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DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
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WINTER OUTAGE FISH SAMPLING PROGRAM

REPORT FOR THE PERIOD OCTOBER-DECEMBER 1982

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Executive Summary

In order to document the effects of the December 9, 1982 shutdown of the Oyster Creek Nuclear Generating Station on the fishes in Oyster Creek, an intensive sampling program was conducted by GPU Nuclear Corporation. The results of that monitoring effort indicated that an estimated 7,774 fish died due to temperature stress resulting from the station shutdown. Bluefish and jacks accounted for 99 percent of the mortalities. While the jacks died quickly and sank to the bottom of Oyster Creek, it is likely that the bluefish survived long enough to leave the creek and move into Barnegat Bay before dying. Four other fish species that had been involved in previous fishkills were found in Oyster Creek but were unaffected by the December 9 shutdown.

Introduction -

This report documents the effects of the December 9, 1982 shutdown of the Oyster Creek Nuclear Generating Station on the fishes in Oyster Creek, based upon sampling conducted by GPU Nuclear Corporation. The major objectives of the sampling program were:

1) To determine the species composition, abundance and distribution of fishes in Oyster Creek prior to Station shutdown.
2) To quantify the extent of any shutdown induced mortalities.
3) To document any movement of fishes into or out of the discharge canal subsequent to plant shutdown.

Data collection began on October 14, 1982 and continued through December 11, 1982. The Oyster Creek Station, which had operated continuously since August 29, 1982, began the shutdown process on the evening of December 9, 1982. At approximately 0500 hours on December 10, the discharge canal temperature had reached ambient.

Materials and Methods -

Pre-Shutdown Survey -

Gill net and bottom trawl samples were collected, at the stations indicated in Figure 1, on October 14-15 and November 16-17, 1982. All sampling was conducted after dark.

Trawling was done with a 4.8 m semiballoon trawl with a 3.9 cm stretch mesh body, a 3.2 cm stretch mesh cod end and a 1.3 cm stretch mesh liner. One five minute trawl sample was taken at stations T1, T4 and T5 during each mid-monthly sampling period. At

stations T2 and T3, the trawl was dragged the length of the residential lagoon (Fig. 1).

At gill net stations G1 and G3 (Fig. 1), samples were collected with a 91.4 x 1.8 m monofilament net, with three 30.5 m panels of 38, 70 and 89 mm stretch mesh. At station G2, samples were collected with a 60 x 2.4 m monofilament net consisting of two 30 m panels of 38 and 89 mm stretch mesh.

All fish captured were identified and enumerated; lengths were measured for most species.

Temperature data were obtained from the continuous temperature recorders located at the condenser intake and discharge of the Oyster Creek Station and at the Route 9 bridge on Oyster Creek. Temperature measurements were also taken with most trawl and gill net samples.

An attempt was made to tag and release fish that could be captured in relatively large numbers, without serious injury. Subsequent tag returns were to be used to generate mark and recapture population estimates for the tagged species. Tagging sessions were held on November 23 and December 2, each session lasting 3-4 hours. Hook and line sampling, using barbless, "Hopkins" type lures, was the most successful method of capturing the most abundant species, the bluefish. These fish were tagged with either a Floy anchor tag, or a hole punched in the operculum, and immediately released.

During and Post-Shutdown Survey -

Dead and stressed fish were collected with dipnets along the banks of the discharge canal, from the condenser discharge to the mouth of Oyster Creek. All fish were identified to species and enumerated; length ranges were obtained.

The 91.4 m gill net described above, was set across the mouth of Oyster Creek from 2200 hours on December 9, 1982 to 0630 hours on December 10, in order to document any movement of fishes into or out of Oyster Creek. All fish captured in the net were identified and enumerated; length ranges were obtained.

A diver using SCUBA equipment swam transects across Oyster Creek and in one residential lagoon (Fig. 1) in order to estimate the number and types of fish that sank to the bottom of the discharge canal following the shutdown. The diver survey began at 0930 and was completed at 1145 during the morning of December 10, 1982. All fish within arms reach of the diver were collected and identified.

Results and Discussion -

Pre-Shutdown Trawling and Gill Netting -

The initial survey of the fish fauna of Oyster Creek on October 14-15 yielded a total of 79 fish comprising 12 species. The species of interest with respect to a possible fish kill included bluefish, spot, and crevalle jack. Their abundance and size range as well as that of other species captured at the various stations are indicated in Table 1.

Water temperature in the discharge canal during the sampling period ranged from 68-70°F, while ambient temperature ranged from 60-63°F. Past experience has indicated that the fall exodus of migratory species from the bay to the ocean occurs when bay water temperatures fall below 60°F. This fall migration was probably just beginning at the time of sampling.

The second survey of the fish fauna of Oyster Creek was conducted on November 16-17, 1982. The sampling effort yielded 117 fish comprising 18 species (Table 2). The species of interest with respect to a possible fish kill included bluefish, spot, crevalle jack, menhaden and weakfish. Menhaden and weakfish were not taken during the October sampling effort, but occurred in small numbers in the November samples.

Water temperature in the discharge canal during the sampling period ranged from 50 to 54°F. Ambient temperature was in the 46-49° range, declining approximately 15°F since the October sampling.

The abundance of spot in the discharge canal increased considerably from October to November. This species appeared to have moved into Oyster Creek as bay temperature declined, and they were rather evenly distributed along the length of the creek.

Bluefish appeared to be concentrating in the warmest water, in the eastern-most portion of the condenser discharge. Eight large bluefish were captured at gill net station G3 during the October sampling effort but none were taken in the gill net at that station on November 17, 1982. Bluefish were observed

swimming in the eastern-most condenser discharge section, and 5 individuals were dip-netted and tagged.

Pre-Shutdown Fish Tagging -

Fifty-six bluefish were tagged prior to station shutdown. All but two of these fish were tagged with a hole in the operculum, because the Floy anchor tagging procedure appeared to be causing considerable trauma. Although observations made during the tagging effort indicated that as many as 5,000 bluefish might be in the discharge canal, it was not possible to tag large numbers of individuals because they were able to remain widely dispersed in the canal during the warm weather experienced in the latter part of November and early December. Ambient water temperature had fallen to the mid-forties during mid-November, but by December 6, 1982, had climbed back to 60°F.

During and Post-Shutdown Survey -

Station shutdown commenced at approximately 2200 hours on December 9, 1982 when ambient water temperature (condenser intake) was approximately 48°F. Condenser discharge temperature at that time was approximately 60°F and the Route 9 bridge temperature, 51°F (Fig. 2). The discharge canal temperature declined until 2220 hours when the two operating dilution pumps were shut off. As a result of the cessation of dilution pumping, the canal temperature, as measured at the Route 9 bridge, increased during the 2220-0030 period (Fig. 2). Water temperature in the condenser discharge area, unaffected by dilution pump activity, continued to decline during that period. At approximately 0430 on December 10,

the entire discharge canal had reached ambient temperature (approx. 46°F).

At approximately 2200 hours on December 9,1982 the 91.4 m gill net was stretched across the mouth of Oyster Creek where it remained until 0630 the following morning.

Large numbers of bluefish were observed swimming in the eastern-most condenser discharge section at 2300 hours. The water temperature in that area was 54°F, the warmest area in the discharge canal at that time. By 0200 hours, the water temperature at the condenser discharge had declined to 50°F and the bluefish were obviously stressed and moving closer to the surface. The bluefish began to disperse and move down the discharge canal at approximately 0235 hours when the condenser discharge temperature was 47°F. At 0330 hours, stressed and dying bluefish began to appear along the banks of Oyster Creek in the vicinity of the Route 9 bridge.

Stressed jacks (crevalle jack and blue runner) were first observed in the area between the condenser discharge and the 30" discharge pipe at 0030 hours when the condenser discharge temperature was 52°F. The jacks began to die at approximately 0200 hours at a temperature of 50°F. Dead and dying jacks were first observed at the Route 9 bridge at 0315.

Stressed and dead fish were collected along the length of Oyster Creek from 0030 to 0600 hours on December 10, 1982. Additional surveys of the creek banks were conducted later in the day on December 10 and during the morning of December 11. This

effort yielded 314 dead or stressed fish, 75% of which were jacks (Table 3). Bluefish (49 individuals) and Atlantic needlefish (24 individuals) were the only other species found in any abundance.

The 8.5 hour gill net set at the mouth of Oyster Creek yielded a total of 57 fish (Table 3). Bluefish accounted for 47% of the total gill net catch. All of the bluefish were found in the upstream side of the net indicating that all movement of this species was out of the creek and into the bay. All of the bluefish were alive but appeared to be stressed.

Atlantic menhaden accounted for 39% of the gill net catch (Table 3). They were found on both sides of the gill net, and appeared to be in good condition. This indicates that Atlantic menhaden were moving into and out of the discharge canal during the shutdown period, and were probably not effected by the temperature change resulting from the shutdown. This hypothesis is supported by the experience of past outages, at similar temperature conditions, during which no menhaden mortality was observed. Furthermore, Atlantic menhaden were collected on the intake travelling screens during the week of December 13, indicating that they continued to occur in the bay at ambient temperature conditions.

One large weakfish found on the upstream side of the gill net (Table 3) appeared to be in good condition, however, the 4 scup and 3 Atlantic needlefish were near death. The latter two species were also found on the upstream side of the net, indicating that they were moving out of the discharge canal.

Only 16 fish were found along the eight diver transects which covered approximately 36,000 square feet of the discharge canal bottom (Fig. 1; Table 3). The diver reported visibility of 6-8 feet in the discharge canal proper and 2 feet in the residential lagoon (Station D2). Crevalle jack accounted for 60% of the fish gathered by the diver, and the 11 individuals were all found at station D8, just south of the condenser discharge. The two American eels and one conger eel found at stations D4 and D5 appeared to have been dead for some time and their death was probably not related to the Station shutdown. No bluefish were found on the canal bottom.

An estimate of the number of crevalle jacks on the bottom of the discharge canal was generated by dividing the total number of individuals found at station D8 (11) by the total area covered by the diver at that station (3,000 sq. ft.). The resulting density of 0.004 crevalle jack/sq. ft. was multiplied by the total bottom area from the condenser discharge to station D7 (625,000 sq. ft.), yielding an estimate of 2,500 individuals. No crevalle jack were found along the bottom downstream of station D8. This estimate conservatively assumes that they were evenly distributed, at the density found at station D8, from the condenser discharge to station D7 (Fig. 1).

The 387 fish caught subsequent to station shutdown are depicted in Figure 3. In an attempt to find a constructive use for these fish, a local zoo (Great Adventure), a bait dealer, and a local farmer were contacted. Largely because of the small

number of fish involved, no one was interested in accepting the fish. All of the fish were subsequently buried on the farm property across from the Oyster Creek Station.

Conclusions -

Pre-shutdown surveys of Oyster Creek indicated the presence of 6 migratory species that have been involved in past shutdown related fishkills (bluefish, crevalle jack, spot, Atlantic menhaden, weakfish, and bay anchovy). As ambient bay temperature declined during the October-November period, the number of species and abundance of most species in the discharge canal increased. Bluefish and spot appeared to be the only species occurring in large numbers. An attempt was made to tag several hundred bluefish in order to obtain a mark and recapture estimate of the population size of that species. Unusually high ambient water temperatures, however, allowed the bluefish to remain dispersed throughout the condenser discharge area, precluding the capture of large numbers of individuals. None of the 56 individuals tagged were found among the bluefish collected subsequent to station shutdown. Observations made during the tagging effort, however, indicated that the number of bluefish in the discharge canal probably did not exceed 5,000. This observation was supported by the fact that relatively few bluefish were captured in the gill net at the mouth of Oyster Creek. The presence of bluefish in the gill net indicates that this species attempted to leave the discharge canal during the shutdown. The temperature shock resulting from the station shutdown was sufficient to cause severe stress, but not the immediate death of the bluefish. They were therefore able to make their way down the discharge canal, probably seeking the warmest available water. These fish

probably died in Barnegat Bay since ambient temperature fell below 40°F during the two days following the shutdown. In the past, bluefish mortalities have been observed at ambient temperatures as high as 47°F, although the temperature shock was 20°F in that instance compared to 11°F in the present case. A local commerical fisherman reported capturing 500 pounds (approx. 250 individuals) of stressed bluefish in the vicinity of the Oyster Creek mouth on December 11, indicating that at least some bluefish survived at ambient temperatures for approximately 36 hours.

The jacks died quickly, once the discharge canal temperature fell below 50°F. This observation is consistent with the behavior of these species during past winter outages. Based upon the diver survey, an estimated 2,500 crevalle jack died and sank to the bottom of the discharge canal. An additional 155 individuals of this species were dipnetted, resulting in a total of 2,655. A total of 80 dead or stressed blue runner were found following the shutdown.

The spot, Atlantic menhaden, weakfish and bay anchovy did not appear to be adversely affected by the station shutdown. Three of these species (spot, Atlantic menhaden and bay anchovy) were found in impingement samples during the week following the shutdown indicating that they were able to survive ambient bay temperatures below 40°F.

Although the Atlantic needlefish was not captured in the trawl and gill net samples prior to the shutdown, this species was observed in the condenser discharge area. This was the first time that the Atlantic needlefish was involved in a shutdown related fishkill.

In summary, the number of fish involved in the fishkill of December 9-10, by species, was as follows:

bluefish	5,000	(visual estimate)
crevalle jack	2,655	(estimate+actual acount)
blue runner	80	(actual count)
Atlantic needlefish	28	(actual count)
scup	9	(actual count)
ladyfish	1	(actual count)
northern kingfish	1	(actual count)
TOTAL	7,774	

Table 1 - Number of individuals and length range (mm, in parentheses) of fishes captured in Oyster Creek, October 14-15, 1982.

Species/Station	G1	G2	G3	T1	T2	T3	T4	T5	TOTALS
bluefish	0	1 (no size-eaten by crabs)	8 (228-475)	0	0	0	0	0	9
spot	0	2 (130+135)	2 (149+150)	2 (132+170)	3 (125-131)	1 (120)	1 (138)	0	11
crevalle jack	0	0	0	0	2 (106+132)	0	0	0	2
white perch	0	0	5 (228-258)	0	0	0	0	0	5
bay anchovy	0	0	0	20 (38-85)	4 (40-45)	7 (40-70)	5 (34-75)	2 (43+52)	38
striped anchovy	0	0	0	0	1 (96)	0	0	0	1
winter flounder	0	0	0	1 (155)	0	0	0	0	1
hogchoker	0	1 (183)	0	1 (142)	2 (131+119)	1 (136)	1 (173)	0	6
oyster toadfish	0	0	0	2 (69+172)	0	0	0	1 (72)	3
northern pipefish	0	0	0	1 (185)	0	0	0	0	1
lookdown	0	0	0	0	1 (89)	0	0	0	1
naked goby	0	0	0	0	1 (40)	0	0	0	1

Table 2 - Number of individuals and length range (mm, in parentheses) of fishes captured in Oyster Creek, November 16-17, 1982.

Species/Station	G1	G2	G3	T1	T2	T3	T4	T5	TOTALS
bluefish	0	0	0	0	0	0	0	0	0
spot	29 (114-159)	9 (110-188)	12 (120-145)	0	0	0	0	1 (135)	51
crevalle jack	1 (105)	1 (105)	0	0	0	0	0	0	2
white perch	0	1 (205)	0	0	0	0	0	0	1
Atlantic menhaden	1 (112)	1 (121)	0	0	0	0	0	0	2
weakfish	0	0	1 (160)	0	0	0	1 (38)	0	2
bay anchovy	0	0	0	2 (50+60)	8 (39-67)	6 (39-56)	7 (33-51)	2 (41+48)	25
winter flounder	0	0	0	7 (84-218)	0	2 (80+119)	0	0	9
hogchoker	0	0	0	0	0	0	1 (122)	0	1
oyster toadfish	0	0	0	0	0	1 (59)	0	0	1
northern pipefish	0	0	0	0	4 (145-193)	2 (166+181)	2 (136+160)	3 (146-170)	11
naked goby	0	0	0	0	0	1 (41)	0	0	1

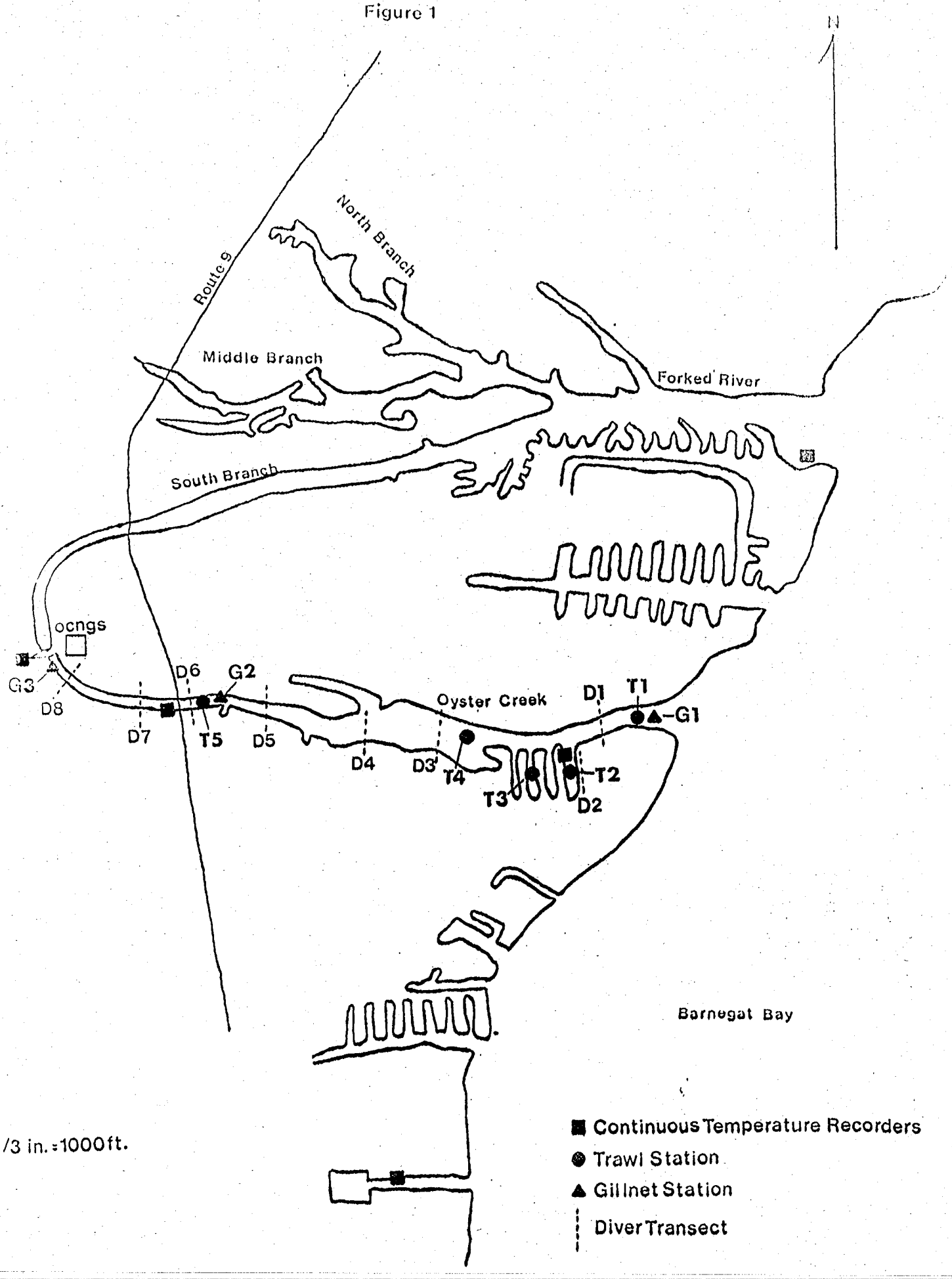
Table 2. (Cont'd) Number of individuals and length range (mm, in parentheses) of fishes captured in Oyster Creek, November 16-17, 1982.

Species/Station	G1	G2	G3	T1	T2	T3	T4	T5	TOTALS
northern searobin	0	1 (255)	0	0	0	0	0	0	1
smallmouth flounder	0	1 (100)	0	0	0	0	0	0	1
blueback herring	0	1 (157)	0	0	0	0	0	0	1
striped killifish	2 (140+200)	0	0	0	0	0	0	0	2
tautog	0	0	1 (185)	0	0	0	0	0	1
fourspine stickleback	0	0	0	0	0	0	1	0	1

Table 3 - Number of individuals and length range (mm) of fishes captured in Oyster Creek following station shutdown, December 9-10, 1982.

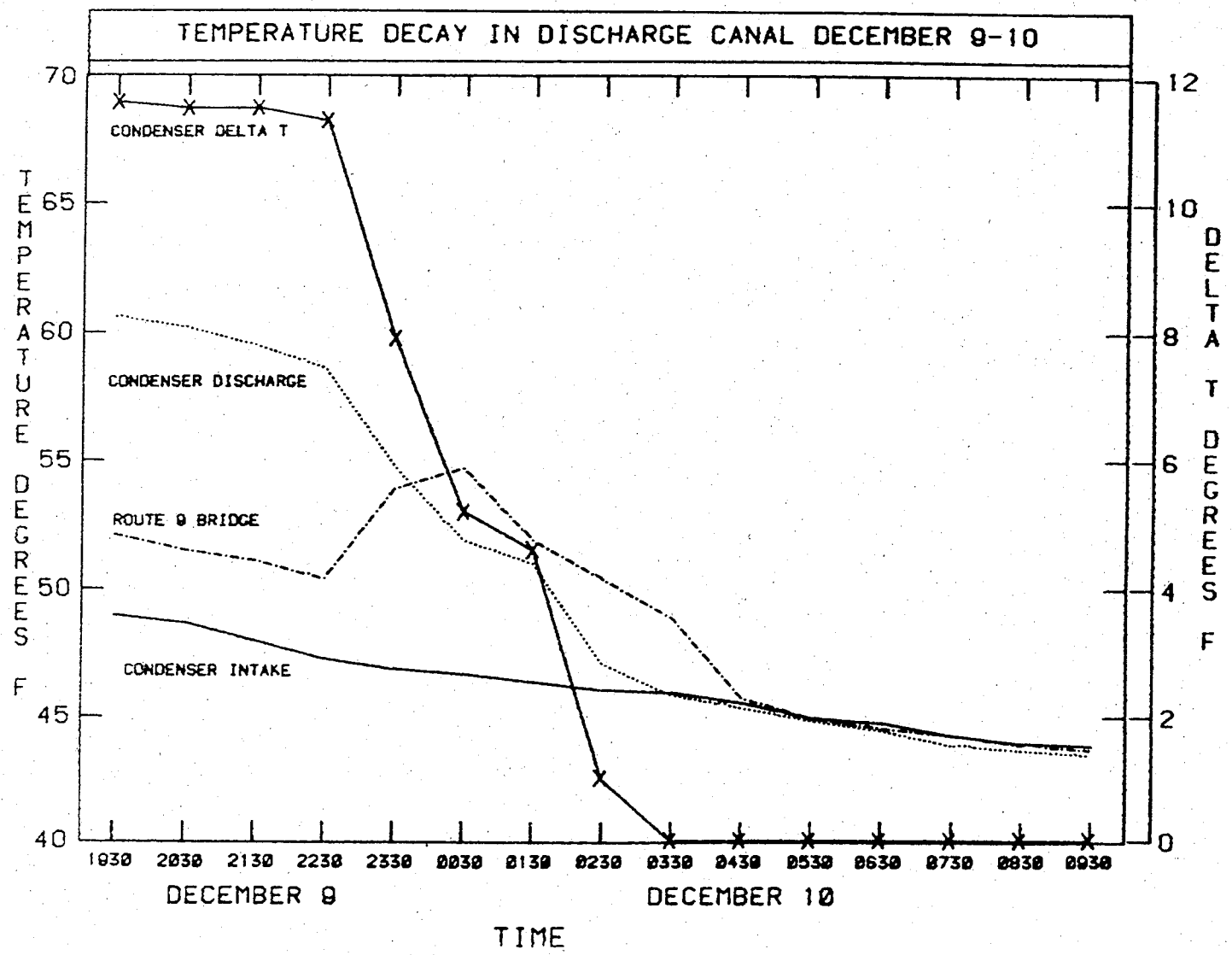
Species/Location	Dipnetted Along Banks of Oyster Creek	Gill Net at Oyster Creek Mouth	Diver Transect	Totals	Length Range
bluefish	49	27	0	76	274-476
crevalle jack	155	0	11 (Station D8)	166	110-204
blue runner	79	0	1 (Station D6)	80	171-218
Atlantic needlefish	24	3	1	28	250-661
Atlantic menhaden	0	22	0	22	107-295
scup	5	4	0	9	205-247
American eel	0	0	2 (Station D5)	2	-
conger eel	0	0	1 (Station D4)	1	-
weakfish	0	1	0	1	455
ladyfish	1	0	0	1	410
northern kingfish	1	0	0	1	185
TOTALS	314	57	16	387	

Figure 1



scale 1/3 in. = 1000 ft.

Figure 2.


TEMPERATURE DECAY IN DISCHARGE CANAL DECEMBER 9-10
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TIME

Figure 3.

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