AB-44

ECOLOGICAL MONITORING AT THE FLORIDA POWER & LIGHT CO. ST. LUCIE PLANT

ANNUAL REPORT 1976

Volume 1

APPLIED BIOLOGY, INC.

Ecological Consultants

5891 NEW PEACHTREE ROAD
ATLANTA, GEORGIA 30340

TABLE OF CONTENTS

VOLUME 1

TABLE OF CONTENTS

VOLUME 2

A. INTRODUCTION

STUDY PURPOSE

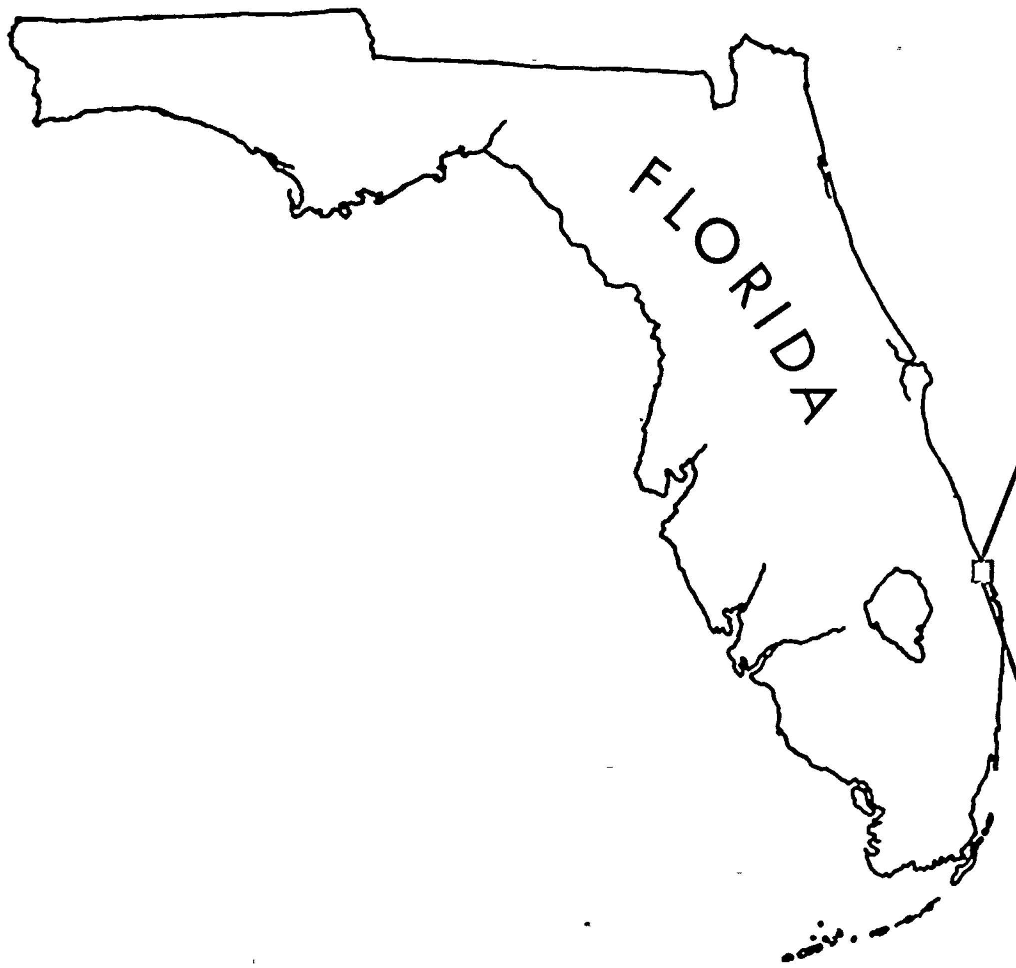
In 1975, Applied Biology, Inc., was asked by Florida Power & Light Company to conduct the Operational Ecological Monitoring Program at their St. Lucie Plant. This program began with preliminary studies on the populations of fishes in the intake and discharge canals in December 1975. The complete sampling program was initiated in March 1976.

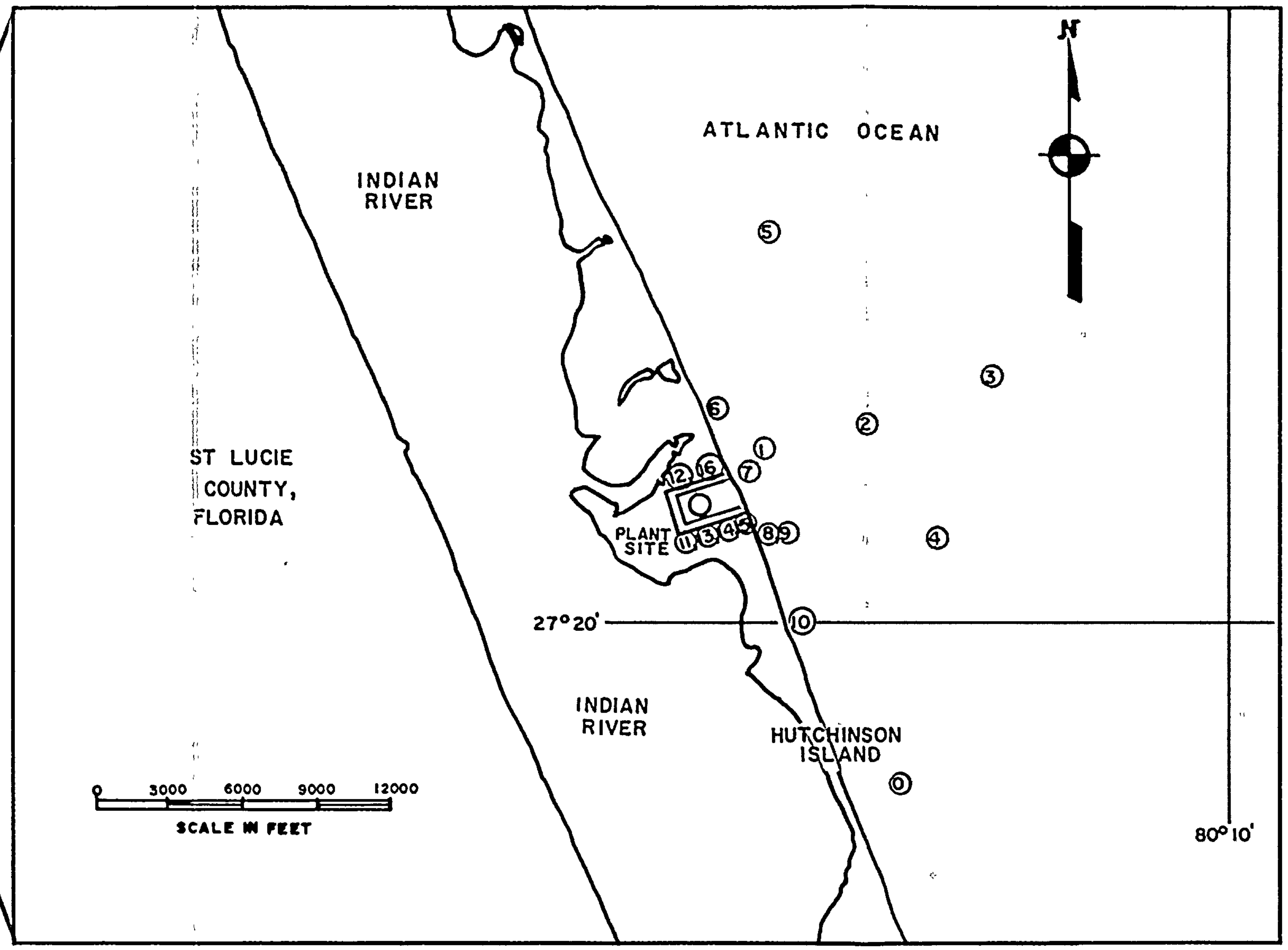
The study was designed to provide information on the effects of operation of the St. Lucie Plant on the indigenous populations of major biotic communities. Seventeen sampling stations (Figure A-1) were established on the plant site and adjacent coastal waters (Table A-1) to study potential plant effects on this marine habitat.

TABLE A-1
OCEANIC SAMPLING STATION LOCATIONS
ST. LUCIE PLANT
1976

Oceanic station	Average depth (m)	Latitude	Longitude
0	8.2	27°19.1' N	80°13.2' W
1	7.6	27°21.2' N	80°14.1' W
2	11.3	27°21.4' N	80°13.3' W
3	7.6	27°21.7' N	80°12.4' W
4	11.3	27°20.6' N	80°12.8' W
5	11.3	27°22.9' N	80°14.0' W

The 1976 sampling program is responsive to portions of the Nuclear Regulatory Commission Environmental Technical Specifications for St.





FLORIDA POWER & LIGHT COMPANY
ST LUCIE PLANT

LOCATION OF ST. LUCIE PLANT
AND SAMPLING STATIONS

MARCH 1977 APPLIED BIOLOGY, INC. FIGURE A-1

Lucie Nuclear Plant Unit 1, as detailed in the Applied Biology, Inc., research proposal of January 1976. The sampling regime is outlined in Table A-2.

SITE DESCRIPTION

The St. Lucie Plant is located on a 1132-acre site on Hutchinson Island in St. Lucie County, Florida (Figure A-1). The island lies between the towns of Fort Pierce and Stuart on the east coast of Florida and is part of a chain of barrier islands which separate the shallow Indian River lagoon from the Atlantic Ocean.

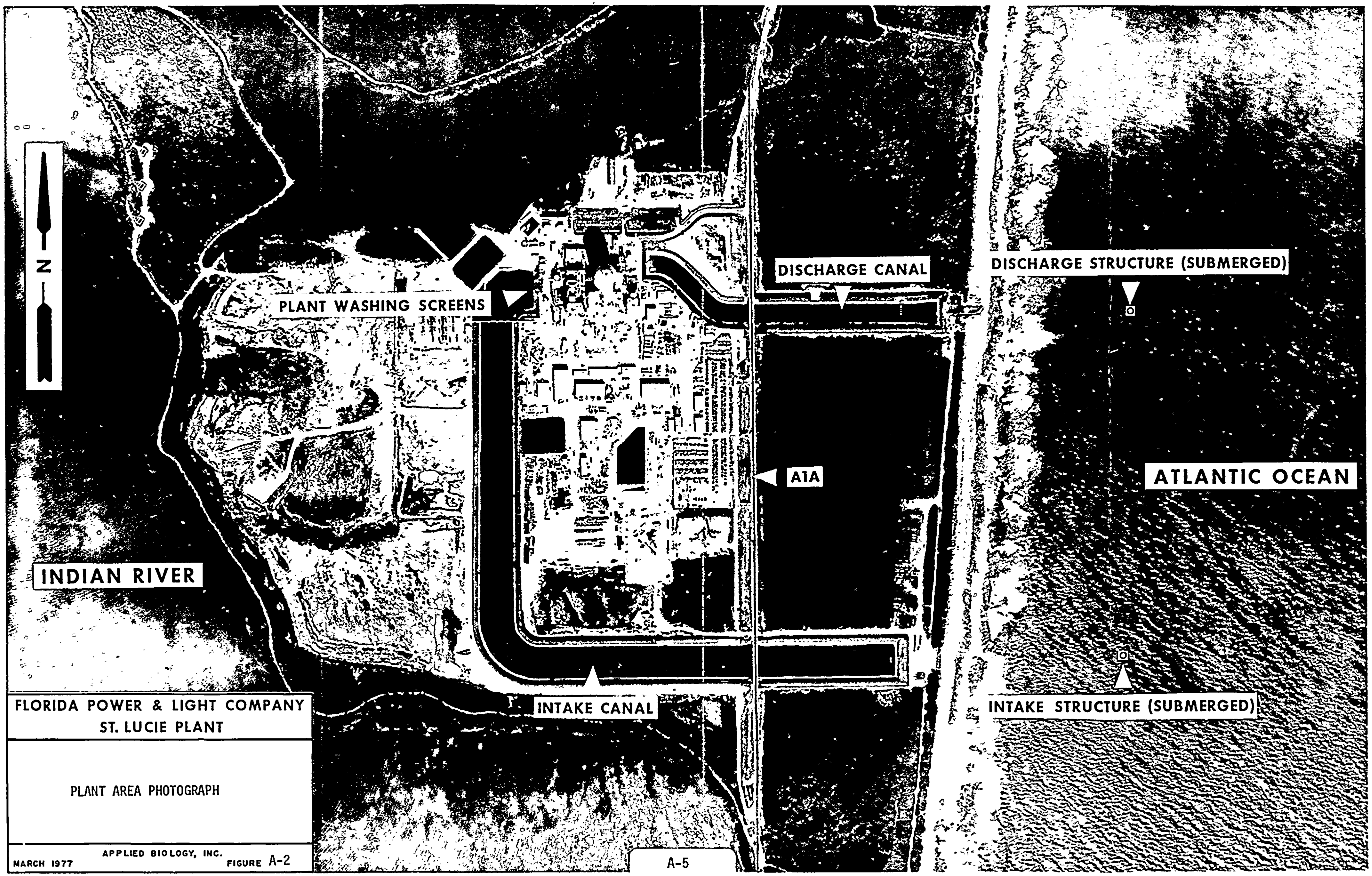
Hutchinson Island is a bar and swale island approximately 22 miles long and up to one mile wide. Sand dunes about 5 meters (15 feet) high line the eastern shore. The dune vegetation is a palmetto and sea grape community which serves to stabilize the shoreline. The western part of the island consists of a mangrove swamp and other tidal littoral vegetation. The interior salt marshes and mangrove communities have been extensively altered over past decades by county mosquito control practices. Large stands of black mangroves, including some on the plant site, have been killed by controlled flooding.

The Atlantic Ocean along Hutchinson Island has an average tidal range of three feet. Gulf Stream currents flow north a few miles offshore, and a weak counter-current usually flows south near shore. The sea floor consists of shifting sand and shell rubble with limited

rock or reef outcroppings. The unstable substrate limits the establishment of rooted macrophytes and attached benthic communities.

The Indian River, west of Hutchinson Island, is a shallow lagoon that receives tidal flushing through the Fort Pierce and St. Lucie Inlets and freshwater runoff from the mainland to the west. The river is a productive region that supports large beds of sea grasses and associated algae and other marine forms.

The St. Lucie Plant presently generates electricity with one 850-megawatt net electric pressurized water reactor. The condenser cooling water is provided by a once-through circulating water system which consists of intake and discharge pipes in the ocean with canals to the plant (Figure A-2). Cooling water is drawn from the Atlantic Ocean through a vertical intake structure located 365 m (1200 ft) offshore. The intake structure is covered with a concrete velocity cap, the top of which is approximately 2.4 m (8 ft) below the water surface. From the intake point, water is drawn into the intake canal through a pipe buried under the dunes. The 90-m (300-ft) wide canal carries the cooling water about 1500 m (5000 ft) to the plant intake structure where pumps provide 33,400 liters/sec (530,000 gal/min) of flow. The water moves through the intake screens, passes through the intake screens, passes through the plant condensers, and is released into the discharge canal.



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT

PLANT AREA PHOTOGRAPH

MARCH 1977 APPLIED BIOLOGY, INC. FIGURE A-2

The design temperature rise of the water passing through the condensers is approximately 24°F (13.4°C). After leaving the plant, the heated water passes through a 60-m (200-ft) wide discharge canal before entering a pipe buried under a dune and the ocean floor. The water is carried about 365 m (1200 ft) offshore and discharged through a Y-shaped pipe 5 m (18 ft) below the water surface. The discharge pipe is located 730 m (2400 ft) north of the intake.

TABLE A-2

BIOLOGICAL SAMPLING SCHEDULE (NUMBER SAMPLES/STATION)
ST. LUCIE PLANT
1976-1977

	Offshore									Intake				Discharge		
Section	0	1	2	3	4	5	6	7	8	11	13	14	15	12	16	Sampling frequency
Adult fish-beach seine							3	3	3							monthly
Adult fish-gill net	1	1	1	1	1	1					1S	1S	1S		1S	monthly
											1B	1B	1B		1B	monthly
Adult fish-otter trawl	1	1	1	1	1	1										monthly
Aquatic macrophytes	2	2	2	2	2	2										quarterly
Benthos-trawl	1	1	1	1	1	1										monthly (with adult fish)
Benthos-grab	4	4	4	4	4	4										quarterly
Ichthyoplankton (fish eggs & larvae)	2	2	2	2	2	2				2				2		twice monthly
Impingement										3						twice weekly (with pumps on)
Phytoplankton and chlorophyll	2S	2S	2S	2S	2S	2S				2S				2S		monthly
	2B	2B	2B	2B	2B	2B				2B				2B		monthly
Thermograph monitoring										Cont.				Cont.		monthly
Water quality & nutrients	2S	2S	2S	2S	2S	2S				2S				2S		monthly
	2M	2M	2M	2M	2M	2M										monthly
	2B	2B	2B	2B	2B	2B				2B				2B		monthly
Zooplankton	2S	2S	2S	2S	2S	2S				2ø				2ø		monthly
	2B	2B	2B	2B	2B	2B										monthly

S = surface sample
M = mid-depth sample
B = bottom sample
ø = oblique tow
Note: Stations 9 and 10 are part of another study.

B. FISH AND SHELLFISH

INTRODUCTION

Fishes distribute themselves within the aquatic ecosystem according to their physiological limitations and biological needs. A consequence of this distribution has been the development of communities or assemblages of fishes which are dependent on the physical conditions and resources of an area. Subsequently, changes in the habitat can lead to a change in the composition of the community.

Changes in community composition and species abundance can be good indicators of environmental alteration (Calhoun, 1966; Warren, 1971). Generally, the harsher the environment, the fewer the number of species but the greater the numbers of individuals of tolerant forms (Warren, 1971).

The purpose of this study was to determine the composition and abundance of fishes in the vicinity of the St. Lucie Plant. The effects of plant operation on habitat, population, distribution and life history were evaluated to determine whether changes in species composition or abundance had occurred.

The evaluation of plant operation required studies of both inshore and oceanic areas. Inshore samples were taken in the

immediate vicinity of the plant. This sampling included collecting impinged specimens at the intake traveling screens and gill netting in the intake and discharge canals. Oceanic samples were taken by gill netting, trawling and beach seining. In analyzing oceanic samples, emphasis was placed on the possible effects of the offshore thermal discharge upon migratory fishes of sport and commercial importance. Ichthyoplankton sampling was conducted both inshore and offshore to evaluate entrainment and thermal discharge effects, respectively.

THE ICHTHYOFAUNAL ASSEMBLAGE

Three relatively distinct oceanic habitats are available to fishes in the vicinity of the St. Lucie Plant: the surf zone, open bottom, and neritic zone.

The surf zone was characterized by water turbulence and a shifting sand substrate. Vegetation and rocky outcroppings or pilings that could provide cover were lacking. One small worm-reef protrusion occurred in the vicinity of the plant, but the amount of cover it provided for fish in the surf zone was minimal. Some species of croaker, Florida pompano and sea catfishes are adapted to these turbulent conditions. Others, such as the herrings, anchovies and jacks (particularly juveniles) seek refuge from predation in the surf zone but move farther offshore at night. Although the herrings and anchovies are considered transients in the surf zone, they were

often the numerically dominant fishes found in this area during the day.

The open bottom beyond the surf zone consisted of a relatively homogeneous shell-hash and, like the surf zone, was lacking vegetation or other cover that could provide shelter for fishes. Dominant fishes were the flatfishes (flounder, sole, and tonguefish), searobins, sand-perch, and cusk-eels. These forms have adapted to living in or on the ocean bottom. Protective coloration and the burying behavior of the flatfish, the hard and spiny exterior of the searobin, and the burrowing nature of the cusk-eel provide some protection against predation on these generally small bottom-dwellers.

The neritic zone consists of the coastal area of open water beyond the surf zone and above the bottom. The vast majority of the fishes found during this study in the vicinity of the St. Lucie Plant were either residents of or transients through the neritic zone. These included the anchovies and herring, Atlantic bumper and other jacks, mojarras, grunts, bluefish, and mackerels. For the most part, the food chain is relatively simple in this type of open oceanic habitat. Phytoplankton and zooplankton serve as a food base for the planktivorous fishes such as anchovies and herring. These, in turn, feed the small piscivorous fishes which support the larger predators such as the jacks, bluefish and mackerels.

The vicinity of the St. Lucie Plant is part of the broad (ca. 27-29°N Latitude) Indian River region. Gilmore (1974) estimates that at least 637 species of fishes could occur in this area of overlap between warm-temperate and tropical Caribbean fish faunas. Extensive collections by the Harbor Branch Foundation (Gilmore, 1974; Jones et al., 1975) indicate that probably less than 40% of these species are characteristic of the surf zone, open bottom, and/or neritic zone. The majority of the species are from the rich grass flats within the Indian River lagoon, from around inlets and surf zone reefs which provide cover, and from the offshore reefs. These inlet and reef zones are most likely beyond the influence of normal operations of the St. Lucie Plant.

IMPINGEMENT

Materials and Methods

The intake structure consists of four bays, each with a bar grill, a traveling screen, a circulating water pump, and auxiliary equipment. Pumps at the intake structure provide a total maximum flow of 2×10^6 liters/min (5.3×10^5 gal/min). The approach velocity to each bay is approximately 30 cm/sec (1 ft/sec).[a] The traveling screens have a mesh size of 9.5 mm (0.38 in) square. Organisms impinged on these screens are washed into a collecting basin and do not survive.

[a] FP&L data, 1971.

Twenty-four hour impingement sampling was initiated on a twice-weekly basis in April 1976. Plant operation was intermittent during July through September, and impingement samples were only taken when the circulating pumps were running. Each 24-hour sampling period was divided into three consecutive 8-hour segments to determine possible diel variations. The time segments were from 0100 to 0900, 0900 to 1700, and 1700 to 0100 hr. Specimens washed off the traveling screens were collected in a 2.9 m^3 (3.8 yd^3) basket of 9.5-mm (0.4-in) square mesh.

Specimens were identified to species, counted, measured to the nearest millimeter, and weighed to the nearest gram. Standard length (SL), the distance from the tip of the snout to the base of the tail, was measured for most fishes. Total length (TL) was measured for fishes and shellfishes with indiscernible tail fins. Carapace (shell) length was measured for shrimp and lobster; carapace width was recorded for crabs. The taxonomic nomenclature for fishes was in accordance with Bailey et al. (1970).

Up to 25 individuals of each species were measured and weighed individually. The total number of individuals, the range of lengths, and the total weight were recorded for the remainder of the specimens of each species. An aliquot was generally taken if the remainder of the specimens totaled 200 or more individuals. Ten to 25% of the

specimens were counted and weighed, and the range of lengths was recorded. When an aliquot was used, the total number of individuals was calculated by:

$$N = \frac{W}{W_1} \times N_1$$

where: N = total number of individuals

W = total weight

N_1 = number of individuals in the aliquot

W_1 = aliquot weight

Results and Discussion

Of the 182 species of fishes collected in the vicinity of the St. Lucie Plant (Table B-1), 125 species (69%) were found during impingement sampling. Individual sampling period data are included in the Appendix (Tables H-1 through H-46) and summarized in Table B-2.

Anchovies (family Engraulidae) occurred in the majority of the samples and comprised 54.5% of the total number of fishes and 22.9% of the biomass. Anchovies accounted for peaks of fish abundance in May (Figure B-1). Anchovies and jacks (Atlantic bumper) represented most of the fishes collected on 21-22 October, when the largest sample was obtained. Anchovies are abundant along the Florida east coast and serve as important forage species for piscivorus fishes. These fishes seldom attain a length of over 76 mm (3 in) and are not sport or commercially harvested.

Jacks (family Carangidae) occurred in over half of the samples and accounted for 30.8% of all fishes collected and 12.2% of the biomass. The predominant jack collected was the Atlantic bumper. Juveniles of this species comprised 61.5% of the total number of fishes collected in the 21-22 October sample (Figure B-1). The Atlantic bumper is also a forage species and is not of sport or commercial importance.

Families of fishes other than anchovies and jacks occurred in relatively low numbers (Table B-2). No other family comprised over 2.8% of the total number of fishes collected. Few sport or commercial fishes were found. Twenty-six black drum and 19 red drum juveniles were collected during all sampling periods combined. Seven juvenile seatrout, one adult seatrout, and four spot were found. Fishes of sport and/or commercial importance besides the sciaenids (drums and seatrout) included five great barracuda and one individual each of gray snapper, striped mullet, Florida pompano, black grouper and cero. No snook, cobia, bluefish, king or Spanish mackerels were collected during impingement surveys, although these species were found to occur offshore and/or in the surf zone.

Fish impingement ranged from 15 to 5,881 individuals per 24-hour sampling period. Mean number of fishes impinged per sample was 351. Biomass of fishes impinged per sample ranged from 26 to 7,933 g

(0.06 to 17.51 lb) with a mean of 1,169 g (2.58 lb). Rates of impingement, expressed as fishes and biomass per hour, are shown in Figures B-1 and B-2, respectively. Exclusive of anchovies and jacks, mean impingement per sample was 46 individuals and 749 g (1.65 lb).

Shellfish of commercial importance collected during impingement sampling included shrimp (*Penaeus, Trachypenaeus,* and *Sicyonia* spp.), blue crab, stone crab, and spiny lobster.

Shrimp comprised 78.1% of the total number of these shellfishes and 23.9% of the total shellfish biomass. Shrimp were collected during every sample and numbered from 5 to 531 (Table B-2), with a mean of 55 individuals, per 24-hour sampling period. The largest numbers of shrimp were found during October and December (Figure B-3). Blue crabs also occurred in every impingement sample and made up 21.4% of the total number of commercially important shellfishes collected and 75.3% of the shellfish biomass. Blue crab impingement ranged from 1 to 65 individuals, with a mean of 15 individuals per sample. The largest numbers were collected from October to December (Figure B-3). Stone crab and spiny lobster impingement was low. Thirteen and four individuals, respectively, were collected during all sampling periods combined.

No commercial landings of shrimp were reported for Martin or St. Lucie Counties in 1974 (Snell, 1976). However, the wide-ranging shrimp boats operate off this area and land their catches elsewhere. A total of about 16,000 kg (35,000 lb) of blue crabs with a dockside value of over $4,000 were reported. Stone crab and spiny lobster landings totaled only 605 and 1,694 kg (1,333 and 3,734 lb), respectively, for Martin and St. Lucie counties in 1974 (Snell, 1976).

The diel studies, conducted to determine differences between daytime and nighttime impingement rates, indicated that there were no significant differences ($P \leq .05$) when all sampling periods were analyzed on the basis of the percentage composition of fishes in the three 8-hour time segments. However, based on absolute numbers, the majority (70%) of the fishes were collected during the 0900-1700 hr segment. This was attributed to "runs" of 545 to 5059 fishes, primarily anchovies, collected during this time segment in five of the 46 sampling periods. Daly (1970) concluded that anchovies feed in the water currents at night and form large schools in protected areas during the day. The tendency for anchovies to congregate during the day could account for the higher impingement rates on the above five occasions.

INSHORE (CANAL) GILL NETS

Materials and Methods

Twice-monthly gill net collections were begun in December 1975 at one intake canal station and one discharge canal station (Stations 15 and 16, respectively). Two additional stations, 13 and 14, were added in the intake canal in January 1976 (Figure B-4). This more intensive effort was incorporated to determine if fishes were accumulating in the intake canal due to entrapment at the intake velocity cap. Sampling was reduced to once per month after April 1976, when results indicated that monthly sampling adequately represented the fish populations.

The nets measured 30.5 m in length by 3 m in depth (100 x 10 ft) and consisted of two 15-m (50-ft) panels of 38- and 51-mm (1.5- and 2-in) stretch mesh sewn end-to-end. One net was fished at the surface and one net at the bottom at each station. The nets at each station were fished at mid-canal and approximately 6 m (20 ft) apart to prevent entanglement (Figure B-5). Sampling duration was two consecutive 24-hour periods.

Water temperature, dissolved oxygen, and salinity were recorded at each station during the sampling periods.

Inshore gill net specimens collected were analyzed by the same methods described under Impingement: Materials and Methods.

Results and Discussion

Inshore gill net data are summarized in Table B-3. All sampling period data are included in the Appendix (Tables H-47 through H-79).

A total of 494 fishes and 64 shellfishes were collected in the intake and discharge canals. The most common fishes collected were croakers, representing 25.3% of the total fishes found. Mullet accounted for 19.6% of the fishes collected, followed by grunt (16.2%), snapper (12.6%), jack (7.7%), porgy (3.2%), and mojarra (2.0%). The remainder of the fishes consisted of families which comprised fewer than 2.0% of the total. Blue crabs accounted for 76.6% of the shellfishes collected.

The rate of capture, calculated as the number of fishes collected per net per 24 hours fished, ranged from zero to five (Figure B-6). No build-up or entrapment of fishes was identified in either the intake or discharge canals. The offshore inlet of the intake pipe was equipped with a velocity cap to ensure a horizontal direction of approach and an intake water velocity of about 61 cm/sec (2 ft/sec).[a] Fishes are likely to detect and avoid a horizontal flow, whereas they may become entrapped by a downward flow. The intake water flow was of sufficient velocity to allow detection and avoidance by fishes. The velocity cap apparently limited the number of fish entering the intake canal.

[a] FP&L data, 1971

The progressive decrease in the number of fishes collected in the discharge canal (Figure B-6) was attributed to movement with the outward flowing current. Additionally, this current will probably limit re-entry by fishes into the discharge canal.

OFFSHORE GILL NETS

Materials and Methods

Monthly gill net collections were initiated in March 1976 at six offshore stations. Stations 1 through 5 were in the vicinity of the plant and Station 0 (control) was located to the south (Figure B-7). The offshore gill net measured 183 m in length by 3.7 m in depth (600 x 12 ft) and was made up of five 36.6-m (120-ft) panels sewn end-to-end. The mesh size of the panels varied, measuring 64, 74, 84, 97 and 117 mm (2.5, 2.9, 3.3, 3.8 and 4.6 in., respectively) stretch length (Figure B-8). The net was fished on the bottom, perpendicular to shore, for 30 minutes at each station.

Water depth, temperature, salinity, dissolved oxygen, turbidity, and transmitted light were recorded at each station during the sampling periods.

Offshore gill net specimens were analyzed by the same methods described under Impingement: Materials and Methods.

Results and Discussion

The Atlantic bumper, crevalle jack, and blue runner (family Carangidae) comprised 66.7% of the 1,734 total fishes collected (Table B-4). Spanish mackerel accounted for 10.3% of the total. The remainder of the fishes consisted of species in which fewer than 100 individuals of each were found. Lengths and weights of these fishes are included in the Appendix (Tables H-80 through H-89).

Forty-seven percent of all fishes collected were from near the point of plant discharge (Station 1). A large number (318) of crevalle jack collected in November and December (Table B-4) partially accounted for the largest percentage of fishes being collected at this station. Whether individuals of this species were attracted to the discharge area or whether these collections were chance occurrences is unresolved at this time.

Exclusive of the above-mentioned crevalle jack, the total number of fishes collected near the point of discharge at Station 1 was comparable to the number collected at the control (496 vs 532 individuals). There was considerable variation both within and between stations over the 10 months sampled, although fewer numbers of fishes were collected overall at Stations 2 through 5 than at 0 and 1 (Figure B-9). The fishes collected were primarily pelagic species whose movements probably accounted for many of these

variations. The larger number of fishes collected at Stations 0 and 1 (over Stations 2-5) was attributed to these stations' nearshore location. Forage species would be more abundant nearshore and would, in turn, attract the larger predators.

The Spanish mackerel was common in March, October and December (Table B-4). This is an important sport and commercial species. Commercial landings in 1974 in Martin and St. Lucie Counties totaled about 590,000 kg (1.3 million lb) with a dockside value to the fishermen of approximately $228,000 (Snell, 1976).

The Spanish mackerel is a migratory species which moves north in the spring, spawns during the summer months in the northern part of its range (north of Cape Canaveral on the Atlantic coast), and migrates south in the fall (Wollam, 1970). The largest number of individuals was collected in the control area south of the plant (Station 0); the second largest number was collected near the point of plant discharge at Station 1 (Table B-4). Movements of these fishes are generally nearshore, as evidenced by operations of the commercial fishermen. The majority of the Spanish mackerel being collected at these two stations was to be expected. No influence by the plant discharge on the migratory pattern and/or nearshore movement of these fishes was observed.

The relationship between lengths and weights are of value in delineating differences in the general physical condition of individuals within or between different areas or at different times of the year. Length/weight relationships for the months of March, October and December, when Spanish mackerel were common in our samples, are plotted in Figure B-10 through B-12. Individuals collected in October and December were generally smaller in both length and weight than those collected in March. Nevertheless, the length/weight relationships (or the slope of the line drawn between the points on each of the figures) are comparable between months. Additionally, no differences in the length/weight relationships between stations were apparent.

Fishes of major[a] sport and/or commercial importance in the St. Lucie area, other than Spanish mackerel, include bluefish and king mackerel. A total of 312,600 and 536,500 kg (686,500 and 1,182,700 lb), respectively, were landed in Martin and St. Lucie Counties in 1974 (Snell, 1976). Ninety-one bluefish and three king mackerel were collected during gill net operations. The bluefish were collected from October to December, primarily in the nearshore areas (Stations 0 and 1, Appendix Tables H-87 through H-89). Twenty-eight bluefish were found at the control (Station 0) and 59 near the point of discharge

---

[a] Comprising over 272,000 kg (600,000 lb) commercially landed in Martin and St. Lucie Counties in 1974.

(Station 1), which would indicate no avoidance of the discharge area. Bluefish are winter visitors to the St. Lucie area. Northerly movement occurs during spring and summer (Beaumariage, 1969) and spawning occurs in offshore waters north of Florida in early summer (Deuel et al., 1966). Northward movement along the Florida coast is probably part of a spawning migration by that part of the population that extends its winter range into south Florida waters (Moe, 1972).

Three king mackerel were collected by gill net operations during the entire study. These were collected in March at Station 1 (near shore around the point of plant discharge) and farther offshore from the plant at Stations 2 and 4 (Appendix Table H-80). The king mackerel is very similar to the Spanish mackerel in its migratory habits; it moves north in the spring, spawns in the summer months north of Cape Canaveral on the Atlantic coast, and moves south in the fall (Wollam, 1970). In addition to its commercial importance, this species is considered the most prominent marine fish in the sport fishery in Florida (Beaumariage, 1973). This species generally occurs farther offshore than the bluefish and Spanish mackerel, as evidenced by only a few individuals in our gill net collections. It is doubtful that plant operations would influence the movements of this species.

Fishes of lesser sport and/or commercial importance included 82 menhaden[a] collected mainly in December at Stations 0 and 1, and 14 greater amberjack collected at Station 3 (the farthest offshore station) in November. Fewer numbers of fishes were collected for cobia (8 individuals), weakfish (3), gray snapper and sheepshead (2 each), and mutton snapper, African pompano, and Florida pompano (1 each).

TRAWLS

Materials and Methods

Monthly trawls at six offshore stations (Figure B-7) were begun in April 1976. One 15-minute tow was made at each station using a 5-m (16.5-ft) semi-balloon bottom trawl of 12.7-mm (0.5-in) stretch mesh in the bag and 6.4-mm (0.3-in) stretch mesh in the cod end (Figure B-13). A digital flowmeter (General Oceanics Model 2030) was used during each tow to enable calculation of the distance trawled. All trawling was conducted at night to limit net avoidance by the fishes.

Water depth, temperature, salinity, dissolved oxygen, and turbidity were recorded at each station during the sampling periods.

Trawl specimens collected were analyzed by the same methods described under Impingement: Materials and Methods.

---

[a] Menhaden are of major commercial importance in northern Florida, but not in the St. Lucie area.

Results and Discussion

Data collected during monthly trawling surveys are summarized in Table B-5. Appendix Tables H-90 through H-99 contain results of the individual trawls and include length and weight data.

Flatfishes such as flounder, sole, and tonguefish were the most common group, comprising 19.6% of the 656 total fishes collected. Other frequently occurring fishes included searobin (17.1% of the total fishes), sand perch (13.1%), cusk-eel (11.0%), grunt (9.3%), snapper (4.1%) and mojarra (4.0%). The remainder of the fishes consisted of species in which fewer than 15 individuals were collected during all sampling periods combined. Grunt, snapper and mojarra enter the commercial landings in Martin and St. Lucie Counties (Snell, 1976), although they are of minor importance compared to other species.

The numbers of fishes collected within and between stations differed considerably (Figure B-14). The largest mean number (15.0) of fishes was collected at Station 5 north of the plant area. Station 0 (control south of the plant area) had a mean of 14.3 fishes and Station 1 in the area of the discharge has a mean of 12.4. The lowest mean number (7.0) of fishes was collected over Pierce Shoals (Station 3), and the mean was only slightly higher at Stations 4 and 2 (7.9 and 9.0, respectively). No plant-related effects can presently be inferred from the above distribution of fishes.

BEACH SEINES

Materials and Methods

Beach seining was initiated in March 1976 at stations located north of the discharge, between the discharge and intake, and south of the intake (Stations 6 through 8; Figure B-7). Three replicate seine hauls were made at each station during each sample period.

The seine was 30.5 m in length by 1.8 m in depth (100 x 6 ft), with a mesh size of 12.7 mm (0.5 in) square. It was heavily weighted along the bottom and had extra flotation along the top to maintain a hanging position under surf conditions. The rolled net was carried out to a depth of approximately 1.2 m (4 ft), deployed parallel to shore, and pulled in perpendicular to shore and onto the beach.

Water temperature and salinity were recorded at each station.

Seine specimens were analyzed by the same methods described under Impingement: Materials and Methods.

Results and Discussion

Herring and anchovy accounted for over half the 1211 fishes collected during beach seine surveys (Table B-6). Spot, sand drum and kingfish each accounted for 8 to 9% of the fishes encountered. Other fish species each comprised 6% or less of the total. The

speckled crab was the predominant shellfish collected. Length and weight data on these fishes and shellfishes are included in Appendix Tables H-100 through H-109.

Fifty-six percent of all fishes collected were found north of the discharge (Station 6; Figure B-7), 14% were found between the discharge and intake (Station 7), and 30% south of the intake (Station 8).

The extreme variations between stations and between replicates at the same station (Figure B-15) are attributed to the chance occurrences of schooling species. For example, the herring collected in June at Station 8 and the anchovies found in July at Station 6 (Table B-6) accounted for 52.6% of all the fishes collected during beach seining operations. Exclusive of these two occurrences, the composition of fishes collected at the three stations varied from 29.5 to 36.8%. It is doubtful that plant operations are influencing the occurrence of fishes along the beach.

ICHTHYOPLANKTON

Materials and Methods

A number of areas along the Atlantic coast are known to be used by fishes for reproduction and/or as nursery grounds. Many fishes spawn seasonally in the same areas year after year. These

reproductive areas are either situated in a nursery area that has an adequate larval food source, or are geographically positioned so that the larvae will drift into a suitable nursery area (Cushing, 1975; Marshall, 1966). The developmental stages of many of these fishes are planktonic and are limited in their ability to avoid unfavorable environmental conditions. In addition, the eggs and larvae of fishes have specific environmental requirements, with little tolerance for abrupt physical or chemical changes.

To determine whether the St. Lucie plant area is used by fishes for reproduction and/or as a nursery, and whether there were plant-related effects, an ichthyoplankton survey was made in the plant area. Ichthyoplankton in the intake (Station 11) and discharge canals (Station 12) and at oceanic Stations 0 through 5 (Figure B-7) were collected twice a month by towing a one-meter diameter, 505-micron mesh net near the surface. The net was towed for 10 to 15 minutes at 3.5 to 4.0 knots. A General Oceanics Model 2030 flowmeter mounted in the mouth of the net enabled calculation of the volume of water filtered. Water volume through the net was calculated by:

$$\text{Cubic meters} = AVT$$

where: A = area of the mouth of the net (m^2)

V = velocity of current (m/sec)

T = time (sec)

Various physical parameters were recorded at the time and location of each sample. Except for occasional night samples at Stations 0

through 5, all ichthyoplankton samples were taken during the day. Fish eggs and larvae were preserved in the field in a 5% formalin solution and returned to the laboratory for analysis.

Larval fishes and eggs were identified to the lowest practical taxon. Although some fish larvae were identified to the generic or species level, these data are presented and analyzed at the ordinal and familial levels to facilitate discussion. After the specimens were identified, the size range and total number of eggs and larvae in each collection were determined and the number per unit volume was calculated.

Results and Discussion

Data from the ichthyoplankton survey are presented in Appendix Tables H-110 to H-127. Spawning was highest in spring and gradually decreased throughout the remainder of the year (Figure B-16). The higher numbers of eggs per cubic meter were recorded in March ($25.5/m^3$) and June ($19.6/m^3$). Fahay (1975) indicated that along the east coast of the United States peak spawning occurred in the spring and summer. In temperate and high latitudes, spawning usually occurs in the spring and fall. In tropical and subtropical waters, however, spawning may occur throughout the year. The area of the St. Lucie plant borders temperate subtropical waters. Thus, in this area spawning could occur for some fishes seasonally and

and for others year-round. Both types of spawning apparently occurred in the plant area.

Two peaks of larval abundance occurred in the vicinity of the St. Lucie Plant, once in the spring and again in the fall (Figure B-16). During these periods the mean number of larvae per cubic meter, based on data from Stations 0 through 5, was highest in April (0.641/m^3) and September (3.074/m^3). During the summer, low numbers of larvae and high numbers of eggs were collected (Figure B-16). Since the plant was usually not in operation during the summer, this result was not considered plant-related.

The timing of spawning may be adapted to the cyclical production of plankton in order to ensure an abundant larval food supply (Jones, 1973; Cushing, 1975, 1973, 1972). Studies on the diet of larval fishes have indicated that small zooplankters, especially copepod larvae, are the first food source many larval fishes use shortly before or after yolk-sac absorption (Bainbridge and McKay, 1968; Cushing, 1959; Lebour, 1921, 1919, 1918). This period is critical to larval survival because once the larvae absorb their yolk-sacs, they die within hours if a food source is not available.

The concentration of food organisms also affects larval feeding success and survival. Blaxter (1963) reviewed a number of field studies and concluded that larvae were most abundant when food items

were present at a concentration of about 30 organisms per liter. Lisinvnenko (1961) found that the abundance of herring larvae increased five-fold with an increase in food items from about 5 to 20 organisms/liter.

At oceanic stations larval abundance was concomitant with zooplankton production periods (Figure B-16). Median zooplankton density ranged from 2.14 to 0.37 organisms/liter in March and April, and from 4.45 to 1.44 organisms/liter in September and October.

It is evident that environmental changes that reduce plankton production or disrupt the link between recruitment and production of larval food in reproductive areas may affect the ecology of coastal fisheries. The results of this study indicate that plant operation apparently has not altered relationships between recruitment and the production of potential larval food.

The presence of eggs and larvae along with an apparently adequate food source in the plant area suggests that this area is used both for reproduction and as a nursery area. However, based on the findings of this study and those of Fahay (1975) and Burrell (1975), this area is not considered either unusually productive or depauperate in comparison to other areas along the southeast coast of the United States.

Night ichthyoplankton collections, which had up to 83 times as many larvae as the day collections (Table B-7), suggested that either larvae were more able to avoid the net during the day (Clutter and Anraku, 1968) or a vertical migration of larvae to the surface was occurring at night. The numbers of eggs per cubic meter, however, were consistently higher during the day (Table B-7); the cause of this phenomenon is not known.

Of the major categories of fish larvae collected at the oceanic Stations (0 through 5), blenniids (blennies), tetraodontiforms (puffers, triggerfishes and filefishes), clupeiforms (herrings and anchovies), and carangids (jacks) were most abundant in the spring. Tetraodontiforms, clupeiforms and gerreids (mojarras) were most abundant in the summer; gerreids, carangids and sciaenids (drums) were most abundant in the fall (Table B-8).

At Station 11 (intake canal), clupeiforms were the major category of larval fishes collected, making up more than 65% of all the fish larvae found at this station during any season (Table B-8). All other larval categories were occasionally collected in low numbers (Appendix Tables H-110 to H-127).

At Station 12 (discharge canal), clupeiforms, blenniids and gobiids were the dominant larval categories (Table B-8); however,

they were only occasionally collected in very low numbers (Appendix Tables H-110 to H-127). Except for the carangids, the adults of these taxa are primarily inshore spawners (Bohlke and Chaplin, 1968; Breder and Rosen, 1966). According to Berry (1959), the occurrence of carangid larvae inshore can be attributed to the tendency of some species in this group (e.g., crevalle jack and horse-eye jack) to migrate inshore at relatively small sizes (21-50 mm standard length).

The percentage composition of clupeiforms (herrings) was usually much higher at Station 11 in the intake canal than at the nearest oceanic station, Station 1 (Table B-8). In addition, larval densities were usually lower in the intake canal than at Station 1 (Appendix Tables H-110 to H-127). The entrainment of clupeiforms into the intake canal is not considered to be highly detrimental to the clupeid populations in the plant area in light of their high fecundity and abundance. The clupeiforms occurring in the area are important forage fishes, but they are not economically important.

No single oceanic station or group of stations consistently had significantly higher or lower ichthyoplankton densities than the other stations (Tables B-9 to B-11). This finding indicates that differences between the oceanic stations were random and probably reflect a patchy ichthyoplankton distribution.

Although not all differences in egg densities between Stations 11 and 12 were significantly different, Station 11 (intake canal) usually had higher densities of eggs than Station 12 (discharge canal) (Table B-11). Larval densities at these stations were usually not significantly different from each other, and no trend was apparent in the differences that occurred (Table B-11). Analysis of variance techniques (Sokal and Rohlf, 1969; Steel and Torrie, 1960) indicated that significant differences in larval or egg densities that occurred between stations were independent of plant operation mode (Table B-11). In effect, differences between stations could not be attributed to plant operation.

Of the physical parameters correlated with ichthyoplankton density, only the correlations with water temperature and dissolved oxygen proved significant (Table B-12). In general, single or multiple variable correlations with ichthyoplankton abundance or location have not been very successful (Parsons and Takahashi, 1973). In a review of the effects of abiotic factors on marine ichthyoplankton, Lillelund (1965) concluded that abiotic factors had only an indirect effect and that overall effects were complex and probably associated with biotic factors.

Egg abundance and water temperature had a negative correlation. According to Jones (1964), an indirect negative effect of temperature

on egg distribution and survival could result from the addition of heated effluents which may lower the density of ambient water. This would affect the buoyancy of pelagic eggs and cause them to sink (deSylva, 1969). As expected, egg abundance and salinity also had a negative correlation, although this correlation was not statistically significant (Table B-12). Since differences in the abundance of eggs at the oceanic stations were usually not significant when the plant was in operation, these indirect relationships were not attributed to plant operation.

Larval abundance, however, was found to increase with increased water temperature (Table B-12), probably because plankton production increases with warmer water temperature. Hermann (1953) related year-class strength directly to water temperature; warm temperatures resulted in good growth of herring, apparently because of an increased food supply. Although larval abundance and water temperature in the plant area were related to each other, this relationship was not attributed to plant operation because statistical differences in larval densities at Stations 0 through 5 were not consistent with respect to any one station or group of stations (Table B-9).

SUMMARY

The purpose of this study was to determine the composition and abundance of fishes in the vicinity of the St. Lucie Plant. The

effects of plant operation on habitat, population, distribution and life history were evaluated to determine if changes in species' composition or abundance occurred.

The evaluation of plant operation required studies of both inshore and oceanic areas. Inshore samples were taken in the immediate vicinity of the plant. This sampling included collecting impinged specimens at the intake traveling screens and gill netting in the intake and discharge canals. Oceanic samples were taken by gill netting, trawling and beach seining. In analyzing oceanic samples, emphasis was placed on the possible effects of the offshore thermal discharge upon migratory fishes of sport and commercial importance. Ichthyoplankton sampling was conducted both inshore and offshore to evaluate entrainment and thermal discharge effects, respectively.

One hundred eighty-two species of fishes were collected in the vicinity of the St. Lucie Plant. Habitats within the area of potential plant influence include the surf zone, open sand bottom and neritic zone.

Anchovies and jacks (primarily Atlantic bumper) comprised 85.2% of the total fishes impinged and 35.1% of the total biomass. Exclusive of anchovies and jacks, mean impingement was 46 individuals and 749 g (1.65 lb) per 24-hr sample period. Few sport or commercial

fishes were found. Shrimp and blue crab were the predominant shellfishes of commercial importance found. Mean impingement rates were 55 and 15 individuals, respectively, per 24-hr sample period. No significant difference ($P \leq .05$) occurred between day and night impingement rates, based on the percentage composition of fishes collected.

A total of 494 fishes and 64 shellfishes were collected by gill netting in the intake and discharge canals. The rate of capture, calculated as the number of fishes collected per net per 24 hours fished, ranged from zero to five. No build-up or entrapment of fishes was identified in either canal.

Jacks comprised the majority of the fishes collected by offshore gill netting. Exclusive of a large number of crevalle jack collected on two occasions, the discharge station was comparable to the control station in the number of fishes found. The majority of the fishes were collected at these two stations and this was attributed to their nearshore location. Fishes of major sport and commercial importance included Spanish mackerel, king mackerel, and bluefish. No influence by the plant discharge on the migratory pattern and/or nearshore movement of these fishes was observed.

Flatfishes, searobin, sand perch and cusk-eel comprised the majority of the 656 total fishes collected during offshore trawling

operations. The numbers of fishes collected within and between stations differed considerably. No plant-related effects could be inferred from the distribution of fishes found.

Herring and anchovy accounted for over half the 1211 fishes collected during beach seine surveys. The extreme variations between stations and between replicates at the same station are attributed to the chance occurrences of schooling species. It is doubtful that plant operations are influencing the occurrence of fishes along the beach.

The presence of eggs and larvae in the plant vicinity suggested that this area was used both for reproduction and as a nursery area. Egg densities were highest in March (25.5/m^3) and gradually decreased throughout the remainder of the year. Larval densities were high in April (0.641/m^3) and September (3.074/m^3). Clupeiforms comprised the majority (65%) of the larval fishes collected in the intake canal. Larval densities were usually lower in the intake canal than at the nearest offshore station. Differences between stations could not be attributed to plant operation. Differences between the oceanic stations were random and probably reflected a patchy ichthyoplankton distribution.

LITERATURE CITED

Bailey, R. M., J. E. Fitch, E. S. Herald, E. A. Lachner, C. C. Lindsey, C. R. Robins, and W. B. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada, 3rd ed. Amer. Fish. Soc., Spec. Publ. No. 6. 149 pp.

Bainbridge, V., and B. J. McKay. 1968. The feeding of cod and redfish larvae. Int. Commn. North West Atl. Fish. Spec. Publ. 7(1):187-217.

Beaumariage, D. S. 1969. Returns from the 1965 Schlitz tagging program including a cumulative analysis of previous results. Fla. Dept. Nat. Resources Mar. Lab., Tech. Ser. 59. 38 pp. (from Moe, 1972).

_______________. 1973. Age, growth, and reproduction of king mackerel, *Scomberomorus cavalla,* in Florida. Fla. Dept. Nat. Resources Mar. Res. Lab., Publ. No. 1. 45 pp.

Berry, F. H. 1959. Young jack crevalles (*Caranx* species) off the southeastern Atlantic coast of the United States. U.S. Fish Wildl. Serv., Fish. Bull. 59:417-535.

Blaxter, J. H. S. 1963. The feeding of herring larvae and their ecology in relation to feeding. Calif. Coop. Oceanic Fish Investig. Rep. 10. pp. 79-88.

Böhlke, J. E., and C. C. G. Chaplin. 1968. Fishes of the Bahamas and adjacent tropical waters. Livingston Publ. Co., Wyneewood, Pa. 771 pp.

Breder, C. M., and D. E. Rosen. 1966. Modes of reproduction in fishes. Natural History Press, Garden City, N.Y. 941 pp.

Burrell, V. G., Jr. 1975. The relationship of proposed offshore nuclear power plants to marine fisheries of the south Atlantic region of the United States. IEEE Ocean 75:491-495.

Calhoun, A. 1966. Inland fisheries management. Calif. Dept. Fish and Game, Sacramento. 546 pp.

Clutter, R. I., and M. Anraku. 1968. Avoidance of samplers. Pages 57-76 *in* Zooplankton sampling. Monographs on oceanographic methodology. Unesco Press, Paris. 174 pp.

Colton, J. B., Jr., and R. R. Marak. 1969. Guide for identifying the common planktonic fish eggs and larvae of continental shelf waters, Cape Sable to Block Island. Bur. Comm. Fish. Lab. Rep. 69-9. 43 pp.

LITERATURE CITED (continued)

Cushing, D. H. 1959. On the nature of production in the sea. Fish. Invest. Land. Ser. 2. Vol. 22, No. 6. 40 pp.

____________. 1972. The production cycle and numbers of marine fish. Symp. Zool. Soc. Lond. 29. pp. 213-32.

____________. 1973. The natural regulation of fish populations. Sea Fisheries Research. pp. 399-411.

____________. 1975. Marine ecology and fisheries. Cambridge University Press, London. 278 pp.

Daly, R. J. 1970. Systematics of southern Florida anchovies (Pisces: Engraulidae). Bull. Mar. Sci. 20(1):70-104.

de Sylva, D. P. 1969. Theoretical considerations of the effects of heated effluents on marine fishes. Pages 229-293 *in* Peter A. Krenkel and Frank L. Parker, eds. Biological aspects of thermal pollution. Vanderbilt Univ. Press.

Deuel, D. G., J. R. Clark, and A. J. Mansueti. 1966. Description of embryonic and early larval stages of bluefish, *Pomatomus saltatrix*. Trans. Amer. Fish. Soc. 95(3):264-271.

Fahay, M. P. 1975. An annotated list of larval and juvenile fishes captured with surface-towed meter net in the South Atlantic Bight during four RV Dolphin cruises between May 1967 and February 1968. NOAA Technical Report, NMFS SSRF-685. 39 pp.

Florida Power & Light Co. 1971. Hutchinson Island Plant Unit No. 1: environment report. Docket No. 50-335, FP&L Co., Miami.

Gilmore, R. G., Jr. 1974. A regional description and checklist of fishes of the Indian River. Pages 119-183 *in* H. A. Fehlmann, principal investigator. Indian River study: first annual report. Harbor Branch Consortium, Fort Pierce, Fla. 183 pp. (unpublished manuscript).

Hermann, Frede. 1953. Influence of temperature on strength of cod year-classes. Annls. Biol. Copenh. 9:31-32.

Hildebrand, S. F., and L. E. Cable. 1938. Further notes on the development and life history of some teleosts at Beaufort, N.C. Bull. Bureau of Fisheries 48(24):505-642.

LITERATURE CITED (continued)

Hildebrand, S. F., and L. E. Cable. 1930. Development and life history of fourteen teleostean fishes at Beaufort, N.C. Bull. Bureau of Fisheries 46(7):383-488.

Jones, J. R. E. 1964. Thermal pollution: the effect of heated effluents. Chapter 13 *in* Fish and river pollution. Butterworths, London.

Jones, R. 1973. The stock and recruitment relation as applied to the North Sea Haddock. Rapp. Proces-Verb. Cons. Int. Explor. Mer. 164. pp. 156-73.

Jones, R. S., R. G. Gilmore, Jr., G. R. Kulczycki, W. C. Magley, and B. Graunke. 1975. Studies of the fishes of the Indian River coastal zone. Pages 57-88 *in* D. K. Young, ed. Indian River coastal zone study: second annual report. Harbor Branch Consortium, Fort Pierce, Fla. 180 pp. (unpublished manuscript).

Lebour, M. V. 1918. The food of post larval fish. Part I. J. Mar. Biol. Ass. U.K. 11:433-69.

__________. 1919. The food of post larval fish. Part II. J. Mar. Biol. Ass. U.K. 12:22-47.

__________. 1919. The food of post larval fish. Part III. J. Mar. Biol. Ass. U.K. 12:261-324.

__________. 1921. The food of young clupeoids. J. Mar. Biol. Ass. U.K., 12:458-67.

Lillelund, K. 1965. Effect of abiotic factors in young stages of marine fish. ICNAF Spec. Publ. 6. pp. 674-686.

Lippson, A. J., and R. L. Moran. 1974. Manual for identification of early developmental stages of fishes of the Potomac Estuary. Martin-Marietta Corp. 282 pp.

Lisivnenko, L. N. 1961. Plankton and the food of larval Baltic herring in the Gulf of Riga. Trudy N.-I. Instituta Rybnogo Khoziaistva Soveta Narodnogo Khoziaistva Latviiskoi SSR 3. pp. 105-138. (Fish. Res. Bd. Canada, Trans. No. 444. 36 pp.

LITERATURE CITED (continued)

Mansueti, A. J., and J. D. Hardy. 1967. Development of fishes of the Chesapeake Bay region. Natural Resource Institute, Univ. of Maryland, College Park. 199 pp.

Marshall, N. B. 1966. The life of fishes. The World Publishing Co., Cleveland, Ohio. 402 pp.

Moe, M. A., Jr. 1972. Movement and migration of south Florida fishes. Fla. Dept. Nat. Resources Mar. Res. Lab., Tech. Ser. No. 69. 25 pp.

Parsons, T., and M. Takahashi. 1973. Biological oceanographic processes. Pergamon Press, New York. 186 pp.

Scotton, L. N., R. E. Smith, N. S. Smith, K. S. Price, and D. P. de Sylva. 1973. Pictorial guide to fish larvae of Delaware Bay, with information and bibliographies useful for the study of fish larvae. Delaware Bay Rep. Series, Vol. 7. College Marine Studies, Univ. of Delaware. 206 pp.

Snell, E. J. 1976. Florida landings, annual summary 1974. Natl. Mar. Fish. Serv., NOAA, Current Fish. Stat. No. 6719. 11 pp.

Sokal, R. R., and F. J. Rohlf. 1969. Biometry. W. H. Freeman and Co., San Francisco. 776 pp.

Steel, R. G. D., and J. H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill, New York. 481 pp.

Warren, C. E. 1971. Biology and water pollution control. W. B. Saunders Co., Philadelphia. 434 pp.

Wollam, M. B. 1970. Description and distribution of larvae and early juveniles of king mackerel, *Scomberomorus cavalla* (Cuvier), and Spanish mackerel, *Scomberomorus maculatus* (Mitchill); (Pisces: Scombridae); in the western North Atlantic. Fla. Dept. Nat. Resources Mar. Res. Lab., Tech. Series No. 61. 35 pp.

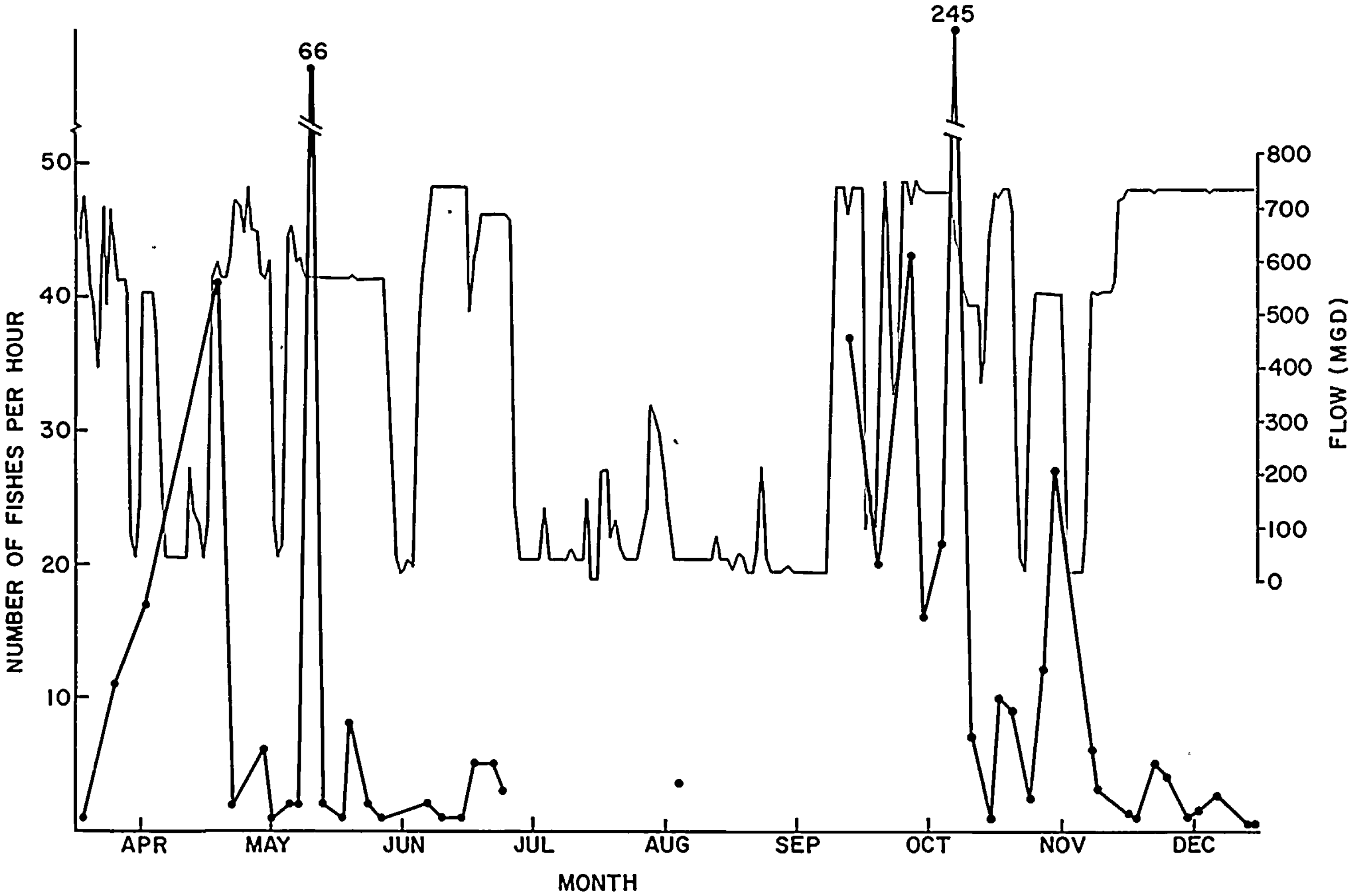


Figure B-1. Rates of impingement: number of fishes collected per hour compared to total flow through the plant in millions of gallons per day, St. Lucie Plant, 1976.

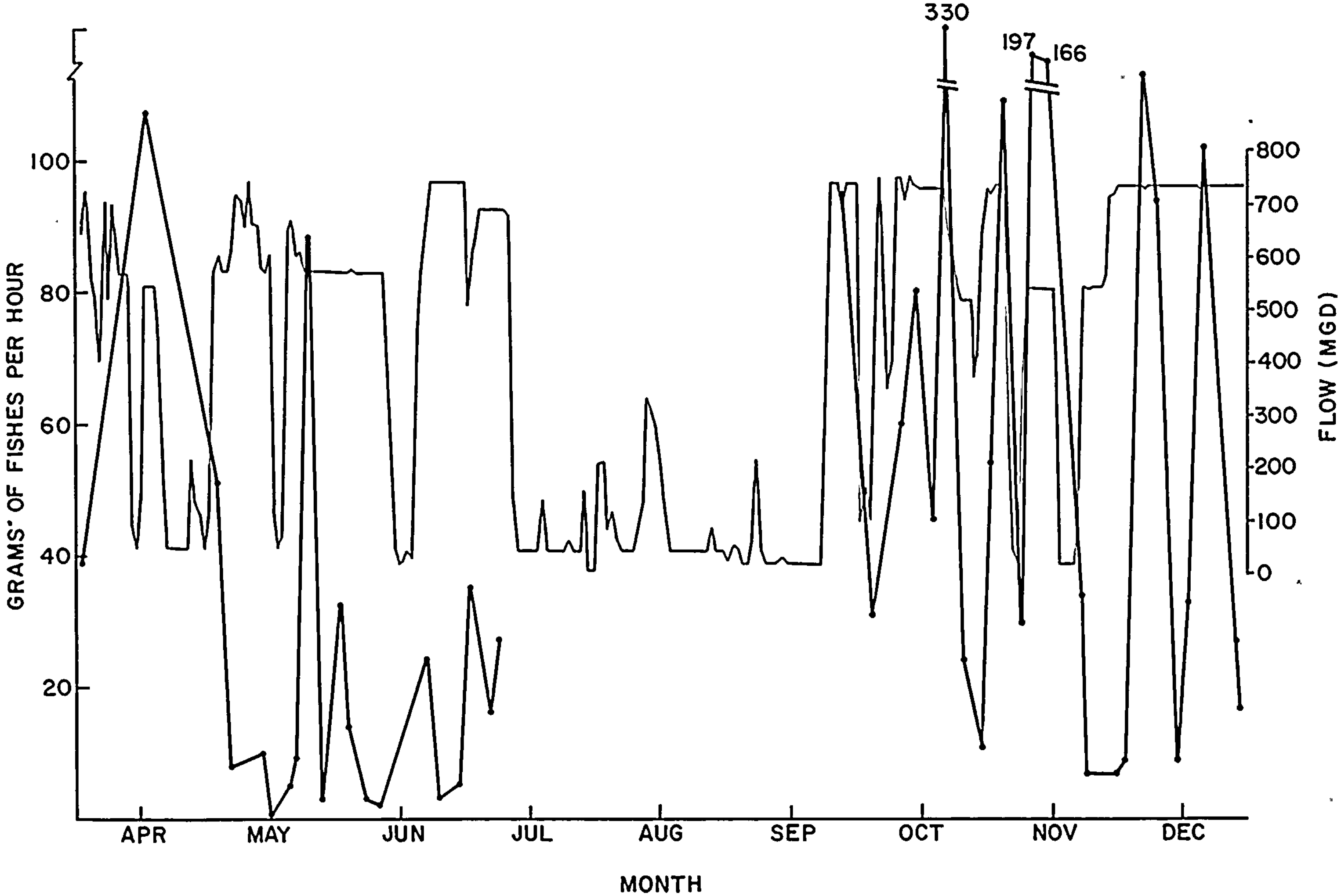


Figure B-2. Rates of impingement: biomass (grams) of fishes collected per hour compared to total flow through the plant in millions of gallons per day, St. Lucie Plant, 1976.

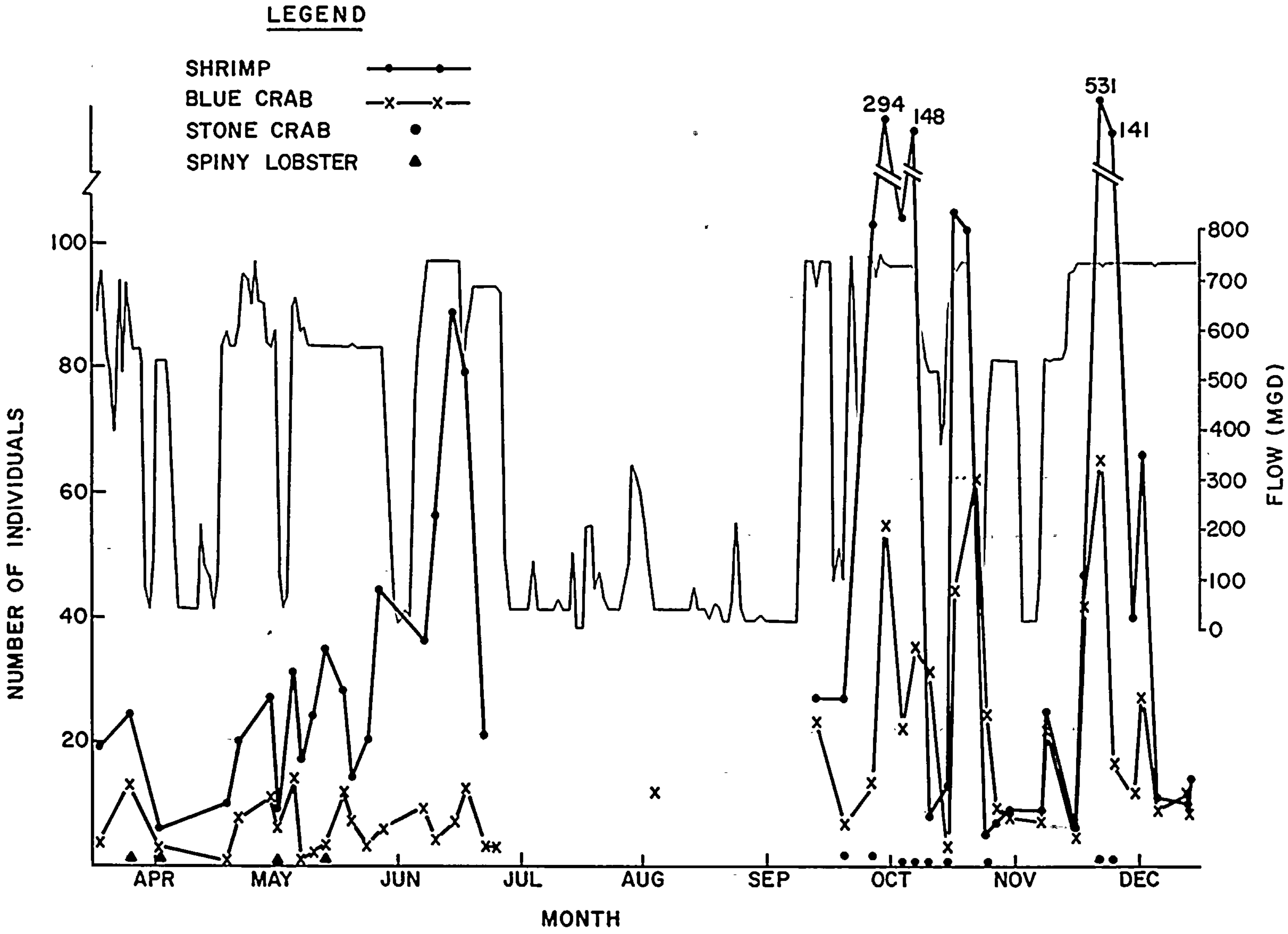


Figure B-3. Rates of impingement: number of commercially important shellfishes collected per day compared to total flow through the plant in millions of gallons per day, St. Lucie Plant, 1976.

FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT

INSHORE (CANAL)
GILL NET STATIONS
1976

MARCH 1977 | APPLIED BIOLOGY, INC. | FIGURE B-4

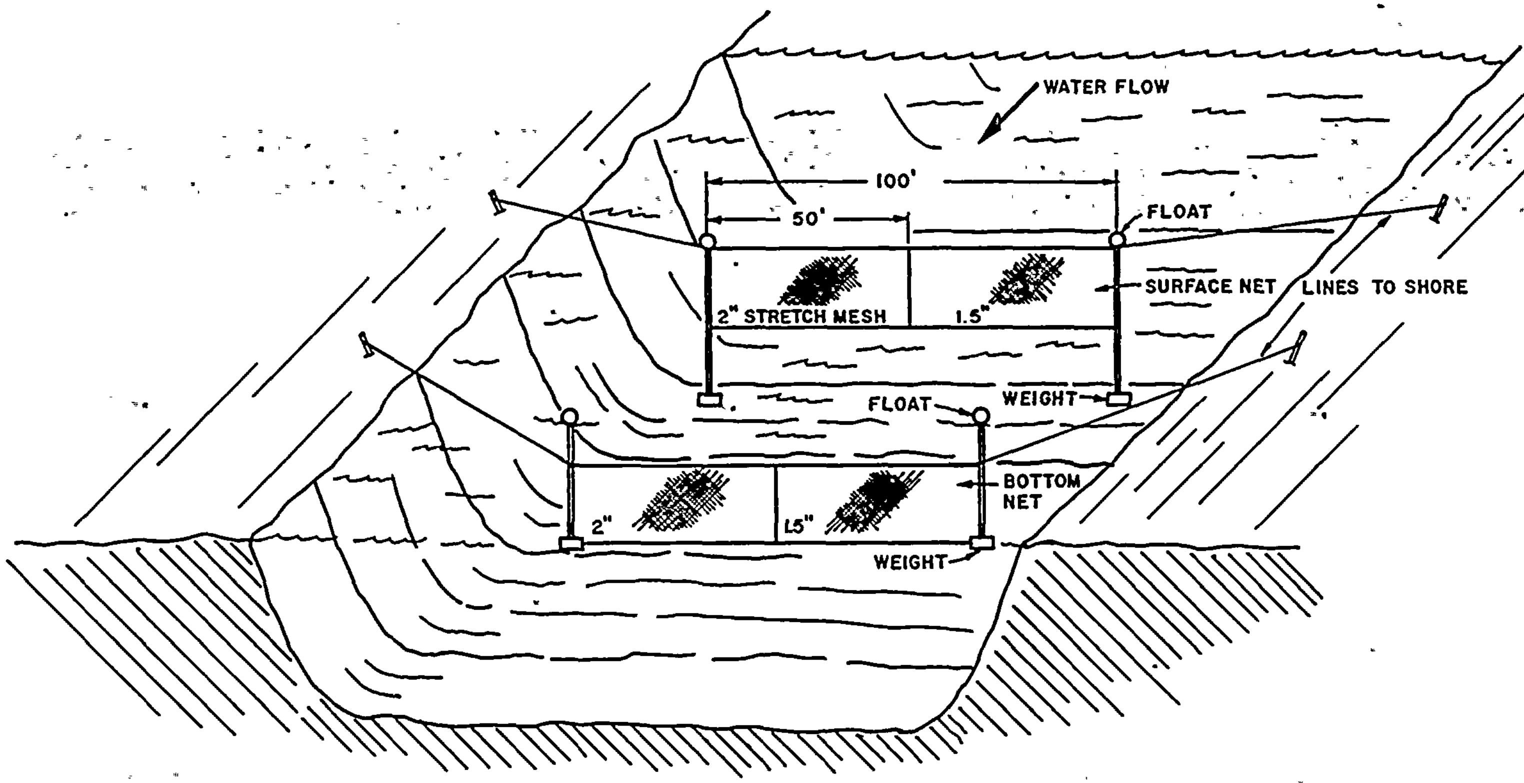


Figure B-5. Diagrammatic view of the inshore (canal) gill nets, St. Lucie Plant, 1976.

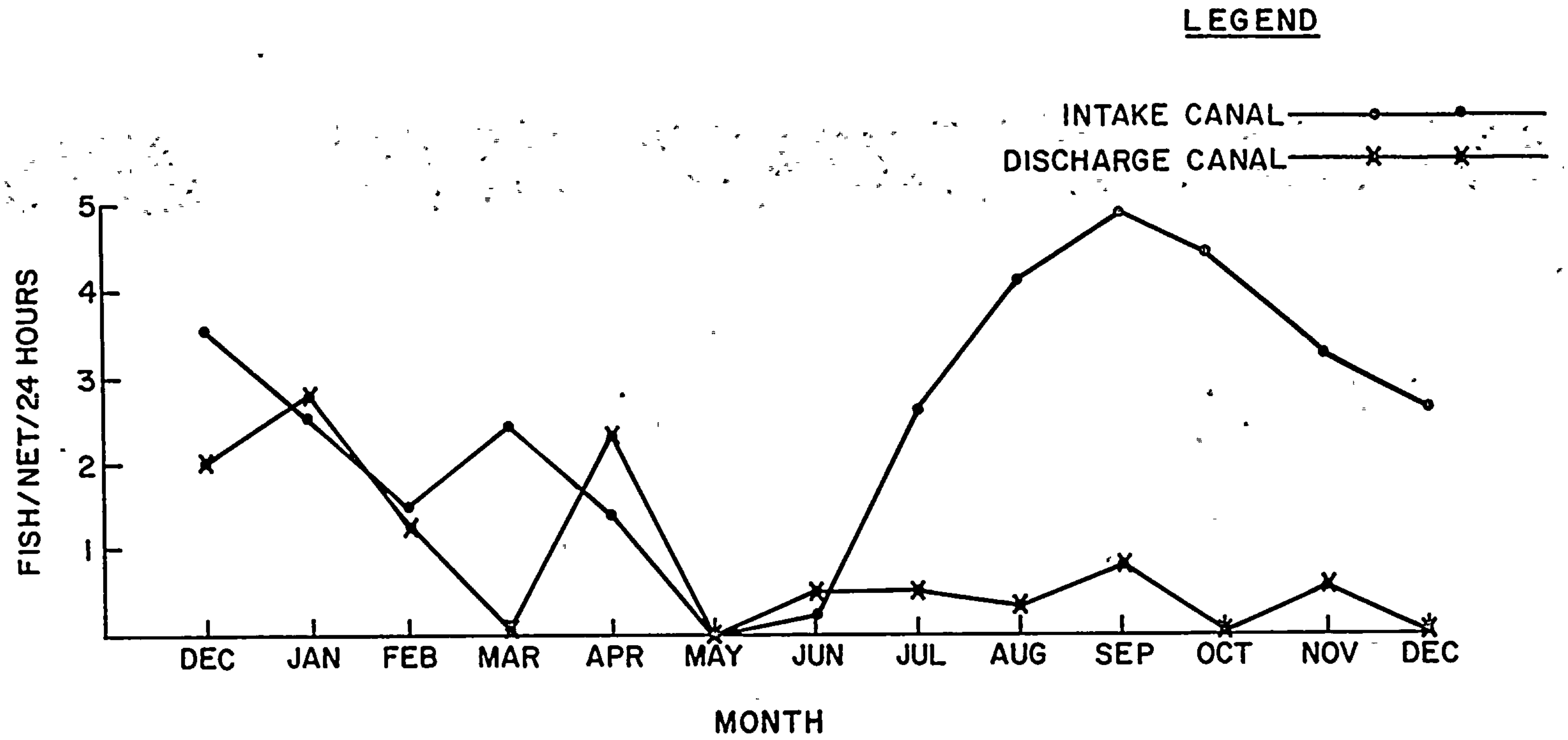
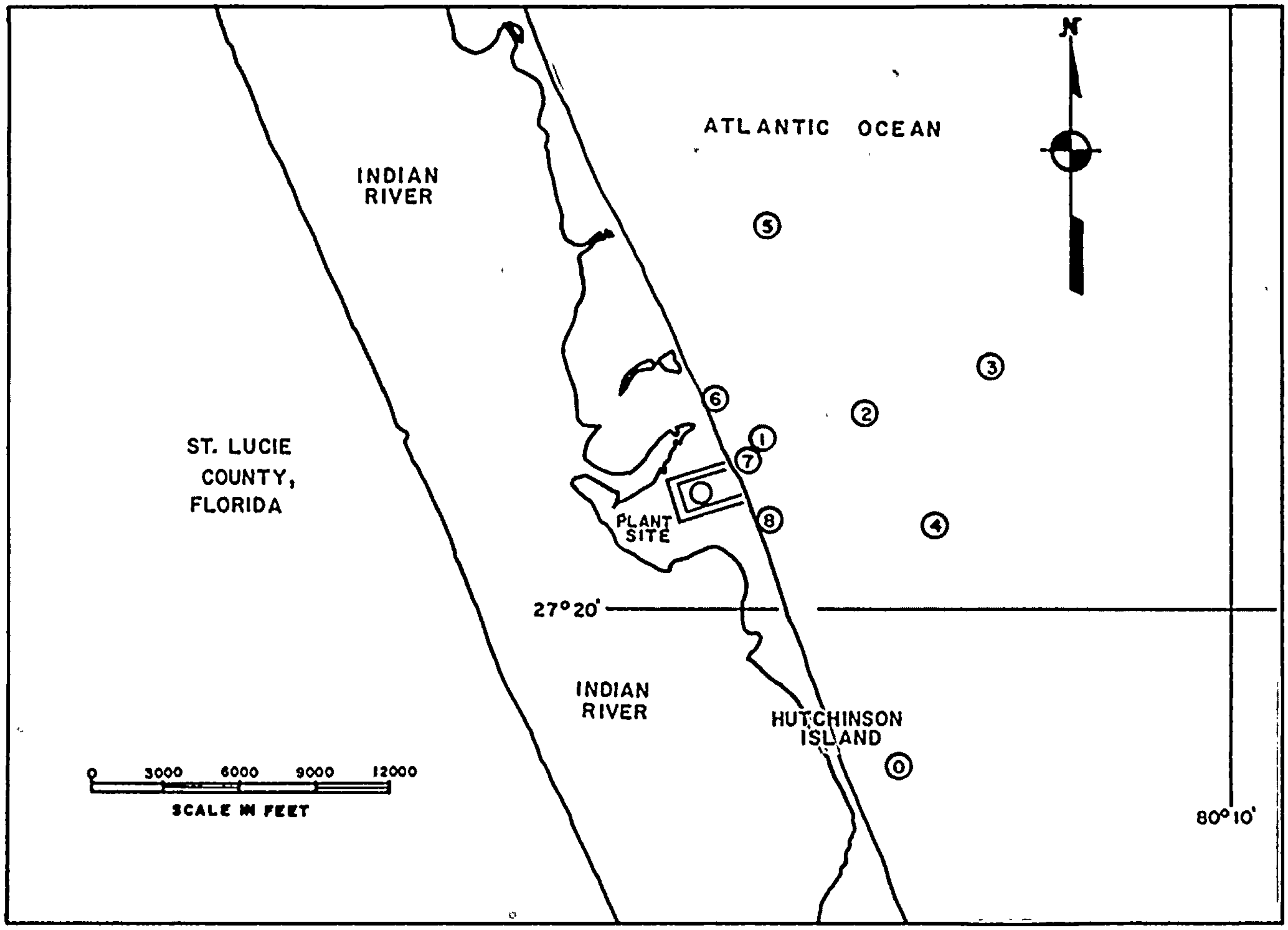


Figure B-6. Inshore (canal) gill net collections: fishes collected per net per 24 hours, St. Lucie Plant, December 1975-December 1976.



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT

OFFSHORE (0-5) AND BEACH (6-8)
FISH SAMPLING STATIONS
1976

MARCH 1977 APPLIED BIOLOGY, INC. FIGURE B-7

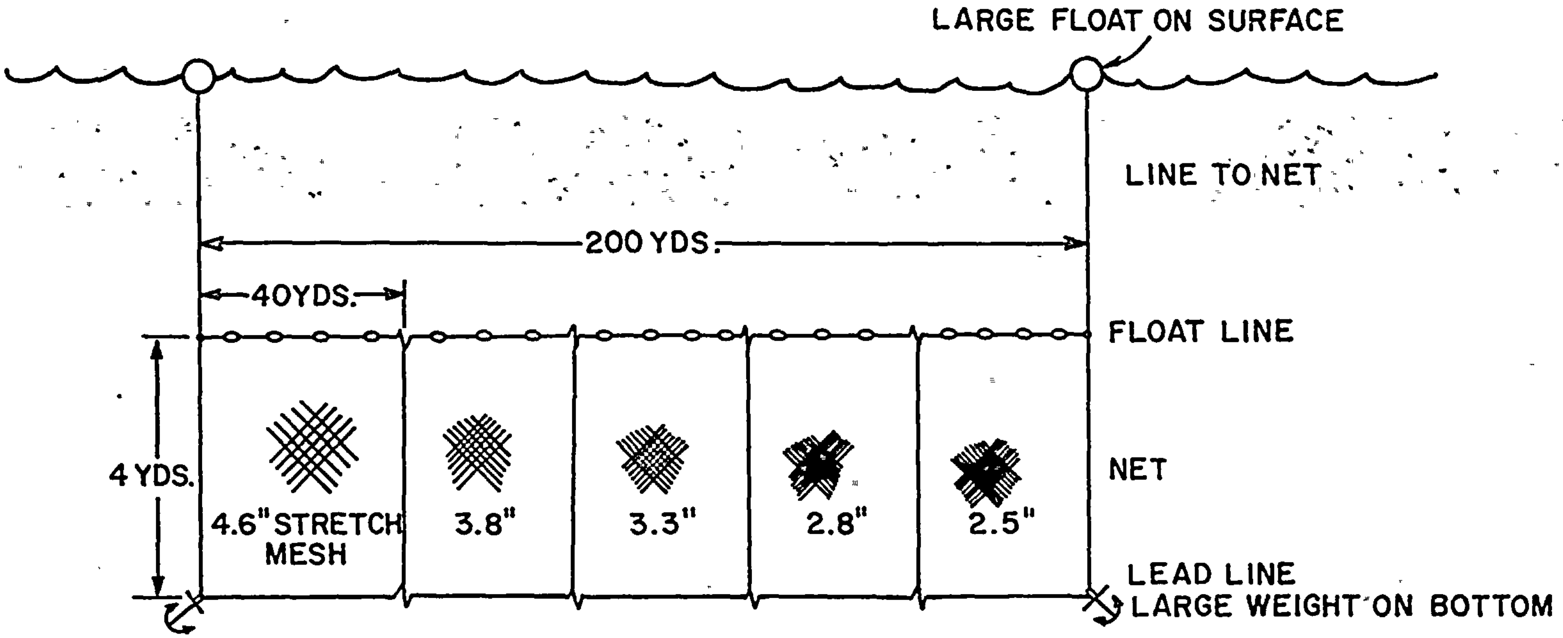


Figure B-8. Diagrammatic view of the offshore gill net, St. Lucie Plant, 1976.

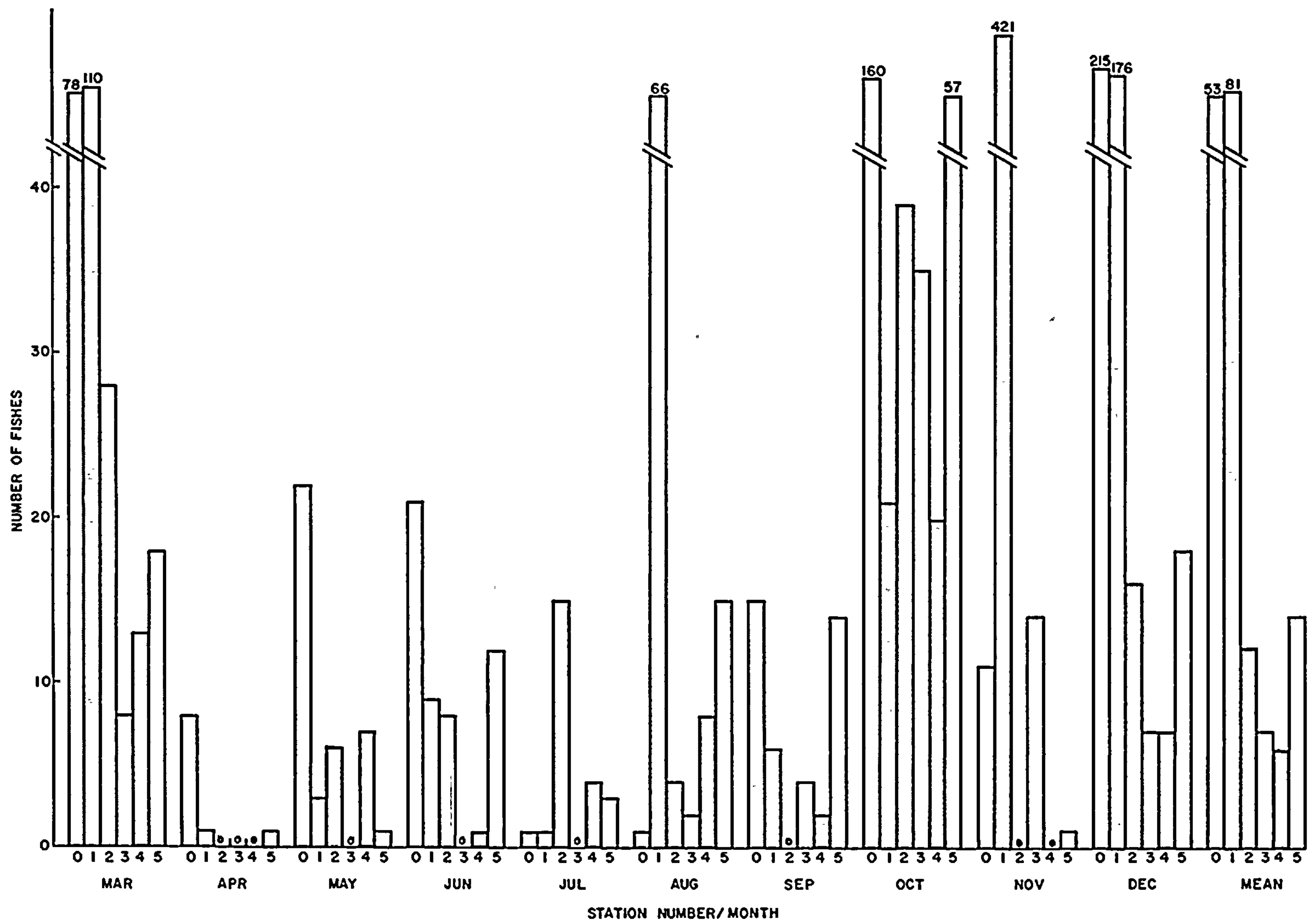


Figure B-9. Offshore gill nets: number of fishes collected per 30 minutes fished at control (0) and experimental stations (1-5), St. Lucie Plant, 1976.

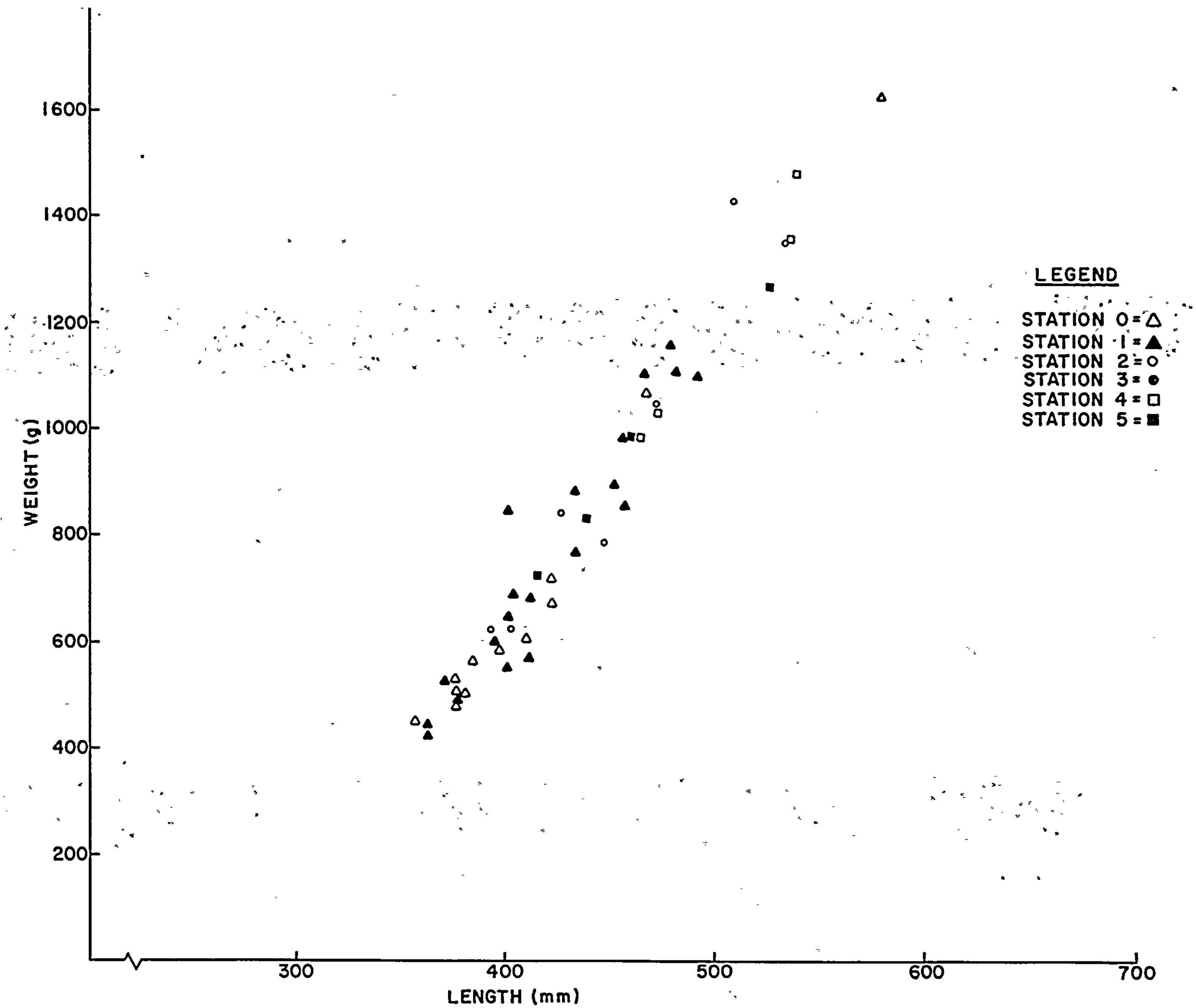


Figure B-10. Length/weight relationship of Spanish mackerel collected by gill net at six offshore stations on 28 March 1976, St. Lucie Plant.

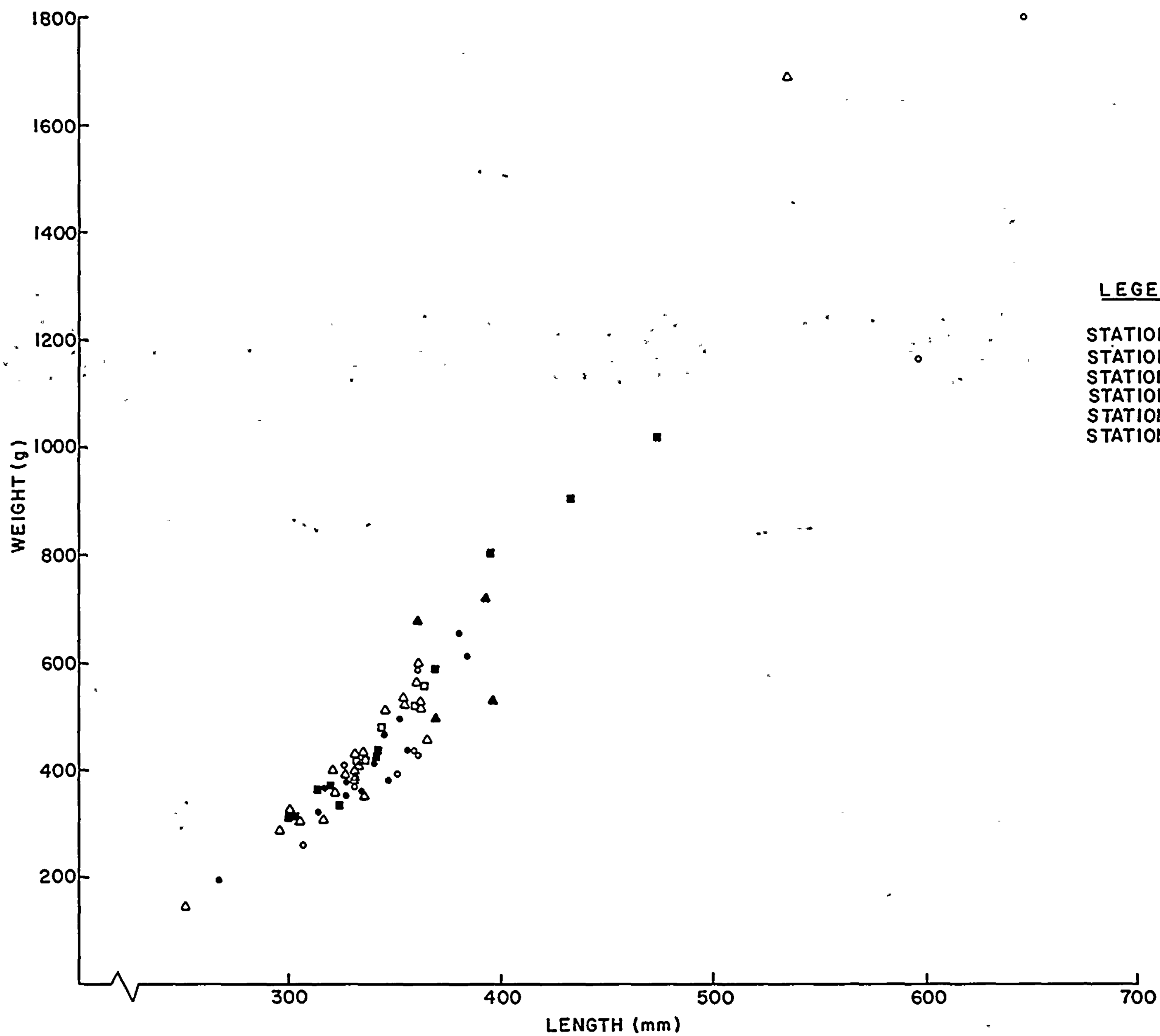


Figure B-11. Length/weight relationship of Spanish mackerel collected by gill net at six offshore stations on 25 October 1976, St. Lucie Plant.

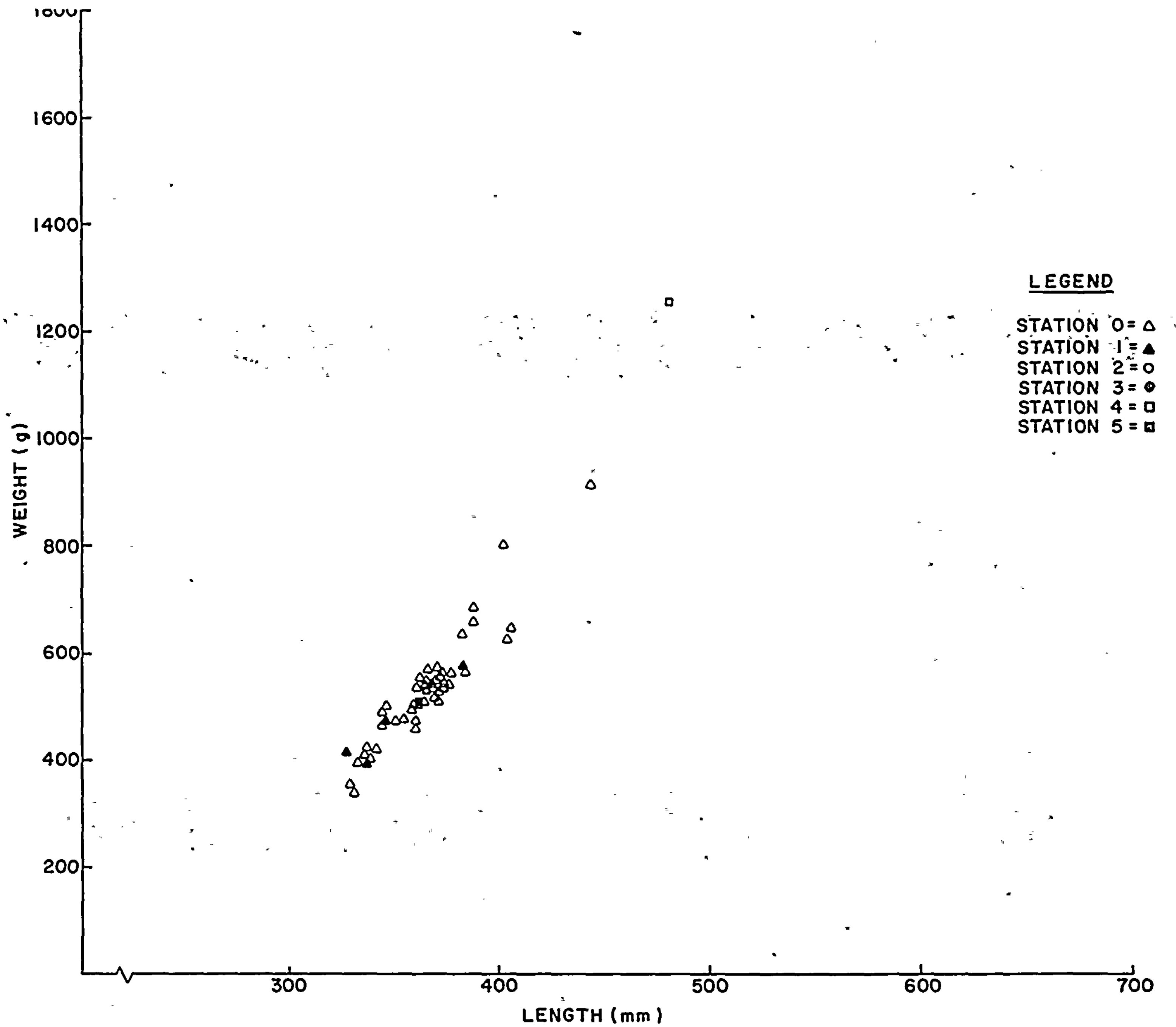


Figure B-12. Length/weight relationship of Spanish mackerel collected by gill net at six offshore stations on 15 December 1976, St. Lucie Plant.

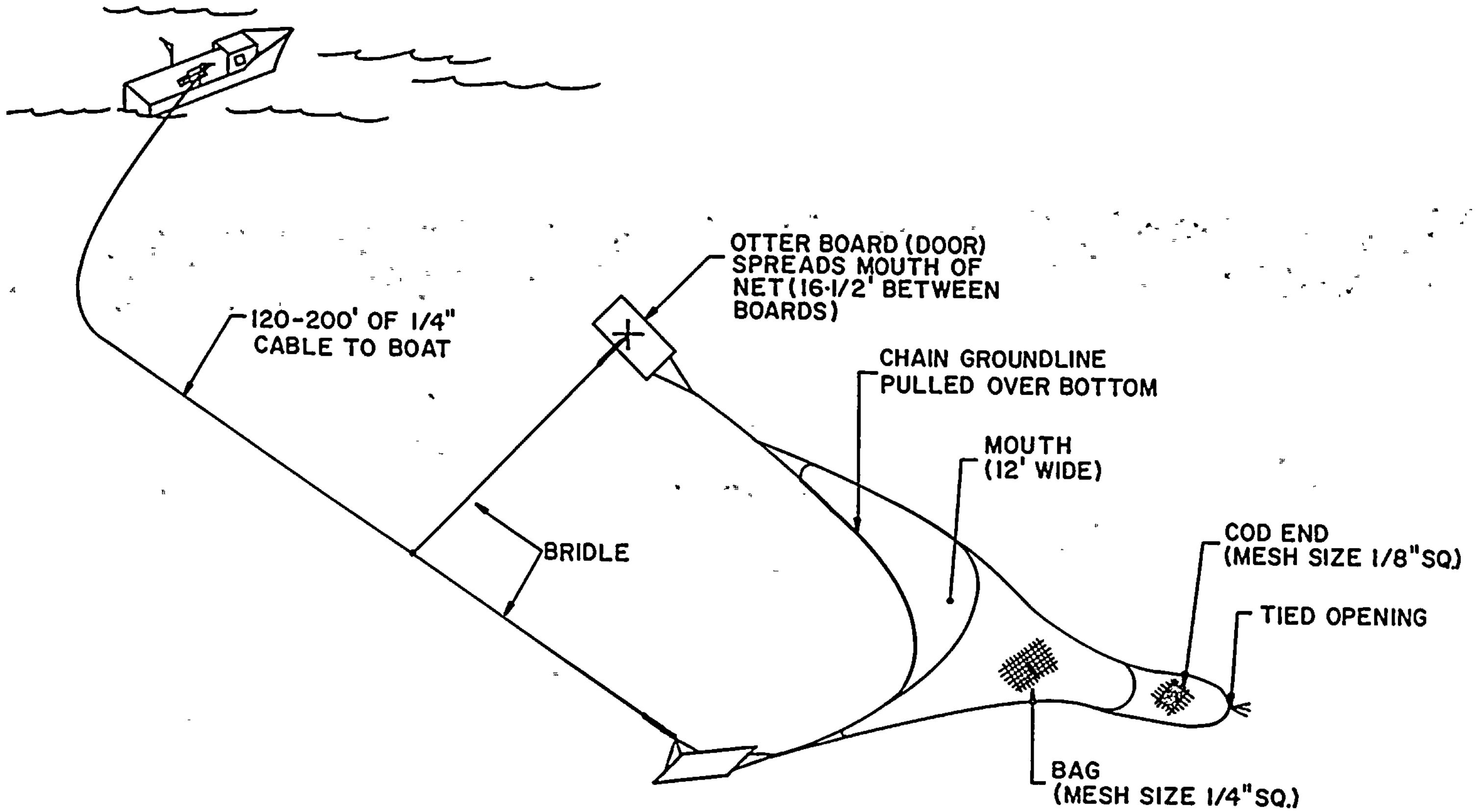


Figure B-13. Diagrammatic view of the bottom trawl, St. Lucie Plant, 1976.

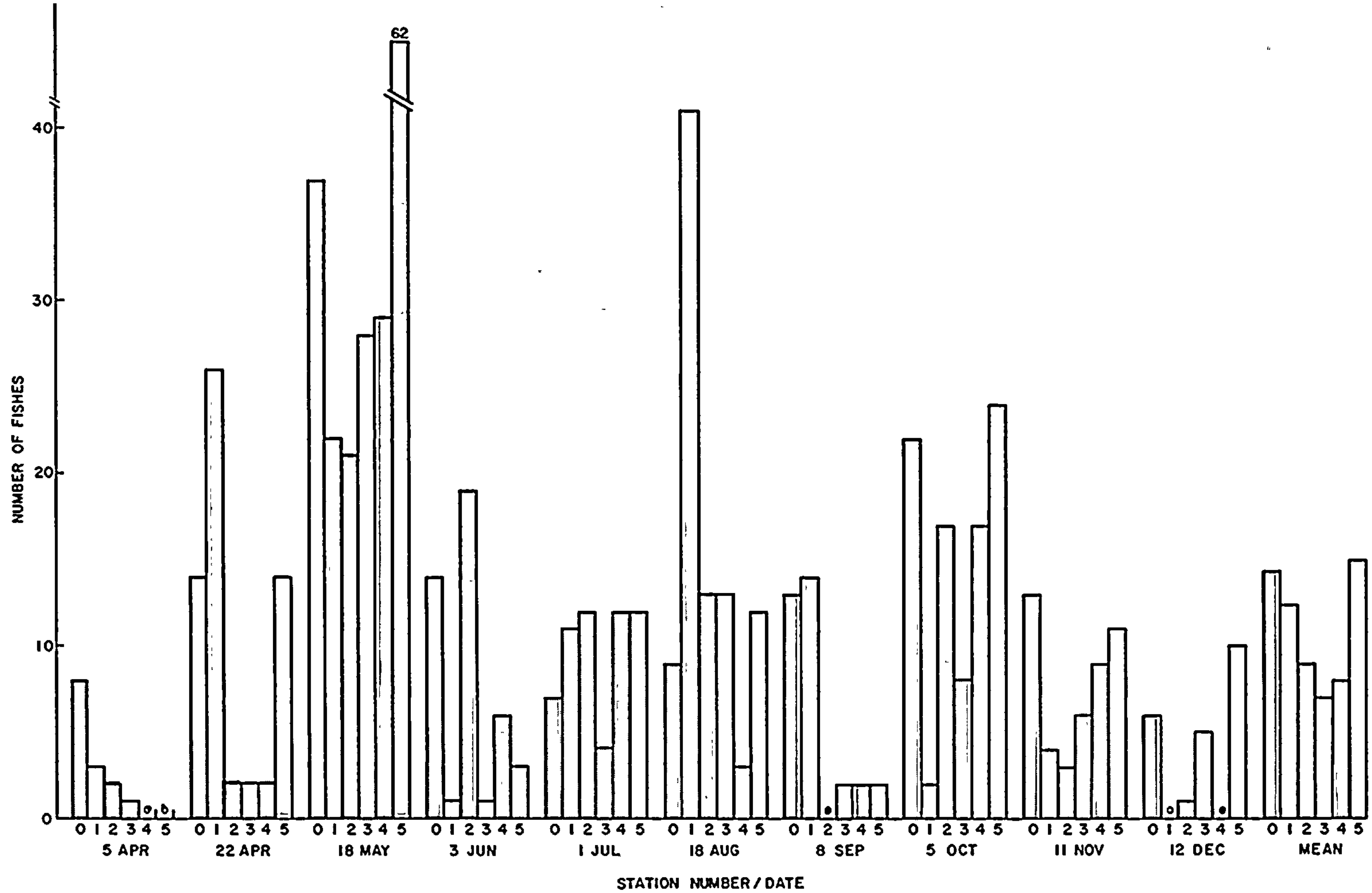


Figure B-14. Trawls: number of fishes collected per 15-minute trawl at offshore control (0) and experimental stations (1-5), St. Lucie Plant, 1976.

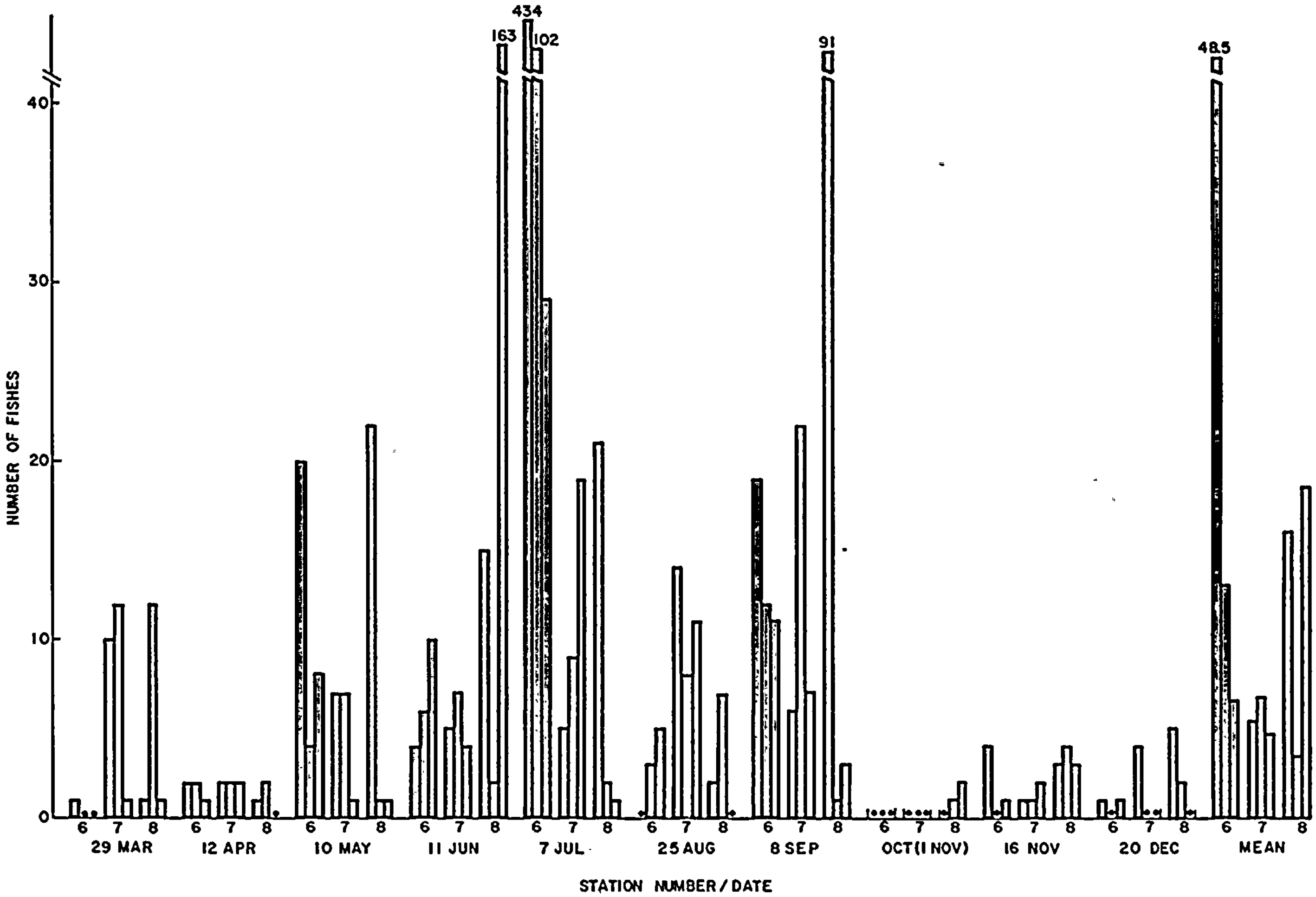


Figure B-15. Beach seines: number of fishes collected during each of three replicates at Stations 6, 7, and 8, St. Lucie Plant, 1976.

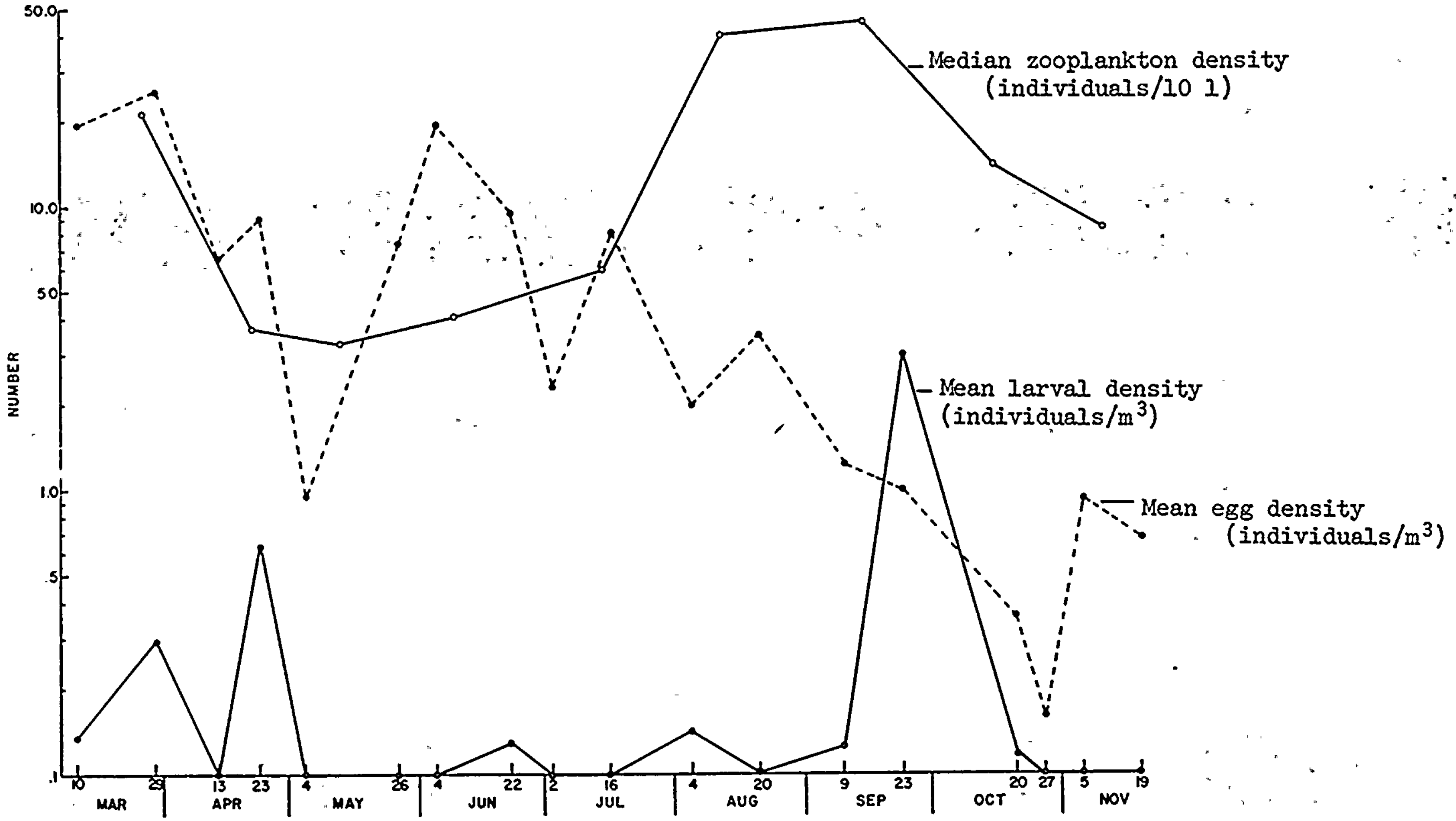


Figure B-16. Number per unit volume of fish eggs, larvae and zooplankton collected at Stations 0 through 5 combined, St. Lucie Plant, 1976.

TABLE B-1

SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER SQUALIFORMES	
Orectolobidae-carpet sharks	
Ginglymostoma cirratum	nurse shark
Carcharhinidae-requiem sharks	
Carcharhinus maculipinnis	spinner shark
Rhizoprionodon terraenovae	Atlantic sharpnose shark
Sphyrnidae-hammerhead sharks	
Sphyrna lewini	scalloped hammerhead
S. mokarran[a]	great hammerhead
S. tiburo	bonnethead
ORDER RAJIFORMES	
Torpedinidae-electric rays	
Narcine brasiliensis	lesser electric ray
Dasyatidae-stingrays	
Gymnura micrura	smooth butterfly ray
Myliobatidae-eagle rays	
Rhinoptera bonasus	cownose ray
Mobulidae-mantas	
Manta birostris	Atlantic manta
ORDER ELOPIFORMES	
Elopidae-tarpons	
Elops saurus	ladyfish
Megalops atlantica[a]	tarpon

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER ANGUILLIFORMES

Congridae-conger eels

Ariosoma impressa	bandtooth conger

Ophichthidae-snake eels

Bascanichthys terres	sooty eel
Myrophis punctatus	speckled worm eel
Mystriophis intertinctus	spotted spoon-nose eel
Ophichthus ocellatus	palespotted eel

ORDER CLUPEIFORMES

Clupeidae-herrings

Brevoortia smithi	yellowfin menhaden
B. tyrannus	Atlantic menhaden
B. smithi x tyrannus	menhaden (hybrid)
Harengula pensacolae	scaled sardine
Opisthonema oglinum	Atlantic thread herring
Sardinella anchovia	Spanish sardine

Engraulidae-anchovies

Anchoa cubana	Cuban anchovy
A. hepsetus	striped anchovy
A. lamprotaenia	bigeye anchovy
A. mitchilli	bay anchovy
A. nasuta	longnose anchovy
Anchoviella perfasciata	flat anchovy
Engraulis eurystole	silver anchovy

ORDER MYCTOPHIFORMES

Synodontidae-lizardfishes

Synodus foetens	inshore lizardfish
Trachinocephalus myops	snakefish

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

	ORDER SILURIFORMES
	Ariidae-sea catfishes
Arius felis	sea catfish
Bagre marinus	gafftopsail catfish
	ORDER BATRACHOIDIFORMES
	Batrachoididae-toadfishes
Porichthys porosissimus	Atlantic midshipman
	ORDER LOPHIIFORMES
	Antennariidae-frogfishes
Histrio histrio	sargassumfish
	Ogcocephalidae-batfishes
Ogcocephalus sp.	batfish
	ORDER GADIFORMES
	Ophidiidae-cusk-eels
Lepophidion sp.	cusk-eel
Ophidion holbrooki	bank cusk-eel
Oophidium omostigmum	polka-dot cusk-eel
	ORDER GASTEROSTEIFORMES
	Fistulariidae-cornetfishes
Fistularia tabacaria	bluespotted cornetfish

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER GASTEROSTEIFORMES
(continued)

Syngnathidae-pipefishes and seahorses	
Hippocampus erectus	lined seahorse
Oostethus lineatus	opossum pipefish
Syngnathus louisianae	chain pipefish
S. pelagicus	sargassum pipefish
S. springeri	bull pipefish

ORDER PERCIFORMES

Centropomidae-snooks	
Centropomus undecimalis	snook
Serranidae-sea basses	
Centropristis philadelphica	rock sea bass
C. striata	black sea bass
Diplectrum bivittatum	dwarf sand perch
D. formosum	sand perch
Epinephelus itajara	jewfish
E. morio	red grouper
Hypoplectrus sp.	hamlet
Mycteroperca bonaci	black grouper
Serraniculus pumilio	pygmy sea bass
Serranus baldwini	lantern bass
Grammistidae-soapfishes	
Rypticus saponaceus	greater soapfish
R. subbifrenatus	spotted soapfish
Priacanthidae-bigeyes	
Pristigenys alta	short bigeye

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER PERCIFORMES
(continued)

Apogonidae-cardinalfishes	
Apogon binotatus	barred cardinalfish
A. pseudomaculatus	twospot cardinalfish
Astrapogon alutus	bronze cardinalfish
A. puncticulatus	blackfin cardinalfish
Phaeoptyx pigmentaria	dusky cardinalfish
Pomatomidae-bluefishes	
Pomatomus saltatrix	bluefish
Rachycentridae-cobias	
Rachycentron canadum	cobia
Echeneidae-remoras	
Echeneis naucrates	sharksucker
Carangidae-jacks and pompanos	
Alectis crinitus	African pompano
Caranx bartholomaei	yellow jack
C. crysos	blue runner
C. hippos	crevalle jack
C. latus	horse-eye jack
Chloroscombrus chrysurus	Atlantic bumper
Selar crumenophthalmus	bigeye scad
Selene vomer	lookdown
Seriola dumerili	greater amberjack
S. zonata	banded rudderfish
Trachinotus carolinus	Florida pompano
T. goodei	palometa
Vomer setapinnis	Atlantic moonfish
Lutjanidae-snappers	
Lutjanus analis	mutton snapper
L. griseus	gray snapper
L. synagris	lane snapper
Rhomboplites aurorubens	vermilion snapper
Lobotidae-tripletails	
Lobotes surinamensis	tripletail

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER PERCIFORMES
(continued)

Gerreidae-mojarras	
Diapterus olisthostomus	Irish pompano
D. plumieri	striped mojarra
Eucinostomus argenteus	spotfin mojarra
E. gula	silver jenny
Gerres cinereus	yellowfin mojarra
Pomadasyidae-grunts	
Anisotremus surinamensis	black margate
A. virginicus	porkfish
Haemulon aurolineatum	tomtate
H. chrysargyreum	smallmouth grunt
H. flavolineatum	French grunt
H. parrai	sailors choice
H. plumieri	white grunt
H. sciurus	bluestriped grunt
Orthopristis chrysoptera	pigfish
Sparidae-porgies	
Archosargus probatocephalus	sheepshead
A. rhomboidalis	sea bream
Calamus bajonado	jolthead porgy
Diplodus argenteus	silver porgy
Lagodon rhomboides	pinfish
Sciaenidae-drums	
Bairdiella chrysura	silver perch
B. sanctaeluciae	striped croaker
Cynoscion nothus	silver seatrout
C. regalis	weakfish
Equetus acuminatus	high-hat
Larimus fasciatus	banded drum
Leiostomus xanthurus	spot
Menticirrhus americanus	southern kingfish
M. littoralis	Gulf kingfish
Micropogon undulatus	Atlantic croaker
Odontoscion dentex	reef croaker
Pogonias cromis	black drum
Sciaenops ocellata	red drum
Umbrina coroides	sand drum

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER PERCIFORMES
(continued)

Ephippidae-spadefishes	
Chaetodipterus faber	Atlantic spadefish
Scaridae-parrotfishes	
Cryptotomus roseus	bluelip parrotfish
Sparisoma sp.	parrotfish
Mugilidae-mullets	
Mugil cephalus	striped mullet
M. curema	white mullet
Sphyraenidae-barracudas	
Sphyraena barracuda	great barracuda
S. borealis	northern sennet
S. guachancho	guaguanche
Polynemidae-threadfins	
Polydactylus virginicus	barbu
Opistognathidae-jawfishes	
Opistognathus sp.	jawfish
Dactyloscopidae-sand stargazers	
Dactyloscopus crossotus	bigeye stargazer
Uranoscopidae-stargazers	
Astroscopus y-graecum	southern stargazer
Clinidae-clinids	
Labrisomus nuchipinnis	hairy blenny
Blenniidae-blennies	
Blennius marmoreus	seaweed blenny
Hypleurochilus aequipinnis	oyster blenny
H. bermudensis	barred blenny

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER PERCIFORMES
(continued)

Gobiidae-gobies	
Bathygobius sp.	goby
Gobiosoma ginsburgi	seaboard goby
Lophogobius cyprinoides	crested goby
Microgobius sp.	goby
Acanthuridae-surgeonfishes	
Acanthurus chirurgus	doctorfish
Trichiuridae-cutlassfishes	
Trichiurus lepturus	Atlantic cutlassfish
Scombridae-mackerels and tunas	
Auxis thazard	frigate mackerel
Euthynnus alletteratus	little tunny
Scomberomorus cavalla	king mackerel
S. maculatus	Spanish mackerel
S. regalis	cero
Stromateidae-butterfishes	
Peprilus paru	harvestfish
P. triacanthus	butterfish
Scorpaenidae-scorpionfishes	
Scorpaena brasiliensis	barbfish
S. grandicornis	plumed scorpionfish
S. plumieri	spotted scorpionfish
Triglidae-searobins	
Prionotus carolinus	northern searobin
P. evolans	striped searobin
P. roseus	bluespotted searobin
P. scitulus	leopard searobin
P. tribulus	bighead searobin
Dactylopteridae-flying gurnards	
Dactylopterus volitans	flying gurnard

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER PLEURONECTIFORMES

Bothidae-lefteye flounders	
Ancylopsetta quadrocellata	ocellated flounder
Bothus ocellatus	eyed flounder
B. robinsi	flounder
Citharichthys macrops	spotted whiff
C. spilopterus	bay whiff
Paralichthys albigutta	Gulf flounder
P. lethostigma	southern flounder
P. squamilentis	broad flounder
Syacium gunteri	shoal flounder
S. micrurum	channel flounder
S. papillosum	dusky flounder
Soleidae-soles	
Achirus lineatus	lined sole
Gymnachirus melas	naked sole
Cynoglossidae-tonguefishes	
Symphurus civitatus	offshore tonguefish
S. diomedianus	spottedfin tonguefish
S. plagiusa	blackcheek tonguefish

ORDER TETRAODONTIFORMES

Balistidae-triggerfishes and filefishes	
Aluterus monoceros	unicorn filefish
A. schoepfi[a]	orange filefish
Balistes capriscus	gray triggerfish
Cantherhines pullus	orangespotted filefish
Monacanthus hispidus	planehead filefish
Ostraciidae-boxfishes	
Lactophrys quadricornis	scrawled cowfish
L. trigonus	trunkfish

TABLE B-1
(continued)
SCIENTIFIC AND COMMON NAMES OF FISHES
COLLECTED IN THE VICINITY OF THE ST. LUCIE PLANT
1976

ORDER TETRAODONTIFORMES (continued)	
Tetraodontidae-puffers	
Sphoeroides nephelus	southern puffer
S. spengleri	bandtail puffer
Diodontidae-porcupinefishes	
Diodon holocanthus	balloonfish

[a] observational record

TABLE B-2

NUMBER AND BIOMASS OF SHELLFISHES AND FISHES COLLECTED DURING 24-HOUR IMPINGEMENT SURVEYS AT THE ST. LUCIE PLANT 1976

Category	APR 1-2		APR 9-10		APR 16-17		MAY 3-4		MAY 13-14		MAY 14-15		MAY 19-20	
	No.[a]	Wt.[b]	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
shrimp	19	89	24	100	6	10	10	25	27	122	9	26	31	101
blue crab	4	347	13	769	3	238	1	16	11	1161	6	500	14	351
stone crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
spiny lobster	-	-	1	1	1	1	-	-	-	-	1	13	-	-
anchovy	21	20	207	283	361	445	986	1167	125	151	13	19	33	45
herring	-	-	4	3	-	-	-	-	1	8	-	-	-	-
grunt	-	-	3	50	19	1412	2	8	1	2	-	-	2	40
mojarra	-	-	30	387	1	1	1	3	2	22	-	-	-	-
croaker	-	-	1	1	12	100	-	-	5	5	1	1	1	3
flounder, sole	2	5	2	4	1	1	3	10	1	5	1	4	-	-
jack	1	831	9	997	1	1	-	-	-	-	-	-	1	1
cutlassfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-
other fish	2	79	4	75	8	602	2	28	4	38	1	2	5	23
Total shellfish	23	436	38	870	10	249	11	41	38	1283	16	539	45	452
Total fish	26	935	260	1800	403	2562	994	1216	139	231	16	26	42	112

[a] Number of individuals.

[b] Total weight in grams.

TABLE B-2
(continued)
NUMBER AND BIOMASS OF SHELLFISHES AND FISHES COLLECTED
DURING 24-HOUR IMPINGEMENT SURVEYS AT THE ST. LUCIE PLANT
1976

	MAY 20-21		MAY 24-25		MAY 27-28		JUN 1-2		JUN 3-4		JUN 7-8		JUN 10-11	
Category	No.[a]	Wt.[b]	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
shrimp	17	84	24	80	35	154	28	112	14	50	20	56	44	137
blue crab	1	4	2	129	3	98	12	657	7	311	3	77	5	13
stone crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
spiny lobster	-	-	1	2	-	-	-	-	-	-	-	-	-	-
anchovy	28	37	1582	2087	44	30	3	5	185	285	40	64	13	18
herring	-	-	5	7	-	-	-	-	-	-	-	-	1	2
grunt	1	109	-	-	-	-	8	126	-	-	-	-	1	1
mojarra	-	-	-	-	1	3	2	4	1	2	-	-	-	-
croaker	1	1	2	4	-	-	-	-	-	-	2	1	-	-
flounder, sole	-	-	-	-	-	-	2	13	-	-	-	-	-	-
jack	-	-	-	-	-	-	-	-	-	-	-	-	-	-
cutlassfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-
other fish	8	75	2	2	7	46	8	382	3	37	3	17	8	19
Total shellfish	18	88	27	211	38	252	40	769	21	361	23	133	49	150
Total fish	38	222	1591	2100	52	79	23	530	189	324	45	82	23	40

[a] Number of individuals.

[b] Total weight in grams.

TABLE B-2
(continued)
NUMBER AND BIOMASS OF SHELLFISHES AND FISHES COLLECTED
DURING 24-HOUR IMPINGEMENT SURVEYS AT THE ST. LUCIE PLANT
1976

	JUN 21-22		JUN 24-25		JUN 28-29		JUL 1-2		JUL 6-7		JUL 8-9		AUG[c] 18	
Category	No.[a]	Wt.[b]	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
shrimp	36	122	56	184	89	334	79	316	21	60	24	29	70	266
blue crab	9	81	4	29	7	165	12	215	3	164	3	99	8	301
stone crab	-	-	-	-	-	-	-	-	-	-	-	-	-	-
spiny lobster	-	-	-	-	-	-	-	-	-	-	-	-	-	-
anchovy	15	26	10	17	14	20	92	129	117	175	68	112	23	35
herring	-	-	-	-	-	-	-	-	-	-	-	-	-	-
grunt	4	4	-	-	3	3	6	9	-	-	-	-	21	119
mojarra	1	2	-	-	1	2	3	14	2	31	2	6	4	71
croaker	2	3	-	-	-	-	-	-	1	1	-	-	1	1
flounder, sole	-	-	1	4	6	44	11	63	3	21	-	-	2	14
jack	-	-	-	-	-	-	1	1	-	-	-	-	-	-
cutlassfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-
other fish	16	536	5	58	6	43	16	615	3	159	4	536	6	132
Total shellfish	45	203	60	213	96	499	91	531	24	224	27	128	78	567
Total fish	38	571	16	79	30	112	129	831	126	387	74	654	57	372

[a] Number of individuals.

[b] Total weight in grams.

[c] 16-hour sample.

TABLE B-2
(continued)
NUMBER AND BIOMASS OF SHELLFISHES AND FISHES COLLECTED
DURING 24-HOUR IMPINGEMENT SURVEYS AT THE ST. LUCIE PLANT
1976

Category	SEP 27-28		OCT 4-5		OCT 11-12		OCT 14-15		OCT 18-19		OCT 21-22		OCT 25-26	
	No.[a]	Wt.[b]	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
shrimp	27	57	27	86	103	427	294	961	104	192	148	251	8	25
blue crab	23	682	7	243	13	741	55	2116	22	651	35	1061	31	1132
stone crab	-	-	2	30	2	40	-	-	1	35	1	1	1	47
spiny lobster	-	-	-	-	-	-	-	-	-	-	-	-	-	-
anchovy	643	953	472	724	1006	1316	247	391	233	290	1446	1914	17	25
herring	10	140	1	2	-	-	-	-	6	5	25	116	-	-
grunt	216	1066	1	4	8	65[c]	2	7	2	18	44	549	3	6
mojarra	10	36	-	-	5	27	5	65	4	18	199	1611	38	229
croaker	-	-	1	2	2	1[c]	32	48	16	21	22	97	13	29
flounder, sole	-	-	1	10	1	8	8	96	4	89	1	11	-	-
jack	1	1	3	2	11	11	40	57	210	263	3819	1898	83	40
cutlassfish	-	-	-	-	2	1	3	1	7	3	269	130	4	5
other fish	7	88	-	-	1	3	46	1257	35	386	56	1607	15	243
Total shellfish	50	739	36	359	118	1208	349	3077	127	878	184	1313	40	1204
Total fish	887	2284	479	744	1036	1432[c]	383	1922	517	1093	5881	7933	173	577

[a] Number of individuals.
[b] Total weight in grams.
[c] Includes fragments.

TABLE B-2
(continued)
NUMBER AND BIOMASS OF SHELLFISHES AND FISHES COLLECTED
DURING 24-HOUR IMPINGEMENT SURVEYS AT THE ST. LUCIE PLANT
1976

Category	OCT 28-29		NOV 1-2		NOV 4-5		NOV 8-9		NOV 11-12		NOV 14-15		NOV 22-23	
	No.[a]	Wt.[b]	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
shrimp	13	38	105	287	102	495	5	14	7	101	9	21	9	38[c]
blue crab	3	64	44	1568	62	2819	24	849	9	355	8	362	7	310
stone crab	1	14	-	-	-	-	1	21	-	-	-	-	-	-
spiny lobster	-	-	-	-	-	-	-	-	-	-	-	-	-	-
anchovy	5	7	44	44	30	57	10	7[c]	72	157	261	136[c]	21	19
herring	-	-	2	4	10	80[c]	2	3	17	28	31	55	-	-
grunt	3	32	3	9	8	108	3	22	31	347	39	1334	4	27
mojarra	1	4	2	4[c]	15	146	2	16	3	37	3	5	1	2
croaker	4	13	42	237	26	217	9	31	21	26	35	1274	9	21
flounder, sole	1	10	11	227	7	155	4	39	1	5	-	-	1	25
jack	4	10	70	64	77	223	18	15[c]	102	407	230	200	36	75
cutlassfish	-	-	25	41	3	7[c]	2	7[c]	26	74[c]	23	72[c]	68	561[c]
other fish	5	289	34	664	34	1614	11	568	15	3641	24	897	8	74
Total shellfish	17	116	149	1855	164	3314	30	884	16	456	17	383	16	348
Total fish	23	365	233	1294[c]	210	2607[c]	61.	708[c]	288	4722[c]	646	3973[c]	148	804[c]

[a] Number of individuals.

[b] Total weight in grams.

[c] Includes fragments.

TABLE B-2
(continued)
NUMBER AND BIOMASS OF SHELLFISHES AND FISHES COLLECTED
DURING 24-HOUR IMPINGEMENT SURVEYS AT THE ST. LUCIE PLANT
1976

	NOV 23-24		NOV 29-30		DEC 2-3		DEC 6-7		DEC 9-10		DEC 14-15		DEC 16-17	
Category	No.[a]	Wt.[b]	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
shrimp	15	47	6	19	47	129[c]	531	1138	141	995[c]	40	249	66	277
blue crab	22	1069	5	355	41	2061	65	1839	16	604	11	453	27	741
stone crab	1	3	1	38	-	-	1	26	1	10	-	-	-	-
spiny lobster	-	-	-	-	-	-	-	-	-	-	-	-	-	-
anchovy	41	52	6	7	3	5	128	542	63	340	20	86[c]	19	67
herring	1	1	1	1	9	23	10	23	7	13	-	-	2	-[c]
grunt	2	5	3	26	2	9	3	57	-	-	-	-	4	139
mojarra	2	3	1	2	1	4	6	27	6	59	2	7	5	48
croaker	2	14	1	-[c]	1	1	8	71	10	54	4	27	10	39[c]
flounder, sole	1	-[c]	-	-	6	119	18	291	5	128	1	-[c]	2	27
jack	7	13	4	4[c]	9	21[c]	30	278	80	565	6	26[c]	22	113
cutlassfish	11	59[c]	13	122[c]	-	-	-	-	-	-	-	-	-	-
other fish	3	23	2	7[c]	5	43[c]	45	1432	32	1097	8	77	16	351
Total shellfish	38	1119	12	412	88	2190[c]	597	3003	158	1609[c]	51	702	93	1018
Total fish	70	170[c]	31	169[c]	36	225[c]	248	2721	203	2256	41	223[c]	80	784[c]

[a] Number of individuals.

[b] Total weight in grams.

[c] Includes fragments.

TABLE B-2
(continued)
NUMBER AND BIOMASS OF SHELLFISHES AND FISHES COLLECTED
DURING 24-HOUR IMPINGEMENT SURVEYS AT THE ST. LUCIE PLANT
1976

	DEC 20-21		DEC 27-28		DEC 28-29									
Category	No.[a]	Wt.[b]	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
shrimp	11	62	10	55	14	78								
blue crab	9	307	11	303	9	411								
stone crab	-	-	-	-	-	-								
spiny lobster	-	-	-	-	-	-								
anchovy	6	11	-	-	3	7								
herring	5	72	2	37	-	-								
grunt	1	30	-	-	-	-								
mojarra	2	5	-	-	1	15								
croaker	8	78	3	12	1	10								
flounder, sole	-	-	2	33	2	101								
jack	81	431	4	22	2	5								
cutlassfish	1	874	1	466	-	-								
other fish	9	946	4	69	6	269								
Total shellfish	20	369	21	358	23	489								
Total fish	113	2447	16	639	15	407								

[a] Number of individuals.

[b] Total weight in grams.

[c] Includes fragments.

TABLE B-3

TOTAL NUMBER OF SHELLFISHES AND FISHES COLLECTED AT INSHORE (CANAL) GILL NET STATIONS (COMBINATION OF TWO NETS PER STATION PER SAMPLING PERIOD), ST. LUCIE DECEMBER 1975-DECEMBER 1976

	17-18 DEC Station		18-19 DEC Station		6-7 JAN Station		19-20 JAN Station				20-21 JAN Station			
Species	15	16	15	16	15	16	13	14	15	16	13	14	15	16
blue crab		2	1		1	1							1	3
other shellfish						3		1						1
mullet		2	2		3		3	1			1		1	
snapper	1				1			1					1	
croaker	1	1	4	1		1	1		1	1	2		3	3
grunt	1		1			1			2	2			2	5
mojarra	2													
jack		1			1		5				3			
porgy		1												2
other fish	3	1				1			1		2	1		1
total fish	8	6	7	1	5	3	9	2	4	3	8	1	7	11

	4-5 FEB Station				5-6 FEB Station				18-19 FEB Station				19-20 FEB Station				3-4 MAR Station			
Species	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16
blue crab										2					1					
other shellfish																				
mullet		2		2						4				1				1	1	1
snapper																				
croaker				2				1		5			2	12	2	1				
grunt				1						1				1	1					
mojarra										1									1	
jack		1															1			
porgy							1					1								
other fish			1	1	1	1		1												
total fish	0	3	1	6	1	1	1	2	0	11	0	1	2	14	3	1	1	1	2	1

	4-5 MAR Station				17-18 MAR Station				18-19 MAR Station				5-6 APR Station			
Species	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16
blue crab				2		2			1					1	2	1
other shellfish																
mullet	1				5	1			1		2			1		
snapper							1		1						1	
croaker	5	1			3	8			2	3	1				2	1
grunt					3	6	4		2	1				2		
mojarra																
jack		1											1			
porgy						1										1
other fish										1					2	1
total fish	6	2	0	0	11	16	5	0	6	5	3	0	1	3	5	3

	6-7 APR Station				28-29 APR Station				29-30 APR Station				19-20 MAY Station				20-21 MAY Station			
Species	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16
blue crab					1			1	1			2								
other shellfish	1								1											
mullet					1				4	2										
snapper					3				1											
croaker					4	2			1	1										
grunt					3			1				1								
mojarra																				
jack	1				1	1	1		1		1									
porgy									2											
other fish					2															
total fish	1	0	0	0	14	3	1	1	9	3	1	1	0	0	0	0	0	0	0	0

TABLE B-3
(continued)
TOTAL NUMBER OF SHELLFISHES AND FISHES COLLECTED AT INSHORE (CANAL) GILL NET STATIONS
(COMBINATION OF TWO NETS PER STATION PER SAMPLING PERIOD), ST. LUCIE
DECEMBER 1975-DECEMBER 1976

	23-24 JUN Station				24-25 JUN Station				19-20 JUL Station				20-21 JUL Station				16-17 AUG Station				17-18 AUG Station				20-21 SEP Station			
Species	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16
blue crab																	1	6				1		4		3		
other shellfish															1										2			
mullet									1				2	3		1	4								3	4		1
snapper									1		1			2			3	5			3	1	2		5	2	2	
croaker								1	4				4	4			5	4	2	1	2		2		4			
grunt								1	2	1						1		1			1	2	1		1	2	1	1
mojarra																	2					1			2			
jack	1				1								1				1									1		
porgy																						1				1		
other fish									1	1					3				1		2	1	2		3	5	1	
total fish	1	0	0	0	1	0	0	2	9	2	1	0	7	9	3	2	15	10	3	1	8	6	7	0	13	15	4	2

	21-22 SEP Station				20-21 OCT Station				21-22 OCT Station				17-18 NOV Station				18-19 NOV Station				15-16 DEC Station				16-17 DEC Station			
Species	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16	13	14	15	16
blue crab	1	1	1												3				1		1							
other shellfish	1								1		2											1						
mullet		1	1			3				2	2		4	3	7		3	1				2	2		4			
snapper	3						4		1	1	4		1				1	1	3		3	1			1			
croaker			1		1				1		4				1			2	2			2						
grunt	1		2	1	2		3			3	3				1	2					1	2	2		1			
mojarra		1																										
jack	1						2										2				3	2	1		2			
porgy	1	1	1											1			1											
other fish	3	3	1		4	2					4		1		2		1		1		1	1	1					
total fish	9	6	6	1	7	5	9	0	2	6	17	0	6	4	11	2	8	4	6	0	8	10	6	0	8	0	0	0

TABLE B-4

TOTAL NUMBER OF FISHES COLLECTED AT OFFSHORE GILL NET STATIONS
(30 MINUTES FISHED PER STATION PER MONTH), ST. LUCIE
MARCH-DECEMBER 1976

Species	28 MAR Station 0	1	2	3	4	5	26 APR Station 0	1	2	3	4	5	20 MAY Station 0	1	2	3	4	5	23 JUN Station 0	1	2	3	4	5
Atlantic bumper	63	82	18	5	7	9	7																	
crevalle jack																								
blue runner			1		1			1				1	15	2	5			1	20	7	8			11
Spanish mackerel	11	21	7		4	5							6				1			2			1	
other fishes	4	7	2	3	1	4	1						1	1	1		6		1					1
total fishes	78	110	28	8	13	18	8	1	0	0	0	1	22	3	6	0	7	1	21	9	8	0	1	12

Species	20 JUL Station 0	1	2	3	4	5	17 AUG Station 0	1	2	3	4	5	21 SEP Station 0	1	2	3	4	5	25 OCT Station 0	1	2	3	4	5
Atlantic bumper			12		2			34		2	3	12		3					121	8	26	17	8	16
crevalle jack																				3		1		4
blue runner	1	1	2		1	3	1	2	4		4	2	12	2		4	1	12	3	1	3	2		8
Spanish mackerel								1			1	1							23	4	9	13	6	12
other fishes			1		1			29					3	1			1	2	13	5	1	2	6	17
total fishes	1	1	15	0	4	3	1	66	4	2	8	15	15	6	0	4	2	14	160	21	39	35	20	57

Species	29 NOV Station 0	1	2	3	4	5	15 DEC Station 0	1	2	3	4	5	MAR-DEC Station 0	1	2	3	4	5	Total by Species	Percent Composition
Atlantic bumper							56	13	12	6	2	13	247	140	68	30	22	50	557	32.1
crevalle jack		269						49				1		321		1		5	327	18.9
blue runner	6	104				1	19					1	77	120	23	6	7	40	273	15.7
Spanish mackerel							44	4			2	1	84	32	16	13	15	19	179	10.3
other fishes	5	48[a]		14			96[a]	110[a]	4	1	3	2	124	201	9	20	18	26	398	23.0
total fishes	11	421	0	14	0	1	215	176	16	7	7	18	532	814	116	70	62	140	1734	100.0

[a] Primarily bluefish, menhaden and/or croaker.

TABLE B-5

TOTAL NUMBER OF FISHES COLLECTED BY TRAWL
(15-MINUTE TRAWL PER STATION PER MONTH), ST. LUCIE
MARCH-DECEMBER 1976

	MAR(5 APR)[a]						22 APR						18 MAY						3 JUN						1 JUL					
	Station						Station						Station						Station						Station					
Species	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5
flatfish[b]	1	2	2	1				2	1	1	1	3	5	2	1	9	8	11	8	1	4	1		1	3	2	3	4	2	4
searobin							5	2	1			1	10	5	4	10	3	12	4		7		2	1	1	1	2		1	1
cusk-eel							1	9				2	13	2	8	7	6	8	1								3		1	
sand perch													5	5	8		9	19	1		7		3	1			2		3	5
grunt	1	1					5					4						3							1	5				
snapper								4																						
mojarra										1		1					1									1				
other fish	6						3	9			1	3	4	8		2	2	9			1		1		2	2	2		5	2
total fish	8	3	2	1	0	0	14	26	2	2	2	14	37	22	21	28	29	62	14	1	19	1	6	3	7	11	12	4	12	12

	18 AUG						8 SEP						5 OCT						11 NOV						12 DEC					
	Station						Station						Station						Station						Station					
Species	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5
flatfish[b]			1	9	1	1	3	1		1			3		3	5	3	8	1				1	1				3		1
searobin	2		2	2							1	1	6		4	2	7	2				1	2	3			1			3
cusk-eel	1			1							1			1			1					1		1	1			1		2
sand perch			3			7	1						1		2		2	2												
grunt	1	19	1			2		5					1					1	2		2			4	2					1
snapper	1						4						8	1	4		2	3												
mojarra	1	15	1					1											3					1						
other fish	3	7	5	1	2	2	5	7		1		1	3		4	1	1	8	7	4	1	4	6	1	3			1		3
total fish	9	41	13	13	3	12	13	14	0	2	2	2	22	2	17	8	16	24	13	4	3	6	9	11	6	0	1	5	0	10

[a] Delayed due to inclement weather.

[b] Flounder, sole, tonguefish.

TABLE B-6

TOTAL NUMBER OF SHELLFISHES AND FISHES COLLECTED BY BEACH SEINE
(COMBINATION OF THREE REPLICATES PER STATION PER MONTH), ST. LUCIE
MARCH-DECEMBER 1976

	29 MAR			12 APR			10 MAY			11 JUN			7 JUL			25 AUG			8 SEP			OCT(1 NOV)[a]			16 NOV			20 DEC		
	Station			Station			Station			Station			Station			Station			Station			Station			Station			Station		
Species	6	7	8	6	7	8	6	7	8	6	7	8	6	7	8	6	7	8	6	7	8	6	7	8	6	7	8	6	7	8
speckled crab	1				1	2				12	3	1	9	2	1	1	17	6		6		3	1	4		2				3
other crabs										1						1	1													
herring							1	1	1			17	486												1	1	2			
anchovy												152	7																	
Atlantic bumper		9	1									1				4	3	1	8	1										
Florida pompano			2						1	4	1	1	1	6	3				10	8	1			3			1	1		
other jacks			5		5		1	6		2	1	2	39	2			2								2	3	2	1		
kingfish		1	4	5	1	2	8	6	22	6	2	3	4	17	1				2	5	9				2		2			6
sand drum			1			1	21			4	4	2	25	3	1	1	21	1	3	7	10									
spot																			18	9	71								3	
sea catfish										1	4	1		1		2	7				2						1			1
porgy		11														1					2									
sennet													1		14															
other fishes		2	1				1	2		3	4	1	2	4	5			1	1	5							2		1	
total fishes	0	23	14	5	6	3	32	15	24	20	16	180	565	33	24	8	33	3	42	35	95	0	0	3	5	4	10	2	4	7

[a] Delayed due to inclement weather.

TABLE B-7

COMPARISONS BETWEEN DAY AND NIGHT SURFACE COLLECTIONS
OF FISH LARVAE AND EGGS AT STATIONS 0 TO 5
ST. LUCIE PLANT
1976

Category	Date	Mean number Day	Mean number Night	Day-night ratio
Eggs	29 MAR	25.534	14.187	1.8:1
	3-4 JUN	19.632	8.731	2.2:1
	4 and 8 AUG	1.950[a]	1.303[b]	1.5:1
Larvae	29 MAR	0.294	24.539	1:83.5
	3-4 JUN	0.027	0.604	1:22.3
	4 and 8 AUG	0.142[a]	1.358[b]	1:9.5

[a] Mean based on samples collected on 4 August.
[b] Mean based on samples collected on 8 August.

TABLE B-8

PERCENTAGE COMPOSITION OF THE MAJOR CATEGORIES OF FISH LARVAE
BY STATION AND SEASON
ST. LUCIE PLANT
1976

Season	Category	Station 0	1	2	3	4	5	11	12
Spring (MAR, APR, MAY)	Gerreidae	4.4	3.4	5.9	6.0	4.6	3.4	1.5	14.0
	Sciaenidae	0.1	0.1	1.0	2.4	1.3	0.5		
	Blenniidae	17.2	7.9	16.1	18.4	16.1	23.8	5.3	30.7
	Tetraodontiformes	3.7	1.5	20.0	5.4	4.0	2.9	0.9	11.2
	Clupeiformes	48.1	77.9	22.0	47.9	53.7	43.6	79.3	5.0
	Carangidae	3.4	0.2	18.1	8.9	10.6	4.9		
	Gobiidae	0.2	0.1		0.4	0.8	0.4	0.2	2.2
	Pleuronectiformes	0.2	0.1	0.1		0.1	0.2		1.7
	Gobiesocidae	0.5	0.1	0.2	0.1		1.9		4.5
	Dactyloscopidae	11.7	3.5	2.2	0.9	4.6	2.9	0.2	
	Serranidae				0.1				
	Scorpaenidae	0.1		0.1	0.2	0.1			
	Atherinidae	1.6	0.1		0.3	0.2	0.1	1.4	5.0
	All others	8.6	5.5	14.2	9.0	3.9	15.4	11.1	25.7

TABLE B-8
(continued)
PERCENTAGE COMPOSITION OF THE MAJOR CATEGORIES OF FISH LARVAE
BY STATION AND SEASON
ST. LUCIE PLANT
1976

Season	Category	Station 0	1	2	3	4	5	11	12
Summer (JUN, JUL, AUG)	Gerreidae	10.6	5.7	27.4	18.1	24.5	14.7	5.3	
	Sciaenidae		2.0	6.0	3.4	1.1	4.1	2.1	12.7
	Blenniidae	11.4	8.2	9.3	10.1	5.2	6.0	7.9	14.5
	Tetraodontiformes	22.6	3.5	3.1	4.2	3.2	9.1	2.1	
	Clupeiformes	28.6	49.7	18.1	37.6	39.2	29.6	66.8	27.3
	Carangidae	0.7	1.5	0.3	2.3	0.5	3.1		
	Gobiidae	1.2	1.9	2.0	2.2	2.5	3.3		25.4
	Pleuronectiformes	1.1	2.4	2.5	0.9	0.5	2.7	9.5	
	Gobiesocidae	0.6	0.2	0.3	0.3			1.0	
	Dactyloscopidae	0.6	2.0	0.9	0.9	0.5	1.9	1.0	
	Serranidae	3.0		0.3		0.6			5.4
	Scorpaenidae		2.3	0.5	0.2			1.0	
	Atherinidae	2.8	8.2	1.7	3.9	5.7	9.1		
	All others	16.8	12.2	27.7	15.9	16.3	16.4	3.2	14.5

TABLE B-8
(continued)
PERCENTAGE COMPOSITION OF THE MAJOR CATEGORIES OF FISH LARVAE
BY STATION AND SEASON
ST. LUCIE PLANT
1976

		Station							
Season	Category	0	1	2	3	4	5	11	12
Fall (SEP, OCT, NOV)	Gerreidae	44.3	19.9	56.1	67.9	22.4	11.3		1.4
	Sciaenidae	19.1	47.7	9.2	3.7	22.8	29.6		1.4
	Blenniidae	0.4	1.6	6.3	0.4	1.8	1.6	0.7	11.2
	Tetraodontiformes	0.2	0.5	0.6	1.2	0.4	1.4	0.4	
	Clupeiformes	5.6	11.2	5.4	1.3	13.8	2.5	94.1	63.6
	Carangidae	23.2	5.6	18.0	21.5	33.4	47.4	0.4	2.9
	Gobiidae	0.1		0.1	0.1	0.1			2.9
	Pleuronectiformes	1.2	7.0	0.6	0.4	0.8	1.7	3.0	6.3
	Gobiesocidae	0.1	0.2	0.1	0.1	0.1	0.2		
	Dactyloscopidae	0.3	1.1	0.7	0.6	0.9	1.3		
	Serranidae	2.3			0.1	0.2	0.1		
	Scorpaenidae			0.5		0.1	0.1		
	Atherinidae	0.1	1.4	0.6	0.1	0.4			8.7
	All others	3.2	3.8	1.8	2.6	2.8	2.8	1.4	1.4

TABLE B-9

STATISTICAL DIFFERENCES IN MEAN DENSITY[a] OF FISH LARVAE AT STATIONS 0 TO 5 WITH RESPECT TO PLANT OPERATION MODE
ST. LUCIE PLANT
1976

Date	Station 0	1	2	3	4	5	Significant difference[b]	Plant operation mode
10 MAR		0.233	0.034				1>2	Down, ambient
29 MAR	0.055	0.694	0.032	0.017	0.554	0.412	none	Down, ambient
13 APR	0.002	0.172		0.072	0.083	0.075	none	Down, ambient
23 APR	0.294	0.908	0.805	0.928	0.782	0.126	1, 2, 3 and 4>0 and 5	Down, ambient
4 MAY	0.039	0.062	0.058	0.253	0.046	0.042	none	Up, ambient
26 MAY	0.123	0.078	0.076	0.019	0.039	0.141	0 and 5>3 and 4	Up, heated
4 JUN	0.024	0.066	0.012	0.004	0.003	0.052	1>0, 2, 3 and 4 5>3 and 4	Up, heated
22 JUN	0.029	0.536	0.021	0.075	0.096	0.022	none	Up, heated
2 JUL	0.071	0.159	0.062	0.042	0.076	0.038	none	Up, ambient
16 JUL	0.149	0.033	0.033	0.156	0.064	0.025	0 and 3>1, 2, 4 and 5	Down, ambient
4 AUG	0.068		0.058	0.402		0.039	none	Down, ambient
20 AUG	0.018	0.028	0.131	0.251	0.120	0.058	none	Down, ambient
9 SEP	0.169	0.158	0.030	0.044	0.112	0.231	none	Up, ambient
23 SEP	3.986	0.950	3.427	4.657	3.812	1.613	none	Up, ambient
20 OCT	0.023	0.040	0.288	0.058	0.233	0.012	2 and 4>0, 1, 3 and 5	Up, ambient
27 OCT	0.009	0.045	0.044	0.015		0.022	1 and 2>0 and 3	Up, ambient
5 NOV	0.008	0.013	0.004	0.004	0.013	0.010	none	Up, ambient
19 NOV	0.002	0.007		0.055	0.035	0.034	3 and 4>0 and 1 5>0	Down, ambient

[a] Individuals/m^3.

[b] Refers to differences at the 95% level of significance.

TABLE B-10

STATISTICAL DIFFERENCES IN MEAN DENSITY[a] OF FISH EGGS AT STATIONS 0 TO 5 WITH RESPECT TO PLANT OPERATION MODE
ST. LUCIE PLANT
1976

Date	Station 0	1	2	3	4	5	Significant difference[b]	Plant operation mode
10 MAR		10.131	29.449				1>2	Down, ambient
29 MAR	9.959	58.182	9.223	47.062	13.637	15.144	none	Down, ambient
13 APR	1.356	0.004		20.796	10.160	0.988	3>4 3 and 4>0, 1 and 5	Down, ambient
23 APR	6.889	5.721	17.354	5.308	12.918	6.966	2>4 2 and 4>0, 1, 3 and 5	Down, ambient
4 MAY	1.196	0.276	1.948	1.142	0.510	0.636	none	Up, ambient
26 MAY	6.322	8.797	9.248	6.408	4.564	9.046	none	Up, heated
4 JUN	17.538	5.368	38.512	12.898	38.064	5.414	none	Up, heated
22 JUN	5.830	2.342	13.714	6.268	20.446	8.938	none	Up, heated
2 JUL	0.804	2.661	1.540	2.759	3.812	2.386	none	Up, ambient
16 JUL	17.228	8.758	5.823	1.010	2.918	13.214	5>2, 3 and 4 0>1, 2, 3 and 4 1>3	Down, ambient
4 AUG	3.668		0.916	1.961		1.235	none	Down, ambient
20 AUG	0.688	6.717	2.497	5.226	1.947	4.365	1>0, 2 and 4 3>0 and 4 5>0	Down, ambient
9 SEP	1.724	0.650	0.778	1.780	0.984	1.649	none	Up, ambient
23 SEP	0.721	0.203	3.684	0.976	0.061	0.358	none	Up, ambient
20 OCT	0.212	0.605	0.812	0.044	0.056	0.458	1>0, 3 and 4 2>0, 3, 4 and 5 5>3 and 4	Up, ambient
27 OCT	0.254	0.382	0.060	0.010		0.094	none	Up, ambient
5 NOV	0.248	0.271	1.102	1.302	1.378	1.344	none	Up, ambient
19 NOV	0.066	0.541		0.536	1.529	0.784	4>0, 1 and 3	Down, ambient

[a] Individuals/m^3.

[b] Refers to differences at the 95% level of significance.

TABLE B-11

STATISTICAL DIFFERENCES IN MEAN DENSITY[a] OF FISH EGGS AND FISH LARVAE AT STATIONS 11 AND 12 WITH RESPECT TO PLANT OPERATION MODE
ST. LUCIE PLANT
1976

Date	Eggs Station 11	Eggs Station 12	Eggs Difference	Larvae Station 11	Larvae Station 12	Larvae Difference	Plant operation mode
10 MAR	0.507	0.011	11>12	0.004	0.000	11>12	Down, ambient
29 MAR	0.984	0.274	11>12[b]	0.000	0.008	12>11[b]	Down, ambient
13 APR	4.391	0.740	11>12[b]	0.174	0.038	11>12[b]	Down, ambient
23 APR	11.563	0.028	11>12[b]	0.211	c	-	Down, ambient
4 MAY	2.284	0.472	11>12[b]	0.012	0.030	12>11[b]	Up, ambient
26 MAY	6.400	0.672	11>12	0.004	0.010	12>11	Up, heated
4 JUN	0.308	4.016	12>11	0.002	0.003	12>11	Up, heated
22 JUN	1.192	1.012	11>12	0.011	0.008	11>12	Up, heated
2 JUL	0.002	0.298	12>11[b]	0.000	0.010	12>11	Up, ambient
16 JUL	3.491	0.173	11>12	0.001	0.002	12>11	Down, ambient
4 AUG	0.914	0.044	11>12[b]	0.007	0.004	11>12	Down, ambient
20 AUG	3.876	0.023	11>12[b]	0.074	0.000	11>12[b]	Down, ambient
9 SEP	7.051	0.143	11>12	0.010	0.004	11>12	Up, ambient
23 SEP	3.792	0.007	11>12[b]	0.381	0.004	11>12[b]	Up, ambient
20 OCT	0.094	0.052	11>12	0.012	0.081	12>11	Up, ambient
27 OCT	0.052	0.004	11>12	0.000	0.002	12>11	Up, ambient
5 NOV	0.224	0.052	11>12[b]	0.000	0.004	12>11	Up, ambient
19 NOV	0.007	0.036	12>11	0.000	0.005	12>11	Down, ambient

[a] Individuals/m^3.
[b] Significant at the 95% level of significance.
[c] Insufficient data to calculate a mean.

TABLE B-12

CORRELATION ANALYSIS OF DENSITY OF ICHTHYOPLANKTON
WITH VARIOUS PHYSICAL PARAMETERS
ST. LUCIE PLANT
1976

Correlation	Error degrees of freedom	Correlation Coefficient
Larvae/m^3		
water temperature	82	0.408[a]
salinity	83	0.076
dissolved oxygen	107	0.263[a]
turbidity	70	-0.077
percent transmittance	54	0.176
Eggs/m^3		
water temperature	83	-0.335[a]
salinity	83	-0.113
dissolved oxygen	82	0.363[a]
turbidity	70	0.073
percent transmittance	73	0.043

[a] Significant at $\alpha = 0.001$.

C. MACROINVERTEBRATES

INTRODUCTION

Marine macroinvertebrate assemblages live at least part of their life cycles within or upon substrates, including bottom sediments, pilings, pipes, and rocks. A community of macroinvertebrates in an aquatic ecosystem is very sensitive to stress, and thus its characteristics serve as a useful tool for detecting environmental perturbations resulting from introduced contaminants. Because of the limited mobility and relatively long life span of benthic organisms, their characteristics are a function of environmental conditions in the recent past (EPA, 1973). For example, benthic communities have been shown to reflect the effects of temperature (Boesch, 1972), salinity (King and Kornicker, 1970), depth (Sanders, 1968), current (O'Gower and Wacasey, 1967), and substrata (Abele, 1972; Bloom et al., 1972) as well as the effects of various pollutants (Holland et al., 1973; Wilhm, 1967; Wilhm and Davis, 1966).

The purpose of this study was to determine the composition and abundance of benthic and swimming macroinvertebrates in the vicinity of the St. Lucie nuclear power plant. The possible effects of plant operation on habitat, population, and distribution of macroinvertebrates were also examined. Diverse sampling procedures were used

to obtain a wide variety of macroinvertebrates and eliminate sampling bias. Emphasis was placed upon the possible influence of thermal discharge upon benthic organisms and commercially valuable swimming organisms such as shrimp.

MATERIALS AND METHODS

Two sampling programs were designed to study the macroinvertebrate assemblages in the oceanic environment near the St. Lucie plant. Samples were collected by bottom trawling and bottom grabs.

Quarterly grab sampling for the smaller benthic infauna (organisms living within the substratum) and epifauna (organisms living on top of the substratum) began in March 1976 at six offshore locations (Figure C-1, Table C-1). Five of these stations (1 through 5) were in the vicinity of the plant discharge and corresponded to locations sampled during preliminary studies conducted from 1971 to 1974 (Gallagher and Hollinger, in press). One additional station, 4.3 kilometers south of the plant discharge, served as a control (Station 0). The grab sampling effort was supplemented by monthly trawl sampling for the larger, more motile invertebrates that are sparsely distributed and are usually able to avoid a grab sampler. The same six offshore stations were sampled by the trawling beginning in March 1976. Physical data such as temperature, salinity, dissolved oxygen concentration, and turbidity were collected at surface mid-depth, and bottom of each station during both trawl and grab sampling.

Grab sampling was conducted with a Shipek bottom grab. This device was used in the perliminary benthic study performed in the St. Lucie plant area, and is recommended for use in similar habitats by EPA (Watling, et al., 1974; Maurer, et al., 1976). The Shipek sampler (Figure C-2) is composed of two concentric half-cylinders, the inner half-cylinder (20 x 20 x 10 cm) rotating through 180° as the sampling scoop. Powerful helical springs close the two half-cylinders so that the sample cannot escape. The sampler was lowered to the bottom with winch and line. When the sampler touched bottom with the scoop opening downward, inertia from a self-contained weight tripped the catch and rotated the scoop upward with the sample enclosed. The semi-circular top minimized washout when the sampler was hauled back aboard the sampling vessel.

Because sample replication is necessary for valid statistical analysis (EPA, 1973), four replicate Shipek samples were taken at each offshore station during each sampling period. All samples were fixed on board the sampling vessel with 10% buffered formalin-seawater solution containing rose bengal stain. The stain colors animal tissue to enable more accurate sorting of the sample. Preserved samples were placed in labeled, individual containers and transported to the laboratory. Three of the four replicates taken at each station were washed through a No. 25 sieve to remove fine sediment and particulate matter. This screen size and procedure

were used to conform with previous offshore monitoring (Gallagher and Hollinger, in press). All material retained on the sieve was hand-sorted in the laboratory, where the stained organisms were identified to the lowest practicable taxon.

The fourth replicate taken at each station was similary sorted, but the organisms (exclusive of molluscan shells) were dried at 105°C for four hours, then weighed on an analytical balance to obtain an estimate of community biomass per unit area. The substratum material of the sample was dried, disaggregated, and placed in a nest of seven sieves (U.S. Standard Mesh Numbers 5, 10, 18, 35, 60, 120 and 230). The nest was shaken for 15 minutes on a Tyler Ro-Tap sieve shaker. The substratum was then analyzed according to the method of Folk (1966) for particle size distribution.

The trawl sampling program for invertebrates was carried out in conjunction with the fish sampling program. Trawls were made at night to reduce net avoidance. The program consisted of one 15-minute tow using a 4.9-m semi-balloon otter trawl at each offshore station. The resulting samples were preserved in 10% buffered formalin-seawater solution, labeled, and transported to the laboratory for sorting and identification to the lowest practicable taxon.

RESULTS AND DISCUSSION

Sediments

Many environmental parameters are known to affect the structure and distribution of marine benthic communities. Among the more important is substratum type. Sharp distinctions occur between fauna associated with hard and soft substrata. Hard substrata are usually represented by rock outcroppings and coral reefs; to a lesser extent they are also represented by large fragments of mollusc shell. These hard substrata generally support a wide variety of cryptic, boring and epifaunal species. Soft substrata, such as the biogenically derived sediment reported by Hathaway (1971) to be widespread on the nearshore continental shelf adjacent to Hutchinson Island, may be expected to support a somewhat lower infaunal biomass and species diversity (Abele, 1974).

Many researchers have correlated various sediment parameters such as grain size and material composition with the species distribution and diversity of benthic macroinvertebrates (Sanders, 1968; Lie, 1968; Lie and Kelley, 1970). Most of this work has focused on benthic communities associated with sand and mud substrata, and little effort has been expended studying the benthic macroinvertebrate community of a shell-hash habitat. Substratum analysis was needed to provide data for describing this little-studied benthic community.

Substratum samples were analyzed for mean particle size, percent gravel composition, and sorting coefficient. The sorting coefficient,

or standard deviation of the mean particle size, was used to describe the degree of sorting or homogeneity of sample particle size as follows:

Sorting Coefficient	over 0.78 mm	very well-sorted or homogeneously sized particles
	0.78 - 0.70 mm	well-sorted
	0.70 - 0.63 mm	moderately well-sorted
	0.63 - 0.50 mm	moderately sorted
	0.50 - 0.25 mm	poorly sorted
	0.25 - 0.125 mm	very poorly sorted
	<0.125 mm	extremely poorly sorted or heterogeneously sized particles

Mean particle sizes and sorting coefficients (standard deviations) of sediment samples collected at the six St. Lucie benthic stations are given in Table C-2. Particle size distribution appears in Table C-3. Three highly different sediment types found at the six benthic stations divided the study area into three zones: 1) the beach terrace (Station 1); (2) the offshore trough (Stations 0, 2, 4, and 5); and 3) the offshore bar-Pierce shoal (Station 3).

Beach terrace sediment was a fine to very fine, moderately well-sorted, gray, non-biogenic sand. It was found exclusively at Station 1 in the seaward edge of the terrace. Offshore trough sediments consist of a somewhat variable, very coarse, very poorly sorted, sandy shell-hash.

A significant quantity of gravel-size shell particles (>2.0 mm) was characteristic of trough sediments. The mean composition of gravel in the sediment ranged from 33% at Station 0 to 13% at Station 5 (Table C-2). Large shell particles impart heterogeneity, with resultant good porosity, to trough sediments.

The offshore-bar sediment is a medium, well-sorted, calcareous sand that was found exclusively at Station 3 atop Pierce Shoal. The absence of gravel-size shell and the general homogeneity of the sediment probably results from hydrological processes that selectively transport medium and fine sand to the shoal crest while removing the larger particles (Duane, et al., 1972). This selective process results in a homogeneous substratum that, because of representative particles, probably retains good porosity.

Benthic Grabs

Grab sampling during 1976 at six offshore stations produced 21,834 individuals of 431 taxa of benthic macroinvertebrates (excluding non-quantitatively sampled meiofaunal species and bryozoa; Appendix Table H-128). The major portion of the taxa collected were annelid worms (50%), while crustaceans and molluscs comprised, almost equally, the bulk of the remaining taxa (25 and 20%, respectively). Echinoderms and minor phyla comprised the remaining portion of taxa (5%).

Both number of taxa and density (individuals/m^2) generally increased at all stations in successive quarters (Table C-4, Figures C-3 and C-4); the only exception occurred at Station 5 (Table C-4). These seasonal increases appeared to be related to seasonal increase in bottom water temperature (Figure C-3). Substratum temperatures during September showed little deviation (0.5°C, maximum) from bottom water temperatures at all offshore stations. Further investigation will provide sufficient data to test for correlation between bottom temperatures and fluctuations in species richness and density.

Mean biomass data for all stations combined decreased each sampling quarter (Table C-4, Figure C-4) from 7.680 g/m^2 in March to 1.348 g/m^2 in September. Comparison of biomass with density and number of taxa suggests that the increases in number of taxa and density through the summer and early fall were probably a result of recruitment of predominantly younger, and therefore smaller, individuals.

A measure directly related to the distribution and abundance of species in a community is species diversity (Appendix Table H-129). The Shannon-Weaver function of species diversity ($\bar{d}$) (Lloyd et al., 1968) is recommended for biological monitoring of water quality (EPA, 1973).

Calculated $\bar{d}$ for most stations increased seasonally (Table C-4). Exceptions to this trend were again found at Station 5 and also at Station 3. Diversity values at the latter were affected by large recruitment of young bivalve molluscs (*Crassinella duplinana*). Mean $\bar{d}$ for all stations combined showed a slight increase seasonally (3.9 to 4.6; Table C-4, Figure C-5). Diversity of the macroinvertebrate community near the St. Lucie plant was consistently high and was generally higher than benthic diversities encountered at any other Florida Power & Light plant. The equitability component of diversity (based on a hypothetical maximum diversity) proposed by Lloyd and Ghelardi (1964) (Appendix Table H-129) varied little seasonally (range = 0.75-0.78). These two functions suggest little change in the actual apportionment of species through the seasons in the offshore area, although number of taxa and density increased.

Individual station characteristics, in terms of number of taxa, density and biomass, are presented in Figure C-6 (see also Table C-4). Generally, the deeper water stations (0, 2, 4, and 5) contained greater numbers of taxa and higher densities. These stations were characterized by heterogeneous and porous shell-hash sediments which provided a suitable substratum for diverse fauna. From 190 to 239 total taxa were collected at these trough stations. Only 54 taxa were collected at Station 1, which was located on the beach terrace adjacent to the plant discharge. Due to the homogeneous composition

of fine sands, beach terrace substrata probably form tightly compacted deposits which may inhibit successful settlement of many benthic macroinvertebrates. Station 3, with 68 taxa, was found to be of intermediate richness compared to trough stations and Station 1. Intermediate richness was characteristic of Pierce Shoal, which lacked large shell material but retained the good porosity needed to provide sufficient oxygen and food supplies to the infauna.

Density and biomass totals indicated similar differences between stations (Figure C-6); the trough stations again supported greater densities ($\bar{x}$ = 11,665 to 15,295 individuals/m^2) and biomass ($\bar{x}$ = 1.850 to 12,463 g/m^2) than Stations 1 and 3 ($\bar{x}$ density = 420 and 2,053 individuals/m^2, and $\bar{x}$ biomass = 0.822 and 0.700 g/m^2, respectively).

The trends observed in number of taxa collected, density, and biomass between stations were also reflected in diversity values (Table C-4). Species diversity ($\bar{d}$) of trough stations was, with one exception, higher than that at Stations 1 and 3 each quarter. Equitability, perhaps a more sensitive function in lower latitudes (EPA, 1973), showed little variation between stations; all values remained within the range of those reported for healthy environments (EPA, 1973).

The distribution of percentage abundance among the major taxa at each station indicated that annelid worms could be considered the dominant group of organisms at the trough stations (Figure C-7). At Station 3, the molluscs appeared to predominate, while Station 1 appeared to be predominantly a crustacean-mollusc community. McCloskey's (1970) index of dominance (Appendix Table H-129) was used to determine which species appear to characterize the stations in the study area. This method essentially ranks each species by abundance and frequency of occurrence. The sum of the rank "scores" for a species indicates its dominance value at a station. This analysis (Table C-5) revealed a dominance of fouling organisms at the trough stations (e.g., tube building worms, *Metavermilia* sp. and *Omphalopoma* sp.; slipper shells, *Crepidula fornicata;* chitons, *Ischnochiton hartmeyeri* and *I. papillosus;* and barnacles, *Balanus trigonus* and *B. venustus*). This finding further indicated the importance of the shell-hash as a habitat requirement at these stations. Dominant species at Stations 1 and 3, however, were burrowing bivalve molluscs (e.g., *Tellina iris* and *Crassinella duplinana*) and amphipod crustaceans (e.g., *Pseudoplatyichnopus* sp. and *Trichophoxus* sp. A). The population dynamics of these species should be a useful tool in assessing future environmental quality.

Because colonial organisms such as hydroids, corals and bryozoans are difficult to quantify, they are not included in grab analyses. The bryozoans, however, occurred in sufficient quantity

to warrant discussion. A total of 34 taxa were collected during the first quarter of sampling (Table C-6). Thirty of these were commonly found encrusting larger shell-hash particles, which accounts for their abundance at the trough stations. Two branching species that are morphologically restricted to large-sized particles for attachment sites were unique to these stations. Conversely, one species that is morphologically well adapted to the use of smaller particles for attachment was the only species that occurred at Station 3. No bryozoans were found at Station 1.

Numerous individuals of several meiofaunal (0.5 - 1 mm in size) groups were retained on screens used to sieve benthic grab samples. In some instances, these organisms were of sufficient size to be considered along with typical macrofaunal forms. However, in many cases they were trapped on the screens only by their adherence to larger particles. These groups include nematodes, gastrotrichs, kinorhynchs, halocarids, and harpacticoid copepods. Since all are historically associated with meiofaunal assemblages and because they were not quantitatively sampled, none were treated in the macroinvertebrate analyses. Relatively large numbers of nematodes and copepods were retained on the sieves, as these forms exhibited the most ubiquitous distributions (Table C-7).

Because the stations appeared to differ distinctly in terms of the biotic parameters discussed above, it was important to determine

whether these differences were due to some environmental heterogeneity or chance. Therefore, stations were compared in terms of faunal similarity with all replicates from all quarters pooled for each station. With the 36 top-ranked species as determined by McCloskey's (1970) dominance index (Table C-5), faunal similarity was calculated between all combinations of stations by the coefficient of Czekanowski (1913). As suggested by Nichols (1970), the modification to this coefficient by Bray and Curtis (1957) was used to account for the relative success of a species at a station, because the species list used for comparisons was reduced to the dominants (Appendix Table H-129). The resulting similarity coefficients were reduced from matrix form to a dendrogram (Figure C-8) using the "nearest neighbor" sorting technique (Lance and Williams, 1967). As indicated by a high association percentile, the dendrogram clearly shows a very close similarity among the trough stations. Stations 1 and 3 are not only faunally dissimilar from the trough stations but also from each other. Because hydrographical data showed no discernible differences between the station, the faunal relationships may be closely related to substrate variations. To test this hypothesis, the stations were ranked according to similarities in both fauna and mean particle size of the sediment, starting with the most dissimilar station. Stations with high degrees of association were placed close together, and those with lower degrees of association farther apart. When compared using the non-parametric rank correlation coefficient,

Kendall's τ (Kendall, 1962; Appendix Table H-129), the rankings show a highly significant correlation ($p \geq .01$) (Table C-8).

It is evident, therefore, that three distinct types of habitat are present: hard-packed sand beach terrace habitat (Station 1), coarse sand offshore shoal (Station 3), and shell-hash trough habitat (Stations 0, 2, 4, and 5). Faunistically, these habitats comprise the turbulent zone of the continental shelf similarly described by Day et al. (1971) for North Carolina. The faunal differences between Station 1 and the trough stations may well be associated with proximity to the surf zone (Day et al., 1971). The low faunal similarity to other stations may be largely a result of the noticeably lower density (420 individuals/m^2) at Station 1. The differences between Station 3 and other stations must be attributed to the topographically unique characteristics of the shoal, although density values approached those for the trough stations.

Benthic Trawls

During nine months (March-November 1976) of trawl collections, 9,040 specimens of macroinvertebrates of 156 taxa were identified (Appendix Tables H-130 to H-135). Although seasonal patterns of species richness (observed number of taxa) varied among stations, maximum species richness was found to occur during August when data from all stations were combined (Figure C-9). In contrast to grab

data, there was no evident association between temperature and species richness patterns.

Species richness data for the nine-month period were pooled and indicated that collections from Stations 0 and 5 were highest in number of taxa, and that collections from Station 3 were lowest (Figure C-10). The results were in general agreement with grab data in that trough stations exhibited higher species richness values than Station 1 or 3. This could be the result of preferences of larger macroinvertebrate species for heterogeneous shell-hash substrates, the greater abundance of potential food source organisms at trough stations, or a combination of the two factors. Trawl data do suggest, however, that a more diverse assemblage of larger, more motile organisms existed at Station 1 than could be seen from grab data.

The Morisita index of community similarity (Morisita, 1959; Appendix Table H-129) was used to compare trawl stations. This index has previously been applied to semi-quantitative data, such as those derived from dredge and trawl samples (Ono, 1961). The Morisita index compares two samples, taking into account abundances of cojoint species, total abundances in each sample, and respective diversity. The dendrogram formed by utilizing the Morisita index and group average sorting (Lance and Williams, 1967) indicated little similarity between Station 4 and all other stations. Little similarity

was also indicated between Stations 1 and 3 and Station 0, 2, and 5 (Figure C-11). When compared to the benthic grab similarity dendrogram (Figure C-8), the major deviation in station grouping using trawl data was the displacement of Station 4. This disparity was due primarily to the large number (2,984 individuals) of sand dollars (*Mellita quinquiesperforata*) collected at that station. The abundance of this organism might be associated with the station's proximity to Pierce Shoal. The grouping of Stations 1 and 3 and Stations 0, 2, and 5 can again be attributed to substrate affinities (see benthic grab similarity discussion).

Comparison of the most abundant species collected at each station (Table C-9) substantiated the results of station similarity analyses. Excluding *Mellita,* many of the more abundant species collected at Station 4 were also collected frequently at other trough stations. Two of these species, the molluscs *Anomia simplex* and *Crepidula fornicata,* are fouling organisms commonly associated with shell-hash. *Trachypenaeus constrictus* and *Portunus spinimanus* are large epifaunal decapod crustacean species, not included as dominants from grab data but among the more abundant species in trawl collections from the trough stations. Stations 1 and 3 were characterized by comparatively high abundances of epifaunal decapod species and a paucity of fouling species. Again, these larger macroinvertebrate forms do not lend themselves to capture by grab samplers, and therefore do not appear as dominant species among forms taken in grab sampling.

Five species of commercially important shellfish occurred in trawl collections. The pink shrimp, *Penaeus duorarum duorarum,* was the most abundant (43 specimens) when all trawl data were pooled. It was captured at Stations 0, 4 and 5. The rock shrimp, *Sicyonia brevirostris,* collected at all stations except Station 1, was the second most abundant (33 specimens). Because of the small number of specimens collected, no inference can be made concerning spatial or seasonal distributions of these two species. Other commercial species include the pink spotted shrimp, *Penaeus brasiliensis*; blue crab, *Callinectes sapidus*; and stone crab, *Menippe mercenaria*; each represented by fewer than four individuals.

The penaeid shrimp, *Trachypenaeus constrictus*, which occasionally occurs in commercial bait shrimp catches (Eldred, 1959) was common to all trawl stations, ranking as the most abundant macroinvertebrate at Stations 0, 1 and 3 (Table C-9). The observed greater abundance of *T. constrictus* at Stations 0 and 1 (Figure C-12) was probably influenced by their relative proximity to shore. Burkenroad (1939) remarked that *T. constrictus* might be restricted largely to sandy bottoms. This may account for their abundance at Station 1 where the substratum was sandiest. The use of inshore water as nursery grounds by this species has been indicated by Joyce (1965) and was further suggested by the rare occurrence in trawl collections of

shrimp greater than 15 mm in carapace length. This may be indicative of migration of *T. constrictus* offshore when reaching this size.

Pooled monthly size frequency data for *T. constrictus* (Figure C-13) varied little from size frequency data at Stations 0 and 1. When compared with abundance data (Figure C-14), pooled size frequencies indicated a protracted juvenile recruitment throughout the sampling period with a substantial pulse of juveniles occurring between March and April at both stations. Seasonal patterns of abundance are apparently different at Stations 0 and 1 during May and June (Figure C-14). This could be due to very localized variations in recruitment and migration. On the other hand, higher water temperatures and turbidity levels were recorded at Station 1, the immediate plant discharge, coincident with periods of power plant operation during May and June. Although data gathered while the plant was operational were insufficient to be conclusive, the actual effect of the discharge on the population of *T. constrictus* might be attributed to avoidance or mortality as a result of higher temperatures, increased turbulence, or both. If the effect of the discharge is in fact responsible for the population decline, then the phenomenon would be expected to be localized at Station 1. Collection of more data during plant operations may support these preliminary conclusions. An increase in juvenile recruitment appears to be responsible for the

observed increase in abundance during July at Station 1. Decreases in abundances at both Stations 0 and 1 (Figure C-14) following July are most likely a result of seasonal responses in population structure of *T. constrictus*.

SUMMARY

The nearshore environment in the vicinity of the St. Lucie Plant supports a rich and diversified assemblage of benthic species. Physical and chemical parameters monitored during the study showed no significant differences between stations (see Section G, Water Quality). However, according to quantitative data, benthic residents at all stations showed increasing density and diversity with increasing seasonal water temperatures.

Analysis of both quantitative and semi-quantitative data revealed faunal dissimilarities between some stations. It was thus inferred that factors other than physical and chemical parameters exerted the strongest influence on faunal dissimilarities. Faunal distribution correlated strongly with sediment type, and observed faunal patterns were most probably related to sediment distribution, which is affected by currents, tides, and storms. Alteration within the community will likewise be associated with any activities, such as plant water discharge, that cause a physical change in the benthic substrate. Because plant operation was intermittent during the sampling periods, however, effects of sustained operation cannot be documented.

LITERATURE CITED

Abele, L. G. 1974. Species diversity of decapod crustaceans in marine habitats. Ecology 55:156-161.

Bloom, S. A., J. L. Simon, and V. D. Hunter. 1972. Animal-sediment relations and community analysis of a Florida estuary. Mar. Biol. 13:43-56.

Boesch, D. F. 1972. Species diversity of marine macrobenthos in the Virginia area. Chesapeake Sci. 13(3):206-211.

Bray, J. R., and J. T. Curtis. 1957. An ordination of the upland forest communities of southern Wisconsin. Ecol. Monogr. 27:352-349.

Burkenroad, M. D. 1939. Further observations on Penaeidae of the northern Gulf of Mexico. Bull. Bingham Oceanogr. Coll. 6(6):1-62.

Czekanowski, J. 1913. Zarys metod statystycznyck: Warsaw.

Day, J. H., J. G. Field, and M. P. Montgomery. 1971. The use of numerical methods to determine the distribution of benthic fauna across the continental shelf of North Carolina. J. Anim. Ecol. 40:93-125.

Duane, D. B., M. E. Field, E. P. Meisburger, D. J. Swift, and S. J. Williams. 1972. Linear shoals onthe Atlantic lower continental shelf, Florida to Long Island. Pages 447-498 *in* D. J. Swift, D. B. Duane, and O. H. Pilken, eds. Shelf sediment transport. Dowden, Hutchinson, and Ross, Inc. Stroudsburg, Pa.

Eldred, B. 1959. A report on the shrimps (Penaeidae) collected from the Tortugas controlled area. Fla. St. Bd. Conserv., Sp. Sci. Rept. No. 2:1-6.

EPA. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. C. I. Weber, ed. EPA 670/4-73-001. Environmental Protection Agency, National Environmental Research Center, Cincinnati.

Folk, R. L. 1966. A review of grain-size parameters. Sedimentology 6:73-93.

Gallagher, R. M., and M. L. Hollinger. In press. Nearshore marine ecology at Hutchinson Island, Florida: 1971-1974. I. Rationale and Methods. Fla. Mar. Res. Publ. 23.

Hathaway, J. C. 1971. Data file continental margin program Atlantic coast of the United States. Vol. 2: Sample collection and analytical data. Woods Hole Oceanogr. Instit. Tech. Rep. Ref. No. 71-15. 54 pp.

Holland, J. S., N. J. Maciolek, and C. H. Oppenheimer. 1973. Galveston Bay benthic community structure as an indicator of water quality. Contr. Mar. Sci., Univ. Tex. 11:169-188.

Joyce, Edwin A. 1965. The commercial shrimps of the northeast coast of Florida. Fla. Bd. Conserv., Prof. Pap. Ser., No. 6:1-224.

Kendall, M. G. 1962. Rank correlation methods, 3rd ed. Hatner Publ. Co., N.Y. 199 pp.

King, C. E., and L. S. Kornicker. 1970. Ostracoda in Texas bays and lagoons: An ecologic study. Smithson. Contrib. Zool. 24:1-92.

Lance, G. N., and W. T. Williams. 1967. A general theory of classificatory sorting strategies. I. Hierarchial systems. Comput. J. 9:373-380.

Lie, U. 1968. A quantitative study of benthic infauna in Puget Sound, Washington, U.S.A., in 1963-1964. Fisk. Dir. Skr. Ser. Havllnders. 14(5):229-556.

Lie, U., and J. C. Kelley. 1970. Benthic infauna communities off the coast of Washington and in Puget Sound. Identification and distribution of the communities. J. Fish. Res. Bd. Canada 27:621-651.

Lloyd, M. J., and R. J. Ghelardi. 1964. A table for calculating the "equitability" component of species diversity. J. Anim. Ecol. 33:217-227.

Lloyd, M. J., J. H. Zar, and J. R. Karr. 1968. On the calculation of information-theoretical measures of diversity. Am. Mid. Nat. 79:257-272.

Maurer, D., P. Kinner, and W. Leathem. 1976. Benthic faunal assemblages off Delmarva Peninsula. Estuar. Coastal Mar. Sci. 4:163-177.

McCloskey, L. R. 1970. Dynamics of the community associated with a marine scleractinian coral. Int. Rev. Ges. Hydrobiol. 55(1):13-81.

LITERATURE CITED (continued)

Morisita, M. 1959. Measuring of interspecific association and similarity between communities. Mem. Fac. Sci. Kyushu Univ., Ser. E (Biol.) 3(1):65-80.

Nichols, F. H. 1970. Benthic polychaete assemblages and their relationship to sediments in Port Madison, Washington. Mar. Biol. 6:48-57.

O'Gower, A. K., and J. W. Wacasey. 1967. Animal communities associated with *Thalassia, Diplanthera,* and sand beds in Biscayne Bay. I. Analysis of communities in relation to water movements. Bull. Mar. Sci. 17(1):175-210.

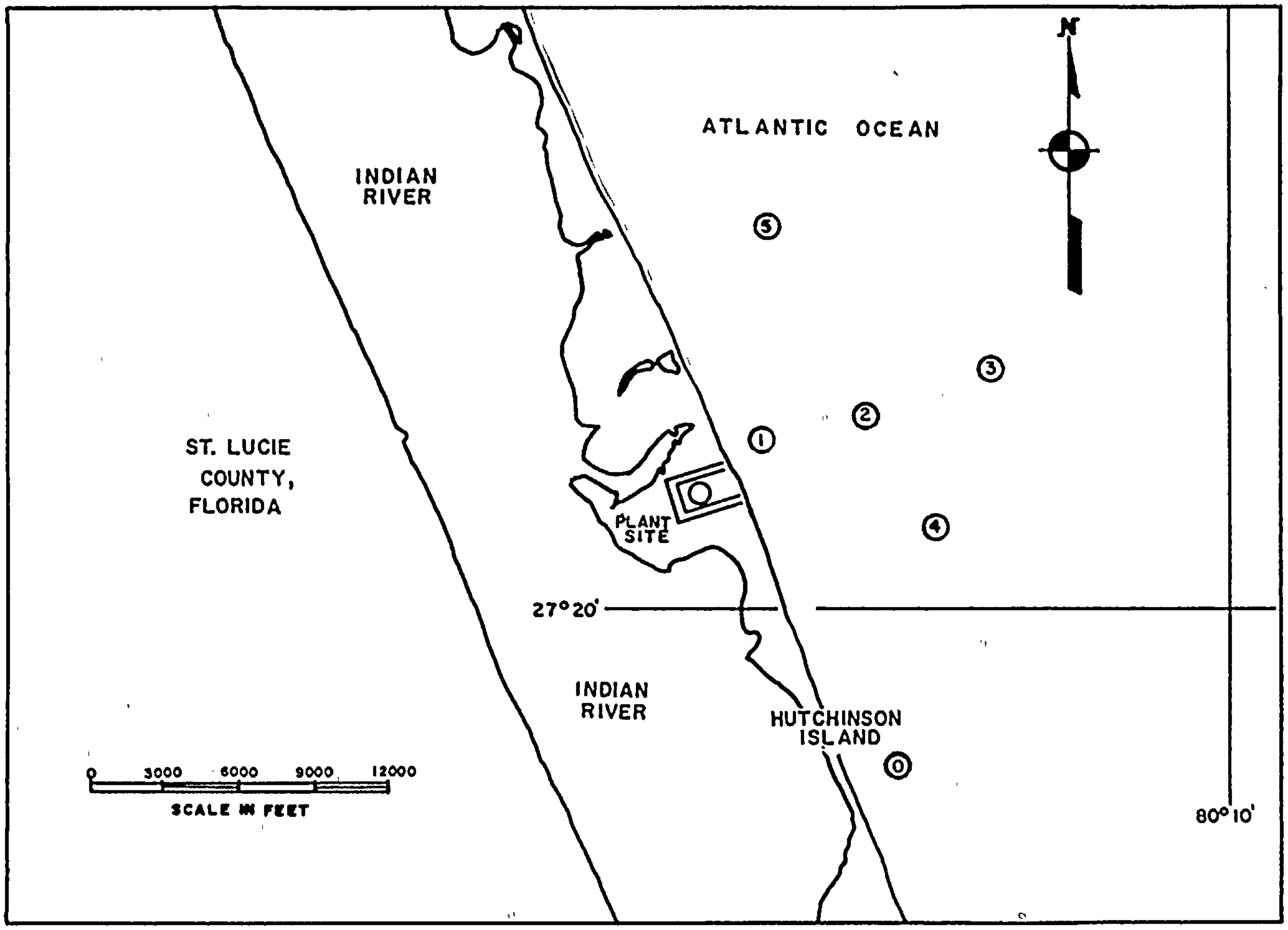
Ono, Y. 1961. An ecological study of the brachyuran community on Tomioka Bay, Amakusa, Kyushu. Records of Oceanographic Works in Japan (Special Number 5):199-210.

Sanders, H. L. 1968. Marine benthic diversity: A comparative study. Am. Nat. 102(925):243-282.

Watling, L., W. Leathem, P. Kinner, C. Wethe, and D. Mauser. 1974. An evaluation of sewage sludge dumping on the benthos of Delaware Bay. Mar. Poll. Bull. 5(3):39-42.

Wilhm, J. L. 1967. Comparison of some diversity indices applied to populations of benthic macroinvertebrates in a stream receiving organic wastes. J. Wat. Poll. Control Fed. 39(10):1673-1683.

Wilhm, J. L., and T. C. Dorris. 1966. Species diversity of benthic macroinvertebrates in a stream receiving domestic and oil refinery effluents. Am. Midl. Nat. 76:426-449.



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT

LOCATIONS OF
BENTHIC MACROINVERTEBRATE
SAMPLING STATIONS
1976

MARCH 1977 APPLIED BIOLOGY, INC. FIGURE C-1

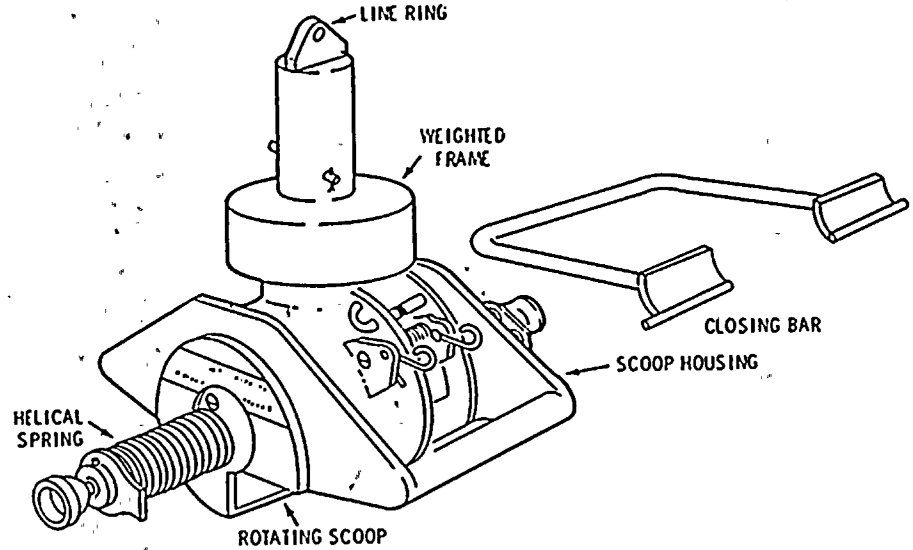


Figure C-2. Shipek scoop sampler.

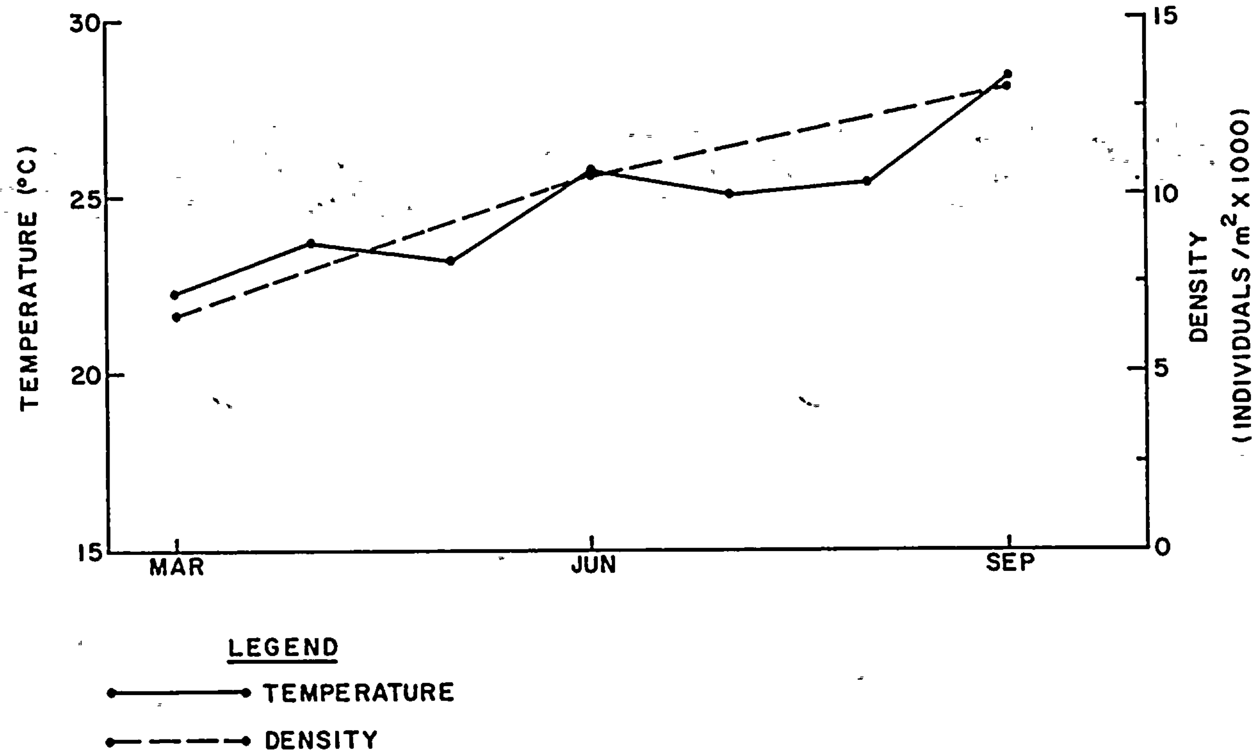


Figure C-3. Mean bottom temperature and mean density of individuals at the benthic macroinvertebrate sampling stations, St. Lucie Plant, 1976.

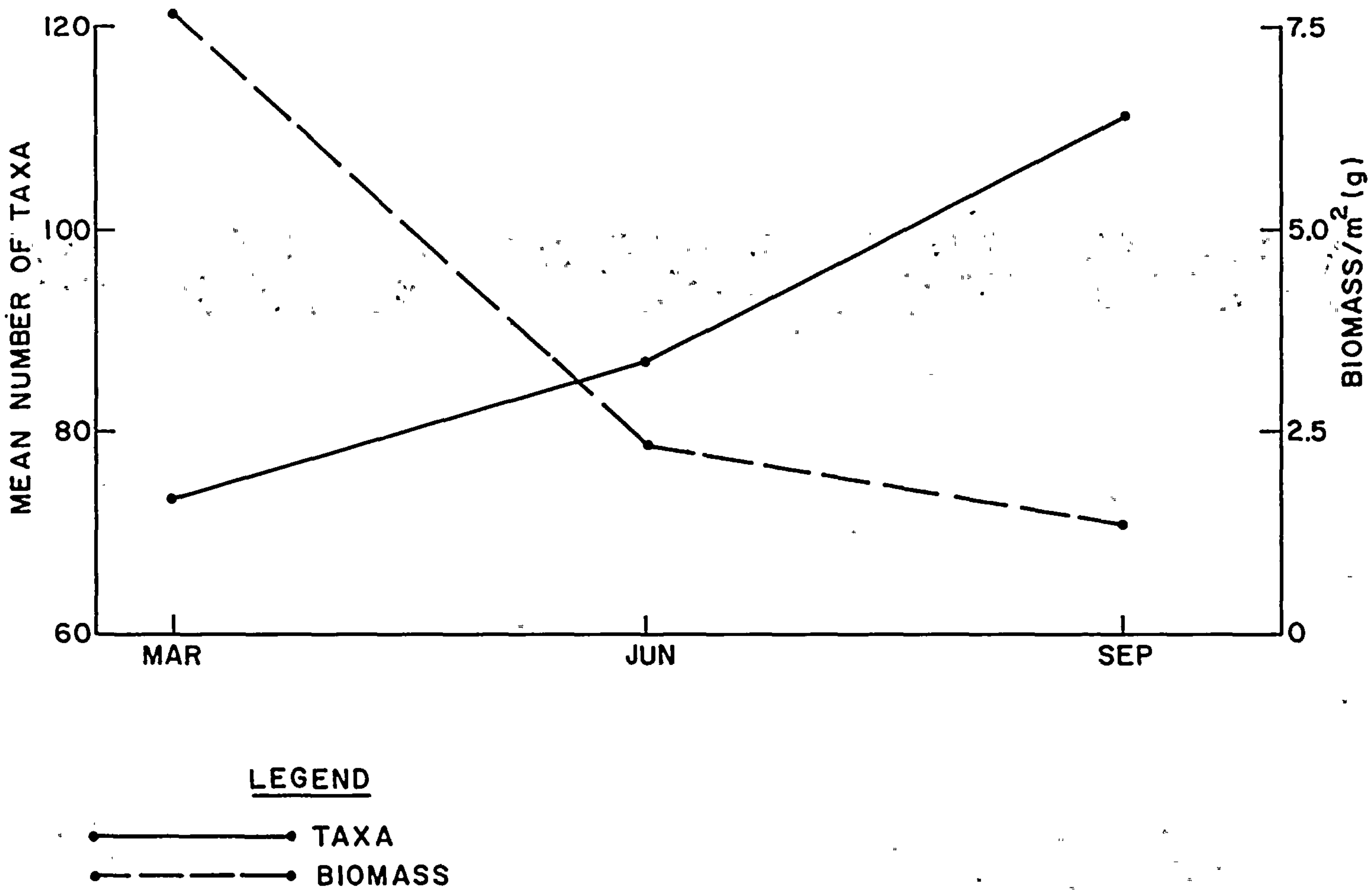


Figure C-4. Mean number of taxa and mean biomass/m^2 of individuals at the benthic macroinvertebrate sampling stations, St. Lucie Plant, 1976.

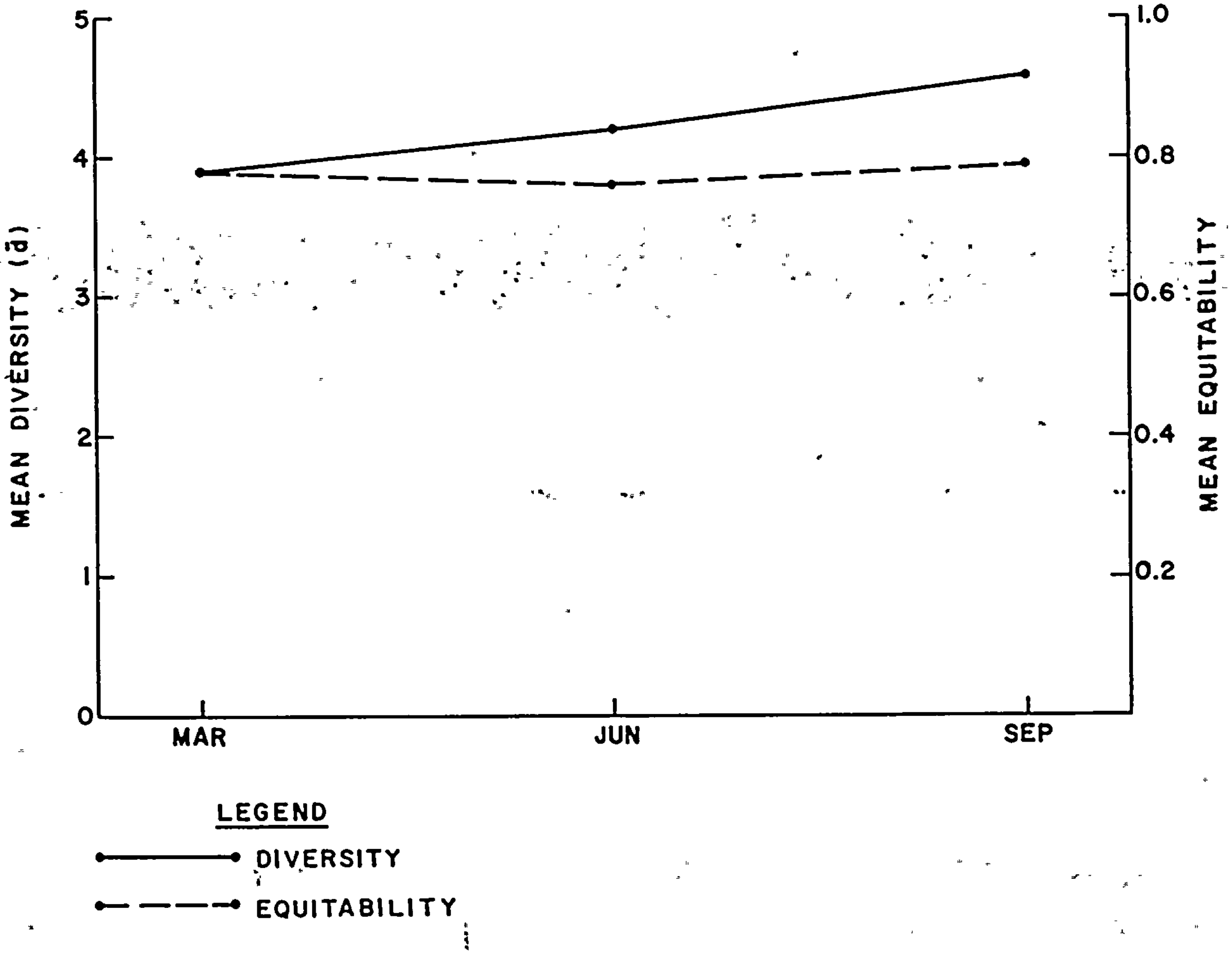


Figure C-5. Mean diversity and mean equitability of the benthic macroinvertebrate community, St. Lucie Plant, 1976.

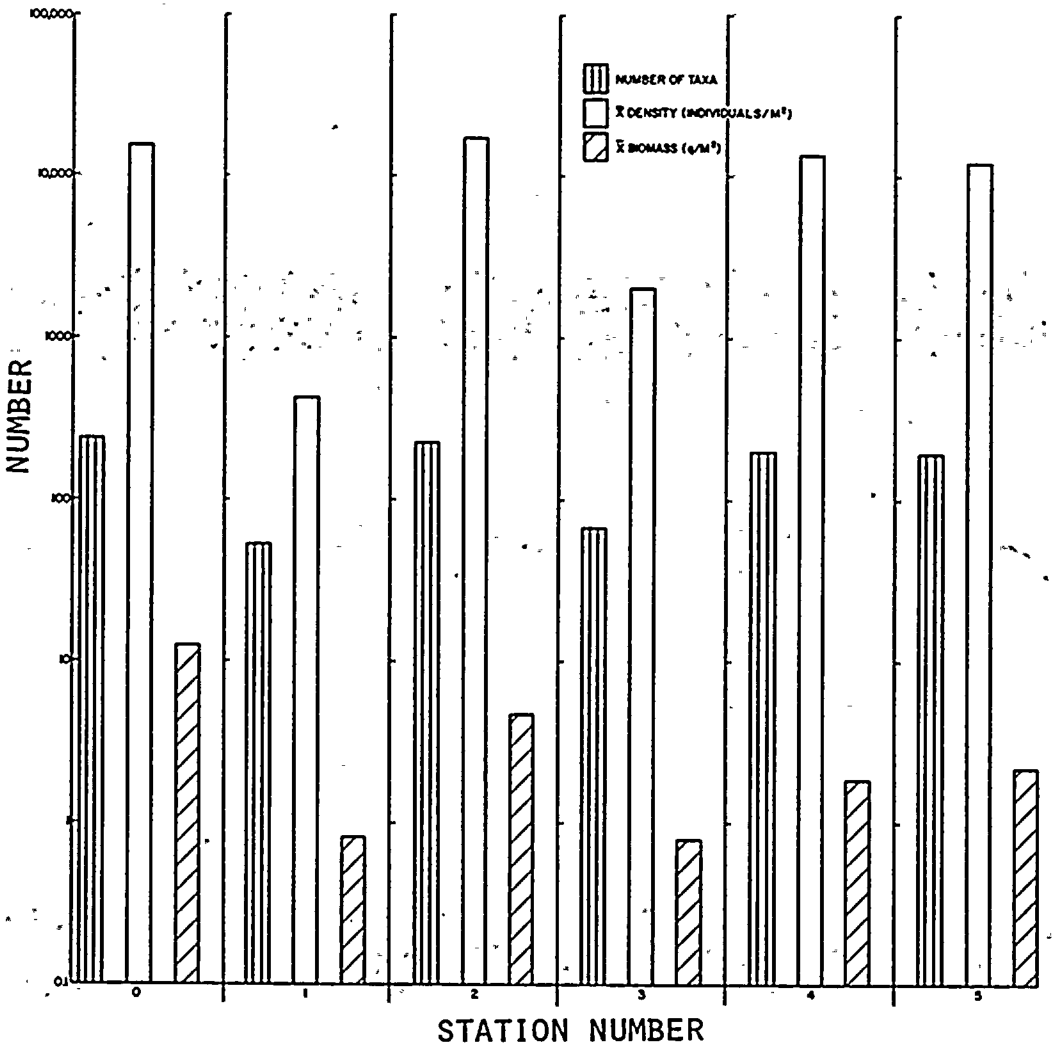


Figure C-6. Benthic macroinvertebrates: number of taxa, density and biomass at each offshore station, St. Lucie Plant, 1976.

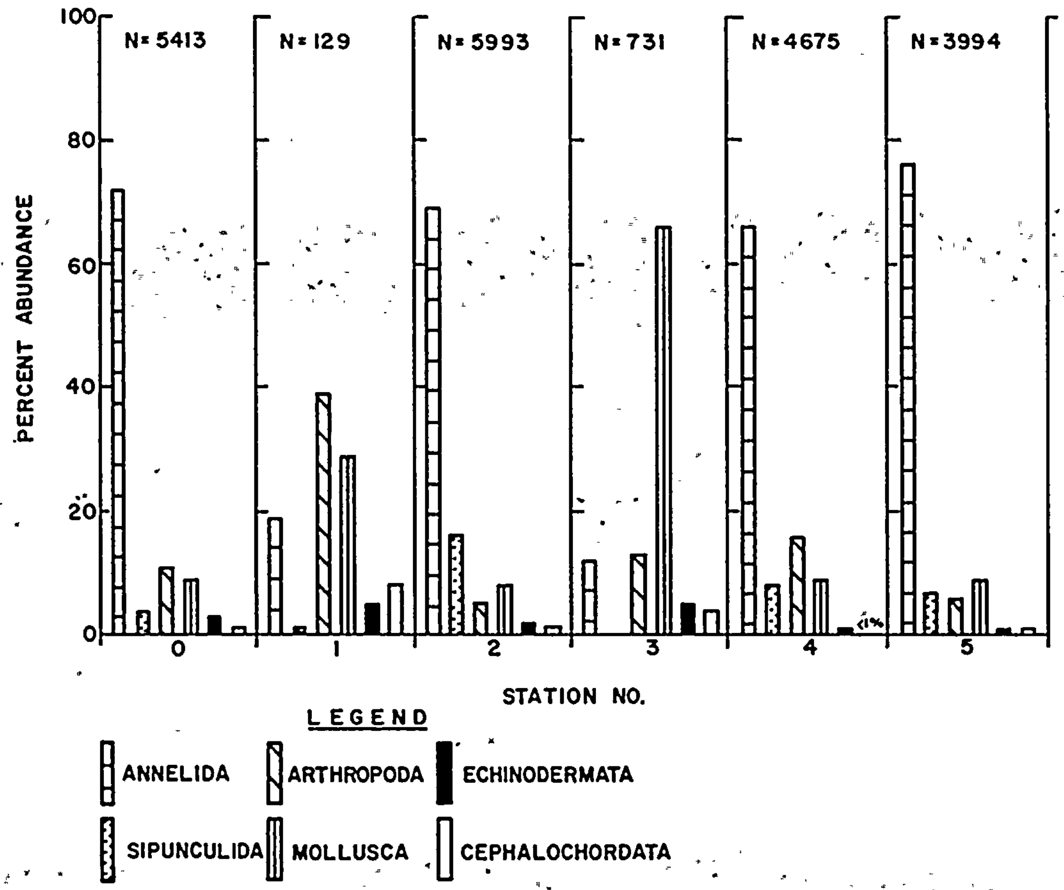


Figure C-7. Benthic macroinvertebrate distribution by major groups, St. Lucie Plant, 1976.

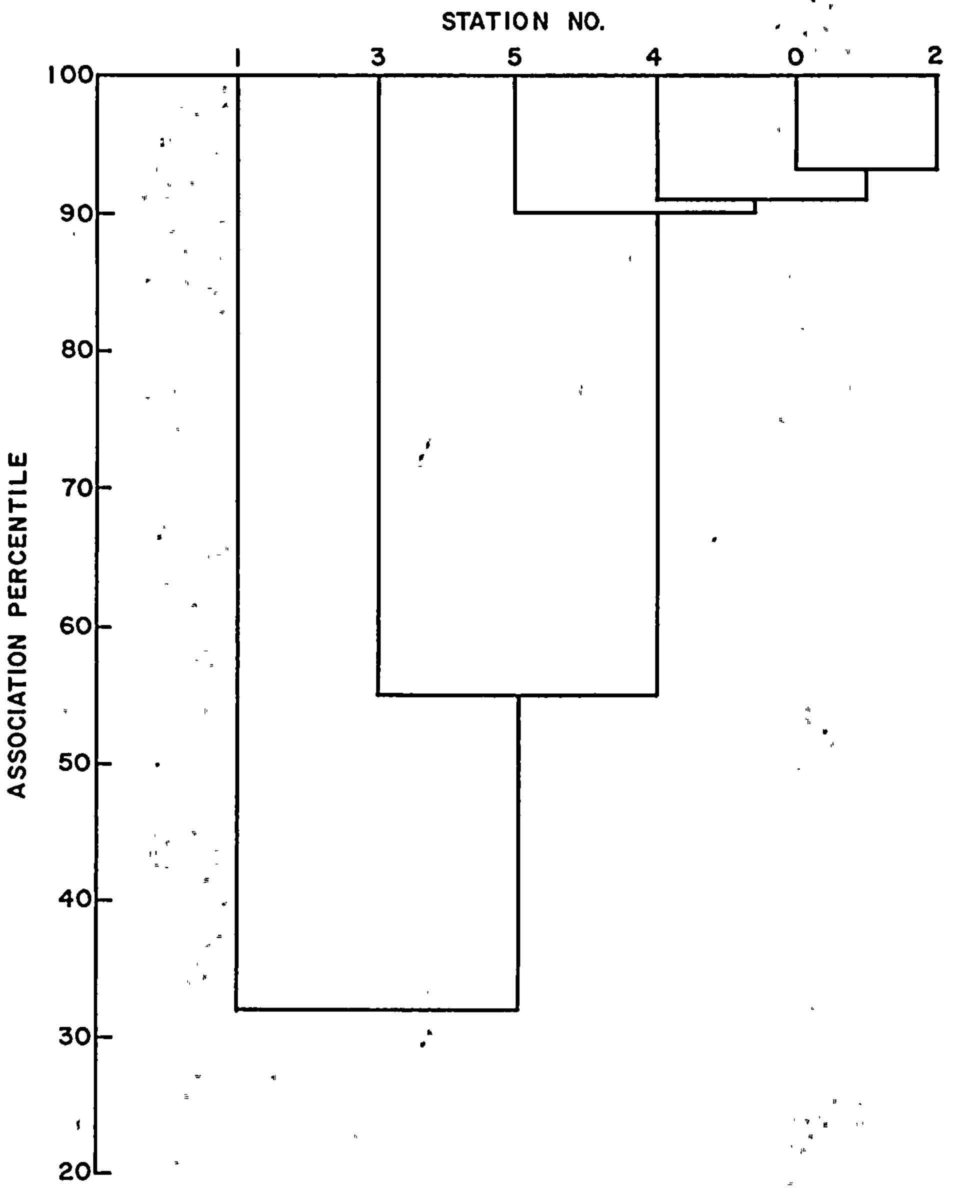


Figure C-8. Dendrogram showing faunal similarity between stations from grab data, St. Lucie Plant, 1976.

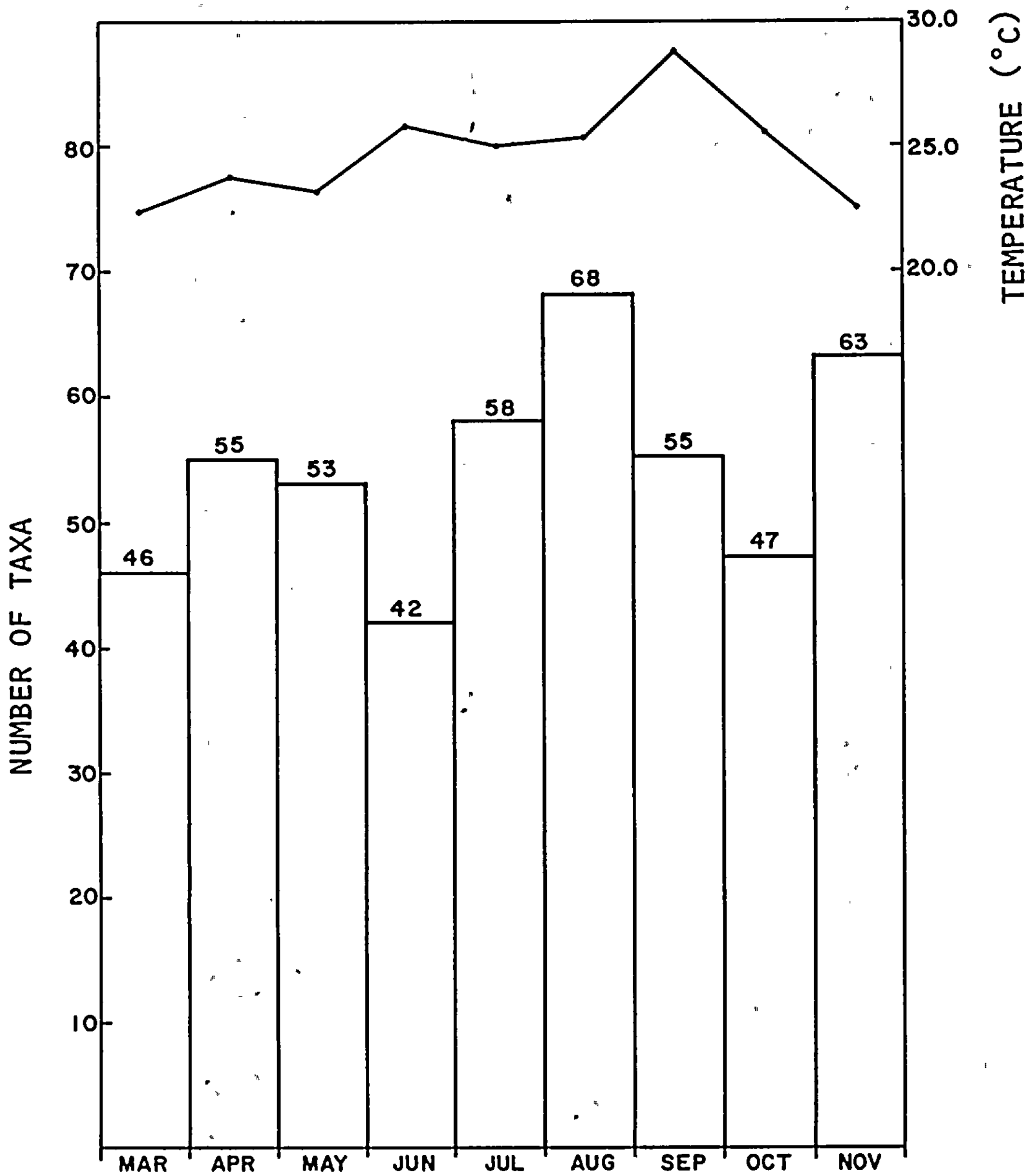


Figure C-9. Total number of macroinvertebrate taxa collected in benthic trawls compared to mean monthly bottom water temperature, St. Lucie Plant, 1976.

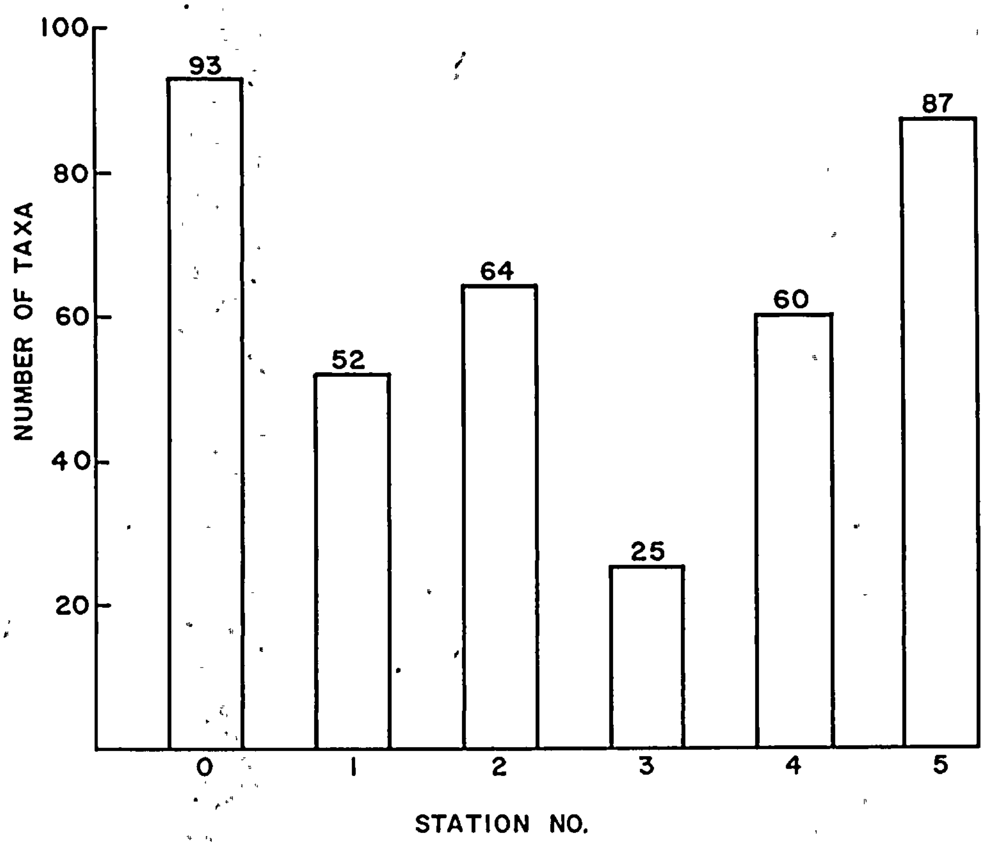


Figure C-10. Total number of macroinvertebrate taxa collected from monthly trawling at each offshore station, St. Lucie Plant, March-November 1976.

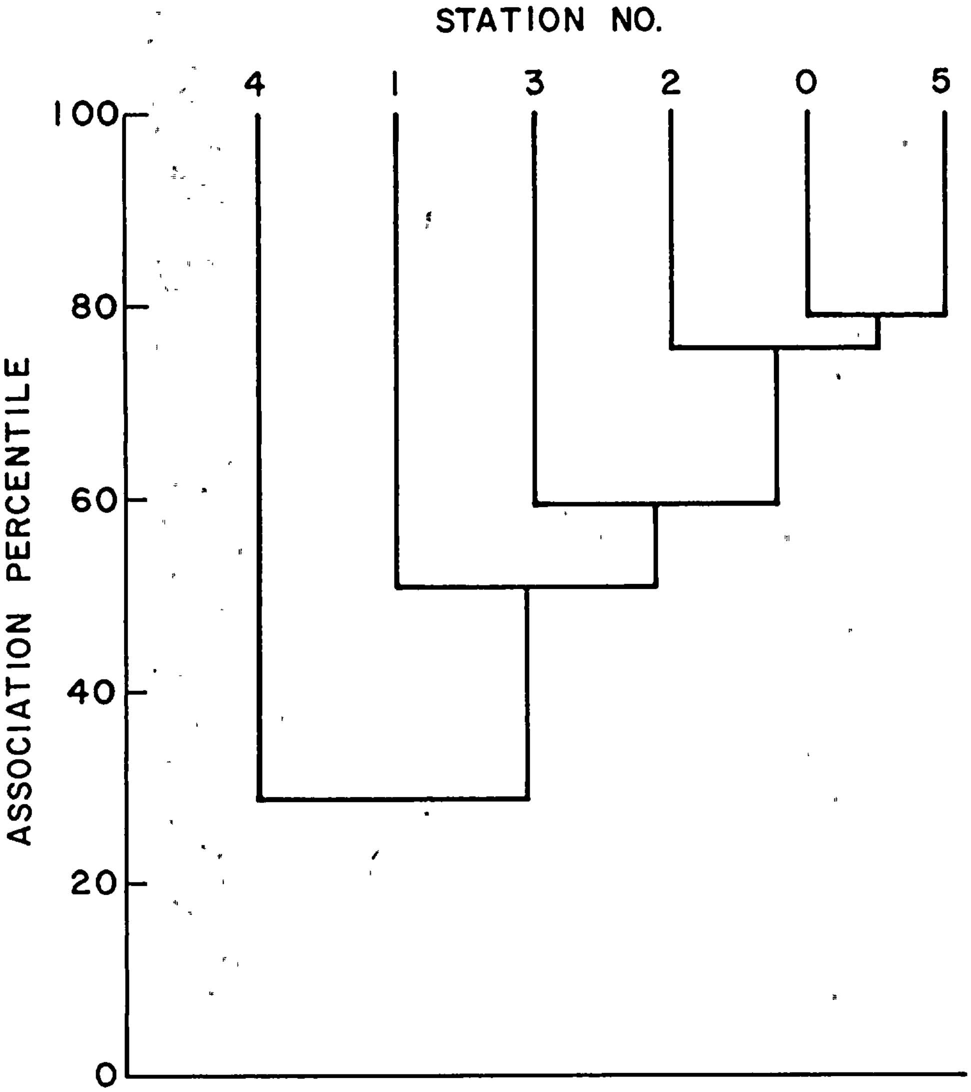


Figure C-11. Dendrogram showing faunal similarity between stations from trawl data, St. Lucie Plant, 1976.

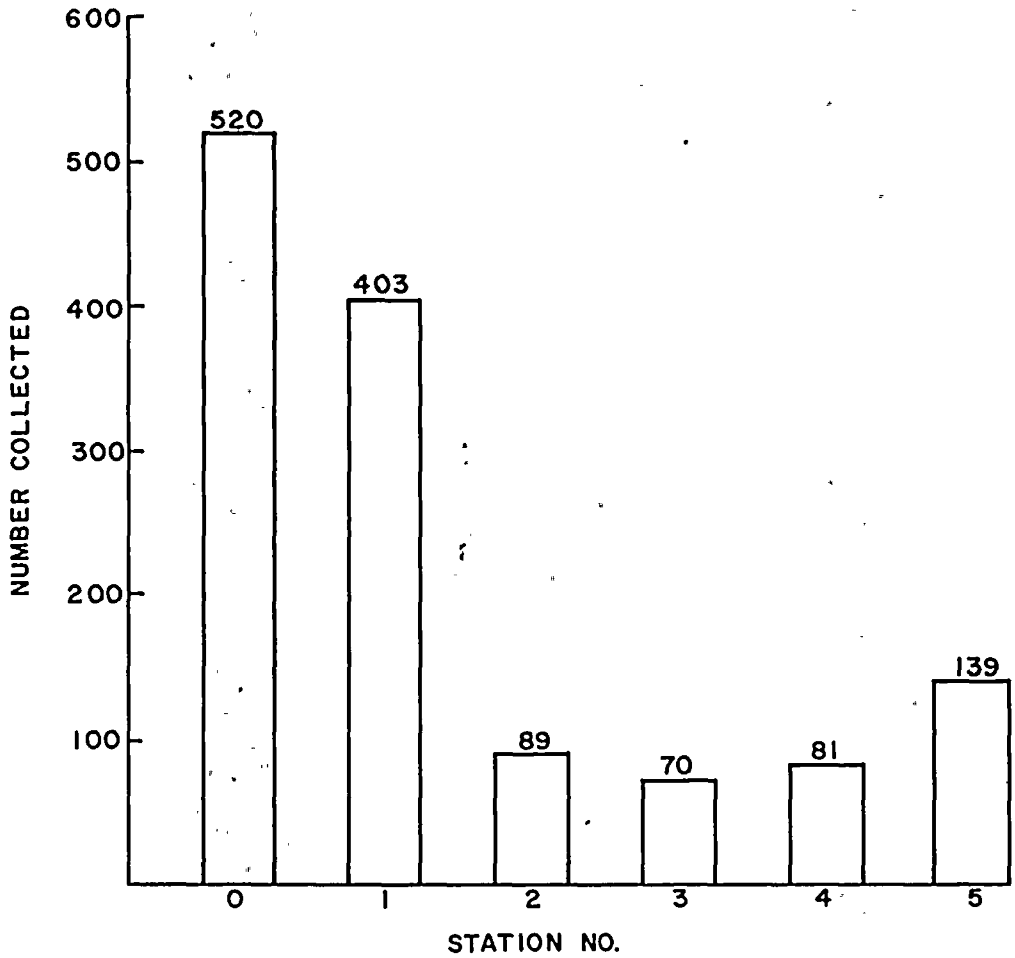


Figure C-12. Abundance of *Trachypenaeus constrictus* from trawl collections, all months combined, St. Lucie Plant, 1976.

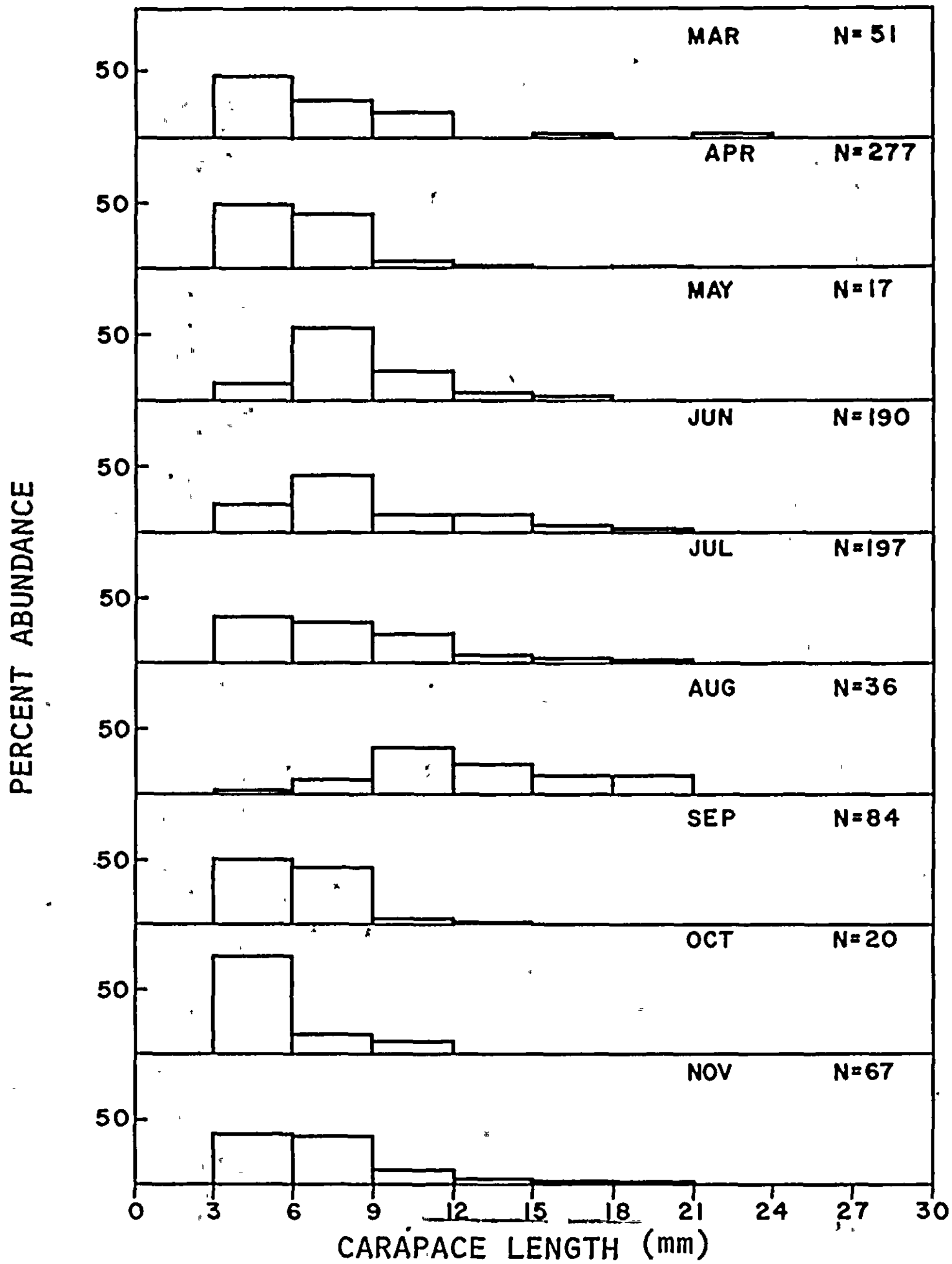


Figure C-13. Size frequency of *Trachypenaeus constrictus* from otter trawl collections, all stations combined, St. Lucie Plant, 1976.

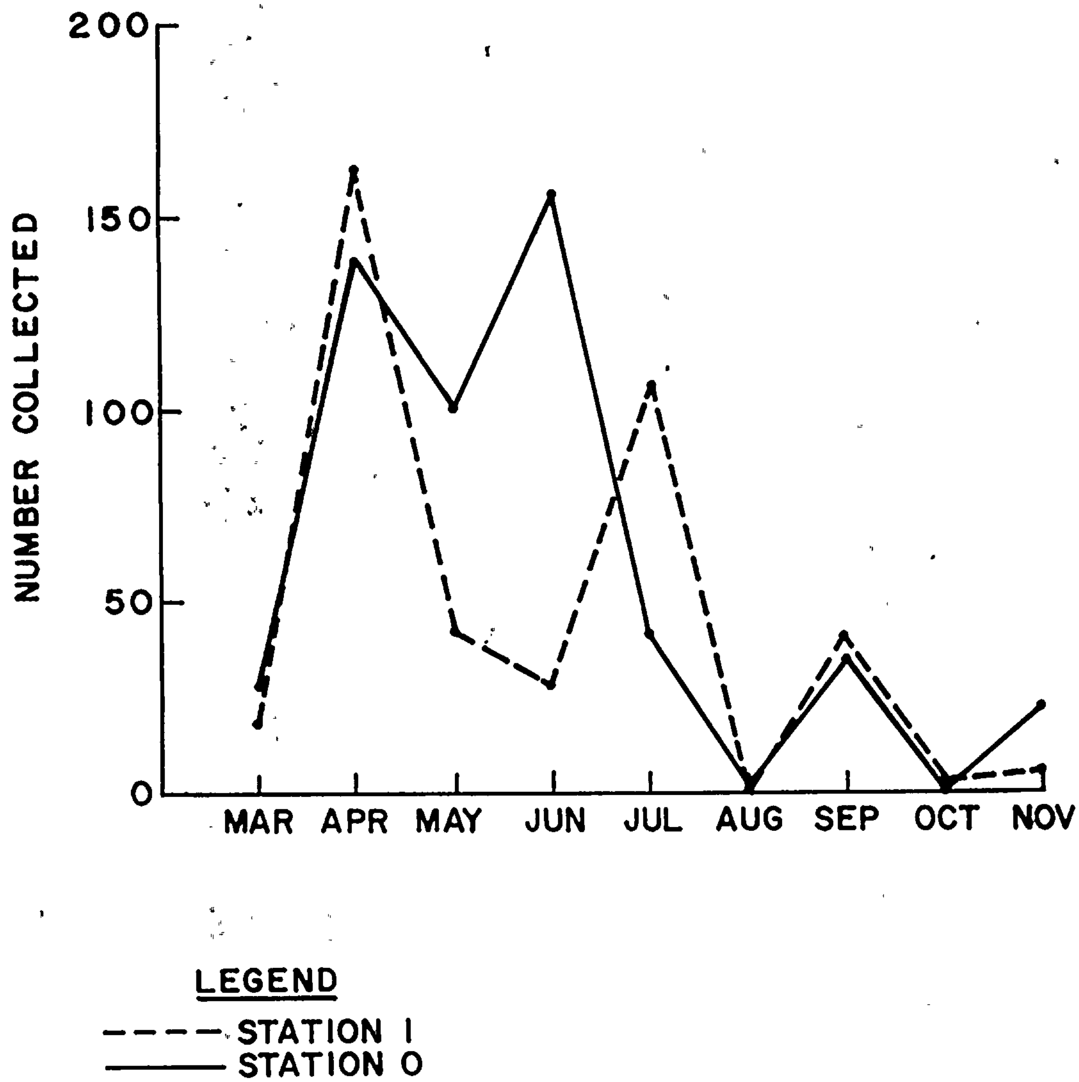


Figure C-14. Seasonal abundance of *Trachypenaeus constrictus* from trawl collections, all stations combined, St. Lucie Plant, 1976.

TABLE C-1

BENTHIC GRAB AND TRAWL STATION COORDINATES
ST. LUCIE PLANT
1976

Station	Depth (m)	Latitude-Longitude
1	7.6	27°21.2' N 80°14.1' W
2	11.3	27°21.4' N 80°13.3' W
3	7.6	27°21.7' N 80°12.4' W
4	11.3	27°20.6' N 80°12.8' W
5	11.3	27°22.9' N 80°14.0' W
0	8.2	27°19.1' N 80°13.2' W

TABLE C-2

ANALYSIS OF SUBSTRATE PARTICLE SIZE AND PERCENTAGE GRAVEL AT BENTHIC STATIONS ST. LUCIE PLANT 1976

Station	Month	Mean grain diameter (mm)	Sorting coefficient (mm) (standard deviation)	Percentage gravel (>2.0 mm)
0	MAR	1.40	0.15	33.1
	JUN	1.71	0.14	39.5
	SEP	1.12	0.15	26.0
1	MAR	0.21	0.68	0
	JUN	0.20	0.62	0
	SEP	0.18	0.59	0
2	MAR	0.80	0.19	15.0
	JUN	1.25	0.24	29.9
	SEP	0.90	0.26	13.8
3	MAR	0.26	0.75	0
	JUN	0.29	0.70	0
	SEP	0.29	0.72	0
4	MAR	0.86	0.25	13.5
	JUN	1.40	0.08	26.6
	SEP	1.20	0.22	20.5
5	MAR	0.72	0.14	19.6
	JUN	0.58	0.48	5.8
	SEP	0.82	0.28	13.2

TABLE C-3

SEDIMENT SIZE ANALYSIS AT BENTHIC STATIONS
ST. LUCIE PLANT
1976

Station	Month	% Composition							
		Pebble (4-64 mm)	Granule (2-4 mm)	Very coarse sand (1-2 mm)	Coarse sand (0.5-1 mm)	Medium sand (0.25-0.5 mm)	Fine sand (0.125-0.25 mm)	Very fine sand (0.63-0.125 mm)	Silt and clay (<0.63 mm)
0	MAR	18.1	15.0	24.2	29.0	9.8	0.6	2.9	0.4
	JUN	22.0	17.5	26.8	25.0	4.8	0.6	2.9	0.3
	SEP	14.5	11.5	18.9	32.9	17.8	0.8	2.8	0.8
1	MAR	0	0	0.8	3.1	38.2	47.8	9.5	0.5
	JUN	0	0	1.8	2.5	28.1	51.0	16.1	0.2
	SEP	0	0	1.8	2.8	23.8	44.6	25.2	1.0
2	MAR	8.2	6.8	13.0	35.3	34.8	1.0	1.0	0.3
	JUN	9.8	20.1	27.9	29.8	8.8	1.1	0.4	2.1
	SEP	7.8	6.0	19.0	41.0	26.0	0.4	<0.1	<0.1
3	MAR	0	0	0.8	3.7	42.9	50.8	0.7	<0.1
	JUN	0	0	1.4	7.4	46.4	44.0	0.4	0.3
	SEP	0	0	1.8	4.9	48.8	43.9	0.5	<0.1
4	MAR	7.8	5.7	15.0	37.9	32.1	0.7	0.6	0.2
	JUN	20.5	6.1	15.8	33.1	15.2	0.7	0.4	0.5
	SEP	12.7	7.8	27.3	37.1	13.8	0.3	0.1	0.3
5	MAR	9.8	9.8	14.2	17.9	36.4	6.7	4.6	0.6
	JUN	3.3	2.5	4.8	37.6	48.8	2.1	0.7	0.2
	SEP	6.9	6.3	17.3	35.3	33.7	0.3	0.1	0.1

TABLE C-4

BENTHIC GRAB MACROINVERTEBRATE DATA AND STATISTICAL INFORMATION FOR OFFSHORE STATIONS
ST. LUCIE PLANT
1976

	Quarter	Station 0	1	2	3	4	5	$\bar{x}$
Number of species	1	96	13	92	17	94	127	73
	2	127	18	130	35	115	98	87
	3	149	35	131	43	200	108	111
	Total[a]	239	54	225	68	200	190	-
Mean number of individuals per sample	1	480 ± 143	13 ± 5	379 ± 176	34 ± 15	354 ± 160	329 ± 63	-
	2	772 ± 299	12 ± 8	731 ± 433	76 ± 53	371 ± 107	592 ± 174	-
	3	584 ± 243	26 ± 12	955 ± 246	137 ± 68	911 ± 177	522 ± 27	-
	Total[b]	5,506	151	6,198	739	4,909	4,331	-
Density (individuals/m^3)	1	11,992	317	9,475	842	8,858	8,225	6,618
	2	19,300	300	18,283	1,892	9,283	14,808	10,644
	3	14,592	642	23,891	3,425	22,767	13,058	13,063
	$\bar{x}$	15,295	420	17,216	2,053	13,636	12,030	-
Biomass (g/m^2)	1	32.434	0.862	8.454	0.694	1.151	2.487	7.680
	2	3.995	1.272	2.881	0.747	3.519	1.984	2.400
	3	0.960	0.332	3.091	0.658	0.881	2.166	1.348
	$\bar{x}$	12.463	0.822	4.807	0.700	1.850	2.212	-
Diversity ($\bar{d}$)	1	4.1	2.5	3.4	4.0	4.3	5.1	3.9
	2	4.4	3.6	4.5	3.3	4.7	4.4	4.2
	3	5.4	4.4	5.0	2.7	4.8	5.2	4.6
	$\bar{x}$	4.6	3.5	4.3	3.3	4.6	4.9	-
Equitability (e)	1	0.69	0.79	0.57	1.10	0.72	0.80	0.78
	2	0.69	1.00	0.70	0.71	0.69	0.74	0.76
	3	0.81	0.97	0.77	0.55	0.76	0.84	0.78
	$\bar{x}$	0.73	0.92	0.68	0.79	0.72	0.79	-

[a] Total number of different species.

[b] Sum of means per sample times number of replicates.

TABLE C-5

TOP-RANKED[a] SPECIES OF BENTHIC MACROINVERTEBRATES
FROM GRAB SAMPLING AT EACH STATION
ST. LUCIE PLANT
1976

Species	Station 0	1	2	3	4	5°
ANNELIDA						
Armandia maculata				6		
Eunice vittata			10		9	
Eurysyllis brevipes			9			
Eusyllis heterocirrata						7
Exogone dispar	2		5			9
Goniadides carolinae	8		4		3	2
Hemipodus roseus	7		6		4	8
Loimia medusa	6					
Mediomastus californiensis						6
Metavermilia sp.	1		2		2	4
Omphalopoma sp.	3		1		1	1
Ophiodromus sp. A						5
Polygordius sp.	9					
Prionospio cristata	5					
Protodorvillea ketersteini			7			3
Syllis regulata carolinae			8			
MOLLUSCA						
Caecum cooperi				9		
Crassinella duplinana				1		10
Crepidula fornicata			3			
Dentalium calamus				3		
Ervilia concentrica		5				
Glycymeris spectralis				4		
Ischnochiton hartmeyeri					10	
I. papillosus					6	
Semele nuculoides				5		
Tellina iris		1				
CRUSTACEA						
Balanus trigonus					8	
B. venustus					7	
Eurydice littoralis				7		
Panathura formosa	4				5	
Protohaustorius sp. A				8		
Pseudoplatyishnopus sp. A		2				
Tiron sp. A		4				
Trichophoxus sp. A		3		2		

TABLE C-5
(continued)
TOP-RANKED[a] SPECIES OF BENTHIC MACROINVERTEBRATES
FROM GRAB SAMPLING AT EACH STATION
ST. LUCIE PLANT
1976

Species	Station 0	1	2	3	4	5
ECHINODERMATA						
Amphiodia pulchella	10					
CEPHALOCHORDATA						
Branchiostoma caribaeum				10		

[a] Ranked according to McCloskey (1970) biological index values.

TABLE C-6

CALCULATED NUMBER OF BRYOZOA COLONIES/m^2
COLLECTED AT OFFSHORE STATIONS WITH THE SHIPEK GRAB
ST. LUCIE PLANT
MARCH 1976

Species	Stations 0	1	2	3	4	5
ANASCA						
Aetae truncata						8
Alderina smitti	17		58			17
Alderina cf. *smitti*			17		8	
Alderineidae sp. A					8	
Beania cupuhriensis					75	8
B. hirtissima					50	
Colletosia bellula					50	
Copodozium ? sp.	8					
Cribrilina radiata	8		83		208	
Cupuladria doma	8		33	8	33	
Discoporella umbellata depressa	267		58		17	33
Floridina parvicella	42				58	
Hincksina ? sp.	17				33	
Hincksinidae sp. A						8
Membranipora serrata ?	58		8		25	42
Membranipora sp.					8	
Membranipora sp. A	8					8
M. tennuis	17		42		50	8
Membraniporidae sp.	17		17			
Retevirgula flectospinata	8				8	
ASCOPHORA						
Cleidochasma porcellanum	17		33			
Cygelisula turrita	17				8	
Hippoporella uvulifera	17		8		67	17
Microporella marsupiata	92		42		100	42
Microporella sp. A	17					
Parasmittina nitidia						17
Parasmittina sp.						8
Schizoporella errata	8				8	8
Smittinidae sp.					8	
Trypostega venusta	42		17		300	108

TABLE C-6
(continued)
CALCULATED NUMBER OF BRYOZOA COLONIES/m^2
COLLECTED AT OFFSHORE STATIONS WITH THE SHIPEK GRAB
ST. LUCIE PLANT
MARCH 1976

Species	Station 0	1	2	3	4	5
CTENOSTOMATA						
Alcyonidium disciforme					8	
A. polyoum			17		8	
Alcyonidium sp.					25	
Bowerbankia gracilis?						8
Number of colonies/m^2	685	0	433	8	1163	340
Number of species	19	0	13	1	23	15

TABLE C-7

PRESENCE OF MIEOFAUNAL FORMS IN GRAB SAMPLES BY STATION AND QUARTER
ST. LUCIE PLANT
1976

	Station																	
	0 Quarter			1 Quarter			2 Quarter			3 Quarter			4 Quarter			5 Quarter		
Group	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Gastrotricha	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-
Kinorhyncha	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
Nematoda	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Acari	X	X	X	-	-	-	X	X	X	-	X	-	X	-	X	-	-	X
Harpacticoida	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X

TABLE C-8

RANK CORRELATION: RANKING OF STATIONS BY FAUNAL ASSOCIATION[a]
COMPARED WITH RANKING BY MEAN PARTICLE SIZE OF SEDIMENTS
ST. LUCIE PLANT
1976

Rank	Ranked by faunal association	Ranked by mean particle size
1st	1	1
2nd	3	3
3rd	5	5
4th	4	2
5th	0	4
6th	2	0

Correlation: $\tau = 0.73$, significant at $\alpha = 0.01$.

[a] Using Bray and Curtis (1957) index.

TABLE C-9

TOP-RANKED SPECIES OF INVERTEBRATES BY ABUNDANCE COLLECTED IN TRAWL SAMPLES[a]
ST. LUCIE PLANT
1976

Species	Station 0	Station 1	Station 2	Station 3	Station 4	Station 5
MOLLUSCA						
Anomia simplex	4 (87)		2 (171)		3 (76)	4 (124)
Chaetopleura apiculata						5 (96)
Crepidula fornicata	2 (464)		1 (1,066)		4 (71)	1 (417)
Turbo castanea			5 (44)			
CRUSTACEANS						
Leptochaela serratorbita		4 (14)				
Metapenaeopsis goodei				4 (19)		
Periclimenes longicaudatus		5 (12)				
Portunus anceps				3 (22)		
P. gibbesii				5 (17)		
P. spinimanus	5 (47)		3 (91)		5 (48)	
Sicyonia dorsalis		2 (22)				
Trachypenaeus constrictus	1 (520)	1 (403)	4 (89)	1 (70)	2 (81)	2 (139)
Trachypenaeopsis mobilispinis				2 (32)		
ECHINODERMATA						
Mellita quinquiesperforata	3 (105)	3 (14)			1 (2,984)	

[a] Numbers in parentheses indicate total abundance for all months.

D. PHYTOPLANKTON

INTRODUCTION

The purpose of the phytoplankton study at the St. Lucie Plant was to monitor changes in phytoplankton density, community composition, pigment levels, and productivity and to examine the relationship between these changes and power plant operation.

Phytoplankton consists of passively drifting or weakly swimming algae. Benthic algae are frequently included temporarily in the phytoplankton. Due to limited motility, these microscopic plants are largely at the mercy of waves and currents in aquatic environments.

Major groups of algae vary in temperature tolerance ranges and temperature ranges for optimum growth and reproduction (Patrick, 1969). Diatoms generally have relatively low temperature tolerance ranges (less than 30°C), while green algae tolerances cover a wider range. Blue-green algae are most tolerant of higher temperatures (thermophilic). Because of these varying temperature optima and tolerance ranges, temperature is an important determinant in the seasonal succession of algal groups and species under natural conditions. Thermal additions to waters from human activity may alter natural seasonal patterns by causing an early onset of

succession or even permanent alteration of species composition (Patrick, 1974). Since phytoplankters are primary producers, they form the basis of the aquatic food chain along with macrophytes, which are important contributors in shallow waters (Reid, 1961). Phytoplankton abundance and community composition either directly or indirectly influences the quantity and quality of all larger organisms that ultimately depend upon them for food.

Phytoplankton standing crop is determined by the dynamic interaction of physicochemical parameters and by grazing pressure from primary consumers. Physicochemical factors which may influence the spatial and temporal distribution of phytoplankton are water temperature, light, nutrient availability, salinity, and currents (Whitford, 1960). Because any of these factors may limit phytoplankton productivity or affect community composition and abundance, their relationship to standing crop must be considered when evaluating the impact of power plant operation. Thus changes in the phytoplankton component of the ecosystem were interpreted with regard to the physicochemical regime which existed at the time samples were collected, as well as to the potential influence of St. Lucie Plant operation.

Pertinent past studies concerning the effects of power plant cooling water discharge on phytoplankton populations have been done

by Morgan and Stross (1969), Warinner and Brehmer (1966), Fox and Moyer (1973), Simmars and Armitage (1974), Menhinick and Jensen (1974), and Knight (1973). The results of these studies on phytoplankton productivity and abundance varied. However, a general trend regarding the amount of change in productivity due to increased temperature was observed in three of these studies.

Morgan and Stross (1969) observed a stimulation in the rate of carbon uptake with an 8°C rise in temperature when ambient water temperature was less than 16°C in the Patuxent River Estuary. This rise inhibited photosynthesis when ambient water temperatures were 20°C or warmer. Passage through the plant cooling system further depressed production when ambient water temperatures were high and offset thermal stimulation when ambient temperatures were low. However, Warinner and Brehmer (1966) observed decreased carbon assimilation with a 5.6° rise in temperature in the York River, Virginia, when ambient temperatures were between 15 and 20°C. Primary production was enhanced due to temperature changes from plant passage when ambient temperatures were low during the winter months. Similar thermal studies at the Crystal River Power Plant, Florida, reflected the findings of the above studies, i.e., that the amount of change in primary production due to temperature increase was dependent upon ambient water temperature at the intake (Fox and Moyer, 1973).

Simmars and Armitage (1974) found that algal density and composition in heated effluent areas of the Potomac River, Virginia, reflected density and composition observed in ambient temperature areas in the vicinity of the power plant. In Lake Norman, North Carolina, plankton populations downlake and uplake from a power plant were essentially similar (Menhinick and Jensen, 1974).

In the Lake Norman study, discharge temperatures were low because cooling water was drawn from the cool hypolimnetic layer of the thermally stratified lake; thermal stimulation in production was thus observed even at maximum ambient temperatures. Knight (1973) found that in Lake Wylie, North Carolina, discharge samples exhibited a decrease in both abundance and diversity of phytoplankton. He also noted a trend toward greater reduction in phytoplankton at the highest ambient temperatures. This reduction was attributed to both mechanical and thermal effects.

MATERIALS AND METHODS

Phytoplankton Analysis

Phytoplankton samples were collected monthly from surface and bottom levels of the water column at six offshore stations and in the intake and discharge canals (Figure D-1). Replicate one-liter whole-water samples were collected at each station with a pump designed to minimize damage to the phytoplankters. Whole-water

samples were used in conjunction with the sedimentation technique for qualitative analyses and quantitative estimates of standing crop. Allen (1930) presented strong evidence that catches made by gravity settling (sedimentation) from one liter of water are fully dependable for most microplankton sampling. This technique provides a more accurate estimate of nanoplankters (those phytoplankters, generally less than 10μ in size, which are not normally retained by the finest mesh plankton nets) than can be obtained from conventional net techniques (Braarud, 1957; Willen, 1962).

The pump used in collections was designed with a reservoir between the collection hose and the pump mechanism (Figure D-2). Water samples were removed from the reservoir before passing through the pump impellers to eliminate possible mechanical damage to the phytoplankters. When the collection hose was located at the proper sampling depth, the pump was operated for a sufficient length of time to ensure that the entire pumping system contained water from that depth.

Samples for water chemistry were collected and physical measurements and weather observations were made concurrently with phytoplankton collections at each station. These data were examined as being potential factors influencing phytoplankton populations.

Each one-liter water sample was preserved in the field with 5% buffered formalin and returned to the laboratory. The preserved samples were allowed to settle for a minimum period of 10 days. The supernatant was siphoned from each settled sample with a vacuum pressure pump and discarded. Each sample was concentrated to approximately 30 ml. The need for additional concentration was determined by the amount of detritus or density of phytoplankters in the sample.

Microscopic analysis was performed by the Utermöhl technique with inverted compound microscopes equipped with calibrated ocular micrometers (Utermöhl, 1958). Identifications and counts were made by placing a well-mixed measured aliquot of a known sample concentrate into a settling chamber. Samples were allowed to settle a minimum of one hour before analysis. Phytoplankton species were enumerated at appropriate magnification by random field counts (Littleford et al., 1940; APHA, 1971; EPA, 1973) in at least two identically prepared counting chambers per replicate sample. Statistical analyses (hierarchical design analysis of variance) were used to determine the examined volume of sample concentrate necessary to ensure 90% accuracy in counts at the 95% confidence interval. This analysis also provided information on the minimum number of replicates, chambers per replicate, and fields per chamber which could be counted without significantly increasing variance.

Counting effort was minimized by this type of analysis, thereby maximizing laboratory efficiency. A minimum of one-half the entire counting chamber was examined to enumerate large and relatively scarce phytoplankters.

All phytoplankters, except some greens and blue-greens, were counted individually. Filamentous green and blue-green algae were measured in 100μ standard lengths with each length representing one counting unit. Colonial forms exclusive of diatoms were counted as each colony representing one counting unit. An average number of individuals per colony was specified where possible. Cells per liter were calculated as N by:

$$N = \frac{\frac{V_s}{V_c}}{V_i} C$$

where: C = count

V_s = volume of sample concentrate (ml)

V_c = determined by multiplying the aliquot volume (ml) by the proportion of the counting chamber which was examined

V_i = initial sample volume (l)

A minimum of two individuals verified both qualitative and quantitative analyses for each group of monthly samples. If discrepancies

were greater than 10%, counts were repeated. Qualitative verification of new species was performed on each sample as new species were encountered. All samples were retained in the Applied Biology, Inc. laboratory as permanent vouchers.

Pigment Analysis

Replicate water samples for pigment determinations were collected concurrently with phytoplankton samples each month. Water sufficient to fill a 6-gallon polyethylene carboy for each replicate was pumped from specified surface and bottom depths at each station. Samples were transported to the laboratory as quickly as possible after collection in an effort to minimize chlorophyll degradation.

Samples were processed according to the method of Strickland and Parsons (1972) and recommendations of Unesco (1966). Samples were filtered through Whatman GFC filters (generally 0.5 to 5 liters total volume) in the Hutchinson Island laboratory on the day of collection. The filters were folded in half with the filtered particulates on the inside and immediately frozen under darkened conditions. The frozen filters were shipped in light-proof containers to the Atlanta laboratory for extraction and analysis on the day following collection.

Frozen filters from replicate samples were extracted by grinding in a 90% aqueous solution of spectrophotometric-grade acetone. Filters were ground approximately 3 minutes with an electric drill-driven tissue grinder. Samples generally steeped for one hour while subsequent samples were being processed. The extracts were decanted into graduated 15-ml centrifuge tubes and spun for a minimum of 10 minutes at approximately 2,000 times gravity in a swing-out centrifuge. The volume of the extract was measured and extinction values were read with 1-cm cuvettes in a spectrophotometer at a slit width of 1.0 nanometer.

Chlorophyll-*a*, -*b*, and -*c* concentrations were determined from readings at 665, 645, and 630 nm, respectively. Carotenoid concentration was determined from extinction at 480 nm. The amount of non-active chlorophyll-*a*, in terms of the quantity of phaeopigments present, was estimated from extinction at 665 nm one minute after acidification with 50% HCl. All extinctions were corrected by subtracting the turbidity reading at 750 nm. Excessive turbidity readings were reduced by additional centrifugation. Results were obtained from the equations of Strickland and Parsons (1972) and chlorophyll and phaeopigment values were expressed as mg/m^3. Carotenoid values were expressed as m-SPU (millispecified pigment unit)/m^3.

RESULTS AND DISCUSSION

Phytoplankton Composition

Ten major groups (divisions, classes) of phytoplankton were observed in collections from the St. Lucie Plant area. These groups were 1) Bacillariophyta (diatoms), 2) Pyrrhophyta (dinoflagellates), 3) Chlorophyta (greens), 4) Cyanophyta (blue-greens), 5) Euglenophyta (euglenoids), 6) Cryptophyta, 7) Xanthophyta, 8) Chrysophyceae (yellow-brown algae and silicoflagellates), 9) Haptophyceae (including coccolithophores), and 10) Prasinophyceae. One additional major group consisted of unidentified phytoflagellates. These were pigmented forms possessing flagella and were generally less than 10 microns in length.

Total phytoplankton densities ranged from a low of 282 x 10^3 cells/liter on the surface at Station 3 in June to 9,844 x 10^3 cells/liter on the bottom in the intake canal in October (Tables D-1 to D-8). Phytoplankton density was generally greatest during March and October with maximum densities observed at most stations during October (Figures D-3 to D-10). Minimum phytoplankton abundance was generally observed in May. Average phytoplankton density was greatest in the intake and discharge canals and at Station 1. Stations 2, 3, and 4 exhibited lowest abundance, while Stations 0 and 5 were intermediate. Phytoplankton was most abundant in the intake canal and least abundant at Station 3. Bottom populations were consistently larger than surface populations at offshore stations.

Differences in average densities between surface and bottom collections in the intake and discharge canals were much smaller (less than half) than those observed offshore.

Several trends in the abundance of particular species were noted (Appendix Tables H-137 to H-144). The following species were more frequently observed at the offshore stations:

Cerataulina bergonii	*Pinnularia* sp. 1
Gomphonema spp.	*Rhizosolenia alata*
Guinardia flaccida	*R. alata* f. *indica*
Leptocylindrus danicus	*R. imbricata*
Navicula sp. 6	*R. setigera*
Nitzschia pungens v. *atlantica*	*R. stolterfothii*
Nitzschia sp. 2	*Thalassionema nitzschioides*
Oscillatoria spp.	*Thalassiothrix frauenfeldii*
Peridinium hirobis	

Navicula sp. *(wawrikae?)* was most abundant offshore from May through August and restricted to offshore stations in March, April, September, and October.

Some species were more frequently observed in the intake/discharge canals. The following species exhibited this general trend:

Gymnodinium simplex	*N. closterium*
Navicula halophila v. *halophila*	*Peridinium trochoideum*
Nitzschia acicularis v. *closterioides*	*Tetraselmis* sp.

Rhaphoneis surirella was generally most abundant in the intake/discharge canals during May through August but more abundant at offshore stations in March, April, September, and October.

Eucampia cornuta, Navicula membranacea, and pennate diatom sp. 3 were restricted to offshore stations when present and *Gomphonema marina* was observed only offshore on five of seven sampling dates when this species was present. *Diploneis interrupta* followed the same trend on three of five sampling dates. *Pleurosigma elongatum* was observed only offshore in March, became more abundant in the intake/discharge canals in May, and was again restricted to the offshore stations from July through October.

Several species, listed below, exhibited a general shift in abundance from offshore to the intake/discharge canals within the May-August period, returning to offshore abundance in September:

Biddulphia aurita	*N. closterium*
Campylosira cymbelliformis	*N. constricta*
Diploneis smithii v. *smithii*	*Nitzschia* sp. 1
Gomphonema spp.	*Oscillatoria* spp.
Grammatophora marina	*Pinnularia* sp. 1
Melosira sp. 1	*Rhaphoneis surirella*
Nitzschia halophila v. *halophila*	Pennate diatom sp. 4

The most important species, in terms of abundance, throughout the sampling interval were diatoms (Appendix Tables H-137 to H-144). *Skeletonema costatum* was the most abundant diatom. The abundance, observed in March and April, decreased in May. *S. costatum* reached a peak in June, decreased to a constant level in July, August, and September, and peaked again in October. *Nitzschia closterium* and *N. delicatissima,* though less abundant than *S. costatum,* followed the same pattern. *Biddulphia aurita, Rhaphoneis surirella, Thalassionema nitzschioides,*

and *Thalassiosira* sp. 1 exhibited similar trends in abundance. Numbers were relatively constant during March and April, lower in May, higher in June and lower again in July. These four species increased in abundance from August, reaching peak abundance in October. Cell numbers of *A. japonica* were greatest during March and April and lower throughout the rest of the sampling interval except in June, when a slight increase occurred. *Leptocylindrus danicus,* though of minor importance, exhibited greatest abundance in May, a month when other diatom species were decreasing. *Nitzschia longissima* was most abundant in April and June whereas *N. paradoxa* was most abundant in October.

Diatoms (Bacillariophyta) were the dominant phytoplankton group in March and April. They accounted for 83 to 99% of the total phytoplankton population at all stations except Station 0. Diatoms accounted for 50% of the total surface phytoplankton at this station in March (Figure D-11, Tables D-1 and D-2). Reduction in the relative importance of diatoms at Station 0 was due to a pulse of the green algae *Chlamydomonas* on the surface. Green algae (Chlorophyta) generally increased in relative importance from March to May when greens accounted for 5 to 37% of the total phytoplankton (Figure D-12, Table D-3). Greens were less abundant than diatoms and unidentified phytoflagellates from June through October (Figures D-13 and D-14). Diatoms were again dominant in June, and accounted for 65 to 88% of

the total phytoplankton at all stations.

Generally, the unidentified phytoflagellate group was second to diatoms in relative abundance. Unidentified phytoflagellates became increasingly important from March through May when this group made up 12 to 49% of the total phytoplankton and continued to be an important component of the phytoplankton population through October. Dinoflagellates (Pyrrhophyta) were most important in May, July, August, and September; however, this group never exceeded 17% of the total phytoplankton and was generally under 10%. The haptophytes were important only in May, accounting for 3 to 22% of the total phytoplankton. Prasinophytes were important in May and October, while cryptophytes were more important from July through October. However, both these groups were minor contributors to the total standing stock of phytoplankton, exceeding 10% on only two occasions (Tables D-3 to D-8).

The phytoplankton community composition at the St. Lucie Plant was typical of a nearshore marine environment. Shifts in population due to plant operation were not evident.

Highly significant differences in phytoplankton abundance between months were indicated for both surface and bottom depths at offshore stations (Table D-10). Phytoplankton densities at surface

stations were significantly greater in October than in all other months except March. Bottom populations were significantly greater in October than in all other months, and densities were significantly greater in March than in May (Table D-11). The high densities observed in March and October are indicative of seasonal increases in phytoplankton abundance. These data fit the typical temperate and subtropical bimodal peak in abundance with an early spring bloom and a late fall resurgence of phytoplankton populations.

Entrainment and Temperature Relationships

Comparison of changes in phytoplankton density between intake (Station 11) and discharge (Station 12) appears in Tables D-12 and D-13. Surface population in the intake canal ranged from 542×10^3 to $5,757 \times 10^3$ cells/liter and in the discharge canal from $1,073 \times 10^3$ to $6,516 \times 10^3$ cells/liter. The range in temperature change (ΔT) between intake and discharge was +0.2 to +8.8°C (Table D-12). Changes in cell density were variable with both increases and decreases in phytoplankton abundance between intake and discharge. There was no discernible relationship between phytoplankton abundance and ΔT. Bottom populations in the intake canal ranged from 960×10^3 to $9,844 \times 10^3$ cells/liter, while densities in the discharge canal ranged from 656×10^3 to $4,375 \times 10^3$ cells/liter. Temperature increases varied from +0.1 to +9.1°C for bottom stations

(Table D-13). No relationship between the magnitude of ΔT and changes in phytoplankton density was evident.

The absence of a trend between changes in phytoplankton density and the magnitude of ΔT may reflect a lack of plant effect. It should be noted, however, that plant operation was intermittent during the period when these data were collected, and these data should not be considered representative of sustained plant operational conditions.

Differences in phytoplankton density between intake and discharge stations were not significant for either surface or bottom depths (Table D-10). However, differences between months were highly significant. The phytoplankton density was significantly greater in October than in May (Table D-14).

Temperature, salinity, dissolved oxygen data and other pertinent physical observations were obtained concurrently with phytoplankton collections and appear in Appendix Tables H-146 to H-150.

Total phytoplankton density at surface stations exhibited a significant positive correlation with temperature in May as did prasinophytes in July, September, and October, and unidentified

phytoflagellates in March (Table D-15). An increase in density with increasing temperature is probably a normal physiological response to optimal temperature. Diatoms showed a significant negative correlation with temperature in September. However, the maximum temperature differential between any stations was only +1.8°C in September, so this reduction in diatoms with increasing temperature was not due to a plant-generated thermal increment. Also, plant effects were not indicated as a factor in the negative correlation between temperature and dinoflagellates in July or prasinophytes in August. A positive correlation between temperature and total bottom phytoplankton density was observed in July.

Pigment Analysis and Primary Productivity

Active chlorophyll-*a* concentration was used as an index of phytoplankton standing crop. Surface values at the offshore stations ranged from 0.5 mg/m^3 at Station 2 in May to 8.97 mg/m^3 at Station 1 in October (Table D-16). Bottom values ranged from 0.41 mg/m^3 at Station 2 in May to 8.30 mg/m^3 at Station 0 in October. Chlorophyll-*a* maxima were consistently observed at offshore stations in October, except on the bottom at Station 5 in March. With respect to trends in concentration, surface and bottom stations were generally consistent and higher values at both depths were generally observed in March, in June or July, and in October (Figure D-15). Peaks in chlorophyll-*a* concentration correspond to periods of highest

phytoplankton density. The lowest chlorophyll-*a* values were generally observed at Station 3, while highest values were observed at Station 1.

Average chlorophyll-*a* concentration in the intake canal ranged from 1.38 to 14.90 mg/m^3 and from 0.81 to 11.40 mg/m^3 in the discharge canal. Chlorophyll-*a* levels were greater in the intake than in the discharge; however, average concentrations in the canals were greater than those observed offshore.

A highly significant difference in chlorophyll-*a* concentration between months was observed for bottom stations in the intake and discharge canals (Table D-17). Chlorophyll-*a* levels were significantly greater in October than in all other months. November levels were significantly greater than April, May, July, and September levels (Table D-18). Chlorophyll-*a* concentrations at offshore surface stations were significantly different, with levels at Station 1 significantly greater than those at Station 3 (Tables D-17 and D-19). Both surface and bottom offshore stations exhibited significant differences between months. Chlorophyll-*a* levels at both surface and bottom were significantly greater in October than in any other month (Tables D-17 and D-20). At surface stations, September levels were significantly greater than those in April, May, July, August, and December, while levels in November were significantly greater than

those in May and December. At bottom stations September and November levels were significantly greater than those observed in May and December. This late fall increase in chlorophyll-*a* levels corresponds to the seasonal peak abundance observed in the phytoplankton population. This October peak in chlorophyll-*a* with minimum chlorophyll-*a* levels in May is in agreement with observations made at the Sebastian and St. Lucie Inlets (Gibson, 1975). A significant positive correlation between chlorophyll-*a* and temperature was observed at bottom stations in March, indicating an increase in chlorophyll-*a* levels with increasing temperature (Table D-21).

The trichromatic chlorophyll analysis allows one to measure chlorophylls-*a*, -*b*, and -*c* separately. Assessment of these various chlorophylls is important, since some algal divisions contain chlorophylls-*a* and -*b* as primary photosynthetic pigments, while other groups contain chlorophylls-*a* and -*c*. Chlorophyll-*b* concentrations were quite low. This pigment ranged from 0.0 to 0.44 mg/m^3 at the surface and from 0.0 to 1.16 mg/m^3 at the bottom at offshore stations (Table D-22). Stations 2 and 4 exhibited lowest chlorophyll-*b* levels, and levels were highest at Station 0. Concentrations were higher on the bottom than at surface stations. This trend was the same in the intake and discharge canals, and chlorophyll-*b* levels were comparable to those offshore. Levels in the discharge canal were higher than those in the intake. Chlorophyll-*b* concentration

was higher in March and July through November with a maximum in October and minimum in June.

Chlorophyll-*c* concentration ranged from 0.02 to 4.49 mg/m^3 at the surface and from 0.24 to 3.95 mg/m^3 on the bottom at the offshore stations (Table D-22). Values were generally slightly greater on the bottom than on the surface. Seasonally, values were larger in March and from September through November, with maximum levels observed in October. Average chlorophyll-*c* concentration was lowest in June, again reflecting the seasonal distribution in phytoplankton abundance. Station 3 was lowest in chlorophyll-*c*, with the greatest concentration at Station 0. Chlorophyll-*c* was greater in the intake and discharge canals than at offshore stations. Levels were higher in the intake canal than in the discharge canal.

Phaeopigments are products of chlorophyll degradation. Measurement of phaeopigment concentration can provide an index to the physiological or growth state of algal populations. Phaeopigments may result from zooplankton grazing and from death and decomposition of algal cells. Phaeopigment levels at the offshore stations ranged from 0.0 to 1.21 mg/m^3 at surface stations and from 0.0 to 3.41 mg/m^3 at bottom stations (Table D-16). Average concentration of phaeopigments on the bottom was 2.4 times greater than that observed

at the surface. This is a typical distribution, since dead phytoplankters sink and thus tend to concentrate at the bottom of the water column. Phaeopigment levels were highest at Stations 0 and 5 and lowest at Stations 2 and 4. Seasonally, phaeopigments were highest in March and October and lowest in May. This trend reflects periods of high and low phytoplankton density.

Phaeopigment levels in the intake canal ranged from 0.0 to 0.69 mg/m^3 and from 0.0 to 1.41 mg/m^3 in the discharge canal. The surface to bottom trend of increasing phaeopigment levels was typical of that observed at offshore stations. Phaeopigment concentration was slightly greater in the discharge canal, but levels in the canals were generally lower than those observed offshore. The largest increase in phaeopigment concentration between intake and discharge canals corresponded to the period of greatest ΔT.

Carotenoids are accessory pigments which aid in algal photosynthesis. The highest offshore carotenoid values were observed at Station 0 and the lowest at Station 3 (Table D-22). Offshore values ranged from 0.72 to 10.10 m-SPU/m^3 at the surface and from 0.68 to 10.96 m-SPU/m^3 at the bottom. Bottom values were generally higher than surface values. Peak carotenoid levels were observed in October with high values in March, September, and November. The lowest concentrations occurred in May. Intake and discharge canal

concentrations were greater than those observed offshore. Carotenoids were higher in the intake than in the discharge canal, but differences were variable and carotenoid levels did not appear to be related to plant operation.

Gross primary productivity was calculated from active chlorophyll-*a* and light data. The total curve of Ryther and Yentsch (1957) was used for photosynthetic rate with an assimilation rate of 3.7 g carbon/hr/g chlorophyll. Productivity ranged from 0.14 to 1.39 g C/m^2/day (Table D-23). The average productivity at Station 1 was lowest with greatest productivity observed at Station 4 (Figure D-16). Seasonally, productivity was highest in July and lowest in May. This difference was statistically significant (Table D-24).

Seasonal variance in organic production has been documented in temperate and higher latitudes. Regularly recurring cycles of an apparently seasonal nature have been observed in tropical seas (Steven, 1971). Thus, seasonal variance in productivity could be expected in the St. Lucie Plant area, which could be classified as a subtropical environment. Low productivity in May was consistent with the observed minimum in phytoplankton density and active chlorophyll-*a* levels. However, maximum productivity was observed in July, while maxima for both phytoplankton density and active chlorophyll-*a* were observed in October. Due to zero light transmittance readings on the bottom in October, productivity data were

available only for Stations 2 and 4. Productivity levels at these two stations, however, were lower than those recorded in July. The October productivity levels may have been reduced by high turbidity and reduced light penetration at the time samples were collected. This lack of correspondence between the observed maxima for chlorophyll-*a* and productivity values may reflect a lag period between high productivity levels and resulting high phytoplankton densities.

Interstation trends in productivity were not clearly evident. All stations generally exhibited minimum productivity in May. However, maximum productivity occurred at Station 0 in June. Station 1 exhibited almost equal productivity maxima in June and August. Maximum productivity at Station 5 occurred in September and productivity was also high at Station 4.

A highly significant negative correlation between productivity and temperature was observed in June and corresponded with maximum recorded temperature increase between intake and discharge (Table D-25). A trend in decreasing productivity with increasing temperature cannot be established from these data, since the relationship between temperature and productivity varied during other months and both May and July collections were made during an observed plant-generated thermal increment.

Species composition and density data for the November collection were not available for analysis at this writing. Since species analysis was completed before submission of this interim report, the species composition and density data for November have been included in the appendix (Table H-145) with a summary table in the text (Table D-9).

SUMMARY

The most important components of the phytoplankton were diatoms. The diatom *Skeletonema costatum* was the most important phytoplankter in terms of density and distribution. Several of the more abundant species fell into general distribution categories: 1) more frequently observed offshore, 2) more frequently observed in the intake and discharge canals, and 3) observed only at offshore stations. Many species exhibited a general shift in abundance from offshore in March to the intake/discharge canals during the May to August period, returning to greater offshore abundance in September. Phytoplankton densities and pigments tended to be greater on the bottom and, except for phaeopigments, at the intake and discharge stations. The greatest increase in phaeopigments between intake and discharge corresponded with the highest observed ΔT. Chlorophyll-*a* levels were also greater in the intake than in the discharge canal. However, average chlorophyll-*a* concentrations in the canals were higher than those observed offshore and phaeopigment levels tended to be higher offshore than in the canals. This situation indicates a physiologically healthy, actively growing phytoplankton community in the canals during this interval of the study.

Statistically significant interstation differences in phytoplankton density, chlorophyll-*a*, and productivity between intake and discharge stations were not observed. Chlorophyll-*a* was significantly greater at Station 1 (closest to the outfall) than at Station 3 (farthest offshore from the outfall). The higher concentrations of active chlorophyll-*a* observed at Station 1 may reflect an enrichment of the immediate vicinity due to the influx of discharge water, which exhibited higher average chlorophyll-*a* values than those observed offshore. Phytoplankton density, chlorophyll-*a*, and productivity exhibited statistically significant differences between months. Seasonally, phytoplankton density, chlorophylls, carotenoids, and phaeopigments exhibited maxima in October. Productivity levels were maximum in July, perhaps reflective of a lag between high productivity and resulting high phytoplankton densities. Minima for the above parameters were observed in May or June.

Lower phytoplankton densities and chlorophyll, carotenoid, and phaeopigment levels were generally observed at Stations 2, 3, and 4. The highest offshore values were generally observed at Stations 0 and 1. Productivity tended to be higher at Station 4 and lower at Station 1. Productivity exhibited a highly significant negative correlation with temperature in June. Although this corresponded with the highest observed ΔT, the relationship between temperature and productivity varied during other months, and

both May and July collections were made during an observed plant-generated thermal increment. Interstation differences in productivity were not statistically significant. Notable trends in the relationship between phytoplankton density and temperature and between chlorophyll-*a* and temperature were not evident. Trends indicating plant effects on phytoplankton could not be substantiated because strong statistical evidence was lacking and partly because plant operation was intermittent during this period of the study. Seasonal influences appeared to be stronger than any plant-related effects.

LITERATURE CITED

Allen, W. E. 1930. Methods in quantitative research on marine microplankton. Bull. Scripps Inst. Oceanogr. 2(8):319-329.

APHA. 1971. Standard methods for the examination of water and waste-water, 13th ed. American Public Health Association, Washington, D. C. 874 pp.

Braarud, T. 1957. Counting methods for determination of the standing crop of phytoplankton. Cons. Internat. Explor. Mer. 144:17.

Environmental Protection Agency. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. EPA 670/4-73-001. National Environmental Research Center, Cinn.

Gibson, R. A. 1975. Phytoplanktonic and hydrochemical variations in the Indian River system including an inventory of pollution sources. Pages 14-45 *in* D. K. Young, ed. Indian River coastal zone study, second annual report. Harbor Branch Consortium, Fort Pierce, Fla. 180 pp. (unpublished manuscript).

Fox, J. L., and M. S. Moyer. 1973. Some effects of a power plant on marine microbiota. Chesapeake Science 14(1):1-10.

Knight, R. L. 1973. Entrainment and thermal shock effects on phytoplankton numbers and diversity. Univ. North Carolina. ESE Publ. No. 336. 72 pp.

Littleford, R. A., C. L. Newcombe, and B. B. Shepherd. 1940. An experimental study of certain quantitative plankton methods. Ecology 21(3):309-322.

Menhinick, E. F., and L. D. Jensen. 1974. Plankton populations. Pages 120-138 *in* L. D. Jensen, ed. Environmental responses to thermal discharges from Marshall Steam Station, Lake Norman, North Carolina. Report No. 11. 235 pp.

Morgan, R. P., II, and R. G. Stross. 1969. Destruction of phytoplankton in the cooling water supply of steam electric station. Chesapeake Science 10:165-171.

Patrick, R. 1969. Some effects of temperature on freshwater algae. Pages 161-185 *in* P. A. Krenkel and F. L. Parker, eds. Biological aspects of thermal pollution. Vanderbilt Univ. Press. 407 pp.

LITERATURE CITED (continued)

Patrick, R. 1974. Effects of abnormal temperatures on algal communities. Pages 335-349 *in* J. W. Gibbons and R. R. Sharitz, eds. Thermal ecology. Technical Information Center, Office of Information Services. U.S. Atomic Energy Commission. 670 pp.

Reid, G. K. 1961. Ecology of inland waters and estuaries. Reinhold, New York. 719 pp.

Ryther, J. H., and C. S. Yentsch. 1957. Estimation of phytoplankton production in the ocean from chlorophyll and light data. Limnol. and Oceanogr. 2:281-286.

Simmons, G. M., Jr., B. J. Armitage, and J. C. White. 1974. An ecological evaluation of heated water discharge on phytoplankton blooms in the Potomac River. Hydrobiologia 45(4):441-465.

Steven, D. M. 1971. Production cycles in tropical waters. Pages 527-529 *in* Symposium on investigations and resources of the Caribbean Sea and adjacent regions. Unesco, Place de Fontenoy, Paris-7. 545 pp.

Strickland, J. D. H., and T. R. Parsons. 1972. A practical handbook of seawater analysis. Fish. Res. Bd. Canad. Ottawa, Bulletin No. 167. 310 pp.

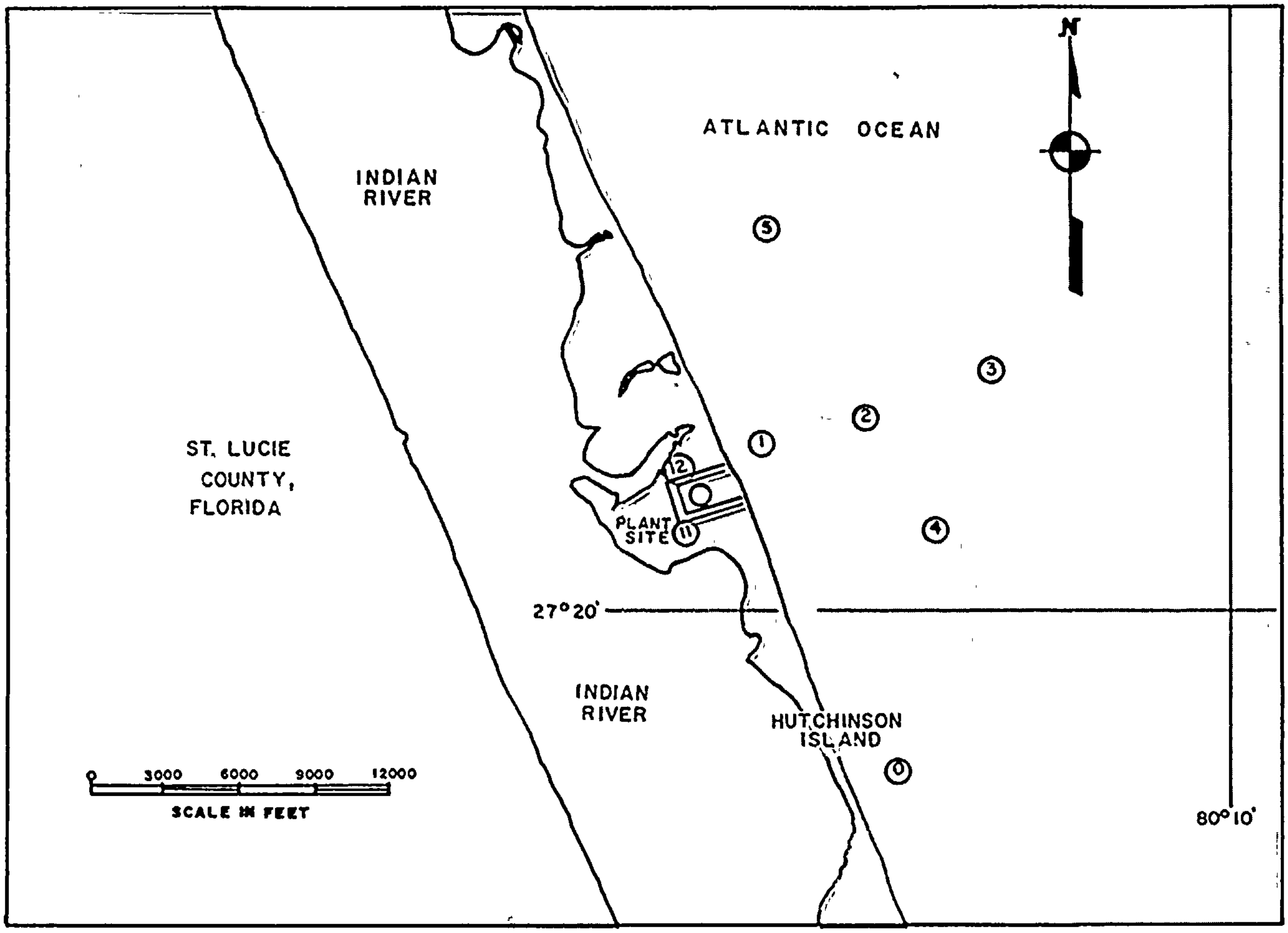
Unesco. 1966. Determination of photosynthetic pigments in sea-water. United Stations Educational, Scientific, and Cultural Organization. Place de Fontenoy, Paris-7. 69 pp.

Warinner, J. E., and M. C. Brehmer. 1966. The effects of thermal effluents on marine organisms. Air and Water Poll. Int. J. 10:277-289.

Whitford, L. C. 1960. Ecological distribution of fresh-water algae. Pages 2-10 *in* C. A. Tryon, Jr., and R. T. Hartman, eds. The ecology of algae. Spec. Publ. No. 2. Pymatuning Laboratory of Field Biology, Univ. of Pittsburgh, Pa. 96 pp.

Willen, T. 1962. Studies on the phytoplankton of some lakes connected or recently isolated from the Baltic. Oikos 13:169-199.

Utermöhl, H. 1958. Zur vervollkommung der quantitativen phytoplankton-methodik. Mitt. Int. Ass. Theor. Appl. Limnol. 9. 38 pp.



FLORIDA POWER & LIGHT COMPANY ST. LUCIE PLANT
LOCATIONS OF PHYTOPLANKTON SAMPLING STATIONS 1976
MARCH 1977 — APPLIED BIOLOGY, INC. — FIGURE D-1

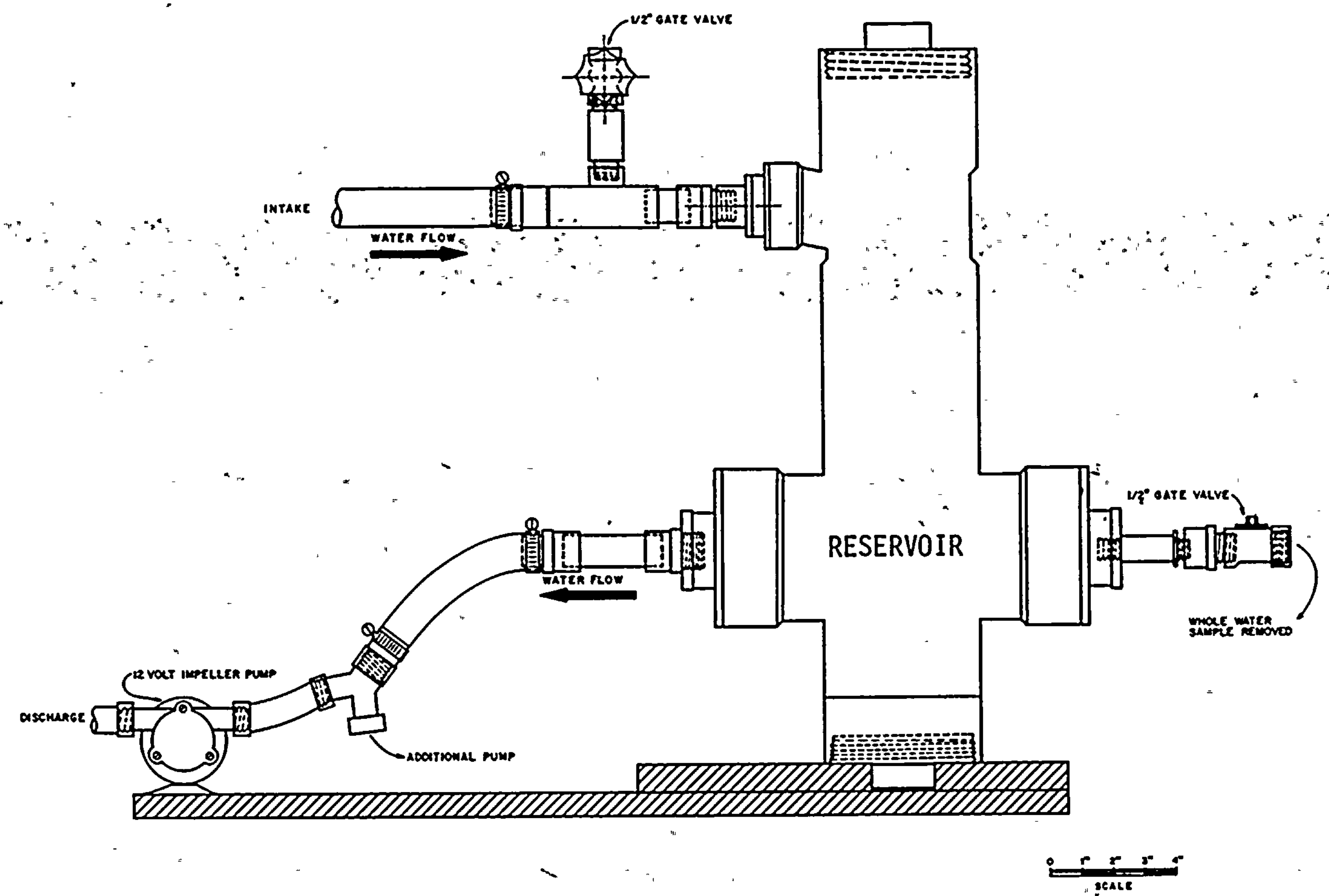


Figure D-2. Pump design for whole water sample collections at the St. Lucie Plant, 1976.

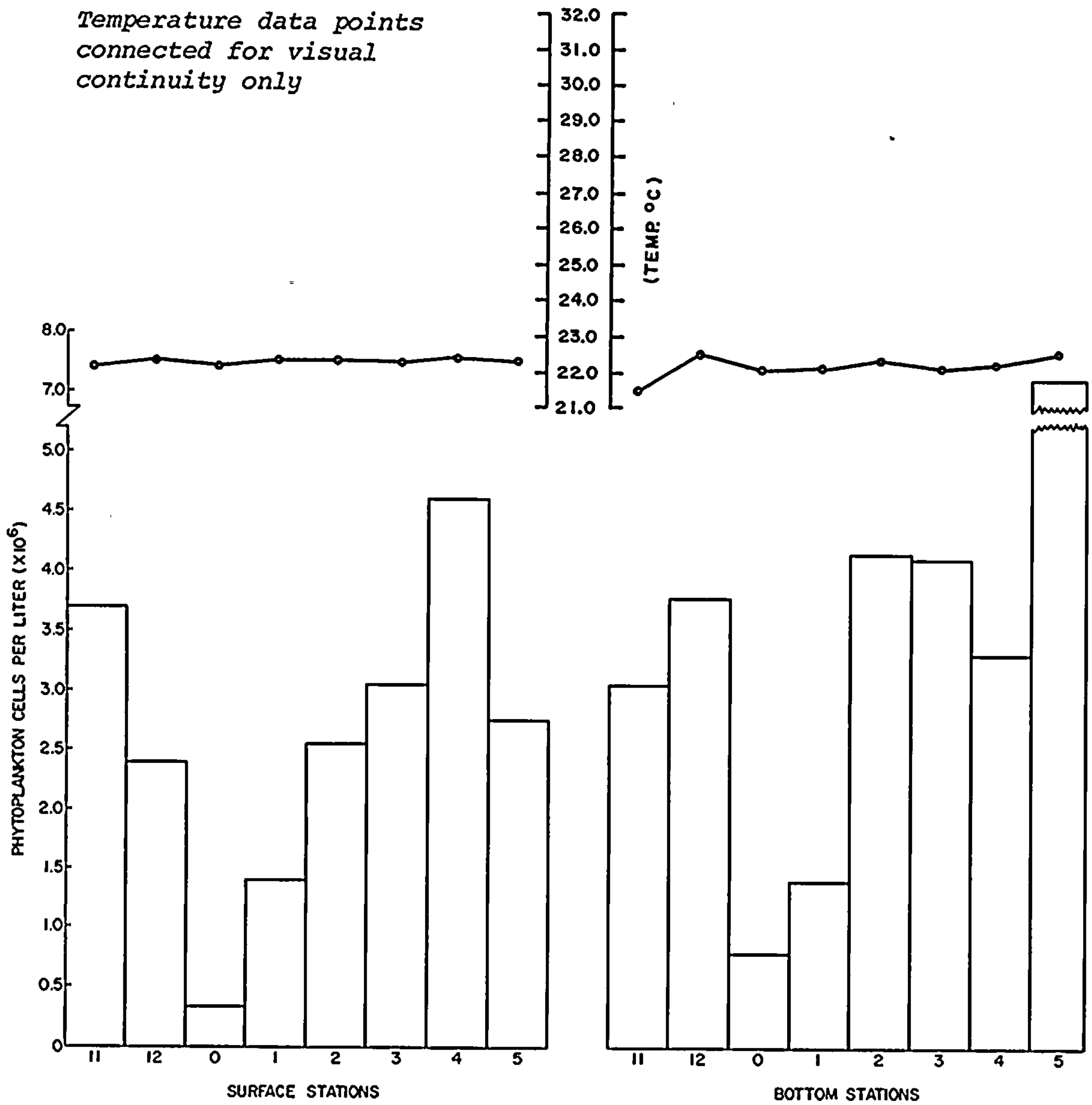


Figure D-3. Phytoplankton density and temperature, St. Lucie Plant, 26 March 1976.

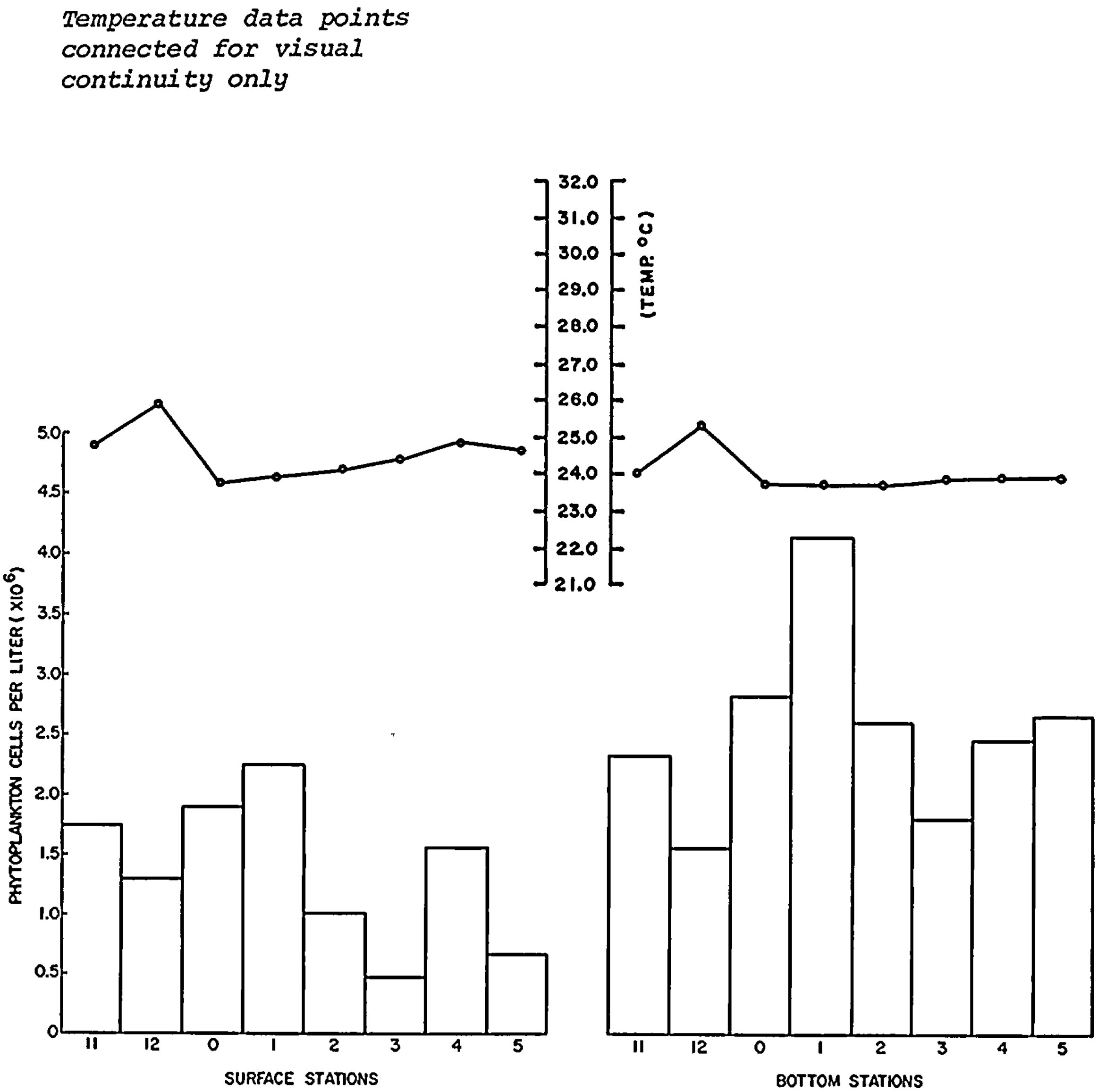


Figure D-4. Phytoplankton density and temperature, St. Lucie Plant, 21 April 1976.

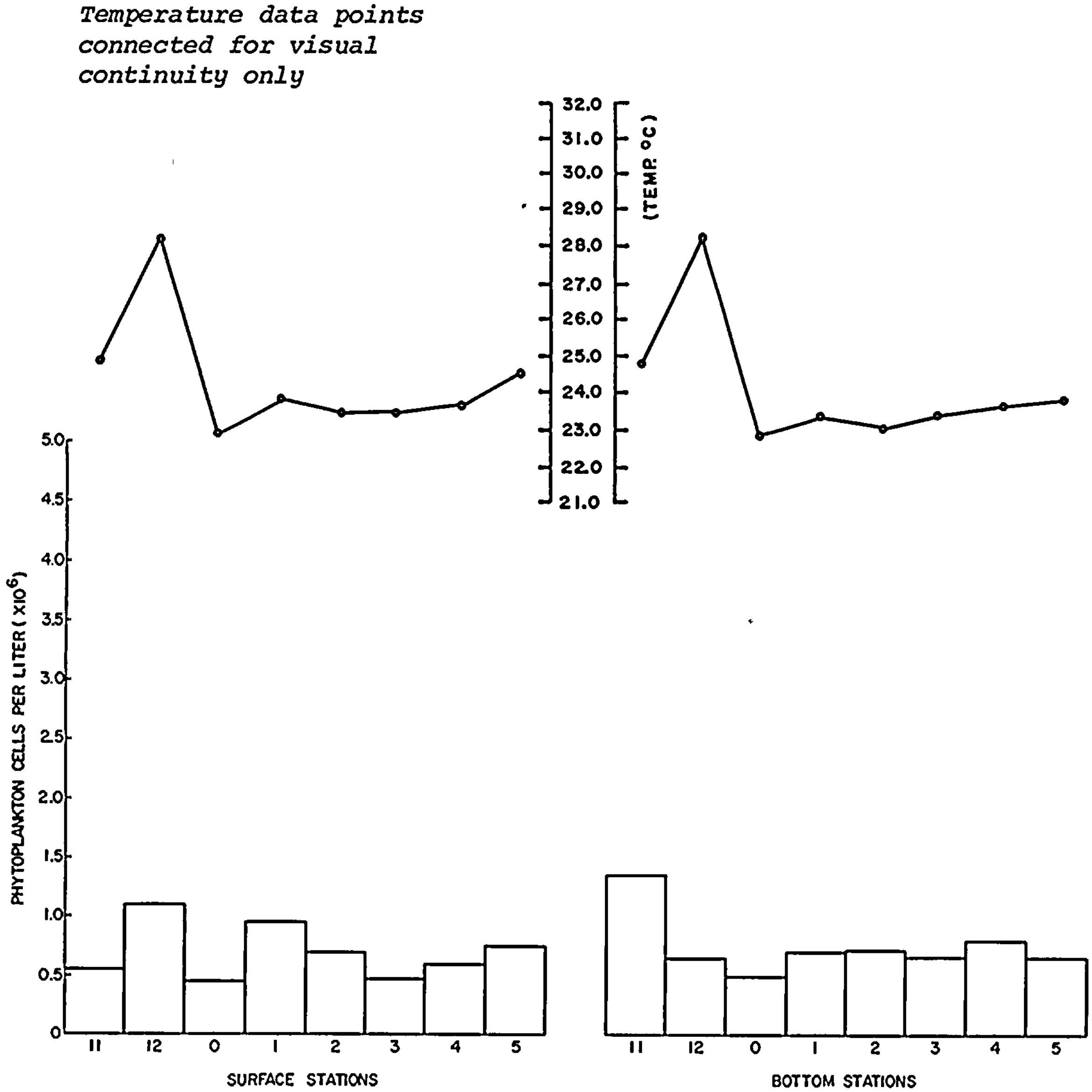


Figure D-5. Phytoplankton density and temperature, St. Lucie Plant, 12 May 1976.

Temperature data points connected for visual continuity only

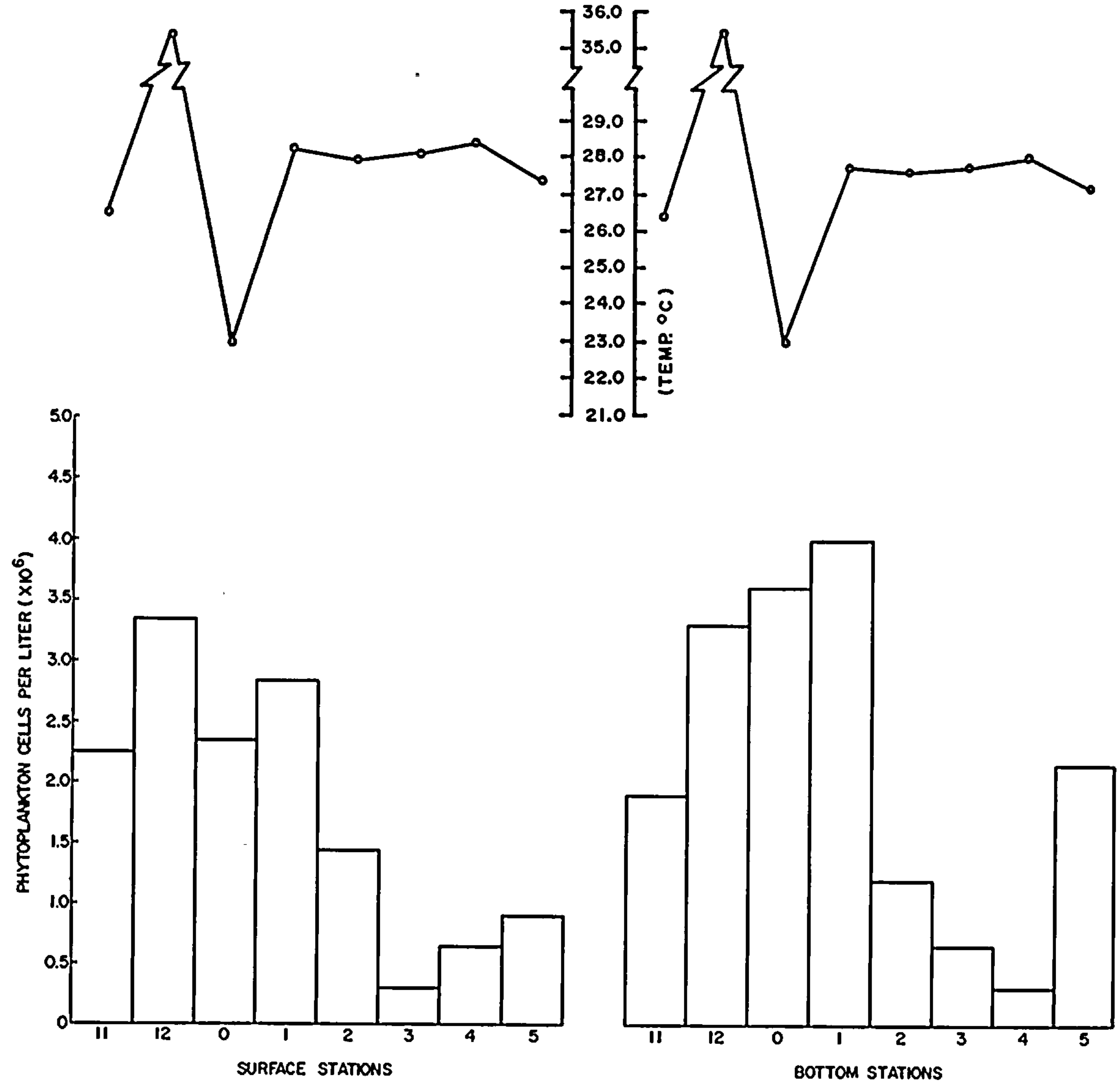


Figure D-6. Phytoplankton density and temperature, St. Lucie Plant, 8 June 1976.

Temperature data points connected for visual continuity only

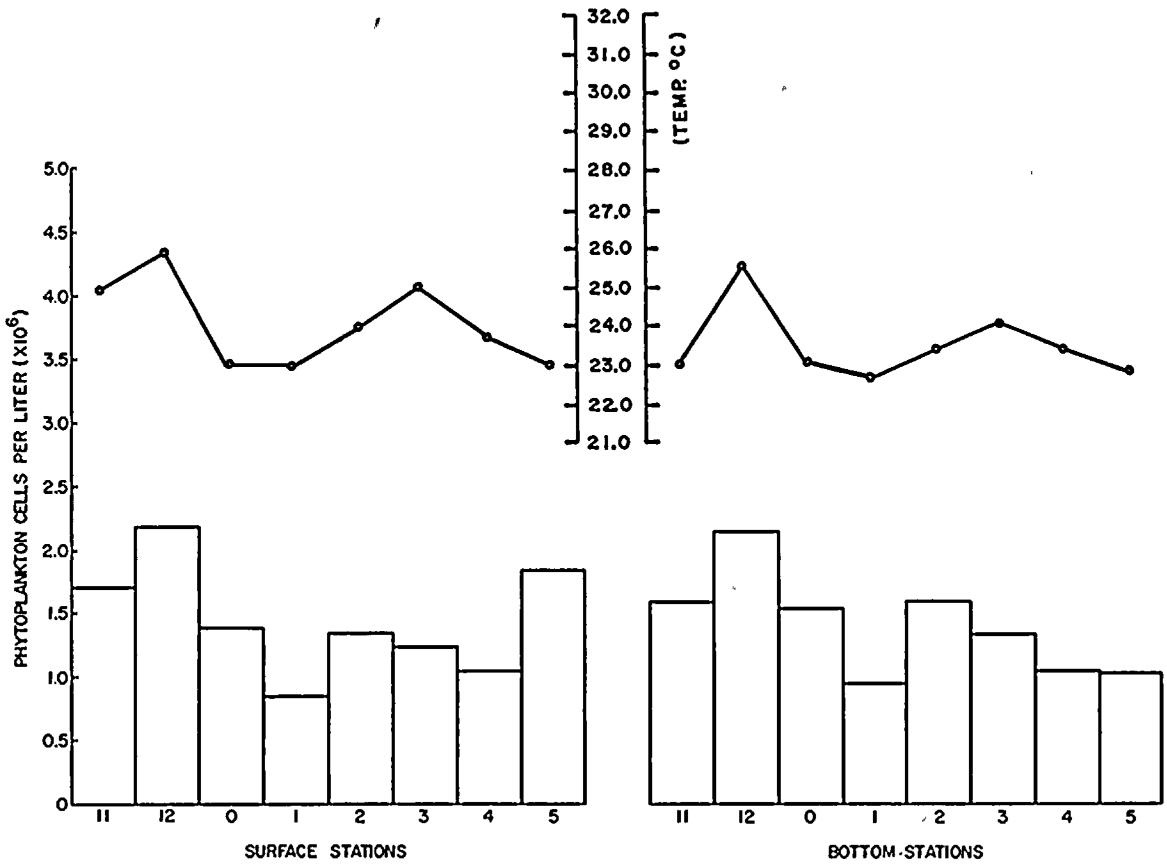


Figure D-7. Phytoplankton density and temperature, St. Lucie Plant, 14 July 1976.

Temperature data points connected for visual continuity only

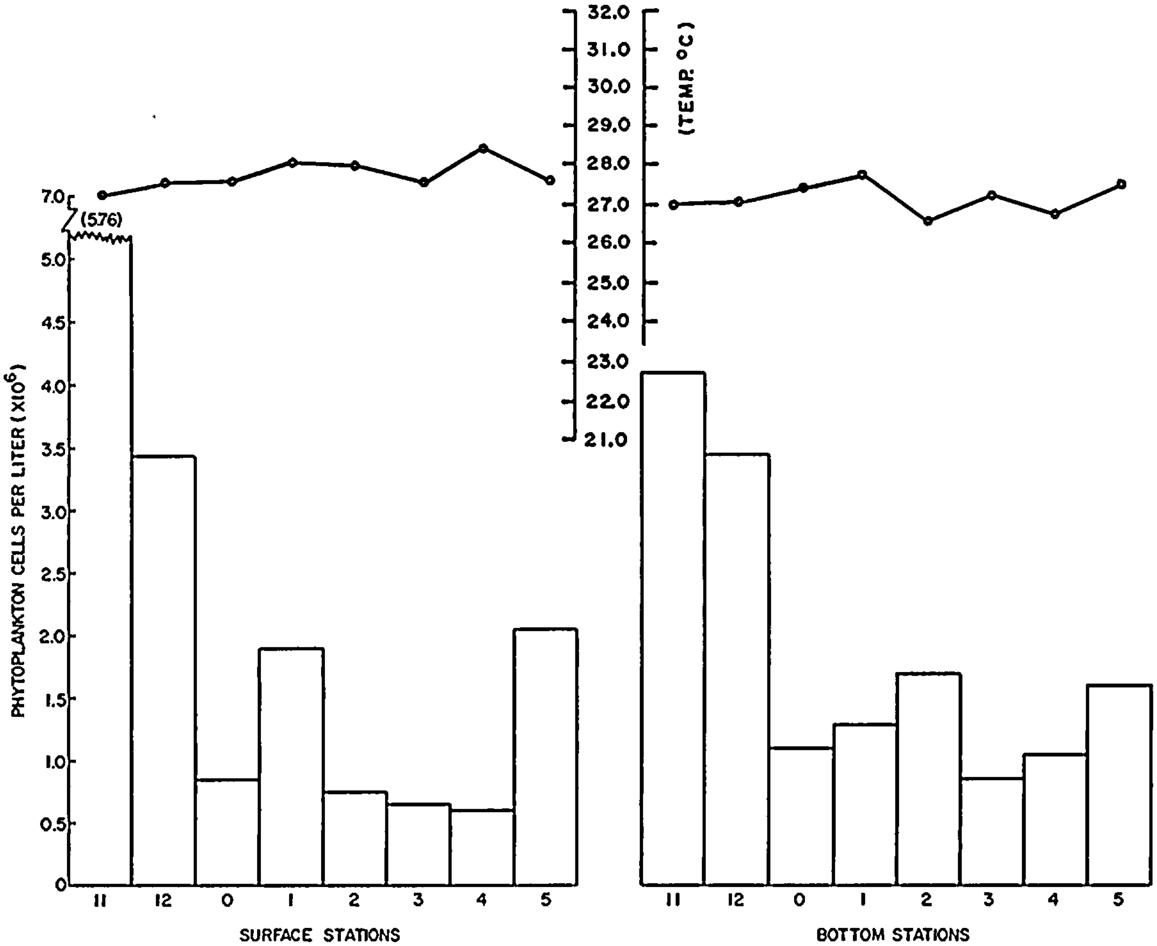


Figure D-8. Phytoplankton density and temperature, St. Lucie Plant, 11 August 1976.

Temperature data points connected for visual continuity only

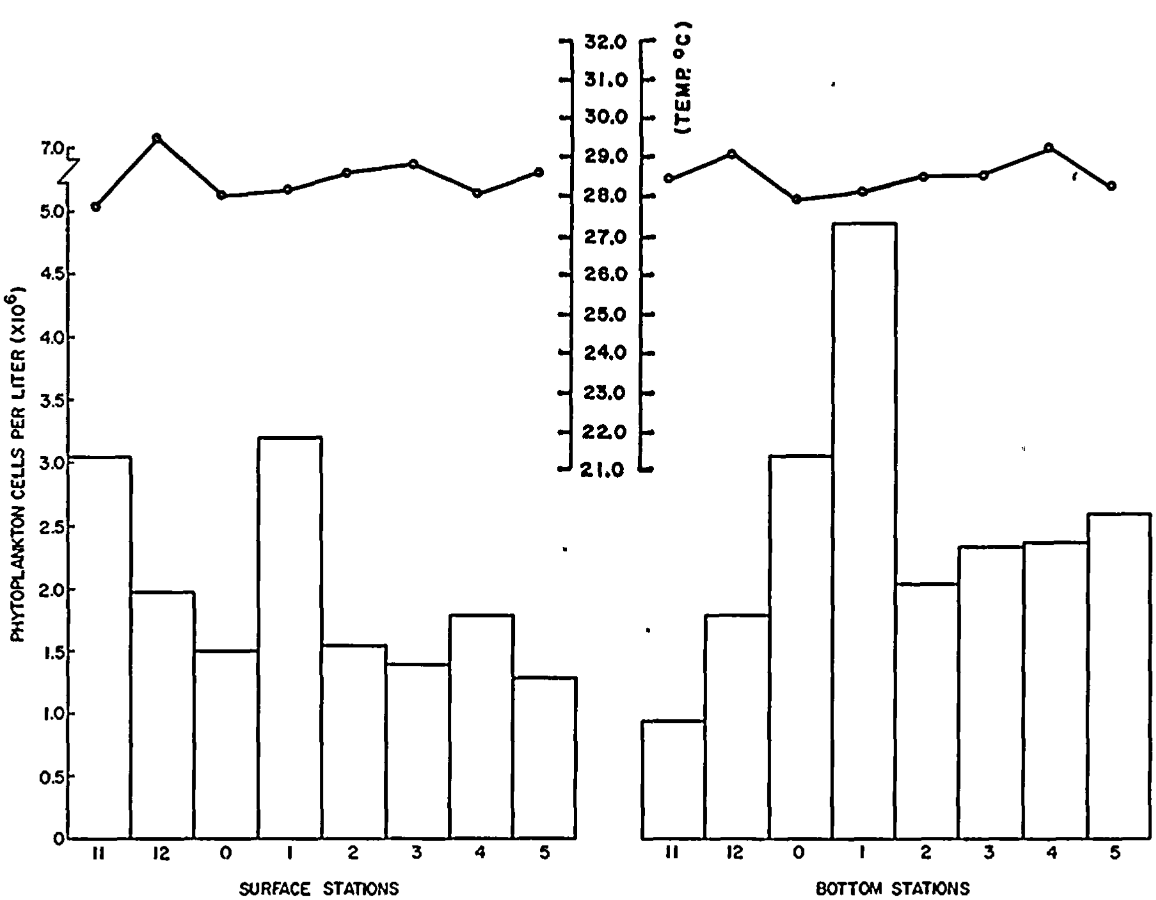


Figure D-9. Phytoplankton density and temperature, St. Lucie Plant, 14 September 1976.

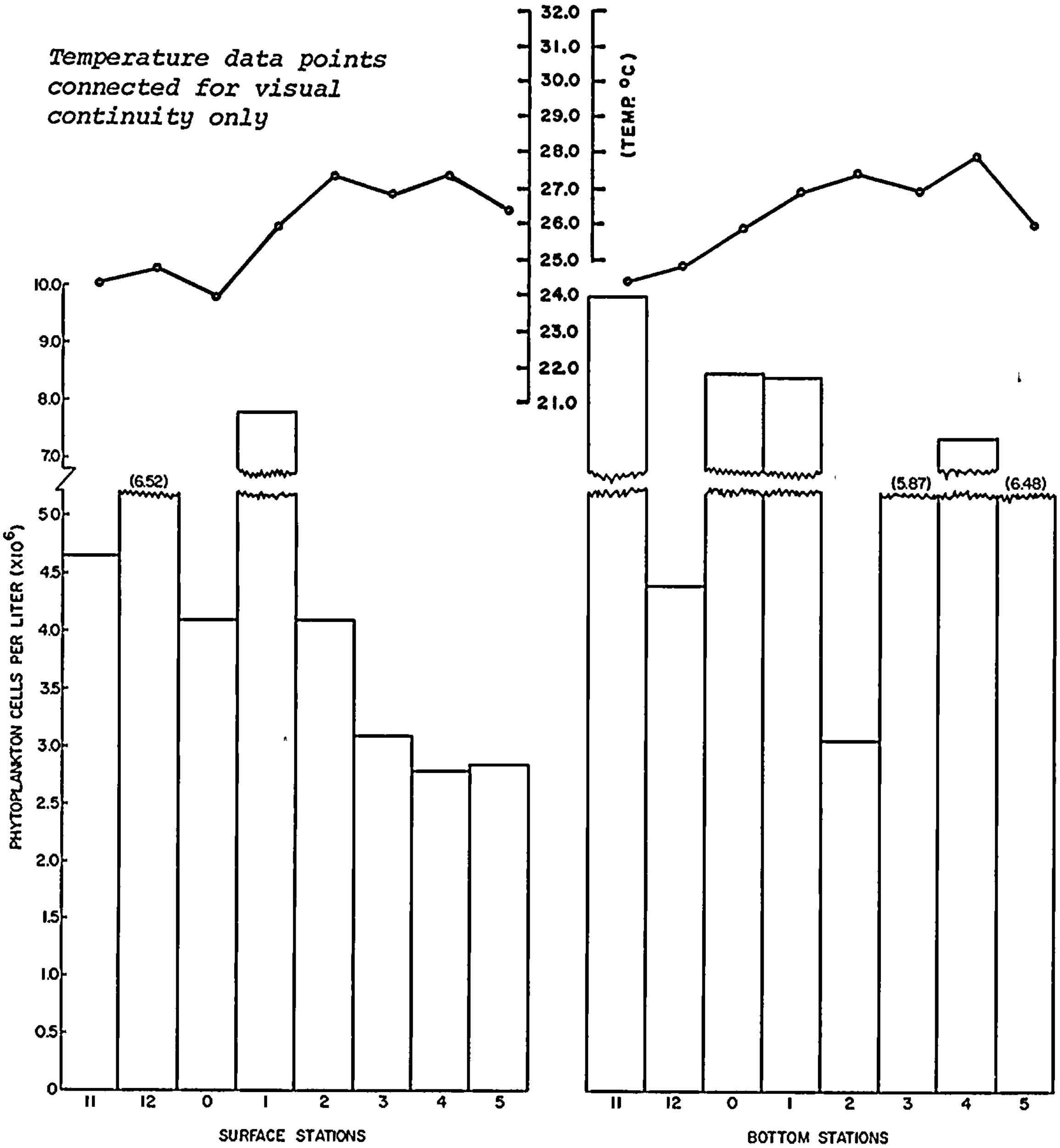


Figure D-10. Phytoplankton density and temperature, St. Lucie Plant, 15 October 1976.

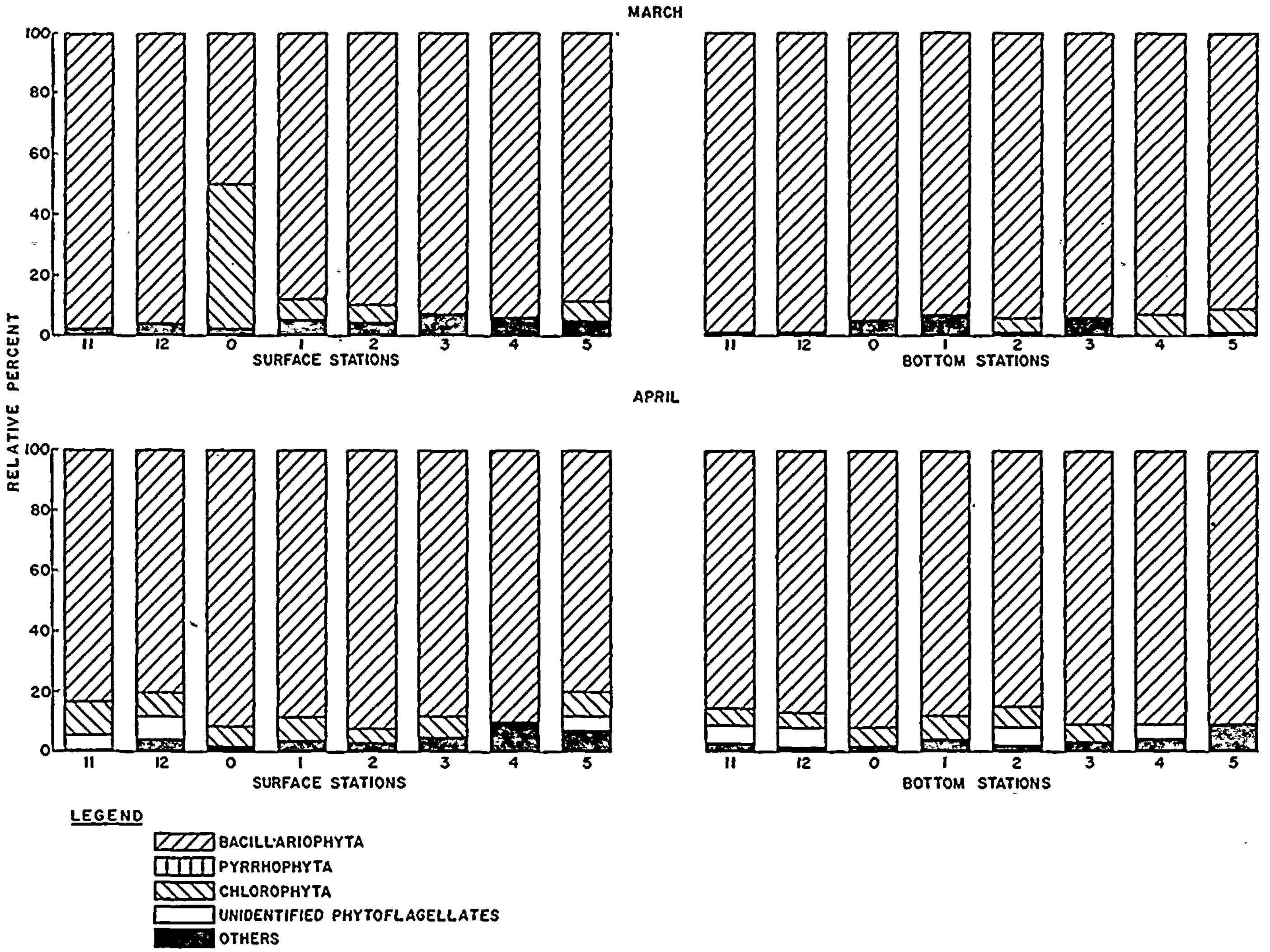


Figure D-11. Phytoplankton percentage composition at the St. Lucie Plant, 26 March and 21 April 1976.

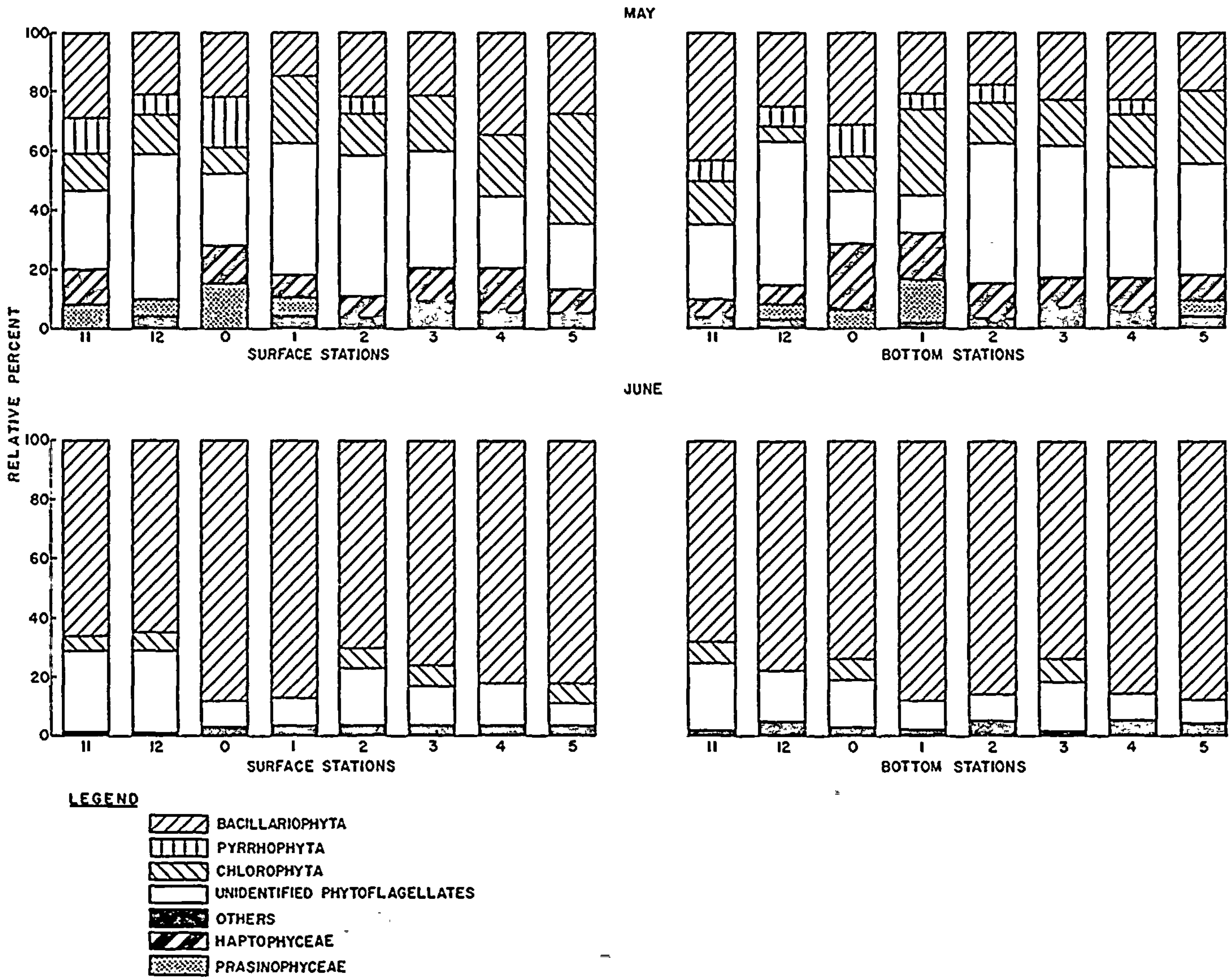


Figure D-12. Phytoplankton percentage composition at the St. Lucie Plant, 12 May and 8 June 1976.

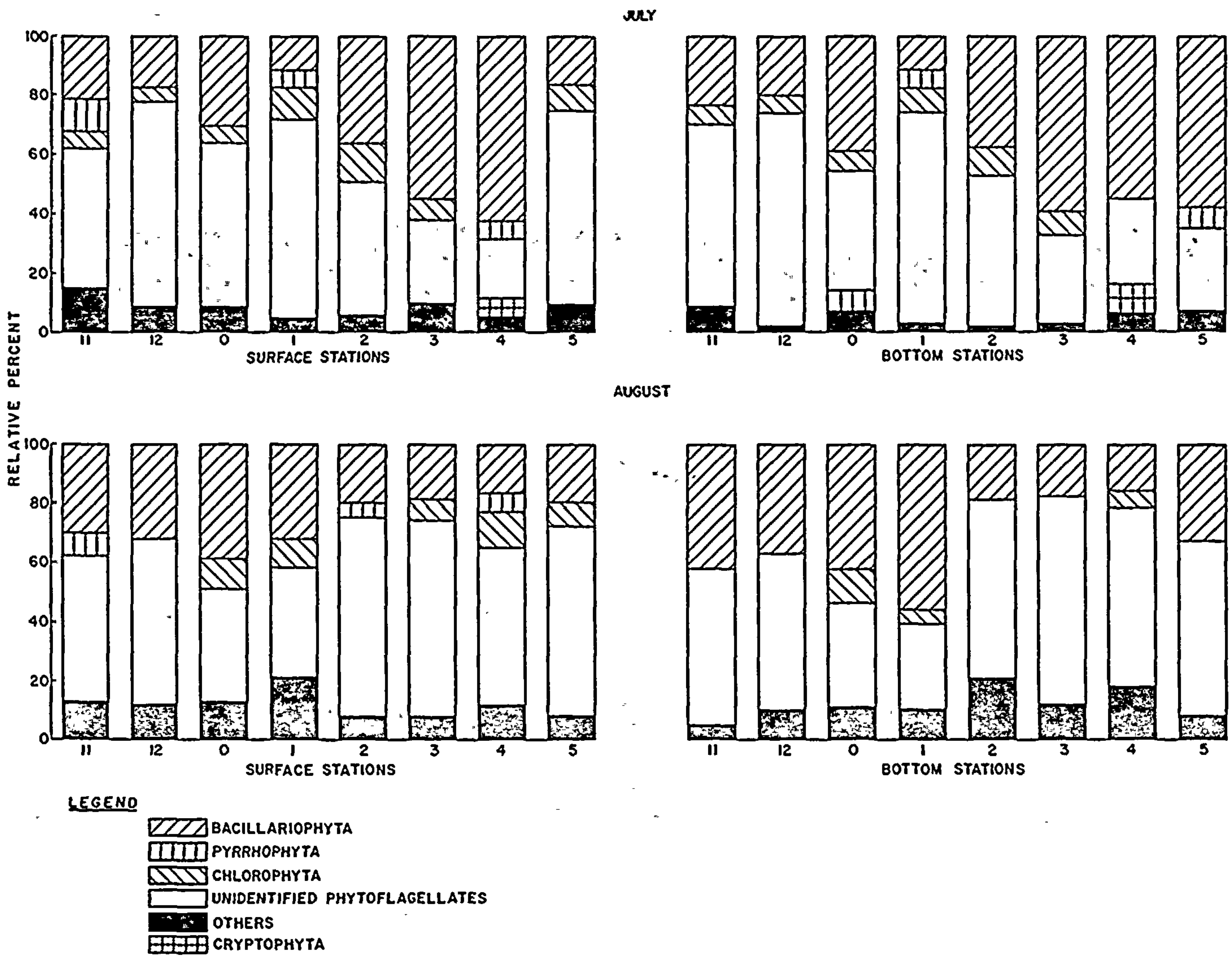


Figure D-13. Phytoplankton percentage composition at the St. Lucie Plant, 14 July and 11 August 1976.

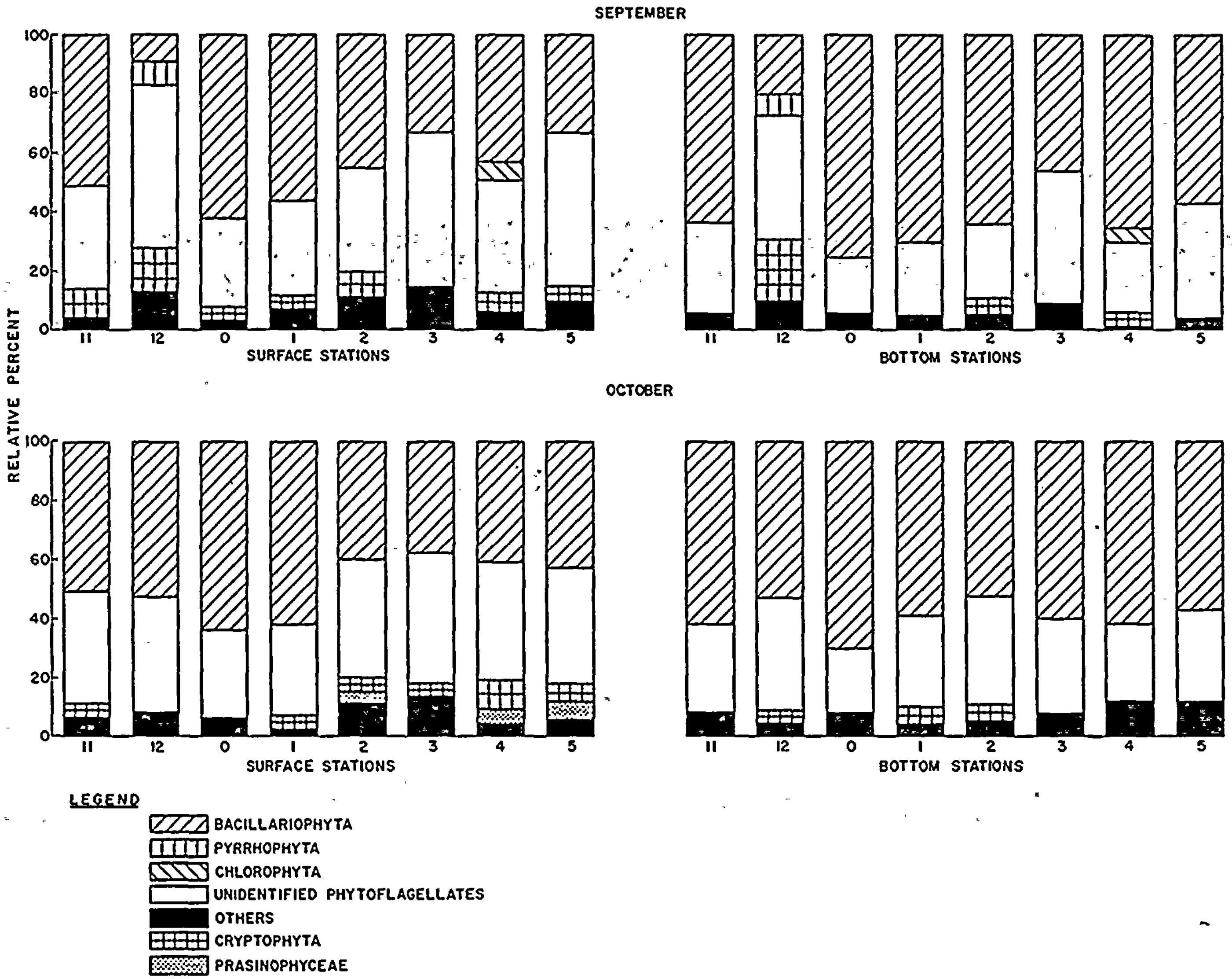


Figure D-14. Phytoplankton percentage composition at the St. Lucie Plant, 14 September and 18 October 1976.

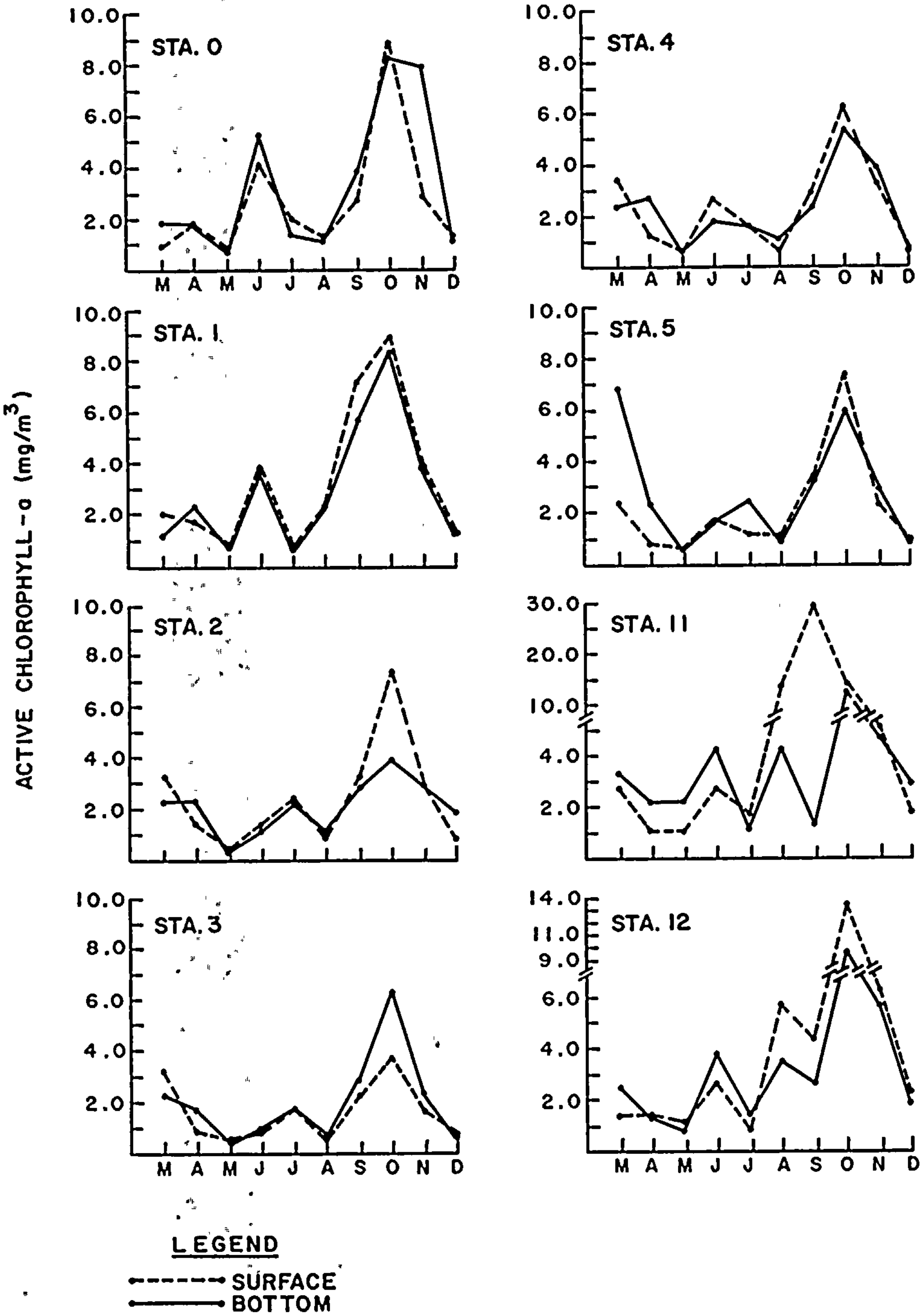


Figure D-15. Active chlorophyll-α concentration at the St. Lucie Plant, March-December 1976 collections.

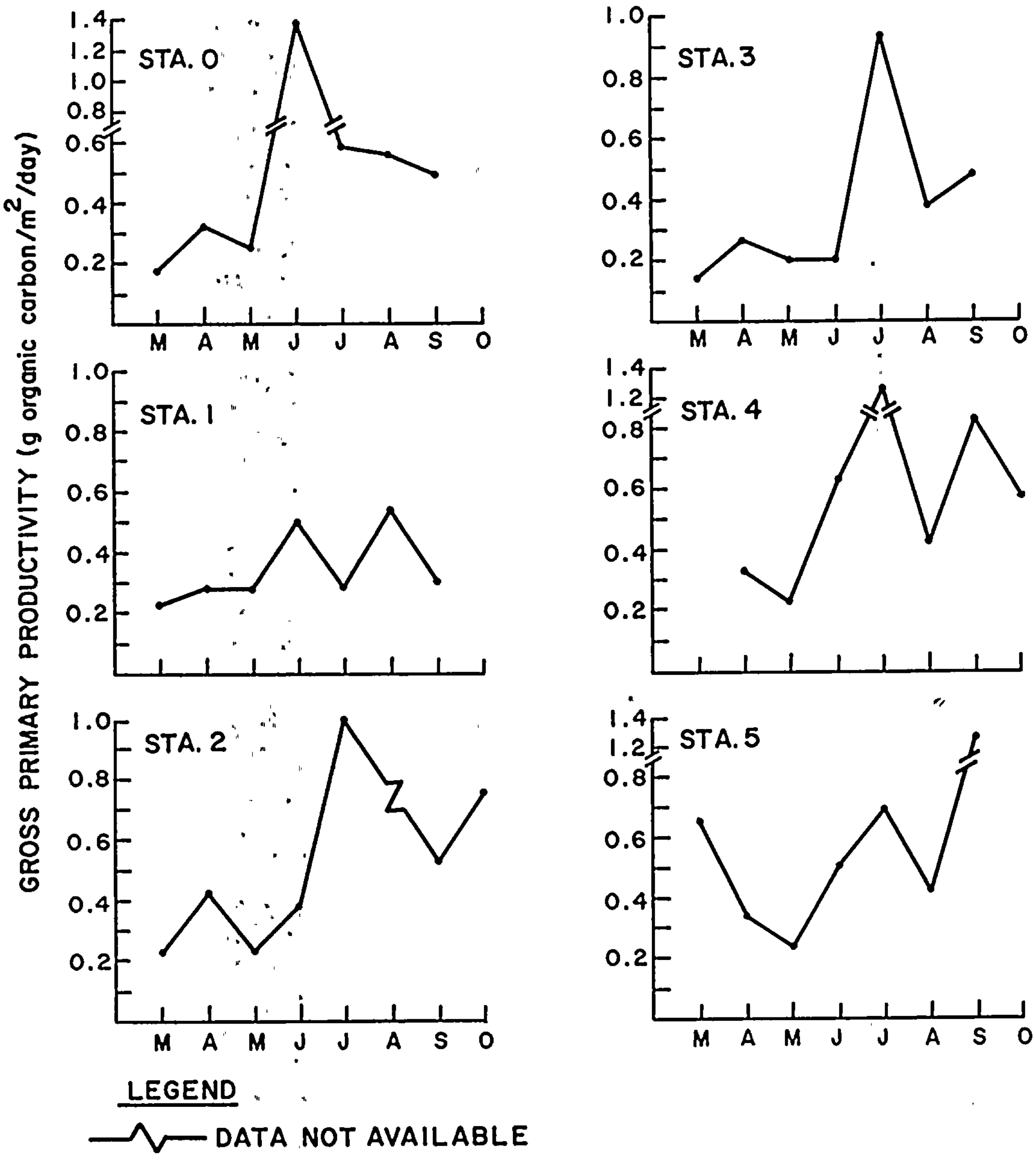


Figure D-16. Gross primary productivity at the St. Lucie Plant, March-October 1976.

TABLE D-1

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION [b]
ST. LUCIE PLANT
26 MARCH 1976

Taxon	11 S	11 B	12 S	12 B	0 S	0 B	1 S	1 B
Bacillariophyta (diatoms)	3,598,237.8 (98)	3,041,148.7 (99)	2,303,438.6 (96)	3,736,226.8 (99)	138,286.8 (50)	753,880.3 (95)	1,244,447.8 (88)	1,329,892.1 (93)
Pyrrhophyta (dinoflagellates)	18,462.2 (1)	12,789.3 (<1)	2,845.0 (<1)	2,127.4 (<1)	425.5 (<1)	614.6 (<1)	26,946.8 (2)	11,396.0 (1)
Chlorophyta (green algae)	25,528.4 (<1)	4,254.8 (<1)	41,128.9 (2)	19,855.4 (1)	133,683.3 (48)	15,789.8 (2)	95,022.1 (7)	60,984.4 (4)
Cyanophyta (blue-green algae)								
Euglenophyta (euglenoids)				2,127.4 (<1)				
Cryptophyta (cryptophytes)							1,418.3 (<1)	
Xanthophyta (xanthophytes)					3,488.9 (1)	13,851.5 (2)	2,836.5 (<1)	
Chrysophyceae (yellow-brown algae and silicoflagellates)								
Haptophyceae (haptophytes including coccolithophores)								
Prasinophyceae (prasinophytes)	25,528.3 (<1)	8,509.5 (<1)	9,927.8 (<1)		127.7 (<1)	1,560.1 (<1)	19,855.4 (<1)	2,826.5 (<1)
Unidentified phytoflagellates	14,182.5 (<1)	17,019.1 (1)	38,292.5 (2)	21,273.7 (1)	808.4 (<1)	9,738.6 (1)	28,364.8 (2)	18,437.1 (1)
Other								1,418.3 (<1)
Total phytoplankton	3,681,974.4	3,083,719.6	2,395,632.5	3,781,610.8	276,819.3	795,434.9	1,418,891.4	1,424,963.6

Taxon	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
Bacillariophyta (diatoms)	2,319,795.2 (90)	3,950,679.4 (94)	2,828,768.7 (93)	3,864,863.2 (94)	4,348,337.1 (94)	3,058,286.0 (93)	2,456,698.6 (89)	6,555,433.4 (91)
Pyrrhophyta (dinoflagellates)	39,723.3 (2)	16,073.4 (<1)	41,141.6 (1)	38,292.5 (1)	39,710.8 (1)	4,018.4 (<1)	46,802.0 (2)	14,182.4 (<1)
Chlorophyta (green algae)	165,934.1 (6)	205,172.0 (5)	134,732.7 (4)	172,316.1 (4)	190,044.1 (4)	224,791.0 (7)	168,061.4 (6)	567,295.7 (8)
Cyanophyta (blue-green algae)			187.5 (<1)			62.5 (<1)		
Euglenophyta (euglenoids)					5,673.0 (<1)			
Cryptophyta (cryptophytes)		5,673.0 (<1)					6,382.1 (<1)	
Xanthophyta (xanthophytes)				7,091.2 (<1)				
Chrysophyceae (yellow-brown algae and silicoflagellates)								
Haptophyceae (haptophytes including coccolithophores)								
Prasinophyceae (prasinophytes)	11,346.0 (<1)						2,127.4 (<1)	
Unidentified phytoflagellates	35,456.0 (1)	11,345.9 (<1)	30,492.0 (1)	41,838.0 (1)	42,547.3 (1)	16,546.3 (1)	57,438.7 (2)	85,094.4 (1)
Other							12,764.2 (<1)	
Total phytoplankton	2,572,254.6	4,188,943.9	3,035,321.6	4,124,401.1	4,626,312.1	3,303,704.2	2,750,274.2	7,222,005.9

[a] Values are expressed as cells per liter and represent the mean of two replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface: B = Bottom.

TABLE D-2

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION [b]
ST. LUCIE PLANT
21 APRIL 1976

Taxon	11 S	11 B	12 S	12 B	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
Station and depth[c]																
Bacillariophyta (diatoms)	1,436,892.3 (83)	1,974,317.4 (85)	1,038,425.6 (80)	1,349,685.4 (87)	1,729,276.1 (91)	2,592,560.6 (92)	1,965,228.3 (88)	3,658,539.8 (88)	903,972.7 (92)	2,222,643.0 (85)	431,724.4 (88)	1,622,949.1 (91)	1,378,486.6 (90)	2,219,250.8 (91)	553,948.8 (80)	2,421,397.S (91)
Pyrrhophyta (dinoflagellates)	18,720.9 (1)	39,727.6 (2)	23,233.3 (2)	15,372.0 (1)	17,514.0 (1)	6,390.6 (<1)	14,891.5 (1)	27,443.1 (1)	13,051.3 (1)	21,982.8 (1)	7,968.7 (2)	6,854.9 (<1)	16,090.3 (1)	5,654.0 (<1)	29,130.8 (4)	19,188.0 (1)
Chlorophyta (green algae)	173,167.0 (10)	150,333.4 (6)	107,153.4 (8)	72,261.6 (5)	123,859.7 (7)	176,570.9 (6)	176,570.8 (8)	336,122.8 (8)	44,816.4 (5)	190,044.1 (7)	32,822.1 (7)	102,113.2 (6)	56,256.9 (4)	95,541.6 (4)	52,002.1 (8)	105,658.8 (4)
Cyanophyta (blue-green algae)		50.0 (<1)			313.9 (<1)	62.5 (<1)	62.5 (<1)	44.5 (<1)		183.4 (<1)					88.6 (<1)	116.7 (<1)
Euglenophyta (euglenoids)																
Cryptophyta (cryptophytes)			1,329.6 (<1)							7,091.2 (<1)	283.7 (<1)					
Xanthophyta (xanthophytes)	1,560.1 (<1)				3,782.0 (<1)											
Chrysophyceae (yellow-brown algae and silicoflagellates)											632.5 (<1)		3,782.0 (<1)			
Haptophyceae (haptophytes including coccolithophores)																
Prasinophyceae (prasinophytes)	17,160.8 (1)	8,509.5 (<1)	30,226.3 (2)	4,872.4 (<1)	2,363.8 (<1)	7,800.4 (<1)	14,891.5 (1)	8,509.5 (<1)			851.0 (<1)	4,491.1 (<1)	14,182.4 (<1)		14,820.7 (2)	2,836.5 (<1)
Unidentified phytoflagellates	93,603.9 (5)	141,824.0 (6)	96,174.5 (7)	107,603.2 (7)	26,473.9 (1)	45,383.7 (2)	55,311.4 (2)	117,241.2 (3)	22,691.9 (2)	161,679.3 (6)	10,602.2 (2)	49,638.4 (3)	56,729.6 (4)	111,934.9 (5)	37,441.6 (5)	98,567.6 (4)
Other								2,127.4 (<1)			5,956.6 (1)	4,491.2 (<1)	2,836.5 (<1)	14,182.4 (1)	4,420.2 (1)	3,545.6 (<1)
Total phytoplankton	1,741,104.0	2,314,760.4	1,296,541.6	1,549,793.6	1,903,581.2	2,828,768.7	2,226,956.1	4,150,028.3	984,531.5	2,603,623.8	490,840.7	1,790,538.0	1,528,364.5	2,446,563.7	691,852.8	2,651,311.0

[a] Values are expressed as cells per liter and represent the mean of two replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface; B = Bottom.

TABLE D-3

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION[b]
ST. LUCIE PLANT
12 MAY 1976

Taxon	11 S	11 B	12 S	12 B	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
	Station and depth[c]															
Bacillariophyta (diatoms)	157,087.1 (29)	576,636.1 (43)	220,343.0 (21)	161,390.7 (25)	99,148.7 (22)	154,581.5 (31)	136,123.7 (15)	140,490.0 (21)	155,433.6 (22)	122,077.2 (18)	101,633.3 (22)	148,037.8 (23)	210,328.4 (35)	182,826.5 (23)	209,738.6 (28)	130,396.9 (20)
Pyrrhophyta (dinoflagellates)	63,348.1 (12)	87,297.0 (7)	78,003.4 (7)	49,091.4 (7)	76,224.9 (17)	51,379.2 (10)	30,973.4 (3)	32,473.8 (5)	42,116.1 (6)	37,819.8 (6)	17,798.9 (4)	26,494.6 (4)	23,961.5 (4)	39,685.0 (5)	19,825.1 (3)	23,435.3 (4)
Chlorophyta (green algae)	64,529.9 (12)	205,644.7 (15)	143,951.4 (13)	35,622.7 (5)	41,568.7 (9)	59,377.0 (12)	211,081.3 (23)	198,470.5 (29)	99,513.1 (14)	96,440.3 (14)	86,512.6 (19)	102,428.4 (16)	120,795.7 (20)	140,499.3 (18)	276,715.8 (37)	166,828.5 (25)
Cyanophyta (blue-green algae)		83.4 (<1)		41.7 (<1)												
Euglenophyta (euglenoids)			1,418.3 (<1)		421.7 (<1)	1,197.7 (<1)		984.0 (<1)								
Cryptophyta (cryptophytes)			1,418.3 (<1)	1,418.3 (<1)		4,727.5 (1)	6,854.8 (1)		2,600.1 (<1)	6,618.5 (1)	3,403.8 (1)			945.5 (<1)		709.1 (<1)
Xanthophyta (xanthophytes)																
Chrysophyceae (yellow-brown algae and silicoflagellates)					421.7 (<1)			1,546.2 (<1)						1,265.1 (<1)		709.1 (<1)
Haptophyceae (haptophytes including coccolithophores)	65,239.0 (12)	81,548.8 (6)	31,910.3 (3)	45,667.4 (7)	61,025.3 (13)	111,316.1 (22)	72,330.2 (8)	109,215.3 (16)	57,438.7 (8)	83,203.4 (12)	51,226.8 (11)	66,184.5 (10)	90,592.4 (15)	90,912.0 (12)	60,848.2 (8)	59,882.5 (9)
Prasinophyceae (prasinophytes)	41,838.1 (8)	36,165.2 (3)	65,239.0 (6)	34,321.5 (5)	68,042.3 (15)	30,192.8 (6)	59,329.7 (6)	96,283.8 (14)	21,510.0 (3)	15,127.9 (2)	13,331.2 (3)	11,345.9 (2)	5,852.0 (1)	32,505.8 (4)	16,251.5 (2)	34,574.7 (5)
Unidentified phytoflagellates	143,951.3 (27)	333,995.4 (25)	525,457.8 (49)	313,714.6 (48)	109,117.2 (24)	84,968.4 (17)	404,670.9 (44)	79,557.1 (12)	335,177.2 (47)	322,413.2 (47)	184,030.9 (40)	276,399.1 (44)	140,470.0 (24)	286,988.1 (37)	162,038.6 (22)	245,912.5 (37)
Other	6,382.2 (1)	11,346.0 (1)	4,964.0 (<1)	14,749.7 (2)		630.4 (<1)	4,963.9 (1)	20,100.2 (3)	3,309.2 (<1)	945.5 (<1)	567.3 (<1)	1,575.9 (<1)	945.5 (<1)	3,156.1 (<1)	7,676.8 (1)	1,721.2 (<1)
Total phytoplankton	542,375.7	1,332,715.3	1,072,706.3	656,018.0	455,970.6	498,370.3	926,327.9	679,121.4	717,098.4	684,644.9	458,505.1	631,836.0	592,945.7	778,782.8	753,094.7	664,169.8

[a] Values are expressed as cells per liter and represent the mean of two replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface; B = Bottom.

TABLE D-4

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION [b]
ST. LUCIE PLANT
8 JUNE 1976

	Station and depth[c]															
	11		12		0		1		2		3		4		5	
Taxon	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B
Bacillariophyta (diatoms)	1,469,874.3 (66)	1,281,739.2 (68)	2,150,362.9 (65)	2,547,242.7 (78)	2,064,582.3 (88)	2,672,707.4 (74)	2,461,424.4 (87)	3,479,906.1 (87)	1,026,243.4 (70)	1,032,572.4 (86)	213,544.8 (76)	481,956.1 (74)	534,118:3 (82)	246,906:3 (86)	739,091.6 (82)	1,361,832.2 (88)
Pyrrhophyta (dinoflagellates)	13,190.2 (1)	15,475.5 (1)	34,619.9 (1)	16,446.0 (1)	8,564.4 (<1)	40,440.0 (1)	5,262.8 (<1)	26,960.0 (1)	29,593.3 (2)	10,533.9 (1)	5,270.4 (2)	6,620.4 (1)	5,271.2 (1)	1,824.6 (1)	17,159.5 (2)	1,265.1 (<1)
Chlorophyta (green algae)	113,147.8 (5)	137,790.7 (7)	197,350.8 (6)	141,434.7 (4)	51,311.2 (2)	269,599.9 (7)	80,233.5 (3)	102,448.0 (3)	100,838.1 (7)	44,732.9 (4)	18,403.8 (7)	50,918.7 (8)	17,761.6 (3)	11,528.8 (4)	58,754.2 (7)	73,173.4 (3)
Cyanophyta (blue-green algae)		13.9 (<1)								16.7 (<1)						
Euglenophyta (euglenoids)	2,631.4 (<1)		2,741.0 (<1)	3,289.2 (<1)						2,631.4 (<1)	657.0 (<1)		1,315.7 (<1)		3,373.5 (<1)	
Crytophyta (crytophytes)			2,741.0 (<1)	6,578.4 (<1)												
Xanthophyta (Xanthophytes)																
Chrysophyceae (yellow-brown algae and silicoflagellates)			2,741.0 (<1)			13,480.0 (<1)			2,875.8 (<1)							1,265.1 (<1)
Haptophyceae (haptophytes including coccolithophores)	10,525.4 (<1)	2,811.2 (<1)	2,741.0 (<1)	6,578.4 (<1)		13,480.0 (<1)	5,392.0 (<1)		5,751.5 (<1)		1,971.9 (1)				1,686.7 (<1)	
Prasinophyceae (prasinophytes)		5,622.4 (<1)		3,289.2 (<1)	13,156.8 (1)		5,392.0 (<1)	16,176.0 (<1)	2,875.8 (<1)	3,947.0 (<1)	1,314.9 (<1)	3,285.1 (1)	3,289.2 (1)	809.1 (<1)	12,369.3 (1)	20,714.8 (1)
Unidentified phytoflagellates	623,628.4 (28)	444,170.1 (23)	932,482.4 (28)	549,293.1 (17)	203,271.4 (9)	566,159.9 (16)	255,020.8 (9)	388,223.9 (10)	285,353.8 (19)	103,938.1 (9)	37,475.5 (13)	108,407.5 (17)	88,150.1 (14)	25,484.8 (9)	66,625.5 (7)	164,610.0 (8)
Other	10,525.4 (<1)	2,811.2 (<1)		6,578.4 (<1)	7,236.2 (<1)	26,960.0 (1)	10,654.7 (<1)		12,574.3 (1)	3,947.1 (<1)	3,946.2 (1)					
Total phytoplankton	2,243,521.4	1,890,434.3	3,325,780.0	3,280,730.1	2,348,122.5	3,602,826.5	2,823,378.6	4,013,714.0	1,466,104.3	1,202,317.7	282,582.2	651,185.8	649,906.5	286,553.6	899,060.3	2,122,860.6

[a] Values are expressed as cells per liter and represent the mean of two replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface; B = Bottom.

TABLE D-5

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION[b]
ST. LUCIE PLANT
14 JULY 1976

Taxon	11 S	11 B	12 S	12 B	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
	Station and depth[c]															
Bacillariophyta (diatoms)	354,123.5 (21)	357,040.5 (23)	382,769.5 (17)	426,755.0 (20)	406,393.5 (30)	601,597.3 (39)	94,729.8 (11)	105,789.1 (11)	482,813.3 (36)	601,197.4 (37)	699,493.0 (55)	803,224.6 (59)	660,175.2 (62)	589,291.3 (55)	292,764.2 (16)	578,323.9 (58)
Pyrrhophyta (dinoflagellates)	182,773.5 (11)	45,320.0 (3)	57,116.7 (3)	7,615.6 (<1)	41,885.6 (3)	68,017.6 (4)	49,341.5 (6)	54,210.6 (6)	20,625.6 (2)	30,145.0 (2)	37,246.0 (3)	25,374.6 (2)	62,717.7 (6)	30,703.1 (3)	71,078.8 (4)	64,732.2 (7)
Chlorophyta (green algae)	97,093.5 (6)	109,455.1 (7)	102,810.1 (5)	121,849.1 (6)	80,725.0 (6)	102,287.5 (7)	97,579.0 (11)	81,742.2 (8)	172,143.5 (13)	136,445.6 (9)	108,402.7 (9)	101,398.2 (8)	36,467.7 (3)	24,015.4 (2)	172,619.5 (9)	15,231.1 (2)
Cyanophyta (blue-green algae)		25.0 (<1)			16,754.2 (1)	33.3 (<1)								8.3 (<1)	15,231.1 (1)	
Euglenophyta (euglenoids)					4,188.6 (<1)			1,072.0 (<1)				2,668.4 (<1)			2,538.5 (<1)	
Cryptophyta (cryptophytes)	68,540.1 (4)	37,779.1 (2)	28,558.4 (1)	15,231.1 (1)	40,743.3 (3)	109,679.1 (7)	5,847.5 (1)	2,168.4 (<1)	15,072.5 (1)	14,279.2 (1)	13,897.8 (1)	4,002.6 (<1)	69,822.5 (7)	102,732.4 (10)	71,078.7 (4)	30,462.3 (3)
Xanthophyta (xanthophytes)																
Chrysophyceae (yellow-brown algae and silicoflagellates)					4,188.6 (<1)	3,807.8 (<1)	2,192.8 (<1)	1,072.0 (<1)	2,379.9 (<1)	1,586.6 (<1)			3,557.9 (<1)	1,334.2 (<1)		3,807.8 (<1)
Haptophyceae (haptophytes including coccolithophores)				7,615.6 (<1)	4,188.6 (<1)				2,379.9 (<1)							3,807.S (<1)
Prasinophyceae (prasinophytes)	28,558.3 (2)	56,444.8 (4)	102,810.7 (5)	7,615.6 (<1)	8,377.2 (<1)	18,964.3 (1)	19,004.2 (2)	28,823.0 (3)	15,865.8 (1)	15,865.8 (1)	52,811.5 (4)	20,012.8 (2)	14,676.0 (1)	14,676.0 (1)	17,769.7 (1)	11,423.3 (1)
Unidentified phytoflagellates	976,696.3 (57)	968,670.1 (61)	1,507,882.1 (69)	1,538,344.3 (72)	753,560.3 (55)	628,433.5 (41)	578,895.5 (67)	688,047.6 (71)	613,211.8 (46)	810,740.5 (50)	351,891.9 (28)	401,590.3 (30)	213,470.0 (20)	304,194.7 (29)	1,185,489.8 (65)	274,160.4 (28)
Other	5,711.7 (<1)	7,615.6 (<1)	11,423.3 (1)		11,804.1 (<1)	3,807.8 (<1)	12,791.2 (2)	5,067.8 (1)	1,586.6 (<1)	3,173.1 (<1)	6,115.0 (<1)	1,334.2 (<1)	889.5 (<1)	1,334.2 (<1)	7,615.6 (<1)	7,615.6 (1)
Total phytoplankton	1,713,502.0	1,582,350.6	2,193,370.6	2,125,026.3	1,372,809.0	1,536,628.0	860,381.5	967,992.6	1,326,078.2	1,613,433.2	1,269,858.0	1,359,605.8	1,061,776.6	1,068,289.6	1,836,185.5	989,564.3

[a] Values are expressed as cells per liter and represent the mean of three replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface; B = Bottom.

TABLE D-6

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION[b]
ST. LUCIE PLANT
11 AUGUST 1976

Taxon	Station and depth[c] 11 S	11 B	12 S	12 B	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
Bacillariophyta (diatoms)	1,749,122.3 (30)	1,725,251.1 (42)	1,105,124.0 (32)	1,280,532.0 (37)	329,460.2 (39)	463,901.2 (42)	606,252.7 (32)	717,894.4 (56)	152,539.3 (20)	320,300.6 (19)	123,588.4 (19)	155,089.9 (18)	105,348.9 (17)	168,771.2 (16)	401,042.1 (20)	514,546.7 (33)
Pyrrhophyta (dinoflagellates)	465,128.9 (8)	45,693.4 (1)	129,531.3 (4)	83,771.3 (2)	22,697.9 (3)	27,581.5 (3)	74,797.8 (4)	18,011.5 (1)	38,116.8 (5)	45,700.2 (3)	28,633.3 (4)	28,558.3 (3)	37,052.2 (6)	11,744.0 (1)	91,386.9 (4)	36,174.0 (2)
Chlorophyta (green algae)	74,251.8 (1)	45,693.4 (1)	30,462.3 (1)	68,540.1 (2)	84,053.8 (10)	131,639.8 (12)	192,123.0 (10)	64,040.9 (5)	30,462.2 (4)	57,878.3 (3)	45,693.3 (7)	28,558.4 (3)	71,868.2 (12)	67,243.0 (6)	154,215.2 (8)	53,309.0 (3)
Cyanophyta (blue-green algae)					25.0 (<1)	8.3 (<1)	16.7 (<1)	37.5 (<1)							25.0 (<1)	
Euglenophyta (euglenoids)	15,231.1 (<1)			7,615.6 (<1)			2,668.4 (<1)	2,001.3 (<1)								
Cryptophyta (cryptophytes)	586,398.6 (10)	106,617.9 (3)	167,542.5 (5)	106,617.9 (3)	45,362.4 (5)	71,156.6 (6)	186,786.2 (10)	100,064.0 (8)	27,923.7 (4)	198,004.7 (12)	19,990.9 (3)	19,990.8 (2)	37,713.0 (6)	140,890.2 (13)	39,981.7 (2)	41,885.6 (3)
Xanthophyta (xanthophytes)																
Chrysophyceae (yellow-brown algae and silicoflagellates)				7,615.6 (<1)	1,334.2 (<1)	1,778.9 (<1)		4,002.5 (<1)					2,134.7 (<1)	13,875.5 (1)		
Haptophyceae (haptophytes including coccolithophores)	15,231.1 (<1)	15,231.1 (<1)	15,231.1 (<1)	53,309.0 (2)					2,538.5 (<1)	12,184.9 (1)	2,855.8 (<1)	5,711.7 (1)			28,558.4 (1)	5,711.7 (<1)
Prasinophyceae (prasinophytes)	9,519.5 (<1)		60,924.6 (2)	22,846.7 (1)	22,681.2 (3)	16,010.2 (1)	133,418.7 (7)	8,005.1 (1)	7,615.6 (1)	18,277.3 (1)		17,135.0 (2)	11,385.0 (2)	22,414.3 (2)	17,135.0 (1)	
Unidentified phytoflagellates	2,842,510.1 (49)	2,162,820.8 (53)	1,934,353.8 (56)	1,789,658.1 (52)	328,210.1 (39)	391,806.3 (35)	717,792.7 (37)	376,240.8 (29)	515,320.0 (67)	1,011,347.2 (60)	436,943.1 (66)	608,293.3 (70)	315,223.9 (52)	629,736.4 (60)	1,313,685.1 (64)	923,387.4 (59)
Other				15,231.1 (<1)	5,336.8 (1)	6,226.2 (1)	8,005.1 (<1)	4,002.6 (<1)		12,184.9 (1)			25,260.6 (4)			
Total phytoplankton	5,757,393.4	4,101,307.7	3,443,169.6	3,435,737.4	839,161.6	1,110,109.0	1,921,861.2	1,294,300.6	774,516.1	1,675,878.1	657,704.8	863,337.9	605,986.5	1,054,674.6	2,046,029.4	1,575,014.4

[a] Values are expressed as cells per liter and represent the mean of three replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface; B = Bottom.

TABLE D-7

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION[b]
ST. LUCIE PLANT
14 SEPTEMBER 1976

Taxon	11 S	11 B	12 S	12 B	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
	Station and depth[c]															
Bacillariophyta (diatoms)	1,570,710.6 (51)	607,370.4 (63)	188,510.1 (9)	354,223.8 (20)	937,114.8 (62)	2,315,353.8 (75)	1,797,523.9 (56)	3,491,689.8 (70)	705,575.3 (45)	1,303,182.8 (64)	460,060.2 (33)	1,091,842.3 (46)	779,540.4 (43)	1,549,590.1 (65)	438,311.6 (33)	1,505,574.6 (57)
Pyrrhophyta (dinoflagellates)	14,841.8 (<1)	11,423.4 (1)	165,663.6 (8)	125,656.8 (7)	22,959.2 (2)	64,753.3 (2)	114,283.6 (4)	38,133.4 (1)	29,342.7 (2)	12,007.7 (1)	33,541.9 (2)	11,448.4 (<1)	32,045.5 (2)	10,706.7 (<1)	45,734.9 (3)	19,039.0 (1)
Chlorophyta (green algae)		13,327.2 (1)		11,423.3 (1)	5,711.7 (<1)	34,270.0 (1)	7,615.6 (<1)	38,077.8 (1)	56,017.9 (4)	68,043.5 (3)		28,558.4 (1)	101,398.2 (6)	117,408.4 (5)	7,615.6 (1)	9,519.5 (<1)
Cyanophyta (blue-green algae)					62.5 (<1)	75.0 (<1)	66.7 (<1)	333.3 (<1)	283.3 (<1)	250.0 (<1)	73.3 (<1)	400.0 (<1)	200.0 (<1)	400.0 (<1)	191.7 (<1)	41.7 (<1)
Euglenophyta (euglenoids)	42,837.6 (1)		5,711.7 (<1)	5,711.7 (<1)					2,667.5 (<1)							
Cryptophyta (cryptophytes)	314,142.1 (10)	19,038.9 (2)	342,700.5 (17)	382,682.2 (21)	79,963.5 (5)	78,059.6 (3)	152,311.3 (5)	114,233.5 (2)	136,043.5 (9)	116,074.3 (6)	57,878.3 (4)	74,251.7 (3)	122,745.2 (7)	112,071.7 (5)	64,732.3 (5)	47,597.3 (2)
Xanthophyta (xanthophytes)					12.5 (<1)											
Chrysophyceae (yellow-brown algae and silicoflagellates)								25,385.2 (1)	5,335.0 (<1)	4,002.6 (<1)	82,248.1 (6)	85,675.1 (4)	5,336.7 (<1)			
Haptophyceae (haptophytes including coccolithophores)	42,837.6 (1)	3,807.8 (<1)	5,711.7 (<1)	17,135.0 (1)			7,615.6 (<1)						13,341.9 (1)			
Prasinophyceae (prasinophytes)	14,279.2 (<1)	3,807.8 (<1)	182,773.6 (9)	137,080.1 (8)	11,423.3 (1)		99,002.4 (3)	12,692.6 (<1)	77,358.1 (5)	28,017.9 (1)	33,508.5 (2)		48,030.7 (3)	10,673.5 (<1)	60,924.5 (5)	9,519.5 (<1)
Unidentified phytoflagellates	1,056,659.8 (35)	297,007.1 (31)	1,096,641.6 (55)	765,364.4 (42)	451,222.4 (30)	582,590.9 (19)	1,043,332.6 (32)	1,269,261.1 (25)	544,174.1 (35)	516,330.5 (25)	725,001.9 (52)	1,062,371.5 (45)	688,440.6 (38)	565,695.4 (24)	696,824.3 (52)	1,018,582.0 (39)
Other		3,807.8 (<1)		5,711.7 (<1)	5,711.7 (<1)				13,337.6 (1)				13,341.8 (1)	26,683.7 (1)	15,231.1 (1)	9,519.5 (<1)
Total phytoplankton	3,056,308.7	959,590.4	1,987,712.8	1,804,989.0	1,514,181.7	3,075,102.6	3,221,751.7	4,989,806.7	1,570,135.0	2,047,909.3	1,392,312.2	2,354,547.4	1,804,421.0	2,393,229.5	1,329,566.0	2,619,393.1

[a] Values are expressed as cells per liter and represent the mean of three replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface; B = Bottom.

TABLE D-8

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION[b]
ST. LUCIE PLANT
15 OCTOBER 1976

Taxon	Station and depth[c] 11 S	11 B	12 S	12 B	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
Bacillariophyta (diatoms)	2,364,536.2 (51)	6,120,022.1 (62)	3,431,215.3 (53)	2,299,797.3 (53)	2,657,252.8 (64)	5,969,679.9 (70)	4,813,648.7 (62)	4,973,342.5 (59)	1,658,338.0 (40)	1,594,753.5 (52)	1,159,285.3 (38)	3,498,266.4 (60)	1,146,814.3 (41)	4,718,720.1 (64)	1,221,924.3 (43)	3,716,765.3 (57)
Pyrrhophyta (dinoflagellates)		45,693.4 (<1)	57,200.0 (1)		30,462.2 (1)	19,038.9 (<1)	53,534.2 (1)	26,683.7 (<1)	50,770.3 (1)	7,615.6 (<1)	72,096.2 (2)	133.3 (<1)	57,116.8 (2)	22,846.7 (<1)	91,386.9 (3)	45,693.4 (1)
Chlorophyta (green algae)	19,038.9 (<1)			38,077.8 (1)	15,231.1 (<1)	38,077.8 (<1)	13,341.9 (<1)	53,367.5 (1)	15,231.1 (<1)	15,231.1 (<1)	32,020.5 (1)			159,926.9 (2)		22,846.7 (<1)
Cyanophyta (blue-green algae)	250.0 (<1)	297,007.1 (3)	83.3 (<1)	83.3 (<1)		166.7 (<1)	666.7 (<1)	166.6 (<1)	555.5 (<1)	66.7 (<1)	575.0 (<1)	333.3 (<1)	312.5 (<1)	400.0 (<1)	10,365.6 (<1)	400.0 (<1)
Euglenophyta (euglenoids)											4,002.6 (<1)				7,615.6 (<1)	
Cryptophyta (cryptophytes)	437,895.1 (9)	228,467.0 (2)	285,583.7 (4)	228,467.0 (5)	76,155.7 (2)	152,311.3 (2)	400,256.1 (5)	466,965.5 (6)	360,470.1 (9)	198,004.8 (6)	280,179.3 (9)	245,490.4 (4)	276,064.3 (10)	251,313.7 (3)	182,773.6 (6)	182,773.6 (3)
Xanthophyta (xanthophytes)		22,846.7 (<1)			66.7 (<1)				66.7 (<1)		25.0 (<1)		104.2 (<1)		16.7 (<1)	200.0 (<1)
Chrysophyceae (yellow-brown algae and silicoflagellates)							26,683.7 (<1)	13,341.9 (<1)			12,007.7 (<1)	10,673.5 (<1)		22,846.7 (<1)		
Haptophyceae (haptophytes including coccolithophores)	38,077.8 (1)	91,386.8 (1)	95,194.6 (1)	19,038.9 (<1)	45,693.4 (1)	133,272.4 (2)			25,385.2 (1)	22,846.7 (1)			28,558.4 (1)	22,846.7 (<1)		114,233.5 (2)
Prasinophyceae (prasinophytes)	38,077.8 (1)	45,693.4 (<1)	57,116.7 (1)	114,233.5 (3)	60,924.5 (1)	76,155.6 (1)	66,709.3 (1)	106,735.0 (1)	319,853.8 (8)	53,309.0 (2)	104,066.6 (3)		152,311.3 (5)	91,386.8 (1)	205,620.3 (7)	22,846.7 (<1)
Unidentified phytoflagellates	1,770,619.1 (38)	2,970,070.8 (30)	2,551,214.7 (39)	1,675,424.5 (38)	1,233,721.7 (30)	1,865,813.7 (22)	2,441,562.6 (31)	2,641,690.7 (31)	1,634,808.1 (40)	1,134,719.3 (37)	1,348,863.3 (44)	1,857,188.6 (32)	1,123,296.0 (40)	1,941,969.4 (26)	1,127,103.8 (39)	2,033,356.2 (31)
Other		22,846.7 (<1)	38,077.8 (1)		15,231.1 (<1)	228,466.9 (3)		133,418.7 (2)	30,462.3 (1)	38,077.9 (1)	76,048.7 (2)	256,163.9 (4)	28,558.4 (1)	114,233.5 (2)	7,615.6 (<1)	342,700.5 (5)
Total phytoplankton	4,668,494.9	9,844,034.0	6,515,686.4	4,375,122.3	4,134,739.2	8,482,983.2	7,816,403.2	8,415,712.1	4,095,941.1	3,064,624.6	3,089,170.2	5,868,249.4	2,813,136.2	7,346,490.5	2,854,422.4	6,481,815.9

[a] Values are expressed as cells per liter and represent the mean of three replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface; B = Bottom.

TABLE D-9

PHYTOPLANKTON DENSITY[a] AND PERCENTAGE COMPOSITION [b]
ST. LUCIE PLANT
10 NOVEMBER 1976

Taxon	11 S	11 B	12 S	12 B	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
Bacillariophyta (diatoms)	765,123.4 (42)	3,451,626.9 (56)	1,192,428.3 (46)	2,630,161.9 (44)	2,816,598.1 (61)	4,724,764.2 (61)	1,563,075.6 (77)	2,977,970.9 (74)	1,509,339.0 (60)	2,103,505.1 (62)	415,473.8 (39)	622,821.3 (53)	1,115,806.3 (55)	1,018,354.8 (50)	715,055.5 (55)	1,427,357.9 (55)
Pyrrhophyta (dinoflagellates)	15,964.4 (1)	57,241.7 (1)	45,726.6 (2)	76,155.6 (1)	8,255.1 (<1)	53,450.8 (1)	23,013.5 (1)	69,040.2 (2)	20,162.9 (1)	26,716.8 (1)	11,556.6 (1)	30,706.6 (3)	45,793.4 (2)	45,693.4 (2)	19,088.9 (2)	19,205.7 (1)
Chlorophyta (green algae)	30,462.3 (2)	19,038.9 (<1)			16,010.2 (<1)	80,051.2 (1)	30,462.3 (2)	22,846.7 (1)	40,025.6 (2)	32,020.5 (1)	3,807.8 (<1)	15,231.1 (1)	7,615.6 (<1)			9,519.5 (<1)
Cyanophyta (blue-green algae)	66.7 (<1)	291.7 (<1)			3,650.0 (<1)	2,833.3 (<1)	433.3 (<1)	233.3 (<1)	3,925.0 (<1)	2,000.0 (<1)	1,816.7 (<1)	2,288.9 (<1)	9,816.6 (1)		6,633.3 (1)	2,333.4 (<1)
Euglenophyta (euglenoids)																
Cryptophyta (cryptophytes)	91,386.8 (5)	437,895.1 (7)	106,617.9 (4)	456,934.0 (8)	368,235.7 (8)	653,751.8 (9)	38,077.8 (2)	190,389.2 (5)	224,143.4 (9)	224,143.5 (7)	79,963.5 (7)	25,385.2 (2)	137,080.2 (7)	45,693.4 (2)	106,617.9 (8)	76,155.7 (3)
Xanthophyta (xanthophytes)												5,077.0 (<1)				
Chrysophyceae (yellow-brown algae and silicoflagellates)					16,010.3 (<1)		7,615.6 (<1)	15,231.1 (<1)	4,002.6 (<1)	10,673.4 (<1)	7,615.6 (1)					9,519.5 (<1)
Haptophyceae (haptophytes including coccolithophores)				38,077.8 (1)			7,615.6 (<1)	30,462.3 (1)		5,336.7 (<1)		5,077.0 (<1)	7,615.6 (<1)			
Prasinophyceae (prasinophytes)		209,428.1 (3)		133,272.4 (2)	64,041.0 (1)	53,367.5 (1)	53,309.0 (3)	106,617.9 (3)	52,033.3 (2)	42,694.0 (1)	68,540.1 (6)	20,308.2 (2)	30,462.3 (2)	45,693.4 (2)	15,231.1 (1)	19,038.9 (1)
Unidentified phytoflagellates	913,867.9 (50)	1,903,891.6 (31)	1,233,721.7 (48)	2,703,526.0 (45)	1,256,804.3 (27)	2,001,280.8 (26)	312,238.2 (15)	586,398.6 (15)	644,412.4 (25)	885,900.3 (26)	475,972.9 (44)	441,702.8 (38)	670,169.9 (33)	891,021.3 (44)	418,856.2 (32)	1,037,620.9 (40)
Others		76,155.6 (1)			48,030.7 (1)	160,102.5 (2)	7,615.6 (<1)	15,231.1 (<1)	36,023.1 (1)	80,051.2 (2)	15,231.1 (1)	5,077.0 (<1)	7,615.6 (<1)		11,423.3 (1)	
Total phytoplankton	1,816,871.5	6,155,569.6	2,578,494.5	6,038,127.7	4,597,635.5	7,729,602.0	2,043,456.5	4,014,421.3	2,534,066.7	3,413,041.5	1,079,978.1	1,173,675.1	2,031,975.5	2,046,456.3	1,292,906.2	2,600,751.5

[a] Values are expressed as cells per liter and represent the mean of three replicates.

[b] Percentage values are given in parentheses.

[c] S = Surface; B = Bottom.

TABLE D-10

ANALYSIS OF VARIANCE FOR PHYTOPLANKTON DENSITY
ST. LUCIE PLANT
MARCH-OCTOBER 1976

INTAKE-DISCHARGE STATIONS					
Depth	Source	Degrees of freedom	Sum of squares	Mean square	F
Surface	Stations	1	$.8615321 \times 10^{11}$	$.8615321 \times 10^{11}$	0.091
	Months	7	$.3495500 \times 10^{14}$	$.4993571 \times 10^{13}$	5.267**
	Error	7	$.6636227 \times 10^{13}$	$.9480324 \times 10^{12}$	
	Total	15	$.4167738 \times 10^{14}$		
Bottom	Stations	1	$.1050566 \times 10^{13}$	$.1050566 \times 10^{13}$	0.449
	Months	7	$.5364225 \times 10^{14}$	$.7663179 \times 10^{13}$	3.279
	Error	7	$.1636155 \times 10^{14}$	$.2337365 \times 10^{13}$	
	Total	15	$.7105437 \times 10^{14}$		

OFFSHORE STATIONS					
Depth	Source	Degrees of freedom	Sum of squares	Mean square	F
Surface	Stations	5	$.8162714 \times 10^{13}$	$.1632543 \times 10^{13}$	1.697
	Months	7	$.4964351 \times 10^{14}$	$.6806216 \times 10^{13}$	7.374**
	Error	35	$.3366269 \times 10^{14}$	$.9617910 \times 10^{12}$	
	Total	47	$.9146891 \times 10^{14}$		
Bottom	Stations	5	$.8534055 \times 10^{13}$	$.1706811 \times 10^{13}$	0.995
	Months	7	$.1487050 \times 10^{15}$	$.2124357 \times 10^{14}$	12.386**
	Error	35	$.6002755 \times 10^{14}$	$.1715073 \times 10^{13}$	
	Total	47	$.2172666 \times 10^{15}$		

** Significant at $\alpha = .01$.

TABLE D-11

DIFFERENCES BETWEEN MONTHLY MEAN PHYTOPLANKTON DENSITY (TUKEY'S TEST)
OFFSHORE STATIONS
ST. LUCIE PLANT
MARCH-OCTOBER 1976

Surface stations							
Month (Mean)	APR (1304354.5)	MAY (650657.1)	JUN (1411525.7)	JUL (1287848.1)	AUG (1140876.6)	SEP (1805394.6)	OCT (4133968.7)
MAR (2446645.5)	1,142,291.0	1,795,988.4	1,035,119.8	1,158,797.4	1,305,768.9	641,250.9	1,687,323.2
APR (1304354.5)		653,697.4	107,171.2	16,506.4	163,477.9	501,040.1	2,829,614.2**
MAY (650657.1)			760,868.6	637,191.0	490,219.5	1,154,737.5	3,483,311.6**
JUN (1411525.7)				123,677.6	270,649.1	393,868.9	2,722,443.0**
JUL (1287848.1)					146,971.5	517,546.5	2,846,120.6**
AUG (1140876.6)						664,518.0	2,993,092.1**
SEP (1805394.6)							2,328,574.1**

** Significant at $\alpha = .01$, HSD = 2.15×10^6.

Bottom stations							
Month (Mean)	APR (2745138.9)	MAY (656154.2)	JUN (1979909.7)	JUL (1255918.9)	AUG (1262219.1)	SEP (2913331.4)	OCT (6609979.3)
MAR (3509908.9)	764,770.0	2,853,754.7*	1,529,999.2	2,253,990.0	2,247,689.8	596,577.5	2,560,070.4*
APR (2745138.9)		2,088,984.7	765,229.2	1,489,220.0	1,482,919.8	168,192.5	3,324,840.4**
MAY (656154.2)			1,323,755.5	599,764.7	606,064.9	2,257,177.2	5,413,825.1**
JUN (1979909.7)				723,990.8	717,690.6	933,421.7	4,090,069.6**
JUL (1255918.9)					6,300.2	1,657,412.5	4,814,060.4**
AUG (1262219.1)						1,651,112.3	4,807,760.2**
SEP (2913331.1)							3,156,648.2**

* Significant at $\alpha = .05$, HSD = 2.438×10^6.
** Significant at $\alpha = .01$, HSD = 2.925×10^6.

TABLE D-12

COMPARISON OF INTAKE (STATION 11) AND DISCHARGE (STATION 12) SURFACE PHYTOPLANKTON
ST. LUCIE PLANT
MARCH-OCTOBER 1976

Date	Temperature (°C) Intake	Temperature (°C) Discharge	ΔT (°C)	Intake (cells/liter)	Discharge (cells/liter)	Changes in cell count[a] (%)
26 MAR	22.0	22.2	+0.2	3,681,974.4	2,395,632.5	-34.9
21 APR	24.9	26.1	+1.2	1,741,104.0	1,296,541.6	-25.5
12 MAY	25.0	28.3	+3.3	542,375.7	1,072,706.3	+97.7
8 JUN	26.5	35.3	+8.8	2,243,521.4	3,325,780.0	+48.2
14 JUL	25.0	26.0	+1.0	1,713,502.0	2,193,370.6	+28.0
11 AUG	27.2	27.5	+0.3	5,757,393.4	3,443,169.6	-40.1
14 SEP	27.5	29.3	+1.8	3,056,308.7	1,987,712.8	-34.9
15 OCT	24.4	24.8	+0.4	4,668,494.9	6,515,686.4	+39.5

[a] Percentage change = $\frac{\text{discharge - intake}}{\text{intake}}$

TABLE D-13

COMPARISON OF INTAKE (STATION 11) AND DISCHARGE (STATION 12) BOTTOM PHYTOPLANKTON
ST. LUCIE PLANT
MARCH-OCTOBER 1976

Date	Temperature (°C)		ΔT (°C)	Intake (cells/liter)	Discharge (cells/liter)	Changes in cell count[a] (%)
	Intake	Discharge				
26 MAR	21.5	22.5	+1.0	3,083,719.6	3,781,610.8	+22.6
21 APR	24.2	25.5	+1.3	2,314.760.4	1,549,793.6	-33.0
12 MAY	24.8	28.5	+3.7	1,332,715.3	656,018.0	-50.7
8 JUN	26.3	35.4	+9.1	1,890,434.3	3,280,730.1	+73.5
14 JUL	23.0	25.5	+2.5	1,582,350.6	2,125,026.3	+34.2
11 AUG	26.9	27.0	+0.1	4,101,307.7	3,435,737.4	-16.2
14 SEP	28.3	29.0	+0.7	959,590.4	1,804,989.0	+88.0
15 OCT	24.5	24.8	+0.3	9,844,034.0	4,375,122.3	-55.5

[a] Percentage change = $\frac{\text{discharge - intake}}{\text{intake}}$

TABLE D-14

DIFFERENCES BETWEEN MONTHLY MEAN SURFACE PHYTOPLANKTON DENSITY (TUKEY'S TEST)
INTAKE AND DISCHARGE STATIONS
ST. LUCIE PLANT
MARCH-OCTOBER 1976

Month (Mean)	APR (1518822.8)	MAY (807541.0)	JUN (2784650.7)	JUL (1953436.3)	AUG (4600281.5)	SEP (2522010.8)	OCT (5592090.7)
MAR (3038803.5)	1,519,980.7	2,231,262.5	254,152.8	1,085,367.2	1,561,478.0	516,792.7	2,553,287.2
APR (1518822.8)		711,281.8	1,265,827.9	434,613.5	3,081,458.7	1,003,188.0	4,073,267.9
MAY (807541.0)			1,977,109.7	1,145,895.1	3,792,740.5	1,714,469.8	4,784,549.7*
JUN (2784650.7)				831,214.4	1,815,630.8	262,639.9	2,807,440.0
JUL (1953436.3)					2,646,845.2	568,574.5	3,638,654.4
AUG (4600281.5)						2,078,270.7	991,809.2
SEP (2522010.8)							3,070,079.9

* Significant at α = .05, HSD = 4.082×10^6.

TABLE D-15

SIMPLE CORRELATION COEFFICIENTS[a] FOR TEMPERATURE VS SELECTED PHYTOPLANKTON GROUPS
ST. LUCIE PLANT
MARCH-OCTOBER 1976

Group	26 MAR	21 APR	12 MAY	8 JUN	14 JUL	11 AUG	14 SEP	15 OCT
				SURFACE STATIONS				
Total phytoplankton	.53032	-.24861	.70740*	.30718	.57259	-.61058	-.45070	-.39598
Bacillariophyta	.49192	-.32829	.64262	.11799	.34531	-.61280	-.78715*	-.49155
Chlorophyta	.60913	-.09723	.21469	.66700	-.08263	.18990	-.18892	-.02436
Cryptophyta	b	b	b	b	-.12224	-.50294	.11499	.19388
Cyanophyta	b	b	b	b	b	b	b	.20467
Haptophyceae	b	b	-.63132	b	b	b	b	-.57328
Prasinophyceae	b	b	.35129	b	.85761**	.22269	.74945*	.72118*
Pyrrhophyta	.67414	.45933	.46121	.61466	.26742	-.56759	.61850	.62803
Unidentified phytoflagellates	.87127**	.69892	.64476	.62520	.35939	-.63968	.13205	-.31410
				BOTTOM STATIONS				
Total phytoplankton	.51239	-.61812	.15409	.04933	.77283*	-.27384	-.44523	-.27423
Bacillariophyta	.50181	-.63357	.16007	.07250	.20558	.00446	-.57209	-.22928
Chlorophyta	.54736	-.50832	-.35899	-.28664	.41878	.22712	.46502	.50344
Cryptophyta	b	b	b	b	-.23730	-.70921*	.53379	.23662
Cyanophyta	b	b	b	b	b	b	b	-.60833
Haptophyceae	b	b	-.69640	b	b	b	b	-.45315
Prasinophyceae	b	b	-.02301	b	-.39978	-.41950	.51223	-.07078
Pyrrhophyta	-.09561	.00487	.28959	-.33819	-.84614**	-.26912	.13864	-.25357
Unidentified phytoflagellates	.42792	.06380	.43534	.08332	.66670	-.42837	-.20520	-.40943

[a] n = 8.

[b] Group not sufficiently represented for analysis.

* Significant at $\alpha = .05$.

** Significant at $\alpha = .01$.

TABLE D-16

ACTIVE CHLOROPHYLL-a AND PHAEOPIGMENTS[a]
ST. LUCIE PLANT
1976

Date	Station	Pigment and Depth[b]					
		Chlorophyll-a (mg/m^3)			Phaeopigment (mg/m^3)		
		S	B	A	S	B	A
MAR 26	0	0.89	1.87	1.38	0.03	1.06	0.55
	1	2.00	1.14	1.57	0.01	0.14	0.08
	2	3.13	2.21	2.67	0.05	0.55	0.30
	3	3.10	2.29	2.70	0.12	0.53	0.33
	4	3.45[c]	2.46	2.96	0.14[c]	0.47	0.31
	5	2.37	6.81	4.59	0.14	3.41	1.78
	11	2.67	3.27	2.97	0.04	0.33	0.19
	12	1.43	2.49	1.96	0.05	0.59	0.32
APR 21	0	1.82	1.84	1.83	ND[d]	0.10	0.05
	1	1.72	2.28	2.00	ND	0.21	0.11
	2	1.48	2.42	1.95	ND	0.41	0.21
	3	0.95	1.59	1.27	ND	0.03	0.02
	4	1.29	2.59	1.94	ND	0.15	0.08
	5	0.84	2.28	1.56	ND	0.11	0.05
	11	1.07	2.17	1.62	0.03	ND	0.02
	12	1.44	1.41[c]	1.43	0.02	ND[c]	0.01

[a] Phaeopigment ≡ phaeophytin-a plus phaeophorbide-a.

[b] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

[c] Value represents single determination.

[d] ND = Not Detected.

TABLE D-16
(continued)
ACTIVE CHLOROPHYLL-a AND PHAEOPIGMENTS[a]
ST. LUCIE PLANT
1976

Date	Station	Chlorophyll-a (mg/m^3) S	Chlorophyll-a (mg/m^3) B	Chlorophyll-a (mg/m^3) A	Phaeopigment (mg/m^3) S	Phaeopigment (mg/m^3) B	Phaeopigment (mg/m^3) A
		Pigment and Depth[b]					
MAY 12	0	0.95	0.68	0.81	0.04	0.03	0.04
	1	0.83	0.60	0.72	0.03	0.02	0.03
	2	0.50	0.41	0.46	0.03	0.02	0.03
	3	0.52	0.49	0.51	0.03	ND[c]	0.02
	4	0.63	0.60	0.62	ND	0.05	0.03
	5	0.58	0.62	0.60	ND	0.02	0.01
	11	1.07	2.22	1.64	ND	0.02	0.01
	12	1.12	0.87	0.99	0.01	0.05	0.03
JUN 8	0	4.02	5.17	4.60	0.03	0.69	0.36
	1	3.79	3.58	3.69	0.71	0.27	0.49
	2	1.48	1.20	1.34	0.03	0.20	0.12
	3	0.79	0.94	0.87	0.02	0.16	0.09
	4	2.60	1.81	2.20	ND	0.12	0.06
	5	1.62	1.52	1.57	0.05	0.20	0.13
	11	2.65	4.29	3.47	0.19	0.22	0.20
	12	2.55	3.79	3.17	0.18	1.41	0.80

[a] Phaeopigment ≡ phaeophytin-a plus phaeophorbide-a.

[b] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

[c] ND = Not Detected.

TABLE D-16
(continued)
ACTIVE CHLOROPHYLL-α AND PHAEOPIGMENTS[a]
ST. LUCIE PLANT
1976

		Pigment and Depth[b]					
		Chlorophyll-α (mg/m^3)			Phaeopigment (mg/m^3)		
Date	Station	S	B	A	S	B	A
JUL 14	0	2.00	1.47	1.74	ND[c]	0.05	0.03
	1	0.83	0.72	0.78	ND	0.02	0.01
	2	2.42	2.19	2.30	ND	ND	ND
	3	1.71	1.57	1.64	ND	ND	ND
	4	1.62	1.67	1.65	ND	ND	ND
	5	1.12	2.43	1.78	ND	ND	ND
	11	1.74	1.02	1.38	ND	<0.005	<0.005
	12	0.81	1.49[d]	0.81	ND	ND[d]	ND
AUG 11	0	1.36	1.13	1.24	0.02	0.20	0.11
	1	2.36	2.26	2.31	0.05	0.08	0.06
	2	0.85	1.11	0.98	<0.005	0.02	0.01
	3	0.53	0.69	0.61	<0.005	<0.005	<0.005
	4	0.67	1.01	0.84	<0.005	0.08	0.04
	5	1.13	0.95	1.04	ND	0.23	0.12
	11	13.00	4.12	8.56	ND	0.26	0.13
	12	5.66	3.48	4.57	ND	ND	ND

[a] Phaeopigment ≡ phaeophytin-α plus phaeophorbide-α.

[b] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

[c] ND = Not Detected.

[d] Value represents single determination.

TABLE D-16
(continued)
ACTIVE CHLOROPHYLL-a AND PHAEOPIGMENTS[a]
ST. LUCIE PLANT
1976

		Pigment and Depth[b]					
		Chlorophyll-a (mg/m^3)			Phaeopigment (mg/m^3)		
Date	Station	S	B	A	S	B	A
SEP 14	0	2.72	3.92	3.32	0.10	0.93	0.52
	1	7.09	5.63	6.36	ND[c]	1.17	0.59
	2	3.16	2.86	3.01	ND	0.23	0.12
	3	2.31	2.92	2.61	ND	0.32	0.16
	4	2.95	2.44	2.69	0.04	0.55	0.30
	5	3.46	3.12	3.29	ND	0.25	0.13
	11	28.55	1.27	14.91	ND	0.24	0.12
	12	4.45	2.63	3.54	0.24	0.06	0.15
OCT 15	0	8.81	8.30	8.55	ND	0.73	0.37
	1	8.97	8.27	8.62	1.21	0.45	0.83
	2	7.30	3.95	5.62	ND	0.17	0.09
	3	3.63	6.30	4.97	0.19	1.72	0.96
	4	6.20	5.29	5.74	ND	0.72	0.36
	5	7.37	5.99	6.68	ND	1.30	0.65
	11	13.53	11.50	12.51	ND	ND	ND
	12	13.22	9.63	11.42	ND	ND	ND

[a] Phaeopigment ≡ phaeophytin-a plus phaeophorbide-a.

[b] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

[c] ND = Not Detected.

TABLE D-16
(continued)
ACTIVE CHLOROPHYLL-a AND PHAEOPIGMENTS[a]
ST. LUCIE PLANT
1976

Date	Station	Pigment and Depth[b] Chlorophyll-a (mg/m^3) S	B	A	Phaeopigment (mg/m^3) S	B	A
NOV 10	0	2.97	7.91	5.44	0.15	2.44	1.30
	1	3.88	3.93	3.91	0.39	0.53	0.46
	2	2.94	2.89	2.91	0.24	0.51	0.38
	3	1.63	2.31	1.97	0.22	0.40	0.31
	4	3.30	3.09	3.19	0.01	0.54	0.28
	5	2.27	2.92	2.60	0.03	0.63	0.33
	11	5.11	4.71	4.91	0.06	0.48	0.27
	12	6.21	5.69	5.95	0.13	0.21	0.17
DEC 13	0	1.26	1.15	1.20	0.17	0.24	0.21
	1	1.16	1.25	1.21	0.13	0.12	0.12
	2	0.77[c]	1.82	1.30	0.11[c]	0.51	0.32
	3	0.61	0.53	0.57	0.07	0.16	0.12
	4	0.70	0.60	0.65	0.14	0.14	0.14
	5	0.80	0.92	0.86	0.09	0.14	0.11
	11	1.83	2.92	2.37	0.17	0.69	0.43
	12	2.35	1.95	2.15	0.19	0.35	0.27

[a] Phaeopigment ≡ phaeophytin-a plus phaeophorbide-a.

[b] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

[c] Value represents single determination.

TABLE D-17

ANALYSIS OF VARIANCE FOR CHLOROPHYLLS
ST. LUCIE PLANT
MARCH-DECEMBER 1976

INTAKE-DISCHARGE STATIONS

Depth	Source	Degrees of freedom	Sum of squares	Mean square	F
Surface	Stations	1	0.5113602×10^{2}	0.5113602×10^{2}	1.716.
	Months	9	0.5698402×10^{3}	0.6331558×10^{2}	2.124
	Error	9	0.2682710×10^{3}	0.2980789×10^{2}	
	Total	19	0.8892472×10^{3}		
Bottom	Stations	1	0.0824180×10^{1}	0.0824180×10^{1}	1.564
	Months	9	0.1377439×10^{3}	0.1530488×10^{2}	29.034**
	Error	9	0.4744220×10^{1}	0.5271356×10^{0}	
	Total	19	0.1433123×10^{3}		

OFFSHORE STATIONS

Depth	Source	Degrees of freedom	Sum of squares	Mean square	F
Surface	Stations	5	0.1561806×10^{2}	0.3123612×10^{1}	3.474**
	Months	9	0.1910393×10^{3}	0.2122659×10^{2}	23.608**
	Error	45	0.4046084×10^{2}	0.8991298×10^{0}	
	Total	59	0.2471182×10^{3}		
Bottom	Stations	5	0.1542856×10^{2}	0.3085712×10^{1}	2.092
	Months	9	0.1561554×10^{3}	0.1735060×10^{2}	11.761**
	Error	45	0.6638944×10^{2}	0.1475321×10^{1}	
	Total	59	0.2379734×10^{3}		

**Significant at $\alpha = .01$.

TABLE D-18

DIFFERENCES BETWEEN MONTHLY MEAN SURFACE CHLOROPHYLL-a (TUKEY'S TEST)
INTAKE AND DISCHARGE STATIONS
ST. LUCIE PLANT
MARCH-DECEMBER 1976

Month (Mean)	APR (1.79)	MAY (1.55)	JUN (4.04)	JUL (1.26)	AUG (3.80)	SEP (1.95)	OCT (10.57)	NOV (5.20)	DEC (2.44)
MAR (2.88)	1.09	1.33	1.16	1.62	0.92	0.93	7.69**	2.32	0.44
APR (1.79)		0.24	2.25	0.53	2.01	0.16	8.78**	3.41*	0.65
MAY (1.55)			2.49	0.29	2.25	0.40	9.02**	3.65*	0.89
JUN (4.04)				2.78	0.24	2.09	6.53**	1.16	1.60
JUL (1.26)					2.54	0.69	9.31**	3.94**	1.18
AUG (3.80)						1.85	6.77**	1.40	1.36
SEP (1.95)							8.62**	3.25*	0.49
OCT (10.57)								5.37**	8.13**
NOV (5.20)									2.76

*Significant at α = .05, HSD = 2.95.

**Significant at α = .01, HSD = 3.85.

TABLE D-19

DIFFERENCES BETWEEN MEAN SURFACE STATION CHLOROPHYLL-a (TUKEY'S TEST)
OFFSHORE STATIONS
ST. LUCIE PLANT
1976

Station (Mean)	1 (3.26)	2 (2.40)	3 (1.58)	4 (2.34)	5 (2.16)
0 (2.68)	0.58	0.28	1.10	0.34	0.52
1 (3.26)		0.86	1.68**	0.92	1.10
2 (2.40)			0.82	0.06	0.24
3 (1.58)				0.76	0.58
4 (2.34)					0.18

**Significant at α = .01, HSD = 1.52.

TABLE D-20

DIFFERENCES BETWEEN MONTHLY MEAN CHLOROPHYLL-a (TUKEY'S TEST)
OFFSHORE STATIONS
ST. LUCIE PLANT
MARCH-DECEMBER 1976

	Surface stations								
Month (Mean)	APR (1.35)	MAY (0.67)	JUN (2.38)	JUL (1.62)	AUG (1.15)	SEP (3.62)	OCT (7.05)	NOV (2.83)	DEC (0.88)
MAR (2.49)	1.14	1.82	0.11	0.87	1.34	1.13	4.56**	0.34	1.61
APR (1.35)		0.68	1.03	0.27	0.20	2.27**	5.70**	1.48	0.47
MAY (0.67)			1.71	0.95	0.48	2.95**	6.38**	2.16**	0.21
JUN (2.38)				0.76	1.23	1.24	4.67**	0.45	1.50
JUL (1.62)					0.47	2.00*	5.43**	1.21	0.74
AUG (1.15)						2.47**	5.90**	1.68	0.27
SEP (3.62)							3.43**	0.79	2.74**
OCT (7.05)								4.22**	6.17**
NOV (2.83)									1.95*

* Significant at α = .05, HSD = 1.83.
** Significant at α = .01, HSD = 2.15.

	Bottom stations								
Month (Mean)	APR (2.17)	MAY (0.57)	JUN (2.37)	JUL (1.68)	AUG (1.19)	SEP (3.48)	OCT (6.35)	NOV (3.84)	DEC (1.05)
MAR (2.80)	0.63	2.23	0.43	1.12	1.61	0.68	3.55**	1.04	1.75
APR (2.17)		1.60	0.20	0.49	0.98	1.31	4.18**	1.67	1.12
MAY (0.57)			1.80	1.11	0.62	2.91**	5.78**	3.27**	0.48
JUN (2.37)				0.69	1.18	1.11	3.98**	1.47	1.32
JUL (1.68)					0.49	1.80	4.67**	2.16	0.63
AUG (1.19)						2.29	5.16**	2.65*	0.14
SEP (3.48)							2.87**	0.36	2.43*
OCT (6.35)								2.51*	5.30**
NOV (3.84)									2.79**

* Significant at α = .05, HSD = 2.34.
** Significant at α = .01, HSD = 2.76.

TABLE D-21

SIMPLE CORRELATION COEFFICIENTS[a] FOR TEMPERATURE
VS CHLOROPHYLL-α
ST. LUCIE PLANT
MARCH-DECEMBER 1976

Date	Surface	Bottom
26 MAR	.66649	.91283*
21 APR	-.29477	-.64310
12 MAY	-.29501	-.36375
8 JUN	-.69173	-.71518
14 JUL	.33433	.39674
11 AUG	.17399	.62465
14 SEP	-.34615	-.49841
15 OCT	-.80816	-.59063
10 NOV	-.80198	-.79566
13 DEC	-.64952	-.73388

[a] n = 6.

* Significant at $\alpha = .05$.

TABLE D-22

RESULTS OF TRICHROMATIC CHLOROPHYLL AND TOTAL CAROTENOID DETERMINATIONS
ST. LUCIE PLANT
1976

		Pigment and Depth[a]											
		Chlorophyll-*a* (mg/m3)			Chlorophyll-*b* (mg/m3)			Chlorophyll-*c* (mg/m3)			Carotenoids (m-SPU/m3)		
Date	Station	S	B	A	S	B	A	S	B	A	S	B	A
MAR 26	0	0.91	2.44	1.68	0.04	1.16	0.60	0.02	4.48	2.25	1.06	9.62	5.34
	1	2.05	1.24	1.65	0.01	0.13	0.07	0.93	0.59	0.76	2.03	1.41	1.72
	2	3.58	2.58	3.08	0.02	0.07	0.05	1.95	1.07	1.51	3.00	2.75	2.88
	3	3.23	2.64	2.94	ND[b]	0.26	0.13	1.08	1.75	1.42	3.32	3.63	3.48
	4	3.62[c]	2.79	3.21	ND[c]	0.08	0.04	1.61[c]	1.07	1.34	3.43[c]	1.97	2.70
	5	2.48	9.00	5.74	ND	0.08	0.04	0.52	3.69	2.11	2.38	10.96	6.67
	11	2.68	3.55	3.12	ND	ND	ND	1.05	1.06	1.06	2.43	2.73	2.58
	12	1.46	2.91	2.19	ND	ND	ND	0.12	0.48	0.30	1.19	2.66	1.93
APR 21	0	1.75	1.93	1.84	ND	0.13	0.07	0.67	1.06	0.87	1.78	2.61	2.20
	1	1.66	2.45	2.06	ND	0.08	0.04	0.60	1.09	0.85	1.66	2.86	2.26
	2	1.44	2.70	2.07	ND	0.15	0.08	0.54	1.04	0.80	1.47	2.89	2.18
	3	0.92	1.64	1.28	ND	0.06	0.03	0.36	0.70	0.53	0.94	2.07	1.51
	4	1.21	2.72	2.00	ND	0.06	0.03	0.53	1.24	0.89	1.26	3.19	2.23
	5	0.77	2.24	1.51	<0.005	0.01	0.01	0.35	0.92	0.64	0.96	2.65	1.81
	11	1.08	2.16	1.62	ND	ND	ND	0.34	0.79	0.57	1.21	2.11	1.66
	12	1.48	1.43[c]	1.46	<0.005	<0.005[c]	<0.005	0.55	0.50[c]	0.53	1.61	1.78[c]	1.70

[a] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

[b] ND = Not Detected.

[c] Value represents single determination.

TABLE D-22
(continued)
RESULTS OF TRICHROMATIC CHLOROPHYLL AND TOTAL CAROTENOID DETERMINATIONS
ST. LUCIE PLANT
1976

Date	Station	Chlorophyll-*a* ($^{mg}/_{m^3}$) S	Chlorophyll-*a* B	Chlorophyll-*a* A	Chlorophyll-*b* ($^{mg}/_{m^3}$) S	Chlorophyll-*b* B	Chlorophyll-*b* A	Chlorophyll-*c* ($^{mg}/_{m^3}$) S	Chlorophyll-*c* B	Chlorophyll-*c* A	Carotenoids ($\frac{m\text{-}SPU}{m^3}$) S	Carotenoids B	Carotenoids A
MAY 12	0	0.99	0.70	0.85	0.06	0.09	0.08	0.49	0.39	0.44	1.38	0.99	1.19
	1	0.86	0.62	0.74	0.04	0.06	0.05	0.37	0.31	0.34	1.24	0.97	1.11
	2	0.53	0.42	0.48	0.03	0.07	0.05	0.31	0.33	0.32	0.80	0.76	0.78
	3	0.55	0.53	0.54	0.02	0.05	0.04	0.24	0.24	0.24	0.87	0.85	0.86
	4	0.61	0.64	0.63	0.01	0.06	0.04	0.35	0.33	0.34	0.87	1.05	0.96
	5	0.58	0.64	0.61	0.01	0.05	0.03	0.25	0.27	0.26	0.98	1.02	1.00
	11	1.07	2.27	1.67	0.02	0.01	0.02	0.50	0.93	0.72	1.42	2.56	1.99
	12	1.14	0.92	1.03	0.06	0.04	0.05	0.45	0.37	0.41	1.71	1.27	1.49
JUN 8	0	4.04	5.67	4.86	ND[b]	0.34	0.17	1.70	2.41	2.06	3.75	5.96	4.86
	1	4.32	3.82	4.07	ND	ND	ND	1.52	1.75	1.64	4.58	3.88	4.23
	2	1.50	1.34	1.42	ND	ND	ND	0.61	0.63	0.62	1.70	1.61	1.66
	3	0.83	1.06	0.95	ND	0.01	0.01	0.32	0.52	0.42	1.05	1.47	1.26
	4	2.63	1.92	2.28	ND	0.01	0.01	1.07	0.90	0.99	2.63	2.23	2.43
	5	1.63	1.67	1.65	ND	0.02	0.01	0.59	0.75	0.67	1.91	2.15	2.03
	11	2.81	4.52	3.67	0.06	0.10	0.08	1.31	2.04	1.68	3.46	5.60	4.53
	12	2.72	4.61	3.67	<0.005	0.93	0.47	1.20	4.67	2.94	2.77	11.09	6.93

Pigment and Depth[a]

[a] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

[b] ND = Not Detected.

TABLE D-22
(continued)
RESULTS OF TRICHROMATIC CHLOROPHYLL AND TOTAL CAROTENOID DETERMINATIONS
ST. LUCIE PLANT
1976

		Pigment and Depth[a]											
		Chlorophyll-*a* ($^{mg}/_{m^3}$)			Chlorophyll-*b* ($^{mg}/_{m^3}$)			Chlorophyll-*c* ($^{mg}/_{m^3}$)			Carotenoids ($\frac{m\text{-}SPU}{m^3}$)		
Date	Station	S	B	A	S	B	A	S	B	A	S	B	A
JUL 14	0	2.01	1.52	1.77	0.09	0.13	0.11	1.05	0.81	0.93	2.50	1.64	2.07
	1	0.82	0.74	0.78	0.10	0.16	0.13	0.50	0.46	0.48	1.29	1.04	1.17
	2	2.39	2.19	2.29	0.06	0.16	0.11	1.31	1.12	1.22	2.84	2.33	2.59
	3	1.57	1.55	1.56	0.04	0.14	0.09	0.93	0.87	0.90	1.94	1.76	1.85
	4	1.63	1.60	1.62	0.07	0.15	0.11	0.90	0.88	0.89	1.98	1.79	1.89
	5	0.97	2.35	1.66	0.10	0.19	0.15	0.65	1.44	1.05	1.49	3.11	2.30
	11	1.65	1.00	1.33	0.11	0.36	0.24	0.84	1.11	0.98	2.25	2.37	2.31
	12	0.78	1.41[b]	1.10	0.06	0.25[b]	0.16	0.49	1.17[b]	0.83	1.64	2.35[b]	2.00
AUG 11	0	1.38	1.25	1.31	0.17	0.20	0.19	0.95	0.90	0.93	2.02	1.80	1.91
	1	2.35	2.32	2.33	0.18	0.29	0.24	1.40	1.34	1.37	3.07	2.83	2.95
	2	0.85	1.13	0.99	0.16	0.19	0.18	0.61	0.80	0.71	1.40	1.66	1.53
	3	0.51	0.68	0.60	0.11	0.15	0.13	0.45	0.52	0.49	0.87	1.17	1.02
	4	0.66	1.07	0.87	0.16	0.24	0.20	0.58	0.74	0.66	1.18	1.66	1.42
	5	1.11	1.09	1.10	0.22	0.21	0.22	0.95	0.88	0.92	1.88	1.74	1.81
	11	12.68	4.33	8.51	ND[c]	0.35	0.18	6.28	2.28	4.28	12.28	5.62	8.95
	12	5.47	3.50	4.49	0.05	0.28	0.17	2.68	2.09	2.39	5.70	4.38	5.04

[a] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

[b] Value represents single determination.

[c] ND = Not Detected.

TABLE D-22
(continued)
RESULTS OF TRICHROMATIC CHLOROPHYLL AND TOTAL CAROTENOID DETERMINATIONS
ST. LUCIE PLANT
1976

		Pigment and Depth[a]											
		Chlorophyll-*a* ($^{mg}/_{m^3}$)			Chlorophyll-*b* ($^{mg}/_{m^3}$)			Chlorophyll-*c* ($^{mg}/_{m^3}$)			Carotenoids ($\frac{m\text{-SPU}}{m^3}$)		
Date	Station	S	B	A	S	B	A	S	B	A	S	B	A
SEP 14	0	2.84	4.54	3.69	0.10	0.29	0.20	1.50	2.27	1.89	2.80	4.50	3.65
	1	7.16	6.42	6.79	0.19	0.35	0.27	3.15	2.99	3.07	7.12	6.54	6.83
	2	3.08	3.00	3.04	0.14	0.13	0.14	1.66	1.40	1.53	3.25	2.96	3.11
	3	2.32	3.16	2.74	0.15	0.21	0.18	1.29	1.69	1.49	2.50	2.92	2.71
	4	2.98	2.81	2.90	0.12	0.16	0.14	1.43	1.32	1.38	3.06	2.67	2.87
	5	3.28	3.31	3.30	0.20	0.20	0.20	1.46	1.74	1.60	3.82	3.32	3.57
	11	27.01	1.43	14.22	ND[b]	0.16	0.08	12.05	0.88	6.47	24.99	1.52	13.26
	12	4.47	2.67	3.57	0.48	0.37	0.43	1.84	1.02	1.43	4.74	2.91	3.83
OCT 18	0	8.63	8.88	8.76	ND	0.32	0.16	4.14	3.65	3.90	7.95	8.20	8.08
	1	9.86	8.70	9.28	0.07	0.25	0.16	4.49	3.87	4.18	10.10	8.02	9.06
	2	6.93	4.12	5.53	0.07	0.21	0.14	3.36	2.05	2.71	6.34	3.72	5.03
	3	3.78	7.43	5.61	0.44	0.52	0.48	3.00	3.47	3.24	4.22	8.12	6.17
	4	6.17	5.81	5.99	0.20	0.18	0.19	3.40	2.74	3.07	5.69	5.62	5.66
	5	7.11	6.87	6.99	0.08	0.36	0.22	3.40	3.30	3.35	6.46	6.87	6.67
	11	13.12	11.68	12.40	ND	ND	ND	6.47	5.49	5.98	11.82	10.87	11.35
	12	12.76	9.56	11.16	ND	ND	ND	5.84	4.57	5.21	10.79	8.46	9.63

[a] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.
[b] ND = Not Detected.

TABLE D-22
(continued)
RESULTS OF TRICHROMATIC CHLOROPHYLL AND TOTAL CAROTENOID DETERMINATIONS
ST. LUCIE PLANT
1976

		Pigment and Depth[a]											
		Chlorophyll-*a* (mg/m^3)			Chlorophyll-*b* (mg/m^3)			Chlorophyll-*c* (mg/m^3)			Carotenoids ($\frac{m\text{-}SPU}{m^3}$)		
Date	Station	S	B	A	S	B	A	S	B	A	S	B	A
NOV 10	0	3.10	9.50	6.30	0.11	0.53	0.32	1.51	3.95	2.73	3.03	9.85	6.44
	1	4.18	4.32	4.25	0.10	0.13	0.12	2.22	2.06	2.14	4.19	4.05	4.12
	2	3.13	3.24	3.19	0.10	0.14	0.12	1.65	1.69	1.67	3.07	3.28	3.18
	3	1.78	2.59	2.19	0.14	0.07	0.11	1.02	1.36	1.19	1.96	2.66	2.31
	4	3.36	3.46	3.41	0.10	0.25	0.18	1.62	1.92	1.77	3.11	3.51	3.11
	5	2.32	3.35	2.84	0.11	0.13	0.12	1.04	1.75	1.40	2.08	3.33	2.71
	11	5.18	5.08	5.13	0.13	0.12	0.13	2.19	2.51	2.35	4.82	4.85	4.84
	12	6.37	5.93	6.15	0.07	0.02	0.05	2.65	2.62	2.64	5.76	5.63	5.70
DEC 13	0	1.38	1.31	1.35	0.07	0.11	0.09	0.66	0.72	0.69	1.41	1.24	1.33
	1	1.26	1.35	1.30	0.05	0.07	0.06	0.58	0.68	0.63	1.23	1.30	1.26
	2	0.98	2.16	1.57	0.06	0.12	0.09	0.54	1.04	0.79	1.06	2.18	1.62
	3	0.66	0.63	0.64	0.06	0.06	0.06	0.40	0.38	0.39	0.72	0.68	0.70
	4	0.79	0.69	0.74	0.08	0.08	0.08	0.46	0.42	0.44	0.84	0.72	0.78
	5	0.86	1.02	0.94	0.07	0.08	0.07	0.50	0.49	0.49	0.86	1.06	0.96
	11	1.97	3.39	2.68	0.08	0.10	0.09	0.86	1.44	1.15	1.82	3.82	2.82
	12	2.51	2.20	2.35	0.10	0.11	0.11	1.12	0.96	1.04	2.37	2.21	2.29

[a] S = Surface; B = Bottom; A = Average. S and B values represent mean of duplicate determinations.

TABLE D-23

GROSS PRIMARY PRODUCTIVITY (P)[a], EXTINCTION COEFFICIENT PER METER (k) AND SURFACE RADIATION (g-cal/cm^2/day)
ST. LUCIE PLANT
MARCH-DECEMBER 1976

Date	Station and parameter												Surface radiation
	0		1		2		3		4		5		
	P	k	P	k	P	k	P	k	P	k	P	k	
26 MAR	0.17	0.61	0.23	0.53	0.21	0.99	0.14	1.50	b	b	0.65	0.55	448.43
21 APR	0.32	0.53	0.28	0.65	0.41	0.44	0.26	0.46	0.31	0.57	0.33	0.43	611.40
12 MAY	0.25	0.28	0.28	0.22	0.22	0.18	0.20	0.22	0.23	0.23	0.24	0.22	511.16
8 JUN	1.39	0.29	0.50	0.65	0.39	0.31	0.20	0.39	0.62	0.31	0.50	0.27	532.67
14 JUL	0.58	0.28	0.28	0.25	1.00	0.21	0.93	0.16	1.27	0.12	0.69	0.24	612.44
11 AUG	0.55	0.20	0.53	0.39	c	c	0.38	0.14	0.47	0.16	0.42	0.22	588.52
14 SEP	0.49	0.43	0.30	1.33	0.52	0.37	0.46	0.36	0.83	0.20	1.28	0.16	317.42
15 OCT	b	b	b	b	0.75	0.53	b	b	0.57	0.70	c	c	377.87

[a] P = g organic carbon produced/m^2/day.

[b] 0.0 transmittance reading on bottom.

[c] Data not available.

TABLE D-24

ANALYSIS OF VARIANCE FOR GROSS PRIMARY PRODUCTIVITY
OFFSHORE STATIONS
ST. LUCIE PLANT
APRIL-JULY AND SEPTEMBER 1976

Source	Degrees of freedom	Sum of squares	Mean squares	F
Stations	5	$.4083067 \times 10^{0}$	.0816613	0.963
Months	4	$.1303113 \times 10^{1}$	.3257783	3.841*
Error	20	$.1696127 \times 10^{1}$	.0848064	
Total	29	$.3407547 \times 10^{1}$		

* Significant at $\alpha = .05$.

TUKEY'S COMPARISON OF MONTHLY MEAN DIFFERENCES

Month (Mean)	MAY (0.24)	JUN (0.60)	JUL (0.79)	SEP (0.65)
APR (0.32)	0.08	0.28	0.47	0.33
MAY (0.24)		0.36	0.55*	0.41
JUN (0.60)			0.19	0.05
JUL (0.79)				0.14

* Significant at $\alpha = .05$, HSD = .503.

TABLE D-25

SIMPLE CORRELATION COEFFICIENTS[a] FOR TEMPERATURE
VS GROSS PRIMARY PRODUCTIVITY
ST. LUCIE PLANT
MARCH-OCTOBER 1976

Date	Surface	Bottom
26 MAR	.64191[b]	.86408
21 APR	-.08393	-.38674
12 MAY	.09692	-.15081
8 JUN	-.92457**	-.92385**
14 JUL	.58224	.65293
11 AUG	.22121[b]	.33883[b]
14 SEP	.20232	.26962
15 OCT	N.A.[c]	N.A.[c]

[a] n = 6.

[b] n = 5.

[c] Data not available; equipment failure.

** Significant at α = .01.

E. ZOOPLANKTON

INTRODUCTION

Zooplankton collectively refers to animals that are non-swimmers, poor swimmers, or free-floating organisms in a body of water. Zooplankters range in size from microscopic to macroscopic organisms variously distributed in the water column. Ecologically, zooplankton may be divided into two main groups: (1) holoplankters, which spend their entire life cycles in the water column, and (2) meroplankters, temporary members of the zooplankton that consist predominantly of larval forms associated with benthic adults.

The availability of soluble nutrients, which promote phytoplankton growth and reproduction, determines the abundance of phytoplankton as a basic food source for the subsequent grazing of zooplankton (Bainbridge, 1953; Davis, 1955). Zooplankters, in turn, are an important food source for many other forms of marine animals.

The purpose of this study was to assess the effects of power plant operation on the density and composition of the zooplankton population. Previous studies in the area include those on general conditions and the zooplankton population, along with studies on

specific zooplankters. Bjornberg (1971), Bsharah (1957), Clarke (1940), Davis (1950), and Reeve (1973) presented studies on zooplankton populations along with associated environmental conditions similar to those at St. Lucie. Reeve (1964) and Woodmansee (1958) studied seasonal patterns of the zooplankton. Studies on chaetognaths in the Florida Current, which passes a few miles east of St. Lucie, include those by Owre (1960), Pierce (1951), and Pierce and Wass (1962). The literature on copepods is extensive; some of the general studies include Grice (1960), Owre (1962), and Park (1970). Lewis (1954 and 1955) studied the occurrence, vertical distribution, and larval forms of euphausids. An additional study on euphausids was contributed by Moore (1952). The distribution of *Lucifer* has been studied by Bowman and McCain (1967). Chen and Bé (1964) studied the seasonal distribution of pteropods, while Chen and Hillman (1970) studied their value as indicators of water masses. Wormelle (1962) surveyed the distribution of pteropods in the Florida Current. Siphonophores of the Florida Current have been studied by Moore (1953).

MATERIALS AND METHODS

Zooplankton was collected monthly at six offshore stations, 0 through 5 (Figure E-1). All except Station 0 were potentially subjected to thermal addition. Stations located in the intake and discharge canals (11 and 12, respectively) were sampled to determine immediate entrainment effects.

Collections were made by horizontally towing a half-meter, 202-micron mesh plankton net. Towing speeds were 0.5 to 2 knots for intervals of 5 to 10 minutes. Duplicate samples, one for qualitative and quantitative analysis and one for biomass, were collected offshore from surface and bottom depths at each station. The water column ranged in depth from 7.1 to 11.2 meters. Surface samples were collected at sufficient depth (1 to 2 meters) to ensure continued submergence of the plankton net. A flowmeter positioned in the mouth of the net indicated the amount of water filtered. Weather conditions, tidal stage, and moon phase were recorded. Wind velocity (knots), current direction and velocity (cm/sec), air and water temperature (°C), salinity (°/₀₀), dissolved oxygen (ppm), and turbidity were measured at each collection.

When the collection of zooplankton was completed, the concentrated sample was washed into a pre-labeled polyethylene bottle and preserved with 5% buffered formalin. The samples were returned to the laboratory and allowed to settle a minimum of four days.

Each sample was then concentrated by vacuum pump to a minimum working volume, which depended on the density of detritus and plankters in the sample. The sample was further concentrated if necessary with a modified Pasteur pipette.

For qualitative and quantitative analysis, replicate one-ml aliquots were withdrawn with a Stempel pipette. Organisms were identified to the lowest practical taxon. Dissections and staining were used when necessary for identification. Keys used for taxonomic identification are included in Literature Cited.

Zooplankters per cubic meter were calculated by multiplying the count by appropriate dilution factors and dividing by the volume of water filtered in cubic meters. The volume of water filtered was calculated by:

$$V = \pi(r^2)l$$

where: V = volume of filtered water

r = radius of net at mouth

l = distance net is hauled.

Biomass of the zooplankton was determined by ash-free dry weight (EPA, 1973). Net samples were washed with several volumes of distilled water to remove any buffer, salt, or other dissolved solid contaminant in the sample. Samples were concentrated by sedimentation or centrifugation. The method chosen was based on the number of samples to be processed. With sedimentation the samples were settled after each washing. If samples were concentrated by centrifugation after washing, a centrifuge with a swing-out head was used.

Dried samples were weighed on an analytical balance. The samples were then ashed in a muffle furnace for one hour at 550°C. Samples were cooled, rewet with distilled water to reintroduce the waters of hydration, and dried to a constant weight at 105°C. Results of the ash-free weight determinations were expressed as milligrams of ash-free weight per unit volume of water.

Aliquots used as subsamples for identification and counts were retained along with the whole sample as vouchers. Vouchers were retained as part of a permanent collection which may be used in the future to verify counts and identifications. Results of analyses were coded along with physical parameters for computer analysis.

RESULTS AND DISCUSSION

Members of eleven phyla, including Protozoa, Coelenterata, Rotifera, Nematoda, Mollusca, Annelida (Polychaeta), Arthropoda (largely Crustacea), Bryozoa, Chaetognatha, Echinodermata, and Chordata, were identified during the March-November 1976 period of this study (Tables E-1 to E-9). Major contributors to the zooplankton population included copepods, which comprised 25 to 95% of the population; cirripedia (barnacle) nauplii, which accounted for 22 to 93%; cladocerans, which made up 23 to 63%; eggs, which comprised 20 to 62%; molluscs, which made up 23 to 57%; and decapods, which accounted for 20 to 55% (Tables E-1 to E-9).

Total zooplankters per cubic meter ranged from 31.0 to 20,206.3. Average densities for stations ranged from 1162.5 to 4588.2 (Table E-10 and Figure E-2).

In general, the zooplankton population at St. Lucie was neritic (nearshore) rather than oceanic (offshore) in character. Oceanic zooplankters such as siphonophores, euphausids, salps, chaetognaths such as *Sagitta bipunctata, S. lyra,* and *S. minima,* and the sergestid shrimp *Lucifer typus* were either absent or present in low concentrations. Neritic forms identified included the chaetognaths *S. friderici, S. helenae,* and *S. hispida*; the copepods *Calanopia americana, Labidocera aestiva,* and *Undinula vulgaris*; and the sergestid shrimp *Lucifer faxoni.* All the above-mentioned zooplankters are holoplanktonic. Other holoplanktonic groups identified in this study include pteropods such as *Clio* sp. and *Creseis acicula,* cladocerans, ostracods, mysids, cumaceans, isopods, hyperiid amphipods, and appendicularians such as *Oikopleura* sp.

Meroplanktonic forms are generally larval stages associated with the benthos. They were major contributors to the zooplankton population. Some of these meroplankters included hydromedusae, molluscan larvae, polychaete larvae, cirripedia (barnacle) nauplii, cypris larvae, decapod larvae, cyphonautes larvae, and echinoderm larvae. Forms generally considered benthic included nematodes, gammarid and caprellid amphipods, and harpacticoid copepods.

Physical parameters monitored during collections included temperature, salinity, and dissolved oxygen. Minimum temperatures, generally in November, ranged from 20.0° to 21.4°C. Maximum temperatures occurred in September and ranged from 27.8° to 29.2°C. The highest temperature (35.4°C) was recorded in the discharge canal in June (Table E-11). Salinities ranged from 30.0 to 36.1 ‰ and were generally lowest in June and highest in November (Table E-12). Dissolved oxygen values ranged from a low of 4.8 ppm in July to a high of 7.6 ppm in October (Table E-13).

The difference in temperature (ΔT) between the intake and discharge stations ranged from +0.2 to +9.0°C (Table E-14). Although fluctuations in temperature between intake and discharge were noted, no significant correlation between total zooplankton abundance and temperature was observed (Table E-15), and zooplankton abundance between these two stations was not significantly different (Table E-16).

Although no significant changes in the zooplankton abundance due to thermal addition were noted, some major physical damage to individual zooplankters was observed. Other studies (Benda and Gulvas, 1976; Cairns, 1976; Davies and Jensen, 1974 and 1975; Heinle, 1976; and Markowski, 1959) show that such damage may be caused by mechanical abrasion due to passage through the plant, exposure to

biocides, or physiological stresses (e.g., response to pressure changes). However, physical damage to the zooplankton was minimal and ranged from <1 to 4% of the total population in the intake canal and from 0 to 2% in the discharge canal (Table E-14). Generally, low percentages of damaged cladocerans, ostracods, copepods, and decapods were noted in collections from the intake and discharge canals (Tables E-17 to E-20). High percentages of damaged chaetognaths (100% in some instances; Table E-21) and of damaged appendicularians (up to 74%; Table E-22) were noted. However, these organisms are highly susceptible to net damage and damage by formalin preservation (Owre, 1960; Pierce, 1951). Thus, the percentages for the latter two groups do not necessarily indicate detrimental effect due to plant operation.

Zooplankton population density fluctuated between the intake and discharge canals. Percentage change from the intake canal into the discharge canal ranged from a 12% decrease to a 484% increase, with a mean 52% decrease (Table E-14).

The observed fluctuations in density between intake and discharge were probably a result of aggregations or patches of zooplankton. Different zooplankton patches were sampled because the lag-time in collection between the intake and discharge canals did not correspond to the time a parcel of water took to pass through the plant.

Patchiness is a recognized factor in sample design. To minimize its effects, attempts will be made to coordinate sampling times in the intake and discharge canals with travel time of a parcel of water through the power plant. Detailed information on this subject is provided by Cushing, 1962; Heinle, 1976; Laevastu, 1962; Wiebe, 1970; and Wiebe and Holland, 1968.

Analysis of variance indicated significant seasonal variation in total zooplankton abundance between months (Table E-16). Tukey's test for difference between means (Table E-23) indicated that zooplankton abundance was significantly greater in September (Figure E-6) than in all other months. Zooplankton densities in September ranged from 1536.6 to 20,206.3 zooplankters per cubic meter (Table E-7). In addition, zooplankton abundance was significantly greater in August than in May (Figures E-4 and E-5). The greater abundance in September was primarily due to copepods, which comprised 28 to 96% of the total zooplankton population. Cladocerans made up from <1 to 63% of the population, and decapods accounted for <1 to 31% of the population. Similar peaks in abundance in the fall (September and October) have been observed by Deevey and Brooks (1971) and Woodmansee (1958). The least productive month was May, when zooplankton densities ranged from 54.9 to 1339.2 zooplankters per cubic meter, with a mean of 442.7 (Figures E-8 and E-9).

Differences in zooplankton abundance from month to month are normal seasonal occurrences. These seasonal differences are thought to be caused by an interaction among the fluctuation of nutrients as they are alternately accumulated and depleted, the availability of these nutrients to promote phytoplankton growth and reproduction, the abundance of phytoplankton as a basic food source, and the subsequent grazing of zooplankton on the phytoplankton (Bainbridge, 1953; Davis, 1955). The seasonal fluctuations of the zooplankton population in this study closely parallel those of the phytoplankton.

Biomass values were generally highest at Stations 2 and 3. Stations 1, 4, and 5 had lower values, while 11, 12, and 0 had the lowest biomass (Figure E-10). Biomass ranged from 0.004×10^{-2} g/m^3 to 16.752×10^{-2} g/m^3 (Table E-24). The lowest mean biomass value, 0.43×10^{-2} g/m^3, was observed in June and the highest mean value, 2.4×10^{-2} g/m^3, in March. However, analysis of variance indicated no significant differences in biomass between stations or months (Table E-25).

In general, the bottom population was greater than the surface population as evidenced by the number of zooplankters per cubic meter and the amount of biomass (Tables E-1 to E-10 and E-24; Figures E-2 to E-10). An exception to this trend was a larger mean surface population at Stations 1 and 2 (Figure E-2). In addition, the mean

number of zooplankters at the control (Station 0) was less than that at all other stations, including both the intake and discharge (Figure E-2).

Certain other observations from this study also deserve mention, although in some instances there was no significant statistical correlation. The increases and decreases of the zooplankton population at the intake and discharge, discussed above, parallel pulses in the cirripedia (barnacle) nauplii population. These zooplankters show a high tolerance to chlorination procedures (Davies and Jensen, 1975). Also, in September at the intake, there was a notable pulse in the population due to an increase of calanoid copepods, probably *Acartia bermudensis*, which comprised 96% of the total zooplankton population (Table E-7, Figure E-8). Finally, in August at Station 3, there was a 75% reduction in the surface cladoceran population (Table E-17).

SUMMARY

Analysis of variance indicated no significant differences in zooplankton abundance between stations, and there was no significant correlation between total zooplankton abundance and temperature. Physical damage to zooplankton was not significantly different between the intake and discharge canals.

Analysis of variance indicated a significant seasonal variation in total zooplankton abundance between months. The population was significantly greater in September than in all other months. Differences in zooplankton abundance from month to month are normal seasonal occurrences. Analysis of variance indicated no significant differences in zooplankton biomass between stations or months.

LITERATURE CITED

Bainbridge, R. 1953. Studies on the interrelationships of zooplankton and phytoplankton. J. Mar. Biol. Ass. U.K. 32:385-447.

Barnes, R. D. 1974. Invertebrate zoology, 3rd ed. W. B. Saunders Company, Philadelphia, Pa. 870 pp.

Benda, R. S., and J. Gulvas. 1976. Effects of the Palisades Nuclear Power Plant on Lake Michigan. Pages 243-250 *in* G. W. Esch and R. W. McFarlane, eds. Thermal Ecology II. ERDA Symposium (CONF-750425), Augusta, Ga.

Björnberg, T. K. S. 1971. Distribution of plankton relative to the general circulation system in the area of the Caribbean Sea and adjacent regions. Pages 343-356 *in* Symposium on investigations and resources of the Caribbean Sea and adjacent regions. Unesco, Paris.

Boden, B. P. 1954. The Euphausiid Crustaceans of southern African waters. Trans. Roy. Soc. S. Africa 34(1):181-243.

Bowman, T. E., and J. C. McCain. 1967. Distribution of the planktonic shrimp, *Lucifer*, in the western North Atlantic. Bull. Mar. Sci. 17(3);660-671.

Bsharah, L. 1957. Plankton of the Florida Current V. Environmental conditions, standing crop, seasonal, and diurnal changes at a station forty miles east of Miami. Bull. Mar. Sci. Gulf and Caribbean 7(3):201-251.

Cairns, J., Jr. 1976. Heated waste-water effects on aquatic ecosystems. Pages 32-38 *in* G. W. Esch and R. W. McFarlane, eds. Thermal Ecology II. ERDA Symposium (CONF-750425), Augusta, Ga.

Chen, C., and A. W. H. Bé. 1964. Seasonal distributions of euthecosomatous pteropods in the surface waters of five stations in the western North Atlantic. Bull. Mar. Sci. Gulf and Caribbean 14(2):185-220.

Chen, C., and N. S. Hillman. 1970. Shell-bearing pteropods as indicators of water masses off Cape Hatteras, North Carolina. Bull. Mar. Sci. Gulf and Caribbean 20(2):350-367.

Clarke, G. L. 1940. Comparative richness of zooplankton in coastal and offshore areas of the Atlantic. Biol. Bull. 78(2):226-255.

Cushing, D. H. 1962. Patchiness. Pages 152-164 *in* J. H. Fraser and J. Corlett, eds. Rapports et Procès-Verbaux des Réunions. Cons. Perm. Intern. pour l'Explor. de la Mer.

Davis, C. C. 1950. Observations of plankton taken in marine waters of Florida in 1947 and 1948. Q. J. Fla. Acad. Sci. 12(2):67-103.

__________. 1955. The marine and fresh-water plankton. Michigan State University Press. 562 pp.

Davies, R. M., and L. D. Jensen. 1974. Pages 162-235 *in* Loren D. Jensen, ed. Environmental responses to thermal discharges from Marshall Steam Station, Lake Norman, North Carolina.

__________________________. 1975. Zooplankton entrainment at three mid-Atlantic power plants. J. Water Pollut. Control Fed. 47(8):2130-2142.

Deevey, G. B., and A. Brooks. 1971. The annual cycle in quantity and composition of the zooplankton of the Sargasso Sea off Bermuda. II. The surface to 2000 m. L. & O. 16(6):927-943.

Environmental Protection Agency. 1973. Biological field and laboratory methods for measuring the quality of surface waters and effluents. EPA-670/4-73-001. National Environmental Research Center, Cincinnati.

Fraser, J. H. 1947. Thaliacea-II. Family: Doliolidae. Fisches d'Identification du Zooplancton. Sheet No. 10.

Geiger, S. R. 1964. Echinodermata: Larvae. Classes: Ophiuroidea and Echinoidea (Plutei). Fisches d'Identification du Zooplancton. Sheet No. 105.

Gosnes, K. L. 1971. Guide to identification of marine and estuarine invertebrates. Wiley-Interscience, New York. 693 pp.

Grant, G. C. 1963. Investigations of inner continental shelf waters off lower Chesapeake Bay. Part IV. Descriptions of the chaetognatha and a key to their identification. Chesapeake Science 4(3):107-119.

Grice, G. D. 1960. Calanoid and cyclopoid copepods collected from the Florida Gulf Coast and Florida Keys in 1954 and 1955. Bull. Mar. Sci. Gulf and Caribbean 10(2):217-226.

Gurney, R. 1927. Report on the larvae of the Crustacea Decapoda. Trans. Zool. Soc. Part 2, pp. 231-286.

LITERATURE CITED (continued)

Heinle, D. R. 1976. Effects of passage through power plant cooling systems on estuarine copepods. Environ. Pollut. 11:39-58.

Hyman, L. H. 1959. The invertebrates: smaller coelomate groups. Vol. 5. McGraw-Hill, New York. pp. 47-63.

Kaestner, A. (Transl. by H. W. Levi and R. L. Levi). 1970. Invertebrate zoology, Vol. III. Interscience Publishers, New York. 523 pp.

Laevastu, T. 1962. The adequacy of plankton sampling. Pages 66-73 *in* J. H. Fraser and J. Corlett, eds. Rapports et Procès-Verbaux des Réunions. Cons. Perm. Intern. pour l'Explor. de la Mer.

Lewis, J. B. 1954. The occurrence and vertical distribution of the euphausiacea of the Florida Current. Bull. Mar. Sci. Gulf and Caribbean 4(4):265-301.

__________. 1955. Some larvae euphausids of the genus, *Stylocheiron* from the Florida Current. Bull. Mar. Sci. Gulf and Caribbean 5(3):190-202.

Markowski, S. 1959. The cooling water of power stations: a new factor in the environment of marine and freshwater invertebrates. J. Anim. Ecol. 28(2):243-258.

Meglitsch, P. A. 1972. Invertebrate zoology, 2nd ed. Oxford University Press, New York. 834 pp.

Miner, R. W. 1950. Field book of seashore life. G. P. Putnam's Sons, New York. 888 pp.

Moore, H. B. 1952. Physical factors affecting the distribution of euphausids in the North Atlantic. Bull. Mar. Sci. Gulf and Caribbean 1(4):278-305.

__________. 1953. Plankton of the Florida Current. II. Siphonophora. Bull. Mar. Sci. Gulf and Caribbean 2(4):559-573.

Newell, G. E., and R. C. Newell. 1963. Marine plankton, a practical guide. Hutchinson Educational, London. 221 pp.

Owre, H. B., and M. Foyo. 1967. Copepods of the Florida Current, Fauna Caribaea, No. 1, Crustacea, Part 1: Copepoda. Institute of Marine Science, University of Miami, Miami. 137 pp.

LITERATURE CITED (continued)

Owre, H. B. 1960. Plankton of the Florida Current. Part VI. The Chaetognatha. Bull. Mar. Sci. Gulf and Caribbean 10(3):255-322.

________. 1962. Plankton of the Florida Current. Part VIII. A list of the copepoda. Bull. Mar. Sci. Gulf and Caribbean 12(3):489-495.

Park, T. S. 1970. Calanoid copepods from the Caribbean Sea and Gulf of Mexico. 2. New species and new records from plankton samples. Bull. Mar. Sci. 20(2):472-546.

Pike, R. B., and D. I. Williamson. 1959. Crustacea. Decapoda: larvae. XI. Paguridea, Coenobitidea, Dromiidea, and Homolidea. Revised ed. Fisches d'Identification du Zooplancton. Sheet 81.

Pierce, E. L. 1951. The chaetognatha of the west coast of Florida. Biol. Bull. 100(3):206-228.

Pierce, E. L., and M. L. Wass. 1962. Chaetognatha from the Florida Current and coastal water of the southeastern Atlantic States. Bull. Mar. Sci. Gulf and Caribbean 12(3):403-431.

Reeve, M. R. 1964. Studies on the seasonal variation of the zooplankton in a marine sub-tropical in-shore environment. Bull. Mar. Sci. Gulf and Caribbean 14(1):103-122.

________. 1973. The ecological significance of the zooplankton in the shallow subtropical waters of south Florida. Second International Conference on Advances in Estuarine Research. 34 pp.

Roberts, M. H., Jr. 1975. Larval development of *Pinnotheres chamae* reared in the laboratory. Chesapeake Sci. 16(4):242-252.

Ryland, J. S. 1965. Polyzoa (Bryozoa). Order Cheilostomata, Cyphonautes larvae. Fisches d'Identification du Zooplancton. Sheet No. 107.

Tokioka, T. 1955. Notes on some chaetognaths from the Gulf of Mexico. Bull. Mar. Sci. Gulf and Caribbean 5(1):52-65.

Tregouboff, G., and M. Rose. 1957. Manuel de Planctonologie Méditerraniénne, Tome I-Texte, Tome II-Illustrations. Centre National De La Recherche Scientifique, Paris. 794 pp.

LITERATURE CITED (continued)

Wiebe, P. H., and W. R. Holland. 1968. Plankton patchiness: effects on repeated net tows. L. & O. 13(2):315-321.

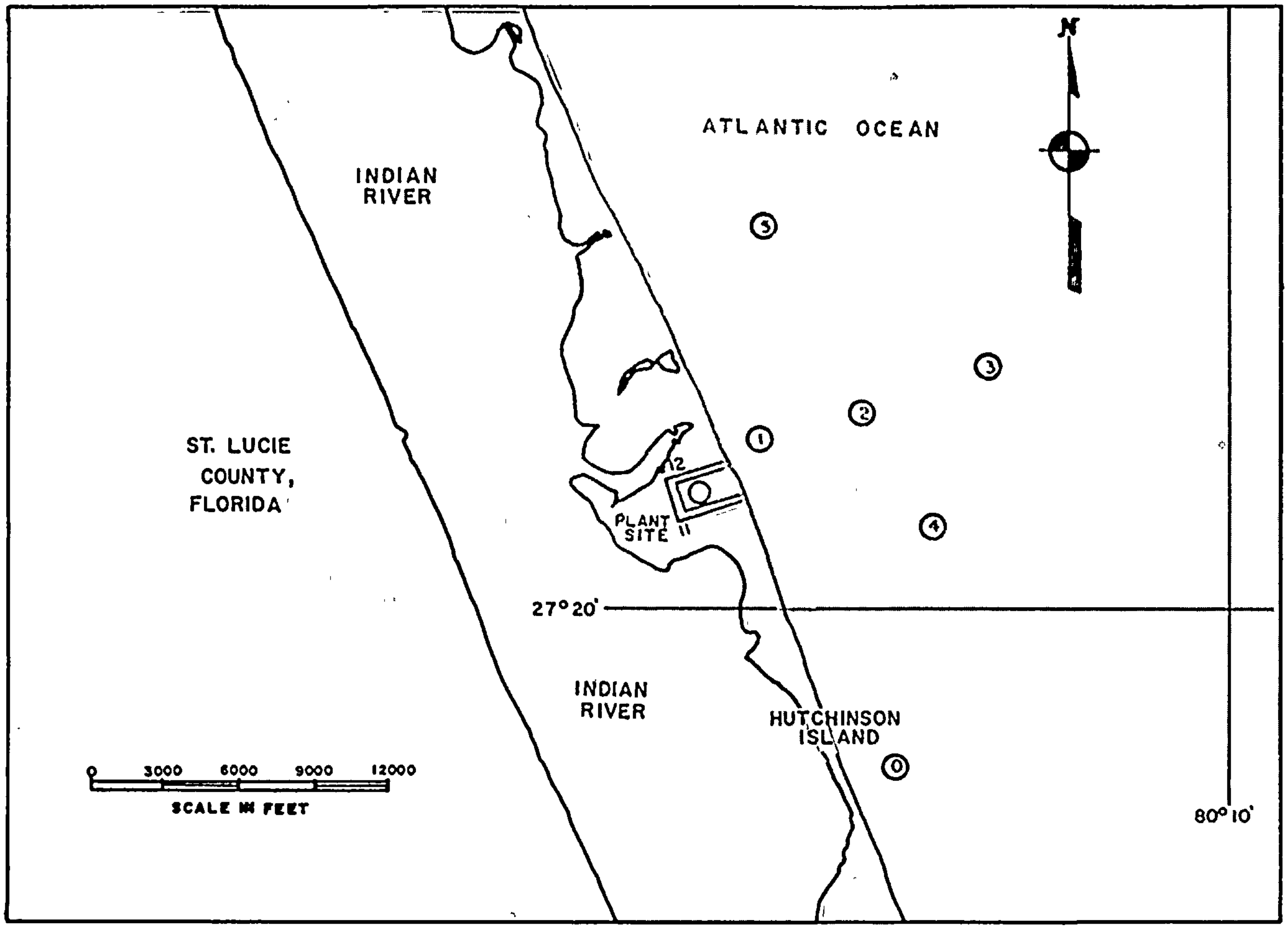
Wiebe, P. H. 1970. Small-scale spatial distribution in oceanic zooplankton. L. & O. 15(2):205-217.

Williamson, D. I. 1960. Crustacea. Decapoda: larvae. VII. Caridea, Family Crangonidae. Stenopodidea. Fisches d'Identification du Zooplancton. Sheet 90.

______________. 1967. Crustacea. Decapoda: larvae. IV. Caridea, Families: Pandalidae and Alpheidae. Fisches d'Identification du Zooplancton. Sheet 109.

Woodmansee, R. A. 1958. The seasonal distribution of the zooplankton off Chicken Key in Biscayne Bay, Florida. Ecology 39(2):247-262.

Wormelle, R. L. 1962. A survey of the standing crop of plankton of the Florida Current. VI. A study of the distribution of the pteropods of the Florida Current. Bull. Mar. Sci. Gulf and Caribbean 12(1):95-136.



FLORIDA POWER & LIGHT COMPANY ST. LUCIE PLANT
LOCATIONS OF ZOOPLANKTON SAMPLING STATIONS 1976
MARCH 1977 APPLIED BIOLOGY, INC. FIGURE E-1

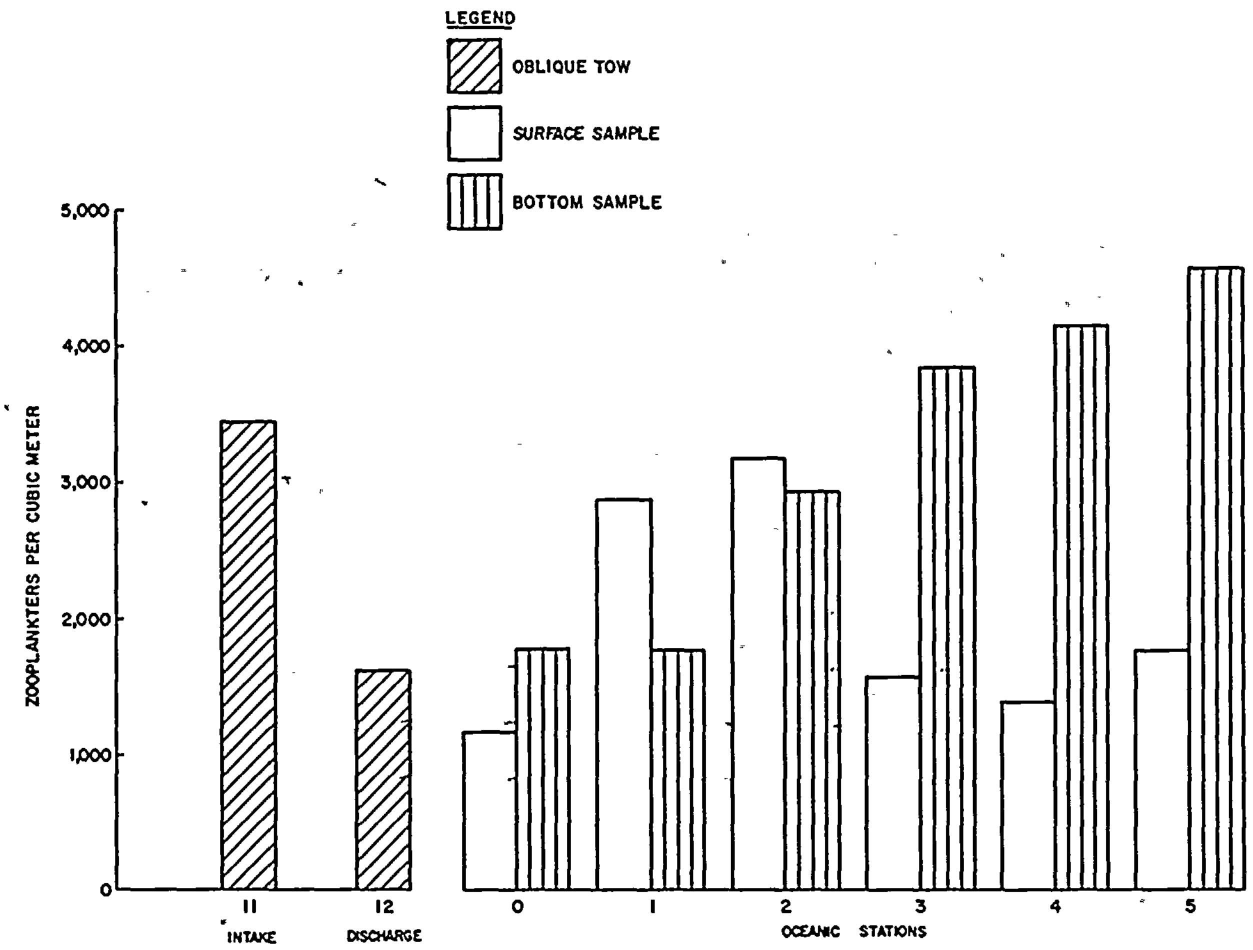


Figure E-2. Mean zooplankters per cubic meter by station at the St. Lucie Plant, March-November 1976.

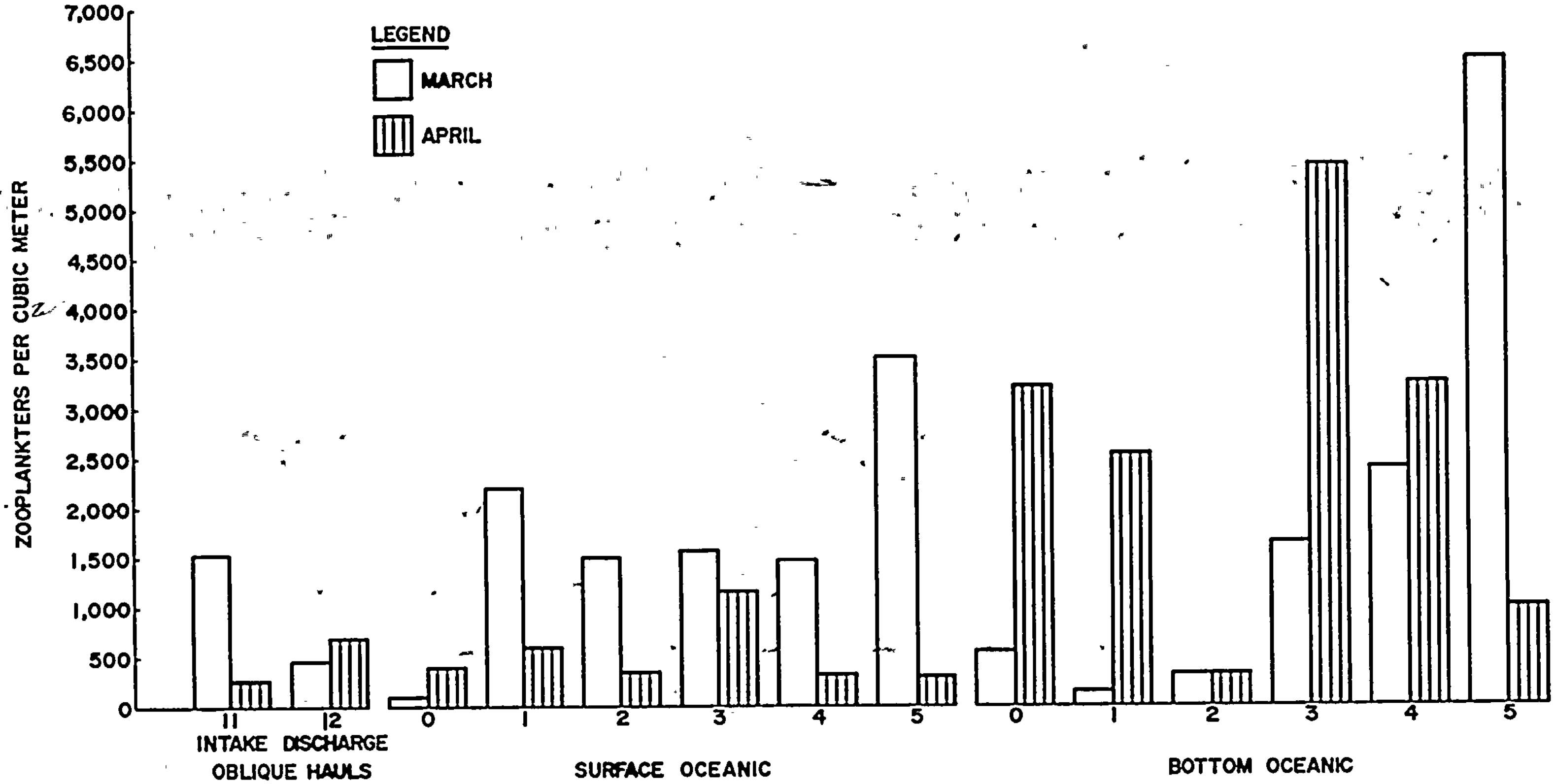


Figure E-3. Total zooplankters per cubic meter by station and date at the St. Lucie Plant, March and April 1976.

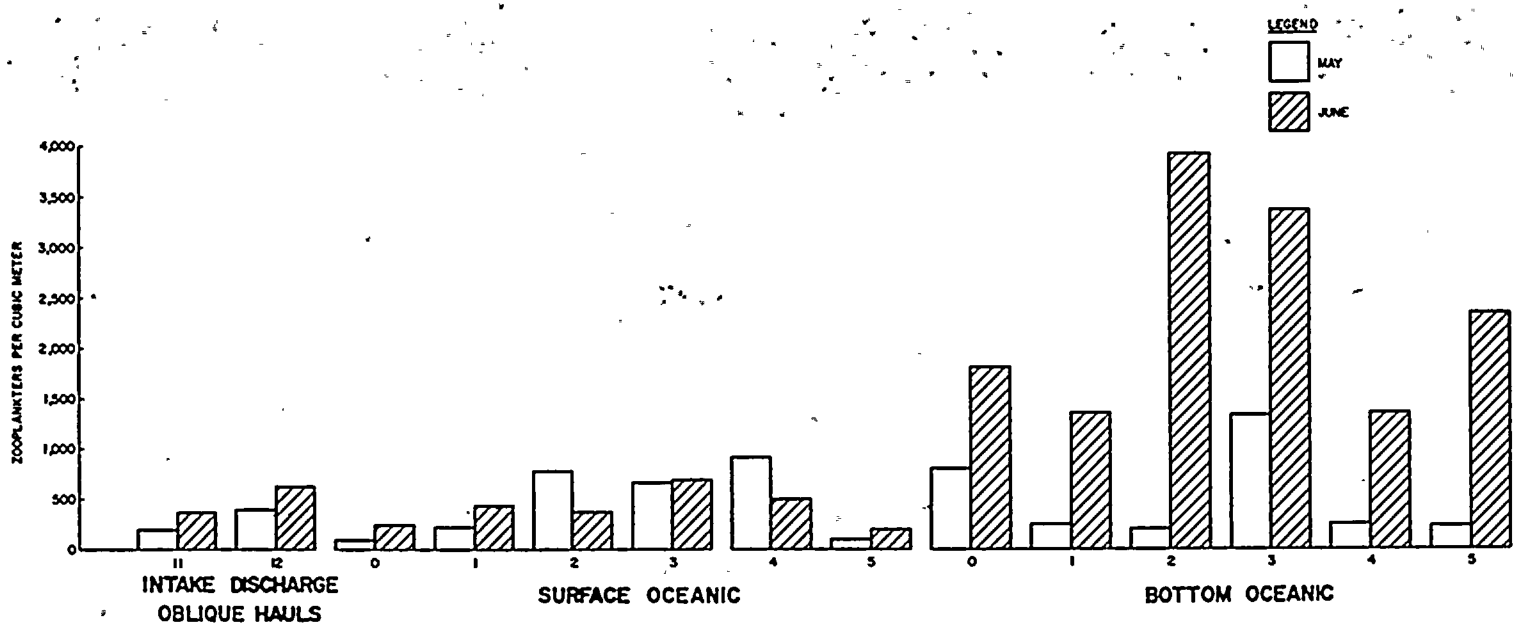


Figure E-4. Total zooplankters per cubic meter by station and date at the St. Lucie Plant, May and June 1976.

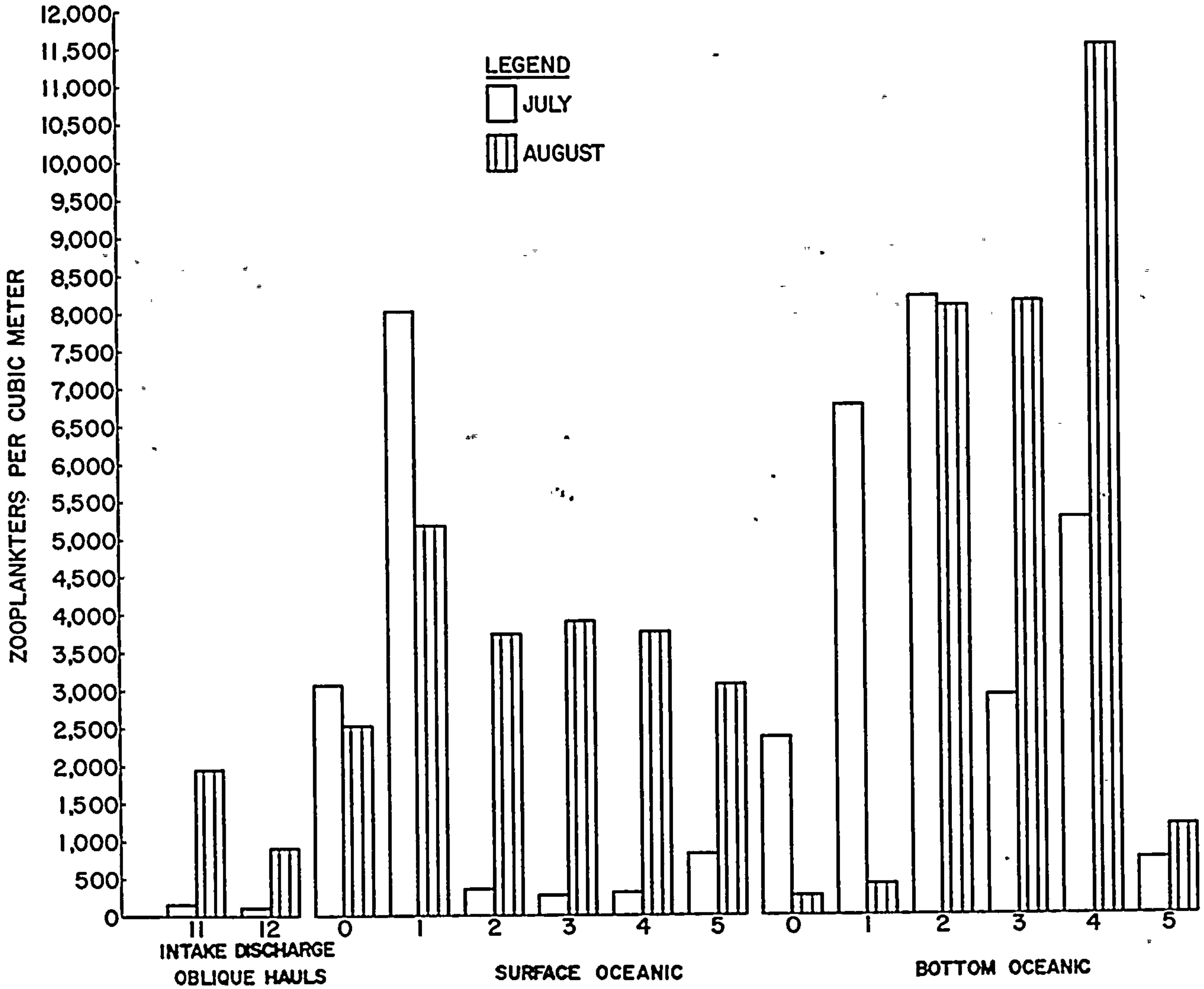


Figure E-5. Total zooplankters per cubic meter by station and date at the St. Lucie Plant, July and August 1976.

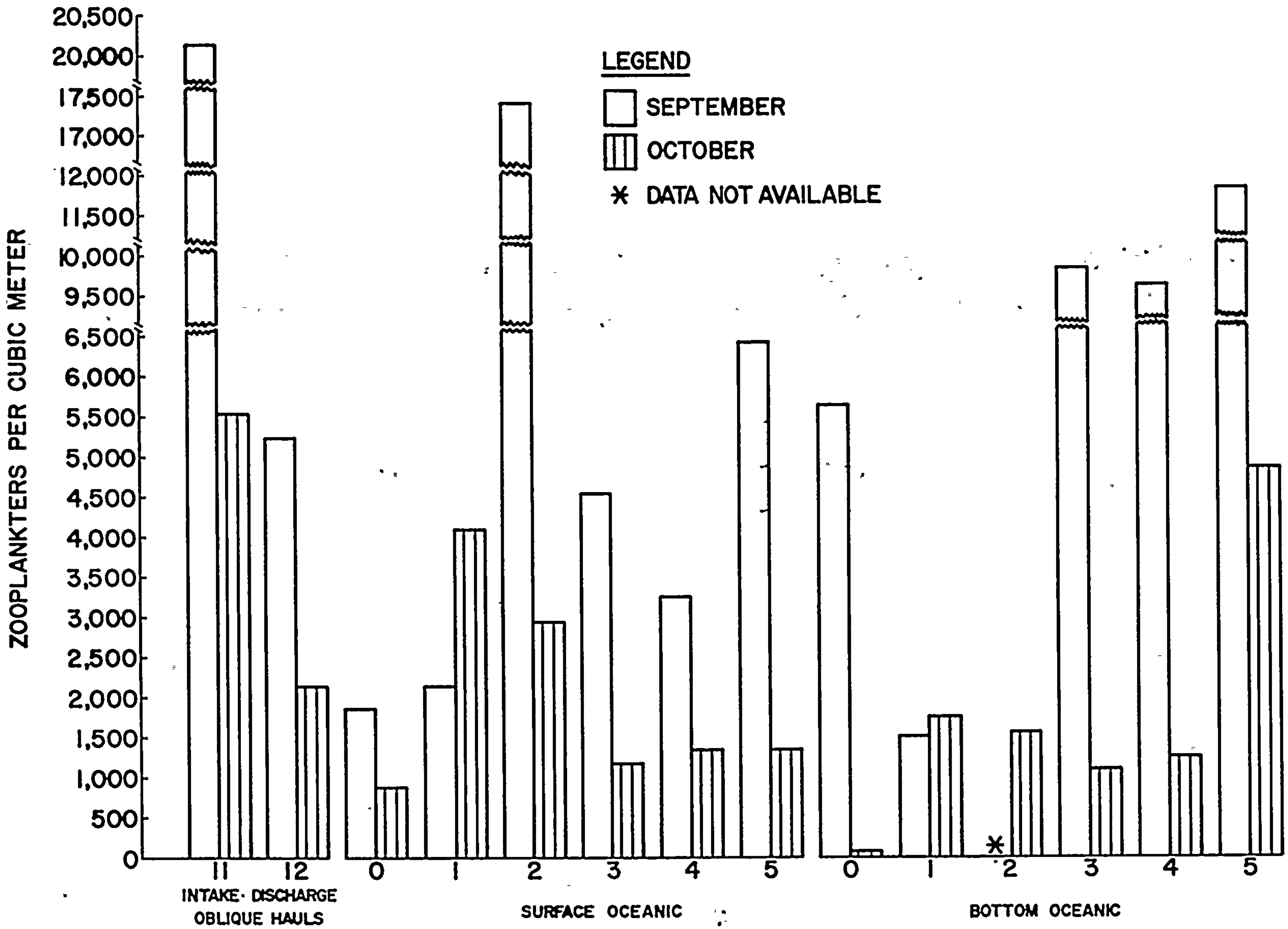


Figure E-6. Total zooplankters per cubic meter by station and date at the St. Lucie Plant, September and October 1976.

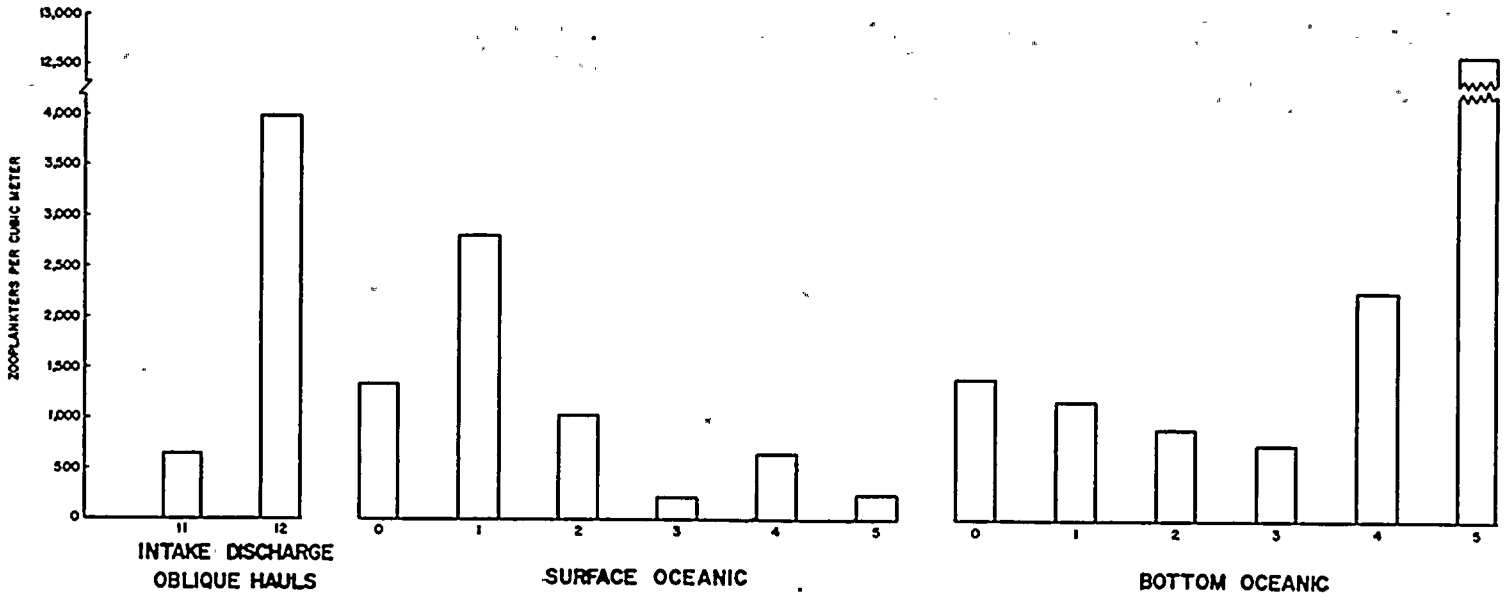


Figure E-7. Total zooplankters per cubic meter by station at the St. Lucie Plant, November 1976.

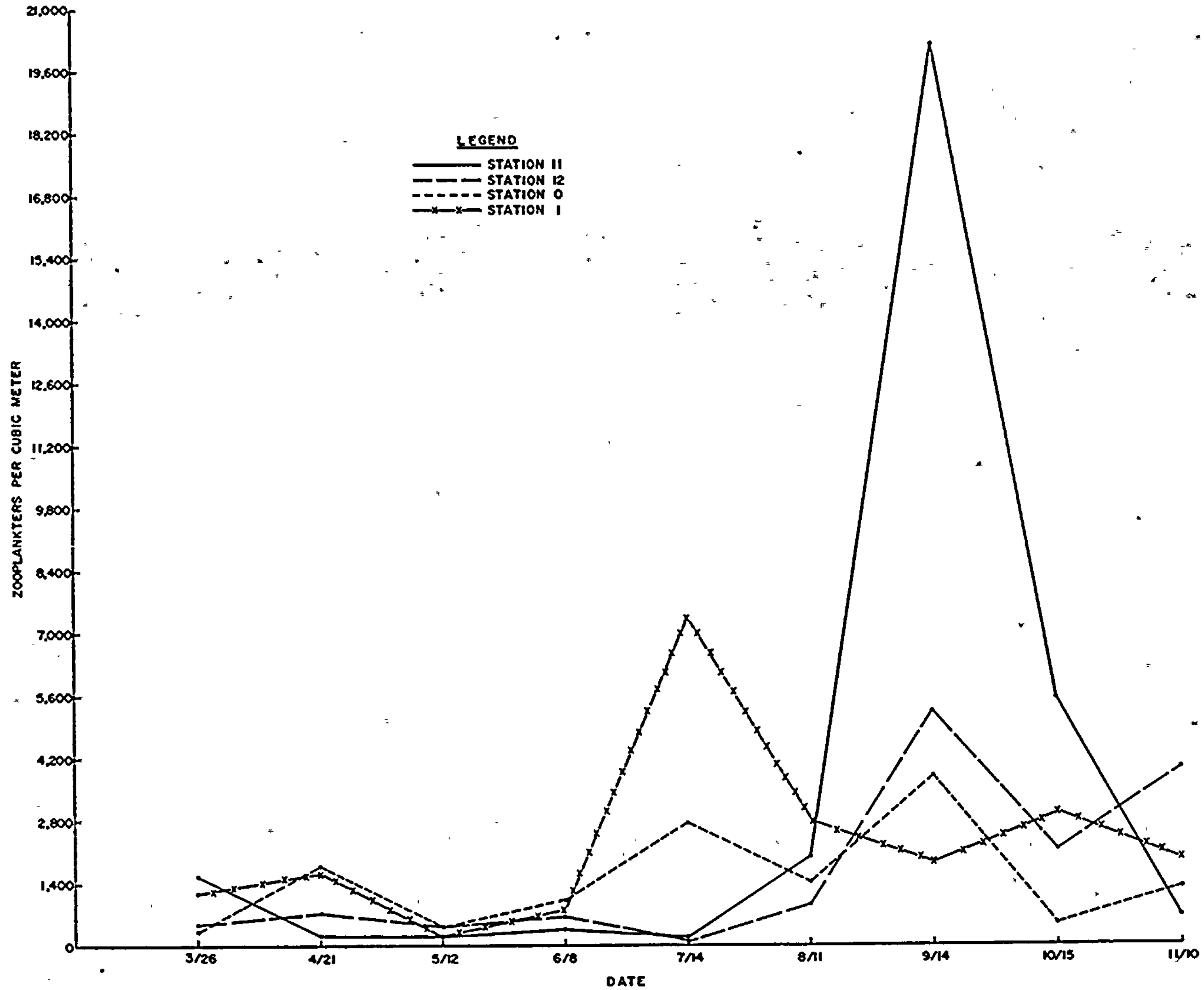


Figure E-8. Mean zooplankters per cubic meter by date at Stations 11, 12, 0, and 1, St. Lucie Plant, March-November 1976.

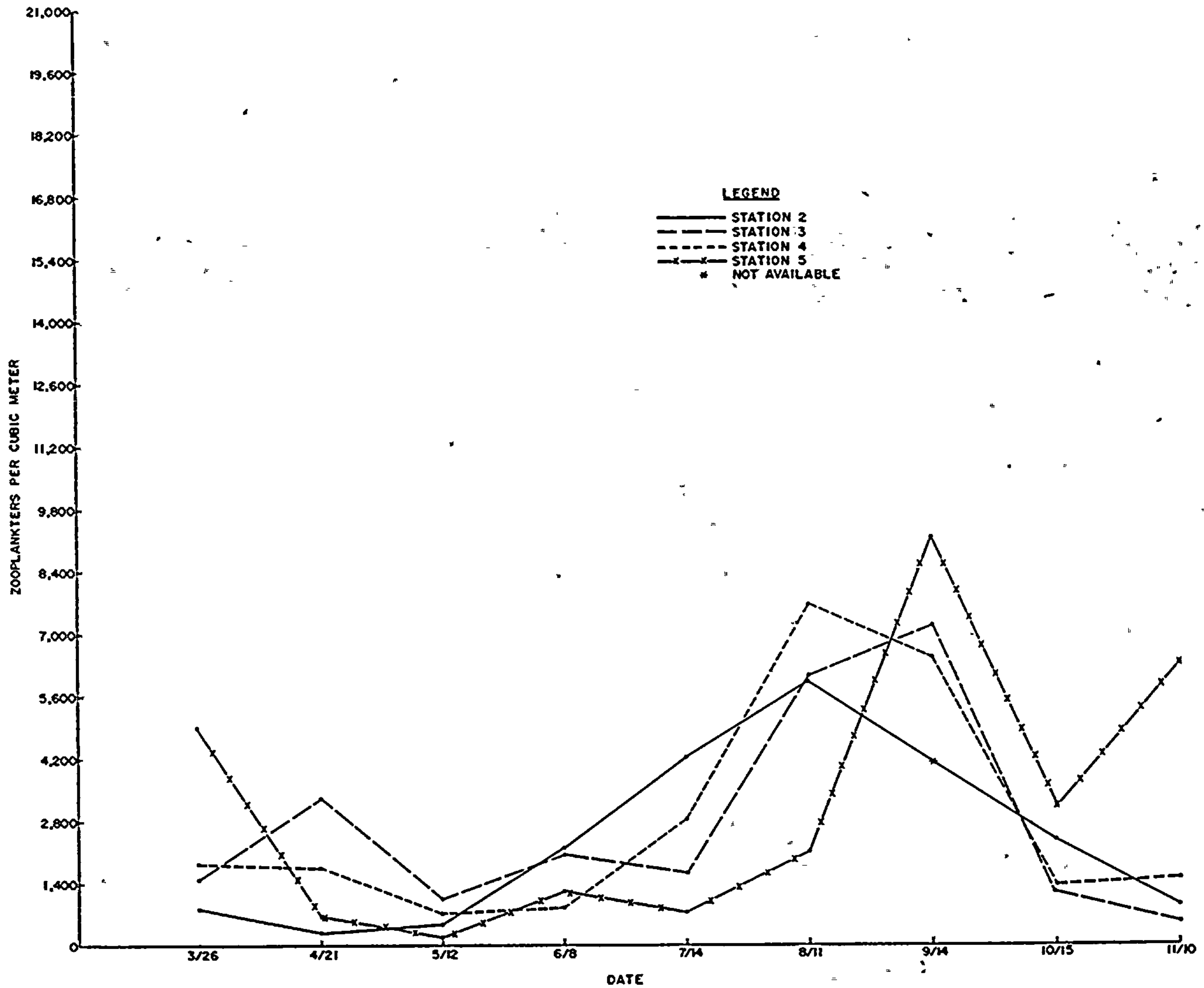


Figure E-9. Mean zooplankters per cubic meter by date at Stations 2, 3, 4, and 5, St. Lucie Plant, March-November 1976.

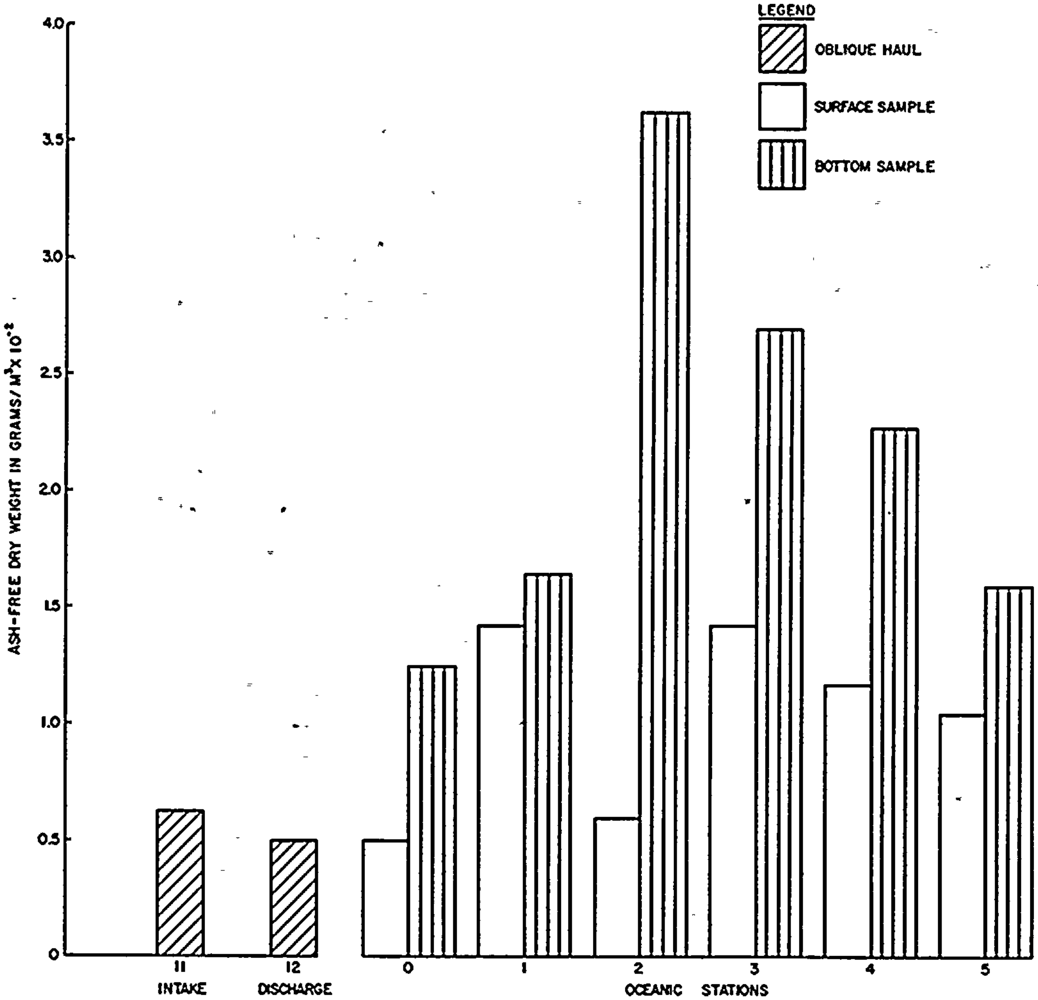


Figure E-10. Zooplankton biomass at the St. Lucie Plant, March-November 1976.

TABLE E-1

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
26 MARCH 1976

Taxon	Station and depth[c]													
	11	12	0		1		2		3		4		5	
	B	B	S[d]	B	S	B	S[e]	B	S	B	S	B	S	B
Protozoa		0.4 (<1)		2.3 (<1)	40.0 (2)	1.7 (1)	32.7 (2)	1.2 (<1)	1.2 (<1)	2.6 (<1)		19.5 (1)		18.0 (<1)
Coelenterata		1.1 (<1)		2.3 (<1)		3.5 (3)	8.2 (1)		18.0 (1)	5.2 (<1)		6.5 (<1)		9.0 (<1)
Mollusca	1.4 (<1)			13.8 (3)	51.5 (2)	3.5 (3)	89.8 (6)	12.0 (4)	34.8 (2)	22.3 (1)		292.0 (12)	432.8 (12)	1480.0 (23)
Polychaeta	1.4 (<1)								1.2 (<1)	2.6 (<1)		3.2 (<1)	9.0 (<1)	9.0 (<1)
Crustacea nauplii	10.8 (1)		3.4 (11)				8.2 (1)		4.8 (<1)	2.6 (<1)		32.5 (1)		
cladocera									2.4 (<1)		5.2 (<1)	6.5 (<1)		
ostracoda	0.9 (<1)		2.6 (8)	2.3 (<1)	165.2 (7)	6.9 (5)	40.8 (3)	21.5 (8)	31.2 (2)	137.5 (8)		133.0 (6)	343.4 (10)	758.0 (12)
copepoda	111.4 (7)	14.9 (3)	18.0 (58)	419.0 (75)	1392.8 (62)	100.5 (73)	841.0 (56)	210.3 (75)	964.8 (61)	1181.9 (72)	1394.1 (95)	1505.6 (63)	2289.3 (65)	3645.8 (56)
cirripedia (barnacle) nauplii	1313.3 (86)	447.6 (93)	0.9 (3)	9.2 (2)	17.1 (1)		40.8 (3)	2.4 (1)		5.3 (<1)		22.7 (1)	1.8 (<1)	9.0 (<1)
decapoda	34.7 (2)	8.1 (2)	2.6 (8)	46.0 (8)	285.4 (13)	3.4 (3)	122.5 (8)	22.8 (8)	358.0 (23)	147.8 (9)	58.8 (4)	175.2 (7)	291.5 (8)	243.7 (4)
others	5.2 (<1)	3.5 (1)		6.9 (1)	97.0 (4)	5.2 (4)	8.2 (1)	2.4 (1)	6.0 (<1)	11.8 (1)	3.5 (<1)	6.4 (<1)	37.7 (1)	162.4 (3)
Chaetognatha			0.9 (3)	4.6 (1)	22.8 (1)	1.7 (1)		2.4 (1)	18.0 (1)	10.4 (1)	5.1 (<1)	35.5 (2)	69.8 (2)	99.3 (2)
Chordata urochordata	51.2 (3)							1.2 (<1)	30.0 (2)	28.8 (2)	3.5 (<1)	35.7 (2)		
fish	1.4 (<1)			23.0 (4)	28.5 (1)	5.2 (4)	16.3 (1)		10.8 (1)	1.3 (<1)			1.8 (<1)	

TABLE E-1
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
26 MARCH 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S[d]	B	S	B	S[e]	B	S	B	S	B	S	B
Eggs	1.6 (<1)	4.9 (1)	2.6 (8)	29.9 (5)	137.0 (6)	6.9 (5)	302.1 (20)	6.0 (2)	103.3 (7)	73.3 (4)		126.6 (5)	51.9 (2)	54.1 (1)
Miscellaneous	1.4 (<1)													
TOTAL	1534.7	480.5	31.0	559.3	2237.6	138.5	1510.6	282.2	1584.5	1633.4	1470.2	2400.9	3529.0	6488.3

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.
[b] For detailed taxonomic listing, see Table H-151.
[c] Ø = oblique; S = surface; B = bottom.
[d] Sample not preserved immediately.
[e] Scyphozoan medusa removed from sample before analysis.

TABLE E-2

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
4 APRIL 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	Bd	S	B	S	Bd	S	B	S	B	S	Bd
Protozoa		2.5 (<1)					1.5 (<1)	0.9 (<1)	6.7 (<1)	33.9 (1)	1.6 (<1)	16.1 (<1)		
Coelenterata			6.7 (2)	5.5 (<1)	8.1 (1)	1.2 (<1)	11.5 (4)		8.9 (<1)		2.4 (<1)	2.7 (<1)	26.6 (9)	2.6 (<1)
Mollusca	1.9 (<1)	1.2 (<1)	36.5 (9)	201.0 (6)	82.9 (13)	402.8 (16)	12.9 (4)	82.5 (26)	32.5 (3)	3096.1 (57)	8.8 (3)	260.8 (8)	17.1 (6)	106.5 (10)
Polychaeta	1.2 (<1)		3.7 (<1)		6.0 (<1)		2.3 (<1)		6.7 (<1)	24.2 (<1)		21.5 (<1)	1.7 (<1)	
Crustacea nauplii		0.6 (<1)	6.0 (1)	35.8 (1)	4.1 (<1)	2.5 (<1)	3.8 (1)	9.2 (3)	10.1 (<1)	4.8 (<1)	3.2 (1)	75.3 (2)	5.1 (<1)	7.8 (1)
cladocera							0.8 (<1)							
ostracoda						2.5 (<1)								
copepoda	52.7 (20)	34.0 (5)	223.0 (55)	2632.9 (81)	358.1 (58)	1844.5 (73)	155.4 (48)	126.1 (40)	378.9 (33)	1787.8 (33)	112.1 (35)	1096.9 (33)	151.7 (49)	633.5 (62)
cirripedia (barnacle) nauplii	0.6 (<1)	648.1 (92)	7.4 (2)	8.3 (<1)	14.2 (2)	22.4 (<1)	3.8 (1)		4.5 (<1)	4.8 (<1)	1.6 (<1)	26.9 (<1)	24.8 (8)	15.6 (2)
decapoda	16.1 (6)	6.9 (<1)	34.1 (9)	159.8 (5)	82.9 (13)	129.3 (5)	7.7 (2)	23.2 (7)	107.7 (9)	208.3 (4)	9.6 (3)	1196.3 (36)	23.2 (8)	160.9 (16)
others	165.7 (62)	1.3 (<1)	8.2 (2)	11.1 (<1)		6.2 (<1)				4.8 (<1)	2.4 (<1)	5.4 (<1)		2.6 (<1)
Chaetognatha			1.4 (<1)				5.4 (2)		4.4 (<1)			2.7 (<1)	0.9 (<1)	
Chordata urochordata	3.8 (1)		2.2 (<1)	41.3 (1)	10.1 (2)	54.6 (2)	29.6 (9)	49.1 (16)	352.0 (31)	193.8 (4)	108.1 (34)	427.4 (13)	8.6 (3)	64.9 (6)
fish	11.8 (4)		5.9 (1)	5.5 (<1)	2.0 (<1)	1.2 (<1)	66.0 (21)		206.3 (18)	4.8 (<1)	12.0 (<1)	8.1 (<1)	17.2 (6)	2.6 (<1)

TABLE E-2
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
4 APRIL 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B[d]	S	B	S	B[d]	S	B	S	B	S	B[d]
Eggs	11.8 (4)	6.3 (<1)	68.4 (16)	132.2 (4)	46.5 (8)	51.0 (2)	21.2 (7)	21.4 (7)	31.4 (3)	116.3 (2)	59.6 (19)	147.8 (4)	30.0 (9)	28.6 (3)
Miscellaneous	+[e]				2.0 (<1)		+[e]		+[e]		+[e]	+[e]	+[e]	
TOTAL	265.6	700.9	403.5	3233.4	616.9	2518.2	321.9	312.4	1150.1	5479.6	321.4	3287.9	306.9	1025.6

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.
[b] For detailed taxonomic listing, see Table H-152.
[c] Ø = oblique; S = surface; B = bottom.
[d] Scyphozoan medusa removed from sample before analysis.
[e] Echinoderm larvae noted as present; however, due to fragility of specimens, a quantitative analysis is not available.

TABLE E-3

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
12 MAY 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	∅	∅	S	B	S[d]	B	S	B	S	B	S	B	S	B
Protozoa		4.9 (1)							0.9 (<1)					
Coelenterata	1.1 (<1)		2.5 (5)	74.4 (9)	25.7 (11)	20.7 (8)	1.8 (<1)	8.1 (4)	3.6 (1)	91.4 (7)		6.0 (2)	2.6 (3)	6.1 (3)
Mollusca	3.8 (2)	7.3 (2)	1.7 (3)			1.9 (<1)	2.8 (<1)	1.2 (<1)	2.7 (<1)		10.0 (1)	3.0 (1)	3.7 (4)	6.1 (3)
Polychaeta				11.4 (1)	5.1 (2)		3.7 (<1)		12.7 (2)	6.5 (<1)	10.0 (1)		0.5 (<1)	
Crustacea														
nauplii	0.7 (<1)			24.7 (3)					8.2 (1)	6.5 (<1)	5.0 (<1)		1.1 (1)	
cladocera												1.5 (1)		
ostracoda					2.6 (1)					222.1 (17)		4.5 (2)		
copepoda	52.6 (26)	143.6 (33)	13.6 (25)	283.4 (36)	66.8 (29)	80.7 (31)	663.7 (85)	98.9 (49)	416.1 (64)	692.7 (52)	599.1 (65)	115.3 (48)	60.7 (61)	128.8 (54)
cirripedia (barnacle) nauplii		12.2 (3)	0.8 (1)		2.6 (1)			2.3 (1)		6.5 (<1)	7.5 (<1)			
decapoda	112.2 (55)	90.0 (21)	2.4 (4)	243.4 (31)	100.2 (43)	124.1 (47)	18.8 (2)	38.5 (19)	44.5 (7)	130.6 (10)	22.5 (2)	52.5 (22)	5.7 (6)	49.1 (21)
others	3.4 (2)	138.7 (32)		15.2 (2)		5.7 (2)		1.2 (<1)	2.7 (<1)	26.1 (2)	7.5 (<1)	7.5 (3)		
Chaetognatha	0.8 (<1)			3.8 (<1)	5.1 (2)	9.4 (4)	18.7 (2)	2.3 (1)	35.4 (5)	19.6 (1)	37.4 (4)		3.1 (3)	6.1 (3)
Chordata														
urochordata	0.4 (<1)			9.5 (1)		3.8 (1)	30.1 (4)	43.1 (22)	80.0 (12)	98.0 (7)	147.3 (16)	24.0 (10)	2.6 (3)	12.2 (5)
fish							2.8 (<1)	1.2 (<1)			2.5 (<1)		1.6 (2)	

TABLE E-3
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
12 MAY 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S[d]	B	S	B	S	B	S	B	S	B
Eggs	29.7 (15)	34.1 (17)	33.9 (62)	121.7 (15)	23.1 (10)	11.3 (4)	38.5 (5)	3.5 (2)	46.3 (7)	39.2 (3)	79.9 (9)	6.0 (2)	17.3 (17)	30.7 (13)
Miscellaneous						+[e]			1.8 (<1)	+[e]				
TOTAL	204.7	430.8	54.9	787.3	231.2	257.6	780.9	200.3	654.9	1339.2	928.7	241.3	98.9	239.1

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.
[b] For detailed taxonomic listing see Table H-153.
[c] Ø = oblique; S = surface; B = bottom.
[d] Scyphozoan medusa removed from sample before analysis.
[e] Echinoderm larvae noted as present; however, due to fragility of specimens, a quantitative analysis is not available.

TABLE E-4

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
8 JUNE 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Protozoa	1.5 (<1)	9.7 (2)	9.5 (4)		28.1 (7)	10.6 (1)	5.5 (2)	4.3 (<1)	3.7 (1)	3.6 (<1)	15.1 (3)	2.4 (<1)	6.3 (4)	10.8 (<1)
Coelenterata	1.1 (<1)							4.2 (<1)			2.0 (<1)			1.8 (<1)
Mollusca	12.4 (3)	10.5 (2)	11.8 (5)	19.3 (1)	5.1 (1)	28.9 (2)	16.4 (5)	220.7 (6)	7.4 (1)	60.5 (2)	5.0 (1)	88.7 (7)		337.4 (15)
Polychaeta	3.0 (1)	2.2 (<1)	4.8 (2)	6.9 (<1)	1.3 (<1)	3.0 (<1)	5.5 (2)	2.1 (<1)	7.3 (1)				6.3 (4)	5.4 (<1)
Crustacea nauplii		0.7 (<1)	2.4 (1)	1.4 (<1)	3.9 (1)	7.6 (1)	4.4 (1)	19.1 (<1)	7.4 (1)	14.3 (<1)	6.0 (1)		4.2 (2)	5.4 (<1)
cladocera	0.5 (<1)	0.7 (<1)				1.5 (<1)	1.1 (<1)				2.0 (<1)		1.1 (1)	1.8 (<1)
ostracoda										3.6 (<1)				
copepoda	159.3 (41)	310.2 (50)	102.0 (42)	1045.3 (59)	260.5 (61)	949.9 (71)	148.7 (42)	2150.6 (55)	479.2 (69)	2096.7 (63)	361.3 (75)	752.5 (56)	112.6 (66)	1367.4 (59)
cirripedia (barnacle) nauplii	181.1 (47)	243.0 (39)	92.5 (37)	609.3 (34)	80.4 (19)	176.6 (13)	141.0 (40)	946.8 (24)	7.4 (1)	398.7 (12)	34.2 (7)	143.8 (11)	12.6 (7)	285.3 (12)
decapoda	8.1 (3)	12.7 (2)	7.1 (3)	53.7 (4)	15.3 (4)	115.6 (9)	5.5 (2)	507.2 (13)	1.9 (<1)	576.8 (17)	7.0 (1)	273.3 (20)	6.4 (4)	236.9 (10)
others	1.1 (<1)	14.1 (2)		2.8 (<1)	3.9 (1)	4.6 (<1)	4.4 (1)	4.2 (<1)	5.6 (1)	24.9 (1)		9.6 (1)		34.1 (1)
Chaetognatha	0.4 (<1)		2.4 (1)	2.8 (<1)		6.1 (<1)		17.0 (<1)	7.6 (1)	7.1 (<1)	1.0 (<1)	7.2 (1)	2.2 (1)	
Chordata urochordata	0.7 (<1)		2.4 (1)	4.1 (<1)	6.4 (1)	3.1 (<1)	1.1 (<1)	8.5 (<1)	148.0 (21)	74.7 (2)	13.1 (3)	19.2 (1)	4.2 (2)	23.3 (1)
fish	0.4 (<1)	1.4 (<1)		1.4 (<1)	10.2 (2)	7.6 (1)	1.1 (<1)	6.4 (<1)	9.3 (1)	14.3 (<1)	18.1 (4)	7.2 (1)	5.3 (3)	

TABLE E-4
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
8 JUNE 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Eggs	18.5 (5)	19.4 (3)	11.8 (5)	28.9 (2)	15.4 (4)	13.7 (1)	16.4 (5)	23.4 (1)	9.3 (1)	67.6 (2)	18.1 (4)	33.6 (3)	10.5 (6)	10.8 (<1)
Miscellaneous		+[d]			+[d]	1.5 (<1) / +[d]	+[d]	+[d]	+[d]		+[d]		+[d]	
TOTAL	388.1	624.6	246.7	1775.9	430.5	1330.3	351.1	3914.5	694.1	3342.8	482.9	1337.5	171.7	2320.4

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.

[b] For detailed taxonomic listing, see Table H-154.

[c] Ø = oblique; S = surface; B = bottom.

[d] Echinoderm larvae noted as present; however, due to fragility of specimens, a quantitative analysis is not available.

TABLE E-5

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
14 JULY 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Protozoa							3.0 (1)						4.2 (1)	
Coelenterata	0.7 (<1)				7.0 (<1)								1.4 (<1)	
Mollusca	0.7 (<1)		6.0 (<1)			16.9 (<1)	6.0 (2)	13.2 (<1)	3.2 (1)	40.9 (1)	1.7 (1)	5.4 (<1)	7.0 (1)	25.3 (3)
Polychaeta			17.9 (1)		35.1 (<1)	5.6 (<1)	3.0 (1)		4.7 (2)	15.7 (1)		16.2 (<1)	1.4 (<1)	
Crustacea nauplii	2.5 (2)		95.6 (3)	6.9 (<1)	42.1 (1)	5.6 (<1)		19.8 (<1)		15.7 (1)			1.4 (<1)	
cladocera														
ostracoda	17.7 (11)		6.0 (<1)	960.9 (40)	28.1 (<1)	2351.6 (35)	1.5 (<1)	112.0 (1)		62.9 (2)	1.7 (1)	108.5 (2)		316.8 (43)
copepoda	59.8 (38)	33.6 (25)	1918.4 (62)	705.1 (30)	6841.8 (85)	3017.0 (45)	154.3 (45)	7630.3 (93)	91.8 (32)	2236.3 (76)	134.2 (43)	4768.3 (90)	541.3 (65)	278.7 (40)
cirripedia (barnacle) nauplii	37.0 (24)	84.4 (62)	35.9 (1)	13.8 (1)	28.1 (<1)	22.6 (<1)		13.2 (<1)		18.9 (1)	1.7 (1)		2.8 (<1)	
decapoda	23.3 (15)	13.8 (10)	131.5 (4)	131.2 (6)	189.7 (2)	383.3 (6)		145.0 (2)	3.1 (1)	147.7 (5)	5.1 (2)	151.9 (3)	39.2 (5)	63.3 (9)
others	1.2 (1)	1.2 (1)	17.9 (1)	89.8 (4)	21.0 (<1)	434.2 (6)		19.8 (<1)	1.6 (1)	31.4 (1)	3.4 (1)	38.0 (1)		
Chaetognatha	2.5 (2)	0.6 (<1)	460.3 (15)	200.4 (8)	625.2 (8)	287.6 (4)	10.6 (3)	72.5 (1)	11.1 (4)	88.1 (3)	8.5 (3)	43.3 (1)	75.5 (9)	
Chordata urochordata	3.2 (2)	0.6 (<1)	35.9 (1)	55.3 (2)	21.1 (<1)	169.2 (3)	15.1 (4)	92.3 (1)	11.1 (4)	28.3 (1)	6.8 (2)		1.4 (<1)	50.7 (7)
fish	7.6 (5)	0.6 (<1)	17.9 (1)			5.6 (<1)	1.5 (<1)						4.2 (1)	

TABLE E-5
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
14 JULY 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Eggs	0.5 (<1)	1.7 (1)	340.6 (11)	221.2 (9)	168.6 (2)	67.7 (1)	149.8 (43)	92.3 (1)	164.5 (57)	254.8 (9)	149.5 (48)	162.8 (3)	152.5 (18)	
Miscellaneous														
TOTAL	156.7	136.5	3083.9	2384.6	8007.8	6766.9	344.8	8210.4	291.1	2940.7	312.6	5294.4	832.3	734.8

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.

[b] For detailed taxonomic listing, see Table H-155.

[c] Ø = oblique; S = surface; B = bottom.

TABLE E-6

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
11 AUGUST 1976

Taxon	11	12	0		1		2		3		4		5	
	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Protozoa		5.5 (1)	5.6 (<1)		10.8 (<1)	4.7 (1)	11.6 (<1)	7.9 (<1)	11.7 (<1)		4.3 (<1)			
Coelenterata					10.8 (<1)		11.6 (<1)		11.7 (<1)		4.4 (<1)	9.2 (<1)		0.6 (<1)
Mollusca	27.2 (1)	5.5 (1)	13.1 (1)	8.7 (3)	195.0 (4)	18.8 (5)	104.4 (3)	365.4 (5)	70.0 (2)	205.0 (3)	28.3 (1)	142.5 (1)	116.5 (4)	15.0 (1)
Polychaeta	4.5 (<1)	6.8 (1)			1028.8 (20)		11.6 (<1)		11.7 (<1)	14.6 (<1)		4.6 (<1)		0.6 (<1)
Crustacea														
nauplii	27.2 (1)		3.7 (<1)	8.7 (3)	10.8 (<1)	9.4 (2)		7.9 (<1)				4.6 (<1)	2.1 (<1)	
cladocera	4.5 (<1)		655.3 (26)	66.9 (23)	1516.1 (29)	117.4 (29)	1246.8 (33)	230.3 (3)	268.3 (7)	2578.2 (32)	130.9 (3)	4187.1 (36)	1226.3 (40)	137.0 (12)
ostracoda							11.6 (<1)	15.9 (<1)		483.4 (6)		114.9 (1)	2.1 (<1)	2.3 (<1)
copepoda	417.0 (21)	128.9 (14)	1739.9 (69)	148.4 (52)	1895.2 (37)	103.3 (25)	2087.7 (55)	4662.0 (58)	3161.7 (80)	3925.8 (48)	3451.4 (91)	6126.6 (53)	1471.9 (47)	526.9 (46)
cirripedia (barnacle) nauplii	1346.0 (68)	744.4 (79)	18.7 (1)		140.8 (3)	47.0 (11)	11.6 (<1)	587.7 (7)	35.0 (1)	58.6 (1)	4.3 (<1)	372.3 (3)	21.2 (1)	163.6 (14)
decapoda	27.2 (1)	16.5 (2)	9.4 (<1)	49.4 (17)	205.8 (4)	84.6 (21)	121.8 (3)	2041.2 (25)	23.3 (1)	161.0 (2)	6.6 (<1)	344.7 (3)	163.1 (5)	277.1 (24)
others	4.5 (<1)				32.5 (1)		5.8 (<1)	15.8 (<1)	11.7 (<1)	29.2 (<1)		59.7 (1)	2.1 (<1)	4.7 (<1)
Chaetognatha	4.5 (<1)	15.1 (2)	50.5 (2)		97.4 (2)		81.2 (2)	103.2 (1)	35.0 (1)	146.4 (2)	43.7 (1)	78.1 (1)	61.4 (2)	16.8 (1)
Chordata														
urochordata	9.0 (<1)	6.9 (1)	18.7 (1)		10.8 (<1)	9.4 (2)	5.8 (<1)	47.7 (1)	233.3 (6)	410.2 (5)	74.2 (2)	87.3 (1)	21.2 (1)	6.4 (1)
fish	99.7 (5)	8.2 (1)	11.2 (<1)	2.9 (1)		4.7 (1)	29.0 (1)		46.7 (1)	58.5 (1)	21.8 (1)	9.2 (<1)	6.4 (<1)	1.7 (<1)

Column heading: Station and depth[c]

TABLE E-6
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
11 AUGUST 1976

Taxon	Station and depth[c]													
	11	12	0		1		2		3		4		5	
	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Eggs			9.3 (<1)			9.4 (2)	40.6 (1)	7.9 (<1)	11.7 (<1)	29.3 (<1)	15.3 (<1)		6.4 (<1)	2.9 (<1)
Miscellaneous	+[d]	+[d]			+[d]	+[d]	+[d]		11.7 (<1)	+[d]	+[d]			2.3 (<1)
TOTAL	1971.3	937.8	2535.4	285.0	5154.8	408.7	3781.1	8092.9	3943.5	8100.2	3785.2	11540.8	3100.7	1157.9

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.

[b] For detailed taxonomic listing, see Table H-156.

[c] Ø = oblique; S = surface; B = bottom.

[d] Echinoderm larvae noted as present; however, due to fragility of specimens, a quantitative analysis is not available.

TABLE E-7

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
14 SEPTEMBER 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Protozoa					2.3 (<1)		15.7 (<1)		3.0 (<1)					
Coelenterata			1.4 (<1)	17.9 (<1)	16.1 (<1)	8.5 (<1)			3.0 (<1)	24.8 (<1)	9.1 (<1)	74.8 (<1)		20.2 (<1)
Mollusca	12.5 (<1)	8.4 (<1)	7.1 (<1)	26.9 (<1)	60.0 (3)	12.7 (<1)	109.9 (1)		32.6 (<1)	105.6 (1)	42.6 (1)	37.4 (<1)	15.3 (<1)	192.2 (1)
Polychaeta	8.4 (<1)				2.3 (<1)		15.3 (<1)		5.9 (<1)	12.4 (<1)			3.8 (<1)	5.1 (<1)
Crustacea														
nauplii	16.6 (<1)		4.3 (<1)	17.9 (<1)	16.2 (<1)	21.2 (1)						12.5 (<1)	3.8 (<1)	
cladocera	58.2 (<1)	8.3 (<1)	351.7 (19)	698.6 (12)	55.5 (3)	93.1 (6)	6014.8 (34)		1875.1 (41)	4281.2 (43)	91.2 (2)	1800.9 (19)	4100.6 (63)	2624.7 (22)
ostracoda				9.0 (<1)	9.2 (<1)		15.7 (<1)			37.3 (<1)	3.0 (<1)			
copepoda	19479.0 (96)	4985.0 (95)	910.6 (48)	3806.7 (67)	1228.6 (57)	914.3 (59)	7349.7 (42)		1580.9 (34)	4728.5 (48)	2156.0 (65)	6468.4 (67)	1797.8 (28)	8202.6 (69)
cirripedia (barnacle) nauplii	481.9 (2)	171.0 (3)	8.5 (<1)	26.9 (<1)	18.5 (<1)	21.2 (1)	455.4 (3)		53.5 (1)	31.1 (<1)	15.2 (<1)	12.5 (<1)	38.2 (<1)	15.2 (<1)
decapoda	33.3 (<1)	33.4 (<1)	507.9 (27)	555.4 (9)	672.1 (31)	410.6 (26)	3266.5 (19)		968.7 (21)	385.2 (4)	857.4 (26)	891.2 (9)	474.4 (7)	672.4 (5)
others	4.2 (<1)		2.9 (<1)	44.9 (<1)	16.1 (<1)	4.2 (<1)	31.4 (<1)		11.9 (<1)	37.2 (<1)		6.2 (<1)	3.8 (<1)	10.1 (<1)
Chaetognatha		8.4 (<1)	28.4 (2)	134.3 (2)	41.6 (2)	29.6 (2)	47.1 (<1)		14.8 (<1)	43.5 (<1)	60.8 (1)	105.9 (1)	7.6 (<1)	40.5 (<1)
Chordata														
urochordata	58.2 (<1)	16.7 (<1)	22.7 (1)	304.5 (5)	4.6 (<1)	8.5 (<1)	15.7 (<1)		3.0 (<1)	124.3 (1)	27.4 (<1)	193.2 (2)	3.8 (<1)	65.7 (<1)
fish	45.7 (<1)	29.2 (<1)					15.7 (<1)		14.9 (<1)	6.2 (<1)		6.2 (<1)		

TABLE E-7
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
14 SEPTEMBER 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Eggs	8.3 (<1)		32.6 (2)	53.8 (<1)	9.3 (<1)	12.7 (1)	94.2 (<1)		11.9 (<1)	37.3 (<1)	27.4 (<1)	43.6 (<1)	11.5 (<1)	5.1 (<1)
Miscellaneous			+[d]		2.3 (<1)		+[d]		+[d]	+[d]			+[d]	
TOTAL	20206.3	5260.4	1878.1	5696.8	2154.7	1536.6	17447.1		4579.2	9854.6	3290.1	9652.8	6460.6	11853.8

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.

[b] For detailed taxonomic listing, see Table H-157.

[c] Ø = oblique; S = surface; B = bottom.

[d] Echinoderm larvae noted as present; however, due to fragility of specimens, a quantitative analysis is not available.

TABLE E-8

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
15 OCTOBER 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Protozoa		1.8 (<1)					1.5 (<1)					2.7 (<1)		3.3 (<1)
Coelenterata		1.8 (<1)		0.9 (1)	4.0 (<1)	1.2 (<1)	10.5 (<1)			1.5 (<1)				
Mollusca	82.0 (1)	100.8 (5)	66.7 (7)	4.5 (5)	359.5 (7)	45.5 (3)	12.0 (<1)	104.8 (7)	58.7 (5)	12.2 (1)	32.2 (2)	27.4 (2)	63.0 (5)	101.0 (2)
Polychaeta	22.0 (<1)	14.4 (1)	68.2 (8)		118.6 (3)		11.0 (<1)		17.4 (1)	1.5 (1)	7.6 (1)		4.6 (<1)	
Crustacea nauplii			3.0 (<1)	2.7 (3)	19.8 (<1)				17.4 (1)		5.7 (<1)		7.0 (1)	
cladocera	62.0 (1)	36.0 (2)	7.6 (1)		162.0 (4)	9.7 (1)	318.1 (11)		21.4 (2)	3.1 (<1)	15.2 (1)		123.7 (9)	3.3 (<1)
ostracoda		1.8 (<1)									1.9 (1)		2.3 (<1)	
copepoda	624.4 (11)	529.5 (24)	416.8 (47)	86.0 (88)	3018.9 (73)	1679.8 (94)	1641.3 (55)	1327.4 (84)	738.1 (61)	699.4 (62)	710.9 (52)	1146.5 (89)	641.6 (46)	4371.0 (90)
cirripedia (barnacle) nauplii	4729.2 (85)	1415.6 (66)	80.3 (9)		252.9 (6)	6.1 (<1)	394.6 (13)	15.0 (1)	123.0 (10)	32.3 (3)	301.4 (22)	8.2 (1)	333.6 (24)	29.3 (1)
decapoda	40.0 (<1)	25.2 (1)	221.2 (25)		102.8 (2)	13.3 (1)	501.1 (17)	49.9 (3)	28.0 (2)	316.4 (28)	98.6 (7)	46.5 (4)	179.7 (13)	325.8 (7)
others	14.0 (<1)	14.4 (1)		0.9 (1)	15.9 (<1)	1.8 (<1)		25.0 (2)	2.6 (<1)		1.9 (<1)		2.3 (<1)	3.3 (<1)
Chaetognatha	10.0 (<1)	12.6 (1)	6.0 (1)	0.9 (1)	55.3 (1)	15.2 (1)	30.0 (1)	24.9 (2)	4.0 (<1)	23.1 (2)	7.6 (1)	41.0 (3)	4.7 (<1)	32.7 (1)
Chordata urochordata	2.0 (<1)	5.4 (<1)	21.2 (2)	1.8 (2)	27.7 (1)	13.4 (1)	42.0 (1)	29.9 (2)	169.8 (14)	43.0 (4)	170.6 (13)	13.7 (1)	14.0 (1)	13.0 (<1)
fish														

TABLE E-8
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
15 OCTOBER 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Eggs						1.2 (<1)			18.7 (2)	1.5 (<1)	1.9 (<1)		11.7 (1)	
Miscellaneous					11.9 (<1)	0.6 (<1)	+[d]		8.0 (1) / +[d]	+[d]	7.6 (<1) / +[d]		9.3 (1) / +[d]	
TOTAL	5585.6	2159.3	891.0	97.7	4149.3	1787.8	2962.1	1576.9	1207.1	1134.0	1363.1	1286.0	1397.5	4882.7

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.

[b] For detailed taxonomic listing, see Table H-158.

[c] Ø = oblique; S = surface; B = bottom.

[d] Echinoderm larvae noted as present; however, due to fragility of specimens, a quantitative analysis is not available.

TABLE E-9

DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
10 NOVEMBER 1976

	Station and depth[c]													
	11	12	0		1		2		3		4		5	
Taxon	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Protozoa														
Coelenterata										1.5 (<1)				
Mollusca	4.3 (1)	173.6 (4)	170.7 (13)	253.8 (18)	196.4 (7)	24.4 (2)	7.5 (1)	14.2 (2)	12.1 (6)	61.9 (8)	34.7 (5)	195.0 (9)	5.5 (2)	997.3 (8)
Polychaeta	15.0 (2)		13.6 (1)	12.9 (1)	137.0 (5)	11.1 (1)	17.5 (2)	17.1 (2)	6.1 (3)	1.5 (<1)	26.7 (4)	16.0 (1)	1.9 (1)	124.7 (1)
Crustacea														
nauplii		9.1 (<1)	10.2 (1)		36.5 (1)	1.1 (<1)	2.5 (<1)	9.3 (1)			10.7 (2)	6.4 (<1)		45.3 (<1)
cladocera					9.1 (<1)		12.5 (1)		4.8 (2)	3.0 (<1)	5.3 (1)		25.1 (11)	
ostracoda				1.3 (<1)		1.1 (<1)								
copepoda	278.2 (41)	484.1 (12)	1024.2 (77)	661.9 (48)	917.7 (33)	556.6 (48)	769.5 (75)	459.0 (50)	104.6 (51)	473.1 (64)	496.4 (76)	863.0 (39)	154.5 (67)	5904.7 (47)
cirripedia (barnacle) nauplii	378.7 (55)	3292.8 (83)	102.4 (8)	376.1 (27)	1451.9 (52)	532.2 (46)	183.0 (18)	363.5 (40)	62.0 (30)	140.6 (19)	32.0 (5)	1070.7 (48)	18.6 (8)	5349.3 (42)
decapoda	1.8 (<1)		3.4 (<1)	9.1 (1)	4.6 (<1)	5.5 (<1)	7.5 (1)	11.4 (1)		21.1 (3)		9.6 (<1)	2.8 (1)	79.3 (1)
others	0.8 (<1)	13.7 (<1)		2.6 (<1)				0.7 (<1)				3.2 (<1)		22.7 (<1)
Chaetognatha	2.9 (<1)	4.6 (<1)	3.4 (<1)	20.7 (2)	9.1 (<1)	4.4 (<1)	5.0 (<1)	3.6 (<1)		10.5 (1)		16.0 (1)		11.3 (<1)
Chordata														
urochordata	0.4 (<1)	9.1 (<1)	10.2 (1)	29.6 (2)	32.0 (1)	22.2 (2)	10.0 (1)	16.4 (2)	6.1 (3)	7.6 (1)	34.7 (5)	35.2 (2)	4.6 (2)	
fish	0.7 (<1)				4.6 (<1)	2.2 (<1)					2.7 (<1)			

TABLE E-9
(Continued)
DENSITY[a] AND PERCENTAGE COMPOSITION (%) OF MAJOR ZOOPLANKTON TAXA[b] COLLECTED
ST. LUCIE PLANT
10 NOVEMBER 1976

Taxon	Station and depth[c]													
	11	12	0		1		2		3		4		5	
	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
Eggs				5.2 (<1)		2.2 (<1)	5.0 (<1)	12.1 (1)	7.3 (4)	18.2 (2)	10.7 (2)	22.4 (1)	15.8 (7)	56.7 (<1)
Miscellaneous	3.9 (1)/+[d]		+[d]	+[d]	4.6 (<1)/+[d]	1.1 (<1)/+[d]		2.8 (<1)/+[d]	1.2 (1)/+[d]	1.5 (<1)/+[d]		3.2 (<1)/+[d]	1.9 (1)/+[d]	+[d]
TOTAL	686.7	3987.0	1338.1	1373.2	2803.5	1164.1	1020.0	910.1	204.2	740.5	653.9	2240.7	230.7	12591.3

[a] Values expressed are undamaged zooplankters per cubic meter and represent the mean of three subsamples.

[b] For detailed taxonomic listing, see Table H-159.

[c] Ø = oblique; S = surface; B = bottom.

[d] Echinoderm larvae noted as present; however, due to fragility of specimens, a quantitative analysis is not available.

TABLE E-10

TOTAL AND MEAN ZOOPLANKTERS PER CUBIC METER[a]
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

Date	Station and depth[b]																				
	11	12	0			1			2			3			4			5			
	Ø	Ø	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	
26 MAR	1534.7	480.5	31.0	559.3	295.2	2237.6	138.5	1188.1	1510.6	282.2	896.4	1584.5	1633.4	1609.0	1470.2	2400.9	1935.6	3529.0	6488.3	5008.7	
21 APR	265.6	700.9	403.5	3233.4	1818.5	616.9	2518.2	1567.6	321.9	312.4	317.2	1150.1	5479.6	3314.9	321.4	3287.9	1804.7	306.9	1025.6	666.3	
12 MAY	204.7	430.8	54.9	787.3	421.1	231.2	257.6	244.4	780.9	200.3	490.6	654.9	1339.2	997.1	928.7	241.3	584.3	98.9	239.1	169.0	
8 JUN	388.1	624.6	246.7	1775.9	1011.3	430.5	1330.3	880.4	351.1	3914.5	2132.8	694.1	3342.8	2018.5	482.9	1337.5	910.2	171.7	2320.4	1246.1	
14 JUL	156.7	136.5	3083.9	2384.6	2734.3	8007.8	6766.9	7387.4	344.8	8210.4	4277.6	291.1	2940.7	1615.9	312.6	5294.6	2803.5	832.3	734.8	783.6	
11 AUG	1971.3	937.8	2535.4	285.0	1410.2	5154.8	408.7	2781.8	3781.1	8092.9	5937.0	3943.5	8100.2	6021.9	3785.2	11540.8	7663.0	3100.7	1157.9	2129.3	
14 SEP	20206.3	5260.4	1878.1	5696.8	3787.5	2154.7	1536.6	1845.7	17447.1	NA[c]	NA[c]	4579.2	9854.6	7216.9	3290.1	9652.8	6471.5	6460.6	11853.8	9157.2	
15 OCT	5585.6	2159.3	891.0	97.7	494.4	4149.3	1787.8	2968.6	2962.1	1576.9	2269.5	1207.1	1134.0	1170.6	1363.1	1286.0	1324.6	1397.5	4882.7	3140.1	
10 NOV	686.7	3987.0	1338.1	1373.2	1355.7	2803.5	1164.1	1983.8	1020.0	910.1	965.1	204.2	740.5	472.4	653.9	2240.7	1447.3	230.7	12591.3	6411.0	
MEAN	3444.4	1635.3	1162.5	1799.2	1480.9	2865.1	1767.6	2316.4	3168.8	2937.5	2160.7	1589.9	3840.6	2715.2	1400.9	4142.5	2711.7	1792.0	4588.2	3190.1	

[a] S, B and Ø values represent the mean of three subsamples.
[b] Ø = oblique; S = surface; B = bottom
[c] Data not available.

TABLE E-11

TEMPERATURES (°C) RECORDED DURING THE ZOOPLANKTON STUDY
ST. LUCIE PLANT
MARCH-DECEMBER 1976

	Station and depth[a]																			
	11	12	0			1			2			3			4			5		
Date	Ø	Ø	S	B	x̄	S	B	x̄	S	B	x̄	S	B	x̄	S	B	x̄	S	B	x̄
26 MAR	21.8	22.4	22.0	22.0	22.0	22.2	22.1	22.2	22.2	22.3	22.3	22.2	22.1	22.2	22.4	22.2	22.3	22.3	22.5	22.4
21 APR	24.6	25.8	23.8	23.8	23.8	24.0	23.8	23.9	24.2	23.8	24.0	24.5	24.0	24.3	25.0	24.0	24.5	24.8	24.0	24.4
12 MAY	24.9	28.4	22.9	22.9	22.9	23.8	23.4	23.6	23.5	23.2	23.4	23.5	23.5	23.5	23.7	23.7	23.7	24.6	23.9	24.3
8 JUN	26.4	35.4	22.9	22.9	22.9	28.2	27.7	28.0	27.9	27.6	27.8	28.1	27.7	27.9	28.3	28.0	28.2	27.3	27.2	27.3
14 JUL	24.0	25.8	23.1	23.0	23.1	23.0	22.6	22.8	24.0	23.3	23.7	25.0	24.0	24.5	23.7	23.3	23.5	23.0	22.7	22.9
11 AUG	27.1	27.3	27.5	27.4	27.5	28.0	27.7	27.9	27.9	26.5	27.2	27.5	27.2	27.4	28.4	26.7	27.6	27.6	27.4	27.5
14 SEP	27.9	29.2	27.8	27.8	27.8	28.0	28.0	28.0	28.5	28.4	28.5	28.7	28.5	28.6	27.9	29.2	28.6	28.5	28.2	28.4
15 OCT	24.5	24.8	24.0	26.0	25.0	26.1	27.0	26.6	27.4	27.5	27.5	27.0	27.1	27.1	27.5	28.0	27.8	26.5	26.2	26.4
10 NOV	20.0	20.4	20.0	20.2	20.1	20.1	20.1	20.1	20.2	20.5	20.4	21.4	21.3	21.4	20.5	20.4	20.5	21.2	20.7	21.0
13 DEC	23.9	28.6	23.8	23.8	23.8	23.7	23.7	23.7	24.2	24.2	24.2	24.4	24.4	24.4	24.2	24.3	24.2	24.5	24.3	24.4

[a] Ø = oblique (mean of surface and bottom values).
S = surface.
B = bottom
x̄ = mean.

TABLE E-12

SALINITIES (°/oo) RECORDED DURING THE ZOOPLANKTON STUDY
ST.LUCIE PLANT
MARCH-DECEMBER 1976

	Station and depth[a]																			
	11	12		0			1			2			3			4			5	
Date	Ø	Ø	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$
26 MAR	35.4	35.7	34.0	33.9	34.0	33.4	34.2	33.8	33.4	33.5	33.5	34.6	33.7	34.2	33.5	33.7	33.6	33.5	33.4	33.5
21 APR	34.2	34.3	34.2	34.2	34.2	34.2	34.0	34.1	33.9	34.0	34.0	34.5	34.2	34.4	34.0	34.1	34.1	32.5	34.2	33.4
12 MAY	34.0	34.4	33.8	34.3	34.1	35.0	35.2	35.1	34.9	35.2	35.1	34.9	35.0	35.0	34.2	34.4	34.3	34.3	34.8	34.6
8 JUN	30.0	30.1	33.8	34.3	34.1	34.5	36.0	35.3	35.5	35.5	35.5	36.0	36.0	36.0	36.0	36.0	36.0	34.5	35.5	35.0
14 JUL	35.1	34.9	35.0	34.9	35.0	35.3	35.3	35.3	35.2	35.3	35.3	34.9	34.9	34.9	35.0	35.3	35.2	35.0	35.1	35.1
11 AUG	34.1	34.5	34.8	35.0	34.9	35.0	35.0	35.0	35.0	34.8	34.9	35.0	35.0	35.0	34.8	35.0	34.9	35.0	35.0	35.0
14 SEP	32.1	34.0	34.5	35.0	34.8	34.0	34.5	34.3	34.5	34.5	34.5	34.5	35.0	34.8	34.5	35.0	34.8	34.0	34.5	34.3
15 OCT	35.0	35.0	35.2	35.0	35.1	35.0	34.5	34.8	35.0	35.2	35.1	35.0	35.2	35.1	35.0	35.5	35.3	35.0	35.0	35.0
10 NOV	35.3	35.0	35.5	35.5	35.5	35.5	35.5	35.5	35.5	35.5	35.5	36.1	35.0	35.6	35.5	35.5	35.5	35.5	35.5	35.5
13 DEC	36.0	35.5	35.1	35.1	35.1	35.1	35.1	35.1	36.0	36.0	36.0	35.8	36.0	35.9	36.0	35.8	35.9	36.0	36.0	36.0

[a] Ø = oblique (mean of surface and bottom values).
S = surface.
B = bottom.
$\bar{x}$ = mean.

TABLE E-13

DISSOLVED OXYGEN (ppm) RECORDED DURING THE ZOOPLANKTON STUDY
ST. LUCIE PLANT
MARCH-DECEMBER 1976

	Station and depth[a]																			
	11	12	0			1			2			3			4			5		
Date	Ø	Ø	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$	S	B	$\bar{x}$
26 MAR	6.8	6.8	6.4	6.4	6.4	6.4	6.4	6.4	6.0	6.0	6.0	6.4	6.2	6.3	6.2	5.9	6.1	6.1	6.0	6.1
21 APR	5.5	5.6	6.0	6.0	6.0	6.0	6.0	6.0	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.0	6.1	6.2	6.1	6.2
12 MAY	6.2	6.0	6.3	6.2	6.3	6.2	6.2	6.2	6.4	5.9	6.2	6.4	6.4	6.4	6.3	6.4	6.4	6.3	6.3	6.3
8 JUN	5.2	4.8	6.3	6.2	6.3	5.2	5.5	5.4	6.1	5.3	5.7	5.6	5.6	5.6	5.8	5.2	5.5	5.7	5.1	5.4
14 JUL	5.3	5.2	6.4	6.1	6.3	6.5	6.2	6.4	6.5	6.2	6.4	6.8	6.3	6.6	6.3	6.1	6.2	6.7	6.8	6.8
11 AUG	5.4	5.4	5.7	5.8	5.8	5.8	6.3	6.1	5.9	5.8	5.9	6.2	6.3	6.3	5.7	6.1	5.9	5.6	4.9	5.3
14 SEP	5.6	NA[b]	5.3	5.4	5.4	5.7	5.1	5.4	5.3	5.1	5.2	5.4	5.1	5.3	5.4	5.1	5.3	5.3	5.4	5.4
15 OCT	7.4	6.8	7.6	7.0	7.3	7.1	7.2	7.2	7.5	7.3	7.4	7.3	6.8	7.1	7.4	7.1	7.3	7.4	7.0	7.2
10 NOV	6.2	6.8	5.8	5.8	5.8	5.8	5.6	5.7	5.6	5.5	5.6	5.7	5.5	5.6	5.6	5.5	5.6	5.8	5.6	5.7
13 DEC	6.2	6.3	5.7	5.7	5.7	6.4	5.9	6.2	5.8	5.9	5.9	6.3	6.2	6.3	6.3	6.0	6.2	6.3	5.9	6.1

[a] Ø = oblique (mean of surface and bottom values).
S = surface.
B = bottom.
$\bar{x}$ = mean.

[b] NA = not available.

TABLE E-14

SUMMARY OF ZOOPLANKTON COUNTS, ZOOPLANKTON PHYSICAL CONDITION, AND INTAKE AND DISCHARGE TEMPERATURES
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

	Parameters							
	Number per cubic meter[a]			% Total population damaged		Temperature (°C)		
Date	Intake	Discharge	% Change[b]	Intake	Discharge	Intake (ambient)	Discharge (thermal)	ΔT
26 MAR	1541.1	482.7	-69	<1	1	21.8	22.4	+0.6
21 APR	273.2	707.2	+159	3	1	24.6	25.8	+1.2
12 MAY	209.3	430.8	+106	2	0	24.9	28.4	+3.5
8 JUN	389.5	628.3	+61	4	1	26.4	35.4	+9.0
14 JUL	159.7	139.9	-12	2	2	24.0	25.8	+1.8
11 AUG	1994.0	943.3	-53	1	1	27.1	27.3	+0.2
14 SEP	20235.4	5260.4	-74	<1	<1	27.9	29.2	+1.3
15 OCT	5605.6	2197.1	-61	<1	2	24.5	24.8	+0.3
10 NOV	692.5	4046.3	+484	1	1	20.0	20.4	+0.4
Mean	3455.6	1648.4	-52					

[a] Values represent the mean of three subsamples.

[b] Percent change $= \frac{\text{Discharge} - \text{Intake}}{\text{Intake}} \times 100.$

TABLE E-15

SIMPLE CORRELATION COEFFICIENTS[a] BETWEEN
TOTAL ZOOPLANKTON PER CUBIC METER AND TEMPERATURE
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

Month	Correlation coefficient	Degrees of freedom
MAR	0.48406	12
APR	-0.36973	12
MAY	-0.23603	12
JUN	-0.16300	12
JUL	0.50367	12
AUG	-0.46266	12
SEP	0.07793	10
OCT	-0.28797	12
NOV	-0.24360	12

[a] Critical values for correlation coefficients at $\alpha = .05$ were df 12 = 0.553 and df 10 = 0.576.

TABLE E-16

ANALYSIS OF VARIANCE FOR ZOOPLANKTON DENSITY
ST. LUCIE PLANT
MARCH-NOVEMBER 1976[a]

Source	Degree of freedom	Sum of squares	Mean square	F values
Stations	7	17411775.99	2487396.57	0.8538
Months	7	53555876.59	7650839.51	2.6261*
Error	49	142752812.8	2913322.71	
TOTAL	63	213720465.4		

[a] September data not included in analysis.
* Significant at $\alpha = .05$.

TABLE E-17

DAMAGE TO CLADOCERAN POPULATION
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

		Station and depth[a]													
		11	12	0		1		2		3		4		5	
Date	Quantity[b]	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
26 MAR	Total									2.4		5.2	6.5		
	Damaged									0		0	0		
	Percent									(0)		(0)	(0)		
21 APR	Total							0.8							
	Damaged							0							
	Percent							(0)							
12 MAY	Total												1.5		
	Damaged												0		
	Percent												(0)		
8 JUN	Total	0.5	0.7				1.5	1.1				5.0		1.1	1.8
	Damaged	0	0				0	0				3.0		0	0
	Percent	(0)	(0)				(0)	(0)				(60)		(0)	(0)
14 JUL	Total														
	Damaged														
	Percent														
11 AUG	Total	4.5		1062.3	96.0	1754.3	216.0	1484.6	317.7	1073.3	3720.2	320.8	5225.8	1478.3	257.2
	Damaged	0		407.0	29.1	238.2	98.6	237.8	87.4	805.0	1142.6	189.9	1038.7	252.0	120.2
	Percent	(0)		(38)	(30)	(14)	(46)	(16)	(28)	(75)	(31)	(59)	(20)	(17)	(47)
14 SEP	Total	58.2	8.3	438.2	859.8	99.4	101.6	8998.7	NA[c]	2698.2	5455.6	185.5	2449.0	4953.6	3444.0
	Damaged	0	0	86.5	161.2	43.9	8.5	2983.9		823.1	1174.4	94.3	648.1	853.0	819.3
	Percent	(0)	(0)	(20)	(19)	(44)	(8)	(33)		(31)	(22)	(51)	(27)	(17)	(24)
15 OCT	Total	66.0	57.6	13.7		209.4	18.2	442.6	5.0	25.4	3.1	20.9		175.0	9.8
	Damaged	4.0	21.6	6.1		47.4	8.5	124.5	5.0	4.0	0	5.7		51.3	6.5
	Percent	(6)	(38)	(45)		(23)	(47)	(28)	(100)	(16)	(0)	(27)		(29)	(66)
10 NOV	Total					9.1		12.5		4.8	6.0	5.3		27.0	
	Damaged					0		0		0	3.0	0		1.9	
	Percent					(0)		(0)		(0)	(50)	(0)		(7)	

[a] Ø = oblique; S = surface; B = bottom.
[b] "Total" and "damaged" are expressed as number per cubic meter and represent the mean of three subsamples.
[c] Data not available.

TABLE E-18

DAMAGE TO OSTRACOD POPULATION
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

Date	Quantity[b]	Station and depth[a] 11 Ø	12 Ø	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
26 MAR	Total	0.9		2.6	2.3	188.4	6.9	49.0	21.5	32.4	140.1		146.0	363.1	812.1
	Damaged	0		0	0	22.9	0	8.2	0	1.2	2.6		13.0	19.7	54.1
	Percent	(0)		(0)	(0)	(12)	(0)	(17)	(0)	(4)	(2)		(9)	(5)	(7)
21 APR	Total						2.5								
	Damaged						0								
	Percent						(0)								
12 MAY	Total					2.6					222.1		4.5		
	Damaged					0					0		0		
	Percent					(0)					(0)		(0)		
8 JUN	Total										3.6				
	Damaged										0				
	Percent										(0)				
14 JUL	Total	17.7		6.0	1050.8	28.1	2441.8	1.5	112.0		62.9	1.7	108.5		342.1
	Damaged	0		0	89.9	0	90.2	0	0		0	0	0		25.3
	Percent	(0)		(0)	(9)	(0)	(4)	(0)	(0)		(0)	(0)	(0)		(7)
11 AUG	Total							11.6	15.9		483.4		114.9	2.1	2.3
	Damaged							0	0		0		0	0	0
	Percent							(0)	(0)		(0)		(0)	(0)	(0)
14 SEP	Total				9.0	9.2		15.7	NA[c]		37.3	3.0			
	Damaged				0	0		0			0	0			
	Percent				(0)	(0)		(0)			(0)	(0)			
15 OCT	Total		1.8									1.9		2.3	
	Damaged		0									0		0	
	Percent		(0)									(0)		(0)	
10 NOV	Total				1.3		1.1								
	Damaged				0		0								
	Percent				(0)		(0)								

[a] Ø = oblique; S = surface; B = bottom.
[b] "Total" and "damaged" are expressed as number per cubic meter and represent the mean of three subsamples.
[c] Data not available.

TABLE E-19

DAMAGE TO COPEPOD POPULATION
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

		Station and depth[a]													
		11	12	0		1		2		3		4		5	
Date	Quantity[b]	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
26 MAR	Total	112.3	14.9	30.0	453.5	1832.4	135.2	857.3	225.8	974.4	1192.4	1406.2	1544.5	2307.2	3690.9
	Damaged	0.9	0	12.0	34.5	439.6	34.7	16.3	15.5	9.6	10.5	12.1	38.9	17.9	45.1
	Percent	(1)	(0)	(40)	(8)	(24)	(27)	(2)	(7)	(1)	(1)	(1)	(3)	(1)	(1)
21 APR	Total	54.6	39.7	229.0	2838.9	362.2	1919.1	162.3	130.8	387.9	1836.3	114.5	1107.6	155.1	651.7
	Damaged	1.9	5.7	6.0	206.0	4.1	74.6	6.9	4.7	9.0	48.5	2.4	10.7	3.4	18.2
	Percent	(4)	(14)	(3)	(7)	(1)	(4)	(4)	(4)	(2)	(3)	(2)	(1)	(2)	(3)
12 MAY	Total	53.4	143.6	13.6	292.9	69.4	80.7	663.7	98.9	418.8	692.7	599.1	115.3	63.8	128.8
	Damaged	0.8	0	0	9.5	2.6	0	0	0	2.7	0	0	0	3.1	0
	Percent	(2)	(0)	(0)	(3)	(4)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(5)	(0)
8 JUN	Total	159.3	311.7	109.1	1059.0	264.3	949.9	149.8	2169.7	479.2	2107.4	361.3	757.3	112.6	1367.4
	Damaged	0	1.5	7.1	13.7	3.8	0	1.1	19.1	0	10.7	0	4.8	0	0
	Percent	(0)	(1)	(7)	(1)	(2)	(0)	(1)	(1)	(0)	(1)	(0)	(1)	(0)	(0)
14 JUL	Total	59.8	34.2	1948.3	732.7	6890.9	3050.8	161.9	7696.2	95.0	2264.6	141.0	4849.7	548.3	304.0
	Damaged	0	0.6	29.9	27.6	49.1	33.8	7.6	65.9	3.2	28.3	6.8	81.4	7.0	25.3
	Percent	(0)	(2)	(2)	(4)	(1)	(1)	(5)	(1)	(3)	(1)	(5)	(2)	(1)	(8)
11 AUG	Total	439.7	128.9	1782.8	171.7	1895.2	112.7	2087.7	4685.8	3173.4	4086.9	3477.6	6232.3	1491.0	532.1
	Damaged	22.7	0	42.9	23.3	0	9.4	0	23.8	11.7	161.1	26.2	105.7	19.1	5.2
	Percent	(5)	(0)	(2)	(14)	(0)	(8)	(0)	(1)	(<1)	(4)	(1)	(2)	(1)	(1)
14 SEP	Total	19508.1	4989.2	924.8	4066.4	1258.6	914.3	7349.7	NA[c]	1580.9	4778.2	2156.0	6530.7	1832.2	8258.2
	Damaged	29.1	4.2	14.2	259.7	30.0	0	0		0	49.7	0	62.3	34.4	50.6
	Percent	(<1)	(<1)	(2)	(6)	(2)	(0)	(0)		(0)	(1)	(8)	(1)	(2)	(1)
15 OCT	Total	634.4	540.3	438.0	94.1	3066.3	1685.9	1668.3	1357.3	759.5	713.2	729.8	1187.5	660.3	4419.9
	Damaged	10.0	10.8	21.2	8.1	47.4	6.1	27.0	29.9	21.4	13.8	18.9	41.0	18.7	48.9
	Percent	(2)	(2)	(5)	(9)	(2)	(<1)	(2)	(2)	(3)	(2)	(3)	(4)	(3)	(1)
10 NOV	Total	287.2	520.6	1068.6	672.2	958.8	569.9	799.6	466.8	119.2	491.2	515.1	901.4	163.8	6108.7
	Damaged	9.0	36.5	44.4	10.3	41.1	13.3	30.1	7.8	14.6	18.1	18.7	38.4	9.3	204.0
	Percent	(3)	(7)	(4)	(2)	(4)	(2)	(4)	(2)	(12)	(4)	(4)	(4)	(6)	(3)

[a] Ø = oblique; S = surface; B = bottom.
[b] "Total" and "damaged" are expressed as number per cubic meter and represent the mean of three subsamples.
[c] Data not available.

TABLE E-20

DAMAGE TO DECAPOD POPULATION
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

Date	Quantity[b]	Station and depth[a] 11 Ø	12 Ø	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
26 MAR	Total	39.0	10.3	3.5	66.7	468.1	5.1	138.9	27.6	365.2	147.8	62.3	178.4	302.3	261.7
	Damaged	4.3	2.2	0.9	20.7	182.7	1.7	16.4	4.8	7.2	0	3.5	3.2	10.8	18.0
	Percent	(11)	(21)	(26)	(31)	(39)	(33)	(12)	(17)	(2)	(0)	(6)	(2)	(4)	(7)
21 APR	Total	21.8	7.5	34.1	168.1	84.9	138.0	7.7	23.2	112.1	222.8	9.6	1209.8	25.0	189.5
	Damaged	5.7	0.6	0	8.3	2.0	8.7	0	0	4.4	14.5	0	13.5	1.8	28.6
	Percent	(26)	(8)	(0)	(5)	(2)	(6)	(0)	(0)	(4)	(7)	(0)	(1)	(7)	(15)
12 MAY	Total	114.1	90.0	2.4	262.4	105.4	135.4	21.6	61.8	44.5	163.2	22.5	64.5	6.7	55.2
	Damaged	1.9	0	0	19.0	5.2	11.3	2.8	23.3	0	32.6	0	12.0	1.0	6.1
	Percent	(2)	(0)	(0)	(7)	(5)	(8)	(13)	(38)	(0)	(20)	(0)	(19)	(15)	(11)
8 JUN	Total	8.5	14.2	16.5	63.4	16.6	123.2	6.6	530.0	1.9	598.0	7.0	294.9	7.5	245.9
	Damaged	0.4	1.5	9.4	9.7	1.3	7.6	1.1	12.8	0	21.4	0	21.6	1.1	9.0
	Percent	(5)	(11)	(57)	(15)	(8)	(6)	(17)	(2)	(0)	(4)	(0)	(7)	(15)	(4)
14 JUL	Total	24.2	13.8	131.5	151.9	203.7	405.8	0	151.6	3.1	153.9	5.1	173.6	39.2	63.3
	Damaged	0.9	0	0	20.7	14.0	22.5	0	6.6	0	6.2	0	21.7	0	0
	Percent	(4)	(0)	(0)	(14)	(7)	(6)	(0)	(4)	(0)	(4)	(0)	(13)	(0)	(0)
11 AUG	Total	27.2	19.2	9.4	52.3	216.6	89.3	121.8	2104.6	23.3	161.0	6.6	353.9	175.8	287.0
	Damaged	0	2.7	0	2.9	10.8	4.7	0	63.4	0	0	0	9.2	12.7	9.9
	Percent	(0)	(13)	(0)	(31)	(5)	(5)	(0)	(3)	(0)	(0)	(0)	(3)	(7)	(3)
14 SEP	Total	33.3	33.4	509.3	609.3	683.6	414.8	3345.0	NA[c]	1025.2	465.9	887.8	928.6	627.4	712.9
	Damaged	0	0	1.4	53.9	11.5	4.2	78.5		56.5	80.7	30.4	37.4	153.0	40.5
	Percent	(0)	(0)	(<1)	(9)	(2)	(1)	(2)		(6)	(17)	(3)	(4)	(24)	(6)
15 OCT	Total	42.0	27.0	222.7	0.9	110.8	18.7	513.1	59.9	33.3	347.0	106.2	52.0	179.7	338.9
	Damaged	2.0	1.8	1.5	0.9	8.0	5.4	12.0	10.0	5.3	30.6	7.6	5.5	0	13.1
	Percent	(5)	(7)	(1)	(100)	(7)	(29)	(2)	(17)	(16)	(9)	(7)	(11)	(0)	(4)
10 NOV	Total	2.2	9.1	3.4	14.3	4.6	6.6	15.0	14.2	2.4	21.1	0	16.0	4.6	79.3
	Damaged	0.4	9.1	0	5.2	0	1.1	7.5	2.8	2.4	0	0	6.4	1.8	0
	Percent	(18)	(0)	(0)	(36)	(0)	(17)	(50)	(20)	(100)	(0)	(0)	(40)	(39)	(0)

[a] Ø = oblique; S = surface; B = bottom.
[b] "Total" and "damaged" are expressed as number per cubic meter and represent the mean of three subsamples.
[c] Data not available.

TABLE E-21

DAMAGE TO CHAETOGNATH POPULATION
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

		Station and depth[a]													
		11	12	0		1		2		3		4		5	
Date	Quantity[b]	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
26 MAR	Total	0.5		0.9	23.0	62.8	1.7	16.3	6.0	26.4	16.9	19.0	64.7	123.4	207.6
	Damaged	0.5		0	18.4	40.0	0	16.3	3.6	8.4	6.5	13.9	29.2	53.6	108.3
	Percent	(100)		(0)	(80)	(64)	(0)	(100)	(60)	(32)	(39)	(73)	(45)	(43)	(52)
21 APR	Total			2.1				6.9	0.9	5.5			2.7	1.8	
	Damaged			0.7				1.5	0.9	1.1			0	0.9	
	Percent			(33)				(22)	(100)	(20)			(0)	(50)	
12 MAY	Total	2.7			7.6	5.1	15.0	30.0	7.0	54.5	117.6	57.4	3.0	5.2	18.4
	Damaged	1.9			3.8	0.	5.6	11.3	4.7	19.1	98.0	20.0	3.0	2.1	12.3
	Percent	(70)			(50)	(0)	(37)	(38)	(67)	(35)	(83)	(35)	(100)	(40)	(67)
8 JUN	Total	1.5	0.7	4.8	6.9		9.1		23.4	9.5	24.9	1.0	9.6	3.3	
	Damaged	1.1	0.7	2.4	4.1		3.0		6.4	1.9	17.8	0	2.4	1.1	
	Percent	(73)	(100)	(50)	(59)		(33)		(27)	(20)	(72)	(0)	(25)	(33)	
14 JUL	Total	2.5	1.7	502.1	248.8	688.4	310.2	12.1	85.7	15.8	103.8	15.3	48.7	86.7	
	Damaged	0	1.1	41.8	48.4	63.2	22.6	1.5	13.2	4.7	15.7	6.8	5.4	11.2	
	Percent	(0)	(65)	(8)	(20)	(9)	(7)	(12)	(15)	(30)	(15)	(44)	(11)	(13)	
11 AUG	Total	4.5	16.5	61.7		97.4	4.7	87.0	119.1	70.0	161.0	59.0	101.1	80.5	18.5
	Damaged	0	1.4	11.2		0	4.7	5.8	15.9	35.0	14.6	15.3	23.0	19.1	1.7
	Percent	(0)	(9)	(18)		(0)	(100)	(7)	(13)	(50)	(9)	(26)	(23)	(24)	(9)
14 SEP	Total		8.4	29.8	161.2	41.6	38.1	47.1	NA[c]	14.8	55.9	82.1	155.8	7.6	55.7
	Damaged		0	1.4	26.9	0	8.5	0		0	12.4	21.3	49.9	0	15.2
	Percent		(0)	(5)	(17)	(0)	(22)	(0)		(0)	(22)	(26)	(32)	(0)	(27)
15 OCT	Total	14.0	12.6	6.0	0.9	55.3	17.6	33.0	39.9	6.7	23.1	7.6	71.1	4.7	45.7
	Damaged	4.0	0	0	0	0	2.4	3.0	15.0	2.7	0	0	30.1	0	13.0
	Percent	(29)	(0)	(0)	(0)	(0)	(14)	(9)	(38)	(40)	(0)	(0)	(42)	(0)	(28)
10 NOV	Total	2.9	9.2	3.4	24.6	13.7	4.4	5.0	3.6	2.4	21.1		32.0		22.6
	Damaged	0	4.6	0	3.9	4.6	0	0	0	2.4	10.6		16.0		11.3
	Percent	(0)	(50)	(0)	(16)	(34)	(0)	(0)	(0)	(100)	(50)		(50)		(50)

[a] Ø = oblique; S = surface; B = bottom.
[b] "Total" and "damaged" are expressed as number per cubic meter and represent the mean of three subsamples.
[c] Data not available.

TABLE E-22

DAMAGE TO APPENDICULARIAN POPULATION
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

Date	Quantity[b]	11 Ø	12 Ø	0 S	0 B	1 S	1 B	2 S	2 B	3 S	3 B	4 S	4 B	5 S	5 B
		Station and depth[a]													
26 MAR	Total	47.0							1.2	30.0	28.8	5.2	35.7		
	Damaged	0.5							0	0	0	1.7	0		
	Percent	(1)							(0)	(0)	(0)	(33)	(0)		
21 APR	Total	1.3		2.2	41.3	10.1	65.8	29.6	53.7	380.0	213.2	113.7	475.8	7.7	70.1
	Damaged	0		0	0	0	12.4	0	4.6	28.0	19.4	5.6	48.4	0	5.2
	Percent	(0)		(0)	(0)	(0)	(19)	(0)	(9)	(7)	(9)	(5)	(10)	(0)	(7)
12 MAY	Total	0.4		0.8	17.1		1.9	32.9	10.5	87.3	65.4	167.3	7.5	4.2	0
	Damaged	0		0.8	7.6		0	2.8	0	7.3	13.1	20.0	0	1.6	0
	Percent	(0)		(100)	(44)		(0)	(9)	(0)	(8)	(20)	(12)	(0)	(38)	(0)
8 JUN	Total	0.7		2.4	6.8	6.4	4.6	1.1	8.5	149.9	85.4	13.1	24.0	5.3	26.9
	Damaged	0		0	2.7	0	1.5	0	0	1.9	10.7	0	4.8	1.1	3.6
	Percent	(0)		(0)	(40)	(0)	(33)	(0)	(0)	(1)	(13)	(0)	(20)	(21)	(13)
14 JUL	Total	3.0	2.3	41.9	62.2	35.2	180.5	18.1	118.7	12.7	31.4	13.6		2.8	50.7
	Damaged	1.4	1.7	6.0	6.9	14.1	11.3	3.0	26.4	1.6	3.1	6.8		1.4	0
	Percent	(47)	(74)	(14)	(11)	(40)	(6)	(17)	(22)	(13)	(10)	(50)		(50)	(0)
11 AUG	Total	4.5		18.7		10.8	9.4	5.8	71.5	256.6	424.8	87.3	87.3	21.2	8.7
	Damaged	0		0		0	4.7	0	23.8	23.3	14.6	13.1	0	0	2.3
	Percent	(0)		(0)		(0)	(33)	(0)	(33)	(9)	(3)	(15)	(0)	(0)	(26)
14 SEP	Total	58.2	16.7	22.7	304.5	4.6	8.5	15.7	NA[c]	3.0	155.3	33.5	205.7	7.6	65.7
	Damaged	0	0	0	0	2.3	0	0		0	31.1	6.1	12.5	3.8	0
	Percent	(0)	(0)	(0)	(0)	(50)	(0)	(0)		(0)	(20)	(18)	(6)	(50)	(0)
15 OCT	Total		3.6	25.7	2.7	27.7	17.6	54.0	39.9	173.8	67.6	172.5	13.7	18.7	26.0
	Damaged		1.8	4.5	0.9	0	4.2	12.0	10.0	4.0	24.6	1.9	0	4.7	13.0
	Percent		(50)	(18)	(33)	(0)	(24)	(22)	(25)	(2)	(36)	(1)	(0)	(25)	(50)
10 NOV	Total	0.8	18.2	10.2	36.1	36.6	23.3	15.0	18.5	7.3	9.1	34.7	48.0	6.5	
	Damaged	0.4	9.1	0	6.5	4.6	1.1	5.0	2.1	1.2	1.5	0	12.8	2.8	
	Percent	(50)	(50)	(0)	(18)	(13)	(5)	(33)	(11)	(16)	(17)	(0)	(27)	(43)	

[a] Ø = oblique; S = surface; B = bottom.
[b] "Total" and "damaged" are expressed as number per cubic meter and represent the mean of three subsamples.
[c] Data not available.

TABLE E-23

DIFFERENCES BETWEEN MONTHLY MEAN ZOOPLANKTON COUNTS
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

Month (Mean)	APR (1306.8)	MAY (442.7)	JUN (1151.5)	JUL (2486.9)	AUG (3606.5)	SEP (7706.5)	OCT (2389.1)	NOV (2163.6)
MAR (1618.5)	311.7	1175.8	476.0	868.4	1988.0	6088.0*	770.6	545.1
APR (1306.8)		864.1	155.3	1180.1	2299.7	6399.7*	917.7	856.8
MAY (442.7)			708.8	2044.2	3163.8*	7263.8*	1946.4	1720.9
JUN (1151.5)				1335.4	2455.0	6555.0*	1237.6	1012.1
JUL (2486.9)					1119.6	5219.6*	2097.8	323.3
AUG (3606.5)						4100.0*	1217.4	1442.9
SEP (7706.5)							5317.4*	5542.9*
OCT (2389.1)								225.5

* Significant at $\alpha = .05$, Tukey's HSD = 2703.5.

TABLE E-24

RESULTS OF ZOOPLANKTON BIOMASS ANALYSIS[a]
ST. LUCIE PLANT
MARCH-NOVEMBER 1976

	Station and depth[b]													
	11	12	0		1		2		3		4		5	
Date	Ø	Ø	S	B	S	B	S	B	S	B	S	B	S	B
26 MAR	0.390	0.096	0.004	1.122	0.864	0.175	1.335	16.752	0.887	0.760	6.496	0.700	3.282	1.223
21 APR	0.093	N.A.[c]	0.137	0.485	0.185	N.A.[c]	0.432	1.465	1.048	6.633	0.405	1.699	N.A.[c]	1.665
12 MAY	0.218	0.612	0.169	1.724	0.963	1.045	0.319	0.118	1.560	4.793	0.682	0.127	0.169	1.274
8 JUN	0.089	0.618	0.093	1.697	0.378	0.110	0.157	0.661	0.466	0.771	0.167	0.447	0.173	0.207
14 JUL	0.111	0.053	1.454	1.849	5.983	8.696	0.380	2.734	0.217	1.167	0.178	5.913	0.414	1.059
11 AUG	0.827	0.279	0.744	0.015	1.151	0.828	0.813	7.006	6.119	2.026	0.891	4.984	1.113	1.482
14 SEP	3.559	1.079	0.484	0.453	0.533	0.121	0.779	3.103	1.523	4.410	0.998	2.390	2.296	4.106
15 OCT	0.187	0.591	0.183	2.686	1.903	1.525	1.049	0.601	0.669	2.942	0.449	0.922	0.759	2.507
10 NOV	0.145	0.795	1.230	1.139	0.894	0.672	0.290	0.304	0.446	0.974	0.391	3.473	0.171	0.926
Station $\bar{x}$	0.624	0.515	0.499	1.241	1.428	1.646	0.617	3.638	1.437	2.719	1.184	2.280	1.047	1.605

[a] Ash-free dry weight expressed in $g/m^3 \times 10^{-2}$.

[b] Ø = Oblique; S = Surface; B = Bottom.

[c] Data not available.

TABLE E-25

ANALYSIS OF VARIANCE[a] FOR ZOOPLANKTON BIOMASS
ST. LUCIE PLANT
MARCH-NOVEMBER 1976[b]

Source	Degree of freedom	Sum of squares	Mean squares	F values
Stations	7	21.878266	3.125466571	1.206008414
Months	7	27.358464	3.908352	1.508096564
Error	49	126.987391	2.591579408	
TOTAL	63	176.224121		

[a] Critical F value for analysis of variance at $\alpha = .05$ with 7 df = 2.25.
[b] April data not included in analysis.

F. AQUATIC MACROPHYTES

INTRODUCTION

The offshore aquatic macrophytes were sampled to determine if the operation of the St. Lucie Plant was affecting this community. The term "aquatic macrophytes" refers to aquatic plants large enough to be seen with the unaided eye. In the marine environment this includes the seaweeds and seagrasses. Marine plants grow in many habitats, but their distribution is limited by the availability of light, substrate and oxygen.

Most marine plants are found from the intertidal zone to depths of 30 to 40 meters. Beyond this depth there is usually insufficient light for photosynthesis due to the light-absorbing properties of seawater (Dawson, 1966). Red algae, however, are adapted to low light levels and have been dredged from depths of 170 meters in clear tropical water (McConnaughey, 1970).

Marine macrophytes usually require a hard substrate for attachment and therefore seaweed is rarely found growing in shifting sands or soft mud. Along the east coast of Florida, seaweed is found on rock outcroppings, worm reefs, shell rubble, and artificial substrates. Algae are usually sparse on and near coral reefs due to grazing by herbivorous reef fish.

Water temperature may limit the growth of marine plants directly by affecting the rate of photosynthesis and indirectly by altering the solubility of oxygen in the water. As a result, many marine plants tolerate only a narrow temperature range (Dawson, 1966).

MATERIALS AND METHODS

Aquatic macrophytes were collected quarterly at each of the six offshore stations during 1976 (Figure F-1). Samples were collected by towing a box-type dredge (46 cm x 46 cm x 25 cm) along the ocean bottom. The tow duration and speed were recorded with each tow and used to compute the surface area sampled. Duplicate samples were taken at each station and preserved with a buffered 5% formalin-seawater solution in labeled containers.

The preserved samples were sorted in the laboratory, and attached macrophytes were scraped from shell and rubble surfaces. Macrophytes were identified to the lowest possible taxon, and all material was retained as voucher specimens. Species identification was according to Taylor (1960).

RESULTS AND DISCUSSION

Less than 1 gram wet weight of algae was collected during any macrophyte dredge sampling in 1976. Algae collected were insufficient for quantitative analysis, even when the area sampled was increased from 13 m^2 to 580 m^2.

The offshore stations, 0 to 5 (Figure F-1), are open areas of shell hash with very little hard substrate for algal attachment. All of the algae collected were found on rubble and shell fragments. The algae were often torn or stunted, probably due to mechanical damage from the dredge, ocean currents, or the unstable substrate.

Twenty-three species of algae were collected during 1976 (Table F-1). Most of the species were red and brown algae. Green algal species comprised only 17% of those collected. This distribution is normal since the Chlorophyta, or green algae, is primarily a freshwater group. The Rhodophyta, or red algae, is the largest and most diverse group of marine plants. With the exception of one species, all red algae are benthic, attached forms (Dawson, 1966). The dredge method of collecting macrophytes selects for attached algae. The bushy red alga, *Agardhiella tenera*, has a strong disklike holdfast as a young plant and was often found attached to shells and rocks.

Subtropical and tropical algal associations typically show seasonal variations. Species diversity and abundance are usually greatest in late summer and fall. Hutchinson Island is located in the subtropical zone (Phillips, 1961) and the algae reflect the characteristic seasonal trends of this latitude. Small amounts of algae were found at only two stations in March (Table F-2). Four stations in June (Table F-3) had one or two algal species, but in

September (Table F-4) algae were collected at all stations. In December the diversity was slightly less than in September and no algae were collected at Station 2. Reproductive algae were collected in September and December.

No trends in diversity and abundance besides seasonal changes were noted between stations. Algal growth at all stations is limited primarily by the lack of substrate. Benthic algae in this offshore area are not important primary producers. The open shifting ocean floor off Hutchinson Island is not a productive area for algae, and material collected was therefore insufficient to make a quantitative evaluation of the benthic macrophyte community.

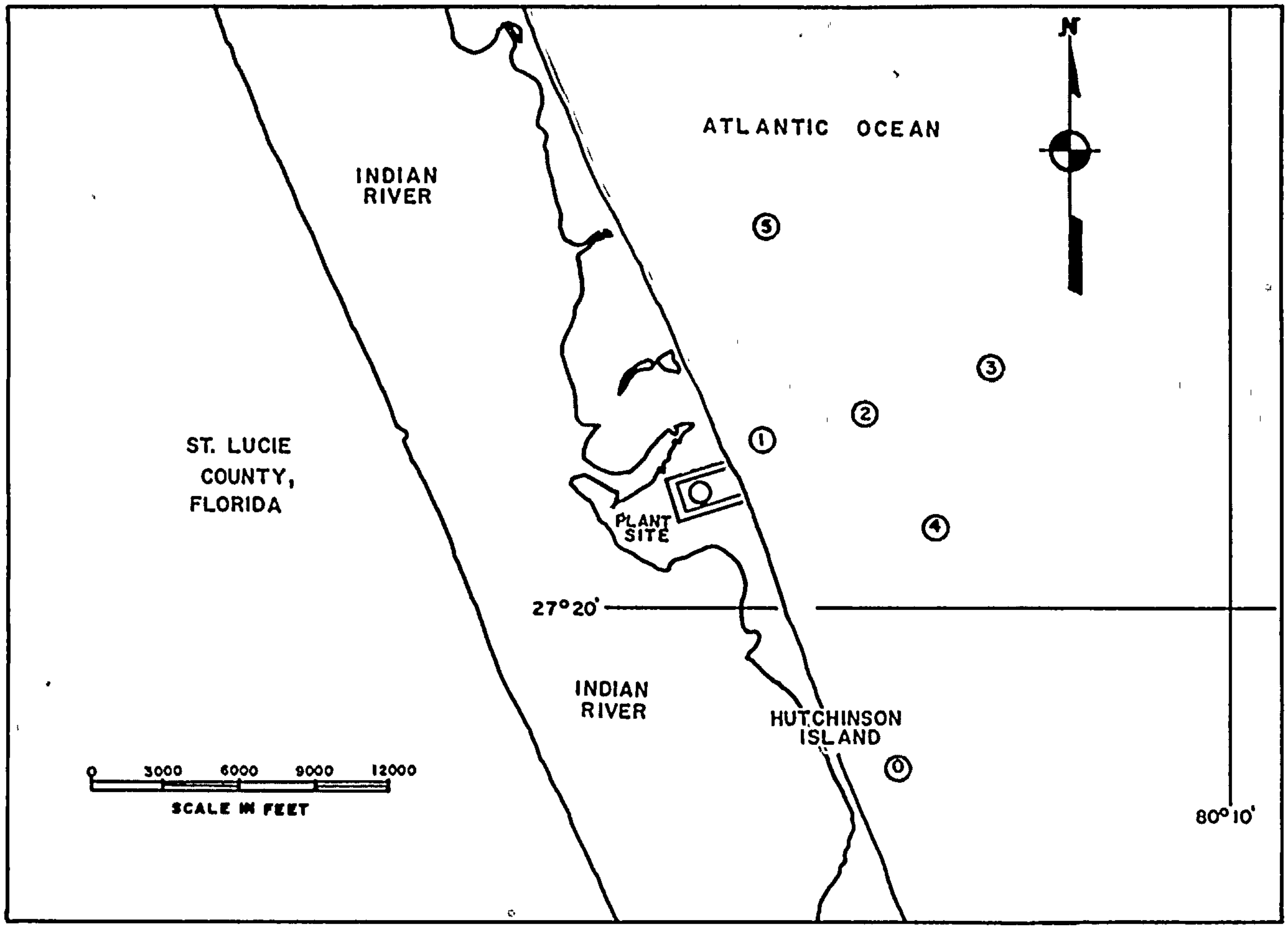
LITERATURE CITED

Dawson, E. Y. 1966. Marine botany. Holt, Rinehart and Winston, Inc., New York. 371 pp.

McConnaughey, B. H. 1970. Introduction to marine biology. C. V. Mosby Co., St. Louis. 449 pp.

Phillips, R. C. 1961. Seasonal aspects of the marine algal flora of the St. Lucie inlet and adjacent Indian River, Florida. Quart. Jour. Fla. Acad. Sci. 24(2).

Taylor, W. R. 1960. Marine algae of the eastern tropical and subtropical coasts of the Americas. Univ. of Michigan Press. 870 pp.



FLORIDA POWER & LIGHT COMPANY
ST. LUCIE PLANT

LOCATIONS OF MACROPHYTE SAMPLING STATIONS 1976

MARCH 1977 APPLIED BIOLOGY, INC. FIGURE F-1

TABLE F-1

MACROPHYTE SPECIES COLLECTED BY DREDGE AT OFFSHORE STATIONS
ST. LUCIE PLANT
1976

CHLOROPHYTA (green algae)
Batophora oerstedi
Cladophora sp.
Enteromorpha sp.
Rhizoclonium sp.

PHAEOPHYTA (brown algae)
Dictyota linearis
Dictyota sp.
Ectocarpus subcorymbosus
Sargassum spp.
Sphacelaria furcigera
S. tribuloides
Sphacelaria sp.

RHODOPHYTA (red algae)
Agardhiella tenera
Agardhiella spp.
Botryocladia pyriformis
Ceramium fastigiatum
Ceramium sp.
Laurencia sp.
Gracillaria sp.
Polysiphonia denudata
P. sphaerocarpa
P. subtilissima
Porphyra umbilicalis
Spermothamnion investiens

TABLE F-2

MACROPHYTE SAMPLING RESULTS
ST. LUCIE PLANT
12 MARCH 1976[a]

Station	Species
0	-------
1	*Agardhiella tenera*
2	*Spacelaria* sp.
3	--------
4	--------
5	--------

[a] Average area sampled was 13 m^2.

TABLE F-3

MACROPHYTE SAMPLING RESULTS
ST. LUCIE PLANT
10 JUNE 1976[a]

Station	Species
0	--------
1	--------
2	*Dictyota linearis*
3	*Agardhiella tenera*
4	*Ceramium fastigiatum* *Cladophora* sp.
5	*Cladophora* sp.

[a] Average area sampled was 145 m^2.

TABLE F-4

MACROPHYTE SAMPLING RESULTS
ST. LUCIE PLANT
10 SEPTEMBER 1976[a]

Station	Species
0	*Rhizoclonium* sp.
	Sphacelaria tribuloides
1	*Agardhiella* sp.
	Botrycladia pyriformis
	Laurencia sp.
2	*Agardhiella tenera*
	Agardhiella sp.
	Batophora oerstedi
	Dictyota sp.
	Polysiphonia denudata
	Sphacelaria furcigera
	S. tribuloides
3	*Porphyra umbilicalis*
4	*Agardhiella* sp.
	Batophora oerstedi
	Dictyota sp.
	Gracillaria sp.
5	*Agardhiella* sp.
	Batophora oerstedi
	Ceramium sp.
	Dictyota sp.
	Ectocarpus subcorymbosus
	Enteromorpha sp.
	Polysiphonia denudata
	Polysiphonia sp.

[a] Average area sampled was 170 m^2.

TABLE F-5

MACROPHYTE SAMPLING RESULTS
ST. LUCIE PLANT
12 DECEMBER 1976[a]

Station	Species
0	*Agardhiella* sp. *Enteromorpha* spp. *Polysiphonia sphaerocarpa*
1	*Enteromorpha compressa* *Enteromorpha* sp. *Polysiphonia subtilissima* *Polysiphonia* sp. *Sargassum* spp.
2	---------
3	*Agardhiella tenera*
4	*Agardhiella tenera* *Spermothamnion investiens*
5	*Sargassum* sp.

[a] Average area sampled was 580 m^2.

G. WATER QUALITY

INTRODUCTION

This study was designed to monitor the physical and chemical parameters of the aquatic habitat at the St. Lucie Plant. The study of physical and chemical parameters provides a measure of water quality and potential productivity. Water quality measurements integrated with biological data provide a unified view of the ecosystem and facilitate the examination of the relationship between the environment and the marine fauna.

The presence of biologically important micronutrients such as inorganic nitrogen species, silicates, phosphates, and total organic carbon is essential for the growth of phytoplankton populations (Yentsch, 1962). Salinity and temperature are also important to the stability and growth of sedentary and motile fauna. Variations in these parameters may cause changes in the metabolism of organisms. Thus, temperature, salinity, and nutrients often have a synergistic effect on the physiological state of marine fauna.

PHYSICAL PARAMETERS

Materials and Methods

Physical oceanographic parameters, including water temperature, salinity, dissolved oxygen, turbidity and percent transmittance

of light, were measured at designated offshore stations at surface, middle, and bottom depths. Stations located within the canals were sampled for temperature, salinity, dissolved oxygen and turbidity at surface and bottom depths. Station locations are indicated on Figure G-1, and parameters measured at each station are given in Table G-1.

Water Temperature Monitoring (continuous)

Ryan-Peabody thermographs were calibrated by comparing meter readings with mercury-in-glass thermometers. Calibrations were made at the beginning and end of a one-month recording period. Thermographs were placed in the water adjacent to the offshore intake and discharge structures at subsurface depths. Data were recorded in °F.

Water Temperature Monitoring (*in situ*)

Water temperatures were recorded *in situ* at biological sampling stations with a Yellow Springs Instrument (YSI) model 33 salinity, conductivity, and temperature meter. Data were recorded in °C.

Salinity

Salinity was measured by one of two methods:

1. A YSI salinity-conductivity-temperature meter model 33 with a 50-foot cable and probe was calibrated prior to use by immersion in water containing known amounts of

commercial artificial sea salts. Salinity data were recorded in the field as parts per thousand (°/₀₀).

2. An American Optical refractometer (model 10419 Goldberg, Temperature Compensating) was calibrated from stock solutions of known sea-salt concentrations. Data were recorded in °/₀₀ in the laboratory.

Dissolved Oxygen

A YSI model 54 or 51B meter with a 50-foot cable and probe was calibrated by readings taken from oxygen-saturated sea water. Data were recorded from readings *in situ*, at designated depths, in ppm (mg/l).

Turbidity

Water turbidity was measured with either an Interocean model 515 TR turbidity meter or a Hellige Turbidimeter. Accuracy of the Interocean meter was determined by calibrating the probe which was immersed in distilled water. The Hellige meter was precalibrated by the manufacturer. Offshore turbidity was measured *in situ*, whereas canal samples were returned to the laboratory for analysis. Turbidity was measured as a function of light attentuation over a fixed path length as recommended by EPA (1974). Data were expressed as percent transmittance of light.

Conventional units of turbidity are based upon FTU (Formazine Turbidity Units) and may be related to percent transmittance values by the following:

$$\% \text{ Transmittance} = ae^{bx}$$

where: $a = 99.69$

$b = -0.0254,$

and x = FTU (Formazine Turbidity Units).

<u>Luminosity (Light Transmittance)</u>

Luminosity (light transmittance through the water column) was recorded with an Interocean Marine Illuminance meter model 510 at offshore stations. Comparisons between incident solar radiation at the surface and at various depths were recorded as luminosity in foot-candles and expressed as percent transmittance of light. Data were taken at surface, middle, and bottom depths at all offshore stations.

<u>Current Velocity</u>

Surface current speed and direction were measured at offshore stations with a General Oceanics model 2030 digital flowmeter lowered to 0.5 m depth. Surface currents were recorded in cm/sec. After a one-minute reading, direction was estimated with a magnetic marine compass.

Wind Direction, Wind Velocity, and Cloud Cover

Wind direction and velocity were estimated at the same time biological samples were taken. Cloud cover was estimated and expressed as clear, partly cloudy, rainy, or similar descriptors.

Results and Discussion

Salinity, temperature, dissolved oxygen, and turbidity data were taken to provide supplementary information to the biological aspects of the program. In the event of unusual or extraordinary observations made of the biotic communities, physical parameter data could delineate plant-related causes versus natural phenomena. Physical oceanographic data were ancillary and not a study objective *per se*. Therefore, only maximum and minimum parameter values have been presented (Tables G-2 through G-4). Current velocity data have been limited to a brief summary, "Current Velocity," below.

With the exception of water temperatures immediately adjacent to the discharge structure, statistical analyses indicated no significant difference ($P \leq .05$) in the distribution of physical parameter values at the surface, middle, or bottom depths. No significant vertical stratification was observed in temperature, salinity, or dissolved oxygen. Analysis of physical oceanographic data indicated that the nearshore ocean water is generally well-mixed and homogeneous.

Water Temperature Monitoring (continuous)

Ryan-Peabody thermograph readings at the ocean intake structure showed nearshore ocean temperatures ranging seasonally from about 65 to 86°F (18.4 to 30.2°C). Maximum surface temperatures normally occurred in September, when ocean temperatures remained above 80°F. Surface temperatures rapidly fell from 77°F (25.2°C) to 65°F (18.5°C) beginning on 2 August and remained depressed until 6 August. These cool ocean temperatures were presumed to be the result of cold water intrusion caused by Gulf Stream eddies that often affect local water conditions (Lee, 1971, 1972; Jossi, 1971).

Daily temperature fluctuations were greatest during April through July (Appendix Figure H-1). Daily ocean temperature variations were from 3 to 5°F (1.7 to 2.8°C). Temperature fluctuations in September and October were less than 2°F. Heated water was discharged into the ocean on 59 days during April through July (Appendix Figure H-2). Recorded discharge temperatures ranged from about 71 to 83°F (21.8 to 28.6°C). Thermograph records for 25 June indicated maximum discharge temperatures exceeded 5.5°F (3.1°C) above ambient for a short period (Figure G-2). The power plant remained inoperative from August to December and operation was resumed in December. Discharge thermograph data were unavailable from August through December. The Ryan-Peabody thermographs located at the discharge structures suffered loss by boat propellers, vandalism (?), theft (?) or destruction due to storm surge during these months.

Water Temperature Monitoring (*in situ*)

The greatest difference in surface temperatures between stations was observed on 22 and 23 June 1976. Temperatures at the discharge (Station 1) were 2.9°F (1.6°C) and 4.3°F (2.4°C) higher, respectively, than surface temperatures at Station 2 on these dates. Surface temperature variation between Stations 2 through 5 and the control Station (0) was less than 1°F (0.5°C). The mid-depth temperature at Station 1 was 3.5°F (1.9°C) above ambient as compared to 2.8°F (1.5°C) above ambient at Station 2. Bottom temperatures on 23 June remained 3.1°F (1.9°C) higher at Station 1 than at Station 2, but no appreciable difference in bottom temperatures was observed on 22 June (Table G-5).

Salinity - Salinity values ranged from 33.8 °/oo to 36.3 °/oo at offshore stations during the study (Table G-2). No significant difference was observed between stations. Salinity value ranges indicated some freshwater influence typical of nearshore Atlantic coastal areas.

Dissolved Oxygen - Dissolved oxygen values ranged from 4.4 ppm to 7.7 ppm during the study at the offshore stations (Table G-3). Surface, mid-depth, and bottom readings showed no stratification of dissolved oxygen.

Turbidity - Station turbidity values ranged from 54% to 100% transmittance. Although turbidity differences between stations (Table G-4) were not significant, higher turbidities were associated with Station 1 near the discharge structure. Physical turbulence and the suspension of particulate matter from the discharge canal probably contributed to the higher turbidity values observed at Station 1.

Light Transmittance - Offshore percent transmittance data (Table G-6) indicate less than 50% of the solar radiation penetrated the surface at offshore stations. Average percent transmittance values were similar in magnitude; however, light transmittance at the control (Station 0) was slightly greater than that at the experimental stations (1 through 5). Mid-depth and bottom readings were highest at Station 3, the shallowest station.

Current Velocity - Surface current velocities ranged from 10.0 to 46.0 cm/sec. The highest current velocities were observed in the fall, and occurred concurrently with maximum wind velocities. These observations are typical of a surface wind stress system. Surface current flow was observed to be generally in a northerly direction. Average surface current velocities were lowest at Station 0 and highest at Station 5. Currents were most variable at Station 1 as a result of turbulence due to plant operation. Turbulence boils were observed only in the immediate vicinity of the discharge.

CHEMICAL PARAMETERS

Materials and Methods

Samples of water for nutrient analyses were collected monthly at designated stations. Station locations are indicated on Figure G-1 and parameters measured are given in Table G-1. The methods used in nutrient analyses are listed in Table G-7. Duplicate samples were taken from surface, middle, and bottom depths. Surface samples were collected by dipping, and subsurface samples were either pumped or sampled with a Niskin bottle. Samples were treated as follows:

Inorganic Nitrogen (NO_3-N, NO_2-N, NH_3-N):
Acid-washed 1-liter polyethylene bottles were charged with 40 mg mercuric chloride ($HgCl_2$), filled with water samples and immediately stored on ice.

Dissolved Silica (SiO_2-Si):
Treated as in Inorganic Nitrogen, above.

Ortho-Phosphate Phosphorous (PO_4-P):
Treated as in Inorganic Nitrogen, above.

Total Organic Carbon (TOC):
Acid-washed 250-ml polyethylene bottles were spiked with 5 ml of concentrated sulfuric acid (H_2SO_4), filled with samples, and immediately stored on ice.

Chemical samples were shipped to the laboratory by air on the day of collection. Methods of analysis used to measure these selected water parameters were from APHA (1976), EPA (1974), and Strickland and Parsons (1972).

Results and Discussion

The distribution of nutrients in the marine environment is a function of diffusion, currents and biological turnover. Nearshore nutrients are generally considered to be well-mixed and homogeneous as a result of turbulence induced by winds or currents (Bowden, 1970). High concentrations of ocean nutrients are spatially limited and usually associated with upwelling (Spencer, 1975), a river-ocean interface (Stefanson and Richards, 1963), or ocean waste disposal outfalls (EPA, 1971).

Micronutrient analyses for ortho-phosphate (PO_4-P), total silicates (SiO_2), nitrate (NO_3-N), nitrite (NO_2-N), ammonia nitrogen (NH_3-N), and total organic carbon (TOC) from monthly collections of seawater are presented in Appendix Tables H-160 through H-169. Nitrate and silicate values reported from March through July 1976 were unusually high for seawater collections. Concentrations ranged from 0.15 to 0.56 ppm NO_3 and 0.02 to 11.20 ppm SiO_2 during this period.

Changes in methodology and analyses for NO_3, SiO_2, and PO_4 made in August resulted in lower values. Procedures for analysis of NH_3 were revised in October and the results reflect lower concentrations. Nutrient analyses following analytical changes were within the expected ranges of concentrations of nearshore Atlantic environments (Armstrong, 1965; Spencer, 1975; Haines, 1973).

Comparison of results from October through December indicated minimal increases of silicates attributable to power plant operation. Plant circulating pump operation was intermittent during these months. Intake (Station 11) and discharge (Station 12) canal waters had slightly higher concentrations of silicates, probably as a result of the suspension of terrigenous material from canal berm erosion (Appendix Tables H-160 through H-169). Ortho-phosphate (PO_4) concentrations were similar at the offshore and canal stations. Nitrite (NO_2) values remained ≤0.01 ppm throughout the year and reflected normal ranges found in marine environments (Spencer, 1975). Ammonia (NH_3) concentrations were only slightly higher in canal water samples than in offshore station samples.

Total organic carbon (TOC) is a quantitative measurement which includes both the dissolved organic carbon (DOC) and particulate organic carbon (POC) present in a given system. Offshore concentrations of TOC at Stations 0 through 5 were not significantly different (P=.05; Table G-8). Bottom TOC concentrations were generally higher than mid-depth or surface values. There were no apparent seasonal fluctuations in TOC: high concentrations were observed in April, September and December while low concentrations were observed in May, June, August and October.

TOC can also be used as a relative indicator of suspended organic matter which may contribute to turbidity. Linear regression analysis, however, indicated TOC accounted for only 14.2% of the variation in surface turbidity, 7.9% of mid-depth, and 2.8% of bottom turbidity.

LITERATURE CITED

APHA. 1976. Standard methods for the examination of water and wastewater, 14th ed. American Public Health Association, Washington, D. C. 874 pp.

Armstrong, F. A. J. 1965. Nutrient distributions. Pages 409-432 *in* J. P. Riley and G. Skirrow, eds. Chemical oceanography, Vol. 1. Academic Press, New York.

Bowden, K. F. 1970. Turbulence II. Oceanogr. Mar. Biol. Ann. Rev. 8:11-32.

Environmental Protection Agency. 1974. Proceedings of seminar on methodology for monitoring the marine environment. Office of Monitoring Systems Program Element No. 1HA326. Washington, D.C.

______________________________. 1971. Limitations and effects of waste disposal on an ocean shelf. Grant 16070EFG. Water Pollution Control Res. Ser.

Haines, E. B. 1973. Nutrient inputs to the coastal zone: 2. The Georgia and South Carolina shelf (unpublished manuscript). Duke University Marine Laboratory, Beaufort, N.C.

Jossi, J. W. 1971. Oceanography: Central Florida's Atlantic continental shelf. NOAA Trop. Atl. Inf. Rep. No. 19. 13 pp.

Lee, T. N. 1972. Florida current spinoff eddies. Ph.D. Dissertation. Florida State University. 98 pp.

_________. 1971. Oceanographic features of nearshore waters on a narrow continental shelf. Pages 105-170 *in* Environmental Protection Agency. Limitations and effects of waste disposal on an ocean shelf. Grant 16070EFG. Water Pollution Control Res. Ser.

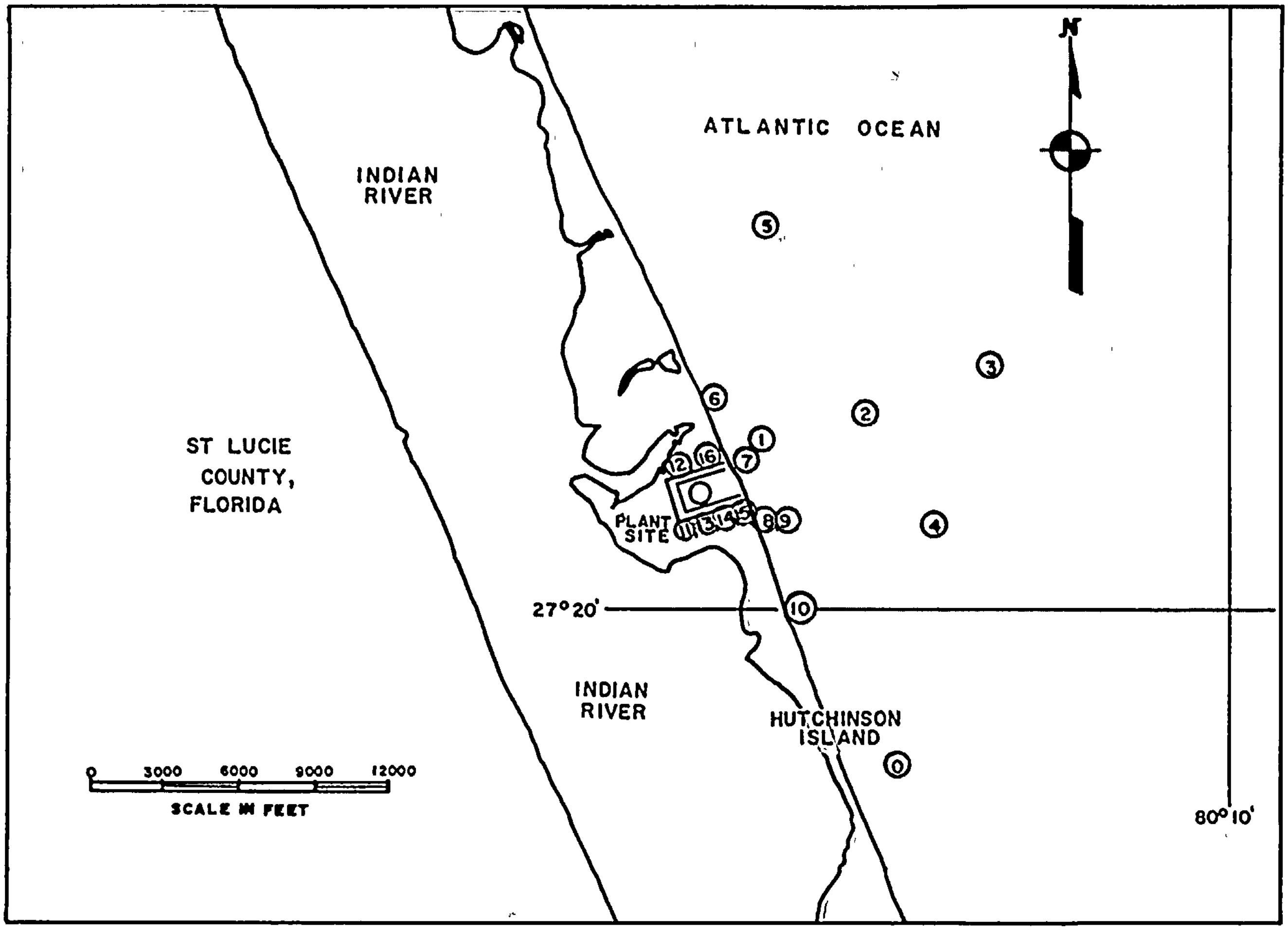
Spencer, C. P. 1975. Nutrient distributions. Pages 245-300 *in* J. P. Riley and G. Skirrow, eds. Chemical oceanography, Vol. 2. Academic Press, New York.

Stefansson, O., and F. A. Richardson. 1963. Processes contributing to the nutrient distributions of the Colombia River and Strait of Juan de Fuca. Limnol. and Ocean. 8(4):394-410.

LITERATURE CITED (continued)

Strickland, J. D., and T. R. Parsons. 1972. A practical handbook of seawater analysis. Fish. Res. Bd. Canad. Ottawa, Bulletin No. 167. 310 pp.

Yentsch, C. S. 1962. Marine plankton. *in* R. A. Lewin, ed. Physiology and biochemistry of algae. Academic Press, New York.



FLORIDA POWER & LIGHT COMPANY ST. LUCIE PLANT
LOCATION OF WATER QUALITY SAMPLING STATIONS 1976
MARCH 1977 · APPLIED BIOLOGY, INC. · FIGURE G-1

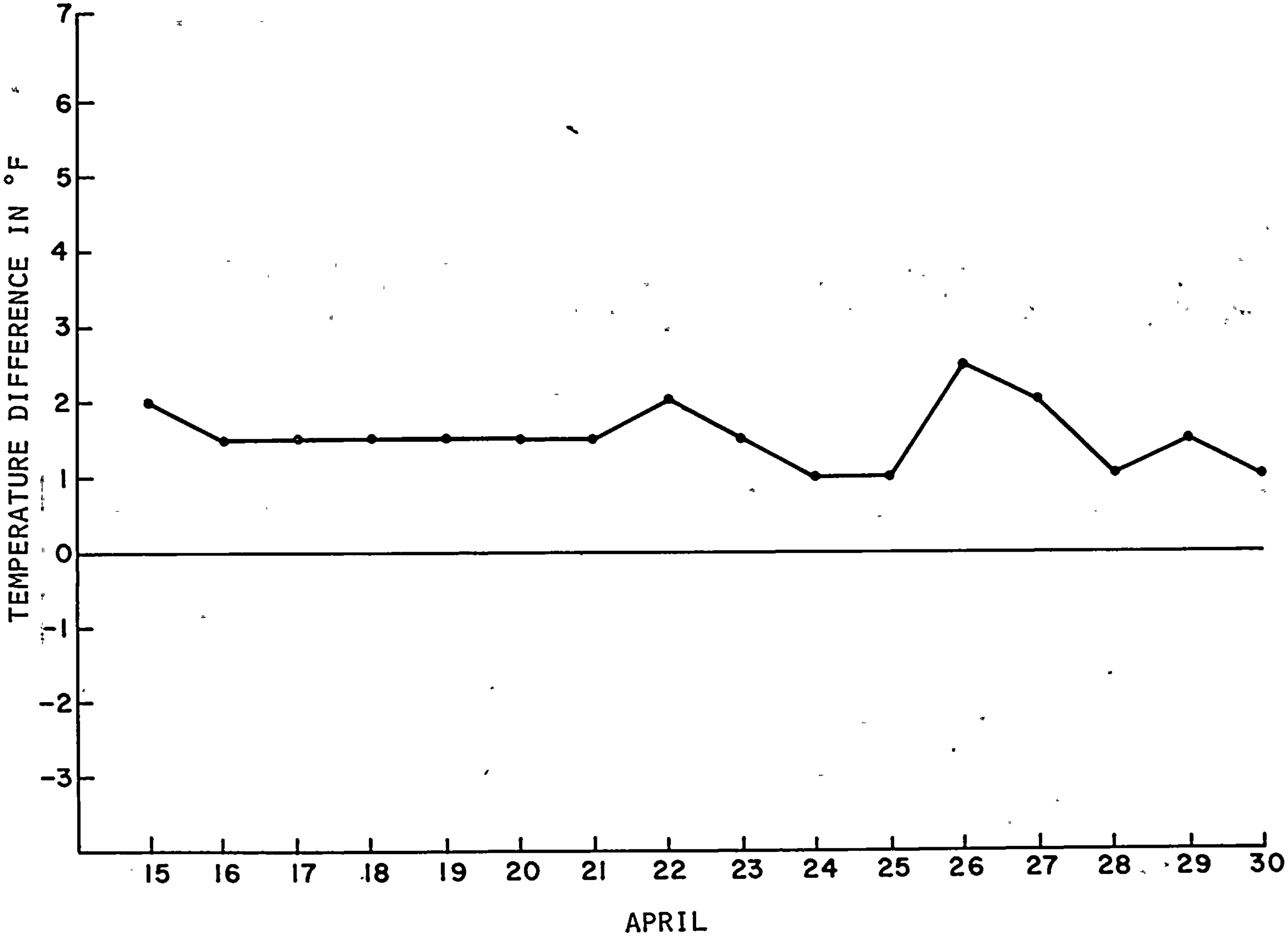


Figure G-2. Surface temperature difference between intake and discharge structures, St. Lucie Plant, 1976.

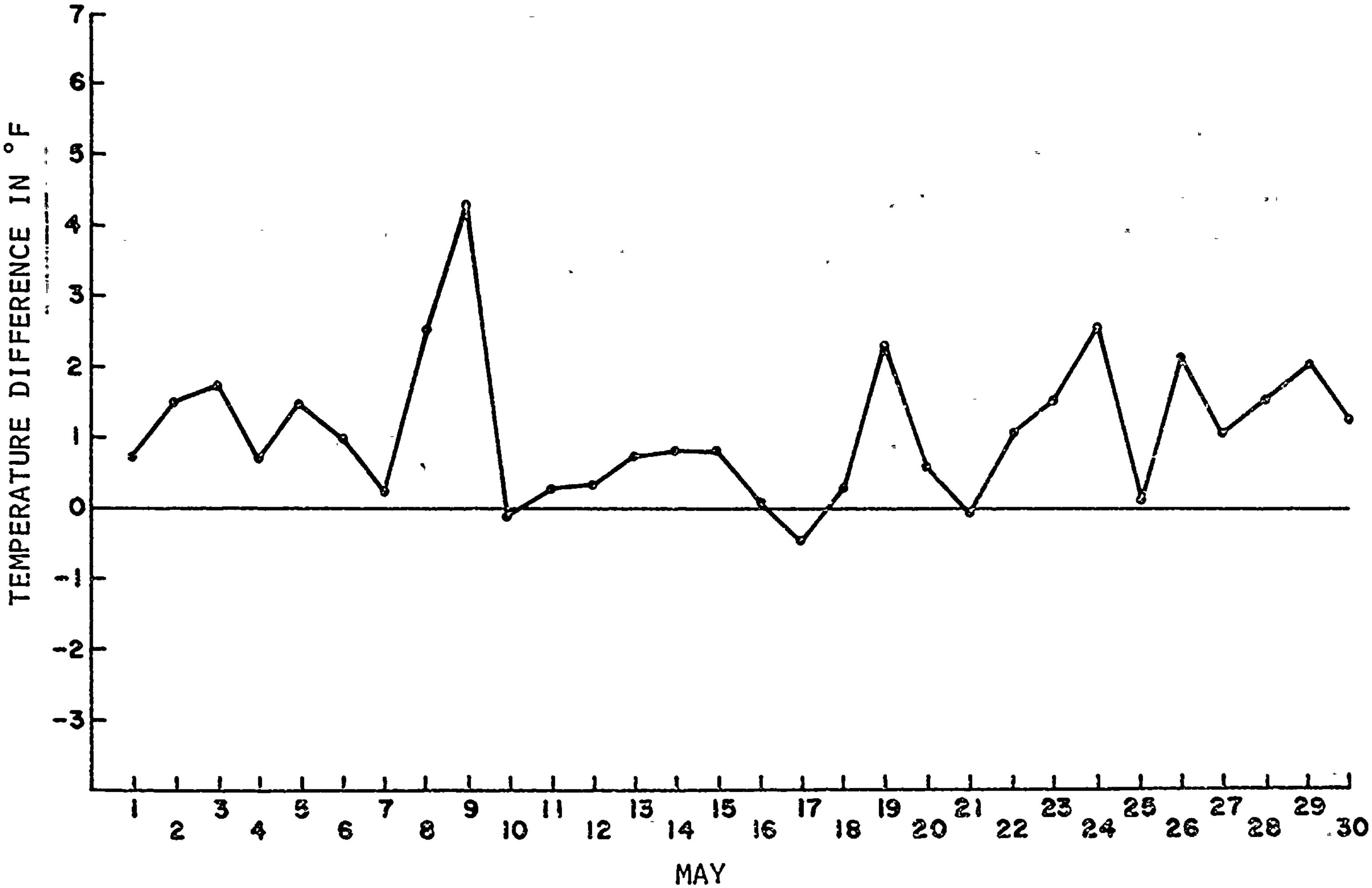


Figure G-2 (continued). Surface temperature difference between intake and discharge structures, St. Lucie Plant, 1976. (Points below "0" indicate water is cooler at discharge than at intake.)

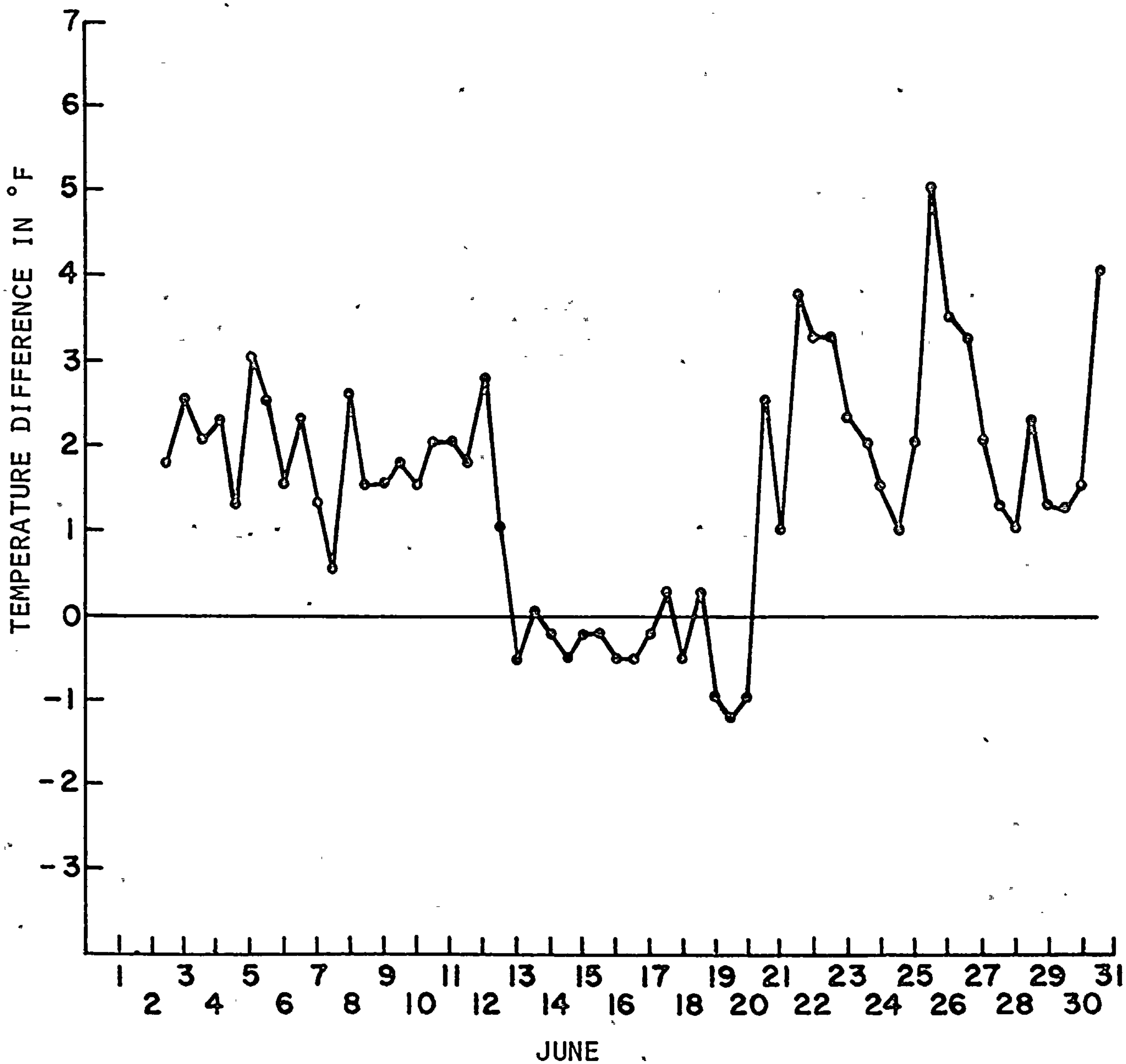


Figure G-2 (continued). Surface temperature difference between intake and discharge structures, St. Lucie Plant, 1976. (Points below "0" indicate water is cooler at discharge than at intake.)

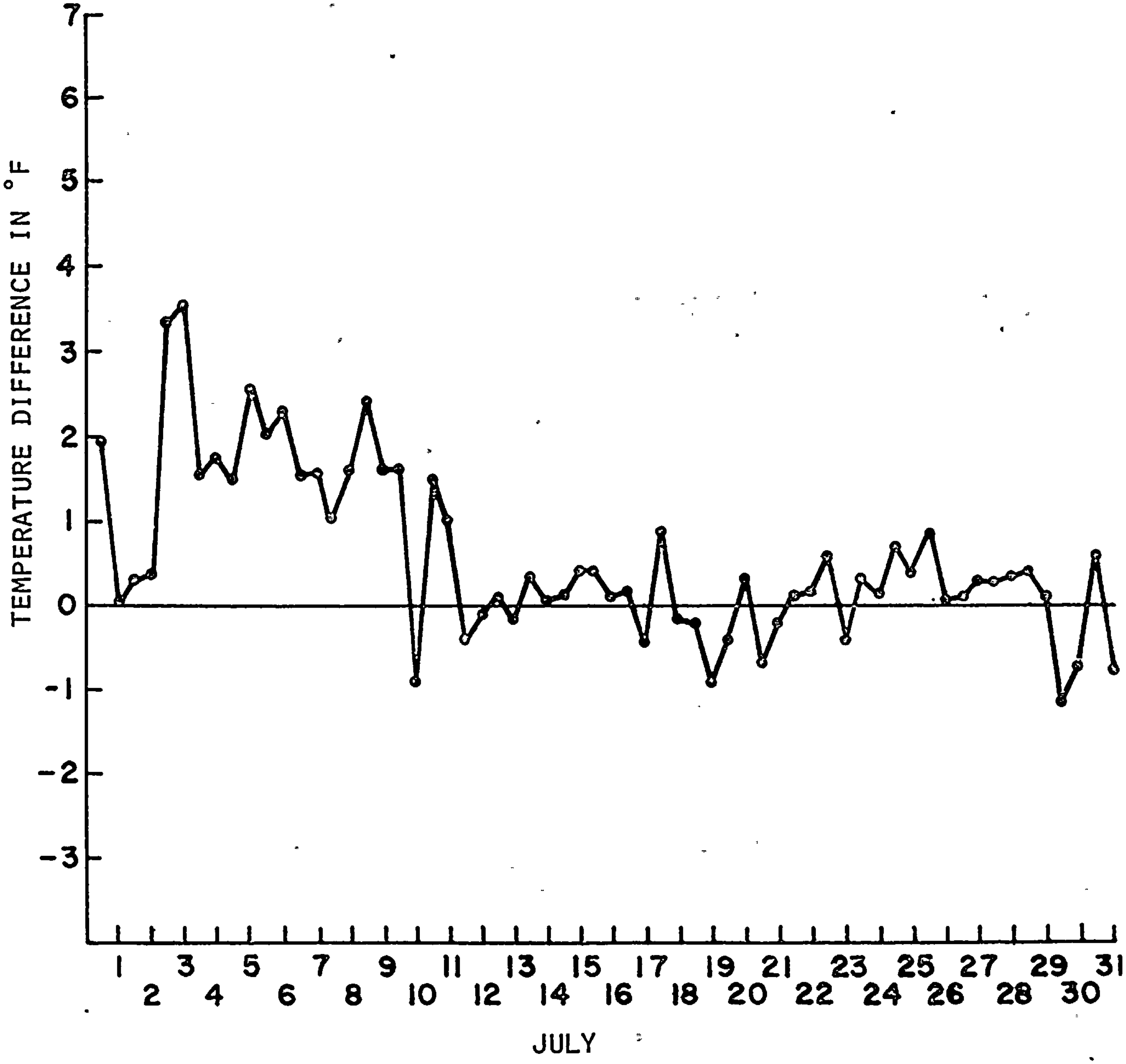


Figure G-2 (continued). Surface temperature difference between intake and discharge structures, St. Lucie Plant, 1976. (Points below "0" indicate water is cooler at discharge than at intake.)

TABLE G-1

STATION NUMBER AND PHYSICAL/CHEMICAL PARAMETERS

Parameter	0	1	2	3	4	5	6	7	8	9[a]	10[a]	11	12	13	14	15	16	Offshore intake	Offshore discharge
water temperature (continuous)																		X	X
water temperature (*in situ*)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
salinity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
dissolved oxygen	X	X	X	X	X	X						X	X	X	X	X	X		
turbidity	X	X	X	X	X	X						X	X						
luminosity	X	X	X	X	X	X													
current velocity	X	X	X	X	X	X													
wind direction, velocity, cloud cover[b]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
tidal cycle, lunar phases	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
$N-NO_3$	X	X	X	X	X	X						X	X						
$N-NO_2$	X	X	X	X	X	X						X	X						
$N-NH_3$	X	X	X	X	X	X						X	X						
$Si-SiO_2$	X	X	X	X	X	X						X	X						
$P-PO_4$	X	X	X	X	X	X						X	X						
TOC	X	X	X	X	X	X						X	X						

[a] Stations 9 and 10 are part of another study being conducted by FP&L.

[b] Data records maintained in the laboratory and are not included in this report.

TABLE G-2

ANALYSIS OF SALINITY DATA FROM OFFSHORE STATIONS
ST. LUCIE PLANT
1976

Depth	Range of salinity (°/₀₀)	Calculated χ^2	Critical χ^2 at 0.05
Surface	33.8-36.3	4.372	35.172
Middle	33.0-36.0	2.383	28.869
Bottom	33.8-36.0	1.179	30.144

TABLE G-3

ANALYSIS OF DISSOLVED OXYGEN DATA FROM OFFSHORE STATIONS
ST. LUCIE PLANT
1976

Depth	Range of dissolved oxygen (ppm)	Calculated χ^2	Critical χ^2 at 0.05
Surface	4.6-7.7	2.564	55.758
Middle	4.5-7.7	10.307	54.572
Bottom	4.4-7.5	25.306	56.942

TABLE G-4

ANALYSIS OF TURBIDITY DATA FROM OFFSHORE STATIONS
ST. LUCIE PLANT
1976

Depth	Range of transmission (%)	Calculated χ^2	Critical χ^2 at 0.05
Surface	71-100	16.958	38.885
Middle	60-100	12.758	37.652
Bottom	54-100	14.016	38.885

TABLE G-5

ANALYSIS OF TEMPERATURE VARIATION BETWEEN OFFSHORE STATIONS
ST. LUCIE PLANT
1976

Depth	Range of temperature °C	Calculated χ^2	Critical χ^2 at 0.05
Surface	20.0-30.8	10.447	61.656
Middle	20.1-30.2	7.590	61.656
Bottom	20.0-29.2	10.261	61.656

TABLE G-6

AVERAGE PERCENT LIGHT TRANSMITTANCE (LUMINOSITY)
AT OFFSHORE STATIONS
ST. LUCIE PLANT
1976

Depth	Value[a]	Station (0)	(1)	(2)	(3)	(4)	(5)
Surface	$\bar{x}$	49.6	41.8	38.1	32.7	38.6	40.8
	sd	33.2	23.4	18.2	10.8	16.5	20.5
	n	33.0	31.0	29.0	28.0	30.0	27.0
Middle	$\bar{x}$	20.1	17.9	16.6	22.3	18.2	20.1
	sd	14.0	12.2	9.2	9.3	10.9	9.3
	n	31.0	31.0	29.0	28.0	30.0	27.0
Bottom	$\bar{x}$	9.7	9.7	8.5	14.9	9.2	9.0
	sd	8.3	8.2	6.2	8.8	8.2	7.5
	n	33.0	31.0	29.0	30.0	30.0	29.0

[a] $\bar{x}$ = mean of all station values for year
sd = standard deviation
n = number of values treated

TABLE G-7

METHODS OF ANALYSIS USED TO MEASURE SELECTED WATER PARAMETERS

Parameter	Method
Ammonia nitrogen (NH_3-N)	Indophenol
Silicates (SiO_2-Si)	Heteropoly blue
Nitrate nitrogen (NO_3-N)	Brucine
Nitrite nitrogen (NO_2-N)	Diazotization
Ortho-phosphate (PO_4-P)	Ascorbic acid
Total organic carbon (TOC)	Combustion-infrared

TABLE G-8

AVERAGE CONCENTRATION OF TOC (ppm) IN SEA WATER SAMPLES
FROM EXPERIMENTAL AND CONTROL STATIONS
ST. LUCIE PLANT
1976

Depth	Value[a]	Station							
		0	1	2	3	4	5	11[b]	12[b]
Surface	$\bar{x}$	8.16	8.64	7.67	8.09	9.87	8.93	9.80	8.43
	sd	3.58	3.75	2.99	3.07	6.15	5.80	3.90	2.50
	n	10	10	10	10	10	10	10	10
Middle	$\bar{x}$	7.96	8.58	8.04	8.13	8.81	8.79		
	sd	3.02	4.10	2.67	2.54	5.00	3.10		
	n	10	10	10	10	10	10		
Bottom	$\bar{x}$	10.01	8.68	8.31	7.97	10.96	10.09	8.22	9.02
	sd	7.17	3.35	3.51	3.24	8.96	4.65	2.51	3.01
	n	10	10	10	10	10	10	10	10

[a] $\bar{x}$ = mean of all station value for year
sd = standard deviation
n = number of values treated

[b] Station depth insufficient for mid-depth sample.