MESA-NYB FUNDED BIOLOGICAL RESEARCH
TRIMESTER PROGRESS REPORT -- JULY-SEPTEMBER 1975

U.S. DEPARTMENT OF COMMERCE
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National Marine Fisheries Service
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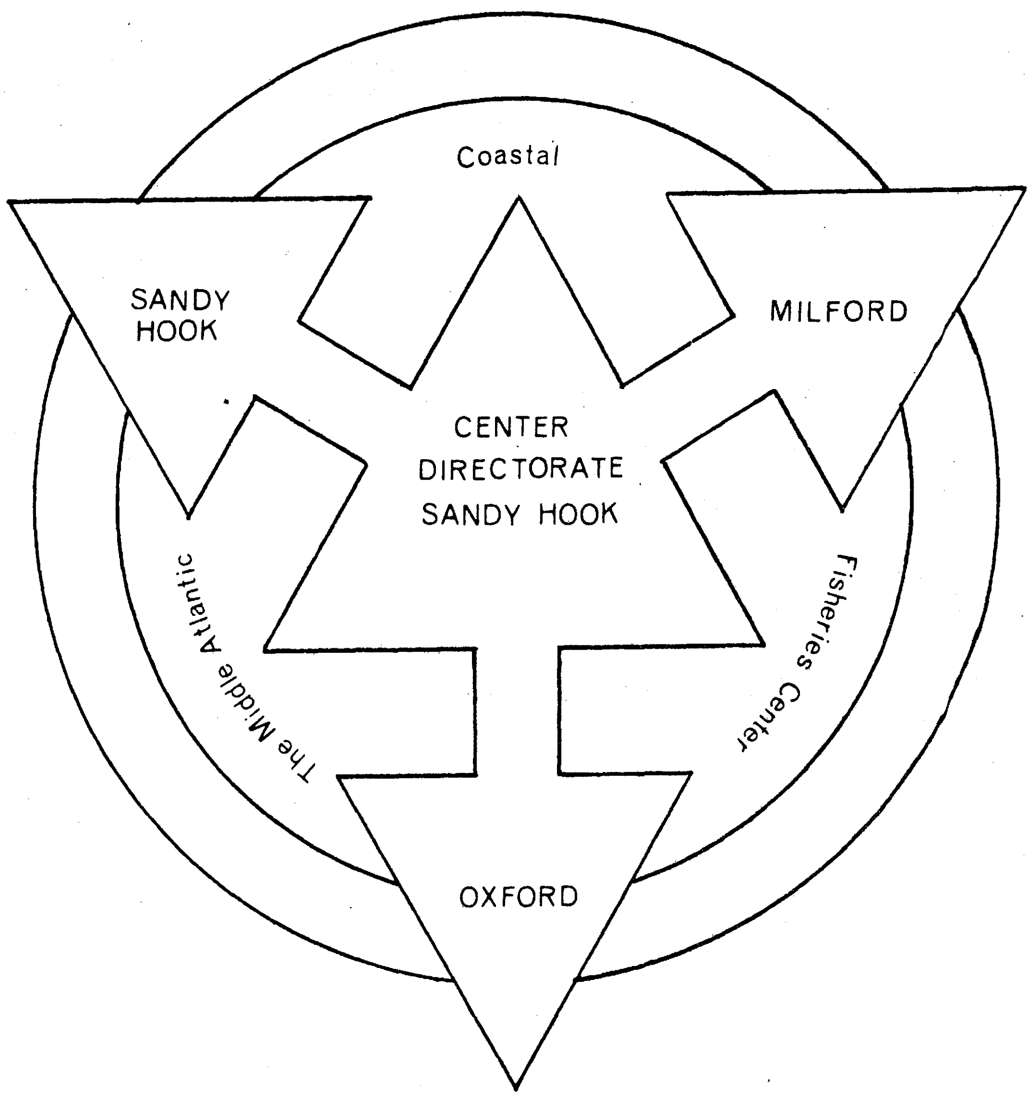
MIDDLE ATLANTIC COASTAL FISHERIES CENTER



Informal Report No. 88

November 1975

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I. INTRODUCTION

This report summarizes progress by this Center in MESA-funded research from July 1 through October 31, 1975. Section II consists of a summary of accomplishments. Section III is a detailed description of activities and accomplishments of the following individual studies:

1. Mutagenesis;
2. Fin Rot and Invertebrate Disease;
3. Benthic Macrofauna and Chemistry;
4. Phytoplankton and Primary Productivity;
5. Seabed Oxygen Consumption;
6. Microbiology.

It should be noted in passing that only the first three of the above studies are receiving direct MESA funding at present. The last three studies are continuations of formerly MESA-funded research which are essential for completion of past work. Proposals have been submitted for continued support of items 4 and 5.

Section V, Appendices, contains (1) Final report by Dr. Cok of Adelphi Univ., (2) a cruise report, and (3) final research reports by Drs. Tietjen and Lee of The City University of New York. The cruise report is that of Delaware II, 12-25 August 1975.

II. SUMMARY OF ACCOMPLISHMENTS

1. Cytogenetic methodology, as developed over the past few months for the study of mutagenesis in fish eggs of the New York Bight, now includes the ability to study formalin-fixed samples up to 30 years old, and the ability to study eggs even smaller than 1 mm mackerel eggs.
2. Approximately 2,000 blastodiscs were removed from eggs from three sources -- (1) Westward cruise, (2) a Sandy Hook lab cruise in the New York Bight of nine years ago, and (3) a Yale University collection of eggs sampled 30 years ago in Long Island Sound. Cytogenetic comparisons are in progress.
3. Winter flounder, held in traps in the sewage sludge area, either developed caudal fin rot or they died. Caudal fin lesions increased in severity with time of exposure.
4. The incidence of fin rot in summer flounder caught in Sandy Hook/ Raritan Bay was 1.8% compared with 0% in Great Bay.
5. Material for histological examination of diseased (eroded) fins and of adjacent musculature as found in winter, summer, and windowpane flounder, was obtained, and facilities were readied for studying disease progression and contagion in laboratory-held winter and summer flounder.
6. Based on collections in the Apex of over 1,000 rock crabs, lady crabs, and lobsters, 300 of which were dissected for histological study of gills, hepatopancreas, and hindgut, various pathological conditions were found. Rock crabs displayed progressive gill

blackening during the summer months. The blackening was characterized by amoebic infections, abundant ciliates, and accumulations of sand and grit; some gills harbored massive bacterial infections and abundant diatoms. Lady crabs, except those which had molted shortly before collection, had discolored or blackened gills. Although lobsters displayed less gill blackening than other species examined, they had an apparent amoebic infection and the hindgut contained large gregarines and larval tapeworms.

7. Agreement was reached on a tape format for the storage of fin rot data, and approximately 15% of existing data was transferred to forms in preparation for key punching.

8. Samples from two more of the five quarterly benthic macrofauna cruises were sorted and identified, specifically one grab per station at 64 stations sampled in the January and March-April 1974 cruises.

9. Ten of 50 special samples obtained at 25 nested stations in the sewage sludge dump site were sorted and identified.

10. Preliminary analyses of the species distribution of benthic macrofauna sampled during three cruises -- August 1973, March-April 1974, and August 1974 -- was incorporated in the MESA Atlas manuscript by Dr. Pearce.

11. A machine listing of reconnaissance cruise data (August, '73) was proofed and hand-corrected. A final tape is being made; species coding of the Outer Continental Shelf (20-35 fathoms) data was completed; and species coding of the March-April 1974 cruise data was partially completed.

12. All Raritan Bay phytoplankton and primary productivity data except species identifications, numbers, diversity, and equitability of phytoplankton have been entered into the MACFC data bank.

13. Extremely high quantities of dissolved organic matter -- up to over 100 mg C m^{-3} hr^{-1} -- were released by phytoplankton to the waters of Raritan, Lower, and Sandy Hook Bays in summer.

14. At certain times, up to 50% of the primary productivity by phytoplankton (50% of the photoassimilated carbon) is in the form of dissolved organic matter.

15. One-hundred and one stations plus three special stations (for a total of 486 cores) were sampled for total seabed oxygen consumption in the Lower Hudson Valley, in the NYB Apex and in the proposed alternate dump sites during the 12-25 August 1975 cruise of the FRS Delaware II.

16. Computerizing, verifying, and analyzing MESA-sponsored seabed oxygen consumption data has been accomplished; results were prepared for presentation at the ASLO/New York Bight Symposium of 3-5 November 1975.

17. Total aerobic and total anaerobic plate counts of sediment bacteria were obtained at stations in the Apex and in areas farther offshore for correlation with fin rot and seabed oxygen consumption data as a result of the FRS Delaware II cruise of 2-3 September 1975. This was a combined cruise with Dr. Joel O'Connor, who obtained sediments for Dr. Timoney of Cornell University for the study of antibiotic resistant types of *Staphylococcus*.

18. About 500 sediment samples were readied for analyses of total organic carbon by the LECO analyzer method to provide additional data for correlation with seabed oxygen consumption and groundfish distribution data. Dr. Parks of Lehigh University has agreed to complete the analyses by December, 1975.

19. All existing groundfish catch data in the Apex were assembled preparatory to reanalyzing for possible avoidance by groundfish of sediments containing appreciably more organic carbon than background levels. Trawling locations were mapped. Final analyses were postponed, however, pending receipt of the new total organic carbon data to be provided by Dr. Parks (#18 above).

20. According to a final report by Dr. Tietjen of The City University of New York, total population densities of major meiofaunal taxa in the New York Bight are well within levels that would be expected for the depths sampled, indicating that population densities are not depressed.

21. According to a final report by Dr. Lee of The City University of New York, fewer Foraminifera were found in samples from both dredge spoil and northern parts of the sewage sludge dump site than in samples from other Apex areas, but not enough samples have been analyzed to justify statistical treatment.

22. The surficial sediment characteristics data for four seasonal cruises in the New York Bight Apex, covering the period June 1973 through April 1974, were received from Dr. Cok of Adelphi University. Data from over 2,000 samples including % of oxidizable carbon, mean grain-size distribution, skewness and kurtosis, are being key-punched for data management and analysis. Preliminary reviews of the data indicate that "high carbon areas" may be defined as those areas containing 2 or more percent of oxidizable carbon. Dr. Cok's final report, minus the very many pages of hand-written data, is forwarded as Appendix #1 to this report.

23. We continue our acceleration and expansion of our ADP processing capabilities. MESA data reports on (1) seasonal sedimentary heavy metals burden (NYB Apex), (2) multi-year hydrography of the New York Bight, (3) benthic macrofaunal distributions and abundances in NYB-Apex (March '74 cruise), and (4) surficial sedimentary characteristics (4 cruises) are in preparation and will be delivered to the MESA Project Office prior to or at the time of the December '75 meeting.

Presentations

1. McNulty, J. Kneeland. 1975. A Review of MESA-funded Benthic Ecological Studies being conducted by the Middle Atlantic Coastal Fisheries Center and by its Contractors. Proceedings of the Belle W. Baruch Institute for Marine Biology and Coastal Research. Symposium: "Ecology of Marine Benthos", 7-10 May 1975.

2. Thomas, James B. 1975. Seabed Oxygen Consumption in the New York Bight. ASLO, Dalhousie University, Halifax, Nova Scotia, 23-26 June 1975.

3. Thomas, James P. 1975. Seabed Oxygen Consumption in the New York Bight (Discussions). 10th European Symposium on Marine Biology, Ostend, Belgium, 17-23 September 1975.

4. Sindermann, Carl J. 1975. Effects of Coastal Pollution on Fish and Shellfisheries. ASLO/MESA Symposium on the Middle Atlantic Shelf and the New York Bight. New York City, 3-5 November 1975.

5. Rosenfield, Aaron. 1975. Disease Problems of Shellfish on the Middle Atlantic Coast. ASLO/MESA Symposium on the Middle Atlantic Shelf and the New York Bight. New York City, 3-5 November 1975.

6. Longwell, A. Crosby. 1975. Chromosome Disturbance and Mitotic Errors in Developing Mackerel Eggs Sampled out of the New York Bight. ASLO/MESA Symposium on the Middle Atlantic Shelf and the New York Bight. New York City, 3-5 November 1975.

7. Thomas, James P. 1975. Seabed Oxygen Consumption - New York Bight. ASLO/MESA Symposium on the Middle Atlantic Shelf and the New York Bight. New York City, 3-5 November 1975.

8. Pearce, John B. 1975. The Temporal and Spatial Distribution of Benthic Macroinvertebrates in the New York Bight. ASLO/MESA Symposium on the Middle Atlantic Shelf and the New York Bight. New York City, 3-5 November 1975.

9. Murchelano, Robert. 1975. Fish Disease Studies in the New York Bight. ASLO/MESA Symposium on the Middle Atlantic Shelf and the New York Bight. New York City, 3-5 November 1975.

Publications

Longwell, A. Crosby. 1975. Chromosome Disturbances and Mitotic Errors in Developing Mackerel Eggs Sampled out of the New York Bight. (Abstract) Amer. Soc. Limnology and Oceanography, Special Symposium, The Middle Atlantic Continental Shelf and New York Bight. pp.13-14.

Murchelano, R. and J. Ziskowski. 1975. Fish Disease Studies in the New York Bight. (Abstract) Amer. Soc. Limnology and Oceanography, Special Symposium, The Middle Atlantic Continental Shelf and New York Bight. p.49.

Pearce, John B. 1975. The Temporal and Spatial Distribution of Benthic Macro-invertebrates in the New York Bight. (Abstract) Amer. Soc. Limnology and Oceanography, Special Symposium, The Middle Atlantic Continental Shelf and New York Bight. pp. 54-56.

Rosenfield, Aaron. 1975. Disease Problems of Shellfish on the Middle Atlantic Coast. (Abstract) Amer. Soc. Limnology and Oceanography, Special Symposium, The Middle Atlantic Continental Shelf and New York Bight. pp.58-59.

Sindermann, Carl J. 1975. Effects of Coastal Pollution on Fish and Fisheries. (Abstract) Amer. Soc. Limnology and Oceanography, Special Symposium, The Middle Atlantic Continental Shelf and New York Bight. pp.63-64.

Thomas, J. B., W. Phoel and F. Steimle. 1975. Seabed Oxygen Consumption - New York Bight. (Abstract) Amer. Soc. Limnology and Oceanography, Special Symposium, The Middle Atlantic Continental Shelf and New York Bight. pp. 67-68.

Submitted for Publication

Bodammer, Joel E. Preliminary ultrastructural observations on microorganisms associated with the gills of rock crabs (*Cancer irroratus*) collected from the New York Bight. Abstract. Annual Meeting, American Microscopical Society, New Orleans, LA, 10-14 November 1975.

1. MUTAGENESIS

Methodology

Improvements in egg dissection (blastodisc removal) procedures and in staining procedures have enabled us to process and study formalin-preserved eggs which are up to thirty (30) years old and have enabled us to study eggs smaller than the one (1) mm eggs heretofore handled. The special photomicroscope was received, has been setup and is now in use. Two technicians have been hired and trained; a third technician is yet to be hired. The methodology for staining long-preserved (formalin) eggs enabled us to make some preliminary comparisons as to relative levels of chromosomal aberrations in long-stored eggs vis-a-vis those taken during the 1974 Westward cruise.

Work Progress

Although newly-prepared slides have been photomicrographed, detailed studies have not as yet been made inasmuch as present project emphasis is on completion of the Westward samples. In this respect, additional slides from samples taken from the first 14 Westward stations were analyzed. For comparative purpose, two (2) 30-year old samples of another species (taken from Long Island Sound and held by Yale University), were studied. Eggs of a third species, taken nine years ago in the New York Bight, were analyzed also for comparative purposes. This Westward-related work was presented at the ASLO meeting. A detailed version of the manuscript will be submitted in the near future to MESA as its requested report on the genetic aspects of the joint Westward cruise.

Approximately 2,000 blastodiscs have been removed from equal numbers of fish eggs as a prerequisite for further processing. Such removals permit the mutagenic study of eggs measuring less than 1 mm in diameter.

Outline of Westward manuscript:

I. Introduction

A. Marine contaminants as mutagens;

B. Genetic sensitivity of fish;

C. Special conditions of zygotic exposure in the neuston;

D. Cytogenetic appraisals of genetic damage in developing fish zygotes;

E. New York Bight as an opportunity to appraise effects of pollutants upon fish zygotes.

II. Materials and Methods

A. Cytogenetic processing procedures as adapted to the neuston;

B. Resumé of life history of the mackerel;

C. Staining and pre-treatment methodology.

III. Discussion

A. Distribution of chromosomal aberrations and mitotic errors in finfish zygotes in the New York Bight.

B. Relative incidence, between stations, of genetically unbalanced cells of fish eggs in the New York Bight.

C. Background rates of chromosome aberrations and mitotic errors for fish and their zygotes;

D. Problem of comparing error incidence in eggs at different developmental states;

E. Fate of advanced fish embryos with genetically unbalanced cells;

F. Genetic damage to zygotes as a parameter in the natural fluctuations of spawning success in the fisheries.

2. FIN ROT AND INVERTEBRATE DISEASE

A. Fin Rot Disease

1. Entrapment studies with winter flounder in sewage sludge areas.

Buoys provided by the MESA Project Office were placed at designated sites in the sewage sludge areas (test) and on the southern shore of eastern Long Island (control). To date, six exposure trials have been conducted with winter flounder (*Pseudopleuronectes americanus*) at the test site and one trial at the control site. Preliminary observations reveal that all fish exposed at the sewage sludge site either develop caudal fin rot or die. Caudal fin lesions are more severe in fish exposed for a longer time; the number of surviving fish is smaller at higher ambient temperatures. Only one exposure trial was made at the control site; however, the condition and percentage survival of the trapped fish were substantially better than at the sewage sludge site.

2. Fin rot incidence in summer flounder from Sandy Hook Bay and Great Bay, N. J.

During the period July 1 - September 30, 1975, a total of 25 trawl collections in Sandy Hook/Raritan Bay and 8 trawl collections in Great Bay were made to determine the monthly incidence of fin rot disease in summer flounder (*Paralichthys dentatus*).

of 320 summer flounder examined from Sandy Hook/Raritan Bay, 6 (1.8%) had fin rot. In Great Bay, 67 summer flounder were examined; none were found with fin rot disease. At this time, insufficient data have been collected to test the hypothesis that the incidence of fin rot disease in summer flounder increases from May through October. Intensive sampling will be conducted in Sandy Hook/Raritan Bay from May through October of FY'76.

3. Histologic studies of normal and fin rot flounder epidermis.

Trawl collections of winter, summer, and windowpane flounder (Scopthalmus aquosus) have been made to obtain the required number of fish for histologic study of fin and somatic epidermis. Excised portions of the dorsal and caudal fins (with adjacent musculature) have been fixed in 10% seawater formalin and blocked in paraffin. The tissues will be cut, stained, and examined when field activities have abated.

4. Fin rot disease progression in laboratory-held winter and summer flounder.

5. Fin rot disease contagion in laboratory-held winter and summer flounder.

The aquarium facilities (tanks, etc.) required for conduct of the experiments planned have been acquired. A Polaroid MP3 copy camera has been equipped with stroboscopic lights so that diseased fish confined under water in enamel holding trays can be photographed. Initial photographs taken of fish underwater have demonstrated the feasibility of this method in documenting gross pathology and contagion.

6. Fin rot disease in pelagic fish from pound and Fyke net fishery in Sandy Hook/Raritan Bay.

On July 23 and 24, a survey of the pound and Fyke net fishery in Sandy Hook/Raritan Bay was made to note how the traps were fished and what species were represented in the catch. Although the fishermen were highly cooperative and freely permitted biologists to view the net emptying process, it was not possible to examine fish for prevalence of fin rot disease at the nets. Since most fishermen sell their catch at the Belford Fisherman's Cooperative, a visit to the co-op established our intent to sample dockside landings. Upon completion of training of a South Hampton College work/study student, the sampling of pound and Fyke net catches via landings at the Belford Cooperative will begin.

B. Invertebrate Disease

1. Collections

Rock crabs (*Cancer irroratus*), lady crabs (*Ovalipes ocellatus*), and lobsters (*Homarus americanus*) were collected by otter trawl in Sandy Hook Bay and in the New York Bight MESA apex. Over 1,000 animals were examined macroscopically for evidence of gill discoloration or blackening and approximately 300 animals were dissected for histological study of gills, hepatopancreas and hindgut (intestine). Several important factors were found to be essential for obtaining statistically valid data on fouling and discoloration:

(1) scheduling collections just prior to molting cycles of host animals; (2) estimating the condition of animals to distinguish those which had recently molted from those which apparently had undergone the final molt of their life cycle; and (3) detecting normal changes in gill color (especially with C. irroratus) which occur during the intermolt period.

2. Epibionts

Lobsters were found to show the least amount of gill discoloration of all species studied; however, they were found to have an apparent amoebic infection possibly due to Paramoeba perniciosa Sprague, Beckett & Sawyer. Large gregarines, probably Porospora gigantea were found in the hindgut as were larval stages of tapeworms. Ciliates (peritrichs and suctorians) frequently were found on gills when specimens were taken shortly after molting. Many lobsters had large populations of sessile ciliates on their gills. Crabs, which were no longer undergoing ecdysis, had discolored or blackened gills. Rock crabs were the animals of choice for following progressive blackening during summer because their period of ecdysis occurs in the winter. Amoebic infections, extensive ciliate populations, and excessive sandy or gritty accumulations were present on the gills. Massive bacterial infections and diatom populations also were found on a significant number of rock crabs. Microscopic examination are continuing and observations will be summarized in the next report.

3. BENTHIC MACROFAUNA

In recognition of the fact that multivariate analysis is the goal of present macrofaunal studies, major emphasis during the past four months has been on procuring additional data and making it available in machine-readable form. Sorting and identification of samples from two more of the five seasonal cruises was accomplished and much of the numerical coding of species and other ADP-preparatory work has been completed (see Table 2, page 25 updating the status of all benthic work). We now have seasonal data from at least 64 stations in the Apex -- at least one grab per station -- for August 1973, and January, March-April, and August 1974.

We are also working up extra samples taken at the sewage and dredge spoil dump sites in February and April 1975. The extra samples consist of two grabs per station at 25 stations in each of the dump sites. They were taken to fill in critical gaps between stations that were visited during the five seasonal cruises. We expect to be able to work up these samples during the next trimester. Ten of these samples from the sewage sludge dump site have already been sorted and identified.

We have exchanged information with the MESA staff on how to set up the benthic macrofaunal tape format and we understand that the approved format will be sent to us soon. We are prepared to supply the tapes on all macrofaunal data as quickly as possible after receipt of the approved format.

Preliminary analysis of the distribution and abundances of benthic macrofauna as sampled during three seasonal cruises has been completed and reported in the MESA Atlas manuscript by Dr. Pearce, from which the accompanying statistics (Table # 1) are taken. Species distribution can be thought of as falling into three broad categories: (1) A few species that occur regularly at many stations, often in great abundance. (Certain species exhibited marked consistency of occurrence, both areally in samples from one season and temporally in samples from all three cruises. They can be categorized as widespread and abundant). (2) A few other species that occur irregularly but often in great abundance. (Certain species exhibited "contagious" distribution, i.e., huge numbers of individuals of a single species occurred in some samples); and (3) A great many additional species that occur irregularly, at few stations, and in few numbers. Some few species, namely *Tellina agilis* and *Nucula proxima*, found in the second category were also in the first category, as illustrated in the lists which follow:

Table #1

Numbers of Macrofaunal Species in Samples from Three Seasonal Cruises

Information	August 1973	March-April 1974	August 1974
Total number species at all stations:	136	136	141
Average number of species/station	19	17	15
Average number of individuals/station:	420	293	174
Range, number of individuals:	1-4182	5-4378	0-1826
Number of species occurring at 50% or more of sampling stations:	6	5	3
Number of species occurring at 40% or more of sampling stations:	8	7	6
Number of species found at only one station:	37	35	36

Widespread and Abundant	Exhibiting Contagious Distribution
Rhyncocoel sp.	Polydora caulbergi
Glycera dibranchiata	Spirorbis borealis
Spiophanes bombyx	Protohaustorius holmes
Tharyx acutus	Protohaustorius wigley
Tellina agilis	Parahaustorius attenuatus
Lumbrineris fragilis	Unciola irrorata
Nucula proxima	Tharyx acutus
Lumbrineris tenuris	Nucula proxima

All of the widespread and abundant species were found in at least 30% of the samples, and by far the majority of them were found in more than 50% of the samples. The numbers per sample of individuals in the "contagious distribution" category ranged from 25 to 4,200. The latter number -- a record to date -- was attained by Nucula proxima. We anticipate that scheduled cooperative studies with CEDDA will contribute a great deal to an understanding of the underlying reasons for these distributional variations.

Data management activities have included (1) proofing and correcting a listing of the reconnaissance cruise data from which a final tape is being made, (2) species coding of the data from the April 1975 Outer Continental Shelf cruise (20-35 fathoms), and (3) species coding of the March-April 1974 seasonal cruise. As mentioned above, we need the approved benthic macroinvertebrate tape format in order to program all existing machine-readable data in acceptable form for archiving in EDS and for cooperative multivariate analyses with CEDDA.

4. PHYTOPLANKTON AND PRIMARY PRODUCTIVITY

Monthly survey cruises in Raritan, Lower and Sandy Hook Bays were completed in March 1975. Since that time, our entire effort has been devoted to entering our raw data into the MACFC data bank for subsequent analyses. Our input consists of 35 variables measured at each of twelve stations and at three to five depths as well on each month over a sixteen-month period. All raw data except for that concerning species identification, numbers, diversity and equitability of phytoplankton have been entered into the data bank. We are now in the process of editing, verifying and correcting this raw input and in correcting the programming itself. Our species identification, counts, and diversity information will be ready for computerization and analysis in March 1976. In the meantime, we anticipate producing 400 SYMAP's of the data as well as a rigorous statistical analysis looking not only at variability, its sources, confidence limits, but also interrelationships of all the variables within a station, by depth, by month, and by year.

Dissolved Organic Matter Released by Phytoplankton

Extremely high quantities of photoassimilated carbon are released to the extracellular environment by phytoplankton in Raritan, Lower and Sandy Hook Bays. Values in excess of 100 mg C m^{-3} hr^{-1} are being found during the summer.

As a comparison, Thomas (Mar. Biol., 1971) found a high value of 2.4 mg C m^{-3} hr^{-1} as dissolved organic matter (DOM) released from phytoplankton to occur in the highly productive estuaries of Georgia. Thomas (personal communication) has found DOM values up to 8 mg C m^{-3} hr-1 to occur in Puget Sound, Washington, with natural populations of phytoplankton. Anderson and Zeutschel (Limnol. Oceanogr., 1970) found values in the range of 4 to 6 mg C m^{-3} hr^{-1} in the highly productive upwelling area off the Washington coast. Ignatiades (J. Mar. Biol. U. K., 1973) found DOM values of 1 to 2 mg C m^{-3} hr^{-1} being released from natural populations of phytoplankton in two Scottish Sea lochs. Only in culture and only when stressing Skeletonema in darkness for 14 days followed by reillumination at 10,000 lux did Ignatiades and Fogg (J. Mar. Biol. U. K., 1973) find DOM values of nearly 40 mg C m^{-3} hr^{-1}.

We have scrutinized our methods and we believe our values are real. We do suspect others may find similar values in highly eutrophic areas if they were to examine these areas intensively. We are presently drawing the data together for a manuscript.

We are also finding that at certain times up to 50% of the primary productivity by phytoplankton (50% of the photoassimilated carbon) is in the form of DOM released to the extracellular environment. However, until our data analysis is further along, we hesitate to speculate on whether or not we are finding abnormally high values of percents of extracellular release (PER) for a highly eutrophic estuary. The expected average PER based on the literature should be less than 10-15%.

5. SEABED OXYGEN CONSUMPTION

Our major effort since March 1975 has been to computerize and verify our data. We paused briefly for a cruise on the FRS Delaware II to the Lower Hudson River, N. Y. Bight Apex, Hudson Shelf Valley and proposed alternate waste disposal sites 12-25 August 1975. One-hundred one stations plus three special stations (486 cores) were sampled with the multiple corer to measure total oxygen consumption by the seabed. Seventy-eight stations were occupied in the Lower Hudson Estuary and New York Bight Apex. Sixty-four stations were part of our standard grid over the apex. Beyond the apex, five stations were sampled down the axis of the Hudson Shelf Valley, twelve within the proposed alternate waste disposal sites (six within each site and six stations on the adjacent continental shelf).

We have also submitted an extended abstract for a paper to be presented at the New York Bight Symposium to be held at the American Museum of Natural History in New York City, 3-5 November 1975.

6. MICROBIOLOGY AND CHEMISTRY

A microbiology sampling cruise was completed aboard the R/V Delaware II, in the Bight, on September 2-3, 1975. This was a combined cruise with Dr. J. O'Connor who obtained sediments for Dr. Timoney of Cornell University for the study of *Staphylococcus* antibiotic resistant types.

Sediments were obtained from offshore stations, areas NB-1, 2D-2 (control areas), stations previously monitored for the fin rot study (disposal areas) and from 32 stations along 2 east-west transects (30-40 numbered series). Both total aerobic plate counts and, from one transect, total anaerobic plate counts were obtained. The counts were done in order to determine any correlation of bacterial numbers in sediments with differences in benthic respiration (O_2 uptake) observed by Dr. Thomas during the 12-25 August cruise, along the same transects.

Some of the sediments were plated aboard the vessel in order to determine effects, if any, of immediate plating of sediment samples as compared with plating later at the Laboratory, and to help solve problems of doing onboard microbiology. Anaerobic counts tended to be a little lower when plated aboard ship and except for 1 station aerobic counts did not vary greatly. However, the number of samples plated aboard was limited. Other microbiology performed was as previously reported under the fin rot study, except that fecal coliform counts were not done because of the increased load for plating the 32 sediment samples. Although analysis and comparisons have not been completed, results from the fin rot stations compare to those of a year ago, except for a tendency for lower plate counts this year.

The aerobic and anaerobic plate counts on the sediments from the two east and west transects generally follow the same pattern observed in O_2 uptake along the same transects in the benthic respirometry studies, that is, higher counts in the sewer sludge and disposal areas with decrease in numbers as one approaches the peripheral areas. Variability in the plate counts does exist, however.

IV. MESA DATA REPORT

Accomplishments

The current state of processing of each data set of each MESA cruise is shown in Table 2. The table is arranged chronologically by cruise and location. It identifies the types and numbers of samples taken and their disposition including subsequent analyses and data processing. We welcome suggestions as to how the table might be improved, and hope that it provides the MESA Project Office with an improved overview of the entire MACFC/MESA effort. An "x" in a column shows that data in that category has been collected or that the indicated activity has been completed. A blank in a column indicates either that an entry is not applicable or that the subject activity has not yet been completed.

The Center's new terminal, which is known as the COPE 1200 Batch-Mode Terminal, provides electronic access to the computer at Fort Monmouth, N.J., an IBM 360/65. The terminal consists of central processor, card reader, and line printer plus a UNIVAC 1701 verifying punch. The central processor contains 4,000 12-bit words of memory. The card reader, capable of handling up to 150 cards per minute, transmits data via telephone lines to Fort Monmouth. It employs a 208B Model encoding and decoding system. The line printer prints data at a rate of 300 lines per minute. The verifying punch functions on-line as a card-punch machine, and off-line as a key-punch verifying machine. It can punch cards at a rate of 20 cards per minute. Plans for future development of the terminal include, tentatively, addition of a pen-plotter.

TABLE 2. DISPOSITION OF BENTHIC SAMPLES AS OF 31 OCTOBER 1975

Vessel/Date	Purpose and Location	# Stations	# Grabs/ Station	Total # Grabs	ROSCOP FORM	Investigator or Discipline	# Samples, Subsamples, or Cores	# Sorted	# Identified	# Analyzed (Chem. or Sedim.)	Final Contract Report Received	Log Sheets Prepared for Keypunching	# Keypunched	Machine Listed	Edited	Data Report	SYMAP	Taped	Tape Edited	Archived at EDS	Tape to CEDDA	Scientific Publications
Historical Data Aug. 1968- Dec. 1971	Corps Study (Apex)	26	1-23	187		Pearce	187	187	187			x	187	x	x	x		x				
Atlantic Twin 5-14 June 73	RECON (Apex)	8 21	20 5	160 105 265	x	Pearce	265	265	265			x	265	x	x			x				
						Grieg	265			265[1]		x	246	x		x						
						Cok	265			265	x											
						Tietjen	265				x											
						Small					x											
Albatross IV 2-6 Aug. 73	1st quarterly cruise (Apex)	64	5	320	x	Pearce	320	174	174			x	174	x		x		x				
						Grieg	320			107		x	107	x		x						
						Cok	320			320	x											
						Tietjen	320				x											
						Small					x											
						Hydrography[2]				x		x	x	x	x		x					
Oregon II 20-25 Oct. 73	2nd quarterly cruise (Apex)	93	5	465	x	Pearce	465	10	10							x						
						Grieg	465			107		x	107			x						
						Cok	465			465	x											
						Small					x											
						Hydrography[2]				x		x	x	x	x		x					
Albatross IV 22-30 Jan. 74	3rd quarterly cruise (Apex)	103	5	515	x	Pearce	515	64	64													
						Grieg	515			107		x	107			x						
						Cok	515			515	x											
						Small					x											
						Thomas	180[3]			180		x	180	x	x	x	x					
						Hydrography[2]				x		x	x	x	x		x					

TABLE 2. (continued)

Vessel/Date	Purpose and Location	# Stations	# Grabs/ Station	Total # Grabs	ROSCOP FORM	Investigator or Discipline	# Samples, Subsamples, or Cores	# Sorted	# Identified	# Analyzed (Chem. or Sedim.)	Final Contract Report Received	Log Sheets Prepared for Keypunching	# Keypunched	Machine Listed	Edited	Data Report	SYMAP	Taped	Tape Edited	Archived at EDS	Tape to CEDDA	Scientific Publications
Oregon II 22 Mar.-3 Apr. 74	4th quarterly cruise (Apex)	103	5	515	x	Pearce	515	64	64													
						Grieg	515			107		x	107	x		x						
						Cok	515			515	x											
						Small					x											
						Thomas	245[3/]			245		x	245	x	x		x					
						Hydrography[2/]				x		x	x	x	x		x					
Venture 21-30 June 74	Alt. Dump Sites (DUPI)																					
	North	33	1	69	x	Pearce	69	69	69			x	69	x		x		x				
	South	36	1			Grieg	69			69												
						Grain size: AOML	69			69												
Delaware II 26 Aug.-5 Sept. 1974	5th quarterly cruise (Apex)	103	5	515	x	Pearce	515	102	78				78	x		x		x				
						Lee					x											
						Heavy metals	515			Storage												
						Grain size	515			Storage												
						Small					x											
						Thomas	300[3/]			300		x	300	x	x	x	x					
						Hydrography[2/]				x		x	x	x	x		x					
Delaware II 2-15 Dec. 74	Seabed O_2 Consumption Apex	63			x	Thomas	241[3/]	--	--	241		x	241	x	x		x					
						Hydrography[2/]				x		x	x	x	x		x					
Delaware II 12-24 Feb. 75	Sludge dump & vicinity	24	2	48	x	Pearce	48	10	10													
						Heavy metals	48			Storage												
						Grain size: Parks	48															
		38	1			Foehrenbach	38[4/]															
		6	1			Exxon and Duedall	12[5/]			x												
						Hydrography[2/]				x		x	x	x	x		x	x				
	Alt. Dump Sites (DUPI)																					
	North	6	5	30		Pearce	30	30	6			x	6	x		x						

TABLE 2. (continued)

Vessel/Date	Purpose and Location	# Stations	# Grabs/ Station	Total # Grabs	ROSCOP FORM	Investigator or Discipline	# Samples, Subsamples, or Cores	# Sorted	# Identified	# Analyzed (Chem. or Sedim.)	Final Contract Report Received	Log Sheets Prepared for Keypunching	# Keypunched	Machine Listed	Edited	Data Report	SYMAP	Taped	Tape Edited	Archived at EDS	Tape to CEDDA	Scientific Publications
Delaware II 12-24 Feb. 75 (continued)	North	6	5	30		Heavy metals				Storage												
						Grain size				Storage												
						Thomas	24			24		x	24	x								
						Hydrography[2]				x		x	x	x								
						Exxon	1[5]			x												
	South	6	5	30		Pearce	30	30	6			x	6	x		x						
						Heavy metals	30			Storage												
						Grain size	30			Storage												
						Thomas	24			24		x	24	x								
						Hydrography[2]				x		x	x									
						Exxon	1[5]			x												
	Lower Hudson Estuary	10				Thomas	40			40		x	40	x								
						Hydrography[2]				x		x	x									
	Hudson Shelf Valley & vicinity	7				Thomas	28			28		x	28									
						Hydrography[2]				x		x	x									
Delaware II 23-30 Apr. 75	Outer Continental Shelf (OCS)	60	5	300	x	Pearce	300	60	60			x	x	x								
						Heavy metals	300			Storage												
						Grain size	300			Storage												
						Hydrography[2]				x												
	Dredge Spoils Dump	25	2	50		Pearce	50			Storage												
						Heavy metals	50			Storage												
						Grain size	50			Storage												
						Hydrography[2]				x												
Kelez 28 May - 2 June 75	Long Island Near Shore (LINS)	59	5	295	x	Pearce	295			Storage												
						Heavy metals	295			Storage												
						Grain size	295			Storage												
						Hydrography[2]				x												

TABLE 2. (continued)

Vessel/Date	Purpose and Location	# Stations	# Grabs/ Station	Total # Grabs	ROSCOP FORM	Investigator or Discipline	# Samples, Subsamples, or Cores	# Sorted	# Identified	# Analyzed (Chem. or Sedim.)	First Contract Report Received	Log Sheets Prepared for Keypunching	# Keypunched	Machine Listed	Edited	Data Report	SYMAP	Taped	Tape Edited	Archived at EDS	Tape to CEDDA	Scientific Publications
Delaware II 12-24 Aug. 75	Seabed O_2 Consumption				x																	
	Apex	69				Thomas	276			276		x	276	x	x							
						Hydrography2/				x		x	x	x	x		x					
	Alt. Dump Sites																					
	North	6				Thomas	24			24		x	24	x								
	South	6				Thomas	24			24		x	24	x								
						Hydrography2/				x		x	x	x								
	Lower Hudson Estuary	78				Thomas	312			312		x	312	x								
						Hydrography2/				x		x	x	x								
	Hudson Shelf Valley & vicinity	11				Thomas	44			44		x	44	x								
						Hydrography2/				x		x	x	x								

1/ Analyses not funded by MESA.
2/ Temperature, salinity, dissolved oxygen, percent saturation of oxygen and sigma T of bottom water.
3/ Some subsamples delivered 11 Nov. 1975 to Dr. Parks at Lehigh University for organic carbon analysis using the LECO analyzer.
4/ Dr. Foerenbach plans to determine chlorinated hydrocarbon residues such as PCB's and DDT, and possibly other contaminants (information from Dennis Sullivan, 12 Oct. 1975.
5/ Exxon has reported to MACFC the results of analyses for heavy hydrocarbons (15+), and Dr. Duedall has incorporated results of analyses for carbon and nitrogen in a manuscript submitted last June to J. Walter Poll. Contr. Fed.

Data handling efforts have been directed toward four sets of benthic data: RECON, 1st and 5th quarterly cruises, and OCS. The RECON set was carefully edited and now stands ready for programming to the MESA tape format, which was finalized just prior to writing this report. The 1st and 5th quarterly cruises are in process of being edited. The OCS data were keypunched and machine-listed.

A computer specialist from the NMFS Central Office devoted over two weeks at Sandy Hook to assist the benthic project with programming. The RECON program was debugged, and a new program was written which summarizes the data by year, shows the average numbers of species and individuals per station, and the maximum and minimum number of individuals. The program also lists each species by number of occurrences of each in ascending order, thus permitting separation of groups of species that occur at 50%, 25%, etc., of all stations during an entire year.

A coding form to accept fin rot data was developed in cooperation with the MESA Project Office. About 15% of the available data have been transferred to the forms and keypunching will begin when a more substantial quantity of data have been transferred. Entries include latitude, longitude, depth, temperature, direction of tow, species, total number of fish, number of diseased fish, the name(s) of diseased fin(s), and whether the disease is deemed active or inactive. Eight species have been included to date: winter flounder, summer flounder, windowpane, fourspot flounder, striped bass, weakfish, bluefish, and yellowtail flounder.

Considerable thought was given to how the mutagenesis data can best be handled, but as yet a standard format has not been developed.

Forwarding Dates

Despite significant gains in ADP capabilities and the best efforts of project personnel, we must revise previously-submitted forwarding dates of tapes for archiving by EDS and for multivariate analyses by CEDDA. The following schedule reflects changes that appear to be attainable in the light of expected continued improvement of our ADP capabilities:

Data Set	Data Report	Tape
RECON	30 Nov. 1975	31 Dec. 1975
Aug. '73 Cruise	Completed	31 Dec. 1975
Aug. '74 Cruise	Completed	31 Dec. 1975
Jan. '74 Cruise	31 Jan. 1976	31 Mar. 1976
Mar. '74 Cruise	29 Feb. 1976	30 Apr. 1976
Oct. '73 Cruise	31 Mar. 1976	31 May 1976

Time devoted to ADP Activities

We can identify several blocks of time that have been devoted exclusively to ADP activities as follows:

Data Handling	Person/Weeks
Benthic Project	11
Fin Rot Project	3
Programming	4
Key-punching	2
ECM Operations	1

Although unfunded by MESA during this trimester, both Dr. Thomas and Mr. O'Reilly have devoted large amounts of time to preparing their data for keypunching, editing machine listings, and obtaining SYMAPS. They are at the stage of having edited and corrected machine listings of the bottom water hydrographic data, and of the primary productivity and seabed oxygen consumption data. They have obtained many SYMAPS of the latter data set. One full-time aid has assisted them with data handling.

APPENDIX 1

Surficial Sediments in the New York Bight Apex

Anthony E. Cok

Received
NOV 7 1975
Knea McNulty

Surficial Sediments in the New York Bight Apex

Introduction

This report is directly concerned with the variation in certain parameters of the surficial sediments collected in the New York Bight Apex over a period of two years. Short Phleger corer liners were inserted in the relatively undisturbed top ten centimeters of sediment collected via Smith-McIntyre grabs at approximately 103 stations. Individual samples per station ranged from 1 to 23 with the result that certain stations (e.g. central dumpsite flank of Christiansen Basin) are represented by more than sixty samples while others are represented by 5 or fewer samples. Total number of samples obtained for this study exceed 3000.

The basic purpose of this investigation has been to explore the range or variability of six major parameters of the New York Bight Apex sediments in order a) to ascertain the possible variation in Benthic organisms associated with these sediments and b) to determine if temporal variation in sediment characteristics exceeds geographic variation. It is obvious that navigational variability or care in handling sediment samples on deck of each individual vessel is beyond the control of this investigator.

This report does not consider the range in variability of all the parameters of all of the sediment samples analyzed.

This type of information cannot be quantitatively handled by an individual investigator because the possible combinations of sample parameter and station locations (which varied from cruise to cruise) must be analyzed via a computer larger than any presently accessible to this investigator. At this time numerical data derived from analysis of the samples and a consideration of the possible meaning of a rough hand plot of the data from one of the cruises will be presented.

Sample Preparation

Samples were received by the investigator in short plastic corer liners capped at both ends. When received the samples were frozen but subsequently they were thawed to facilitate analysis. As a means of avoiding operator bias or selectivity the samples were analyzed on a random basis. The chief investigator had the sole responsibility for compiling and collating the data although a large number of individual technicians were involved in the basic handling and analysis of the samples. Six parameters were selected as having the greatest overall value in relating to benthic organism variety and size. These were:

a. hydrogen peroxide digestion of organics (ie. oxidizable organics)
b. graphic mean grain size
c. median grain size
d. inclusive graphic standard deviation
e. inclusive graphic skewness
f. graphic kurtosis

Digestible Organics

An approximate five gram sample removed from a composite of the top 4 centimeters of sediment was dried to a constant weight at 60° C. It was placed in a 150 ml erlenmeyer flask and covered by 2 centimeters of 30% H_2O_2 swirled in intervals of several hours over a twenty four hour period. Distilled water was added and the resultant supernatant very carefully siphoned. After drying, another portion of 30% H_2O_2 was added for an additional 24 hours. Distilled water was added again and the supernatant siphoned. The sample was redried to a constant weight at 60° C and the percentage of material lost due to oxidation was calculated.

Grain Size Distribution

A 5 to 10 gram sample was prepared by immersing it in a 4% Calgon solution for twenty four hours. Toward the end of this period the sample was subjected to low level sonification to facilitate disruption of the less tenacious agglomerates. After careful decantation distilled water was added and sonification performed again. After decantation the sample was placed in an oven until most of the remaining water had evaporated. A slightly damp sample was carefully removed to be processed by a Rapid Sediment Analyzer (R.S.A.) at Adelphi University. Knowing the initial weight of a sample is not necessary with an R.S.A. because the machine automatically measures the relative weight of each sample as it is processed.

Final particle size values are given as settling diameter values (Psi) - a more realistic value than sieve sizes which often do not reflect the true grain size of the particle measured but only the length of the two shortest axes. For example a mica platelet and a quartz grain may remain in the same screen but these two particles would have remarkably different hydraulic characteristics in a natural setting.

The cumulative frequency of occurrence was plotted against grain size measured both in the Wentworth scale and by particle diameter. The cumulative frequency curve plotted on a probability scale provides the "shape" values which are compared to a "normal distribution". A normal distribution on a probability scale plots as a straight line; thus, any deviation from normality caused by a sediment composed of two or more populations results in an inflection in the curve (Moss, 1972). This method makes it possible to analyze for bimodality of tri-modality, normally an impossible procedure with non-probability scales. Sediment statistics are derived from the cumulative frequency curve.

The grain size, expressed in the Wentworth scale, is given in Ø (phi) units, where $Ø = -\log_2 d$, and d = particle diameter in millimeters (Folk, 1968). The statistical parameters of importance are the mean ($\bar{Ø}$), the median (MdØ), the coefficient of sorting or the standard deviation ($\sigma Ø$), the skewness (S_k) and the kurtosis (k). The formulae used in these calculations were:

- mean ϕ : $\bar{\phi} = \dfrac{\phi 84 + \phi 50 = \phi 16}{3}$
- sorting : $\sigma\phi = \dfrac{\phi 84 - \phi 16}{4} + \dfrac{\phi 95 - \phi 5}{6.6}$
- skewness : $S_k = \dfrac{\phi 84 + \phi 16 - 2\phi 50}{2\ (\phi 84 - \phi 16)} + \dfrac{\phi 95 + \phi 5 - 2\phi 50}{2\ (\phi 95 - \phi 5)}$
- kurtosis : $k = \dfrac{\phi 95 - \phi 5}{2.44\ (\phi 75 - \phi 25)}$

These sediment parameters derived from grain size distributions are used as follows. The mean ($\bar{\phi}$) describes the "effective" size of the sample in that it is a measure of the most predominant grain size in the total sample. $\bar{\phi}$ is used in most of the sediment transport equations to obtain an approximation of the current velocity required to initiate movement. The sorting measure ($\sigma\phi$) indicates how well sorted the particle sizes are in a specific sample. If most of the particles are the same size, as for example in a sample of Jones Beach Sand, the sample is said to be well sorted. If these is a wide range of particle sizes, the sample is said to be poorly sorted. Therefore the parameter $\sigma\phi$ provides an indication of the range of conditions that can exist in the transporting fluid (range of velocity, degree of turbulence, etc.) to cause a specific amount of sediment movement. Quantitatively:

$\sigma\phi$ = 0 to 1.1	Sample is well sorted.
$\sigma\phi$ = 1.1 to 1.6	Sample is moderately sorted.
$\sigma\phi$ > 1.6	Sample is poorly sorted.

The skewness measure (S_k) is also an indicator of the amount of sediment transport that can be expected from a current velocity determined by using $\bar{\phi}$. When $S_k>0$, the sediment distribution is skewed towards the finer material which, being smaller in size than the mean particle size, is also susceptible to transport under the $\bar{\phi}$ current velocity. When $S_k<0$, the sediment distribution is skewed toward the coarser material which under the $\bar{\phi}$ current velocity is less susceptible to movement.

The following discussion does not attempt to describe the total variation of sediment parameters in the New York Bight Apex but merely to provide baseline information derived from samples from one cruise very early in the sampling period that can be used for comparison with data from subsequent cruises.

Organics - %C

Map I illustrates the variability of digestible organics in the New York Bight Apex in early 1973. Previous studies of organics in this area utilizing similar preparatory methods served to demonstrate that a value of 2% C appears to be a "normal" level of organic material in the sandy sediments that dominate the coastal areas of New Jersey and Long Island.

Percent organics rapidly increase toward the central dumpsite and Christiansen Basin. Values of C increase beyond

17% C in the central basin and the upper end of the Hudson Cross Shelf Valley. It is however, virtually impossible to separate the effect of introduction of digestible organics via human activity such as the dumping of sewage waste from the natural tendency of fine grained sediment which are naturally enriched in organic detritus to collect or settle in these central depressions.

Graphic Mean

The graphic mean is the best graphic measure for demonstrating grain size variations over a wide geographic area. Mean size as illustrated in Map II demonstrates that the average particle zone of sediment in the New York Bight varies primarily as a function of water depth with finest sizes (4 Ø or finer) concentrated in the basinal or channel areas. Coarser sediments flank these areas with anomalously coarse material present in the area commonly known as the Cellar Dirt dumping zone.

Median diameter (Map III) is the most commonly used grain size measure. It is easiest to determine although it is unaffected by variations in the coarser or finer fraction of a sample. A comparison of Maps II and III serves to demonstrate that variation in median size is considerably less intense than variation in the graphic mean. Median size might well serve as a general indication of the energy level required to maintain sediment of a certain size in certain areas of the New

York Bight Apex. The mean size however more clearly reflects the overall pattern of sediment dispersal as a function of depth current velocity and slope within the depositional areas.

Inclusive graphic standard deviation is the measure of sorting of the sediment in the New York Bight Apex. It is by far the most useful grain size parameter for demonstrating the extent of equilibration of sediment to the current flow regime. The only area in the Apex that demonstrates very poor sorting is on the western flank of the Christiansen Basin (Map IV). The greatest interval variation in sediment particle sizes in this area where a sorting coefficient greater than 2∅ exists is indicative of a lack of response by the surficial sediment to modification by bottom currents. This may be due, in part, to a continued influx of mixed particle sizes. Areas well to the east of the basin and cross shelf valley are moderately sorted while the coastal areas are poorly sorted.

Inclusive graphic skewness (Map V) illustrates the areas in the Apex where sediments with an excess amount of finer (a + value) or an excess number of coarse particles (a - value) exist. It is interesting to note that the few areas where a plus value dominates are on topographically high areas and areas with excessive coarse material are either in or adjacent to topographically low areas. In all of these areas the surficial sediment is far from equilibrium with the depositional environment.

This fact is also demonstrated by Map VI which illustrates the graphic kurtosis of the Bight Apex sediments. The dominance of kurtosis values less than 1.00 or Platykurtic sediments (P) demonstrates that even the central portion of the sediments are somewhat poorly sorted in relation to its tail portions. Only the very leptokurtic areas (L) contain sediments that are somewhat better sorted in the central portion. It is also a fact that strongly Platykurtic sediments are often bimodal or made up of two or more populations of sediment. This may clearly be the case in the south central L area where ample dumping in the recent past may have introduced parcels of sediment that have no uniform central grain size.

The brief description of the variation of the six parameters selected to illustrate sediment characteristics in the New York Bight Apex by no means is meant to be an exhaustive or complete evaluation of these parameters. The discussion only serves to introduce these parameters so as to provide a baseline description of the variation. An exhaustive evaluation of these values can only come after machine plotting of these parameters for all the available stations occur.

A precise interpretation of the variability of these factors cannot be made with hand drawn maps since too much subjective evaluation is possible. The investigator is looking foward to a compilation of such maps for an insight into the subtle variations that can occur in sediments at one station over a period of a few months to several years.

APPENDIX 2

SUBLITTORAL MEIOBENTHOS OF THE NEW YORK BIGHT

A Report to: National Marine Fisheries Service
Middle Atlantic Coastal Fisheries Center
Sandy Hook Marine Laboratory
Highlands, New Jersey 07732

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July 1975

Final Report - NOAA Contract No. 03-4-043-311

INTRODUCTION

The major objective of our first year's participation in the NCAA-MESA New York Bight study was to obtain information on the variability of meiofauna population densities in the sediments of the Bight. With this information on hand, we envisioned being able to establish a sampling program which would enable us to describe the spatial and temporal distribution of the meiofauna in the Bight with maximum efficiency.

Our future plans called for the initiation of more intensive sampling of selected stations in the study area; the stations were to be selected on the basis of sedimentary and hydrographic data supplied by other participants in the MESA program.

The rationale for studies of the meiofauna inhabiting the New York Bight appeared obvious, in view of the uncertainty of their position in the food webs of marine bottoms which yield high catches of demersal fish (Rees 1940; Mare 1942; Smidt 1951; McIntyre 1964; Tietjen 1969), their high metabolic rates and rapid turnover (Wieser and Kanwisher 1961; Gerlach 1971; Tietjen and Lee 1972) and their possible role in the remineralization of organic matter (McIntyre 1964; 1969; Johannes 1965).

Information on the variability of meiofauna population densities in the study area was obtained by analysis of replicate samples taken on a cruise of the R/V ATLANTIC TWIN in the Bight between 5 and 11 June 1973. A series of eight stations was taken for the purpose of obtaining replicate samples. The data resulting from the analysis of three of these stations were sent to Dr. S.B. Saila of the University of Rhode Island for statistical analysis, and were included in our Quarterly Report to the Sandy Hook Marine Laboratory made in March 1974. Dr. Saila's analysis of the data showed that three samples would give us enough precision to be within plus or minus 50 % of the mean population density at these stations. If more precision was desired (plus or minus 20 % of the mean), an unwieldy number of samples (more than 30) would be needed. We chose to restrict the number of samples examined per station, therefore, to three.

METHODS

All samples were taken with a Smith-McIntyre grab. The meiofauna were subsampled by inserting a 2.5 cm plastic core tube into the sediment near the center of the grab to a depth of 5 cm. Formalin containing 2 % Rose Bengal was added, and the sample placed in a labelled jar.

In the laboratory, the volume of the samples was noted. The samples were washed through a set of two sieves, the larger one with a mesh opening of 0.500 mm and the smaller one with a mesh opening of 0.074 mm. Animals which passed through the larger sieve but which were retained on the smaller sieve were regarded as meiofauna.

We completed analysis of one more of the reconnaissance stations (Station 3), and when the data on meiofauna density variability at this station agreed with that from the three prior stations studied, we decided to initiate the more intensive phase of the study.

We obtained preliminary data on sediment distribution in the Bight from Dr. Anthony Cok of Adelphi University. Unfortunately, sedimentary data for a relatively large number of stations established in the MESA sampling grid system were not available to us at the time. Therefore, the bases on which we established the stations to be studied in more detail were position in the Bight apex and the time necessary for sample analysis. With the level of technical assistance available to us, we decided that a maximum of ten stations could be adequately studied. These stations are indicated in Figure 1; they are SYMAP station numbers 4, 7, 10, 16, 25, 32, 33, 36, 39 and 53. We had originally intended to include some stations far removed from the sewage sludge and dredge spoil dump sites (such as SYMAP stations 94, 76 97, etc.), but for reasons unknown to us, many of these sites were not sampled on all of the NOAA cruises in the Bight. Furthermore, many of the samples had become dried out by the time we received them. Amongst all of the samples taken, it was not easy to find ten stations for which there were at least three good samples for faunal analysis.

RESULTS

The faunal analysis of the fourth station examined for sample variability, Station 3, taken on 6 June 1973 by the ATLANTIC TWIN, is given in Table 1. Since these data add nothing to what is already covered in our Quarterly Report of March 1974, nothing more will be said of them.

The population densities of the major meiofauna taxa identified from samples taken at SYMAP stations 4, 7, 10, 16, 25, 32, 33, 36, 39 and 53 in August 1973 (Albatross IV), January 1974 (Albatross IV) and September 1974 (Delaware) are given in Table 2. The population levels of meiofauna at all 10 stations are well within the range normally found in subtidal regions of similar depth (Moore 1931; Wieser 1960; McIntyre 1964), and appear to not differ from the levels reported by Tietjen (1974) for Long Island Sound. Particular attention should be paid to Stations 32 and 33, which are located in or near the area designated as the Sewage Sludge dump site. At these two stations, the population densities of nematodes, formainifera, harpacticoid copepods and polychaetes , the four most abundant taxa encountered, appear to not differ from the levels observed at the other stations. Furthermore, they do not differ from the densities reported by Moore (1931) for the Clyde Sea; Wieser (1960) for Buzzards Bay; McIntyre (1964) for the North Sea and Tietjen (1974(for Long Island Sound. It does not appear, therefore, on the basis of the data gathered to date and presented here, that meiofauna levels are depressed in the New York Bight. Total population densities of meiofauna are well within what would be expected for the depths sampled.

Unfortunately, expiration of the contract occurred before any statistical analysis of the data presented in Table 2 could be initiated. Thus nothing can be said of the spatial and temporal variations of meiofauna in the Bight. Furthermore, any statistical analysis of the data gathered to date would be almost meaningless, in view of the fact that an insufficient length of time has been studied. In other words, what is called for is a long term study, not another one-shot study. The value of long term meiofauna studies is apparent in the recent paper by McIntyre and Murison (1973); it makes excellent reading.

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"SYMAP station numbers" and locations

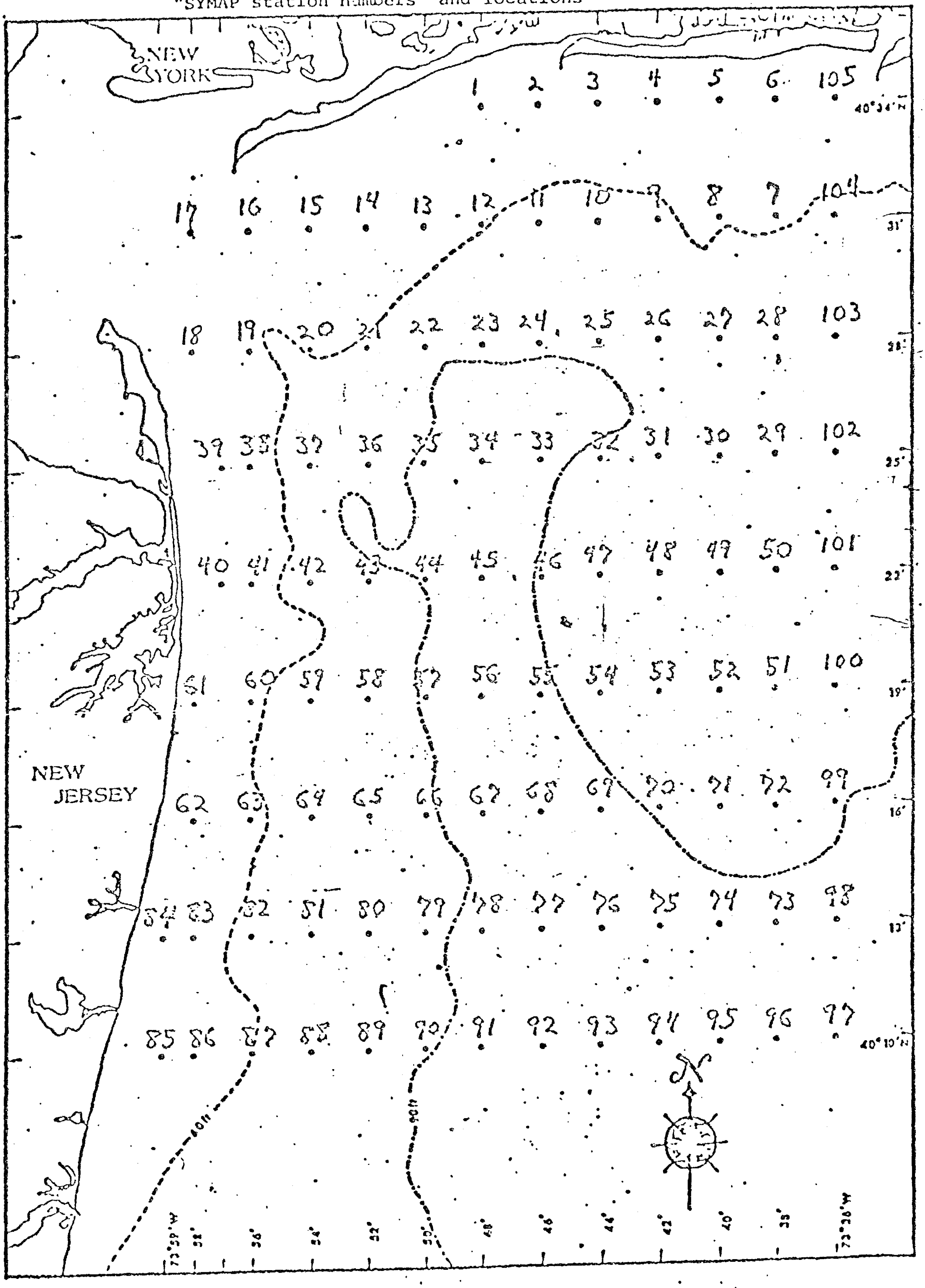

Figure 1. Map showing stations sampled for meiofauna anlysis. SYMAP stations reported on in present study are Stations 4, 7, 10, 16, 25, 32, 33, 39, 36 and 53.

Table 1. Numbers of meiofauna per 100 cm^3 of sediment at Station 3 in the New York Bight, 6 June 1973.

Meiofauna Group	GRAB NUMBER 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Nematoda	1360	900	2268	1670	3317	923	1235	1160	1452	1008	1596	1020	1893	676	2250	920	1510	1970	1751
Foraminifera	1410	660	1106	833	1103	90	490	463	638	760	1446	300	1400	638	855	589	725	426	1610
Harpacticoida	41	19	48	12	32	35	46			12	7	26	110	5	31		79	38	
Ostracoda	22	15	11	35	77	24	31	10	33	4	11		74	14	41		83	35	
Polychaeta	15		22	23	63	107	15	33	95	24	14	7	36	5	7	3	26	50	24
Nauplii	11	22	137	50	167	4	65	19	5	4	89		335	33	41	7	39	38	114
Lamellibranchs	4	7	85	19	77	10	31	24	129	4	11	7	36	5	7	7	35	58	138
Ciliated Protozoa	185	130	636	540	1026	62	146	305	19	112	550	111	287	109	238		152	222	28
Kinorhynchs	7	4		4	32		8			8			3		14		4		10
Gastrotrichs	155	170	4	92	5		119	10	176	232	139	74	16	71	334	60	100		
Halicarids						4	4												
TOTAL	32455	1027	4225	3278	5899	1259	2190	2024	2547	2168	3872	1545	4210	1556	3818	1586	2753	2842	3675

Table ... Numbers of meiofauna at ten stations in the New York Bight in August, 1973, January 1974 and September, 1974.

Population densities are given in numbers per 10 cm^2. Each density given represents the mean of three samples.

Meiofauna Taxon	AUGUST 1973 Station 4	7	10	16	25	32	33	36	39	53
Nematoda	691	483	1756	155	1031	1285	3122	831	1823	843
Foraminifora	1625	298	649	123	1371	72	270	72	370	566
Harpacticoida	63	266	531	112	461	112	32	17	140	160
Ostracoda	2	83	22	3	11		1	4	8	34
Polychaeta	27	87	83	9	203	29	9	51	59	44
Kinorhyncha	1		14						1	3
Gastrotricha				8	4	1		3		
Lamellibranchs	10	2	14		77	2	1	4	3	8
Halicarids		1						1	2	
Tanaids		2		12						
Tardigrada										
Nauplii	4	48	52	49	247	6	7	4	12	52
TOTAL	2433	1270	3171	471	3405	1507	3442	975	2388	1741

Meiofauna Taxon	JANUARY 1974 Station 4	7	10	16	25	32	33	36	39	53
Nematoda	268	193	729	166	471	1084	580	1385	1644	509
Foraminifora	293	635	556	52	1274	177	270	239	49	161
Harpacticoida	64	39	141	101	94	119	50	13	32	67
Ostracoda	16	28	5	7	20		1		3	14
Polychaeta	3	22	28		28	42	75	34	3	23
Kinorhyncha			1		1					1
Gastrotricha		13	29	6	1				2	2
Lamellibranchs	17	17	11	34	71	8	15	23	1	33
Halicarids		19	4							
Tanaids				1						
Tardigrada		17		4						
Nauplii	31	58	22	10	8	61	21	4	7	7
TOTAL	692	1035	1549	348	1972	1481	1012	1698	1741	817

Meiofauna Taxon	SEPTEMBER 1974 Station 4	7	10	16	25	32	33	36	39	53
Nematoda	1064	2131	810	343	631	1559	440	412	451	3[illegible]
Foraminifora	209	73	216	655	1169	30	175	65	303	7
Harpacticoida	5	24	3	143	11	31	26	140	873	5
Ostracoda	8	6	2	3	2	1	5	20	111	
Polychaeta	25	16	62	20	69	76	3	30	33	2
Kinorhyncha			1		1					
Gastrotricha				9			2	6	12	3
Lamellibranchs	34		4	45	1					[illegible]
Halicarids									2	
Tanaids										
Tardigrada										
Nauplii		68	3	3	4	2	3	10	18	[illegible]
TOTAL	1345	2318	1101	1178	1930	1728	654	683	1893	106[illegible]

APPENDIX 3

Contract
03 - 4 - 043 - 315

The Distribution of Foraminifera of The New York Metropolitan Region

FINAL REPORT

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SUMMARY

More than 100 benthic samples and 20 plankton tows were analyzed for the presence and distribution of Foraminifera (small animals known to be sensitive environmental indicators of marine water quality). While the samples analyzed, thus far, are too fragmentary in time and space to allow us to draw distribution maps we conclude that there are presently comparatively large numbers of Foraminifera in the benthic communities of the lower N.Y. Harbor and Bight Foraminifera were not collected in the plankton. The Foraminifera in the initial NOAA-MESA samples given to us for study were partially decalcified but those collected by us in the summer of 1974 were not. Although it is possible that the decalcification of the animals might reflect poor health it is more likely that the MESA samples were improperly preserved or stored. Based on the fragmentary data we obtained in the present MESA project and the very sketchy data obtained from Cores and unpublished theses, we guess that the Foraminifera population in lower N.Y. Bay and Bight may be similar to assemblages found in Cores after the retreat of glaciers at the end of the Pleistocene approximately 11,000 years ago. Fewer Foraminifera were found in samples analyzed from both the dredging spoil and northern parts of the sludge dump site but not enough samples have been studied to justify statistical treatment; superficial analysis of the data may suggest an approximately 90% reduction in Foraminifera in the northern parts of the dump site.

Foraminifera have been acknowledged by several generations of biological oceanographers, paleoecologists, and micropaleontologists as good indicators of the marine environments in which they grow (See reviews: Loeblich and Tappan 1964, Murray 1973, Myers 1942 a and b, and Phleger 1960 and 1964). They have decided advantages for this role because they are naturally abundant in the ocean, have shells or tests which are left behind after the animals die, and they are relatively small in size (meiofauna) which makes it feasible to collect and characterize significant numbers of animals. Distinctive assemblages of benthic or pelagic foraminifera have been described which characterize various habitats. i.e., marine marshes, zones in lagoons, near-shore turbulent zones, inner or outer continental shelf, upper or lower continental slope, deep sea, etc. These modern assemblages have been valuable clues to paleoecology. Within the last decade or so, foraminiferal trends along sewer outfalls have also been used to establish the kinds and magnitude of the effects of ocean pollution (Bandy et al. 1964, Watkins 1961, Schafer 1973, Bartlett 1972). In the Restigouche estuary which encompasses a large region between Campbellton, North New Brunswick and the Gaspe peninsula, Quebec, distinct biotopes based on species diversity and population density are developed locally especially near Dalhousie peninsula and Belledune Point in response to the effects of effluent discharge. Facultative, pollution-tolerant species that are usually abundant adjac ent to the outer edge of abiotic zones include the Elphidium incertum/clavatum complex, E. margavitaceum, Bucella frigida, and occasionally Protelphidium orbiculare. Ammotium cassis, Ammomargimulina fluvialis, Pseudopolymorphina, Novangliae and Reophax spp are among the more pollution sensitive species in Chaleur Bay. At the Laguna Beach and Orange County outfalls in California, selected foraminiferan species are more numerous as compared to elsewhere on the mainland shelf. At the Laguna Beach outfall the planktonic populations are 50 times as abundant in the sediments near the outfall as elsewhere. A Buliminella elegantissima-Bolivina vaughani population is abundant within 500 M of the outfall while a number of species including Bucella frigida are reduced near the outfall. The Nonionella miocenica stella and the Epistominella bradyana groups were excluded from the outfall area; the latter group living only at stations furthest from the outfall.

The foraminifera of the New York metropolitan region have been studied by a number of groups of workers but a cohesive and comprehensive picture of foraminiferan distribution in the region has not been synthesized because there are many gaps between the various studies and some studies have not merited publication in scholarly journals. The distribution of foraminifera in Long Island Sound has received the most attention (Parker 1952, McCrone et al. 1961, Charmatz 1961, Cousminer 1959[unpublished], Ronai 1955, Buzas 1965, Schafer 1968). The *Elphidium incertum/clavatum* complex and *Bucella frigida* are the most abundant of the living and total populations. *Eggerella advena*, *Ammonia beccarii* and *Elphidium subarticum* are abundant. The *Eggerella advena* distribution seems to be generally related to various types of pollution in the sound (Schafer 1964, 1968). The species is abundant in Northport Bay and the mouth of Oyster Bay but absent in the western sound. Since the species was observed in sediments cored near the Throggs Neck Bridge, Schafer (1968) concluded that it is now excluded because of the heavy pollution. It is still abundant near the northern and eastern river outfalls in the sound. *Bucella frigida* seems to be a good biological indicator of chronic high nitrate and phosphate concentrations. *Quinqueloculina seminulum*, *Q. subrotunda* and *Pseudopolymorphina novangliae* decreased in number from east to west, a possible reflection of increased chronic pollution effects in the western sound (Schafer 1968). The foraminifera of marshes in the greater New York metropolitan region are not too different from the species found in New England (Cushman 1944, Todd and Low 1961, and Parker and Athearn 1959) and studied in detail by our laboratory (Lee *et al.* 1969 and Matera and Lee 1972). Marsh foraminifera are not as abundant as they once were, but neither are the marshes and shallow embayments which once were their habitat. Many of the remaining marshes are also unsuitable as habitats. Marsh foraminifera are very seasonal in their distribution but taken on an annual basis the *Elphidium incertum/clavatum* complex, *E. translucens*, *Protelphidium tisburyensis*, *Ammonia beccarii*, *Ammotium salsum*, *Trochammina inflata* and *Quinqueloculina seminulum* dominate the marsh communities. In the Hudson River the arenaceous foraminifer, *Miliammina fusca* has been found as far north as Iona Island and Croton Point. *Ammobaculites* sp and *Ammomarginulina fluvialis* were common in samples south of the Bear Mountain-Peekskill region (Feigl 1956, McCrone and Schafer 1966, and Weiss 1974). The foraminiferal and pollen assemblages in cores taken in the lower Hudson River from Peekskill to the Narrows have been used by Weiss (1974) to reconstruct some of the paleoecology, stratigraphy and geological development of this part of the estuary during late-Pleistocene time. He found 32 species of foraminifera in his cores. *Ammobaculites* was the dominant arenaceous type and *Elphidium clavatum* and *Ammonia beccarii* the most abundant calcareous species. Weiss recognized four distinct fossil assemblage zones which he believed were primarily influenced by salinity gradients in the estuary (Zone 1, *Ammobaculites* salinity 10-15 ‰; Zone 2, *Ammonia beccarii*, salinity 15-20 ‰; now thriving in the Tappan Zee area of the estuary; Zone 3, *Elphidium clavatum*, salinity 20-25 ‰, depth less than 15 M, lower bay seaward; Zone 4, *Elphidium* spp and *Globigerina bulloides*, approximately 32 ‰, depths 30-50 M, population similar now thriving more than 100 miles NE in eastern Long Island Sound, Block Island Sound, Buzzards Bay, Nantucket Sound and Vineyard Sound). Estuarine conditions favorable to the foraminifera found in assemblage 4 developed in the lower Hudson River estuary as early as 11,000 years ago (Weiss 1974, Core 5 at the Holland Tunnel site).

Foraminifera in the brackish water bays and lagoons of the New York Bight seem similar to those found in the Long Island Sound (Ronai 1955, Behm and Grekulinski 1958, Smith 1971). Pollution and recent development of many marshes have restricted populations from some areas in which they were previously reported (Ronai 1955, Behm and Grekulinski 1958). Other published studies on the foraminifera from the Bight show that we have very spotty knowledge of this area. Gevirtz and coworkers (1971) recently published the results of transverses made perpendicular to the shoreline at Great South beach across the continental shelf and slope between the Hudson Canyon and Block Channel. *Eggerella advena* and *Elphidium* spp dominate the area between 0 and 10 fathoms; *Bucella frigida*-*Haplophragmoides major* assemblages were representative of inner and central shelf faunas (20-35 Fm); deeper waters were characterized by Uvigerina peregrina, Gyroidina soldanii, Angulogenerina angulosa, and Chilostomella ovoidea biofacies. Planktonic forams were absent from sediment collected in shallow waters and were found in abundance in waters deeper than 65 Fm.

Shupack (1934) studied some available core samples he obtained from the Port of N. Y. Authority in Raritan Bay, from engineers constructing the New York City water supply tunnel #2 near Hamilton Avenue, Brooklyn, as well as samples he collected himself in lower New York Bay. The species he found in recent and pleistocene sediments were quite similar. Elphidium spp and Ammonia beccarii were common. Elphidium clavatum was common in all 7 of his cores and Elphidium incertum was common in the lower bay. A more detailed reconnaissance of benthic organisms in New York Harbor and adjacent waters was made by Smith (1971). He found Elphidium spp and Ammonia beccarii in sediments from lower bay, upper bay and Arthur Kill. The numbers of Foraminifera he recovered in his samples were relatively low but in general agreement with Shupack, with Elphicium clavatum and A. beccarii the most abundant species. E. clavatum was also found in one sample taken near the sewage-sludge disposal site. Many of the specimens he studied were thoroughly decomposed although still recognizable.

In the 18 man months of NOAA-MESA support we were able to analyze the Foraminifera in more than 100 benthic samples and 20 plankton tows taken from the New York Bay and Bight. Our data are summarized in tables 1 & 2 and Figures 3 & 4. As mentioned in our report last January many of the Foraminifera in the MESA samples were decalcified. Since the Foraminifera we collected in the Summer of 1974 were not decalcified we think it is more likely that the MESA samples were not properly preserved rather than that the Foraminifera were in poor condition. We remain open on this question since the samples were taken at different times. The Foraminiferan assemblege in the Bay and Bight is dominated by a single "species" or morphological complex of species known variously but commonly referred to in the literature as the Elphidium incertum/clavatum complex. This species is quite abundant in the Northeast United States and Canada and is dominant in many collections from Long Island Sound and from Long Island salt marshes. Eggerella advena, Bucella frigida, Haplophragmoides major and a score of rarer species were also found. Fewer Foraminifera were found in collections from the northern part of the dump sites. Populations were down to perhaps 10% of the levels at other stations including the southern part of the sewer sludge dump site, but we have examined so few samples that we would not have confidence in statistical comparisons.

The populations presently found in the lower Bay and Bight are very similar to those found by Shupack (1934) and Weiss (1974) in their studies of Pleistocene sediments. Though our picture is sketchy because our studies are limited and other data on the area is spotty our best guess at this time is that dumping in the Bight and other human activities in New York City have caused localized reductions in Foraminiferal populations but that the overall Foraminiferal assemblege has undergone little change since the end of the Pleistocene roughly 11,000 years ago when estuarine conditions developed which were favorable to the Foraminifera presently found here. We do not feel we have analyzed sufficient well preserved benthic samples nor do we have data from enough Pleistocene cores to merit the writing of a scientific paper at this time. We hope sometime in the future to complete this study.

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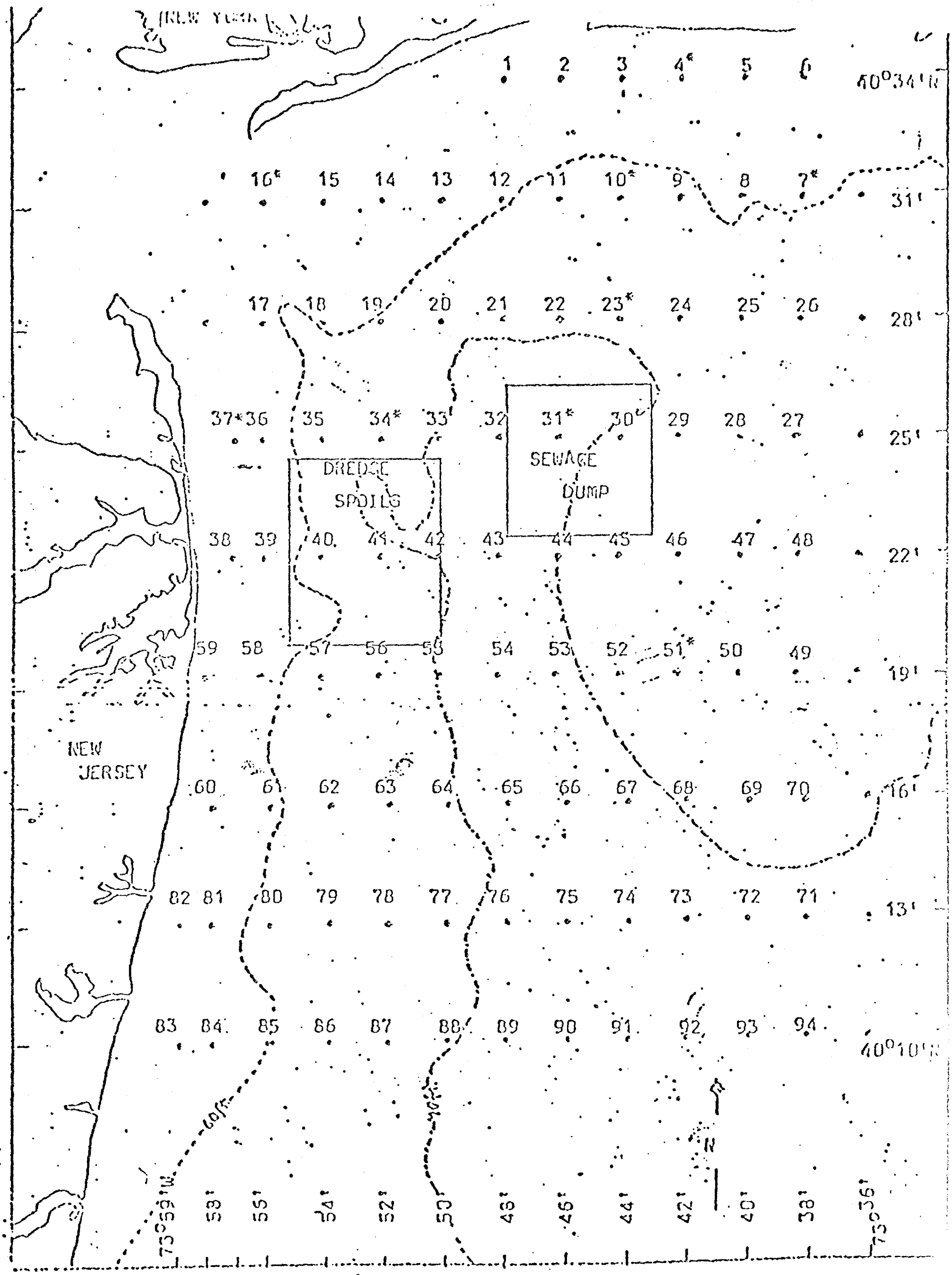


Fig. 1 Collection sites for benthic foraminifera in the New York Bight as of August 1973.
* stations analyzed in the laboratory.

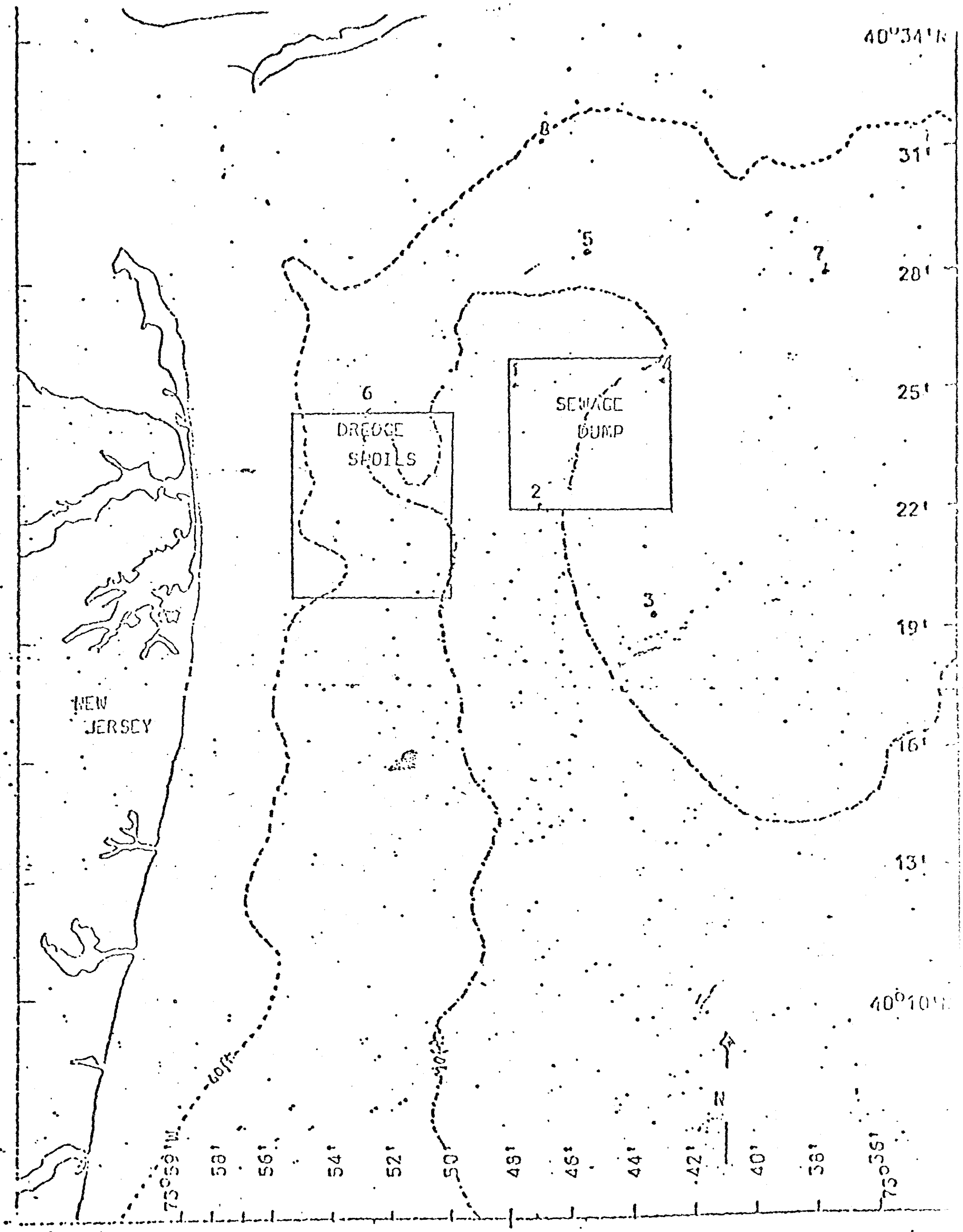


Fig. 2 Collection sites for benthic foraminifera in the New York Bight for June 1973.

DATE	STATION	COMMENT	DEPTH ft.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
													GRAB									
6/73	1	NW Sewage Dump	113				46										78					
	2	SW Sewage Dump	120			7,605	22							4,824	5,404		4,416					
	3	Outer Bight	83		1,410	660	1,106	833	1,103	90	30	463	638	760	1,446	300	1,400	638	855	589	725	426
	4	NE Sewage Dump	82		5	10	0	21	14	16	-	8	-	14	5	13	4	51	17	21	48	8
	5	N of Sewage Dump	85									3,890										234
	6	N border Dredge Spoils	90		19	405	13	11	17	17	81	57	26	40	166	137	26	17	24	5	65	73
	7	NE of Dump	70			7																
	8	N toward L.I.	65		12	1	6	-	18	9	5	4	14	14	10	6	-	7	11	3	28	10
8/73	4	Off L.I.	35	5,850		2,492	412															
	7	Off L.I.	55	181			969	1,245														
	10	Off L.I.	69		1,231		2,420	244														
	15	Mouth of Estuary	28		726	4	10															
	23	N. of Sewage Dump	86		1,580	4,507	2,142															
	30	N. Sewage Dump	63	93																		
	31	[illegible] Sewage Dump	100	330																		
	34	Off Sandy Hook	80			29	136															
	37	Off Sandy Hook	40	-	1.658	212	68															
	51	Outer Bight	80		585	1,360	1,420															

Table 1 Numbers of live benthic foraminifera found per 100 cm^3 in samples taken from the New York Bight during June and August 1973.
* deleted from average.

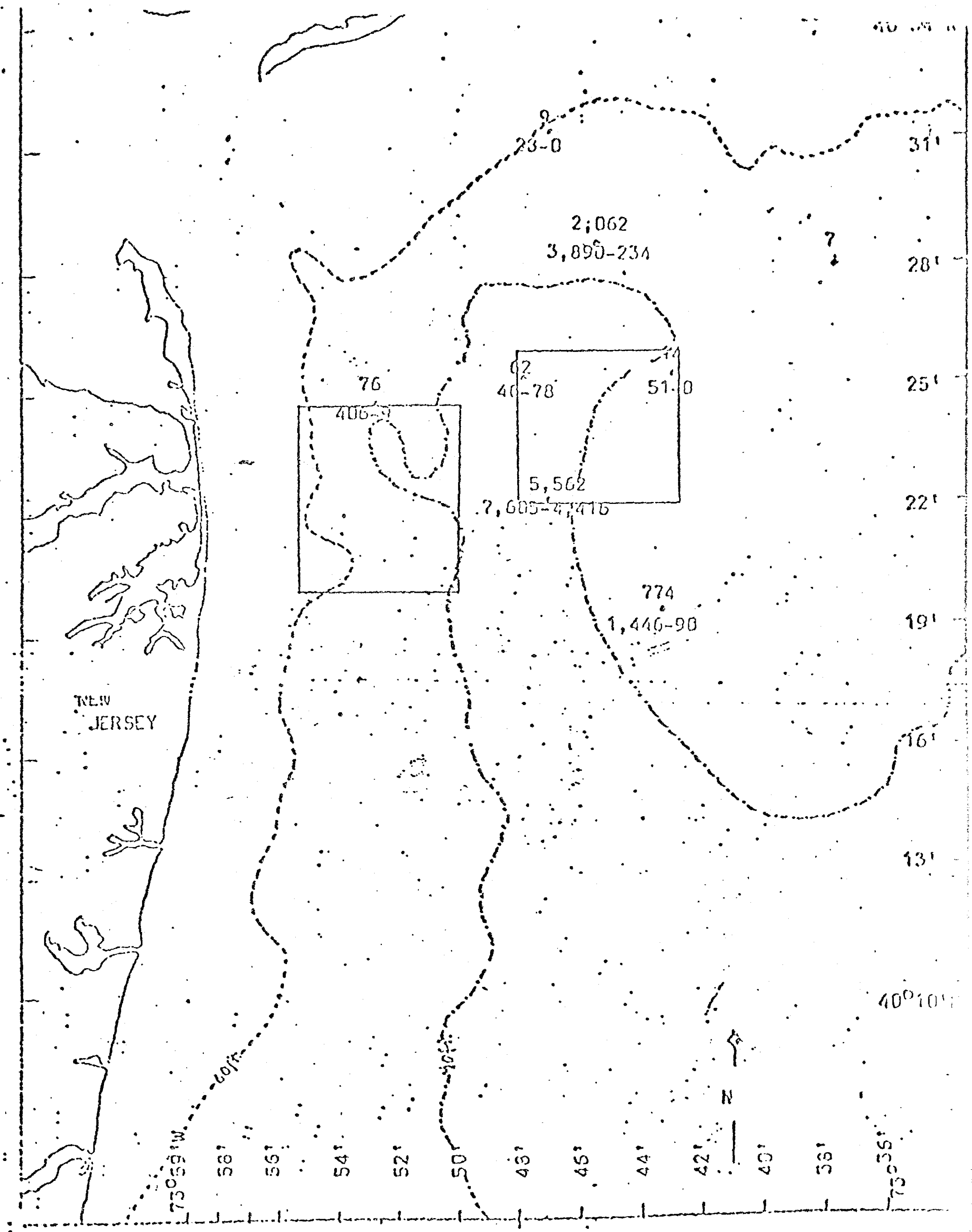


Fig. 3 Numbers of live benthic foraminifera found per 100 cm³ in samples taken from the New York Bight during June 1973 - means and ranges.

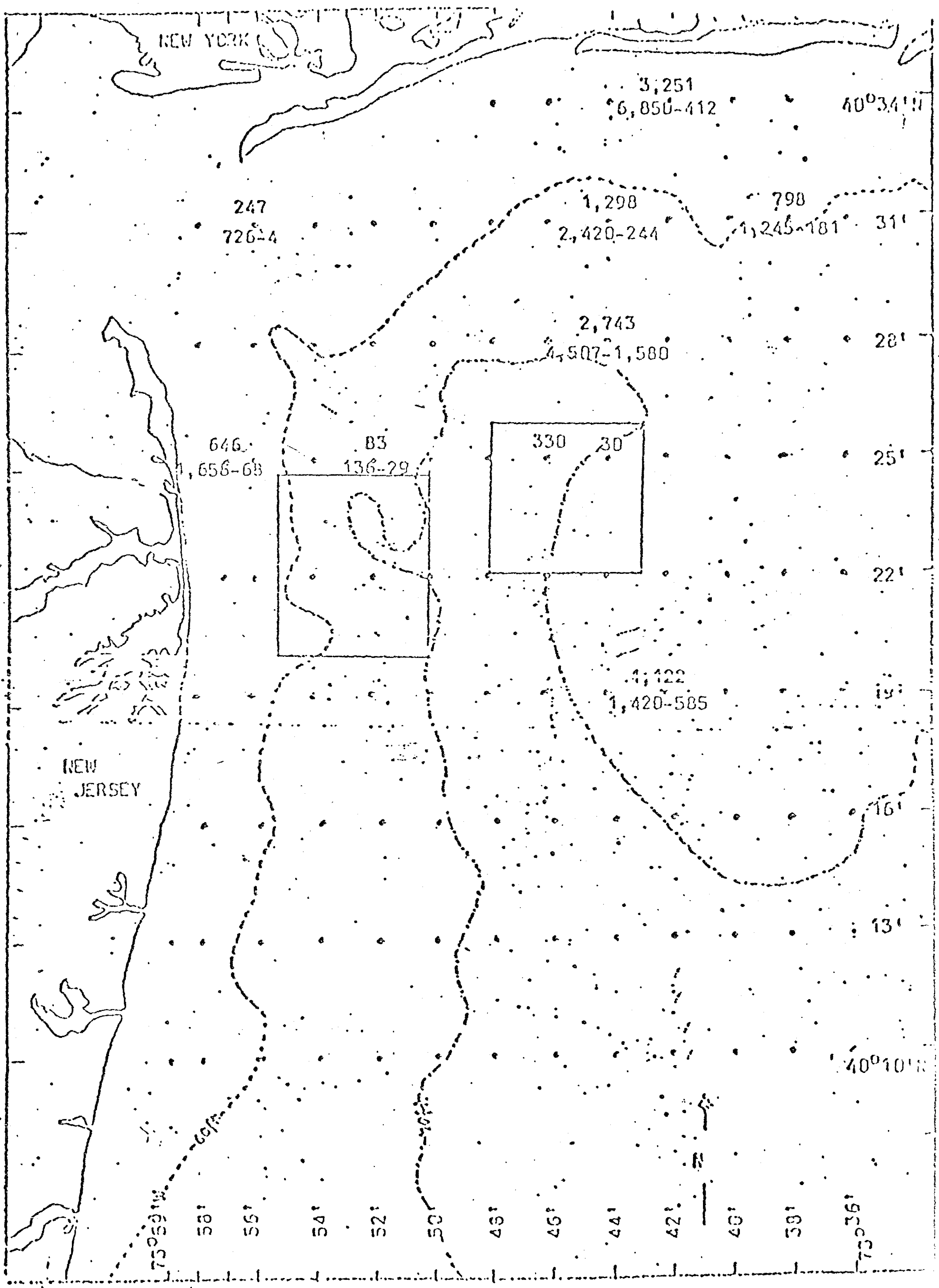


Fig. 4 Numbers of live benthic foraminifera found per 100 cm³ in samples taken from the New York Bight during August 1973 - means and ranges.

TABLE 2

Number of planktonic foraminifera found in the Hudson River estuary and New York Bight.

Date	Station	200 μ Samples #/m³	80 μ Samples #/m³
9/1/73	A3	0	
	P1	0	
	D3	0	
10/2/73	D5	2.3	
11/3/73	A1	0	
	A3	0	
	P1	0	
	D3	0	
	B4	0	
1/26/74	A1		0
	A2		0
	A3		0
	A4		0.08
4/10/74	B4		0
	C5		0
	D5		0.12
	D3		0
4/27/74	C3		0.02
	C5		0
	D5		0
6/22/74	C5		0
7/15/74	C5		0

TABLE 3

Stations sampled for plankton in Hudson River and the New York Bight.

Station	Latitude	Longitude	Comments
A1	40°52'53"	mid channel	river, above G.W. Bridge
A2	40°49'31"	mid channel	river, below G.W. Bridge
A3	40°40'18"	74°02'18"	upper bay, above V.B.
A4	40°35'18"	74°02'39"	lower bay, below V.B.
P1	40°28.6'	73°54.0'	Sandy Hook
B2	40°29.1'	73°46.8'	North Transect off Long Island
B3	40°29.4'	73°40.5'	"
B4	40°30.0'	73°30.0'	"
C2	40°25.4'	73°48.0'	Sludge dump, fringe
C3	40°24.0'	73°45.5'	Sludge dump, center
C4	40°22.4'	73°42.0'	Sludge dump, fringe
C5	40°16.7'	73°32.4'	Reference
D2	40°24.0'	73°53.0'	Dredge dump, fringe
D3	40°22.0'	73°52.5'	Dredge dump, center
D4	40°20.0'	73°52.1'	Dredge dump, fringe
D5	40°10.0	73°50.0'	Reference

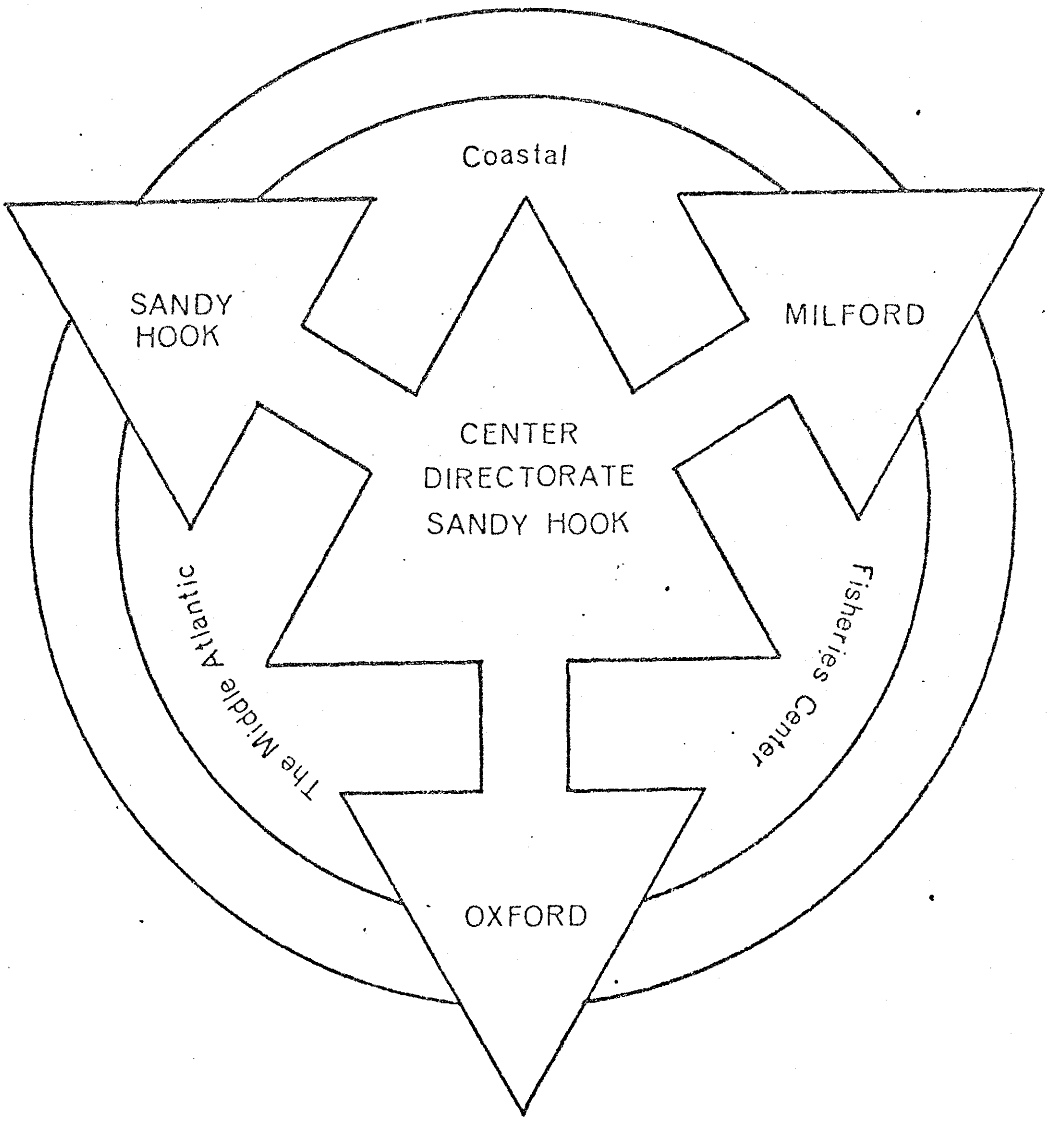
APPENDIX 4

Cruise Report
NOAA Ship <u>Delaware II</u>
12-25 August 1975

Cruise D-75-12

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



Ecosystems Investigations, Sandy Hook Laboratory, Highlands, New Jersey

(Funded by NOAA-MESA Appropriations)

Cruise Report
NOAA Ship Delaware II
12-25 August 1975
Cruise D-75-12

INTRODUCTION:

The NOAA Ship Delaware II departed Sandy Hook (SH) 0420 hrs. on 12 August bound for Fire Island sea buoy to pick up Dr. Robert M. White, NOAA, Administrator, and party. Raydist was calibrated at Ambrose Light Tower at 0526 hrs. Scientists on board included Mr. Holston (MACFC Deputy Director), Dr. Merrill (Director, Resource Assessment Inv.), Dr. Thomas (Chief Biol., Oceanography Inv.), Mr. Azarovitz (Chief, Coastal Survey Inv.), Mr. Phoel (Oceanographer), Mr. Larkin (Student Trainee), Mr. Silverman (Fishery Biologist), and Mr. Pringle and Mr. Stephenson (Raydist Operators). Vessel arrived at sea buoy at 0810 hrs. Dr. White and party boarded 0940 hrs.

Two trawl stations were accomplished; one at 1055 hrs. at 40° 32.3'N, 73° 36.6'W (trawl hauled 1125 hrs. at 40° 31.9'N, 73° 38.6'W) and one at 40° 25.6'N, 73° 46.2'W, at 1229 hrs (hauled at 40° 26.9'N, 73° 47.3'W at 1259 hrs.).

Two Smith-McIntyre bottom grab sampling stations were occupied; one at 1342 hrs. at the dredge spoil area (cores of bottom mud collected here for PCB analyses), and one at 1430 hrs. at the sewage sludge area near the eastern edge of the Christiaensen Basin. The Pamatmat Multiple Corer was also used at the sewage area to collect bottom sediment for seabed oxygen consumption experiments.

At 1505 hrs. vessel proceeded for Fire Island sea buoy arriving 1703 hrs. Dr. White and party disembarked 1710 hrs. Vessel proceeded to SH arriving 2055 hrs.

On 13 August, vessel departed SH 1210 hrs. bound for the New York Bight Apex to accomplish sampling for sea bed oxygen consumption experiments and to test Cerame-Vivas Rock Dredge at selected stations for Dr. Ida Thompson, Asst. Professor, Dept. of Geology, Princeton University. Dr. Thompson was interested in megabenthic populations of echinoderms and molluscs. At 1340 hrs., Raydist calibrated at Ambrose Light Tower. Multiple coring began at station 1 at 1415 hrs.

On 14 August, coring continued until 1130 hrs. when Cerame-Vivas dredging began (40° 15.3'W, 73° 44.2'W). Five dredge stations were accomplished ending at 40° 15.8'N, 73° 41.5'W. At 1615 hrs., Raydist calibrated at Ambrose Light Tower. At 1830 hrs., multiple coring again initiated at station 15.

On 15 August, coring again suspended at 1208 hrs. at station 26 to commence dredge operations at 40° 32.6'N, 73° 40.2'W. Six dredge stations accomplished ending at 1654 hrs. at 40° 17.4'N, 73° 33.6'W. Multiple coring commenced at 1739 hrs. at station 27.

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On 16 August, coring suspended at 1200 hrs. at station 38. Dredging commenced 1252 hrs. Five dredge stations occupied by Dr. Thompson. Dredging suspended 1613 hrs. At 1645 hrs. Chief Scientist decided to suspend Apex sampling in favor of Lower and Raritan Bay stations for multiple coring. Fresh easterly wind. Sea moderate with waves from the southeast. At 1731 hrs. sampled station 39 in Swash Channel off SH. Continued sampling stations in Lower and Raritan Bay until 2155 hrs. at station 43. Vessel then proceeded to SH arriving 2225 hrs.

On 17 August, departed SH 0805 hrs. bound for Chapel Hill Channel South to begin multiple coring in the Lower Hudson River. Coring commenced 0844 hrs. Completed station 50 in Hudson River off the Harlem River entrance at 1335 hrs. Completed coring at Romer Shoal 1609 hrs. Raydist calibrated at Ambrose Light Tower 1720 hrs. Commenced coring station 38A at 1740 hrs.

On 18 August, multiple coring was suspended after station 62 at 1030 hrs. Cerame-Vivas Rock Dredging for Dr. Thompson commenced at 1055 hrs. Dredging suspended 1725 hrs. Eight dredge stations completed. Commenced multiple coring station 63 at 1910 hrs.

On 19 August, multiple coring suspended at 1645 hrs. at station 78. Dredging commenced 1735 hrs. Dredging suspended 2153 hrs. Six dredge stations occupied.

On 20 August, Raydist calibrated 0035 hrs. at Ambrose Light Tower. Dropped anchor at 0310 hrs. at station I (40° 25'N, 73° 48'W) to sample water column and seabed for oxygen consumption. Station completed 1045 hrs. Vessel proceeded to SH arriving 1215 hrs. to disembark Dr. Thompson and Ms. Heilweil, her assistant. Departed SH 1700 hrs. bound for station II (40° 23.5'N, 73° 57'W). Anchored at 1818 hrs.

On 21 August, station completed by 1054 hrs. Vessel proceeded to station I (40° 25'N, 73° 48'W) anchoring at 1130 hrs. to sample water column. Station completed by 1550 hrs. Vessel proceeded to station III (40° 19'N, 73° 38'W) dropping anchor 1750 hrs.

On 22 August, vessel dragged anchor short distance due to wind (18 knots SW, sea moderate). Vessel hauled anchor and returned to station III dropping anchor 0423 hrs. Station completed 1050 hrs. Raydist land based station at Fire Island closed down and tower at Moriches Inlet activated during this station. At 1317 hrs. vessel proceeded for Ambrose Light Tower for Raydist calibration for Moriches Inlet Station. 1430 hrs. calibration completed. Vessel proceeded to SH arriving 1638 hrs. to drop off William Stephenson, Raydist Operator, with impacted tooth. Mr. Stephenson returned and vessel departed SH 1945 hrs. bound for station 79 beside N "B" buoy at 2050 hrs. Raydist calibrated at Ambrose Light Tower. Coring commenced station 79 at 2340 hrs. Completed station 79 at 2400.

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On 23 August, mate McAdams too sick to stand watch. Other mate Mr. Tobiasen had left ship on 17 August for temporary reassignment on FRS Albatross IV. Thus, Captain had to continue to stand watch. Arrived station 80 at 0225 hrs. Proceed to station 81 arriving 0455 hrs. Unable to get cores due to weather. At 0615, decided to head for SH to get mate McAdams to doctor. Arrived SH 1118 hrs. Lt. Kaiser, Sandy Hook Port Captain, replaced McAdams. Vessel departed SH 1300 hrs. bound for stations in the Hudson Shelf Valley. Coring commenced on station 82 at 1541 hrs.

On 24 August, coring continued uneventfully at stations 88 through 100.

On 25 August, completed multiple coring for cruise at station 101 at 0035 hrs. Vessel proceeded to SH arriving 0550 hrs. Vessel off loaded by 1900 hrs. except for heavy gear which was off loaded by crew the next morning.

SCIENTIFIC PERSONNEL:

Pamatmat multiple core operations.

James Thomas - Party Chief
William Phoel
Wesley Webb
Mark Epstein
Ida Thompson
Shelly Heilweil
William Pringle - RAYDIST operator
William Stephenson - RAYDIST operator

CRUISE OBJECTIVES:

Objective of this cruise was to provide baseline data necessary to the accomplishment of MESA Task No. 3 in MACFC, Informal Report No. 13, Benthic Respiration. Multiple coring operations for seabed oxygen consumption continued to obtain a second summer survey for the Apex and add new information on the Lower Hudson River, Lower and Raritan Bays, Hudson Shelf Valley, proposed alternate waste disposal sites and adjacent continental shelf.

OPERATIONS:

Stations were sampled with the multiple corer for seabed oxygen consumption in Lower Bay, Upper Bay and Lower Hudson River as well as at stations selected on a grid (1 min. Lat. x 1 min. Long.) overlying the apex of the

Cruise Report
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New York Bight. Additional stations were sampled in the Hudson Shelf Valley beyond the apex and on the shelf adjacent the valley as well as in the two proposed alternate waste disposal sites. Sampling locations follow (Figs. 1-5 and Table 1).

Multiple core casts to obtain undisturbed bottom sediment with overlying bottom water were made to measure seabed oxygen consumption by the seabed according to the methods of Pamatmat (Limnol. Oceanogr. 1971). The cores were equilibrated for 1 hour in a water bath regulated to within two degrees of *in situ* temperature. Following equilibration, the oxygen consumption was monitored for approximately 6 hours. Initial and final dissolved oxygen samples were taken and processed according to the azide modification of the idometric method using 0.025 N PAO instead of sodium thiosulfate. Reagents were added to the sample with a 1 ml insulin syringe. A 2 ml Gilmont microburet with needle was used in the titration of the 35 ml samples. Concentrated formalin was added to several of the samples at selected stations and the oxygen decrease was monitored for 6 hours. One of the cores was stored frozen for later carbon analysis. A Niskin bottle with reversing thermometer was attached to the frame of the multiple corer to collect bottom water for salinity and dissolved oxygen determinations and to record bottom temperature with a reversing thermometer at each station. At approximately eight stations in the Hudson River a BT strapped to the multiple corer frame was used to eliminate the five minute equilibration time in congested waters. The oxygen samples were titrated on board using a sample volume of 203 ml titrating with 0.025 N PAO with thyodene as the indicator. The salinity samples were stored for later analysis at Sandy Hook using an RS7-B salinometer.

RESULTS:

One-hundred one stations plus three special stations (486 cores) were sampled with the multiple corer to measure total oxygen consumption by the seabed. Seventy-eight stations were occupied in the Lower Hudson Estuary and New York Bight Apex. Sixty-four stations were part of our standard grid over the apex. Beyond the apex five stations were sampled down the axis of the Hudson Shelf Valley, twelve within the proposed alternate waste disposal sites (six within each site) and six stations on the adjacent Continental Shelf. The data from these samples are now being processed.

Thirty-one stations were sampled by Dr. Ida Thompson (Asst. Professor, Dept. of Geology, Princeton University) using a Cerame-Vivas Rock Dredge. She was investigating the megebenthos for echinoderms and molluscs.

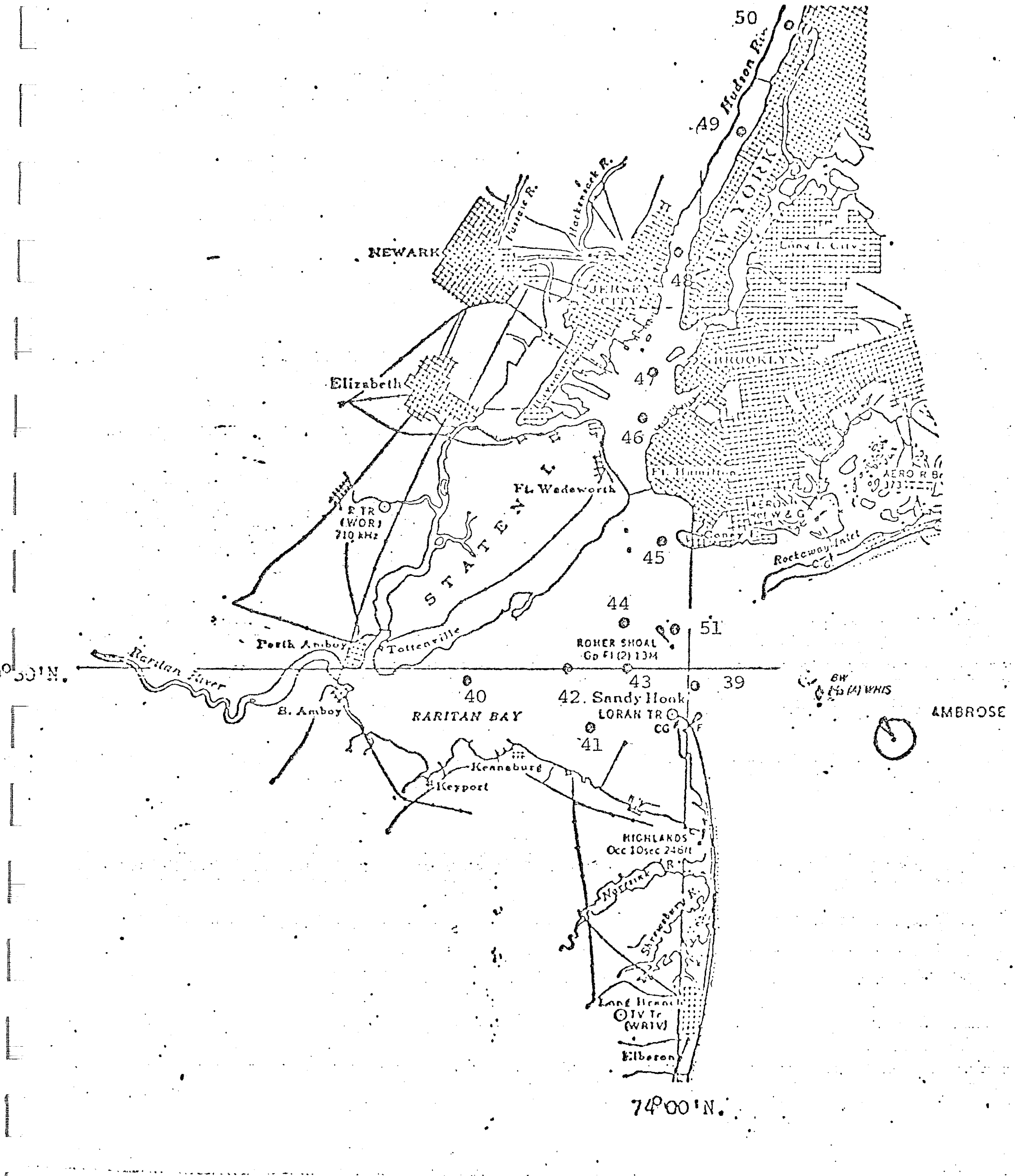

Fig. 1. Multiple corer stations in the Lower Hudson Estuary for seabed oxygen consumption studies 12-25 August '75 on FRS Delaware II (D-75-12)

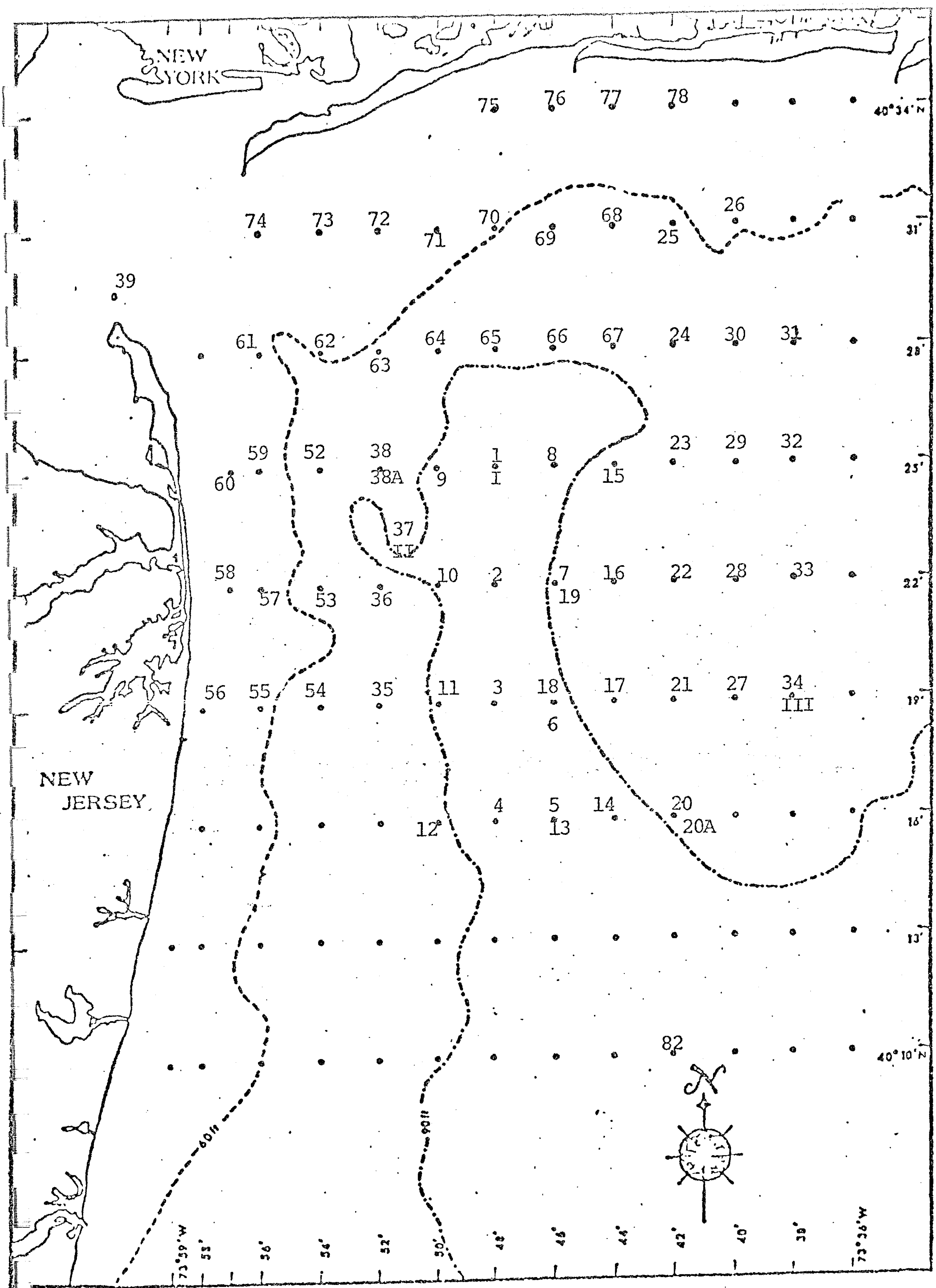

Fig. 2. Multiple corer stations in the Apex of the New York Bight for seabed oxygen consumption studies 12-25 August 1975 on FRS Delaware II (D-75-12).

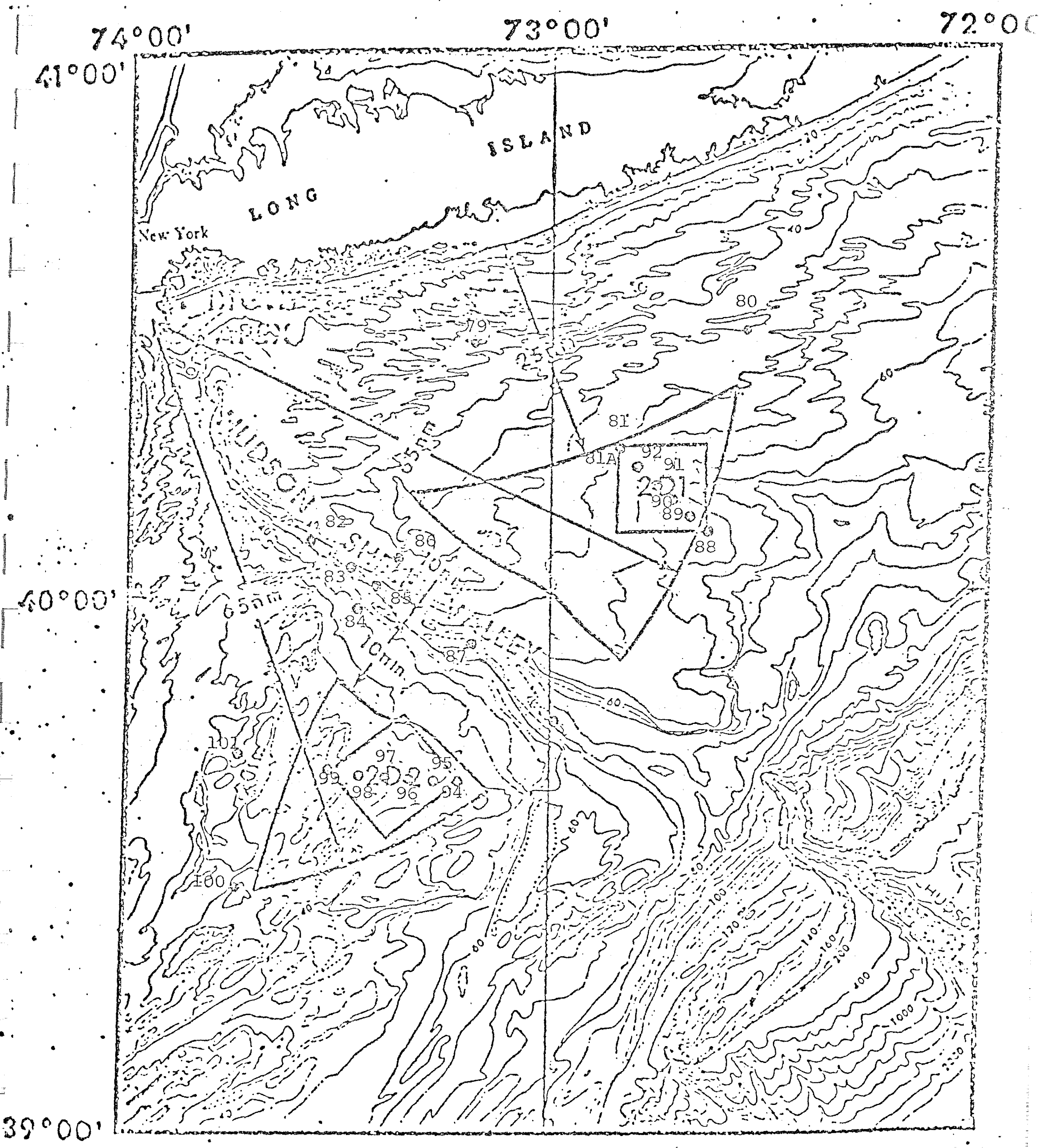

Fig. 3 Multiple corer stations in the Hudson Shelf Valley, adjacent shelf, and proposed alternate waste disposal sites in the New York Bight 12-25 August '75 on FRS Delaware II (D-75-12)

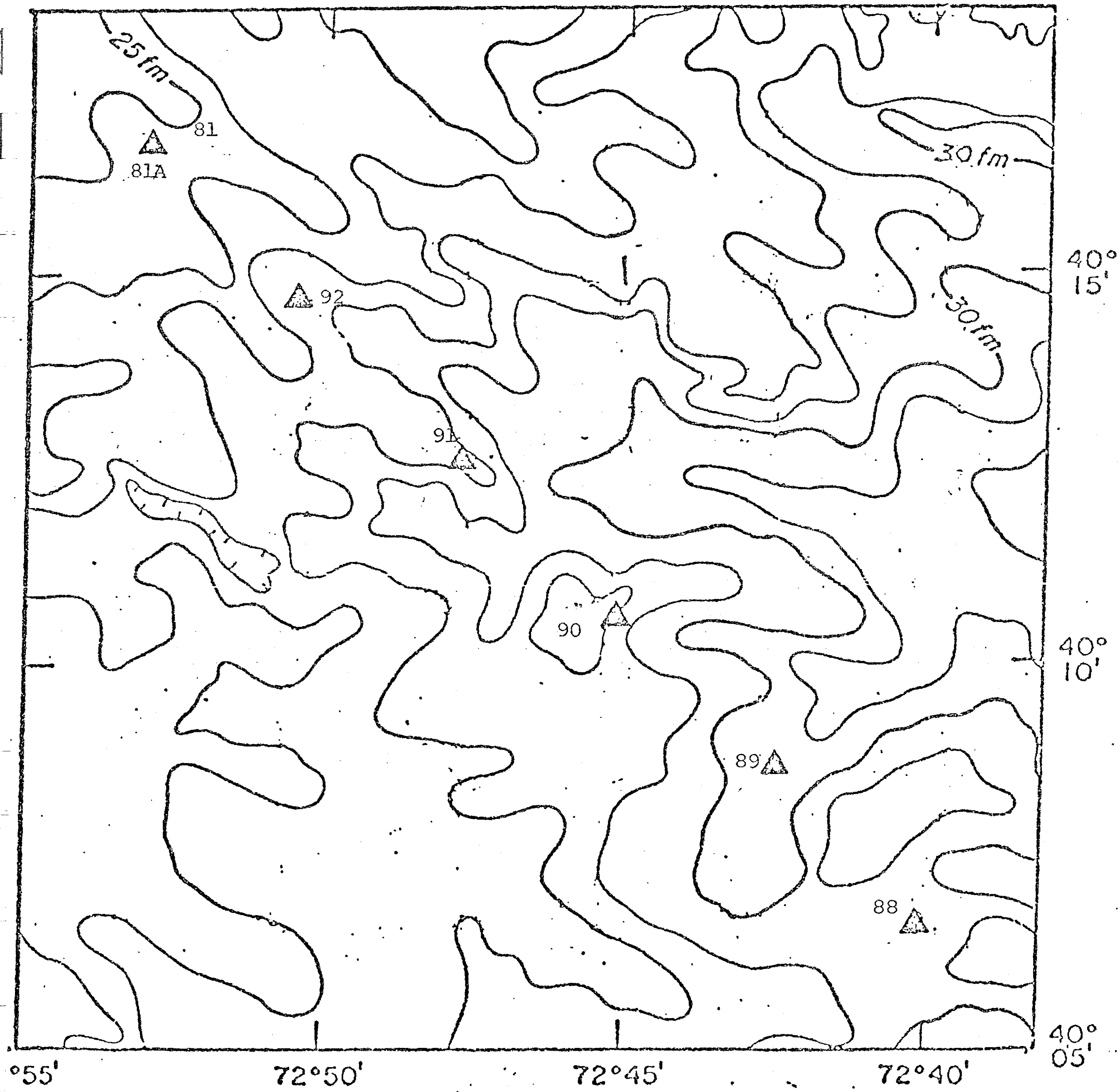

Fig. 4. Bathmetric and sample location map, Area 2D1 (northern area). Contour interval 1 fathom. ▲ multiple corer stations.

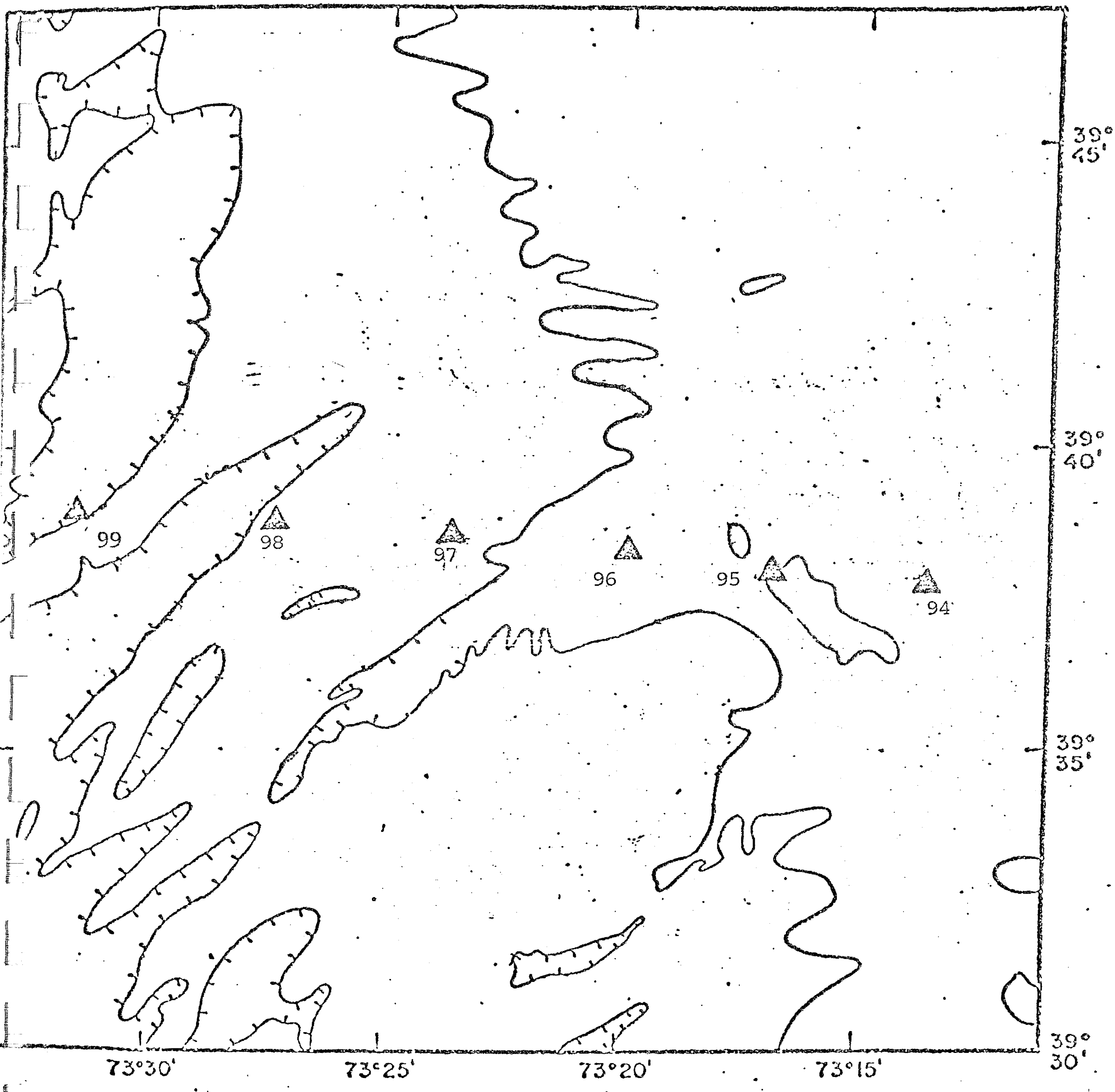

Fig. 5. Bathymetric and sample location map, Area 2D2 (southern area). Contours are the 20 fm. isobath. ▲ multiple corer sampling stations.

Table 1 Station Positions for Multiple Coring

Apex - New York Bight

Lat. N.	Long. W	Sta. #
40° 25'	73° 48'	1, I
40° 22'	73° 48'	2
40° 19'	73° 48'	3
40° 16'	73° 48'	4
40° 16'	73° 46'	5
40° 19'	73° 46'	6
40° 22'	73° 46'	7
40° 25'	73° 46'	8
40° 25'	73° 50'	9
40° 22'	73° 50'	10
40° 19'	73° 50'	11
40° 16'	73° 50'	12
40° 16'	73° 46'	13
40° 16'	73° 44'	14
40° 25'	73° 44'	15
40° 22'	73° 44'	16
40° 19'	73° 44'	17
40° 19'	73° 46'	18
40° 22'	73° 46'	19
40° 16'	73° 42'	20
40° 19'	73° 42'	21
40° 22'	73° 42'	22
40° 25'	73° 42'	23
40° 28'	73° 42'	24
40° 31'	73° 42'	25
40° 31'	73° 40'	26
40° 19'	73° 40'	27
40° 22'	73° 40'	28
40° 25'	73° 40'	29
40° 28'	73° 40'	30
40° 28'	73° 38'	31
40° 25'	73° 38'	32
40° 22'	73° 38'	33
40° 19'	73° 38'	34, III
40° 19'	73° 52'	35
40° 22'	73° 52'	36
40° 23.5'	73° 52'	37, II
40° 25'	73° 52'	38
40° 29.43'	73° 59.75'	39

Lower - Raritan Bay

Lat. N.	Long. W	Sta. #
40° 29.41'	74° 10.9'	40
40° 28.09'	74° 04.5'	41
40° 30.0'	74° 05.70'	42
40° 30.0'	74° 03.2'	43
40° 31.2'	74° 03.25'	44
40° 34.5'	74° 01.5'	45

Upper Bay

Lat. N.	Long. W	Sta. #
40° 38.6'	74° 02.9'	46
40° 40.3'	74° 02.31'	47

Manhattan

Lat. N.	Long. W	Sta. #
40° 44.25'	74° 01.1'	48

Upper Manhattan

Lat. N.	Long. W	Sta. #
40° 49.54'	73° 57.7'	49

Spuyten Duyvil

Lat. N.	Long. W	Sta. #
40° 52.9'	73° 55.75'	50

Romer Shoal

Lat. N.	Long. W	Sta. #
40° 31.2'	74° 00.8'	51

Apex

Lat. N.	Long. W	Sta. #
40° 25'	73° 54'	52
40° 22'	73° 54'	53
40° 19'	73° 54'	54
40° 19'	73° 56'	55
40° 19'	73° 58'	56
40° 22'	73° 56'	57
40° 22'	73° 57'	58
40° 25'	73° 56'	59
40° 25'	73° 57'	60
40° 28'	73° 56'	61
40° 28'	73° 54'	62
40° 28'	73° 52'	63
40° 28'	73° 50'	64
40° 28'	73° 48'	65
40° 28'	73° 46'	66
40° 28'	73° 44'	67
40° 31'	73° 44'	68
40° 31'	73° 46'	69
40° 31'	73° 48'	70
40° 31'	73° 50'	71
40° 31'	73° 52'	72
40° 31'	73° 54'	73
40° 31'	73° 56'	74
40° 34'	73° 48'	75
40° 34'	73° 46'	76
40° 34'	73° 44'	77
40° 34'	73° 40'	78

Table 1 - Continued

Continental Shelf - East

N "B" Buoy

	Lat. N.	Long. W.	Sta. #
	40° 25.75'	73° 11.00'	79
	40° 26.75'	72° 38.25'	80

Proposed Alternate Waste Disposal Site - North

	Lat. N.	Long. W.	Sta. #
	40° 16.75'	72° 53.20'	81, 81A

Hudson Shelf Valley and Adjacent Shelf

	Lat. N.	Long. W.	Sta. #
	40° 10'	73° 42'	82
	40° 06'	73° 34'	83
	39° 59'	73° 32'	84
	40° 03'	73° 27'	85
"HA"Buoy	40° 07'	73° 22'	86

Hudson Shelf Valley and Shelf Adjacent

	Lat. N.	Long. W.	Sta. #
	39° 56'	73° 11'	87

Proposed Alternate Waste Disposal Site - North

	Lat. N.	Long. W.	Sta. #
	40° 06.67'	72° 40.04'	88
	40° 08.75'	72° 42.60'	89
	40° 10.75'	72° 45.25'	90
	40° 12.70'	72° 47.75'	91
	40° 14.75'	72° 50.50'	92

Hudson Shelf Valley

	Lat. N.	Long. W.	Sta. #
	39° 47'	72° 59'	93

Proposed Alternate Waste Disposal Site - South

	Lat. N.	Long. W.	Sta. #
	39° 38.40'	73° 12.50'	94
	39° 38.57'	73° 16.20'	95
	39° 38.74'	73° 19.90'	96
	39° 38.91'	73° 23.60'	97
	39° 39.08'	73° 27.30'	98
	39° 39.25'	73° 31.00'	99

New Jersey Shelf

	Lat. N.	Long. W.	Sta. #
	39° 33'	73° 44.75'	100
"B" Buoy	39° 46'	73° 45'	101

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SUBMITTED BY:

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Date September 5, 1975

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