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INVENTORY OF MAJOR ESTUARINE SYSTEMS IN NEW JERSEY

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John F. McClain, et al

New Jersey Department of Environmental Protection
Trenton, New Jersey

July 1971

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The inventory was accomplished in two phases. Phase I of the 1969 - 1970 Estuarine Inventory consisted of a survey of the fishes of the Great Bay - Mullica River System and, to a lesser extent, the Maurice and Manasquan Rivers. The object was to determine what species of finfish utilize the estuarine waters of New Jersey. The second phase mapped and described the physical - chemical attributes of the estuary. Monthly sampling surveys recorded conditions from 1968 into August 1970. (Sinha, OEIS)

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Inventory of Major Estuarine Systems in New Jersey

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Department of Environmental Protection
Division of Fish, Game and Shellfish
Trenton, New Jersey 08625

July 1971
Completion Report for period June 1968 to August 1970

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PHASE I - FISH STUDY

John F. McClain, Jr.

INTRODUCTION

Phase I of the 1969-1970 Estuarine Inventory consisted of a survey of the fishes of the Great Bay-Mullica River System and, to a lesser extent, the Maurice and Manasquan Rivers. The object was to determine what species of finfish, at some stage in their life cycle, utilize our estuarine waters.

ACKNOWLEDGEMENTS

Ronald White initiated this Phase of the project and was of great assistance to me when I took over. Paul Hamer and Walter Murawski contributed their knowledge. Ted Metzger, Harry Bustard, James Leonard and Russell Tilton assisted with the field work. Ted Metzger also assisted in the analysis of the data. Ottawa Pullen sorted and identified the plankton. John Nakai collected the May and June plankton samples.

METHODS AND MATERIALS

All sampling was done with a 300-foot bag seine, ten feet deep. The dimensions are as follows: top line 3/16" nylon with 3 x 1½" spongex floats every 18 inches; bottom line double ¼" nylon with #9 leads every 18 inches; outer wings each 75 feet long 1" stretch mesh Style #4; inner wings each 55 feet long 5/8" stretch mesh Style #4; 15 feet on each side of bag 3/8" stretch mesh Style #4; bag 10' x 10' 3/8" stretch mesh Style #4. The seine was set from a 17' Boston Whaler.

Five seining stations were utilized in the Mullica River-Great Bay Estuary, three in the Manasquan River and three in the

2.

Maurice River (see Figures 1, 2 and 3 for specific locations). The stations were sampled monthly when possible. Data was collected as follows: the catch was speciated, each species was weighed, measured, and counted if numbers allowed. Aliquot samples were taken when individual numbers of any species were so great as to make processing the entire catch impractical. The subsamples were counted and measured and the data adjusted accordingly. Surface water temperatures were taken at each station with a pocket thermometer. Water samples were taken and salinities were run at the laboratory by John Makai on a wide range salinity hydrometer. Weather conditions also were recorded.

Plankton samples were taken at six stations - four in Great Bay and two in the Mullica River (see Figure 1 for specific locations). A plankton net rig, revised from one used by Dovel as reported in Chesapeake Science, Vol. 5, No. 1-2, pp. 77-90, Mar.-June 1964, was constructed. It is designed to fish two one-meter plankton nets simultaneously, one at the surface and one at the bottom. Instead of the large concrete weight and cable used by Dovel for his deep water work, two six pound grappling hooks attached to six feet of heavy chain and 5/16" polypropelene line were used. In addition to these modifications, a lighted staff buoy was added for night work.

CM_2-T.S.K. Flowmeters were on order but arrived too late to be used.

RESULTS AND DISCUSSION

Seining - Great Bay-Mullica River

Sixty species of finfish were taken during the sampling

period. A list of the species taken including scientific and common names is shown in Table 1.

Results by Station:

Little Beach. This station is a sandy beach located just inside Little Egg Inlet on the southern shore. The bottom is hard sand. It is seinable at all tidal stages. Thirty-one species of fish were taken at this station (see Table 2). Silversides were the most abundant, over 24,000 being taken, followed by bay anchovy 4941, striped killifish 602, and silver perch 571 (see Table 3). Four species, the sand lance, smallmouth flounder, sheepshead minnow and permit were taken exclusively at this station. The last two species were taken once (Table 2).

The temperature during sampling operations ranged from 46°F. in November to 77° F. in August, and the salinity from 25 °/oo in May to 31.8 °/oo in June and October (Table 4).

Cape Horn. This station is located on the north side of Great Bay. It consists of a peat bank covered with saltwater cordgrass with a drop of about 4 feet. The bottom is primarily peat pieces, detritus and mud. The station was seined at or near high tide to minimize difficulties caused by the near vertical bank and irregular terrain.

Thirty-one species of fish were taken at this station. The bay anchovy was the most abundant, over 13,000 appearing in the samples. Silversides were second in number - 6298, and silver perch third with 581 fish taken. Again silversides were taken in every sample. The northern pipefish, northern puffer and the winter flounder were also common fishes at this station. Two species were taken only at this station: two red hake, one in June 1969 and one in May 1970, and one black sea bass in July 1969.

Temperatures during sampling ranged from 40° F. in March to 74° F. in June and August; salinities from 24 °/oo in May to 31.9 °/oo in July.

Graveling Point. This station is located on the north shore of Great Bay approximately 1.2 nautical miles below the river mouth. It is composed of sand and mud. It was originally seinable at all except low water. In March we found an oyster stake infringing on the seining area. We were able to continue using the site by seining at high tide.

Twenty-four species of fish were taken. Again the bay anchovy was the most abundant (over 11,000), followed by silversides (6800), and the silver perch (1261). Other common species were the striped killifish, northern puffer, oystertoadfish and winter flounder.

The temperature when hauls were made ranged from 47° F. in November and March to 78° F. in August. The salinity ranged from 19 °/oo in August to 28.9 °/oo in June.

Landing Creek. This station is located on the southern side of Great Bay approximately 2.4 nautical miles below the river mouth. Physically it is similar to Cape Horn, with the exception of a two foot drop off the bank. The bottom is very irregular and covered with large pieces of peat. It was seinable from two hours before high tide until two hours after.

The greatest number of species was taken at this station (33), as well as the most fish (over 44,000). The bay anchovy again heads the list (over 40,000), followed by the silversides (1218), the silver perch (932) and the oystertoadfish (173). Other common fish were the northern pipefish, Atlantic needlefish and the mummichog.

5.

For seven of the 33 species, the catch at Landing Creek constituted over 40% of the total number of these species taken throughout the year.

The temperature while sampling ranged from 38° F. in March to 76° F. in August, and the salinity from 13.8 °/oo in May to 27.5°/oo in July and October.

Lower Bank. This station is located at river mile 14 on the northern bank of the Mullica River just downstream of the county highway bridge. The bottom is mostly gravel with some mud and a few waterlogged stumps and branches. The station is a spit of land projecting downstream. It was not seinable at high tide as it was completely covered by water.

Thirty species were taken at this station. The four most abundant species were the bay anchovy (4500), alewife (883), white perch (326) and golden shiner (212). Other common species included the brown bullhead, yellow perch, white sucker and banded killifish.

The temperatures encountered during sampling ranged from 36° F. in December to 77° F. in June, and the salinities from < 1 °/oo in December to 4.7 °/oo in September.

Monthly Results:

June was the first sampling month of the project year. All stations were sampled. The temperature ranged from 70° F. to 77° F. and the salinity from 3.8 °/oo to 31.8 °/oo. Twenty-four species were taken, numbering over 23,000 (see Table 5). Of these, 95% were bay anchovies, 3% silversides and 2% other. Most abundant of the latter was the alewife (92 fish), followed by the northern puffer (75), the bluefish (21) and the winter flounder (18) (see Table 6).

In July 37 species were taken, the greatest number for any one month. However, the number of individual fish was the lowest of the summer months. The reason was the lack of large numbers of bay anchovies and silversides. These species numbered only 5825 fish in July as opposed to 22,005 in June, 14,302 in August, 50,531 in September, and 20,152 in October. Excluding these two, July's catch was the third largest of the year. Three species were taken only in July: sea bass, sheepshead minnow and the smooth dogfish (Table 5). Some of the more numerous species were the Atlantic needlefish, 32% of the year's catch, banded killifish 46%, bluefish 58%, hogchoker 96%, sennet 96%, striped killifish 78%, white perch 49%, and winter flounder 40% of the year's catch. The temperature ranged from 72° F. to 76° F. and the salinity <1 °/oo to 31.9 °/oo.

August's sampling resulted in 16,000 fish comprising 34 species. Again the majority were bay anchovies and silversides. Excluding these species results in the highest monthly catch of the year, 2302 fish. The highest temperatures were recorded this month also, ranging from 74° to 78° F. The salinity ranged from <1 °/oo to 27 °/oo. Two species made their only appearance of the year, the black crappy at Lower Bank and the spot at Landing Creek and Little Beach. The alewife and the brown bullhead reached their highest numbers in August (440 and 126 respectively). Other common species were the silver perch, striped killifish, white perch, golden shiner, northern puffer and Atlantic needlefish.

September's catch numbered 52,600 fish, 45,000 of which were bay anchovies and 5,400 silversides. Three other species also appeared in large numbers - silver perch 1377, striped anchovy 350,

and oyster toadfish 161. Silver perch were taken at all four bay stations.

Oyster toadfish were taken at all bay stations except Little Beach where it was never taken. Also, this was the only month oyster toadfish were taken at Lower Bank. The temperature at Lower Bank was 64° F. and the salinity 47 °/oo. All striped anchovies were taken at Landing Creek (temperature 64° F. and salinity 25 °/oo).

Thirty-three species numbering 21,000 fish were taken in October. Ninety-six percent were either bay anchovies or silversides. The other 4% consisted primarily of alewives 310, silver perch 148, and Atlantic menhaden 144. The alewives were taken at Lower Bank in 68° F. water with a salinity of 3.8 °/oo. Sixty-two were measured and ranged from 8 to 12 cm. One hundred and fourty menhaden were taken at Landing Creek. Water temperature was 68° F. and salinity 27.6 °/oo. Thirty-five were measured and ranged from 10 to 19 cms. The other 4 menhaden were taken at Lower Bank. Seventy-one silver perch were taken at Cape Horn (water temperature 65° F. and salinity 30.8 °/oo), 23 at Graveling Point (62° F. and 24.9 °/oo), and 54 at Landing Creek (68° F. and 28 °/oo). Temperatures at the sampling stations ranged from 62° F. to 68° F., and salinity from 3.8 °/oo to 30.8 °/oo.

Cape Horn was not sampled in November. Twelve species were taken at the remaining four stations. Silversides constituted 81% of the catch. Next in abundance was the golden shiner 10%, followed by the sand lance 3%. Temperatures ranged from 45° F. to 48° F., and salinity from 20.3 °/oo to 25.6 °/oo (no salinity for Lower Bank).

Only Lower Bank was sampled in December. The water tempera-

ture was 36° F. and the salinity ≤ 1 °/oo. Seven species were taken numbering 66 fish. The golden shiner constituted 68% of the catch. This was one of the two months that white perch were not taken at Lower Bank.

No sampling was done during January or February because of the weather and ice.

Water temperatures during March ranged from 38° F. to 47° F. and salinity from 1 °/oo to 27.7 °/oo. All stations except Little Beach were sampled, with over 300 fish taken. Silversides constituted 66% of the catch, followed by the three-spined stickleback. The only pollock taken during the sampling year was a 3 cm. fry found in a Landing Creek haul on March 10. The water temperature was 38° F. and the salinity 24 °/oo.

Graveling Point was not sampled in April or May due to the abundance of striped bass fishermen.

In April the water averaged 10° warmer than in March. The temperature ranged from 45° F. to 57° F., and the salinity from ≤ 1°/oo to 28.2 °/oo. Blueback herring appeared in the Landing Creek sample. It was their first occurrence in any sample since the preceding June. Silversides were the most abundant species, followed by the johnny darter, yellow perch, blueback, golden shiner, and windowpane. Fifteen species were taken for a total of 129 fish.

The temperature in May was 70° F. at Lower Bank and 57° F. at Landing Creek, an increase of 18° F. and 12° F. over April. No temperature was taken at Little Beach or Cape Horn because of a broken thermometer. However, the temperature at the Fish Factory, which is approximately half way between the latter two stations, was 64° F. on the sampling day. This rise in temperature is reflected in the number

of species (28) and individuals (1721) taken. Bay anchovies and silversides made up 47% of the catch, followed by sea herring 29%, mummichog 6%, and white perch 5%.

The bay anchovy was the most abundant species, constituting 61% of the 124,000 fish taken. It was taken at all stations in salinities ranging from 2 °/oo to 32 °/oo, and temperatures from 38° to 77° F. Next in abundance were the silversides, making up 32% of the catch. They were taken at all stations in all sampling months except December. Salinities ranged from <1 °/oo to 30 °/oo, and temperatures from 38° to 78° F. Third was the silver perch, 3% of the catch. It was taken at all bay stations. The known salinities ranged from 18 °/oo to 31 °/oo and the known temperatures from 48° F. to 78° F. Tables 7 and 8 give the salinity and temperature ranges of some common species. Length frequencies of 10 common species are given in Tables 9 through 15.

Seining - Manasquan River.

Three stations were seined in the Manasquan River during June, July and August 1969, and April and May 1970. Forty-six species totalling 28,600 individuals were taken. A list of the species including common and scientific names is given in Table 16. The results are summarized in Table 17. Following is a brief description of each station and the results. For specific locations, see Figure 2.

Inlet. This station is located on the north shore of the Manasquan River approximately 500 yards upstream from the Coast Guard Station. The bottom is sand and the depth at mean-low water is ten feet. Over 20,000 fish were taken at this station; 18,900 were silversides (see Table 17). Other common species were the northern puffer,

the winter flounder and the bluefish. The temperatures ranged from 45° F. in April to 75° F. in July, and salinity from 18.5 °/oo in June to 32 °/oo in July (Table 18).

Osborn Island. This station is located on the western side of Osborn Island 2½ nautical miles above the inlet. The bottom is sand and the depth at mean low water is six feet. Silversides were the most numerous species - 1328 fish, followed by winter flounder, weakfish and bay anchovy. Temperatures ranged from 49° F. in April to 76° F. in August and salinities from 7.9 °/oo to 29.8 °/oo.

Bluffs. This station is located on the northern bank at the upper end of the river approximately 5.1 nautical miles from the mouth. The bottom is stones and gravel and the depth at mean low water about three feet. This station was accessible only at high water. During April and May a 60-foot bag seine was used for sampling. Nineteen species, numbering over 2500 individuals, were taken. The bay anchovy was the most numerous, 1069 fish. Silversides numbered 628, the lowest number of the three stations.

Overall, silversides and bay anchovies made up 86% of the catch.

Seining - Maurice River.

Thirty-four species of finfish were taken during the sampling period. A list of the species taken is given in Table 19. Sampling was conducted during June and August 1969 and April and May 1970 at these stations. The results are summarized in Table 20. A brief description of each station and the results follows. For specific locations see Figure 3.

East Point Cove. This station is located in the Maurice River Cove at East Point. The water is approximately six feet at high

tide, which is the only time we seined here. The bottom is sand and mud. The station was surrounded by gill nets in the spring, which may have had some effect on the number of large fish taken with the seine. Twenty-three species were taken numbering 10,800 fish. Most abundant were the silversides - 4642, followed by the bay anchovy - 3276 and the American eel - 1639 (see Table 20). Butterfish, filefish, cusk eel and kingfish were taken only at East Point. Temperatures ranged from 55° F. to 80° F. and salinity from 14 °/oo to 23 °/oo (see Table 21).

Leesburg. This station is located on the eastern bank of the river approximately 6½ nautical miles upstream. It was not seined in April or May due to the presence of large numbers of fishermen. Sixteen species were taken here. The bay anchovy was the most abundant - 44 fish, followed by the hogchoker and silversides.

Yawpshore. This station is located on the eastern bank, 13 miles upstream. The bottom is gravel. Fourteen species, totalling 1031 individuals, were taken. White perch were the most numerous species with 301 fish caught. Next was spottailed shiner 312, hickory shad 166, and bay anchovy 119. The salinity at this station was always less than 1 °/oo when we sampled.

Plankton Sampling - Great Bay-Mullica River Stations

Light "4". This station is located on the inland waterway approximately 200 yards off the Coast Guard Station on the north side of Little Egg Inlet. The depth at mean low water is 22 feet. The strong current made sampling difficult.

Light "20". This station is also on the inland waterway 2.6 nautical miles southwest of Light "4" in the southern half of Great Bay. The depth at mean low water is seven feet, during sampling

about ten feet.

Cape Horn. This station is located approximately 150 yards off Cape Horn on the north shore of Great Bay. The depth at mean low water is 13 feet.

Graveling Point. This station is halfway between Graveling Point and Cape Horn, about 750 yards offshore. The depth at mean low water is ten feet.

French Point R 6. This station is located six miles upstream of the river mouth off French Point. The depth at mean low water is 25 feet.

Lower Bank R 14. This station is located at river mile 14 just downstream of the county highway bridge. The depth at mean low water is seven feet.

Plankton sampling was conducted at night on a flooding tide during June, July, August and October 1969. Sampling in April and May 1970 was done during the day on a flooding tide. The results are summarized in Table 22.

TABLE 1. A list of species taken in the Great Bay-Mullica River Estuary, common and scientific names. June 1969 to May 1970.

Alewife, Alosa pseudoharengus (Wilson)
American eel, Anguilla rostrata (LeSueur)
Atlantic menhaden, Brevoortia tyrannus (Latrobe)
Atlantic needlefish, Strongylura marina (Walbaum)
Banded killifish, Fundulus diaphanus (LeSueur)
Bay anchovy, Anchoa mitchilli (Valenciennes)
Black crappie, Pomoxis nigromaculatus (LeSueur)
Blueback herring, Alosa aestivalis (Mitchill)
Bluefish, Pomatomus saltatrix (Linnaeus)
Bluegill, Lepomis macrochirus Rafinesque
Brown bullhead, Ictalurus nebulosus (LeSueur)
Chain pickerel, Esox niger LeSueur
Crevalle, Caranx hippos (Linnaeus)
Cunner, Tautogolabrus adspersus (Walbaum)
Fusiform darter, Etheostoma fusiforme (Girard)
Four-spined stickleback, Apeltes quadracus (Mitchill)
Golden shiner, Notemigonus crysoleucas (Mitchill)
Hickory shad, Alosa mediocris (Mitchill)
Hogchoker, Trinectes maculatus (Bloch and Schneider)
Johnny darter, Etheostoma nigrum Rafinesque
N. Kingfish, Menticirrhus saxatilis (Bloch and Schneider)
*Mullet, Mugil sp.
Mummichog, Fundulus heteroclitus (Linnaeus)
Naked goby, Gobiosoma bosci (Lacepède)
Northern pipefish, Syngnathus fuscus Storer
Northern puffer, Sphaeroides maculatus (Bloch and Schneider)
Oyster toadfish, Opsanus tau (Linnaeus)
Permit, Trachinotus falcatus (Linnaeus)
Pollock, Pollachius virens (Linnaeus)
Red hake, Urophycis chuss (Walbaum)
Sand lance, Ammodytes americanus DeKay
Sea bass, Centropristes striatus (Linnaeus)
Sea herring, Clupea harengus harengus (Linnaeus)
Sea horse, Hippocampus hudsonius DeKay
Sea robin, Prionotus sp.
Sennet, Sphyraena borealis DeKay
Sheepshead minnow, Cyprinodon variegatus (Lacepède)
Silver perch, Bairdiella chrysura (Lacepède)
**Silversides, Menidia sp.
Smallmouth flounder, Etropus microstomus (Gill)
Smooth dogfish, Mustelus canis (Mitchill)
Spiny boxfish, Chilomycterus schoepfi (Walbaum)
Spot, Leiostomus xanthurus Lacepède
Pinfish, Lagodon rhomboides (Linnaeus)
Spottailed shiner, Notropis hudsonius (Clinton)
Striped anchovy, Anchoa hepsetus (Linnaeus)
Striped bass, Morone saxatilis
Striped killifish, Fundulus majalis (Walbaum)
Striped mullet, Mugil cephalus (Linnaeus)

TABLE 1. (Continued)

Summer flounder, Paralichthys dentatus (Linnaeus)
Sunfish, Lepomis gibbosus (Linnaeus)
Tautog, Tautoga onitis (Linnaeus)
Three-spined stickleback, Gasterosteus aculeatus Linnaeus
Weakfish, Cynoscion regalis (Bloch and Schneider)
White catfish, Ictalurus catus (Linnaeus)
White mullet, Mugil curema Valenciennes
White perch, Morone americanus
White sucker, Catostomus commersoni (Lacépède)
Windowpane, Scophthalmus aquosus (Mitchill)
Winter flounder, Pseudopleuronectes americanus (Walbaum)
Yellow perch, Perca flavescens (Mitchill)

* Mullet - Thirteen mullet were identified as to species - two striped mullet and 11 white mullet. Twenty-two were not speciated.

** Silversides - Three species involved: Menidia menidia, Menidia beryllina, and Membras vagrans. These fishes will be speciated in following surveys.

TABLE 1a. Number of species taken at each station in Great Bay-Mullica River Estuary.

Lower Bank	Landing Creek	Little Beach	Cape Horn	Graveling Point.
30	33	32	31	23

TABLE 2a. Number of species taken monthly in Great Bay-Mullica River Estuary

June	24
July	37
August	34
September	25
October	33
November	12
December	7
March	13
April	15
May	28

TABLE 2. Number of times each species occurred at each station during sampling year in the Great Bay-Mullica River Estuary

Species	LOCATION					
	Lower Bank	Landing Creek	Little Beach	Cape Horn	Graveling Point	
Alewife	5	4	2	1	0	12
American eel	3	5	1	6	0	15
Atlantic menhaden	2	1	0	0	1	4
Atlantic needlefish	0	3	1	5	2	11
Bay anchovy	3	6	4	6	2	21
Blueback herring	1	2	0	1	0	4
Bluefish	3	5	3	4	2	17
Bluegill	2	0	0	0	0	2
Brown bullhead	6	0	0	0	0	6
Chain pickerel	4	0	0	0	0	4
Crevalle	3	1	0	0	1	5
Cunner	0	1	0	1	1	3
Fusiform darter	1	0	0	0	0	1
Four-spined stickleback	0	1	1	1	0	3
Golden shiner	9	0	0	0	0	9
Hogchoker	1	2	0	0	0	3
Hickory shad	1	0	0	0	0	1
Johnny darter	4	1	0	0	0	5
Kingfish	0	0	4	0	2	6
Menidia sp.	4	9	9	8	7	37
Mullet	0	2	3	1	2	8
Mummichog	1	3	2	3	1	10
Naked goby	2	0	0	1	0	3
Northern puffer	0	2	5	4	4	15
Oyster toadfish	1	6	0	6	5	18
Pipefish	1	7	6	7	3	24
Pollack	0	1	0	0	0	1
Red Hake	0	0	0	2	0	2
Permit	0	0	1	0	0	1
Sand lance	0	0	2	0	0	2
Sea bass	0	0	0	1	0	1
Sea herring	0	1	2	2	0	5
Sea horse	0	0	2	1	0	3
Sea robin	0	0	1	3	0	4
Sennet	0	0	1	1	2	4
Sheepshead minnow	0	0	1	0	0	1
Silver perch	0	5	2	4	4	15
Smallmouth flounder	0	0	2	0	0	2
Smooth dogfish	0	1	0	0	0	1
Spiny boxfish	0	2	1	1	1	5
Spot	0	1	1	0	0	2
Spottailed shiner	2	0	0	0	0	2
Striped anchovy	0	2	1	0	0	3
Striped bass	3	3	1	1	1	9
Striped killifish	0	5	6	2	5	18

TABLE 2. (Continued)

Species	LOCATION					
	Lower Bank	Landing Creek	Little Beach	Cape Horn	Gravelings Point	
Summer flounder	0	0	1	3	1	5
Tautog	0	3	0	2	1	6
Threespined stickleback	0	2	1	1	2	6
Weakfish	1	0	2	0	0	3
White perch	8	3	0	0	0	11
Windowpane	0	2	7	3	1	13
Winter flounder	0	5	4	7	5	21
Yellow perch	5	0	0	0	0	5
Sunfish	1	0	0	0	0	1
White catfish	2	0	0	0	0	2
White sucker	5	0	0	0	0	5
Pinfish	0	3	0	1	2	6
Banded killifish	8	0	0	0	0	8
Black crappy	1	0	0	0	0	1

TABLE 3. Number of each species taken at each station in Great Bay-Mullica River Estuary.

Species	LOCATION					Total
	Lower Bank	Landing Creek	Little Beach	Cape Horn	Graveling Point	
Alewife	883	22	4	16	-	925
American eel	15	29	1	29	-	74
Atlantic menhaden	8	140	-	-	1	149
Atlantic needlefish	-	58	10	40	15	123
Banded killifish	126	-	-	-	-	126
Bay anchovy	4,580	40,987	4,941	13,045	11,778	75,331
Black crappy	2	-	-	-	-	2
Blueback herring	1	25	-	25	-	51
Bluefish	15	35	23	24	49	146
Bluegill	3	-	-	-	-	3
Brown bullhead	135	-	-	-	-	135
Chain pickerel	4	-	-	-	-	4
Crevalle	8	1	-	-	4	13
Cunner	-	10	-	1	1	12
Fusiform darter	13	-	-	-	-	13
Four-spined stickleback	-	8	2	3	-	13
Golden shiner	212	-	-	-	-	212
Hogchoker	53	2	-	-	-	55
Hickory shad	16	-	-	-	-	16
Johnny darter	35	1	-	-	-	36
Kingfish	-	-	26	-	11	37
Menidia sp.	62	1,218	24,516	6,298	6,828	38,923
Mullet	-	7	16	3	7	33
Mummichog	32	90	18	4	1	145
Naked Goby	23	-	-	1	-	24
Northern Pipefish	1	64	23	50	15	153
Northern puffer	-	6	20	125	38	189
Oyster toadfish	2	173	-	30	28	233
Pollock	-	1	-	-	-	1
Permit	-	-	1	-	-	1
Red hake	-	-	-	2	-	2
Sand lance	-	-	18	-	-	18
Sea bass	-	-	-	1	-	1
Sea herring	-	500	6	4	-	510
Sea horse	-	-	2	2	-	4
Sea robin	-	-	1	7	-	8
Sennet	-	-	5	23	19	47
Sheepshead minnow	-	-	1	-	-	1
Silver perch	-	932	571	581	1,262	3,346
Smallmouth flounder	-	-	5	-	-	5
Smooth dogfish	-	1	-	-	-	1
Spiny boxfish	-	2	1	1	1	5
Spot	-	2	1	-	-	3
Pinfish	-	10	-	18	5	33

TABLE 3. (Continued)

Species	LOCATION Lower Bank	Landing Creek	Little Beach	Cape Horn	Graveling Point	Total
Spottailed shiner	5	-	-	-	-	5
Striped anchovy	-	375	9	-	-	384
Striped bass	5	4	1	1	1	12
striped killifish	-	18	602	2	187	809
Summer flounder	-	-	1	4	1	6
Sunfish	2	-	-	-	-	2
Tautog	-	5	-	5	1	11
Three-spined stickleback	-	31	1	9	3	44
Weakfish	2	-	5	-	-	6
White catfish	7	-	-	-	-	7
White perch	326	57	-	-	-	384
White sucker	11	-	-	-	-	11
Windowpane	-	3	32	5	4	44
Winter flounder	-	8	21	73	22	123
Yellow perch	30	-	-	-	-	30
Shiner	5	-	-	-	-	5
Centrarchids	34	-	-	-	-	34
Clupeidae	-	3	-	-	-	3
Anchovy larvae	-	2	-	-	-	2
Total for each Station for year	6,657	44,830	30,884	20,432	20,282	123,084
Percent	5%	36%	25%	17%	16%	
Station totals excluding bay anchovy and silversides	2,015	2,625	1,427	1,089	1,676	8,830
Percent	23%	30%	16%	12%	19%	

TABLE 4. Temperature and salinity at seining stations in Great Bay-Mullica River Estuary.

	Lower Bank		Landing Creek		Little Beach		Cape Horn		Gravelling Point	
	Temp. °F.	Sal. °/oo	Temp. °F.	Sal. °/oo	Temp. °F.	Sal. °/oo	Temp. °F.	Sal. °/oo	Temp. °F.	Sal. °/oo
June	77	3.8	74	26.6	74	31.8	74	29.8	70	28.9
July	74	<1	74	27.5	76	-	72	31.9	76	-
August	76	<1	76	18.5	77	27	74	27	78	19
September	64	4.7	64	25	67	30.9	64	31.3	63	27.1
					57 30	31.8				
October	68	3.8	68	27.5	64	30.8	65	30.8	62	24.9
November	46	-	48	20.3	46	25.6	No Sample		47	20.5
December	36	<1	No Sample		No Sample		No Sample		No Sample	
March	40	1	38	24	No Sample		40	27.7	47	25.1
April	57	.1	45	23.4	52	28.2	50	27.4	No Sample	
May	75	<1	57	13.8	-	25.0	-	24.0	No Sample	

TABLE 5. Number of times each species was taken each month during sampling year in the Great Bay-Mullica River Estuary.

Species	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
Alewife	2	4	3	1	1	-	-			-	-	1	12
American eel	2	2	2	2	3	-	-			-	2	2	15
Atlantic menhaden	-	-	-	1	2	1	-			-	-	-	4
Atlantic needlefish	-	3	3	2	2	-	-			-	-	1	11
Bay anchovy	5	3	3	5	3	-	-			-	-	2	21
Black drum	-						-				-	-	
Blueback herring	1	-	-	-	-	-	-			-	1	2	4
Bluefish	4	5	3	1	4	-	-			-	-	-	17
Bluegill	-	-	-	-	-	-	1			-	-	1	2
Brown bullhead	1	1	1	-	1	1	1			-	-	-	6
Chain pickerel	1	1	-	-	1	-	-			1	-	-	4
Cunner	-	-	3	-	-	-	-			-	-	-	3
Crevalle	-	2	1	1	1	-	-			-	-	-	5
Filefish	-		-	-	-	-	-			-	-	-	
Fusiform darter	-	-	-	-	-	-	-			-	-	1	1
Four-spined stickleback	-	-	-	-	-	-	-			2	1	-	3
Golden shiner	-	1	1	1	1	1	1			1	1	1	9
Hogchoker	1	1	1	-	-	-	-			-	-	-	3
Hickory shad	-	-	-	-	-	-	-			-	-	1	1
Johnny darter	-	-	1	-	-	1	1			-	2	-	5
Kingfish	1	1	2	-	2	-	-			-	-	-	6
Menidia sp.	5	5	4	4	6	4	-			3	3	3	37
Mullet	-	1	2	4	1	-	-			-	-	-	8
Mummichog	1	2	-	-	2	1	-			-	1	3	10
Naked goby	-	1	-	-	1	-	-			1	-	-	3
Northern puffer	4	4	3	2	1	-	-			-	-	1	15
Oyster toadfish	3	3	3	4	3	-	-			-	-	2	18
Pipefish	3	4	3	4	5	-	-			-	2	3	24
Pollack	-	-	-	-	-	-	-			1	-	-	1
Red hake	1	-	-	-	-	-	-			-	-	1	2
Permit	-	-	-	-	1	-	-			-	-	-	1
Sandlance	-	-	-	-	1	1	-			-	-	-	2
Sea bass	-	1	-	-	-	-	-			-	-	-	1
Sea herring	2	1	-	-	-	-	-			-	-	2	5
Sea horse	-	-	-	-	1	-	-			-	-	2	3

No Sampling

No Sampling

TABLE 5. (Continued)

Species	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
Sea robin	-	2	1	1	-	-	-			-	-	-	4
Sennet	-	2	1	1	-	-	-			-	-	-	4
Sheepshead minnow	-	1	-	-	-	-	-			-	-	-	1
Silver perch	-	3	3	4	3	1	-			-	-	1	15
Smallmouth flounder	-	-	-	-	2	-	-			-	-	-	2
Smooth dogfish	-	1	-	-	-	-	-			-	-	-	1
Spiny boxfish	1	2	2	-	-	-	-			-	-	-	5
Spot	-	-	2	-	-	-	-			-	-	-	2
Pinfish	-	-	2	2	2	-	-			-	-	-	6
Spottailed shiner	-	-	-	-	1	-	-			-	-	1	2
Striped anchovy	-	1	1	1	-	-	-			-	-	-	3
Striped bass	2	4	1	-	-	-	-			-	-	2	9
Striped killifish	2	2	3	3	3	2	-			1	1	1	18
Summer flounder	2	1	2	-	-	-	-			-	-	-	5
Sunfish	-	-	-	-	-	-	-			-	-	1	1
Tautog	1	1	-	3	2	-	-			-	-	-	6
Three-spined stickleback	-	1	-	-	-	-	-	No Sampling	No Sampling	3	2	-	6
Weakfish	-	-	1	1	1	-	-			-	-	-	3
White catfish	-	-	1	-	-	-	-			-	-	1	2
White perch	1	1	2	1	1	1	-			2	1	1	11
White sucker	-	-	1	-	-	1	1			1	1	-	5
Windowpane	3	1	-	1	2	-	-			-	3	3	13
Winter flounder	4	2	3	2	4	-	-			3	2	1	21
Yellow perch	-	1	-	-	-	-	1			1	1	1	5
Banded killifish	-	1	1	1	1	1	1			1	-	1	8
Black crappy		1											1

TABLE 6. Number of each species taken monthly in the Great Bay-Mullica River Estuary.

Species	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mar.	Apr.	May	Total
Alewife	92	44	440	31	310	-	-	-	-	8	925
American eel	8	13	19	6	15	-	-	-	6	7	74
Atlantic menhaden	-	-	-	4	144	1	-	-	-	-	149
Atlantic needlefish	-	39	33	31	19	-	-	-	-	1	123
Banded killifish	-	58	12	4	25	2	3	4	-	18	126
Bay anchovy	21,278	1,450	2,310	45,081	4,744	-	-	-	-	468	75,331
Black drum											
Blueback herring	1	-	-	-	-	-	-	-	12	38	51
Bluefish	21	84	16	1	24	-	-	-	-	-	146
Bluegill	-	-	-	-	-	-	1	-	-	2	3
Brown bullhead	1	2	126	-	2	2	2	-	-	-	135
Chain pickerel	1	1	-	-	1	-	-	1	-	-	4
Crevalle	-	7	4	1	1	-	-	-	-	-	13
Cunner	-	-	12	-	-	-	-	-	-	-	12
Filefish	-	-		-	-	-	-	-	-		
Fusiform darter	-	-	-	-	-	-	-	-	-	13	13
Fourspined stickleback	-	-	-	-	-	-	-	11	2	-	13
Golden shiner	-	2	65	10	3	46	45	3	12	26	212
Hogchoker	1	53	1	-	-	-	-	-	-	-	55
Hickory shad	-	-	-	-	-	-	-	-	-	16	16
Johnny darter	-	-	7	-	-	7	6	-	16	-	36
Northern kingfish	1	1	18	-	17	-	-	-	-	-	37
Menidia sp.	727	4,375	11,992	5,450	15,408	390	-	197	42	342	38,923
Mullet	-	2	6	14	11	-	-	-	-	-	33
Mummichog	11	18	-	-	3	3	-	-	1	109	145
Naked goby	-	3	-	-	1	-	-	20	-	-	24
Northern pipefish	8	27	39	22	25	-	-	-	4	28	153
Northern puffer	75	72	12	13	1	-	-	-	-	16	189
Oyster toadfish	10	21	27	161	12	-	-	-	-	2	233
Pollack	-	-	-	-	-	-	-	1	-	-	1
Red hake	1	-	-	-	-	-	-	-	-	1	2
Permit	-	-	-	-	1	-	-	-	-	-	1
Sand lance	1	-	-	-	3	14	-	-	-	-	18
Sea bass	-	1	-	-	-	-	-	-	-	-	1

TABLE 6. (Continued)

Species	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mar.	Apr.	May	Total
Sea herring	8	1	-	-	-	-	-	-	-	501	510
Sea horse	-	-	-	-	1	-	-	-	-	3	4
Sea robin	-	6	1	1	-	-	-	-	-	-	8
Sennet	-	45	1	1	-	-	-	-	-	-	47
Sheepshead minnow	-	1	-	-	-	-	-	-	-	-	1
Silver perch	-	619	1,185	1,377	148	1	-	-	-	16	3,346
Smallmouth flounder	-	-	-	-	5	-	-	-	-	-	5
Smooth dogfish	-	1	-	-	-	-	-	-	-	-	1
Spiny boxfish	1	2	2	-	-	-	-	-	-	-	5
Spot	-	-	3	-	-	-	-	-	-	-	3
Pinfish	-	-	9	4	20	-	-	-	-	-	33
Spottailed shiner	-	-	-	-	3	-	-	-	-	2	5
Striped anchovy	-	9	25	350	-	-	-	-	-	-	384
Striped bass	3	4	2	-	-	-	-	-	-	3	12
Striped killifish	14	632	93	35	25	6	-	2	1	1	809
Summer flounder	2	2	2	-	-	-	-	-	-	-	6
Sunfish	-	-	-	-	-	-	-	-	-	2	2
Tautog	-	1	-	4	6	-	-	-	-	-	11
Three-spined stickleback	-	1	-	-	-	-	-	41	2	-	44
Weakfish	-	-	4	1	1	-	-	-	-	-	6
White catfish	-	-	6	-	-	-	-	-	-	1	7
White perch	6	187	63	1	33	6	-	3	1	84	384
White sucker	-	-	6	-	-	1	1	1	2	-	11
Windowpane	14	3	-	1	4	-	-	-	12	10	44
Winter flounder	18	50	22	4	17	-	-	8	3	1	123
Yellow perch	-	1	-	-	-	-	8	6	13	2	30
Black crappy	-	-	2	-	-	-	-	-	-	-	2

TABLE 6. (Continued)

Species	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mar.	Apr.	May	Total
Shiner	-	-	5	-	-	-	-	-	-	-	5
Total each species each month	22,303	7,838	16,604	52,611	21,033	479	66	300	129	1,721	123,084
Percent	18%	6%	13%	43%	17%	Tr.	Tr.	Tr.	Tr.	1%	
Total monthly catch excluding bay anchovy and silversides	3% 298	23% 2,013	26% 2,302	24% 2,080	10% 881	1% 89	Tr. 66	1% 103	1% 87	1% 911	8,830

73%

Bay anchovy = 61% of total catch
Menidia sp. = 32% of total catch
93%

73%

TABLE 7. Range in salinities at which various species were taken in the Great Bay-Mullica River Estuary.

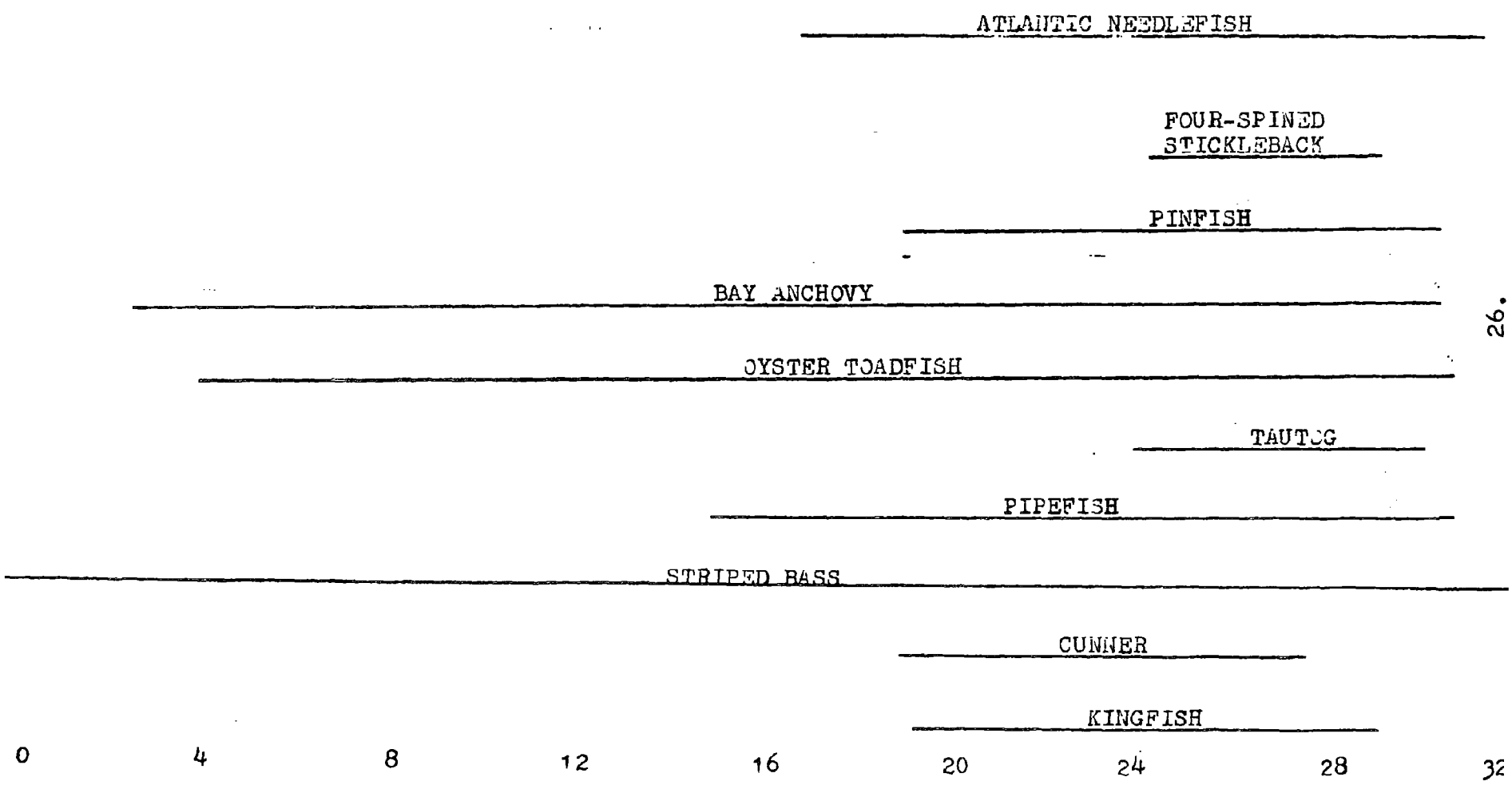


TABLE 8. Range in temperature at which various species were taken in the Great Bay-Mullica River Estuary.

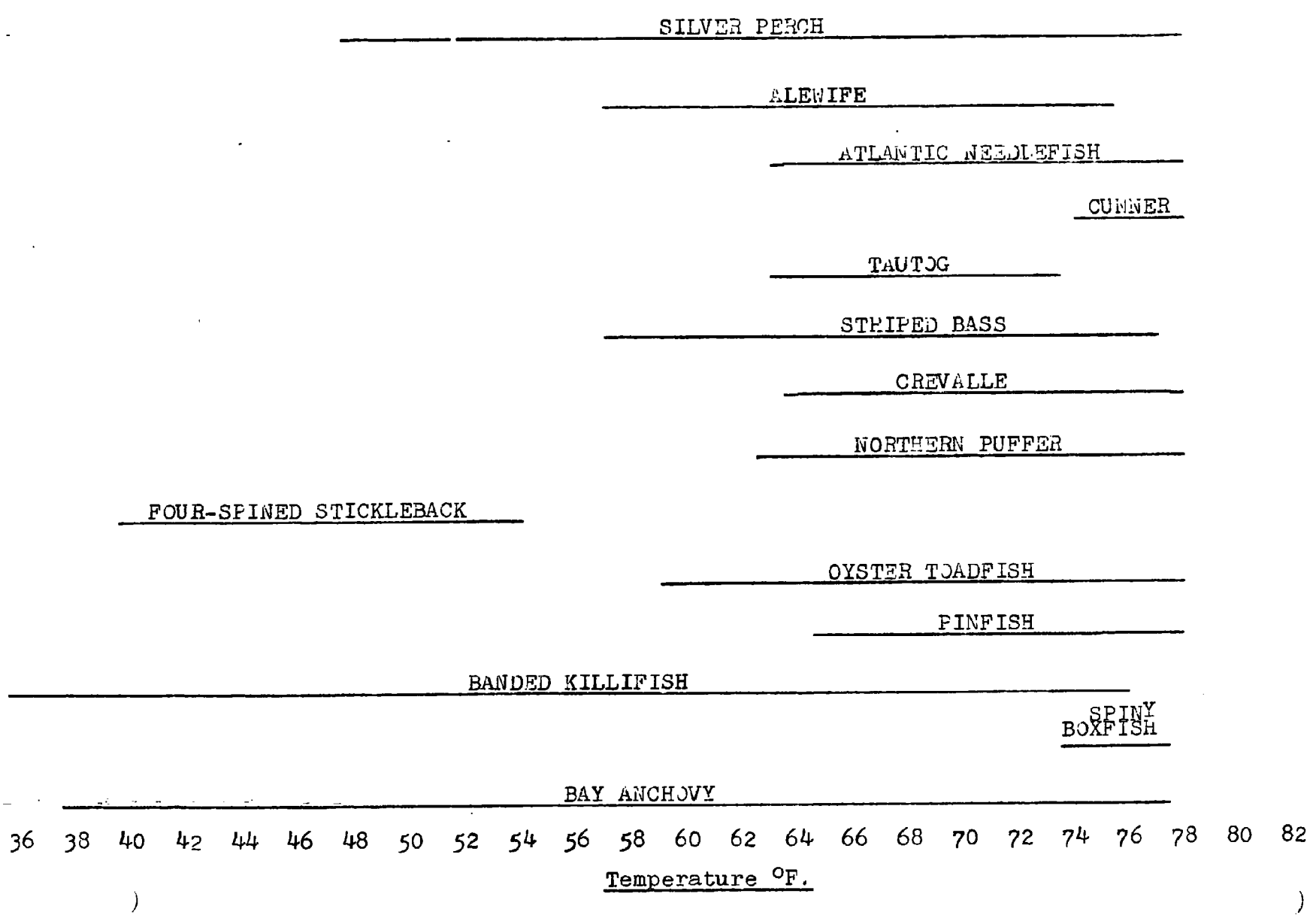


TABLE 9. Length Frequencies of 52 blueback herring taken in the Great Bay-Mullica River Estuary.

Cms.	June	April	May	
1				
2				
3				
4				
5				
6				
7				
8		1	1	
9				
10			8	
11			3	
12			1	
13			2	
14	1		5	
15			2	
16			1	
17			3	
18		1	4	
19		1	2	
20		3	1	
21			3	
22			2	
23		1		
24		2		
25				
26				
27				
28				
29				
30		1		
31		1		
32		2		
Total	1	13	38	52

TABLE 10. Length frequencies of 145 Bluefish taken in the Great Bay-Mullica River Estuary.

Cms.	June	July	August	September	October	
3		21				
4	2	21				
5	1					
6	3	1				
7	9					
8	5	4				
9	1	7				
10		8				
11		10				
12		4				
13		6				
14		1	1		1	
15			2		1	
16			2		1	
17			4		2	
18			4		4	
19					3	
20			1		3	
21			2	1	2	
22					2	
23					1	
24					4	
Total	21	83	16	1	24	145

TABLE 11. Length frequencies of 133 mummichogs taken in the Great Bay-Mullica River Estuary.

Cms.	June	July	October	November	April	May	
1							
2							
3				1			
4				2		44	
5			1		1	34	
6	1		1			13	
7	3	1	1			8	
8	2	6				7	
9	3					2	
10	1						
11	1						
Total	11	7	3	3	1	108	133

TABLE 12. Length frequencies of 639 silver perch taken in the Great Bay-Mullica River Estuary.

Cms.	July	August	September	October	November	May	
1							
2	30						
3	14	14					
4	5	73	21	2			
5		35	102	10			
6		1	44	62			
7			41	36	1		
8		2	18	14			
9		11	10	9			
10		5	3	7			
11				7			
12							
13				1			
14							
15	1					1	
16	1					3	
17	3						
18	11						
19	11						
20	15					6	
21	3					4	
22						2	
Total	94	141	239	148	1	16	639

TABLE 13. Length frequencies of 331 striped killifish taken in the Great Bay-Mullica River Estuary.

Cms.	June	July	August	Sept.	October	Nov.	March	April	May	
1										
2		1	5							
3		34	16							
4		35	22							
5			21	4	2				1	
6			11	5						
7		15	7	8	5	1		1		
8	5	13	9	5	5	3				
9	2	14	1	9	8		1			
10	3	10	1	3	4		1			
11		6		1	1	1				
12	2	6								
13						1				
14	1	7								
15		5								
16	1	7								
17		1								
Total	14	154	93	35	25	6	2	1	1	331

TABLE 14. Length frequencies of 275 White perch taken in the Great Bay-Mullica River Estuary.

Cms.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mar.	Apr.	May
1			26							
2			29							
3										
4		13								
5		69								
6		17								
7						1				6
8				1						14
9										7
10										1
11	2									3
12										2
13					2	1				14
14					3					10
15	1				2					13
16	1		1							4
17			2		4	1				5
18	1		3		1	2		1		1
19			1		1					1
20					1	1				3
21										
22			1							
23										
24										
25										
26								1	1	
Total	5	99	63	1	14	6	0	2	1	84

275

TABLE 15. Length frequencies of 121 Winter flounder taken in the Great Bay-Mullica River Estuary.

Cms.	June	July	August	Sept.	Oct.	March	April	May	
3	1								
4	8	2							
5	4	16	1						
6		14	7						
7		6	10						
8		2	3						
9				1	1				
10				1	2				
11					4		1		
12				1	2				
13		1							
14		1			1				
15	2	2							
16	2							1	
17		3	1			2			
18	1	1				1			
19		1				1			
20									
21						1			
22		1		1	3				
23					2	1			
24						2	1		
25					1				
26									
27									
28									
29									
30									
31									
32									
33							1		
Total	17	50	22	4	16	8	3	1	121

TABLE 16. A list of species taken in the Manasquan River.

Alewife, Alosa pseudoharengus (Wilson)
American eel, Anguilla rostrata (LeSueur)
Atlantic menhaden, Brevoortia tyrannus (Latrobe)
Atlantic needlefish, Strongylura marina (Walbaum)
Atlantic sea herring, Clupea harengus harengus (Lennaeus)
Banded killifish, Fundulus diaphanus (LeSueur)
Bay anchovy, Anchoa mitchilli (Valenciennes)
Blueback herring, Alosa aestivalis (Mitchill)
Bluefish, Pomatomus saltatrix (Linnaeus)
Bluegill, Lepomis macrochirus Rafinesque
Butterfish, Poronotus triacanthus (Peck)
Chub mackerel, Scomber colias Gmelin
Common filefish, Monacanthus hispidus (Linnaeus)
Coronet fish, Fistularia tabacaria
Crevalle (jack), Caranx hippos (Linnaeus)
Cunner, Tautogolabrus adspersus (Walbaum)
Grubby sculpin, Myoxocephalus aeneus (Mitchill)
Hickory shad, Alosa mediocris (Mitchill)
Northern Kingfish, Menticirrhus saxatilis (Bloch and Schneider)
Longhorn sculpin, Myoxocephalus octodecemspinosus (Mitchill)
Lookdown, Selene vomer (Linnaeus)
Mullet, Mugil sp.
Mummichog, Fundulus heteroclitus (Linnaeus)
Naked goby, Gobiosoma bosci (Lacépède)
Northern pipefish, Syngnathus fuscus (Storer)
Northern puffer, Sphaeroides maculatus (Bloch and Schneider)
Oyster toadfish, Opsanus tau (Linnaeus)
Permit (red pompano), Trachinotus falcatus (Linnaeus)
Oceanpout, Macrozoarces americanus (Bloch and Schneider)
Red hake, Urophycis chuss (Walbaum)
Sand lance, Ammodytes americanus (DeKay)
Black sea bass, Centropristes striatus (Linnaeus)
Sea robin, Prionotus sp.
Sennet, Sphyraena borealis (DeKay)
Silver perch, Bairdiella chrysura (Lacépède)
Silversides, Menidia sp.
Striped anchovy, Anchoa hepsetus (Linnaeus)
Striped bass, Morone saxatilis
Striped killifish, Fundulus majalis (Walbaum)
Summer flounder, Paralichthys dentatus (Linnaeus)
Tautog, Tautoga onitis (Linnaeus)
Warsaw grouper, Epinephelus nigritus (Holbrook)
Weakfish, Cynoscion regalis (Bloch and Schneider)
White perch, Morone americanus
Windowpane, Scophthalmus aquosus (Mitchill)
Winter flounder, Pseudopleuronectes americanus (Walbaum)

Blue crab

TABLE 17. Number of each species taken monthly at each station, Manasquan River.

Species	Month	Inlet	Treasure Island	Bluffs	Monthly Total	
Alewife	April	-	-	-	-	
	May	-	-	-	-	
	June	-	6	42	48	
	July	-	-	57	57	
	August	-	3	-	3	
Station total		-	9	99	108	Total for year
American eel	April	-	-	-	-	
	May	-	1	-	1	
	June	-	21	2	23	
	July	-	8	2	10	
	August	-	9	-	9	
Station Total		-	38	4	42	Total for year
Atlantic Needlefish	April	-	-	-	-	
	May	-	-	-	-	
	June	1	4	-	5	
	July	-	-	1	1	
	August	76	57	-	133	
Station Total		77	61	1	139	Total for year
Atlantic sea herring	April	-	-	-	-	
	May	3	-	-	3	
	June	2	19	1	22	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		5	19	1	25	Total for year
Banded Killifish	April	-	-	23	23	
	May	-	-	61	61	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		0	0	84	84	Total for year

TABLE 17. (Continued)

Species	Month	Inlet	Treasure Island	Bluffs	Monthly Total	
Bay anchovy	April	-	-	-	-	
	May	5	39	-	44	
	June	-	108	296	404	
	July	-	114	43	157	
	August	-	-	720	720	
Station Total		5	261	1069	1325	Total for year
Blueback herring	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	1	-	1	
	August	2	-	-	2	
Station Total		2	1	0	3	Total for year
Bluefish	April	-	-	-	-	
	May	1	-	-	1	
	June	19	1	5	25	
	July	8	10	9	27	
	August	35	15	10	60	
Station Total		63	26	24	113	Total for year
Bluegill	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	1	1	
	August	-	-	-	-	
Station Total		0	0	1	1	Total for year
Butterfish	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	1	-	-	1	
Station Total		1	0	0	1	Total for year
Common filefish	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	1	-	-	1	
	August	29	-	-	29	
Station Total		30	0	0	30	Total for year

TABLE 17. (Continued)

Species	Month	Inlet	Treasure Island	Bluffs	Monthly Total	
Coronetfish	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	1	-	-	1	
Station Total		1	0	0	1	Total for year
Cunner	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	2	-	-	2	
	August	1	-	-	1	
Station Total		3	0	0	3	Total for year
Crevalle jack	April	-	-	-	-	
	May	-	-	-	-	
	June	2	-	-	2	
	July	-	-	-	-	
	August	2	-	90	92	
Station Total		4	0	90	94	Total for year
Grubby sculpin	April	-	-	-	-	
	May	-	-	-	-	
	June	1	-	-	1	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		1	0	0	1	Total for year
Hickory shad	April	-	5	-	5	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		0	5	0	5	Total for year
Kingfish	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	6	22	-	28	
Station Total		6	22	0	28	Total for year

TABLE 17. (Continued)

Species	Month	Inlet	Treasure Island	Bluffs	Monthly Total	
Longhorn sculpin	April	-	1	-	1	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		0	1	0	1	Total for year
Lookdown	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	4	-	4	
Station Total		0	4	0	4	Total for year
Mackeral	April	-	-	-	-	
	May	-	-	-	-	
	June	1	-	-	1	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		1	0	0	1	Total for year
Menhaden	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	5	5	
	July	-	-	-	-	
	August	-	-	54	54	
Station Total		0	0	59	59	Total for year
Silversides	April	18	9	-	27	
	May	68	-	-	68	
	June	11,740	896	144	12,780	
	July	4,290	252	480	5,022	
	August	2,800	171	4	2,925	
Station Total		18,916	1,328	628	20,822	Total for year
Mullet	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	8	-	1	9	
Station Total		8	-	1	9	Total for year

TABLE 17. (Continued)

Species	Month	Inlet	Treasure Island	Bluffs	Monthly Total	
Mummichog	April	-	-	-	-	
	May	-	-	101	101	
	June	5	2	144	151	
	July	3	-	120	123	
	August	1	-	-	1	
Station Total		9	2	365	376	Total for year
Naked Goby	April	-	-	-	-	
	May	-	1	-	1	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	2	-	2	
Station Total		0	3	0	3	Total for year
Northern Pipefish	Aptil	3	1	-	4	
	May	-	13	-	13	
	June	2	8	-	10	
	July	1	33	-	34	
	August	-	-	-	-	
Station Total		6	55	0	61	Total for year
Northern puffer	April	-	-	-	-	
	May	4	-	-	4	
	June	-	20	0	20	
	July	1	5	-	6	
	August	857	12	-	869	
Station Total		862	37	0	899	Total for year
Oyster toadfish	April	-	-	-	-	
	May	-	-	-	-	
	June	1	-	2	3	
	July	-	8	-	8	
	August	-	6	-	6	
		1	14	2	17	Total for year
Permit	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	1	-	1	
	August	-	-	-	-	
Station Total		0	1	0	1	Total for year

TABLE 17. (Continued)

Species	Month	Inlet	Treasure Island	Bluffs	Monthly Total	
Ocean pout	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	2	-	2	
	August	-	-	-	-	
Station Total		0	2	0	2	Total for year
Red hake	April	-	-	-	-	
	May	-	1	-	1	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		0	1	0	1	Total for year
Sand lance	April	-	-	-	-	
	May	2	-	-	2	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		2	0	0	2	Total for year
Sea bass	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	2	-	-	2	
Station Total		2	0	0	2	Total for year
Sea Robin	April	-	-	-	-	
	May	1	-	0	1	
	June	-	10	-	10	
	July	-	-	-	-	
	August	11	1	-	12	
Station Total		12	11	0	23	Total for year
Sennet	April	-	-	-	-	
	May	-	-	-	-	
	June	8	-	-	8	
	July	22	-	-	22	
	August	1	-	-	1	
Station Total		31	0	0	31	

TABLE 17. (Continued)

Species	Month	Inlet	Treasure Island	Bluffs	Monthly Total	
Silver perch	April	-	-	-	-	
	May	-	3	-	3	
	June	-	3	-	3	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		0	6	0	6	Total for year
Striped anchovy	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	63	39	102	
Station Total		0	63	39	102	Total for year
Striped bass	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	2	2	
	July	-	-	1	1	
	August	-	-	-	-	
Station Total		0	0	3	3	Total for year
Striped killifish	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	36	36	
	August	15	-	-	15	
Station Total		15	0	36	51	Total for year
Summer flounder	April	-	-	-	-	
	May	-	1	-	1	
	June	-	-	-	-	
	July	-	1	-	1	
	August	-	1	-	1	
Station Total		0	3	0	3	Total for year
Tautog	April	-	-	-	-	
	May	-	-	-	-	
	June	-	1	-	1	
	July	1	-	-	1	
	August	19	-	-	19	
Station Total		20	1	0	21	Total for year

TABLE 17. (Continued)

Species	Month	Inlet	Treasure Island	Bluffs	Monthly Total	
Warsaw grouper	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	1	-	-	1	
Station Total		1	0	0	1	Total for year
Weakfish	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	-	-	
	July	-	-	-	-	
	August	-	320	-	320	
Station Total		0	320	0	320	Total for year
White perch	April	-	-	-	-	
	May	-	-	-	-	
	June	-	-	1	1	
	July	-	-	-	-	
	August	-	-	-	-	
Station Total		0	0	1	1	Total for year
Windowpane	April	-	-	-	-	
	May	3	-	-	3	
	June	9	-	-	9	
	July	3	-	-	3	
	August	7	-	-	7	
Station Total		22	0	0	22	Total for year
Winter Flounder	April	25	224	0	249	
	May	11	10	-	21	
	June	8	29	5	42	
	July	2	380	-	382	
	August	64	42	-	108	
Station Total		110	685	5	800	Total for year
		20,216	2,980	2,512	25,708	

TABLE 18. Temperature and salinity at seining stations in the Manasquan River.

	Manasquan Inlet		Osborne Island		Bluffs	
	Temp. °F.	Sal. °/oo	Temp. °F.	Sal. °/oo	Temp. °F.	Sal. °/oo
June	69	18.5	69	18.4	69	<1
July	75	32	74	29.8	74	7.1
August	72	26	76	19.5	78	16
April	45	22.9	49	7.9	52	<1
May	59	31.6	68	19.1	62	13.4

TABLE 19. List of the fishes taken in the Maurice River.

Alewife, Alosa pseudoharengus (Wilson)
American eel, Anguilla rostrata (LeSueur)
Atlantic menhaden, Brevoortia tyranus (Latrobe)
Atlantic needlefish, Strongylura marina (Walbaum)
Banded killifish, Fundulus diaphanus (LeSueur)
Bay anchovy, Anchoa mitchilli (Valenciennes)
Black drum, Pogonias cromis (Linnaeus)
Blueback herring, Alosa aestivalis (Mitchill)
Bluefish, Pomatomus saltatrix (Linnaeus)
Butterfish, Poronotus triacanthus (Peck)
Crevalle, Caranx hippos (Linnaeus)
Croaker, Micropogon undulatus (Linnaeus)
Cusk eel, Rissola marginata (DeKay)
Golden shiner, Notemigonus crysoleucas (Mitchill)
Hickory shad, Alosa mediocris (Mitchill)
Hogchoker, Trinectes maculatus (Bloch and Schneider)
Johnny darter, Etheostoma nigrum (Rafinesque)
Northern Kingfish, Menticirrhus saxatilis (Bloch and Schneider)
Naked goby, Gobiosoma bosci (Lacepède)
Northern pipefish, Syngnathus fuscus (Storer)
Northern puffer, Sphaeroides maculatus (Bloch and Schneider)
Oyster toadfish, Opsanus tau (Linnaeus)
Silversides, Menidia sp.
Spot, Leiostomus xanthurus (Lacepède)
Spottailed shiner, Notropis hudsonius (Clinton)
Striped bass, Morone saxatilis
Striped killifish, Fundulus majalis (Walbaum)
Summer flounder, Paralichthys dentatus (Linnaeus)
Unidentified ray
Weakfish, Cynoscion regalis (Bloch and Schneider)
White perch, Morone americanus
Windowpane, Scophthalmus aquosus (Mitchill)
Yellow perch, Perca flavescens (Mitchill)

TABLE 20. Number of each species taken monthly at each station, Maurice River.

Species	Month	East Point	Leesburg	Yapshore	Monthly Total
Alewife	June	-	4	84	88
	August	-	-	3	3
	April	-	No Sample	-	-
	May	-	No Sample	-	-
Total		0	4	87	91
American eel	June	1,420	1	1	1,422
	August	6	-	2	8
	April	29	No Sample	1	30
	May	184	No Sample	-	184
Total		1,639	1	4	1,644
Atlantic needlefish	August	6	-	-	6
Total		6	0	0	6
Bay anchovy	June	17	44	119	180
	August	3,124	-	-	3,124
	April	71	No Sample	-	71
	May	64	No Sample	-	64
Total		3,276	44	119	3,439
Blueback herring	June	-	1	-	1
	August	-	-	20	20
Total		0	1	20	21
Bluefish	June	-	2	15	17
	August	12	-	-	12
Total		12	2	15	29
Black drum	August	182	-	-	182
Butterfish	June	1	-	-	1
Crevalle Jack	August	11	2	-	13

TABLE 20. (Continued)

Species	Month	East Point	Leesburg	Yapshore	Monthly Total
Croaker	June	344	-	-	344
Cusk eel	April	2	No Sample	-	2
Filefish	August	1	-	-	1
Banded killifish	May	-	No Sample	26	26
Golden shiner	June	-	-	1	1
	April	-	-	3	3
	May	-	-	1	1
Total		0	0	5	5
Hickory shad	April	3	No Sample	165	168
	May	-	-	1	1
Total		3	0	166	169
Hogchoker	June	-	34	36	70
	August	-	1	3	4
Total		0	35	39	74
Johnny darter	August	-	-	1	1
Kingfish	August	4	-	-	4
Menhaden	June	431	-	-	431
	August	9	-	-	9
Total		440	0	0	440
Menidia	June	344	10	-	354
	August	4,080	-	27	4,107
	April	150	No Sample	-	150
	May	68	No Sample	-	68
Total		4,642	10	27	4,679

TABLE 20. (Continued)

Species	Month	East Point	Leesburg	Yapshore	Monthly Total
Northern puffer	June	-	3	-	3
	August	1	-	-	1
Total		1	3	0	4
Naked goby	August	-	1	-	1
Oyster toadfish	June	1	3	-	4
	August	8	-	-	8
Total		9	3	0	12
Northern pipefish	June	-	11	-	11
	August	1	-	-	1
	April	16	No sample	-	16
Total		17	11	0	28
Striped bass	April	1	No Sample	-	1
Striped killifish	June	5	2	-	7
	August	-	1	-	1
	April	2	No Sample	-	2
	May	7	No Sample	-	7
Total		14	3	0	17
Spottailed shiner	June	-	-	8	8
	August	-	-	44	44
	April	-	No Sample	120	120
	May	-	No Sample	40	40
Total		0	0	212	212
Spot	August	24	-	-	24
Summer flounder	June	-	2	-	2
Unidentified ray	June	1	-	-	1

TABLE 20. (Continued)

Species	Month	East Point	Leesburg	Yapshore	Monthly Total
White perch	June	-	-	252	252
	August	-	2	37	39
	April	19	No Sample	3	22
	May	37	No Sample	9	46
Total		56	2	301	359
Weakfish	August	16	7	-	23
Windowpane	April	160	No Sample	-	160
	May	15	No Sample	-	15
Total		175		0	175
Yellow perch	August	-	-	6	6
	April	-	No Sample	2	2
	May	-	No Sample	1	1
Total		0		9	9
		10,877	131	1,031	12,039

TABLE 21. Temperature and salinity at seining stations in the Maurice River

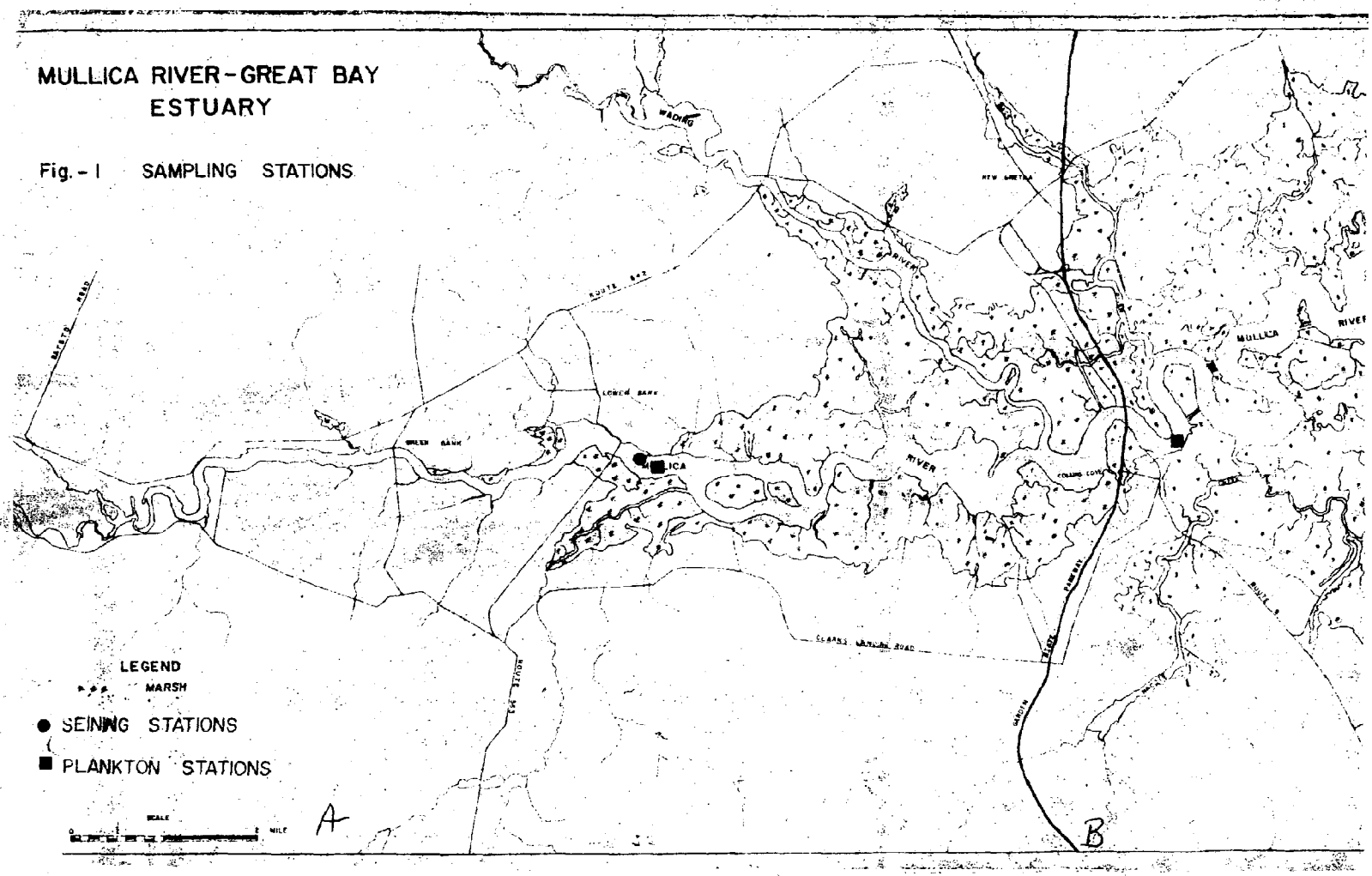
	East Point Cove		Leesburg		Yapshore	
	Temp. °F.	Sal. °/oo	Temp. °F.	Sal. °/oo	Temp. °F.	Sal. °/oo
June	80	23	78	15.8	83	<1
August	80	14	82	3	84	<1
April	55	16	No Sample		58	<1
May	66	14.8	No Sample		68	<1

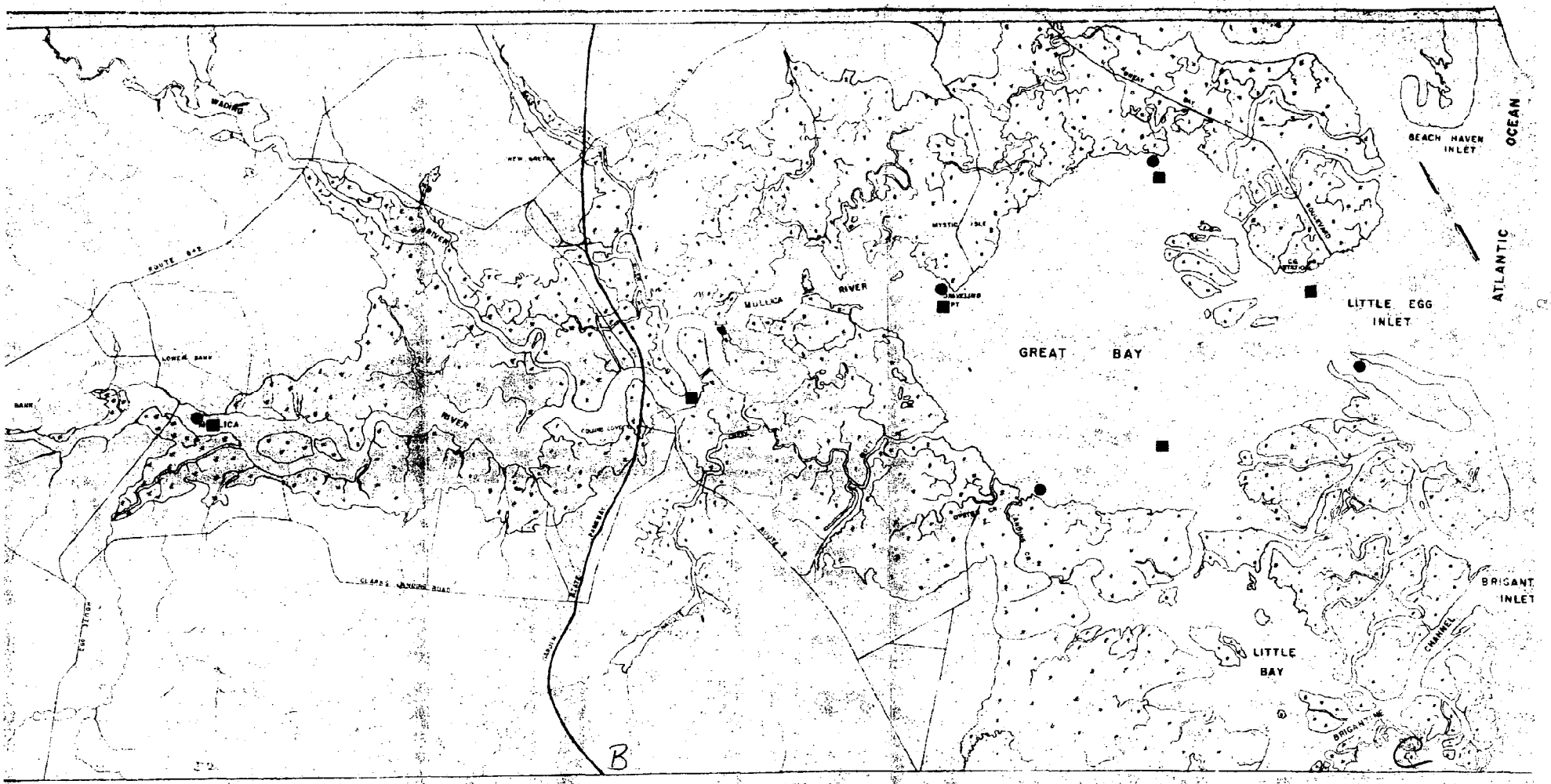
TABLE 22. Plankton samples: frequency of occurrence and number of specimens taken at the surface (s) and bottom (b) at plankton stations in Great Bay-Mullica River Estuary.

	Light 4 Bay		Light 20 Bay		Cape Horn Bay		Graveling Point - Bay		French Point - R6		Lower Bank - R14		
	Freq. Occ.	No.	Freq. Occ.	No.	Freq. Occ.	No.	Freq. Occ.	No.	Freq. Occ.	No.	Freq. Occ.	No.	Total
Alewife	-	-	-	-	-	-	-	-	-	-	1	2b	2b
American eel	1	1s 1b	-	-	-	-	1	2s	2	2s 1b	2	2s 2b	7s 4b
Bay anchovy	1	42s 32b	?	947s 3117b	3	204s 26b	4	1252s 2051b	4	3604s 829b	4	802s 757b	6,851s 6,812b
Gobiosoma sp.	2	17s 17b	3	17s 3b	2	3s 1b	2	101s 588b	5	156s 44b	3	111s 64b	405s 717b
Grubby sculpin	-	-	-	-	1	1s	-	-	2	2s	-	-	3s
Hogchoker	-	-	1	1b	-	-	-	-	-	-	2	4s	4s 1b
Mackeral	1	1b	1	1s	-	-	-	-	-	-	-	-	1s 1b
Menhaden	-	-	1	2s	-	3s 1b	-	-	-	-	1	1b	5s 2b
Silversides	2	32s 7b	1	5s	2	7s 2b	1	2s 2b	1	1b	-	-	46s 12b
Northern pipefish	3	34s 34b	2	34s 1b	3	14s 4b	3	86s 58b	4	133s 56b	1	2b	301s 155b
Northern puffer	1	1b	1	1s	-	-	1	5s	1	17s 7b	1	1s	24s 8b
Sand lance	1	1s	-	-	-	-	-	-	1	4b	-	-	1s 4b
Silver perch	1	1b	1	1s	1	1b	1	2s 3b	-	-	-	-	3s 5b
Striped anchovy	1	2s	1	14s	2	27s	1	6s	1	4b	2	293s 7b	342s 11b

TABLE 22. (Continued)

	Light 4 Bay		Light 20 Bay		Cape Horn Bay		Graveling Point - Bay		French Point -B6		Lower Bank R 14		Total
	Freq. Occ.	No.	Freq. Occ.	No.	Freq. Occ.	No.	Freq. Occ.	No.	Freq. Occ.	No.	Freq. Occ.	No.	
Windowpane	1	1b	-	-	-	-	-	-	-	-	-	-	1b
Winter flounder	1	1b	-	-	-	-	-	-	1	1b	1	1b	3b
Four-spined stickleback	-	-	-	-	1	1s	-	-	-	-	-	-	1s
Total	16	225	12+?	4144	16	295	14	4158	22	4861	18	2049	15,732


MULLICA RIVER-GREAT BAY
ESTUARY
Fig. - I SAMPLING STATIONS
LEGEND
MARSH
SEINING STATIONS
PLANKTON STATIONS
A
B



WADING
RIVER
NEW GRETNA
ROUTE 642
LOWER BANK
BANK
RIVER
COLLINS COVE
CLARKS LANDING ROAD
GARDEN STATE PARKWAY
MULLICA
RIVER
MYSTIC ISLE
GREAT BAY
BEACH HAVEN INLET
OCEAN
ATLANTIC
LITTLE EGG INLET
BRIGANT INLET
LITTLE BAY
CHANNEL
BRIGANTINE
B

Fig.- 2 MANASQUAN RIVER SAMPLING STATIONS

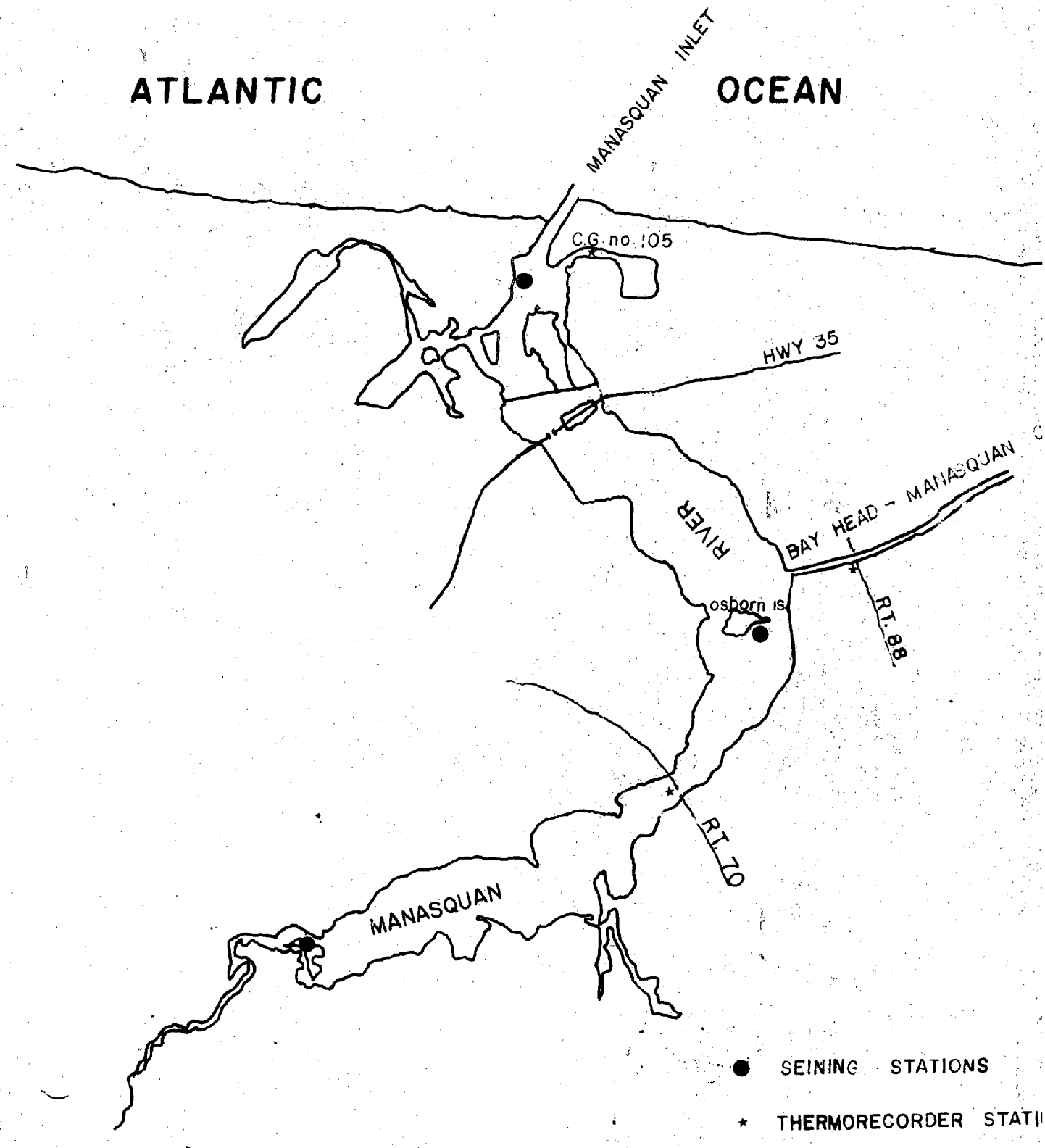
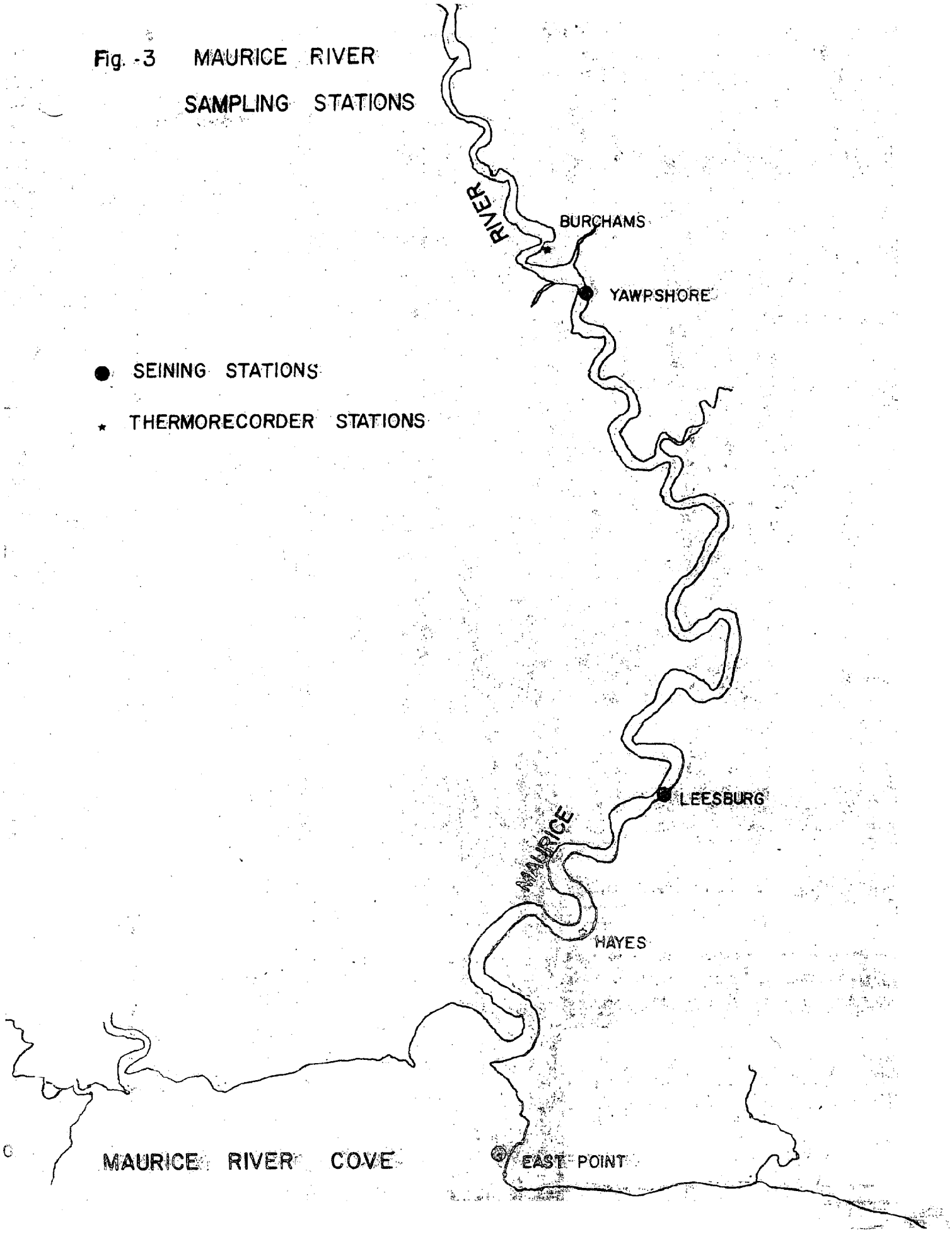


Fig. -3 MAURICE RIVER

SAMPLING STATIONS



PHASE II

PHYSICAL-CHEMICAL STUDIES

John F. Makai
Phase Leader

INTRODUCTION

It was the objective of this Phase to map and/or describe the physical-chemical attributes of the Mullica-Great Bay Estuary. Monthly sampling surveys were established to record conditions on a yearly basis. However, this particular study extended from 1968 into the 1970 year.

ACKNOWLEDGMENTS

Phase leader would like to thank the cooperation and guidance from Dr. James Durand and Mr. R. Nadeau of Rutgers University along with Paul Hamer and Walter Murawski. Appreciation also is extended to the Soils and Conservation Offices of Burlington, Atlantic and Ocean Counties. In connection with the field work, thanks to Fishery Workers Russell Tilton, James Leonard, Harry Bustard, Tom Dempsey, and help with some laboratory work, Robert Weaver. A special thanks goes out to Fishery Worker Ferdinand Metzger who not only helped with some field work but also with the preparation of some charts and graphs for this report.

DESCRIPTION OF THE AREA

The length of the survey area of the Mullica-Great Bay Estuary extending from Little Egg Inlet to the Green Bank Bridge (river mile 17) is approximately 16.02 miles. The maximum width of the bay extending from the northeast shore (near Cape Horn) to the southwestern portion (Landing Creek) is 4.3 miles. The total acreage for the estuarine system sampled was 52,068.17 acres in-

cluding part of the Brigantine National Wildlife Refuge and both the Bass and Wading Rivers. From this total acreage, Brigantine Refuge consists of 13,434 acres of salt marsh, 4,390 acres of water and 1,561 acres of upland. The remainder of marshland in this estuary is approximately 18,741.96 acres. Water acreage of Great Bay is 9,138.65 acres, and the Mullica River is 3,850.32 acres. The two main tributaries affecting the estuary are the Bass and Wading Rivers with 285.58 and 666.66 water acres, respectively.

About 62% of total acreage is composed of tidal marsh. Marshland consists of organic silt subject to daily flooding on flats extensively found along the Mullica and Wading Rivers. The tide is of the semi-diurnal type; there are two flood tides and two ebb tides in a normal day. A grass cover of salt-tolerant grasses occurs on this soil. Salt hay was formerly harvested but is not now. Methane, or marsh gas, forms in the soil.

The estuary has been extensively ditched by the New Jersey Mosquito Commission to reduce the breeding areas of the mosquito. Some dredging has been done in the Mullica and Wading Rivers to provide a channel for small pleasure boats. All dredged material was disposed of by pumping into diked areas of marsh. There is also dredging each year along and in the Intracoastal Waterway located on the southern portion of the bay and Little Egg Inlet which is subject to constant weather erosion. Little Beach, which extends into Little Egg Inlet, is subject to change from year to year.

Charlesworth (1968) (unpublished) states in Great Bay the average fresh water discharge into the bay from the Mullica River is of the magnitude of 312 $ft.^3/sec.$ (U.S. Geological Survey 1966). For a complete tidal cycle of 45×10^3 sec., this amounts to 14.040×10^6 $ft.^3$, which compared to an estimated mean tide prism of

1934 x 10^6 ft.^{3} gives a salt water-fresh water ratio of about 133 which is higher than what is considered the dividing ratio (100) between a partially-mixed and well-mixed estuary (Pritchard, in Lauff, 1967). He concluded that the flow is most likely dominated by the tide and there is little vertical stratification of salinity (at least away from the mouth of the Mullica River) and no opposing surface and bottom flow.

Charlesworth also found on the basis of current drogue data analysis of hydrographic charts and aerial photography and observations of * foam lines and ice floes, the ebb current in Great Bay exhibits the following characteristics:

(a) From the area of the mouth of the Mullica River, the flow is dominantly (1) across the bay toward the tidal deltaic complex where it drains centripetally into the numerous channels, and (2) along the southwest part of Great Bay in a broad sweep to Little Beach Channel and the middle ground of inner Little Egg Inlet. This flow is augmented by that issuing from Great and Main Marsh Thorofares. Maximum ebb velocities in Great Bay are probably of a magnitude of 1.5 ft/sec., with greater velocities at the mouth of the Mullica River and near the entrance to inner Little Egg Inlet.

(b) The outflow from ittle Egg Inlet is of the form of a broad jet with its axis along the Little Egg Inlet gorge, and with maximum velocities perhaps as high as 5.0 ft/sec. The flow is directed towards the southeast with the outer limits of the flow also affected by the coastal current. The juncture of ebb and flood currents,

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* The "foam lines" are lines of foam, detrital matter and trash, including lines of intersection between two differently colored masses of water, and zones of shear between two water masses.

issuing from or flowing into Little Egg and Brigantine Inlets is most likely off Little Beach where the six foot contour is close to the beach and the 12 foot contour is indented towards Brigantine Inlet.

The gross ebb flow pattern of Little Egg Inlet is reflected in the broad lobate nature of the offshore contours.

Charlesworth's flood current patterns in this estuary were also determined mainly from drogue data and analysis of hydrographic charts and exhibit the following characteristics:

(a) In Great Bay the stream lines of flow may also be independent of the direction of flow, but it is most likely that the flow across the northeast half of the bay, issuing from the tidal delta complex, is the dominant flow and of greater magnitude than the ebb. The submerged spit at Graveling Point suggests, for example, the dominance of the flood current along this part of the north side of the bay. Flow through the middle ground and Little Beach Channel at inner Little Egg Inlet enters the lagoon behind Little Beach spit, Great Thorofare, Little Bay via Main Marsh Thorofare, and the southwest side of Great Bay. Maximum flood current velocities in Great Bay are probably around 1.5 ft./sec. with higher velocities at inner Little Egg Inlet and the entrances to the Mullica River and Main Marsh Thorofare.

(b) The flood pattern in Little Egg Inlet is markedly different from the ebb pattern. The flow is of the form of an asymmetric tidal drain with the greater flow coming from an upcoast, or northeast direction. In Little Egg Inlet the flood current, unlike the ebb, does not conform to the bottom topography but flows directly to Shooting Thorofare and inner Little Egg Inlet. Along

Little Beach the flood current conforms to the topography of the shoals, and the line of divergence of Little Egg Inlet and Brigantine Inlet flood currents if off south Little Beach.

In outer Little Egg Inlet the flood velocities are perhaps as high as 5.0 ft./sec. In inner Little Egg Inlet, flood currents attain velocities of at least 5.0 to 5.5 ft./sec.

In the Mullica River Basin, there are gaging stations located on the Mullica River near Batsto, on the Batsto River at Batsto, and on the Oswego River at Harrisville, to measure the amount of river discharge daily. The Mullica and Oswego Rivers are occasionally regulated by ponds and cranberry bogs located upstream. No data will be presented in this report concerning river discharge from these three gaging stations except what was quoted from Charlesworth.

Figures 1 and 2 represent bottom profiles of the estuary at certain points and locations of these areas can be seen in Figure 3.

METHODS AND PROCEDURES

Laboratory Equipment: Since dissolved oxygen and salinity analyses were to be done in rather large quantities, two 50 ml. automatic burets were set up connected to two four-liter aspirator bottles elevated close to the ceiling. An electric magnetic stirring motor was purchased to produce a uniform agitation action in analysis.

The Twelfth Edition of Standard Methods for the Examination of Water and Wastewater is being used as the source for most of the chemical analyses being run.

The following analytical procedures are being used:

Dissolved Oxygen (ppm.) - Determinations are based on the Winkler Method with an Azide Modification of Iodometric Method. The standard 300 ml. BOD bottles are being used as sampling bottles.

Salinity (^{o}/oo) - Determinations are based on two procedures: (i) all hydro-run samples are analyzed according to the Knudsen Method; (ii) all transect and nutrient sampling are analyzed according to wide range salinity Hydrometers.

Turbidity (units) - Determinations are based on the Jackson Candle Method.

Carbon Dioxide (ppm.) - This procedure and all chemical reagents used in this analysis are from the Hach Chemical Company. All water samples are collected in 300 ml. Citrate Magnesium Bottles.

pH - Determinations are based on a portable pH Taylor Slide Comparator. This set has a range from 3.8 to 11.6 in .2 gradations.

Temperature (^{o}F.): Water temperatures, under the supervision of John McClain, Phase I, Fish Study, were being recorded by eight Ryan Thermorecorders with a range of 30° to 90° F. and a recording time of 45 days in selected areas throughout the year.

Seven recorders were housed in a protective pipe assembly designed by Ronald White. Each consisted of a 10 to 20 foot length of four-inch aluminum irrigation pipe with a locking cover. The cover was made by welding an aluminum disc to a flanged ring. The cover is placed on top of the coupling end of the pipe and a collar placed around the assembly so as to seal together the flanges of the cover

and the coupling. The instrument is suspended in the pipe from a nylon line attached to a welded loop on the underside of the cover and is prevented from falling through the pipe by a brass bolt across the bottom. A piece of chain is passed around a piling and secured by the same lock which secures the collar, providing a tamper-proof, non-removable installation. These assemblies were strapped to pilings with automotive hose clamps.

The eightth instrument was contained in a one-foot section of four inch galvanized pipe. A bolt runs through each end of the pipe and the recorder is hung on one of the ends. A twenty foot length of chain connects the pipe to a large concrete block placed on the bottom by the New Jersey Bureau of Navigation. The pipe is dropped overboard in a predetermined direction from the block to facilitate recovery with a grapple.

Three thermorecorders were placed in the Mullica-Great Bay Estuary (primary); three were placed in the Manasquan River (secondary); and two were placed in the Maurice River (secondary)(see Figures 4, 2 and 3 of Fish Study Section for exact locations). It will be noted that the thermographs placed in the secondary estuaries were to be used as a comparison to the primary estuary along with any fish data collected in the Fish Study. The physical-chemical survey did no sampling in the secondary estuaries.

All field water temperatures were recorded with a Tele-Thermometer indicator with a 50 foot probe. This instrument has been tested and found to have a $\pm$ .3 deviation. All air, and occasionally surface, temperatures were recorded by Taylor pocket thermometers in 2° Fahrenheit (F) gradations, range -30° to 120° F., with a $\pm$ .5 deviation.

Bottom water sampling: All sub-surface water samples were taken with a one-liter water sampler attached to 50 feet of line, calibrated every two feet. If strong currents are encountered, four or five pound window sash weights are attached to the end of the water sampler.

Nutrient Analyses: Procedures and all chemical reagents used for these analyses were taken with the portable colorimetric field kits supplied from the Hach Chemical Company.

Total Phosphate Test Kit (ppm). Model PO-21

Nitrate-Nitrite Test Kit (ppm). Model NI-10

Ammonium Nitrogen Tester (ppm). Model NI-8

Detergents Kit (ppm). Model DE-2

Tidal data was obtained from the Coast and Geodetic Survey Tide Tables, Atlantic Coast of North America. Water temperatures for the Atlantic Ocean off Atlantic City were obtained from the Coast and Geodetic Survey. Eight Model D Waterproof Ryan Thermographs were used to record year round temperature data. Coast and Geodetic Survey Charts with a scale of 1:24000 were used for all morphometric measurements. Linear measurements were obtained with the use of a map rotometer. All area measurements were computed with a Compensating Polar Planimeter.

Phase II, Physical-Chemical Studies, has been divided into five major categories:

I. Water Quality. From November 1968 through May 1970, with the exception of September 1969 to write Annual Report, bi-monthly collections of surface and bottom waters were made at fourteen stations. Six of these stations corresponded to the plankton stations discussed in the Fish Study. Analyses of water samples

usually were completed within five hours after collections.

The following is a list of the stations sampled (Figure 4):

Bay Stations	River Stations
B-1 Coast Guard Station (Little Egg Inlet)	R-0 Deep Point (mouth of Mullica River)
B-2 Cape Horn	R-3 Akimbo Point
B-3 Light #20	R-6 French Point
B-4 Mid-Bay	R-9 Collins Point
B-5 Graveling Point	R-12 Hog Island
	R-14 Lower Bank
	R-17 Green Bank

Main Tributaries

B-0 Bass River (mouth)
W-0 Wading River (mouth)

When weather conditions did not permit sampling by boat, then water samples were collected by car from the following shore stations:

Bay Stations	River Stations
SB-1 Coast Guard Station	SR-6 Chestnut Neck Dock
SB-5 Graveling Point	SR-12 Clarks Landing
	SR-14 Lower Bank Bridge
	SR-17 Green Bank Bridge

Main Tributaries

SB-0 Bass River Oyster House Dock

II. Transects. This type of sampling was conducted by boat, consisting of a continuous zig-zag pattern initiated at Little Egg Inlet following the Intercoastal Waterway Channel and continuing by compass throughout the bay and ending at Oysterbed Point Light, near the mouth of the Mullica River (Figure 5). Surface temperature readings and salinity samples were collected two or more times a month when possible from each transect on both tidal cycles.

Surface temperatures were being recorded from the Tele-Thermometer indicator with a 50-foot probe. The probe was attached to the transom of the boat about six inches below the water line. Salinity samples were collected in 8 oz. prescription bottles and

were brought back to the laboratory for analysis done with the wide range Salinity Hydrometer.

The locations of sampling on each transect were determined by distance versus time method. Results will provide a monthly mean distribution pattern for surface salinities and temperatures on both tidal cycles.

III. Land Usage. This particular survey was conducted by car either visiting each of the Soils Conservation Offices in the various counties or by road survey. It was initiated with the aim of getting some idea of how lands adjacent to this estuary were being used. It could indicate sources of pollution and/or potential sources of pollution.

IV. Nutrient Water Quality. During October 1969 through May 1970 surface water samples were collected monthly at six stations on a falling tide. During the winter months, two stations could not be sampled (NB-3 and NR-0).

The following is a list of the stations that were selected and sampled (see Figure 4):

Bay Stations	River Stations
NB-1 Coast Guard Station (Little Egg Inlet)	NR-0 Near Basses Bay
NB-2 Near mouth of Big Creek	NR-7 Garden State Parkway Bridge
NB-3 Light #20	NR-14 Lower Bank Bridge

The following tests were run on water samples collected:

A. Nitrogen Cycle
   (1) Ammonium, Nitrogen (NH_4)
   (2) Nitrite (NO_2)
   (3) Nitrate (NO_3)

B. Phosphate Cycle
   (1) Orthophosphate
   (2) Metaphosphate (poly -)
   (3) Organically Bound Phosphate

C. Detergents

Surface temperatures, salinities and pH were also taken along with these tests.

V. Pesticides. Analyses were originally planned to be run on mud, selected fish and/or invertebrates. Spearing was selected as a pesticide indicator because of its variability of tolerance and the quantity found during any period of the year. Anchovies and white perch were used when spearing were not available.

Fish were collected monthly from both bay and river seining stations by estuarine personnel and kept frozen in sterile plastic bags until time of analysis.

FINDINGS

Water Quality. All water quality data collected during this type of sampling from November 1968 through March 1970 are listed in Tables 1 to 14. All data ranges for the following stations being discussed will be considered surface water quality. Sampling was either stopped or conducted at shore stations due to weather or ice conditions in the winter months.

Coast Guard Station (Little Egg Inlet): Station B-1 lies approximately 480 yards off the Coast Guard Station in the Intracoastal Waterway at Buoy C"3. Adjacent to Buoy C"3 lies a sandbar, separating two channels, which at mean low water has a depth range of one to four feet. The Intracoastal Waterway channel, where B-1 is located, has a depth at mean low water of 40 feet. Bottom is hard sand; subject to very strong currents.

Surface water temperatures at this station ranged from 28° to 79° and air temperatures from 27° to 87° F. (Table 1). Salinity varied from 18.9 °/oo to 31.6 °/oo. pH readings were found to be

basic (7.9 to 8.5). Dissolved oxygen concentrations ranged from 2.9 to 12.2 ppm (see also °/o saturation Figure 6). Carbon dioxide values were from 3.5 to 12.1 ppm. Turbidity readings were found to range from clear to 75 JTU (Jackson Turbidity Units).

Cape Horn, Great Bay: Site B-2, located on the northeast side of Great Bay, was sampled approximately 700 yards from shore. Depth at mean low water in sampling area is four feet. Bottom is composed of sticky mud and shellfish beds.

Surface water temperatures range from 35.5° to 78° F. and air temperatures from 23.6° to 78° F. (Table 2). Salinity varied from 21.4 °/oo to 30.7 °/oo. pH readings were the same as the Inlet (7.9 to 8.5). Dissolved oxygen concentrations ranged from 5.1 to 11.5 ppm., and carbon dioxide from 4.7 to 12.6 ppm (see also Figure 6). Turbidity values were found to range from clear to 30 JTU.

Light #20, Great Bay: Station B-3, is located on the Intracoastal Waterway on the southern portion of Great Bay, about 1200 yards from shore. At mean low water it is seven feet in depth. Bottom is composed of sticky mud. During an ebbing tide, Little Bay which lies adjacent to this bay partially empties into it.

Surface water temperatures ranged from 38° to 80.5° F. and air temperatures from 38° to 85° F. (Table 3). Salinity varied from 14.8 °/oo to 29.5 °/oo. All pH readings were basic (7.9 to 8.3). Dissolved oxygen values recorded ranged from 5.7 to 11.2 ppm. and carbon dioxide from 3.9 to 12.7 ppm. (see also Figure 6). Turbidity readings did not exceed the minimum sale of 24 JTU.

Mid-Bay, Great Bay: Area B-3 is roughly 2500 yards from Graveling Point, south, at the intersection of bearings 105° E. to Seven Islands and 346° NNW to Graveling Point. At mean low water

depth is seven feet and bottom is composed of sticky mud.

Surface water temperatures range from 35° to 82.5° F. and air temperatures from 38° to 83° F. (Table 4). Salinity varied from 15.7 °/oo to 28.7 °/oo. All pH readings were basic (7.9 to 8.4). Dissolved oxygen concentrations ranged from 5.4 to 12.0 ppm. and carbon dioxide readings ranged from 2.3 to 10.8 ppm. Turbidity readings recorded from clear to 30 JTU.

Graveling Point, Great Bay: Station B-5 is located 680 yards off Graveling Point on the northern portion of the bay. This area is located near shellfish beds and has a depth at mean low water of seven feet. Bottom is composed of sticky mud.

During the winter months, sampling was conducted from a shore station (Figure 4). Surface water temperatures range from 28° to 82° F. and air temperatures from 22° to 86° F. (Table 5). Salinity varied from 16.9 °/oo to 26.8 °/oo. pH values recorded were basic (7.5 to 8.3). Dissolved oxygen concentrations ranged from 5.5 to 12.3 ppm. and carbon dioxide from 2.8 to 11.7 ppm. (see also Figure 6). Turbidity readings recorded from clear to 160 JTU.

Deep Point, Mullica: This station has been designated as the mouth of the Mullica River (R-0) and has a depth range at mean low water to be from 17 to 30 feet. Bottom is composed of mud.

Surface water temperatures ranged from 31.8° to 83.5° F. and air temperatures ranged from 39° to 82° F. (Table 6). Salinity varied from 10.0 °/oo to 24.6 °/oo. Some pH readings recorded were found to be slightly basic (7.3 to 8.3). Dissolved oxygen concentrations ranged from 4.3 to 11.8 ppm. and carbon dioxide from 4.4 to 10.1 ppm. (see also Figure 6). Turbidity values recorded from clear to 70 JTU.

Akimbo Point, Mullica: Site R-3 (river mile 3) has a depth range at mean low water of 13 to 19 feet. Bottom was found to be composed of mud.

Surface water temperatures ranged from 31.8° to 82° F. and air temperatures from 39° to 91° F. (Table 7). Salinity varied from 8.7 °/oo to 23.1 °/oo. pH readings were found to be near neutral or slightly basic (6.9 to 7.9). Dissolved oxygen concentrations ranged from 4.0 to 12.0 ppm. and carbon dioxide from 2.4 to 12.3 ppm. (see also Figure 6.) Turbidity values were low ranging from clear to 35 JTU.

Bass River (Main Tributary): Station B-0 was located approximately 200 yards from its mouth during most of the year. During this time all data were collected up river (1100 yards) at the Oyster House Dock (Figure 4).

Surface water temperatures were found to range from 30.5° to 82° F. and air temperatures from 21° to 91° F. (Table 8). Salinity varied from 2.8 °/oo to 19.7 °/oo. pH readings ranged from slightly less than neutral to slightly basic (6.7 to 7.7). Dissolved oxygen concentrations recorded ranged from 3.8 to 12.0 ppm. and carbon dioxide from 3.1 to 14.2 ppm. (see also Figure 6). Turbidity recorded ranged from clear to 110 JTU.

French Point, Mullica: Site R-6 near shellfish beds, at mean low water has a depth of 13 feet and a bottom composition of hard sand. Whenever weather conditions prevented sampling by boat, data was recorded off Chestnut Neck Dock (650 yards from original station, Figure 4).

Surface water temperatures ranged from 29° to 82° F. and air temperatures from 21° to 94° F. (Table 9). Salinity varied from

2.8 °/oo to 20.7 °/oo. pH values ranged from slightly acid to slightly basic (6.7 to 7.7). Dissolved oxygen concentrations ranged from 3.4 to 12.6 ppm. and carbon dioxide from 2.5 to 15.8 ppm. (see also Figure 6). Turbidity readings recorded from clear to 250 JTU.

Wading River (Main Tributary): Site W-0 was sampled 200 yards from its mouth during most of the year. Depth at mean low water is nine feet and a bottom composed of mud.

Surface water temperatures range from 36° to 83° F. and air temperatures from 39° to 93° F. (Table 10). Salinity varied from 1.0 °/oo to 16.7 °/oo. pH values ranged from acid to slightly basic (5.7 to 7.5). Dissolved oxygen concentrations ranged from 3.6 to 11.9 ppm. and carbon dioxide from 2.6 to 14.6 ppm. (see also Figure 6). Turbidity values recorded from clear to 55 JTU.

Collins Point, Mullica: Site R-9 lies adjacent to Swan Bay and is 1100 yards from the mouth of the Wading River going up stream. At mean low water, the channel has a depth range of seven to 16 feet. Bottom consists of hard sand.

Surface water temperatures range from 36° to 83° F. and air temperatures from 39° to 89° F. (Table 11). Salinity varied from 1.0 °/oo to 14.8 °/oo. pH values ranged from acid to slightly basic (5.7 to 7.5). Dissolved oxygen concentrations ranged from 3.6 to 11.9 ppm. and carbon dioxide from 3.0 to 14.6 ppm. (see also Figure 6). Turbidity readings recorded from clear to 45 JTU.

Hog Island, Mullica: Site R-12 at mean low water has a channel depth of eight feet. Bottom is made up of mud with some vegetation. Sampling was not attempted here during December, January and February but rather at Clarks Landing 1000 yards up

river (Figure 4). Here the bottom is composed of sticky mud and probably was the cause for a great deal of the turbidity recorded here.

Surface water temperatures ranged from 30° to 84° F. and air temperatures from 31° to 92° F. (Table 12). Salinity varied from .3 °/oo to 11.8 °/oo. pH values recorded ranged from acid to slightly basic (4.3 to 7.3). Dissolved oxygen concentrations ranged from 3.3 to 12.0 ppm. and carbon dioxide from 2.4 to 15.6 ppm. (see also Figure 6). Turbidity readings ranged from clear to 290 JTU.

Lower Bank Bridge, Mullica: Site R-14 is approximately 100 yards from bridge going upstream and is adjacent to the Pace Maker Boat Works. At mean low water the channel has a depth of seven feet. Bottom consists of mud with sand along shore. Some vegetation is prominent. During the winter months sampling was conducted off the bridge.

Surface water temperatures range from 31° to 84° F. and air temperatures from 19° to 93° F (Table 13). Salinity varied from $<$ .1 °/oo to 5.2 °/oo. All pH readings were acid (4.1 to 6.9). Dissolved oxygen concentrations ranged from 3.6 to 13.0 ppm. and carbon dioxide from 2.8 to 17.3 ppm. (see also Figure 6). Turbidity values were low ranging from clear to 40 JTU.

Green Bank Bridge, Mullica: Site R-17 is located approximately 100 yards from bridge. At mean low water it has a channel depth of eight feet. The bottom is composed of mud and the shore consists of hard sand with gravel. This station is considered fresh water and vegetation is present.

Surface water temperatures ranged from 30.5° to 83.5° F. and air temperature from 19° to 95.5° F. (Table 14). Salinity varied from $<$.1 °/oo to 1.7 °/oo. All pH readings were acid (4.1

to 5.9). Dissolved oxygen concentrations ranged from 4.1 to 12.4 ppm. and carbon dioxide varied from 2.9 to 18.2 ppm. (see Figure 6). Turbidity readings recorded ranged from clear to 40 JTU.

On August 21, 1969 a 12-hour temperature and salinity analysis was conducted in Little Egg Inlet approximately 300 yards off Seven Bridges Road (near Coast Guard Station) within the Intracoastal Waterway. This station was sampled hourly at three different levels, namely surface, middle and bottom. Table 15 lists the data recorded from the Inlet and Figures 7 and 8 represent top and bottom temperatures and salinity patterns.

As previously mentioned in Methods and Procedures section, three thermorecorders were installed in the Mullica-Great Bay Estuary. The location of each instrument was as follows: (1) attached to the dock pilings of Seven Islands (Fish Factory); (2) on the bottom near Oysterbed Point; and (3) attached to the pilings off the Lower Bank Bridge (Figure 4). All three recorders were installed during June 1969 and ran periodically through May 1970. During this period, data was lost for 111 days at the fish factory, 114 days at Oysterbed Point and 96 days at Lower Bank Bridge. In summary, the malfunctions were attributed to winter conditions and not being able to recover the instruments or to the recorder itself.

In the secondary estuaries, three recorders were placed in the Manasquan River and two in the Maurice River during January 1970 through May 1970. The locations in the Manasquan River were as follows: (1) Bay Head-Manasquan Canal attached to Route #88 bridge; (2) Route #70 bridge, and (3) at the Coast Guard Station in Manasquan Inlet (Figure). During this period, data was lost for 11 days at the Coast Guard Station, 45 days at Route #70 bridge and 38

days at Route #88 bridge.

The two instruments located on the Maurice River were as follows: (1) station M-1 at Hayes Marina, and (2) station M-2 at Burchans (Figure). During time of recording, station M-1 thermo-recorder malfunctioned for 60 days and station M-2 malfunctioned for 15 days.

Figures 9, 10, 11, 12, 13, 14, 15 and 16 represent a graphic summary of the data recorded from the thermographs installed at the locations just mentioned.

Collins Cove: During the first part of January 1969, attention was focused to an area on the Mullica River called Collins Cove. This area consisted of a 36-foot deep dredge hole created when the Garden State Parkway was being built. Its location is approximately a quarter of a mile away from the Mullica River Parkway Bridge going up river; entrance is gained through Port Republic Hunting Grounds off Clarks Landing Road.

For the past three years, ice fishing in this area has proved to be very productive for white perch. A hydrographic study was undertaken to determine what conditions caused the white perch to be so abundant in this area (Tables 16 and 17). From the Use Survey, it was learned that fish were being caught between 12 to 15 feet below surface. Sampling from the ice and later on by boat revealed that during the first part of January 1969 surface temperatures varied from 30.2° to 31.8° F., whereas at 15 feet temperatures ranged from 31.5° to 35° F. and bottom from 46.5° to 48° F. There was a temperature difference ranging from top to bottom of 16.2° to 16.5° F. (Table 16). The second portion of January surface temperatures ranged from 29.5° to 35.5° F.; at 15 feet temperatures recorded from

30° to 34°F. and bottom 39° to 49° F. The recording of 39° F. was the last reading taken for this month at the bottom. It was during this time that a cooling period became evident until finally in March the surface temperatures were warmer than bottom.

Salinity readings also sharply increased from surface to bottom. Maximum bottom salinity recorded was 25.9 °/oo; other readings were close to 24 °/oo. Readings of this magnitude are typical of the bay. Dissolved oxygen concentrations sharply decreased from surface to bottom (it was not until the end of January 1969 that traces of oxygen were recorded on the bottom). As the temperature and salinity would increase, dissolved oxygen would decrease. A vertical comparison of Collins Cove to conditions that existed during January 1969 in the Mullica River can be seen in Table 16-A.

Readings taken in January 1970 are compared with January 1969 in Figure 17. Maximum bottom water temperatures recorded were only 37° F., a 12° F. difference from 1969's highest reading. Salinities were found to be less than 20 °/oo; however, readings of this nature still were atypical for the area. Dissolved oxygen values were found still to have a wide difference from top to bottom; however, oxygen was recorded present on the bottom in all analyses as compared to 1969 sampling. February 1970 revealed a cooling period had taken place as in the previous year.

Secondary Water Quality Stations. Water quality was conducted at four other location areas for a brief period during the sampling year because of their possible effects on the estuary. They were the following: two main tributaries - Bass and Wading Rivers; Upper Watershed Region (from R-14 going up river as far as Route #542); and the Intracoastal Waterway (Main Marsh Thorofare) around Little

Bay, adjacent to Great Bay (Figure 4).

During the months of July and August 1969 water analyses were taken once from each of the main tributaries (Tables 18 to 21).

In February 1970 sampling was done from shore stations along the Upper Watershed Region terminating at Route #542 (Batsto Road) which runs perpendicular to both Mullica and Batsto Rivers. Nutrient samplings were also included in this particular analysis (Table 22).

Little Bay and the Intracoastal Waterway that lies around it was sampled during the month of August 1969 (Table 23).

Transects. Plates 1 to 4 are highs and possible lows from six months of monthly mean surface isohalines and isotherms recorded in Great Bay Estuary during 1969-1970. Problems arose that would not allow a completion of this portion of the report for the plotting of minimum isohalines and isotherms patterns.

Nutrient Water Quality. From October 1969 through May 1970 surface temperatures, salinities, and pH were taken along with the nutrient study (Tables 24 to 30). Due to chloride interference, ammonia determinations were limited to the river stations. Data results from the nitrogen tests were found reasonable; however, there is the possibility that chloride may also interfere with this analysis. A change in technique may be considered for next year's study.

No appreciable traces of nitrites were found at any of the selected stations throughout the sampling year.

Coast Guard Station, Little Egg Inlet: Site NB-1 is located in the same area as the hydro-station described previously. Sampling was also conducted from Seven Bridge Road shore when weather conditions prevented the use of a boat.

Surface water temperatures ranged from 29° to 65.9° F. and air temperatures from 20° to 68° F. (Table 24). Salinity varied from 20.5 °/oo to 32.5 °/oo. All pH readings were basic (7.9 to 8.1). Nitrate readings were few ranging from 0.0 to .18 p.p.m. Orthophosphate values ranged from .02 to .76 ppm.

Big Creek, Great Bay: Site NB-2, located on the northern portion of the bay, was sampled approximately 100 yards from the mouth of Big Creek (Fl. R "2 light) in the bay. During the months of December, January and February, samples were taken from the shore of Graveling Point (approximately 2700 yards from outlet of Big Creek).

Surface water temperatures ranged from 31° to 64.4° F. and air temperatures from 30° to 67° F. (Table 25). Salinity varied from 17.1 °/oo to 31.2 °/oo. All pH were basic (7.9 to 8.0). Nitrate readings ranged from 0.0 to .13 ppm. and orthophosphate from .12 to .92 ppm.

Light #20, Great Bay: Site NB-3 is located in the same area as the B-3 station.

Surface water temperatures ranged from 40° to 64.2° F. and air temperatures from 47° to 65° F. (Table 26). Salinity varied from 14.1 °/oo to 32 °/oo. All pH readings were basic (7.7 to 8.0). Nitrate values were very few ranging from 0.0 to 0.09 ppm. Orthophosphate readings ranged from .06 to .76 ppm.

Basses Bay, Mullica: Site NR-0 is located 600 yards from Deep Point, downstream near Basses Bay.

Surface water temperatures ranged from 43° to 64.7° F. and air temperatures from 45° to 66° F. (Table 27). Salinity varied from 14.2 °/oo to 25.4 °/oo. pH values varied from acid to slightly basic (5.5 to 7.7). Very few nitrate readings were recorded (0.0 to .18 ppm.). Orthophosphate readings ranged from 0.0 to .44 ppm.

Garden State Parkway Bridge, Mullica: Site NR-7 is located 100 yards from bridge upstream. During winter months samples were acquired from shore.

Surface water temperatures ranged from 30° to 66° F. and air temperatures from 31° to 68° F. (Table 28). Salinity varied from 5.0 °/oo to 21.8 °/oo. pH readings ranged from acidic to slightly basic (5.4 to 7.3). Nitrate values ranged from 0.0 to .44 ppm. Orthophosphate readings were low ranging 0.0 to .40 ppm. except for two instances where high readings of 2.0 and 5.6 ppm. were found. Ammonia readings were high ranging from .6 to 3.5 ppm.

Lower Bank Bridge, Mullica: Site NR-14 is located in the same area as the R-14 station described previously.

Surface water temperatures ranged from 30° to 67° F. and air temperatures from 32° to 78° F. (Table 29). This station is considered basically fresh water. During this particular sampling, salinity ranged from 0.0 °/oo to .2 °/oo with the exception of one high reading of 6.5 °/oo. All pH readings were acidic (4.4 to 4.9). Nitrate values varied from 0.0 to 1.23 ppm. Orthophosphate readings ranged from 0.0 to 2.4 ppm. and ammonia readings were low ranging from .5 to 1.4 ppm. except for one high reading of 4.4 ppm.

DISCUSSION

Surface water temperatures during the winter months of December 1968 through the first part of February 1969 ranged from 29° F. to 32.5° F. The temperature distribution throughout the estuary had not differed more than 2.5° F. at any one hydro-station. This would seem to indicate a uniform temperature existing throughout

the estuary during this period. However, if one would note the mean surface temperatures for each of these months in both river and bay, February 1969 would show a rise in temperature close to 35° F. instead of the uniformity just mentioned (Figure 18.). This sudden rise in temperature is due to the changes that took place in the later days of February. However, December 1969 through the first part of February 1970, surface water temperatures ranged from 28° to 46.4° F. During the month of December 1969 water temperatures were found still warm ranging from 36.3° tc 46.4° F. as compared to last year's recordings. From January 1970 to early February surface water temperatures ranging 28° to 34° F. were comparable to last year's winter months. The temperature distribution throughout the estuary during that period had not differed more than 5° F. at any one station. From Tables 1 to 14 one can note a definite air-temperature relationship. During November 1968 through March 1970 the temperature difference between surface and bottom ranged 0.0° to 6.5° F.

From the hydro data mean surface temperatures for both river and bay stations were plotted and compared with ocean temperatures recorded at the Steel Pier in Atlantic City by the U. S. Coast and Geodetic Survey (Figure 18). It would seem that the bay was colder than both the river and the ocean from December 1968 until March 1969. During March there was a change over leaving the ocean colder until about the middle of August 1969. September shows the bay cooling off and becoming colder at the end of October 1969.

Figures 9 to 16 are monthly means and extremes of thermorecorders in the Great Bay Estuary. It was during December 1969 the lowest extreme was recorded at the fish factory on Seven Islands (28.8° F). This cold front was recorded at Oysterbed Point in January

1970 (34.9°F.) and at the Lower Bank bridge in February (30°F.). The warmest extreme at all three locations was recorded in July 1969 as being 87.3° F. at the fish factory; Oysterbed Point was 81.5° F. and 84.5° F. at R-14.

At Route 88 Canal bridge in the Manasquan River, the lowest extreme was recorded in January and February 1970 (28° F.), whereas Route 70 Bridge was only 31° F. in January, and at Manasquan Coast Guard Station 32° F. also in January and February. Recorders were not in long enough to determine the warmest extreme.

In the Maurice River, station M-1's lowest extreme was recorded in January and February 1970 (32°F.) and station M-2 recorded also in January and February 1970 (29°F.). Recorders were also not in long enough to determine the warmest extreme.

Surface dissolved oxygen ranged from 2.9 to 12.6 ppm. During the first part of August 1969 heavy rains for a few days caused the low readings. Except for August, dissolved oxygen values did not drop below 5.0 ppm. or 63 °/oo saturation. Oxygens ranged from 9.7 to 12.6 ppm. during the colder months but gradually decreased with an increase in temperature. Surface and bottom dissolved oxygen differed by 0.0 to 2.5 ppm.

All surface pH readings for the bay and Little Egg Inlet ranged from 7.5 to 8.5, and the river stations from 4.1 to 8.4. The difference from surface and bottom deviated 0 to .8.

Salinity for the bay ranged from 14.8 °/oo to 31.6 °/oo and the river from $<$ .1 to 24.6 °/oo. The maximum reading of 31.6 °/oo was observed at the surface of station B-1 while a minimum of less than .1 °/oo was recorded at stations R-17 and R-14 Tables 1, 13 and 14). Their respective ranges were $<$.1 °/oo to 1.7 °/oo and $<$.1 °/oo

to 6.2 °/oo. At R-17 station only twice has there been readings exceeding 1 °/oo, attributable to storm tides or moon tidal cycles.

Free carbon dioxide analysis was initiated during March 1969. Water analyses in the bay revealed a surface range from 2.3 to 12.7 ppm. and in the river from 2.4 to 18.2 ppm. Figure 19 shows upstream sampling with the most degree of variability and the bay the least. It is generally recommended that the free carbon dioxide should not exceed 25 mg/l for aquatic animals. Carbon dioxide values were found to be higher during the summer months with the month of August having the highest values, probably due to the heavy rainfall in this area. During the winter months, the bay values were higher than the river.

Turbidity values ranged from clear to 290 JTU (Jackson Turbidity Units). It will be noted that the word "clear" does not indicate lack of turbidity but that it will fall in the range of 5 to 24 JTU. There was not definite distinction made at this time for this particular range other than by estimated approximations. The Jackson Turbidimeter has a usable range only above 25 JTU; lower turbidities cannot be measured on this instrument. Turbidity readings were less in the bay as compared to the river stations. Readings were taken mostly during the winter months. Most of the turbidity values recorded in the late 1969 and early 1970 were taken at shore stations -- off beaches, docks or bridges during ice conditions.

Nutrient Analysis. As stated in the section Findings, there were no indications of detergents or nitrite being present.

Nitrate. Nitrate values in the bay were found to be low and only present during the winter months. In the river readings were also recorded during the winter months along with an upstream

rise in values from the mouth of the river. Station NR-14, the farthest upstream station, had a maximum of 1.23 ppm recorded during the month of January. A secondary water quality sampling of the Upper Watershed was initiated during February 1970 at NR-14 and proceeded upstream to where Rt. #542 (Batsto Road) crosses over the Mullica and Batsto Rivers (Table 22). Nitrate values were found to be 1.50 and 1.41 respectively.

Ammonia. Ammonia water samples collected in the river ranged from .5 to 3.6 ppm. An exception was station NR-14 with 4.4 ppm. found in March 1970 contrasting from its range of .5 to 1.4 ppm. Ellis (1937) notes that although the tolerance of fish differs with species and other factors, 2.5 mg./l of ammonia is considered harmful to fish in the 7.4 to 8.5 pH range.

The Mullica River was highest in ammonia during the months of October through December and began decreasing to a low in February. From here there is an upswing and one can only assume it will reach its peak during the summer.

Phosphate. Orthophosphate, the soluble form of phosphate, was found in the bay ranging from .02 to .92 ppm. The highest values were recorded during November, January and April. The river readings ranged from 0.0 to 5.6 ppm. and were highest during the months of December and January and lowest during March.

From the February sampling upstream, it was learned that 2.8 ppm. of PO_3 was recorded at Sweetwater and 2.0 ppm. on the upper Mullica River Branch.

Figure 20 shows monthly mean values plotted to compare NO_3 and PO_3 values during the eight months surveyed.

Pesticide Analysis: All samples were analyzed by Quality Control Lab in Philadelphia for chlorinated hydrocarbons. Results were given in ppm. total DDT by gas chromatography.

Table 30 shows that B HC (alpha, beta, gamma and delta) and Hepta Epoxide were $<.01$ ppm. Dieldrin was present in only one out of eight samples, the rest were $<.01$ ppm. DDD and DDE were present in all samples along with DDT-p,p'. DDT-o,p' was present in only one sample, the rest recording $<.01$ ppm.

Total DDT recorded in the bay ranged from .28 to .56 ppm. and the river from .56 to 1.12 ppm. It would seem that from the data pesticide levels are higher in the fall.

Land Usage. Killam (1969) reports that the total area in the Mullica River watershed includes approximately 328 square miles in Burlington County, in addition to 31 square miles in Ocean County, 154 square miles in Atlantic County and 65 square miles in Camden County. Approximately thirty to forty percent of the land area in the watershed has been purchased by the State of New Jersey and has been designated as the State Forest Park and Wharton Tract.

Soil Survey #5 (Mount Holly) reports that Burlington County is the largest county in the State of New Jersey, with a population of 224,499 in 1960, covering 827 square miles. It roughly covers an area of 529,351 acres, of which 524,160 are land and 5,191 acres are water. The county extends from the Delaware River to the Great Bay

on the Atlantic Ocean comprising about 54% forest, 30% farmland (184,727 acres), 12% urban and 4% federally-owned land.

"Basically Burlington is devoted to farming where most of the productive farmland is in the 1/3 of the county paralleling the Delaware River and 2/3 portion to the east is mostly woodland (much of this section is in the 20% of the county that is state-owned Forests and Parks).

"From the geology and topography view, this county is alluvial sand, gravel, loam and clay mixed. Along the Delaware River extending back from 10 to 14 miles is rather fertile loam. To the east of this loam the soil is mostly sand over clay which extends to the marshes and bays of the ocean. There lies a narrow strip between the loam and sand districts (Pines) that produces oak. To the east of 'Pines' and extending well into Ocean County is a section of stunted growth called the 'Plains'. In the southern portion of this County, bordering on the Mullica River, are located two large iron ore deposits.

(1) lies along the Atsion River and its branches.

(2) the other along the Wading River and its many branches.

"All rivers within this County either flow southwest to the Atlantic or northwest to the Delaware River. Those emptying into the Ocean are Mullica, Wading, Batsto and Bass Rivers, and those into the Delaware are Crosswick, Black, Craft, Assicunk, Rancocas and Pennsauken Creek.

"The lands that the State of New Jersey owns is a total of 275,757 acres under the jurisdiction of Department of Conservation and Economic Development. Within Burlington County there is over 100,000 acres of this land (Table 31).

Within the Pine Region, the most important industry are cranberries and have been cultivated near Pemberton since about 1825, but production on a commercial scale did not begin in southern New Jersey until after the Civil War. However, due to insect, disease and drought disasters lead to the abandonment of cranberry acreage. Such lands became covered with red maple, sweet bay, southern white cedar and various shrubs, grasses, and sedges. Several of these abandoned cranberry bogs recently have been cleared and flooded to provide shallow lakes around which developers have constructed numerous small houses (Presidential Lakes, Lebanon Lakes, Shamong Estates, etc.).

"The characteristic lowlands are associated to the blueberry and cranberry crops extensively produced in this County. A great deal of these crops are produced south and southwest of Chatsworth. Other private holdings are located on Bass River, Shamong, Tabernacle, Washington and Woodland Townships. Both crops require a good water supply for efficient production. Blueberries need ground water held constant in summer while cranberries need water in fall for harvesting and in winter and spring for frost production. Land currently developed for cranberry and blueberry production are generally graded or smoothed to insure surface drainage. This involves stockpiling of the surface soil, smoothing and grading the subsoil to a designed grade and replacing the surface soil. Ditches are dug for drainage and canals are constructed to carry water where it is needed. Excess excavated material is spread over the low areas."

The towns that are found in the immediate area sampled in the Great Bay Estuary are very small and are situated along the Burlington-Ocean County border. They are as follows: New Gretna

(largest of this area), Wading River (few homes scattered along Turtle Creek Road which runs parallel with the Wading River), Lower Bank comprises mostly homes and Pacemaker Boat Works which is located on the Mullica River adjacent to the Lower Bank Bridge; Green Bank, located on Route 563, homes are located parallel to the Mullica River; Crowleytown, located on Route #542; Batsto, historic site located on Batsto-Washington Road.

Killiam (1969) reports that at the present time there is only one treatment facility located within the Mullica Watershed of Burlington County. This plant is located in Washington Township and is owned and operated by the Pacemaker Corporation (Figure 3). The plant has a design capacity of 0.01 MGD and discharges the treated effluent into the Mullica.

"The only other inhabited sites are small recent developments: Shamong Park Estates and Woodland Lakes. These are located on the north-most section of the Wading River. They include approximately 50 dwellings."

Special Report #29 (Toms River) states that Ocean County lies within the Coastal Plains in east central New Jersey between latitude 39° 30' and 40° 10' North and between longitude 74° 02' and 74° 33' West. The Atlantic Ocean forms the eastern boundary of the county. It comprises a total area of 750 square miles, of which 639 square miles is land. Barnegat Bay along the eastern margin of the county comprises most of the water area. Upland area consists of 563 square miles (excluding salt marsh and beach area), of which approximately 87% was forested with stands of pine, oak and cedar in 1939 (Moore, 1939).

"In land utilization, agriculture is a minor factor. In 1959, 7% of land was devoted to agriculture. The poultry industry

accounted for 11 million of the 12 million dollars in farm products sold in 1959. Also blueberries and cranberries are a main specialty crop. More than 3/4 of the land area of this County lies below an altitude of 150 feet and much of this is occupied by swamps, streams and salt marsh.

"The County is drained principally by east and southeast flowing consequent streams of the Coastal drainage area. These streams have a dentritic drainage pattern from north to south. The most important streams are the Manasquan River, Metedeconk River, Toms River, Cedar Creek, Forked River, Oyster Creek and Mill Creek. Other streams such as Crosswick Creek flows northward to the Delaware River. The coastal streams drain into Barnegat Bay, Little Egg, and Great Bay."

An area that over the years has given way to home waterfront developments lies between State Route 9 and Great Bay Boulevard intersecting in Tuckerton. There are two prominent developments that have risen from the salt marshes on the northern portion of Great Bay namely Atlantis Development and Mystic Island. Mystic Island is the larger of the two developments with constant dredging and filling still taking place. The principal outlet for boats from this area is by Big Creek emptying into Great Bay. Unfortunately, time did not allow statistical data to be presented concerning this area.

Census Facts (Mays Landing) reports that Atlantic County contains approximately 368,000 acres of land area running from the Delaware River along the channel of the Mullica River to Little Egg Inlet of the Atlantic Ocean. Of the total just mentioned, 43,688 acres or 12% are classified as farm land. Since 1910, farming has been a declining trend.

Towns having an immediate effect on the Great Bay Estuary within Atlantic County are Sweetwater, Pleasant Mills and Hammonton. It can also be noted that the Hammonton Sewage Plant has its drainage system located on the Mullica River Watershed. There are a few scattered homes found along Clarks Landing Road (runs parallel with the Mullica River) and others with waterfront docks located up around Sweetwater.

State-owned land in this county comprises Port Republic Hunting and Fishing Grounds, and a portion of the Green Bank State Forest. Brigantine National Wildlife Refuge, located in both Atlantic and Ocean Counties, is federally owned.

In all three counties there are camping grounds located in the various State Forests and Parks. It was mentioned before that there are cranberry bogs located throughout the three counties from which their drainage empties into this Watershed.

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TABLE 1. Water Analysis Data Collected at the Little Egg Inlet Station (B-1).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	10:30AM	High+2½	-	-	-	28.2	-	-	-	9.5	-	-	-	40.0	-
12/18/68*	11:00AM	High +5	34.0	29.0	-	26.9	-	8.0	-	11.1	-	-	-	50.0	-
12/27/68*	11:20AM	Low +3	36.0	29.0	-	25.6	-	8.0	-	11.4	-	-	-	40.0	-
1/15/69*	10:00AM	High +5	44.0	30.5	-	29.5	-	8.2	-	11.6	-	-	-	Cl.	-
1/20/69	--	--	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69*	10:30AM	Low +1½	42.0	30.0	-	24.0	-	-	-	11.6	-	-	-	25.0	-
2/25/69*	10:30AM	Low +2	48.0	38.2	-	24.0	-	7.9	-	12.2	-	-	-	Cl.	-
3/6/69**	11:50AM	High +3	41.0	36.0	35.0	29.5	29.3	8.1	8.1	10.8	10.8	7.5	-	Cl.	25'
3/24/69**	11:00AM	Low +5	46.0	41.2	40.5	30.6	30.9	8.4	8.4	10.3	9.6	7.4	-	Cl.	34'
4/8/69**	11:34AM	Low +5½	53.0	46.5	46.2	31.6	30.9	8.3	8.4	9.7	9.6	7.3	11.9	Cl.	25'
4/28/69	10:43AM	High +5	64.0	60.5	61.0	28.5	28.6	8.4	8.4	8.0	7.9	5.3	6.3	Cl.	20'
5/6/69	11:30AM	High +½	57.0	56.0	54.5	31.2	31.3	8.4	8.4	8.8	8.9	6.6	6.6	Cl.	13'
5/27/69	10:37AM	Low +½	66.0	62.0	61.5	26.0	28.2	8.1	8.1	7.7	8.1	6.7	6.9	Cl.	7'
6/10/69	10:31AM	Low +½	71.0	68.0	67.5	28.2	29.8	8.1	8.1	6.9	6.7	8.1	7.3	Cl.	-
6/18/69	9:49AM	High	75.0	66.0	62.5	31.0	31.3	8.1	8.1	6.4	6.4	12.1	11.4	Cl.	29'
7/9/69	10:15AM	Low+2½	78.0	74.0	74.0	26.4	27.5	8.1	8.1	6.4	6.6	8.3	8.8	Cl.	10'
7/17/69	10:17AM	High +1	87.0	75.0	73.0	30.0	30.2	8.5	8.1	5.9	4.9	6.3	8.9	Cl.	36'
8/6/69***	11:45AM	Low +3½	77.0	79.0	74.5	18.9	25.0	7.9	7.9	2.9	4.4	8.7	12.8	Cl.	30'
8/26/69	11:31AM	High +5	85.0	76.5	76.5	27.6	28.1	8.1	8.1	6.3	5.9	9.3	8.5	Cl.	22'
10/7/69	10:45AM	Low	69.0	64.6	65.3	27.8	28.1	8.1	8.1	7.3	7.3	10.7	8.7	Cl.-10	26'
10/27/69	11:55AM	High+3½	64.0	55.5	56.5	29.5	29.5	8.1	8.1	7.9	8.0	3.8	12.4	Cl.-15	18'
11/13/69	11:45AM	High+1½	46.0	54.3	53.8	30.4	30.9	8.5	8.5	7.9	7.7	5.9	5.9	Cl.-4	34'
11/24/69	1:23PM	High +6	46.0	44.0	44.1	27.0	27.1	7.9	8.0	9.1	9.9	6.5	6.4	Cl.-5	26'
12/4/69*	11:20AM	Low +2	35.0	38.1	-	30.3	-	8.0	-	10.3	-	6.5	-	Cl.-24	-
12/12/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/12/70*	11:15AM	High	42.0	29.5	-	29.3	-	7.8	-	11.4	-	7.4	-	40.0	-
1/23/70*	12:35PM	High+4½	27.0	28.0	-	27.9	-	7.9	-	12.1	-	7.2	-	Cl.-24	-
2/4/70*	-	-	-	29.0	-	27.0	-	-	-	-	-	-	-	-	-
2/11/70*	11:05AM	Low+5½	35.0	36.0	-	26.9	-	7.9	-	9.7	-	7.8	-	75.0	-
3/12/70	11:50AM	High +½	44.0	38.0	37.0	29.0	30.0	8.0	8.1	9.9	9.8	5.9	6.8	Cl.-3	25'
3/18/70	11:00AM	Low	38.0	37.0	36.5	24.5	24.9	8.0	8.1	11.2	11.3	3.5	4.4	Cl.-11	20'

* Sampling from shore of Little Egg Coast Guard Station

** Sampling taken at Buoy 96.

*** Heavy rains.

TABLE 2. Water Analysis Data Collected at the Cape Horn Station (B-2).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	10:48	High+2½	-	-	-	28.4	27.1	-	-	9.5	9.2	-	-	31.0	-
12/18/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/27/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/15/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/25/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/6/69	12:17PM	High +3	43.0	35.5	34.5	23.6	24.9	8.1	7.9	8.5	7.8	4.7	-	Cl.	7'
3/24/69	11:25AM	Low +5	45.0	44.0	44.0	26.9	26.8	8.4	8.4	10.8	10.3	5.5	-	Cl.	7'
4/8/69	12:04PM	Low +5½	60.0	50.0	50.0	28.0	28.8	8.1	8.1	6.6	6.5	10.0	10.1	Cl.	5'
4/28/69	11:11AM	High+5½	64.0	59.5	59.5	25.1	25.0	8.1	8.1	5.4	4.0	9.6	11.6	30.0	4'
5/6/69	11:55AM	High +½	58.0	57.0	57.0	30.7	30.6	8.4	8.3	8.5	8.5	6.6	6.2	Cl.	6'
5/27/69	11:00AM	Low +½	66.0	63.5	63.5	25.5	25.4	8.1	8.1	5.6	5.6	7.2	5.4	Cl.	5'
6/10/69	11:07AM	Low +½	76.5	71.5	70.0	27.3	28.4	8.1	8.1	7.0	7.4	7.7	7.2	Cl.	4'
6/18/69	10:23AM	High +½	73.0	68.5	68.5	28.3	32.3	8.1	8.1	6.5	6.7	9.9	10.9	Cl.	7'
7/9/69	10:43AM	Low +2½	90.0	76.5	74.5	25.9	26.9	8.1	8.1	6.5	6.9	8.0	-	Cl.	4'
7/17/69	10:40AM	High +1	84.0	76.0	75.0	28.5	28.5	8.5	8.5	6.1	6.3	7.9	7.3	Cl.	7'
8/6/69*	12:12PM	Low +4	79.0	78.0	77.5	2?.9	21.1	7.9	7.9	5.1	4.7	12.6	11.9	Cl.	6'
8/26/69	12:18PM	High +5½	82.0	77.5	77.5	26.3	26.2	8.1	8.1	5.8	5.7	10.3	9.5	Cl.	5'
10/7/69	11:13AM	Low +½	67.0	66.0	65.6	25.8	26.1	8.1	8.1	7.1	7.0	10.6	10.8	Cl.-15	5'
10/27/69	12:15PM	High +3	66.0	54.5	55.0	28.0	28.2	8.1	8.1	8.1	7.7	6.7	6.6	Cl.-10	6'
11/13/69	12:10PM	High +2	47.0	52.1	53.0	28.2	30.1	8.1	8.1	8.1	7.7	7.2	7.6	Cl.-6	8'
11/24/69	1:55PM	High +6	47.0	43.5	43.6	24.7	25.0	7.9	7.9	10.0	9.9	5.8	6.6	Cl.-5	4'
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/12/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/12/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/23/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/4/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/12/70	12:12PM	High +1	42.0	38.0	38.0	27.5	27.8	8.0	8.0	10.0	9.9	5.0	4.7	Cl.-3	7'
3/18/70	11:20AM	Low	38.0	38.0	38.0	21.4	23.3	8.0	8.0	11.5	11.7	4.7	4.9	Cl.-10	4'

* Heavy rains.

TABLE 3. Water Analysis Data Collected at the Light #20 Station (B-3).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/18/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/27/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/15/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/25/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/6/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/24/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4/8/69	12:30PM	Low +5	56.0	52.0	52.0	27.7	26.3	8.1	8.1	9.6	9.6	9.0	9.7	Cl.	8'
4/28/69	11:42AM	High +5	63.0	60.0	60.0	23.6	23.7	8.1	8.1	10.2	8.2	9.1	7.8	Cl.	5'
5/6/69	12:12PM	High	56.0	60.0	60.0	28.3	28.3	8.3	8.1	8.4	8.5	4.2	4.7	Cl.	7'
5/27/69	11:17AM	Low	69.0	64.0	64.0	24.6	24.6	8.1	8.1	8.2	8.2	7.1	5.9	Cl.	5'
6/10/69	11:25AM	Low	72.0	72.0	70.5	26.2	27.9	8.1	8.1	7.4	6.8	9.2	9.4	Cl.	5'
6/18/69	10:43AM	High	73.0	73.0	72.5	29.5	29.7	8.1	8.1	7.2	7.1	11.2	8.9	Cl.	7'
7/9/69	11:00AM	Low +2	77.0	78.0	74.5	26.8	27.2	7.9	8.1	6.0	6.8	8.0	9.2	Cl.	6'
7/17/69	11:00AM	High +½	85.0	78.5	77.0	27.3	27.9	8.1	8.4	6.3	6.4	4.0	4.9	Cl.	7'
8/6/69 *	11:20AM	Low +2	79.0	80.5	80.0	14.8	21.6	7.9	7.9	-	3.7	9.9	11.9	Cl.	6'
8/26/69	11:31AM	High +4	83.0	78.0	78.0	25.7	25.6	8.1	8.1	5.7	5.8	12.7	10.8	Cl.	6'
10/7/69	11:33AM	Low +½	66.0	66.6	65.1	25.0	26.1	8.1	8.1	7.1	6.9	10.6	9.6	Cl.-10	7'
10/27/69	11:35AM	High +2	64.0	54.0	53.2	28.3	28.4	8.1	8.1	8.2	8.1	9.3	6.1	Cl.-5	9'
11/13/69	11:20AM	High +1	49.0	52.0	52.2	26.6	26.6	8.1	8.1	8.2	8.1	7.9	7.1	Cl.-5	9'
11/24/69	1:02 PM	High+4½	47.0	42.3	43.0	22.2	27.1	7.9	7.9	10.5	10.4	6.4	5.8	Cl.-7	6'
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/12/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/12/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/23/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/4/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/12/70	12:30PM	High+½	44.0	38.0	38.0	25.7	25.7	8.0	8.0	9.8	9.7	5.0	6.0	Cl.-4	7'
3/18/70	10:40AM	High +5	3[illegible].0	38.0	38.0	22.4	25.3	7.9	8.0	11.2	11.2	3.9	3.3	Cl.-10	8'

* Heavy rains.

TABLE 4. Water Analysis Data Collected at the Mid-Bay Station (B-4).

Date	Time	Tidal Stage	Temperature (° F.) Air.	Sur.	Bot	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	11:08AM	High +2	-	-	-	21.9	26.4	-	-	10.2	9.6	-	-	45.0	-
12/18/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/27/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/15/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/25/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/6/69	12:35PM	High+2½	41.0	35.0	34.0	19.7	20.9	8.0	7.9	12.0	11.9	4.3	-	Cl.	10'
3/24/69	11:40AM	Low +4½	46.0	44.5	44.5	24.9	25.4	8.4	8.4	10.5	10.4	3.0	-	Cl.	9'
4/8/69	12:48PM	Low +5½	55.5	52.0	52.5	27.0	25.2	8.1	8.1	9.6	9.5	8.9	10.1	Cl.	7'
4/28/69	11:55AM	High+5½	65.0	59.5	59.5	22.2	22.3	8.1	8.1	8.0	8.2	9.6	9.7	30.0	5'
5/6/69	12:22PM	High +½	57.0	60.0	59.8	-	28.2	-	8.1	8.3	8.2	4.0	6.3	-	8'
5/27/69	11:27AM	Low	63.0	65.0	64.5	23.8	24.1	8.1	8.1	8.2	7.9	4.4	7.5	Cl.	5½'
6/10/69	11:37AM	Low +½	75.0	73.5	70.5	26.1	28.0	8.1	8.1	6.8	7.5	9.4	8.8	Cl.	5'
6/18/69	10:54AM	High	76.0	73.0	72.5	28.0	28.4	8.1	8.1	6.6	6.6	8.2	9.8	Cl.	8'
7/9/69	11:08AM	Low +2	83.0	77.5	75.0	20.9	24.8	7.9	8.0	6.0	6.5	8.7	11.4	Cl.	6'
7/17/69	11:07AM	High +½	83.0	78.5	77.0	25.8	25.7	8.1	8.1	6.5	6.2	4.9	4.7	Cl.	8'
8/6/69*	12:37PM	Low +3½	78.0	82.5	80.0	15.7	17.1	7.9	7.9	5.4	4.3	10.8	11.0	Cl.	8'
8/26/69	12:31PM	High +5	79.0	78.0	77.0	23.6	25.6	8.1	8.1	5.5	5.3	2.3	2.0	Cl.	7'
10/7/69	11:45AM	Low	66.0	66.2	65.5	24.7	25.2	8.1	8.1	7.4	6.6	13.4	14.5	Cl.-10	7'
10/27/69	12:30PM	High +3	64.5	53.5	54.8	28.7	25.4	8.1	8.1	8.2	7.8	6.8	7.6	Cl.-5	9'
11/13/69	12/35PM	High+1½	49.0	51.3	52.0	24.8	28.1	7.9	8.1	8.3	8.1	6.9	7.8	Cl.-5	9'
11/24/69	2:17PM	High +6	46.0	42.2	42.5	22.2	22.7	7.9	7.9	10.4	10.2	6.6	7.5	Cl.-10	6'
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/12/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/12/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/23/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/4/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/12/70	1:05PM	High +1	44.0	39.0	38.0	24.2	24.4	8.0	8.0	9.9	9.7	6.4	4.6	Cl.-4	8'
3/18/70	11:35AM	High +6	38.0	38.0	38.0	20.6	21.6	8.0	8.0	11.6	11.5	5.0	6.1	Cl.-15	5'

* Heavy rains

TABLE 5. Water Analysis Data Collected at the Graveling Point Station (B-5).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot	Salinity Sur.	Pot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	11:26AM	High+2½	-	-	-	20.1	20.2	-	-	10.4	10.2	-	-	55.0	9'
12/18/68	12:00N	High +5	37.0	29.0	28.0	19.0	24.7	7.9	7.9	12.0	11.2	-	-	25.0	9'
12/27/68*	12:05PM	Low +2½	39.0	29.4	-	21.1	-	7.9	-	12.0	-	-	-	Cl.	-
1/15/69*	10:44AM	High *5	42.0	30.2	-	26.7	-	7.9	-	11.8	-	-	-	Cl.	-
1/20/69	11:30AM	High +1	39.0	31.8	31.5	25.8	26.3	-	-	11.8	11.5	-	-	Cl.	22'
2/11/69*	11:15AM	Low +1	45.0	29.0	-	26.8	-	-	-	11.7	-	-	-	30.0	-
2/25/69*	11:10AM	Low +1	48.0	39.8	-	20.8	-	7.8	-	12.1	-	-	-	Cl.	-
3/6/69	12:45PM	High+2½	40.0	35.0	34.5	18.1	18.2	8.0	7.8	12.1	12.1	2.8	-	Cl.	9'
3/24/69	11:50AM	Low +4½	47.0	45.0	45.0	21.3	21.4	8.3	8.4	11.2	11.1	3.0	-	Cl.	10'
4/8/69	1:10PM	Low +5½	60.0	52.5	52.0	24.7	25.3	8.1	8.1	9.8	10.0	9.2	10.0	Cl.	9'
4/28/69	12:12PM	High+5½	65.0	60.0	59.5	17.5	17.7	7.9	7.9	8.2	8.1	9.2	8.7	Cl.	7'
5/6/69	12:35PM	High +⅓	58.0	62.0	61.0	23.6	25.1	7.9	7.9	7.9	7.8	8.0	5.4	Cl.	11'
5/27/69	11:40AM	Low -	68.0	65.5	65.0	19.9	20.3	7.9	7.9	7.7	7.8	5.8	7.5	Cl.	9'
6/10/69	11:52AM	Low +⅓	76.0	73.0	71.5	22.2	23.7	7.9	7.9	6.4	7.1	8.3	8.8	Cl.	6'
6/18/69	11:06AM	High	77.0	74.5	74.0	26.8	27.1	8.1	8.1	6.9	7.0	8.4	8.6	Cl.	8'
7/9/69	11:20AM	Low +2	77.5	78.0	76.0	18.0	21.0	7.8	7.9	6.0	6.2	8.5	10.5	Cl.	8'
7/17/69	11:27AM	High +1	86.0	78.5	77.0	21.8	23.8	8.1	8.1	6.9	6.6	5.7	5.8	Cl.	8'
8/6/69 **	12:53PM	Low+3½	82.0	82.0	80.0	16.9	20.4	7.9	7.9	5.5	4.8	9.8	10.4	Cl.	9'
8/26/69	12:45PM	High +5	79.0	78.0	78.0	21.4	21.4	7.9	7.9	6.0	5.2	11.7	12.4	Cl.	8'
10/7/69	11:57AM	Low	68.0	66.8	66.0	21.6	23.0	7.9	7.7	6.8	6.7	10.0	11.1	Cl.=10	8.5'
10/27/69	12:43PM	High +3	62.5	53.0	52.8	25.0	25.0	8.1	8.1	8.4	8.1	7.0	6.5	Cl.-5	10'
11/13/69	12:50PM	High +½	49.0	51.0	50.9	23.2	24.6	7.9	7.9	8.2	8.2	7.3	5.4	Cl.-6	9'
11/24/69	2:33PM	High +6	46.0	42.0	42.3	-	19.2	-	7.9	10.2	10.3	6.6	6.5	Cl.-10	8'
12/4/69*	11:50AM	Low +1	35.0	37.5	-	24.0	-	8.0	-	11.6	-	5.5	-	Cl.-20	-
12/12/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/12/70*	11:57AM	Low+6	42.0	29.5	-	21.6	-	7.5	-	11.9	-	7.4	-	Cl.-15	-
1/23/70*	1:23PM	High +4	27.0	28.0	-	22.0	-	7.6	-	12.3	-	8.5	-	Cl.10	-
2/4/70*	1:27PM	Low	22.0	31.2	-	18.4	-	7.7	-	12.2	-	8.5	-	160.0	-
2/11/70*	11:30AM	Low+5½	35.0	35.0	-	20.3	-	7.9	-	10.0	-	6.3	-	70.0	-
3/12/70	1:17PM	High +1	44.0	39.0	38.0	22.8	23.5	8.0	8.0	9.9	9.8	5.9	4.9	Cl.-5	8'
3/18/70	11:50AM	Low	38.0	39.0	40.0	18.1	17.7	7.9	7.9	11.4	11.6	5.6	4.2	Cl.-17	7'

* Sampling taken from shore station.
** Heavy rains.

TABLE 6. Water Analysis Data Collected at the Deep Point Station (R-0).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	11:46AM	High+2⅓	-	-	-	17.5	16.7	-	-	10.7	10.2	-	-	70.0	34'
12/18/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/27/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/15/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/20/69	11:50AM	High+1½	39.0	31.8	31.2	24.6	24.7	-	-	11.5	11.4	-	-	Cl.	36'
2/11/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/25/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/6/69	1:00PM	High +3	41.0	35.0	34.5	17.1	17.7	7.9	7.8	11.8	11.8	4.5	-	Cl.	25'
3/24/69	12:05PM	Low +4½	47.0	45.5	45.0	18.6	21.7	8.3	8.4	10.9	10.7	6.6	-	Cl.	21'
4/8/69	1:30PM	Low +6	60.0	54.5	52.0	21.6	22.2	8.0	8.1	9.6	9.6	8.0	10.8	Cl.	20'
4/28/69	12:30PM	High +6	68.0	59.5	59.0	14.7	15.9	7.7	7.9	8.3	8.4	8.5	7.2	Cl.	20
5/6/69	12:46PM	High +½	58.0	62.5	61.2	21.9	23.8	7.9	7.9	8.2	8.1	8.1	8.5	Cl.	23'
5/27/69	11:57AM	Low +⅓	66.0	65.0	64.5	16.7	20.5	7.9	7.9	7.6	7.8	7.2	7.8	Cl.	19'
6/10/69	12:07PM	Low +½	76.0	72.5	68.5	19.6	22.9	7.7	7.7	6.3	5.9	8.5	10.0	Cl.	16'
6/18/69	11:21AM	High +½	78.0	76.5	75.0	23.5	24.8	8.1	8.0	6.7	6.5	9.3	9.3	Cl.	18'
7/9/69	11:47AM	Low +2½	78.0	76.5	75.5	15.8	13.8	7.5	7.7	5.9	5.7	7.7	8.1	Cl.	17'
7/17/69	11:40AM	High +1	81.0	83.5	77.0	19.6	21.8	8.1	8.1	7.0	6.2	6.1	7.2	Cl.	21'
8/6/69 *	1:05PM	Low +3⅓	82.0	82.5	80.0	10.0	17.9	7.3	7.5	4.3	3.2	9.2	12.9	Cl.	24'
8/26/69	1:00PM	High +5	78.0	79.0	78.5	20.0	20.6	7.9	7.8	5.4	5.4	10.1	11.2	Cl.	16'
10/7/69	12:12PM	Low	68.5	66.8	67.0	17.6	19.5	7.7	7.7	7.0	7.1	10.0	10.8	Cl.-12	18'
10/27/69	1:00PM	High +3⅓	62.5	53.0	53.0	23.3	23.2	8.1	8.1	8.2	8.0	8.1	8.4	Cl.-10	22'
11/13/69	1:02PM	High +2	49.5	51.2	50.0	22.2	23.6	7.9	7.9	8.0	8.0	8.0	8.0	Cl.-5	20'
11/20/69	11:20AM	High+5½	44.0	47.0	46.2	16.3	16.3	7.7	7.7	9.5	9.6	5.2	6.8	Cl.-15	15'
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/12/69	11:23AM	High +½	46.0	44.8	44.8	11.0	10.9	7.3	7.5	10.1	10.1	6.3	6.9	Cl.-10	18'
1/12/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/23/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/4/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/12/70	1:27PM	High +1	44.0	39.0	38.0	18.0	22.3	7.9	8.0	10.0	9.8	5.1	5.8	Cl.-5	20'
3/19/70	11:32AM	High +5	44.0	41.0	40.0	17.6	18.0	7.9	7.9	11.3	11.7	4.4	4.5	Cl.-10	18'

* Heavy rains.

TABLE 7. Water Analysis Data Collected at the Akimbo Point Station (R-3).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	12:02PM	High+2½	-	-	-	15.2	15.6	-	-	10.2	9.9	-	-	35.0	-
12/18/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/27/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/15/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/20/69	12:07PM	High+1½	39.0	31.8	31.0	23.1	22.3	-	-	11.3	11.4	-	-	Cl.	16'
2/11/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/25/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/6/69	1:10PM	High +3	42.5	35.0	34.0	13.6	16.0	7.7	7.7	12.0	11.8	3.5	-	Cl.	15'
3/24/69	12:20PM	Low +4½	48.0	45.5	45.2	15.7	18.0	7.9	8.0	10.5	10.5	2.4	-	Cl.	14'
4/8/69	2:01PM	High	57.0	53.0	52.0	16.6	19.5	7.8	7.9	9.0	9.1	9.1	10.7	Cl.	17'
4/28/69	12:50PM	High +6	68.0	59.0	58.5	13.0	14.5	7.7	7.7	8.2	8.1	6.9	7.7	Cl.	16'
5/6/69	1:01PM	High +½	56.0	62.0	61.5	19.1	20.9	7.7	7.9	7.6	7.6	7.1	9.3	Cl.	20'
5/27/69	12:14PM	Low +½	64.0	66.6	65.5	13.8	16.2	7.7	7.7	7.7	7.3	6.0	8.7	Cl.	19'
6/10/69	12:27PM	Low +½	82.0	72.5	72.0	18.8	19.9	7.5	7.5	6.1	5.9	9.6	8.9	Cl.	14'
6/18/69	11:36AM	High +½	80.0	76.0	75.5	22.5	22.5	7.9	7.9	5.9	5.9	9.0	9.9	Cl.	15'
7/9/69	12:00N	Low +2½	77.0	77.5	77.0	16.0	16.6	7.5	7.5	5.7	5.5	7.9	7.9	Cl.	17'
7/17/69	11:51AM	High +1	91.0	82.0	81.5	17.0	18.5	7.9	7.9	6.1	6.0	6.9	6.4	Cl.	14'
8/6/69*	1:22PM	Low +3½	80.0	82.0	80.5	5.4	10.4	6.9	7.3	4.0	3.6	10.5	11.7	Cl.	14'
8/26/69	1:14PM	High +5	77.0	78.5	78.0	16.4	17.3	7.5	7.5	4.7	4.6	12.3	15.4	Cl.	16'
10/7/69	12:26PM	Low	68.0	67.0	67.0	19.1	21.8	7.7	7.9	6.7	6.5	9.7	9.7	Cl.-15	14'
10/27/69	1:14PM	High+3½	62.5	53.5	53.2	20.2	22.1	7.9	7.9	8.2	8.1	7.0	8.1	Cl.15	17'
11/13/69	1:18PM	High +2	51.0	51.2	51.1	19.0	22.2	7.9	7.9	8.2	8.0	7.7	8.0	Cl.-18	18'
11/20/69	11:43AM	High+5½	44.0	47.2	46.2	14.5	14.4	7.7	7.7	9.7	9.6	5.4	6.6	Cl.-15	12'
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/12/69	11:40AM	High +½	46.5	44.8	44.2	8.7	10.9	7.4	7.6	10.3	9.9	5.2	6.3	Cl.-11	17'
1/12/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/23/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/4/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/12/70	1:45PM	High +1	44.0	39.0	38.0	16.6	19.1	7.7	7.9	9.8	9.7	5.0	6.0	Cl.-15	17'
3/19/70	11:45AM	High +5	44.0	41.0	40.5	15.5	16.0	7.9	7.7	11.2	11.1	4.5	6.4	Cl.-18	12'

* Heavy rains

TABLE 8. Water Analysis Data Collected at the Bass River Station (B-0).

Date	Time	Tidal Stage	Temperature (°F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	12:24PM	High+2½	-	-	-	9.5	9.5	-	-	10.2	10.2	-	-	35.0	-
12/18/68*	1:13PM	High +5	46.0	31.0	-	6.9	-	7.1	-	11.3	-	-	-	Cl.	-
12/27/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/15/69*	11:10AM	High+4½	40.0	30.5	-	11.4	-	7.1	-	10.5	-	-	-	Cl.	-
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69*	11:55AM	Low +1	47.0	32.0	-	6.3	-	-	-	12.5	-	-	-	35.0	-
2/25/69*	11:30AM	Low +1	48.0	37.0	-	6.7	-	6.9	-	11.4	-	-	-	Cl.	-
3/6/69	1:35PM	High +3	43.0	36.0	35.5	8.1	7.9	7.4	7.3	11.9	11.9	6.6	-	35.0	14'
3/24/69	1:00PM	Low +5	46.0	46.0	45.5	13.0	13.7	7.7	7.7	10.1	9.8	6.0	-	Cl.	-
4/8/69	2:17PM	High	60.0	54.0	53.0	12.4	12.5	7.5	7.5	9.0	8.9	6.5	8.5	Cl.	8'
4/28/69	1:12PM	High +6	74.0	62.0	60.0	7.6	7.6	7.5	7.5	8.2	8.2	5.7	5.2	Cl.	6'
5/6/69	1:14PM	High+½	59.0	62.5	62.0	16.0	16.2	7.5	7.5	7.4	7.2	6.8	8.0	Cl.	8'
5/27/69	12:25PM	Low	65.0	66.6	65.5	10.0	11.1	7.5	7.5	7.8	7.8	6.4	6.0	Cl.	8'
6/10/69	12:40PM	Low +½	83.0	73.0	72.5	14.5	15.2	7.3	7.3	6.2	6.0	7.7	7.0	Cl.	6'
6/18/69	11:50AM	High +½	79.0	78.5	76.0	19.7	19.7	7.7	7.7	6.0	5.9	9.7	12.1	Cl.	9'
7/9/69	12:12PM	Low +2½	83.0	78.0	76.5	12.9	11.4	7.5	7.1	6.0	4.7	7.1	9.7	Cl.	7'
7/17/69	12:01PM	High +½	91.0	81.0	80.0	12.5	14.3	7.5	7.5	6.3	6.1	6.9	10.0	Cl.	7'
8/6/69**	1:33PM	Low +3½	79.0	82.0	81.5	2.8	3.3	6.3	6.3	3.3	3.3	13.9	9.4	Cl.	8'
8/26/69	1:30PM	High +5	77.0	79.0	79.0	10.7	10.8	7.3	7.3	3.8	3.7	14.2	12.1	Cl.	8'
10/7/69	12:37PM	Low	67.0	65.8	65.3	13.9	13.9	7.5	7.5	7.1	7.2	8.2	10.2	Cl.-15	8'
10/27/69	1:27PM	High +3	64.0	53.2	54.2	16.7	16.8	7.7	7.7	8.3	8.3	6.8	7.5	Cl.-20	8'
11/13/69	1:34PM	High +2	51.0	51.3	51.7	17.0	17.0	7.7	7.7	8.1	7.9	7.7	6.3	Cl.-10	7'
11/20/69	12:57PM	High+6½	44.0	45.7	46.0	9.1	8.9	7.5	7.5	9.4	9.2	4.5	4.4	Cl.-10	6'
12/4/69*	12:15PM	Low +1	36.0	37.3	-	16.6	-	7.5	-	7.7	-	4.2	-	Cl.-21	-
12/12/69	11:55AM	High +½	48.0	44.8	44.8	7.9	8.3	7.4	7.3	10.2	10.1	4.3	4.9	Cl.-11	10'
1/12/70*	12:27PM	Low +5½	42.0	31.1	-	8.7	-	7.0	-	12.0	-	5.1	-	25.0	-
1/23/70*	1:50PM	High +4	29.0	31.0	-	6.5	-	6.7	-	10.8	-	4.8	-	Cl.-23	-
2/4/70*	1:55PM	High +6	21.0	34.0	-	3.1	-	7.1	-	11.5	-	3.1	-	110.0	-
2/11/70*	11:55AM	Low +4½	35.0	36.0	-	8.0	7.3	-	9.9	-	4.0	-	-	Cl.-23	-
3/12/70	2:00PM	High +1	42.0	39.5	39.0	11.8	12.9	7.5	7.5	9.8	9.7	4.0	6.0	Cl.-9	7'
3/19/70	12:00N	High +5	44.0	42.0	41.0	10.1	10.6	7.5	7.5	11.3	11.2	4.0	5.0	Cl.-15	6'

* Sampling taken off Bass River Oyster House Dock.
** Heavy rains

TABLE 9. Water Analysis Data Collected at the French Point Station (R-6).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	12:42PM	High+2½	-	-	-	11.0	11.0			10.2	10.1	-	-	35.0	-
12/18/68*	1:40PM	High +6	43.0	29.0	-	8.6	-	7.4	-	12.3	-	-	-	40.0	-
12/27/68*	12:45PM	Low +2½	39.0	30.5	29.0	8.6	11.4	7.4	7.5	12.2	12.1	-	-	Cl.	8'
1/15/69*	11:30AM	High +5	42.0	30.0	29.9	14.1	14.2	7.3	7.4	10.7	10.8	-	-	Cl.	7'
1/20/69	12:22PM	High+1½	39.0	31.6	30.3	20.7	20.8	-	-	11.4	11.3	-	-	Cl.	18'
2/11/69*	12:12PM	Low +1½	49.0	32.2	31.9	7.2	8.1	-	-	12.6	12.4	-	-	45.0	8'
2/25/69*	11:45AM	Low +1	48.8	36.0	35.5	6.4	6.3	7.0	7.0	12.1	12.2	-	-	Cl.	7.5'
3/6/69	1:55PM	High +3	43.0	35.0	35.0	9.3	9.0	7.5	7.3	12.0	12.0	3.2	-	30.0	17'
3/24/69	1:15PM	Low +5	47.0	46.0	45.5	13.5	15.2	7.7	7.9	10.1	10.3	6.2	-	Cl.	25'
4/8/69	2:40PM	High +½	58.0	53.5	52.5	13.8	14.6	7.5	7.5	8.7	8.7	7.8	8.0	Cl.	22'
4/28/69	1:25PM	High +6	73.0	61.0	59.5	6.6	8.1	7.5	7.5	8.2	8.1	5.8	6.4	Cl.	20'
5/6/69	1:25PM	High +½	59.0	62.0	61.8	16.7	17.7	7.7	7.7	7.3	7.2	9.0	9.1	Cl.	23'
5/27/69	12:35PM	Low +½	66.0	65.5	65.0	9.2	10.9	7.5	7.5	7.6	7.2	5.5	5.4	Cl.	22'
6/10/69	12:53PM	Low +½	79.0	73.0	72.0	14.6	15.3	7.5	7.5	6.3	6.0	7.9	9.6	Cl.	24'
6/18/69	12:01PM	High +½	80.0	75.0	75.0	19.2	20.3	7.7	7.8	5.9	5.6	8.8	8.1	Cl.	17'
7/9/69*	12:23PM	Low +2½	77.0	77.0	76.5	14.9	14.1	7.5	7.3	5.9	5.8	6.3	6.0	Cl.	20'
7/17/69	12:14PM	High +1	94.0	83.0	80.5	14.2	15.7	7.7	7.7	6.1	6.6	6.7	7.8	Cl.	16'
8/6/69**	1:43PM	Low +3½	80.0	82.0	81.0	2.8	4.6	6.3	6.5	3.4	2.8	9.7	10.5	Cl.	15'
8/26/69	1:40PM	High+5½	76.0	78.5	78.5	11.7	12.2	7.3	7.3	3.9	3.8	15.8	16.0	Cl.	22'
10/7/69	12:52PM	Low	67.0	66.0	66.0	11.9	15.7	7.5	7.5	7.7	6.4	8.9	9.6	Cl.-15	20'
10/27/69	1:42PM	High+3½	64.5	53.3	53.8	18.0	18.3	7.7	7.7	8.1	8.1	7.0	8.4	Cl.-23	22'
11/13/69	1:42PM	High +2	51.0	51.0	51.0	18.4	19.0	7.7	7.7	8.2	8.0	7.1	6.9	Cl.-10	24'
11/20/69	1:15PM	Low	43.0	46.4	45.8	8.1	8.3	7.5	7.5	9.9	9.9	4.8	4.2	Cl.-10	14'
12/4/69*	12:45PM	Low +1	37.0	36.5	36.0	10.1	10.6	7.5	7.7	11.2	11.2	4.1	4.8	Cl.-23	8'
12/12/69	12:06PM	High +½	48.0	44.5	44.3	8.3	9.2	7.3	7.2	10.2	10.1	5.3	5.2	Cl.-11	32'
1/12/70*	12:40PM	Low +5½	42.0	31.0	-	10.2	-	6.8	-	12.1	-	5.2	-	35.0	-
1/23/70*	2:10PM	High+4½	29.0	30.0	-	9.0	-	6.7	-	11.1	-	5.1	-	Cl.-24	-
2/4/70*	2:10PM	Low	21.0	34.0	-	5.3	-	7.3	-	12.2	-	2.5	-	250.0	-
2/11/70*	12:10PM	Low +4½	37.0	36.0	36.0	8.9	9.6	7.5	7.3	10.3	10.4	4.2	4.2	Cl.-23	8'
3/12/70	2:10PM	High +1	41.0	39.5	39.0	13.1	14.2	7.5	6.8	9.9	9.7	5.5	4.6	Cl.-22	37'
3/19/70	12:12PM	High+5	44.0	41.0	40.5	10.0	9.9	7.5	7.5	11.1	11.0	4.3	4.4	Cl.-22	25'

* Sampling off Chestnut Neck Marina Dock
** Heavy rains.

TABLE 10. Water Analysis Data Collected at the Wading River Station (W-0).

Date	Time	Tidal Stage	Temperature (° F.) Air.	Sur.	Bot	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. SUr.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	12:57PM	High +3	-	-	-	7.6	7.8	-	-	10.2	10.1	-	-	55.0	-
12/18/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/27/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/15/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/25/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/6/69	2:05PM	High +3	44.0	36.0	36.0	6.0	5.7	7.3	7.1	11.9	11.9	2.7	-	30.0	-
3/24/69	1:30PM	Low +5	48.0	46.2	46.0	9.1	10.3	7.5	7.5	9.9	9.7	5.6	-	Cl.	17'
4/8/69	2:56PM	High +½	60.0	53.5	52.5	10.4	10.6	7.5	7.5	8.9	8.5	6.5	7.8	30.0	11'
4/28/69	1:42PM	High +6	76.0	63.0	61.5	1.5	1.9	6.8	6.9	8.1	7.9	5.3	5.4	Cl.	10'
5/6/69	1:39PM	High +⅓	59.0	63.0	62.0	12.9	13.9	7.5	7.5	7.3	6.9	6.6	7.7	Cl.	13'
5/27/69	12:49PM	Low +½	65.0	66.0	66.0	4.0	6.8	7.1	7.3	7.6	7.3	4.4	4.2	Cl.	9'
6/10/69	1:30PM	Low +1	80.0	73.0	73.0	9.6	12.5	7.2	7.3	6.4	6.2	6.0	6.5	Cl.	9'
6/18/69	12:16PM	High +½	75.0	74.0	74.0	16.7	17.4	7.5	7.5	5.9	5.5	7.9	8.9	Cl.	10'
7/9/69	12:39PM	Low +2½	87.0	77.0	76.5	3.1	7.9	6.5	7.3	5.3	5.6	7.2	7.1	Cl.	12'
7/17/69	12:27PM	High +1	93.0	83.0	80.5	10.4	11.9	7.5	7.3	6.6	5.8	5.7	7.6	Cl.	9'
8/6/69*	1:58PM	Low +3⅓	78.0	81.5	81.0	1.0	.9	5.7	5.7	3.6	6.1	14.1	14.2	Cl.	14'
8/26/69	1:55PM	High+5½	74.0	79.0	79.0	6.9	7.1	6.5	6.5	3.7	3.6	14.6	14.2	Cl.	8'
10/7/69	1:07PM	Low	67.5	65.8	65.5	7.1	9.5	7.3	7.3	5.2	4.7	6.0	7.4	Cl.17	11'
10/27/69	1:59PM	High+3½	64.5	54.0	54.8	14.4	14.6	7.5	7.5	5.9	5.9	7.6	7.8	Cl.-10	9'
11/13/69	2:07PM	High +2	51.0	51.8	51.5	14.0	14.8	7.5	7.5	8.3	8.0	5.9	6.6	Cl.-9	12'
11/20/69	1:35PM	Low	42.5	46.2	45.0	3.1	3.1	6.2	6.2	10.2	-	2.6	2.8	Cl.-23	6'
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/12/69	12:23PM	High +½	48.0	45.1	44.9	5.9	6.5	7.2	7.1	10.5	10.3	4.5	4.7	Cl.-9	14'
1/12/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/23/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/4/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/12/70	2:25PM	High +1	39.0	40.0	39.5	9.2	9.5	6.8	6.7	9.8	9.7	4.2	4.6	Cl.-15	8'
3/19/70	12:30PM	High +5	44.0	41.0	40.0	5.5	5.6	6.3	6.3	11.1	11.0	2.8	3.0	30.0	8'

* Heavy rains

TABLE 11. Water Analysis Data Collected at the Collins Point Station (R-9).

Date	TIME	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	1:22PM	High +3	-	-	-	7.2	7.7	-	-	10.8	10.3	-	-	35.0	-
12/18/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/27/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/15/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/25/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/6/69	2:10PM	High +3	44.0	36.0	35.5	5.4	5.4	7.3	7.1	11.9	12.0	3.3	-	25.0	16'
3/24/69	1:40 P	Low +5½	50.0	46.5	46.0	8.4	9.6	7.5	7.5	6.8	6.9	6.0	-	Cl.	20'
4/8/69	3:09PM	High +½	58.0	54.0	53.5	8.1	9.3	7.4	7.4	8.7	8.7	5.9	5.7	Cl.	17'
4/28/69	1:53PM	Low	74.0	63.5	59.0	3.2	7.3	7.1	7.4	8.1	8.1	4.8	4.9	25.0	14'
5/6/69	1:50PM	High +⅓	59.0	63.0	62.0	11.2	13.4	7.5	7.5	7.4	7.0	5.9	5.9	Cl.	13'
5/27/69	1:00PM	Low +½	65.0	66.0	65.0	6.0	11.1	7.3	7.5	7.6	6.6	4.2	5.7	Cl.	14'
6/10/69	1:45PM	Low +1	80.0	73.0	71.5	11.0	14.2	7.3	7.4	6.6	5.9	6.9	6.4	Cl.	13'
6/18/69	12:42PM	High +½	78.0	74.5	74.5	14.8	18.3	7.5	7.5	5.7	5.5	9.0	8.6	Cl.	16'
7/9/69	12:47PM	Low +2½	78.5	77.0	76.5	5.9	9.5	7.1	7.3	5.8	5.7	6.8	7.4	Cl.	11'
7/17/69	12:34PM	High +1	89.0	83.0	80.5	7.9	11.2	7.3	7.3	6.2	5.6	6.9	8.8	Cl.	12'
8/6/69*	2:08PM	Low +3½	81.0	81.0	81.0	1.0	.8	5.7	5.7	3.6	3.2	14.6	12.9	Cl.	15'
8/26/69	2:05PM	High+5½	77.0	79.0	79.0	7.1	7.9	6.5	6.5	3.9	3.6	12.6	15.1	Cl.	10'
10/7/69	1:18PM	Low	68.0	66.0	65.8	9.3	14.2	7.5	7.5	7.9	6.4	6.4	9.1	Cl.-15	18'
10/27/69	2:12PM	High+3½	64.2	54.1	54.1	14.4	13.6	7.5	7.5	8.6	8.3	6.4	7.5	Cl.-15	11'
11/13/69	2:20PM	High +2	51.1	51.1	51.5	10.0	14.9	7.5	7.5	8.2	8.1	5.0	6.4	Cl.-10	14'
11/20/69	1:47PM	Low +½	41.8	46.2	45.3	4.1	4.9	6.3	6.3	10.1	10.1	3.0	3.6	25.0	8'
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/12/69	12:35PM	High +⅓	48.0	45.4	45.1	4.0	5.5	7.1	7.1	10.5	10.3	3.9	4.2	25.0	12'
1/12/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/23/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/4/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/12/70	2:36PM	High +½	39.0	40.0	39.5	7.7	9.9	6.5	6.7	9.8	9.7	4.1	4.5	Cl.-22	16'
3/19/70	12:30PM	High +5	45.0	40.0	40.0	6.1	6.1	6.5	6.5	11.4	11.4	3.0	3.9	45.0	9'

* Heavy rains

TABLE 12. Water Analysis Data Collected at the Hog Island Station (R-12).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	1:38PM	High +3	-	-	-	3.7	4.0	-	-	10.7	10.7	-	-	60.0	-
12/18/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/27/68*	1:45PM	Low +2	40.0	30.8	-	1.8	-	5.9	-	11.6	-	-	-	40.0	-
1/15/69*	11:30AM	High -4	42.0	30.0	29.9	3.1	-	6.3	-	8.7	-	-	-	-	-
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69*	12:35PM	Low -1	45.0	32.0	-	1.3	-	-	-	12.0	-	-	-	70.0	-
2/25/69*	12.05PM	Low-½	46.0	38.1	-	.5	-	5.0	-	10.3	-	-	-	95.0	-
3/6/69	2:50PM	High+3½	44.0	37.0	36.5	1.0	.8	6.1	6.1	11.8	11.7	4.6	-	25.0	-
3/24/69	1:50PM	Low +5	50.0	47.0	46.5	4.1	4.0	7.2	7.1	9.9	9.8	4.9	-	30.0	10'
4/8/69	3:32PM	High +½	58.0	55.0	55.0	3.9	4.1	7.1	7.0	8.8	8.7	7.4	5.4	30.0	8'
4/28/69	2:12PM	Low	78.0	66.0	65.5	.3	.3	4.3	4.5	8.4	8.3	7.0	6.4	Cl.	3.5'
5/6/69	2:13PM	High +½	61.0	63.0	63.0	7.3	7.5	7.2	7.2	7.1	7.1	3.9	4.8	Cl.	8'
5/27/69	1:17PM	Low +½	67.0	67.0	67.0	.6	.5	6.3	6.1	6.7	6.7	5.2	5.8	30.0	4'
6/10/69	2:15PM	Low +1	80.0	73.5	73.5	5.9	6.3	6.7	6.8	6.2	6.0	6.5	5.8	Cl.	5'
6/18/69	12:56PM	High +½	73.0	74.0	74.0	11.8	11.6	7.3	7.3	6.1	5.8	6.2	8.4	Cl.	9'
7/9/69	1:00PM	Low +2½	78.5	77.0	77.0	1.3	1.3	6.3	6.4	5.1	4.9	8.0	-	Cl.	7'
7/17/69	12:47PM	High +1	92.0	84.0	81.0	7.1	4.1	6.8	7.1	6.4	6.0	6.2	8.5	Cl.	7'
8/6/69**	2:23PM	Low +3½	82.0	81.5	80.5	.5	.2	4.7	4.8	3.4	3.0	15.6	17.0	Cl.	8'
8/26/69	2:23PM	High+5½	76.0	79.5	79.5	1.9	1.9	5.5	5.6	3.3	3.3	14.6	8.5	Cl.	7'
10/7/69	1:39PM	Low	69.0	65.8	65.0	2.3	3.3	6.3	6.5	7.4	7.2	5.2	5.4	Cl.-22	8'
10/27/69	2:33PM	High+3½	64.2	54.3	54.1	7.6	9.0	7.3	7.3	9.1	8.8	5.0	5.3	Cl.-20	8'
11/13/69	2:37PM	High +2	51.0	50.8	50.8	6.9	8.7	7.3	7.3	8.5	8.3	3.9	4.5	Cl.-11	9'
11/20/69	2:12PM	Low +½	41.0	46.2	45.5	.3	.3	5.1	5.1	8.5	8.3	2.5	3.1	Cl.-23	6'
12/4/69*	1:05PM	Low +1	37.0	36.5	-	1.1	-	5.4	-	11.8	-	2.4	-	290.0	-
12/12/69	12:52PM	High +½	48.0	46.0	46.1	2.4	-	6.7	-	10.2	-	3.0	-	-	8'
1/12/70*	1:05PM	Low +5½	36.0	32.0	-	.4	-	5.6	-	11.0	-	4.8	-	30.0	-
1/23/70*	2:40PM	High +4	31.0	31.5	-	.5	-	5.7	-	10.7	-	5.3	-	Cl.-24	-
2/4/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/70*	12:30PM	Low +4	39.0	36.0	-	.6	-	5.3	-	9.9	-	3.4	-	85.0	-
3/12/70	2.53PM	High +1	38.0	40.0	39.5	4.3	4.3	6.1	6.1	9.9	9.8	3.9	3.2	Cl.-23	8'
3/19/70	1:02PM	High+5½	46.0	42.0	42.0	.6	.6	5.1	5.1	11.1	11.2	2.7	2.2	40.0	4'

* Sampling fromClarks Landing Shore Station.
** Heavy rains

TABLE 13. Water Analysis Data Collected at the Lower Bank Bridge Station (R-14).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Pot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	2:04PM	High +3	-	-	-	.7	.8	-	-	10.7	10.5	-	-	80.0	-
12/18/68	2:30PM	High+5½	38.0	31.0	31.0	.3	.2	4.6	4.6	11.4	12.2	-	-	30.0	8'
12/27/68	2:15PM	Low +2½	42.0	31.5	30.5	.4	-	4.6	-	12.2	11.9	-	-	Cl.	8'
1/15/69	12:27PM	High+4½	43.0	31.2	31.0	.5	.5	5.9	5.9	13.0	11.0	-	-	Cl.	8.5'
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69	12:59PM	Low +1	42.0	32.0	32.5	.3	.3	-	-	12.5	12.7	-	-	85.0	9'
2/25/69	12:30PM	Low +½	48.0	38.8	39.0	.1	.1	4.6	4.6	11.5	11.6	-	-	Cl.	6'
3/6/69	3:10PM	High +3	47.0	37.5	38.0	.3	.1	4.7	4.5	11.7	11.8	4.7	-	Cl.	6'
3/24/69	2:05PM	Low +5	49.0	48.0	47.5	1.1	1.2	6.1	6.1	9.8	9.7	6.2	-	35.0	10'
4/8/69	3:48PM	High +½	58.0	57.0	57.0	.8	.9	6.1	6.1	8.9	8.9	6.8	6.7	30.0	9'
4/28/69	2:35PM	Low	82.0	67.5	67.0	.1	.1	4.1	4.1	8.2	8.2	8.0	8.1	Cl.	7'
5/6/69	2:35PM	High +½	64.0	66.0	65.5	2.4	2.9	6.3	6.3	7.1	7.1	8.0	5.3	25.0	8'
5/27/69	1:37PM	Low	67.0	66.5	66.5	.2	.1	4.9	4.7	7.0	6.9	7.4	6.0	Cl.	8'
6/10/69	2:30PM	Low +1	78.0	74.0	73.5	1.8	1.6	6.1	6.2	5.9	6.4	7.1	7.5	Cl.	7'
6/18/69	1:10PM	High +½	74.0	74.0	75.0	5.2	6.2	6.9	7.1	6.9	6.1	5.2	6.2	Cl.	8'
7/9/69	1:15PM	Low +2	79.0	76.5	75.0	.2	.3	5.3	5.1	5.6	5.5	7.9	-	Cl.	6'
7/17/69	12:59PM	High +½	93.0	34.0	83.0	1.2	1.5	6.1	6.3	5.4	5.3	7.8	7.7	Cl.	8'
8/6/69*	2:35PM	Low +3	82.0	81.0	80.0	.3	.2	4.6	4.5	3.7	3.6	17.3	18.4	Cl.	8'
8/26/69	2:37PM	High +5	77.0	80.0	80.0	1.6	2.1	4.9	4.9	3.6	3.4	13.9	18.1	Cl.	6'
10/7/69	1:53PM	Low	68.5	65.3	65.3	.3	.4	5.8	5.9	7.1	7.2	5.3	5.8	Cl.-22	7'
10/27/69	2:49PM	High +3	64.0	52.7	53.0	3.5	3.9	6.3	6.3	9.3	9.1	3.0	3.0	Cl.-22	8'
11/13/69	2:55PM	High +2	51.0	49.8	49.8	2.4	3.2	5.9	5.9	8.3	8.0	3.4	3.9	Cl.-10	9'
11/20/69	2:30PM	Low +1	39.5	46.0	45.2	.2	.1	4.8	5.0	11.1	10.7	3.4	3.4	Cl.-22	7'
12/4/69	1:27PM	High	34.0	36.9	37.0	.1	.04	4.9	4.9	12.1	12.1	2.8	2.3	Cl.-21	6'
12/12/69	1:03PM	High	48.0	46.4	-	.2	.1	6.6	-	9.7	-	3.7	-	Cl.-20	8'
1/12/70	1:30PM	Low +5	36.0	31.5	31.2	.4	.3	5.4	5.2	11.2	11.3	5.1	5.2	Cl.-10	10'
1/23/70	2:55PM	High +4	31.0	31.0	-	.1	-	4.7	-	12.1	-	5.3	-	Cl.-10	-
2/4/70	2:46PM	High +6	19.0	33.0	-	.1	-	4.7	-	12.1	-	4.4	-	70.0	-
2/11/70	12:45PM	Low +3½	39.0	37.0	37.0	.2	.2	4.5	4.5	10.3	10.4	4.3	4.4	Cl.-20	9'
3/12/70	3:07PM	High +1	37.0	40.0	40.0	1.5	2.0	5.3	5.3	10.1	9.9	3.1	2.1	Cl.-24	8'
3/19/70	1:18PM	High +5	44.0	42.5	42.0	<.1	<.1	4.7	4.7	11.2	11.3	3.4	3.9		

* Heavy rains.

TABLE 14. Water Analysis Data Collected at the Green Bank Bridge Station (R-17).

Date	Time	Tidal Stage	Temperature (° F.) Air	Sur.	Bot.	Salinity Sur.	Bot.	pH Sur.	Bot.	D.O. Sur.	Bot.	CO_2 Sur.	Bot.	Turb.	Depth
11/21/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/18/68	3:00PM	High+5½	38.0	31.0	-	-	.2	4.4	4.4	12.4	12.0	-	-	Cl.	14'
12/27/68	3:00PM	Low +3	42.5	30.5	30.5	.2	-	4.1	-	11.9	11.9	-	-	Cl.	13'
1/15/69	12:50PM	High+4½	43.5	31.2	31.1	.1	.1	5.9	5.9	12.1	12.3	-	-	Cl.	12'
1/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2/11/69	1:30PM	Low +1	46.0	32.5	32.5	.1	.1	-	-	12.1	12.0	-	-	Cl.	-
2/25/69	12:50PM	Low +½	49.0	39.5	39.0	.1	.1	5.0	5.0	11.5	11.5	-	-	Cl.	6'
3/6/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/24/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4/8/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4/28/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5/6/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5/27/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/10/69	2:45PM	Low +1	76.0	74.5	73.5	1.7	1.1	4.9	4.7	7.0	7.0	7.1	7.0	Cl.	8'
6:18/69	1:25PM	High	73.0	75.0	75.5	1.0	1.1	5.1	5.1	5.9	5.5	5.9	7.4	Cl.	8'
7/9/69	1:31PM	Low +2	79.0	75.5	75.5	.3	.2	5.1	4.8	6.5	6.5	9.7	-	Cl.	8'
7/17/69	1:15PM	High +½	95.5	83.5	83.0	.2	.1	4.7	4.7	5.9	5.7	9.4	-	Cl.	8'
8/6/69*	2:54PM	Low +3	83.0	79.5	78.5	.3	.4	4.3	4.1	4.1	4.1	18.2	17.9	Cl.	8'
8/26/69	2:59PM	High +5	74.0	80.0	80.0	.2	.3	4.7	4.7	4.4	4.5	16.0	15.5	Cl.	8'
10/7/69	2:12PM	Low	71.0	65.0	64.9	<.1	<.1	5.8	5.8	7.9	8.0	4.9	6.8	Cl.-20	7'
10/27/69	3:08PM	High +3	62.0	51.9	52.0	.2	.3	5.1	5.2	9.6	9.5	3.5	3.8	Cl.-22	9'
11/13/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/20/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/4/69	1:50PM	Low	34.0	36.9	37.0	<.1	<.1	4.7	4.7	12.0	11.9	2.9	3.0	22.0	6'
12/12/69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/12/70	2:00PM	Low +5½	36.0	31.2	31.5	.2	.1	4.7	4.5	11.1	10.9	6.2	7.9	Cl.-5	9'
1/23/70	3:20PM	High +4	31.0	31.0	-	<.1	-	4.5	-	12.0	-	5.7	-	Cl.-5	-
2/4/70	3:02PM	High +6	19.0	32.0	-	<.1	-	4.7	-	11.7	-	5.7	-	40.0	-
2/11/70	1:05PM	Low +4	39.0	38.0	38.0	.1	.2	4.3	4.5	9.8	9.8	4.3	5.2	Cl.-22	7'
3/12/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/19/70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* Heavy rains.

TABLE 14A. Dissolved Oxygen Percent Saturation for Great Bay Estuary.

Date	B-1 Sur.	B-1 Bot.	B-2 Sur.	B-2 Bot.	B-3 Sur.	B-3 Bot.	B-4 Sur.	B-4 Bot.	B-5 Sur.	B-5 Bot.	R-0 Sur.	R-0 Bot.	R-3 Sur.	R-3 Bot.
11/21/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/18/68	88	-	-	-	-	-	-	-	90	87	-	-	-	-
12/27/68	90	-	-	-	-	-	-	-	93	-	-	-	-	-
1/15/69	100	-	-	-	-	-	-	-	95	-	-	-	-	-
1/20/69	-	-	-	-	-	-	-	-	97	94	93	94	91	92
2/11/69	91	-	-	-	-	-	-	-	93	-	-	-	-	-
2/25/69	107	-	-	-	-	-	-	-	107	-	-	-	-	-
3/6/69	96	95	103	94	-	-	98	96	98	97	94	95	94	92
3/24/69	99	91	105	99	-	-	101	100	105	105	102	101	96	97
4/8/69	100	99	99	98	102	102	102	101	104	105	102	99	91	92
4/28/69	95	95	88	65	116	93	89	92	90	89	89	90	87	85
5/6/69	101	101	99	98	99	100	-	97	92	91	95	94	86	87
5/27/69	89	97	96	96	99	98	98	95	91	91	89	91	88	84
6/10/69	88	86	92	97	93	97	91	98	84	92	80	74	77	74
6/18/69	80	78	83	88	99	95	89	89	93	94	93	94	79	78
7/9/69	85	90	90	92	79	93	80	88	79	83	76	72	74	72
7/17/69	85	65	85	86	90	90	91	86	96	90	100	83	85	83
8/6/69 *	40	59	70	63	-	52	75	57	76	67	56	44	51	47
8/26/69	88	83	81	80	80	82	77	74	81	71	74	73	62	61
10/7/69	89	90	87	86	87	85	90	81	83	81	82	85	80	79
10/27/69	90	92	90	86	90	89	90	85	89	86	86	84	85	85
11/13/69	88	86	87	85	87	87	93	87	85	86	82	82	82	82
11/24/69	89	96	95	95	96	99	95	94	-	92	89	89	90	88
12/4/69	95	-	-	-	-	-	-	-	100	-	-	-	-	-
12/12/69	-	-	-	-	-	-	-	-	-	-	94	94	93	91
1/12/70	93	-	-	-	-	-	-	-	91	-	-	-	-	-
1/23/70	96	-	-	-	-	-	-	-	92	-	-	-	-	-
2/4/70	-	-	-	-	-	-	-	-	96	-	-	-	-	-
2/11/70	85	-	-	-	-	-	-	-	82	-	-	-	-	-
3/12/70	90	89	90	95	87	80	88	79	88	86	85	84	83	76
3/18/70	95	97	99	99	99	101	99	99	97	100	98	101	97	96

* Heavy rains.

TABLE 14A. (Continued)

Date	B-0		R-6		W-0		R-9		R-12		R-14		R-17	
	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.
11/21/68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/18/68	82	-	86	-	-	-	-	-	-	-	79	84	-	83
12/27/68	-	-	86	86	-	-	-	-	79	-	83	-	80	-
1/15/69	77	-	79	79	-	-	-	-	59	-	90	76	84	85
1/20/69	-	-	90	87	-	-	-	-	-	-	-	-	-	-
2/11/69	39	-	91	90	-	-	-	-	83	-	86	87	83	83
2/25/69	87	-	91	91	-	-	-	-	77	-	88	88	88	88
3/6/69	91	90	91	92	89	89	89	90	88	87	87	88	-	-
3/24/69	92	89	92	94	87	86	86	87	85	84	84	83	-	-
4/8/69	89	88	87	87	87	82	85	85	84	83	86	85	-	-
4/28/69	86	86	86	84	84	80	92	83	88	87	88	87	-	-
5/6/69	83	80	82	81	80	77	81	78	76	76	76	75	-	-
5/27/69	87	86	83	80	81	80	82	73	72	72	74	73	-	-
6/10/69	78	74	78	73	77	76	80	71	74	72	68	69	81	74
6/18/69	80	78	77	73	75	70	72	71	75	70	82	73	69	64
7/9/69	77	59	76	74	65	69	72	71	63	70	66	64	76	76
7/17/69	84	80	84	88	89	76	82	74	83	76	68	68	75	72
8/6/69*	43	42	44	36	45	75	45	39	43	37	45	44	50	49
8/26/69	49	48	50	49	47	45	50	45	40	40	44	42	54	55
10/7/69	81	81	87	74	82	74	87	73	79	76	74	75	83	83
10/27/69	84	85	83	83	85	84	87	83	88	85	86	85	86	86
11/13/69	80	79	81	80	81	78	77	79	79	77	74	71	-	-
11/20/69	84	82	88	87	87	-	87	86	88	87	93	88	-	-
12/4/69	93	-	88	87	-	-	-	-	87	-	89	89	88	88
12/12/69	91	91	91	92	92	91	90	90	87	-	81	-	-	-
1/12/70	88	-	90	-	-	-	-	-	76	-	77	76	77	75
1/23/70	78	-	78	-	-	-	-	-	74	-	84	-	83	-
2/4/70	82	-	89	-	-	-	-	-	-	-	86	-	80	-
2/11/70	75	-	79	80	-	-	-	-	72	-	76	76	73	72
3/12/70	81	74	82	75	80	73	79	73	78	77	78	77	-	-
3/19/70	95	93	93	91	89	88	91	91	88	89	89	89	-	-

* Heavy rains.

TABLE 15. Twelve Hour Temperature and Salinity Readings at Little Egg Inlet off the Coast Guard Station Road, Great Bay, August 21, 1969.

Time	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 Noon	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM
Temperature													
Surface	67.5	69.0	69.5	68.5	66.5	67.0	70.0	71.5	72.0	71.5	70.0	69.0	69.5
Middle	65.5	68.0	67.0	67.0	67.0	67.5	72.0	72.0	72.5	71.5	68.5	68.5	68.5
Bottom	65.0	68.0	67.0	66.5	67.0	68.5	72.0	75.0	73.5	71.0	70.0	68.0	67.5
Salinity													
Surface	28.8	27.1	28.1	29.8	31.8	32.2	32.0	31.6	31.6	31.7	31.4	30.9	30.7
Middle	29.4	29.2	29.0	31.1	31.5	32.0	31.6	31.5	31.6	31.7	31.5	31.7	30.9
Bottom	30.1	29.1	30.6	31.2	31.5	32.0	31.5	31.5	31.7	31.6	31.5	32.3	31.3

Tidal Stage	Time AM	Time PM	Depth
High Tide		2:39	24'
Low Tide	8:03	9:27	16'

TABLE 16. Vertical Analyses of Collins Cove 1969.

Date: January 9, 1969 Tide: High + 2½
Time: 3:34 P.M. Air: 52.0° F.

Depth	Temperature (° F.)	D.O.	Salinity	pH	H_2S
Surface	30.8	11.0	7.0	6.8	
5'	30.5	11.0	12.2	7.4	
10'	31.0	9.7	15.4	7.5	
15'	34.4	7.6	16.9	7.3	
20'	36.0	2.6	18.0	7.2	
25'	46.0	.4	23.9	7.2	
Bottom 26'	47.3	.03	24.8	7.2	

Date: January 15, 1969 Tide: Low
Time: 1:30 P.M. Air: 44.0°F.

Surface	30.2	10.6	11.4	7.2	
5'	30.0	9.9	15.9	7.4	
10'	29.5	10.5	16.5	7.4	
15'	31.5	9.7	17.3	7.5	
20'	34.6	4.8	17.8	7.3	
25'	45.5	.4	24.3	7.1	
Bottom 26'	46.5	.2	24.3	7.2	

Date: January 17, 1969 Tide: High +1
Time: 9:50 A.M. Air: 38.0° F.

Surface	29.5	11.1	16.6	7.5	-
5'	29.4	10.8	17.5	7.5	-
10'	29.8	10.2	18.2	7.5	-
15'	30.0	10.7	18.3	7.5	-
20'	31.5	9.8	18.7	7.5	-
25'	36.0	5.1	19.5	7.2	-
30'	40.0	2.6	20.8	7.2	.1
Bottom 36'	48.5	.1	25.9	7.2	.3

TABLE 16. (Continued)

Date: January 17, 1969 Tide: High +4½
Time: 1:40 P.M. Air: 44.0° F.

Depth	Temperature (°F.)	D.O.	Salinity	pH	H_2S
Surface	30.0	10.9	12.7	7.3	-
5'	29.7	10.8	14.7	7.4	-
10'	29.5	10.8	18.4	7.5	-
15'	30.5	10.5	18.2	7.5	-
20'	33.0	9.6	19.1	7.3	-
25'	36.5	3.9	19.9	-	-
30'	46.8	.5	24.9	7.2	.1
Bottom 34'	49.0	-	-	-	.3

Date: January 21, 1969 Tide: Low + 4
Time: 10:00 A.M. Air: 35.0° F.

Surface	34.0	12.2	12.2	-	
5'	33.5	12.1	13.2	-	
10'	33.5	10.5	15.1	-	
15'	33.5	11.5	18.8	-	
20'	35.0	8.6	19.5	-	
25'	36.5	5.8	20.0	-	
30'	43.5	2.9	20.3	-	
Bottom 36'	43.5	2.1	21.4	-	

Date: January 27, 1969
Time: 2:30 P.M.

Surface	35.5
5'	35.5
10'	34.0
15'	34.0
20'	36.5
25'	37.5
30'	39.0
Bottom 34'	39.0

TABLE 16. (Continued)

Date: February 7, 1969 Tide: Low + 4
Time: 10:50 A.M. Air: 39.5° F.

Depth	Temperature (° F.)	D.O.	Depth	Salinity	pH
Surface	32.0	12.3	Surface	6.8	7.0
2'	32.0	12.3			
4'	31.9	12.4	5'	6.1	7.1
6'	31.9	12.2			
8'	31.7	12.1			
10'	31.7	11.9	10'	9.8	7.4
12'	32.0	11.8			
14'	32.1	11.5	15'	12.7	7.2
16'	34.0	9.6			
18'	34.5	7.9			
20'	34.9	8.1	20'	17.8	7.1
22'	35.1	3.3			
24'	35.8	2.1	25'	-	-
26'	36.0	-			
28'	37.3	1.6			
Bottom 30'	37.3	-	30'	-	-

Date: February 18, 1969 Tide: High + 2
Time: 12:30 P.M. Air: 36.0° F.

Depth	Temperature (°F.)	D.O.	Salinity	pH
Surface	30.2	12.1	12.7	7.2
5'	30.2	11.1	15.0	6.9
10'	29.8	10.8	15.6	7.4
15'	30.0	14.3	16.1	7.5
20'	30.0	10.9	16.7	7.4
25'	30.2	10.6	16.5	7.3
30'	30.5	4.3	18.0	7.0
35'	37.0	2.2	19.2	6.6
Bottom 37'	37.0	1.7	19.7	6.9

Date: March 18, 1969 Tide: High + 2
Time: 11:30 A.M. Air: 64.0° F.

					CO_2
Surface	41.2	11.0	11.5	7.5	6.2
5'	41.5	11.4	11.9	7.7	5.0
10'	40.2	11.2	13.0	7.7	6.9
15'	39.8	11.0	13.6	7.7	6.0
20'	39.8	10.8	14.0	7.7	6.5
25'	3 .8	10.5	14.4	7.7	8.1
30'	36.5	6.9	16.3	7.4	10.9
Bottom 36'	36.5	4.8	16.9	7.3	10.2

TABLE 17. Vertical Analyses of Collins Cove, 1970.

Date: January 6, 1970 Tide: High +3
Time: 11:00 A.M.

Depth	Temperature (°F.)	D.O.	D.O.(Sat.) (%)	Salinity (°/oo)	pH
Surface	32.0	11.74	83	4.85	6.9
15'	35.8	6.03	48	15.12	7.1
Bottom 22'	37.0	5.27	44	18.50	7.3
Date: January 12, 1970					
Time: 2:30 P.M.				Tide: High + 1½	
Surface	30.9	12.11	84	5.12	6.6
16'	33.5	8.67	67	14.22	7.1
Bottom 26'	37.0	4.36	36	18.17	7.1
Date: January 23, 1970					
Time: 4:00 P.M.				Tide: Low	
Surface	30.8	10.82	75	4.25	6.1
10'	32.0	6.51	48	13.31	6.7
20'	35.0	3.31	26	16.35	6.5
Bottom 27'	36.8	2.59	21	17.61	6.6
Date: February 24, 1970					
Time: 4:00 P.M.				Tide: High +6	
Surface	37.0				
Mid	35.0				
Bottom 27'	36.0				

TABLE 18. Water Analysis Data Collected in the Bass River July 31, 1969.

Depth	Station	Time	Tide	Temperature (°F.) Air	Sur.	Bot.	Salinity (°/oo) Sur.	Bot.	pH Sur.	Bot	Turb. TJU	D.O. Sur.	Bot.	D.O. % Sat. Sur.	Bot.	CO_2 Sur.	Bot.
15'	B-0	11:21AM	Low +6	85.0	81.0	74.5	2.5	2.4	6.3	6.3	Cl.	3.5	3.4	44	39	11.3	11.1
13'	B-1R	11:41AM		86.0	80.0	80.5	1.5	1.4	6.1	5.9	Cl.	3.4	3.4	42	42	7.5	7.8
9'	B-2R	11:52AM		87.0	81.0	80.5	1.8	1.9	6.0	6.0	Cl.	3.5	3.3	43	40	8.7	11.7
8'	B-3R	12:07PM		81.0	81.5	81.0	3.4	3.4	6.5	6.5	Cl.	2.5	2.5	31	32	13.2	15.1
5'	B-4R	12:27PM		89.0	80.5	79.5	1.3	1.7	5.9	6.0	Cl.	3.1	2.6	39	32	15.3	17.2

TABLE 19. Secondary Water Analysis Data Collected in the Bass River, August 13. 1969.

Depth	Station	Time	Tide	Temperature (°F.) Air	Sur.	Bot.	Salinity (°/oo) Sur.	Bot.	pH Sur.	Bot.	Turb. TJU	D.O. Sur.	Bot.	D.O. % Sat. Sur.	Bot.	CO_2 Sur.	Bot.
8'	B-0	10:51AM	High	87.0	80.0	79.0	8.3	10.5	7.1	7.3	Cl.	4.1	3.9	52	51	12.9	13.6
16'	B-1R	11:09AM		85.0	80.5	79.0	5.6	6.7	6.7	6.7	Cl.	3.2	3.2	40	40	9.7	11.0
13'	B-2R	11:19AM		84.0	79.0	78.5	4.4	4.8	6.7	6.5	Cl.	2.9	2.6	36	33	13.9	12.9
9'	B-3R	11:32AM		84.0	82.0	82.0	2.6	3.1	6.7	6.5	Cl.	3.6	3.0	46	38	14.4	16.6
3½'	B-4R	11:45AM		83.0	78.0	77.0	2.1	4.3	6.3	6.3	Cl.	5.2	-	62	-	7.9	-
	Mullica	12:22PM		86.0	81.5	79.5	4.3	-	6.3	-	-	3.3	-	42	-	11.8	-

TABLE 20. Water Analysis Data Collected in the Wading River, July 15, 1969

Depth	Station	Time	Tide	Temperature (°F.) Air	Temperature (°F.) Sur.	Temperature (°F.) Bot.	Salinity (°/oo) Sur.	Salinity (°/oo) Bot.	pH Sur.	pH Bot.	Turb. TJU	D.O. Sur.	D.O. Bot.	% Sat. D.O. Sur.	% Sat. D.O. Bot.	CO_2 Sur.	CO_2 Bot.
14'	W-0	11:15AM	High+1½	93.0	80.0	77.5	10.0	13.3	7.4	7.2	Cl.	6.2	5.6	80	73	6.8	7.6
9'	W-1R	11:25AM		91.0	78.5	78.0	8.1	10.1	7.5	7.3	Cl.	6.1	6.0	77	76	8.7	8.9
4'	W-2R	11:40AM		85.0	78.5	77.0	2.0	-	6.3	-	Cl.	-	5.0	-	-	-	9.3
10'	W-3R	11:50AM		91.0	79.5	77.5	1.5	1.6	6.3	5.9	Cl.	5.1	4.9	63	58	9.9	11.0
8'	W-4R	12:06PM		86.0	79.0	78.5	.5	.4	6.1	6.1	Cl.	5.4	5.2	66	62	9.0	9.7
6'	W-5R	12:20PM		85.0	80.0	78.0	.1	<.1	6.1	5.9	Cl.	5.9	5.9	72	71	10.2	10.7
5'	W-6R	12:31PM		82.0	78.5	77.0	<.1	-	5.9	-	Cl.	-	6.7	-	-	-	9.9
3'	W-7R	12:46PM		93.0	78.5	-	<.1	-	6.1	-	Cl.	6.9	-	83	-	-	9.5
2½'	W-8R	1:00PM		90.0	78.0	-	<.1	-	6.1	-	Cl.	1.5	-	18	-	-	10.1

TABLE 21. Secondary Water Analysis Data Collected in the Wading River, August 13, 1969.

Depth	Station	Time	Tide	Temperature (°F.) Air	Temperature (°F.) Sur.	Temperature (°F.) Bot.	Salinity (°/oo) Sur.	Salinity (°/oo) Bot.	pH Sur.	pH Bot.	Turb. TJU	D.O. Sur.	D.O. Bot.	% Sat. D.O. Sur.	% Sat. D.O. Bot.	CO_2 Sur.	CO_2 Bot.
12'	W-0	12:30PM	High+1½	83.0	81.0	79.0	4.0	6.5	6.3	6.9	Cl.	6.5	3.0	82	38	12.8	12.2
18'	W-1R	12:40PM		83.0	81.5	80.5	2.5	3.3	5.9	6.3	Cl.	3.0	2.9	37	36	11.5	13.1
3'	W-2R	13:08PM		84.0	82.0	80.5	.5	-	4.9	-	Cl.	3.2	-	41	-	15.3	-
11'	W-3R	13:20PM		87.0	78.0	77.5	.6	.3	4.5	4.7	Cl.	3.0	3.5	36	41	18.7	16.5
8'	W-4R	13:35PM		88.0	77.0	77.0	.4	.2	4.5	4.5	Cl.	3.3	3.5	41	41	20.0	16.6
6'	W-5R	13:48PM		87.0	76.5	76.0	.2	.2	4.5	4.3	Cl.	4.2	4.7	49	55	17.7	15.2
6'	W-6R	14:03PM		91.0	76.0	76.0	.2	-	4.5	-	-	4.6	-	54	-	15.0	-

TABLE 22. Water Analysis Data Collected in Upper Watershed of Mullica River, February 17, 1970.

Station	Depth	Time	Tide	Temperature (°F.) Air	Sur.	Bot.	Salinity (°/oo) Sur.	Bot.	pH Sur.	Bot	Turb. TJU	D.O. Sur.	Bot.	CO_2 Sur.	Bot.
Lower Bank R-14	7'	2:45PM	Low	40.0	36.0	35.5	<.1	<.1	4.5	4.5	Cl.-15	10.8	10.8	6.1	6.0
Green Bank R-17	8'	3:15PM	Low	40.0	36.5	36.5	<.1	<.1	4.5	4.5	Cl.- 5	11.0	11.0	5.8	8.0
Sweetwater WR-20	-	4:34PM	Low	40.0	36.0	-	*		3.8	-	Cl.- 5	10.4	-	8.4	-
Upper Mullica River WR-30	-	3:56PM		40.0	36.0	-	*		4.4	-	Cl.-10	11.1	-	5.3	-
Batsto R. WR-29	-	4:12PM		40.0	36.0	-	*		4.3		Cl.- 4	10.9	-	5.5	-

NURTIENT DATA

Station	Depth	Time	Tide	NO_2 Sur.	PO_3 (Ortho) Sur.	NH_3 Sur.	NO_3 Sur.
Lower Bank R-14	7'	2:45PM	Low	0.00	.22	.5	1.14
Green Bank R-17	8'	3:15PM	Low	0.00	.30	.7	1.50
Sweetwater WR-20	-	4:34PM	Low	0.00	2.80	1.1	1.01
Upper Mullica River WR-30	-	3:56PM		0.00	2.00	.50	1.41
Batsto R. WR-29	-	4:12PM		0.00	1.00	.6	1.0

* Fresh Water

TABLE 23. Water Analysis Data Collected Around Little Bay, August 14, 1969.

Depth	Station	Time	Tide	Temperature (°F.) Air	Temperature (°F.) Sur.	Temperature (°F.) Bot.	Salinity °/oo Sur.	Salinity °/oo Bot.	pH Sur.	pH Bot.	Turb. TJU	D.O. Sur.	D.O. Bot.	D.O.% Sat. Sur.	D.O.% Sat. Bot.	CO_2 Sur.	CO_2 Bot.
8'	Light #20 B-3	11:15AM	High+1½	81.0	79.5	77.5	22.7	23.9	8.5	8.5	Cl.	7.5	6.6	104	91	11.0	10.3
	Light #28 T-1	11:30AM		82.0	78.5	76.5	22.8	-	8.1	-	Cl.	6.0	-	82	-	11.2	-
	Buoy 40-A T-2	11:41AM		83.0	78.0	77.0	27.5	-	8.1	-	Cl.	6.6	-	95	-	10.0	-
	Black Pt. T-3	11:52AM		83.0	77.5	76.5	28.4	-	8.5	-	Cl.	6.5	-	92	-	10.8	-
	Fl. "3" T-4	12:04PM		80.0	74.5	74.0	27.8	-	8.5	-	Cl.	6.7	-	91	-	11.1	-
	Inlet T-5	12:20PM		81.0	72.5	72.5	28.2	29.9	8.1	8.1	Cl.	6.9	6.8	92	92	7.7	9.0
	Little Bay T-6	12:54PM		80.0	76.0	75.5	30.2	-	8.1	8.1	Cl.	7.6	-	107	-	9.8	-

TABLE 24. Nutrient Analysis Data Collected at the Little Egg Inlet Station (NB-1).

Date	Time	Tide	Temperature (°F.) Air	Sur.	Bot.	Salinity (°/oo) Sur.	Bot.	pH Sur.	Bot.	Depth Feet	NO_2 Sur.	NO_3 Sur.	PO_3 (Orth) Sur.
10/16/69	1:49PM	High +3	68.0	65.9	65.3	32.5	31.6	-	-	20	0.00	.04	-
10/31/69	2:18PM	High +3	56.0	56.0	-	31.4	-	-	-	-	0.00	0.00	.28
11/24/69*	1:23PM	High +6	46.0	44.0	44.1	27.0	27.1	7.9	8.0	26	0.00	.18	.76
12/4/69**	11:20AM	Low +2	35.0	38.1	-	30.3	-	8.0	-	-	0.00	0.00	.36
1/26/70**	1:17PM	High+3½	52.0	29.0	-	24.9	-	-	-	-	0.00	0.00	.40
2/5/70**	12:15PM	High+5⅓	20.0	29.0	-	27.0	-	-	-	-	0.00	0.00	.12
3/24/70	12:21PM	High +4	50.0	39.0	-	27.8	-	8.1	-	-	0.00	0.00	.14
4/22/70***	12:00N	High +4	58.0	50.0	-	20.5	-	7.9	-	-	0.00	0.00	.32
5/19/70	10:55AM	High+3⅓	68.0	58.0	-	28.3	-	8.1	-	-	0.00	0.00	.02

* Strong current. ** Sampling taken from shore of Little Egg Coast Guard Station.
*** After heavy rains.

TABLE 25. Nutrient Analysis Data Collected at the Big Creek Station (NB-2).

Date	Time	Tide	Temperature (°F.) Air	Sur.	Bot.	Salinity (°/oo) Sur.	Bot.	pH Sur.	Bot.	Depth Feet	NO_2 Sur.	NO_3 Sur.	PO_3 (Ortho) Sur.
10/16/69	2:10PM	High+2½	67.0	64.4	64.5	31.2	31.2	-		8	0.00	.04	-
10/31/69	2:33PM	High+2½	56.0	52.0	-	31.0	-	-		-	0.00	.02	.44
11/24/69	1:55PM	High+5⅓	47.0	43.5	43.6	24.7	25.0	7.9		4	0.00	.09	.90
12/4/69*	11:50AM	Low +1¼	35.0	37.5	-	24.0	-	8.0		-	0.00	0.00	.36
1/26/70*	1:55PM	High+3½	56.0	31.0	-	22.7	-	-		-	0.00	.13	.92
2/5/70*	1:07PM	High +6	30.0	31.5	-	17.1	-	-		-	0.00	0.00	.26
3/24/70	12:40PM	High +4	48.0	40.0	-	26.6	-	8.0		-	0.00	0.00	.12
4/22/70**	12:27PM	High +4	58.0	50.0	-	20.8	-	7.9		-	0.00	0.00	.16
5/19/70	11:14AM	High+3⅓	65.0	60.0	-	26.3	-	7.9		-	0.00	0.00	.6

* Sampling taken from shore station.
** After Heavy rains.

TABLE 26. Nutrient Analysis Data Collected at the Light #20 Station (NB-3).

Date	Time	Tide	Temperature (°F.) Air	Sur	Bot	Salinity (°/oo) Sur.	Bot	pH Sur.	Depth Feet	NO_2 Sur.	NO_3 Sur.	PO_3 (Ortho) Sur.
10/16/69	1:25PM	High+1⅓	65.0	64.2	64.6	32.0	31.5	-	9	0.00	.04	.14
10/31/69	2:04PM	High +2	56.0	52.0	-	30.9	-	-	-	0.00	0.00	.22
11/24/69	1:02PM	High+4⅓	47.0	42.3	43.0	-	27.1	7.9	6	0.00	.09	.64
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-
1/26/70	-	-	-	-	-	-	-	-	-	-	-	-
2/5/70	-	-	-	-	-	-	-	-	-	-	-	-
3/24/70	12:04PM	High +3	52.0	40.0	-	27.0	-	8.0	-	0.00	0.00	.14
4/22/70*	11:40AM	High+3⅓	60.0	50.0	-	14.1	-	7.7	-	0.00	0.00	.76
5/19/70	11:29AM	High+3⅓	62.0	60.0	-	24.0	-	7.9	-	0.00	0.00	.06

* After heavy rains.

TABLE 27. Nutrient Analysis Data Collected at the Basses Bay Station (NR-0).

Date	Time	Tide	Temperature (°F.) Air	Sur.	Bot.	Salinity (°/oo) Sur.	Bot.	pH Sur.	Depth Feet	NO_2 Sur.	NO_3 Sur.	PO_3 (Ortho) Sur.	NH_3
10/16/69	2:33PM	High+2⅓	65.0	64.7	64.0	25.4	27.7	-	21	-	-	-	-
10/23/69	12:10PM	Low +1⅓	45.0	57.2	-	-	-	6.8	-	0.00	0.00	.44	3.5
11/7/69	1:21PM	Low	46.0	50.0	-	20.7	-	5.5	-	0.00	0.00	.40	3.6
12/4/69	-	-	-	-	-	-	-	-	-	-	-	-	-
1/26/70	-	-	-	-	-	-	-	-	-	-	-	-	-
2/5/70	-	-	-	-	-	-	-	-	-	-	-	-	-
3/25/70	3:20PM	High +5	54.0	43.0	-	15.5	-	7.7	-	0.00	.18	0.00	1.8
4/13/70	10:39AM	Low *2	54.0	50.0	-	14.2	-	7.7	-	0.00	.09	.16	2.3
5/20/70	1:52PM	High+2⅓	66.0	63.0	-	14.8	-	7.7	-	0.00	0.00	.08	2.8

TABLE 28. Nutrient Analysis Data Collected at the Garden State Parkway Bridge Station (NR-7).

Date	Time	Tide	Temperature (°F.) Air	Sur.	Bot.	Salinity (°/oo) Sur.	Bot.	pH Sur.	Depth Feet	NO_2 Sur.	NO_3 Sur.	PO_3 (Ortho) Sur.	NH_3 Sur.
10/16/69	2:50PM	High +2	65.0	65.5	65.0	21.8	20.6	-	20	-	-	-	-
10/23/69	12:30PM	Low +2½	45.0	57.0	-	-	-	-	-	0.00	.26	.16	1.1
11/7/69	1:42PM	Low	46.0	51.0	-	12.7	-	5.4	-	0.00	0.00	.36	2.0
12/4/69	12:27PM	Low +1	37.0	37.9	-	-	-	-	-	0.00	0.00	5.60	3.6
1/26/70	2:30PM	High+3½	49.0	30.0	-	8.9	-	-	-	0.00	.22	2.00	2.4
2/5/70	1:41PM	High +5	31.0	32.0	-	5.0	-	-	-	0.00	.44	.20	.72
3/25/70	3:45PM	High +5	54.0	44.0	-	5.4	-	7.3	-	0.00	.26	0.00	.48
4/13/70	11:00AM	Low +1½	54.0	50.0	-	5.6	-	7.3	-	0.00	.09	.20	0.6
5/20/70	2:11PM	High +2	68.0	66.0	-	5.5	-	7.1	-	0.00	.09	.40	1.3

TABLE 29. Nutrient Analysis Data Collected at the Lower Bank Bridge Station (NR-14).

Date	Time	Tide	Temperature (°F.) Air	Sur.	Bot.	Salinity (°/oo) Sur.	Bot.	pH Sur.	Depth Feet	NO_2 Sur.	NO_3 Sur.	PO_3 (Ortho) Sur.	NH_3 Sur.
10/16/69	3:18PM	High +1	65.0	65.1	65.0	6.5	8.3	-	9	0.00	0.00	.02	-
10/23/69	12:53PM	Low +3⅓	45.0	54.0	-	-	-	-	-	0.00	0.00	.36	1.4
11/7/69	2:01PM	High+5⅓	44.0	49.0	-	-	-	-	-	0.00	.26	.24	1.1
12/4/69	1:27PM	Low +⅓	34.0	36.9	-	.2	.1	4.9	6	0.00	1.14	2.40	.7
1/26/70	3:00PM	High +2	50.0	30.0	-	<0.00		-	-	0.00	1.23	1.00	1.1
2/5/70	2:08PM	High+4½	32.0	31.8	-	.1	-	-	-	0.00	1.14	.14	1.1
3/25/70	4:10PM	High +4	52.0	46.0	-	<0.00		4.4	-	0.00	.66	.12	0.5
4/13/70	11:22AM	Low +⅓	56.0	52.0	-	<0.00		4.7	-	0.00	.53	.48	1.0
5/20/70	2:39PM	High+3½	78.0	67.0	-	<0.00		4.7	-	0.00	.53	.48	1.0

TABLE 30. Chlorinated Hydrocarbon found in tissues of fish collected in Great Bay-Mullica River Estuary 1969 and 1970.

Station	Date	Tissue*	BHC Alpha	BHC Beta	BHC Gamma	BHC Delta	BHC Total	HEPTA Epxide	Dieldrin	DDE	DDD	DDT (pp')	DDT (op')	DDT Total
Cape Horn B-2	9/22/69 Spearing	WPB	<.01	<.01	<.01	<.01	<.01	<.01	≤ .01	.15	.14	.27	< .01	.56
	5/13/70 Spearing	WPB	<.01	<.01	<.01	<.01	<.01	<.01	< .01	.14	.08	.10	< .01	.32
Landing Creek	10/14/69 Spearing	WPB	<.01	<.01	<.01	<.01	<.01	<.01	< .01	.20	.08	.25	< .01	.53
	5/13/70 Spearing	WPB	<.01	<.01	<.01	<.01	<.01	<.01	< .01	.14	.05	.09	< .01	.28
Graveling Point B-5	10/10/69 Spearing	WPB	<.01	<.01	<.01	<.01	<.01	<.01	< .01	.17	.13	.25	< .01	.55
	7/13/69 Spearing	WPB	<.01	<.01	<.01	<.01	<.01	<.01	.13	.08	.13	.07	< .01	.28
Lower Bank R-14	9/24/69 Alewives	WPB	<.01	<.01	<.01	<.01	<.01	<.01	< .01	.32	.02	.22	< .01	.56
	5/13/70 White Perch	WPB	<.01	<.01	<.01	<.01	<.01	<.01	< .01	.25	.05	.71	.11	1.12

* Whole Product Basis (PPM)

TABLE 31. State of New Jersey owned land within boundaries of Burlington County.

State Forests	Locations	Acreage	Total
Lebanon State Forest	Woodland Township	13,641	
	Pemberton Township	1,465	
	Southampton Township	79	
			15,185
Penn Forest	Washington Township	2,958	
			2,958
Green Bank Forest	Washington Township	1,533	1,533
Bass River Forest	Bass River Township	7,604	
	Woodland Township	30	
			7,634
Wharton Tract	Bass River Township	2,245	
	Shamong Township	16,183	
	Tabernacle Township	10,015	
	Washington Township	41,185	
	Medford Township	1,547	
			71,175
State Parks			
Mount Laurel	Mount Laurel Township	19.75	19.75
Historic Sites			
Carranza Memorial	Tabernacle Township	10.00	
Lawrence House	Burlington City	.241	10.241
Fish and Game Property			
Medford	Medford Township	214.10	214.10
		Total	98,729.091

NOTE:

(1) That 7,000 additional acres of Lebanon State Forest are situated in Ocean County adjoining Burlington.

(2) That 10,088 acres in Atlantic County and 13,513 acres in Camden County comprise the balance of Wharton Tract.

FIG-1 PROFILES OF GREAT BAY AT MEAN HIGH WATER

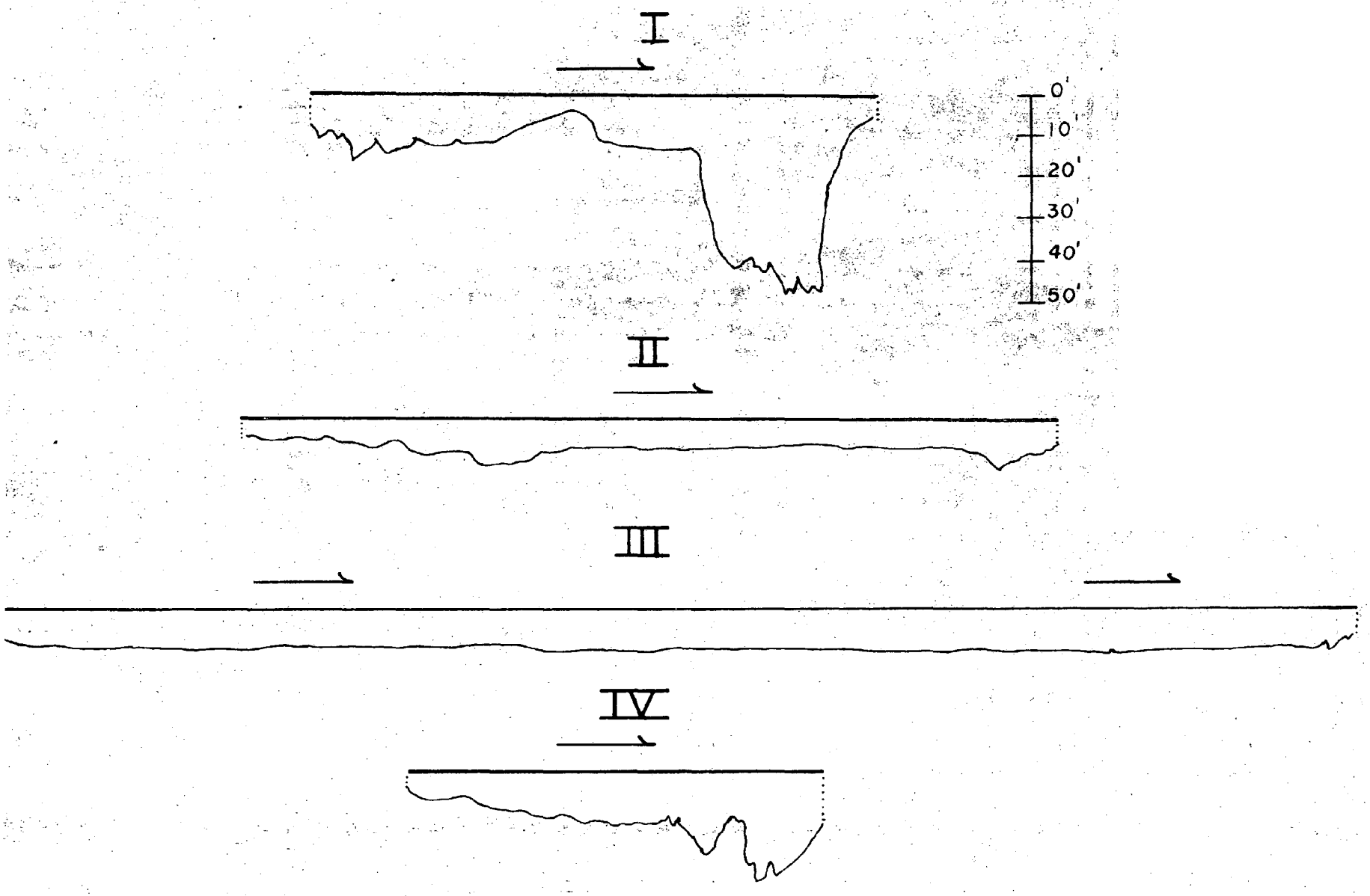
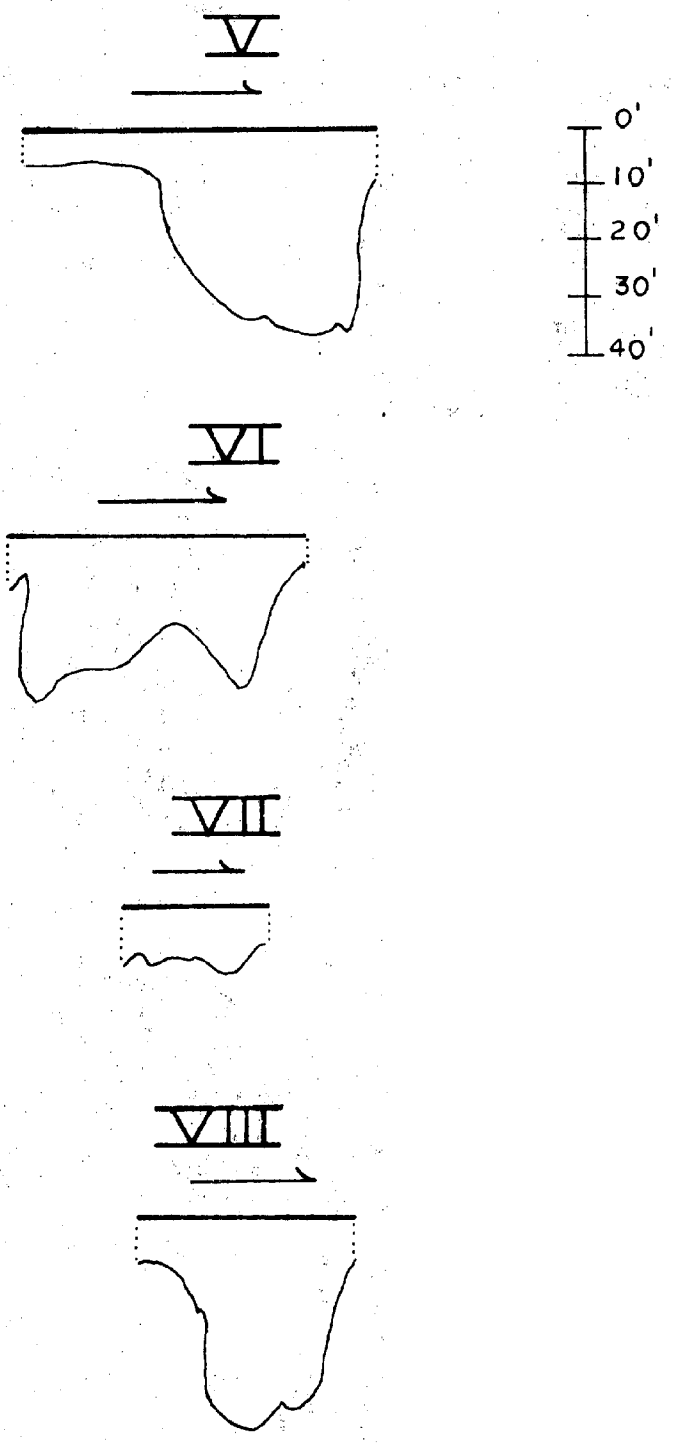
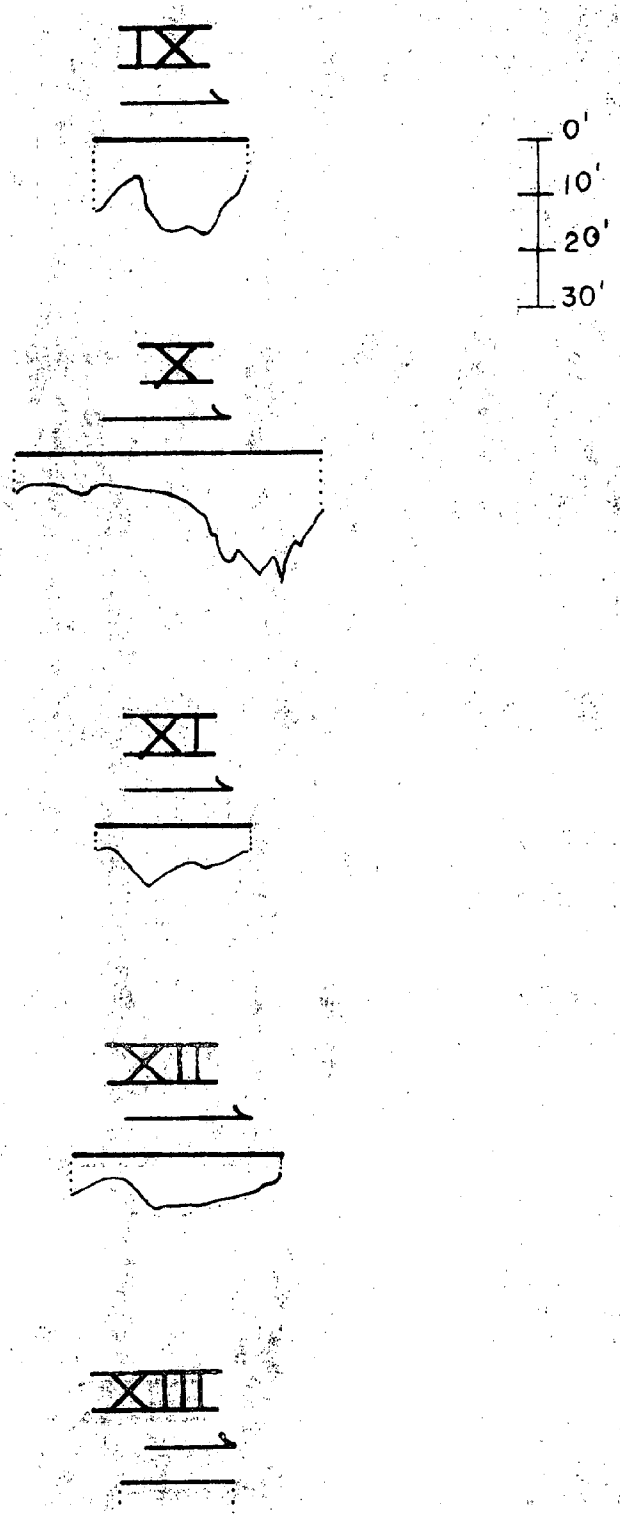
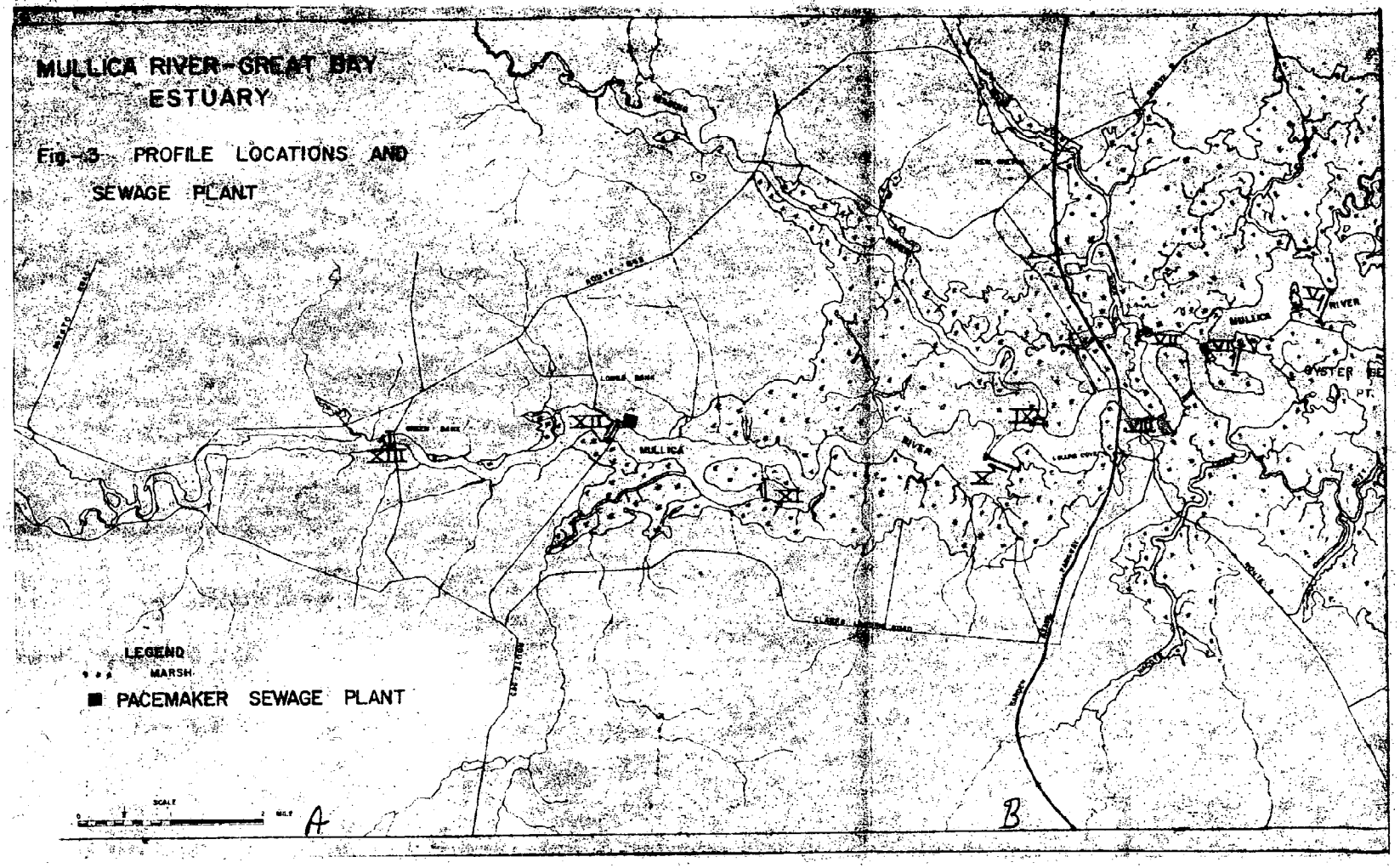


FIG. 2 PROFILES OF MULLICA RIVER WATER QUALITY STATIONS AT MEAN HIGH WATER



PROFILES OF MULLICA RIVER WATER QUALITY STATIONS AT MEAN HIGH WATER

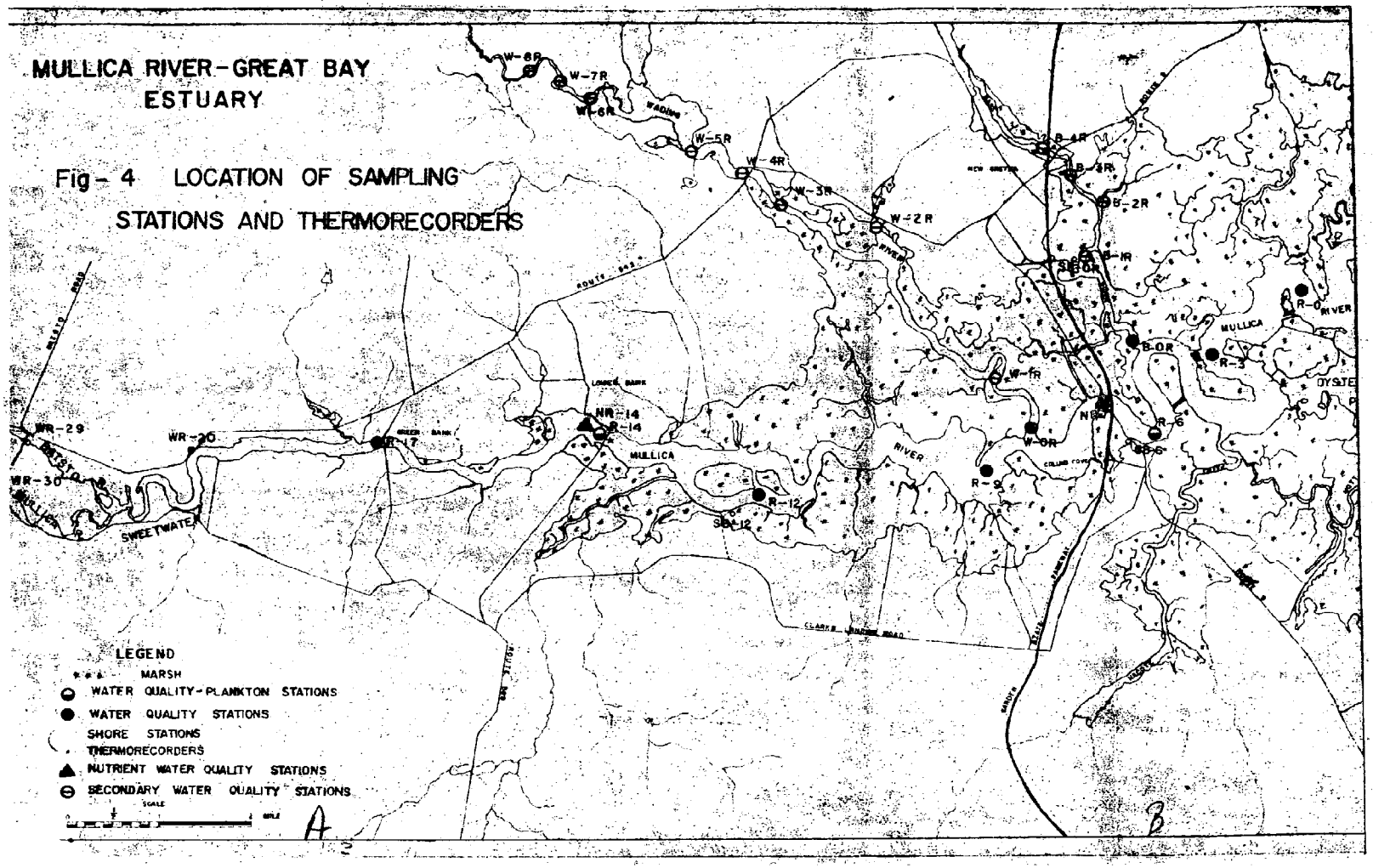


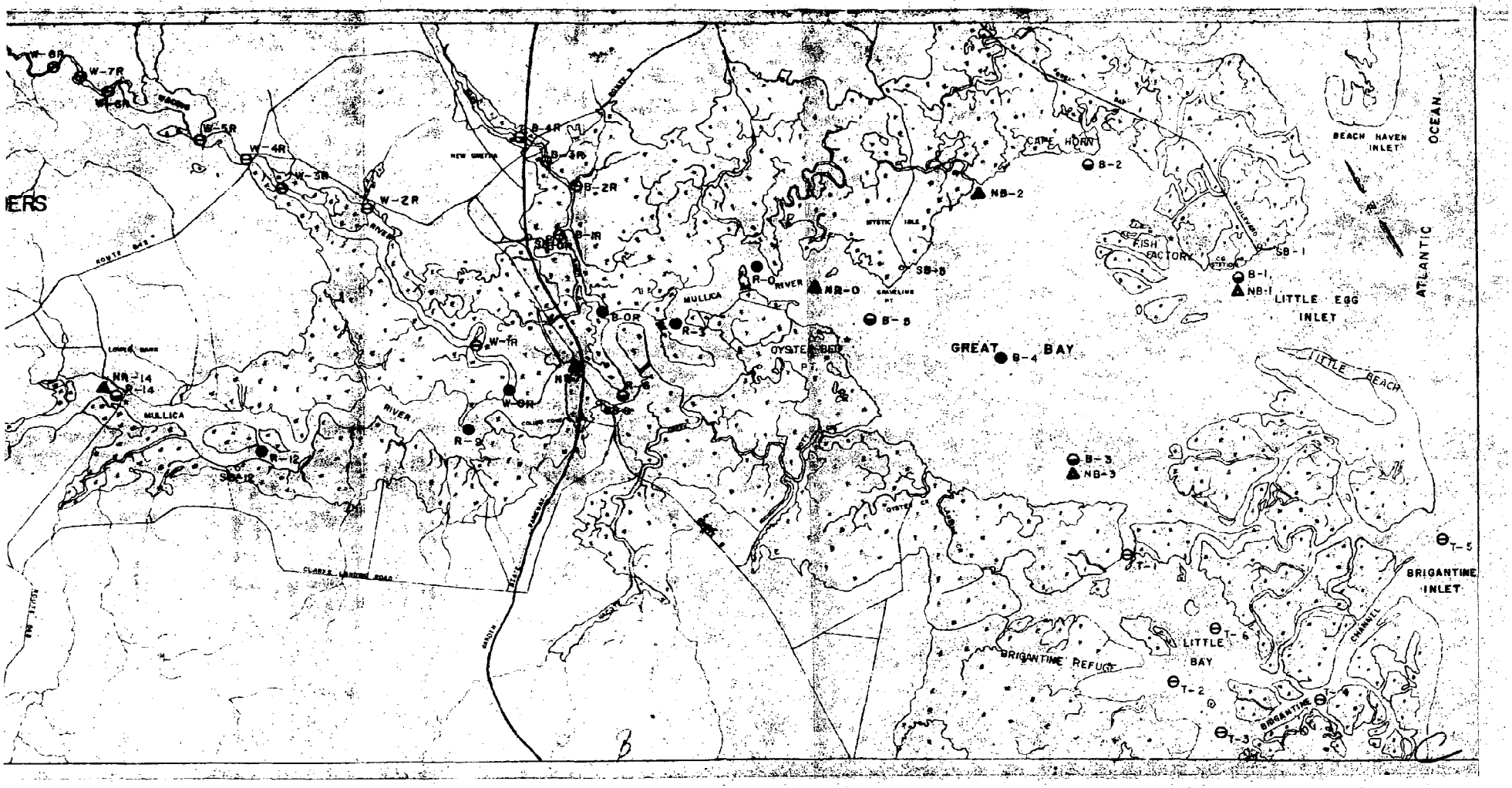

MULLICA RIVER-GREAT BAY
ESTUARY
Fig.-3 PROFILE LOCATIONS AND
SEWAGE PLANT
LEGEND
MARSH
PACEMAKER SEWAGE PLANT
SCALE
A
B

GREAT BAY
LITTLE EGG INLET
ATLANTIC OCEAN
BEACH HAVEN INLET
LITTLE BEACH
BRIGANTINE INLET
LITTLE BAY
BRIGANTINE REFUGE
BRIGANTINE CHANNEL
OYSTER BED PT.
MULLICA RIVER
FISH FACTORY
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII
B

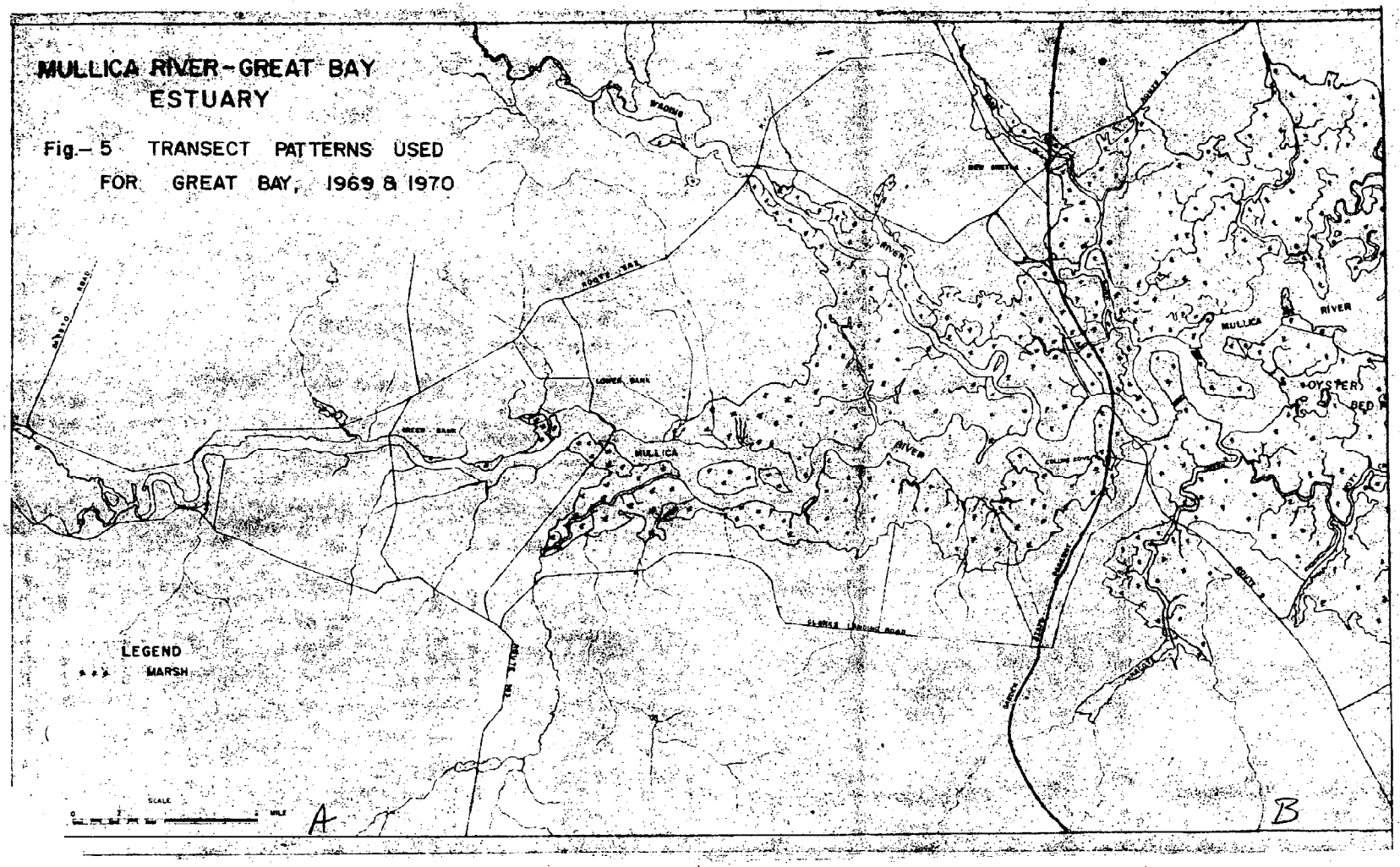
MULLICA RIVER-GREAT BAY
ESTUARY

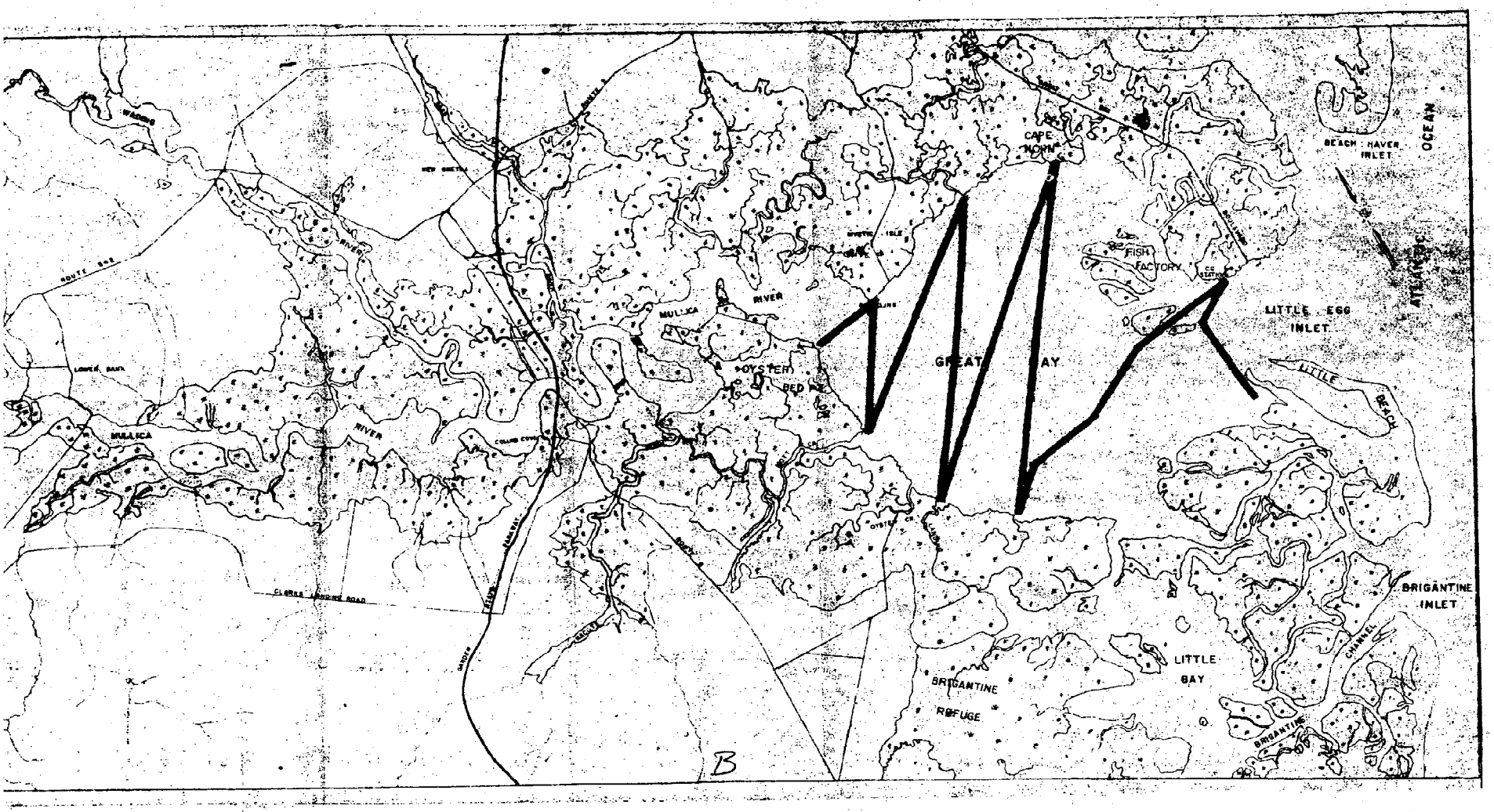
Fig - 4 LOCATION OF SAMPLING
STATIONS AND THERMORECORDERS





W-6R
W-7R
W-5R
W-4R
W-3R
W-2R
B-4R
B-3R
B-2R
B-1R
B-0R
W-1R
W-0R
R-9
R-12
SB-12
NR-14
R-14
MULLICA
RIVER
NEW GRETNA
CLARKS LANDING ROAD
GARDEN STATE PARKWAY
R-0
NR-0
R-3
OYSTER BED PT.
B-5
SB-5
MYSTIC ISLE
GRAVELING PT
GREAT BAY
B-4
B-3
NB-3
NB-2
B-2
CAPE HORN
FISH FACTORY
SB-1
B-1
NB-1
LITTLE EGG INLET
BEACH HAVEN INLET
ATLANTIC OCEAN
LITTLE BEACH
T-1
T-2
T-3
T-5
T-6
LITTLE BAY
BRIGANTINE REFUGE
BRIGANTINE CHANNEL
BRIGANTINE INLET


MULLICA RIVER-GREAT BAY
ESTUARY
Fig.- 5 TRANSECT PATTERNS USED
FOR GREAT BAY, 1969 & 1970
LEGEND
MARSH
MULLICA
RIVER
OYSTER
BED
LOWER BANK
GREEN BANK
ROUTE 542
CLARKS LANDING ROAD
SCALE
A
B



CAPE NORM
BEACH HAVEN INLET
OCEAN
FISH FACTORY
LITTLE EGG INLET
LITTLE BEACH
MULLICA
RIVER
OYSTER BED
GREAT BAY
BRIGANTINE INLET
LITTLE BAY
BRIGANTINE REFUGE
CHANNEL
B

FIG. 6 — SURFACE D.O. % SATURATION RANGES FOR GREAT BAY - MULLICA RIVER ESTURARY - DECEMBER 1968 THROUGH MARCH 1970

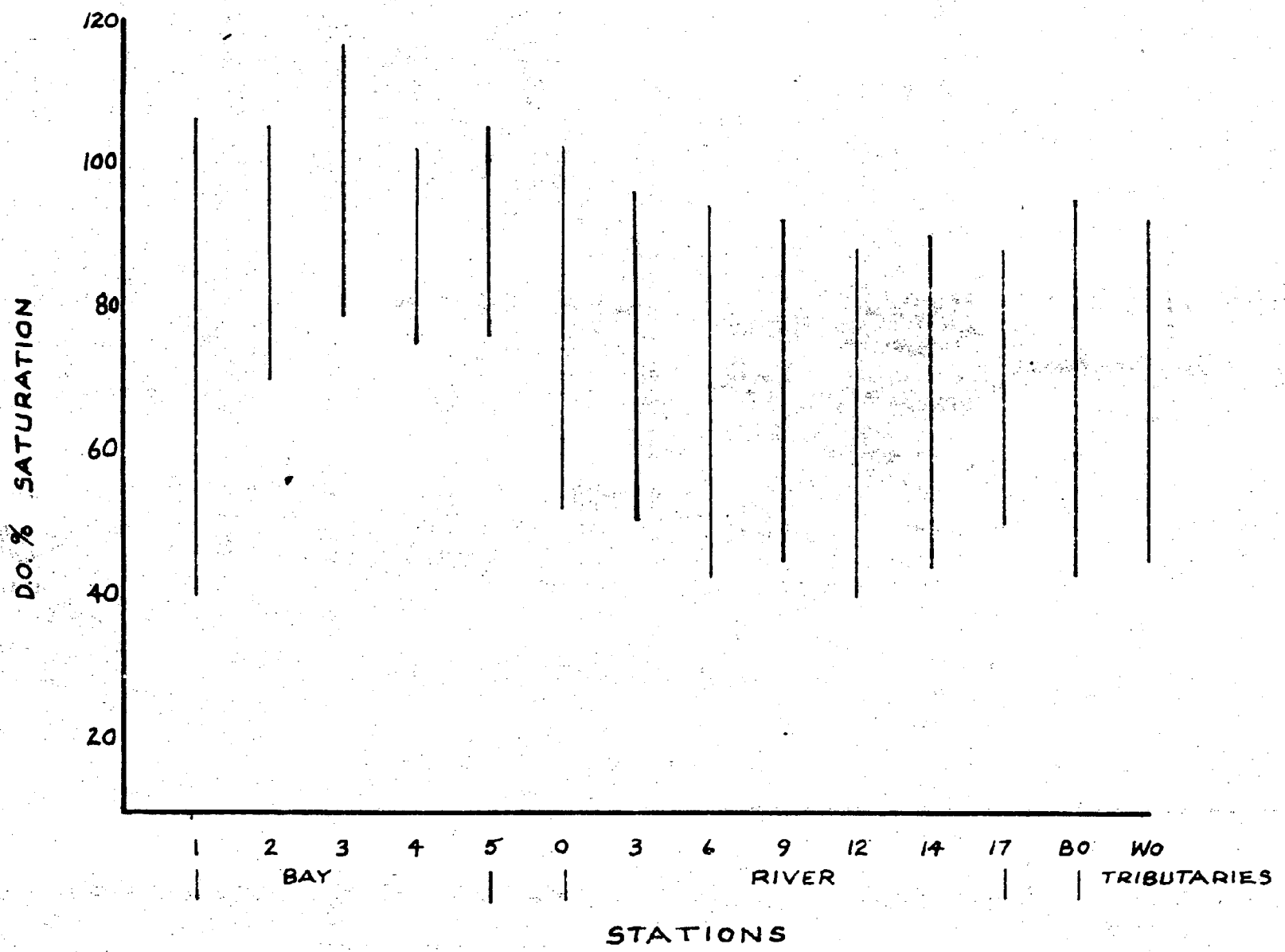


FIG. 7 12 HOUR TEMPERATURE RECORDING ON LITTLE EGG INLET, 8-21-69

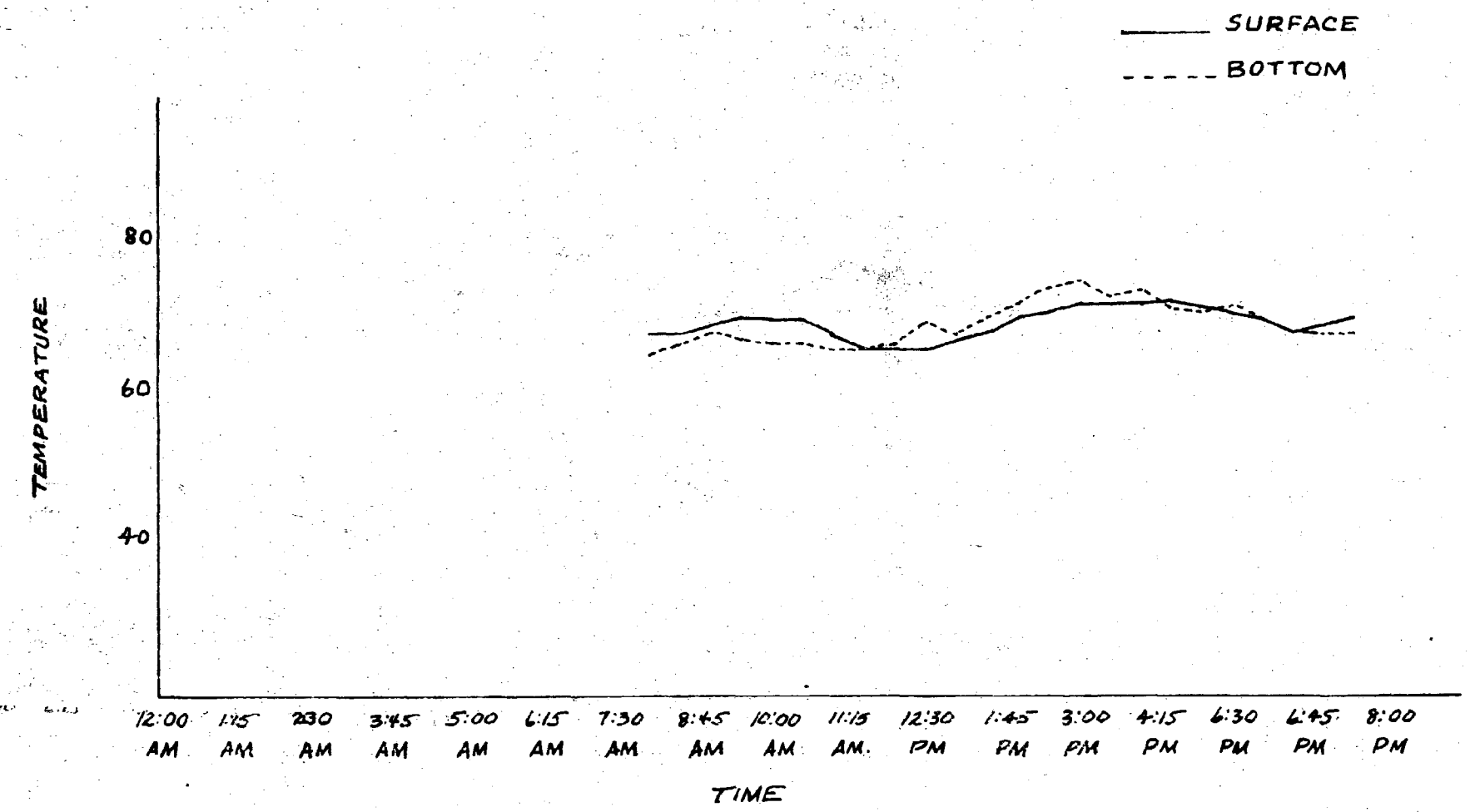


FIG. 8 12 HOUR SALINITY RECORDING ON LITTLE EGG INLET 8-21-69

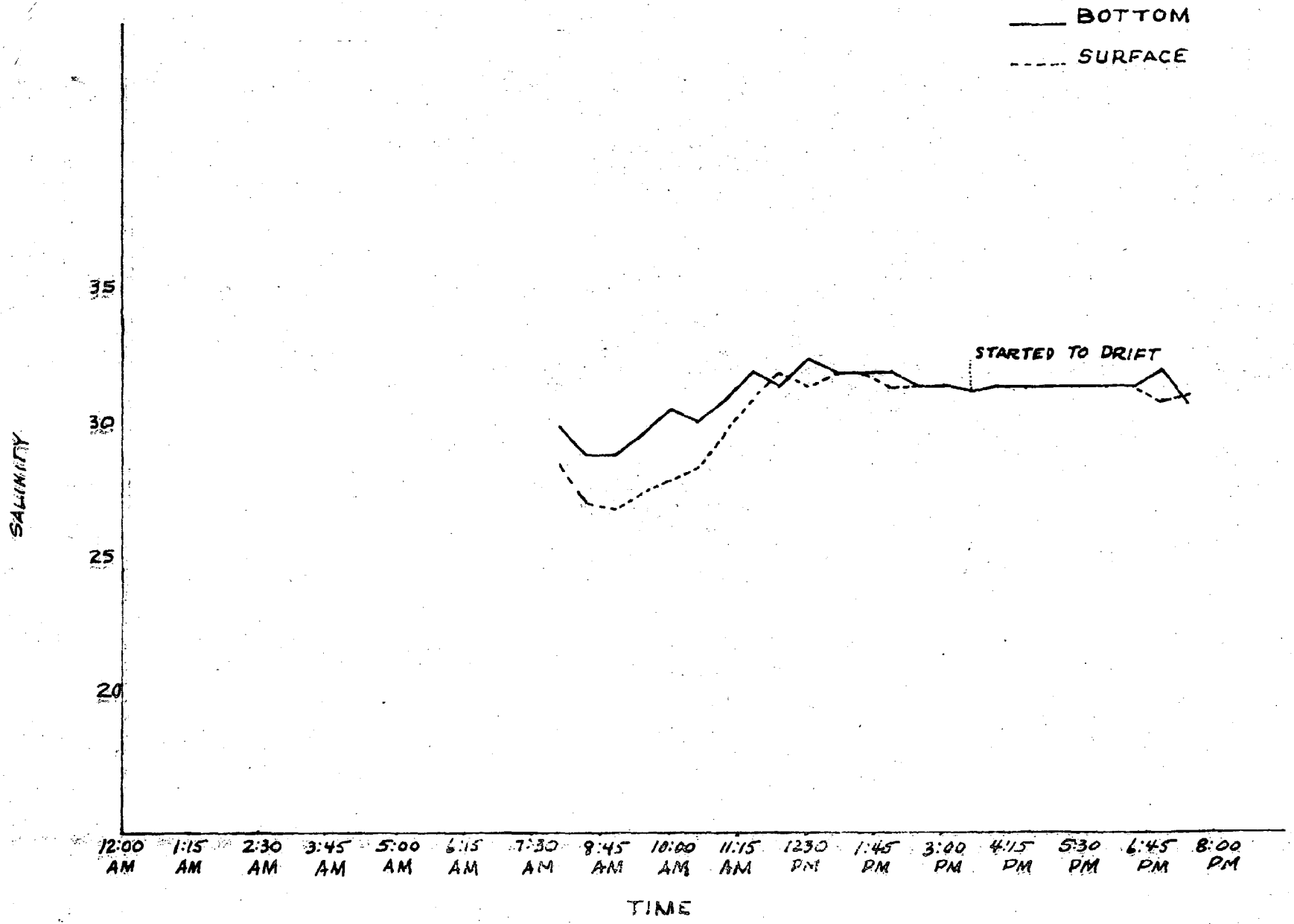


FIG. 9 FISH FACTORY
MONTHLY MEANS & EXTREMES

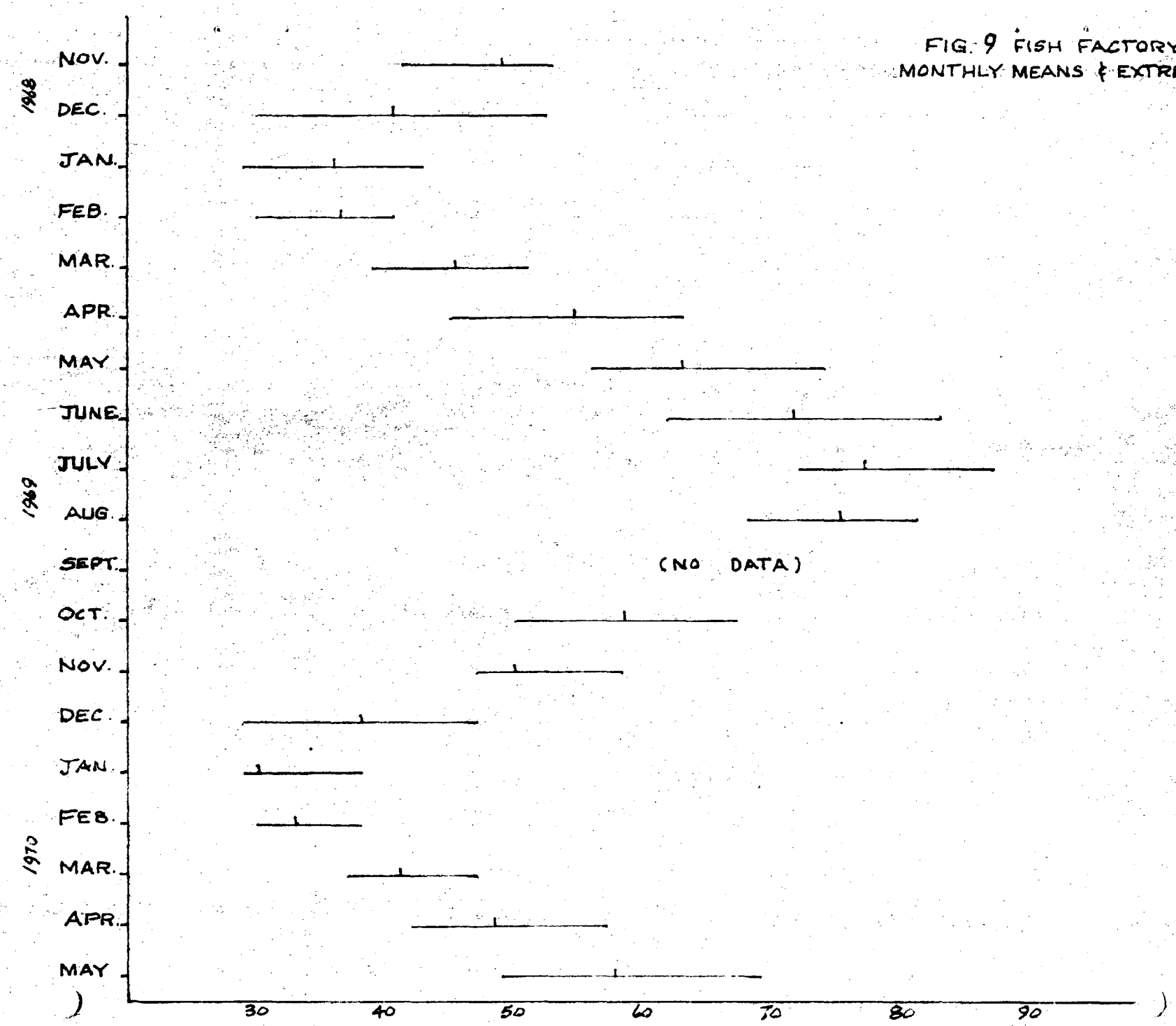


FIG. 10 OYSTER BED POINT
MONTHLY MEANS & EXTREMES

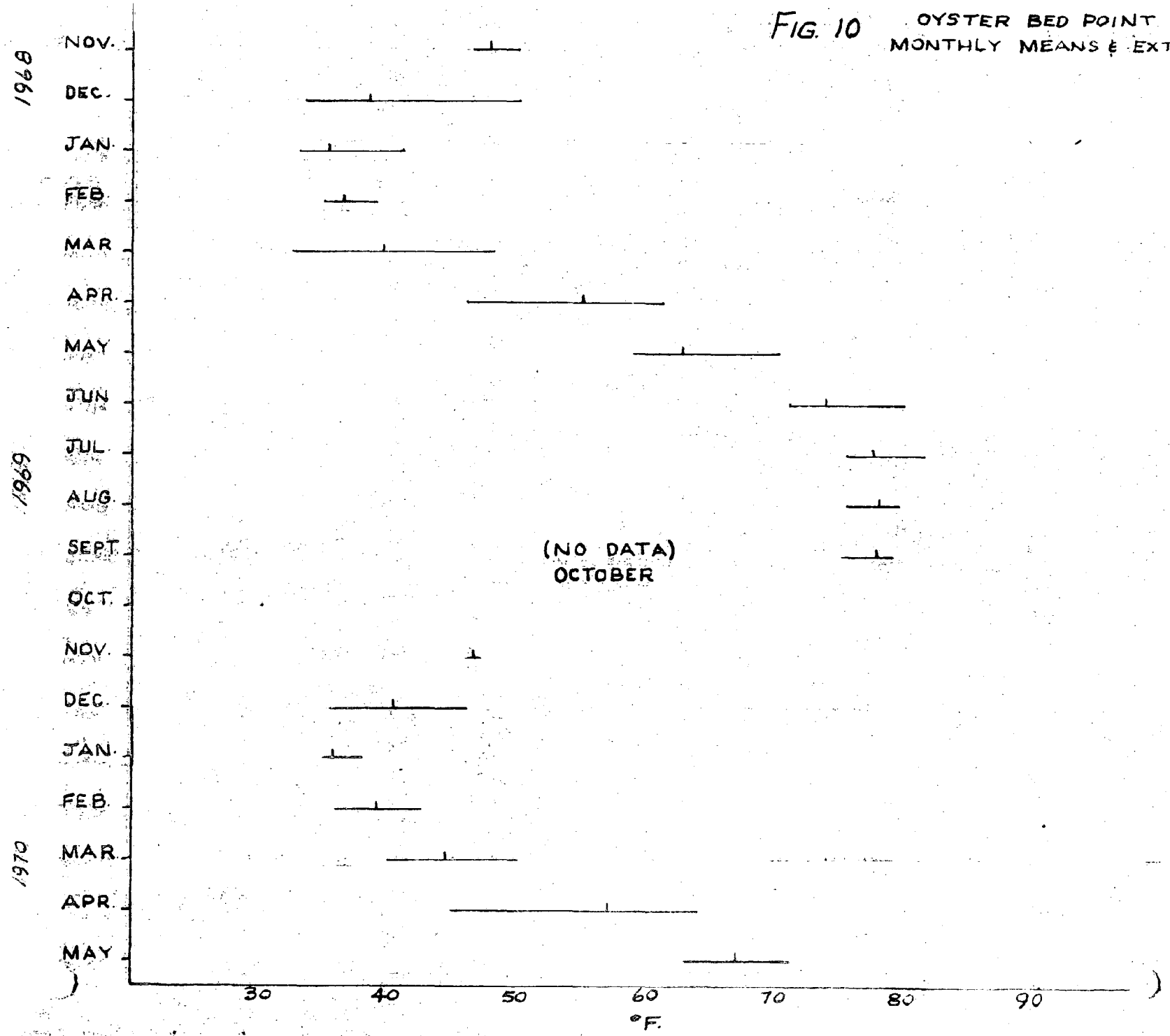


FIG 11

LOWER BANK
MONTHLY MEANS & EXTREMES

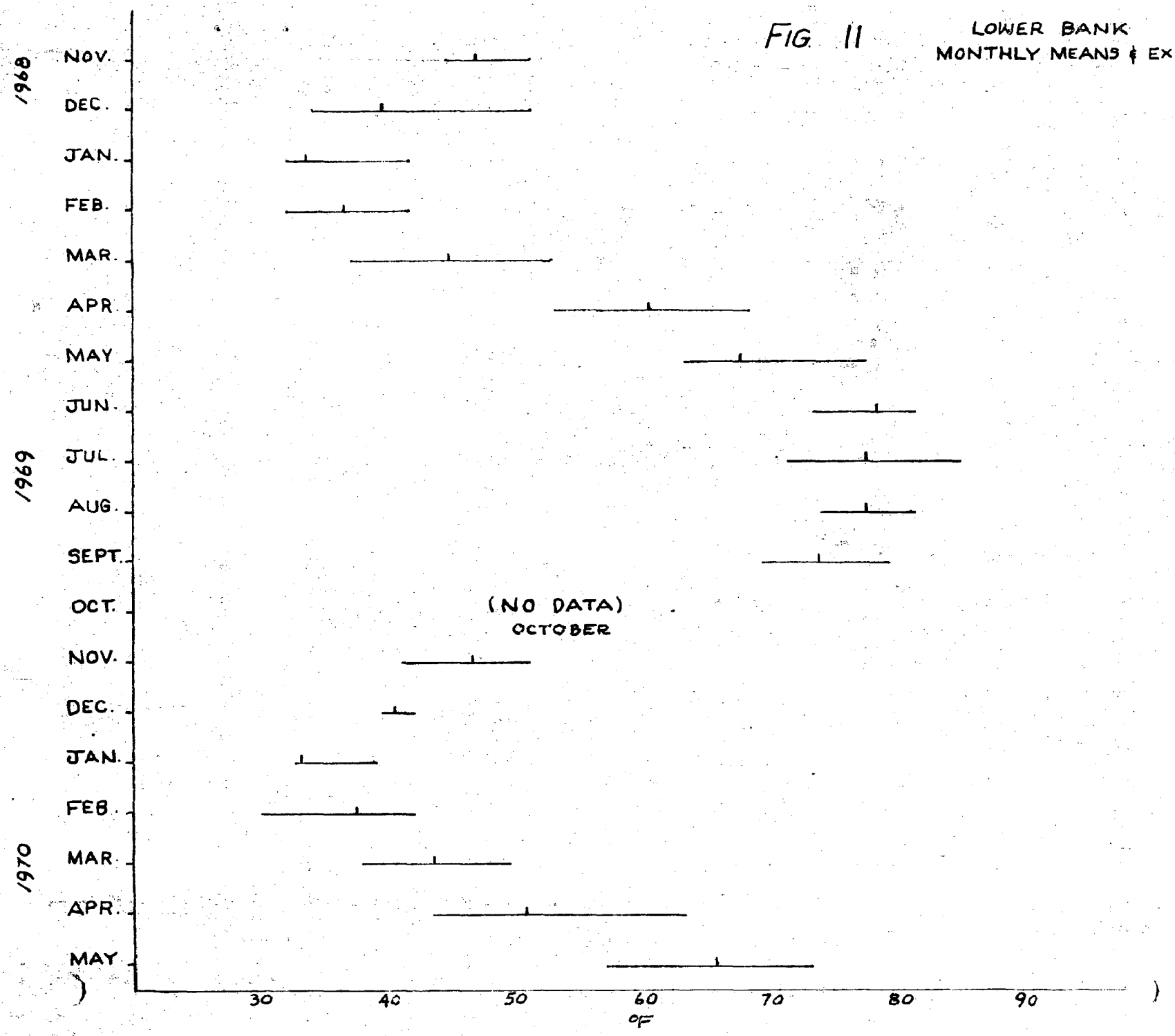


FIG. 12 MANASQUAN COAST GUARD
MONTHLY MEANS & EXTREMES

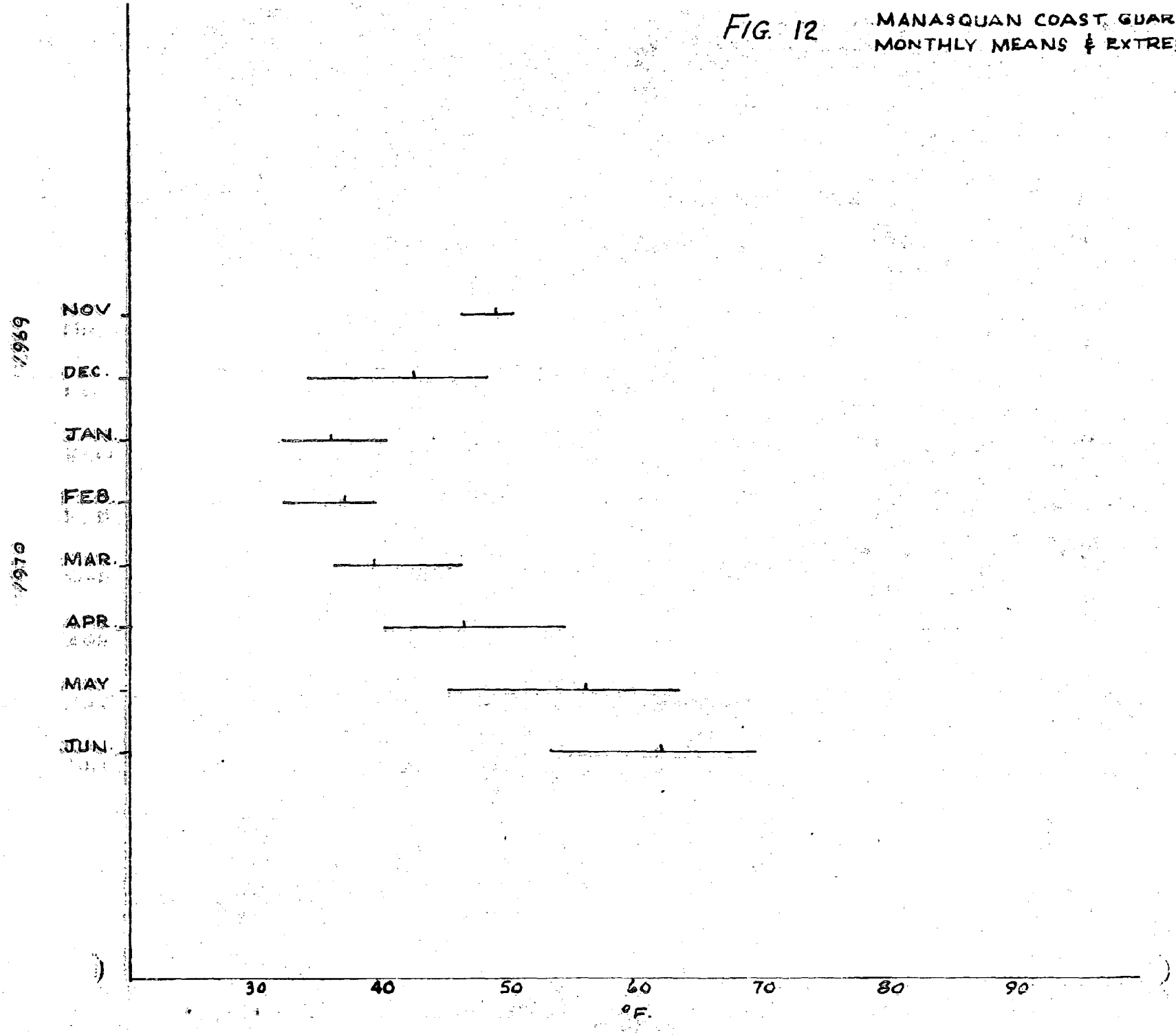
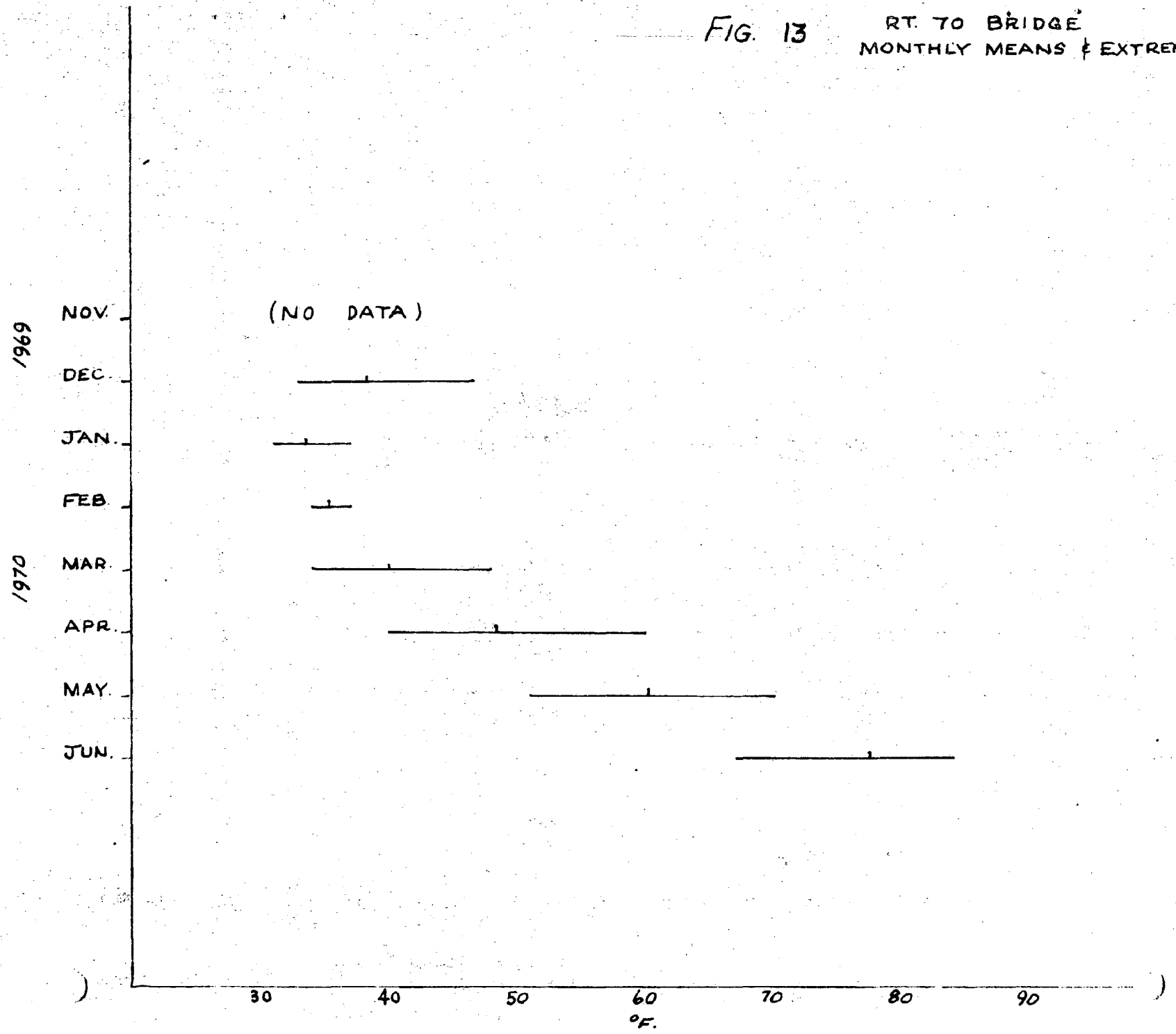


FIG. 13 RT. 70 BRIDGE
MONTHLY MEANS & EXTREMES



MONTHLY MEANS & EXTREMES

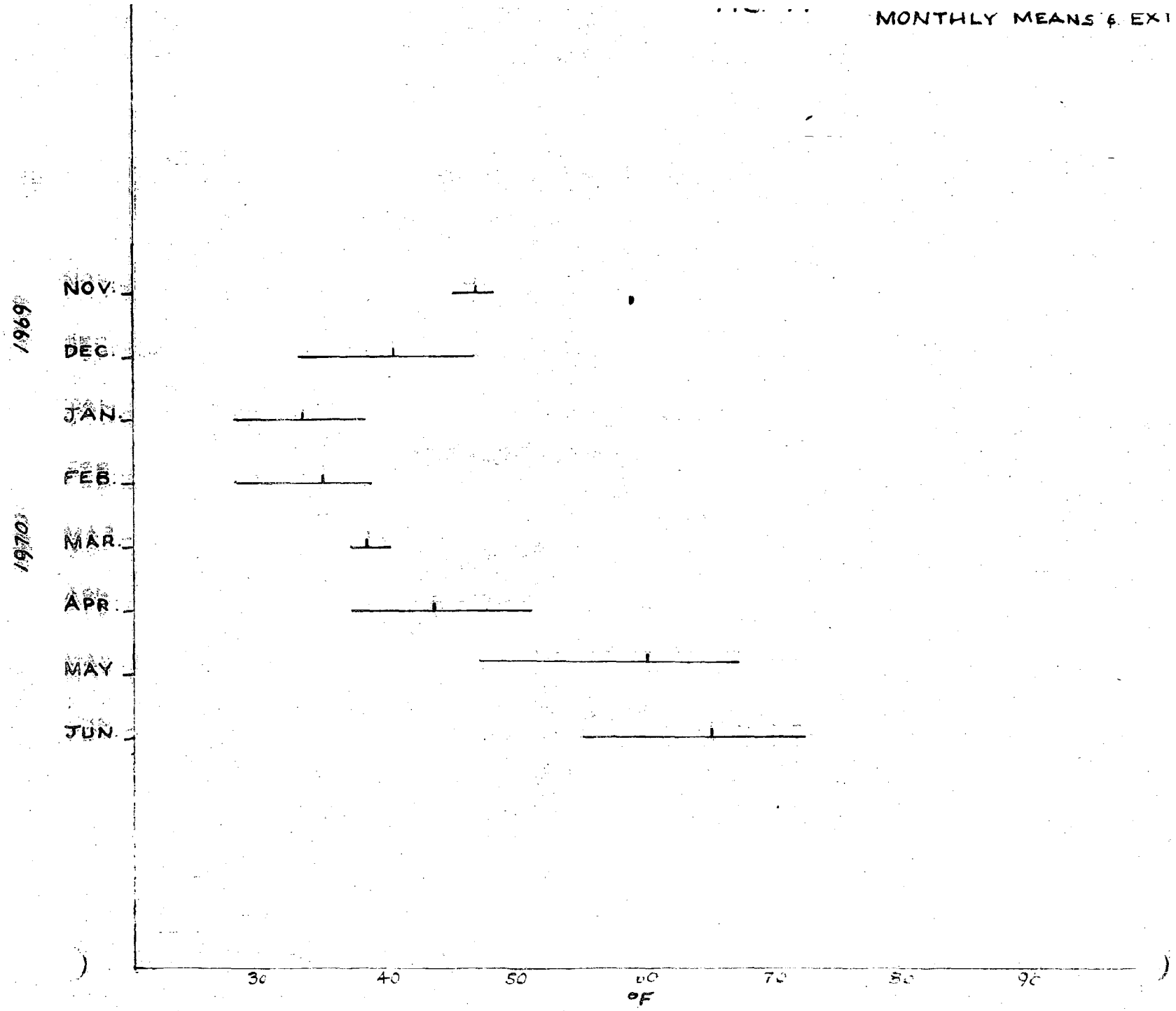


FIG. 15

STATION M1 HAYES
MONTHLY MEANS & EXTREMES

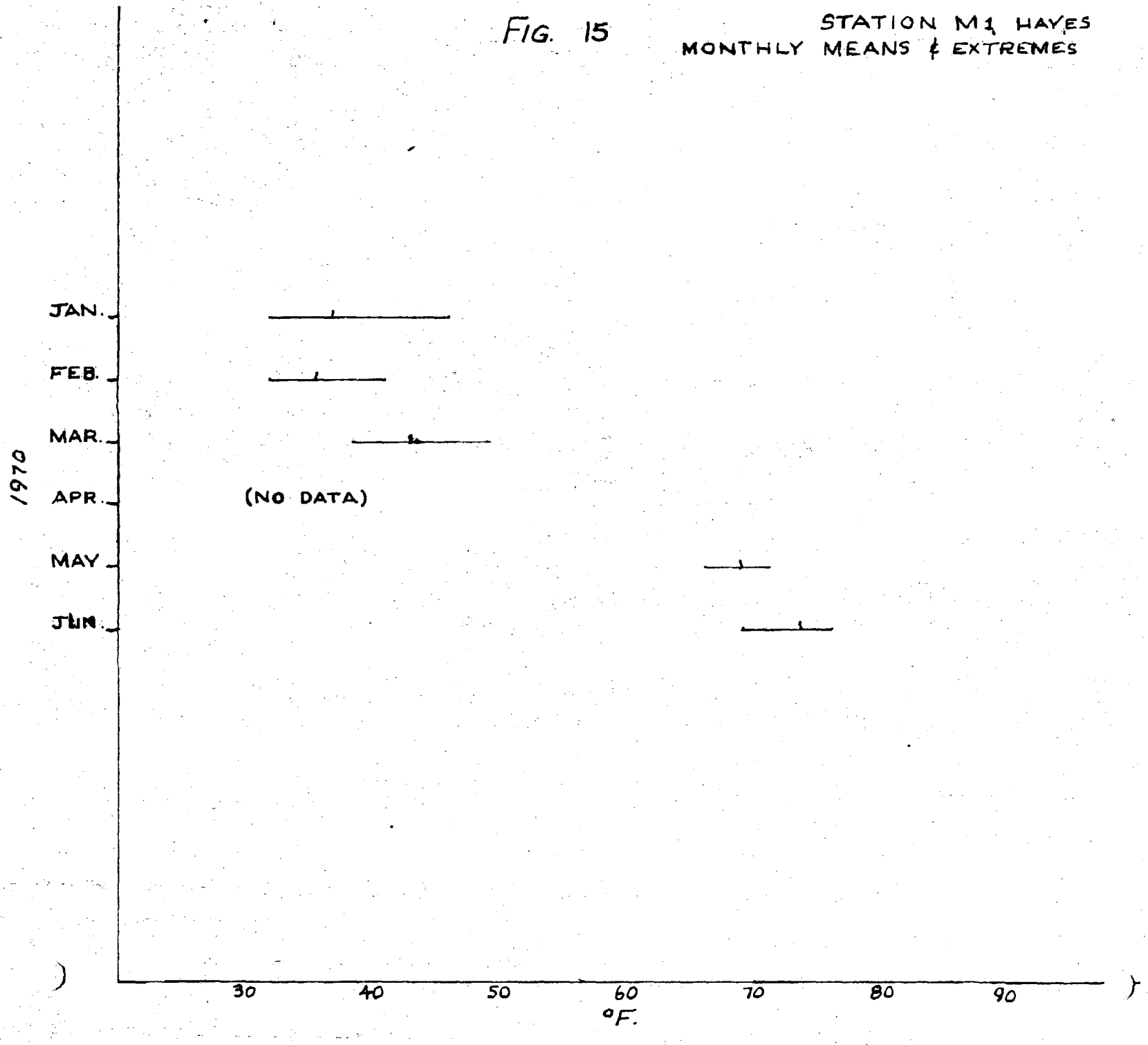


FIG. 16

MONTHLY MEANS & EXTREMES

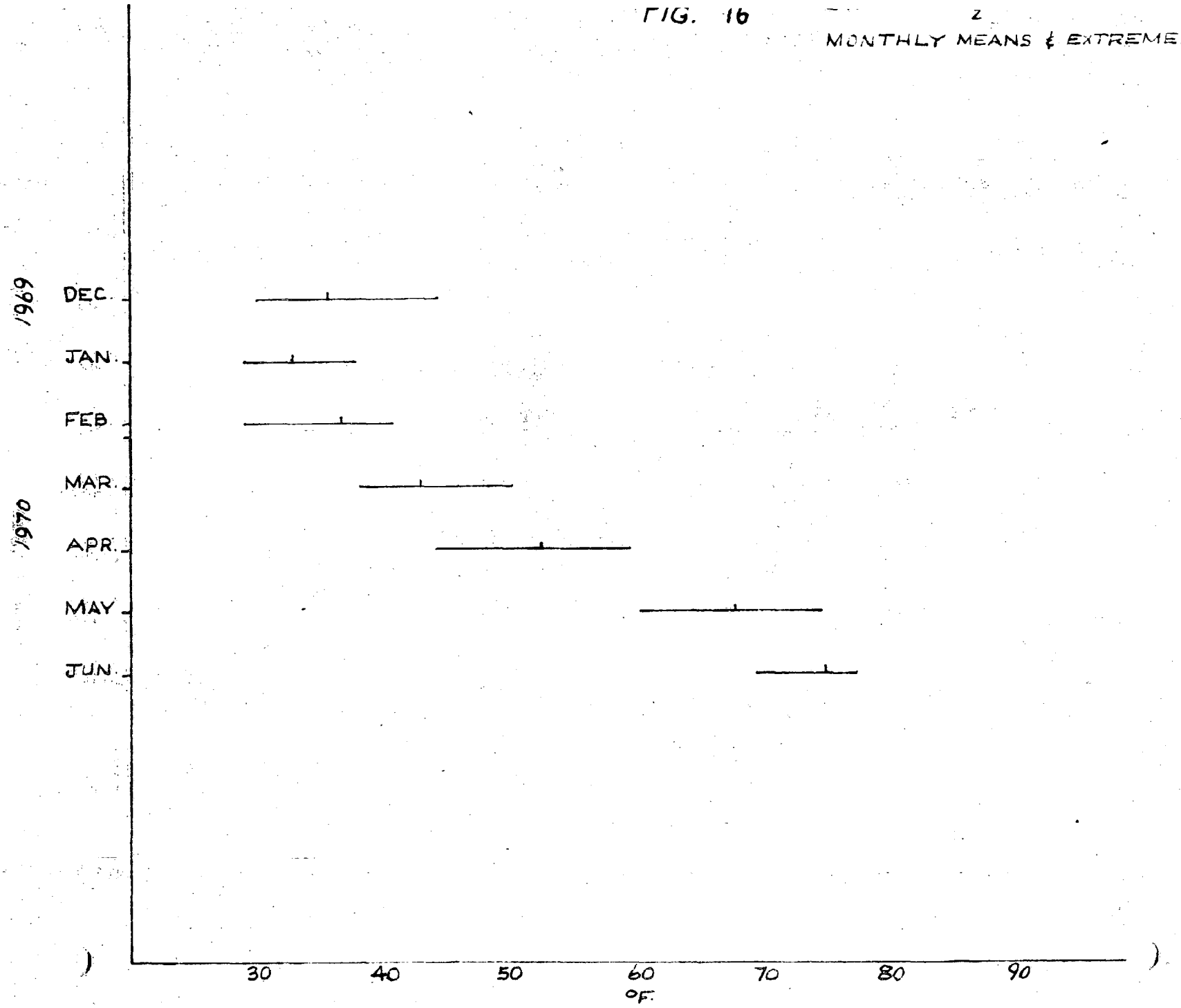
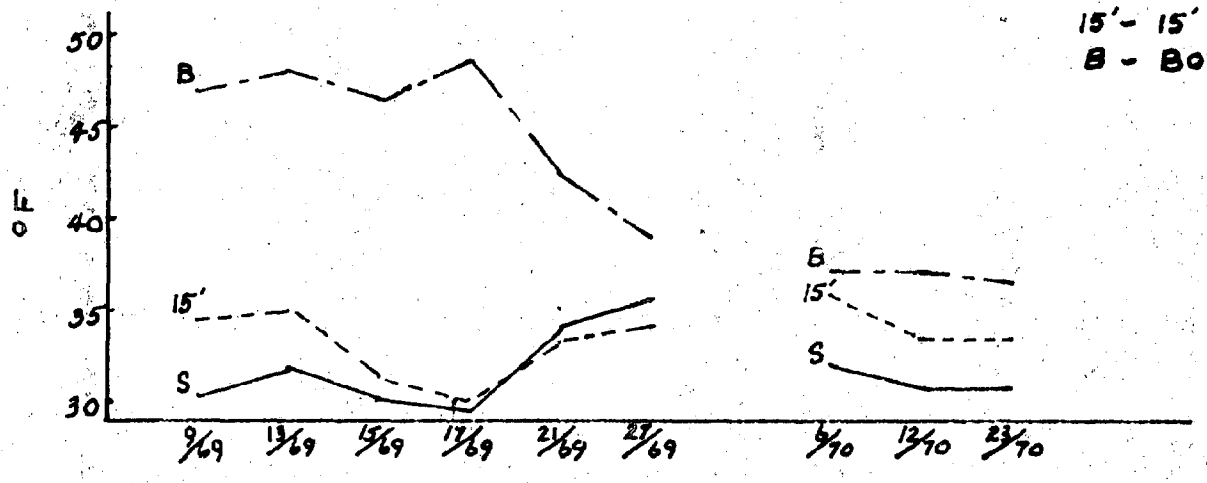
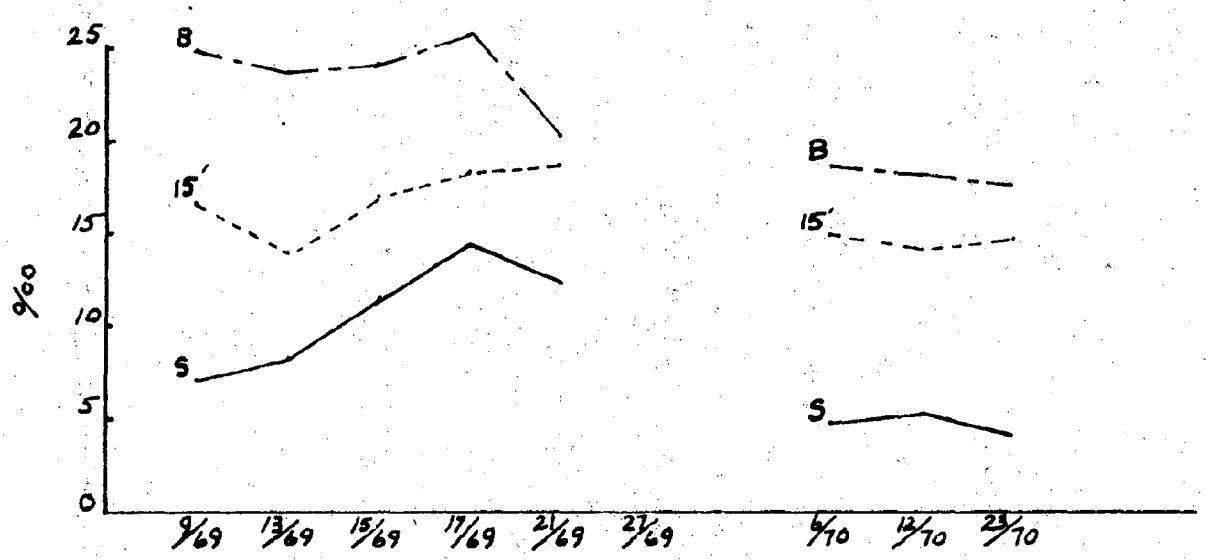


FIG 17 COLLINS COVE VERTICAL STUDY SURFACE, 15' AND BOTTOM
JANUARY 1969 AND 1970

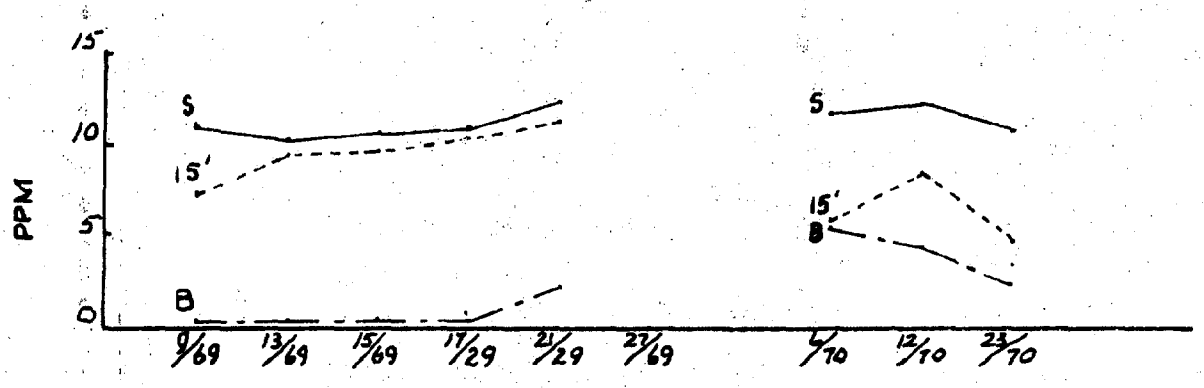
S - SURFACE
15' - 15' MARK
B - BOTTOM



TEMPERATURE



SALINITY



DISSOLVED OXYGEN

FIG. 18 MEAN SURFACE HYDRO TEMPERATURES OF GREAT BAY - MULLICA RIVER ESTURY AND ATLANTIC CITY STEEL PIER OCEAN TEMPERATURE FROM DECEMBER 1968 THROUGH MARCH 1970

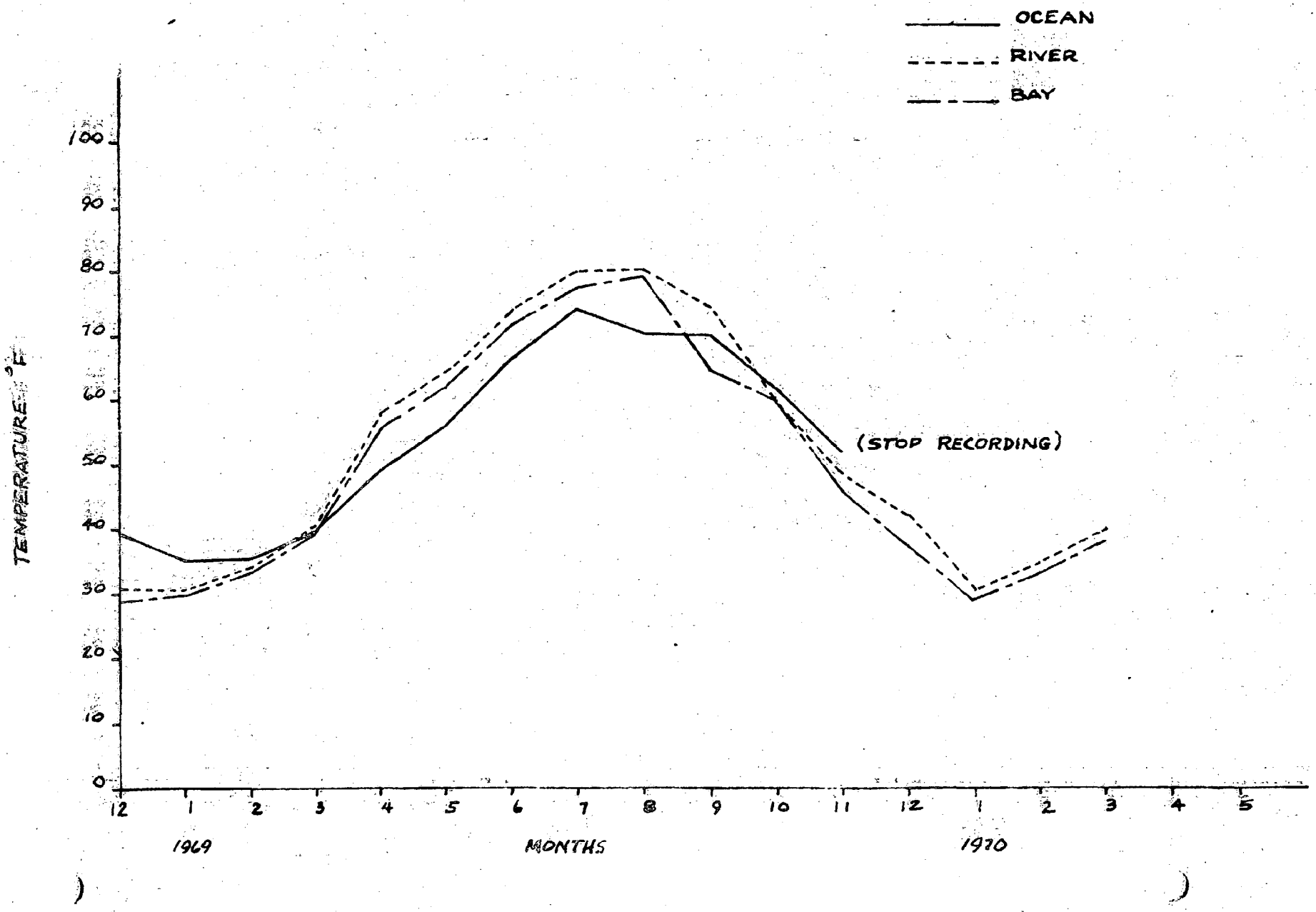
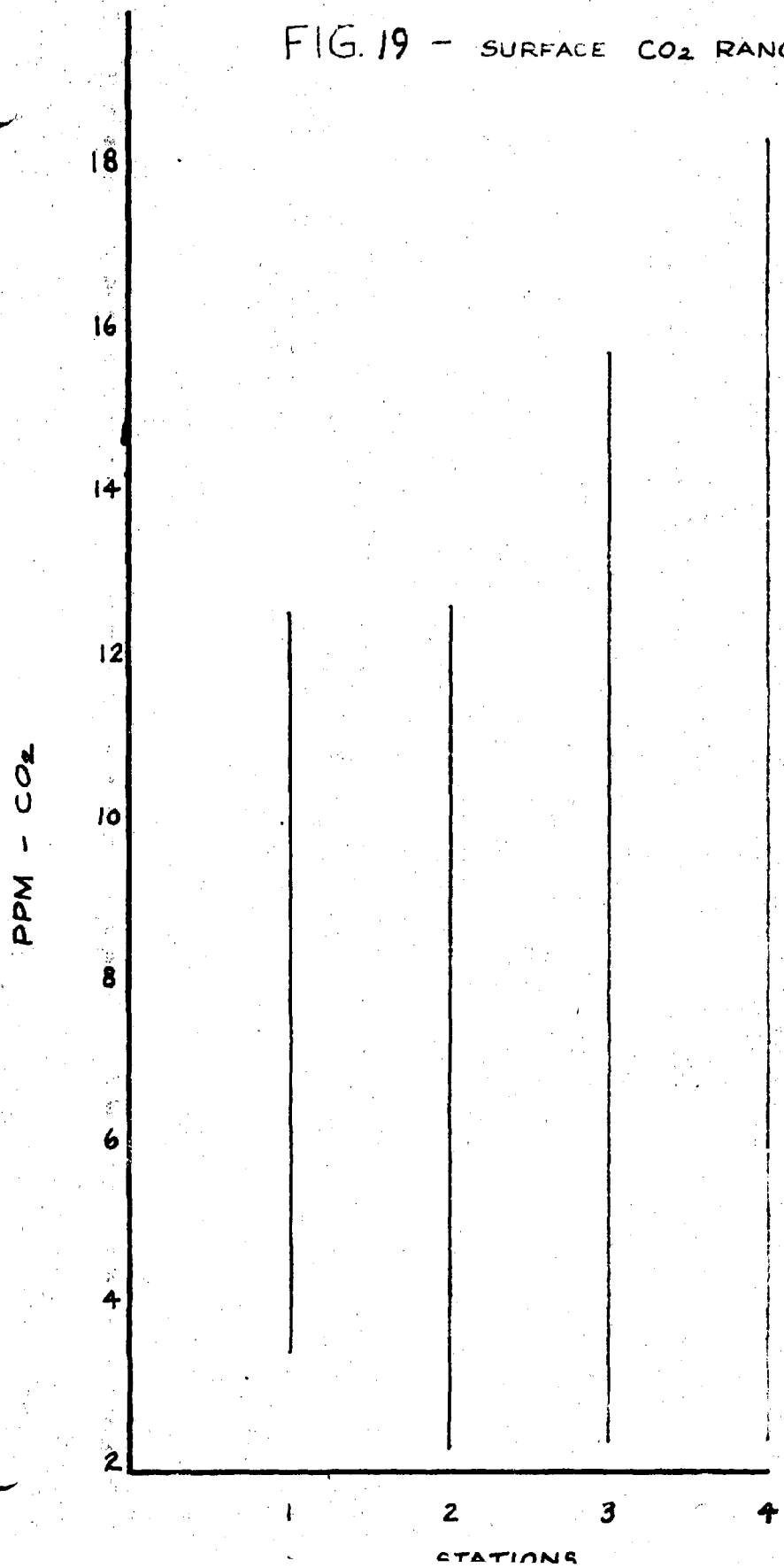


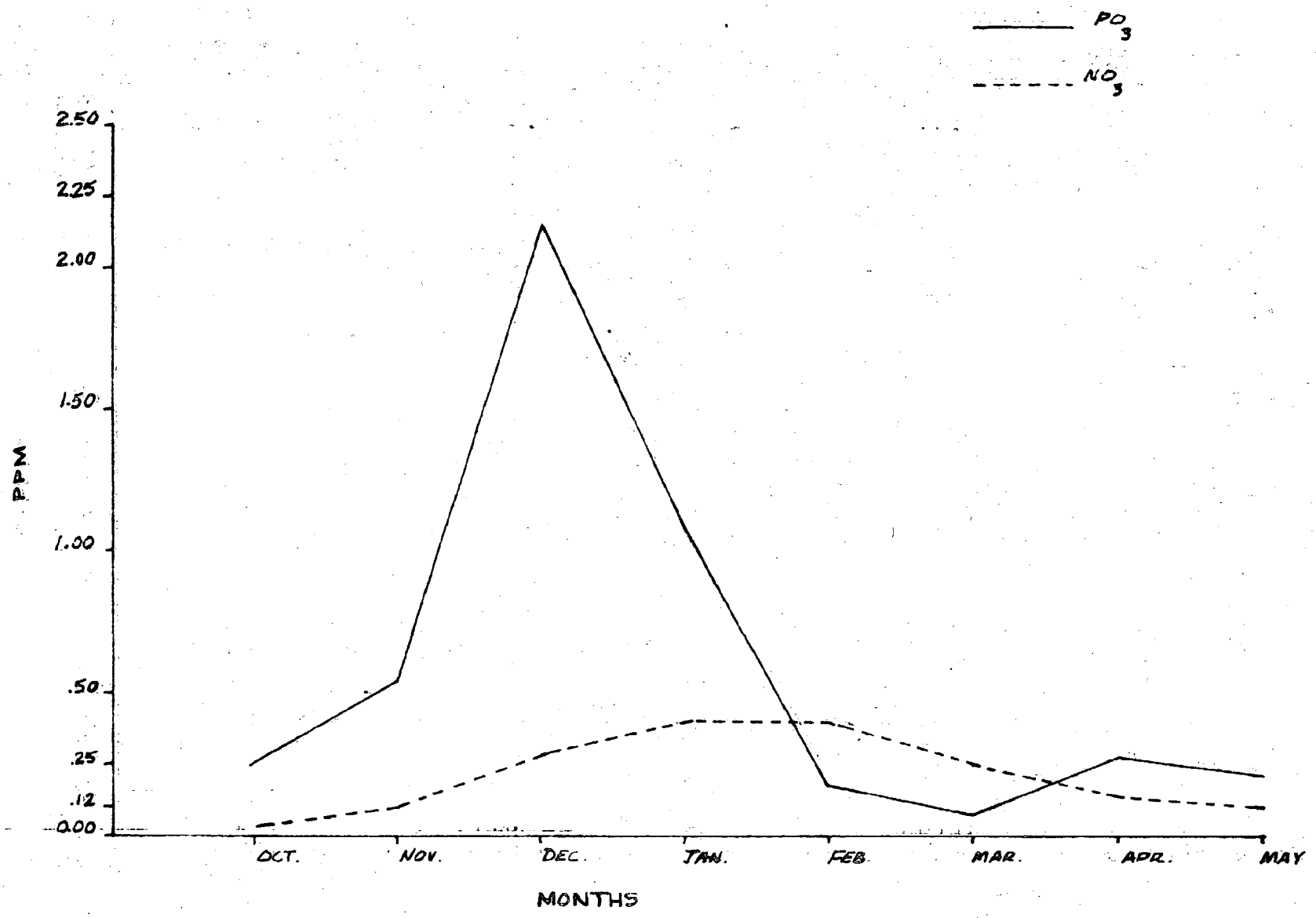
FIG. 19 – SURFACE CO_2 RANGE – MARCH 1969 – MARCH 1970

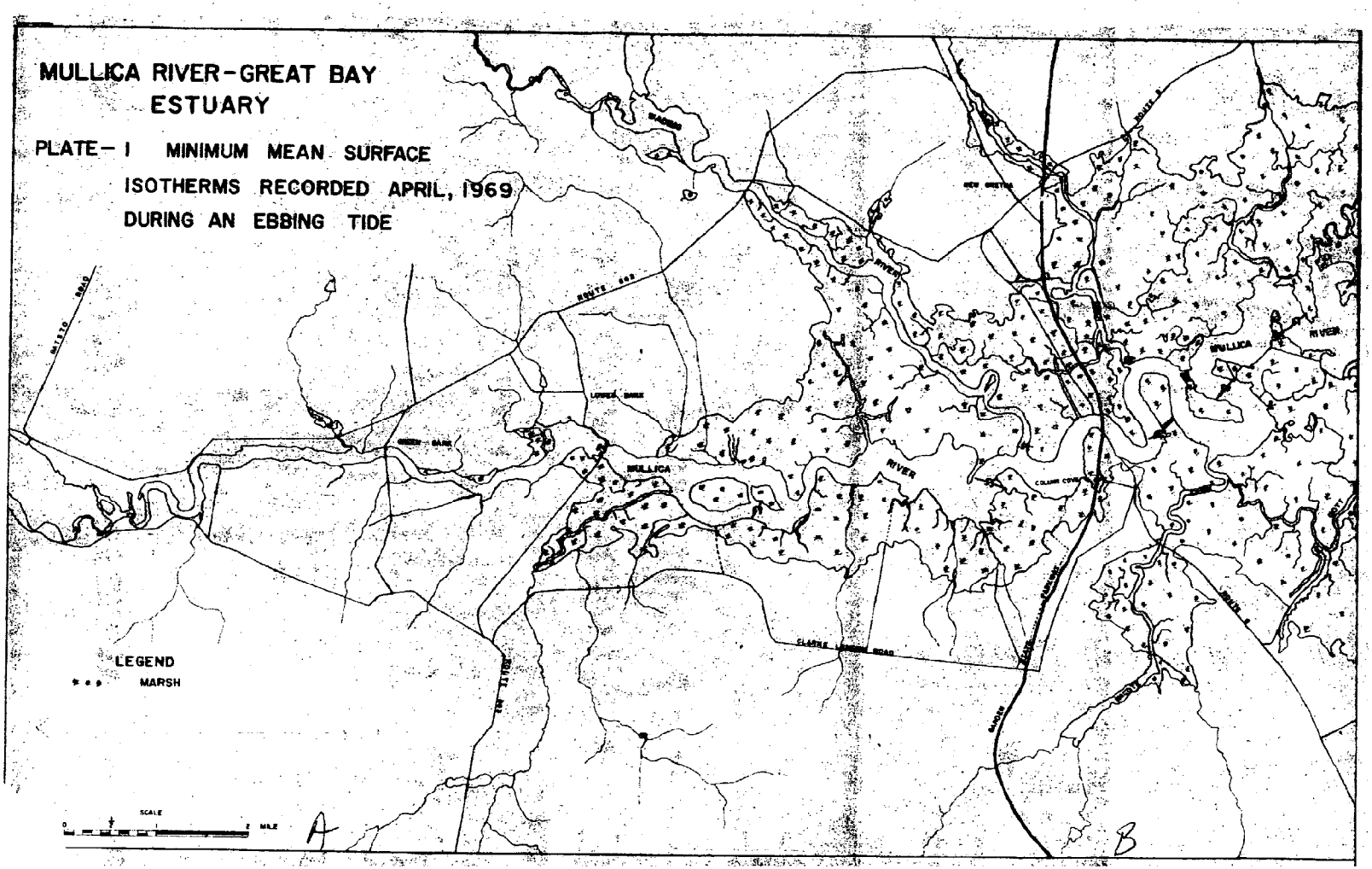


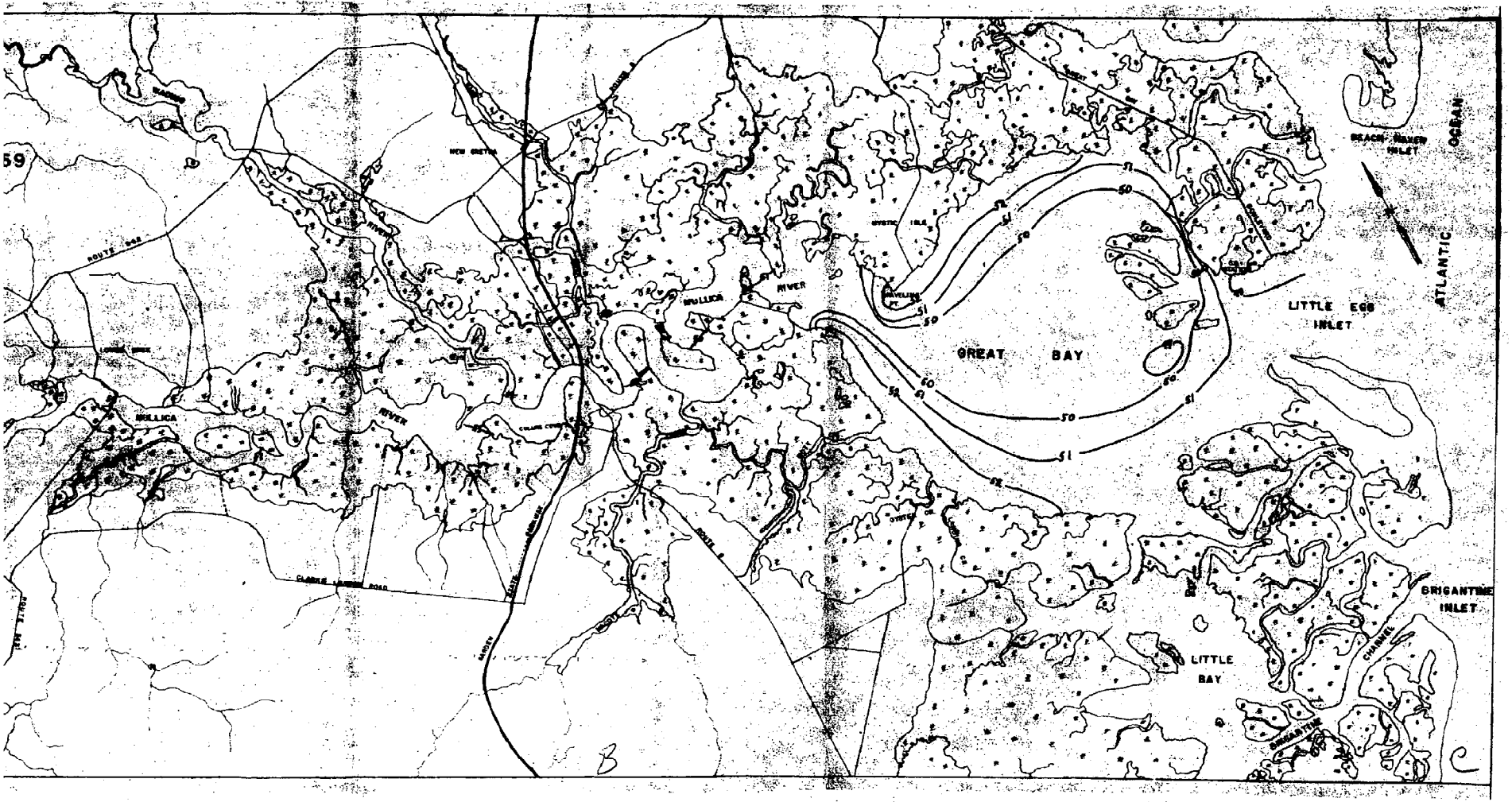
STATIONS

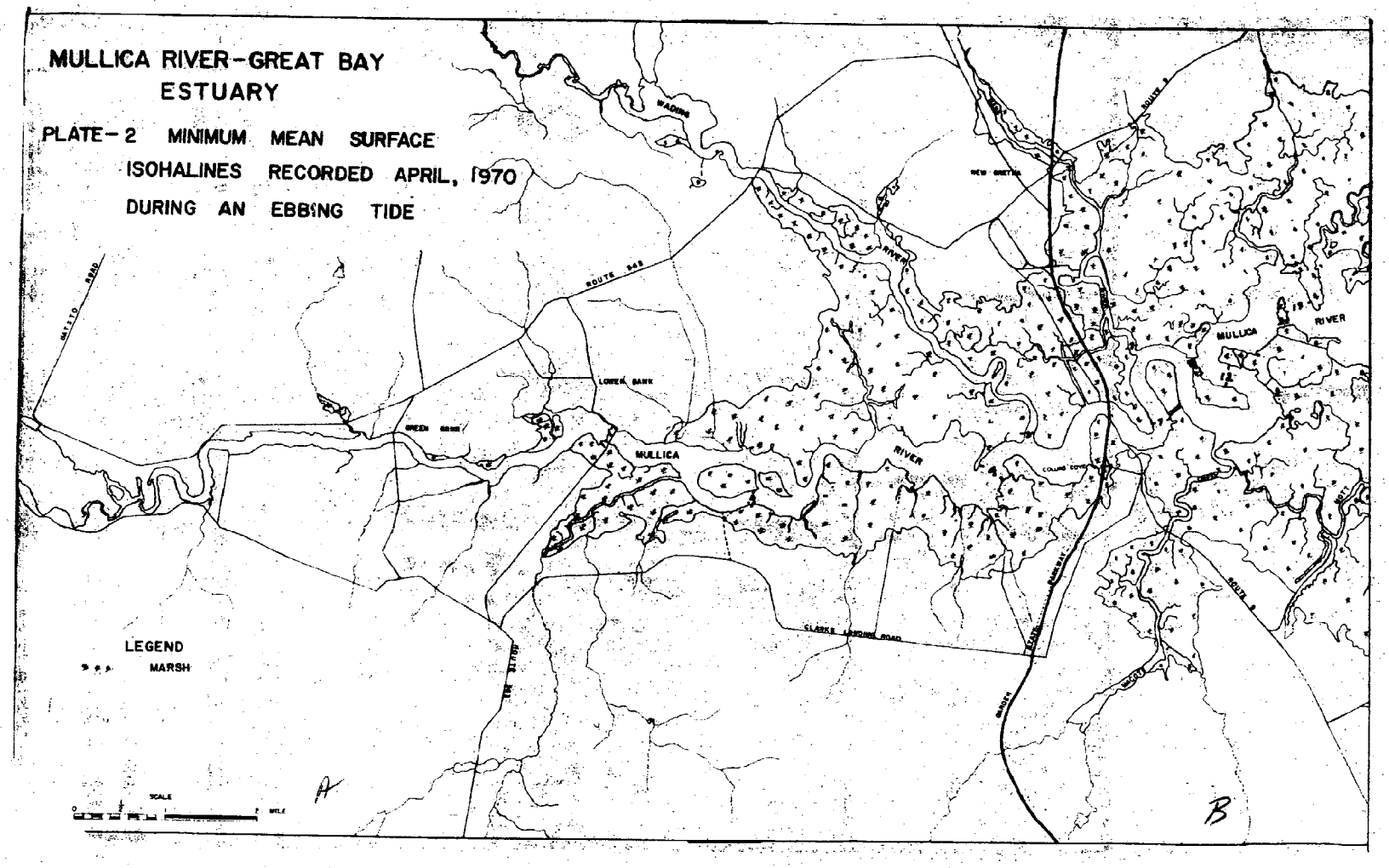
1. UPPER BAY – B-1, 2
2. LOWER BAY – B-3, 4, 5
3. DOWN RIVER – R-0, 3, B-0 R-6
4. UP RIVER – W-0, R-9, 12, 14, 17

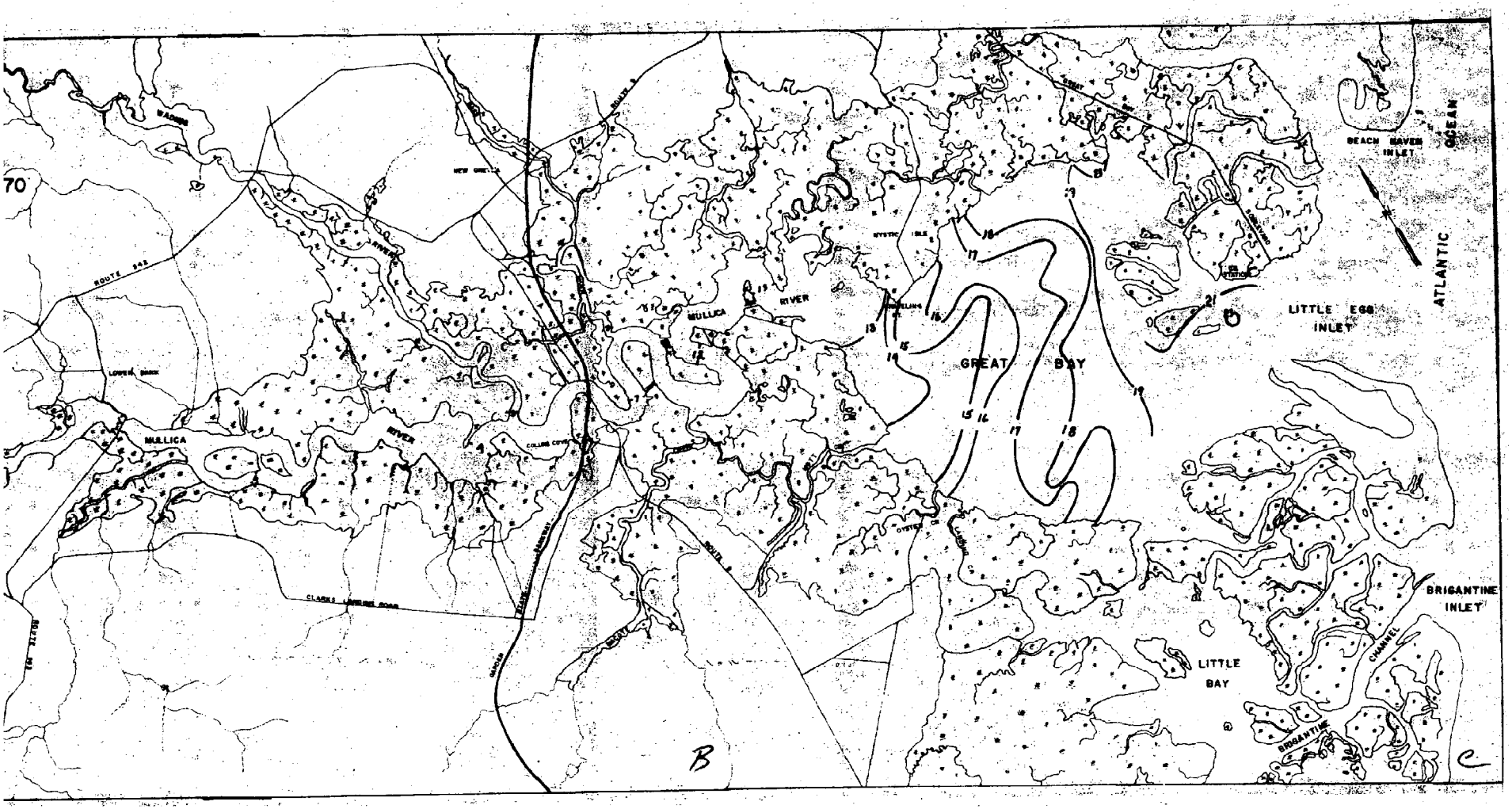
FIG. 20 NO_3 AND PO_3 CYCLE IN THE SURFACE WATERS OF GREAT BAY - MULLICA RIVER ESTUARY, 1969 AND 1970

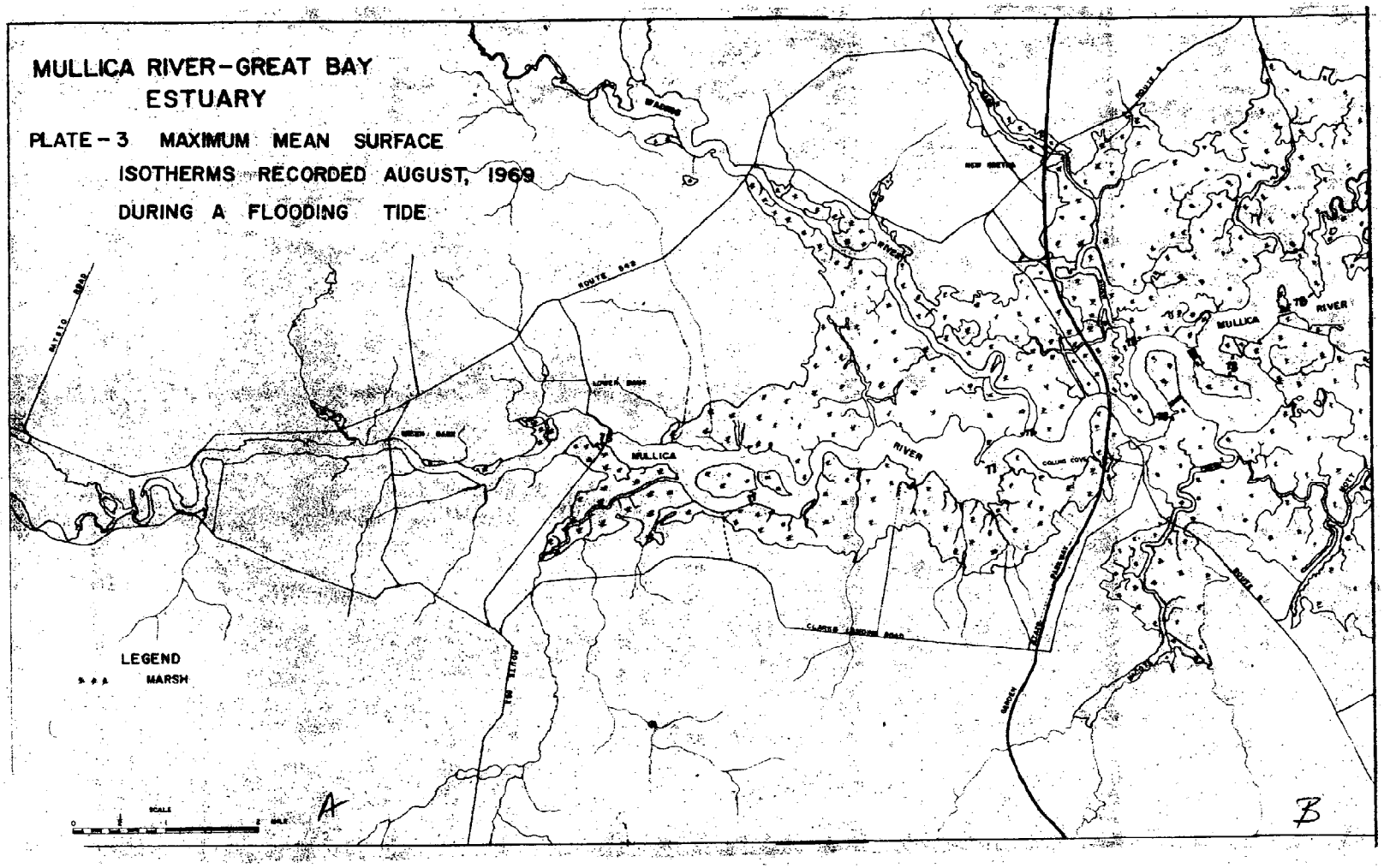


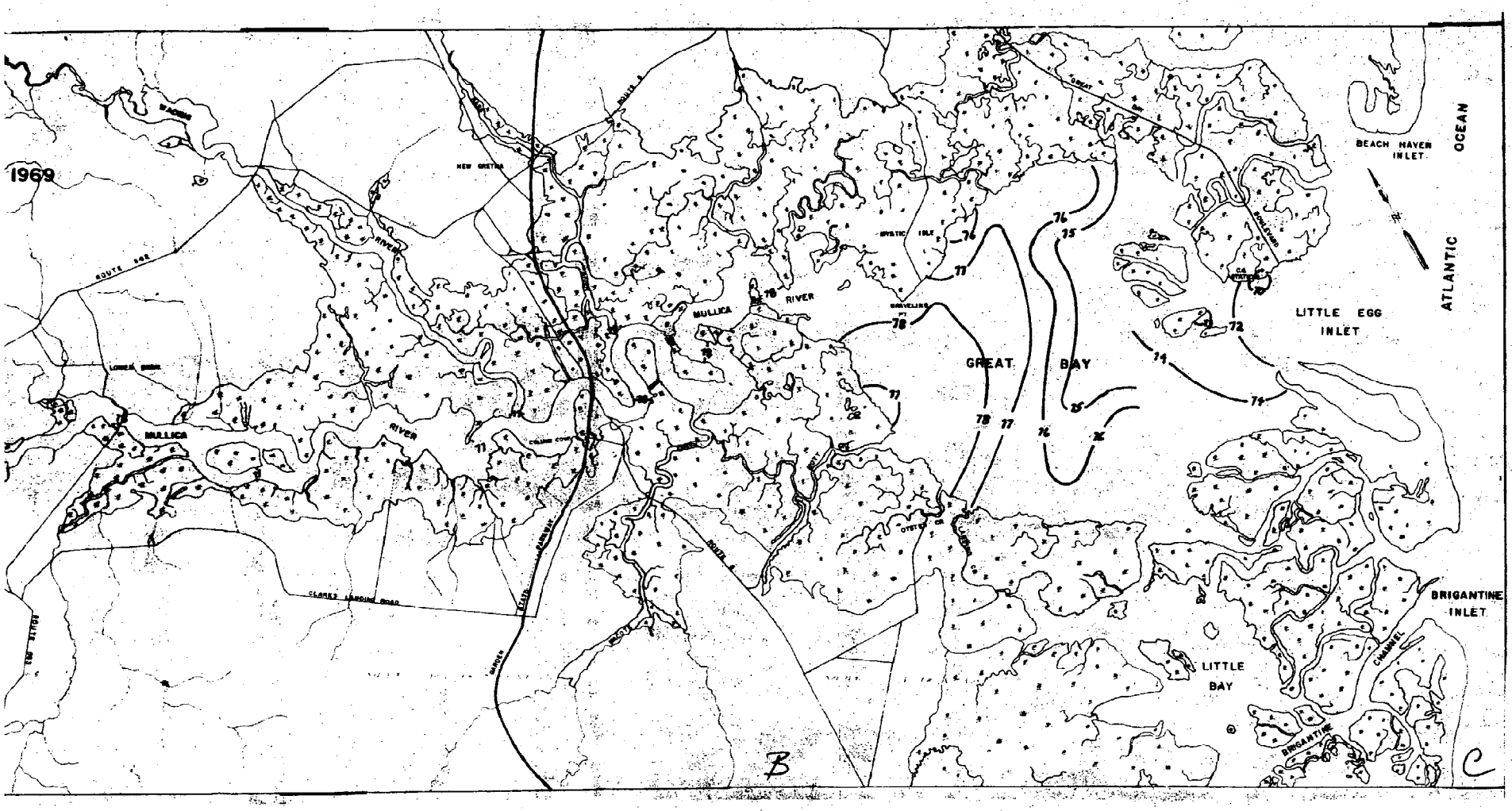

MULLICA RIVER-GREAT BAY
ESTUARY
PLATE- I MINIMUM MEAN SURFACE
ISOTHERMS RECORDED APRIL, 1969
DURING AN EBBING TIDE
LEGEND
MARSH
SCALE
MILE
A
B

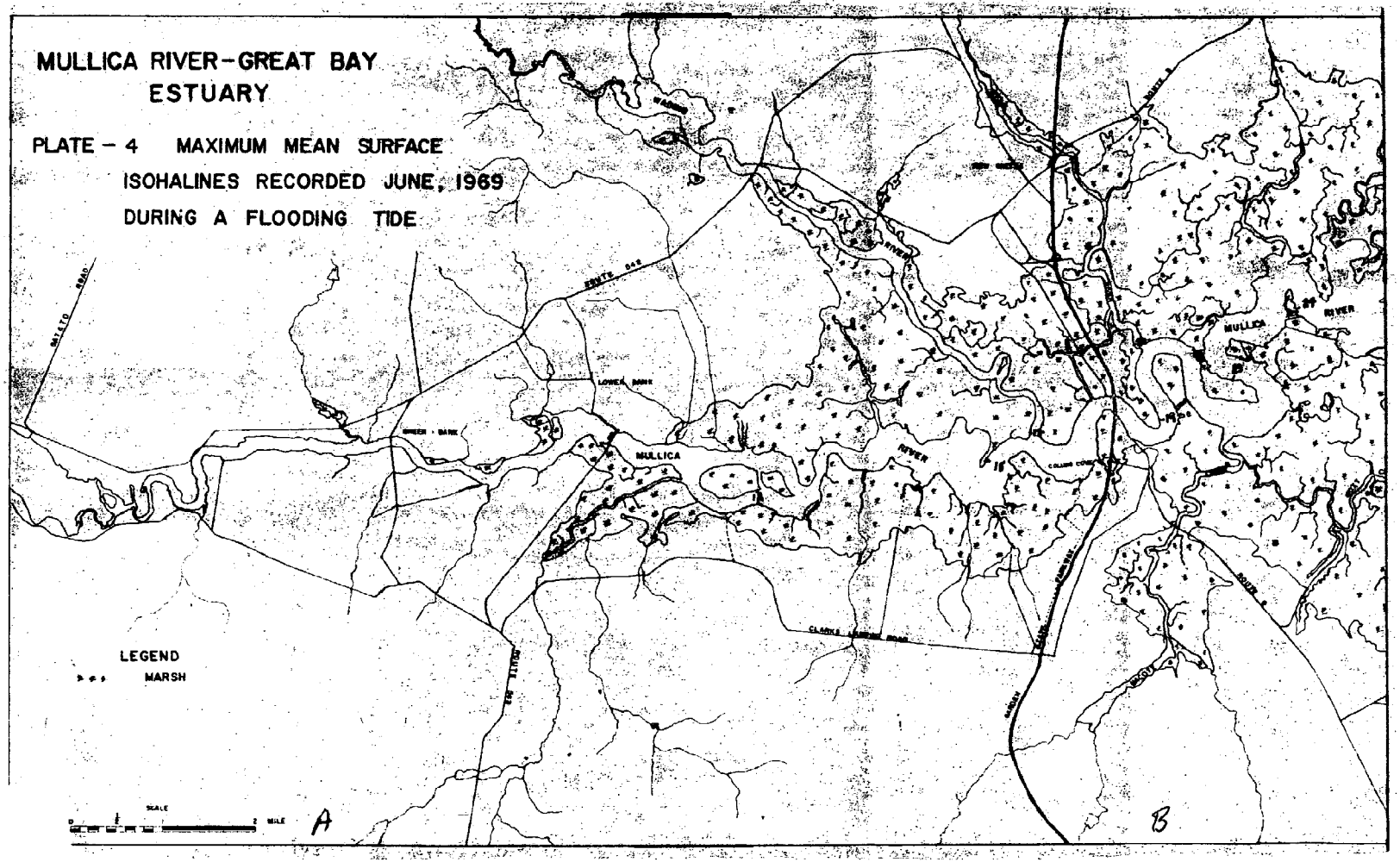

59
ROUTE 562
MULLICA
RIVER
NEW GRETNA
MULLICA
RIVER
GREAT BAY
LITTLE EGG INLET
BEACH HAVEN INLET
ATLANTIC OCEAN
BRIGANTINE INLET
LITTLE BAY
CHANNEL
B
C


MULLICA RIVER-GREAT BAY
ESTUARY
PLATE-2 MINIMUM MEAN SURFACE
ISOHALINES RECORDED APRIL, 1970
DURING AN EBBING TIDE
LEGEND
MARSH
SCALE
MILE
A
B
MULLICA
RIVER
ROUTE 543
LOWER BANK
GREEN BANK
CLARKE LANDING ROAD
COLLINS COVE
NEW GRETNA
WADING
ROUTE 9
ROUTE 542
GARDEN STATE PARKWAY


70
MULLICA
RIVER
GREAT BAY
LITTLE EGG INLET
ATLANTIC OCEAN
BEACH HAVEN INLET
BRIGANTINE INLET
LITTLE BAY
BRIGANTINE CHANNEL
B
B
C


MULLICA RIVER-GREAT BAY
ESTUARY
PLATE - 3 MAXIMUM MEAN SURFACE
ISOTHERMS RECORDED AUGUST, 1969
DURING A FLOODING TIDE
LEGEND
MARSH
MULLICA
RIVER
ROUTE 542
A
B


1969
NEW GRETNA
MULLICA
RIVER
MULLICA
RIVER
GREAT
BAY
LITTLE EGG
INLET
BEACH HAVEN
INLET
ATLANTIC
OCEAN
BRIGANTINE
INLET
LITTLE
BAY
BRIGANTINE
CHANNEL
CLARKS LANDING ROAD
ROUTE 542
ROUTE 8
B
C


MULLICA RIVER-GREAT BAY
ESTUARY
PLATE - 4 MAXIMUM MEAN SURFACE
ISOHALINES RECORDED JUNE, 1969
DURING A FLOODING TIDE
LEGEND
MARSH
SCALE
MILE
A
B
MULLICA
RIVER

LITTLE BAY
BRIGANTINE CHANNEL
BRIGANTINE INLET
LITTLE EGG INLET
ATLANTIC OCEAN
BEACH HAVEN INLET

Phase III. Use Studies
Paul E. Hamer

INTRODUCTION

Our survey of the use made of the Mullica River-Great Bay System was limited to the tidal waters and their adjoining marshland by practical limitations. A survey of the entire watershed was impossible since the cost of manpower would be prohibitive. Covering less than the entire watershed introduces problems of defining boundaries. The upland edge of the marsh is a clear-cut natural boundary, and the entire area within this boundary is open, making it easily observable from an aircraft. It is also the area that is most closely related to, and which has the greatest immediate effect upon, the estuarine resources. This study constitutes the most comprehensive one that has been focused on New Jersey's estuarine areas. A previous study (Younger and Hamer, 1954; Younger and Zamos, 1955) covered the marine sport fishery of the State in general but was not designed to reveal the extent of sport fishing in individual estuaries. Other studies, conducted in New Jersey, have concentrated on a particular sport or species. In the study herein described, we have endeavored to study all of the important recreational and vocational activities conducted within the study area throughout the year.

ACKNOWLEDGEMENTS

A number of individuals have been involved in this program. The study was begun by Charles Ritson, who was inducted into the Armed Forces shortly after the project began. Rodgers ... Todd conducted the work until his transfer from our Bureau. The survey was finally completed by John McClain. Russell Tilton assisted with field sampling during the entire study. Final analysis of the data

was carried out by the writer, with the assistance of Ferdinand Metzger.

METHODS

The man-days of activity expended in the project area were estimated from flight counts, while the estimated harvest was based on creel and bag checks. Sampling times and places were randomly chosen.

For each week of the survey (with the exception of January and February), two week days and one weekend day or holiday were randomly chosen for aerial surveys. During January and February three days per month, one weekend and two week days, were scheduled. The starting time for each of these flight days was also randomly chosen between the hours of 10 A.M. and 3 P.M., since this was shown to be the greatest activity period of the day (Briggs 1965).

Flights followed a predetermined path unless it was necessary to deviate to get complete counts. This occurred when large numbers of boats could not be counted on one pass, or when closer observation of marsh areas was necessary to find waterfowl hunters. The flight pattern generally adherred to began at Brigantine Channel. From there the observer flew to the town of Oyster Creek, then across the southern part of Great Bay to the Little Egg Coast Guard Station. He then flew to Graveling Point and up the Mullica River to the town of Green Bank, across country to the town of Wading River and down the Wading River, over the Bass River, over to and along Great Bay Boulevard to the mouth of Little Egg Inlet, completing the circuit. See Figure 1.

Flight time was generally a little more than one hour. An altitude of 200 feet was found to be generally desirable, but

occasionally lower or higher altitudes were used, depending on visibility and the kind of activity that was being enumerated at the moment.

To facilitate counting, the study area was broken up into readily definable sectors. Counts were made for each activity in each sector and recorded on a field sheet. The data was summarized on a monthly basis for each activity in each sector, with weekdays and weekend or holidays kept separate. Means for weekdays and weekend-holidays were then multiplied by the number of such days in the month on which no flights were made. This figure was added to the actual flight totals to arrive at an estimate for the month. The estimate is considered to be a minimal one, representing only the number of man-days during the peak use period. There is no doubt that individuals entered and left the study area both before and after the peak use period, but we know of no practical way of estimating this minor fraction of the total use figure.

Creel and bag checks were scheduled on the same days as flight counts, and on two additional randomly chosen days per week. Of these five days, three (randomly chosen) were spent interviewing boat fishermen and two interviewing bank fishermen, except during the hunting season when the number was reduced to two and one, respectively, and the other two days were devoted to hunter interviews. Bank fishermen interviews were scheduled by selecting the starting point on the route, and the starting hour (between 8 A.M. and 5 P.M.) randomly. For each party the interviewer recorded: time of interview, number of anglers, number of hours fished, the number of fish of each species taken, and the angler's place of residence. Enough parties were interviewed "just as they were leaving" to provide a

substantial estimate of the average number of hours fished per angler-day.

Boat anglers were interviewed for the same information as bank fishermen either when returning to a randomly chosen access point, which provided complete trip data, or on the water. It is felt that the incomplete interviews were the best way to include anglers who did not use the public access points in our survey.

The mean number of anglers per boat, derived from creel census data, was used to convert the boat counts obtained in the aerial survey to man-days of activity.

Hunters were interviewed at randomly chosen access points at the end of their day, for the same basic information as the fishermen were.

Harvest estimates were obtained by multiplying the average catch (or kill) per man-hour by the average number of hours per trip, and this figure was then multiplied by the appropriate activity estimate obtained by the flight count.

The following definitions were used in the study:

Bank fisherman - any individual fishing without a boat.

Boat fisherman - any individual fishing from a boat of any size or description.

Boating - any boat, the occupants of which were not obviously engaged in, or about to engage in, fishing, shellfishing, water skiing or hunting.

Catch/effort - average number of fish caught per hour spent fishing; fish per man-hour.

Fish/angler - average number of fish caught per trip; fish per man-day.

Other (Use) - activity that was unknown or which did not fit in one of the categories listed. Includes, but is not limited to, sightseers, bird watchers and other naturalists, non-fishermen attached to parties of bank fishermen, etc.

Shellfishermen - any individual harvesting clams, oysters, scallops or mussels.

RESULTS

Use Estimates

A total of 115 flights was completed out of 138 which were scheduled. The remaining 23 flights were cancelled because of unfavorable weather conditions. No adjustments were attempted in compiling the data. It would be reasonable to conclude that if counts could have been made on these days, they would have had a tendency to be lower than average because of weather conditions. By eliminating these low counts, the estimates derived from the remaining data would be increased slightly. Since we know that our estimates were lowered because of our inability to measure the early morning, evening and night activity, an increase resulting from the elimination of these low counts would be negligible.

Our monthly use estimates and their totals are presented in Table 1. It is interesting to note that fishing was by far the most important activity, accounting for 70% of the total. This is a minimal figure since we know that a substantial proportion of the boaters, the second largest category, were actually fishermen underway from one fishing ground to another or between fishing grounds and a landing. The monthly air count summaries upon which these estimates are based are presented in Tables 2 through 13. These Tables show the activity by sector for each month. Tables 14, 15 and 16

present the distribution of the three predominant activities, boat fishing, boating and bank fishing, by month and sector of the estuary in the original count form. The data indicate that Great Bay is by far the most popular boat fishing area, with the Lower Mullica River and the Brigantine Wildlife Refuge (actually, the portion of the Intracoastal Waterway which passes through the Refuge) of secondary importance. Bank fishermen preferred Great Bay Boulevard by a substantial margin. The Middle Mullica River was second but one must bear in mind the fact that two-thirds of the activity entered in this category was ice fishing in January. The Lower Mullica ranked third. Great Bay ranked most important in the boating category. Since it is known that a substantial proportion of the boaters are actually fishermen, one would expect a relationship between boat fishing areas and boating.

Our shellfishermen estimate is probably low because much of this activity is carried on at the lower half of the tidal cycle and only about half of our flights could be expected to fall during this period. As would be expected, the data show that this activity was pursued in the Great Bay and Brigantine Refuge sectors.

Waterfowl hunters were found to be difficult to count. Since the prevailing method of hunting involves attracting the birds with decoys to the hidden hunter, the skillful hunter is hidden from aerial observation by man or bird.

The estimated grand total of 129,698 man-days for all kinds of activity is no doubt low for the reasons already mentioned. It probably can be increased by 10 percent with little danger of over-estimating.

While these low estimates might be considered an indication

of serious shortcomings in our method, one must bear in mind the fact that a system designed to measure 'everything' must be a compromise and expected to fall short in some areas. The only alternative would be separate surveys, each of which would be focused on one or perhaps two closely related activities. Every effort will be made to improve our techniques in future surveys.

Harvest Estimates

Creel census results, expanded to the extent of our use estimates, indicate that about a million fish are taken by anglers from the Great Bay-Mullica Estuary in a year's time (Table 17). The catch composition, in terms of the numbers of fish actually censused and in percentages, is presented in Tables 18 and 19 for the boat fishery and the bank fishery, respectively. For boat fishermen, the blowfish made up more than half the total catch, followed by white perch, winter flounder, bluefish and striped bass, in that order. Bank fishermen (including ice fishermen) caught mostly white perch, with winter flounder, blue crabs, and blowfish following in descending order of importance.

Waterfowl hunters averaged about one bird per trip over the entire season. Actually, success was low early in the season, with the highest bird per trip ratio at the end of the season. This is shown by data in Table 20. The September data reflects conditions in 1969, but should not be considered typical. Clapper rail populations were at an extremely low level that year, and in addition, most of the birds moved south because of cool weather immediately after the season opened. The remaining hunting data is considered typical. Table 21 lists the species taken and the importance of each in the hunter's bag.

TABLE 1. Estimated Total Man-days for All Types of Activity by Month.

Month	Fishing		Boating	Shell-fishing	Bathers	Water Skiers	Hunters	Others	Total
	Bank	Boat							
January	(Ice)*3,605	-	-	25	-	-	-	-	3,630
February	30	36	*144	122	-	-	-	36	368
March	1,031	*1,586	410	84	-	-	-	88	3,199
April	2,603	*10,993	1,506	656	-	-	-	157	15,915
May	1,506	*10,442	2,030	1,159	-	-	-	152	15,289
June	776	*14,742	4,505	1,065	360	125	-	435	22,008
July	932	*15,768	4,375	1,518	383	99	-	385	23,460
August	1,356	*15,523	6,185	1,254	457	352	-	779	25,906
September	829	7,350	2,703	247	76	132	158	139	11,634
October	338	*1,969	1,409	353	-	-	421	140	4,630
November	485	502	516	254	-	-	*600	64	2,421
December	19	147	312	104	-	-	*616	40	1,238
Totals	Ice 3605	9,905	79,058	24,095	6,841	1,276	708	1,795	2,415	129,698 Man-days
Fishing Total		92,568							
Rank	5	3	1	2	4	8	9	7	6	

* Predominant Use for the month

TABLE 2. Monthly Flight Count Summary - January.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
*Ice Bank			*1150	100															1150	100
Boat																			0	-
Boating																			0	-
Shell-fish											3	100							3	<1
Bathers																			0	-
Water Ski																			0	-
Hunters																			0	-
Others																				
Total	0		1150		0		0		0		3		0		0		0		1153	
Percent	-		100		-		-		-		100		-		-		-			100

* Ice Fishermen

TABLE 3. Monthly Flight Count Summary - February.

	Mullica River						Wading River		Bass River		Great Bay				Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank									3	75					5	55.5		8
Boat			2	100									1	11.1				3
Boating	2	100			3	100			1	25			2	22.2			3	37.5	11
Shell-fish											8	100	6	66.6			5	62.5	19
Bathers																			
Water Ski																			
Hunters																			
Others							2	100							4	44.4			6
Total	2		2		3		2		4		8		9		9		8		47
Percent		100		100		100		100		100		100		99.9		99.9		100	

TABLE 4. Monthly Flight Count Summary - March.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge*		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank			65	51.6	11	47.9					15	14.1			147	88.5			238	50.7
Boat	1	33.0	48	38.1	7	30.5			2	100	53	50.0	32	72.6	6	3.6			149	31.7
Boating	2	67.0	9	7.1	3	13.1					14	13.2	7	15.9	3	1.8			38	8.1
Shell-fish					2	8.7					15	14.1	3	6.8					20	4.3
Bathers																				
Water Ski																				
Hunters																				
Others			4	3.2							9	8.5	2	4.5	10	6.0			25	5.3
Total	3		126		23		0		2		106		44		166				470	
Percent		100		100		100				100		100		100		100				100

* Not included in this survey.

TABLE 5. Monthly Flight Count Summary - April .

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank	8	47.1	130	61.6	40	13.8	1	9.1	3	15	38	4.9	45	11.9	414	90			679	29.9
Boat	8	47.1	70	33.2	217	75.1	9	81.8	10	50	608	78.1	230	61.0	36	7.8	68	68.7	1256	55.3
Boating	1	5.9	7	3.3	32	11.1	1	9.1	7	35	30	3.9	78	20.7	10	2.2			166	7.3
Shell-fish											110	14.1	24	6.4			31	31.3	165	7.3
Bathers																				
Water Ski																				
Hunters																				
Others			4	1.9															4	0.2
Total	17		211		289		11		20		778		377		460		99		2270	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 6. Monthly Flight Count Summary - May.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank	6	40	140	65.1	117	49.1	10	55.5			22	3.1	4	0.8	228	69.1			527	22.7
Boat	3	20	57	26.5	79	33.2	5	27.8			476	67.6	399	80.9	37	11.2	145	50.8	1201	51.6
Boating	3	20	17	7.9	38	16.0	3	16.7	5	100	51	7.2	73	14.8	19	5.8	24	8.4	233	10
Shell-fish					3	1.3					154	21.9	16	3.2	1	0.3	111	38.9	285	12.3
Bathers																				
Water Ski																				
Hunters																				
Others	3	20	1	0.5	1	0.4									43	13.0	5	1.8	53	2.8
Total	15		215		238		18		5		703		492		328		285		2299	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 7. Monthly Flight Count Summary - June.

	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank	8	9.5	67	42.7	23	11.8	4	19.0	3	12	33	5.2			149	48.9	42	14.6	329	12.8
Boat	1	1.2	33	21	120	61.8	11	52.4			387	61.5	696	82.8	13	4.3	101	35	1362	53.1
Boating	32	38.1	40	25.5	46	23.7	6	28.6	22	88	98	15.6	141	16.8	19	6.2	16	5.6	420	16.4
Shell-fish					1	0.5					61	9.7	1	0.1			129	44.8	192	7.5
Bathers	18	21.4	3	1.9							43	6.8	4	0.5	41	13.4			109	4.3
Water Ski	11	13.1	1	0.6															12	0.5
Hunters																				
Other	14	16.7	13	8.3	4	2.1					6	1.0			83	27.2			120	4.7
Total	84		157		194		21		25		628		842		305		288		2544	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 8. Monthly Flight Count Summary - July.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank	18	31.0	41	29.9	9	5.8	7	58.3			5	0.7			183	55			263	10.9
Boat	3	8.6	42	30.7	100	64.5	2	16.7	1	9	421	64.7	574	86.8	22	6.6	142	35.8	1309	54.1
Boating	12	20.7	51	37.2	44	28.4	1	8.3	10	91	120	18.4	85	12.9	7	2.1	65	16.4	395	16.3
Shell-fish					1	0.6					66	10.1	2	0.3	2	0.6	193	48.6	264	10.9
Bathers	7	12.1			1	0.6					39	6.0			22	6.6			69	2.9
Water Ski	7	12.1	2	1.5															9	0.4
Hunters																				
Others	9	15.5	1	0.7			2	16.7							97	29.1			109	4.5
Total	58		137		155		12		11		651		661		333		397		2418	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 9. Monthly Flight Count Summary - August.

	Mullica River						ading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank	8	5.1	67	36.8	64	16.3	2	6.7	10	19.6			5	0.7	296	45.3			452	12.0
Boat	13	8.3	28	15.4	219	55.6	11	36.6	7	13.7	595	58.1	567	78.8	60	9.2	216	38.9	1716	45.5
Boating	41	26.1	55	30.2	107	27.2	15	50	29	56.8	245	23.9	141	19.6	52	8.0	66	11.9	751	19.9
Shell-fish					1	0.3					71	6.9	5	0.7	5	0.8	168	30.2	250	6.2
Water Ski	36	22.9	4	2.2	3	0.8	2	6.7			1	0.1					4	0.7	50	1.3
Bathers	18	11.5									107	10.5			46	7.0			171	4.5
Hunters																			0	0
Others	41	26.1	28	15.4					5	9.8	4	0.4	3	0.4	194	29.7	102	18.4	377	10.0
Total	157		182		394		30		51		1023		721		653		556		3767	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 10. Monthly Flight Count Summary - September

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank	5	11.1	29	33.6	10	6.3	1	7.7							171	53.4			216	13.5
Boat	1	2.2	20	23.2	116	72.5			4	33.4	356	68.7	233	82.2	30	9.4	86	51.2	846	52.7
Boating	22	48.8	29	33.6	32	20.0	3	23.1	8	66.6	80	15.4	47	16.6	8	2.5	21	12.5	250	15.6
Shell-fish					2	1.3					66	12.7	2	0.7			57	33.9	127	7.9
Bathers	3	6.7									16	3.1							19	1.2
Water Ski	7	15.5	1	1.2			3	23.1											11	0.7
Hunters							2	15.4					1	0.4	15	4.7	4	2.4	22	1.4
Others	7	15.5	7	8.1			4	30.8							97	30.3			115	7.2
Total	45		86		160		13		12		518		283		321		168		1606	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 11. Monthly Flight Count Summary - October.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank			5	7.7	8	8									105	30.6			118	11.6
Boat			18	27.7	62	62	1	1.4	5	14.7	54	32.0	36	32.1	23	6.7	11	9.2	210	20.6
Boating	1	33.3	18	27.7	27	27	11	14.9	7	20.6	31	18.3	30	26.8	10	2.9	17	14.3	143	14.0
Shell-fish					1	1			1	2.9	84	49.7	5	4.5	1	0.3	17	14.3	109	10.7
Bathers																			0	0
Water Ski																			0	0
Hunters	1	33.3	19	29.2	2	2	62	83.8	10	29.4			40	35.7	160	46.6	74	62.9	367	36.0
Others	1	33.3	5	7.7					11	32.4			1	0.9	44	12.8			53	5.2
Total	3		65		100		74		34		169		112		343		119		1019	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 12. Monthly Flight Count Summary - November.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank					3	4.5									204	73.9			207	28.2
Boat			24	43.6	9	13.6					24	25.6	17	32.1	4	1.4	4	12.9	82	11.2
Boating	1	33.3	3	5.5	17	25.8	4	4.4	4	80	22	14.3	29	54.7	4	1.4	11	35.5	95	12.9
Shell-fish					4	6.1					105	68.2					14	45.7	123	16.8
Bathers																			0	0
Water Ski																			0	0
Hunters	2	66.7	27	49.1	32	48.5	87	95.6	1	20	3	1.9	7	13.2	39	14.1			198	27.0
Others			1	1.8	1	1.5									25	9.1	2	6.5	29	4.0
Total	3		55		66		91		5		154		53		276		31		734	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 13. Monthly Flight Count Summary - December.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bank			1	2.8	4	13.8									1	4.3			6	1.8
Boat			17	47.2															17	5.0
Boating			6	16.7	12	41.4			2	100	6	23.1	6	54.5			6	4.6	38	11.1
Shellfish											17	65.4	2	18.1	1	4.3	6	4.6	26	7.6
Bathers																			0	0
Water Ski																			0	0
Hunters	6	100	12	33.3	13	44.8	79	100			3	11.5	3	27.3	13	56.5	118	90.8	247	72.2
Others															8	34.8			8	2.3
Total	6		36		29		79		2		26		11		23		130		342	
Percent		100		100		100		100		100		100		100		100		100		100

TABLE 14. Distribution of Boat Fishing by Sector and Month.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
January																			0	0
February																			0	0
March	1	3.0	48	14.3	7	0.7	-	-	2	6.0	53	1.8	32	1.1	6	2.6			149	1.8
April	8	24.2	70	20.9	217	23.2	9	20.9	10	30.3	608	20.4	230	8.2	36	15.6	68	8.7	1256	15.5
May	3	9.1	57	17.0	79	8.5	5	11.7	-	-	476	16.0	399	14.3	37	16.0	145	18.6	1201	14.8
June	1	3.0	33	9.8	120	12.8	11	25.6	-	-	387	13.0	696	24.9	13	5.6	101	12.9	1362	16.6
July	5	15.2	42	12.5	100	10.7	2	4.7	1	3.0	421	14.1	574	20.5	22	9.5	142	18.2	1309	15.9
August	13	39.4	28	8.3	219	23.4	11	25.6	7	21.2	595	20.0	567	20.3	60	30.0	216	27.6	1716	20.9
Sept.	1	3.0	20	5.9	116	12.4	-	-	4	12.1	356	12.0	233	8.3	30	13.0	86	11.0	846	10.3
Oct.	-	-	18	5.4	62	6.6	1	2.3	5	15.1	54	1.8	36	1.3	23	10.0	11	1.4	210	2.6
Nov.	1	3.0	3	0.9	17	1.8	4	9.3	4	12.1	22	0.8	29	1.0	4	1.7	11	1.4	95	1.2
Dec.	-	-	17	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	0.2
Total	33		336		937		43		33		2972		2796		231		780		8191	
Percent		99.9		100		100.1		100		99.9		99.9		99.9		100		99.8		100
		0.4%		4.1%		11.4%		0.5%		0.4%		36.3%		34.4%		.8%		9.5%		100%

TABLE 15. Distribution of Boating by Sector and Month.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
January																			0	0
February																			0	0
March	2	1.7	9	3.8	3	0.8					14	2.0	7	1.1	3	2.3			38	1.5
April	1	.9	7	3.0	32	8.9	1	2.3	7	7.5	30	4.3	78	12.2	10	7.6			166	6.5
May	3	2.6	17	7.2	38	10.6	3	6.8	5	5.3	51	7.3	73	11.5	19	14.4	24	10.6	233	9.2
June	32	27.8	40	17.0	46	12.9	6	13.6	22	23.4	98	14.1	141	22.1	19	14.4	16	7.1	420	16.5
July	12	10.4	51	21.7	44	12.3	1	2.3	10	10.6	120	17.2	85	13.3	7	5.3	65	28.8	395	15.6
August	41	35.6	55	23.4	107	29.9	15	34.1	29	30.9	245	35.2	141	22.1	52	39.4	66	29.2	751	29.6
Sept.	22	19.1	29	12.3	32	8.9	3	6.8	8	8.5	80	11.5	47	7.4	8	6.1	21	9.3	250	9.9
Oct.	1	.9	18	7.7	27	7.5	11	25.0	7	7.5	31	4.4	30	4.7	10	7.6	17	7.5	152	6.0
Nov.	1	.9	3	1.3	17	4.7	4	9.1	4	4.3	22	3.2	29	4.6	4	3.0	11	4.9	95	3.7
Dec.			6	2.6	12	3.4			2	2.1	6	.9	6	.9			6	2.7	38	1.5
Total	115		235		358		44		94		697		637		132		226		2538	
Percent		99.9		100.0		99.9		100		100.1		100.1		99.9		100.1		100		100
		4.5%		9.3%		14.1%		1.7%		3.7%		27.5%		25.1%		5.2%		8.9%		100%

TABLE 16. Distribution of Bank Fishing by Sector and Month.

	Mullica River						Wading River		Bass River		Great Bay						Brig. Refuge		Total	
	Upper		Middle		Lower						North		South		Blvd.					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
January			1150*	67.9															1150	27.5
February																			0	0
March			65	3.8	11	3.8					15	13.3			147	7.7			238	5.7
April	8	15.1	130	7.7	40	13.8	1	4	3	18.7	38	33.6	45	85.1	414	21.8			679	16.2
May	6	11.2	140	8.3	117	40.5	10	40			22	19.5	4	7.6	228	12.0			527	12.6
June	8	15.1	67	4.0	23	8.0	4	16	3	18.7	33	29.2			149	7.9	42	100	329	7.9
July	18	34.0	41	2.4	9	3.4	7	28			5	4.4			183	9.6			263	6.3
August	8	15.1	67	4.0	64	22.1	2	8	10	62.6			5	9.4	296	15.6			452	10.8
Sept.	5	9.5	29	1.7	10	3.5	1	4							171	9.0			216	5.2
Oct.			5	0.3	8	2.8									105	5.5			118	2.8
Nov.					3	1.0									204	10.6			107	4.9
Dec.			1	0.1	4	1.4									1	0.1			6	0.1
Total	53		1695		289		25		16		113		53		1898		42		4185	
Percent		100.1		100		100		100		100		100		100		99.9		100		100
		1.3%		40.5%		6.9%		0.6%		0.4%		2.7%		1.3%		45.4%		1.0%		100.1%

* Based on air and ground counts.

TABLE 17. Estimated Total Catch of Fish, by Month, for Bank and Boat Fishermen

Month	Bank	Boat	Combined
January	84,790 (ice fishing)	*	84,790
February	*	*	*
March	2,846	17,232	20,078
April	2,915	53,416	56,331
May	6,070	88,235	94,305
June	2,933	106,142	109,075
July	5,536	384,739	390,275
August	8,786	132,566	141,352
September	7,623	102,900	110,523
October	1,657	17,720	19,377
November	2,766	1,958	4,724
December	42	2,373	2,415
	125,964	907,281	1,033,245

* Not enough data, insignificant.

TABLE 18. Boat Fishing Catch Composition by Month.

Species	January		March		April		May		June		July	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Blackfish	-	-	-	-	-	-	-	-	-	-	-	-
Blowfish	-	-	-	-	-	-	874	71	3,050	91.2	325	
Blue crab	-	-	-	-	-	-	-	-	-	-	-	-
Bluefish	-	-	-	-	-	-	168	13	156	4.7	2	
Eels	-	-	1	1	7	1	2	-	4	0.1	-	-
W. Flounder	-	-	76	74	374	49	188	15	-	-	-	-
Fluke	-	-	-	-	-	-	2	-	91	2.7	69	
Herring	-	-	-	-	-	-	-	-	-	-	-	-
Kingfish	-	-	-	-	-	-	-	-	32	1.0	46	
Scup	-	-	-	-	-	-	-	-	-	-	-	-
Sea bass	-	-	-	-	-	-	-	-	2	0.1	-	-
Striped bass	-	-	23	23	384	50	14	1	6	0.2	-	-
Weakfish	-	-	-	-	-	-	-	-	2	0.1	2	
White perch	536	100	2	2	-	-	3	-	-	-	7	
Other*	-	-	-	-	-	-	-	-	-	-	-	-
	536	100%	102	100%	765	100%	1,251	100%	3,343	100%	451	100%

Species	August		September		October		November		December		Total	
Blackfish	-	-	5		6		-	-	-	-	11	0.1
Blowfish	1,259		754		10		-	-	-	-	6,272	65.9
Blue crab	-	-	98		-	-	1		-	-	99	1.0
Bluefish	16		163		1		-	-	-	-	506	5.3
Eels	25		5		-	-	1		-	-	45	0.5
W. Flounder	-	-	-	-	-	-	-	-	-	-	638	7.2
Fluke	9		-	-	-	-	-	-	-	-	171	1.8
Herring	-	-	-	-	-	-	-	-	-	-	-	-
Kingfish	46		39		1		-	-	-	-	164	1.7
Scup	4		54		-	-	-	-	-	-	58	0.6
Sea bass	7		-	-	-	-	-	-	-	-	9	0.1
Striped bass	-	-	6		-	-	-	-	-	-	433	4.5
Weakfish	14		56		-	-	-	-	-	-	74	0.8
White perch	86		21		15		109		233	100	1,012	10.6
Other*	28		39		-	-	-	-	-	-	67	0.7
	1,494		1,240		33		111		233	100%	9,559	100%
											9,559	

* Other includes: catfish, sea robin, shark, sculpin.

TABLE 19. Bank Fishing Catch Composition by Month.

SPECIES	January		March		April		May		June		July	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Blackfish												
Blowfish							246	65	97	63.8	8	3.3
Blue crab									8	5.3	62	25.4
Bluefish							1	-				
Eels					1	-	15	4	2	1.3	3	1.2
W. flounder			337	97	237	93	68	18	1	0.7		
Fluke							1	-	4	2.6	1	0.4
Herring												
Kingfish							2	-	3	2.0		
Scup												
Sea bass											3	1.2
Striped bass					19	7	10	3				
Weakfish			6	2							166	68.4
White perch	24,851 (Ice fishing)	100	2	1			36	10	31	20.4		
Other									6	3.9		
Total	24,851	100%	345	100%	257	100%	379	100%	152	100%	243	100%

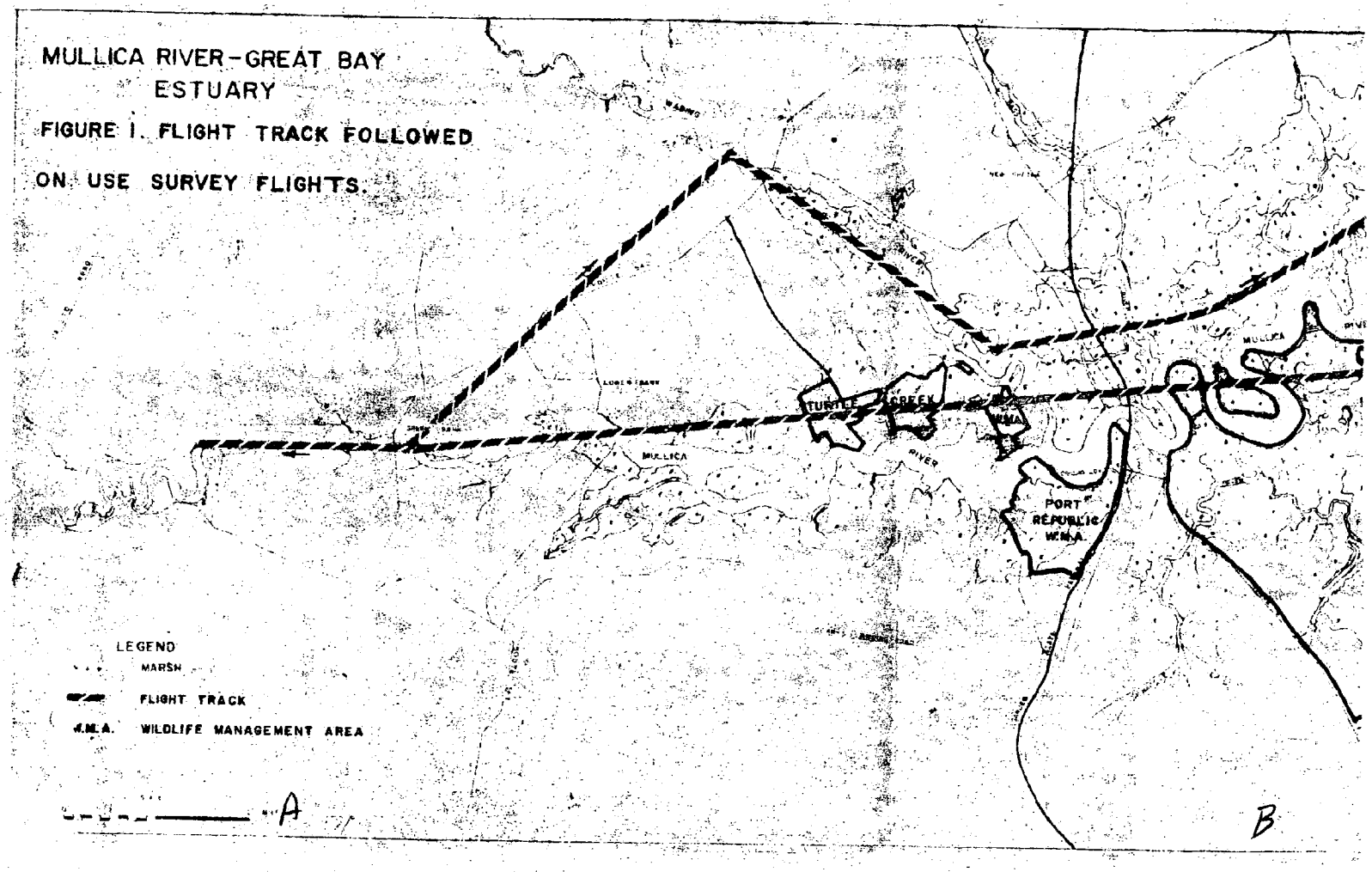
SPECIES	August		September		October		November		December		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Blackfish			27	10.3	141	34.1					168	0.6
Blowfish	80	17.4	89	34.1							520	1.8
Blue crab	288	62.8	39	14.9	128	40.0	17	2.1			542	2.0
Bluefish	2	0.4	20	7.6	9	2.2					31	0.1
Eels	14	3.1	14	5.4	12	2.9	8	1.0			69	0.2
W. flounder					95	23.0	787	96.8	5	62.5	1,530	5.4
Fluke											6	<.1
Herring												
Kingfish	13	2.8	2	0.8							20	0.1
Scup	1	0.2	50	19.2	2	0.5					53	0.2
Sea bass											3	<.1
Striped bass											29	0.1
Weakfish											6	<.1
White perch			20	7.6	22	5.3					25,128	89.2
Other	60	13.1			4	1.0			3	37.5	73	0.3
Total	458	100%	261	100%	413	100%	812	100%	8	100%	28,178	

TABLE 20. Estimated Total Hunter Man-days and Harvest by Month.

	September	October	November	December	Total
Man-days	158	421	600	616	1,795
Birds	24	253	600	924	1,801
Birds/Man-day	0.16	0.60	1.00	1.50	1.00

TABLE 21. Species Composition of Waterfowl Harvest by Month.

	Rails		Ducks and Geese							
	September		October		November		December		Total	
Species	No.	%	No.	%	No.	%	No.	%	No.	%
Black duck			31	38.8	17	18.0	42	34.1	90	30.3
Brant			1	1.3	29	30.7	44	35.8	74	24.9
Bufflehead			3	3.8	28	29.7	7	5.7	38	12.8
Clapper rail	24	100								
Teal, G.W.			18	22.5	1	1.0			19	6.4
Mallard			11	13.7	1	1.0	6	4.9	18	6.1
Mergansers			3	3.8	8	8.5	4	3.3	15	5.1
Widgeon			5	6.2	3	3.2	5	4.1	13	4.4
Goose			6	7.5	3	3.2			9	3.0
Scaup			1	1.3	3	3.2	1	0.8	5	1.7
Scoter							5	4.1	5	1.7
Pintail							3	2.4	3	1.0
Gadwall							2	2.4	2	0.7
Goldeneye							2	2.4	2	0.7
Old squaw					1	1.0			1	0.3
Ruddy duck							1	0.8	1	0.3
Shoveler							1	0.8	1	0.3
Wood duck			1	1.3					1	0.3
Total	24	100%	80	100%	94	100%	123	100%	297	100%


MULLICA RIVER-GREAT BAY
ESTUARY
FIGURE 1. FLIGHT TRACK FOLLOWED
ON USE SURVEY FLIGHTS.
LEGEND
MARSH
FLIGHT TRACK
W.M.A. WILDLIFE MANAGEMENT AREA
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