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COMPARISON OF NATURAL AND ALTERED ESTUARINE SYSTEMS

The Field Data - Volume II

Center for Coastal and Environmental Studies
Rutgers - The State University of New Jersey

New Jersey Department of Environmental Protection,
Division of Fish, Game, and Shellfisheries, and
Division of Coastal Resources

September 1979

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COMPARISON OF NATURAL AND ALTERED ESTUARINE SYSTEMS: The Field Data - Volumes I and II

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USERS GUIDE TO THE FIELD DATA - VOLUMES I AND II

The Estuarine Evaluation Project was a cooperative venture by Rutgers - the State University and the New Jersey Department of Environmental Protection. Its purpose was to study how a lagoon home development built on a salt marsh would affect the processes, functions, and conditions normally found in such an area. The specific site chosen is presently known as Village Harbour; however, at the time of the study, it was called Beach Haven West. It is located in Ocean County near Manahawkin, New Jersey. The investigation was multifaceted and was conducted from 1973 through 1977.

The results of this study are presented in a two-part format. The first part is a two volume set which is titled "The Field Data". The data represent a compilation of the documents submitted by the principal investigators in fulfillment of their project responsibilities. The purpose of these reports is to establish data sets of the many components forming the estuarine system and to investigate the individual units. The second part entitled "Analysis", draws upon selected portions of the field data to evaluate the effects of and the changes brought about by the lagoon development's presence.

In assembling the two volumes of field data, certain guidelines were employed. The principal objective was the preservation of the intent and meaning of the original investigator. To accomplish this, the two volumes were organized as a compilation of the original research reports with a minimum of editing or modification. This was to ensure the integrity and logic of each report was retained as the author intended. In general, changes were made only to maintain a standard format. Major changes were subject to the approval of the original authors. This guideline served to reinforce the direct connection between the report and the researcher who authored it. It also assured the scientific validity of the subsequent analysis. One consequence of this minimum change policy was the retention of the units system employed by the investigator. The problem of dealing in the British and metric systems concurrently was not deemed significant enough to warrant the extensive changes required. Another guideline concerned the choice of documents in the field data volumes. If a number of reports were produced over the course of the investigation, the summary versions of the reports were included. If such superseding documents were unavailable, all available reports were appended and placed in the compilation.

It is intended that the contents of the reports in the two field data volumes are the responsibility of the original authors. All manuscripts were subject to author review and approval prior to publication. The compilers of the field data assume responsibility only for the accurate transferal of text from the submitted original reports into the final format.

Within the field data volumes, the taxonomic nomenclature follows Gosner (1971) for the estuarine benthic invertebrates and Bailey et al. (1960) for the fish. Note that the editors consider *Nassarius obsoletus* and *Ilyanassa obsoleta* synonymous as are *Phragmites communis* and *Phragmites australis*.

Because the report sizes in the field data volumes varied considerably, two types of organization were employed. Those reports under 30 pages were written in a condensed format. Features such as separate title pages, table of contents,

list of figures, list of tables, and separate acknowledgement and abstract pages (when requested), were used only in the larger reports. Condensation of the format size was a primary objective in the smaller reports.

Appendices are found in reports of all sizes and were employed to include (1) additional data not referred to in the report itself (see the Durand et al. and Good et al. reports); (2) raw data (see the Haskin and Ray report); and (3) figures and/or tables which would disrupt the text if placed in the body of the report because of the number of pages involved (see McClain et al. report).

The specific organization of the field data contribution is as follows:

1) Users Guide

2) Order of Reports

3) Abstracts

4) Compiled Reports

The order of the abstracts and the compiled reports followed as much as possible their sequence of use in the analysis. This order follows.

ORDER OF REPORTS

Report No.		
1	J. Durand, T. Sugihara, and C. Yearsley	ESTUARINE EVALUATION STUDY: PRIMARY AQUATIC PRODUCTION AND NITROGEN. FOUR YEAR REPORT, 1973-1977.
2	R. Good and B. Frasco	ESTUARINE EVALUATION STUDY: A FOUR YEAR REPORT ON PRODUCTION AND DECOMPOSITION DYNAMICS OF SALT MARSH COMMUNITIES OF THE MANAHAWKIN MARSHES, OCEAN COUNTY, NEW JERSEY.
3	D. Slate	MARSH PRODUCTIVITY: SUBMERGED SALT POND VEGETATION.
4	H. Haskin and G. Ray	ESTUARINE EVALUATION STUDY: BENTHIC INVERTEBRATES. FOUR YEAR REPORT, 1973-1977.
5	F. Ferrigno, L. Widjeskog, and E. Tomlin	MARSH PRODUCTIVITY: SURFACE INVERTEBRATE POPULATION INDICES.
6	J.R. Trout	MARSH PRODUCTIVITY: SURFACE INVERTEBRATE POPULATION INDICES.
7	J. McClain, J. Makai, and P. Himchak	STUDIES OF THE MANAHAWKIN BAY - LITTLE EGG HARBOR SYSTEM: (1) FINFISH STUDY: (2) PHYSICAL - CHEMICAL STUDY; AND (3) USE STUDY.
8	P. Festa	ANALYSIS OF THE FISH FORAGE BASE IN THE LITTLE EGG HARBOR ESTUARY.
9	R. Bosenberg	RODENT POPULATIONS.
10	J. Penkala and J. Sweger	WILDLIFE INDEXES: AVIAN DENSITY AND DIVERSITY.
11	L. Widjeskog and F. Ferrigno	WILDLIFE INDEXES: NESTING SURVEY.
12	J.R. Trout	WILDLIFE INDEXES: STATISTICAL ANALYSIS OF THE NESTING SURVEY DATA.
13	W. Shoemaker and F. Ferrigno	WILDLIFE INDEXES: WATERFOWL USE AND HARVEST.
14	J. Applegate, S. Salmore, and J. Blydenburg	RECREATIONAL USE OF NEW JERSEY'S WETLANDS BY THE CITIZENS OF NEW JERSEY.
15	J. Applegate and S. Sterner	A STUDY OF THE RECREATIONAL USE OF NEW JERSEY'S MARINE ENVIRONMENT.
16	S. Sterner and J. Applegate	ESTIMATES OF THE 1975 SPORT HARVEST OF MARINE FISHES.

ABSTRACTS

The abstracts are short, generally less than 250 words, and are intended to speed access by the reader to the individual reports of interest. The abstracts cover discrete research areas and may draw upon more than one report in the collation for their basis.

Abstract of the Primary Aquatic Productivity and Nitrogen: Four Year Report 1973-1977 study prepared by James Durand, Teruo Sugihara, and Charles Yearsley.

This study compares aspects of stratification, the nitrogen cycle, and primary production in a salt marsh system and an adjacent developed area near Manahawkin, New Jersey. Greater and more prolonged stratification is associated with the increased depths found in the lagoon development. The lower portions of the stratified water columns are subject to periodic anoxia and high ammonia-N levels. In all areas, the organic nitrogen fraction is the dominant nitrogen form found generally followed by ammonia-N, nitrate-N, and nitrite-N. In addition to nitrogen standing stocks, processes such as nitrogen fixation, excretion, and ammonification were also studied and partial nitrogen budgets constructed. Primary production studies were done on the microflora associated with the marsh surface, intertidal zone, and benthic sediments as well as the phytoplankton. The phytoplankton community is the greatest importance in both the natural and developed areas. Enrichment studies show the summer phytoplankton productive capacity to be nitrogen limited. High rates of production are also associated with the bulkhead algae community; however, its limited distribution minimizes its absolute total contribution. The productive capacity of the marsh surface edaphic algae community is directly related to light incidence. Consequently, the habitats with decreased grass canopy densities, like the *Spartina alterniflora* forms, have higher rates of primary production. In addition, the *S. alterniflora* short form occupies 60% of the marsh surface which magnifies the contribution of its edaphic algae to the total salt marsh productivity. As in the rest of this study, water column depth is stressed as a critical factor to production because of its relationship to the size of the euphotic zone, turbidity, and the type of biological activity possible in the benthos.

Abstract of the research on the production and decomposition dynamics of the salt marsh communities of the Manahawkin marshes performed by Ralph Good, Barry Frasco, Kay Smith, and William Brown.

In the Manahawkin salt marsh-estuarine ecosystem, vascular plant primary production and the fate of this biomass were studied from 1973 to 1976. All phases of both processes were subsequently related to environmental parameters. Using the harvest method, estimates of annual aboveground net production (g dry wt$\cdot m^{-2}\cdot yr^{-1}$) are as follows: tall form *Spartina alterniflora*, 825-735; short form *S. alterniflora*, 444-574; *S. patens*, 535-618; and *Distichlis spicata*, 613-644. Belowground production is generally about 5 times greater than aboveground. Total net primary production of short form *S. alternatiflora* on an energy basis is estimated at 16.0 kcal$\cdot m^{-2}\cdot yr^{-1}$, or 5.12 x 10^9 kcal for the entire marsh. These figures compared favorably with results for the world's most productive ecosystems. Standing crops of crude fiber, nitrogen-free extract, crude fat (aboveground material only), and crude protein (belowground material only) are shown to be a function of dry matter biomass. The accumulation of crude protein in aboveground

material at the beginning of the growing season is thought to be a storage mechanism for potentially limiting nitrogen. Approximately 90% of the annual net primary production of the vascular plants remained at the end of the growing season. Based upon the analyses of plant material placed in litter bags and left on the marsh, a general decomposition pattern is described for the majority of study sites. Decomposition rates, however, vary with the type of plant material and the environmental regime. The amount of aboveground material in g dry wt·m^{-2}·$month^{-1}$ entering the detrital food chain during the first year of decomposition is as follows: tall form *S. alterniflora*, 44 (6.0%); short form *S. alterniflora*, 20 (4.5%); and *S. patens*, 8 (1.5%). Additional biomass losses during the growing season are estimated from phenological studies, and are probably about 10% of the net aboveground production. Chemical analyses of decompositional material reveal at nearly all study sites, percent crude fat decreased and percent crude protein increased with time. The latter is attributed to colonization of the plant material by bacteria and fungi. The balance of production, decomposition, detrital export, accumulation, and incorporation into peat with seasonal tidal fluctuations and sea level changes are discussed in their relation to marsh stability.

Abstract of the 1976 Submerged Salt Pond Vegetation study prepared by Dennis Slate.

The purpose of the salt pool submerged vegetation study is to delineate the physical and chemical parameters which could be used to predict the presence or absence of *Ruppia maritima* and to measure the production of *Ruppia* in the salt pools of the Manahawkin marsh. Three parameters, depth, salinity, and surface area, accurately predicted 21 or 24 attempts. *Ruppia* occurs generally in ponds of large surface area, increased depth, and lower salinity. Peak *Ruppia* biomass occurs in late July - early August. The biomass estimates range from 0.04 to 79.60 g dry wt·m^{-2} with an overall mean of 30.2 g dry wt·m^{-2}.

Abstract of the Benthic Invertebrates: Four Year Report 1973-1977 study prepared by Harold Haskin and Gary Ray.

During July 1973 - February 1975, an inventory of natural or undisturbed creeks, partially disturbed waterways, and fully lagooned waterways in the Manahawkin, New Jersey area quantified the distribution of benthic invertebrate species within the study area. During July 1975 - March 1977, emphasis was placed on the study of distribution, population structure, growth, production, and food web relationships of the dominant benthic species. All sampling was done on a seasonal basis using a ponar dredge (0.05 m^2).

A total of 185 species were collected. The two major dominant species are *Ampelisca abdita* and *Streblospio benedicti*. These two account for approximately 60 and 9% of all the organisms collected, respectively. The 20 most numerous species account for approximately 90% of the total collection. Of the taxonomic groups, the Crustacea are the most numerous, followed by the Polychaeta and the Mollusca.

Total species listings for each waterway type are nearly identical; however, species in the dredged and partially disturbed waterways were lost and replaced at a greater rate than in the natural creeks. Numbers of individuals and biomass

estimates are inversely related to degree of development or disturbance. The creeks have 9 times the individuals and 25 times the biomass of the lagoon community. Species distribution is apparently affected by hydrographic factors, sediment characteristics, and distance from the bay. Seasonal fluctuations in species, number of individuals, and biomass seem related to reproductive patterns of the dominant species and also to predation pressure. Production for the natural creek and lagooned waterways is estimated at 3.0 and 0.3 $kcal \cdot m^{-2} \cdot year^{-1}$, respectively.

Abstract of the research on surface invertebrate populations in the Cedar Run area performed by Fred Ferrigno, Lee Widjeskog, Earl Tomlin, and J. Richard Trout.

A preliminary study was conducted during August 1974 on the marsh surface invertebrate populations inhabiting 10 major cover types within the Cedar Run marsh evaluation study area. Point and interval estimates of the population densities within each cover type as well as total yield for the marsh complex were obtained for the following invertebrates: *Modiolus demissus*, *Melampus bidentatus*, *Uca pugnax*, *Philoscia vittata*, *Orchestia grillus*, ants, true bugs, crickets, grasshoppers, leaf-hoppers, and spiders. The most prevalent invertebrates in terms of density and frequency of occurrence are *Melampus*, *Philoscia*, leaf-hoppers, *Orchestia*, and the spiders (in decreasing order of importance). These account for approximately 99% of the total yield (6,327,992 organisms, SD = 456,175) from the study area. About 96% of this total marsh population occurs within the extensive *Spartina alterniflora* (short form) and *S. patens* covers types. Invertebrates are scarce in stands of *Phragmites australis*, *Scirpus olneyi*, and *Panicum virgatum*, and also in the incompletely lagooned area at Popular Point.

Abstract of the 1976 Manahawkin Bay - Little Egg Harbor System: Finfish Study; Physical-Chemical Study; and Use Study prepared by John McClain, John Makai, and Peter Himchak.

The purpose of the finfish study is to inventory the fish inhabiting the Manahawkin Bay - Little Egg Harbor system. The combined data of all the collection methods (seine, trawl, and gill net) indicate the five most numerous species in decreasing order are the bay anchovy, the Atlantic silverside, the fourspine stickleback, the mummichog, and the tidewater silverside. Together they comprise 80% of the total catch. Altogether 66 species of finfish were collected.

The purpose of the physical-chemical study is to describe the Manahawkin Bay - Little Egg Harbor system in terms of its morphology, biota, and physico-chemical factors. Water quality in the system is good. In general, reduced oxygen levels are not found in the bay but are found in some of the creeks and especially in the lagoons. The dissolved oxygen levels in the lagoons are manifestations of temperature stratification. The bay lacks both temperature and salinity vertical gradients. Horizontal salinity gradients and seasonal salinity variation are greatest in the creeks. The data indicate high coliform counts of unknown origin in certain areas (most of these areas were in the developed sites). DDT, DDT metabolites, and certain heavy metals are present in animal tissue samples with higher levels found in the sediments tested.

The purpose of the use study is to determine the ways in which the Manahawkin Bay - Little Egg Harbor system is used by man. During the first study period (July 1973 - February 1974), it is estimated over 1.58 x 10^5 man-days of activity occurred in the study area with a resulting harvest in excess of 4.4 x 10^5 fish, 1.4 x 10^7 shellfish, and 300 waterfowl. Between June 1974 and May 1975, excluding November and December 1974, an estimated 2.3 x 10^5 mandays of activity produced a harvest of over 4.5 x 10^5 fish and over 1.9 x 10^7 clams.

Abstract of the 1978 Analysis of the Fish Forage Base in the Little Egg Harbor Estuary study prepared by Patrick Festa.

The purpose of this study is to identify the forage base and the allocation of this forage base among the Little Egg Harbor fish through stomach contents analysis. The forage base consists of 142 taxa which support at least 64 fish species. The trophic relationships present are complex because of the flexible dietary habits of the fish surveyed (55 species). Forage populations of particular importance include the class Polychaeta, the order Calanoida, the suborder Gammeridea, the order Mysidacea, the infraorder Panaeidae, and the class Osteichthyes. Some of the food chain associations indicated are *Mercenaria*-winter flounder; *Cymadusa*-pipefish; and calanoid copepod-sand lance-striped bass. The utilization of the forage base is analyzed in terms of use of a given forage item and also in terms of forage items consumed by a given fish species. Habitat area and seasonal aspects are also examined.

Abstract of the 1977 Rodent Populations study prepared by Robert Bosenberg.

Trapping of the rodents on the Cedar Run marsh was conducted periodically from April 1975 to June 1977. Total trapping effort using both live and killing traps amounted to 18,610 trap nights. Rodent species captured include the meadow vole (*Microtus pennsylvanicus*), muskrat (*Ondatra zibethica*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), and the meadow jumping mouse (*Zapus hudsonius*). *Microtus* was the only mouse species captured in sufficient numbers to permit population density estimates. Peak densities of this species occur in July. Densities are greater in the incompletely lagooned section than in either the mosquito-ditched or natural marsh areas. Population densities are similar for the latter two sections. Densities within different vegetation cover types are related to the marsh alteration type in which they occur. A significant decline in *Microtus* numbers occurred in the incompletely lagooned area due to the effects of Hurricane Belle. The relation between *Microtus* populations and topographic relief, cover effects, predation, availability of nesting sites, and food resources are discussed. Muskrats are found to be restricted to the *Scirpus*-dominated vegetation located near the marsh-upland ecotone. The average number of huts observed in November of 1975 and 1976 was 21.5. Estimates of muskrat density for the area of marsh bordering and upland exceed five animals per hectare, and the total population for the Cedar Run study area probably exceeds 114 individuals. Due to the low capture success for the Norway rat, no reliable population estimates are possible.

Abstract of the 1976 Wildlife Indexes: Avian Density and Diversity study prepared by Joseph Penkala and Joseph Sweger.

Bird censuses were conducted during the spring and fall migration periods within the following major vegetational associations of the Cedar Run marsh: upland-marsh ecotone, *Iva frutescens - Spartina patens, S. alterniflora,* and the marsh interface with Cedar Run and Little Egg Harbor. Six visits were made during the period 20 April - 8 August 1975 and the line transect - mean flushing distance method used to determine the diversity and density of the avifauna. A total of 976 birds comprised of 87 different species were observed during the study period. Species which are typically considered to be summer residents are most prevalent. Sharp-tailed sparrows have the highest density of any species, followed by the red-winged blackbird and barn swallows. The laughing gull is the most abundant of the larger species. Reliable density estimates of most species are not possible due to their infrequent occurrence. The *S. alterniflora* habitat accounts for the greatest number of birds observed and has the highest species diversity, averaging 68.3 individuals and 17 species observed per visit. The upland-marsh ecotone has the lowest diversity and density.

Abstract of the research on bird nesting in the Cedar Run area performed by Lee Widjeskog, Fred Ferrigno, and J. Richard Trout.

During August 1974, nine major vegetation cover types of the Cedar Run marsh study area were surveyed to determine the species and density of nesting birds. Point and interval estimates of the number of nests for each species within a cover type as well as estimates of the total number of nests for each cover type and for the entire marsh were obtained. A total of 149 nests were actually observed, and the estimated number for the entire marsh is 2,739.5 (SD = 361.0). Nesting species, in decreasing order of importance, include the sea-side and sharp-tailed sparrows (*Ammospiza maritima* and *A. caudacuta*), clapper rail (*Rallus longirostris*), willet (*Catoptrophorus semipalmatus*), long-billed marsh wren (*Telmatodytes palustris*), red-winged blackbird (*Agelaius phoeniceus*), and the black duck (*Anas rubripes*). Sparrows account for 64% of the estimated total. Nests occurring within the extensive areas of short form *Spartina alterniflora* and *S. patens* account for 44% (1,213.9 nests) and 40% (1,099.6 nests), respectively, of the total marsh estimate. Although the density of clapper rail nests is high (13.29 nests$\cdot$ha^{-1}) in tall form *S. alterniflora*, the overall importance of this cover type is minimized by its small areal contribution. Very little nesting occurred in stands of *Scirpus olneyi, Panicum virgatum,* or *Distichlis spicata*, and no bird species were observed to be utilizing either *Phragmites australis* or dredge spoil areas.

Abstract of the 1974 Wildlife Indexes: Waterfowl Use and Harvest study prepared by William Shoemaker and Fred Ferrigno.

During the fall and winter of 1973-74, waterfowl utilization and harvest data were obtained for the Cedar Run study area. Monthly aerial waterfowl counts were carried out from September to January. Hunter counts and bag checks were conducted on Saturdays and one day of each week from October to January. Waterfowl populations in the immediate study area increase from 800 in September to a maximum of 3,200 in December with a grand tally of 9,270 birds. This represents an increase from 1.46 to 5.86 birds per hectare of marsh. Black ducks are the most

abundant, accounting for 35.3% of the total. Greater and lesser scaup are next in importance (20.5%). Within the surrounding ecosystem of Little Egg Harbor and its bordering salt marshes, the waterfowl population increases from 1,600 in September to 20,000 in December, with a total count of 50,050 birds. Dominant species are the brant (21.8%), greater and lesser scaup (21.0%), black ducks (19.2%), and bufflehead (15.0%). Hunter use of the study area amounts to 874 man-days and 1.61 hunters per hectare of marsh for a total harvest of 2,407 waterfowl. Hunter success was 2.65 birds per hunter-day and 4.4 waterfowl per hectare of marsh. Diving ducks, primarily the scaup, are the preferred species. The greater scaup accounts for 76.8% of the total estimated harvest. These results demonstrate the Cedar Run marsh and adjacent bay to be a prime wintering area for waterfowl and also one with a considerable recreational value in terms of hunter use and success.

Abstract of the 1974 and 1975 annual reports submitted on the Recreational Use of New Jersey's Wetlands by New Jersey Citizens prepared by James Applegate, Stephen Salmore, and John Blydenburg and James Applegate and Stephen Salmore, respectively.

The primary objective of this study is to quantify the recreational benefits provided by New Jersey's wetlands to New Jersey residents. Univariate analysis indicates wildlife observation is the most popular salt marsh activity in which 15% of the New Jersey population participated. It is followed by crabbing (12%), picnicking/other (12%), fishing (10%), clamming (5%), and hunting (3%). Subsequent cluster analysis divided the salt marsh users into grouping which could be combined into more inclusive categories. The activity categories chosen were extractive (fishing, hunting, crabbing, and clamming), appreciative (wildlife observation and picnicking/other), and nonexclusive (occasional participants but not exclusively in one activity). Of the approximately 19% of the New Jersey population which utilized the wetlands (under this analysis), 6.6, 5.6, and 7.2% belong to the appreciative, nonexclusive, and extractive categories, respectively. Other more restrictive groupings were examined as were the origin of the participants in the various activities and man-day estimates of marine environment use. The estimated means of man-days of recreation (in millions of man-days) provided by crabbing, estuary fishing, ocean fishing, surf fishing, and clamming are 2.5, 2.0, 1.7, 1.1, and 1.0, respectively.

Abstract of the Estimates of the 1975 Sport Harvest of Marine Fishes prepared by Stephen Sterner and James Applegate in 1976.

Utilization of the stocks of bluefish, weakfish, fluke, white perch, striped bass, mackerel, whiting, cod, pollack, winter flounder, and tuna were estimated for either the 1 January - 1 June 1975 period for the 1 July - 20 December 1975 period. These estimates were referenced to the type of fishing done (ocean, river/bay, or surf) and who the fishing was done by (those who fish 10 days or less annually or those who fish more).

During the 1 January - 1 June 1975 period estimates were made on the striped bass, mackerel, whiting, cod, pollack, winter flounder, and weakfish harvests. Winter flounder (1.62×10^5 fish), mackerel (1.19×10^5 fish), and striped bass (9.9×10^3 fish) lead the combined fishing effort (for both types of fishermen) for the bay/river, ocean, and surf fishing categories, respectively.

During the 1 July - 20 December 1975 period estimates were made on the bluefish, weakfish, striped bass, tuna, fluke, and white perch harvests. Bluefish, with a mean combined catch of 3.44×10^5 are taken most frequently by ocean fishermen. Striped bass (5.8×10^4 fish) dominate the surf fishing while fluke (1.85×10^5 fish) lead the harvest by bay and river fishermen.

7. STUDIES OF THE MANAHAWKIN BAY - LITTLE EGG HARBOR SYSTEM:

1. FINFISH STUDY: John F. McClain

2. PHYSICAL - CHEMICAL STUDY: John Makai

3. USE STUDY: Peter J. Himchak[1]

[1]The authors of the following studies are members of the New Jersey Division of Fish, Game, and Shellfisheries and are based at the Nacote Creek Research Station, Absecon, New Jersey. This report was prepared for the New Jersey Division of Fish, Game, and Shellfisheries with funds provided in part by the Commercial Fisheries Research and Development Act for Project 3-223-R-1 during the period 1973 to 1976.

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PHASE I, FISH STUDIES

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ABSTRACT

The purpose of this portion of the project was to inventory the fishes inhabiting the Manahawkin Bay - Little Egg Harbor system.

Eighteen seine, 21 trawl, and 8 gill net stations located in various creeks and lagoons as well as the bay itself were sampled for finfish. There were 66 species of fish in various stages of their life cycles collected during the survey period. Water quality parameters of the following ranges were recorded: salinity, 1.0 to 31.8 °/oo; water temperature, -1.0 to 29.0°C; and dissolved oxygen (D.O.), 0.00 to 14.34 mg O_2/1.

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INTRODUCTION

This is the final report of a survey of the fishes of the Little Egg Harbor - Manahawkin Bay system. Work was begun in July 1973 and concluded at the end of May 1975. See Figure 1 for a map of the area and Table 1 for a species list. The figures for this report (as well as the other two reports which form this submission from the Nacote Creek Research Station) are in Appendix A. Tables 1 through 90, which are associated with the following finfish report, are contained in Appendix B.

METHODS AND MATERIALS

Three types of fishing gear were utilized to sample fish in the system: gill net, seine, and trawl.

The gill net used was an experimental monofilament model of the following dimensions: five panels 25 feet (ft) x 6 ft, one each of 0.50 inch (in), 0.75 in, 1.00 in, 1.50 in, and 2.00 in square mesh.

Three seine types were used during sampling: a 25 ft bag seine 5 ft deep with a 5 ft x 5 ft bag, all 0.50 in stretch mesh knotless nylon netting; an 80 ft x 6 ft bag seine (0.50 in square mesh) with 6 ft x 6 ft x 6 ft bag of 0.375 in square mesh; and a 150 ft x 10 ft bag seine (0.625 in stretch mesh) with a 10 ft x 10 ft x 10 ft bag of 0.375 in stretch mesh.

Trawling was done with a 16 ft semiballon trawl of the following dimensions: 16 ft head headrope, 19 ft footrope, body 1.50 in stretch mesh No. 9 thread, codend 1.25 in stretch mesh No. 15 thread, innerliner 0.50 in stretch mesh No. 63 thread knotless nylon; doors 24 in x 12 in x 1 in mahogany with 0.375 in nylon rope, 100 ft of rope on each door, doors weighing 15 pounds (lbs) each. A trawl

sample consisted of a tow by a 17 ft Boston Whaler for 5 minutes; warp length was adjusted for depth. Two tows were made at each station under normal conditions.

The catch of each sample was counted by species and all fish were weighed and then measured for total length. Subsamples were taken when individual members of any species were so great as to make processing of the entire catch impractical. These subsamples were counted, measured, and weighed, and the data developed was projected to reflect the total captured weight of the species.

SEINING RESULTS

Eighteen stations were sampled at various times during the survey (see Figures 1 and 2 for station locations and Table 2 for description). Tables 3 through 20 list sampling results by station and Tables 21 through 28 summarize the data on a seasonal basis as well. Forty-eight species of finfish numbering 25,662+ specimens were taken. Table 29 lists the 10 most abundant species, their number and percent of total seine catch. Utilizing three seines, 278 hauls were made: 193 hauls with the 25 ft seine (catch per haul or c/h = 33.4 specimens); 51 hauls with the 80 ft seine (c/h = 77.5 specimens); 34 hauls with the 150 ft seine (c/h = 447.9 specimens). Seasonal c/h for the five most abundant species is given in Table 30. Following is a seasonal account of seine results.

Summer

There were 43 species of finfish collected during the summer, 37 species in 1973, and 38 in 1974; 31 species appeared in both summer samples. Fifteen were taken only in the summer; most of these were strays from the south such as the crevalle jack, mojarra, permit, and filefish. The c/h was 31.6 specimens for the 25 ft seine, 29.6 for the 80 ft seine, and 635.3 for the 150 ft seine.

Three forage species made up 81% of the total catch. The most abundant of these was the Atlantic silverside, followed by the bay anchovy, and the four-spine stickleback. These species were taken at all three types sampling stations - bay, creek, and lagoon.

The spot ranked fourth, most of those collected being young of the year. The summer catch accounted for 96% of all spot. They occurred at all three types of sampling stations. Most were taken in the 150 ft seine. The c/h was 30.8 specimens. The c/h for the 25 ft and 80 ft seines was 0.3 and 0.1, respectively.

The tidewater silverside ranked fifth. They were taken at creek and lagoon stations. Most (82%) were collected in salinities less than 18 $^{o}/oo$. The c/h was 5.5 specimens for the 25 ft seine and 7.9 for the 80 ft. None were taken with the 150 ft seine, which was used primarily at bay stations.

Other species with 100 or more specimens taken during the summer were: banded killifish, mummichog, northern pipefish, and silver perch. The summer catch of mummichogs was only 9% of the total mummichog catch. Conversely, the other three species were taken primarily in the summer.

Fall

Twenty-nine species were caught in the fall, 26 in 1973, and 15 in 1974; 11 species were common to both years. The c/h was 39.1 specimens for the 25 ft seine, 55.7 specimens for the 80 ft, and 437.4 specimens for the 150 ft.

Four forage species made up 86% of the fall catch. Three of these, the Atlantic silversides, tidewater silversides, and the mummichog, appeared throughout the system. The fourth, the bay anchovy, was collected at only four stations. One haul at station 9 (Lagoon 24) yielded 88% of the fall anchovy catch. The mummichog and tidewater silverside were most abundant in the fall, 35% and 67% of their total seine catches occurred then.

Fifth in abundance was the fourspine stickleback which made up 2.8% of the fall catch. They were taken in all sampling regions. The c/h was 19 specimens for the 150 ft seine and 0.5 for both the 25 ft and 80 ft seines.

Another species making up more than 2% of the catch was the banded killifish. They were collected in upper Mill Creek and Lagoons 77 and 100 which branch off the creek. Salinities at the time of capture ranged from 1.00 to 7.09 $^{o}/_{oo}$. The 150 ft seine was not used at these stations. The c/h was 4.6 specimens for the 25 ft seine and 0.1 for the 80 ft seine.

Two other species numbered over 100 specimens. The naked goby was collected primarily at creek stations; c/h was 9.4 specimens for the 150 ft seine and less than 0.5 for both the 25 ft and 80 ft. The rainwater killifish was taken in all three sampling regions, however, the largest numbers were associated with lagoons with natural banks. The c/h was 0.4 specimens for the 25 ft seine, 2.3 specimens for the 80 ft, and 2.6 specimens for the 150 ft.

Winter

There were 13 species taken in the winter, 10 in 1974, and 12 in 1975. Nine species occurred in the samples for both years. The c/h was 5.4 specimens for the 25 ft seine, 17.2 specimens for the 80 ft, and 177.5 specimens for the 150 ft.

The fourspine stickleback made up 52% of the winter catch. It appeared at all sampling station types, however, most of the fish were taken in the bay. The c/h was 1.6 specimens for the 25 ft seine, 2.2 specimens for the 80 ft seine, and 160 specimens for the 150 ft seine. Only two hauls were made with the 150 ft seine during the winter.

Second in abundance was the Atlantic silverside. Most were collected at station 20 (Lagoon 07) in the winter of 1975. The c/h was 2.8 specimens for the 25 ft seine and 0.1 for the 80 ft. The winter catch, while ranking second for the season, accounted for only 2% of the total Atlantic silverside catch.

The above species combined with the mummichog, sheepshead minnow, and the tidewater silverside made up 93% of the winter catch. The mummichog and tidewater silverside were the least abundant in the winter; c/h with the 80 ft seine was 7.5 specimens and 1.7 specimens, respectively.

Spring

Twenty-six species were taken during the spring. The c/h was 33.5 specimens for the 25 ft seine and 390.4 for the 150 ft; the 80 ft seine was not used.

Five species made up 92% of the spring catch. In descending order of abundance, they were fourspine stickleback, mummichog, Atlantic silverside, bay anchovy, and tidewater silverside.

The fourspine stickleback accounted for 35% of the catch. It was collected at three stations, two in the bay and one lagoon. Station 2, a bay station, accounted for 98% of the catch. The c/h was 204 specimens for the 150 ft seine and 0.1 for the 25 ft.

Mummichogs were captured at all three sampling station types. They made up 28% of the spring catch and 51% of the total mummichog catch. The c/h was 8.8 specimens for the 25 ft seine and 114.3 for the 150 ft.

The Atlantic silverside was taken at five stations. This catch accounted for 8% of all Atlantic silversides taken and 19% of the total spring catch. The c/h was 13.8 specimens for the 25 ft seine and 28 specimens for the 150 ft.

Of all bay anchovies, 5% were collected in the spring. They were taken at nine stations throughout the system; c/h was 2.7 specimens for the 25 ft seine and 18.6 for the 150 ft.

Tidewater silversides were taken at all three types of sampling stations, but most were collected at lagoon stations. The c/h was 3.3 specimens for the 25 ft seine and 1.0 for the 150 ft.

Blueback herring ranked sixth, making up 2% of the spring catch. All were collected at lagoon stations and appeared to be 1 year old.

Atlantic menhaden were seventh in abundance. All except one were taken at lagoon stations, and most were young of the year.

TRAWL RESULTS

Tables 31 through 59 list sampling results by station. See Figures 1 and 2 for station locations and Table 60 for station descriptions. The 10 most abundant species, their number, and percentages of the total trawl catch are given in Table 61. All trawling efforts (427 hauls) yielded 9,730+ specimens of 54 species. Seasonal c/h for these species is given in Table 62. Following is a seasonal account of trawl results.

Summer

One hundred fifty-three hauls resulted in the collection of 4,218+ specimens of 41 species. Thirty-one species were taken in 1973 and 30 in 1974; 23 species appeared in both years. Overall c/h for the summer was 27.6 specimens. Seven species numbered over 100 specimens. Together they made up 92% of the trawl catch. They were bay anchovy (47%), spot (22%), fourspine stickleback (12%), oyster toadfish (3%), silver perch (3%), winter flounder (3%), and weakfish (2%).

The bay anchovy was abundant in the bay and creeks; none were taken in the lagoons. The c/h was 13.2 specimens in 1973 and 12.5 in 1974.

Spot were taken at the bay, creek, and lagoon stations; most were young of the year. The c/h was 5.6 specimens in 1973 and 6.9 in 1974. During the summer, 88% of the specimens were captured with the remaining 12% caught in the fall.

All but 24 fourspine sticklebacks were taken at bay stations. The c/h for 1973 was 2.6 and 4.0 for 1974.

Of all oyster toadfish, 73% were collected in the summer; the c/h was 0.8 specimens in 1973 and 1.0 in 1974.

Winter flounder ranked sixth with 116 specimens; 78% of these were taken at station 5 near Barnegat Inlet with 56 specimens captured in two tows on 14 August 1973. The c/h was 0.7 specimens in 1973 and 0.8 in 1974.

Weakfish were seventh in abundance with 107 specimens taken this season constituting 80% of the total weakfish catch. All but one of these were young of the year. The c/h was 0.9 specimens in 1973 and 0.4 in 1974.

Other species collected primarily during the summer include American eel (59%), black sea bass (60%), bluefish (71%), northern pipefish (51%), summer flounder (63%), and tautog (41%).

Fall

Thirty-two species of fish were taken in 1973 and 14 species in 1974 with 12 species common to both years. In total 1,658 specimens were captured during both years. The c/h was 16.0 specimens for 1973 and 7.5 for 1974. Combined c/h was 13.6 specimens. The difference

between the 2 years was partially due to boat engine failure during most of November and all of December 1974. Bay anchovy, fourspine stickleback, mummichog, spot, and tidewater silverside numbered over 100 specimens. These species made up 70% of the fall catch.

The mummichog ranked first in abundance with 330 specimens; 324 of which were collected in one haul at station 15 in December 1973. Apparently, the trawl was pulled through a school during retrieval. Six were taken at station 16 on the same day. The c/h was 2.7 specimens.

Second in abundance was the bay anchovy. They were taken at all three sampling station types, bay, creek, and lagoon. The c/h was 1.2 in 1973, 5.6 in 1974, and 2.3 overall.

The fourspine stickleback was third with 278 specimens. It also appeared at all sampling station types. The c/h was 3.2 in 1973; the overall c/h dropped to 2.3 as no specimens were collected in 1974.

Spot were taken in October only, 123 in 1973 and 4 in 1974. Of the 14 stations sampled both years, spot appeared at 11 in 1973 and none in 1974. Lower water temperatures in October 1974 may have been the cause. Spot were collected at all sampling station types. The c/h was 1.5 in 1973 and 1.0 overall.

The tidewater silverside ranked fifth with 120 specimens, all collected in 1973 with 118 of these taken in December. It was taken at three stations, Thompson's Creek, Mill Creek, and Lagoon 100. Salinities at the latter stations were 13.48 and 16.48 °/oo, respectively. The c/h was 1.4 specimens in 1973 and 1.0 overall. Absence of the species in the fall of 1974 was possibly due to the fact that no trawling was done in December of that year.

Three important commercial and recreational species captured in the fall were weakfish, white perch, and winter flounder. A total of 26 weakfish were taken, 20 in October 1973 and 6 in October 1974. All appeared to be young of the year.

White perch ranked sixth with 87 specimens. Except for three specimens taken in the bay, all white perch were collected in Mill Creek and two lagoon stations branching off the creek. Salinities at these stations ranged from 10.23 to 19.25 °/oo. Two white perch were taken at station 8 in the bay just off the mouth of Mill Creek and one was collected at station 10 just off the mouth of Cedar Run. Recorded salinities were 30.86 and 28.19 °/oo, respectively. These samples were collected on 5 December 1973. The c/h was 0.7 specimens overall.

There were 70 winter flounder taken, ranging in age from young of the year to 5+ years. The c/h was 0.6 specimens overall.

Winter

In 60 hauls, 13 species numbering 790 specimens were collected. The c/h was 13.2 specimens overall. Due to weather conditions and engine problems, no sampling was conducted in January or February 1975.

The fourspine stickleback accounted for 49% of the winter catch with 300 of 388 specimens netted at station 25 on 27 February 1974. They appeared in all three sampling regions. The c/h was 6.5 specimens.

Second in abundance was the tidewater silverside with 141 specimens; 92% were taken at station 15 on 15 February 1974. The recorded salinity was 12.97 °/oo. They were also taken at station 18 in February and March in salinities of 15.75 and 15.32 °/oo, respectively. The c/h was 2.4 specimens.

Blueback herring ranked third with 69 specimens; 22 were collected at station 25 in February 1974 and 45 at station 11 in March 1975. All specimens appeared to be young of the year. The c/h was 1.1 specimens.

There were 65 white perch taken, 14 in Mill Creek and 51 in Lagoon 77 off Mill Creek. Salinities ranged from 10.41 to 15.75 °/oo. These specimens ranged from young of the year to 9 years old. The c/h was 1.1 specimens.

Winter flounder ranked sixth with 53 specimens; 8 specimens were collected in creeks and 45 in the bay. They ranged from young of the year to 4+ years. More than 60% appeared to be 4 years or older.

Spring

The 92 hauls made yielded 3,040+ specimens of 31 species. Sampling was carried out in June 1974 and April and May 1975. Spring provided the greatest seasonal c/h, 33.1 specimens.

The high c/h was due to the abundance of the bay anchovy; 52% of the total anchovy catch was collected in the spring. Most of these were taken in Dinner Point and Westecunk creeks. The c/h in these creeks was 78.8 specimens; overall c/h for the spring was 26.6 specimens.

Atlantic menhaden ranked second with 291 specimens, all collected in June 1974. This represents 92% of the total menhaden catch. Again, most (98%) were taken in Dinner Point and Westecunk creeks. The c/h in the creeks were 15.8 specimens; overall c/h was 3.2 specimens. All specimens were young of the year. The above species made up 90% of the total spring catch.

The third most abundant species was the Atlantic silverside. The 65 specimens taken during the spring accounted for 35% of all the Atlantic silversides taken trawling. The winter catch was also 35%, with 20% taken in the fall, and 10% in the summer. The c/h for the spring was 0.7 specimens.

Winter flounder ranked fourth with 55 specimens. Most of those captured in June were young of the year. Those collected in April and May ranged from 2 to 5 years old. The c/h was 0.6 specimens.

GILL NET RESULTS

Gill net stations are indicated by a G preceding the trawl or seine station with which they were associated (e.g. GT-2) indicates the gill net station located near trawl station 2 off Marshelder Island). Tables 63 through 70 list water quality data and fish taken at eight stations sampled during the second year of the study (June 1974 to July 1975). Tables 71 through 74 list the number of each species taken seasonally at each station. Three gill net sets were made during the first year of the survey and the results are given in Table 75.

Altogether, 614 specimens representing 21 species of finfish were taken. Two of these, the smooth dogfish and the striped bass, were taken only by gill net.

The Atlantic menhaden was the most abundant species. The 310 specimens collected comprised 50% of the gill net catch. They were taken during the July through December and February through May periods at five stations.

The bluefish ranked second, 78 specimens were taken constituting 13% of the catch. They appeared during the months of July through October and at seven stations.

White perch ranked third, 73 specimens making up 12% of the catch. They were captured from December through May and at three stations, two of which were located in the Beach Haven West lagoon system.

The four most abundant fish was the spot, 66 specimens constituting 11% of the catch. They were taken July through October and at six stations.

The alewife ranked fifth in abundance. Twenty-seven specimens making up 4% of the catch were captured. They were taken in January and again in March through May and at two stations.

COMBINED RESULTS

There were 66 species of finfish taken in the study area. Table 76 lists the number of each species taken by each gear, overall rank, and the percent of the total catch each species comprises. Tables 77 and 78 summarize the species distribution as shown by the capture data for the seine and trawl, respectively. Table 79 describes the capture locations of selected species. Table 80 relates the seasonal occurrence of the finfish species sampled. Twenty-three species are represented by more than 100 specimens. The following is a short account of 13 of these.

Bay Anchovy

The bay anchovy is an euryhaline forage fish found primarily in estuaries and coastal waters. During the survey, 9,700+ specimens, comprising 27% of the total catch, were taken.

The catch was almost evenly split between seine (51%) and trawl (49%). They were collected at 13 of 18 seine stations and 18 of 21 trawl stations. The c/h was 1.2 specimens for the 25 ft seine, 17.7 for the 80 ft seine, 13.8 for the 150 ft seine, and 11.1 for the trawl.

They appeared in the catch 9 months overall. Three were taken by trawling in March. During April through November, they were taken by both gear types. Bay anchovies were most abundant in the summer (July, August, September), 5,480 specimens constituting 55% of the total anchovy catch. The September catch ranked highest overall (3,218 specimens) and seining was the more effective method (2,394 specimens). May was the high month for the trawl catch with 1,650 specimens.

Recorded water quality parameters at which anchovies were taken were: salinity, 2.20 to 31.22 °/oo; water temperature, 4.0 to 30.5°C; and dissolved oxygen, 1.93 to 12.75 mg O_2/1.

Stomach analyses of 29 fish species taken in the area (Festa 1975) showed the bay anchovy to be an important diet item of the bluefish, summer flounder, and weakfish.

Conversely, bay anchovy stomachs contained: fish eggs; polychaetes (*Nereis* sp. and *Polydora* sp.); Crustaceans (amphipods, isopods, tanaids, and Caridean shrimp); insects (Chironomidae larvae); and nematodes.

Atlantic Silverside

The Atlantic silverside is another important euryhaline forage species. It ranked second in abundance in the study area, 9,330 specimens comprising 26% of the catch.

Seining accounted for 98% of the catch and trawling 2%. It was taken at 17 of 18 seine stations and 13 of 21 trawl stations. The c/h was 9.0 for the 25 ft seine, 21.6 for the 80 ft seine, 172.4 for the 150 ft seine and 0.44 for the trawl. Atlantic silversides appeared in all months in both types of gear. Most (57%) were captured in the summer (July, August, September) followed by fall (30%), spring (9%), and winter (2%). Water quality parameters recorded when Atlantic silversides were taken were: salinity, 1.00 to 31.81 °/oo; water temperature, 0.5 to 30.5°C; and dissolved oxygen, 3.16 to 12.74 mg O_2/1.

Regarding the food web study, the only positive identification of the Atlantic silverside was in striped bass stomachs. However, *Menidia* sp. were found in bluefish and northern sennet. Other species taken in the study area and known to feed on Atlantic silversides are the summer flounder and weakfish.

Atlantic silverside stomachs contained: polychaete remains; Crustaceans (amphipods, decapods, mysids, calanoids, and harpacticoids); nematodes; Hydrozoans; and diatoms.

Fourspine Stickleback

The fourspine stickleback ranked third overall. The 5,224 specimens taken constituted 14% of the total catch. Of these, 77% were taken by seine and 23% by trawl. They appeared at 15 of 18 seine stations and 18 of 21 trawl stations.

The c/h was 0.5 for the 25 ft seine, 0.7 for the 80 ft seine, 114.8 for the 150 ft seine, and 2.7 for the trawl. They were taken in all months of the year by both gear types. Most were taken in summer (48%) followed by spring, winter, and fall. Recorded water quality parameters at the time of capture were: salinity, 1.00 to 30.86 °/oo; water temperature, -1.0 to 29.0°C; and dissolved oxygen, 0 to 12.87 mg O_2/1.

Fourspines were utilized as food by the following species: Atlantic needlefish, oyster toadfish, spotted hake, weakfish, and white perch.

The fourspine stickleback fed on: fish eggs; annelids (polychaetes and oligochaetes); Crustaceans (amphipods and isopods); mollusks (gastropods and bivalves); and Platyhelminthes (Turbellarians).

Mummichogs

Mummichogs (2,559 specimens) made up 7% of the total catch; 87% were collected by seine, 13% by trawl, and 4 specimens by gill net. Of the 331 mummichogs taken in the trawl, 324 were captured in one tow at station T-15 in December 1973. They appeared at 16 of 18 seine stations and 3 of 21 trawl stations. The c/h was 5.9 for the 25 ft seine, 3.8 for the 80 ft seine, 27.2 for the 150 ft seine, and 0.8 for the trawl.

Mummichogs were captured year round seining and in July and December trawling. Most (48%) were taken in spring (April, May, June) followed by fall, summer, and winter. Recorded water quality ranges for this species are: salinity, 3.95 to 30.32 °/oo; water temperature, 3.0 to 33.0°C; and dissolved oxygen, 2.36 to 13.20 mg O_2/1.

Although no mummichogs were positively identified, *Fundulus* sp. were found in 10% of the mummichog and 3.5% of the white perch stomachs. Some other species known to feed on mummichogs are bluefish, striped bass, summer flounder, and weakfish.

Mummichogs are omniverous. Festa (1975) found other *Fundulus* species, amphipods, decapods, nematodes, and plant remains in mummichog stomachs.

Tidewater Silverside

Fifth in abundance was the tidewater silverside, 2,215 specimens constituting 6% of the catch. Seining accounted for 88% of the catch and trawling 12%. They were collected at 13 of 18 seine and 5 of 21 trawl stations. The c/h was 4.3 specimens for the 25 ft seine, 7.2 for the 80 ft seine, 21.8 for the 150 ft seine, and 0.6 for the trawl.

They were taken in all months except March by seine and in February, March, July, November, and December by trawl. Of the total catch, 65% were taken in the fall, followed by summer, winter, and spring. Water quality parameters recorded when tidewater silverside were taken were: salinity, 1.00 to 25.95 °/oo; water temperature, 1.0 to 33.0°C; and dissolved oxygen, 0.00 to 12.50 mg O_2/1.

No tidewater silversides were positively identified in the fish stomachs studied, however, *Menidia* sp. were found in bluefish and northern sennet. Striped bass, summer flounder, and weakfish also feed on these silversides.

Stomach of this species contained: fish remains, Gammaridean remains, copepods, Cladocerans, Cumaceans, Acarians, Turbellarians, insect remains, diatoms, and other unidentified algae.

Spot

Spot were sixth in abundance; 1,760 specimens making up 5% of the catch. Captured spot ranged from 3 to 18 cm. The larger ones were in their second summer. Length frequencies for 620 spot are given in Tables 81 and 82. Most were taken trawling (64%), 32% were taken seining, and 4% by gill nets. They appeared at 13 of 18 seine stations, 19 of 21 trawl stations, and 7 of 8 gill net stations. The c/h was 0.1 for the 25 ft seine, 14.6 for the 150 ft seine and 2.5 for the trawl.

They were captured June through October, 90% being captured in the summer, followed by fall (8%) and spring (2%). Recorded water quality ranges at the time of capture were: salinity, 4.69 to 29.88 °/oo; water temperature 12.2 to 29.0°C; and dissolved oxygen, 0.65 to 10.34 mg O_2/1.

Spot were found in bluefish and oyster toadfish stomachs.

Spot feed primarily on amphipods, especially *Ampelisca* sp. and other Gammarideans; polychaetes, copepods (harpacticoids and calanoids), and mysids (*Neomysis americana*).

Atlantic Menhaden

Atlantic menhaden ranked seventh, 798 specimens constituting 2% of the catch. Most of these were juveniles, ranging from 3 to 15 cm. See Table 83 for length frequency.

Of the total, 22% were captured by seining, 39% trawling, and 39% in the gill net. They appeared at 7 of 18 seine stations, 6 of 21 trawl stations, and 6 of 8 gill net stations. The c/h was 0.5 for the 25 ft seine, 2.3 for the 150 ft seine, and 0.7 for the trawl.

They were taken in all months of the year. Nine specimens (1%) were taken in winter, one in January, one in February, and seven in March. Of the total, 48% were taken in spring, 42% in summer, and 9% in fall. Recorded water quality ranges for this species were: salinity, 1.87 to 27.85 °/oo; water temperature, 4.0 to 29.0°C; and dissolved oxygen 0.00 to 12.70 mg O_2/1.

Atlantic menhaden were found in bluefish stomachs. They are also eaten by striped bass and weakfish.

All menhaden stomachs analyzed contained diatoms and other algal species; 20% contained calanoid copepods.

Banded Killifish

The banded killifish was eighth in abundance. The 545 specimens made up 2% of the catch. All except one specimen were taken by seine. They appeared at 9 of 18 seine stations and one trawl station. The c/h was 2.7 for the 25 ft seine.

They appeared 11 out of 12 months, none being taken in December; 60% were captured during the summer; 35% in the fall, 2% in the winter, and 1% in the spring. Water quality parameters at time of capture ranged from: salinity, 1.00 to 27.90 °/oo; water temperature, 2.0 to 29.0°C; and dissolved oxygen 0.78 to 12.74 mg O_2/1.

Fundulus spp. were found in mummichogs and white perch stomachs.

Banded killifish stomachs contained: polychaete remains, Gammaridean amphipods, isopods, Cumaceans, nematodes, and diatoms.

Silver Perch

Silver perch ranked ninth, the 492 specimens constituting 1% of the catch. Those measured were primarily young of the year. See Tables 84 and 85 for length frequency. Of the total, 66% were collected by seining and 33% by trawling; four specimens were caught by gill net. They appeared at 6 of 18 seine stations, 12 of 21 trawl stations, and 2 of 8 gill net stations. The c/h for the 25 ft seine was 0.2, for the 80 ft seine 0.4, for the 150 ft seine 8.4, and for the trawl 0.4.

They were taken July through November; 85% were captured in the summer and 14% in the fall. Recorded water quality parameters at time of capture were: salinity, 22.43 to 30.41 °/oo; water temperatures, 7.5 to 25.5°C; and dissolved oxygen 5.90 to 9.31 mg O_2/1.

Silver perch were found in summer flounder stomachs.

They fed on unidentified fish, gastropods (*Bittium* sp.), decapods (*Crangon septemspinosa*), and mysids (*Neomysis americana*).

Winter Flounder

Winter flounder were 10th in abundance, the 342 specimens constituting 1% of the total catch; 15% were taken by seining and 85% by trawling. They were captured at 9 of 18 seine stations and 20 of 21 trawl stations. None were taken at T-26 in Thompson's Creek. The c/h was less than 0.1 for the 25 ft and 80 ft seines, 0.9 for the 150 ft seine, and 0.7 for the trawl.

Winter flounder were found year-round in the study area. Of the total, 43% were collected in the summer, 22% in the fall, and 17% each in winter and spring. Recorded water quality ranges at the time of sampling were: salinity, 1.25 to 31.80 °/oo; water temperature, -1.0 to 28.5°C; and dissolved oxygen 3.94 to 12.56 mg O_2/1.

Winter flounder stomachs contained: naked gobies; many species of annelids and nematodes; amphipods, decapods, Cumaceans, mysids and Brachyuran crabs; and many mollusks. Bivalve siphons, primarily *Mercenaria mercenaria*, were found in 28% of all winter flounder stomachs.

Length frequency data for the winter flounder is listed in Tables 86 and 87.

White Perch

White perch ranked 12th in abundance, the 293 specimens composing 1% of the total catch. They were taken by all three gear types: seine (9%), trawl (66%), and gill net (25%). They were captured at 4 of 18 seine stations, 6 of 21 trawl stations, and 3 of 8 gill net stations. The c/h was 0.1 for the 25 ft seine and 0.4 for the trawl.

Perch were taken year-round trawling, primarily in the summer by seine and in the winter by gill net. Overall 41% were taken in the winter, 10% in the spring, 17% in the summer, and 32% in the fall. Water quality parameters at which perch were taken were: salinity, 1.00 to 30.86 °/oo; water temperature 0.5 to 29.0°C; and dissolved oxygen 0.00 to 10.72 mg O_2/1.

While some fish and fish eggs were found in white perch stomachs, invertebrates made up most of their diet. Annelids, primarily polychaete remains, were found in 28% of the stomachs examined. Crustaceans were the most abundant food item. In descending order of occurrence those identified were: mysids - (*Neomysis americana*); decapods - (*Crangon septemspinosa*); amphipods - (*Gammarus fasciatus* and *Leptocheirus plumulosus*); and calanoid copepods.

Bluefish

Bluefish ranked 17th with 153 specimens. They were taken by all three types of gear; seine (38%), trawl (11%), and gill net (51%). Bluefish were captured at 11 of 18 seine stations, 8 of 21 trawl stations, and 7 of 8 gill net stations. The c/h was less than 0.1 for the 25 ft seine and the trawl and 1.1 for the 150 ft seine.

Of the 128 specimens measured, 124 were probably young of the year. See Table 88 for length frequency. They appeared June through October, 89% of these July through September with 50% in August. Recorded water quality ranges at the time of capture were: salinity, 1.00 to 29.88 °/oo; water temperature, 2.5 to 28.5°C; and dissolved oxygen 0.00 to 10.72 mg O_2/1.

Fish remains were found in 54% of the bluefish stomachs examined. Those species identified are: bay anchovy, Atlantic menhaden, silverside species, and spot. Invertebrates found include *Nereis* spp., *Crangon septemspinosa, Palaemonetes vulgaris, Neomysis americana,* and Brachyuran crab larva.

Weakfish

Nineteenth in abundance was the weakfish with 139 specimens. They were most abundant in trawl samples with 133 specimens (96%) taken. Three weakfish were taken by seine and three in the gill net. They were taken at 3 of 18 seine, 17 of 21 trawl, and 1 of 8 gill net stations. The c/h was 0.31 for the trawl. They were present August through October, with most specimens (94) being taken in August. Water quality parameters at the times when weakfish were taken were: salinity, 13.82 to 29.05 °/oo; water temperature, 14.01 to 27.0°C; and dissolved oxygen, 1.44 to 9.26 mg O_2/1.

Fish remains were found in 50% of the weakfish stomachs examined; the only identifiable species was the bay anchovy. The three most important forage invertebrates in decreasing order are: *Neomysis americana, Crangon septemspinosa,* and *Ampelisca* spp. Others are *Callinectes sapidus* and Xanthidean crab remains.

Length frequency data for weakfish is listed in Tables 89 and 90.

SUMMARY

The fish population of the Manahawkin Bay - Little Egg Harbor system was sampled July 1973 through May 1975. The following gear was utilized: a 25 ft x 5 ft bag seine, an 80 ft x 6 ft bag seine, a 150 ft x 10 ft bag seine, a 16 ft bottom trawl, and a 125 ft x 6 ft experimental gill net.

The 18 seine stations were sampled at various times. Seven of these were located in the bay, five in creeks, five in lagoons, and one in a tidal pool on the salt marsh. A total of 278 seine hauls were made; 48 species of finfish numbering 25,662+ specimens were taken. The c/h for the 25 ft seine was 33.4 specimens, for the 80 ft seine 77.5, and for the 150 ft seine 447.9. The 10 most abundant species numbered 24,118 specimens and made up 97% of the seine catch.

There were 21 trawl stations sampled; 12 were bay stations, 7 were creek stations, and 2 were lagoon stations. Fifty-four species of finfish totaling 9,730 specimens were collected in 427 trawl hauls. The c/h was 22.6 specimens. The 10 most abundant species totaled 8,765 specimens and constituted 90% of the trawl catch.

Eight gill net stations were located in the bay, one in Dinner Point Creek, and four in lagoons; 21 species of finfish numbering 614 specimens were captured. Two of these, the smooth dogfish and the striped bass were taken only by gill net. The five most abundant species numbered 554 specimens and made up 90% of the catch.

Altogether, 66 species of finfish totaling 35,989+ specimens were taken. The five most abundant species were: bay anchovy, Atlantic silverside, fourspine stickleback, mummichog, and tidewater silverside. These five made up 80% of the total catch.

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PHASE II, PHYSICAL-CHEMICAL STUDIES

John F. Makai

ABSTRACT

The purpose of this portion of the study was to map and/or describe the physical and chemical attributes of the Manahawkin Bay - Little Egg Harbor system.

Thirty-four water quality stations were selected and scheduled accordingly to be sampled bimonthly, monthly, and/or seasonally from July 1973 until February 1974 and from June 1974 until May 1975. The following parameters were measured: temperature, tidal stage, water depth, dissolved oxygen, salinity, pH, carbon dioxide, transparency, ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, detergent, B.O.D., orthophosphate, and total and fecal coliforms.

During the two survey periods, water temperatures ranged from -2.7 to 30.5° C. Dissolved oxygen ranged from 0.0 to 17.1 mg O_2/1. The pH ranged from 5.7 to 10.0. Salinity ranged from 0.3 to 32.0 °/oo. Carbon dioxide ranged from 0.0 to 36.3 mg CO_2/1. Secchi disc depth measurements ranged from 3 inches (in) to 11 feet (ft). B.O.D. levels ranged from 0.0 to >12.2 mg O_2/1. Nitrite nitrogen ranged from 0.0 to 0.036 mg NO_2-N/1 and nitrate nitrogen ranged from 0.0 to 3.98 mg NO_3-N/1. Ammonia levels ranged from 0.0 to 0.4 mg NH_3-N/1. Orthophosphate ranged from 0.0 to 0.17 mg PO_4-P/1. Detergent concentrations ranged from 0.0 to 0.34 mg/1. Bacterial analysis showed coliform counts ranging from < 3 to 4,600 most probable number per 100 ml (MPN/100 ml), and fecal coliform counts from < 3 to 2,400 MPN/100 ml.

Slight traces of DDT and its metabolites were detected in 84.6% of the fish, with values ranging up to 17.0 ppb. Only 20% of the shellfish meat showed any traces. Of the sediment samples, 76.6% did show traces of DDT and its metabolites with concentrations ranging up to 69 ppb. The other insecticide observed was heptachlor epoxide, detected in 33.3% of the samples.

Heavy metal analysis of fish, shellfish, and sediment samples showed that cadmium, chromium, lead, zinc, and mercury were present. In the fish samples, only slight traces of cadmium and chromium (<0.01 ppm) were detected. Lead ranged from 0.0 to 6.1 ppm, zinc from 5.65 to 16.85 ppm, and mercury from 0.0 to 0.4 ppm. In the shellfish meat, only slight traces of chromium (<0.01 ppm) were detected. Cadmium ranged from <0.01 to 0.75 ppm; lead ranged from 0.0 to 5.7 ppm; zinc ranged from 2.5 to 20.0 ppm; and mercury from 0.0 to 0.29 ppm. In the sediment samples, cadmium ranged from 0.0 to 3.0 ppm; chromium from 3.0 to 50.0 ppm; lead from 0.0 to 297.5 ppm; zinc from 2.0 to 66.6 ppm; and mercury from 0.0 to 2.75 ppm.

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William Andrews for their fine effort in conducting most of the field work; and to Student Assistant Richard Lyons, who aided in the collection of water samples and analysis.

INTRODUCTION

Over the years, New Jersey's coastal areas have become a significant real estate frontier. The tremendous demands by individuals to have homes built near direct access to the water system had brought development to an all-time record. However, suitable construction sites have become exhausted and the trend now would be to dredge-fill wetlands to provide lagoon-type real estate. Lagoons are usually bulkheaded to prevent erosion and allow for boat dockage.

The importance of marshland in an estuarine ecosystem has been well documented. De la Cruz (1973) stated that every square meter surface of marsh, regardless of geographic location, produces about the same amount of organic material annually and will supply the same biomass of detritus to the estuarine food chain. Therefore, it is evident that the secondary productivity of coastal waters manifested in the productive fisheries and shellfisheries is dependent on the biological process occurring on the marshes.

Gagliano (1974) determined that losses of marsh areas or disturbances of the marsh in ways which limit food production will cause reduction of stocks dependent on those food resources. The direct loss of good habitat with the rise of artificial areas (lagoons) has made it necessary to evaluate such an area as to what role this would now play in the food web.

The objective of this study is to evaluate the importance of the Manahawkin Bay - Little Egg Harbor system by determining population utilizations and conditions. Special emphasis will be placed on comparing an artificial area to a natural area. Such information could be used to help maintain coastal waters at a level which would allow their continued use as spawning, nursery, and harvest areas.

MATERIALS AND METHODS

The Manahawkin Bay - Little Egg Harbor system study area originally was planned to include all water acreage from Beach Haven Inlet (lower boundary) to Barnegat Inlet (upper boundary). Since the studies of the upper Barnegat system (Makai 1973) had ended at Barnegat Inlet, the new survey should have continued from there. However, in December (during the first survey period), it was decided to reduce the study area and designate Sandy Island as the upper boundary.

Field sampling was conducted during July 1973 to February 1974, and from June 1974 to May 1975. During these two survey periods, 34 water quality stations were selected and scheduled accordingly to be sampled bimonthly, monthly, and/or seasonally. A special emphasis was placed in comparing a habitat that has already been developed (artificial) to a natural area. This artificial system will be defined as wetland and uplands that have, after dredge-fill operations, been created into lagoon-type real estate development.

Dinner Point Creek and the drainages from Meyers Pond and Oyster Point were chosen as the "natural" area. It was felt that close proximity of the two systems would allow for a good comparison of habitat.

Location of all stations can be seen in Figures 3, 4, and 5 (all figures for this report in Appendix A). Due to the shallowness of this system, most bay stations were located in the channel of the Intracoastal Waterway. This allowed for both surface and bottom sampling.

Sixteen chemical and physical parameters measured were divided as follows.

Hydro Run Surveys

Bimonthly sampling of surface and bottom waters were conducted at 31 stations during maximum flood and ebbing tides. The survey area was divided into three sampling frequencies: (1) the entire bay region (9 stations) and the mouths of Dinner Point Creek, Mill Creek, and Beach Haven West Complex; (2) Dinner Point (4 stations) and Mill Creek (7 stations); and (3) Beach Haven West Lagoon Complex (11 stations). During this survey, the following parameters were measured: temperature, tidal stage, water depth, dissolved oxygen, pH, salinity, carbon dioxide, and Secchi disc depths.

Most of the 31 stations corresponded to the seining, trawling, and gill netting stations selected in the fish study. The above water quality data were also collected during all field work of the fish survey.

Nutrient Collections

Surface water samples were collected monthly at 21 of the 34 stations during a falling tide. Two 1,000 ml polyethylene bottles were filled at each station. During the first survey period (July 1973 - February 1974), one bottle was fixed with 40 mg of mercuric chloride. Continuously high nitrate nitrogen results forced a change in fixing agents (1 ml of H_2SO_4). Both bottles were stored in a cooler packed with ice during field collections. All samples were stored in a refrigerator or ice chest (depending on availability) and transported early the following morning to the Lebanon Laboratory for immediate analysis. Water samples were tested for ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, orthophosphate, detergent (all usually within 96 hours after collection), and B.O.D. levels.

Bacterial Monitoring Program

Seasonal sampling was conducted at 27 of the 34 water quality stations. Collections were taken 18 in below the surface, in sterilized 6 oz. glass bottles, during a flood tide. Within 1 hour of completing the survey, samples were taken to the Bureau of Shellfish Control at Leeds Point for evaluation.

Tributary Survey

Five major tidal creeks situated within the study area were also chosen to be seasonally sampled during both a flood and ebb tide. Such systems were Tuckerton Creek, Thompson Creek, Parker Run, Westecunk (West) Creek, and Cedar Run. The parameters measured were temperature, water depth, tidal stage, salinity, pH, dissolved oxygen, Secchi disc depth, and carbon dioxide.

Twenty-four Hour Tidal Survey

A 24 hour monitoring program was conducted seasonally in Dinner Point Creek and Beach Haven West (System A - mouth of Lagoon 08). Parameters measured hourly

were as follows: tidal stage, temperature, oxygen concentrations, salinity, and Secchi disc depths (as daylight permitted). Gill netting and plankton sampling were also included during this survey.

Pesticide and Heavy Metal Survey

Selected fish, shellfish, and sediment samples were analyzed for both pesticides (chlorinated hydrocarbons) and heavy metal (mercury, cadmium, lead, chormium, and zinc) concentrations. Species of fish chosen were: oyster toadfish, winter and summer flounder, white perch, menhaden, and spot. Shellfish collected were the ribbed mussels and hard clam. Composite samples (20 g) of each species were placed in plastic (polyethylene) bags and kept frozen until time of analysis.

Sediment samples were collected periodically through the summer months (1974-1975 period) with a 6 in Eckman bottom dredge. All samples were placed in plastic pint containers while in the field. Within 24 hours after collection, excess water was decanted from the sample. The remainder (mud) was placed in a drying oven at 70°C (158 °F). The dry residue was then pulverized and stored in 6 oz. wide mouth glass jars until analyzed.

Isohaline and Isotherm Distribution Study

Two simultaneous transects, initiating in Beach Haven Inlet and running north to Sandy Island, were conducted during two flood and ebbing tides. Surface water temperatures and salinity levels were measured during June and July at selected stations within the bay.

Water temperatures were recorded with a FT_3 Marine Hydrographic Thermometer and salinity levels were measured by titration with $AgNO_3$ (silver nitrate) for chlorinity and converted using Knudsen tables.

Laboratory Equipment

Most of the equipment and procedures used in testing water samples have been described in Makai (1971, 1973). However, there were some changes which shall be noted here.

All of the following analytical procedures are according to Standard Methods (American Public Health Association 1971).

Ammonia Distillation Method

Nitrite Nitrogen - Naphthylamine - Sulfanilic Acid Method

Nitrate Nitrogen - Ultraviolet Spectrophotometric Method

Orthophosphate - Stannous Chloride Method

Detergents - Methylene Blue Method (ABS)

B.O.D. (Biochemical Oxygen Demand) 5 day test

Total and fecal coliform counts - tests determined by New Jersey Bureau of Shellfish Control

Nitrate nitrogen levels were detected on a Beckman DB-4V (visible spectrophotometer). All other colorimetric tests were run with a Bausch and Lomb Colorimeter Spectronic 20.

All pesticide samples (chlorinated hydrocarbons) were analyzed by the New Jersey Health Department with a Microtek 220 Electron Capture Gas Chromatograph equipped with a tritium detector. Samples were injected on three different columns (OU-17, SE-30, and OU-210) in order to verify and confirm the presence of pesticides in the sample. The method used to extract the pesticides in the sample is the official procedure found in the Methods of Analysis of the Association Official Analytical Chemist (Assoc. Official Anal. Chem. 1975).

All heavy metal levels (Pb, Cd, Cr, and Zn) except mercury, were measured on a Perkin Elmer Model 303 Atomic Absorption Spectrophotometer according to methods listed in Standard Methods (13th edition). Mercury levels were detected with a Perkin Elmer Model 303 Atomic Absorption Spectrophotometer according to methods listed in A.O.A.C. (1973, Vol. 56, No. 2).

Transparency - Secchi disc (30 cm)

Seven Model D Waterproof Ryan Thermographs were used to record year-round water temperature data. This instrument has a recording span of 45 days and two centigrade ranges: -5^{o} to $+25^{o}$ and $+10^{o}$ to 40^{o}C. In order to change temperature ranges, the recorder had to be sent back to the company for calibration.

All recorders were housed in a protective pipe assembly (Makai 1971). Only six recorder stations were selected and the seventh instrument was used as a spare. Location and depth were as follows: Beach Haven Inlet - Flashing Light, Red no. 92 (15 ft); Little Egg Harbor - Long Point (14 ft); Manahawkin Bay - Flashing Light no. 6 (6 ft); Lower Barnegat - Flashing Light no. 73 (7 ft); Beach Haven West - System A, Lagoon no. 08 (7 ft); and Dinner Point Creek (3 ft).

Tidal data was obtained from the Coast and Geodetic Survey Tide Tables Atlantic Coast of North America (U.S. Department of Commerce 1973, 1974, 1975). Coast and Geodetic Survey Charts with a scale of 1:24,000 and Nautical Chart 824-SC (1:40,000) were used for all bay and tributary morphometric measurements.

Linear measurements were obtained with the use of a map rotometer. All area measurements were computed with a Keuffel and Esser Compensating Polar Planimeter. Profiles were mapped with a Bendix Fathometer.

Description of Area

The Manahawkin Bay - Little Egg Harbor watershed study area consisted of all water acreage of the Little Egg Harbor Bay, Manahawkin Bay, drainages of Dinner Point, Meyers Pond, Popular Point, Mill Creek, Beach Haven West Lagoon Complex, and other tributaries such as Tuckerton Creek, Thompson Creek, Parker Run, Westecunk Creek, and Cedar Run. This was a total of 26,247 acres surveyed; Little Egg Harbor - Manahawkin Bay comprising 97.4% of the total.

This estuarine system is located in the southern portion of Ocean County and is separated from the Atlantic Ocean by the land barrier Long Beach Island. The only access to the ocean from this area would be either through Beach Haven Inlet or Barnegat Inlet via Oyster Creek Channel and/or Double Creek Channel.

Islands and flats near Barnegat Inlet restrict the amount of tidal water entering or leaving the bay. Currents within this inlet are found to be rapid (4.2 ft/sec). It was reported by Ichthyological Associates (1972) that the tidal flow enters the inlet and splits into a northward flow to Bayhead and a southward flow to the Manahawkin Causeway.

Beach Haven Inlet allows more tidal exchange as compared to Barnegat Inlet. Storm conditions are constantly altering the channel configuration in the inlet and eventually effect the flow pattern. Such changes greatly determine the shape of the southern tip of Long Beach Island.

According to Charlesworth (1968), the flood current pattern in the Intracoastal Waterway channel behind the barrier island is the major entering channel, as well as issuing channel, and Marshelder Channel is of intermediate importance. Some minor flow also passes through the numerous islands via Barrel, Middle, and Hither channels.

Charlesworth also reported that the ebb current pattern in south Little Egg Harbor is interpreted to be that of a tidal drain, with the greatest centripetal drainage into the Intracoastal Waterway section behind the barrier island between Beach Haven and Holgate. Flow through Marshelder Channel from the southwest portion of Little Egg Harbor would be the next major drainage area. Table 91 lists maximum observed current velocities in the vicinity of Beach Haven Inlet (Table 91 through 171 which are associated with this report, are located in Appendix B.) The tidal flow through Manahawkin Bay and Little Egg Harbor is in a north-south direction. The tide is of the semidiurnal type; there are two flood and two ebb tides in a normal day. Tidal influence extends to the Manahawkin Causeway. The high water difference is 3 hours and 17 minutes from Little Egg - Beach Haven Inlet. The tidal range is 1.5 - 2.6 ft. North of the Manahawkin Causeway, the tidal range is smaller, 0.8 - 1.5 ft.

The bay system is very shallow. At mean low water, the bay depth ranges from 0.5 to 34 ft. From the 25,563 water acres, 88% are 6 ft or less in depth. Access through the 18 mile (statute) study area is provided by the Intracoastal Waterway which extends from Beach Haven Inlet northward along the eastern portion of the bay as far as channel light Flashing Red "34" (Brant Beach area). From here, it runs northwest to the Manahawkin Causeway and changes again to a northeastern direction, which eventually leads to the lower Barnegat Bay region. A smaller channel running, parallel with the shore line, allows access to the western portion of the bay (Long Point northward to Manahawkin Causeway).

The land barrier Long Beach Island is approximately 21 miles long. The eastern bay shore is heavily developed; however, there are portions of this island that still contain undisturbed beaches, dunes, and marshes. The only access to Long Beach Island is by the Manahawkin Causeway. A great deal of the western bay shore still remains natural marsh. It is estimated that a total of 15,922 acres of wetlands are located within the study area. Portions of this total acreage are part of the Great Bay Boulevard Wildlife Management Area (3,789 acres) and Manahawkin Wildlife Management Area (965 acres); both are managed by the Division of Fish, Game, and Shellfisheries. Also included are Federally owned and/or managed property such as the wetlands extending south of Mill Creek (3,800 acres) and the Gunning River Refuge (3,506 acres) which is adjacent to the Manahawkin tract.

VEGETATION -- According to the Wetlands Inventory conducted by the New Jersey Department of Environmental Protection, 12 plant species have been identified on wetland maps for the study area: *Spartina alterniflora* (tall and short salt marsh cordgrass); *Spartina patens* (saltmeadow cordgrass), *Iva frutescens* (hightide bush), *Baccharis halimifolia* (sea myrtle), *Distichlis spicata* (spike grass), *Juncus gerardi* (block grass), *Panicum virgatum* (switch grass), *Scirpus olneyi* (olvey's bulrush), *Phragmites australis* (common reed), *Typha* spp. (cattail), and *Spartina cynosuroides* (salt reed grass).

MARINE PLANTS -- There is very little information on the benthic flora for the Manahawkin Bay - Little Egg Harbor system. Studies have been conducted on marine algae for the Barnegat Bay system. Both Moeller (1964) and Loveland et al. (1971, 1972) have identified and listed marine algae for that system. Loveland (1969) reported that most algae in Barnegat Bay appear to be unattached and great masses of the dominant species drift with the currents along the bottom. From the total of 119 benthic algae species he identified, only 16 occurred over 50% of the time. The more dominant species included *Ceramium fastigiatum, Gracilaria verrucosa, Ulva lactuca, Agardhiella temera,* and *Codium fragile.*

It has been reported by the New Jersey Department of Environmental Protection during a bay scallop population study that beds of eel grass, *Zostera marina*, extend from Marshelder Island along the eastern portion of the bay northward into Barnegat Bay. During ecological studies conducted in the Little Egg Harbor area by Ichthyological Associates (1973), it was reported the area off Beach Haven Heights had sparsely rooted *Zostera marina* and *Fucus* sp. Floating mats of *Ulva lactuca* (sea lettuce) were found to be very abundant. It was also reported both rooted (extensive beds) and floating *Zostera* were present in the water area off 14th Street, Ship Bottom. *Entermorpha* and *Ulva* were also present. McCurdy (1971) reported, while collecting sediment samples, finding both *Zostera* and *Codmium* in the waters near Surf City. *Gracilaria* was also identified in the Tuckerton Cove area.

Ichthyological Associates also reported *Zostera* beds near Cedar Run. *Fucus* was found along the banks, and *Ulva* was observed floating throughout the area. Near the mouth of Parker Run, beds of *Zostera* were also present. *Fucus* was reported to be attached to the banks, and *Agardhiella* sp. and *Ulva* floating throughout the area. In Beach Haven Inlet, floating *Fucus, Zostera,* and *Ulva* (not rooted) were reported.

Sisson (1968) reports that *Codium fragile* (Japanese oyster weed) will attach itself to any hard substrate including live oysters, oyster shells, mussels, sea scallop, and bay scallops. It has caused mortality to the oyster and scallop population in Rhode Island waters. So far, it has become a nuisance on the clam beds of Barnegat Bay and Little Egg Harbor. The presence of *Zostera* and *Ruppia* within an estuary is important because they are primary producers that provide food for aquatic organisms (Odum 1961).

MARSHLAND DEVELOPMENT -- Since the implementation of the Wetlands Act of 1970, New Jersey has sought to control the permanent alterations or loss of remaining coastal wetlands. Ferrigno (1973) reported that during the past 20 years, 23.5% of the 263,000 acres of tidal marsh in New Jersey have been lost to development. There are several forms of alteration; usually the most obvious is dredging and filling activities. The main purposes for dredge and fill operations are to provide: (1) land for housing development and access to coastal bays and

rivers; (2) land for industrial development and access for transportation; and (3) navigational channels.

In a study conducted by Nieswand et al. (1972), it was reported that over 90% of the total lagoon developments along the New Jersey shore are located within Ocean County. Ferrigno (1972) reported from a total of 37,007 acres surveyed, 26,078 acres or 70.5% of the tidal marsh are still remaining.

Within the study area, there are 15,922 acres of tidal marshland (including all State and Federally owned land). This southern portion has had little development as compared to the remainder of the county (Makai 1973). Ferrigno (1974) reported that 2,139 acres of riparian land extending from Marshelder Channel to the Manahawkin Causeway (Route 72) had been filled. This development has been restricted primarily to the Manahawkin and Tuckerton areas. In this type of situation, development is referred to as "lagoon type-single family summer dwelling".

It is interesting to note that within the Manahawkin area, Beach Haven West Lagoon Complex (Stafford Township) comprises 1,038.3 acres or 49% of the 2,139 acres of wetlands reported to have been filled. In 1972, it was reported this area provided development for a total of 3,625 lots and 1,989 homes. Presently, at least 3,000 homes have been constructed.

Of the 62 lagoon systems (Ocean County) identified by Nieswand et al., 16 were situated within the study area. This would account for a total of 2,061.6 acres of lagoon systems. This would be 25% of the total lagoon development acreage that has taken place within this county. This was estimated to be 48,000 ft of developed shoreline. The total length of these lagoons was 221,950 ft and having the capacity for 7,106 homes. At present, there must be nearly 4,000 built.

The Nieswand et al. study also points out that Stafford and Little Egg Harbor Townships contain a relatively larger amount of lagoon development; Tuckerton and Long Beach contain a significant amount of lagoon development; while Union, Harvey Cedars, Ship Bottom, and Beach Haven contain relatively little lagoon development. The only municipalities having shoreline but no lagoon development in this area were Surf City and Eagleswood.

SEWAGE TREATMENT PLANTS -- Lagoon-type developments provide not only access to coastal areas, but also accommodate a great number of people in relatively small areas. A great majority of these homes were originally constructed for recreational usage or summer housing. Previously, treatment plants usually could handle year-round loads; however, more of these summer homes are now being converted into permanent dwellings. The ever-increasing number of people living in the area during the summer as well as year-round has produced overloads that septic systems and existing treatment plants cannot handle. This has generated great concern about the water quality conditions within our tidal bays and tributaries. Such conditions may threaten the propagation and harvesting of shellfish within these waters. A very good example of this kind of problem is found in the tidal waters of Raritan Bay.

The water quality of our coastal waters are now protected by the New Jersey Department of Environmental Protection and the U.S. Environmental Protection Agency. In the past, most coastal homes were serviced by septic systems. State regulations covering the installation of wastewater facilities in critical areas, dated January 15, 1972, prohibit septic tank construction in New Jersey below

elevation 10.0 (feet) U.S.C. and G.S. and in other critical areas which are defined as those that at one time were below elevation 10.0 and have since been filled above elevation 10.0.

Some of the effects of Federal and State requirements in Ocean County are reported by Fellows, Reed, and Weber (1973a, b): (1) several areas in the county have been condemned for shellfishing; (2) coastline communities which have in the past stored sludge during the summer for discharge to the ocean during the winter months have been placed under court order to stop this practice; and (3) the adoption of new stringent water quality standards by the State and the U.S.E.P.A. have precluded construction of even tertiary treatment plants which would discharge into the streams of the county.

Ocean County is now in the process of updating existing treatment facilities, providing sewer lines, and proposing that all regional processing facilities (secondary treatment) have ocean discharge. Ocean outfalls have been proposed for the northern (via Mantoloking Borough), central (via Berkley Township), and southern (via Surf City Borough) areas within the county.

The following are also planned:

1) Barnegat Light and Harvey Cedars - A collection system has been proposed for the entire area of both boroughs.

2) Beach Haven - This borough has been reported to be completely serviced with sewer lines. The existing primary treatment plant is servicing both the Borough of Beach Haven and the Holgate section of Long Beach Island and discharging the effluent into the Atlantic Ocean. It is expected that the facility will be abandoned upon completion of the proposed regional system.

3) Ship Bottom and Surf City - These boroughs are also completely serviced with sewer lines, and the primary treatment plants which also discharge into the Atlantic Ocean will be abandoned. The Surf City treatment facility also serves the North Beach Section of Long Beach Township.

4) Long Beach Township - This township has been divided into five sections which are: High Bar Harbor, Loveladies, North Beach, Brant Beach, and Holgate. Only the Brant Beach section is completely serviced with sewerage connections. This treatment facility (primary) which discharges into the Atlantic Ocean will be abandoned. The Holgate section is connected to the Beach Haven treatment plant and the North Beach section is connected to the Surf City treatment plants. Collection systems have been proposed for the remaining areas and will be linked to the regional system.

5) Union - This township has been reported to be in the process of forming a municipal utilities advisory group to plan the overall wastewater development of this area. Some of the existing developed areas are served by the Indianolo Treatment Plant in Ocean Township (Makai 1973). An interim treatment facility has been approved by the County Sewage Authority of Barnegat Village, however this facility will be abandoned upon completion of the regional facilities.

6) Eagleswood - This township is sparsely populated and there are no plans for construction of a collection system.

7) Stafford - The Township Municipal Utilities Authority is reported to operate a treatment plant which only services the Beach Haven West Lagoon Complex. This facility will also be abandoned.

8) Little Egg Harbor - It is reported that the majority of existing developed areas in the township are serviced either by the Mystic Islands treatment plant (privately owned) or by the Tuckerton Municipal Utilities Authority. At present, the township is proposing a master plan for wastewater management. The Mystic Island Facility will be abandoned upon completion of a regional system and there are plans to include a collection system with the regional facilities.

9) Tuckerton - The Municipal Utilities Authority operates a treatment plant (secondary) which is reported to serve the majority of the developed areas within the borough as well as a small portion of Little Egg Harbor Township.

Table 92 lists data collected by Nieswand et al. (1972) on existing treatment plants that do provide service for developed areas (lagoon systems) situated with the study area. Table 93, also from this study, lists those particular systems that are now connected to these facilities. Approximately 56% or 9 out of 16 lagoon systems reported, are serviced by treatment facilities.

SHELLFISH[2] -- On the basis of sewage pollution, this water system is one of the cleanest and most productive estuaries along the New Jersey coast. Of the 34,789 acres between Beach Haven Inlet and Barnegat Inlet, only 2,480 acres are condemned for the harvest of shellfish. Another 902 acres are seasonally condemned (harvest is permitted from January through April). This leaves a total of 31,407 acres, or 90% of this system, open to shellfishing throughout the year. Commercially important shellfish found within the system include the hard clam, *Mercenaria mercenaria*; bay scallop, *Argopecten irradians*; and blue mussel, *Mytilus edulis*. The soft clam, *Mya arenaria* and eastern oyster, *Crassostrea virginica* are also found within this system but are not of commercial importance.

Hard Clams, *Mercenaria mercenaria* -- Hard clams are found in abundance in this estuary and support numerous commercial shellfishermen. This area also provides hard clams for thousands of recreational clammers (see Use Study following this report). Harvest methods include: treading, tonging, and raking. The areas harvested by the commercial shellfishermen extend from Cedar Run south to Tuckerton Cove, on the western side of the bay. A few commercial men also work in upper Manahawkin Bay. The seasonal water behind Long Beach Island is worked extensively from January until the end of April. When it becomes warmer in the spring, wading becomes popular in the shallow areas of the bay that have high densities of clams.

In 1973, Ocean County produced 809,105 pounds of hard clam meats and in 1974, 923,530 pounds. Ocean County was responsible for 59.5% of the New Jersey hard clam landings in 1975 with a total of 964,785 pounds of meat. The majority of the

[2] This section was authored by Tom McCloy, a Fisheries Biologist with the N.J. Division of Fish, Game, and Shellfisheries.

landings in this county are harvested from within the Manahawkin Bay - Little Egg Harbor system.

In the fall of 1972, an excellent set of seed clams was discovered on the flats behind Goosebar Sedge, in Little Egg Harbor. The flats are usually exposed at low water. Consequently, a severe winter could destroy many of the clams if they were not harvested. To alleviate this problem, harvest of the legal size clams (1.5 in) was permitted until November. During this time, most of the seed clams harvested were planted on leased ground in Atlantic and Ocean Counties. The clams originally taken from the Goosebar Sedge most likely contributed to the 1973 and 1974 hard clam landings in both Ocean and Atlantic Counties.

In the Manahawkin Bay - Little Egg Harbor system, there are over 1,500 acres of bay bottom leased to shellfishermen for the culture of shellfish. These grounds are used primarily as clam layout lots. Clams are planted on these layout lots and held for future use. The clammer may decide to hold the clams when the market is saturated or until their value increases. Some shellfishermen are experimenting with hatchery reared seed clams. Once the seed reaches a certain size, it is planted on leased lots where they hopefully attain a marketable size. At present, this operation has not been successful.

Blue Mussel, *Mytilis edulis* -- Blue mussel beds are found around the numerous islands in the southeast section of Little Egg Harbor. The most extensive beds are between Beach Haven Inlet and Foxboro Point. It is commonly found in the sides and bottom of channels and on marsh banks with hard substrates. This mollusk is a suspension feeder and depends on water currents to carry food particles to it.

Bay Scallop, *Argopecten irradians* -- The bay scallop is another commercially important shellfish in Manahawkin Bay and Little Egg Harbor. They inhabit the extensive eelgrass beds from Marshelder Islands north into Barnegat Bay. Harvesting of bay scallops is accomplished by the use of dredges. Harvesting is restricted to the months from November through March and there is a daily limit. During the 1973-1974 season, the area from Marshelder Island north to Egg Island accounted for 100% of the bay scallop landings in New Jersey with a total of 76,889 pounds of meat. In 1975, bay scallops were not abundant enough to support a commercial fishery. It required 2 hours to catch 1 bushel as compared with the 1973-1974 season when the 10 bushel limit could be caught in 3 to 4 hours.

Soft Clams, *Mya arenaria* and Oysters, *Crassostrea virginica* -- There is a sparse scattering of soft clams on some of the sand bars throughout the bays. Most of the tidal creeks emptying into the system have remnant populations of oysters. Presently, there are no commerical quantities of soft clams or oysters within this system.

Figure 6 shows the distribution pattern of shellfish within the Manahawkin Bay - Little Egg Harbor system according to commercial value prepared by the U.S. Department of the Interior, Fish and Wildlife Service.

FINDINGS

Morphometric Data

Upper and lower boundaries of the Manahawkin Bay - Little Egg Harbor system were established arbitrarily for the purpose of survey and analysis as follows:

Upper Boundary: Farthest point north of Manahawkin Bay indicated by a line from the mouth of Gunning River across the Intracoastal Waterway to Harvey Cedars (channel flashing light R no. 2).

Lower Boundary: Indicated by a line across Beach Haven Inlet from Shooting Thorofare to the southern tip of Long Beach Island.

The data compiled included the following measurements and calculations made according to Shuster (1959) and Welch (1948):

1) Maximum length (MXL):

15.9 statute miles; 13.8 nautical miles

Length of line connecting the two most extreme parts of the bay and crossing no land other than islands. In this case, a line from the tip of the Shooting Thorofare (Beach Haven Inlet) to Sandy Island (channel light no. 82).

2) Maximum effective length (MXEL):

11.4 statute miles; 9.9 nautical miles

Length of straight line connecting the most remote extremeties of the bay along which wind and wave action occur without any kind of land interruption. In this case, it is a line from the cove adjacent to the southern tip of Long Beach Island north to the Manahawkin causeway (U.S. Route 72).

3) Maximum width (MXW):

4.6 statute miles; 4.0 nautical miles

Length of a straight line connecting the most remote extremities of the bay and crossing no land other than islands. It is a line approximately at right angles to the maximum length axis. It is a line from the mouth of Tuckerton Creek (flashing red light no. 17) to Holgate.

4) Maximum effective width (MXEW):

4.2 statute miles; 3.7 nautical miles

Length of straight line connecting the most remote extremities of the width of the bay along which wind and wave action occur without any kind of land interruption. It is a line from the mouth of Thompson Creek to Liberty Thorofare.

5) Mean width (MEW):

2.5 statute miles; 2.2 nautical miles

The area of the bay divided by its maximum length.

6) Maximum depth (MXD):

34 ft; 10.4 m; 5.7 fathoms

The maximum depth is known.

7) Mean depth (MED):

3.5 ft; 0.6 fathoms

The volume of the bay divided by its surface area.

8) Mean depth - Maximum depth relation (MED/MXD): 0.10

The mean depth divided by the maximum depth. This is expressed as a decimal value and serves as an index figure which indicates in general the character of the approach of basin shape to conical forms.

9) Maximum depth - Surface area relation (MXD/AS): 0.21

The maximum depth divided by the square root of the surface area. It is expressed as a decimal value and is an indication of the relation of depth to horizontal extent.

10) Total surface area (AS)

39.9 square miles (statute); 25,563 acres

Total surface area of the bay. The Coast and Geodetic Survey Chart was divided into 14 sections to enable easier and more accurate handling of the planimeter. The results for each sector were combined to give the total area.

11) Length of shoreline (LSH):

East shoreline: 34.3 statute miles; West shoreline: 41.5 statute miles; Total: 75.8 statute miles.

The length of the shoreline enclosing the bay measured in statute miles.

12) Volume (V):

3,861,946,790 ft^3
28,889,370,202 gallons
Formula: $v=1/3\ (A_1 + A_2 + A_1A_2)h$

Where A is the area of the upper surface of a contour stratum and A_2 is the area of the lower surface of the same stratum, the height of the stratum is shown by h. The volume for each stratum is computed from the formula, the sum of the volumes being the total volume at mean low water (Reid 1961).

13) Hypsographic curve:

A curve constructed by plotting depth along the ordinate and area along the abscissa. Such a curve provides not only certain elements in the form of a basin, but it also provides a means whereby areas at any depth level may be determined (Figure 7).

14) Profiles:

These provide a pictorial representation of the basin configuration along a selected line. All the profiles selected were perpendicular to the ship channel and are illustrated in Figure 8.

Water Quality Data

All physical and chemical data collected from July 1973 through February 1974 and June 1974 through May 1975 are presented in Tables 1 to 171. This would also include all water quality data reported in the Fish Studies section.

Beach Haven Inlet

The inlet is relatively deep and narrow, permitting tidal water intrusion into the Little Egg Harbor - Manahawkin Bay system. Mud flats divide the area into two main channels (Marshelder Channel and the eastern channel) which parallel Long Beach Island. Water depth within these channels at mean low water ranges from 0.5 to 34 ft. Currents within the inlet are swift.

Station MB-1 was situated in the east channel, approximately 500 yards off the mouth of Big Sheepshead Creek. The water depth ranged from 10 to 18 ft at mean low water with a bottom composition of hard sand.

Water temperatures at this station varied from 3.5 to 24.0°C and air temperature from 1.0 to 31.0°C (Table 94). Salinity varied from 27.5 to 32.0 °/oo. The pH readings were all basic (7.6 to 8.65). Dissolved oxygen concentrations ranged from 5.6 to 10.9 mg O_2/1. Carbon dioxide values were from 0.0 to 19.8 mg CO_2/1. Secchi disc depths ranged from 3.0 in to 10 ft.

B.O.D. levels ranged from 0.2 to 3.6 mg O_2/1 (Table 95). Only traces of nitrite nitrogen were observed (<0.005 mg NO_2-N/1). Nitrate nitrogen ranged from 0.28 to 0.65 mg NO_3-N/1. Ammonia nitrogen levels were slight (0.0 to 0.3 mg NH_3-N/1). Orthophosphate levels ranged from 0.0 to 0.09 mg PO_4-P/1. Detergent levels ranged from 0.03 to 0.32 mg/1. All total and fecal coliform counts were <30 MPN/100 ml.

Little Egg Harbor - Manahawkin Bay

The land barrier along the eastern portion of the bay extending from Beach Haven Inlet north to Barnegat Inlet is known as Long Beach Island. A great portion of this area is developed (bulkheaded and filled in). On the other hand, the western portion of the bay still retains a great deal of natural shoreline and marshland (portions of which are Federal and State owned).

There were 11 water quality stations selected in the bay area; however, 2 stations (MB-3 & MB-4) were dropped during the first survey period. See Figure 3 for the location of stations MB-2 to MB-11A. Depths ranged from 0.5 to 25 ft at mean low water with bottom composition varying from hard sand to soft mud, detritus, and submerged vegetation.

Water temperature recorded ranged from -1.0 to 29.5°C and air temperatures from -4.0 to 35.0°C (Tables 96 to 106). Salinity varied from 19.8 to 30.8 °/oo. The pH readings were all basic (7.1 to 8.45). Dissolved oxygen levels varied from 5.4 to 13.4 mg O_2/1 and percent saturation from 72 to 146%. Carbon dioxide values were from 0.0 to 13.4 mg CO_2/1. Secchi disc depths ranged from 3.0 in to 9.5 ft.

B.O.D. levels ranged from 0.0 to 5.8 mg O_2/1 (Tables 107 to 113). Only slight traces of nitrite nitrogen were observed (<0.005 mg NO_2-N/1). Nitrate nitrogen ranged from 0.22 to 0.94 mg NO_3-N/1. Ammonia nitrogen levels were slight (0.0 to 0.3 mg NH_3-N/1). Orthophosphate levels ranged from 0.0 to 0.17 mg PO_4-P/1. Detergent concentrations ranged from 0.0 to 0.33 mg/1. Total coliform counts ranged from <3 to 750 MPN/100ml and fecal coliform counts from <3 to 230 MPN/100 ml.

Dinner Point Creek

This water system, along with the drainage from both Meyers Pond and Popular Point, were selected as "natural" areas (all wetlands). Dinner Point Creek, the largest of the three streams, is located approximately 4 miles south of the Manahawkin Causeway (Route 72). Meyers Pond and Popular Point are 2 and 1.7 miles south of Route 72, respectively. All three systems are tidally influenced by the upper portion of Little Egg Harbor.

There were six stations selected in the "natural" area. Four were located in the main stem of Dinner Point Creek: DPC-1 (mouth), DPC-2 (above the confluence of the second branch), DPC-2A (approximately 950 yards upstream of station DPC-2) and DPC-3 (upper end). Stations MP-0 (Meyers Pond) and PP-0 (Popular Point) were located at the mouth of their respective drainages (Figure 3). It should be noted that water quality measurements in these two systems included only the fish survey, bacterial, and nutrient collections. Access to these areas were limited to high water. Dinner Point Creek was found to be extremely shallow; water depth ranging from 0.5 to 4 ft at mean low water. Bottom composition was soft mud, detritus, and submerged vegetation.

Water temperatures recorded at these stations ranged from -0.5 to 30.0°C and air temperatures from -2.7 to 33.0°C (Tables 114 to 117). Salinity varied from 3.3 to 29.6 °/oo. The pH readings ranged from acid to basic (6.3 to 8.3). Dissolved oxygen levels varied from 0.0 to 12.3 mg O_2/1 and percent saturation from 0.0 to 124%. Carbon dioxide values were 0.0 to 36.3 mg CO_2/1. Secchi disc depths measured from 6.0 in to 4.5 ft.

B.O.D. concentrations ranged from 0.0 to 6.0 mg O_2/1 (Tables 118 to 121). Only slight traces of nitrite nitrogen were observed (<0.007 mg NO_2-N/1). Nitrate nitrogen ranged from 0.04 to 3.98 mg NO_3-N/1. Ammonia nitrogen levels were slight (0.0 to 0.3 mg NH_3-N/1). Orthophosphate ranged from 0.0 to 0.11 mg PO_4-P/1. Detergent concentrations were from 0.0 to 0.34 mg/1. Total coliform counts ranged from <3 to 4,600 MPN/100ml and fecal coliforms from <3 to 750 MPN/100ml.

Mill Creek

This water system, although part of the artificial area, has been presented separately because it is the receiving waters from both the upland drainage of Manahawkin Lake and the effluent (secondary treatment) of the Stafford Municipal Utilities Authority.

The creek has been dredged to provide upstream access to lagoon housing. All lagoons along the upstream south shore are presently undeveloped (no bulkheading or housing present). All lagoons located along the upstream north area are developed (housing present although bulkheading may or may not be present).

Seven stations were selected in this water system. Stations MC-0, MC-1, MC-2, MC-3, and MC-6 were located in the main channel. Stations MC-4 and MC-5 were located at the distal end of an undeveloped and developed lagoon, respectively. See Figure 4 for locations. Bottom composition varied from soft mud to hard sand and detritus. Water depth measured ranged from 3 to 18 feet.

Water temperature recorded at these stations ranged from -0.5 to 30.5°C and air temperatures from -4.0 to 33.5°C (Tables 122 to 128). Salinity varied from 0.3 to 27.1 °/oo. The pH values ranged from acid to basic (6.2 to 8.9). Dissolved oxygen concentrations ranged from 0.0 to 15.0 mg O_2/1 and percent saturation from 0.0 to 169%. Carbon dioxide values were from 0.0 to 10.3 mg CO_2/1. Secchi disc depths recorded ranged from 9.0 in to 5.0 ft.

B.O.D. levels ranged from 0.0 to >12.2 mg O_2/1 (Tables 129 to 132). Slight traces of nitrite nitrogen were observed (< 0.004 mg NO_2-N/1). Nitrate nitrogen ranged from 0.36 to 0.90 mg NO_3-N/1. Ammonia nitrogen levels were slight (0.0 to 0.3 mg NH_3-N/1). Orthophosphate ranged from 0.0 to 0.06 mg PO_4-P/1. Detergent levels measured ranged from 0.03 to < 0.2 mg/1. Total coliform counts ranged from 3.6 to 4,600 MPN/100 ml and fecal coliform counts ranged from < 3 to 2,400 MPN/100 ml.

Beach Haven West Lagoon Complex

In order to simplify presenting data, this artificial area was subdivided into the following: System A, B, C, and D (Figures 4 and 5). This complex is tidally influenced from Manahawkin Bay; none of these systems have any fresh water input other than street runoff or housing effluent.

Almost all of the lagoons are developed (housing and bulkheads) with the exception of the lower portion of System D (area parallel to Mill Creek). At present, homes are being constructed and the perimeter of this area will eventually be bulkheaded.

Eleven stations were selected within these systems and the 11 are as follows: System A - station BHW-7 was situated in the main channel and station BHW-8 was located near the mouth of Lagoon 08; station BHW-1 was situated below the juncture of Systems D and B; System B - station BHW-4 was located in the main channel whereas station BHW-5 was situated at the distal end of Lagoon 15; upstream station BHW-6 was midway in Lagoon 24; System D - station BHW-2 was located at the distal end of undeveloped Lagoon 43, whereas station BHW-3 was located in the main channel between Lagoons 62 and 63; System C - station BHW-9 was located at the mouth and station BHW-10 was upstream in the main channel, just below the mouth of Lagoon 31; station BHW-11 was located at the distal end of Lagoon 37.

Water temperature recorded at these stations ranged from 0.4 to 30.0°C and air temperatures from 1.3 to 35.0°C (Tables 133 to 143). Salinity ranged from 13.2 to 28.5 °/oo. The pH readings varied from slightly acid to basic (6.85 to 8.3). Dissolved oxygen levels were from 0.0 to 13.1 mg O_2/1 and percent saturation from 0.0 to 141%. Carbon dioxide values ranged from 0.0 to 11.2 mg CO_2/1. Secchi disc depths recorded ranged from 1.5 to 11.0 ft. and water depths measured were from 4 to 26 ft.

B.O.D. values recorded ranged from 0.0 to 6.2 mg O_2/1 (Tables 144 and 150). Slight traces of nitrite nitrogen were observed (< 0.007 mg NO_2-N/1). Nitrate nitrogen levels ranged from 0.42 to 2.03 mg NO_3-N/1. Ammonia nitrogen values

were small 0.0 to 0.4 mg NH_3-N/1. Orthophosphate ranged from 0.0 to 0.055 mg PO_4-P/1. Detergent concentration detected ranged from 0.09 to 0.30 mg/1. Total coliform counts ranged from 11 to 4,600 MPN/100 ml and fecal coliform from 3.6 to 1,500 MPN/100 ml.

Tidal Creek Survey

Four out of five tidal creeks selected were sampled during the 2 year study. Thompson Creek could not be worked into the schedule.

TUCKERTON CREEK -- This water system is located in the lower western portion of Little Egg Harbor. Saline water entering via Marshelder Channel greatly influences this region. The creek has been extensively developed and receives waters from the upland drainage of Tuckerton Lake and the effluent (secondary) of the Tuckerton Municipal Utilities Authority (Table 92).

Seven stations were selected in this tributary. Station TC-0 was situated approximately 500 yards off the mouth of the creek. Stations TC-1 (Flashing Light "17"), TC-3 (near clam house), TC-5 (across from Hayes BP gas station), TC-6 (near Gulf Station), and TC-7 (below lake drainage) were located in the main stem and TC-2 (borrow pit) and TC-4 (near Daddy Tucker Drive) were in lagoons (Figure 3).

Water temperatures recorded at these stations ranged from 2.0 to 27.0°C and air temperatures ranged from 2.0 to 27.0°C (Table 151). Salinity varied from 1.6 to 29.8 °/oo. The pH readings ranged from slightly acid to basic (6.8 to 9.15). Dissolved oxygen concentrations ranged from 0.0 to 17.1 mg O_2/1 and percent saturation from 0.0 to 181%. Carbon dioxide ranged from 0.0 to 25.5 mg CO_2/1. Secchi disc depths recorded ranged from 1.0 to 6.5 ft and water depths varied from 3 to 21 ft.

PARKER RUN -- This tidal creek is located approximately 3 miles north of Tuckerton Creek. Most of the surrounding area remains in a natural state with the exception of an upstream site (partial upland and wetlands) along the southern shore and an access road leading to a small developed region near the mouth (northern shore).

Six stations were selected in this system. Station PR-0 was located approximately 200 yards off the mouth of the creek). Stations PR-1 (Flashing Light "1") and PR-2 (near cedar stakes) were situated in the main stem. Stations PR-3 (undeveloped cove), PR-4 (south branch), and PR-5 (end) were in the channel of the creek extensions (Figure 3).

Water temperatures recorded in this system ranged from 3.0 to 24.0°C and air temperatures from 3.0 to 27.0°C (Table 152). Salinity varied from 3.4 to 28.4 °/oo. The pH readings ranged from slightly acid to basic (6.8 to 8.72). Dissolved oxygen levels ranged from 0.0 to 16.9 mg O_2/1 and percent saturation from 0.0 to 170. Carbon dioxide values ranged from 0.0 to 12.6 mg CO_2/1. Secchi disc depths varied from 9.0 in to 7 ft. Water depth recorded ranged from 3 to 20 ft.

WESTECUNK (WEST) CREEK -- This tributary situated in Eagleswood Township is located about 1 mile north of Long Point (channel light no. 2). The south side of this creek has been extensively developed, however, most of the northern area still remains in natural state. This system receives the waters of all drainage from the town of West Creek as well as from the cranberry bogs further west.

Eight stations were selected in this system. Station WC-0 was situated approximately 150 yards off the mouth of the creek. Stations WC-1 (Flashing Light "3"), WC-2 (upstream of Flashing Light "6"), WC-3 (across from Texaco), WC-4 (bridge), WC-5 (adjacent to lagoon), WC-6 (above public launching ramp), and WC-7 (below Rt. 9) were all located in the main stream. See Figure 3 for locations.

Water temperature recorded at these stations ranged from -0.5 to 28.5°C and air temperatures from -1.5 to 34.0°C (Table 153). Salinity varied from 0.4 to 28.6 °/oo. The pH values ranged from acid to basic (6.2 to 8.4). Dissolved oxygen concentrations ranged from 1.4 to 13.5 mg O_2/1 and percent saturation from 30 to 147%. Carbon dioxide levels ranged from 0.0 to 10.2 mg CO_2/1. Secchi disc values ranged from 1.5 to 5 ft and the sampled water depths ranged from 3.25 to 10 ft.

CEDAR RUN -- This water system is situated between Mill Creek and Dinner Point Creek. Except for some small homes, docks, and an access road constructed along the northern shore, most of the surrounding area remains in a natural state (wetlands).

Six stations were selected in this system. Station CR-0 was situated approximately 600 yards off the mouth of the creek. Stations CR-1 to CR-5 were located in the main stream (see Figure 3).

Water temperatures in this system ranged from 1.0 to 28.3°C and air temperatures from -1.0 to 29.5°C (Table 154). Salinity varied from 1.5 to 28.3 °/oo. The pH values ranged from acid to basic (6.0 to 8.3). Dissolved oxygen concentrations ranged from 3.2 to 11.9 mg O_2/1 and percent saturation from 45 to 114%. Carbon dioxide levels ranged from 0.0 to 11.7 mg CO_2/1. Secchi disc measurements ranged from 1.0 to 4.0 ft and water depths from 1 to 8 ft.

Thermograph Data

As was previously mentioned, six thermographs were placed in selected areas to record daily water temperatures over a 45 day period (Figure 3). However, during the months of July and August and at some stations in September of the first survey period, data was lost due to time spent sending recorders back to the company for calibration. At the end of this first survey period (July 1973 to February 1974), the instruments were not pulled out while preparing an interim report. This allowed a complete recording of 12 months of data.

Figure 9 shows monthly mean, standard deviation, and ranges of temperature for each station. This also shows that the recorded water temperatures during the survey periods ranged from -2.7 to 29.4°C. It should also be noted that water temperatures at Long Point, Manahawkin Bridge, and Lower Barnegat Bay during the month of August 1973 exceeded the range on the tape (>25°C). This was due, as explained above, to a shortage of available instruments calibrated for the high range (+20 to +40°C) and the situation was not corrected until September.

Pesticide - Heavy Metal Analysis

Monthly fish collections showed it was very difficult to collect the same species consistently at selected stations. Even more so to collect a sufficient quantity of any species at a particular station. This was especially evident during

the winter and some of the spring collections. Both sampling stations and fish species were selected according to their availability within specific areas.

Oyster toadfish (*Opsanus tau*), winter flounder (*Pseudopleuronectes americanus*), summer flounder (*Paralichthys dentatus*), Atlantic menhaden (*Brevoortia tyrannus*), white perch (*Morone americana*), and spot (*Leiostomus xanthurus*) were the selected species in all chlorinated hydrocarbons and heavy metal testing. The oyster toadfish and white perch made up 57% of the samples.

Hard clam, *Mercenaria mercenaria*, and the Atlantic ribbed mussel, *Modiolus demissus*, were the two shellfish species selected for the pesticide and heavy metal analysis. As was previously mentioned in the shellfish section, the hard clam is the more abundant and is consistently found throughout the bay system. The ribbed mussel, on the other hand, is not commercially important but can be found along the sedge banks (intertidal) of most of the tributaries.

A total of 54 samples were sent to the State of New Jersey Fisheries Laboratory, Lebanon for analysis. Samples were analyzed for the chlorinated hydrocarbons L-BHC, lindane, aldrin, heptachlor, heptachlor epoxide, dieldrin, and DDT and its metabolites. Heavy metal analysis included cadmium, chromium, lead, zinc, and mercury.

Results of residue analysis for the chlorinated hydrocarbons found in fish, sediment, and shellfish are listed in Tables 155 to 159. The data from these analyses are reported in microgram per kilogram (ppb). Results of heavy metal concentrations detected in fish, sediment, and shellfish are listed in Tables 160 to 162. All data are reported in milligram per kilogram (ppm).

Slight traces of DDT and its metabolites were detected in 34.6% of the fish samples with values ranging up to 17 ppb. Only 20% of the shellfish samples showed any traces. None of the other insecticides were detected in either the shellfish or fish meat.

The chlorinated hydrocarbons insecticides, generally speaking, are the most toxic to aquatic life. They are known to be very stable compounds and found to be very difficult to control once released into the environment. Some of the organochlorine pesticides, including some of their metabolites, are directly toxic at concentrations of less than 1 mg/1.

DDT and its metabolites were detected in 76.6% of the sediment samples. Concentrations ranged up to 69 ppb. The only other insecticide observed was heptachlor epoxide; detected in 33.3% of the samples.

Results for Little Egg Harbor Bay and Manahawkin Bay showed that only one sediment sample collected north of the Manahawkin Causeway (Route 72) had any detectable traces of DDT. The rest of the samples collected from the bay along with Lagoon System D (Beach Haven West) did not show any detectable pesticides. All of the tributaries and the remainder of the Beach Haven West complex did show slight traces of DDT.

The Bureau of Commercial Fisheries, at the Milford, Connecticut laboratory, reported that DDT, toxaphine, and aldrin were found to be very toxic to oyster and

clam larvae. Lindane, on the other hand, was almost nontoxic to these larvae, but it inhibited the growth of plankton organisms in their food chain when present in low concentrations.

Smith (1972) reported DDT concentrations ranging from 1.15 to 3.70 ppm resulted in 55 to 98% mortality of winter flounder embryos and vertical deformaties in 2-44% of the hatched larvae. Concentrations of heptachlor, endrin, and lindane (0.3-0.4 ppb) killed or immobilized half of the adult commercial brown and pink shrimp (crustaceans) exposed in 48 hour laboratory tests. DDT and dieldrin showed similar effects at 1-6 ppb (Butler and Springer 1963). In mollusks such as the oyster, Calabrese (1972) reported that DDT at 0.05 ppm caused over 90% mortality of oyster larvae and almost completely prevented growth in the survivors.

In studies of the upper Barnegat Bay system (Makai 1973), DDT and its metabolites were detected in concentrations ranging up to 300 ppb in fish and 2,234 ppb in sediment. The pesticide levels detected in the fish samples for both estuarine areas (Upper Barnegat Bay and Little Egg Harbor - Manahawkin Bay) did not exceed the FDA's established maximum permissable levels for human consumption. However, it would appear that DDT concentrations recorded during this study are in sufficient quantities to have sublethal effects on estuarine organisms.

Analysis of the fish, shellfish, and sediment samples showed that all five heavy metal elements were present. Only slight traces (<0.01 ppm) of chromium were detected in the fish and shellfish meat. This was also the case for cadmium with the exception of two readings: 0.50 ppm and 0.75 ppm (detected in the hard clam and ribbed mussel, respectively). The concentrations of lead, zinc, and mercury detected in the fish samples were comparable to the levels found in the shellfish samples (Table 163).

Results also showed the hard clam to have slightly higher concentrations of zinc and mercury in the meat than the mussel. In fact, the highest heavy metal levels observed in the edible tissue of both the fish and shellfish were those of zinc. These levels were detected in the white perch netted in Mill Creek and the Atlantic menhaden collected in the Beach Haven West Lagoon Complex. Hard clams collected in the bottom waters near Main Point, Manahawkin Bay had 20 ppm levels and the ribbed mussels taken from Parker Run had concentrations of 17 ppm.

The heavy metal concentrations in the sediment were found to be much higher than the other samples. Chromium and zinc were detected in all 30 of the mud samples. Of the five elements, lead was found in the highest concentrations. Such concentrations were observed in the subaqueous samples collected at channel light Flashing Green "21" and Meyers Pond (197.5 ppb); Tuckerton and West Creeks (265 ppb); and channel light Flashing Green "53" and Cedar Run (237.5 ppb). Results also showed that the upstream stations in most of the tributaries had higher levels of cadmium than the downstream sites (mouths).

The highest levels of mercury were detected in the bottom samples collected in Dinner Point Creek (2.75 ppm); Meyers Pond and channel light Flashing Green "53" (2.07 ppm); Mill Creek (2.03 ppm); and Cedar Run (2.01 ppm). No high levels were detected in fish or shellfish (<0.4 ppm). In studies of the upper Barnegat system (Makai 1973), it was reported levels >1 ppm were detected in the bottom waters of Toms River near Pelican Island and in Forked River. Abnormally high levels of mercury are considered to be those exceeding the FDA established maximum of 0.5 ppm for food and 0.005 ppm for water. According to Julian (unpublished

paper), hard clams taken from Barnegat Bay were found to have mercury levels ranging from 0.0 to 0.275 mg/kg in edible tissue and 0.0 to 0.3 mg/kg in the shell. The levels detected in the fish, shellfish, and mud are within the limits established by the FDA.

Metals reach the marine environment by many ways, including natural weathering as well as municipal and industrial discharges. These metals are, in varying degrees, poisonous to humans and marine life, although some of them are essential in trace amounts to humans, as well as other animal life.

Dow and Hurst (1972) have summarized from the literature effects of heavy metals on marine resources:

Cadmium is extremely toxic to oysters, less toxic to hard clams, and moderately to all other animals. Pringle et al. (1968) reported a 15 week 50% lethal dose (LD_{50}) of 0.1 mg/1 and inhibition of shell growth for *Crassostrea virginica*. Cadmium also damages the intestinal tract, kidney, and gills of marine fish. It increases the toxicity of other metals.

Lead is toxic to oyster gonads; it also adversely affects hard and soft clam reproduction. Toxic to most enzyme systems, lead causes 100% mortality to lobsters in tanks. It inhibits one cell algal growth at concentrations of 0.5 ppm in water and is 100% lethal in 7 days. Oyster larvae were killed by 3.0 ppm levels. Lead is extremely toxic to soft clams above 0.02 ppm in water.

Zinc damages the gills of fish. It is toxic to oysters in very small amounts.

Chromium is not toxic except in large concentrations. This would also vary with valence state, form, pH, synergistic or antagonistic effects from other constituents, and the species of organisms involved.

It would appear that some of the heavy metal concentrations recorded in this system are in sufficient quantities to have sublethal effects on estuarine organisms.

Twenty-four Hour Tidal Survey

The objective of this study was to seasonally compare temperatures, salinity, and dissolved oxygen levels on an hourly basis for a period of 24 hours in a natural versus artificial system. Dinner Point Creek, selected as the natural area, was very shallow (chart depths indicating 0.5 to 4.0 ft at mean low water). However, just downstream from the first branch, water depths (measured with a fathometer) were about 5 ft at low water.

As was previously mentioned, the lagoons within the Beach Haven West complex do not receive any fresh water input other than from storm drains or effluent pipes associated with the surrounding dwellings. The mouth of Lagoon 08, situated in System A, was chosen as a station because of its close proximity to the bay area and its ready accessibility.

Results from this survey can be found in Figures 10 to 21.

In the natural drainage system where shallow depths are evident, it was found that air temperatures directly influenced water temperatures. As one would expect, surface and bottom temperatures were similar. In the lagoon complex, this

relationship was not evident. Surface and bottom readings varied throughout the survey. Water temperatures were stratified three out of the four periods. The spring survey revealed the greatest stratification; bottom waters remaining consistently colder with a 3.4 to 5.0°C difference over the 24 hour period. On the other hand, the fall survey showed little stratification (0.2°C difference). Water temperatures during the extreme periods (winter and summer) were found to be less stratified, generally evident from early morning until late evening. During the winter, bottom waters were warmer than the surface (0.0 to 2.4°C difference); the summer was just the reverse. Vertical temperature difference ranged from 0.5 to 2.5°C.

The results indicated the salinity distribution within the natural area is regulated by tidal flow and seasonal patterns. During the summer survey, low stream flows produce salinity levels ranging from 22.6 to 27.3 °/oo. But during the spring (high flow period), salinity levels recorded ranged from 19.1 to 27.3 °/oo. There was little variation between surface and bottom during the sampling.

Unlike the cyclic salinity patterns observed in the tidal creek, the salinity distribution in the lagoon area was found generally to be uniform, with little variation. It would appear concentrations are dependent on wind agitation and seasonal dilution. Salinity levels, during the summer survey, ranged from 24.5 to 25.8 °/oo; whereas, the spring survey showed concentrations ranging from 24.1 to 24.6 °/oo.

On the other hand, dissolved oxygen profiles within the natural area appeared to be regulated according to seasonal conditions. During the summer survey, dissolved oxygen levels were cyclic ranging from 2.0 to 7.5 mg O_2/1. Oxygen levels are normally regulated by tidal flows and periods of photosynthetic activity; however, peak levels occurred during flood tides regardless of illumination (Figure 20). Concentrations below 4.0 mg O_2/1 were recorded only during the early morning hours. There was little variation over a 24 hour period. Concentrations ranged from 8.0 to 10.1 mg O_2/1 with the decline in levels recorded during the early morning.

In the artificial area, large vertical differences in oxygen levels were found during both the summer and spring surveys. Bottom concentrations (0.0 to 8.0 mg O_2/1) during these periods were found to be variable compared to the surface levels. This condition was not evident during the other periods. Surface levels during the survey appeared to be regulated by wind agitation and seasonal patterns. Concentrations did not fall below 5.0 mg O_2/1.

The distribution of temperature, salinity, and dissolved oxygen recorded in the artificial system seems to indicate circulation within this area is very poor at times. The water quality of such an area would be dependent on climatic conditions. Bottom waters during the spring and summer surveys were at times completely void of oxygen. Such anaerobic conditions cannot continuously support a good benthic population. Thermal stratification was evident during three out of the four periods. Such conditions observed in some dredge holes (borrow pits) have been reported to attract overwintering finfish such as the white perch (Makai 1969). More research would be needed to completely evaluate the benefits of stratification within areas for overwintering populations. However, it has been observed that the white perch is one of the more common species found in the artificial systems (see preceeding Fish Studies report for more details). The fluctuation of anoxic conditions observed during the spring and summer periods within the area would not be considered good water quality criteria for most of your living organisms. Only your more tolerant species could exist (e.g. eels and blue claw crabs).

Isohaline and Isotherm Distribution

Figures 22 to 25 present isohaline and isotherm distribution patterns mapped both on an incoming and falling tide during the summer season.

DISCUSSION

Water temperatures recorded during the two survey periods (July 1973 - February 1974 and June 1974 - May 1975) ranged from -2.7 to 30.5°C. As one would expect, the lowest extremes were observed during the months of January and February with the latter being the coldest month. The minimum temperature of -2.7°C was recorded in Dinner Point Creek. It is interesting to point out that this was the only system where water temperatures fell below 0.0°C for 5 consecutive months (December 1974 through April 1975). This tributary is very shallow and found with water depths ranging from 0.5 to 4 ft at mean low water. As was reported during the 24 hour tidal survey, water temperatures are greatly affected by air temperatures.

Temperatures below 0.0°C were also recorded at stations WC-0 and MC-0 (-0.5°C); MB-9 and T-8 (-1.0°C); and the thermograph station located near Long Point (ranging from -2.2 to -1.7°C). Water temperatures at or above 29.5°C (85°F) were observed at the following stations: MB-8, MB-0, MC-0, PP-0, BHW-6, and BHW -10 (29.5°C); DPC-3 and BHW-5 (30.0°C); and MC-6A (30.5°C). The maximum temperature of 30.5°C was recorded in Lagoon 91 (MC-6A) during the month of August.

Temperatures monitored at Beach Haven Inlet (Flashing Light "92") were considered representative of ocean temperatures. The inshore bays, characteristically shallow, are greatly influenced by air temperatures. The data show that seasonal trends were consistent within this system as observed during previous studies conducted within the coastal waters of New Jersey. During the summer, ocean waters were cooler than inshore regions; however, in September average water temperatures were found to be similar with the exception of Dinner Point Creek (Figure 26). Temperatures observed in this tributary were somewhat cooler as compared to the other areas. This trend was observed during the periods October 1973 to March 1974 and September 1974 to April 1975. Generally, water temperatures gradually decreased from the end of September through December. In January and February, severe cold conditions caused abrupt changes in water temperatures, after which mean temperatures began to steadily increase from March on.

Water temperatures along the western portion of the bay are greatly influenced from the tributary drainages (see Figure 26).

The bay area showed only small vertical temperature gradients generally not differing more than 0.6°C between the surface and the bottom. The only exception was a difference of 1.8°C recorded during September 1973. Typically, during the warmer months, water temperatures tended to increase from Beach Haven Inlet to the Manahawkin Causeway.

Thermal stratification was evident during both the summer and winter periods in some of the artificial systems. Late spring and summer temperatures were found to be much more stratified with bottom temperatures showing more variability than the surface e.g. Stations BHW-2, BHW-3, BHW-6, BHW-8, and MC-5. The highest vertical temperature difference, 16.7°C was observed at BHW-6.

Not all stations within the artificial complex were found to be thermally stratified. Only station BHW-6, the farthest upstream site in System B, was consistently stratified throughout the study. This was also the case in the channel of Mill Creek, but to a lesser degree.

Salinity patterns were similar to the water temperature stratification observed in Mill Creek insofar as the effects of fresh water intrusion in this system. It is interesting to point out that the bottom waters of lagoon stations MC-4 and MC-5 were found to have salinity levels greater than the downstream channel station MC-3.

In the lagoon complex, vertical salinity stratification was less pronounced but nevertheless evident. Bottom levels measured in some lagoons were also found to be higher than the downstream station, e.g. station BHW-2, BHW-3, BHW-6, and BHW-8.

In the bay, salinity levels recorded for the surface and bottom waters were found to be similar; vertical differences never exceeded 2.1 °/oo. The highest salinity levels were recorded at Beach Haven Inlet (32.0 °/oo). This station had a range of 27.5 to 32.0 °/oo. The salinity differences from Beach Haven Inlet to the Manahawkin Causeway (Rt. 72) were never more than 8.9 °/oo. Except for one reading of 19.8 °/oo, levels were never less than 20.0 °/oo.

Generally, average levels between tidal stages within the artificial areas were similar (see Figure 27). Overall averages from June to December ranged from 24 to 25.6 °/oo with the exception in September when levels were around 23.0 °/oo. From midwinter through spring, when climatic conditions influenced tidal dilution, average levels were between 21.0 to 22.0 °/oo.

Average salinity levels were higher in Dinner Point Creek as compared to Mill Creek. Average levels were also somewhat higher in the artificial areas than the natural system. Station DPC-3, the farthest upstream site in Dinner Point Creek, was found to undergo the greatest salinity fluctuation (3.3 to 26.2 °/oo). Station MC-6, the farthest upstream station in Mill Creek was observed to have a range of 0.3 to 14.7 °/oo.

Oxygen levels recorded in the artificial systems were found at times to be extremely stratified and variable. This condition was not evident at those stations situated at the mouths of the lagoon complex (e.g. stations BHW-1 and BHW-9).

All of the submerged waters within the artificial system (excluding stations BHW-1, BHW-5, and BHW-9) were found at some period of the survey to have oxygen levels less than 3.0 mg O_2/1. Such concentrations are critical for many living organisms. This also was true for Stations MC-4 and MC-5 located in Mill Creek.

Anoxic conditions (<1.0 mg O_2/1 within the lagoon complex) were found at depths ranging from 7 to 26 ft. Almost 50% of these readings were observed at water depths over 15 ft (depths usually observed in the channel). Depths less than 15 ft were found in the distal end of the lagoons. Station BHW-6, in System B, had oxygen levels above 4.0 mg O_2/1 only during the months of October and November. The rest of the year, the bottom waters were void of oxygen.

In the bay, some vertical oxygen stratification was evident but to a lesser degree. Surface oxygen levels were found to vary. Levels recorded in the lower bay area were generally lower than concentrations observed in the upper bay.

Concentrations were never detected below 5.4 mg O_2/1.

In the natural area, oxygen levels below 5.0 mg O_2/1 were measured during the study. This was very evident during the summer months and to a lesser degree in the fall. It is interesting to note that levels as low as 2.8 mg O2/1 were observed during the fall sampling of the first study period. Normally, oxygen levels during this time of year are found to be around 9.0 mg O2/1. The data show that the farthest upstream station (DPC-3) had reduced oxygen levels throughout the year. The second study again showed reduced oxygen levels in this system. Except for stations DPC-3 (the farthest station upstream), the data suggest reduced levels to be consistent with ebbing tides. It would appear from the reduced levels observed at this station, the area is stressed with respect to oxygen concentration during certain periods of the season.

Only once were the deeper bottom waters of the main channel of Mill Creek found to have levels below 3.0 mg O_2/1. However, at stations MC-4 (undeveloped) and MC-5 (developed lagoons), large differences in surface and bottom oxygen levels were observed. Bottom waters generally had low or nonexistent levels of oxygen. Surface concentrations during the summer period were found to be extremely high (15.0 mg O2/1).

High surface dissolved oxygen levels were also observed in Tuckerton Creek and Parker Run. Oxygen levels of 15.0 mg O_2/1 or more were observed in Tuckerton Creek at Station TC-2 (16.2 mg O_2/1), TC-4 (16.8 mg O_2/1), and TC-5 (17.1 mg O_2/1) during October. In Parker Run, at station PR-4, high levels were observed in February (15.9 mg O_2/1) and April (16.8 mg O_2/1). There were other stations exhibiting unusually high surface oxygen levels; however, such concentrations did not exceed 15.0 mg O_2/1. High concentrations (in mg O2/1) were observed at stations TC-4 (14.4), TC-5 (10.3), and TC-6 (13.3) during July and in Parker Run at stations PR-3 (12.6 and 13.1), PR-4 (14.5), and PR-5 (14.9 and 12.2) during April. Anoxic conditions were also observed in some of the bottom waters of these two tributaries during the summer period (e.g. stations TC-2, TC-6, PR-4, and PR-5).

The waters of Westecunk Creek and Cedar Run were also found to be stratified. Reduced oxygen levels, evident primarily during the warmer months, were limited to the upstream stations of both tributaries (e.g. stations WC-3, WC-4, WC-5, CR-2, and CR-3).

The oxygen data is plotted for each system in Figure 28.

The pH levels measured in the bay were basic or nearly so. There was little difference between surface and bottom readings. Maximum levels recorded in the bay were found in the waters at stations MB-1 (pH=8.65) during August; MB-5 (pH= 8.5) and T-2 (pH=10.0) during October; and MB-9 (pH=8.5) during October and May.

In the natural area, pH readings ranged from slightly acid to basic with the exception of station DPC-3, where levels were found to vary from acid to near basic.

In the artificial system (the lagoon complex), pH levels ranged from slightly acid to basic. Readings above 8.5 were only recorded in Mill Creek at stations MC-3 (8.7), MC-4 (8.5, 8.8, and 8.9) and MC-5 (8.5 and 8.9); except for station MC-4 with a reading of 8.8 (recorded in July), all the other values were measured

during August. Mill Creek was also found to have the lowest pH in the system (5.7 recorded at Station T-18).

Readings above 8.5 were observed in Tuckerton Creek and Parker Run. The highest pH measurements in the tributaries during the two study periods were at station TC-6 (9.0 and 9.15 during the month of July). Other readings were taken during this period at station TC-2 (8.55) and TC-5 (8.65). In Parker Run, during April, pH values of 8.72 and 8.5 were observed at stations PR-4 and PR-5, respectively.

Average surface carbon dioxide concentrations were lowest in the bay area as compared to the other systems (Figure 29). Both Mill Creek and Beach Haven West were found to be similar insofar as levels were lowest during the summer months and increased as winter approached. A gradual decrease in February was followed by an abrupt increase in April and a subsequent rapid decline. In the Dinner Point Creek system, this pattern was reversed. During the summer, carbon dioxide levels gradually increased until August and then slowly decreased with the onset of the winter period. From February through June, the levels were very similar. The highest concentration was detected at station DPC-2A (36.3 mg CO_2/1).

Average Secchi disc values were greater in the artificial system than in the natural areas. Except for maximum depths recorded at stations BHW-2 (8 ft 6 in), BHW-7 (11 ft), and BHW-8 (10 ft) during the first survey, depths never exceeded 6 ft 6 in during the second period. Dinner Point Creek being shallower with a soft mud bottom, was found at times to be extremely turbid. Light penetration never exceeded 4 ft 6 in. Average readings ranged from 1 to 2 ft.

Transparency values generally were high in the bay. Maximum depths or areas of greatest light penetration were Beach Haven Inlet at 10 ft (MB-1) and Sandy Island at 9 ft 6 in (MB-11A).

Biochemical Oxygen Demand (B.O.D.) values recorded during the two study periods were found to be good. Generally, average B.O.D. levels were high during the summer period but gradually dropped going into the fall (Figure 30). However, during November 1974, there was an abrupt increase followed by a decrease going into the spring. It has been suggested that a clear stream or harbor should not have a B.O.D. of greater than 4.0 ppm (Lackey 1958). Only during the second study period did concentrations exceed 4 mg O_2/1.

In the artificial system, B.O.D. values generally were found to be higher than the natural area. The drainages (main stem) of Mill Creek and Dinner Point Creek had similar mean levels; however, station MC-6A (Lagoon 91) located in Mill Creek, was found during November to have a B.O.D. value >12.0 mg O_2/1. On the other hand, neither Dinner Point Creek nor the bay area concentrations exceeded 6.0 mg O_2/1.

Nitrite nitrogen was detected only during 2 months of the two studies. The concentrations detected were negligible; 0.036 mg NO_2-N/1 was the highest level detected.

The nitrate nitrogen values measured during the first survey period (July 1973 to February 1974) were extremely high. Such unusually high readings were considered unrealistic and were omitted from the data. Data collected during the second survey showed Dinner Point Creek to have higher nitrate levels than the artificial systems. Peak levels (0.97 - 3.98 mg NO_3-N/1) were observed at the farthest upstream station, DPC-3. Concentrations were found to be consistently higher at this

station. The data also showed average levels recorded in Mill Creek to be slightly lower than the bay. The highest level observed in the bay was 0.94 mg NO_3-N/1 recorded at Station MB-9.

Ammonia nitrogen levels, when detected, were found to be very low (0.0 to 0.4 mg NH_3-N/1). During the first survey period, only small amounts were generally found. Concentrations were found to be even lower during the second survey period as compared to the initial survey (0.0 - 0.16 mg NH_3-N/1). It was during the second survey that no ammonia nitrogen was detected in the bay area. The only levels observed in Dinner Point Creek were detected at station DPC-3. With the exception of one reading (< 0.01 mg NH_3-N/1) there was no ammonia nitrogen present in the artificial systems during the second period. In Mill Creek, only the stations MC-3, MC-4, and MC-5 located above the sewage treatment facility showed traces of ammonia nitrogen.

Small amounts of the soluble form of phosphate were detected (0.0 - 0.17 mg PO_4-P/1). During the first survey period, average levels were highest in September. The second period showed maximum levels occurred during the month of November. It was also during this month that the highest concentration, 0.17 mg PO_4-P/1, was recorded at station MB-7.

Detergent (MBAS) levels detected during the 1973-74 survey were all <0.2 mg/1. Because of such low levels, it was decided during the 1974-75 period to survey only a few selected stations. During this second survey period, concentrations were found to range from 0.0 to 0.34 mg/1. The effect of detergent concentrations of 0.5 ppm on fish life is believed to be minimal (Eisler 1965).

Detergent values recorded were highest during the months of September, October, and November. It was during the month of October that the maximum reading of 0.34 mg/1 was recorded (at station DPC-3).

As was reported earlier, the waters of the Manahawkin Bay - Little Egg Harbor system were found to be very productive by both the commercial and recreational clammer (also see the following Use Study). The State of New Jersey Health Department, Bureau of Shellfish Control, located at Leeds Point, Absecon, routinely inspects and analyzes the water quality of New Jersey's coastal bays and waters. Contamination is determined by the number of coliform bacterial counts. The total coliform median MPN (most probable number) of the water can not exceed 70 per 100 ml, and not more than 10% of the samples can ordinarily exceed a MPN of 230 per 100 ml for a five-tube decimal dilution test. However, there are other factors that also must be taken into consideration before a particular area is classified. It is equally important to conduct a hydrographic study of an area and if necessary to also include shoreline investigations. Even if the bacterial counts may be considered good, an area could be closed if other factors prove to be a danger to public health (Eisle pers. comm.).[3]

Naturally, overlying waters of shellfish areas are classified by standards developed by the U.S. Public Health Service and member states of the Cooperative Program for the Certification of Interstate Shellfish Shippers. The accepted standards are:

[3] William Eisle heads the Shellfish Control Unit of the New Jersey Department of Environmental Protection.

0-70 Coliform bacteria per 100 ml of water - Clean

71-700 Coliform per 100 ml of water - Moderately Contaminated

Over 700 Coliform per 100 ml of water - Grossly Contaminated

Tables 164 to 169 lists coliform density in MPN/100 ml. Results indicate that coliform counts did exceed 700 MPN/100 ml in the Manahawkin Bay - Little Egg Harbor system (Tables 170 and 171).

In the bay areas, both total and fecal coliform counts were low except for one total coliform count of 750 MPN/100 ml observed at station MB-5 during August. However, in the natural area (Dinner Point Creek drainage) several high total coliform readings were observed during the two survey periods (930 to 4,600 MPN/100 ml). Readings were consistently high at station DPC-3 during the summer and fall period. An attempt was made to try to determine what was the contributing source of pollution. Unfortunately, only one successful run was made to establish a fecal coliform-streptococcus ratio. No conclusive interpretation could be made; this particular test was conducted during a period of low readings (total coliform counts). However, the results have suggested that there are traces of human influence. This area is also reported to support a good wildlife population. The low dissolved oxygen concentrations that have been monitored throughout the survey at this station may further indicate stress conditions. Determining whether present upland developments are the source of these organisms would necessitate further research.

In Mill Creek, high total coliform counts were observed during September (930 - 4,600 MPN/100 ml) and once during November (1,100 MPN/100 ml). The maximum value of 4,600 MPN/100 ml was recorded at station MC-5 (Lagoon 98). As was previously mentioned, this system receives the treated effluent (secondary) of the Beach Haven West sewage treatment facility and the drainage from Manahawkin Lake. During September, high readings were observed both below and above the treatment plant. High fecal coliform counts were also recorded periodically in the upland drainage (91-2,400 MPN/100 ml). The fecal streptococcus tests, although limited, did suggest both human and animal influence.

Several high total coliform counts were measured in the artificial complex (930-4,600 MPN/100 ml). Readings were found to be very sporadic. It is most probable, as suggested by the fecal streptococcus tests, that the duck population utilizing these lagoons was the major contributing factor.

SUMMARY

The Manahawkin Bay - Little Egg Harbor system study area was bounded on the north by a line from the mouth of Gunning River across the Intracoastal Waterway to Harvey Cedars and on the south by a line across Beach Haven Inlet from Shooting Thorofare to the southern tip of Long Beach Island. The survey concentrated on Little Egg Harbor , Manahawkin Bay, drainages of Dinner Point Creek, Meyers Pond, Popular Point, Mill Creek, and Beach Haven West Lagoon Complex. Also included were tributaries such as Tuckerton Creek, Parker Run, Westecunk (West) Creek, and Cedar Run. Water acreage for these areas surveyed were a total of 26,247 acres. The bay volume consisted of 28,889,370,202 gallons with a mean depth of 3.5 ft and a shoreline length of 75.8 statute miles.

It was estimated that a total of 15,922 acres of wetlands are located within the study area. The portions that are state owned are the Great Bay Boulevard Wildlife Management Area (3,789 acres) and the Manahawkin Wildlife Management Area (965 acres). Also included are Federally owned and/or managed property such as the wetlands extending south of Mill Creek (3,800 acres) and the Gunning River Refuge (3,506 acres) which is adjacent to the Manahawkin Tract.

According to the Wetlands Inventory by the New Jersey Department of Environmental Protection, 12 plant species have been identified in the study area: *Spartina alterniflora* (tall and short salt marsh cordgrass), *Spartina patens* (salt-meadow cordgrass), *Iva frutescens* (hightide bush), *Baccharis halimifolia* (sea myrtle), *Distichlis spicata* (spike grass), *Juncus gerardi* (black grass), *Panicum virgatum* (switch grass), *Scirpus olneyi* (threesquare), *Phragmites australis* (common reed), *Typha* spp. (cattail), and *Spartina cynosuroides* (salt reed grass).

A total of 16 lagoon systems have been identified. This would account for 2,061.6 acres of development resulting in 48,000 ft of developed shoreline.

This water system is one of the cleanest and most productive estuaries along the New Jersey coast. Of the 34,789 acres between Beach Haven Inlet and Barnegat Inlet, only 2,480 acres are condemned. Commercially important shellfish found within the system include the hard clams, *Mercenaria mercenaria*; bay scallop, *Argopectin irradians*; and blue mussel, *Mytilus edulis*. Of these, the hard clam is the most important. Because of its abundance, the hard clam supports more shellfishermen than any other shellfish within this system. The soft clam, *Mya arenaria*, and the eastern oyster, *Crassostrea virginica* are also found within this system but are not of commercial importance.

Water temperatures ranged from -2.7 to 30.5°C. The demonstrated seasonal trends were consistent with those observed during previous studies conducted within the coastal waters of New Jersey. The lowest temperature extremes were recorded during the months of January and February and the highest extremes during August. The bay area showed very little vertical temperature difference; generally not exceeding more than 0.6°C. Thermal stratification was evident during both the summer and winter periods in some of the artificial systems. Some water columns had a vertical temperature gradient of 16.7°C.

Salinity ranged from 0.3 to 32.0 °/oo with the highest averages observed during the fall months. In the bay, salinity levels recorded for the surface and bottom water were similar; vertical differences never exceeding 2.1 °/oo. The salinity differences between Beach Haven Inlet and the Manahawkin Causeway were never more than 8.9 °/oo. Except for the reading of 19.8 °/oo, levels never dropped below 20.0 °/oo. In the lagoon complex, vertical salinity stratification was less pronounced but nevertheless evident. The bottom levels measured in some lagoons were also found to be higher than their downstream counterparts. The maximum salinity fluctuation recorded in the surface waters by any one station was at station DPC-3, the farthest upstream sampling location in Dinner Point Creek (3.3 to 26.2 °/oo).

Dissolved oxygen levels ranged from 0.0 to 17.1 mg O_2/1. In the bay, some stratification was evident but to a lesser degree. Concentrations were never detected below 5.4 mg O_2/1. However, in Dinner Point Creek, levels below 5.0 mg O_2/1 were measured during the summer months and to a lesser degree in the fall. Reduced oxygen levels were consistently observed at station DPC-3 (farthest site upstream) during a falling tide.

All of the submerged waters within the artificial systems (excluding BHW-1, BHW-5, and BHW-9) were found at some period of the survey to have oxygen levels less than 3.0 mg O_2/1. Anoxic conditions (<1 mg O_2/1) were found at depths ranging from 7 to 26 ft. Nearly 50% of these readings were observed at water depths over 15 ft (depths usually observed in the channel). The bottom waters of Station BHW-6 in System B were found with oxygen concentrations above 4.0 mg O2/1 only during the months of October and November.

At Mill Creek, on the other hand, only once were the bottom waters within the main channel found with oxygen below 3.0 mg O_2/1. Lagoon stations MC-4 and MC-5, both located in this tributary, were generally observed with bottom water oxygen concentrations greatly reduced or absent. During the summer period, surface levels were found to be extremely high (15.0 mg O_2/1).

High surface levels (15.0 mg O_2/1 or more) were also observed in Tuckerton Creek and Parker Run during various portions of the survey.

The pH readings throughout the Manahawkin Bay - Little Egg Harbor system ranged from 5.7 to 10.0. Normally, readings did not go over 8.5 except during the months of July and August.

"Free" carbon dioxide levels were measured and ranged from 0.0 to 36.3 mg O_2/1. Generally, average levels for the system were highest during the warmer months and lowest during the winter.

Secchi disc values ranged from 3.0 in to 11 ft. Transparency values were generally high in the bay. Average readings were found to be higher in the artificial system as compared to the natural area (Dinner Point Creek). Dinner Point Creek, being shallower with a soft mud bottom, was found at times to be extremely turbid. Light penetration never exceeded 4.5 ft.

Biochemical Oxygen Demand (B.O.D.) values measured during the two study periods were found to be good. Generally, average levels were high during the summer period but gradually dropped going into the fall. Levels ranged from 0.0 to 12.0 mg O_2/1.

Nitrite nitrogen (0.036 mg NO_2-N/1 maximum) and ammonia nitrogen concentrations (0.0 to 0.4 mg NH_3-N/1) were very low.

Nitrate nitrogen levels recorded during the second survey ranged from 0.0 to 3.98 mg NO_3-N/1. High concentrations (0.97 to 3.98 mg NO_3-N/1) were consistently measured in Dinner Point Creek (station DPC-3). Generally, levels in the system were found to be higher during the fall rather than the winter season.

Small concentrations of orthophosphate were detected (0.0 - 0.17 mg PO_4-P/1) the highest level being recorded in the bay at station MB-7.

Slight traces of detergent were detected within this system ranging from 0.0 to 0.34 mg/1.

A bacterial monitoring program showed that total coliform counts ranged from <3 to 4,600 MPN/100 ml and fecal coliform from <3 to 2,400 MPN/100 ml. In the bay areas, both total and fecal coliform counts of 4,600 MPN/100 ml were observed in Dinner Point Creek, Mill Creek, and in the lagoon complex. Determining whether animal or human influence was the contributing factor would necessitate further research.

Results of residue analysis for the chlorinated hydrocarbon showed slight traces of DDT and its metabolites were detected in 34.6% of the fish samples with values ranging up to 17 ppb. Only 20% of the shellfish meat showed any traces. None of the other insecticides were detected in either fish or shellfish meat.

DDT and its metabolites were detected in 76.6% of the sediment samples. Concentrations ranged up to 69 ppb. The only other insecticide observed was heptachlor epoxide (detected in 33.3% of the samples).

Analysis of fish, shellfish, and sediment samples showed that all five elements were present. Only slight traces (<0.01 ppm) of chromium and cadmium were detected in the fish meat. Lead ranged from 0.0 to 6.1 ppm, zinc from 5.65 to 16.85 ppm, and mercury from 0.0 to 0.4 ppm. Only slight traces of chromium (<0.01 ppm) were detected in the shellfish samples. Cadmium ranged from <0.01 to 0.75 ppm; lead ranged from 0.0 to 5.7 ppm, zinc ranged from 2.5 to 20.0 ppm, and mercury from 0.0 to 0.29 ppm.

In the sediment samples cadmium ranged from 0.0 to 3.0 ppm, chromium from 3.0 to 50.0 ppm, lead from 0.0 to 297.5 ppm, zinc from 2.0 to 66.6 ppm, and mercury from 0.0 to 2.75 ppm.

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PHASE III, USE STUDY

Peter J. Himchak

ABSTRACT

The use study of the Manahawkin Bay - Little Egg Harbor system was designed to determine the ways in which the estuarine system is used; the estimated total man-days of activity for each major type of user-group; expenditure estimates for various user-groups; and an estimated resource harvest for the entire system.

Aerial surveys, bag and creel surveys, and expenditure surveys were the three integrated survey methods utilized to obtain data for the above determinations.

For the 8 month study period, July 1973 to February 1974, resultant tabulations show that an estimated 158,269 man-days of activity had occurred within the study area. During which an estimated 446,754 fish (including crabs), 14,365,902 shellfish, and 306 waterfowl were harvested at an estimated cost to those involved of $835,222.55.

During a second sampling period from June 1974 to May 1975, excluding November and December 1974, an estimated 230,326 man-days of activity occurred within the study area with an estimated total harvest of over 450,000 fish (including crabs) and over 19 million hard clams. An estimated $2,206,033.04 were spent by those persons using the study area during this time period.

ACKNOWLEDGEMENTS

The use study of Manahawkin Bay - Little Egg Harbor was initiated by Assistant Fisheries Biologist Bruce A. Halgren. The study continued under his supervision throughout the initial 8 month period (July 1973 to February 1974) and during the first 7 months of the 12 month period (June 1974 to January 1975). Upon his transfer to a different project, I assumed leadership of the study.

Fisheries Worker Russell Tilton performed most of the field work throughout the 20 months of sampling. His enthusiasm and dedication is most appreciated.

Principal Fisheries Biologist Paul E. Hamer is also acknowledged for his supervisory assistance and recommendations.

The assistance with field work by other laboratory personnel is also greatly appreciated. Those of assistance include: Senior Fisheries Workers Jeffrey Carlson and Keith Lockwood; Fisheries Workers Barry Preim and William Andrews; and Summer Worker Frederick Bubeck.

INTRODUCTION

This study is an attempt to estimate the extent and types of all major estuarine activities occurring within the Manahawkin Bay - Little Egg Harbor system. Under the continuing Estuarine Evaluation Project the Bureau of Fisheries is conducting an intensive survey and inventory of all the major New Jersey estuaries, usually allocating an entire year for each system. Manahawkin Bay - Little Egg Harbor represents the fifth major estuarine system to be studied under this project.

The study area covers tidal waters and associated marshlands with the upland treeline serving as an easily recognizable boundary line. It is within these areas that most activities affecting estuarine resources are conducted. Covering the entire watershed was prohibitive due to insufficient manpower. The northern boundary of this study area was Sandy Island in Barnegat Bay (roughly the same latitude as Harvey Cedars). Little Egg Harbor Inlet and Great Bay Boulevard were the southern limits of the survey area (Figure 31 which can be found in Appendix A). Activities performed on the bay side of Long Beach Island such as bank fishing were included, whereas those activities such as surf fishing on the ocean side of the barrier island were not considered.

The survey attempted to determine how the estuary is used by man, both commercially and recreationally; the different types of user-groups[3]; an estimated total man-days[3] for each activity; total resource harvest and total expenditures by the different user-groups. There is also presented a comparison between the total use picture of the Beach Haven West lagoon community and the adjacent natural marsh.

Initially, an 8 month study of the Manahawkin Bay - Little Egg Harbor system was conducted from 1 July 1973 to 28 February 1974. This was followed by a similar 12 month study of the same area from 1 June 1974 to 31 May 1975. The 3 month interim was due to administrative scheduling for report writing. This report presents the results of 20 months of field work covering both study periods.

DEFINITIONS

The following list of terms and their definitions are presented for clarity and understanding of segment areas, activities, and other terms appearing throughout this report. This list originally appeared in the Nacote Creek Research Station Miscellaneous Report No. 14M, Eight Month Study of the Little Egg Harbor - Manahawkin Bay System, and is reproduced here in its entirety.

1) Bank fisherman is any individual fishing or crabbing without a boat.

2) Beach Haven West is the lagoon community located on the west side of Manahawkin Bay, south of State Highway 72, and north of Mill Creek (Figure 31: Section A). For the purposes of this study, only those activities occurring within the tidal waters (lagoons) of the community or those activities directly involved with the tidal waters, such as bank fishing, were included on the aerial survey data sheets (i.e. activities such as backyard barbecues were not included).

3) Boat fisherman is any individual fishing or crabbing from a boat of any type, size, or description.

4) Boating is any boat, the occupants of which were not obviously engaged in, or had engaged in fishing, shellfishing, water skiing, or hunting.

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[3]Consult definitions section for an explanation of these terms.

5) Catch per effort is the average number of fish or shellfish caught per hour of fishing or shellfishing (fish per man-hour) unless otherwise stated such as catch per man-day.

6) East Little Egg Harbor is that portion of the study area bordered on the south by Little Egg Inlet; on the west by a line from Tucker Island sand bar to Goosebar Sedge to East Sedge Island to Shelter Island; on the north by a line from Long Point to Marshelder Islands; and on the east by Long Beach Island (Figure 31: Section 3).

7) East Lower Manahawkin Bay is that portion of the study area bordered on the south by a line from Long Point to the Marshelder Islands; on the north by State Highway 72; on the east by Long Beach Island; and on the west by a line from Shelter Island to Cedar Bonnet Island (Figure 31: Section 4).

8) East Upper Manahawkin Bay is that portion of the study area bordered on the south by State Highway 72; on the north by a line from Dipper Point to Maiden Land in the Borough of Harvey Cedars; on the west by a line from Cedar Bonnet Island to Sandy Island; and on the east by Long Beach Island (Figure 31: Section 5).

9) Hours per angler is the average number of hours spent per fishing trip.

10) Man-day is an indeterminate length of time an individual spends on the study area during any day.

11) Natural marsh is that portion of section 1 of the study area that is bordered by Mill Creek on the north; Meyers Pond Creek on the south; and the upland tree line to the west (Figure 31: Section B). Boats involved in activities in very close proximity, (within 10 to 20 ft) to the shoreline of the marsh were also included in this section.

12) Others is any activity that was either unknown or which did not fit in the listed categories of major user-groups. This would include, but is not limited to sightseers, bird watchers, hikers, naturalists, picnickers, and nonfishermen (with groups of bank fishermen).

13) Shellfishing is any individual harvesting clams, oysters, scallops, or mussels.

14) User-group is a major activity category and its participants, such as bank fishermen, boat fishermen, etc.

15) West Little Egg Harbor is that portion of the study area bordered on the north by a line from Long Point to the Marshelder Islands; on the south by Great Bay Boulevard; on the west by the upland tree line; and on the east by East Little Egg Harbor (Figure 39: Section 2).

16) West Lower Manahawkin Bay is that portion of the study area bordered on the north by State Highway 72; on the south by a line from Long Point to the Marshelder Islands; on the west by the upland tree line; and on the east by East Lower Manahawkin Bay (Figure 39: Section 1).

17) West Upper Manahawkin Bay is that portion of the study area bordered on the south by State Highway 72; on the north by a line from Dipper Point to Maiden Lane in the Borough of Harvey Cedars; on the west by the upland tree line; and on the east by East Upper Manahawkin Bay (Figure 31: Section 6).

Table 172 is a subsection of this definition list that also appears in the above mentioned Miscellaneous Report No. 14M and includes those species of fish and shellfish harvested by sport and commercial fishermen interviewed in the study area. Note that Tables 172 to 249 which relate to the use study can be found in Appendix B.

METHODS

Three integrated methods were employed to accomplish the objectives of the use study. Aerial surveys provided the data for monthly estimates of total man-days of activity within the study area. Bag and creel surveys yielded total harvest estimates for the study area. Expenditure surveys enabled the calculation of per trip expenditures and total expenditures for the different user-groups. In addition, a survey was initiated in June 1974, to determine the geographical origin of the different user-groups in the study area. A detailed presentation of the methods employed is given below.

Aerial Survey

Three aerial surveys were scheduled weekly, two on weekdays and one on a weekend day or holiday. The days for scheduling of flights were randomly chosen. Due to the greater recreational pressure on weekend days these data were segregated from weekdays data. Holiday flight data were treated as weekend days due to similar recreational pressure.

During January and February of both study periods, sampling frequency was reduced to one weekday flight and one weekend flight per week to minimize expenditures during minimal activity periods. This practice went into effect after the last day of duck hunting season in January. Also, there were no aerial surveys conducted during November 1974 and December 1974 when monies allocated to this study were temporarily exhausted.

All flights were randomly scheduled between 1000 and 1500 hours, considered the greatest activity period of the day (Briggs 1962). It should be realized that the estimate of total man-days of activity will be low since user-groups utilizing the study area only during the early morning or late afternoon hours were not accounted for. No adjustments were made to monthly estimates to correct for this.

The survey area was divided into eight sections: East and West Little Egg Harbor, East and West Lower Manahawkin Bay, East and West Upper Manahawkin Bay, Beach Haven West, and the natural marsh. These divisions within the survey area facilitated counting and provided better understanding of areas of activity. These areas are described in the preceding definitions section and are shown on Figure 31. Nine major activities were tallied for each section of the survey area to better understand where the different activities were being performed. These activities include: bank fishing, boat fishing, boating, shellfishing,

bathing, sailing, water skiing, hunting, and trapping, with all other activities listed in a miscellaneous category (others).

All survey flights followed the shoreline within the survey area at an average altitude of 500 ft. A single pass through the survey area was generally the rule. Deviations from the flight plan sometimes became necessary to more accurately count large numbers of boats or persons, to clarify the type of activity being performed, or to locate waterfowl hunters. Altitude, ranging from 200 to 700 ft, was influenced by visibility and areas of high population density.

Attempts were made to reschedule those flights cancelled because of adverse weather conditions. Counts on foul weather days, if possible, would understandably lower the man-days estimates. Corrections for these cancelled flights on bad weather days were not made. Some cancelled flights could not be rescheduled and were lost for the month.

Boat counts were recorded on the field data sheets for the following activities: boat fishing, boating, shellfishing, and sailing. Actual head counts of people were taken for bank fishing, bathing, water skiing, hunting, and trapping. The average number of persons per boat was determined on a monthly basis using the bag and creel survey data.

Weekday means and weekend-holiday means of man-days of activity were computed by area and activity. These means were expanded according to the number of weekdays and weekend days/holidays in that particular month to determine a monthly estimate. Monthly estimates were computed for each activity in each of the eight sectors of the study area.

Bag and Creel Survey

To estimate the resource harvest per user-group, bag and creel surveys were conducted. Bank and boat fishermen, shellfishermen, hunters, and trappers were personally interviewed to determine the average catch per unit effort for each user-group.

Three bag and creel surveys were scheduled weekly coinciding with the three aerial survey days. One of the two weekday surveys was allocated to bank fishermen and the other to boat fishermen. The weekend survey was alternately scheduled for bank or boat fishermen. During hunting season, one survey day each week was reserved for hunters. The type of survey for each day was randomly chosen. During periods of minimal activity within the study area, such as the winter months, a bag and creel survey would include all user-groups as well as expenditures of those user-groups.

In conducting a bag and creel survey, the known access sites throughout the entire area were visited during the daylong survey. Transportation was by automobile. During the summer months, two interviewers were sometimes utilized, each covering half of the survey area.

In addition, one boat by boat survey was scheduled weekly to obtain incomplete trip data from boat fishermen, clammers, and hunters who might otherwise be missed during surveys by automobile. The number of boat by boat surveys was determined by weather conditions and boat availability at the laboratory.

For each bag and creel survey, the field worker interviewed as many people as possible during the course of the day. Only those persons engaged in their activity for a minimum of 1 hour were counted. This time of 1 hour was arbitrarily considered the minimum angler or hunter trip to represent a true catch per effort ratio.

The following data were obtained during a bag and creel survey: number of persons in the party; hours engaged in the activity per person; how many hours each individual planned to remain participating in that activity; and catch or harvest by number of each species. Bank fishermen were usually recorded singularly, while boat fishermen at access areas at the end of their trip were interviewed as a group. The number of anglers per boat was recorded and averaged monthly. These data were used to expand the boat counts taken during aerial surveys to arrive at estimates of total persons engaged in boat fishing, boating, and sailing. The average number of clammers per boat was determined from data taken on boat by boat surveys.

Data derived from bag and creel surveys were summarized monthly. Harvest per effort for hunters and clammers and catch per effort for fishermen were determined from the above described data. Total harvest and catch estimates were calculated by integrating data from aerial surveys and bag and creel surveys.

Expenditure Survey

Expenditure survey data were used to estimate average expenditures of the major user-groups both on a per trip basis and for the year. Originally, expenditure data were collected during bag and creel surveys from one out of every four persons interviewed by the field worker. During the summer months, one survey day per week was randomly chosen for collecting expenditure data only. For the 12 month study period, an expenditure survey was scheduled weekly throughout most of the year.

Data were collected on the following expenditures: bait, boat gas and oil, number of trips annually, miles traveled, and any miscellaneous fees. Food and lodging costs were prorated on a daily basis. For example, if a bank fisherman were paying for lodging by the week, one-seventh of this dollar figure was entered on the field data sheets for that day. To estimate the daily value of equipment, the person interviewed was asked to estimate the original cost of his equipment present, the average age of the equipment, and the number of times a year he uses the equipment present for the activity in which he was engaged. The original equipment cost was divided by the product of equipment age and number of trips annually to estimate equipment cost for that day's usage. The round trip mileage for using the estuary was multiplied by the appropriate number of cents per mile for the time period in which the activity took place. During the 8 month survey from July 1973 to February 1974, 5 cents per mile was multiplied by the round trip mileage to estimate car traveling expenses (Department of the Interior 1972). For the 12 month survey, June 1974 to May 1975, a figure of 12 cents per mile was used (Federal government allowance for employees' traveling expenses).

Expenditures data were summarized on a monthly basis to give expenditure means for expense categories, value of equipment, and miles traveled. These

means were subsequently multiplied by user-group estimates from the aerial surveys to estimate total expenditures for the different user-groups.

Residence Survey

An additional segment was added to the use study for the 12 month period, June 1974 to May 1975. This new survey was to determine the county or state of residence of those persons utilizing the survey area.

If the person were from out of state, that particular state was recorded. The yearly percentages of persons residing in Pennsylvania, New York, and the individual counties of New Jersey who traveled to the Manahawkin Bay - Little Egg Harbor survey area either for recreational or commercial reasons were computed. People were interviewed for county or state residence during both the bag and creel survey and the expenditure survey.

RESULTS

Aerial Survey - Use Estimates

Of all the flights scheduled during the 20 months of sampling, 72% were completed; 53 flights were cancelled due to inclement weather conditions. If it had been possible to obtain a count of persons using the study area on bad weather days, monthly estimates would understandably be lowered. As stated in the methods section, monthly estimates (as reported) of total man-days of activity are expected to be lower than the actual number since those persons using the study area during early morning and late day or night hours were missed altogether.

The numbers of flights scheduled and completed during the 20 months of field sampling are listed in Tables 173 and 174. Of the 96 scheduled flights, 75% were completed during the 8 month study of the Manahawkin Bay - Little Egg Harbor system. During the 12 month study of the Manahawkin Bay - Little Egg Harbor system, 69% of the 94 scheduled flights were completed. In summation, the two time periods combined yield the data in Table 175.

Results of the two study periods will first be presented separately. A comparison of the findings will then be made attempting to combine the 20 months of data into yearly estimates of total man-days of activity.

EIGHT MONTH STUDY: JULY 1973 TO FEBRUARY 1974 -- The following use estimates for Manahawkin Bay - Little Egg Harbor during July 1973 to February 1974 are taken from the Nacote Creek Research Station, Miscellaneous Report No. 14M. During the 8 month study period, a total of 158,269 man-days of activity were spent on the study area (Table 176). Boat fishing was the most heavily engaged in activity in the study area and represented 42.25% of all activity in the study area. Even this figure, however, is considered minimal since a substantial portion of boaters, the second largest single category, were actually fishermen under way from one fishing ground to another, or between fishing grounds and a landing. Following boat fishing in popularity were boating (22.51%), shellfishing (11.75%), sailing (10.90%), bathing (5.56%), bank fishing (4.91%), others (1.11%), water skiing (0.68%), and hunting (0.34%).

The greatest activity demands upon the study area occurred during the summer. July (36.44%) and August (39.00%) accounted for over 75% of all the activity that took place during the 8 month study period. After the summer months, user activity declined steadily for the remainder of the study period. Tables 177 through 184 give estimated man-days of activity figures by area and activity for each month of the survey, while Table 185 gives the total estimated man-days of activity for the entire study period, also broken down by area and activity. These tables also present figures for that percentage of user-group activity that occurred in each area section (this figure appears as the upper percentage figure on the charts and is totalled across) and for that percentage of the total sector activity that each user-group represents (this figure appears as the lower percentage figure and is totalled down).

East Little Egg Harbor accommodated the greatest activity demands placed on the study area (27.55%). This is due mainly to the fact that it contained the greatest percentage of boat fishermen and boaters, the two most popular user-groups. This section of the study area also accounted for the greatest amount of user activity in the category of others. The majority of the fishing done in this portion of the bay was by private boats with fluke being the most sought after and successfully caught species; weakfish, striped bass, and bluefish were also taken.

West Little Egg Harbor ranked second in overall activity and accounted for the greatest percentage of shellfishermen (42.77%) and bank fishermen (25.42%) and the second greatest percentage of boat fishermen and boaters.

East Lower Manahawkin Bay ranked third in overall activity and accounted for the greatest percentage of sailors (32.28%) and bathers (43.89%) and the second greatest percentage of bank fishermen.

West Upper Manahawkin Bay had the lowest percentage of overall activity, but had the second highest percentage of hunter activity. It also probably had the greatest number of boat rentals for fishing and crabbing, and undoubtedly produced the best crabbing in the study area.

West Lower Manahawkin Bay accounted for only 14.03% of all activity in the study area but it contained the subsections of Beach Haven West and the natural marsh, and therefore deserves some special comment in this portion of the report. Table 186 shows the total man-days of activity estimates for the Beach Haven West and natural marsh subsections.

Beach Haven West accommodated over 10 times the total amount of activity of the natural marsh. This figure may, however, be very misleading. Over 68% of the activity occurring in Beach Haven West was boating. It does not matter whether these boaters were on their way to go pleasure boating, boat fishing, or water skiing. It seems obvious that they were on their way somewhere else to enjoy their end activity. In this regard, the lagoon community was acting only as a docking facility. It is also probable that the sailboats encountered within the lagoon community were also in transit to the bay to fully realize the enjoyment of sailing, although moving under sail within the lagoon complex must test their skills to the utmost.

The natural marsh subsection has a higher percentage of activity for only two activity categories. These are boat fishing, which makes up 0.70% of the

total boat fishing of West Lower Manahawkin Bay, and hunters which make up 27.20% of all area 1 hunters and 13.20% of all hunters within the study area.

Tables 187, 188, and 189 show the distribution of bank fishing, boat fishing, and boating, respectively, for the 8 month study period by sector and month.

TWELVE MONTH STUDY: JUNE 1974 TO MAY 1975 -- It is estimated that 230,326 man-days of activity were spent in the study area during 10 months of aerial surveys. Since no aerial surveys were conducted during November 1974 and December 1974, a yearly estimate of total man-days of activity is not presented in this section for the 12 month study period. Table 190 presents the estimated total man-days of activity by activity category and month. Tables 191 through 200 present the monthly estimates of man-days of activity for those 10 months in which aerial surveys were conducted.

Boat fishing again accounted for the greatest percentage of activity, 46.56%. The remaining activity categories and their percentages are reported as follows: boating (22.00%), shellfishing (16.75%), bank fishing (6.91%), sailing (3.68%), bathing (3.34%), others (0.54%), water skiing (0.17%), and hunting (0.05%). The estimated total man-days of hunting activity, 117 man-days, appears to be a gross underestimate for the study period due to having data for only the month of October.

By month, the summer months of July and August understandably accounted for over 60% of the total activity occurring within the study area. The months sampled and their corresponding percentage of the total estimated activity are as follows: January (1.10%), February (0.85%), March (2.42%), April (3.36%), May (4.54%), June (12.60%), July (28.26%), August (31.94%), September (10.13%), and October (4.80%).

East Little Egg Harbor with the great recreational pressures of boat fishing and boating, accommodated the most activity, 28.90%.

West Little Egg Harbor accommodated 27.35% of the activity during the study period, again, boat fishing (45.61%) predominating the activity. The greatest percentage of shellfishing (49.89%) occurred within this area.

West Lower Manahawkin Bay, including Beach Haven West and the natural marsh area, accounted for 15.41% of all activity categories. Boat fishing and shellfishing were the dominant activity.

The greatest percentage of bank fishermen, 28.32%, was located in West Upper Manahawkin Bay.

East Upper Manahawkin Bay contained the most bathers within the survey area (33.65%).

Refer to Table 201 for a complete breakdown of activity by area and activity category. Tables 202 through 204 present the distribution of bank fishing, boat fishing, and boating by area and month for the study period.

A comparison of Beach Haven West and the natural marsh area is given in Table 205. Again, the boating estimate of 4,051 for Beach Haven West may be

misleading in estimating total activity for that area. It is very likely that many of these boats were in transit from the lagoon community to participate in boat fishing, pleasure boating, or some other activity elsewhere.

COMPARISON OF USE ESTIMATES FOR THE TWO SAMPLING PERIODS -- Aerial surveys were conducted each month of the 8 month study period. During the 12 month study of the same area, aerial surveys were conducted during only 10 of the 12 months due to temporary expiration of project funds. Consequently, only 6 months of the year were sampled twice as shown in Table 206. For those months which were sampled twice, the 12 month study shows an average increase of 16.27% over the 8 month study in total man-days of activity.

This increase of 16.27% from the first study period to the second was used to estimate those months when no aerial surveys were conducted or the study was not in progress. This was done to provide two 12-month periods of total man-days of activity, thus giving yearly estimates of total man-days of activity for the two study periods. Yearly estimates were not previously given when each study period was analyzed separately. Table 207 lists the data for the two estimated yearly totals of man-days of activity.

Table 208 is a comparison by activity category of estimated man-days of activity for the two study periods showing the totals for those 6 months which were sampled twice.

The four major activity categories of bank fishing, boat fishing, boating, and shellfishing showed increases in man-days of activity of 60%, 26%, 24%, and 52%, respectively. These increases account for an additional 38,604 man-days of activity. Major decreases in use estimates occurred in the sailing and bathing categories, a decrease of 12,120 man-days of activity. The overall difference in use estimates for the two 6 month sampling periods shows a net increase of 24,847 man-days of activity when all activity categories are considered.

Bag and Creel Survey - Harvest Estimates

EIGHT MONTH STUDY: JULY 1973 TO FEBRUARY 1974 -- The following harvest estimates are taken from the Nacote Creek Research Station, Miscellaneous Report No. 14M. A total of 1,878 persons were interviewed during the bag and creel surveys for this study period (Table 209).

Bag and creel interviews, expanded to the extent of the use estimates, indicate that over 4×10^5 fish (including crabs), 9.5×10^6 clams, 4.5×10^6 bay scallops, and 300 waterfowl were harvested from the study area during the 8 month study period. Estimated total catch, catch composition, and catch per effort statistics on the above mentioned renewable resources are given in Tables 210 through 216.

The boat fisherman accounted for 94.86% of the total estimated fish catch. The highest estimated boat catch occurred in July and decreased every month after that throughout the survey period. Boat fishing catch per effort peaked at over four fish per hour in October, but averaged only slightly above one fish per hour for the survey period. The blue claw crab constituted the most readily caught species and comprised 68.21% of the total catch. The fluke was undoubtedly the most sought after fish and was the second most plentiful

representative in the fisherman's creel at 13.12% of the catch. Bluefish (9.67%), blowfish (1.48%), and spot (1.37%) comprised the bulk of the remaining catch.

Blue claw crabs accounted for the majority (79.36%) of the bank fisherman's catch. Bluefish (6.43%), fluke (4.66%), spot (3.30%), eels (0.97%), and weakfish (0.97%) were also taken with fair success by the bank angler. The highest estimated bank catch occurred in July, and like the boat catch, decreased every month after that throughout the survey period. The best catch per effort occurred in November for the bank fisherman with 1.38 fish per hour. The survey long average was 1.02 fish per hour, slightly lower than that of the boat fisherman. The "others" category of fish taken represented 1.82% of the total combined estimated catch and was mainly comprised of the oyster toadfish, northern sea robin, sandbar shark, and smooth dogfish.

The bank fisherman had his highest estimated catch in July, which stands to reason since he also had more man-days of participation in July than any other month. The boat fisherman, on the other hand, had over 3,000 more man-days of participation in his sport in August than in July, but recorded a greater catch in July. This was due basically to better fishing (a better catch per effort ratio) and more hours spent on the water in July (a longer average man-day).

The waterfowl harvest estimates given in this report are probably low. The aerial survey flights were scheduled randomly between 1000 and 1400 hours so that they occurred during the peak activity period (Briggs 1962). There is no doubt that hunters frequently entered and left the study area before and after the peak activity period, or to be more precise, before and after the aerial survey flight. Waterfowl hunters increase their success by being inconspicuous and staying out of sight of their prey. Thus, the skillful hunter may also have escaped observation by aerial survey and further lowered the estimated hunter activity and harvest figures. Hunter interviews were also difficult to obtain and low numbers of interviews could also cause inaccuracies in the survey.

An estimated total waterfowl harvest of 306 birds was recorded on the survey area during the 1973 hunting season with a hunter success ratio of 0.11 birds per hour. The black duck (38.56%) and bufflehead (29.74%) comprised the bulk of the hunter's bag (Table 215).

Shellfishing was the third most heavily engaged in activity within the study area during the 8 month survey, and during the winter months of December, January, and February, the most heavily engaged in activity. Sport and commercial shellfishermen harvested over 14.3×10^6 shellfish during that period. Shellfishing is the only year-round, heavily engaged in activity in the study area. It has high recreational and commercial interests; produces a highly valuable commodity; and the shellfishermen spent an estimated total of 96,000 dollars to engage in their activity for 8 months. This must be ranked as being among the top two or three more important human activities within the study area.

Clams are harvested on a year-round basis. The highest harvest levels occur in the summer months when recreational and part-time commercial clammers swell the ranks. The highest catch per effort levels occur during the winter months when only the full-time experienced commercial clammers are active.

Scallops are harvested only during the open season which extends into the three cold weather months of November, December, and January. During this period, an estimated 4,658,326 bay scallops were harvested at an outstanding estimated catch per effort rate of over 776 scallops per hour (Table 216).

TWELVE MONTH STUDY: JUNE 1974 TO MAY 1975 -- Data from over 2,500 interviews (Table 217) during bag and creel surveys were expanded to estimate total harvest for the Manahawkin Bay - Little Egg Harbor system. Total estimated bank fishing, boat fishing, shellfishing, and hunter harvest are presented in Tables 218 through 224 for those 10 months in which aerial surveys were conducted. It is estimated that over 4.5×10^5 fish (including crabs), and over 19×10^6 clams, were harvested within the survey area during a 10 month period. Hunter harvest figures are suspect due to the small amount of data taken only during the month of October 1974.

Bank fishermen caught an estimated 46,594 fish (Table 218), 89.60% of which were blue claw crabs. Of the finfish species caught by bank fishermen, bluefish (3.90%), winter flounder (2.97%), and eels (0.82%), comprised the bulk of the catch. Less than 3.00% of the estimated total catch of bank fishermen was composed of species other than those mentioned above. The summer months of July and August accounted for over 60% of the 10 month total catch; again this was comprised mostly of blue claw crabs.

Catch per effort figures for bank fishermen given in Table 222 show the greatest success in August and September, 1.79 and 1.77 fish (including crabs) per hour. The yearly catch per effort for bank fishermen was 1.32 fish per hour and was greatly influenced by the crabbing success of the summer months.

Boat fishermen caught an estimated 412,287 fish, including 242,651 blue claw crabs, for the 10 months sampled (Table 29). The blue claw crab represents 58.85% of the total estimated catch. Following crab were fluke, 79,450 for 19.27%; bluefish, 31,112 for 7.55%; black sea bass, 21,590 for 5.24%; winter flounder, 15,222 for 3.69%; and weakfish, 11,390 for 2.76%. The total catch is based on the total estimated man-days for boat fishermen. It has been mentioned that a good percentage of those counted in the user-group, boating, were actually boat fishermen in transit. Boat fishing man-days of activity for the 10 month period are estimated at 107,239 man-days. Total estimated catch is based on this figure. The boating category accounts for an estimated 50,682 man-days of activity. What percentage of these boaters were actually boat fishermen is not known. Therefore, the total estimated boat fishing catch is a low estimate. Catch per effort figures for boat fishermen (Table 221) are highest for September, 1.66, and October, 1.93, when bluefish, black sea bass, fluke, and weakfish dominated the catch. The 10 month catch per effort average for both fishermen was 1.19 fish (including crabs) per hour.

Table 220 shows the total estimated combined fishing catch composition for bank and boat fishermen for the 10 month period. Of the total estimated catch, 458,881 fish and crabs, boat fishermen accounted for 89.85% of the catch, compared to 10.15% for bank fishermen. Of the combined man-days of activity for bank and boat fishermen, 123,159 man-days, bank fishermen accounted for only 12.93% of the activity while boat fishermen accounted for 87.07%. Catch per effort comparisons show bank fishermen having slightly better success than boat fishermen, 1.32 to 1.19. Species listed in the "others" include sharks, sea robins, and oyster crackers.

Only 32 hunters were interviewed during the survey period, hunter activity being estimated at 117 man-days during the month of October 1974. Since no aerial surveys were conducted during November 1974 and December 1974, no estimate of total man-days of hunting activity is given. Table 222 represents the actual and estimated data for hunter harvest based on hunter interviews. Species harvested include the green-winged teal, mallard, black duck, and blue-winged teal (Table 223).

State owned land in the Great Bay Boulevard area was surveyed by game biologists for waterfowl harvest during the 1974-1975 waterfowl hunting season (Widjeskog and Toth 1975). Only about half of the Great Bay Boulevard area surveyed under the above project is included in the Manahawkin Bay - Little Egg Harbor survey area (the marshland north of the boulevard). For the entire Great Bay Boulevard area, hunters spent 2,129 days harvesting 854 ducks and 46 geese. Rail hunters harvested 524 clapper rails and 7 sora rails during an additional 221 days of hunter activity in that same area.

Clamming total harvest estimates based on the 10 months of field data project a total of 19,177,104 hard clams taken from the Manahawkin Bay - Little Egg Harbor system (Table 234). The clamming harvest was estimated on a daily basis for each clammer interviewed and expanded based on the estimated man-days of clamming activity for each month. Catch per effort figures show the number of clams harvested per hour based on interview data. Clamming activity was highest during the month of July (9,878 man-days of activity), but showed the lowest catch per effort (44.43 clams per hour). Both the commercial and recreational clamming data are combined in estimating catch per effort and total harvest. Over 3×10^6 clams were harvested during the months of August and September, reflecting good catch per effort and man-days of activity figures. The best catch per effort occurred in the month of October when 205.67 clams were harvested per hour.

COMPARISON OF HARVEST ESTIMATES FOR THE TWO SAMPLING PERIODS -- For the 6 months of the year which were sampled twice and have total harvest estimates, comparisons are given in Tables 225 through 227. Bank fishing, boat fishing, and clamming harvest estimates are presented, as well as catch per effort figures. Hunter harvests were not compared due to insufficient data. Estimates of catch per man-day, as opposed to catch per man-hour, are used throughout this section of comparisons of total harvest estimates.

Table 225 compares the estimated bank fishing catch by species for the two time periods: July, August, September, October 1973, January, and February 1974 against July, August, September, October 1974, January, and February 1975. The total estimated catch of Manahawkin Bay - Little Egg Harbor shows an increase of 79% from the first sample to the second a year later. However, total man-days of bank fishing activity increased 60% for the same time periods, from 7,503 to 11,997 man-days. When total catches are compared for an equal number of man-days of activity, the estimated bank fishing catches show an increase of 12%. The catch per man-day for the second time period shows an increase from 3.00 to 3.35 fish (including crabs) per man-day.

Boat fishing harvest comparisons show a decrease of 24% from the first sampling period to the second. Adjusting total harvest estimates for equal numbers of man-days of boat fishing activity, a comparison shows an even larger

decrease in number of fish and crabs of 40%. Table 226 shows the comparison of harvest estimates by species. The bulk of the estimated harvest decrease was due to a substantial reduction in the blue claw crab catch from 289,052 to 187,193 crabs. Comparing estimated boat fishing catches for the two sampling periods excluding the crab catch figures reduces the percent difference in half from 40% to 20%. The closing or significant reduction in business of a large boat livery could produce such a drastic reduction in the catch of blue claw crabs. Also, reduced sampling at such boat liveries would also produce such a decrease in catch estimates. Catch per effort figures for the two sampling periods also show a decrease in numbers of fish (including crabs) per man-day of boat fishing activity (Table 226). Comparing catch per effort for total harvest estimates, there was a decrease from 6.47 fish per man-day for the first sampling period 1973-1974 to 3.90 fish per man-day for the second sampling period 1974-1975. Catch per effort figures for finfish species only show a decrease from 2.02 to 1.62 fish per man-day.

Hard clam harvest comparisons are presented in Table 227. For an equal number of man-days for each sampling period, there occurred a 9% decrease in the total number of clams harvested. Total man-days of clamming activity increased 63% from the first sampling period, 1973-1974, to the second sampling period, 1974-1975. Total catch estimates increased only 49%. Adjusting either, total catch for an equal number of man-days of activity shows a 9% decrease in total number of hard clams harvested.

Expenditure Survey - Expenditure Estimates

EIGHT MONTH STUDY: JULY 1973 TO FEBRUARY 1974 -- Over 1,600 persons were interviewed for expenditure data during this sampling period (Table 228). Tables 229 through 232 present the estimated expenditures of bank fishermen, boat fishermen, shellfishermen, hunters, bathers, and sailors. The following text analyzes these data and is taken from the Nacote Creek Research Station Miscellaneous Report 14M.

An estimated total of 74,632 angler days were spent on the study area with an accompanying estimated $738,921.27 expenditure on the part of the anglers involved. This works out to be an expenditure of $9.90 per angler trip, including equipment costs. The estimated 446,754 fish (including crabs) taken by anglers over the survey period cost an average of $1.65 per fish.

Boat fishermen spent an estimated $697,987.66 on an estimated 66,861 fishing trips for an average of $10.44 per trip or $1.65 per fish. Bank fishermen spent an estimated $40,933.61 on an estimated 7,771 fishing trips for an average of $5.27 per trip or $1.78 per fish.

Shellfishermen spent an estimated 18,603 man-days on the bay at an estimated cost to the shellfishermen of $96,301.28 or approximately $5.18 per trip. An estimated 538 man-days were spent in the study area by hunters at an estimated cost of $8,676.35 or $16.13 per trip. Bather man-days were estimated at 8,795 with an accompanying expenditure of $29,204.15 for an estimated $3.32 expenditure per trip. Sailors enjoyed an estimated 17,250 man-days engaged at their sport at an estimated cost of $300,797.97 or $17.44 per trip.

Per trip expenses ranged from a high for sailors of $17.44 through hunters ($16.13), boat fishermen ($10.44), bank fishermen ($5.27), and shellfishermen ($5.18) to a low of $3.32 for bathers.

Total estimated expenditure for all categories surveyed for expenditures for the 8 month survey period was $1,173,891.02.

TWELVE MONTH STUDY: JUNE 1974 TO MAY 1975 -- Over 2,400 persons were interviewed for expenditure data during this sampling period (Table 233). Tables 234 through 237 present expenditure breakdowns for the major activity groups.

Bank fishermen spent an estimated $116,464.95 for the 10 month period, June 1974 to May 1975, excluding November and December 1974 (Table 234). The average per trip expenditure of $7.33 consisted of $0.59 for bait, $0.62 for food, $0.48 for lodging, $0.40 for equipment, and $5.21 for traveling expenses. Other expenses included equipment rental and miscellaneous fees, a total of $0.04 per trip. The estimated total harvest for bank fishermen for this sampling period was 46,594 fish (including crabs). The cost per fish estimate was $2.50.

Boat fishermen during this same time period spent an estimated $1,630,680.52 to harvest an estimated 412,287 fish (including crabs). This comes to $3.96 per fish. Per trip expenditures for a boat fisherman was estimated at $15.21 ($0.66 for bait, $0.54 for boat gas and oil, $2.05 for equipment rentals, $0.29 for food, $0.82 for lodging, $6.65 for equipment, $4.18 for traveling expenses and $0.02 for miscellaneous fees). Estimated total expenditures for boat fishermen are presented on a monthly basis in Table 235.

Estimated total expenditures for shellfishermen, Table 236, were $209,924.95 for the above sampling period. The estimated per trip expenditure of $6.23 was comprised of $1.21 for boat gas and oil, $0.29 for food, $0.40 for related fees, $1.81 for equipment, and $2.53 for traveling expenses. Clamming expenditure data included both the year-long commercial clammer and the seasonal recreational clammer. It would be a fair assumption that the per trip expenditure for a commercial clammer would be less than the estimate of $6.23 due to reduced traveling expenses and equipment value, whereas the per trip expenditure of a recreational clammer would be more.

Sailing expenditures were estimated at $23.24 per man-day of activity based on 85 interviews (Table 237). Of this estimated daily expense, $0.95 was for equipment rental, $2.39 for food, $3.27 for lodging, $0.44 for related fees, $5.98 for equipment, and $10.21 for traveling expenses. The total estimated expenditures for sailors for the 4 months of June, July, August, and September 1974 were $186,962.39.

One hundred eighty-six bathers were interviewed for expenditure data. The bathing expenditure estimate of $8.15 per man-day of activity can be broken down into the following categories: $3.41 for traveling expenses, $3.00 for lodging, $1.69 for food, and $0.04 for miscellaneous fees.

Total expenditures for the activity groups interviewed within the survey area for a 10 month period were estimated at $2,206,033.04. Expenditure data were not tabulated for those persons in the activity categories of boating,

water skiing, and the "others" category. Hunter expenditure estimates are not given due to insufficient data.

COMPARISON OF COST ESTIMATES FOR THE TWO SAMPLING PERIODS -- There is an increase in per trip expenditure estimates for all the major activity categories sampled during the two study periods (Table 238). The per trip expenditure estimates for the listed activity categories are broken down below into separate per trip expenses to better understand where expenditure estimates have increased. The most obvious increase is in traveling expenses where the per mile cost estimate has gone from $.05 for the first sampling period to $.12 for the second sampling period. Bait, equipment, and food expenses may have increased from one year to the next. Bank fishing per trip expenditures increased from $5.27 to $7.33 due largely to increased travel costs (Table 239). Boat fishermen's per trip expenditure estimates went from $10.44 to $15.21, again due largely to travel expenses and also due somewhat to equipment cost increases (Table 240). Clammers' per trip expenditures increased from $5.18 to $6.23, travel cost extimates rose substantially while equipment costs decreased somewhat (Table 241). Sailing again proved to be the most expensive activity with per trip expenditure estimates increasing from $17.44 to $23.24, even though equipment cost estimates were nearly half as much (Table 242). Bathers' per trip expenditure increased in every major expense category. The per trip expenditure estimates of $3.32 and $8.15 are explained in Table 243. Hunters' per trip expenditure estimates are not compared due to insufficient data for the second sampling period, June 1974 to May 1975.

Residence Survey

Over 2,500 persons during the survey year, June 1974 to May 1975, were asked their county and/or state of residence, during either the bag and creel or expenditure surveys. The yearly summarization of these data appears in Table 244. New Jersey residents accounted for 70.75% of the sportsmen using the Manahawkin Bay - Little Egg Harbor system who engaged in either bank fishing, boat fishing, or clamming throughout the year. Pennsylvania residents accounted for 24.19% of the total; New York, 4.62%; and other states, 0.44%. Over half the total number of persons interviewed were bank fishermen.

Tables 245 through 248 give a seasonal breakdown of the place of residence for persons using the survey area during four 3 month intervals.

The percentages of those persons residing in the separate counties within the state of New Jersey on interview data are in Table 249.

SUMMARY

The use study of the Manahawkin Bay - Little Egg Harbor system was an attempt to estimate the total man-days of the major estuarine activities; the total resource harvest of fishermen, shellfishermen, and hunters; and the total expenditures of the major activities occurring within the study area.

Aerial surveys were designed to determine the numbers of persons engaged in the major activities of bank fishing, boat fishing, shellfishing, boating, sailing, water skiing, bathing, and hunting. These separate activities were also tabulated by eight geographical areas to better develop a total use picture of the study area.

During bag and creel surveys, data were obtained through personal interviews to estimate the total resource harvest, as well as catch per effort figures, for the major activity categories of bank fishing, boat fishing, shellfishing, and hunting.

Expenditure data were also obtained through personal interviews to estimate the total expense and per trip expense of the major activity categories.

A residence survey was conducted to determine the county and/or state of residence of those persons participating in the estuarine related activities.

This report presents the above estimates for two separate sampling periods. Initially, the use study of Manahawkin Bay - Little Egg Harbor was conducted from July 1973 to February 1974 (hereafter referred to as the first sampling period). The study was resumed in June 1974 and continued to May 1975 (the second sampling period). Estimates of total activity, resource harvest, and expenditures are presented for each sampling period. Activity estimates, catch per effort estimates, and per trip expenditure estimates were then compared for the two sampling periods.

Aerial survey data show an increase of 16.27% in estimated man-days of activity from the first sampling period to the second. Yearly estimates of total man-days of activity are 203,672 man-days for June 1973 to May 1974 and 236,814 man-days for the time period, June 1974 to May 1975. The four major activity categories of bank fishing, boat fishing, boating, and shellfishing showed increases in man-days of activity of 60%, 26%, 24% and 52% respectively, whereas, major decreases in use estimates occurred in the sailing and bathing categories.

Bank fishing resource harvest estimates show an increase of 79% from the first sampling period to the second. The catch per effort increased from 3.00 to 3.35 fish (including crabs) per man-day, and the total bank fishing activity increased 60%. Boat fishing harvest comparisons show a decrease of 24% from the first sampling period to the second, due mostly to a reduction in the blue claw crab catch. Catch per effort estimates decreased from 6.47 to 3.90 fish (including crabs) per man-day. Hard clam harvest estimates decreased 9% when comparing an equal number of man-days of activity. Over 19 x 10^6 clams were harvested for the 10 month period, June 1974 to May 1975 excluding November and December 1974. An estimated total waterfowl harvest of 306 birds were recorded on the survey area during the 1973 hunting season with a hunter success ratio of 0.11 birds per hour.

Bank fishermen's per trip expenditures increased from $5.27 to $7.33, boat fishermen from $10.44 to $15.21, shellfishermen from $5.18 to $6.23, sailors from $17.44 to $23.24, and bathers from $3.32 to $8.15, all due mostly to increased traveling costs.

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Figures for the Studies of the Manahawkin
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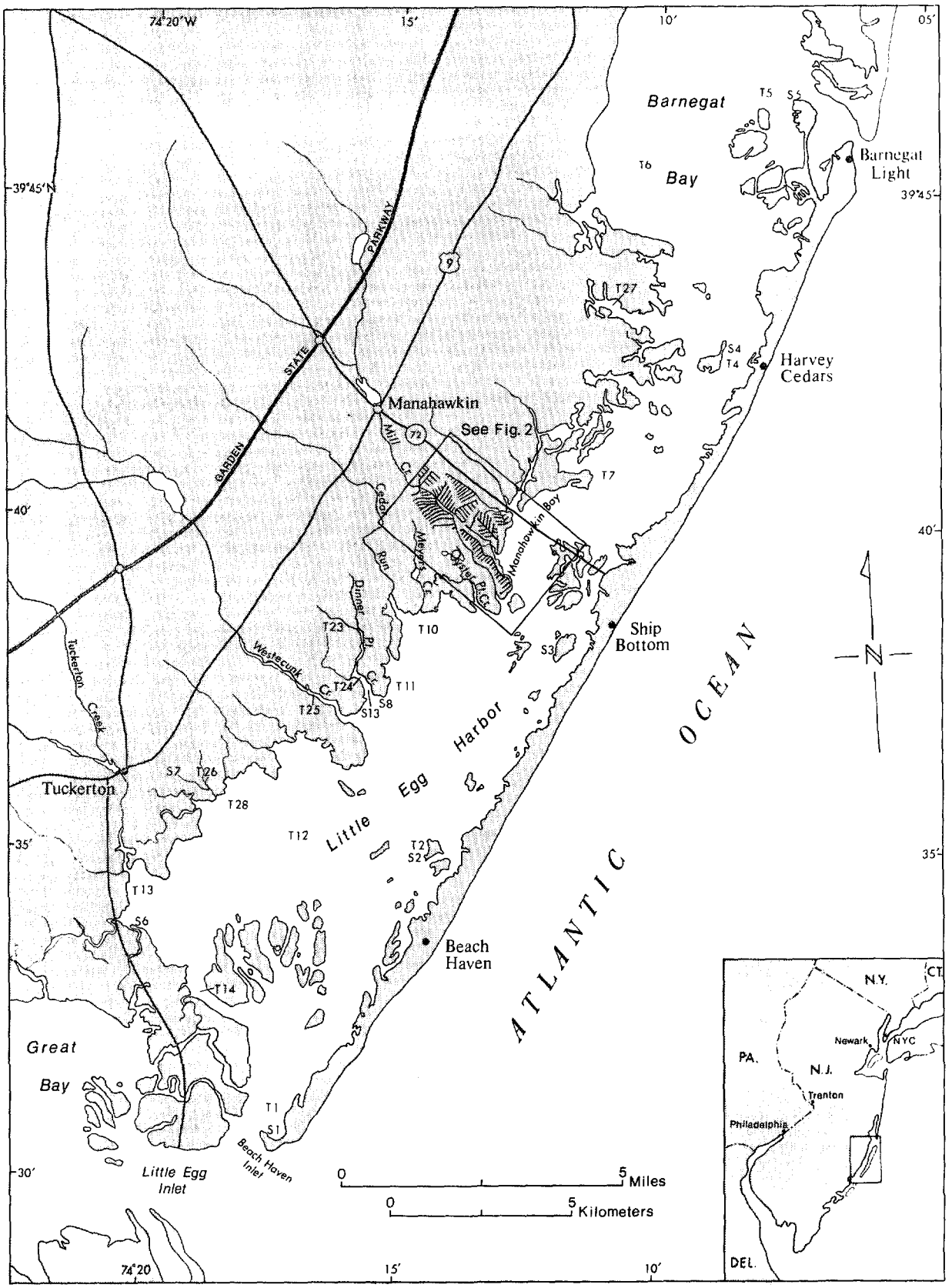


Fig. 1. Location of fish sampling stations in the Manahawkin Bay - Little Egg Harbor system.

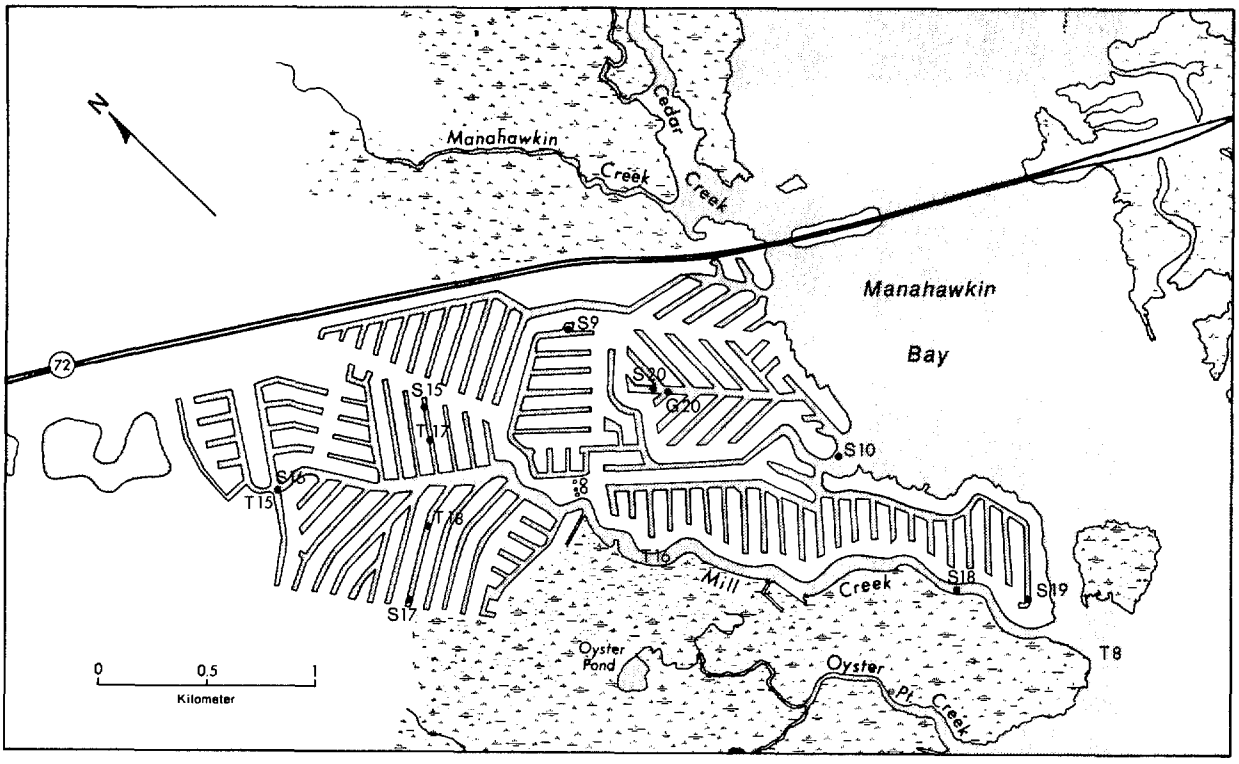
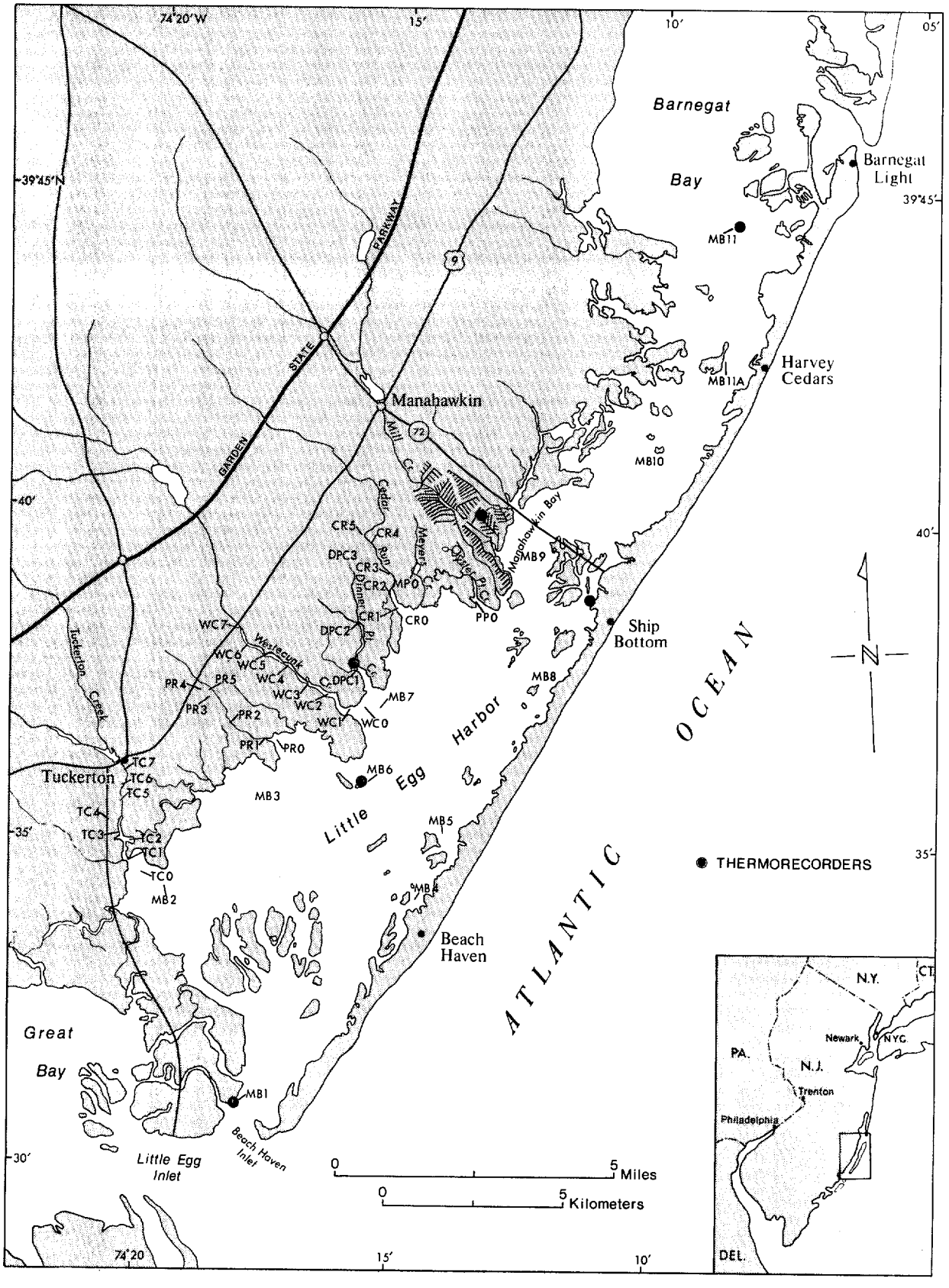


Fig. 2. Location of the fish sampling stations in Beach Haven West.



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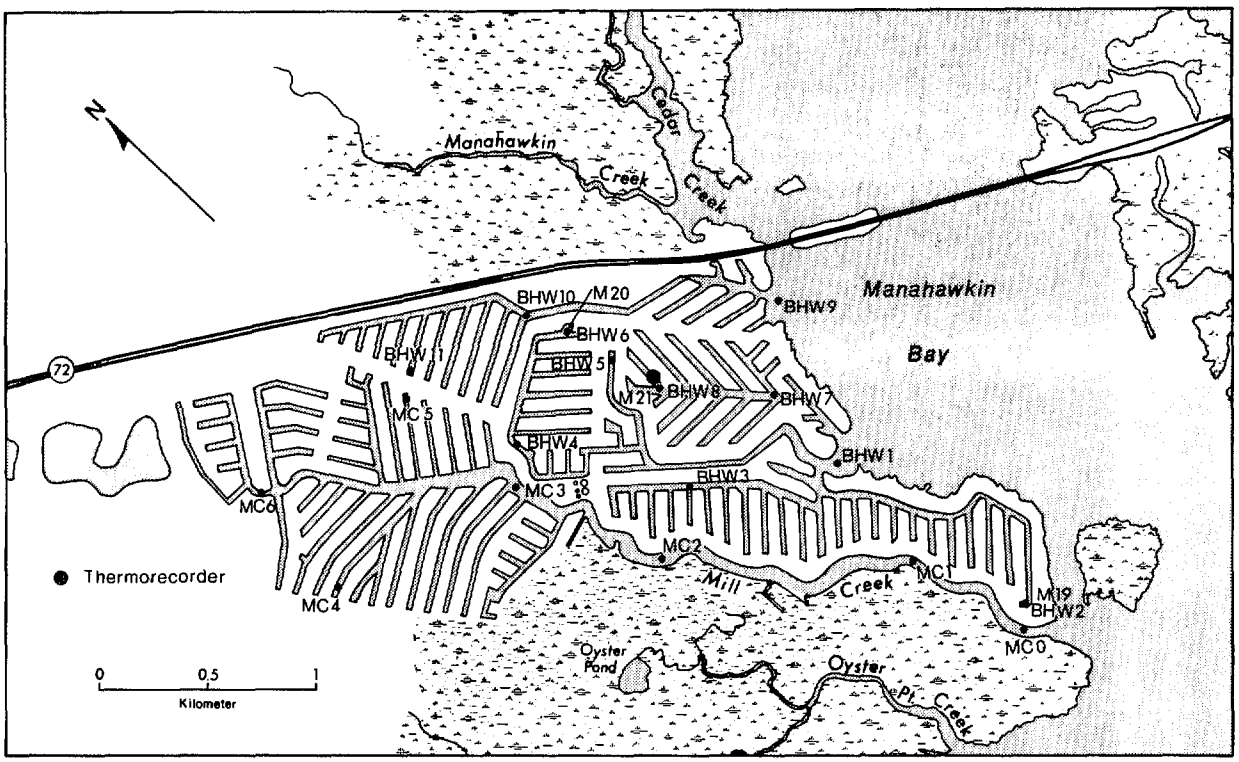

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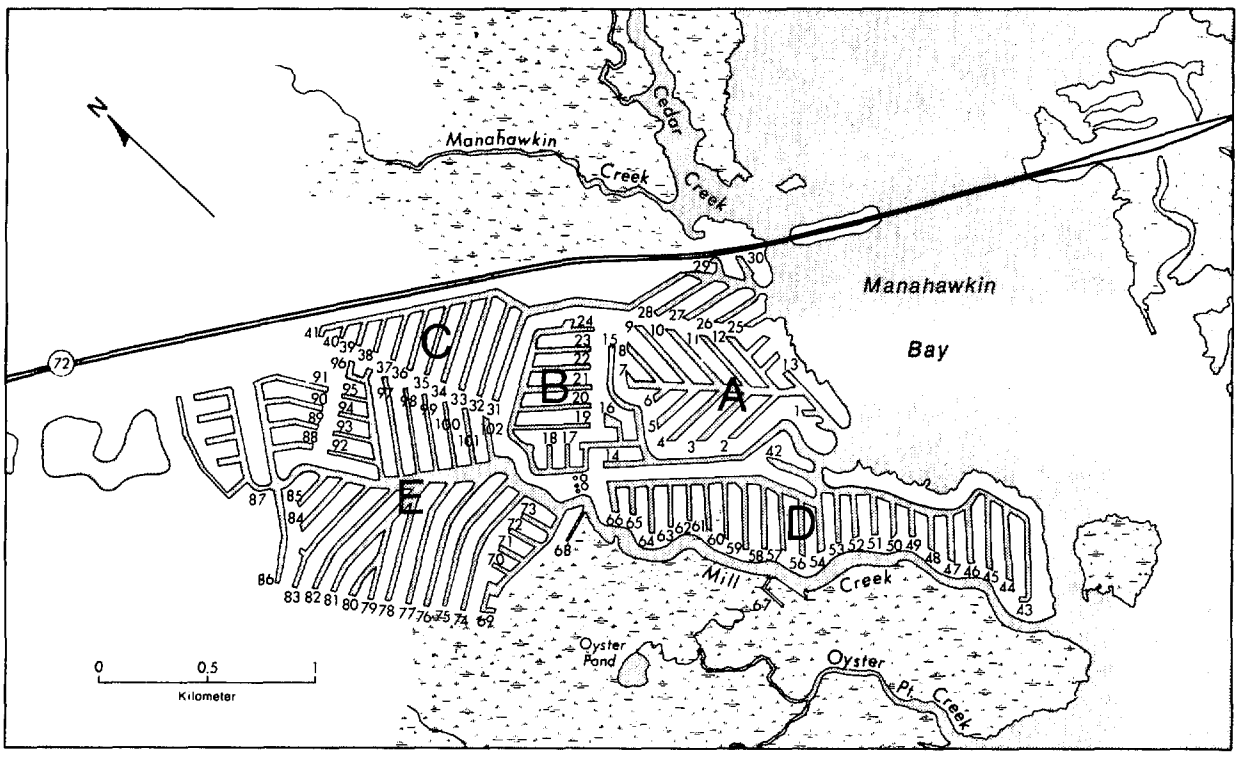

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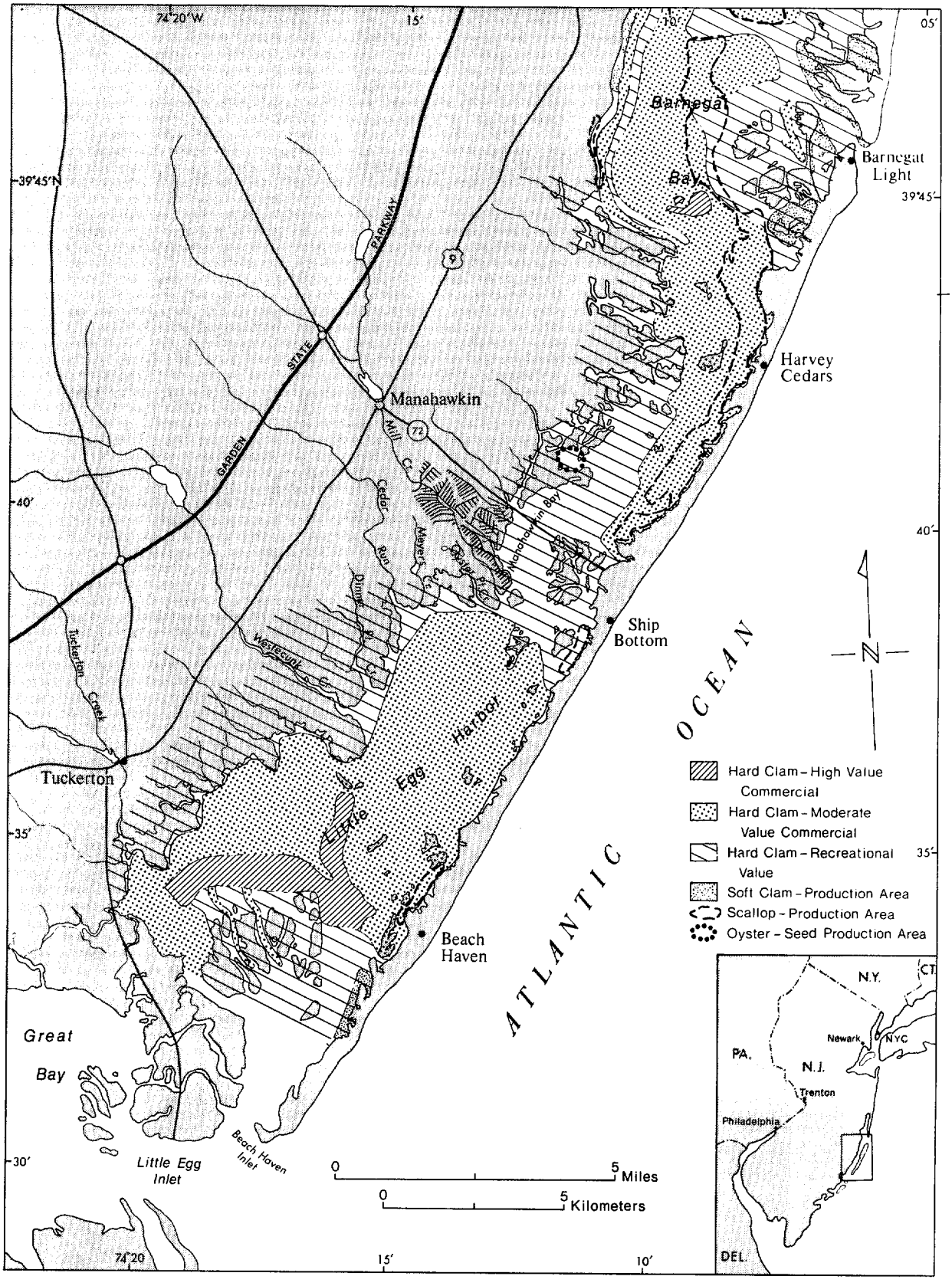

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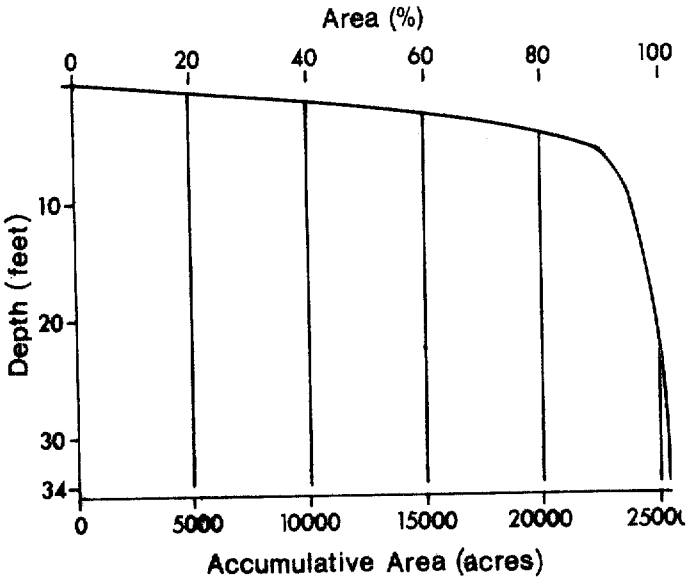

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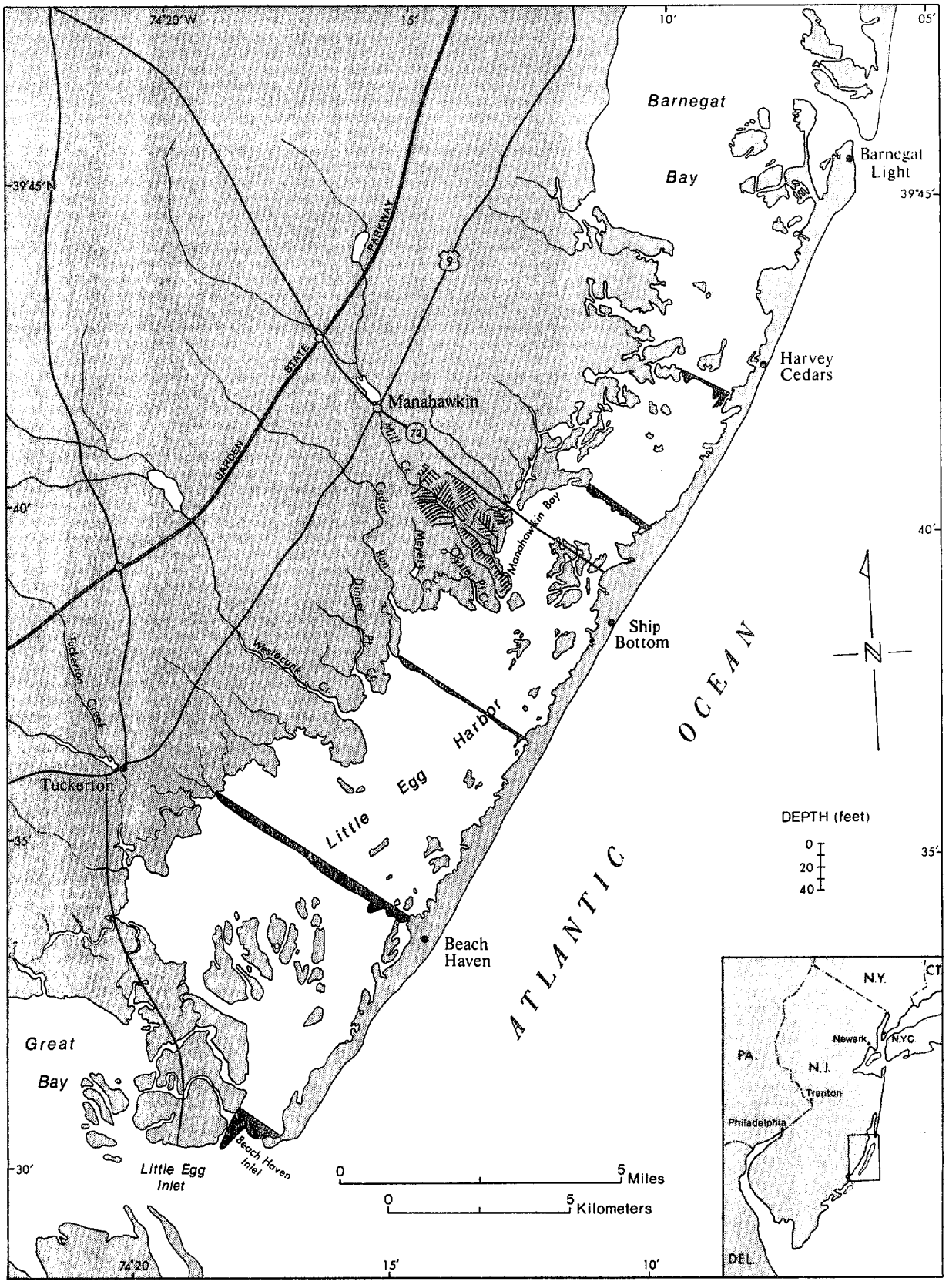

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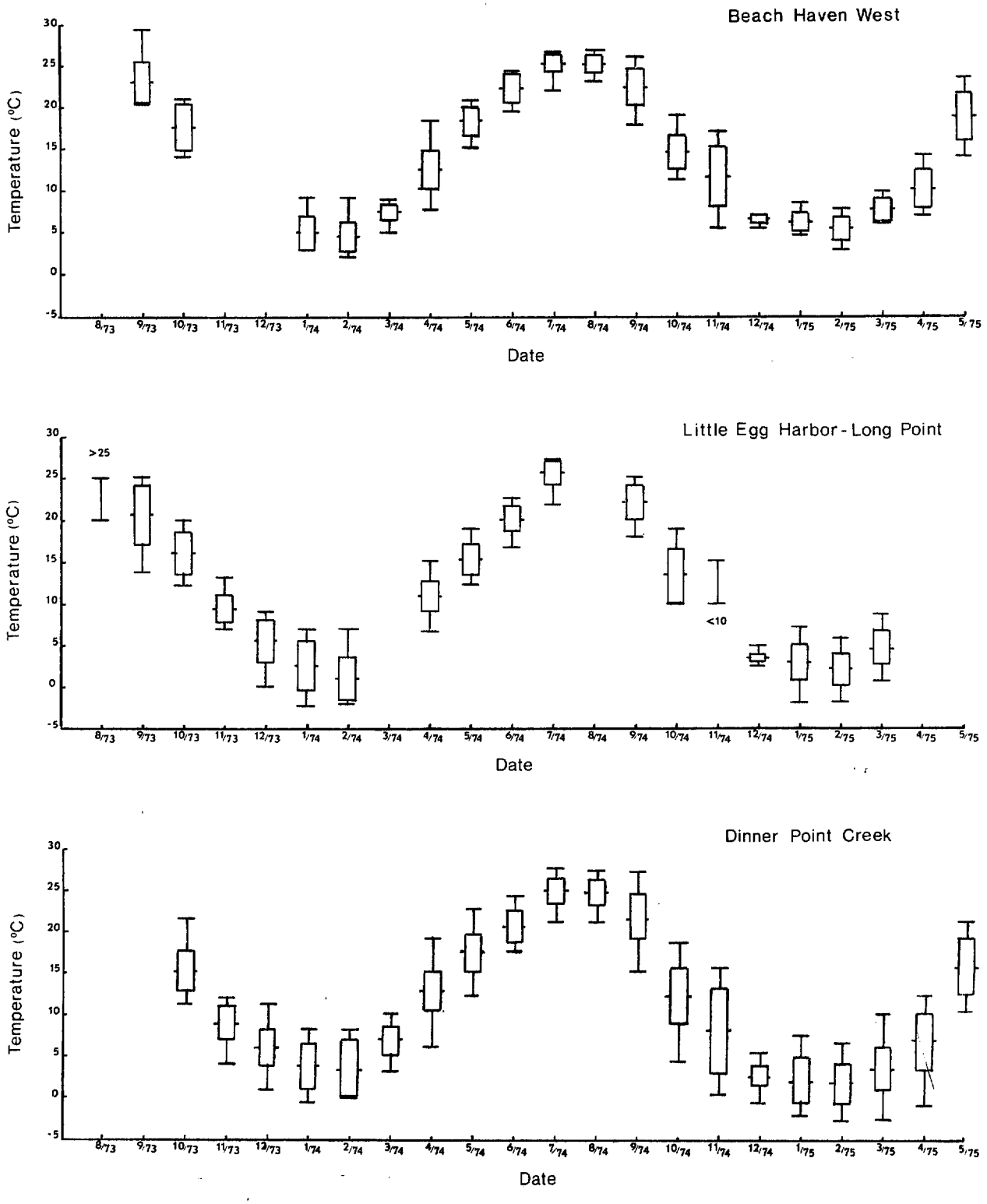

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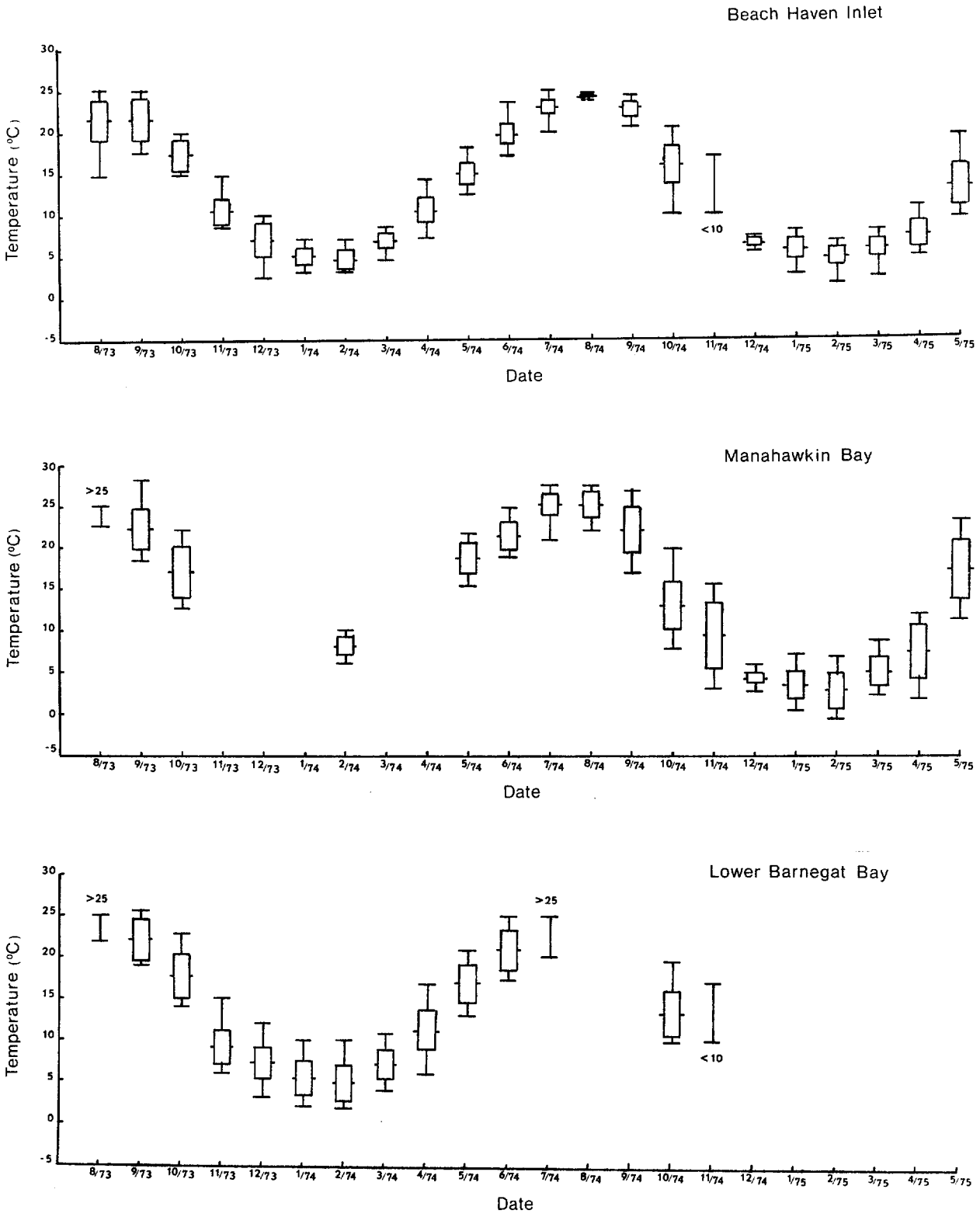

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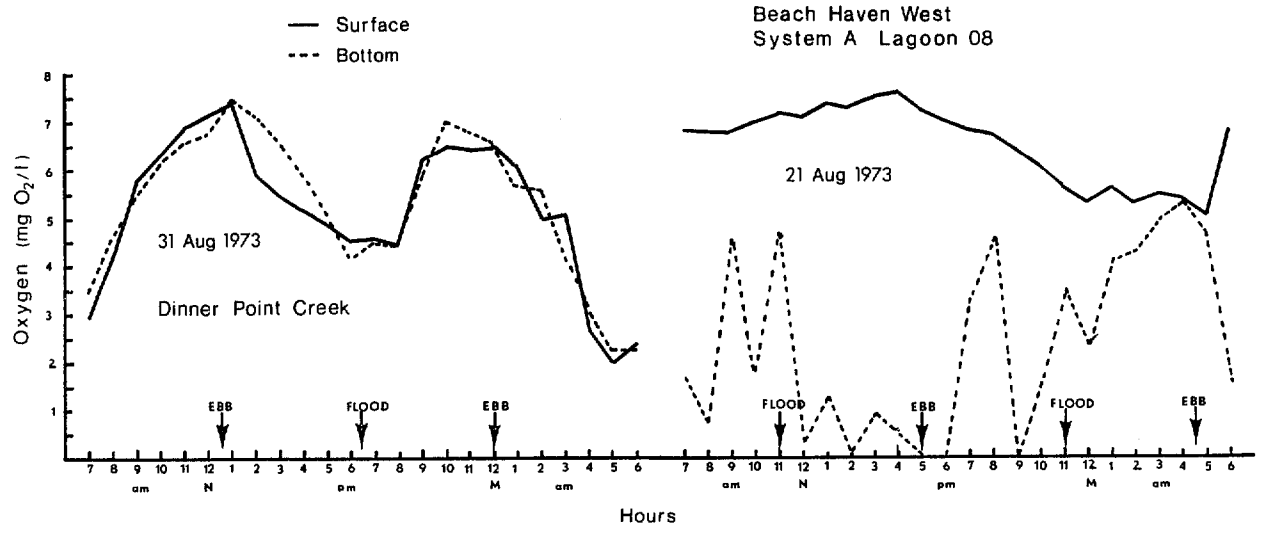

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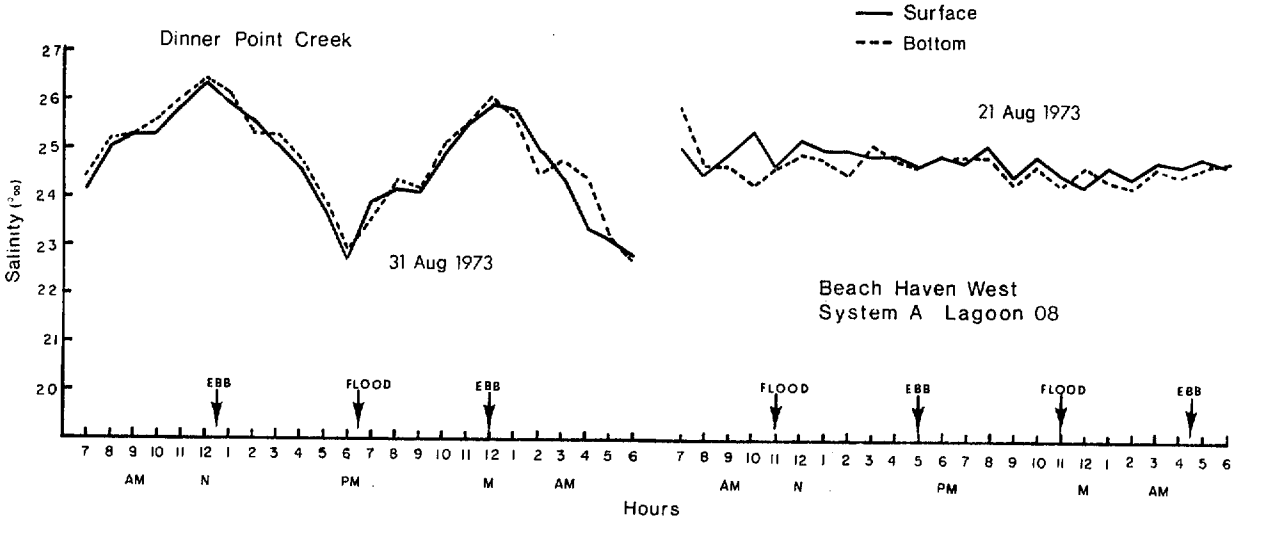

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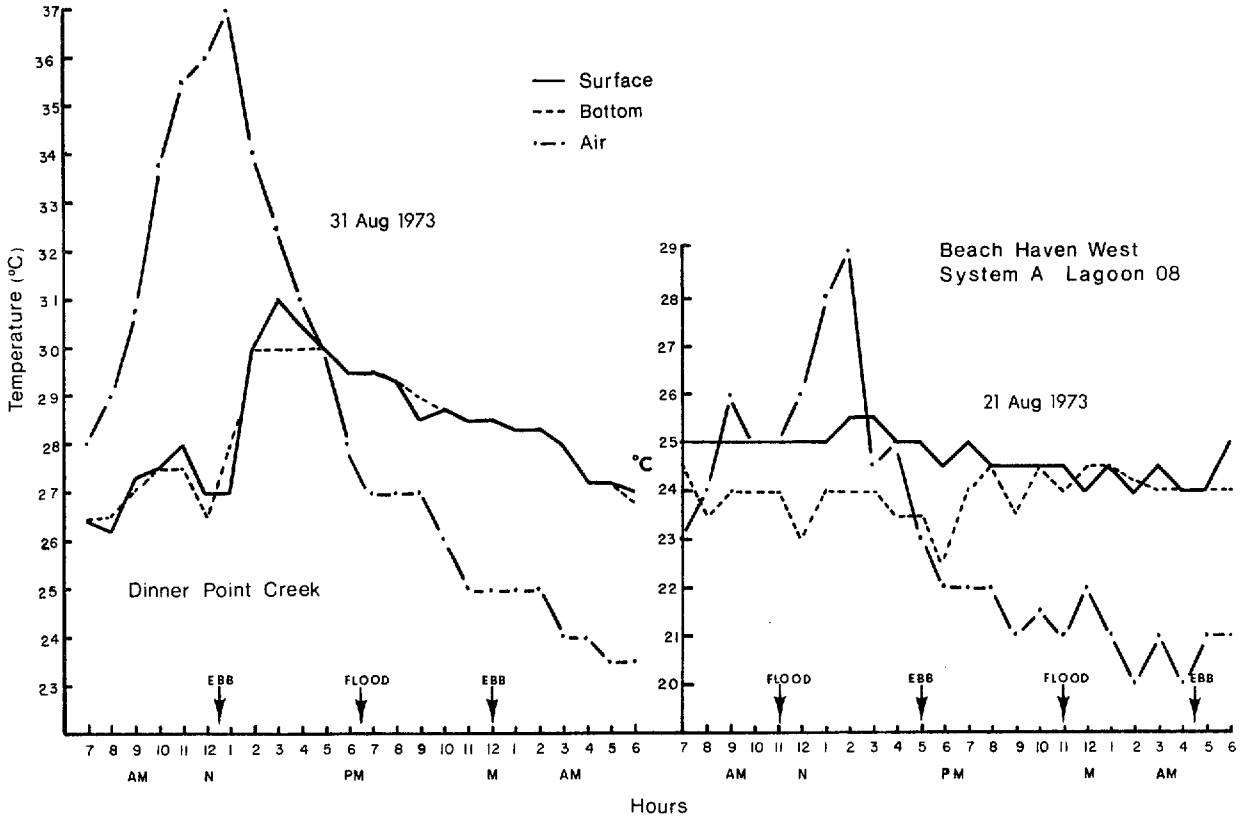

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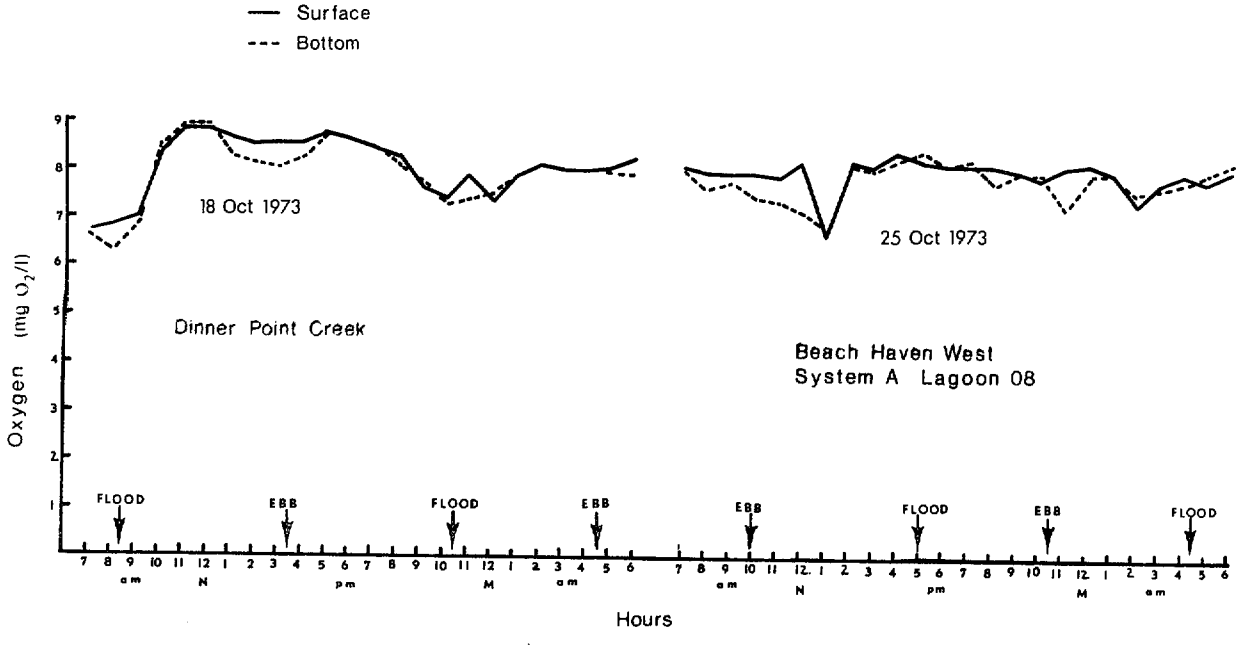

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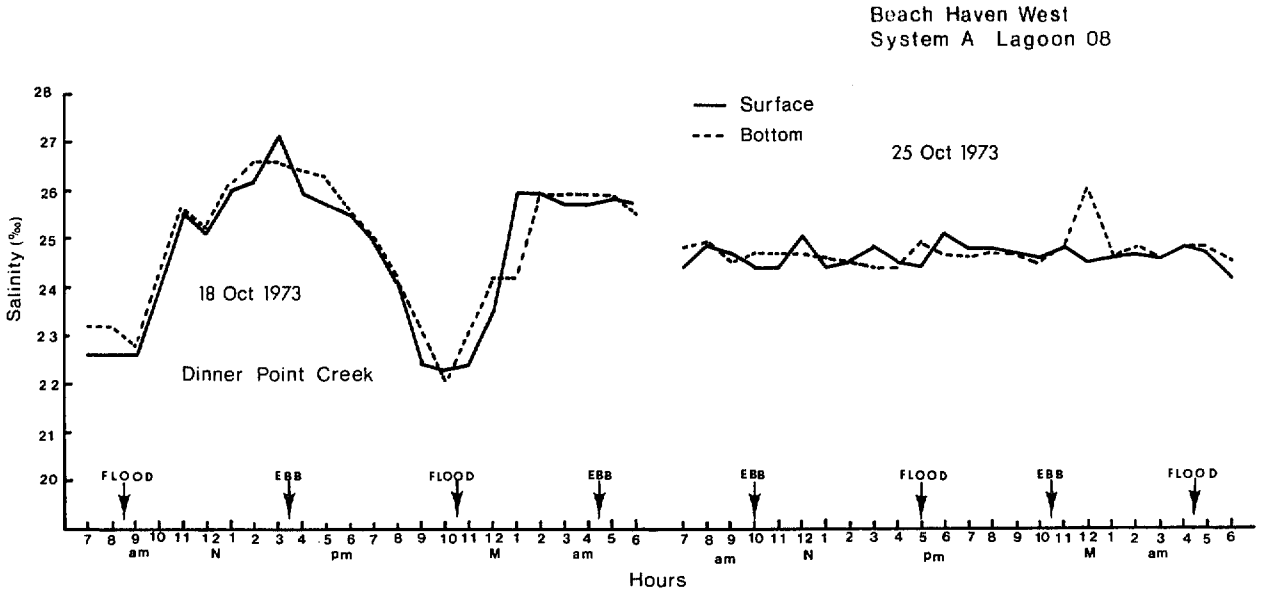

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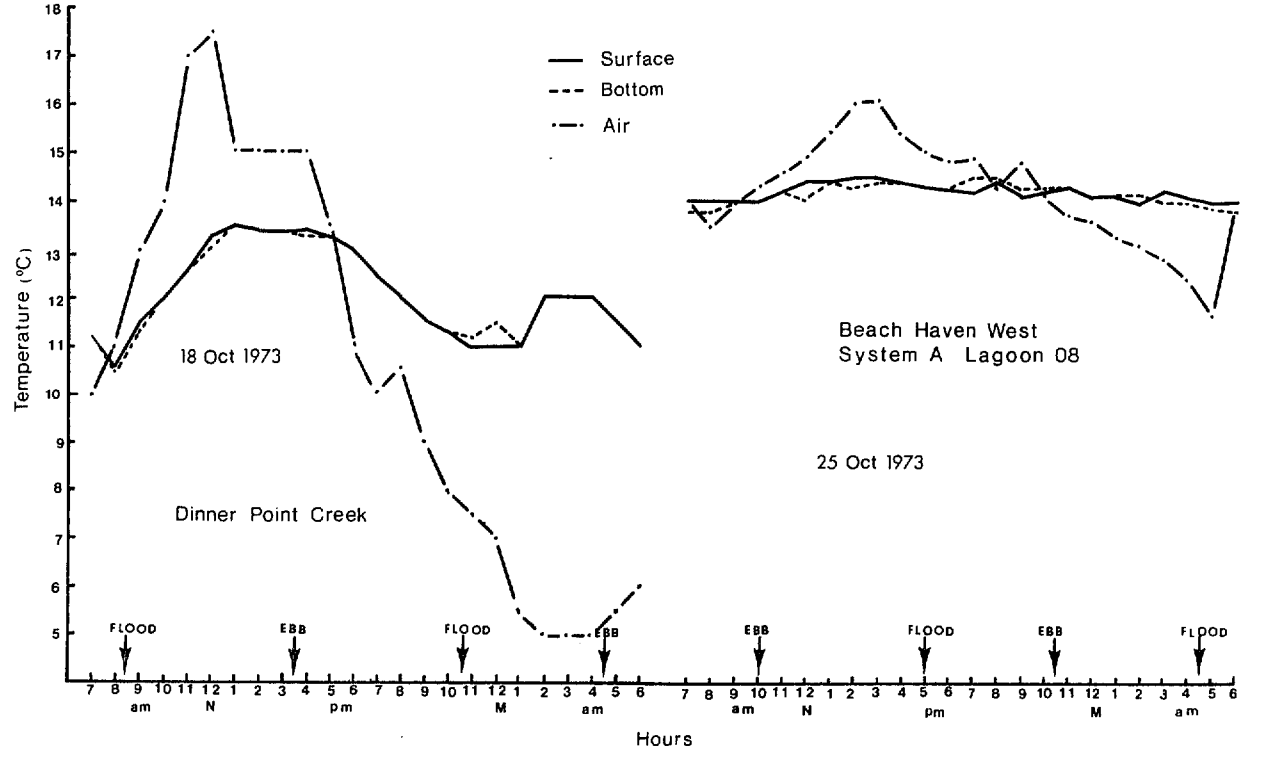

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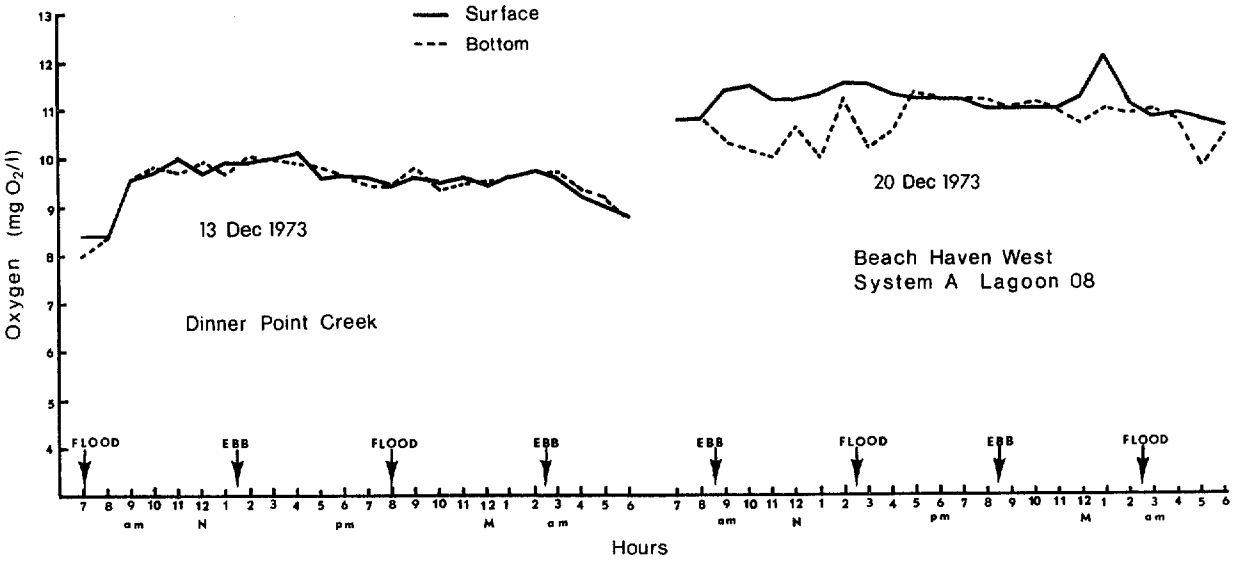

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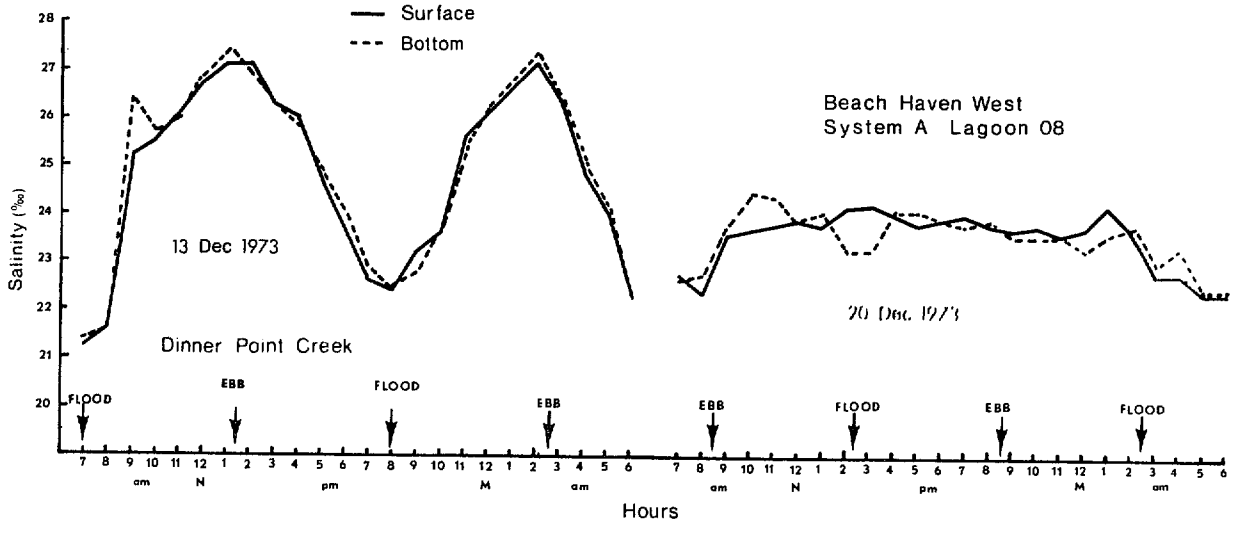

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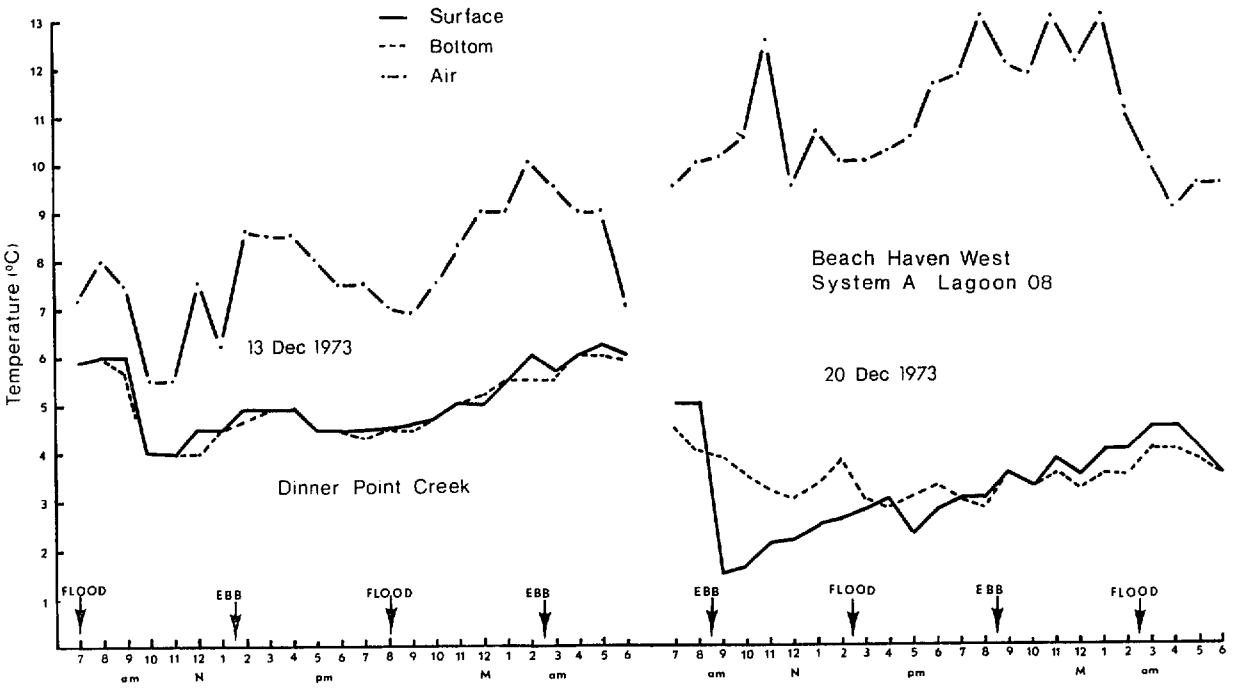

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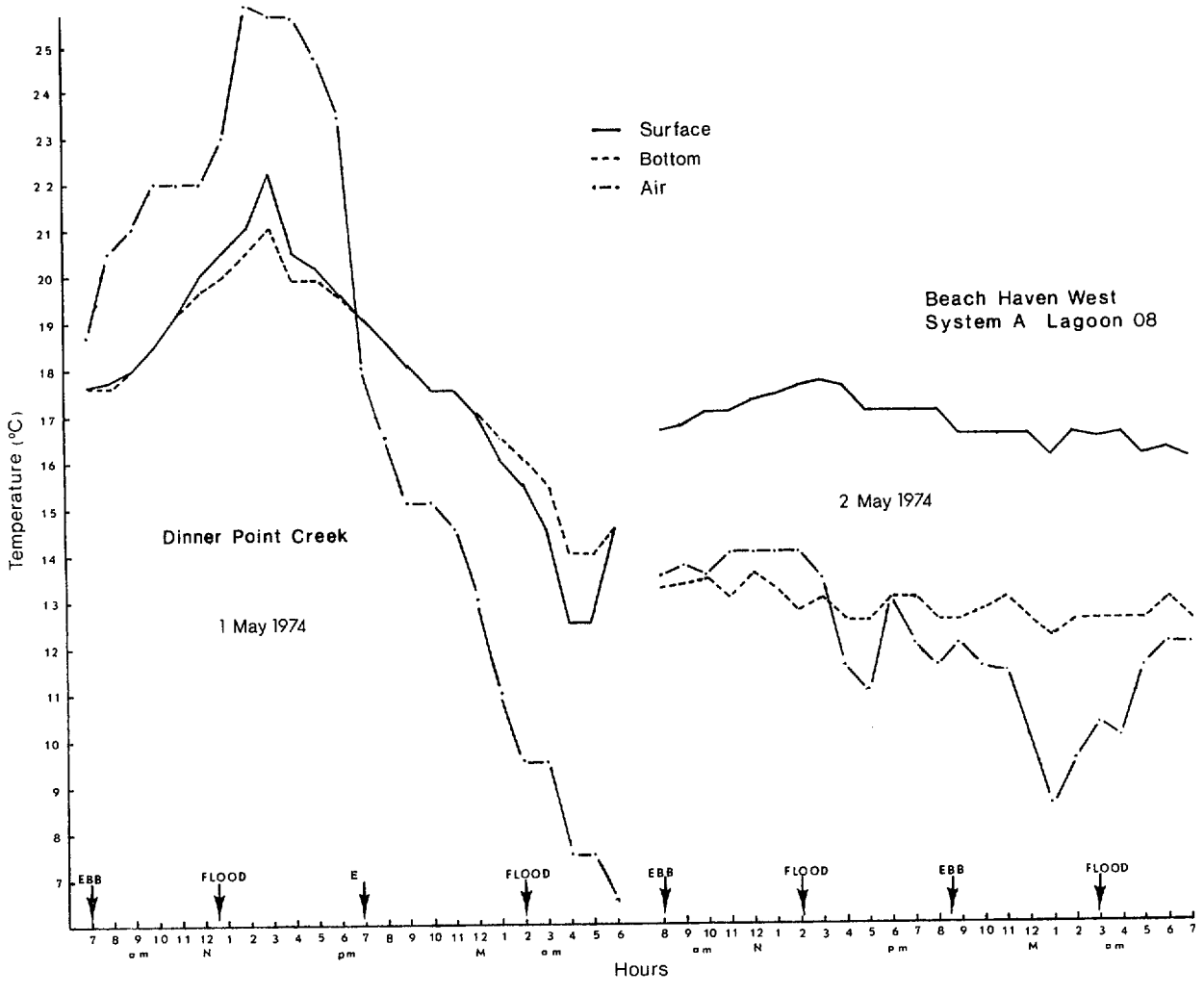

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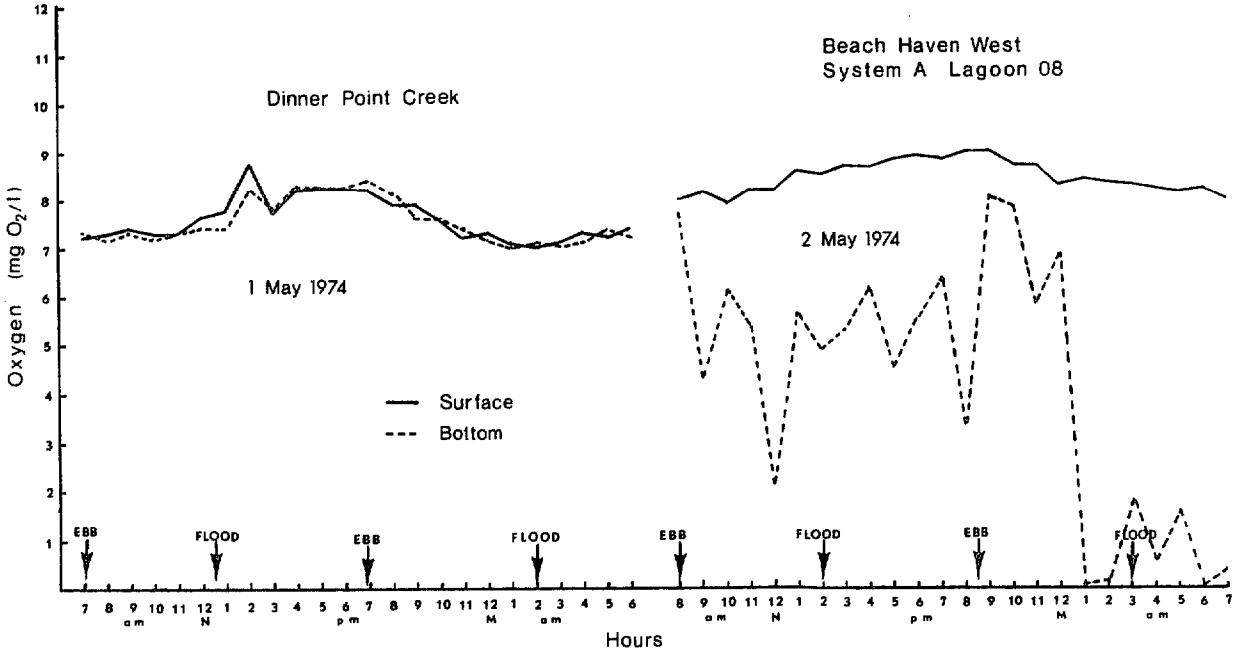

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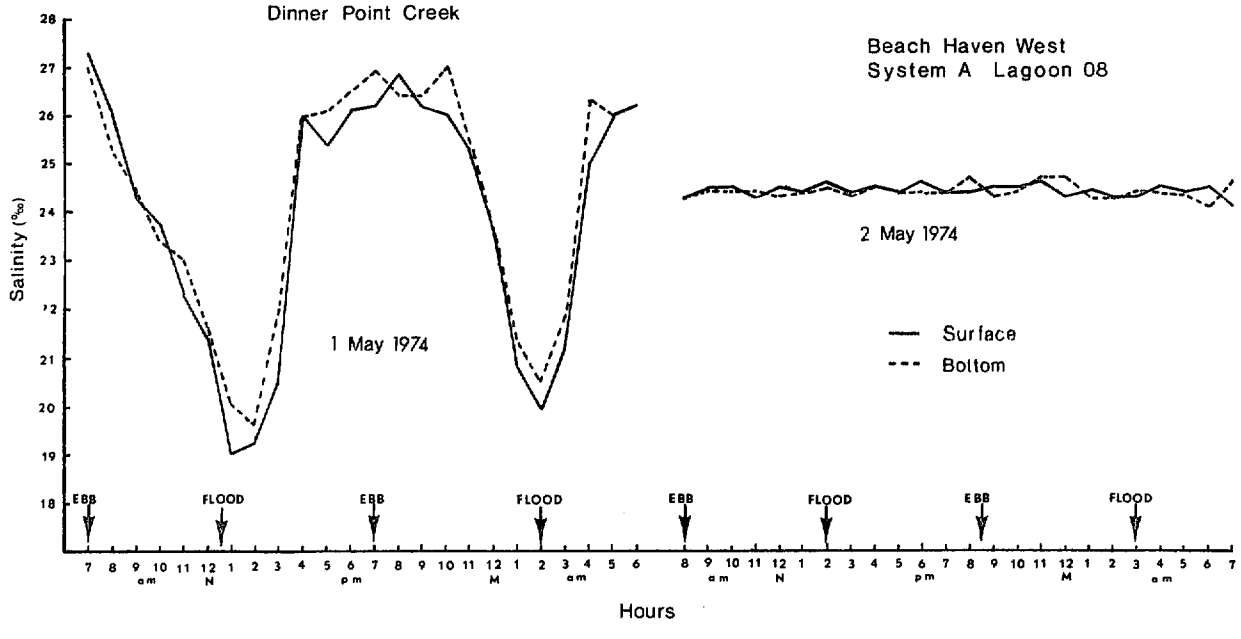

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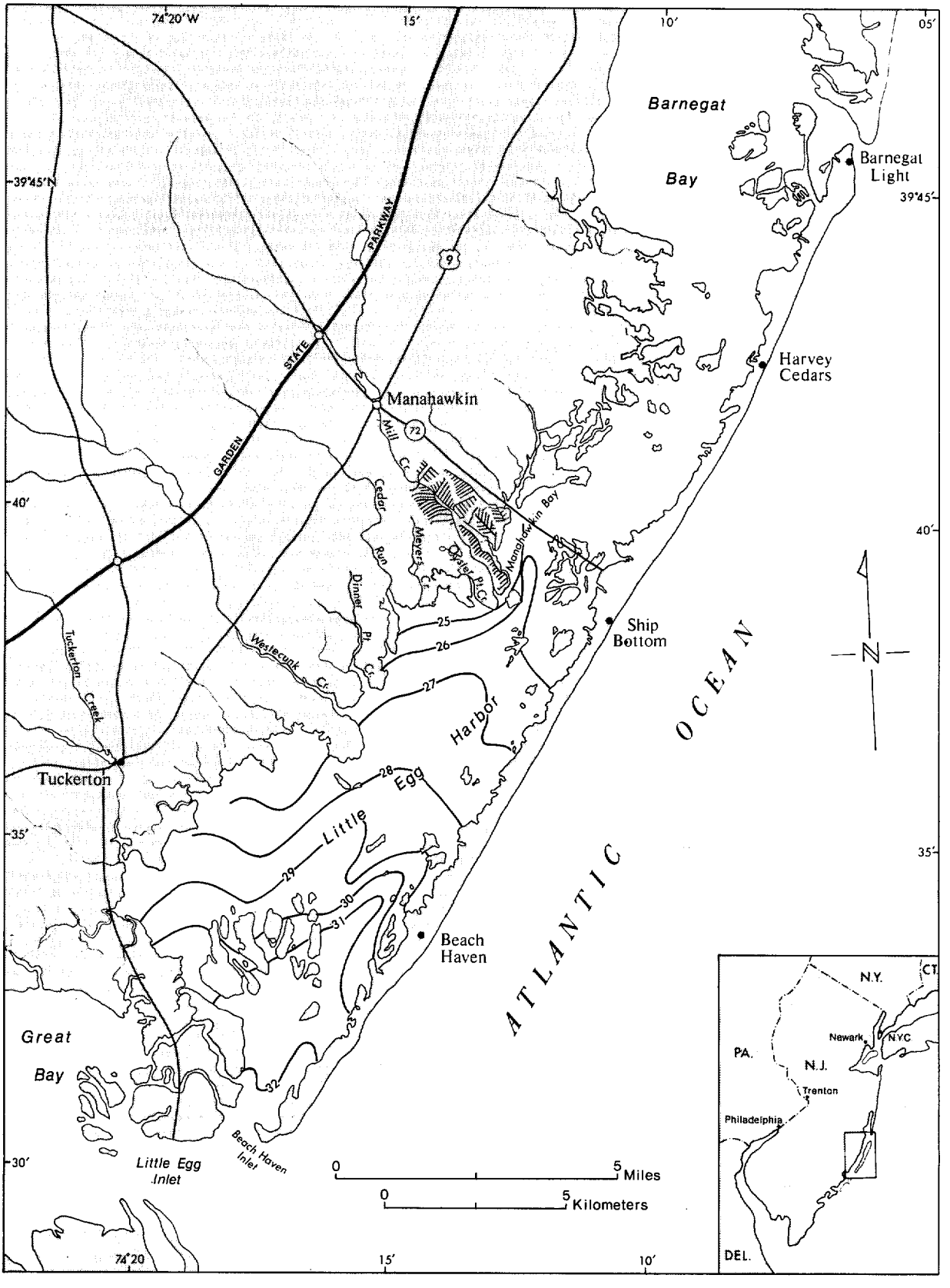

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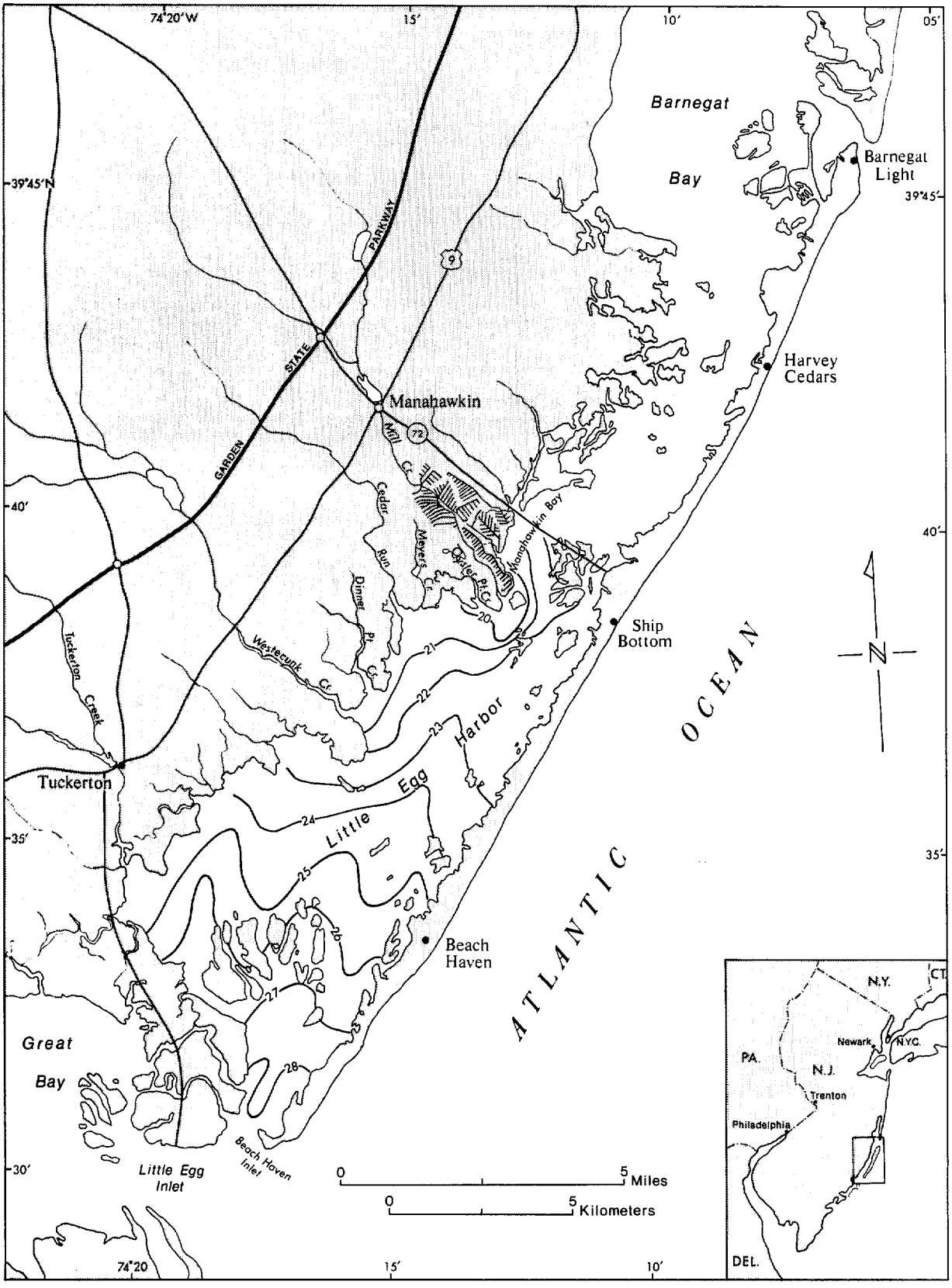

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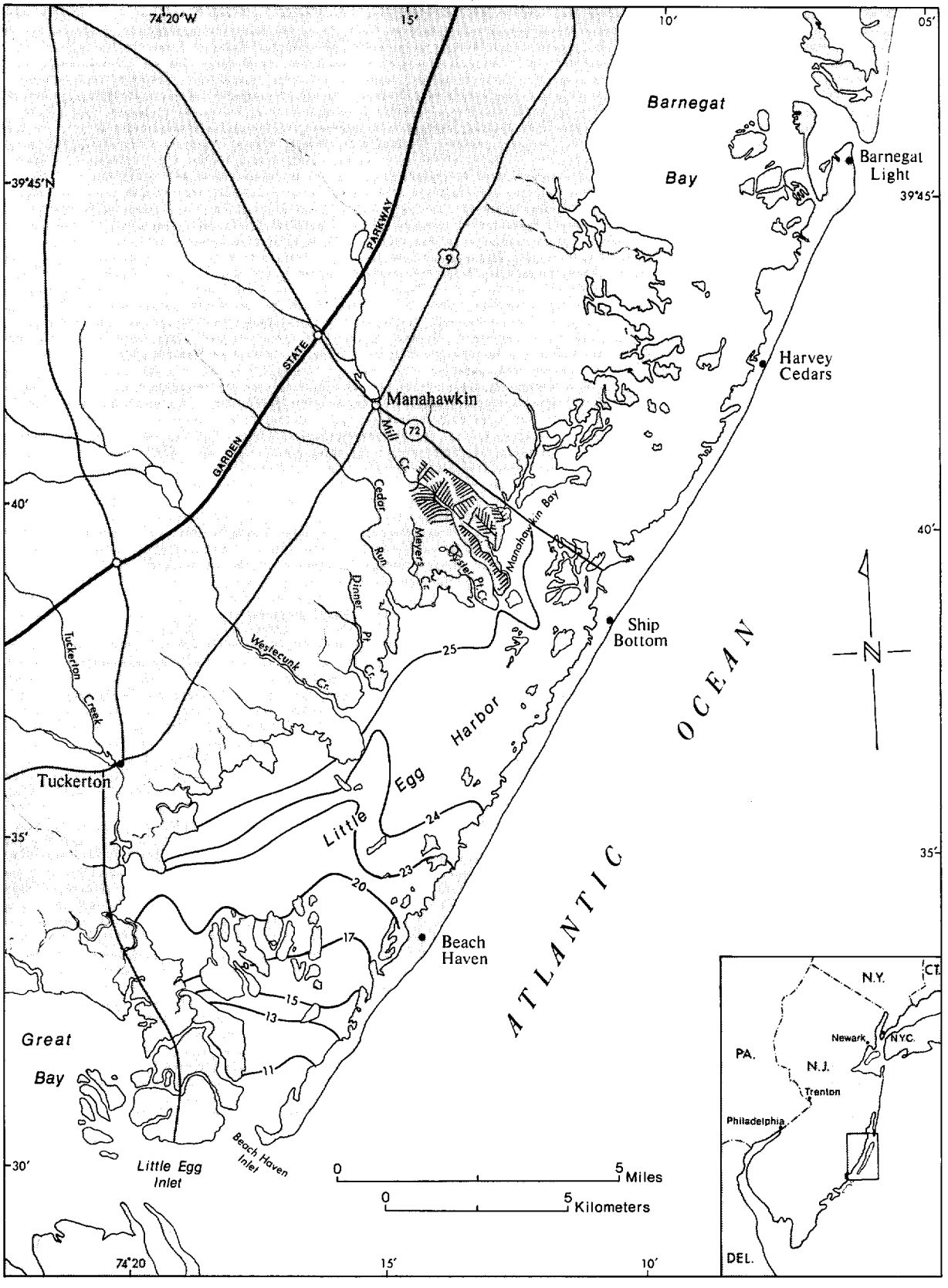

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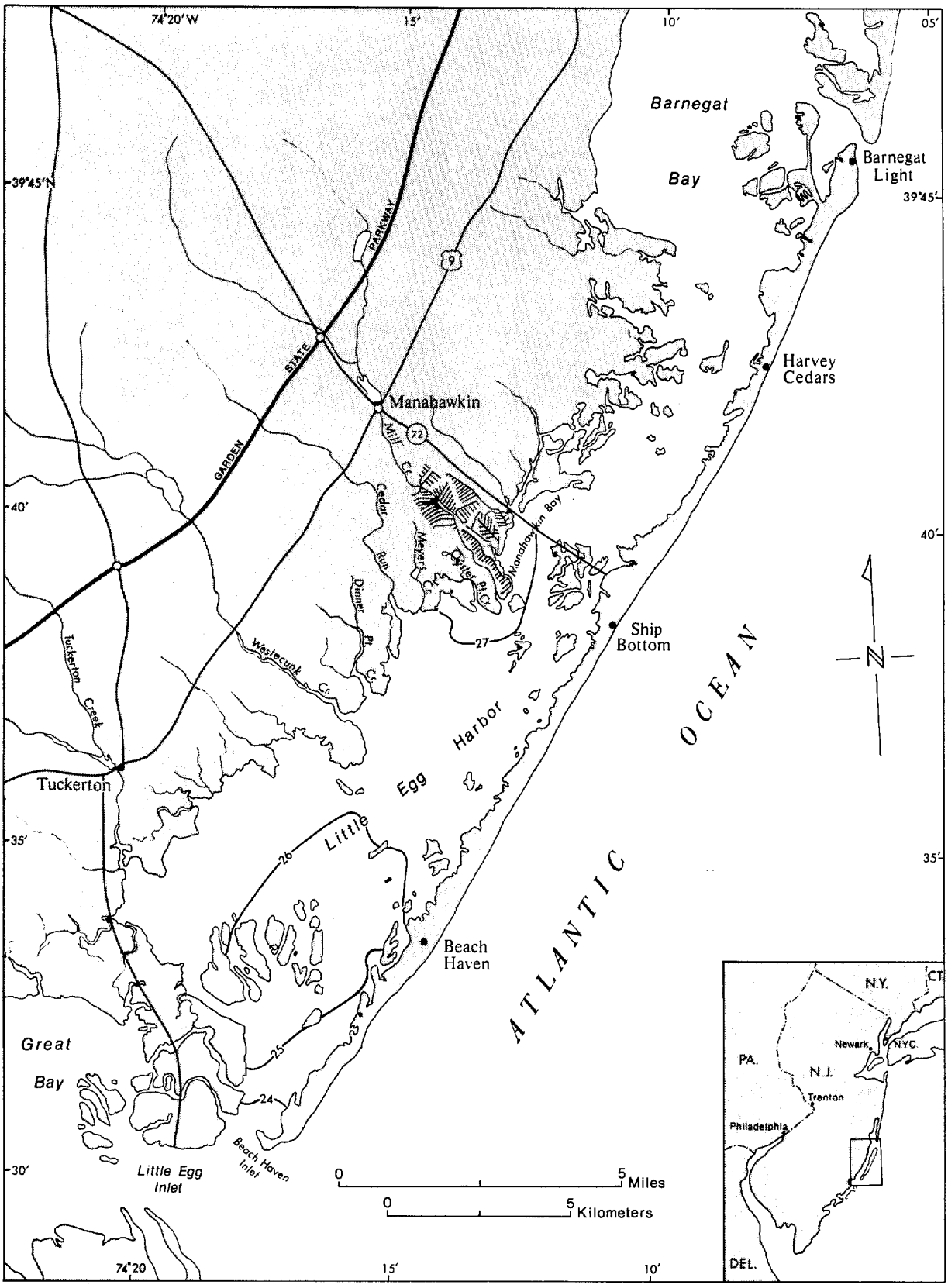

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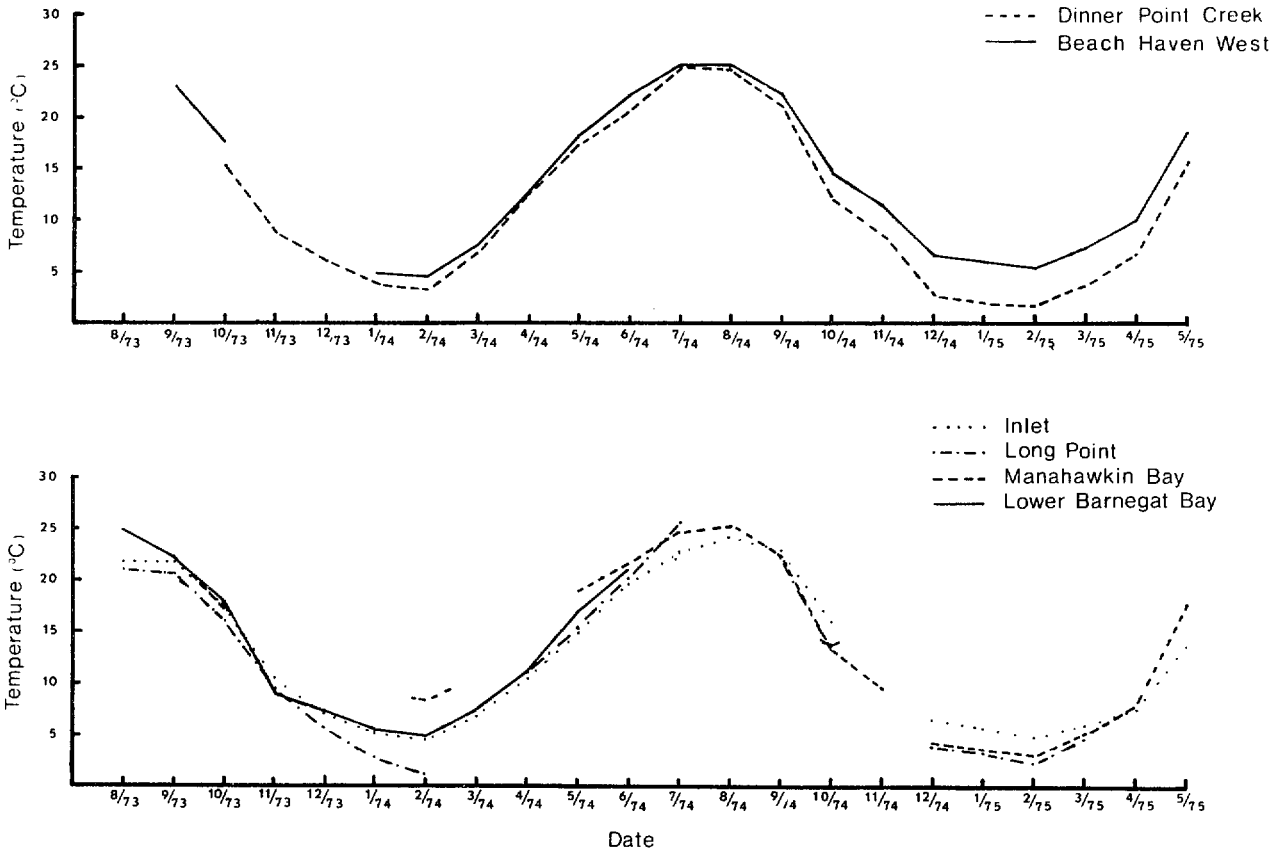

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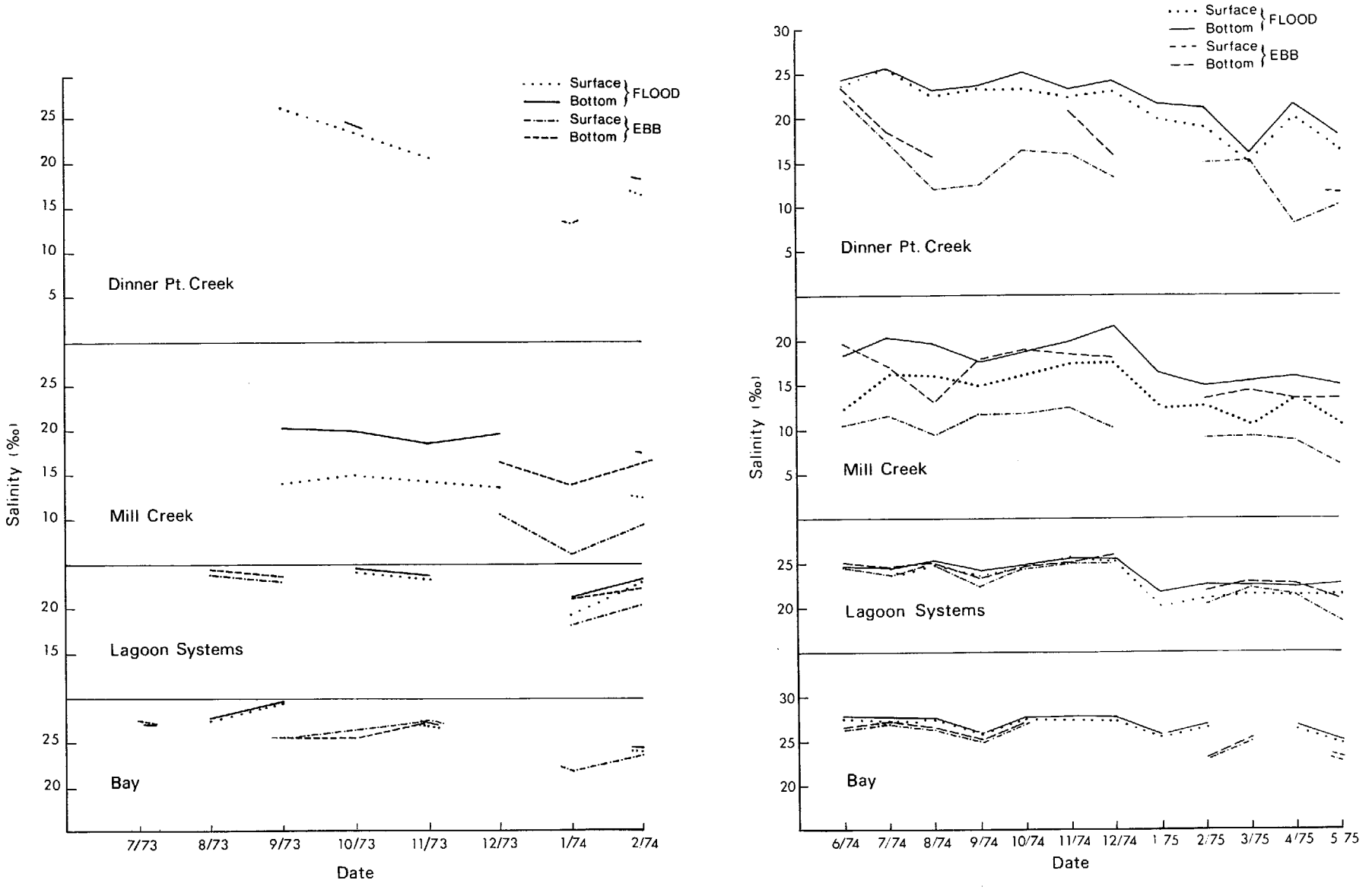

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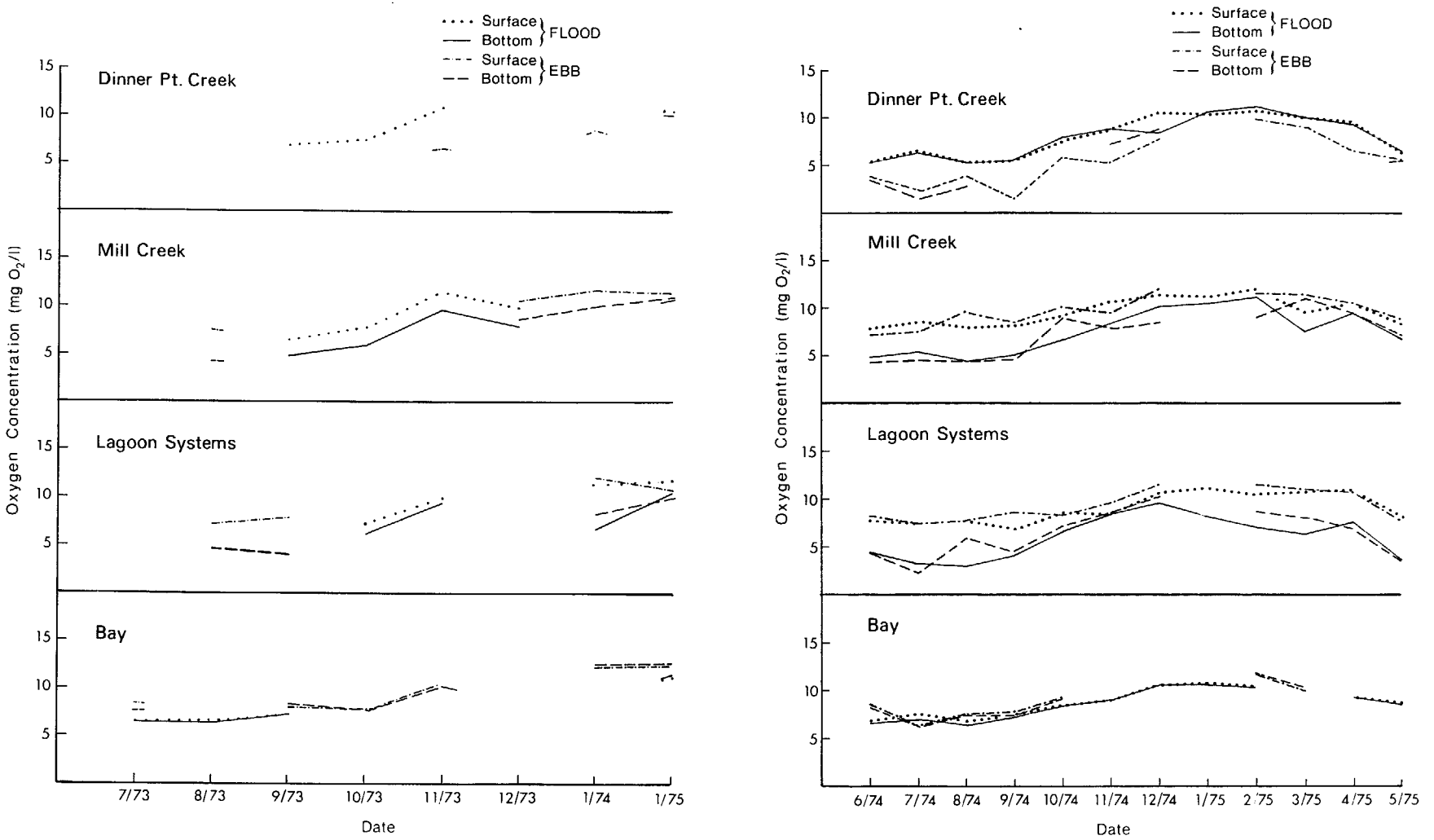

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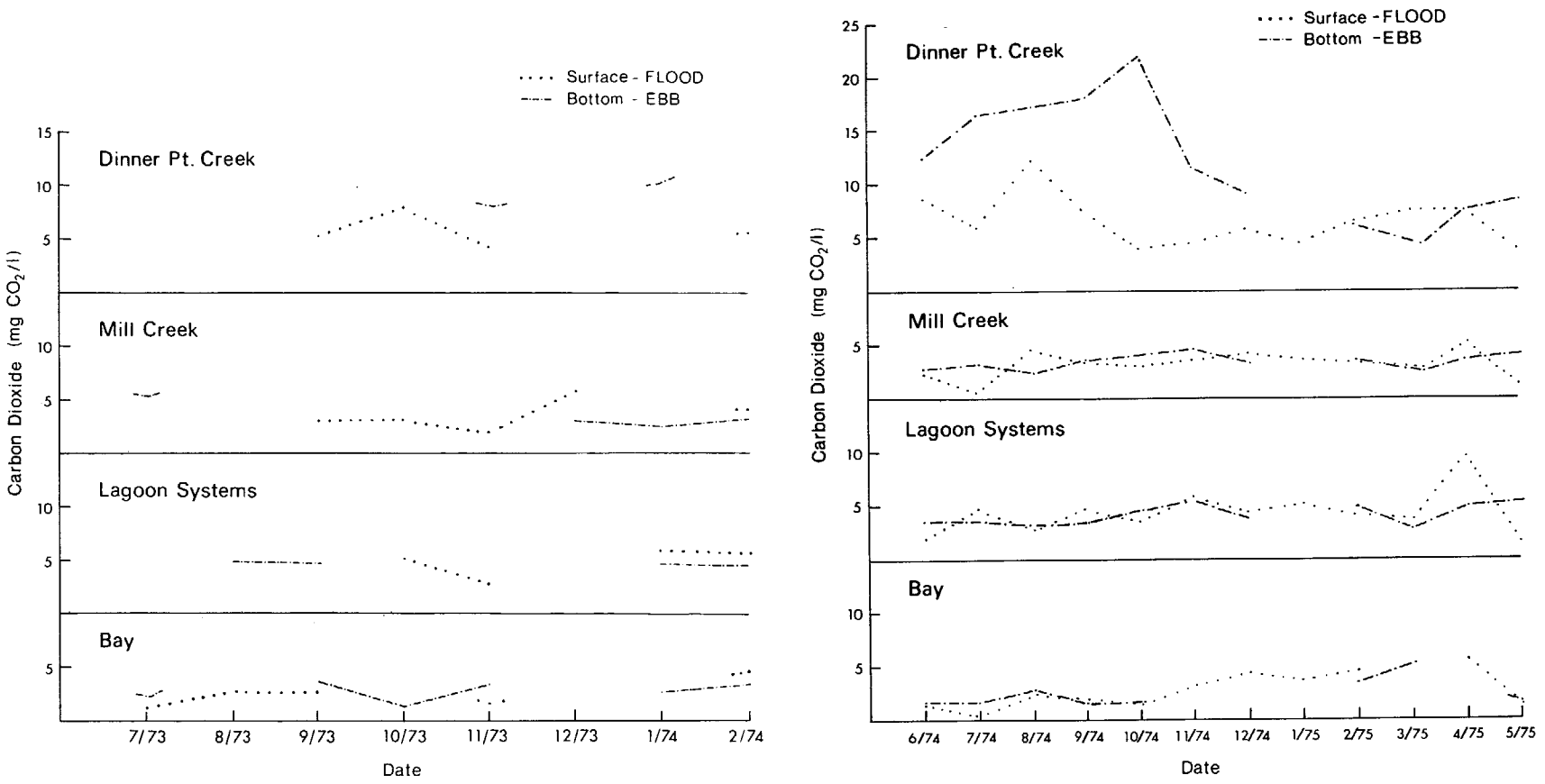

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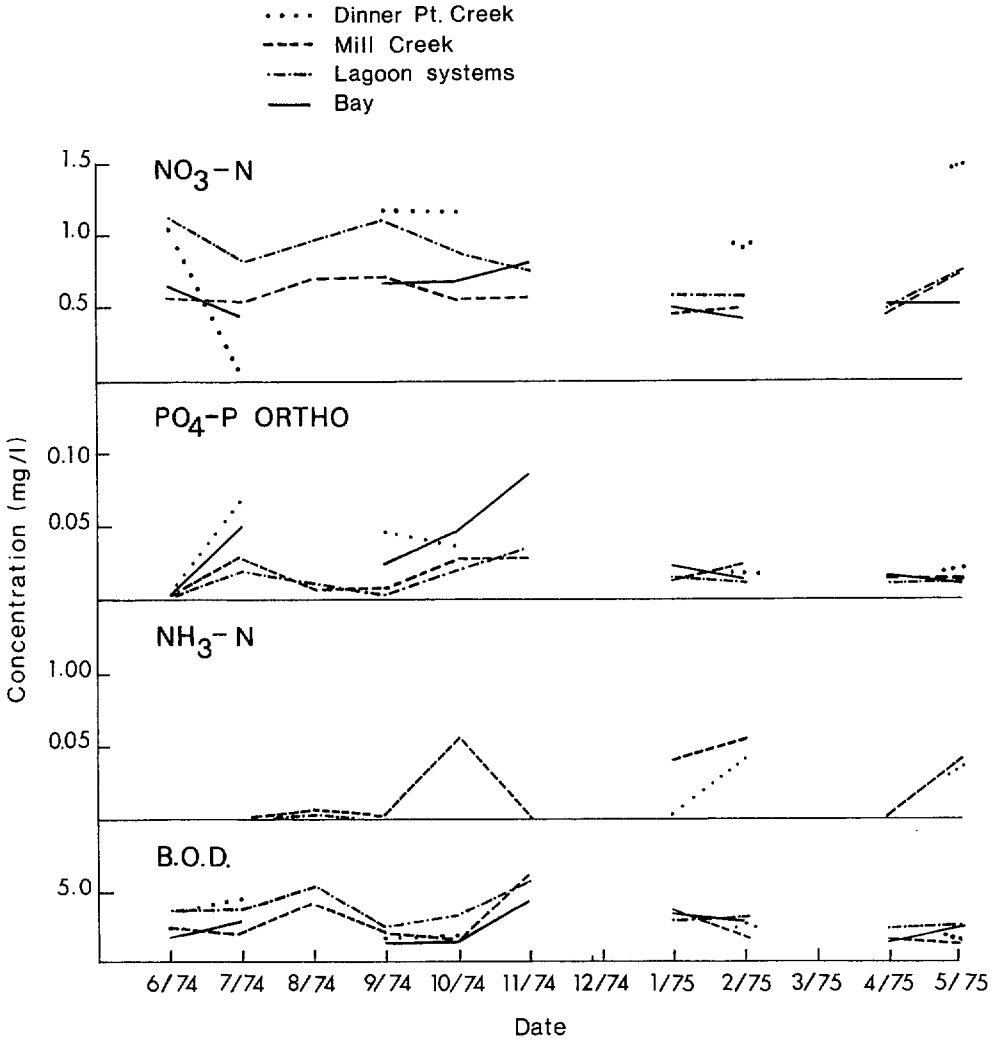

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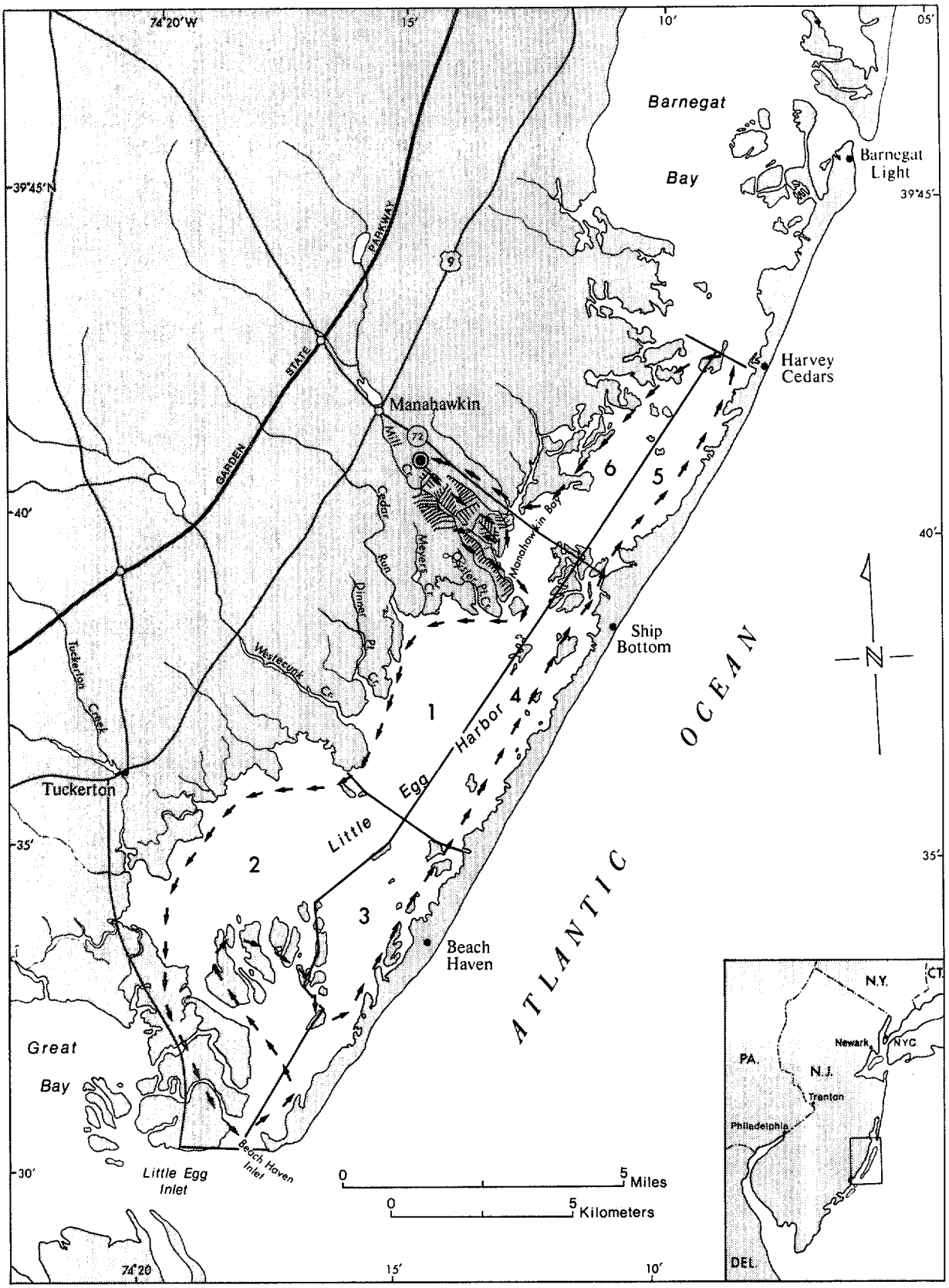

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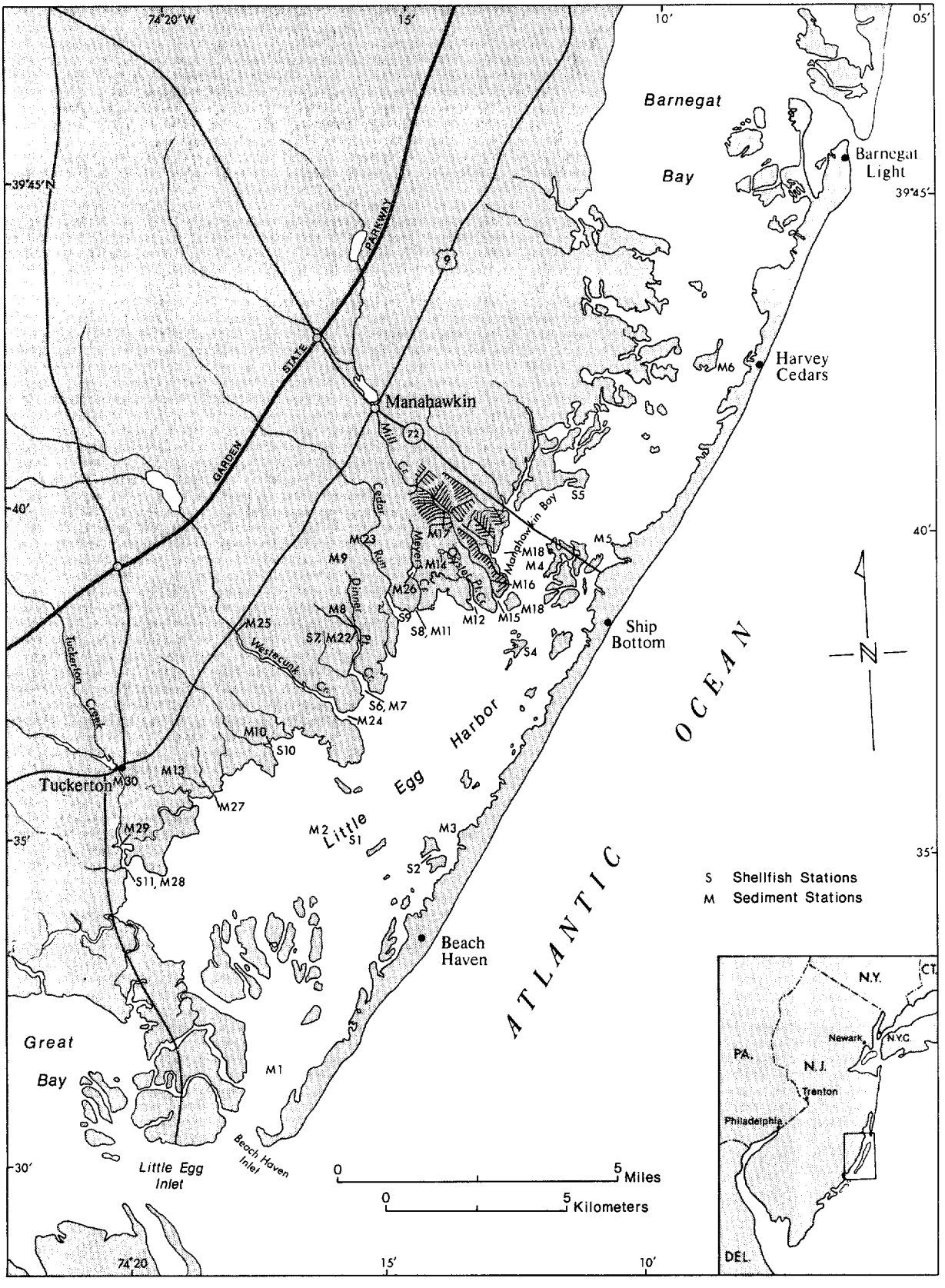

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Editor's note: The accuracy of the contents of Appendix B are the sole responsibility of the authors.

Table 1. Common and scientific names of fish taken in the Manahawkin Bay - Little Egg Harbor system.

Alewife	*Alosa pseudoharengus*
American eel	*Anguilla rostrata*
American sand lance	*Ammodytes americanus*
American shad	*Alosa sapidissima*
Atlantic croaker	*Micropogon undulatus*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic needlefish	*Strongylura marina*
Atlantic silverside	*Menidia menidia*
Banded killifish	*Fundulus diaphanus*
Bay anchovy	*Anchoa mitchilli*
Black sea bass	*Centropristes striatus*
Blueback herring	*Alosa aestivalis*
Bluefish	*Pomatomus saltatrix*
Blue runner	*Caranx crysos*
Bluespotted cornetfish	*Fistularia tabacaria*
Brown bullhead	*Ictalurus nebulosus*
Butterfish	*Peprilus triacanthus*
Crevalle jack	*Caranx hippos*
Cunner	*Tautogolabrus adspersus*
Fourspine stickleback	*Apeltes quadracus*
Golden shiner	*Notemigonus crysoleucas*
Gray snapper	*Lutjanus griseus*
Hogchoker	*Trinectes maculatus*
Inshore lizardfish	*Synodus foetens*
Lined seahorse	*Hippocampus erectus*
Lookdown	*Selene vomer*
Mojarra	*Eucinostomus* sp.
Mummichog	*Fundulus heteroclitus*
Naked goby	*Gobiosoma bosci*
Northern kingfish	*Menticirrhus saxatilis*
Northern pipefish	*Syngnathus fuscus*
Northern puffer	*Sphoeroides maculatus*
Northern sea robin	*Prionotus carolinus*
Northern sennet	*Sphyraena borealis*

Table 1. Continued.

Oyster toadfish	*Opsanus tau*
Permit	*Trachinotus falcatus*
Pinfish	*Lagodon rhomboides*
Planehead filefish	*Monacanthus hispidus*
Pollock	*Pollachius virens*
Pumpkinseed	*Lepomis gibbosus*
Rainwater killifish	*Lucania parva*
Red hake	*Urophycis chuss*
Redfin pickerel	*Esox americanus americanus*
Scup	*Stenotomus chrysops*
Sheepshead minnow	*Cyprinodon variegatus*
Silver perch	*Bairdiella chrysura*
Smallmouth flounder	*Etropus microstomus*
Smooth dogfish	*Mustelus canis*
Spot	*Leiostomus xanthurus*
Spotted hake	*Urophycis regius*
Striped anchovy	*Anchoa hepsetus*
Striped burrfish	*Chilomycterus schoepfi*
Striped killifish	*Fundulus majalis*
Striped mullet	*Mugil cephalus*
Striped sea robin	*Prionotus evolans*
Summer flounder	*Paralichthys dentatus*
Tautog	*Tautoga onitis*
Threespine stickleback	*Gasterosteus aculeatus*
Tidewater silverside	*Menidia beryllina*
Weakfish	*Cynoscion regalis*
White mullet	*Mugil curema*
White perch	*Morone americana*
Windowpane	*Scophthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*
Herring	*Alosa* sp.
Shiner	*Notropis* sp.

Table 2. Description of seine stations in the Manahawkin Bay - Little Egg Harbor system.

Station	Location	Bottom	Sampling depth (ft)
1	Southern tip of Long Beach Island near Beach Haven Inlet	Sand	5
2	Southwest end of Marshelder Island	Sand and mud	2-4
3	Southwest tip of Flat Island	Silt, clay, and fine sand	5
4	Northern end of Sandy Island	Mud and sand	3-4
5	Northern tip of Long Beach Island near Double Creek Channel	Medium and fine sand	5
6	Southwestern end of Little Egg Harbor - east of Big Thorofare	Pebbles - medium fine and very fine sand silt and clay	5
7	Small cove at upper end of Thompson Creek	Medium and very fine sand - silt and clay	4
8	Tidal pool on marsh north of the mouth of Dinner Point Creek	Silt, clay, and detritus	
9	Cove at the end of Lagoon System B in Beach Haven West	Pebbles - very fine sand	3-14
10	Manahawkin Bay - off Lagoon System A in Beach Haven West	Medium and coarse sand with peat chunks	3-6
12	Upper Dinner Point Creek	Fine, medium, and coarse sand - primarily silt and clay	1-4
13	Northeastern bank of Lower Dinner Point Creek - near mouth	Primarily silt and clay some sands	2-4
15	Distal end of Lagoon 100 off Mill Creek in Beach Haven West	Gravel grading into sand	3-6
16	North bank of Upper Mill Creek	Pebbles, very coarse, coarse, and medium sand	3-6
17	Distal end of Lagoon 77 off Mill Creek in Beach Haven West	Fine, medium, and coarse sand	3-15
18	North shore of Lower Mill Creek	Pebbles, coarse and ium sand with peat chunks	2-4

Table 2. Continued.

Station	Location	Bottom	Sampling depth (ft)
19	Distal end of Lagoon 43 in Lagoon System D - Beach Haven West	Medium sand, silt and clay	3-14
20	Lagoon 7 in Lagoon System A - Beach Haven West	Primarily medium sand, some coarse and fine sand	2-12

Table 3. Number of fish taken and water quality recorded at seine station 1.

	7/18/73	
Surface water quality data		
D.O. (mgO_2/l)	9.61	
Salinity (°/oo)	26.50	
pH	10.00	
H_2O temp. (°C)	23.0	
CO_2 (mgO_2/l)	5.35	
Air temp. (°C)	24.0	
Depth (ft)	5.0	
Secchi (ft)		
Seine (ft)	150	
Species	LR	No.
Atlantic silverside	5-11	680
Butterfish	2	1
Northern puffer		1
Rainwater killifish	5	1
Striped killifish	11	1
Total		684

Table 4. Number of fish taken and water quality recorded at seine station 2.

	7/19/73		9/28/73		10/16/73		1/29/74	
Surface water quality data								
D.O. ($mgO_2/1$)	8.23		6.13		6.29		8.30	
Salinity (°/oo)	24.00		27.29		25.62		24.42	
pH	10.00				7.80		6.25	
H_2O temp. (°C)	25.0		20.5				7.0	
CO_2 ($mgCO_2/1$)	5.85				5.10		1.45	
Air temp. (°C)	26.0		21.0				9.0	
Depth (ft)			3.0		5.0		2.0	
Secchi (ft)								
Seine (ft)	150		150		80		80	
Species	LR	No.	LR	No.	LR	No.	LR	No.
American eel			21-26	2				
Atlantic needlefish	8-15	45	30-40	3				
Atlantic silverside	4-8	450	3-5	800	7-9	2		
Bay anchovy				300				
Bluefish	15	1	20-23	2				
Fourspine stickleback	2-5	57	3-5	850			4-6	19
Gray snapper			3-5	4				
Mojarra sp.			2	7				
Mummichog			3-9	40			8-10	20
Naked goby								
Northern pipefish	10-13	12	33	2	18	1		
Northern puffer								
Northern sea robin								
Northern sennet	11	1	23-24	2				
Oyster toadfish	21	1	10-21	4				
Pinfish								
Planehead filefish								
Rainwater killifish			2-3	18	3	1		
Sheepshead minnow					4	1		
Silver perch			4-5	5				
Spot	4-7	51	9-11	14				
Spotted hake								
Striped burrfish	21-23	2						
Striped killifish					6	1	5-7	7
Summer flounder								
Tautog			7-9	2				
Threespine stickleback								
Tidewater silverside					3-5	190		
Weakfish								
Winter flounder								
Total		620		2,055		196		46

Table 4. Continued.

	6/26/74		7/17/74		8/19/74		9/30/74	
Surface water quality								
D.O. (mgO_2/l)	8.39		5.44		6.99		7.42	
Salinity (°/oo)	28.80		29.16		28.89		29.87	
pH	7.80		7.80		7.80		7.60	
H_2O temp. (°C)	19.5		22.0		23.5		15.0	
CO_2 ($mgCO_2/l$)			2.74		1.88		0.00	
Air temp. (°C)	21.0		23.0		29.5		18.0	
Depth (ft)	4.0		3.0		4.0		2.5	
Secchi (ft)	2.0		3.0		4.0		2.0	
Seine (ft)	150		150		150		150	
Species	LR	No.	LR	No.	LR	No.	LR	No.
American eel	12	1	42-52	2				
Atlantic needlefish	5-8	5			24-31	9		
Atlantic silverside	3-11	84	4-7	16	5-9	840	7-10	65
Bay anchovy							4-6	1,000
Bluefish	10-11	2	12	1	13-17	4		
Fourspine stickleback	2-5	1,000	2-4	6	3-5	21	4-5	1,000
Gray snapper	4-5	2						
Mojarra sp.								
Mummichog	4-9	775	4-7	24	4-8	3		
Naked goby							4	1
Northern pipefish	10-13	3	6-16	5	11-16	15	14-20	6
Northern puffer					2	1		
Northern sea robin					13	1		
Northern sennet					13-17	2		
Oyster toadfish	8-20	2	20-21	2			14-22	6
Pinfish			8	1				
Planehead filefish			5	1				
Rainwater killifish	4	1			3	2		
Sheepshead minnow	5	1						
Silver perch					3-7	16	7	1
Spot	4-6	6	8-10	20			16	1
Spotted hake	17	1						
Striped burrfish			2-3	2				
Striped killifish								
Summer flounder					23	1		
Tautog								
Threespine stickleback								
Tidewater silverside								
Weakfish					8	1		
Winter flounder								
Total		1,883		80		916		2,080

Table 4. Continued.

	10/30/74		12/20/74		3/25/75		4/30/75		5/28/75		Study total
D.O. (mgO_2/l)	9.00		11.23		10.10		10.0		8.18		
Salinity ($^o/oo$)	27.29		27.54		27.48		28.69		27.01		
pH	8.30		6.95		7.60		8.10		7.90		
H_2O temp. (^oC)	15.5		4.0		11.5		14.0		23.5		
CO_2 ($mgCO_2/l$)	0.00		0.00		0.00		0.00		0.00		
Air temp. (^oC)	21.0		4.0		20.0		14.0		25.0		
Depth (ft)	3.0		3.0		2.50		3.5		3.0		
Secchi (ft)	3.0		3.0		2.50		3.5		3.0		
Seine (ft)	150		150		150		150		150		
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel											5
Atlantic needlefish											62
Atlantic silverside	5-9	72	3-6	2			7-12	80			2,411
Bay anchovy											1,300
Bluefish											10
Fourspine stickleback	3-5	120	3	16	3-4	320	3-5	8	3-6	400	3,817
Gray snapper											6
Mojarra sp.											7
Mummichog	5-11	3	4	2	2	1	3-6	9	4-6	7	884
Naked goby											1
Northern pipefish	5-18	3					16-22	3			50
Northern puffer											1
Northern sea robin									8-9	2	3
Northern sennet											5
Oyster toadfish									16-26	3	18
Pinfish											1
Planehead filefish	3-4	15									16
Rainwater killifish											22
Sheepshead minnow			4	2							4
Silver perch											22
Spot											92
Spotted hake											1
Striped burrfish											4
Striped killifish											8
Summer flounder											1
Tautog											2
Threespine stickleback									5-6	6	6
Tidewater silverside											190
Weakfish											1
Winter flounder	12	1			13-24	4	18	1	2	1	7
Total		214		22		325		101		419	8,957

Table 5. Number of fish taken and water quality recorded at seine station 3.

	7/19/73	
Surface water quality data		
D.O. (mgO_2/l)	9.90	
Salinity (o/oo)	22.00	
pH	10.20	
H_2O temp. (^oC)	25.8	
CO_2 ($mgCO_2/l$)	6.35	
Air temp. (^oC)	26.0	
Depth (ft)		
Secchi (ft)		
Seine (ft)	150	
Species	**LR**	**No.**
Atlantic needlefish	8	1
Atlantic silverside	4-6	580
Fourspine stickleback	2-3	23
Northern pipefish	10	1
Spot	5	1
Total		606

Table 6. Number of fish taken and water quality recorded at seine station 4.

	7/2/74	8/19/74	9/30/74	4/28/75	5/23/75	Study total
Surface water quality data						
D.O. (mgO_2/l)	7.77	5.22	8.42	9.48	9.24	
Salinity ($^o/oo$)	27.01	26.02	24.33	24.25	16.56	
pH	8.00	7.95	7.70	8.00	8.15	
H_2O temp. (^oC)	24.0	25.0	18.0	14.2	23.0	
CO_2 ($mgCO_2/l$)	0.00	0.00	0.00	0.00	0.00	
Air temp. (^oC)	27.0	25.0	21.0	18.0	21.0	
Depth (ft)	4.0	4.0	3.0	4.0	4.0	
Secchi (ft)	3.0	4.0	2.0	4.0	4.0	
Seine (ft)	150	150	150	150	150	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel			9-51	4	27	1					5
American sand lance							5	1			1
Atlantic needlefish	8-10	4	9-12	2							6
Atlantic silverside	4-12	160	5-9	100	7-13	12	8-12	25	9-12	7	304
Bay anchovy	7-8	3					5-8	50			53
Bluefish	11	1	12-26	6							7
Fourspine stickleback	4-6	6			4-5	9	4-5	20			35
Inshore lizardfish			14	1							1
Mummichog	7-9	6	7	1	4-9	13			5-7	8	28
Naked goby			1	1							1
Northern pipefish	12-17	3	12-18	13	13-20	20	10-19	9	11-21	32	77
Oyster toadfish	7-23	3	5-22	8	6-27	4	9	1	9	2	18
Rainwater killifish									3	1	1
Silver perch					5-12	55					55
Spot	4-11	22	13	1							23
Striped burrfish			9-12	3							3
Striped killifish	8-10	18									18
Summer flounder					26-27	2					2
Tautog			20	1	7	1					2
Threespine stickleback									3-4	5	5
White perch							31	1			1
Winter flounder	7-9	14	7-9	7							21
Total		240		148		117		107		55	667

Table 7. Number of fish taken and water quality recorded at seine station 5.

	10/2/73		11/27/73		Study total
Surface water quality data					
D.O. (mgO_2/l)	8.81		8.61		
Salinity ($^o/oo$)	28.01		29.43		
pH	8.19		8.10		
H_2O temp. (^oC)	20.5		11.5		
CO_2 ($mgCO_2/l$)	0.00		0.00		
Air temp. (^oC)	24.0		12.5		
Depth (ft)	2.0		6.0		
Secchi (ft)					
Seine (ft)	80		80		
Species	**LR**	**No.**	**LR**	**No.**	**No.**
American sand lance			8-11	75	75
Atlantic needlefish	37	1			1
Atlantic silverside	6-9	720	8-13	19	739
Fourspine stickleback			5	1	1
Mummichog	10-11	2			2
Northern kingfish	8-9	2			2
Northern pipefish	16	1			1
Spot	13	2			2
Striped killifish	6-13	40			40
Winter flounder	7-9	3			3
Total		771		95	866

Table 8. Number of fish taken and water quality recorded at seine station 6.

	7/23/73		9/28/73		10/30/73		11/5/73		Study total
Surface water quality data									
D.O. ($mgO_2/1$)	8.03		6.43		8.29		12.13		
Salinity (o/oo)	24.00		27.20		28.68		29.04		
pH	7.60				7.65		7.95		
H_2O temp. (oC)	25.5		20.5		23.5		9.0		
CO_2 ($mgCO_2/1$)					7.00		0.00		
Air temp. (oC)	25.0		22.0		12.0		12.0		
Depth (ft)			5.0		4.0		5.0		
Secchi (ft)									
Seine (ft)	150		150		150		150		
Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel			49-70	3	53-56	2			5
American sand lance							9	1	1
Atlantic menhaden			27-31	20					20
Atlantic needlefish	9-58	5							5
Atlantic silverside	4-8	150	4-9	95	5-14	9	5-10	1,500	1,754
Bay anchovy	6-8	90	2-4	200	5-6	3			293
Bluefish	12-15	3	19-22	2					5
Fourspine stickleback			3-5	12	2-3	8			20
Inshore lizardfish	10	1							1
Mummichog	5-6	2							2
Naked goby			2-4	16	3-4	5			21
Northern pipefish	8-13	8	12-15	4	13-18	4			16
Northern sennet	7-13	64	8-16	3					67
Oyster toadfish	20-23	2	5-6	3	20-22	2			7
Pinfish	6-8	12	11	1					13
Rainwater killifish	3	1							1
Silver perch	4	2		195	3-4	5			202
Spot	6-11	31	11-17	18					49
Striped anchovy			8-9	2					2
Striped killifish	2	1			3-6	2			3
Striped mullet					11-16	2			2
Tautog			5-7	10	7	1			11
Weakfish			13	1					1
White mullet	7	1	9-16	13					14
Winter flounder			8	1	9-10	2			3
Total		373		599		45		1501	2,518

Table 9. Number of fish taken and water quality recorded at seine station 7.

	7/23/73		10/31/73		11/30/73		Study total
Surface water quality data							
D.O. ($mgO_2/1$)	8.33		5.96		8.51		
Salinity (o/oo)	18.25		23.48		21.80		
pH	7.30		8.71		7.10		
H_2O temp. (^oC)	26.2		13.0		9.0		
CO_2 ($mgCO_2/1$)			7.10		6.10		
Air temp. (^oC)	29.0		12.5		12.0		
Depth (ft)	4.0		4.0		4.0		
Secchi (ft)							
Seine	150		150		80		
Species	LR	No.	LR	No.	LR	No.	No.
American eel	46-63	3	24-52	3			6
Atlantic menhaden	6-7	2					2
Atlantic needlefish	7-19	19					19
Atlantic silverside	4-9	46	3-8	11			57
Bay anchovy	6-9	900					900
Bluefish	8-15	3					3
Crevalle jack	6-8	60					60
Fourspine stickleback	2-4	2	3-4	3			5
Gray snapper			5	1			1
Hogchoker			4-5	4			4
Mummichog	5-11	19			4-5	90	109
Naked goby			2-5	80			80
Oyster toadfish	2-25	6	10-25	6			12
Rainwater killifish	3	2	2	7			9
Sheepshead minnow					3-4	3	3
Silver perch			2-5	5			5
Spot	7-11	329					329
Striped killifish	3-7	6			4-6	3	9
Tidewater silverside					5	1	1
White mullet	13-15	46					46
Total		1,443		120		97	1,660

Table 10. Number of fish taken and water quality recorded at seine station 8.

	8/30/73		10/12/73		1/23/74		Study total
Surface water quality data							
D.O. (mgO_2/l)	6.86		6.04		5.00		
Salinity (o/oo)	25.44		30.32		15.81		
pH	6.51				6.80		
H_2O temp. (^oC)	33.0		17.0		6.5		
CO_2 ($mgCO_2/l$)			7.30		7.05		
Air temp. (^oC)	33.0		19.0		10.0		
Depth (ft)							
Secchi (ft)							
Seine (ft)							
Species	LR	No.	LR	No.	LR	No.	No.
Mummichog	4-7	58	3-8	11		63	132
Rainwater killifish	3	6				8	14
Sheepshead minnow	3-4	18	3-4	18		46	82
Tidewater silverside	4-5	4				18	22
Total		86		29		135	250

Table 11. Number of fish taken and water quality recorded at seine station 9.

	11/26/73		1/29/74		6/12/74		7/16/74	
Surface water quality data								
D.O. (mgO_2/l)	8.12		10.60		7.60		7.92	
Salinity ($^o/oo$)	7.61		17.54		24.96		22.90	
pH			7.25		7.80		7.00	
H_2O temp. (^oC)	10.0		9.0				27.0	
CO_2 ($mgCO_2/l$)	3.40		5.35		0.00		0.00	
Air temp. (^oC)	10.0		11.0		23.5		27.0	
Depth (ft)	8.0				4.5		13.0	
Secchi (ft)					2.5		2.0	
Seine (ft)	150		80		25		150	
Species	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic menhaden							10-15	40
Atlantic silverside	7-8	2	5-10	4			4-7	48
Banded killifish							7-8	5
Bay anchovy					7-10	2	7-8	8
Blueback herring							11-13	18
Bluefish							12-13	2
Crevalle jack							7-8	2
Fourspine stickleback	3	24	3-5	5				
Mummichog	2-3	3			4-7	7	8	1
Naked goby								
Northern pipefish								
Rainwater killifish	2	1						
Sheepshead minnow	3	2	3	2				
Spot								
Striped killifish	4-7	3	4	1				
Striped mullet			13-15	3				
Threespine stickleback			6	1				
Tidewater silverside	3-7	280			2-6	3		
White mullet					4-5	20	5-9	13
Winter flounder					7	1		
Total		315		16		33		137

Table 11. Continued.

	8/16/74		10/25/74		11/27/74		12/18/74	
Surface water quality data								
D.O. (mgO_2/l)	8.76		9.85		10.04		10.79	
Salinity (°/oo)			23.51		24.14		23.93	
pH	7.90		8.00				7.64	
H_2O temp. (°C)	24.9		12.5		5.0		4.0	
CO_2 ($mgCO_2/l$)	0.00		2.69		0.32		0.00	
Air temp. (°C)	25.0		15.0		0.0		4.0	
Depth (ft)	6.0		14.0				10.0	
Secchi (ft)	3.5		3.0				2.0	
Seine (ft)	150		150		150		150	
Species	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic menhaden	4-5	2	11-14	9				
Atlantic silverside	4-9	18	10	1				
Banded killifish								
Bay anchovy	4-5	10	3-4	1,225				
Blueback herring	12-15	2						
Bluefish	13-27	11	19	1				
Crevalle jack	7	1						
Fourspine stickleback								
Mummichog	8-9	2	2-3	4	3-4	2		
Naked goby								
Northern pipefish			10	1				
Rainwater killifish								
Sheepshead minnow					3-4	2		
Spot	12-15	4						
Striped killifish	3-11	16						
Striped mullet								
Threespine stickleback								
Tidewater silverside			3-6	130	4-5	300		
White mullet	8-10	4						
Winter flounder	8	1						
Total		71		1,371		304		0

Table 11. Continued.

	1/10/75		4/30/75		5/29/75		Study total
Surface water quality data							
D.O. (mgO_2/l)	10.38		8.66		6.64		
Salinity ($^o/oo$)	24.05		22.12		18.73		
pH	7.65		7.80		7.35		
H_2O temp. (^oC)	6.60		13.0		22.5		
CO_2 ($mgCO_2/l$)	6.99		5.00		5.58		
Air temp. (^oC)	13.5		15.0		26.0		
Depth (ft)	3.5		17.0		10.0		
Secchi (ft)	3.5		4.0		4.0		
Seine (ft)	150		150		150		
Species	LR	No.	LR	No.	LR	No.	No.
Atlantic menhaden					11-17	4	55
Atlantic silverside							73
Banded killifish							5
Bay anchovy					5-10	80	1,325
Blueback herring					9-16	70	90
Bluefish							14
Crevalle jack							3
Fourspine stickleback							29
Mummichog					3	1	20
Naked goby					3	1	1
Northern pipefish							1
Rainwater killifish							1
Sheepshead minnow							6
Spot							4
Striped killifish	4-12	6	6	1	6-8	2	29
Striped mullet							3
Threespine stickleback			6	2			3
Tidewater silverside	3-5	24			4-6	7	744
White mullet							37
Winter flounder							2
Total		30		3		165	2,445

Table 12. Number of fish taken and water quality recorded at seine station 10.

	7/30/73		9/7/73		10/16/73		11/12/73		1/17/74		2/19/74	
Surface water quality data												
D.O. (mgO_2/l)	7.25		5.88		8.07		10.25				12.30	
Salinity (o/oo)			24.80		24.56		23.82		19.70		22.97	
pH					8.00		7.85				8.10	
H_2O temp. (°C)	27.0		26.0				7.5		10.0		2.0	
CO_2 ($mgCO_2/l$)			6.25		4.05		0.00				2.65	
Air temp. (°C)	29.0		20.0				4.5		5.0		6.0	
Depth (ft)					5.0						4.0	
Secchi (ft)												
Seine (ft)	25		25		80		80		80		25	
Species	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Atlantic silverside	3-6	260	7-9	120	6-10	170						
Banded killifish												
Bay anchovy												
Blueback herring												
Bluefish												
Fourspine stickleback					3	1					4	5
Mummichog												
Northern kingfish												
Northern pipefish	13-15	2										
Smallmouth flounder					12	1						
Striped killifish					9	1						
Striped sea robin												
Threespine stickleback												
Tidewater silverside											5	1
Weakfish												
Winter flounder					21	1						
Total		262		120		174		0		0		6

Table 12. Continued.

	6/12/74		7/9/74		8/15/74		9/25/74		10/23/74		11/11/74	
Surface water quality data												
D.O. (mgO_2/l)	7.00		8.50		6.69		7.52		10.10		9.15	
Salinity (°/oo)	24.60		24.14		25.30		23.78		24.60		25.95	
pH	7.50		7.95		7.80		7.40		8.15		8.05	
H_2O temp. (°C)	24.5		28.5		25.5		17.5		10.5		13.5	
CO_2 ($mgCO_2/l$)	0.00		0.00		2.69		2.42		2.69		2.69	
Air temp (°C)	25.5		39.0		27.5		18.0		21.0		21.0	
Depth (ft)	3.5		3.0		4.0		4.0		3.5		5.0	
Secchi (ft)	2.5		2.0		4.0		2.0		3.5		5.0	
Seine (ft)	25		25		25		80		80		25	
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic silverside	10-11	6	3-7	8	7-8	15	7-11	48			8-12	11
Banded killifish							3	1				
Bay anchovy	6-7	5	7-9	4	7-8	6	4-7	26				
Blueback herring					12-13	7						
Bluefish			11	1	14-17	4	19	1				
Fourspine stickleback												
Mummichog	6	1							3	1	5-9	2
Northern kingfish			6-8	9			5	2				
Northern pipefish							15	1				
Smallmouth flounder												
Striped killifish	9	1					6	2				
Striped sea robin							7	1				
Threespine stickleback												
Tidewater silverside									3-5	12	4-6	90
Weakfish					10	1						
Winter flounder	7	1	7-8	3								
Total		14		25		33		82		13		103

Table 12. Continued.

	12/13/74	1/30/75	2/20/75	3/26/75	4/16/75	5/15/75	Study total
Surface water quality data							
D.O. (mgO_2/l)	11.23	10.98	11.45	9.65	9.90	8.66	
Salinity ($^o/oo$)	25.77	22.27	21.42	21.76	21.76	19.83	
pH	7.70	7.80	7.70	7.75	8.00	7.90	
H_2O temp. (^oC)	5.0	4.0	6.0	10.0	8.5	20.5	
CO_2 ($mgCO_2/l$)	5.38	2.96	3.70	1.95	0.00	0.00	
Air temp (^oC)	12.5	5.0	8.50	8.0	14.0	18.0	
Depth (ft)	5.0	3.0	6.0	4.0	3.0	6.0	
Secchi (ft)	5.0	3.0	4.0	2.5	2.5	4.0	
Seine (ft)	25	25	25	25	25	25	
Species	**LR No.**	**LR No.**	**LR No.**	**LR No.**	**LR No.**	**LR No.**	**No.**
Atlantic silverside		4 2				7 1	641
Banded killifish							1
Bay anchovy							41
Blueback herring							7
Bluefish							6
Fourspine stickleback							6
Mummichog	4 1			3 1			17
Northern kingfish							1
Northern pipefish							2
Smallmouth flounder							1
Striped killifish							4
Striped sea robin							1
Threespine stickleback			6 1	6 1			2
Tidewater silverside	5 2					3 1	106
Weakfish							1
Winter flounder							5
Total	3	2	1	2	0	2	842

Table 13. Number of fish taken and water quality recorded at seine station 12.

	8/13/73		9/26/73		10/12/73		11/28/73		1/25/74		2/20/74		6/20/74		7/22/74	
Surface water quality data																
D.O. (mgO_2/l)	3.16				4.06		5.99		7.50		9.70		3.26		0.00	
Salinity (o/oo)	12.57		17.36		19.05		21.71		10.50		9.11		20.08		22.12	
pH	6.40		6.80				8.00		6.60		6.70		6.98		6.80	
H_2O temp. (^oC)	25.5		20.0		15.0		12.5		5.0		6.0		23.0		24.0	
CO_2 ($mgCO_2/l$)					12.20		9.50		5.75		4.10		13.80		13.25	
Air temp. (^oC)	32.0		23.0		20.5		17.6		12.0		8.0		28.0		28.5	
Depth (ft)			3.0				2.3		2.5		2.5		2.0		2.0	
Secchi (ft)													1.0		1.0	
Seine (ft)	25		80		80		80		80		25		25		25	
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic silverside	4-7	8														
Banded killifish																
Mummichog	2-8	2	4-8	8											5-10	7
Naked goby																
Rainwater killifish					2-3	4										
Tidewater silverside			2-5	95	3-7	10							6-7	8	6	3
Total		10		103		14		0		0		0		8		10

Table 13. Continued.

	8/20/74	10/29/74	12/17/74	1/29/75	2/24/75	4/13/75	5/27/75	Study total
Surface water quality data								
D.O. (mgO_2/l)	2.36	5.00		9.60	6.98	5.34	2.55	
Salinity (o/oo)	15.17	12.97	14.43	12.32	5.54	22.48	14.92	
pH	6.80	7.20	6.70	6.90	6.55	7.10	6.85	
H_2O temp. (^oC)	23.5	13.5	6.0	7.0	8.0	12.0	23.5	
CO_2 ($mgCO_2/l$)	10.22	9.68	4.82	3.97	3.97	10.01	8.68	
Air temp. (^oC)	28.0	19.0	6.0	13.0	12.0	13.0	30.5	
Depth (ft)	3.0	2.0	3.0	4.0	2.5	1.5	3.0	
Secchi (ft)	3.0	2.0	3.0	2.0	1.0	1.0	2.0	
Seine (ft)	25	25	25	25	25	25	25	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
Atlantic silverside															8
Banded killifish							3	4							4
Mummichog	7	1	3-6	24	3	2					3-19	12			56
Naked goby			4	1											1
Rainwater killifish															4
Tidewater silverside	4-7	23	4	2											141
Total		24		27		2		4		0		12		0	214

Table 14. Number of fish taken and water quality recorded at seine station 13.

	8/13/73		9/26/73		10/12/73		11/28/73		1/23/74		2/20/74	
Surface water quality data												
D.O. (mgO_2/l)	6.71				7.33		7.47		12.50		11.10	
Salinity (o/oo)	27.07		24.24		26.58		26.92		21.15		26.04	
pH	7.40		7.50				7.72		6.95		6.80	
H2O temp (oC)			19.5		17.0		12.5		4.0		5.0	
CO_2 ($mgCO_2/l$)					3.65		6.35		1.70		2.90	
Air temp. (^oC)	33.0		23.0		18.0		15.0		10.0		8.0	
Depth (ft)							3.0				3.0	
Secchi (ft)												
Seine (ft)	25		80		80		80		80		25	
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic needle-fish			27	1								
Atlantic silver-side	7	1	4-10	34	5-12	19						
Bay anchovy			5	3	5-6	8			7	1		
Bluefish												
Crevalle jack			6	1								
Fourspine stickle-back			3	4	3-4	6					3	3
Mummichog					8	1	6	1				
Naked goby			4	1	3-4	8						
Northern pipefish	13	1	8-14	5	12	1						
Northern sennet					8	1						
Oyster toadfish			5	1								
Permit	6-10	2										
Silver perch			3-6	20	2-8	19						
Spot	8-13	4	10	1								
Tautog					7-10	2						
Threespine stickle-back									7	1		
Tidewater silver-side											5	1
White mullet												
Total		8		71		65		1		2		4

Table 14. Continued.

	6/20/74		7/23/74		8/20/74		9/30/74		10/29/74		12/17/74	
Surface water quality data												
D.O. (mgO_2/l)	6.79		8.51		6.9		8.02		9.75		9.70	
Salinity (o/oo)	26.35		27.29		27.29		25.75		24.60		26.76	
pH	7.75		7.70		7.65		7.60		8.20		7.85	
H_2O temp.(°C)			26.0		26.0		18.0		14.5		6.0	
CO_2 ($mgCO_2/l$)	4.75		1.37		4.57		2.15		0.00		0.00	
Air temp. (°C)			27.0		29.0		18.0		19.0		7.0	
Depth (ft)	2.0		3.0		4.0		2.5		3.0		4.0	
Secchi (ft)	1.0		3.0		4.0		2.5		3.0		2.0	
Seine (ft)	25		25		25		80		25		25	
Species	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Atlantic needlefish					22	1						
Atlantic silverside	10	1			7-10	160	3-10	60			8-10	11
Bay anchovy	6-9	35	2-3	100			7-9	3				
Bluefish					17	1						
Crevalle jack												
Fourspine stickleback												
Mummichog									3-4	3		
Naked goby					4	1						
Northern pipefish					13	1			16	1		
Northern sennet												
Oyster toadfish							20	1				
Permit												
Silver perch												
Spot												
Tautog												
Threespine stickleback												
Tidewater silverside									3-4	3		
White mullet							12	1				
Total		36		100		164		65		7		11

Table 14. Continued.

	1/29/75	2/24/75	4/25/75	5/28/75	Study total
D.O. (mgO_2/l)	10.78	10.10	8.66	7.50	
Salinity (°/oo)	26.02	23.91	24.98	24.14	
pH	7.51	7.80	7.85	7.70	
H_2O temp. (°C)	5.0	8.0	12.5	22.0	
CO_2 ($mgCO_2/l$)	2.65	0.00	0.00	2.63	
Air temp. (°C)	9.0	12.0	13.5	22.0	
Depth (ft)	4.0	3.0	3.5	3.0	
Secchi (ft)	2.5	2.0	3.0	3.0	
Seine (ft)	25	25	25	25	

Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
Atlantic needlefish									2
Atlantic silverside					7-13	110			396
Bay anchovy					7	1	5-9	10	161
Bluefish									1
Crevalle jack									1
Fourspine stickleback									13
Mummichog							5	1	6
Naked goby									10
Northern pipefish							15	1	10
Northern sennet									1
Oyster toadfish									2
Permit									2
Silver perch									39
Spot									5
Tautog									2
Threespine stickleback									1
Tidewater silverside					3-6	6			10
White mullet									1
Total		0		0		117		12	663

Table 15. Number of fish taken and water quality recorded at seine station 15.

	8/13/73		9/7/73		10/3/73		11/8/73		1/28/74	
Surface water quality data										
D.O. (mgO_2/l)	10.34		7.35		10.64		10.93		9.70	
Salinity (°/oo)	9.49		2.80		3.95		9.81		7.83	
pH	8.20				7.20		6.65		7.25	
H_2O temp. (°C)	29.0		26.0		22.5				8.5	
CO_2 ($mgCO_2/l$)	6.85		1.95		1.95		2.20		0.00	
Air temp. (°C)	32.0		26.0		25.0		8.0		11.0	
Depth (ft)									3.5	
Secchi (ft)										
Seine (ft)	25		25		25		25		25	
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic menhaden										
Atlantic silverside					6	1				
Banded killifish	2-5	20	5-8	3	3-7	17			3	1
Bay anchovy										
Bluefish										
Fourspine stickleback									3-5	15
Herring sp.										
Hogchoker			2	1	3	2				
Mummichog							4-5	3		
Naked goby			2-3	3	3-5	2				
Rainwater killifish									3	1
Sheepshead minnow							3-4	2	4	1
Spot	11	1								
Tidewater silverside	3-6	38								
White perch	16-22	4			8-9	2				
Total		63		7		24		5		18

Table 15. Continued.

	2/28/74		6/17/74		7/9/74		Study total
Surface water quality data							
D.O. (mgO_2/l)	12.17		6.73		11.71		
Salinity ($^o/oo$)	19.15		3.95		10.73		
pH	6.60		7.80		8.10		
H_2O temp. (^oC)	3.0		24.0		29.0		
CO_2 ($mgCO_2/l$)	2.65		2.97		1.14		
Air temp. (^oC)	9.0		26.0		40.0		
Depth (ft)	6.0		3.0		4.5		
Secchi (ft)			2.0		2.0		
Seine (ft)	25		25		25		
Species	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**No.**
Atlantic menhaden			5-8	11			11
Atlantic silverside							1
Banded killifish							41
Bay anchovy			7-9	28			28
Bluefish			8	2			2
Fourspine stickleback	4	2			3-4	2	19
Herring sp.					4	1	1
Hogchoker							3
Mummichog			7-8	20			23
Naked goby							5
Rainwater killifish							1
Sheepshead minnow							3
Spot							1
Tidewater silverside			3-8	10	7-9	26	74
White perch					19	1	7
Total		2		71		30	220

Table 16. Number of fish taken and water quality recorded at seine station 16.

	8/13/73		9/7/73		10/3/73		11/2/73		1/28/74		2/19/74	
Surface water quality data												
D.O. (mgO_2/l)	0.78		10.72		9.45		8.00		9.70		11.40	
Salinity ($^o/oo$)	4.69		1.00		1.00		1.25		3.01		1.00	
pH	7.20				6.50		7.40		6.90		6.90	
H_2O temp. (^oC)	27.0		25.0		20.4		12.8		9.5		2.0	
CO_2 ($mgCO_2/l$)	5.85		0.45				3.40		2.45		2.15	
Air temp. (^oC)	30.0		26.0		21.5		18.5		11.0		7.0	
Depth (ft)									4.0		5.0	
Secchi (ft)												
Seine (ft)	25		25		25		25		25		25	
Species	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
American eel												
Atlantic menhaden												
Atlantic silverside					5-6	6						
Banded killifish	2-7	28	5-9	80	3-6	32	3-8	40	3-5	8	3	1
Bay anchovy												
Blueback herring												
Bluefish			8	1								
Crevalle jack												
Fourspine stickleback									4	23	3	2
Hogchoker			2-4	2								
Mummichog												
Notropus												
Sheepshead minnow					4	1			3	1		
Spot												
Tidewater silverside	3-6	12	3-6	32								
White perch			6-7	3	6-7	2		2				
Winter flounder												
Total		40		118		41		42		32		3

Table 16. Continued.

	6/17/74	7/9/74	8/6/74	9/26/74	10/22/74	11/18/74
Surface water quality data						
D.O. (mgO_2/l)	8.39	7.98	9.26	9.63	9.40	10.67
Salinity (°/oo)	2.20	8.91	7.36	1.00	7.09	7.43
pH	7.20	7.15	7.75	7.55	7.40	7.80
H_2O temp. (°C)	22.5	28.0	26.0	17.5	10.0	9.0
CO_2 ($mgCO_2/l$)	3.20	3.43	1.01	1.88	4.84	1.61
Air temp. (°C)	23.5	35.0	28.0	20.0	16.0	13.5
Depth (ft)	4.0	4.0	3.0	3.5	6.0	5.0
Secchi (ft)	4.0	4.0	3.0	3.5	4.0	4.0
Seine (ft)	25	25	25	25	80	25

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
American eel									14-16	6		
Atlantic menhaden		1		11	1							
Atlantic silverside							4-6	11				
Banded killifish	8-9	2	6-8	24	3-8	68	4-7	50	4-5	2		
Bay anchovy	8-10	9	8-9	3								
Blueback herring					14	1						
Bluefish	7	1		11	2	18	1					
Crevalle jack						11	1					
Fourspine stickleback												
Hogchoker							3	1				
Mummichog											5-6	2
Notropus						4	1					
Sheepshead minnow												
Spot			10-11	3								
Tidewater silverside	7-8	22	7-9	7	2-7	42						
White perch				14	1							
Winter flounder				8	1							
Total		35		42		114		62		8		2

Table 16. Continued.

	12/5/74	1/6/75	3/18/75	4/16/75	5/8/75	Study total
Surface water quality data						
D.O. (mgO_2/l)	11.36	12.51	11.10	9.90	8.37	
Salinity (°/oo)	7.61	1.70	1.87	4.98	1.00	
pH	6.50	6.80	6.60	7.25	6.60	
H2O temp. (°C)	5.0	4.0	8.0	10.0	16.0	
CO_2 ($mgCO_2/l$)	2.15	2.42	1.11	6.12	3.16	
Air temp. (°C)	5.0	8.0	11.0	15.0	19.0	
Depth (ft)	3.0	3.0	5.0	3.0	6.0	
Secchi (ft)	3.0	3.0	3.0	3.0	3.0	
Seine (ft)	25	25	25	25	25	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel											6
Atlantic menhaden					5	1					3
Atlantic silverside											17
Banded killifish							3	3	6	1	339
Bay anchovy											12
Blueback herring											1
Bluefish											5
Crevalle jack											1
Fourspine stickleback											25
Hogchoker											3
Mummichog											2
Notropus											1
Sheepshead minnow											2
Spot											3
Tidewater silverside							3-6	15			130
White perch											8
Winter flounder											1
Total		0		0		1		18		1	559

Table 17. Number of fish taken and water quality recorded at seine station 17.

	8/13/73		9/10/73		10/3/73		11/8/73		1/28/74		2/28/74	
Surface water quality data												
D.O. ($mgO_2/1$)	10.05		8.68		10.64		8.58		10.70		10.72	
Salinity (°/oo)	4.69		7.25		6.35		14.58		3.57		12.59	
pH	8.00		7.25		7.45		6.70		7.20		6.80	
H_2O temp. (°C)	28.5		21.5		22.0		9.0		5.2			
CO_2 ($mgCO_2/1$)	1.95				0.00		2.90		2.45		4.10	
Air temp. (°C)	30.5		27.0		22.5		9.0		10.5			
Depth (ft)									3.0		8.0	
Secchi (ft)												
Seine (ft)	25		25		25		25		25		25	
Species	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Alewife	6	4										
Atlantic menhaden												
Atlantic needlefish												
Atlantic silverside	6-10	2										
Banded killifish	3-5	4	4-6	30	4-6	100				3	3	1
Bay anchovy												
Blueback herring												
Fourspine stickleback									3-5	4	4-5	6
Hogchoker	2-7	3	3-4	2								
Mummichog							3-6	11				
Naked goby			5	1								
Rainwater killifish							3	2				
Sheepshead minnow							3-4	8				
Spot	10	1										
Summer flounder												
Tidewater silverside	2-7	18	4-7	75							4-5	3
White perch	6-8	7	7-9	3								
Total		39		111		100		21		7		10

Table 17. Continued.

	6/17/74		7/9/74		8/6/74		9/26/74		10/22/74		11/18/74	
Surface water quality data												
D.O. (mgO_2/l)	8.44		12.74		9.40		8.93		7.35		9.89	
Salinity (°/oo)	10.50		8.20		7.90		12.56		16.26		13.84	
pH	7.50		8.20		7.90		7.45		7.70		8.00	
H_2O temp. (°C)	24.0		29.0		26.0		19.0		14.0		14.0	
CO_2 ($mgCO_2/l$)	3.43		0.00		0.79		2.15		6.46		3.50	
Air temp. (°C)	24.5		40.0		28.0		23.0		12.0		12.0	
Depth (ft)	4.0		4.0		4.0		4.0		12.0		15.0	
Secchi (ft)	3.0		2.5		3.0		2.0		4.0		5.0	
Seine (ft)	25		25		25		25		25		25	
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Alewife												
Atlantic menhaden	5-6	70	8-11	10								
Atlantic needlefish			10	1	10	1						
Atlantic silverside			3-9	38	3-7	17			4-5	3		
Banded killifish			4	1			4-6	7				
Bay anchovy	8-9	11	9	2								
Blueback herring	13-14	3										
Fourspine stickleback												
Hogchoker							3-5	4				
Mummichog	6-8	4			4	3			3-5	3	3-6	500
Naked goby							4	1				
Rainwater killifish							3	1				
Sheepshead minnow			4	1	2-3	3			3	1	4-5	16
Spot												
Summer flounder					16	1						
Tidewater silverside	4-8	60									3-7	18
White perch					16	1						
Total		148		53		26		13		7		534

Table 17. Continued.

	1/6/75		3/18/75		4/16/75		5/8/75		Study total
Surface water quality data									
D.O. (mgO_2/l)	13.20		11.53		10.63		8.56		
Salinity (°/oo)	10.73		4.43		6.26		2.81		
pH	7.10		6.65		7.30		6.70		
H_2O temp. (°C)	3.0		6.0		9.0		18.0		
CO_2 ($mgCO_2/l$)	2.69		1.39		2.50		2.89		
Air temp. (°C)	6.0		11.0		15.0		20.0		
Depth (ft)	5.0		4.0		4.0		11.0		
Secchi (ft)	2.0		3.0		4.0		2.0		
Seine (ft)	25		25		25		25		
Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
Alewife									4
Atlantic menhaden									80
Atlantic needlefish									2
Atlantic silverside									60
Banded killifish									146
Bay anchovy									13
Blueback herring							10-12	17	20
Fourspine stickleback									10
Hogchoker									9
Mummichog	3	5	4	1					527
Naked goby									2
Rainwater killifish									3
Sheepshead minnow									29
Spot									1
Summer flounder									1
Tidewater silverside							4-5	3	177
White perch									11
Total		5		1		0		20	1,095

Table 18. Number of fish taken and water quality recorded at seine station 18.

	8/13/73		9/10/73		10/3/73		11/2/73		1/28/74		6/17/74	
Surface water quality data												
D.O. ($mgO_2/1$)	7.61		6.76		7.62		8.08		9.60		7.25	
Salinity (°/oo)	14.79		18.90		12.79		4.45		19.60		13.71	
pH	8.10		7.45		7.40		6.60		7.30		7.70	
H_2O temp. (°C)	27.5		23.0		12.2		13.5		8.0		25.0	
CO_2 ($mgCO_2/1$)	3.90				3.40		2.45		1.95		16.45	
Air temp. (°C)	30.0		23.5		26.0		18.7		10.5		24.5	
Depth (ft)									2.0		3.0	
Secchi (ft)											3.0	
Seine (ft)	25		25		25		25		25		25	
Species	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Atlantic needlefish												
Atlantic silverside	4-9	85	6-9	330	4-9	190						
Banded killifish												
Bay anchovy												
Bluefish											9	1
Fourspine stickleback							3-4	17	4	7		
Mummichog	5-7	3			5-7	20	3-8	50			5-7	287
Naked goby	4	1					3-5	15				
Northern pipefish			12	1								
Northern sea robin												
Oyster toadfish												
Rainwater killifish							4	1				
Sheepshead minnow					3	1	3-4	9	4	1		
Silver perch												
Spot	6-8	4	12	1	10-13	3					5-7	7
Striped killifish					4	1						
Summer flounder												
Tidewater silverside												
Winter flounder	7	1										
Total		94		332		215		92		8		295

Table 18. Continued.

	7/9/74		8/29/74		9/17/74		10/22/74		11/18/74	
Surface water quality data										
D.O. (mgO_2/l)	7.82		8.26		6.80		9.90		10.04	
Salinity (°/oo)	23.08		8.10		22.43		19.70		24.51	
pH	7.90				7.50		7.90		8.10	
H_2O temp. (°C)	28.0		28.0		23.0				8.0	
CO2 ($mgCO_2/l$)	1.14		0.00		0.80		6.19		0.00	
Air temp. (°C)	38.0		28.5		24.5		16.50		12.5	
Depth (ft)	3.0		4.0		4.0		3.0		3.0	
Secchi (ft)	3.0		4.0		3.0		3.0		3.0	
Seine (ft)	25		25		80		80		25	
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic needlefish	8	1								
Atlantic silverside	3-9	12	3-10	17	5-9	35	5	1		
Banded killifish										
Bay anchovy			3-4	4	3	1				
Bluefish			14	1						
Fourspine stickleback			3	1						
Mummichog			4-5	2			5	1	3-5	2
Naked goby			3-4	2	4	1				
Northern pipefish			12	1	9-11	2	21	1		
Northern sea robin			4	1						
Oyster toadfish			4-6	4						
Rainwater killifish										
Sheepshead minnow									4	2
Silver perch					9	1				
Spot	8	3								
Striped killifish	10-19	12					6	1		
Summer flounder			6	1						
Tidewater silverside									3	1
Winter flounder	8	2	8	2						
Total		30		36		40		4		5

Table 18. Continued.

	12/5/74		3/18/75		4/16/75		5/8/75		Study total
Surface water quality data									
D.O. (mgO_2/l)	11.45		11.24		10.09		8.90		
Salinity (°/oo)	26.65		20.70		17.95		9.63		
pH	6.00		7.25		7.90		7.10		
H_2O temp. (°C)			7.0		8.0		17.0		
CO_2 ($mgCO_2/l$)	0.00		0.56		2.50		3.42		
Air temp. (°C)	0.0		11.0		14.0		19.0		
Depth (ft)	3.0		3.0		2.5		4.0		
Secchi (ft)	3.0		3.0		2.5		4.0		
Seine (ft)	25		25		25		25		
Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
Atlantic needlefish									1
Atlantic silverside			3-4	4					674
Banded killifish			6	2					2
Bay anchovy									5
Bluefish									2
Fourspine stickleback			3	1					26
Mummichog									365
Naked goby									19
Northern pipefish							15-16	2	7
Northern sea robin									1
Oyster toadfish									4
Rainwater killifish							5	1	2
Sheepshead minnow									13
Silver perch									1
Spot									18
Striped killifish							5-11	14	28
Summer flounder									1
Tidewater silverside							3	2	3
Winter flounder			11	1					6
Total	0		8		0		19		1,178

Table 19. Number of fish taken and water quality recorded at seine station 19.

	9/10/73		10/16/73		11/21/73		1/29/74		2/19/74		6/20/74	
Surface water quality data												
D.O. (mgO_2/l)	4.45		6.44		9.90		9.90		12.10		6.84	
Salinity (°/oo)	25.08		24.92		22.11		19.52		21.89		25.01	
pH	7.30		7.65		7.40		7.40		7.70		7.70	
H_2O temp. (°C)	22.0				8.0		7.0		2.0			
CO_2 ($mgCO_2/l$)	7.80		8.30		3.65		5.35		4.80		6.72	
Air temp. (°C)	23.0				12.5		9.0		6.5			
Depth (ft)	4.0		6.0				8.0		3.0		3.0	
Secchi (ft)												
Seine (ft)	80		80		80		80		25		25	
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
American eel												
Atlantic menhaden	15	1										
Atlantic needlefish	11-20	3										
Atlantic silverside	4-9	65										
Banded killifish											7	1
Bay anchovy	3-6	890			3	1						
Blueback herring	4	1										
Bluefish											8-9	3
Fourspine stickleback							3-4	5	3-4	6		
Mummichog	4-6	3	2-4	8							6-7	3
Naked goby												
Rainwater killifish			2-3	60								
Sheepshead minnow			2	4							4	1
Spot											4-5	2
Striped killifish	3-7	4	4	1							6-7	6
Striped mullet												
Tidewater silverside			4-5	14	3-6	26					4-6	10
White mullet												
Winter flounder											5	1
Total		937		87		27		5		6		27

Table 19. Continued.

	7/18/74		8/28/74		9/25/74		10/23/74		11/11/74		12/14/74	
Surface water quality data												
D.O. (mgO_2/l)	5.99		5.90		5.92		8.85		7.80		11.13	
Salinity (o/oo)	22.85		22.43		22.52		24.24		23.60		24.51	
pH	7.55		7.55		7.30		8.05		7.70		7.75	
H_2O temp. (^oC)	26.0		30.5		19.0		11.0		13.5		3.0	
CO_2 ($mgCO_2/l$)	6.86		4.30		8.34		5.65		4.04		5.11	
Air temp. (^oC)	25.0		29.5		18.5		21.0		21.0		9.0	
Depth (ft)	4.5		5.0		3.0		3.0		5.0		14.0	
Secchi (ft)	2.0		3.0		2.0		3.0		3.0		6.0	
Seine (ft)	25		25		25		25		25		25	
Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
American eel	28	1										
Atlantic menhaden												
Atlantic needlefish												
Atlantic silverside	5	1	47	4								
Banded killifish					2-4	2						
Bay anchovy			3-4	4								
Blueback herring												
Bluefish												
Fourspine stickleback												
Mummichog	4-8	3					2-4	6	3	1		
Naked goby	4	1	2-4	2	3	3						
Rainwater killifish												
Sheepshead minnow					4-5	4			4	1		
Spot												
Striped killifish					4	2						
Striped mullet												
Tidewater silverside					4-5	19	3-6	10	4-6	54	5	2
White mullet					3-11	17						
Winter flounder												
Total		6		10		47		16		56		2

Table 19. Continued.

	1/30/75	2/20/75	3/26/75	4/25/75	5/15/75	Study total
Surface water quality data						
D.O. (mgO_2/l)	10.68	12.00	10.29	9.33	7.36	
Salinity (°/oo)	20.10	20.35	21.76	21.60	21.80	
pH	7.60	7.67	6.60	7.50	7.35	
H_2O temp. (°C)	4.0	5.5	11.0	15.0	19.5	
CO_2 ($mgCO_2/l$)	3.17	3.17	3.06	4.45	4.21	
Air temp. (°C)	7.0	10.0	6.0	20.0	11.0	
Depth (ft)	5.0	5.0	4.0	3.0	5.0	
Secchi (ft)	3.5	3.0	3.0	3.0	3.0	
Seine (ft)	25	25	25	25	25	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel									16	1	2
Atlantic menhaden											1
Atlantic needlefish											3
Atlantic silverside							7-11	450			520
Banded killifish											3
Bay anchovy									6-8	7	872
Blueback herring							8	1			2
Bluefish											3
Fourspine stickleback											11
Mummichog									4-8	24	48
Naked goby											6
Rainwater killifish											60
Sheepshead minnow											10
Spot											2
Striped killifish											13
Striped mullet									3	1	1
Tidewater silverside									4-6	10	145
White mullet											17
Winter flounder											1
Total		0		0		0		451		43	1,720

Table 20. Number of fish taken and water quality recorded at seine station 20.

	9/12/73	11/21/73	1/17/74	2/19/74	6/12/74	7/18/74
Surface water quality data						
D.O. ($mgO_2/1$)	6.48	10.44		12.50	8.50	6.58
Salinity ($^o/oo$)	25.40	24.20	20.08	23.51	24.42	23.91
pH	7.70	7.80		8.00	8.00	7.90
H_2O temp. (^oC)	23.2	7.5	1.0		25.0	26.0
CO_2 ($mgCO_2/1$)	2.90	0.00		2.15	0.00	2.51
Air temp. (^oC)	25.5	11.5	5.0	7.0	23.0	27.0
Depth (ft)	8.0			4.0	4.0	4.5
Secchi (ft)					2.5	2.5
Seine (ft)	80	80	80	25	25	25

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic needlefish												
Atlantic silverside		24									4-5	5
Banded killifish	4	1										
Bay anchovy									6	1		
Fourspine stickleback												
Mummichog												
Naked goby												
Northern pipefish												
Rainwater killifish												
Sheepshead minnow												
Tidewater silverside						1		3 1				
White mullet												
Total		25		0		1		1		1		5

Table 20. Continued.

	8/15/74		9/25/74		10/23/74		11/11/74		12/13/74		1/30/75	
Surface water quality data												
D.O. (mgO_2/l)	8.86		5.22		8.90		8.95		11.43		7.60	
Salinity (°/oo)	26.02		27.90		24.60		25.95		25.77		21.55	
pH	8.00		7.30		8.15		8.10		7.90		7.40	
H_2O temp. (°C)	28.0		18.0		10.0		13.5		5.0		4.0	
CO_2 ($mgCO_2/l$)	0.00		4.57		2.96				3.50		0.00	
Air temp. (°C)	27.5		18.0		20.0		22.5		10.0		5.0	
Depth (ft)	2.0		5.0		6.5		12.0		11.0		4.0	
Secchi (ft)	2.0		2.0		3.5		6.0		6.0		3.5	
Seine (ft)	25		25		25		25		25		25	
Species	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Atlantic needlefish	7	1										
Atlantic silverside			8	4	4-10	55	8	1			3-4	9
Banded killifish			5	2								
Bay anchovy												
Fourspine stickleback					3	1						
Mummichog	5-6	3			3-7	30	3-5	7				
Naked goby			4	1								
Northern pipefish												
Rainwater killifish			3	2	3-4	5	3	8				
Sheepshead minnow							4	1				
Tidewater silverside			3-7	27			4-6	170	4-5	2		
White mullet					10-14	15						
Total		4		36		106		187		2		9

Table 20. Continued.

	2/30/75		3/26/75		4/25/75		5/15/75		Study total
Surface water quality data									
D.O. (mgO_2/l)	11.70		10.83		8.95		7.70		
Salinity (°/oo)	20.72		12.07		22.48		18.73		
pH	7.60		7.80		7.80		7.55		
H_2O temp. (°C)	4.0		8.5		15.5		22.5		
CO_2 ($mgCO_2/l$)	0.00		3.61		1.67		3.16		
Air temp. (°C)	5.0		8.0		18.0		21.0		
Depth (ft)	4.0		5.0		6.5		5.0		
Secchi (ft)	3.5		5.0		3.5		2.5		
Seine (ft)	25		25		25		25		
Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
Atlantic needlefish									1
Atlantic silverside		104	3-4	18					220
Banded killifish									3
Bay anchovy									1
Fourspine stickleback	4	2			4	1			4
Mummichog	3-5	2					3	1	43
Naked goby									1
Northern pipefish	12	1							1
Rainwater killifish			2	1	3	1			17
Sheepshead minnow			4	1					2
Tidewater silverside					5	1	4-5	8	210
White mullet									15
Total		109		20		3		9	518

Table 21. Number of fish taken at seine stations during summer 1973.

Species	Station														
	1	2	3	6	7	8	10	12	13	15	16	17	18	19	20
Alewife												4			
American eel		2		3	3									1	
Atlantic menhaden				20	2									3	
Atlantic needlefish		48	1	5	19				1						
Atlantic silverside	680	1,250	580	245	46		380	8	25			2	415	65	24
Banded killifish										23	108	34			
Bay anchovy		300		290	900				3					860	
Blueback herring														1	
Bluefish		3		5	3						1				
Butterfish	1														
Crevalle jack				60					1						
Fourspine stickleback		907	23	12	2				4						
Gray snapper		4													
Hogchoker										1	2	5			
Inshore lizardfish				1											
Mojarra sp.		7												3	
Mummichog		40		2	19	58		10					3		
Naked goby				16					1	3		1	1		
Northern pipefish		14	1	12			2		6				1		
Northern puffer	1														
Northern sennet		3		67											
Oyster toadfish		5		5	6				1						
Permit									2						
Pinfish				13											
Rainwater killifish	1	18			2	6									
Sheepshead minnow						18									
Silver perch		5		197					20						
Spot		65	1	49	329				5	1		1	5		
Striped anchovy				2											
Striped burrfish		2													

Table 21. Continued.

Species	Station 1	2	3	6	7	8	10	12	13	15	16	17	18	19	20
Striped killifish	1			1	6										4
Tautog		2		10											
Tidewater silverside						4		95		38	46	93			
Weakfish				1											
White mullet				13	46										
White perch										4	3	10			
Winter flounder				1									1		
Total	684	2,675	606	1,030	1,383	86	382	113	69	70	160	150	426	933	29

Table 22. Number of fish taken at seine stations during fall 1973.

Species	Station 2	5	6	7	8	9	10	12	13	15	16	17	18	19	20
American eel			2	3											
American sand lance		75	1												
Atlantic needlefish		1													
Atlantic silverside	2	739	1,509	11		2	170		19	1	6		190		
Banded killifish										17	72	100			
Bay anchovy			3						8					1	
Fourspine stickleback		1	8	3		24	1		6				17		
Gray snapper				1											
Hogchoker				4						2					
Mummichog		2		90	11	3			2	3		11	70	8	
Naked goby			5	80					8	2			15		
Northern kingfish		2													
Northern pipefish	1	1	4						1						
Oyster toadfish			2	6											
Rainwater killifish	1			7		1		4				2	1	60	
Sheepshead minnow	1			3	18	2					1		1	4	
Silver perch			5	5					19						
Smallmouth flounder							1								
Spot		2											3		

Table 22. Continued.

Species	Station 2	5	6	7	8	9	10	12	13	15	16	17	18	19	20
Striped killifish		40	2	3		3	1			2		8	10	1	
Striped mullet	1		2												
Tautog			1						2						
Tidewater silverside	190			1		280		10						14	
White perch										2	2				
Winter flounder		3	2				1				2			26	
Total	196	866	1,546	217	29	315	174	14	65	29	83	121	307	114	0

Table 23. Number of fish taken at seine stations during winter 1974.

Species	Station 2	8	9	10	12	13	15	16	17	18	19	20
Atlantic silverside		4				1						
Banded killifish							1	9	4			
Fourspine stickleback	19	5		5		3	17	25	10	7	11	
Mummichog	20			63								
Rainwater killifish				8								
Sheepshead minnow		2		46				1		1		
Striped killifish	7	1										
Striped mullet		3										
Threespine stickleback		1				2						
Tidewater silverside				19					3			2
Total	46	16	0	141	0	6	20	35	17	8	11	2

Table 24. Number of fish taken at seine stations during spring 1974.

Species	Station										
	2	9	10	12	13	15	16	17	18	19	20
American eel	1										
Atlantic needlefish	5										
Atlantic menhaden						11	1	70			
Atlantic silverside	84		6		1						
Banded killifish							2			1	
Bay anchovy		2	5		35	28	9	11			1
Blueback herring								3			
Bluefish	2					2	1		1	3	
Fourspine stickleback	1,000										
Gray snapper	2										
Mummichog	775	7	1			20		4	287	3	
Northern pipefish	3										
Oyster toadfish	2										
Rainwater killifish	1										
Sheepshead minnow	1									1	
Spot	6								7	2	
Spotted hake	1										
Striped killifish			1							6	
Tidewater silverside		3		8		10	22	60		10	
White mullet		20									
Winter flounder		1	1							1	
Total	1,883	33	14	8	36	71	35	148	295	27	1

Table 25. Number of fish taken at seine stations during summer 1974.

Species	Station											
	2	4	9	10	12	13	15	16	17	18	19	20
American eel	2	1									1	
Atlantic menhaden			42					1	10			
Atlantic needlefish	9	6							1	1		1
Atlantic silverside	921	272	66	71		220		11	55	64	5	9
Banded killifish			5	1				142	8		2	2
Bay anchovy	1,000	3	18	36		103		3	2	5	4	
Blueback herring			20	7				1				
Bluefish	5	7	13	6		1		3		1		
Crevalle jack			2					1				
Fourspine stickleback	1,027	15					2			1		
Herring sp.							1					
Hogchoker								1	4			
Inshore lizardfish		1										
Mummichog	27	20	3	11	8				3	2	3	3
Naked goby	1	1				1			1	3	6	1
Northern kingfish				1								
Northern pipefish	26	36				1				3		
Northern puffer	1											
Northern sea robin	1									1		
Northern sennet	2											
Notropus sp.						1						
Oyster toadfish	8	15				1			4			
Pinfish	1											
Planehead filefish	1											
Rainwater killifish	2								1			2
Sheepshead minnow								3	4			
Silver perch	17	55								1		
Spot	21	23	4					3		3		
Striped burrfish	2	3										
Striped killifish		18	16	2						12	2	

Table 25. Continued.

Species	Station 2	4	9	10	12	13	15	16	17	18	19	20
Striped sea robin				1								
Summer flounder	1	2							1	1		
Tidewater silverside					26		26	49			19	27
Tautog	1	1										
Weakfish	1		1									
White mullet			17			1					17	
White perch							1	2				
Winter flounder		21	1	3				1	2	2		
Total	3,077	500	208	139	34	329	30	218	92	100	63	45

Table 26. Number of fish taken at seine stations during fall 1974.

Species	Station 2	9	10	12	13	16	17	18	19	20
Atlantic menhaden	9					6				
Atlantic silverside	74	1	11				3	1		56
Banded killifish						2				
Bay anchovy		1,225								
Bluefish		1								
Fourspine stickleback	136									1
Mummichog	5	6	4	26	3	2	503	3	7	37
Naked goby				1						
Northern pipefish	3	1			1			1		
Rainwater killifish	15									13
Sheepshead minnow	2	2					17	2	1	1
Striped killifish								1		
Tidewater silverside		430	104	2	3		18	1	66	172
White mullet										15
Winter flounder	1									
Total	236	1,675	119	29	18	10	541	9	74	295

Table 27. Number of fish taken at seine stations during winter 1975.

Species	Station									
	2	9	10	12	13	16	17	18	19	20
American eel						1				
Atlantic silverside			2					4		131
Banded killifish				4				2		
Fourspine stickleback	320							1		2
Mummichog	1		1				6			2
Northern pipefish										1
Rainwater killifish										1
Sheepshead minnow										1
Striped killifish		6								
Threespine stickleback			2							
Tidewater silverside		24								
Winter flounder	4							1		
Total	325	30	5	4	0	1	6	8	0	138

Table 28. Number of fish taken at seine stations during spring 1975.

Species	Station										
	2	4	9	10	12	13	16	17	18	19	20
American eel										1	
American sand lance			1								
Atlantic silverside	80	32		1		110				450	
Banded killifish							4				
Bay anchovy		50	80			11				7	
Blueback herring			70					17		1	
Fourspine stickleback	408	20									1
Mummichog	16	8	1	1	12					24	1
Naked goby			1								
Northern pipefish	3	41				1			2		
Northern sea robin	2										
Oyster toadfish	3	3									
Rainwater killifish		1							1		1
Striped killifish			3						14		
Striped mullet										1	
Threespine stickleback	6	5	2								
Tidewater silverside			7	1		6	15	3	2	10	9
White perch		1									
Winter flounder	2										
Total	520	161	169	3	12	128	19	20	19	494	12

Table 29. Ten most abundant species captured by seine, their number, and percent of catch.

Species	No.	%
Atlantic silverside	9,135	36
Bay anchovy	5,004	20
Fourspine stickleback	4,044	16
Mummichog	2,264	9
Tidewater silverside	1,953	8
Banded killifish	544	2
Spot	530	2
Silver perch	324	1
Northern pipefish	166	1
Sheepshead minnow	154	1
Total	24,118	96%

Table 30. Seasonal catch/haul of the five most abundant species taken by seine.

	Seine length (ft)	Summer	Fall	Winter	Spring
Atlantic silverside	25	13.0	7.0	3.0	14.0
	80	18.0	33.0	0.2	
	150	254.0	177.0		28.0
Bay anchovy	25	2.0			3.0
	80	74.0	0.3		
	150	157.0	136.0		19.0
Fourspine stickleback	25	<0.1	0.4	2.0	<0.1
	80	0.3	0.3	2.0	
	150	124.0	19.0	160.0	204.0
Mummichog	25	2.0	17.0	0.2	9.0
	80	1.0	4.0	8.0	
	150	7.0	2.0	0.5	114.0
Tidewater silverside	25	6.0	9.0	0.1	3.0
	80	8.0	8.0	2.0	
	150		79.0	12.0	1.0

Table 31. Number of fish taken and water quality data recorded at trawl station 2.

		8/1/73	9/20/73	11/14/73	1/29/73	6/11/74
Water quality data						
D.O. (mgO_2/l)	surface	7.41		11.48	10.30	8.50
	bottom	7.32		11.48	10.40	8.50
Salinity (o/oo)	surface	28.62		29.40	25.30	28.71
	bottom			30.82	25.66	28.53
pH	surface	8.4			7.85	8.10
	bottom			8.00	6.85	8.05
H_2O temp. (°C)	surface	25.0	19.5	10.0	7.0	24.0
	bottom	25.5	19.5	9.0		24.0
CO_2 ($mgCO_2/l$)	surface			0.00	11.77	0.00
Air temp. (°C)		26.0	20.0	15.0	9.0	23.5
Depth (ft)					3.5	3.0
Secchi (ft)						3.0

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic silverside			8	1						
Black sea bass										
Fourspine stickleback	3-5	25	3-5	200	3-5	15	4	1	3-5	10
Gray snapper										
Northern pipefish	16	1	14-17	4	14	1				
Northern puffer										
Northern sea robin	16	1								
Oyster toadfish	24-25	2	18	1						
Pinfish										
Planehead filefish	7	1								
Red hake			3-4	10						
Smallmouth flounder					6	1				
Spot										
Spotted hake										
Striped burrfish										
Summer flounder										
Tautog			7-9	2						
Weakfish										
Winter flounder	17	1	19-22	2			11	1		
Total		31		224		17		2		10

Table 31. Continued.

		7/3/74	8/13/74	10/10/74	3/25/75	4/17/75	5/28/75	Study total
Water quality data								
D.O. (mgO_2/l)	surface	7.56	8.86	9.53	9.65	10.68	9.72	
	bottom	7.46	9.26	9.33	9.95	10.78	9.81	
Salinity (o/oo)	surface	27.74	28.89	27.65	27.11	28.86	26.65	
	bottom	28.26	28.71	27.83	26.74	29.04	26.29	
pH	surface	7.75	8.15	10.0	7.80	8.00	7.95	
	bottom	7.75	8.10	6.0	7.85	7.95	8.05	
H_2O temp. (°C)	surface	25.5	23.0	13.5	11.0	8.5	22.5	
	bottom	26.0	23.5	14.0	11.0	9.0	23.0	
CO_2 ($mgCO_2/l$)	surface	0.00	0.00	0.00	2.5	0.00	0.00	
Air temp. (°C)		28.0	27.0	17.0	15.0	14.0	25.0	
Depth (ft)		4.0	4.0	7.0	4.0	2.5	7.0	
Secchi (ft)		4.0	4.0	7.0	4.0	5.0	7.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
Atlantic silverside			8	1									2
Black sea bass	14	1	19	1									2
Fourspine stickleback	4-6	250	5	1			3-4	2	3	1	5	1	506
Gray snapper			12	1	6	1							2
Northern pipefish	16-22	5	15-17	3									14
Northern puffer			11	1									1
Northern sea robin													1
Oyster toadfish	13-26	4	20-26	3									10
Pinfish			11-12	2									2
Planehead filefish													1
Red hake											9	1	1
Silver perch			4-6	6									16
Smallmouth flounder													1
Spot													4
Spotted hake	19	1											1
Striped burrfish			8	1									1
Summer flounder			21	1									1
Tautog		1	21	1									4
Weakfish			8-10	10									10
Winter flounder	18	1	7-9	5			29	1					11
Total		263		37		1		3		1		2	591

Table 32. Number of fish taken and water quality data recorded at trawl station 4.

		8/9/73	10/9/73	11/18/73	12/3/73	1/30/74
Water quality data						
D.O. (mgO_2/l)	surface	6.91	6.44	10.44	10.94	10.60
	bottom	6.86	5.44	10.34	10.79	10.00
Salinity (°/oo)	surface	24.42	24.78	25.48	24.96	21.62
	bottom	23.87	25.88	25.57	25.23	21.58
pH	surface	8.30	8.20	7.95	7.90	7.80
	bottom	8.20	8.21	8.00	7.85	7.61
H_2O temp. (°C)	surface	26.0	19.0	7.5	5.5	8.0
	bottom	26.5	19.5	8.5	5.5	7.5
CO_2 ($mgCO_2/l$)	surface	0.00	11.45	0.00	2.70	0.00
Air temp. (°C)		25.5	18.5	10.5	9.5	12.5
Depth (ft)					10.0	12.0
Secchi (ft)						

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
American sand lance									13	1
Atlantic silverside	4-5	3								
Bay anchovy										
Fourspine stickleback	2-4	7			3-4	4	4-5	10		
Naked goby							4	1		
Northern pipefish	11	1					16	1		
Oyster toadfish	8-10	2	10-29	2	6	1	5-10	2		
Tautog										
Weakfish										
Winter flounder			29	1	25-28	3			26-32	14
Total		13		3		8		14		15

Table 32. Continued.

		6/10/74	7/2/74	8/14/74	10/21/74	4/28/74	5/23/74	Study total
Water quality data								
D.O.	surface	7.90	8.89	7.28	10.05	10.00	8.08	
($mgO_2/1$)	bottom	8.35	9.06	7.38	10.30	9.33	7.94	
Salinity	surface	24.76	25.95	26.02	26.38	24.25	16.56	
(o/oo)	bottom	24.58	27.38	25.48	31.22	24.61	16.92	
pH	surface	8.15	8.10	8.10	7.95	8.05	7.95	
	bottom	8.20	8.00	8.10	8.00	8.00	8.05	
H_2O temp.	surface	17.0	24.0	24.0	7.0	13.0	22.0	
(°C)	bottom	17.0	24.0	24.0	5.5	13.0	22.0	
CO_2 ($mgCO_2/1$)	surface	0.00	0.00	0.00	0.00	0.00	0.00	
Air temp. (°C)		29.0	28.0	26.5	4.0	18.0	21.0	
Depth (ft)		8.0	5.0	5.0	10.0	14.0	9.0	
Secchi (ft)		5.0	4.0	3.0	4.0	6.5	8.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
American sand lance													1
Atlantic silverside			11	1									4
Bay anchovy	6-9	3	7-8	7	6-8	100	8	2	44	1			113
Fourspine stickleback			5	3									24
Naked goby	5	1											2
Northern pipefish			18-25	7			19	1					10
Oyster toadfish			2-13	10					10	1			18
Tautog	32	1									16	1	2
Weakfish					10	1							1
Winter flounder	6-7	5	7-10	4					27	1	16	1	29
Total		10		32		101		3		3		2	204

Table 33. Number of fish taken and water quality data recorded at trawl station 5.

		8/14/73	9/19/73	10/2/73	11/18/73	12/3/73
Water quality data						
D.O.	surface	6.83	7.92	7.92	10.40	10.20
($mgO_2/1$)	bottom	7.90	7.87	8.02	10.25	10.30
Salinity	surface	26.00	24.90	28.71	26.38	27.20
(°/oo)	bottom	27.00	25.44	28.71	26.74	26.56
pH	surface		8.10	8.05	8.10	7.70
	bottom		8.00	8.10	8.05	7.85
H_2O temp.	surface	23.0	17.0	19.5	9.0	6.5
(°C)	bottom	19.0	17.0	18.4	9.0	6.5
CO_2	surface	6.35	4.15		0.00	1.20
($mgCO_2/1$)						
Air temp. (°C)			16.0	21.0	12.0	9.5
Depth (ft)		7.0	8.0	5.0		6.0
Secchi (ft)						

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
American eel										
American sand lance							11	1		
Atlantic silverside									11	1
Black sea bass					6	1				
Bluespotted cornetfish			46	1						
Butterfish			15	1						
Cunner	4	1								
Fourspine stickleback										
Lined seahorse									4-5	4
Northern pipefish	17	1	15	1						
Planehead filefish			14-15	2	13	1				
Pollack										
Red hake										
Scup			8-12	2						
Smallmouth flounder					6	1				
Spot			14	2	13-17	10				
Spotted hake										
Tautog									11	1
Threespine stickleback										
Windowpane							31	1		
Winter flounder	6-29	56	19-22	4	10-22	4	24-28	2	12-24	2
Total		58		13		17		4		8

Table 33. Continued.

		7/2/74	8/14/74	4/28/75	5/23/75	Study total
Water quality data						
D.O. (mgO_2/l)	surface	7.93	6.79	9.14	8.27	
	bottom	8.41	6.59	9.09	8.03	
Salinity (o/oo)	surface	28.08	27.11	28.86	20.19	
	bottom	27.38	27.47	30.10	21.98	
pH	surface	7.95	7.95	7.85	7.80	
	bottom	8.10	7.70	7.80	7.80	
H_2O temp. (°C)	surface	24.0	24.0	11.0	18.0	
	bottom	24.0	23.5	11.0	19.0	
CO_2 ($mgCO_2/l$)	surface	0.00	0.00	0.00	0.00	
Air temp. (°C)		24.0	30.0	17.0	25.0	
Depth (ft)		8.0	8.0	8.0	8.0	
Secchi (ft)		5.5	5.0	8.0	8.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel	30	1							1
American sand lance					11	1			2
Atlantic silverside			18-21	3					4
Black sea bass									1
Bluespotted cornetfish									1
Butterfish									1
Cunner			3	2					3
Fourspine stickleback									4
Lined seahorse	9-11	2				6			8
Northern pipefish	20-21	2			17-23	3			7
Planehead filefish									3
Pollock					4	1	4	1	2
Red hake							9	1	1
Scup									2
Smallmouth flounder									1
Spot									12
Spotted hake	18	1							1
Tautog							6	1	1
Threespine stickleback									1
Windowpane									1
Winter flounder	7-22	8	17-26	5	19-37	6	17-21	3	90
Total		14		10		17		6	147

Table 34. Number of fish taken and water quality data recorded at trawl station 6.

		9/19/73	10/2/73	11/18/73	12/3/73	Study total
Water quality data						
D.O. (mgO_2/l)	surface	7.67	8.02	10.05	10.30	
	bottom	7.52	7.72	10.00	10.15	
Salinity (o/oo)	surface	26.44	25.32	26.74	25.48	
	bottom	25.99	25.14	26.92	26.02	
pH	surface	8.2	8.01	8.05	7.83	
	bottom	8.3	8.00	8.01	7.80	
H_2O temp.(oC)	surface	19.0	19.0	9.0	6.0	
CO_2 ($mgCO_2/l$)	surface	2.45	9.75	0.0	2.20	
Air temp. (oC)		17.5	20.0	8.5	10.0	
Depth (ft)		8.0	9.0		7.0	
Secchi (ft)						

Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel	52	1							1
Bay anchovy	2	200							200
Blue runner			14	1					1
Fourspine stickleback					3-5	14	3-5	5	19
Hogchoker	9	1							1
Northern pipefish					14-19	2	13-14	2	4
Oyster toadfish	24	1							1
Scup			14	1					1
Silver perch			6-11	3					3
Spot			11-13	8					8
Tautog			11	1					1
Weakfish			14	1					1
Winter flounder					21	1	23-29	4	5
Total		203		15		17		11	246

Table 35. Number of fish taken and water quality data recorded at trawl station 7.

		8/9/73	10/9/73	1/30/74	2/7/74	6/10/74
Water quality data						
D.O. (mgO_2/l)	surface	7.75	8.02	10.50	11.93	8.35
	bottom	7.82	7.77	10.70	12.56	8.10
Salinity (o/oo)	surface	24.24	24.45	20.26	24.42	23.51
	bottom	23.69	24.51	18.10	24.42	23.87
pH	surface	8.40	8.06	7.80	7.60	8.05
	bottom	8.30	8.01	7.80	7.60	8.05
H_2O temp. (°C)	surface	27.0	19.5	8.0	0.5	18.5
	bottom	26.5	19.0	8.0	1.0	18.5
CO_2 ($mgCO_2/l$)	surface	0.00		0.00	6.92	0.00
Air temp. (°C)		25.5	19.5	10.5	2.0	29.5
Depth (ft)				6.0	6.0	5.0
Secchi (ft)						3.0

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic menhaden					10	1				
Atlantic silverside										
Bay anchovy									7-8	9
Fourspine stickleback					3	1	3-4	4		
Northern pipefish									16-21	3
Oyster toadfish	23	1	24	1						
Spot	9-10	6								
Summer flounder									9	1
Winter flounder			22	1	10-27	2	22-32	2	6-16	3
Total		7		2		4		6		16

Table 35. Continued.

		7/1/74	8/9/74	10/21/74	4/9/75	5/12/75	Study total
Water quality data							
D.O. (mgO_2/l)	surface	7.56	7.03	9.95	10.98	8.03	
	bottom	7.69	6.98	9.95	10.68	8.18	
Salinity (o/oo)	surface	25.77	27.11	24.96	23.21	20.55	
	bottom	25.77	27.11	25.14	23.91	20.19	
pH	surface	7.95	7.80	7.95	7.72	8.00	
	bottom	8.10	7.80	7.85	7.90	8.10	
H_2O temp. (oC)	surface	22.0	15.9	6.5	5.0	18.0	
	bottom	23.0	15.0	6.0	6.0	18.0	
CO_2 ($mgCO_2/l$)	surface	3.66	4.84	6.99	3.89	0.00	
Air temp. (oC)		23.5	27.0	8.0	12.0	18.0	
Depth (ft)		7.0	6.0	6.0	6.5	6.0	
Secchi (ft)		2.0	2.0	4.0	4.5	4.5	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
Atlantic menhaden											1
Atlantic silverside					10	2					2
Bay anchovy	6-9	18	3	2							29
Fourspine stickleback											5
Northern pipefish	17	1	17-21	2	10	1	20	1			8
Oyster toadfish											2
Spot											6
Summer flounder	35	1	16	1	30	1			26	1	5
Winter flounder	6-9	13							16	1	22
Total		33		3		5		1		3	80

Table 36. Number of fish taken and water quality recorded at trawl station 8.

		8/7/73		9/11/73		10/5/73		11/19/73	
Water quality data									
D.O. (mgO_2/l)	surface	6.73		7.28		7.43		11.32	
	bottom	8.39		7.18		7.38		11.32	
Salinity (°/oo)	surface	24.60		27.52		24.87		24.51	
	bottom	24.05		28.45		24.78		24.51	
pH	surface	8.30				8.10		7.79	
H_2O temp. (°C)	surface	27.5		22.0		22.0		9.0	
CO_2 ($mgCO_2/l$)	surface			0.00		1.00		2.70	
Air temp (°C)		28.1		25.0		22.5		7.0	
Secchi (ft)								4.0	
Species		LR	No.	LR	No.	LR	No.	LR	No.
American eel				64	1				
American shad									
Atlantic silverside				6-8	4				
Bay anchovy									
Black sea bass				8-24	3				
Fourspine stickleback		3	1			3-6	5	3-4	17
Naked goby								4	1
Northern kingfish				10	1				
Northern pipefish				12-18	25	12-17	3		
Northern puffer				11	1				
Oyster toadfish		8-25	10	9-28	32	23-75	5		
Silver perch				8-10	5	5-7	11		
Spot		7-10	2	10-14	6	12	1		
Spotted hake									
Striped burrfish		20	1						
Tautog									
Weakfish				12	1				
White perch									
White flounder						18-26	4		
Total			14		79		29		18

Table 36. Continued.

		12/3/73	1/16/74	2/7/74	6/10/74	7/1/74	8/9/74
Water quality data							
D.O. (mgO_2/l)	surface	8.81	12.57	11.89	8.90	7.62	6.44
	bottom	9.01	12.67	12.08	7.80	6.91	5.94
Salinity (°/oo)	surface	27.47	18.08	21.50	21.56	24.51	25.66
	bottom	30.86	20.76	22.00	23.57	24.69	26.20
pH	surface	8.20	7.70	6.70	8.15	7.90	7.70
	bottom				8.20	7.95	7.70
H_2O temp. (°C)	surface	10.0	0.0	0.5	18.0	23.0	23.5
	bottom				18.0	23.0	20.0
CO_2 ($mgCO_2/l$)	surface	2.90	3.15	0.00	0.00	4.11	1.61
Air temp. (°C)		11.00	2.0	1.0	29.5	23.0	28.5
Depth (ft)					4.0	5.0	7.0
Secchi (ft)					22.5	2.0	2.0

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
American eel							18-49	3				
American shad	13	1										
Atlantic silverside												
Bay anchovy							6-9	3	7-10	6	4-5	9
Black sea bass							10-30	7	12	1	14	2
Fourspine stickleback	3-4	4	3-5	12	3-4	4	5-6	2				
Naked goby												
Northern kingfish												
Northern pipefish							14-21	7	18-20	2		
Northern puffer												
Oyster toadfish							10-21	5	18-27	12	20-24	8
Silver perch												
Spot												
Spotted hake							12-19	4				
Striped burrfish												
Tautog							12-16	6			13-22	5
Weakfish											3	1
White perch	20-25	2										
White flounder							6-20	4	7-21	4	6-8	4
Total		7		12		4		41		25		30

Table 36. Continued.

		10/9/74	11/6/74	3/21/75	4/9/75	5/12/75	Study Total
Water quality data							
D.O. (mgO_2/l)	surface	8.73	8.65	9.80	10.88	8.08	
	bottom	8.78	8.50	9.90	11.07	8.08	
Salinity (o/oo)	surface	24.60	25.95	19.81	22.85	18.55	
	bottom	24.24	26.11	22.20	23.03	19.11	
pH	surface	7.70	8.30	7.60	7.95	8.15	
	bottom	7.70	8.30	7.60	7.70	8.20	
H_2O temp. (°C)	surface	14.0	16.0	7.5	6.5	18.0	
	bottom	14.0	16.0	7.5	6.0	18.0	
CO_2 ($mgCO_2/l$)	surface	0.00	0.00	3.06	5.84	0.00	
Air temp. (°C)		17.0	18.0	11.0	10.0	18.0	
Depth (ft)		3.0	5.0	7.0	8.0	8.0	
Secchi (ft)		2.0	2.0	3.0	4.0	4.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel	60	1									5
American shad											1
Atlantic silverside			10	1	10	2			11-12	4	11
Bay anchovy	5-6	18							5-8	500	536
Black sea bass											13
Fourspine stickleback											45
Naked goby											1
Northern kingfish											1
Northern pipefish											39
Northern puffer									5-19	2	1
Oyster toadfish	13	1									73
Silver perch											16
Spot											9
Spotted hake					9	1					5
Striped burrfish											2
Tautog											11
Weakfish											2
White perch											2
White flounder					24-33	12	30	1			29
Total		20		1		15		1		506	802

Table 37. Number of fish taken and water quality recorded at trawl station 10.

		8/8/73	10/5/73	11/12/73	12/6/73	1/6/74	2/27/74
Water quality data							
D.O. (mgO_2/l)	surface	6.83	7.33	10.58	8.71	12.87	11.30
	bottom		7.23	10.54	8.81	12.87	11.30
Salinity (°/oo)	surface	24.60	23.87	26.74	27.83	19.99	21.42
	bottom		23.69	26.92	28.19	19.89	22.77
pH	surface		8.00	7.80	7.00	7.80	
	bottom		8.00	7.60	7.90	7.80	
H_2O temp. (°C)	surface	28.0	22.5	5.0		0.5	
	bottom		22.5	7.0		1.0	
CO_2 ($mgCO_2/l$)	surface		2.45	3.40	5.10	2.20	5.05
Air temp. (°C)		27.0	24.5	7.0	10.0	3.0	1.0
Depth (ft)			6.0	9.0	5.0	5.0	
Secchi (ft)							

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic silverside							9-11	7				
Bay anchovy			5-6	9								
Black sea bass												
Bluefish												
Fourspine stickleback			4	1	3-5	24	4-5	6	3-5	10	4-5	3
Lined seahorse												
Naked goby							4-5	3				
Northern kingfish	3	1										
Northern pipefish					16	1						
Northern puffer												
Oyster toadfish			23	1								
Silver perch												
Spot	8-12	190	12	1								
Spotted hake												
Summer flounder												
Tidewater silverside												
Weakfish												
White perch							21	1				
Winter flounder			17-26	8			15-26	2			25-28	2
Total		191		20		25		19		10		5

Table 37. Continued.

		6/11/74		7/1/74		8/9/74		10/9/74		11/6/74	
Water quality data											
D.O. (mgO_2/l)	surface	7.00		8.22		6.43		9.08		8.30	
	bottom	6.70		7.92		6.53		9.03		8.50	
Salinity (°/oo)	surface	24.78		25.23		26.56		25.30		26.47	
	bottom	24.42		24.51		26.74		24.96		25.77	
pH	surface	7.80		7.95		7.70		7.85		8.36	
	bottom	7.90		9.20		7.80		7.70		8.20	
H_2O temp. (°C)	surface	24.5		23.0		23.3		14.0		16.5	
	bottom	24.0		23.0		23.3		14.5		16.5	
CO_2 ($mgCO_2/l$)	surface	0		3.66		4.57		0		0	
Air temp. (°C)		27.5		24.0		27.2		17.0		18.0	
Depth (ft)		5.0		4.0		6.0		4.5		5.0	
Secchi (ft)		2.0		2.0		3.0		4.0		5.0	
Species		**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Atlantic silverside		10	1							10	1
Bay anchovy		6-10	13	6-9	45	12	4	4-7	22		
Black sea bass				13	1						
Bluefish		6	1	9	1						
Fourspine stickleback											
Lined seahorse		8	1								
Naked goby											
Northern kingfish											
Northern pipefish											
Northern puffer				3	1						
Oyster toadfish		9-24	4	21	2						
Silver perch								11	1		
Spot		14-16	4	6	1						
Spotted hake		32-34	2								
Summer flounder								22	1		
Tidewater silverside				5	1						
Weakfish						8	2				
White perch											
Winter flounder											
Total			26		52		6		24		1

Table 37. Continued.

		3/24/75	4/9/75	5/12/75	Study total
Water quality data					
D.O. (mgO_2/l)	surface	9.70	10.78	8.03	
	bottom	9.55	10.78	7.89	
Salinity (o/oo)	surface	27.81	25.32	21.44	
	bottom	24.25	25.68	21.62	
pH	surface	7.80	7.95	8.00	
	bottom	7.70	7.90	8.00	
H_2O temp. (°C)	surface	9.0	6.0	17.0	
	bottom	8.5	5.5	17.0	
CO_2 ($mgCO_2/l$)	surface	3.90	5.28	0.00	
Air temp. (°C)		11.0	10.0	17.0	
Depth (ft)		6.0	5.0	5.0	
Secchi (ft)		2.5	3.0	3.0	

Species	LR	No.	LR	No.	LR	No.	No.
Atlantic silverside			9-19	2	10-11	2	13
Bay anchovy					6-9	150	243
Black sea bass							1
Bluefish							2
Fourspine stickleback							44
Lined seahorse							1
Naked goby							3
Northern kingfish							1
Northern pipefish					13	1	2
Northern puffer							1
Oyster toadfish							7
Silver perch							1
Spot							192
Spotted hake							4
Summer flounder							3
Tidewater silverside							1
Weakfish							2
White perch							1
Winter flounder			27-32	2			14
Total		0		4		153	536

Table 38. Number of fish taken and water quality recorded at trawl station 11.

		8/7/73		9/11/73		10/5/73		11/12/73	
Water quality data									
D.O. (mgO_2/l)	surface	6.93		8.27		6.88		9.80	
	bottom	7.61		7.87		6.73		10.20	
Salinity (°/oo)	surface	24.96		29.20		24.45		28.35	
	bottom	25.48		29.30		24.05		28.35	
pH	surface	8.10		8.00		7.85		7.70	
	bottom	8.10		8.00		7.90		7.70	
H_2O temp. (°C)	surface	27.5		21.0		22.0		5.5	
	bottom	27.0				21.5		6.0	
CO_2 ($mgCO_2/l$)	surface			2.20		1.95		2.20	
Air temp. (°C)		28.0		23.0		24.5		6.5	
Depth (ft)						8.0		8.0	
Secchi (ft)									
Species		LR	No.	LR	No.	LR	No.	LR	No.
Atlantic croaker									
Atlantic silverside									
Bay anchovy		3-8	108	3-6	25	5	1		
Black sea bass						6	1		
Blueback herring									
Crevalle jack									
Fourspine stickleback						5	1	3-4	3
Lookdown				12	1				
Naked goby						5	1		
Northern pipefish				10-12	2	14-20	6		
Northern puffer						17	1		
Oyster toadfish						9-25	8		
Pinfish				11	1				
Scup							1		
Sheepshead minnow								3	1
Silver perch						4-7	3		
Spot		10-11	3			14	1		
Striped anchovy				10	1				
Striped burrfish									
Summer flounder		27	1	33	1	30	1		
Threespine stickleback									
Weakfish		6-7	3			10	1		
Windowpane				20	1				
Winter flounder						10-22	5	14-27	9
Total			115		32		31		13

Table 38. Continued.

		12/6/73	1/16/74	2/27/74	6/26/74	7/1/74	8/9/74
Water quality data							
D.O.	surface	8.91	12.77	7.40	8.39	8.60	6.14
(mgO_2/l)	bottom	9.11	12.77	5.50	8.08	7.77	6.04
Salinity	surface	29.07	22.07	25.20	25.23	25.33	28.53
(o/oo)	bottom	28.71	20.35	25.00	26.29	24.87	28.53
pH	surface	7.80	7.80		7.95	7.95	7.65
	bottom	7.90	7.80		7.80	7.90	7.70
H_2O temp.	surface		0.5		19.0	23.0	23.5
(^oC)	bottom		0.0		19.0	23.0	23.0
CO_2	surface	3.65	2.45	5.30	0.00	3.06	4.84
($mgCO_2/l$)							
Air temp. (^oC)		10.0	3.5	0.0	20.0	25.0	26.75
Depth (ft)		5.0	5.0		8.0	7.5	7.0
Secchi (ft)					2.0	2.5	2.5

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic croaker	2-3	2										
Atlantic silverside					9-12	5						
Bay anchovy							5-8	22	6-9	84	4-5	10
Black sea bass												
Blueback herring												
Crevalle jack									4	1		
Fourspine stickleback	5	1	3-5	27	5	3						
Lookdown												
Naked goby												
Northern pipefish												
Northern puffer												
Oyster toadfish												
Pinfish												
Scup												
Sheepshead minnow												
Silver perch												
Spot											14	2
Striped anchovy												
Striped burrfish									23	1		
Summer flounder							16	1	35	1		
Threespine stickleback												
Weakfish					5	1					6-32	2
Windowpane	25	1										
Winter flounder	13-25	2			13-26	5			8	1	8-9	2
Total		6		27		14		23		88		16

Table 38. Continued.

		10/9/74	11/6/74	3/24/75	4/9/75	5/12/75	Study total
Water quality data							
D.O. (mgO_2/l)	surface	9.12	8.25	9.40	10.78	7.98	
	bottom	9.28	8.20	9.20	10.49	7.98	
Salinity (o/oo)	surface	26.38	28.62	24.98	26.74	22.34	
	bottom	27.11	28.62	23.55	31.80	22.52	
pH	surface	7.80	8.19	7.80	7.90	8.00	
	bottom	7.85	8.20	7.90	7.80	8.00	
H_2O temp. (°C)	surface	15.0	16.0	9.0	6.0	18.0	
	bottom	15.0	15.0	9.0	6.0	17.0	
CO_2 ($mgCO_2/l$)	surface		0.00	3.34	4.44	2.67	
Air temp. (°C)		17.5	17.0	11.0	10.5	17.0	
Depth (ft)		5.5	6.0	6.0	5.0	5.0	
Secchi (ft)		5.0	5.0	2.5		2.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
Atlantic croaker											2
Atlantic silverside							10-11	23			28
Bay anchovy									6-7	250	500
Black sea bass											1
Blueback herring					7-10	45	8	1			46
Crevalle jack											1
Fourspine stickleback											35
Lookdown											1
Naked goby											1
Northern pipefish			20	1			16	1	14	1	11
Northern puffer											1
Oyster toadfish									15	1	9
Pinfish											1
Scup											1
Sheepshead minnow											1
Silver perch											3
Spot											6
Striped anchovy											1
Striped burrfish											1
Summer flounder	23	1									6
Threespine stickleback											1
Weakfish											6
Windowpane											2
Winter flounder					15-21	3	16-25	3	14-18	4	34
Total		1		1		48		28		256	699

Table 39. Number of fish taken and water quality recorded at trawl station 12.

		8/3/73	9/11/73	10/4/73	11/14/73	6/11/74	7/3/74	8/3/74
Water quality data								
D.O.	surface	5.66	7.97	8.12	10.20	7.40	8.18	6.91
(mgO_2/l)	bottom	7.41	7.03	6.14	9.31	7.30	7.20	6.89
Salinity	surface	29.07	28.87	25.84	29.22	26.92	27.90	28.50
(o/oo)	bottom	28.70	28.78	26.20	29.04	26.92	27.01	28.71
pH	surface			8.00	7 90	6.70	7.60	7.85
	bottom			7.95	7.91	8.10	7.60	7.80
H_2O temp.	surface	25.5	22.0	21.5	7.0	24.0	26.5	23.0
(^oC)	bottom	25.0	22.1	20.5	8.0	24.0	25.0	23.0
CO_2 ($mgCO_2/l$)	surface		3.90	3.90	0.00	0.00	0.00	3.70
Air temp. (^oC)		27.0	21.5	23.5	14.0	25.0	29.0	24.0
Depth (ft)				8.0	8.0	5.0	7.5	9.0
Secchi (ft)						2.5	3.0	4.0

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Bay anchovy			3-7	22	5-7	10	4	1	6-8	26	3-9	5	3	1
Black sea bass							9				14	1		
Cunner														
Fourspine stickleback							3-4	2	4-5	8				
Lined seahorse	12	1												
Lookdown					6-7	2								
N. pipefish	11-17	2			11	1	13-19	6			19-20	3		
Northern sea robin					15	1								
Oyster toadfish			19	1	20-26	2					22	1		
Red hake									13	1				
Scup					21	1								
Silver perch			3-9	7	5-13	17	5	1						
Spot			13-15	4	15	1								
Spotted hake									19	1				
Striped anchovy			9	1										
Summer flounder			36	1										
Tautog					6	1	8	1	14	1				
Weakfish			14	1	11-16	2								
Winter flounder			10-24	2			19	1						
Total		3		39		38		13		37		10		1

Table 39. Continued.

		10/10/74		3/25/75		4/17/75		5/13/75		Study total
Water quality data										
D.O.	surface	8.48		9.65		9.65		7.98		
(mgO_2/l)	bottom	8.73		9.26		9.65		7.98		
Salinity	surface	28.35		26.04		28.51		23.06		
(°/oo)	bottom	27.47		28.59		28.51		23.60		
pH	surface	8.20		7.60		7.90		7.85		
	bottom	8.20		7.65		7.90		7.90		
H_2O temp.	surface	14.00		10.00		8.50		19.00		
(°C)	bottom	13.8		9.50		8.50		18.50		
CO_2	surface	0.00		0.00		0.00		0.00		
($mgCO_2/l$)										
Air temp. (°C)		17.50		18.00		15.00		22.00		
Depth (ft)		7.00		7.00		6.00		9.00		
Secchi (ft)		7.00		3.00		2.00		3.50		
Species		LR	No.	LR	No.	LR	No.	LR	No.	No.
Bay anchovy		3-4	10					6-9	4	79
Black sea bass										2
Cunner		5	1							1
Fourspine stickle-back										10
Lined seahorse										1
Lookdown										2
Northern pipefish								12	1	13
Northern sea robin										1
Oyster toadfish										4
Red hake										1
Scup										1
Silver perch										25
Spot										5
Spotted hake								15	2	3
Striped anchovy										1
Summer flounder										1
Tautog										3
Weakfish										3
White flounder				11-27	3	13-31	3			9
Total			11		3		3		7	165

Table 40. Number of fish taken and water quality data taken at trawl station 13.

		7/16/73	8/3/73	9/24/73	10/4/73	11/9/73	Study total
Water quality data							
D.O. (mgO_2/l)	surface	7.33	7.12	6.58	6.98	9.14	
	bottom		6.24	6.14	6.73	8.34	
Salinity (o/oo)	surface		26.38	27.70	27.29	27.29	
	bottom		28.71	27.34	26.92	26.38	
pH	surface			7.75	7.80	7.85	
	bottom			7.70	7.85	7.80	
H_2O temp. (°C)	surface		26.7	20.5	23.0	6.5	
	bottom	24.0	25.2	20.5	21.5	7.5	
CO_2 ($mgCO_2/l$)	surface			4.40	1.70	1.40	
Air temp. (°C)		2.50	2.85	19.00	26.00	5.00	
Depth (ft)				5.0	6.0		
Secchi (ft)							

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
American eel			52	1							1
Atlantic silverside					7	1					2
Bay anchovy	7	1	4-5	5	4-6	300	4-8	6			312
Black sea bass					19	1					1
Fourspine stickleback									4	2	2
Naked goby									2-5	25	25
Northern pipefish	9	1					12	1	12-16	8	10
Oyster toadfish	22	1	19-23	2	20-26	3	21-26	3	6	1	10
Silver perch					4-11	7	6	2	7	1	10
Spot	3-7	9	6-8	3	10-13	12	11-16	4			28
Striped anchovy						7	1				1
Tautog							9	1			1
Weakfish			3-7	24			14	1			25
Winter flounder									10-27	2	2
Total		12		35		326		18		39	430

Table 41. Number of fish taken and water quality recorded at trawl station 14.

		9/24/73		10/4/73		11/9/73		7/17/74	
Water quality data									
D.O. (mgO_2/l)	surface	7.18		7.03		8.73		6.78	
	bottom	7.18		6.83		8.49		6.83	
Salinity (°/oo)	surface	29.23		28.01		30.50		30.23	
	bottom	29.05		28.26		30.41		29.24	
pH	surface	7.90		7.90		7.90		7.80	
	bottom	7.90		7.90		7.90		7.80	
H_2O temp. (°C)	surface	20.50		21.50		9.00		25.00	
	bottom	20.00		20.50		9.00		24.00	
CO_2 ($mgCO_2/l$)	surface	4.40		3.90		1.30		0.00	
Air temp. (°C)		19.50		26.50		5.50		27.00	
Depth (ft)		14.00		17.00		12.00		7.00	
Secchi (ft)						2.00		2.50	
Species		**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Bay anchovy		3-8	9	4-8	18	5-6	2	7-9	18
Bluefish								11-15	2
Mummichog								6	1
Northern pipefish						2-7	5		
Silver perch						8	1		
Smallmouth flounder				7-9	3				
Spot		18	1	16	2				
Spotted hake									
Striped anchovy				11	1				
Summer flounder									
Tautog		21	1	8	1				
Weakfish		14	1						
Windowpane		34	1	14-24	2				
Winter flounder						21	1		
Total			13		27		9		21

Table 41. Continued.

		8/13/74	10/30/74	4/17/75	5/13/75	Study total
Water quality data						
D.O. (mgO_2/l)	surface	7.13	8.55	9.75	8.37	
	bottom	6.97	8.30	9.60	9.28	
Salinity (o/oo)	surface	28.71	29.97	30.28	26.29	
	bottom	28.89	30.68	30.81	26.46	
pH	surface	7.80	8.10	7.90	7.80	
	bottom	7.80	8.20	7.90	8.10	
H_2O temp. (°C)	surface	23.3	15.5	8.0	16.0	
	bottom	23.3	14.5	8.0	17.0	
CO_2 ($mgCO_2/l$)	surface	6.46	0.00	0.00	3.42	
Air temp. (°C)		27.6	20.0	13.0	23.0	
Depth (ft)		9.0	10.0	8.5	5.5	
Secchi (ft)		4.0	5.0	3.0	5.5	

Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
Bay anchovy	5	1							48
Bluefish	14-22	3							5
Mummichog									1
Northern pipefish			17	1	21	1			7
Silver perch									1
Smallmouth flounder									3
Spot									3
Spotted hake							14	1	1
Striped anchovy									1
Summer flounder	20-65	2							2
Tautog									2
Weakfish									1
Windowpane	20	1					29	1	5
Winter flounder									1
Total		7		1		1		2	81

Table 42. Number of fish taken and water quality recorded at trawl station 15.

		8/10/73		9/18/73		10/17/73		11/8/73	
Water quality data									
D.O.	surface	6.92		7.28		7.87		10.83	
(mgO_2/l)	bottom	2.44		1.93		5.34			
Salinity	surface			1.00		5.21			
(°/oo)	bottom			10.28		13.82		14.49	
pH	surface	6.80				7.60		6.70	
	bottom	7.10				7.40		6.50	
H_2O temp.	surface	27.0		20.0		13.5		7.5	
(°C)	bottom	27.0		22.0		14.0		8.5	
CO_2 ($mgCO_2/l$)	surface	3.00		8.30		2.45		2.90	
Air temp. (°C)		31.0		24.0		13.0		10.5	
Depth (ft)				6.0		7.0		6.5	
Secchi (ft)								2.5	
Species		LR	No.	LR	No.	LR	No.	LR	No.
American eel									
Atlantic menhaden									
Atlantic silverside									
Bay anchovy		4-8	18	7-8	2	6-7	2		
Blueback herring		3	1						
Bluefish									
Brown bullhead		15-20	2	20-21	3				
Crevalle jack									
Fourspine stickle-back									
Gold shiner		15	2						
Hogchoker				3-8	17	5-8	7	4-8	6
Mummichog									
Naked goby									
Pumpkinseed									
Redfin pickerel				26	1				
Spot		10-12	10	9-24	30	10-14	31		
Summer flounder									
Tidewater silverside									
Weakfish						15-17	3		
White perch		4-27	11	7-15	5	7-20	7		
Winter flounder									
Total			44		58		50		6

Table 42. Continued.

		12/12/73	1/22/74	2/15/74	6/13/74	7/8/74	8/9/74
Water quality data							
D.O.	surface	10.15	11.05	14.34	8.40	8.18	6.99
($mgO_2/1$)	bottom	9.45	9.60	9.95	6.05	6.42	5.31
Salinity	surface	4.58	1.00	4.13	2.09	7.25	<1.00
(o/oo)	bottom	13.48	10.41	12.97	12.14	9.45	9.31
pH	surface	7.65	6.30	6.75	7.25	7.25	6.30
	bottom	7.35	6.90	6.75	7.55	9.45	6.90
H_2O temp.	surface	4.5	0.0		22.5	28.0	25.7
(^oC)	bottom	6.0	0.5		24.5	28.0	25.7
CO_2	surface	3.40	4.40	2.40		3.66	3.50
($mgCO_2/1$)							
Air temp. (^oC)		3.00	11.5		25.5	3.20	27.5
Depth (ft)		7.0	7.0	7.0	5.5	6.0	4.0
Secchi (ft)				4.5	3.0	3.0	3.0

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
American eel												
Atlantic menhaden							4-5	7	6	2		
Atlantic silverside	7-11	22	4-5	7								
Banded killifish												
Bay anchovy							6-10	28	8-11	21	8-10	3
Blueback herring									15	2		
Bluefish							6	2	7	1		
Brown bullhead											25-35	2
Crevalle jack											13	1
Fourspine stickle-back	4	2	4	2								
Golden shiner							18	1				
Hogchocker	4-7	2										
Mummichog	4-9	324										
Naked goby												
Pumpkinseed												
Redfin pickerel												
Spot							4-6	2	8-10	8	11-16	18
Summer flounder									14	1	16-19	2
Tidewater silverside	4-5	64			4-5	130						
Weakfish												
White perch			7-11	2			19-24	5	14-15	3	7-15	3
Winter flounder												
Total		414		11		130		45		38		29

Table 42. Continued.

		10/15/74		3/21/75		4/10/75		5/29/75		Study total
Water quality data										
D.O. (mgO_2/l)	surface	9.40		11.43		10.39		7.31		
	bottom	9.10		6.98		9.70		6.83		
Salinity (°/oo)	surface	11.51		4.00		1.87		1.51		
	bottom	12.79		12.43		11.71		7.21		
pH	surface	8.10		7.15		6.80		7.10		
	bottom	8.05		7.15		7.25		7.10		
H_2O temp. (°C)	surface	17.5		7.0		9.0		22.5		
	bottom	18.5		8.0		8.0		23.0		
CO_2 ($mgCO_2/l$)	surface	1.08		2.22		2.22		5.05		
Air temp. (°C)		23.0		10.0		8.0		30.0		
Depth (ft)		5.0		5.0		6.0		7.0		
Secchi (ft)		5.0		2.0		2.0		3.5		
Species		**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**No.**
American eel								29-51	2	2
Atlantic menhaden										9
Atlantic silverside										29
Banded killifish						10	1			1
Bank anchovy		4-7	12					6-9	16	102
Blueback herring						9	1			4
Bluefish										3
Brown bullhead						29	1	27	1	9
Crevalle jack										1
Fourspine stickleback										4
Golden shiner										3
Hogchocker		3	2			5	1	5	1	36
Mummichog										324
Naked goby						4	1			1
Pumpkinseed								9	2	2
Redfin pickerel										1
Spot										99
Summer flounder										3
Tidewater silverside										194
Weakfish										3
White perch		17-18	3	11-27	12	15	1	9-25	3	55
Winter flounder		12	1							1
Total			18		12		6		25	886

Table 43. Number of fish taken and water quality recorded at trawl station 16.

		8/28/73	9/18/73	10/17/73	11/8/73	1/25/74	6/24/74
Water quality data							
D.O. (mgO_2/l)	surface	7.35	6.09	8.02	10.05	10.30	6.53
	bottom	5.83	6.44	7.82	9.46	9.90	3.94
Salinity (o/oo)	surface	13.44	17.05	18.17	9.27	12.61	12.50
	bottom	16.78	18.59	19.25	19.13	16.93	18.64
pH	surface	7.55	7.33	7.80	6.80	7.08	7.40
	bottom	7.45	7.30	7.80	6.80	7.20	7.30
H_2O temp. (°C)	surface	27.0	20.5	15.5	8.5	6.0	22.5
	bottom	26.0	20.5	16.0	7.0	6.0	24.0
CO_2 ($mgCO_2/l$)	surface		6.85	4.15	2.90	4.90	2.74
Air temp. (°C)		31.0	20.0	15.0	11.0	8.0	23.0
Depth (ft)			12.0	10.0	12.0	8.0	13.0
Secchi (ft)					2.5		2.5

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Alewife									16	1		
American eel			71	1								
Atlantic menhaden												
Bay anchovy			11	6	5-8	20						
Blueback herring												
Fourspine stickleback							4	1	3-5	16		
Hogchoker	6-9	7	14-15	2	8-15	9	12-17	2				
Naked goby							3	2			4	1
Oyster toadfish	15	1					5	1			13-20	2
Spot	10-12	9	11-14	7	10-13	14						
Summer flounder												
Weakfish			12	1	9-14	6						
White perch	16-21	2			20	1	10	2			23	1
Winter flounder							24	1	31	1	7-9	4
Total		19		17		50		9		18		8

Table 43. Continued.

		7/8/74	8/9/74	10/15/74	3/21/75	4/10/75	5/29/75	Study total
Water quality data								
D.O. (mgO_2/l)	surface	9.17	8.51	8.75	10.25	10.39	9.04	
	bottom	6.37	5.12	7.60	9.85	10.49	7.12	
Salinity (o/oo)	surface	12.56	16.62	15.72	7.36	12.07	10.19	
	bottom	18.39	27.29	20.63	11.35	17.36	12.02	
pH	surface		7.60	8.05	7.10	7.40	7.60	
	bottom		7.40	8.10	7.00	7.70	7.35	
H_2O temp. (°C)	surface	25.0	25.0	19.0	8.0	8.5	23.0	
	bottom	25.0	25.5	17.5	7.5	7.0	22.0	
CO_2 ($mgCO_2/l$)	surface	2.29	4.30	2.42	2.78	4.17	3.10	
Air temp. (°C)		30.0	28.5	25.0	11.0	13.0	28.0	
Depth (ft) 12.0		12.0	8.0	15.0	8.0	12.0	9.0	
Secchi (ft)		3.0	2.5	3.5	3.0	3.0	3.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
Alewife													1
American eel							12	1					2
Atlantic menhaden	6-8	5											5
Bay anchovy			7	3	3-8	18							47
Blueback herring	7	1							5	1			2
Fourspine stickleback													17
Hogchoker					9	1							21
Naked goby											4	1	4
Oyster toadfish	11-13	2	11-17	3	19-23	2					6-21	3	14
Spot													30
Summer flounder	11	1											1
Weakfish			5-8	2									9
White perch													6
Winter flounder					11	1	15-22	2	15-20	3	17	2	14
Total		9		8		22		3		4		6	173

Table 44. Number of fish taken and water quality recorded at trawl station 17.

		7/28/73	8/18/73	9/18/73	10/17/73	11/8/73
Water quality data						
D.O. (mgO_2/l)	surface		7.99	7.28	9.12	10.93
	bottom		0.49	1.39	1.44	10.63
Salinity (o/oo)	surface		8.84	2.79	9.43	9.81
	bottom	14.79	18.50	12.57	17.45	10.55
pH	surface		7.45	6.31	7.45	6.65
	bottom	6.65	6.80	6.98	7.20	6.90
H_2O temp. (°C)	surface		22.0	21.0	11.0	7.5
	bottom	23.0	25.5	20.0	12.7	11.5
CO_2 ($mgCO_2/l$)	surface			6.85	3.00	2.20
Air temp. (°C)		26.5	27.5	24.0	14.0	8.0
Depth (ft)				16.0	10.0	7.0
Secchi (ft)						3.0
Species		LR No.	LR No.	LR No.	LR No.	LR No.
Bay anchovy						
Bluefish						
Fourspine stickleback						
Hogchoker					4-8 3	
Mummichog						
Spot					12-13 3	
Summer flounder						
Tidewater silverside					4-5	
White perch					7-12	
Winter flounder						
Total		0	0	0	6	0

Table 44. Continued.

		12/12/73	1/25/74	2/28/74	6/13/74	7/8/74
Water quality data						
D.O. (mgO_2/l)	surface	9.85	10.60	12.17	9.75	11.97
	bottom	9.16	0.00	10.53	9.65	0.00
Salinity (°/oo)	surface		7.27	13.59	10.77	10.19
	bottom	16.38	18.62	19.15	10.50	18.93
pH	surface	7.30	7.10	6.60	8.10	
	bottom	7.65	6.60	6.70	8.00	
H_2O temp. (°C)	surface	6.0	6.0	3.0	25.0	27.0
	bottom	7.5	7.5	6.0	17.0	18.0
CO_2 ($mgCO_2/l$)	surface	4.90	5.20	2.65	1.60	0.91
Air temp. (°C)		4.0	8.0	9.0	25.0	31.0
Depth (ft)		11.0	10.0		11.0	10.0
Secchi (ft)					3.0	3.0
Species		LR No.	LR No.	LR No.	LR No.	LR No.
Bay anchovy						
Bluefish						
Fourspine stickleback		3-5 110	3-4 3			
Hogchoker						
Mummichog		4-9 6				
Spot						
Summer flounder						
Tidewater silverside		54				
White perch		15				
Winter flounder						
Total		185	3	0	0	0

Table 44. Continued.

		8/9/74	10/15/74	3/21/75	4/10/75	5/29/75	Study total
Water quality data							
D.O. (mgO_2/l)	surface	7.92	9.15	10.15	10.49	11.21	
	bottom	0.00	5.30	9.60	0.59	0.62	
Salinity (o/oo)	surface	2.45	12.79	7.00	10.26	7.79	
	bottom	18.08	18.08	8.82	17.26	15.30	
pH	surface	7.70	8.10	6.85	7.25	7.80	
	bottom	6.90	7.90	6.90	7.00	6.90	
H_2O temp. (°C)	surface	25.0	18.0	8.0	10.0	23.5	
	bottom	26.0	17.0	8.0	7.5	19.0	
CO_2 ($mgCO_2/l$)	surface	0.65	0.20	2.50	4.17	1.10	
Air temp. (°C)		28.5	25.0	15.0	8.0	28.0	
Depth (ft)		11.0	11.0	10.0	8.0	8.0	
Secchi (ft)		3.0	5.0	4.0	3.0	3.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
Bay anchovy			3-5	13							13
Bluefish	15	1									1
Fourspine stickleback											113
Hogchoker											3
Mummichog											6
Spot											3
Summer flounder			20	1							1
Tidewater silverside											54
White perch											15
Winter flounder							16	1			1
Total		1		14		0		1		0	210

Table 45. Number of fish taken and water quality recorded at trawl station 18.

		7/25/73	8/10/73	9/18/73	10/17/73	11/8/73
Water quality data						
D.O. (mgO_2/l)	surface		6.53	6.14	8.76	8.59
	bottom		1.37	1.44	5.84	4.78
Salinity (o/oo)	surface			3.78	10.54	14.58
	bottom	10.41		15.88	16.00	14.31
pH	surface		7.70	6.70	7.55	6.70
	bottom	6.80	7.30	7.00	7.00	6.30
H_2O temp. (oC)	surface		28.0	20.5	14.5	9.0
	bottom	22.0	22.5	21.0	12.0	12.0
CO_2 ($mgCO_2/l$)	surface		5.35	7.05	2.90	2.90
Air temp. (oC)		25.5	31.0	19.5	15.0	9.0
Depth (ft)				11.0	11.0	6.0
Secchi (ft)						3.0
Species		**LR No.**	**LR No.**	**LR No.**	**LR No.**	**LR No.**
Alewife						
American eel					50 1	
American shad						
Bay anchovy						
Blueback herring						
Fourspine stickleback						
Hogchoker				3-8 2	7-8 4	
Spot				10-14 16	11-14 14	
Tidewater silverside						
Weakfish				12-14 2		
White perch				7-20 6	8-22 23	7-12 19
Winter flounder						
Total		0	0	26	42	19

Table 45. Continued.

		1/22/74	2/27/74	6/13/74	7/8/74	8/9/74
Water quality data						
D.O. (mgO_2/l)	surface	10.75	10.72	9.85	11.81	12.60
	bottom	10.10	7.92	6.05	0.47	10.00
Salinity (o/oo)	surface	7.00	12.59	7.18	8.53	6.35
	bottom	10.68	15.75	11.78	15.84	11.87
pH	surface	5.70	6.80	8.20		9.00
	bottom	6.60	6.70	7.65		7.90
H_2O temp. (oC)	surface	5.0		22.5	28.0	25.5
	bottom	4.0		18.5	26.0	25.5
CO_2 ($mgCO_2/l$)	surface	4.40	4.10	1.37	0	1.61
Air temp. (oC)		11.0		22.0	3.0	28.5
Depth (ft)		12.0		6.5	12.0	8.0
Secchi (ft)				2.5	3.0	3.0

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Alewife										
American eel										
American shad										
Bay anchovy										
Blueback herring										
Fourspine stickleback										
Hobchoker										
Spot										
Tidewater silverside			5	5						
Weakfish										
White perch	9-11	9	8-31	42						
Winter flounder										
Total		9		47		0		0		0

Table 45. Continued.

		10/15/74	3/21/75	4/10/75	5/29/75	Study total
Water quality data						
D.O. (mgO_2/l)	surface	8.95	9.55	10.49	9.43	
	bottom	4.90	6.78	5.00	5.58	
Salinity (°/oo)	surface	10.23	10.63	7.72	5.59	
	bottom	16.26	15.32	14.60	9.99	
pH	surface	8.15	7.35	7.30	7.40	
	bottom	7.85	6.90	6.95	7.05	
H_2O temp. (°C)	surface	17.0	7.5	9.5	23.0	
	bottom	17.0	8.5	8.0	22.0	
CO_2	surface	1.61	3.34	4.45	2.95	
Air temp. (°C)		25.0	13.0	9.0	29.0	
Depth (ft)		11.0	10.0	9.0	8.0	
Secchi (ft)		4.0	3.5	2.5	2.5	

Species	10/15/74 LR	10/15/74 No.	3/21/75 LR	3/21/75 No.	4/10/75 LR	4/10/75 No.	5/29/75 LR	5/29/75 No.	Study total No.
Alewife					12	1			1
American eel									1
American shad					12	1			1
Bay anchovy					7	1			1
Blueback herring			11	1	16	1			2
Fourspine stickleback					4-5	2			2
Hogchoker	9	1							7
Spot									30
Tidewater silverside			3-4	6					11
Weakfish									2
White perch	16-20	14			14	1			114
Winter flounder					15-17	2			2
Total		15		7		9		0	174

Table 46. Number of fish taken and water quality recorded at trawl station 23.

		7/16/73	8/17/73	9/11/73	10/30/73	11/28/73	6/18/74
Water quality data							
D.O. (mgO_2/l)	surface	4.31		6.34	4.54	7.65	3.78
	bottom			6.14	4.73	7.59	3.32
Salinity (o/oo)	surface		24.42	27.07	21.04	26.01	1.98
	bottom		22.79	27.20	21.40	27.11	21.89
pH	surface		7.80	7.90	5.98	7.11	7.05
	bottom		7.80	7.90	7.10	7.79	7.10
H_2O temp. (°C)	surface		23.5		12.5	12.0	23.0
	bottom	27.0	23.5		12.5	12.0	24.0
CO_2 ($mgCO_2/l$)	surface		7.80	3.90	10.50	2.70	11.88
Air temp. (°C)		27.5	22.0	24.0	13.5	16.5	29.0
Depth (ft)					6.0	6.0	5.0
Secchi (ft)						1.0	2.0

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Alewife												
American eel			50	1	59	1						
Atlantic menhaden											5-8	150
Atlantic silverside			6-7	4							11-12	3
Bay anchovy			5-7	30	5-8	35			9	1	5-10	72
Blueback herring												
Crevalle jack					5	1						
Fourspine stickleback									4-6	2		
Hogchoker									4-5	2		
Naked goby									3-5	12		
Northern pipefish												
Oyster toadfish			21-27	4	24-30	2					20	1
Silver perch					9-10	21						
Spot	8-11	70	10-14	12	13	2	12-14	8				
Summer flounder												
Weakfish			8-10	12	11-13	2						
Winter flounder							11-23	2	13-25	2		
Total		70		63		64		10		19		226

Table 46. Continued.

		7/22/74	8/20/74	10/18/74	3/25/75	4/29/75	5/13/75	Study total
Water quality data								
D.O. (mgO_2/l)	surface	6.44	5.71	8.70	9.11	8.95	6.93	
	bottom	5.54	5.41	7.05	9.16	8.61	6.73	
Salinity (°/oo)	surface	29.36	25.66	23.87	23.19	24.61	15.84	
	bottom	27.11	25.48	23.69	22.48	24.25	16.74	
pH	surface	7.35	7.20	7.60	7.65	7.80	7.60	
	bottom	7.45	7.51	7.55	7.85	6.80	7.50	
H_2O temp. (°C)	surface	24.5	25.5	14.0	11.0	13.0	19.5	
	bottom	25.0	25.5	14.0	11.0	13.0	19.0	
CO_2	surface	5.94	6.73	3.23	4.17	4.73	5.00	
Air temp. (°C)		25.0	28.0	10.0	19.0	13.5	23.0	
Depth (ft)		5.0	4.0	4.0	5.0	6.0	4.5	
Secchi (ft)		2.5	3.5	2.0	2.0	2.5	2.5	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
Alewife											5	2	2
American eel													2
Atlantic menhaden	5	1											151
Atlantic silverside					9	1			8-11	12	9-12	18	38
Bay anchovy	6-8	16	4-8	22	5-7	18			6-9	14	5-9	240	448
Blueback herring									5	2			2
Crevalle jack													1
Fourspine stickleback													2
Hogchoker													2
Naked goby													12
Northern pipefish			12	1									1
Oyster toadfish	11-23	3			22	1							11
Silver perch													21
Spot	9-13	380											472
Summer flounder	19	1			23	1							2
Weakfish			6-8	3	15	1							18
Winter flounder					10-13	4							8
Total		401		26		26		0		28		260	1,193

Table 47. Number of fish taken and water quality recorded at trawl station 24.

		8/8/73	9/11/73	10/30/73	11/28/73	6/18/74	7/22/74
Water quality data							
D.O. (mgO_2/l)	surface		7.18	7.12	8.27	7.44	7.03
	bottom		7.23	6.15	7.97	7.44	7.42
Salinity (o/oo)	surface	21.71	27.40	24.98	27.83	25.84	27.81
	bottom			24.98	27.83	25.48	27.85
pH	surface		7.90	7.30	7.70	7.60	7.20
	bottom		7.90	7.62	7.29	7.70	7.75
H_2O temp. (^oC)	surface	28.0	21.0	13.5	11.9	23.5	24.5
	bottom			13.5	11.6	24.0	24.5
CO_2 ($mgCO_2/l$)	surface		5.10	8.80	3.40	5.26	2.74
Air temp. (^oC)		26.0	21.0	13.5	15.5	29.0	24.0
Depth (ft.)				5.0	4.0	4.0	3.5
Secchi (ft.)						2.5	2.5

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Alewife												
American eel			59	1								
Atlantic croaker							4	1				
Atlantic menhaden									4-5	24	4-5	2
Atlantic silverside			8	1								
Bay anchovy	3-4	104	3-6	104	5-7	8	4	1	7-10	70	6-9	44
Blueback herring												
Bluefish									8	1		
Crevalle jack			11-13	2								
Fourspine stickleback					3	1	3-5	11				
Hogchoker							4-5	3				
Naked goby			4	1			3-4	3				
Northern pipefish			15	1								
Northern sea robin	3-5	3										
Oyster toadfish			5-13	2			6	1			25-28	2
Silver perch			8-10	7								
Spot	8-13	8	10-17	11	11-13	6					10-13	19
Spotted hake												
Striped sea robin									5	1		
Summer flounder			36	1							18	1
Weakfish	4-9	9	11-13	5								
Winter flounder	7	1							7	1		
Total		125		136		15		20		97		68

Table 47. Continued.

		8/20/74	10/18/74	3/25/75	4/29/75	5/13/75	Study total
Water quality data							
D.O. (mgO_2/l)	surface	6.10	8.20	9.45	8.71	7.74	
	bottom	5.90	6.65	9.50	8.37	6.88	
Salinity (o/oo)	surface	25.84	24.24	23.91	25.32	19.65	
	bottom	25.84	24.24	23.55	26.74	20.01	
pH	surface	7.57	7.60	7.80	7.75	7.90	
	bottom	7.60	7.35	7.65	7.90	7.70	
H_2O temp. (°C)	surface	25.5	14.0	11.0	13.0	19.5	
	bottom	25.5	14.0	11.0	13.0	19.0	
CO_2 ($mgCO_2/l$)	surface	6.46	3.77	3.34	3.34	2.37	
Air temp. (°C)		29.0	10.0	18.0	15.0	23.0	
Depth (ft)		5.0	4.0	3.0	5.0	3.5	
Secchi (ft)		3.5	3.0	2.5	2.5	2.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.	No.
Alewife									5	1	1
American eel			35	1			35				2
Atlantic croaker											1
Atlantic menhaden											26
Atlantic silverside					10	1					2
Bay anchovy	5-8	32	4	2			5-8	90	4-6	249	695
Blueback herring							5	1			1
Bluefish											1
Crevalle jack											2
Fourspine stickleback											12
Hogchoker											3
Naked goby											4
Northern pipefish											1
Northern sea robin											3
Oyster toadfish	4-31	4									9
Silver perch	4-7	4									11
Spot											44
Spotted hake									14	1	1
Striped sea robin											1
Summer flounder											2
Weakfish	7	1									15
Winter flounder	10-19	2	10	1			15	1			6
Total		43		4		1		92		242	843

Table 48. Number of fish taken and water quality recorded at trawl station 25.

		8/17/73		9/20/73		10/5/73		11/28/73		2/27/74	
Water quality data											
D.O. (mgO_2/l)	surface					6.53		8.27		10.96	
	bottom					6.73		7.97			
Salinity (o/oo)	surface			23.01		25.05		28.35		25.88	
	bottom	27.83		24.90		24.24		27.83		26.24	
pH	surface					7.80		7.70			
	bottom	8.00				7.20		7.29			
H_2O temp. (^oC)	surface	23.9		19.0		22.5		11.9			
	bottom	24.0		19.5		22.0		11.6			
CO_2 ($mgCO_2/l$)	surface	13.65				1.45		2.90		5.30	
Air temp. (^oC)				22.0		24.5		6.5		0.0	
Depth (ft)				6.0		5.0		4.0			
Secchi (ft)								1.0			
Species		**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Alewife											
American eel				33-51	2						
Atlantic menhaden											
Atlantic silverside								9-12	3	9-11	9
Bay anchovy		4-8	80	5-8	46	3-8	7	4	1		
Blueback herring										7-10	22
Bluefish											
Fourspine stickleback				2-3	5	4	1			4-5	300
Hogchoker											
Northern pipefish				2-4	3	16	1				
Oyster toadfish				4-23	2	24	1				
Red hake											
Silver perch		4-7	44	4-7	5						
Spot		8-13	18	11-15	111						
Spotted hake											
Summer flounder		32	1	35	1						
Tautog							1				
Weakfish		4-12	10	8-12	3		1				
Winter flounder						15-18	2	13	1	13-32	
Total			153		78		14		5		

Table 48. Continued.

		6/18/74		7/3/74		8/13/74		10/10/74		3/24/75	
Water quality data											
D.O. (mgO_2/l)	surface	7.04		6.32		11.10		9.63		9.11	
	bottom	6.99		5.59		6.11		8.27		9.01	
Salinity (o/oo)	surface	25.66		13.66		12.97		14.61		12.74	
	bottom	25.30		33.06		26.38		27.49		22.12	
pH	surface	7.80		7.20		8.00		8.65		7.60	
	bottom	7.75		7.20		7.70		8.25		7.60	
H_2O temp. (oC)	surface	24.0		25.5		24.5		15.0		9.0	
	bottom	24.0		24.5		24.0		14.0		16.0	
CO_2 ($mgCO_2/l$)	surface	3.66		1.83		3.23		2.15		3.06	
Air temp. (oC)		28.0		28.5		25.5		19.0		11.0	
Depth (ft)		4.0		7.0		9.0		7.0		7.0	
Secchi (ft)		2.5		2.5		3.0		3.0		3.0	
Species		LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Alewife										25	1
American eel						53	1				
Atlantic menhaden		4-5	110	5-9	11	6	3				
Atlantic silverside										8-11	40
Bay anchovy		7-9	440	7-10	240	7-8	100	3-7	80	3-4	3
Blueback herring										6	1
Bluefish		9	1	12	1	17	1				
Fourspine stickleback											
Hogchoker				7-18	11	9	2	5	1		
Northern pipefish						11-18	2				
Oyster toadfish		10	1	18-24	4	5-30	7	21-25	2		
Red hake		20	1								
Silver perch						3-5	6				
Spot				12-13	2	13-15	5	14-17	4		
Spotted hake		14-20	9								
Summer flounder				13-16	2	20-22	2	24	1		
Tautog											
Weakfish						3-6	6	12-15	5		
Winter flounder		7	2	9	1			9	1		
Total			564		272		132		94		45

Table 48. Continued.

		4/17/75		5/12/75		Study total
Water quality data						
D.O. (mgO_2/l)	surface	9.26		8.82		
	bottom	9.31		6.73		
Salinity (o/oo)	surface	13.15		6.33		
	bottom	23.91		18.73		
pH	surface	7.30		7.50		
	bottom	7.65		7.80		
H_2O temp. (°C)	surface	9.0		19.0		
	bottom	9.0		17.5		
CO_2($mgCO_2/l$)	surface	5.56		3.16		
Air temp. (°C)		20.0		16.0		
Depth (ft)		6.5		7.0		
Secchi (ft)		3.0		3.0		
Species		**LR**	**No.**	**LR**	**No.**	**No.**
Alewife						1
American eel						3
Atlantic menhaden						124
Atlantic silverside						52
Bay anchovy		5-7	3	7-9	250	1,250
Blueback herring		10-11	5			28
Bluefish						3
Fourspine stickleback						306
Hogchoker						14
Northern pipefish		13-17	2			8
Oyster toadfish		6	1	28	1	19
Red hake						1
Silver perch						55
Spot						40
Spotted hake				13-16	4	13
Summer flounder						7
Tautog						1
Weakfish						22
Winter flounder		16	1			13
Total			12		255	1,960

Table 49. Number of fish taken and water quality recorded at trawl station 26.

		7/16/73	8/17/73	9/24/73	11/12/73	Study total
Water quality data						
D.O. (mgO_2/l)	surface	6.59		6.63	11.22	
	bottom			6.34	10.72	
Salinity ($^o/oo$)	surface		27.11	26.89		
	bottom		27.83	26.89		
pH	surface		7.80	7.70	7.85	
	bottom		7.80	7.65	7.70	
H_2O temp. (^oC)	surface		24.5	20.0	5.5	
	bottom	26.0	24.5	20.0	6.5	
CO_2 ($mgCO_2/l$)	surface		9.75	4.40	0.00	
Air temp. (^oC)		24.5	25.0	21.0	17.0	
Depth (ft)				3.0	6.0	
Secchi (ft)					4.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	No.
Atlantic silverside			8	1					1
Bay anchovy	7	2	4-8	17	4-8	75			94
Black sea bass	13	1							1
Bluefish	9	1							1
Fourspine stickleback							3	30	30
Lookdown			5	1					1
Naked goby							3-4	19	19
Northern pipefish					18	1	13	1	2
Oyster toadfish	26	1	17	1	22-27	5			7
Spot	3-8	32	10-14	23	3-15	9			64
Tautog					6	1			1
Tidewater silverside							4-5	2	2
Weakfish			7-10	4	3	1			5
Total		37		47		92		52	228

Table 50. Number of fish taken and water quality recorded at trawl station 27.

		9/19/73		10/9/73		Study total
Water quality data						
D.O. (mgO_2/l)	surface	7.33		8.17		
	bottom	7.33		7.72		
Salinity (o/oo)	surface	17.14		25.39		
	bottom	17.59		25.30		
pH	surface	7.75		8.06		
	bottom	7.65		8.00		
H_2O temp. (^oC)	surface	19.5		19.0		
	bottom	19.5		19.0		
CO_2 ($mgCO_2/l$)	surface	6.35		0.00		
Air temp. (^oC)		16.0		20.5		
Depth (ft)		4.0				
Secchi (ft)						
Species		**LR**	**No.**	**LR**	**No.**	**No.**
American eel			2			2
Bluefish		18	1			1
Oyster toadfish		25-29	2	14-26	2	4
Winter flounder				6	1	1
Total			5		3	8

Table 51. Number of fish taken and water quality recorded at trawl station 28.

		10/4/73
Water quality data		
D.O. (mgO_2/l)	surface	7.38
	bottom	7.52
Salinity (o/oo)	surface	25.66
	bottom	25.84
pH	surface	7.90
	bottom	7.95
H_2O temp. (^oC)	surface	21.7
	bottom	20.5
CO_2 ($mgCO_2/l$)	surface	
Air temp. (^oC)		24.5
Depth (ft)		5.0
Secchi (ft)		

Species	LR	No.
Bay anchovy	3-6	20
Silver perch	6-7	2
Spot	12-18	19
Summer flounder	36	1
Weakfish	4-14	5
Winter flounder	11	1
Total		48

Table 52. Number of fish taken at trawl stations during summer 1973.

Species	Station																			
	2	4	5	6	7	8	10	11	12	13	14	15	16	17	18	23	24	25	26	27
American eel				1		1							1			2	1	2		2
Atlantic silverside	1	3				4				2						4	1		1	
Bay anchovy				200				133	22	301	9	20	6			65	208	126	94	
Black sea bass						3				1									1	
Blueback herring												1								
Bluefish																			1	1
Bluespotted cornetfish			1																	
Brown bullhead												5								
Butterfish			1																	
Crevalle jack																1	2			
Cunner			1																	
Fourspine stickleback	224	7				1												5		
Golden shiner												2								
Hogchoker			1	1								17	9		2					
Lined seahorse									1											
Lookdown								1											1	
Naked goby																	1			
Northern kingfish							1													
Northern pipefish	5	1	2			25		2	2	1							1	3	1	
Northern puffer						1														
Northern sea robin	1																3			
Oyster toadfish	3	2		1	1	42			1	4			1			6	2	2	7	2
Pinfish								1												
Planehead filefish	1		2																	
Redfin pickerel												1								
Scup			4																	
Silver perch	10					5			7	7						21	7	49		
Spiny boxfish						1														
Spot	4		2		6	6	190	3	4	21	1	40	16		16	84	19	29	64	
Striped anchovy						2		1	1	1										

Table 52. Continued.

Species	Station																				
	2	4	5	6	7	8	10	11	12	13	14	15	16	17	18	23	24	25	26	27	
Summer flounder								2	1								1	2			
Tautog	2										1								1		
Weakfish						1		3	1		1		1		2	14	14	13	5		
White perch												16	2		6						
Windowpane								1			1										
Winter flounder	3		60						2								1				
Total	254	13	74	203	7	93	191	147	42	338	13	102	36	0	26	197	261	231	176	5	

Table 53. Number of fish taken at trawl stations during fall 1973.

Species	Station																				
	2	4	5	6	7	8	10	11	12	13	14	15	16	17	18	23	24	25	26	27	28
American eel															1						
American sand lance			1																		
American shad						1															
Atlantic croaker								2									1				
Atlantic silverside			1				7					22						3			
Bay anchovy							9	1	11	6	20	2	20			1	8	8			20
Black sea bass			1					1	1												
Blue runner				1																	
Fourspine stickleback	15	14	4	19		26	31	7	2	2		2	1	110		2	12	1	30		
Hogchoker												15	11	3	4	2	3				
Lookdown									2												
Mummichog												324		6							
Naked goby		1				1	3	1		25			2			12	3		19		
Northern pipefish	1	1		4		3	1	6	7	9	5							1	1		
Northern puffer								1													
Northern sea robin									1												
Oyster toadfish		5			1	5	1	8	2	4							1	1	2	2	
Planehead filefish			1																		
Scup				1				1	1												
Sheepshead minnow								1													

Table 53. Continued.

Species	Station																				
	2	4	5	6	7	8	10	11	12	13	14	15	16	17	18	23	24	25	26	27	28
Silver perch				3		11		3	18	3	1										2
Smallmouth flounder	1		1								4										
Spot			10	8		1	1	1	1	4	2	31	14	3	14	8	6				19
Striped anchovy											1										
Summer flounder								1													1
Tautog		1	1						2	1	1							1			
Tidewater silverside												64		54							
Weakfish				1				1	2	1		3	6					1			5
White perch						2	1					7	3	15	42						
Windowpane			1					1		2											
Winter flounder		4	6	5	1	4	10	14	1	2	1		2			4	1	3		1	1
Total	17	25	27	43	2	54	64	49	51	57	37	470	59	191	61	29	35	19	52	3	48

Table 54. Number of fish taken at trawls during winter 1974.

Species	Station																				
	2		4		7		8		10		11		15		16		17		18		25
Alewife															1						
American sand lance			1																		
Atlantic menhaden					1																
Atlantic silverside																					9
Blueback herring											5										22
Fourspine stickleback	1				5		4		15		13		27		16		3				300
Threespine stickleback											1										
Tidewater silverside													130						5		
White perch																			51		
Winter flounder	1		14		4				2		5				1						5
Total	2		15		10		4		17		24		157		18		3		56		336

Table 55. Number of fish taken at trawl stations during spring 1974.

Species	Station													
	2	4	7	8	10	11	12	15	16	17	18	23	24	25
American eel				3										
Atlantic menhaden								7				150	24	110
Atlantic silverside					1							3		
Bay anchovy		3	9	3	13	22	26	28				72	70	440
Black sea bass				7										
Bluefish					1			2					1	1
Fourspine stickleback	10			2	1		8							
Golden shiner								1						
Lined seahorse					1									
Naked goby		1							1					
Northern pipefish			3	7										
Oyster toadfish				5	4				2			1		1
Red hake							1							1
Spot								2						
Spotted hake				4	4		1							9
Striped sea robin													1	
Summer flounder			1		2	1								
Tautog		1		6			1							
White perch								5	1					
Winter flounder		5	3	4					4				1	2
Total	10	10	16	41	27	23	37	45	8	0	0	226	97	564

Table 56. Number of fish taken at trawl stations during summer 1974.

Species	Station															
	2	4	5	7	8	10	11	12	14	15	16	17	18	23	24	25
American eel			1													1
Atlantic menhaden										2	5			1	2	4
Atlantic silverside	1	1														
Bay anchovy		107		20	15	49	94	6	19	24	3			38	76	340
Black sea bass	2		3		3	1		1								
Blueback herring										2	1					
Bluefish						1			5	1		1				2
Brown bullhead										2						
Crevalle jack							1			1						
Cunner			2													
Fourspine stickleback	251	3														
Gray snapper	1															
Hogchoker															13	
Lined seahorse			2													
Mummichog									1							
Northern pipefish	8	7	2	1	2			3						1		2
Northern puffer	1					1										
Oyster toadfish	7	10			20	2		1			5			3	6	11
Pinfish	2															
Silver perch	6														4	6
Spot						1	2			26				380	19	7
Spotted hake	1		1													
Striped burrfish	1				1		1									
Summer flounder	1			2			1		2	3	1			1	1	4
Tautog	2				5											
Tidewater silverside						1										
Weakfish	10	1			1	2	2				2			3	1	6
White perch										6						
Windowpane									1							
Winter flounder	6	4	13	13	8		3								2	1
Total	300	133	24	36	55	58	104	11	28	67	17	1	0	427	111	407

Table 57. Number of fish taken at trawl stations during fall 1974.

Species	Station														
	2	4	7	8	10	11	12	14	15	16	17	18	23	24	25
American eel				1										1	
Atlantic silverside			2	1	1								1		
Bay anchovy		2		18	22		10		12	18	13		18	2	80
Cunner							1								
Gray snapper	1														
Hogchoker									2	1		1			1
Northern pipefish		1	2			1		1							
Oyster toadfish				1						2			1		2
Silver perch					1										
Spot															4
Summer flounder			1		1	1					1		1		1
Weakfish													1		5
White perch									3			14			
Winter flounder									1	1			4	1	1
Total	1	3	5	21	25	2	11	1	18	22	14	15	26	4	94

Table 58. Number of fish taken at trawl stations during winter 1975.

Species	Station											
	2	8	10	11	12	15	16	17	18	23	24	25
Alewife												1
American eel							1					
Atlantic silverside		2									1	40
Bay anchovy												3
Blueback herring				45					1			1
Fourspine stickleback	2											
Spotted hake		1										
Tidewater silverside									6			
White perch						12						
Winter flounder	1	12		3	3		2					
Total	3	15	0	48	3	12	3	0	7	0	1	45

Table 59. Number of fish taken at trawl stations during spring 1975.

Species	Stations															
	2	4	5	7	8	10	11	12	14	15	16	17	18	23	24	25
Alewife													1	2	1	
American eel										2						
American sand lance			1										1			
American shad																
Atlantic menhaden																
Atlantic silverside						4	23							30		
Banded killifish										1						
Bay anchovy		1			500	150	250	4		16			1	254	330	253
Black sea bass																
Blueback herring							1			1			1	2	1	5
Bluefish																
Brown bullhead										2						
Fourspine stickleback	2												2			
Golden shiner																
Hogchoker										2						
Lined seahorse			6													
Naked goby										1	1					2
Northern pipefish			3	2	2	1	2	1	1							1
Oyster toadfish		1					1				3					1
Pollack			2							2						
Red hake			1													
Spot																
Spotted hake								2	1						1	4
Summer flounder				1												
Tautog		1														
Threespine stickleback			1													
White perch										4			1			
Windowpane									1							
Winter flounder	1	2	9	1	1	2	7	3			5	1	2		1	1
Total	3	5	23	4	507	157	284	10	3	31	10	1	9	288	334	267

Table 60. Description of trawl stations in the Manahawkin Bay - Little Egg Harbor system.

Station	Location	Bottom type	Sampling depth (ft)
2	Little Egg Harbor northwest of Marshelder Island	Sand and mud	2-7
4	Intracoastal Waterway-southeast of Sandy Island near Flashing Red Light "82".	Medium and fine sand	5-14
5	Double Creek Channel in Barnegat Bay near Barnegat Inlet	Fine sand, silt, and clay	5-8
6	Lower Barnegat Bay in Intracoastal Waterway near Flashing Red Light "68".	Very fine sand, silt, and clay	7-9
7	Manahawkin Bay-north of Route 72 off Main Point	Silt and clay	5-7
8	Manahawkin Bay-south of Route 72 off mouth of Mill Creek	Silt, clay, and fine sand	3-13
10	Little Egg Harbor off mouth of Cedar Run Creek	Silt, clay, and fine sand	4-9
11	Little Egg Harbor-off Dinner Point	Fine sand, silt, and clay	5-8
12	Little Egg Harbor-off Thompson Creek-near marker W Or "X"	Silt, clay, fine and very fine sand-covered with detritus	
13	Little Egg Harbor-cove north of mouth of Tuckerton Creek	Silt, clay, and very fine sand	4-6
14	Little Egg Harbor in Marshelder Channel near Flashing Light "7".	Primarily fine sand, some silt, clay, and very fine sand	5-17
15	Upper Mill Creek in Lagoon System E	Primarily silt and clay, some fine and medium sand	4-7
16	Lower Mill Creek-just below sewer plant	Primarily silt and clay, some medium and fine sand	8-15
17	Lagoon 100 off Mill Creek in Lagoon System E	Silt and clay, some very fine sand	7-16

Table 60. Continued.

Station	Location	Bottom type	Sampling depth (ft)
18	Lagoon 77 opposite above	Silt, clay, and very fine sand	6-12
23	Upper Dinner Point Creek	Silt, clay, fine and medium sand	4-6
24	Lower Dinner Point Creek	Silt, clay, fine and medium sand-shell fragments	3-5
25	Westecunk Creek	Silt, clay, fine and very fine sand	4-9
26	Thompson Creek-off Little Egg Harbor	Silt, clay, fine sand, and shell fragments	3-6
27	Gunning River off lower Barnegat Bay		4
28	Little Egg Harbor off Thompson Creek	Silt and clay	5

Table 61. Ten most abundant species taken trawling, the number taken, and percent of the trawl catch.

Species	Number taken	Percent of catch
Bay anchovy	4,730	49
Fourspine stickleback	1,180	12
Spot	1,074	11
Mummichog	331	3
Atlantic menhaden	316	3
Winter flounder	293	3
Tidewater silverside	262	3
Oyster toadfish	198	3
White perch	193	3
Atlantic silverside	188	2
Total	8,765	90

Table 62. Seasonal catch/haul of the 10 most abundant species collected by trawl.

Species	Season			
	Summer	Fall	Winter	Spring
Bay anchovy	13.0	2.0	<0.1	27.0
Fourspine stickleback	3.0	2.0	6.0	0.3
Spot	6.0	1.0	0.0	<0.1
Mummichog	<0.1	3.0	0.0	0.0
Atlantic menhaden	0.2	0.0	<0.1	3.0
Winter flounder	0.8	0.6	0.9	0.6
Tidewater silverside	<0.1	1.0	2.0	0.0
Oyster toadfish	0.9	0.3	0.0	0.2
White perch	0.2	0.7	1.0	0.1
Atlantic silverside	0.1	0.3	1.0	0.7

Table 63. Number of fish taken and water quality recorded at GT-2.

		7/31/74	8/30/74	9/19/74	10/30/74	12/20/74	Study total
Water quality data							
D.O. (mgO_2/l)	surface	8.91		9.30	9.00	10.64	
	bottom	8.91		9.40		10.64	
Salinity (o/oo)	surface	30.07	30.68	28.89	27.59	27.01	
	bottom	29.70	28.07	29.07		27.01	
pH	surface		7.70	7.35	8.30	7.70	
	bottom		7.72	7.60		7.85	
H_2O temp. (°C)	surface	28.0	27.0	24.0	15.5	4.0	
	bottom	28.0	27.5	24.0		4.0	
CO_2 ($mgCO_2/l$)	surface	0.00	10.76	0.00	0.00	0.00	
Depth (ft)		4.0	4.0	4.0	2.0	4.0	
Secchi (ft)		4.0	4.0	4.0	2.0	2.0	
Air temp. (°C)		28.0	30.0	28.0	20.0	4.5	

Species	7/31/74 LR	7/31/74 No.	8/30/74 LR	8/30/74 No.	9/19/74 LR	9/19/74 No.	10/30/74 LR	10/30/74 No.	12/20/74 LR	12/20/74 No.	Study total No.
Bluefish	18	1	15-21	13							14
Northern sea robin	18	1									1
Smooth dogfish	39-45	8	49	1							9
Spot	13-14	2			16	2					4
Striped burrfish	21	1									1
Summer flounder					23	1					1
Tautog					25	1					1
Total		13		14		4		0		0	31

Table 64. Number of fish taken and water quality recorded at GS-13.

		7/23/74	8/30/74	9/19/74	10/29/74	12/18/74
Water quality data						
Tide stage						
D.O.	surface	6.93		6.60	9.85	9.50
($mgO_2/1$)	bottom	7.03		7.35	10.30	9.55
Salinity	surface	27.99	22.61	26.74	24.05	28.01
(o/oo)	bottom	27.81		27.11	26.02	28.89
pH	surface	7.60	7.35	7.40	7.95	7.75
	bottom	6.80		7.50	8.19	7.70
H_2O temp.	surface	27.9	28.0	25.0		7.0
(^oC)	bottom	26.0		24.0		7.0
CO_2	surface	2.28	4.30	18.83	0.00	0.00
($mgCO_2/1$)						
Depth (ft)		4.0	3.0	5.0	3.0	5.0
Secchi (ft)		3.0	1.5	3.5	3.0	2.0
Air temp. (^oC)		26.0	30.0	27.0		

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic menhaden	26-28	7	27-36	3	27-33	7	30	1		
Bluefish			17-24	13	19-22	6				
Oyster toadfish	24	1	25	1						
Smooth dogfish			52-55	3	47-53	6				
Spot			15-19	18	16-18	9				
Summer flounder					21	1				
Weakfish			10-12	2	12	1				
White perch										
Total		8		40		30		1		0

Table 64. Continued.

		1/29/75-1/30/75		2/24/75-2/25/75		5/27/75-5/28/75		Study total
Water quality data								
Tide stage		In	Out	In	Out	In	Out	
D.O. (mgO_2/l)	surface	10.68	11.07	9.35	9.55	6.88	6.44	
	bottom	10.63		9.95	9.75	5.39		
Salinity (°/oo)	surface	26.18	22.97	22.12	26.31	22.34	23.06	
	bottom	26.55		21.42	25.32	28.88		
pH	surface	7.70	7.60	7.35	7.60	7.70	7.60	
	bottom	7.60		7.66	7.40	7.60		
H_2O temp. (°C)	surface	6.0	5.0	7.0	7.0	22.5	21.5	
	bottom	6.0		7.5	7.0	23.0		
CO_2 ($mgCO_2/l$)	surface	2.65	4.23	1.85	0.00	3.68	3.68	
Depth (ft)		5.0	3.0	4.5	5.5	3.0	3.0	
Secchi (ft)		2.0	1.5	2.0	0.6	3.0	3.0	
Air temp (°C)		10.0	5.0	12.0	7.0	30.5	25.5	

Species	LR	No.	LR	No.	LR	No.	No.
Atlantic menhaden							18
Bluefish					16-25	2	21
Oyster toadfish							2
Smooth dogfish							9
Spot							27
Summer flounder							1
Weakfish							3
White perch	37	1	26-30	6	24-35	4	11
Total		1		6		6	92

Table 65. Number of fish taken and water quality recorded at GT-8.

		8/29/74		9/18/74		10/7/74		Study total
Water quality data								
D.O. (mgO_2/l)	surface	6.49		6.90		8.73		
	bottom			6.60		9.68		
Salinity (o/oo)	surface	23.15		24.60		24.33		
	bottom			24.24		27.90		
pH	surface	7.75		7.45		7.65		
	bottom			7.50		7.70		
H_2O temp. (°C)	surface			22.5		16.0		
	bottom			22.0		15.0		
CO_2 ($mgCO_2/l$)	surface	1.61		0.00		0.00		
Depth (ft)		5.0		5.0		6.0		
Secchi (ft)		3.0		3.0		3.5		
Air temp. (°C)		30.0		28.5		19.5		
Species		LR	No.	LR	No.	LR	No.	No.
Atlantic menhaden		40	1	10-36	16			17
Black sea bass				19	1			1
Bluefish		14-23	10	16-29	19			29
Mummichog		9-10	3					3
Northern kingfish						15	1	1
Oyster toadfish				11	1			1
Permit		8	1					1
Silver perch				8	2			2
Spot		14-18	7	13-16	2	14-18	11	20
Summer flounder		19-21	2	20	1			3
Total			24		42		12	78

Table 66. Number of fish taken and water quality recorded at GT-17.

		7/11/74	8/28/74	9/17/74	10/2/74	11/18/74
Water quality data						
Tide stage						
D.O.	surface	9.95	9.94	8.55	9.18	9.84
(mgO_2/l)	bottom	0.00	7.79	0.00	0.45	2.25
Salinity	surface	22.00	6.71	12.43	13.66	12.38
(o/oo)	bottom	25.23	8.93	17.72	18.55	20.91
pH	surface	8.00	8.60	7.60	7.20	7.90
	bottom	6.50	8.10	6.90	7.05	7.55
H_2O temp.	surface	27.0	27.0	24.0	14.5	5.0
(°C)	bottom	22.0	27.0	21.0	17.5	12.0
CO_2	surface	1.83	0.00	0.00		4.00
($mgCO_2/l$)						
Depth (ft)		5.0	7.0	15.0	10.0	10.0
Secchi (ft)		2.0	3.0	3.0	4.0	5.0
Air temp (°C)		27.0	29.5	25.0	12.5	13.0

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Alewife										
Atlantic menhaden	27	1	27-13	2	3-4	45	12-15	30		
Atlantic silverside										
Blueback herring	13	1							15	1
Bluefish	13	1	16-17	2	26	1	31	1		
Golden shiner										
White perch										
Total		3		4		46		31		1

Table 66. Continued.

		1/6/75-1/7/75		2/19/75		3/26/75-3/27/75	
Water quality data							
Tide stage		In	Out			In	Out
D.O.	surface	13.49	12.46			9.80	9.85
(mgO_2/l)	bottom	7.98	1.67	12.21		0.29	9.90
Salinity	surface	10.37	9.63	4.54		6.62	10.63
(°/oo)	bottom	16.92	20.55	19.45		18.55	11.35
pH	surface	7.40	7.42	7.20		7.20	7.32
	bottom	7.00	6.94	6.85		6.90	7.30
H_2O temp.	surface	4.0	4.0	6.7		8.5	8.0
(°C)	bottom	6.0	7.0	7.0		8.5	8.0
CO_2	surface	0.81	1.61	2.12		1.95	2.50
($mgCO_2/l$)							
Depth (ft)		8.0	11.0	4.0		12.0	7.0
Secchi (ft)		4.0	3.0	3.0		3.0	3.0
Air temp (°C)		6.0	7.0	9.0		6.0	3.0
Species		LR	No.	LR	No.	LR	No.
Alewife						28-32	12
Atlantic menhaden							
Atlantic silverside							
Blueback herring							
Bluefish							
Golden shiner							
White perch		22-31	26			21-27	5
Total			26		0		17

Table 66. Continued.

		4/24/75-4/25/75		5/8/75-5/9/75		Study total
Water quality data						
Tide stage		In	Out	In	Out	
D.O. (mgO_2/l)	surface	10.29	10.24	8.61	8.75	
	bottom	0.69	0.49	7.89	0.00	
Salinity (°/oo)	surface	8.44	6.62	7.25	12.92	
	bottom	13.87	17.12	8.71	16.92	
pH	surface	7.21	7.05	6.80	7.20	
	bottom	7.10	7.10	7.15	6.90	
H_2O temp. (°C)	surface	13.5	14.0	18.0	18.0	
	bottom	12.0	10.5	16.0	12.5	
CO_2 ($mgCO_2/l$)	surface	4.39	1.39	2.89	1.58	
Depth (ft)		10.0	9.0	6.0	12.0	
Secchi (ft)		3.5	3.0	3.0	3.5	
Air temp. (°C)		18.0	17.0	22.0	22.0	
Species		LR	No.	LR	No.	No.
Alewife		27-29	3			15
Atlantic menhaden		22-35	2	24	1	81
Atlantic silverside		11-12	3			3
Blueback herring						2
Bluefish						5
Golden shiner		16	1			1
White perch		9	1	23	1	33
Total			10		2	140

Table 67. Number of fish taken and water quality recorded at GT-13.

		7/11/74	8/16/74	9/17/74	10/2/74	11/18/74
Water quality data						
Tide stage						
D.O. (mgO_2/l)	surface	11.08	10.33	2.50	4.92	9.89
	bottom	3.57	0.98	0.75	21.46	0.39
Salinity (o/oo)	surface	8.17	12.97	15.53	16.20	13.84
	bottom	12.94	15.90	16.08	17.29	20.01
pH	surface	8.10	8.13	6.95	7.10	8.00
	bottom	7.00	6.90	7.05	6.70	7.45
H_2O temp. (°C)	surface	27.0	24.9	24.0	18.0	14.0
	bottom	27.0	24.9	23.0	18.0	12.0
CO_2 ($mgCO_2/l$)	surface	0.00	10.76	8.61	4.84	3.50
Air temp. (°C)		29.0		25.0	13.0	12.0
Depth (ft)		7.0	6.0	13.0	11.0	
Secchi (ft)		2.0	3.5	3.0	4.0	

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Alewife										
Atlantic menhaden	17-28	6	14-29	29	17-29	7	17	1		
Atlantic silverside										
Blueback herring	11	1								
Bluefish	10	2	17-21	4						
Spot	12-14	6								
White perch										
Total		15		33		7		1		0

Table 67. Continued.

		12/6/74	1/6/75-1/7/75		2/19/75	3/26/75-3/27/75	
Water quality data							
Tide stage			In	Out		In	Out
D.O.	surface	12.43	13.20	14.53	11.51	8.82	10.29
(mgO_2/l)	bottom	7.20	2.86	0.30	0.10	7.94	5.00
Salinity	surface	10.73	7.25	15.48	5.54	11.35	9.90
(°/oo)	bottom	20.91	18.37	20.01	16.40	22.85	15.32
pH	surface	7.00	6.82	7.30	6.90	7.20	7.30
	bottom	7.10	6.75	6.84	6.90	7.20	7.30
H_2O temp.	surface	2.0	4.0	5.0	7.50	7.30	7.08
(°C)	bottom	6.0	7.0	6.5	6.5	10.0	6.0
CO_2	surface	4.57	1.35	0.00	2.38	9.00	7.00
($mgCO_2/l$)							
Depth (ft)		9.0	6.0	8.5	11.0	10.0	10.0
Secchi (ft)		8.0	11.0	8.0	4.0	3.5	3.0
Air temp (°C)		3.0	2.5	3.0	9.0	11.0	3.5

Species	LR	No.	LR	No.	LR	No.	LR	No.
Alewife							27-33	3
Atlantic menhaden	13-16	15					9-33	7
Atlantic silverside								
Blueback herring								
Bluefish								
Spot								
White perch	30	1	23-25	4			27-33	5
Total		16		4		0		15

Table 67. Continued.

		4/24/75-4/25/75		5/9/75-5/10/75		Study total
Water quality data						
Tide stage		In	Out	In	Out	
D.O. (mgO_2/l)	surface	6.76	9.85	8.80	9.24	
	bottom	7.84	7.25	6.78	8.95	
Salinity (°/oo)	surface	7.72		3.55	7.43	
	bottom	14.24	14.42	8.53	8.17	
pH	surface	7.18	7.80	6.65	7.00	
	bottom	7.18	7.80	6.65	7.00	
H_2O temp. (°C)	surface	6.69	7.60	7.15	7.10	
	bottom		14.0	17.0	18.0	
CO_2 ($mgCO_2/l$)	surface	11.00	12.00	16.00	11.50	
Depth (ft)		8.0	10.1			
Secchi (ft)		3.5	3.0			
Air temp (°C)		19.0	20.0	20.0	22.0	
Species		LR	No.	LR	No.	No.
Alewife		20-33	6	31	1	10
Atlantic menhaden				23-31	4	69
Atlantic silverside		12	4			4
Blueback herring				18	1	2
Bluefish						6
Spot						6
White perch				24-29	10	20
Total			10		16	117

Table 68. Number of fish taken and water quality recorded at GS-19.

		8/28/74		9/18/74		10/7/74		11/11/74		12/13/74	
Water quality data											
Tide stage											
D.O. (mgO_2/l)	surface	5.90		6.80		7.87		7.80		11.13	
	bottom			6.55		7.42		7.30		6.50	
Salinity (o/oo)	surface	22.43		22.61		23.78		23.60		24.51	
	bottom	25.14		22.97		23.78		24.69		26.65	
pH	surface	7.55				7.10		7.70		7.75	
	bottom	7.00				7.30		7.95		7.50	
H_2O temp. (°C)	surface	24.5		26.0		17.0		13.5		3.0	
	bottom	27.0		23.0		15.0		13.0		5.5	
CO_2 ($mgCO_2/l$)	surface	4.30		1.61		5.38		4.40		5.11	
Air temp. (°C)		30.0		26.0		23.0		21.0		9.0	
Depth (ft)		5.0		9.0		6.0					
Secchi (ft)		3.0		3.0		4.0					
Species		LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic menhaden		12-14	10	13	1						
Spot		16	1								
Total			11		1		0		0		0

Table 68. Continued.

		2/20/75-2/21/75		5/20/75-5/21/75		Study total
Water quality data						
Tide stage		In	Out	In	Out	
D.O. (mgO_2/l)	surface	11.50	11.70	7.70	7.70	
	bottom	8.90	0.00	1.35	0.19	
Salinity (°/oo)	surface	19.99	19.99	18.73	18.37	
	bottom	20.35	24.98	21.09	21.26	
pH	surface	6.70	7.60	7.35	7.60	
	bottom	7.60	6.80	7.00	7.10	
H_2O temp. (°C)	surface	5.0	4.0	22.0	21.0	
	bottom	4.0	6.0	24.0	18.0	
CO_2 (mg CO_2/l)	surface	3.97	3.70	3.68	5.00	
Air temp. (°C)		10.0	9.0	24.0	24.0	
Depth (ft)		6.5	8.0	10.0	8.0	
Secchi (ft)		3.0	4.5	4.0	3.0	
Species		LR	No.	LR	No.	No.
Atlantic menhaden		9	1			12
Spot						1
Total			1		0	13

Table 69. Number of fish taken and water quality recorded at GS-20.

		7/29/74	8/29/74	9/26/74	10/23/74	11/11/74
Water quality data						
Tide stage						
D.O. (mgO_2/l)	surface	6.78	7.28	7.72	8.90	8.95
	bottom	8.76		5.11	9.25	7.55
Salinity (°/oo)	surface	24.98	21.71	23.42	24.60	25.95
	bottom	25.32		23.60	24.24	25.95
pH	surface	7.85	7.90	7.60	8.15	8.10
	bottom	7.45		7.25	8.15	8.10
H_2O temp. (°C)	surface	27.0	27.5	19.0	10.0	13.5
	bottom	28.0		19.0	10.0	12.5
CO_2 ($mgCO_2/l$)	surface	0.00	0.00	2.15	2.96	
Depth (ft)		4.0	14.0	9.0		
Secchi (ft)		2.5	3.0	2.5		
Air temp (°C)		30.0	30.0	20.0	20.0	22.5

Species	LR	No.	LR	No.	LR	No.	LR	No.	LR	No.
Atlantic menhaden	11-12	4	12-13	9	3-4	85	12-13	2	8-16	9
Blueback herring										
Bluefish	15	1	16-21	2						
Mummichog										
Total		5		11		85		2		9

Table 69. Continued.

		12/13/74		1/23/75-1/25/75		2/20/75-2/21/75	
Water quality data							
Tide stage				In	Out	In	Out
D.O.	surface	11.43		11.44	11.27	11.90	12.81
(mgO_2/l)	bottom	9.75		0.00	0.00	9.00	5.20
Salinity	surface	25.77		0.82	20.46	20.72	20.70
(°/oo)	bottom	22.54		24.94	25.12	20.72	21.76
pH	surface	7.90		7.40	7.20	7.15	7.80
	bottom	7.70		7.10	6.70	7.80	7.45
H_2O temp.	surface	5.0		3.0	4.0	3.5	5.0
(°C)	bottom	6.5		7.0	7.0	5.0	4.0
CO_2	surface	3.50		0.00	3.61	3.70	2.65
($mgCO_2/l$)							
Depth (ft)				12.0		7.0	7.0
Secchi (ft)				4.0		4.0	4.5
Air temp (°C)		10.0		6.0	7.0	9.0	9.0
Species		LR	No.	LR	No.	LR	No.
Atlantic menhaden							
Blueback herring							
Bluefish							
Mummichog						9	1
Total			0		0		1

Table 69. Continued.

		4/24/75-4/25/75		5/20/75-5/21/75		Study total
Water quality data						
Tide stage		In	Out	In	Out	
D.O. (mgO_2/l)	surface	9.21	8.95	8.08	6.83	
	bottom	8.92	5.95	2.40	6.44	
Salinity (°/oo)	surface	21.94	22.48	18.55	18.73	
	bottom		22.30	23.06	19.29	
pH	surface	9.95	7.80	7.70	8.00	
	bottom	7.95	7.50	7.15	8.0	
H_2O temp. (°C)	surface	4.0	15.5	23.5	23.0	
	bottom	13.0	12.0	18.0	22.0	
CO_2 ($mgCO_2/l$)	surface	3.89	1.67	0.00	0.00	
Depth (ft)		6.5	8.0	10.0	9.0	
Secchi (ft)		3.5	4.0	5.0	2.0	
Air temp. (°C)		16.0	18.0	27.0	27.0	
Species		LR	No.	LR	No.	No.
Atlantic menhaden				25	3	112
Blueback herring				10	1	1
Bluefish						3
Mummichog						1
Total			0		4	117

Table 70. Number of fish taken and water quality recorded at GS-4.

		7/31/74		9/20/74		Study total
Water quality data						
D.O. (mgO_2/l)	surface	8.66		7.60		
	bottom	8.56		7.75		
Salinity (°/oo)	surface	25.50		24.33		
	bottom	29.88		23.42		
pH	surface			7.85		
	bottom			7.80		
H_2O temp. (°C)	surface	28.0		23.5		
	bottom	28.0		24.0		
CO_2 ($mgCO_2/l$)	surface	0.00		0.00		
Depth (ft)		4.0				
Secchi (ft)		2.0				
Air temp. (°C)		28.0		25.0		
Species		**LR**	**No.**	**LR**	**No.**	**No.**
Bluefish		12	1	18	1	2
Silver perch				10-11	2	2
Spot		12-16	4	16	1	5
Tautog				23	1	1
Total			5		5	10

Table 71. Number of fish taken at gill net stations during summer 1974.

Species	Station								
	GT-2	GS-4	GT-8	GT-12	GS-13	GT-17	GT-18	GS-19	GS-20
Atlantic menhaden			17	45	17	3	42	11	98
Black sea bass			1						
Blueback herring						1	1		
Bluefish	14	2	29	1	19	3	6		3
Mummichog			3						
Northern sea robin	1								
Oyster toadfish			1		2				
Permit					1				
Silver perch		2	2						
Smooth dogfish	9				9				
Spot	4	5	9		27		6	1	
Striped burrfish	1								
Summer flounder	1		3		1				
Tautog	1	1							
Weakfish					3				
Total	31	10	65	46	79	7	55	12	101

Table 72. Number of fish taken at gill net stations during fall 1974.

Species	Station						
	GT-2	GT-8	GS-13	GT-17	GT-18	GS-19	GS-20
Atlantic menhaden			1	30	16		11
Blueback herring				1	1		
Bluefish				1			
Northern kingfish		1					
Spot		11					
Total	0	12	1	32	17	0	11

Table 73. Number of fish taken at gill net stations during winter 1975.

Species	Station				
	GS-13	GT-17	GT-18	GT-19	GS-20
Alewife		12	3		
Atlantic menhaden			7	1	
Mummichog					1
White perch	7	31	9		
Total	7	43	19	1	1

Table 74. Number of fish taken at gill net stations during spring 1975.

Species	Station				
	GS-13	GT-17	GT-18	GT-19	GS-20
Alewife				1	
Atlantic menhaden		3	4		3
Atlantic silverside					
Blueback herring			1		1
Golden shiner					
Oyster toadfish	2				
White perch	4	2	10		
Total	6	5	15	1	4

Table 75. Results of three gill net sets made during first segment of study.

		GS-13 July 1973		GS-20 October 1973		GT-18 January 1974	
Water quality data							
D.O. (mgO_2/l)	surface	6.95		7.23		10.70	
	bottom	7.15		0.65			
Salinity (o/oo)	surface	25.30		25.20		3.57	
	bottom	25.05		24.85			
pH	surface					7.20	
	bottom						
H_2O temp. (oC)	surface	27.0		14.2		5.2	
	bottom	27.0					
CO_2 ($mgCO_2/l$)	surface					2.45	
Air temp. (oC)							
Depth (ft)							
Secchi (ft)							
Species		**LR**	**No.**	**LR**	**No.**	**LR**	**No.**
Alewife						29-34	2
Atlantic menhaden				16	1		
Spot			1	12-13	2		
Striped bass						48	1
White perch						22-36	9

Table 76. Number of each species by gear type, overall rank, and percent of total catch.

Species	Number				Rank	Percent of catch
	Seine	Trawl	Gill net	Total		
Alewife	4	6	27	37	30	*
American eel	29	22		51	27	*
American sand lance	77	3		80	24	*
American shad		2		2	56	*
Atlantic croaker		3		3	54	*
Atlantic menhaden	172	316	310	798	7	2
Atlantic needlefish	103			103	23	*
Atlantic silverside	9,135	188	7	9,330	2	26
Banded killifish	544	1		545	8	2
Bay anchovy	5,004	4,730		9,734	1	27
Black sea bass		22	1	23	32	*
Blueback herring	120	85	5	210	15	*
Bluefish	58	17	78	153	17	*
Blue runner		1		1	62	*
Bluespotted cornetfish		1		1	62	*
Brown bullhead		9		9	40	*
Bluefish	1	1		2	56	*
Crevalle jack	65	5		70	26	*
Cunner		4		4	50	*
Fourspine stickleback	4,044	1,180		5,224	3	14
Golden shiner		3	1	4	50	*
Gray snapper	7	2		9	40	*
Hogchoker	19	87		106	22	*
Inshore lizardfish	2			2	56	*
Lined seahorse		10		10	38	*
Lookdown		4		4	50	*
Mojarra sp.	7			7	43	*
Mummichog	2,264	331	4	2,599	4	7
Naked goby	148	72		220	14	*
Northern kingfish	3	2	1	6	44	*
Northern pipefish	166	137		303	11	1
Northern puffer	2	4		6	44	*
Northern sea robin	4	5	1	10	38	*
Northern sennet	73			73	25	*
Oyster toadfish	61	198	5	264	13	1
Permit	2		1	3	54	*
Pinfish	14	3		17	36	*
Planehead filefish	16	4		20	33	*
Pollock		2		2	56	*
Pumpkinseed		2		2	56	*

Table 76. Continued.

Species	Number				Rank	Percent of catch
	Seine	Trawl	Gill net	Total		
Rainwater killifish	136			136	20	*
Red hake		4		4	50	*
Redfin pickerel		1		1	62	*
Scup		5		5	49	*
Sheepshead minnow	154	1		155	16	*
Silver perch	324	164	4	492	9	1
Smallmouth flounder	1	5		6	44	*
Smooth dogfish			18	18	35	*
Spot	530	1,074	66	1,670	6	5
Spotted hake	1	29		30	31	*
Striped anchovy	2	4		6	44	*
Striped bass			1	1	62	*
Striped burrfish	7	4	1	12	37	*
Striped killifish	153			153	17	*
Striped mullet	6			6	44	*
Striped sea robin	1	1		2	56	*
Summer flounder	5	35	5	45	29	*
Tautog	17	27	2	46	28	*
Threespine stickleback	17	2		19	34	*
Tidewater silverside	1,953	262		2,215	5	6
Weakfish	3	133	3	139	19	*
White mullet	130			130	21	*
White perch	27	193	73	293	12	1
Windowpane		8		8	42	*
Winter flounder	49	293		342	10	1
Herring sp.	1					*
Notropus sp.	1					*
Total	25,662	9,707	614	35,983		
Total %	71	27	2	100		

* Less than 1%

Table 77. Species distribution at seine stations in the Manahawkin Bay - Little Egg Harbor system.

Species	Stations																	
	1	2	3	4	5	6	7	8	9	10	12	13	15	16	17	18	19	20
Alewife															x			
American eel		x		x		x	x							x			x	
American sand lance				x	x	x												
Atlantic menhaden						x	x		x				x	x	x		x	
Atlantic needlefish		x	x	x	x	x	x					x			x	x	x	x
Atlantic silverside	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Banded killifish									x	x	x		x	x	x	x	x	x
Bay anchovy		x		x		x	x		x	x		x	x	x	x	x	x	x
Blueback herring									x	x				x	x		x	
Bluefish		x		x		x	x		x	x		x	x	x		x	x	
Butterfish		x																
Crevalle jack							x		x			x		x				
Fourspine stickleback		x	x	x	x	x	x		x	x		x	x	x	x	x	x	x
Gray snapper		x					x											
Hogchoker							x						x	x	x			
Inshore lizardfish				x		x												
Mojarra sp.		x																
Mummichog		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Naked goby		x		x		x	x		x		x	x	x		x	x	x	x
Northern kingfish					x					x								
Northern pipefish		x	x	x	x	x			x	x						x		x
Northern puffer	x	x																
Northern sea robin		x														x		
Northern sennet		x				x						x						
Oyster toadfish		x		x		x	x					x				x		

Table 77. Continued.

Species	Stations																	
	1	2	3	4	5	6	7	8	9	10	12	13	15	16	17	18	19	20
Permit												x						
Pinfish		x				x												
Planehead filefish		x																
Rainwater killifish	x	x		x		x	x	x	x		x		x		x	x	x	x
Sheepshead minnow		x					x	x	x				x	x	x	x	x	x
Silver perch		x		x		x	x					x						
Smallmouth flounder										x								
Spot		x	x	x	x	x	x		x			x	x	x	x	x	x	
Spotted hake		x																
Striped anchovy						x												
Striped burrfish		x		x														
Striped killifish	x	x		x	x	x	x		x	x						x	x	
Striped mullet						x			x								x	
Striped sea robin										x								
Summer flounder		x		x											x	x		
Tautog		x		x		x						x						
Threespine stickleback		x		x					x	x		x						
Tidewater silverside		x					x	x	x	x	x	x	x	x	x	x	x	x
Weakfish		x				x				x								
White mullet						x	x		x			x					x	x
White perch				x									x	x	x			
Winter flounder		x		x	x	x			x	x				x		x	x	

Table 78. Species distribution at trawl stations in the Manahawkin Bay - Little Egg Harbor system.

Species	Stations																				
	2	4	5	6	7	8	10	11	12	13	14	15	16	17	18	23	24	25	26	27	28
Alewife															x	x	x	x			
American eel			x	x		x				x		x	x		x	x	x	x		x	
American sand lance		x	x																		
American shad						x									x						
Atlantic croaker								x									x				
Atlantic menhaden					x							x	x			x	x	x			
Atlantic silverside	x	x	x		x	x	x	x		x		x				x	x	x	x		
Banded killifish												x									
Bay anchovy		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Black sea bass	x		x			x	x	x	x	x									x		
Blueback herring								x				x	x		x	x	x	x			
Bluefish							x				x	x		x			x	x	x	x	
Blue runner				x																	
Bluespotted cornetfish			x																		
Brown bullhead												x									
Butterfish			x																		
Crevalle jack								x				x				x	x				
Cunner			x						x												
Fourspine stickleback	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		
Golden shiner												x									
Gray snapper	x																				
Hogchoker				x								x	x	x	x	x	x	x			
Lined seahorse			x				x		x												
Lookdown								x	x										x		
Mummichog											x	x									

Table 78. Continued.

Species	Stations																				
	2	4	5	6	7	8	10	11	12	13	14	15	16	17	18	23	24	25	26	27	28
Naked goby		x				x	x	x		x		x	x			x	x		x		
Northern kingfish						x	x														
Northern pipefish	x	x	x	x	x	x	x	x	x	x	x					x	x	x	x		
Northern puffer	x					x	x	x													
Northern sea robin	x								x								x				
Oyster toadfish	x	x		x	x	x	x	x	x	x			x			x	x	x	x	x	
Pinfish	x							x													
Planehead filefish	x		x																		
Pollock			x																		
Pumpkinseed												x									
Red hake	x		x						x									x			
Redfin pickerel												x									
Scup			x	x				x	x												
Sheepshead minnow								x													
Silver perch	x			x		x	x	x	x	x	x					x	x	x			x
Smallmouth flounder	x		x								x										
Spot	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Spotted hake	x		x			x	x		x		x						x	x			
Striped anchovy								x	x	x	x										
Striped burrfish	x					x		x													
Striped sea robin																	x				
Summer flounder	x				x		x	x	x		x	x	x	x		x	x	x			x
Tautog	x	x	x	x		x			x	x	x							x	x		
Threespine stickleback			x					x													
Tidewater silverside							x					x		x	x				x		
Weakfish	x	x		x		x	x	x	x	x	x	x	x		x	x	x	x	x		x
White perch						x	x					x	x	x	x						
Windowpane			x					x		x											
Winter flounder	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x

Table 79. Distribution of fish species caught by seine (S) or trawl (T) between the Barnegat and Beach Haven inlets.

Station location	Alewife	Blueback herring	Atlantic menhaden	Bluefish	Summer flounder	Tautog	Weakfish	White perch	Black sea bass	Winter flounder
Northern part of the zone:										
Clam Island (S-5/T-5)						x			x	x
Midbay (T-6)						x	x			x
Sandy Island (S-4/T-4)				x	x	x	x	x		x
Gunning River (T-27)				x						x
Center part of the zone:										
Main Point (T-7)			x		x					x
Flat Island (S-3)										
Lagoon System A (S-20)		x	x	x						
Lagoon System B (S-10)		x		x			x			x
(S-9)		x	x	x						x
Lagoon System D (S-19)										
Mill Creek (T-8)						x	x		x	x
(S-18)										
(T-16)										
(S-17)										
(T-18)										
(T-17)										
(S-15)										
(S-16/T-15)	x	x	x	x	x		x	x		x

Table 79. Continued.

Station location	Alewife	Blueback herring	Atlantic menhaden	Bluefish	Summer flounder	Tautog	Weakfish	White perch	Black sea bass	Winter flounder
Central part of the zone:										
Popular Point (T-8)						x	x		x	x
Cedar Run (T-10)				x	x		x	x	x	x
Dinner Point Creek (T-11)		x			x		x		x	x
(S-8/S-13)						x	x	x		
(T-24)				x			x			x
(T-23)	x	x	x		x		x			
Southern part of the zone:										
Westecunk Creek (T-25)	x	x	x	x	x	x	x			x
Marshelder Islands (S-2/T-2)				x	x	x	x		x	x
Thompson Creek (T-28)					x		x			x
(T-26)						x	x		x	
(S-7)			x	x						
Midbay (T-12)					x	x	x		x	x
Tuckerton Creek (T-13)						x	x		x	x
Big Thorofare (S-6)			x	x		x	x			x
Marshelder Channel (T-14)				x	x	x	x			x
Beach Haven Inlet (T-1/S-1)										

Table 80. Seasonal occurrence of finfish in the Manahawkin Bay - Little Egg Harbor system.

Species	Season			
	Winter	Spring	Summer	Fall
Alewife	x	x	x	
American eel	x	x	x	x
American sand lance	x	x		x
American shad		x		x
Atlantic croaker			x	
Atlantic menhaden	x	x	x	x
Atlantic needlefish		x	x	x
Atlantic silverside	x	x	x	x
Banded killifish	x	x	x	x
Bay anchovy				
Black sea bass		x	x	x
Blueback herring	x	x	x	x
Bluefish		x	x	x
Blue runner				x
Bluespotted cornetfish			x	
Brown bullhead		x	x	
Butterfish			x	
Crevalle jack			x	
Cunner			x	
Fourspine stickleback	x	x	x	x
Golden shiner		x	x	
Gray snapper		x	x	x
Hogchoker		x	x	x
Inshore lizardfish			x	
Lined seahorse		x	x	
Lookdown			x	x
Mojarra sp.			x	
Mummichog	x	x	x	x
Naked goby		x	x	x
Northern kingfish			x	x
Northern pipefish	x	x	x	x
Northern puffer			x	
Northern sea robin		x	x	x
Northern sennet			x	x
Oyster toadfish		x	x	x
Permit			x	
Pinfish			x	
Planehead filefish			x	x
Pollock		x		
Pumpkinseed		x		

Table 80. Continued.

Species	Season			
	Winter	Spring	Summer	Fall
Rainwater killifish	x	x	x	x
Red hake		x		
Redfin pickerel			x	
Scup			x	x
Sheepshead minnow	x	x	x	x
Silver perch			x	x
Smallmouth flounder				x
Smooth dogfish			x	
Spot		x	x	x
Spotted hake	x	x	x	
Striped anchovy			x	x
Striped bass	x			
Striped burrfish			x	
Striped killifish	x	x	x	x
Striped mullet	x	x		x
Striped sea robin		x	x	
Summer flounder		x	x	x
Tautog		x	x	x
Threespine stickleback	x	x		
Tidewater silverside	x	x	x	x
Weakfish			x	x
White mullet		x	x	x
White perch	x	x	x	x
Windowpane		x	x	x
Winter flounder	x	x	x	x

Table 81. Length frequency of 497 spot taken in the Manahawkin Bay - Little Egg Harbor system in 1973.

Length (cm)	July	August	September	October	Cumulative total
1					
2					
3	3				3
4	5				8
5	15				23
6	15	2			40
7	18	3			61
8	12	10			83
9	13	8	4		108
10	10	35	22	3	178
11	4	36	27	20	265
12		22	35	31	353
13		10	21	40	424
14		3	15	16	458
15			11	7	476
16			6	5	487
17			3	5	495
18			1	1	497
Total	95	129	145	128	497

Table 82. Length frequency of 123 spot taken in the Manahawkin Bay - Little Egg Harbor system in 1974.

Length (cm)	June	July	August	September	October	Cumulative total
1						0
2						0
3						0
4	3	1				4
5	5					9
6	7	3				19
7	2	6				27
8		8				35
9		8				43
10		21				64
11		13	1			78
12		5	5			88
13		3	3			94
14			14		3	111
15			6			117
16		2	1	2		122
17					1	123
Total	17	70	30	2	4	123

Table 83. Length frequency of 548 Atlantic menhaden taken in the Manahawkin Bay - Little Egg Harbor system, June 1974 through May 1975.

Length (cm)	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Feb	Mar	Apr	May	Cumulative total
3							7					7
4	4	1	2				5					19
5	61	2	1									83
6	42	3	3									131
7	1	3										135
8	4	3				1						143
9								1	2			146
10		103		1					3			253
11	3	66			3						1	326
12	2		6	3	5	1					1	344
13		1	12	14	3	4						378
14			19	6	5	2						410
15		20	11		1						1	443
16				1		1			1			446
17	1	1			1						1	450
18	1	1										452
19												
20												
21												
22										1		453
23											1	454
24											1	455
25				1							3	459
26	5	4									1	469
27	3	3	2	5								482
28	3	3		6							1	495
29			1	2								498
30				4	1							503
31			1								1	505
32				1								506
33				1					1			508
34												
35										35		543
36			1	3								547
37												
38												
39												
40			1									548
41												
42												
Total	130	214	60	48	19	9	12	1	7	36	12	548

Table 84. Length frequency of 204 silver perch taken in the Manahawkin Bay - Little Egg Harbor system.

Length (cm)	July	August	September	October	November	Cumulative total
2				1		1
3			10	5		16
4	2	3	21	5		47
5		14	15	8	1	85
6		4	8	22		119
7		1	5	8	1	134
8			8	1	1	144
9			32			176
10			14			190
11			5	3		198
12			1	4		203
13				1		204
Total	2	22	119	58	3	204

Table 85. Length frequency of 88 silver perch taken in the Manahawkin Bay - Little Egg Harbor system in 1974.

Length (cm)	August	September	Cumulative total
3	2		2
4	10		12
5	10	15	37
6	1	25	63
7	3	11	77
8		2	79
9		1	80
10		1	81
11		2	83
12		5	88
Total	26	62	88

Table 86. Length frequency of 171 winter flounder taken in the Manahawkin Bay - Little Egg Harbor system from August 1973 through February 1974.

Length (cm)	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Cumulative total
6	1		1					2
7	2	1	2					7
8		1						8
9			2					10
10		1	3					14
11	3			1		2		17
12					1			18
13				2	1		2	23
14	1							24
15	3		1		1			29
16	8							37
17	7		1					45
18	7		4					56
19	4	3	4	1				68
20	8	2	4					82
21	4		2	4				92
22	2	2	5	2		1	1	105
23			1		1		3	110
24	2	1		3	1			117
25	2			4	1		1	125
26	1		2		1	3	3	135
27	3			3	1	3		145
28	1			3	1	3	1	154
29	3		1		1	4		163
30						1	1	165
31				1		2		168
32						1	2	171
Total	59	11	33	24	10	20	14	171

Table 87. Length frequency of 169 winter flounder taken in the Manahawkin Bay - Little Egg Harbor system from June 1974 through May 1975.

Length (cm)	Jun	Jul	Aug	Oct	Mar	Apr	May	Cumulative total
1								
2							2	2
3								
4								
5	1							3
6	3	3						9
7	10	15	4					38
8	2	21	9					70
9	1	5	5	1				82
10		1	1	3				87
11				1	2			90
12				3				93
13				1	2	1		97
14							1	98
15					2	3		103
16	1				1	3	2	110
17		1	1		1	1	5	119
18		2				1	1	123
19	1					1	1	126
20	1	2	2			2		133
21		2			2		1	138
22		1			2			141
23			1			1		143
24					2			145
25						1		146
26			1		1	1		149
27					4	2		155
28					1			156
29					3			159
30					1	2		162
31					1	1		164
32						2		166
33					2			168
34								
35								
36								
37						1		169
38								
39								
40								
Total	20	53	24	9	27	23	13	169

Table 88. Length frequency of 128 bluefish taken in the Manahawkin Bay - Little Egg Harbor system in 1974.

Length (cm)	June	July	August	September	October	Cumulative total
1						
2						
3						
4						
5						
6	3					3
7	1	1				5
8	2					7
9	4	1				12
10	1	2				15
11	1	5				21
12		4	1			26
13		2	3			31
14			9			40
15		2	8			50
16			13	1		64
17			12	1		77
18		1	3	2		83
19			3	9	1	95
20			3	4		102
21			6	4		112
22			2	3		117
23			3	1		121
24			2	1		124
25						
26			1	1		126
27						
28						
29				1		127
30						
31					1	128
Total	12	18	69	28	1	128

Table 89. Length frequency of 99 weakfish taken in the Manahawkin Bay - Little Egg Harbor system, 1973.

Length (cm)	August	September	October	Cumulative total
1				
2				
3	6			6
4	11		1	18
5	8			26
6	5		1	32
7	10			42
8	13	1	1	57
9	5		1	63
10	2		3	68
11	1	4	2	75
12	1	4		80
13		6	2	88
14		3	4	95
15			1	96
16			1	97
17			2	99
Total	62	18	19	99

Table 90. Length frequency of 38 weakfish taken in the Manahawkin Bay-Little Egg Harbor system, 1974.

Length (cm)	August	September	October	Cumulative total
3	2			2
4	3			5
5	2			7
6	3			10
7	2			12
8	7			19
9	6			25
10	5			30
11				
12	1	1	2	34
13			1	35
14				
15			2	37
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32	1			38
Total	32	1	5	38

Table 91. Maximum observed current velocities for selected locations in the vicinity of Beach Haven Inlet after Charlesworth (1968).

Location	Depth	Ebb velocity (ft/sec)	Flood velocity (ft/sec)
Beach Haven Inlet	Surface	3.5	4.0
	Mid depth	3.0	4.0
	Bottom	2.5	3.0
Entrance to Little Egg Harbor	Surface	3.5	5.5
	Mid depth	8.0	6.0
	Bottom	5.5	3.5

Table 92. Sewerage treatment facilities according to townships and lagoon systems within the Manahawkin Bay - Little Egg Harbor system*.

Treatment plant no.	Location	Operator	Year built	Design capacity (MGD)	Average flow (MGD)	Type of treatment	Receiving waters
	Union Township	Building and Land Technology, Inc.	1973	0.500		Tertiary	Ground
1	Stafford Township	Stafford Municipal Utilities Authority	1960	0.314	0.30 S# 0.17 W#	Secondary	Mill Creek to Manahawkin Bay
2	Tuckerton	Tuckerton Municipal Utilities Authority	1965	0.500	0.20 S 0.17 W	Secondary	Tuckerton Creek to Little Egg Harbor
3	Little Egg Harbor Township	Mystic Islands Sewerage Co.	1960	0.308	0.28 S 0.17 W	Secondary	Rose Creek to Great Bay
	Surf City	Municipal	1960	0.722		Primary	Atlantic Ocean
4	Ship Bottom	Ship Bottom Sewerage Authority	1957	1.200	0.32 S 0.18 W	Primary	Atlantic Ocean
5	Long Beach Township	Long Beach Township Municipal Sewerage Authority	1948	2.000	1.00 S 0.70 W	Primary	Atlantic Ocean
6	Beach Haven	Beach Haven Sewerage Authority		0.600	0.84 S 0.50 W	Primary	Atlantic Ocean

* Data taken from Nieswand, Stillman, and Esser (1973)

S = Summer and W = Winter

Table 93. Lagoon systems located in the Manahawkin Bay - Little Egg Harbor system*.

Municipality	Development name	Type of sewage disposal system	Connection date	Treatment plant number	Area (acres)	Number of houses
Union	Seaman Shores	Septic tank			62.9	18
Stafford	Beach Haven West	Sewers	1966	1	1,038.3	3,000#
Little Egg Harbor	Deerfield Park	Septic tank			32.6	8
Tuckerton	Tuckerton Shores	Sewers	1971	2	48.2	54
Tuckerton	Holly Lake Park	Sewers	1965	2	58.3	108
Tuckerton	Tuckerton Beach	Sewers	1965	2	204.1	547
Little Egg Harbor	Atlantic	Sewers	1970	3	62.9	50
Long Beach	High Bar Harbor	Septic tank			80.3	189
Long Beach	Holly Lagoons	Septic tank			64.7	84
Long Beach	Lighthouse Park					
Long Beach	Long Beach Club Estates					
Long Beach	Loveladies Harbor Estates	Septic tank			233.9	281
Harvey Cedars	High Point	Septic tank			41.1	38
Long Beach	North Beach Harbor	Septic tank			13.8	15
Ship Bottom	Ship Bottom 1	Sewers	1957	4	8.0	0
Ship Bottom	Ship Bottom 2	Sewers	1957	4	13.1	25
Long Beach	The Dunes	Sewers	1948	5	47.3	84
Beach Haven	Webster Lagoons	Sewers	1965	6	52.1	53

* Nieswand, Stillman and Esser (1973) is the primary source of data.

Fellows, Reads, and Weber (1973) is the source of this data.

Table 94. Water analysis data collected at the Beach Haven Inlet station, Buoy "F" (MB-1).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	515	High	21.0	19.5	17.7			7.80	7.80
7/31/73	1725	Low +2.5	24.0	23.0	22.5	29.8	30.0	8.10	8.20
8/16/73	905	High	24.0	22.5	22.5	29.4	29.6	8.10	8.20
9/26/73	930	High +2.5	23.0	19.0	19.2	30.1	29.8	8.00	8.00
9/27/73	1405	Low	24.0	20.3	20.0	29.5	29.3	8.05	8.05
10/31/73	545	Low +1.5	7.5	12.0	12.0	28.5	28.6	7.65	
11/13/73	1100	High +1.5	1.0	9.5	9.8	30.5	30.4	7.82	7.83
11/20/73	1100	Low +1.0	7.5	9.0	8.8	30.8	30.8	8.00	8.00
6/20/74	716	High	22.0	18.0	17.8	30.6	30.0	7.95	
6/29/74	1113	Low	25.0	21.5	21.0	29.9	30.2	7.80	7.80
7/10/74	1140	High	31.0	20.0	19.3	31.0	31.0	7.80	7.80
7/25/74	615	Low	19.0	21.0	21.0	30.3	30.8	7.70	7.70
8/13/74	850	Low	22.5	20.9	21.0	29.7	30.7	7.95	7.95
8/20/74	1000	High +0.5	26.5	22.5	22.5	30.9	30.2	8.65	8.00
9/10/74	820	Low +0.5	21.0	21.0	20.5	28.1	28.3	7.60	7.60
9/17/74	835	High +0.5	22.0	21.0	21.0	30.6	30.6	7.60	7.65
10/10/74	910	Low +0.5	15.0	14.3	14.0	31.3	31.1	8.20	8.20
10/31/74	810	High +0.5	16.0	13.5	13.5	31.2	31.2	8.20	8.20
11/14/74	805	High +0.5	11.5	11.7	11.7	30.9	31.4	8.05	8.10
12/18/74	1105	High +0.5	4.0	6.5	6.5	31.5	32.0	7.90	7.85
12/31/74	905	High	1.0	5.5	5.5	31.6	30.9	7.90	7.85
1/29/75	1015	High +1.5	6.5	4.5	4.5	30.8	30.8	8.00	7.95
2/20/75	1000	Low +1.5	9.0	3.7	3.5	27.5	27.5	7.85	7.90
2/28/75	1000	High +0.5	3.5	4.3	4.4	29.2	31.3	7.80	7.82
3/26/75	1015	High +3.5	5.9	6.3		29.9	30.6	7.70	7.75
4/25/75	945	High +2.5	18.0	9.0	8.4	31.8	31.8	7.80	7.80
5/8/75	630	High +1.0	10.0	9.5	9.5	31.8	30.9	7.90	7.95
5/20/75	937	Low	23.0	16.7	16.7	28.6	28.4	7.85	7.92

Table 94. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	D.O. saturation (%) Surface	D.O. saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/26/73	7.1	7.9			2.2	6.0	13
7/31/73	7.8	7.7	106	104	6.9	6.0	10
8/16/73	7.8	7.7	106	105	0.0	10.0	12
9/26/73	7.6	7.8	97	98	2.5	4.0	25
9/27/73	7.5	7.6	98	98	6.9	3.5	25
10/31/73	8.3	8.2	92	90	1.5		
11/13/73	8.6	8.6	92	92	2.9	4.0	25
11/20/73	9.2	9.2	96	95		3.5	25
6/20/74	6.0	6.1	75	75	1.4	4.0	22
6/29/74	6.6	6.6	89	89	3.0	5.0	25
7/10/74	5.7	5.6	75	72	0.0	8.0	12
7/25/74	5.9	5.9	79	78	2.1	6.0	
8/13/74	6.7	6.5	89	87	4.0	4.0	24
8/20/74	7.2	7.1	100	96	0.0	10.0	26
9/10/74	6.3	6.3	81	82	1.1	4.0	24
9/17/74	6.6	6.6	88	88	0.8	10.0	25
10/10/74	8.4	8.4	98	98	3.2	6.0	
10/31/74	8.2	8.1	96	94	4.6	8.0	23
11/14/74	8.4	8.4	94	95	7.5	3.5	25
12/18/74	9.5	9.5	94	95	2.7	0.3	20
12/31/74	10.1	10.3	100	101	0.0	2.5	22
1/29/75	9.8	10.0	93	94	3.7	2.0	19
2/20/75	10.9	10.7	97	96	2.7	3.5	28
2/28/75	10.0	10.0	94	95	3.2	4.0	30
3/26/75	9.5	10.1	93		19.8	1.5	9
4/25/75	9.0	8.9	94	93	6.1	3.5	25
5/8/75	9.0	9.1	96	97	3.2	3.0	24
5/20/75	7.9	8.0	96	97	0.0	8.0	

Table 95. Nutrient analysis data collected at the Beach Haven Inlet station, Buoy "F" (MB-1).

Date	Time (EST)	Tide (h)	Temperature surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1205	High +3.0	24.0	0.8	0.002		0.30		
9/27/73	1405	Low	20.3	0.8			<0.14	0.060	
10/31/73	545	Low +1.5	12.0	0.2			<0.20	0.090	<0.20
11/20/73	1100	Low +1.5	9.0	1.6			<0.20	0.025	<0.20
6/30/74	1100	Low +0.5	21.6	0.4		0.46	0.00	0.000	0.03
7/30/74	945	High +0.5	23.8	0.6		0.28	0.00	0.000	0.04
8/28/74	1000	High +5.5		1.4	0.005	0.63	<0.01	0.040	
9/24/74	700	High +5.5	18.0	1.0		0.56	0.00	0.030	0.28
10/30/74	1100	High +4.0		0.8		0.65	0.00	0.060	0.22
11/26/74	1230	Low +1.5	5.5	3.0		0.61	0.00	0.060	0.32
1/2/75	1355	High +3.0	4.8	3.6		0.48	0.00	0.020	0.18
2/20/75	1000	Low	3.7	2.4		0.36	0.00	0.010	0.06
4/21/75	1202	Low +2.0	11.0	1.0		0.65	0.00	0.030	0.12
5/22/75	803	High +3.0	11.8	2.4		0.51	0.00	0.020	0.09

Table 96. Water analysis data collected at the bay station, Flashing Light "9" (MB-2).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	530	Low +5.5	22.5	22.5	22.5			7.80	7.70
7/31/73	1645	Low	23.5	25.0	25.0	28.9	29.0	8.40	8.10
8/16/73	940	Low +6.0	23.5	22.5	22.5	29.6	30.1	7.70	8.20
9/26/73	915	High +0.5	23.0	19.0	18.9	29.3	29.3	8.00	8.00
9/27/73	1425	High +5.0	24.0	30.3	20.0	27.1	26.9	8.00	8.00
11/13/73	1125	High +0.5	10.5	9.0	9.0	29.6	29.6	7.80	7.80
11/20/73	1129	Low	7.7	7.5	7.5	28.4	28.5	8.15	8.15
6/20/74	745	Low +4.5	23.0	21.2	21.5	29.2	29.2	7.80	7.78
6/29/74	1412	Low +1.0	25.0	24.0	23.5	28.3	28.4	7.80	7.80
7/10/74	1210	Low +5.0	32.5	27.0	27.0	28.9	29.3	7.75	7.70
7/25/74	645	High +5.0	19.0	22.4	22.0	29.6	29.7	7.62	7.64
8/13/74	920	High +4.5	23.5	22.1	22.0	28.5	28.3	7.80	7.80
8/20/74	1030	Low +5.5	26.5	24.0	24.0	29.5	29.5	8.00	7.85
9/10/74	840	High +5.5	22.0	21.0	20.7	27.1	27.1	7.50	7.50
9/17/74	900	Low +5.0	23.0	21.2	21.2	29.2	29.0	7.55	7.60
10/10/74	930	High +5.5	17.0	13.8	13.8	29.0	29.0	8.15	8.15
10/31/74	855	High	17.0	18.8	13.8	30.2	30.1	8.10	8.20
11/14/74	825	Low +5.0	11.5	10.6	10.6	29.8	30.3	8.05	8.05
12/18/74	1135	Low +5.5	3.0	4.8	4.8	29.3	29.5	7.85	7.85
12/31/74	925	Low +4.5	1.0	4.5	4.5	28.8	29.0	7.85	7.80
1/29/75	1050	High +1.5	7.0	4.8	4.8	30.8	28.7	8.00	8.00
2/20/75	1020	Low	9.5	3.4	3.4	26.0	26.0	7.85	7.70
2/28/75	1020	Low +5.0	3.2	4.5	4.5	29.2	28.9	7.75	7.75
3/26/75	1015	High +3.0	6.5	8.4	8.4	26.6	26.7	7.85	7.75
4/25/75	1000	High +1.0	17.5	12.5	10.0	28.6	29.8	7.60	7.65
5/8/75	645	Low +5.5	18.0	17.0	17.0	27.5	27.7	7.80	7.80
5/20/75	955	High +4.5	23.0	20.9	20.9		25.2		8.00

Table 96. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	D.O. saturation (%) Surface	D.O. saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/26/73	7.1	6.2			5.2	5.0	6.0
7/31/73	10.3	8.1	146	116	0.0	5.0	5.0
8/16/73	6.0	5.6	81	77	5.9	4.0	6.0
9/26/73	7.2	7.2	92	91		3.0	7.5
9/27/73	8.0	7.9	102	100	5.2	2.5	6.0
11/13/73	8.9	8.8	116	92	0.5	3.5	6.5
11/20/73	11.1	11.0	111	110		3.5	4.5
6/20/74	6.1	6.2	80	82	3.4	3.0	5.0
6/29/74	8.6	8.8	119	122	0.0	3.0	4.0
7/10/74	6.6	5.3	97	79	0.7	4.5	4.5
7/25/74	6.1	6.0	83	80	0.0	4.5	4.5
8/13/74	7.2	7.2	96	95	4.8	4.0	4.0
8/20/74	6.0	6.3	84	88	5.2	7.0	8.0
9/10/74	6.8	6.9	89	88	4.6	4.5	4.5
9/17/74	6.3	6.2	83	81	2.4	4.5	7.5
10/10/74	8.6	8.8	99	101	3.8	4.5	4.5
10/31/74	8.1	8.0	94	93	4.4	4.5	6.0
11/14/74	8.3	8.6	90	94	7.1	3.0	6.0
12/18/74	10.3	11.0	97	104	4.8	1.0	8.0
12/31/74	10.1	10.5	97	98		1.5	6.5
1/29/75	10.2	10.1	98	95	3.2	2.5	6.0
2/20/75	11.4	11.8	101	105	2.1	3.0	4.5
2/28/75	9.9	9.8	94	93	4.2	2.0	6.0
3/26/75	9.3	9.2	94	93	4.8	1.0	5.0
4/25/75	8.2	8.3	91	88	7.2	3.0	5.0
5/8/75	8.0	7.9	96	95	5.8	3.5	5.0
5/20/75	8.1	8.0		102	10.0	4.0	4.0

Table 97. Water analysis data collected at the midbay station (MB-3).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	600	High	22.5	24.6	24.0			7.90	7.90
7/31/73	1635	Low	23.5	24.0	24.0	29.2	28.9	8.10	8.10
8/16/73	955	Low +5.0	22.0	22.0	22.0	29.3	30.0	8.20	8.20
9/26/79	900	High	23.0	19.0	18.7	29.3	29.2	7.90	7.80
9/27/73	1435	High +5.0	23.0	20.3	19.8	26.2	26.[illegible]	8.00	8.00
10/31/73	645	Low +0.5	7.1	11.2	11.2	24.9	24.9	7.55	7.60
11/13/73	1135	High +0.5	11.0	6.0	6.0	27.5	27.5	7.95	7.90
11/20/73	1140	High +6.0	7.5	7.9	7.9	29.6	29.6	8.10	8.10

Table 97. Continued.

Date	D.O. (mgO_2/l)		O_2 saturation (%)		CO_2 ($mgCO_2/l$)	Secchi	Depth
	Surface	Bottom	Surface	Bottom	Surface	(ft)	(ft)
7/26/73	6.4	6.2			0.3	5.0	6.0
7/31/73	7.2	7.3	100	101	8.8	6.0	8.0
8/16/73	6.9	6.9	92	93	4.9	4.0	10.0
9/26/73	7.0	7.1	89	89	3.9	3.5	10.0
9/27/73	7.9	7.4	101	94	5.0	3.0	8.0
10/31/73	7.6	7.5	80	80	1.6	1.5	6.0
11/13/73	10.8	10.9	104	88	2.3	4.5	8.5
11/20/73	10.1	10.6	103	108		3.8	5.0

Table 98. Water analysis data collected at the midbay station, Pole "65" (MB-4).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	715	High +1.5	23.0	23.0	23.0			7.80	7.70
7/31/73	1600	High +5.5	25.0	26.0	26.0	28.9	29.1	8.30	8.20
8/16/73	1025	Low +5.5	24.0	22.0	22.0	29.4	30.1	8.30	8.10
9/26/73	945	High +0.5	23.0	18.7	18.7	28.2	29.0	7.95	8.00
9/27/73	1450	High +5.0	22.0	20.2	20.3	26.9	26.8	8.05	8.00
10/31/73	1820	Low	7.2	11.7	11.7	27.6	27.8	7.75	7.78
11/13/73	1155	High +0.5	11.5	8.0	8.0	29.5	29.6	7.84	7.71
11/20/73	1150	High +6.0	10.0	7.0	7.0	28.7	28.7	8.18	8.20

Table 98. Continued.

Date	D.O. (mgO_2/l)		O_2 saturation (%)		CO_2 ($mgCO_2/l$)	Secchi (ft)	Depth (ft)
	Surface	Bottom	Surface	Bottom	Surface		
7/26/73	6.1	5.7		00	2.0	5.0	5.0
7/31/73	8.9	8.0	131	117	0.0	7.0	10.0
8/16/73	5.7	6.0	77	81	3.4	6.0	12.0
9/26/73	7.1	7.4	89	93	3.9	4.0	10.0
9/27/73	7.8	7.6	100	97	4.3	4.0	9.0
10/31/73	7.7	7.8	89	84	1.1	3.0	8.0
11/13/73	9.2	9.4	96	94	1.7	4.0	10.5
11/20/73	11.3	11.2	110	111		3.0	6.0

Table 99. Water analysis data collected at the bay station, Flashing Green Light "53" (MB-5).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
1/17/74	1115	Low	1.3	1.7	2.7	24.5	25.0	8.00	8.01
2/14/74	1015	Low +0.5	4.8	1.3	2.3	23.5	24.1	8.00	7.95
2/28/74	1425	High +1.0	6.5	4.0	4.0	26.2	26.9		
6/20/74	924	High	24.0	22.2	22.2	29.2	28.8	8.00	7.95
7/10/74	1227	Low +5.0	33.0	29.0	28.5	27.9	28.6	8.10	8.10
7/25/74	700	High +5.0	20.0	22.7	22.5	29.2	29.4	7.89	7.90
8/13/74	945	High +4.5	23.5	22.3	22.4	28.3	28.8	8.10	8.10
8/20/74	1100	Low +5.5	26.5	25.2	24.8	28.3	28.8	8.00	7.95
9/10/74	850	High +5.5	23.5	21.0	21.0	25.6	25.3	7.80	7.80
9/17/74	925	Low +5.0	24.0	21.0	21.0	27.4	27.8	7.70	7.70
10/10/74	1015	High +6.0	18.0	13.7	13.7	28.1	28.4	8.50	8.50
10/31/74	925	High	18.5	14.2	14.0	28.0	28.6	8.10	8.20
11/14/74	905	Low +5.5	11.5	10.2	10.0	27.7	28.0	8.20	8.20
12/31/74	950	Low +4.5	1.5	3.5	3.5	27.7	28.1	7.80	7.85
1/29/75	1200	High +2.0	7.2	4.5	4.3	27.9	28.2	7.90	7.90
2/20/75	1050	Low	10.0	3.6	3.6	23.6	23.4	8.00	8.00
2/28/75	1150	High +0.5	3.8	5.0	4.7	27.6	28.0	7.75	7.75
3/26/75	1150	High +3.0	7.1	8.6	8.7	25.7	25.7	7.90	7.80
4/25/75	1030	High +1.5	14.5	12.0	11.0	28.4	28.1	7.77	7.72
5/20/75	725	Low +5.5	12.5	13.5	13.5	25.9	26.3	8.25	8.28
5/20/75	1033	High +4.5	20.4	19.5	19.5	24.3	24.3	8.30	8.25

Table 99. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
1/17/74	12.5	12.4	106	108	2.2	3.0	7.5
2/14/74	12.4	12.6	104	108	2.9	3.0	7.5
2/28/74	11.2	11.4	102	112	5.5	2.0	5.5
6/20/74	6.3	6.2	85	84	2.1	4.0	7.0
7/10/74	8.7	8.3	133	126	0.0	4.5	7.5
7/25/74	6.1	6.1	83	81	0.0	4.5	7.0
8/13/74	8.0	8.0	107	104	0.0	3.5	5.0
8/20/74	7.4	7.4	105	94	0.0	8.0	9.0
9/10/74	7.9	7.9	102	99	2.2	3.5	5.5
9/17/74	7.0	7.0	91	86	0.0	6.5	9.5
10/10/74	9.5	9.5	108	109	0.0	6.0	6.0
10/31/74	7.7	8.2	87	94	0.0	8.0	8.0
11/14/74	8.8	8.8	92	93	0.0	7.0	8.0
12/31/74	10.5	10.3	95	94		3.5	6.0
1/29/75	10.3	10.4	95	97	3.2	3.5	7.0
2/20/75	12.0	12.1	105	105	1.9	4.5	5.0
2/28/75	10.4	10.3	97	97	5.6	3.0	8.0
3/26/75	9.6	9.6	96	96	3.7	2.5	6.0
4/25/75	8.5	8.5	94	94	6.7	6.0	7.5
5/8/75	8.7	9.0	97	97	0.0	6.5	5.5
5/20/75	8.3	8.0	103	99	0.0	5.5	5.5

Table 100. Water analysis data collected at the bay station, Long Point (MB-6).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
1/17/74	1128	Low	1.5	1.5	1.5	24.8	25.0	7.98	7.98
2/14/74	1040	Low +1.0	5.5	1.5	1.5	22.8	22.6	7.95	7.90
2/28/74	1505	High +1.5	7.0	3.5	3.5	25.7	26.0		
6/20/74	928	High	25.0	22.7	22.7	28.3	28.4	7.95	7.90
6/29/74	1432	Low +1.5	25.0	23.0	22.5	24.9	26.3	7.89	7.90
7/10/74	1245	Low +5.5	33.0	28.0	28.0	27.2	27.5	7.95	7.85
7/25/74	910	High +5.5	19.0	22.5	22.5	28.5	28.5	7.70	7.70
8/13/74	1005	High +5.5	23.5	21.6	21.7	26.7	26.5	8.00	7.95
8/20/74	1110	High	26.5	25.0	24.6	28.8	28.5	7.90	7.80
9/10/74	905	High +6.0	24.0	20.5	20.7	23.5	23.5	7.60	7.55
9/17/74	1005	High	23.0	21.5	21.5	28.3	28.3	7.60	7.60
10/10/74	1030	High +6.0	18.0	13.6	13.6	27.9	29.0	8.20	8.20
10/31/74	915	High	18.0	13.4	13.4	28.2	28.2	8.10	8.20
11/14/74	845	Low +5.5	11.5	10.0	10.0	28.7	28.4	8.05	8.05
12/31/74	935	Low +4.5	1.5	3.5	4.0	28.1	27.7	7.85	7.90
1/29/75	1115	High +0.5	7.0	4.2	4.2	27.2	28.7	7.95	7.95
2/20/75	1040	Low	9.5	3.7	3.4		22.9	7.80	7.85
2/28/75	1055	Low +5.5	3.2	4.8	4.7	27.1	28.0	7.75	7.75
3/26/75	1136	High +3.0	5.8	8.5	8.5	25.9	25.9	7.72	7.70
4/25/75	1020	High +1.5	15.0	11.5	10.5	28.0	29.6	7.70	8.70
5/8/75	700	Low +5.5	11.0	13.0	13.0	24.5	25.4	8.05	8.00
5/20/75	1007	High +4.5	23.0	19.1	19.1	22.7	23.2	8.00	8.10

Table 100. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	Salinity (°/oo) Surface	Salinity (°/oo) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
1/17/74	12.2	13.0	103	110	1.7	2.5	6.5
2/14/74	12.0	12.4	100	102	5.8	3.0	8.0
2/28/74	11.2	11.6	100	104	5.8	1.0	8.0
6/20/74	6.9	6.7	94	91	2.3	2.0	8.0
6/29/74	8.6	8.1	115	107	3.4	3.0	6.5
7/10/74	7.4	7.0	110	104		3.0	8.0
7/25/74	6.0	6.0	81	81	3.4	2.3	10.0
8/13/74	6.8	6.9	89	90	4.6	2.5	7.0
8/20/74	6.3	6.0	90	85	8.1	6.0	10.0
9/10/74	6.3	6.0	80	76	4.8	2.0	10.0
9/17/74	6.5	6.5	86	86	3.2	4.0	9.0
10/10/74	8.5	8.7	97	100	2.7	4.5	6.5
10/31/74	8.5	8.5	96	96	3.0	4.0	9.0
11/14/74	8.5	8.5	91	90	4.7	0.8	11.0
12/31/74	10.8	10.6	99	97	5.4	2.0	10.0
1/29/75	10.4	10.1	94	93	3.4	2.5	8.0
2/20/75	11.4	11.5		100	2.7	3.0	9.0
2/28/75	10.0	9.8	93	91	5.8	2.5	11.0
3/26/75	9.4	9.5	94	95	6.1	1.5	9.5
4/25/75	8.4	8.3	90	89	8.9	3.5	9.5
5/8/75	8.7	8.0	96	88	3.2	4.0	10.5
5/20/75	7.9	7.7	97	94	2.1	3.3	8.0

Table 101. Water analysis data collected at the bay station (MB-7).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/16/73	1050	High	24.0	24.0	24.0	27.3	27.1	8.20	8.10
9/11/73	815	Low +5.0	20.0	20.7	21.0	30.4	29.7	7.90	
9/26/73	840	Low +5.5	21.0	19.0	18.7	27.2	25.6	7.90	7.95
9/27/73	1510	High +5.0	23.0	20.5	20.7	24.6	24.8	8.10	8.05
10/15/73	930	Low +3.5	19.0	16.0	16.0	25.8	26.0	7.89	7.80
10/31/73	700	Low	6.2	11.0	11.0	25.8	25.6	7.70	7.65
11/12/73	1035	High	9.0	5.5	5.5	28.1	28.0	7.85	7.80
11/13/73	1215	High +1.0	10.5	6.5	6.5	27.5	27.9	7.90	7.90
11/20/73	1210	High +6.0	7.0	6.9	6.9	28.0	27.8	8.20	8.18
11/30/73	930	Low +2.0	6.5	7.7	7.5			7.40	7.55
1/17/74	1140	Low	1.5	1.0	1.0	23.2	22.9	7.95	7.90
1/30/74	725	High +5.5	9.0	8.0	8.0	20.7	20.2	7.80	7.85
2/14/74	1055	Low +1.0	5.0	2.0	2.2	21.7	21.4	7.85	7:80
2/15/74	1055	Low	-2.5	1.5	1.5	23.2	23.2	7.10	7.10
2/21/74	940	High	7.5	3.5	3.8	23.6	23.4	8.10	8.00
2/28/74	1518	High +1.5	6.0	4.0	3.7	24.6	24.4		
6/18/74	740	Low +5.5	23.0	22.7	22.7	27.6	28.7	7.95	7.95
6/20/74	935	High	25.0	22.7	22.7	28.0	28.0	7.90	7.90
6/25/74	800	Low	18.0	19.8	20.0	27.5	27.1	7.70	7.70
6/29/74	1442	Low +1.0	25.0	23.5	23.5	25.1	24.9	8.00	7.97
7/9/74	700	Low	25.0	26.5	26.5	26.1	26.7	7.88	7.90
7/10/74	1250	Low +5.5	33.0	28.0	28.0	27.2	27.2	7.85	7.90
7/23/74	1200	Low +5.0	27.0	23.5	23.5	29.2	28.5	7.80	7.80
7/25/74	720	High +5.5	19.0	22.2	22.2	27.8	27.5	7.72	7.73
8/5/74	1035	Low +5.5	27.0	25.5	25.3	29.0	28.6	7.75	7.75
8/13/74	1015	High +5.5	23.5	21.5	21.5	25.8	25.8	8.00	8.00
8/20/74	1120	High	27.9	25.4	25.0	27.4	27.8	7.90	7.90
8/27/74	1115	High +6.0	26.5	25.7	25.5	24.2	24.6	7.90	7.90
9/10/74	915	High +5.5	24.0	20.7	20.7	23.7	23.5	7.80	7.79
9/16/74	948	High +0.5	22.5	21.0	21.0	26.9	27.1	7.30	7.40
9/17/74	1015	High	24.0	21.2	21.2	27.4	27.8	7.60	7.65

Table 101. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
10/2/74	1008	High	13.5	16.0	16.0	28.8	28.8	7.79	7.79
10/10/74	1033	High +6.0	18.0	13.7	13.7	28.2	28.6	8.30	8.30
10/22/74	835	Low	8.0	6.2	6.2	24.5	24.7	8.15	8.07
10/31/74	1020	High +0.5	18.5	13.7	13.7	28.0	28.4	8.10	8.10
11/14/74	945	High +0.5	12.0	10.0	10.0	28.4	28.0	8.10	8.15
11/18/74	1220	High	12.0	6.6	6.9	26.3	27.4	8.05	8.00
11/21/74	900	Low +0.5	7.0	7.5	7.5	28.2	28.4	8.05	8.02
12/5/74	1420	High	7.0	2.4	2.4	27.2	27.4	7.88	7.80
12/11/74	1320	Low	6.5	3.3	3.3	25.9	25.9	7.85	7.85
12/31/74	1000	Low +4.5	2.0	3.5	4.0	27.2	27.4	7.90	7.90
1/28/75	1035	High +0.5	5.5	3.2	3.2	26.2	26.5	7.70	7.70
1/29/75	1130	High +1.5	7.2	4.3	4.3	26.6	26.9	7.91	7.95
2/4/75	1105	Low +0.5	-2.4	0.0	0.0	21.0	20.6	7.50	7.45
2/11/75	1100	High +1.0	6.0	1.5	1.5	28.4	28.4	7.75	7.75
2/20/75	1100	Low	9.5	3.7	3.7	21.9	21.9	7.85	7.90
2/28/75	1105	Low +5.5	3.2	4.8	4.7	27.1	27.5	7.78	7.80
3/5/75	955	Low	3.2	1.0	1.0	23.7	23.7	7.80	7.80
3/18/75	1230	Low +5.5	6.9	5.1	5.0	22.9	24.3	7.88	7.90
3/26/75	1242	High +4.0	6.0	9.3	9.2	24.6	25.0	7.80	7.80
4/8/75	734	High	2.9	3.0	3.0	27.2	27.1	7.93	7.95
4/16/75	756	Low +1.0	7.8	6.7	6.7	23.4	24.3	7.80	7.90
4/25/75	1040	High +1.5	14.0	12.0	12.0	25.9	25.9	7.65	7.70
5/6/75	1150	High +6.0	17.0	13.5	13.0	23.6	23.8	7.95	7.95
5/8/75	710	Low +5.5	12.5	13.0	13.5	23.4	23.5	8.20	8.20
5/13/75	1100	High	20.0	18.0	17.4	25.0	25.3	7.88	7.85
5/20/75	1014	High +4.5	22.0	19.5	19.5	22.3	22.5	8.20	8.20

Table 101. Continued.

Date	D.O. ($mgO_2/1$) Surface	D.O. ($mgO_2/1$) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/1$) Surface	Secchi (ft)	Depth (ft)
8/16/73	7.1	7.1	97	97	7.3	3.0	4.0
9/11/73	6.7	6.8	88	89	0.0	3.0	6.0
9/26/73	6.8	6.6	86	81	4.7	2.0	8.0
9/27/73	8.4	8.1	107	103	3.9	3.0	7.5
10/15/73	7.2	7.2	84	85	3.7	2.0	7.0
10/31/73	7.7	7.7	81	82	1.3	3.0	5.0
11/12/73	10.2	10.2	98	98	2.5	3.0	7.5
11/13/73	10.6	10.4	106	102	1.7	3.5	6.0
11/20/73	11.4	9.2	112	112		2.5	7.0
11/30/73	9.0	9.0			13.4	1.0	7.0
1/17/74	12.5	12.5	103	102	2.2	1.0	4.5
1/30/74	9.5	9.5	91	95	2.4	1.0	5.0
2/14/74	12.2	12.1	102	101	4.1	0.5	4.0
2/15/74	11.5	11.3	96	94		0.8	4.5
2/21/74	10.9	10.7	97	95	5.1	1.5	6.0
2/28/74	10.6	11.0	95	98		0.5	3.0
6/18/74	6.0	6.7	81	91	3.2	3.0	7.5
6/20/74	6.5	6.6	88	90	2.3	2.0	7.0
6/25/74	7.2	7.1	91	90	4.3	1.5	8.0
6/29/74	9.7	9.0	132	122	2.7	2.0	6.0
7/9/74	6.5	5.9	95	86	3.2	2.5	8.0
7/10/74	7.1	7.1	105	105	0.0	3.0	6.0
7/23/74	7.0	6.9	97	94	1.4	3.0	13.0
7/25/74	5.9	6.0	79	80	2.7	2.0	7.0
8/5/74	6.6	5.4	95	78	5.5	2.0	6.0
8/13/74	7.4	7.2	96	94	0.0	2.0	7.0
8/20/74	7.1	7.1	94	91	3.9	6.0	11.0
8/27/74	7.2	7.2	96	91	4.6	2.0	8.0
9/10/74	7.9	7.9	100	99	1.9	2.5	5.0
9/16/74	6.5	6.4	85	82	4.0	2.5	7.0
9/17/74	6.7	6.6	87	86	1.9	4.0	8.0

Table 101. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
10/2/74	7.4	7.4	88	89	3.2	2.8	10.0
10/10/74	9.2	9.2	106	106	0.0	4.5	5.0
10/22/74	9.9	9.9	93	94	5.1	4.0	6.5
10/31/74	8.8	8.6	100	98	2.7	5.0	7.0
11/14/74	8.6	8.6	91	91	5.0	1.0	8.5
11/18/74	9.6	9.5	93	93	1.6	3.5	9.0
11/21/74	8.8	9.3	88	93	4.3	3.0	7.0
12/5/74	11.3	11.4	104	97	6.7	1.3	11.0
12/11/74	10.8	10.8	96	96	6.5	2.0	7.0
12/31/74	10.7	11.0	97	101	5.1	1.5	6.0
1/28/75	10.7	10.6	93	94	6.1	2.0	8.0
1/29/75	10.6	10.4	97	97	4.2	2.5	11.0
2/4/75	12.4	12.4	96	97	3.7	1.5	5.0
2/11/75	11.6	11.6	99	99	4.7	3.5	7.5
2/20/75	11.7	11.7	101	101	2.7	3.0	4.0
2/28/75	10.0	10.0	93	93	5.6	2.3	6.0
3/5/75	11.8	11.8	97	97	0.0	3.0	7.0
3/18/75	10.8	10.7	98	98	3.5	2.5	9.0
3/26/75	9.5	9.7	96	97	4.3	1.5	7.0
4/8/75	10.5	10.2	93	90	9.1	1.8	8.0
4/16/75	9.6	9.5	91	91	5.6	3.0	6.0
4/25/75	8.5	8.4	92	91	5.0	3.5	4.5
5/6/75	9.2	9.2	101	100	2.5	3.3	9.0
5/8/75	8.8	8.9	95	97	0.0	4.0	5.5
5/13/75	7.6	7.3	92	88	0.0	2.5	6.5
5/20/75	8.4	8.4	103	104	0.0	4.0	5.0

Table 102. Water analysis data collected at the bay station, Flashing Red "34" (MB-8).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	745	High +1.5	24.0	24.5	24.0			8.20	8.20
7/31/73	1530	High +4.5	24.0	27.5	27.5	26.6	26.7	8.30	8.20
8/16/73	1200	High +1.0	23.5	25.5	25.0	27.5	27.5	8.30	8.30
9/26/73	1005	High +0.5	24.0	19.0	19.0	25.2	25.3	8.05	8.05
9/27/73	1650	High +6.0	20.0	20.3	20.3	24.8	24.8	8.05	8.00
10/31/73	908	Low +2.0	8.0	11.9	11.9	25.4	25.5	7.75	7.75
11/13/73	1335	High +2.0	9.0	5.6	5.0	26.0	25.8	7.95	7.95
11/20/73	1415	Low +1.5	6.5	6.6	6.6	25.8	25.7	8.10	8.10
1/17/24	1345	Low +2.0	1.5	0.5	0.5	22.0	21.9	7.95	7.91
2/14/74	1250	High +2.5	5.5	0.0	0.5	24.6	24.8	7.95	7.95
2/28/74	1700	High +1.0	5.0	3.5	3.5	23.7	23.7		
6/20/74	1110	Low	27.0	24.5	24.0		27.4	8.35	8.35
6/29/74	402	High +2.5	25.0	23.0	23.0	26.5	26.1	8.04	8.05
7/10/74	1440	High +0.5	34.0	29.5	29.0	26.4	27.2	8.05	8.10
7/25/74	915	Low +1.0	23.0	23.5	23.0	26.4	26.6	7.90	7.90
8/20/74	1520	High +2.0	27.5	26.5	26.2	25.6	26.2	8.20	8.20
9/5/74	1215	Low +1.0	20.0	21.7	21.7	25.6	25.3	7.80	7.80
9/10/74	1145	High +1.0	26.0	22.0	21.7	24.2	23.9	7.90	7.85
9/17/74	1235	High +2.0	24.0	21.5	21.5	25.1	25.3	7.80	7.80
10/10/74	1240	Low +1.0	20.0	14.5	14.5	25.6	26.3	8.45	8.40
10/31/74	1048	High +1.0	19.0	14.0	14.0	25.9	25.9	8.10	8.00
11/14/74	1300	High +2.5	12.5	10.5	10.5	26.8	26.6	8.15	8.15
12/31/74	1130	Low +5.5	3.0	3.0	3.0	25.8	26.1	7.85	7.90
1/29/75	1210	High +1.0	7.0	4.3	4.3	23.9	24.1	7.85	7.95
2/20/75	1315	Low +1.5	7.5	3.5	3.5	21.8	21.8	7.85	
2/28/75	1220	High +0.5	3.5	5.2	5.0	25.2	25.3	7.85	7.85
3/26/75	1210	High +3.0	5.1	8.9	9.0	23.4	23.6	7.90	7.90
4/25/75	1100	High +1.5	15.0	13.0	12.5	24.0	25.1	8.05	8.02
5/8/75	735	Low +5.0	12.5	13.5	13.5	23.4	23.4	8.28	8.28
5/20/75	1052	High +4.5	21.5	19.9	19.9	22.3	22.5	8.35	8.38

Table 102. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/26/73	5.7	6.0			0.0	6.0	6.0
7/31/73	7.8	7.7	114	113	0.0	4.0	4.0
8/16/73	6.4	6.4	91	90	0.0	7.0	10.0
9/26/73	7.5	7.2	93	89	2.5	9.0	9.0
9/27/73	8.2	8.1	104	103	3.0	4.0	4.0
10/31/73	7.8	7.8	84	84	2.3	5.0	9.0
11/13/73	11.3	11.2	107	102	0.3	5.0	9.0
11/20/73	10.9	10.8	105	104	0.0	4.0	7.0
1/17/74	12.9	13.0	104	105	1.7	3.0	5.0
2/14/74	13.0	13.1	106	108	3.9	4.0	7.5
2/28/74	11.5	11.7	102	102	2.9	4.0	4.5
6/20/74	6.7	6.4		88	0.0	3.5	5.0
6/29/74	9.0	8.3	120	111	0.0	2.0	7.0
7/10/74	9.0	8.5	139	130	0.0	3.0	7.0
7/25/74	5.4	5.4	74	72	0.0	3.0	6.0
8/20/74	7.1	7.2	101	103	0.0	2.8	9.0
9/5/74	7.0	7.1	91	92	5.1	5.5	10.0
9/10/74	8.4	8.3	108	107	2.2	3.5	7.0
9/17/74	7.3	7.2	95	94	0.0	5.0	7.0
10/10/74	9.4	9.3	107	106	0.0	5.0	6.0
10/31/74	8.8	8.8	98	99	0.0	7.5	7.5
11/14/74	9.2	9.2	98	98	0.0	6.0	6.0
12/31/74	11.0	10.9	97	96	3.2	5.5	9.0
1/29/75	11.2	11.5	101	103	3.7	4.0	8.0
2/20/75	12.0	12.1	104	105	13.0	4.0	5.0
2/28/75	10.4	10.6	95	98	4.8	4.5	7.0
3/26/75	9.8	9.8	98	98	3.9	4.0	7.5
4/25/75	8.7	8.6	94	94	0.0	5.0	7.5
5/8/75	9.1	9.0	100	99	9.0	7.0	6.0
5/20/75	7.7	7.9	95	98	0.0	5.0	5.0

Table 103. Water analysis data collected at the bay station, Flashing Green "21" (MB-9).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	645	High	22.5	23.8	23.8			8.10	8.10
8/16/73	1145	High +0.5	23.0	24.5	24.5	25.7	25.8	8.30	8.30
8/23/73	1045	High +5.5	21.2	21.5	21.5	24.4	26.1	8.30	8.40
9/11/73	930	High +0.5	25.0	20.5	21.0	26.6	26.7	8.20	8.30
9/20/73	1115	Low +0.5	21.5	19.5	19.5	23.8	23.7	7.75	7.85
9/26/73	1020	High +0.5	23.0	18.7	18.7	23.5	23.4	7.90	7.90
9/27/73	1635	High +6.0	21.0	20.3	20.0	23.9	23.9	8.10	8.10
10/12/73	930	High	21.0	16.5	16.5	24.8	24.4	8.06	8.05
10/15/73	1100	Low +4.5	20.0	15.8	15.8	24.6	23.2	8.06	8.00
10/24/73	830	High +1.0	14.0	13.7	13.9	25.6	25.8	8.00	8.00
10/31/73	850	Low +1.0	7.1	11.1	11.5	26.0	25.8	7.80	7.80
11/9/73	930	High +0.5	7.0	6.8	6.9	25.1	25.3	7.65	7.70
11/12/73	1220	High +1.5	6.5	4.3	4.5	24.1	24.1	7.95	8.00
11/13/73	1325	High +1.5	9.3	5.9	5.5	24.5	25.2	8.00	8.00
11/20/73	1503	Low +0.5	7.0	7.0	7.0	24.5	24.4	8.20	8.18
12/12/73	1130	High	2.5	4.0	4.0	25.5	25.7	7.65	7.65
12/18/73	1230	Low	0.0	0.0	1.0	24.9	25.3	7.55	7.50
1/16/74	1125	Low	4.5	0.1	0.3	20.8	20.5	7.85	7.85
1/17/74	1245	Low	1.3	1.0	1.0	20.3	20.6	7.80	7.85
1/18/74	1320	Low +0.5	0.0	-1.0	-1.0	20.7	20.9	7.72	7.70
1/22/74	925	High	7.3	3.0	3.0	20.3	20.6	7.75	7.80
2/14/74	1150	Low +1.0	6.2	2.2	2.0	24.6	24.6	8.00	8.00
2/19/74	830	High	5.0	1.7	1.8	23.2	23.9	8.10	8.00
2/28/74	940	Low +0.5	6.0	2.5	2.5	23.0	22.7		
2/28/74	1615	High +2.0	5.8	4.3	4.3	22.8	22.9		
6/18/74	828	High	24.0	23.2	23.0	25.5	25.7	8.20	8.30
6/20/74	1105	High	25.0	23.5	23.0	26.9	27.1	8.15	8.12
6/21/74	1030	Low +4.5	25.0	24.7	24.5	26.1	27.4	8.10	8.10
6/25/74	900	Low	16.0	19.5	19.0	24.7	25.1	8.10	8.10
6/26/74	945	Low	20.0	18.6	18.6	24.9	24.3	8.15	8.15
6/27/74	1100	Low	19.0	19.0	19.0	24.9	25.2	8.05	8.05
6/29/74	1550	Low +1.0	25.0	24.0	23.0	25.6	25.6	8.20	7.95
7/9/74	905	Low +1.0	28.5	27.5	27.5	24.5	25.1	8.10	8.10

Table 103. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/10/74	1530	Low +5.0	35.0	29.5	29.0	24.0	24.7	8.15	8.15
7/15/74	1255	Low	31.0	28.0	27.5	24.5	25.8	8.15	8.05
7/17/74	840	High +0.5	22.0	24.5	24.5	24.5	24.0	8.10	8.10
7/23/74	1305	Low +5.0	25.0	24.8	24.2	26.4	27.1	8.10	8.10
7/25/74	820	High +6.0	22.0	22.5	22.3	25.9	26.0	7.95	7.90
8/5/74	1120	High	27.5	26.0	25.5	28.5	28.5	7.95	7.80
8/13/74	1230	Low	24.0	23.2	23.2	25.6	24.8	8.20	8.15
8/16/74	1006	High +1.5	27.0	25.2	24.8	25.1	25.3	8.00	8.04
8/20/74	1315	High +1.0	27.5	26.2	26.0	25.6	25.6	8.10	8.00
8/27/74	1430	Low +1.5	28.0	26.5	26.5	21.6	21.6	8.00	8.00
9/9/74	945	Low	23.0	20.0	20.2	23.7	23.9	7.85	7.85
9/10/74	1030	Low	26.0	22.9	22.0	23.9	23.9	7.80	7.80
9/16/74	1100	High +1.0	26.0	20.7	20.5	23.7	23.9	7.50	7.53
9/17/74	1155	High +1.0	26.5	21.5	21.9	23.9	24.2	7.50	7.70
9/27/74	710	High	15.0	16.6	16.5	25.2	25.2	7.95	7.90
10/2/74	1110	High +0.5	13.0	15.0	14.7	25.9	25.9	7.75	7.90
10/8/74	945	Low	12.8	12.5	13.5	25.4	25.6	7.85	7.85
10/10/74	1125	Low	21.0	14.2	14.2	25.6	25.8	8.45	8.50
10/15/74	1010	High +0.5	21.0	17.0	16.9	28.8	28.6	8.39	8.40
10/22/74	930	Low	10.0	6.3	6.3	25.9	25.8	8.05	8.00
10/31/74	1055	High +0.5	19.0	14.5	14.5	25.2	24.6	8.20	8.10
11/14/74	1230	High +2.5	12.5	10.0	10.0	27.7	27.5	8.05	8.05
11/18/74	1400	High +1.0	10.0	5.8	5.8	25.6	25.9	8.10	8.10
11/21/74	1015	Low +0.5	7.0	7.3	7.3	27.2	26.6	8.10	8.10
11/22/74	1115	Low	4.0	5.0	4.5	26.7	26.5	8.25	8.25
12/3/74	1245	High	6.0	5.0	5.0	26.4	26.8	7.90	7.90
12/4/74	1250	Low +4.5	4.0	3.2	3.5	26.1	27.1	7.75	7.80
12/6/74	1015	Low	4.8	1.6	1.7	27.4	27.5	7.98	7.95
12/11/74	1420	Low +1.5	5.0	3.0	3.8	26.1	26.3	7.85	7.85
12/18/74	1230	Low +5.0	4.0	4.8	4.8	27.2	28.6	7.83	7.80
12/31/74	1025	Low +4.0	1.5	3.0	2.5	23.8	24.1	7.85	7.90
1/27/75	1130	High +1.5	2.8	2.7	2.7	21.9	21.7	7.85	7.85
1/29/75	1255	High +1.5	6.5	4.2	4.3	23.4	23.7	8.00	7.90
2/3/75	1102	Low +0.5	2.5	1.0	1.0	21.7	21.7	7.85	7.75

Table 103. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
2/13/75	1201	High +0.5	-4.0	-0.5	-0.5	21.4	21.1	7.75	7.75
2/18/75	1036	Low +1.0	6.5	3.0	3.0	21.2	21.8	7.95	7.95
2/20/75	1300	Low +1.0	7.5	4.3	4.0	21.9	22.3	8.00	8.00
2/26/75	935	Low +4.5	6.5	5.5	5.5	25.9	25.7	7.80	7.80
2/28/75	1500	High +3.0	3.8	5.9	4.7	24.6	25.0	7.87	7.90
3/5/75	1025	Low	3.5	0.8	0.6	23.2	23.8	7.90	7.90
3/25/75	909	High +1.0	14.1	9.5	9.4	22.8	23.4	7.90	7.92
3/26/75	1223	High +3.0	5.3	8.9	8.9	22.7	22.3	7.95	7.95
3/27/75	1046	High +1.0	3.0	5.5	5.5	23.6	23.6	7.88	7.85
4/1/75	745	High +6.0	9.5	5.5	5.5	23.2	23.2	7.85	7.88
4/2/75	934	Low	7.5	8.0	8.0	22.9	22.9	8.00	8.02
4/8/75	834	High +0.5	5.0	3.0	3.2	23.4	23.4	7.90	7.85
4/9/75	906	High +0.5	5.5	4.3	4.3	22.5	22.9	7.90	7.85
4/25/75	1110	High +1.5	14.5	13.0	13.0	24.1	24.7	7.82	7.79
5/6/75	1239	High +6.0	15.2	13.4	13.4	22.1	22.5	8.10	8.10
5/8/75	800	Low +5.0	11.5	13.5	13.5	22.9	23.0	8.20	8.20
5/12/75	1017	Low +4.5	19.0	17.5	17.4	22.9	23.0	8.50	8.30
5/13/75	1125	Low +5.5	22.9	18.8	18.5	22.9	22.9	8.35	8.35
5/19/75	1052	Low	22.4	19.1	19.0	19.8	20.2	8.20	8.23
5/20/75	1100	High +5.5	21.5	20.5	20.5	20.4	20.4	8.40	8.39

Table 103. Continued.

Date	D.O. ($mgO_2/1$) Surface	D.O. ($mgO_2/1$) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/1$) Surface	Secchi (ft)	Depth (ft)
7/26/73	6.4	6.4			0.0	3.5	4.0
8/16/73	6.7	6.8	91	94	2.0	5.0	5.0
8/23/75	7.3	7.2	94	94	0.9	5.0	12.0
9/11/73	8.1	7.7	103	99	0.9	8.5	9.5
9/20/73	8.8	8.9	109	109	2.2	4.5	8.0
9/26/73	6.9	7.2	84	88	5.4	6.5	11.5
9/27/73	8.8	8.7	110	109	3.7	4.0	4.0
10/12/73	7.1	7.4	84	86	2.6	4.5	4.5
10/15/73	8.0	8.0	93	92	1.5	4.0	5.0
10/24/73	9.3	9.2	103	103	0.0	9.0	9.0
10/31/73	8.2	8.2	87	88	1.7	4.0	11.0
11/9/73	9.5	9.6	93	93	4.0	3.5	8.0
11/12/73	11.5	11.5	103	104	1.5	5.0	5.0
11/13/73	12.0	11.6	113	109	0.0	4.0	9.0
11/20/73	11.3	10.8	109	104	0.0	3.5	8.0
12/12/73	10.4	10.2	94	93	6.4	2.0	6.0
12/18/73	11.3	11.3	92	95	3.7	5.0	4.0
1/16/74	13.2	13.2	104	105	7.2	4.0	8.0
1/17/74	12.7	12.6	102	101	2.2	2.0	8.0
1/18/74	12.7	12.7	98	98	3.9	2.0	6.0
1/22/74	11.3	11.4	96	97	3.9	2.5	9.0
2/14/74	12.9	12.7	110	109	2.2	3.0	8.0
2/19/74	11.7	11.5	98	97	2.2	2.5	8.0
2/28/74	11.5	11.5	98	97	4.6	3.0	8.0
2/28/74	11.6	11.8	104	105	4.1	1.0	7.0
6/18/74	7.1	6.7	95	90	0.0	2.5	10.5
6/20/74	7.2	6.6	98	90	0.0	2.5	8.0
6/21/74	7.7	7.6	107	105	0.0	3.0	8.0
6/25/74	7.4	7.4	92	91	3.0	1.0	10.0
6/26/74	7.5	7.7	91	94	2.5	2.0	8.0
6/27/74	8.0	8.1	98	100	0.0	2.5	9.0
6/29/74	10.5	9.4	142	126	0.0	2.0	5.0
7/9/74	6.8	6.8	100	101	0.0	2.0	10.0

Table 103. Continued.

Date	D.O. (mgO_2/l)		O_2 saturation (%)		CO_2($mgCO_2/l$)	Secchi	Depth
	Surface	Bottom	Surface	Bottom	Surface	(ft)	(ft)
7/10/74	8.1	7.6	122	114	0.0	2.0	10.0
7/15/74	7.4	7.1	108	104	0.0	2.0	8.0
7/17/74	6.5	6.4	90	89	0.0	3.0	6.0
7/23/74	7.6	7.6	106	104	0.0	2.0	11.5
7/25/74	6.3	6.3	83	83	9.4	2.5	6.0
8/5/74	5.7	5.4	83	74	5.0	1.0	10.0
8/13/74	8.1	8.1	109	108	0.0	2.0	9.0
8/16/74	7.7	7.3	107	101	0.0	3.0	6.0
8/20/74	7.8	7.9	111	112	0.0	7.0	9.0
8/27/74	7.7	7.4	107	103	4.3	1.5	9.0
9/9/74	8.4	7.9	105	99	0.5	2.5	7.0
9/10/74	8.4	8.2	108	106	0.8	2.5	6.0
6/16/74	8.1	8.1	102	102	0.0	4.0	9.0
9/17/74	7.9	8.1	102	106	1.6	5.0	9.0
9/27/74	9.8	8.6	118	103	0.0	4.5	8.0
10/2/74	8.2	8.5	95	97	0.0	5.5	9.0
10/8/74	9.1	9.0	99	101	0.0	2.5	6.0
10/10/74	9.8	9.9	110	111	0.0	5.5	8.0
10/15/74	7.8	7.9	95	96	0.0	4.3	8.5
10/22/74	10.4	10.6	99	100	0.0	4.5	8.0
10/31/74	8.9	8.5	101	97	0.0	7.0	9.0
11/14/74	8.8	8.8	93	92	4.5	1.0	9.0
11/18/74	11.0	11.0	104	104	0.0	5.0	10.0
11/21/74	9.7	10.4	95	95	2.7	3.0	4.5
11/22/74	10.2	10.1	97	96	5.4	2.0	8.0
12/3/74	9.3	9.7	87	92	4.3	0.3	12.0
12/4/74	10.5	10.5	91	95	4.8	0.3	7.0
12/6/74	11.7	11.4	100	98	5.9	3.0	8.5
12/11/74	11.1	11.0	94	100	3.5	3.0	12.0
12/18/74	10.1	10.0	95	94	5.9	3.0	11.0
12/31/74	11.6	11.4	101	98	5.1	3.0	10.0
1/27/75	11.1	11.3	94	96	4.8	1.0	10.0
1/29/75	11.4	11.0	101	99	3.4	2.5	10.0
2/3/75	11.9	12.4	96	100	3.7	3.0	8.0

Table 103. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
2/13/75	12.3	12.4	96	96	3.4	1.5	5.0
2/18/75	12.2	12.2	103	109	1.9	5.5	8.0
2/20/75	12.0	11.9	106	105	2.4	4.0	7.0
2/26/75	9.6	9.7	90	91	4.2	1.0	5.0
2/28/75	11.0	11.2	100	102	3.4	3.0	10.0
3/5/75	11.8	11.3	96	92	0.0	4.5	10.0
3/25/75	10.0	9.6	101	96	0.0	3.5	11.0
3/26/75	10.1	10.1	100	99	4.8	3.0	5.0
3/27/75	10.2	9.8	94	90	2.5	4.0	10.0
4/1/75	10.5	10.5	96	96	3.1	4.5	9.5
4/2/75	10.5	10.6	102	103	2.5	5.0	10.0
4/8/75	10.9	10.7	94	93	6.1	2.5	7.0
4/9/75	11.4	11.3	101	101	6.1	4.5	9.5
4/25/75	8.6	8.3	93	90	6.7	3.5	9.0
5/6/75	10.0	9.9	108	108	0.0	5.0	11.0
5/8/75	9.0	9.1	99	100	0.0	7.0	10.0
5/12/75	8.3	7.9	99	94	0.0	4.5	11.0
5/13/75	8.2	7.9	99	95	0.0	4.5	11.0
5/19/75	7.8	7.4	94	89	0.0	6.0	8.0
5/20/75	8.5	8.3	105	103	0.0	5.0	8.5

Table 104. Water analysis data collected at the bay station, Pole "6" (MB-10).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	800	High +1.0	23.0	24.0	24.0			8.30	8.30
7/31/73	1510	High +4.0	25.5	28.0	27.5	23.9	25.1	8.30	8.10
8/16/73	1215	High +0.5	23.5	25.0	25.0	25.7	25.5	8.20	8.20
9/26/73	1100	High +1.0	24.0	18.7	18.7	25.3	25.8	8.10	8.10
9/27/73	1705	Low	20.0	20.2	20.3	25.4	25.3	8.00	8.10
10/31/73	935	Low +1.5	8.5	11.5	11.6	25.8	26.6	7.78	7.80
11/13/73	1405	High +2.0	10.4	5.5	5.5	24.8	24.9	7.90	7.90
11/20/73	1430	Low +0.5	6.5	6.5	6.5	25.0	25.0	8.05	8.10
1/17/74	1325	Low +0.5	1.5	0.6	0.6	21.5	21.6	7.88	7.80
2/14/74	1200	Low +0.5	6.0	1.3	1.3	24.9	24.9	8.05	8.05
2/28/74	1630	High +2.5	5.0	4.0	4.0	23.2	23.2		
6/20/74	1120	High +1.0	25.0	24.0	23.5	26.2	26.1	8.35	8.35
6/29/74	1615	Low +1.5	25.0	23.0	22.5	26.8	26.7	8.04	8.00
7/25/74	935	Low	23.0	23.0	23.0	25.5	26.0	8.00	7.95
8/1/74	1055	High +1.5	29.0	27.5	27.0	26.0	25.7	8.15	8.10
9/5/74	1235	High +0.5	20.5	21.0	21.0	23.5	23.5	7.80	7.80
9/10/74	1200	Low +0.5	27.0	22.0	21.7	25.6	24.9	7.90	7.90
9/17/74	1255	Low +0.5	24.0	21.5	21.5	24.6	23.9	7.70	7.80
10/10/74	1255	Low +1.5	20.0	14.2	14.2	25.4	25.4	8.25	8.30
10/31/74	1210	High +2.0	19.0	14.5	14.5	25.5	25.2	8.10	8.00
11/14/74	1315	High +2.0	12.5	10.7	10.7	25.7	25.7	8.20	8.00
12/31/74	1145	Low +5.0	2.5	3.0	3.0	24.5	24.9	7.80	7.80
1/29/75	1355	High +2.0	6.5	4.5	4.6	21.9	21.9	8.02	8.00
2/20/75	1340	Low +1.5	7.0	4.0	4.0	22.9	23.2	8.05	7.85
4/25/75	1130	High +1.5	14.0	13.5	13.0	26.3	26.2	8.05	8.00
5/8/75	810	Low +5.0	13.5	13.5	13.5	23.7	24.0	8.15	8.10
5/20/75	1207	Low	24.0	20.5	20.5	22.0	21.8	8.35	8.35

Table 104. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/26/73	7.0	6.7			0.0	4.0	7.0
7/31/73	8.5	7.6	125	110	0.0	8.0	8.0
8/16/73	6.6	6.4	92	89	0.0	6.0	6.0
9/26/73	7.7	7.7	95	95	0.0	6.5	7.5
9/27/73	8.8	8.8	111	111	0.1	4.0	4.0
10/31/73	8.2	8.2	88	87	0.9	3.0	5.0
11/13/73	11.2	11.3	104	105	0.5	4.5	5.0
11/20/73	11.4	11.4	109	109	0.0	4.0	4.0
1/17/74	12.9	13.0	104	105	1.9	2.5	5.0
2/14/74	13.4	13.4	113	113	0.7	4.0	6.0
2/28/74	11.6	11.6	103	103	3.6	2.5	6.0
6/20/74	7.5	7.5	102	102	0.2	2.5	5.0
6/29/74	8.4	8.4	114	113	0.0	2.0	4.5
7/25/74	6.2	6.3	83	85	0.0	2.5	6.0
8/1/74	6.7	6.1	98	89	0.0	2.5	8.0
9/5/74	7.4	7.5	94	96	6.2	3.5	5.5
9/10/74	8.4	8.5	111	110	0.0	2.5	6.0
9/17/74	7.6	7.6	100	98	0.0	4.0	5.0
10/10/74	8.9	9.0	100	101	0.0	5.0	8.0
10/31/74	9.1	9.1	103	102	0.0	7.0	8.5
11/14/74	9.6	9.6	101	101	0.0	4.5	7.5
12/31/74	11.3	11.5	99	101	4.0	4.5	8.5
1/29/75	11.6	11.8	103	105	2.4	2.5	5.0
2/20/75	12.0	11.7	106	104	1.1	4.0	6.0
4/25/75	9.0	9.1	102	101	4.5	5.5	7.0
5/8/75	9.0	8.6	100	95	0.0	8.0	8.0
5/20/75	8.3	8.1	103	100	0.0	7.5	7.5

Table 105. Water analysis data collected at the bay station, Flashing Red "73" (MB-11).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	825	High +1.5	23.0	23.5	23.3			8.10	8.20
7/31/73	1450	High +3.5	26.0	27.5	27.0	23.5	23.7	8.20	8.10
8/16/73	1235	High +1.0	23.0	25.0	25.0	24.1	24.4	8.20	8.20
9/26/73	1120	High +1.5	23.0	18.9	18.3	26.5	27.5	8.10	8.00
9/27/73	1725	Low	20.0	19.8	20.0	25.5	25.6	8.10	8.10

Table 105. Continued.

Date	D.O. (mgO_2/l)		O_2 saturation (%)		CO_2 ($mgCO_2/l$)	Secchi (ft)	Depth (ft)
	Surface	Bottom	Surface	Bottom	Surface		
7/26/73	6.8	6.5	88	86	0.0	6.0	8.0
7/31/73	7.8	7.5	113	106	0.0	5.0	8.0
8/16/73	6.9	6.8	94	93	1.0	5.0	10.0
9/26/73	7.6	7.4	95	92		6.0	10.0
9/27/73	8.1	7.9	102	100	3.4	4.0	8.0

Table 106. Water analysis data collected at the bay station, Sandy Island (MB-11A).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
1/17/74	1305	Low	7.2	0.7	0.7	21.6	21.7	7.90	7.90
2/14/74	1230	Low +0.5	6.2	1.5	1.5	24.8	24.7	8.05	8.00
2/28/74	1645	High +1.5	5.0	4.1	4.1	23.7	23.6		
6/20/74	1130	High +0.5	25.0	23.5	23.5	25.6	25.8	8.35	8.35
6/29/74	1630	Low +1.0	25.0	23.5	24.0	26.7	26.5	8.10	8.10
7/25/74	945	Low	23.0	22.7	22.5	25.7	26.6	8.10	8.10
8/1/74	1110	High +1.5	28.0	27.7	27.3	25.9	26.7	8.15	8.15
9/5/74	1355	High +1.0	20.0	21.0	21.0	23.2	23.2	7.85	7.85
9/10/74	1215	Low +0.5	27.0	22.5	21.5	24.9	25.3	7.90	7.85
9/17/74	1305	High +1.5	23.9	21.4	21.4	24.1	24.1	7.70	7.70
10/10/74	1310	Low	20.0	14.0	14.0	25.4	25.6	8.30	8.30
10/31/74	1220	High +1.5	19.5	14.5	14.5	26.2	26.2	8.10	8.10
11/14/74	1320	High +2.5	12.5	10.8	11.0	25.9	25.5	8.05	8.15
12/31/74	1155	Low +5.0	2.0	3.0	3.0	24.7	24.5	7.80	7.85
1/29/75	1415	High +2.0	7.0	5.0	5.0	21.9	21.5	8.10	8.10
2/20/75	1355	Low +1.5	7.5	4.2	4.0	23.9	23.4	7.90	7.90
4/25/75	1145	High +1.5	14.0	13.5	13.0	24.2	24.3	8.05	8.00
5/8/75	820	Low +5.0	13.5	13.5	13.0	24.0	24.1	8.10	8.10
5/20/75	1215	High +6.0	24.0	20.9	20.9	22.0	22.2	8.40	8.35

Table 106. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
1/17/74	12.8	13.0	103	105	1.9	1.5	3.0
2/14/74	13.3	13.1	112	110	1.7	4.0	8.0
2/28/74	11.5	11.5	102	102	4.1	1.0	8.0
6/20/74	7.9	7.9	106	107		2.5	5.0
6/29/74	9.9	9.7	136	133	0.0	2.0	6.0
7/25/74	7.0	6.8	93	91	0.0	2.0	6.0
8/1/74	7.0	6.0	101	88	0.0	2.0	11.0
9/5/74	7.5	7.5	96	96	4.2	3.5	13.0
9/10/74	8.8	8.3	116	107	0.0	3.0	11.0
9/17/74	8.0	7.8	102	100	0.0	4.0	5.5
10/10/74	9.2	9.2	103	104	0.0	5.0	14.0
10/31/74	9.5	9.5	106	106	0.0	6.0	6.0
11/14/74	9.4	9.4	99	100	3.5	2.5	5.5
12/3/74	11.6	11.2	101	98		3.5	15.0
1/29/75	12.1	12.1	108	107	2.9	2.5	5.5
2/20/75	12.0	11.6	108	104	1.6	4.5	13.0
4/25/75	9.1	9.1	101	100	2.2	5.5	11.5
5/8/75	9.4	9.3	104	102	0.0	9.5	14.0
5/20/75	8.5	7.9	107	99	0.0	8.0	12.0

Table 107. Nutrient analysis data collected at the bay station, Flashing Light "9" (MB-2).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1225	High +1.5	28.0	1.6	0.002		0.30		
9/27/73	1425	High +5.0	20.3	1.4			<0.14	0.060	
6/30/74	1115	High +5.0	24.5	2.8		0.70	0.00	0.000	0.00
7/30/74	1005	High +3.5	26.6	1.7		0.40	0.00	0.050	
9/24/74	720	High +4.0	14.7	1.0		0.72	0.00	0.040	
10/31/74	1030	High +2.0	13.7	1.4		0.61	0.00	0.030	
2/20/75	1020	Low	3.4	3.2		0.34	0.00	0.020	
5/22/75	818	High +1.5	19.8	2.4		0.47	0.00	0.010	

Table 108. Nutrient analysis data collected at the bay station, Pole "65" (MB-4).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_5$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1245	High +2.0	27.5	1.2	0.003		0.30		
9/27/73	1450	High +5.0	20.2	0.8			<0.14	0.045	
10/31/73	620	Low	11.7	0.0			<0.20	0.044	<0.20

Table 109. Nutrient analysis data collected at the bay station, Flashing Green Light "53" (MB-5).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
6/30/74	1030	High +4.0	24.5	2.8		0.72	0.00	0.020	
7/30/74	1020	High +3.5	27.0	2.4		0.22	0.00	0.070	0.05
9/24/74	735	High +4.0	15.0	1.2		0.74	0.00	0.010	
10/30/74	1045	High +2.0	13.7	1.4		0.63	0.00	0.050	
11/26/74	1440	Low +1.0	4.0	5.0		0.70	0.00	0.030	
1/2/75	1620	High +3.0	4.0	3.2		0.48	0.00	0.020	
2/20/75	1045	Low	3.6	3.2		0.42	0.00	0.020	
4/21/75	1145	Low	12.0	1.8		0.49	0.00	0.010	
5/22/75	833	High +1.5	20.5	2.6		0.46	0.00	0.010	

Table 110. Nutrient analysis data collected at the bay station (MB-7).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1305	High +2.0	28.5	0.4	0.004		0.20		
9/27/73	1510	High +5.0	20.5	0.6			<0.14	0.050	
10/31/73	700	Low		0.0			<0.20	0.025	<0.20
1/31/74	930	Low	7.0	1.6			0.07	0.035	<0.20
6/30/74	1135	High +5.0	24.1	1.4		0.64	0.00	0.000	
7/30/74	1030	High +3.5	26.5	2.4		0.62	0.00	0.050	
9/24/74	745	High +4.0	16.0	1.2		0.61	0.00	0.030	0.31
10/30/74	1100	High +2.0	13.2	1.0		0.64	0.00	0.090	0.24
11/26/74	1315	Low	4.0	3.2		0.92	0.00	0.170	0.16
1/2/75	1405	High +1.0	4.5	4.8		0.55	0.00	0.050	0.12
2/20/75	1100	Low	3.7	3.4		0.38	0.00	<0.010	0.08
4/21/75	945	High +4.5	10.3	1.2		0.51	0.00	0.010	0.12
5/22/75	843	High +1.5	20.5	3.0		0.54	0.00	0.010	0.10

Table 111. Nutrient analysis data collected at the bay station, Flashing Red "34" (MB-8).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1	Detergent (mg/1)
8/30/73	1615	High +5.0	28.0	1.0	0.005		0.30		
9/27/73	1650	High	20.3	1.0			<0.14	0.025	
10/31/73	908	Low +2.0		0.0			<0.20	0.015	<0.20
1/31/74	1135	Low +0.5	6.5	1.8			0.00	0.035	<0.20
6/30/74	1405	Low +0.5	24.3			0.58	0.00	0.000	
7/30/74	1145	High +4.5	27.5	3.8		0.60	0.00	0.080	0.10
9/24/73	850	High +4.0	15.5	1.0		0.66	0.00	0.020	0.33
10/30/74	1200	High +3.0	13.2	2.2		0.72	0.00	0.030	0.29
11/26/74	1430	Low +0.5	4.0	5.8		0.88	0.00	0.080	0.24
1/2/75	1610	High +3.0	4.0	3.0		0.53	0.00	<0.010	0.22
2/20/75	1315	Low +2.0	3.5	2.8		0.40	0.00	0.010	0.09
4/21/75	1134	High +6.0	10.6	1.6		0.48	0.00	0.020	0.02
5/22/75	1030	High +3.0	21.3	2.4		0.49	0.00	0.010	0.12

Table 112. Nutrient analysis data collected at the bay station, Flashing Green "21" (MB-9).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/1)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1605	High +5.5		1.4	0.002		0.20		
9/27/73	1634	High	20.7	1.2			<0.14	0.020	
10/31/73	850	Low +1.0	11.1	0.0			<0.20	0.028	<0.20
1/31/74	1120	Low +0.5	6.0	1.6			0.00	0.050	<0.20
6/30/74	1355	Low	25.4	2.0		0.94	0.00	0.000	0.03
7/30/74	1135	High +4.0	27.5	4.0		0.35		0.080	
9/24/74	840	High +4.5	15.3	1.4		0.70	0.00	0.020	
10/30/74	1335	High +4.0	14.0	1.8		0.73	0.00	0.030	
11/26/74	1500	Low +0.5	3.5	5.0		0.90	0.00	0.100	
1/2/75	1555	High +2.5	4.0	3.0		0.48	0.00	0.010	
2/20/75	1300	Low +1.0	4.3	2.8		0.53	0.00	<0.010	
4/21/75	1120	High +5.5	10.8	1.6		0.44	0.00	0.010	
5/22/75	925	High +2.0	21.5	2.8		0.60	0.00	0.010	

Table 113. Nutrient analysis data collected at the bay station, Pole 6 (MB-10).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/1)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
9/27/73	1700	Low	20.2				<0.14	0.035	
10/31/73	935	Low +1.5		0.2			<0.20	0.031	<0.20
1/31/74	1150	Low +1.0		2.8			0.00	0.030	<0.20
6/30/74	1425	Low +0.5	25.2	1.6		0.55	0.00	0.000	
7/30/74	1153	High +4.0	27.5	4.4		0.64	0.00	0.020	
9/24/74	905	High +4.5	15.4	2.0		0.82	0.00	<0.010	
10/30/74	1325	High +3.5	13.5	2.0		0.71	0.00	0.030	
2/20/75	1340	Low +1.5	4.0	2.2		0.46	0.00	0.010	
5/22/75	1045	High +3.0	21.5	1.8		0.51	0.00	<0.010	

Table 114. Water analysis data collected at the mouth of Dinner Point Creek (DPC-1).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	625	High +0.5	22.5	24.0	24.0			7.70	7.80
7/31/73	1625	High +5.5	24.0	26.5	26.5	27.8	27.7	8.10	8.30
8/16/73	1100	Low +5.5	23.0	23.5	23.0	28.7	28.5	8.20	8.20
9/11/73	825	Low +5.5	21.0	21.0	21.0	27.8	28.1	7.95	8.00
9/26/73	850	Low +5.5	22.5	18.5	18.5	24.3	24.5	7.75	7.75
9/27/73	1520	High +5.5	22.5	21.0	21.0	22.3	22.3	7.50	7.50
10/15/73	945	Low +4.0	20.0	16.0	15.5	25.0	24.7	7.80	7.80
10/31/73	745	Low +0.5	7.1	9.4	9.4	19.0	19.7	6.85	6.75
11/12/73	1055	High	7.0	5.3	5.0	26.8	26.7	7.95	7.85
11/13/73	1225	High +1.0	12.0	6.5	6.5	25.9	26.4	7.88	7.90
11/20/73	1220	Low	7.0	6.8		26.1		8.10	
11/30/73	940	Low +2.5	6.3	5.7				7.20	
1/17/74	1147	Low	1.8	1.3	1.3	19.4		7.60	
1/30/74	745	High +5.5	9.0	8.0		19.5		7.75	
2/14/74	1105	Low +1.0	5.2	2.2		20.6		7.35	
2/15/74	1115	Low	-2.7	1.5	1.3	18.1		7.05	
2/21/74	955	High +0.5	8.0	4.0	4.0	21.5	21.5	8.00	8.10
2/28/74	1530	High +1.5	7.0	6.0	6.0	19.9	19.7		
6/18/74	750	Low +5.5	23.0	23.3	23.0	26.2	26.5	7.95	7.90
6/20/74	945	High	25.0	23.0	23.0	26.2	26.5	7.80	7.85
6/25/74	815	Low	17.0	19.0	19.0	24.7	24.1	6.80	6.75
6/29/74	1453	Low +1.5	25.0	25.3	25.0	20.9	20.9	7.30	7.20
7/9/74	710	Low +0.5	25.0	26.5	26.5	20.9	21.3	7.35	7.48
7/10/74	1255	Low +5.5	33.0	29.0	29.0	26.4	25.7	8.00	7.90
7/23/74	1215	Low +5.5	28.0	24.5	24.5	26.9	26.9	7.70	7.80
7/25/74	725	High +5.5	22.0	21.4	21.4	25.7		7.10	
8/5/74	1041	Low +5.0	28.0	26.3	26.3	27.1	27.3	7.85	7.80
8/13/74	1035	High +5.5	22.5	22.5	22.5	21.7	21.7	7.30	7.30
8/20/74	1135	High	26.2	25.6	25.6	25.8	26.0	7.75	7.70
8/27/74	1130	High +6.0	28.0	27.0	27.0	17.8		7.95	
9/10/74	925	High +5.0	24.0	22.0		16.7		7.00	
9/16/74	1000	High	24.0	20.7	20.7	25.6	25.6	7.30	7.30
9/17/74	1000	High	24.0	21.2	21.4	25.3	26.4	7.60	7.60

Table 114. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
10/2/74	1020	High	14.0	15.7	15.7	27.4	27.0	7.80	7.79
10/10/74	1045	Low	20.0	13.5	13.5	24.6	24.9	7.85	7.70
10/22/74	845	Low	9.0	5.5	6.2	18.2	19.7	7.40	7.50
10/31/74	1025	High +1.0	19.0	14.2	14.0	25.3	25.5	8.00	8.10
11/14/74	1005	High +0.5	12.0	10.3	10.3	25.5	25.9	7.80	7.80
11/18/74	1235	High	11.5	6.6	6.5	26.1	26.3	8.05	8.00
11/21/74	925	Low +0.5	8.0	7.5	7.3	23.6	23.9	7.80	7.80
12/5/74	1425	High	8.0	2.5	2.5	26.3	25.9	7.80	7.80
12/11/74	1335	Low	8.0	2.7	3.0	20.9	21.3	7.60	7.68
12/31/74	1005	Low +5.0	2.5	4.0	3.5	24.9	24.9	7.80	7.95
1/28/75	1050	High +0.5	5.7	3.2	3.2	22.8	24.0	7.70	7.70
1/29/75	1145	High +1.5	7.2	4.5	5.0	26.2	25.9	7.90	7.90
2/4/75	1120	Low +0.5	-2.0	-0.5	-0.5	18.8	18.8	7.50	7.45
2/11/75	1108	High +1.0	7.0	1.5	1.0	23.5	23.5	7.75	7.73
2/20/75	1110	Low +0.5	9.0	4.6	4.3	22.5		7.90	
2/28/75	1120	Low +5.5	3.6	5.3	5.2	25.0	25.2	7.80	7.80
3/5/75	1010	Low	3.5	0.7	0.4	18.4	20.5	7.40	7.60
3/18/75	1238	Low +5.0	7.0	5.4	5.4	21.1	21.1	7.78	7.80
3/26/75	1249	High +4.0	4.7	9.0	9.0	23.4	23.6	7.85	7.82
4/8/75	745	High	3.0	3.0	3.0	26.0	25.8	7.80	7.90
4/16/75	805	Low +0.5	8.0	6.0	6.0	16.4	16.0	7.40	7.48
4/25/75	1045	High +1.5	15.0	14.0	13.5	29.6	28.5	7.70	7.68
5/6/75	1140	High +5.5	19.0	14.7	14.3	14.6	15.9	7.45	7.45
5/8/75	715	Low +5.5	11.0	13.5	13.5	20.9	21.4	8.00	8.00
5/13/75	1050	Low +5.0	21.0	19.2	19.0	22.3	22.9	7.90	7.90
5/20/75	1017	High +4.5	20.4	20.7	20.7	15.3		7.55	

Table 114. Continued

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/26/73	6.2	6.3			4.1	3.5	4.0
7/31/73	7.4	7.7	107	111	10.3	4.0	7.0
8/16/73	6.6	6.5	90	88	3.4	4.0	8.0
9/11/73	6.7	7.1	87	93	3.9	2.0	6.0
9/26/73	6.9	6.8	84	83	6.1	2.0	6.0
9/27/73	6.4	6.1	105	77	12.6	2.5	4.0
10/15/73	7.6	8.1	89	93	4.7	2.0	5.0
10/31/73	3.8	3.6	37	36	2.3	3.5	6.0
11/12/73	11.8	10.6	116	99	2.5	3.0	4.0
11/13/73	10.9	11.0	105	97	2.0	3.0	6.0
11/20/73	10.9		106			2.5	4.0
11/30/73	8.8				0.0	0.5	4.0
1/17/74	11.6		94		5.5	0.8	2.0
1/30/74	7.7		71		7.7	1.0	2.0
2/14/74	11.2		94		7.5	1.0	1.5
2/15/74	11.1		90		6.7	1.0	2.5
2/21/74	11.0	11.2	97	98	5.3	2.0	3.0
2/28/74	10.9	11.0	100	100	6.3	0.5	4.0
6/18/74	6.6	6.5	89	87	4.1	2.0	6.0
6/20/74	6.5	6.8	87	92	5.5	1.0	6.0
6/25/74	3.6	3.4	44	42	13.7	2.0	6.0
6/29/74	6.9	6.6	94	90	7.5	1.5	5.0
7/9/74	3.6	3.3	51	47	10.3	2.0	5.0
7/10/74	8.2	7.5	124	113	0.0	2.5	8.0
7/23/74	7.0	6.9	98	97	4.6	2.0	5.5
7/25/74	3.6		46		8.7	1.5	1.5
8/5/74	5.7	5.5	83	80	6.0	1.5	2.0
8/13/74	4.6	4.5	59	58	11.3	2.0	5.0
8/20/74	6.2	6.2	87	87	6.6	2.5	4.0
8/27/74	7.7		107		8.8	0.8	2.0
9/10/74	2.6		31		13.7	1.5	1.5
9/16/74	6.5	6.4	83	82	4.0	3.0	6.0
9/17/74	6.4	6.5	83	84	4.8	3.0	6.0

Table 114. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
10/2/74	7.6	7.7	89	91	3.0	3.0	4.0
10/10/74	7.2	7.2	80	80	9.4	3.5	5.5
10/22/74	8.6	8.9	76	81	14.0	2.0	5.0
10/31/74	8.8	8.9	98	100	2.7	4.0	5.0
11/14/74	8.5	8.4	88	87	7.1	0.8	4.5
11/18/74	10.5	10.3	102	100	1.9	4.5	7.5
11/21/74	8.7	8.6	84	83	10.2	3.0	4.0
12/5/74	11.1	11.1	97	96	6.2	1.8	6.0
12/11/74	10.9	11.1	93	95	8.3	2.0	5.0
12/31/74	10.8	10.8	97	96	2.2	2.5	3.5
1/28/75	11.7	11.6	93	93	5.6	2.0	6.0
1/29/75	10.6	10.6	98	98	0.0	2.5	7.5
2/4/75	12.3	12.2	94	93	6.1	2.0	4.5
2/11/75	12.2	12.1	102	100	5.5	3.0	7.0
2/20/75	11.4		102		2.7	3.0	3.0
2/28/75	10.4	10.4	96	95	4.8	2.8	8.0
3/5/75	11.4	11.4	90	90	4.2	1.5	5.0
3/18/75	11.1	11.1	94	94	4.5	2.0	3.5
3/26/75	10.1	10.1	100	100	4.4	2.8	3.5
4/8/75	10.5	10.5	92	92	9.5	2.0	4.0
4/16/75	8.4	8.6	75	77	8.1	2.5	6.0
4/25/75	8.7	8.0	100	91	8.3	2.5	6.0
5/6/75	7.7	7.7	82	82	6.4	1.5	5.0
5/8/75	8.6	9.0	93	98	4.5	3.0	5.0
5/13/75	7.9	7.7	97	94	1.8	1.8	6.0
5/20/75	5.3		64		8.2	1.5	1.5

Table 115. Water analysis data collected at the mouth of Dinner Point Creek station (DPC-2).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
9/11/73	850	Low +5.5	23.0	19.5		27.4		7.90	
10/15/73	1015	Low +4.0	21.0	15.5	15.5	23.8	23.9	7.60	7.63
11/12/73	1125	High	7.5	5.5		26.1		7.80	
11/30/73	1005	Low +2.5	6.7	5.5				6.65	
2/15/74	1125	Low	-1.5	1.3	1.3	17.2		7.05	
2/21/74	1010	High	8.0	3.8	4.0	20.5	22.1	8.10	8.10
6/18/74	800	Low +5.0	24.0	22.5	22.5	23.7	24.8	7.30	7.50
6/25/74	825	Low	17.0	18.5	18.7	23.1	23.1	6.70	6.70
7/9/74	735	Low +0.5	25.0	25.5	25.3	16.9		7.00	
7/23/74	1225	Low +5.5	29.0	24.8	24.8	27.1	27.3	7.80	7.75
8/5/74	1050	Low +5.0	28.0	27.0	25.5	25.8	25.9	8.00	7.95
8/27/74	1040	High +5.5	29.0	25.5	24.9	9.7	9.8	7.05	7.05
9/16/74	1010	High	25.0	20.7	20.7	24.8	24.2	7.28	7.30
10/2/74	1030	High	14.0	15.2	15.0	26.5	26.7	7.75	7.79
10/22/74	855	Low	10.0	5.6	5.6	13.1		6.90	
11/18/74	1245	Low +6.0	12.0	6.5	6.5	26.1	26.3	7.95	7.90
11/21/74	935	Low +0.5	8.0	7.5	7.4	18.2	21.6	7.50	7.45
12/5/74	1445	High	8.5	2.3	2.3	26.0	26.3	7.78	7.78
12/11/74	1345	Low	8.0	2.5	2.6	11.1		6.95	
1/28/75	1105	High +0.5	5.7	3.2	3.2	22.4	22.8	7.70	7.70
2/11/75	1115	High +1.0	7.0	1.0	1.0	22.8	22.8	7.75	7.75
3/18/75	1253	Low +5.0	7.2	5.6	5.4	18.1	18.7	7.70	7.70
4/8/75	745	High	3.3	3.0	2.9	25.0	25.2	7.90	7.85
4/16/75	815	Low +0.5	8.0	6.0	5.6	7.9	13.2	7.00	7.00
5/6/75	1130	High +6.0	19.0	15.0	14.9	8.8	8.8	7.05	7.10
5/13/75	1043	Low +4.5	22.0	19.0	18.8	15.1	19.3	7.79	7.77

Table 115. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
9/11/73	8.8		111		5.9	2.0	3.0
10/15/73	7.6	7.5	87	86	5.9	2.0	7.0
11/12/73	10.8		102		2.7	3.0	5.0
11/30/73	2.8				10.8	0.5	2.0
2/15/74	11.2		89		6.3	1.0	1.5
2/21/74	12.2	10.9	106	94	5.3	1.5	5.0
6/18/74	4.3	4.8	56	63	9.1	2.0	5.0
6/25/74	2.5	2.5	31	30	12.8	2.0	3.0
7/9/74	1.7		22		16.7	2.0	2.0
7/23/74	7.1	6.9	100	98	3.2	2.0	5.0
8/5/74	5.7	5.8	81	82	8.8	1.5	4.0
8/27/74	2.9	2.9	36	37	26.1	0.8	4.0
9/16/74	6.4	6.3	82	79	7.3	1.5	4.5
10/2/74	7.8	7.8	90	90	2.7	3.0	4.0
10/22/74	4.6		40		27.7	1.5	2.0
11/18/74	10.0	10.0	93	93	3.2	4.0	4.0
11/21/74	6.9	7.0	64	66	11.0	2.0	2.5
12/5/74	11.3	11.2	98	98	6.2	2.0	3.5
12/11/74	7.7	7.0	61		8.9	1.0	2.0
1/28/75	11.2	11.1	96	96	5.0	2.5	4.5
2/11/75	12.3	12.0	101	99	4.7	3.5	4.0
3/18/75	10.3	10.5	92	94	8.1	1.5	11.0
4/8/75	10.5	10.4	91	90	8.0	2.5	6.5
4/16/75	7.2	6.7	60	57	6.1	1.5	5.0
5/6/75	5.5	5.6	57	57	7.9	1.0	7.5
5/13/75	7.4	7.6	88	90	3.7	1.8	8.5

Table 116. Water analysis data collected at the Dinner Point Creek station (DPC-2A).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/9/74	755	Low +0.5	26.0	24.0	25.0	14.8	15.9	6.70	6.80
7/23/74	1235	Low +5.5	29.0	24.0	24.0	25.7	26.0	7.45	7.45
8/5/74	1054	Low +5.0	28.0	25.6	25.5	21.8	21.9	8.00	8.05
8/27/74	1150	High +6.0	30.0	26.5	25.0	8.4		6.70	6.50
9/16/74	1020	High	25.5	20.3	20.3	24.4	24.4	7.20	7.20
10/2/74	1035	High	14.0	15.0	15.0	26.5	26.1	7.65	7.75
10/22/74	905	Low	11.0	7.0	7.0	10.2		6.70	
11/18/74	1255	High	12.5	5.5	5.5	21.1	21.3	7.45	7.65
11/21/74	945	Low +0.5	8.0	7.7	7.0	13.6	16.9	6.90	7.25
12/5/74	1500	High	8.0	2.2	2.0	26.1	25.9	7.75	7.75
12/11/74	1400	Low	8.0	4.3	3.5	8.2	10.4	6.55	6.60
1/28/74	1130	High +1.0	5.5	3.0	3.0	22.1	22.1	7.70	7.69
2/11/75	1120	High +1.0	7.0	1.0	1.0	14.8	21.0	7.45	7.50
3/18/75	1304	Low +5.0	7.2	5.6	5.5	14.0	14.4	7.35	7.35
4/8/75	801	High	3.3	3.9	3.7	16.8	18.1	7.70	7.70
4/16/75	825	Low +0.5	8.2	6.2	6.2	5.3		6.90	
5/6/75	1125	High +4.5	21.0	15.2	15.2	7.7	9.7	6.70	6.80
5/13/75	1030	Low +4.5	24.0	19.0	19.0	14.2	14.4	7.30	7.30

Table 116. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/9/74	1.9	0.0	25	0	28.8	1.0	4.5
7/23/74	5.8	5.8	80	79	9.1	1.8	5.0
8/5/74	4.8	4.9	66	66	13.1	1.5	4.0
8/27/74	2.6	1.4	33		26.5	0.8	5.0
9/16/74	5.8	5.8	73	72	8.6	1.5	4.5
10/2/74	8.7	8.7	89	88	5.1	3.0	6.0
10/22/74	2.4		21		36.3	1.5	2.0
11/18/74	8.7	8.8	79	80	11.0	2.8	4.0
11/21/74	3.1	6.1	28	55	12.1	1.0	3.5
12/5/74	11.3	11.1	98	95	7.3	1.8	4.0
12/11/74	5.0	6.5	41	53	10.0	1.0	3.5
1/28/75	11.2	10.8	96	93	5.6	2.0	6.0
2/11/75	9.9	10.9	77	88	6.9	2.0	6.0
3/18/75	10.3	9.8	89	86	7.3	1.5	6.0
4/8/75	9.8	9.8	83	84	7.4	1.3	4.0
4/16/75	6.1		51		7.5	1.0	1.5
5/6/75	5.6	5.8	58	61	9.9	1.0	4.0
5/13/75	5.5	5.4	64	62	3.7	1.3	3.0

Table 117. Water analysis data collected at the Dinner Point Creek station (DPC-3).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
9/11/73	855	Low +5.0	24.0	19.0		26.2		7.75	
10/15/73	1030	Low +4.0	22.5	15.0		22.4		7.53	
11/12/73	1200	High +0.5	7.5	7.5		5.5		7.00	
11/30/73	820	Low +1.5	7.7	6.5				6.30	
1/18/74	1135	High +5.0	3.0	0.4		8.6		6.50	
1/30/74	1240	Low +3.5	15.0	10.0		5.4		7.35	
2/21/74	1025	High +0.5	8.0	4.0	4.0	4.8	9.4	6.70	6.80
6/18/74	810	Low +5.0	25.0	21.7	22.0	18.6	19.3	6.85	6.80
6/25/74	840	Low	16.0	18.5	18.8	19.7	20.0	6.55	6.55
7/9/74	815	Low +0.5	26.5	24.5	24.5	10.0		6.55	
7/23/74	1245	Low +5.5	29.0	23.7	23.7	22.1	22.1	7.00	7.10
8/5/74	1100	Low +5.0	29.0	25.3	25.5	12.8	18.2	7.65	7.83
8/27/74	1200	High +6.0	30.0	26.5	26.0	3.7		6.30	
9/16/74	1030	High	26.0	19.0	19.2	15.8	18.0	6.91	6.93
9/23/74	1000	Low	16.8	16.5		8.5		6.80	
10/2/74	1045	High	13.0	13.8	13.8	10.6	20.2	7.10	7.10
11/18/74	1305	High	12.5	5.5	5.7	14.4	16.2	7.05	7.10
11/21/74	955	Low	8.5	8.0		8.7		6.80	
12/5/74	1505	High	8.0	4.5	1.4	11.5	18.2	6.45	6.97
1/28/75	1140	High +1.0	5.8	3.7	3.0	6.7	13.9	7.05	7.20
2/4/75	1015	High +5.5	-1.0	0.3		4.1		6.60	
2/11/75	1136	High +1.0	7.0	0.5	0.5	8.9	13.7	7.10	7.20
3/5/75	922	High +5.0	5.7	2.5		3.7		6.40	
3/18/75	1310	Low +5.0	7.5	5.9	5.6	7.1	10.7	6.80	6.95
4/8/75	808	High	2.5	4.5	4.3	7.4	10.6	7.00	7.05
4/16/75	835	Low +0.5	8.2	7.0	7.0	3.5		6.50	
5/6/75	1120	High +4.5	23.5	14.7	14.5	3.3		6.40	
5/13/75	1120	Low +4.0	25.0	19.4	19.4	11.5	12.6	7.00	7.00

Table 117. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
9/11/73	5.4		67		4.9	2.0	3.5
10/15/73	6.9		78		12.9	2.0	4.0
11/12/73	9.4		77		9.1	1.5	2.0
11/30/73	3.9				13.2		2.0
1/18/74	8.4		62		13.8	1.5	1.5
1/30/74	6.3		57		18.3	1.5	1.5
2/21/74	7.9	7.6	62	62	5.6	1.5	2.0
6/18/74	2.8	2.3	35	29	16.5	2.0	3.5
6/25/74	2.2	2.1	26	24	14.9	3.0	3.5
7/9/74	0.8		11		19.2	6.0	2.0
7/23/74	4.9	4.7	65	62	13.0	1.8	3.0
8/5/74	3.6	3.4	47	45	20.6	1.5	3.0
8/27/74	1.8		23		13.0	0.8	1.5
9/16/74	3.4	3.3	41	40	12.1	2.5	2.5
9/23/74	0.6		6		24.8	0.8	2.0
10/2/74	5.4	6.3	55	68	6.5	3.0	4.0
11/18/74	6.2	6.3	76	55	0.0	1.5	3.5
11/21/74	3.4		30		12.4	1.0	1.0
12/5/74	7.4	9.1	62	73	7.3	1.5	3.0
1/28/75	6.9	8.5	54	69	6.1	1.5	3.0
2/4/75	6.3		43		9.5	1.0	1.0
2/11/75	8.6	10.2	63	78	10.6	1.0	3.0
3/5/75	5.9		45		5.0		1.0
3/18/75	8.2	8.4	69	71	10.5	1.3	3.5
4/8/75	8.9	8.7	72	72	4.6	1.0	3.0
4/16/75	5.2		44		8.3	0.5	1.0
5/6/75	4.4		44		9.1	1.0	2.0
5/13/75	3.8	3.8	44	43	5.3	1.0	2.5

Table 118. Nutrient analysis data collected at the Dinner Point Creek station (DPC-1).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/l)	NO_3-N ($mgNO_3$-N/l)	NH_3-N ($mgNH_3$-N/l)	PO_4-P ($mgPO_4$-P/l)	Detergent (mg/l)
8/30/73	1315	High +2.0	28.5	1.0	0.007		0.30		
9/27/73	1515	High +5.0	21.0	0.8			<0.14	0.050	
10/31/73	715	Low +6.0	9.4	0.4			<0.20	0.016	<0.20
11/20/73	1220	High +6.0	6.8	3.2			<0.20	0.000	<0.20
1/31/74	950	Low	5.5	2.4			0.14	0.110	<0.20
6/30/74	1145	High +5.0	25.2	3.6		0.90	0.00	0.000	0.00
7/30/74	1035	High +3.5	26.5	4.2		0.57		0.080	
9/24/74	755	High +1.5	15.4	1.4		0.80	0.00	0.040	
10/30/74	1110	High +2.0	13.8	1.8		0.70	0.00	0.040	
2/20/75	1110	Low	4.6	3.0		0.04	0.00	<0.010	
5/22/75	847	High +1.5	21.0	3.6		0.61	0.00	<0.010	

Table 119. Nutrient analysis data collected at the Dinner Point Creek station (DPC-3).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/l)	NO_3-N ($mgNO_3$-N/l	NH_3-N ($mgNH_3$-N/l)	PO_4-P ($mgPO_4$-P/l)	Detergent (mg/l)
6/30/74	1015	High +3.0	24.5	1.8		1.37	0.00	<0.010	
7/30/74	1140	High +4.0	30.0	2.4		0.97		0.030	0.18
9/24/74	915	High +5.0	14.0	1.2		2.02	0.00	0.020	0.12
10/30/74	1450	High +5.0	15.5	1.8		2.42	0.00	0.040	0.34
11/26/74	1330	High +6.0	6.5	3.6		2.80	0.00	0.040	0.03
1/2/75	1415	High +0.5	5.2	3.2		1.10	0.00	0.020	0.07
2/20/75	1213	Low +0.5	10.8	2.0		2.33	0.16	0.030	0.05
4/21/75	1004	High -4.0	10.5	1.4		1.95	0.00	0.040	0.09
5/22/75	1037	High -3.0	24.5	2.2		3.98	0.14	0.050	0.07

Table 120. Nutrient analysis data collected at the Meyers Pond station (MP-0).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/l)	NO_3-N ($mgNO_3$-N/l)	NH_3-N ($mgNH_3$-N/l)	PO_4-P ($mgPO_4$-P/l)	Detergent (mg/l)
8/30/73	1335	High +2.5	29.0	1.4	0.002		0.30		
9/27/73	1530	High +5.5	21.0	1.0			<0.14	0.050	
10/31/73	725	Low +0.5		0.0			<0.20	0.013	<0.20
11/20/73	1230	High +5.5		3.0			<0.20	0.021	<0.20
1/31/74	1015	Low	4.5	2.2			0.14	0.040	<0.20
6/30/74	1200	High +5.5	26.7	3.8		0.96	0.00	0.000	
7/30/74	1050	High +3.5	26.7	5.5		0.82		0.060	
9/24/74	805	High +4.0	15.0	1.6		0.88	0.00	0.030	
10/30/74	1115	High +3.0	13.8	1.8		0.73	0.00	0.030	
2/20/75	1130	Low	5.0	3.0		0.80	0.00	0.020	
5/22/75	902	High +1.5	21.2	0.2		0.70	0.00	0.010	

Table 121. Nutrient analysis data collected at the Popular Point station (PP-0).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/l)	NO_3-N ($mgNO_3$-N/l)	NH_3-N ($mgNH_3$-N/l)	PO_4-P ($mgPO_4$-P/l)	Detergent (mg/l)
8/30/73	1345	High +2.5	29.5	1.0	0.002		0.30		
9/27/73	1555	High +5.5	21.3	1.2			<0.14	0.085	<0.20
10/31/73	745	Low +1.5		0.6			<0.20	0.028	<0.20
11/20/73	1250	Low +5.5		2.6			<0.20	0.013	<0.20
1/31/74	1025	Low	5.7	3.4			0.14	0.050	
6/30/74	1215	High +5.5	26.0	4.2		0.93	0.00	0.000	
7/30/74	1100	High +3.5	27.8	6.0		0.71		0.080	
9/24/74	815	High +4.0	15.4	2.0		1.04	0.00	0.090	
10/30/74	1130	High +2.0	14.0	2.2		0.76	0.00	0.030	
2/20/75	1140	Low	4.5	2.2		0.48	0.00	0.010	
5/22/75	910	High +3.5	21.8	0.2		0.63	0.00	0.010	

Table 122. Water analysis data collected at the mouth of Mill Creek station (MC-0).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	945	High +4.0	23.0	24.5	24.5			7.80	7.80
8/16/73	1115	High	24.0	25.0	25.0	24.8	25.5	8.20	8.20
9/11/73	940	High +0.5	25.5	21.0	21.5	26.0	25.8	8.00	8.00
9/26/73	1030	High +1.0	24.5	18.9	18.7	22.1	22.5	7.80	7.80
9/27/73	1605	High +5.5	22.5	20.5	20.5	15.5	22.5	7.90	7.60
10/15/73	1110	Low +4.5	22.5	16.0	15.8	23.0	23.1	7.89	7.82
10/31/73	805	Low	7.1	11.0	12.0	8.6	23.6	7.05	7.30
11/12/73	1235	High +1.5	5.5	4.3	4.3	23.2	23.5	7.90	7.95
11/13/73	1250	High +1.0	10.5	5.5	5.5	22.8	22.9	7.90	7.90
11/20/73	1310	Low	7.0	8.0	6.9	15.4	22.4	8.20	8.05
12/12/73	1140	High	2.0	4.5	4.0	24.2	24.1	7.65	7.60
12/18/73	1235	Low +0.5	-1.0	1.0	0.5	12.1	22.3	7.20	7.50
1/17/74	1205	Low	1.3	2.0	1.0	11.2	18.8	7.30	7.75
1/18/74	1135	Low +0.5	0.0	1.0	-0.5	17.7	18.9	7.30	7.50
2/14/74	1120	Low +0.5	5.5	3.2	2.2	19.2	20.4	7.45	7.75
2/15/74	1215	Low +0.5	-1.0	2.3	1.0	12.7	22.8	6.90	6.95
2/21/74	1110	High	7.7	3.4	3.4	22.6	22.8	8.00	8.10
2/28/74	1555	High +1.5	6.5	4.0	4.0	23.0	23.0		
6/18/74	840	High +0.5	25.0	23.2	23.0	24.3	24.9	8.10	8.05
6/20/74	955	High	26.5	23.5	23.2	23.9	25.3	8.03	8.00
6/25/74	930	Low +0.5	17.0	21.0	20.0	14.6	21.8	7.65	7.75
6/29/74	1515	Low +1.0	25.0	24.0	23.0	12.9	23.8	8.20	7.95
7/9/74	915	Low +1.5	29.0	28.0	27.5	14.4	21.6	8.10	8.05
7/10/74	1310	Low +5.0	33.5	29.5	29.0	24.0	23.6	8.15	8.10
7/23/74	1315	High	26.0	25.0	24.5	25.0	24.8	7.95	7.95
7/25/74	810	High +6.0	21.0	23.5	22.7	16.4	25.3	7.51	7.70
8/5/74	1127	High	28.0	26.0	25.7	26.9	27.1	7.95	7.85
8/13/74	1135	High +6.0	24.0	23.5	22.5	14.2	24.6	8.45	8.00
8/20/74	1215	High	31.6	26.2	25.8	24.1	23.9	7.95	7.85
8/27/74	1245	Low	31.0	26.5	25.5	12.3	19.2	8.35	7.50
9/10/74	945	High +6.0	25.0	22.0	21.2	12.2	21.0	8.23	7.60
9/16/74	1110	High +1.0	26.0	21.5	21.0	22.1	23.3	7.28	7.30
9/17/74	1100	High +0.5	23.5	21.9	21.5	22.5	23.0	7.60	7.40

Table 122. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
9/23/74	1045	Low +0.5	16.0	19.5	19.0	14.9	21.8	7.55	7.50
10/2/74	1120	High +1.0	13.0	15.5	15.3	24.9	24.5	7.85	7.85
10/10/74	1055	High +6.0	22.0	15.0	14.0	16.7	24.9	8.25	8.25
10/22/74	935	Low	11.0	8.8	7.5	16.0	21.8	7.90	8.00
10/31/74	1100	High +1.0	19.0	14.4	14.4	23.9	23.9	8.20	8.10
11/14/74	1050	High +1.0	12.0	10.2	10.2	25.5	25.2	8.00	8.00
11/18/74	1415	High +1.5	10.0	6.5	6.2	25.2	24.7	8.00	7.95
11/21/74	1030	Low +1.0	7.0	7.4	7.5	15.8	21.9	7.70	7.95
12/4/74	1315	Low +5.5	5.0	3.2	3.1	25.7	26.1	7.80	7.85
12/11/74	1430	Low	6.0	4.2	4.0	17.1	23.8	7.75	7.70
12/31/74	1020	Low +4.5	2.0	3.0	3.0	23.1	23.2	7.90	7.75
1/29/75	1245	High +1.5	7.0	4.3	4.3	21.0	21.2	7.90	8.00
1/31/75	1245	Low +5.5	1.5	3.7	3.7	19.1	22.7	7.75	7.65
2/3/75	1120	Low +1.0	1.0	2.5	1.0	12.2	16.3	7.60	7.60
2/13/75	1225	High +1.0	-4.0	-0.5	-0.2	19.3	19.5	7.70	7.70
2/20/75	1110	Low	8.5	5.0	3.8	11.5	19.8	7.50	7.80
2/28/75	1230	High +0.5	3.0	5.1	4.7	23.0	23.2	7.90	7.75
3/5/75	1034	Low	3.5	2.5	1.5	14.1	20.2	7.60	7.70
3/25/75	921	High +1.0	14.1	9.3	9.4	20.9	20.9	7.85	7.85
4/1/75	754	High +5.5	9.5	6.4	6.0	13.0	19.8	7.75	7.78
4/8/75	845	High +1.0	5.0	3.1	3.0	21.6	22.1	7.85	7.87
4/25/75	1115	High +2.0	15.5	13.0	13.0	25.4	25.2	7.70	7.68
5/6/75	1245	Low	16.0	14.3	12.7	9.2	19.3	7.60	7.95
5/8/75	745	Low +5.0	13.5	14.0	14.0	12.4	22.5	8.18	8.23
5/13/75	1132	High	22.5	19.0	18.4	20.0	20.6	8.10	8.10
5/20/75	1108	High +5.5	23.5	21.5	21.5	8.9	17.0	7.55	7.95

Table 122. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/26/73	7.4	5.7				3.5	14.0
8/16/73	6.1	6.0	84	83	5.4	4.0	14.0
9/11/73	6.5	7.0	84	91	2.0	4.0	12.0
9/26/73	6.6	5.0	79	59	0.0	3.5	13.5
9/27/73	8.3	6.1	100	75	5.2	2.5	9.0
10/15/73	7.7	7.6	89	87	3.7	3.0	16.0
10/30/73	7.7	6.8	73	73	0.8	2.0	10.0
11/12/73	11.1	10.6	99	99	2.5	4.0	13.0
11/13/73	11.4	11.4	105	105	2.3	4.5	13.0
11/20/73	12.0	11.1	110	100		3.5	10.0
12/12/73	10.0	9.8	91	88	6.4	3.5	9.0
12/18/73	11.3	10.8	86	87	3.7	2.0	8.0
1/17/74	13.0	12.4	101	99	4.3	3.0	9.5
1/18/74	11.7	13.0	97	96	0.0	3.0	12.0
2/14/74	12.3	12.2	104	102	4.6	4.0	8.0
2/15/74	11.9	11.5	94	94	3.6	3.0	17.0
2/21/74	11.3	11.1	98	97	5.1	3.0	12.0
2/28/74	12.0	11.8	105	103	4.1	2.0	14.0
6/18/74	6.9	6.5	92	87	0.0	2.0	12.0
6/20/74	6.8	6.4	92	86	2.1	2.0	9.0
6/25/74	6.7	6.2	81	77	3.4	2.0	9.0
6/29/74	10.2	8.8	128	117	0.0	2.0	8.0
7/9/74	7.7	6.6	105	95	3.0	2.0	9.0
7/10/74	7.9	7.6	118	115	0.0	2.0	12.0
7/23/74	7.8	7.3	109	100	2.1	2.0	13.0
7/25/74	5.7	5.1	73	67	3.9	2.0	12.0
8/5/74	5.6	5.0	81	72	6.3	2.0	10.0
8/13/74	8.8	6.5	110	85	2.4	1.8	14.0
8/20/74	6.3	6.2	89	88	6.1	2.5	14.0
8/27/74	9.6	4.2	126	57	3.4	1.6	12.0
9/10/74	9.8	6.4	118	80	1.9	2.0	9.0
9/16/74	6.5	6.3	82	80	5.1	2.0	13.0
9/17/74	6.6	6.3	85	80	4.3	2.0	11.0

Table 122. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
9/23/74	8.3	7.0	97	85	4.0	2.8	8.5
10/2/74	7.6	7.6	88	87	3.2	3.0	13.0
10/10/74	9.6	9.0	104	100	3.5	3.5	9.5
10/22/74	10.0	9.6	94	91	5.4	3.0	8.0
10/31/74	8.5	8.6	95	96	1.9	4.5	11.0
11/14/74	8.7	8.7	91	91	6.4	1.5	14.0
11/18/74	10.2	10.3	98	97	3.0	4.5	13.0
11/21/74	10.4	9.8	96	95	4.3	6.0	9.5
12/4/74	11.3	11.4	95	93	4.8	0.8	13.0
12/11/74	11.9	10.4	101	93	3.5	2.5	12.0
12/31/74	11.0	10.1	95	87	4.3	3.0	9.0
1/29/75	11.2	11.0	99	98	4.5	2.5	10.0
1/31/75	11.1	11.0	95	94	3.2	3.5	13.0
2/3/75	11.5	11.7	91	91	3.7	3.0	8.0
2/13/75	12.4	12.2	95	95	3.7	3.0	11.0
2/20/75	11.5	11.3	96	98	7.4	3.0	8.0
2/28/75	11.0	10.3	99	92	4.2	3.5	12.0
3/5/75	11.7	11.5	93	93	2.6	5.0	9.8
3/25/75	9.5	9.6	93	95	2.5	3.5	12.0
4/1/75	10.5	10.3	92	94	5.1	4.5	9.0
4/8/75	10.9	10.5	93	90	6.7	3.0	8.0
4/25/75	8.2	8.5	90	94	8.3	3.3	14.0
5/6/75	9.2	8.9	95	93	4.1	3.0	10.0
5/8/75	8.9	9.0	98	110	0.0	6.0	13.0
5/13/75	7.6	8.6	92	101	0.0	3.8	13.0
5/20/75	6.4	5.8	76	72	6.3	2.0	10.0

Table 123. Water analysis data collected at the Mill Creek station (MC-1).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
9/11/73	955	High +1.0	26.5	21.0	21.5	24.9	26.0	8.00	8.00
10/15/73	1125	Low +5.0	22.5	16.0	16.0	23.2	23.6	7.88	7.82
11/12/73	1245	High +1.5	6.5	4.5	4.3	23.0	23.0	8.00	7.50
2/15/74	1225	Low +1.5	-1.0	2.5	1.5	10.4	22.4	7.05	7.02
2/21/74	1120	High +1.5	7.8	4.2	3.5	20.3	22.8	8.10	8.10
6/18/74	850	High +0.5	25.0	24.9	23.2	20.5	24.8	8.10	8.10
6/25/74	945	Low +1.0	17.0	21.0	20.5	13.3	21.4	7.50	7.80
7/9/74	920	Low +1.5	29.0	27.8	28.0	13.3	22.8	8.10	7.80
7/23/74	1320	High	27.0	25.0	24.5	25.0	25.0	7.95	7.90
8/5/74	1130	High	29.0	26.5	25.7	26.7	27.1	8.05	7.80
8/27/74	1300	Low	31.0	26.7	25.2	11.7	14.2	8.25	7.80
9/16/74	1125	High +1.5	26.5	21.5	21.3	22.8	22.5	7.40	7.35
9/23/74	1100	Low +1.0	16.0	20.0	19.8	14.0	23.4	7.50	7.50
10/2/74	1125	High +1.0	13.0	15.7	15.5	24.1	24.3	7.85	7.85
10/22/74	945	Low +0.5	11.0	9.3	7.2	15.5	24.7	7.95	8.05
11/18/74	1420	High +1.5	10.0	6.2	6.1	24.9	24.9	7.95	7.90
11/21/74	1040	Low +1.0	7.2	7.9	7.9	15.4	20.7	7.95	8.02
12/4/74	1330	Low +5.5	5.5	3.1	3.1	22.1	26.1	7.85	7.80
12/11/74	1440	Low	6.0	4.5	3.0	15.8		7.65	7.70
1/31/75	1300	High	2.0	3.7	3.7	20.4	20.8	7.80	7.75
2/3/75	1128	Low +1.0	0.8	2.6	1.5	11.9	13.7	7.42	7.45
2/13/75	1250	High +1.5	-4.0	0.3	0.0	17.7	18.7	7.65	7.60
3/5/75	1040	Low	3.5	2.9	1.4	13.8	21.0	7.50	7.70
3/25/75	930	High +1.5	14.0	9.5	9.5	20.9	20.7	7.87	7.83
4/1/75	802	High +5.5	9.5	6.5	6.5	12.1	18.6	7.45	7.72
4/8/75	849	High +1.0	5.0	9.5	3.3	20.2	20.9	7.85	7.80
5/6/75	1253	Low	16.0	15.0	12.5	7.1	20.8	7.55	7.92
5/13/75	1137	High	22.0	19.0	18.2	20.3	20.9	8.08	8.12

Table 123. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
9/11/73	6.2	6.2	79	81	3.9	4.0	12.0
10/15/73	7.4	7.4	87	86	3.5	3.0	13.0
11/12/73	11.0	11.0	99	98	2.2	4.0	18.0
2/15/74	11.9	11.4	93	94	3.1	3.5	11.0
2/21/74	11.4	11.0	100	97	3.6	3.0	15.0
6/18/74	7.2	6.1	95	82	2.7	2.5	13.0
6/25/74	6.8	6.3	81	77	3.2	2.0	9.0
7/9/74	7.6	5.6	107	81		2.0	16.0
7/23/74	7.3	6.7	101	92	0.2	2.0	11.0
8/5/74	6.0	4.9	86	69	9.1	2.0	13.5
8/27/74	9.5	6.4	125	83	3.6	2.0	9.0
9/16/74	6.7	5.7	85	72	2.2	1.8	14.0
9/23/74	8.4	6.1	99	76	3.8	2.8	9.0
10/2/74	7.8	7.6	90	87	3.5	3.0	14.0
10/22/74	9.8	9.6	93	93	5.4	3.0	13.0
11/18/74	10.0	9.9	94	93	3.2	4.5	16.0
11/21/74	9.9	9.6	92	91	4.3	5.0	10.5
12/4/74	10.6	10.3	94	89	5.1	1.0	12.0
12/11/74	11.9	10.2	102		4.0	2.5	12.0
1/31/74	11.0	10.8	95	93	4.8	3.0	15.0
2/3/75	11.9	11.4	94	90	3.2	3.5	8.0
2/13/75	12.4	11.8	96	91	4.5	3.0	15.0
3/5/75	11.7	11.4	94	93	3.2	4.5	11.5
3/25/75	9.4	9.4	93	93	2.5	3.5	14.0
4/1/75	10.3	10.1	90	93	3.2	4.3	10.0
4/8/75	10.9	10.9	94	93	6.1	2.8	12.0
5/6/75	9.3	8.0	96	84	3.7	3.0	13.5
5/13/75	8.1	8.3	98	98	0.0	3.5	13.0

Table 124. Water analysis data collected at the Mill Creek station (MC-2).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	1010	High +4.5	24.0	24.5	25.0			7.60	7.20
9/11/73	1005	High +1.0	26.5	22.5	22.5	13.0	20.7	7.95	8.00
10/15/73	1145	Low +5.0	23.5	16.5	16.5	20.7	20.6	7.81	7.70
11/12/73	1255	High +2.0	6.5	6.0	5.0	13.9	21.2	6.80	7.90
12/12/73	1150	High	2.5	4.5	4.5	18.2	23.0	7.60	7.65
12/18/73	1255	Low +0.5	0.0	0.8	1.5	10.6	18.3	7.00	7.20
1/18/74	1350	Low +0.5	-0.5	1.5	1.0	4.1	15.5	6.80	7.35
2/15/74	1230	Low +0.5	0.0	2.6	2.0	6.5	17.7	7.15	7.10
2/21/74	1130	High +2.0	7.8	4.5	4.0	10.2	21.1	7.70	8.00
6/18/74	900	High +0.5	25.0	23.4	24.1	10.7	20.4	7.90	8.05
6/25/74	1000	Low +1.0	17.0	21.0	21.0	9.4	22.6	7.30	7.65
7/9/74	925	Low +1.5	29.0	28.0	28.0	12.6	16.2	7.90	7.85
7/23/74	1335	High	28.0	25.3	24.3	18.2	22.1	7.95	7.80
8/5/74	1150	High +0.5	30.0	27.5	26.6	15.3	21.8	7.90	8.15
8/27/74	1315	Low +0.5	30.0	26.7	25.5	10.3	13.3	8.10	7.40
9/16/74	1135	High +1.5	27.5	22.7	21.8	14.2	19.6	7.32	7.30
9/23/74	1110	Low +1.0	16.0	20.5	21.2	12.7	20.4	7.30	7.35
10/2/74	1135	High +1.0	14.0	16.3	16.3	14.0	21.8	7.80	7.75
10/22/74	955	Low	11.0	9.7	8.7	10.4	20.0	7.60	7.85
11/18/74	1435	High +1.5	10.0	8.0	6.9	16.2	22.2	7.75	7.85
11/21/74	1050	Low +1.0	7.5	8.5	8.0	12.4	21.2	7.90	8.00
12/4/74	1345	Low +5.5	5.5	4.0	3.7	17.9	20.7	7.70	7.70
12/11/74	1445	Low	6.0	4.8	3.3	12.1	21.6	7.45	7.55
1/31/75	1315	High	3.0	4.0	4.5	12.1	16.8	7.60	7.70
2/3/75	1140	Low +1.0	1.0	3.4	2.2	8.6	15.9	7.30	7.35
2/13/75	1305	High +1.5	-4.0	1.6	0.4	10.1	16.2	7.55	7.43
3/5/75	1050	Low	3.5	3.9	2.4	9.4	19.0	7.30	7.65
3/25/75	939	High +1.5	12.6	10.4	9.5	9.0	17.5	7.35	7.75
4/1/75	818	High +5.5	9.5	7.0	6.4	9.2	17.7	7.32	7.68
4/8/75	904	High +1.0	5.2	4.3	4.9	10.3	17.9	7.80	7.80
5/6/75	1313	Low	16.5	15.3	13.0	6.5	18.0	7.40	7.80
5/13/75	1154	High +0.5	22.8	20.6	18.8	9.1	15.5	7.65	7.95

Table 124. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/26/73	7.0	2.9			4.4	3.0	10.0
9/11/73	7.2	6.4	88	83	4.9	3.0	9.0
10/15/73	6.9	7.2	79	83	4.4	3.0	16.0
11/12/73	10.5	10.7	92	94	2.0	3.5	12.0
12/12/73	9.8	9.9	82	81	4.7	3.5	16.0
12/18/73	11.0	10.4	82	84	1.7	2.5	9.0
1/18/74	12.0	12.0	88	94	2.9	3.5	14.0
2/15/74	11.8	11.6	90	95	2.7	3.5	10.0
2/21/74	11.7	11.3	96	99	3.1	3.0	15.0
6/18/74	7.8	6.0	96	80	3.0	2.5	16.0
6/25/74	6.7	5.2	79	66	3.4	2.5	15.0
7/9/74	6.5	5.3	89	74	2.5	2.0	10.0
7/23/74	7.7	6.5	103	88	2.5	2.0	16.0
8/5/74	6.8	5.3	93	74	4.8	2.0	10.0
8/27/74	9.8	4.2	120	55	3.2	2.0	10.0
9/16/74	8.9	6.0	110	76	3.5	3.0	13.0
9/23/74	7.9	4.7	93	58	4.0	3.0	13.5
10/2/74	8.8	7.6	97	87	3.5	3.5	15.0
10/22/74	10.2	9.1	95	88	4.0	4.0	16.0
11/18/74	10.3	9.5	97	89	4.0	4.5	15.0
11/21/74	10.1	9.1	93	88	4.8	5.0	16.0
12/4/74	10.9	10.4	93	91	4.6	2.5	15.0
12/11/74	12.3	11.1	104	98	4.3	2.3	14.0
1/31/75	10.7	10.7	88	93	4.0	3.0	12.0
2/3/75	10.9	10.8	86	88	2.9	3.5	14.0
2/13/75	12.0	11.8	91	91	3.7	3.0	14.0
3/5/75	11.7	11.7	94	97	2.9	4.0	15.0
3/25/75	9.5	9.3	89	90	7.8	3.5	16.0
4/1/75	10.2	10.1	88	91	3.8	3.5	15.0
4/8/75	11.3	10.8	92	94	4.5	2.5	16.0
5/6/75	9.3	7.6	96	80	3.7	2.5	15.0
5/13/75	7.9	7.4	91	86	2.6	3.5	14.5

Table 125. Water analysis data collected at the Mill Creek station (MC-3).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/26/73	1111	High +5.5	24.0	24.0	25.0			7.60	6.70
9/11/73	1010	High +1.0	27.1	21.5	22.5	6.6	16.6	7.70	7.70
10/15/73	1155	High	23.5	17.0	17.0	16.2	19.6	7.89	7.80
11/12/73	1315	High +2.0	6.0	6.5	6.0	14.6	15.3	7.80	7.90
12/12/73	1205	High +0.5	2.0	5.0	4.5	13.7	20.9	7.60	7.55
12/18/73	1305	Low +1.0	0.0	1.0	1.5	10.3	11.5	7.65	6.85
1/18/74	1400	Low +0.5	0.0	1.5	1.5	4.0	11.2	6.72	7.05
2/15/74	1235	Low +0.5	2.5	2.9	2.3	6.6	15.9	7.25	7.50
2/21/74	1140	High +2.0	8.0	4.3	4.1	9.7	13.7	7.80	7.70
6/18/74	910	High +1.0	25.0	23.3	23.7	5.4	13.7	7.85	7.90
6/25/74	1015	Low +1.0	17.0	21.2	21.0	9.3	17.5	7.10	7.35
7/9/74	945	Low +1.5	29.0	28.5	28.0	10.7	15.1	7.60	7.60
7/23/74	145	Low +1.5	28.0	25.6	24.8	14.1	21.2	8.35	7.80
8/5/74	1200	High +0.5	30.0	27.6	25.7	11.9	20.5	8.70	8.05
8/27/74	1325	Low +0.5	29.0	26.7	25.7	9.5	11.0	8.10	7.60
9/16/74	1150	High +2.0	28.0	22.5	22.5	12.4	13.7	7.49	7.49
9/23/74	1125	Low +1.0	16.0	20.7	21.2	11.8	15.8	7.35	7.30
10/2/74	1145	High +1.0	14.0	16.3	16.7	12.0	14.0	7.60	7.65
10/22/74	1010	Low +0.5	12.0	8.8	10.0	9.3	17.3	7.70	8.00
11/18/74	1445	High +2.0	10.5	8.0	7.9	13.1	15.7	7.60	7.70
11/21/74	1110	Low +1.0	7.0	8.6	8.0	13.1	17.4	7.75	7.95
12/4/74	1400	Low +5.5	6.0	3.8	3.8	17.7	20.4	7.60	7.60
12/11/74	1455	Low	6.0	4.9	4.9	9.8	15.7	7.70	7.65
1/31/75	1325	High +0.5	3.0	4.5	4.2	10.7	16.1	7.40	7.45
2/3/75	1146	Low +1.0	1.0	3.6	2.9	8.6	10.0	7.15	7.28
2/13/75	1315	High +1.5	-4.0	2.0	1.9	8.8	8.0	7.30	7.40
3/5/75	1056	Low	3.8	4.1	3.6	7.7	12.3	7.20	7.25
3/25/75	946	High +1.5	13.0	10.9	9.9	6.8	9.9	7.25	7.20
4/1/75	829	High +5.0	10.0	7.3	7.1	6.8	9.2	7.25	7.20
4/8/75	911	High +1.0	5.3	4.4	4.0	8.1	14.2	7.35	7.20
5/6/75	1319	Low	16.5	15.1	13.5	5.5	7.5	7.30	7.30
5/13/75	1200	High +0.5	22.0	20.7	18.5	8.6	10.8	7.60	7.63

Table 125. Continued.

Date	D.O. (mgO_2/l) Surface	Bottom	O_2 saturation (%) Surface	Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/26/73	7.2	3.6			4.7	3.0	5.5
9/11/73	7.8	5.5	91	69	2.5	3.0	8.0
10/15/73	7.9	7.3	89	84	3.5	3.0	6.0
11/12/73	11.8	11.2	105	99	2.5	3.0	8.0
12/12/73	10.7	10.0	91	88	5.1	4.0	7.0
12/18/73	10.9	10.9	84	85	3.7	2.5	6.0
1/18/74	11.6	11.5	85	88	2.9	4.0	6.0
2/15/74		11.8		95	3.6	3.5	6.0
2/21/74	11.6	11.6	95	97	3.1	3.0	6.0
6/18/74	8.4	6.5	102	82	2.5	2.5	6.0
6/25/74	7.5	4.6	87	56	6.6	2.0	6.0
7/9/74	6.9	4.6	94	64	2.7	2.5	5.0
7/23/74	10.4	5.7	139	78	0.0	2.0	7.5
8/5/74	8.5	4.8	114	65	2.3	2.0	6.0
8/27/74	9.1	5.7	118	73	3.9	2.0	5.0
9/16/74	8.8	7.8	108	97	3.5	3.0	5.5
9/23/74	7.9	5.4	93	66	3.2	3.0	5.0
10/2/74	9.0	8.2	97	90	3.5	3.5	6.0
10/22/74	10.6	9.2	96	89	3.0	3.5	5.0
11/18/74	10.3	10.1	95	96	3.5	4.5	6.0
11/21/74	10.1	9.6	94	90	4.0	5.0	6.5
12/4/74	10.9	10.3	93	91	4.8	3.0	6.0
12/11/74	13.3	12.0	110	103	2.7	2.5	5.0
1/31/75	10.6	10.7	88	83	4.2	3.0	4.5
2/3/75	10.7	10.8	85	85	2.7	3.5	5.0
2/13/75	11.6	11.7	88	89	2.7	3.3	5.0
3/5/75	11.7	11.4	94	93	2.4	4.0	4.5
3/25/75	9.3	9.2	87	86	2.0	3.0	6.5
4/1/75	10.6	10.3	91	90	4.5	4.5	4.5
4/8/75	11.3	11.1	91	92	3.3	2.0	6.0
5/6/75	9.2	8.8	94	88	2.6	2.5	4.5
5/13/75	8.1	7.8	93	88	2.4	3.8	5.3

Table 126. Water analysis data collected at the Mill Creek station, Lagoon 81 (MC-4).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
9/11/73	1020	High +1.0	28.0	22.5	23.5	12.9	14.7	7.70	7.30
10/15/73	1240	High +0.5	25.5	18.5	19.0	14.5	14.3	7.60	7.40
11/12/73	1330	High +2.5	5.5	8.5	8.5	10.6	15.4	7.90	7.60
12/12/73	1215	High +0.5	2.0	6.0	8.5	14.9	17.8	7.40	7.30
12/18/73	1317	Low +0.5	0.0	4.0	5.5	16.8	17.5	7.05	6.85
1/18/74	1420	Low +0.5	0.0	1.0	4.0	3.0	10.3	6.70	6.55
2/15/74	1245	Low +0.5	4.0	2.0	2.6	4.0	13.2	6.70	6.80
2/21/74	1155	High +2.0	8.1	5.3	5.0	8.4	13.9	7.40	7.60
6/18/74	925	High +1.0	27.0	24.0	18.5	7.7	13.3	8.00	6.95
6/25/74	1025	Low +1.0	17.0	19.7	21.5	7.4	24.8	7.80	7.00
7/9/74	1000	Low +2.0	30.0	28.0	22.5	11.8	13.7	8.05	6.80
7/23/74	1350	High +0.5	28.0	27.0	23.5	9.5	16.0	8.80	6.95
8/5/74	1207	High +0.5	28.4	26.5	26.5	11.2	13.5	8.90	7.35
8/27/74	1335	Low +0.5	29.0	27.5	23.0	7.7	10.3	8.50	6.80
9/16/74	1200	High +2.0	28.0	23.5	21.3	12.8	13.9	7.50	7.09
9/23/74	1140	Low +1.0	16.0	20.0	21.5	10.9	14.6	7.25	7.00
10/2/74	1150	High +1.0	14.5	18.8	18.0	14.9	15.5	7.35	7.20
10/22/74	1015	Low +0.5	13.5	12.5	12.5	14.7	16.2	7.75	7.65
11/18/74	1455	High +2.0	10.5	10.0	11.5	16.9	17.3	8.15	7.55
11/21/74	1120	Low +1.5	7.0	8.9	10.0	12.6	17.4	7.55	7.55
12/4/74	1405	Low +5.5	6.5	3.8	5.8	17.0	20.2	7.76	7.45
12/11/74	1505	Low +0.5	6.0	3.5	7.0	10.7	19.3	7.40	6.90
1/31/75	1335	High +0.5	3.2	3.5	6.0	4.8	13.0	6.90	7.10
2/13/75	1325	High +2.0	-4.0	1.6	2.6	7.7	9.9	6.70	6.75
3/5/75	1113	Low	4.0	3.5	5.1	10.4	11.4	7.15	7.10
3/25/75	958	High +1.5	13.2	10.5	8.0	10.6	13.2	7.05	7.00
4/1/75	840	High +5.0	10.0	7.5	7.6	12.1	13.9	7.25	7.20
4/8/75	924	High +1.5	5.5	5.5	4.5	10.3	11.5	7.50	7.25
5/6/75	1330	Low	17.0	17.2	12.9	6.1	11.9	7.40	7.00
5/13/75	1215	High +1.5	22.3	21.6	14.0	9.1	10.4	7.49	7.00

Table 126. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
9/11/73	4.3	2.1	53	26	6.6	2.0	8.0
10/15/73	6.8	5.9	78	68	3.9	3.0	11.0
11/12/73	15.0	6.3	135	59	0.0	3.0	10.0
12/12/73	8.9	5.5	78	52	4.4	4.5	10.0
12/18/73	8.7	6.4	72	55	3.2	4.0	8.0
1/18/74	11.7	11.1	84	89	2.7	3.0	6.0
2/15/74	10.9	8.7	81	70	2.9	4.5	8.0
2/21/74	11.5	9.8	96	84	0.0	3.0	8.0
6/18/74	9.2	0.7	112	8	2.1	3.0	9.0
6/25/74	7.4	0.6	83	8	1.6	3.0	8.0
7/9/74	8.0	1.5	109	18	2.7	2.0	7.0
7/23/74	12.5	0.0	163	0	0.0	1.0	10.0
8/5/74	11.0	0.0	144	0	1.5	2.0	8.5
8/27/74	13.0	0.0	169	0	0.0	2.5	7.0
9/16/74	8.5	2.5	106	30	3.8	2.5	7.0
9/23/74	9.5	0.5	110	6	3.2	3.0	7.0
10/2/74	3.8	3.5	44	40	5.4	3.0	8.5
10/22/74	9.8	9.8	104	75	4.0	3.5	7.0
11/18/74	12.1	6.4	119	65	1.6	3.3	8.0
11/21/74	7.4	6.5	71	64	8.6	3.5	6.0
12/4/74	12.3	9.4	104	86	3.8	3.0	6.0
12/11/74	12.3	1.3	99	12	5.1	2.8	8.0
1/31/75	11.6	6.9	90	60	3.4	3.0	9.0
2/13/75	11.7	10.1	88	79	3.2	3.5	9.0
1/5/75	11.3	10.8	91	91	2.6	3.5	6.0
3/25/75	8.6	4.0	82	36	2.8	4.0	9.5
4/1/75	10.0	7.5	90	67	4.2	2.0	7.0
4/8/75	10.1	7.6	85	63	5.0	2.0	8.8
5/6/75	9.7	4.2	104	43	3.2	2.8	7.3
5/13/75	8.9	2.2	104	22	1.8	3.3	9.5

Table 127. Water analysis data collected at the Mill Creek station, Lagoon 98 (MC-5).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
9/11/73	1030	High +1.0	29.5	20.0	23.8	5.7	13.9	8.20	7.20
10/15/73	1215	High	25.0	16.0	19.3	6.7	14.4	7.70	7.07
11/12/73	1345	High +2.5	6.5	6.0	11.5	4.9	15.7	7.55	7.20
12/12/73	1228	High +0.5	2.0	3.0	8.5	7.3	18.0	7.75	7.20
12/18/73	1325	Low +1.0	0.0	1.0	6.5	8.5	16.4	7.20	6.60
1/18/74	1430	Low +1.0	1.0	1.0	4.5	4.1	14.5	6.70	6.80
2/15/74	1300	Low +1.0	4.0	2.5	3.3	8.7	10.1	6.80	6.80
2/21/74	1205	High +2.0	8.0	4.2	5.2	5.9	15.5	7.10	7.50
6/18/74	935	High +1.0	27.0	23.5	18.0	4.9	13.7	7.60	6.80
6/25/74	1040	Low +1.5	18.0	23.0	22.5	15.1	16.0	7.20	7.05
7/9/74	1015	Low +2.0	31.0	27.5	22.0	6.7	12.9	8.20	6.80
7/23/74	1405	High +0.5	28.0	26.5	23.8	12.1	16.2	7.75	6.85
8/5/74	1220	High +0.5	31.0	27.5	23.0	7.2	13.9	8.90	7.00
8/27/74	1345	Low +0.5	29.0	26.7	24.0	7.0	10.8	8.50	6.85
9/16/74	1210	High +2.0	28.0	23.2	22.3	8.1	14.6	7.50	7.00
9/23/74	1150	Low +1.5	16.5	22.0	21.0	12.2	15.1	7.20	6.95
10/2/74	1200	High +1.0	15.0	13.2	18.0	8.9	14.9	7.35	7.05
10/22/74	1025	Low +0.5	14.0	4.7	13.2	4.5	16.2	7.25	7.65
11/18/74	1505	High +2.0	10.5	6.9	12.7	6.2	15.8	7.35	7.15
11/21/74	1130	Low +1.5	6.8	8.0	12.5	6.1	15.6	7.90	7.25
12/4/74	1415	Low +6.0	7.0	4.8	6.0	12.5	18.9	7.65	7.35
12/11/74	1515	Low +0.5	6.0	3.0	7.5	3.8	15.5	7.10	6.80
1/31/75	1355	High +0.5	4.0	5.0	7.5	11.2	12.9	7.70	6.90
2/3/75	1156	Low +1.0	1.2	2.5	7.3	7.5	10.4	7.10	7.03
3/5/75	1132	Low	4.0	3.9	6.4	8.6	12.1	7.10	7.15
3/25/75	1009	High +2.0	13.5	11.0	8.1	3.7	12.3	7.70	6.90
4/1/75	853	High +5.0	10.0	6.0	8.0	5.7	13.3	7.15	7.08
4/8/75	936	High +1.5	5.5	5.2	6.0	7.9	10.9	7.35	7.05
5/6/75	1340	Low	16.5	15.4	13.9	3.3	11.7	7.05	7.05
5/13/75	1228	High +2.0	20.3	21.5	14.5	1.8	11.5	7.15	6.98

Table 127. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
9/11/73	5.9	0.4	65	5	2.0	2.5	9.0
10/15/73	9.7	0.4	101	5	2.0	3.0	12.0
11/12/73	11.6	5.7	96	57	1.7	3.0	10.0
12/12/73	9.8	2.9	77	28	10.3	4.0	10.5
12/18/73	11.3	1.9	87	16	3.0	3.0	10.0
1/18/74	11.1	1.2	80	10	3.1	3.0	8.0
2/15/74	11.4	11.2	88	89	2.4	5.0	8.5
2/21/74	12.1	8.7	96	75	0.0	4.5	8.5
6/18/74	8.2	0.3	98	4	2.1	2.5	9.0
6/25/74	3.7	0.0	47	0	0.9	3.0	8.0
7/9/74	9.9	0.0	132	0	4.1	2.5	8.0
7/23/74	5.5	0.0	74	0	0.0	2.0	10.0
8/5/74	9.9	0.0	128	0	2.0	2.5	8.5
8/27/74	10.4	1.8	134	23	0.0	2.3	8.0
9/16/74	10.7	0.3	129	4	1.6	3.0	8.5
9/23/74	6.8	0.0	82	0	6.5	3.5	8.0
10/2/74	10.2	3.8	102	43	2.2	3.0	9.0
10/22/74	11.4	6.3	91	66	2.7	3.5	7.0
11/18/74	11.3	3.1	96	32	2.7	4.5	8.5
11/21/74	9.9	3.5	86	36	2.4	4.0	8.0
12/4/74	12.4	8.7	105	78	3.0	3.3	7.5
12/11/74	11.7	4.3	89	39	2.4	2.8	7.0
1/31/75	11.2	12.9	79	28	4.2	3.5	8.0
2/3/75	11.2	6.0	86	53	2.7	4.0	6.0
3/5/75	11.4	9.8	91	86	2.6	4.5	7.0
3/25/75	9.8	3.7	91	34	1.4	3.3	10.5
4/1/75	11.1	8.1	92	74	2.6	4.5	7.0
4/8/75	10.9	6.0	90	52	3.9	2.0	9.0
5/6/75	9.4	4.8	114	49	2.6	2.5	7.5
5/13/75	8.6	2.7	97	28	1.1	3.3	7.5

Table 128. Water analysis data collected at the Mill Creek station, Manahawkin Lake drainage (MC-6).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
7/27/73	1130	High +5.5	24.0	24.0	25.0			7.20	6.80
9/11/73	1040	High +1.0	30.0	19.5	23.0	0.8	10.6	6.60	7.70
10/15/73	1255	High +0.5	25.0	16.5	17.5	1.6	12.3	7.00	7.75
11/12/73	1400	High +2.5	6.5	6.5	7.5	1.0	11.5	7.90	7.70
12/12/73	1245	High +1.0	3.0	4.5	6.0	4.6	13.5	7.65	7.35
12/18/73	1345	Low +1.0	0.0	1.5	2.0	2.6	6.4	7.00	7.00
1/18/74	1445	Low +1.0	0.5	1.5	3.0	0.3	8.1	6.20	6.60
2/15/74	1310	Low +2.0	5.0	3.5	3.0	6.7	11.7	6.75	6.75
2/21/74	1215	High +2.5	8.1	6.3	5.2	0.8	6.6	7.00	7.50
6/18/74	950	High +1.0	27.0	22.9	24.0	0.6	11.3	6.65	7.55
6/25/74	1100	Low +1.5	18.0	19.5	22.0	1.6	9.9	6.65	7.05
7/9/74	1025	Low +2.5	31.0	28.5	28.5	6.7	9.3	7.40	7.60
7/23/74	1420	High +1.0	28.0	23.5	25.3	0.5	13.7	7.30	7.80
8/5/74	1240	High +2.0	31.0	27.4	26.6	4.8	9.7	7.50	7.40
8/27/74	1400	Low +1.0	29.0	26.5	26.0	2.1	2.4	7.10	6.90
9/16/74	1225	High +2.5	27.0	21.0	22.5	2.4	11.0	6.80	6.95
9/23/74	1200	Low +1.5	16.5	19.0	22.0	6.3	11.1	7.30	7.30
10/2/74	1205	High +1.5	15.5	15.0	17.5	4.1	11.1	7.10	7.05
10/22/74	1045	Low +1.0	15.0	10.0	12.5	8.2	11.3	7.45	7.80
11/18/74	1515	High +2.0	10.4	7.2	8.8	10.4	13.5	7.50	7.70
11/21/74	1145	Low +1.5	6.8	9.5	6.7	12.2	14.7	7.40	7.50
12/4/74	1430	Low +6.0	7.0	3.2	5.2	3.7	14.4	7.00	7.55
12/11/74	1530	Low +0.5	5.5	4.4	5.4	1.7	13.5	6.85	7.50
1/31/75	1405	High +1.0	4.5	5.5	4.8	0.6	7.4	7.45	6.95
2/3/75	1210	Low +2.0	3.5	4.0	4.5	3.4	7.8	7.10	7.10
2/13/75	1350	High +2.0	-3.0	2.7	3.4	2.2	8.8	6.75	6.80
3/5/75	1140	Low	4.0	3.9	5.6	2.1	5.7	7.00	7.15
3/25/75	1024	High +2.0	13.0	10.7	9.6	1.0	6.3	6.32	6.75
4/1/75	913	High +4.5	10.5	8.0	8.0	2.6	3.0	6.80	6.70
4/8/75	955	High +1.5	5.7	5.5	4.5	2.6	5.2	6.90	7.20
5/6/75	1400	Low +0.5	16.5	15.0	14.0	2.6	3.6	3.90	6.50
5/13/75	1245	High +1.0	21.0	20.0	19.0	1.6	3.8	6.80	6.70

Table 128. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
7/27/73	7.9	4.7			6.4	3.0	5.0
9/11/73	8.1	6.0	87	74		1.5	4.5
10/15/73	8.2		84		1.7	4.0	6.0
11/12/73	10.2	10.8	84	96	2.5	3.0	6.0
12/12/73	10.2	9.5	81	83	3.4	4.0	7.5
12/18/73	10.5	11.7	81	92	2.2	3.0	3.0
1/18/74	11.3	10.1	82	79	1.9	3.5	4.0
2/15/74	10.8	10.0	85	80	1.7	3.5	6.0
2/21/74	12.0	11.1	97	94	2.7	2.0	5.0
6/18/74	7.9	5.5	92	69	3.8	3.0	5.0
6/25/74	7.8	5.0	85	60	2.5	2.5	4.0
7/9/74	8.0	7.7	107	104	2.7	2.0	3.5
7/23/74	9.4	8.3	112	109	1.4	2.0	5.0
8/5/75	9.2	7.6	117	99	2.5	2.5	5.0
8/27/74	8.5	6.8	105	83	2.3	2.0	3.0
9/16/74	7.8	6.1	88	74	3.0	3.0	4.5
9/23/74	8.8	7.8	97	94	2.7	2.5	4.0
10/2/74	9.4	7.1	94	78	1.1	3.5	5.0
10/22/74	10.5	9.7	99	96	3.8	3.5	3.5
11/18/74	11.0	10.1	97	95	3.5	3.5	5.0
11/21/74	9.5	7.7	90	73	4.8	3.0	4.0
12/4/74	11.8	10.3	90	89	2.4	1.5	5.0
12/11/74	11.4	11.8	89	102	3.2	2.5	4.0
1/31/75	11.5	10.5	91	86	0.8	2.3	5.5
2/3/75	11.9	10.0	93	82	1.3	4.0	4.0
2/13/75	12.3	10.4	91	82	1.3	3.0	12.0
3/5/75	11.9	11.1	92	90	1.6	3.0	3.0
3/25/75	10.3	8.4	93	76	0.8	2.0	5.0
4/1/75	10.4	10.4	89	90	2.2	3.0	3.5
4/8/75	10.9	10.7	88	85	2.1	1.8	3.0
5/6/75	8.4	8.0	84	79	5.4	2.0	3.0
5/13/75	8.1	8.0	88	87	1.1	3.0	3.8

Table 129. Nutrient analysis data collected at the Mill Creek station (MC-1).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1400	High +2.5	28.5	2.8	0.004		0.30		
9/27/73	1610	High +6.0	20.7	2.0			<0.14	0.050	
10/31/73	805	Low +0.5	11.0	0.2			<0.20	0.016	<0.20
11/20/73	1310	High +6.5	8.0	2.6			<0.20	0.013	<0.20
1/31/74	1045	Low +0.5	7.0	1.0			0.28	0.060	<0.20
6/30/74	1345	Low +0.5	25.8	4.4		0.72	0.00	0.000	0.03
7/30/74	1105	High +4.0	27.6	6.6		0.61	0.00	0.010	
8/28/74	1130	High +6.5	27.0	3.6	0.000	0.74	0.00	0.020	0.08
9/24/74	830	High +4.5	16.5	2.4		0.90	0.00	0.010	
10/30/74	1140	High +2.5	14.0	2.4		0.80	0.00	0.010	
11/26/74	1355	Low	5.0	5.4		0.58	0.00	0.060	
1/2/75	1445	High +1.5	3.8	2.6		0.51	0.00	0.020	
2/20/75	1322	Low +1.5	6.5	2.0		0.51	0.00	<0.010	
4/21/75	1058	High +5.0	11.0	2.0		0.40	0.00	0.030	
5/22/75	917	High +2.0	21.7	3.0		0.63	0.00	<0.010	

Table 130. Nutrient analysis data collected at the Mill Creek station (MC-3).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/l)	NO_3-N ($mgNO_3$-N/l)	NH_3-N ($mgNH_3$-N/l)	PO_4-P ($mgPO_4$-P/l)	Detergent (mg/l)
8/30/73	1410	High +2.5	28.5	2.4	0.003		0.30		
9/27/73	1215	High +2.0	20.7	1.8			<0.14	0.050	
10/31/73	1129	Low +4.0	12.0	0.0			<0.20	0.013	<0.20
11/20/73	1320	Low		3.2			<0.20	0.050	<0.20
1/31/74	1050	Low +1.5	6.5	1.0			0.21	0.030	<0.20
6/30/74	1050	High +4.0	24.8	2.8		0.55	0.00	0.010	
7/30/74	1015	High +3.0	26.0	1.3		0.61	0.00	0.030	0.07
8/28/74	1115	High +4.5	27.0	2.8	0.000	0.69	<0.01	<0.010	
9/24/74	945	High +5.5	18.5	2.8		0.90	0.00	0.020	
10/30/74	1515	High +6.0	14.3	2.4		0.61	0.00	0.030	
11/26/74	1405	Low	5.0	4.2		0.56	0.00	0.030	
1/2/75	1500	High +1.5	4.7	3.6		0.42	0.00	0.010	
2/20/75	1304	Low +1.0	7.7	2.2		0.48	0.05	0.030	
4/21/75	1040	High +5.0	11.5	1.8		0.40	0.00	<0.010	
5/22/75	936	High +2.0	22.1	0.6		0.85	0.05	0.020	

Table 131. Nutrient analysis data collected at the Mill Creek station, Lagoon 87 (MC-6).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4- ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1420	High +2.5	28.5	0.2	0.004		0.20		
9/27/73	1200	High +1.5	20.7	0.6			<0.14	0.025	
10/31/73	1116	Low +3.5	12.0	0.2			<0.20	0.006	<0.20
1/31/74	1108	Low +0.5		0.4			0.07	0.040	<0.20
6/30/74	1035	High +3.5	24.8	1.2		0.48	0.00	0.000	
7/30/74	955	High +2.5	25.5	0.0		0.45	0.00	0.010	
8/28/74	1050	High +4.0	25.0	1.4	0.000	0.65	<0.01	0.000	
9/24/74	925	High +4.5	14.5	1.2		0.50	0.00	0.000	0.05
10/30/74	1500	High +5.5	14.5	0.08		0.40	0.11	0.030	0.07
11/26/74	1345	High +6.0	8.0	2.2		0.40	0.00	0.020	0.05
1/2/75	1425	High +1.0	5.4	3.4		0.38	0.11	0.010	
4/20/75	1240	Low +0.5	8.0	1.4		0.51	0.11	0.030	0.00
4/21/75	1016	High +4.5	11.0	1.8		0.36	0.00	<0.010	0.00
5/22/75	1101	High +3.5	23.0	0.2		0.70	0.08	0.010	0.00

Table 132. Nutrient analysis data collected at the Mill Creek station, Lagoon 91 (MC-6A).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. (mgO_2/l)	NO_2-N ($mgNO_2$-N/1)	NO_3- ($mgNO_3$-N/1)	NH_3- ($mgNH_3$-N/1)	PO_4- ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1426	High +3.0	30.5	1.8	0.003		0.30		
9/27/73	1205	High +1.5	20.5	4.0			<0.14	0.055	
10/31/73	1116	Low +1.5	12.0	0.2			<0.20	0.031	<0.20
1/31/74	1105	Low		1.0			0.21	0.025	<0.20
6/30/74	1045	High +3.5	26.0	1.6		0.53	0.00	0.000	0.00
7/30/74	1005	High +2.5	27.0	0.4		0.50	0.00	0.060	
8/28/74	1100	High +4.0	27.2	8.3		0.70	0.00	0.000	0.05
9/24/74	935	High +5.0	15.0	2.0		0.58	0.00	0.000	
10/30/74	1505	High +5.5	15.0	0.8		0.45	0.11	0.040	
11/26/74	1350	High +6.0	7.5	>12.2		0.76	0.00	0.030	
1/2/75	1430	High +1.0	5.5	5.0		0.51	0.05	<0.010	0.06
4/21/75	1024	Low +3.5	11.5	0.8		0.63	0.00	<0.010	

Table 133. Nutrient analysis data collected at Beach Haven West station (BHW-1).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/16/73	1125	High	23.0	25.0	25.0	25.3	25.5	8.10	8.10
8/23/73	1105	High +5.5	22.0	23.0	21.5		24.2	8.10	8.00
9/20/73	1126	Low +1.0	21.5	19.4	19.5	23.0	23.1	7.60	7.75
9/26/73	1035	High +1.0	23.5	19.3	18.5	23.4	23.5	7.75	7.70
9/27/73	1620	High +6.0	22.0	20.7	20.2	23.0	23.7	7.70	7.70
10/12/73	1000	High	21.0	16.6	16.5	24.4	24.4	7.97	8.00
10/24/73	915	High +1.5	13.9	13.8	13.6	24.5	24.5	8.02	8.25
10/30/73	825	Low +1.0	7.0	11.0	12.0	23.8	24.2	7.65	7.55
11/9/73	950	High +1.0	6.5	6.5	6.5	23.8	23.9	7.60	7.70
11/13/73	1305	High +1.5	10.0	5.5	5.0	23.7	23.4	7.70	7.75
11/20/73	1347	Low +0.5	7.0	7.5	7.0	24.1	24.0	8.10	8.05
1/16/74	1145	Low +0.5	4.7	0.4	0.6	19.9	20.0	7.70	7.70
1/17/74	1220	Low	1.3	1.0	1.0	19.7	19.7	7.80	7.70
1/22/74	945	High +0.5	8.0	3.0	2.9	19.5	19.6	7.65	7.60
2/14/74	1135	Low +0.5	6.3	2.5	1.5	22.9	23.9	7.80	7.85
2/19/74	840	High +0.5	5.3	1.6	1.6	23.2	23.5	8.00	8.00
2/28/74	955	High +2.0	6.0	3.0	3.0	22.2	22.2		
2/28/74	1605	High +2.0	6.0	4.4	4.4	22.1	22.0		
6/20/74	1010	High	25.0	23.2	23.5	24.8	24.1	7.95	8.05
6/21/74	1045	High	25.0	25.0	24.9	25.2	25.4	8.01	8.07
6/26/74	1005	Low	20.0	20.5	19.5	24.5	25.1	7.95	7.80
6/29/74	1530	Low +1.0	25.0	24.0	22.0	24.7	24.9	7.90	7.60
7/10/74	1315	Low +5.5	34.0	29.0	29.0	24.0	24.0	8.10	8.15
7/15/74	1305	Low +0.5	31.0	27.5	26.5	24.0	23.4	8.05	7.85
7/17/74	855	High +1.0	22.5	25.0	25.0	24.1	24.0	8.00	7.95
7/25/74	815	High +6.0	21.0	23.3	22.5	24.6	25.7	7.70	7.70
8/13/74	1240	Low +1.5	24.0	24.0	23.0	25.3	25.3	8.00	7.00
8/16/74	1017	High +1.5	27.0	24.5	24.0	24.8	25.3	7.80	7.80
8/20/74	1330	High +1.5	27.5	26.2	25.6	24.6	24.6	7.85	7.80

Table 133. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
9/9/74	955	Low +0.5	24.0	21.5	20.5	22.3	22.8	7.80	7.65
9/10/74	1035	Low	26.0	22.0	21.3	22.8	23.2	7.70	7.50
9/17/74	1205	High +1.5	26.5	21.5	21.2	22.8	23.2	7.65	7.60
9/27/74	730	High +0.5	15.5	16.7	16.3	24.1	24.5	7.60	7.70
10/8/74	1000	Low +0.5	13.0	13.8	13.0	24.7	24.9	7.72	7.75
10/10/74	1130	Low	21.0	14.5	13.5	24.7	24.9	8.20	8.15
10/15/74	1000	High +0.5	22.0	16.7	16.5	26.3	26.3	8.15	8.20
10/31/74	1110	High +1.0	19.0	14.3	13.8	24.1	24.3	8.10	8.20
11/14/74	1145	High +2.0	13.0	10.3	10.3	25.9	25.9	8.00	8.05
11/22/74	1105	Low	5.0	6.2	5.9	25.8	25.9	7.90	8.10
12/3/74	1230	High	6.5	5.0	5.0	26.5	26.8	7.76	7.80
12/6/74	1025	Low +0.5	6.0	2.6	2.0	25.9	26.7	7.95	7.65
12/31/74	1035	Low +4.5	2.0	3.0	3.0	23.8	24.0	7.80	7.70
1/27/75	1115	High +1.5	3.0	2.8	2.8	21.2	21.1	7.65	7.65
1/29/75	1305	High +2.0	7.0	4.2	4.2	20.7	20.8	7.95	7.95
2/18/75	1046	Low +1.5	6.5	3.0	3.0	20.9	21.1	7.85	7.82
2/20/75	1155	Low +1.5	8.0	4.0	3.9	20.2	21.2	7.65	7.75
2/26/75	945	Low +5.0	6.0	5.5	5.5	24.1	23.4	7.85	7.80
2/28/75	1445	High +3.0	4.0	5.5	5.0	21.6	22.9	7.72	7.80
3/6/75	1201	Low	7.0	3.6	3.2	22.7	22.7	7.65	7.92
3/27/75	1050	High +1.0	3.5	6.0	5.5	22.1	22.3	7.81	7.81
4/2/75	944	Low	7.7	8.4	8.0	21.8	22.1	7.90	7.80
4/9/75	916	High +0.5	6.0	4.7	4.5	22.5	22.5	7.80	7.88
4/25/75	1125	High +2.0	14.5	13.0	12.5	24.1	23.8	7.78	7.70
5/8/75	755	Low +5.0	12.5	13.5	14.0	21.8	22.0	8.05	7.90
5/12/75	1028	Low +5.0	19.0	17.9	17.6	23.2	23.1	8.30	8.30
5/19/75	1100	Low	22.5	19.9	18.8	18.7	19.1	8.00	7.90

Table 133. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/16/73	6.3	5.8	87	80	6.4	4.0	16.0
8/23/73	6.6	7.3		94	4.4	4.0	4.0
9/20/73	7.9	7.8	97	96	4.2	4.0	4.0
9/26/73	7.8	6.3	96	76	5.9	3.5	16.0
9/27/73	7.8	6.5	98	82	4.4	2.5	4.5
10/12/73	7.0	6.9	82	81	3.0	4.5	4.5
10/24/73	8.8	8.9	78	98	0.0	11.0	22.0
10/30/73	8.0	7.5	83	81	1.5	4.0	8.0
11/9/73	9.7	9.6	92	91	2.9	3.5	13.0
11/13/73	10.6	11.8	82	103	8.3	4.5	14.0
11/20/73	11.2	10.4	106	108	0.0	3.5	8.0
1/16/74	12.5	12.3	99	98	3.1	3.5	13.0
1/17/74	12.5	12.4	100	99	4.3	3.0	9.5
1/22/74	11.4	11.2	96	95	5.5	2.5	16.0
2/14/74	12.3	12.5	105	105	4.8	4.5	16.0
2/19/74	11.9	11.7	100	98	1.7	3.5	19.0
2/28/74	11.0	10.9	95	94	4.8	3.5	11.5
2/28/74	11.8	11.7	105	104	6.0	3.0	14.0
6/20/74	6.6	6.4	88	87	1.8	2.0	12.0
6/21/74	7.4	7.4	102	103	0.0	2.0	17.0
6/26/74	7.4	6.4	94	80	4.6	2.0	17.0
6/29/74	9.1	6.4	123	84	1.4	2.0	19.0
7/10/74	8.7	8.6	131	129	0.0	2.0	16.0
7/15/74	7.2	4.9	104	70	11.9	1.5	15.0
7/17/74	6.2	4.5	86	62	1.6	2.5	13.0
7/25/74	5.5	4.8	72	63	4.8	3.0	13.0
8/13/74	7.2	6.7	98	89	3.8	1.5	11.0
8/16/74	6.1	5.6	82	76	2.7	2.5	18.0
8/20/74	6.7	5.8	95	82	5.5	3.5	14.0

Table 133. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
9/9/74	8.0	6.9	102	86	3.5	3.0	13.0
9/10/74	6.1	5.7	78	73	4.0	3.0	14.0
9/17/74	7.0	6.6	89	84	3.5	3.0	13.0
9/27/74	7.6	6.6	90	77	2.7	3.0	8.0
10/8/74	8.7	8.8	97	96	2.7	3.0	12.0
10/10/74	8.6	8.0	97	89	4.6	3.3	13.0
10/15/74	7.8	7.9	93	94	3.0	3.0	15.0
10/31/74	8.7	8.3	97	89	2.2	4.5	14.5
11/14/74	8.6	8.7	89	90	5.3	5.0	12.0
11/22/74	9.9	9.7	94	92	5.1	3.5	16.0
12/3/74	10.6	10.5	93	91	4.8	3.0	17.0
12/6/74	11.4	10.8	99	94	5.4	4.5	16.0
12/31/74	10.7	10.9	93	95	3.2	4.0	6.0
1/27/75	11.3	11.1	96	94	4.0	2.5	13.0
1/29/75	11.2	11.2	96	97	3.4	2.5	7.5
2/18/75	12.0	11.9	102	100	3.2	4.5	15.0
2/20/75	11.5	11.3	100	99	4.5	4.0	13.0
2/26/75	9.9	9.7	93	89	3.7	3.0	10.0
2/28/75	10.9	10.8	99	97	3.2	3.5	15.0
3/6/75	11.3	11.2	99	98	2.9	5.5	14.5
3/27/75	10.3	9.9	96	90	3.4	4.0	13.0
4/2/75	10.7	10.0	104	97	4.5	3.5	13.0
4/9/75	11.1	11.1	100	99	8.3	4.3	12.0
4/25/75	7.7	8.5	84	92	7.8	3.5	15.0
5/8/75	8.8	8.1	95	89	2.1	4.0	14.0
5/12/75	8.2	8.5	97	100	0.0	4.3	13.5
5/19/75	7.8	4.7	94	56	4.2	3.8	14.0

Table 134. Water analysis data collected at the Beach Haven West station, Lagoon System D, Lagoon 43 (BHW-2).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/23/73	1130	High +6.0	22.0	23.5	22.0			8.20	7.80
9/20/73	1140	Low +1.0	20.0	20.0	19.7	23.2	23.5	7.55	7.20
10/12/73	1020	High +0.5	23.0	17.2	16.9	24.2	24.1	7.80	7.60
10/24/73	925	High +1.5	14.0	14.0	13.3	24.0	24.3	7.40	7.42
11/9/73	1010	High +1.5	6.5	7.5	7.9	23.6	24.0	7.75	7.60
1/16/74	1205	Low +0.5	4.5	0.5	4.5	18.1	20.8	7.18	7.10
1/22/74	955	High +0.5	8.2	3.2	6.5	19.2	23.9	7.45	6.75
2/19/74	850	High +0.5	6.0	2.0	2.0	22.8	23.3	7.70	7.70
2/28/74	1005	Low +1.0	7.0	3.5	3.5	22.0	22.0		
6/21/74	1100	High	25.0	24.5	17.5	24.7	24.9	7.80	7.30
6/26/74	1020	Low	20.0	19.8	18.5	24.1	25.1	7.75	7.10
7/15/74	1315	Low +0.5	23.6	26.5	23.0	23.1	24.1	7.85	6.90
7/17/74	905	High +1.0	23.0	25.0	19.0	23.4	24.3	7.65	6.90
8/16/74	1029	High +1.5	28.0	25.2	22.0	24.6	25.3	7.80	7.20
9/9/74	1005	Low +0.5	24.0	21.7	20.7	22.1	22.8	7.75	7.20
9/27/74	750	High	17.0	17.5	18.0	23.4	23.2	7.40	7.35
10/8/74	1015	Low +0.5	13.0	13.8	13.8	24.5	24.4	7.50	7.50
10/15/74	950	High	21.8	16.0	16.0	24.5	24.5	8.02	7.85
11/22/74	1055	Low	5.0	6.6	6.5	24.9	25.4	7.95	7.90
12/3/74	1215	Low +5.0	7.3	4.9	5.2	25.9	26.1	7.90	7.80
12/6/74	1035	Low +0.5	9.0	3.2	3.2	24.9	25.4	7.82	7.65
1/27/75	1045	High +1.0	3.0	2.8	6.5	20.3	22.9	7.55	7.15
2/18/75	1100	Low +1.5	6.8	4.5	6.4	18.9	22.7	7.60	7.00
2/26/75	1000	Low +5.0	6.0	5.0	5.0	20.5	23.7	7.50	6.85
3/6/75	1150	Low	7.2	5.6	6.5	21.9	23.4	7.65	6.85
3/27/75	1100	High +1.0	3.5	6.5	6.9	21.6	23.9	7.65	6.90
4/2/75	1000	Low +0.5	8.0	8.4	7.5	21.2	22.9	7.80	7.00
4/9/75	929	High +0.5	6.3	5.5	7.1	21.1	21.4	8.00	7.20
5/12/75	1037	Low +5.0	19.8	17.4	11.9	21.5	23.5	7.73	7.00
5/19/75	1112	Low	22.5	19.5	11.2	18.0	23.4	7.78	6.88

Table 134. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/23/73	6.8	4.5			4.9	3.0	16.0
9/20/73	6.6	3.0	82	37	7.1	3.0	12.0
10/12/73	5.3	6.0	63	70	6.9	5.0	11.0
10/24/73	6.3	5.8	71	64	11.2	6.0	18.0
11/9/73	9.7	8.4	93	82	3.1	8.5	12.0
1/16/74	12.1	8.3	95	74	5.3	3.5	12.5
1/22/74	11.5	0.0	97	0	6.3	3.0	14.0
2/19/74	11.9	11.7	100	99	4.8	4.0	8.5
2/28/74	10.7	10.2	93	89	6.0	3.5	10.5
6/21/74	7.9	2.2	107	26	1.8	2.0	11.0
6/26/74	7.6	0.0	95	0	6.4	2.0	14.0
7/15/74	6.3	0.0	91	0	4.8	2.0	12.0
7/17/74	4.4	0.0	60	0	7.8	2.0	14.0
8/16/74	7.8	0.0	108	0	5.4	2.5	13.0
9/9/74	8.9	2.1	114	26	4.3	2.5	12.5
9/27/74	6.0	1.7	117	20	5.1	3.0	16.0
10/8/74	7.8	6.9	87	77	5.7	3.0	10.0
10/15/74	7.4	5.6	86	65	6.2	3.3	14.0
11/22/74	9.4	9.3	90	88	6.7	3.5	14.0
12/3/74	9.8	8.4	91	78	5.1	4.0	15.0
12/6/74	11.3	10.4	100	92	7.5	3.5	11.0
1/27/75	10.7	3.1	91	29	6.9	4.0	15.0
2/18/75	11.2	5.1	97	47	5.3	4.5	14.0
2/26/75	9.8	0.0	87	0	5.0	3.5	14.0
3/6/75	10.2	1.1	93	10	2.4	4.5	13.0
3/27/75	11.0	0.0	102	0	5.0	3.5	13.5
4/2/75	10.6	1.1	104	10	5.4	4.0	11.5
4/9/75	12.1	5.0	110	47	10.8	4.0	14.0
5/12/75	7.7	0.0	91	0	2.1	4.5	14.0
5/19/75	7.6	0.0	91	0	8.9	3.3	14.5

Table 135. Water analysis data collected at the Beach Haven West channel station, Lagoon System D (BHW-3).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (o/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/23/73	1150	Low	22.0	23.5	15.0	23.7		8.30	7.40
9/20/73	1200	Low +1.0	20.0	20.5	21.0	23.0	24.9	7.75	7.00
10/12/73	1040	High +1.0	26.0	18.0	17.9	24.0	24.2	7.69	7.70
10/24/73	1007	High +2.5	17.2	14.9	14.2	24.4	24.5	7.75	7.98
11/9/73	1025	High +1.5	6.0	8.5	8.5	23.9	24.4	7.78	7.98
1/16/74	1220	Low +1.0	5.0	1.0	6.0	18.1	24.4	7.30	6.90
1/22/74	1015	High +0.5	8.5	3.3	6.6	21.2	23.9	7.55	6.85
2/19/74	900	High +0.5	6.1	2.0	2.5	23.2	23.9	7.90	7.70
2/28/74	1030	Low +1.5	7.0	3.9	4.1	22.2	22.5		
6/21/74	1130	High +0.5	25.0	24.5	19.5	24.9	26.1	7.89	6.93
6/26/74	1036	Low +0.5	20.0	21.0	19.0	24.6	26.0	7.90	7.05
7/15/74	1330	Low +1.0	33.0	28.7	18.5	23.4	26.0	8.10	6.95
7/17/74	920	High +1.5	24.0	25.5	18.0	23.8	25.6	7.90	6.95
8/16/74	1049	High +2.0	28.0	25.7	18.4	25.3	25.6	7.90	6.90
9/9/74	1020	Low +1.0	25.0	22.5	21.5	22.1	24.2	7.80	7.20
9/27/74	820	High +1.0	19.0	18.3	18.7	23.6	24.5	7.40	7.00
10/8/74	1035	Low +1.0	14.5	14.5	14.0	24.7	24.9	7.60	7.50
10/15/74	1025	High +0.5	22.5	16.9	15.5	25.1	25.6	8.30	7.80
11/22/74	1130	Low +0.5	5.0	7.0	6.9	25.4	25.1	8.02	8.06
12/3/74	1305	High +0.5	6.5	4.7	4.8	25.9	26.1	8.00	8.00
12/6/74	1050	Low +1.0	8.5	3.7	3.2	25.6	25.9	8.05	7.90
1/27/75	1150	High +2.0	2.8	3.0	6.0	20.4	24.8	7.70	7.20
2/18/75	1114	Low +2.0	6.5	3.0	6.4	20.5	24.8	7.55	7.05
2/26/75	1025	High	8.0	6.0	6.0	20.5	28.5	7.55	7.30
3/6/75	1214	Low	7.0	4.9	5.4	22.7	22.9	7.75	7.65
3/27/75	1120	High +1.5	4.0	7.4	6.2	21.8	22.3	7.78	7.20
4/2/75	1018	High +1.0	8.0	8.9	6.6	22.1	22.1	7.85	7.38
4/9/75	947	High +1.0	6.5	5.5	5.0	21.8	21.6	7.85	7.85
5/12/75	1057	Low +5.0	21.0	18.5	13.7	21.6	22.7	8.00	7.40
5/19/75	1127	Low	23.0	20.5	12.0	18.2	22.3	7.90	7.10

Table 135. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/23/73	6.3	0.0	84		4.4	3.0	18.0
9/20/73	8.5	0.0	106	0	4.2	3.5	15.0
10/12/73	5.5	3.8	59	45	4.9	4.0	24.0
10/24/73	8.0	7.2	90	81	3.2	5.0	19.0
11/9/73	9.2	8.6	91	86	1.8	4.0	13.0
1/16/74	12.0	0.5	95	5	4.3	4.0	19.0
1/22/74	11.7	0.1	100	1	6.7	3.0	17.0
2/19/74	11.6	9.3	98	80	5.1	4.0	18.0
2/28/74	10.6	9.5	93	84	4.6	4.0	16.5
6/21/74	7.9	0.4	108	5	1.8	3.0	21.0
6/26/74	7.5	0.0	96	0	3.2	2.0	16.0
7/15/74	9.0	0.0	132	0	0.0	1.5	16.0
7/17/74	6.3	0.0	89	0	2.3	2.0	16.0
8/16/74	8.0	0.0	113	0	3.2	2.5	16.0
9/9/74	8.9	0.0	115	0	3.8	3.0	13.5
9/27/74	6.5	0.0	78	0	6.2	3.0	15.0
10/8/74	8.3	4.9	94	55	5.9	3.0	19.0
10/15/74	8.7	3.6	103	42	3.5	3.5	20.0
11/22/74	9.1	9.0	87	86	5.4	5.0	16.0
12/3/74	10.8	10.6	99	98	4.3	4.0	15.0
12/6/74	11.8	10.5	106	93	3.2	5.0	14.0
1/27/75	11.5	3.2	98	30	5.6	3.5	15.0
2/18/75	11.5	0.1	97	1	4.2	4.5	16.0
2/26/75	10.1	1.6	92	15	4.8	4.5	15.0
3/6/75	10.9	9.5	98	87	3.2	5.0	13.0
3/27/75	10.6	5.0	101	46	3.2	5.0	15.0
4/2/75	10.7	5.3	108	50	5.2	4.8	13.0
4/9/75	11.2	11.0	102	99	9.2	4.5	14.0
5/12/75	7.8	0.3	93	4	0.0	5.0	18.0
5/19/75	8.1	0.0	100	0	5.1	3.8	18.0

Table 136. Water analysis data collected at the Beach Haven West channel station, Lagoon System B (BHW-4).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/23/73	1315	Low +1.0	22.5	25.7	23.5			8.20	8.10
9/20/73	1320	Low +2.5	23.5	21.2	20.8	23.0	23.4	7.55	7.05
10/12/73	1155	High +2.0	26.0	19.3	18.2	23.7	23.8	7.76	7.78
10/24/73	1055	High +3.0	20.0	15.0	14.5	24.0	24.1	7.91	7.57
11/9/73	1125	High +2.5	7.0	9.0	8.5	23.4	24.2	7.80	7.75
1/16/74	1320	Low +2.0	5.5	1.8	2.0	19.7	23.5	7.60	7.40
1/22/74	1315	High +1.5	8.7	3.7	4.0	18.9	20.2	7.50	7.20
2/19/74	1015	High +2.0	7.0	2.6	2.6	23.2	23.0	7.90	7.90
2/28/74	1115	Low +2.0	8.5	4.5	4.7	22.1	21.9		
6/21/74	1225	High +1.5	26.5	25.5	21.0	24.9	24.9	7.80	7.10
6/26/74	1110	Low +1.0	20.0	21.7	21.3	24.7	24.7	7.85	7.65
7/15/74	1410	Low +1.5	33.0	27.5	22.0	23.1	24.1	7.90	7.10
7/17/74	955	High +2.0	24.5	26.0	21.5	23.8	24.3	7.85	7.10
8/16/74	1130	High +2.5	28.0	26.5	24.0	24.8	25.6	8.00	7.10
9/9/74	1050	Low +1.5	25.0	23.0	21.5	22.5	23.9	7.85	7.45
9/30/74	945	High +0.5	17.0	18.7	18.5	23.6	23.4	7.40	7.30
10/8/74	1115	Low +1.5	14.5	14.9	14.5	24.1	24.1	7.65	7.60
10/15/74	1055	High +1.0	23.0	17.2	16.5	24.5	24.5	8.15	8.20
11/22/74	1210	Low +1.0	7.0	7.5	7.5	24.5	24.7	8.00	7.95
12/3/74	1330	High +0.5	7.0	5.0	5.0	25.7	25.9	7.95	7.90
12/6/74	1120	Low +1.5	9.0	3.3	3.3	24.1	25.6	8.02	7.90
1/27/75	1215	High +2.5	3.5	4.0	5.0	20.8	20.6	7.50	7.40
2/18/75	1209	Low +2.5	7.1	3.4	2.4	20.2	20.3	7.55	7.50
2/26/75	1100	High +0.5	10.0	5.1	4.7	21.6	21.9	7.75	7.75
3/6/75	1252	Low +0.5	7.3	5.1	4.7	21.6	21.9	7.75	7.75
3/27/75	1151	High +2.0	4.0	7.5	7.1	21.2	21.2	7.75	7.70
4/2/75	1059	Low +1.5	8.0	9.4	8.0	21.1	21.2	7.88	7.85
4/9/75	1036	High +2.0	6.7	6.0	5.5	21.6	21.2	7.90	7.85
5/12/75	1037	Low +5.0	21.5	18.5	13.7	21.3	21.6	7.70	7.30
5/19/75	1208	Low +0.5	23.5	21.5	14.9	18.9	21.4	7.70	7.25

Table 136. Continued.

Date	D.O. ($mgO_2/1$) Surface	D.O. ($mgO_2/1$) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/1$) Surface	Secchi (ft)	Depth (ft)
8/23/73	7.4	4.8			10.8	3.0	16.0
9/20/73	7.1	1.4	91	18	6.4	3.0	
10/12/73	6.6	6.1	81	73	5.4	3.0	
10/24/73	8.2	7.0	94	79	7.1	4.0	
11/9/73	9.0	9.0	90	98	1.5	3.0	11.0
1/16/74	12.2	12.3	101	104	8.4	3.5	6.5
1/22/74	11.7	9.6	100	83	6.0	4.5	8.0
2/19/74	11.7	11.9	100	102	6.3	4.5	7.0
2/28/74	10.7	10.5	95	94	1.7	4.0	6.5
6/21/74	7.7	0.6	108	7	2.1	2.3	12.0
6/26/74	6.4	4.9	83	63	4.1	2.0	12.0
7/15/74	8.0	0.0	117	0	0.0	2.0	12.0
7/17/74	5.9	0.0	83	0	5.3	2.0	22.0
8/16/74	9.0	0.0	127	0	0.0	2.5	12.0
9/9/74	8.7	3.5	113	45	3.5	3.0	14.0
9/30/74	5.4	3.1	65	38	5.4	3.0	13.0
10/8/74	8.4	7.8	96	88	4.3	3.0	13.0
10/15/74	8.6	7.3	102	86	4.6	3.5	12.0
11/22/74	9.3	9.9	91	88	5.1	4.5	11.0
12/3/74	10.2	10.0	95	93	5.4	4.5	16.0
12/6/74	12.1	11.0	106	97	4.0	5.0	11.0
1/27/75	10.4	8.9	91	82	6.9	4.0	10.0
2/18/75	11.3	11.6	97	96	5.3	5.0	14.0
2/26/75	10.1	9.6	91	85	5.0	5.0	14.0
3/6/75	11.2	10.9	101	98	3.4	5.5	11.5
3/27/75	10.7	10.0	102	94	4.2	4.5	13.0
4/2/75	11.1	10.5	110	101	5.5	5.0	12.5
4/9/75	11.3	10.7	104	97	9.2	4.5	12.0
5/12/75	7.9	4.5	94	49	4.2	6.5	13.0
5/19/75	7.5	1.8	94	23	6.1	4.8	12.0

Table 137. Water analysis data collected at the Beach Haven West station, Lagoon System B, Lagoon 15 (BHW-5).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/23/73	1255	Low +0.5	24.0	24.5	22.5		23.8	8.30	8.30
9/20/73	1300	Low +2.5	24.0	21.0	20.8	23.2	23.1	7.65	7.65
10/12/73	1135	High +1.5	26.0	19.0	18.0	24.2	24.0	7.79	7.80
10/24/73	1040	High +3.0	16.5	15.0	14.5	24.0	24.1	7.81	7.70
11/9/73	1110	High +2.5	5.5	8.5	8.5	23.2	24.1	7.80	7.80
1/16/74	1340	Low +2.0	5.3	2.6	5.0	14.1	21.7	7.50	7.10
1/22/74	1145	High +2.0	8.7	4.8	6.2	19.2	20.9	7.40	7.05
2/19/74	1030	High +2.0	7.2	1.0	2.5	20.4	23.2	7.70	7.90
2/28/74	1130	Low +2.5	8.5	4.5	4.5	21.8	22.3		
6/21/74	1205	High +1.0	27.0	26.0	26.4	24.6	24.7	7.90	7.98
6/26/74	1100	Low +1.0	20.0	20.5	20.5	25.0	24.3	7.90	7.78
7/15/74	1345	Low +1.0	33.0	29.5	25.0	23.4	23.4	8.15	7.70
7/17/74	945	High +1.5	24.0	26.0	23.0	24.0	24.1	7.85	7.70
8/16/74	1115	High +2.0	28.0	27.5	25.5	25.1	25.3	7.80	7.85
9/9/74	1040	Low +1.0	25.0	23.0	21.5	22.8	22.8	7.90	7.60
9/30/74	930	High	18.0	18.7	18.2	23.4	24.0	7.50	7.40
10/8/74	1100	Low +1.5	15.0	14.5	14.2	24.5	24.5	7.60	7.65
10/15/74	1040	High +0.5	23.5	17.4	16.5	26.3	24.5	8.13	8.15
11/22/74	1150	Low +1.0	8.0	7.4	7.0	24.5	24.3	8.05	7.90
12/3/74	1320	High +0.5	7.0	4.6	4.9	25.2	25.7	8.05	7.90
12/6/74	1110	Low +1.0	9.0	3.7	3.2	25.4	25.9	8.01	7.95
1/27/75	1200	High +1.0	3.5	3.5	4.5	20.1	20.4	7.50	7.50
2/18/75	1158	Low +2.5	7.9	3.8	2.4	21.2		7.65	7.70
2/26/75	1045	High +0.5	10.0	6.5	6.0	19.4	19.3	7.75	7.70
3/6/75	1238	Low +0.5	7.0	5.6	5.6	21.9	22.1	7.80	7.82
3/27/75	1137	High +1.5	4.0	8.2	7.2	21.9	21.4	7.83	7.75
4/2/75	1044	Low +1.0	7.8	8.6	7.6	21.8	22.1	7.90	7.75
4/9/75	1017	High +1.5	6.3	5.7	5.0	21.8	21.4	7.92	7.89
5/12/75	1125	Low +5.5	21.0	18.4	14.6	21.3	21.3	7.80	7.80
5/19/75	1157	Low	23.5	21.7	16.3	18.9	20.7	7.85	7.35

Table 137. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/23/73	6.9	6.8		89	2.5	3.0	8.0
9/20/73	7.8	6.9	99	88	4.4	3.0	8.0
10/12/73	6.7	6.8	82	82	2.7	4.0	4.0
10/24/73	7.8	7.6	89	86	5.1	4.0	6.0
11/9/73	9.4	9.3	93	92	3.1	4.0	5.0
1/16/74	11.5	3.5	92	32	0.0	4.0	12.0
1/22/74	11.2	7.0	99	65	6.7	4.5	13.0
2/19/74	11.6	11.6	94	99	6.3	4.5	12.0
2/28/74	10.4	9.5	93	84	6.3	4.0	11.0
6/21/74	8.4	8.6	118	123	0.0	2.3	7.0
6/26/74	7.6	7.0	97	89	5.0	2.0	7.0
7/15/74	9.4	4.4	140	61	0.0	2.0	10.0
7/17/74	5.7	4.2	81	56	3.9	2.0	8.0
8/16/74	8.5	7.7	124	108	0.0	2.5	6.0
9/9/74	9.4	4.9	123	62	1.9	3.0	8.0
9/30/74	7.3	4.3	89	52	3.8	3.0	9.0
10/8/74	7.9	8.2	90	92	4.3	3.5	7.5
10/15/74	8.2	8.2	99	97	2.4	3.5	8.0
11/22/74	9.7	9.7	95	93	4.3	4.5	5.0
12/3/74	11.2	10.4	103	96	3.2	4.0	6.0
12/6/74	11.6	11.2	104	99	4.0	4.0	7.0
1/27/75	11.3	10.9	97	96	6.4	4.0	7.0
2/18/75	11.7	11.6	102		5.6	4.5	9.0
2/26/75	10.1	10.1	93	92	4.5	4.5	8.0
3/6/75	11.2	10.8	103	98	2.1	6.3	6.5
3/27/75	10.9	9.4	106	89	4.0	4.5	10.0
4/2/75	10.8	9.6	107	92	6.0	5.0	8.0
4/9/75	11.4	10.6	105	95	10.8	4.0	9.0
5/12/75	8.0	8.0	95	89	3.7	5.0	8.5
5/19/75	8.1	3.8	102	43	5.5	3.8	9.0

Table 138. Water analysis data collected at the Beach Haven West station, Lagoon System B, Lagoon 24 (BHW-6).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/23/73	1330	Low +1.5	22.5	24.0	11.5	23.7	25.1	8.20	7.50
9/20/73	1330	Low +2.5	23.5	21.0	12.5	22.8	25.5	7.70	6.90
10/12/73	1210	High +2.0	26.0	19.0	12.2	23.5	25.6	7.70	7.10
10/24/73	1107	High +3.5	19.0	15.0	11.0	23.8	25.4	7.82	7.01
11/19/73	1135	High +2.5	7.0	8.5	9.5	21.9	23.3	7.70	7.60
1/16/74	1355	Low +2.5	5.3	1.1	7.3	13.2	23.9	7.10	7.00
1/22/74	1155	High +2.5	8.7	5.0	7.5	19.0	23.9	7.45	7.45
2/19/74	1045	High +2.5	7.0	2.1	6.5	23.5	24.1	7.70	7.50
2/28/74	1150	Low +3.0	9.0	4.6	7.1	21.8	23.7		
6/21/74	1250	High +2.0	26.8	26.1	13.0	24.7	24.9	7.91	6.90
6/26/74	1128	Low +1.5	20.0	21.4	11.5	24.3	25.3	7.88	7.05
7/15/74	1420	Low +1.5	33.0	29.2	12.5	23.1	24.5	8.10	7.20
7/17/74	1002	High +2.0	24.5	25.0	13.0	23.1	25.6	7.90	6.85
8/16/74	1145	High +2.0	28.0	25.6	14.8	24.9	24.9	7.90	6.90
9/9/74	1105	Low +1.5	26.0	22.5	13.5	21.7	24.9	7.85	6.90
9/30/74	1015	High +1.0	17.0	19.0	12.5	22.5	25.1	7.55	7.00
10/8/74	1125	Low +2.0	14.8	15.0	12.0	24.1	24.9	7.60	7.00
10/15/74	1120	High +1.5	24.0	17.1	13.2	24.0	25.6	8.30	7.23
11/22/74	1220	Low +1.5	7.0	7.8	9.0	24.1	24.7	8.02	7.75
12/3/74	1345	High +1.0	7.0	5.0	5.7	24.7	25.9	8.01	7.80
12/6/74	1130	Low +1.5	9.0	3.5	5.6	24.5	25.2	8.02	7.65
1/27/75	1230	High +2.5	3.5	3.5	6.5	16.9	25.5	7.45	7.20
2/18/75	1219	Low +3.0	6.8	3.0	7.0	20.5	25.3	7.50	7.00
2/26/75	1210	High +0.5	7.0	6.5	7.0	18.2	24.1	7.60	7.00
3/6/75	1305	Low +1.0	7.2	6.6	7.6	21.1	24.1	7.65	7.30
3/27/75	1201	High +2.0	3.5	6.9	7.5	20.7	24.6	7.70	6.90
4/2/75	1113	Low +1.5	8.0	9.0	8.0	21.2	24.8	7.90	6.90
4/9/75	1050	High +2.0	6.5	6.4	8.0	20.7	24.8	7.95	7.10
5/12/75	1148	High +1.0	22.0	18.5	9.0	21.1	24.1	7.65	6.90
5/19/75	1221	Low +0.5	24.0	20.7	9.4	18.9	24.0	7.75	6.95

Table 138. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/23/73	6.6	0.0	83	0	4.4	3.0	26.0
9/20/73	8.1	0.0	102	0	4.4	3.0	24.0
10/12/73	6.5	0.0	79	0	7.1	3.0	25.0
10/24/73	8.7	0.0	98	0	5.9	3.0	23.0
11/19/73	9.3	4.6	92	43	2.2	3.0	20.0
1/16/74	11.0	0.0	84	0	5.1	4.0	22.0
1/22/74	11.5	0.0	101	0	6.3	4.5	24.0
2/19/74	11.8	0.0	100	0	7.5	4.5	25.0
2/28/74	10.6	0.0	95	0	5.3	4.0	7.0
6/21/74	8.9	0.0	126	0	1.6	2.3	25.0
6/26/74	8.2	0.0	104	0	5.0	2.0	24.0
7/15/74	8.5	0.0	127	0	0.0	2.0	23.0
7/17/74	8.7	0.0	119	0	0.0	2.5	24.0
8/16/74	8.8	0.0	123	0	0.0	2.5	25.0
9/9/74	8.9	0.0	114	0	4.3	3.0	19.5
9/30/74	7.7	0.0	94	0	5.4	3.5	24.0
10/8/74	7.4	0.0	84	0	6.2	2.8	24.0
10/15/74	8.6	0.0	101	0	4.8	3.5	22.0
11/22/74	9.1	4.5	89	45	7.0	4.0	21.0
12/3/74	11.3	8.6	103	81	4.6	4.5	26.0
12/6/74	12.1	6.6	107	108	3.2	5.0	22.0
1/27/75	11.3	0.8	95	7	5.8	4.0	21.0
2/18/75	11.4	0.0	96	0	5.3	5.0	22.0
2/26/75	10.3	0.0	94	0	3.4	4.0	22.0
3/6/75	10.7	0.0	100	0	5.8	5.0	20.0
3/27/75	10.5	0.0	100	0	4.3	4.0	23.0
4/2/75	11.5	0.0	113	0	3.5	5.0	22.0
4/9/75	11.5	0.0	106	0	8.9	4.3	23.0
5/12/75	7.6	0.0	91	0	4.7	7.0	23.0
5/19/75	7.9	0.0	97	0	7.9	4.5	20.0

Table 139. Water analysis data collected at the Beach Haven West channel station, Lagoon System A, (BHW-7).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
10/12/73	1100	High +1.0	26.0	17.2	16.5	24.4	24.6	7.85	7.84
10/24/73	935	High +2.0	17.5	14.1	13.9	24.7	24.9	7.90	8.08
11/9/73	1040	High +2.0	6.0	6.5	7.0	23.2	23.9	7.80	7.85
1/16/74	1240	Low +1.0	6.7	1.0	2.5	20.1	21.4	7.60	7.35
1/22/74	1030	High +1.0	8.5	3.1	3.5	17.4	21.4	7.60	7.35
2/19/74	920	High +1.0	6.3	1.7	1.7	23.9	23.2	8.15	8.10
2/28/74	1045	Low +2.0	8.0	3.5	3.6	22.2	22.3		
6/18/74	1015	High +2.0	29.0	25.7	24.0	24.6	24.6	8.15	8.10
6/27/74	1115	Low	19.0	20.5	20.0	25.2	25.2	7.85	7.70
7/9/74	1100	Low +3.0	31.5	29.0	19.0	24.1		7.90	7.15
8/1/74	1030	High +1.5	29.0	27.5	23.5	25.0	26.4	7.80	7.80
9/9/74	1130	Low +2.0	26.0	21.7	21.3	23.2	23.5	7.80	7.35
9/30/74	1045	High +1.5	17.5	19.0	18.3	24.1	24.9	7.70	7.70
10/8/74	1155	Low +2.5	15.0	14.0	13.9	25.4	25.1	7.75	7.65
10/15/74	1135	High +2.0	25.0	17.1	16.8	24.9	25.4	8.30	8.30
11/22/74	1240	Low +2.0	4.5	6.6	6.4	25.4	25.8	8.15	8.10
12/3/74	1410	High +1.5	7.0	5.0	4.9	26.1	26.1	7.90	7.90
12/6/74	1145	Low +2.0	9.0	3.2	2.7	25.9	26.3	7.85	7.98
1/27/75	1255	High +3.5	3.0	3.3	2.7	19.9	20.8	7.75	7.75
2/18/75	1244	Low +3.5	6.8	3.7	1.0	20.2	21.1	7.70	7.78
2/26/75	1145	High +1.5	11.0	6.5	5.5	20.7	21.2	7.80	7.80
3/6/75	1331	Low +1.5	7.2	4.9	4.0	22.9	23.3	7.85	7.87
3/27/75	1225	High +2.5	4.0	7.7	6.0	21.8	23.3	7.88	7.80
4/2/75	1140	Low +2.0	8.2	9.0	6.4	21.6	22.1	7.95	7.95
4/9/75	1122	High +2.5	6.5	6.0	5.0	21.9	22.1	7.95	7.95
5/12/75	1217	High +1.5	22.0	18.6	12.7	21.6	23.4	8.20	7.20
5/19/75	1303	Low +1.5	22.0	21.0	13.0	19.1	22.9	8.10	7.25

Table 139. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
10/12/73	7.0	6.7	83	78	3.9	5.5	10.0
10/24/73	8.3	8.6	93	92	2.2	11.0	13.0
11/9/73	10.1	10.1	95	96	2.2	4.5	7.0
1/16/74	12.4	9.6	100	81	2.9	3.5	10.0
1/22/74	11.5	9.9	97	86	4.8	3.0	12.5
2/19/74	11.7	11.7	99	90	1.9	4.0	8.5
2/28/74	11.0	10.9	96	96	5.3	4.0	7.0
6/18/74	8.1	7.7	113	104	0.0	2.5	6.0
6/27/74	8.0	5.8	101	73	3.0	2.5	8.0
7/9/74	8.3	0.8	125	10	0.0	2.0	17.0
8/1/74	6.7	5.7	97	78	4.3	2.0	16.0
9/9/74	8.0	3.7	102	47	3.8	2.5	12.0
9/30/74	7.6	7.0	93	86	3.5	3.0	8.0
10/8/74	9.9	8.8	112	99	3.5	3.0	12.0
10/15/74	8.2	8.1	98	96	3.0	3.5	5.0
11/22/74	9.8	9.8	95	95	4.8	4.5	6.0
12/3/74	10.5	10.2	98	95	4.6	4.0	9.0
12/6/74	11.4	11.1	101	98	0.0	4.0	8.0
1/27/75	11.4	11.3	97	96	4.2	3.0	10.0
2/18/75	11.8	12.0	101	96	4.8	4.5	10.0
2/26/75	10.4	10.3	97	94	2.9	4.0	7.5
3/6/75	11.4	11.0	102	98	0.0	5.0	14.5
3/27/75	10.5	10.0	101	92	2.1	4.5	14.5
4/2/75	10.6	9.9	104	93	4.5	5.0	14.0
4/9/75	11.4	11.0	105	98	9.5	5.0	18.0
5/12/75	8.6	0.3	104	4	0.0	5.5	20.0
5/19/75	7.8	0.5	95	5	2.1	3.5	19.0

Table 140. Water analysis data collected at the Beach Haven West station, Lagoon System A, Lagoon 08 (BHW-8).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/23/73	1225	Low	24.0	24.5	23.2	24.9	25.5	8.20	7.80
9/20/73	1225	Low +1.5	20.0	20.5	19.7	23.6	23.9	8.00	7.70
10/12/73	1110	High +1.5	24.0	17.9	16.6	24.7	24.6	7.60	7.72
10/24/73	945	High +2.0	18.3	14.5	14.2	24.2	24.8	7.85	7.80
11/9/73	1050	High +2.0	5.0	7.5	9.0	24.4	24.4	7.90	7.95
1/16/74	1255	Low +1.5	6.5	1.1	6.0	16.6	23.5	7.70	6.90
1/22/74	1045	High +1.0	8.7	3.2	6.7	19.4	22.5	7.70	7.10
2/19/74	940	High +1.5	6.7	2.0	2.1	22.8	23.9	7.90	7.90
2/28/74	1100	Low +2.0	8.0	4.0	4.0	22.3	22.4		
6/18/74	1024	High +2.0	25.0	25.0	19.3	24.6	24.0	8.10	8.10
6/27/74	1128	Low +0.5	20.0	21.0	17.0	25.2	26.7	7.90	7.05
7/9/74	1115	Low +3.5	31.5	29.3	19.8	24.0	25.6	8.05	7.05
8/1/74	1040	High +2.0	29.0	27.7	18.5	25.1	25.3	7.80	7.15
8/9/74	1140	Low +2.0	26.0	22.5	21.3	23.3	23.7	7.80	7.40
9/30/74	1100	High +2.0	17.5	19.0	18.2	24.1	24.7	7.57	7.10
10/8/74	1210	Low +2.5	16.0	14.3	13.4	24.7	24.9	7.65	7.52
10/15/74	1145	High +2.0	23.0	17.1	16.2	25.1	25.1	8.20	8.08
11/22/74	1250	Low +2.0	6.0	7.0	6.6	25.4	24.9	8.15	8.12
12/3/74	1435	High +1.5	7.0	5.0	5.0	25.4	26.8	8.00	7.80
12/6/74	1200	Low +2.0	9.5	3.2	2.7	25.8	26.8	7.90	7.85
1/27/75	1305	High +3.5	3.0	3.7	7.0	20.4	23.0	7.60	7.10
2/18/75	1247	Low +3.5	6.5	3.2	6.5	20.7	22.9	7.70	7.10
2/26/75	1150	High +1.5	12.0	6.0	5.5	20.9	21.4	7.80	7.70
3/6/75	1342	Low +2.5	7.1	5.0	4.8	22.7	23.0	7.80	7.85
3/27/75	1233	High +2.5	4.0	7.5	6.4	21.9	22.9	7.88	7.70
4/2/75	1150	Low +2.5	8.2	9.5	7.0	21.8	22.9	7.89	7.75
4/9/75	1133	High +3.0	6.5	6.4	5.7	21.8	23.2	7.90	7.80
5/12/75	1229	High +2.5	23.5	18.5	13.4	21.8	22.9	8.20	7.50
5/19/75	1314	Low +1.5	22.5	21.5	15.5	19.1	21.3	8.10	7.50

Table 140. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/23/73	6.9	4.4	95	58	5.4	3.0	12.0
9/20/73	9.6	3.8	120	47	0.0	4.5	9.0
10/12/73	5.3	5.6	63	66	6.9	4.5	12.0
10/24/73	7.8	7.6	88	85	5.4	10.0	13.0
11/9/73	10.3	9.9	100	100	1.0	5.5	10.0
1/16/74	12.5	1.4	99	12	2.9	3.0	13.0
1/22/74	12.3	3.5	104	33	3.9	4.5	14.0
2/19/74	12.0	10.7	101	91	3.4	4.5	11.0
2/28/74	10.6	10.4	94	92	4.6	2.5	12.0
6/18/74	7.9	1.6	109	19	0.0	2.5	13.0
6/27/74	8.3	0.0	106	0	1.6	2.0	14.0
7/9/74	9.1	0.0	139	0	0.0	2.0	11.0
8/1/74	6.8	0.0	100	0	2.0	3.0	12.0
8/9/74	9.5	4.3	124	56	1.9	4.0	12.0
9/30/74	7.1	0.0	87	0	4.0	3.0	10.0
10/8/74	9.3	6.2	104	69	2.7	3.3	13.0
10/15/74	8.7	6.5	104	76	1.6	5.0	11.0
11/22/74	9.5	9.4	93	89	5.1	5.0	15.0
12/3/74	10.7	7.6	99	71	4.3	5.0	15.0
12/6/74	11.4	10.4	101	92	4.0	4.5	11.0
1/27/75	11.5	5.0	99	47	4.8	4.0	12.0
2/18/75	12.0	5.0	103	47	3.7	4.0	15.0
2/26/75	10.5	1.0	96	9	2.7	4.5	12.0
3/6/75	11.1	10.2	100	93	3.7	5.0	11.0
3/27/75	11.0	6.4	105	60	3.5	4.0	14.0
4/2/75	10.7	8.7	107	82	4.5	5.5	10.0
4/9/75	11.6	9.8	109	90	10.0	5.0	12.5
5/12/75	9.0	3.4	107	37	0.0	5.3	12.0
5/19/75	7.7	4.3	96	49	1.3	4.0	11.0

Table 141. Water analysis data collected at the mouth of Beach Haven West station, Lagoon System C (BHW-9).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/16/75	1135	High	22.5	25.0	25.0	25.3	25.8	8.10	8.00
8/23/73	1405	Low +1.5	22.5	22.7	22.7		23.8	8.20	8.30
9/26/73	1050	High +1.0	23.5	19.4	18.5	23.5	24.1	7.80	7.70
9/27/73	1625	High +6.0	22.0	20.6	20.0	23.0	23.5	7.80	7.80
10/12/73	1235	High +2.5	19.0	17.5	16.7	24.6	24.8	7.82	7.80
10/24/73	1140	High +4.0	18.4	14.4	14.1	24.8	24.6	8.03	7.91
10/30/73	840	Low +1.0	7.0	11.0	11.0	23.5	24.6	7.45	7.35
11/9/73	1205	High +3.5	6.0	6.5	7.0	23.2	23.2	7.75	7.80
11/13/73	1315	High +1.0	10.0	5.5	5.0	23.5	23.6	7.80	7.85
11/20/73	1355	Low	7.0	7.4	7.0	23.6	24.0	8.00	8.05
1/16/74	1420	Low +2.5	5.0	1.0	1.1	19.7	19.5	7.52	7.50
1/17/74	1230	Low	1.3	1.0	1.0	19.3	19.3	7.65	7.65
1/22/74	1250	High +3.5	9.5	4.0	3.5	19.4	19.4	7.50	7.50
2/14/74	1145	Low +0.5	6.3	2.7	2.7	22.6	23.7	7.70	7.80
2/19/74	1115	High +3.0	6.5	2.0	2.0	23.5	23.5	8.10	8.00
2/28/74	1210	Low +3.0	9.0	3.6	3.0	21.8	22.1		
6/20/74	1027	High	26.0	24.0	23.5	25.0	25.1	8.15	8.05
6/27/74	1145	Low +0.5	21.0	20.0	19.5	24.9	24.1	7.70	7.78
6/29/74	1536	Low +1.0	25.0	24.5	24.5	24.3	24.5	7.86	7.90
7/10/74	1335	Low +5.0	35.0	29.0	28.3	24.3	24.0	8.10	7.95
7/25/74	830	High +6.0	23.0	23.0	22.7	24.3	25.3	7.60	7.68
8/13/74	1255	Low +0.5	24.5	24.4	23.0	25.6	25.3	8.00	8.00
8/20/74	1340	High +1.5	28.0	26.5	25.4	24.6	24.9	8.00	7.80
9/10/74	1045	Low	27.0	22.5	21.2	22.1	22.8	7.60	7.60
9/17/74	1215	High +1.5	25.5	21.6	21.3	23.3	22.8	7.70	7.65
9/30/74	1120	High +2.0	17.0	18.7	18.5	24.7	25.2	7.60	7.60
10/10/74	1140	Low	24.0	14.2	14.7	24.7	24.3	8.15	8.15
10/31/74	1117	High +1.0	19.0	14.4	14.0	24.5	24.6	8.00	8.00
11/14/74	1155	High +2.0	13.0	10.5	10.3	25.7	25.5	8.20	8.25
12/31/74	1045	Low +4.5	1.5	3.0	3.0	23.8	23.6	7.80	7.70
1/29/75	1310	High +2.0	6.8	4.6	4.3	20.9	21.2	7.95	7.91
2/20/75	1205	Low	8.3	4.3	4.6	20.7	21.2	7.65	7.65
2/28/75	1430	High +2.5	4.0	5.4	5.1	22.5	23.0	7.85	7.80
5/20/75	1120	High +6.0	23.5	21.4	21.4	18.3	18.4	8.00	8.10

Table 141. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/16/73	6.5	5.3	90	74	4.9	6.0	10.0
8/23/73	8.0	8.5		111	4.9	5.5	6.0
9/26/73		6.5		79	5.9	4.5	9.0
9/27/73	7.7	7.3	96	91	7.6	3.0	10.0
10/12/73	7.0	6.9	84	81	4.4	5.0	6.0
10/24/73	8.7	8.5	98	95	3.9	5.0	6.0
10/30/73	7.1	7.0	75	73	1.6	3.5	4.0
11/9/73	10.0	9.9	94	94	1.9	4.0	5.0
11/13/73	11.1	11.2	98	107	1.8	5.0	7.0
11/20/73	11.1	11.3	110	100	1.0	4.0	6.0
1/16/74	13.1	12.9	105	104	3.1	3.0	8.0
1/17/74	12.5	12.6	100	100	4.1	3.0	7.0
1/22/74	11.4	11.6	99	99	5.3	3.0	10.0
2/14/74	12.3	12.6	105	109	1.2	4.0	6.0
2/19/74	11.7	11.9	100	101	2.9	4.0	4.5
2/28/74	11.5	11.5	100	99	3.4	3.0	5.0
6/20/74	6.6	6.4	90	85	2.7	2.0	4.0
6/27/74	7.3	6.3	92	74	6.4	2.0	8.0
6/29/74	9.2	9.5	128	130	0.0	2.0	3.0
7/10/74	9.2	6.7	138	99	0.0	2.0	10.0
7/25/74	5.6	4.7	75	62	5.5	2.5	11.0
8/13/74	7.5	6.9	102	92	3.8	1.5	6.0
8/20/74	7.0	5.3	101	74	4.0	3.0	11.0
9/10/74	8.8	8.4	111	108	4.8	2.5	8.0
9/17/74	7.2	6.4	93	82	3.5	3.0	11.5
9/30/74	7.5	7.1	92	87	3.0	3.5	6.0
10/10/74	8.7	8.7	98	99	4.6	4.0	4.0
10/31/74	8.6	8.8	97	98	0.0	4.5	4.5
11/14/74	8.8	8.8	93	92	6.4	4.0	8.0
12/31/74	10.8	10.7	94	93	4.0	4.0	9.0
1/29/75	11.3	11.1	100	99	4.2	2.5	6.0
2/20/75	11.5	11.5	101	101	3.4	4.0	9.0
2/28/75	10.9	10.9	98	99	3.2	3.8	10.0
5/20/75	7.8	7.9	97	98	4.2	3.8	4.0

Table 142. Water analysis data collected at the Beach Haven West channel station, Lagoon System C (BHW-10).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/23/73	1425	Low +2.0	22.5	24.0	23.5	24.0		8.20	7.80
10/12/73	1250	High +2.5	21.0	18.3	17.0	24.0	24.6	7.60	7.83
10/24/73	1150	High +4.0	20.0	14.9	14.4	24.0	24.5	7.80	7.98
11/9/73	1220	High +3.5	5.0	7.0	6.5	23.3	23.5	7.65	7.70
1/16/74	1435	Low +3.0	5.3	2.5	1.5	18.9	19.8	7.30	7.40
1/22/74	1310	High +3.5	9.0	4.7	2.7	18.5	19.4	7.15	7.40
2/19/74	1130	High +3.0	7.0	2.5	2.6	23.2	23.0	7.90	7.90
2/28/74	1225	Low +3.0	9.2	4.6	3.1	21.6	21.9		
6/20/74	1040	High	26.0	24.5	24.0	23.5	24.6	7.95	7.95
6/27/74	1155	Low +0.5	21.0	20.5	20.0	24.5	24.7	7.80	7.45
7/10/74	1345	Low +5.5	35.0	29.5	20.0	23.6	24.3	8.00	7.10
7/25/74	845	High +6.0	23.0	23.0	22.7	24.3	25.0	7.57	7.58
8/13/74	1310	Low +0.5	26.0	25.0	23.0	25.3	25.6	7.90	7.50
8/20/74	1400	High +1.5	29.0	26.5	25.3	24.2	24.2	7.95	7.70
9/10/74	1105	Low	27.0	22.7	21.0	23.6	23.2	7.65	7.40
9/30/74	1135	High +2.0	17.0	19.0	18.5	23.6	24.1	7.50	7.45
10/10/74	1205	Low	23.0	15.1	14.3	24.0	24.5	8.00	8.10
10/31/74	1130	High +1.0	21.5	15.0	13.0	23.9	24.3	7.90	8.00
11/14/74	1200	High +1.5	13.0	11.4	10.7	25.2	25.3	7.95	8.00
12/31/74	1100	Low +4.5	2.0	3.5	3.5	23.8	23.6	7.65	7.80
1/29/75	1320	High +1.5	7.3	5.6	4.4	19.5	20.5	7.84	7.85
2/20/75	1220	Low +0.5	8.5	4.2	3.0	19.8	20.3	7.65	7.55
2/28/75	1400	High +3.0	4.3	6.0	5.6	20.7	22.7	7.60	7.70
5/20/75	1132	High +6.0	25.5	23.5	23.5	17.8	19.1	7.82	7.50

Table 142. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/23/73	8.0	5.9	108		3.0	3.0	7.0
10/12/73	7.5	6.8	90	81	4.7	5.0	7.0
10/24/73	8.4	8.2	95	96	5.4	7.0	10.0
11/9/73	9.8	9.8	93	92	2.1	5.0	8.0
1/16/74	11.6	11.5	97	102	7.2	3.5	10.0
1/22/74	11.6	11.2	101	94	6.7	3.0	9.0
2/19/74	12.1	11.7	104	100	5.1	4.0	7.0
2/28/74	10.9	11.2	97	96	5.8	4.5	9.0
6/20/74	7.7	5.5	106	74	4.3	2.0	7.0
6/27/74	8.6	4.3	107	53	2.7	2.0	11.0
7/10/74	9.3	0.7	140	9	0.0	2.0	12.0
7/25/74	5.8	3.5	77	47	5.5	2.5	11.0
8/13/74	8.1	3.0	112	39	4.6	2.5	9.0
8/20/74	8.6	4.9	121	67	7.9	3.0	12.0
9/10/74	9.6	3.6	125	46	3.8	2.5	8.0
9/30/74	7.7	6.1	94	74	4.3	3.5	10.0
10/10/74	8.5	8.2	97	92	6.5	3.5	9.0
10/31/74	9.5	8.3	109	90	5.9	3.8	9.5
11/14/74	8.6	8.4	92	88	5.7	4.0	10.0
12/31/74	10.9	10.6	96	93	4.3	4.5	10.0
1/29/75	11.3	11.1	102	98	4.0	3.5	11.0
2/20/75	11.7	12.2	102	103	5.8	3.5	10.0
2/28/75	10.6	10.2	96	94	5.3	4.0	12.0
5/20/75	7.7	5.9	98	76	6.6	4.0	9.0

Table 143. Water analysis data collected at the Beach Haven West station, Lagoon System C, Lagoon 37 (BHW-11).

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
8/23/73	1425	Low +2.0	22.5	25.5	23.5	23.3		8.20	7.80
10/12/73	1300	High +3.0	23.0	17.7	17.6	24.0	23.9	7.61	7.60
10/24/73	1205	High +4.0	20.5	15.5	15.0	24.0	24.3	7.80	7.65
11/9/73	1230	High +3.5	6.5	7.5	7.8	23.2	23.7	7.70	7.80
1/16/74	1450	Low +3.0	5.0	0.6	7.0	17.8	19.6	6.85	7.15
1/22/74	1320	High +3.5	8.7	4.5	3.5	19.2	19.9	7.40	7.30
2/19/74	1145	High +3.0	7.0	3.0	4.8	22.4	22.6	7.90	7.90
2/28/74	1240	Low +3.5	9.2	5.0	5.1	21.7	21.7		
6/20/74	1050	High	25.0	24.0	23.5	23.7	24.2	7.80	7.75
6/27/74	1205	Low +0.5	21.0	21.5	21.0	23.8	25.5	7.75	7.55
7/10/74	1410	Low +5.5	35.0	29.0	25.5	23.6	23.6	7.95	7.70
7/25/74	855	High +6.0	25.0	23.5	23.5	23.7	24.3	7.50	7.45
8/13/74	1320	Low +1.0	26.0	24.4	23.3	24.9	24.9	7.85	7.80
8/20/74	1410	High +1.5	29.0	28.0	25.0	23.7	24.8	7.85	7.45
9/10/74	1125	Low	29.0	23.0	22.0	21.7	22.6	7.75	7.50
9/30/74	1150	High +2.0	18.5	19.2	18.7	23.6	24.0	7.42	7.45
10/10/74	1215	Low	24.0	15.0	14.9	24.1	24.1	8.10	8.10
10/31/74	1140	High +1.0	22.0	15.0	13.6	23.9	24.5	8.00	8.00
11/14/74	1210	High +1.5	13.5	11.2	11.2	24.8	24.8	7.95	7.95
1/29/75	1330	High +1.5	7.5	5.5	5.5	20.1	19.9	7.70	7.90
2/20/75	1235	Low +0.5	9.0	4.8	4.8	20.2	20.3	7.70	7.60
2/28/75	1415	High +2.0	4.2	7.0	6.1	21.8	22.0	7.80	7.75
5/20/75	1140	High +6.0	25.5	21.6	21.6	17.7	18.6	7.55	7.78

Table 143. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
8/23/73	8.5	5.2	117		4.9	2.0	6.0
10/12/73	6.5	5.7	78	68	6.1	4.0	6.0
10/24/73	8.8	7.4	102	86	6.9	4.0	5.0
11/9/73	10.0	9.9	96	96	2.9	4.0	6.0
1/16/74	13.1	11.4	103	106	9.4	4.0	5.0
1/22/74	11.6	11.1	102	95	6.3	3.5	6.0
2/19/74	12.1	12.2	104	110	5.8	4.0	5.5
2/28/74	10.7	10.7	96	97	5.1	4.0	4.0
6/20/74	7.2	6.6	98	88	6.2	2.0	5.0
6/27/74	10.4	6.6	133	85	0.0	2.0	5.5
7/10/74	9.3	6.4	141	94	1.6	2.0	6.0
7/25/74	6.2	4.3	83	58	7.3	2.5	5.5
8/13/74	8.0	7.7	109	103	0.3	1.8	6.0
8/20/74	8.8	0.0	128	0	3.3	3.0	7.0
9/10/74	10.6	7.9	138	102	0.0	2.3	5.0
9/30/74	6.3	5.8	77	71	8.3	3.0	5.0
10/10/74	8.1	8.1	92	91	4.3	3.0	5.0
10/31/74	9.5	9.1	107	100	6.2	3.5	5.0
11/14/74	8.9	8.8	94	93	5.2	4.0	4.0
1/29/75	11.0	10.8	99	97	5.0	3.0	6.0
2/20/75	11.8	12.2	104	108	6.1	4.0	4.5
2/28/75	11.3	10.6	106	98	4.0	3.5	6.5
5/20/75	8.3	7.5	103	94	5.3	4.0	5.0

Table 144. Nutrient analysis data collected at the Beach Haven West station, Lagoon System D (BHW-3).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1455	High +3.5	29.0	2.6	0.003		0.40		
9/27/73	1233	High +2.0	21.0	2.4			<0.14	0.055	
10/31/73	1136	Low +4.0	13.0	0.4			<0.20	0.031	<0.20
1/31/74	1110	Low +0.5	6.5	2.8			0.07	0.025	<0.20
6/30/74	1320	Low +0.5	26.5	3.6		2.03	0.00	0.000	
7/30/74	1125	High +4.0	28.7	5.2		0.71		0.000	0.12
8/28/74	1140	High +5.0	27.5	5.6	0.000	0.91	<0.01	<0.010	0.14
9/24/74	1027	High +6.0	18.0	3.2		1.14	0.00	<0.010	0.21
10/30/74	1530	High +6.0	14.3	3.0		0.82	0.00	0.030	0.30
11/26/74	1400	Low	5.5	5.6		0.70	0.00	0.040	
1/2/75	1515	High +2.0	5.2	3.4		0.61	0.00	0.020	
2/2/75	1330	Low +1.5	5.0	2.8		0.52	0.00	<0.010	
4/21/75	1047	High +5.0	10.2	2.4		0.45	0.00	0.010	0.14
5/22/75	1142	High +4.0	24.0	0.6		0.67	0.00	<0.010	0.09

Table 145. Nutrient analysis data collected at the Beach Haven West station, Lagoon System A (BHW-7).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1505	High +3.5	29.0	2.0	0.003		0.30		
9/27/73	1245	High +2.5	21.3	2.0			<0.14	0.040	
10/31/73	1147	Low +4.5	13.5	0.2			<0.20	0.025	<0.20
6/30/74	1135	High +5.0	25.5	2.2		0.93	0.00	0.000	
7/30/74	1040	High +3.5	27.5	1.6		0.71		0.030	
8/28/74	1235	High +6.0	27.5	5.0	0.000	0.91	0.00	0.010	
9/24/74	1050	Low	17.5	1.4		0.96	0.00	0.000	
10/30/74	1555	Low	13.8	2.8		0.87	0.00	0.020	
2/20/75	1352	Low +2.0	5.0	3.0		0.53	0.00	<0.010	
4/21/75	1112	High +5.5	10.8	2.0		0.42	0.00	<0.010	
5/22/75	1210	High +4.5	24.0	3.2		0.66	0.00	<0.010	

Table 146. Nutrient analysis data collected at the Beach Haven West station, Lagoon System B (BHW-4).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
6/30/74	1055	High +4.0	24.2	4.0		0.85	0.00	0.010	
7/30/74	1020	High +3.0	27.5	4.5		0.75		0.030	
8/28/74	1120	High +4.5	27.0	4.8	0.000	0.94	0.00	<0.010	
9/24/74	955	High +5.5	18.5	2.4		1.06	0.00	0.010	
10/30/74	1525	High +6.0	14.5	4.2		0.94	0.00	0.020	
11/26/74	1416	Low	5.7	6.2		0.73	0.00	0.030	
1/2/75	1525	High +2.0	5.0	1.6		0.55	0.00	<0.010	
2/20/75	1310	Low +1.5	4.5	2.8		0.61	0.00	0.010	
4/21/75	1042	High +5.0	10.6	3.2		0.53	0.00	0.010	
5/22/75	1126	High +4.0	23.0	3.4		0.73	0.00	<0.010	

Table 147. Nutrient analysis data collected at the Beach Haven West station, Lagoon System B, Lagoon 15 (BHW-15).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1525	High +4.0	30.0	3.2	0.005		0.30		
9/27/73	1218	High +2.0	20.5	2.4			<0.14	0.050	
10/31/73	1133	Low +4.0	12.5	0.8			<0.20	0.038	<0.20
1/31/74	1117	Low +0.5		1.2			0.00	0.030	<0.20

Table 148. Nutrient analysis data collected at the Beach Haven West station, Lagoon System B, Lagoon 15 (BHW-6).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1535	High +4.0	29.5	3.2	0.004		0.30		
9/27/73	1137	High +1.0	22.3	3.0			<0.14	0.040	
10/31/73	1100	Low +3.5	12.0	1.2			<0.20	0.050	<0.20
1/31/74	1125	Low +1.0		3.0			0.00	0.030	<0.20
6/30/74	1100	High +4.0	27.0			1.00	0.00	0.000	
7/30/74	1030	High +3.0	28.0	4.5		0.76		0.010	
8/28/74	1150	High +5.0	28.0	4.8		0.98	0.00	0.010	
9/24/74	1010	High +6.0	18.0	3.2		1.01	0.00	0.000	
10/30/74	1545	High +6.0	14.5	4.8	0.000	0.98	0.00	0.010	
11/26/74	1425	Low	6.2	5.2		0.84	0.00	0.030	
1/2/75	1535	High +2.0	5.2	3.6		0.60	0.00	0.020	
2/20/75	1345	Low +2.0	6.0	2.8		0.63	0.00	0.010	
4/21/75	1108	High +5.0	11.4	2.6		0.51	0.00	0.010	
5/22/75	1158	High +4.5	24.0	3.0		0.65	0.00	<0.010	

Table 149. Nutrient analysis data collected at the Beach Haven West station, Lagoon System (BHW-10).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
8/30/73	1600	High +4.0	29.5	1.8	0.007		0.20		
9/27/73	1145	High +1.5	21.3	2.4			<0.14	0.050	
10/31/73	1105	Low +3.5	12.5	0.0			<0.20	0.013	<0.20
1/31/74	1120	Low +0.5		2.0			0.00	0.035	<0.20
6/30/74	1110	High +4.0	26.3	3.0		0.91	0.00	0.000	
7/30/74	1055	High +3.5	28.0	2.2		1.24		0.020	
8/28/74	1200	High +5.0	27.0	6.0	0.000	1.04	0.00	0.010	
9/24/74	1010	High +5.5	17.5	1.2		1.14	0.00	0.000	
10/30/74	1535	High +6.0	14.4	2.4		0.87	0.00	0.020	
11/26/74	1420	High +5.5	5.0	5.0		0.71	0.00	0.030	
1/2/75	1545	High +2.0	4.9	3.0		0.57	0.00	<0.010	
2/20/75	1337	Low +1.5	6.0	2.6		0.57	0.00	<0.010	
4/21/75	1105	High +5.0	11.3	1.6		0.46	0.00	0.010	
5/22/75	1152	High +4.0	23.0	2.8		0.75	0.00	0.010	

Table 150. Nutrient analysis data collected at the Beach Haven West station, Lagoon System C, Lagoon 37 (BHW-11).

Date	Time (EST)	Tide (h)	Temperature-Surface (°C)	B.O.D. ($mgO_2/1$)	NO_2-N ($mgNO_2$-N/1)	NO_3-N ($mgNO_3$-N/1)	NH_3-N ($mgNH_3$-N/1)	PO_4-P ($mgPO_4$-P/1)	Detergent (mg/1)
9/27/73	1255	High +3.0	20.5	3.4			<0.14	0.050	
10/31/73	1110	Low +3.5	13.0	0.2			<0.20	0.015	<0.20
1/31/74	1112	Low +1.5		1.2			0.00	0.030	<0.20
6/30/74	1115	High +4.0	25.2	5.0		1.05	0.00	0.000	
7/30/74	1105	High +3.5	28.0	4.8		0.81	0.00	0.030	
8/28/74	1145	High +4.5	27.7	5.7	0.036	1.05	0.00	0.010	
9/24/74	1005	High +5.5	17.5			1.09	0.00	0.000	
10/30/74	1510	High +5.5	14.3	2.4		0.84	0.00	0.020	
11/26/74	1415	High +6.0	5.3	7.2		0.80	0.00	0.040	
1/2/75	1550	High +2.0	5.2	2.8		0.55	0.00	<0.010	
2/20/75	1255	Low +1.0	5.0	4.4		0.55	0.00	<0.010	
4/21/75	1032	High +4.0	10.7	1.8		0.51	0.00	0.010	
5/22/75	1116	High +3.5	24.0	1.4		0.85	0.00	0.020	

Table 151. Secondary water analysis data collected at Tuckerton Creek, 1973-75.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station TC-0									
8/8/73	1005	Low	26.5	27.0	26.5	26.6	27.9	8.30	8.40
11/19/73	1140	Low +1.0	15.0	8.0	7.5	25.4	27.3	8.10	8.15
7/18/74	810	High	24.5	24.8	24.8			7.80	7.80
7/23/74	630	Low +1.0	23.0	22.7	22.5	28.2	27.8	7.65	7.60
10/4/74	1050	High	12.7	11.5	11.3	27.9	28.3	7.75	7.70
11/11/74	1255	High +6.0	14.0	11.5	11.4	29.8	29.4	8.21	8.25
2/7/74	1145	High +5.0	5.0	3.4	3.5	27.8	27.8	7.70	7.75
3/10/75	950	High +2.0	2.0	2.0	2.0	27.3	27.5	7.75	7.75
3/31/75	1152	Low +5.5	9.0	5.7	5.7	26.4	26.3	7.87	7.90
4/8/75	1324	High	8.4	4.9	4.9	26.9	26.6	7.75	7.88
Station TC-1									
8/8/73	1020		26.5	27.0	27.0	18.2	25.9	8.10	8.10
11/19/73	1150		15.0	9.0	7.3		27.3	8.15	8.20
7/18/74	820		24.0	25.0	24.8			7.90	7.80
7/23/74	635		23.0	23.8	23.7	25.0	27.5	7.55	7.78
10/4/74	1100		13.0	11.5	11.3	27.0	27.7	7.75	7.80
11/11/74	1310		15.0	11.6	11.2	25.9	28.6	8.15	8.25
2/7/74	1155		5.0	3.9	3.5	23.2	27.1	7.50	7.55
3/10/75	940		2.0	2.5	2.5	26.7	26.9	7.70	7.70
3/31/75	1159		9.0	5.9	5.5	24.9	25.3	7.80	7.83
4/8/75	1332		8.4	5.8	5.0	20.0	25.2	7.70	7.85
Station TC-2									
8/8/73	1035		26.0	26.5	13.0	16.0	26.5		7.70
11/19/73	1205		14.5	8.5	8.5	18.5	27.7	8.00	7.70
7/18/74	835		25.0	25.3	13.5			8.55	6.95
7/23/74	650		24.0	22.7	14.5	23.6	28.8	7.80	6.80
10/4/74	1120		13.0	12.3	14.5	22.9	26.7	8.25	7.50
11/11/74	1320		16.0	11.0	11.1	25.2	28.9	8.15	8.05
2/7/74	1210		5.0	4.0	6.5	19.5	28.5	7.30	7.10
3/10/75	930		2.0	3.5	5.5	27.1	28.0	7.67	7.20
3/31/75	1210		9.0	6.0	4.9	15.9	28.2	7.65	7.28
4/8/75	1345		8.4	6.0	5.5	18.6	23.2	7.70	7.20

Table 151. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (o/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station TC-3									
8/8/73	1055		26.5	26.7	27.0	13.0	23.7	8.00	7.90
11/19/73	1220		14.0	9.3	7.8	9.3	24.7	7.60	8.15
7/18/74	845		24.0	25.3	25.0			8.15	7.80
7/23/74	705		24.0	23.7	24.0	18.9	25.5	7.33	7.45
10/4/74	1145		13.0	13.2	12.0	17.8	27.0	8.10	7.80
11/11/74	1330		15.0	11.7	11.5	25.9	27.3	8.05	8.05
2/7/74	1220		5.0	4.6	3.4	11.5	26.0	7.30	7.55
3/10/75	920		2.0	3.3	2.5	18.9	25.2	7.40	7.60
3/31/75	1220		9.0	5.9	5.6	14.7	22.9	7.45	7.79
4/8/75	1358		8.4	7.4	4.4	15.7	24.3	7.50	7.70
Station TC-4									
8/8/73	1110		26.5	26.0	24.5	8.1	11.5	7.80	8.00
11/19/73	1230		14.0	10.0	9.5	12.6	19.0	7.90	8.10
7/18/74	900		24.0	26.0	26.0			8.80	7.40
7/23/74	715		24.5	22.0	24.0	19.6	25.0	7.25	7.30
10/4/74	1150		13.0	13.8	12.3	21.1	24.5	8.20	7.80
11/11/74	1340		15.0	11.5	11.5	20.3	26.2	7.90	7.90
2/7/74	1230		5.0	4.6	3.5	12.6	24.6	7.45	7.30
3/10/75	910		2.0	4.0	3.5	18.0	23.4	7.35	7.40
3/31/75	1229		9.0	7.0	7.4	16.1	22.9	7.50	7.60
4/8/75	1409		8.4	8.0	5.5	21.0	21.5	7.55	7.68
Station TC-5									
8/8/73	1130		26.5	24.5	26.7	6.3	10.3	7.40	7.30
11/19/73	1245		14.0	10.0	7.8	7.2	27.1	7.20	8.10
7/18/74	905		24.0	25.3	26.0			8.65	7.65
7/23/74	730		24.5	23.0	23.7	12.6	26.0	6.90	7.30
10/4/74	1200		13.5	14.8	12.0	15.3	26.3	8.15	7.75
11/11/74	1355		16.0	12.7	12.0	15.3	26.3	8.15	7.75
2/7/74	1245		5.0	5.0	3.5	7.8	26.4	7.50	7.40
3/10/75	850		2.0	4.5	2.8	12.8	25.6	7.15	7.60
3/31/75	1244		9.0	8.1	6.9	8.5	24.1	7.18	7.49
4/8/75	1422		8.4	7.7	5.0	14.4	22.1	7.30	7.65

Table 151. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station TC-6									
8/8/73	1150		27.0	24.5	25.0	3.4	17.4	7.10	7.30
11/19/73	1300		14.0	9.8	8.5	6.4	25.1	7.30	8.00
7/18/74	915		25.0	25.0	25.3			9.15	7.00
7/23/74	735		25.0	21.7	23.7	9.2	25.6	9.00	6.90
10/4/74	1215		13.0	11.0	14.3	14.4	24.5	7.70	7.35
11/11/74	1410		16.0	13.0	12.1	15.4	25.7	8.22	7.95
2/7/74	1255		5.0	5.0	3.4	8.6	25.3	7.50	7.40
3/10/75	840		2.0	5.3	4.0	16.2	24.6	7.10	7.55
3/31/75	1257		9.0	8.1	7.1	13.2	22.8	7.00	7.25
4/8/75	1432		8.4	7.6	4.7	12.8	23.2	7.30	7.55
Station TC-7									
8/8/73	1215		27.0	23.5	24.0	1.6	4.7	6.80	6.80
11/19/73	1310		14.0	10.0	9.0	6.2	23.2	7.90	7.70
7/18/74	930		24.0	24.3	25.0			7.10	7.10
7/23/74	745		25.5	21.8	23.5	5.7	17.1	6.90	6.80
10/4/74	1220		13.5	14.3	15.0	12.9	23.4	7.30	7.25
11/11/74	1425		15.0	12.2	12.7	11.3	20.0	8.45	7.90
2/7/74	1305		5.0	5.0	4.0	9.7	21.4	7.20	7.45
3/10/75	825		2.0	6.0	4.5	5.4	20.0	6.80	7.00
3/31/75	1300		9.0	7.6	8.5	16.4	18.9	7.00	7.20
4/8/75	1444		8.4	7.3	4.7	14.2	22.5	7.20	7.35

Table 151. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
Station TC-0							
8/8/73	7.1	7.6	103	110	18.3	3.0	4.0
11/19/73	11.0	11.5	109	114	0.0	3.0	4.0
7/18/74	5.5	5.3			2.3	3.5	6.0
7/23/74	6.1	6.5	74	79	3.2	5.0	5.0
10/4/74	9.9	9.3	108	101	3.0	6.5	7.5
11/11/74	9.4	9.9	104	109	1.1	8.0	8.0
2/7/74	10.9	11.0	93	94	4.8	2.0	6.0
3/10/75	11.0	10.9	96	95	5.6	3.5	5.0
3/31/75	10.7	10.3	102	98	2.5	2.8	6.0
4/8/75	11.9	11.3	111	105	8.3	2.5	5.0
Station TC-1							
8/8/73	7.7	4.9	106	71	4.8	2.0	4.0
11/19/73	12.0	11.6		115	0.0	3.0	6.0
7/18/74	5.7	5.0			2.5	4.0	6.0
7/23/74	5.8	5.2	72	64	4.6	2.0	4.0
10/4/74	9.7	9.8	105	70	3.5	6.5	7.0
11/11/74	9.8	10.1	106	110	4.0	5.0	5.0
2/7/74	10.7	10.7	92	91	5.0	2.5	5.0
3/10/75	10.6	11.1	93	98	6.6	3.5	5.5
3/31/75	10.9	10.9	103	102	4.3	2.5	5.5
4/8/75	11.0	11.0	101	103	6.6	2.3	4.0
Station TC-2							
8/8/73	8.5	0.4	115	4	24.0	3.0	12.0
11/19/73	14.4	7.3	140	75	1.7	3.0	20.0
7/18/74	9.2	0.0			0.0	1.8	15.0
7/23/74	7.5	0.0	93		3.2	3.5	18.0
10/4/74	16.2	5.4	174	62	0.0	2.5	18.0
11/11/74	9.9	8.2	105	90	4.3	7.0	21.0
2/7/74	11.6	0.0	102		4.0	3.3	18.0
3/10/75	11.7	4.8	106	45	4.8	4.0	21.0
3/31/75	10.8	2.8	96	26	5.0	4.5	20.0
4/8/75	11.1	4.2	100	39	6.7	2.8	17.0

Table 151. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
Station TC-3							
8/8/73	7.3	2.9	98	56	25.0	3.0	6.0
11/19/73	12.6	11.4	116	110	1.2	2.5	6.0
7/18/74	7.8	5.1			1.6	3.0	6.0
7/23/74	5.3	4.6	64	59	4.6	3.0	6.0
10/4/74	11.9	9.8	125	107	0.0	4.0	8.0
11/11/74	10.4	9.2	112	103	3.8	5.0	6.0
2/7/74	11.0	10.6	97	90	2.4	3.0	8.0
3/10/75	11.2	10.8	95	94	5.9	4.0	8.5
3/31/75	10.9	11.2	95	103	4.6	3.5	7.0
4/8/75	11.2	10.6	103	96	7.2	3.3	6.5
Station TC-4							
8/8/73	8.4	8.2	108	104	25.5	2.0	4.0
11/19/73	11.5		110		0.0	2.5	2.5
7/18/74	14.4	2.0			0.0	2.0	7.0
7/23/74	6.3	1.2	76	14	7.3	3.0	6.0
10/4/74	16.8	9.9	182	107	0.0	2.5	8.0
11/11/74	10.4	8.8	107	94	5.1	3.5	5.0
2/7/74	11.2	9.8	99	82	4.0	3.0	5.0
3/10/75	11.3	9.7	97	85	6.3	4.0	7.5
3/31/75	11.0	9.4	100	91	3.1	4.5	5.0
4/8/75	11.0	10.4	100	101	7.9	3.3	5.0
Station TC-5							
8/8/73	7.1	4.0	87	54	24.5	3.0	6.0
11/19/73	12.4	10.4	114	103	1.5	3.0	10.0
7/18/74	10.3	3.9			0.0	1.5	10.0
7/23/74	4.6	1.8	55	21	8.0	2.0	6.5
10/4/74	17.1	9.2	181	100	0.0	1.5	8.5
11/11/74	10.8	10.1	112	108	0.0	3.5	8.0
2/7/74	11.0	9.8	97	82	3.2	3.3	8.0
3/10/75	11.2	10.3	94	90	6.0	4.5	10.0
3/31/75	11.0	8.7	98	83	3.2	4.0	9.5
4/8/75	11.5	9.8	105	89	7.6	2.5	7.0

Table 151. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
Station TC-6							
8/8/73	6.9	0.9	83	12		3.0	8.0
11/19/73	14.2	10.3	130	103	1.0	2.0	8.0
7/18/74	13.2	0.0			1.1	1.5	8.0
7/23/74	8.6	0.0	106		3.9	1.5	7.0
10/4/74	8.4	6.1	92	111	3.2	1.5	8.0
11/11/74	11.8	8.1	122	88	3.2	4.0	8.0
2/7/74	11.0	9.0	98	75	2.7	3.3	7.0
3/10/75	10.6	10.3	93	93	5.8	4.5	9.5
3/31/75	10.7	7.7	98	74	4.8	5.0	8.0
4/8/75	10.6	9.5	96	96	6.1	2.5	7.5
Station TC-7							
8/8/73	7.1	6.4	83	77	13.5	2.0	4.0
11/19/73	11.5	10.2	105	101	2.9	2.5	4.0
7/18/74	7.4	1.0			5.5	1.5	5.0
7/23/74	7.3	1.6	95	19	3.7	1.0	4.0
10/4/74	4.1	3.5	43	40	7.0	3.0	6.0
11/11/74	12.1	9.3	120	98	2.2	1.5	4.5
2/7/74	8.9	9.5	77	81	3.2	3.3	4.0
3/10/75	11.7	8.3	97	73	4.6	4.0	5.0
3/31/75	9.4	9.9	87	95	8.2	4.5	4.5
4/8/75	10.9	9.2	99	83	4.8	3.0	3.0

Table 152. Secondary water analysis data collected at Parker Run Creek, 1973-75.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station PR-0									
8/8/74	1225	High	27.0	23.3	23.0	27.5	28.2	7.60	7.60
8/12/74	1025	Low	26.0	22.5	22.0	27.8	27.8	7.65	7.70
10/25/74	1130	Low	15.0	10.3	10.3	26.6	27.1	8.10	8.10
11/4/74	1120	Low +5.0	23.0	16.3	16.4	28.4	28.2	8.10	8.10
1/8/75	1240	Low	7.0	4.5	4.5	27.4	27.0	7.95	7.95
2/7/75	1355	Low +0.5	3.0	3.0	3.0	25.3	25.3	7.70	7.70
4/1/75	1306	Low +5.5	16.0	7.7	7.6	25.0	25.0	7.90	7.85
4/17/75	1320	High	18.4	9.3	8.0	27.3	27.3	7.90	7.95
Station PR-1									
8/8/74	1235		27.0	23.3	22.7	26.7	27.5	7.50	7.55
8/12/74	1030		26.0	23.0	22.5	25.3	27.4	7.60	7.75
10/25/74	1140		16.0	11.2	10.7	24.6	25.5	7.80	8.00
11/4/74	1140		25.0	16.3	16.2	27.7	27.9	8.15	8.15
1/8/75	1255		7.0	4.8	4.6	23.8	26.1	7.80	7.95
2/7/75	1405		3.0	3.9	3.1	21.0	23.5	7.70	7.70
4/1/75	1313		16.0	8.4	8.1	25.7	25.3	7.88	7.85
4/17/75	1329		18.2	9.0	8.0	25.9	27.3	7.85	7.87
Station PR-2									
8/8/74	1335		26.0	24.0	24.0	26.7	27.5	7.40	7.35
8/12/74	1040		26.0	23.0	23.0	19.6	19.6	7.65	7.65
10/25/74	1150		17.0	13.0	12.7	21.2	21.2	7.80	7.80
11/4/74	1150		25.5	16.5	16.5	27.1	27.1	8.08	8.12
1/8/75	1300		7.5	5.7	5.7	21.3	21.1	7.70	7.65
2/7/75	1410		3.0	4.8	4.5	17.7	18.1	7.65	7.52
4/1/75	1326		16.0	9.0	8.9	23.9	24.3	7.90	7.90
4/17/75	1358		18.2	9.6	9.4	25.1	24.9	7.87	7.87

Table 152. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station PR-3									
8/8/74	1255		27.0	23.3	25.0	19.6	25.3	7.30	7.10
8/12/74	1050		25.0	23.0	23.0	14.9	24.6	7.35	7.05
10/25/74	1200		17.0	12.0	11.3	22.8	24.6	7.80	7.70
11/4/74	1200		27.0	16.4	16.0	24.3	25.3	7.80	8.00
1/8/75	1315		7.0	5.2	4.2	20.4	25.2	7.60	7.80
2/7/75	1420		3.0	4.6	2.5	14.1	24.6	7.70	7.65
4/1/75	1335		16.0	9.5	7.0	20.7	23.7	8.10	7.75
4/17/75	1405		18.2	9.6	8.0	20.3	23.9	8.25	7.78
Station PR-4									
8/8/74	1305		27.0	24.5	22.5	18.6	25.2	8.15	6.80
8/12/74	1110		25.0	24.0	23.0	15.3	25.3	7.55	7.00
10/25/74	1215		18.0	13.0	12.3	19.4	23.2	7.70	7.70
11/4/74	1210		29.0	16.6	15.5	24.3	25.0	7.70	8.10
1/8/75	1320		7.5	3.8	5.6	16.2	24.7	7.40	7.65
2/7/75	1430		3.0	5.0	4.0	21.0	23.1	8.00	7.40
4/1/75	1351		16.0	12.0	8.0	18.7	22.2	8.45	7.10
4/17/75	1428		18.3	10.6	8.4	19.6	22.7	8.72	7.55
Station PR-5									
8/8/74	1320		26.0	24.2	22.7	17.1	25.3	7.30	6.90
8/12/74	1125		25.0	24.0	23.5	12.8	23.9	7.00	6.90
10/25/74	1225		19.0	15.0	13.0	3.4	14.7	7.00	7.40
11/4/74	1220		29.0	16.4	16.3	18.5	23.6	7.61	7.82
1/8/75	1330		8.0	8.5	5.6	18.7	24.3	7.55	7.50
2/7/75	1435		3.0	5.1	5.5	17.4	22.1	7.71	7.60
4/1/75	1407		16.0	11.0	8.5	14.5	21.8	8.50	7.55
4/17/75	1445		18.4	10.6	8.3	20.9	23.0	8.15	7.75

Table 152. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
Station PR-0							
8/8/74	5.8	5.5	71	66	6.0	5.0	6.0
8/12/74	6.4	6.3	86	84	5.9	6.0	7.0
10/25/74	9.6	9.6	95	95	5.1	1.5	4.5
11/4/74	8.1	8.2	97	97	3.8	2.5	7.0
1/8/75	11.1	10.9	97	96	3.5	3.5	4.5
2/7/75	11.3	11.3	96	95	5.8	1.8	5.0
4/1/75	10.6	10.3	104	101	1.2	0.8	5.0
4/17/75	10.1	10.4	104	105	4.2	5.0	7.0
Station PR-1							
8/8/74	5.5	5.5	68	67	7.0	4.0	8.0
8/12/74	6.5	6.6	87	88	7.5	3.0	6.0
10/25/74	9.7	9.7	97	97	7.5	5.5	5.5
11/4/74	8.1	8.1	96	97	3.5	2.5	6.0
1/8/75	11.1	10.7	98	94	5.7	3.5	6.0
2/7/75	12.2	11.7	108	100	4.0	2.5	4.5
4/1/75	10.2	10.1	102	101	10.8	0.8	6.0
4/17/75	10.1	10.3	103	103	2.5	4.5	5.3
Station PR-2							
8/8/74	4.9	4.8	60	66	6.3	3.5	6.0
8/12/74	8.0	8.3	103	107	5.7	2.5	7.0
10/25/74	9.9	9.7	104	101	6.2	2.5	3.0
11/4/74	7.6	7.7	91	92	5.4	3.3	6.0
1/8/75	10.8	10.9	97	98	5.7	4.0	4.0
2/7/75	13.0	13.2	118	119	3.4	3.3	6.0
4/1/75	10.7	10.8	103	113	5.2	2.0	6.0
4/17/75	10.4	10.3	107	105	8.3	5.0	6.0

Table 152. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
Station PR-3							
8/8/74	5.6	1.6	73	22	6.0	3.0	17.0
8/12/74	8.3	1.4	104	18	6.7	3.5	16.0
10/25/74	9.1	8.6	92	86	6.7	7.0	16.5
11/4/74	7.0	7.1	81	84	12.6	4.5	20.0
1/8/75	10.2	9.6	90	82	5.9	4.0	16.0
2/17/75	12.2	10.5	110	87	3.2	3.5	18.0
4/1/75	12.6	9.0	125	87	0.0	2.5	16.0
4/17/75	13.1	8.5	130	83	2.2	2.5	20.0
Station PR-4							
8/8/74	12.6	0.0	165		0.0	4.5	10.0
8/12/74	9.1	0.0	114		5.4	3.5	9.0
10/25/74	9.4	7.8	97	79	5.7	5.5	8.0
11/4/74	7.5	3.7	88	43	7.0	5.0	10.0
1/8/75	10.7	8.9	93	78	3.5	5.0	6.0
2/7/75	15.9	9.8	151	85	0.0	2.8	9.0
4/1/75	14.5	3.8	150	37	0.0	2.5	8.0
4/17/75	16.9	6.2	170	61	0.0	2.3	9.0
Station PR-5							
8/8/74	8.4	0.0	129	0	5.8	3.0	10.0
8/12/74	9.7	0.0	123	0	8.1	3.0	7.0
10/25/74	10.0	9.0	109	93	2.2	3.5	4.0
11/4/74	6.9	6.6	77	76	7.5	5.5	6.0
1/8/75	10.0	9.7	95	86	6.5	4.0	7.0
2/7/75	13.2	11.8	121	107	4.0	2.5	8.0
4/1/75	14.9	8.9	147	88	0.0	2.8	7.0
4/17/75	12.2	7.6	125	78	3.1		9.0

Table 153. Secondary water analysis data collected at Westecunk (West) Creek, 1973-75.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station WC-0									
8/7/73	1015	Low	31.5	27.5	27.5	24.8	26.6	8.20	8.20
8/15/73	1000	High	24.0	22.5	22.5	28.4	28.6	7.90	8.30
11/26/73	1145	High +0.5	9.0	10.6	10.7	28.5	28.5	8.02	7.90
7/8/74	1155	High	33.0	28.0	28.0	25.6	27.0	7.80	7.80
7/24/74	730	Low	22.5	23.0	22.8	27.5	27.1	7.80	7.75
10/18/74	1125	High +2.0	10.0	14.7	14.7	26.9	26.8	7.75	7.75
10/23/74	1020	Low +0.5	16.0	8.5	9.0	23.4	23.8	8.10	8.10
2/4/75	1120	Low +1.0	-1.5	-0.5	-0.5	21.0	22.4	7.50	7.45
3/13/75	1011	High +0.5	7.2	4.4	4.0	27.7	28.0	7.85	7.85
Station WC-1									
8/7/73	1035		31.0	27.5	26.5	15.1	25.7	7.80	8.10
8/15/73	1010		24.0	23.0	22.5	22.9	28.2	7.90	8.10
11/26/73	1130		9.0	10.7	10.7	27.8	28.4	7.90	8.00
7/8/74	1205		34.0	28.5	27.5	23.1	26.7	7.80	7.80
7/24/74	740		23.0	22.5	23.2	17.9	24.6	7.30	7.40
10/18/74	1135		12.0	14.0	14.5	24.3	26.6	7.70	7.65
10/23/74	1030		16.5	8.9	8.5	22.0	22.6	8.05	8.10
2/4/75	1130		-1.5	1.0	1.0	19.0	21.7	7.65	7.60
3/13/75	1017		7.2	4.4	4.0	22.1	26.2	7.75	7.80
Station WC-2									
8/7/73	1045		29.5	27.5	27.5	12.0	24.3	7.70	8.00
8/15/73	1015		23.5	24.0	23.0	11.7	28.0	7.30	7.90
11/26/73	1200		9.0	10.7	10.6	25.5	28.0	8.00	7.98
7/8/74	1215		34.0	28.5	28.0	17.3	24.7	7.60	7.75
7/24/74	750		23.0	23.3	23.5	15.3	23.6	7.15	7.35
10/18/74	1140		11.0	14.0	14.3	22.5	26.4	7.65	7.89
10/23/74	1040		17.5	9.5	8.6	18.6	22.5	8.05	8.05
2/4/75	1140		-1.5	1.5	2.0	21.4	21.2	7.70	7.65
3/13/75	1024		7.2	6.1	4.4	11.5	24.1	7.48	7.72

Table 153. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station WC-3									
8/7/73	1110		30.5	27.0	28.0	8.0	23.0	7.40	7.90
8/15/73	1025		24.0	23.5	24.0	7.7	27.2	7.10	7.80
11/26/73	1215		9.0	10.7	10.9	20.9	26.2	7.90	7.89
7/8/74	1225		24.0	28.0	27.5	13.3	24.5	7.25	7.60
7/24/74	800		23.0	21.7	23.5	10.3	24.1	6.95	7.28
10/18/74	1155		11.0	14.0	14.3	15.4	23.7	7.90	7.78
10/23/74	1050		18.0	10.2	9.0	16.4	24.5	8.05	8.05
2/4/75	1150		-1.5	1.0	2.5	3.9	23.7	7.80	7.60
3/13/75	1034		7.2	6.5	4.0	8.1	26.5	7.40	7.80
Station WC-4									
8/7/73	1125		32.0	26.5	27.5	4.8	23.0	7.10	8.00
8/15/73	1035		24.0	23.5	23.5	8.5	25.8	6.80	7.90
11/26/73	1225		9.0	10.5	11.0	16.4	26.7	7.80	7.99
7/8/74	1235		34.0	28.5	27.5	12.9	24.9	7.25	7.55
7/24/74	810		23.0	21.3	23.3	7.7	17.9	6.80	7.00
10/18/74	1205		12.0	14.5	14.5	15.1	23.4	8.20	7.70
10/23/74	1100		19.5	10.2	9.2	14.6	23.2	8.05	8.05
2/4/75	1200		-1.5	1.5	3.0	5.4	22.3	7.30	7.50
3/13/75	1044		7.2	4.9	4.2	10.3	11.0	7.52	7.78
Station WC-5									
8/7/73	1135		28.0	25.5	27.0	3.0	23.2	6.20	7.90
8/15/73	1045		24.0	23.5	23.0	7.9	24.3	6.90	7.70
11/26/73	1235		9.0	10.5	11.0	15.5	26.0	7.77	7.91
7/8/74	1250		34.0	28.0	27.8	14.2	23.4	7.30	7.65
7/24/74	815		23.0	20.3	23.7	4.3	17.9	6.60	7.00
10/18/73	1215		12.0	15.0	15.5	17.1	23.9	8.40	7.83
10/23/74	1105		19.0	10.0	9.5	17.8	24.3	8.05	8.05
2/4/75	1210		-1.5	1.7	3.0	4.0	23.0	7.25	7.55
3/13/75	1051		7.2	5.6	4.3	11.0	25.7	7.30	7.70

Table 153. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station WC-6									
8/7/73	1145		27.0	25.0	26.0	1.0	23.7	6.80	7.50
8/15/73	1058		24.5	25.0	24.0	3.7	26.3	6.80	7.80
11/26/73	1250		9.0	10.8	10.9	15.3	23.7	7.40	7.88
7/8/74	1300		34.0	28.0	27.8	16.7	23.6	7.40	7.35
7/24/74	820		23.0	20.0	23.5	0.6	21.4	6.55	6.80
10/18/74	1220		11.0	15.5	15.7	20.3	25.9	7.85	7.55
10/23/74	1110		19.5	10.5	10.1	15.1	24.9	8.05	7.80
2/4/75	1220		-1.5	20.0	3.2	1.9	15.8	7.10	7.45
3/13/75	1056		7.2	5.4	4.0	19.3	24.6	7.55	7.75
Station WC-7									
8/7/73	1200		25.0	24.5	26.0	0.4	22.5	6.70	7.60
8/15/73	1310		26.0	25.0	25.5	5.4	24.4	6.80	7.70
11/26/73	1300		9.0	11.0	11.0	10.4	28.4	7.05	7.65
7/8/74	1305		33.0	28.0	27.5	10.7	24.0	7.50	7.20
7/24/74	830		23.0	19.7	23.5	3.2	7.7	6.35	6.70
10/18/74	1230		12.0	15.8	16.0	16.9	23.2	7.65	7.65
10/23/74	1120		20.5	11.0	11.2	17.5	24.1	7.95	7.95
2/4/75	1230		-1.5	2.0	4.0	0.7	21.0	7.08	7.40
3/13/75	1105		7.2	6.6	4.0	3.7	20.7	7.20	7.50

Table 153. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	$CO_2(mgCO_2/l)$ Surface	Secchi (ft)	Depth (ft)
Station WC-0							
8/7/73	6.7	6.9	97	101		4.0	4.0
8/15/73	5.2	5.1	70	69	8.8	3.0	6.0
11/26/73	8.8	9.0	94	97	0.0	3.0	6.0
7/8/74	7.4	6.7	108	100	3.4	3.0	5.0
7/24/74	6.0	6.0	73	73	4.6	1.5	4.0
10/18/74	8.0	7.9	92	90	3.8	1.5	6.0
10/23/74	10.5	10.8	104	108	5.7	3.3	3.3
2/4/75	12.3	12.2	97	97	6.1	1.5	5.0
3/13/75	10.7	10.6	93	91	3.9	5.0	10.0
Station WC-1							
8/7/73	6.7	6.3	90	90		4.0	6.0
8/15/73	4.9	4.9	64	66	6.8	4.0	10.0
11/26/73	9.0	8.8	96	95	0.0	2.0	6.0
7/8/74	8.0	6.6	110	90	2.3	2.5	6.0
7/24/74	5.8	5.1	71	62	6.4	2.0	4.0
10/18/74	8.2	8.0	91	92	4.6	2.0	8.0
10/23/74	10.5	10.4	106	100	4.6	3.8	4.5
2/4/75	12.5	12.3	102	100	4.2	2.0	4.0
3/13/75	10.7	10.7	93	92	5.6	3.5	8.0
Station WC-2							
8/7/73	6.5	5.0	87	72		3.0	8.0
8/15/73	4.6	4.9	58	66	9.7	3.0	6.0
11/26/73	8.8	8.7	92	93	0.0	3.0	5.0
7/8/74	7.5	7.2	103	97	4.8	2.0	8.0
7/24/74	5.3	4.6	63	56	5.3	2.5	7.0
10/18/74	8.4	7.8	92	89	4.0	2.5	8.0
10/23/74	10.6	10.3	103	101	5.1	2.3	6.5
2/4/75	12.5	12.1	104	102	4.2	3.5	6.0
3/13/75	10.5	10.6	95	92	5.0	3.5	8.0

Table 153. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
Station WC-3							
8/7/73	6.5	5.7	84	82		3.0	6.0
8/15/73	4.5	4.3	54	58	1.9	3.0	10.0
11/26/73	9.2	8.3	94	88	1.5	4.0	9.0
7/8/74	7.3	5.5	98	73	5.0	2.5	8.0
7/24/74	5.0	3.7	59	44	6.4	3.0	8.0
10/18/74	9.2	7.9	96	91	3.5	3.0	9.0
10/23/74	10.9	9.5	107	95	5.1	3.3	7.0
2/4/75	12.6	11.1	103	93	2.7	3.3	7.0
3/13/75	9.9	10.4	90	90	5.6	3.5	8.5
Station WC-4							
8/7/73	6.7	6.6	84	94		3.0	8.0
8/15/73	3.7	3.6	45	48	10.2	4.0	10.0
11/26/73	9.1	8.3	90	88	2.5	4.0	9.5
7/8/74	7.5	5.0	104	66	3.4	2.5	8.0
7/24/74	5.1	2.6	60	31	5.5	3.5	6.0
10/18/74	11.4	7.9	121	89	1.4	3.0	8.0
10/23/74	10.9	10.1	106	101	5.1	3.3	8.0
2/4/75	12.2	11.2	101	95	1.3	3.3	7.5
3/13/75	10.4	10.2	91	88	3.3	3.5	10.0
Station WC-5							
8/7/73	7.5	3.4	92	49		3.0	7.0
8/15/73	3.7	3.6	45	48	1.9	4.0	5.0
11/26/73	9.2	8.5	90	90	2.5	3.5	9.5
7/8/74	8.6	7.0	118	96	4.6	2.5	6.0
7/24/74	5.5	2.7	63	32	5.5	4.0	5.0
10/18/74	13.5	8.0	147	92	0.0	2.0	8.0
10/23/74	11.1	10.1	109	103	5.9	3.0	7.0
2/4/75	12.5	11.5	104	98	1.1	3.5	5.5
3/13/75	9.9	10.4	88	90	5.0	3.5	8.0

Table 153. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2 ($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
Station WC-6							
8/7/73	5.7	2.2	68	30		5.0	7.0
8/15/73	3.6	3.7	44	51	8.8	4.0	10.0
11/26/73	9.2	8.8	91	92	3.9	3.5	10.0
7/8/74	7.5	4.4	102	57	4.0	2.5	7.0
7/24/74	6.0	1.4	68	17	4.1	4.5	8.0
10/18/74	11.1	6.8	125	79	0.8	2.5	10.0
10/23/74	11.4	7.7	111	80	6.5	3.3	9.0
2/4/75	13.0	11.1	110	94	1.3	3.5	6.0
3/13/75	10.2	10.4	91	89	6.1	3.5	10.0
Station WC-7							
8/7/73	8.5	3.4	101	48		5.0	6.0
8/15/73	2.9	2.1	36	22	9.7	4.0	8.0
11/26/73	9.1	8.5	87	92	2.5	4.0	7.0
7/8/74	8.5	4.4	117	57	5.3	3.0	6.0
7/24/74	6.7	3.5	77	41	5.9	4.0	5.0
10/18/74	8.2	8.3	90	96	4.3	4.0	6.5
10/23/74	9.9	9.1	99	95	6.7	3.3	5.0
2/4/75	12.7	10.8	107	93	1.3	3.3	5.0
3/13/75	9.9	10.0	90	86	5.6	4.5	7.0

Table 154. Secondary water analysis data collected at Cedar Run, 1973-75.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station CR-0									
8/13/73	1000	Low	24.5	27.0	26.0	26.5	25.9	8.30	8.20
9/6/73	1100	Low	29.0	27.5	27.5	27.1	27.2	7.90	7.90
11/14/73	1230	High	19.0	7.5	8.0	26.6	28.3	7.98	8.00
7/29/74	1315	Low	28.5	27.7	27.7	23.9	24.6	8.00	8.05
8/19/74	1025	Low +4.5	25.0	25.3	25.3	24.1	26.0	7.45	7.50
10/21/74	900	Low +1.0	4.0	7.0	7.0	24.1	24.1	7.90	8.10
11/19/74	1300	High +0.5	10.5	7.0	7.0	26.2	26.4	8.00	8.00
1/14/75	1130	High +0.5	-1.0	4.0	4.0	22.1	21.7	7.53	7.68
2/19/75	1050	Low +0.5	8.0	4.5	4.5	20.7	21.1	7.80	7.85
3/4/75	945	High +0.5	1.0	1.0	1.0	22.5	22.5	7.80	7.83
3/21/75	944	High +5.5	8.5	6.5	6.5	21.4	21.6	7.65	7.60
Station CR-1									
8/13/73	1010		23.0	27.0	26.0	23.4	25.8	8.10	8.10
9/6/73	1115		29.5	27.5	27.5	18.5	21.1	7.50	7.55
11/14/73	1245		16.5	8.0	7.8	23.7	22.2	7.95	8.00
7/29/74	1335		29.0	28.3	26.7	20.0	22.5	7.75	7.80
8/19/74	1035		25.0	25.0	25.0	20.3	24.5	7.20	7.35
10/21/74	905		4.5	6.7	7.0	20.9	21.9	7.70	7.80
11/19/74	1310		10.5	7.2	7.2	24.8	25.0	8.00	7.95
1/14/75	1140		-1.0	3.8	3.8	20.3	21.4	7.40	7.60
2/19/75	1125		8.0	4.8	4.0	20.2	21.4	7.75	7.70
3/4/75	954		1.0	1.4	1.4	20.3	20.2	7.70	7.60
3/21/75	950		8.5	6.5	6.4	13.2	15.6	7.10	7.18

Table 154. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station CR-2									
8/13/73	1025		23.5	27.5	26.0	19.8	25.4	7.80	8.00
9/6/73	1125		28.0	27.0	27.0	12.8	23.5	7.20	7.25
11/14/73	1300		19.0	8.0	7.5	22.0	23.2	7.85	7.97
7/29/74	1340		28.5	28.0	26.7	14.2	22.9	7.05	7.35
8/19/74	1045		24.0	24.8	25.0	19.2	23.9	7.10	7.25
10/21/74	915		4.0	6.5	7.5	13.8	21.9	7.10	7.90
11/19/74	1325		10.0	8.0	6.5	21.8	23.9	7.80	7.85
1/14/75	1145		-1.0	3.5	4.0	13.6	20.1	7.15	7.50
2/19/75	1140		8.2	6.0	3.6	9.9	19.6	7.20	7.70
3/4/75	1002		1.0	1.6	2.9	10.6	18.2	7.00	7.28
3/21/75	1000		8.5	6.5	6.5	6.6	19.6	6.81	7.35
Station CR-3									
8/13/73	1045		24.0	27.5	27.5	14.5	25.6	7.50	8.00
9/6/73	1140		26.0	25.5	27.0	5.5	9.3	6.60	6.60
11/14/73	1315		21.0	9.0	7.5	20.8	23.1	7.80	7.95
7/29/74	1050		29.0	26.7	26.7	9.5	12.4	6.80	6.80
8/19/74	1050		24.0	25.4	25.0	21.0	23.5	7.15	7.25
10/21/74	930		4.0	6.3	7.7	8.7	19.4	7.00	7.40
11/19/74	1335		11.0	8.0	7.0	22.1	23.0	7.70	7.95
1/14/75	1200		-1.0	4.0	4.5	14.3	16.5	7.08	7.30
2/19/75	1150		8.3	7.0	5.0	6.6	10.6	7.10	7.10
3/4/75	1013		1.0	1.9	2.9	6.8		6.90	
3/21/75	1010		8.7	6.5	6.4	3.5	4.4	6.22	6.50

Table 154. Continued.

Date	Time (EST)	Tide (h)	Temperature (°C)			Salinity (°/oo)		pH	
			Air	Surface	Bottom	Surface	Bottom	Surface	Bottom
Station CR-4									
8/13/73	1100		24.0	27.0	26.0	11.0	23.0	7.10	7.90
9/6/73	1145		29.0	25.0	25.5	4.1	3.7	6.40	6.40
11/14/73	1325		20.0	10.0	7.5	20.6	23.0	7.80	7.75
7/29/74	1410		28.5	26.2	26.0	9.2	7.5	6.70	6.70
8/19/74	1100		24.0	25.2	25.0	22.8	23.2	7.25	7.25
10/21/74	940		5.0	6.5	9.0	7.8	19.4	6.80	7.50
11/19/74	1345		11.5	8.3	7.5	21.2	23.6	7.60	7.81
1/14/75	1215		-1.0	4.8	5.5	14.7	19.7	7.28	7.43
2/19/75	1210		8.3	7.0	5.0	4.1	8.1	6.80	6.90
3/4/75	1025		1.0	2.4	3.0	4.8	13.2	6.70	7.05
3/21/75	1020		8.7	6.6	7.5	2.3	3.7	6.00	6.10
Station CR-5									
8/13/73	1110		23.0	25.0	24.0	2.8	5.2	6.90	6.90
9/6/73	1200		29.0	24.0	24.0	1.9	1.7	6.30	6.30
11/14/73	1345		19.0	9.5		5.8		6.80	
7/29/74	1415		28.0	25.2	25.0	5.7		6.80	
8/19/74	1115		25.0	24.8	25.0	22.6		7.15	
10/21/74	950		6.0	6.7	6.7	7.8		6.80	
11/19/74	1357		12.0	9.0	8.2	15.1	16.3	7.35	7.40
1/14/75	1230		0.0	4.9	5.6	5.9	16.1	6.60	7.10
2/19/75	1220		8.3	7.3	6.5	3.0		6.50	
3/4/75	1033		1.0	3.0	3.0	4.1		6.60	
3/21/75	1030		8.8	7.7	7.5	1.5	2.2	6.00	6.30

Table 154. Continued.

Date	D.O. ($mgO_2/1$) Surface	D.O. ($mgO_2/1$) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/1$) Surface	Secchi (ft)	Depth (ft)
Station CR-0							
8/13/73	6.0	6.4	87	91	7.3	4.0	6.0
9/6/73	6.4	6.2	94	91	5.9	2.0	6.0
11/14/73	11.0	11.2	11	113	0.0	3.0	7.0
7/29/74	7.6	7.6	103	103	1.3	2.0	4.0
8/19/74	5.9	5.4	82	75	5.9	3.0	5.0
10/21/74	9.9	10.1	95	97	3.5	4.0	4.0
11/19/74	10.3	10.3	102	101	2.2	4.0	5.0
1/14/75	10.2	10.2	90	90	4.1	2.0	5.0
2/19/75	11.7	11.3	103	100	3.2	3.5	4.5
3/4/75	11.6	11.6	95	95	3.9	2.5	3.0
3/21/75	10.2	10.1	93	92	6.4	2.5	4.5
Station CR-1							
8/13/73	5.8	5.9	82	84	7.8	3.0	6.0
9/6/73	5.8	5.5	81	79	4.9	3.0	4.0
11/14/73	11.6	11.6	114	112	0.3	3.5	5.0
7/29/74	7.9	7.1	109	94	4.8	1.8	5.0
8/19/74	5.6	4.8	75	67	8.6	3.0	8.0
10/21/74	9.9	10.0	93	94	6.5	2.5	5.5
11/19/74	10.6	10.7	102	104	3.3	4.0	6.0
1/14/75	10.5	10.3	91	91	5.2	2.0	6.0
2/19/75	11.2	11.2	99	98	2.7	3.0	4.0
3/4/75	11.0	10.9	89	88	5.7	1.5	3.5
3/21/75	9.7	10.0	88	91	5.6	1.5	4.0

Table 154. Continued.

Date	D.O. ($mgO_2/1$) Surface	D.O. ($mgO_2/1$) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/1$) Surface	Secchi (ft)	Depth (ft)
Station CR-2							
8/13/73	5.7	5.6	80	79	4.4	3.0	4.0
9/6/73	5.9	3.2	80	45	9.3	3.0	6.0
11/14/73	11.2	11.4	109	110	1.1	3.5	6.5
7/29/74	6.5	4.1	88	52	7.6	1.8	6.0
8/19/74	5.4	4.4	71	61	5.4	3.0	6.0
10/21/74	8.8	8.8	78	84	6.2	2.0	6.0
11/19/74	9.6	9.9	93	94	7.0	3.0	7.0
1/14/75	10.5	9.9	86	86	4.9	1.5	6.5
2/19/75	10.6	9.3	90	79	4.0	2.8	6.0
3/4/75	10.1	9.9	77	81	5.7	2.0	6.0
3/21/75	9.1	9.3	82	84	7.1	2.0	7.0
Station CR-3							
8/13/73	5.6	5.2	76	76	9.3	3.0	5.0
9/6/73	5.8	3.6	72	46	9.0	3.0	4.0
11/14/73	10.9	11.2	107	108	1.3	3.5	6.0
7/29/74	6.1	5.8	81	76	7.3	1.8	4.0
8/19/74	4.9	4.7	66	65	7.5	3.0	6.5
10/21/74	8.2	8.2	70	78	6.2	2.3	3.5
11/19/74	9.6	9.7	96	93	5.9	3.0	5.0
1/14/75	10.0	9.9	84	86	5.2	1.5	4.5
2/19/75	11.9	8.5	99	68	4.5	2.3	3.0
3/4/75	10.2		77		5.6	1.3	1.3
3/21/75	8.8	9.5	79	86	4.5	2.0	3.5

Table 154. Continued.

Date	D.O. (mgO_2/l) Surface	D.O. (mgO_2/l) Bottom	O_2 saturation (%) Surface	O_2 saturation (%) Bottom	CO_2($mgCO_2/l$) Surface	Secchi (ft)	Depth (ft)
Station CR-4							
8/13/73	4.8	4.5	64	63	11.7	2.0	3.0
9/6/73	5.1	5.3	62	64	8.8	2.0	3.0
11/14/73	11.0	11.0	110	116	1.5	3.0	6.0
7/29/74	6.2	5.4	80	69	8.6	1.8	4.0
8/19/74	4.7	4.5	65	62	9.2	3.0	5.0
10/21/74	7.9	8.4	67	81	8.6	1.5	4.0
11/19/74	9.6	9.8	93	95	7.0	3.0	4.0
1/14/75	9.8	9.5	84	85	5.4	1.5	6.0
2/19/75	8.5	8.3	72	64	4.0	2.3	5.5
3/4/75	9.3	10.0	70	81	4.5	1.0	3.3
3/21/75	8.6	8.5	77	78	8.1	2.5	4.0
Station CR-5							
8/13/73	6.2	4.8	75	56	5.9	3.0	3.0
9/6/73	6.3	6.3	74	74	9.5	2.0	2.0
11/14/73	9.3		84		7.0	3.0	3.5
7/29/74	8.5		111		4.3	1.8	1.8
8/19/74	4.4		60			2.0	2.0
10/21/74	7.5		64		8.1	1.5	1.5
11/19/74	9.0	9.2	85	86	6.5	3.0	3.0
1/14/75	9.4	9.3	76	80	4.6	1.5	3.0
2/19/75	9.2		77		4.0	2.0	1.8
3/4/75	9.9		75		4.0	1.0	1.3
3/21/75	8.7		80		6.7	1.0	1.0

Table 155. Chlorinated hydrocarbons detected in tissue of fish collected from Manahawkin Bay - Little Egg Harbor system, 1973-75. Results are in µg/kg.

Location*	Species	Date	P.P. DDE	O.P. DDE	O.P. DDD	O.P. DDT	DDD	DDT	DDT total
Little Egg Harbor Bay									
T-2	Oyster toadfish	7/3/74	Trace#	Neg.†	Neg.	Neg.	Neg.	Neg.	Trace
T-12	Summer flounder	9/13/73	5.0	Neg.	Neg.	Neg.	Neg.	Neg.	5.0
T-11	Winter flounder	5/12/75	5.0	Neg.	Neg.	Neg.	Neg.	Neg.	5.0
Manahawkin Bay									
S-4	Oyster toadfish	8/19/74	5.0	Neg.	Neg.	Neg.	Neg.	Neg.	5.0
T-7	Oyster toadfish	10/9/73	5.0	Neg.	Neg.	Neg.	Neg.	Neg.	5.0
T-16	Winter flounder	4/10/75	Trace	Neg.	Neg.	Neg.	Trace	Trace	Trace
Dinner Point Creek									
T-23	Oyster toadfish	8/17/73	Trace	Neg.	Neg.	Neg.	Trace	Trace	Trace
T-24	Spot	10/30/73	Trace	Neg.	Neg.	Neg.	Trace	Trace	Trace
Mill Creek									
T-15	White perch	6/13/74	17.0	Neg.	Neg.	Neg.	Trace	Trace	17.0
T-17	White perch	10/15/74	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
GS-15	White perch	1/7/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
T-15	White perch	3/21/75							
Beach Haven West Lagoon Complex									
S-9	Menhaden	7/16/74	Trace	Neg.	Neg.	Neg.	Neg.	Neg.	Trace
GS-20	Menhaden	9/26/74	15.0	Neg.	Neg.	Neg.	Trace	Trace	15.0

* See Figure 32 for exact location

\# Results reported as trace are < 1 µg/kg

† Negligible

Table 156. Chlorinated hydrocarbons detected in tissue of fish collected from Manahawkin Bay - Little Egg Harbor system, 1973-75. Results are reported in µg/kg.

Location*	Species	Date	L-BHC	B-BHC	Lindane	Aldrin	Heptachlor	Heptachlor Epoxide	Dieldrin
Little Egg Harbor Bay									
T-2	Oyster toadfish	7/3/74	Neg.#	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
T-12	Summer flounder	9/13/73	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
T-11	Winter flounder	5/12/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Manahawkin Bay									
S-4	Oyster toadfish	8/19/74	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
T-7	Oyster toadfish	10/9/73	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
T-16	Winter flounder	4/10/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Dinner Point Creek									
T-23	Oyster toadfish	8/17/73	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
T-24	Spot	10/30/73	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Mill Creek									
T-15	White perch	6/13/74	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
T-17	White perch	10/15/74	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
GS-15	White perch	1/7/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
T-15	White perch	3/21/75							
Beach Haven West Lagoon Complex									
S-9	Menhaden	7/16/74	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
GS-20	Menhaden	9/26/74	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

* See Figure 32 for exact location

Negligible

Table 157. Chlorinated hydrocarbons detected in sediment collected from Manahawkin Bay - Little Egg Harbor, 1973-75. Results reported in µg/kg.

Location*	L-BHC	Lindane	Aldrin	Heptachlor Epoxide	Dieldrin	O.P. DDE	P.P. DDE	O.P. DDT	P.P. TDE	P.P. DDT	DDT total
M1	Neg.#	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
M2	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
M3	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
M4	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
M5	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
M6	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	10.0	Neg.	Neg.	22.0	32.0
M7	Neg.	Neg.	Neg.	<1.0	Neg.	Neg.	<1.0	Neg.	Neg.	Neg.	<1.0
M8	Neg.	Neg.	Neg.	2.0	Neg.	Neg.	1.0	Neg.	Neg.	Neg.	1.0
M9	Neg.	Neg.	Neg.	6.0	Neg.	Neg.	<1.0	Neg.	Neg.	Neg.	<1.0
M10	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	13.0	Neg.	Neg.	6.0	19.0
M11	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	15.0	6.0	Neg.	12.0	33.0
M12	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	6.0	Neg.	Neg.	Neg.	6.0
M13	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	24.0	Neg.	Neg.	31.0	55.0
M14	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	26.0	Neg.	Neg.	11.0	37.0
M15	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	<1.0	Neg.	Neg.	10.0	10.0
M16	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	24.0	Neg.	Neg.	6.0	30.0
M17	Neg.	Neg.	Neg.	6.0	Neg.	Neg.	8.0	Neg.	19.0	3.0	30.0
M18	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
M19	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
M20	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	9.0	Neg.	7.0	11.0	27.0
M21	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	6.0	Neg.	5.0	7.0	18.0
M22	Neg.	Neg.	Neg.	4.0	Neg.	Neg.	9.0	Neg.	Neg.	10.0	19.0
M23	Neg.	Neg.	Neg.	6.0	Neg.	Neg.	5.0	Neg.	Neg.	16.0	21.0
M24	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	9.0	Neg.	Neg.	12.0	21.0
M25	Neg.	Neg.	Neg.	<1.0	Neg.	Neg.	5.0	Neg.	10.0	16.0	31.0
M26	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	35.0	Neg.	Neg.	Neg.	35.0
M27	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	51.0	Neg.	6.0	12.0	69.0
M28	Neg.	Neg.	Neg.	<1.0	Neg.	Neg.	2.0	Neg.	<1.0	<1.0	2.0
M29	Neg.	Neg.	Neg.	3.0	Neg.	Neg.	12.0	Neg.	2.0	3.0	17.0
M30	Neg.	Neg.	Neg.	2.0	Neg.	Neg.	25.0	Neg.	27.0	16.0	68.0

* See Figure 32 for exact location

Negligible

Table 158. Chlorinated hydrocarbons detected in shellfish meat collected from Manahawkin Bay - Little Egg Harbor system, 1973-75.

Location*	Species	Date	P.P. DDE	O.P. DDE	O.P. DDD	O.P. DDT	DDD	DDT	DDT total
S1	Hard clams	6/3/75	Trace#	Neg.†	Neg.	Neg.	Neg.	Neg.	Trace
S2	Hard clams	6/10/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S4	Hard clams	6/10/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S5	Hard clams	6/13/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S6	Hard clams	6/10/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S7	Ribbed mussels	6/16/75	Trace	Neg.	Neg.	Neg.	Neg.	Neg.	Trace
S8	Ribbed mussels	6/16/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S9	Ribbed mussels	8/22/74	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S10	Ribbed mussels	2/7/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S11	Ribbed mussels	2/7/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

* See Figure 32 for exact location

Trace amounts are those < 1 µg/kg

† Negligible

Table 159. Chlorinated hydrocarbons detected in shellfish meat collected from Manahawkin Bay - Little Egg Harbor system, 1973-75. Results reported in µg/kg.

Location*	Species	Date	L-BHC	B-BHC	Lindane	Aldrin	Heptachlor	Heptachlor Epoxide	Dieldrin
S1	Hard clams	6/3/75	Neg.#	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S2	Hard clams	6/10/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S4	Hard clams	6/10/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S5	Hard clams	6/13/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S6	Hard clams	6/10/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S7	Ribbed mussels	6/16/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S8	Ribbed mussels	6/16/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S9	Ribbed mussels	8/22/74	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S10	Ribbed mussels	2/7/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
S11	Ribbed mussels	2/7/75	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

* See Figure 32 for exact location

Negligible

Table 160. Heavy metal concentrations detected in fish whole produce collected from Manahawkin Bay - Little Egg Harbor system, 1973-75. Results reported in µg/kg.

Location*	Species	Date	Length (cm)	Cadmium	Chromium	Lead	Zinc	Mercury
Little Egg Harbor								
T-2	Oyster toadfish	7/3/74	25	<0.01	<0.01	4.40	6.85	0.30
T-12	Summer flounder	9/13/73	32	<0.01	<0.01	2.30	9.35	0.00
T-11	Winter flounder	5/12/75	14-17	<0.01	<0.01	2.30	8.10	0.05
Manahawkin Bay								
S-4	Oyster toadfish	8/19/74	18-19	<0.01	<0.01	6.10	6.50	0.27
T-7	Oyster toadfish	10/9/73	28	<0.01	<0.01	0.00	9.35	0.00
T-16	Winter flounder	4/10/75	20	<0.01	<0.01	0.00	8.75	0.05
Dinner Point Creek								
T-23	Oyster toadfish	8/17/73	24	<0.01	<0.01	0.60	5.75	0.20
T-24	Spot	10/30/73	12-13	<0.01	<0.01	0.00	8.75	0.09
Mill Creek								
T-15	White perch	6/13/74	22	<0.01	<0.01	3.10	16.25	0.40
T-17	White perch	10/15/74	17-18	<0.01	<0.01	5.25	5.65	0.14
GS-15	White perch	1/7/75	22	<0.01	<0.01	0.00	12.25	0.09
T-15	White perch	3/21/75	16-18	<0.01	<0.01	2.85	8.10	0.00
Beach Haven West Lagoon Complex								
S-9	Menhaden	7/16/74	9-10	<0.01	<0.01	0.40	11.25	0.00
GS-20	Menhaden	9/26/74	12-13	<0.01	<0.01	2.30	16.85	0.00

* See Figure 32 for exact location

Table 161. Heavy metal concentrations detected in sediment collected from Manahawkin Bay - Little Egg Harbor system, 1973-75. Results are reported in µg/kg.

Location*	Cadmium	Chromium	Lead	Zinc	Mercury
M1	0.75	3.0	0.0	2.0	0.00
M2	0.00	33.0	62.5	41.0	0.04
M3	1.50	22.5	237.5	26.5	2.07
M4	1.00	24.0	297.5	22.0	0.01
M5	0.75	8.5	90.0	17.5	0.00
M6	0.50	41.0	0.0	13.0	0.05
M7	2.50	47.5	0.0	72.5	0.05
M8	0.00	32.5	0.0	49.0	0.12
M9	3.00	18.5	90.0	66.0	2.75
M10	1.00	29.5	0.0	49.0	0.01
M11	1.75	33.5	297.5	57.0	2.07
M12	1.50	23.5	0.0	35.0	0.03
M13	1.25	50.0	0.0	21.5	0.01
M14	2.00	33.5	0.0	4.0	0.02
M15	1.00	13.5	175.0	45.5	2.03
M16	0.75	27.5	210.0	39.0	0.00
M17	1.50	11.0	0.0	18.0	0.03
M18	1.00	30.0	210.0	50.0	0.21
M19	0.75	23.5	90.0	29.0	0.07
M20	2.25	18.5	0.0	56.0	0.01
M21	2.00	24.5	175.0	55.5	0.08
M22	1.50	29.0	210.0	36.0	2.01
M23	1.75	4.0	150.0	3.0	0.01
M24	0.50	30.5	265.0	44.0	0.04
M25	2.25	23.0	210.0	35.0	0.12
M26	1.00	41.0	237.5	49.0	1.82
M27	1.25	35.0	0.0	30.0	0.00
M28	0.50	42.5	265.0	13.0	0.04
M29	1.00	13.5	150.0	24.0	0.01
M30	2.00	27.0	237.5	71.5	0.06

* See Figure 32 for each location

Table 162. Heavy metal concentrations detected in shellfish meat collected from Manahawkin Bay - Little Egg Harbor system, 1973-75. Results reported in µg/kg.

Location*	Species	Date	Cadmium	Chromium	Lead	Zinc	Mercury
S1	Hard clams	6/3/75	<0.01	<0.01	3.30	11.50	0.10
S2	Hard clams	6/10/75	<0.01	<0.01	1.20	9.00	0.08
S4	Hard clams	6/10/75	<0.01	<0.01	0.00	8.75	0.18
S5	Hard clams	6/13/74	0.50	<0.01	2.30	20.00	0.29
S6	Hard clams	6/10/75	<0.01	<0.01	1.85	7.25	0.08
S7	Ribbed mussels	6/16/75	0.75	<0.01	1.05	5.50	0.09
S8	Ribbed mussels	6/16/75	<0.01	<0.01	0.60	5.00	0.06
S9	Ribbed mussels	8/22/74	<0.01	<0.01	0.20	3.75	0.07
S10	Ribbed mussels	2/7/75	<0.01	<0.01	5.70	17.25	0.00
S11	Ribbed mussels	2/7/75	<0.01	<0.01	3.30	2.50	0.05

* See Figure 32 for each location

Table 163. Comparison of heavy metal levels detected in fish, mud, and shellfish samples collected in the Manahawkin Bay - Little Egg Harbor system, 1973-75. Results reported in mg/kg.

	Fish			Mud			Shellfish		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum
Cadmium		<0.01		0.00	1.28	3.00	<0.01		0.75
Chromium		<0.01		3.00	26.48	50.00		<0.01	
Lead	0.00	2.11	6.10	0.00	122.00	297.50	0.00	1.95	5.70
Zinc	5.60	9.55	16.85	2.00	36.48	66.60	2.50	9.05	20.00
Mercury	0.00	0.11	0.40	0.00	0.46	2.75	0.00	0.10	0.29

Table 164. Total coliform and fecal coliform counts for Manahawkin Bay - Little Egg Harbor, 1973-75.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
Buoy "F"	9/17/73	Low +4.0	<30.0	<30.0	
MB-1	10/2/73	Low +5.0	<30.0	<30.0	
	18/13/74	High +6.0	<30.0	<30.0	
	8/20/74	Low +1.0	<30.0	<30.0	
	9/10/74	High +5.5	<30.0	<30.0	<30
	9/17/74	High +5.5	<30.0	<30.0	
	11/14/74	High +5.0	<3.0	<3.0	
	1/29/75	Low +1.0	<3.0	<3.0	
	5/22/75	High +5.0	<3.0	<3.0	
Flashing Red "9"	9/17/73	Low +2.5	36.0	<30.0	
MB-2	10/2/73	Low +2.5	30.0	<30.0	
	8/13/74	Low	73.0	36.0	
	8/20/74	Low +5.0	<30.0	<30.0	
	9/10/74	High +5.5	<30.0	<30.0	
	9/17/74	Low +5.0	<30.0	<30.0	
	11/14/74	Low +5.0	<3.0	<3.0	
	1/29/75	High +0.5	<3.0	<3.0	
	5/22/75	High +1.5	<3.0	<3.0	
Flashing Green "53"	9/17/73	High +1.0	<30.0	<30.0	
MB-5	10/2/73	Low +4.0	230.0	230.0	
	8/13/74	High +5.0	750.0	36.0	
	8/20/74	Low +5.5	<30.0	<30.0	
	9/10/74	High +5.5	<30.0	<30.0	
	9/17/74	High +5.5	<30.0	<30.0	<30 (>1)*
	11/14/74	Low +5.5	23.0	23.0	
	1/29/75	High +1.0	<3.0	<3.0	
	5/22/75	High +1.5	<3.0	<3.0	
Flashing Red "34"	9/17/73	High	36.0	<30.0	
MB-8	10/2/73	Low +4.5	30.0	<30.0	
	1/23/74	High +2.5	<30.0	<30.0	
	1/29/74	Low +3.5	<30.0	<30.0	
	1/31/74	Low +2.5	<30.0	<30.0	
	8/13/74	Low +3.0	36.0	36.0	
	8/20/74	High +3.0	36.0	30.0	
	9/10/74	Low +1.0	36.0	36.0	<30 (1.2)*
	9/17/74	High +2.0	<30.0	<30.0	
	11/14/74	High +3.0	3.6	3.6	
	1/29/75	High +1.0	<3.0	<3.0	
	5/22/75	High +3.0	3.6	3.6	

Table 164. Continued.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
Flashing Green "21" MB-9	9/17/73	Low +5.5	<30.0	<30.0	
	10/2/73	Low +5.5	<30.0	<30.0	
	1/23/74	High +1.5	36.0	36.0	
	1/29/74	Low +3.0	<30.0	<30.0	
	1/31/74	Low +2.0	<30.0	<30.0	
	8/13/74	Low	<30.0	<30.0	
	8/20/74	High +1.0	<30.0	<30.0	
	9/10/74	Low	<30.0	<30.0	<30
	9/17/74	High +1.0	<30.0	<30.0	
	11/14/74	High +2.5	3.6	3.6	
	1/29/75	High +2.5	3.6	3.6	
	5/22/75	High +4.0	9.1	9.1	
Flashing Red "82" MB-11A	8/20/74	High +0.5	<30.0	<30.0	
	9/10/74	Low +0.5	<30.0	<30.0	<3
	9/17/74	High +1.5	<30.0	<30.0	
	11/14/74	High +2.0	<3.0	<3.0	
	1/29/75	High +2.0	<3.0	<3.0	
	5/22/75	High +5.0	<3.0	<3.0	

* Fecal coliform streptococcus ratio is not significant

Table 165. Total coliform and fecal coliform counts for Dinner Point Creek, 1973-75.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
DPC-1 (Mouth)	9/17/73	Low +2.5	<30	<30	
	10/2/73	Low +3.5	<30	<30	
	1/23/74	Low +5.0	<30	<30	
	1/29/74	High +5.5	36	<30	
	1/31/74	Low	<30	<30	
	8/13/74	High +5.5	<30	<30	
	9/10/74	Low	91	<30	36 (.08)*
	9/17/74	High	36	30	
	11/14/74	High +0.5	93	36	
	1/29/75	Low +0.5	<3	<3	
	5/22/75	High +0.5	93	43	
DPC-2 (Middle)	9/17/73	Low +2.5	2,400	73	
	10/2/73	Low +3.5	<30	<30	
	1/23/74	Low +5.0	<30	<30	
	1/29/74	Low	<30	<30	
	1/31/74	Low	<30	<30	
	8/13/74	High +5.0	91	<30	
	9/10/74	Low +5.5	36	<30	
	9/17/74	Low +5.5	<30	<30	
	11/14/74	High	23	23	
	1/29/75	High	<3	<3	
	5/22/75	High +1.0	210	150	
DPC-3 (End)	9/17/73	Low +2.0	930	230	
	10/2/73	Low +4.5	930	230	
	1/23/74	Low +5.0	430	<30	
	1/29/74	Low +4.5	36	<30	
	1/31/74	Low +3.0	<30	<30	
	8/13/74	High +5.5	1,500	750	
	8/20/74	High	4,600	230	
	9/10/74	Low +1.0	430	150	39 (3.8)#
	9/17/74	Low +5.0	4,600	150	
	11/14/74	High +2.5	1,100	93	
	1/29/75	High +2.0	460	<3	
	5/22/75	High +3.0	460	240	

* Fecal coliform streptococcus ratio indicates animal influence

Fecal coliform streptococcus ratio indicates human influence

Table 166. Total coliform and fecal coliform counts for Meyers Pond, 1973-75.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
Meyers Pond	9/17/73	Low +3.0	210	150	
MP-0	10/2/73	Low +3.0	<30	<30	
	1/23/74	Low +5.5	<30	<30	
Mouth	1/29/74	Low	<30	<30	
Mouth	1/31/74	Low	<30	<30	
Mouth	8/13/74	High +6.0	<30	<30	
Mouth	8/20/74	High	<30	<30	
Mouth	9/10/74	High +5.5	36	36	<30 (1.2)*
Mouth	9/17/74	High	36	<30	
Mouth	11/14/74	High +1.0	15	9.1	
Mouth	1/29/75	High +1.0	21	<3	
Mouth	5/22/75	High +1.5	43	43	

* Fecal coliform streptococcus ratio is not significant

Table 167. Total coliform and fecal coliform counts for Popular Point, 1973-75.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
Popular Point	9/17/73	Low +3.0	<30	<30	
PP-0	10/2/73	Low +3.0	36	<30	
	1/23/74	High +0.5	36	36	
	1/29/74	Low	<30	<30	
	1/31/74	Low	<30	<30	
	8/13/74	High +6.0	<30	<30	
	8/20/74	High +1.5	<30	<30	
	9/10/74	High +5.5	36	<30	<30
	9/17/74	High	<30	<30	
	11/14/74	High +1.0	43	9.1	
	1/29/75	High +1.0	43	<3	
	5/22/75	High +1.5	<3	<3	

Table 168. Total coliform and fecal coliform for Mill Creek, 1973-75.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
Mill Creek	9/17/73	Low +3.0	430.0	230.0	
MC-1	10/2/73	Low +3.0	<30.0	<30.0	
	1/23/74	High +0.5	<30.0	<30.0	
	1/29/74	Low	91.0	<30.0	
	1/31/74	Low +0.5	<30.0	<30.0	
	8/13/74	Low	230.0	91.0	
	8/20/74	High +0.5	<30.0	<30.0	
	9/10/74	High +6.0	36.0	36.0	<30 (1.2)*
	9/17/74	Low +6.0	36.0	<30.0	
	11/14/74	High +1.0	43.0	23.0	
	1/29/75	High +4.0	43.0	3.6	
	5/22/75	High +2.0	43.0	23.0	
MC-2	9/17/73	Low +3.0	1,500.0	150.0	
(below plant)	10/2/73	Low +3.0	36.0	<30.0	
	1/23/74	High +0.5	230.0	<30.0	
	1/29/74	Low	<30.0	<30.0	
	1/31/74	Low	<30.0	<30.0	<30 (3.03)#
	8/13/74	High +6.5	91.0	36.0	
	8/20/74	High +0.5	36.0	<30.0	
	9/10/74	High +6.0	230.0	91.0	
	9/17/74	High	430.0	36.0	
	11/14/74	High +1.0	93.0	3.6	
	1/29/75	High +3.5	240.0	<3.0	
	5/22/75	High +2.0	150.0	93.0	
MC-3	9/17/73	Low +3.0	2,400.0	2,400.0	
(above plant)	10/2/73	Low +2.0	230.0	<30.0	
	1/23/74	High +0.5	91.0	<30.0	
	1/29/74	Low	150.0	<30.0	
	1/31/74	Low	<30.0	<30.0	
	8/13/74	Low	150.0	<30.0	
	8/20/74	High +0.5	230.0	36.0	
	9/10/74	High +6.0	430.0	430.0	36 (12.0)#
	9/17/74	Low +6.0	91.0	91.0	
	11/14/74	High +1.0	93.0	7.3	
	1/29/75	High +3.0	3.6	9.1	
	5/22/75	High +2.0	150.0	93.0	

Table 168. Continued.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
MC-4 (Lagoon 81)	9/17/73	Low +3.0	930.0	230.0	
	10/2/73	Low +2.5	45.0	<30.0	
	1/23/74	High +1.0	91.0	<30.0	
	1/29/74	Low +0.5	91.0	<30.0	
	1/31/74	Low	<30.0	<30.0	
	8/13/74	Low	91.0	91.0	
	8/20/74	High +0.5	230.0	<30.0	
	9/10/74	High	<30.0	<30.0	<30
	9/17/74	Low +6.0	<30.0	<30.0	
	11/14/74	High +1.0	39.0	23.0	
	1/29/75	High +2.5	150.0	<3.0	
	5/22/75	High +2.0	240.0	240.0	
MC-5 (Lagoon 98)	9/17/73	Low +3.0	4,600.0	430.0	
	10/2/73	Low +3.0	230.0	<30.0	
	1/23/74	High +1.0	230.0	36.0	
	1/29/74	Low +0.5	230.0	36.0	
	1/31/74	Low +1.0	<30.0	<30.0	
	8/13/74	Low	91.0	<30.0	
	8/20/74	High +1.0	230.0	230.0	
	9/10/74	Low +1.0	91.0	36.0	30 (1.2)*
	9/17/74	High +0.5	230.0	36.0	
	11/14/74	High +1.0	1,100.0	--	
	5/22/75	High +2.5	240.0	93.0	
MC-6 (Lake drainage)	9/17/73	Low +3.0	930.0	230.0	
	10/2/73	Low +2.0	230.0	45.0	
	1/23/74	High +1.0	36.0	<30.0	
	1/29/74	Low +0.5	36.0	<30.0	
	1/31/74	Low +0.5	<30.0	<30.0	
	8/13/74	High +5.5	36.0	<30.0	
	8/20/74	High	91.0	<30.0	
	9/10/74	Low +1.0	150.0	150.0	36 (4.0)#
	9/17/74	High +1.0	430.0	<30.0	
	11/14/74	High +3.0	240.0	93.0	
	1/29/75	High +3.0	240.0	23.0	
	5/22/75	High +3.5	150.0	150.0	

*Fecal coliform streptococcus ratio is not significant

#Fecal coliform streptococcus ratio indicates human influence

Table 169. Total coliform and fecal coliform for Beach Haven West, 1973-75.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
BHW-2 (Lagoon 45)	9/17/73	Low +4.0	230.0	230.0	
	10/2/73	Low +4.0	36.0	36.0	
	1/23/74	High +1.0	<30.0	<30.0	
	1/29/74	Low +1.5	<30.0	<30.0	
	1/31/74	Low +1.5	<30.0	<30.0	
	8/13/74	High +6.0	<30.0	<30.0	
	8/20/74	High +1.0	<30.0	<30.0	
	9/10/74	Low +2.0	36.0	36.0	<30 (1.2)*
	9/17/74	High	36.0	30.0	
	11/14/74	High +3.0	93.0	7.3	
	1/29/75	High +3.0	15.0	3.6	
	5/22/75	High +4.0	1,100.0	240.0	
BHW-3 (Lagoon System D-Channel)	9/17/73	Low +4.0	<30.0	<30.0	
	10/2/73	Low +2.5	430.0	230.0	
	1/23/74	High +1.5	73.0	<30.0	
	1/29/74	Low +1.5	<30.0	<30.0	
	1/31/74	Low +1.5	<30.0	<30.0	
	8/13/74	Low	4,600.0	1,500.0	
	8/20/74	High +1.0	140.0	91.0	
	9/10/74	High +2.0	<30.0	<30.0	<30
	9/17/74	High +0.5	<30.0	<30.0	
	11/14/74	High +3.5	240.0	93.0	
	1/29/75	High +3.5	43.0	3.6	
	5/22/75	High +4.0	43.0	43.0	
BHW-1 (Lagoon System B)	9/17/73	Low +5.5	230.0	91.0	
	10/2/73	Low +3.0	91.0	36.0	
	1/23/74	High +1.0	<30.0	<30.0	
	1/29/74	Low +2.0	230.0	<30.0	
	1/31/74	Low +1.5	36.0	<30.0	
	8/13/74	Low	36.0	<30.0	
	8/20/74	High +1.5	230.0	91.0	
	9/10/74	Low +2.5	73.0	36.0	<3 (1.2)*
	9/17/74	High +1.5	36.0	36.0	
	11/14/74	High +2.0	15.0	9.1	
	1/29/75	High +1.5	11.0	6.2	
	5/22/75	High +3.0	240.0	240.0	

Table 169. Continued.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
BHW-4 (Lagoon System B-Channel)	9/17/73	Low +5.0	230.0	91.0	
	10/2/73	Low +2.5	91.0	91.0	
	1/23/74	High +1.0	150.0	36.0	
	1/29/74	Low +2.0	36.0	<30.0	
	1/31/74	Low +1.0	<30.0	<30.0	
	8/13/74	High +3.5	91.0	36.0	
	8/20/74	High +0.5	230.0	230.0	
	9/10/74	Low +1.0	91.0	36.0	91 (0.3)#
	9/17/74	High	930.0	930.0	
	11/14/74	High +3.0	43.0	43.0	
	1/29/75	High +3.0	93.0	23.0	
	5/22/75	High +4.0	210.0	150.0	
BHW-6 (Lagoon System B-Lagoon 24)	9/17/73	Low +5.0	930.0	230.0	
	10/2/73	Low +2.0	<30.0	<30.0	
	1/23/74	High +4.5	430.0	<30.0	
	1/29/74	Low +2.0	91.0	36.0	
	1/31/74	Low +2.0	<30.0	<30.0	
	8/13/74	Low	<30.0	<30.0	
	8/20/74	High +1.0	36.0	<30.0	
	9/10/74	Low +1.5	<30.0	<30.0	<30
	9/17/74	High	36.0	36.0	
	11/14/74	High +3.5	93.0	23.0	
	1/29/75	High +3.5	7.3	<3.0	
	5/22/75	High +4.5	240.0	240.0	
BHW-7 (Lagoon System A-Channel)	9/17/73	Low +4.5	91.0	91.0	
	10/2/73	Low +3.0	91.0	91.0	
	1/23/74	High	36.0	<30.0	
	1/29/74	Low +2.5	36.0	36.0	
	1/31/74	Low +1.5	<30.0	<30.0	
	8/13/74	Low	230.0	91.0	
	8/20/74	High +1.5	36.0	36.0	
	9/10/74	Low +1.5	91.0	91.0	36 (2.5)†
	9/17/74	High +0.5	150.0	36.0	
	11/14/74	High +3.5	91.0	23.0	
	1/29/75	High +3.5	9.1	3.6	
	5/22/75	High +4.5	240.0	93.0	

Table 169. Continued.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
BHW-8	9/17/73	Low +4.5	230.0	91.0	
	10/2/73	Low +3.0	36.0	36.0	
	1/23/74	High	<30.0	<30.0	
	1/29/74	Low +2.5	<30.0	<30.0	
	1/31/74	Low +1.5	<30.0	<30.0	
	8/13/74	Low	<30.0	<30.0	
	8/20/74	High +1.0	230.0	<30.0	
	9/10/74	Low +1.5	91.0	91.0	<30 (3.03)**
	9/17/74	High +0.5	210.0	150.0	
	11/14/74	High +4.0	460.0	43.0	
	1/29/75	High +4.0	93.0	<3.0	
	5/22/75	High +4.5	460.0	460.0	
BHW-9 (Lagoon System C-mouth)	9/17/73	Low +5.5	2,400.0	210.0	
	10/2/73	Low +1.5	<30.0	<30.0	
	1/23/74	High +0.5	<30.0	<30.0	
	1/29/74	Low +2.5	<30.0	<30.0	
	1/31/74	Low +2.0	<30.0	<30.0	
	8/13/74	Low +0.5	72.0	30.0	
	8/20/74	High +1.5	73.0	<30.0	
	9/10/74	Low	36.0	<30.0	36 (0.8)*
	9/17/74	High +1.5	36.0	36.0	
	11/14/74	High +2.0	93.0	93.0	
	1/29/75	High +2.0	23.0	23.0	
	5/22/75	High +3.0	460.0	460.0	
BHW-10 (Lagoon System C-Channel)	9/17/73				
	10/2/73	High +1.5	91.0	91.0	
	1/23/74	High +0.5	91.0	<30.0	
	1/29/74	Low +2.5	<30.0	<30.0	
	1/31/74	Low +2.0	<30.0	<30.0	
	8/13/74	Low +0.5	91.0	36.0	
	8/20/74	High +1.5	230.0	36.0	
	9/10/74	Low	36.0	36.0	<30 (1.2)*
	9/17/74	High +1.0	36.0	36.0	
	11/14/74	High +1.5	43.0	43.0	
	1/29/75	High +2.0	93.0	21.0	
	5/22/75	High +4.0	460.0	460.0	

Table 169. Continued.

Station	Date	Tide (h)	Total coliform (MPN/100ml)	Fecal coliform (MPN/100ml)	Fecal streptococcus (MPN/100ml)
BHW-11	9/17/73				
(Lagoon	10/2/73	Low +2.0	<30.0	<30.0	
System C-	1/23/74	High +1.5	<30.0	<30.0	
Lagoon 37)	1/29/74	Low +3.0	<30.0	<30.0	
	1/31/74	Low +2.0	<30.0	<30.0	
	8/13/74	Low +0.5	36.0	36.0	
	8/20/74	High +2.0	91.0	<30.0	
	9/10/74	Low	36.0	<30.0	<30.0
	9/17/74	High +0.5	36.0	36.0	
	11/14/74	High +2.0	21.0	21.0	
	1/29/75	High +2.0	43.0	<3.0	
	5/22/75	High +3.5	460.0	460.0	

* Fecal coliform streptococcus ratio is not significant

\# Fecal coliform streptococcus ratio indicates animal influence

† Fecal coliform streptococcus ratio indicates a mixture of human and animal influence.

** Fecal coliform streptococcus ratio indicates human influence

Table 170. Minimum, maximum, and mean total coliform count (MPN/100ml) observed seasonally in the Manahawkin Bay - Little Egg Harbor system, 1973-75.

Year	Season	Level	Bay	Dinner Point Creek	Mill Creek	Lagoon complex
1973	Summer	Minimum	<30.0	<30.0	<30.0	<30.0
		Mean	32.4	720.0	1,798.3	546.4
		Maximum	36.0	2,400.0	4,600.0	2,400.0
	Fall	Minimum	<30.0	<30.0	<30.0	<30.0
		Mean	87.5	217.2	133.5	95.6
		Maximum	230.0	930.0	230.0	430.0
	Winter	Minimum	<30.0	<30.0	<30.0	<30.0
		Mean	31.0	71.2	99.1	60.3
		Maximum	36.0	430.0	230.0	430.0
1974	Summer	Minimum	<30.0	<30.0	<30.0	<30.0
		Mean	100.5	708.6	128.0	328.6
		Maximum	750.0	4,600.0	230.0	4,600.0
	Fall	Minimum	<3.0	15.0	<30.0	15.0
		Mean	22.8	471.4	214.7	109.3
		Maximum	36.0	4,600.0	1,100.0	930.0
	Winter	Minimum	<3.0	<3.0	3.6	7.3
		Mean	3.1	99.2	135.3	43.0
		Maximum	3.6	460.0	240.0	93.0
	Spring	Minimum	<3.0	<3.0	43.0	43.0
		Mean	4.3	161.8	162.2	39.1
		Maximum	9.1	460.0	340.0	1,100.0

Table 171. Minimum, maximum and mean total fecal coliform count (MPN/100ml) observed seasonally in the Manahawkin Bay - Little Egg Harbor system, 1973-75.

Year	Season	Level	Bay	Dinner Point Creek	Mill Creek	Lagoon complex
1973	Summer	Minimum	<30.0	<30.0	<30.0	<30.0
		Mean	<30.0	102.6	611.7	133.0
		Maximum	<30.0	230.0	240.0	230.0
	Fall	Minimum	<30.0	<30.0	<30.0	<30.0
		Mean	87.5	70.0	32.5	70.1
		Maximum	230.0	230.0	45.0	230.0
	Winter	Minimum	<30.0	<30.0	<30.0	<30.0
		Mean	31.0	30.4	36.8	30.6
		Maximum	36.0	36.0	36.0	36.0
1974	Summer	Minimum	<30.0	<30.0	<30.0	<30.0
		Mean	31.8	132.2	57.8	124.2
		Maximum	37.0	750.0	91.0	1,500.0
	Fall	Minimum	<3.0	9.1	3.6	7.3
		Mean	22.8	49.0	69.2	73.4
		Maximum	36.0	150.0	430.0	930.0
	Winter	Minimum	<3.0	<3.0	<3.0	<3.0
		Mean	3.1	5.0	8.3	9.3
		Maximum	3.6	<3.0	23.0	23.0
	Spring	Minimum	<3.0	<3.0	23.0	23.0
		Mean	4.3	95.8	115.3	284.6
		Maximum	9.1	240.0	240.0	460.0

Table 172. Estimated total man-days of activity by activity category and month for the 8 month study period, July 1973 - February 1974.

Month	Fishing		Boating	Shell-fishing	Sailing	Water skiing
	Bank	Boat				
July 1973	3,025	23,193	14,165	5,344	5,714	574
August 1973	1,967	26,506	13,139	6,595	8,952	370
September 1973	1,762	11,159	5,093	1,520	1,775	127
October 1973	657	4,070	1,589	715	753	
November 1973	204	1,555	765	594	56	
December 1973	64	273	537	1,096		
January 1974	69	95	199	1,598		
February 1974	23	10	134	1,141		
Total	7,771	66,861	35,621	18,603	17,250	1,071
%	4.91	42.25	22.51	11.75	10.90	0.68
Ranking	6	1	2	3	4	8

Table 172. Continued.

Month	Bathing	Hunting	Other	Total	%	Ranking
July 1973	4,770		893	57,678	36.44	2
August 1973	3,564		633	61,726	39.00	1
September 1973	461		132	22,029	13.92	3
October 1973		114	50	7,948	5.02	4
November 1973		100		3,274	2.07	5
December 1973		324	12	2,306	1.46	6
January 1974			39	2,000	1.26	7
February 1974				1,308	0.83	8
Total	8,795	538	1,759	158,269	100.00	
%	5.56	0.34	1.11	100.01		
Ranking	5	9	7			

Table 173. July 1973 - Estimated total man-days of activity by area and activity category.

Activity category	West Lower Manahawkin Bay		West Little Egg Harbor		East Little Egg Harbor		East Lower Manahawkin Bay		East Upper Manahawkin Bay		West Upper Manahawkin Bay		Activity total	
	Total*	%Area#	Total	%Area	Total	%Area	Total	%Area	Total	%Area	Total	%Area	Total	%Area
	%Activity†		%Activity		%Activity		%Activity		%Activity		%Activity		%Activity	
Bank fishing	295	3.23	577	4.66	571	3.77	804	8.20	338	5.31	440	9.09	3,025	5.24
	9.75		19.07		18.88		26.58		11.17		14.55		100.00	
Boat fishing	4,188	45.87	6,273	50.64	5,934	39.19	2,247	22.92	1,919	30.12	2,632	54.35	23,193	40.21
	18.06		27.05		25.59		9.69		8.27		11.35		100.01	
Boating	2,332	25.54	2,666	21.52	4,272	28.21	2,269	23.15	1,506	23.64	1,120	23.13	14,165	24.56
	16.46		18.82		30.16		16.02		10.63		7.91		100.00	
Shell-fishing	1,221	13.37	2,013	16.25	1,321	8.72	641	6.54	102	1.60	46	0.95	5,344	9.27
	22.85		37.67		24.72		11.99		1.91		0.86		100.00	
Sailing	338	3.70	378	3.05	1,399	9.24	1,926	19.65	1,173	18.41	500	10.32	5,714	9.91
	5.92		6.62		24.48		33.71		20.53		8.75		100.01	
Water skiing	134	1.47	20	0.16	48	0.32	171	1.74	176	2.76	25	0.52	574	1.00
	23.34		3.48		8.36		29.79		30.66		4.36		99.99	
Bathing	578	6.33	361	2.91	928	6.13	1,666	16.99	1,157	18.16	80	1.65	4,770	8.27
	12.12		7.57		19.45		34.93		24.26		1.68		100.01	
Hunting														
Others	45	0.49	99	0.80	670	4.42	79	0.81					893	1.55
	5.04		11.09		75.03		8.85						100.01	
Area total	9,131	100.00	12,387	99.99	15,143	100.00	9,803	100.00	6,371	100.00	4,843	100.01	57,678	100.01
	15.83		21.48		26.25		17.00		11.05		8.40		100.01	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 174. August 1973 - Estimated total man-days of activity by area and activity category.

Activity category	West Lower Manahawkin Bay Total*	%Area#	%Activity†	West Little Egg Harbor Total	%Area	%Activity	East Little Egg Harbor Total	%Area	%Activity	East Lower Manahawkin Bay Total	%Area	%Activity	East Upper Manahawkin Bay Total	%Area	%Activity	West Upper Manahawkin Bay Total	%Area	%Activity	Activity total Total	%Area	%Activity
Bank fishing	92	1.24	4.68	443	2.99	22.52	652	3.62	33.15	256	2.37	13.01	156	2.67	7.93	368	7.59	18.41	1,967	3.19	100.00
Boat fishing	4,032	54.44	15.21	6,440	43.44	24.30	8,646	48.04	32.62	2,707	25.05	10.21	1,546	26.47	5.83	3,135	64.63	11.83	26,506	42.94	100.00
Boating	1,592	21.50	12.12	2,590	17.47	19.71	4,488	24.94	34.16	2,104	19.47	16.01	1,629	27.89	12.40	736	15.17	5.60	13,139	21.29	100.00
Shell-fishing	920	12.42	13.95	2,800	18.89	42.46	1,891	10.51	28.67	886	8.20	13.43	49	0.84	0.74	49	1.01	0.74	6,595	10.68	99.99
Sailing	534	7.21	5.97	1,770	11.94	19.77	1,602	8.90	17.90	2,898	26.82	32.37	1,629	27.89	18.20	519	10.70	5.80	8,952	14.50	100.01
Water skiing	72	0.97	19.46	29	0.20	7.84	83	0.46	22.43	68	0.63	18.39	86	1.47	23.24	32	0.66	8.64	370	0.60	100.01
Bathing	164	2.21	4.60	465	3.14	13.05	348	1.93	9.76	1,850	17.12	51.91	733	12.55	20.57	4	0.08	0.11	3,564	5.77	100.00
Hunting																					
Others				287	1.94	45.34	287	1.59	45.34	38	0.35	6.00	13	0.22	2.05	8	0.16	1.26	633	1.03	99.99
Area total	7,406	99.99	12.00	14,824	100.01	24.02	17,997	99.99	29.16	10,807	100.01	17.51	5,841	100.00	9.46	4,851	100.00	7.86	61,726	100.00	100.01

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 175. September 1973 - Estimated total man-days of activity by area and activity category.

Activity category	West Lower Manahawkin Bay Total*	%Area# %Activity†	West Little Egg Harbor Total	%Area %Activity	East Little Egg Harbor Total	%Area %Activity	East Lower Manahawkin Bay Total	%Area %Activity	East Upper Manahawkin Bay Total	%Area %Activity	West Upper Manahawkin Bay Total	%Area %Activity	Activity total Total	%Area %Activity
Bank fishing	147 8.34	4.96	540 30.65	9.53	141 8.00	2.18	414 23.50	16.30	174 9.88	7.31	346 19.64	17.12	1,762 100.01	8.00
Boat fishing	1,795 16.09	60.56	3,326 29.81	58.68	3,396 30.43	52.61	699 6.26	27.52	752 6.74	31.58	1,191 10.67	58.93	11,159 100.00	50.66
Boating	762 14.96	25.71	959 18.83	16.92	1,933 37.95	29.95	535 10.50	21.06	588 11.55	24.70	316 6.20	15.64	5,093 99.99	23.12
Shell-fishing	144 9.47	4.86	676 44.47	11.93	577 37.96	8.96	63 4.14	2.48	10 0.66	0.42	50 3.29	2.47	1,520 99.99	6.90
Sailing	92 5.18	3.10	108 6.08	1.91	255 14.37	3.95	442 24.90	17.40	780 43.94	32.76	98 5.52	4.85	1,775 99.99	8.06
Water skiing	24 18.90	0.81	35 27.56	0.62	5 3.94	0.08	19 14.96	0.75	33 25.98	1.39	11 8.66	0.54	127 100.00	0.58
Bathing			20 4.34	0.35	44 9.54	0.68	344 74.62	13.54	44 9.54	1.85	9 1.95	0.45	461 99.99	2.09
Hunting														
Others			4 3.03	0.07	104 78.79	1.61	24 18.18	0.94					132 100.00	0.60
Area total	2,964 13.45	100.00	5,668 25.73	100.01	6,455 29.30	100.00	2,540 11.53	99.99	2,381 10.81	100.01	2,021 9.17	100.00	22,029 99.99	100.01

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 176. October 1973 - Estimated total man-days of activity by area and activity category.

Activity category	West Lower Manahawkin Bay Total* %Activity†	%Area#	West Little Egg Harbor Total %Activity	%Area	East Little Egg Harbor Total %Activity	%Area	East Lower Manahawkin Bay Total %Activity	%Area	East Upper Manahawkin Bay Total %Activity	%Area	West Upper Manahawkin Bay Total %Activity	%Area	Activity total Total %Activity	%Area
Bank fishing	15 2.28	1.21	250 38.05	11.52	45 6.85	2.30	117 17.81	11.34	51 7.76	5.83	179 27.25	26.40	657 100.00	8.27
Boat fishing	710 17.44	57.40	1,053 25.87	48.50	1,241 30.49	63.48	364 8.94	35.27	411 10.10	46.97	291 7.15	42.92	4,070 99.99	51.21
Boating	223 14.03	18.03	364 22.91	16.77	509 32.03	26.04	240 15.10	23.26	210 13.22	24.00	43 2.71	6.34	1,589 100.00	19.99
Shell-fishing	191 26.71	15.44	433 60.56	19.94	73 10.21	3.73	18 2.52	1.74					715 100.00	9.00
Sailing	54 7.17	4.37	26 3.45	1.20	46 6.11	2.35	293 38.91	28.39	199 26.43	22.74	135 17.93	19.91	753 100.00	9.47
Water skiing														
Bathing														
Hunting	36 31.58	2.91	28 24.56	1.29	16 14.04	0.82			4 3.51	0.46	30 26.32	4.42	114 100.01	1.43
Others	8 16.00	0.65	17 34.00	0.78	25 50.00	1.28							50 100.00	0.63
Area total	1,237 15.56	100.01	2,171 27.32	100.00	1,955 24.60	100.00	1,032 12.98	100.00	875 11.00	100.00	678 8.53	99.99	7,948 99.99	100.00

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 177. November 1973 - Estimated total man-days of activity by area and activity category.

Activity category	West Lower Manahawkin Bay Total*	%Area#	%Activity†	West Little Egg Harbor Total	%Area	%Activity	East Little Egg Harbor Total	%Area	%Activity	East Lower Manahawkin Bay Total	%Area	%Activity	East Upper Manahawkin Bay Total	%Area	%Activity	West Upper Manahawkin Bay Total	%Area	%Activity	Activity total Total	%Area	%Activity
Bank fishing	12	3.53	5.88	107	8.47	52.45	60	5.42	29.41	17	11.41	8.33				8	3.09	3.92	204	6.23	99.99
Boat fishing	64	18.82	4.12	520	41.17	33.44	676	61.12	43.47	45	30.20	2.89	68	43.31	4.37	182	70.27	11.70	1,555	47.50	99.99
Boating	141	41.47	18.43	241	19.08	31.50	202	18.26	26.41	77	51.68	10.07	59	37.58	7.71	45	17.37	5.88	765	23.37	100.00
Shell-fishing	75	22.06	12.63	367	29.06	61.78	148	13.38	24.92				4	2.55	0.67				594	18.14	100.00
Sailing							20	1.81	35.71	10	6.71	17.86	26	16.56	46.43				56	1.71	100.00
Water skiing																					
Bathing																					
Hunting	48	14.12	48.00	28	2.22	28.00										24	9.27	24.00	100	3.05	100.00
Others																					
Area total	340	100.00	10.38	1,263	100.00	38.58	1,106	99.99	33.78	149	100.00	4.55	157	100.00	4.80	259	100.00	7.91	3,274	100.00	100.00

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 178. December 1973 - Estimated total man-days of activity by area and activity category.

Activity category	West Lower Manahawkin Bay		West Little Egg Harbor		East Little Egg Harbor		East Lower Manahawkin Bay		East Upper Manahawkin Bay		West Upper Manahawkin Bay		Activity total	
	Total* %Activity†	%Area#	Total %Activity	%Area	Total %Activity	%Area	Total %Activity	%Area	Total %Activity	%Area	Total %Activity	%Area	Total %Activity	%Area
Bank fishing			22 34.38	2.85	6 9.38	0.84	25 39.06	12.25			11 17.19	8.73	64 100.01	2.78
Boat fishing	20 7.33	4.77	82 30.04	10.64	67 24.54	9.38	41 15.02	20.10	52 19.05	72.22	11 4.03	8.73	273 100.01	11.84
Boating	147 27.37	35.08	201 37.43	26.07	89 16.57	12.46	69 12.85	33.82	20 3.72	27.78	11 2.05	8.73	537 99.99	23.29
Shell-fishing	69 6.30	16.47	406 37.04	52.66	552 500.36	7.31	69 6.30	33.82					1,096 100.00	47.53
Sailing														
Water skiing														
Bathing														
Hunting	177 54.63	42.24	54 16.67	7.00							93 28.70	73.81	324 100.00	14.05
Others	6 50.00	1.43	6 50.00	0.78									12 100.00	0.52
Area total	419 18.17	99.99	771 33.43	100.00	714 30.96	99.99	204 8.85	99.99	72 3.12	100.00	126 5.46	100.00	2,306 99.99	100.01

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 179. January 1974 - Estimated total man-days of activity by area and activity category.

Activity category	West Lower Manahawkin Bay		West Little Egg Harbor		East Little Egg Harbor		East Lower Manahawkin Bay		East Upper Manahawkin Bay		West Upper Manahawkin Bay		Activity total	
	Total*	%Area#	Total	%Area	Total	%Area	Total	%Area	Total	%Area	Total	%Area	Total	%Area
	%Activity†		%Activity		%Activity		%Activity		%Activity		%Activity		%Activity	
Bank fishing	9	2.07	13	1.92	3	1.76	32	4.69	3	10.71	9	100.00	69	3.45
	13.04		18.84		4.35		46.38		4.35		13.04		100.00	
Boat fishing	48	11.03	10	1.48			12	1.76	25	89.29			95	4.75
	50.53		10.53				12.63		26.32				100.01	
Boating	37	8.51	90	13.31	10	5.88	62	9.09					199	9.95
	18.59		45.23		5.03		31.16						100.01	
Shell-fishing	332	76.32	533	78.85	157	92.35	576	84.46					1,598	79.90
	20.78		33.35		9.82		36.06						100.01	
Sailing														
Water skiing														
Bathing														
Hunting														
Others	9	1.38	30	4.44									39	1.95
	23.08		76.92										100.00	
Area total	435	100.00	676	100.00	170	99.99	682	100.00	28	100.00	9	100.00	2,000	100.00
	21.75		33.80		8.50		34.10		1.40		0.45		100.00	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 180. February 1974 - Estimated total man-days of activity by area and activity category.

Activity category	West Lower Manahawkin Bay Total*	%Area#	%Activity†	West Little Egg Harbor Total	%Area	%Activity	East Little Egg Harbor Total	%Area	%Activity	East Lower Manahawkin Bay Total	%Area	%Activity	East Upper Manahawkin Bay Total	%Area	%Activity	West Upper Manahawkin Bay Total	%Area	%Activity	Activity total Total	%Area	%Activity
Bank fishing				23	2.77	100.00													23	1.76	100.00
Boat fishing										5	3.65	50.00	5	100.00	50.00				10	0.76	100.00
Boating	52	19.12	38.81	77	9.29	57.46				5	3.65	3.73							134	10.24	100.00
Shell-fishing	220	80.88	19.28	729	87.94	63.89	65	100.00	5.70	127	92.70	11.13							1,141	87.23	100.00
Sailing																					
Water skiing																					
Bathing																					
Hunting																					
Others																					
Area total	272	100.00	20.80	829	100.00	63.38	65	100.00	4.97	137	100.00	10.47	5	100.00	0.38				1,308	99.99	100.00

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 181. Estimated total man-days of activity for the 8 month study period by area and activity category, July 1973 - February 1974.

Activity category	West Lower Manahawkin Bay		West Little Egg Harbor		East Little Egg Harbor		East Lower Manahawkin Bay		East Upper Manahawkin Bay		West Upper Manahawkin Bay		Activity total	
	Total*	%Area#	Total	%Area	Total	%Area	Total	%Area	Total	%Area	Total	%Area	Total	%Area
	%Activity†		%Activity		%Activity		%Activity		%Activity		%Activity		%Activity	
Bank fishing	570	2.57	1,975	5.12	1,478	3.39	1,665	6.57	722	4.59	1,361	10.64	7,771	4.91
	7.33		25.42		19.02		21.43		9.29		17.51		100.00	
Boat fishing	10,857	48.98	17,704	45.88	19,960	45.77	6,120	24.14	4,778	30.38	7,442	58.20	66,861	42.25
	16.24		26.48		29.85		9.15		7.15		11.13		100.00	
Boating	5,286	23.81	7,188	18.63	11,503	26.38	5,361	21.14	4,012	25.51	2,271	17.76	35,621	22.51
	14.84		20.18		32.29		15.05		11.26		6.38		100.00	
Shell-fishing	3,172	14.29	7,957	20.62	4,784	10.97	2,380	9.39	165	1.05	145	1.13	18,603	11.75
	17.05		42.77		25.72		12.79		0.89		0.78		100.00	
Sailing	1,018	4.58	2,282	5.91	3,322	7.62	5,569	21.96	3,807	24.20	1,252	9.79	17,250	10.90
	5.90		13.23		19.26		32.28		22.07		7.26		100.00	
Water skiing	230	1.04	84	0.22	136	0.31	258	1.02	295	1.88	68	0.53	1,071	0.68
	21.48		7.84		12.70		24.09		27.54		6.35		100.00	
Bathing	742	3.34	846	2.19	1,320	3.03	3,860	15.22	1,934	12.29	93	0.73	8,795	5.56
	8.44		9.62		15.01		43.89		21.99		1.06		100.01	
Hunting	261	1.18	110	0.29	16	0.04			4	0.03	147	1.15	538	0.34
	48.51		20.45		2.97				0.74		27.32		99.99	
Others	68	0.31	443	1.15	1,086	2.49	141	0.56	13	0.08	8	0.06	1,759	1.11
	3.87		25.18		61.74		8.02		0.74		0.45		100.00	
Area total	22,204	100.01	38,589	100.01	43,605	100.00	25,354	100.00	15,730	100.01	12,787	99.99	158,269	100.01
	14.03		24.38		27.55		16.02		9.94		8.08		100.00	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 182. Distribution of bank fishing by sector and month, July 1973 - February 1974.

Month	West Lower Manahawkin Bay		West Little Egg Harbor		East Little Egg Harbor		East Lower Manahawkin Bay		East Upper Manahawkin Bay		West Upper Manahawkin Bay		Month total	
	Total* / %Month†	%Area#	Total / %Month	%Area	Total / %Month	%Area	Total / %Month	%Area	Total / %Month	%Area	Total / %Month	%Area	Total / %Month	%Area
July 1973	295 9.75	51.75	577 19.07	29.22	571 18.88	28.63	804 26.58	48.29	338 11.17	46.81	440 14.55	32.33	3,025 100.00	38.93
August 1973	92 4.68	16.14	443 22.52	22.43	652 33.15	44.11	256 13.01	15.38	156 7.93	21.61	368 18.71	27.04	1,967 100.00	25.31
September 1973	147 8.34	25.79	540 30.65	27.34	141 8.00	9.54	414 23.50	24.86	174 9.88	24.10	346 19.64	25.42	1,762 100.01	22.67
October 1973	15 2.28	2.63	250 38.05	12.66	45 6.85	3.04	117 17.81	7.03	51 7.76	7.06	179 27.25	13.15	657 100.00	8.45
November 1973	12 5.88	2.11	107 52.45	5.42	60 29.41	4.06	17 8.33	1.02			8 3.92	0.59	204 100.00	2.63
December 1973			22 34.38	1.11	6 9.38	0.41	25 39.06	1.50			11 17.19	0.81	64 100.01	0.82
January 1974	9 13.04	1.58	13 18.84	0.66	3 4.35	0.20	32 46.38	1.92	3 4.35	0.42	9 13.04	0.66	69 100.00	0.89
February 1974			23 100.00	1.16									23 100.00	0.30
Area total	570 7.33	100.00	1,975 25.42	100.00	1,478 19.02	99.99	1,665 21.43	100.00	722 9.29	100.00	1,361 17.51	100.00	7,771 100.00	100.00
Ranking	6		1		3		2		5		4			

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month or time period.

Table 183. Distribution of boat fishing by sector and month, July 1973 - February 1974.

Month	West Lower Manahawkin Bay		West Little Egg Harbor		East Little Egg Harbor		East Lower Manahawkin Bay		East Upper Manahawkin Bay		West Upper Manahawkin Bay		Month total	
	Total* %Month†	%Area#	Total %Month	%Area	Total %Month	%Area	Total %Month	%Area	Total %Month	%Area	Total %Month	%Area	Total %Month	%Area
July 1973	4,188 18.06	38.57	6,273 27.05	35.43	5,934 25.59	29.73	2,247 9.69	36.72	1,919 8.27	40.16	2,632 11.35	35.37	23,193 100.01	34.69
August 1973	4,032 15.21	37.14	6,440 24.30	36.38	8,646 32.62	43.32	2,707 10.21	44.23	1,546 5.83	32.36	3,135 11.83	42.13	26,506 100.00	39.64
September 1973	1,795 16.09	16.53	3,326 29.81	18.79	3,396 30.43	17.01	699 6.26	11.42	752 6.74	15.74	1,191 10.67	16.00	11,159 100.00	16.69
October 1973	710 17.44	6.54	1,053 25.87	5.95	1,241 30.49	6.22	364 8.94	5.95	411 10.10	8.60	291 7.15	3.19	4,070 99.99	6.09
November 1973	64 4.12	0.59	520 33.44	2.94	676 43.47	3.39	45 2.89	0.74	68 4.37	1.42	182 11.70	2.45	1,555 99.99	2.33
December 1973	20 7.33	0.18	82 30.04	0.46	67 24.54	0.34	41 15.02	0.67	52 19.05	1.09	11 4.03	0.15	273 100.01	0.41
January 1974	48 50.53	0.44	10 10.53	0.06			12 12.63	0.20	25 26.32	0.52			95 100.01	0.14
February 1974							5 50.00	0.80	5 50.00	0.10			10 100.00	0.01
Area total	10,857 16.24	99.99	17,704 26.48	100.01	19,960 29.85	100.01	6,120 9.15	100.01	4,778 7.15	99.99	7,442 11.13	100.01	66,861 100.00	100.00
Ranking	3		2		1		5		6		4			

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month or time period.

Table 184. Distribution of boating by sector and month, July 1973 - February 1974.

Month	West Lower Manahawkin Bay Total* / %Month†		West Little Egg Harbor Total / %Month	%Area	East Little Egg Harbor Total / %Month	%Area	East Lower Manahawkin Bay Total / %Month	%Area	East Upper Manahawkin Bay Total / %Month	%Area	West Upper Manahawkin Bay Total / %Month	%Area	Month total Total / %Month	%Area
July 1973	2,332 16.46	44.12	2,666 18.82	37.09	4,272 30.16	37.14	2,269 16.02	42.32	1,506 10.63	37.54	1,120 7.91	49.32	14,165 100.00	39.77
August 1973	1,592 12.12	30.12	2,590 19.71	36.03	4,488 34.16	39.02	2,104 16.01	39.25	1,629 12.40	40.60	736 5.60	32.41	13,139 100.00	36.89
September 1973	762 14.96	14.42	959 18.83	13.34	1,933 37.95	16.80	535 10.50	9.98	588 11.55	14.66	316 6.20	13.91	5,093 99.99	14.30
October 1973	233 14.03	4.22	364 22.91	5.06	509 32.03	4.42	240 15.10	4.48	210 13.22	5.23	43 2.71	1.89	1,589 100.00	4.46
November 1973	141 18.43	2.67	241 31.50	3.35	202 26.41	1.76	77 10.07	1.44	59 7.71	1.47	45 5.88	1.98	765 100.00	2.15
December 1973	147 27.37	2.78	201 37.43	2.80	89 16.57	0.77	69 12.85	1.29	20 3.72	0.50	11 2.05	0.48	537 99.99	1.51
January 1974	37 18.59	0.70	90 45.22	1.25	10 5.03	0.09	62 31.16	1.16					199 100.00	0.56
February 1975	52 38.81	0.98	77 57.46	1.07			5 3.73	0.09					134 100.00	0.38
Area total	5,286 14.84	100.01	7,188 20.18	99.99	11,503 32.39	100.00	5,361 15.05	100.01	4,012 11.26	100.00	2,271 6.38	99.99	35,621 100.00	100.02
Ranking	4		2		1		3		5		6			

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month or time period.

Table 185. Estimated total man-days of activity by activity category and month for the 12 month study period, June 1974 - May 1975.

Month	Fishing		Boating	Shell-fishing	Sailing	Water skiing
	Bank	Boat				
June 1974	1,916	16,545	4,825	3,292	854	14
July 1974	3,706	32,203	13,709	9,878	2,626	100
August 1974	4,808	33,175	21,476	6,436	3,596	232
September 1974	2,327	11,630	5,247	2,748	967	25
October 1974	1,050	4,844	2,186	2,519	287	
January 1975	69	48	54	2,314		
February 1975	37	8	74	1,826		
March 1975	538	1,282	328	3,369		
April 1975	548	3,312	774	3,069	20	
May 1975	921	4,192	2,009	3,123	117	10
Total	15,920	107,239	50,682	38,574	8,467	381
%	6.91	46.56	22.00	16.75	3.68	0.17
Ranking	4	1	2	3	5	8

Table 185. Continued.

Month	Bathing	Hunting	Other	Total	%	Ranking
June 1974	1,298		286	29,030	12.60	3
July 1974	2,616		262	65,100	28.26	2
August 1974	3,692		144	73,559	31.94	1
September 1974	85		295	23,324	10.13	4
October 1974		117	58	11,061	4.80	5
January 1975			47	2,532	1.10	9
February 1975			15	1,960	0.85	10
March 1975			47	5,564	2.42	8
April 1975			16	7,739	3.36	7
May 1975			85	10,457	4.54	6
Total	7,691	117	1,255	230,326	100.00	
%	3.34	0.05	0.54		100.00	
Ranking	6	9	7			

Table 186. June 1974 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total*	%Area#	Total	%Area	Total	%Area	Total	%Area
	%Activity†		%Activity		%Activity		%Activity	
Bank fishing	8	1.55	12	18.75	432	4.34	184	6.79
	0.42		0.63		22.55		9.60	
Boat fishing	49	9.50	40	62.50	6,373	0.97	1,596	58.94
	0.30		0.24		38.52		9.65	
Boating	385	74.61			731	7.34	563	20.79
	7.98				15.15		11.67	
Clamming					1,988	19.96	299	11.04
					60.39		9.08	
Sailing					34	0.34	46	1.70
					3.98		5.39	
Water skiing								
Bathing	54	10.47			360	3.61		
	4.16				27.73			
Hunting								
Others	20	3.88	12	18.75	44	0.44	20	0.74
	6.99		4.20		15.38		6.99	
Area total	516	100.01	64	100.00	9.962	100.00	2,708	100.00
	1.78		0.22		34.32		9.33	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 186. Continued.

Activity category	West Upper Manahawkin Bay Total* / %Activity†	%Area#	East Upper Manahawkin Bay Total / %Activity	%Area	East Lower Manahawkin Bay Total / %Activity	%Area	East Little Egg Harbor Total / %Activity	%Area	Activity total Total / %Activity	%Area
Bank fishing	426 22.23	20.01	162 8.46	8.30	490 25.57	16.26	202 10.54	2.33	1,916 100.00	6.60
Boat fishing	1,354 8.18	63.60	553 3.34	28.33	904 5.46	29.99	5,676 34.31	65.35	16,545 100.00	56.99
Boating	207 0.29	9.72	351 7.27	17.98	548 11.36	18.18	2,040 42.28	23.49	4,825 100.00	16.62
Clamming	74 2.25	3.48	180 5.47	9.22	476 14.46	15.79	275 8.35	3.17	3,292 100.00	11.34
Sailing	52 6.09	2.44	180 21.08	9.22	174 20.37	5.77	368 43.09	4.24	854 100.00	2.94
Water skiing			14 100.00	0.72					14 100.00	0.05
Bathing	8 0.62	0.38	454 34.98	23.26	410 31.59	13.60	12 0.92	0.14	1,298 100.00	4.47
Hunting										
Others	8 2.80	0.38	58 20.28	2.97	12 4.20	0.40	112 39.16	1.29	286 100.00	0.98
Area total	2,129 7.33	100.01	1,952 6.72	100.00	3,014 10.38	99.99	8,685 29.92	100.01	29,030 100.00	99.99

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 187. July 1974 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West Total*	%Area#	%Activity†	Natural marsh area Total	%Area	%Activity	West Little Egg Harbor Total	%Area	%Activity	West Lower Manahawkin Bay Total	%Area	%Activity
Bank fishing	44	3.02	1.19	2	1.02	0.05	740	4.91	19.97	321	4.02	8.66
Boat fishing	21	1.44	0.07	168	85.28	0.52	8,735	57.93	27.12	3,910	48.93	12.14
Boating	1,171	80.43	8.54	15	7.61	0.11	1,622	10.76	11.83	1,315	16.46	9.59
Clamming							3,374	22.38	34.16	2,088	26.13	21.14
Sailing	19	1.30	0.72				39	0.26	1.49	220	2.75	8.38
Water skiing							17	0.11	17.00			
Bathing	201	13.80	7.68				526	3.49	20.11	116	1.45	4.43
Hunting												
Others				12	6.09	4.58	26	0.17	9.92	21	0.26	8.02
Area total	1,456	99.99	2.24	197	100.00	0.30	15,079	100.01	23.16	7,991	100.00	12.27

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 187. Continued.

Activity category	West Upper Manahawkin Bay		East Upper Manahawkin Bay		East Lower Manahawkin Bay		East Little Egg Harbor		Activity total	
	Total* %Activity†	%Area#	Total %Activity	%Area	Total %Activity	%Area	Total %Activity	%Area	Total %Activity	%Area
Bank fishing	1,227 33.11	19.23	520 14.03	9.53	447 12.06	5.78	405 10.93	1.95	3,706 100.00	5.69
Boat fishing	2,893 8.98	45.33	1,818 5.65	33.33	2,802 8.70	36.23	11,856 36.82	56.98	32,203 100.00	49.47
Boating	960 7.00	1.04	1,370 9.99	25.12	1,968 14.36	25.45	5,288 38.57	25.41	13,709 99.99	21.06
Clamming	809 8.19	12.68	388 3.93	7.11	1,160 11.74	15.00	2,059 20.84	9.90	9,878 100.00	15.17
Sailing	363 13.82	5.69	448 17.06	8.21	821 31.26	10.62	716 27.27	3.44	2,626 100.00	4.03
Water skiing	14 14.00	0.22	24 24.00	0.44	26 26.00	0.34	19 19.00	0.09	100 100.00	0.15
Bathing	116 4.43	1.82	886 33.87	16.24	465 17.78	6.01	306 11.70	1.47	2,616 100.00	4.02
Hunting										
Others					44 16.79	0.57	159 60.69	0.76	262 100.00	0.40
Area total	6,382 9.80	100.01	5,454 8.38	99.98	7,733 11.88	100.00	20,808 31.96	100.00	65,100 99.99	99.99

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 188. August 1974 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total*	%Area#	Total	%Area	Total	%Area	Total	%Area
	%Activity†		%Activity		%Activity		%Activity	
Bank fishing	51	2.91	121	14.72	923	5.99	465	4.32
	1.06		2.52		19.20		9.67	
Boat fishing	49	2.79	84	10.22	6,516	42.28	6,124	56.96
	0.15		0.25		19.64		18.46	
Boating	1,497	85.35	577	70.19	4,192	27.20	2,116	19.68
	6.97		2.69		19.52		9.85	
Clamming					2,637	17.11	1,806	16.80
					40.97		28.06	
Sailing	18	1.03	4	0.49	224	1.45	194	1.80
	0.50		0.11		6.23		5.39	
Water skiing					32	0.21	40	0.37
					13.79		17.24	
Bathing	128	7.30			846	5.49		
	3.47				22.91			
Hunting								
Others	11	0.63	36	4.38	40	0.26	7	0.07
	7.64		25.00		27.78		4.86	
Area total	1,754	100.01	822	100.00	15,410	99.99	10,752	100.00
	2.38		1.12		20.95		14.62	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 188. Continued.

Activity category	West Upper Manahawkin Bay Total* / %Activity†	%Area#	East Upper Manahawkin Bay Total / %Activity	%Area	East Lower Manahawkin Bay Total / %Activity	%Area	East Little Egg Harbor Total / %Activity	%Area	Activity total Total / %Activity	%Area
Bank fishing	1,372 28.54	21.97	575 11.96	8.13	855 17.78	9.58	446 9.28	1.98	4,808 100.01	6.54
Boat fishing	3,058 9.22	48.97	2,407 7.26	34.02	3,373 10.17	37.81	11,564 34.86	51.21	33,175 100.01	45.10
Boating	784 3.65	12.55	1,669 7.77	23.59	2,910 13.55	32.62	7,731 36.00	34.24	21,476 100.00	29.20
Clamming	406 6.31	6.50	189 2.94	2.67	189 2.94	2.12	1,209 18.78	5.35	6,436 100.00	8.75
Sailing	160 4.45	2.56	998 27.75	14.11	838 23.30	9.39	1,160 32.26	5.14	3,596 99.99	4.89
Water skiing	11 4.74	0.18	32 13.79	0.45	55 23.71	0.62	62 26.72	0.27	232 99.99	0.32
Bathing	450 12.19	7.21	1,205 32.64	17.03	701 18.99	7.86	362 9.80	1.60	3,692 100.00	5.02
Hunting										
Others	4 2.78	0.06					46 31.94	0.20	144 100.00	0.20
Area total	6,245 8.49	100.00	7,075 9.62	100.00	8,921 12.13	100.00	22,580 30.70	99.99	73,559 100.01	100.02

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 189. September 1974 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total*	%Area#	Total	%Area	Total	%Area	Total	%Area
	%Activity†		%Activity		%Activity		%Activity	
Bank fishing	30	4.98			541	8.90	180	5.51
	1.29				23.25		7.74	
Boat fishing	50	8.31	30	85.71	2,720	44.72	1,678	51.36
	0.43		0.26		23.39		14.43	
Boating	484	80.40			1,042	17.13	475	14.54
	9.22				19.86		9.05	
Clamming					1,409	23.17	869	26.60
					51.27		31.62	
Sailing	3	0.50			291	4.78	30	0.92
	0.31				30.09		3.10	
Water skiing					12	0.20		
					48.00			
Bathing					17	0.28		
					20.00			
Hunting								
Others	35	5.81	5	14.29	50	0.82	35	1.07
	11.86		1.69		16.95		11.86	
Area total	602	100.00	35	100.00	6,082	100.00	3,267	100.00
	2.58		0.15		26.08		14.01	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 189. Continued.

Activity category	West Upper Manahawkin Bay Total* / %Activity†	%Area#	East Upper Manahawkin Bay Total / %Activity	%Area	East Lower Manahawkin Bay Total / %Activity	%Area	East Little Egg Harbor Total / %Activity	%Area	Activity total Total / %Activity	%Area
Bank fishing	646 27.76	29.81	193 8.29	9.92	431 18.52	16.81	306 13.15	4.59	2,327 100.00	9.98
Boat fishing	1,138 9.79	52.51	870 7.48	44.71	1,307 11.24	50.98	3,837 32.99	57.60	11,630 100.01	49.86
Boating	276 5.26	12.74	389 7.41	19.99	490 9.34	19.11	2,091 39.85	31.39	5,247 99.99	22.50
Clamming	49 1.78	2.26	135 4.91	6.94	135 4.91	5.27	151 5.49	2.27	2,748 99.98	11.78
Sailing	53 5.48	2.45	311 32.16	15.98	173 17.89	6.75	106 10.96	1.59	967 99.99	4.15
Water skiing					3 12.00	0.12	10 40.00	0.15	25 100.00	0.11
Bathing			43 50.59	2.21	25 29.41	0.98			85 100.00	0.36
Hunting										
Others	5 1.69	0.23	5 1.69	0.26			160 54.24	2.40	295 99.98	1.26
Area total	2,167 9.29	100.00	1,946 8.34	100.01	2,564 10.99	100.02	6,661 28.56	99.99	23,324 100.00	100.00

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 190. October 197 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total*	%Area#	Total	%Area	Total	%Area	Total	%Area
	%Activity†		%Activity		%Activity		%Activity	
Bank fishing					406	10.08	89	6.88
					38.67		8.48	
Boat fishing			8	38.10	1,600	39.73	616	47.60
			0.17		33.03		12.72	
Boating	152	89.41			490	12.17	258	19.94
	6.95				22.42		11.80	
Clamming					1,418	35.21	309	23.88
					56.29		12.27	
Sailing					36	0.89	22	1.70
					12.54		7.67	
Water skiing								
Bathing								
Hunting			9	42.86	50	1.24		
			7.69		42.72			
Others	18	10.59	4	19.05	27	0.67		
	31.03		6.90		46.55			
Area total	170	100.00	21	100.01	4,027	99.99	1,294	100.00
	1.54		0.19		36.41		11.70	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 190. Continued.

Activity category	West Upper Manahawkin Bay Total* / %Activity†	%Area#	East Upper Manahawkin Bay Total / %Activity	%Area	East Lower Manahawkin Bay Total / %Activity	%Area	East Little Egg Harbor Total / %Activity	%Area	Activity total Total / %Activity	%Area
Bank fishing	286 27.24	36.11	63 6.00	7.16	134 12.76	10.38	72 6.86	2.78	1,050 100.01	9.49
Boat fishing	232 4.79	29.29	488 10.07	55.45	560 11.56	43.38	1,340 27.66	51.82	4,844 100.00	43.79
Boating	116 5.31	14.65	196 8.97	22.27	376 17.11	28.97	600 27.45	23.20	2,186 100.01	19.76
Clamming	78 3.10	9.85	52 2.06	5.91	138 5.48	10.69	524 20.80	20.26	2,519 100.00	22.77
Sailing	22 7.67	2.78	72 25.09	8.18	85 29.62	6.58	20 17.42	1.93	287 100.01	2.59
Water skiing										
Bathing										
Hunting	58 49.57	7.32							117 100.00	1.06
Others			9 15.52	1.02					58 100.00	0.52
Area total	792 7.16	100.00	880 7.96	99.99	1,291 11.67	100.00	2,586 23.38	99.99	11,061 100.01	99.98

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 191. January 1975 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West Total*	%Area#	%Activity†	Natural marsh area Total	%Area	%Activity	West Little Egg Harbor Total	%Area	%Activity	West Lower Manahawkin Bay Total	%Area	%Activity
Bank fishing												
Boat fishing							24	1.63	50.00			
Boating							23	1.56	42.59	8	1.82	14.81
Clamming							1,402	95.24	60.59	432	98.18	18.67
Sailing												
Water skiing												
Bathing												
Hunting												
Others							23	1.56	48.94			
Area total							1,472	99.99	58.14	440	100.00	17.38

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 191. Continued.

Activity category	West Upper Manahawkin Bay Total* / %Activity†	%Area#	East Upper Manahawkin Bay Total / %Activity	%Area	East Lower Manahawkin Bay Total / %Activity	%Area	East Little Egg Harbor Total / %Activity	%Area	Activity total Total / %Activity	%Area
Bank fishing	15 21.74	4.53			54 78.26	100.00			69 100.00	2.73
Boat fishing	8 16.67	2.42	8 16.67	5.41			8 16.67	9.20	48 100.01	1.90
Boating			8 14.81	5.41			15 27.78	17.24	54 99.99	2.13
Clamming	300 12.96	90.63	132 5.70	89.19			48 2.07	55.17	2,314 99.99	91.39
Sailing										
Water skiing										
Bathing										
Hunting										
Others	8 17.02	2.42					16 34.04	18.39	14 100.00	1.86
Area total	331 13.07	100.00	148 5.85	100.00	84 2.13	100.00	87 3.44	100.00	2,532 100.01	100.01

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 192. February 1975 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West Total*	%Area#	%Activity†	Natural marsh area Total	%Area	%Activity	West Little Egg Harbor Total	%Area	%Activity	West Lower Manahawkin Bay Total	%Area	%Activity
Bank fishing												
Boat fishing										8	2.61	100.00
Boating										18	5.88	24.32
Clamming							974	98.51	54.44	280	91.50	15.33
Sailing												
Water skiing												
Bathing												
Hunting												
Others							15	1.49	100.00			
Area total							1,009	100.00	51.48	306	99.99	15.61

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 192. Continued.

Activity category	West Upper Manahawkin Bay Total* / %Activity	%Area#	East Upper Manahawkin Bay Total / %Activity	%Area	East Lower Manahawkin Bay Total / %Activity	%Area	East Little Egg Harbor Total / %Activity	%Area	Activity total Total / %Activity	%Area
Bank fishing	8 21.62	10.67			29 78.38	14.95			37 100.00	1.89
Boat fishing									8 100.00	0.41
Boating	13 17.57	17.33	23 31.08	15.54	10 13.51	5.15	10 13.51	4.39	74 99.99	3.78
Clamming	54 2.96	72.00	125 6.85	84.46	155 8.49	79.90	218 11.94	95.61	1,826 100.01	93.16
Sailing										
Water skiing										
Bathing										
Hunting										
Others									15 100.00	0.77
Area total	75 3.83	100.00	148 7.55	100.00	194 9.90	100.00	228 11.63	100.00	1,960 100.00	100.01

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular category.

Table 193. March 1975 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West Total* / %Activity†	%Area#	Natural marsh area Total / %Activity	%Area	West Little Egg Harbor Total / %Activity	%Area	West Lower Manahawkin Bay Total / %Activity	%Area
Bank fishing					118 21.93	4.84	2 0.37	0.32
Boat fishing					524 40.37	21.51	80 6.24	12.74
Boating	4 1.22	100.00			78 23.78	3.20	58 17.68	9.24
Clamming					1,696 50.34	69.62	488 14.49	77.71
Sailing								
Water skiing								
Bathing								
Hunting								
Others					20 42.55	0.82		
Area total	4 0.07	100.00			2,436 43.78	99.99	628 11.29	100.01

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 193. Continued.

Activity category	West Upper Manahawkin Bay Total*	%Area#	%Activity†	East Upper Manahawkin Bay Total	%Area	%Activity	East Lower Manahawkin Bay Total	%Area	%Activity	East Little Egg Harbor Total	%Area	%Activity	Activity total Total	%Area	%Activity
Bank fishing	135	46.08	25.09	32	7.14	5.95	244	23.33	45.35	7	0.99	1.30	538	9.67	99.99
Boat fishing	20	6.83	1.56	266	59.38	20.75	86	8.22	6.71	306	43.16	23.87	1,282	23.04	100.00
Boating	20	6.83	6.10	42	9.38	12.80	30	2.87	9.15	96	13.54	29.27	328	5.90	100.00
Clamming	116	39.59	3.44	101	22.54	3.00	677	64.72	20.09	291	41.04	8.64	3,369	60.55	100.00
Sailing															
Water skiing															
Bathing															
Hunting															
Others	2	0.68	4.26	7	1.56	14.89	9	0.86	19.15	9	1.27	19.15	47	0.84	100.00
Area total	293	100.00	5.27	448	100.00	8.05	1,046	100.00	18.80	709	100.00	12.74	5,564	100.00	100.00

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 194. April 1975 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total* / %Activity†	%Area#	Total / %Activity	%Area	Total / %Activity	%Area	Total / %Activity	%Area
Bank fishing	22 4.01	22.45	16 2.92	100.00	191 34.85	6.27	26 4.74	2.95
Boat fishing	18 0.54	18.37			940 28.38	30.84	200 6.04	22.68
Boating	58 7.49	59.18			120 15.50	3.94	168 21.71	19.05
Clamming					1,793 58.42	58.83	484 15.77	54.88
Sailing								
Water skiing								
Bathing								
Hunting								
Others					4 25.00	0.13	4 25.00	0.45
Area total	98 1.27	100.00	16 0.21	100.00	3,048 39.38	100.00	882 11.40	100.01

* Total man-days within the category.
# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 194. Continued.

Activity category	West Upper Manahawkin Bay Total*	%Area#	%Activity†	East Upper Manahawkin Bay Total	%Area	%Activity	East Lower Manahawkin Bay Total	%Area	%Activity	East Little Egg Harbor Total	%Area	%Activity	Activity total Total	%Area	%Activity
Bank fishing	110	49.33	20.07				183	11.40	33.39				548	7.08	99.98
Boat fishing	48	21.52	1.45	396	78.42	11.96	620	38.63	18.72	1,090	80.03	32.91	1,312	42.80	100.00
Boating	16	7.17	2.07	74	14.65	9.56	176	10.97	22.74	162	11.89	20.93	774	10.00	100.00
Clamming	41	18.39	1.34	31	6.14	1.01	614	38.26	20.01	106	7.78	3.45	3,069	39.66	100.00
Sailing				4	0.79	20.00	12	0.75	60.00	4	0.29	20.00	20	0.26	100.00
Water skiing															
Bathing															
Hunting															
Others	8	3.59	50.00										16	0.21	100.00
Area total	223	100.00	2.88	505	100.00	6.53	1,605	100.01	20.74	1,362	99.99	17.60	7,739	100.01	100.01

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 195. May 1975 - Estimated total man-days of activity by area and activity category.

Activity category	Beach Haven West Total* / %Activity†	%Area#	Natural marsh area Total / %Activity	%Area	West Little Egg Harbor Total / %Activity	%Area	West Lower Manahawkin Bay Total / %Activity	%Area
Bank fishing					255 27.69	5.69	107 11.62	9.09
Boat fishing					1,307 31.18	29.18	442 10.54	37.55
Boating	300 14.93	100.00			367 18.27	8.19	152 7.47	12.91
Clamming					2,534 81.14	56.58	434 13.90	36.87
Sailing							16 13.68	1.36
Water skiing							5 50.00	0.42
Bathing								
Hunting								
Others					16 18.82	0.36	21 24.71	1.78
Area total	300 2.87	100.00			4,479 42.83	100.00	1,177 11.26	99.98

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 195. Continued.

Activity category	West Upper Manahawkin Bay Total*	%Area#	East Upper Manahawkin Bay Total	%Area	East Lower Manahawkin Bay Total	%Area	East Little Egg Harbor Total	%Area	Activity total Total	%Area
	%Activity†		%Activity		%Activity		%Activity		%Activity	
Bank fishing	283	47.32			216	30.81	60	2.11	921	8.81
	30.73				23.45		6.51		100.00	
Boat fishing	94	15.72	195	55.08	212	30.24	1,942	68.19	4,192	40.09
	2.24		4.65		5.06		46.33		100.00	
Boating	183	30.60	119	33.62	195	27.82	693	24.33	2,009	19.21
	9.11		5.92		9.71		34.49		100.00	
Clamming	23	3.85			31	4.42	101	3.55	3,123	29.87
	0.74				0.99		3.23		100.00	
Sailing	10	1.67	40	11.30	31	4.42	20	0.70	117	1.12
	8.55		34.19		26.50		17.09		100.01	
Water skiing	5	0.84							10	0.10
	50.00								100.00	
Bathing										
Hunting										
Others					16	2.28	32	1.12	85	0.81
					18.82		37.65		100.00	
Area total	598	100.00	354	100.00	701	99.99	2,848	100.00	10,457	100.01
	5.72		3.39		6.70		27.24		100.01	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 196. Estimated total man-days of activity for the 12 month study period (only 10 months of aerial surveys) by area and activity category, June 1974 - May 1975.

Activity category	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total*	%Area#	Total	%Area	Total	%Area	Total	%Area
	%Activity†		%Activity		%Activity		%Activity	
Bank fishing	155	3.16	151	13.01	3,606	5.72	1,374	4.67
	0.97		0.95		22.65		8.63	
Boat fishing	187	3.82	330	28.57	28,739	45.61	14,654	49.77
	0.17		0.31		26.80		13.66	
Boating	4,051	82.67	592	51.26	8,665	13.75	5,131	17.43
	7.99		1.17		17.10		10.12	
Shellfishing					19,245	30.55	7,489	25.43
					49.89		19.41	
Sailing	40	0.82	4	0.35	624	0.99	528	1.79
	0.47		0.05		7.37		6.24	
Water skiing					61	0.10	45	0.15
					16.01		11.81	
Bathing	383	7.82			1,749	2.78	116	0.39
	4.98				22.74		1.51	
Hunting			9	0.78	50	0.08		
			7.69		42.74			
Others	84	1.71	69	5.97	265	0.42	108	0.37
	6.69		5.50		21.12		8.61	
Area total	4,900	100.00	1,155	100.00	63,004	100.00	29,445	100.00
	2.13		0.50		27.35		12.78	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 196. Continued.

Activity category	West Upper Manahawkin Bay Total* / %Activity†	%Area#	East Upper Manahawkin Bay Total / %Activity	%Area	East Lower Manahawkin Bay Total / %Activity	%Area	East Little Egg Harbor Total / %Activity	%Area	Activity total Total / %Activity	%Area
Bank fishing	4,508 28.32	23.44	1,545 9.70	8.17	3,083 19.37	11.37	1,498 9.41	2.25	15,920 100.00	6.91
Boat fishing	8,845 8.25	45.98	7,001 6.53	37.02	9,864 9.20	36.37	37,619 35.08	56.52	107,239 100.00	46.56
Boating	2,575 5.08	13.39	4,241 8.37	22.43	6,701 13.22	24.71	18,726 36.95	28.14	50,682 100.00	22.00
Clamming	1,950 5.06	10.14	1,333 3.46	7.05	3,575 9.27	13.18	4,982 12.92	7.49	38,574 100.01	16.75
Sailing	660 7.79	3.43	2,053 24.25	10.86	2,134 25.20	7.87	2,424 28.63	3.64	8,467 100.00	3.68
Water skiing	30 7.87	0.16	70 18.37	0.37	84 22.05	0.31	91 23.88	0.14	381 99.99	0.17
Bathing	574 7.46	2.98	2,588 33.65	13.69	1,601 20.82	5.90	680 8.84	1.02	7,691 100.00	3.34
Hunting	58 49.57	0.30							117 100.00	0.05
Others	35 2.79	0.18	79 6.29	0.42	81 6.45	0.03	534 42.55	0.80	1,255 100.00	0.54
Area total	19,235 8.35	100.00	18,910 8.21	100.00	27,123 11.78	100.00	66,554 28.90	100.00	230,326 100.00	100.00

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Activity is the percent of the total activity associated with a particular activity category.

Table 197. Distribution of bank fishing by sector and month, June 1974 - May 1975.

Month	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total* / %Month†	%Area#	Total / %Month	%Area	Total / %Month	%Area	Total / %Month	%Area
June 1974	8 0.42	5.16	12 0.63	7.95	432 22.55	11.98	184 9.60	13.39
July 1974	44 1.19	28.39	2 0.05	1.32	740 19.97	20.52	321 8.66	23.36
August 1974	51 1.06	32.90	121 2.52	80.13	923 19.20	25.60	465 9.67	33.84
September 1974	30 1.29	19.35			541 23.25	15.00	180 7.74	13.10
October 1974					406 38.67	11.26	89 8.48	6.48
January 1975								
February 1975								
March 1975					118 21.93	3.27	2 0.37	0.15
April 1975	22 4.01	14.19	16 2.92	10.60	191 34.85	5.30	26 4.74	1.89
May 1975					255 27.69	7.07	107 11.62	7.79
Area total	155 0.97	99.99	151 0.93	100.00	3,606 23.17	100.00	1,374 8.55	100.00
Ranking	7		8		2		6	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month.

Table 197. Continued.

Month	West Upper Manahawkin Bay Total* %Month†	%Area#	East Upper Manahawkin Bay Total %Month	%Area	East Lower Manahawkin Bay Total %Month	%Area	East Little Egg Harbor Total %Month	%Area	Month total Total %Month	%Area
June 1974	426 22.23	9.45	162 8.46	10.49	490 25.57	15.89	202 10.54	13.48	1,916 100.00	12.04
July 1974	1,227 33.11	27.22	520 14.03	33.66	447 12.06	14.50	405 10.93	27.04	3,706 100.00	23.28
August 1974	1,372 28.54	30.43	575 11.96	37.22	855 17.78	27.73	446 9.28	29.77	4,808 100.01	30.20
September 1974	646 27.76	14.33	193 8.29	12.49	431 18.52	13.98	306 13.15	20.43	2,327 100.00	14.62
October 1974	286 27.24	6.34	63 6.00	4.08	134 12.76	4.35	72 6.86	4.81	1,050 100.01	6.60
January 1975	15 21.74	0.33			54 78.26	1.75			69 100.00	0.43
February 1975	8 21.62	0.18			29 78.38	0.94			37 100.00	0.23
March 1975	135 25.09	2.99	32 5.95	2.07	244 45.35	7.91	7 1.30	0.47	538 99.99	3.38
April 1975	110 20.07	244			183 33.39	5.94			548 99.99	3.44
May 1975	283 30.73	6.28			216 23.45	7.01	60 6.51	4.01	921 100.00	5.79
Area total	4,508 27.88	99.99	1,545 9.51	100.01	3,083 19.29	100.00	1,498 9.72	100.01	15,920 100.00	100.01
Ranking	1		4		3		5			

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month.

Table 198. Distribution of boat fishing by sector and month, June 1974 - May 1975.

Month	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total* / %Month†	%Area#	Total / %Month	%Area	Total / %Month	%Area	Total / %Month	%Area
June 1974	49 0.30	26.20	40 0.24	12.12	6,373 38.52	22.18	1,596 9.65	10.89
July 1974	21 0.07	11.23	168 0.52	50.91	8,735 27.12	30.39	3,910 12.14	26.68
August 1974	49 0.15	26.20	84 0.25	25.45	6,516 19.64	22.67	6,124 18.46	41.79
September 1974	50 0.43	26.74	30 0.26	9.09	2,720 23.39	9.46	1,678 14.43	11.45
October 1974			8 0.17	2.42	1,600 33.03	5.57	616 12.72	4.20
January 1975					24 50.00	0.08		
February 1975							8 100.00	0.05
March 1975					524 40.87	1.82	80 6.24	0.55
April 1975	18 0.54	9.63			940 28.38	3.27	200 6.04	1.36
May 1975					1,307 31.18	4.55	442 10.54	3.02
Area total	187 0.17	100.00	330 0.30	99.99	28,739 26.93	99.99	14,654 13.48	99.99
Ranking	8		7		2		3	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month.

Table 198. Continued.

Month	West Upper Manahawkin Bay Total* %Month†	%Area#	East Upper Manahawkin Bay Total %Month	%Area	East Lower Manahawkin Bay Total %Month	%Area	East Little Egg Harbor Total %Month	%Area	Month total Total %Month	%Area
June 1974	1,354 8.18	15.31	553 3.34	7.90	904 5.46	9.16	5,676 34.31	15.09	16,545 100.00	15.43
July 1974	28,933 8.98	32.71	1,818 5.65	25.97	2,802 8.70	28.41	11,856 36.82	31.52	32,203 100.00	30.03
August 1974	3,058 9.22	34.57	2,407 7.26	34.38	3,373 10.17	34.20	11,564 34.86	30.74	33,175 100.01	30.94
September 1974	1,138 9.79	12.87	870 7.48	12.43	1,307 11.24	13.25	3,837 32.99	10.20	11,630 100.01	10.84
October 1974	232 4.79	3.75	488 10.07	6.97	560 11.56	5.68	1,340 27.66	3.56	4,844 100.00	4.52
January 1975	8 16.67	0.09	8 16.67	0.11			8 16.67	0.02	48 100.01	0.04
February 1975									8 100.00	0.01
March 1975	20 1.56	0.23	266 20.75	3.80	86 6.71	0.87	306 23.87	0.81	1,282 100.00	1.20
April 1975	48 1.45	0.54	396 11.96	5.66	620 1.72	6.29	1,090 32.91	2.90	3,312 100.00	3.09
May 1975	94 2.24	1.06	195 4.65	2.79	212 5.06	2.15	1,942 46.33	5.16	4,192 100.00	3.91
Area total	8,845 6.30 5	100.00	7,001 6.53 6	100.01	9,864 9.11 4	100.01	37,619 35.19 1	100.00	107,239 100.01	100.01

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month.

Table 199. Distribution of boating by sector and month, June 1974 - May 1975.

Month	Beach Haven West		Natural marsh area		West Little Egg Harbor		West Lower Manahawkin Bay	
	Total* / %Month†	%Area#	Total / %Month	%Area	Total / %Month	%Area	Total / %Month	%Area
June 1974	385 7.98	9.50			731 15.15	8.44	563 11.67	10.97
July 1974	1,171 8.54	28.91	15 0.11	2.53	1,622 11.83	18.72	1,315 9.59	25.63
August 1974	1,497 6.97	36.95	577 2.69	97.47	4,192 19.52	48.38	2,116 9.85	41.24
September 1974	484 9.22	11.95			1,042 19.86	12.03	475 9.05	9.26
October 1974	152 6.95	3.75			490 22.42	5.65	258 11.80	5.03
January 1975					23 42.59	0.27	8 14.81	0.16
February 1975							18 24.32	0.35
March 1975	4 1.22	0.10			78 23.78	0.90	58 17.68	1.13
April 1975	58 7.49	1.43			120 15.50	1.38	168 21.71	3.27
May 1975	300 14.93	7.41			367 18.27	4.24	152 7.57	2.96
Area total	4,051 7.74	100.00	592 1.13	100.00	8,665 17.62	100.00	5,131 10.50	100.00
Ranking	6		8		2		4	

* Total man-days within the category.
\# %Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month.

Table 199. Continued.

Month	West Upper Manahawkin Bay Total* / %Month†	%Area#	East Upper Manahawkin Bay Total / %Month	%Area	East Lower Manahawkin Bay Total / %Month	%Area	East Little Egg Harbor Total / %Month	%Area	Month total Total / %Month	%Area
June 1974	207 4.29	8.04	351 7.27	8.28	548 11.36	8.18	2,040 42.28	10.89	4,825 100.00	9.52
July 1974	960 7.00	37.28	1,370 9.99	32.30	1,968 14.36	29.37	5,288 38.57	28.24	13,709 99.99	27.05
August 1974	784 3.65	30.45	1,669 7.77	39.35	2,910 13.55	43.43	7,731 36.00	41.28	21,476 100.00	42.37
September 1974	276 5.26	10.72	389 7.41	9.17	490 9.34	7.31	2,091 39.85	11.17	5,247 99.99	10.35
October 1974	116 5.31	4.50	196 8.97	4.62	374 17.11	5.58	600 27.45	3.20	2,186 100.01	4.31
January 1975			8 14.81	0.19			15 27.78	0.08	54 99.99	0.11
February 1975	13 17.57	0.50	23 31.08	0.54	10 13.51	0.15	10 13.51	0.05	74 99.99	0.15
March 1975	20 6.10	0.78	42 12.80	0.99	30 9.15	0.45	96 29.27	0.51	328 100.00	0.65
April 1975	16 2.07	0.62	74 9.56	1.74	176 22.74	2.63	162 20.93	0.87	774 100.00	1.53
May 1975	183 9.11	7.11	119 5.92	2.81	195 9.71	2.91	693 34.49	3.70	2,009 100.00	3.96
Area total	2,575 5.06	100.00	4,241 8.29	99.99	6,701 13.16	100.01	18,726 36.49	99.99	50,682 99.99	100.00
Ranking	7		5		3		1			

*Total man-days within the category.
%Area is the percent of the total activity occurring within a particular area.
† %Month is the percent of the total activity associated with a particular month.

Table 200. Numbers of persons interviewed during bag and creel survey by month and activity category, July 1973 - February 1974.

Month	Bank fishermen	Boat fishermen	Clammers	Hunters	Totals
July 1973	414	210	26		650
August 1973	300	261	12		573
September 1973	227	120	15		362
October 1973	19	77	22	7	125
November 1973	9	30	15	9	63
December 1973	10	17	6	15	48
January 1974	24	4	10		38
February 1974	8	3	8		19
Totals	1,011	722	114	31	1,878

Table 201. Total estimated bank fishing catch composition by month for July - February 1974.

Species	July	August	September	October	November
Blue claw crab	9,100	4,698	1,773	2,651	
Bluefish	127	782	567		
Eel	177	21	24		
Flounder					90
Fluke	904	21	32		113
Kingfish			40		
Northern puffer	25	7	176		
Scup					
Sea bass	25	48	112		
Spot			599		158
Striped bass					
Tautog		7			
Weakfish	211		8		
White perch	9	7			45
Other	237	28	24	30	
Total	10,815	5,619	3,355	2,681	406
%	47.10	24.47	14.61	11.68	1.77
Ranking	1	2	3	4	5

Table 201. Continued.

Species	December	January	February	Total	%	Ranking
Blue claw crab				18,222	79.36	1
Bluefish				1,476	6.43	2
Eel				222	0.97	6
Flounder	46	25		161	0.70	10
Fluke				1,070	4.66	3
Kingfish				40	0.17	12
Northern puffer				208	0.91	8
Scup						
Sea bass				185	0.81	9
Spot				757	3.30	4
Striped bass	15			15	0.07	14
Tautog				7	0.03	13
Weakfish				219	0.95	7
White perch				61	0.27	11
Other				319	1.39	5
Total	61	25		22,962	100.02	
%	0.27	0.11	0.00	100.01		
Ranking	6	7	8			

Table 202. Total estimated boat fishing catch composition by month for July 1973 - February 1974.

Species	July	August	September	October	November
Blue claw crab	107,323	70,520	44,898	66,311	
Bluefish		23,224	15,773	1,993	
Eel	370	569	291		
Flounder			194	514	1,375
Fluke	33,870	15,959	5,649	63	57
Kingfish			97	63	
Northern puffer		2,131	4,087	63	
Scup			2,824		
Sea bass	1,110	1,284	583	641	
Spot			5,357	451	
Striped bass					1,261
Tautog	178			63	
Weakfish	370	2,712	97	127	
White perch		2,845		63	
Other	4,811	1,853	1,068	63	
Total	148,032	121,097	80,918	70,415	2,693
%	34.93	28.57	19.09	16.62	0.64
Ranking	1	2	3	4	5

Table 202. Continued.

Species	December	January	February	Total	%	Ranking
Blue claw crab				289,052	68.21	1
Bluefish				40,990	9.67	3
Eel				1,230	0.29	13
Flounder	514	71	7	2,675	0.63	11
Fluke				55,598	13.12	2
Kingfish				160	0.04	15
Northern puffer				6,281	1.48	5
Scup				2,824	0.67	10
Sea bass				3,618	0.85	7
Spot				5,808	1.37	6
Striped bass	21			1,282	0.30	12
Tautog				241	0.06	14
Weakfish				3,306	0.78	8
White perch		24		2,932	0.69	9
Other				7,795	1.84	4
Total	535	95	7	423,792	100.00	
%	0.13	0.02	0.00	100.00		
Ranking	6	7	8			

Table 203. Total estimated combined fishing catch composition by month for July 1973 - February 1974.

Species	July	August	September	October	November
Blue claw crab	116,423	75,218	46,671	68,962	
Bluefish	127	24,006	16,340	1,993	
Eel	547	590	315		
Flounder			194	514	1,465
Fluke	34,774	15,980	5,681	63	170
Kingfish			137	63	
Northern puffer	25	2,138	4,263	63	
Scup			2,824		
Sea bass	1,135	1,332	695	641	
Spot			5,956	451	158
Striped bass					1,261
Tautog	178	7		63	
Weakfish	581	2,712	105	127	
White perch	9	2,852		63	45
Other	5,048	1,881	1,092	93	
Total	158,847	126,716	84,273	73,096	3,099
%	35.6	28.36	18.86	16.36	0.69
Ranking	1	2	3	4	5

Table 203. Continued.

Species	December	January	February	Total	%	Ranking
Blue claw crab				307,274	68.78	1
Bluefish				42,466	9.51	3
Eel				1,452	0.33	12
Flounder	560	96	7	2,836	0.63	10
Fluke				56,668	12.68	2
Kingfish				200	0.04	15
Northern puffer				6,489	1.45	6
Scup				2,824	0.63	11
Sea bass				3,803	0.85	7
Spot				6,565	1.47	5
Striped bass	36			1,297	0.29	13
Tautog				248	0.06	14
Weakfish				3,525	0.79	8
White perch		24		2,993	0.67	9
Other				8,114	1.82	4
Total	596	120	7	446,754	100.00	
%	0.13	0.03	00.0	99.99		
Ranking	6	7	8			

Table 204. Estimated total catch and catch per effort (C/E) by month, for bank, boat, and combined fishing for July 1973 - February 1974.

Month	Bank Fishermen		Boat Fishermen		Combined	
	Catch	C/E	Catch	C/E	Catch	C/E
July	10,815	1.09	148,032	0.94	158,847	0.95
August	5,619	1.12	121,097	0.91	126,716	0.92
September	3,355	0.80	80,918	1.53	84,273	1.48
October	2,681	1.02	70,415	4.21	73,096	3.78
November	406	1.38	2,693	0.40	3,099	0.46
December	61	0.33	535	0.49	596	0.47
January	25	0.31	95	0.40	120	0.28
February	0	0	7	0.40	7	0.15
Total	22,962	1.02	423,792	1.15	446,754	1.14

Table 205. Summary of hunter harvest on survey area showing raw and estimated data for 1973.

Month	Hunters interviewed	Man-hours of interviewed hunters	Birds harvested by interviewed hunters	Birds/ hunter	Man-hours/ hunter*	Catch/ hunter	Estimated hunter man-days of activity	Estimated total harvest
October	7	39	4	0.57	5.57	0.10	114	63
November	9	35	3	0.33	5.00	0.09	100	45
December	15	76	9	0.60	5.07	0.12	324	198
Total	31	150	16	0.52	5.19	0.11	538	306

* Based upon complete trip data

Table 206. Estimated waterfowl harvest by species for October 1973 - December 1973.

Species	Estimated total	%
Black duck	118	38.56
Bufflehead	91	29.74
Mallard	15	4.90
Scaup	60	19.61
Widgeon	22	7.19
Total	306	100.00

Table 207. Total estimated man-days of activity, catch, and catch per effort (C/E) by month, for clamming, scalloping, and combined shellfishing for July 1973 - February 1974.

Month	Clamming			Scalloping			Combined		
	Man-days	Catch	C/E	Man-days	Catch	C/E	Man-days	Catch	C/E
July	5,344	3,157,287	83.33				5,344	3,157,287	83.33
August	6,595	2,083,499	73.47				6,595	2,083,499	73.47
September	1,520	806,406	143.00				1,520	806,406	143.00
October	715	548,957	213.27				715	548,957	213.27
November	413	483,250	218.71	181	371,756	406.29	594	855,006	293.64
December	606	736,858	217.91	490	1,811,578	791.67	1,096	2,548,436	449.48
January	773	649,323	190.91	825	2,474,992	882.35	1,598	3,124,315	503.42
February	825	1,241,996	314.29				825	1,241,996	314.29
Total	16,791	9,707,576	11.06	1,496	4,658,326	776.61	18,287	14,365,902	153.81

Table 208. Numbers of persons interviewed during bag and creel survey by month and activity category for June 1974 - May 1975.

Month	Bank fishermen	Boat fisherman	Clammers	Hunters	Total
June 1974	237	86	44		367
July 1974	444	208	159		811
August 1974	352	227	14		593
September 1974	191	212	15		418
October 1974	26	10	14	32	82
November 1974	7	22	5		34
December 1974	20				20
January 1975	5	1	28		34
February 1975	3		30		33
March 1975	95	13	17		125
April 1975	107	14	6		127
May 1975	33	29	4		66
Total	1,520	822	336	32	2,710

Table 209. Total estimated bank fishing catch composition by month for June 1974 - May 1975.

Species	June	July	August	September	October	January	February
Blue claw crab	4,476	9,953	18,687	7,320	1,050		
Bluefish		25	779	1,011			
Eel	137	134		110			
Flounder			27	12		83	12
Fluke		8	41	36			
Kingfish							
Northern puffer		17					
Scup				195			
Sea bass		8	41	73	81		
Spot				244			
Striped bass							
Tautog			27				
Weakfish				24			
White perch				12			
Other	16	100	109	73			
Total	4,629	10,245	19,711	9,110	1,131	83	12
%	9.93	21.99	42.30	19.55	2.43	0.18	0.03
Ranking	4	2	1	3	5	9	10

Table 209. Continued.

Species	March	April	May	Total	%	Ranking
Blue claw crab	79	15	167	41,747	89.60	1
Bluefish				1,815	3.90	2
Eel				381	0.82	4
Flounder	877	374		1,385	2.97	3
Fluke				85	0.18	10
Kingfish						
Northern puffer				17	0.04	13
Scup				195	0.42	8
Sea bass				203	0.44	7
Spot				244	0.52	6
Striped bass						
Tautog		36	84	147	0.32	9
Weakfish				24	0.05	12
White perch		41		53	0.11	11
Other				298	0.64	5
Total	956	446	251	46,594	100.00	
%	2.05	1.00	0.54	100.01		
Ranking	6	7	8			

Table 210. Estimated boat fishing catch composition by month for June 1974 - May 1975.

Species	June	July	August	September	October	January	February
Blue claw crab	54,828	89,796	65,032	26,552	5,813		
Bluefish		5,883	5,699	19,530			
Eel	192	619	731	384			
Flounder	385	3,251		110			
Fluke	14,813	22,604	31,858	3,237			
Kingfish				55			
Northern puffer				55			
Scup			146	329			
Sea bass	192		3,215	10,917	7,266		
Spot				219			
Striped bass				55			
Tautog	19			603			
Weakfish		464	9,061	1,865			
White perch							
Other	1,154	1,238	1,315	2,140			
Total	71,756	123,855	117,057	66,051	13,079		
%	17.40	30.04	28.39	16.02	3.17	0.00	0.00
Ranking	3	1	2	4	5	9	9

Table 210. Continued.

Species	March	April	May	Total	%	Ranking
Blue claw crab	394	236		242,651	58.85	1
Bluefish				31,112	7.55	3
Eel				1,926	0.47	8
Flounder	4,142	7,334		15,222	3.69	5
Fluke			6,938	79,450	19.27	2
Kingfish				55	0.01	12
Northern puffer				55	0.01	12
Scup				475	0.12	10
Sea bass				21,590	5.24	4
Spot				219	0.05	11
Striped bass				55	0.01	12
Tautog			144	939	0.23	9
Weakfish				11,390	2.76	6
White perch						
Other			1,301	7,148	1.73	7
Total	4,536	7,570	8,383	412,287		
%	1.10	1.84	2.03	99.99		
Ranking	8	7	6			

Table 211. Total estimated combined fishing catch composition by month for June 1974 - May 1975.

Species	June	July	August	September	October	January	February
Blue claw crab	59,304	99,749	83,719	33,872	6,863		
Bluefish		5,908	6,478	20,541			
Eel	329	743	731	494			
Flounder	385	3,251	27	122		83	12
Fluke	14,813	22,612	31,899	3,273			
Kingfish				55			
Northern puffer		17		55			
Scup			146	524			
Sea bass	192	8	3,256	10,990	7,347		
Spot				463			
Striped bass				55			
Tautog	192		27	603			
Weakfish		464	9,061	1,889			
White perch				12			
Other	1,170	1,338	1,424	2,213			
Total	76,305	134,100	136,768	75,161	14,210	83	12
%	16.65	29.22	29.80	16.38	3.10	0.02	0.00
Ranking	3	2	1	4	5		10

Table 211. Continued.

Species	March	April	May	Total	%	Ranking
Blue claw crab	473	251	167	284,398	61.98	1
Bluefish				32,927	7.18	3
Eel				2,307	0.50	8
Flounder	5,019	7,708		16,607	3.62	5
Fluke			6,938	79,535	17.33	2
Kingfish				55	0.01	13
Northern puffer				72	0.02	12
Scup				670	0.15	10
Sea bass				21,793	4.75	4
Spot				463	0.10	11
Striped bass				55	0.01	13
Tautog		36	228	1,086	0.24	9
Weakfish				11,414	2.49	6
White perch		41		53	0.01	15
Other			1,301	7,446	1.62	7
Total	5,492	8,036	8,634	458,881	100.01	
%	1.20	1.75	1.88	100.00		
Ranking	8	7	6			

Table 212. Estimated total catch and catch per effort (C/E) by month for bank, boat, and combined fishing for June 1974 - May 1975.

Month	Bank fishermen		Boat fishermen		Combined	
	Catch	C/E	Catch	C/E	Catch	C/E
June 1974	4,629	1.49	71,756	1.41	76,385	1.46
July 1974	10,245	1.08	123,855	1.36	134,100	1.17
August 1974	19,711	1.79	117,057	0.88	136,768	1.31
September 1974	9,110	1.77	66,051	1.66	75,161	1.70
October 1974	1,131	0.61	13,079	1.93	14,210	0.92
January 1975	83	0.23			83	0.23
February 1975	12	0.17			12	0.17
March 1975	956	0.68	4,536	0.98	5,492	0.72
April 1975	466	0.47	7,570	0.89	8,036	0.54
May 1975	251	0.14	8,383	0.78	8,634	0.49
Total	46,594	1.32	412,287	1.19	458,881	1.24

Table 213. Summary of hunter harvest in the survey area showing raw and estimated data for 1974.

Month	Number of hunters interviewed	Man-hours of interviewed hunters	Birds harvested by interviewed hunters	Birds/ hunter	Estimated hunter man-days of activity	Estimated total harvest
October	32	72	17	0.53	117	62
Total	32	72	17	0.53	117	62

Table 214. Actual and estimated waterfowl harvest by species for October 1974.

Species	Actual harvest	Estimated harvest	%
Green-winged teal	7	26	41.18
Mallard	5	18	29.41
Black duck	3	11	17.65
Blue-winged teal	2	7	11.76
Total	17	62	100.00

Table 215. Clamming by month, estimated total harvest, and catch per man-hour for June 1974 - May 1975.

Month	Clammers interviewed	Man-hours	Clams	C/E	Remaining hours	Total man-hours	Expanded catch	Estimated man-days clamming	Estimated total harvest
June 1974	44	229.5	10,547	45.96	4.0	233.5	10,732	3,212	803,000
July 1974	159	448.5	19,927	44.43	259.0	707.5	31,434	9,878	1,975,600
August 1974	14	50.0	6,030	120.60	10.0	60.0	7,236	6,436	3,387,368
September 1974	15	85.5	15,925	186.26	6.0	91.5	17,042	2,748	3,053,333
October 1974	14	30.0	6,170	205.67	16.5	46.5	9,564	2,519	1,679,333
January 1975	28	89.5	11,375	127.09	29.5	119.0	15,124	2,314	1,285,556
February 1975	30	92.5	12,275	132.70	62.0	154.5	20,502	1,826	1,217,333
March 1975	17	64.0	6,280	98.12	32.0	96.0	9,420	3,369	1,871,667
April 1975	6	14.0	1,950	139.28	17.0	31.0	4,318	3,069	2,192,143
May 1975	4	15.0	2,150	143.33	0.0	15.0	2,150	3,123	1,678,612
Total	331	1,118.5	92,629	82.81	436	1,554.5	127,522	40,707	19,143,945

Table 216. Comparison of bank fishing catch estimates for the two sampling periods.

Species	July 1973-February 1974*	July 1974-February 1975*	Percent difference 74-75/73-74
Blue claw crab	18,222	37,010	103
Bluefish	1,476	1,815	23
Eel	222	244	10
Flounder	25	134	436
Fluke	957	85	-91
Kingfish	40		Decrease
Northern puffer	208	17	-92
Scup		195	Increase
Sea bass	185	203	10
Spot	599	244	-59
Striped bass			
Tautog	7	27	286
Weakfish	219	24	-89
White perch	16	12	-25
Other	319	282	-12
Total	22,495	40,292	79
Man-days	7,503	11,997	60
C/E (Man-day)*	3.00	3.35	12

* Does not include the months of November and December.

Table 217. Comparison of boat fishing catch estimates for the two sampling periods.

Species	July 1973-February 1974*	July 1974-February 1975*	Percent difference 74-75/73-74
Blue claw crab	289,052	187,193	-35
Bluefish	40,990	31,112	-24
Eel	1,230	1,734	41
Flounder	786	3,361	328
Fluke	55,541	57,699	4
Kingfish	160	55	-66
Northern puffer	6,281	55	-99
Scup	2,824	475	-83
Sea bass	3,618	21,398	491
Spot	5,808	219	-96
Striped bass		55	Increase
Tautog	241	603	150
Weakfish	3,306	11,390	244
White perch	2,932		Decrease
Other	7,795	4,693	-40
Total	420,564	320,042	-24
Man-days	65,033	81,908	26
C/E (Man-day)	6.47	3.9	-40
Minus crabs	131,512	132,849	
C/E (Man-day)	2.02	1.62	20

* Does not include the months of November and December.

Table 218. Comparison of clamming harvest estimates for the two sampling periods.

Month	July 1973 - February 1974*			July 1974 - February 1975*		
	Man-days	Catch	Catch per man-day	Man-days	Catch	Catch per man-day
July	5,344	3,157,287	591	9,878	1,952,862	198
August	6,595	2,083,499	316	6,436	3,326,492	517
September	1,520	806,406	531	2,748	3,122,094	1,136
October	715	548,957	768	2,519	1,720,837	683
January	773	649,323	840	2,314	1,249,891	540
February	825	1,214,996	1,505	1,826	1,247,888	683
Total	15,772	8,487,468		24,721	12,620,064	

* Does not include the months of November and December.

Table 219. Numbers of persons interviewed during expenditure surveys by month and activity category for July 1973 - February 1974.

Month	Bank fishermen	Boat fishermen	Clammers	Sailors	Bathers	Other	Total
July 1973	182	231	11	88	118		630
August 1973	155	234		27	52		468
September 1973	220	72	4	4			300
October 1973		72	22			10	104
November 1973	6	27	8			5	46
December 1973	14		11			12	37
January 1974	25		6				31
February 1974							
Total	602	636	62	119	170	27	1,616

Table 220. Estimated total expenditures of bank fishermen by month and major expenditure categories for July 1973 - February 1974 (in dollars).

Month	Bait	Equipment rental	Food	Lodging	Fees	Equipment	Travel	Totals
July	1,452.00	60.50	1,210.00	4,779.50		2,299.00	6,608.10 (for 132,162 miles)	16,409.10
August	472.08		491.75	3,855.32	19.67	1,199.87	3,790.40 (for 75,808 miles)	9,829.09
September	757.66	17.62	2,907.30	810.52	17.62	951.48	4,493.15 (for 69,863 miles)	9,955.35
October	282.51	6.57	1,084.05	302.22	6.57	354.78	1,302.50 (for 26,050 miles)	3,339.20
November	128.52		67.32			381.48	170.05 (for 3,401 miles)	747.37
December	80.00					17.92	146.55 (for 2,931 miles)	244.47
January	37.95		88.32	52.44		13.80	114.25 (for 2,285 miles)	306.76
February	12.65		29.44	17.48		4.60	38.10 (for 762 miles)	102.27
Total	3,223.37	84.69	5,878.18	9,817.48	43.86	5,222.93	16,663.10 (for 313,262 miles)	40,933.61*

* Note the annual per trip expenditure was $5.27.

Table 221. Estimated total expenditures of boat fishermen by month and major expenditure categories for July 1973 - February 1974 (in dollars).

Month	Bait	Gas and oil for boat	Equipment rental	Food
July	9,741.06	8,813.34	50,096.88	4,870.53
August	11,662.64	9,807.22	55,927.66	7,686.74
September	6,249.04	9,373.56	12,609.67	1,115.90
October	1,628.00	1,872.20	3,337.40	732.60
November	482.05	684.20		171.05
December	84.63	120.12		30.03
January	29.45	41.80		10.45
February	3.10	4.40		1.10
Total	29,879.97	30,716.84	121,971.61	14,618.40

Table 221. Continued.

Month	Lodging	Fees	Equipment	Travel	Total
July	19,714.05		159,335.91	37,108.80 (for 742,176 miles)	289,680.57
August	7,686.74	795.18	113,180.60	40,275.85 (for 805,517 miles)	247,022.63
September		1,004.31	88,490.87	1,712.50 (for 342,470 miles)	120,555.85
October		1,058.20	13,675.20	5,950.35 (for 119,007 miles)	28,253.95
November			7,557.30	1,140.60 (for 22,812 miles)	10,035.20
December			1,326.78	200.25 (for 4,005 miles)	1,761.81
January			461.70	69.70 (for 1,394 miles)	613.10
February			48.60	7.35 (for 147 miles)	64.55
Total	27,400.79	2,857.69	384,076.96	86,465.40 (for 2,037,528 miles)	697,987.66*

*Note the annual per trip expenditure was $10.44.

Table 222. Estimated total expenditures of shellfishermen by month and major expenditure categories for June 1974 - May 1975 (in dollars).

Month	Gas and oil for boat	Food	Fees	Equipment	Travel	Total
July	10,313.92	2,404.80		17,528.32	2,929.20 (for 58,784 miles)	33,186.24
August	12,728.35	2,967.75		21,631.60	3,627.25 (for 72,545 miles)	40,954.95
September	1,896.60	380.00	425.60	2,584.00	1,736.60 (for 34,732 miles)	6,995.80
October	892.40	50.05	235.95	1,029.50	698.90 (for 13,978 miles)	2,906.80
November	855.36		41.58	487.08	467.80 (for 9,356 miles)	1,851.82
December	2,060.48		54.80	1,512.48	687.75 (for 13,755 miles)	4,315.51
January	1,598.00		95.88	1,326.34	532.95 (for 10,659 miles)	3,553.17
February	1,141.00		68.46	947.03	380.50 (for 7,610 miles)	2,536.99
Total	31,459.11	5,802.60	922.27	47,046.35	11,070.95 (for 221,419 miles)	96,301.28*

* Note the annual per trip expenditure was $5.18.

Table 223. Estimated total expenditures of hunters, bathers, and sailors by major expenditure categories for July 1973 - February 1974 (in dollars).

Activity category	Months involved	Gas and oil for boat	Equipment rental	Food	Lodging
Hunting	October - December	231.20		34.20	
Bathing	July - September		381.60	3,445.05	16,349.50
Sailing	July - November		22,563.04	9,316.08	20,993.16

Table 223. Continued.

Activity category	Months involved	Fees (including ammo)	Equipment	Travel	Total	Overall per trip expenditure
Hunting	October - December	528.84	6,595.86	1,286.25 (for 25,725 miles)	8,676.35	16.13
Bathing	July - September	1,095.64		7,932.35 (for 158,647 miles)	29,204.15	3.32
Sailing	July - November	692.16	198,791.48	48,432.05 (for 968,641 miles)	300,787.97	17.44

Table 224. Numbers of persons interviewed during expenditure surveys by month and activity category for June 1974 - May 1975.

Month	Bank fishermen	Boat fishermen	Clammers	Sailors	Bathers	Others	Total
June 1974	125	137	8	20	16	21	327
July 1974	407	352	53	20	91		923
August 1974	192	223	16	42	79		552
September 1974	177	230	11	3		3	424
October 1974	15	12	16			20	63
November 1974	13	22	4				39
December 1974	10					2	12
January 1975	4	8	13				25
February 1975		3					3
March 1975	19	13	7				39
April 1975	42	9					51
May 1975	4	11	4				19
Total	1,008	1,020	132	85	186	46	2,477

Table 225. Estimated total expenditures of bank fishermen by month and major expenditure categories for June 1974 - May 1975 (in dollars).

Month	Bait	Equipment rental	Food	Lodging	Fees	Equipment	Travel	Totals
June	804.72		1,360.36	2,490.80		1,226.24	6,175.65 (for 51,464 miles)	12,057.77
July	1,778.88	259.42	3,261.28	1,297.10		2,001.24	17,851.06 (for 148,759 miles)	26,448.98
August	2,980.96		4,279.12	3,461.76	240.40	576.96	30,884.67 (for 257,372 miles)	42,423.87
September	1,210.04		605.02	418.86	116.35	930.80	12,847.83 (for 107,065 miles)	16,128.90
October	525.00					147.00	361.62 (for 3,014 miles)	1,033.62
January	40.02					160.08	248.40 (for 2,070 miles)	448.50
February								
March	823.14		285.14			274.38	3,985.93 (for 33,216 miles)	5,368.59
April	602.80					482.24	1,826.81 (for 15,223 miles)	2,911.85
May	653.91					478.92	8,510.04 (for 70,917 miles)	9,642.87
Total	9,419.47	259.42	9,790.92	7,668.52	356.75	6,277.86	82,692.01 (for 689,100 miles)	116,464.95*

* Note the annual per trip expenditure was $7.33.

Table 226. Estimated total expenditures of boat fishermen by month and major expenditure categories for June 1974 - May 1975 (in dollars).

Month	Bait	Gas and oil for boat	Equipment rental	Food
June	8,272.50	8,934.30	27,464.70	8,107.05
July	18,677.74	19,321.80	73,744.87	9,016.84
August	19,241.50	13,270.00	73,316.75	9,289.00
September	7,908.40	13,490.80	6,745.40	3,837.90
October	4,553.36	1,211.00		
January		144.00		29.76
February		98.42		
March	1,346.10			1,089.70
April	5,166.72		19,408.32	
May	5,365.76	1,341.44	19,031.68	
Total	70,532.08	57,811.76	219,711.72	31,370.25

Table 226. Continued.

Month	Lodging	Fees	Equipment	Travel	Total
June	52,613.10	165.45	94,141.05	88,588.55 (for 738,238 miles)	288,286.70
July	13,847.29		142,337.26	148,004.99 (for 1,233,375 miles)	424,950.79
August	20,568.50		345,683.50	121,539.93 (for 1,012,833 miles)	602,909.18
September	697.80	697.80	45,124.40	37,960.32 (for 316,336 miles)	116,462.82
October			18,310.32	14,822.64 (for 123,522 miles)	38,897.32
January				101.49 (for 846 miles)	275.25
February		17.02	5.52	20.69 (for 172 miles)	141.65
March			1,153.80	1,349.18 (for 11,243 miles)	4,938.78
April			2,053.44	23,182.68 (for 193,189 miles)	49,811.16
May		1,467.20	64,179.52	12,621.27 (for 105,177 miles)	104,006.87
Total	87,726.69	2,347.47	712,988.81	448,191.74 (for 3,734,931 miles)	1,630,680.52*

* Note the annual per trip expenditure was $15.21.

Table 227. Estimated total expenditures of shellfishermen by month and major expenditure categories for June 1974 - May 1975 (in dollars).

Month	Gas and oil for boat	Food	Fees	Equipment	Travel	Totals
June	1,020.52		65.84	4,641.72	4,345.44 (for 36,212 miles)	10,073.52
July	8,692.64	6,025.58		18,175.52	35,963.76 (for 299,698 miles)	68,857.50
August	6,307.28	3,411.08	257.44	21,753.68	8,186.59 (for 68,222 miles)	39,916.07
September	5,001.36	494.64	109.92	2,610.60	1,797.19 (for 14,977 miles)	10,013.71
October	3,576.98		9,723.34	6,272.31	2,097.82 (for 17,481 miles)	21,670.45
January	2,128.88		2,614.82	1,504.10	2,029.80 (for 16,915 miles)	8,277.60
February						
March	8,018.22			4,211.25	28,299.60 (for 235,830 miles)	40,529.07
April						
May	5,871.24		593.37	1,686.42	2,436.00 (for 20,300 miles)	10,587.03
Total	40,617.12	9,931.30	13,364.73	60,855.60	85,156.20 (for 709,635 miles)	209,924.95*

* Note the annual per trip expenditure was $6.23.

Table 228. Estimated total expenditures of bathers and sailors by major expenditure categories for June 1974 - May 1975 (in dollars).

Months involved	Equipment rental	Food	Lodging	Fees	Equipment	Travel	Total	Overall per trip expenditure
Bathing expenditures:								
June 1974		3,543.54	10,955.12	324.50		3,797.43 (for 31,645 miles)	18,620.59	
July 1974		5,258.16	4,185.60			7,901.37 (for 65,845 miles)	17,345.13	
August 1974		4,061.20	7,716.28			14,257.03 (for 118,808 miles)	26,034.51	
Bathing total		12,862.90	22,857.00	324.50		25,955.83 (for 216,298 miles)	62,000.23	$ 8.15
Sailing expenditures:								
June 1974		4,697.00	6,405.00	1,708.00	7,703.08	8,557.08 (for 71,309 miles)	29,070.16	
July 1974	6,696.30	3,939.00	10,031.32	1,838.20	12,552.28	28,203.24 (for 235,027 miles)	63,260.34	
August 1974	970.92	8,666.36	9,853.04		12,154.48	45,223.30 (for 376,861 miles)	76,868.10	
September 1974		1,934.00			15,713.75	116.04 (for 967 miles)	17,763.79	
Sailing total	7,667.22	19,236.36	26,289.36	3,546.20	48,123.59	82,099.66 (for 684,164 miles)	186,962.39	$23.24

Table 229. Yearly totals of county and/or state of residence of persons using the Manahawkin Bay-Little Egg Harbor system during the 12 month study, June 1974 - May 1975.

Origin	Bank fishing	Boat fishing	Clamming	Total	%
Pennsylvania	340	226	42	608	24.19
New York	100	16		116	4.62
New Jersey	992	518	268	1,778	70.75
By county:					
Ocean	319	202	170	691	
Burlington	220	108	26	354	
Camden	189	45	10	244	
Mercer	48	44	2	94	
Essex	26	21	12	59	
Bergen	35	19	3	57	
Hunterdon	10	6	19	35	
Union	13	19	1	33	
Somerset	11	14	5	30	
Gloucester	14	15		29	
Middlesex	19	4	5	28	
Morris	23	3	1	27	
Hudson	16	3	6	25	
Monmouth	7	4	2	13	
Cumberland	10			10	
Atlantic	2		3	5	
Other counties	30	11	3	44	
Other states	8	3		11	0.44
Total	1,440	763	310	2,513	100.00

Table 230. County and/or state of residence of persons using the Manahawkin Bay-Little Egg Harbor system during the months of June, July, and August 1974.

Origin	Bank fishing	Boat fishing	Clamming	Total	%
Pennsylvania	257	169	42	468	27.18
New York	83	13		96	5.57
New Jersey	647	345	160	1,152	66.90
By county:					
Ocean	121	100	69	290	
Burlington	152	73	25	250	
Camden	147	32	10	189	
Mercer	42	33	2	77	
Bergen	29	19	3	51	
Essex	22	16	12	50	
Hunterdon	10	6	19	35	
Somerset	11	14	5	30	
Gloucester	11	15		26	
Middlesex	19	4	4	28	
Morris	23	3	1	27	
Hudson	16	3	6	25	
Union	9	15	1	25	
Monmouth	5	4	2	11	
Cumberland	10			10	
Other counties	20	8		28	
Other states	3	3		6	0.35
Total	990	530	202	1,722	100.00

Table 231. County and/or state of residence of persons using the Manahawkin Bay-Little Egg Harbor system during the months of September, October, and November 1974.

Origin	Bank fishing	Boat fishing	Clamming	Total	%
Pennsylvania	39	57		96	19.71
New York	16	3		19	3.90
New Jersey	163	172	32	367	75.36
By county:					
Ocean	81	101	28	210	
Burlington	30	35	1	66	
Camden	30	13		43	
Mercer	4	11		15	
Essex	4	5		9	
Union	4	4		8	
Other counties	10	3	3	16	
Other states	5			5	1.03
Total	223	232	32	487	100.00

Table 232. County and/or state of residence of persons using the Manahawkin Bay-Little Egg Harbor system during the months of December 1974 and January and February 1975.

Origin	Bank fishing	Boat fishing	Clamming	Total	%
Pennsylvania	5			5	6.02
New York					
New Jersey	20	1	57	78	93.98
By county:					
Ocean	8	1	54	63	
Burlington	7			7	
Atlantic			3	3	
Bergen	2			2	
Monmouth	2			2	
Camden	1			1	
Other counties					
Other states					
Total	25	1	57	83	100.00

Table 233. County and/or state of residence of persons using the Manahawkin Bay-Little Egg Harbor system during the months of March, April, and May 1975.

Origin	Bank fishing	Boat fishing	Clamming	Total	%
Pennsylvania	39			39	17.65
New York	1			1	0.45
New Jersey	162		19	181	81.90
By county:					
Ocean	109		19	128	
Burlington	31			31	
Camden	11			11	
Bergen	4			4	
Gloucester	3			3	
Atlantic	2			2	
Mercer	2			2	
Other counties					
Other states					
Total	202		19	221	100.00

8. ANALYSIS OF THE FISH FORAGE BASE IN THE LITTLE EGG HARBOR ESTUARY

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[1]Currently the author is with the New York Department of Environmental Conservation; the research was conducted while he was associated with the New Jersey Division of Fish, Game, and Shellfisheries. This report was prepared for the New Jersey Division of Fish, Game, and Shellfisheries with funds in part supplied by the Dingell-Johnson Federal Aid to Fisheries Funds administered by the U.S. Fish and Wildlife Service during the period 1972 to 1977.

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Spotted hake, *Urophycis regius* 8.50
Striped burrfish, *Chilomycterus schoepfi* 8.51
Striped bass, *Morone saxatilis* 8.51
Striped killifish, *Fundulus majalis* 8.51
Striped mullet, *Mugil cephalus* 8.51
Striped sea robin, *Prionotus evolans* 8.51
Summer flounder, *Paralichthys dentatus* 8.51
Tautog, *Tautoga onitis* 8.51
Threespine stickleback, *Gasterosteus aculeatus* 8.52
Tidewater silversides, *Menidia beryllina* 8.52
Weakfish, *Cynoscion regalis* 8.53
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ABSTRACT

The forage base for resident and migratory fish utilizing Little Egg Harbor consists of at least 142 invertebrate and vertebrate taxa. Stomach content analyses conducted on 1,340 fish of 55 species provide estimates of the importance of each forage taxa to species and species-size group components of the fish populations. Over 300 species or genus level predator-prey relationships are documented. Through comparison of fish survey data and stomach contents, the relative predation impact of each fish species on selected forage populations was determined for the study period.

Little Egg Harbor contains a diverse biological community supported by at least four primary production modes. While the trophic structure of the estuary is extremely complex, the importance of calanoid copepods, certain gammarid amphipods, mysid shrimp, and caridean shrimp to the production of desirable fish species is evident.

INTRODUCTION

With the nation's increasing awareness of environmental conditions the ecological importance of marine tidal estuaries has been a focal point of discussion, research, and social action. The advent of legislative controls on the development and use of estuaries has caused studies of ecological relationships within these areas to be subjects of political as well as scientific concern. These studies in addition to increasing our scientific knowledge and our ability to manage populations of estuary associated organisms have become the basis of regulatory decisions on how estuarine areas may be used by man. As the philosophical arguments between "economic" and "environmental" interests mature and land use regulation becomes a fact of life, the need for detailed, site-specific evaluations of potential ecological impacts increases.

Trophic relationships existing in tidal estuaries have been studied by a number of researchers as reviewed by de Sylva (1975). General pathways of energy flow from sun to fish have been established. Estuarine food webs have been characterized as detritus-based or phytoplankton-based with primary consumers consisting of benthic invertebrates or zooplankton forms. Recreationally or commercially important fishes, with a few exceptions, are primary or secondary carnivores. While the role of various invertebrate and forage fish groups in estuarine food webs has been characterized, the species components and the relative importance of these groups to the production of fish has not generally been identified. This is particularly true of Middle Atlantic Coast systems. Regulatory action on proposed land uses within estuarine areas is, in most instances, based upon the evaluation of on site data. Fisheries scientists are often called upon to collect and/or evaluate these data as to their relationship to the production of "desirable" fish species. While the overall value of estuaries to the production of fish in terms of providing both nursery and feeding habitat may be an accepted truth, the role of specific sites in the scheme of production must often be determined indirectly through analysis of invertebrate populations. This is especially true of estuaries which service transient populations of migratory fish species.

Without reference to the relative importance of given invertebrate taxa as food to given fish species, the evaluation of on site data is difficult. Of necessity these data often consist solely of a list of species present and their densities. This paper will provide a reference source for documenting a number of species-specific invertebrate-fish relationships and examine the relative importance of these relationships in one Middle Atlantic estuarine system.

The Little Egg Harbor study area (which includes Manahawkin Bay) is depicted in Figure 1. The estuary is separated from the Atlantic Ocean by a barrier beach island, Long Beach Island, which is commercially and residentially developed except for the southern tip. The west shore, south of Mill Creek, remains primarily in a natural state consisting of a broad *Spartina* marsh interspersed with tidal creeks. North of Mill Creek, a number of lagoon-type housing developments have replaced portions of the natural shoreline. The bay is shallow with natural depths generally less than 8 feet. A system of dredged channels runs along the periphery of the bay and into some of the tributary creeks. Fresh water inflow is limited, the primary sources being the Tuckerton, Westecunk, and Mill creeks. Data collected from July 1973 through February 1974 (Makai et al. 1974) give a surface water temperature range of -2.2 to 28°C and a salinity range of

21.4 to 30.8 grams per liter or parts per thousand ($^{o}/_{oo}$) in the bay proper. The study area has a total surface acreage of 25,563 acres.

Paralleling this research, studies of nutrient chemistry, marsh and phytoplankton productivity, and benthic invertebrate and zooplankton distributions were conducted by Rutgers University. The New Jersey Division of Fish, Game, and Shell fisheries concurrently studied finfish distributions, water chemistry, and recreational use in the estuary. The collation of this research may provide the most detailed picture of an estuarine ecological system ever assembled.

Broad objectives of the present study were to identify the forage base being utilized by resident and migratory fishes in Little Egg Harbor and to describe the allocation of that base among the consumers. The data and findings obtained are organized in terms of which species consumed a given forage item and what items were consumed by a given fish species. While emphasis was placed on describing the value of the various forage taxa to the overall fish community, the redundancy incurred by describing the diets of individual fish species was considered desirable since it allowed practical reference to the data from both directions of interest.

METHODS

The diet components of the fish species utilizing Little Egg Harbor were identified through analysis of their stomach contents. Fish were collected at sampling stations which were previously selected for a study of fish distributions within the estuary. Collections were accomplished by seine, otter trawl, gill net, and in one case by hook and line. The sampling was conducted over a 2 year period beginning in July 1973 with stations sampled once a month, except as prohibited by ice conditions or equipment failure. Figures 1 and 2 locate stations with the letter indicating seine, trawl, or gill net gears. In the final data analysis, stations were grouped into inlet, bay, tidal pool, Mill Creek and lagoon habitat areas. This allowed for an overview of forage utilization within different sets of salinity, bottom type, spatial confinement, and water quality parameters. The assignment of stations to these groups was somewhat subjective in that a number of stations were transitional. Stations at the mouths of tidal creeks, for example, shared both bay and creek characteristics, while lagoons connecting directly with Mill Creek had somewhat different characteristics than those situated deep in the lagoon complex.

Fish captured at these stations were immediately placed in marked containers of 10% formalin. Upon return from the field, a subsample of fish collected at each station was selected for stomach analysis. Selection was geared toward obtaining larger samples of those species which were abundant in the study area and those species which were of importance in the regional recreational fishery. The sampling gears were generally assumed to be inefficient for the capture of larger game species such as adult weakfish, bluefish, and striped bass in open bay and inlet areas; thus the sample is lacking in this respect. The striped bass sample was augmented by fish caught by hook and line. The Little Egg Harbor estuary functions as a nursery area for weakfish and bluefish and the sample did adequately represent first year specimens.

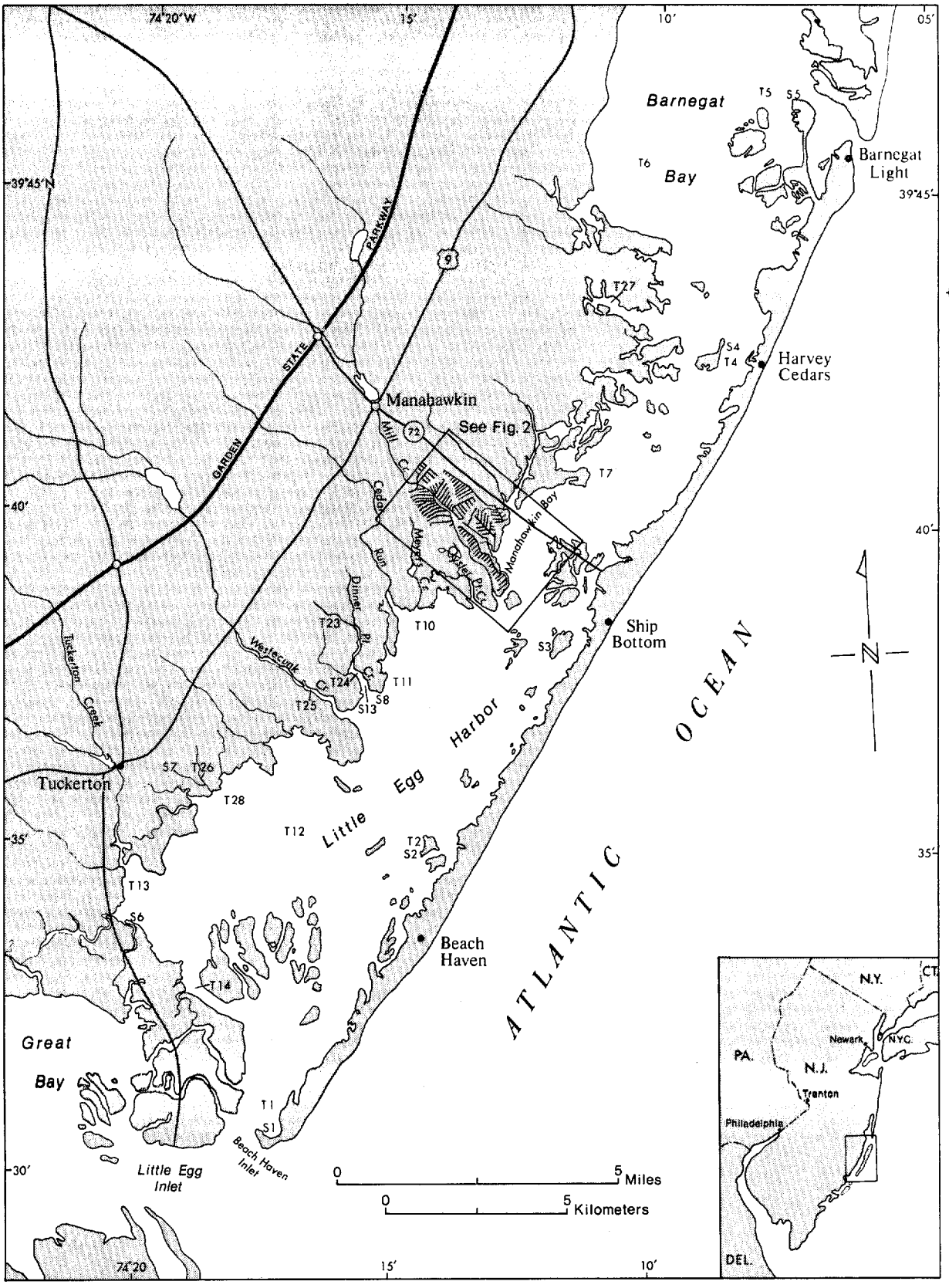

Fig. 1. Study area and station location.

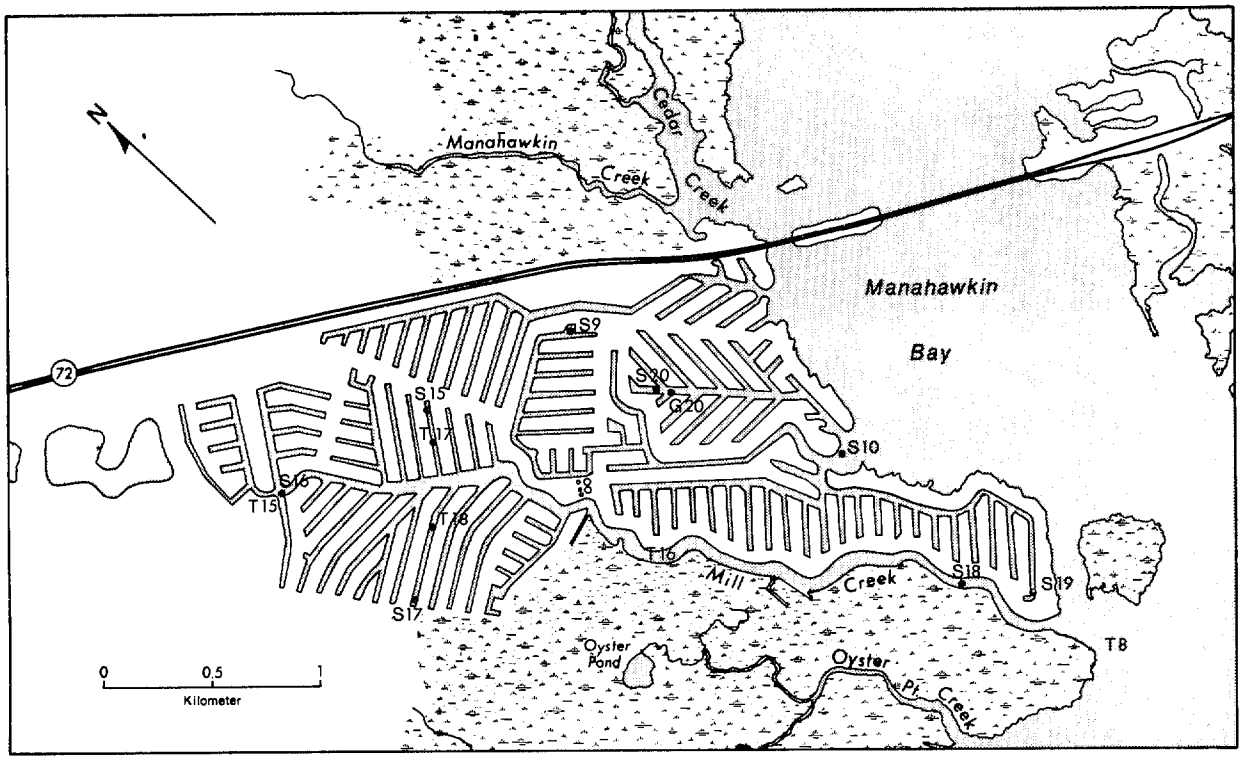

Fig. 2. Mill Creek-lagoon portion of the study area.

Selected fish were weighed to the nearest gram and measured to the nearest centimeter. The stomachs of larger fish were removed and placed in vials of 10% buffered (sea water) formalin. Whole small fish were preserved prior to analysis. Stomachs were removed in a variety of ways depending on species morphology. Generally a cut was made anteriorly from the anus to the gill isthmus with additional incisions dorsally so that the skin could be folded back to expose the digestive tract. Hemostats were placed on the esophagus and intestine proximal to the stomach and the tract severed distal of the hemostats allowing the stomach to be removed with a minimum loss of contents. In species which lack a readily discernable stomach, such as the tautog, the anterior portion of the tract was removed with care taken to include bulging areas. Content analysis was accomplished as follows:

1) The stomach was opened on a gridded plastic culture dish by pinching the tissue to the plate with a scalpel or, in larger specimens, by slicing or cutting the stomach open longitudinally. The operation was carried out under a dissecting scope when necessary.

2) Contents were spread over a portion of the plate and items separated by type into different cells of the grid.

3) For identification, individuals were removed to a second plate and keyed. After all types were identified as far as possible, the organisms were counted and the smallest and largest individuals of each taxon measured via eyepiece micrometer to obtain a size range. In cases where numbers prohibited actual counts, as occurred with some copepod species, the recovered organisms were spread over the grid as evenly as possible and counts made in five cells. Results were averaged and multiplied by the total number of cells (25).

4) The volume of each item group was determined by displacement in distilled water. Excess water was removed from the organisms prior to measurement by touching them with a piece of lens paper. The precision of volume measurements was dictated by item size. Large organisms required the use of large cylinders and measurements were to the nearest ml. Measurement to the nearest 0.05 ml was possible for intermediate sized organisms or large numbers of small items such as mysid shrimp. Measurements in the 0.05 to 0.001 ml range were made with an altered 1 inch 0.01 ml pipet equipped with a magnifying glass (Figure 3). A log was kept on volumes of small species such as gammarids and copepods of various size ranges. From this log, average individual volumes by length were calculated using the mid range length, number of individuals in the sample, and total volume. This assumes a normal distribution with the mid range equal to the mean length. In most cases the distribution of length was skewed to either larger or smaller individuals. However, it was assumed that the distributions approached normality over many samples. Regression lines, of the form Log Volume (ml) = Log Length (mm) x M + B, were developed on these calculations for assigning volumes to individual organisms which were too small and too few to measure directly (Figure 4). In cases where actual measurements were not available for estimating volume, geometrical calculations, on the basis of cylinders, spheres, etc. were used for estimation. Trace items, such as a few sediment grains or a bit of detritus were assigned a volume of 0.0005 ml.

5) Data sheets recorded fish species, fish length, weight, station of capture, date of capture, time and tide at capture, content items, number of each item type, volume of each item type, and size range. Water quality parameters at time of collection were catalogued in a commercial fish distribution study (McClain 1977).

6) Data analysis was accomplished using the SAS-76 program package and computer facilities of Rutgers University, New Brunswick, New Jersey.

ALLOCATION AND RELATIVE UTILIZATION OF THE FORAGE BASE

One hundred forty-two forage taxa were identified in the stomach contents of 55 fish species (Table 1) surveyed in the Little Egg Harbor estuary. The tables of Appendix A list the fish species from which each forage organism or group of organisms was recovered. For each consumer species, data are provided on the percent of its total stomach content volume composed of the particular

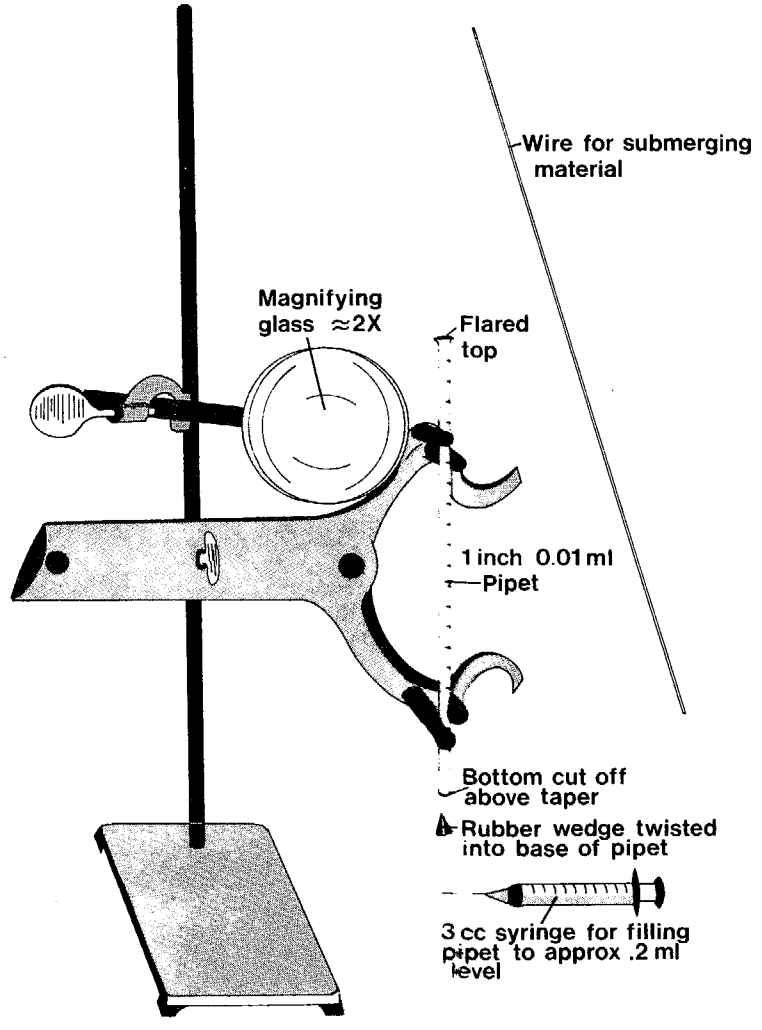

Fig. 3. Apparatus for determining volumes in 0.05 to 0.001 ml range.

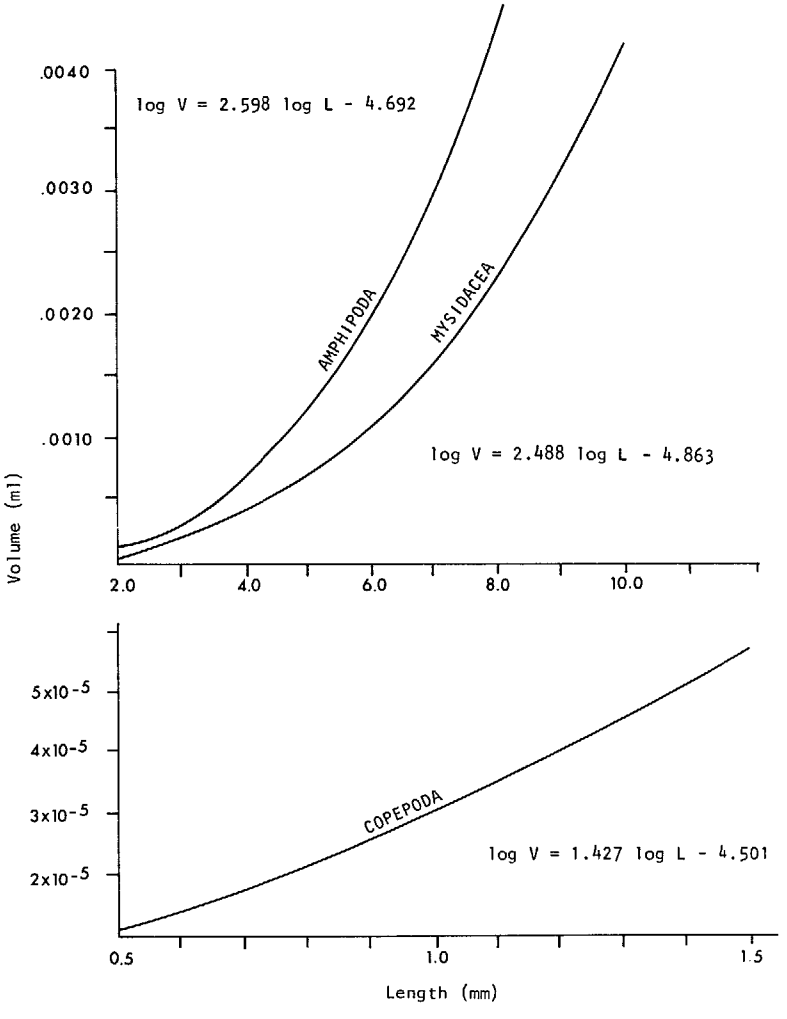

Fig. 4. Length-volume relationships calculated for three invertebrate taxa.

forage item, the percent occurrence of the forage item in the sample, and the average number (or volume) of forage items in each stomach. Where appropriate, a predation index rank is provided. The predation index was calculated as $A \times P \times 10^4$, with A equal to the total number of the given forage item recovered from the consumer stomachs divided by the number of consumer specimens examined (individuals per fish) and P equal to the proportion of McClain's total fish sample (Table 2) made up by the consumer species. This index provides a relative measure of the predation impact which a particular consumer population had upon a given forage population in the study area during the study period. It weighs individual consumption rates by relative population size. For example, fourspine stickleback stomachs contained an average of 0.16 *Cymadusa compta* while lined seahorse stomachs contained an average of 13. Assuming that these averages are proportional to the number of *C. compta* consumed by each species during a unit of time, a given seahorse would consume 81 times as many *C. compta* as a stickleback. However, since there were far more stickleback than seahorses in the estuary (519:1 in McClain's survey), the stickleback population represented a greater predation threat to *C. compta* than did the seahorse population.

The tables of Appendix A indicate potential areas of interspecies competition. Data were not available for determining if food supply was a limiting factor for any of the fish species utilizing Little Egg Harbor, and thus there is little basis for firm conclusions on food competition versus food sharing relationships. The diversity of feeding habits observed would suggest, however, that interspecific competition is minimal.

The trophic structure of the Little Egg Harbor estuary is very complex. Use of the identified food resources (Table 3) is well divided among the various fish species present and often among size groups within these species. This division of the forage base adds stability to the trophic structure. The potential for competition is no doubt reduced by a number of the species-specific, predator-prey relationships observed as well as by the variety of food items available. This situation in turn is a function of the diversity of ecological niches present in the system. Such a condition allows the concurrent production of a large variety of fish species of various life stages within the estuary.

It is important that, except as noted, the data presented here be considered only in the positive sense; i.e. utilization of a given organism by a given fish species is documented, whereas nonutilization is not. The absence of a given organism in the fish stomachs may be a function of sample size, station selection, sampling procedures, or the organism's scarcity in the estuary. Low utilizations of organisms known to be common in the study area are noted in the discussions of the various forage groups; however, conditions in other estuaries may well effect different patterns or degrees of use.

The following pages review findings on the allocation and relative utilization by fish of the various prey organisms identified.

Appendix A complements the discussion.

Table 1. Sample of fishes collected from Little Egg Harbor and Manahawkin Bay for stomach content analysis.

Species	Number examined	Number with empty stomachs	Sample size
Alewife, *Alosa pseudoharengus*	12	1	11
American eel, *Anguilla rostrata*	11	1	10
American sand lance, *Ammodytes americanus*	4	0	4
Atlantic menhaden, *Brevoortia tyrannus*	42	0	42
Atlantic needlefish, *Strongylura marina*	20	0	20
Atlantic silversides, *Menidia menidia*	89	4	85
Banded killifish, *Fundulus diaphanus*	18	0	18
Bay anchovy, *Anchoa mitchilli*	108	7	101
Black sea bass *Centropristes striatus*	18	1	17
Blueback herring, *Alosa aestivalis*	17	0	17
Bluefish, *Pomatomus saltatrix*	126	29	97
Brown bullhead, *Ictalurus nebulosus*	5	0	5
Crevalle jack, *Caranx hippos*	11	2	9
Cunner, *Tautogolabrus adspersus*	4	0	4
Fourspine stickleback, *Apeltes quadracus*	80	4	76
Golden shiner, *Notemigonus crysoleucas*	3	0	3
Gray snapper, *Lutjanus griseus*	2	0	2
Hogchoker, *Trinectes maculatus*	10	3	7
Inshore lizardfish, *Synodus foetens*	2	0	2
Lined seahorse, *Hippocampus erectus*	3	0	3
Mummichog, *Fundulus heteroclitus*	87	8	81*(35)
Naked goby, *Gobiosoma bosci*	9	1	8
Northern kingfish, *Menticirrhus saxatilis*	2	0	2
Northern pipefish, *Syngnathus fuscus*	21	0	21
Northern puffer, *Sphoeroides maculatus*	3	0	3
Northern sea robin *Prionotus carolinus*	4	0	4
Northern sennet, *Sphyraena borealis*	7	0	7

Table 1. Continued.

Species	Number examined	Number with empty stomachs	Sample size
Oyster toadfish, *Opsanus tau*	35	5	30
Permit, *Trachinotus falcatus*	1	0	1
Pinfish, *Lagodon rhomboides*	3	0	3
Planehead filefish, *Monacanthus hispidus*	3	1	2
Pumpkinseed, *Lepomis gibbosus*	2	0	2
Rainwater killifish, *Lucania parva*	20	9	15*(9)
Red hake, *Urophycis chuss*	4	1	3
Redfin pickerel, *Esox americanus*	2	1	1
Scup, *Stenotomus chrysops*	1	0	1
Sheepshead minnow, *Cyprinodon variegatus*	52	7	48*(23)
Silver perch, *Bairdiella chrysura*	28	2	26
Smooth dogfish, *Mustelus canis*	12	0	12
Spot, *Leiostomus xanthurus*	94	1	93
Spotted hake, *Urophycis regius*	18	1	17
Striped bass, *Morone saxatilis*	13	2	11
Striped burrfish, *Chilomycterus schoepfi*	2	0	2
Striped killifish, *Fundulus majalis*	16	3	13
Striped mullet, *Mugil cephalus*	5	1	4
Striped sea robin, *Prionotus evolans*	3	0	3
Summer flounder, *Paralichthys dentatus*	41	3	38
Tautog, *Tautoga onitis*	25	0	25
Threespine stickleback, *Gasterosteus aculeatus*	6	0	0
Tidewater silversides, *Menidia beryllina*	43	4	39*(37)
White perch, *Morone americana*	80	1	79
White mullet, *Mugil curema*	11	0	11
Weakfish, *Cynoscion regalis*	51	0	51
Windowpane flounder, *Scophthalmus aquosus*	4	0	4

Table 1. Continued.

Species	Number examined	Number with empty stomachs	Sample size
Winter flounder *Pseudopleuronectes americanus*	147	6	141
Number of species 55	1,449	109	1,340*(1,266)

* Only a portion of those specimens collected in the tide pool habitat were included in the overall analyses due to a lack of volumetric data. Number in parantheses is sample included in Appendix A and B.

Sediment

Recognizable amounts of sediment occurred in the stomach contents of 22 fish species. Particles less than 50 μm were generally not detected or enumerated. It is presumed that in most cases sediment particles were ingested incidental to the capture of prey organisms. Fishes which feed on tube-dwelling amphipods and polychaetes would be expected to ingest sediment from the surrounding bottom and particles incorporated in the tubes themselves. The occurrence data is somewhat biased in favor of smaller fishes whose diet analyses generally required the use of higher microscope magnifications. This increased the chances of detecting small particles.

The ingestion of sediments may facilitate the digestive processes of algae or detritus-feeding fishes including the mullets and Atlantic menhaden. Of the 14 mullet stomachs examined, all but one contained high proportions of sediment. Hidlebrand and Schroeder (1928) note that white and striped mullet taken from Chesapeake Bay contained substantial quantities of mud. Baird (1873) observed large quantities of "mud" in the stomachs of menhaden collected from Great Egg Harbor, New Jersey.

There may be a significant nutritional value associated with algae and bacteria bound to these sediment particles. Such components possibly form a substantial portion of the energy intake of the mullets. On the basis of relative volumes consumed such a contribution would appear to be minor in the other species. The relative propensity for the ingestion of sediment, as suggested in Appendix A, may be of interest in studies concerning the transfer of sediment associated chemical compounds from the environment to fish.

Algae

Recognizable amounts of algae were observed in the stomachs of 18 species of fish. Component groups included diatoms, filimentous and solitary greens, and dinoflagellates. The Atlantic menhaden is known to be a phytoplankton feeder and this was apparent by the high occurrence of algae in the specimens examined. A number of other species contained diatoms which, based on the mouth morphology of the species, were probably grazed from the substrate. Included in this group were banded killifish, planehead filefish, striped mullet, and white mullet. Algae comprised 15.7% of the diet volume of banded killifish and 39.7% of the stomach contents recovered from two filefish

Table 2. Total length (cm) ranges of fish in the stomach analysis sample and the proportion of each species in fish collections in Little Egg Harbor (McClain 1977).

Species	Sample length range	Proportion x 10^{-4}
Alewife	6 - 13	5.6
Alewife	27 - 34	4.7
American eel	11 - 61	14.2
American sand lance	9 - 12	22.2
Atlantic menhaden	4 - 8	57.5
Atlantic menhaden	11 - 16	124.2
Atlantic menhaden	25 - 28	40.0
Atlantic needlefish	5 - 16	20.0
Atlantic needlefish	24 - 58	5.8
Atlantic silversides	3 - 13	2,592.9
Banded killifish	3 - 10	151.5
Bay anchovy	5 - 11	2,705.2
Black sea bass	6 - 21	6.4
Blueback herring	7 - 15	58.4
Bluefish	6 - 10	5.0
Bluefish	11 - 20	28.9
Bluefish	21 - 36	8.6
Brown bullhead	21 - 35	2.5
Crevalle jack	4 - 13	19.5
Cunner	3 - 5	1.1
Fourspine stickleback	2 - 6	1,451.8
Golden shiner	15 - 18	1.1
Gray snapper	4 - 5	2.5
Hogchoker	2 - 17	29.5
Inshore lizardfish	10 - 14	0.6
Lined seahorse	8 - 12	2.8
Mummichog	3 - 11	722.3
Naked goby	3 - 5	61.1
Northern kingfish	15 - 19	1.7
Northern pipefish	9 - 21	84.2
Northern puffer	2 - 11	1.7
Northern sea robin	8 - 18	2.8
Northern sennet	10 - 17	20.3
Oyster toadfish	4 - 13	34.7
Oyster toadfish	18 - 28	38.6
Permit	8	0.8
Pinfish	6 - 11	4.7
Planehead filefish	5 - 13	5.6
Pumpkinseed	9 - 10	0.6
Rainwater killifish	3 - 4	37.8

Table 2. Continued.

Species	Sample length range	Proportion x 10^{-4}
Red hake	8 - 20	1.1
Redfin pickerel	26	0.3
Scup	14	1.4
Sheepshead minnow	3 - 5	43.1
Silver perch	3 - 12	139.7
Smooth dogfish	39 - 56	5.0
Spot	3 - 10	180.9
Spot	11 - 19	283.2
Spotted hake	5 - 19	8.3
Striped burrfish	23 - 25	3.3
Striped bass	43 - 58	0.3
Striped killifish	4 - 13	42.5
Striped mullet	11 - 16	1.7
Striped sea robin	4 - 7	0.6
Summer flounder	6 - 24	7.8
Summer flounder	26 - 65	4.7
Tautog	6 - 16	9.4
Tautog	20 - 32	3.3
Threespine stickleback	5 - 7	5.3
Tidewater silversides	4 - 9	615.6
White perch	7 - 12	29.7
White perch	14 - 26	45.6
White perch	29 - 37	6.1
White mullet	3 - 14	36.1
Weakfish	5 - 10	26.4
Weakfish	11 - 17	11.7
Weakfish	32 - 62	0.6
Windowpane	15 - 34	2.2
Winter flounder	3 - 11	30.3
Winter flounder	12 - 21	34.2
Winter flounder	22 - 33	30.6

specimens. Dinoflagellates formed an important component of the mummichog diet during the summer at the tide pool station.

As with vascular plant material, the role of algae in the production of fish within the estuary is, with the exception of menhaden, primarily associated with invertebrate forage production. The phytoplankton-copepod energy transfer is particularly important in the food chains of many small fish and ultimately to the diets of piscivorous species (Figures 5 and 6).

Table 3. Identified components of the fish forage base in Little Egg Harbor.

Sediment

Algae

Plant detritus

Porifera

Hydrozoa

Anthozoa, Actiniaria

Turbellaria

Nemertea

Nematoda

Bryozoa

Gastropoda

Bittium alternatum

Crepidula spp.

Mitrella lunata

Ilyanassa obsoleta

Haminoea solitaria

Pelecypoda

Mytilus edulis

Laevicardium mortoni

Mercenaria mercenaira

Family Tellinidae

Tagelus divisus

Ensis directus

Mya arenaria

Lyonsia hyalina

Solemya velum

Oligochaeta

Hirudinea

Polychaeta

Phyllodoce maculata

Phyllodoce arenae

Eumida sanguinea

Eteone spp.

Family Aphroditidae

Family Polynoidae

Stenelais spp.

Glycera americana

Family Goniadidae

Nephtys spp.

Family Syllidae

Nereis succinea

Family Capitellidae

Clymenella torquata

Maldanopsis elongata

Scolecolepides viridis

Polydora ligni

Streblospio benedicti

Aricidea sp.

Lumbrineris tenuis

Arabella iricolor

Scoloplos fragilis

Hypaniola grayi

Table 3. Continued.

Pista palmata	*Edotea triloba*
Sabella microphthalma	*Erichsonella attenuata*
Limulus polyphemus	*Erichsonella filiformis*
Arachnida, Order Acari	Family Oniscidae
Insecta	Amphipoda
Order Plecoptera	*Ampelisca abdita*
Order Diptera	*Ampelisca vadorum*
Order Coleoptera	*Ampelisca verrilli*
Order Hymenoptera	*Ampithoe longimana*
Order Homoptera	*Cymadusa compta*
Order Hemiptera	*Rudilemboides naglei*
Cladocera	*Microdeutopus gryllotalpa*
Ostracoda	*Lembos* sp.
Copepoda	*Batae catharinensis*
Order Calanoida	*Corophium* spp.
Order Harpacticoida	*Erichtonius rubricornis*
Order Cyclopoda	*Erichthonius brasiliensis*
Cirripedia	*Unciola serrata*
Cumacea	*Cerapus tubularis*
Isopoda and Tanaidacea	*Gammarus* spp.
Tanais cavolini	*Gammarus mucronatus*
Leptochelia savignyi	*Elasmopus leavis*
Cyathura polita	*Casco bigelowi*
Cirolana sp.	*Melita* sp.
Idotea balthica	*Maera danae*
Idotea phosphorea	Family Lysianassidae

Table 3. Continued.

Family Hyalidae

Monoculodes edwardsi

Microprotopus ranei

Leptocheirus plumulosus

Paraphoxus spinosus

Orchestia platensis

Stenothoe minuta

Parametopella cypris

Suborder Caprellidae

Order Mysidacea

Neomysis americana

Mysidopsis bigelowi

Order Decapoda

Penaeus sp.

Palaemonetes vulgaris

Palaemonetes pugio

Hippolyte sp.

Crangon septemspinosa

Pagurus longicarpus

Ovalipes ocellatus

Callinectes sapidus

Neopanope texanna

Rhithropanopeus harrisii

Eurypanopeus depressus

Aslidiacea, Family Molgulidae

Osteichthyes

Menidia menidia
(Atlantic silversides)

Anchoa mitchilli
(Bay anchovy)

Apeltes quadracus
(Fourspine stickleback)

Ammodytes americanus
(American sand lance)

Brevoortia tyrannus
(Atlantic menhaden)

Family Bothidae
(Lefthand flatfishes)

Bairdiella chrysura
(Silver perch)

Cynoscion regalis
(Weakfish)

Leiostomus xanthurus
(Spot)

Fundulus heteroclitus
(Mummichog)

Gobiosoma bosci
(Naked goby)

Prionotus spp.
(Sea robins)

Pseudopleuronectes americanus
(Winter flounder)

Strongylura marina
(Atlantic needlefish)

Syngnathus fuscus
(Northern pipefish)

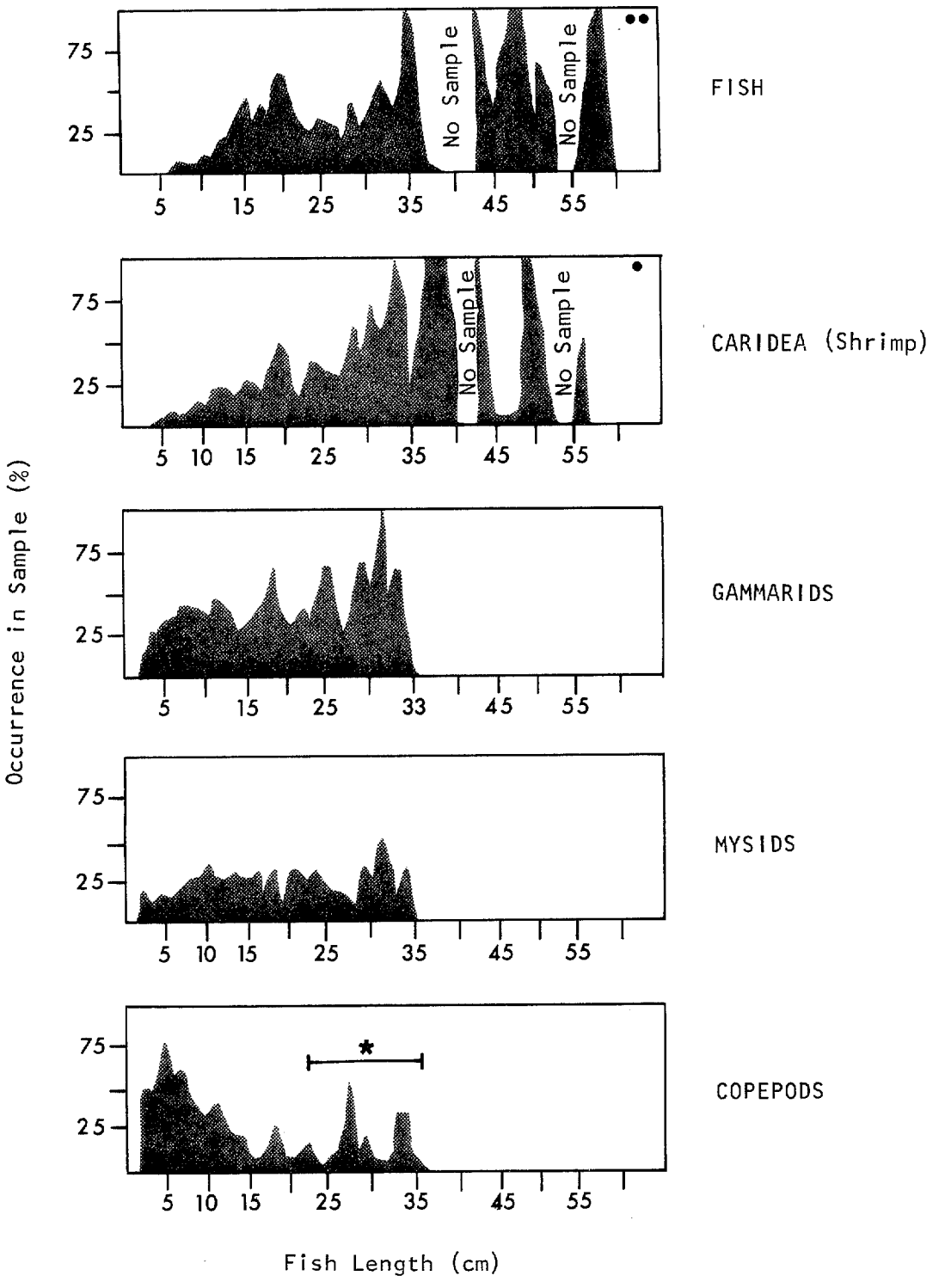

Fig. 5. Percent occurrence of five major forage categories by fish length. Note that the dots in the fish and Caridea plots represent single occurrences of individuals.

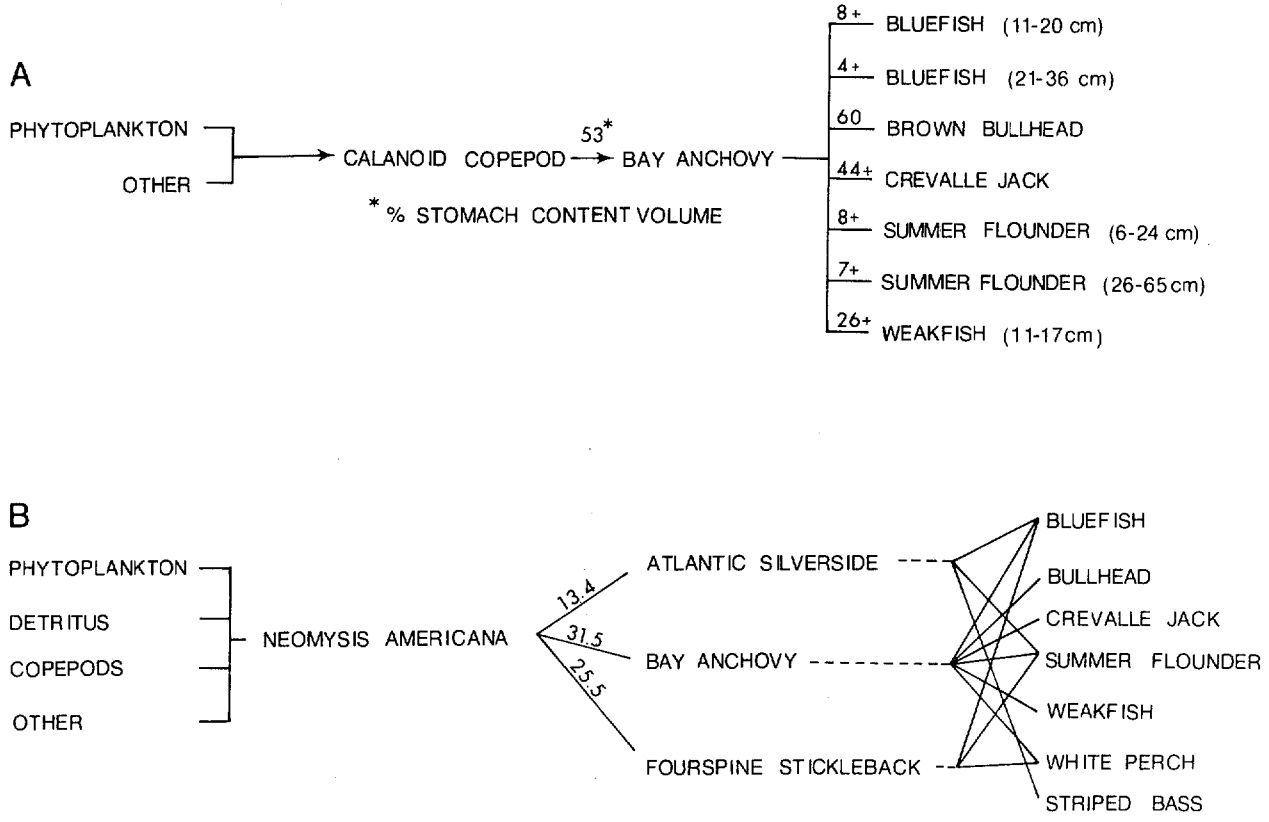

Fig. 6. Some simplified trophic relationships observed in Little Egg Harbor.

Vascular Plant Detritus

Plant fragments in various degrees of decomposition occurred in 35 of the fish species examined. Whole sections of eelgrass blades were found in some of the larger specimens and were particularly evident in species consuming larger blue crabs, *Callinectes sapidus*. These included smooth dogfish, oyster toadfish, and American eel. Smaller eelgrass fractions were observed in a number of other fishes. Most of the fibrous plant material recovered was not readily identifiable as to its source. Fragment sizes ranged down to microscopic proportions.

Of those fishes for which volumetric analyses were conducted, plant detritus was ingested in larger amounts by oyster toadfish, banded killifish, and smooth dogfish. As a population, oyster toadfish consumed the largest amount of fibrous plant detritus in the study area. On the basis of occurrence data and qualitative observations, it appeared that this material comprised a major portion of the diet volume of white mullet and sheepshead minnow. Whether these species are capable of digesting fibrous plant material or ingest it to obtain associated algal and bacterial components is not known. Pyle (1964) noted that the stomachs of sheepshead minnows collected in Barnegat Bay, New Jersey also contained high proportions of detritus.

In most of the other fish species concerned, it is rather certain that the ingestion of plant detritus is incidental to the capture of other food. The opportunity for fish to obtain this material is very high; the observed volumes consumed are low. The highest percent occurrences of detritus in the fish stomachs by area was observed in the tide pool sample in association with the sheepshead minnow population.

A large portion of the invertebrate populations utilized by fish in Little Egg Harbor are known to be organic detritus feeders. In this sense, the production of desirable fish species is clearly associated with the availability of plant detritus. The pathways and quantifications of invertebrate utilization are subjects requiring further study.

Phylum Nemertea

American eel, brown bullhead, and winter flounder specimens contained the remains of nemertean worms tentatively of the genus *Cerebratulus*. Nemerteans comprised 12.2% of the diet volume collected from winter flounder in the 22-33 cm size range although occurring in only two fish. These were the two largest flounder specimens collected.

Phylum Porifera

Portions of unidentified sponge occurred in the stomach contents of one summer flounder collected from the bay. Sponges apparently are of little direct food value to fishes in the system.

Phylum Cnidaria

CLASS HYDROZOA -- Hydroid stolens and polyps occurred in generally small quantities in the stomach contents of 13 fish species. They comprised 19.8% of the stomach content volume of the two planehead filefish examined, and may contribute substantially to the diet of this grazing species. Hydroid pieces were found in two of the three northern puffer specimens. This fish is presently scarce in the system (Festa 1978), but has been very abundant in past years. No consistent attempt was made to identify the taxa involved; the genus *Campanularia* was tentatively identified in one instance. Hydroids may provide habitat for various amphipods. In the overall fish sample it is assumed that most ingestion occurred incidentally to the capture of other foods. Occurrence in the sample was highest at the tide pool station in association with the sheepshead minnow and mummichog populations. A somewhat higher occurrence was noted in spring and fall collections.

CLASS ANTHOZOA -- An unidentified anemone was found in the stomach of a windowpane collected at a bay station.

Phylum Platyhelminthes

CLASS TURBELLARIA -- Fourteen species of fish contained turbellarians in their stomach contents. While not significant in terms of stomach volume, occurrence was high in a number of fish, particularly in bay anchovy. The role played by turbellarians is unclear. Specimens collected from the fish stomachs did not, in general, show signs of deterioration and apparently were not being digested

by the fish. Most were in the size range of 0.5 to 0.7 mm., and all were presumed to be of the order Neorhabdocoela.

Phylum Aschelminthes

CLASS NEMATODA -- Sixteen fish species had nematodes in their stomachs. These nematodes appeared to be immune from digestion. With a few exceptions, the cuticle of recovered nematodes was intact and showed no sign of dissolution. It is postulated that these nematodes were lodged in the stomachs feeding on materials ingested and partially digested by the fish. They were often found intertwined with other materials in the stomachs. A 50% or higher occurrence was observed in the sample of oyster toadfish, spot, and tautog. The size of nematodes generally increased with the size of the fish specimens. Spot contained an average of 24.3 nematodes in their stomach contents. While nematode infestation did not appear to be correlated with any gross signs of emaciation, the effect on fish growth rates, particularly in spot, should be investigated.

These findings contrast with those of Odum and Heald (1972) who observed few nematodes in the stomachs of fish collected in the North River, Florida, although the organisms were common in benthic samples.

Phylum Bryozoa

Clumps of bryozoa were found in the stomach contents of one bullhead, one summer flounder, two tautog, and one winter flounder. Bryozoans do not appear to be of direct value as fish food in the Little Egg Harbor system. Indirectly they may contribute to fish production by providing cover for various amphipods.

Phylum Mollusca

CLASS GASTROPODA -- Gastropod larvae occurred in the diets of six fish species. They were of most importance in bay anchovy, which contained an average of 12.5 larvae per fish. The contribution of gastropod larvae to the overall anchovy diet was low (1.9% total volume); however, during particular time periods the daily intake was significant. Larvae occurred in fish collected from May through August with high numbers encountered in individual anchovies taken on 10 June (136), 1 July (158), and 9 July (281) in 1974. The 9 July specimens were taken from a lagoon station while the others were from bay stations. Gastropod larvae occurred in a higher percentage of tidal creek and bay station fish.

Adult gastropod forms were found in the stomachs of 12 fish species. At least five taxa were represented:

Genus *Bittium*: *Bittium alternatum* Say was the only species identified. It occurred in the diet of winter flounder and oyster toadfish. Unspeciated members of the genus occurred in fourspine stickleback, silver perch, and tautog. Stickleback had the highest predation index rank followed by siver perch. Occurrence was limited to bay and inlet station fish. *Bittium* contributed little to the total volume of the stomachs examined. Highest occurrence was observed in the tautog sample.

Genus *Crepidula*: This taxon comprised 55.4% of the total stomach content volume collected from three northern puffer and 99% of the content volume of a

single 8 cm permit. The genus also occurred in fourspine stickleback, oyster toadfish, tautog, and winter flounder. In some cases only the soft body parts were recovered from the fish stomachs. With one exception, occurrence was limited to bay collected fish. During the sampling period, *Crepidula* apparently was not a major fish food source in the estuary. A relative increase in the northern puffer population, however, would be expected to increase the contribution of *Crepidula* to overall fish production.

Mitrella lunata Say: This dove shell is found from Massachusetts to Texas (Abbott 1968). It occurred in the stomachs of one American eel, one oyster toadfish, one permit, and one winter flounder. No pattern was observed in terms of habitat or seasonal occurrence.

Family Nassariidae: Four individuals were recovered from the stomachs of one bullhead, two oyster toadfish, and one striped burrfish. These remains were tentatively identified as *Ilyanassa obsoleta* Say. The species is abundant in many areas of Little Egg Harbor and its low occurrence in the fish sample indicates a disproportionately low utilization as fish food.

Haminoea solitaria Say: This gastropod belongs to a group of genera commonly called "Bubble shells". Abbott (1968) notes these are generally carnivorous forms although they occasionally feed on algae. *H. solitaria* occurred in the stomach contents of two oyster toadfish taken at bay station T-9 and one winter flounder collected at inlet station T-5.

In general, gastropods appear to contribute only minimally to the production of fish in Little Egg Harbor. The utilization of gastropod larvae by bay anchovy represented the major trophic relationship observed in the survey sample. The relative value of gastropods in terms of fish production may be very sensitive to large fluctuations of the northern puffer population. In past years, this fish was a dominant species in the system.

CLASS PELECYPODA -- Bivalve molluscs were present in the stomachs of 16 species of fish. At least nine genera were represented. Since a large portion of the pelecypod component consisted of crushed and fragmented remains, it is probable that a number of other taxa were included in the unclassified category. In general, adult forms of this class were better represented in the stomach contents than the gastropods. Pelecypod siphons formed an important portion of the winter flounder diet.

Family Mytilidae: The blue mussel, *Mytilus edulis* Linne, was identified in the diets of fourspine stickleback, lined seahorse, striped burrfish, and striped bass. An unidentified mussel occurred in the stomach contents of one spot. Although common in the area, the ribbed mussel *Modiolus demissus* Dillwyn is apparently not heavily utilized by fish in the system. The occurrence of mussels was limited to fish collected at bay and inlet stations.

Laevicardium mortoni Conrad: This small cockle occurred in the stomach contents of a winter flounder taken at bay station T-4.

Family Veneridae: The remains of whole venus clams were found in the stomachs of three spot and the one scup specimen. The survey sample gave no indication of heavy fish predation on hard clam seed, *Mercenaria mercenaria* Linne, in the estuary. The occurrence of venus siphon tips, primarily *M. mercenaria*,

in the diet of winter flounder is discussed in detail in the section on pelecypod siphons. That relationship represents the major utilization of the family by fish in the system.

Family Tellinidae: One unidentified tellin was recovered from a winter flounder stomach. The fish was collected at inlet station T-5 in December.

Ensis directus Conrad: The soft parts of one razor clam were collected in entirety from a winter flounder taken at a lower Mill Creek station. No portions of either valve were observed in the stomach. One individual was recovered from an oyster toadfish. *E. directus* may have contributed minimally to the siphon tips recovered from winter flounder.

Tagelus divisus Spengler: The remains of one specimen were recovered from a winter flounder stomach.

Mya arenaria Linne: An entire soft clam was found in the stomach contents of an American eel taken in Mill Creek. Outside the study area the remains of a small soft clam were identified in the stomach of a mummichog collected in Raritan Bay, N.J. Siphon tips and seed clams of this species have been documented in the diet of winter flounder in other areas as discussed in the pelecypod siphon section.

Lyonsia hyalina Conrad: Seven individuals were collected from the stomach of a single winter flounder taken at bay station T-4. This was the only occurrence of the glassy lyonsia in the fish sample.

Solemya velum Say: This species was identified in the diet of black sea bass, smooth dogfish, and tautog. All occurrences were in August. The sea bass and tautog specimens were collected at bay station T-2.

Pelecypod siphons: Portions of pelecypod siphons were observed in the stomachs of spot, white perch, and winter flounder. This item contributed minimally to the diet of spot and white perch, but was a major food source for winter flounder in the estuary.

Through direct comparison with intact siphons from the various large pelecypods found in the Little Egg Harbor system, it was determined that at least 75% of the siphon tips recovered from winter flounder were of *Mercenaria mercenaria*. This is the dominant large pelecypod in the study area, making up 91% by weight of dredge collections of Garlo et al. (1974). Of the remaining, less distinguishable tips, most appeared to be *M. mercenaria* siphons in more advanced stages of digestion. A few siphon tips from *Mya arenaria* were recovered from smaller flounder and at least one siphon of *Ensis directus* was observed. In contrast, *M. arenaria* siphons comprised 17% of the diet volume of four winter flounder collected over soft clam beds in Raritan Bay, N.J. suggesting that the fish opportunistically attack either clam.

Pelecypod siphons accounted for 14.1% of the total stomach content volume collected from winter flounder in Little Egg Harbor. They occurred in 27.5% of the specimens examined at an average of 3.08 siphons per fish. Siphons were not heavily utilized by fish in the 3 to 11 cm size group, occurring in only 7.1% of the sample. Siphons were an important diet item in the 12 to 21 cm group of flounder, comprising 22.5% of the stomach contents volume and occurring

in 29.3% of the sample. This contrasts with the findings of Frame (1974) who found only a 2.8% occurrence of siphons in 176, 1 year old fish taken from the Weneatic River estuary in Massachusetts. Larger fish (22-33 cm) consumed higher numbers of siphon tips averaging over six per specimen, but the relative importance of the item declined to 12.4% of the diet volume. Siphons occurred in over 50% of these larger winter flounder. One 29 cm specimen contained 82 siphon tips. This predator-prey relationship was observed throughout the study area with lower intensity in inlet stations and the fresher areas of tidal creeks. The highest utilization of hard clams occurred in the November to May period, reflecting the presence of adult winter flounder in the estuary.

The recovered siphon tips averaged 5.96 mm in width and had a mean length of 3.37 mm. There is no apparent relationship between the width of the siphon attacked and the length which the fish is able to remove (correlation coefficient = 0.54, n = 128).

The occurrence of pelecypod siphons in the diet of winter flounder has been documented by a number of investigators. Kurtz (1975) found that unidentified siphons comprised 0.63% and 17.38% by weight of the stomach contents of 469 winter flounder taken in Shinnecock and Great South Bay, Long Island. Of special interest is the paper of Medcof and MacPhail (1952), which considered predation on soft clams along the coast of New Brunswick, Canada. Two thirds of the flounder specimens they examined contained soft clam siphons with an average of 16 per fish. Their study concluded that flounders can be enormously destructive of seed clams and that they injure adult clams by nipping off the ends of their siphons.

The effect of flounder predation on the Little Egg Harbor hard clam population is apparently not as severe as that described on soft clams in New Brunswick since young or entire hard clams were not present in the fish stomachs examined. Medcof and MacPhail (1952) found that mortality rates of *Mya* over a 10 day period were not increased for specimens having 0.25 to 0.50 inch of their siphons cut off. Observations in the present study likewise suggest little direct mortality associated with flounder attacks on clam siphons. During the winter and early spring of 1974, 203 hard clams collected from the adjacent Great Bay estuary were examined as to the condition of their siphons. Overall, 47.3% of the sample displayed signs of recent or past siphon damage ranging in severity from disfiguration to the total absence of a siphon. In 18% of the specimens the siphonal tentacles were missing. These organs contain tactile and chemoreceptor cells (Morton 1958) which regulate particle intake and monitor water quality. The clams are apparently able to regenerate these tentacles. However, the temporary loss of tentacles would be assumed to have some negative effect on the general function of the animal. Clams in Little Egg Harbor are subject to repetitive attack. Many of the siphon tips recovered from the flounder stomachs had disfigured distal margins showing signs of healed or regenerated areas.

The hard clam - winter flounder relationship is interesting because, in a sense the siphons represent a "renewable food resource" for the flounder which might be of consideration for aquaculture situations.

Pelecypod larvae: Larval stages of pelecypoda occurred in the stomach contents of one bay anchovy and one spot. Twenty-five larvae were recovered from the two fish. Both fish were collected in tidal creek stations, the anchovy on 21 May 1974 and the spot on 30 August 1973.

Phylum Annelida

CLASS OLIGOCHAETA -- Unidentified oligochaetes occurred in the stomach contents of fourspine stickleback, pumpkinseed, spot, and winter flounder. These worms were assumed to be of the family Tubificidae. Oligochaetes do not appear to contribute significantly to the diet of fish populations in the estuary except possibly in the case of spot. Occurrence in spot was limited to three fish, two taken in Mill Creek and one from a bay station. The two Mill Creek fish contained 64 and 71 worms with the result that oligochaetes comprised 4.2% of the total stomach contents collected from the species. Overall, oligochaetes were found in the stomachs of seven individual fish. High densities of tubificid worms are often associated with organically rich sediments subject to anaerobic conditions. In studies of Upper New York Bay, in muddy sediments along previously dredged shorelines, densities as high as 10,969 per square meter have been recorded (Texas Inst., Inc. 1976). The utilization of tubificids by bottom feeding fishes may be expected to increase in such areas; however, they were not observed in the limited stomach analysis work conducted at that site.

CLASS HIRUDINEA --One unidentified leech was recovered from the stomach of a mummichog taken at Mill Creek Station S-18 in June.

CLASS POLYCHAETA -- Polychaetes as a group comprise one of the major fish food resources in the Little Egg Harbor estuary. Adult forms were observed in the diets of 32 fish species. They comprised over 10% of the stomach content volume in 16 species, over 30% in five. Larval forms occurred in low numbers in the diets of menhaden, bay anchovy, blueback herring, fourspine stickleback, striped killifish, and winter flounder. Relatively higher utilization of larvae occurred in lagoon stations. No thorough attempt was made to identify larval forms, however, a large portion appeared to be spionids.

Due to the rapid deterioration of polychaetes in the fish stomachs, it was difficult to assess the relative contribution of the various component taxa to the fish diets. At least 19 families were represented. Fifteen species were identified. To an extent the unclassified groups listed in Appendix A might be proportioned relative to identified taxa; however, larger species or those species with distinctive hard body parts (jaws, setae, etc.) were somewhat less likely to occur in the unclassified category. As a group, polychaetes were utilized throughout the year and in all habitats.

Family Phyllodocidae: Three species were identified in the fish stomachs: *Phyllodoce maculata*, *P. arenae* Webster, and *Eumida sanguinea* Oersted. Unspeciated individuals of the genus *Eteone* were also recovered. The family occurred in the diets of six fish species being of most importance in the naked goby sample (30.6% volume). Spot were determined to have the greatest predation impact on the family followed by goby and mummichog. *Phyllodoce* was observed in fish taken at bay, lagoon, and Mill Creek stations. *Eteone* appeared to be more closely associated with the Mill Creek and tide pool stations, but also occurred in fish collected from bay and lagoon stations. The single *Eumida* identified was found in a winter flounder collected at bay station T-2.

Family Aphroditidae: Two individuals were collected from the stomach contents of winter flounder. The remains could not be speciated. One flounder was taken at lagoon station S-10 and one at bay station T-2.

Family Polynoidae: Unidentified members of this family occurred in two winter flounder, one collected at inlet station T-5 and one at bay station T-2. A total of five individuals were observed.

Family Sigalionidae, Genus *Sthenelais*: One individual was identified in the stomach contents of a winter flounder collected in Mill Creek.

Family Syllidae: Two individuals were observed. One was in a fourspine stickleback collected at bay station T-4 and one in a spot collected at bay station T-11.

Family Glyceridae, Genus *Glycera*: A total of 28 glycerids were identified in the stomach contents of northern kingfish, white perch, and winter flounder. *Glycera americana* Leidy was the only species positively identified; however, it is likely that other species were involved. In Little Egg Harbor the genus was of importance in the diet of large winter flounder and comprised 9.9% of the stomach contents collected from two kingfish. Winter flounder had the greatest predation impact during the study period. Utilization was considerably higher in fish collected at inlet stations. No seasonal pattern was apparent.

Family Goniadidae: *Glycinde solitaria* Webster and *Goniadella gracilis* Verrill were tentatively identified. Occurrence was limited to winter flounder with most utilization by young of the year fish. This family occurred in 10 fish, nine of which were collected during the summer; eight of the 10 were from bay stations.

Family Nephtyidae, Genus *Nephtys*: One small bluefish (10 cm), one spot, and one large winter flounder contained *Nephtys* remains. The bluefish and spot were collected from lagoon station T-18 in July; the flounder was from a bay station.

Family Nereidae, Genus *Nereis*: *Nereis succinea* Frey and Leuckart was the dominant species observed although other unidentified species occurred in the fish stomachs. The rather distinctive prostomium, antennae, and jaws of this genus facilitated the recognition of quite skimpy and well-digested remains. It can be assumed that most occurrences were enumerated. The high utilization of this genus relative to other polychaete components as indicated by Appendix A is probably exaggerated to some degree. Even so this genus clearly represented one of the major polychaete taxa in the fish diets examined. It occurred in 15 species, being of significant importance in the stomach contents of 6 to 10 cm bluefish, 11 to 13 cm oyster toadfish, and 12 to 21 cm winter flounder. With the exception of the tide pool station, occurrence was system wide, from low salinity areas of Mill Creek to inlet collected fish. The greatest predation impact on the genus was effected by Atlantic silversides, bay anchovy, and winter flounder. Sanders et al. (1960) characterized the generic *Nereis caudata* in Barnstable Harbor, Massachusetts as an indiscriminate deposit feeder subsisting primarily on diatoms and detritus.

Family Spionidae: Three genera were identified in the stomachs of the sampled fish. The family occurred in seven species, being utilized to a larger extent by brown bullhead, spot, and young of the year winter flounder. Spot had the greatest predation impact on this group of polychaetes. *Scolecolepides viridis* Verrill was observed in stomach contents of bullhead and white perch collected in Mill Creek and winter flounder taken in the bay. The genus *Polydora* was dominant in the group, occurring in menhaden, anchovy, fourspine stickleback,

spot, white perch, and winter flounder. *P. lingi* (Webster) was the only species identified. Relative occurrence of this species was highest in bay and tidal creek fish. Utilization was markedly higher during the spring.

Streblospio benedicti Webster was a diet item of winter flounder. Sixty-seven individuals were observed in the stomach contents of three flounder collected in Mill Creek. One occurrence was recorded for a fish collected at the inlet site. This species comprised 38% of the stomach content volume of four winter flounder collected in Raritan Bay, N.J.

Family Capitellidae: Component genera were not distinguished. Polychaetes of this family occurred in four fish species with heavy utilization by 3 to 21 cm winter flounder. They comprised 21.8% of the stomach content volume of eight naked goby specimens but occurred in only one of the fish. Overall utilization was highest during the summer. Somewhat greater use was observed in inlet fish but the family was represented in all habitats except the tide pool.

Family Maldanidae: *Cylmenella torquata* Leidy was a stomach content component of scup and winter flounder. Occurrence was limited to bay station fish. *Maldanopsis elongata* occurred more frequently in the flounder sample and again was limited to bay stations. This species was also observed in the stomach contents of one gray snapper.

Family Terebellidae: This group was an important diet item for large winter flounder. It occurred in 48.9% of the sample comprising 16.5% of the content volume. *Pista palmata* Verrill was the major component and the only species identified. Other unidentified species were represented in the sample. *P. palmata* occurred primarily in bay collected fish; however, 10 specimens were observed in two flounder collected at the mouth of Mill Creek. Utilization by flounder was notably higher during the spring months. An unidentified terebellid was also collected from the one scup specimen examined.

Family Paraonidae, Genus *Aricidea*: Three individuals of this genus were identified in the stomach contents of one winter flounder taken at bay station T-2.

Family Lumbrineridae, Genus *Lumbrineris:* Occurring in tautog and winter flounder, this group was observed in bay and tidal creek collected fish. *L. tenuis* Verrill was identified in winter flounder. A total of seven individuals from this genus was represented in the sample.

Family Arabellidae, *Arabella iricolor* Montagu: Three individuals were encountered in the stomach contents of two winter flounder. One fish was collected at bay station T-2 in March, the other at the mouth of Mill Creek (T-8) also during March.

Family Sabellidae, *Sabella microphthalma* Verrill: Identified in three winter flounder. The fish were taken at tidal creek, bay, and Mill Creek stations.

Family Orbiniidae, Genus *Scoloplos*: This genus, as with a number of the other polychaete groups, was observed only in the stomachs of winter flounder. *S. fragilis* was identified as one component. In one case, 35 individuals were encountered in the stomach contents of one flounder. The fish was taken at bay station T-2.

Family Ampharetidae, *Hypaniola grayi*: This was a major item in the stomach contents of two pumpkinseed taken in upper Mill Creek. The species was also identified in the diet of spot, striped killifish, white perch, and winter flounder. The occurrence of *H. grayi* was strongly associated with the Mill Creek specimens and to a lesser extent with lagoon stations. A few *H. grayi* did occur in bay and tidal creek station fish. Utilization was highest during the summer and spot were calculated to be the major predator population.

While the utilization of polychaetes was expectedly associated with bottom feeding fishes, pelagic, and even planktonic feeding species including menhaden, anchovy, and bluefish apparently took advantage of swarming and juvenile forms. Winter flounder consumed the largest variety of polychaetes; however, a larger sample of other fish species might, to a degree, have reduced the observed differences in utilization. The high use of errant forms, particularly *Nereis*, suggests that special attention should be given to this group in evaluating the forage value of benthic populations. As a group, polychaetes contribute at some level to all categories of fish production in the Little Egg Harbor estuary.

Phylum Arthropoda

CLASS MEROSTOMATA -- Three young horseshoe crabs (*Limulus polyphemus*) were found in the stomach of a winter flounder collected at inlet station T-1 in August. A 3.1 mm (width) specimen also occurred in the stomach contents of a winter flounder taken in Raritan Bay in September.

CLASS ARACHNIDA -- One water mite (Order Acari) was encountered in the stomach contents of a fourspine stickleback taken at lagoon station S-15. Another occurred in a tidewater silverside collected in Upper Mill Creek. Both were winter collections.

CLASS INSECTA -- Insects occurred with surprising frequency in the fish stomachs examined. As a group, they were found in fish collected throughout the study area and during all seasons. Representatives of six orders were identified in the diets of 18 fish species.

Larval forms, primarily of the Dipteran family Chironimidae, were ingested by 15 fish species and comprised 6.1 and 4.2% respectively of the stomach contents of hogchoker and rainwater killifish. Mummichog and tidewater silversides accounted for most of the predation on Chironimidae larvae. Utilization by fish in general was relatively higher during the winter and at the tide pool station. A plecopteran larva was recovered from a white perch collected at lagoon station G-17 on 29 January 1974.

Adult insect forms comprised an important diet constituent of Atlantic needlefish. In small needlefish (5-16 cm) this group made up 41.7% of the diet volume. In larger specimens (24-58 cm) adult insect forms represented 11.8% of the diet volume. Tidewater silversides, Atlantic silversides, and striped killifish also consumed adult insects on a regular basis. The silversides were the most important predators in the system. Midges and winged ants occurred most frequently and it is assumed that these were taken from the water's surface. Coleoptera, Homoptera, and Hemiptera were also represented in the stomach contents. Expectedly, utilization of adult insects was highest during the summer months.

CLASS CRUSTACEA -- Subclass Branchiopoda, Order Cladocera: Occurring in seven fish species, cladocerans do not appear to be a major food resource for fish within the size ranges sampled in the Little Egg Harbor system. Although high numbers of Cladocera were found in individual fish, their contribution to the overall diet in terms of stomach content volume was generally small. Greatest utilization was by bay anchovy. Relative occurrence was highest at lagoon and Mill Creek stations during the summer.

Subclass Ostracoda: At least 10 fish species consumed ostracods. The subclass, however, contributed little to the total diet volume of these species. Bay anchovy represented the major predator on ostracods. Relative utilization of ostracods was highest during the spring and distributed over bay, Mill Creek, and tidal creek stations. A lower rate of utilization was observed in fish collected in the lagoons.

Subclass Copepoda: Copepods were found in the stomach contents of 31 of the 55 fish species examined. The occurrence of copepods was generally associated with small fish and planktivores (Figure 5). The subclass clearly represents a major share of the fish food resources in Little Egg Harbor and plays a significant part in the estuary's role as a fish nursery area. Copepods were distinguished to the order level.

Order Calanoida: This order was the major food source for zooplankton feeders occurring in a total of 24 fish species. It was the dominant diet constituent of sand lance, larger alewife, bay anchovy, and blueback herring. One blueback herring contained over 4,000 calanoids in its stomach. A total of 17 fish contained over 1,000 individuals. The bay anchovy population was calculated to have the greatest predation impact on calanoids. Relative utilization in the fish sample was highest at lagoon stations followed by tidal creek, Mill Creek, tide pool, bay, and inlet station fish. Overall calanoids occurred in 21.4% the total fish sample. Percent occurrence in the total sample was markedly higher during the winter and spring months.

Order Harpacticoida: Harpacticoid copepods were identified in the stomach contents of 22 fish species. In general they were of less importance volumetrically than the calanoid component. High utilization by spot was observed, the order making up 13.7% of the diet volume of 3-10 cm fish and 10.3% in the 11-19 cm fish. As observed with the calanoids, harpacticoid utilization in the total sample was relatively higher during the winter and spring months. The distribution of harpacticoids in the sample indicated higher relative utilization by tidepool and Mill Creek fishes.

Order Cyclopoda: There was an unexpected paucity of this copepod component in the fish stomachs. A number of occurrences may have been masked in the abundance of calanoids encountered. Small numbers of cyclopods mixed with hundreds or thousands of calanoids in a given stomach were probably overlooked.

The contribution of cyclopods to the fish diets examined was, at any account, minimal relative to the other copepod components. Cyclopods were only recognized in the stomach contents of two bay anchovies and one spot. All were collected from Mill Creek.

Subclass Cirripedia: Adult barnacle remains were found in the stomach contents of four fish species, being of most importance volumetrically to tautog (0.6%). Barnacle larvae occurred in four species with highest occurrence in the menhaden and anchovy diets. During the study period fish containing larvae were collected on dates from 21 May through 9 July. Approximately half of these were taken on 17 June and 18 June in 1974.

Subclass Malacostraca, Order Cumacea: Cumaceans occurred in the stomach contents of five fish species. They represented 3.1% of the diet volume of banded killifish, 2.9% of the 3-10 cm spot diet, and 2.1% of the diet of young of the year winter flounder. Occurrences exceeded 30% in killifish and young of the year flounder. With one exception, (25 March) occurrence was limited to the summer months. Cumaceans were not recovered from the stomachs of fish taken at inlet, lagoon, or tide pool stations. Utilization appeared to be uniform throughout the bay, Mill Creek, and tidal creek stations.

Orders Tanaidacea and Isopoda: This group of crustaceans contributed over 10% of the stomach content volume of banded killifish (10.5%), cunner (12.6%), grey snapper (19.0%), northern puffer (18.4%), 4-13 cm oyster toadfish (19.9%), striped killifish (16.8%), and 6 to 16 cm tautog (63.3%). Overall they occurred in 24 fish species. Eight taxa were identified.

The tanaids *Tanais cavolini* and *Leptochelia savignyi* were of minor importance in the diets of the fish examined. A total of 75 *T. cavolini* were collected from spot, striped killifish, white perch, and winter flounder. Seventy-two of these were from four spot taken in Mill Creek (T-16) on 28 August 1973. A single *L. savignyi* was recovered from an anchovy taken in Mill Creek during May.

The isopod component was made up primarily of *Cyathura polita*, *Idotea* spp., *Edotea triloba*, and *Erichsonella* spp. *C. polita* occurred in eight of the fish species studied and was of greatest importance in the diet of banded killifish (10.5% volume). This species was utilized by the total fish population to a greater extent in the Mill Creek and bay habitats. It did not occur in inlet or tide pool samples. Utilization was highest during the fall and not observed during the winter months.

Idotea balthica and *Idotea phosphorea* were identified in the fish stomach analyses with *I. balthica* dominating. As a group the genus occurred in 13 species of fish. It comprised 19% of the stomach content volume collected from two grey snapper, 13.8% of the 4-13 cm oyster toadfish diet, and 14.6% of the striped killifish diet. It was of most importance in the diet of 6-16 cm tautog contributing 47.2% of the total volume sampled. Larger oyster toadfish contained 1.93 individuals on the average and represented the major predator group on the genus. Utilization of *I. balthica* was highest in inlet station fish, while *I. phosphorea* was identified only in bay and tidal creek fish.

Edotea triloba comprised 12.6% of the stomach content volume of four young of the year cunner. It contributed minimally to the diets of eight other species. As a population, Atlantic silversides were the major predators on *E. triloba*. Utilization occurred in all but the tide pool habitats with slightly higher use observed in inlet collected fish. No use was recorded during the winter months.

The genus *Erichsonella* was found in the stomachs of seven fish species. In the sample of three northern puffer (3-11 cm) the genus constituted 18.4% of the stomach contents. It was of considerable importance to small (6-16 cm) tautog, comprising 15.7% of their diet volume. Two species, *E. attenuata* and *E. filiformis*, were identified. The occurrence of *E. attenuata* was limited to the summer months; *E. filiformis* was identified in fish collected from spring through fall. Neither species occurred in fish collected from inlet, lagoon, or the tide pool station.

The remains of one *Cirolana* sp. were tentatively identified in the stomach contents of a brown bullhead captured in upper Mill Creek (T-15). This genus is a common parasite on the gills of fish, particularly bluefish, in the study area. A terrestrial "pill bug" (Fam. Oniscidae) was also found in the stomach of a bullhead taken at this Mill Creek station.

Order Amphipoda: The suborders Gammaridea and Caprellidea were represented in the stomach contents examined. Bousfield (1973) was the major text used in identification of the gammarids collected. Except where otherwise noted, his work is also the reference for comments on species habits, distributions, and biology. Caprellids were not identified beyond the suborder.

Suborder Gammaridea: Twenty-six species of gammarid amphipods were identified in the sample. At least three additional species occurred but could only be identified to genus or family level. In all, 13 families were represented in the diets of 38 finfish species in the study area. As a group, gammarids comprised over 10% of the diet volume of Atlantic silversides (14.4%), banded killifish (41.3%), blueback herring (19.7%), cunner (70.5%), fourspine stickleback (34.2%), lined seahorse (71.2%), mummichog (13.9%), naked goby (40.0%), northern pikefish (35.0%), planehead filefish (20.5%), pumpkinseed (15.9%), rainwater killifish (61.8%), spot (22.3%), striped killifish (11.8%), striped sea robin (11.7%), threespine stickleback (25.1%), tidewater silversides (11.2%), white perch (10.4%), and young of the year winter flounder (19.0%).

Gammarids occurred in fish stomachs collected from all six habitat types and during all periods of the year. Generally, they occurred more frequently in bay fish and during the summer; however, they do provide an important fish food resource in all habitats throughout the year. Utilization of the various families encountered is discussed in the following section.

Family Ampeliscidae: *Ampelisca* was the only genus identified in the stomach contents examined. Three species, *Ampelisca abdita* (Mills), *A. vadorum* (Mills), and *A. verrilli* (Mills), were represented.

A. abdita is a dominant benthic organism in the study area (Haskin and Ward 1974). Durand and Nadeau (1972) encountered densities in excess of 5,000 individuals per square meter in the neighboring Great Bay estuary. The species ranges from Maine to Florida and is found in marine to brackish water (10 °/oo) salinities (Bousfield 1973). *A. abdita* occurred in the stomach contents of 16 fish species. It was of particular importance in the diet of young winter flounder comprising 14.4% of the stomach volume and occurring in 59% of the specimens examined. These 3 to 11 cm flounder contained an average of 8.3 *A. abdita* per fish. This amphipod represented 10% or more of the stomach content volume collected from Atlantic silversides, cunner, lined seahorse, and naked goby. It was a frequent food item in 5 to 10 cm weakfish. Based on calculated

predation indices for the study period, Atlantic silversides had the largest impact on the *A. abdita* population followed by spot, winter flounder, and weakfish (Figure 7). Utilization of the species by fish was evenly spread over the spring, summer, and fall months. It occurred in all habitats except the tidal pool. Heaviest utilization occurred in the tidal creek habitat with lower occurrence in the lagoon areas.

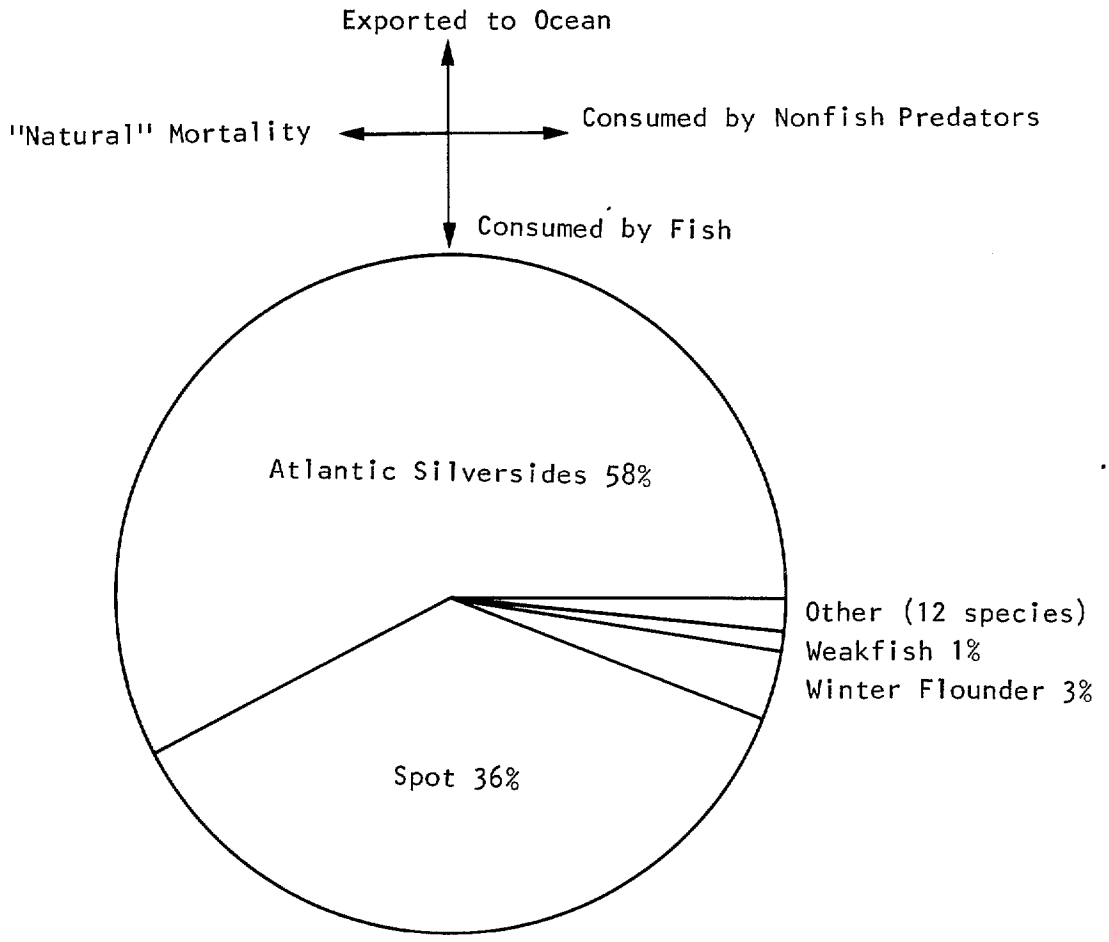

Fig. 7. Fate of *Ampelisca abdita* in the Little Egg Harbor estuary.

Ampelisca vadorum, which ranges from the Gulf of St. Lawrence to Georgia, is larger than *A. abdita* and is generally found in coarser sediments. It is associated with somewhat higher salinities. *A. vadorum* occurred in the stomach contents of eight fish species. It was of most importance in the diet of large (22-33 cm) winter flounder which contained an average of 3.4 individuals per fish. Fourspine stickleback had the greatest impact on the population. The organism was not encountered in fish stomachs collected from inlet, lagoon, or tide pool habitats. Highest relative utilization occurred in the bay during the spring months. Occurrence was most frequent in fish taken from stations T-12 and T-2.

Three *Ampelisca verrilli* were identified in the stomach contents of two winter flounder. Both fish were collected in the bay.

Ampeliscids comprise an important fish food source in the Little Egg Harbor estuary. They are consumed directly by the young of at least seven recreationally or commercially valuable fish species and contribute to the diet of forage species utilized by other desirable fishes. Baird (1873) documented their presence in the diets of scup taken from Great Egg Harbor, New Jersey and summer flounder collected at Woods Hole, Mass. As postulated by Durand and Nadeau (1972), the tube building activity of ampeliscids may also act to stabilize bottom sediments and contribute to the production of other benthic forms.

Family Ampithoidae: Two species, *Cymadusa compta* Smith and *Ampithoe longimana* Smith, were identified from the fish sample. *C. compta* dominated, occurring in the diet of 17 fish species. It was a major item in the stomach contents of the lined seahorse and the northern pipefish. The three species appear to be associated with eelgrass *(Zoestera)* beds. *C. compta* frequents salinities as low as 5 °/oo (Bousfield 1973). The stomachs of three seahorse specimens contained a total of 39 *C. compta*. Striped killifish, fourspine stickleback, and northern pipefish were the three major predators on this species in the study area. Odum and Heald (1972) identified *C. compta* as a food of juvenile fishes in Whitewater Bay, Florida. In Little Egg Harbor, rleative utilization of this species was highest during the winter and at inlet and bay stations. Only one specimen was recovered from fish samples collected in lagoon areas. None occurred in tide pool fish.

Ampithoe longimana occurred in the stomach contents of one silver perch and one winter flounder. Both fish were collected at bay stations. Bousfield notes *A. longimana* to be a species which favors higher salinities (to 22 $^{o}/_{oo}$) and which feeds on diatoms.

Family Aoridae: Some confusion exists over the genera included in this family. Bousfield includes *Unciola* and *Leptocheirus* while Gosner (1971) lists these with Families Corophiidae and Photidae, respectively. Data analyses for this paper, for consistency, followed Gosner's text which covers the whole

gamut of estuarine invertebrates. The reader should consider the different groupings, however, when reviewing the Appendices.

Microdeutopus gryllotalpa Costa occurred in the diet of 10 fish. It was of most importance, volumetrically, in the stomach contents of fourspine stickleback (3.2%) and striped killifish (4.3%). The stickleback had the greatest predation impact on the species followed by mummichog, spot, and striped killifish. Outside the study area *M. gryllotalpa* was tentatively identified as a diet item for young of the year striped bass in upper New York Bay (Festa 1975). Bousfield (1973) lists its western Atlantic range as Cape Cod to Chesapeake Bay. It is associated with vegetation stands and underwater structures. The species occurred in fish collected throughout the study area with the exception of tide pool specimens. It had a markedly higher percentage of occurrence at inlet stations but was also recovered from a brown bullhead collected in a low salinity area of Mill Creek. Observed utilization was confined to the summer and fall months.

The minute *Rudilemboides nageli* Bousfield was identified in the stomach contents of four winter flounder. This species, ranging from Cape Cod to Georgia is associated with eelgrass beds (Bousfield 1973). It occurred only at station S-10 (Figure 2) from an August collection.

At least one species of the genus *Lembos* Bate was collected from fish within the study area. Occurrence was observed in striped sea robins, tautog, and winter flounder. It was found during the summer months in all habitat areas except the tide pool.

Family Bateidae: *Batea catharinensis* Muller occurred in two winter flounder. The fish were collected from two bay stations, once in July and once in October. This species is generally associated with gravel bottoms.

Family Corophiidae: Sixteen fish species contained amphipods of this family. Including the genus *Unciola*, at least four species were represented in the fish stomachs examined. (As previously noted, Bousfield includes *Unciola* within Aoridae.) Small white perch (7-12 cm) utilized this group most extensively. Corophiids comprised 20.2% of the stomach content volume of two planehead filefish.

Members of the genus *Corophium* were the most frequently encountered component of the family. They occurred in bay anchovy, mummichog, northern pipefish, planehead filefish, silver perch, spot, tautog, white perch, weakfish, and winter flounder. These amphipods were not routinely identified to species level in the stomach analysis; however, more than one species occurred including *C. tuberculatum*.

Erichthonius rubricornis Smith and *Erichthonius brasiliensis* Dana were both identified in the fish diets. *E. rubricornis* was recovered from fourspine stickleback and *E. brasiliensis* from fourspine stickleback and striped killifish. Unspeciated members of this genus also were identified in silver perch, planehead filefish, tautog, and winter flounder. The genus occurred in summer and fall collections with highest occurrence in fish taken at inlet stations.

Unciola serrata Shoemaker was the only species identified in the genus *Unciola* although others probably occurred in the "unclassified" category. *U.*

serrata was found in the stomach contents of a winter flounder collected from Mill Creek. Unspeciated members of the genus occurred in pinfish and tautog. Observed utilization was limited to Mill Creek and bay habitats.

Cerapus tubularis Say was encountered in the stomachs of fourspine stickleback, lined seahorse, northern pipefish, northern puffer, spot, summer flounder, and winter flounder. It was not found in fish collected from tide pool, lagoon, or inlet stations. Utilization was documented only for the summer months.

Family Gammaridae: Members of the family Gammaridae comprised the most widely utilized group of amphipods in the study area. They were found in the stomach contents of 24 fish species, forming a substantial portion of the diet volume in cunner (34%), naked goby (24.9%), rainwater killifish (61.8%), and threespine stickleback (21.1%). The genera *Gammarus*, *Elasmopus*, *Casco*, *Melita*, and *Maera* were included within this family following Gosner. Bousfield, however, places the latter four in a new family Melitidae.

Genus Gammarus: A number of species exist within the study area; however, with the exception of *G. mucronatus* Say these in general could not be readily distinguished from the remains collected from the fish stomachs. *G. mucronatus* was the major diet item observed in the sample of nine rainwater killifish; it also comprised 6.9% of the diet volume of mummichog. In total, this species was identified in the stomach contents of nine fish species. Mummichog had the greatest predation impact. *G. mucronatus* appeared to be utilized heavily during the winter months. It was a major fish food item in the tide pool habitat and in fish collected from lagoon stations. It was not recovered from inlet areas. Bousfield (1973) described *G. mucronatus* as a dominant tide pool species found in salinities down to 4 $^{o}/_{oo}$. Given the extreme conditions of salinity and temperature often occurring in these pools, the species must be tolerant of a wide range of environmental conditions.

Other species of *Gammarus* occurred in 12 fish species. They represented 21% of the diet of banded killifish and were observed most frequently in fish collected from Mill Creek and lagoon stations.

Amphipods of the genus *Gammarus* have been documented in the diet of estuarine and marine fish at a number of sites outside the study area. Among others Baird (1873) found it in tomcod (*Microgadus tomcod*) from New Haven Harbor and in sea herring from Vineyard Sound; Dexter (1947) found it in killifish and cunner at Cape Ann, Massachusetts; and Festa (1975) observed it in striped bass, mummichog, and Atlantic silversides from Upper New York Bay.

Elasmopus leavis Smith: Bousfield notes that this species is often found intertidally under algae and stones and subtidally among eelgrass clumps. In the Little Egg Harbor study area, *E. leavis* was observed in the stomach contents of 11 fish species. The data indicate that it was of high importance in the diets of naked goby and young cunner. Spot had the greatest impact on the *E. leavis* population followed by fourspine stickleback. Highest percent occurrence was in fish collected during the summer from bay and inlet stations.

Genera *Casco*, *Melita*, and *Maera*: *Casco bigelowi* Blake was identified in the stomach of a single winter flounder collected in the bay during September. An unspeciated individual of the genus *Melita* was also recovered from a winter flounder collected in the bay. *Melita nitida* Smith occurred in the stomachs

of two winter flounder collected from Raritan Bay, New Jersey (Festa 1975). Odum and Heald (1972) in a study of Florida mangrove communities, found this species to be the most common in their benthic samples, but the least common of the major amphipod components found in fish stomachs. *Maera danae* Stimpson occurred in the stomachs of pinfish, tautog, and winter flounder collected at two bay stations and one inlet station.

Families Lysianassidae, Hyalidae and Oedicerotidae: Two individuals belonging to the family Lysianassidae occurred in the stomachs of two black sea bass collected from Mill Creek in June. A single unspeciated member of the family Hyalidae was recovered from a spotted hake stomach. The fish was taken in the bay during June. *Monoculodes edwardsi* Holmes, a member of the family Oedicerotidae, was identified in the stomach contents of northern sea robin and white perch. It occurred in bay, Mill Creek, and lagoon collections, twice in May and once in January.

Family Photidae: *Leptocheirus plumulosus* Schoemaker, which Bousfield (1973) includes in the family Aoridae, was the major species encountered. *Microprotopus raneyi* Wigley was the other species identified. *L. plumulosus* was a dominant food item in the diet of 7 to 12 cm white perch. It also formed a significant portion of the stomach content volume in banded killifish and blueback herring. These three fish were the major predators on the species. Bousfield described the species as a brackish water, tube-dwelling amphipod. Its utilization by the white perch population apparently decreases as fish size increases. Fish 7 to 12 cm contained an average of 15.7 *L. plumulosus* in their stomachs; the 14 to 26 cm sample had 5.3. The amphipod did not occur in the seven 29 to 37 cm fish examined. Its occurrence was markedly associated with fish collected in the lower salinity areas of Mill Creek. It was found throughout the year. In total, *L. plumulosus* was identified in the stomach contents of 13 fish species.

Micropterus raneyi was found in the stomach contents of nine winter flounder, seven of which were collected at bay stations. This species was utilized primarily during the summer months by young of the year flounder.

Family Phoxocephalidae: *Paraphoxus spinosus* Holmes was the only family member identified. One individual was collected from a winter flounder stomach.

Family Talitridae: Six individuals, identified as *Orchestia platensis* Kroyer, were collected from the stomachs of one Atlantic silversides and one white perch. Both fish were collected in lagoons connecting to Mill Creek (S-18, T-17). Dexter (1947) identified this species as a food source of cunner and killifish at Cape Ann, Massachusetts.

Family Stenothoidae: Two species, *Stenothoe minuta* Holmes, and *Parametopella cypris* Holmes, were identified in the fish stomachs examined. *S. minuta* occurred in northern pipefish, silver perch, and winter flounder. *P. cypris* was collected from northern puffer, striped sea robin, and a 6 cm weakfish. Bousfield (1973) notes that both of these species are associated with hydroid and ectoproct colonies. These are small forms; both reach approximately 2 mm in length.

Summary: The suborder Gammaridea clearly represents a major food resource for finfish utilizing the Little Egg Harbor area. Sufficient documentation exists to conclude the suborder provides an important estuarine food source for fish along most of the Western Atlantic coast. The diversity of the component families and genera is such that all of the various benthic niches encountered in the study area appear to contain a representative member.

A number of specific gammarid-fish food coactions were apparent. *Ampelisca abdita* was heavily utilized by winter flounder. *Gammarus mucronatus* was associated with tide pool fishes, particularly rainwater killifish and mummichog. *Cymadusa compta* was a major food of northern pipefish and seahorses, both known to frequent eelgrass beds. *Leptocheirus plumulosus* was strongly associated with the low salinity areas of Mill Creek and was a staple for young white perch. The gammarids as a whole were more heavily utilized by resident fishes than by migratory species. Competition (among the fishes) for the gammarid food resource is no doubt reduced by the various species-specific relationships observed.

Suborder Caprellidea: Caprellids occurred in the stomach contents of cunner, fourspine stickleback, northern pipefish, planehead filefish, and striped killifish. They contributed 7% of the content volume recovered from the four cunner specimens and 1.4% of the northern pipefish contents. Percent occurrence was highest in inlet collected fish and the suborder was only recovered from specimens collected during the summer months.

Order Mysidacea: In the transfer of energy from phototroph to fish, the mysid population of Little Egg Harbor can be thought of as a master gear. Occurring in the diet of 24 fish species, mysids accounted for more than 20% of the stomach content volume in alewife, bay anchovy, crevalle jack, both sticklebacks, pipefish, silver perch, 4-7 cm striped sea robin, 14-37 cm white perch, and 5-17 cm weakfish. In an additional seven species, mysids contributed over 10% of the diet volume. Relative to the estuary's nursery function, mysids can be considered as a major "starter food" for summer flounder, alewife, weakfish, and winter flounder. The white perch population, which represents the most important resident finfish species in terms of angler use, is dependent upon a mysid food source. Mysids also contribute significantly to the diet of forage species utilized by the piscivorous components of the food web.

Outside the study area there are numerous references on the importance of mysid shrimp in estuarine trophic structures. Odum and Heald (1972) observed that they are an important source of food for many fishes in the North River, Florida estuary. Van Engel and Joseph (1968) characterized *Neomysis americana* as one of the two most important fish food sources in the Upper York River. In his 1873 report, Baird notes the occurrence of mysids in the stomach content of summer flounder taken at Great Egg Harbor, New Jersey.

Two species were identified in the present study: *Neomysis americana* and *Mysidopsis bigelowi*. *Neomysis* was clearly the dominant form, being identified in 23 species. This was the major diet constituent of 6-13 cm alewife (99.5% volume), northern pipefish (58.6%), threespine stickleback (56.5%), and 5-10 cm weakfish (41.4% volume). Atlantic silversides and bay anchovy were the major predators on *N. americana* (Figure 8). *Mysidopsis bigelowi* was identified in the stomachs of nine fish species. With the exception of the three striped sea robins examined, it contributed only a minor fraction of the mysid component.

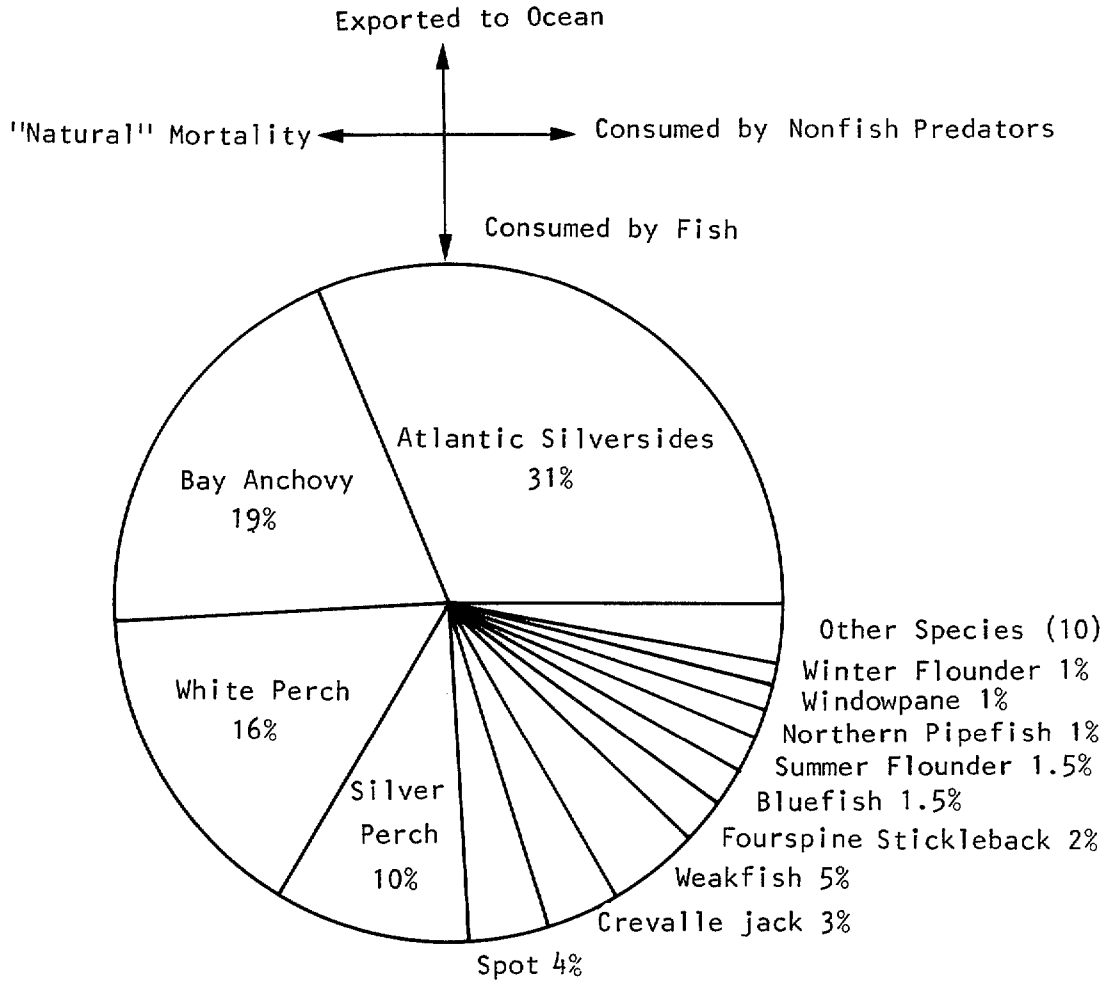

Fig. 8. Fate of *Neomysis americana* in the Little Egg Harbor estuary.

Neomysis occurred in 18.4% of the total fish sample and *Mysidopsis* in 1.5%. The two species were found together in a number of stomachs. Utilization of *N. americana* was relatively higher in fish collected from tidal creek stations, followed by fish collected in lagoon, bay, and Mill Creek specimens. The

sequence for *Mysidopsis* was bay, lagoon, tidal creek, and Mill Creek specimens. This species did not occur in fish taken from inlet stations. Neither species occurred in the tide pool fishes. The temporal distribution of occurrences indicated somewhat higher utilization of *Neomysis* during winter and spring months. The occurrence of *Mysidopsis* was markedly higher during the fall. Hopkins (1958) observed that *Mysidopsis* populations in Indian River Inlet appear to peak in late fall and winter.

Neomysis americana also occurred in the stomachs of young striped bass and northern pipefish collected at Caven Point, Upper New York Bay, and in winter flounder, bay anchovy, crevelle jack, and spot taken at Conaskonk Point, Raritan Bay.

Order Decapoda: Decapods represented a major food source for the medium and larger sized fish in the estuary. Four infraorders are involved: Penaeidae, Caridea, Anomura, and Brachyura.

Infraorder Penaeidae: One large shrimp of the genus *Penaeus* occurred in the stomach of a summer flounder taken at bay station S-2 in August. This genus was rarely encountered in the trawl collections of McClain and appeared to be of little importance as a fish food in the estuary.

Infraorder Caridea: Larval forms of Caridean shrimp comprised 17.5% of the diet volume of 7-15 cm blueback herring and 3.6% of the volume collected from 6-10 cm bluefish. They were of nominal importance in another eight fish species. Occurrence in the fish stomachs during the study was observed on dates between 22 April and 18 August. A blueback herring collected at lagoon station G20 contained an estimated 500 larvae. The relative occurrence of Caridean larvae in the fish stomachs was highest during spring and in lagoon and bay station samples. Larvae were not recovered from tide pool fish.

Grass shrimp of the genus *Palaemonetes* occurred in the diets of 16 fishes. This group comprised a dominant food item in 6-10 cm bluefish and 22-33 cm winter flounder. It made up 60.5% of the stomach contents of the three pinfish examined, 16.2% of the black sea bass diet, 16.8% of the silver perch diet, 33.8% in spotted hake, and 16.5% in 6-24 cm summer flounder. Two species represented were *P. vulgaris* and *P. pugio*. A third, *P. intermedius*, was tentatively identified.

Palaemonetes vulgaris occurred in 2.8% of the total fish sample. Found in the stomach contents of 13 species, this was the dominant component of the genus. Utilization of both species was relatively higher during the winter and fall months. Occurrences of *P. vulgaris* were most frequent in bay fish. *P. pugio* was more common in specimens collected at the inlet. None were taken from tide pool fish. The species were found concurrently in the stomachs of some fish. *P. pugio* occurred in a total of nine species representing 15% of the diet volume in spotted hake. This species dominates in many of the estuaries of northern New Jersey and was identified in the stomachs of striped bass, mummichog, and spot collected in a tributary of the Hackensack River.

A single shrimp of the genus *Hippolyte* was identified from the stomach contents of a weakfish taken at bay station T-2 in August 1974.

As a species *Crangon septemspinosa* is the most widely utilized fish food organism in the estuary. Occurring in 26 of the fish species studied, *C. septemspinosa* represented 6.5% of the total volume of material recovered from the fish sample. This shrimp was the dominant food item in the samples of northern sea robin, northern kingfish, silver perch, spotted hake, 6-24 cm summer flounder, large white perch, and windowpane flounder. It contributed significantly to the diets of Atlantic silversides, sea bass, crevalle jack, seahorse, mummichog, red hake, and weakfish. The top three predators on the *Crangon* population were silver perch, Atlantic silversides, and white perch (Figure 9). Percent occurrence of this species was greatest in inlet collected fish but utilization was high throughout the estuary, with the exception of the tide pool station. It occurred in a somewhat larger proportion of fish taken during the fall and summer months. Again, using Baird as a historical reference, *Crangon* was documented as a food source for striped bass, white perch, kingfish, weakfish, toadfish, summer flounder, and hickory shad at Great Egg Harbor in 1872. In other cursory analyses conducted during the study, *Crangon* was found in the stomachs of striped bass, Atlantic tomcod, and mummichog in Upper New York Bay; in crevalle jack and mummichog from Raritan Bay; and in white perch and striped bass from Oyster Creek, a tributary of neighboring Barnegat Bay. In the York River (Va.), Van Engel and Joseph (1968) found that *C. septemspinosa* comprised 25.2% of the diet volume of white perch, 12.2% of juvenile weakfish, 7.3% of the black drum diet, and 44.0% of the southern kingfish contents. *Crangon septemspinosa* was also identified in the diet of winter flounder utilizing Long Island bays (Kurtz 1975).

The species clearly represents a major forage item throughout most of New Jersey's estuaries and deserves closer attention from ecologists in defining its environment requirements and its tolerances to various forms of pollution.

Infraorder Anomura: Hermit crabs of the genus *Pagurus* occurred in the stomach contents of black sea bass, striped burrfish, and summer flounder. Burrfish were calculated to be the major predators on this genus. *P. longicarpus* was the only species identified.

Infraorder Brachyura: Larval forms of Brachyura occurred in the stomach contents of 12 fish species. On a percent volume basis they were of most importance to Atlantic silversides and 3-16 cm Atlantic needlefish, representing 3.1% and 4.9% of their respective diets. Larvae were found in the fish stomachs from the second week of June through the end of September. High numbers were encountered on 26 June, 9 July, and 19 July in 1974. The percentage of occurrence was highest in fish collected from the inlet and bay stations. Larvae were not recovered from fish taken at the tide pool station.

Adult crabs were of particular importance to the larger bottom-feeding fishes in the estuary. Occurring in 18 species, brachyuran crabs accounted for over 20% of the diet volume in American eel, black sea bass, oyster toadfish, smooth dogfish, striped burrfish, and tautog. They also contributed significantly to the diets of bluefish, bullhead, and summer flounder.

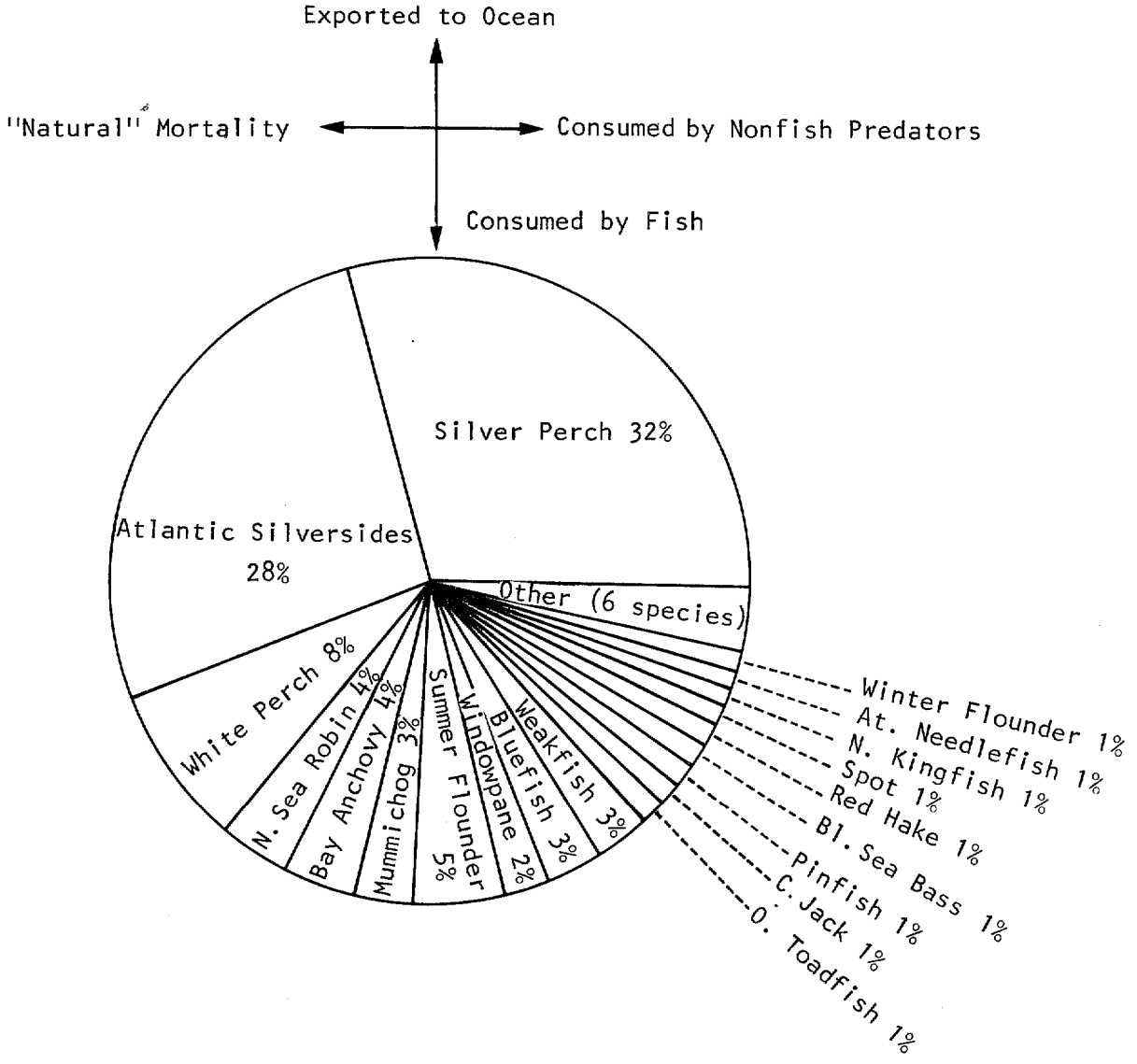

Fig. 9. Fate of *Crangon septemspinosa* in the Little Egg Harbor estuary.

The lady or calico crab, *Ovalipes ocellatus*, was identified in the stomach contents of sea bass and tautog, comprising 15.7% and 12.6% of their respective diet volumes. Five individuals were recovered, all from fish taken at bay collections during September.

Blue claw crabs, *Callinectes sapidus*, represented over 90% of the stomach content volumes of American eel and smooth dogfish and 83.2% of the contents of the two striped burrfish examined. This species accounted for over 10% of the diet volume in 21-36 cm bluefish, brown bullhead, 18-28 cm toadfish, and 26-65 cm summer flounder. Remains of both soft and hardshell stages were encountered with smaller instars representing most of the hardshell occurrences. One *C. sapidus* was found in the stomach of a winter flounder collected on 27 February 1974. Other occurrences were limited to the period from the second week of June through the first week of November. Relative utilization was highest in fish collected from tidal creek and Mill Creek stations.

Of the 12 fish species which consumed blue claw crabs, American eels, and dogfish appear to have had the greatest predation impact on the crab population during the study period. A total of 51 blue claw crabs were identified in the fish stomachs examined. Smooth dogfish contained an average of 1.33 crabs per fish. If this were considered to be a minimum daily ration from June through September, 160 crabs would be consumed by each dogfish in the estuary.

Mud crabs of the family Xanthidea occurred in 15 fish species, being of special importance to the smaller oyster toadfish and 20-32 cm tautog. They comprised 26% of the stomach contents of black sea bass and 21% of the smaller tautog contents. Three species of xanthid crabs were identified. *Neopanope texanna* appeared in the widest variety of fish species (11) followed by *Rhithropanopeus harrisii* (8) and *Eurypanopeus depressus* (3).

Neopanope was the major xanthid component in the tautog diet, *Rhithropanopeus* in the toadfish. A large portion of the xanthid remains found in the fish stomachs could not be identified to the species level. With one exception, mud crab occurrence in the fish diets were confined to the period from 21 March through 14 November. The remains of one unidentified specimen were recovered from the stomach of a stickleback collected on 6 January 1974. Xanthids occurred in fish collected from all habitats except the tide pool.

Phylum Chordata

CLASS ASCIDIACEA -- Two tunicates of the family Molgulidae were recovered from the stomach contents of two winter flounder. Both fish were collected in March 1974, one each from bay stations T-2 and T-12.

CLASS OSTEICHTHYES -- Fish eggs appeared in the diet of 11 fish species. On a seasonal basis, they comprised a significant portion of the food intake of Atlantic silversides, striped killifish, and 7-12 cm white perch. The white perch fed heavily on fish eggs in upper Mill Creek during the months of April and May. It is assumed that these were clupeid eggs. The occurrences in Atlantic silversides and striped killifish were associated with July collections at inlet stations. Overall, fish eggs were observed in fish stomachs from the second week of March through the third week of July. In the plankton-feeding anchovies the occurrence of fish eggs was confined to the 21 May through 26 June period during the study years.

Fish larvae occurred in a number of fish stomachs but at a much lower frequency than expected. Eight *Fundulus* larvae were recovered from the stomach of one tidewater silversides; *Menidia* larvae occurred in the Atlantic needlefish sample; other larval remains were not identifiable. Because of their relativity

low occurrence and the problem of categorizing fish remains as larvae, young, etc., the larval forms were lumped with the "Class Osteichthyes, except eggs" category for data analysis purposes.

As with the polychaete component, a large portion of the fish remains recovered from the sampled stomachs could not be speciated. A portion of these remains consisted solely of backbones and in some cases only a few vertebrae. Even so, 15 taxa were identified in the stomach contents, 10 to the species level. Fish contributed to the diet of 25 fish species. On the basis of diet volume and percent occurrence, the following fishes and size groups were considered to be piscivorous within the Little Egg estuary: 24-58 cm Atlantic needlefish, 11-36 cm bluefish, inshore lizardfish, northern sennet, redfin pickerel, striped bass, 26-65 cm summer flounder, and 35-62 cm weakfish. In addition, fishes comprised over 50% of the diet volume of brown bullhead, crevalle jack, 18-28 cm oyster toadfish, red hake, and 11-17 cm weakfish.

Cannibalism was confirmed only in Atlantic needlefish and mummichog. The second largest mummichog in the sample contained another surprisingly large mummichog in its stomach. This was the only occurrence of fish in the stomach contents of the 34 mummichogs examined. This occurrence, however, accounted for 50% of the total stomach content volume recovered from the species. This case exemplifies the need for considering both percent volume and percent occurrence data.

A total of 335 fish were recovered from the 1,340 fish stomachs examined. Of these, 185 (55%) could be identified beyond the class level. Table 4 gives proportions of the various taxonomic groups in the fish stomachs and in the fish survey conducted by McClain (1977). It assumed that the identified components of the recovered fish remains are representative of the unclassified component.

Table 4. Proportions of the taxonomic groups in the fish stomachs and in the fish survey.

Taxon	Proportion of fish in stomachs	Proportion of fish in survey sample
Silversides (2 species)	.17	.32
Anchovies	.23	.27
Fourspine stickleback	.11	.15
Atlantic menhaden	.03	.02
Bothidae (Lefthanded flatfish)	.01	< .01
Silver perch	.02	.01
Weakfish	.02	< .01
Spot	.04	.05
Killifish (*Fundulus* spp.)	.15	.10
Naked goby	.06	.01
Sea robin (*Prionotus* spp.)	.01	< .01
Winter flounder	.01	.01
Atlantic needlefish	.01	.01
Northern pipefish	.01	.01
	Correlation coefficient = .915	

There is a good degree of correlation in the two sets of proportions. As noted earlier, most of the striped bass analysed were taken by hook and line. All but one of the American sand lance recovered from the fish stomachs occurred in these bass so a comparison of proportions for this species is not appropriate.

There did seem to be a disproportionately high utilization of naked goby, primarily by winter flounder and black sea bass. Ivlev's (1961) electivity index could be applied to these data, however, with the number of variables involved (species, habitat, gear type, etc.) any interpretation beyond the general relationship suggested in Table 1 would be rather meaningless.

Silversides (Family *Atherinidae*) were identified in the stomach contents of five species. *Menidia menidia* Linnaeus and *Menidia beryllina* Cope were common in McClain's collections. A third species, the rough silversides, *Membras martinica* Goode and Bean has been recorded in neighboring estuaries.

Silversides occurred in the stomachs during the summer and fall months. They comprised 71.9% of the diet volume of the larger needlefish, 44.1% of the northern sennet stomach contents, and 10.1% of the 11-20 cm bluefish diet volume.

Anchovies also were identified in the diets of five fish species and were particularly important, volumetrically, in the stomach content volume of brown bullhead taken in upper Mill Creek. Two fish collected on 9 August 1974 contained a total of nine anchovies. This occurrence is interesting in that it is difficult to imagine bullheads actively pursuing the pelagic anchovy unless the prey were disabled or trapped. In any case, the examination of a larger sample of bullhead will be necessary before conclusions on this relationship can be formulated. Crevalle jack and bluefish apparently had the greatest predation impact on anchovy during the study period. Occurrence of this forage species in the fish stomachs was confined to the June through October period. McClain (1977) identified two species in the study area, *Anchoa mitchilli* and *A. hepsetus* with the former dominating.

Fourspine stickleback (*Apeltes quadracus*) were identified in the stomach contents of six fish species in the study area. Oyster toadfish in the 18-28 cm size range had the highest calculated predation index. The species comprised 26% of the stomach content volume of 5-16 cm needlefish. Summer flounder in the 26-65 cm range averaged 0.38 sticklebacks per fish and were the third most important predator species on the fourspine stickleback population. All but two of the 20 sticklebacks recovered from the fish stomachs were found in specimens collected in the bay. One stickleback occurred in the stomach of a white perch taken at lagoon station G-17 in January. The other exception was recovered from a summer flounder taken at a tidal creek station.

Occurrences of American sand lance (*Ammodytes americanus*) were limited to striped bass and windowpane specimens at the inlet site. All three species were associated with the higher salinity inlet sections of the study area. Sand lance comprised 30% of the stomach content volume of the striped bass sample. It is commonly postulated that bass follow schools of sand lance on their excursions into inlet areas from the ocean.

Menhaden (*Brevoortia tyrannus*) were identified in the stomach contents of bluefish and red hake. Occurrences were limited to fish taken at lagoon and tidal creek stations. The opportunity for trapping the menhaden in these habitats may function to increase utilization at these stations. This species represented the largest fish component in the 21-36 cm bluefish diet.

As a side note, during January 1974 a high mortality of menhaden occurred in Oyster Creek, a tributary of neighboring Barnegat Bay. Oyster Creek receives the heated effluent from a nuclear generating station and the fish kill occurred after a plant shutdown. Twelve live striped bass in the 30-44 cm size range were captured by trawl during the ensuing investigation. These bass were gorged with menhaden in the 6-12 cm size range. A total of 38 menhaden were recovered from the 12 stomachs.

Two flatfish of the family Bothidae were recovered from the stomach of a striped bass collected in Little Egg Inlet in November. Three silver perch (*Bairdiella chrysura*) occurred in the stomach contents of a 30 cm summer flounder taken at bay station T-11 in October. Young of the year weakfish (*Cynoscion regalis*) occurred in the stomachs of bluefish, one smooth dogfish, and one striped bass. The bluefish and dogfish were collected during August at bay and tidal creek stations. The bass was taken in the inlet in October. Young spot occurred in the stomachs of bluefish and oyster toadfish. Spot comprised 54% of the total stomach contents collected from 18-28 cm toadfish.

Killifish of the genus *Fundulus* were identified in the diets of four fish species including *F. heteroclitus* (mummichog). Killifish appeared to be a staple of the young bluefish frequenting Mill Creek, lagoon, and tidal creek stations. Of 28 killifish recovered from the stomachs, only one occurred in a bay collected fish, and none in inlet collections. Eight *Fundulus* larvae were observed in the stomach contents of a tidewater silversides which resulted in the silversides having the highest predation index on the genus. One killifish was recovered from each of two white perch collected at lagoon stations during November and January.

Gobiosoma bosci, the naked goby, occurred in four fish species. Winter flounder and black sea bass were the major predators on this small bottom dweller, which was also consumed by bluefish and white perch.

The remains of two sea robins (*Prionotus*) were recovered from the stomachs of two summer flounder collected in August. One fish was taken in the bay, the other in a tidal creek. The bay collected flounder was 65 cm in length and was the largest summer flounder examined. Two young of the year winter flounder (*Pseudopleuronectes americanus*) were also found in the stomach contents of a summer flounder. The fish was 35 cm in length and was collected in the bay during July.

The only occurrences of Atlantic needlefish (*Strongylura marina*) observed were in the stomach contents of other needlefish. The consumers were 8 and 7 cm long; the "consumees" were 3.2 and 4.3 cm long.

Northern pipefish, *Syngnathus fuscus*, were found in the stomachs of one American eel and one summer flounder. The fish were taken at Mill Creek and bay stations during June and July. Baird noted the occurrence of pipefish in the stomachs of Oyster toadfish taken in Great Egg Harbor Bay in 1872, and area

fishermen have reported their occurrence in the stomachs of striped bass taken in Little Egg Harbor Inlet.

OBSERVATIONS ON THE DIETS OF FISH SPECIES UTILIZING THE LITTLE EGG HARBOR ESTUARY

The data collected do not lend themselves to a detailed analysis of food habits for all of the 55 fish species in the survey. Because of species scarcity in the system or the limits of the study scope, sample sizes were too small to consider all of the size, spatial, and temporal variations affecting diets. The sample sizes were selected with emphasis on numerically dominant species and species of direct management concern to the recreational fishery. Appendix B lists the various taxa recovered from the stomachs of each fish species and provides percent volume, percent occurrence, and average content (individuals per fish) data.

In this section, the sample will be considered on the "whole system" basis with reference to fish size groups where data permits. In this sense, the data presented in Appendix B reflect the "average" stomach contents of fish collected throughout the system, throughout the year. The following discussions highlight the findings presented in Appendix B. The appendix should be consulted for a complete picture of diet diversities and identified components. The degree of confidence associated with these findings is a function of sample size and this should be taken into account when referencing these data.

Alewife, *Alosa pseudoharengus*

The stomach contents of 11 alewives contained a minimum of nine invertebrate taxa. Six fish in the 6-13 cm size range fed heavily on *Neomysis americana* while the diet of five fish in the 27-34 cm size range was dominated by calanoid copepods. Calanoids appeared in only one of the smaller fish. This suggests that the younger fish pursue individual prey items while the adults, to a larger degree, filter feed on the zooplankton. The larger fish contained an average of over 2,000 calanoids in their stomachs.

American eel, *Anguilla rostrata*

Blue claw crab (*Callinectes sapidus*) remains dominated in the stomach contents recovered from 10 eel specimens. Occurring in four fish, the crabs accounted for 90% of the content volume recovered. Xanthid crabs comprised the second most important diet group in terms of volume and occurrence. The remains of a pipefish were found in the stomach of one eel.

American sand lance, *Ammodytes americanus*

Calanoid copepods were the only organisms present in the stomach contents of the four sand lance specimens examined. These fish contained an average of 524 copepods in their stomachs.

Atlantic menhaden, *Brevoortia tyrannus*

Due to a thorough mixing of fine algae, detritus, and sediment components in the stomachs, volumetric data could not be obtained for menhaden with the methods employed in the study. On the basis of subjective observations and

occurrence data it was clear that algal matter comprised the major diet component in all three size groups examined. Calanoid copepods were second in terms of occurrence but probably ranked lower than the sediment component in total content volume. Smaller fish (4-8 cm) had more diverse diets than the larger specimens. The ingestion of harpacticoid copepods, polychaete larvae, and turbellarians was markedly higher in the smaller size group.

Atlantic needlefish, *Strongylura marina*

Fish and adult insect forms were the major diet constituents for both size groups examined. Insects, predominently Dipteran midges and winged ants, were relatively more important in the stomach contents of the smaller fish (5-16 cm). Silversides, fourpsine stickleback, and needlefish were recovered from the larger sample. This was one of two species for which cannibalism was confirmed.

Atlantic silversides, *Menidia menidia*

The diet of Atlantic silversides was very diverse. At least 21 taxa occurred in the stomachs of the 85 specimens examined. Items of greater importance, in terms of both volume and occurrence, included calanoid copepods, ampeliscid amphipods, *Neomysis americana*, and fish eggs.

Banded killifish, *Fundulus diaphanus*

Amphipods dominated the stomach contents recovered from 18 specimens. *Leptocheirus plumulosus* was a major component. Algae, polychaetes, and the isopod *Cyathura polita* were also of importance in the stomachs examined.

Bay anchovy, *Anchoa mitchilli*

While at least 22 taxa were present in the diet of bay anchovies, calanoid copepods and mysid shrimp clearly formed the major forage base for this species during the study period. Together, Calanoida and *Neomysis americana* formed over 84% of the stomach content volume recorded from 101 specimens. Amphipods, primarily ampeliscids, were of tertiary importance.

Black sea bass, *Centropristes striatus*

Brachyuran crabs dominated the diet of the 17 specimens examined. Component taxa included *Ovalipes, Callinectes,* and Xanthidea. Caridean shrimp were of secondary importance, forming 28% of the diet volume.

Blueback herring, *Alosa aestivalis*

Calanoid copepods, mysid shrimp, *Leptocheirus plumulosus*, and Caridean larvae were the major stomach content components in 13 specimens ranging in length from 7 to 15 cm. Copepods formed the dominant food item, representing 48.5% of the diet volume and occurring in all of the fish examined. The stomachs contained an average of 973 copepods.

Bluefish, *Pomatomus saltatrix*

The sample of 97 bluefish was divided into three size groups. Fish in the 6-10 cm length range fed primarily on grass shrimp (*Palaemonetes*), errant poly-

polychaete forms (*Nereis* and *Nephtys*), and fish. Silversides were the only fish prey identified in the fish remains observed.

The 11-20 cm group was essentially piscivorous with fish comprising 82% of the diet volume recovered from 62 specimens (Figure 10). Killifish (*Fundulus*) and silversides (Family Atherinidae) were the dominant forage species in terms of volumes consumed. Anchovies, while third in terms of volume, occurred most frequently in the stomachs. Other fish identified in the stomachs of this group were fourspine stickleback, Atlantic menhaden, weakfish, spot, and naked goby. Grass shrimp were of less importance than sand shrimp (*Crangon*) in this group.

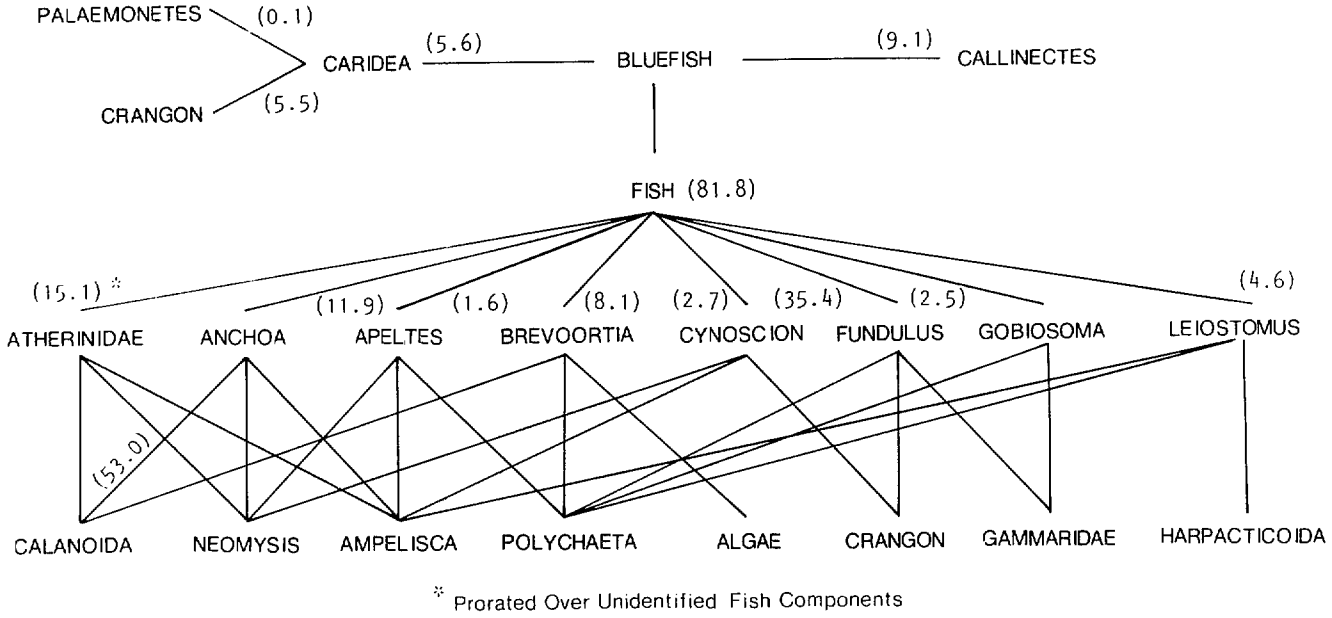

Fig. 10. A portion of the food web involving 11-20 cm bluefish.

Bluefish (21-36 cm) relied almost entirely on a diet of fish and crabs. Fish comprised 86% of the stomach contents recovered from 19 specimens and occurred in 84% of that sample. Menhaden and killifish were the major forage species identified. Blue claw crab (*Callinectes*) remains occurred in two stomachs contributing 12% of the total sample volume. *Crangon septemspinosa* occurred in 32% of the specimens but comprised only 2% of the total stomach contents volume.

Brown bullhead, *Ictalurus nebulosus*

Although essentially a freshwater species, bullheads frequented the upper areas of Mill Creek and were taken in bottom salinities to 11.7°/oo. Fish and polychaetes were the major groups recovered from the stomachs of five specimens. Anchovies formed 60% of the volume of the stomach contents collected. *Callinectes* remains contributed 13.2% of the volume and polychaetes, including *Nereis*, *Spionidae*, and *Capitellidae*, contributed 16%.

Crevalle jack, *Caranx hippos*

Nine specimens in the 4-13 cm size range contained mysid shrimp, *Crangon septemspinosa*, and fish remains. Anchovies comprised the largest volume percentage in the stomach contents; *Neomysis americana* occurred most frequently and contributed 30% of the total content volume.

Cunner, *Tautogolabrus adspersus*

Gammarids, particularly *Ampelisca abdita* and *Elasmopus leavis*, were the major diet constituents of four young of the year specimens. The isopod *Edotea triloba* was third in terms of content volume and occurred in two of the specimens.

Fourspine stickleback, *Apeltes quadracus*

The stomach contents of 76 specimens contained a minimum of 29 forage taxa. Among the more important food items in terms of relative volumes consumed and occurrence in the sample were calanoid copepods and *Neomysis americana*. These two items comprised 38% of the diet volume. Six gammarid species were identified in the contents and the suborder, as a group, contributed 34% of the recovered food volume. Various molluscs, polychaetes, and isopods also occurred in the stickleback diet.

Golden shiner, *Notemigonus crysoleucas*

Calanoid copepods and unidentified polychaete remains were the major content items identified in the stomachs of three specimens. Unclassified material consisting of hard, "seed-like" objects comprised 55% of the stomach contents.

Gray snapper, *Lutjanus grissus*

Two specimens contained a polychaete of the family Maldanidae, one calanoid copepod, pelecypod remains, an isopod, and one fish egg.

Hogchoker, *Trinectes maculatus*

Polychaetes dominated the stomach contents of seven specimens. *Nereis* sp. was the only component identified. Chironimidae larvae occurred in three fish and were second in terms of volume of identified material.

Inshore lizardfish, *Synodus foetens*

Unidentified fish remains were the only items recovered from the stomachs of two specimens.

Lined seahorse, *Hippocampus erectus*

Cymadusa compta was the major food item recovered from the three specimens. *Ampelisca abdita* and small *Crangon* were of secondary importance in terms of volume. This was one of five species which contained the remains of mussels (family Mytilidae). Seahorse prey items were surprisingly large considering the morphology of the seahorse mouth.

Mummichog, *Fundulus heteroclitus*

Seventeen taxa were identified in 34 specimens. Another mummichog, 4.1 cm in length, occurred in the stomach of the second largest specimen (10 cm) and accounted for 50% of the total volume recovered from the species. More frequent diet components were *Gammarus mucronatus*, polychaetes, and algae. Larger individuals are apparently quite aggressive, taking shrimp as well as other fish.

Naked goby, *Gobiosoma bosci*

Gammarids, particularly *Elasmopus leavis* and polychaetes, including Phyllodocidae and Capitellidae were the major components in the stomachs of eight specimens.

Northern kingfish, *Menticirrhus saxatilis*

Crangon septemspinosa was the dominant item in the stomach contents of two specimens. Also identified were polychaetes of the family Capitellidae and *Glycera americana*.

Northern pipefish, *Syngnathus fuscus*

Neomysis americana and *Cymadusa compta* comprised over 90% of the stomach contents volume of 21 specimens. Calanoid copepods occurred frequently as did ampeliscids and turbellarians. A total of 16 taxa were identified in the diet sample.

Northern puffer, *Sphoeroides maculatus*

Three young "blowfish" contained at least 12 different food items of which gastropods of the genus *Crepidula* predominated. The specimens contained the remains of 24 *Crepidula* in total. Isopods, particularly *Erichsonella*, were of secondary importance.

Northern sea robin, *Prionotus carolinus*

Crangon septemspinosa dominated the stomach contents of four specimens. It comprised 80% of the recovered volume and occurred in all four fish.

Northern sennet, *Sphyraena borealis*

This is a piscivorous species. Fish remains comprised 95% of the diet volume of seven specimens. Silversides was the only forage species identified. Mysids occurred in the smallest (10 cm) specimens.

Oyster toadfish, *Opsanus tau*

Two size groups were analysed; 4-13 cm and 18-28 cm fish. The smaller toadfish fed primarily on polychaetes, particularly *Nereis*, and on isopods and xanthid crabs. *Idotea* was the major isopod component. *Crangon septemspinosa* occurred in 20% of the sample (3 fish) and comprised 10% of the content volume recovered from this group. The diet volume of the larger size group was dominated by fish remains of which spot were the major component. *Callinectes sapidus* occurred in two of the 15 specimens and contributed 12.4% of the total stomach volume. Isopods were of lesser importance volumetrically to the larger fish but were consumed at a higher rate (2.53 per fish).

The larger fish also consumed quantities of eelgrass, possibly ingested during the capture of crabs. A number of large nematodes were also found enmeshed with the stomach contents of five specimens.

Permit, *Trachionotus falcatus*

One specimen was examined. Its stomach contained the remains of 15 *Crepidula* and one *Mitrella lunata*.

Pinfish, *Lagodon rhomboides*

The stomach contents of three pinfish in the 6-11 cm length range contained *Crangon*, *Palaemonetes*, and a variety of gammarids. The shrimp comprised 94% of the diet volume.

Planehead filefish, *Monacanthus hispidus*

A 5 cm and a 13 cm specimen contained algae, hydrozoa, unidentified pelecypod remains, Corophiidae amphipods, and caprellid amphipods. Algae and hydroids contributed 60% of the content volume, suggesting a grazing feeding mode for the species.

Pumpkinseed, *Lepomis gibbosus*

Two specimens collected from upper Mill Creek had fed primarily on polychaetes, particularly *Hypaniola* and *Nereis*. Gammarids including *Leptocheirus plumulosus* were of secondary importance.

Rainwater killifish, *Lucania parva*

The diet of nine specimens was dominated by *Gammarus mucronatus*, which contributed 62% of the total stomach content volume and occurred in six of the fish. The remaining contents included *Nereis*, Copepoda, and Mysidacea.

Redfin pickerel, *Esox americanus americanus*

The remains of an unidentified fish were recovered from the stomach of a 26 cm specimen collected in Mill Creek.

Scup, *Stenotomus chrysops*

The stomach contents of a single 14 cm scup contained six invertebrate taxa and the remains of an unidentified fish. Three polychaetes of the family Maldanidae contributed approximately 38% of the content volume. The fish remains comprised 22.5% of the volume.

Sheepshead minnow, *Cyprinodon variegatus*

The stomach contents of 29 specimens could not be partitioned volumetrically because of the mixture of sediment, algae, and detritus components occurring in a number of fish. Algae, including diatoms and filimentous forms, appeared to form the bulk of the ingested material. Less important forage items included copepods, hydroid stolens, and Chironimidae larvae. The diet indicates that the species obtain its food primarily by grazing the substrate.

Silver perch, *Bairdiella chrysura*

This is apparently quite an agressive species, feeding mainly upon mysid and Caridean shrimp. Twenty-six specimens in the 3-12 cm size range contained a total of 56 sand and grass shrimp. *Crangon septemspinosa* was the dominant form. Fish remains occurred in the stomachs of four specimens. Seventeen forage taxa were identified in the sample.

Smooth dogfish, *Mustelus canis*

Blue claw crabs, *Callinectes sapidus*, occurred in the stomachs of 10 of the 12 dogfish examined. The crabs constituted over 90% of the diet volume. Fish remains were observed in two specimens and these included a young of the year weakfish.

Spot, *Leiostomus xanthurus*

Spot had a very diverse diet with a minimum of 32 forage taxa occurring in the sample of 92 fish. Ampeliscid amphipods and Harpacticoid copepods were major food sources for the 3-10 cm group, while polychaetes and, to a lesser extent, ampeliscids predominated in the 11-19 cm group. It is suggested by their diet that spot are opportunistic bottom feeders. Young spot are very abundant in many years; however, few reach a catchable or marketable size while in Little Egg Harbor. While spot represent a food source, at least for oyster toadfish and bluefish, it is unlikely that predation occurs on a significant portion of the population. The species thus removes a great biomass of forage from the system upon its out-migration in the fall.

Spotted hake, *Urophycis regius*

Caridean shrimp dominated the stomach contents of 16 specimens in the 5-19 cm size range. *Palaemonetes* and *Crangon* accounted for over 80% of the diet volume recovered from this sample. Other food sources identified included *Neomysis*, xanthid crabs, fourspine stickleback, and gammarid amphipods.

Striped burrfish, *Chilomycterus schoepfi*

Two specimens (23 and 25 cm) contained a variety of molluscs and crabs with *Callinectes* dominating in terms of volume. Xanthid crabs occurred in both specimens with a total of six individuals recovered. The remains of a hermit crab (*Pagurus* sp.) were found in the stomach contents of one fish.

Striped bass, *Morone saxatilis*

A total of 11 specimens in the size range of 43-58 cm were examined. Fish remains occurred in nine of these specimens and comprised approximately 94% of the total food volume recovered. Sand lance dominated the identified portion of these remains. Other components consisted of silversides, weakfish, and the remains of a left-handed flounder. *Crangon septemspinosa* contributed 6% of the diet volume.

Striped killifish, *Fundulus majalis*

The stomach contents of 13 striped killifish were composed of 14 identified taxa and an amount of unidentified "mucus-like" material. Polychaetes, isopods, and amphipods contributed about equally to 40% of the diet volume. *Idotea* formed 14% of the volume. Fish eggs were important seasonally. Sediment was recovered from the stomachs of six fish.

Striped mullet, *Mugil cephalus*

Algae and sediment were the only materials recovered from the stomachs of four specimens.

Striped sea robin, *Prionotus evolans*

Mysid shrimp, including both *Neomysis* and *Mysidopsis*, dominated the stomach contents of three 11-16 cm specimens. Gammarid amphipods, *Crangon*, and xanthids were of secondary importance.

Summer flounder, *Paralichthys dentatus*

Fish remains comprised 32.6% of the diet volume of 6-24 cm specimens and 74.3% of the volume recovered from 25-65 cm specimens. In the smaller group, anchovies, sticklebacks, and silversides were identified. The fish component was supplemented by mysid and Caridean shrimp, of which *Crangon* was of somewhat more importance (Figure 11).

At least seven species of fish occurred in the stomachs of the larger size group. These included silversides, anchovies, sticklebacks, silver perch, sea robins, winter flounder, and pipefish. Brachyuran crabs, primarily *Callinectes*, were of secondary importance in this size group.

Tautog, *Tautoga onitis*

The two size groups of tautog consumed similar varieties of invertebrates, but the relative importance of given items differed considerably between the groups. Fish between 6 and 16 cm (18 specimens) depended heavily on isopods,

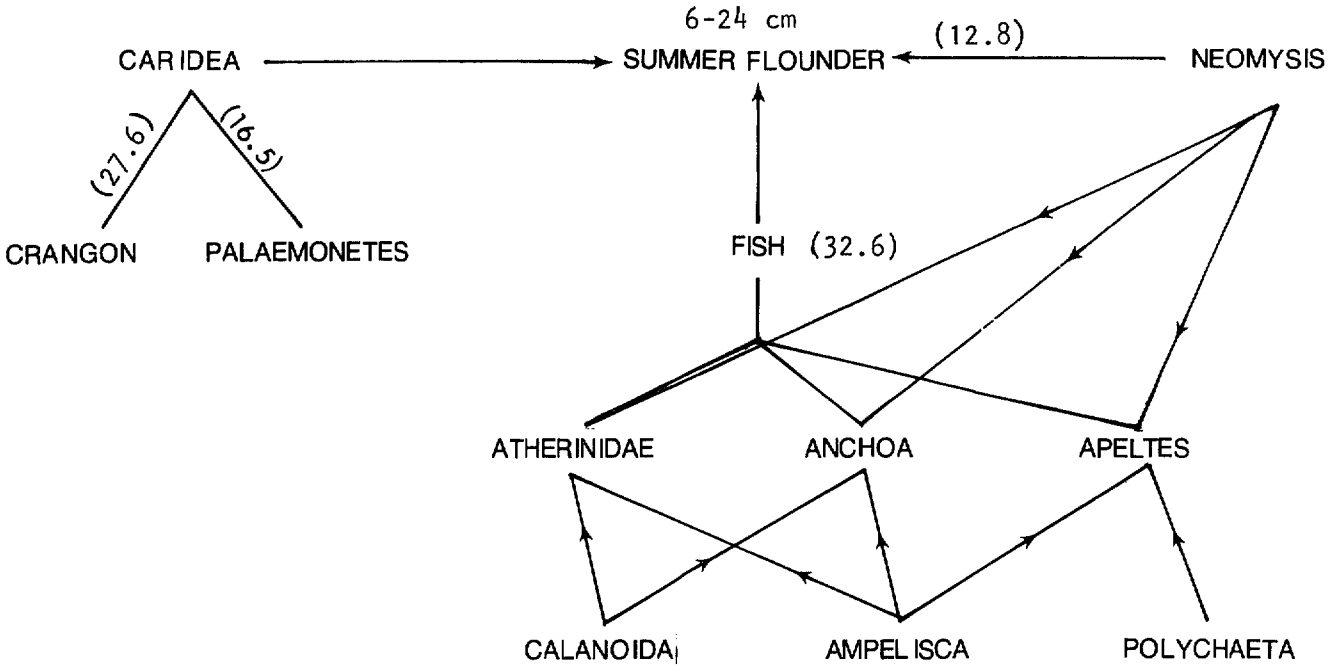

Fig. 11. A portion of the food web involving 6-24 cm summer flounder.

especially *Idotea*, while this taxon contributed little to the diet volume of fish in the 20-32 cm size range. All of the larger fish (7) contained Brachyuran crabs which composed 87% of the total diet volume. Crabs occurred in less than half of the smaller fish sample and contributed only 23% of the stomach content volume.

At least 24 forage taxa occurred in the overall tautog sample. The two size groups shared at least 8 of these. Molluscs occurred in the larger fish but not in the smaller specimens. The inverse was true for copepods, barnacles, and fish remains.

Threespine stickleback, *Gasterosteus aculeatus*

Neomysis americana, gammarids, and calanoid copepods were the major constituents in the stomach contents of six specimens. *Neomysis* contributed 56.5% of the total content volume and occurred in four fish.

Tidewater silversides, *Menidia beryllina*

Thirty-seven specimens ranging in length from 4-9 cm were examined. Thirteen taxa were identified in their stomach contents with copepods dominating

in terms of volume, occurrence, and numbers. Gammarids including *Leptocheirus plumulosus* were of secondary importance. Larval killifish were recovered from the stomach of one specimen.

Weakfish, *Cynoscion regalis*

The importance of fish in the weakfish diet increased with specimen length while the relative importance of mysid and *Crangon* components decreased. *Neomysis americana* dominated the diet of 27 weakfish (5-10 cm), occurring in 78% of the sample and contributing 41.4% of the contents volume. Fish remains were second in terms of volume for this group and *Crangon* third. Gammarids, particularly *Ampelisca*, were second in terms of occurrence (59%) but contributed only 6.6% of the diet volume.

Fish remains were the major diet item for the 11-17 cm group of weakfish. (Figure 12). Anchovies were the only identified component. *Neomysis* had a high occurrence in the stomachs of this size group but contributed less to the total food volume (23%) than it did in the smaller fish. Gammarids occurred infrequently.

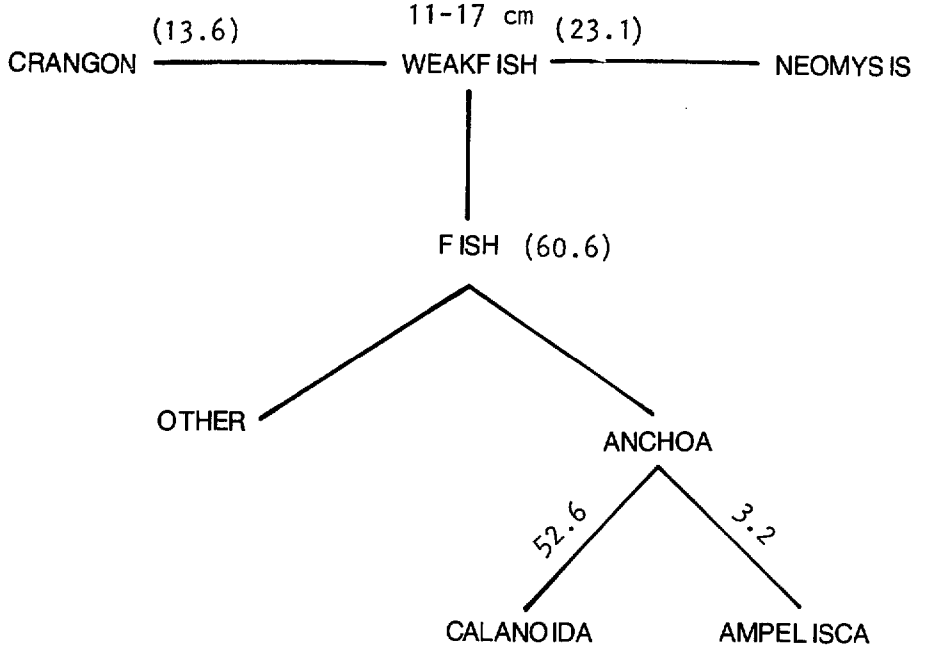

Fig. 12. A portion of the food web involving 11-17 cm weakfish.

The stomachs of a 32 cm specimen and a 62 cm specimen contained unidentified fish remains, polychaete remains, and one *Crangon*. Fish remains accounted for over 99% of the total volume.

White perch, *Morone americana*

The sample of 79 white perch was separated into three size groups. Based on length frequency distribution these groups were assumed to represent the one, two, and three plus age groups.

Eighteen specimens in the 7-12 cm length range contained at least 10 forage taxa. Gammarids, particularly *Leptocheirus plumulosus* and Corophiidae, represented the major food source in terms of total volume for this group. *Neomysis* occurred most frequently and contributed approximately 10% of the diet volume. Fish remains, including *Fundulus*, occurred in the stomachs of three specimens. Fish eggs, which were tentatively identified as clupeid eggs, were seasonally important both in terms of volume and occurrence.

Neomysis and *Crangon* were of increased importance in the 14-26 cm group of perch. Together, these constituted 61.2% of the diet volume. Gammarids were second to mysids in terms of occurrence with six component taxa identified. As a group, the gammarids contributed 11.2% of the diet volume. Fish and fish eggs were of less importance to this size group. One fourspine stickleback and one naked goby were identified in the 54 specimen sample.

The diet of seven perch in the 29-37 cm size range was dominated by *Crangon septemspinosa*, which contributed 62% of the volume and occurred in five fish. Killifish (*Fundulus* sp.) were recovered from one specimen. Mysids were of secondary importance in this group.

White mullet, *Mugil curema*

Eleven white mullet ranging in length from 3 to 14 cm were examined. Stomach contents were composed of sediment, plant detritus, and algae. No animal components were observed.

Windowpane, *Scophthalmus aquosus*

Crangon, *Neomysis*, and American sand lance were the major constituents in the stomachs of four specimens. One sand lance occurred in the windowpane, contributing approximately 12% of the total food volume recovered from the sample. Three hundred sixty-two mysids represented 10% of the volume and 32 *Crangon* comprised 56% of the food volume.

Winter flounder, *Pseudopleuronectes americanus*

Molluscs comprised approximately 15% of the total stomach contents recovered from 142 flounder. Ten molluscan species contributed to the diet. Four hundred thirty-seven pelecypod siphon tips were recovered from the stomach samples. On the basis of terminal pigmentation, size, shape, and tentacle configuration, approximately 75% of these siphons were unmistakably from *Mercenaria mercenaria*. Of the remaining tips, most appeared to be hard clam siphons

which were partially digested. A few *Mya arenaria* (soft clam) siphons were identified and at least one razor clam (*Ensis directus*). Pelecypod siphons comprised over 14% of the winter flounder diet.

The fish averaged 3.08 siphon tips per specimen in the total sample. In the 12-21 cm length group, the siphons comprised 22.5% of the diet volume with an average of 3.85 tips per fish. In the 22-33 cm group, the siphons represented a lower volume percentage, but actual consumption increased to an average of 6.16 tips per specimen. Siphons did not contribute significantly to the diet of the 3-11 cm group occurring in only four of 56 specimens.

Polychaetes comprised approximately 35% of the overall winter flounder diet and were the dominant forage group both in terms of volume and frequency of occurrence. At least 27 species are being utilized within Little Egg Harbor. In the 3-11 cm length group, *Maldanopsis elongata* and members of the genera *Phyllodoce* and *Nereis* and of the families Capitellidae and Spionidae were important. In the 12-21 cm group, *Glycera americana, Nereis succinae, Pista palmata,* and capitellids were of volume importance, while *Pista* and *Glycera* were major items in the 22-33 cm group. In the total sample, *P. palmata* occurred most frequently with capitellids, *Nereis* spp., *Polydora lingni,* and *Hypaniola grayi* following. On an average, each specimen contained 8.4 polychaetes.

A large variety of crustaceans were utilized by winter flounder with amphipods and decapods occurring most frequently. Harpacticoid copepods and Cumaceans were consumed regularly by small fish but did not comprise a major portion of their diet volume. The isopod *Cyathura polita* occurred in 14.1% of the stomachs, forming approximately 1% of the diet volume in medium and large size fish.

An average of 12.8 amphipods per fish existed in the total sample. This constituted 6.5% of the diet volume. Amphipods were of major importance in the diet of small fish with *Ampelisca abdita* clearly dominating (14.4% volume). The larger ampeliscid, *A. vadorum*, was found in smaller numbers, but, because of its size, formed an almost equal portion of the diet volume in large fish and exceeded *A. abdita* in the 12-21 cm group. In total, ampeliscids accounted for 4.6% of the diet volume, occurring at a rate of 9.8 individuals per fish. Other amphipods which occurred frequently or formed a significant portion of the sample volume were *Cymadusa compta, Microdeutopus gryllotalpa, Corophium* spp., and *Elasmopus laevis.*

The mysid shrimp, *Neomysis americana,* occurred in 9.3% of the total fish sample and comprised 10.8% of the diet volume of the small and medium length specimens.

Decapods were of considerable importance in the diets of larger fish comprising 26.1% of the volume collected from the 22-33 cm length group. *Palaemonetes vulgaris* was the major species consumed. *Crangon septemspinosa* formed 4.7% of the diet volume in the 12-21 cm length group. Mud crabs including *Neopanope texana* and *Rhithropanopeus harrisii* occurred in 20% of the large fish sample.

A number of other items were consumed by the flounder sampled. Four naked gobies, *Gobiosoma bosci*, were the only fish identified in the stomachs. Nemertean remains, probably *Cerebratulus* sp., were found in four stomachs. Two of these occurred in the two largest (33 cm) fish examined. Nematodes occurred in 15.7% of the sampled fish. A young horseshoe crab (3.2 cm width) was found in an 18 cm specimen. Recognizable amounts of fibrous plant detritus comprised about 1% of the total diet volume in 37% of the stomachs.

THE FORAGE BASE BY HABITAT AREA

The stomach analysis survey included fish collected from 49 stations within the Little Egg Harbor estuary. These stations were segregated into six habitat types to examine spatial differences in the forage base. The word "habitat" is loosely used, being applied to morphological and salinity characteristics. Sampling intensity and the fish species composition of the sample varied from habitat to habitat. The classification of borderline or transitional stations was subjective, and there was always the possibility that a fish collected in one habitat had actually fed in another. Given these uncertainties and variations, few firm conclusions can be drawn on habitat-forage interractions; however, the following sections discuss certain relationships which are suggested by the data.

Inlet

Sixteen fish species totalling 58 individuals (Table 5) were collected from six inlet stations. At the time of collection, salinities at these stations ranged from 22.0 to 30.1°/oo, and dissolved oxygen levels ranged from 6.6 to 10.3 mg $O_2 \cdot l^{-1}$. Surface measurements were applied to seine samples and bottom measurements to trawl collections. Four stations were located in Beach Haven Inlet and two in Barnegat Inlet.

A total of 39 forage taxa were collected from the inlet specimens (Table 6). *Limulus polyphemus* and sand lance, *Ammodytes americanus*, were the only forage items unique to this habitat. *Mytilus edulis* was the most frequently occurring mollusc, while *Nereis* spp. and *Glycera* spp. were the major polychaete components in the sampled fish. *Cymadusa compta* and *Microdeutopus gryllotalpa* were the most frequently occurring amphipods. *Idotea balthica* was the dominant isopod component. *Crangon* occurred in the stomachs much more than *Palaemonetes*, and sandlance had the highest percent occurrence of the forage fish components.

Of 17 flounder collected at inlet stations only one contained siphon tips, this indicates that siphons are not an important diet item for winter flounder utilizing inlet areas.

Fish eggs were a major seasonal diet component of Atlantic silversides taken at inlet stations.

The calanoid copepod-to-sand lance-to-striped bass food chain was one clearly identified relationship associatied with the inlet habitat.

Table 5. Breakdown of Little Egg Harbor sample by habitat type.

Species	Habitat						Total
	Inlet	Bay	Tidal creeks	Mill Creek	Artificial lagoons	Tidal pool	
Alewife		2	1	2	6		11
American eel		1	2	6	1		10
American sand lance	4						4
Atlantic menhaden			8	9	25		42
Atlantic needlefish		17	1	1	1		20
Atlantic silversides	8	29	20	17	11		85
Banded killifish				15	3		18
Bay anchovy		41	31	21	8		101
Black sea bass	2	7	1	6	1		17
Blueback herring		1	5	5	6		17
Bluefish	1	28	21	16	31		97
Brown bullhead				5			5
Crevalle jack		1	4	1	3		9
Cunner	3	1					4
Fourspine stickleback		37		17	22		76
Golden shiner				3			3
Gray snapper		2					2
Hogchoker				3	4		7
Inshore lizardfish		2					2
Mummichog		8	1	5	6	61	81
Naked goby		1		4	3		8
Northern kingfish					2		2
Northern pipefish		15	1	5			21
Northern puffer		3					3
Northern sea robin		4					4
Northern sennet		7					7
Oyster toadfish		14	5	11			30
Permit				1			1
Pinfish		3					3
Planehead filefish	2						2
Pumpkinseed				2			2
Rainwater killifish		1		1	5	8	15
Redhake		2	1				3
Redfin pickerel					1		1
Scup		1					1
Sheepshead minnow		1		2	6	39	48

Table 5. Continued.

Species	Habitat						Total
	Inlet	Bay	Tidal creeks	Mill Creek	Artificial lagoons	Tidal pool	
Silver perch		18	5	1	2		26
Smooth dogfish		7	5				12
Spot	3	24	29	22	15		93
Spotted hake		12	1	4			17
Lined seahorse	2	1					3
Striped burfish		1		1			2
Striped bass	10		1				11
Striped killifish	1	3		2	7		13
Striped mullet		2			2		4
Striped sea robin			1	1	1		3
Summer flounder	1	18	9	8	2		38
Tautog	1	13	3	8			25
Threespine stickleback		1	4		1		6
Tidewater silversides		1	2	19	7	10	39
White perch		1	2	32	44		79
White mullet			5	1	5		11
Weakfish	1	20	22	5	3		51
Windowpane	2	2					4
Winter flounder	17	77	17	25	5		111
Total	58	430	208	287	239	118*	1,340

* The stomachs of 74 tide pool specimens were only qualitatively evaluated.

Table 6. Percent occurrence of forage taxa by habitat and season.

Forage species	Habitat						Season			
	Inlet	Bay	Tidal creeks	Mill Creek	Lagoon	Tidal pool	Spring	Summer	Fall	Winter
Bittium alternatum		3.4					0.5	0.3		
Crepidula spp.		2.1		0.3			0.5	1.2		0.6
Mitrella lunata		1.7	0.5	0.7				0.4		0.6
Nassariidae		0.5		0.7				0.4	0.5	
Haminoea solitaria	1.7	0.5						0.4		
Mytilus edulis	3.4	0.5					0.5	0.3	0.5	
M. mercenaria (siphons)	1.7	7.0	1.4	2.1	0.4		10.9	0.7	5.2	2.5
Lyonsia hyalina		0.2					0.5			
Solomya velum		0.5	0.5					0.4		
Oligochaeta		0.5		1.4	0.4		1.0	0.3	1.0	0.6
Phyllodoce maculata		0.7		0.7	0.4		1.0	0.6		
Phyllodoea arenae		0.2		0.3			1.0			
Eteone spp.		0.5		1.0	0.4	1.7	0.5	0.7		0.6
Polynoidae	1.7	0.2					0.5	0.1		
Stenelais spp.				0.3			0.5			
Glycera spp.	8.6	1.2		0.3	0.4		1.0	1.0	1.0	1.2
Goniadidae	1.7	1.9		0.3				1.3		0.6
Nephtys spp.		0.2			0.8			0.3	0.5	
Nereis spp.	10.3	3.3	1.9	4.9	3.8		3.1	4.5	4.3	0.6
Capitellidae	6.9	1.4	1.0	0.3	0.8			1.9	0.5	0.6
Clymenella torquata		0.9					0.5	0.1	1.0	
Maldanopsis elongata		1.9						0.3	1.9	1.2
Scolecolepides viridis		0.7		0.7			0.5	0.6		
Polydora spp.		3.3	3.8	0.7	1.3		9.3	1.0	1.0	
Streblospio benedicti	1.7			1.0				0.6		
Aricidea sp.		0.2					0.5			
Lumbrinereis spp.		0.9	0.5					0.6		0.6
Arabella iricolor		0.2		0.3			1.0			
Scoloplos spp.	1.7	0.2		0.3			0.5	0.3		
Hypaniola grayi		0.7	1.0	3.1	1.3		1.6	1.9		0.6
Pista palmata		4.0		1.0			6.7	0.1	1.4	1.8
Sabella microphthalma		0.2	0.5	0.3			1.0	0.1		
Limulus polyphemus	1.7							0.1		
Plecoptera					0.4					0.6
Diptera(Adult & Larvae)		1.9	0.5	15.0	12.1	27.1	5.2	8.1	5.7	8.0

Table 6. Continued.

Forage species	Habitat						Season			
	Inlet	Bay	Tidal creeks	Mill Creek	Lagoon	Tidal pool	Spring	Summer	Fall	Winter
Coleoptera			0.5				0.5			
Hymenoptera	1.7	1.6	0.5					1.3		
Homoptera		0.5		0.7	0.4			0.7		
Hemiptera				0.3					0.5	
Cladocera		1.9		2.8	2.5	1.7		2.9	0.1	0.6
Ostracoda		5.6	4.8	6.3	1.3	5.9	10.4	4.8	1.0	0.6
Calanoida	8.6	18.8	21.6	25.8	24.3	7.6	43.0	14.1	14.8	36.2
Harpacticoida	6.9	14.0	10.6	20.6	10.9	27.1	23.8	13.8	8.6	16.6
Cyclopoda				1.0			0.5	0.3		
Cirripedia (larvae)			1.9	2.4	2.1		0.5	2.2		
Cumacea		3.3	4.3	5.2			0.5	5.3		
Tanais cavolini		0.2		1.7	0.4			1.0		
Leptochelia savignyi				0.3			0.5			
Cyathura polita		3.7	1.0	7.7	2.1		4.7	3.2	6.7	
Idotea balthica	10.3	2.8	1.0	5.2			1.6	4.6		
Idotea phosphorea		0.7	0.5				0.5	0.4		
Edotea triloba	3.4	1.4	1.4	2.8	0.4		1.0	2.0	1.9	
Erichsonella attenuata		1.2		1.0				1.2		
Erichsonella filiformis		0.5	0.5	1.0			0.5	0.6	0.5	
Oniscidae				0.3				0.1		
Ampelisca abdita	1.7	9.3	12.5	7.7	1.3		8.3	8.8	6.2	1.2
Ampelisca vadorum		4.9	1.9	1.0			9.8	0.9	0.5	1.2
Ampelisca verrilli		0.7					0.5			1.2
Ampithoe longimana		0.5					0.5	0.1		
Cymadusa compta	8.6	6.3	1.9	3.1	0.4		2.1	3.6	4.3	4.9
Rudilemboides naglei		0.9						0.6		
Microdeutopus gryllotalpa	8.6	1.1	1.4	1.7	0.8			2.4	1.4	
Lembos sp.	1.7	0.2	1.0		0.4			0.7		
Batae catharinensis		0.5						0.1	0.5	
Corophium spp.	5.2	4.7	1.9	2.8	2.5		1.4	4.0	3.3	1.8
Erichthonius rubricornis		0.2						0.1		
Erichthonius brasiliensis		0.5			0.4			0.3	0.5	
Unciola serrata				1.0			1.0	0.1		
Cerapus tubularis	1.7	0.9	0.5	0.7				1.2		
Gammarus sp.		0.7	1.4	5.2	3.3	6.8	3.1	2.2	0.5	4.3
Gammarus mucronatus		0.7	0.5	1.0	3.8	4.2	1.5	1.4	1.4	3.1
Elasmopus leavis	3.4	4.7	0.5	2.4	0.4		0.5	3.9	1.0	3.6
Casco bigelowi	1.7	0.2							1.0	

Table 6. Continued.

Forage species	Habitat						Season			
	Inlet	Bay	Tidal creeks	Mill Creek	Lagoon	Tidal pool	Spring	Summer	Fall	Winter
Melita sp.		0.2					0.5			
Maera danae	3.4	0.7						0.3	1.4	
Lysianassidae				0.7				0.3		
Hyalidae		0.2						0.1		
Monoculodes edwardsi		0.2		0.3	0.4		1.0			0.6
Microprotopus ranei	1.7	1.6	0.5				0.5	1.2		
Leptocheirus plumulosus	1.7			12.9	3.3		1.0	6.2	4.2	1.8
Paraphoxus spinosus		0.2						0.1		
Orchestia platensis				0.3	0.4			0.1	0.5	
Stenothoe minuta		0.5		0.3			0.5	0.3		
Parametopella cypris		0.5	0.5					0.4		
Caprellidae	3.4	0.7		0.7				1.0		
Neomysis americana	3.4	18.1	32.2	12.2	20.9		34.7	11.2	21.4	25.8
Mysidopsis bigelowi		2.8	0.5	0.3	2.1			1.6	3.3	0.6
Penaeus sp.		0.2						0.1		
Palaemonetes vulgaris	1.7	5.1	1.9	1.7	1.3		2.1	2.0	3.3	6.1
Palaemonetes pugio	1.7	1.2	1.0	1.0			0.5	0.7	1.4	1.2
Hippolyte sp.		0.2						0.1		
Crangon septemspinosa	22.4	15.6	15.4	5.2	7.5		5.7	12.4	17.6	6.1
Pagurus longicarpus		0.2							0.5	
Ovalipes ocellatus		0.5							1.0	
Callinectes sapidus	1.7	2.1	6.3	4.5	1.7			4.3	4.3	0.6
Neopanope texanna	1.7	4.9		3.5	0.4		2.6	3.2	2.9	
Rhithropanopeus harrisii		1.2	1.4	2.1	1.3		1.0	1.8	1.0	
Eurypanopeus depressus				0.3			1.6	0.2		
Menidia spp.	1.7	1.9		0.7	0.4			1.6	1.4	
Anchoa spp.	1.7	1.2	1.4	1.7	0.8			2.0	1.0	
Apeltes quadracus		2.3	0.5		0.4			1.3	1.0	0.6
Ammodytes americanus	12.1							0.1	2.8	
Brevoortia tyrannus			1.0		1.3			0.6	0.5	
Bairdiella chryusra		0.2							0.5	
Cynoscion regalis	1.7	0.2	0.5					0.3	0.5	
Leiostomus xanthurus		0.5	0.5					0.4		
Fundulus spp.	0.2	2.9	0.3	2.1			1.3	1.4	0.6	
Gobiosoma bosci		0.5		1.4	0.4		1.0	0.1	1.0	1.0
Pseudopleuronectes		0.2						0.1		
Syngnathus fuscus	0.2		0.3					0.2		
Fish sample size	(58)	(430)	(208)	(287)	(239)	(118)	(193)	(694)	(210)	(163)

Bay

The open bay habitat was the most intensively sampled area of the estuary. Stomach analyses were conducted on 430 fish of 41 species. A total of 17 stations were surveyed. Salinity minimums at these stations ranged from 16.6 to 28.3°/oo at the time of sampling. Maximum salinities ranged from 26.9 to 31.8°/oo. Dissolved oxygen levels ranged from 5.2 to 12.7 mg $O_2 \cdot l^{-1}$.

Little Egg Harbor Bay is shallow with natural depths generally less than 8 ft. A series of dredged channels cross the bay with depths to 20 ft as these channels approach the inlet. Sediment composition ranges from silt to gravel. Large areas of the bay are vegetated with dense eelgrass beds.

A total of 94 forage taxa were identified in the fish collected in the bay. Calanoid and harpacticoid copepods along with *Neomysis* in association with the smaller fish occurred most frequently in the overall sample. *Crangon* was encountered most frequently in the larger fish. The remaining forage species were evenly proportioned in terms of percent occurrence over the sample of bay fish with the range of occurrences for a given species running from 0.2 to 9.3%.

Bittium and siphon tips of *Mercenaria* associated with the winter flounder sample accounted for the most frequent mollusk-fish incidents. *Nereis* spp., *Polydora* spp., and *Pista palmata* were the most frequently occurring polychaetes.

Of the six isopods identified *Cyathura polita* was encountered most often followed in frequency by *Idotea balthica*. A total of 26 amphipod species were identified in the stomachs of bay fish. Of these *Ampelisca abdita* and *Cymadusa compta* occurred most often. *Cragnon septemspinosa* was the most heavily utilized shrimp species, and *Neopanope* was the dominant xanthid component.

Fourspine stickleback, followed by silversides and anchovies, were the most frequently encountered forage fish species.

Overall, the trophic structure of the open bay is extremely complex. A large number of food chain associations can be developed from the data obtained. The *Mercenaria* siphon tip - winter flounder relationship was strongest in this habitat. A number of associations including the eelgrass community were present, including *Cymadusa* - pipefish. The importance of eelgrass, *Zostera marina*, in the trophic structure of Little Egg Harbor is a subject needing further study. Beyond providing habitat for a variety of amphipod and isopod forage species, it is likely that eelgrass detritus represents a major portion of the trophic base in the estuary. Briggs and O'Connor (1971) in a comparison of vegetated and open sand bottoms in Great South Bay, New York found that many estuarine fishes displayed a marked preference for the eelgrass habitat.

Tidal Creeks

Eight sampling stations were located in natural tidal creeks. From these, a total of 108 fish of 28 species were examined. The tidal creek stations were differentiated from Mill Creek stations in that they received little fresh water input, and they had totally undeveloped shorelines consisting of *Spartina* marsh. Essentially, these creeks represent confined extensions of the bay. Bottom sediments consisted primarily of muds. Minimum salinities at these stations

ranged from 5.5 to 26.8$^{o}/_{oo}$ at the time of sampling, and dissolved oxygen minimums ranged from 2.6 to 6.9 mg $O_2 \cdot l^{-1}$.

Forty-eight forage taxa were identified in the stomach analysis. Insects of the Order Coleoptera were the only forage taxon unique to this habitat. Only one occurrence was observed. Mollusk components were *Mitrella*, *Solemya*, and siphon tips of *Mercenaria*. *Polydora* spp. was the most frequently encountered polychaete component. There was a high occurrence of copepods and mysids in the small fish examined. *Ampelisca abdita* clearly dominated the amphipod component in the stomachs of tidal creek fish. As in the other habitats, *Crangon* occurred more frequently than *Palaemonetes*. Of the forage fish species (6 taxa), *Fundulus* in association with young of the year bluefish, had the highest percentage of occurrence.

Mill Creek

Six stations were sampled in Mill Creek. The stomachs of 287 fish of 36 species were analysed.

Mill Creek stations ranged from seasonally fresh water areas to essentially bay-type areas at the mouth of the creek. Most of the shoreline of Mill Creek has been developed or distrubed by lagoon and bulkhead construction. Minimum salinities at the sampling stations ranged from less than 1 to 19.1$^{o}/_{oo}$ at time of sampling. Maximum salinities ranged from 8.9 to 30.9$^{o}/_{oo}$. Dissolved oxygen levels ranged from 0.8 to 12.7 mg $O_2 \cdot l^{-1}$.

A total of 70 forage taxa were identified from fish collected within the creek. This degree of variety relative to the tidal creek stations is possibly attributable to the number of salinity regimes occurring in Mill Creek.

Mercenaria siphon tips, associated with the winter flounder specimens collected in the lower portions of the creek, were the most frequently encountered mollusk component. *Nereis* spp. was the polychaete most often encountered. *Hypaniola grayi* followed *Nereis* in terms of frequency of occurrence. The overall occurrence of *Hypaniola* was strongly associated with Mill Creek stations. *Cyathura polita* and *Idotea balthica* respectively were the most frequently encountered isopods. In higher salinity areas, *Ampelisca abdita* was commonly observed in the fish stomachs. The occurrence ratio of *Crangon* to *Palaemonetes* was closer in Mill Creek than in the other habitats; however, *Crangon* still dominated. Anchovies and naked goby were the major forage fish components while fish eggs were important seasonally to white perch in upstream areas. Calanoid copepods and *Neomysis* represented the dominant zooplankton forage.

Lagoons

Two hundred thirty-nine fish of 31 species were collected from 11 lagoon stations. The lagoon complex (Figure 2) consists of man-made channels cut into upland or filled areas adjacent to Mill Creek. The character of these lagoons differs greatly, depending upon their distance from the creek or bay. Interior lagoons are poorly flushed and frequently stratified during the summer. Lagoons connecting directly to Mill Creek had higher flushing rates, exhibited better water quality, and were accessible to fish moving through Mill Creek. The lagoons varied in age from over 12 years old (1966) to newly dug, unbulkheaded

sections. Bottom sediments in the older lagoons consisted of deep, very fine organic muds, while the new lagoons still contained some sandy or gravel-sand bottom areas. Salinity minimums at lagoon stations ranged from 2.8 to 19.7$^{o}/_{oo}$. Dissolved oxygen minimums ranged from 0.0 to 7.4 mg $O_2 \cdot \ell^{-1}$ at the time of sampling.

A total of 47 forage taxa were identified in the stomachs of fish collected from lagoon stations. The occurrence of a clam siphon in a single flounder specimen represented the only occurrence of mollusks in this habitat. *Nereis* spp. followed by *Hypaniola* and *Polydora* were the major polychaete components. As a group, amphipods were encountered less frequently in lagoon fish than in fish collected in other habitats. *Gammarus mucronatus* occurred most frequently. The lagoon sample contained a high proportion of fish species which, in other habitats, fed heavily on amphipods. These included spot, stickleback, white perch, and silversides. Pelagic food components including calanoid copepods, *Neomysis*, and *Crangon* occurred in proportions equivalent to those observed in other areas of the estuary. Menhaden and killifish were the most frequently encountered fish items and occurred primarily in bluefish stomachs.

Tidal Pool

One hundred eighteen[2] fish of four different species were collected from a tide pool located in the *Spartina* marsh adjacent to Dinner Point Creek. Salinity in the pool ranged from 15.8 to 30.3$^{o}/_{oo}$ at the time of sampling, temperatures ranged from 6.5 to 33.0°C and dissolved oxygen concentrations ranged from 5.0 to 6.9 mg $O_2 \cdot l^{-1}$.

In addition to the seven invertebrate taxa listed in Table 6, gastropod larvae and hydrozoan pieces were found in the stomachs of these fish specimens. Algae (including filamentous green, diatom, and dinoflagellate components) represented the major food source for sheepshead minnow and mummichog in terms of diet importance. Harpacticoid copepods and Cladocera were the dominant foods of tidewater silversides, while rainwater killifish fed primarily on Chironimidae larvae and *Gammarus mucronatus*. The relative importance of these items varied from season to season. Dinoflagellates occurred most frequently in the summer sample, diatoms in the fall, and filimentous algae in the winter and spring. Chironimidae larvae were second in terms of overall occurrences (Tables 7-8) and were found in all seasons. Importance as listed in Table 7 is based on qualitative observations as to which component contributed the most volume to the contents of individual fish stomachs.

SEASONAL COMPONENTS OF THE FORAGE BASE

Tables 6 and 9 list the occurrence of the various taxa in the fish stomachs by season. The months of March, April, and May were considered as spring; June, July, and August as summer, etc. A larger proportion of the fish sample was collected during the summer, and therefore a larger variety of forage species might be expected in that sample.

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[2] Only 44 of these were included in the overall data analysis due to a lack of volumetric data.

Table 7. Rank in importance of food items in tidal pool (S-8).

Content item	Percent importance*	Percent occurrence
Dinoflagellates	33.1	59.9
Algae other than diatoms or dinoflagellates	29.7	55.1
Chironimidae larva	11.0	22.0
Harpacticoid copepods	5.9	27.1
Diatoms	4.2	78.0
Copepods-nondescript	3.4	5.9
Gammarus mucronatus	3.4	4.2
Fibrous plant remains	2.5	13.6
Gammarus sp. remains	1.7	6.8
Cladocera	1.7	1.7
Calanoid copepods	0.8	7.6
Adult insect remains	0.8	3.4
Copepod nauplii	0.8	3.4
Polycheate remains	0.8	1.7
Ostracoda	-	5.9
Nematodes	-	5.1
Hydroid remains	-	4.2
Cycloid scales	-	3.4
Chironimidae pupa	-	1.7
Gastropod larva	-	0.8
Analyzed according to food groups:		
All algae	67.0	
Insects	11.8	
Copepods	10.9	
Amphipods	5.1	
Detritus	2.5	

* Percent of the sample in which this item was qualitatively determined to contribute the highest volume proportion in the stomach contents.

Table 8. Stomach content analysis for tide pool fishes by season - All species combined.

Seasons	Summer		Fall		Winter		Spring		Total	
Content item	%O*	%I#	%O	%I	%O	%I	%O	%I	%O	%I
Algae except diatoms and dinoflagellates	10.9	2.2	82.8	65.5	80.0	33.3	92.3	38.5	55.1	29.7
Dinoflagelates	82.6	73.9	31.0	10.3	26.7	3.3	84.6	7.7	55.9	33.1
Diatoms	45.7		93.1	6.9	63.3	10.0	84.6		78.0	4.2
Chironimidae larvae	26.1	13.0	10.3	6.9	23.3	13.3	30.8	7.7	22.0	11.0
Fibrous plant remains	6.5	2.2	24.1	6.9			46.2		13.6	2.5
Cladocera	4.3	4.3							1.7	1.7
Copepoda-nondescript			6.9	3.4	10.0	6.7	15.4	7.7	5.9	3.4
Gammarid remains	6.5	2.2	3.4		13.3	3.3			6.8	1.7
Harpacticoid copepods	28.3		17.2		33.3	20.0	30.8	7.7	27.1	5.9
Gastropod larva			3.4						0.8	
Calanoid copepods	8.7		3.4		3.3		30.8	7.7	7.6	0.8
Cycloid scales	4.3		6.9						3.4	
Chironimidae pupa			6.9						1.7	
Ostracoda	15.2								5.9	
Adult insect remains	8.7	2.2							3.4	0.8
Nematodes	6.5		6.9				7.7		5.1	
Gammarus mucronatus					6.7	6.7	23.1	15.4	4.2	3.4
Hydroid remains							23.1		4.2	
Polycheate remains									1.7	0.8
Copepod nauplii							30.8	7.7	3.4	0.8
										99.8
Sample size	(46)		(29)		(30)		(113)		(118)	

* Percent occurrence

\# Percent of the sample in which this item was quantitatively determined to contribute the highest volume proportion in the stomach contents.

Table 9. Breakdown of Little Egg Harbor sample by season of collection.

Species	Season			
	Spring*	Summer	Fall	Winter
Alewife	7	2		2
American eel	2	8		
American sand lance			4	
Atlantic menhaden		33	9	
Atlantic needlefish		20		
Atlantic silversides	33	34	7	11
Banded killifish		14	2	2
Bay anchovy	40	59	2	
Black sea bass		14	3	
Blueback herring	5	4		4
Bluefish		79	18	
Brown bullhead	1	2	2	
Crevalle jack		9		
Cunner		3	1	
Fourspine stickleback	18	18		40
Golden shiner		3		
Gray snapper		2		
Hogchoker	2		5	
Inshore lizardfish		2		
Mummichog	1	8	6	19
Naked goby		5	3	
Northern kingfish			2	
Northern pipefish	7	12	2	
Northern puffer		3		
Northern sea robin	2	2		
Northern sennet		7		
Oyster toadfish	1	26	3	
Permit		1		
Pinfish		3		
Planefish		1	1	
Pumpkinseed	2			
Rainwater killifish	2	6		1
Red hake	1	2		
Redfin pickerel			1	
Scup			1	
Sheepshead minnow	12	2	3	12
Silver perch		6	20	
Smooth dogfish		12		
Spot		79	13	
Spotted hake	5	10		

Table 9. Continued.

Species	Season			
	Spring*	Summer	Fall	Winter
Lined seahorse		3		
Striped burrfish		2		
Striped bass	1		10	
Striped killifish		9	4	
Striped mullet			2	2
Striped sea robin		2	1	
Summer flounder	1	29	8	
Tautog	1	14	9	1
Threespine stickleback	3			3
Tidewater silversides	1	18		18
White perch	13	19	17	30
White mullet		8	3	
Weakfish		32	19	
Windowpane		3	1	
Winter flounder	32	64	28	18
No. of species	24	46	32	14
No. of fish	193	694	210	163

* March, April, May

Taxa which occurred more frequently in the stomachs during the spring than in other seasons included *Mercenaria* (siphon tips), *Polydora*, *Pista*, Calanoida, Harpacticoida, *Ampelisca vadorum*, *Neomysis*, and fish eggs. The siphon tips, *Pista*, and *A. vadorum* were major components of adult winter flounder which were actively feeding during these months prior to emigration from the bay. Perch utilization of clupeid eggs in Upper Mill Creek accounted for the high occurrence of fish eggs during the spring. The spring fish population contained a high proportion of small resident species including stickleback and perch. This increased the percent occurrence of *Neomysis* relative to the summer months when a variety of larger fish were present in the estuary.

The presence of migratory predator species including bluefish, weakfish, and summer flounder in the estuary during the summer and fall months is reflected by the increased occurrence of fish, *Crangon*, and crab components during these seasons.

During the winter months fish activity in the system is essentially limited to white perch, winter flounder, and small resident species including sticklebacks and silversides. Mollusk and polychaete forage components are utilized rather exclusively by winter flounder during these months. *Palaemontes* occurred as frequently as *Crangon* in the overall sample with *Palaemontes* dominating the flounder diet and *Crangon* the perch diet. A total of 38 taxa were identified in the winter sample. Calanoid copepods and *Neomysis* continued to dominate the diet of small fish.

DIET DIVERSITY

The relative diversity of the diets of 33 fish species-size groups were examined using the formula:

Diversity = $P_i \log_{10} P_i$ (adapted from Shannon and Weaver 1963) where P_i = the proportion on the basis of numbers of individuals, of the i th prey species in the total diet sample. The base 10 log is considered appropriate since most of the diets involved over 10 prey species. The stomach contents of 10 individual fish from each species-size group were pooled for the analysis. For each group, the minimum number of species contained in the stomachs was determined. Prey items which were not identified to higher taxonomic levels were proportioned over identified component species.

Results of the analysis are presented in Table 10. Black sea bass had the highest diet diversity; 11 to 17 cm weakfish had the lowest. These data indicate, to a degree, the flexibility of the feeding patterns of the various species-size groups examined. High diversity values might suggest a high capacity for adaption to changes in the forage base, whereas low values suggest a lower tolerance. It is important to note the size ranges involved since an increased spread would be expected to result in increased diversity. Species to species comparisons are thus more meaningful for sample groups of similar size ranges.

As a general finding, the diet diversity of fish within a species increased with fish size. Examples of this include oyster toadfish, bluefish, summer flounder, white perch, and spot. Medium size winter flounder and weakfish were the exceptions.

The diversity data are not necessarily consistent with the distribution of percent volume data observed for various forage items in given fish species samples. This is due to the fact that there were wide ranges in the size of prey items consumed by fish of certain species. As an example, 90% of the diet volumes of American eel and smooth dogfish consisted of blue claw crab remains, yet these fish had relatively high diet diversities in terms of types and numbers of prey organisms. For this reason, using diet diversity as an index of a species capacity for adapting to changes in available forage populations would require an analysis of volumetric as well as numerical proportions.

SUMMARY AND RECOMMENDATIONS

Carbon fixation in the Little Egg Harbor estuary is accomplished by phytoplankton, sedentary algae, *Spartina* marsh, and submerged eelgrass beds. The relative contribution of each component to the ultimate production of fish is unknown since few of the observed fish food chains can be linked to a single phototrophic group. The diversity exhibited at the phototroph level is multiplied by each ensuing trophic level, resulting in a complexity which essentially defies the construction of an inclusive schematic overview. The fish forage base consists of a mixture of primary consumers, carnivores, and omnivores, which include at least 142 taxa. Diets of the surveyed fish species are very flexible. Forty-seven different prey species were identified in the stomach contents of one size group of winter flounder. The stomach contents of subsamples of 10 fish of 33 different species-size group combinations contained an average of 12 different prey taxa.

Table 10. Diet diversity based on numbers of prey organisms consumed (n = 10)

Species	Size range (cm)	Minimum number of prey species	Total number of individuals	Diet diversity index	Diet diversity rank
Black sea bass	6-21	20	83	1.052	1
Tautog	6-16	15	137	0.996	2
Winter flounder	12-21	21	472	0.974	3
Mummichog	3-11	12	34	0.960	4
Oyster toadfish	18-28	16	77	0.941	5
American eel	11-61	11	27	0.931	6
Winter flounder	3-11	21	206	0.907	7
Oyster toadfish	4-13	10	46	0.902	8
Winter flounder	22-33	33	899	0.775	9
Bluefish	11-20	7	22	0.756	10
Summer flounder	26-65	13	101	0.749	11
Spotted hake	5-19	12	84	0.742	12
Striped killifish	4-13	13	115	0.725	13
White perch	14-26	18	1,109	0.718	14
Atlantic needlefish	5-16	8	155	0.674	15
Smooth dogfish	39-56	6	27	0.638	16
Spot	11-19	24	1,278	0.632	17
Northern pipefish	9-21	13	239	0.601	18
Atlantic silversides	3-13	11	313	0.571	19
Silver perch	3-12	11	152	0.545	20
Bluefish	21-36	4	16	0.528	21
Striped bass	43-58	6	83	0.495	22
Bluefish	6-10	10	434	0.452	23
Fourspine stickleback	2-6	9	142	0.428	24
Banded killifish	3-10	7	81	0.389	25
Summer flounder	6-24	11	692	0.372	26
White perch	7-12	9	1,167	0.370	27
Weakfish	5-10	11	317	0.267	28
Spot	3-10	9	1,869	0.263	29
Bay anchovy	5-11	10	1,399	0.191	30
Tidewater silversides	4-9	7	2,087	0.136	31
Blueback herring	7-15	9	11,516	0.121	32
Weakfish	11-17	5	680	0.091	33

The complexity of the Little Egg trophic structure provides a stability and variety in the system's forage base which allows for the concurrent production of at least 64 species of fish (McClain 1977). This diversity, however, does not preclude the fact that certain organisms play more important roles than others in the transfer of energy from plant to fish. Table 11 lists some of the forage taxa which were found to be of particular importance in the diets of various fishes. These can be considered as key organisms in the trophic

structure of the estuary. Calanoid copepods, *Neomysis americana*, various gammarids, and *Crangon septemspinosa* were identified as major characters in the food chains of many of the fish species surveyed, and loss of these organisms would no doubt be reflected in changes in the diversity and species composition of fish populations. This group, which contains planktivores, detritivores, and omnivores, exemplifies the value of a multifaceted primary production base.

Table 11. Fish forage taxa of greater importance in the Little Egg Harbor estuary.

Forage taxon	High importance in the diet of:
Plant material: Algae and plant detritus	Menhaden, mullet, filefish, sheepshead minnow, mummichog
Gastropoda	permit, northern puffer
Mercenaria mercenaria (siphons)	winter flounder
Phyllodocidae	naked goby
Nereis spp.	oyster toadfish, pumpkinseed, bluefish, winter flounder
Capitellidae	naked goby, winter flounder
Terebellidae	winter flounder
Insecta	Atlantic needlefish
Calanoida	alewife, American sand lance, bay anchovy, blueback herring, stickleback
Harpacticoida	spot
Cyathura polita	banded killifish
Idotea spp.	oyster toadfish, striped killifish, tautog, gray snapper
Ampelisca abdita	Atlantic silversides, cunner, winter flounder
Cymadusa compta	seahorse, pipefish
Corophiidae	filefish, white perch
Gammarus mucronatus	rainwater killifish
Elasmopus leavis	cunner, naked goby
Leptocheirus plumulosus	banded killifish, blueback herring, white perch
Neomysis americana	alewife, Atlantic silversides, bay anchovy, crevalle jack, stickleback, pipefish, silver perch, sea robin , summer flounder, white perch, weakfish
Palaemonetes vulgaris	alewife, bluefish, pinfish, silver perch, spotted hake, winter flounder

Table 11. Continued.

Forage taxon	High importance in the diet of:
Crangon septemspinosa	kingfish, sea robin, pinfish, red hake, silver perch, spotted hake, summer flounder, white perch, weakfish, windowpane
Callinectes sapidus	American eel, smooth dogfish, striped burrfish
Neopanope texanna	tautog
Rhithropanopeus harrisii	oyster toadfish
fish eggs	Atlantic silversides, striped killifish, white perch
silversides	Atlantic needlefish, bluefish, northern sennet
anchovies	crevalle jack, weakfish
stickleback	Atlantic needlefish
American sand lance	striped bass
Atlantic menhaden	bluefish, red hake
spot	oyster toadfish
killifish	bluefish, white perch

Of the estuarine food web types characterized by deSylva (1975), the Little Egg Harbor trophic structure appears to be most similar to that of the Delaware River estuary. Most of the invertebrate species identified in Little Egg Harbor are assumedly detritus-feeders; however, the importance of phytoplankton-feeding taxa, including Calanoida and Mysidea, would tend to equalize the value of the phytoplankton base in terms of total energy flow. A quantitative examination of invertebrate diets would serve to identify the relative contribution of each energy pathway in the production of fish. Such a study will be necessary to complete analysis of the Little Egg Harbor trophic structure.

The tidal estuaries of New Jersey, including Little Egg Harbor, are utilized by a large number of migratory fish species; thus, at any given time a substantial portion of the fish biomass in these systems is composed of transient fishes. These include winter flounder, weakfish, bluefish, menhaden, summer flounder, sea bass, and others. Because of this, much of the energy fixed within the estuarine fish fauna is ultimately exported to the ocean (Figure 13).

Since two-thirds of the recreationally and commercially important fish species along the Atlantic coast are estuary-dependent at some life stage (McHugh 1976), the study of estuarine food webs has a number of fish management implications. Fluctuations in the abundance of estuarine forage organisms may have profound effects on the year to year abundance of harvestable fish. In spite of this, management and environmental protection actions have generally been geared to tolerance levels exhibited by target fish species, ignoring the possibly higher sensitivity of their forage base to pollution and habitat loss.

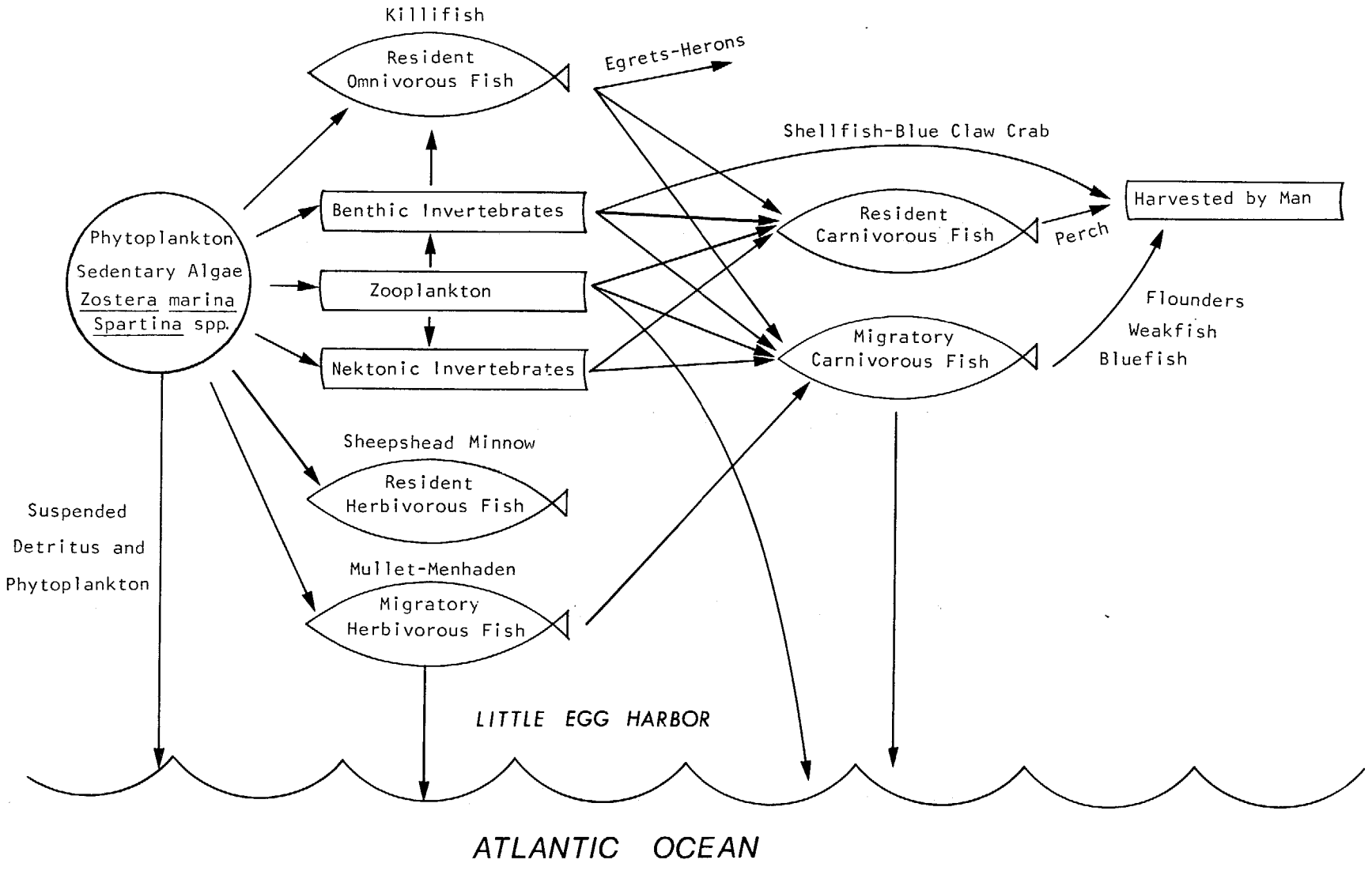

Fig. 13. Pathways of carbon flow through the Little Egg Harbor system.

The concept of forage management in estuaries should be further explored by fisheries scientists. A primary need is the development of systematic methods for evaluating the forage potential of given estuarine areas. The present study provides some insight in this respect:

1) Forage base assessments must consider planktonic, benthic, and nektonic invertebrate populations to provide an accurate picture of fish food potential.

2) Assessments must consider the species composition as well as the densities of these invertebrate populations.

The monitoring of key forage populations in representative estuaries will be a necessary step in developing and implementing predictive models of fish abundance. In New Jersey waters, mysid and Caridean shrimp populations would be obvious candidates. At a minimum, forage species management should include the protection of critical habitats and the maintenance of acceptable water quality conditions. This will require defining optimal salinity, dissolved oxygen, and temperature regimes as well as determining the tolerances of key species to various chemical contaminants. Pertinent data should be catalogued from existing literature and, as necessary, developed through new research. Physical habitat preferences of important forage organisms also need to be defined and this knowledge incorporated in fisheries management activities. Considering the multispecies benefits which might be accrued by shifting invertebrate production from unutilized to heavily utilized forms, the ultimate management concept of actively manipulating populations of forage organisms is deserving of thought.

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The following definitions apply to APPENDIX A and B:

Sample size:	The number of consumer stomachs examined which contained food. Fish with empty stomachs were excluded from the analyses.
% Volume:	Of the total volume of material recovered from the sample of consumer stomachs, the percent composed of the given forage item.
% Occurrence:	Percent of the consumer stomachs which contained the given forage item.
ml x 10^{-4}/fish:	The average volume of the fish forage item recovered from the stomachs of the consumer species.
Ind/fish:	The average number of the given forage organisms recovered from the stomachs of the consumer species.
P.I. Rank:	An estimate of the relative predation impact which the consumer species had upon the population of the forage taxon. Predation impact was determined by multiplying Ind/fish by the proportion of the consumer species in fish population surveys (see text).

APPENDIX A
Allocation of the Forage Base
in Little Egg Harbor
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Diet item	Size range (cm):	% Volume			% Occurrence			Ind/fish		
	Sample size:	6-13	27-34	Total	6-13	27-34	Total	6-13	27-34	Total
		6	5	11	6	5	11	6	5	11
Algae			1.5	1.0		40.0	18.2		29.00*	13.20*
Plant detritus		0.2	1.1	0.8	33.3	20.0	27.0	2.00*	22.00*	10.90*
Class Insecta-all forms		0.2		<0.1	33.3		18.2	0.33		0.18
Family Chironimidae, larvae		0.1		<0.1	16.7		9.1	0.17		0.09
Adult forms		0.1		<0.1	16.7		9.1	0.17		0.09
Subclass Ostracoda			<0.1	<0.1		20.0	9.1		1.40	0.64
Subclass Copepoda, Order Calanoida		<0.1	65.5	44.6	16.7	100.0	54.5	0.83	2,077.80	519.70
Order Mysidacea, *Neomysis americana*		99.5	5.2	35.3	50.0	20.0	36.4	13.67	2.50	8.50
Infraorder Caridea, larval forms		<0.1		<0.1	16.7		9.1	0.17		0.09
Genus *Palaemonetes*-total			21.5	14.6		40.0	18.2		0.60	0.27
Palaemonetes vulgaris			20.7	14.1		20.0	9.1		0.40	0.18
Genus *Palaemonetes* unclassified			0.8	0.5		20.0	9.1		0.20	0.09
Crangon septemspinosa			5.2	3.5		20.0	9.1		0.20	0.09
Infraorder Brachyura, larvae		0.2		<0.1	16.7		9.1	0.83		0.45

*ml x 10^{-4}/fish

American eel, *Anguilla rostrata*
Size range (cm), 11-61
Sample size, 10

Diet item	% Volume	% Occurrence	Ind/fish
Algae	0.1	10.0	50.0*
Plant detritus	0.4	30.0	201.0*
Phylum Nemertea	<0.1	10.0	0.1
Class Gastropoda, *Mitrella lunata*	<0.1	10.0	0.1
Class Pelecypoda, *Mya arenaria*	1.0	10.0	0.1
Order Isopoda, total	0.1	10.0	0.5
Genus *Idotea*	<0.1	10.0	0.3
Genus *Erichsonella*	0.1	10.0	0.2
Suborder Gammaridea, total	0.1	20.0	0.7
Genus *Ampelisca*	<0.1	10.0	0.2
Family Gammaridae, *Gammarus mucronatus*	0.1	10.0	0.4
Unclassified	<0.1	10.0	0.1
Infraorder Brachyura, total	93.9	50.0	0.9
Callinectes sapidus	90.9	40.0	0.5
Family Xanthidea, total	3.0	20.0	0.4
Neopanope texanna	2.0	10.0	0.2
Rhithropanopeus harrisii	0.8	10.0	0.2
Unclassified	0.2	10.0	0.1
Class Osteichthyes, *Syngnathus fuscus*	0.3	10.0	0.1

*ml x 10^{-4}/fish

American sand lance, *Ammodytes americanus*
Size range (cm), 9-12
Sample size, 4

Stomach contents	% Volume	% Occurrence	Ind/fish
Subclass Copepoda, Order Calanoida	100.0	100.0	523.75

Atlantic menhaden, *Brevoortia tyrannus*

		% Occurrence				Ind/fish			
	Size range (cm):	4-8	11-16	25-28	Total	4-8	11-16	25-28	Total
Diet item	Sample size:	19	15	8	42	19	15	8	42
Sediment		21.1	40.0	37.5	31.0				
Algae		68.4	100.0	87.5	83.3				
Plant detritus			26.7	12.5	11.9				
Class Turbellaria		21.1			9.5	0.42			0.19
Class Gastropoda larvae		5.3			2.4	0.11			0.05
Class Polychaeta (excluding larvae)		5.3	6.7		4.8	1.42	0.07		0.66
Family Spionidae		5.3			2.4	1.42			0.64
Unclassified			6.7		2.4		0.07		0.02
Class Polychaeta, larvae		15.8	6.7		9.5	0.58	0.07		0.29
Order Cladocera		26.3			11.9	9.60			4.36

Atlantic menhaden, *Brevoortia tyrannus* continued.

		% Occurrence				Ind/fish			
	Size range (cm):	4-8	11-16	25-28	Total	4-8	11-16	25-28	Total
Diet item	Sample size	19	15	8	42	19	15	8	42
Subclass Copepoda, total		68.4	33.3	75.0	54.8	39.60	28.40	98.75	46.86
Order Calanoida		63.2	20.0	37.5	42.9	19.40	28.30	67.50	31.73
Order Harpacticoidia		21.1	20.0	12.5	19.0	19.40	0.13	0.13	8.83
Unclassified		5.3		25.0	7.1	0.80		31.12	6.30
Subclass Cirripedia, larvae		15.8			7.1	0.21			0.09
Infraorder Brachyura, larvae		5.3			2.4	1.68			0.76

Atlantic needlefish, *Strongylura marina*

		% Volume			% Occurrence			Ind/fish		
	Size range (cm):	5-16	24-58	Total	5-16	24-58	Total	5-16	24-58	Total
Diet item	Sample size:	15	5	20	15	5	20	15	5	20
Class Polychaeta, total		3.2		0.6	20.0		15.0	0.20		0.15
Genus *Nereis*		1.2		0.3	6.7		5.0	0.07		0.05
Unclassified		2.0		0.3	13.3		10.0	0.13		0.10
Class Insecta, adult forms		41.7	11.8	17.8	46.7	60.0	50.0	5.00	8.00	5.25
Order Cladocera		<0.1		<0.1	6.7		5.0	0.67		0.05
Subclass Copepoda, Order Harpacticoidia		<0.1		<0.1	6.7		5.0	1.67		1.25
Infraorder Caridea, larvae		0.1		<0.1	6.7		5.0	2.60		0.45
Crangon septemspinosa			4.9	3.9		40.0	10.0		0.60	0.15

Atlantic needlefish, *Strongylura marina* continued.

		% Volume			% Occurrence			Ind/fish		
	Size range (cm):	5-16	24-58	Total	5-16	24-58	Total	5-16	24-58	Total
Diet item	Sample size:	15	5	20	15	5	20	15	5	20
Infraorder Brachyura, larvae		4.9			20.0		15.0	46.90		35.20
Class Osteichthyes, total		50.0	83.3	76.6	40.0	60.0	45.0	1.47	0.80	1.30
Family Atherinidae		0.8	71.9	57.6	6.7	20.0	10.0	1.07	0.20	0.85
Apeltes quadracus		26.0		5.2	6.7		5.0	2.13		0.10
Strongylura marina		7.7		1.5	13.3		10.0	0.13		0.10
Unclassified		15.5	11.4	12.3	13.3	40.0	20.0	0.13	0.60	0.25

Atlantic silverside, *Menidia menidia*
Size range (cm), 3-13
Sample size, 85

Diet item	% Volume	% Occurrence	Ind/fish
Algae	<0.1	7.1	0.30*
Plant detritus	1.2	10.6	6.00*
Class Hydrozoa	0.5	2.4	2.40*
Class Nematoda	<0.1	1.2	0.01
Class Gastropoda, larval forms	<0.1	2.4	0.56
Class Gastropoda, adult forms	<0.1	1.2	0.01
Class Polychaeta, total	8.0	3.5	0.20
Genus *Nereis*	8.0	2.4	0.19
Unclassified	<0.1	1.2	0.01
Class Insecta	1.1	14.1	0.74
Order Cladocera	<0.1	3.5	1.96
Subclass Ostracoda	<0.1	1.2	0.01
Subclass Copepoda, total	9.2	42.4	101.81
Order Calanoida	9.2	40.0	101.73
Order Harpacticoida	<0.1	7.1	0.08
Subclass Cirripedia, larval forms	<0.1	1.2	0.01
Order Isopoda, *Edotea triloba*	<0.1	1.2	0.01

Atlantic silverside, *Menidia menidia*
Size range (cm), 3-13
Sample size, 85 continued.

Diet item	% Volume	% Occurrence	Ind/fish
Suborder Gammaridea, total	14.4	14.1	4.33
Genus *Ampelisca*, total	10.1	8.2	4.15
Ampelisca abdita	10.0	5.9	4.13
Ampelisca vadorum	<0.1	1.2	0.01
Unclassified	0.1	1.2	0.01
Family Gammaridae, total	0.1	2.4	0.02
Gammarus mucronatus	<0.1	1.2	0.01
Unclassified	0.1	1.2	0.01
Family Photidae	2.2	1.2	0.04
Orchestia platensis	0.5	1.2	0.05
Unclassified	1.5	7.1	0.07
Order Mysidacea, total	13.7	28.2	2.14
Neomysis americana	13.4	22.4	2.07
Unclassified	0.3	4.7	0.07
Infraorder Caridea, larval forms	0.1	5.9	0.42
Genus *Palaemonetes*	<0.1	1.2	0.04
Crangon septemspinosa	12.0	3.5	0.08
Infraorder Brachyura, larval forms	3.1	11.8	5.09
Infraorder Brachyura, Family Xanthidea	5.2	2.4	0.07
Class Osteichthyes, eggs	31.0	12.9	3.86

*ml x 10^{-4}/fish

Banded killifish, *Fundulus diaphanus*
Size range (cm), 3-10
Sample size, 18

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	7.8	55.6	6.80*
Algae	15.7	38.9	13.60*
Plant detritus	6.7	16.7	6.00*
Class Nematoda	<0.1	5.6	0.11
Class Polychaeta	10.1	33.3	0.33
Class Insecta, Family Chironomidae, larvae	2.2	16.7	1.06
Subclass Copepoda	0.2	11.1	0.61
Order Cumacea	3.1	38.9	0.83
Order Isopoda, *Cyathura polita*	10.5	16.7	0.44
Suborder Gammaridea, total	41.3	50.0	5.67
Family Gammaridea	4.3	22.2	0.44
Family Photidae, *Leptocheirus plumulosus*	16.1	22.2	1.72
Unclassified	20.9	44.2	3.51
Class Osteichthyes, eggs	1.1	5.5	0.06

*ml x 10^{-4}/fish

Bay anchovy, *Anchoa mitchilli*
Size range (cm), 5-11
Sample size, 101

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	0.2	5.0	0.20*
Plant detritus	0.2	4.0	0.20*
Class Turbellaria	1.0	41.6	2.38
Class Nematoda	<0.1	2.0	0.02
Class Polychaeta, total excluding larvae	1.0	13.9	0.76
Genus *Nereis*	0.4	4.0	0.05
Family Spionidae	0.2	5.9	0.24
Unclassified	0.4	4.0	0.47
Class Polychaeta, larval forms	1.0	5.0	0.21

Bay anchovy, *Anchoa mitchilli*
Size range (cm), 5-11
Sample size, 101 continued.

Diet item	% Volume	% Occurrence	Ind/fish
Class Insecta, all forms	0.3	6.9	0.10
Larval forms, Family Chironimidae	0.2	6.9	0.09
Adult forms	0.1	1.0	0.01
Order Cladocera	2.2	7.9	35.35
Subclass Ostacoda	0.2	30.7	0.98
Subclass Copepoda, total	53.6	87.1	148.16
Order Calanoida	52.6	77.2	143.83
Order Harpacticoida	0.6	42.6	3.38
Order Cyclopoda	<0.1	2.0	0.02
Unclassified	0.4	3.0	0.93
Subclass Cirripedia, larval forms	<0.1	10.9	0.22
Order Cumacea	<0.1	2.0	0.03
Orders Isopoda and Tanaidacea, total	<0.1	2.0	0.02
Leptochelia savignyi	<0.1	1.0	0.01
Unclassified	<0.1	1.0	0.01
Suborder Gammaridea, total	4.1	11.9	0.33
Genus *Ampelisca*, total	3.2	4.0	0.25
Ampelisca abdita	0.3	1.0	0.01
Unclassified	2.9	1.0	0.24
Family Corophiidae	0.3	4.0	0.04
Family Photidae, *Leptocheirus plumulosus*	0.5	2.0	0.02
Unclassified	0.1	2.0	0.02
Order Mysidacea, total	31.8	22.8	1.38
Neomysis americana	31.5	19.8	1.24
Unclassified	0.3	4.0	0.14
Infraorder Caridea, larval forms	0.2	7.9	0.15
Crangon septemspinosa	<0.1	1.0	0.01
Infraorder Brachyura, larval forms	1.2	20.8	1.78
Class Osteichthyes, eggs	0.5	8.9	0.15

*ml x 10^{-4}/fish

Black sea bass, *Centropristes striatus*
Size range (cm), 6-21
Sample size, 17

Diet item	% Volume	% Occurrence	Ind/fish
Plant detritus	<0.1	5.9	1.80*
Class Pelecypoda	3.9	5.9	0.18
Class Polychaeta	<0.1	11.8	0.12
Order Isopoda, total	3.0	35.3	1.12
Genus *Idotea*	2.9	29.4	1.06
Genus *Erichsonella*	<0.1	5.9	0.06
Suborder Gammaridea, total	0.6	47.1	2.12
Genus *Ampelisca*, total	<0.1	17.7	0.24
Ampelisca abdita	<0.1	11.8	0.18
Ampelisca vadorum	<0.1	5.9	0.06
Family Ampithoidae, total	<0.1	11.8	0.12
Cymadusa compta	<0.1	5.9	0.06
Unclassified	<0.1	5.9	0.06
Family Aoridae, *Microdeutopus gryllotalpa*	<0.1	5.9	0.06
Family Gammaridae, total	0.4	23.5	1.06
Elasmopus leavis	0.2	23.5	0.65
Unclassified	0.2	5.9	0.41
Family Lysianassidae	<0.1	11.8	0.12
Unclassified	0.1	5.9	0.52
Order Mysidacea, *Neomysis americana*	0.5	11.8	0.35
Genus *Palaemonetes*, total	16.2	23.5	0.59
Palaemonetes vulgaris	3.5	11.8	0.18
Unclassified	12.7	11.8	0.41
Crangon septemspinosa	11.6	52.9	0.94
Genus *Pagurus*	1.7	5.9	0.06
Infraorder Brachyura, total	55.2	70.6	1.53
Ovalipes ocellatus	15.7	5.9	0.12
Callinectes sapidus	13.5	11.8	0.12
Family Xanthidea, total	26.0	64.7	1.29
Neopanope texanna	7.8	47.1	0.71
Rhitropanopeous harrisii	7.9	17.6	0.24
Eurypanopeus depressus	0.9	5.9	0.06
Unclassified	9.4	17.6	0.28
Class Osteichthyes, total	7.1	17.6	0.28

*ml x 10^{-4}/fish

Blueback herring, *Alosa aestivalis*
Size range (cm), 7-15
Sample size, 13

Diet item	% Volume	% Occurrence	Ind/fish
Algae	<0.1	7.7	0.40*
Plant detritus	0.2	15.4	0.70*
Class Hydrozoa	<0.1	7.7	0.38*
Class Turbellaria	<0.1	7.7	0.08
Class Polychaeta	<0.1	7.7	0.46
Class Insecta, Family Chironimidae, larvae	0.4	7.7	0.23
Subclass Ostracoda	<0.1	15.4	0.77
Subclass Copepoda, total	48.5	100.0	972.60
Order Calanoida	48.2	100.0	962.90
Order Harpacticoida	0.4	46.2	9.70
Suborder Gammaridea, Family Photidae, *Leptocheirus plumulosus*	9.7	15.4	2.92
Order Mysidacea, total	11.4	30.8	2.08
Neomysis americana	8.0	23.1	1.23
Unclassified	3.4	15.4	0.85
Infraorder Caridea, larval forms	17.5	23.1	38.62

*ml x 10^{-4}/fish

Bluefish, *Pomatomus saltatrix*

	% Volume				% Occurrence				Ind/fish			
Size range (cm):	6-10	11-20	21-36	Total	6-10	11-20	21-36	Total	6-10	11-20	21-36	Total
Diet item Sample size:	16	62	19	97	16	62	19	97	16	62	19	97
Sediment		<0.1		<0.1		1.6		1.0		0.08*		0.05*
Plant detritus	<0.1	0.6	0.6	0.6	6.3	17.7	15.8	15.5	0.30*	60.90*	158.90*	70.20*
Class Turbellaria		<0.1		<0.1		1.6		1.0		0.16		0.10
Class Polychaeta, total	28.6	<0.1		0.5	25.0	3.2		6.2	0.50	0.03		0.10
Genus *Nephtys*	11.2			0.2	6.3			1.0	0.13			0.02
Genus *Nereis*	17.4	<0.1		0.3	18.8	3.2		5.2	0.38	0.03		0.08
Class Insecta, adult forms	0.2			<0.1	6.3			1.0	0.06			0.01

Bluefish, *Pomatomus saltatrix* continued.

	% Volume				% Occurrence				Ind/fish			
Size range (cm):	6-10	11-20	21-36	Total	6-10	11-20	21-36	Total	6-10	11-20	21-36	Total
Diet item Sample size:	16	62	19	97	16	62	19	97	16	62	19	97
Subclass Copepoda, Order Calanoidia	0.2	<0.1		<0.1	18.8	1.6		4.1	9.00	0.02		1.49
Subclass Cirripedia, adult forms		<0.1		<0.1		1.6		1.0		0.02		0.01
Suborder Gammaridea, *Gammarus mucronatus*	0.4			<0.1	6.3			1.0	0.06			0.01
Order Mysidacea, total	0.1	2.8	<0.1	1.5	6.3	12.9	5.3	10.3	0.13	15.90	0.05	10.16
Neomysis americana	0.1	2.1	<0.1	1.1	6.3	9.7	5.3	8.2	0.13	10.30	0.05	6.64
Mysidopsis bigelowi		0.7		0.4		3.2		2.1		5.52		3.53
Infraorder Caridea, larva	3.6			<0.1	18.8			3.1	16.75			2.76
Genus *Palaemonetes*, total	33.5	0.1		0.7	18.8	4.8		6.2	3.38	0.06		0.60
Palaemonetes vulgaris	24.5	0.1		0.5	12.5	3.2		4.1	3.25	0.03		0.56
Palaemonetes pugio	8.9			0.2	6.3			1.0	0.13			0.02
Unclassified		<0.1		<0.1		1.6		1.0		0.03		0.02
Crangon septemspinosa	6.0	5.5	1.8	3.9	18.8	22.6	31.6	23.7	0.31	0.52	0.47	0.47
Infraorder Brachyura, larvae	0.4			<0.1	25.0			4.1	4.06			0.67
Infraorder Brachyura, *Callinectes sapidus*		9.1	12.2	10.3		3.2	10.5	4.1		0.03	0.11	0.04
Class Osteichthyes, eggs	0.7			<0.1	6.3			1.0	6.19			0.20
Class Osteichthyes, adult forms	26.3	81.8	85.5	82.3	37.5	72.6	84.2	69.1	0.63	1.23	1.21	1.12
Family Atherinidae	6.7	10.1		5.6	6.3	9.7		7.2	0.06	0.11		0.08
Genus *Anchoa*		7.9	3.6	5.9		11.3	5.3			0.24	0.05	0.16
Apeltes quadracus		1.1		0.6		3.2		2.1		0.06		0.04
Brevoortia tyrannus		5.4	30.1	16.1		4.8	5.3	4.1	0.05	0.05		0.04
Cynoscion regalis		1.8		1.0		1.6		1.0		0.02		0.01
Leiostomus xanthurus		3.1		1.6		1.6		1.0		0.02		0.01
Genus *Fundulus*		23.7	22.2	22.6		9.7	15.8	9.3		0.19	0.26	0.18
Gobiosoma bosci		1.7		0.9		1.6		1.0		0.05		0.03
Unclassified	19.6	27.0	29.9	28.0	31.3	38.7	63.2	42.3	0.56	0.48	0.89	0.58

*ml x 10^{-4}/fish

Brown bullhead, *Ictalurus nebulosus*
Size range (cm), 20-35
Sample size, 5

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	0.9	40.0	158.0*
Plant detritus	0.1	80.0	23.0*
Phylum Nemertea	0.1	20.0	0.2
Phylum Bryozoa	<0.1	20.0	14.0*
Class Gastropoda, Family Nassariidae	0.1	20.0	0.2
Class Pelecypoda	0.5	20.0	0.2
Class Polychaeta, total	16.0	40.0	25.8
Genus *Nereis*	0.5	20.0	0.2
Family Spionidae	7.1	40.0	20.2
Family Capitellidae	0.1	20.0	0.4
Unclassified	8.3	20.0	5.0
Class Insecta, larval forms, Family Chironimidae	0.2	60.0	0.8
Subclass Copepoda, Order Harpacticoida	<0.1	20.0	0.2
Order Isopoda, total	2.3	80.0	5.6
Cyathura polita	1.7	80.0	3.0
Edotea triloba	0.1	40.0	2.2
Genus *Cirolana*	<0.1	20.0	0.2
Family Oniscidae	0.5	10.0	0.1
Suborder Gammaridea, total	3.4	80.0	15.4
Family Aoridae, *Microdeutopus gryllotalpa*	<0.1	20.0	0.4
Family Photidae, *Leptocheirus plumulosus*	3.3	40.0	14.2
Unclassified	0.1	40.0	0.8
Order Mysidacea, *Neomysis americana*	<0.1	20.0	0.2
Infraorder Brachyura, total	13.4	80.0	1.0
Callinectes sapidus	13.2	20.0	0.2
Unclassified	0.2	60.0	0.8
Class Osteichthyes, total	60.1	80.0	2.2
Genus *Anchoa*	60.1	40.0	1.8
Unclassified	<0.1	40.0	0.4

*ml x 10^{-4}/fish

Crevalle jack, *Caranx hippos*
Size range (cm), 4-13
Sample size, 9

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	<0.1	22.2	1.1*
Order Mysidacea, total	30.4	77.8	31.0
Neomysis americana	30.3	77.8	30.8
Mysidopsis bigelowi	<0.1	22.2	0.2
Crangon septemspinosa	16.2	33.3	0.4
Class Osteichthyes, total	53.3	33.3	0.9
Genus *Anchoa*	44.1	11.1	0.7
Unclassified	9.2	22.2	0.2

*ml x 10^{-4}/fish

Cunner, *Tautogolabrus adspersus*
Size range (cm), 3-5
Sample size, 4

Diet item	% Volume	% Occurrence	Ind/fish
Plant detritus	2.3	25.0	1.30*
Phylum Porifera	2.3	25.0	1.30*
Class Nematoda	0.2	25.0	0.25
Class Polychaeta	2.3	25.0	0.25
Subclass Copepoda, total	0.5	75.0	1.00
Order Calanoida	0.4	50.0	0.75
Order Harpacticoida	0.1	25.0	0.25
Order Isopoda, *Edotea triloba*	12.6	50.0	3.25
Suborder Gammaridea, total	70.5	50.0	5.75
Genus Ampelisca, *A. abdita*	30.6	25.0	1.50
Family Gammaridae, *Elasmopus leavis*	34.9	50.0	2.00
Unclassified	5.0	25.0	2.25
Infraorder Brachyura, larval forms	2.4	25.0	0.75
Unclassified material	6.9		

*ml x 10^{-4}/fish

Fourspine stickleback, *Apeltes quadracus*
Size range (cm), 2-6
Sample size, 76

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	0.6	3.9	0.30*
Algae	0.5	7.9	0.20*
Plant detritus	0.5	5.3	0.20*
Class Turbellaria	0.1	7.9	0.18
Class Nematoda	2.4	10.5	0.59
Class Gastropoda, total	0.3	2.6	0.12
Genus *Bittium*	0.2	1.3	0.01
Genus *Crepidula*	<0.1	1.3	0.11
Class Pelecypoda, Family Mytilidae	3.0	1.3	0.08
Class Oligochaeta	0.3	2.6	0.34
Class Polychaeta, larval forms	<0.1	1.3	0.01
Class Polychaeta, total excluding larvae	6.7	10.5	0.18
Family Phyllodocidae	2.3	1.3	0.01
Family Syllidae	0.1	1.3	0.01
Family Spionidae	0.1	3.9	0.08
Unclassified	4.2	6.6	0.08
Order Acari	<0.1	1.3	0.01
Class Insecta, larval forms, Family Chironimidae	0.3	3.9	0.07
Subclass Ostracoda	<0.1	3.9	0.07
Subclass Copepoda, total	14.9	73.7	19.87
Order Calanoida	12.4	50.0	14.37
Order Harpacticoida	2.0	42.1	4.47
Unclassified	0.5	10.5	1.03
Order Isopoda, total	6.1	3.9	0.04
Genus *Idotea*	6.0	2.6	0.03
Edotea triloba	<0.1	1.3	0.01

Fourspine stickleback, *Apeltes quadracus*
Size range (cm), 2-6
Sample size, 76 continued.

Diet item	% Volume	% Occurrence	Ind/fish
Suborder Gammaridea, total	34.2	29.0	1.11
Genus *Ampelisca, A. vadorum*	3.5	1.3	0.09
Family Ampithoidae, *Cymadusa compta*	6.0	3.9	0.16
Family Aoridae, *Microdeutopus gryllotalpa*	3.2	2.6	0.20
Family Corophiidae	1.8	2.6	0.04
Family Gammaridae, total	0.9	2.6	0.03
Elasmopus laevis	0.6	1.3	0.01
Unclassified	0.3	1.3	0.01
Family Photidae, *Leptocheirus plumulosus*	0.4	1.3	0.01
Suborder Caprellidae	<0.1	2.6	0.03
Order Mysidacea, total	26.0	13.2	0.26
Neomysis americana	25.5	11.8	0.25
Unclassified	0.5	1.3	0.01
Infraorder Caridea, larval forms	<0.1	1.3	0.01
Infraorder Brachyura, Family Xanthidea	0.1	1.3	0.01
Class Osteichthyes, eggs	3.5	1.3	0.04

*ml x 10^{-4}/fish

Golden shiner, *Notemigonus crysoleucas*
Size range (cm), 15-18
Sample size, 3

Diet item	% Volume	% Occurrence	Ind/fish
Algae	1.0	33.3	1.70*
Plant detritus	1.0	33.3	1.70*
Class Polychaeta	22.5	33.3	0.33
Subclass Copepoda, total	20.1	33.3	108.00
Order Calanoida	19.6	33.3	104.33
Order Harpacticoida	0.4	33.3	3.67
Unclassified Material	55.4		

*ml x 10^{-4}/fish

Gray snapper, *Lutjanus griseus*
Size range (cm), 4 and 5
Sample size, 2

Diet item	% Volume	% Occurrence	Ind/fish
Class Pelecypoda	2.4	50.0	0.5
Class Polychaeta, Family Maldanidae	23.7	50.0	0.5
Subclass Copepoda, Order Calanoida	1.9	50.0	0.5
Order Isopoda, Genus *Idotea*	19.0	50.0	0.5
Class Osteichthyes, eggs	24.6	50.0	0.5
Unclassified Material	28.4		

Hogchoker, *Trinectes maculatus*
Size range (cm), 2-17
Sample size, 7

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	2.1	42.9	7.10*
Plant detritus	0.6	28.3	2.10*
Class Polychaeta, total	48.4	57.1	0.57
Genus *Nereis*	5.4	14.3	0.14
Unclassified	43.0	42.9	0.43
Class Insecta, larval forms, Family Chironimidae	6.1	42.9	1.57
Subclass Copepoda, Order Harpacticoida	<0.1	14.3	0.29
Suborder Gammaridea, total	0.9	28.6	0.29
Family Photidae, *Leptocheirus plumulosus*	0.7	14.3	0.14
Unclassified	0.2	14.3	0.14
Unclassified Material	41.9		

*ml x 10^{-4}/fish

Inshore lizardfish, *Synodus foetens*
Size range (cm), 10 and 14
Sample size, 2

Diet item	% Volume	% Occurrence	Ind/fish
Class Osteichthyes, unclassified	100.0	100.0	1.00

Lined seahorse, *Hippocampus erectus*
Size range (cm), 8-12
Sample size, 3

Diet item	% Volume	% Occurrence	Ind/fish
Class Pelecypoda, Family Mytilidae	1.3	33.3	0.33
Class Polychaeta	4.0	33.3	0.33
Suborder Gammaridea, total	71.2	100.0	16.67
Genus *Ampelisca, A. abdita*	13.2	33.3	3.33
Family Ampithoidae, *Cymadusa compta*	56.7	66.7	13.00
Family Corophiidae	1.2	33.3	0.33
Order Mysidacea, *Neomysis americana*	9.0	33.3	0.33
Crangon septemspinosa	13.2	33.3	0.33
Infraorder Brachyura, larval forms	1.3	33.3	0.33

Mummichog, *Fundulus heteroclitus*
Size range (cm), 3-11
Sample size, 34

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	0.7	14.7	1.90*
Algae	1.4	44.1	3.70*
Plant detritus	0.6	14.7	1.50*
Class Hydrozoa	0.1	8.8	0.30*
Class Nematoda	<0.1	14.7	0.21
Class Polychaeta, total	3.3	14.7	0.18
Family Phyllodocidae	<0.1	2.9	0.03
Unclassified	3.3	11.8	0.15

Mummichog, *Fundulus heteroclitus*
Size range (cm), 3-11
Sample size, 34 continued.

Diet item	% Volume	% Occurrence	Ind/fish
Class Insecta, all forms	2.1	32.4	2.00
Larval forms	2.0	29.4	1.94
Family Chironimidae	2.0	26.5	1.88
Unclassified	<0.1	2.9	0.06
Adult forms	0.1	5.9	0.06
Subclass Copepoda, total	<0.1	17.6	0.29
Order Calanoida	<0.1	5.9	0.09
Order Harpacticoida	<0.1	14.7	0.21
Order Isopoda, *Edotea triloba*	0.6	2.9	0.03
Suborder Gammaridea, total	13.9	44.1	1.15
Family Ampithoidae, *Cymadusa compta*	1.6	5.9	0.06
Family Aoridae, *Microdeutopus gryllotalpa*	0.6	2.9	0.29
Family Corophiidae	1.1	2.9	0.09
Family Gammaridae, total	7.1	14.7	0.47
Gammarus mucronatus	6.9	11.8	0.44
Unclassified	0.2	2.9	0.03
Family Photidae, *Leptocheirus plumulosus*	0.3	2.9	0.03
Unclassified	3.2	17.6	0.21
Genus *Palaemonetes, P. pugio*	5.6	2.9	0.03
Crangon septemspinosa	11.2	2.9	0.03
Class Osteichthyes, Genus *Fundulus*	50.4	2.9	0.03
Class Osteichthyes, eggs	3.4	2.9	0.32
Unclassified Material	6.7		

*ml x 10^{-4}/fish

Naked goby, *Gobiosoma bosci*
Size range (cm), 3-5
Sample size, 8

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	1.9	25.0	1.10*
Plant detritus	1.1	12.5	0.60*
Class Turbellaria	1.9	25.0	0.38
Class Polychaeta, total	52.4	25.0	0.50
Family Phyllodocidae	30.6	25.0	0.38
Family Capitellidae	21.8	12.5	0.13
Order Isopoda, *Edotea triloba*	0.3	12.5	0.13
Suborder Gammaridea, total	40.0	50.0	1.88
Genus *Ampelisca, A. abdita*	15.1	37.5	1.25
Family Gammaridae, total	24.9	25.0	0.63
Gammarus mucronatus	2.2	12.5	0.13
Elasmopus laevis	22.7	12.5	0.50
Order Mysidacea, total	2.4	25.0	0.38
Mysidopsis bigelowi	2.2	12.5	0.25
Unclassified	0.2	12.5	0.25

*ml x 10^{-4}/fish

Northern kingfish, *Menticirrhus saxatilis*
Size range (cm), 15 and 19
Sample size, 2

Diet item	% Volume	% Occurrence	Ind/fish
Plant detritus	0.2	50.0	5.0*
Class Polychaeta, total	20.6	50.0	2.0
Family Capitellidae	9.9	50.0	1.0
Glycera americana	9.9	50.0	0.5
Unclassified	0.8	50.0	0.5
Crangon septemspinosa	79.2	100.0	3.0

*ml x 10^{-4}/fish

Northern pipefish, *Syngnathus fuscus*
Size range (cm), 9-21
Sample size, 21

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	<0.1	4.8	0.20*
Algae	0.2	4.8	0.80*
Class Turbellaria	0.9	23.8	1.95
Class Nematoda	<0.1	9.5	0.14
Subclass Copepoda, total	2.1	42.9	18.90
Order Calanoida	1.4	33.3	10.57
Order Harpacticoida	<0.1	19.0	0.43
Unclassified	0.7	4.8	7.90
Order Isopoda, total	0.5	14.3	0.29
Genus *Idotea*	0.3	9.5	0.19
Genus *Erichsonella*	0.1	4.8	0.05
Unclassified	0.1	4.8	0.05
Suborder Gammaridea, total	35.0	47.6	2.19
Genus *Ampelisca*, total	2.4	14.3	0.38
Ampelisca abdita	2.2	9.5	0.33
Unclassified	0.2	4.8	0.05
Family Ampithoidae, *Cymadusa compta*	31.8	9.5	0.86
Family Corophiidae	<0.1	9.5	0.10
Family Gammaridae	<0.1	4.8	0.10
Family Stenothoidae	0.5	4.8	0.67
Suborder Caprellidae	1.4	9.5	0.33
Order Mysidacea, *Neomysis americana*	58.6	47.6	2.95
Infraorder Caridea, larval forms	<0.1	4.8	0.05
Infraorder Brachyura, Family Xanthidea	0.4	4.8	0.05
Infraorder Brachyura, larval forms	0.4	14.3	0.76

*ml x 10^{-4}/fish

Northern puffer, *Sphoeroides maculatus*
Size range (cm), 2-11
Sample size, 3

Diet item	% Volume	% Occurrence	Ind/fish
Plant detritus	2.8	66.7	25.00*
Class Hydrozoa	0.4	66.7	3.33*
Class Turbellaria	<0.1	33.3	0.33
Class Gastropoda, larval forms	<0.1	33.3	3.00
Class Gastropoda, Genus *Crepidula*	55.4	66.7	8.00
Class Polychaeta	18.4	33.3	0.67
Order Cladocera	<0.1	33.3	0.33
Subclass Ostracoda	<0.1	66.7	2.33
Subclass Copepoda, Order Calanoida	<0.1	33.3	0.67
Order Isopoda, total	18.4	66.7	1.33
Genus *Idotea*	<0.1	33.3	0.33
Genus *Erichsonella*	18.4	33.3	1.00
Suborder Gammaridea, total	2.5	66.7	2.33
Genus *Ampelisca, A. vadorum*	1.8	33.3	1.00
Family Corophiidae	<0.1	33.3	0.67
Family Stenothoidae	<0.1	33.3	0.33
Unclassified	0.7	33.3	0.33

*ml x 10^{-4}/fish

Northern sea robin, *Prionotus carolinus*
Size range (cm), 8-18
Sample size, 4

Diet item	% Volume	% Occurrence	Ind/fish
Plant detritus	0.3	50.0	12.50*
Suborder Gammaridea, total	7.6	50.0	6.50
Genus *Ampelisca, A. abdita*	<0.1	25.0	0.25
Family Ampithoidae, *Cymadusa compta*	6.7	50.0	4.50
Family Gammaridae, *Elasmopus leavis*	0.4	25.0	1.50
Monoculodes edwardsi	0.5	25.0	0.25

Northern sea robin, *Prionotus carolinus*
Size range (cm), 8-18
Sample size, 4 continued.

Diet item	% Volume	% Occurrence	Ind/fish
Genus *Palaemonetes, P. vulgaris*	7.9	25.0	0.25
Crangon septemspinosa	80.4	100.0	9.75
Infraorder Brachyura, unclassified adult forms	3.8	25.0	0.75
Infraorder Brachyura, larval forms	<0.1	25.0	0.25

*ml x 10^{-4}/fish

Northern sennet, *Sphyraena borealis*
Size range (cm), 10-17
Sample size, 7

Diet item	% Volume	% Occurrence	Ind/fish
Order Mysidacea, *Neomysis americana*	5.1	14.3	2.57
Class Osteichthyes, total	94.9	71.4	0.71
Family Atherinidae	44.1	28.6	0.29
Unclassified	50.8	42.9	0.42

Oyster toadfish, *Opsanus tau*

		% Volume			% Occurrence			Ind/fish		
	Size range (cm):	4-13	18-28	Total	4-13	18-28	Total	4-13	18-28	Total
Diet item	Sample size:	15	15	30	15	15	30	15	15	30
Plant detritus		2.2	11.7	11.3	26.7	33.3	30.0	28.30*	3,579.30*	1,803.80*
Class Nematoda		2.0	0.7	0.7	60.0	53.3	56.7	2.00	4.73	3.37
Class Gastropoda, total			4.2	4.0		33.3	16.7		0.60	0.30
Genus *Bittium*			<0.1	<0.1		6.7	3.3		0.07	0.03
Genus *Crepidula*			<0.1	<0.1		6.7	3.3		0.07	0.03
Mitrella lunata			<0.1	<0.1		6.7	3.3		0.07	0.03
Family Nassariidae			3.3	3.1		13.3	6.7		0.13	0.07
Haminoea solitaria			0.8	0.8		13.3	6.7		0.27	0.13

Oyster toadfish, *Opsanus tau* continued.

Diet item	Size range (cm):	% Volume			% Occurrence			Ind/fish		
		4-13	18-28	Total	4-13	18-28	Total	4-13	18-28	Total
	Sample size	15	15	30	15	15	30	15	15	30
Class Pelecypoda, *Ensis directus*			0.4	0.4		6.7	3.3		0.07	0.03
Class Polychaeta, total		23.0		0.9	33.3		16.7	0.60		0.30
Genus *Nereis*		20.1		0.8	26.7		13.3	0.47		0.23
Unclassified		2.9		0.1						
Subclass Copepoda, Order Harpacticoida		<0.1		<0.1	6.7		3.3	0.80		0.40
Orders Tanaidacea and Isopoda, total		19.9	2.9	3.6	46.7	33.3	40.0	0.87	2.53	1.70
Cyathura polita		6.1		0.2	20.0		10.0	0.33		0.17
Genus *Idotea*		13.8	2.4	2.9	26.7	33.3	30.0	0.53	1.93	1.23
Genus *Erichsonella*			0.4	0.4		20.0	10.0		0.60	0.30
Suborder Gammaridea, total		0.7	0.5	0.5	13.3	33.3	23.3	0.27	1.53	0.90
Family Ampithoidae, *Cymadusa compta*		0.4	0.2	0.2	6.7	6.7	6.7	0.13	1.20	0.67
Unclassified		0.3	0.3	0.3	6.7	26.7	16.7	0.13	0.33	0.23
Genus *Palaemonetes*, total			1.0	1.0		20.0	10.0		0.20	0.10
Palaemonetes vulgaris			0.4	0.4		6.7	3.3		0.07	0.03
Palaemonetes pugio			0.5	0.5		6.7	3.3		0.07	0.03
Unclassified			0.1	0.1		6.7	3.3		0.07	0.03
Crangon septemspinosa		10.4		0.4	20.0		10.0	0.27		0.13
Infraorder Brachyura, total		39.5	22.4	23.1	40.0	33.3	36.7	0.67	0.87	0.76
Callinectes sapidus		2.6	12.4	12.0	6.7	13.3	10.0	0.07	0.13	0.10
Family Xanthidea, total		36.9	10.0	11.1	33.3	26.7	30.0	0.60	0.73	0.67
Neopanope texanna		3.2	9.1	8.9	13.3	13.3	13.3	0.13	0.60	0.37
Rhithropanopeus harrisii		28.5	0.5	1.6	13.3	6.7	10.0	0.33	0.07	0.20
Unclassified		5.2	0.4	0.6	6.7	6.7	6.7	0.13	0.07	0.10
Class Osteichthyes, eggs		<0.1		<0.1	13.3		6.7	0.47		0.23
Class Osteichthyes, total except eggs		0.7	55.6	53.4	13.3	26.7	20.0	0.13	0.60	0.37
Apeltes quadracus			0.8	0.7		6.7	3.3		0.07	0.03
Leiostomus xanthurus			54.4	52.2		13.3	6.7		0.47	0.23
Unclassified		0.7	0.4	0.5	13.3	6.7	10.0	0.13	0.07	0.10

*ml x 10^{-4}/fish

Permit, *Trachinotus falcatus*
Size range (cm), 8
Sample size, 1

Diet item	% Volume	% Occurrence	Ind/fish
Class Gastropoda, total	100.0	100.0	16.0
Genus *Crepidula*	99.0	100.0	15.0
Mitrella lunata	1.0	100.0	1.0

Pinfish, *Logodon rhomboides*
Size range (cm), 6-11
Sample size, 3

Diet item	% Volume	% Occurrence	Ind/fish
Suborder Gammaridea, total	6.5	100.0	2.33
Genus *Ampelisca*, total	0.4	66.7	1.00
Ampelisca abdita	0.4	33.3	0.67
Unclassified	<0.1	33.3	0.33
Family Corophiidae	5.5	33.3	1.00
Family Gammaridae	0.6	33.3	0.33
Genus *Palaemonetes, P. vulgaris*	60.3	33.3	1.33
Crangon septemspinosa	33.3	66.7	1.33

Planehead filefish, *Monacanthus hispidus*
Size range (cm), 5 and 13
Sample size, 2

Diet item	% Volume	% Occurrence	Ind/fish
Algae	39.7	50.0	500.00*
Class Hydrozoa	19.8	50.0	250.00*
Class Pelecypoda	9.9	50.0	0.50
Suborder Gammaridea, total	20.5	100.0	10.50
Family Aoridae, *Microdeutopus gryllotalpa*	0.3	50.0	0.50
Family Corophiidae	20.2	100.0	10.00
Suborder Caprellidae	0.1	50.0	0.50
Unclassified material	10.1		

*ml x 10^{-4}/fish

Pumpkinseed, *Lepomis gibbosus*
Size range (cm), 9 and 10
Sample size, 2

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	0.4	100.0	5.0*
Plant detritus	0.2	50.0	2.5*
Class Oligochaeta	0.4	50.0	0.5
Class Polychaeta, total	79.6	100.0	8.0
Genus *Nereis*	50.3	50.0	1.0
Hypaniola grayi	21.0	50.0	6.5
Unclassified	8.3	50.0	0.5
Class Insecta, larval forms, Family Chironimidae	1.3	50.0	1.0
Suborder Gammaridea, total	15.9	50.0	21.0
Family Gammaridae	8.4	50.0	6.0
Family Photidae, *Leptocheirus plumulosus*	7.5	50.0	15.0

*ml x 10^{-4}/fish

Rainwater killifish, *Lucania parva*
Size range (cm), 3-4
Sample size, 9

Diet item	% Volume	% Occurrence	Ind/fish
Algae	3.5	22.2	0.70*
Class Turbellaria	3.1	22.2	0.22
Class Polychaeta, Genus *Nereis*	11.8	11.1	0.11
Class Insecta, larval forms, Family Chironimidae	4.2	22.2	0.89
Subclass Copepoda, total	5.0	44.4	2.67
Order Calanoida	3.9	22.2	1.78
Order Harpacticoida	1.1	22.2	0.89
Suborder Gammaridea, *Gammarus mucronatus*	61.8	66.7	2.89
Order Mysidacea	10.6	11.1	0.11

* ml x 10^{-4}/fish

Red hake, *Urophycis chuss*
Size range (cm), 8-20
Sample size, 3

Diet item	% Volume	% Occurrence	Ind/fish
Class Nematoda	0.2	33.3	2.00
Suborder Gammeridea, *Cymadusa compta*	5.5	33.3	0.67
Crangon septemspinosa	39.9	66.7	5.33
Class Osteichthyes, *Brevoortia tyrannus*	54.5	33.3	0.33

Redfin pickerel, *Esox americanus americanus*
Size range (cm), 26
Sample size, 1

Diet item	% Volume	% Occurrence	Ind/fish
Class Osteichthyes	100.0	100.0	1.0

Scup, *Stenotomus chrysops*
Size range (cm), 14
Sample size, 1

Diet item	% Volume	% Occurrence	Ind/fish
Class Pelecypoda, Family Veneridae	0.1	100.0	2.0
Class Polychaeta, total	37.6	100.0	4.0
Family Maldanidae	37.5	100.0	3.0
Family Terebellidae	<0.1	100.0	1.0
Order Isopoda, *Cyathura polita*	2.3	100.0	1.0
Suborder Gammaridea, Genus *Ampelisca*	1.0	100.0	1.0
Order Mysidacea, *Neomysis americana*	7.5	100.0	5.0
Class Osteichthyes	22.5	100.0	1.0
Unclassified material	29.0		

Sheepshead minnow, *Cyprinodon variegatus*
Size range (cm), 3-5
Sample size, 29

Diet item	% Occurrence
Sediment	20.7
Algae	96.6
Plant detritus	34.5
Class Hydrozoa	13.8
Class Insecta, larval forms, Family Chironimidae	3.4
Subclass Copepoda, total	27.6
Order Calanoida	10.3
Order Harpacticoida	13.8

Silver perch, *Bairdiella chrysura*
Size range (cm), 3-12
Sample size, 26

Diet item	% Volume	% Occurrence	Ind/fish
Class Gastropoda, Genus *Bittium*	<0.1	3.8	0.04
Class Polychaeta, Genus *Nereis*	0.3	3.8	0.04
Subclass Copepoda, total	<0.1	11.5	1.38
Order Calanoida	<0.1	11.5	1.35
Order Harpacticoida	<0.1	3.8	0.04
Order Isopoda, Genus *Idotea*	0.1	3.8	0.04
Suborder Gammaridea, total	1.9	34.6	1.23
Genus *Ampelisca*, total	0.2	15.4	0.69
Ampelisca abdita	<0.1	7.7	0.62
Ampelisca vadorum	0.1	7.7	0.08
Family Ampithoidae, total	1.7	19.2	0.34
Cymadusa compta	0.5	15.4	0.19
Unclassified	1.2	3.8	0.15
Family Corophiidae	<0.1	11.5	0.08
Family Gammaridae, *Gammarus mucronatus*	<0.1	3.8	0.04
Family Stenothoidae	<0.1	3.8	0.04
Order Mysidacea, total	20.4	57.7	14.04
Neomysis americana	18.3	42.3	11.81
Mysidopsis bigelowi	2.1	23.1	2.23
Genus *Palaemonetes*, total	16.8	19.2	0.42
Palaemonetes vulgaris	12.3	11.5	0.19
Palaemonetes pugio	3.4	3.9	0.08
Unclassified	1.1	3.9	0.15
Crangon septemspinosa	43.6	53.9	1.73
Class Osteichthyes	14.5	15.4	0.19

Smooth dogfish, *Mustelus canis*
Size range (cm), 39-56
Sample size, 12

Diet item	% Volume	% Occurrence	Ind/fish
Class Pelecypoda	0.1	8.3	0.08
Class Polychaeta	<0.1	8.3	0.08
Genus *Palaemonetes, P. vulgaris*	0.6	25.0	0.58
Crangon septemspinosa	0.4	25.0	0.50
Infraorder Brachyura, *Callinectes sapidus*	90.7	83.3	1.33
Class Osteichthyes, total	2.5	16.7	0.17
Cynoscion regalis	2.1	8.3	0.08
Unclassified	0.4	8.3	0.08
Unclassified material	5.7		

Spot, *Leiostomus xanthurus*

	% Volume			% Occurrance			Ind/fish		
Size range (cm):	3-10	11-19	Total	3-10	11-19	Total	3-10	11-19	Total
Diet item Sample size:	48	44	92	48	44	92	48	44	92
Sediment	1.1	0.8	0.86	10.4	9.1	9.7	1.10*	3.40*	2.20*
Algae		<0.1	<0.1		2.3	1.1		0.10*	0.05*
Plant detritus	0.1	0.4	0.36	2.1	34.1	17.4	0.10*	1.80*	0.92*
Class Hydrozoa	0.2	0.1	0.1	4.2	11.4	7.6	0.21*	0.57*	0.38*
Class Turbellaria	0.3	0.1	0.2	10.4	11.4	10.9	0.21	0.32	0.26
Class Nematoda	1.7	1.1	1.3	50.0	50.0	50.0	20.90	28.00	24.30
Class Gastropoda, unclassified		<0.1	<0.1		2.3	1.1		0.07	0.03
Class Gastropoda, larval forms	<0.1	<0.1	<0.1	2.1	2.3	2.2	0.02	1.25	0.61
Class Pelecypoda, larval forms		<0.1	<0.1		2.3	1.1		0.59	0.28
Class Pelecypoda, adult forms, total	2.4	5.7	5.0	10.4	6.8	8.7	0.31	1.68	0.97
Family Mytilidae		<0.1	<0.1		2.3	1.1		0.02	0.01
Family Veneridae	1.7	2.9	2.7	4.2	2.3	3.3	0.15	1.59	0.84
Siphons		2.7	2.1		2.3	1.1		0.05	0.02
Unclassified	0.7	0.1	0.2	6.3	2.3	4.3	0.15	0.02	0.10
Class Oligochaeta		4.2	3.3		6.8	3.3		3.09	1.48

Spot, *Leiostomus xanthurus* continued.

		% Volume			% Occurrence			Ind/fish		
	Size range (cm):	3-10	11-19	Total	3-10	11-19	Total	3-10	11-19	Total
Diet item	Sample size:	48	44	92	48	44	92	48	44	92
Class Polychaeta, larvae		<0.1		<0.1	2.1		1.1	0.02		0.01
Class Polychaeta, adult forms, total		6.4	29.4	24.3	29.2	31.8	30.4	1.10	6.32	3.60
Family Phyllodocidae		0.2	0.7	0.6	6.3	6.8	6.5	0.15	0.16	0.15
Family Syllidae			<0.1	<0.1		2.3	1.1		0.02	0.01
Genus *Nephthys*			2.7	2.1		2.3	1.1		0.02	0.01
Genus *Nereis*		0.3	3.7	2.9	2.1	6.8	4.3	0.06	0.07	0.07
Family Spionidae			6.9	5.4		4.5	2.2		4.84	2.32
Hypaniola grayi		4.6	5.8	5.5	4.2	4.5	4.3	0.60	0.75	0.67
Unclassified		1.3	9.6	7.8	16.7	18.2	17.4	0.29	0.45	0.37
Class Insecta, larvae total		<0.1	0.9	0.7	2.1	18.2	9.8	0.02	0.50	0.25
Family Chironomidae, larvae		<0.1	0.5	0.4	2.1	13.6	7.6	0.02	0.32	0.16
Unclassified larvae			0.4	0.3		4.5	2.2		0.18	0.09
Order Cladocera		<0.1		<0.1	2.1		1.1	0.02		0.01
Subclass Ostracoda		<0.1	<0.1	<0.1	4.2	9.1	6.5	0.35	0.27	0.32
Subclass Copepoda, total		33.5	11.2	16.1	91.7	70.5	81.5	170.30	204.10	186.50
Order Calanoida		0.4	0.9	0.8	4.2	29.5	16.3	1.42	11.68	6.33
Order Harpacticoida		13.7	10.3	11.0	35.4	59.1	46.7	88.17	191.45	137.60
Order Cyclopoda			<0.1	<0.1		2.3	1.1		0.05	0.02
Unclassified		19.4	<0.1	4.3	56.3	2.3	30.4	80.71	0.92	42.60
Order Cumacea		2.9	0.1	0.7	12.5	4.5	8.7	0.50	0.09	0.30
Orders Tanaidacea and Isopoda, total		1.1	2.1	1.9	12.5	15.9	14.1	0.17	1.77	0.93
Tanais cavolini			1.1	0.9		9.1	4.3		1.64	0.78
Cyathura polita		0.5	1.0	0.9	8.3	9.1	8.7	0.10	0.11	0.11
Edotea triloba		0.2	<0.1	<0.1	2.1	2.3	2.2	0.02	0.02	0.02
Genus *Erichsonella*		0.4		<0.1	2.1		1.1	0.04		0.02

Spot, *Leiostomus xanthurus* continued.

Diet item	Size range (cm):	% Volume			% Occurrence			Ind/fish		
		3-10	11-19	Total	3-10	11-19	Total	3-10	11-19	Total
	Sample size:	48	44	92	48	44	92	48	44	92
Suborder Gammaridea, total		49.5	14.7	22.3	68.8	59.1	64.1	16.06	28.27	21.90
Genus *Ampelisca*, total		32.5	13.2	17.4	33.3	36.4	34.8	10.94	26.14	18.20
Ampelisca abdita		4.1	8.9	7.9	4.2	15.9	9.8	2.85	22.10	12.00
Unclassified		28.4	4.3	9.5	29.2	20.5	25.0	8.09	4.04	6.20
Family Aoridae, *Microdeutopus gryllotalpa*		0.4	0.2	0.2	4.2	4.5	4.3	0.10	0.05	0.08
Family Corophiidae		<0.1	0.6	0.5	2.1	18.2	9.8	0.02	0.89	0.43
Family Gammaridae, total		1.0	0.2	0.4	4.2	9.1	6.5	0.25	0.52	0.38
Elasmopus laevis			0.2	0.2		6.8	3.3		0.50	0.24
Unclassified		1.0	<0.1	0.2	4.2	2.3	3.3	0.25	0.02	0.14
Family Photidae, *Leptocheirus plumulosus*		0.2	0.2	0.2	2.1	6.8	4.3	0.15	0.30	0.22
Unclassified		15.4	0.3	3.6	39.6	20.5	30.4	4.60	0.37	2.59
Order Mysidacea, total		0.1	8.9	6.9	2.1	20.5	10.9	0.02	3.27	1.58
Neomysis americana			6.1	4.8		15.9	7.6		2.61	1.25
Mysidopsis bigelowi			2.7	2.1		2.3	1.1		0.57	0.27
Unclassified		0.1	<0.1	<0.1	2.1	2.3	2.2	0.02	0.09	0.06
Infraorder Caridea, larvae			<0.1	<0.1		2.3	1.1		0.02	0.01
Crangon septemspinosa			2.2	1.7		2.3	1.1		0.02	0.01
Infraorder Brachyura, total		0.1	5.4	4.3	2.1	2.3	2.2	0.02	0.02	0.02
Family Xanthidea unclassified		0.1			2.1		1.1	0.02		0.01
Unclassified			5.4	4.3		2.3	1.1		0.02	0.01
Class Osteichthyes, eggs		<0.1		<0.1	2.1		1.1	0.02		0.01
Class Osteichthyes, except eggs			<0.1	<0.1		2.3	1.1		0.02	0.01

*ml x 10^{-4}/fish

Spotted hake, *Urophycis regius*
Size range (cm), 5-19
Sample size, 16

Diet item	% Volume	% Occurrence	Ind/fish
Plant detritus	1.9	12.5	31.60*
Class Nematoda	<0.1	18.8	0.38
Subclass Ostracoda	<0.1	6.3	0.13
Subclass Copepoda, Order Calanoida	0.1	25.0	3.75
Orders Tanaidacea and Isopoda	0.5	18.8	0.19
Suborder Gammaridea, total	1.3	31.3	0.69
Genus *Ampelisca*, total	0.7	12.5	0.31
Ampelisca vadorum	0.5	6.3	0.13
Unclassified	0.2	6.3	0.18
Family Ampithoidae, *Cymadusa compta*	0.6	18.8	0.31
Family Hyalidae	<0.1	6.3	0.06
Order Mysidacea, *Neomysis americana*	10.6	31.3	3.63
Genus *Palaemonetes*, total	33.8	12.5	0.44
Palaemonetes vulgaris	18.8	12.5	0.38
Palaemonetes pugio	15.0	6.3	0.06
Crangon septemspinosa	47.7	50.0	1.63
Infraorder Brachyura, Family Xanthidea	5.6	6.3	0.06
Class Osteichthyes, total	5.7	25.0	0.25
Apeltes quadracus	3.8	12.5	0.13
Unclassified	1.9	12.5	0.13

*ml x 10^{-4}/fish

Striped bass, *Morone saxatilis*
Size range (cm), 43-58
Sample size, 11

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	<0.1	9.1	90.90*
Class Pelecypoda, Family Mytilidae	0.3	9.1	0.09
Class Polychaeta	0.1	9.1	0.09
Crangon septemspinosa	5.9	36.4	3.27
Class Osteichthyes, total	93.9	81.8	4.18
Family Atherinidae	2.6	9.1	0.09
Ammodytes americanus	30.0	54.5	2.18
Family Bothidae	3.8	9.1	0.18
Cynoscion regalis	18.1	9.1	0.18
Unclassified	39.4	45.5	1.55

*ml x 10^{-4}/fish

Striped burrfish, *Chilomycterus schoepfi*
Size range (cm), 23 and 25
Sample size, 2

Diet item	% Volume	% Occurrence	Ind/fish
Plant detritus	1.3	100.0	585.00*
Class Gastropoda, Family Nassariidae	1.7	50.0	0.50
Class Pelecypoda, Family Mytilidae	1.1	50.0	0.50
Order Isopoda, Genus *Idotea*	0.6	50.0	1.00
Suborder Gammaridea, Family Ampithoidae	<0.1	50.0	0.50
Genus *Pagurus*	2.2	50.0	1.00
Infraorder Brachyura, total	93.1	100.0	4.00
Callinectes sapidus	83.2	50.0	1.00
Family Xanthidea, total	10.0	100.0	3.00
Neopanope texanna	5.5	50.0	1.50
Rhithropanopeus harrisii	3.3	50.0	1.00
Unclassified	1.2	50.0	1.50

*ml x 10^{-4}/fish

Striped killifish, *Fundulus majalis*
Size range (cm), 4-13
Sample size, 13

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	9.4	46.2	12.00*
Plant detritus	0.6	15.4	0.80*
Class Hydrozoa	0.3	7.7	0.38*
Class Turbellaria	0.3	10.8	0.22
Class Nematoda	0.1	30.8	1.69
Class Polychaeta, total except larvae	10.8	38.5	2.38
Hypaniola grayi	0.1	7.7	0.23
Unclassified	10.7	30.8	2.15
Class Polychaeta, larval forms	0.3	7.7	0.08
Class Insecta, Family Chironimidae, larvae	4.0	15.4	0.15
Class Copepoda, Order Harpacticoida	0.4	15.4	4.38
Orders Tanaidacea and Isopoda, total	16.8	30.8	1.54
Tanais cavolini	0.4	7.7	0.08
Genus *Idotea*	14.6	15.4	1.38
Edotea triloba	1.8	7.7	0.08
Suborder Gammaridea, total	11.8	38.5	1.23
Family Ampithoidae, *Cymadusa compta*	6.1	15.4	0.85
Family Aoridae, *Microdeutopus gryllotalpa*	4.3	7.7	0.15
Family Corophiidae	0.8	7.8	0.08
Family Gammaridae, *Elasmopus laevis*	0.8	7.7	0.15
Suborder Caprellidae	0.3	7.7	0.08
Class Osteichthyes, eggs	31.6	15.4	0.54
Unclassified material	13.0		

*ml x 10^{-4}/fish

Striped mullet, *Mugil cephalus*
Size range (cm), 11-16
Sample size, 4

Diet item	% Occurrence
Sediment	100
Algae	100

Striped sea robin, *Prionotus evolans*
Size range (cm), 4-7
Sample size, 3

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	1.4	33.3	1.70*
Class Turbellaria	4.5	33.3	3.67
Class Copepoda, Order Calanoida	0.4	33.3	1.00
Suborder Gammaridea, total	11.7	66.7	3.00
Genus *Ampelisca, A. abdita*	5.7	33.3	1.33
Family Aoridae	5.7	33.3	1.33
Family Stenothoidae	0.3	33.3	0.33
Order Mysidacea, total	76.3	100.0	6.33
Neomysis americana	42.2	66.7	3.00
Mysidopsis bigelowi	34.2	33.3	3.33
Crangon septemspinosa	5.7	33.3	0.33
Infraorder Brachyura, Family Xanthidae, *Eurypanopeus depressus*	3.0	33.3	0.67

*ml x 10^{-4}/fish

Summer flounder, *Paralichthys dentatus*

Diet item	Size range (cm):	% Volume			% Occurrence			Ind/fish		
		6-24	26-65	Total	6-24	26-65	Total	6-24	26-65	Total
	Sample size:	25	13	38	25	13	38	25	13	38
Plant detritus		0.2	1.1	0.9	24.0	38.5	28.9	9.80	770.00*	92.60*
Class Nematoda		<0.1		<0.1	4.0		2.6	0.04		0.03
Phylum Bryozoa		<0.1		<0.1	4.0		2.6	0.20*		0.13*
Suborder Gammaridea, total		0.5	<0.1	<0.1	32.0	7.7	23.7	1.08	0.08	0.74
Genus *Ampelisca*, *Ampelisca abdita*		<0.1		<0.1	8.0		5.3	0.08		0.05
Family Ampithoidae, *Cymadusa compta*		0.1		<0.1	4.0		2.6	0.04		0.03
Family Corophiidae		<0.1	<0.1	<0.1	4.0	7.7	5.3	0.12	0.08	0.11
Family Gammaridae		<0.1		<0.1	4.0		2.6	0.08		0.05
Family Photidae, *Leptocheirus plumulosus*		0.4		<0.1	12.0		7.9	0.76		0.50
Order Mysidacea, total		14.2	0.4	2.3	52.0	23.1	42.1	41.68	1.69	28.00
Neomysis americana		12.8	0.4	2.2	44.0	23.1	36.8	36.28	1.69	24.44
Mysidopsis begelowi		1.4		0.1	12.0		7.9	5.36		3.53
Unclassified		<0.1		<0.1	4.0		2.6	0.04		0.03
Penaeus sp.		2.5		0.4	4.0		2.6	0.04		0.03
Genus *Palaemonetes*, total		16.5	1.4	3.5	12.0	7.7	10.5	0.28	0.54	0.37
Palaemonetes vulgaris		10.0	1.4	2.6	8.0	7.7	7.9	0.20	0.54	0.32
Palaemonetes pugio		5.5		0.8	4.0		2.6	0.04		0.03
Unclassified		1.0		0.1	4.0		2.6	0.04		0.03
Crangon septemspinosa		27.6	6.9	9.8	40.0	53.9	44.7	2.56	3.92	3.03
Genus *Pagurus*			0.1	0.1		7.7	2.6		0.08	0.03
Infraorder Brachyura, total		5.5	14.2	13.0	20.0	30.8	23.7	0.44	0.31	0.39
Callinectes sapidus		0.3	13.6	11.8	4.0	7.7	5.3	0.08	0.08	0.08
Family Xanthidea, total		5.2	0.5	1.2	16.0	23.1	18.4	0.36	0.23	0.32
Neopanope texanna		1.9	0.5	0.7	8.0	15.4	10.5	0.16	0.15	0.16
Rhithropanopeus harrisii		3.2	<0.1	0.5	12.0	7.7	10.5	0.20	0.08	0.16

Summer flounder, *Paralichthys dentatus* continued.

	% Volume			% Occurrence			Ind/fish		
Size range (cm):	6-24	26-65	Total	6-24	26-65	Total	6-24	26-65	Total
Diet item Sample size:	25	13	38	25	13	38	25	13	38
Class Osteichthyes, total	32.6	74.3	68.5	36.0	69.2	47.4	0.60	1.69	0.97
Family Atherinidae	1.9	3.4	3.2	4.0	7.7	5.3	0.04	0.15	0.08
Genus *Anchoa*	8.1	6.5	6.7	4.0	15.3	7.9	0.04	0.08	0.05
Apeltes quadracus	4.5	1.7	2.1	12.0	15.4	13.2	0.20	0.38	0.26
Bairdiella chrysura		8.9	7.7		7.7	2.6		0.23	0.08
Genus *Prionotus*		43.4	37.4		15.4	5.3		0.15	0.05
Pseudopleuronectes americanus		8.4	7.2		7.7	2.6		0.15	0.05
Syngnathus fuscus		1.0	0.9		7.7	2.6		0.08	0.03
Unclassified	18.1	2.0	3.3	24.0	23.1	23.7	0.32	0.46	0.37

*ml x 10^{-4}/fish

Tautog, *Tautoga onitis*

	% Volume			% Occurrence			Ind/fish		
Size range (cm):	6-16	20-32	Total	6-16	20-32	Total	6-16	20-32	Total
Diet item Sample size:	18	7	25	18	7	25	18	7	25
Sediment	<0.1	0.1	0.1	5.6	14.3	8.0	1.50*	19.20*	6.50*
Plant detritus	<0.1	2.3	1.8	16.7	85.7	36.0	0.80*	306.40*	86.40*
Class Nematoda	0.9	<0.1	0.2	55.6	42.9	52.0	13.89	4.71	11.32
Phylum Bryozoa		2.1	1.6		28.6	8.0		285.71*	80.00*
Class Gastropoda, total		0.7	0.5		42.9	12.0		5.43	1.52
Genus *Bittium*		0.1	<0.1		28.6	8.0		1.57	0.44
Genus *Crepidula*		0.6	0.5		42.9	12.0		3.86	1.08
Class Pelecypoda, total		0.5	0.4		14.3	4.0		0.29	0.08
Solemya velum		0.5	0.4		14.3	4.0		0.14	0.04
Unclassified		<0.1	<0.1		14.3	4.0		0.14	0.04

Tautog, *Tautoga onitis* continued.

Diet item	Size range (cm):	% Volume			% Occurrence			Ind/fish		
		6-16	20-32	Total	6-16	20-32	Total	6-16	20-32	Total
	Sample size:	18	7	25	18	7	25	18	7	25
Class Polychaeta, total		3.6	1.2	1.7	11.1	42.9	20.0	0.17	0.57	0.28
Genus *Nereis*			<0.1	<0.1		14.3	4.0		0.14	0.04
Genus *Lumbrineris*			1.0	0.8		14.3	4.0		0.29	0.08
Unclassified		3.6	0.2	0.9	11.1	14.3	12.0	0.17	0.14	0.16
Subclass Copepoda, total		<0.1		<0.1	11.1		8.0	0.17		0.12
Order Calanoida		<0.1		<0.1	11.1		8.0	0.11		0.08
Order Harpacticoida		<0.1		<0.1	5.6		4.0	0.06		0.04
Subclass Cirripedia, adult forms		0.6		0.1	5.6		4.0	0.11		0.08
Orders Tanaidacea and Isopoda		63.3	1.7	15.5	55.6	42.9	52.0	3.56	1.00	2.84
Genus *Idotea*		47.2	1.0	11.4	33.3	14.3	28.0	2.17	0.42	1.68
Genus *Erichsonnella*		15.7	0.6	4.0	33.3	28.6	32.0	1.22	0.42	1.00
Unclassified		0.4	<0.1	0.1	11.1	14.3	12.0	0.17	0.14	0.16
Suborder Gammaridea, total		7.8	<0.1	1.8	72.2	42.9	64.0	7.83	0.57	5.80
Genus *Ampelisca, A. abdita*		<0.1		<0.1	5.6		4.0	0.11		0.08
Family Ampithoidae, *Cymadusa compta*		6.2	<0.1	1.4	22.2	14.3	20.0	3.67	0.14	2.68
Family Aoridae, total		<0.1	<0.1	<0.1	5.6	14.3	8.0	0.17	0.14	0.16
Microdeutopus gryllotalpa		<0.1		<0.1	5.6		4.0	0.17		0.12
Unclassified			<0.1	<0.1		14.3	4.0		0.14	0.04
Family Corophiidae		1.1		0.2	27.8		20.0	2.00		1.44
Family Gammaridae, total		0.04	<0.1	<0.1	11.1	14.3	12.0	1.00	0.29	0.80
Elasmopus laevis		<0.1	<0.1	<0.1	5.6	14.3	8.0	0.22	0.29	0.24
Maera danae		0.4		<0.1	5.6		4.0	0.77		0.56
Unclassified		0.1		<0.1	11.1		8.0	0.88		0.64
Crangon septemspinosa		3.7	<0.1	0.9	11.1	28.6	16.0	0.11	0.29	0.16
Infraorder Brachyura, total		23.1	87.1	72.7	44.4	100.0	60.0	1.39	7.86	3.20
Ovalipes ocellatus			12.6	9.8		14.3	4.0		0.43	0.12
Callinectes sapidus		<0.1	7.3	5.7	5.6	28.6	12.0	0.06	0.29	0.12
Family Xanthidea, total		21.3	67.1	56.9	33.3	100.0	52.0	1.28	7.14	2.92
Neopanope texanna			28.1	21.8		57.1	16.0		2.57	0.72
Rhithropanopeus harrisii			11.2	8.7		28.6	8.0		1.43	0.40
Unclassified		21.3	27.8	26.4	33.3	42.9	36.0	1.28	3.14	1.80
Unclassified					5.6		4.0	0.06		0.04
Class Osteichthyes unclassified		<0.1		<0.1	5.6		4.0	0.06		0.04

*ml x 10^{-4}/fish

Threespine stickleback, *Gasterosteus aculeatus*
Size range (cm), 5-7
Sample size, 6

Diet item	% Volume	% Occurrence	Ind/fish
Algae	2.0	16.7	0.90*
Class Copepoda, total	12.3	83.3	11.50
Order Calanoida	12.0	66.7	11.00
Order Harpacticoida	0.2	16.7	0.33
Unclassified	0.1	16.7	0.17
Suborder Gammaridea, total	25.1	33.3	0.33
Family Gammaridae	21.1	16.7	0.17
Unclassified	4.0	16.7	0.17
Order Mysidacea, *Neomysis americana*	56.5	66.7	1.17

*ml x 10^{-4}/fish

Tidewater silverside, *Menidia beryllina*
Size range (cm), 4-9
Sample size, 37

Diet item	% Volume	% Occurrence	Ind/fish
Sediment	<0.1	2.7	0.02*
Algae	1.4	24.3	0.50*
Class Turbellaria	0.3	10.8	0.22
Class Gastropoda, larval forms	<0.1	2.7	0.14
Class Insecta, total	6.8	18.9	0.51
Family Chironimidae, larvae	0.6	8.1	0.11
Adult forms	6.3	13.5	0.41
Order Cladocera	0.5	8.1	1.89
Subclass Ostracoda	0.3	5.4	0.30
Subclass Copepoda	70.7	81.1	73.16
Order Calanoida	13.6	37.8	15.50
Order Harpacticoida	1.0	24.3	2.24
Unclassified	56.1	21.6	55.42
Subclass Cirripedia, larval forms	<0.1	2.7	0.05

Tidewater silverside, *Menidia beryllina*
Size range (cm), 4-9
Sample size, 37 continued.

Diet item	% Volume	% Occurrence	Ind/fish
Order Cumacea	0.1	5.4	0.05
Order Isopoda, *Cyathura polita*	0.3	2.7	0.03
Suborder Gammaridea, total	11.2	16.2	0.62
Family Gammaridae	1.4	2.7	0.03
Family Photidae, *Leptocheirus plumulosus*	3.4	5.4	0.08
Unclassified	6.4	13.5	0.51
Class Osteichthyes, Genus *Fundulus* (larvae)	8.3	2.7	0.21

*ml x 10^{-4}/fish

Weakfish, *Cynoscion regalis*

	% Volume				% Occurrence				Ind/fish			
Size range (cm):	5-10	11-17	32-62	Total	5-10	11-17	32-62	Total	5-10	11-17	32-62	Total
Diet item Sample size:	27	22	2	51	27	22	2	51	27	22	2	51
Plant detritus		<0.1		<0.1		9.1		3.9		1.60*		0.69*
Class Polychaeta, total	1.8	<0.1	<0.1	<0.1	3.7	4.5	50.0	5.9	0.04	0.05	0.50	0.06
Genus *Nereis*		<0.1		<0.1		4.5		2.0		0.05		0.02
Unclassified	1.8		<0.1	<0.1	3.7		50.0	3.9	0.04		0.50	0.04
Suborder Gammaridea, total	6.6	0.1		0.4	59.3	18.2		39.2	5.37	0.55		3.08
Genus *Ampelisca*, total	6.2	0.1		0.4	44.4	13.6		29.4	5.11	0.50		2.90
Ampelisca abdita	4.8	<0.1		0.3	33.3	4.5		19.6	4.20	0.09		2.25
Ampelisca vadorum	<0.1			<0.1	3.7			2.0	0.04			0.02
Unclassified	1.4	0.1		0.1	7.4	9.1		7.8	0.85	0.41		0.63

Weakfish, *Cynoscion regalis* continued.

Diet Item	% Volume				% Occurrence				Ind/fish			
Size range (cm):	5-10	11-17	32-62	Total	5-10	11-17	32-62	Total	5-10	11-17	32-62	Total
Sample size:	27	22	2	51	27	22	2	51	27	22	2	51
Family Ampithoidae, *Cymadusa compta*	<0.1			<0.1	3.7			2.0	0.04			0.02
Family Aoridae, *Microdeutopus gryllotalpa*	<0.1			<0.1	3.7			2.0	0.04			0.02
Family Corophiidae	<0.1			<0.1	3.7			2.0	0.04			0.02
Family Gammaridae, *Elasmopus laevis*	0.3			<0.1	7.4			3.9	0.07			0.04
Family Stenothoidae	<0.1			<0.1	3.7			2.0	0.07			0.04
Unclassified	0.1	<0.1		<0.1	3.7	4.5		3.9	0.04	0.04		0.04
Order Mysidacea, total	43.4	23.1		8.2	81.5	72.7		74.5	18.52	37.86		26.14
Neomysis americana	41.4	23.1		8.1	77.8	72.7		72.5	17.59	37.86		25.65
Mysidopsis bigelowi	1.9			0.1	7.4			3.9	0.85			0.45
Unclassified	0.1			<0.1	3.7			2.0	0.07			0.04
Genus *Palaemonetes*, *P. pugio*	1.7			<0.1	3.7			2.0	0.07			0.04
Crangon septemspinosa	19.2	13.6	0.7	5.0	25.9	36.4	50.0	31.4	0.33	1.23	0.50	0.73
Infraorder Brachyura, total	0.9	0.9		0.3	3.7	4.5		3.9	0.07	0.05		0.06
Callinectes sapidus		0.9		0.2		4.5		2.0		0.05		0.02
Family Xanthidea	0.9			<0.1	3.7			2.0	0.07			0.04
Class Osteichthyes, total	26.1	60.6	99.3	85.4	14.8	59.1	100.0	37.3	0.15	1.04	2.50	0.63
Genus *Anchoa*		25.7		6.6		9.1		7.8		0.18		0.08
Unclassified	26.1	34.9	99.3	78.8	14.8	50.0	100.0	33.3	0.15	0.86	2.50	0.55

*ml x 10^{-4}/fish

White mullet, *Mugil curema*
Size range (cm), 3-14
Sample size, 11

Diet item	% Occurrence
Sediment	90.9
Plant detritus	63.7
Algae	54.5

White perch, *Morone americana*

	% Volume				% Occurrence				Ind/fish			
Size range (cm):	7-12	14-26	29-37	Total	7-12	14-26	29-37	Total	7-12	14-26	29-37	Total
Diet item Sample size:	18	54	7	79	18	54	7	79	18	54	7	79
Sediment		<0.1		<0.1		1.9		1.3		0.10*		0.06*
Plant detritus	<0.1	1.1		0.7	5.6	31.5		22.8	0.30*	59.40*		40.60*
Class Hydrozoa		<0.1		<0.1		1.9		1.3		0.09*		0.06*
Class Nematoda		<0.1		<0.1		1.9		1.3		0.02		0.01
Class Pelecypoda, total		0.4		0.2		3.7		2.5		0.07		0.05
Siphons		<0.1		<0.1		1.9		1.3		0.02		0.01
Unclassified		0.3		0.2		1.9		1.3		0.06		0.04
Class Polychaeta, total	7.7	3.7	1.8	3.4	38.9	31.5	28.6	32.9	0.39	0.76	0.29	0.63
Genus *Glycera*		1.2		0.8		1.9		1.3		0.02		0.01
Genus *Nereis*		0.3	1.8	0.7		3.7	28.6	6.3		0.04	0.29	0.05
Family Spionidae		<0.1		<0.1		1.9		1.3		0.04		0.03
Hypaniola grayi		<0.1		<0.1		1.9		1.3		0.06		0.04
Unclassified	7.7	2.2		1.9	38.9	22.2	28.6	24.1	0.39	0.61	0.29	0.51
Class Insecta, total	2.1	1.1	<0.1	0.8	27.8	33.3	14.3	30.4	2.11	3.24	0.71	2.76
Larval forms, total	2.1	1.1	<0.1	0.8	27.8	31.5	14.3	29.1	2.11	3.11	0.71	2.67
Family Chironimidae	2.1	1.0	<0.1	0.8	27.8	27.8	14.3	26.6	2.11	3.09	0.71	2.66
Unclassified		0.1		<0.1		1.9		1.3		0.02		0.01
Adult forms		<0.1		<0.1		3.7		2.5		0.11		0.08

White perch, *Morone americana* continued.

Diet item	% Volume				% Occurrence				Ind/fish			
Size range (cm):	7-12	14-26	29-37	Total	7-12	14-26	29-37	Total	7-12	14-26	29-37	Total
Sample size	18	54	7	79	18	54	7	79	18	54	7	79
Subclass Copepoda, Order Calanoida	0.2	5.5		3.5	11.1	14.8		12.7	5.72	170.00		117.50
Subclass Cirripedia, adult		0.2		0.1		1.9		1.3		0.02		0.01
Orders Tanaidacea and Isopoda		0.3		0.2		9.3		6.3		0.17		0.11
Tanais cavolini		<0.1		<0.1		1.9		1.3		0.02		0.01
Cyathura polita		0.3		0.2		9.3		6.3		0.15		0.10
Suborder Gammaridea, total	53.3	11.2	0.2	10.4	50.0	38.9	42.9	41.8	27.06	9.20	0.57	12.50
Family Ampithoidae, *Cymadusa compta*		0.5		0.3		3.7		2.5		0.22		0.15
Family Corophiidae	15.7	0.1		1.1	11.1	7.4		7.6	11.06	0.44		2.82
Family Gammaridae, total	2.1	6.6	0.1	4.3	16.7	18.5	28.6	19.0	0.22	3.19	0.43	2.27
Gammarus mucronatus		0.2	0.1	0.1		5.6	28.6	6.3		0.44	0.43	0.34
Elasmopus laevis		<0.1		<0.1		1.9		1.3		0.06		0.04
Unclassified	2.1	6.4		4.2	16.7	16.7		15.2	0.22	2.69		1.89
Monoculodes edwardsi	<0.1			<0.1	5.6			1.3	0.06			0.01
Family Photidae, total	35.4	3.9		4.7	38.9	27.8		27.8	15.72	5.31		7.22
Leptocheirus plumulosus	35.4	3.9		4.7	38.9	25.9		26.6	15.72	5.30		7.20
Unclassified		<0.1		4.7		1.9		1.3		0.02		0.01
Orchestia platensis		<0.1		<0.1		1.9		1.3		0.04		0.03
Order Mysidacea, total	10.5	43.8	20.0	34.3	72.2	63.0	57.1	64.6	8.67	44.31	73.71	38.80
Neomysis americana	10.5	43.8	20.0	34.3	66.7	63.0	57.1	63.3	8.61	44.31	73.71	38.78
Unclassified	<0.1			<0.1	5.6			1.3	0.06			0.01

White perch, *Morone americana* continued.

	% Volume				% Occurrence				Ind/fish			
Size range (cm):	7-12	14-26	29-37	Total	7-12	14-26	29-37	Total	7-12	14-26	29-37	Total
Diet item / Sample size	18	54	7	79	18	54	7	79	18	54	7	79
Infraorder Caridea, larvae		<0.1		<0.1		3.7		2.5		0.06		0.04
Genus *Palaemonetes*, total		5.5	1.4	3.9		3.7	14.3	12.6		0.69	0.29	0.49
Palaemonetes vulgaris		4.8		3.0		3.7		2.5		0.63		0.43
Palaemonetes pugio			1.4	0.4			14.3	10.1			0.29	0.03
Unclassified		0.7		0.5		1.9		1.3		0.06		0.04
Crangon septemspinosa	1.7	17.4	62.0	30.2	5.6	11.1	71.4	15.2	0.06	0.67	4.57	0.87
Infraorder Brachyura, total except larvae		7.1		4.5		9.3		6.3		0.11		0.08
Callinectes sapidus		3.3		2.1		5.6		3.8		0.06		0.04
Family Xanthidea, total		3.8		2.4		3.7		2.5		0.06		0.04
Neopanope texanna		1.4		0.9		1.9		1.3		0.02		0.01
Rhithropanopeus harrisii		2.4		1.5		1.9		1.3		0.04		0.03
Infraorder Brachyura larval forms		<0.1		<0.1		1.9		1.3		0.19		0.13
Class Osteichthyes, total except eggs	10.5	1.7	4.2	3.0	16.7	5.6	14.3	8.9	0.16	0.06	0.14	0.09
Apeltes quadracus		0.7		0.4		1.9		1.3		0.02		0.01
Genus *Fundulus*	10.5		4.2	2.0	5.6		14.3	2.5	0.06		0.14	0.03
Gobiosoma bosci		0.7		0.4		1.9		1.3		0.02		0.01
Unclassified	<0.1	0.3		0.2	11.1	1.9		3.8	0.11	0.02		0.04
Class Osteichthyes, eggs	14.0	1.0		1.5	22.2	7.4		10.1	60.90	12.10		22.14

*ml x 10^{-4}/fish

Windowpane, *Scophthalmus aquosus*
Size range (cm), 15-34
Sample size, 4

Diet item	% Volume	% Occurrence	Ind/fish
Plant detritus	<0.1	50.0	2.50*
Order Actiniaria	<0.1	25.0	0.25
Suborder Gammaridea, *Cymadusa compta*	<0.1	25.0	0.25
Order Mysidacea, *Neomysis americana*	10.2	50.0	90.50
Genus Palaemonetes	7.5	25.0	1.75
Palaemonetes vulgaris	5.9	25.0	1.50
Unclassified	1.6	25.0	0.25
Crangon septemspinosa	56.2	50.0	8.00
Class Osteichthyes, total	17.4	25.0	1.00
Ammodytes americanus	11.9	25.0	0.25
Unclassified	5.5	25.0	0.75

*ml x 10^{-4}/fish

Winter flounder, *Pseudopleuronectes americanus*

	% Volume				% Occurrence				Ind/fish			
Size range (cm):	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total
Diet item Sample size:	56	41	45	142	56	41	45	142	56	41	45	142
Sediment	0.4	<0.1	0.4	0.3	25.0	9.8	15.6	17.6	1.8*	2.4*	64.6*	21.9*
Plant detritus	0.5	0.4	1.2	1.1	25.0	29.3	57.8	36.6	2.2*	19.4*	223.9*	77.4*
Phylum Nemertea		1.5	12.2	9.8		2.4	4.4	2.1		0.02	0.04	0.02
Class Hydrozoa	<0.1	0.5	0.4	0.4	1.8	7.3	8.9	5.6	0.36*	24.63*	81.33*	33.0*
Class Tubellaria	<0.1	<0.1		<0.1	19.6	2.4		8.5	0.38	0.02		0.16
Class Nematoda	<0.1	<0.1	<0.1	<0.1	21.4	17.1	6.7	15.5	41.1	2.15	0.40	17.00
Phylum Bryozoa	2.1			<0.1	1.8			0.7	8.93*			3.5*

Winter flounder, *Pseudopleuronectes americanus* continued.

	% Volume				% Occurrence				Ind/fish			
Size range (cm):	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total
Diet item Sample size:	56	41	45	142	56	41	45	142	56	41	45	142
Class Gastropoda, total		0.3	<0.1	<0.1		4.9	8.9	4.2		0.12	0.16	0.08
Genus *Bittium*		0.1	<0.1	<0.1		2.4	4.4	2.1		0.02	0.09	0.04
Genus *Crepidula*		<0.1	<0.1	<0.1		2.4	2.2	1.4		0.07	0.04	0.04
Mitrella lunata			<0.1	<0.1			2.2	0.7			0.02	0.01
Haminoea solitaria		0.1		<0.1		2.4		0.7		0.02		0.01
Class Pelecypoda, total	0.2	22.7	13.8	15.3	7.1	34.1	53.3	29.6	0.14	3.90	6.27	3.17
Laevicardium mortoni			<0.1	<0.1			2.2	0.7			0.02	0.01
Family Tellinidae			<0.1	<0.1			2.2	0.7			0.02	0.01
Tagelus divisus		<0.1		<0.1		2.4		0.7		0.02		0.01
Ensis directus		0.2		<0.1		2.4		0.7		0.02		0.01
Lyonsia hyalina			1.2	0.9			2.2	0.7			0.16	0.05
Siphons	0.02	22.5	12.4	14.1	7.1	29.3	51.1	27.5	0.14	3.85	6.02	3.08
Unclassified			0.2	0.1			2.2	0.7			0.04	0.01
Class Oligochaeta	<0.1			<0.1	1.8			0.7	0.02			0.01
Class Polychaeta, total except larvae	61.2	41.4	33.1	35.3	83.9	65.9	77.8	76.8	6.98	9.50	9.20	8.42
Family Phyllodocidae	4.1		<0.1	0.1	21.4		6.7	10.6	0.68		0.16	0.32
Family Aphroditidae	<0.1	1.2		0.2	1.8	2.4		1.4	0.02	0.02		0.01
Family Polynoidae		<0.1	0.1	<0.1		2.4	2.2	1.4		0.10	0.02	0.04
Genus *Stenelais*			0.3	0.2			2.2	0.7			0.02	0.01
Genus *Glycera*	0.3	5.2	8.3	7.5	3.6	7.3	11.1	7.7	0.04	0.12	0.42	0.18
Family Goniadidae	11.0	<0.1		0.3	14.3	4.9	7.0		0.21	0.05		0.10
Genus *Nephtys*		0.7		0.1		4.8		1.4		0.05		0.01
Genus *Nereis*	3.5	12.4	<0.1	2.5	7.1	24.4	4.4	11.3	0.23	1.27	0.04	0.47
Family Spionidae	4.6	2.1	1.1	1.4	25.0	17.0	11.1	18.3	1.98	1.71	2.82	2.17
Family Capitellidae	11.5	12.6	<0.1	2.7	12.5	9.8	2.2	8.4	1.61	5.32	0.04	2.18
Family Maldanidae	13.1	2.2	0.5	1.1	5.4	4.9	8.9	6.3	0.09	0.37	0.16	0.19
Family Terebellidae	2.6	3.6	16.5	13.6	3.6	9.8	48.9	19.7	0.04	0.32	4.00	1.37

Winter flounder, *Pseudopleuronectes americanus* continued.

Diet item	% Volume				% Occurrence				Ind/fish			
Size range (cm):	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total
Sample size:	56	41	45	142	56	41	45	142	56	41	45	142
Genus *Aricidea*			<0.1	<0.1			2.2	0.7			0.07	0.02
Genus *Lumbrineris*	2.6		<0.1	<0.1	5.4		2.2	2.8	0.07		0.02	0.04
Arabella iricolor			1.1	0.8			4.4	1.4			0.07	0.02
Sabella microphthalma		0.3		<0.1		7.3		2.1		0.07		0.02
Genus *Scoloplos*	<0.1	<0.1	0.2	0.2	1.8	2.4	2.2	2.1	0.02	0.02	0.77	0.26
Hypaniola grayi	1.5		0.1	0.1	14.3		4.4	7.0	0.70		0.11	0.06
Unclassified	6.4	1.1	4.9	4.5	30.4	7.3	22.2	21.1	1.93	0.10	0.47	0.93
Class Polychaeta, larval forms	<0.1			<0.1	1.8			0.7	0.02			0.01
Class Merostomata, *Limulus polyphemus*		<0.1		<0.1		2.4		0.7		0.07		0.02
Subclass Ostracoda	0.2		<0.1	<0.1	10.7		2.2	4.9	0.13		0.20	0.11
Subclass Copepoda, total	<0.1			<0.1	28.6			11.3	1.50			0.59
Order Calanoida	<0.1			<0.1	7.1			2.8	0.07			0.03
Order Harpacticoida	<0.1			<0.1	25.0			9.9	1.43			0.56
Subclass Cirripedia, adult forms			<0.1	<0.1			4.4	1.4			0.04	0.01
Order Cumacea	2.1		<0.1	<0.1	30.4		2.2	12.7	1.52		0.02	0.61
Orders Tanaidacea and Isopoda	1.0	3.7	1.5	1.9	17.9	26.8	26.7	23.2	0.30	0.51	0.76	0.51
Tanais cavolini	<0.1			<0.1	1.8			0.7	0.02			0.01
Cyathura polita	0.4	0.9	0.9	0.9	7.1	14.6	22.2	14.1	0.11	0.15	0.60	0.27
Genus *Idotea*		2.7	0.5	0.9		12.2	4.4	4.9		0.36	0.04	0.12
Edotea triloba	0.5		<0.1	<0.1	12.5		4.4	6.3	0.18		0.11	0.11
Suborder Gammaridea, total	19.0	10.2	5.6	6.8	80.4	70.7	64.4	72.5	11.27	8.37	18.16	12.60
Genus *Ampelisca*	14.6	2.1	4.9	4.6	62.5	41.5	44.4	50.7	8.46	4.05	16.40	9.70
Ampelisca abdita	14.4	0.5	1.7	1.7	58.9	22.0	17.8	35.2	8.34	2.80	10.93	7.56
Ampelisca vadorum	0.1	1.4	1.5	1.4	3.6	19.5	22.2	14.1	0.05	1.20	3.40	1.44
Unclassified	0.1	0.2	1.7	1.5	3.6	2.4	13.3	6.3	0.07	0.05	2.07	0.70

Winter flounder, *Pseudopleuronectes americanus* continued.

Diet item	% Volume				% Occurrence				Ind/fish			
Size range (cm):	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total
Sample size:	56	41	45	142	56	41	45	142	56	41	45	142
Family Ampithoidae, *Cymadusa compta*	0.5	3.0	0.4	0.9	5.4	7.3	11.1	7.7	0.09	0.93	0.47	0.31
Family Aoridae, total	0.5	0.5	<0.1	0.1	16.1	9.8	2.2	9.9	0.43	0.80	0.04	0.42
Microdeutopus gryllotalpa	0.1	<0.1	<0.1	<0.1	5.4	7.3	2.2	4.9	0.07	0.12	0.04	0.08
Unclassified	0.4	0.5		0.1	10.7	2.4		4.9	0.36	0.68		0.34
Family Corophiidae	0.4	<0.1	0.2	0.2	19.6	2.4	17.8	14.1	0.48	0.02	1.02	0.52
Family Gammaridae, total	1.7	1.0	<0.1	0.3	19.6	9.8	13.3	14.7	0.71	1.02	0.13	0.62
Gammarus mucronatus	<0.1			<0.1	1.8			0.7	0.02			0.01
Elasmopus laevis	1.5	0.5	<0.1	0.1	16.1	4.9	4.4	9.2	0.63	0.78	0.04	0.49
Unclassified	0.2	0.5	<0.1	0.1	1.8	4.9	4.4	3.5	0.07	0.24	0.09	0.13
Batae catharinensis	<0.1	0.3		<0.1	1.8	2.4		1.4	0.02	0.10		0.04
Family Photidae, total	0.6	0.3		<0.1	14.3	7.3		7.7	0.75	0.59		0.46
Leptocheirus plumulosus		0.3		<0.1		4.9		1.4		0.56		0.16
Unclassified	0.6	<0.1		<0.1	14.3	2.4		6.3	0.75	0.02		0.30
Paraphoxus spinosus	<0.1			<0.1	1.8			0.7	0.02			0.01
Family Stenothoidae			<0.1	<0.1			2.2	0.7			0.02	0.01
Unclassified	0.7	3.0	0.1	0.7	7.1	9.8	4.4	7.0	0.30	0.85	0.07	0.39
Order Mysidacea, *Neomysis americana*	10.8	10.8	<0.1	2.4	3.6	22.0	6.7	9.9	0.50	5.07	0.07	1.68
Genus *Palaemonetes*, total		3.5	22.2	18.1		7.3	28.9	11.3		0.07	2.58	0.84
Palaemonetes vulgaris			19.3	15.1			24.4	7.7			2.27	0.72
Palaemonetes pugio		1.2	0.5	0.6		2.4	4.4	2.1		0.02	0.05	0.02
Unclassified		2.3	2.4	2.4		4.9	6.7	3.5		0.05	0.27	0.10

Winter flounder, *Pseudopleuronectes americanus* continued.

Diet item	Size range (cm):	% Volume				% Occurrence				Ind/fish			
		3-11	12-21	22-33	Total	3-11	12-21	22-33	Total	3-11	12-21	22-33	Total
	Sample size	56	41	45	142	56	41	45	142	56	41	45	142
Crangon septemspinosa		2.2	4.7	0.5	1.4	1.8	7.3	6.7	4.9	0.04	0.15	0.07	0.08
Infraorder Brachyura, larvae		<0.1			<0.1	1.8			0.7	0.02			0.01
Infraorder Brachyura, total except larvae			0.8	4.5	3.7		14.6	24.4	12.0		0.22	1.18	0.44
Callinectes sapidus			0.5	0.2	0.2		9.8	4.4	4.2		0.15	0.05	0.06
Family Xanthidea, total			0.2	4.4	3.5		2.4	20.0	7.0		0.05	1.13	0.37
Neopanope texanna				1.2	0.9			13.3	4.2			0.51	0.16
Rhithropanopeus harrisii				2.4	1.9			4.4	1.4			0.36	0.11
Eurypanopeus depressus				0.2	0.2			6.7	2.1			0.18	0.06
Unclassified			0.1	0.6	0.5		2.4	2.2	1.4		0.05	0.09	0.04
Unclassified			<0.1		<0.1		2.4		0.7		0.02		0.01
Class Ascidiacea, Family Molgulidae				0.2	0.1			4.4	1.4			0.05	0.01
Class Osteichthyes, total				2.3	1.8			8.9	2.8			0.11	0.04
Gobiosoma bosci				2.0	1.6			8.9				0.09	0.03
Unclassified				0.3	0.2			2.2	0.7			0.02	0.01

*ml x 10^{-4}/fish

APPENDIX B
Stomach Analyses Data for Fish
Species Collected in Little Egg Harbor
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Phylum Chordata, Class Ascidiacea, Family Molgulidae	8.193
Class Osteichthyes (bony fishes), Eggs	8.194
Class Osteichthyes - Total Except Eggs	8.194
Family Atherinidae (Silversides)	8.195
Genus *Anchoa* (Anchovies)	8.196
Apeltes quadracus (Fourspine stickleback)	8.196
Ammodytes americanus (American sand lance)	8.196
Brevoortia tyrannus (Atlantic menhaden)	8.197
Family Bothidae (Left handed flatfish)	8.197
Bairdiella chrysura (Silver perch)	8.197
Cynoscion regalis (Weakfish)	8.197
Leiostomus xanthurus (Spot)	8.198
Genus *Fundulus* (Killifish)	8.198
Gobiosoma bosci (Naked goby)	8.198
Genus *Prionotus* (Sea robins)	8.199
Pseudopleuronectes americanus (Winter flounder)	8.199
Strongylura marina (Atlantic needlefish)	8.199
Syngnathus fuscus (Northern pipefish)	8.199

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	ml x 10^{-4}/ fish
		Sediment			
Atlantic menhaden	4-8	19		21.1	
Atlantic menhaden	11-16	15		40.0	
Atlantic menhaden	25-28	8		37.5	
Banded killifish	3-10	18	7.8	55.6	6.80
Bay anchovy	5-11	101	0.2	5.0	0.20
Bluefish	11-20	62	<0.1	1.6	0.08
Brown bullhead	21-35	5	0.9	40.0	158.00
Crevalle jack	4-13	9	<0.1	27.2	1.10
Fourspine stickleback	2-6	76	0.6	3.9	0.30
Hogchoker	2-17	7	2.1	42.9	7.10
Mummichog	3-11	34	0.7	14.7	1.90
Naked goby	3-5	8	1.9	25.0	1.10
Northern pipefish	9-21	21	<0.1	4.8	0.20
Pumpkinseed	9 and 10	2	0.4	100.0	5.00
Sheepshead minnow	3-5	29		20.7	
Spot	3-10	48	1.1	10.4	1.10
Spot	11-19	44	0.8	9.1	3.40
Striped bass	43-58	11	<0.1	9.1	90.90
Striped killifish	4-13	13	9.4	46.2	12.00
Striped mullet	11-16	4		100.0	
Striped sea robin	4-7	3	1.4	33.3	1.70
Tautog	6-16	18	<0.1	5.6	1.50
Tautog	20-32	7	0.1	14.3	19.20
Tidewater silverside	4-9	37	<0.1	2.7	0.02
White perch	14-26	54	<0.1	1.9	0.10
White mullet	3-14	11		90.9	
Winter flounder	3-11	56	0.4	25.0	1.80
Winter flounder	12-21	41	<0.1	9.8	2.40
Winter flounder	22-33	45	0.4	15.6	64.60

Algae

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	ml x 10^{-4}/ fish
Alewife	27-34	5	1.5	40.0	29.00
American eel	11-61	10	0.1	10.0	50.00
Atlantic menhaden	4-8	19		68.4	
Atlantic menhaden	11-16	15		100.0	
Atlantic menhaden	25-28	8		87.5	
Atlantic silverside	3-13	85	<0.1	7.1	0.30
Banded killifish	3-10	18	15.7	38.9	13.60
Blueback herring	7-15	13	<0.1	7.7	0.40
Fourspine stickleback	2-6	76	0.5	7.9	0.20
Golden shiner	15-18	3	1.0	33.3	1.70
Mummichog	3-11	34	1.4	44.1	3.70
Northern pipefish	9-21	21	0.2	4.8	0.80
Planehead filefish	5-13	2	39.7	50.0	500.00
Rainwater killifish	3-4	9	3.5	22.2	0.70
Sheepshead minnow	3-5	29		96.6	
Spot	11-19	44	<0.1	2.3	0.10
Striped mullet	11-16	4		100.0	
Threespine stickleback	5-7	6	2.0	16.7	0.90
Tidewater silverside	4-9	37	1.4	24.3	0.50
White mullet	3-14	11		54.5	

Plant detritus

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	ml x 10^{-4} / fish
Alewife	6-13	6	0.2	33.3	2.00
Alewife	27-34	5	1.1	20.0	22.00
American eel	11-61	10	0.4	30.0	201.00
Atlantic menhaden	11-16	15		26.7	
Atlantic menhaden	25-28	8		12.5	
Atlantic silverside	3-13	85	1.2	10.6	6.00
Banded killifish	3-10	18	6.7	16.7	6.00
Bay anchovy	5-11	101	0.2	4.0	0.20
Black sea bass	6-21	17	<0.1	5.9	1.80
Blueback herring	7-15	13	0.2	15.4	0.70
Bluefish	6-10	16	<0.1	6.3	0.30
Bluefish	11-20	62	0.6	17.7	60.90
Bluefish	21-36	19	0.6	15.8	158.90
Brown bullhead	21-35	5	0.1	80.0	23.00
Cunner	3-5	4	2.3	25.0	1.30
Fourspine stickleback	2-6	76	0.5	5.3	0.20
Golden shiner	15-18	3	1.0	33.3	1.70
Hogchoker	2-17	7	0.6	28.3	2.10
Mummichog	3-11	34	0.6	14.7	1.50
Naked goby	3-5	8	1.1	12.5	0.60
Northern kingfish	15-19	2	0.2	50.0	5.00
Northern puffer	2-11	3	2.8	66.7	25.00
Northern sea robin	8-18	4	0.3	50.0	12.50
Oyster toadfish	4-13	15	2.2	26.7	28.30
Oyster toadfish	18-28	15	11.7	33.3	3,579.30
Pumpkinseed	9 and 10	2	0.2	50.0	2.50
Sheepshead minnow	3-5	29		34.5	
Smooth dogfish	39-56	12	5.5	75.0	5,544.20
Spot	3-10	48	0.1	2.1	0.10
Spot	11-19	44	0.4	34.1	1.80
Spotted hake	5-19	16	1.9	12.5	31.60
Striped burrfish	23 and 25	2	1.3	100.0	585.00
Striped killifish	4-13	13	0.6	15.4	0.80
Summer flounder	6-24	25	0.2	24.0	9.80
Summer flounder	26-25	13	1.1	38.5	770.00

Plant detritus continued.

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	ml x 10^{-4}/ fish
Tautog	6-16	18	<0.1	16.7	0.80
Tautog	20-32	7	2.3	85.7	306.40
White perch	7-12	18	<0.1	5.6	0.30
White perch	14-26	54	1.1	31.5	59.40
White mullet	3-14	11		63.7	
Weakfish	11-17	22	<0.1	9.1	1.60
Windowpane	15-34	4	<0.1	50.0	2.50
Winter flounder	3-11	56	0.5	25.0	2.20
Winter flounder	12-21	41	0.4	29.3	19.40
Winter flounder	22-33	45	1.2	57.8	223.90

Phylum Nemertea

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	Ind/fish	P.I. rank
American eel	11-61	10	<0.1	10.0	0.10	1
Brown bullhead	21-35	5	0.1	20.0	0.20	4
Winter flounder	12-21	41	1.5	2.4	0.02	3
Winter flounder	22-33	45	12.2	4.4	0.04	2

Phylum Porifera

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	ml x 10^{-4}/ fish
Summer flounder	26-65	13	1.5	7.7	0.11

Phylum Cnidaria
Class Hydrozoa

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	ml x 10^{-4}/ fish
Atlantic silverside	3-13	85	0.5	2.4	2.40
Bay anchovy	5-11	101	<0.1	1.0	0.001
Blueback herring	7-15	13	<0.1	7.7	0.38
Cunner	3-5	4	2.3	25.0	1.25
Mummichog	3-11	34	0.1	8.8	0.30
Northern puffer	2-11	3	0.4	66.7	3.33
Planehead filefish	5 and 13	2	19.8	50.0	250.00
Sheepshead minnow	3-5	29		13.8	
Spot	3-10	48	0.2	4.2	0.21
Spot	11-19	44	0.1	11.4	0.57
Striped killifish	4-13	13	0.3	7.7	0.38
Tautog	6-16	18	0.8	16.7	11.67
White perch	14-26	54	<0.1	1.9	0.09
Winter flounder	3-11	56	<0.1	1.8	0.36
Winter flounder	12-21	41	0.5	7.3	24.60
Winter flounder	22-33	45	0.4	8.9	81.30

Class Anthozoa
Order Actiniaria

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Windowpane	15-34	4	<0.1	25.0	0.25

Phylum Platyhelminthes
Class Turbellaria

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Atlantic menhaden	4-8	19	1.2	21.1	0.42
Bay anchovy	5-11	101	1.0	41.6	2.38
Blueback herring	7-15	13	<0.1	7.7	0.08
Bluefish	11-20	62	<0.1	1.6	0.16
Fourspine stickleback	2-6	76	0.1	7.9	0.18
Naked goby	3-5	8	1.9	25.0	0.38
Northern pipefish	9-21	21	0.9	23.8	1.95
Northern puffer	2-11	3	<0.1	33.3	0.33
Rainwater killifish	3-4	9	3.1	22.2	0.22
Spot	3-10	48	0.3	10.4	0.21
Spot	11-19	44	0.1	11.4	0.32
Striped killifish	4-13	13	<0.1	7.7	0.08
Striped sea robin	4-7	3	4.5	33.3	3.67
Tidewater silverside	4-9	37	0.3	10.8	0.22
Winter flounder	3-11	56	<0.1	19.6	0.38
Winter flounder	12-21	41	<0.1	2.4	0.02

Phylum Aschelminthes
Class Nematoda

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Atlantic silverside	3-13	85	<0.1	1.2	0.01
Banded killifish	3-10	18	<0.1	5.6	0.11
Bay anchovy	5-11	101	<0.1	2.0	0.02
Cunner	3-5	4	0.2	25.0	0.25
Fourspine stickleback	2-6	76	2.4	10.5	0.59
Mummichog	3-11	34	<0.1	14.7	0.21
Northern pipefish	9-21	21	<0.1	9.5	0.14
Oyster toadfish	4-13	15	2.0	60.0	2.00
Oyster toadfish	18-28	15	0.7	53.3	4.73

Phylum Aschelminthes
Class Nematoda continued.

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Red hake	8-20	3	0.2	33.3	2.00
Spot	3-10	48	1.7	50.0	20.85
Spot	11-19	44	1.1	50.0	28.00
Spotted hake	5-19	16	<0.1	18.8	0.38
Striped killifish	4-13	13	0.1	30.8	1.69
Summer flounder	6-24	25	<0.1	4.0	0.04
Tautog	6-16	18	0.9	55.6	13.89
Tautog	20-32	7	<0.1	42.9	4.71
White perch	14-26	54	<0.1	1.9	0.02
Winter flounder	3-11	56	<0.1	21.4	4.11
Winter flounder	12-21	41	<0.1	17.1	2.15
Winter flounder	22-33	45	<0.1	6.7	0.40

Phylum Bryozoa

Consumer species	Size range of consumer (cm)	Sample size	% Volume	% Occurrence	ml x 10^{-4}/ fish
Brown bullhead	21-35	5	<0.1	20.0	14.00
Summer flounder	6-24	25	<0.1	4.0	0.20
Tautog	20-32	7	2.1	28.6	285.71
Winter flounder	3-11	56	2.1	1.8	8.93

Phylum Mollusca
Class Gastropoda - Larval Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic menhaden	4-8	19		5.3	0.11	5
Atlantic silverside	3-13	85	<0.1	2.4	0.56	2
Bay anchovy	5-11	101	1.9	27.7	12.50	1
Northern puffer	2-11	3	<0.1	33.3	3.00	6
Spot	3-10	48	<0.1	2.1	0.02	7
Spot	11-19	44	<0.1	2.3	1.25	3
Tidewater silverside	4-9	37	<0.1	2.7	0.14	4

Class Gastropoda - Adult Forms Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
American eel	11-61	10	<0.1	10.0	0.10
Atlantic silverside	3-13	85	<0.1	1.2	0.01
Brown bullhead	21-35	5	0.1	20.0	0.20
Fourspine stickleback	2-6	76	0.3	2.6	0.12
Northern puffer	2-11	3	55.4	66.7	8.00
Oyster toadfish	18-28	15	4.2	33.3	0.60
Permit	8	1	100.0	100.0	16.00
Silver perch	3-12	26	<0.1	3.8	0.04
Spot	11-19	44	<0.1	2.3	0.07
Striped burrfish	23 and 25	2	1.7	50.0	0.50
Tautog	20-32	7	0.7	42.9	5.43
Winter flounder	12-21	41	0.3	4.9	0.12
Winter flounder	22-33	45	<0.1	8.9	0.16

Genus *Bittium*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Fourspine stickleback	2-6	76	0.2	1.3	0.01	1
Oyster toadfish	18-28	15	<0.1	6.7	0.06	5
Silver perch	3-12	26	<0.1	3.8	0.04	2
Tautog	20-32	7	0.1	28.6	1.57	3
Winter flounder	12-21	41	0.1	2.4	0.02	6
Winter flounder	22-33	45	<0.1	4.4	0.09	4

Genus *Crepidula*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Fourspine stickleback	2-6	76	<0.1	1.3	0.11	1
Northern puffer	2-11	3	55.4	66.7	8.00	3
Oyster toadfish	18-28	15	<0.1	6.7	0.07	5
Permit	8	1	99.0	100.0	15.00	4
Tautog	20-32	7	0.6	42.9	3.86	2
Winter flounder	12-21	41	<0.1	2.4	0.07	6
Winter flounder	22-23	45	<0.1	2.2	0.04	7

Mitrella lunata

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	<0.1	10.0	0.10	1
Oyster toadfish	18-28	15	<0.1	6.7	0.07	2
Permit	8	1	1.0	100.0	1.00	3
Winter flounder	22-33	45	<0.1	2.2	0.02	4

Family Nassariidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Brown bullhead	21-35	5	0.1	20.0	0.20	3
Oyster toadfish	18-28	15	3.3	13.3	0.13	1
Striped burrfish	23 and 25	2	1.7	50.0	0.50	2

Haminoea solitaria

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Oyster toadfish	18-28	15	0.8	13.3	0.27	1
Winter flounder	12-21	41	0.1	2.4	0.02	2

Class Pelecypoda
Adult Forms Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	1.0	10.0	0.10	8
Black sea bass	6-21	17	3.9	5.9	0.18	17
Brown bullhead	21-35	5	0.5	20.0	0.20	14
Fourspine stickleback	2-6	76	3.0	1.3	0.08	4
Gray snapper	4 and 5	2	2.4	50.0	0.50	9
Lined seahorse	8-12	3	1.3	33.3	0.33	13
Oyster toadfish	18-28	15	0.4	6.7	0.07	11
Planehead filefish	5 and 13	2	9.9	50.0	0.50	10
Scup	14	1	0.1	100.0	2.00	10
Smooth dogfish	39-56	12	0.1	8.3	0.08	16
Spot	3-10	48	2.4	10.4	0.31	5
Spot	11-19	44	5.7	6.8	1.68	1

Class Pelecypoda
Adult Forms Total continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Striped burrfish	23 and 25	2	1.1	50.0	0.50	7
Striped bass	43-58	11	0.3	9.1	0.09	18
Tautog	20-32	7	0.5	14.3	0.29	12
White perch	14-26	54	0.3	3.7	0.07	15
Winter flounder	3-11	56	0.2	7.1	0.14	6
Winter flounder	12-21	41	22.7	34.1	3.90	3
Winter flounder	22-33	45	13.8	53.3	6.27	2

Family Mytilidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Fourspine stickleback	2-6	76	3.0	1.3	0.08	1
Lined seahorse	8-12	3	1.3	33.3	0.33	4
Spot	11-19	44	<0.1	2.3	0.02	2
Striped burrfish	23 and 25	2	1.1	50.0	0.50	3
Striped bass	43-58	11	0.3	9.1	0.09	5

Laevicardium mortoni

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	22-33	45	<0.1	2.2	0.02

Family Veneridae*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Scup	14	1	0.1	100.0	2.00	3
Spot	3-10	48	1.7	4.2	0.15	2
Spot	11-19	44	2.9	2.3	1.59	1

* Does not include siphon tips

Family Tellinidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	23-33	45	<0.1	2.2	0.02

Ensis directus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Oyster toadfish	18-28	15	0.4	6.7	0.06	1
Winter flounder	12-21	41	0.2	2.4	0.02	2

Tagelus divisus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	12-21	41	<0.1	2.4	0.02

Mya arenaria

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
American eel	11-61	10	1.0	10.0	1.00

Lyonsia hyalina

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	22-33	45	1.2	2.2	0.16

Solemya velum

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	3.9	5.9	0.18	1
Smooth dogfish	39-56	12	<0.1	8.3	0.08	3
Tautog	20-32	7	0.5	14.3	0.14	2

Siphon Tips - Class Pelecypoda

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Spot	11-19	44	2.7	2.3	0.05	3
White perch	14-26	54	<0.1	1.9	0.02	5
Winter flounder	3-11	56	0.2	7.1	0.40	4
Winter flounder	12-21	41	22.5	29.3	3.85	2
Winter flounder	22-23	45	12.4	51.1	6.02	1

Class Pelecypoda
Larval Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bay anchovy	5-11	101	<0.1	1.0	0.01	2
Spot	11-19	44	<0.1	2.3	0.59	1

Phylum Annelida
Class Oligochaeta

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Fourspine stickleback	2-6	76	0.3	2.6	0.34	2
Pumpkinseed	9 and 10	2	0.4	50.0	0.50	4
Spot	11-19	44	4.2	6.8	3.09	1
Winter flounder	3-11	56	<0.1	1.8	0.02	3

Class Hirudinea

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Mummichog	3-11	34	0.1	2.9	0.03

Class Polychaeta - Larval Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic menhaden	4-8	19		15.8	0.58	2
Atlantic menhaden	11-16	15		6.7	0.07	5
Bay anchovy	5-11	101	1.0	5.0	0.21	1
Blueback herring	7-15	13	<0.1	7.7	0.46	3
Fourspine stickleback	2-6	76	<0.1	1.3	0.01	4
Spot	3-10	48	<0.1	2.1	0.02	6
Striped killifish	4-13	13	0.3	7.7	0.08	7
Winter flounder	3-11	56	<0.1	1.8	0.02	8

Class Polychaeta - Total Adult Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Atlantic menhaden	4-8	19	-	5.3	1.42
Atlantic menhaden	11-16	15	-	6.7	0.07
Atlantic needlefish	5-16	15	3.2	20.0	0.20
Atlantic silverside	3-13	85	8.0	3.5	0.20
Banded killifish	3-10	18	10.1	33.3	0.33
Bay anchovy	5-11	101	1.0	13.9	0.76
Black sea bass	6-21	17	<0.1	11.8	0.12
Bluefish	6-10	16	28.6	25.0	0.50
Bluefish	11-20	62	<0.1	3.2	0.03
Brown bullhead	21-35	5	16.0	40.0	25.80
Cunner	3-5	4	2.3	25.0	0.25
Fourspine stickleback	2-6	76	6.7	10.5	0.18
Golden shiner	15-18	3	22.5	33.3	0.33
Gray snapper	4 and 5	2	23.7	50.0	0.50
Hogchoker	2-17	7	48.4	57.1	0.57
Lined seahorse	8-12	3	4.0	33.3	0.33
Mummichog	3-11	34	3.3	14.7	0.18
Naked goby	3-5	8	52.4	25.0	0.50
Northern kingfish	15 and 19	2	20.6	50.0	2.00
Northern puffer	2-11	3	18.4	33.3	0.67

Class Polychaeta - Total Adult Forms continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Oyster toadfish	4-13	15	23.0	33.3	0.60
Planehead filefish	5 and 13	2	9.9	50.0	0.50
Pumpkinseed	9 and 10	2	79.6	100.0	8.00
Rainwater killifish	3-4	9	11.8	11.1	0.11
Scup	14	1	37.6	100.0	4.00
Silver perch	3-12	26	0.3	3.8	0.04
Smooth dogfish	39-56	12	<0.1	8.3	0.08
Spot	3-10	48	6.4	29.2	1.10
Spot	11-19	44	29.4	31.8	6.32
Striped bass	43-58	11	0.1	9.1	0.09
Striped killifish	4-13	13	10.8	38.5	2.38
Tautog	6-16	18	3.6	11.1	0.17
Tautog	20-32	7	1.2	42.9	0.57
White perch	7-12	18	7.7	38.9	0.39
White perch	14-26	54	3.7	31.5	0.76
White perch	29-37	7	1.8	28.5	0.29
Weakfish	5-10	27	<0.1	3.7	0.04
Weakfish	11-17	22	<0.1	4.5	0.05
Weakfish	32-62	2	<0.1	50.0	0.50
Winter flounder	3-11	56	61.2	83.9	6.98
Winter flounder	12-21	41	41.4	65.9	9.50
Winter flounder	22-3	45	33.1	77.8	9.20

Family Phyllodocidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	<0.1	5.9	0.06	8
Fourspine stickleback	2-6	76	2.3	1.3	0.01	6
Mummichog	3-11	34	<0.1	2.9	0.03	4
Naked goby	3-5	8	30.6	25.0	0.38	3
Spot	3-10	48	0.2	6.3	0.15	2
Spot	11-19	44	0.7	6.8	0.16	1
Winter flounder	3-11	56	4.1	21.4	0.68	5
Winter flounder	22-33	45	<0.1	6.7	0.16	7

Family Aphroditidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Winter flounder	3-11	56	<0.1	1.8	0.02	2
Winter flounder	12-21	41	1.2	2.4	0.02	1

Family Polynoidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Winter flounder	12-21	41	<0.1	2.4	0.10	1
Winter flounder	22-33	45	0.1	2.2	0.02	2

Genus *Sthenelais*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	22-33	45	0.3	2.2	0.02

Family Syllidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Fourspine stickleback	2-6	76	0.1	1.3	0.01	1
Spot	11-19	44	<0.1	2.3	0.02	2

Genus *Glycera*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Northern kingfish	15 and 19	2	9.9	50.0	0.50	5
White perch	14-26	54	1.2	1.9	0.02	4
Winter flounder	3-11	56	0.3	3.6	0.04	3
Winter flounder	12-21	41	5.2	7.3	0.12	2
Winter flounder	22-33	45	8.3	11.1	0.42	1

Family Goniadidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Winter flounder	3-11	56	11.0	14.3	0.21	1
Winter flounder	12-21	41	9.9	4.9	0.05	2

Genus *Nephtys*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bluefish	6-10	16	11.2	6.3	0.13	3
Spot	11-19	44	2.7	2.3	0.02	1
Winter flounder	22-33	41	0.7	2.4	0.05	2

Genus *Nereis*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic needlefish	5-16	15	1.2	6.7	0.07	15
Atlantic silverside	3-13	85	8.0	2.4	0.19	1
Bay anchovy	5-11	101	0.4	4.0	0.05	2
Bluefish	6-10	16	17.4	18.8	0.38	13
Bluefish	11-20	62	<0.1	3.2	0.03	16
Brown bullhead	21-35	5	0.5	20.0	0.20	19
Hogchoker	2-17	7	5.4	14.3	0.14	10
Oyster toadfish	4-13	15	20.1	26.7	0.47	5
Pumpkinseed	9 and 10	2	50.3	50.0	1.00	17
Rainwater killifish	3-4	9	11.8	11.1	0.11	9
Silver perch	3-12	26	0.3	3.8	0.04	8
Spot	3-10	48	0.3	2.1	0.06	6
Spot	11-19	44	3.7	6.8	0.07	4
Tautog	20-32	7	<0.1	14.3	0.14	20
White perch	14-26	54	0.3	3.7	0.04	14
White perch	29-37	7	1.8	28.6	0.29	11
Weakfish	11-17	22	<0.1	4.5	0.05	18
Winter flounder	3-11	56	3.5	7.1	0.23	7
Winter flounder	12-21	41	12.4	24.4	1.27	3
Winter flounder	22-33	45	<0.1	4.4	0.04	12

Family Spionidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic menhaden	4-8	19	0.3	5.2	1.42	5
Bay anchovy	5-11	101	0.2	5.9	0.24	2
Brown bullhead	21-35	5	7.1	40.0	20.20	8
Fourspine stickleback	2-6	76	0.1	3.9	0.08	3
Spot	11-19	44	6.9	4.5	4.84	1
White perch	14-26	54	<0.1	1.9	0.04	9
Winter flounder	3-11	56	4.6	25.0	1.98	6
Winter flounder	12-21	41	2.1	17.0	1.71	7
Winter flounder	22-33	45	1.1	11.1	2.82	4

Family Capitellidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Brown bullhead	21-35	5	0.1	20.0	0.40	6
Naked goby	3-5	8	21.8	12.5	0.13	3
Northern kingfish	15 and 19	2	9.9	50.0	1.00	4
Winter flounder	3-11	56	11.5	12.5	1.61	2
Winter flounder	12-21	41	12.6	9.8	5.32	1
Winter flounder	22-33	45	<0.1	2.2	0.04	5

Family Maldanidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Gray snapper	4 and 5	2	23.7	50.0	0.50	5
Scup	14	1	37.5	100.0	3.00	3
Winter flounder	3-11	56	13.1	5.4	0.09	4
Winter flounder	12-21	41	2.2	4.9	0.37	1
Winter flounder	22-33	45	0.5	8.9	0.16	2

Family Terebellidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Scup	14	1	<0.1	100.0	1.00	3
Winter flounder	3-11	56	2.6	3.6	0.04	4
Winter flounder	12-21	41	3.6	9.8	0.32	2
Winter flounder	22-33	45	16.5	48.9	4.00	1

Genus *Aricidea*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	22-23	45	<0.1	2.2	0.07

Genus *Lumbrineris*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Tautog	20-32	7	1.0	14.3	0.29	2
Winter flounder	3-11	56	2.6	5.4	0.07	1
Winter flounder	22-33	45	<0.1	2.2	0.02	3

Arabella iricolor

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	22-33	45	1.1	4.4	0.07

Sabella microphthalma

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	12-21	41	0.3	7.3	0.07

Genus *Scoloplos*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Winter flounder	3-11	56	<0.1	1.8	0.02	3
Winter flounder	12-21	41	<0.1	2.4	0.02	2
Winter flounder	22-33	45	0.2	2.2	0.77	1

Hypaniola grayi

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Pumpkinseed	9 and 10	2	21.0	50.0	6.50	7
Spot	3-10	48	4.6	4.2	0.60	2
Spot	11-19	44	5.8	4.5	0.75	1
Striped killifish	4-13	13	0.1	7.7	0.23	4
White perch	14-26	54	<0.1	1.9	0.06	6
Winter flounder	3-11	56	1.5	14.3	0.70	3
Winter flounder	22-33	45	0.1	4.4	0.11	5

Phylum Arthropoda
Class Merostomata
Limulus polyphemus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	12-21	41	<0.1	2.4	0.07

Class Arachnida
Order Acari

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Fourspine stickleback	2-6	76	<0.1	1.3	0.01	2
Tidewater silverside	4-9	37	<0.1	2.7	0.03	1

Class Insecta
All Forms - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Alewife	6-13	6	0.2	33.3	0.33
Atlantic needlefish	5-16	15	41.7	46.7	5.00
Atlantic needlefish	25-58	5	11.8	60.0	8.00
Atlantic silverside	3-13	85	1.1	14.1	0.74
Banded killifish	3-10	18	2.2	16.7	1.06
Bay anchovy	5-11	101	0.3	6.9	0.10
Blueback herring	7-15	13	0.3	7.7	0.23
Bluefish	6-10	16	0.2	6.3	0.06
Brown bullhead	21-35	5	0.2	60.0	0.80
Fourspine stickleback	2-6	76	0.3	3.9	0.07
Hogchoker	2-17	7	6.1	42.9	1.57
Mummichog	3-11	34	2.1	32.4	2.00
Pumpkinseed	9 and 10	2	1.3	50.0	1.00
Rainwater killifish	3-4	9	4.2	22.2	0.89
Sheepshead minnow	3-5	29		3.4	0.03
Spot	3-10	48	<0.1	2.1	0.02
Spot	11-19	44	0.9	18.2	0.50
Striped killifish	4-13	13	4.0	15.4	0.15
Tidewater silverside	4-9	37	6.8	18.9	0.51
White perch	7-12	18	2.1	27.8	2.11
White perch	14-26	54	1.1	33.3	3.24
White perch	29-37	7	<0.1	14.3	0.71

Class Insecta
Larval Forms - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Alewife	6-13	6	0.1	16.7	0.17
Atlantic silverside	27-34	85	<0.1	1.2	0.02
Banded killifish	3-10	18	2.3	16.7	1.06
Bay anchovy	5-11	101	0.2	6.9	0.09
Blueback herring	7-15	13	0.4	7.7	0.23
Brown bullhead	21-35	5	0.2	60.0	0.80
Fourspine stickleback	2-6	76	0.3	4.0	0.07
Hogchoker	2-17	7	6.1	42.9	1.57
Mummichog	3-11	34	2.0	29.4	1.94
Pumpkinseed	9 and 10	2	1.3	50.0	1.00
Rainwater killifish	3-4	9	4.2	22.2	0.89
Sheepshead minnow	3-5	29		3.4	0.03
Spot	3-10	48	<0.1	2.1	0.02
Spot	11-19	44	0.9	18.2	0.50
Tidewater silverside	4-9	37	0.6	8.1	1.03
White perch	7-12	18	2.1	27.8	2.11
White perch	14-26	54	1.1	31.5	3.11
White perch	29-37	7	<0.1	14.3	0.71

Family Chironimidae
Larval Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	6-13	6	0.1	16.7	0.17	16
Banded killifish	3-10	18	2.3	16.7	1.06	4
Bay anchovy	5-11	101	0.2	6.9	0.09	3
Blueback herring	7-15	13	0.4	7.7	0.23	11
Brown bullhead	21-35	5	0.2	60.0	0.80	14
Fourspine stickleback	2-6	76	0.3	4.0	0.07	6
Hogchoker	2-17	7	6.1	42.9	1.57	9
Mummichog	3-11	34	2.0	26.5	1.88	1

Family Chironimidae
Larval Forms continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Pumpkinseed	9 and 10	2	1.3	50.0	1.00	17
Rainwater killifish	3-4	9	4.2	22.2	0.89	10
Sheepshead minnow	3-5	29	-	3.5	0.03	15
Spot	3-10	48	<0.1	2.1	0.02	13
Spot	11-19	44	0.5	13.6	0.32	7
Tidewater silverside	4-9	37	0.6	8.1	1.03	2
White perch	7-12	18	2.1	27.8	2.11	8
White perch	14-26	54	1.0	27.8	3.09	5
White perch	29-37	7	<0.1	14.3	0.71	12

Class Insecta
Adult Forms - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	6-13	6	0.1	16.7	0.17	9
Atlantic needlefish	5-16	15	41.7	46.7	5.00	3
Atlantic needlefish	24-58	5	11.8	60.0	8.00	4
Atlantic silverside	3-13	85	1.1	14.1	0.72	1
Bay anchovy	5-11	101	0.1	1.0	0.01	6
Bluefish	6-10	16	0.2	6.3	0.06	10
Mummichog	3-11	34	0.1	5.9	0.06	5
Striped killifish	4-13	13	4.0	15.4	0.15	7
Tidewater silverside	4-9	37	6.3	13.5	0.41	2
White perch	14-26	54	<0.1	3.7	0.13	8

Class Crustacea
Subclass Branchiopoda
Order Cladocera

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic menhaden	4-8	19		26.3	9.60	4
Atlantic needlefish	5-16	15	<0.1	6.7	0.67	5
Atlantic silverside	3-13	85	<0.1	3.5	1.96	2
Bay anchovy	5-11	101	2.2	7.9	35.35	1
Northern puffer	2-11	3	<0.1	33.3	0.33	7
Spot	3-10	48	<0.1	2.1	0.02	6
Tidewater silverside	4-9	37	0.5	8.1	1.89	3

Subclass Ostracoda

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	27-34	5	<0.1	20.0	1.40	8
Atlantic silverside	3-13	85	<0.1	1.2	0.01	7
Bay anchovy	5-11	101	0.2	30.7	0.98	1
Blueback herring	7-15	13	<0.1	15.4	0.77	6
Fourspine stickleback	2-6	76	<0.1	3.9	0.07	3
Northern puffer	2-11	3	<0.1	66.7	2.33	10
Spot	3-10	48	<0.1	4.7	0.35	5
Spot	11-19	44	<0.1	9.1	0.27	4
Spotted hake	5-19	16	<0.1	6.3	0.13	12
Tidewater silverside	4-9	37	0.3	5.4	0.30	2
Winter flounder	3-11	56	0.2	10.7	0.13	11
Winter flounder	22-33	41	<0.1	2.4	0.20	9

Subclass Copepoda - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Alewife	6-13	6	<0.1	16.7	0.83
Alewife	27-34	5	65.5	100.0	2,077.80
American sand lance	9-12	4	100.0	100.0	523.75
Atlantic menhaden	4-8	19		68.4	39.60
Atlantic menhaden	11-16	15		33.3	28.40
Atlantic menhaden	25-28	8		75.0	98.75
Atlantic needlefish	5-16	15	<0.1	6.7	1.67
Atlantic silverside	3-13	85	9.2	42.4	101.81
Banded killifish	3-10	18	0.2	11.1	0.61
Bay anchovy	5-11	101	53.6	87.1	148.16
Blueback herring	7-15	13	48.5	100.0	972.62
Bluefish	6-10	16	0.2	18.75	9.00
Bluefish	11-20	62	<0.1	1.6	0.02
Brown bullhead	21-35	5	<0.1	20.0	0.20
Cunner	3-5	4	0.5	75.0	1.00
Fourspine stickleback	2-6	76	14.9	73.7	19.87
Golden shiner	15-18	3	20.1	33.3	108.00
Gray snapper	4 and 5	2	1.9	50.0	0.50
Hogchoker	2-17	7	<0.1	14.3	0.28
Mummichog	3-11	34	<0.1	17.6	0.29
Northern pipefish	9-21	21	2.1	42.9	18.90
Northern puffer	2-11	3	<0.1	33.3	0.67
Oyster toadfish	4-13	15	<0.1	6.7	0.80
Rainwater killifish	3-4	9	5.0	44.4	2.67
Sheepshead minnow	3-5	29		27.6	
Silver perch	3-12	26	<0.1	11.5	1.38
Spot	3-10	48	33.5	91.7	170.33
Spot	11-19	44	11.2	70.5	204.09
Spotted hake	5-19	16	0.1	25.0	3.75
Striped killifish	4-13	13	0.4	15.4	4.38

Subclass Copepoda - Total continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Striped sea robin	4-7	3	0.4	33.3	1.00
Tautog	6-16	18	<0.1	11.1	0.17
Threespine stickleback	5-7	6	12.3	83.3	11.50
Tidewater silverside	4-9	37	70.7	81.1	73.20
White perch	7-12	18	0.2	11.1	5.72
White perch	14-26	54	5.5	14.8	170.00
Winter flounder	3-11	56	<0.1	28.6	1.50

Order Calanoida

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	6-13	6	<0.1	16.7	0.83	23
Alewife	27-34	5	65.5	100.0	2,077.80	6
American sand lance	9-12	4	100.0	100.0	523.75	5
Atlantic menhaden	4-8	19		63.2	19.42	12
Atlantic menhaden	11-16	15		20.0	28.27	9
Atlantic menhaden	25-28	8		37.5	67.50	11
Atlantic silverside	3-13	85	9.2	40.0	101.73	2
Bay anchovy	5-11	101	52.6	77.2	143.83	1
Blueback herring	7-15	13	48.2	100.0	962.90	3
Bluefish	6-10	16	0.2	18.8	9.00	21
Bluefish	11-20	62	<0.1	1.6	0.02	30
Cunner	3-5	4	0.4	50.0	0.75	28
Fourspine stickleback	2-6	76	12.4	50.0	14.37	4
Golden shiner	15-18	3	19.6	33.3	104.33	17
Gray snapper	4 and 5	2	1.9	50.0	0.50	25
Mummichog	3-11	34	<0.1	5.9	0.09	19
Northern pipefish	9-21	21	1.4	33.3	10.57	13
Northern puffer	2-11	3	<0.1	33.3	0.67	26
Rainwater killifish	3-4	9	3.9	22.2	1.78	18
Sheepshead minnow	3-5	29		10.3		

Order Calanoida continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Silver perch	3-12	26	<0.1	11.5	1.35	15
Spot	3-10	48	0.4	4.2	1.42	14
Spot	11-19	44	0.9	29.5	11.68	10
Spotted hake	5-19	16	0.1	25.0	3.75	22
Striped sea robin	4-7	3	0.4	33.3	1.00	29
Tautog	6-16	18	<0.1	11.1	0.11	27
Threespine stickleback	5-7	6	12.0	66.7	11.00	20
Tidewater silverside	4-9	37	13.6	37.8	15.50	7
White perch	7-12	18	0.2	11.1	5.72	16
White perch	14-26	54	5.5	14.8	170.00	8
Winter flounder	3-11	56	<0.1	7.1	0.07	24

Order Harpacticoida

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic menhaden	4-8	19		21.1	19.37	6
Atlantic menhaden	11-16	15		20.0	0.13	16
Atlantic menhaden	25-28	8		12.5	0.13	19
Atlantic needlefish	5-16	15	<0.1	6.7	1.67	14
Atlantic silverside	3-13	85	<0.1	7.1	0.08	9
Bay anchovy	5-11	101	0.6	42.6	3.38	3
Blueback herring	7-15	13	0.4	46.2	9.69	7
Brown bullhead	21-35	5	<0.1	20.0	0.20	23
Cunner	3-5	4	0.1	25.0	0.25	24
Fourspine stickleback	2-6	76	2.0	42.1	4.47	4
Golden shiner	15-18	3	0.4	33.3	3.67	20
Hogchoker	2-17	7	<0.1	14.3	0.29	17
Mummichog	3-11	34	<0.1	14.7	0.21	8
Northern pipefish	9-21	21	<0.1	19.0	0.43	12

Order Harpacticoida continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Oyster toadfish	4-13	15	<0.1	6.7	0.80	15
Rainwater killifish	3-4	9	1.1	22.2	0.89	13
Sheepshead minnow	3-5	29		13.8		
Silver perch	3-12	26	<0.1	3.8	0.04	18
Spot	3-10	48	13.7	35.4	88.17	2
Spot	11-19	44	10.3	59.1	191.45	1
Striped killifish	4-13	13	0.4	15.4	4.38	10
Tautog	6-16	18	<0.1	5.6	0.06	22
Threespine stickleback	5-7	6	0.2	16.7	0.33	21
Tidewater silverside	4-9	37	1.0	24.3	2.24	5
Winter flounder	3-11	56	<0.1	25.0	1.43	11

Order Cyclopoda

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bay anchovy	5-11	101	<0.1	2.0	0.02	1
Spot	11-19	44	<0.1	2.3	0.05	2

Subclass Cirripedia - Adult Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bluefish	6-10	62	<0.1	1.6	0.02	5
Tautog	6-16	18	0.6	5.6	0.11	2
White perch	14-26	54	0.2	1.9	0.02	3
Winter flounder	3-11	56	<0.1	1.8	0.02	4
Winter flounder	22-33	45	<0.1	4.4	0.04	1

Subclass Cirripedia - Larval Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic menhaden	4-8	19		15.8	0.21	4
Atlantic silverside	3-13	85	<0.1	1.2	0.01	3
Bay anchovy	5-11	101	<0.1	10.9	0.22	1
Tidewater silverside	4-9	37	<0.1	2.7	0.05	2

Subclass Malacostraca
Order Cumacea

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Banded killifish	3-10	18	3.1	38.9	0.83	1
Bay anchovy	5-11	101	<0.1	2.0	0.03	3
Spot	3-10	48	2.9	12.5	0.50	2
Spot	11-19	44	0.1	5.5	0.09	6
Tidewater silverside	4-9	37	0.1	5.4	0.05	5
Winter flounder	3-11	56	2.1	30.4	1.52	4
Winter flounder	27-33	45	<0.1	2.2	0.02	7

Orders Tanaidacea and Isopoda - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
American eel	11-61	10	0.1	10.0	0.50
Atlantic silverside	3-13	85	<0.1	1.2	0.01
Banded killifish	3-10	18	10.5	16.7	0.44
Bay anchovy	5-11	101	<0.1	2.0	0.02
Black sea bass	6-21	17	3.0	35.3	1.12
Brown bullhead	21-35	5	2.3	80.0	5.60
Cunner	3-5	4	12.6	50.0	3.25

Orders Tanaidacea and Isopoda - Total continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Fourspine stickleback	2-6	76	6.1	3.9	0.04
Gray snapper	4 and 5	2	19.0	50.0	0.50
Mummichog	3-11	34	0.6	2.9	0.03
Naked goby	3-5	8	0.3	12.5	0.13
Northern pipefish	9-21	21	0.5	14.3	0.29
Northern puffer	2-11	3	18.4	66.7	1.33
Oyster toadfish	4-13	15	19.9	46.7	0.87
Oyster toadfish	18-28	15	2.9	33.3	2.53
Scup	14	1	2.3	100.0	1.00
Silver perch	3-12	26	0.1	3.8	0.04
Spot	3-10	48	1.1	12.5	0.17
Spot	11-19	44	2.1	15.9	1.77
Spotted hake	5-19	16	0.5	18.8	0.19
Striped burrfish	23 and 25	2	0.6	50.0	1.00
Striped killifish	4-13	13	16.8	30.8	1.54
Tautog	6-16	18	63.3	55.6	3.56
Tautog	20-32	7	1.7	42.9	1.00
Tidewater silverside	4-9	37	0.3	2.7	0.03
White perch	14-26	54	0.3	9.3	0.17
Winter flounder	3-11	56	1.0	17.9	0.30
Winter flounder	12-21	41	3.7	26.8	0.51
Winter flounder	22-33	45	1.5	26.7	0.76

Tanais cavolini

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Spot	11-19	44	1.1	9.1	1.64	1
Striped killifish	4-13	13	0.4	7.7	0.08	2
White perch	14-26	54	<0.1	1.9	0.02	3
Winter flounder	3-11	56	<0.1	1.8	0.02	4

Leptochelia savignyi

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Bay anchovy	5-11	101	<0.1	1.0	0.01

Cyathura polita

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Banded killifish	3-10	18	10.5	16.7	0.44	1
Brown bullhead	21-35	5	1.7	80.0	3.00	7
Oyster toadfish	4-13	15	6.1	20.0	0.33	6
Scup	14	1	2.3	100.0	1.00	11
Spot	3-10	48	0.5	8.3	0.10	5
Spot	11-19	44	1.0	9.1	0.11	2
Tidewater silverside	4-9	37	0.3	2.7	0.03	3
White perch	14-26	54	0.3	9.3	0.15	8
Winter flounder	3-11	56	0.4	7.1	0.11	10
Winter flounder	12-21	41	0.9	14.6	0.15	9
Winter flounder	22-33	45	0.9	22.2	0.60	4

Genus *Idotea*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	<0.1	10.0	0.30	10
Black sea bass	6-21	17	2.9	29.4	1.06	8
Fourspine stickleback	2-6	76	6.0	2.6	0.03	3
Gray snapper	4&5	2	19.0	50.0	0.50	14
Northern pipefish	9-21	21	0.3	9.5	0.19	6
Northern puffer	2-11	3	< 0.1	33.3	0.33	16
Oyster toadfish	4-13	15	13.8	26.7	0.53	5
Oyster toadfish	18-28	15	2.4	33.3	1.93	1
Silver perch	3-12	26	0.1	3.8	0.04	9
Spotted hake	5-19	16	0.5	18.8	0.19	12
Striped burrfish	23&25	2	0.6	50.0	1.00	11
Striped killifish	4-13	13	14.6	15.4	1.38	2
Tautog	6-16	18	47.2	33.3	2.17	4
Tautog	20-32	7	1.0	14.3	0.42	13
Winter flounder	12-21	41	2.7	12.2	0.36	7
Winter flounder	22-33	45	0.5	4.4	0.04	15

Edotea triloba

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic silverside	3-13	85	<0.1	1.2	0.01	1
Brown bullhead	21-35	5	0.1	40.0	2.20	6
Cunner	3-5	4	12.6	50.0	3.30	8
Fourspine stickleback	2-6	76	<0.1	1.3	0.01	3
Mummichog	3-11	34	0.5	2.9	0.03	2
Naked goby	3-5	8	0.3	12.5	0.13	4
Spot	3-10	48	0.2	2.1	0.02	9
Spot	11-19	44	<0.1	2.3	0.02	5
Striped killifish	4-13	13	1.8	7.7	0.08	10
Winter flounder	3-11	56	0.5	12.5	0.18	7
Winter flounder	22-33	45	<0.1	4.4	0.11	11

Genus *Erichsonella*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	0.1	10.0	0.20	5
Black sea bass	6-21	17	<0.1	5.9	0.06	8
Northern pipefish	9-21	21	0.1	4.8	0.05	4
Northern puffer	2-11	3	18.4	33.3	1.00	6
Oyster toadfish	18-28	15	0.4	20.0	0.60	1
Spot	3-10	48	0.4	2.1	0.04	3
Tautog	6-16	18	15.7	33.3	1.22	2
Tautog	20-32	7	0.6	28.6	0.43	7

Genus *Cirolana*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Brown bullhead	21-35	5	<0.1	20.0	0.2

Family Oniscidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Brown bullhead	21-35	10	0.5	10.0	0.10

Order Amphipoda
Suborder Gammaridea - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
American eel	11-61	10	0.1	20.0	0.70
Atlantic silverside	3-13	85	14.4	14.1	4.33
Banded killifish	3-10	18	41.3	50.0	5.67
Bay anchovy	5-11	101	4.1	11.9	0.33
Black sea bass	6-21	17	0.6	47.1	2.12
Blueback herring	7-15	13	19.7	15.4	2.92
Bluefish	6-10	16	0.4	6.3	0.06
Brown bullhead	21-35	5	3.4	80.0	15.40
Cunner	3-5	4	70.5	50.0	5.75
Fourspine stickleback	2-6	76	34.2	29.0	1.11
Hogchoker	2-17	7	0.9	28.6	0.29
Lined seahorse	8-12	3	71.2	100.0	16.67
Mummichog	3-11	34	13.9	44.1	1.15
Naked goby	3-5	8	40.0	50.0	1.88
Northern pipefish	9-21	21	35.0	47.6	2.19
Northern puffer	2-11	3	2.5	66.7	2.33
Northern sea robin	8-18	4	7.6	50.0	6.50
Oyster toadfish	4-13	15	0.7	13.3	0.27

Order Amphipoda

Suborder Gammaridea - Total continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Oyster toadfish	18-28	15	0.5	33.3	1.53
Pinfish	6-11	3	6.5	100.0	2.33
Planehead filefish	5&13	2	20.5	100.0	10.50
Pumpkinseed	9&10	2	15.9	50.0	21.00
Rainwater killifish	3-4	9	61.8	66.7	2.89
Red hake	8-20	3	5.5	33.3	0.67
Scup	14	1	0.1	100.0	1.00
Silver perch	3-12	26	1.9	34.6	1.23
Spot	3-10	48	49.5	68.8	16.06
Spot	11-19	44	14.7	59.1	28.27
Spotted hake	5-19	16	1.3	31.3	0.69
Striped burrfish	23&25	2	<0.1	50.0	0.50
Striped killifish	4-13	13	11.8	38.5	1.23
Striped sea robin	4-7	3	11.7	66.7	3.00
Summer flounder	6-24	25	0.5	32.0	1.08
Summer flounder	26-65	13	<0.1	7.7	0.08
Tautog	6-16	18	7.8	72.2	7.83
Tautog	20-32	7	<0.1	42.9	0.57
Threespine stickleback	5-7	6	25.1	33.3	0.33
Tidewater silverside	4-9	37	11.2	16.2	0.62
Weakfish	5-10	27	6.6	59.3	5.37
Weakfish	11-17	22	0.1	18.2	0.55
White perch	7-12	18	53.3	50.0	7.06
White perch	14-26	54	11.2	38.9	9.20
White perch	29-37	7	0.2	42.9	0.57
Windowpane	15-34	4	<0.1	25.0	0.25
Winter flounder	3-11	56	19.0	80.4	11.27
Winter flounder	12-21	41	10.2	70.7	8.37
Winter flounder	22-33	45	5.6	64.4	18.16

Genus *Ampelisca* - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	<0.1	10.0	0.20	16
Atlantic silverside	3-13	85	10.1	8.2	4.15	1
Bay anchovy	5-11	101	3.2	4.0	0.25	4
Black sea bass	6-21	17	<0.1	17.7	0.24	20
Cunner	3-5	4	30.6	25.0	1.50	19
Fourspine stickleback	2-6	76	3.5	1.3	0.09	9
Lined seahorse	8-12	3	13.2	33.3	3.33	13
Naked goby	3-5	8	15.1	37.5	1.25	11
Northern pipefish	9-21	21	2.4	14.3	0.38	12
Northern puffer	2-11	3	1.8	33.3	1.00	18
Northern sea robin	8-18	4	<0.1	25.0	0.25	24
Pinfish	6-11	3	0.4	66.7	1.00	15
Scup	14	1	0.1	100.0	1.00	21
Silver perch	3-12	26	0.2	15.4	0.69	10
Spot	3-10	48	32.5	33.3	10.94	3
Spot	11-19	44	13.2	36.4	26.94	2
Spotted hake	5-19	16	0.7	12.5	0.31	17
Striped sea robin	4-7	3	5.7	33.3	1.33	23
Summer flounder	6-24	25	<0.1	8.0	0.08	25
Tautog	6-16	18	<0.1	5.6	0.11	22
Weakfish	5-10	27	6.2	44.4	5.11	8
Weakfish	11-17	22	0.1	13.6	0.50	14
Winter flounder	3-11	56	14.6	62.5	8.46	6
Winter flounder	12-21	41	2.1	41.5	4.05	7
Winter flounder	22-33	45	4.9	44.4	16.40	5

Ampelisca abdita

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic silverside	3-13	85	10.0	5.9	4.13	1
Bay anchovy	5-11	101	0.3	1.0	0.01	11
Black sea bass	6-21	17	<0.1	11.8	0.18	15
Cunner	3-5	4	30.6	0.25	1.50	14
Lined seahorse	8-12	3	13.2	33.3	3.33	12
Naked goby	3-5	8	15.1	37.5	1.25	9
Northern pipefish	9-21	21	2.2	9.5	0.33	10
Northern sea robin	8-18	4	<0.1	25.0	0.25	20
Pinfish	6-11	3	0.4	33.3	0.67	13
Silver perch	3-12	26	<0.1	7.7	0.62	8
Spot	3-10	48	4.1	4.2	2.85	3
Spot	11-19	44	8.9	15.9	22.10	2
Striped sea robin	4-7	3	5.7	33.3	1.33	18
Summer flounder	6-24	25	<0.1	8.0	0.08	19
Tautog	6-16	18	<0.1	5.6	0.11	17
Weakfish	5-10	27	4.8	33.3	4.2	6
Weakfish	11-17	22	<0.1	4.5	0.09	16
Winter flounder	3-11	56	14.4	58.9	8.34	5
Winter flounder	12-21	41	0.5	22.0	2.80	7
Winter flounder	22-33	45	1.7	17.8	10.93	4

Ampelisca vadorum

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic silverside	3-13	85	<0.1	1.2	0.01	4
Black sea bass	6-21	17	<0.1	5.9	0.06	10
Fourspine stickleback	2-6	76	3.5	1.3	0.09	1
Northern puffer	2-11	3	1.8	33.3	1.00	6
Silver perch	3-12	26	0.1	7.7	0.08	5
Spotted hake	5-19	16	0.5	6.3	0.13	8
Weakfish	5-10	27	<0.1	3.7	0.04	9
Winter flounder	3-11	56	0.1	3.6	0.05	7
Winter flounder	12-21	41	1.4	19.5	1.20	3
Winter flounder	22-33	45	1.5	22.2	3.40	2

Family Ampithoidae - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Black sea bass	6-21	17	<0.1	11.8	0.12
Fourspine stickleback	2-6	76	6.0	4.0	0.16
Lined seahorse	8-12	3	56.7	66.7	13.00
Mummichog	3-11	34	1.6	5.9	0.06
Northern pipefish	9-21	21	31.8	9.5	0.86
Northern sea robin	8-18	4	6.7	50.0	4.50
Oyster toadfish	4-13	15	0.4	6.7	1.20
Oyster toadfish	18-28	15	0.2	6.7	0.13
Red hake	8-20	3	5.5	33.3	0.67
Silver perch	3-12	26	1.7	19.2	0.34
Spotted hake	5-19	16	0.6	18.8	0.31
Striped burrfish	23&25	2	<0.1	50.0	0.50
Striped killifish	4-13	13	6.1	15.4	0.85
Summer flounder	6-24	25	0.1	4.0	0.04
Tautog	6-16	18	6.2	22.2	3.67
Tautog	20-32	7	<0.1	14.3	0.14
Weakfish	5-10	27	<0.1	3.7	0.04
White perch	11-17	54	0.5	3.7	0.22
Windowpane	15-34	4	<0.1	25.0	0.25
Winter flounder	3-11	56	0.5	5.4	0.09
Winter flounder	12-21	41	3.0	7.3	0.93
Winter flounder	22-33	45	0.4	11.1	0.47

Cymadusa compta

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	<0.1	5.9	0.06	20
Fourspine stickleback	2-6	76	6.0	4.0	0.16	2
Lined seahorse	8-12	3	56.7	66.7	13.00	6
Mummichog	3-11	34	1.6	5.9	0.06	5
Northern pipefish	9-21	21	31.8	9.5	0.86	3
Northern sea robin	8-18	4	6.7	50.0	4.50	11
Oyster toadfish	4-13	15	0.4	6.7	0.13	15
Oyster toadfish	18-28	15	0.2	6.7	1.20	4

Cymadusa compta continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Red hake	8-20	3	5.5	33.3	0.67	17
Silver perch	3-12	26	0.5	15.4	0.19	9
Spotted hake	5-19	16	0.6	18.8	0.31	14
Striped killifish	4-13	13	6.1	15.4	0.85	1
Summer flounder	6-24	25	0.1	4.0	0.04	21
Tautog	6-16	18	6.2	22.2	3.67	7
Tautog	20-32	7	<0.1	14.3	0.14	19
Weakfish	5-10	27	<0.1	3.7	0.04	16
White perch	14-26	54	0.5	3.7	0.22	12
Windowpane	15-34	4	<0.1	25.0	0.25	18
Winter flounder	3-11	56	0.5	5.4	0.09	13
Winter flounder	12-21	41	3.0	7.3	0.93	8
Winter flounder	22-33	45	0.4	11.1	0.47	10

Family Aoridae - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Black sea bass	6-21	17	<0.1	5.9	0.06
Brown bullhead	21-35	5	<0.1	20.0	0.40
Fourspine stickleback	2-6	76	3.2	2.6	0.20
Mummichog	3-11	34	0.6	2.9	0.29
Planehead filefish	5&13	2	0.3	50.0	0.50
Spot	3-10	48	0.4	4.2	0.10
Spot	11-19	44	0.2	4.5	0.05
Striped killifish	4-13	13	4.3	7.7	0.15
Striped sea robin	4-7	3	5.7	33.3	1.33
Tautog	6-16	18	<0.1	5.6	0.17
Tautog	20-32	7	<0.1	14.3	0.14
Weakfish	5-10	27	<0.1	3.7	0.04
Winter flounder	3-11	56	0.5	16.1	0.43
Winter flounder	12-21	41	0.5	9.8	0.80
Winter flounder	22-33	45	<0.1	2.2	0.04

Microdeutopus gryllotalpa

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	<0.1	5.9	0.06	13
Brown bullhead	21-35	5	<0.1	20.0	0.40	12
Fourspine stickleback	2-6	76	3.2	2.6	0.20	1
Mummichog	3-11	34	0.6	2.9	0.29	2
Planehead filefish	5&13	2	0.3	50.0	0.50	7
Spot	3-10	48	0.4	4.2	0.10	3
Spot	11-19	44	0.2	4.5	0.05	4
Striped killifish	4-13	13	4.3	7.7	0.15	5
Tautog	6-16	18	<0.1	5.6	0.17	9
Weakfish	5-10	27	<0.1	3.7	0.04	11
Winter flounder	3-11	56	0.1	5.4	0.07	8
Winter flounder	12-21	41	<0.1	7.3	0.12	6
Winter flounder	22-33	45	0.91	2.2	0.04	10

Batae catharinensis

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Winter flounder	3-11	56	<0.1	1.2	0.02	2
Winter flounder	12-21	41	0.3	2.4	0.10	1

Family Corophiidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bay anchovy	5-11	101	0.3	4.0	0.04	3
Fourspine stickleback	2-6	76	1.8	2.6	0.04	5
Lined seahorse	8-12	3	1.2	33.3	0.33	19
Mummichog	3-11	34	1.1	2.9	0.09	4
Northern pipefish	9-21	21	<0.1	9.5	0.10	12
Northern puffer	2-11	3	<0.1	33.3	0.67	16
Pinfish	6-11	3	5.5	33.3	1.00	13

Family Corophiidae continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Planehead filefish	5&13	2	20.2	100.0	10.00	6
Silver perch	3-12	26	<0.1	11.5	0.08	11
Spot	3-10	48	<0.1	2.4	0.02	14
Spot	11-19	44	0.6	18.2	0.89	2
Striped killifish	4-13	13	0.8	7.8	0.08	15
Summer flounder	6-24	25	<0.1	4.0	0.12	18
Summer flounder	26-65	13	<0.1	7.7	0.08	20
Tautog	6-16	18	1.1	27.8	2.00	9
Weakfish	5-10	27	<0.1	3.7	0.04	17
White perch	7-12	18	15.7	11.1	11.06	1
White perch	14-26	54	0.1	7.4	0.44	8
Winter flounder	3-11	56	0.4	19.6	0.48	10
Winter flounder	12-21	41	<0.1	2.4	0.02	21
Winter flounder	22-33	45	0.2	17.8	1.02	7

Family Gammaridae - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
American eel	11-61	10	0.1	10.0	0.40
Atlantic silverside	3-13	85	0.1	2.4	0.02
Banded killifish	3-10	18	4.3	22.2	0.44
Black sea bass	6-21	17	0.4	23.5	1.06
Bluefish	6-10	16	0.4	6.3	0.06
Cunner	3-5	4	34.9	50.0	2.00
Fourspine stickleback	2-6	76	0.9	2.6	0.03
Mummichog	3-11	34	7.1	14.7	0.47
Naked goby	3-5	8	24.9	25.0	0.63
Northern pipefish	9-21	21	<0.1	4.8	0.10
Northern sea robin	8-18	4	0.4	25.0	1.50
Pinfish	6-11	3	0.6	33.3	0.33
Pumpkinseed	9&10	2	8.4	50.0	6.00
Rainwater killifish	3-4	9	61.8	66.7	2.89
Silver perch	3-12	26	<0.1	3.9	0.04

Family Gammaridae - Total continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Spot	3-10	48	1.0	4.2	0.25
Spot	11-19	44	0.2	9.1	0.52
Striped killifish	4-13	13	0.8	7.7	0.15
Summer flounder	6-24	25	<0.1	4.0	0.08
Tautog	6-16	18	0.4	11.1	1.00
Tautog	20-32	7	<0.1	14.3	0.29
Threespine stickleback	5-7	6	21.1	16.7	0.17
Tidewater silverside	4-9	37	1.4	2.7	0.03
Weakfish	5-10	27	0.3	7.4	0.07
White perch	7-12	18	2.1	16.7	0.22
White perch	14-26	54	6.6	18.5	3.19
White perch	29-37	7	0.1	28.6	0.43
Winter flounder	3-11	56	1.7	19.6	0.70
Winter flounder	12-21	41	1.0	9.8	1.02
Winter flounder	22-33	45	<0.1	13.3	0.13

Gammarus mucronatus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	0.1	10.0	0.40	6
Atlantic silverside	3-13	85	<0.1	1.2	0.01	3
Bluefish	6-10	16	0.4	6.3	0.06	10
Mummichog	3-11	34	6.9	11.8	0.44	1
Naked goby	3-5	8	2.2	12.5	0.13	5
Rainwater killifish	3-4	9	61.8	66.7	2.89	2
Silver perch	3-12	26	<0.1	3.9	0.04	7
White perch	14-26	54	0.2	5.6	0.44	4
White perch	29-37	7	0.1	28.6	0.43	8
Winter flounder	3-11	56	<0.1	1.8	0.02	9

Elasmopus leavis

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	0.2	23.5	0.65	8
Cunner	3-5	4	34.9	50.0	2.00	10
Fourspine stickleback	2-6	76	0.6	1.3	0.01	2
Naked goby	3-5	8	22.7	12.5	0.50	3
Northern sea robin	8-18	4	0.4	25.0	1.50	7
Spot	11-19	44	0.2	6.8	0.50	1
Striped killifish	4-13	13	0.8	7.7	0.15	6
Tautog	6-16	18	<0.1	5.6	0.22	11
Tautog	20-32	7	<0.1	14.3	0.29	14
Weakfish	5-10	27	0.3	7.4	0.07	12
White perch	14-26	54	<0.1	1.9	0.06	9
Winter flounder	3-11	56	1.5	16.1	0.63	5
Winter flounder	12-21	41	0.5	4.9	0.78	4
Winter flounder	22-33	45	<0.1	4.4	0.04	13

Family Lysianassidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Black sea bass	6-21	17	<0.1	11.8	0.12

Family Hyalidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Spotted hake	5-19	16	<0.1	6.3	0.06

Monoculodes edwardsi

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Northern sea robin	8-18	4	0.5	25.0	0.25	3
White perch	7-12	18	<0.1	5.6	0.06	1
White perch	29-37	7	<0.1	14.3	0.14	2

Family Photidae - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Atlantic silverside	3-13	85	2.2	1.2	0.04
Banded killifish	3-10	18	16.1	22.2	1.72
Bay anchovy	5-11	101	0.5	2.0	0.02
Blueback herring	7-15	13	19.7	15.4	2.92
Brown bullhead	21-35	5	3.3	40.0	14.20
Fourspine stickleback	2-6	76	0.4	1.3	0.01
Hogchoker	2-17	7	0.7	14.3	0.14
Mummichog	3-11	34	0.3	2.9	0.03
Pumpkinseed	9&10	2	7.5	50.0	15.00
Spot	3-10	48	0.2	2.1	0.15
Spot	11-19	44	0.2	6.8	0.30
Summer flounder	6-24	25	0.4	12.0	0.76
Tidewater silverside	4-9	37	3.4	5.4	0.08
White perch	7-12	18	35.4	38.9	15.72
White perch	14-26	54	3.9	27.8	5.31
Winter flounder	3-11	56	0.6	14.3	0.75
Winter flounder	12-21	41	0.3	7.3	0.59

Leptocheirus plumulosus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Banded killifish	3-10	18	16.1	22.2	1.72	2
Bay anchovy	5-11	101	0.5	2.0	0.02	6
Blueback herring	7-15	13	19.7	15.4	2.92	4
Brown bullhead	21-35	5	3.3	40.0	14.20	8
Fourspine stickleback	2-6	76	0.4	1.3	0.01	12
Hogchoker	2-17	7	0.7	14.3	0.14	15
Mummichog	3-11	34	0.3	2.9	0.03	10
Pumpkinseed	9&10	2	7.5	50.0	15.00	13
Spot	3-10	48	0.2	2.1	0.15	9
Spot	11-19	44	0.2	6.8	0.30	5
Summer flounder	6-24	25	0.4	12.0	0.76	14
Tidewater silverside	4-9	37	3.4	5.4	0.08	7
White perch	7-12	18	35.4	38.9	15.70	1
White perch	14-26	54	3.9	25.9	5.30	3
Winter flounder	12-21	41	0.3	4.9	0.56	11

Paraphoxus spinosus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	3-11	56	<0.1	1.8	0.02

Orchestia platensis

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic silverside	3-13	85	0.5	1.2	0.05	1
White perch	14-26	54	<0.1	1.9	0.04	2

Family Stenothoidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Northern pipefish	9-21	21	0.5	4.8	0.67	1
Northern puffer	2-11	3	<0.1	33.3	0.33	5
Silver perch	3-12	26	<0.1	3.9	0.04	2
Striped sea robin	4-7	3	0.3	33.3	0.33	6
Weakfish	5-10	27	<0.1	3.7	0.04	3
Winter flounder	22-33	45	<0.1	2.2	0.02	4

Suborder Caprellidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Cunner	3-5	4	7.0	25.0	0.50	5
Fourspine stickleback	2-6	76	<0.1	2.6	0.03	1
Northern pipefish	9-21	21	1.4	9.5	0.33	2
Planehead filefish	5&13	2	0.1	50.0	0.50	4
Striped killifish	4-13	13	0.3	7.7	0.08	3

Order Mysidacea - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Alewife	6-13	6	99.5	50.0	13.67
Alewife	27-34	5	5.2	20.0	2.50
Atlantic silverside	3-13	85	13.7	28.2	2.14
Bay anchovy	5-11	101	31.8	22.8	1.38
Black sea bass	6-21	17	0.5	11.8	0.35
Blueback herring	7-15	13	11.4	30.8	2.08
Bluefish	6-10	16	0.1	6.3	0.13
Bluefish	11-20	62	2.8	12.9	15.85
Bluefish	21-36	19	<0.1	5.3	0.05
Brown bullhead	21-35	5	<0.1	20.0	0.20

Order Mysidacea - Total continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Crevalle jack	4-13	9	30.4	77.8	31.00
Fourspine stickleback	2-6	76	26.0	13.2	0.26
Lined seahorse	8-12	3	9.0	33.3	0.33
Naked goby	3-5	8	2.4	25.0	0.38
Northern pipefish	9-21	21	58.6	47.6	2.95
Northern sennet	10-17	7	5.1	14.3	2.57
Rainwater killifish	3-4	9	10.6	11.1	0.11
Scup	14	1	7.5	100.0	5.00
Silver perch	3-12	26	20.4	57.7	14.04
Spot	3-10	48	0.1	2.1	0.02
Spot	11-19	44	8.9	20.5	3.27
Spotted hake	5-19	16	10.6	31.3	3.63
Striped sea robin	4-7	3	76.3	100.0	6.33
Summer flounder	6-24	25	14.2	52.0	41.68
Summer flounder	26-65	13	0.4	23.1	1.69
Threespine stickleback	5-7	6	56.5	66.7	1.17
Weakfish	5-10	27	43.4	81.5	18.52
Weakfish	11-17	24	23.1	72.7	37.86
White perch	7-12	18	10.5	72.2	8.67
White perch	14-26	54	43.8	63.0	44.31
White perch	29-37	7	20.0	57.1	73.71
Windowpane	15-34	4	10.2	50.0	90.50
Winter flounder	3-11	56	10.8	3.6	0.50
Winter flounder	12-21	41	10.8	22.2	5.07
Winter flounder	22-33	45	<0.1	6.7	0.07

Neomysis americana

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	6-13	6	99.5	50.0	13.67	17
Alewife	27-34	5	5.2	20.0	2.50	22
Atlantic silverside	3-13	85	13.4	22.4	2.07	1
Bay anchovy	5-11	101	31.5	19.8	1.24	2
Black sea bass	6-21	17	0.5	11.8	0.35	27
Blueback herring	7-15	13	8.0	23.1	1.23	18
Bluefish	6-10	16	0.1	6.3	0.13	30
Bluefish	11-20	62	2.1	9.7	10.34	11
Bluefish	21-36	19	<0.1	5.3	0.05	31
Brown bullhead	21-35	5	<0.1	20.0	0.20	32
Crevalle jack	4-13	9	30.3	77.8	30.78	6
Fourspine stickleback	2-6	76	25.5	11.8	0.25	10
Lined seahorse	8-12	3	9.0	33.3	0.33	29
Northern pipefish	9-21	21	58.6	47.6	2.95	14
Northern sennet	10-17	7	5.1	14.3	2.57	19
Scup	14	1	7.5	100.0	5.00	25
Silver perch	3-12	26	18.3	42.3	11.81	4
Spot	11-19	44	6.1	15.9	2.61	5
Spotted hake	5-19	16	10.6	31.3	3.63	20
Striped sea robin	4-7	3	42.2	66.7	3.00	23
Summer flounder	6-24	25	12.8	44.0	36.28	12
Summer flounder	26-65	13	0.4	23.1	1.69	24
Threespine stickleback	5-7	6	56.5	66.7	1.17	26
Weakfish	5-10	27	41.4	77.8	17.59	7
Weakfish	11-17	22	23.1	72.7	37.86	9
White perch	7-12	18	10.5	66.7	8.67	13
White perch	14-26	54	43.8	63.0	44.31	3
White perch	29-37	7	20.0	57.1	73.71	8
Windowpane	15-34	4	10.2	50.0	90.50	15
Winter flounder	3-11	56	10.8	3.6	0.50	21
Winter flounder	12-21	41	10.8	22.0	5.07	16
Winter flounder	22-33	45	<0.1	6.7	0.07	28

Mysidopsis bigelowi

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic silverside	3-13	85	<0.1	1.2	0.01	5
Bluefish	11-20	62	0.7	3.2	5.52	3
Crevalle jack	4-13	9	<0.1	22.2	0.22	9
Naked goby	3-5	8	2.2	12.5	0.25	7
Silver perch	3-12	26	2.1	23.1	2.23	1
Spot	11-19	44	2.7	2.3	0.57	2
Striped sea robin	4-7	3	34.2	33.3	3.33	8
Summer flounder	6-24	25	1.4	12.0	5.36	4
Weakfish	5-10	27	1.9	7.4	0.85	6

Order Decapoda
Infraorder Penaeidea
Genus Penaeus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Summer flounder	6-24	25	2.5	4.0	0.04

Infraorder Caridea
Larval Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	6-13	6	<0.1	16.7	0.17	10
Atlantic needlefish	5-16	15	0.1	6.7	0.60	6
Atlantic silverside	3-13	85	0.1	5.9	0.42	2
Bay anchovy	5-11	101	0.2	7.9	0.15	3
Blueback herring	5-15	13	17.5	23.1	38.62	1
Bluefish	6-10	16	3.6	18.8	16.75	4
Fourspine stickleback	2-6	76	<0.1	1.3	0.01	5
Northern pipefish	9-21	21	<0.1	4.8	0.05	8
Spot	11-19	44	<0.1	2.3	0.02	7
White perch	14-26	54	<0.1	3.7	0.06	9

Genus Palaemonetes - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Alewife	27-34	5	21.5	40.0	0.60
Atlantic silverside	3-13	85	<0.1	1.2	0.04
Black sea bass	6-21	17	16.2	23.5	0.59
Bluefish	6-10	16	33.5	18.8	3.38
Bluefish	11-20	62	0.1	4.8	0.06
Mummichog	3-11	34	5.6	2.9	0.03
Northern sea robin	8-18	4	7.9	25.0	0.25
Oyster toadfish	18-28	15	1.0	20.0	0.20
Pinfish	6-11	3	60.5	33.3	1.33
Silver perch	3-12	26	16.8	19.2	0.42
Smooth dogfish	39-56	12	0.6	25.0	0.58
Spotted hake	5-19	16	33.8	12.5	0.44
Summer flounder	6-24	25	16.5	12.0	0.28
Summer flounder	26-65	13	1.4	7.7	0.54
Weakfish	5-10	27	1.7	3.7	0.07
White perch	14-26	54	5.5	3.7	0.69
White perch	29-37	7	1.4	14.3	0.29
Windowpane	15-34	4	7.5	25.0	1.75
Winter flounder	12-21	41	3.5	7.3	0.07
Winter flounder	22-33	45	22.2	28.9	2.58

Palaemonetes vulgaris

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	27-34	5	20.7	20.0	0.40	12
Black sea bass	6-21	17	3.5	11.8	0.18	13
Bluefish	6-10	16	24.5	12.5	3.25	4
Bluefish	11-20	62	0.1	3.2	0.03	14
Northern sea robin	8-18	4	7.9	25.0	0.25	15
Oyster toadfish	18-28	15	0.4	6.7	0.07	9
Pinfish	6-11	3	60.5	33.3	1.33	5
Silver perch	3-12	26	12.3	11.5	0.19	3

Palaemonetes vulgaris continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Smooth dogfish	39-56	12	0.6	25.0	0.58	8
Spotted hake	5-19	16	18.8	12.5	0.38	7
Summer flounder	6-24	25	10.0	8.0	0.20	11
Summer flounder	26-65	13	1.4	7.7	0.54	10
White perch	14-26	54	4.8	3.7	0.63	2
Window pane	15-34	4	5.9	25.0	1.50	6
Winter flounder	22-33	45	19.3	24.4	2.27	1

Palaemonetes pugio

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bluefish	6-10	16	8.9	6.3	0.13	8
Mummichog	3-11	34	5.6	2.9	0.03	1
Oyster toadfish	18-28	15	0.5	6.7	0.07	3
Silver perch	3-12	26	3.4	3.9	0.08	2
Spotted hake	5-19	16	15.0	6.3	0.06	9
Summer flounder	6-24	25	5.5	4.0	0.04	10
Weakfish	5-10	27	1.7	3.7	0.07	4
White perch	26-65	7	1.4	14.3	0.29	5
Winter flounder	12-21	41	1.2	2.4	0.02	7
Winter flounder	22-33	45	0.5	4.4	0.04	6

Genus *Hippolyte*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Weakfish	5-10	27	2.1	3.7	0.04

Crangon septemspinosa

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	27-34	5	5.2	20.0	0.20	33
Atlantic needlefish	24-58	5	4.9	40.0	0.60	22
Atlantic silverside	3-13	85	12.0	3.5	0.08	2
Bay anchovy	5-11	101	<0.1	1.0	0.01	6
Black sea bass	6-21	17	11.6	52.9	0.94	17
Bluefish	6-10	16	6.0	18.8	0.31	26
Bluefish	11-20	62	5.5	22.6	0.52	11
Bluefish	21-36	19	1.8	31.6	0.47	21
Crevalle jack	4-13	9	16.2	33.3	0.44	15
Lined seahorse	8-12	3	13.2	33.3	0.33	27
Mummichog	3-11	34	11.2	2.9	0.03	7
Northern kingfish	15&29	2	79.2	100.0	3.00	20
Northern sea robin	8-18	4	80.4	100.0	9.75	5
Oyster toadfish	4-13	15	10.4	20.0	0.27	13
Pinfish	6-11	3	33.0	66.7	1.33	16
Red hake	8-20	3	39.9	66.7	5.33	18
Silver perch	3-12	26	43.6	53.9	1.73	1
Smooth dogfish	39-56	12	0.4	25.0	0.50	23
Spot	11-19	44	2.2	2.3	0.02	19
Spotted hake	5-19	16	47.7	50.0	1.63	12
Striped bass	43-58	11	5.9	36.4	3.27	31
Striped sea robin	4-7	3	5.7	33.3	0.33	29
Summer flounder	6-24	25	27.6	40.0	2.56	8
Summer flounder	26-65	13	6.9	53.9	3.92	9
Tautog	6-16	18	3.7	11.1	0.11	30
Tautog	20-32	7	<0.1	28.6	0.29	32
Weakfish	5-10	27	19.2	25.9	0.33	14
Weakfish	11-17	22	13.6	36.4	1.23	12
Weakfish	32-62	2	0.7	50.0	0.50	34
White perch	7-12	18	1.7	5.6	0.06	25

Crangon septemspinosa continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
White perch	14-26	54	17.4	11.1	0.67	3
White perch	29-37	7	62.0	71.4	4.57	4
Windowpane	15-34	4	56.2	50.0	8.00	10
Winter flounder	3-11	56	2.2	1.8	0.04	28
Winter flounder	12-21	41	4.7	7.3	0.15	20
Winter flounder	22-33	45	0.5	6.7	0.07	24

Infraorder Anomura
Genus *Pagurus*

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	1.7	5.9	0.06	2
Striped burrfish	23&25	2	2.2	50.0	1.00	1
Summer flounder	26-65	13	0.1	7.7	0.08	3

Infraorder Brachyura
Larval Forms

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Alewife	6-13	6	0.2	16.7	0.83	8
Atlantic menhaden	4-8	19		5.3	1.68	4
Atlantic needlefish	5-16	15	4.9	20.0	46.90	3
Atlantic silverside	3-13	85	3.1	11.8	5.09	1
Bay anchovy	5-11	101	1.2	20.8	1.78	2
Bluefish	6-10	16	0.4	25.0	4.06	6
Cunner	3-5	4	2.4	25.0	0.75	9
Lined seahorse	8-12	3	1.3	33.3	0.33	10
Northern pipefish	9-21	21	0.4	14.3	0.76	5
Northern sea robin	8-18	4	<0.1	25.0	0.25	11
White perch	14-26	18	<0.1	1.9	0.19	7
Winter flounder	3-11	56	<0.1	1.8	0.02	12

Infraorder Brachyura
Adult Forms Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
American eel	11-61	10	93.9	50.0	0.90
Atlantic silverside	3-13	85	5.2	2.4	0.07
Black sea bass	6-21	17	55.2	70.6	1.53
Bluefish	11-20	62	9.1	3.2	0.03
Bluefish	21-36	19	12.2	10.5	0.11
Brown bullhead	21-35	5	13.4	80.0	1.00
Fourspine stickleback	2-6	76	0.1	1.3	0.01
Northern pipefish	9-21	21	0.4	4.8	0.05
Northern sea robin	8-18	4	3.8	25.0	0.75
Oyster toadfish	4-13	15	39.5	40.0	0.67
Oyster toadfish	18-28	15	22.4	33.3	0.87
Smooth dogfish	39-56	12	90.7	83.3	1.33
Spot	3-10	48	0.1	2.1	0.02
Spot	11-19	44	5.4	2.3	0.02
Spotted hake	5-19	16	5.6	6.3	0.06
Striped burrfish	23&25	2	93.1	100.0	4.00
Summer flounder	6-24	25	5.5	20.0	0.44
Summer flounder	26-65	13	14.2	30.8	0.31
Tautog	6-16	18	23.1	44.4	1.39
Tautog	20-32	7	87.1	100.0	7.86
Weakfish	5-10	27	0.9	3.7	0.07
Weakfish	11-17	22	0.9	4.5	0.05
White perch	14-26	54	7.1	9.3	0.11
Winter flounder	12-21	41	0.8	14.6	0.22
Winter flounder	22-33	45	4.5	24.4	1.18

Ovalipes ocellatus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	15.7	5.9	0.12	2
Tautog	20-32	7	12.6	14.3	0.43	1

Callinectes sapidus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	90.9	40.0	0.50	1
Black sea bass	6-21	17	13.5	11.8	0.12	12
Bluefish	11-20	62	9.1	3.2	0.03	11
Bluefish	21-36	19	12.2	10.5	0.11	10
Brown bullhead	21-35	5	13.2	20.0	0.20	16
Oyster toadfish	4-13	15	2.6	6.7	0.07	7
Oyster toadfish	18-28	15	12.4	13.3	0.13	4
Smooth dogfish	39-56	12	90.7	83.3	1.33	2
Striped burrfish	23&25	2	83.2	50.0	1.00	5
Summer flounder	6-24	25	0.3	4.0	0.08	13
Summer flounder	26-65	13	13.6	7.7	0.08	17
Tautog	6-16	18	<0.1	5.6	0.06	15
Tautog	20-32	7	7.3	28.6	0.29	9
Weakfish	11-17	22	0.9	4.5	0.05	14
White perch	14-26	54	3.3	5.6	0.06	6
Winter flounder	12-21	41	0.5	9.8	0.15	3
Winter flounder	22-33	45	0.2	4.4	0.04	8

Family Xanthidea - Total

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
American eel	11-61	10	3.0	20.0	0.40
Atlantic silverside	3-13	85	5.2	2.4	0.07
Black sea bass	6-21	17	26.0	64.7	1.29
Fourspine stickleback	2-6	76	0.1	1.3	0.01
Northern pipefish	9-21	21	0.4	4.8	0.05
Northern sea robin	8-18	4	3.8	25.0	0.75
Oyster toadfish	4-13	15	36.9	33.3	0.60
Oyster toadfish	18-28	15	10.0	26.7	0.73
Spot	3-10	48	0.1	2.1	0.02
Spotted hake	5-19	16	5.6	6.3	0.06
Striped burrfish	23&25	2	10.0	100.0	3.00

Family Xanthidea - Total continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Summer flounder	6-24	25	5.2	16.0	0.36
Summer flounder	26-65	13	0.5	23.1	0.23
Tautog	6-16	18	21.3	33.3	0.33
Tautog	20-32	7	67.1	100.0	2.78
Weakfish	5-10	27	0.9	3.7	0.07
White perch	14-26	54	3.8	3.7	0.06
Winter flounder	12-21	41	0.2	2.4	0.05
Winter flounder	22-33	45	4.4	20.0	1.13

Neopanope texanna

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	2.0	10.0	0.20	8
Black sea bass	6-21	17	7.8	47.1	0.71	4
Northern pipefish	9-21	21	0.4	4.8	0.05	7
Northern sea robin	8-18	4	0.8	25.0	0.25	12
Oyster toadfish	4-13	15	3.2	13.3	0.13	5
Oyster toadfish	18-28	15	9.1	13.3	0.60	1
Spotted hake	5-19	16	5.6	6.3	0.06	13
Striped burrfish	23&25	2	5.5	50.0	1.50	6
Summer flounder	6-24	25	1.9	8.0	0.16	9
Summer flounder	26-65	13	0.5	15.4	0.15	11
Tautog	20-32	7	28.1	57.1	2.57	3
White perch	14-26	54	1.4	1.9	0.02	10
Winter flounder	22-33	45	1.2	13.3	0.51	2

Rhithropanopeus harrisii

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	0.8	10.0	0.10	9
Black sea bass	6-21	17	7.9	17.6	0.24	8
Oyster toadfish	4-13	15	28.5	13.3	0.33	1
Oyster toadfish	18-28	15	0.5	6.7	0.07	5
Striped burrfish	23&25	2	3.3	50.0	1.00	4
Summer flounder	6-24	25	3.2	12.0	0.20	7
Summer flounder	26-65	13	<0.1	7.7	0.08	10
Tautog	20-32	7	11.2	28.6	1.43	3
White perch	14-26	54	2.4	1.9	0.04	6
Winter flounder	29-37	45	2.4	4.4	0.36	2

Eurypanopeus depressus

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	0.9	5.9	0.06	3
Striped sea robin	4-7	3	3.0	33.3	0.67	2
Winter flounder	22-33	45	0.2	6.7	0.18	1

Phylum Chordata
Class Ascidiacea
Family Molgulidae

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Winter flounder	22-33	45	0.2	4.4	0.04

Class Osteichthyes (bony fishes)
Eggs

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic silverside	3-13	85	31.0	12.9	3.86	1
Banded killifish	3-10	18	1.1	5.5	0.06	3
Bay anchovy	5-11	101	0.5	8.9	0.15	5
Bluefish	6-10	16	0.7	6.3	6.19	8
Fourspine stickleback	2-6	76	3.5	1.3	0.04	7
Gray snapper	4&5	2	24.6	50.0	0.50	12
Mummichog	3-11	34	3.4	2.9	0.32	6
Oyster toadfish	18-28	15	<0.1	13.3	0.47	10
Spot	3-10	48	<0.1	2.0	0.02	11
Striped killifish	4-13	13	31.6	15.4	0.54	9
White perch	7-12	18	14.0	22.2	60.90	2
White perch	14-26	54	1.0	7.4	12.10	4

Class Osteichthyes - Total Except Eggs

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
American eel	11-61	10	0.3	10.0	0.10
Atlantic needlefish	5-16	15	50.0	40.0	1.47
Atlantic needlefish	24-58	5	83.3	60.0	0.80
Black sea bass	6-21	17	7.1	17.6	0.29
Bluefish	6-10	16	26.3	37.5	0.63
Bluefish	11-20	62	81.8	72.6	1.23
Bluefish	21-36	19	85.5	84.2	1.21
Brown bullhead	21-35	5	60.1	80.0	2.20
Crevalle jack	4-13	9	53.3	33.3	0.89
Inshore lizardfish	10-14	2	100.0	100.0	1.00
Mummichog	3-11	34	50.4	2.9	0.03
Northern sennet	10-17	7	94.9	71.4	0.71
Oyster toadfish	4-13	15	0.7	13.3	0.13
Oyster toadfish	18-28	15	55.6	26.7	0.60

Class Osteichthyes - Total Except Eggs continued.

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Red hake	8-20	3	54.5	33.3	0.33
Redfin pickerel	26	1	100.0	100.0	1.00
Scup	14	1	22.5	100.0	1.00
Silver perch	3-12	26	14.5	15.4	0.19
Smooth dogfish	39-56	12	2.5	16.7	0.17
Spot	11-19	44	<0.1	2.3	0.02
Spotted hake	5-19	16	5.7	25.0	0.25
Striped bass	43-58	11	93.9	81.8	4.18
Summer flounder	6-24	25	32.6	36.0	0.60
Summer flounder	26-65	13	74.3	69.2	1.69
Tautog	6-16	18	<0.1	5.6	0.05
Tidewater silverside	4-9	37	8.3	5.4	0.24
Weakfish	5-10	27	26.1	14.8	0.15
Weakfish	11-17	22	60.6	59.1	1.04
Weakfish	32-62	2	99.3	100.0	2.50
White perch	7-12	18	10.5	16.0	0.16
White perch	14-26	54	1.7	5.6	0.06
White perch	29-37	7	4.2	14.3	0.14
Windowpane	15-34	4	17.4	25.0	1.00
Winter flounder	22-33	45	2.3	8.9	0.11

Family Atherinidae (Silversides)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic needlefish	5-16	15	0.8	6.6	1.07*	2
Atlantic needlefish	24-58	5	71.9	20.0	0.20	4
Bluefish	6-10	16	6.7	6.3	0.06	7
Bluefish	11-20	62	10.1	9.7	0.11	3
Northern sennet	10-17	7	44.1	28.6	0.29	1
Striped bass	43-58	11	2.6	9.1	0.09	8
Summer flounder	6-24	25	1.9	4.0	0.04	6
Summer flounder	26-65	13	3.4	7.7	0.15	5

* larvae

Genus *Anchoa* (Anchovies)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bluefish	11-20	62	7.9	11.3	0.24	2
Bluefish	21-36	19	3.6	5.3	0.05	5
Brown bullhead	21-35	5	60.1	40.0	1.80	4
Crevalle jack	4-13	9	44.1	11.1	0.66	1
Summer flounder	6-24	25	8.1	4.0	0.04	7
Summer flounder	26-65	13	6.5	15.3	0.08	6
Weakfish	11-17	22	25.9	9.7	0.18	3

Apeltes quadracus (Fourspine stickleback)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Atlantic needlefish	5-16	15	26.0	6.7	0.13	2
Bluefish	11-20	62	1.1	3.2	0.06	4
Oyster toadfish	18-28	15	0.8	6.7	0.07	1
Spotted hake	8-20	16	3.8	12.5	0.13	6
Summer flounder	6-24	25	4.5	12.0	0.20	5
Summer flounder	26-65	13	1.7	15.4	0.38	3
White perch	14-26	54	0.7	1.9	0.02	7

Ammodytes americanus (American sand lance)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Striped bass	43-58	11	30.0	54.5	2.18	1
Windowpane	15-34	4	11.9	25.0	0.25	2

Brevoortia tyrannus (Atlantic menhaden)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bluefish	11-20	62	5.4	4.8	0.05	1
Bluefish	21-36	19	30.1	5.3	0.05	2
Red hake	8-20	3	54.5	33.3	0.33	3

Family Bothidae (Left handed flatfish)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Striped bass	43-58	11	3.8	9.1	0.18

Bairdiella chrysura (Silver perch)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Summer flounder	26-65	13	8.9	7.7	0.23

Cynoscion regalis (Weakfish)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bluefish	11-20	62	1.8	1.6	0.02	1
Smooth dogfish	39-56	12	2.1	8.3	0.08	2
Striped bass	43-58	11	18.1	9.1	0.18	3

Leiostomus xanthurus (Spot)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bluefish	11-20	62	3.1	1.6	0.02	2
Oyster toadfish	18-28	15	54.4	13.3	0.47	1

Genus *Fundulus* (Killifish)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Bluefish	11-20	62	23.7	9.7	0.19	3
Bluefish	21-36	19	22.2	15.8	0.26	4
Mummichog*	3-11	34	50.4	2.9	0.03	2
Tidewater silverside#	4-9	37	8.3	2.7	0.21	1
White perch	7-12	18	10.5	5.6	0.06	5
White perch	29-37	7	4.2	14.3	0.14	6

* One occurrence in largest specimen

\# Larvae only

Gobiosoma bosci (Naked goby)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
Black sea bass	6-21	17	5.2	5.9	0.18	2
Bluefish	11-20	62	1.7	1.6	0.05	3
White perch	14-26	54	0.7	1.9	0.02	4
Winter flounder	22-33	45	2.0	8.9	0.09	1

Genus *Prionotus* (Sea robins)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Summer flounder	26-65	13	43.4	15.4	0.15

Pseudopleuronectes americanus (Winter flounder)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Summer flounder	26-65	13	8.4	7.7	0.15

Strongylura marina (Atlantic needlefish)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish
Atlantic needlefish	5-16	15	7.7	13.3	0.13

Syngnathus fuscus (Northern pipefish)

Consumer species	Size range (cm)	Sample size	% Volume	% Occurrence	Ind/ fish	P.I. rank
American eel	11-61	10	0.3	10.0	0.10	1
Summer flounder	26-65	13	1.0	7.7	0.08	2

9. RODENT POPULATION

Robert Bosenberg[1]

ABSTRACT

Trapping of rodent species resident on the 639 ha (1,335 acres) portion of the Barnegat National Wildlife Refuge (Cedar Run marsh evaluation study area) was carried out periodically from April 1975 to June 1977. Total trapping effort, using both live and killing traps, amounted to 18,610 trap nights. Rodent species captured included the meadow vole (*Microtus pennsylvanicus*), muskrat (*Ondatra zibethica*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), and the meadow jumping mouse (*Zapus hudsonius*). *Microtus* was the only mouse species captured in numbers appropriate for estimating population density. Population estimates were derived from the Schnabel procedure with Overton correction for known losses. The density of this species was greater in an incompletely lagooned area than in either a mosquito ditched area or a "natural" marsh area. Densities in the latter two areas were similar. Densities in July were greater than densities in April and/or September. Density in vegetative cover types was related to marsh alteration type. Hurricane Belle (9-10 August 1976) caused a significant reduction in *Microtus* density in the incompletely lagooned area.

Muskrat activity was generally restricted to an area dominated by *Scirpus* sp. adjacent to a pine/oak/maple uplands community. Population estimates were derived from a removal technique and subsequent regression procedures applied to data collected in November 1975 and again in March 1977. The population of muskrats was estimated to exceed five muskrats per ha (2.47 acres).

In 800 trap nights, a total of five Norway rats (*Rattus norvegicus*) were captured. No estimate of the population density of this species was possible.

INTRODUCTION

Salt marshes are known to be highly productive ecosystems and their importance to estuarine systems has been well established (Teal 1962; Odum et al. 1972; Kirby and Gosselink 1976). However, salt marsh rodent populations are not well understood. Rodents serve as a food for a variety of avian and other mammalian species. Estimates of population density of the rodent species are thus necessary to the understanding of the functioning of a New Jersey salt marsh ecosystem.

PROCEDURES

Microtus 1975/1976

From aerial photographs of and visitations to the study area, the area was partitioned into three marsh alteration types. Each alteration type was termed a

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[1]The author is presently with Beecham Laboratories; the research was conducted while he was associated with Cook College, Rutgers University. This report was prepared for the N.J. Division of Fish, Game, and Shellfisheries with funds provided in part by the Federal Aid to Wildlife (Pittman-Robertson) Act for Project W-53-R-2, "Wetlands Ecology," during the period 15 August 1974 to 31 August 1977.

section (ST). The location of the three ST's comprising the area are presented in Figure 1. The ST's were characterized as follows:

ST 1 - The alteration in this portion of the area was incomplete lagooning in preparation for residential development. The lagoon embankments were constructed by placing sequential layers of marsh sod one atop another to a height of approximately 1.2 m (4 ft). *Spartina patens*, *Iva frutescens*, and pokeweed (*Phytolacca* sp.) were the plant species growing on the embankments. The area of ST 1 was 44 ha (110 acres);

ST 2 - The alteration in this part of the area was mosquito ditching. Spoil piles up to 0.45 m (1.5 ft) high paralleled mosquito ditch spoil piles. Plant species associated with spoil piles included *S. alterniflora* low vigor, *S. patens*, *I. frutescens*, and a goldenrod (*Solidago* sp.). The area of ST 2 was 279 ha (700 acres);

ST 3 - This portion of the area was relatively unaltered. Of the three ST's, ST 3 most closely resembled undisturbed, naturally occurring salt marsh. *S. patens* and *S. alterniflora* low vigor were the predominate vegetative species. The area of ST 3 was 210 ha (525 acres).

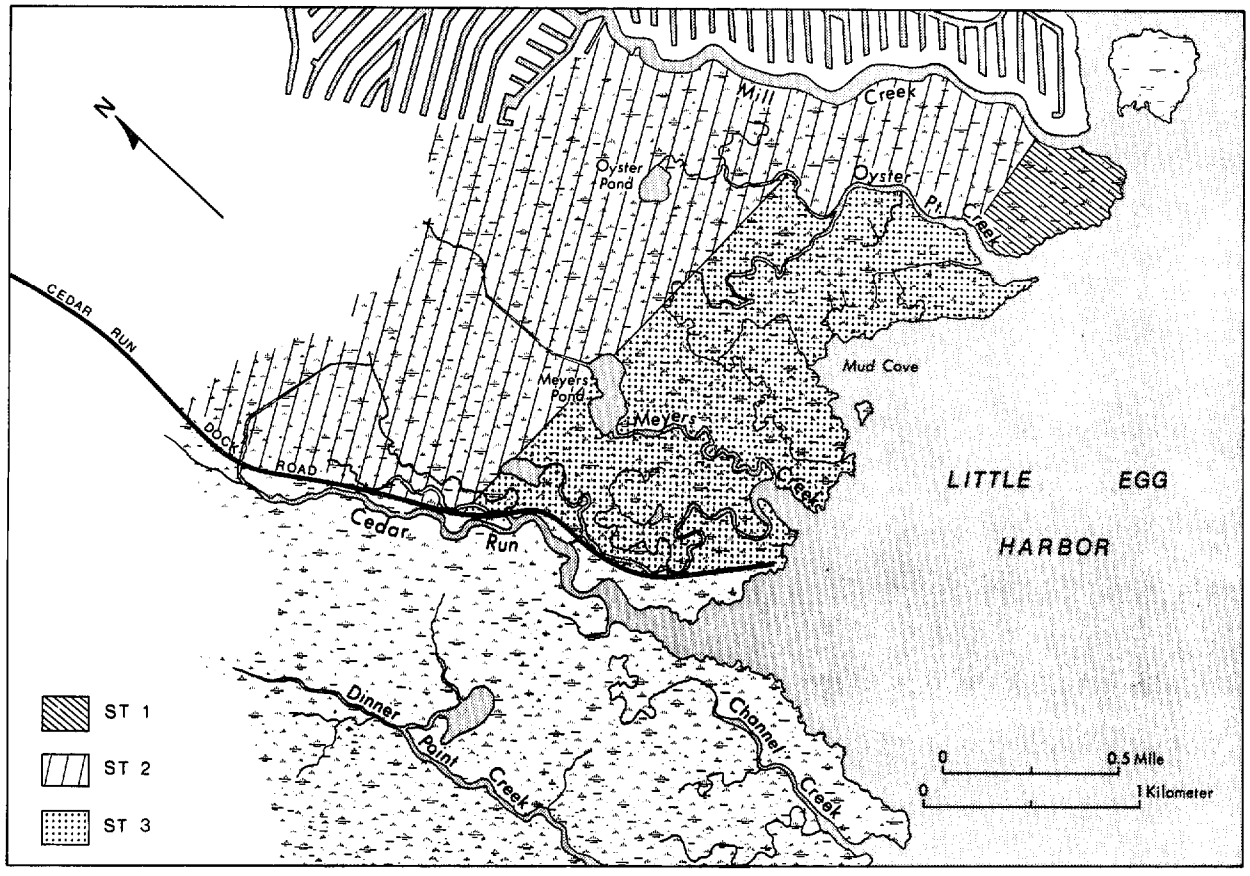

Fig. 1. Sections of the Cedar Run marsh evaluation study area.

As used in the context of this study, a cover type (CT) referred not only to stands of individual plant species but also to the vegetative complexes associated with lagoon embankments (LB) and mosquito ditch spoil piles (MDSP). The extent of each CT was then determined. Trapping effort was stratified in proportion to the area of each ST and then again in proportion to the area of each CT within a ST. Cover types in which trapping effort was expended included *S. alterniflora* low vigor (SALV), *S. alterniflora* high vigor (SAHV), *S. patens* (SP), mosquito ditch spoil piles (MDSP), and *Distichlis spicata* (DS). These CT's collectively comprise 75% of the total study area. Representative sites for trap grids within CT's were then selected (Figure 2). Two restrictions were placed on selected sites. Sites had to be large enough to facilitate placement of the proportionate number of traps. Sites also had to be accessible. At each site, small Sherman live traps were set in a grid configuration. The between trap interval was 10 m. Traps were baited with Quaker Oats and checked twice daily. With one exception, trapping was conducted for four consecutive 24 hour periods on 11 dates in 1975. The dates were 20-23 April, 4-7 May, 18-21 May, 15-18 June, 6-9 July, 20-23 July, 17-20 August, 7-10 September, 27-29 September, 18-21 October, and 8-11 November 1975. Traps were checked for only three consecutive days during the 27-29 September date. During this date and the 18-21 October date, excessive flooding precluded sampling of established trapping sites. For this reason, only data collected during the other nine dates were analyzed.

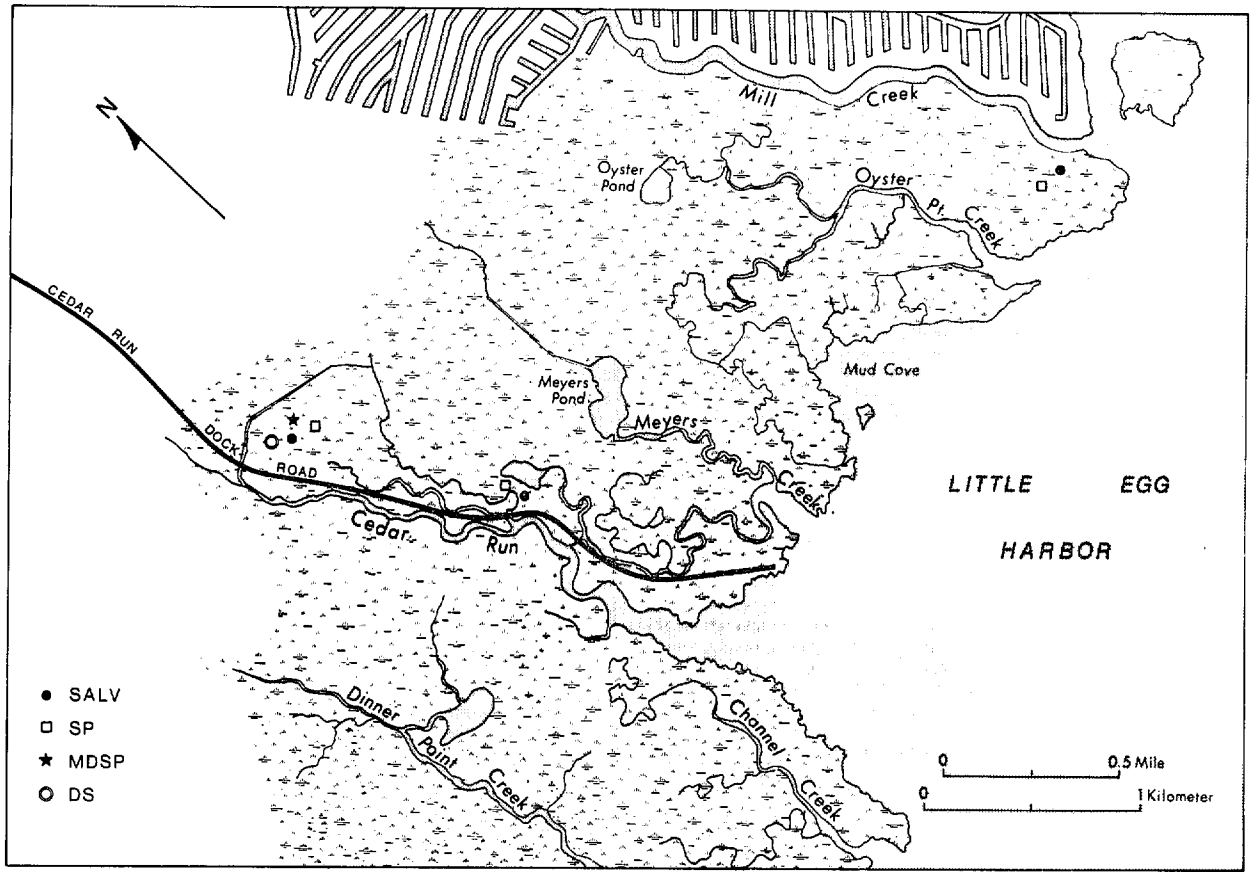

Fig. 2. Location of grids for 1975 mouse study.

When a *Microtus* was captured, it was toe clipped for identification and the assigned number recorded. Also recorded was the CT and ST in which each capture occurred. Animals found dead in traps were collected and appropriate data recorded.

The study of mouse populations conformed to a partially hierarchic experimental design. The main effects were ST, CT, and date. Day within day and, for 1976 only, grid within CT represented nested effects. The response for both years was estimated population size per 0.2 ha (0.5 acre).

Estimates of population were obtained by using a computer program of the Schnabel procedure with Overton correction for known losses (Overton 1965; Chapman and Overton 1966) prepared by Mr. Stephen Sterner, Research Associate, Rutgers University. Data on the number of animals captured, marked, dead, and recaptured in each grid each day were recorded. Each grid was assumed to sample a total area that included an area that extended a distance of 5 m beyond the margin of the grid. Because grids differed in size, it was necessary to convert all population estimates to a common area, 0.2 ha. After the conversions were made, the ANOVA was carried out.

Field procedures used during 1976 differed from those of 1975. The primary differences were a modification of the number of traps per grid and the use of replicate grids in each CT. The number of traps per grid was reapportioned subsequent to an analysis of the 1975 data. The use of replicate grids (Figure 3) was made possible by an increase in available traps. These modifications permitted only a once daily checking of traps.

Additionally, replicate grids were set on the lagoon embankment (LB) CT of ST 1. The number of days within dates was increased to five. The dates during which *Microtus* were trapped in 1976 were 24-28 April, 3-7 June, 29 June - 3 July, 30 July - 3 August, 13-17 August, and 6-10 September 1976. Date 13-17 August followed within two days of the high tides and winds of Hurricane Belle (10-11 August). These dates approximately correspond with the 1975 dates.

Although the above-mentioned modifications precluded between year comparisons, they did permit a more detailed examination of *Microtus* population density as a function of ST, CT, and date. All other procedures were identical between 1975 and 1976.

Microtus 1977

In ST 2, two areas were trapped for *Microtus* (Figure 4). The two areas were approximately equivalent in size and shared the same cover types. Although the proportionate areas of each cover type differed, they were nonetheless considered replicates. Some of the CT's in replicate 1 had previously been sites for trapping grids in 1975 and 1976. The population of *Microtus* in replicate 2 had not previously been subjected to trapping. Both replicates were completely surrounded by mosquito ditches. Shure (1971) reported mosquito ditches restricted the movements of *Microtus*. Thus, immigration and emigration during the 10 day study were assumed to be negligible. Population changes attributable to births were also assumed to be negligible. Thus, population density changes were totally a function of death. Again, due to the short duration of the study, deaths due to trapping were assumed to be the only source of population density changes. For the live

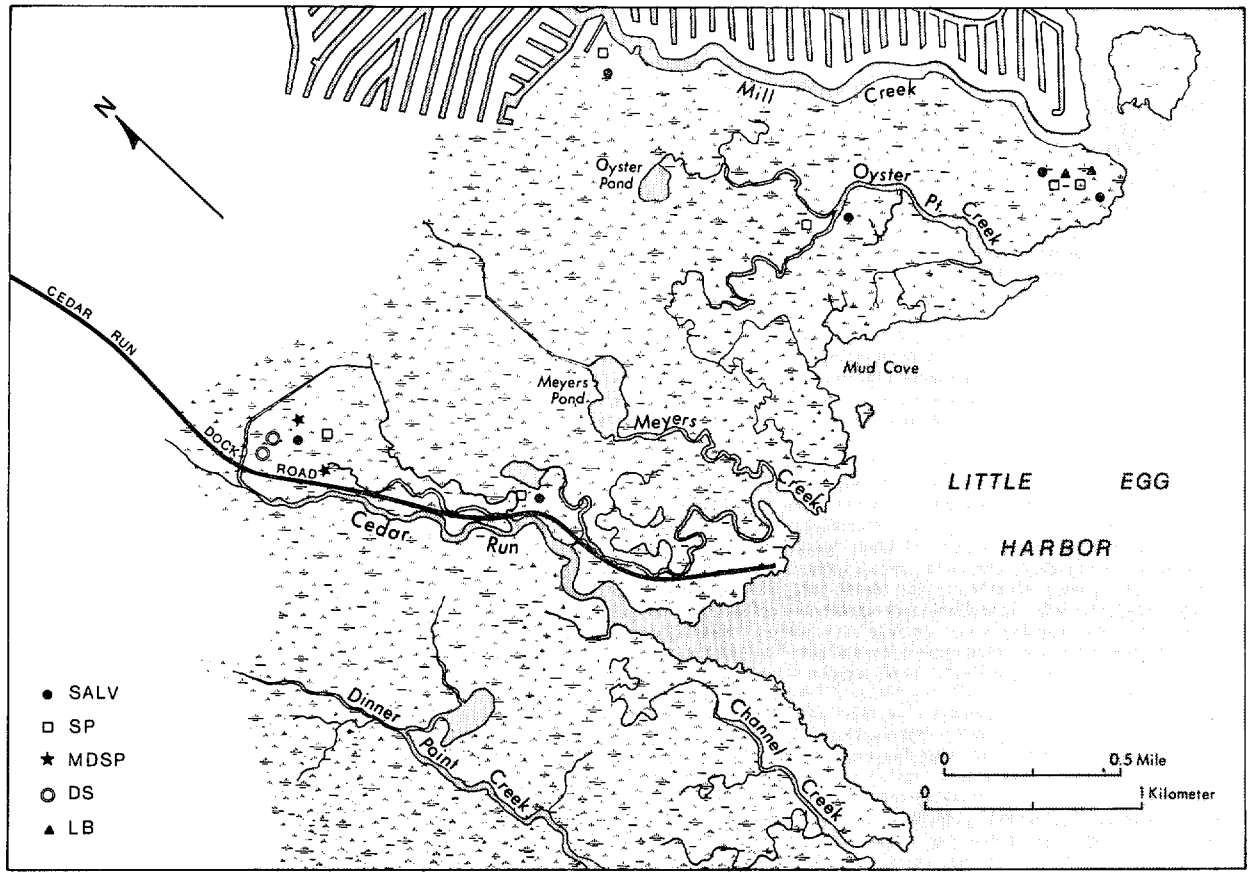

Fig. 3. Location of grids for 1976 mouse study.

trapping phase which occurred during the first 5 days of the study, these were accounted for by the modified Schnabel procedure (a known loss correction method). Sherman live traps were set on 10 m intervals in a grid configuration, baited with Quaker Oats, and checked once each day. The grids encompassed the whole of each replicate. Captured animals were toe clipped for identification and released. The same information recorded for each capture in previous years was recorded during this study also.

At the end of the 5 day live trapping study (2-6 June), all live traps were removed from each replicate. However, in replicate 2 only, live traps were replaced by Victor mouse traps baited with peanut butter (a preliminary study showed no difference between either oats or peanut butter as baits). Traps were again set and checked once daily for the next 5 days. Estimates of population from snap trapping were obtained by the removal method (Hayne 1949) and subsequent regression procedures (Zar 1974).

FINDINGS

Microtus 1975/1976

During the time interval 20 April through 11 November 1975, there occurred 6,133 trap nights during which 804 total captures of 319 individual rodent specimens of three species were recorded. This was equivalent to a capture success of

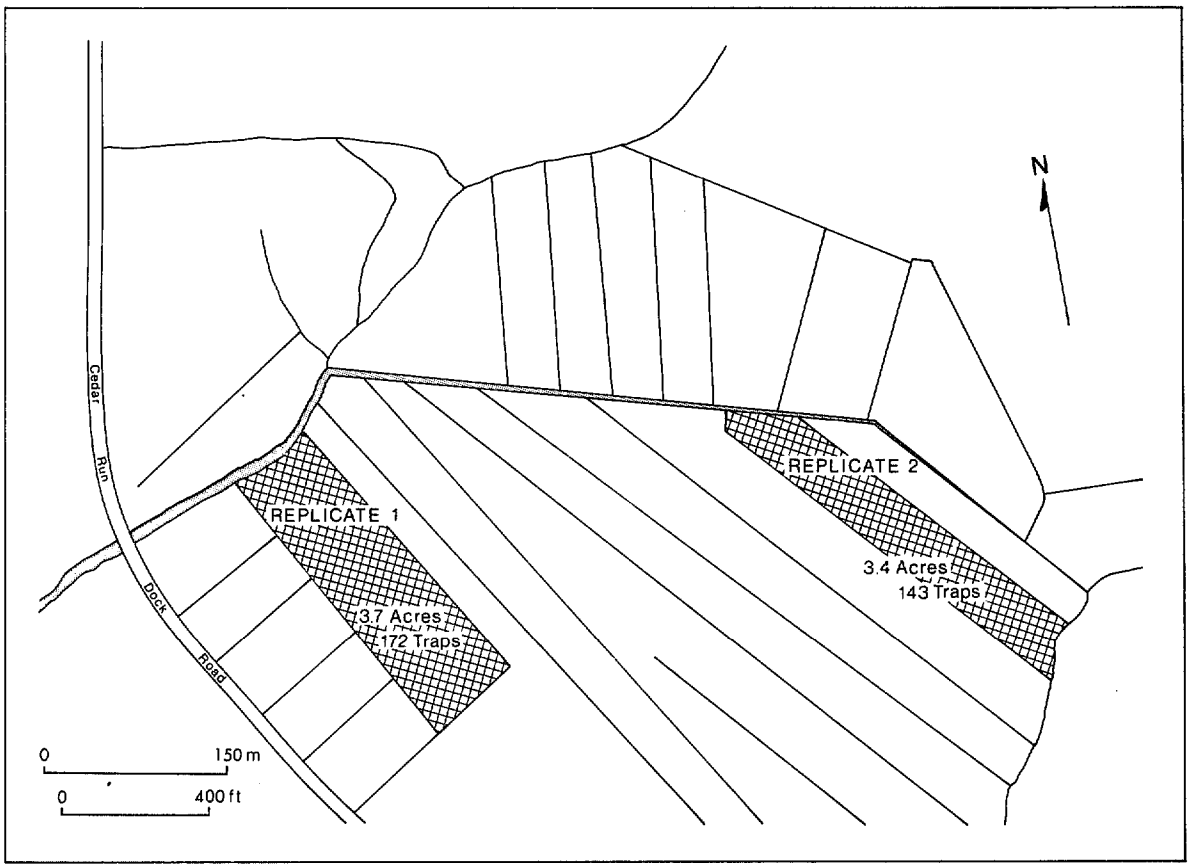

Fig. 4. Replicate areas for 10 day mouse study 2-11 June 1977 in the southwestern corner of the study area.

13%. Three hundred sixteen individuals were *Microtus*, two were *Mus*, and one was a *Zapus*. The 316 *Microtus* were collectively captured a total of 801 times. This was equivalent to slightly more than 2.5 captures of each individual.

During the time interval 24 April through 10 September 1976, there occurred 8,880 trap nights during which 1,902 captures of 608 individual rodent specimens of three species were recorded. This was equivalent to a capture success of 21%. Of the 608 individuals captured, 595 were *Microtus*, 12 were *Mus*, and 1 was a *Rattus*. The 595 *Microtus* were collectively captured a total of 1,885 times. This was equivalent to slightly more than three captures of each individual.

In 1975, a total of seven captures of *Microtus* occurred in SAHV. Thus, trapping in this cover type was discontinued in subsequent years. Analyses of the 1975 data by the time of day traps were checked yielded similar results.

Direct comparisons between ST's were possible only by examining *Microtus* population densities in the two CT's common to all three ST's. These CT's were SALV and SP. The data were sorted accordingly and the appropriate analyses performed on data from each of the 2 years. This procedure tested the hypotheses that *Microtus* population density was a function of ST, CT, date, and the interactions thereof.

During both years, the density of this species was a function of date. The form of the response was curvilinear (Figures 5 and 6). Maximum density occurred during early July. In 1975, there occurred a fourfold increase in population size from April to early July. For the same time in 1976, a threefold increase was observed. In both years, the population declined after early July. By early October, densities approximated late April densities. The difference between park densities and October densities was threefold. The effects of high tides and winds were apparently negligible during 1975.

Microtus population density was also a function of ST in both years. Density of this species was higher in ST 1 than in either ST 2 or ST 3. *Microtus* densities in ST 2 and ST 3 were similar. However, in 1975, the differences in densities between CT's in each of the ST's were not consistent. Densities in SALV and SP in ST's 2 and 3 were similar. The density of *Microtus* was higher in SP than in SALV of ST 1.

To more fully examine some of the differences noted above and to characterize the response of *Microtus* to marsh alterations, the data were sorted and analyzed by ST. This permitted an analysis of *Microtus* density in all of the CT's in each of the three ST's. However, it did preclude direct comparisons between ST's, as not all CT's occurred in all ST's. Statistically, an analysis by ST tested the hypothesis that *Microtus* population density in each ST was a function of date, CT, and the interaction thereof.

Microtus density in ST 1 was a function of date and CT. In 1975, although density was not significantly different between dates ($P < 0.25$), the data did suggest seasonal differences. In 1976, density did differ between dates (Figure 7). The form of the response was curvilinear. Peak density occurred in early June and persisted through early July. The April to June increase was twofold. The decrease from early July to mid-August was approximately threefold. Hurricane Belle apparently caused a significant reduction in *Microtus* population density.

During both years, *Microtus* density in ST 1 was also a function of CT. In 1975, *Microtus* density was higher in SP than SALV. In 1976, *Microtus* densities in SP and SALV were similar. *Microtus* density in LB was higher in 1976 than in either SP or SALV.

In ST 2, *Microtus* density was probably a function of date during both years, as well as a function of CT in 1975. The form of the response relative to date was curvilinear (Figure 8 and 9) and approximated that previously described for ST 1. The increase and decrease were both about twofold. In 1975, there occurred a decrease in estimated population density of *Microtus* at a time when density should be near maximum. No reason for this is known.

In 1975, the density of *Microtus* was higher in DS than all other CT's while densities in SALV, SP, and MDSP were similar ($F_{calc.}^{3,24} = 4.260$ $P < 0.05$).

The density of *Microtus* in ST 3 statistically was not a function of date or CT, although a date effect was suggested by the data.

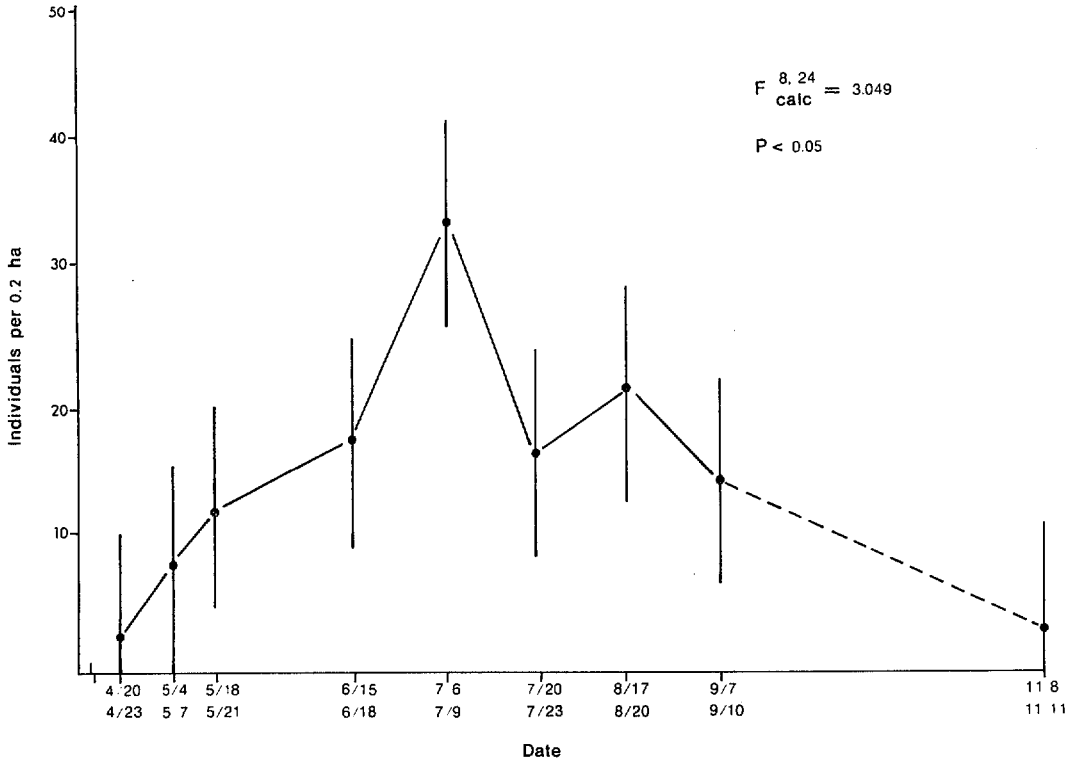

Fig. 5. *Microtus* per 0.2 ha in *S. alterniflora* and *S. patens* for 1975. Means and 95% least significant intervals are indicated.

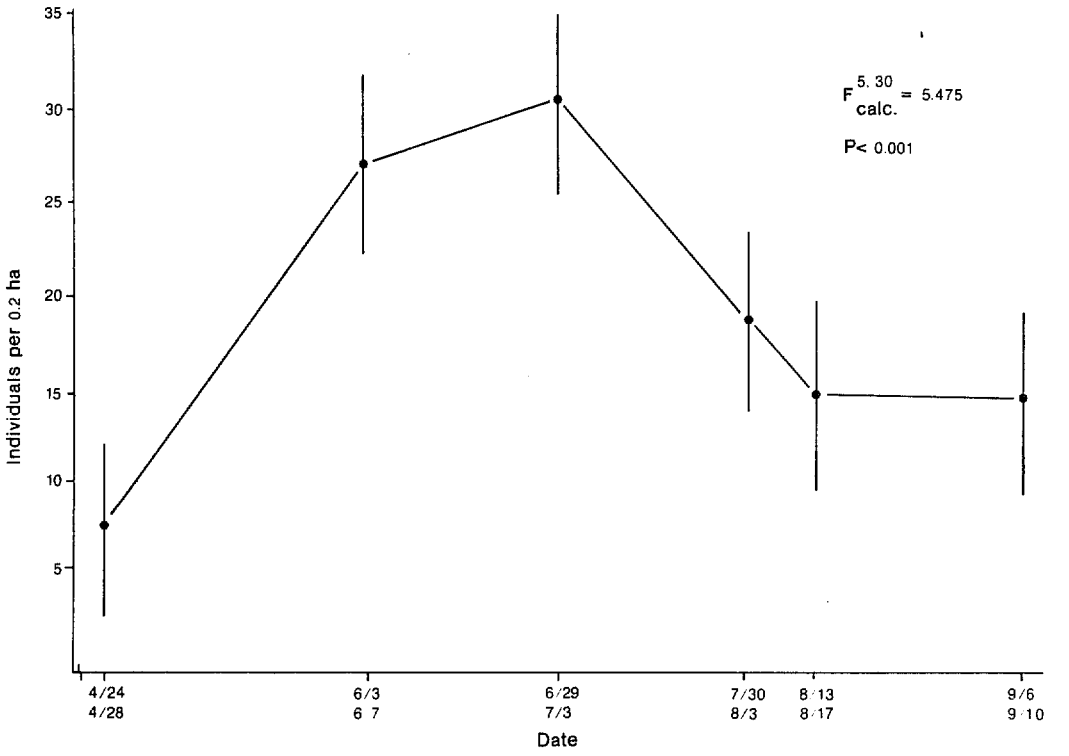

Fig. 6. *Microtus* per 0.2 ha in *S. alterniflora* and *S. patens* in 1976. Means and 95% least significant intervals are indicated. Note: Hurricane Belle occurred during 9-10 August.

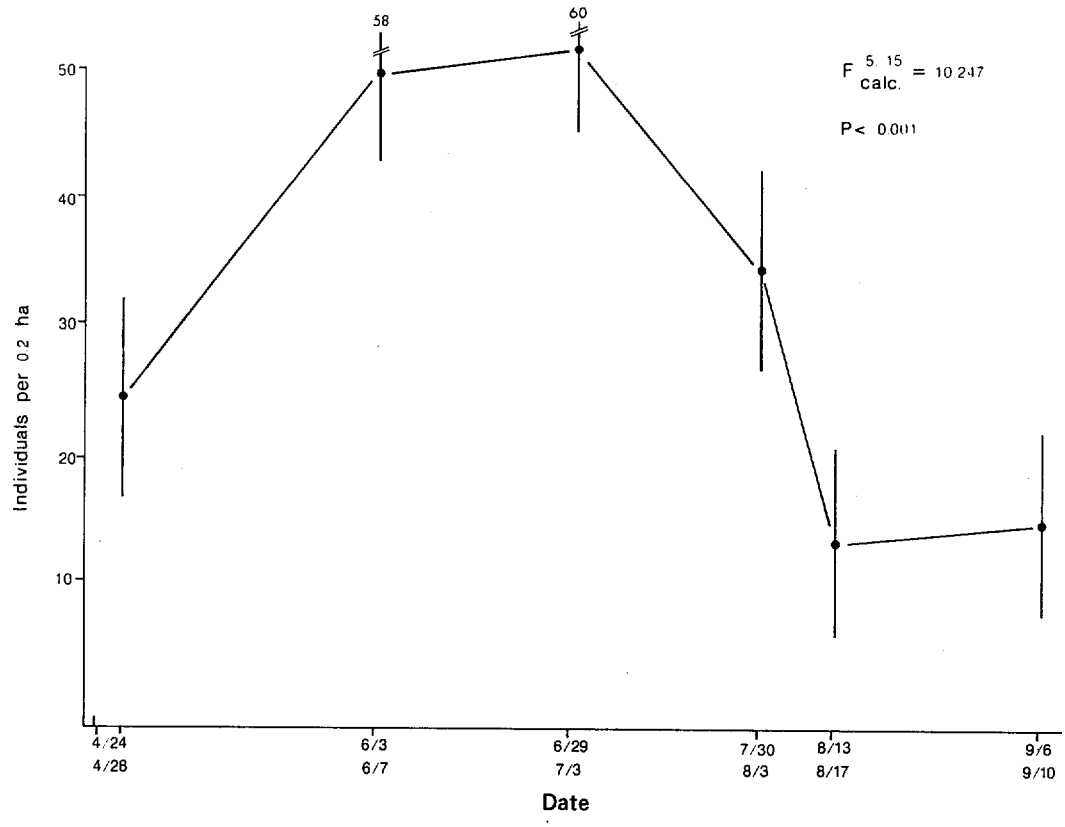

Fig. 7. *Microtus* per 0.2 ha in ST 1 during 1976. Means and 95% least significant intervals are indicated. Note: Hurricane Belle occurred during 9-10 August.

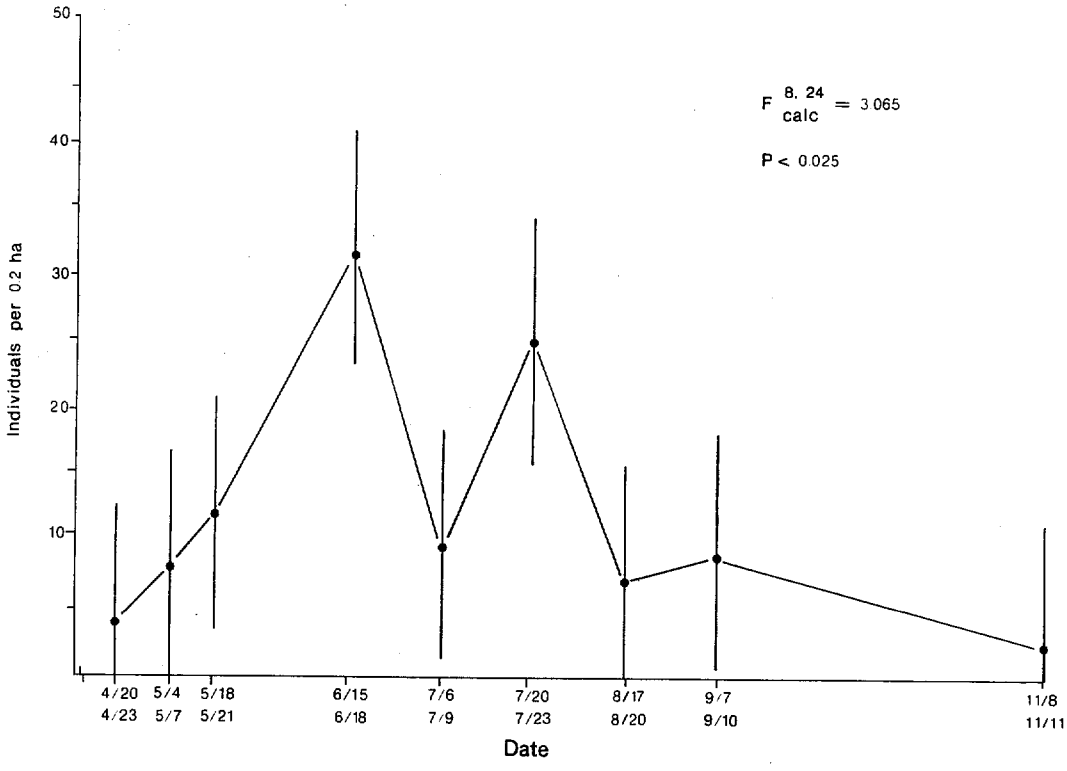

Fig. 8. *Microtus* per 0.2 ha in ST 2 during 1975. Means and 95% least significant intervals indicated.

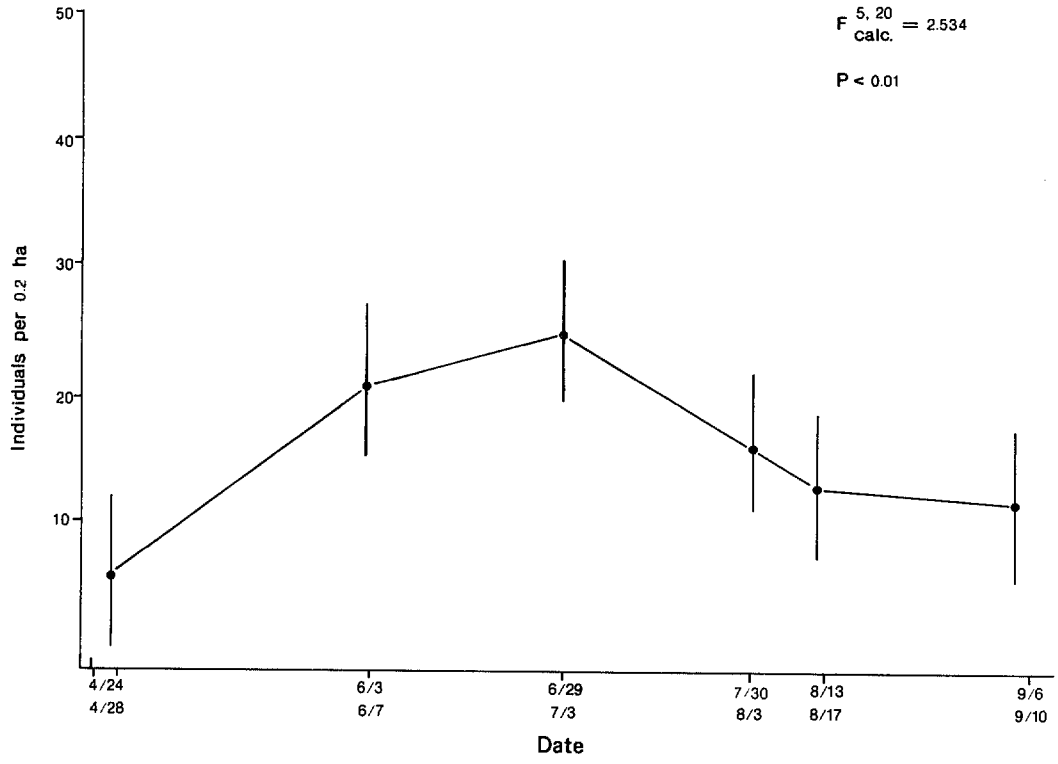

Fig. 9. *Microtus* per 0.2 ha in ST 2 during 1976. Means and 95% least significant intervals are indicated. Note: Hurricane Belle occurred during 9-10 August.

The high tides and winds that occurred on two occasions in 1975 had a negligible impact on the population density of this species. Hurricane Belle did cause a decrease in density in ST 1. Elsewhere, the impact of Hurricane Belle was apparently negligible.

Whether the population density of *Microtus* was a function of any changes undergone by the various CT's from April to September is open to conjecture. Statistically, the indicator of such a difference, the date by CT interaction, was not significant (ST 1, $P < 0.25$; ST 2, $P < 0.5$; ST 3, $P < 0.25$). Yet, a plot of these data did suggest such differences (Figures 10, 11, and 12).

Microtus 1977

In 870 trap nights in replicate 1, 30 individual *Microtus* were captured a total of 49 times. This was a capture success of 6%. Of the 30 animals captured, 10 were found dead in traps upon initial capture. They had apparently drowned. The 20 animals marked and released were recaptured a total of 39 times. This was equivalent to two captures of each marked individual.

In 715 trap nights in replicate 2, 47 *Microtus* were captured a total of 60 times. This was a 8% capture success. Of the 47 individuals captured, 24 were dead in the traps upon initial capture. These too had apparently drowned. The 23 animals marked and released were captured a total of 36 times. This was equivalent to approximately 1.5 captures of each marked individual.

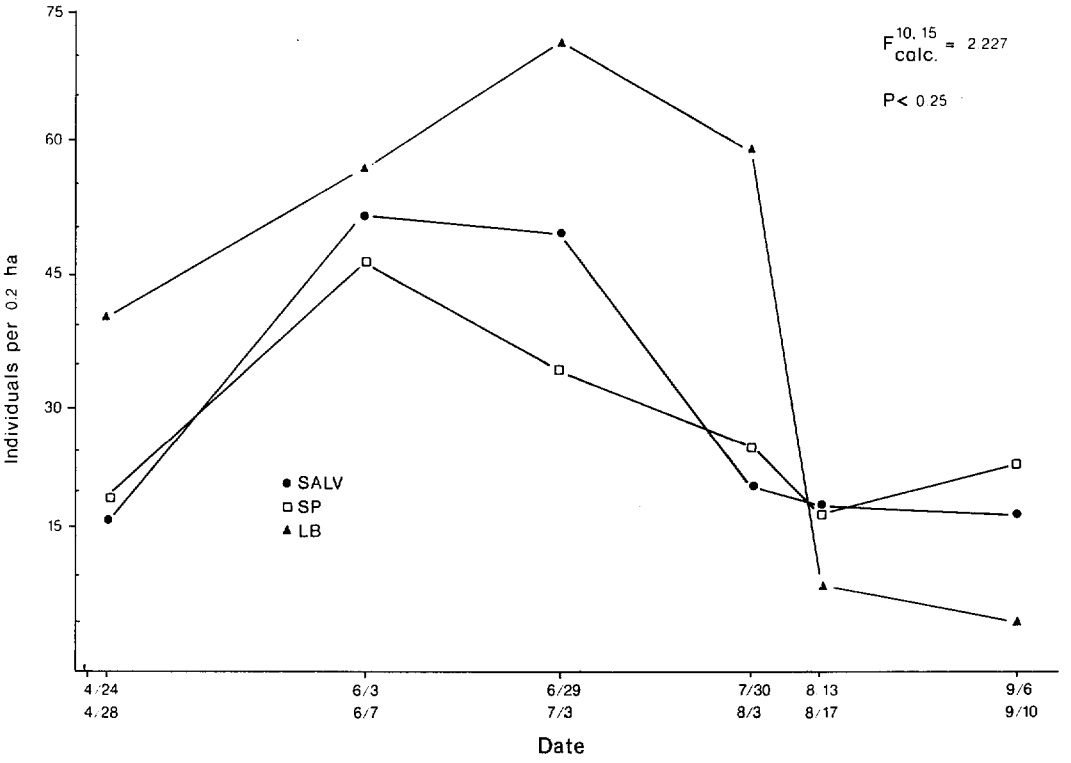

Fig. 10. Estimated *Microtus* population density by CT in ST 1 in 1976. Note: Hurricane Belle occurred during 9-10 August.

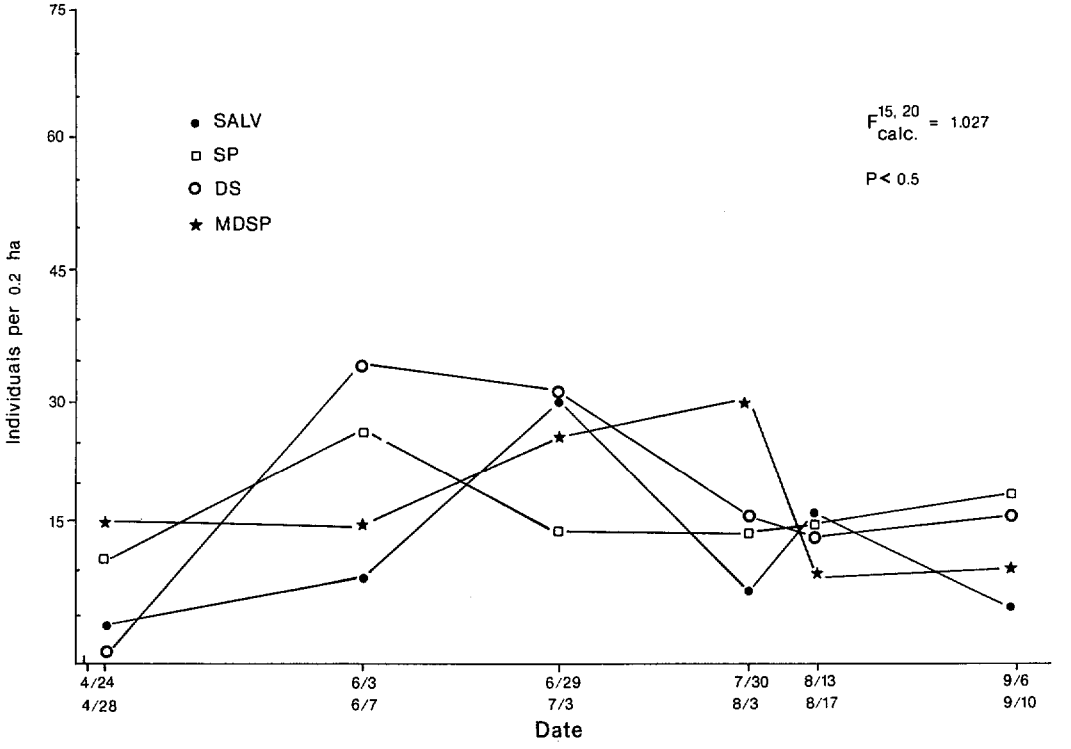

Fig. 11. Estimated *Microtus* population density by CT in ST 2 in 1976. Note: Hurricane Belle occurred during 9-10 August.

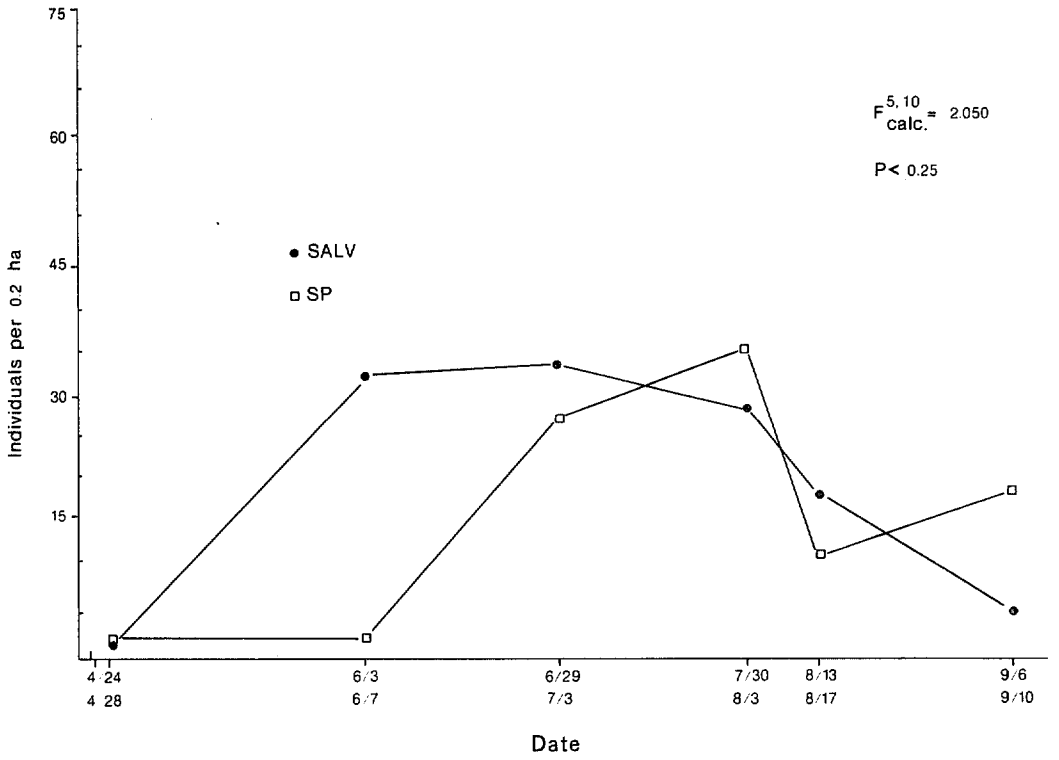

Fig. 12. Estimated *Microtus* population density by CT in ST 3 in 1976. Note: Hurricane Belle occurred during 9-10 August.

The estimates of *Microtus* population density in each replicate are presented in Figure 13. No statistical difference in population size existed between replicates. The probability of capturing a previously marked individual was approximately 0.5. In both replicates, the proportion of the estimated population actually captured was greater than 78%.

The estimated population of *Microtus* in replicate 2 based upon a removal technique was similar to live trapping estimates.

In order to characterize the distribution of animals relative to the various CT's, the number of captures of *Microtus* each day in each replicate in each CT was the response to an ANOVA of the live trapping data. Distribution was thus assumed to be a function of days, replicates, and CT's, as well as the appropriate interactions. The distribution of captures was significantly related to only CT. More captures occurred in MDSP. This response was consistently the same between replicates and days.

ANALYSES

Although the 1977 results are based upon a point-time study, they do substantiate both statistically and biologically the findings from 1975 and 1976.

Population density was shown to be significantly higher in the incompletely lagooned section than elsewhere in the area. This was not unexpected. Harris (1953), Fisler (1961), and Shure (1970, 1971) reported *Microtus* occupied areas of topographic relief. Such areas would be levees, hummocks, muskrat huts, and mosquito ditch spoil piles.

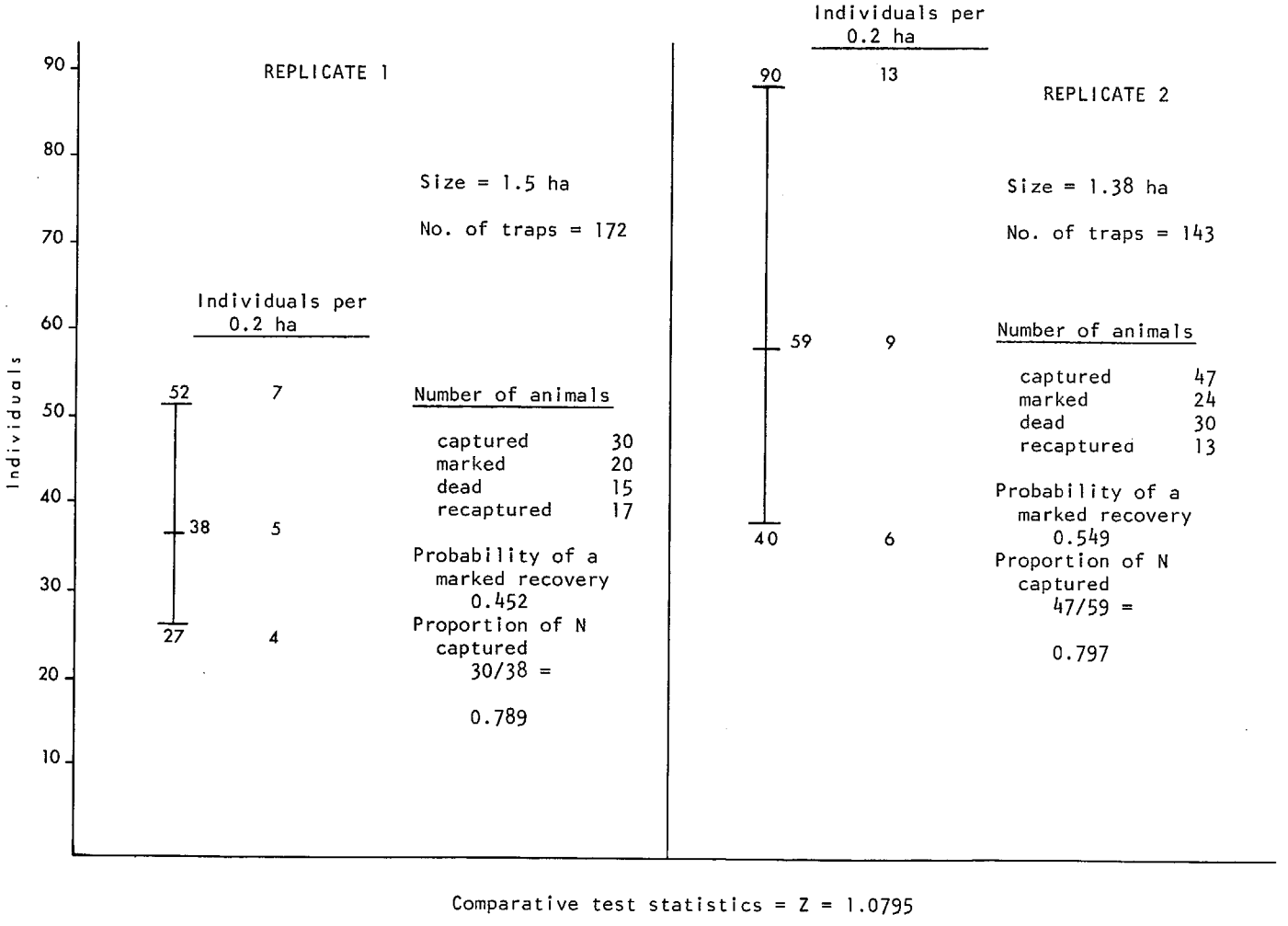

Fig. 13. Live trapping data for the 26 June 1977 period; 95% confidence intervals indicated.

The presence of such areas function as locations to which escape from unusually high water situations can be effected. This function is to some extent related to the vegetation associated with such areas. Johnston (1957) and Fisler (1961) observed *Microtus californicus* during high tides and reported this species moves to higher ground, clings to emergent vegetation, or holds onto floating debris held in place by emergent vegetation. During the high tides associated with the 18-21 October 1975 date, *M. pennsylvanicus* in ST 2 were observed to respond similarly. The mice were observed to cling to emergent vegetation just above the water line. The close proximity of individuals of different sexes and sizes was apparently tolerated.

The vegetative community associated with mosquito ditch spoil piles (Shisler 1973) and lagoon embankments, as well as the juxtaposition of areas of topographic relief in relation to the location and extent of other cover types, may all be functionally related to the success of such a strategy. Again, during the 18-21 October date, herring gulls (*Larus argentatus*), great black-backed gulls (*L. marinus*), and laughing gulls (*L. atricilla*) were "working" the relatively sparsely vegetated lagoon embankments. Very few gulls were "working" portions of the area where *Microtus* were known to be clinging to emergent *I. frutescens*.

Additionally, Fisler (1961) and Stark (1963) reported *M. californicus* tended to stay within their home ranges during periods of high water. In ST 1, the patches of SP and SALV were in close proximity to lagoon embankments and were of a size easily traversed by a *Microtus*. Thus, the home ranges of many mice in ST 1 may well have encompassed a portion of a lagoon embankment. Therefore, movement to lagoon embankments by a significant portion of the *Microtus* population resident in ST 1 could have occurred. Additionally, *Peromyscus leucopus* increased the use of peripheral portions of their home ranges during a period of flooding (Ruffer 1961) and heavy predation by crows on voles resulted in a decrease in vole populations after cover had been removed (Getz 1970). Collectively, these studies as well as observations made during a period of high water on the area may explain why the population density of *Microtus* was significantly reduced after Hurricane Belle in ST 1 but the population density in ST 2 was not reduced.

Another difference between ST's may be the availability of nest sites. *Microtus* nests are found in all cover types except SALV. All nests found in ST 3 were in SP, and all were estimated to be approximately 2.54 cm (1 inch) above the surface of the marsh. *Microtus* nests found in SP and DS of ST 2 were of a similar construction. Nests found in MDSP of this ST appeared to be identical to others in size and shape. However, they did not appear to be elevated as much above the surface of the mosquito ditch spoil pile as were nests in SP or DS. Some nests on the mosquito ditch spoil pile were not elevated. Both elevated and unelevated nests were found in SP of ST 1. Stark (1963) has reported voles constructing nests elevated above the water line.

Microtus also nested in lagoon embankments. The layering of the pieces of marsh sod forming the lagoon embankments apparently were suited for nesting. Nests constructed in lagoon embankments would be predated less by avian predators and be less susceptible to losses attributable to other predators. Nests constructed in embankments, particularly those nearer the upper portions of the embankments, would also be subjected less often to inundation by higher than normal tides. This could result in an increased number of animals entering the potential trapping population.

Cover serves a multiplicity of functions (Birney et al. 1976). For this reason, accounting for between cover type differences in *Microtus* density is difficult.

The mitigating effects of cover on the temperature (Stark 1963) and humidity regimes (Getz 1961, 1965) have been studied. Given its dense, prostrate growth form, the microhabitat associated with *S. patens* should be less variable throughout the year than in *S. alterniflora*. *Microtus* may respond to these differences more during winter and summer than during the more moderate conditions that would prevail during spring or autumn.

Structural differences, availability of water, reduced intraspecific contacts, and food quality may contribute to the observed differences in *Microtus* density between CT's. Eadie (1953), Mossman (1955), Pearson (1959), Wirtz and Pearson (1960), and Bosenberg (1975) have all demonstrated *Microtus* dispersion to be correlated with various measures of either vegetative structure or density. The greater availability of utilizable water in *S. patens* relative to *S. alterniflora* (Getz 1966) might also be proposed as a contributing factor as well as frequency of contacting conspecifics (Krebs et al. 1971). In less densely vegetated areas, an increased frequency of intraspecific contacts resulting in agonistic interactions in *M. pennsylvanicus* was reported (Warnock 1965). The utilization of the various vegetative species as foods may also be involved. A greater availability of foods in dense cover determined the dispersion of *M. californicus* in a California grassland community (Batzli 1968).

Those attributes of cover that are functions of aboveground standing crop biomass can be expected to vary in concert with seasonal variations of biomass. The production rate of *S. alterniflora* low vigor in the Mullica River - Great Bay area of Ocean County, New Jersey during 1972 was greatest between 5 June and 7 July (Squires and Good 1974). Between 7 July and 31 August of the same year, production continued but at a reduced rate. From 31 August through 4 October, production was negative. An analysis of the nutritive content of *S. alterniflora* from 5 June through 4 October showed only protein content to be independent of dry matter standing crop. From this, the authors conclude any organism utilizing *S. alterniflora* as a food source consumes an amount of total energy directly proportional to the quantity of material ingested. Noting crude fiber increases proportionately with biomass, and small grazing herbivores generally exhibit a relatively low digestive efficiency (French et al. 1976), a greater volume of food must be ingested to acquire a given amount of energy. A *Microtus* would thus have to spend a greater amount of time foraging between 7 July and 4 October than between 5 June and 7 July.

The protein standing crop in SALV approached 70% of the yearly total by 7 July (Squires and Good 1974). By 7 July, however, only 35% of the total dry matter has accumulated. Thus, protein content was high early in the year at a time when the nitrogen requirements of *Microtus* would also be high due to reproductive activities. Similar seasonal data are not available for the other vegetative species. But the protein content of SP and DS was shown to be lower than that of SALV from other studies (Udell et al. 1969). Findings from the same study showed the crude fiber content of SP and DS to be greater than that of SALV.

Collectively, these studies suggest seasonally related qualitative differences in the food value of the various plant species of the marsh. Biochemical

and reciprocal transplant studies (Shea et al 1975) and analyses of the chemical composition (Squires and Good 1974) showed SAHV and SALV to be similar. Thus, data from Squires and Good (1974) were used to illustrate the relationship between *Microtus* population density and seasonal changes in crude protein content of *S. alterniflora* (Figure 14). The depicted relationship appears to be more than coincidental. This hypothesis is supported in part by the work of Batzli and Pitelka (1971). Under the premise that population cycles of *Microtus californicus* are related to nutritive factors, they found that seasonal changes in the condition of the voles were correlated with dietary changes. The end of the breeding season was associated with low growth rates, low survival rates, and low fat reserves. At the same time, vegetation was drying and the diet changed from one dominated by grass stems and leaves to one dominated by grass seeds.

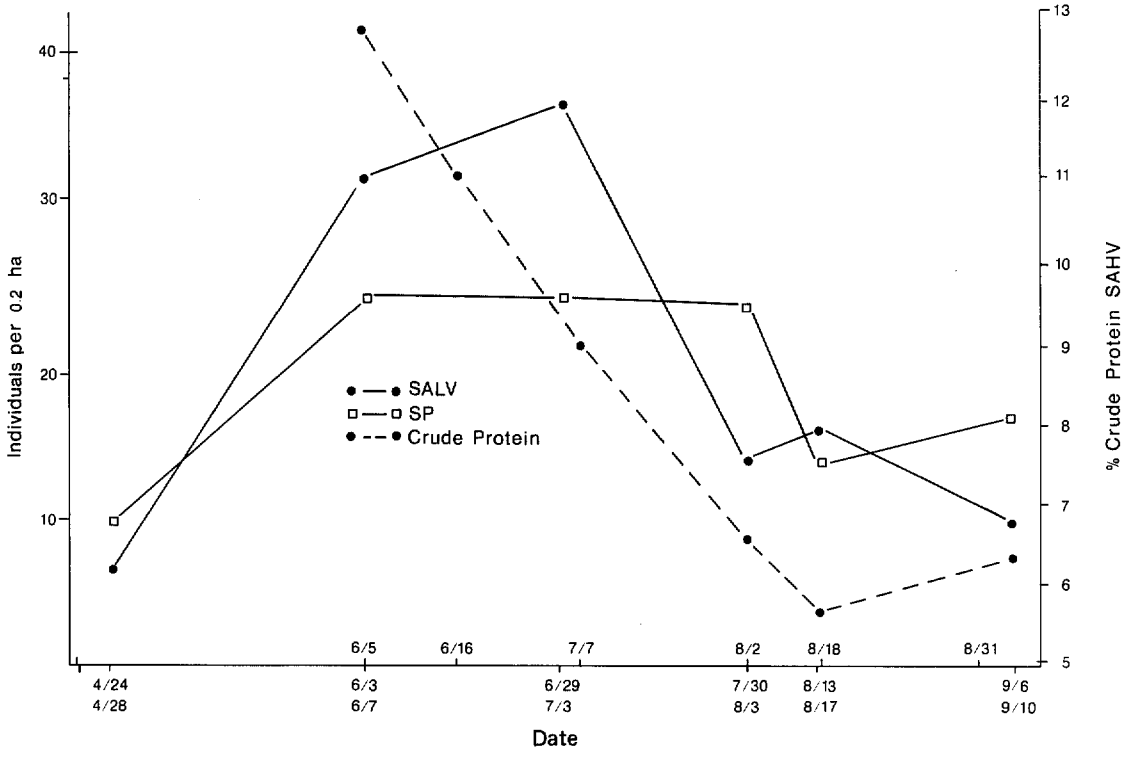

Fig. 14. *Microtus* per 0.2 ha in *S. alterniflora* and *S. patens* in 1976 and crude protein as % of *S. alterniflora* high vigor (adapted from Squires and Good 1974). Note: Hurricane Belle occurred during 9-10 August.

PROCEDURES

Muskrats 1976

On 14 November 1976, the area was surveyed for muskrat huts. Twenty-two huts were found. This compared favorably with the 21 huts counted during November 1975. During both years, huts were never more than 274 m (900 ft) from the upland ecotone. On 16 November 1976, the area was surveyed for muskrat sign. Sign included feeding stations, surface feeding activity, burrow entrances, and pellet groups. These indices of muskrat population size were more abundant in the same area as the huts. Two locations were selected for trapping of muskrats (Figure 15). The number of #110 Conibear traps set in each location was proportional to the amount of sign. Forty-six traps were set in location B. Fourteen were set

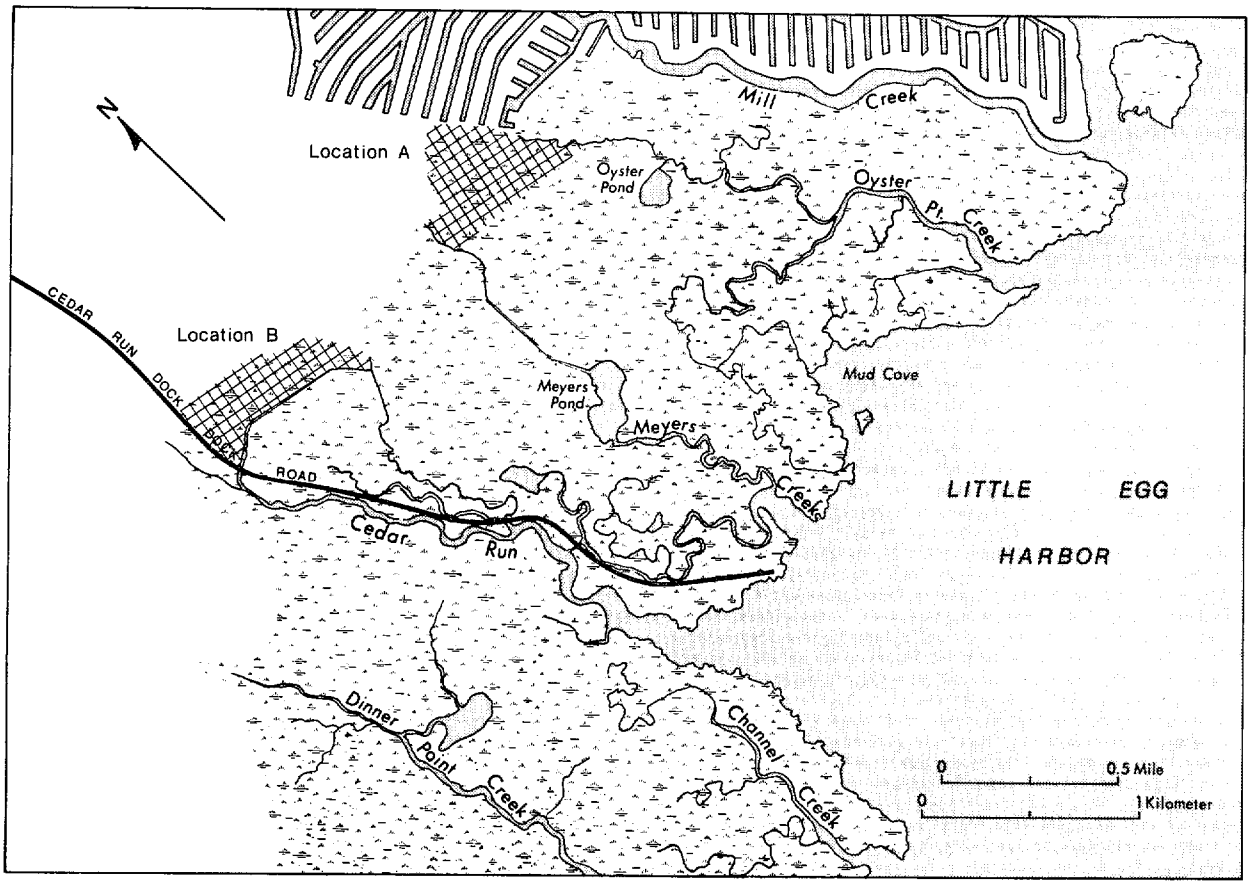

Fig. 15. Locations sampled for muskrats 27 November - 5 December 1976.

in location A. For both locations, this trap apportionment constituted a 40% sampling of the potentially trappable sets. Within a location, traps were distributed in proportion to the amount of sign in mosquito ditches and non-mosquito ditch waterways. The latter category included natural tidal ditches and a man-made waterway flowed by tides. At the juncture with Cedar Creek, the man-made waterway was approximately 4.6 m (15 ft) wide and 1.8 m (6 ft) deep. At its terminus, it was approximately 1 m (3.3 ft) wide and approximately 0.3 m (1 ft) deep. The dimensions changed gradually over the length of this waterway, a distance of 808 m (2,650 ft).

The number of potential trap sets exceeded the number of traps. For this reason, tracks, pellet groups, evidence of feeding activity, and the shape of burrow entrances were criteria by which trap sets were determined. Traps were set $\pm$ 2.5 hours either side of slack low water. Traps were checked each day during this time interval for nine consecutive days. When an animal was captured, the location of the capture was recorded as was the animal's sex and estimated age (Taber 1971).

Under the premise that as animals are removed from the population, a decrease in the captures per unit effort (captures per 100 trap nights) will be observed. If the rate of decrease is constant, by regressing captures per 100 trap nights on cumulative capture, an estimate of population size can be made (Hayne 1949). Because a prediction of the independent variable, cumulative catch, was desired, the method of inverse prediction was used (Zar 1974). Statistical significance was assumed when $P < 0.05$.

FINDINGS

From 27 November through 5 December 1976, a total of six muskrats were captured in location A. This was equivalent to a capture success of 5%. Three of the animals were males. Two of the males were adults. The females were all adults. No further analyses were possible.

In location B, 27 muskrats were captured in 414 trap nights. This was a capture success of 7%. Sixteen of the muskrats were males. A ratio of 16 males to 11 females did not differ from a 50/50 sex ratio ($P < 0.5$). Only one young animal of each sex was captured.

The estimated population of muskrats in location B was 35 animals. The lower and upper end points of the 95% confidence intervals were 21 and 52, respectively. Because 27 animals were captured, the true estimated population was between 27 and 52 muskrats.

These data probably did not reflect the true population of muskrats in this location. Following the third day of trapping, the extremely cold weather that characterized the winter of 1976-77 predominated, causing a freeze-up that persisted through the end of the study and beyond. For this reason, it was deemed necessary that muskrats be trapped again in early spring.

PROCEDURES

Muskrats 1977

On 5 March 1977, location B, inclusive of a man-made ditch that delineated marsh from uplands, was again surveyed for muskrat sign. From the survey data, 58 traps were proportionately distributed (Figure 16). The use of 58 traps represented a sampling of 60% of the potentially trappable sets. All other procedures were identical with those used previously.

FINDINGS

From 9 March to 17 March 1977, 23 muskrats were captured in 522 trap nights. This was a capture success of 4%. Twelve of the 23 animals were males. The ratio of 12 males to 11 females did not differ from a 50/50 sex ratio ($P < 0.9$).

The estimated population of muskrats was 26. The lower and upper end points of the 95% confidence interval about the estimate were 16 and 36, respectively. Because 23 animals were captured, the true estimated population was between 23 and 36.

From a visual inspection of the data, there appeared to be a disproportionate number of muskrats captured in traps located in an area dominated by *Scirpus* sp. or in traps located on a waterway directly opposite an area dominated by *Scirpus*. To test this possibility, the number of successful trap nights and the number of unsuccessful trap nights in *Scirpus* (+) and non-*Scirpus* (-) areas were cast into a two by two contingency table and a χ^2 analysis performed. The null hypothesis of proportionate captures between the two areas was rejected ($P < 0.005$, Table 1). These results could have been due to unequal trapping effort.

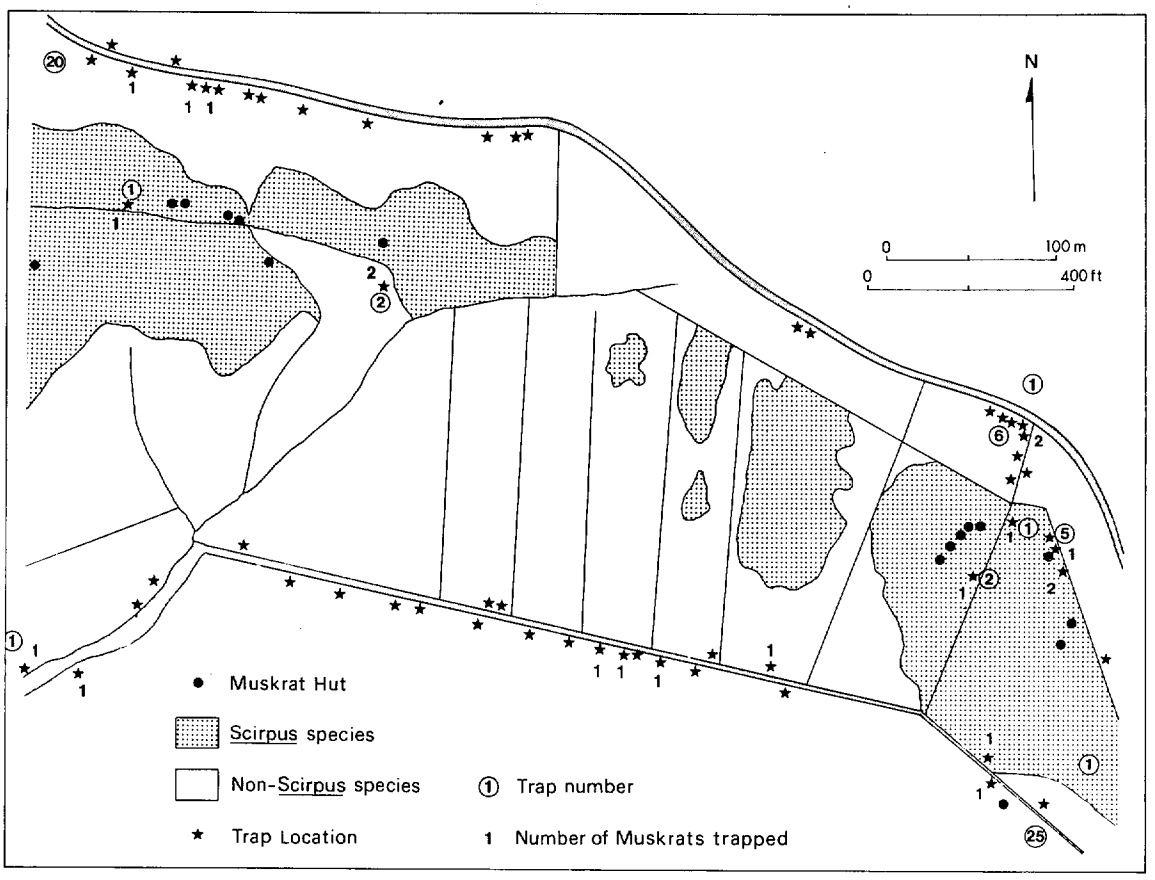

Fig. 16. Location B, 9-17 March 1977.

Table 1. χ^2 analysis of 9-17 March 1977 muskrat captures.

	+ *Scirpus* sp.	− *Scirpus* sp.	
Catch	12	11	23
No-catch	87	412	499
Total	99	423	522

H_o: proportionate captures between cover types
H_1: disproportionate captures between cover types
χ^2: 15.14 $\chi^2_{.05,\ 1} = 3.84$ $P < 0.005$

ANALYSES

Because weather necessitated sampling of muskrats on two occasions, an explicit estimate of population size was not possible. However, the data do permit inferences about the minimum muskrat population size.

Relative to the fall data, the spring data were not confounded by weather. The 95% confidence interval about the estimated population of muskrats in location

B was thus reasonable. By assuming there to have been at least 36 muskrats in this location in spring, the 27 animals removed during the fall suggests there was a minimum of 63 muskrats in location B. Location B was 19.7 ha (48.8 acres). On a per area basis, an estimated population of 63 muskrats was equivalent to 3.2 muskrats per ha (1.3 per acre) in location B. On a per area of *Scirpus* basis, this was equivalent to 4.7 muskrats per ha (1.9 per acre).

The validity of these estimates seem biologically justified for several reasons. First, only 48% of the potentially trappable sets were sampled in the fall and only 60% were sampled in the spring. Had the remaining sets been trapped, additional muskrats would have likely been captured. Thus, the true population probably exceeded the estimated population. The magnitude of the difference was unknown. Secondly, in 1975 and 1976, 16 huts were known to exist in location B. All 16 were in *Scirpus*. By assuming five muskrats per hut (Dozier 1948), an estimate of 80 muskrats was obtained. This agreed with the minimum estimate derived from trapping. Finally, population density estimates derived from trapping agreed with estimates of muskrat population density in some marsh habitats (Widjeskog and Ferrigno 1973) but lower than estimates of muskrat population density on the Swan Bay and Tuckahoe Wildlife Management Area (Widjeskog and Ferrigno 1974).

The average number of huts counted on the Cedar Run study area was 21.5. If each hut contained five muskrats, and by accounting for the six muskrats captured in location A, the muskrat population of the area exceeded 114 muskrats.

The average price paid per pelt at a Sussex County, New Jersey fur sale held 20 March 1977 was approximately $5.25. By this criteria, the value of the muskrat population of the area was $600.

A 50/50 sex ratio in young muskrats was reported by Errington (1939) and McCann (1944). Thus, it was not surprising that such a ratio was observed during this study. An equal sex ratio in both the fall and spring data suggests that losses that occurred during the interval between trapping periods were not related to sex.

The suggested disparity in capture success between cover types when assessed in the light of the study by Widjeskog and Ferrigno (1974) appears to be real. However, it can be further evaluated. In future studies, an equal number of traps should be set in *Scirpus* and non-*Scirpus* cover types. Disparitous success observed under these conditions would support the contention that the dispersion of muskrats was related to *Scirpus*. The ultimate test would be to alter the amount of *Scirpus* in areas where muskrats are known to be resident in accordance with a randomized block experimental design.

PROCEDURES

Rats

During 1975 and 1976, rat sign was observed throughout the area but was more abundant along the marsh-upland ecotone and in the vicinity of the houses, buildings, and wharves along Cedar Run Dock Road. For this reason, replicate trap lines of 12 Victor rat snap traps each were established in four areas. The areas were:

1) Within 30 m (300 ft) of the dwellings along the road.

2) On the upland side of the ecotone.

3) In *Iva frutescens* along the man-made waterway flowed by Cedar Run and trapped for muskrats.

4) In *I. frutescens* growing on mosquito ditch spoil piles.

The traps were set at 15 m intervals, baited with bacon and checked once daily. This study was concurrent with the 1977 *Microtus* study.

FINDINGS

In 960 trap nights, five Norway rats (*Rattus norvegicus*) were captured. This was a capture success of 0.5%. Three animals, two females and a male, were captured adjacent to the dwellings. Two other rats, one of each sex, were captured in the ecotone. All animals were adults in breeding condition.

ANALYSES

No indices or estimates of rat population size were generated. These results should not, however, be construed as indicative of a sparse rat population. In addition to the five traps that captured a rat, 12 others had been sprung and the bait removed. If the traps were sprung by rats, this would constitute an unacceptable number of misses.

An alternative to snap trapping would be to use live traps. To do so would be more expensive but may well be a more effective method of assessing rat populations.

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10. WILDLIFE INDEXES: AVIAN DENSITY AND DIVERSITY

Joseph M. Penkala and Joseph Sweger[1]

ABSTRACT

Bird censuses were conducted on the Cedar Run study area. The study area is a salt marsh in Ocean County, New Jersey. The line transect mean flushing distance method of censusing was used to collect the data. The density and diversity of birds in four different habitat types were determined. Eighty-seven species of birds were observed.

BACKGROUND

This job is part of the Wetlands Project's contribution to a cooperative effort of a number of agencies who are attempting to evaluate various ecological aspects of 1,350 acres of salt marsh on the Cedar Run study area. The avifauna of the salt marsh ecosystem provides both consumptive and nonconsumptive recreational resources. In addition, these birds are important to the functioning of the ecosystem. The "Wetlands Act" in New Jersey seeks to preserve and protect estuarine ecosystems. A very detailed knowledge of how they function will aid in the implementation of the "Wetlands Act" and will insure that the objectives of the law are met.

OBJECTIVE

The purpose of this study is to determine the density and diversity of avifauna on the Cedar Run study area during the spring and fall migration.

PROCEDURES

The Study Area

The Cedar Run study area is located in Ocean County, New Jersey. The area includes 1,350 acres of salt marsh, 287 acres of tidal ditches, and 192 acres of bay shore (Figure 1). The marsh study area is vegetated with a mixture of short salt marsh cordgrass (*Spartina alterniflora*) and saltmeadow cordgrass (*Spartina patens*). Other species of vegetation present are marsh elder (*Iva frutescens*), spike grass (*Distichlis spicata*), reed (*Phragmites australis*), switch grass (*Panicum virgatum*), and widgeon grass (*Ruppia maritima*) (Ferrigno and Widjeskog 1974).

Four different transects were censused on each trip. The transects are depicted in Figure 1. Each of the transects is representative of a major

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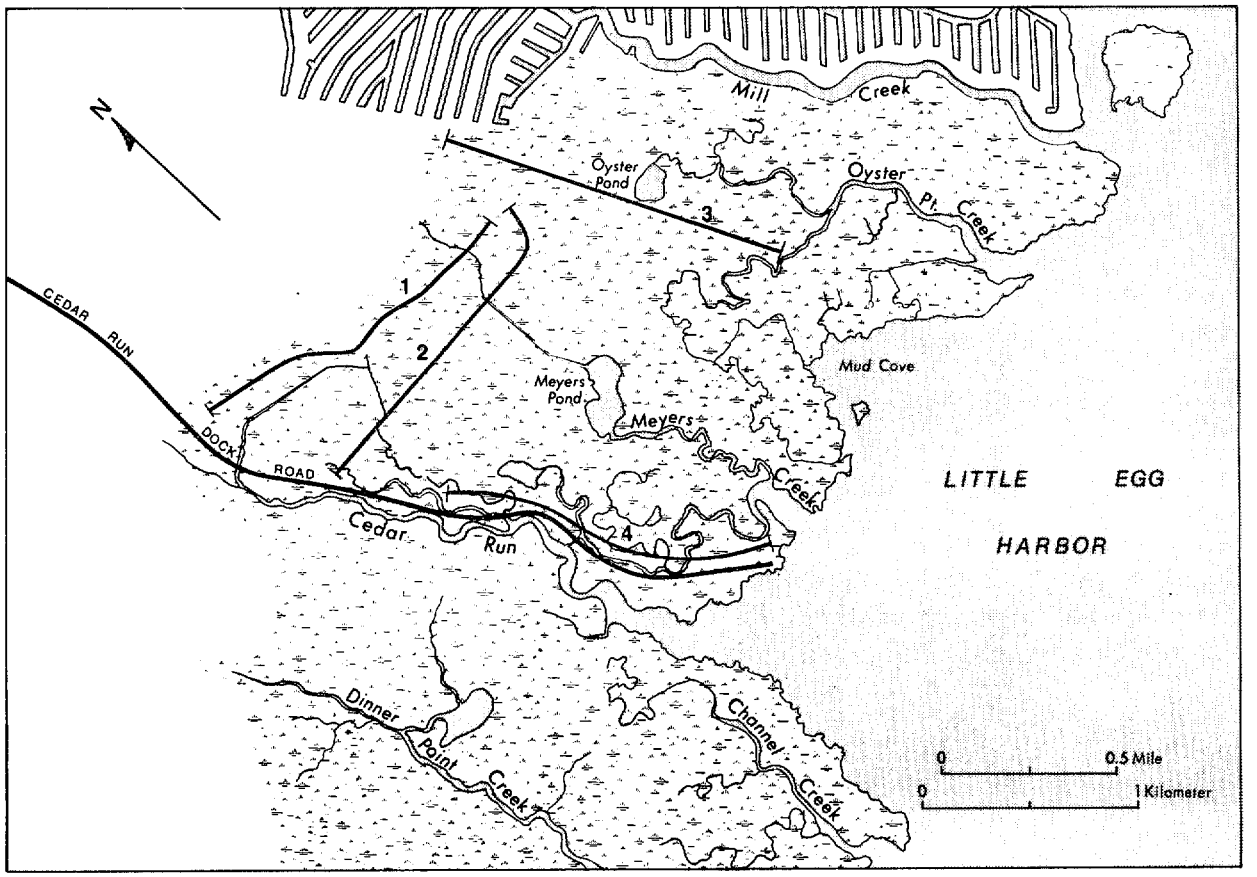

Fig. 1. Cedar Run study area transects.

vegetational association found on the study area. Descriptions of the vegetation along the transects are as follows:

1. Upland Marsh Edge: The species present were: white cedar (*Chamaecyparis thyoides*), red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), poison ivy (*Rhus radicans*), staghorn sumac (*Rhus typhina*), cat briar (*Smilax spp.*), common reed (*Phragmites australis*), sedges (*Juncus spp.*), pin oak (*Quercus palustris*), and switch grass (*Panicum virgatum*).

   This area is the interface between the marsh and hardwood uplands.

2. *Iva/Spartina patens* Area: Species present were *Spartina patens*, *Distichlis spicata*, *Phragmites australis*, *Spartina alterniflora*, and *Iva frutescens*. This area was gridded with mosquito ditches. The ditch edges were covered with *Iva frutescens* or *Spartina alterniflora* (tall) depending on location.

3. *Spartina alterniflora* Area: The vegetation of this area consisted of both short and tall *Spartina alterniflora* and some small areas of

Spartina patens and *Distichlis spicata*. The area was predominately *Spartina alterniflora* (short). This transect also included two salt marsh ponds.

4. Creek and Bay-Marsh Interface: This transect recorded birds in close association with the creek along Cedar Run Road. The creek bank was lined with *Iva frutescens* and *Spartina alterniflora* (tall). The bay-marsh interface recorded birds that were in close association with the area where the marsh and bay meet.

Field Methods

Each of the transects was approximately one mile in length. Two experienced observers walked the transects. Each observer walked two of the transects each trip. The transects were traversed at a normal rate of speed. The species and distance at which a bird was first sighted were recorded. Six visits to the study area were made. The dates of the visits were 20 April, 30 April, 21 May, 3 June, 9 June, and 8 August 1975. Binoculars used were 7 X 35. Observer-transect combinations were changed on each trip.

Statistical Methods

A simple count of the number of different species seen was used as a measure of diversity.

The density of the birds was estimated by taking an average of the sighting distance for each species for each trip. This average sighting distance multiplied by the transect length yielded the area censused for each species. The area censused divided into the number of birds of that species seen yielded the density of bird per unit area.

$$\bar{X}_d = \frac{\sum_{i=1}^{j} D_i}{N}$$

D = distance for the ith through jth bird

N = number of bird distances

$\bar{X}d$ = mean sighting distance

$$Ac = (2)(\bar{X}_d)(L)$$

Ac = area censused for a species

L = transect length

$$Aca = (Ac/43{,}000)$$

Aca = area censused in acres

$$Bd = (N/Aca)$$

Bd = bird density per acre

FINDINGS

Diversity

Eighty-seven species of birds were observed during the study period (Table 1).

Table 1. All species of birds observed on the Cedar Run study area.

1.	Pied-billed grebe *Podilymbus podiceps*	16.	Mallard *Anas platyrhynchos*
2.	Double-crested cormorant *Phalacrocorax auritus*	17.	Black duck *Anas rubripes*
3.	Great blue heron *Ardea herodias*	18.	Gadwall* *Anas strepera*
4.	Common egret *Casmerodius albus*	19.	Pintail *Anas acuta*
5.	Snowy egret *Leucophoyx thula*	20.	Green-winged teal *Anas carolinensis*
6.	Little blue heron *Florida caerulea*	21.	Blue-winged teal *Anas discors*
7.	Louisiana heron *Hydranassa tricolor*	22.	American widgeon *Mareca americana*
8.	Green heron *Butorides virescens*	23.	Bufflehead *Bucephala albeola*
9.	Black-crowned night heron *Nycticorax nycticorax*	24.	Red-breasted merganser *Mergus serrator*
10.	American bittern *Botaurus lentiginosus*	25.	Turkey vulture *Cathartes aura*
11.	Glossy ibis *Plegadis falcinellus*	26.	Red-tailed hawk *Buteo jamaicensis*
12.	Whistling swan* *Olor columbianus*	27.	Broad-winged hawk* *Buteo platypterus*
13.	Canada goose* *Branta canadensis*	28.	Marsh hawk *Circus cyaneus*
14.	Atlantic brant* *Branta bernicla*	29.	Osprey *Pandion haliaetus*
15.	Snow goose* *Chen hyperborea*	30.	Peregrine falcon* *Falco peregrinus*

Table 1. Continued.

31. Sparrow hawk
Falco sparverius

32. Bobwhite
Colinus virginianus

33. Clapper rail
Rallus longirostris

34. American coot
Fulica americana

35. American oystercatcher
Haematopus palliatus

36. Semipalmated plover
Charadrius semipalmatus

37. Killdeer
Charadrius vociferus

38. Ruddy turnstone
Arenaria interpres

39. Black-bellied plover
Squatarola squatarola

40. Common snipe
Capella gallinago

41. Whimbrel
Numenius phaeopus

42. Spotted sandpiper
Actitis macularia

43. Willet
Catoptrophorus semipalmatus

44. Greater yellowlegs
Totanus melanoleucus

45. Lesser yellowlegs
Totanus flavipes

46. Dunlin*
Erolia alpina

47. Short-billed dowitcher
Limnodromus griseus

48. Semipalmated sandpiper
Ereunetes pusillus

49. Great black-backed gull
Larus marinus

50. Herring gull
Larus argentatus

51. Ring-billed gull
Larus delawarensis

52. Laughing gull
Larus atricilla

53. Common tern
Sterna hirundo

54. Least tern
Sterna albifrons

55. Black skimmer
Rynchops nigra

56. Rock dove
Columba livia

57. Mourning dove
Zenaidura macroura

58. Short-eared owl
Asio flammeus

59. Belted kingfisher
Hagaceryle alcyon

60. Yellow-shafted flicker
Colaptes auratus

61. Hairy woodpecker
Dendrocopos villosus

62. Downy woodpecker
Dendrocopos pubescens

63. Eastern phoebe
Sayornis phoebe

64. Eastern wood pewee*
Contopus virens

Table 1. Continued.

65. Tree swallow
Iridoprocne bicolor

66. Barn swallow
Hirundo rustica

67. Blue jay
Cyanocitta cristata

68. Common crow
Corvus brachyrhynchos

69. Fish crow
Corvus ossifragus

70. Carolina chickadee
Parus carolinensis

71. Tufted titmouse
Parus bicolor

72. Long-billed marsh wren
Telmatodytes palustris

73. Short-billed marsh wren
Cistothorus platensis

74. Mockingbird
Mimus polyglottos

75. Catbird
Dumetella carolinensis

76. Robin
Turdus migratorius

77. Starling
Sturnus vulgaris

78. Sharp-tailed sparrow
Ammospiza caudacuta

79. Red-winged blackbird
Agelaius phoeniceus

80. Eastern meadowlark
Sturnella magna

81. Song sparrow
Melospiza melodia

82. Yellowthroat
Geothylpis trichas

83. Rufous-sided towhee
Pipilo erythrophthalmus

84. Yellow warbler
Dendroica petechia

85. American goldfinch
Spinus tristis

86. Kingbird
Tyrannus tyrannus

87. Seaside sparrow
Ammospiza maritima

* Reported by other observers to have been present during the study period.

In addition to those species observed by survey personnel, birds observed by other workers involved in other activities were also included. This was done so that infrequently occurring birds would also be included in the diversity figures.

Diversity by visit and habitat type presented in Table 2 are the species diversity counts for each visit and habitat type. The upland edge site was dropped after the third visit because the density of the vegetation impeded the observer to the point where accurate counts were no longer possible.

The highest species diversity was observed on the *S. alterniflora* transect and the lowest on the *Iva/S. patens* and upland sites. There appears to be a slight decrease in species diversity over time. During the early transect counts, birds were still migrating; this phenomenon accounts for the early peaks in species diversity.

Table 2. Numbers of species of birds observed by visit and site.

	No. of different species	20 April	30 April	21 May	3 June	9 June	8 August	Means for site
Creek and Bay-Marsh Interface	33	16	17	13	9	8	8	11.8
Upland Marsh Edge	24	14	11	13				12.0
Iva/S. patens	24	8	9	11	10	7	9	9.0
S. alterniflora	48	16	19	17	18	15	17	17.0
Mean per visits		13.0	14.0	13.5	12.3	8.3	11.3	

Density

Density estimates were calculated when a species had been seen at least three times. Densities for species seen most frequently have a higher probability of being most accurately estimated.

The following set of tables (Table 3 through 6) lists species present and densities, for each of the transects and each of the visits. The total number of individuals and total number of species for each transect-time combination is also presented in Appendix A.

The total number of individuals observed by site and visit combination are presented in Table 7.

The *S. alterniflora* transect accounted for the largest number of individuals observed. The depression in the number of individuals seen on the 9 June transect was a function of sporadic rain that day.

While many different species of birds visited the site, only a small proportion were observed often enough to calculate reliable density estimates. The censusing was conducted during migration periods. Therefore most birds would be expected to be seen infrequently. Birds that are normally considered summer residents were seen most frequently. This group would consist of red-winged blackbirds, sharp-tailed sparrows, clapper rails, barn swallows, common crows, fish crows, willets, laughing gulls, common egrets, snowy egrets, herring gulls, long-billed marsh wrens, glossy ibis, and great blue herons. Sharp-tailed sparrows had the highest density of any species. Next in density were the barn swallows and red-winged blackbirds. Of the larger species, the laughing gull was the most abundant. The *S. alterniflora* transect and Creek and Bay-Marsh Interface transect had the highest diversity of birds as well as the greatest density.

Since the study area is such a mixture of vegetation types it becomes difficult to assign densities to various habitats. The birds move easily from one habitat type to the next. To assign relative values of importance to the habitat types would be impossible. To use these data to estimate bird populations on other marsh areas of different proportions of the various habitats

Table 3. Birds observed along the Creek and Bay-Marsh Interface transect and their estimated density (No./acre).

	Species	20 April	30 April	21 May	3 June	9 June	8 August
1.	Greater yellowlegs	*					
2.	Mallard	0.340			*	*	
3.	Laughing gull	*	0.041	0.012	0.036	*	*
4.	Barn swallow	0.326	0.201	0.082	*	0.133	*
5.	Willet	*	*	*		*	
6.	Red-winged blackbird	*	0.611	1.12	*	*	*
7.	Marsh hawk	*					
8.	Fish crow	*					
9.	Common crow	*	*			*	*
10.	Tree swallow	*					0.081
11.	Common egret	*	0.061				*
12.	Clapper rail	0.138	0.049	0.421	0.617		
13.	Starling	*	0.321	*	0.181		
14.	Snowy egret	*					
15.	American bittern	*					
16.	Herring gull	0.055					*
17.	Short-billed dowitcher				*		
18.	Common tern						
19.	Sharp-tailed sparrow			2.98	1.431	1.312	0.256
20.	Glossy ibis					*	
21.	Red-breasted merganser		*				
22.	Bufflehead		*	*			
23.	Rock dove		0.410	*			
24.	Great black-backed gull		*				
25.	Black-bellied plover		*				
26.	Ruddy turnstone		*				
27.	Belted kingfisher		*				
28.	Yellow-shafted flicker		*				
29.	Pied-billed grebe			*			
30.	Double-crested cormorant			*			
31.	Common tern			0.061	*		
32.	Least tern			*			
33.	Ringbilled gull		*				

* Less than three individuals seen

would be impossible. The year-to-year variation in the populations has not been accounted for. The results represent the bird density and diversity on the Cedar Run study area during the 1975 season.

Table 4. Birds observed along the *S. alterniflora* transect and their estimated densities (No./acre).

	Species	20 April	30 April	21 May	3 June	9 June	8 August
1.	Mallard	0.444			0.093	*	
2.	Black duck	0.302		*			1.14
3.	Common crow	0.024	0.218		0.058	*	
4.	Meadowlark	0.074	*			*	0.102
5.	Oyster catcher	*					
6.	Snowy egret	0.099	*			0.060	*
7.	Marsh hawk	*			*		
8.	Killdeer	*					
9.	Greater yellowlegs	0.034					*
10.	Fish crow	0.060					0.040
11.	Great blue heron	*	*				*
12.	Common egret	*	*				0.065
13.	Sharp-tailed sparrow	2.870	1.513	3.612	1.300	*	0.241
14.	Least tern	*		*	0.254	0.087	
15.	Black-crowned night heron	*					
16.	Clapper rail	*		0.129	*		
17.	Long-billed marsh wren			*	*	*	
18.	Song sparrow				*		
19.	Willet			*	0.200	0.343	*
20.	Herring gull			0.018	0.095	0.067	
21.	Red-winged blackbird			0.096	0.303	0.339	0.102
22.	Glossy ibis			*	0.122	*	0.061
23.	Mourning dove				*		
24.	Barn swallow			0.217	0.375	0.147	0.316
25.	Laughing gull				0.081	0.122	*
26.	Black-bellied plover				*		
27.	Little blue heron				*		
28.	Short-billed dowitcher				0.114		
29.	Tree swallow					*	0.161
30.	Louisiana heron					*	
31.	Gadwall			*			
32.	Green-winged teal		0.072				
33.	Blue-winged teal		*				
34.	Pintail		*				
35.	American widgeon		*				
36.	Common snipe		*				
37.	Spotted sandpiper		0.021				
38.	Dunlin		*				
39.	Lesser yellowlegs		*				
40.	Black skimmer		*				
41.	Common tern		*	*			
42.	American coot			*			
43.	Great black-backed gull			*			
44.	Short-billed marsh wren			*			
45.	Seaside sparrow		*				
46.	Eastern kingbird					*	
47.	Starling						0.325
48.	Whimbrel						*

* Less than three individuals seen

Table 5. Birds observed along the *Iva/S. patens* transect and their estimated densities (No./acre).

Species	20 April	30 April	21 May	3 June	9 June	8 August
1. Red-winged blackbird	0.234	0.361	0.412	2.163	0.290	*
2. Song sparrow	*	*				
3. Starling	*	*				
4. Meadowlark	0.030	*	*	*	*	
5. Common egret	*	*	0.021	0.037		0.019
6. Yellow-shafted flicker	*					
7. American bittern	*					*
8. Laughing gull	*	0.020	0.076			*
9. Barn swallow		0.817	0.111	0.165		*
10. Sharp-tailed sparrow		3.162	3.616	1.943	*	1.809
11. Willet			*	0.333	*	
12. Common crow			*	*		
13. Herring gull				0.040		*
14. Mallard				*		
15. Snowy egret			*		*	
16. Long-billed marsh wren					*	
17. Tree swallow			*		*	0.245
18. Short-billed marsh wren						0.250
19. Mourning dove				*		
20. Eastern kingbird		*				
21. Robin		*				
22. Sparrow hawk		*				
23. Green heron			*			

* Less than three individuals seen

Table 6. Birds observed along the Upland Marsh Edge transect and their estimated densities (No./acre).

Species	20 April	30 April	21 May
1. Yellow throat	0.754	0.015	0.410
2. Red-winged blackbird	*		0.113
3. Mallard	*		
4. Sharp-tailed sparrow	*		*
5. Willet	*		
6. Fish crow	*		
7. Belted kingfisher	*		
8. Yellow-shafted flicker	0.250		
9. Laughing gull	*		
10. Blue jay	*	*	*
11. Song sparrow	*		
12. Yellow warbler	*	0.041	0.121
13. Gold finch	1.107		
14. Turkey vulture		*	
15. Hairy woodpecker		*	
16. Carolina chickadee		0.116	0.616

Table 6. Continued.

Species	20 April	30 April	21 May
17. Robin		*	
18. Tufted titmouse		*	
19. American bittern		*	
20. Mockingbird		*	
21. Rufous-sided towhee	*	*	.751
22. Red-tailed hawk			*
23. Bobwhite quail			*
24. Eastern phoebe			*

* Less than three individuals seen

Table 7. Number of individuals of all species observed by site and visit combination.

Visit	20 April	30 April	21 May	3 June	9 June	8 August	Means with respect to transect
Iva/S. patens	25	65	66	61	11	32	43.3
Upland Edge	30	20	38	out	out	out	29.3
Creek and Bay-Marsh Interface	33	48	63	34	27	13	36.3
S. alterniflora	69	59	96	73	46	67	68.3
Means with respect to visit	39.2	48.0	65.7	56.0	28.0	37.3	

REFERENCES CITED

Ferrigno, F., L. Widjeskog and E. Tomlin. 1974. Marsh Productivity (Cedar Run Evaluation Study). N.J. Department of Environmental Protection. 6 p.

APPENDIX A

Number and Density of Birds Observed

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Number and density of birds observed along *S. alterniflora* transect on 8 August 10.25

Density and number of birds observed along *Iva/S. patens* transect on 20 April.

Species	Number observed	Density (No./acre)
1. Red-winged blackbird	13	0.234
2. Song sparrow	1	*
3. Starling	3	#
4. Meadowlark	3	0.030
5. Common egret	2	*
6. Yellow-shafted flicker	1	*
7. American bittern	1	*
8. Laughing gull	1	*
25 individuals 8 species		

* Not observed three or more times
\# Seen in flock - no density estimates can be calculated

Density and number of birds observed along the Upland Marsh Edge transect on 20 April.

Species	Number observed	Density (No./acre)
1. Yellow throat	10	0.754
2. Fish crow	1	*
3. Belted kingfisher	1	*
4. Red-winged blackbird	2	*
5. Yellow-shafted flicker	3	0.250
6. Laughing gull	1	*
7. Towhee	1	*
8. Blue jay	1	*
9. Song sparrow	1	*
10. Yellow warbler	2	*
11. Goldfinch	4	1.107
12. Mallard	1	*
13. Sharp-tailed sparrow	1	*
14. Willet	1	*
30 individuals 14 species		

* Not observed three or more times

Number and density of birds observed along Creek and Bay-Marsh Interface transect on 20 April.

	Species	Number observed	Density (No./acre)
1.	Greater yellowlegs	1	*
2.	Mallard	3	0.340
3.	Laughing gull	2	*
4.	Barn swallow	8	0.326
5.	Willet	1	*
6.	Red-winged blackbird	1	*
7.	Marsh hawk	1	*
8.	Fish crow	1	*
9.	Common crow	1	*
10.	Tree swallow	2	*
11.	Common egret	1	*
12.	American bittern	1	*
13.	Herring gull	3	0.055
14.	Clapper rail	4	0.138
15.	Starling	2	*
16.	Snowy egret	1	*
	33 individuals		
	16 species		

* Not observed three or more times

Number and density of birds observed along the *S. alterniflora* transect on 20 April.

	Species	Number observed	Density (No./acre)
1.	Mallard	6	0.444
2.	Black duck	13	0.302
3.	Common crow	3	0.024
4.	Meadowlark	8	0.074
5.	Oyster catcher	2	*
6.	Snowy egret	5	0.099
7.	Marsh hawk	1	*
8.	Killdeer	2	*
9.	Greater yellowlegs	3	0.034
10.	Fish crow	5	0.060
11.	Great blue heron	1	*
12.	Common egret	1	*
13.	Sharp-tailed sparrow	12	2.87
14.	Least tern	2	*
15.	Black-crowned night heron	1	*
16.	Clapper rail	1	*
	69 individuals		
	16 species		

* Not observed three or more times

Number and density of birds observed along Upland Marsh Edge transect on 30 April.

Species	Number observed	Density (No./acre)
1. Turkey vulture	2	*
2. Mockingbird	1	*
3. Towhee	1	*
4. Yellowthroat	3	0.015
5. Hairy woodpecker	1	*
6. Carolina chickadee	3	0.116
7. Robin	2	*
8. Tufted titmouse	1	*
9. Yellow warbler	3	0.041
10. Blue jay	2	*
11. American bittern	1	*
20 individuals 11 species		

* Not observed three or more times

Number and density of birds observed along *S. alterniflora* transect on 30 April.

Species	Number observed	Density (No./acre)
1. Green-winged teal	11	0.072
2. Blue-winged teal	2	*
3. Pintail	1	*
4. American widgeon	3	#
5. Common snipe	2	*
6. Spotted sandpiper	4	0.021
7. Dunlin	1	*
8. Lesser yellowlegs	1	*
9. Common crow	3	0.218
10. Meadowlark	1	*
11. Sharp-tailed sparrow	6	1.513
12. Great blue heron	2	*
13. Common egret	2	*
14. Snowy egret	1	*
15. Black skimmer	5	#
16. Common tern	2	*
17. Red-tailed hawk	1	*
18. Osprey	2	*
19. Laughing gull	7	0.121
59 individuals 19 species		

* Not observed three or more times
# Seen in flock-no density estimates can be calculated

Number and density of birds observed along Creek and Bay-Marsh Interface transect on 30 April.

	Species	Number observed	Density (No./acre)
1.	Red-breasted merganser	1	*
2.	Bufflehead	2	*
3.	Rock dove	5	0.410
4.	Clapper rail	9	0.049
5.	Red-winged blackbird	4	0.611
6.	Common crow	1	*
7.	Common egret	3	0.061
8.	Great black-backed gull	1	*
9.	Ring-billed gull	2	*
10.	Laughing gull	3	0.041
11.	Starling	5	0.321
12.	Barn swallow	5	0.201
13.	Black-bellied plover	2	*
14.	Ruddy turnstone	1	*
15.	Willet	2	*
16.	Belted kingfisher	1	*
17.	Yellow-shafted flicker	1	*
	48 individuals		
	17 species		

* Not observed three or more times

Number and density of birds observed along *Iva/S. patens* transect on 30 April.

	Species	Number observed	Density (No./acre)
1.	Starling	2	*
2.	Meadow lark	1	*
3.	Common egret	2	*
4.	Laughing gull	6	0.020
5.	Eastern kingbird	1	*
6.	Robin	1	*
7.	Song sparrow	2	*
8.	Sparrow hawk	1	*
9.	Red-winged blackbird	14	0.361
10.	Sharp-tailed sparrow	29	3.162
11.	Barn swallow	6	0.817
	65 individuals		
	11 species		

* Not observed three or more times

Number and density of birds observed along Upland Marsh Edge transect on 21 May.

	Species	Number observed	Density (No./acre)
1.	Yellowthroat	7	0.410
2.	Yellow warbler	5	0.121
3.	Carolina chickadee	3	0.616
4.	Yellow-shafted flicker	4	0.098
5.	Blue jay	2	*
6.	Rufous-sided towhee	4	0.751
7.	Mockingbird	1	*
8.	Belted kingfisher	1	*
9.	Sharp-tailed sparrow	2	*
10.	Red-tailed hawk	1	*
11.	Bobwhite quail	3	*
12.	Red-winged blackbird	4	0.113
13.	Eastern phoebe	1	*
	38 individuals 13 species		

* Not observed three or more times

Number and density of birds observed along *S. alterniflora* transect on 21 May.

	Species	Number observed	Density (No./acre)
1.	Gadwall	2	*
2.	American coot	1	*
3.	Long-billed marsh wren	2	*
4.	Willet	1	*
5.	Clapper rail	6	0.129
6.	Red-winged blackbird	4	0.096
7.	Glossy ibis	6	#
8.	Barn swallow	13	0.217
9.	Least tern	1	*
10.	Common tern	1	*
11.	Black duck	9	0.026
12.	Great black-backed gull	1	*
13.	Herring gull	7	0.018
14.	Sharp-tailed sparrow	40	3.612
15.	Short-billed marsh wren	1	*
16.	Seaside sparrow	1	*
	96 individuals 16 species		

* Not observed three or more times

\# Seen in flock - no density estimates can be calculated

Number and density of birds observed on Creek and Bay-Marsh Interface transect on 21 May.

	Species	Number observed	Density (No./acre)
1.	Pied-billed grebe	1	*
2.	Double-crested cormorant	4	#
3.	Bufflehead	2	*
4.	Clapper rail	9	0.421
5.	Laughing gull	3	0.012
6.	Common tern	3	0.061
7.	Least tern	1	*
8.	Sharp-tailed sparrow	20	2.98
9.	Red-winged blackbird	12	1.12
10.	Barn swallow	4	0.082
11.	Starling	1	*
12.	Rock dove	2	*
13.	Willet	1	*
	63 individuals		
	13 species		

* Not observed three or more times
\# Seen in flock - no density estimates can be calculated

Number and density of birds observed on *Iva/S. patens* transect on 21 May.

	Species	Number observed	Density (No./acre)
1.	Green heron	2	*
2.	Sharp-tailed sparrow	31	3.616
3.	Red-winged blackbird	10	0.412
4.	Common crow	2	*
5.	Common egret	3	0.021
6.	Snowy egret	2	*
7.	Barn swallow	6	0.111
8.	Tree swallow	2	*
9.	Meadowlark	2	*
10.	Willet	2	*
11.	Laughing gull	4	0.076
	66 individuals		
	11 species		

* Not observed three or more times

Number and density of birds observed along *S. alterniflora* transect on 3 June.

	Species	Number observed	Density (No./acre)
1.	Long-billed marsh wren	1	*
2.	Song sparrow	1	*
3.	Willet	8	0.200
4.	Sharp-tailed sparrow	8	1.30
5.	Herring gull	7	0.095
6.	Red-winged blackbird	6	0.330
7.	Glossy ibis	3	0.122
8.	Mourning dove	2	*
9.	Barn swallow	6	0.375
10.	Common crow	5	0.058
11.	Least tern	5	0.254
12.	Laughing gull	5	0.081
13.	Black-bellied plover	2	*
14.	Marsh hawk	1	*
15.	Little blue heron	1	*
16.	Clapper rail	1	*
17.	Short-billed dowitcher	7	0.114
18.	Mallard	4	0.093
	73 individuals 18 species		

* Not observed three or more times

Number and density of birds observed along Creek and Bay-Marsh Interface transect on 3 June.

	Species	Number observed	Density (No./acre)
1.	Mallard	2	*
2.	Clapper rail	3	0.617
3.	Barn swallow	2	*
4.	Short-billed dowitcher	1	*
5.	Laughing gull	3	0.036
6.	Common tern	2	*
7.	Red-winged blackbird	1	*
8.	Starling	3	0.181
9.	Sharp-tailed sparrow	17	1.431
	34 individuals 9 species		

* Not observed three or more times

Number and density of birds observed along *Iva/S. patens* transect on 3 June.

	Species	Number observed	Density (No./acre)
1.	Barn swallow	5	0.165
2.	Sharp-tailed sparrow	21	1.943
3.	Common egret	4	0.037
4.	Red-winged blackbird	17	2.163
5.	Mourning dove	1	*
6.	Willet	5	0.333
7.	Common crow	1	*
8.	Meadowlark	1	*
9.	Herring gull	5	0.040
10.	Mallard	1	*
	61 individuals 10 species		

* Not observed three or more times

Number and density of birds observed along Creek and Bay-Marsh Interface transect on 9 June.

	Species	Number observed	Density (No./acre)
1.	Barn swallow	8	0.133
2.	Sharp-tailed sparrow	12	1.312
3.	Red-winged blackbird	1	*
4.	Glossy ibis	2	*
5.	Mallard	1	*
6.	Willet	1	*
7.	Common crow	1	*
8.	Laughing gull	1	*
	27 individuals 8 species		

* Not observed three or more times

Number and density of birds observed along *Iva/S. patens* transect on 9 June.

	Species	Number observed	Density (No./acre)
1.	Red-winged blackbird	5	0.290
2.	Sharp-tailed sparrow	1	*
3.	Long-billed marsh wren	1	*
4.	Snowy egret	1	*
5.	Willet	1	*
6.	Meadowlark	1	*
7.	Tree swallow	1	*
	11 individuals 7 species		

* Not observed three or more times

Number and density of birds observed along *S. alterniflora* transect on 9 June.

	Species	Number observed	Density (No./acre)
1.	Sharp-tailed sparrow	1	*
2.	Long-billed marsh wren	1	*
3.	Laughing gull	6	0.122
4.	Willet	7	0.343
5.	Red-winged blackbird	5	0.339
6.	Least tern	5	0.087
7.	Snowy egret	5	0.060
8.	Common crow	2	*
9.	Glossy ibis	2	*
10.	Barn swallow	3	0.147
11.	Herring gull	5	0.067
12.	Mallard	1	*
13.	Tree swallow	1	*
14.	Louisiana heron	1	*
15.	Meadowlark	1	*
	46 individuals 15 species		

* Not observed three or more times

Number and density of birds observed along Creek and Bay-Marsh Interface transect on 8 August.

Species	Number observed	Density (No./acre)
1. Tree swallow	3	0.081
2. Barn swallow	1	*
3. Red-winged blackbird	1	*
4. Common crow	2	*
5. Sharp-tailed sparrow	3	0.256
6. Herring gull	1	*
7. Common egret	1	*
8. Laughing gull	1	*
13 individuals 8 species		

* Not observed three or more times

Number and density of birds observed along *Iva/S. patens* transect on 8 August.

Species	Number observed	Density (No./acre)
1. Tree swallow	3	0.245
2. Barn swallow	2	*
3. Sharp-tailed sparrow	12	1.809
4. American bittern	1	*
5. Short-billed marsh wren	4	0.250
6. Common egret	5	0.019
7. Herring gull	2	*
8. Laughing gull	1	*
9. Red-winged blackbird	2	*
32 individuals 9 species		

* Not observed three or more times

Number and density of birds observed along *S. alterniflora* transect on 8 August.

	Species	Number observed	Density (No./acre)
1.	Fish crow	5	0.040
2.	Eastern kingbird	1	*
3.	Laughing gull	1	*
4.	Sharp-tailed sparrow	6	0.244
5.	Meadowlark	5	0.102
6.	Starling	4	0.325
7.	Red-winged blackbird	3	0.102
8.	Whimbrel	1	*
9.	Common egret	4	0.065
10.	Glossy ibis	6	0.061
11.	Black duck	14	1.14
12.	Willet	1	*
13.	Great blue heron	1	*
14.	Greater yellowlegs	2	*
15.	Snowy egret	2	*
16.	Barn swallow	3	0.316
17.	Tree swallow	4	0.161
	67 individuals 17 species		

* Not observed three or more times

11. WILDLIFE INDEXES: NESTING SURVEY

Lee Widjeskog and Fred Ferrigno[1]

SUMMARY

Nest searches were made in nine marsh vegetation types on the Cedar Run study area. Seven species of birds were found nesting in the area. A total of 149 nests were located in 100, 0.5 acre search areas. The results are being statistically analyzed by Dr. Trout, Rutgers University. The final results will be presented in future reports as soon as this analysis is complete.

BACKGROUND

During the past 20 years, New Jersey has lost 23.5% of its 263,000 acres of tidal marsh to channel dredging, filling for houses, roads and marinas, and diking for agricultural purposes (Ferrigno, Widjeskog, and Toth 1973). The demand for recreational and retirement communities has resulted in a building boom with the subsequent conversion of large acreages of New Jersey's coastal wetlands into lagoon developments.

Since the enforcement of the riparian laws and the passage of the "Wetlands Act", marsh losses have been minimal. Nevertheless, development companies are planning to test the legality of these laws. In some areas, they will attempt to enlarge present developments. The lagoon development of Beach Haven West, near Manahawkin, New Jersey was such an area. Presently, it encompasses 1,038 acres, with over 2,500 houses and 137,000 ft of lagoons. Plans for another 1,350 acres of developments just south of Beach Haven West indicate future expansion of this lagoon community.

This job is part of the wetlands project's contribution to the team effort of various agencies attempting to evaluate 1,350 acres of salt marsh threatened by the Beach Haven West development in the Cedar Run to Mill Creek area.

In 1974, a waterfowl hunter survey on the area showed that 874 man days were spent in harvesting 2,407 waterfowl on this study area (Shoemaker and Ferrigno 1974).

OBJECTIVES

This study's objective is to determine the species and density of bird nesting in the major vegetational types.

PROCECURES

During the summer of 1974, a ground search was made of randomly selected 0.5 acre study segments in the different types of vegetative cover on the Cedar Run study area. On the tall salt marsh cordgrass (*Spartina alterniflora*) marsh

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[1]The authors are members of the Bureau of Wildlife Management within the New Jersey Department of Environmental Protection. This report was prepared for the New Jersey Division of Fish, Game, and Shellfisheries with funds provided in part by the Federal Aid to Wildlife (Pittman-Robertson) Act for Project W-53-R-3, "Wetlands Ecology", during the period 1 February 1974 to 30 October 1974.

16 segment counts were made; 36 on short salt marsh cordgrass (*S. alterniflora*); 24 on the salt meadow cordgrass (*Spartina patens*); 5 on the high tide bush (*Iva frutescens*); 10 on spike grass (*Distichlis spicata*); 3 on reed (*Phragmites australis*); 4 on three-square (*Scirpus olneyi*); 1 on switchgrass (*Panicum virgatum*); and 1 on spoil areas.

Each 0.5 acre segment was thoroughly searched, nests were counted, and species identified.

All successful nests recorded were determined by locating small fragments of shells in the nest. Any nesting that occurred after July was not recorded in this survey. It is possible that some of the nests may have been the results of raising a second brood as in the case of clapper rail. No attempt was made to distinquish between single and multiple nestings.

In the case of the long-billed marsh wren only the actual nests were counted. The numerous decoy nests were not included.

In searching the 0.5 acre segments of tall salt marsh cordgrass, the census area usually involved the edges of tidal creeks. Tall salt marsh cordgrass boarders these creeks and varies in width from 5 to 10 ft.

FINDINGS

A total of 100, 0.5 acre areas were searched. On those areas, a total of 149 nests were found composed of seven species of birds. Those found include clapper rail (*Rallus longirostris*), long-billed marsh wren (*Telmatodytes palustris*), willet (*Catoptrophorus semipalmatus*), red-winged blackbird (*Agelaius phoeniceus*), and black duck (*Anas rubripes*). The sharp-tailed sparrow (*Ammospiza caudacuta*) and seaside sparrow (*A. maritima*) were both found nesting on the area. Due to the difficulty in telling the two nests apart all sparrow nests were grouped under one category.

The results of the survey are shown in Table 1. This information is to be analyzed by a statistician and this report will be presented as soon as analysis is completed.

Table 1. Bird nesting in major marsh vegetation types on the Cedar Run study area.

Vegetative types	Acreage	No. plots	Bird species*	Nests found	No. per acre	Estimated total per type
Tall salt marsh cordgrass (*Spartina alterniflora*)	23.7	16	Sparrows	4	0.54	12.80
			Clapper-rail	43	5.38	127.57
			Subtotal	47	5.92	140.37
Short salt marsh cordgrass (*S. alterniflora*)	809.4	36	Clapper-rail	6	0.33	267.10
			Sparrows	19	1.06	857.97
			L.B. marsh wren	1	0.06	48.56
			Willet	1	0.06	48.56
			Subtotal	27	1.51	1,222.19

Table 1 Continued.

Vegetative types	Acreage	No. plots	Bird species*	Nests found	No. per acre	Estimated total per type
Saltmeadow cordgrass (*Spartina patens*)	347.3	24	Clapper-rail	1	0.09	31.26
			Sparrows	28	2.34	812.69
			Willets	9	0.75	260.48
			Subtotal	38	3.17	1,104.43
High tide bush (*Iva frutescens*)	29.2	5	Sparrows	5	2.00	58.40
			L.B. marsh wren	10	4.00	116.80
			R.W. blackbird	5	2.00	58.40
			Subtotal	20	8.00	233.60
Black spike grass (*Distichlis spicata*)	22.7	10	Clapper-rail	5	1.00	22.70
			Sparrows	3	0.65	14.76
			Willet	1	0.25	5.68
			Subtotal	9	1.90	43.14
Common reed (*Phragmites australis*)	8.7	3	None	0	0	0
Three-square (*Scirpus olneyi*)	3.0	4	Sparrows	5	2.50	7.50
			R.W. blackbird	1	0.50	1.50
			Black duck	1	0.50	1.50
			Subtotal	7	3.50	10.50
Switchgrass (*Panicum virgatum*)	1.0	1	Sparrows	1	2.00	2.00
			Subtotal	1	2.00	2.00
Spoil	6.8	1	None	0	0	0
			Grand total	149	3.25	2,756.17

* Clapper rail (*Rallus longirostris*), sparrows - sharp-tailed sparrow (*Ammospiza caudacuta*) and seaside sparrow (*A. maritima*), willet (*Catoptrophorus semipalmatus*), red-winged blackbird (*Agelaius phoeniceus*), black duck (*Anas rubripes*), and long-billed marsh wren (*Telmatodytes palustris*).

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12. WILDLIFE INDEXES: STATISTICAL ANALYSIS OF THE NESTING SURVEY DATA

J. Richard Trout[1]

BACKGROUND

During August 1974 an experiment was conducted by Ferrigno to study the bird population on the Cedar Run marshes. Before the experiment was commenced the number of acres of each vegetation type was established. The 100 sampling stations were then allocated among the vegetation types based on the relative amounts of the vegetation present in the total marsh area. A summary of the vegetation types and sampling effort may be found in Table 1. The data collected from this experiment was transmitted by Ferrigno in March 1975 for the purpose of statistical analysis. A summary of the bird species found on the marsh study area is shown in Table 2 and the data collected is displayed in Table 3.

OBJECTIVES

The objective of the statistical analysis was to obtain point and interval estimates of the number of nests of the various bird species in the different vegetation types on the Cedar Run marshes. Additionally, it was of interest to obtain an estimate of the total number of nests within each of the cover types as well as an estimate of the number of nests for each of the bird species on the study area.

PROCEDURES

Without making any distributional assumption relating to the counts of bird nests an unbiased estimate of the mean count may be obtained using the sample mean (Cochran 1963). That is if X_{ijk} is the count for the k^{th} sample for bird species i in vegetation type j then

$$\bar{X}_{ij} = \sum_{k=1}^{n_{ij}} X_{ijk} \qquad (1)$$

may be used to estimate μ_{ij} which is the mean number of individuals for species i in vegetation type j. The corresponding variance, σ_{ij}^2, may be estimated by S_{ij}^2 where

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[1]The author is an Associate Professor of Statistics at Cook College, Rutgers University and the New Jersey Agricultural Experiment Station. This report was prepared for the New Jersey Division of Fish, Game, and Shellfisheries with funds provided in part by the Federal Aid to Wildlife (Pittman-Robertson) Act for Project W-53-R-3, "Wetlands Ecology," during the period 1 February 1974 to 30 October 1974.

Table 1. Vegetation types in the Cedar Run marsh study area.

Identification number	Vegetation type	Area		Number of sampling plots
		Acres	Percent	
1	Threesquare *(Scirpus olneyi)*	3.0	0.2	4
2	Reed *(Phragmites australis)*	8.7	0.6	3
3	Marsh elder *(Iva frutescens)*	29.2	2.2	5
4	Switchgrass *(Panicum virgatum)*	1.5	0.1	1
5	Salt hay or saltmeadow cordgrass *(Spartina patens)*	347.3	25.7	24
6	Mosquito ditches	7.5	0.6	0
7	Fill	6.8	0.5	1
8	Tall, high vigor, salt marsh cordgrass *(Spartina alterniflora)*	23.7	1.8	16
9	Spike grass *(Distichlis spicata)*	22.7	1.7	10
10	Short, low vigor, salt marsh cordgrass *(Spartina alterniflora)*	809.4	59.9	36
11	Permanent salt marsh ponds, Widjeon grass *(Ruppia maritima)*	90.6	6.7	0*
Total		1,350.4	100.0	100

*To be considered in other studies and will not be further mentioned in this analysis.

Table 2. Bird Species found nesting on the Cedar Run marsh study area.

Species number	Species	Common name
1	*Ammospiza caudacuta* *Ammospiza maritima*	Sparrow
2	*Rallus longirostris*	Clapper rail
3	*Telmatodytes palustris*	Long-billed marsh wren
4	*Catoptrophorus semipalmatus*	Willet
5	*Agelaius phoeniceus*	Red-winged blackbird
6	*Anas rubripes*	Black duck

Table 3. Number of nests found on the Cedar Run marsh study area.

Vegetation type	Plot no.	Bird species number					
		1	2	3	4	5	6
1	A-2	2				0	0
	A-8	2				1	0
	A-20	1				0	0
	A-21	0				0	1
2	1						
	2						
	3						
3	A-5	1		4		2	
	B-2	1		2		0	
	B-3	2		4		2	
	B-6	1		0		0	
	B-9	0		0		1	
4	A-1	1					
5	B-1	1	0		0		
	B-4	0	0		0		
	B-10	1	0		0		
	B-11	1	0		0		
	B-12	1	0		1		
	B-13	0	0		0		
	C-1	0	0		1		
	C-5	0	0		0		
	D-5	1	0		0		
	D-6	4	0		0		
	D-10	1	0		0		
	E-1	2	0		0		
	E-2	0	0		0		

Table 3. Continued.

Vegetation type	Plot no.	Bird species number 1	2	3	4	5	6
	E-3	0	0		0		
	F-2	7	0		0		
	G-1	1	1		1		
	G-2	1	0		2		
	G-6	0	0		0		
	G-11	2	0		1		
	G-12	2	0		0		
	H-1	0	0		1		
	H-2	0	0		2		
	H-9	1	0		0		
	H-10	2	0		0		
7	4						
8	E-6	0	4				
	E-10	0	2				
	E-12	0	6				
	E-13	0	3				
	E-14	0	8				
	F-5	2	0				
	F-6	0	4				
	F-7	1	2				
	F-8	0	3				
	F-12	1	0				
	F-15	0	1				
	G-9	0	3				
	H-6	0	0				
	H-11	0	5				
	H-13	0	0				
	H-14	0	2				
9	A-3	0	0		0		
	A-4	0	0		0		
	A-6	0	0		0		
	A-7	0	1		0		
	B-3	2	2		0		
	C-3	0	0		0		
	C-4	0	1		0		
	C-6	1	1		0		
	D-3	0	0		1		
	D-4	0	0		0		
10	B-7	2	1	0	0		
	B-9	1	0	1	0		
	D-1	2	0	0	0		
	D-2	0	0	0	0		
	D-7	0	0	0	0		
	D-8	0	0	0	0		

Table 5. Estimated number of nests for each bird species and vegetation type found on the Cedar Run marsh study area.

Vegetation type	Species 1 $\hat{N}$ *	Species 1 SE #	Species 2 $\hat{N}$	Species 2 SE	Species 3 $\hat{N}$	Species 3 SE
1	7.5	1.6				
2						
3	58.4	17.6			116.8	49.9
4	2.0	1.1†				
5	810.3	219.9	28.9	28.4		
6						
7						
8	11.8	5.5	127.3	22.4		
9	13.6	8.5	22.7	8.9		
10	854.3	234.1	269.8	100.8	44.9	44.4

Vegetation type	Species 4 $\hat{N}$ *	Species 4 SE #	Species 5 $\hat{N}$	Species 5 SE	Species 6 $\hat{N}$	Species 6 SE
1			1.5	0.8	1.5	0.8
2						
3			58.4	24.9		
4						
5	260.4	90.1				
6						
7						
8						
9	4.5	4.0				
10	44.9	44.0				

* $\hat{N}$ is the estimated number of nests found in the entire study area for the indicated bird species and vegetation type combination.
# SE is the standard error of the estimate, $\hat{N}$.
† The standard error shown here was based on the pooled standard deviations associated with the other vegetation types for this bird species.

Table 6. Approximate 95% confidence intervals for the number of nests for each bird species and selected vegetation type found in the Cedar Run marsh study area.

Bird Species	Vegetation type 5 $\hat{N}$*	LL#	UL†	Vegetation type 8 $\hat{N}$	LL	UL
1	810.3	355.3	1,265.3	11.8	0.1	23.5
2	28.9	0.0	87.7	127.3	79.6	175.0
3						
4	260.4	74.0	446.8			
5						
6						

Bird Species	Vegetation type 9 $\hat{N}$	LL	UL	Vegetation type 10 $\hat{N}$	LL	UL
1	13.6	0.0	32.8	854.8	379.1	1,329.5
2	22.7	2.6	42.8	269.8	65.2	474.4
3				44.9	0.0	135.0
4	4.5	0.0	13.5	44.9	0.0	135.0
5						
6						

* $\hat{N}$ is the estimated number of nests found in the entire study area for the indicated bird species and vegetation type combinations.
# LL is the lower limit of the 95% confidence interval.
† UL is the upper limit of the 95% confidence interval.

Table 7. Estimated number of nests for each vegetation type in the Cedar Run marsh study area.

Vegetation type	Estimated number of nests	Standard deviation of estimate
1	10.5	2.0
2		
3	233.6	58.5
4	2.0	1.1
5	1,009.6	239.3
6		
7		
8	139.1	23.1
9	40.8	12.9
10	1,213.9	262.5
Total	2,739.5	361.0

Table 8. Estimated number of nests for each bird species found in the Cedar Run marsh study area.

Bird Species	Estimated number of nests	Standard deviation of estimate
1	1,757.9	321.8
2	448.7	107.5
3	161.7	66.8
4	309.8	100.5
5	59.9	24.9
6	1.5	0.8
Total	2,739.5	361.0

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13. WILDLIFE INDEXES: WATERFOWL USE AND HARVEST

William Shoemaker and Fred Ferrigno[1]

SUMMARY

As part of an estuarine evaluation study of marshland threatened by a housing development, waterfowl utilization, and hunter surveys were conducted during the fall and winter of 1973-1974. Aerial waterfowl utilization counts on the 1,370 acre study area indicated that the waterfowl population increased from 800 in September to 2,690 in January representing an increase from 0.59 to 2.37 waterfowl per marsh acre. During the same period, the surrounding ecosystem started with 1,600 birds in September and swelled to 20,000 waterfowl by mid-December.

Hunter surveys showed considerable recreational value of the study area for hunting. Hunters spent 874 man days harvesting 2,407 waterfowl, an average of 2.65 birds per hunter day. In addition, 1.79 waterfowl were taken per marsh acre and hunter use amounted to 0.65 hunters per acre.

BACKGROUND

During the past 20 years, New Jersey has lost 23.5% of its 263,000 acres of tidal marsh to channel dredging, filling for houses, roads and marinas, and diking for agricultural purposes (Ferrigno, Widjeskog, and Toth 1973). The demand for recreational and retirement communities has resulted in a building boom, with the subsequent conversion of large acreages of New Jersey's coastal wetlands into lagoon developments.

Since the enforcement of the riparian laws and the passage of the "Wetlands Act," marsh losses have been minimal. Nevertheless, development companies are planning to test the legality of these laws. In some areas, they will attempt to enlarge present developments. The lagoon development of Beach Haven West, near Manahawkin, New Jersey was such an area. Presently, it encompasses 1,038 acres with over 2,500 houses and 137,000 ft of lagoons. Plans for another 1,350 acres of developments just south of Beach Haven West indicate future expansion of this lagoon community.

This job is part of the wetlands project's contribution to the team effort of various agencies attempting to evaluate 1,350 acres of salt marsh threatened by the Beach Haven West development in the Cedar Run to Mill Creek area.

OBJECTIVES

The purpose of this study is to determine wildlife utilization and harvest indexes for the Cedar Run estuarine evaluation study area.

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[1]The authors are members of the Bureau of Wildlife Management within the New Jersey Department of Environmental Protection. This report was prepared for the N.J. Division of Fish, Game, and Shellfisheries with funds provided in part by the Federal Aid to Wildlife (Pittman-Robertson) Act for Project W-53-R-2, "Wetlands Ecology," during the period 1 September 1973 to 30 January 1974.

PROCEDURE

During the fall and winter of 1973-1974, waterfowl utilization and harvest data were collected for the Cedar Run study area. Waterfowl utilization was determined by aerial counts made during the middle of the months of September, October, November, December, and January.

Hunter bag checks were conducted on Saturdays and one day of each week. On these checked days, the total use by hunters was determined by counting all the different hunters throughout the day by use of car and boat. Samples of these hunters were checked and their bags examined as they terminated the day's hunt. The total number of birds harvested on that day was computed by using a proportion of the total number of hunters, the sampled hunters, and the birds they harvested. The one weekday total was projected for the entire week. Holidays were treated the same as Saturdays. Car counts indicated the importance of access areas to hunters. The hunter survey was made by William Shoemaker. Fred Ferrigno was responsible for the aerial waterfowl censuses.

FINDINGS

Study Area

Figure 1 defines the boundaries of the Cedar Run study area. The immediate study area included 1,350 acres of salt marsh, 287 acres of tidal ditches, and 192 acres of bay shore north of Cedar Run (Figure 1). These marshes contribute nutrients and food web organisms throughout the entire ecosystem. Accordingly, a larger area encompassing all the salt marshes and most of Little Egg Harbor from Marshelder Channel to Route 72 will also be studied. It involves 9,419 acres of marsh and 14,284 acres of bay and other large tidal waters.

The study area is a mixed, short salt marsh cordgrass (*Spartina alterniflora*) - salt meadow cordgrass (*Spartina patens*) marsh. With a tidal range of approximately 3 - 3.5 ft, it is typical of short salt marsh cordgrass marshes which are succeeding to salt meadow cordgrass. Short salt marsh cordgrass dominated the 1,350 acre study area (Ferrigno, Widjeskog, and Tomlin 1974). It totaled nearly 60% of the total vegetation composition. It was followed by salt meadow cordgrass with 26%. Other types in order of abundance included salt marsh ponds which usually supported widgeon grass (*Ruppia maritima*), marsh elder (*Iva frutescens*), tall salt marsh cordgrass (*S. alterniflora*), spike grass (*Distichlis spicata*), reed (*Phragmites australis*), mosquito ditches, fill, and switch grass (*Panicum virgatum*). The bottom of adjacent Little Egg Harbor provided lush growths of eelgrass (*Zostera marina*) and some sea lettuce (*Ulva* sp.).

The entire salt marsh study area is privately owned and hunting is controlled solely by commercial hunting concerns. Diving ducks, primarily scaup, were the preferred species.

Hunting was accomplished from large three to four man gunning boxes dug and sodded into the marsh near the shoreline. The tops were just above the marsh level. Most large points and islands had several gunning boxes situated so the decoy rigs could be used under any weather conditions, except during periods of extreme high tides when the boxes were flooded.

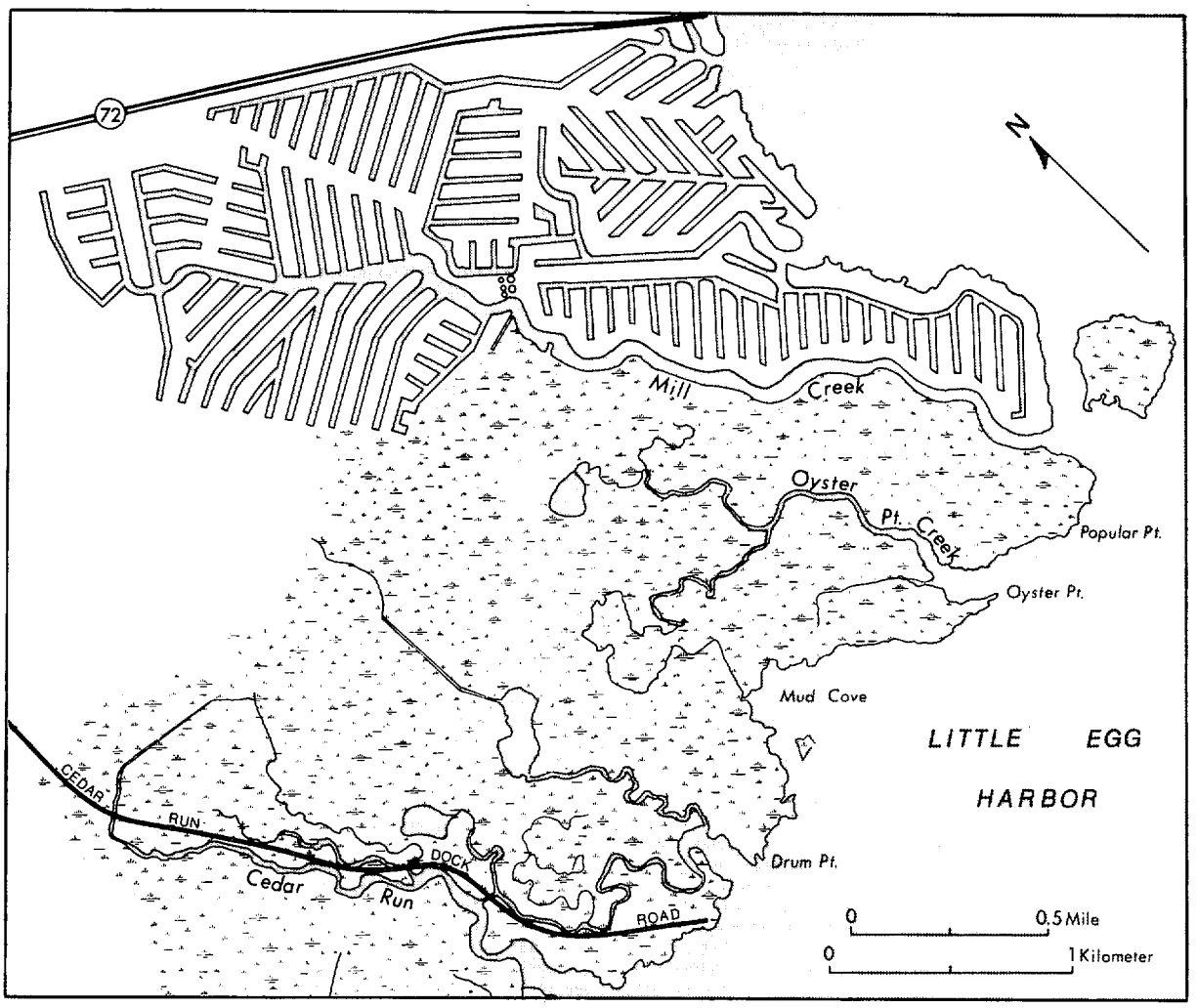

Fig. 1. Cedar Run study area.

Each active gunning box employed a guide. Hunters were transported to the hunting area in a power boat. Towed behind this boat were Barnegat Bay sneak boxes, racked with decoys. The hunting rigs usually consisted of 40 to 80 decoys; 6 to 12 black duck and mallard decoys; 30 to 60 diving duck decoys, primarily scaup; and several goose decoys.

Waterfowl Utilization

CEDAR RUN STUDY AREA -- On the study area, which included 192 acres of bay, 9,270 waterfowl were tallied on the five counts (Table 1). Short salt marsh cordgrass marshes and the adjacent bay are prime wintering areas. Accordingly, waterfowl populations increased as the season progressed. Total waterfowl increased from 800 on 17 September to 2,690 by 7 January 1974.

Nineteen different species of waterfowl were observed in the study area (Table 1). Black ducks (*Anas rubripes*) were the most abundant species using the marsh. They comprised 35.3% of the total waterfowl. Greater (*Aythya marila*) and lesser scaup (*Aythya affinis*) followed next with 20.5% of the species composition. Their use was mostly confined to the adjacent bay shore.

Table 1. Waterfowl utilization of the Cedar Run study area, based on midmonth aerial censuses from September 1973 to January 1974.

Species	17 Sep 1973		22 Oct 1973		20 Nov 1973		18 Dec 1973		7 Jan 1974		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Whistling swan									30	1.1	30	0.3
Canada goose			200	19.8			40	1.3	40	1.5	280	3.0
Brant							60	1.9	100	3.7	160	1.7
Mallard	410	51.3	20	2.0	230	14.7	270	8.4	340	12.6	1,270	13.7
Black duck	90	11.2	630	62.3	800	51.0	970	30.3	780	29.0	3,270	35.3
Gadwall			10	1.0							10	0.1
Pintail			30	3.0	20	1.3					50	0.5
Blue-winged teal	300	37.5	20	2.0							320	3.5
Green-winged teal			100	9.9	200	12.7					300	3.2
American widgeon					300	19.1					300	3.2
Shoveller					10	0.6					10	0.1
Canvasback									60	2.2	60	0.7
Scaup							1,000	31.3	900	33.5	1,900	20.5
Goldeneye									40	1.5	40	0.4
Bufflehead					10	0.6	820	25.6	310	11.5	1,140	12.3
Old squaw							10	0.3	20	0.8	30	0.3
Mergansers							30	0.9	70	2.6	100	1.1
Total	800	100.0	1,010	100.0	1,570	100.0	3,200	100.0	2,690	100.0	9,270	99.9

Mallards (*Anas platyrhynchos*) were next with 13.7%, followed by bufflehead (*Bucephala albeola*) 13.7%, blue-winged teal (*Anas discors*) 3.5%, green-winged teal (*Anas carolinensis*) 3.2%, widgeon or baldpate (*Mareca americana*) 3.2%, canada geese (*Branta canadensis*) 3.0%, and brant (*Branta bernicla*) 1.7%. The remaining nine species made up only 3.5%. In order of abundance, they included red-breasted merganser (*Mergus serrator*), hooded mergansers (*Lophodytes cucullatus*), canvasback (*Aythya valisineria*), pintails (*Anas acuta*), goldeneyes (*Bucephala clangula*), oldsquaw (*Clangula hyemales*), whistling swans (*Olor columbianus*), gadwalls (*Anas strepera*), and shovellers (*Spatula clypeata*).

LITTLE EGG HARBOR BAY AND MARSHES -- Five aerial counts were also conducted on the bulk of the ecosystem surrounding the study area. The surveyed areas covered all Little Egg Harbor and adjacent marshes from Marshelder Channel to Route 72. A summary of waterfowl use of this area is presented in Table 2.

Total waterfowl from five censuses amounted to over 50,000 birds. Commencing with 1,600 in September, waterfowl population swelled to approximately 20,000 in December and January. Dominant winter populations in order of abundance amounted to about 5,000 greater and lesser scaup, 4,000 brant, 3,000 buffleheads, 3,000 black ducks, 1,800 mallards, 1,000 goldeneyes, 600 old squaws, and 700 mergansers (red-breasted and hooded). Other species of less significance include whistling swans, Canada goose, gadwall, pintail, blue-winged teal, green-winged teal, widgeon, shoveller, canvasback, white-tailed scooter (*Melanitta fusca deglandi*), surf scooter (*Melanitta perspicillata*), and common scooter (*Oidemia nigra americana*). Twenty-two different species were observed on these flights. Other waterfowl occasionally observed on the area in the past, included wood duck (*Aix sponsa*), ring-necked duck (*Aythya collaris*) ruddy duck (*Oxyura jamaicensis*), snow goose (*Chen hyperborea*), and redhead (*Aythya americana*).

Winter waterfowl population of Beach Haven West amounted to approximately 900 mallards, 30 pekin ducks, 10 black ducks, and occasional scaup, canvasback, teal, or coot (Figley and Vandruff 1974).

Waterfowl Harvest

Table 3 is a summary of the hunter survey on the Cedar Run study area. Greater scaup dominated over other species in the hunter's bag and made up 76.8% of the composition. Other species of importance in order of abundance included bufflehead (13.4%), mallard (3.6%), black duck (2.0%), lesser scaup (1.5%), old squaw (1.4%), coot (*Fulica americana*) (0.5%), Canada goose (0.2%), red-breasted merganser (0.2%), green-winged teal (0.2%), and blue-winged teal (0.2%).

The examined bag from 232 hunters indicated they harvested 609 ducks, 1 goose, and 3 coot. Hunter success amounted to 2.65 birds per hunter day.

ESTIMATED TOTAL USE AND HARVEST -- Utilizing the information on total hunter use together with the sampled hunters and their bags, the total harvest of the study area was computed. Based on these computations, the estimated total number of hunter days, and their success was 874 days to harvest 2,407 waterfowl (Table 4).

Table 2. Waterfowl utilization of Little Egg Harbor and adjacent marshes from Marshelder Channel to Route 72 based on aerial counts.

Species	17 Sep 1973		22 Oct 1973		20 Nov 1973		18 Dec 1973		7 Jan 1974		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Whistling swan									30	0.2	30	0.1
Canada goose			200	9.5			40	0.2	200	1.1	440	0.9
Brant			300	13.9	3,600	48.5	3,000	15.0	4,000	21.2	10,900	21.8
Mallard	800	50.0	390	18.1	900	12.1	1,200	6.0	1,800	9.6	5,090	10.2
Black duck	500	31.3	900	41.9	1,400	18.8	4,800	24.0	2,000	10.6	9,600	19.2
Gadwall			10	0.4							10	0.0
Pintail			30	1.4	20	0.3					50	0.1
Blue-winged teal	300	18.7	20	0.9							320	0.6
Green-winged teal			100	4.6	200	2.7					300	0.6
American widgeon					300	4.0					300	0.6
Shoveller					10	0.1					10	0.0
Canvasback									500	2.7	500	1.0
Scaup					500	6.7	6,000	29.9	4,000	21.2	10,500	21.0
Goldeneye							200	1.0	2,000	10.6	2,200	4.4
Bufflehead					500	6.7	4,000	20.0	3,000	15.9	7,500	15.0
Old squaw							400	2.0	600	3.2	1,000	2.0
Scooters			200	9.3							200	0.4
Mergansers							400	2.0	700	3.7	1,100	2.2
Total	1,600	100.0	2,150	100.0	7,430	99.9	20,040	100.1	18,830	100.0	50,050	100.1

Table 3. Waterfowl harvest on the Cedar Run study area.

Species	Examined Harvest No.	Examined Harvest %	Estimated Harvest No.
Canada goose	1	0.2	4
Mallard	22	3.6	87
Black duck	12	2.0	47
Green-winged teal	1	0.2	4
Blue-winged teal	1	0.2	4
Greater scaup	470	76.8	1,852
Lesser scaup	10	1.5	39
Bufflehead	82	13.4	323
Old squaw	9	1.4	35
Red-breasted merganser	1	0.2	4
Coot	3	0.5	12
Total	612	100.0	2,411

Table 4. Distribution of hunter utilization and waterfowl harvest on the Cedar Run study area 1973-1974.

Dates	Hunter days	Number hunters checked	Ducks checked	Estimated total ducks harvested	Geese harvested	Estimated total geese harvested
13 Oct	18	16	17	19	1	1
15 Oct - 19 Oct	15	3	7	35	0	0
20 Oct	15	4	3	11	0	0
22 Oct - 26 Oct	0	0	*	*	0	0
27 Oct	0	0	*	*	0	0
29 Oct - 2 Nov	0	0	*	*	0	0
3 Nov	0	0	*	*	0	0
5 Nov - 9 Nov*	50	9	9	50	0	0
10 Nov*	15	6	6	15	0	0
12 Nov - 16 Nov*	50	6	6	50	0	0
17 Nov*	12	3	1	4	0	0
19 Nov - 20 Nov*	20	6	6	20	0	0
21 Nov - 23 Nov	48	16	64	192	0	0
24 Nov	24	22	73	80	0	0
26 Nov - 30 Nov	145	15	36	348	0	0
1 Dec	24	19	19	24	0	0
3 Dec - 7 Dec	100	20	41	205	0	0

Table 4. Continued.

Dates	Hunter days	Number hunters checked	Ducks checked	Estimated total ducks harvested	Geese harvested	Estimated total geese harvested
8 Dec	20	8	39	98	0	0
10 Dec - 14 Dec	75	6	17	213	0	0
15 Dec	16	9	12	21	0	0
17 Dec - 21 Dec	65	13	59	295	0	0
22 Dec	18	9	31	62	#	#
24 Dec - 28 Dec	85	14	74	449	#	#
29 Dec	25	14	20	36	#	#
31 Dec - 1 Jan	34	14	74	180	#	#
Total	874	232	614	2,407	1	1

* Special scaup season

\# Duck or goose season closed

REGULATIONS -- The hunting season in 1973-1974 allowed 42 days for the regular duck season, 14 days for the special scaup season and 60 days for the Canada goose season. New Jersey again selected the point system and split the regular duck season (13 October to 20 October; 21 November to 1 January). The goose season ran continuously from 13 October to 21 December. Under the point system, mallard, black duck, wood duck, and hooded merganser were 70 points; blue-winged teal, widgeon, scaup, and sea ducks were 10 points; and all others were 25 points. The brant season was closed.

CRIPPLING LOSSES -- Crippling losses were estimated from information obtained through hunter interviews. Of a total of 768 ducks downed by hunters, 156 (20.3%) were not retrieved. The estimated total loss to crippling amounted to 615 waterfowl.

SCAUP HARVEST -- Scaup were the dominant species harvested during the survey. The distribution of their harvest is presented in Figure 2. Hunter success, based on the number of scaup harvested per hunter, increased as the season progressed. These results correspond with the waterfowl utilization (Table 2), which indicated an influx of thousands of scaup during the month of December.

HUNTER DISTRIBUTION -- Hunting pressure was fairly evenly distributed throughout the regular hunting season (Table 4). During the special scaup season, use by hunters was down considerably. Hunters were less enthusiastic over the regular scaup season. They expressed preferences for post-season scaup seasons.

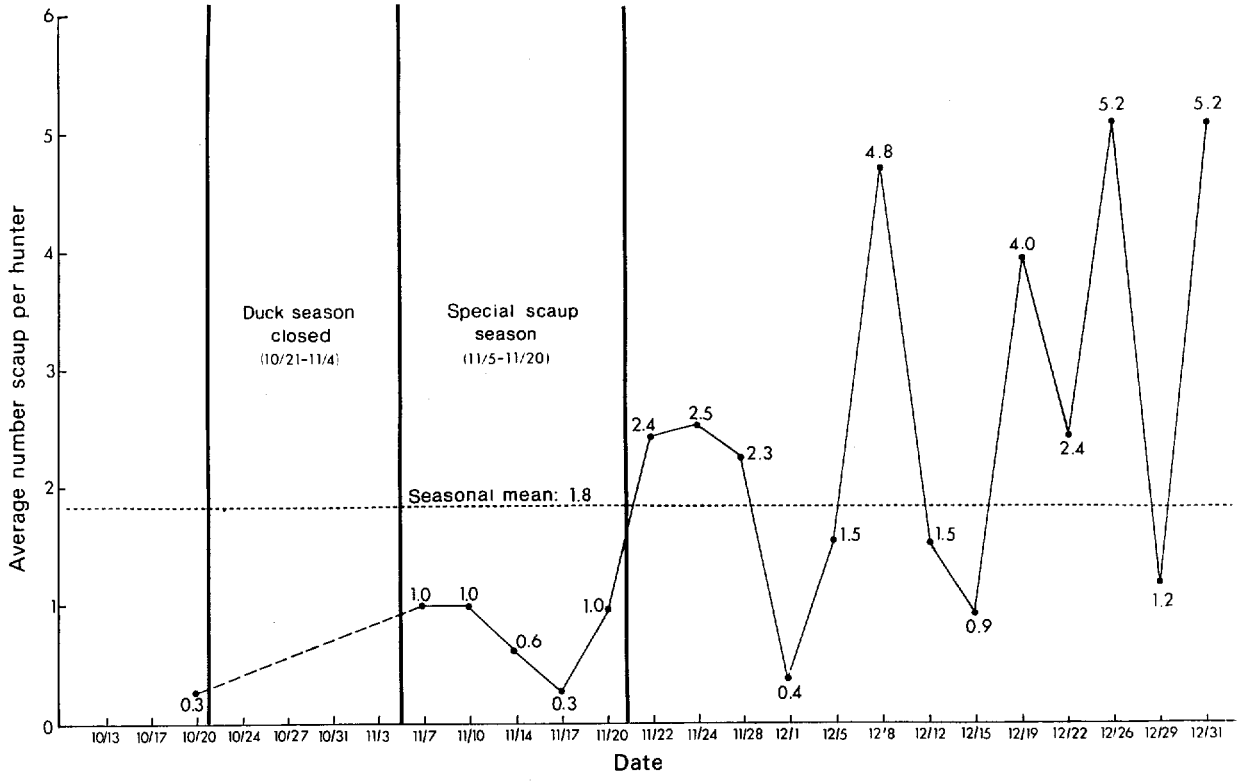

Fig. 2. Average number of scaup harvested per hunter (Cedar Run) 1973-1974.

Survey Values

The values of the study area and surrounding ecosystem to waterfowl and hunter are presented in Table 5. These data illustrate the high waterfowl utilization, recreational use, and success by hunters. Hunter success on the Cedar Run area was an exceptionally high 1.79 waterfowl taken per acre of marsh. Hunter use per marsh acre was 0.65 hunters per acre. Waterfowl utilization increased from 0.59 per marsh acre in September to 2.37 waterfowl per acre in December. During the same period use of the surrounding ecosystem increased from 0.17 to 2.13 waterfowl per marsh acre.

Table 5. Annual value of the Cedar Run and surrounding ecosystem to waterfowl and hunters for survey year 1973-1974.

	Study Area Cedar Run	Surrounding Ecosystem Little Egg Harbor and marshes Marshelder Channel to Route 72
Filled in marsh (acres)	1,038	2,139
Acres of marsh	1,350	9,419
Acres of bay, rivers (open water)	479	14,284
Total (open water and marsh)	1,829	23,703
Percent marsh	73.8	39.7
Percent open water	26.2	60.3
Total hunter days	874	
Number of hunters *	155	
Estimated ducks harvested	2,407	
Estimated geese harvested	4	
Ducks taken per acre of marsh	1.78	
Ducks taken per total area	1.32	
Geese taken per acre of marsh	0.003	
Geese taken per acre total area	0.002	
Total waterfowl taken per acre of marsh	1.79	
Total waterfowl taken per acre of total area	1.32	
Hunter use per acre of marsh	0.65	
Hunter use per acre of total area	0.48	
Waterfowl utilization per acre of marsh (Sep)	0.59	0.17
Waterfowl utilization per acre of total area (Sep)	0.44	0.07
Waterfowl utilization per acre of marsh (Oct)	0.75	0.23
Waterfowl utilization per acre of total area (Oct)	0.55	0.09
Waterfowl utilization per acre of marsh (Nov)	1.16	0.79
Waterfowl utilization per acre of total area (Nov)	0.86	0.31
Waterfowl utilization per acre of marsh (Dec)	2.37	2.13
Waterfowl utilization per acre of total area (Dec)	1.75	0.85
Waterfowl utilization per acre of marsh (Jan)	1.99	2.00
Waterfowl utilization per acre of total area (Jan)	1.47	0.79

* Number of hunters was determined by dividing the hunter days by 5.63 (the average number of days hunted by the 1969 duck hunters in New Jersey as reported by the Bureau of Sports Fisheries and Wildlife in Administrative Report No. 186).

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14. RECREATIONAL USE OF NEW JERSEY'S WETLANDS BY THE CITIZENS OF NEW JERSEY

James E. Applegate, Steven A. Salmore, and John Blydenburg[1]

INTRODUCTION

This portion of the Estuarine Evaluation Study is designed to measure recreational benefits provided to citizens of New Jersey by the coastal environment of the state. The study, as described in the original proposal, consisted of three phases:

1) A survey to describe, in general terms, the recreational use of the marine environment in its broadest sense is phase 1.

2) An estimate of those forms of recreation associated with the harvest of wetlands productivity is phase 2.

3) An estimate of recreation which does not involve the harvesting of a product of the wetlands ecosystem is phase 3.

Collection of data for phase 1 and phase 2 has been completed. In order to reduce the standard error of estimates for phase 2 (by providing adequate sample sizes of respondents), an extensive survey document was administered to a subset of a general population sample during each of two New Jersey Polls, instead of one as initially planned. This decision precluded data collection for phase 3 during this first year of the study. We anticipate collecting data for phase 3 during the second year of the study. The urgent need for data on the value of our marine environment dictated that a substantial portion of the research funds be invested in the collection of data, with little investment in detailed analysis of data. This report, then, presents a summary of methodology used to date and general summaries of important data. The survey documents have been appended to the report in anticipation that certain data which are not discussed in this report may be of critical importance to resource managers during the coming year. Such data are immediately retrievable from our data banks, and we will be pleased to provide the information to the granting agency upon request. More detailed discussion of all data, however, will be included in a subsequent report, as a greater proportion of our research effort is diverted from data collection to analysis.

METHODS

All data were collected in the New Jersey Poll, a quarterly telephone survey of the general population of New Jersey conducted by the Eagleton Institute of

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[1]At the time of the study, the first author was associated with the Department of Forestry at Cook College, Rutgers University and the remaining authors were with the Eagleton Institute of Rutgers University. Presently, John Blydenburg is affiliated with Clark University in Worcester, Massachusetts. The other authors have remained with their respective organizations. This report was prepared for the New Jersey Division of Fish, Game, and Shellfisheries with funds provided in part by the New Jersey Division of Marine Services during the period June 1973 to May 1974.

Rutgers University. Samples for each poll consisted of approximately 1,200 randomly selected New Jersey residents over 18 years of age. Specific survey questions for this study were added to the poll after formulation and pretesting in consultation with Eagleton Institute social psychologists. Data were collected and coded by Eagleton technicians and processed as an SPSS file using the IBM 360-70 facilities at Rutgers University.

Phase 1

A series of meetings was held with Eagleton personnel during September 1973 to generate a series of survey items that would allow a general estimate of the use of New Jersey's marine environment. The resultant questions (Appendix A) were administered during the October 1973 New Jersey Poll. Briefly, each respondent was asked if he had used the New Jersey shore during the past year. The shore was loosely defined for each respondent as: (1) ocean and beaches; (2) inshore bays and rivers; and (3) salt marshes. Affirmative respondents were asked to describe their reasons for going to each area. Responses to this series of open-ended questions provided data on which subsequent activity codes were built and allowed an estimate of the annual use of the New Jersey shore by the general population.

Phase 2

Using data on recreational use of natural productivity provided by phase 1, a detailed survey document was prepared to describe saltwater fishermen, crabbers, shellfishermen, and duck hunters (Appendix B). The format of the New Jersey Poll required that our detailed study of recreational use involve a subset of a general population sample. Our studies of fishermen, for example, involved approximately 200 respondents in a poll of about 1,200 citizens. In order to reduce the standard error of the estimate, the sample size was increased by adding the same battery of questions to two additional polls in January (Poll 9) and March (Poll 10) of 1974. Data in phase 2 are therefore based on a general population survey of 2,410 respondents. Minor modifications between Poll 9 and Poll 10 (primarily an addition of questions to learn more about crabbers) reduced the sample size for certain elements of our analysis.

An additional word of caution is in order regarding extensive extrapolation from data presented in this report. The purpose of this entire study was to provide data of a very broad nature where none had previously existed. We are confident that the data are reliable, i.e. repeatable using the same questions in the same population. Extended experience with 12 New Jersey Polls shows that constant population parameters such as the distribution of age and education vary within the confidence range established by a single survey. The question of validity, whether the estimates reflect what is actually occurring in the population, presents a more difficult problem. Our investment in extensive rather than intensive study has prevented a detailed investigation of biases that may be associated with responses to our questions. In addition, group interviews of coastal zone users were not conducted prior to formulation of the questionnaire. Such interviews are valuable in enabling the social psychologist to word questions in a way that will maximize the validity of results. Although most items investigated in this study appear straightforward, others might have been aided by the insight gained through group interview. Our estimate of shellfishermen, for example, appears greater than one might expect from data on the sale of clamming licenses or intuitive understanding of the system. Our wording of this question may have added affirmative responses from among those who gather clamshells along the beach, when we were trying to estimate those who collect clams for the table.

As time and research funding allow, such problems will be investigated during the course of this study. For the purpose of this report, however, the following should be remembered: We are certain that the data are reliable, but their validity has yet to be ascertained. Interpretation and use of data by the reader should be tempered by this understanding.

RESULTS

General

The following sections present data on the use of New Jersey's marine environment by residents of New Jersey over 18 years of age. It is worthy of emphasis that all estimates are based on this sampling frame, and therefore are not estimates of use of the marine environment by the total population. No data on use of the New Jersey marine environment by residents under the age of 18 or by nonresidents were collected. The estimates presented in this report are therefore conservative.

Tabular data include confidence intervals where appropriate. All confidence intervals represent two units of standard error in this report. Extrapolations of certain data to the number of man-days of recreation have not been included. The computation of confidence interval for a parameter that is a product of two estimates is complex and has not been performed at this time. Since data without such information are subject to unwarranted generalization, their reporting will await a more comprehensive discussion in a later report.

Results are presented primarily in tabular form. The discussion presents brief comments on those elements of the preliminary analysis that we have found interesting.

General Use

Undifferentiated estimates of use of the marine environment appear in Table 1. Approximately 68% of New Jersey residents used the New Jersey shore in some way in 1973. The majority, 44%, used the beaches and oceans; 19% used the estuaries; and 9% used the salt marshes. Although the last figure was larger than we expected, it is worth noting the majority of users in this category may make brief trips to selected locations in order to use the salt marsh. In an earlier study, we found that 18% of New Jersey residents had visited Brigantine National Wildlife Refuge at some time, where the primary attraction is appreciative use of salt marsh wildlife. More detailed investigation of the use of salt marshes will be made in subsequent studies.

Saltwater Fishing

GENERAL -- Our study indicates that New Jersey has approximately 800,000 resident saltwater fishermen over 18 years of age (Table 2). Data on nonresidents and fishermen under 18 would undoubtedly raise this estimate more than 1,000,000 fishermen.

An almost equal proportion of fishermen used the ocean (62%) and estuaries (61%). Surf fishing was practiced by 29% of all of saltwater fishermen. As one might expect, the categories are not mutually exclusive; many people fished in more than one of these areas.

Table 1. Use of New Jersey shore in 1973 by residents of New Jersey over 18 years of age. The confidence intervals represent two units of standard error (n = 1,210).

Area	Number of respondents	Percent of total population	Estimated number in population
Beaches and oceans	553	44.5 ± 2.8	2,241,924 ± 141,064
Salt marshes	106	8.5 ± 2.0	428,233 ± 100,760
Bays and rivers	234	18.8 ± 2.0	947,150 ± 100,760
None	396	31.9 ± 2.8	1,607,131 ± 141,065

Table 2. Saltwater fishing activity among New Jersey residents in 1973. The confidence intervals represent two units of standard error (n = 2,410).

Category	Number of respondents	Percent of saltwater fishermen	Percent of total population	Estimated number in population
Fished in salt water	381		15.8 ± 1.5	796,008 ± 75,570
Surf fishing	111	29.1 ± 4.7	4.6 ± 0.9	231,749 ± 45,342
Ocean fishing	236	61.9 ± 5.0	9.8 ± 1.2	493,727 ± 60,456
Estuary fishing	231	60.6 ± 5.0	9.6 ± 1.2	483,651 ± 60,456

SURF FISHING -- For the purpose of investigating surf fishing, the New Jersey coast was divided into four sections, delineated by rather well-known landmarks. These sections are: (1) North - from Manasquan Inlet northward; (2) North Central - from Manasquan Inlet to Barnegat Inlet; (3) South Central - from Barnegat Inlet to Beach Haven Inlet; and (4) South - from Beach Haven Inlet southward. The distribution of surf fishing effort among those respondents who participated appears in Table 3. The North Jersey shore was used by a greater number of surf anglers than any other section. Utilization generally decreased from north to south. The average number of days fished by all surf fishermen was 10.6. Surf fishermen spent more days at their sport, on the average, than either ocean fishermen (mean or $\bar{x}$ = 6.9 days) or estuarine fishermen ($\bar{x}$ = 8.6 days).

OCEAN FISHING -- Geographically dividing the ocean sport fishery of New Jersey is more difficult than for either surf or estuarine fishing. A substantial portion of the effort occurs on commercial craft and the fishermen has little knowledge of the exact location of this fishing. For this reason, we asked the respondent to tell us the port from which the boat sailed, an easily identified location, and subsequently coded the towns into the following categories: (1) North - the vessel entered the ocean via the New York Bight; (2) North Central - entered via Shark River or Manasquan Inlet; (3) Central - entered via Barnegat Inlet; (4) South

Table 3. Distribution of surf fishing in New Jersey in 1973. The confidence intervals represent two units of standard error (n = 111).

Area	Number of respondents	Percent of surf fishermen	Percent of total population	Average days/fisherman	Number in population
North *	58	51.3 ± 9.5	2.4 ± 0.6	11.3 ± 2.7	120,912 ± 30,288
North Central #	39	34.5 ± 9.0	1.6 ± 0.5	10.7 ± 2.1	80,608 ± 25,190
South Central †	30	26.5 ± 8.4	1.2 ± 0.4	11.3 ± 2.5	60.456 ± 20,152
South **	20	17.7 ± 7.2	0.8 ± 0.4	7.7 ± 2.6	40,304 ± 20,152

* North of Manasquan Inlet

\# Manasquan Inlet to Barnegat Inlet

† Long Beach Island

** South of Long Beach Island

Central - entered via Beach Haven/Little Egg Inlet; and (5) South - entered from one of the estuaries south of Little Egg Inlet. This classification is roughly comparable to that established for surf fishing.

The distribution of ocean fishing by region appears in Table 4. The data indicate that the greatest use occurs in the North Central region from which an estimated 166,000 fishermen embarked in 1973. Those who have seen Manasquan Inlet at 1600 hours on an August Sunday can appreciate the magnitude of this use.

The distribution of fishing effort among private and commercial vessels is most interesting (Table 5). About half of the ocean fishermen used a party boat during 1973, and the average number of days fished was 4.8 ± 1.8. The relatively large standard error reflects the occurrence of a few anglers who spent many days on a party boat. Charter boats were used by 26% of ocean fishermen but were used less often by those who used them ($\bar{x}$ = 2.9 ± 0.6 days). Private craft were the most popular form of ocean fishing; 62% of all ocean fishermen used them. In addition to being used most often, private craft were used more frequently ($\bar{x}$ = 10.3 ± 2.6 days) by those who fished from them.

ESTUARINE FISHING -- Geographic distribution of estuarine angling was based on major identifiable estuary units (Table 6). The data indicate that Barnegat Bay is by far the most popular estuary for fishing, with almost twice as many users as its nearest competitor, the Raritan Bay/Sandy Hook Bay complex. Approximately 230,000 anglers used Barnegat Bay in 1973.

Table 4. Distribution of ocean fishing (excluding surf fishing) in New Jersey in 1973. The confidence intervals represent two units of standard error (n = 236).

Area	Number of respondents	Percent of all ocean fishermen	Percent of total population	Number in population
North *	52	22.0 ± 5.2	2.1 ± 0.6	105,799 ± 30,228
North Central #	80	33.9 ± 6.2	3.3 ± 0.8	166,255 ± 40,304
Central †	45	19.1 ± 5.2	1.9 ± 0.6	95,722 ± 30,228
South Central **	34	14.4 ± 4.6	1.4 ± 0.4	70,532 ± 20,152
South ##	53	22.5 ± 5.4	2.1 ± 0.6	105,799 ± 30,228

* Entered ocean via New York Bight

\# Entered ocean via Shark River or Manasquan Inlet

† Entered ocean via Barnegat Inlet

** Entered ocean via Beach Haven/Little Egg Inlet or vicinity of Atlantic City

Entered ocean south of Atlantic City through Delaware Bay

Table 5. Type of boat used by ocean fishermen. The confidence intervals represent two units of standard error (n = 236).

Type of boat	Number of respondents	Percent of all ocean fishermen	Percent of total population	Average days/fisherman	Total no. of fishermen in population
Party boat	118	50.0 ± 6.4	4.8 ± 0.8	4.8 ± 1.8	241,825 ± 40,304
Charter boat	63	26.7 ± 5.6	2.6 ± 0.6	2.9 ± 0.6	130,989 ± 25,190
Private boat	146	61.8 ± 6.4	6.1 ± 1.0	10.3 ± 2.6	307,320 ± 50,380

The southern New Jersey estuaries of Great Bay and Great Egg Harbor have relatively fewer individuals who use them, but the data suggest that those who use them may do so more intensively. The average number of days fished per fisherman in these estuaries was 15.4 ± 10.5 and 21.0 ± 13.0, respectively, compared to estimates that range from 5.9 to 7.0 for other estuaries. Broad confidence intervals for the larger estimates reflect the small sample sizes for these estuaries and the presence of a few respondents who fished many days, and in general suggest that conclusions drawn from them should be cautious.

Table 6. Distribution of estuarine fishing in New Jersey in 1973. The confidence intervals represent two units of standard error (n = 231).

Location	Number of respondents	Percent of estuarine fishermen	Percent of total population	Average days/fisherman	Total number of fishermen in population
Raritan/ Sandy Hook Bay	59	25.5 ± 5.7	2.4 ± 0.6	7.0 ± 2.4	120,913 ± 30,228
Barnegat	111	48.1 ± 8.7	4.6 ± 0.9	7.2 ± 2.3	231,749 ± 45,342
Manahawkin Bay/Little Egg Harbor	28	12.1 ± 4.3	1.2 ± 0.4	6.2 ± 5.5	60,456 ± 20,152
Great Bay	31	13.4 ± 4.5	1.3 ± 0.5	15.4 ± 10.5	65,494 ± 25,190
Great Egg Harbor	26	11.3 ± 4.2	1.1 ± 0.4	21.0 ± 13.0	55,418 ± 20,152
Delaware Bay	40	17.3 ± 5.0	1.7 ± 0.5	6.8 ± 2.8	85,647 ± 25,190
Other	48	20.8 ± 5.3	2.0 ± 0.6	5.9 ± 1.6	100,761 ± 30,228

Approximately 86,000 people rented boats for the purpose of fishing in estuaries in 1973 (Table 7). More than three times that number - almost 300,000 - fished from private craft, while about 161,000 fished from shore at some time in 1973.

Table 7. Type of access used by estuarine fishermen. The confidence intervals represent two units of standard error (n = 231).

Access	Number of respondents	Percent of estuarine fishermen	Percent of total population	Number of fishermen in population
Fished from bank	77	33.3 ± 6.2	3.2 ± 0.7	161,217 ± 35,266
Rented boat	42	18.2 ± 5.1	1.7 ± 0.5	85,647 ± 25,190
Private boat	141	61.0 ± 6.4	5.9 ± 1.0	297,244 ± 50,380

OTHER ACTIVITIES -- Estimates were obtained for the amount of crabbing, shellfishing, and duck hunting that occurred at the New Jersey shore during 1973 (Table 8). A substantial 12.8% of respondents indicated that they had gone crabbing at least once in 1973. That represents an estimated 645,000 ± 70,000 crabbers among New Jersey residents over 18 years of age. Barnegat Bay was again the most popular location for crabbing, with over half of those who crabbed (52%) having gone there (Table 9). The geographic distribution of crabbing effort displayed in Table 9 represents data collected only in New Jersey Poll 10. Questions generating these data were added to the general survey after the extensive nature of crabbing activity was revealed in New Jersey Poll 9. The remaining activities, shellfishing and duck hunting, had insufficient participation to generate meaningful geographic distributions.

Table 8. Other recreational activities based on estuarine productivity. The confidence intervals represent two units of standard error (n = 2,410).

Activity	Number of respondents	Percent of total population	Average days/activity	Total number in population
Crabbing	309	12.8 ± 1.4	7.5 ± 1.4	644,868 ± 70,532
Shellfishing	93	3.9 ± 0.8	11.6 ± 3.4	196,483 ± 40,304
Duck hunting	24	1.0 ± 0.4	2.1 ± 0.2	50,380 ± 20,152

Table 9. Distribution of crabbing in New Jersey in 1973. The confidence intervals represent two units of standard error (n = 147).

Area	Number of respondents	Percent of all crabbers	Percent of total population	Number in total population
Raritan Bay/ Sandy Hook	35	23.8 ± 7.0	3.0 ± 1.0	151,141 ± 50,380
Barnegat Bay	77	52.4 ± 8.2	6.5 ± 1.4	327,472 ± 70,532
Manhawkin Bay/Little Egg Harbor	11	7.5 ± 4.3	0.9 ± 0.5	45,342 ± 25,190
Great Bay	3	2.0 ± 2.3	0.3 ± 0.3	15,114 ± 15,114
Great Egg Harbor	10	6.8 ± 4.2	0.8 ± 0.5	40,304 ± 25,190
Delaware Bay	24	16.3 ± 6.1	2.0 ± 0.8	100,761 ± 40,304
Other	25	17.0 ± 6.2	2.1 ± 0.8	105,799 ± 40,304

Shellfishermen were estimated to number 196,000 $\pm$ 40,000 in New Jersey. Respondents indicated an average of 11.6 $\pm$ 3.4 days spent shellfishing. The elevated nature of this estimate may reflect confusion among respondents between shellfishing and gathering shells, as previously discussed.

Between 30,000 and 70,000 duck hunters used the New Jersey shore in 1973 (Table 8). The data indicate that many hunters use the shore, but that each hunts relatively infrequently. The average days hunting per hunter was only 2.1 $\pm$ 0.2, the lowest participation rate of any recreational activity reported in this study.

The Future

The second year of the study will see a greater relative investment in analyses of data already collected. This will take the place of cross-tabulations of data, many of which will be of managerial interest. In addition, participation in the several forms of recreational activity will be related to socioeconomic and demographic variables in both univariate and multivariate treatments.

Data collection will concentrate on specific uses of the salt marsh and on general uses of estuaries and salt marsh for recreational purposes not dependent on biological productivity of the environment (phase 3).

APPENDIX A

Questions Added to New Jersey Poll
in October, 1973

228. New Jersey being a coastal state has a wide variety of different kinds of shore areas. On land there are beaches and salt marshes, and there is the ocean and the inshore bays and rivers. Have you visited any of these shore areas during the past year?

1. YES
2. NO → GO TO Q. 230, PAGE 16
9. DON"T KNOW

(IF "YES" TO Q. 228, ASK:)

229. Which of the areas have you used? (READ LIST)

	YES	NO	DON'T KNOW
Beaches and Ocean	1	2	9
Salt Marsh	1	2	9
Bays and Rivers	1	2	9

229A. (FOR EACH AREA VISITED, ASK:)

What was your reason for going to the _____?

(PROBE: Could you be more specific?)

BEACHES AND OCEAN _____

_____

SALT MARSH _____

_____

BAYS AND RIVERS _____

_____

APPENDIX B

Questions Added to
New Jersey Poll 9 and New Jersey Poll 10
in January and March 1974

ASK ALL RESPONDENTS

225-226. Did you go crabbing in New Jersey in the past year? (IF YES:) How many days last year did you go crabbing?

_____ [ ][ ]

227-228. Did you gather clams or other shellfish in New Jersey in the past year? (IF YES:) How many days last year did you gather clams:

_____ [ ][ ]

229. Did you go fishing in New Jersey this past year?

1. YES
2. NO → GO TO PAGE 17 (SKIP 3 pgs.)
9. DON'T KNOW

230. Did you go saltwater fishing in the past year?

1. YES
2. NO → GO TO PAGE 17 (SKIP 3 pgs.)
9. DON'T KNOW

231. When you go fishing do you usually take young people under 18 with you, only occasionally take them, or never take young people with you?

1. USUALLY
2. OCCASIONALLY
3. NEVER
9. DON'T KNOW

232. Did you go surf fishing in the past year?

1. YES
2. NO
9. DON'T KNOW → GO TO Q. 241, PAGE 15 (NEXT PAGE)

(IF "YES" TO Q. 232, ASK:)

ASK FOR EACH AREA:

Did you go surf fishing between _____ last year? About how many days did you fish there last year?

233-234. Between Sandy Hook and Manasquan Inlet? _____
235-236. Between Manasquan Inlet and Barnegat Inlet? _____
237-238. Between Barnegat Inlet and Beach Haven Inlet? _____
239-240. Between Beach Haven Inlet and Cape May? _____

(IF "NO" OR "DON'T KNOW" TO ABOVE 4 QUESTIONS, ASK:)

240A. Where did you go surf fishing in New Jersey last year (what town)? How many days did you fish there?

TOWN	DAYS
_____	_____
_____	_____
_____	_____
_____	_____

241. Did you go fishing in the ocean from a boat in the past year?

1. YES
2. NO
9. DON'T KNOW

→ GO TO Q.257, PAGE 16 (NEXT PAGE)

(IF "YES" TO Q. 241, ASK:)

242-249. What town or towns in New Jersey did the boat leave from?

_____

_____

_____

250-251. Did you fish on a party boat? (IF YES:) How many days last year?

_____

252-253. Did you fish from a charter boat? (IF YES:) How many days last year?

_____

254-255. Did you fish from a private boat last year? (IF YES:) How many days last year?

_____

(IF "YES" TO Q. 254-255, ASK:)

256. Did you own the boat?

1. YES
2. NO
9. DON'T KNOW

257. Did you fish in any saltwater bays or rivers during the past year?

1. YES
2. NO
9. DON'T KNOW

→ GO TO PAGE 17 (NEXT PAGE)

(IF "YES" TO Q. 257, ASK:)

Did you fish in _____ last year? How many days did you fish there last year?

258-259.	Raritan Bay or Sandy Hook Bay	_____
260-261.	Barnegat Bay	_____
262-263.	Little Egg Harbor or Manahawkin Bay	_____
264-265.	Great Bay	_____
266-267.	Great Egg Harbor	_____
268-269.	Delaware Bay	_____

270-277. Did you fish in any other saltwater bays or rivers in New Jersey last year? How many days?

BAY OR RIVER	DAYS		
_____	_____		
_____	_____		
_____	_____		

278. When fishing in the bays or rivers, did you fish from shore or in a boat?

1. SHORE
2. BOAT
3. BOTH
9. DON'T KNOW

(IF "BOAT" OR "BOTH" ON Q. 278, ASK:)

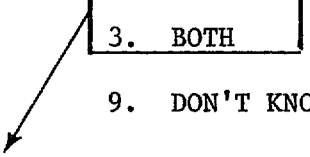
279. Did you rent the boat or was it privately owned?

1. RENTED

2. PRIVATE

3. BOTH

9. DON'T KNOW



(IF PRIVATE OR BOTH, ASK:)

280. Did you own the boat:

1. YES
2. NO
9. DON'T KNOW

15. A STUDY OF THE RECREATIONAL USE OF NEW JERSEY'S MARINE ENVIRONMENT

James E. Applegate and
Stephen L. Sterner[1]

INTRODUCTION

Study Objectives

The primary objective of this study was to accumulate a factual data base from which it would be possible to quantify the recreation benefits provided to the citizens of New Jersey by the state's coastal wetlands. More specifically, project objectives included the following: (1) describe, in general terms, the recreational use of the marine environment in its broadest sense; (2) estimate the extent of specific recreational activities associated with the harvest of wetland productivity; and (3) estimate the extent of recreational activities which do not involve the harvesting of wetland productivity.

Order of Material Presented

This Introduction presents the objectives and scope of the study. The Method section provides an explanation of the methodology and research design of the study. Data collection and sampling methods are set forth, as well as a description of interpretive procedures. The Topology of Salt Marsh Users section discusses the activities occurring in the salt marsh ecosystem from two points of view; first as univariate nonhomogeneous activity types and second as mutually exclusive categories resulting from a cluster analysis. The Use of the Marine Environment section involves man-day estimates for various extractive activities that occur throughout New Jersey's marine environment and concludes with a discussion of certain demographics of the users.

Scope of Study

Several limitations of data were established to provide boundaries for the research design. These limits determined who was surveyed as well as the specific time periods basic to the study. All data collection was restricted to New Jersey residents over 18 years of age. All reported estimates are based upon this sampling frame and are therefore conservative approximations of the actual parameters. Data for the recreational activities associated with the harvest of wetland productivity relate to 1973, while data for the "nonharvest" associated activities relate to 1974.

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[1]At the time of the study the authors were associated with the Department of Forestry at Cook College, Rutgers University. The first author is currently an Associate Professor there. The second author is employed by the Pennsylvania Bureau of Forestry as a biometrician. This report was prepared for the New Jersey Division of Fish, Game, and Shellfisheries with funds provided in part by the New Jersey Division of Marine Services during the period June 1974 through May 1975.

METHOD

The Research Design

The purpose of a research design is to insure accuracy of findings and economy of data gathering. Since this study was to accumulate data of a broad nature where none had previously existed, the overall design consisted of two distinct but complimentary research patterns: (1) an exploratory procedure and (2) a descriptive format.

The exploratory procedure was the outcome of a series of meetings held with social psychologists from Eagleton Institute of Rutgers University. Its purpose was to seek new relationships and knowledge of the related environment. A series of open-ended questions was developed to provide new insight on how individuals related themselves to New Jersey's marine environment, which was defined loosely as (1) oceans and beaches, (2) inshore bays and rivers, and (3) salt marshes. Data from this initial round of questions was used to construct activity codes and to design the close-ended questions used in subsequent polls.

The descriptive format attempted to describe the characteristics of certain given situations and environmental conditions associated with the study. One such situation, the determination of activities occurring on the salt marsh ecosystem and the extent of participation in these activities, illustrates this procedure. Exploratory questioning made it possible to structure one all-inclusive close-ended question of possible salt marsh activities. Respondents provided brief subjective replies designed for interpretation as degrees of involvement in the various activities, and directly acceptable for analytical treatment. This physical structure of the survey documents reflected the descriptive format. Prior to final implementation all survey documents were pretested and the responses evaluated to eliminate ambiguous terminology and awkward wording.

Sampling Method

Data collection was conducted as a part of the Eagleton Institute's quarterly telephone survey of the general population of New Jersey. Samples for each poll consisted of approximately 1,200 randomly selected New Jersey residents over 18 years of age. For a detailed discussion of Eagleton's selection method see Applegate (1973). A previous report discussed in detail the sampling procedures for data associated with activities involving harvest of wetland productivity. Since that report additional resourses were invested in a third New Jersey Poll to obtain data involving "nonharvest" activities on the wetlands. Sampling procedures for the third poll remained unchanged, therefore a detailed discussion is unwarranted.

Tabulating

All data sets were key punched and verified by Eagleton personnel and placed in SPSS disk files for retrieval and processing. Data processing was done on an IBM 370/158 run at Rutgers University with an OS MVT option.

A TYPOLOGY OF SALT MARSH USERS[2]

Introduction

Attempts to study diverse and numerous types of outdoor recreation activities that occur within a given system, such as a salt marsh ecosystem, become immediately hampered by the constraints of the conventional conceptual frameworks used in standardizing activity categories. The method used by researchers and planners has been to survey national, state, and local populations on a limited set of activities for the purpose of establishing demands and trends for each activity. As a result each individual's participation record is broken down and used to compile and project "annual activity occasions per capita by activity in order to determine regional resources and facility needs."[3] This method results in much confusion since it is possible for one individual to be a member of several activity groups. Ditton (1975) in a discussion concerning the identification of recreation types pointed out, "that to consider all those who have gone boating, boaters, is, at best, a perilous oversimplification of the data." He further stated this type of activity classification "fails to probe the total recreation behavior pattern of the individuals being typed." The failure of univariate techniques to comprehensively describe activity types has thus resulted in a wider use of methods that analyze multivariate participation records. One such technique, known as cluster analysis, results in mutually exclusive activity groups. These groups represent aggregates of individuals within which recreation participation patterns are similar.

Part of the descriptive format of this study questioned individuals about the activities they participated in when at a salt marsh. Responses fell into six different categories including both consumptive and nonconsumptive activities and indicated the individual's frequency of participation. The standard method for reporting this information would tabulate the responses into "nonhomogeneous" (or "nonmutually" exclusive) aggregates representing the six reported categories. However, to investigate in more detail the intervariable relationship and to perhaps reveal more descriptive and homogeneous groups a cluster analysis would be applied. The results of both techniques are reported below.

Nonhomogeneous groupings

Table 1 presents a tabular summary of participation in six activities by salt marsh visitors. For the purpose of univariate treatment the responses of always, usually, and sometimes were collapsed into a single category indicating positive participation in an activity. Treatment otherwise would have resulted in 24 "nonexclusive" categories and further frustrated parsimonious description. Table 2 displays the new groupings along with extrapolated population estimates.

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[2]A typology is a doctrine or theory of types and as a classification is based on the comparative study of types.

[3]Ditton, Robert, B. "Clustering Recreation Participation Data to Identify Recreation Types," Indicators of change in the recreation environment-A National Research Symposium. Penn State HPER Series No. 6, College of Health, Physical Education and Recreation, Pennsylvania State University, 1975, pp. 75-86.

Table 1. Summary of user participation in six activities when at a salt marsh.

Response	Activity					
	Fishing	Hunting	Clamming	Crabbing	Watch animals and birds	Picnicking or other types of recreation
Always						
n*	33	10	6	21	71	32
%#	16.0	4.8	3.0	10.3	34.6	15.7
Usually						
n	19	6	4	23	24	33
%	9.2	2.9	2.0	11.3	11.7	16.2
Sometimes						
n	53	13	36	76	59	54
%	25.7	6.3	17.8	37.3	28.8	26.5
Never						
n	101	177	156	84	51	85
%	49.0	85.9	77.2	41.2	24.9	41.7
Total n†	206	206	202	204	205	204

* n = number of individuals participating in an activity.

% = (n/ Total n)(100).

† Total n = total number of salt marsh users found in a sample of 1,005 N.J. residents.

Table 2. Nonhomogeneous groupings of salt marsh users (All confidence intervals are reported at the 95% level of confidence).

	Activity					
	Fishing	Hunting	Clamming	Crabbing	Watch animals and birds	Picnicking or other types of recreation
Participate:						
n	105	29	46	120	154	119
Percent of salt marsh users	51.0 ± 6.8	14.1 ± 4.7	22.8 ± 5.8	58.8 ± 6.7	75.1 ± 5.9	58.3 ± 6.8
Percent of total population	10.4 ± 1.9	2.9 ± 1.0	4.6 ± 1.3	11.9 ± 2.0	15.3 ± 2.2	11.8 ± 2.0
Estimated number in population	523,897 ±95,712	146,087 ±50,375	231,724 ±65,487	599,459 ±100,749	770,733 ±110,824	594,421 ±100,749
Never participate:						
n	101	177	156	84	51	85
Percent of salt marsh users	49.0 ± 6.8	85.9 ± 4.7	77.2 ± 5.8	41.2 ± 6.7	24.9 ± 5.9	41.7 ± 6.8

A review of the activity groups in Table 2 revealed that the animal and bird watching category represented the greatest number of salt marsh users. In other words, more individuals had animal and bird watching common to their salt marsh recreation pattern than any other activity. This does not, however, infer that bird and animal watching was the most important or dominating component of individual activity patterns. Nor does it necessarily reflect the existence or relative size of a homogeneous group of exclusive bird and animal watchers. The same argument applies to the other five activities. Consequently the estimates lack the descriptive qualities necessary for clearly identifying salt marsh-based recreation types.

In order to more fully comprehend the participation patterns of salt marsh users, individual activity records were analyzed on a multivariate basis using a cluster analysis.

Homogeneous Groupings

Cluster analysis is a collective term used to describe methods for establishing mutually similar entities from a matrix of resemblance coefficients. Resemblance coefficients are tabulated for every pair of entities over all observed variables. Due to the number of calculations, computer assistance was mandatory. The algorithm used was UPGMA (unweighted pair-group method using arithmetic averages) developed by Sokal and Michener (1958) and probably the most frequently used clustering strategy.

The data clustered was that presented in Table 1 where participation in an activity was recorded at one of four levels: always, usually, sometimes or never. A total of 194 individuals were included in the analysis. They represented 19.3 $\pm$ 2.4% of the general population or 972,231 $\pm$ 120,900 individuals. Results of the analysis are presented in the following manner: (1) a detailed discussion of the 13 major clusters, (2) reduction of the 13 clusters to six for extrapolation purposes, and (3) reduction of the six clusters into three categories based on broad similarities uncovered by the analysis.

The following terminology was adopted and used throughout the discussion. The activities of fishing, hunting, crabbing, and clamming were designated as extractive while animal/bird watching and picnicking/other types of recreation were designated appreciative or nonextractive. Table 3 describes the 13 clusters.

The tree like diagram or dendrogram in Figure 1 illustrates the common method of displaying the results of a cluster analysis. Clusters are mutually exclusive categories of individuals based on similar participation patterns across all six activities. The level at which linkages occurred reflected certain similarities between clusters. In the following discussion significance of the fusion levels represented movement from exclusive participation in appreciative activities to participation in a combination of both extractive and appreciative activities.

The next step in the analysis was to find linkages between these 13 mutually exclusive clusters. The second level linkages in the clustering hierarchy resulted in the groupings presented in Table 4. Clusters 2, 3, and 4 linked due to a similar high degree of participation in animal/bird watching. The linkage of clusters 5, 6, and 7 was due primarily to a rather low degree of

Table 3. Cluster description.

Cluster	Description
1	This group was heavily dominated by individuals who never participated in any form of extractive activity. When visiting a salt marsh they participated exclusively in both categories of appreciative activities and they always did so on each visit.
	Clusters 2, 3, and 4 are connected by the common link that members of each group always participated in animal and bird watching when at a salt marsh, however, they seldom if ever participated in picnicking or other types of "nonextractive" activities. Their differentiation was due to the following:
2	Occasional involvement in fishing and crabbing.
3	Total uninvolvement in extractive activities.
4	Occasional involvement in fishing, crabbing, and clamming.
	Members of clusters 5, 6, and 7 possessed a similar qualification in that they did not designate any single activity in which they always participated when at a salt marsh. Most individuals participated in one to three activities but only occasionally. Their differentiation was due to the following:
5	Occasionally participated in fishing, crabbing, and bird and animal watching.
6	Occasionally participated in crabbing and bird and animal watching with usual participation in fishing.
7	Occasionally participated in bird and animal watching exclusively.
8	As in the three previous clusters individuals of this group did not designate any single activity in which they always participated when at a salt marsh. However, most members participated in all activities except hunting. Their level of participation in any one activity was usually to occasionally.
	In the remaining clusters, many individuals again designated single activities in which they always or usually participated. It is important to note, however, that these activities fell under the extractive category.

Table 3. Continued.

Cluster	Description
	Clusters 9 and 10 are similar in that they both contain individuals who always or usually participated in fishing. Their differentiation resulted from their standing on the remaining activities.
9	Occasional participation in crabbing and clamming. Participation in both "nonextractive" activities was at the level of usually to sometimes.
10	Participation of activities other than fishing was seldom if ever.
11	A small cluster of individuals who always and exclusively participated in crabbing when at a salt marsh.
12	These individuals always or usually participated in hunting. They occasionally participated in all other activities except clamming.
13	This last cluster includes individuals who always or usually participated in at least two of the extractive activities. They also usually participated in a "nonextractive" activity as well.

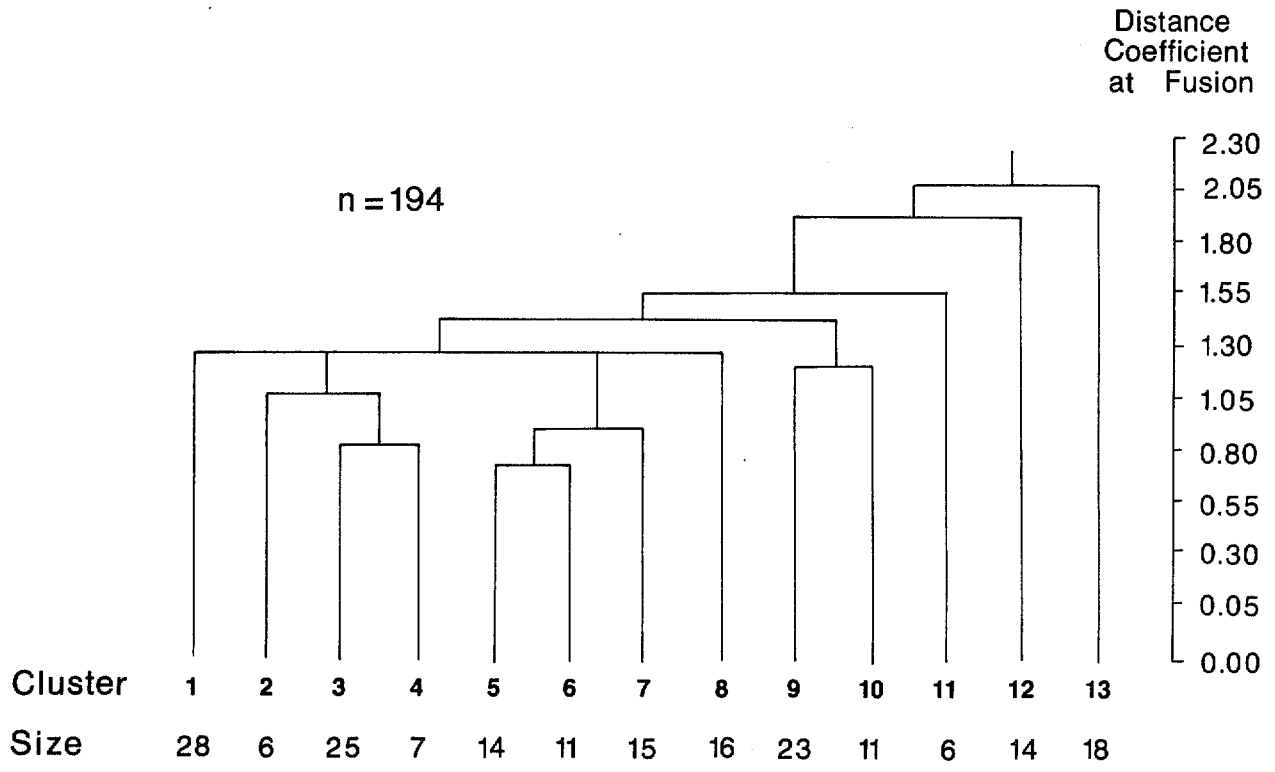

Fig. 1. Dendrogram of salt marsh users from the clustering of six activity variables.

Table 4. Homogeneous clusters of salt marsh users within which activity participation patterns are similar for New Jersey residents in 1974 (n = 1,005).

Clusters	Size	Percent of salt marsh users	Percent of population	Estimated number in population
1	28	14.4 ± 4.9	2.8 ± 1.0	141,049 ± 50,375
2, 3, 4	38	19.6 ± 5.6	3.9 ± 1.2	196,461 ± 60,450
5, 6, 7	40	20.6 ± 5.7	4.0 ± 1.2	201,499 ± 60,450
8	16	8.2 ± 3.9	1.6 ± 0.7	80,500 ± 35,262
9, 10	34	17.5 ± 5.3	3.4 ± 1.1	171,274 ± 55,412
11, 12, 13	38	19.6 ± 5.6	3.9 ± 1.2	196,461 ± 60,450

involvement on a wide category of activities. Clusters 9 and 10 were linked due to heavy involvement in fishing. The remaining clusters, 11, 12, and 13 were linked because of heavy involvement in a variety of extractive activities.

The dominating linkage pattern tended to place individuals who participated primarily in appreciative activities on the left side of the dendrogram while participants in extractive activities were placed on the right. The placement was not, however, totally bipolar. Participants in extractive activities were also involved in appreciative activities, however, their level of appreciative involvement was more variable than their level of extractive involvement. The final linkages are presented in Table 5 and represent three mutually exclusive participation patterns of salt marsh users.

1) Appreciative Type. Most individuals were involved exclusively in one or both appreciative activities with a few who occasionally participated in one or two extractive activities.

2) "Nonexclusive" Type. These individuals represented a gradient between the appreciative and extractive types. Participation was in various combinations of both appreciative and extractive activities, however, their level of involvement was only occasionally. They designated no single activity or group of activities in which they frequently participated.

3) Extractive Type. Frequent participation in one or more extractive activities along with variable participation in appreciative activities was the common linkage factor for group members.

Table 5. Summary of the major homogeneous salt marsh user groups (n = 1,005).

Participation type	Cluster	Size	Percent of salt marsh users	Percent of total population	Estimated number in population
Appreciative	1	66	34.0 ± 6.7	6.6 ± 1.5	332,473 ± 75,562
	2				
	3				
	4				
Nonexclusive	5	56	28.9 ± 6.4	5.6 ± 1.4	282,098 ± 70,524
	6				
	7				
	8				
Extractive	9	72	37.1 ± 6.8	7.2 ± 1.6	362,697 ± 80,599
	10				
	11				
	12				
	13				

The final outcome of the clustering procedure therefore was the maximization of intergroup differences and the minimization of intragroup differences. For planning purposes, these groups represent a recreation type structure based upon homogeneous participation characteristics.

USE OF THE MARINE ENVIRONMENT

Man-day Estimates

This section presents estimates of the number of man-days of recreation provided by activities involving the harvest of marine productivity. Estimates pertain to undifferentiated participation in ocean fishing, estuary fishing, crabbing, surf fishing, and clamming. Data for the estimates were derived from New Jersey Polls 9 and 10. The calculation of man-day values first required the estimation of two other statistics: (1) the probabilities associated with individual participation and each activity ($\hat{p}$) and (2) the average number of days individuals participated in each activity on an annual basis ($\hat{\mu}$). Figure 2 presents the estimates of mean activity days and their associated 95% confidence limits. Due to the skewness of the original data (a large number of light users versus a small number of heavy users) it was necessary to apply a logarithmic transformation in

order to obtain more accurate mean estimates. The asymmetrical confidence limits in Figure 2 resulted from the transformation procedure. The probabilities were simply the observed relative frequencies of encountering participants in each activity out of the general population sample of 2,410 random phone calls. The estimate of man-days was then expressed by:

$\hat{M} = N\ \hat{p}\ 10^{\hat{\mu}}$, where $\hat{M}$ = estimated number of man-days,

N = number of N.J. residents over 18 years of age,

$\hat{p}$ = probability of participation in an activity,

$\hat{\mu}$ = mean number of activity days in logarithmic form.

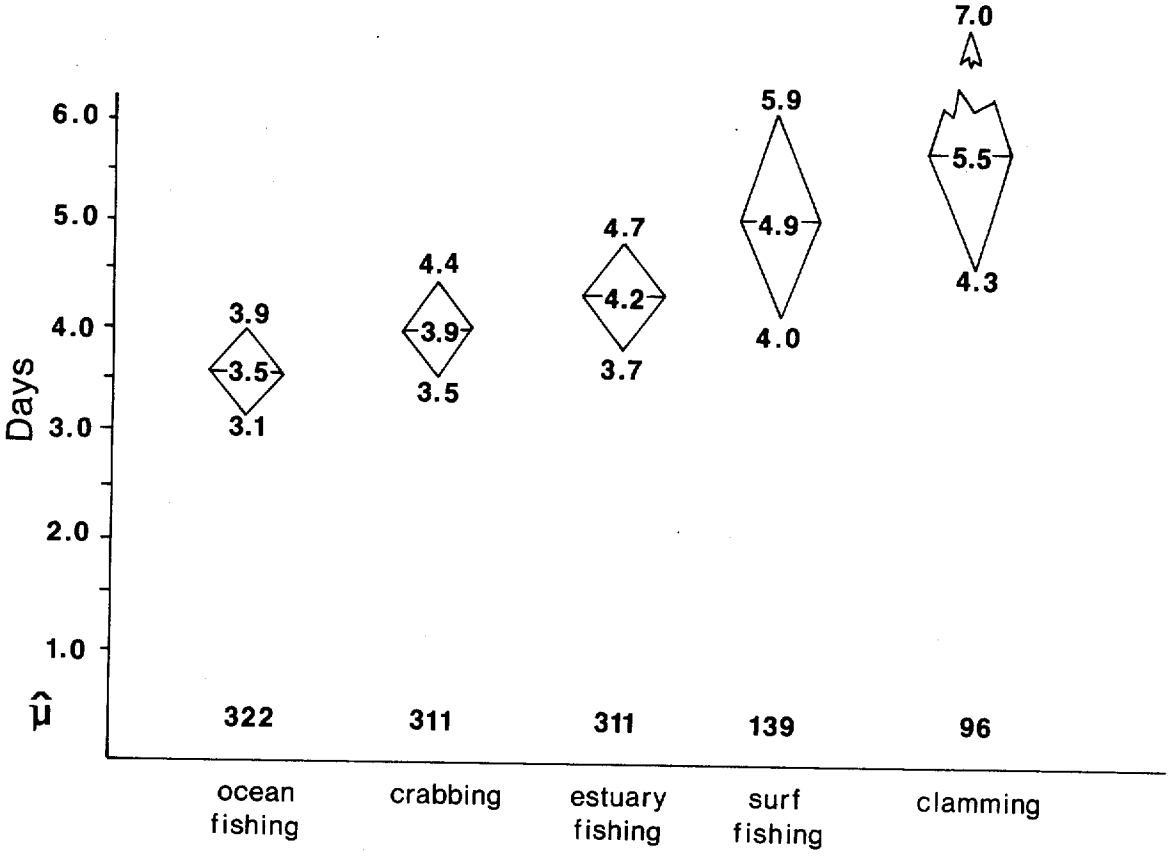

Fig. 2. Average number of days of participation in marine related activities for New Jersey residents in 1974. Confidence intervals are reported at the 95% level ($n = 2,410$).

In order to determine the reliability of $\hat{M}$ as an estimate of man-days, it was necessary to compute the variance of $\hat{M}$ for establishing confidence limits around $\hat{M}$.

Due to the different methods used to estimate $\hat{p}$ and $\hat{\mu}$ (one being logarithmic, the other nonlogarithmic), the variance of $\hat{M}$ required special derivation

and special thanks is given to Richard Trout of the Statistics Department of Cook College for his assistance. The final expression in simplified form was:

$$\text{VAR}\ (\log(\hat{M})) = (1/\hat{p})^2\ \text{VAR}\ (\hat{p}) + \text{VAR}\ (\hat{\mu}).$$

The 95% confidence limits were set by taking the antilog of L_1 and L_2 where,

$$L_1 = \log\ (\hat{M}) - 1.96\ (\text{VAR}\ (\log\ (\hat{M})))^{1/2}$$

$$L_2 = \log\ (\hat{M}) + 1.96\ (\text{VAR}\ (\log\ (\hat{M})))^{1/2}$$

All pertinent statistics are reported in Table 6 and a summary of the number of man-days for each activity is given in Figure 3.

Table 6. Statistics associated with man-day estimates.

Statistics	Ocean fishing	Estuary fishing	Crabbing	Surf fishing	Clamming
$\hat{\mu}$	322	311	311	139	96
$\log\ \hat{\mu}$	0.54046	0.61960	0.59322	0.68877	0.74078
$S^2\ \log\ \hat{\mu}$	0.21156	0.55669	0.21259	0.23039	0.27391
$\hat{p}$	0.0979	0.0958	0.1282	0.0460	0.0385
$S^2\ \log\ \hat{p}$	3.66×10^{-5}	3.60×10^{-5}	4.64×10^{-5}	1.82×10^{-4}	1.5×10^{-5}
$\log\ \hat{M}$	6.23357	6.30341	6.40337	6.05422	6.02945
VAR $\log\ \hat{M}$	0.004479	0.004637	0.003505	0.010250	0.013191
$\hat{M}$	1,712,251	2,010,978	2,531,476	1,132,970	1,070,184
L_1	1,265,865	1,478,888	1,937,929	717,412	637,307
L_2	2,316,047	2,734,511	3,306,814	1,789,239	1,797,083

The high estimate for crabbing, which was fourth in the mean activity day estimates, can be explained by the high probability of locating crabbers in the general population. Combining all six activities would result in over 8×10^6 man-days of recreation associated with marine productivity harvesting in 1974.

Origin of Users

Individuals who participated in marine related activities were broken down by their county of origin and related to major coastal geographic locations where the activities took place. The results are displayed in Tables 7 to 10, one each for ocean fishing, estuary fishing, crabbing, and surf fishing. Each table displays the county of origin of the users and the percentage of individuals from that county who went to a specific geographic area to participate

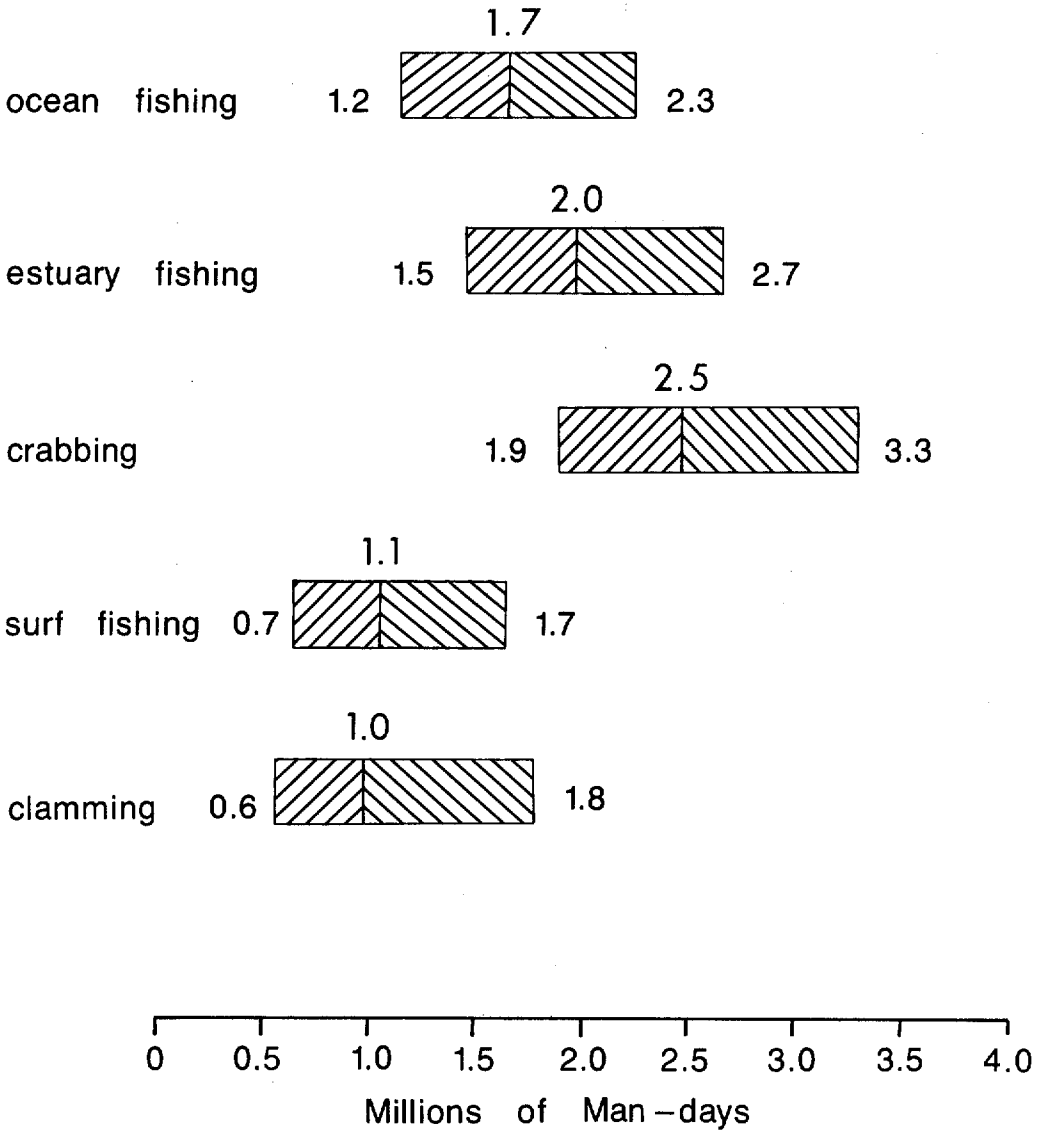

Fig. 3. Estimates of the number of man-days of recreation provided by New Jersey's marine environment in 1974.

in a certain activity. The estimated number of individuals who participated in that activity as well as the relative importance of each coastal geographic area based on user numbers is indicated on Table 11.

Table 7. County breakdown of the origin of ocean fishermen by designated coastal geographic locations.

Geographic location: Counties:	North*	North Central*	Central†	South Central**	South**
Northern zone:					
Bergen	19.1	6.3	10.8	3.2	2.3
Essex	8.5	15.9	5.4		
Hudson	4.2	11.1	8.1		
Morris	4.2	1.6	8.1	3.2	
Passaic	4.2	7.9	5.4		
Sussex	4.2	1.6			
Union	10.6	3.2	5.4	9.7	2.3
Warren					2.3
Central zone:					
Burlington	2.1		2.7	22.6	11.4
Hunterdon		1.6	2.7		
Mercer	2.1	9.5	5.4	9.7	9.1
Middlesex	21.2	17.5	8.1	6.4	
Monmouth	12.8	7.9			2.3
Ocean		3.2	2.7	6.4	4.5
Somerset	4.2	6.3	5.4		2.3
Southern zone:					
Atlantic			13.5	25.8	4.5
Camden		1.6	13.5	6.4	27.2
Cape May			2.7		6.8
Cumberland				3.2	
Gloucester	2.1	1.6		3.2	22.7
Salem		3.2			2.3

* North = Entered ocean via New York Bight

\# North Central = Entered ocean via Shark River or Manasquan Inlet

† Central = Entered ocean via Barnegat Inlet

** South Central = Entered ocean via Beach Haven/Little Egg Inlet or near Atlantic City.

South = Entered ocean south of Atlantic City through Delaware Bay

Table 8. County breakdown of the origin of estuary fishermen by designated coastal geographic locations in percent.

Geographic location: Counties:	Raritan Bay/Sandy Hook	Barnegat Bay	Manahawkin Bay/Little Egg Harbor	Great Bay	Great Egg Harbor	Delaware Bay
Northern zone:						
Bergen	18.9	12.5	10.0	6.3	14.8	
Essex	15.1	11.5				7.7
Hudson	3.8	6.7	13.3	9.4	11.1	
Morris	3.8	5.8	3.3			
Passaic	1.9	1.0	3.3			
Sussex		1.0				
Union	7.5	5.8	6.7			
Warren		1.0			3.7	2.6
Central zone:						
Burlington		6.7	3.3	3.1	3.9	7.7
Hunterdon		1.0	3.3			
Mercer	1.9	9.6	10.0	15.6	18.5	2.6
Middlesex	18.9	10.6	13.3			
Monmouth	20.8	1.9	6.7		5.9	2.6
Ocean		7.7	3.3	3.1		2.6
Somerset	5.7	3.8	3.3			2.6
Southern zone:						
Atlantic			10.0	28.1	11.1	2.6
Camden	1.9	11.5	10.0	18.8	14.8	17.9
Cape May					3.7	7.7
Cumberland		1.9		15.6	11.1	30.8
Gloucester					3.7	5.1
Salem						7.7

Table 9. County breakdown of the origin of crabbers by designated coastal geographic locations in percent.

Geographic location: Counties:	Raritan Bay/Sandy Hook	Barnegat Bay	Manahawkin Bay/Little Egg Harbor	Great Bay	Great Egg Harbor	Delaware Bay
Northern zone:						
Bergen	17.2	15.4				
Essex	3.4	3.1	8.3		16.7	
Hudson	13.8	7.7	8.3			
Morris		1.5				
Passaic	13.9	4.6	8.3			5.6
Sussex						
Union	3.4	6.2	8.3			5.6
Warren						
Central zone:						
Burlington	3.4	6.2	8.3	33.3	16.7	11.1
Hunterdon		1.5				
Mercer	3.4	6.2				5.6
Middlesex	34.4	16.9	8.3			
Monmouth	6.9	6.2				
Ocean		9.2	8.3			
Somerset		3.1				
Southern zone:						
Atlantic			8.3	33.3	16.7	5.6
Camden		10.8	25.0	33.3	33.3	5.6
Cape May						5.6
Cumberland			8.3			16.7
Gloucester		1.5			16.7	11.1
Salem						27.8

Table 10. County breakdown of the origin of surf fishermen by designated coastal geographic locations in percent.

Geographic locations: Counties:	North*	North Central#	South Central†	South**
Northern zone:				
Bergen	8.6	10.0	16.7	
Essex	13.8	15.0		15.0
Hudson	8.6	2.5		5.0
Morris	3.4	2.5		
Passaic			3.3	
Sussex	1.7	2.5		
Union	12.1	12.5	10.0	5.0
Warren	1.7	2.5		5.0
Central zone:				
Burlington	3.4	7.5	16.7	5.0
Hunterdon				
Mercer	1.7	10.0	16.7	5.0
Middlesex	17.2	7.5	6.7	
Monmouth	19.0	2.5	10.0	5.0
Ocean	1.7	10.0	3.3	
Somerset	1.7	5.0		
Southern zone:				
Atlantic	1.7			
Camden	1.7	5.0	10.0	40.0
Cape May	1.7		3.3	5.0
Cumberland				5.0
Gloucester		5.0	3.3	5.0
Salem				

* North = Area north of Manasquan inlet

\# North central = Area between Manasquan Inlet and Barnegat Inlet

† South central = Long Beach Island

** South = Area south of Long Beach Island

Table 11. Summary of the estimated number of fishermen involved in any one type of fishing and the ranking of their use of a location.

Fishing type	Estimated number of fishermen in the population	Geographical location	Relative order of importance based on user numbers within a fishing type
Ocean fishing	493,727 ± 60,456	North	3
		North Central	1
		Central	4
		South Central	5
		South	2
Estuary fishing	483,651 ± 60,456	Raritan Bay/Sandy Hook	2
		Barnegat Bay	1
		Manahawkin Bay/Little Egg Harbor	5
		Great Bay	4
		Great Egg Harbor	6
		Delaware Bay	3
Crabbing	644,868 ± 70,532	Raritan Bay/Sandy Hook	2
		Barnegat Bay	1
		Manahawkin Bay/Little Egg Harbor	4
		Great Bay	6
		Great Egg Harbor	5
		Delaware Bay	3
Surf fishing	231,749 ± 45,342	North	1
		North Central	2
		South Central	3
		South	4

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16. ESTUARINE EVALUATION STUDY: ESTIMATES OF THE 1975 SPORT HARVEST OF MARINE FISHES IN NEW JERSEY BASED ON PHONE INTERVIEWS OF A PANEL OF NEW JERSEY FISHERMEN

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INTRODUCTION

This study considers the problem of estimating the annual catch of New Jersey's mixed-species marine sport fishery in order to provide base line trends in statewide harvesting. A panel of 304 marine sport fishermen selected from a stratified random sample of New Jersey residents and sampled periodically during 1975 provided the source of harvest data.

The primary objectives of this study were: (1) to provide harvest estimates of the principal saltwater game fishes harvested by New Jersey residents during 1975 and (2) to evaluate phone interviews of a panel of saltwater fishermen as a technique for obtaining harvest estimates.

Since panel selection took place during June 1975, the estimates for the period prior to 1 June are compiled from information that necessitated panel members to recall their catch records over a span of 5 months. The second set of estimates are compiled from periodically resampling the panel members in order to reduce the recall span.

The first set of estimates include the following species: striped bass, mackerel, whiting, cod, pollack, winter flounder, and weakfish. The second set includes tuna, bluefish, weakfish, striped bass, fluke, and white perch.

METHODS

General

The most frequently used methods of data collection that one encounters for the purpose of estimating sport fisheries catches are creel censuses, on site interviews, and end of the season mail or phone surveys. However, if the purpose of the study is to estimate the total catch of a mixed-species harvest on a large scale (i.e., such as a statewide basis), the costs associated with on site survey and censusing teams become extremely prohibitive. On the other hand, the relatively inexpensive end of season mail and phone surveys involve the problem of the respondent's capability of accurately recalling the numbers of the different species of fish he caught throughout the year. With these problems in mind, it was decided that a phone interview system could be utilized where individuals would be recontacted at various intervals throughout the year in order to minimize recall errors. This type of an approach can be best visualized as a large panel of individuals which represents a cross-sectional subset of all New Jersey marine sport fishermen from which repeated sampling would be possible. One additional criterion, however, was necessary to complete the design. A study conducted a year earlier located a sample of 381 marine fishermen from random phone interviews of New Jersey residents and reported a ratio of 6.5 to 1 for persons who fished 10 or less days a year to those who fished more than 10 days a year. Recalling the old (but not so well documented) fishing proverb that 10% of the fishermen catch 90% of the fish, it was decided to form a stratified panel of an equal number of light (those who fished 10 or less days a year) and heavy (those who fished more than 10 days a year) fishermen. It was felt that this modification would provide more accurate estimates of fishing harvest.

Design of the Survey Documents

Appendix A of this report contains copies of the finalized survey documents that were designed by a cooperative effort with members of the Eagleton Institute. The first document entitled "Fishing Poll 1975" was designed with four purposes in mind.

1) To provide a standard format for the selection of panel members.

2) To provide criteria for stratifying panel members by level of use (light and heavy) as well as by type of use (ocean fishing, surf casting, and bay and river fishing).

3) To collect other background information for each panel member and his or her household.

4) To provide the necessary data for estimating the harvest of various fish species for the period of 1 January to 1 June 1975.

The flow chart in Figure 1 outlines the physical structure of the Fishing Poll by: (1) summarizing the nature of the questions in the different sections; and (2) illustrating the flow pattern of the interviewing procedure.

The second document of Appendix A entitled "Harvest Estimate Poll" was designed to be used during the resampling period from 30 June to 30 December. The information obtained from this document was used to compile the harvest records for each panel member. Each panel member was interviewed using this document in three resampling periods. The call back procedure is described in the Harvest Poll Sampling section below.

Both survey documents were pretested on a group of 26 individuals who regularly participate in various types of saltwater fishing. Following the interview, these individuals were asked to relate their impressions as to the clearness of the questions, the accuracy of the fishing terminology, and whether the questions seemed, to them, to flow in a logical and "nonrepetitive" manner. By this process, serious ambiguities were eliminated prior to actual panel selection.

Panel Selection

The original design called for a panel of 400 saltwater fishermen to be selected by means of random phone calls from the general population of New Jersey residents over 18 years of age. The panel was to be stratified into 200 light (annual use being $\leq$ 10 days) and 200 heavy (annual use being > 10 days) fishermen. It was originally estimated that the maximum number of random phone calls required to select all panel members would be approximately 7,000. This was assuming that the probability of locating a heavy user in the general population was about 1 out of 35 or approximately 0.03. After 100 random phone calls were placed, a check of the probability value was made and found to be too high. The actual probability of locating a heavy fisherman was running around 0.015 or 1 out of 67. At this rate, it would have taken at least 14,000 random phone calls to complete the panel selection, assuming the value of 0.015 would not change. In order to stay within the financial constraints of the project and still select an adequate sample it was decided to modify the sampling design in the following manner:

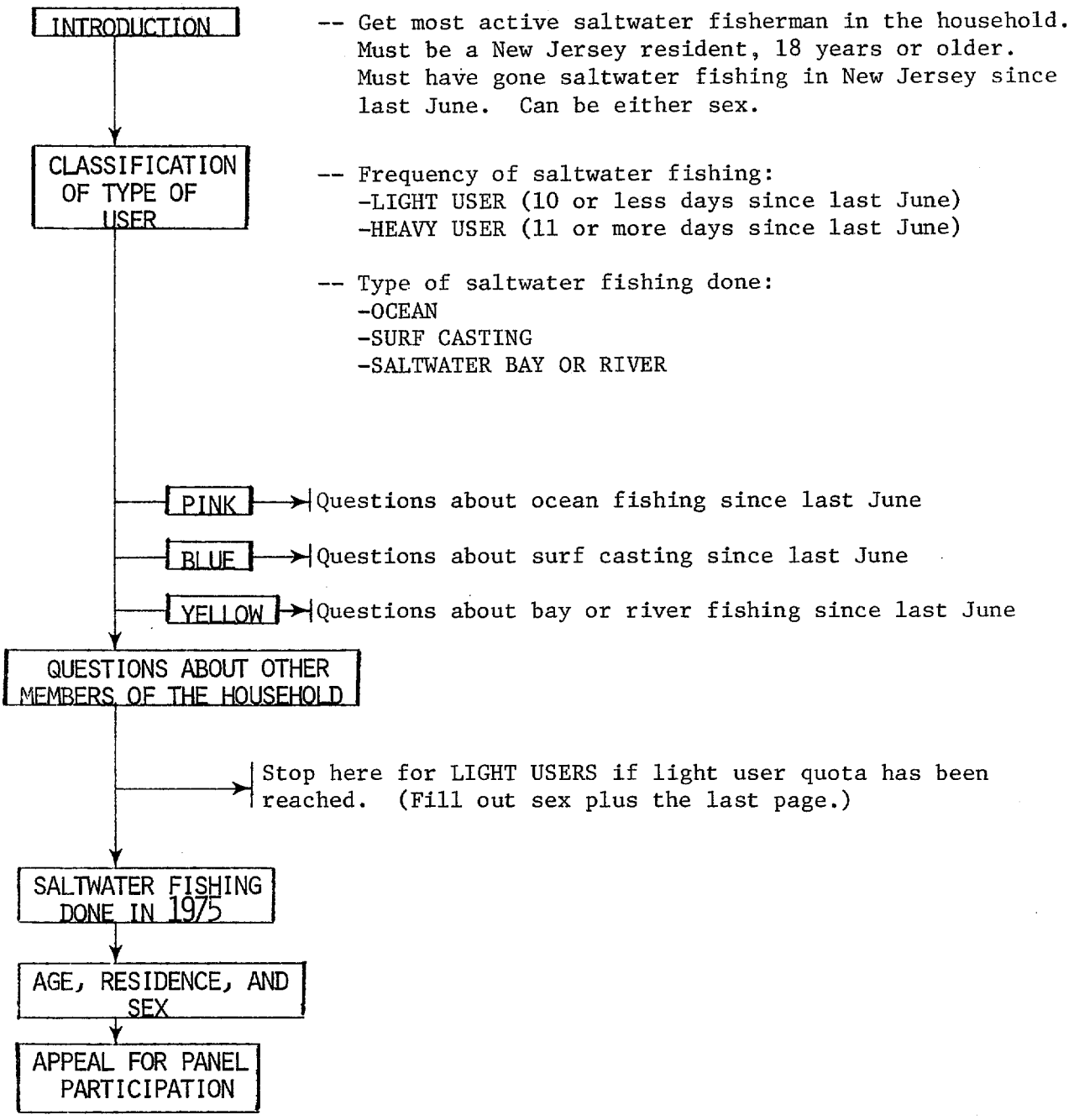

Fig. 1. Fishing harvest poll outline.

1) Reduce the panel size of 400 fishermen to 300, with 150 light and 150 heavy.

2) Continue the random sampling but with the additional condition that when a heavy user was located, he was asked to provide the name of another heavy user, hereafter designated a referral. These referrals were included on the panel only to fill the slots left vacant after the maximum quota of 7,000 phone calls was reached. Panel selection was completed on 7 June 1975 with 151 light, 119 heavy, and 32 referrals who consented to participate in the harvest survey. A breakdown of all sample sizes is given in the top section of Table 1.

Table 1. Sample sizes.

	Strata		
	Light	Heavy	
		Contacts	Referrals
Background poll (1 January 1975 to 1 June 1975):			
Total number	153	119	32
Number fishing in:			
Ocean	39	49	17
Bay	31	51	18
Surf	8	18	7
Harvest poll (1 July 1975 to 30 December 1975):			
Total number	153	119	32
Number contacted at least once	147	112	30
Number fished at least once	91		
Ocean	56	65	23
Bay	37	51	14
Surf	20	20	10

Harvest Poll Sampling

The "resampling" procedure was designed so that each panel member would be recontacted three additional times throughout the 26 week "resampling" period of 30 June to 29 December 1975. All call backs were conducted on Monday evenings between 1830 and 2230 hours.

At this point, the stratification categories of level of use as well as type of fishing entered the methodology, since it was important that each weekly sample represent as broad a cross-section of use patterns as possible. Each weekly sample consisted of 30 light and 14 heavy fishermen who participated in as many as possible of all the various types of fishing (ocean, surf and bay, and river).

Figure 2, a condensed flow chart of the harvest poll, illustrates the interviewing format used during the "resampling" periods. Each panel member was asked to estimate his past fishing effort and catch for: (1) the past week; (2) the week prior to that; and (3) the period since he was last contacted, excluding the past 2 weeks.

The lower section of Table 1 reports the various sample size totals of contacted individuals who actually did some type of fishing during the polling periods. As expected, the heavy fishing category contained the better sample sizes.

ESTIMATING THE SPORT FISHERIES HARVEST FOR VARIOUS SPECIES OF MARINE FISHES

General

Estimates of catch by species are reported for two successive periods during 1975. The first set of estimates covers the period from 1 July to 20 December 1975, while the second set covers the period from 1 January to 1 June 1975. Due to the nature of the design (see METHODS), data for the first set of estimates were obtained during the three "resampling" periods and then compiled to form a complete record of all fishing trips taken by each panel member. Data for the second set of estimates were taken directly from the survey document used to form the panel.

Preliminary analysis of each set of catch data (frequently distributions of the number of fish by species) brought to light the following statistical attributes: (1) the data were characterized by "over-dispersion" (i.e. standard deviations were consistently greater than the mean catch of each species); (2) the frequency distributions of catch by species were skewed to the right indicating more catches below the mean of the species than above it; and (3) each frequency distribution contained a high proportion of zero's or "no catches". This skewness, which occurred in the distribution of both strata (both light and heavy fishermen), appears to be a typically natural and logical occurrence with which one must deal when processing fish harvest records and can probably be best explained in terms of the behavior patterns of the fisherman as well as the fish. However, because of the skewness, it is not possible to directly apply the techniques of "normal" statistics in order to obtain acceptable estimates of total catch. Therefore, it was necessary to fit the data to some other form of "non-normal" series. After investigating the Poisson series and a log-normal series without success, the negative binomial distribution was found to provide acceptable fits in all but a few of the species catch distributions. Those few which it did not fit contained the least amount of data.

Use of the Negative Binomial Distribution

For the negative binomial distribution, the expected frequencies of catch containing 0, 1, 2, 3 .....X individuals are given by:

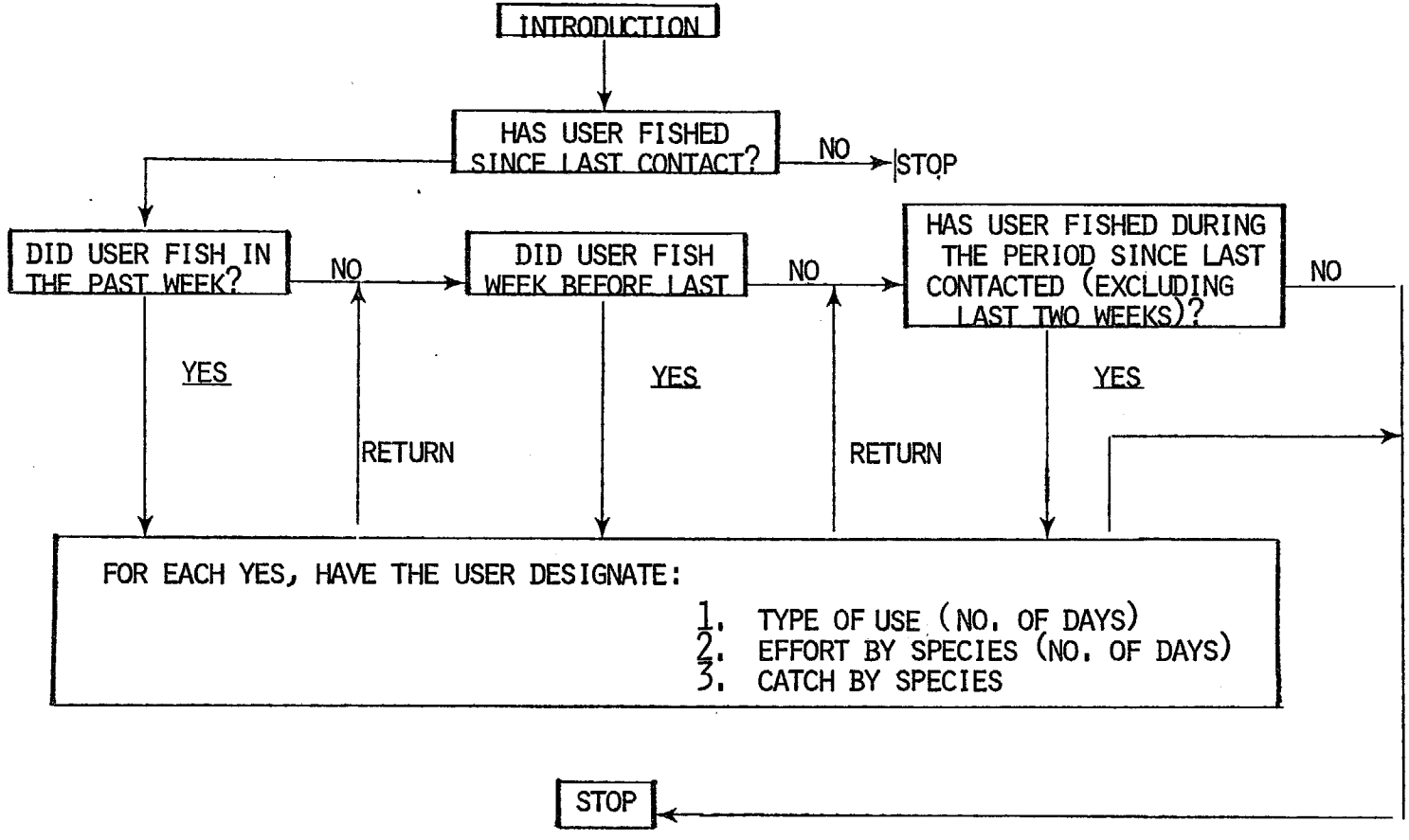

Fig. 2. Harvest estimate poll outline.

Table 2. Comparison of observed values to a negative binomial distribution.

Area:	Species	Strata: Light fishermen Chi-squared	DF	Strata: Heavy fishermen Chi-squared	DF
For July to December:					
Ocean:	Bluefish	10.48*	2	7.58	4
	Weakfish	1.65	1	1.96	2
	Striped bass	0.004	1	1.08	2
	Tuna			0.30	1
Surf:	Striped bass	4.20	2	3.07	3
	Bluefish	10.90*	2	1.18	3
	Weakfish	4.00*	1	0.18	0#
Bay:	Bluefish	1.59	1	1.54	1
	Fluke	1.80	4	9.77	5
	Weakfish	2.80	1	1.50	2
	White perch	2.13	0#	4.20	0#
For January to June:					
Ocean:	Striped bass	3.01	0#	0.80	2
	Mackerel	2.70	2	19.25*	3
	Whiting	0.82	3	1.40	3
	Cod	3.55	0#	4.74*	1
	Pollack			0.14	0#
Bay:	Winter flounder	4.0	2	4.36	4
	Weakfish	1.29	1	9.28*	2
	Striped bass	10.7	0#	0.37	0#
Surf:	Striped bass			0.51	1

* Indicates a significant difference at the 95% level

\# Indicates that the observed frequency distribution contained three or less classes

Table 3. Mean catch by species after the application of the transformation described.

Area:	Species	Strata: Light fishermen Mean *	Light fishermen Variance #	Heavy fishermen Mean *	Heavy fishermen Variance #
For July to December:					
Ocean:	Bluefish	2.40	0.0007	2.60	0.009
	Weakfish	0.29	0.029	0.58	0.066
	Striped bass	0.55	0.187	0.18	0.009
	Tuna	0.12	0.020	0.29	0.095
Bay:	Bluefish	0.42	0.049	0.29	0.948
	Weakfish	0.27	0.127	0.69	0.043
	Fluke	1.50	0.098	2.50	0.008
	White perch	0.03	2.760	0.05	0.062
Surf:	Bluefish	0.73	0.020	0.71	0.165
	Weakfish	0.45	0.072	0.17	0.619
	Striped bass	2.40	0.002	1.70	0.053
For January to June:					
Ocean:	Mackerel	0.80	0.323	1.90	0.199
	Whiting	0.38	0.505	1.30	0.201
	Cod	0.08	0.662	0.09	0.524
	Striped bass	0.07	0.862	0.24	0.183
	Pollack			1.00	13.090
Bay:	Winter flounder	0.44	0.279	3.80	0.041
	Weakfish	0.22	0.7381	0.17	0.595
	Striped bass	0.02	9.750	0.03	3.379
Surf:	Striped bass	0.25	0.500	0.50	0.193

* Back transformed

\# In the transformed state

Table 4. Estimated catches of bluefish during the period of July to December 1975.

	Ocean fishing		Bay&river fishing		Surf fishing	
	Light	Heavy	Light	Heavy	Light	Heavy
Estimated catch	226,000	118,000	26,000	11,000	25,000	10,000
Lower limit***	151,000	72,000	11,000	4,000	11,000	3,000
Upper limit***	339,000	193,000	59,000	29,000	91,000	41,000
Combined estimated catch	344,000		37,000		35,000	
Lower limit***	183,000		10,000		7,000	
Upper limit***	645,000		135,000		172,000	

Table 5. Estimated catch of weakfish during the period of July to December 1975.

	Ocean fishing		Bay&river fishing		Surf fishing	
	Light	Heavy	Light	Heavy	Light	Heavy
Estimated catch	27,000	26,000	17,000	25,000	15,000	2,400
Lower limit***	14,000	11,000	5,000	12,000	5,000	200
Upper limit***	52,000	62,000	54,000	53,464	43,000	28,000
Combined estimated catch	54,000		42,000		18,000	
Lower limit***	18,000		10,000		1,200	
Upper limit***	156,000		169,000		250,000	

Table 6. Estimated catch of striped bass during the period of July to December 1975.

	Ocean fishing		Surf fishing	
	Light	Heavy	Light	Heavy
Estimated catch	52,000	8,000	34,000	24,000
Lower limit***	33,000	2,000	17,000	9,000
Upper limit***	81,000	32,000	66,000	62,000
Combined estimated catch	60,000		58,000	
Lower limit***	14,000		18,000	
Upper limit***	251,000		185,000	

Table 7. Estimated catch of fluke from bay and river fishing during the period of July to December 1975.

Estimate	Light	Heavy
Estimated catch	93,000	92,000
Lower limit***	52,000	56,000
Upper limit	165,000	151,000
Combined estimated catch	185,000	
Lower limit***	87,000	
Upper limit***	394,000	

Table 8. Estimated catch of white perch from bay and river fishing during the period of July to December 1975.

Estimate	Light	Heavy
Estimated catch	2,000	2,000
Lower limit***		800
Upper limit***		4,000
Combined estimated catch	4,000	
Lower limit		
Upper limit		

Table 9. Estimated catch of tuna from ocean fishing during the period of July to December 1975.

Estimate	Light	Heavy
Estimated catch	11,000	13,000
Lower limit***	7,000	5,000
Upper limit***	17,000	36,000
Combined estimated catch	24,000	
Lower limit		
Upper limit		

Table 10. Estimated catch of white perch from bay and river fishing during the period of July to December 1975.

Estimate	Light	Heavy
Estimated catch	1,900	1,800
Lower limit***		780
Upper limit***		4,300
Combined estimated catch	3,700	
Lower limit		
Upper limit		

Table 11. Estimated catch of mackerel from ocean fishing during the period of January to June 1975.

Estimate	Light	Heavy
Estimated catch	52,000	67,000
Lower limit**	13,000	22,000
Upper limit**	218,000	207,000
Combined estimated catch	119,000	
Lower limit**	19,000	
Upper limit**	737,000	

Table 12. Estimated catch of whiting from ocean fishing during the period of January to June 1975.

Estimate	Light	Heavy
Estimated catch	25,000	46,000
Lower limit**	4,000	15,000
Upper limit**	145,000	143,000
Combined estimated catch	71,000	
Lower limit**	9,000	
Upper limit**	553,000	

Table 13. Estimated catch of winter flounder from bay and river fishing during the period of January to June 1975.

Estimate	Light	Heavy
Estimated catch	22,000	140,000
Lower limit**	6,000	78,000
Upper limit**	83,000	250,000
Combined estimated catch	162,000	
Lower limit**	38,00	
Upper limit**	687,000	

Table 14. Estimated catch of weakfish from bay and river fishing during the period of January to June 1975.

Estimate	Light	Heavy
Estimated catch	11,000	6,000
Lower limit*	3,000	1,800
Upper limit*	38,000	21,000
Combined estimated catch	17,000	
Lower limit*	3,000	
Upper limit*	109,000	

Table 15. Estimated catch of cod from ocean fishing during the period of January to June 1975.

Estimate	Light	Heavy
Estimated catch	5,200	3,200
Lower limit*	1,400	1,000
Upper limit*	19,200	10,000
Combined estimated catch	8,400	
Lower limit*	1,500	
Upper limit*	48,000	

Table 16. Estimated catch of pollack from ocean fishing during the period of January to June 1975.

Estimate	Light	Heavy
Estimated catch		35,000
Lower limit		
Upper limit		

Table 17. Estimated catch of striped bass during the period of January to June 1975.

Estimate	Ocean fishing		Bay&river fishing		Surf fishing	
	Light	Heavy	Light	Heavy	Light	Heavy
Estimated catch	4,600	8,500	1,000	1,100	3,400	6,500
Lower limit*	1,000	4,200			1,000	3,000
Upper limit*	20,000	17,000			11,700	14,000
Combined estimated catch	13,100		2,100		9,900	
Lower limit*	2,500				2,300	
Upper limit*	68,000				43,000	

Determination of Sample Size

Since the design of this study centered around a new method of collecting data from participants in various types of marine sport fishing, it is necessary to ascertain its relative effectiveness within the limits of the data and also to determine the necessary sample sizes, in order to improve the precision of the estimates.

The degree of precision of any study depends directly upon the total numbers of samples from which the estimated parameters are calculated. For many purposes, an error of 10% of the mean is considered a reasonable standard in ecological problems (Southwood 1966). Rojas (1964) has shown that if the dispersion of a series has been found to fit a negative binomial distribution, then the desired number of samples is given by:

$$N = \frac{1/\overline{X} + 1/K}{D^2} \qquad (4)$$

where

K = the dispersion parameters of the negative binomial,

$\overline{X}$ = the mean of the series, and

D = the required level of accuracy expressed as a decimal.

Using equation (4), sample sizes were calculated for each species-fisherman strata type at five different levels of precision. Table 18 gives the sample sizes (number of panel members) for the July to December survey period while Table 19 contains sample sizes for the January to June survey period. As one can see from the tables, the sample sizes by species for a particular level of precision vary quite a bit. Since it would be necessary to choose only two sizes, one for each strata, certain species would be measured with greater precision than others depending on the sizes chosen.

The relative precision of the estimates presented in the previous section (Results and Discussion) are provided in Tables 20 and 21. These values are based on the actual sample of the study that were given previously in Table 1. During the July to December survey period, the precision estimates for the light strata of fishermen ranged from a high of 0.14 for ocean bluefish to a low of 0.85 for bay-river white perch while for the heavy strata they ranged from a high of 0.17 for ocean bluefish and bay-river fluke to a low of 0.59 for surf weakfish. Table 21 can be read in a similar manner, however, it should be noted that the overall precision estimates of Table 21 are much lower than those of Table 20. This can be interpreted as demonstrating that the method of "resampling" panel members throughout the second survey period provides estimates of greater precision than those obtained from the single contact method of the first survey period.

Critique of Panel Interview Technique

With the advent of extended jurisdiction in marine fisheries management, it will be necessary to estimate the sport harvest of marine fishes on a continuing basis. Since the technique adopted in this study may have merit in the gathering of such data, the following brief critique of the method is provided based on the experience of this study:

Table 18. Number of samples (panel members) required to describe the dispersion of species catch at various levels of relative precision (P) under a negative binomial distribution (P was calculated with data from the July to December survey period).

Species		Strata: Light fishermen, P = 0.10	0.20	0.30	0.40	0.50	Strata: Heavy fishermen, P = 0.10	0.20	0.30	0.40	0.50
Ocean:	Bluefish	103	26	12	7	4	245	61	27	15	10
	Weakfish	550	138	62	35	22	575	144	64	36	23
	Striped bass	612	153	68	39	25	1,004	251	112	63	40
	Tuna						1,002	250	112	63	41
Bay:	Bluefish	408	102	46	26	17	635	159	71	40	26
	Weakfish	598	150	67	38	24	415	104	47	26	17
	Fluke	178	44	20	12	8	182	46	21	12	8
	White perch	2,696	674	300	169	107	1,910	478	213	120	77
Surf:	Bluefish	264	66	30	17	11	530	133	59	34	22
	Weakfish	387	97	43	25	16	1,035	259	115	65	42
	Striped bass	106	27	12	7	4	309	78	35	20	13

Table 19. Number of samples (panel members) required to describe the dispersion of species catch at various levels of relative precision (P) under a negative binomial distribution (P was calculated with data from January to June survey period).

Species		Strata: Light fishermen, P = 0.10	0.20	0.30	0.40	0.50	Strata: Heavy fishermen, P = 0.10	0.20	0.30	0.40	0.50
Ocean:	Mackerel	825	207	92	52	33	835	209	93	53	34
	Whiting	1,030	258	115	65	42	836	209	93	53	34
	Cod	1,372	344	153	86	55	1,421	356	158	89	57
	Striped bass	1,538	385	171	97	62	840	210	94	53	34
	Pollack										
Bay:	Winter Flounder	697	175	78	44	28	390	98	44	25	16
	Weakfish	1,120	280	125	70	45	1,482	371	165	93	60
	Striped bass	4,040	1,010	450	253	162	3,620	905	403	227	145
Surf:	Striped bass						533	134	60	34	22

Table 20. Attained relative precision (P) based on the sample (panel) sizes (for the July to December survey period).

Species		Strata: Light fishermen P	Strata: Heavy fishermen P
Ocean:	Bluefish	0.14	0.17
	Weakfish	0.31	0.26
	Striped bass	0.33	0.34
	Tuna		0.34
Bay:	Bluefish	0.33	0.31
	Weakfish	0.40	0.25
	Fluke	0.22	0.17
	White perch	0.85	0.54
Surf:	Striped bass	0.23	0.32
	Bluefish	0.36	0.42
	Weakfish	0.44	0.59

Table 21. Attained relative precision (P) based on the sample (panel) sizes (for the January to June survey period).

Species		Strata: Light fishermen P	Strata: Heavy fishermen P
Ocean:	Mackerel	0.46	0.36
	Whiting	0.51	0.36
	Cod	0.59	0.46
	Striped bass	0.63	0.36
	Pollack		
Bay:	Winter Flounder	0.47	0.24
	Weakfish	0.60	0.46
	Striped bass	1.14	0.72
Surf:	Striped bass		0.46

1) The method lends itself to statistical treatment of data. Harvest estimates are provided with confidence limits. While these confidence intervals were relatively broad in this study due to limitations of sample size, the investigator would be able to select sample sizes based on desired levels of precision.

2) The cost of obtaining data through phone interview will be greatly below that for dockside interview. There are no travel costs nor expensive man-days expended to obtain data on low-harvest days. Data collection is at a centralized location, on a schedule that is not affected

by weather, weekends, or holidays, thus reducing the logistical problems of a dockside interview technique.

3) There are problems in defining the population from which the panel is selected. In our study, the population was defined as adult N.J. residents. We ignored young N.J. residents and nonresident fishermen due to budget constraints of this study. In a larger study, juveniles could be included without great difficulty, but nonresidents would provide greater problems. Neither group is a problem in dockside interviewing since data are generally related to boat catch without regard to age or residence of the fishermen. On the other hand, once defined, the panel representing all of the fishing effort of interest. Dockside interviews have innate problems of boats docked at private lagoons and fishermen who return at extraordinary hours.

4) The greatest problem of phone interviewing involve recall biases and veracity of the respondents. In face-to-face interviewing at the dockside, the respondent need only count the fish of the day and report them. In phone interviewing, the respondent must recall the fish that he himself caught on several trips. Obviously, accuracy of reporting suffers. The extent of these problems, and their effect on harvest estimation require further study.

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APPENDIX A

FISH 101-105

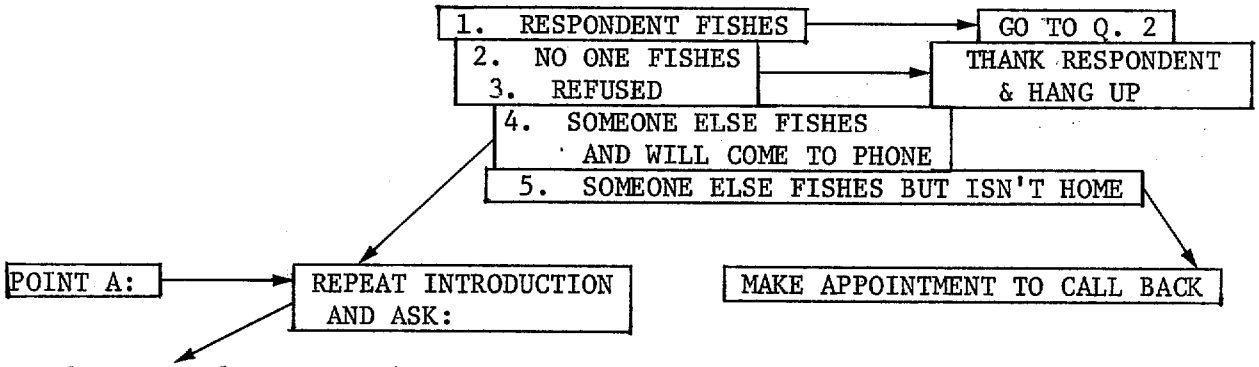
FISHING POLL
June 1975

106-109

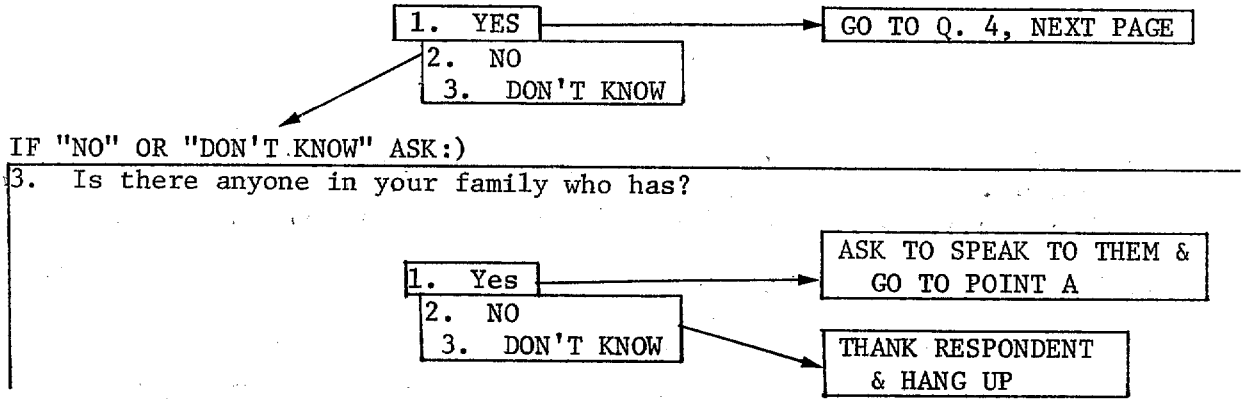
TIME INTERVIEW BEGAN _____

Hello, my name is _____ (first and last names). I'm (a student at/on the staff of) Rutgers University and I'm taking a survey of saltwater fishermen in New Jersey for the Marine Science Center.

1. May I speak to the person who does the most fishing in your family?



2. Have you done any saltwater fishing in New Jersey in the past year (since last June?



4. How many days since last June have you been saltwater fishing in the waters around New Jersey?

110	111	112

(IF GREATER THAN 75 days, ASK:)

5. Are you a commercial fisherman, or has all that been sport fishing? (Anyone who is paid in any way to fish is a commercial fisherman. Sport fishermen use rod and reel to fish; commercial fishermen use nets. Captains and crew members of charter or head boats are commercial fishermen unless they do their own sport fishing at other times.)

113-
- 1. ONLY COMMERCIAL FISHERMAN → THANK RESPONDENT & HANG UP
- 2. SPORT FISHERMAN → GO TO Q. 7
- 3. PARTLY BOTH

(IF "PARTLY BOTH" TO Q. 5, ASK:)

6. In that case we are only going to be talking about your own sport fishing, not any fishing connected with your work. How many days since last June did you yourself go sport fishing in the waters around New Jersey?

114	115	116

7. In general, do you fish mostly on weekends, mostly during the week, or at both times?

117-
1. WEEKEND
2. WEEKDAY
3. BOTH
9. DON'T KNOW

8. For the purposes of our survey we have divided all saltwater fishing into three categories--ocean fishing from a boat or pier, surf casting, or fishing in saltwater bays and rivers. Which of these have you done since last June?

(INTERVIEWER: CIRCLE ALL THAT APPLY)

Ocean fishing	118-	1 → Ask questions on PINK paper
Surf casting	119-	1 → Ask questions on BLUE paper
Bay and river fishing	120-	1 → Ask questions on YELLOW paper

(INTERVIEWER: IF RESPONDENT ONLY DID OCEAN FISHING, SKIP THE NEXT QUESTION (Q. 9). IF RESPONDENT DID NOT GO OCEAN FISHING, SKIP THESE PINK PAGE QUESTIONS.

9. Let's talk about saltwater fishing on the ocean. How many of your trips around New Jersey since last June were spent fishing on the ocean from a boat or pier?

121	122	123

10. Was that trip/Were those trips on a private boat owned by you or a friend, on a head boat, on a charter boat, or did you fish from a pier? (A head boat is a boat which makes regularly scheduled trips and sells tickets. A charter boat is a boat and crew specifically hired for the trip.)

(INTERVIEWER: CIRCLE ALL THAT APPLY)

A.	Private boat	124-	1
B.	Head boat	125-	1
C.	Charter boat	126-	1
D.	Pier	127-	1
E.	Don't Know	128	1

→ SKIP TO Q. 14

IF "A" NOT MENTIONED, SKIP TO Q. 13

(IF MENTIONED "A", ASK:)

11. Did you own that boat, or was it a friend's?

129-
1. OWN BOAT
2. FRIEND'S (OR SOMEONE ELSE'S)
9. DON'T KNOW → SKIP TO Q. 13

(IF ANSWERED 1 or 2 TO Q. 11, ASK:)

12. Was the boat kept in the water or on a trailer?

130-
1. WATER
2. TRAILER
3. BOTH (VOLUNTEERED ONLY)
9. DON'T KNOW

13. From what town or port in New Jersey did the boat leave? (Were there any others?) (OR: In what town was the pier?)

131	132	133	134
135	136	137	138
139	140	141	142

DUP 201-204 | 2 205 | DUP 206-209

14. When you fish out on the ocean from a boat or pier, what particular kinds of fish do you go out for?

(INTERVIEWER: DO NOT READ THE TYPES OF FISH. Circle all the ones mentioned. If you don't recognize a name, ask the respondent if it is also called by another name. If you still don't recognize it, ask the respondent to spell it and write it in "Other".)

			Hours spent fishing on average trip
No particular kinds of fish/all kinds	210-	1	211 212
Albacore	213-	1	214 215
Blowfish (Blows)	216-	1	217 218
Bluefish (Blues)	219-	1	220 221
Bonita	222-	1	223 224
Cod	225-	1	226 227
Fluke (Summer Flounder)	228-	1	229 230
Ling (Shitbellies)	231-	1	232 233
Mackerel	234-	1	235 236
Pollack	237-	1	238 239

			Hours spent fishing on average trip
Porgy	240-	1	241 242
Striped Bass (Stripers; Bass)	243-	1	244 245
Tuna	246-	1	247 248
Weakfish (Weaks; Sea-trout)	249-	1	250 251
Whiting	252-	1	253 254
Winter Flounder	255-	1	256 257
Other Specify)_____	258 259		260 261
Other (Specify)_____	263 264		265 266

15. FOR EACH SPECIES MENTIONED, ASK:
When you go out for _____, about how many hours on the average do you spend fishing for it--that is, with your line in the water. (We don't include the time spent travelling out and back and getting set up.)

(INTERVIEWER: IF RESPONDENT ONLY DID SURF CASTING, SKIP THE NEXT QUESTION, (Q. 16). IF RESPONDENT DID NOT GO SURF CASTING, SKIP THESE BLUE PAGES.)

16. Now let's talk about the surf casting you did since last June. How many trips since last June have you gone surf casting?

273 274 275

17. Did you go surf casting between _____ last year?

		Yes	No	Don't Know
A....Sandy Hook and Manasquan Inlet	276-	1	2	9
B....Manasquan Inlet and Barnegat Inlet	277-	1	2	9
C....Barnegat Inlet and Beach Haven Inlet	278-	1	2	9
D....Beach Haven Inlet and Cape May	279-	1	2	9

DUP	3	DUP
301-304	305	306-309

18. When you go surf casting, what particular kinds of fish are you going for?

(INTERVIEWER: DO NOT READ THE TYPES OF FISH. Circle all the ones mentioned. If you don't recognize a name, ask the respondent if it is also called by another name. If you still don't recognize it, ask the respondent to spell it and write it in "Other".)

			Hours spent fishing on average trip
No particular kinds of fish/all kinds	310-	1	311 312
Albacore	313-	1	314 315
Blowfish (Blows)	316-	1	317 318
Bluefish (Blues)	319-	1	320 321
Bonita	322-	1	323 324
Cod	325-	1	326 327
Fluke (Summer Flounder)	328-	1	329 330
Ling (Shitbellies)	331-	1	332 333

			Hours spent fishing on average trip
Mackerel	334	1	335 336
Pollack	337-	1	338 339
Porgy	340-	1	341 342
Striped Bass (Stripers; Bass)	343-	1	344 345
Tuna	346-	1	347 348
Weakfish (Weaks; Sea trout)	349-	1	350 351
Whiting	352-	1	353 354
Winter Flounder	355-	1	356 357
Other (Specify)_____	358 359		360 361
Other (Specify)_____	363 364		365 366

19. FOR EACH SPECIES MENTIONED, ASK:
When you go out for _____, about how many hours on the average do you spend fishing for it--that is, with your line in the water. (We don't include the time spent travelling out and back and getting set up.)

(INTERVIEWER: IF RESPONDENT ONLY FISHED SALTWATER BAYS AND RIVERS, SKIP THE NEXT QUESTION (Q. 19) AND GO TO Q. 28. IF RESPONDENT DID NOT FISH SALTWATER BAYS AND RIVERS, TURN QUESTIONNAIRE OVER AND START WITH Q. 28.)

20. Let's talk now about the trips you spent fishing saltwater bays and rivers since last June. How many trips of that type have you made (since last June, to fish saltwater bays and rivers)?

373	374	375

21. Did you use a private boat owned by yourself or a friend, rent a rowboat, hire a charter boat, or fish from the shore? (CIRCLE ALL MENTIONED)

A.	Private boat	376-	1
B.	Rent a rowboat	377-	1
C.	Hire a charter boat	378-	1
D.	Fish from the Shore	379-	1
E.	Don't Know	380-	1

IF DID NOT MENTION "A", SKIP TO Q. 24

DUP	4	DUP
401-404	405	406-409

(IF MENTIONED "A", ASK)

22. Did you own that boat, or was it a friend's?

410-
1. OWN BOAT
2. FRIEND'S (OR SOMEONE ELSE'S)
9. DON'T KNOW → SKIP TO Q. 24

23. Was the boat kept in the water or on a trailer?

411-
1. WATER
2. TRAILER
3. BOTH (VOLUNTEERED ONLY)
9. DON'T KNOW

24. Did you fish in _____ last year?

			Yes	No	Don't Know
A.	Raritan Bay or Sandy Hook Bay	412-	1	2	9
B.	Barnegat Bay	413-	1	2	9
C.	Little Egg Harbor or Manahawkin Bay	414-	1	2	9
D.	Great Bay	415-	1	2	9
E.	Delaware Bay	416-	1	2	9

25. Did you fish in any saltwater bays or rivers since last June other than the ones just mentioned? Which ones? (Only New Jersey Bays and rivers.)

_____ [ ] 417

_____ [ ] 418

_____ [ ] 419

26. When you fish saltwater bays or rivers, what particular kinds of fish do you go out for?

(INTERVIEWER: DO NOT READ THE TYPES OF FISH. Circle all the ones mentioned. If you don't recognize a name, ask the respondent if it is also called by another name. If you still don't recognize it, ask the respondent to spell it and write it in "Other".)

			Hours spent fishing on average trip
No particular kinds of fish/all kinds	420-	1	[ ][ ] 421 422
Albacore	423-	1	[ ][ ] 424 425
Blowfish (Blows)	426-	1	[ ][ ] 427 428
Bluefish (Blues)	429-	1	[ ][ ] 430 431
Bonita	432-	1	[ ][ ] 433 434
Cod	435-	1	[ ][ ] 436 437
Fluke (Summer Flounder)	438-	1	[ ][ ] 439 440

			Hours spent fishing on average trip
Ling (Shitbellies)	441-	1	442 443
Mackerel	444-	1	445 446
Pollack	447-	1	448 449
Porgy	450-	1	451 452
Striped Bass (Stripers; Bass)	453-	1	454 455
Tuna	456-	1	457 458
Weakfish (Weaks; Sea trout)	459-	1	460 461
Whiting	462-	1	463 464
Winter Flounder	465-	1	466 467
Other (Specify)_____	468 469		470 471
Other (Specify)_____	473 474		475 476

FOR EACH SPECIES MENTIONED:
When you go out for _____, about how many hours on the average do you spend fishing for it--that is, with your line in the water. (We don't include the time spent travelling out and back and getting set up.)

DUP	5	DUP
501-504	505	506-509

28. Besides yourself, how many other people in your household have gone saltwater fishing in New Jersey since last June?

[ ] 525

IF NO ONE, SKIP TO INSTRUCTIONS BEFORE Q. 34

29. Starting with the oldest, could you give me the ages of these other saltwater fishermen in your household?

Under 10	526-	1	2	3	4	5	6	7	8	9
11 - 17	527-	1	2	3	4	5	6	7	8	9
18 - 59	528-	1	2	3	4	5	6	7	8	9
60 and over	529-	1	2	3	4	5	6	7	8	9

30. When you go fishing, do you go with these other fishermen in your household all of the time, some of the time, only rarely, or never?

530-
1. ALL THE TIME
2. SOME OF THE TIME
3. ONLY RARELY
4. NEVER
9. DON'T KNOW

31. I'd like you to think now of all the fish caught by all the fishermen in your household, including yourself, since last June. About what percentage of all these fish would you say you personally caught?

[ ][ ][ ] 531 532 533

IF RESPONDENT ANSWERS THIS QUESTION, SKIP TO INSTRUCTIONS BEFORE Q. 34.

IF RESPONDENT HAS TROUBLE ANSWERING IN A PERCENTAGE OR UNDERSTANDING WHAT IT MEANS, ASK:

32. Well, let me ask that question another way. About how many saltwater fish would you say you personally have caught in the last year? (More than 10? 20? 50? 100? 200? 500? 1,000?)

[ ][ ][ ][ ] 534 535 536 537

33. About how many saltwater fish has everyone else in your household combined caught in the last year? (More than 10? 20? 50? 100? 200? 500? 1,000?)

538	539	540	541

IF THE RESPONDENT HAS FISHED 10 DAYS OR LESS IN THE PAST YEAR (A "LIGHT USER") (CHECK P. 2, Q. 4) AND THE QUOTA HAS BEEN REACHED, THANK THE RESPONDENT AND HANG UP. OTHERWISE, CONTINUE TO Q. 34.

34. Now I'd like to ask you about the fishing you've done and the number of fish you've caught since January 1st of this year. How many days have you gone saltwater fishing in New Jersey since the beginning of 1975?

542	543	544

IF "NONE, SKIP TO Q. 37, PAGE 13

IF "ONE" OR MORE, ASK Q. 35, NEXT PAGE

35. I'm going to read you a list of different types of fishing people do, and for each one, could you tell me how many times you have done it since January 1st of this year.

(INTERVIEWER: START AT DESIGNATED POINT AND READ ENTIRE LIST. If Respondent says he has done some type of fishing (e.g. surf casting) which he didn't mention in Q. 8, P. 2, ask him about the discrepancy and, if necessary, go back and ask the questions on the colored sheets about that type of fishing.)

FOR EACH TYPE OF FISHING DONE, ASK: HOW MANY _____ (type of fish) did you catch?

	No. of days in past year	No. of fish caught
A. Ocean fishing for stripers	545 546 547	
No. of stripers caught		548 549 550 551

	No. of days in past year	No. of fish caught
B. Ocean fishing for mackerel and whiting	552 553 554	
No. of mackerel caught		555 556 557 558
No. of whiting caught		559 560 561 562
C. Ocean fishing for cod and pollack	563 564 565	
No. of cod caught		566 567 568 569
No. of pollack caught		570 571 572 573
D. Bay and river fishing for winter flounder	574 575 576	
No. of winter flounder caught		577 578 579 580

DUP 601-604 | 6 605 | DUP 606-609

E. Bay and river fishing for weakfish	610 611 612	
No. of weakfish caught		613 614 615 616
F. Bay and river fishing for stripers	617 618 619	
No. of stripers caught		620 621 622 623

	No. of days in past year	No. of fish caught
G. Surf fishing for stripers	624 625 626	
No. of stripers caught		627 628 629 630

36. Are there any other types of saltwater fish that weren't on that list that you've caught since January 1st? How many did you catch?

Type of fish		No. caught
_____	631 632	633 634 635 636
_____	637 638	639 640 641 642
_____	643 644	645 646 647 648
_____	649 650	651 652 653 654

Now some questions so we can classify your answers.

37. In which of these age groups are you? (READ RESPONSES)

655-
1. 18 - 20
2. 21 - 24
3. 25 - 29
4. THIRTIES (30 - 39)
5. FORTIES (40 - 49)
6. FIFTIES (50-59)
7. 60 AND OVER
9. REFUSED

38. Where do you live--in what township or municipality? In what county is that?

656 657 658 659

39. (SEX)

660- 1. MALE
2. FEMALE

These questions are part of a continuing study the Marine Science Center at Rutgers University is making of the types and amount of fish that New Jersey fishermen catch. We would like to call you back sometime in the summer and again in the fall to find out what types of fish you have caught during the rest of the season.

40. Would you be willing to participate in this study?

661- 1. YES
2. NO--unspecified reason
NO--reason was: _____

→ THANK RESPONDENT AND HANG UP

41. Our follow-up calls later in the season will have to be made on Monday or Tuesday nights. Would you still be able to participate?

662- 1. YES
2. NO → THANK RESPONDENT & HANG UP

42. If we can't get you at this number, should we just keep on trying, or is there another phone number we should call? (INTERVIEWER: WRITE IN THE 1 or 2 BEST PHONE NUMBERS GIVEN.)

☐☐☐ - ☐☐☐ - ☐☐☐☐

☐☐☐ - ☐☐☐ - ☐☐☐☐

43. On Mondays or Tuesdays what is the best time to reach you at this number/ these numbers (between 6 and 10 p.m.)?

Mondays (or both days): _____

Tuesdays: _____

44. And who should we ask for? (All we need is a name so when we call back, the person who answers the phone will know who we're talking about. A first name or nickname is fine, although a full name is better.

_____

Thank you very much. We really appreciate your cooperation. In order to help us, could you just keep a mental note of how often you fish and the types and number of fish you catch. If you want to write it down, that would be even better.

Thank you again.

TIME INTERVIEW ENDED _____ LENGTH OF INTERVIEW [ ][ ] 663 664

INTERVIEWER'S NUMBER [ ][ ][ ] 665 666 667

BOOTH NUMBER [ ][ ] 668 669

LOCATION NUMBER [ ][ ][ ] 670 671 672

AREA CODE

1. 201
2. 609

EXCHANGE _____

NUMBER OF CALLS MADE TO THIS NUMBER

673- 1
2
3
4

TYPE OF USER (CIRCLE ONE)

674- 1. LIGHT (10 or less days in last year)
2. HEAVY (11 or more days in last year)

FISH7
701-705

HARVEST ESTIMATE POLL

INTERVIEWER: Write in data from the last questionnaire for this person before calling the number:

Respondent ID Number: ___ ___ ___ ___
706 707 708 709

Week Contacted: ___ ___
710 711

Day Contacted:

712- 1. MONDAY
2. TUESDAY
9. OTHER (SPECIFY _____)

Respondent's Name: _____

Month last contacted: _____

Telephone Number: _____

Alternate Telephone Number: _____

Hello, my name is _____ (first and last name). I'm a student at/on the staff of Rutgers University and I'm continuing a survey for the Marine Science Center. May I speak to _____, please? (This is part of a study of New Jersey fishermen. We spoke to _____ last _____ and he knows we were going to call him again. May I speak with him, please?)

Result of contact:

713- 1. SUCCESSFUL CONTACT
2. REFUSED ACCESS TO RESPONDENT
3. RESPONDENT REFUSES--NO REASON GIVEN
___ RESPONDENT REFUSES--REASON WAS
___ _____
(fill in code)

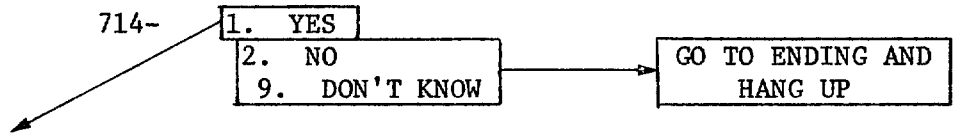
CALL BACKS:

--RESPONDENT BUSY (MAKE APPOINTMENT FOR NEXT EVENING OR LATER THAT EVENING)
--RESPONDENT NOT HOME (ASK IF HE CAN BE REACHED AT ANOTHER NUMBER, OR MAKE AN APPOINTMENT TO CALL BACK LATER IN THE EVENING OR THE NEXT EVENING)

When respondent comes to the phone, reintroduce yourself and say:

We were talking to you this past _____ (month of last contact) about the saltwater fishing you do around New Jersey. We would just like to ask you a few more questions.

1. Have you done any saltwater fishing in New Jersey since we talked to you last? (Since last _____.)



2. About how many days have you spent saltwater fishing in New Jersey since then?

715	716	717

IF "NONE", SKIP TO CONCLUSION

IF "ONE" OR MORE, ASK:

3. For the purposes of our survey we have divided all saltwater fishing into three categories--ocean fishing from a boat or pier, surf casting, or fishing in saltwater bays and rivers. Which of these have you done in New Jersey in the past week?

FOR EACH TYPE MENTIONED, ASK:

How many days have you done that in the past week?

		No. of days in past week
Ocean fishing	719-	
Surf-casting	720-	
Bay or river fishing	721-	

(INTERVIEWER: IF "NONE", SKIP TO Q. 5, PAGE 4. IF "ONE" OR MORE, ASK THE APPLICABLE PARTS OF Q. 4 BELOW.)

4. For each of the following types of fishing, how many days have you done each one in the past week?

IF RESPONDENT HAS DONE THAT TYPE OF FISHING, ASK: And how many _____ did you catch on that trip/those trips?

	No. of days past week	
A. Ocean fishing for tuna	722 723	
No. of tuna caught		724 725 726
B. Ocean fishing for bluefish	727 728	
No. of bluefish caught		729 730 731
C. Ocean fishing for weakfish	732 733	
No. of weakfish caught		734 735 736
D. Ocean fishing for stripers	737 738	
No. of stripers caught		739 740 741
E. Ocean fishing for tile	742 743	
No. of tile caught		744 745 746
F. Saltwater bay and river fishing for fluke	747 748	
No. of fluke caught		749 750 751

No. of days past week

G. Saltwater bay and river fishing for weakfish

752 753

No. of weakfish caught

754 755 756

H. Saltwater bay and river fishing for white perch

757 758

No. of white perch caught

759 760 761

I. Saltwater bay and river fishing for bluefish

762 763

No. of bluefish caught

764 765 766

J. Surf fishing for stripers

767 768

No. of stripers caught

769 770 771

K. Surf fishing for bluefish

772 773

No. of bluefish caught

774 775 776

DUP 801-804 | 8 805 | DUP 806-812

L. Surf fishing for weakfish

813 814

No. of weakfish caught

815 816 817

5. Now let's talk about week before last. Did you go ocean fishing, surf casting or saltwater bay and river fishing in New Jersey that week?

FOR EACH TYPE MENTIONED, ASK:

How many days did you do that week before last?

		No. of days week before last
Ocean fishing	818-	☐
Surf casting	819-	☐
Bay or river fishing	820-	☐

(INTERVIEWER: IF "NONE", SKIP TO Q. 7, PAGE 5. IF "ONE OR MORE, ASK THE APPLICABLE PARTS OF Q. 6 BELOW.)

6. For each of the following types of fishing, how many days did you do each one week before last?

IF RESPONDENT HAS DONE THAT TYPE OF FISHING, ASK:

And how many _____ did you catch on that trip/those trips?

	No. of days
A. Ocean fishing for tuna	☐☐ 821 822
No. of tuna caught	☐☐☐ 823 824 825
B. Ocean fishing for bluefish	☐☐ 826 827
No. of bluefish caught	☐☐☐ 828 829 830
C. Ocean fishing for weakfish	☐☐ 831 832
No. of weakfish caught	☐☐☐ 833 834 835

No. of days

D. Ocean fishing for stripers

836 837

No. of stripers caught

838 839 840

E. Ocean fishing for tile

841 842

No. of tile caught

843 844 845

F. Saltwater bay and river fishing for fluke

846 847

No. of fluke caught

848 849 850

G. Saltwater bay and river fishing for weakfish

851 852

No. of weakfish caught

853 854 855

H. Saltwater bay and river fishing for white perch

856 857

No. of white perch caught

858 859 860

I. Saltwater bay and river fishing for bluefish

861 862

No. of bluefish caught

863 864 865

J. Surf fishing for stripers

866 867

No. of stripers caught

868 869 870

No. of days

K. Surf fishing for bluefish [ ][ ] 871 872

No. of bluefish caught [ ][ ][ ] 873 874 875

L. Surf fishing for weakfish [ ][ ] 876 877

No. of weakfish caught [ ][ ][ ] 878 879 880

DUP 901-904 | 9 905 | DUP 906-912

And what about the rest of the time since we last called you, but not including the last 2 weeks. Did you go ocean fishing, surf casting, or saltwater bay and river fishing in New Jersey during that time?

FOR EACH TYPE MENTIONED, ASK:

How many days did you do that during that time?

	No. of days since last called	
Ocean fishing	913- [ ]	-914
Surf casting	915- [ ]	-916
Bay or river fishing	917- [ ]	-918

(INTERVIEWER: IF NONE, SKIP TO CONCLUSION. IF "ONE" OR MORE, ASK THE APPLICABLE PARTS OF Q. 8, FOLLOWING PAGE.)

8. Of each of the following types of fishing, how many days have you done each one during that time? (Since we last called you, but not including the last 2 weeks.)

IF RESPONDENT HAS DONE THAT TYPE OF FISHING, ASK: How many _____ did you catch on that trip/those trips?

No. of days since last called (except last 2 weeks)

A. Ocean fishing for tuna

919 920

No. of tuna caught

921 922 923

B. Ocean fishing for bluefish

924 925

No. of bluefish caught

926 927 928

C. Ocean fishing for weakfish

929 930

No. of weakfish caught

931 932 933

D. Ocean fishing for stripers

934 935

No. of stripers caught

936 937 938

E. Ocean fishing for tile

939 940

No. of tile caught

941 942 943

F. Saltwater bay and river fishing for fluke

944 945

No. of fluke caught

946 947 948

G. Saltwater bay and river fishing for weakfish

949 950

No. of weakfish caught

951 952 953

H. Saltwater bay and river fishing for white perch

954 955

No. of white perch caught

956 957 958

No. of days since last called (except last 2 weeks)

I. Saltwater bay and river fishing for bluefish [ ][ ] 959 960

No. of bluefish caught [ ][ ][ ] 961 962 963

J. Surf fishing for stripers [ ][ ] 964 965

No. of stripers caught [ ][ ][ ] 966 967 968

K. Surf fishing for bluefish [ ][ ] 969 970

No. of bluefish caught [ ][ ][ ] 971 972 973

L. Surf fishing for weakfish [ ][ ] 974 975

No. of weakfish caught [ ][ ][ ] 976 977 978

CONCLUSION:

IF NOT THE LAST CONTACT SAY:

Thank you very much for your help. We will be calling you again later in the season. (HANG UP)

IF THE LAST CONTACT, SAY:

9. Let me ask you one last question. Have you done more fishing, less fishing, or different kinds of fishing than usual as a result of our calling you?

979- 1. MORE FISHING
2. LESS FISHING
3. MORE AND DIFFERENT KIND
4. LESS AND DIFFERENT KIND
9. DON'T KNOW

980- [ ] Other (Specify _____)
(FILL IN CODE)

THANK YOU VERY MUCH. (HANG UP)

APPENDIX B

Fitting Catch Data to
Negative Binomial Expectation

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Results of fitting the negative binomial distribution to the July to December 1975 catch of bluefish from ocean fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0.0	12	15.65	0	0.0	21	23.87
1	1.0	24	15.24	1-2	1.5	23	16.39
2-3	1.5	12	17.27	3-4	3.5	11	9.29
4-5	4.5	4	5.73	5-10	7.5	11	15.51
6-10	8.0	4	1.86	11-20	15.5	12	11.65
				21-60	45.5	8	10.30
				61-100	85.5	2	0.70
Chi-squared		10.48				7.58	
DF		2				4	
K		2.252				0.429	
Means before transformation		1.71				8.53	

Results of fitting the negative binomial distribution to the July to December 1975 catch of weakfish from ocean fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0.0	43	43.12			48	47.91
1	1.0	9	7.87	1-10	5.5	28	27.70
2-3	2.5	3	4.00	11-20	15.5	8	6.00
4-5	4.5	1	0.77	21-45	35.5	3	4.67
				46-80	62.5	2	1.12
Chi-squared		1.65				1.96	
DF		1				2	
K		0.341				0.180	
Means before transformation		0.39				5.03	

Results of fitting the negative binomial distribution to the July to December 1975 catch of striped bass from ocean fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0	47	46.89	0	0,0	63	62.96
1	1	7	7.55	1-5	2.5	16	15.04
2	2	2	0.27	6-10	8.5	5	3.99
				11-35	22.5	3	4.87
				36-75	55.0	1	0.81
Chi-squared		0.004			1.08		
DF		1			2		
K		0.895			0.104		
Means before transformation		0.20			2.40		

Results of fitting the negative binomial distribution to the July to December 1975 catch of tuna from ocean fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0	49		0	0.0	64	65.00
1	1	7		1-10	5.5	19	18.73
(No suitable estimate of K possible)				11-20	15.5	3	2.67
				21-70	45.0	2	1.42
Chi-squared					0.30		
DF					1		
K					0.106		
Means before transformation					1.73		

Results of fitting the negative binomial distribution to the July to December 1975 catch of striped bass from ocean fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0	47	46.89	0	0,0	63	62.96
	1	1	7	7.55	1-5	2.5	16	15.04
	2	2	2	0.27	6-10	8.5	5	3.99
					11-35	22.5	3	4.87
					36-75	55.0	1	0.81
Chi-squared			0.004			1.08		
DF			1			2		
K			0.895			0.104		
Means before transformation			0.20			2.40		

Results of fitting the negative binomial distribution to the July to December 1975 catch of tuna from ocean fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0	49		0	0.0	64	65.00
1	1	7		1-10	5.5	19	18.73
(No suitable estimate of K possible)				11-20	15.5	3	2.67
				21-70	45.0	2	1.42
Chi-squared					0.30		
DF					1		
K					0.106		
Means before transformation					1.73		

Results of fitting the negative binomial distribution to the July to December 1975 catch of striped bass from surf fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0	7	6.03	0	0.0	10	10.57
	1	1	3	5.71	1-3	1.5	9	7.29
	2	2	5	3.81	4-6	5.0	4	3.29
	3	3	4	2.19	7-21	14.0	3	6.10
	4-10	7	1	2.00	22-36	29.5	3	1.78
					36-50	42.5	1	1.32
Chi-squared			4.20			3.07		
DF			2			3		
K			2.43			0.34		
Means before transformation			1.55			6.83		

Results of fitting the negative binomial distribution to the July to December 1975 catch of bluefish from surf fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0	12	11.51	0	0.0	15	15.30
1	1	3	4.36	1-2	1.5	5	4.55
2	2	1	2.04	3-4	3.5	3	2.09
3	3	4	1.08	5-10	7.5	3	3.14
				11-30	20.5	2	3.31
				31-80	55.5	2	1.16
Chi-squared		10.90				1.18	
DF		1				3	
K		0.680				0.195	
Means before transformation		0.85				5.97	

Results of fitting the negative binomial distribution to the July to December 1975 catch of weakfish from surf fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0.0	13	12.72	0	0.0	22	21.85
	1-2	1.5	4	4.87	1-10	5.5	6	6.23
	3-4	3.5	2	1.42	11-40	25.0	2	1.49
	5-10	7.5	1	0.54				
Chi-squared			4.00				0.18	
DF			1				0	
K			0.363				0.101	
Means before transformation			0.90				2.23	

Results of fitting the negative binomial distribution to the July to December 1975 catch of bluefish from bay and river fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0.0	23	23.33	0	0	42	42.65
	1-2	1.5	11	8.58	1-5	3	19	16.19
	3-4	3.5	2	2.76	6-10	8	3	3.56
	5-20	12.5	1	2.25	11-90	54	1	2.57
Chi-squared			1.59				1.54	
DF			1				1	
K			0.322				0.173	
Means before transformation			1.03				1.77	

Results of fitting the negative binomial distribution to the July to December 1975 catch of fluke from bay and river fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0.0	11	12.39	0	0.0	14	15.92
	1-2	1.5	14	11.65	1-2	1.5	16	15.11
	3-4	3.5	5	5.72	3-4	3.5	12	9.01
	5-6	5.5	4	3.09	5-6	5.5	10	6.18
	7-8	7.5	2	1.73	7-8	7.5	4	4.44
	9-40	25.0	1	2.34	9-20		4	11.11
					21-35	28.0	4	2.65
					36-65	50.0	1	0.41
Chi-squared			1.80				9.77	
DF			3				5	
K			0.721				0.611	
Means before transformation			2.57				5.49	

Results of fitting the negative binomial distribution to the July to December 1975 catch of weakfish from bay and river fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0.0	26	25.73	0	0.0	34	33.27
	1-4	2.5	7	8.69	1-5	3.0	21	20.28
	5-8	6.5	3	1.65	6-15	10.5	6	8.20
	9-12	10.5	1	1.33	16-25	20.5	3	2.12
					26-35	30.5	1	0.50
Chi-squared			2.80				1.50	
DF			1				2	
K			0.200				0.261	
Means before transformation			1.03				3.14	

Results of fitting the negative binomial distribution to the July to December 1975 catch of white perch from bay and river fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0.0	34	33.97	0	0.0	59	58.96
	1-4	2.5	2	2.35	1-2	2.5	3	4.25
	5-8	6.5	1	0.26	3-4	3.5	3	1.02
Chi-squared			2.13				4.20	
DF			0				0	
K			0.043				0.067	
Means before transformation			0.27				0.24	

Results of fitting the negative binomial distribution to the January to June 1975 catch of striped bass from ocean fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0	33	32.82	0	0.0	45	45.00
1-3	1	3	3.66	1-5	3.0	15	12.72
4-6	5	2	0.64	6-15	10.5	4	5.18
				16-30	23.0	2	2.17
				30-80	55.0	1	0.71
Chi-squared		3.01			0.80		
DF		0			2		
K		0.076			0.125		
Means before transformation		0.45			2.56		

Results of fitting the negative binomial distribution to the January to June 1975 catch of mackerel from ocean fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0.0	22	21.00	0	0.0	34	30.94
	1-20	10.5	8	10.8	1-50	25.5	15	21.18
	21-50	35.5	5	3.02	51-199	150.0	6	7.10
	51-150	100.5	3	2.95	200-299	250.0	4	2.07
	151-251	200.5	1	0.46	300-399	350.0	4	1.04
					400-499	450.0	3	0.75
Chi-squared			2.70			19.25		
DF			2			3		
K			0.122			0.120		
Means before transformation			19.15			66.79		

Results of fitting the negative binomial distribution to the January to June 1975 catch of whiting from ocean fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0	28	24.49	0	0.0	35	32.81
1-15	8	8	8.79	1-30	15.5	16	18.72
16-40	28	3	2.65	31-99	65.0	6	6.80
41-100	70.5	3	1.96	100-199	150.0	3	3.04
100-200	150.5	1	0.68	200-399	250.0	4	2.59
				400-600	500.0	2	1.02
Chi-squared		0.82			1.40		
DF		2			3		
K		0.098			0.120		
Means before transformation		11.28			41.88		

Results of fitting the negative binomial distribution to the January to June 1975 catch of cod from ocean fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0	33	33.03	0	0	53	52.80
	1-5	3	4	4.95	1-5	3	7	8.44
	6-10	8	2	0.59	6-10	8	5	2.03
					11-50	35.5	1	1.47
Chi-squared			3.55			4.74		
DF			0			1		
K			0.085			0.074		
Means before transformation			0.51			1.44		

Results of fitting the negative binomial distribution to the January to June 1975 catch of pollack from ocean fishing.

	Light fishermen				Heavy fishermen			
	Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
	0	0	38		0	0	64	63.98
	1	1	1		1	1-5	2	1.53
	(No suitable estimate of K possible)							
Chi-squared						0.14		
DF						0		
K						0.015		
Means before transformation						0.11		

Results of fitting the negative binomial distribution to the January to June 1975 catch of winter flounder from bay and river fishing.

Light Fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0.0	19	18.50	0	0.0	22	20.27
1-10	5.5	6	8.54	1-15	8.0	23	24.08
11-20	15.5	4	1.83	16-30	23.0	11	7.09
21-30	25.5	1	0.85	31-60	45.5	6	7.30
31-50	40.5	1	0.47	61-100	80.5	2	4.54
				101-200	150.5	3	3.87
				201-400	300.5	2	1.51
Chi-squared		4.0			4.36		
DF		2			4		
K		0.148			0.258		
Means before transformation		4.71			29.51		

Results of fitting the negative binomial distribution to the January to June 1975 catch of weakfish from bay and river fishing.

Light fishermen				Heavy fishermen			
Class size	Class midpoint	Observed frequency	Theoretical frequency	Class size	Class midpoint	Observed frequency	Theoretical frequency
0	0.0	22	21.53	0	0.0	50	49.65
1-20	10.5	6	7.27	1-10	5.5	10	10.39
21-40	30.5	2	1.11	11-50	30.15	4	5.53
41-80	55.5	1	0.56	51-100	75.5	3	1.84
				101-130	115.5	2	0.34
Chi-squared		1.29			9.28		
DF		1			2		
K		0.091			0.068		
Means before transformation		4.94			8.64		