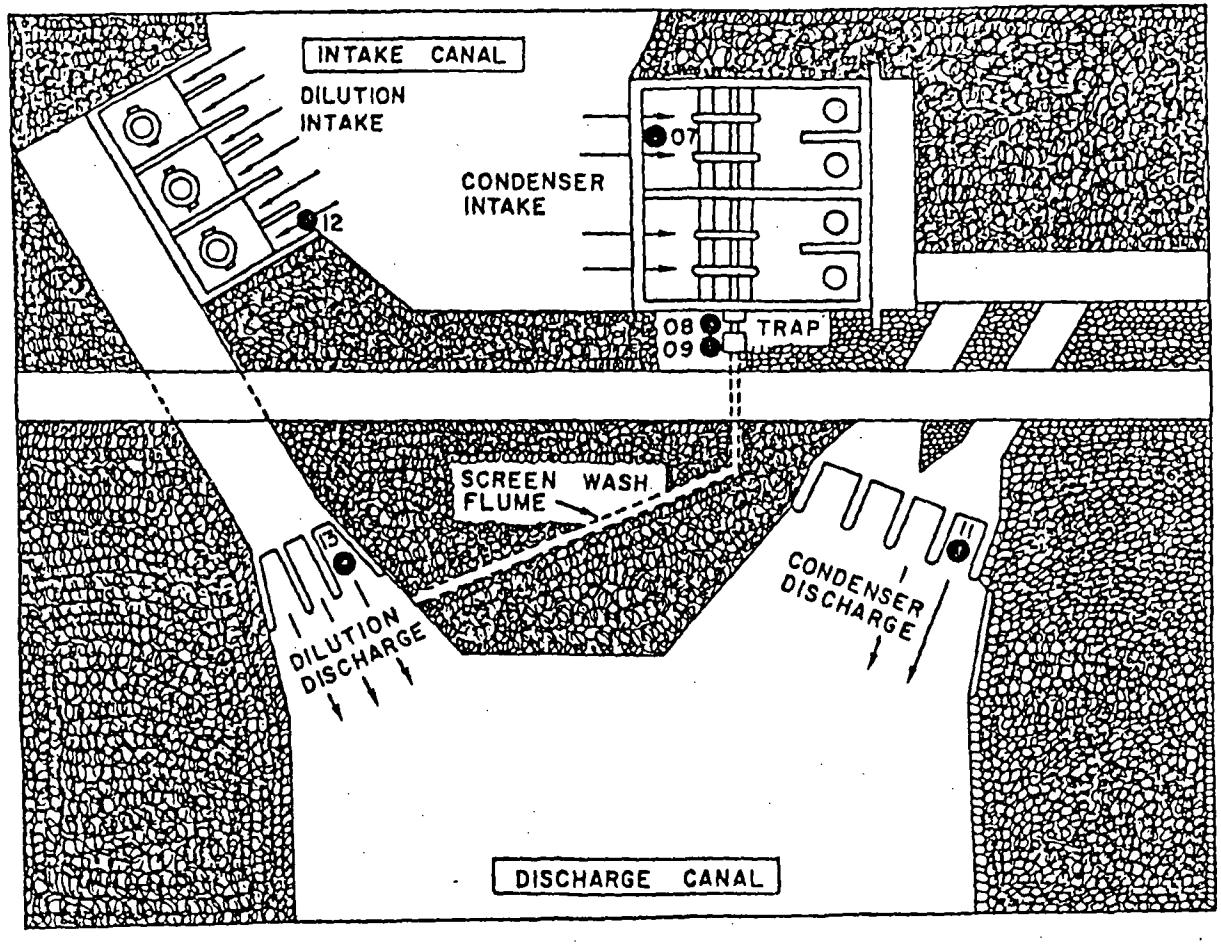

Fig. D1-10. Diagram of the intake and discharge of the circulating water system and the dilution pumps at the Oyster Creek Generating Station.

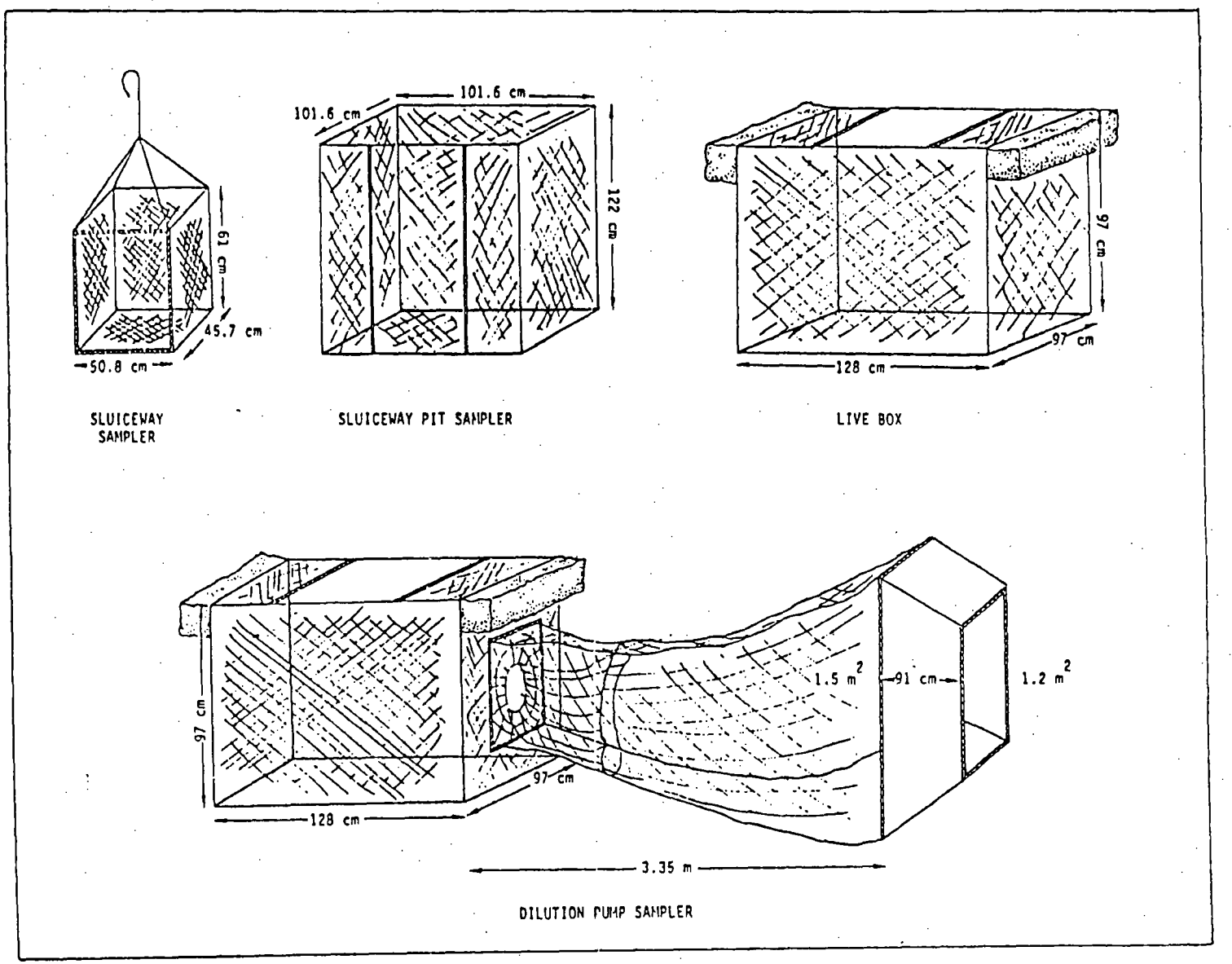

Fig. D1-11. Sampling gear used in the impingement, dilution pump, and delayed mortality studies for the Oyster Creek Generating Station Ecological Studies.

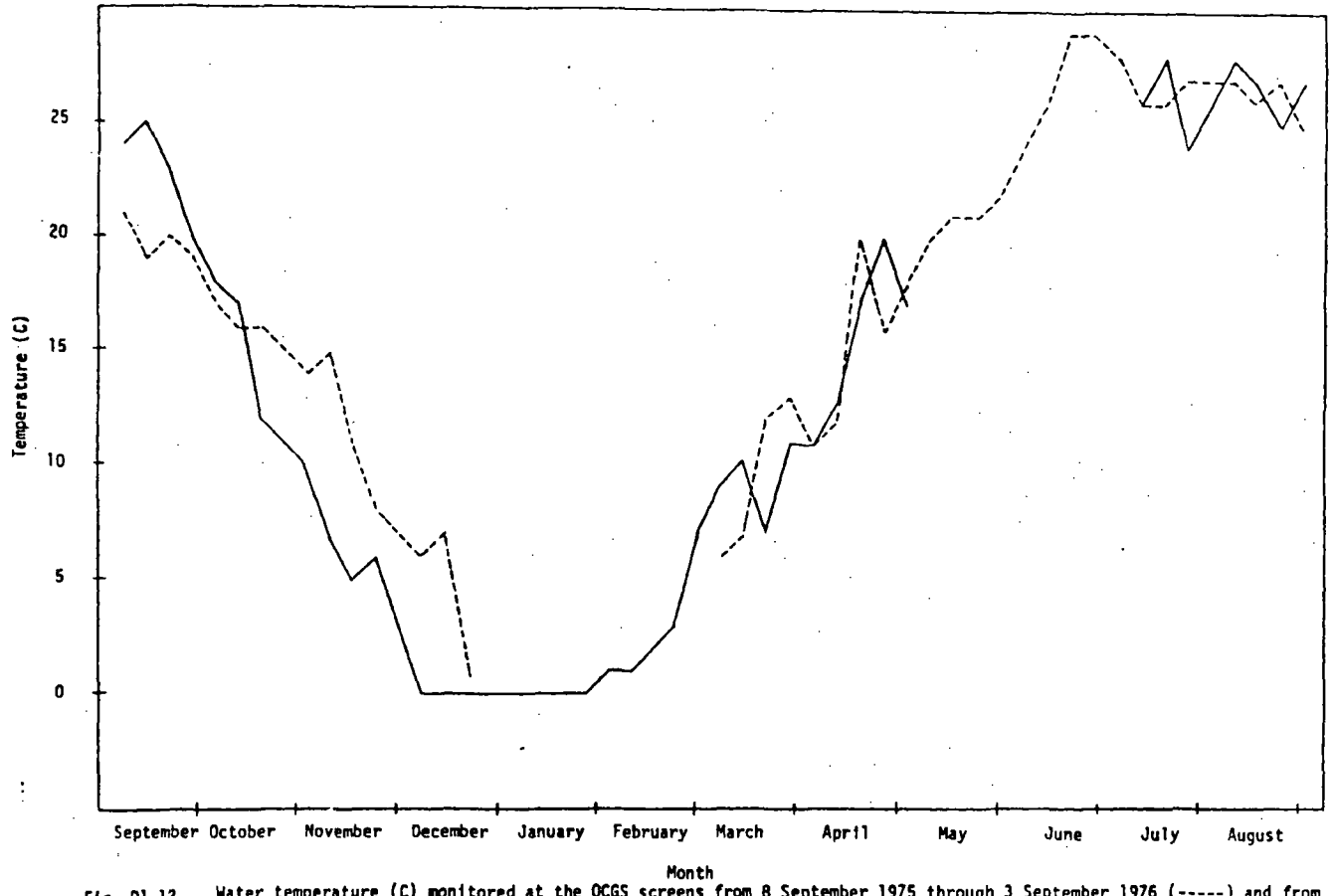

Fig. D1-12. Water temperature (C) monitored at the OCGS screens from 8 September 1975 through 3 September 1976 (-----) and from 4 September 1976 through 2 September 1977 (——). No samples were taken 24 December through 7 March 1976 and 14 May through 12 July 1977.

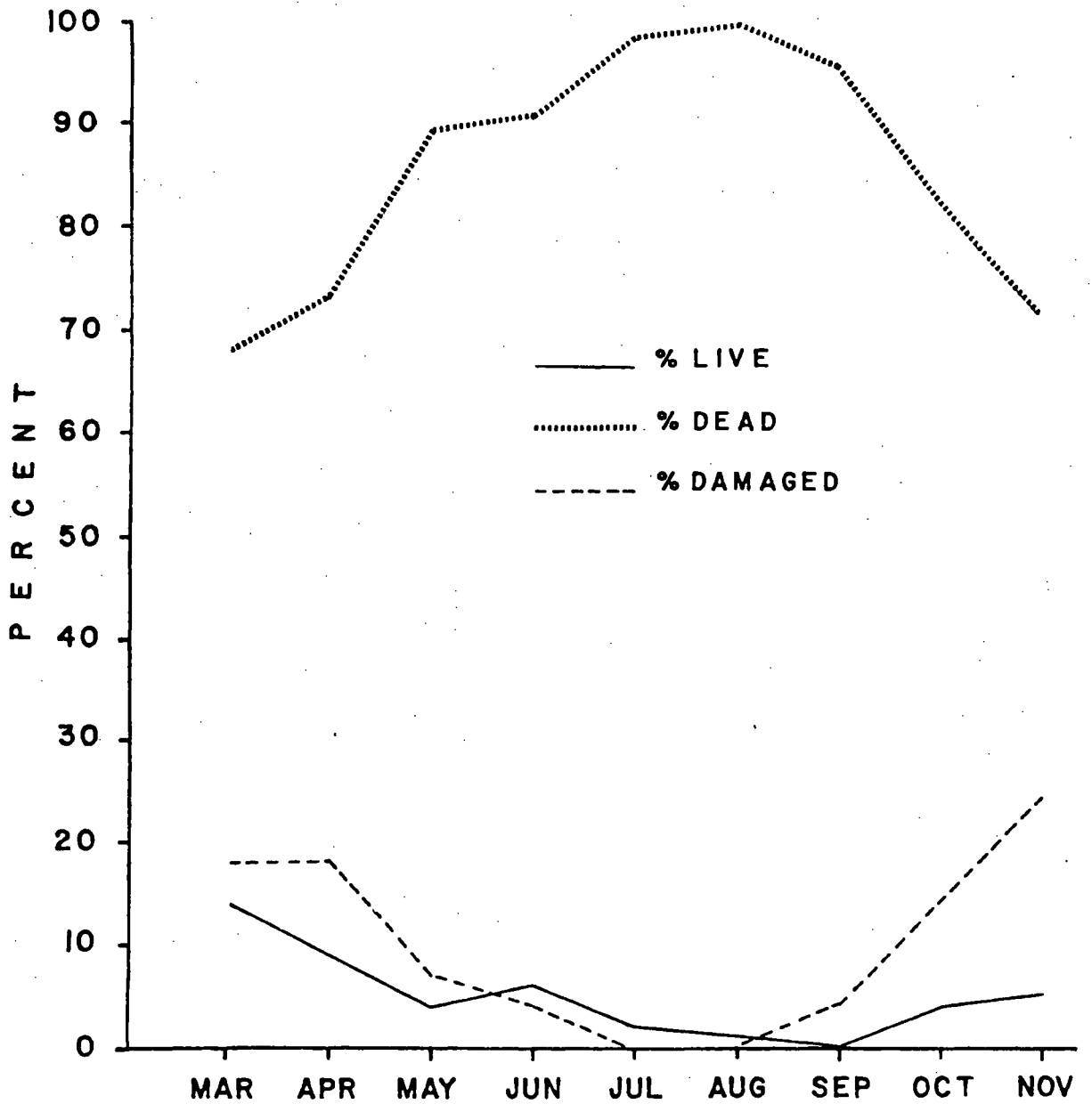

Fig. D1-13. Seasonal variation in the condition of the bay anchovy collected immediately after impingement on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from March through November 1976.

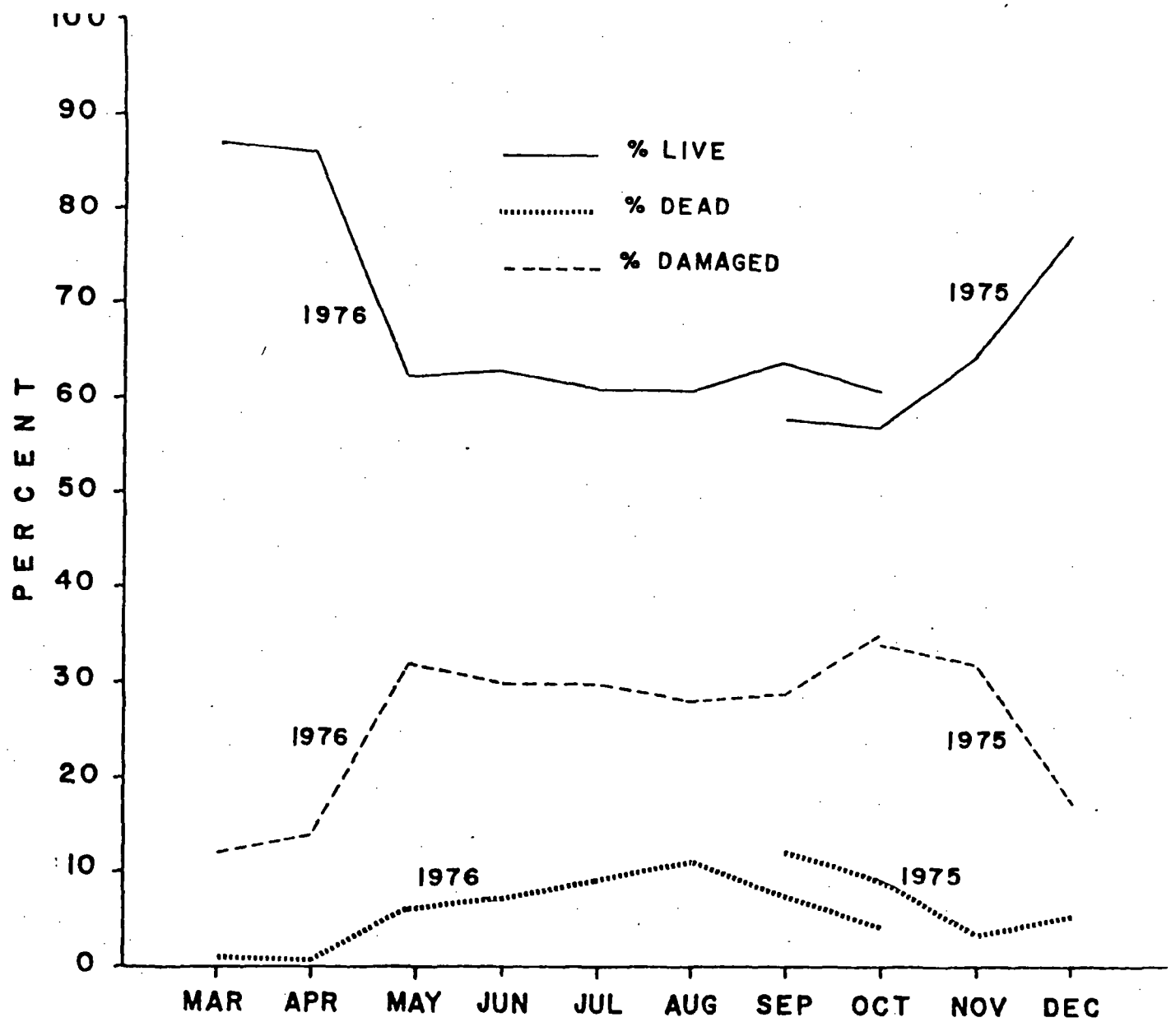

Fig. D1-14. Seasonal variation in the condition of the blue crab collected immediately after impingement on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through October 1976.

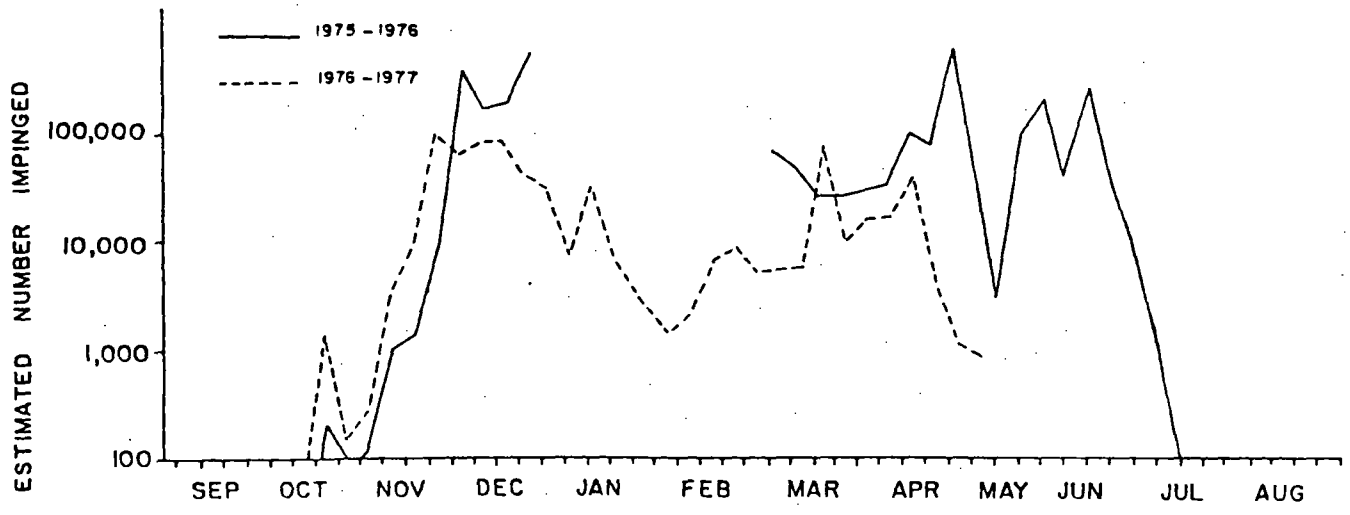

Fig. D1-15. Total estimated number impinged of Crangon septemspinosa by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

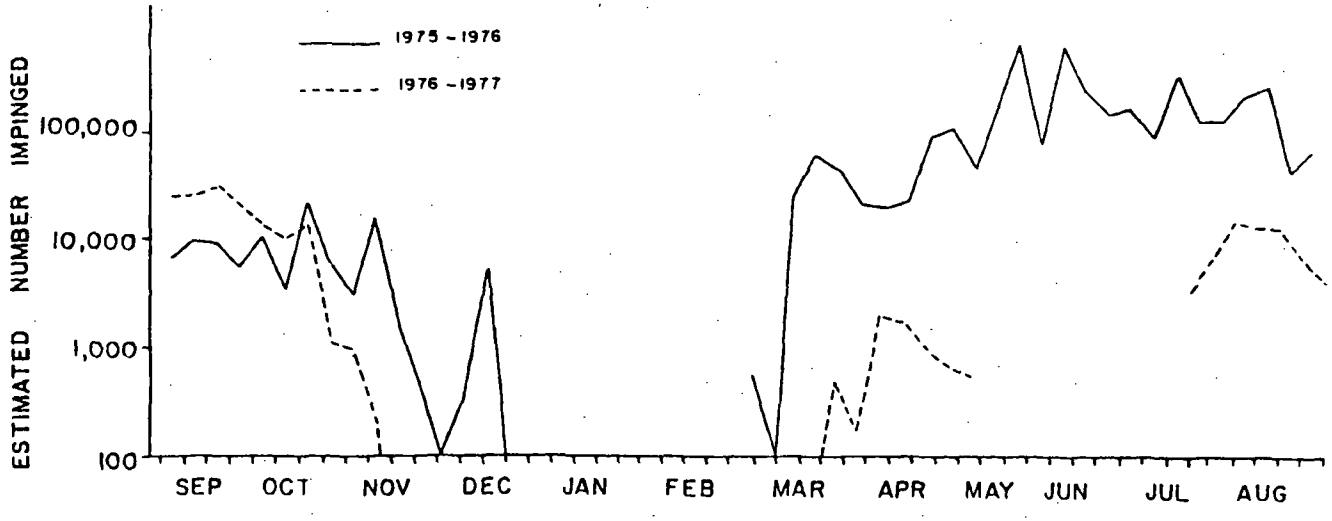

Fig. D1-16. Total estimated number impinged of Callinectes sapidus by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

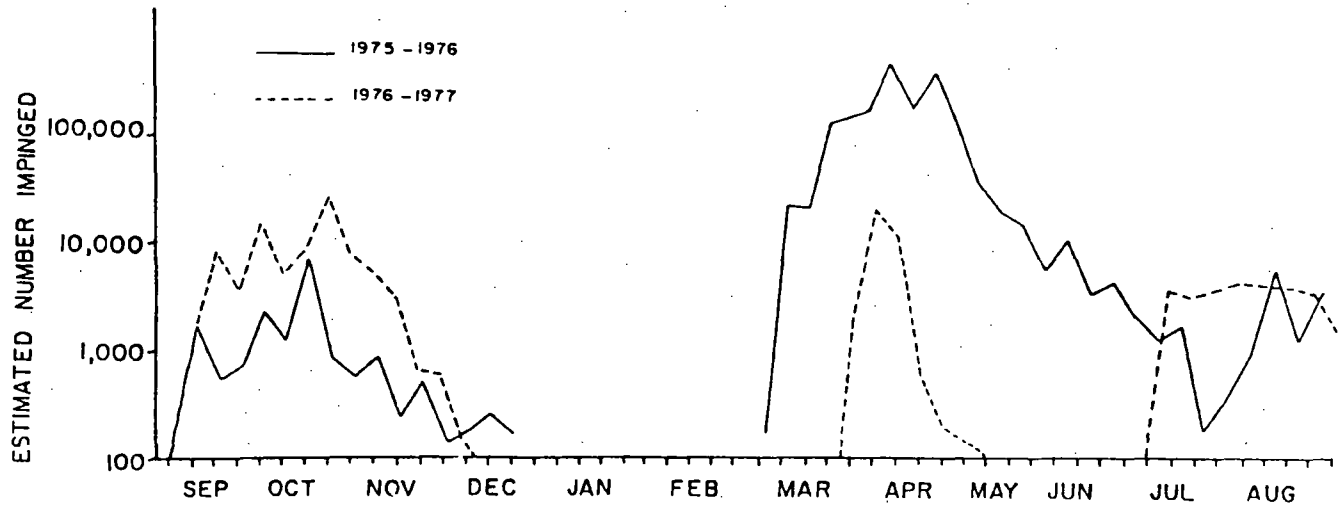

Fig. D1-17. Total estimated number impinged of Anchoa mitchilli by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

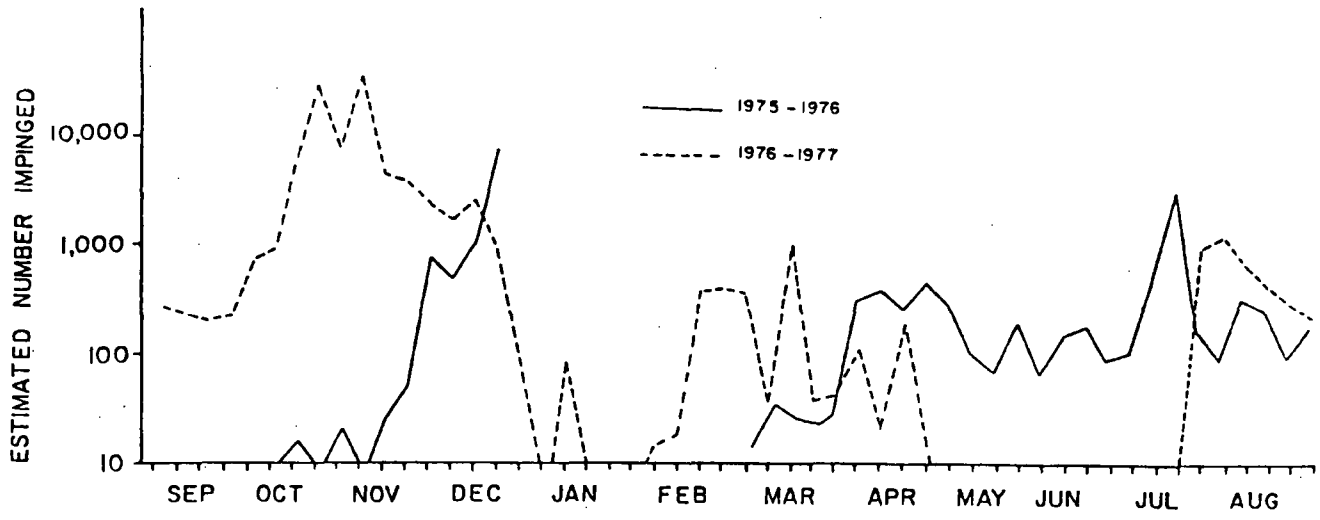

Fig. D1-18. Total estimated number impinged of Brevoortia tyrannus by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

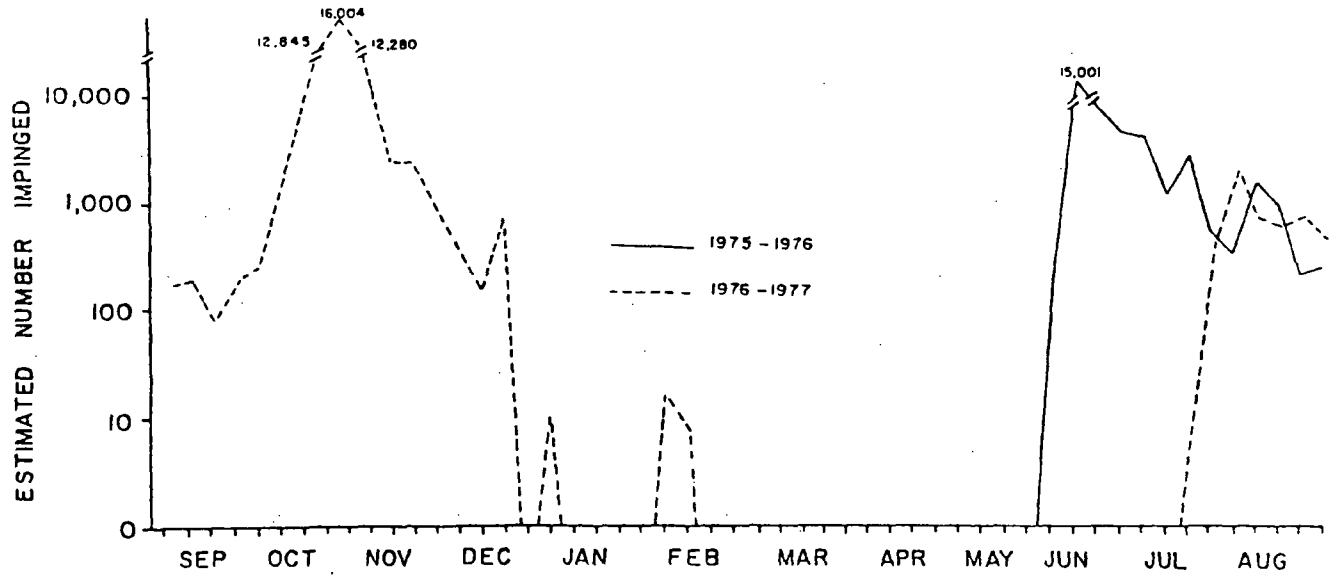

Fig. D1-19. Total estimated number impinged of Leiostomus xanthurus by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

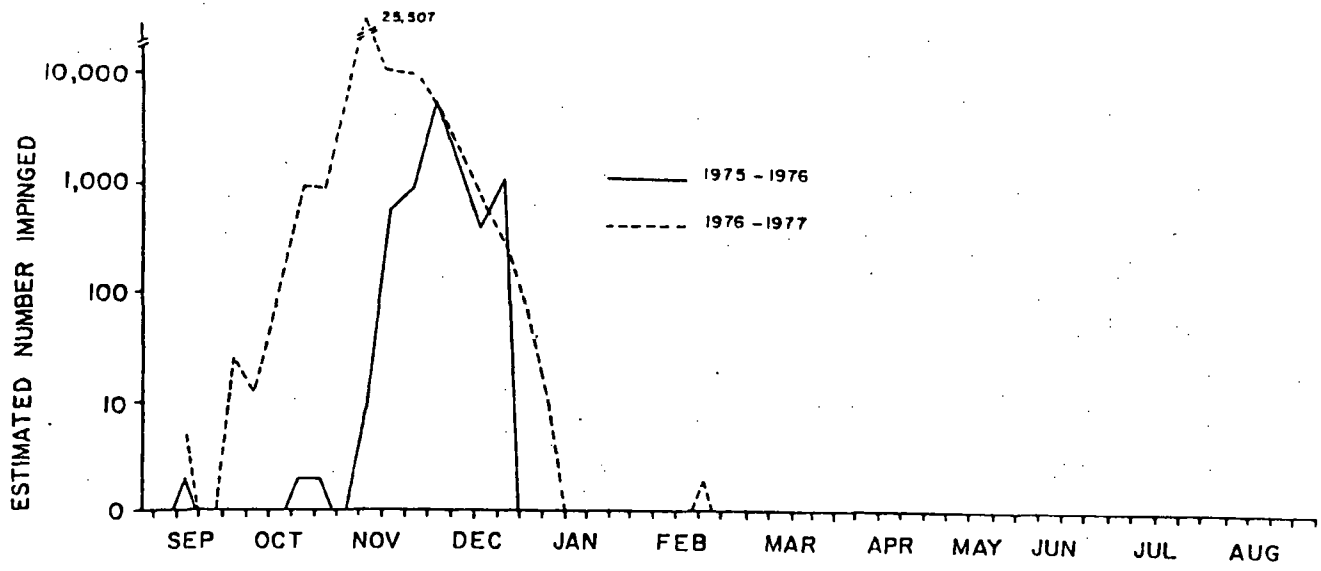

Fig. D1-20. Total estimated number impinged of Etropus microstomus by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

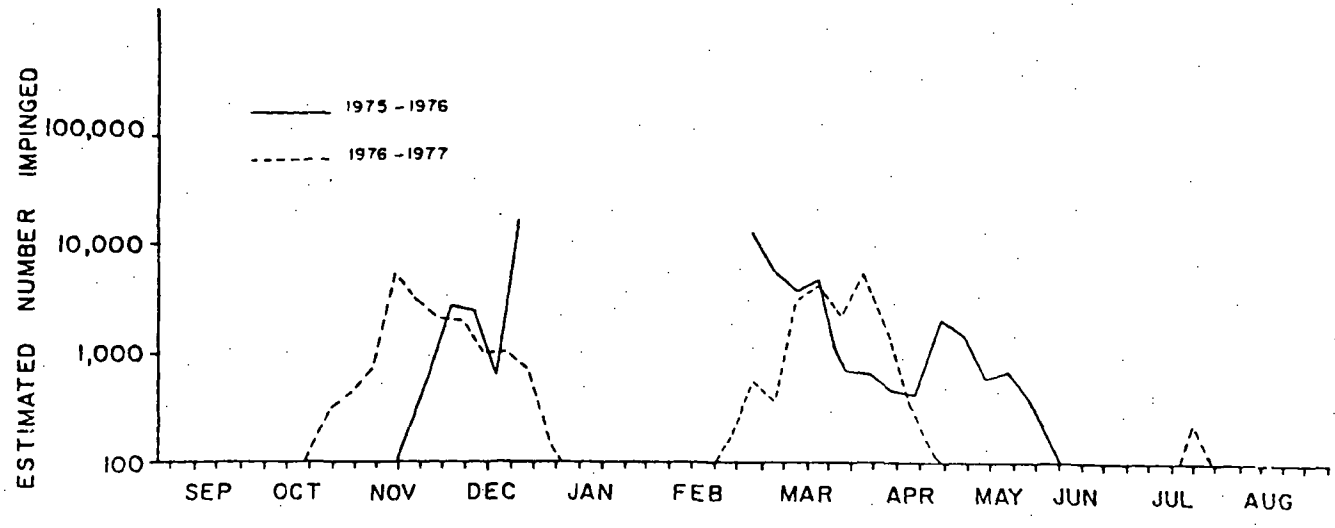

Fig. D1-21. Total estimated number impinged of Menidia menidia by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

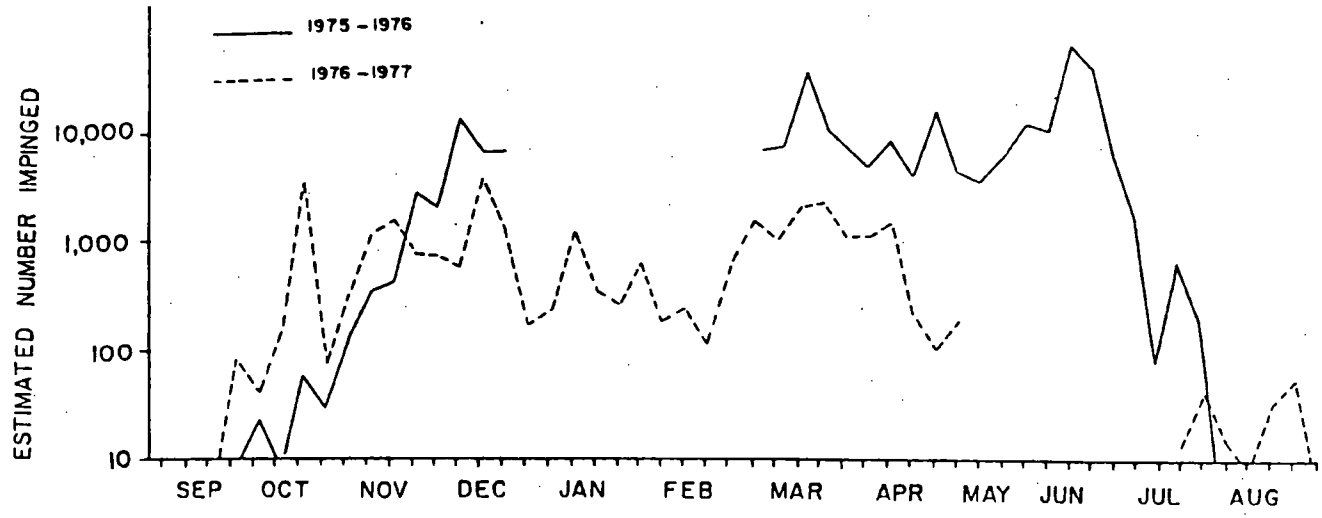

Fig. D1-22. Total estimated number impinged of Palaemonetes vulgaris by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

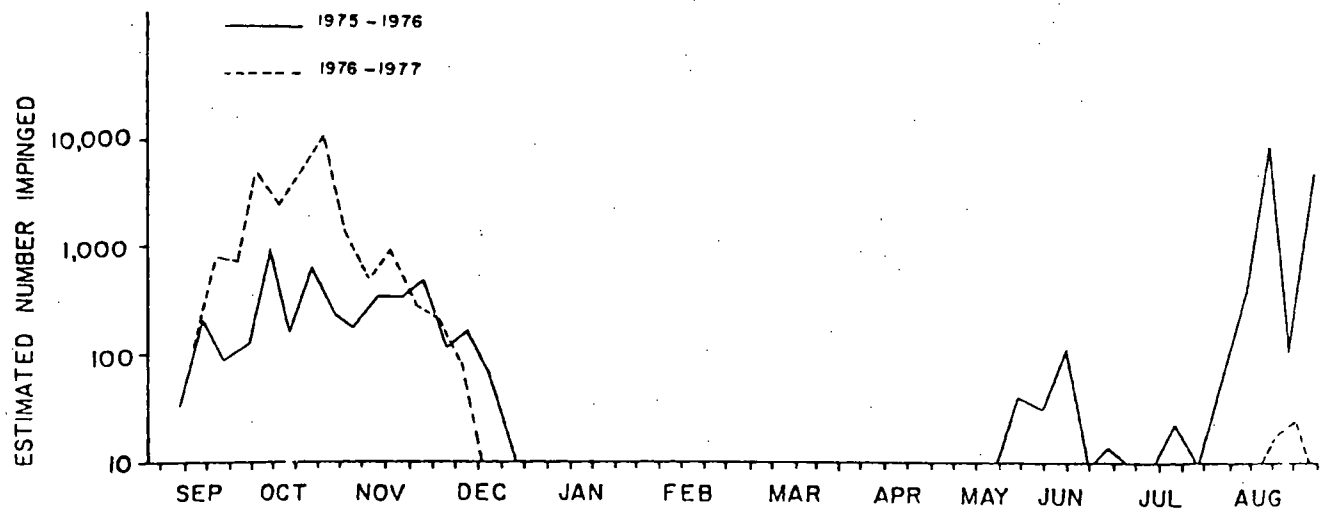

Fig. D1-23. Total estimated number impinged of Prionotus evolans by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

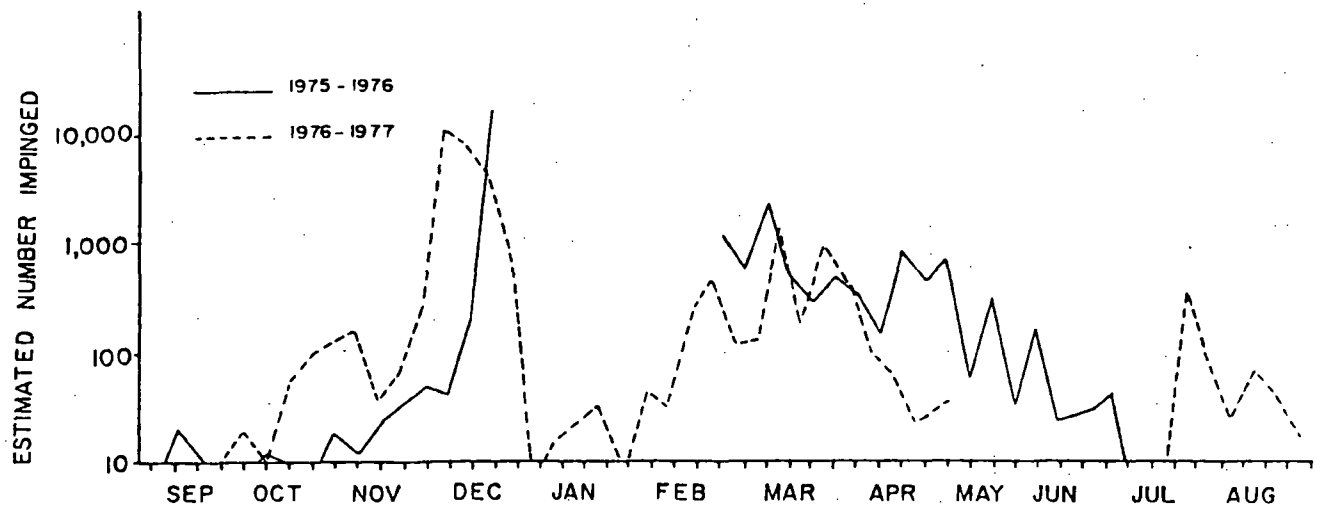

Fig. D1-24. Total estimated number impinged of Alosa aestivalis by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

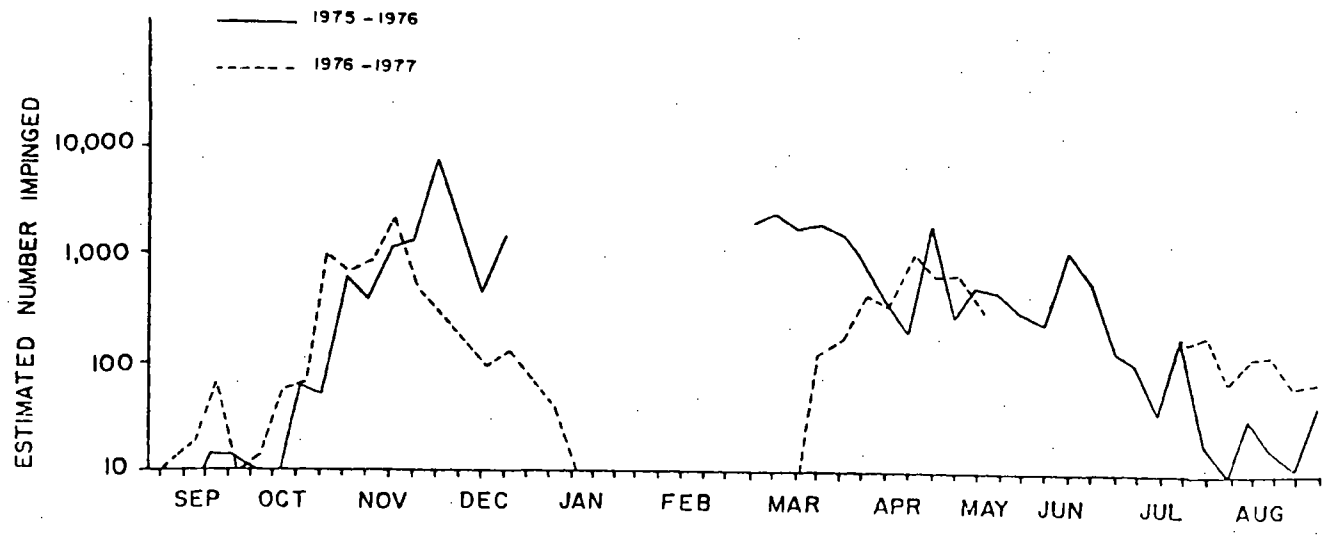

Fig. D1-25. Total estimated number impinged of Syngnathus fuscus by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

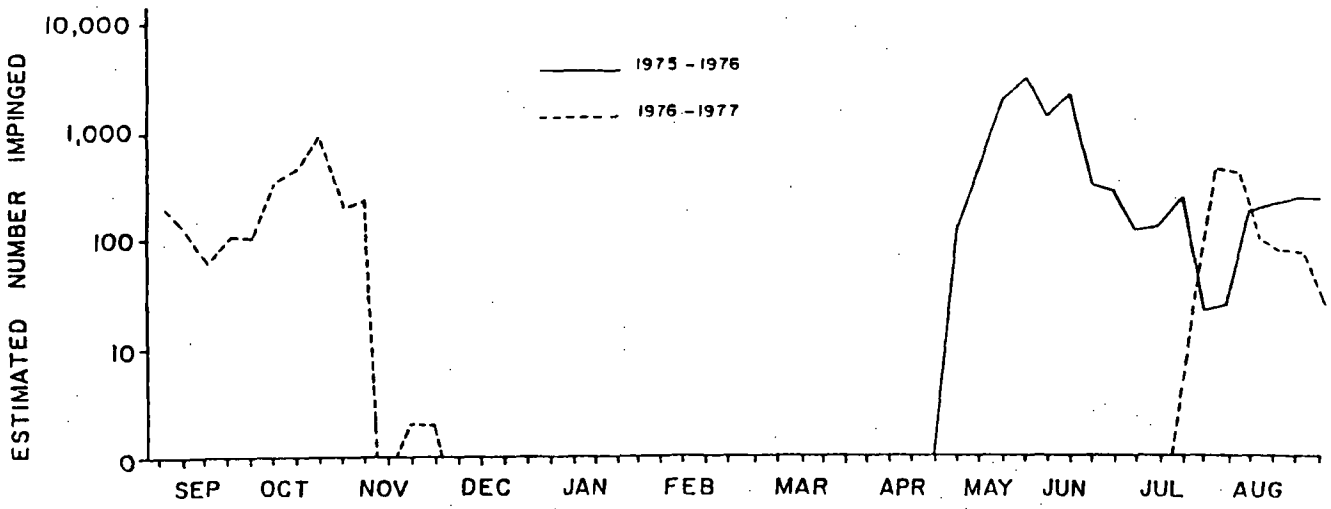

Fig. D1-26. Total estimated number impinged of Pomatomus saltatrix by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

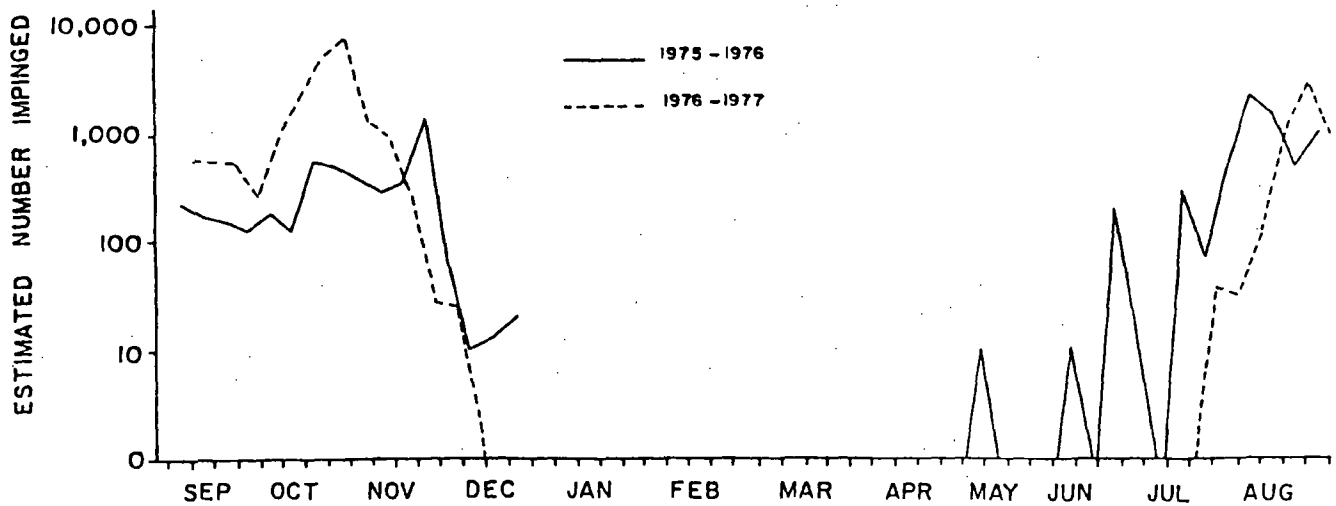

Fig. D1-27. Total estimated number impinged of Cynoscion regalis by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

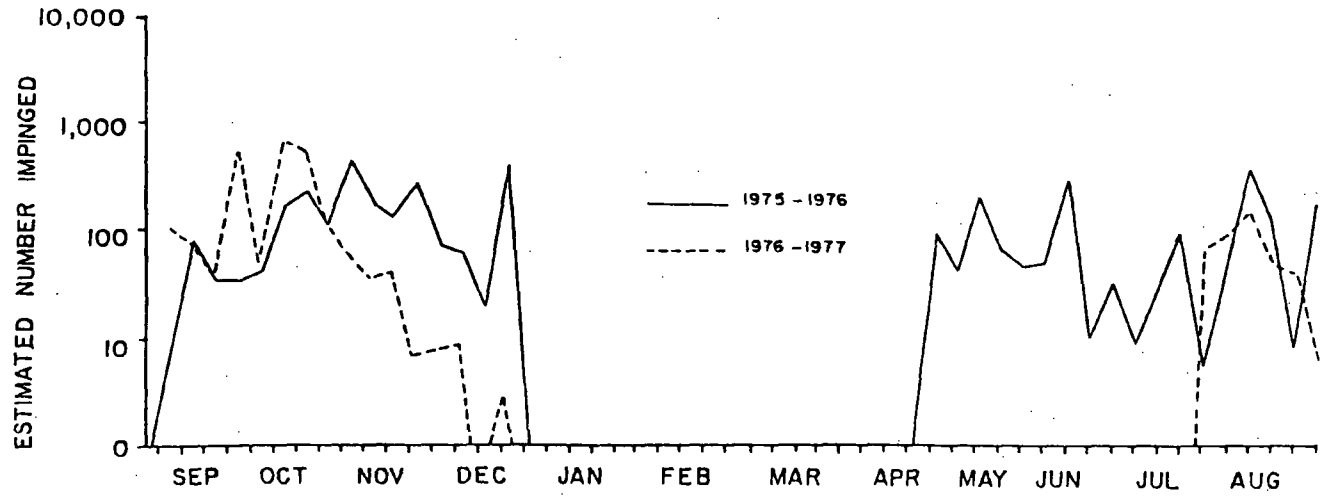

Fig. D1-28. Total estimated number impinged of Paralichthys dentatus by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

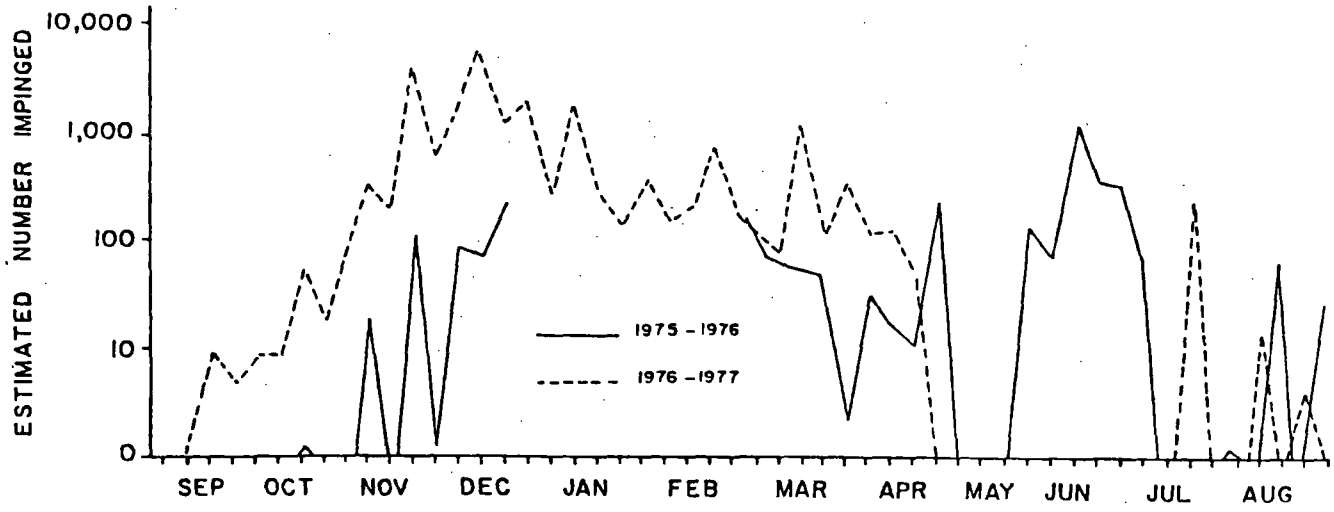

Fig. D1-29. Total estimated number impinged of Pseudopleuronectes americanus by week on the traveling screens at the Oyster Creek Generating Station, Forked River, New Jersey from September 1975 through August 1977. No samples were taken 24 December 1975 through 7 March 1976 and 14 May through 12 July 1977.

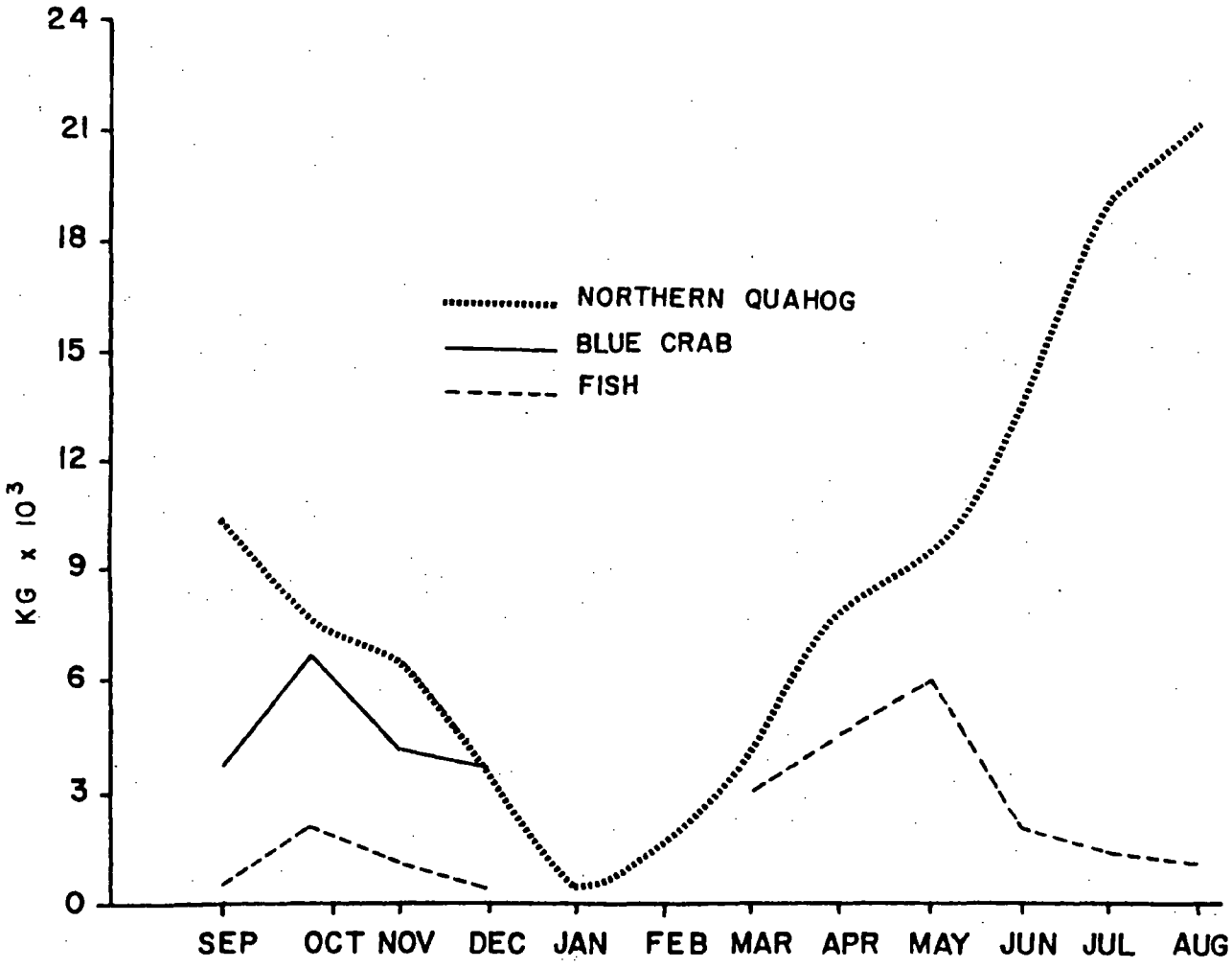

Fig. D1-30. Commercial landings of the northern quahog, blue crab, and fish reported from Barnegat Bay from September 1976 through August 1977.

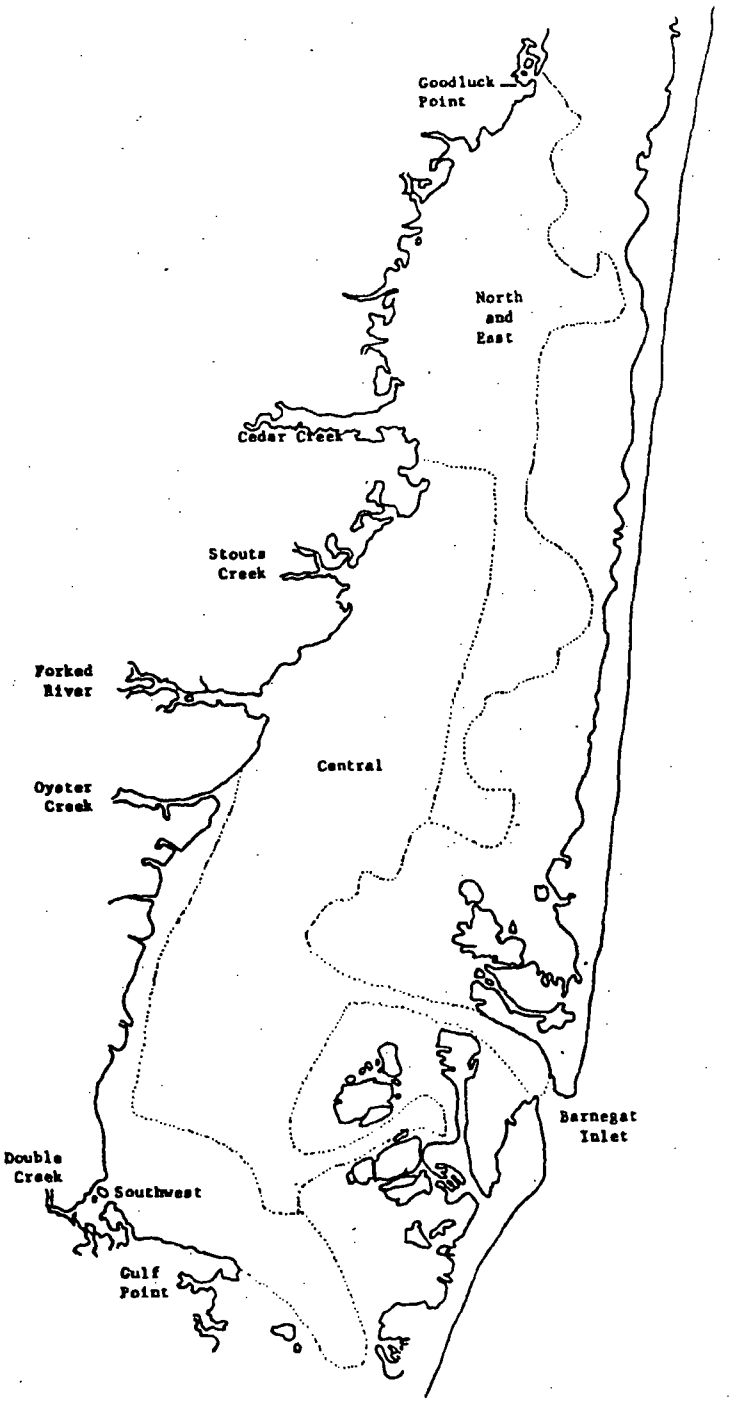

Fig. D1-31. Strata used to determine the population of bay anchovy in Barnegat Bay with a 4.9-m trawl in October 1976.

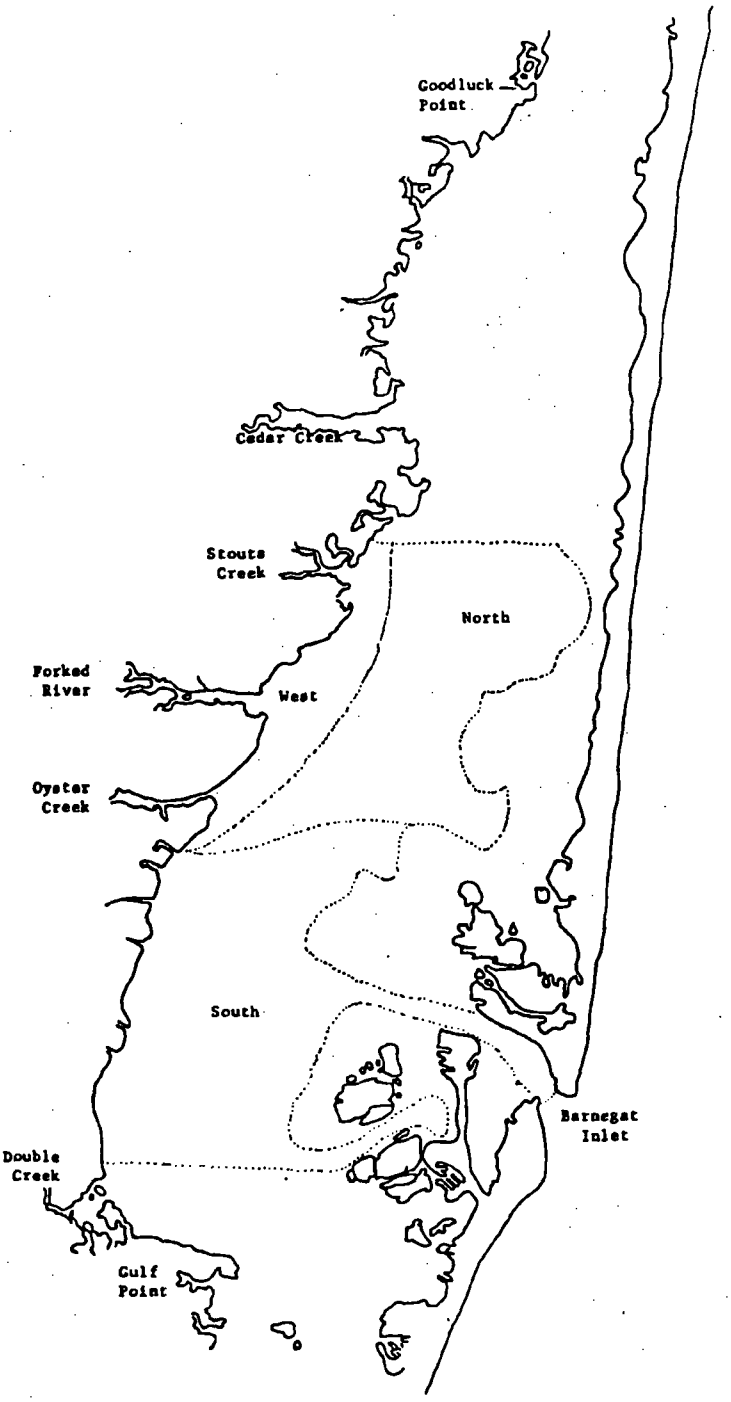

Fig. D1-32. Strata used to determine the population of the bay anchovy in Barnegat Bay with a 4.9-m trawl in May 1976.

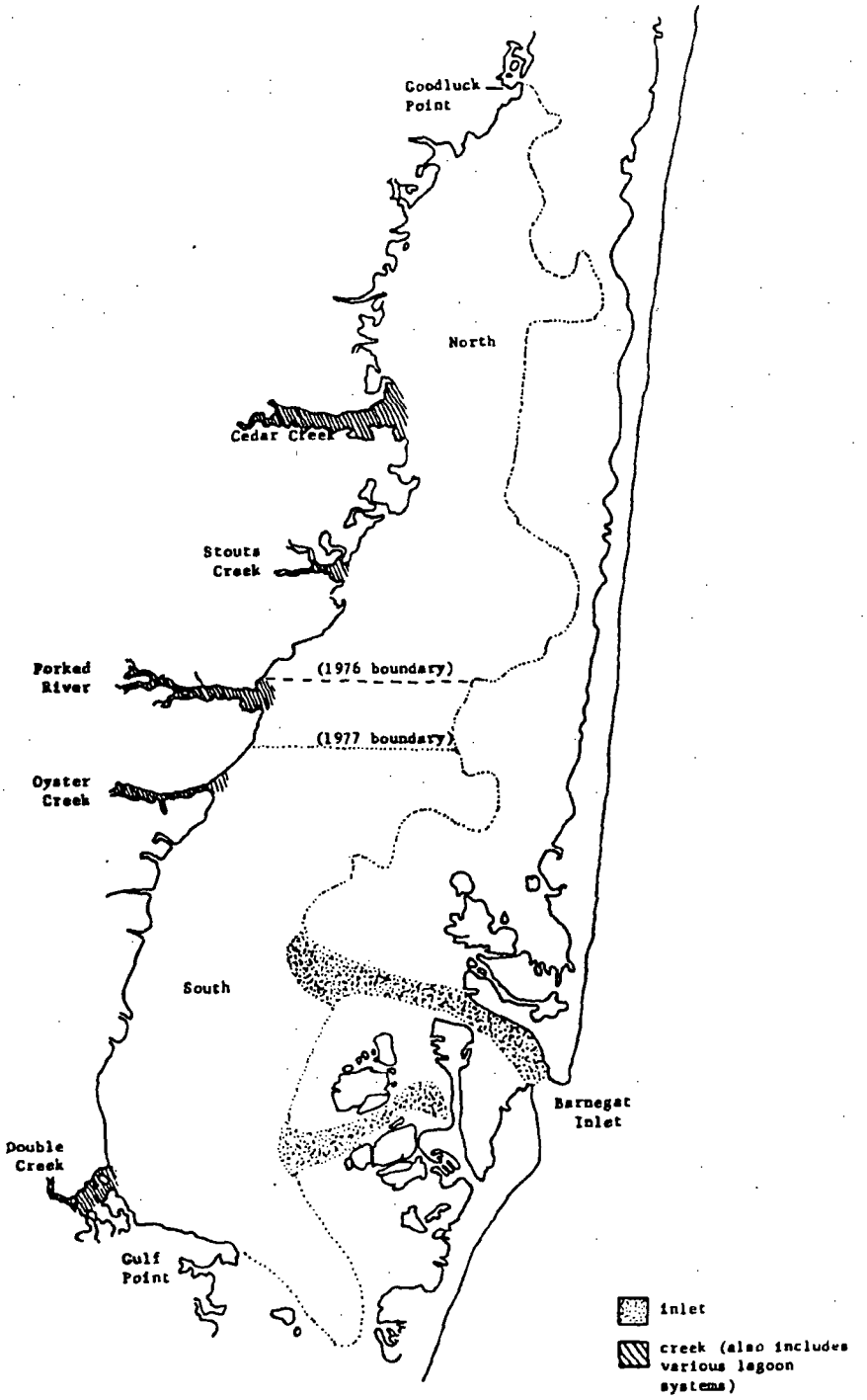

Fig. D1-33. Strata used to determine the population of the winter flounder in Barnegat Bay with a 4.9-m trawl in April 1976 and March 1977.

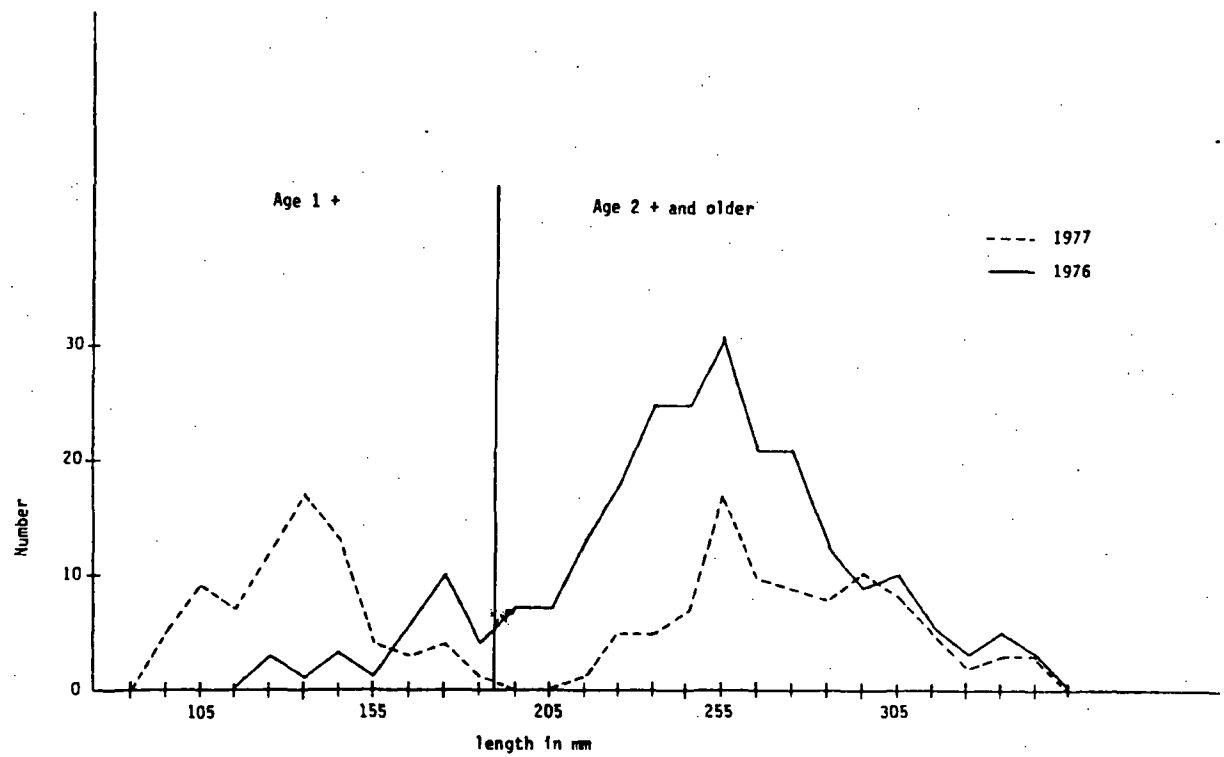

Fig. D1-34. Length-frequency distribution of winter flounder taken in population surveys in April 1976 and March 1977 in Barnegat Bay, N. J.

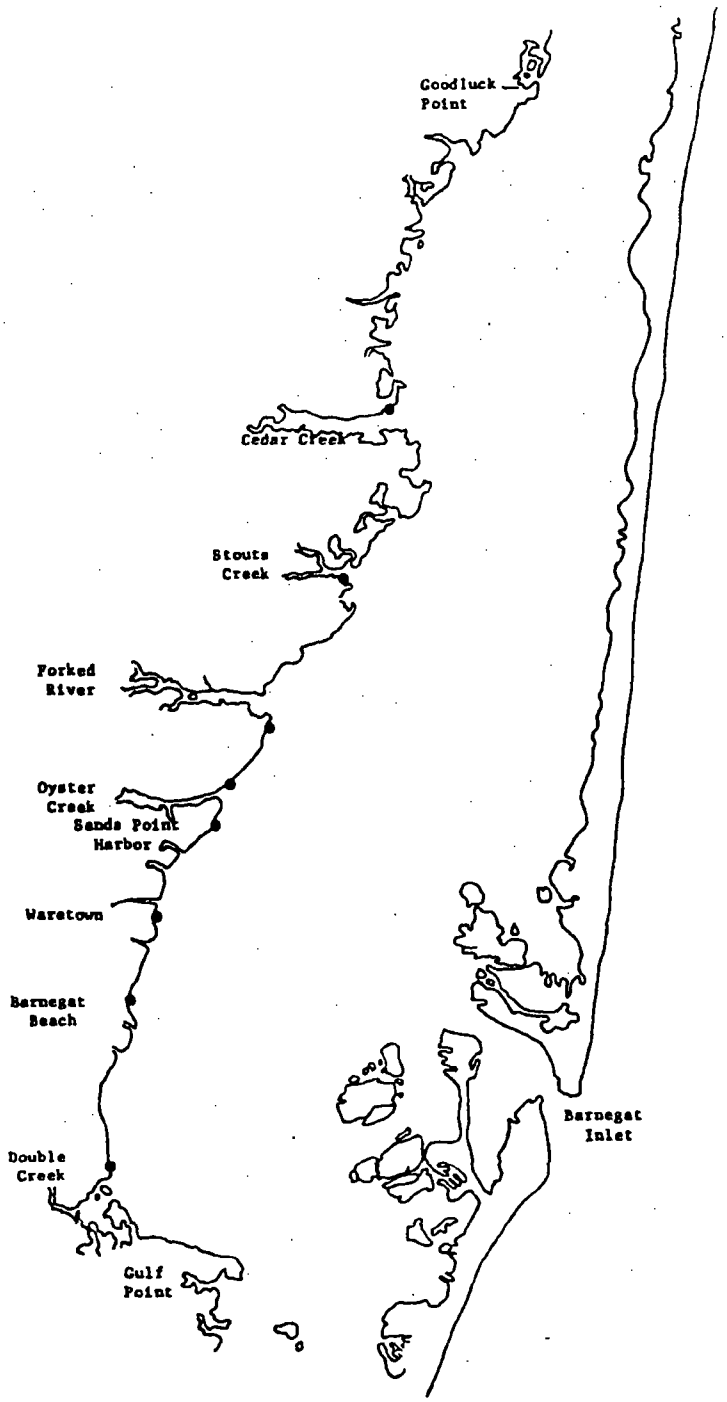

Fig. D1-35. Areas sampled by 4.6-m seine (●) in a survey of the population of the sand shrimp in Barnegat Bay in April 1977.

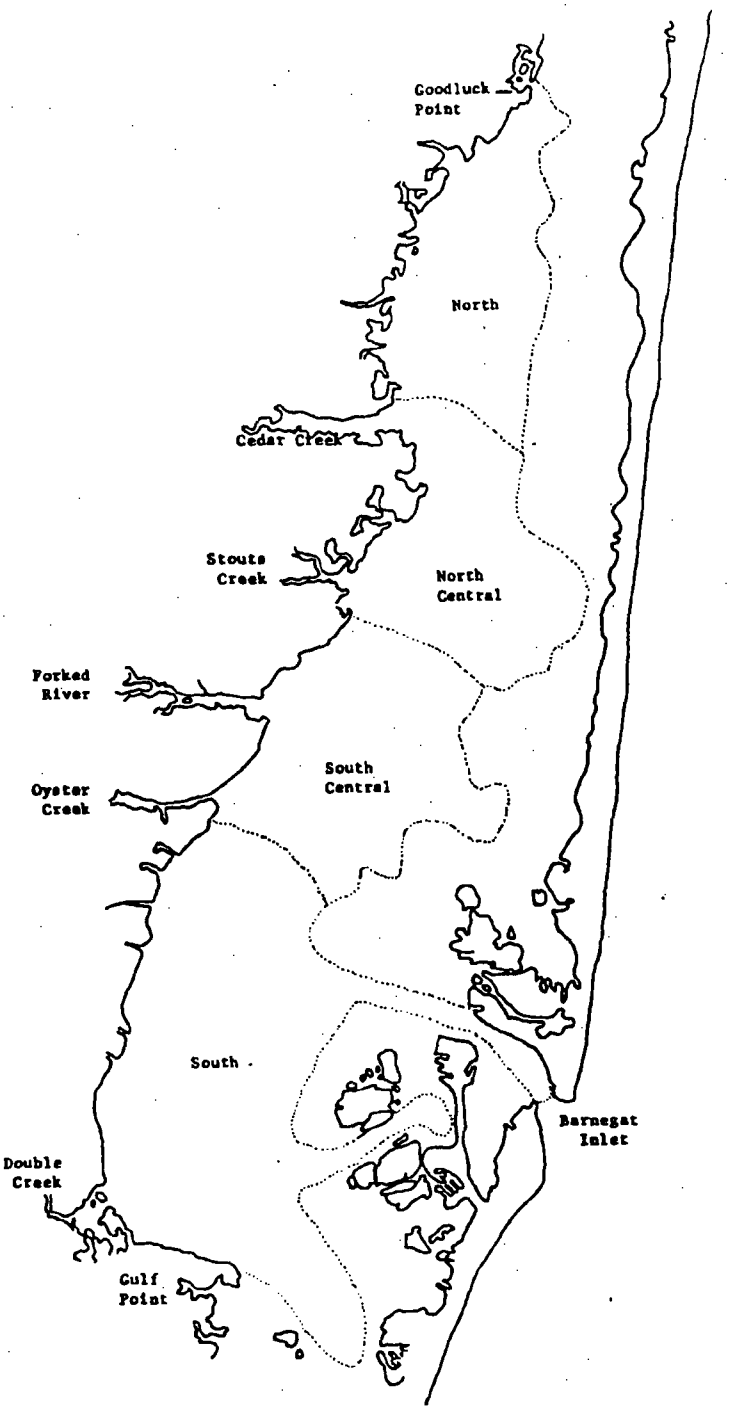

Fig. D1-36. Strata used to determine the populations of blue crab and northern pipefish in Barnegat Bay with a 4.9-m trawl in July 1976 and July-August 1977.

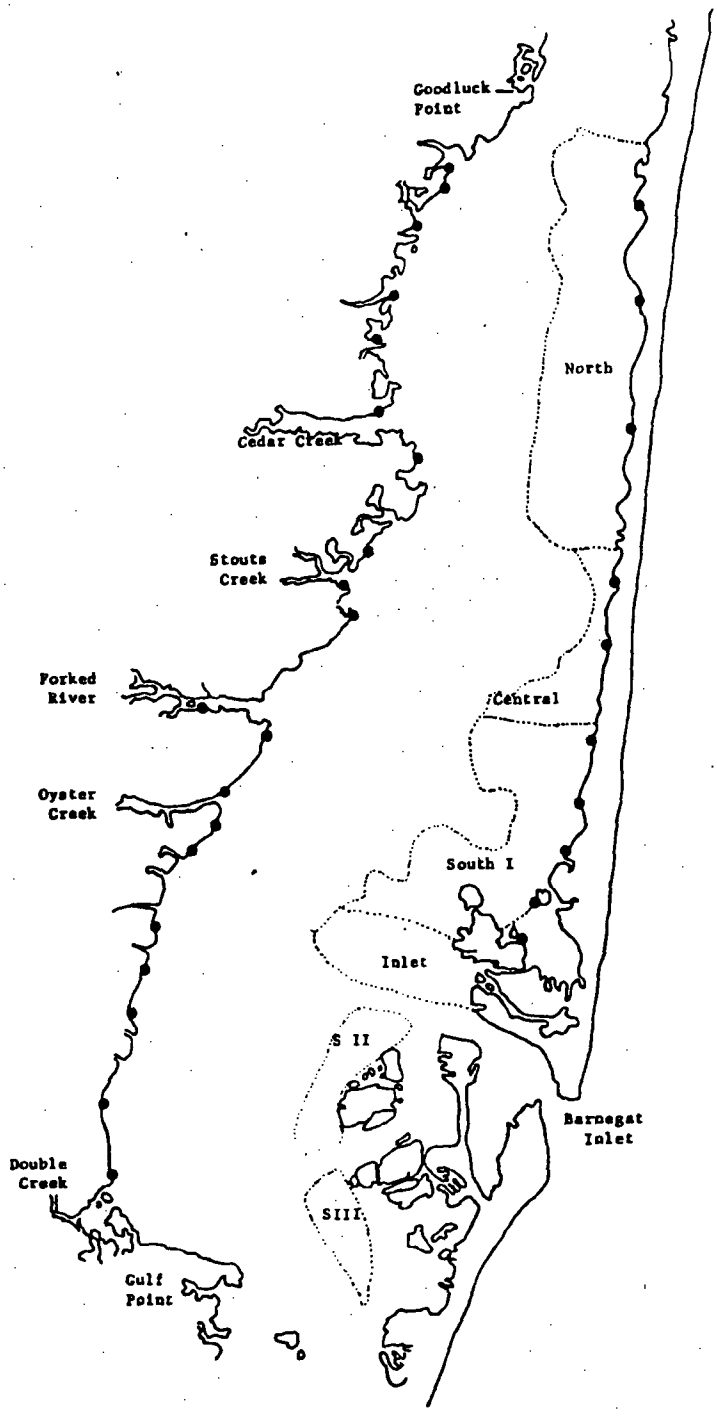

Fig. D1-37. Strata used to determine the populations of blue crab and northern pipefish in Barnegat Bay with a 2.7-m trawl and areas sampled by pushnet (●) in July-August 1977.

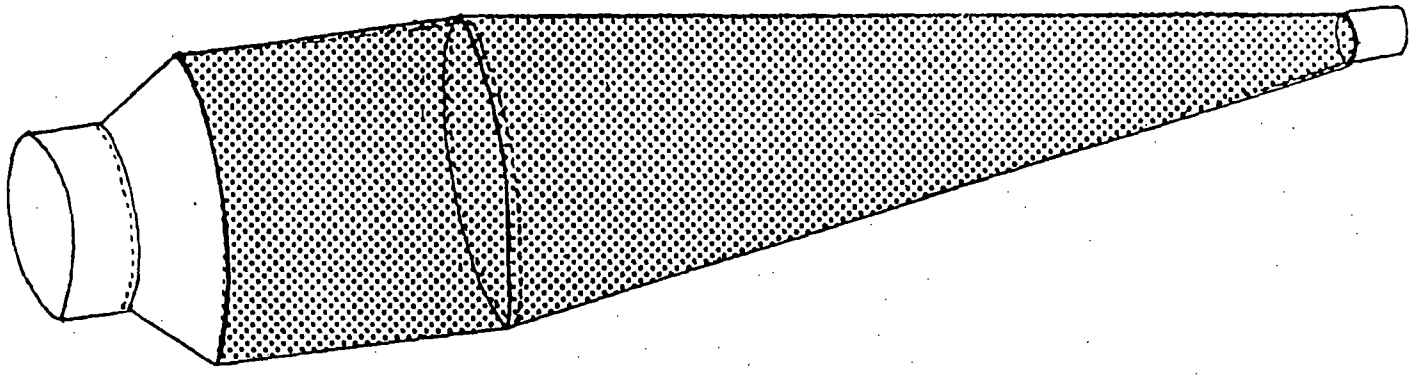

Fig. D1-38. The Clarke-Bumpus sampler with modified cylinder-cone net and velocity reduction cone used to collect ichthyoplankton for condition determinations.

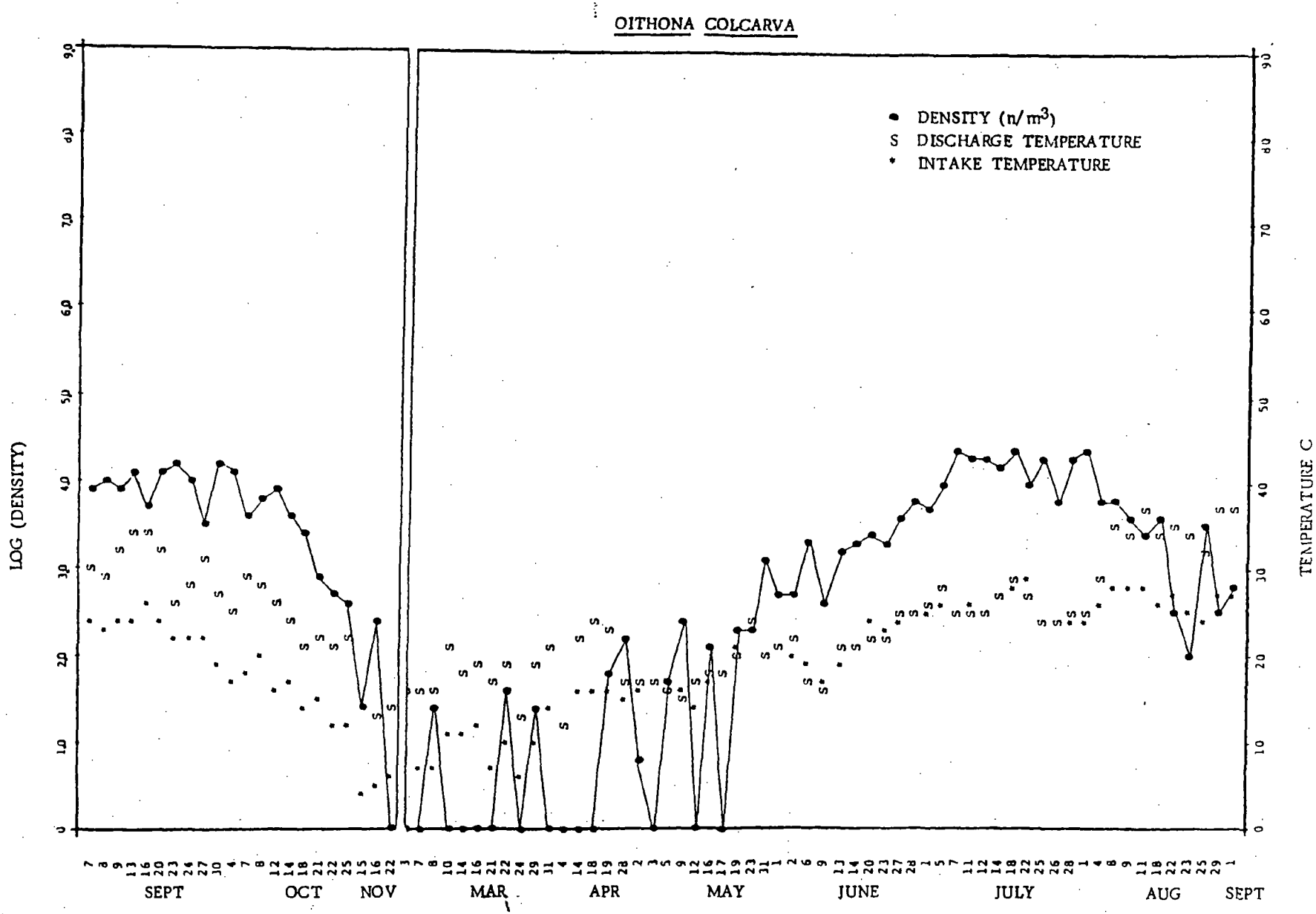

Fig. DI-39. Log density (n/m^3) of Oithona colcarva taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

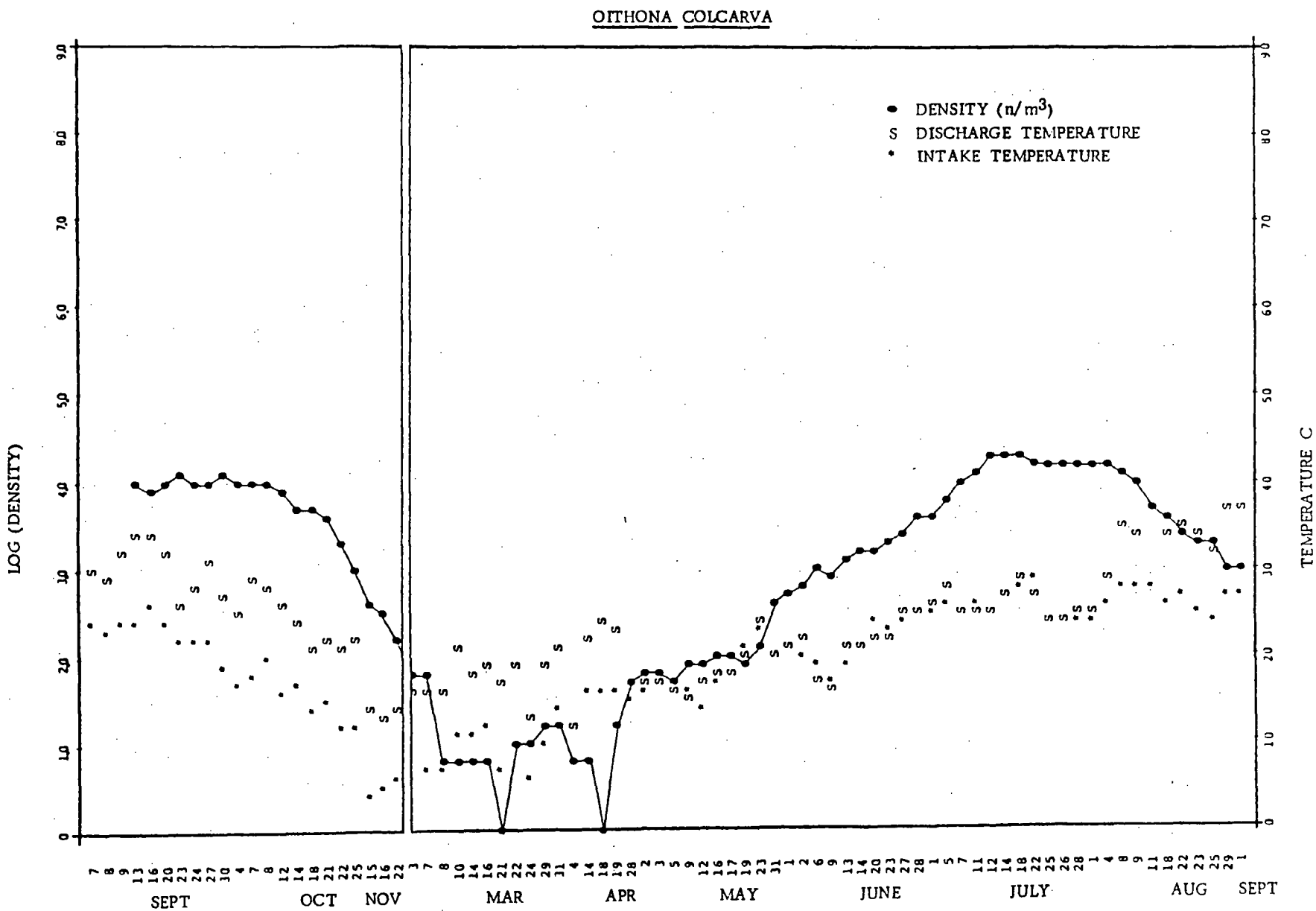

Fig. D1-40.. The moving average of the log density (n/m^3) of Oithona colcarva taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

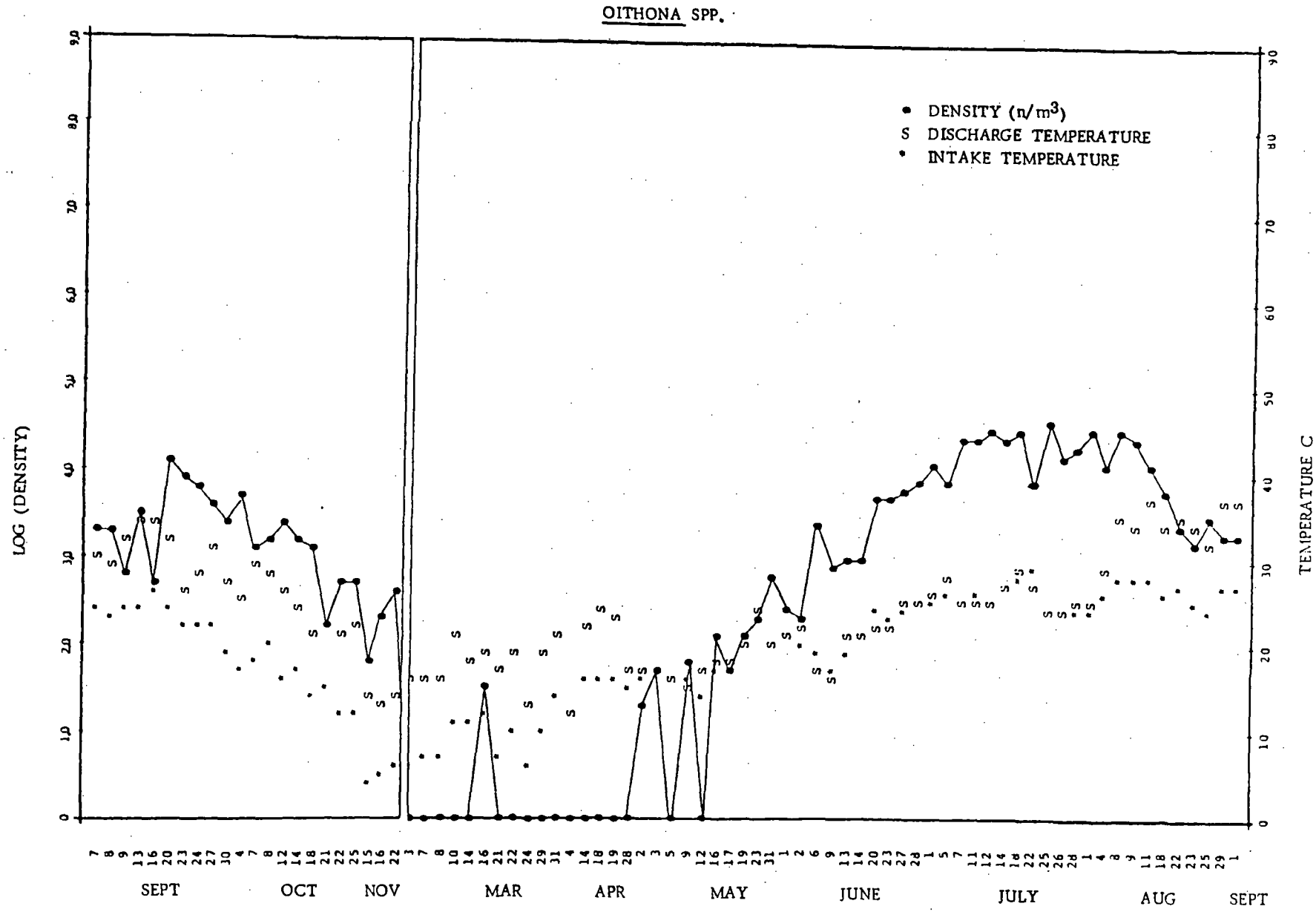

Fig. D1-41. Log density (n/m^3) of Oithona spp. taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

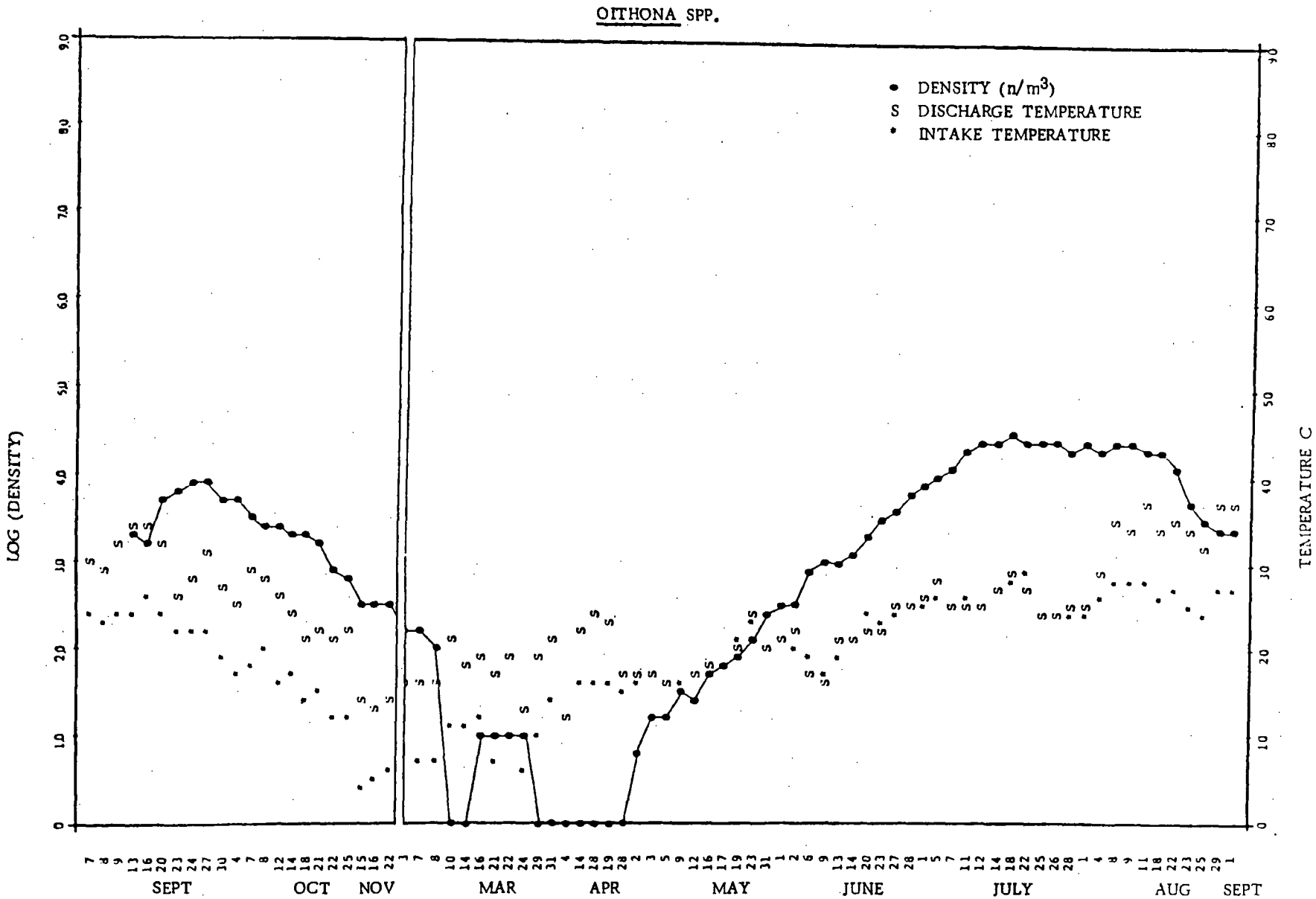

Fig. D1-42. The moving average of the log density (n/m^3) of Oithona spp. taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

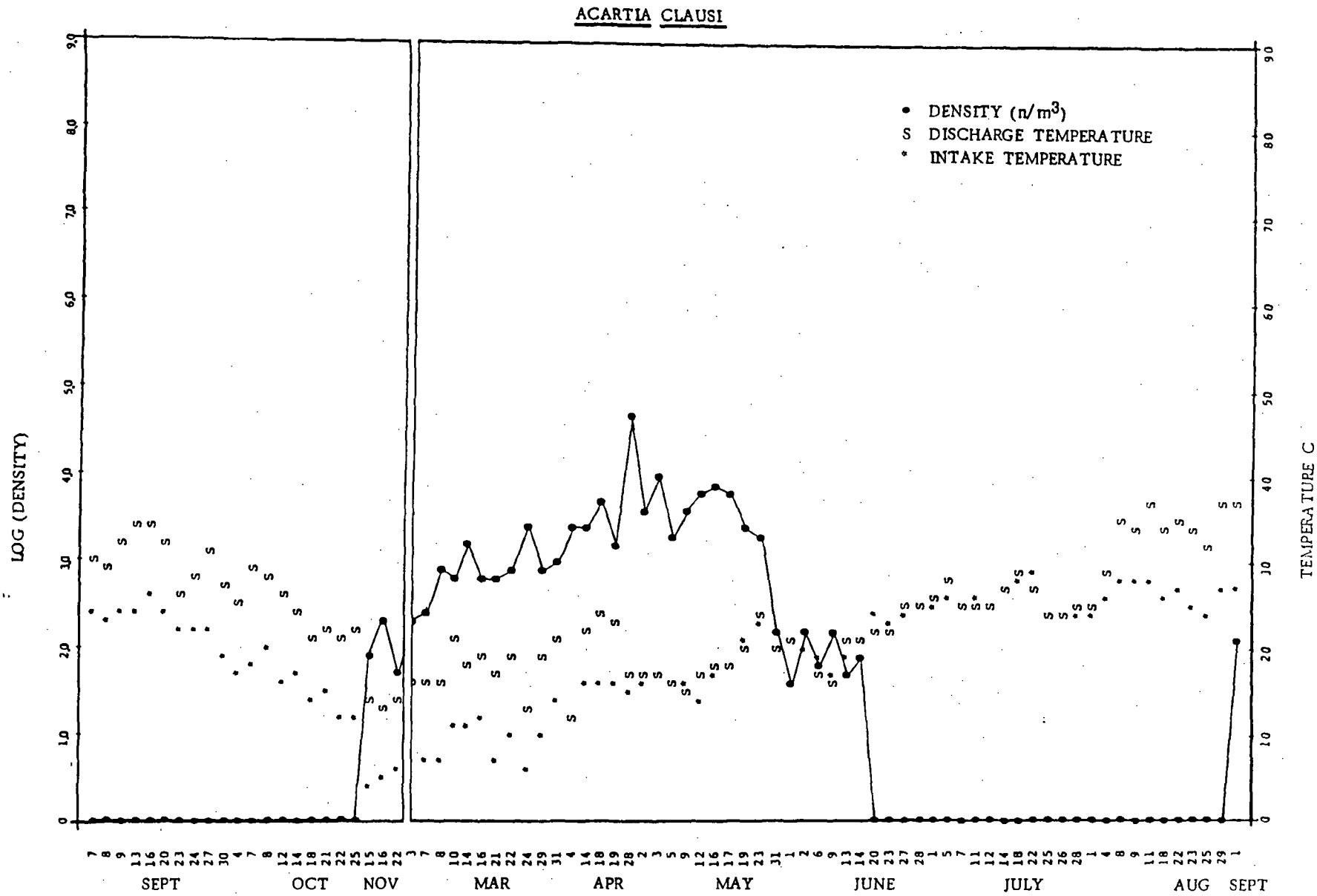

Fig. D1-43. Log density (n/m^3) of total Acartia clausi taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

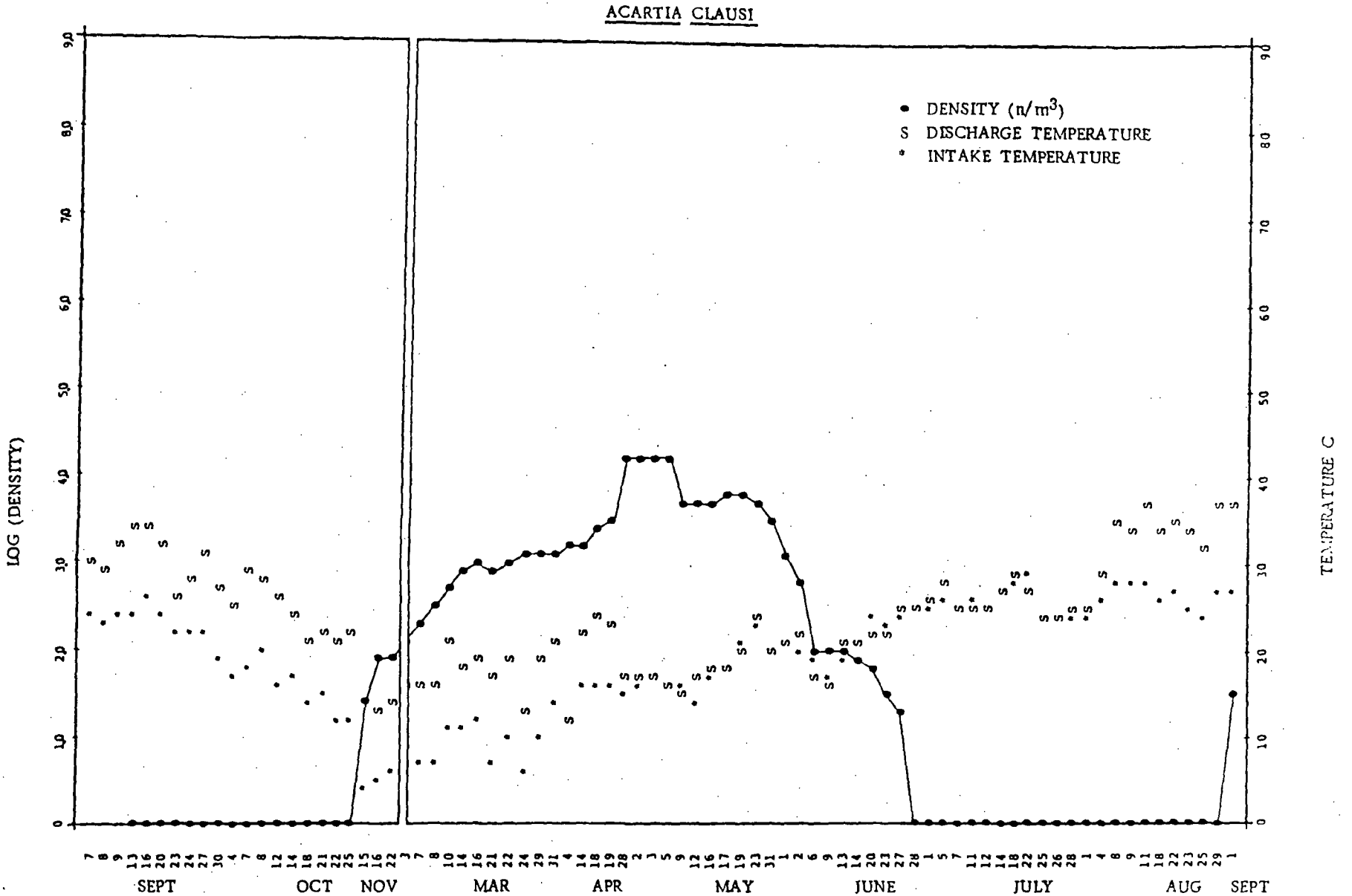

Fig. D1-44. The moving average of the log density (n/m^3) of Acartia clausi taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

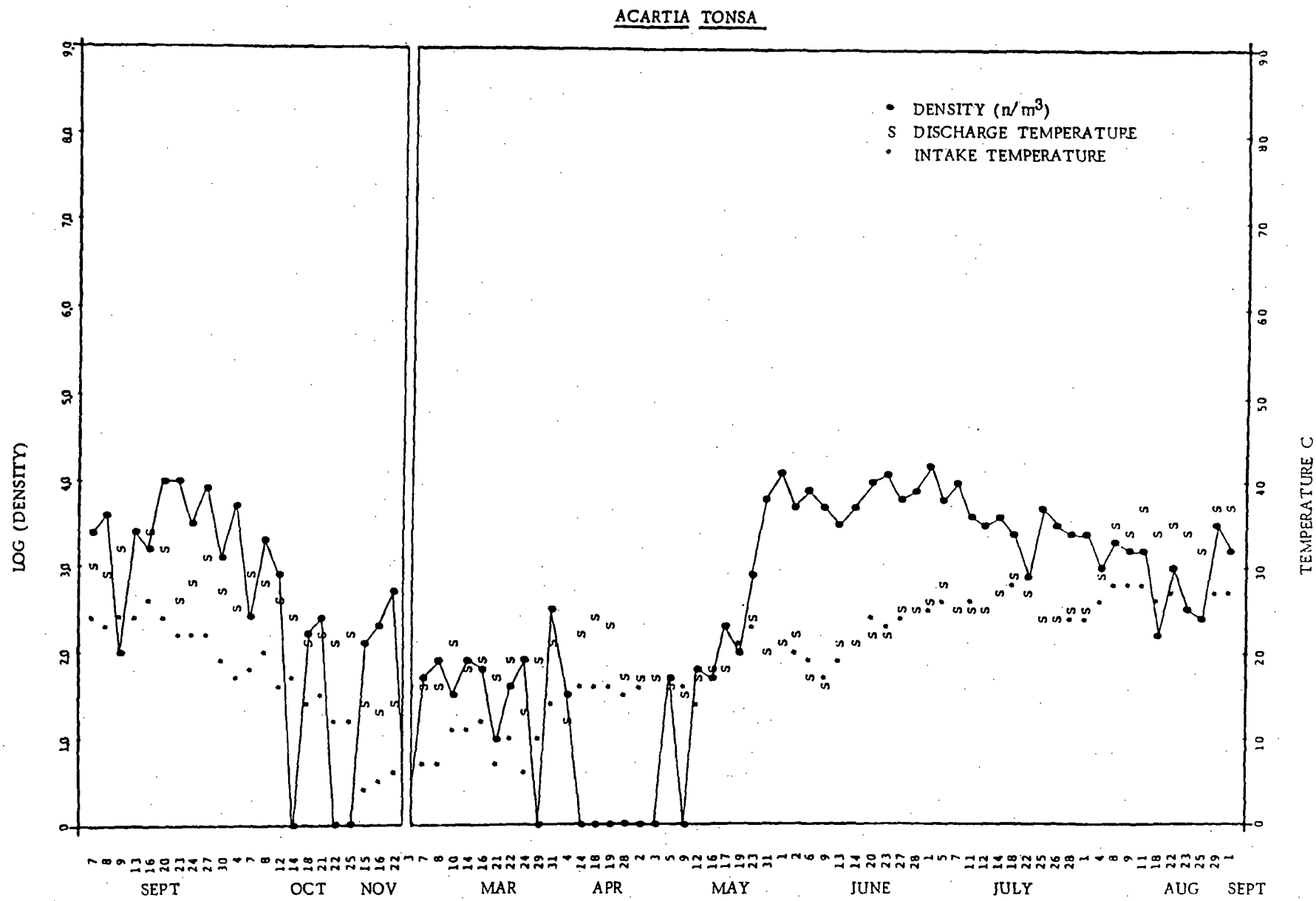

Fig. D1-45. Log density (n/m^3) of Acartia tonsa taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

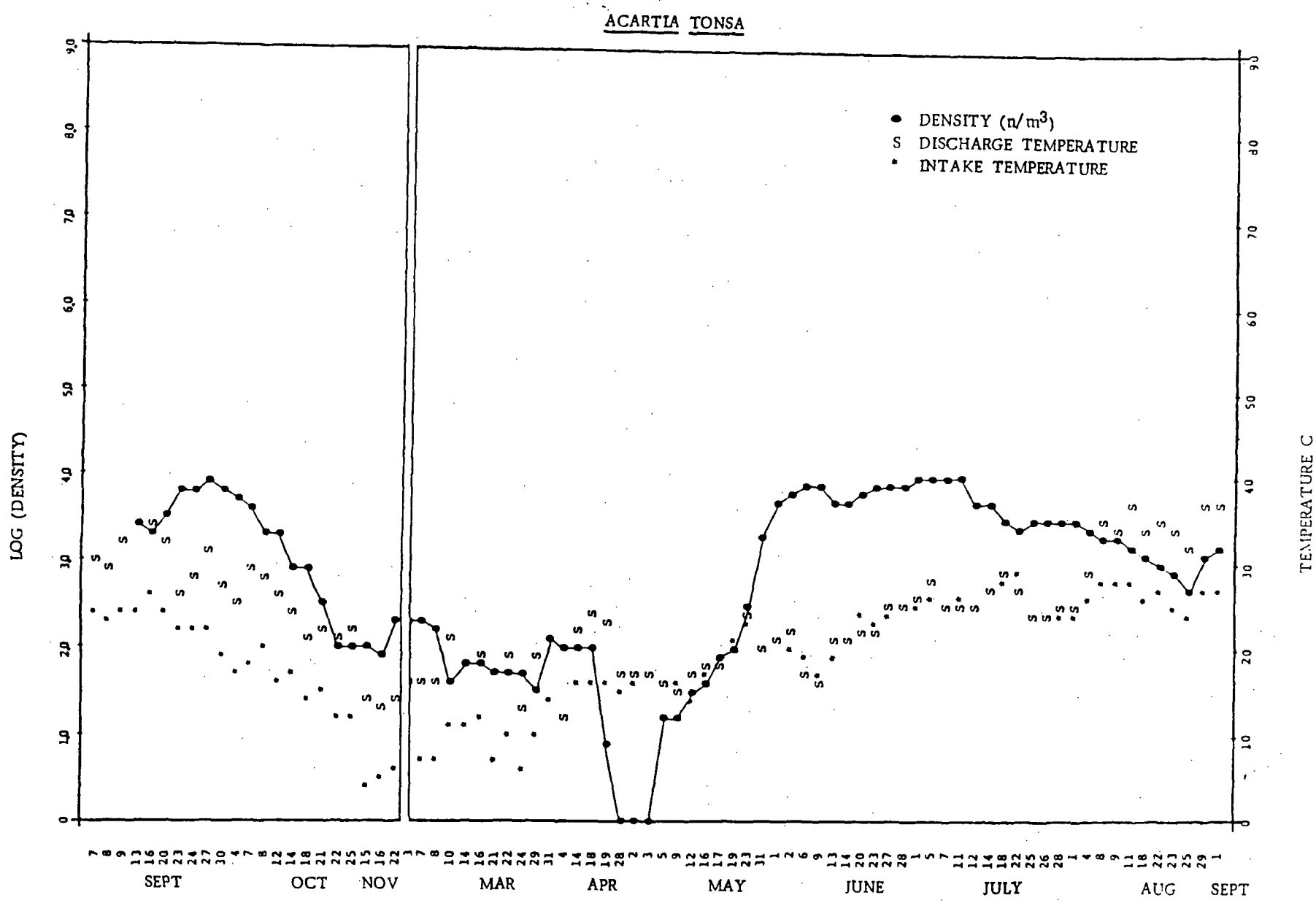

Fig. D1-46. The moving average of the log density (n/m^3) of Acartia tonsa taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

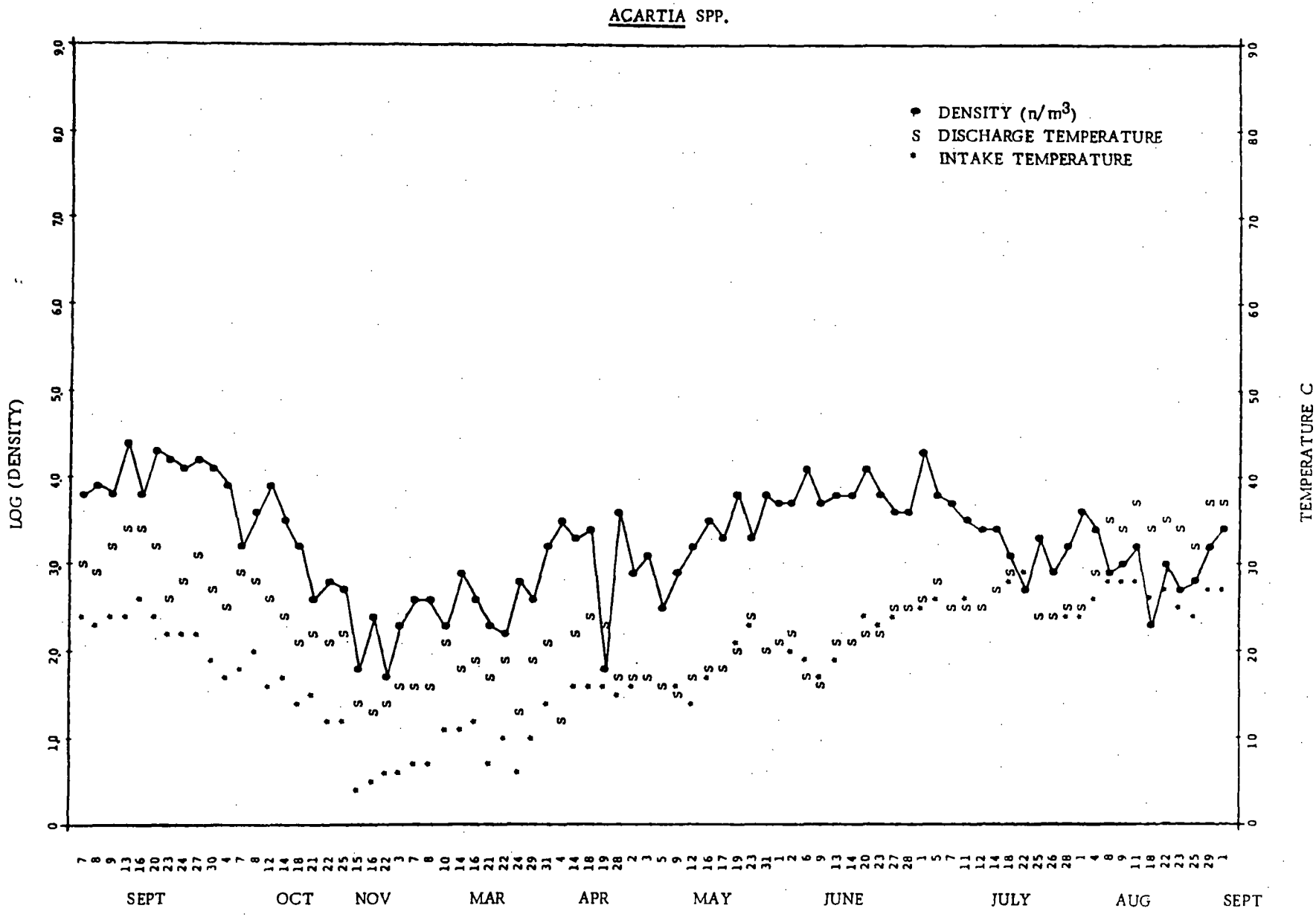

Fig. DI-47. Log density (n/m^3) of Acartia spp. taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

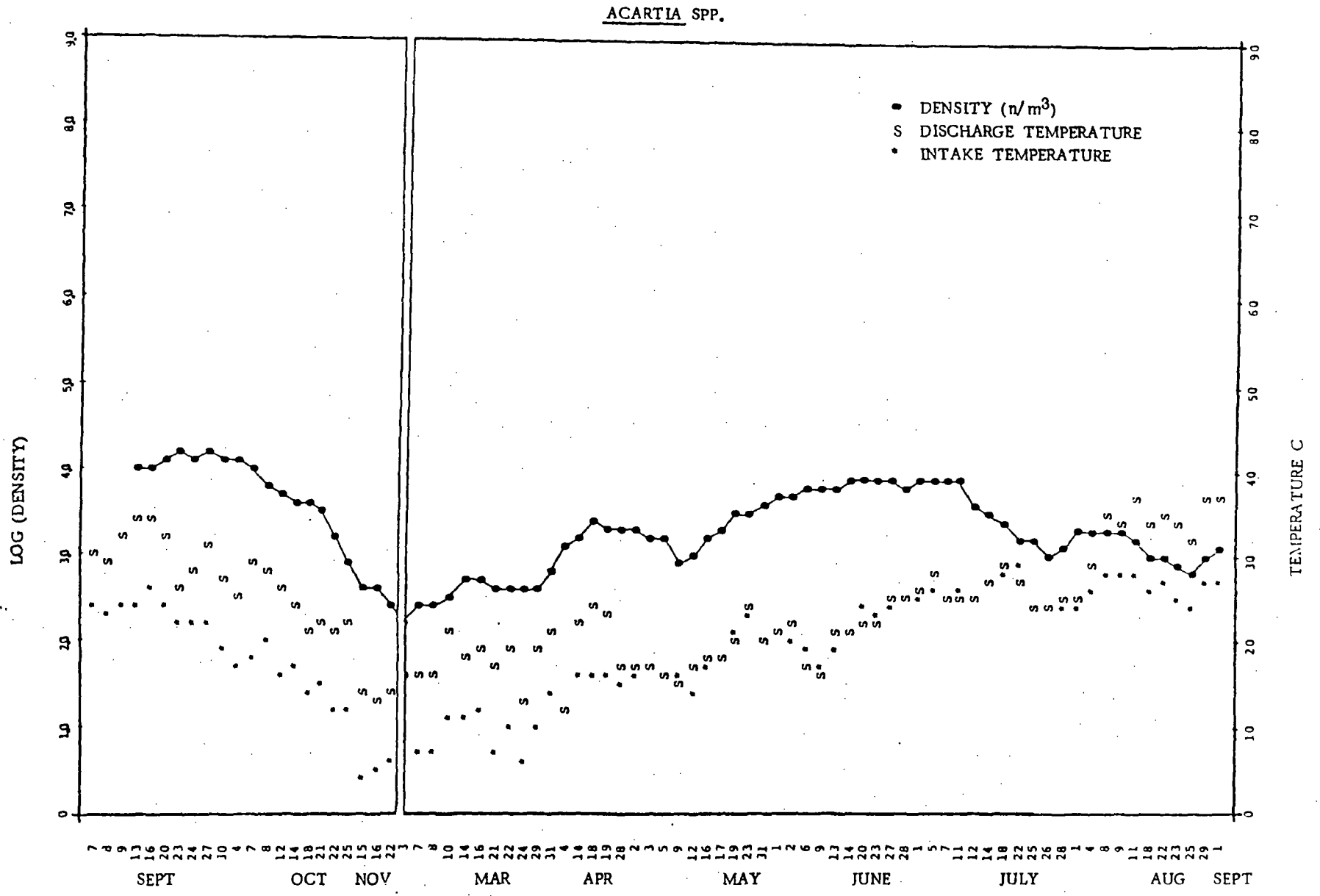

Fig. D1-48. The moving average of the log density (n/m^3) of Acartia spp. taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

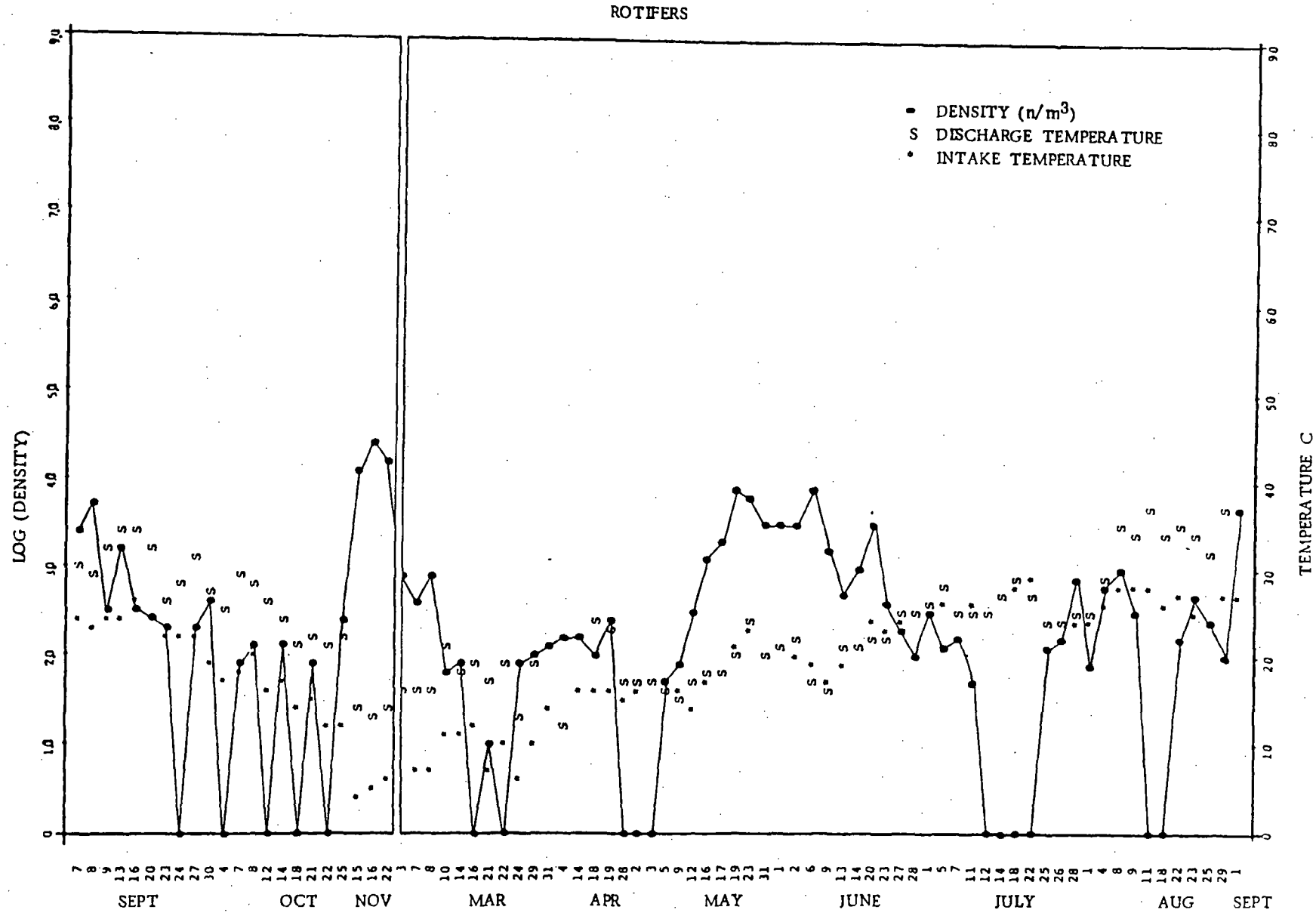

Fig. D1-49. Log density (n/m^3) of rotifers taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

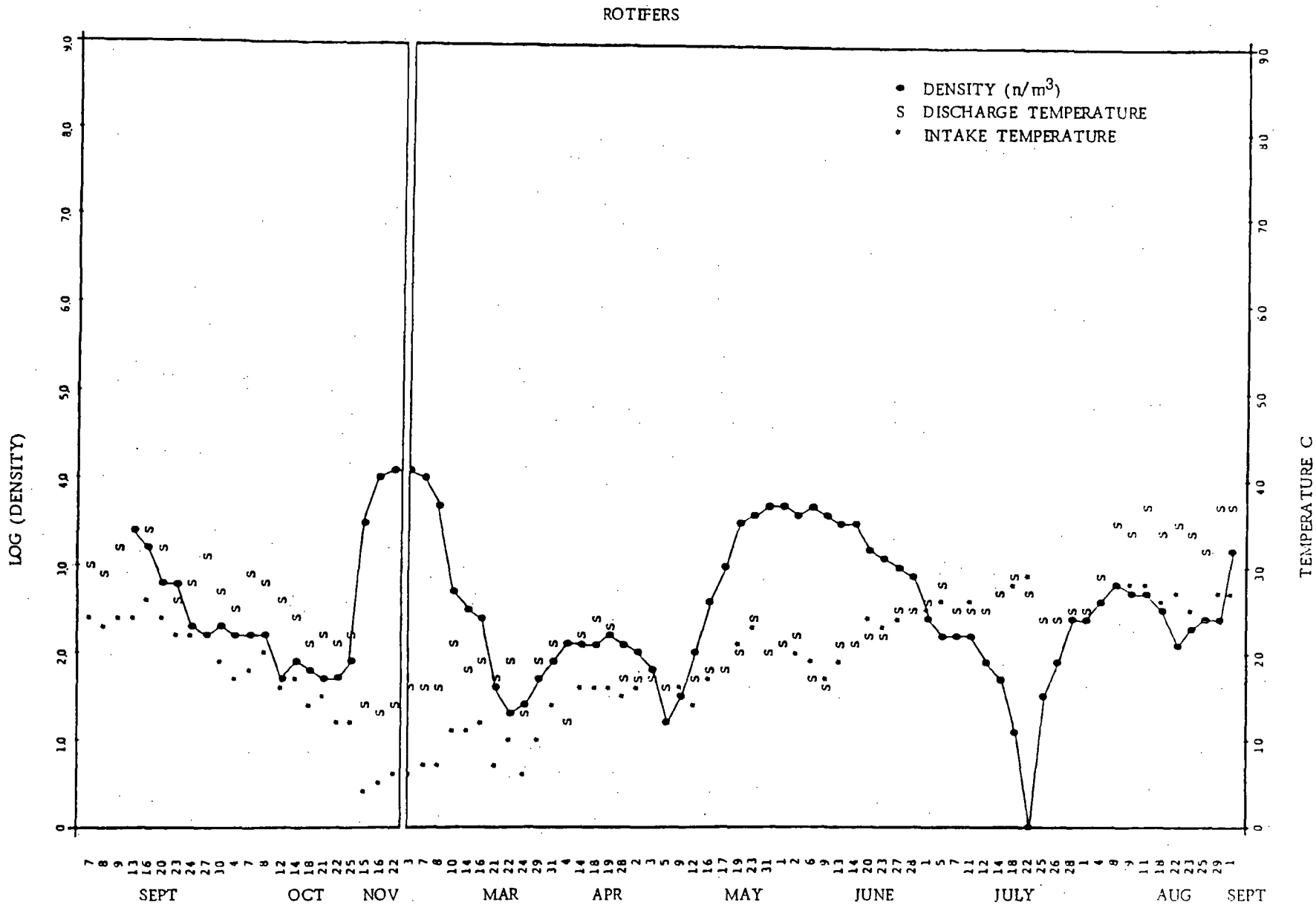

Fig. D1-50. The moving average of the log density (n/m^3) of rotifers taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

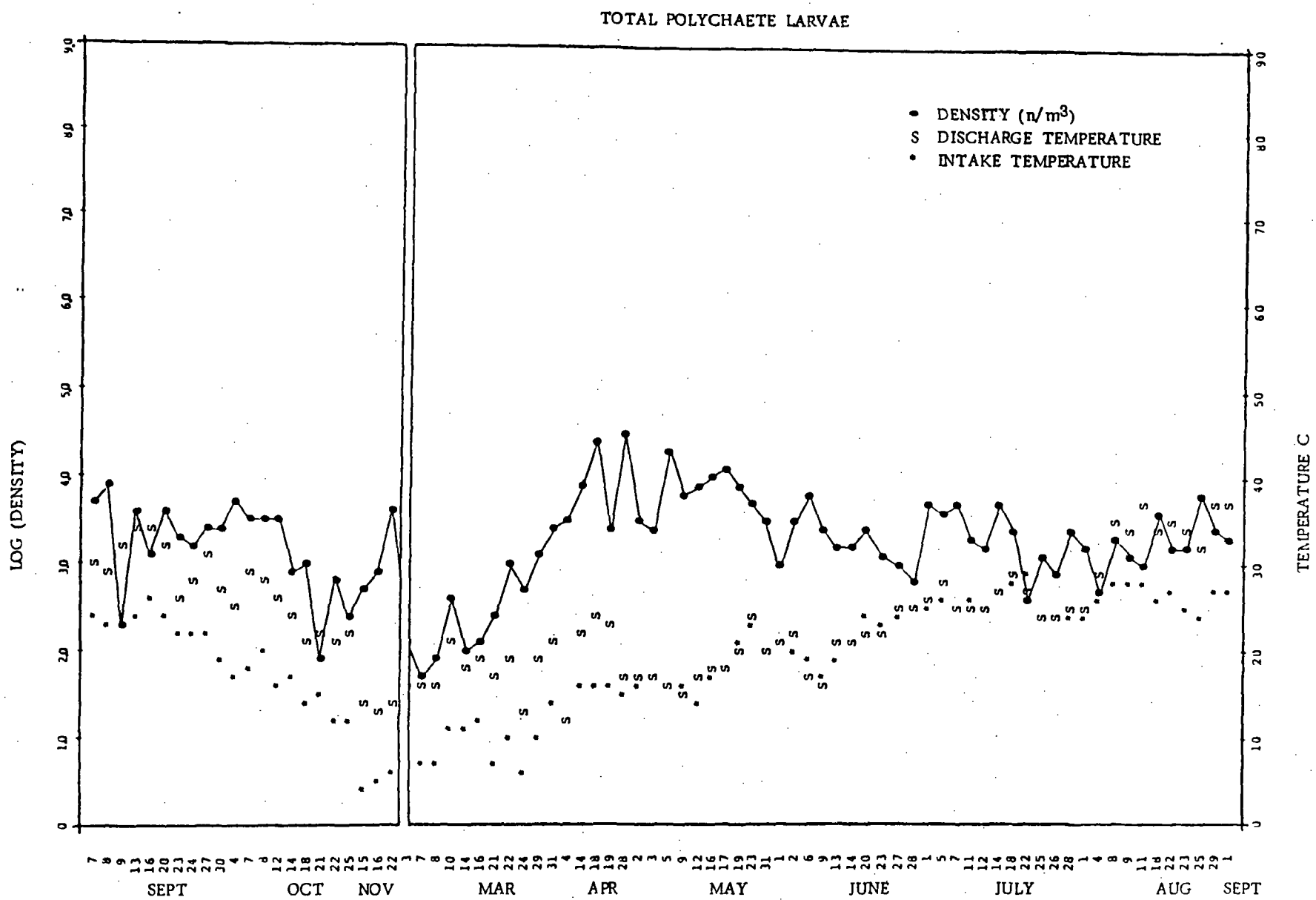

Fig. D1-51. Log density (n/m^3) of total polychaete larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

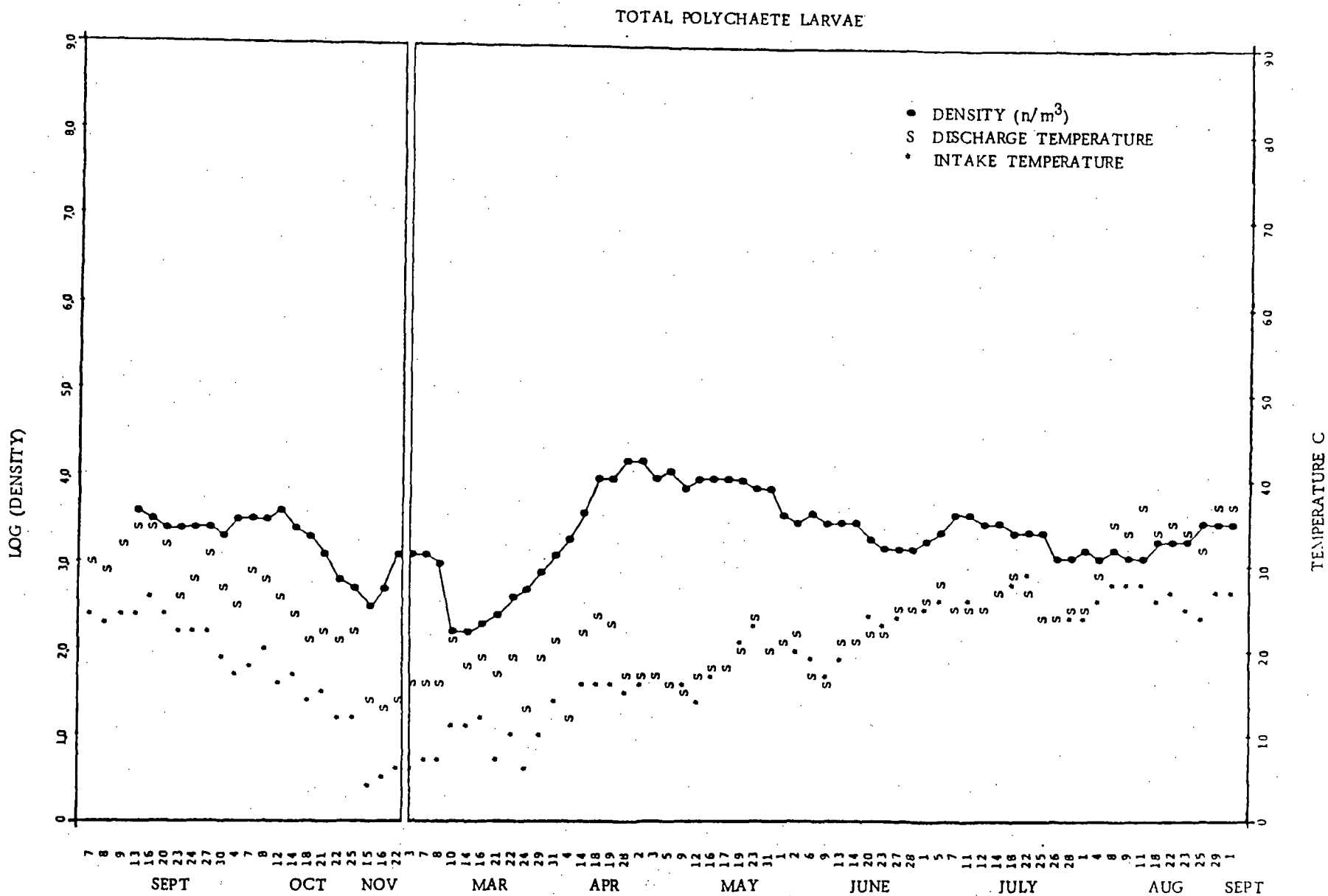

Fig. D1-52. The moving average of the log density (n/m^3) of total polychaete larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

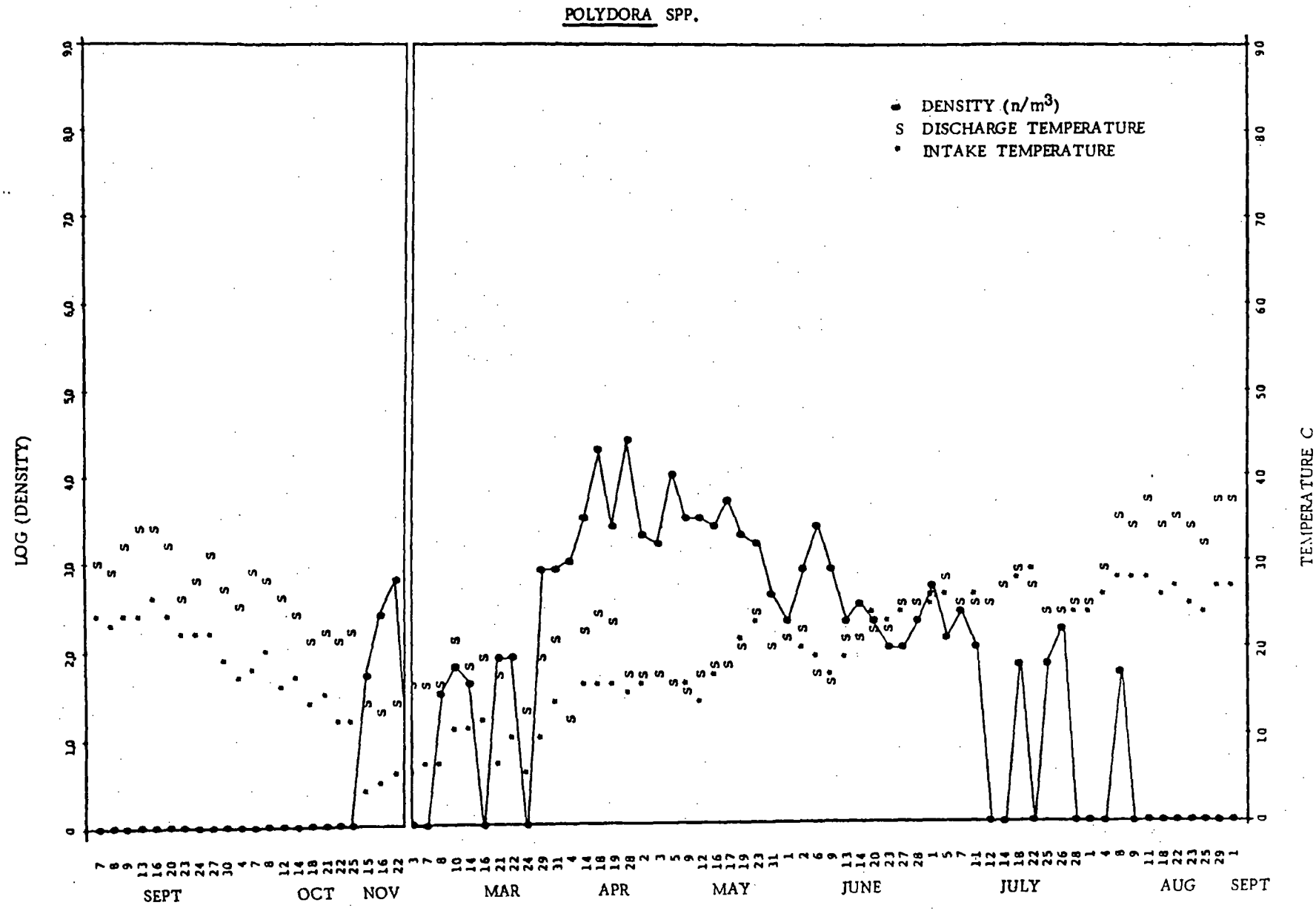

Fig. D1-53. Log density (n/m^3) of total Polydora spp. taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

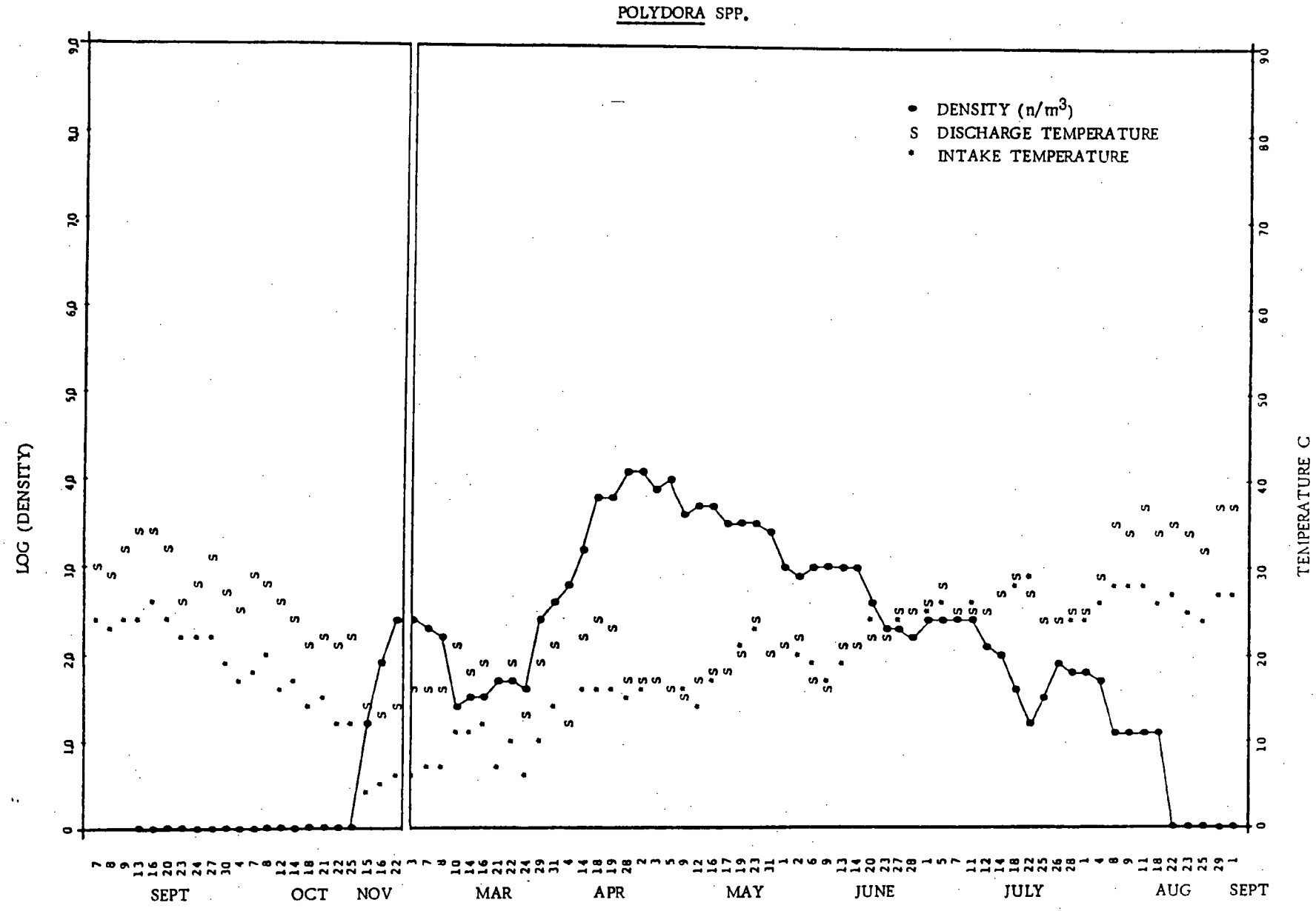

Fig. D1-54. The moving average of the log density (n/m^3) of Polydora spp. taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

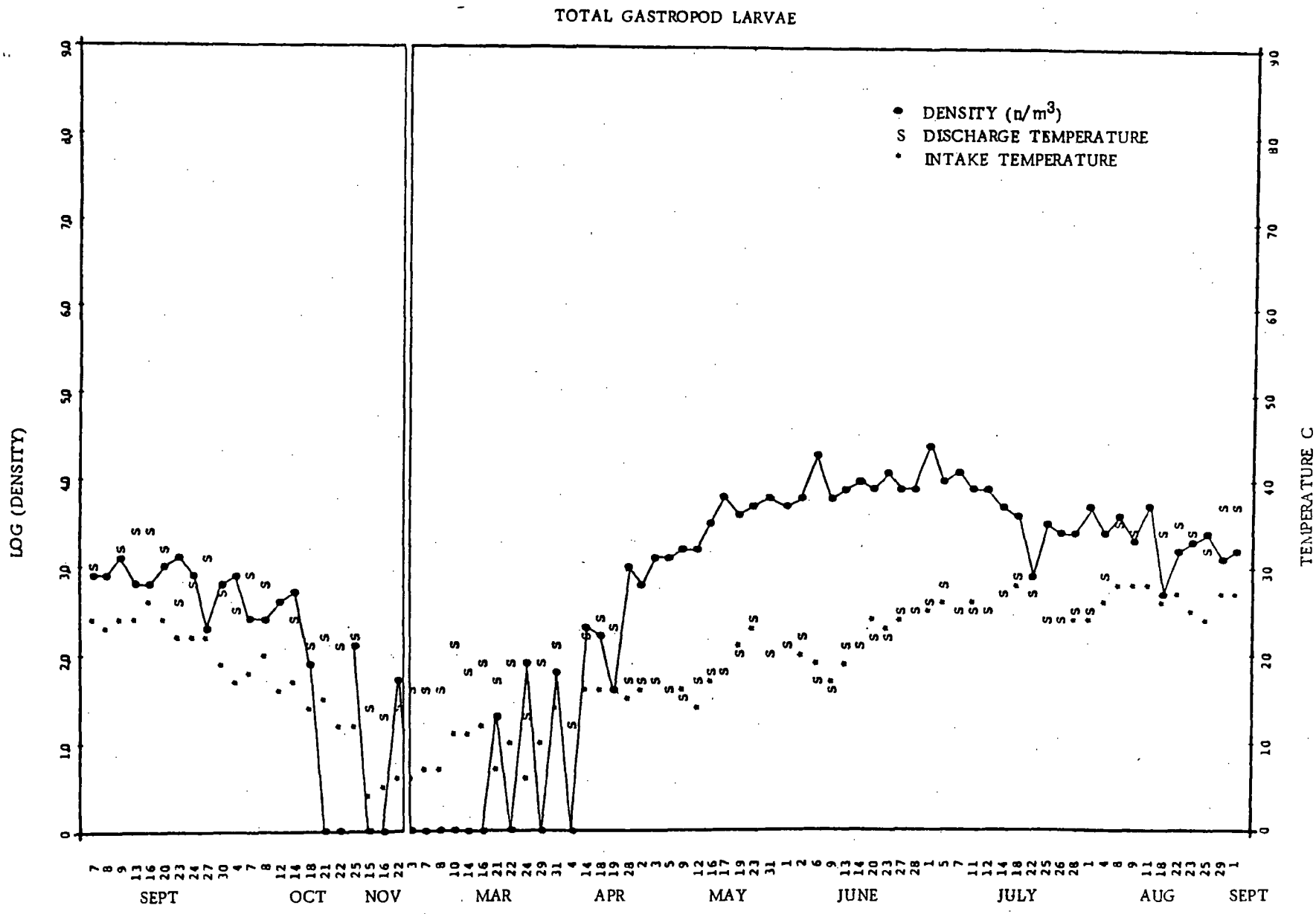

Fig. DI-55. Log density (n/m^3) of total gastropod larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

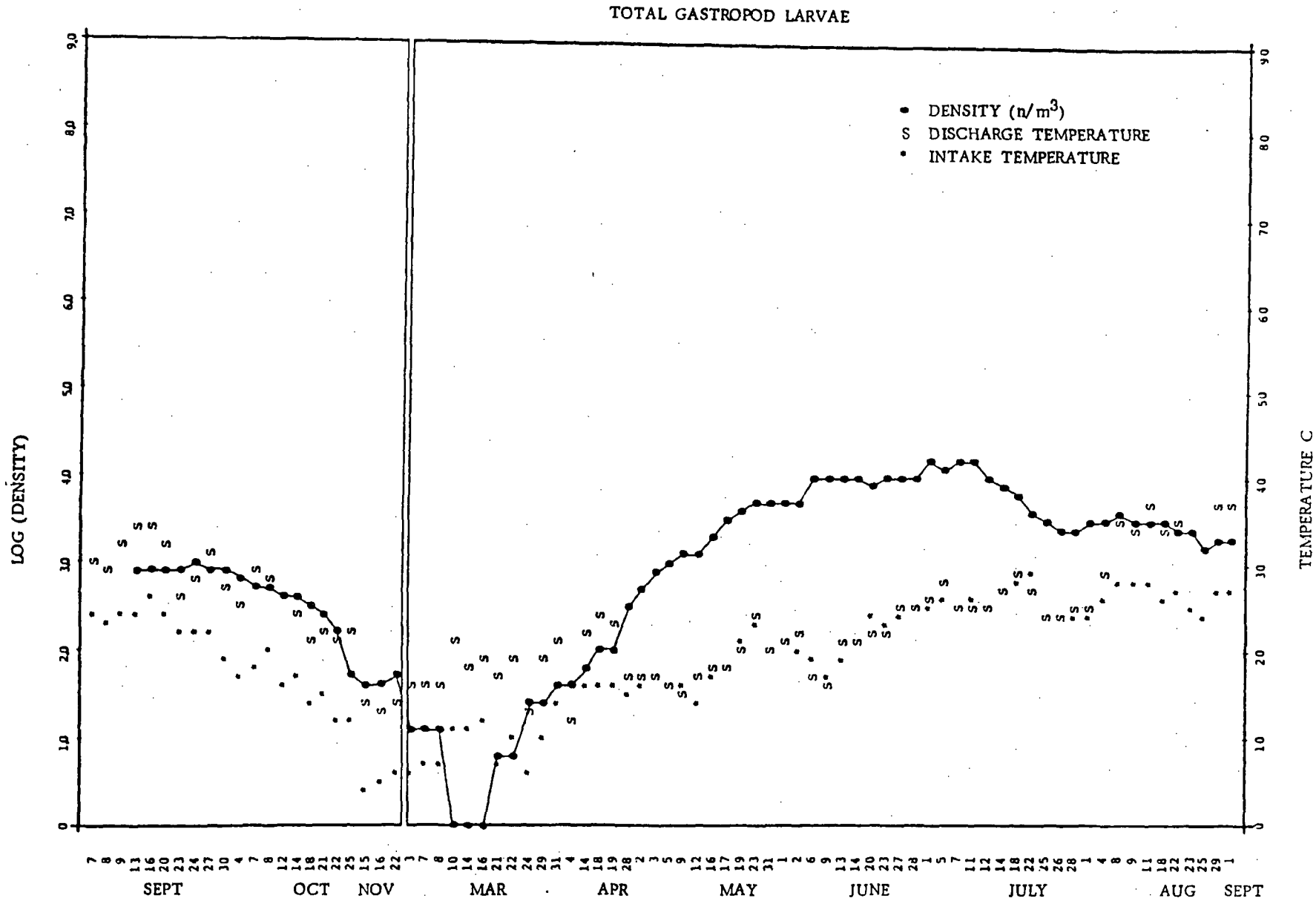

Fig. D1-56. The moving average of the log density (n/m^3) of total gastropod larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

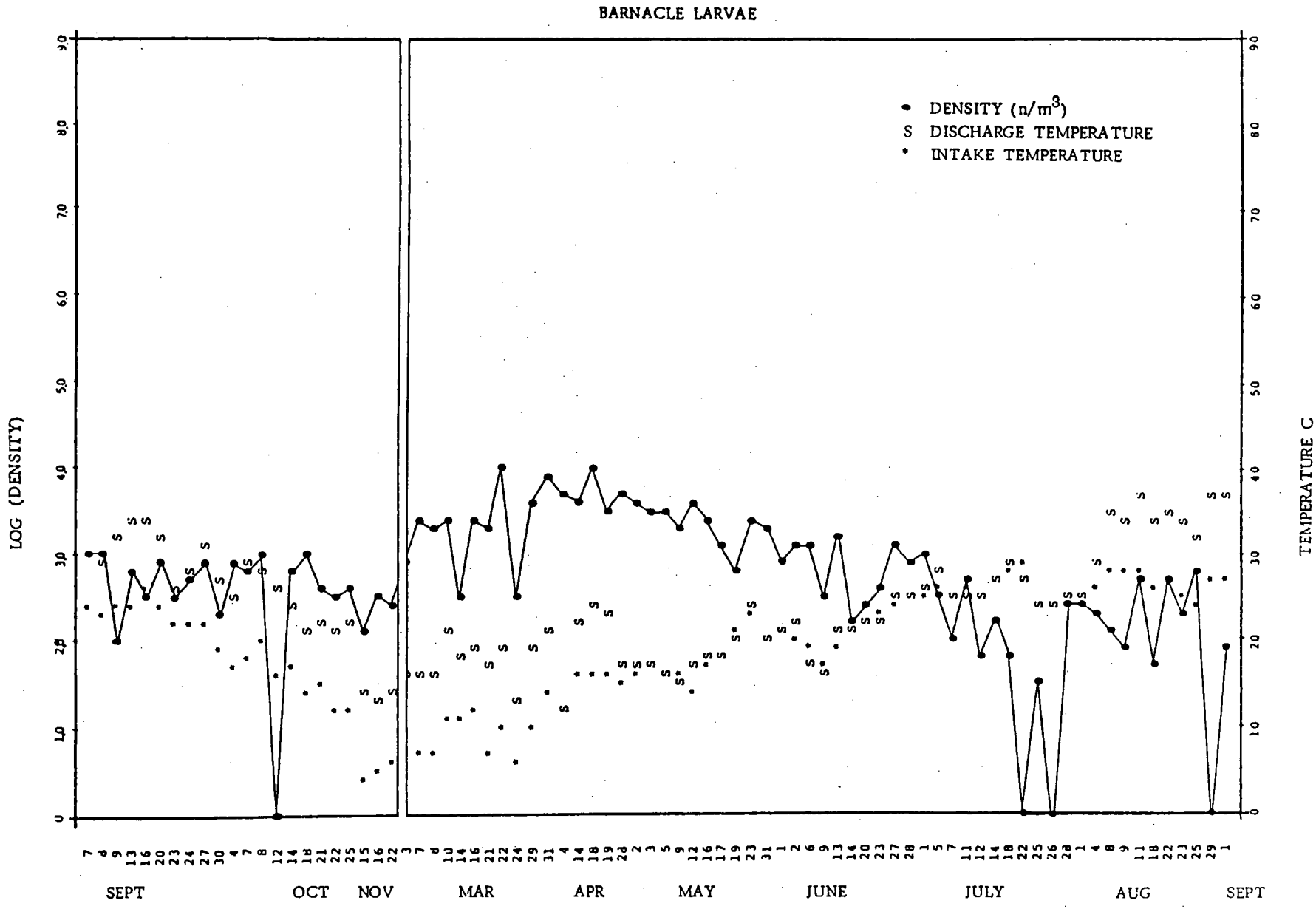

Fig. D1-57. Log density (n/m^3) of barnacle larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

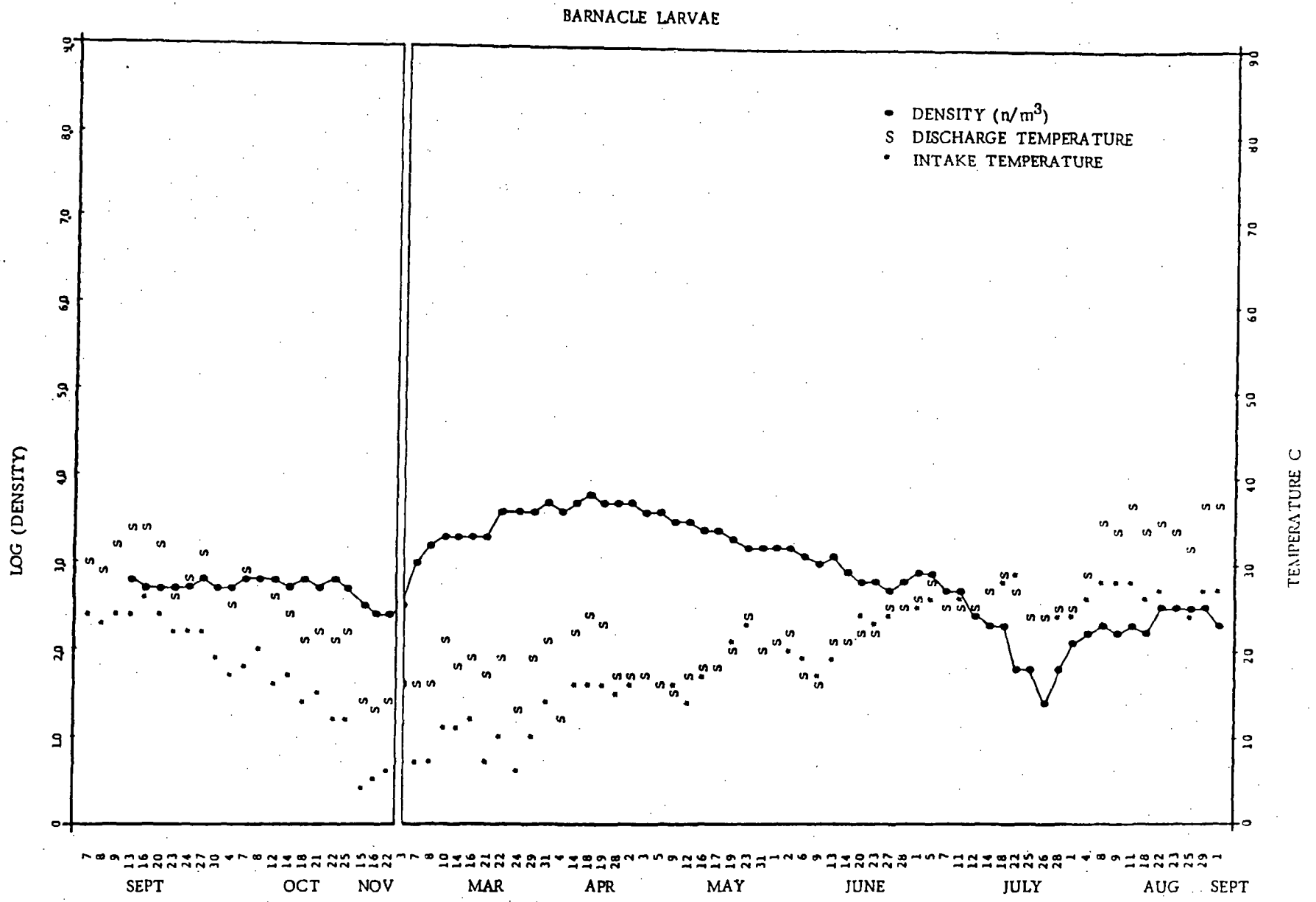

Fig. D1-58. The moving average of the log density (n/m^3) of barnacle larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

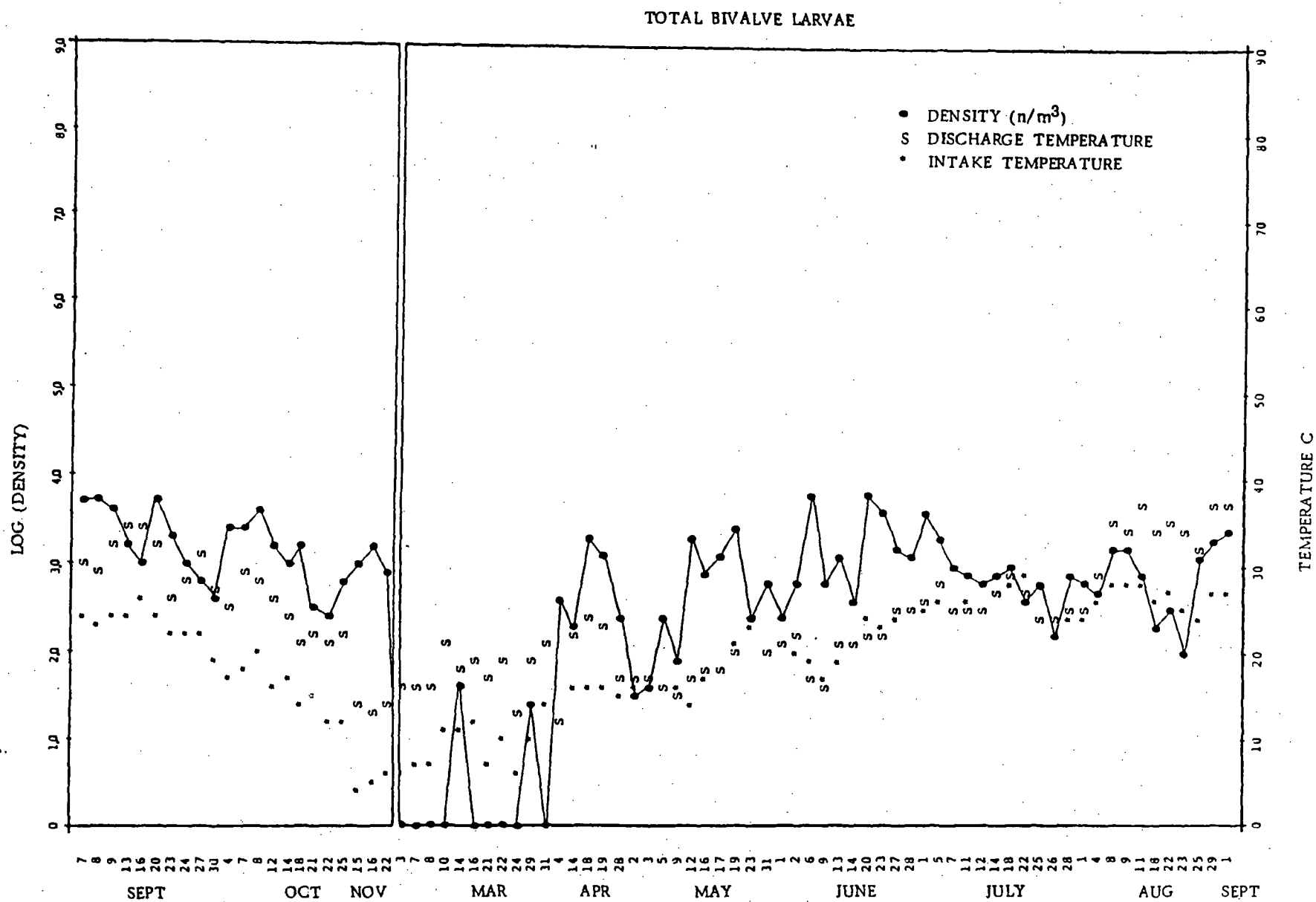

Fig. D1-59. Log density (n/m^3) of total bivalve larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

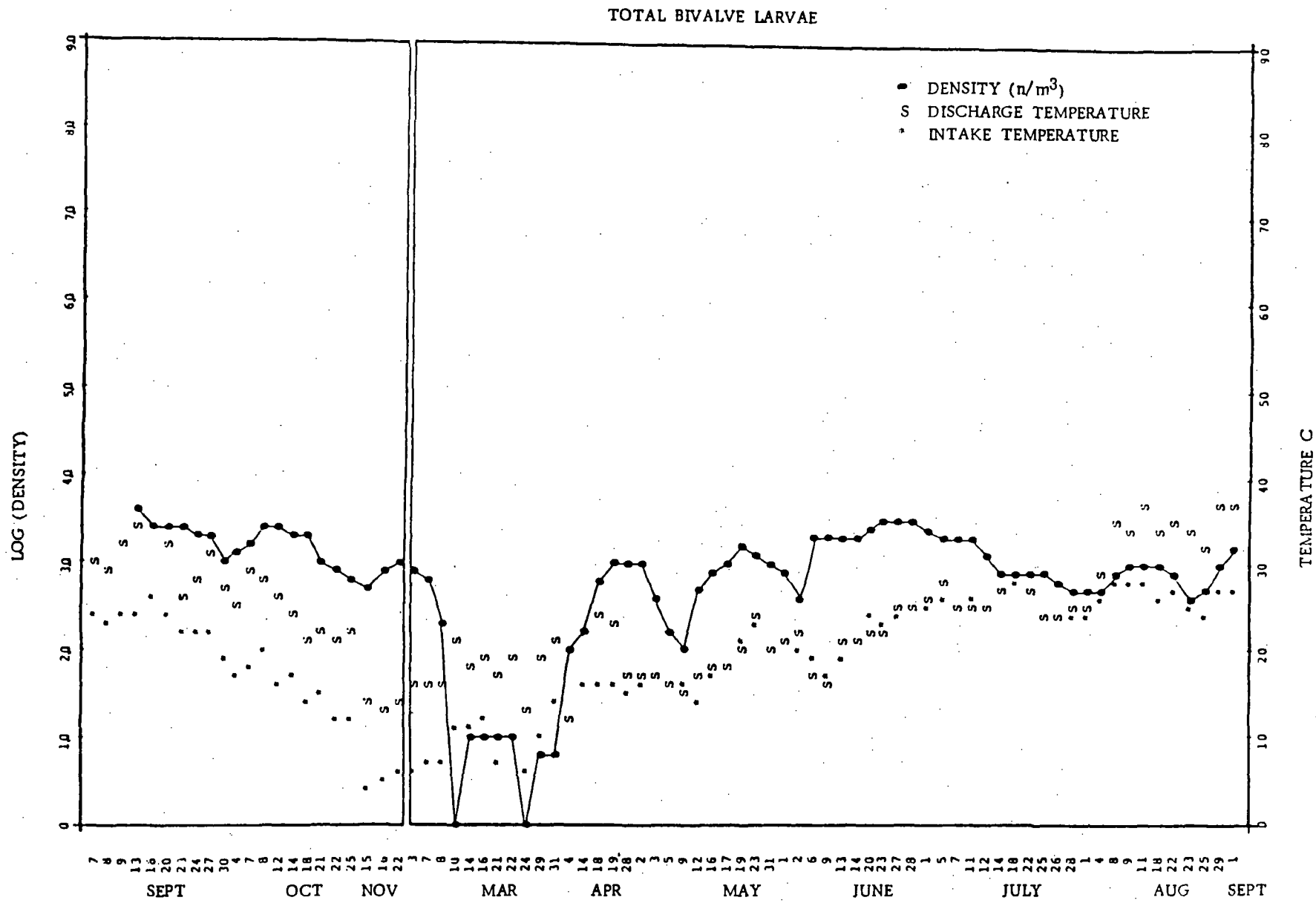

Fig. DI-60. The moving average of the log density (n/m^3) of total bivalve larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

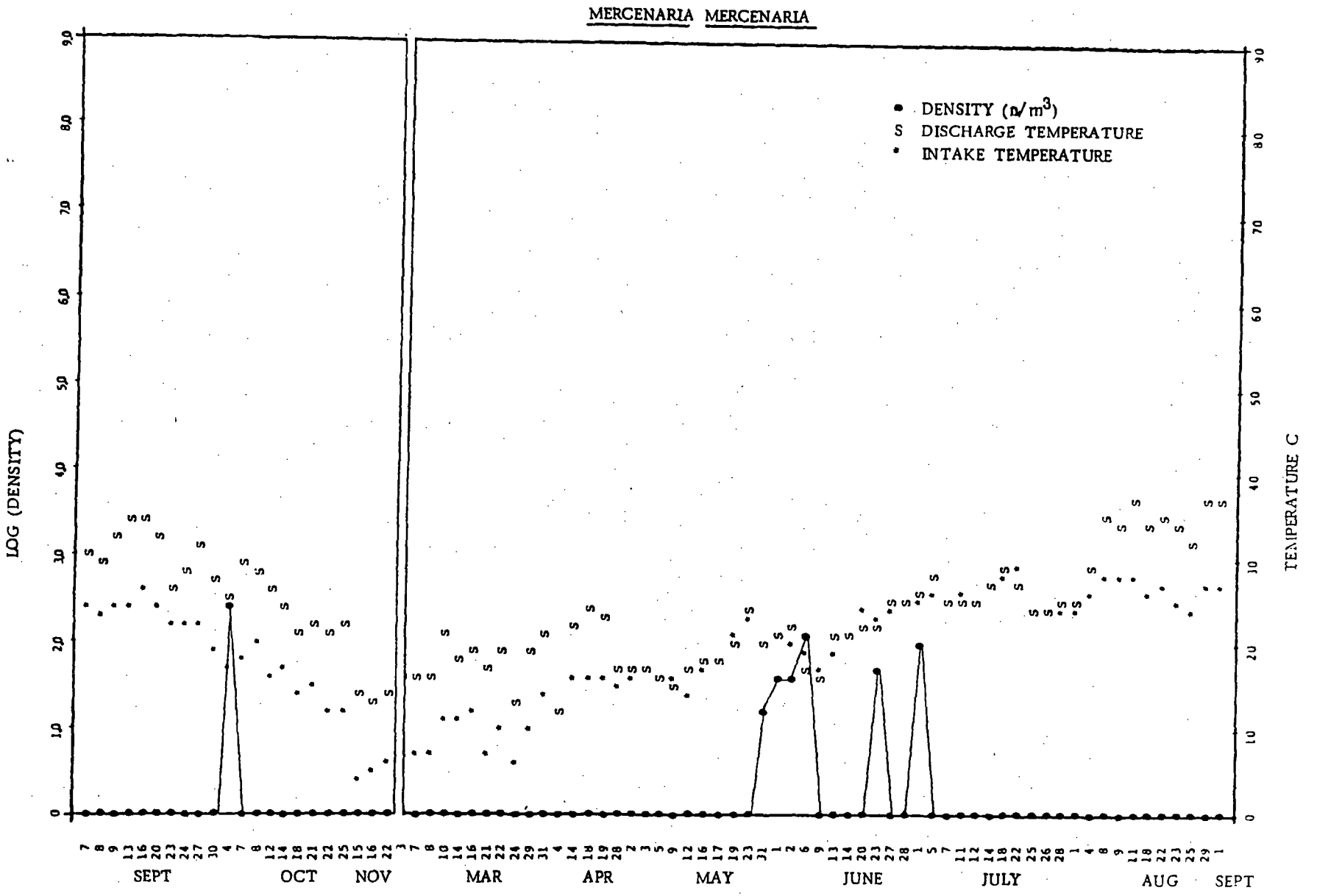

Fig. D1-61. Log density (n/m^3) of Mercenaria mercenaria taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

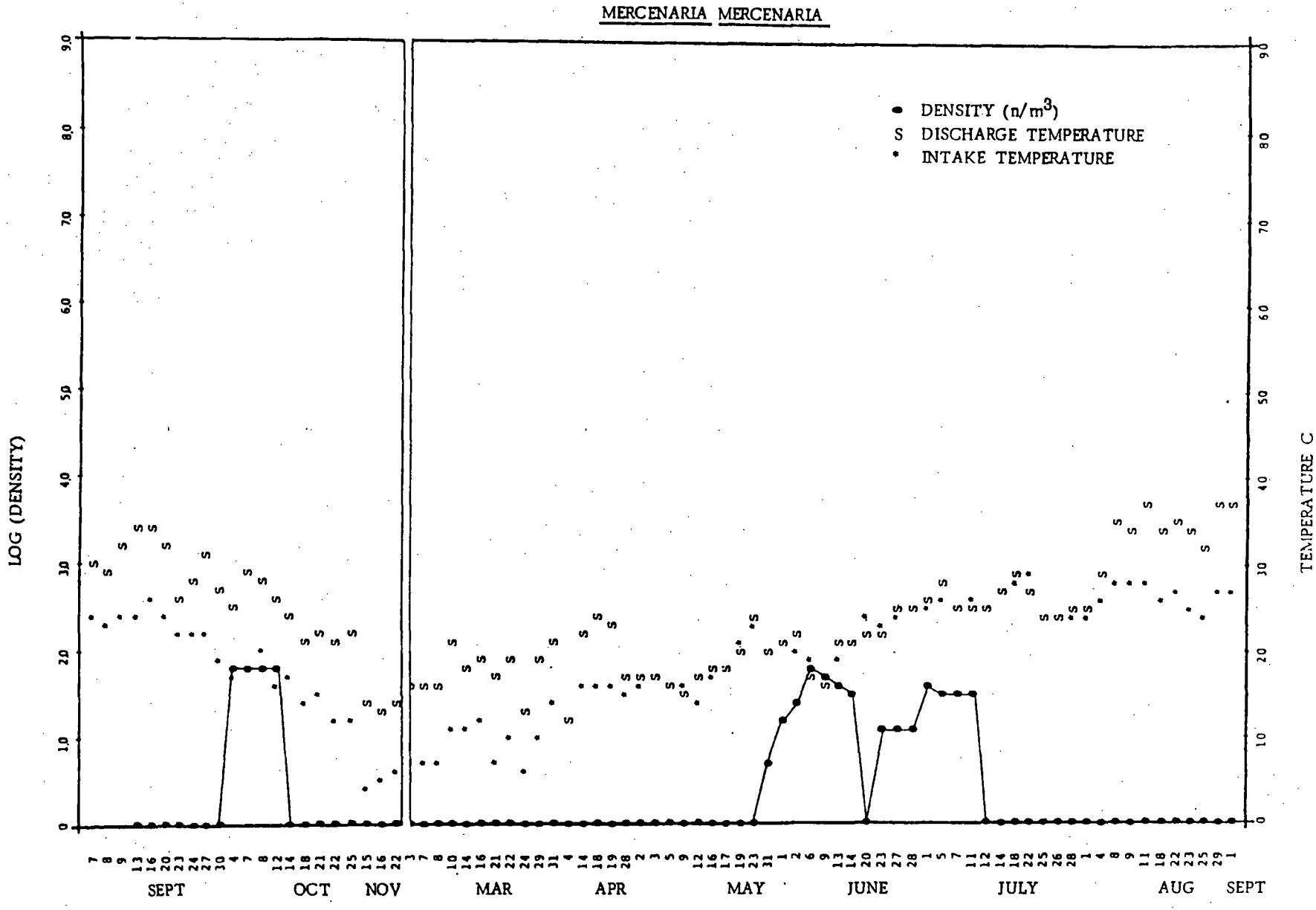

Fig. D1-62. The moving average of the log density (n/m^3) of Mercenaria mercenaria taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

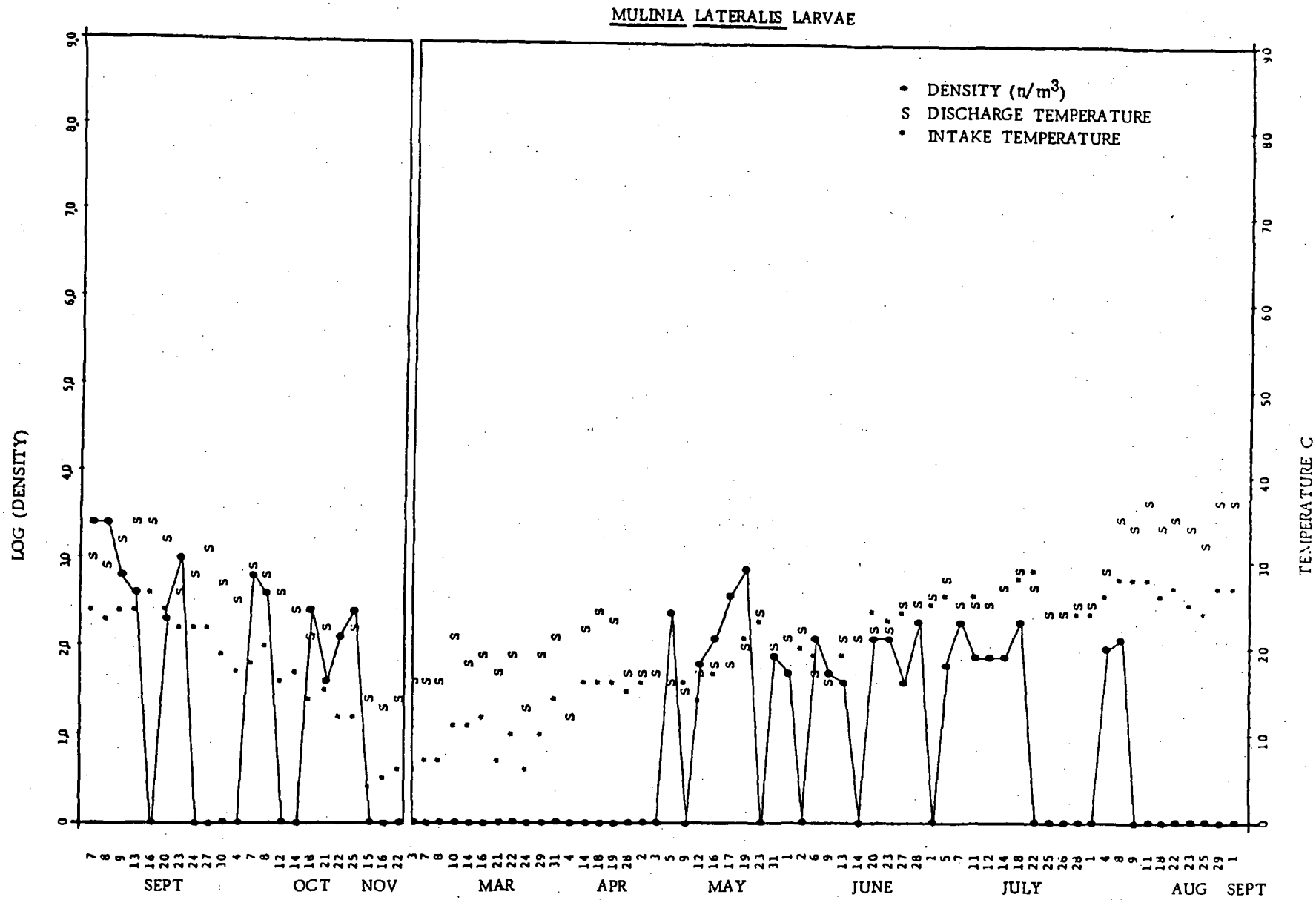

Fig. D1-63. Log density (n/m^3) of Mulinia lateralis larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July 1977 when OCGS did not circulate water.

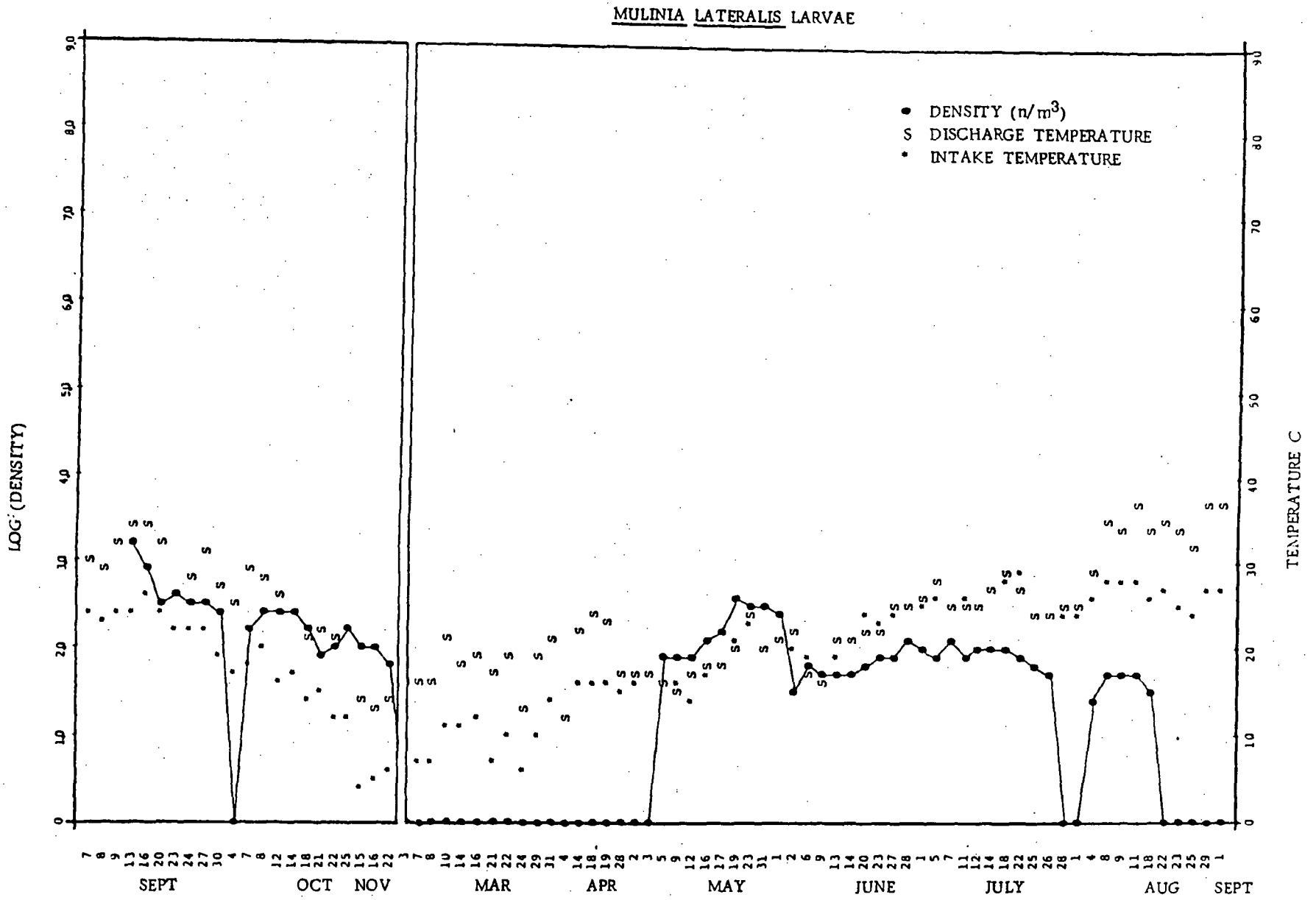

Fig. D1-64. The moving average of the log density (n/m^3) of Mulinia lateralis larvae taken in collections at the Oyster Creek Generating Station discharge versus intake and discharge temperature from 7 September - 22 November 1976, 3 March - 12 May 1977, and 22 July - 1 September 1977. The dilution pump discharge was sampled from 16 May through 18 July when OCGS did not circulate water.

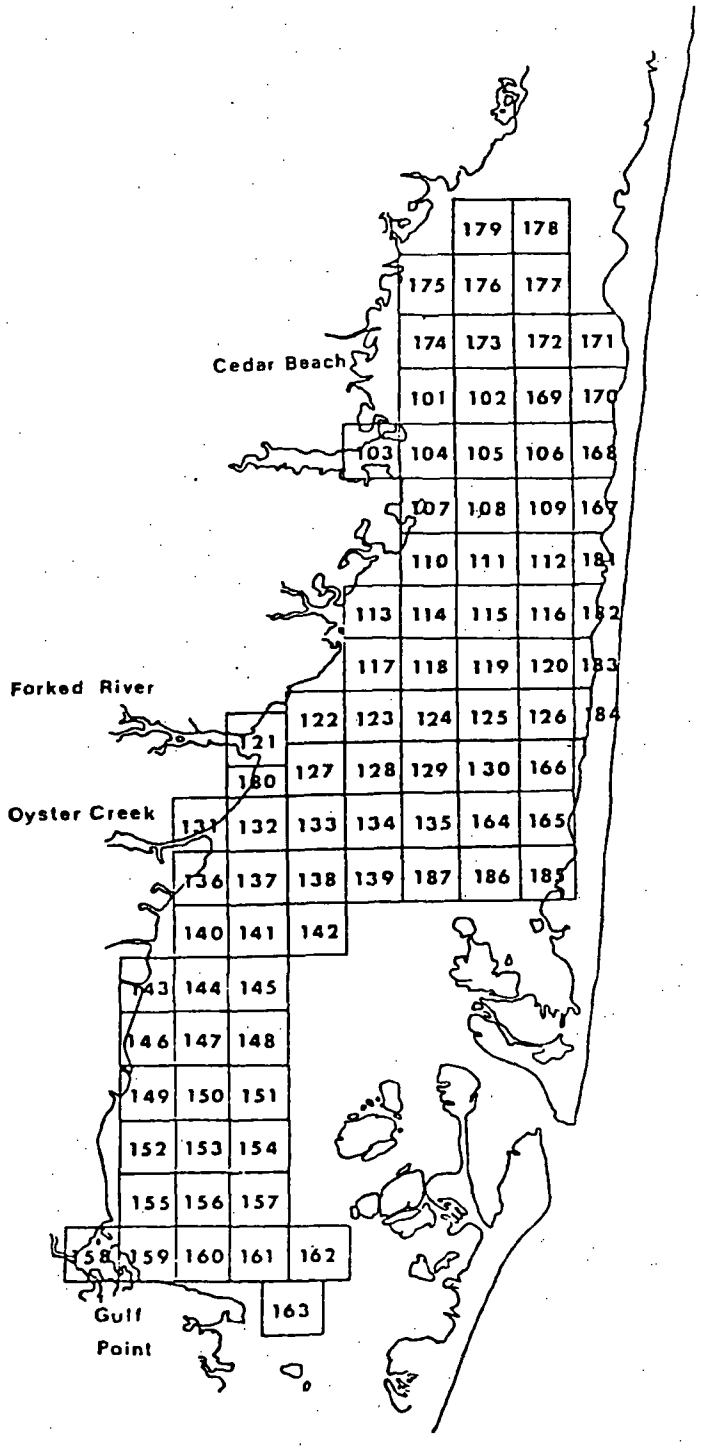

Fig. D1-65. Quadrates used for macrozoo- and ichthyoplankton population studies in Barnegat Bay from March 1977 through September 1977.

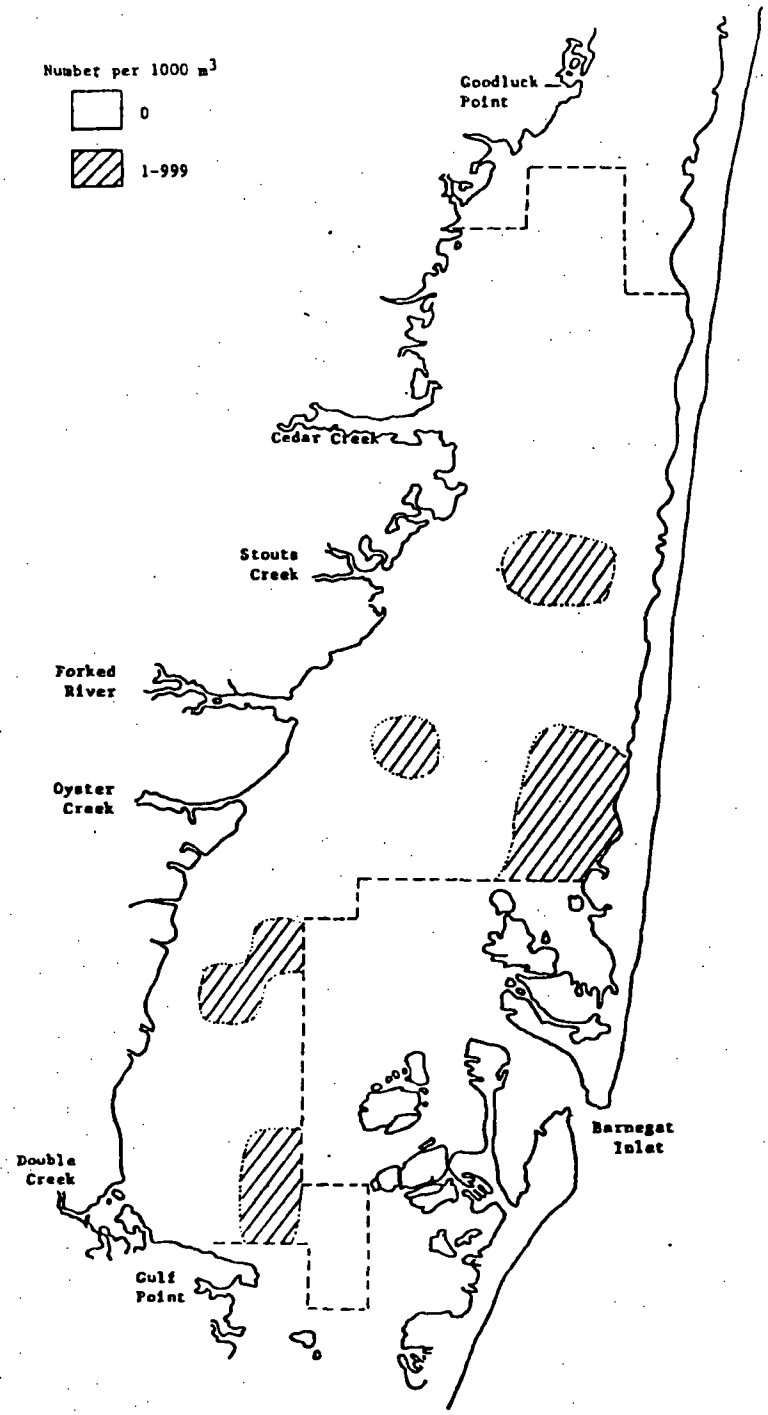

Fig. D1-66. Distribution of sand shrimp zoeae on 11 March 1977. Collections were taken within the area bounded by the dashed line. No collections taken at OCCS during the survey.

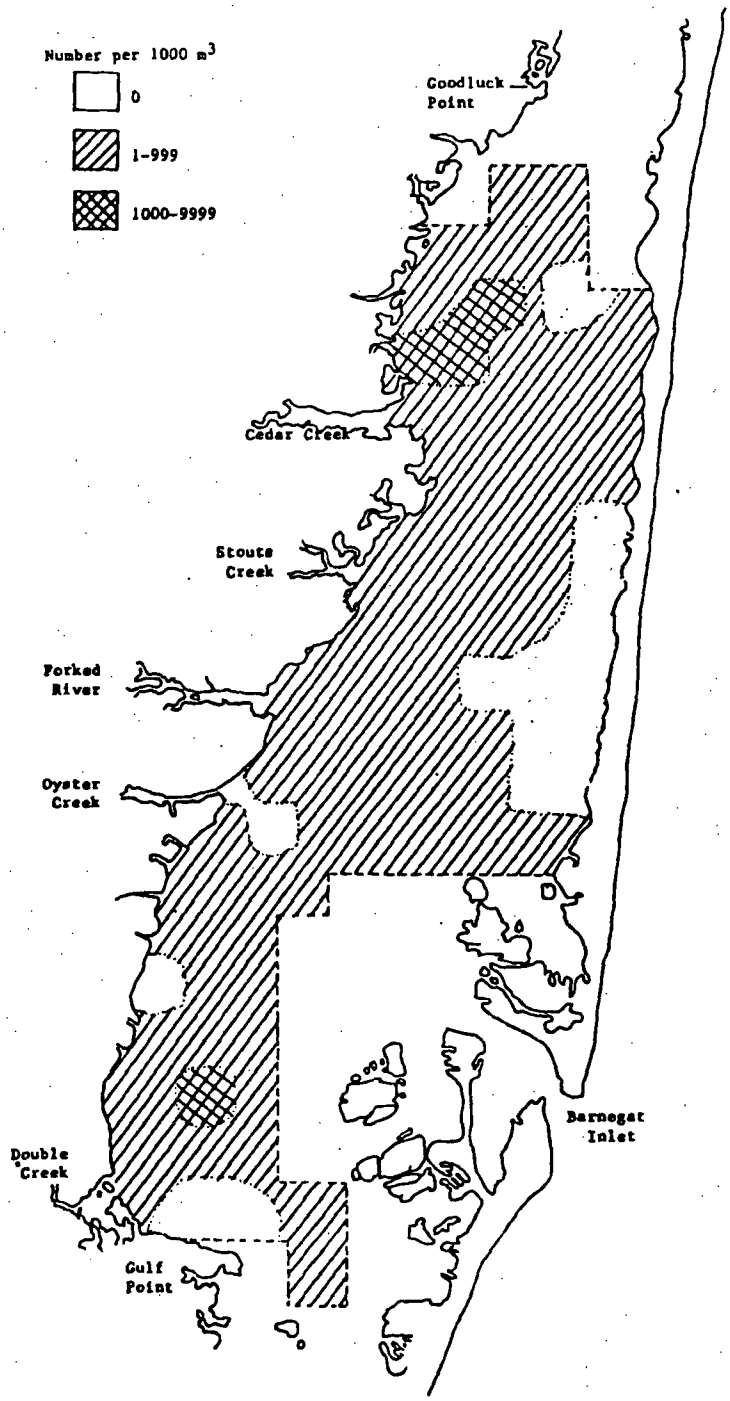

Fig. D1-67. Distribution of sand shrimp zoeae on 29 March 1977. Collections were taken within the area bounded by the dashed line. No collections taken at OCGS during the survey.

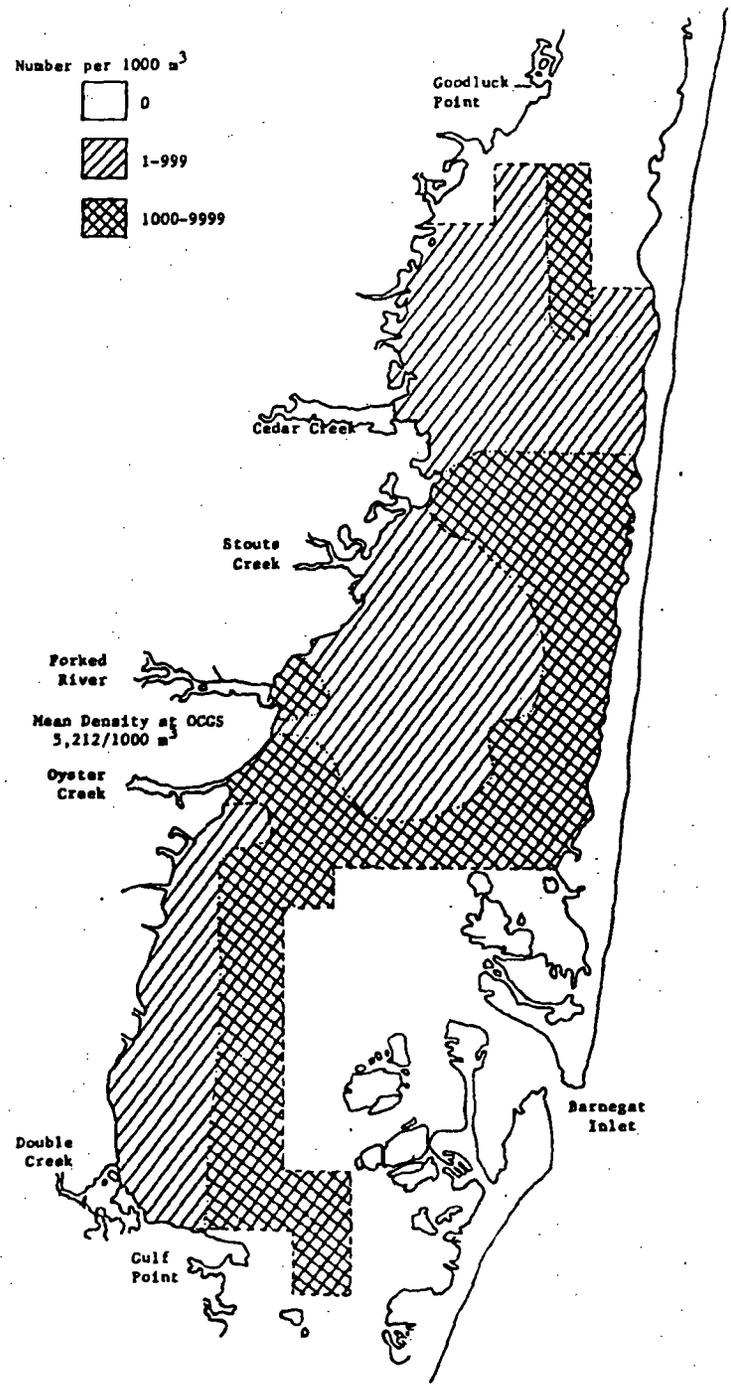

Fig. D1-68. Distribution of sand shrimp zoeae on 18 May 1977. Collections were taken within the area bounded by the dashed line.

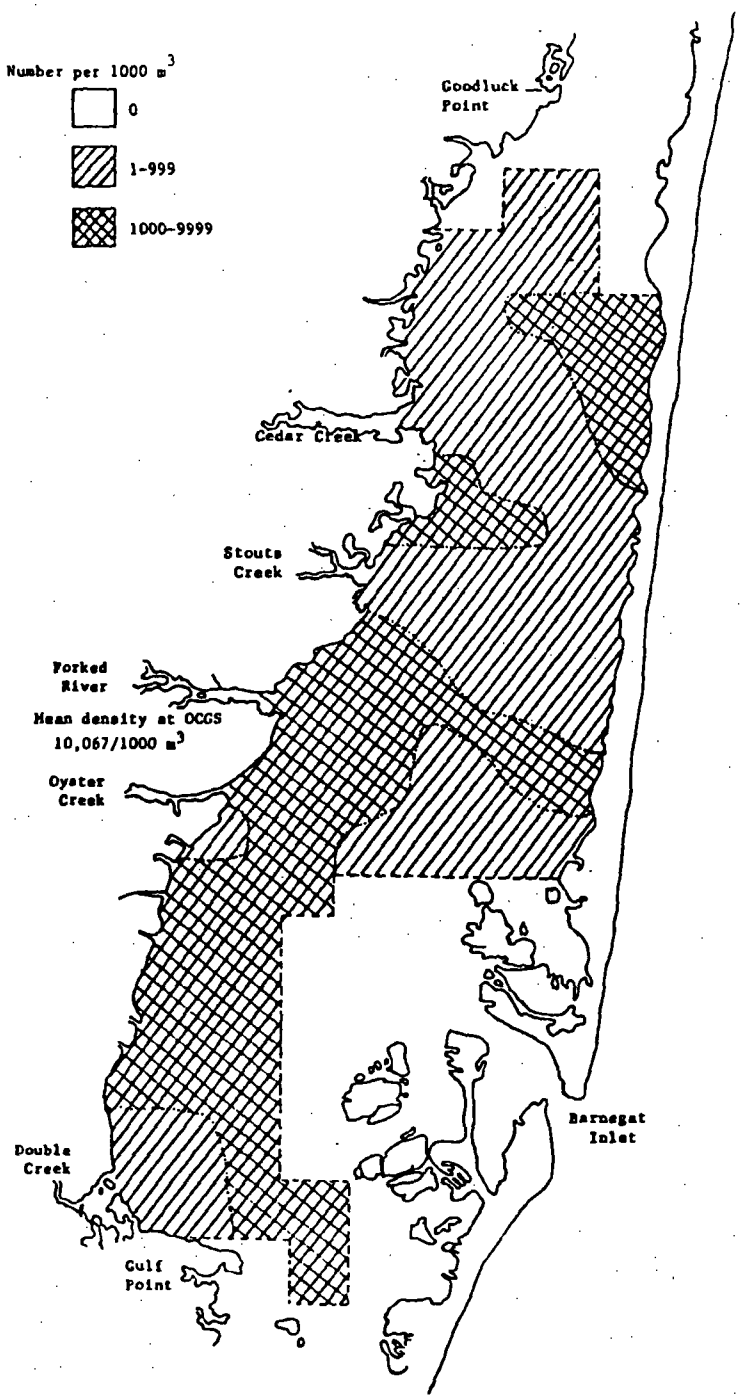

Fig. D1-69. Distribution of sand shrimp zoeae on 8 June 1977. Collections were taken within the area bounded by the dashed line.

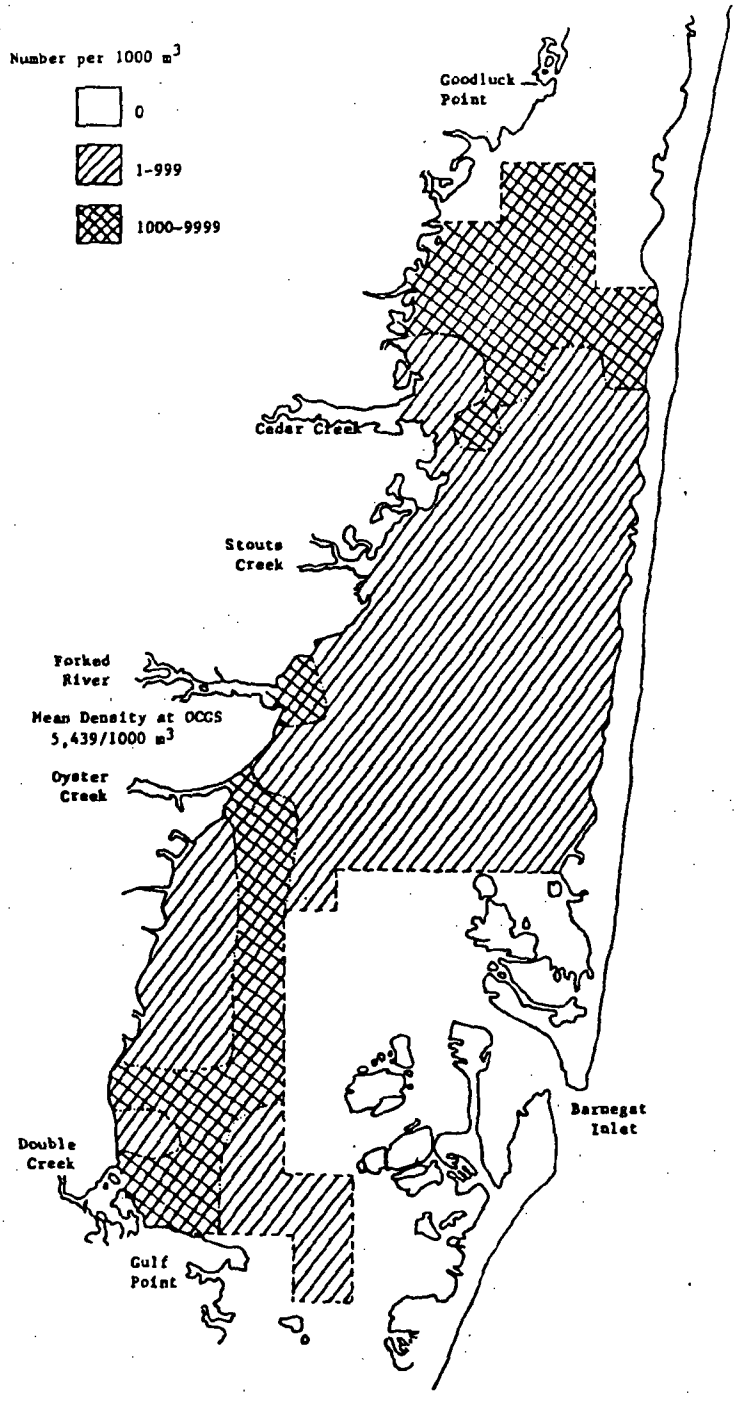

Fig. D1-70. Distribution of sand shrimp zoeae on 22 June 1977. Collections were taken within the area bounded by the dashed line.

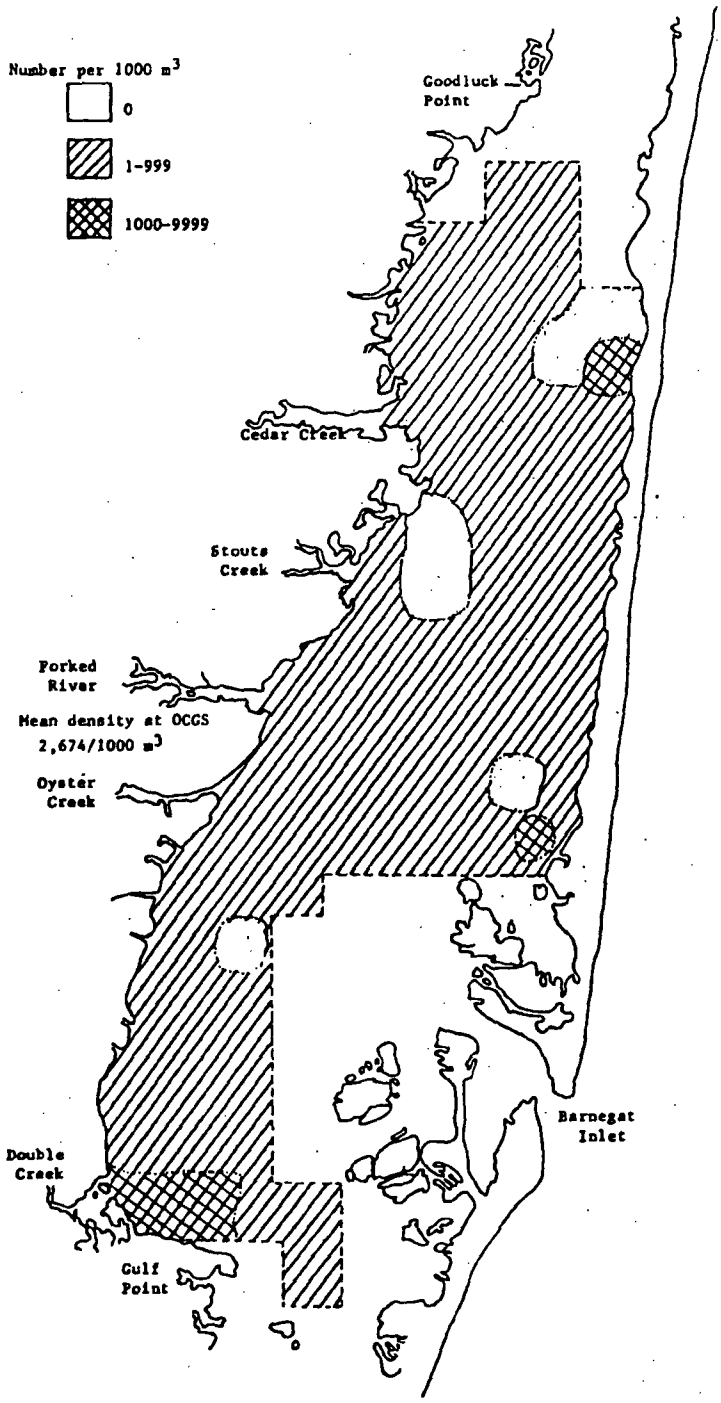

Fig. D1-71. Distribution of sand shrimp zoeae on 6 July 1977. Collections were taken within the area bounded by the dashed line.

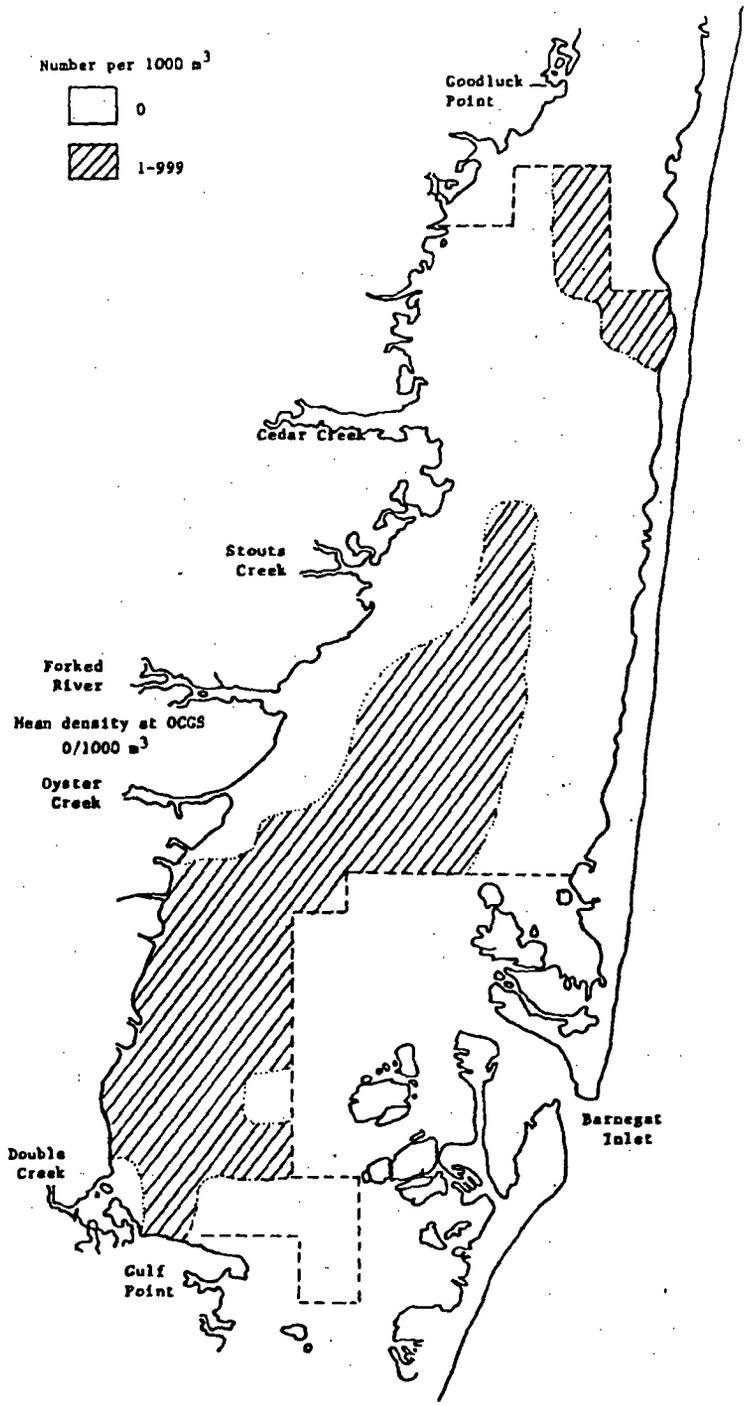

Fig. D1-72. Distribution of sand shrimp zoeae on 21 July 1977. Collections were taken within the area bounded by the dashed line.

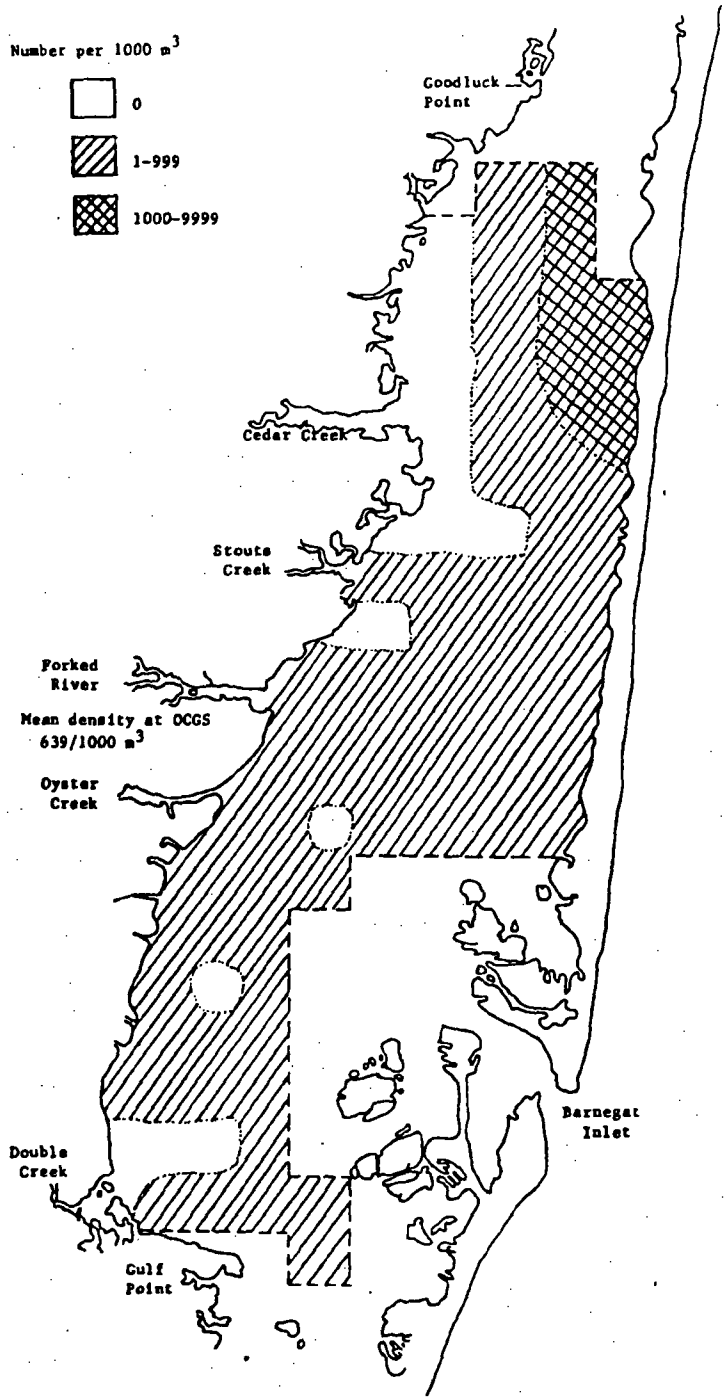

Fig. D1-73. Distribution of grass shrimp zoeae on 8 June 1977. Collections were taken within the area bounded by the dashed line.

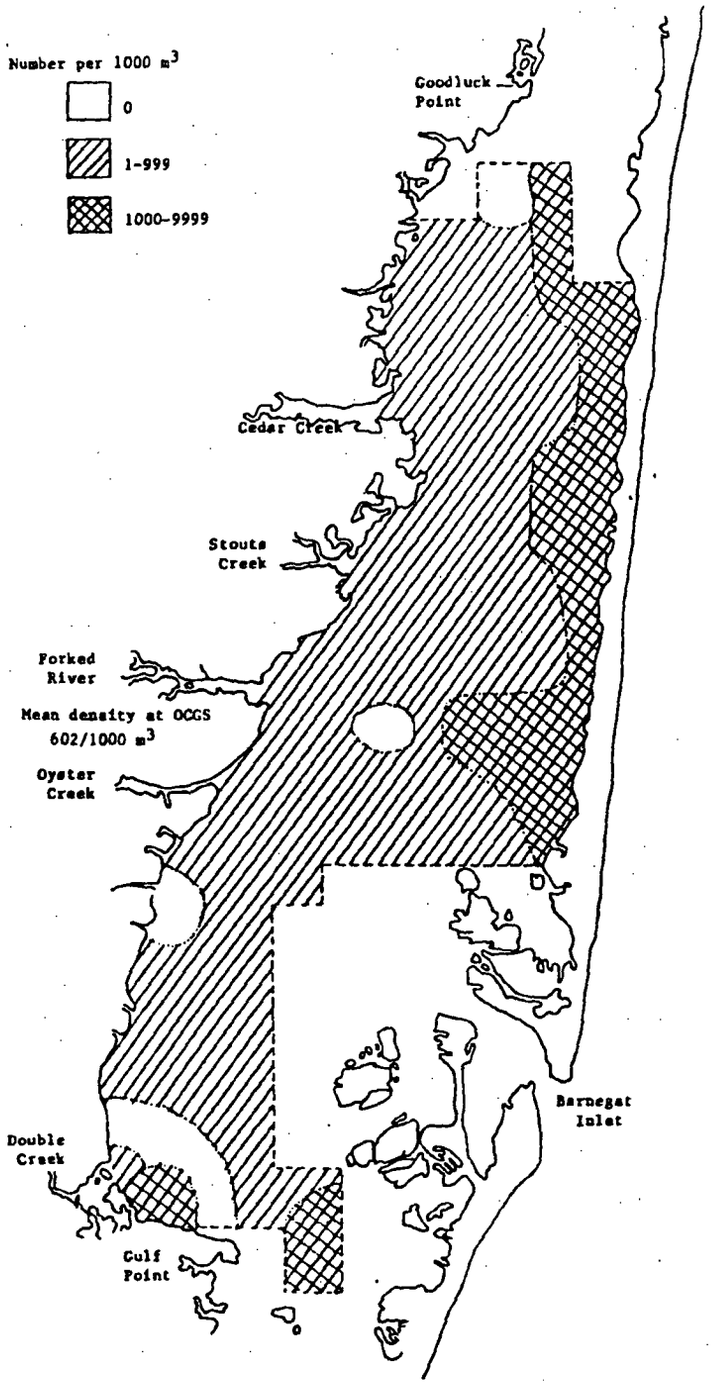

Fig. D1-74. Distribution of grass shrimp zoeae on 22 June 1977. Collections were taken within the area bounded by the dashed line.

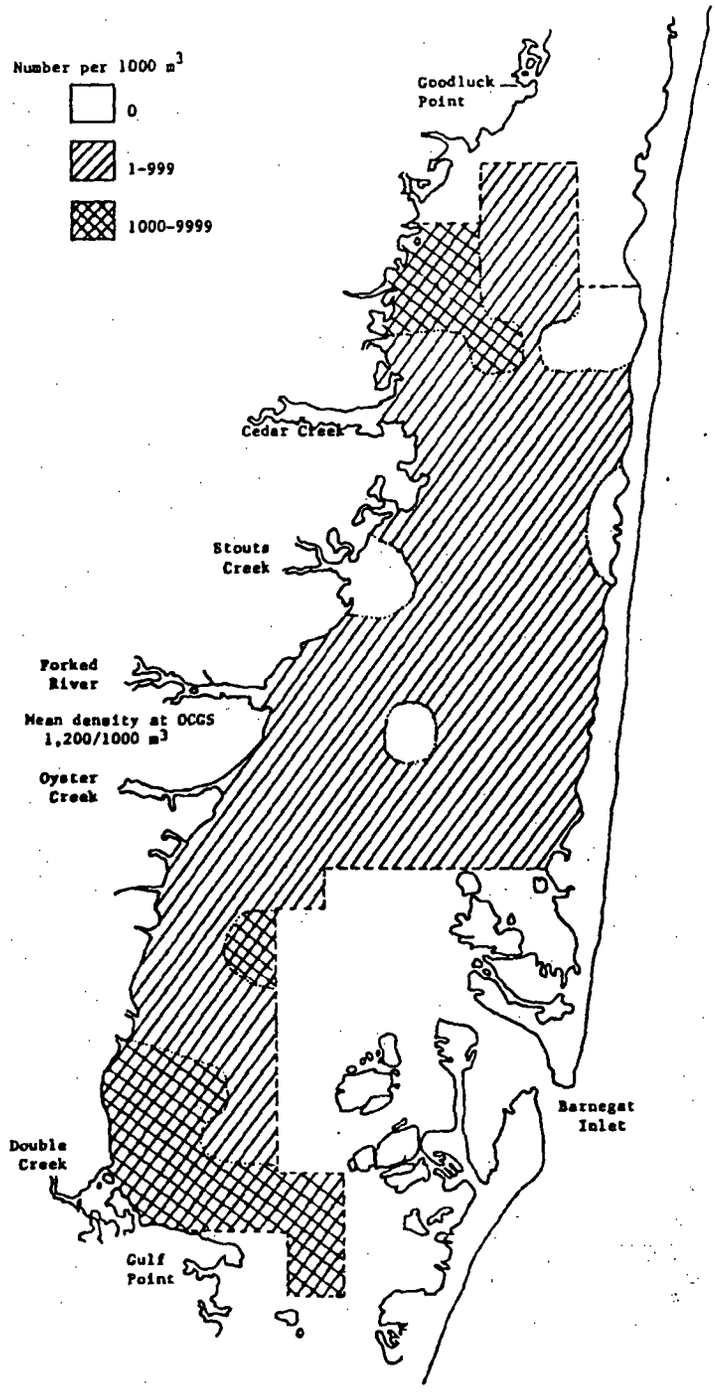

Fig. D1-75. Distribution of the grass shrimp zoeae on 6 July 1977. Collections were taken within the area bounded by the dashed line.

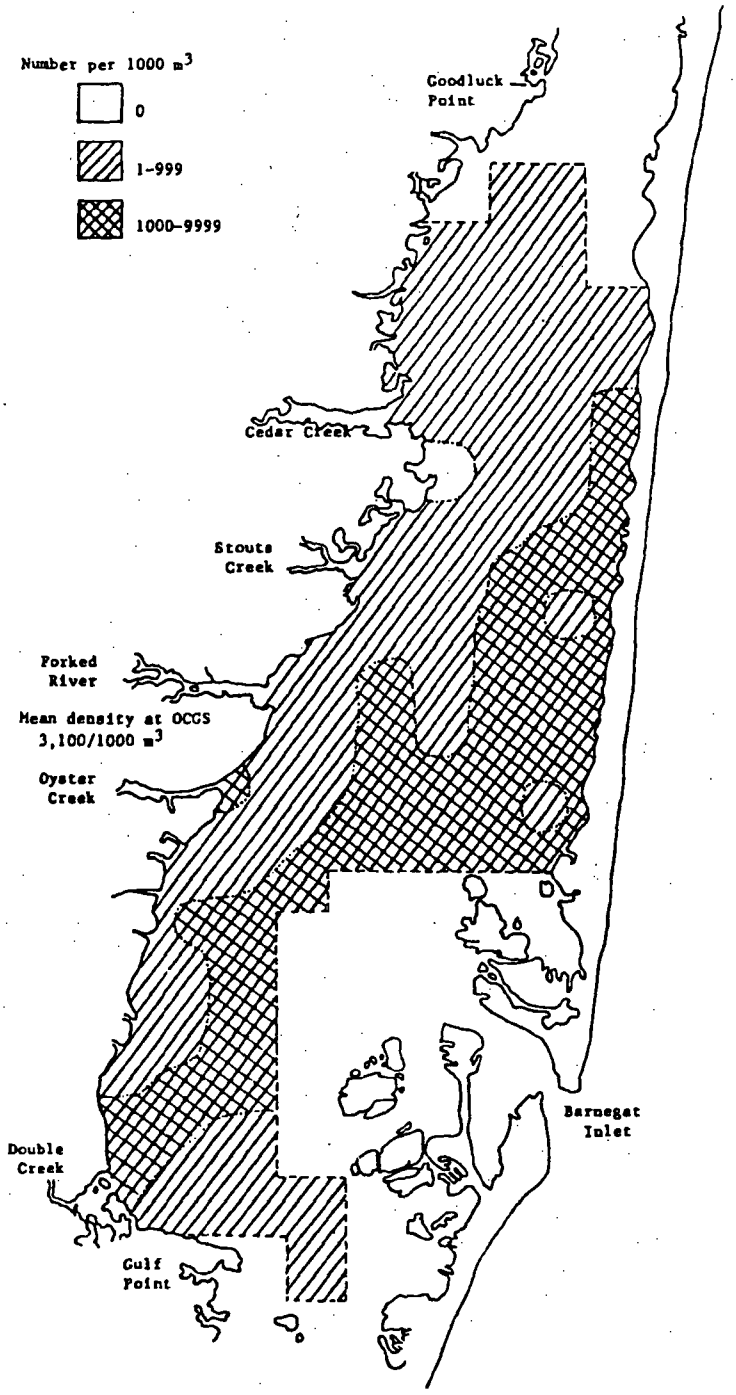

Fig. D1-76. Distribution of grass shrimp zoeae on 21 July 1977. Collections were taken within the area bounded by the dashed line.

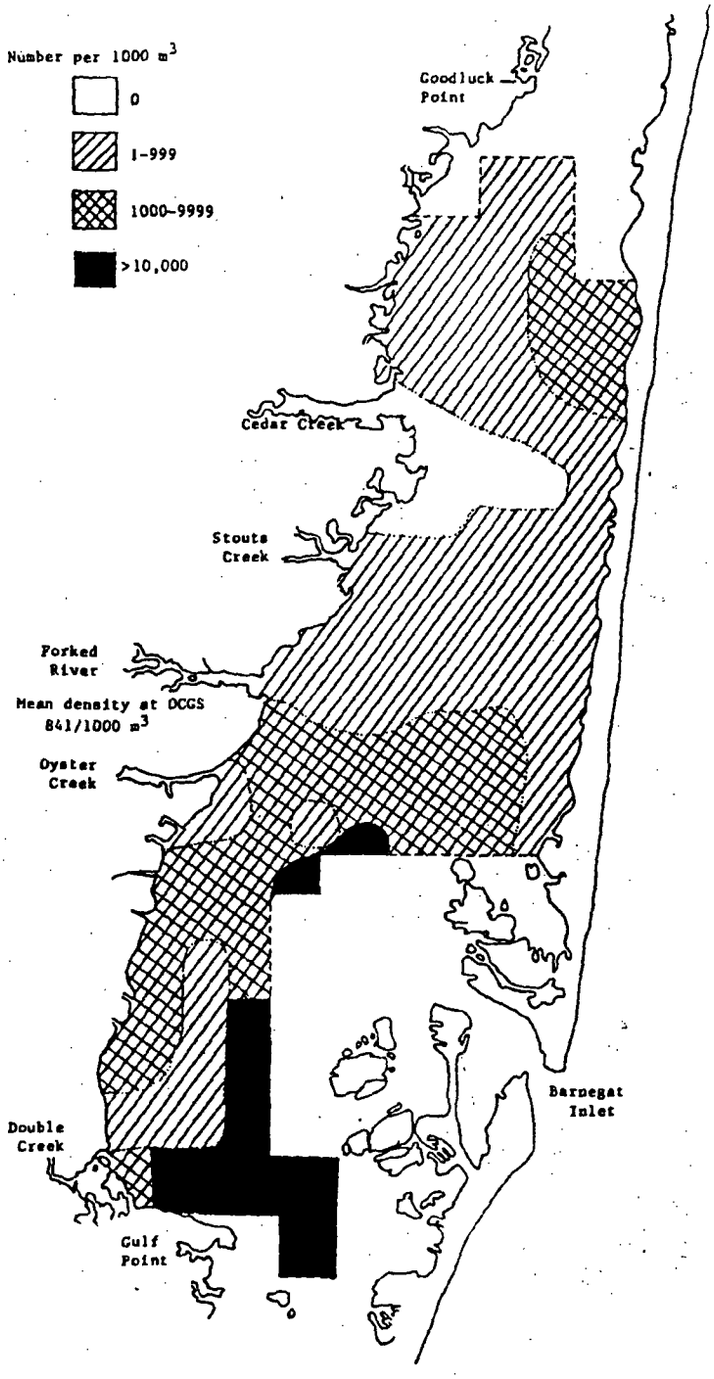

Fig. D1-77. Distribution of the zoeae of the mud crab, Neopanope texana, on 8 June 1977. Collections were taken within the area bounded by the dashed line.

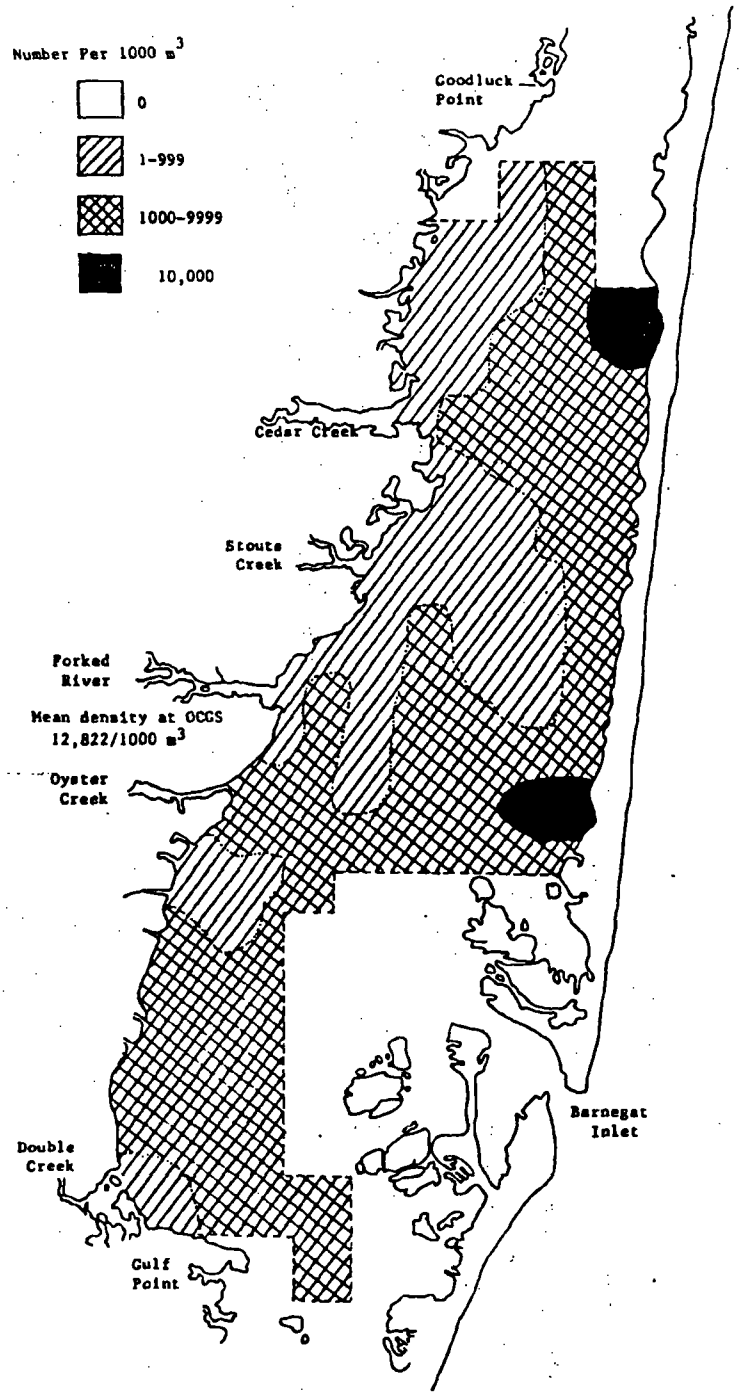

Fig. D1-78. Distribution of the zoeae of the mud crab, Neopanope texana, on 22 June 1977. Collections were taken within the area bounded by the dashed line.

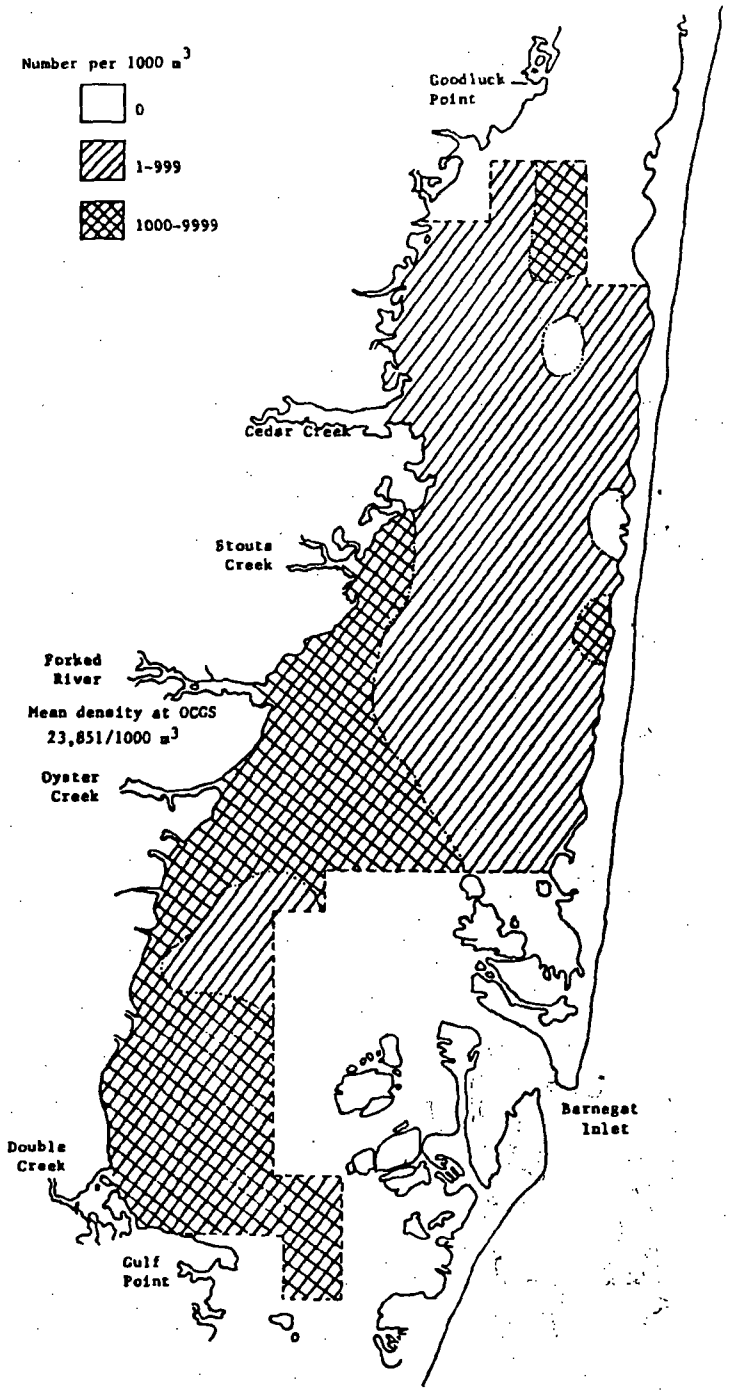

Fig. D1-79. Distribution of the zoeae of the mud crab, Neopanope texans, on 6 July 1977. Collections were taken within the area bounded by the dashed line.

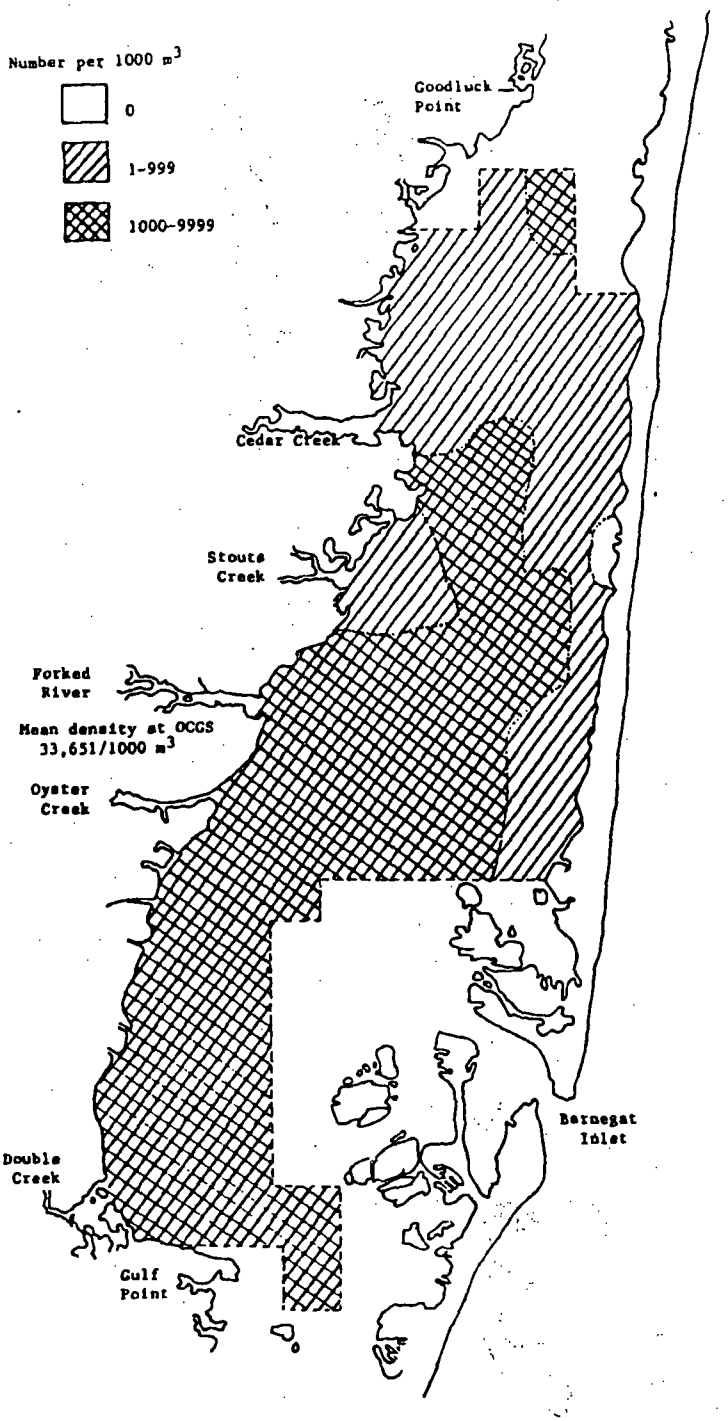

Fig. D1-80. Distribution of the zoeae of the mud crab, Neopanope texana, on 21 July 1977. Collections were taken within the area bounded by the dashed line.

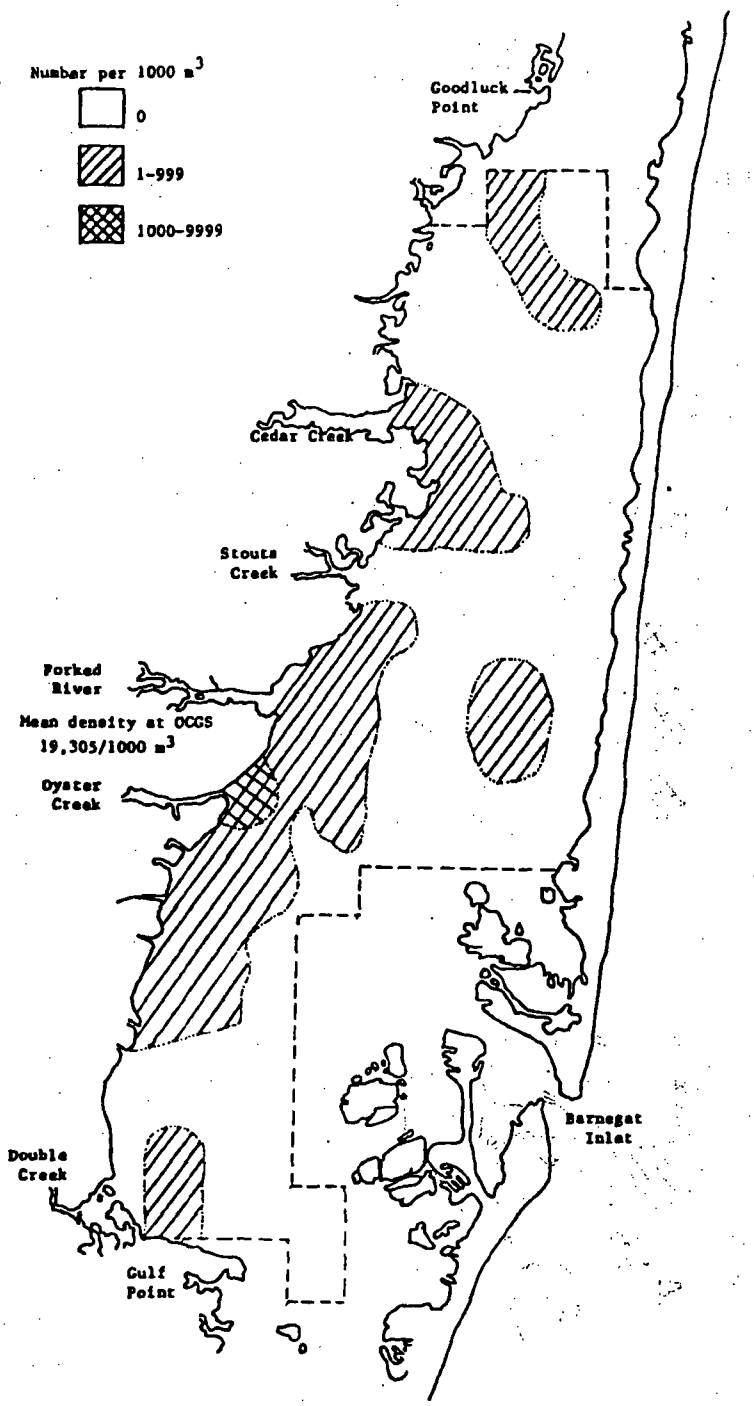

Fig: D1-81. Distribution of the zoeae of the mud crab, Panopeus herbstii, on 8 June 1977. Collections were taken within the area bounded by the dashed line.

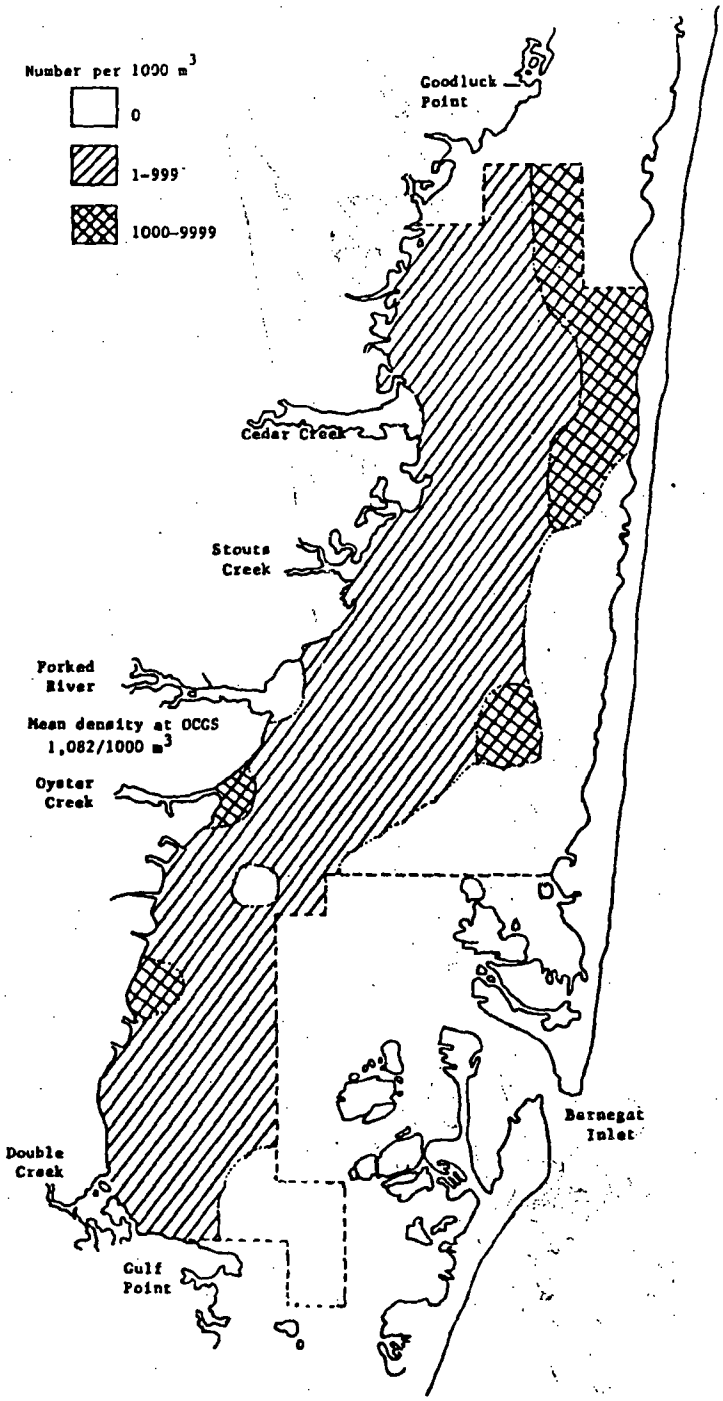

Fig. D1-82. Distribution of the zoeae of the mud crab, Panopeus herbstii, on 22 June 1977. Collections were taken within the area bounded by the dashed line.

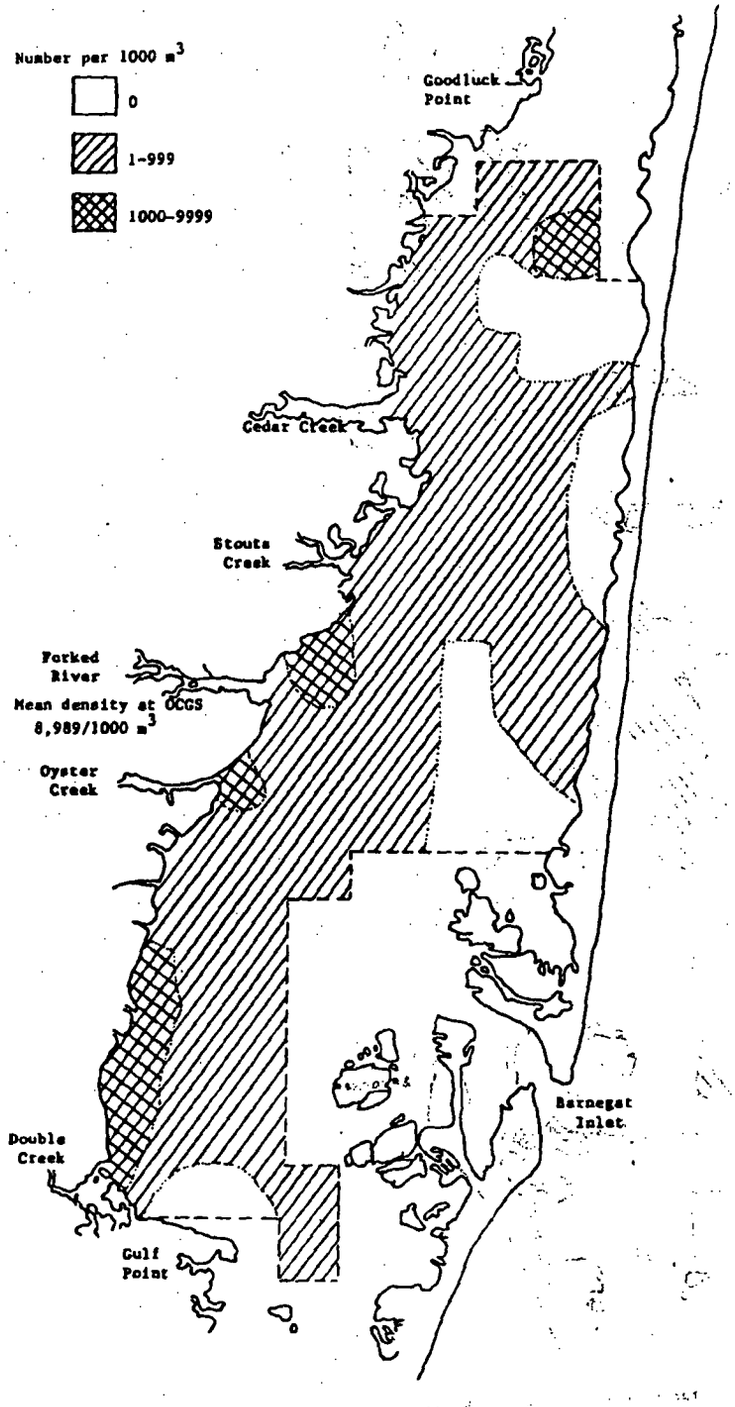

Fig. D1-83. Distribution of the zoeae of the mud crab, Panopeus herbstii, on 6 July 1977. Collections were taken within the area bounded by the dashed line.

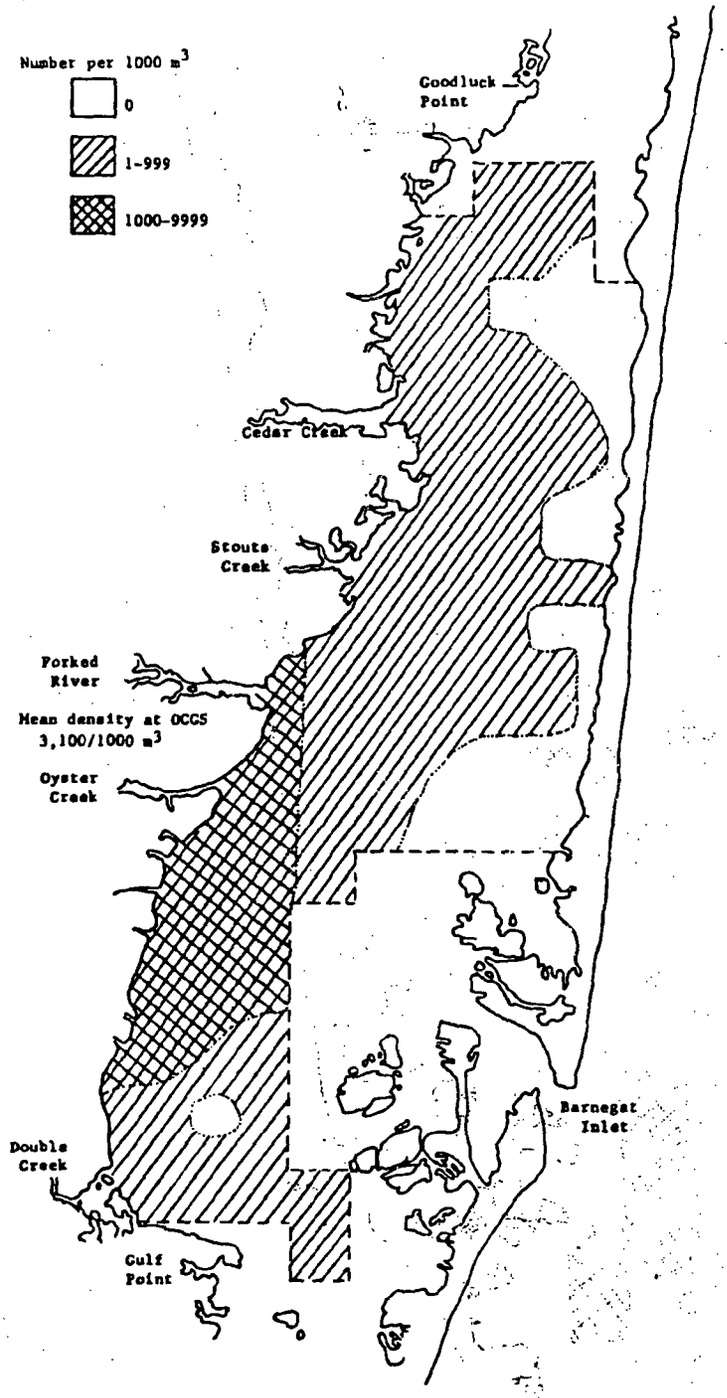

Fig. D1-84. Distribution of the zoeae of the mud crab, Panopeus herbstii, on 21 July 1977. Collections were taken within the area bounded by the dashed line.

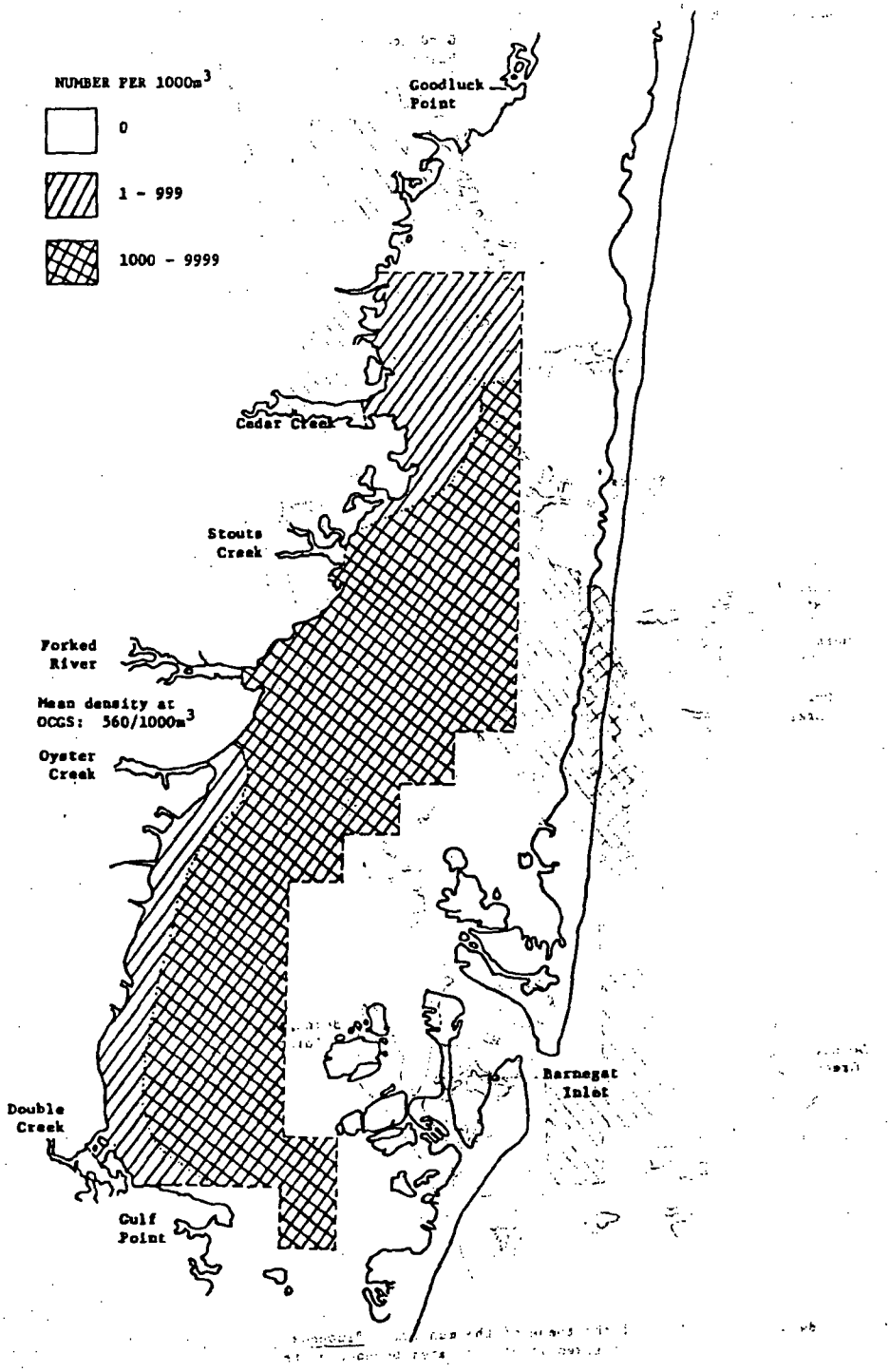

Fig. D1-85. Distribution of blue crab megalopae on the night of 19 September 1977. Collections were taken within the area bounded by the dashed line.

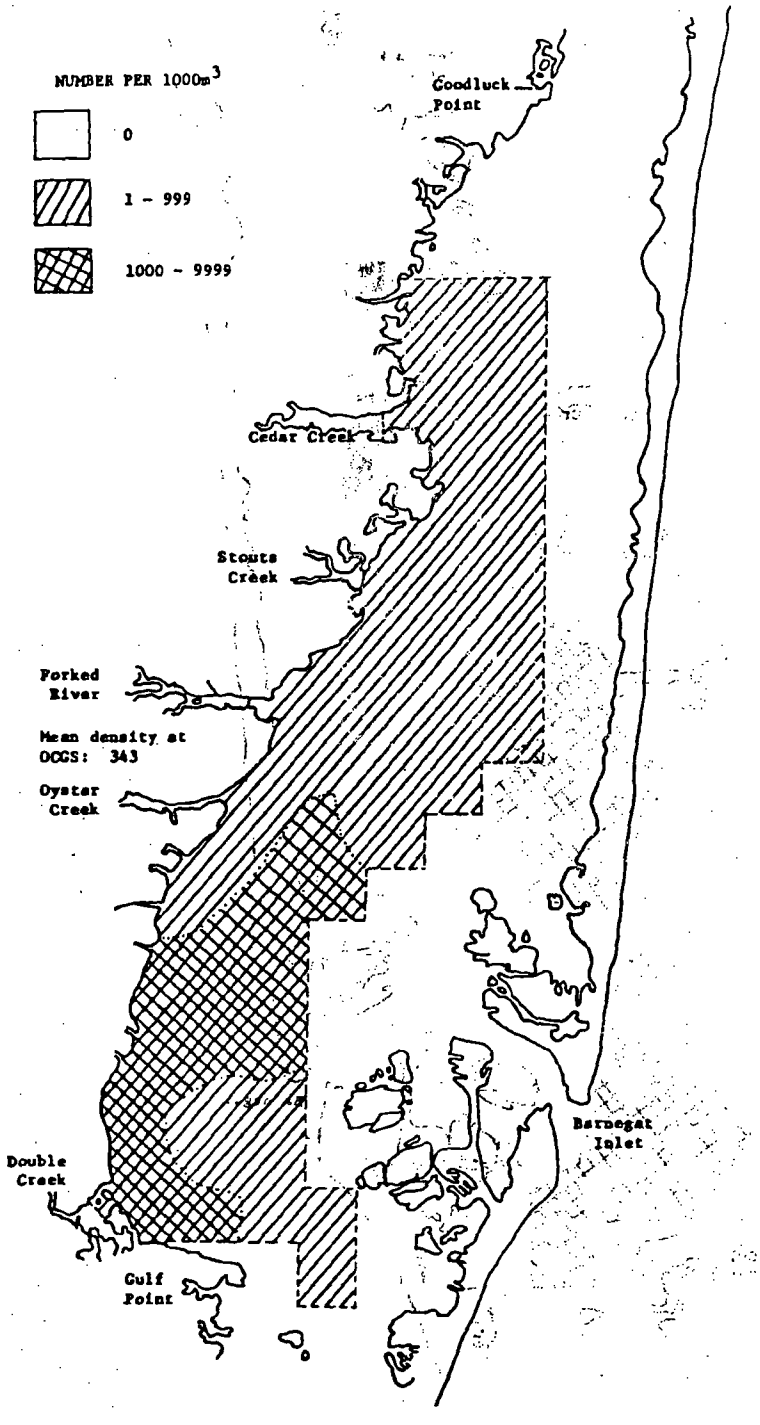

Fig. D1-86. Distribution of blue crab megalopae on the night of 28 September 1977. Collections were taken within the area bounded by the dashed line.

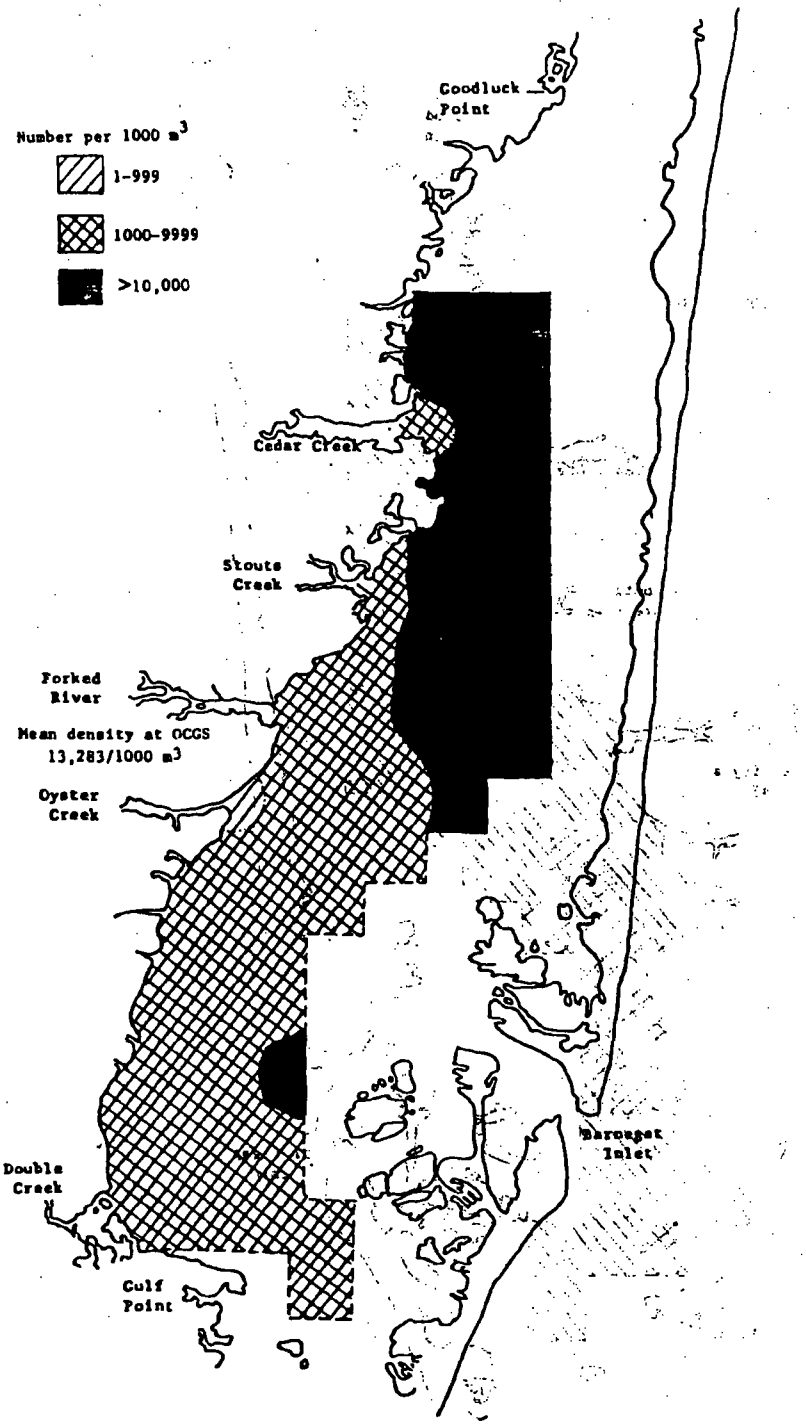

Fig. D1-87. Distribution of Neomysis americana on the night of 19 September 1977. Collections were taken within the area bounded by the dashed line.

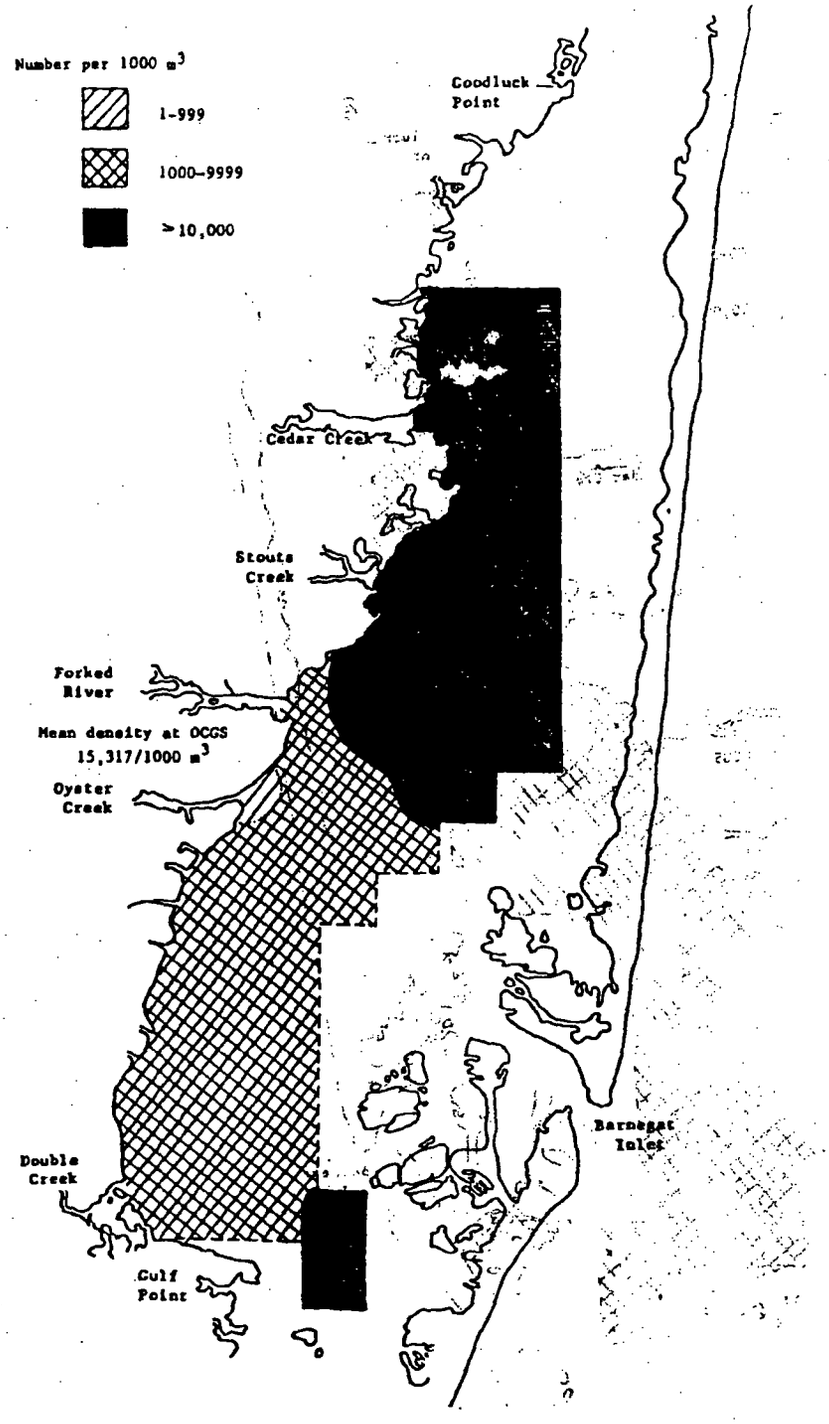

Fig. D1-88. Distribution of Neomysis americana on the night of 28 September 1977. Collections were taken within the area bounded by the dashed line.

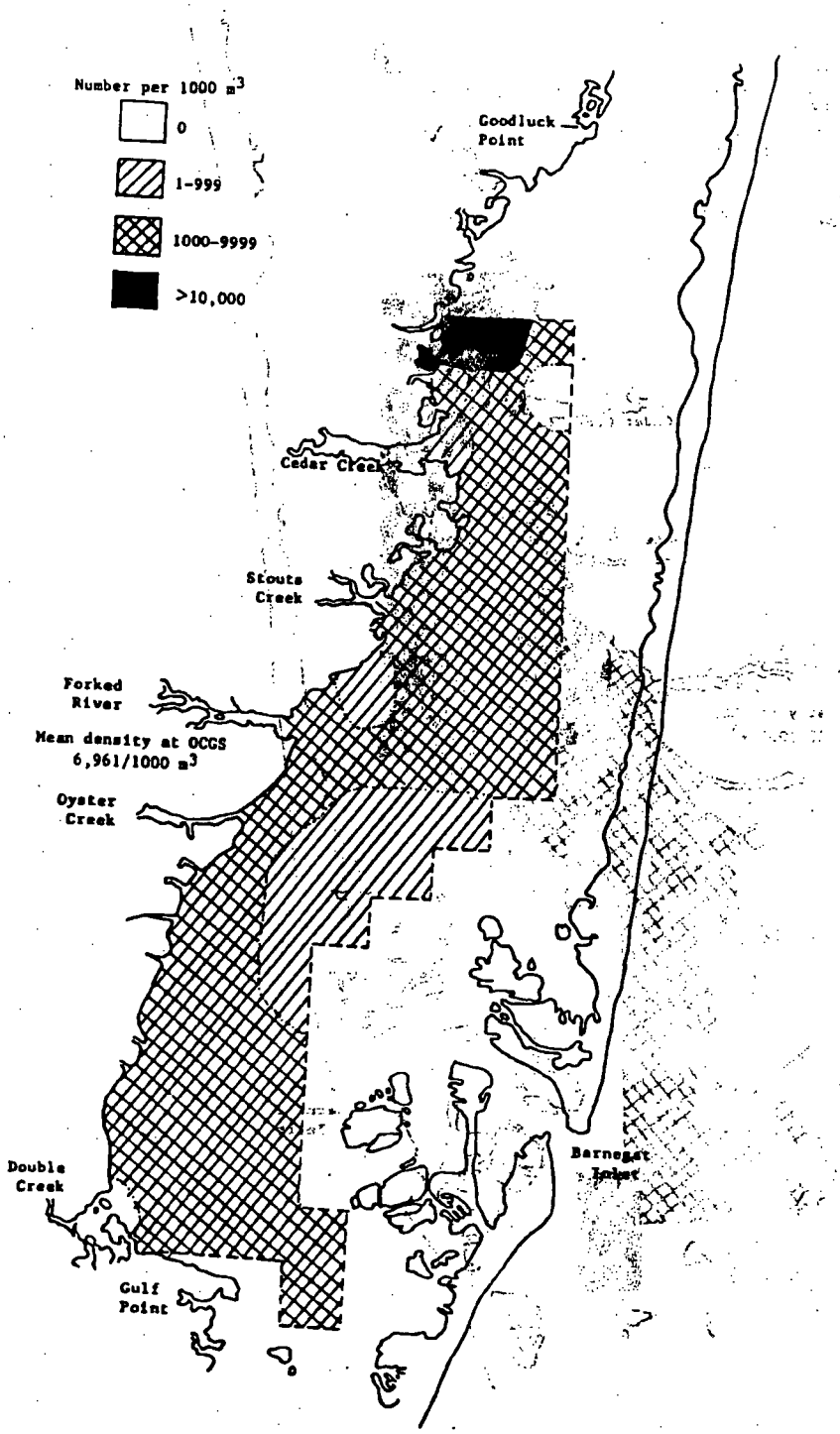

Fig. D1-89. Distribution of Mysidopsis bigelowi on the night of 19 September. Collections were taken within the area bounded by the dashed line.

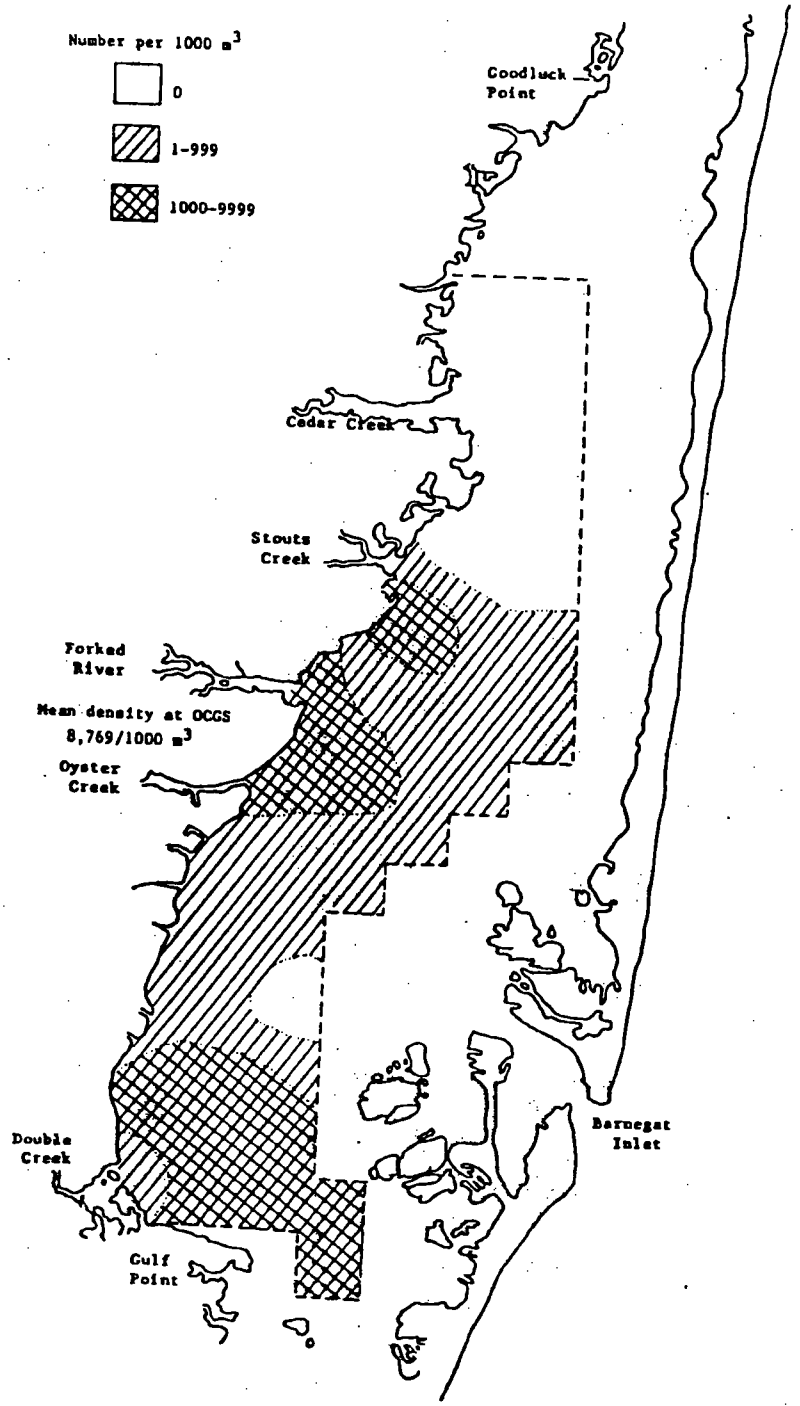

Fig. D1-90. Distribution of Mysidopsis bigelowi on the night of 28 September. Collections were taken within the area bounded by the dashed line.