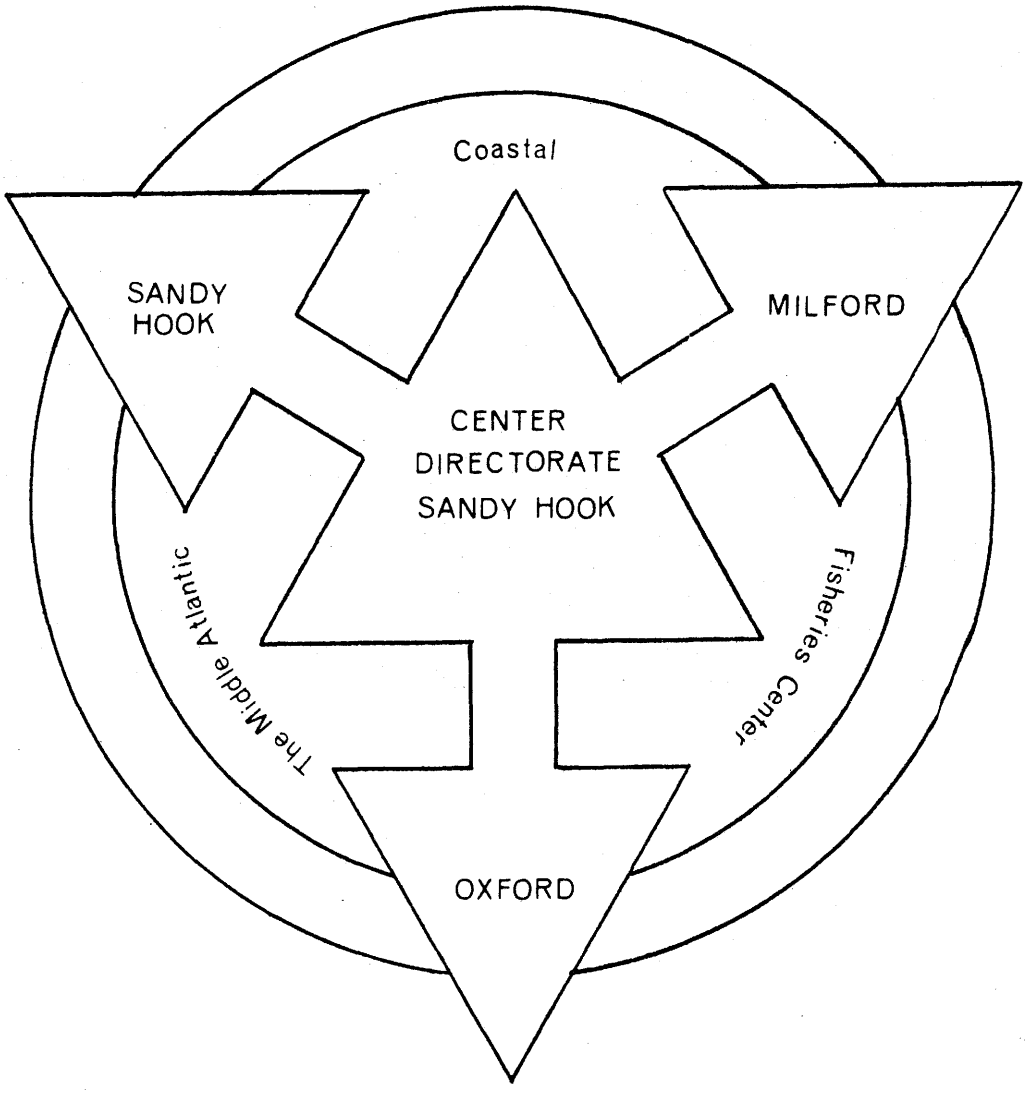
MESA-NYB-FUNDED BIOLOGICAL RESEARCH

PROGRESS REPORT
March 1975 - June 1975

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

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



Informal Report No. 74

July 18, 1975

PROGRESS REPORT

March 1975 - June 1975

MESA-NYB-FUNDED BIOLOGICAL RESEARCH
CONDUCTED BY THE
MIDDLE ATLANTIC COASTAL FISHERIES CENTER
NATIONAL MARINE FISHERIES SERVICE

Informal Report No. 74

July 18, 1975

This report has been prepared by the Middle Atlantic Coastal Fisheries Center, National Marine Fisheries Service, for administrative use by the MESA-NYB Project Manager. It does not constitute publication; conclusions reached must be considered tentative; and the material contained must not be referenced or cited in any way in scientific publications.

TABLE OF CONTENTS

	Page
I. Introduction	1
II. Summary of Accomplishments	3
III. Detailed Report of Progress by Budget Categories	6
1. Statistical Design and Analysis	7
2. ADP - Format and Operations	8
3. Benthic Respiration	10
4. Benthic Macrofauna	16
5. Benthic Meiofauna	19
6. Microbiology -- Fin Rot	21
7. Phytoplankton and Primary Productivity	24
8. Resource Distribution and Abundance	39
IV. MESA Data Report	43
V. Appendices	48

I. INTRODUCTION

This report summarizes progress by this Center in MESA-funded research from March 1, 1975, through June 30, 1975. Section II consists of a summary of important accomplishments. Section III is a detailed review by budget category, covering:

1. Statistical Design and Analysis
2. ADP Format and Operations
3. Benthic Respiration
4. Benthic Macrofauna
5. Benthic Meiofauna
6. Microbiology
7. Plankton and Primary Productivity
8. Resource Distribution and Abundance

Much research within the Center is closely related to the goals of MESA, but is unreported here because funding is by NMFS. We have attempted to integrate the activities of such studies with MESA activities insofar as is possible. For example, substantial improvement this trimester in our ADP capability funded largely by NMFS has aided MESA studies considerably. In many other activities mutual benefits accrue, e. g., (1) wide-ranging resource assessment cruises in which the apex is one small but important geographical segment, (2) our benthic studies in Long Island Sound and Raritan Bay

which amplify our understanding of man-induced impacts on the infauna of the apex, (3) the contaminants work at the Milford laboratory, and (4) the pathogenicity studies at the Oxford laboratory.

II. SUMMARY OF ACCOMPLISHMENTS

1. Automatic data processing capabilities and accomplishments have improved markedly during the report period, and will continue to do so with the aid of a terminal to be installed at the Center this summer which will provide access to the computer center at Fort Monmouth.
2. Ten authored data reports suitable for publication in the MESA Technical Report series have been completed and turned over to the MESA-NYB Office for publication. The reports contain computer listings of data preceded by descriptions of materials and methods.
3. Benthic macrofaunal assemblages of the proposed alternate dump sites were described together with descriptions of particle-size distributions of sediments at faunal sampling sites. The species composition is close to the known sand fauna complex of species as now imperfectly known covering extensive areas of the Middle Atlantic Shelf.
4. The heavy metals burdens of Cd, Cr, Cu, Ni, Pb, and Zn in sediments of the proposed alternate dump sites was reported as being at much lower levels than the levels found in and near dump sites.

5. Seabed oxygen consumption levels at the proposed alternate dump sites were reported to be as low as the lowest levels found in the Bight apex.

6. No fecal coliforms were found at the proposed alternate dump sites, and the Clostridium perfringens count was low relative to observations in the Bight apex. Analyses were made also of total aerobes, presumptive Vibrio species, lipolytic forms, proteolytic forms, starch hydrolysis, and chitin hydrolysis.

7. Cages containing entrapped winter flounder have been placed in the sewage sludge area of the Bight apex twice; fish caged for two and four weeks invariably displayed active or progressive caudal fin lesions. Microbiological studies continued, and one paper on the histology of fin rot disease was published.

8. A series of sixteen monthly cruises of the phytoplankton and primary productivity study of Raritan Bay and the Lower Hudson estuary was completed in March. Since that time, activities have concentrated on getting massive quantities of data into the computer, most of which should be accomplished in about one month.

9. Because by now large quantities of demersal fish and shellfish data have been rendered machine readable, the capability to analyze the data definitively for avoidance of high-carbon areas has increased markedly.

10. Final contract reports on resistant coliforms (Dr. Koditschek) and on ciliate protozoans (Dr. Small) were received and are reproduced in the appendix.

11. The draft of a manuscript on the fisheries of the New York Bight by Dr. McHugh was received and is summarized in Section III. 8 of this report.

III. DETAILED REPORT OF PROGRESS BY BUDGET CATEGORIES

1. STATISTICAL DESIGN AND ANALYSES

During the reporting period a modification of a contract with Dr. Saul Saila of the University of Rhode Island was negotiated covering additional work and extension until June 30, 1976, of a previous contract administered by this Center to conduct statistical analyses of the distribution and abundance of benthic macrofauna. Negotiations were completed in June. The modification calls for an anlysis of the numbers of replicate samples that are necessary to achieve reliable sampling of benthic macroinvertebrates at various levels of confidence. Data for the analyses are those collected in June 1973 during the so-called "RECON" cruise of the Atlantic Twin. Twenty grabs per station were obtained at eight stations supplemented by an additional five grabs per station at 21 stations.

2. ADP-FORMAT AND OPERATIONS

Automatic data processing capabilities and accomplishments have improved markedly during the report period, and will continue to do so with the aid of a terminal providing direct access to the computer center at Fort Monmouth and with institution of an improved data managements system. The terminal will be installed this summer.

Activities have not only provided services related to archiving and retrieval of data sets for various investigations, but have also initiated longer range actions for increasing efficiency and for expanding service to the Center. These include completion of a contract for installation of a COPE 1200 batch terminal and implementation of a multi-file data management system (SELGEM).

ADP activities within the Resource Assessment Investigation utilized the historical and current research survey data (groundfish and ichthyoplankton) for various user specifications, and began analyses of these data to estimate sizes of population, recruitment and spawners, the rates of growth, mortality and recruitment, i.e., active involvement of stock assessment of commercially and recreationally important species in the Middle Atlantic Bight. In the trimester over 11,000 data cards were

keypunched for integration in the Resource Assessment data file.

Within the Ecosystem Investigation, ADP activities were oriented to research survey data (benthos, primary productivity, chemical, etc.) storage and retrieval for further analyzing the environmental impact studies, with special refe'ences to the MESA apex area. Some 11,600 cards were keypunched and entered into the data bank. In addition, programs were written to derive estimates of respiration, sigmat-t macrofaunal listings and for a Bight SYMAP configuration. ADP activities of Pathobiology and Experimental Biology Investigations were initiated with a compilation of historical and current experimental data to a Center data bank. Pathobiology is creating a worldwide finfish and shellfish disease registery within our facility. Our study groups of mutagenesis and physiological effects of environmentally stressed marine finfish and shellfish began formatting to computerize their historical data and current research materials.

3. BENTHIC RESPIRATION

The consumption of oxygen by the seabed was measured during March, August and December 1974 and in February 1975. The methodology was that of Pamatmat (Limnol. Oceanogr., 1971) for total oxygen consumption.

In March (Fig. 1) two areas of heightened seabed oxygen consumption can be identified. The area of elevated rates in the center of the figure is located over the upper Hudson Shelf Valley and Christiaensen Basin (the so called "amphi-theater") and would appear to define the area most affected by ocean dumping. No discernible effects on seabed oxygen consumption are observed near the acid area (40°20'N, 73°40'W) in March or during the other cruises. The second area of elevated rates at the lower left side of the figure is located off Asbury Park, N.J. This area exhibits elevated rates in both March and August (as high as are measured in the apex) but not in December 1974, or February 1975. Values are highest nearest the coast and decrease to seaward indicating a probable source of organic matter (i.e. ocean outfall of sewage) near the coast in that region.

In August (Fig. 2), in response to higher water temperatures, seabed oxygen consumption rates are higher throughout the apex <u>except</u> for the area of the waste disposal grounds previously described as having elevated rates. Oxygen consumption rates

in this area are not only depressed compared with the surrounding area, but are also more typical of winter values measured during March. Such values are indicative of an overstressed area. The highest rates at this time of year occur on the periphery of the depressed area and decrease with distance from the impacted area.

In December (Fig. 3), the highest values are again found over the sewage sludge and dredge spoil disposal areas.

During the last trimester we have computerized our data and are now in the process of making additional analyses via the computer. Total seabed oxygen consumption data from our February 1975 cruise to the apex has now been plotted (Fig. 4). The values in February are somewhat lower than those measured in December 1974 (Fig. 3) and the area of elevated rates is less. However, the winter data of December (Fig. 3) and February (Fig. 4) are very consistent, both exhibiting elevated rates over the dredge spoil and sewage sludge areas.

The values are indicative of the quantity of organic matter oxidized per unit area of seabed per unit time as well as of in situ environmental conditions which affect living marine resources.

In June, Dr. Thomas presented a paper, Seabed Oxygen Consumption in the New York Bight, at the American Society of Limnology and Oceanography meetings in Halifax, Nova Scotia.

Figure 1. Total Seabed Oxygen Consumption (ml $O_2/m^2/hr$)
March - April 1974
FRS Oregon II Cruise D-74-1

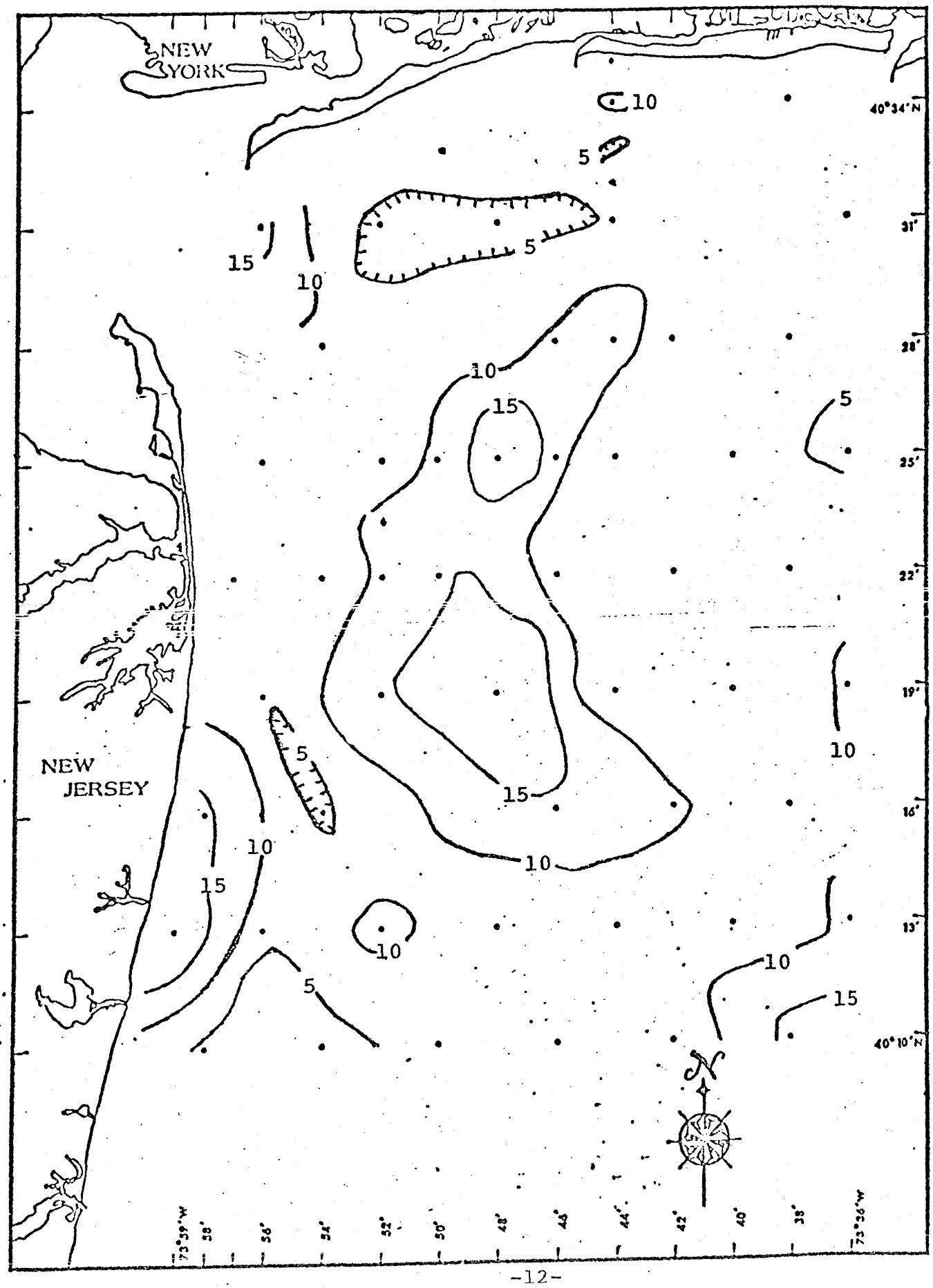


Figure 2. Total Seabed Oxygen Consumption (ml $O_2/m^2/hr$)
26 August - 6 September 1974
FRS Delaware II Cruise D-74-9

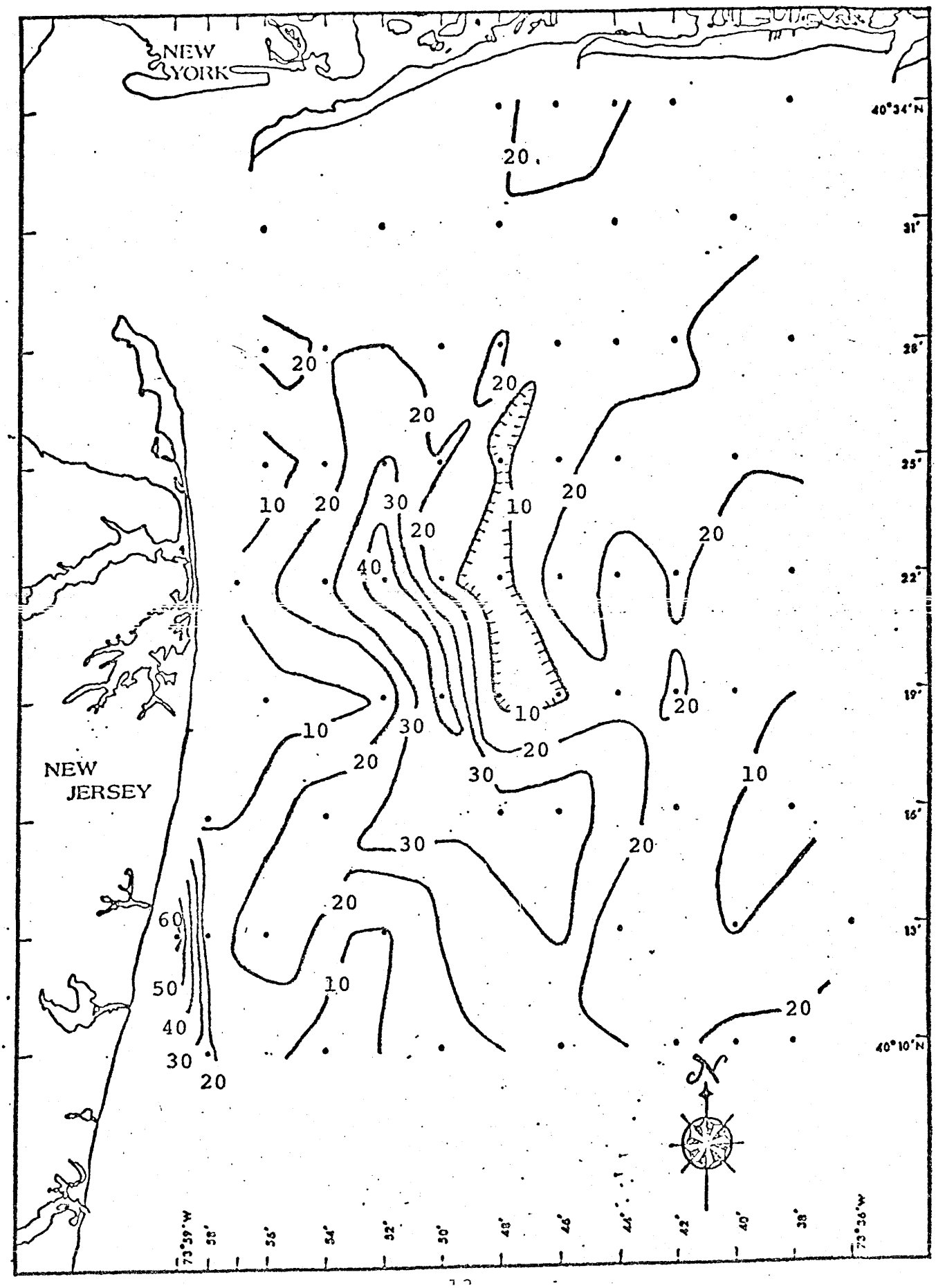


Figure 3. Total Seabed Oxygen Consumption (ml $O_2/m^2/hr$)
December 1974
FRS Delaware II Cruise D-74-16

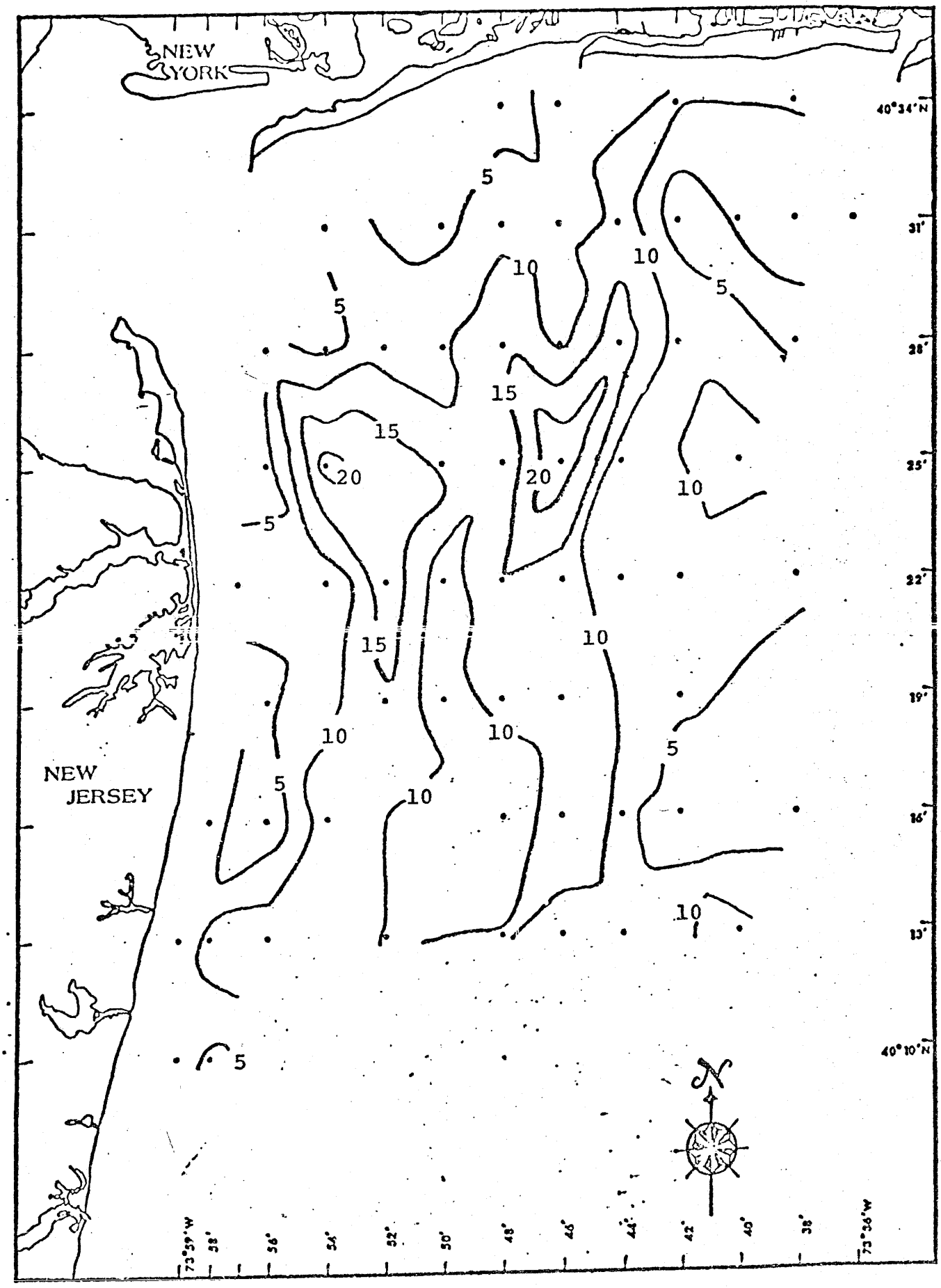
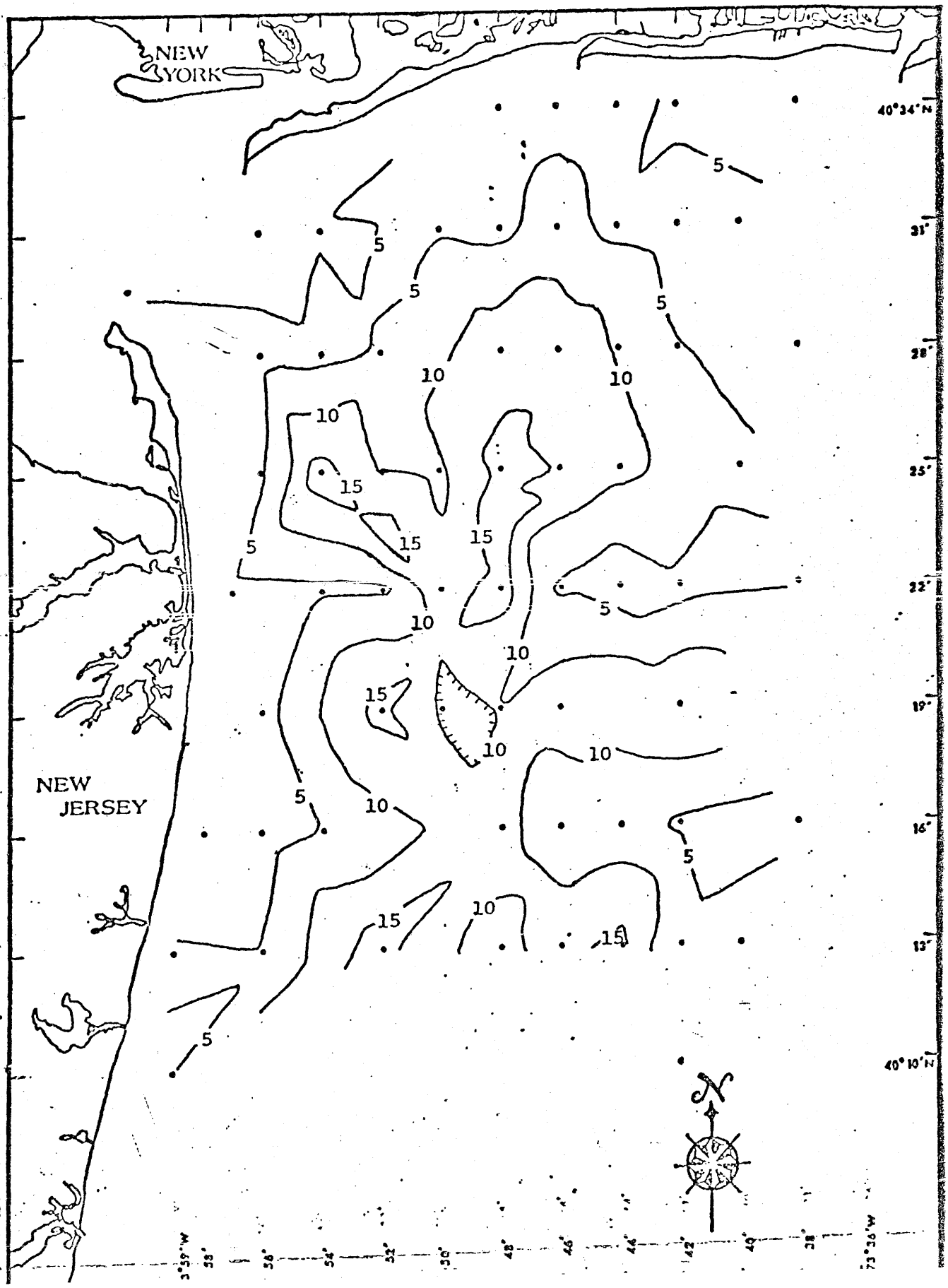


Figure 4. Total Seabed Oxygen Consumption (ml $O_2/m^2/hr$)
February 12-24, 1975
FRS Delaware II Cruise D-75-2



4. BENTHIC MACROFAUNA

Emphasis during this trimester has been on sorting and identifying the animals from the proposed alternate dump sites and from regions of the shelf that lie within the same depth range as the proposed sites. Field work consisted of two major cruises, the R/V DELAWARE cruise of 23 - 30 April 1975 (Cruise D-75-4) to 60 stations in 20-35 fathoms from Montauk Point to Cape May, plus 25 supplemental samples from the dredge spoil sump site alone, and the R/V KELEZ cruise of 28 May - 2 June 1975 (Cruise K-75-1) to sample 59 stations in the Long Island nearshore area (see cruise reports in appendices). Sampling on both cruises was accomplished by means of the Smith-McIntyre grab. Sediment subsamples were retained for subsequent analyses of particle-size distributions and heavy metals burdens. Five grab samples were taken at each station except in the dredge spoil dump site area where two samples per station were taken. Bottom salinity, temperature, and oxygen were also measured.

Sorting and identifying of proposed alternate dump site samples were completed on 3 June following which we immediately forwarded the data as recorded by hand on lab work sheets to the MESA-NYB office as part of our preliminary report providing input for EPA's environmental impact statement. Since then all

of the data have been key-punched and listed in a data report which is ready for publication.

Grab 1 of 5 grab samples collected on the April 1975 R/V DELAWARE cruise are about 80% sorted and identified; since laboratory work began on them on 5 June, we anticipate completion by about 30 July.

A tape of historical data representing the period 1967 to 1971 was received from Dr. Saila and converted to a data report after editing and adding diversity data.

The manuscripts of two more data reports were completed during this period which record the species and numbers of individuals in grab 1 of 5 grab samples collected by the R/V ALBATROSS on 2 - 6 August 1973 and by the R/V DELAWARE on 26 August - 5 September 1974 (the first and fifth quarterly cruises, respectively).

Three data reports consisting of computer listings were assembled. They were:

John Pearce, James Thomas, Jan Caracciolo, Martha Halsey, and Leslie Rogers. NOAA Data Report No. Distribution and abundance of benthic organisms in the New York Bight apex, 2-6 August 1973.

John Pearce, James Thomas, Jan Caracciolo, Martha Halsey, and Leslie Rogers. NOAA Data Report No. Distribution and abundance of benthic organisms in the New York Bight apex, 26 August - 6 September 1974.

James Thomas, Leslie Rogers, John Pearce, Jan Caracciolo, Martha Halsey, and Knee McNulty. NOAA Data Report No. Distribution and abundance of benthic organisms in the outer New York Bight and proposed alternate dump sites, June 1974 and February 1975.

Table 1. An Updated Summary of all Benthic Work

VESSEL-DATE	PURPOSE	# STATIONS	# GRABS/ STA.	TOTAL GRABS	# SORTED	# IDENT.	# KEY PUNCHED	°C	SAL.	DO	KEY PUNCH	SYMAP	HM	STATE OF SAMPLE	GS	STATE OF SAMPLE	M	STATE OF SAMPLE	OTHER SAMPLES & DISPOSITION THEREOF
1. Atlantic Twin 5-14 June 1973	MESA RECON	8 21	20 5	160 105 265	done	done	265	Not taken					265	Greig	265	COK	265	Tietjen	TECH. REP. in prep.
2. Albatross IV 2-6 Aug. 73	1st. quarterly cruise	64	5	320	174	174	Sent to Saila	x	x	x	x	x	320	Greig	320	COK	320	Tietjen	TECH. REP. to MESA-NYB
3. Ferrel 16-20 Oct.73	SUMP IA SUVAR-A	50	1	50				Not taken					50	Storage	50	AOML	50	Storage	2-1½" cores for AOML organics & sediment bottom photos SSS & SRP
4. Oregon II 20-25 Oct. 73	2nd quarterly cruise	93	5	465	20	5		x	x	x	x	x	465	Greig	465	COK	465	Storage	None
25-30 Oct. 73	SUMP IB	-Aborted due to hurricane																	
5. Albatross IV 22-30 Jan. 74	3rd quarterly cruise	103	5	515				x	x	x	x	x	515	Greig	515	COK	515	Storage	None
6. Albatross IV 30-31 Jan. 74	SUMP II	88	1	88				Not taken					88	Storage	88	AOML	88	Storage	Sample surface for AOML sediment organics, bottom photos, SSS &
7. Oregon II 22 Mar.-3 Apr.74	4th quarterly	103	5	515				x	x	x	x	x	515	Greig	515	COK	515	Storage	None

Table 1. (Continued)

VESSEL-DATE	PURPOSE	# STATIONS	# GRABS/ STA.	TOTAL GRABS	# SORTED	# IDENT.	# KEY PUNCHED	°C	SAL.	DO	KEY PUNCH	SYMAP	HM	STATE OF SAMPLE	GS	STATE OF SAMPLE	M	STATE OF SAMPLE	MISC.
8. Venture May 74	SUMP III	88	1	88				Not taken					88	Storage	88	AOML	88	Storage	¼ surface scrape for AOML-sed. transport and organics Bottom Photos SSS & SRP
9. Venture 21-30 June,74	Alt. Dump (DUPI) NORTH	33	1	69	69	69	69						69	Done Milford	69	Done AOML	69		TECH. REP. to MESA-NYB
	SOUTH	36	1																
10. Atlantic Twin 30 July - 5 Aug. 74	Nekton Dives SSS & SRP for AOML	0		0				Not taken						Not taken					Biological and Geological Observations Tiger Scarp (Balt. Can.) and Alt. Dump Sites SSS & SRP
11. Delaware II 26 Aug.-5 Sept. 1974	5th quarterly report	103	5	515	101	48		x	x	x	x	x	515	Storage	515		515		TECH. REP. TO MESA-NYB
12. Ferrel 3-6 Sept. 74	SUMP IV	87	1	87				Not taken					87	Storage	87	AOML	87		¼ surface scrape AOML sediments and organics SSS & SRP Bottom Photos

Table 1. (Continued)

VESSEL-DATE	PURPOSE	# STATIONS	# GRABS/ STA.	TOTAL GRABS	# SORTED	# IDENT.	# KEY PUNCHED	°C	SAL.	DO	KEY PUNCH	SYMAP	HM	STATE OF SAMPLE	GS	STATE OF SAMPLE	M	STATE OF SAMPLE	MISC.
13. Delaware II 6-14 Nov. 74	SUMP V	87	1	87				Not taken					87	Storage	87	AOML	87		4 surface scrape AOML sediments and organics SSS & SRP Bottom Photos
14. Delaware II 12-24 Feb.75	DUPI's sludge and	25	2	50				Done for apex					50		50		NT		Exxon - 8 grabs
	Dump site survey	12	5	60	60	45	45	x	x	x	x		60	Milford	60	Done AOML	NT		TECH. REP. to MESA-NYB
				110															
15. Delaware II 23-30 Apr.75	OCS	60	5	300	60	60	60	60	60	60	60		300	Milford	300	Dr. Parks Leheigh			TECH. REPT. in preparation
	Dredge spoils	25	2	50				5	5	5				Storage		Storage			
16. Kelez 28 May - 2 June 75	LINS	59	5	295									295	Storage	295	Storage			

5. BENTHIC MEIOFAUNA

A final report on the ciliate protozoa associated with man-induced change to the sublittoral environment of the New York Bight in the period June 1973 to February 1975 was received from Dr. Eugene B. Small of the University of Maryland.

The summary of Dr. Small's report, reproduced in full in the appendix, follows:

1. Sampling of planktonic and benthic ciliate populations in chosen areas of the New York Bight has been successful over a period of twenty months.

2. Large seasonal variations in numbers of populations have been observed quantitatively; this includes faunal as well as numerical variations.

3. Presence of large numbers of bactivorous ciliates have been observed to be associated with sewage dumps during the warm summer months.

4. Cysts of bactivorous ciliates (pollution associated species as well as "clean water" associated species) can be recovered from the sediments any season of the year; sewage associated species predominate in the areas proximal to the sewage and dredging spoils dump sites and clean water species in the areas designated as control areas (e.g. the Long Island and New Jersey shore stations).

5. Benthic ciliates are affected by climatic and substrate variabilities; lows occur during the winter and in areas proximal to the sewage and dredging spoils dump sites. Sewage sludge is made up of small particles which may account for the absence of ciliates in the dump site muds (rather than the "bacterial" pollution and/or biochemical saprobity).

6. MICROBIOLOGY -- FIN ROT

Prevalence

Monthly Delaware II cruises to determine fin rot disease prevalence in demersal fishes from the Hudson Corridor (Raritan Bay to Hudson Canyon) have continued. Presently, data analysis is complete through June 1975. Fin rot disease in flounders from the apex area is substantially less prevalent than anticipated. Catches generally were small and large numbers of flounders were not obtained. From March through June only 417 winter flounder (*Pseudopleuronectes americanus*) were examined; three (0.7%) exhibited fin rot. No summer flounder (*Paralichthys dentatus*), fourspot flounder (*Paralichthys oblongus*) and yellowtail flounder (*Limanda ferruginea*) -- 332, 290, and 97 respectively -- were noted with fin rot.

Four Delaware II cruises were made to the apex area of the New York Bight during April (1), May (1), and June (2) specifically to assess fin rot disease prevalence in migrating winter flounder. On each cruise (except the second June cruise), 20 preselected stations were fished with a 3/4 Yankee otter trawl. The station locations were the same each month. Winter and summer flounder were the only fish examined exhibiting fin rot disease. Of 895 winter flounder examined, 28 (3.1%) had fin rot. Of 470 summer flounder examined, 5 (1.0%) were diseased. Yellowtail flounder were not abundant (140) and did not exhibit fin rot. Although

575 foursport flounder were examined, only 1 (0.1%) had fin rot. The numerically most abundant flounder, the windowpane, continues to show negligible disease prevalence (3/1796; 0.16%). Published: Ziskowski, J. and R. Murchelano. 1975. Fin erosion in winter flounder. Mar. Poll. Bull. 6:26-28.

Histopathology

Published: Murchelano, R.A. 1975. The histopathology of fin rot disease in winter flounder from the New York Bight. J. Wildl. Dis. 11(2):263-268.

Microbiology

In May and June (Delaware II cruises to New York Bight apex), active caudal lesions of entrapped winter flounder were cultured bacteriologically. Several trawl-caught winter flounder which appeared to have active lesions also were cultured. Seventeen pure clones of bacteria were obtained from seven winter flounder cultured in May. Although the bacteria were initially grown in TYG broth supplemented with 3% fish extract, all were able to grow for at least two transfers on unsupplemented TYG agar. Three of the cultures then failed to grow upon transfer into broth for serologic studies. Of the fourteen clones that grew, none consistently evoked high agglutinin titers in sera from fin rot-diseased fish. However, 73% (11/15) of the fish sera examined from the May cruise had extremely high antibody levels

against one of the bacterial isolates. In several cases bacterial agglutination was observed at serum dilutions of 131 million. By using broth supplemented with fish extract, growth of one of the three isolates which earlier had failed to grow was possible. This organism is a large, gram negative rod that on the basis of its zoning growth in semisolid media appears to prefer micro-aerophilic conditions. No biochemical characterizations of the bacterial clones isolated yet have been made.

Cage Studies

To date, cages containing entrapped winter flounder have been placed in the sewage sludge area of the Bight apex twice. In May, the cages were left in place for a four-week period; in June, the cages were retrieved after two weeks. Winter flounder caged for two and four weeks invariably display active or progressive caudal fin lesions. The lesions are more advanced in fish entrapped for four weeks than for two weeks. Control cages placed in a clean water environment outside of the Bight apex (eastern Long Island) could not be retrieved. Several attempts have been made to retrieve the cages with a grapnel but with no success. Until entrapped winter flounder are successfully retrieved from the control area, the influence of the cage itself as the initiator of the lesions cannot be minimized. Winter flounder with caudal fin rot rarely are noted in the Bight apex; most lesions are confined to the dorsal and anal fins.

7. PHYTOPLANKTON AND PRIMARY PRODUCTIVITY

Raritan Bay and Lower Hudson Estuary:

As of March 1975 monthly field sampling for studies of phytoplankton primary productivity in the Raritan Bay Lower Hudson estuary was completed. In all, sixteen monthly cruises occurred between November 1973 and March 1975. Station locations are shown in Figure 1. Primary productivity, photosynthetically active radiation, light extinction, temperature, salinity, dissolved oxygen, pH, alkalinity, phytoplankton nutrients (ammonia, nitrite, nitrate, phosphate, silicate, etc.) chlorophyll pigments, particulate organic carbon and nitrogen, hydrocarbons and particulate heavy metal concentrations were measured.

During the first seven months of our study, we observed an average of 11 percent of the photoassimilated carbon to be released as dissolved organic matter (<0.45 micron). Table 1 presents a breakdown of percent release according to month. Looking at the data more broadly we are occassionally finding exceedingly high rates of release (25 mg $C/m^3/hr$) which may be indicative of environmental stress.

Beginning in March 1973, we fractionated particulate production into two size classes, nannoplankton (<20 microns) and netplankton (>20 microns), so that we could assess the relative potential contribution of these two size classes to the food chain. On Table 2 are found nannoplankton/netplankton

ratio progressively increased from 0.49 to 24.3. Or, in other words, nannoplankton were responsible for 33% of particulate productivity in March and 96% in August (Fig. 2). These results will be most interesting to examine in light of the recent paper presented at the ASLO meetings 1975 that menhaden feed only on particles $> 12\ \mu$ (Durbin, 1975).

Extreme spatial and temporal changes in the distribution of chlorophyll "a" concentration, and assimilation potential (total primary productivity at optimum light intensity and ambient sea surface temperature) have been observed. In February assimilation potential (assimilation potential is highly correlated with phytoplankton biomass concentration) was fairly similar throughout the estuary, ranging between 20 and 60 mgc/m^3hr. In March, during spring bloom of Skeletonema costatum, much spatial heterogeneity was observed. Values for assimilation potential ranged from 40 near Rockaway, Long Island to 380 $mgC/m^3/hr$ at station 15, Sandy Hook Bay. Similarly, in April and May, low assimilation values measured in Sandy Hook Bay and Raritan Bay (see Figs. 3, 4, 5 and 6). Maps of chlorophyll "a" concentrations (Figs. 7, 8, 9 and 10) substantiate these trends. Samples of seawater, collected and preserved during our cruises, are presently being analyzed for phytoplankton species composition, density, and average cell size, so that we may causally link changes in these structural aspects of the phytoplankton

community to concurrent changes in nannoplankton/netplankton productivity rations, release of dissolved organic matter, and total primary productivity. Our efforts are continuing along these lines.

Since March 1975 our activities have been concentrated on getting our massive quantities of data into the computer. We anticipate completing this phase in about one month with the exception of our data on phytoplankton species identification, number, diversity, and cell size. This phase will be completed about December 1975.

Table 1. AVERAGE PERCENT OF TOTAL PHYTOPLANKTON PRIMARY PRODUCTIVITY RELEASED AS DISSOLVED ORGANIC MATTER ($<$ 0.45 micron) IN SURFACE WATER OF RARITAN-LOWER HUDSON ESTUARY

Month-Year	# of Stations Sampled	Average % DOM
Nov - 73	3	17.5
Dec - 73	3	11.1
Jan - 74	5	5.9
Feb - 74	11	9.2
Mar - 74	11	9.7
Apr - 74	11	11.5
May - 74	12	12.5

Table 2: AVERAGE RATIO OF NANNOPLANKTON (< 20 microns)/TO NETPLANKTON (> 20 microns) PRIMARY PRODUCTIVITY IN SURFACE WATER OF RARITAN-LOWER HUDSON ESTUARY

Month-Year	# of Stations Sampled	Average Nanno/netplankton Productivity Ratio
Mar - 74	11	0.49
Apr - 74	12	0.90
May - 74	12	1.57
Jun - 74	11	17.51
Jul - 74	12	23.40
Aug - 74	10	24.23

Figure 1.

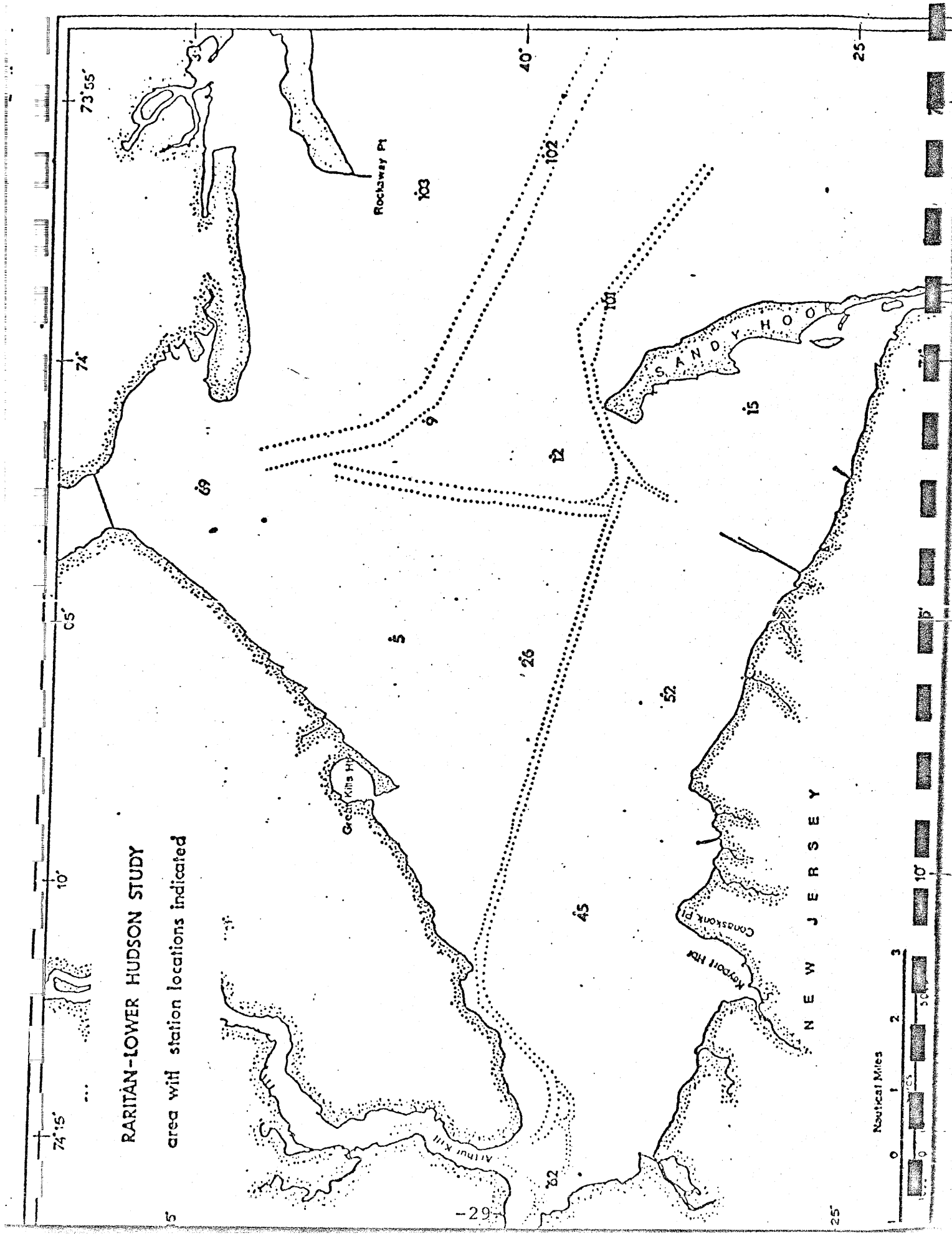
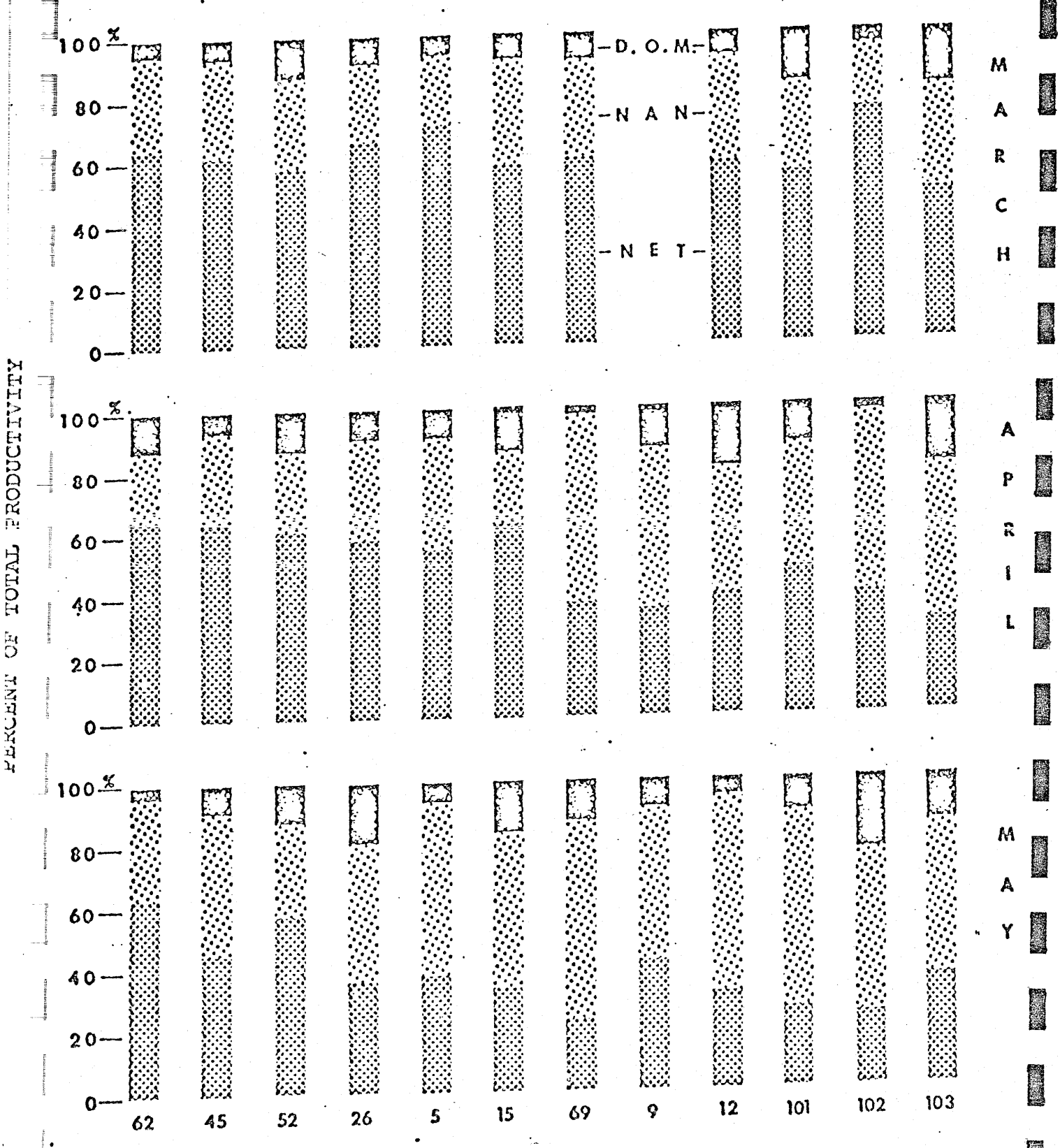

RARITAN-LOWER HUDSON STUDY
area with station locations indicated
Rockaway Pt
SANDY HOOK
NEW JERSEY
Great Kills Hbr
Arthur Kill
Keyport Hbr
Conaskonk Pt
Nautical Miles
73°55'
74°
74°15'
40'
25'
05'
10'
15'
103
102
101
9
12
15
69
5
26
52
45
82

Figure 2.

% CONTRIBUTION TO TOTAL PRIMARY PRODUCTIVITY BY NETPLANKTON, NANNOPLANKTON, & DISSOLVED ORGANIC MATTER



STATIONS IN RARITAN-LOWER HUDSON ESTUARY

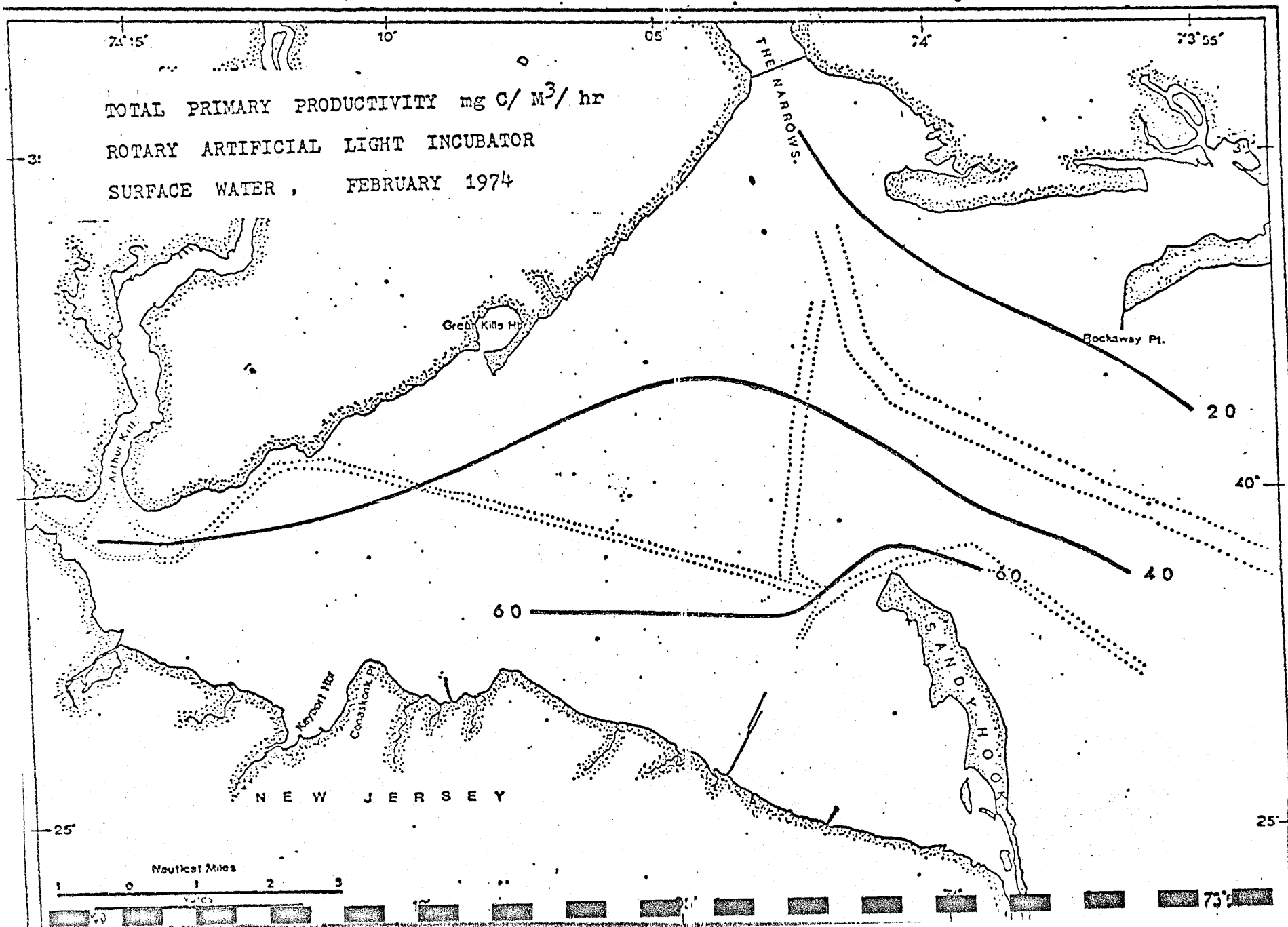

TOTAL PRIMARY PRODUCTIVITY mg C/ M3/ hr
ROTARY ARTIFICIAL LIGHT INCUBATOR
SURFACE WATER , FEBRUARY 1974
THE NARROWS
Rockaway Pt.
Arthur Kill
Keyport Hbr
Coaster Pt.
NEW JERSEY
SANDY HOOK
20
40
60
Nautical Miles

Figure 3.

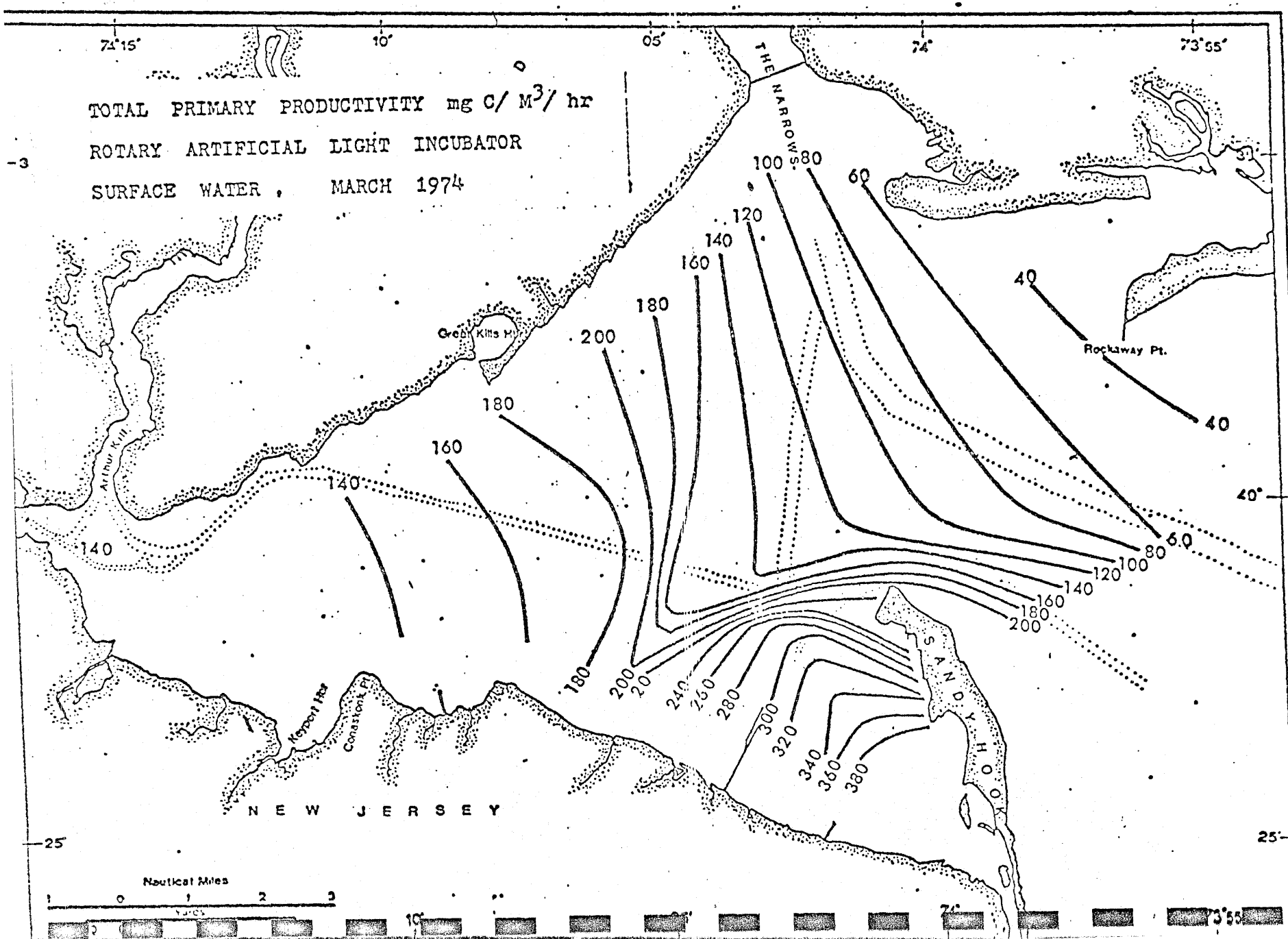

TOTAL PRIMARY PRODUCTIVITY mg C/ M3/ hr
ROTARY ARTIFICIAL LIGHT INCUBATOR
SURFACE WATER , MARCH 1974
74°15'
10'
05'
74°
73°55'
THE NARROWS
Rockaway Pt.
Arthur Kill
Keyport Hbr
Conastoga Pt
SANDY HOOK
NEW JERSEY
Nautical Miles
40°
25'
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380

Figure 4.

Figure 5.

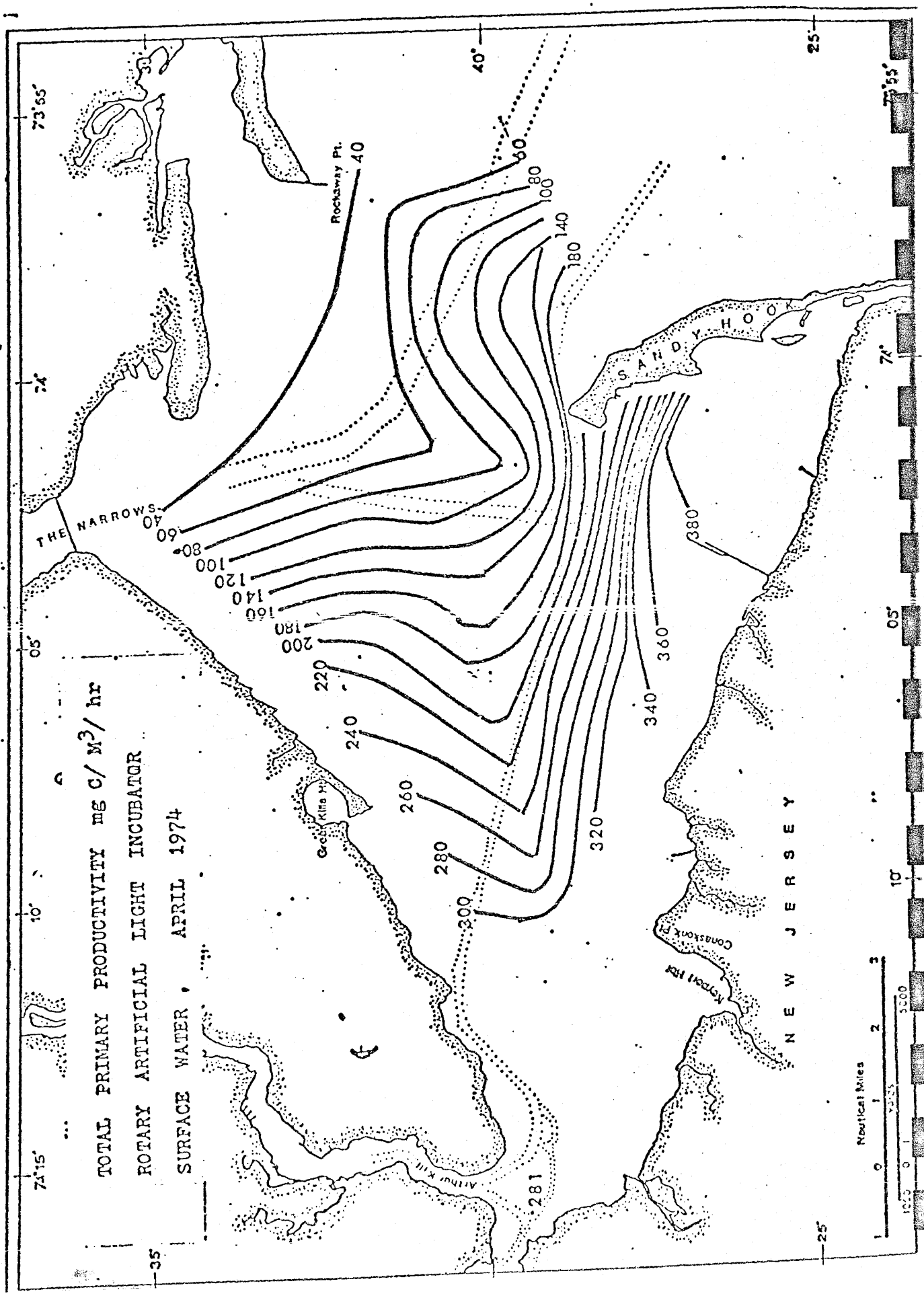
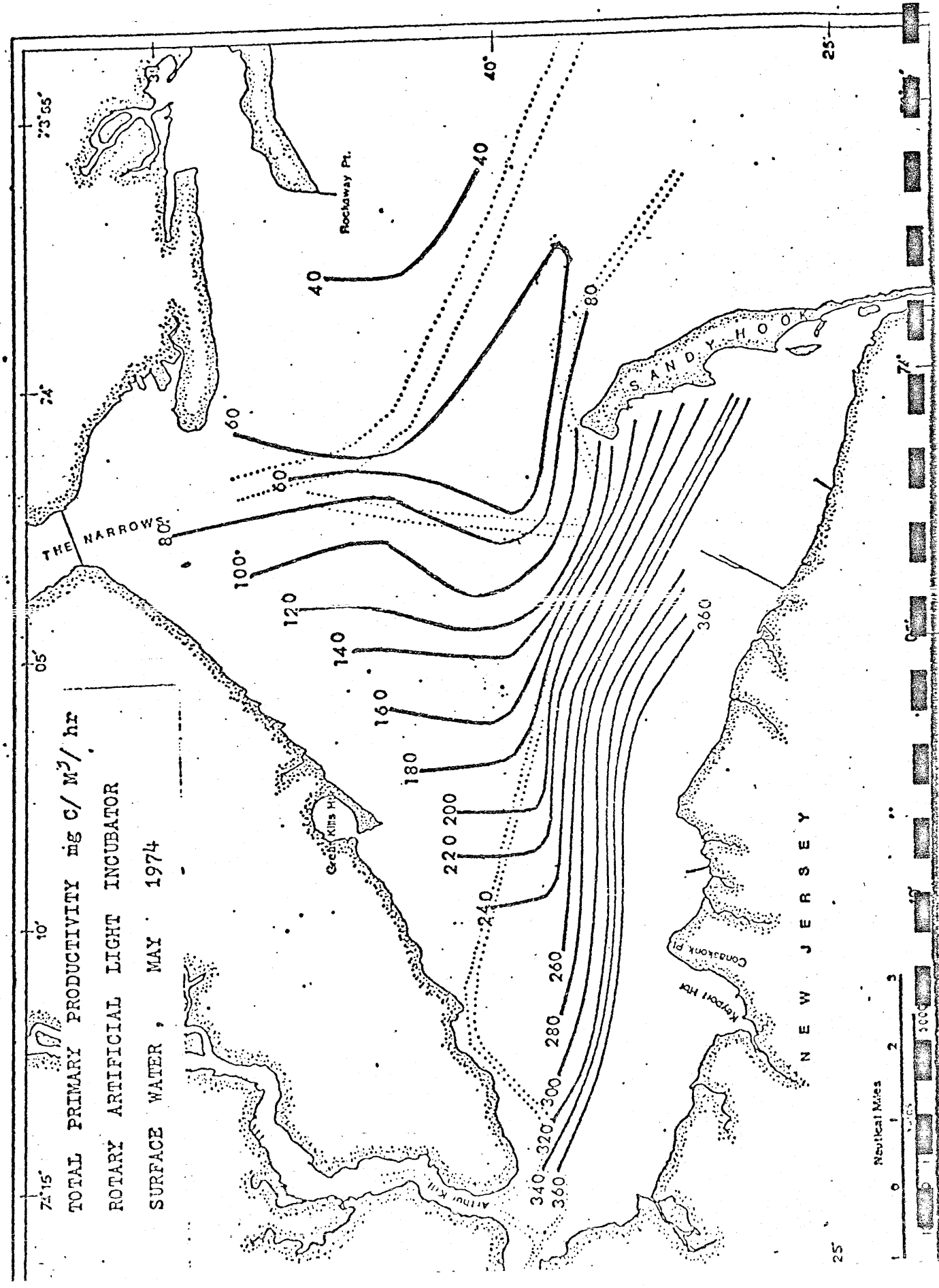

TOTAL PRIMARY PRODUCTIVITY mg C/ M3/ hr
ROTARY ARTIFICIAL LIGHT INCUBATOR
SURFACE WATER , APRIL 1974
THE NARROWS
Rockaway Pt.
SANDY HOOK
NEW JERSEY
Coney Island
Arthur Kill
Nautical Miles
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
281

Figure 6.


TOTAL PRIMARY PRODUCTIVITY mg C/ M³/ hr
ROTARY ARTIFICIAL LIGHT INCUBATOR
SURFACE WATER , MAY 1974
THE NARROWS
Rockaway Pt.
SANDY HOOK
NEW JERSEY
Navesink R.
Shrewsbury R.
Raritan Bay
Keyport Hbr
Conaskonk Pt.
Nautical Miles
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360

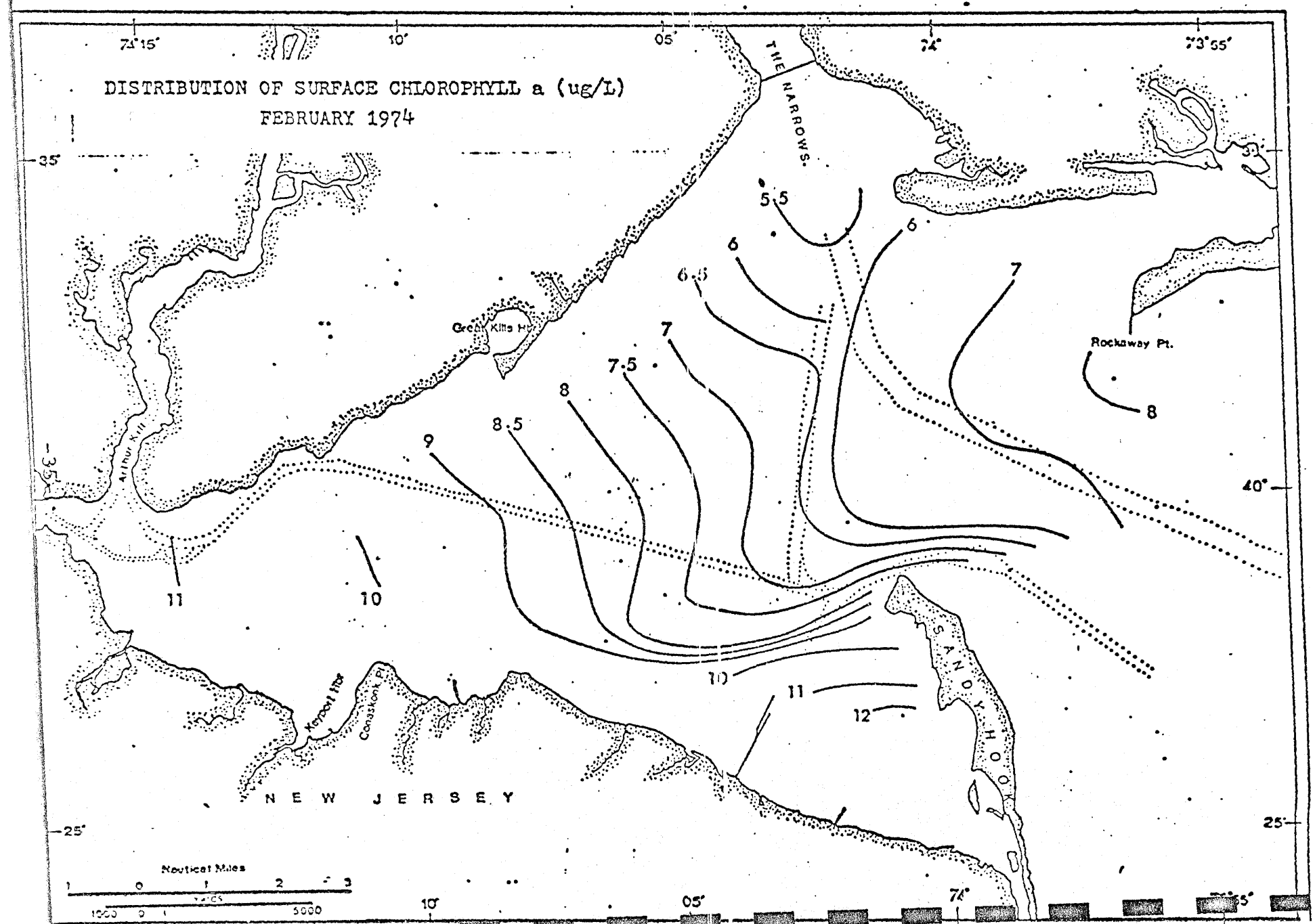

DISTRIBUTION OF SURFACE CHLOROPHYLL a (ug/L)
FEBRUARY 1974
THE NARROWS
Rockaway Pt.
Arthur Kill
Kill Van Kull
Constable Pt.
SANDY HOOK
NEW JERSEY
Nautical Miles
Yards
5.5
6
6.5
7
7.5
8
8.5
9
10
11
12

Figure 7.

Figure 8.

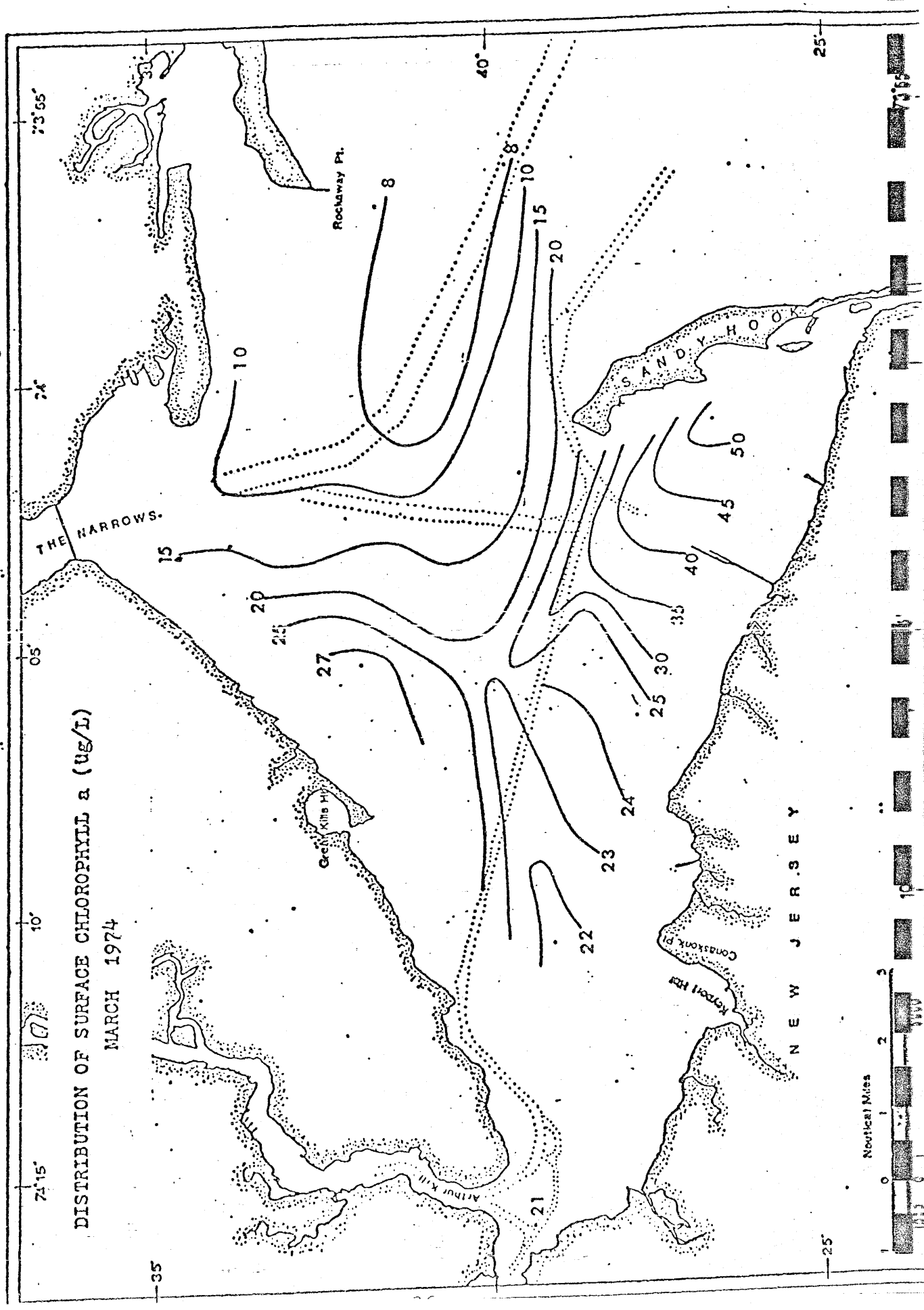

DISTRIBUTION OF SURFACE CHLOROPHYLL a (Ug/L)
MARCH 1974
THE NARROWS
SANDY HOOK
Rockaway Pt.
Great Kills Hd
Arthur Kill
Conaskonk Pt
Keyport Hd
NEW JERSEY
Nautical Miles
73°55'
74°
05'
10'
74°15'
35'
40'
25'
8
10
15
20
21
22
23
24
25
27
30
33
40
45
50

Figure 9.

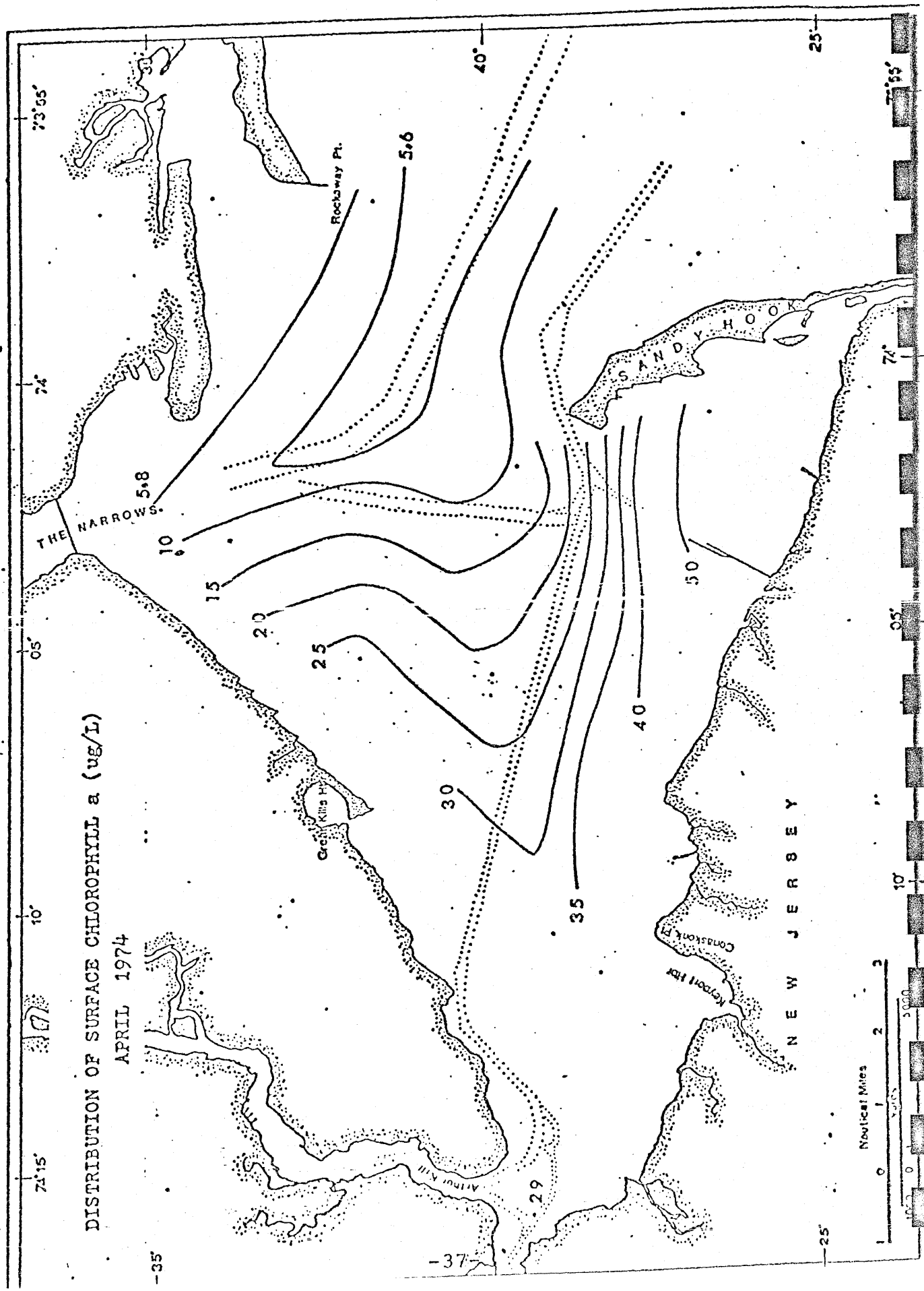
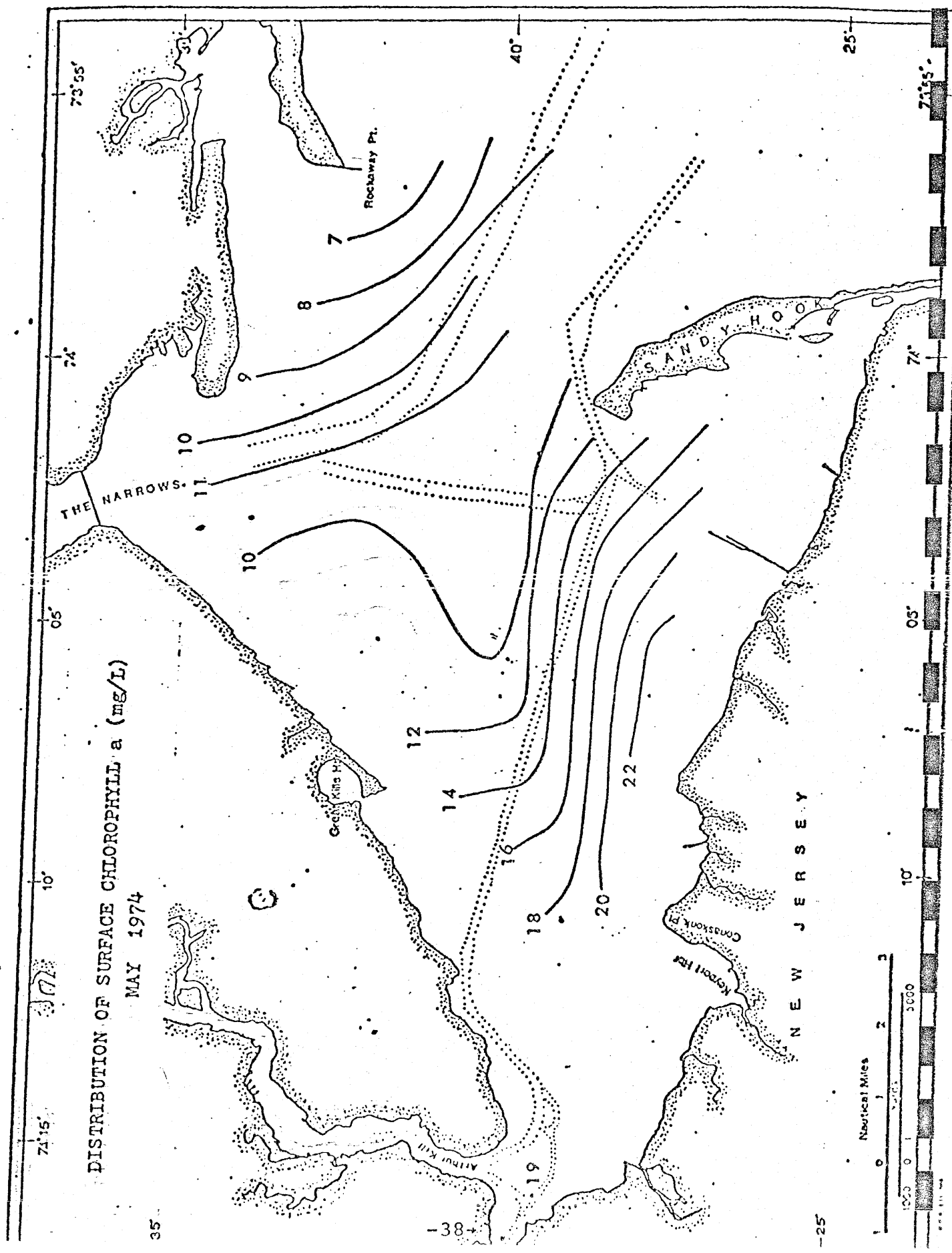

DISTRIBUTION OF SURFACE CHLOROPHYLL a (ug/L)
APRIL 1974
THE NARROWS
Rockaway Pt.
SANDY HOOK
NEW JERSEY
Great Kills Hbr
Raritan Bay
Keyport Hbr
Conaskonk Pt
5.8
5.6
10
15
20
25
30
35
40
50
29
Nautical Miles
73°55'
74°
05'
10'
74°15'
-35'
-25'
-40'
-50'

Figure 10.


DISTRIBUTION OF SURFACE CHLOROPHYLL a (mg/L)
MAY 1974
THE NARROWS
SANDY HOOK
Rockaway Pt.
Great Kills H.
Conassock Pt.
Keyport Hbr.
Arthur Kill
NEW JERSEY
Nautical Miles
7
8
9
10
11
10
12
14
16
18
19
20
22
73°55'
40'
25'
74°
05'
10'
74°15'
35'
-25'

8. RESOURCE DISTRIBUTION AND ABUNDANCE

A study of the distribution and abundance of fish and shellfish to gain further understanding of their avoidance of high carbon areas continued. During the reporting period, five major assessment cruises were conducted having stations within the MESA area, as listed below.

Date	Vessel	Number of stations occupied in the New York Bight	Number of stations occupied in N.Y. Bight apex
March 4-21	Albatross IV	22	1
March 18-24	Atlantic Twin	39	12
April 1-10	Albatross IV	48	6
May 5-13	Delaware II	63	11
June 2-9	Delaware II	64	12

Dr. J.L. McHugh of the State University of New York completed in June a 134-page draft of a manuscript entitled "Fisheries and fishery resources of the New York Bight", thus bringing near to completion a study funded in part by MESA. The manuscript concerns primarily the history of New Jersey fisheries as revealed by analysis of landing statistics, but because the fisheries of New York state were studied previously

using the same approach (McHugh, 1972 -- Fish. Bull. 70 (3): 585-610), Dr. McHugh has been able to combine historical records of the two states to provide an overall view of historical trends pertaining to the entire New York Bight. Among his findings is separation of the fisheries into four periods: (1) an initial period of exploitation of traditional inshore resources from about 1880, when records were first kept, until about 1930 (oyster, bluefish, American shad, and weakfish); (2) development of offshore trawl fisheries for demersal species in the 1930's and early 1940's (haddock, silver hake, Atlantic cod, butterfish and yellowtail flounder); (3) response to meat shortages and high prices for fish data in World War II and in the postwar period of about 1950 (hard clam, Atlantic herring, red hake, soft clam, and Atlantic mackerel); and (4) concentration on certain resources that are temporarily abundant, a trend continuing to the present (sea scallop, black sea bass, summer flounder, scup, American lobster, and striped bass). Without exception, landings have peaked at historical maxima, then have declined, showing that first one species is exploited then another. On the brighter side, several coastal species have supported increasing catches in the 1970's, e.g. scup, summer flounder, bluefish, weakfish, striped bass, blue crab, and menhaden. Dr. McHugh writes that the reasons for the increases are unknown and there is no guarantee that they will continue.

Several cruise reports and data reports were assembled during the period, all of which contain descriptions of methods and results, information not requiring repetition here. The reports are listed below. Two of the three cruise reports are included in the appendix of this report; the third is not yet available for distribution. The data reports are being distributed simultaneously with this report.

Azarovitz, T.R. 1975. Cruise Report - Coastal Groundfish Survey, Atlantic Twin (March 18-24, 1975).

Azarovitz, T.R. 1975. Cruise Report - Monthly Groundfish Survey, New York Bight, Albatross IV (April 1-10, 1975).

Azarovitz, T.R. 1975. Cruise Report - Catch of Albatross IV on Groundfish Survey 75-3, Part I, March 14-18, 1975 and Part II, March 20-29, 1975 (Covering Mid-Atlantic Shelf and Lower Georges Bank).

Azarovitz, T.R., M. Silverman, V. Anderson, A. Thoms, and C. Aussicker. NOAA Data Report No. Demersal Finfish Catches in the New York Bight by Stations and Species. R/V Atlantic Twin October 1 - December 5, 1972.

Azarovitz, T.R., M. Silverman, V. Anderson, A. Thoms, and C. Aussicker. NOAA Data Report No. Demersal Finfish Catches in the New York Bight by Stations and Species. R/V Atlantic Twin May 8 - June 4, 1973.

Azarovitz, T.R., M. Silverman, V. Anderson, A. Thoms, and C. Aussicker. NOAA Data Report No. Demersal Finfish Catches in the New York Bight by Stations and Species. R/V Atlantic Twin October 1 - November 7, 1973.

Azarovitz, T.R., M. Silverman, V. Anderson, A. Thoms, and C. Aussicker. NOAA Data Report No. Demersal Finfish Catches in the New York Bight by Stations and Species. R/V Delaware II and Atlantic Twin April 1 - May 2, 1974.

Azarovitz, T.R., M. Silverman, V. Anderson, A. Thoms, and C. Aussicker. NOAA Data Report No. Demersal Finfish Catches in the New York Bight by Stations and Species. R/V Albatross IV and Delaware II September 23 - October 4, 1974.

Azarovitz, T.R., M. Silverman, V. Anderson, A. Thoms, and C. Aussicker. NOAA Data Report No. Demersal Finfish Catches in the New York Bight. R/V Albatross IV and Atlantic Twin March 4-24, 1975.

Ropes, J.W. and A.S. Merrill. NOAA Data Report No. Historical cruise data on surf clams and ocean quahogs, 1965-67, 1969, 1970, 1974.

IV DATA REPORT

As described in considerable detail in Section II 2., above, the Center has made substantial progress in data management during the reporting period. The ten MESA data reports which we set out to produce (MACFC Informal Report 52 Vol. I, p. 66) have been assembled in manuscript form with three exceptions--reconnaissance samples of benthic communities, hydrography of NYB apex, and fish disease. These three are still in preparation. The Center has, however, submitted four data reports on the September - October 1975 catch of demersal finfish, the March 1975 catch of demersal finfish, and the benthic macroinvertebrates at the proposed alternate dump sites sampled in June 1974 and February 1975.

The next four pages consist of an updated tabulation of the state of data processing.

CHEMISTRY

CRUISE #	OF SAMPLES	ANALYSIS	TABULATED	KEY-PUNCH	SYMAP	STATISTICAL ANALYSIS	DATA REPORT	REMARKS
#1-Atlantic Twin (Recon.)	265	265	265	--	--	--	Saila	Analysis completed - not funded by MESA
#2-Albatross IV1/	320	107	107 2/	--	--	--	Saila	213 samples available for analysis - other than heavy metals
#3-Ferrel (SUMP 1A) (SUVAR A)	50	Storage	--	--	--	--	--	Samples not funded by MESA - Stored pending "needs" decision
#4-Oregon II	465	107	107 2/	--	--	--	Saila	358 samples available for analysis-other than heavy metals
#5-Albatross IV	515	107	107 2/	--	--	--	Saila	408 samples available for analysis - other than heavy metals
#6-Albatroll IV	88	Storage	--	--	--	--	--	Samples not funded by MESA - Stored pending "needs" decision
#7-Oregon II	515	107	107 2/	--	--	--	Saila	408 samples available for analysis - other than heavy metals
#8-Venture (SUMP III)	88	Storage	--	--	--	--	--	Samples not funded by MESA - Stored pending "needs" decision
#9-Venture (Alt. Dump Site)	69	69	69	--	--	--	--	DATA to MESA - New York Bight
#10-Atlantic Twin	(For AOML)	--	--	--	--	--	--	Not funded by MESA
#11-Delaware II	515	Storage	--	--	--	--	--	Samples not funded by MESA - 515 available for analysis other than heavy metals
#12-Ferrel (SUMP IV)	87	Storage	--	--	--	--	--	Samples not funded by MESA - Stored pending "needs" decision
#13-Delaware II (SUMP V)	87	Storage	--	--	--	--	--	Samples not funded by MESA - Stored pending "needs" decision
#14-Delaware II	110	50	--	--	--	Exxon - 8 grabs		50 in storage - not funded by MESA - stored pending "needs"decision. 8 grabs to Exxon for analysis; 38-Foehrenbach-compl.; 6- Duedall.

1/ Cruise terminated prior to completion - generator breakdown
2/ Samples analyzed for five (5) heavy metals through 8.0K year-end (one-time) MESA funding. In formal Report submitted to MESA-

MACROFAUNA - BENTHOS - DR. JOHN PEARCE, MACFC

CRUISE #	DATES	# OF SAMPLES	SORTED	IDENTIFIED	KEY-PUNCHED	TABULATED	SENT T
#1-Atlantic Twin (Recon.)	6/5-14/73	265	265	265	265	265	Tech. re in prep.
#2-Albatross IV	8/2-6/73	320	174	174	174	174	Tech. re to MESA-NYB
#4-Oregon II	10/20-25/73	465	20	5	--	--	--
#5-Albatross IV	1/22-30/74	515	--	--	--	--	--
#7-Oregon II	3/22-4/3/74	515	--	--	--	--	--
#9-Venture (Alt.Dump-site)	6/21-30/74	69	69	69	69	69	Tech. re to MESA-NYB
#11-Delaware II	8/26-9/5/74	515	101	101	101	101	Tech.rep to MESA-NYB
#14-Delaware II	2/12-24/75	60	60	45	45	45	Tech. re to MESA-NYB

SEA-BED OXYGEN CONSUMPTION - DR. THOMAS, MACFC

CRUISE #	DATES	# OF SAMPLES	ANALYSIS (SHIP-BOUND)	ANALYSIS (CARBON)	TABULATION	KEY-PUNCH	MAPPING COMPLETED
#5-Albatross IV	1/22-30/74	180 cores	Done	Done	Done	--	Hand-Plotted
#7-Oregon II	3/22-4/3/74	245	Done	Done	Done	Done	SYMAP
#11-Delaware II	8/26-9/6/74	300	Done	Done	Done	Done	Hand-Plotted
#15-Delaware II	12/2-15/74	241	Done	Done	Done	Done	Hand-Plotted
#14-Delaware II	2/12-24/75 1/	A292	Done	Done	Done	Done	In preparation
		B 80	Done	Done	Done	Done	In preparation

1/ Cruise included NYB - Apex (A) and Alternated Dump Sites (B).

SEDIMENT CHARACTERISTICS - DR. COK, ADELPHI UNIVERSITY

CRUISE #	DATES	# OF SAMPLES	ANALYSIS COMPLETED	TABULATIONS	INTERPOLATION	KEY-PUNCH	SYMAP
#1-Atlantic Twin	1/5-14/73	265	265	265	In Process	--	In preparatic
#2-Albatross IV	8/2-6/73	320 2/	320	320	In Process	--	In preparatic
#4-Oregon II	10/20-25/73	465	465	465	In Process	--	In preparatic
#5-Albatross	1/22-30/74	515	515	515	In Process	--	In preparatic
#7-Oregon II	3/22-4/3/74	515	515	515	In Process	--	In preparatic

V. APPENDICES

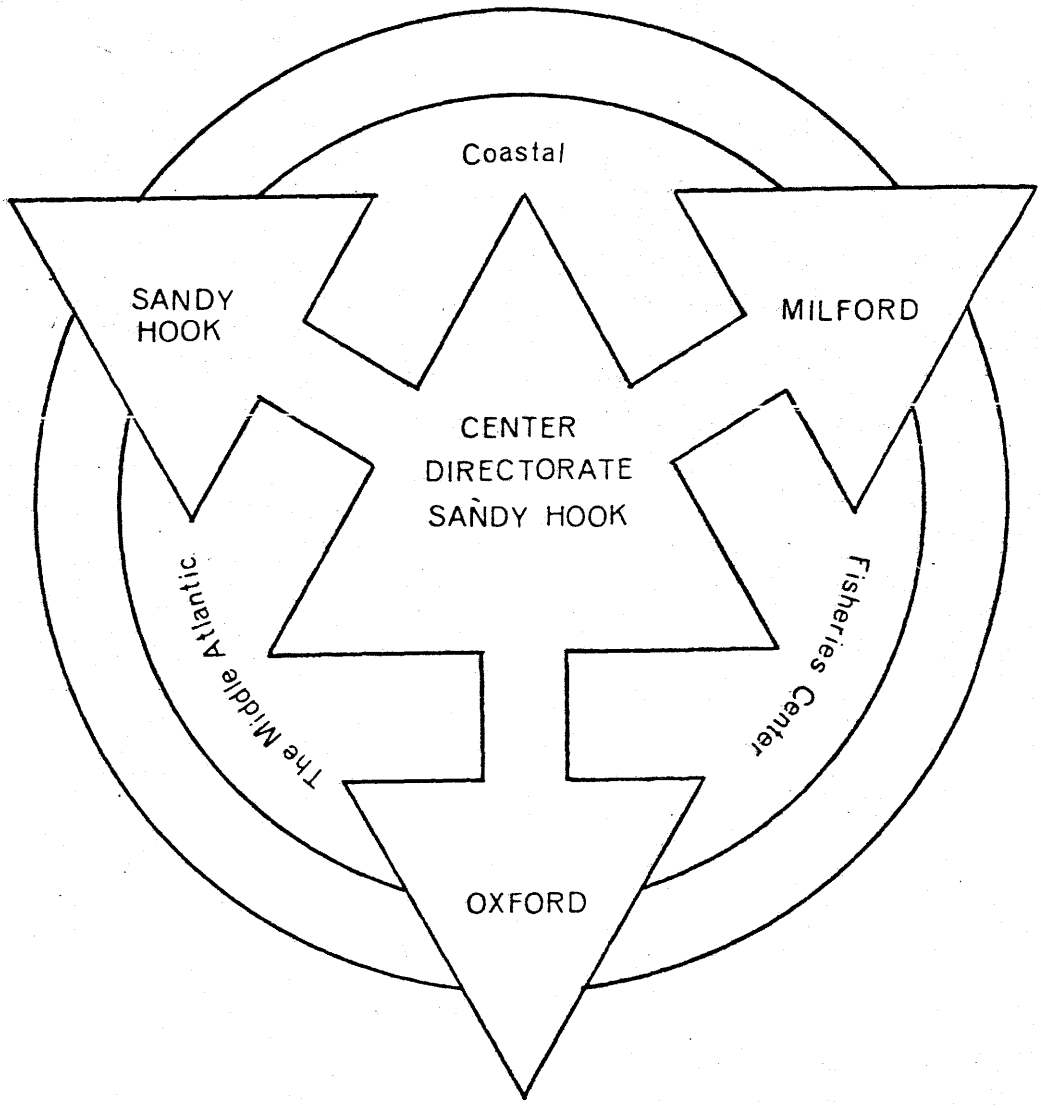
1. Further analyses of heavy metals in sediments collected from the outer New York Bight.
2. Final research report to USDC/NOAA/NMFS/MACFC: Analysis of the ciliate protozoa associated with the man induced change to the sublittoral environment of the New York Bight, June 1973 to February 1975 by Eugene B. Small.
3. Final research report to USDC/NOAA/NMFS/MACFC: Study of antimicrobial resistant bacteria isolated from sediments in the area of the sewage dump sites in the New York Bight, March 17, 1975, by Leah Koditschek.
4. Cruise Report -- Delaware II, 12-24 February 1975.
5. Cruise Report -- Albatross IV and Atlantic Twin -- Albatross March 14-18, Atlantic Twin March 18-24. 1975 spring groundfish survey.
6. Catch of Albatross IV on groundfish survey 75-3, part I, March 14-18, 1975, and part II, March 20-29, 1975.
7. Cruise Report -- Albatross IV, April 1-10, 1975. Monthly assessment survey.
8. Cruise Report -- Delaware II, 23-30 April 1975. Benthic macrofauna.
9. Cruise Report -- Kelez, 28 May - 2 June 1975. Benthic macrofauna.

McNULTY

Further Analyses of Heavy Metals in Sediments Collected from the Outer New York Bight

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

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



Informal Report No. 63

Ecosystems Investigations

May 1975

Further Analyses of Heavy Metals in Sediments Collected from the Outer New York Bight

U. S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Middle Atlantic Coastal Fisheries Center
Ecosystems Investigations

Richard Greig, Milford Laboratory
John B. Pearce, Sandy Hook Laboratory

Informal Report No. 63
May 1975

Further Analyses of Heavy Metals in Sediments Collected from the Outer New York Bight

ABSTRACT

Sediment samples from 82 stations located between 20-35 fathoms in the New York Bight were analyzed for the metals Cd, Cr, Cu, Ni, Pb and Zn. The samples were collected in June 1974 and February 1975. In most instances Cd, Cr and Cu were below the detection limits of the methoology used. All metals were present in far smaller amounts than in the New York Bight Apex where extensive ocean disposal of dredging spoils, industrial wastes and sewage sludge has occurred. The data are useful as a baseline against which environmental change can be compared.

INTRODUCTION

Recent reports from the Middle Atlantic Coastal Fisheries Center (MACFC) have provided data on the abundance and distribution of heavy metals in sediments collected from stations located in the New York Bight Apex (Greig et al., 1974) and beyond the continental shelf-slope break (Graikoski et al., 1974). Because of the possibility of eventual ocean disposal of solid wastes in shelf waters seaward of the Bight Apex and the probability of petroleum exploration and drilling on the outer continental shelf, personnel of Ecosystems Investigations have recently collected sediment samples at stations

located between 20-35 fathoms within two proposed alternate ocean disposal sites and a potential oil development site located within the boundaries of the Baltimore Canyon Trough (Fig. 1). The samples were analyzed using the techniques given in Greig et al. (1974).

Since the subject offshore sites have not been directly impacted upon by ocean disposal, as have the Apex stations and the offshore deep water disposal stations reported upon by Graikoski et al. (1974), the heavy metals values reported herein may be regarded as background or baseline. It must be recognized, however, that crustal erosion and subsequent terrigenous export has added to the heavy metal burdens of shelf sediments and some limited amounts of entrained materials, having their origins in ocean dumping and ocean outfalls, may have been deposited on the outer shelf sediments.

RESULTS

The results of analyses conducted on sediment samples collected at stations within the two alternate disposal sites are given in Tables 1-5. The data resulting from the analysis of samples collected at stations located within the Baltimore Canyon Trough are presented in Table 6. The values obtained were generally one to two orders of magnitude less than those previously reported for sediments collected from the New York

Bight Apex (Carmody et al., 1973; and Greig et al., 1974). The amounts of metals present were also somewhat less than those reported for deep water stations located at the mouth of the Hudson Canyon (Graikoski et al., 1974). This general area has been designated the deep water site (station 106) for ocean disposal of certain toxic industrial wastes.

Cadmium, chromium and copper were rarely detectable in sediments; nickel and zinc were usually measurable but were present in very small amounts relative to their abundance in Bight Apex sediments. Lead varied somewhat but was often not detectable.

Since heavy metal additions to sediments are known to be associated with ocean disposal practices and certain offshore petroleum development procedures, the data reported herein should form an excellent baseline useful in describing the impact and extent of ocean disposal and oil exploration and drilling practices.

ACKNOWLEDGMENTS

Samples were collected at the alternate dump site stations during a June 1974 R/V Venture cruise and a February 1975 R/V Delaware cruise. Ms. Leslie Rogers was responsible for sample collection and processing during the Venture cruise and Dr. James Thomas was Chief Scientist during the Delaware cruise.

Samples were collected from the Baltimore Canyon Trough area during a joint USGS-NOAA R/V Mt. Mitchell cruise held in May 1974. Mr. David Radosh was responsible for the collection and handling of the sediment samples during this cruise.

LITERATURE CITED

Carmody, D., J. Pearce and W. Yasso.

1973. Trace metals in sediments of New York Bight. Mar. Poll. Bull., 4(9):132-5.

Graikoski, J., R. Greig, D. Wenzloff, B. Nelson and A. Adams.

1974. Trace metals in marine biota and sediments collected from offshore waters of New York Bight. NMFS, MACFC, Highlands, N.J., Informal Report No. 38, 5 pp.

Greig, R., D. Wenzloff, B. Nelson, A. Adams and J. Graikoski.

1974. Distributions of five metals in sediments from the New York Bight. NMFS, MACFC, Highlands, N.J., Informal Report No. 36. 6 pp.

Figure 1. Location of benthic sampling areas in New York Bight. Alternate dump sites (ADS) #1 (north) and #2 (south) indicated by 1. Baltimore Canyon Trough (BCT) sites indicated by 2; BCT activities reported upon in this paper were conducted in area 2 north.

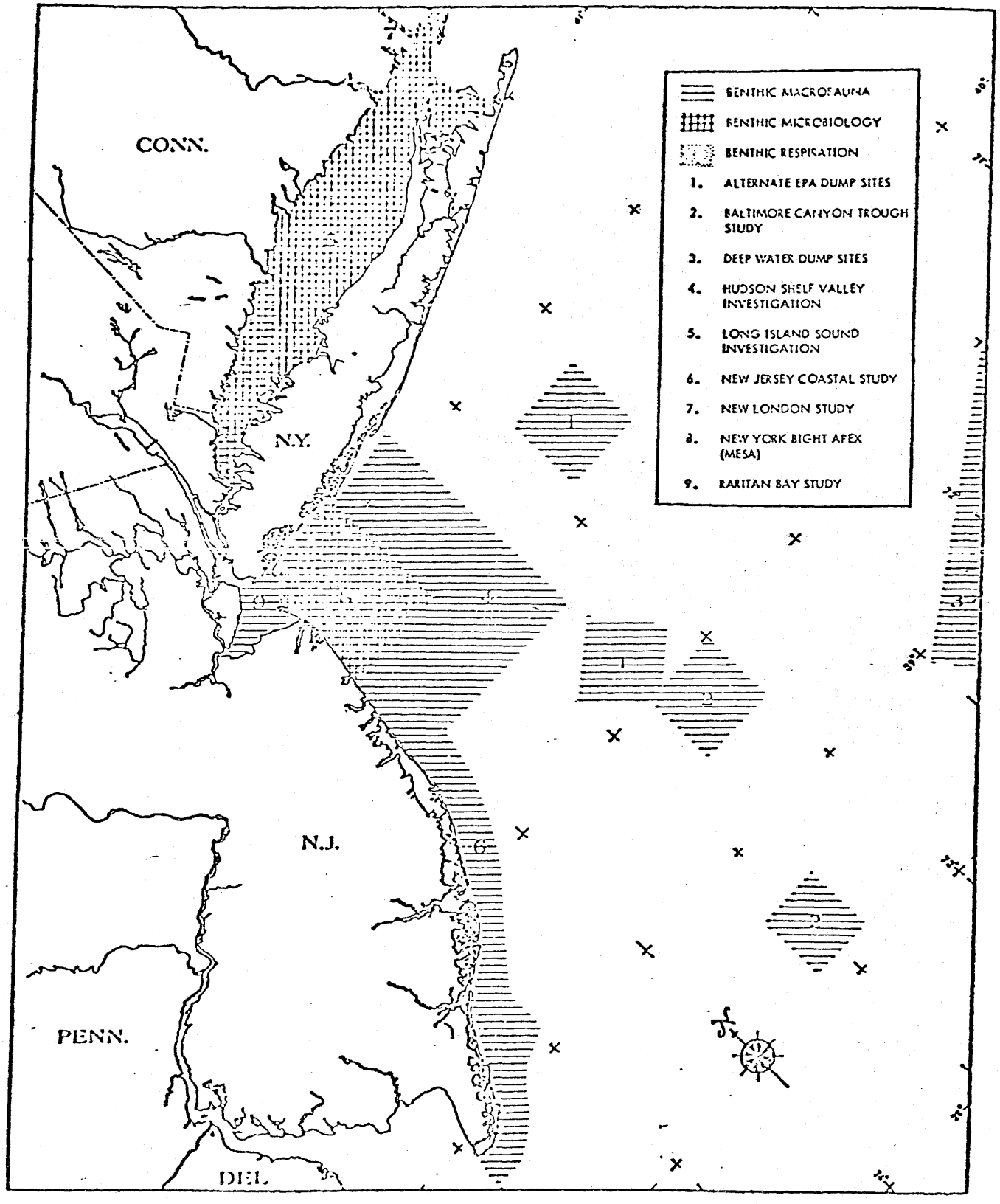


Table 1. Metal Concentrations in the top 1½ inches of sediment collected from alternate dump sites in the New York Bight. Stations 1-29.

Lab Code	Field Code		Metal Concentrations (ppm, dry weight)[a]					
			Cd	Cr	Cu	Ni	Pb	Zn
14905	D-75-2	DUPI -1 G1	ND[b]	ND	ND	4.8	ND	7.2
14906	"	" G2	ND	ND	ND	7.2	ND	6.5
14907	"	" G3	ND	ND	ND	ND	ND	4.5
14908	"	" G4	ND	ND	ND	5.7	ND	6.8
14909	"	" G5	ND	ND	ND	6.2	ND	---
14910		DUPI Sta. 1	ND	ND	ND	7.4	ND	7.1
14911		" Sta. 2	ND	ND	ND	5.5	ND	7.9
14912		" Sta. 3	ND	ND	ND	7.0	ND	7.6
14913		" Sta. 4	ND	ND	ND	6.0	ND	9.1
14914		" Sta. 5	ND	ND	ND	8.9	ND	9.5
14915		" Sta. 6	ND	ND	ND	7.2	ND	8.4
14916		" Sta. 7	ND	ND	ND	8.5	ND	9.4
14917		" Sta. 9	ND	ND	ND	6.9	ND	10.2
14918		" Sta. 10	ND	ND	ND	8.2	ND	9.4
14919	D-75-2	DUPI 11 G1	ND	ND	ND	8.4	Nd	8.0
14920	"	" G2	ND	ND	ND	6.0	ND	9.7
14921	"	" G3	ND	ND	ND	4.5	ND	9.2
14922	"	" G4	ND	ND	ND	8.6	ND	8.1
14923	"	" G5	ND	ND	ND	9.6	ND	8.9
15052		DUPI Sta. 11	ND	ND	ND	ND	ND	9.7
14924		" Sta. 12	ND	ND	ND	11.2	ND	8.9
14925		" Sta. 13	ND	ND	ND	9.3	ND	9.8
14926		" Sta. 21	ND	ND	ND	9.7	ND	10.1
14927		" Sta. 29	ND	ND	ND	8.6	ND	10.2
14928	D-75-2	DUPI 29 G1	ND	ND	ND	7.7	ND	9.9
14929	"	" G2	ND	ND	ND	11.6	4.0	9.8
14930	"	" G3	ND	ND	ND	9.3	ND	9.9
14931	"	" G4	ND	ND	ND	6.2	ND	9.6

a. Values are the mean of duplicate measurements.

ND= Not Detectable - Detection limits= Cd-1.0, Cu-4.0, Pb-4.0, Cr-4.0 to 4.4 Ni-4.0, Zn-3.0.

ble 2. Metal concentrations in the top 1½ inches of sediment collected from alternate dump sites in the New York Bight, Stations 37-64.

Lab Code	Field Code		Metal Concentrations (ppm, dry weight)[a]					
			Cd	Cr	Cu	Ni	Pb	Zn
14932		DUPI Sta. 37	ND[b]	ND	ND	9.8	4.0	10.6
14933		" Sta. 45	ND	ND	ND	9.5	ND	9.7
14934		" Sta. 53	ND	ND	ND	8.1	ND	9.8
14935		" Sta. 54	ND	ND	ND	8.1	ND	11.4
14936		" Sta. 55	ND	ND	ND	9.5	ND	10.2
14937	D-75-2	DUPI 56 G1	ND	ND	ND	8.3	ND	13.4
14938	"	" G2	ND	ND	ND	8.2	ND	11.6
14939	"	" G3	ND	ND	ND	ND	4.0	11.3
14940	"	" G4	ND	ND	ND	7.5	4.0	11.1
14941	"	" G5	ND	ND	ND	9.6	ND	12.3
14942		DUPI Sta. 56	ND	ND	ND	8.1	ND	13.5
14943		" Sta. 57	ND	ND	ND	7.1	ND	10.4
14944		" Sta. 58	ND	ND	ND	10.2	ND	11.8
14945		" Sta. 59	ND	ND	ND	8.1	ND	10.8
14946		" Sta. 60	ND	ND	ND	4.9	4.0	9.8
14947		" Sta. 61	ND	ND	ND	5.9	ND	12.3
14948		" Sta. 62	ND	ND	ND	7.5	ND	11.5
14949		" Sta. 63	ND	ND	ND	5.6	ND	12.9
14950		" Sta. 64	ND	ND	ND	ND	ND	13.7
14951	D-75-2	DUPI 64 G1	ND	ND	ND	8.9	ND	11.4
14952	"	" G2	ND	ND	ND	ND	ND	11.5
14953	"	" G3	ND	ND	ND	10.4	ND	12.5
14954	"	" G4	ND	ND	ND	9.2	ND	13.2
14955	"	" G5	ND	ND	ND	8.5	ND	12.5
14956		DUPI Sta. 65	ND	ND	ND	12.4	ND	12.3

a. Values are the mean of duplicate measurements.

b. ND= Not Detectable (See Table 1 for detection limits).

Table 3. Metal concentrations in the top 1½ inches of sediment collected from alternate dump sites in the New York Bight, Stations 66-88.

Lab Code	Field Code		Metal Concentrations (ppm, dry weight)[a]					
			Cd	Cr	Cu	Ni	Pb	Zn
14957	D-75-2	DUPI 66 G1	ND[b]	ND	ND	8.5	4.0	13.0
14958	"	" G2	ND	ND	ND	9.6	ND	12.1
14959	"	" G3	ND	ND	ND	8.0	4.0	12.6
14960	"	" G4	ND	ND	ND	6.8	ND	12.1
14961	"	" G5	ND	ND	ND	---	5.0	11.8
14962		DUPI Sta. 66	ND	ND	ND	7.9	4.0	12.8
14963		" Sta. 67	ND	ND	ND	11.0	5.0	12.3
14964		" Sta. 68	ND	ND	ND	6.3	6.0	13.0
14965		" Sta. 69	ND	ND	ND	11.3	6.0	11.8
14966		" Sta. 70	ND	ND	ND	17.2	5.0	29.2
14967		" Sta. 71	ND	ND	ND	---	5.0	10.9
14968		" Sta. 72	ND	ND	ND	6.5	4.0	ND
14969	D-75-2	DUPI 72 G1	ND	ND	ND	5.8	ND	7.3
14870	"	" G2	ND	ND	ND	ND	ND	3.6
14971	"	" G3	ND	ND	ND	6.8	ND	7.1
14972	"	" G4	ND	ND	ND	4.7	ND	5.8
14943	"	" G5	ND	ND	ND	6.9	ND	4.1
14974		DUPI Sta. 73	ND	ND	ND	ND	ND	4.2
14975		" Sta. 74	ND	ND	ND	6.3	ND	4.8
14976		" Sta. 75	ND	ND	ND	ND	4.0	6.6
14977		" Sta. 76	ND	ND	ND	ND	ND	4.0
14978		" Sta. 77	ND	3.9	ND	--	ND	4.8
14979		" Sta. 78	ND	ND	ND	6.1	ND	6.2
14980		" Sta. 79	ND	5.1	ND	6.2	4.0	9.9
14981		" Sta. 80	ND	ND	ND	6.1	ND	4.0
14982		" Sta. 81	ND	ND	ND	ND	ND	6.6

a. Values are the mean of duplicate measurements.

b. ND= Not Detectable (See Table 1 for detection limits).

Table 4. Metal concentrations in the top 1½ inches of sediment collected from alternate dump sites in the New York Bight.

Lab Code	Field Code		Metal Concentrations (ppm, dry weight)[a]					
			Cd	Cr	Cu	Ni	Pb	Zn
14983	D-75-2	DUPI 82 G1	ND[b]	ND	ND	ND	ND	5.6
14984	"	" G2	ND	ND	ND	ND	ND	5.7
14985	"	" G3	ND	ND	ND	ND	ND	5.5
14986	"	" G4	ND	ND	ND	5.1	ND	4.6
14987	"	" G5	ND	ND	ND	5.8	ND	6.4
14988		DUPI Sta. 82	ND	ND	ND	ND	ND	6.6
14989		" Sta. 83	ND	ND	ND	4.6	ND	6.1
14990		" Sta. 84	ND	ND	ND	ND	ND	6.8
14991		" Sta. 85	ND	ND	ND	4.7	ND	5.3
14992	D-75-2	DUPI 86 G1	ND	ND	ND	6.3	ND	5.5
14993	"	" G2	ND	ND	ND	6.1	5.0	8.3
14994	"	" G3	ND	ND	ND	5.6	4.0	7.1
14996	"	DUPI Sta.86 G4	ND	ND	ND	6.4	4.0	5.0
14997	"	DUPI 86 G4	ND	ND	ND	5.9	4.0	4.7
14998	"	" G5	ND	ND	ND	ND	4.0	6.7
14999		DUPI Sta. 86	ND	ND	ND	ND	5.0	8.8
15000		" Sta. 87	ND	ND	ND	ND	6.0	11.3
14995		" Sta. 88	ND	ND	ND	6.1	4.0	9.0
15001		" Sta. 89	ND	ND	ND	ND	ND	6.1
15002		" Sta. 90	ND	ND	ND	ND	ND	8.4
15003		" Sta. 91	ND	ND	ND	5.0	7.0	12.1
15004	D-75-2	DUPI 92 G1	ND	ND	ND	ND	ND	12.4
15005	"	" G2	ND	ND	ND	6.2	ND	11.0
15006	"	" G3	ND	ND	ND	ND	ND	11.7
15007	"	" G4	ND	ND	ND	6.0	ND	11.1
15008	"	" G5	ND	ND	ND	ND	ND	10.1
15009		DUPI Sta. 92	ND	ND	ND	5.1	ND	12.0
15010		" Sta. 93	ND	ND	ND	10.3	5.0	12.9
15011		Sta. 94	ND	ND	ND	ND	ND	5.4

[a] Values are the mean of duplicate measurements.

[b] ND= Not Detectable (See Table 1 for detection limits).

Table 5. Metal concentrations in the top 1½ inches of sediment collected from alternate dump sites in the New York Bight.

Lab Code	Field Code		Metal Concentrations (ppm, dry weight)[a]					
			Cd	Cr	Cu	Ni	Pb	Zn
15012		DUPI Sta. 95	ND[b]	ND	ND	ND	ND	6.6
15013		" Sta. 96	ND	4.6	ND	7.8	8.0	14.7
15014		" Sta. 97	ND	ND	ND	ND	4.0	7.8
15015		" Sta. 98	ND	ND	ND	ND	7.0	12.0
15016		" Sta. 99	ND	ND	ND	5.2	7.0	8.8
15017	D-75-2	DUPI 100 G1	ND	ND	ND	ND	ND	7.7
15018	"	" G2	ND	ND	ND	ND	6.0	9.2
15019	"	" G3	ND	ND	ND	5.8	ND	7.4
15020	"	" G4	ND	ND	ND	7.6	ND	7.1
15021	"	" G5	ND	ND	ND	ND	ND	7.8
15022		DUPI Sta. 100	ND	6.1	ND	9.4	6.0	12.5
15023		" Sta. 101	ND	4.5	ND	6.1	ND	8.0
15024	D-75-2	DUPI 102 G1	ND	ND	ND	4.5	5.0	9.4
15025	"	" G2	ND	ND	ND	ND	ND	8.3
15026	"	" G3	ND	ND	ND	5.2	6.0	9.3
15027	"	" G4	ND	ND	ND	ND	4.0	8.5
15028	"	" G5	ND	ND	ND	ND	ND	7.0
15029		DUPI Sta. 102	ND	ND	ND	7.9	6.0	7.4
15030		" Sta. 103	ND	ND	ND	5.5	4.0	6.9
15031		" Sta. 104	ND	ND	ND	5.0	4.0	8.2

a. Values are the mean of duplicate measurements.

b. ND= Not Detectable (See Table 1 for detection limits).

Table 6. Metal concentrations in the top 1½ inches of sediment collected from the Baltimore Canyon.

Lab Code	Field Code				Metal Concentrations (ppm, dry weight)[a]					
					Cd	Cr	Cu	Ni	Pb	Zn
15038	BCI -	001 -	GR001	MM-01	ND[b]	ND	ND	11.8	<12.5	16.5
15039	"	004	"	"	ND	ND	ND	<13.7	<12.5	13.5
15040	"	007	"	"	ND	ND	ND	7.7	ND	6.9
15041	"	010	"	"	ND	ND	ND	7.7	ND	9.5
15042	"	025	"		ND	ND	ND	ND	ND	6.3
15043	"	028	"		ND	ND	ND	5.8	ND	9.3
15044	"	031	"	"	ND	ND	ND	7.0	ND	10.3
15045	"	037	"	"	ND	ND	ND	ND	ND	10.1
15046	"	048	"	"	ND	ND	ND	<12.0	<17.5	11.5
15047	"	051	"	"	ND	ND	ND	<15.5	<12.5	12.3
15048	"	054	"	"	ND	ND	ND	9.6	ND	11.4
15049	"	063	"	"	ND	ND	ND	5.2	ND	9.8
15050	"	083	"	"	ND	ND	ND	11.5	ND	12.2
15051	"	086	"	"	ND	ND	ND	8.3	ND	9.9

Values are the mean of duplicate measurements.

b. ND = Not Detectable (See Table 6 for detection limits).

FINAL RESEARCH REPORT TO

U.S.Department of Commerce
National Oceanographic and Atmospheric
Administration

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

Institution

University of Maryland
College Park, Maryland 20742

Title of Research

Analysis of the Ciliate Protozoa Associated with the Man Induced Change to the Sublittoral Environment of the New York Bight: June, 1973 to February, 1975.

Contract Number

03-3-043-48

Principal Investigator

Eugene B Small

Eugene B. Small
Associate Preofessor
Department of Zoology

Received
MAY 16 1975
Knee Mc Nulty
cc: Dr. Sindermann/Hobs.
Dr. Pearce

Sampling for the ciliated protozoa present in the planktonic and benthic environments of the New York Bight has been continued over the past eight months under contract number 03-3-043-48 for the U.S. Department of Commerce. Objectives for this study included: a) determining the feasibility of qualitative and quantitative marine ciliate sampling, b) establishing and monitoring the presence of the populations of marine ciliates throughout a yearly cycle, and, c) correlating the presence of small bactivorous ciliates with the presence of sewage pollution.

Samples were concentrated during the autumn and early winter months in order to give a more complete representation of the full seasonal cycle of planktonic ciliate populations. Data from the past two years of collections have been collated in the Appendix. This includes all data present in the six and twelve month reports, the report given last December, and the data presented herein for the first time.

The initial year established the feasibility and usefulness of some of the collection methods. Many extraction and concentration methods were attempted; several were abandoned. Marine ciliates were found in the planktonic as well as most benthic environments of the Bight throughout the year.

Definitive quantitative studies of the marine protozoa have only recently begun. Beers and Stewart (1969a, 1969b, 1971), working in the eastern Pacific, have perfected a large continuous peristaltic pump whereby samples of the water column are obtained throughout towed intervals. Their work is an exhaustive qualitative examination of the micro-zooplankton. Ciliated protozoa formed the greatest numerical fraction of the plankton, although, due to their small size, their biomass and volume fractions were less than half of the total. Protozoa consistently were greater in numbers within the

euphotic zone than below it. This relationship may be changed by vertical movement within the water column at night; their samples were consistently obtained during mid day.

Ciliates, both tintinnids and others, were found to be important components in most plankton assemblages studied. A possible correlation was found between high numbers of protozoa and phytoplankton productivity. Beers and Stewart (1971) recognized that with the capacity of a rapid division rate, and the assumption that the increase of their predators would lag behind their own increase, the total protozoan food consumption could theoretically increase almost geometrically for a short period of time. The authors calculated during a coastal survey off of La Jolla (Beers and Stewart, 1970) that the standing stock of ciliates may have been cropping a larger amount of organic carbon per day than was being produced by the size class of phytoplankton upon which it was assumed that they feed.

The systems above are predominately open ocean assemblages based upon phytoplankton productivity. Quantitative studies involving bactivorous assemblages are relatively even more rare; cooperation between protozoan and microbial ecologists is a necessary factor. Lighthart (1971) performed a study of bactivorous protozoa in the Puget sound. His methods were not sufficient to adequately reflect the numbers of ciliates found; however,he did find bactivorous protozoa to be most numerous at the sediment-water interface.

Small, et al (International Estuarine Research Foundation Symposium,1973), working in a small subestuary of the Chesapeake Bay, has found a seasonal variability as well as a food source variability in ciliate assemblages. Predominant organisms in the summer encompass a diversity of trophic levels (herbivores, bacterivores, carnivores). The winter assemblage includes mostly tintinnid herbivores. Often in places of water stratification three distinct

numerical peaks occur in the vertical column. These peaks correspond to: a) just below the water surface, b) just below the eupotic zone, and, c) just above the sediment-water interface. Ciliate numbers are highest when their predators are absent (spatially or temporally), and also during the summer months when species richness is high as well.

Psammobiotic ciliate populations are regulated by food source and climatic patterns as well as by substrate particle size. Fauré-Fremiet (1950) and Dragesco (1960) both observed that marine interstitial ciliates are least numerous in sediment that has a silt-clay fraction (particles ≤ 63 µm in size) greater than 10-14 %. Areas in the Bight in which the sediment is characterized as fine black muck are those sites of the greatest dredging spoils and sewage dumping. These areas would not be inimical to ciliates which live at the sediment-water interface since the ciliates would be unaffected by interstitial size.

Sampling was planned in order to attempt to take advantage of the previously reported trends in marine planktonic ciliate populations. At each station two samples of thirty liters were taken, one from three feet below the surface and one from three to ten feet above the bottom. Several stations were also sampled at a depth of from three to ten feet below the euphotic zone (three times the Secchi disk value). It must be understood that these values are most meaningful for vertical samples taken in relatively slow moving waters (e.g. a subestuary of the Chesapeake Bay) where vertical stratification is an important concept, and, that ciliates are easily transported by water currents. Diurnal vertical migration may have an affect on the data presented since several samples were obtained at night. Patchiness of predator distribution and short term reproductive responses of the ciliates to sudden "attractiveness" within the environment (e.g. a phytoplankton bloom or a sewage dump)

are not examined within this study. Emphasis is placed upon seasonal population trends as reflected by quantitative data taken throughout a seasonal cycle.

Sediment sampling included material for immediate live examination as well as enrichment cultures. The enrichment culture data gives an indication of cyst forming bactivorous ciliates present in the plankton at some portion of the year.

Plankton samples that were obtained quantitatively were concentrated on 80, 35, and 20 µm Nytex nylon monofilament mesh filters. Aliquots of the concentrated plankton soup from each size class were preserved in Bouin's fixative and stored at University of Maryland until enumeration. Counts have been made by mixing 5 ml. aliquots from each size class vial and then taking measured portions of the well mixed combination sample. A sedimentation chamber of 5 ml. volume was used in conjunction with a Zeiss inverted compound microscope at magnifications of 160x to 200x. A 1 ml. Sedgewick-Rafter counting cell was also used, in conjunction with a Zeiss compound microscope at magnifications of 125x-200x. When the Sedgewick-Rafter cell was used, five samples were counted in order to obtain a sufficient sample. Statistical determination of the 95% range of the numbers of organisms has been done following the techniques of Lund, et al (1958). Individual phytoplankters were counted in the later samples in an effort to determine whether the ciliate and phytoplankton populations mutually influenced one another.

Identification and characterization of the psammobiotic ciliates was performed qualitatively. Live examination using a Zeiss compound microscope with Nomarski phase interference optics has been of utmost importance as an aid to the identification of these fragile forms.

Bactivorous scutico ciliates have continued to be found at the sewage

site most notably during August. These ciliates are small voracious bactivores when bacteria are present in sufficient numbers. In the absence of bacteria, they are capable of forming cysts and waiting until the next bacterial bloom. Berk (1974) found that a species of Uronema isolated from the Chesapeake Bay was capable of sustained growth and reproduction at concentrations of bacteria on the order of 10^6 cells $ml.^{-1}$; lower concentrations were not adequate for growth or reproduction. Karakashian and Karakashian (1973) found that Paramecium bursaria does not form food vacuoles at bacterial concentrations of less than 3.5×10^4 cells $ml.^{-1}$ These reports suggest that bactivorous ciliates are physiologically limited to areas of high bacterial concentrations. Berk also found that Uronema is capable of feeding upon non-viable bacterial cells at the required concentration. When fed autoclaved cultures, the ciliates survived. This would indicate that ciliates are possibly feeding on non-marine bacteria which arrive in the sewage as well as marine forms that would decompose it.

The oceanic environment is notably low in bacterial concentration. Areas of high bacterial concentrations are usually localized to areas of high organic nutrient input. This type of situation is present at the sewage dump site in the Bight. Bacteria, like ciliates and most other plankton forms, are easily transported by water movement. Sewage outfall, transported and diluted by water currents, is limited by water stratification when present. Since planktonic bactivorous scutico ciliates are most likely limited to a locality in which sewage is present or has recently been present, the presence of these ciliates in large numbers is an indication of the probable presence of a recent sewage outfall. In times of stress these ciliates form resistant cysts which fall to the sediment. Presence of these cysts in the sediment indicates probable presence of a sewage outfall over or nearly over that sediment at some point in the recent past.

The scutico ciliates are most prevalent during the warm summer months. Data for the August cruises (1973 and 1974) gives the best illustration of the validity of the previous assumptions. In 1973, the initial collection coincided with a sewage dump approximately half a mile away from the collection site. Small visible pieces of black debris were present in the surface sample. Scutico ciliates were present in a range of from 170 to 250 ciliates per liter. In August, 1974, a surface oil slick was present over brownish colored water when the initial collection was made. Peritrich ciliates, 240 per liter, were present attached to the debris by their stalks (95% range: 211-280 ciliates per liter), giving a total value of over 390 bactivorous ciliates per liter. Four hours later nearly all bactivorous ciliates were absent from the protozoan assemblage within the plankton. A similar pattern is present for the silicoflagellates, many of which are facultative bacterivores.

Peritrich ciliates are important components of activated sludge sewage plants. Small (1973) reported them in a small sewage polluted stream in Illinois during the spring and fall months in extremely high numbers. Factors which seemed to be important in the presence of these sessile, stalked, voracious and efficient bacterivores were the high dissolved oxygen and low water temperatures found concommitently during the seasonal changes. Presence of the peritrichs at similar times in the plankton of the New York Bight could reflect a similar seasonality in oceanic peritrich distribution.

When water temperatures become low at the onset of winter, the algivorous tintinnid species begin to predominate in the micro-zooplankton. Throughout the winter months the tintinnids remain the most important ciliate plankton component numerically. Their numbers fluctuate wildly in response to weather, plankton blooms, and predators. The high count of between 137 and 200 tintinnids per liter on 20 February, 1975, was during a time of unusually calm and mild weather with large numbers of algae and other phyto-

plankton present, but relatively low numbers of zooplankters. It appears to hold true that the copepods in the Chesapeake Bay influence the numbers of tintinnids both by predation and competition. This would indicate that the times of high numbers of tintinnids would appear both spatially and temporally in "windows" of the copepod populations (Small et al, 1975, unpublished).

Most ciliates are capable of extremely rapid reproduction: from four to six hours in the case of some of the smaller scutico ciliates, and from twenty-four to thirty-six hours in the case of the tintinnids. Sampling with the frequency maintained within this study gives no indication of such short term population fluctuations nor the possible magnitude attained by these fluctuations. Indications of size of patchiness or movement of patches were also not included within the scope of the sampling program. It must be emphasized that this is a preliminary indication of the probable population fluctuations followed by the planktonic ciliates through the seasons.

Psammobiotic ciliate populations follow the basic trends reported by Fauré-Fremiet (1950) and Dragesco (1960). Interstitial ciliates are wholly absent from areas where the sediment tends to be mucky. All of the benthic ciliate populations appear to be high in both numbers and diversity in the summer and very low in numbers with lowered diversity in the winter. The Long Island coast has less species represented than the samples taken from the New Jersey coast as far south as was sampled. Most surprisingly, the acid waste dump site has the highest number of very fragile forms; this may reflect something of the nature of ionic requirements of these ciliates. Benthic communities tend to be somewhat more trophically balanced than the planktonic communties; this may reflect the dearth of well developed communities in the proximity of the sewage and dredging spoils dump areas. Other than the presence of cysts in the sediment, few indications of low diversity and stressed communities due to the extreme level of pollution exist.

SUMMARY

1. Sampling of planktonic and benthic ciliate populations in chosen areas of the New York Bight has been successful over a period of twenty months.

2. Large seasonal variations in numbers of populations have been observed quantitatively; this includes faunal as well as numerical variations.

3. Presence of large numbers of bactivorous ciliates have been observed to be associated with sewage dumps during the warm summer months.

4. Cysts of bactivorous ciliates (pollution associated species as well as "clean water" associated species) can be recovered from the sediments any season of the year; sewage associated species predominate in the areas proximal to the sewage and dredging spoils dump sites and clean water species in the areas designated as control areas (e.g. the Long Island and New Jersey shore stations).

5. Benthic ciliates are affected by climatic and substrate variabilities; lows occur during the winter and in areas proximal to the sewage and dredging spoils dump sites. Sewage sludge is made up of small particles which may account for the absence of ciliates in the dump site muds (rather than the "bacterial" pollution and/or biochemical saprobity).

Literature Cited:

Beers, J.R, and G.L.Stewart, 1969a. The vertical distribution of micro-zooplankton and some ecological observations. J.Cons.int.Explor.Mer.,33(1):30-44.

_____ 1969b. Micro-zooplankton and its abundance relative to the larger zooplankton and other seston components. Mar.Biol. 4:182-189.

_____ 1970. Numerical abundance and estimated biomass of micro-zooplankton. In: The ecology of the plankton of La Jolla, California, in the period April through September, 1967 (Part VI), J.D.H.Strickland, editor, Bull.Scripps Instn.Oceanogr., 17:67-87.

_____ 1971. Micro-zooplankters in the plankton communities of the upper waters of the eastern tropical Pacific. Deep Sea Research, 18: 861-883.

Dragesco,J.,1960. Ciliés mésopsammiques littoraux. Trav.Stn.biol.Roscoff (NS), 12:1-356.

Fauré-Fremiet,E., 1950. Ecologie des ciliés psammophiles littoraux. Bull.Biol. France et Belg., 84:35-75.

Karakashian,M.W., and S.J.Karakashian, 1973. Intracellular digestion and sybiosis in Paramecium bursaria. Exp.Cell Res.,81:111-119.

Lighthart,B., 1969. Planktonic and benthic bactivorous Protozoa at eleven stations in Puget Sound andadjacent Pacific ocean. J.Fish Res. Bd. Canada, 26:299-304.

Small,E.B., 1973. A study of ciliate protozoa from a small polluted stream in east-central Illinois. Amer.Zool., 13(1):225-230.

Berk, S.G., 1974. Uptake and utilization of marine bacteria by ciliate Protozoa. Master's thesis. University of Maryland, College Park, Maryland.

APPENDIX

APPENDIX: PART A

Compendium of Cruises, Dates, and Samples
Taken, June, 1973 to February, 1975

Protozoology Sampling Cruises: June, 1973 to February, 1975

Dates	Research Vessel	Sampling Methods: Sediment	Sampling Methods: Water Column	Number of Stations
1. 18-20 June, 1973	Rorqual	L,S,U,W		5
2. 2-8 August	Albatross IV	L,S,M,U,W	N-CF	5
3. 14,27,29 August	Xiphias	L,S,M,U,W	N-CF	5
4. 18 September	Ferrel	L,U		4
5. 20-27 October	Oregon II	L,M,U	N-CF	7
6. 26-30 November	Ferrel	L,U		8
7. 23 January-1 February, 1974	Albatross IV	L,M,U	N-CF	8
8. 21 March-3 April	Oregon II	L,M,U	N-CF,PP	20
9. 27-30 August	Delaware II	L,U	N-CF,PP	13
10. 11 October	Xiphias	L,U	N-CF	6
11. 18-19 October	Commonwealth II	L,U	N-CF	7
12. 1 November	Xiphias	L,U	N-CF	2
13. 19-20 February	Rorqual	L,U	N-CF	5

Sediment methods:
L -Lackey's 16 oz. jars, enrichment cultures
M -Millipore filtering grab water
S -Spoon's test tube extraction method
U -Uhlig's seawater ice extraction columns
W -Winogradsky column

Water Column methods:
N-CF -Nisken water sample filtered through a cascade of graded filters
PP -Peristaltic pump water sample filtered through graded filters

Table 1

Cruise: Boat and Dates: 1. R/V Albatros IV 2 - 8 August, 1973 (AII) 2. R/V Xiphias 14 August, 1973

Station (Position)	Secchi EZ	Total Depth	Nisken Samples: Depth, Temp. Top 1.filt.	Mid 1.filt.	Bottom 1.filt.	Grab Jars	Sample Bag	Grab water	Uhlig Extraction	Phys. Parameter Sediment type
1.										
7-AIV Long Island Control	21' 63'	30'	3 ft.		30 ft.	2	1	2 liters	2-80μ mesh 10" ice	clean fine sa
16-AIV N.Y. Harbor Control	11' 33'	25'	3 ft.		25 ft.	2	1	2 liters	2-80μ mesh	clean fine sa dark sand at depth ~4"
32-AIV Sewage	19' 57'	107'	3 ft.	60 ft.	107 ft.	2	1	4 liters	2-80μ mesh 35μ mesh	black muck
35-AIV Dredge Site	5' 15'	70'	3 ft. 23.5°C	20 ft. 22.5°C	70 ft. 16°C	2	1	2 liters	2-80μ mesh 35μ mesh	black muck
51-AIV Acid Waste			3 ft.			2	1	2 liters	2-80μ mesh	fine sand, redd from iron floc
2.										
7-AIV	33.5' 101.5'	70'	3' 15 l. 24°C		70' 10 lit. 12°C		1		2-80μ mesh	coarse sand some oil
8-AIV	27' 60'	60'	3' 15 l. 24°C		60' 15 l. 16°C		1		2-80μ mesh	coarse sand some sludge
11-AIV	32.5' 97.5'	52'	3' 15 l. 24°C		52' 5 l. 15°C		1		2-80μ mesh	clean fine sa
16-AIV	13' 39'	30'	3' 15 l. 24°C		39' 15 l. 17°C		1		2-80μ mesh	coarse sand, covered by sma mussels

Cruise; Boat and Dates: R/V Xiphias 27 August, 1973 and 29 August, 1973

Station (Position)	Secchi EZ	Depth	Nisken Samples Depth	Liters filt.	Temp. °C	Presence of Ciliates	DO
32-AIX							
	Secchi	110'	3'	6	24	+	2.40
Drift:	10'		10'	22	22.5	++	8.15
0.9 mile			20'	17	22	+	7.52
			30'	22	22	++	7.40
Sewage			40'	20.5	21	++	7.40
	EZ		50'	18	20		7.46
Tide coming	30'		60'	20	19	+	
in			70'	14	18		6.50
			80'	9	11		
			90'	16	10.5	++	5.25
			100'	17.5	9	++	
			110'	14	8.5	+	5.18
32-AIX							
	Secchi	110'	3'	16	25	+	7.60
Drift:	21'		10'	13.5	24		7.65
0.4 mile			20'	20	23	+	7.72
			30'	14	22	+	7.44
Sewage			40'	21.5	21	++	6.64
	EZ		50'	18	21		7.45
	63'		60'	18.5	19		6.76
			70'	20	14	+	5.12
			80'	16	13	+	4.94
			90'	23	10	++	4.94
			100'	22	11	+	
			110'	21.5	10	+	5.12

Cruise; Boat and Dates R/V Ferrel 18 September 1973 and R/V Oregon II 20-27 October 197

Station & Date	Secchi ft	EZ ft	Depth ft	Nisken Samples Depth	Liters	Temp°C	Grab Samples Jars	Bag	Grab Water	Uhlig	Bot. Temp	Sediment type
MESA grid 13 18 sept	43	128	98				2	1		2-35μ	11.8	black muck
MG 18 18 Sept	17	49	82				2	1		2-35μ	13.5	black muck
MG 23 18 Sept	22	66	160				2	1		2-80μ	11.04	clean sand, coarse
MG 22 18 Sept	22	66	68				2	1		2-80μ	15.37	clean sand, coarse
7-OII 3 L I Shore Control 20 Oct	15	45	52	3 52	13 27	14.0 12.5	2	1	2 1.	2-80μ		small starfish, coarse clean sand, broken shel
16 -OII NY Harbor Control 21 Oct			28	3 28	28.2 10.5	11.5 12.1	2	1	1 1.	2-80μ		fine clean sand, broken shells
35-OII-Sew. 22 Oct	32	96	108	3 108	29.9 13.5	14 11	2	1	2 1,			black muck
38-OII-Dredg. Spoils 22 Oct	15	45	70	3 50 70	28 29 12	14 16 12	2	1	2 1.			black muck
54-OII Acid 23 Oct	25	75	80	3 80	25 25.8	16 16.12	2	1	2 1.	2-80μ		fine graded sand, brown black at 1" depth
82-OII NJ Shore Control 25 Oct			42	3 42	25 29.8	16.0 15.0	2	1	1 1,	2-80μ		evenly mixed clean sand shell pieces

Table 4

Cruise; Boat and Dates: R/V Ferrel 26 - 30 November, 1973

Station: Water Sampling Grid Number	Depth	Temperature °C Top	Bottom	Sediment type
#1	43'	10.95	10.96	Coarse, clean sand with broken shells small, live mussels
#5	56'	10.62	10.60	Fine black sand, some muck near Nassau City sewage outfall
#12	77'	10.85	11.11	dark grey muck, some sand
#13	127'	10.98	11.40	Black, globby ugly muck, sulfurous
#19	87'	11.40	11.43	Very fine, grey black muck, Nereid polychaetes present.
#21	67'	11.50	11.56	Fine, clean sand
#23	170'	11.32	11.45	Fine, predominately clean sand; reddish as though some acid waste contaminatio
#25	103'	11.25	11.29	Fine, clean sand

Cruise: Boat and Dates: R/V Albatross IV 23 January-1 February, 1974

Station & Date	Secchi EZ	Total Depth	Nisken Samples: Depth, Temp., Liters Filtered Top	Mid	Bottom	Grab Sample Jars	Bag	GrabWater	Uhlig Extraction	Sediment Type
St. 7 23 Jan.	14' 42'	52'	3' 5.5°C. 25 l.		47' 3.4°C 5 l.	2	1	1 l.	2-80 mesh	clean coarse sand, some pebbles
St. 16 24 Jan.	8' 24'	18'	3' 5.0° 5 l.		15' 5.2° 12.5 l.	2	1	.5 l.	2-80 mesh	fine grey clean sand
St. 32 25 Jan.	19' 57'	108'	3' 5.5° 7 l.	65' 6.8° 16 l.	105' 6.3° 5 l.	2	1	2 l.	-	black muck-top layer of grey-brown
St. 35 25 Jan.	11' 33'	75'	3' 4.5° 10 l.	40' 6.0° 7.5 l.	73' 6.3° 5 l.	2	1	1 l.	-	black muck-sand and rocks present
St. 51 26 Jan.	11' 33'	86'	3' 6.5° 28.5 l.	40' 6.8° 15 l.	84' 6.8° 15 l.	2	1	1 l.	2-80 mesh	fine sand
St. 82 28 Jan.	9' 27'	36'	3' 6.8° 9 l.		33' 6.4° 10 l.	2	1	2 l.	2-80 mesh	fine black sand, broken shells
St. 90 28 Jan.						2	1	4 l.	3-80 mesh	fine sand
St. 92 28 Jan.	16' 48'	210'	3' 6.7° 14 l.	60' 6.9° 27 l.	205' 7.5° 12.5 l.	2	1	.5 l.	2-80 mesh	grey silty sand

Date	Secchi EZ	Total Depth	Nisken Samples: Depth, Temp., Liters Filtered Top	Mid	Bottom	Grab Sample Jars	Bag	Grab Water	Uhlig Extraction	Sediment Type
St. 7 23 March	16' 48'	45'	3' 6.0°C 23 l.		42' 13	2		4 l.	2-80	very coarse clean sand
St. 16 23 March	9' 27'	23'	3' 9 l.		20' 7.0° 3 l.	2	1	2 l.	2-80	fine clean sand, grey-brown color
St. 31 24 March	16'	108'	3' 16 l.	53' 21 l.	105' 6.0° 5.5 l.	2		2 l.	2-T.K.S.	grey brown muck
St. 34 25 March	11.5' 33.5'	52'	3' 20 l.		45' 6.22° 14 l.	2		2 l.		black muck, grey-brown on top
St. 51 26 March	19.5' 58.5'	84'	3' 27 l.		75' 9 l.	2	1	4 l.	2-80 2-T.K.S.	fine grey-brown sand
St. 57 2 April		30'	Multiple Core Sample		5.6°	2				fine graded sand, some black muck on top
St. 82 28 March	15' 45'	51'	3' 7.0° 14 l.		45' 6.1° 4 l.	2		2 l.	2-80	coarse sand, some gravel
St. 90 29 March		190'	Sediment Grab Sample Only			2	1	1 l.	2-80	coarse sand, some pebbles, some silt
St. 92 30 March	13' 39'	200'	3' 5.5° 16 l.	50' 5.5° 17 l.	195' 6.0° 3 l.	2		0.5 l.		brown-black muck
St. 99 30 March		78'	Multiple Core Sample		5.5°	2				fine clean graded sand

Stations 21,22,23,29,30,32,33,43,44,45 had sediment samples taken via the Lackey jar method, two jars per station.

Table 7

Cruise: Boat and Dates: R/V Delaware II 26-31 August, 1974

Station & Date	Secchi EZ Depth	Nisken Samples: Depth, Temp., Liters Filtered Top	Mid	Bottom	Grab Sample Jars	Bag	Grab Water	Uhlig Extraction	Sediment Characteristics
St. 8 27 August		3'		18'					
	22'	8.0 l.		9.0 l.	2	1	1 l.	2-80u	fine brown sand with shell debris mixed in
St. 15 28 August		3'		45'					
				19.3°	2	1	1 l.	2-80u	coarse sand, some gravel, well aerated
	52'	18.0 l.		16.0 l.					
St. 30 29 August	a) 4'	3'							
	12'	23.9°							
	95'	5.0 l.			Plankton Tow- Vertical				
	b) 33'	3'		75'					
	99'	24.0°		15.5°	2	1	2 l.		black, unctuous muck
	80'	24.0 l.		18.0 l.					
St. 33 29 August	42'	3'		95'	Plankton Tow- Vertical				
	126'	23.5°		15.0°	2	1	1 l.		black muck, some sand and a little gravel
	100'	22.5 l.		10.0 l.					

Stations 21, 22, 23, 31, 32, 34, 42, and 43 had sediment samples taken via the Lackey Jar method, two jars per station.

Table 8

Cruise: Boat and Dates: R/V Xiphias 11 October and 1 November, 1974

Station & Date (Loran fix)	Secchi EZ Depth	Nisken Samples Depth, Temp., Liters Filtered Top	Mid	Bottom	Jars	Grab Sample Bag	Uhlig Extraction	Sediment Characteristics
3207x4587 Edge sewage 11 Oct.	95'				2			spaghetti mud, dark brown to black, worm tubes
3204x4609 Just out of sewage area 11 Oct.	90'				2	2 lge.		clean medium mixed sand, brown to tan color
3224x4615 Sewage 11 Oct.	28' 84' 120'	3' 17.0° 12.0 l.	80' 14.8° 21.5 l.	110' 11.5° 8.0 l.	2			black muck
3286x4576 Edge dredge 11 Oct.	65'				2	1	4-80 u	coarse sand with black muck present in the interstices
3290x4576 Edge dredge 11 Oct.	47'				2	1	4-80 u	medium, clean looking sand
3303x4571 Edge beach 11 Oct.	40'				2	1	4-80 u	medium to fine clean looking sand, many sand dollars present in sample
3219x4623 Sewage 1 Nov.	11' 33' 108'	3' 15.0° 18.0 l.	35' 10.0° 18.0 l.	100' 8.5° 25.0 l.	Plankton tow-vertical 2			black muck
3308x4566 Edge beach	40'				2	1	4-80 u	fine sand with some black muck in the interstices

Table 9

Cruise: Boat and Dates: R/V Commonwealth 18-19 October, 1974

Station & Date	Secchi EZ Depth	Nisken Samples: Depth, Temp., Liters Filtered Top	Mid	Bottom	Grab Sample Jars	Bag	Uhlig Extraction	Sediment Characteristics
St. 35	11'	3'	37'	61'				
Dredge	33'		15.3°	15.2°				Black muck with greyish surface layer (5 cm.)
18 Oct.	64'	24.0 l.	13.0 l.	7.0 l.	2			
St. 37								
Edge dredge near beach								
18 Oct.					2	1	2-80 u	fine sand, clean looking
St. 82								
N.J.shore,control								
18 October					2			mucky sand and large gravel pieces
St. 16								
Near N.Y.Harbor								
19 October					2			medium sand, some black muck present
St. 92		3'		175'				
Hudson canyon		14.65°		12.00°				
18 October	180'	16.0 l.		8.0 l.	2			fine, somewhat mucky sand
St. 32	28'	3'		95'				
Sewage	84'	15.37°		13.20°				
19 Oct.	110'	16.0 l.		15.0 l.	2			black muck
St. 51		3'		60'				
Acid waste		15.40°		15.45°				
19 Oct.	73'	16.0 l.		16.0 l.	1	1	1-80 u	fine sand with a little muck in interstices

TABLE 10

CRUISE: Boat and Dates: R/V Rorqual 19, 20 February, 1975

Station Date	Secchi Depth EZ	Water Column: Nisken Samples, Depth Temp., Liters Filtered			Other Samples	Sediment Type
Station 35 Dredge 19 Feb.	12' 36' 68'	3' 6.0° 25.0 l.	40' 6.0° 27.0 l.	63' 6.0° 22.0 l.	none	
LORAN: 3296x4563					2 Lackey jars 1 bagful sediment	murky grey-black sand
LORAN: 3303x4558					2 Lackey jars 1 bagful sediment	fine sand, some muck under top layer of aerated sand
LORAN: 3308x4554					2 Lackey jars 1 bagful sediment	fine grained clean looking sand
Station 32 Sewage 20 Feb.	16' 48' 108'	3' 6.0° 29.0 l.	50' 6.0° 28.0 l.	100' 6.5 30.0 l.	Plankton tow taken vertically through the euphotic zone	

APPENDIX: PART B

Compendium of Ciliated Protozoa Found in Samples, Qualitative Data and Feeding Preferences

Table 1

Site: Tentative Genera/Species	Feeding Preference							
	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
Sandy Hook Point St.	Sandy		Control			21 June 73		
Uronema marinum	+							
Euplotes crassus	+	+	+					
Loxophyllum sp.						+		
Litonotus sp.						+		
Tintinnid sp.(ord.)	+							
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Trachelocercid sp.(fam.)			+	+	+	+		
Scutico sp.(ord.)	+							
St.36 (Alb.IV MESA Grid)	edge of dredge spoils, coarse sand					18 and 21 June 73		
Cyclidium dimacronucleatum	+							
Uronema nigricans	+							
Loxophyllum sp.						+		
Coleps sp				+				
Scutico sp.(ord.)	+							
Trachelocerca sp.			+	+	+	+		
Hypotrichs (ord.)	+	+	+	+	+	+		
Trachelocercid (fam.)			+	+	+	+		
St.35* (Alb.IV)	Black rubble, brick pieces			Dredge Spoils		18 June 73		
C.dimacronucleatum	+							
St. 35(Alb.IV)**	Black rubble, oil globs			Dredge Spoils		18 June 73		
U.nigricans	+							
C.dimacronucleatum	+							
St.23(Alb.IV)	Black muck,sand			Sewage edge		19 June 73		
C.dimacronucleatum	+							
Trachelocercid(fam.)			+	+	+	+		
St.32(Alb.IV)	Silty mud			Sewage		19 June 73		
Anophrys sp.	+							
Trachelocercid(fam.)			+	+	+	+		
Scutico sp.(ord.)	+							

Site:Tentative Genera/Species	Feeding Preference							
	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St.32(Alb.IV),cont'd.								
Scutico sp.2 (ord.)	+							
Scutico sp.3 (ord.)	+							
Scutico sp.4 (ord.)	+							

* Old Station W-2, close to present Albatross IV Mesa Grid St.35.
**Old Station 67, close to present Albatross IV Mesa Grid St.23.

Table 2
Feeding Preference

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St. 7 (Alb.IV) Coarse Sand, Gravel			Control			3 August 73		
Water col:								
Scutico (Ord.)	+							
Cyclidium polyschizonucleatum	+							
Sed/Water:								
Pseudoprorodon sp.			+	+				
Paraspathidium sp.			+	+	+	+	+	+
Metopus sp.	+							
Plagiopyla sp.	+							
Sediment:								
Lacrymaria sp. 1						+		
Lacrymaria sp. 2						+		
Metopus sp.	+							
Litonotus sp.						+		
Loxophyllum sp.						+		
Tracheloraphis sp. 1			+	+	+	+		
Tracheloraphis sp. 2			+	+	+	+		
Scuticos (order)								
St. 16 (Alb.IV) Fine clean sand			Control			3 August 73		
Water column (bottom):								
Euplotes sp.	+		+					
Water column (top):								
Frontonia sp.			+	+				
Sed/Water:								
Euplotes sp.	+		+					
Sediment:								
Remanella sp.			+	+	+			
Loxophyllum sp.						+		
Amphileptus sp.					+	+		
Litonotus sp.						+		
Trachelocerca sp.			+	+	+	+		
Cyclidium sp.	+							
Euplotes n. sp. 1	+			+				

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Feeding Preference Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
Euplotes sp. 1	+		+					
Euplotes sp. 2	+		+					
Pseudoprorodon sp.			+	+				
Paraspathidium sp.			+	+	+	+	+	+
Metopids (family)	+							
St. 32 (Alb.IV)	Sewage			Black muck			4 August 73	
Water column:								
Scutico (order)	+							
Pseudocohnilembus persalinis	+							
Cyclidium polyschizonucleatum	+							
Euplotes sp.	+		+					
Sed/water:								
Scutico sp. (order)	+							
Sediment:								
diatoms (Rhizoselenis setigera)								
St. 35 (Alb.IV)	Dredge Spoils			Black rubble, muck			4 August 73	
Water column (bottom):								
Euplotes sp.	+		+					
Scutico sp. (order)	+							
Water column (7m):								
Frontonia sp.			+	+				
Scutico sp. (order)	+							
Water column (1m):								
Euplotes sp.	+		+					
Scutico sp. (order)	+							
Cyclidium polyschizonucleatum	+							
Sediment:								
Cyclonema sp.	+							
Uronema elegans	+							
Euplotes sp.	+		+					

Site: Tentative Genera/Species	Feeding Preference							
	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St. 7	Coarse sand, some oil					14 August 73		
1 meter:	diverse phytoplankton, Gymnodinium bloom							
13 meter (bottom):								
dinoflagellates, radiolaria, diatoms								
Pseudoprorodon sp.			+	+	+	+		
hypotrich	+	+	+					
scuticociliate	+							
Bottom grab:								
hymenostome	+							
gymnostome sp. 1			+	+	+	+		
gymnostome sp. 2			+	+	+	+		
Uhlig:								
hymenostome	+							
Frontonia sp.			+	+				
Euplotes sp.	+		+					
Tracheloraphis sp.			+	+	+	+		
St. 8	Coarse sand, some oil sludge					14 August 73		
1 meter	diverse phytoplankton, some metazoa							
Tintinnids	+							
Cyclidium sp.	+							
scuticociliates	+							
10 meter (bottom):								
hypotrich	+	+	+					
Euplotes sp.	+		+					
Lacrymaria sp.						+		
Prorodon sp.	+		+	+				
Metopid	+							
scuticociliates	+							
Bottom grab:								
organic debris								
Uhlig:								
Trachelocerca sp. 1			+	+	+	+		
Trachelocerca sp. 2			+	+	+	+		
Tracheloraphis sp.			+	+	+	+		
Gruberia sp.	+		+					
Chlamydodon sp.			+					
Litonotus sp.						+		

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Feeding Preference Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
Paraspathidium sp.			+	+	+	+		
Loxophyllum sp.						+		
scuticociliates	+							
St. 11	Fine, clean sand					14 August 73		
1 meter:	organic debris, micrometazoa, diverse phytoplankton							
Tintinnids	+							
8 meter (bottom):	*Ceratium*, other dinoflagellates, micrometazoa							
scuticociliates	+							
Bottom grab:	Foraminifera, Radiolaria, *Gymnodinium*, diverse phytoplankton							
scuticociliates	+							
Uhlig:								
Litonotus sp.						+		
Tracheloraphis sp.			+	+	+	+		
Hemiophrys sp.						+		
Loxophyllum sp.						+		
Prorodon sp.			+	+				
Dileptus sp.						+		
Lacrymaria sp.						+		
St. 16	Coarse sand with clumps of small mussels overlying organic muck						14 August 73	
1 meter:	organic debris, phytoplankton							
scuticociliates	+							
10 meter (bottom):								
phytoplankton, micrometazoa								
Lacrymaria sp.						+		
scuticociliates	+							
hymenostome sp. 1	+							
hymenostome sp. 2	+							
Bottom grab:								
Euplotes sp. 1	+		+					
Euplotes sp. 2	+							
Aspidisca sp.	+							
Lacrymaria sp.						+		
Paraspathidium sp.				+	+			
Trachelocerca sp.			+	+	+	+		
Uhlig:								
Frontonia sp.			+					

Site: Tentative Genera/Species	Feeding Preference							
	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
Prorodon sp.	+		+	+				
Hemiophrys sp.						+		
Trachelocerca sp. 1			+	+	+	+		
Trachelocerca sp. 2			+	+	+	+		
hypotrich	+	+	+					

Feeding Preference

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St. 32	Sewage sludge		110' deep		low tide		27 August 73	
3 feet:	algal strands, micrometazoa, diatoms, Gymnodinium							
1 ciliate (Colpoda sp.).	+							
10 feet:	micrometazoa, algae diatoms, dinoflagellates, euglenoids, Gymnodinium							
Metopid sp.	+							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
scuticociliate sp. 3	+							
20 feet:	much organic debris, diatoms, algae, Gymnodinium, Peradinium, euglenoids, micrometazoa							
Cyclidium sp.	+							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
scuticociliate sp. 3	+							
30 feet:	mostly organic debris, diatoms, algae, Peradinium, euglenoids							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
hymenostome sp. 1	+							
hymenostome sp. 2	+							
Tintinnid sp.	+							
40 feet:	organic debris, algae, diatoms, Ceratium, Peradinium, Radiolaria, micrometazoa							
Tintinnid sp. 1	+							
scuticociliate sp.	+							
50 feet:	sand, organic debris, algae, dinoflagellates, metazoan larval forms							
scuticociliate sp.	+							
60 feet:	algae, diatoms, dinoflagellates, molluscan larvae							
no ciliates								
70 feet:	algae, dinoflagellates, metazoan larvae							
scuticociliate sp.	+							
80 feet:	sand, oil, organic debris, algae							
no ciliates seen								
90 feet:	algae, organic debris, diatoms							
scuticociliate sp.	+							
Euplotes sp.	+			+				
hypotrich sp.	+		+	+				
100 feet:	diatoms, algae, organic debris, dinoflagellates							
Tintinnid sp.	+							
hymenostome sp.	+							
scuticociliate sp. 1	+							

Feeding Preference

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
scuticociliate sp. 2	+							
110 feet:	organic debris, sludge, oil, sand, algae							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
St. 32	Sewage sludge		110' deep		outgoing tide		29 August 73	
3 feet:	organic debris, algae, oil globs, diatoms, dinoflagellates, euglenoids							
Tintinnid sp.	+							
hymenostome sp.	+							
scuticociliate sp.	+							
10 feet:	organic debris, fibers, sand, Ceratium, algae, diatoms, Gymnodinium, Peridinium							
no ciliates								
20 feet:	sand, organic debris, euglenoids, algae, Ceratium							
scuticociliate sp.	+							
30 feet:	organic debris, Ceratium, sand, fibers, oil, micrometazoa, algae, Peridinium, Gymnodinium, euglenoids							
Tintinnid sp.	+							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
scuticociliate sp. 3	+							
40 feet:	large oil globs, organic debris, diatoms, algae, micrometazoa, Peridinium, Ceratium, Gymnodinium, euglenoids							
hypotrich sp.	+	+	+					
scuticociliate sp.	+							
50 feet:	organic debris, oil globs, sand grains, euglenoids Polykrikos, Gymnodinium, metazoan larval forms							
no ciliates								
60 feet:	organic debris, fibers, algae, diatoms, Peradinium, euglenoids							
no ciliates								
70 feet:	organic debris, diatoms, metazoan larval forms, sand dinoflagellates, algae, tissue debris							
Colpoda sp.	+							
80 feet:	organic debris, larvae, sand, oil, fibers, diatoms, algae, euglenoids, dinoflagellates							
scuticociliate sp.	+							
90 feet:	oil, diatoms, fibers, algae, debris, dinoflagellates, euglenoids							
scuticociliate sp.	+							
100 feet:	organic debris, oil, sand, algae, diatoms, euglenoids							
scuticociliate sp.	+							

Feeding Preference

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
110 feet:	oil, sand, sludge, fibers, algae, organic debris							
scuticociliate sp.	+							

Table 5

Site:Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
				Feeding Preference				
R/V Ferrel cruise		Sediment samples only				18 September 73		
St.13 (water sampling cruise)		Sewage sludge						
nothing seen- no phytoplankton or zooplankton, mostly oil globs and dirty debris.								
St.22 (water sampling cruise)		Clean sand						
Euplotes sp.	+		+					
Tracheloraphis sp.			+	+	+	+		
Coleps sp.				+				
Loxophyllum sp.							+	
Trachelocerca sp.1			+	+	+	+		
Trachelocerca sp.2			+	+	+	+		
Trachelocerca sp. 3			+	+	+	+		
St.23 (water sampling cruise)		Clean sand, some sludge						
oil globs and a Foraminifera								

Table 6

Site:Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
			Feeding Preference					
R/V Oregon II cruise						19-26 October 73		
St.7(Or.II)Long Island Coast Control			Clean sand		52' depth			
Top water column: diatoms,algal strands,debris								
Bottom water column:diatoms,sand grains,algal strands								
Grab water:debris,algal strands								
Uhlig extraction:								
Trachelocerca sp.1			+	+	+	+		
Trachelocerca sp.2			+	+	+	+		
Lacrymaria sp.						+		
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Prorodon sp.1	+		+					
Prorodon sp.2	+		+					
Euplotes sp.	+		+					
Loxophyllum sp.						+		
St. 16(Or.II)N.Y.Harbor Control			Clean sand		28' depth			
Top water column:algal strands,fibers,*Gymnodinium*								
Bottom water column:algal strands,debris,sand,oil,diatoms,Euglenoids								
Scutico sp.(ord.)	+							
Grab water:debris,diatoms,fibers,*Gymnodinium*,*Polykrikos*								
Uhlig extraction:								
Loxophyllum sp.1						+		
Loxophyllum sp.2						+		
Remanella sp.			+	+	+			
Trcheloraphis sp.			+	+	+	+		
Euplotes sp.	+		+					
Frontonia sp.		+	+					
Sonderia sp.	+	+	+					
Spirostomum sp.	+							
Geleia sp.					+	+		
Lacrymaria sp.						+		
Scutico sp.1(ord.)	+							
Scutico sp.2(ord.)	+							
St.35(Or.II)Sewage dumping site			Black muck		108' depth			
Top water column:diatoms,algal strands,fibers,oil								

Table 6 (cont'd.)

Site:Tentative Genera/Species	Feeding Preference							
	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St.35(Or.II),cont'd.								
Plagiopyla sp.	+	+	+					
Bottom water column:algal strands,debris,oil,diatoms,sand								
Scutico sp.1(ord.)	+							
Scutico sp.2(ord.)	+							
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Grab water:debris,diatoms,algal strands								
Uhlig extraction:sand,fibers,debris,diatoms								
St.38(Or.II)Dredge spoils			Black muck		70' depth			
Top water column:algal strands,debris,Gymnodinium,Peradinium								
Scutico sp.1(ord.)	+							
Scutico sp.2(ord.)	+							
Mid water column:algal strands,diatoms,debris,dinoflagellates,euglenoids								
Scutico sp.(ord.)	+							
Bottom water column:algal strands,diatoms,dinoflagellate,euglenoids								
Plagiopyla sp.	+	+	+					
Grab water:debris								
Uhlig extraction:debris,sediment								
St.54(Or.II)Acid waste			Fine sand, reddish color			80' depth		
Top water:algal strands, diatoms,sand,debris,fibers,dinoflagellates,euglenoids								
Bottom water column:algal strands,diatoms,sand,fibers								
Grab water:algal strands,diatoms,sand								
Uhlig extraction:sand,fibers,iron flock								
Trachelocerca sp.1			+	+	+	+		
Trachelonema sp.			+	+	+	+		
Loxophyllum vermiforme						+		
Centrophorella sp.						+		
Remanella sp.1			+	+	+			
Remanella sp.2			+	+	+			
Trachelocerca sp.2			+	+	+	+		
Trachelocerca sp.3			+	+	+	+		
Lacrymaria sp.1						+		
Lacrymaria sp.2						+		
Prorodon sp.	+	-	+	+				

Table 6 (cont'd.)

Site:Tentative Genera/Species	Feeding Preference							
	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St.85(Or.II)N.J.coast control			Fine,clean sand			42' depth		
Top water column:algal strands,diatoms,sand								
Bottom water column:algal strands,diatoms,euglenoids,*Gymnodinium*								
Grab water:diatoms,sand,debris								
Uhlig extraction:								
Lacrymaria sp.						+		
Remanella sp.			+	+	+			
Loxophyllum sp.						+		
Tracheloraphis sp.			+	+	+	+		
Condylostoma clarissimum			+		+	+		
Euplotes sp.		+	+					
Trachelocercid sp.(fam.)			+	+	+	+		
St.91(Or.II)Deep water Hudson River canyon control			Fine,clean sand			100' depth		
Grab water:sand, debris								
Uhlig extraction:sand,diatoms,algal strands,debris								
unidentified Trachelocercid and trachelocercid type ciliates								
Trachelocerca sp.			+	+	+	+		

Table 7

Feeding Preference

Sites:Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Ferrel cruise		Sediment samples only			26-30 November 73			
St.1(water sampling cruise)L.I.shore control								
Loxophyllum sp.						+		
Euplotes sp.	+		+					
Scutico sp.(ord.)	+							
St.5(water sampling cruise)L.I.shore control								
Trachelocerca sp.			+	+	+	+		
Loxophyllum sp.						+		
Litonotus sp.						+		
Tracheloraphis sp.			+	+	+	+		
Lacrymaria sp.						+		
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Condylostoma clarissimum			+		+	+		
St.12(water sampling cruise)Sewage								
data pending results from Lackey's (1961) modified live aquarium extraction method								
St.13(water sampling cruise)Dredge spoils								
data pending results from Lackey's (1961) modified live aquarium extraction method								
St.19(water sampling cruise)Acid waste								
Geleia sp.					+	+		
Lacrymaria sp.						+		
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Euplotes sp.	+		+					
Dileptus sp.						+		
Trachelocercid sp.(fam.)			+	+	+	+		
St.21(water sampling cruise)N.J.shore control								
Condylostoma sp.			+		+	+		
Condylostoma clarissima			+		+	+		
Trachelocerca sp.			+	+	+	+		
Tracheloraphis sp.1			+	+	+	+		

Table 7 (cont'd.)

Feeding Preference

Sites:Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St.21(cont'd.)								
Tracheloraphis sp.2			+	+	+	+		
Frontonia sp.		+	+					
St.23(water sampling cruise)Control								
Trachelocercid sp.(fam.)			+	+	+	+		
Tracheloraphis sp.1			+	+	+	+		
Tracheloraphis sp.2			+	+	+	+		
St.25(water sampling cruise)Control								
Condylostoma clarissimum			+		+	+		
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Prorodon sp.	+		+					
Paraspathidium sp.				+	+			
Gruberia sp.	+		+					
Heterotrich sp.(ord.)	+		+					
Trachelocerca sp.			+	+	+	+		
Loxophyllum sp.						+		
Geleia sp.					+	+		
Euplotes sp.	+		+					
Tracheloraphis sp.			+	+	+	+		
Condylostoma enigmatica			+		+	+		
Lacrymaria sp.						+		

Sites:Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Albatross IV								
23 Jan. to 1 Feb., 1974								
St. 7 40°31'N 73°38'W								
Water col:								
Top: algae, diatoms, Ceratium, Peradinium								
Tintinnid sp.1	+	a	+	+	+			
Bottom:algae, diatoms, Ceratium, Peradinium								
Tintinnid sp.1	+	a	+	+	+			
Sed/Water:								
Metopids	+							
Scuticociliate	+							
Sediment:								
Hypotrichs	+	a,d	+	+	+	+	+	
Condylostoma			+		+	+		
Trachelonema			+	+	+	+		
Lacrymaria					+	+		
St.16 40°31'N 73°38'W								
Water col:								
Top:dense algae, diatoms, Ceratium, Polykrikos, copepods								
Tintinnid sp.1	+	a	+	+	+			
Tintinnid sp.2	+	a	+	+	+			
Tintinnid sp.3	+	a	+	+	+			
Tintinnid sp.4	+	a	+	+	+			
Bottom:algae,diatoms,foraminifera, Ceratium, Peradinium								
Tintinnid sp.1	+	a	+	+	+			
Sed/Water:								
Euplotes	+			+				
Sediment:								
Condylostoma			+		+	+		
Litonotus						+		
Nassula		a						
Lacrymaria						+		
Euplotes	+			+				
Trachelocercid sp.1			+	+	+	+		
Trachelocercid sp.2			+	+	+	+		
Scuticociliate	+							

Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St. 32 40°25'N 73°48'W								
Water col:								
Top:algae, Ceratium								
Tintinnid sp.1	+	a	+	+	+			
Tintinnid sp.2	+	a	+	+	+			
Tintinnid sp.3	+	a	+	+	+			
Mid:algae, diatoms								
Tintinnid sp.1	+	a	+	+	+			
Tintinnid sp.2	+	a	+	+	+			
Bottom: all present seem dead								
Sed/Water:--								
Sediment:--								
St. 35 40°25'N 73°54'W								
Water col:								
Top:very dense with algae and diatoms, Ceratium								
Tintinnid sp.1	+	a	+	+	+			
Tintinnid sp.2	+	a	+	+	+			
Mid:very dense with algae and diatoms, Ceratium, Peradinium, Gymnodinium								
Tintinnid sp.1	+	a	+	+	+			
Bottom:algae and other phytoplankton seem dead								
Tintinnid sp.1	+	a	+	+	+			
Acuticociliate	+							
Sed/Water:--								
Sediment:--								
St. 51 40°19'N 73°42'W								
Water col:								
Top:algae,diatoms, Ceratium,Peradinium, Gymnodinium								
Tintinnid sp.1								
Mid:algae, diatoms, Ceratium, Gymnodinium								
Bottom:algae, few diatoms								
Sed/Water:--								
Sediment:								
Coxophyllum						+		
Cleia					+	+		
Helicoprorodon			+	+	+	+		
Prontonia			+	+				
Acrymaria sp.1						+		
Acrymaria sp.2						+		

Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St. 51 (cont'd.)								
Sediment (cont'd.):								
Condylostoma			+		+	+		
Euplotes	+		+					
Trachelocercid sp.1			+	+	+	+		
Scuticociliate	+							
St. 82 40°13'N 73°59'W								
Water col:								
Top:extremely dense algae, diatoms, Ceratium								
Tintinnid sp.1	+	a	+	+	+			
Bottom:algae, copepods, Ceratium								
Sed/Water:								
Euplotes	+		+					
Lacrymaria						+		
Metopid	+							
Sediment:								
Loxophyllum sp.1						+		
Loxophyllum sp.2						+		
Trachelocerca sp.1			+	+	+	+		
Trachelocerca sp.2			+	+	+	+		
Tracheloraphis			+	+	+	+		
Lacrymaria						+		
Metopid sp.1	+							
Metopid sp.2	+							
Trachelonema			+	+	+	+		
Euplotes	+		+					
Geleia					+	+		
Scuticociliate	+							
St. 90 40°10'N 73°44'W								
Sediment:								
Loxophyllum						+		
Lacrymaria						+		
Trachelocerca sp.1			+	+	+	+		
Trachelocerca sp.2			+	+	+	+		
Euplotes	+		+					
Scuticociliate	+							

tes:tentative nera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
. 92 40°10'N 73°42'W								
ter col:								
p:algae, Ceratium, Peradinium								
ntinnid sp.1	+	a	+	+	+			
d:algae, diatoms, Ceratium, Peradinium								
ntinnid sp.1	+	a	+	+	+			
ntinnid sp.3	+	a	+	+	+			
ttom:diatoms, Ceratium								
d/Water:very silty								
plotes	+		+					
diment:								
plotes	+		+					
achelocercid sp.1			+	+	+	+		

Genera/Species	Bacteria	Detritus or Algae	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Oregon II		a or d						
21 March-3 April, 1974								
St. 7 40°31'N 73°38'W 23 March Long Island Shore Control								
Water Column:								
Top: algal strands, sand, Ceratium, Peridinium, copepods, rotifer								
Tintinnid sp.1	+	a						
Bottom: algae, Ceratium, Gymnodinium, diatoms, nauplii								
Tintinnid sp.1	+	a						
Bed/Water: Ceratium, Peridinium, algae, nauplii								
Sediment: nematodes, debris, Peridinium, flatworm								
Hypotrich	+	a,d	+	+	+	+	+	+
Trachelocercid			+	+	+	+		
Blepharisma spiralis			+					
Macrogamaria					+	+		
Tintinnid sp.1	+	a,d						
St. 16 40°31'N 73°38'W 23 March New York Harbor Control								
Water column:								
Top: algae, Ceratium, diatoms, nauplii								
Tintinnid sp.1	+	aaa						
Tintinnid sp.2	+	a						
Bottom: algae, sand, Ceratium, Gymnodinium, rotifers								
Bed/Water: algae, debris, Gymnodinium, Ceratium, gelatinous zooflagellates								
Neutico siliate	+							
Sediment:								
Trachelocercid sp.1			+	+	+	+		
Trachelocercid sp.2			+	+	+	+		
Trachelocercid sp.3			+	+	+	+		
Cycloraphis			+	+	+	+		
Exorhyllum sp.1						+		
Exorhyllum sp.2						+		
Exorhyllum sp.3						+		
Vorticella						+		
Macrogamaria sp.1						+		
Macrogamaria sp.2						+		
Helicoprorodon			+	+	+	+		
Euplotes	+	a	+					
Condylostoma			+		+	+		
Hypotrichs	+	a,d	+	+	+	+	+	+
Metopids	+							
Neutico ciliates	+							

Sites: Tentative

Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micrometazoa	Histophages
St. 31 40°25'N 73°48'W 24 March Sewage Dump Site								
Water column:								
Top: algae, Ceratium, nauplii, copepods, polychaete larvae, diatoms, Peridinium								
Tintinnid sp.1	+	a						
Massula		a						
Middle: algae, nauplii, copepods, Ceratium, Gymnodinium, Polykrikos, other dinoflagellates								
Bottom: algae, Ceratium, foraminifers, debris								
Sed/Water: silt								
St. 34 40°25'N 73°54'W 25 March Dredging Spoils Dump Site								
Water column:								
Top: algae, sand, Ceratium, nauplii, copepods								
Tintinnid sp.1	+	a						
Hypotrich	+	a,d	+	+	+	+	+	+
Bottom: debris, Ceratium, Peridinium, nauplii, diatoms								
Tintinnid sp.1	+	a						
Sed/Water: debris, dead amphipods								
St. 51 40°19'N 73°42'W 26 March Acid Waste Dump Site								
Water column:								
Top: algae, Ceratium, Gymnodinium, Peridinium, other dinoflagellates, zooflagellates, euglenoids, rotifers								
Bottom: debris, algae, Ceratium, Peridinium, nauplii								
Tintinnid sp.1	+	a						
Sed/Water: debris, algae, sand, Ceratium, other dinoflagellates								
Sediment:								
Centrophorella sp.1						+		
Centrophorella sp.2						+		
Euanella sp.1						+		
Euanella sp.2						+		
Euanella sp.3						+		
Euanella sp.4						+		
Parodon		a	+	+	+			
Trachelocercid sp.1			+	+	+	+		
Trachelocercid sp.2			+	+	+	+		
Trachelocercid sp.3			+	+	+	+		
Chaenia						+		
Exorhyllum						+		
Aerymaria						+		
Exodid sp.						+		

Sites:Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micrometazoa	Histophages
Station 57 40°19' 73°52'W 2 April New Jersey Shore Control A								
Multiple Core Station								
Sediment:sand, oil, rotifers								
Trachelocercid			+	+	+	+		
St. 82 40°13'N 73°59'W 28 March New Jersey Shore Control B								
Water column:								
Top: algae, diatoms, Ceratium, Cryptomonas, Peridinium								
Tintinnid sp.1	+	a						
Bottom: algae, Ceratium, Peridinium								
Tintinnid sp.1	+	a						
Sed/Water: algae, dinoflagellates, diatoms								
Euplotes	+		+					
Sediment:								
Trachelocercid			+	+	+	+		
Centrophorella						+		
Lacrymaria						+		
St. 90 40°10'N 73°44'W 29 March Deep Water Sediment Station								
Sediment: Cryptomonas								
Euplotes	+		+					
St. 92 40°10'N 73°42'W 29 March Deep Water Control								
Water column:								
Top: algae, Ceratium, polycheete larvae, Peridinium								
Tintinnid sp.1	+	a						
Middle: algae, Ceratium, nauplii, copepods, diatoms								
Bottom: Debris, algae, diatoms, Ceratium, nauplii								
St. 99 40°22'N 73°36'W 2 April Outer Control Station								
Multiple Core Station								
Sediment: Euglenoid, flatworms, flagellates								
Tintinnid sp.1	+	a						
Trachelocercid sp.1			+	+	+	+		
Trachelocercid sp.2			+	+	+	+		
Trachelocercid sp.3			+	+	+	+		
Pseudomrorodon			+	+	+			
Metopid	+							
Loxophyllum								
Mesionotus						+		
Centrophorella						+		
						+		

Sites:Tentative

Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Delaware II								
26-31 August, 1974								
St. 8								
Water col:								
Top: heliozoa, acantharian, desmid, ctenophores, polychaete larvae, diatoms, Gymnodinium, euglenoid								
Tintinnid	+	a						
Oligotrich	+	a						
Bottom: acantharia, polychaete larvae, diatoms, copepods, radiolarian								
Tintinnid	+	a						
Scutico ciliate	+							
St. 15								
Water col:								
Top: acantharia, diatoms, Gymnodinium, euglenoid								
Bottom: diatoms, copepods, rotifers, hydroid, Cryptomonas, Chromulina, Ceratium								
Tintinnid sp.1	+	a						
Tintinnid sp.2	+	a						
Sediment;								
Metopid	+							
Litonotus								
Prorodon		a	+	+	+	+		
Euplotes								
Remanella						+		
St. 30								
Water col:								
Top AM: many ciliates (peritrichs, tintinnids, scuticos)								
Vorticella	+							
Philasterid	+							
Uronema	+							
Uronema nigricans	+							
Top PM: copepods, ctenophores with Trichophrya salparum, ceratium, daphnia, pelecypod larva, chaetognath larvae, dinoflagellate rotifer								
Pseudocohnilembus	+							
Euplotes	+	a,d	+	+	+			
Oligotrich	+							
Tintinnid	+	a						
Cyclidium	+							
Uronema nigricans	+							

Table 11
FEEDING PREFERENCE

Site:Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Xiphias								
11 October, 1974								
Sewage dump site								
Water column:								
Top: diatoms, *Ceratium*, copepods, rotifer								
Peritrichs	+							
Vorticella	+							
Mid: *Ceratium*, *Gymnodinium*, copepods, flagellates								
Bottom:								
Uronema nigricans	+							
Dredge edge(a)								
Sediment: nematodes								
Dredge edge(b)								
Sediment:								
Keronopsis			+		+			
Uronema	+							
Cyclidium	+							
Pleuronema	+							
Condylostoma			+		+	+		
Spirostomum								
Metopids	+							
Trachelocerca sp.1								
Trachelocerca sp.2			‡	‡	‡	‡		
Dredge edge(c)								
Sediment: nematodes, copepods								
Remanella						+		
Pleuronema	+							
Coleps			+					

Table 12
Feeding Preference

Site: Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Commonwealth								
18-19 October, 1974								
Station 35 Dredge								
Water column :								
Top: copepods, pelecypod larvae, Ceratium, radiolaria								
Hypotrich		+	+	+	+			
Mid: copepods, organic debris, oil blobs, Ceratium								
Bottom: chaetognath larva, sand, debris								
Station 92 Hudson canyon								
Water column:								
Top: copepods, sand, debris								
Bottom: diatoms, copepods, sand, debris								
Station 32 Sewage								
Water column:								
Top: diatoms, salps, copepods, debris, flagellates, hydroid								
Bottom: copepods, pelecypod larvae, debris								
Station 51 Acid waste								
Water column:								
Top: hydroid medusa, copepods, fish and pelecypod larvae, debris								
Hypotrich		+	+	+	+			
Bottom: copepods, euglenoids, pelecypod larvae, sand								

Table 15

Feeding Preference

Sites: Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Xiphias								
1 November, 1974								
Sewage								
Water column:								
Top: copepods, silicoflagellates, *Ceratium*								
Mid: *Ceratium*, silicoflagellates, debris								
Tintinnids	+	a						
Bottom: copepods, flagellates								
Uronema	+							
Station 37 Beach edge								
Sediment: nematodes								
Colpes			+					
Pleuronema	+							
Platiophyla	+	a	+					
Prorodon		a	+	+	+			
Centrophorella						+		
Loxophyllum						+		
Frontonia			+			o		
Helicoprorodon			+	+	+	+		
Remanella						+		
Lacrymaria						+		
Litonotus						+		
Trachelocerca sp.1			+	+	+	+		
Trachelocerca sp.2			+	+	+	+		

Table 14
Feeding Preference

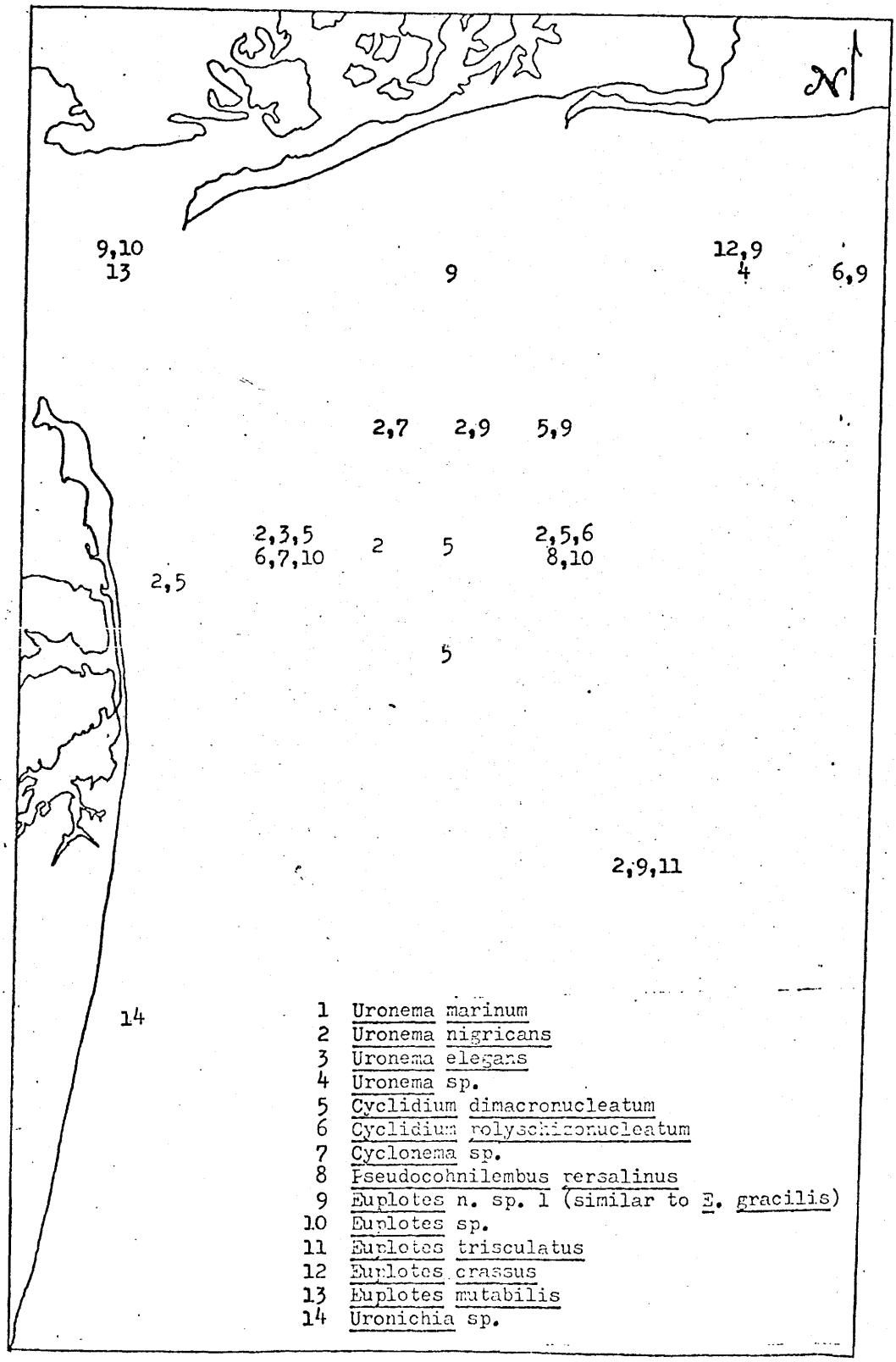
Sites:Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-Flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Rorqual								
19,20 February, 1975								
Dredge Water column:								
Top: algae, fibers								
Tintinnid sp.1		a						
Tintinnid sp.2		a						
Tintinnid sp.3		a						
Mid: algae, diatoms, organic debris								
Tintinnids, 3 spp.		aa						
Bottom: algae, diatoms, sand, debris								
Tintinnids, 5 spp.		aa						
Sediment:								
Scuticociliates, 2 spp.	+							
Sewage Water column:								
Top: algae, phytoplankton								
Bot: algae, phytoplankton								
Dredge edge								
Sediment:								
Metopid sp.	+							
Hypotrichs, 2 spp.	+	a,d	+	+	+			
Trachelocerca sp.			+	+	+	+	+	
Tracheloraphis sp.			+	+	+	+	+	
Centrophorella sp.						+		
Flagiopyla sp.	+	a	+	+	+			
Scuticociliates	+							

APPENDIX: PART C

1. Updated distributional map

2. Abstract for Society of Protozoologists Meetings, August, 1975

Figure 1: Distribution of indicator organisms in the New York Bight



Seasonal fluctuations of planktonic ciliate protozoa from a polluted marine environment

CADY A. SOUKUP, SUZANNE J. SUCHARD, EUGENE B. SMALL
Dept. of Zoology, University of Maryland, College Park, Maryland, 20742

Plankton from the water column over the major sewage dump site in the New York Bight has been sampled over a period of twenty one months. Quantitative counts of the ciliates present indicate seasonal fluctuation in the ciliate plankton population.

Samples were collected from depths of (a) 1 m., (b) 1m. below the euphotic zone (range:3-30 m.), (c) 1 m. above the bottom (range:25-33 m.). The samples were gravity filtered through 80μ, 35μ, and 20μ mesh Nytex monofilament nylon net filters as soon as possible. Filters were placed in a 20 ml. aliquot of filtered seawater and swirled to suspend the filtrate. Ten ml. of the resulting concentrated plankton soup were examined for live material and ten ml. were fixed in ten ml. of Bouin's preservative for later counting.

Data analysis indicates that there are three major population peaks corresponding roughly to the summer, autumn, and winter seasons. Bactivorous scutico ciliates predominate in the relatively large summer population peak; bactivorous peritrichs outnumber the scutico ciliates in the large autumn peak; algivorous tintinnids predominate in the smaller winter peak and are also present in low numbers during the spring phytoplankton blooms. (Supported by U.S.Department of Commerce contract 03-3-043-48 in conjunction with the NOAA Marine Ecosystems Analysis Program).

APPENDIX: PART D

Quantitative Data for the
Sewage Dump Site:

August, 1973 to February, 1975

QUANTITATIVE DATA:

SEWAGE SITE 40°25'N x 73°48'W

Date	Depth Secchi EZ	Sample Depth	Liters Filtered	Temp.	DO	Direct Observ.	Ciliates Raw Count	95% Range	Ciliates / Liter	95% Range
27 August 1973	110'	3'	6	24°C	2.40	+	105	85-125	210.0	170-250
		10'	22	22.5	8.15	++	30	21-43	16.4	11-23
	10'	20'	17	22	7.52	+	38	27-53	26.8	19-37
		30'	22	22	7.40	++	40	29-55	21.8	16-30
	30'	40'	20.5	21	7.40	++	95	78-118	55.6	46-69
		50'	18	20	7.46		28	19-41	18.6	13-27
		60'	20	19		+	28	19-41	16.8	11-25
		70'	14	18	6.50		28	19-41	24.0	16-35
		80'	9	11			42	31-57	56.0	41-76
		90'	16	10.5	5.25	++	54	41-71	40.5	31-53
		100'	17.5	9		++	27	18-40	18.5	12-27
		110'	14		5.18	+	42	31-57	36.0	27-49
29 August	110'	3'	16	25	7.60	+	163	135-190	122.2	101-142
		10'	13.5	24	7.65		22	14-34	26.0	17-40
	21'	20'	20	23	7.72	+	44	32-60	35.2	26-48
		30'	14	22	7.44	+	32	22-46	27.4	19-39
	63'	40'	21.5	21	6.64	++	52	39-69	38.7	22-51
		50'	18	21	7.45		32	22-46	21.3	15-31
		60'	18.5	19	6.76		34	24-48	29.4	21-41
		70'	20	14	5.12	+	119	96-133	71.4	58-80
		80'	16	13	4.94	+	14	8-24	10.5	6-19
		90'	23	11	4.94	++	20	13-32	13.9	9-22
		100'	22	10		+	35	25-49	25.4	18-36
-		110'	21.5		5.12	+	13	7-19	7.2	4-11
22 October	108'	3'	29.9	14		+	48	36-64	19.2	14-26
	32'	105'	13.5	11		+	40	29-55	47.4	34-65
	96'									
25 January 1974	108'	3'	7	5.5		+	70*	55-89	30.0	21-43
	19'	65'	16	6.8		+	49*	37-54	9.2	5-18
	57'	105'	5	6.3			35*	25-49	21.0	13-33
24 March	108'	3'	16			+	29*	20-42	5.4	2-13
	16'	53'	21				16*	9-27	2.2	0.4-8
	48'	105'	5.5	6.0			22*	14-34	12.0	7-22

Date	Depth Secchi EZ	Sample Depth	Liters Filtered	Temp.	Hypo-trichs	Peri-trichs	Tin-tinnids	Ciliates	Total Ciliates	Silico-flagellates	Cera-tium	Dino-physis	Gymno-dinium
29 Aug. 1974	[a] 95' 4.5' 13.5'	5'	5.0	23.9°		240.0	9.6	153.6	403.2	432.0	24.0		144.0
	[b] 80' 35'	3'	24.0	24.0°		2.0	4.0		6.0	2.5		2.5	22.4
	105'	75'	18.0	15.5°			34.6		34.6	23.3		30.0	
11 Oct.	120'	3'	12.0	17.0°	4.0				4.0	105.0	55.0	5.0	5.0
	28'	30'	21.5	14.8°		8.9	8.9		17.8	39.0	273.4	69.7	2.8
	84'	110'	8.0	11.5°			42.0	6.0	48.0	7.5	7.5	7.5	
19 Oct.	110' 30'	3'	16.0	15.4°			21.0		21.0	90.0	21.0	15.0	
	90'	100'	15.0	13.2°		3.2	22.4		25.6	92.8	38.4		
1 Nov.	108'	3'	18.0	15.0°			10.0		10.0	39.3	4.7	40.7	4.0
	11'	35'	18.0	10.0°	0.67		16.7	1.3	18.67		11.3	5.3	
	33'	100'	25.0	8.5°	1.2		30.0	2.4	33.6		16.8	9.8	
20 Feb. 1975	108'	3'	29.0	6.0°			137.9		137.9	45.1	21.7	9.3	25.5
	16'	50'	28.0	6.0°			199.3		199.3	40.0	11.8	8.6	11.8
	48'	100'	30.0	6.5°			188.0		188.0	3.0	10.0	8.6	

RESEARCH REPORT TO

United States Department of Commerce
National Oceanographic and Atmospheric
Administration

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

Institution

Montclair State College
Upper Montclair, New Jersey 07043

Project Title:

Study of Antimicrobial Resistant Bacteria Isolated from Sediments in the Area of the Sewage Dump Sites in the New York Bight.

Contract No. 03-4-043-337

Principal Investigator

Leah Koditschek
Leah Koditschek
Professor of Biology
(Microbiology)

Research Assistant: Paul Guyre

Date of Submission

March 17, 1975

Table of Contents

Page No.

Abstract
Key Words & Phrases
Introduction
Materials & Methods 1-5
- I. Preparation of Materials for Sampling
- II. Sampling Procedure
- III. Sample Processing
- IV. Membrane Filtration
- V. Antimicrobial Agents Used for Selection of Resistant Bacteria
- VI. Determination of Bound Water
- VII. Recovery & Viability Studies

Results 6-9
- 1. Incidence of Hg^R & TE^R Bacteria at Stations
- 2. Antimicrobial Spectrum of Isolates
- 3. Recovery Experiment
- 4. Statistical Analysis

Discussion 10-12
Problems 12-13
Recommendations 13-17
- 1. Desorption Studies
- 2. Sample Storage Studies
- 3. Conjugation Under Marine Conditions
- 4. Statistical Analysis
- 5. Potential Biohazard & Future Sampling

References Cited 18-21
Appendix
- Figure 1
- Tables 1-10 Results
- Table 11 Sampling Procedure
- Table 12 Weight of Kim-Kaps
- Table 13 Abbreviations
- Table 14 Definitions
- Table 15 Estimate of Time Required for 6 Station Sampling & Sample Analysis.

Acknowledgments

ABSTRACT

On four sampling trips in summer, 1974, sediment samples (and one sampling of overlying water) from selected stations around the sewage dump site in the New York Bight were analyzed for coliforms, and non-coliforms resistant to mercury and antibiotics. Although few, or no coliforms could be found in these samples, a gradient of bacteria resistant to mercury and tetracycline was identified around MESA station 34 in a northeasterly direction (toward Long Island). Approximately 1% of the sediment bacteria desorbed by Standard Methods technique were consistently found resistant to $HgCl_2 10^{-3}M$ and/or tetracycline 40 mcg/ml at MESA station 34. The antibiogram of a majority of the isolates from these sediments showed multiple antibiotic resistance on preliminary testing. More variable concentrations of resistant bacteria were found between MESA stations 23 and 24 and between MESA stations 33 and 24. All sediments from which antimicrobial resistant bacteria were isolated in appreciable number showed high bound water content, much debris, little or no evidence of normal benthic macrofauna and a black, gelatinous consistency indicative of pollution. In contrast, stations 22 and 39 along the Sandy Hook transect showed insignificant or no resistant bacteria, and no other indication of pollution. Analysis of surf water and sediments from a bathing beach at Sandy Hook State Park revealed a significant number of bacteria resistant to 7 or more antibiotics in water with very low coliform counts. These data suggest that the techniques used in these studies are sensitive in detecting pollution gradients which are not detectable by coliform counts. Our work revealed the need for more basic studies, particularly in techniques for maximal desorption of sediment bacteria, and for viability of multiresistant bacteria in these sediments and the feasibility of transfer of resistance plasmids in such bacterial populations under conditions prevailing in sediments at the sewage dump site in the N. Y. Bight. The biohazard of the distribution of multiple resistant bacteria in the N. Y. Bight area clearly indicates the need for continued surveillance, particularly in relation to potential contamination of beach areas on the Long Island shore.

Key Words and Phrases

New York Bight

Coliforms

Antimicrobial resistant bacteria

Sewage dump site

Pollution gradient

Sediment bacteria

Bacteria resistant to heavy metals

Bacteria resistant to tetracycline

Antibiogram

Biohazard of multiresistant bacteria

Antimicrobial resistant bacteria at bathing beach

INTRODUCTION

Our previous study in summer 1972 on water and sediments from the sewage dump sites in the New York Bight (NOAA Contract No. N-043-48-72)[1] revealed significant numbers of coliforms resistant to antibiotics and some heavy metals among the resident bacteria in the sediment at NOAA station 59 (the approximate center of the sewage dump site.[2]) Some of these multiple resistant coliform isolates were shown to be donors of R plasmids[a] during conjugation with a recipient strain of Salmonella gallinarum. During analysis of this water and sediment it became obvious that the number of lac^- resistant strains isolated was much greater than the resistant coliforms, and we concluded that surveillance of the possible public health hazards of these polluted areas must provide for analysis of lac^- as well as lac^+ isolates.[1,2] It was also evident that there was need to assay the incidence of multiple resistant bacteria from sediment at stations around the presumed center of the sewage dump site, and to examine sediments from relatively unpolluted control sites. In May 1974, we were provided with funds through MESA Contract No. 03-4-043-337 to pursue these studies.

Since two years had elapsed, and the MESA grid now used in sampling was different from the NOAA grid we had used in 1972, it was necessary to explore a number of MESA stations in the vicinity of NOAA station 59. Specifically, we examined sediment from MESA stations 34 and 33, as well as three inter-station sites, designated ~~as~~ 24+X, 23^+ (see Table 1 and Fig. 1). Additionally, frozen and refrigerated samples from MESA station 62, Alternate Dump Site North, and MESA station 93, Alternate Dump Site South were received on 6/29/74 and examined. To monitor control sites and possible movements of pollution along the Sandy Hook transect we examined sediment from MESA stations 22, 19, 16, and 39 (Table 1, Fig. 1). On two sampling trips, 7/29 and 8/9, we also collected bathing water and surf sediment from Sandy Hook State Park.

A number of problems which became apparent during our work last summer will be reviewed in the section on "Discussion and recommenda-

(a) See Table 14 for definition of terms used.

tions" and they point to the need for some base studies, particularly in terms of sediment storage by refrigeration or freezing, control studies on sediment processing, bacterial viability in sediments from the dump site and statistical analysis of the number of replicate samples required for a given assay confidence. In spite of this, the data reviewed in this report indicates the potential usefulness of our analysis to "fingerprint" sediment pollution.

Materials and Methods

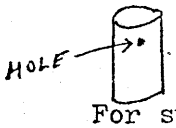
Microbiological techniques used in these studies have been described previously,[2,3] therefore only special methods of interest will be included here

I. PREPARATION OF MATERIALS FOR SAMPLING (See Tables 11 and 12)

1. Preparation of Sterile Corers

Large 35 mm I.D. plastic cores were kindly supplied by the Sandy Hook Marine Lab. These were wiped with alcohol, capped and covered with sterile foil or paper prior to use.

For the most part, it was found that smaller "Kim-Kap" cores, which held about 10 grams of wet sediment, were most convenient. #1[8] Kim-Kaps (Kimble, obtained from S/P) were used for sampling wherever possible. A small hole was placed at the top to allow air to leave the cap, as sediment displaced it when the Kap was pushed into the surface of the sediment in the Smith McIntyre grab.



For sterilization, the hole on the Kim-Kap was covered with sterile indicator tape, the caps were wrapped in aluminum foil in packs of 8, and autoclaved for 15 min. at 15 lbs. (121°C). The package was arranged with a fold of the foil for easy opening and removal of individual Kim-Kaps and maintenance of sterility of the rest in the pack during sampling. As each Kap was inserted into the surface of the sediment, the sterile tape was removed from the vent hole to permit exit of air within the Kap. When the desired amount of sediment was inserted into the Kap, the tape was replaced to prevent inrush of air which would push sediment out. Sometimes it was helpful to rotate the Kap as it was being removed from the sediment in the grab, especially if the sediment was retentive of water (usually in polluted sediments), or had loose gravel.

Nineteen Kim-Kaps (#1[8]), to be used for coring sediment from a grab sample, were weighed and the results were recorded. Since the average weight of a Kim-Kap was determined as 2.112 gm (see Table 12), 2.1 gm was used as the tare value for all Kim-Kaps in sampling.

2. All other containers for sediment or water were sterilized by autoclaving or alcohol wipe and covered with sterile paper or foil until use.

II. THE SAMPLING PROCEDURE

Sediment samples were obtained by personnel of the Sandy Hook Laboratory, MACFC, on board the Delaware II on 5/21/74 and the Venture on 6/26/74. All othe samples were obtained by technicians from the Montclair State College Microbiology Laboratory with the help of Sandy Hook personnel on board the Rorqual.

1. Sediment

Site locations were located by Loran. A Smith McIntyre grab was used to obtain sediment. After "cracking" the jaws of the grab to allow the H_2O layer to flow off, the sediment temperature was determined with an alcohol sanitized laboratory thermometer and cores of approximately 10 grams were taken with sterile Kim-Kaps. A minimum of five cores and an average of 8 cores per grab were taken. Effort was made to obtain 2 grabs per station, yielding 16 cores per station. Cores were immediately placed in sterile screw cap jars. Samples were then placed in a cooler chest (5-10°C) while on board ship and left there until arrival at the lab. In the lab, samples were immediately placed in a 5-10°C refrigerator. Sediment samples from Sandy Hook State Park were taken with 35 mm diameter cores by wading into the surf area at the swimming beach.

2. Water

Water samples were obtained with a Niskin 5 L H_2O bottle. Approximately 2 L of the water was distributed in sterile nalgene sample bottles and placed in the cooler on ship. Bathing beach water was obtained by immersion of sterile plastic bottles.

III. SAMPLE PROCESSING

The sediment suspension (SS) was prepared at a concentration of 10 g wet wt. Sediment/400 ml in sterile buffered H_2O (Standard Methods).[4] Therefore, 1 ml of SS was assumed to be equivalent to 0.025 g wet sediment.(*)

The outside of the core was cleaned with 70% ethanol soaked cotton or paper towel to remove any extraneous sediment. The tare knob (Mettler Balance Model H20T was set to 2.1 gm. The sterile tape covering the vent hole on the core was removed. The Kim-Kap core was placed on the balance and the sediment weight in it was adjusted to 10± 0.1 gm. This was done aseptically, using a flamed spatula. (The balance was wiped inside with

(*)Although sediment suspension was stirred constantly during removal of aliquots for filtration, it was quite difficult to ensure uniform suspension of large particles at all times, and the assumption of 0.025 g wet sediment/ml may be subject to some error (see Statistical Analysis).

70% ethanol prior to use.) Generally, the sediment weight adjustment required removal of sediment from the core. The core (10 ± 0.1 g sediment) was then emptied into sterile Waring Blendor (Model 1120) and the Kim-Kap was rinsed thoroughly with a wash bottle containing sterile buffered H_2O. All rinses were added to the Blendor jar. The volume was increased with sterile buffered water until the agitator in the Blendor jar was just covered (ca. 50 ml). The sample was then blended for 60 seconds. This preparation was poured via a sterile funnel into a 500 ml sterile Florence flask on which 400 ml was marked. The Blendor jar and funnel were then rinsed into the Florence flask to transfer any residual sediment. The total volume was brought to 400 ml SS. Thus a 10 ml aliquot of SS was assumed to contain 0.25 g wet sediment.[1] A sterile magnetic stirring rod was added and the sample was processed as soon as possible. The sample was always stirred with a magnetic stirrer on a magnetic plate centered so that sediment was at maximum suspension during removal of aliquots to enhance desorption and suspension of bacteria. Processed sediment (SS) was stored at 5° C for replicate filtration, but was not used after 3 days of storage.

IV. MEMBRANE FILTRATION

Membrane filtration (MF) of SS was performed according to Standard Methods [4] with the modification that SS was stirred constantly during removal of aliquots for filtration. Large bore sterile pipettes were used for transfer of SS aliquots to 0.45 µm pore membrane filters (MF, Millipore Corp., Bedford, Mass.) to enhance rapid delivery and minimize sediment deposition in the pipette (this becomes a problem with sandy, larger grain sediment). Small volumes of SS were introduced into 10 ml of sterile buffered H_2O in the sterile filter holders. Sterility of filter holders was controlled for each dilution series of filtrations per sediment sample by pre-rinse and post-rinse with sterile buffered H_2O. If either pre-rinse or post-rinse MF showed colonies, results were discarded, or if colony counts on these controls were low (a few colonies per filter) these counts were subtracted from sample counts, but this was a rare problem.

V. ANTIMICROBIAL AGENTS USED FOR SELECTION OF RESISTANT BACTERIA

The rationale for the choice of antimicrobial selective agents will be discussed elsewhere in this report. Buffered $HgCl_2$ was introduced into sterile molten media to give a concentration of 5×10^{-4} M for initial isolation on Trypticase Soy Agar (TSA) and 1×10^{-3} M for initial isolation

on mFC[5] or reisolation on TSA (sensitivity testing with 14 laboratory stock cultures used as controls indicated that mFC agar required a higher concentration of Hg^{2+} for full inhibition of control cultures). For antibiograms, sterile filter paper discs (BBL) were impregnated with pH adjusted buffered 10^{-2} M $HgCl_2$ and 10^{-2} M $K_2Cr_2O_7$. $Pb(NO_3)_2$ 10^{-1} M (pH 4.3) and $CuSO_4$ 10^{-1} M (pH 4.4) for sensi disc impregnation could not be buffered because of precipitate formation. Therefore, control discs adjusted to the same pH were used to monitor pH toxicity. The potencies of antibiotic discs (BBL or Difco) used for the antibiotic spectrum of isolates is as follows:

E = erythromycin	15 mcg	
NA = nalidixic acid	30 mcg	
TE = tetracycline	30 mcg	
A = (chlortetracycline) (aureomycin)	30 mcg	
S = streptomycin or dihydro-streptomycin	10 mcg	
AM = ampicillin	10 mcg	
GM = gentamicin	10 mcg	
K = kanamycin	30 mcg	
C = chloramphenicol	5 mcg	resistance to this potency is not too significant and a substitution to C 30 was made (see Table 6, isolates A42 - E61b)
CR = cephalothin	30 mcg.	
Cl = colistin	10 mcg.	(Table 6, isolates of 8/9 samplings only)
G = gantrisin (sulfisoxazole)	1 mgm	(this is not an antibiotic but is a chemotherapeutic drug used for many urinary infections)

Antimicrobial analysis of isolates is still in progress, and multiresistant clones are being checked as R Factor donors by conjugation with S. gallinarum 244.[1-3]

Stock solutions of crystalline tetracycline (TE) purchased from Sigma Chemical Co. or Lederle (American Cyanamid Co.) were found to form precipitates on refrigeration storage and therefore we attempted to substitute the antibiotic chlortetracycline (Chl) which is known to give a similar inhibition spectrum. However, we found that the instability of chlortetracycline in supplemented media required constant monitoring for potency. As a result, we reverted to the use of tetracycline but maintained stock solutions at lower concentration, i.e., 400 mcg TE·HCL/ml. 10 ml of this stock solution was added

to 90 ml of melted media to give a concentration of 40 mcg/ml. Thus, either Chl or TE is indicated for initial antibiotic resistance selection, but TE was used for resistant isolates.

VI. DETERMINATION OF BOUND WATER

Cores containing 10± 0.1 g of wet sediment from each station were dried in an oven at approximately 100° C for several days to constant temperature and weighed after storage in a desiccator at ambient temperatures. Dry weights and bound water (i.e., loss of weight on desiccation) are shown in Table 4.

VII. RECOVERY AND VIABILITY STUDIES: *E. coli* ATCC 11303 IN STERILE SEDIMENT

1. Sediment Inoculation

20 gm (wet weight) sediment was taken from a large plastic core obtained from MESA station 34 (received as frozen core from Dr. Thomas, trip of 5/21/74). This was dried overnight in an oven at 140° C to constant dry weight at 13.9 g and sterilized by autoclaving. To this dry sediment were added 5.1 ml of sterile distilled H_2O and 1.0 ml of *E. coli* ATCC 11303 incubated in trypticase soy broth (TSB) for 20 hrs. at 37° C. The thick slurry was mixed thoroughly (by hand) with a sterile spatula. At 0 time, viable counts were made on the TSB culture and on the inoculated sediment (see following section).

2. Sediment Processing for Recovery Studies

Half the inoculated sediment (approx. 10 g wet weight) was frozen in the ice tray of a household refrigerator (approximately - 10° C) and half was refrigerated at 5° C. Viable counts were determined at the times listed under "Results" according to the following procedures:

1. 1.0 g of the inoculated sediment was suspended in a total volume of 99 ml buffered sterile H_2O.

2. After vigorous hand shaking, a sterile stirring rod was added and stirring continued at maximum speed on a magnetic stirrer.

3. A sample of one ml was removed from the bottom of the flask, during stirring, for viable count dilutions. The results are recorded under "unblended sample." (Table 9)

4. The same sample was now placed in a Waring Blendor (Laboratory Supply Co., Inc., Hicksville, N.Y. 11801, Model 228.1.00), agitated for 1 minute, and 1 ml was removed for viable count dilutions. The results are recorded as counts from "blended sample." (Table 9)

5. Aliquots of the frozen inoculated sediment were thawed and processed at 3, 4 and 7 days for viable counts. The original TSB culture was stored at 5° C and assayed as a control for viable cells at the same time. (Table 9)

RESULTS

1. Incidence of Hg^R and TE^R Bacteria at Stations

Tables 1 and 2 indicate that MESA station 34 contained highly polluted sediment, but no coliforms could be demonstrated in this sediment either by MPN or by filtration of SS and incubation on mFC medium.[5] The highest incidence of resistant bacteria was uniformly found in sediments from this station, and in spite of some variation in the bound water content of these cores (see Table 4), the loss of water following desiccation of these cores is consistently high (3.4-5.3 g) as compared with the small water loss from clean sandy sediment cores (1.6-1.8 g). Average counts indicate an incidence of 4×10^4 Hg^R bacteria out of an average total population of 2.7×10^6, i.e., greater than 1% of the resident bacteria eluted from these sediments were resistant to $HgCl_2$. The average bacterial population resistant to chlortetracycline (Chl) or tetracycline (TE) was lower (1.4×10^4), or less than 1% of the average bacterial density. Table 3 shows that the highest number of resistant isolates was obtained from this station and that the incidence of Hg^R isolates is about double the antibiotic resistant isolates. (40 Hg^R/24TE^R). Station 24+ shows a "pollution profile" similar to station 34, but not as severe, as evidenced by some life in the sediment, less bound water, greater variability and lower incidence in resistant bacteria found in different cores (3×10^4 Hg^R in one core compared with 6.4×10^3 Hg^R in another core from the same grab) and lower numbers of resistant isolates (20 Hg^R/8 TE^R). A comparison of the data for these "pollution parameters" in Tables 2, 3 and 4 indicates a pollution gradient from station 34 to 24+ to 23+. Data for stations 33 and station X are insufficient and somewhat contradictory due to poor sampling conditions (see section on Discussion).

The data for station 39 and alternate dump sites demonstrates that these sediments composed of clean sand, with little bound water, do not harbor resistant bacteria in detectable numbers (even 20 ml of SS from station 39, equivalent to 0.5 g wet sediment, did not show any resistant colonies on selective media, and only 2 Hg^R and 2 TE^R colonies were found by repeated replica plating). In spite of the obvious presence of anaerobic bacteria and black deposits in the sediment from station 93, the assay results (Tables 2, 3 and 4) indicated that

this sediment was free of sewage pollution. Thus the pollution parameters we used permitted differentiation from the "false positive" MPN reactions shown by anaerobes found in the clean sediment of station 93 as contrasted with "false positive" MPN reactions shown by polluted sediments from stations 34 and 24+.

2. Antimicrobial Spectrum of Isolates

Table 3 shows that a small fraction of bacteria which grew on media supplemented with 10^{-3} M $HgCl_2$ or tetracycline antibiotics were examined for antimicrobial spectrum due to time limitations (see Discussion section on problems). Resistant colonies were picked at random from MF culture on selective media or from replica plating[2], and there is not a proportional relationship between colony counts on selective media and number of resistant isolates per station. Nevertheless, where the overall incidence of resistant colonies was highest, i.e., station 34, a greater number of isolates were analyzed. Table 5 shows the antibiogram of Hg^R isolates from station 34 which were also resistant to 3 or more antibiotics. The data indicates the following:

1. Most Hg^R isolates were also resistant to Cu, Cr, and possibly Pb (results obscured by ppt. formation).

2. Five of these Hg^R cultures on initial isolation were resistant to 7 or more antibiotics.

3. Comparison with Table 6 reveals that after repeated transfer for 5 months on solid media supplemented only with Hg, there is evidence of loss of multiple antibiotic resistance, indicating some segregation of genes in the progeny of these bacteria. Such spontaneous segregation of plasmid genes has been demonstrated by other investigators.[7] In 2 cultures, there is evidence of spontaneous mutation for resistance to additional antibiotics. These genetic changes following a relatively short period of storage suggest some degree of genetic instability among some of the resistant bacteria resident in these polluted sediments.

Bathing beach sediment, which visually appeared clean and showed low bound water, revealed the accumulation of some resistant bacteria probably as a reflection of the transient pollution load from swimmers. Thus, the bathing

water showed much higher incidence of resistant bacteria than the bathing sediment (Table 3), as well as coliforms (though in small number, - see Table 2). This is in marked contrast to the water from the sewage dump site, where neither coliforms nor significant numbers of resistant bacteria could be detected within the small number of samples examined (i.e., resistant bacteria are sequestered in the sediment at the sewage dump site).

Table 3 shows that there is a much higher incidence of antibiotic resistant isolates (20 TE^R/23 Hg^R) in bathing water as compared with the ratio at station 34 (24 antibiotic resistant isolates/40 Hg^R). Comparison of Table 5 and Table 8 makes apparent another difference, i.e., the incidence of multiple resistance to antibiotics is much higher among either Hg^R or TE^R resistant isolates from the bathing water than it is from the sediment at station 34. Thus, although direct filtration of water sample yielded only 6 TE^R colonies/ 100 ml bathing water, replica plating of colonies from non-inhibitory media yielded a total of 13 TE^R isolates whose antibiogram showed that 12 of these isolates were simultaneously resistant to 7 or more antibiotics (see Table 8). In contrast, the antibiogram of 18 resistant isolates from station 34 (Table 5) shows that only 13 of the 18 are resistant to TE, and only 5 out of 18 are resistant to 7 or more antibiotics.

3. Recovery Experiment

Results of the recovery and viability experiment are found in Table 9. It will be noted that *E. coli* maintained in TSB at 5°C did not show a marked change in viability for about 4 days' refrigeration (within an intrinsic error of plate counts of about 6%). Blended SS did show some decline in viability on the third day of refrigeration, and therefore SS were usually not assayed after 3 days' refrigeration; but instead, new cores were processed whenever possible. The footnotes to this figure indicate that the filtration of larger particles in the sediment does introduce errors in dilution series, and for that reason an effort was subsequently made to define the inherent error in analysis of SS by filtration of 5 replicate dilutions (see statistical analysis of replicate filtrations below). It appears that the unblended sediment shows better recovery in this experiment than the blended sediment (31.9% vs. 23.4%). This difference cannot be considered significant in terms of one experiment; and, therefore, we

conclude that Standard Methods procedure[4] yields a desorption of 20-30% of resident bacteria in this sediment. Freezing of SS for 3 days does not appear to affect viability of E. coli in this experiment.

4. Statistical Analysis

Table 10 shows the colony counts obtained on 5 MF replicates of SS from station 34. It is evident that the standard deviation for .05 ml and 0.1 ml aliquots of freshly processed cores is low, and the 95% confidence limits for these replicates is less than ±5. However, filtration on 5 and 10 ml of SS, usually necessary to give countable plates on inhibitory media, shows high standard deviation (18.2-23.2) partially due to the presence of larger amounts of particulate matter on the MF. If one compares the counts on TSA + Hg of 10 ml and 5 ml, it is obvious that there is no proportional relationship, and that high density of resistant colonies increases overall counts so that some plates are TMTC after filtration of 10 ml and give very low counts at 5 ml. It is known that many gram-negative mercury resistant bacteria metabolize mercury salts and produce volatile Hg^0. We have demonstrated that growth of resistant strains does reduce the inhibition of $HgCl_2$ supplemented media as follows: We cultured MF containing 10 ml SS from station 34 on TSA + Hg which inhibited growth of the controls, E. coli 11303 and S. gallinarum 244. After prolonged growth of the Hg^R sediment bacteria on the inhibitory media, the MF was removed, and the plates were streaked with the sensitive control strains. It was found that the sensitive strains were not fully inhibited by this metabolized medium. As a result of these observations, an effort was made to read Hg supplemented plates after shorter incubation. Similar observations on the metabolism of mercury compounds to "threshold level" which permit reversion of normal growth by less resistant strains have been recorded,[8] and these gradations in Hg resistance may play a significant ecological role.

DISCUSSION

The results of this investigation show that sediment analysis for bacteria resistant to selected antimicrobials (Hg and TE) yields data which can be used to differentiate polluted sediments (station 34) from control, non-polluted sediments (station 39), and to distinguish natural anaerobic deposits of sulfides (station 93) from the polluted, organic-rich black sediments. Furthermore, the results suggest that the methods developed in these studies may be used as a "biological profile" of sediment pollution, gradients of pollution, and to differentiate between probable sources of pollutants. For example:

1. Site 34 is probably an "old" (see below) sewage sludge dump site characterized by consistently high counts of bacteria resistant to heavy metals and antibiotics, but <u>negligible coliform counts</u>. The sediment is a black, gelatinous paste, showing high volume of bound water, high organic content and general toxicity, with no visible life. Preliminary examination of the antimicrobial spectrum of some of the isolates from station 34 showed that 19% were resistant to Cu, Pb, and Cr salts as well as $HgCl_2$, and to four or more antibiotics. Also, 35% of the isolates resistant to $HgCl_2$ showed intermediate to full resistance to tetracycline.

2. Stations 24+ and 23+ are similar to station 34, but may have experienced more recent or intermittent dumping or may be subject to more sediment movement, since the resistant bacterial counts are more variable. The sediment is not as uniform and shows sand, black gelatinous silt, as well as pieces of debris. The gradation in bound water content, incidence in Hg^R and TE^R populations in these sediments and comparison of Hg^R and TE^R isolate numbers (Table 2 and Table 3) are in general agreement, indicating a pollution gradient from station 34 to 24+ to 23+. The pollution gradient suggests a pattern of sewage sludge movement or deposit radiating from station 34 in a northeasterly direction toward the Long Island transect, but not in a northwesterly direction (note low values for Hg^r bacteria at site X or 22). The absence of detectable coliforms at station 34, and the presence of more than 1% Hg^r non-coliforms (lac^-) in this sediment may be interpreted as indicating "old sewage sludge" or very rapid carry-off of new sludge deposits from this area. Presumably, there has been genetic interchange between resistant bacteria in the sewage sludge and some of the gram-negative bacteria resident in these sediments to enhance selection of resistant

populations in this toxic environment,[36a] but this requires experimental elucidation.

3. Site 39 and the alternate dump sites show sandy sediment in which no resistant bacteria could be demonstrated by MF. Replica plating of vast numbers of colonies yielded a few (insignificant) numbers of resistant isolates from station 39. It is interesting to note that coliforms were found (see Table 2) in one sampling of station 39, although the sediment is clean, coarse sand, and shows no evidence of pollution. The total bacterial counts on non-inhibitory media were about one log. lower than the polluted sites, and there was an abundance of shell fragments. This was considered a control site.

4a. Sediment from the Sandy Hook Bathing Beach gave counts similar to control sites, but replica plating revealed a higher incidence of bacteria resistant to many antibiotics and some heavy metals.

4b. Water taken at several sites in the surf of the Sand Hook Bathing Beach consistently showed coliforms on mFC media and variable low MPN values. This water uniformly yielded higher counts of resistant bacteria than any other water. The antimicrobial spectrum of 12 out of 51 bathing water isolates examined have been found to be resistant to 7 or more antibiotics (Table 8). Such a profile is probably characteristic of recent domestic (human) pollution, and although the pollution levels at these beaches is probably low in comparison to those reported in other bathing beaches,[9-11] it must be emphasized that coliform counts alone gave no indication of additional health hazards which may be present in this bathing water,[9-12] and additional surveillance is suggested.

5. Reliable sediment-surface water samples for MESA stations were obtained only on the trip 8/9/74. (On 7/29/74 trip the line for the Niskin bottle was too short to permit bottom sampling.) TE^R bacteria in small numbers were detected in one deep-water sampling from stations 34 and 24^+, indicating the movement of some resistant bacteria from these sediments into the overlying water. Seasonal currents and marine bacteria feeders undoubtedly enhance such transport of bacteria from the sediments[13] and should be investigated.

6. Other sites show "profiles" intermediate between the control sites (39, alternate dump sites) and the sewage sludge sites 34 and 24^+.

The significant points that emerge from this study are that coliform

counts alone do not adequately reveal possible health hazards present in recently polluted bathing water (human pollution) and are almost meaningless in areas of industrial pollution (heavy metals, hydrocarbons, etc.) or pollution beds in the marine environment. A variety of non-enteric pathogens may be present in recreational waters with low coliform counts.[10-12]

Although there is evidence of rapid die-off of sewage bacteria in marine waters,[13-16] sedimentation and flocculation even in waters with low density coliforms may result in accumulation of polluting bacteria in the sediment.[15] A recent report documents the release of sediment bound sewage bacteria simply as a result of dredging[16] and there is ample evidence that a variety of pathogens and coliforms from sewage are sequestered in sediment often some distance from the sewage deposit, or point of discharge.[15]

The limited sampling from the Sandy Hook Park bathing area demonstrates that although this swimmming area shows low coliform counts and clean surf sand, recent transient pollution contributed to it by the swimmers is immediately detectable in the incidence of multiple antibiotic-resistant bacteria (Table 8). Thus, assay for resistant strains, non-coliforms (lac^-), as well as coliforms (lac^+) seems to be a rather sensitive indicator of <u>recent pollution</u>. The surf action probably prevents these transient resistant bacteria from adsorbing to the surf sediment, and if the daily contribution by swimmers is not excessive, these bacteria probably do not survive for long. However, the fact that they could readily be demonstrated in a bathing area which more than meets present water quality standards, gives emphasis to the need for continued monitoring of <u>all</u> recreational water in the metropolitan marine environment for bacteria resistant to antibiotics.

<u>Problems</u>

1. Although the utmost cooperation was extended to us by personnel at the Sandy Hook Laboratory, there were some problems related to boat scheduling and bad weather, which interfered with sampling in June and July.

2. The NOAA contract specified 5 sampling sites (NOAA stations 36, 1956, 60, 6, and 59) for sediment sampling, as a result of the change to the new MESA grid we found it necessary to survey sediment

from 12 stations. We also attempted to assay water from 7 stations.

3. An additional problem was presented by the apparent change in the resident bacteria found in the polluted sediments since our last sampling in 1972, or the inability to locate the site of recent sewage sludge dumping. Since we had expected to find coliforms in the sewage dump site we concentrated on preparation of coliform media (mFC, BGLB, PRLB, etc. (see Standard Methods[4]). The early results were not very meaningful because many lac^- (non-coliform) bacteria are inhibited by mFC and many lac^+ (non-coliforms, i.e., Clostridia) give false positives in MPN using BGLB or PRLB. It became apparent that the polluted sediments around station 34 could not be assayed on coliform media because coliforms were not present in this sediment or were not desorbed by the Standard Methods blending procedure (see discussion on recovery experiment).

As a result of the above problems, significant data did not become available until the end of July. At that time we had exhausted most of our supplies (media, millipore filters, plates, etc.). In order to continue with the sampling of 8/9, we had to request supplemental funds to cover purchase of additional materials and wages for additional part-time technical help. These were kindly provided as supplemental funds (8/26/74), and we succeeded in obtaining very good data on samples from the 8/9 trip. We still retain a set of frozen cores from that trip for future studies. The results of 8/9 sampling confirmed our confidence in the potential usefulness of our methods to survey pollution gradients in marine sediment.

Recommendations

The results obtained in this study indicate that analysis for antimicrobial resistant bacteria is significant in identifying pollution concentration and gradients. However, before this method is used for additional surveillance, we would recommend the need for some base studies as follows:

1. Desorption Studies (Project I) - We assumed that blending all sediments with a standard buffer (Standard Methods[4]) would desorb resident bacteria. Literature reports[17] suggest that this assumption may be invalid, particularly in relation to changes in surface charges associated with R plasmids.[18] The preliminary recovery experiment performed by us with the inoculation of the ATCC type coliform (*E. coli*

11303) into sterile ~~sandy~~ sediment revealed a desorption of 20-30% of the inoculum. It is obvious, therefore, that basic data must be obtained to insure the optimum ionic suspension for desorption of coliform, and non-coliform bacteria, particularly with further sampling. We, therefore, suggest additional recovery studies using antibiotic^R Hg^R clones and known R donor cultures to determine the optimal ionic suspension for desorption, after inoculating each into sterile sediment from station 34.

2. Sample Storage Studies. The results of one recovery experiment indicated some loss in viability after SS was stored for three days, but we have meager data on the viability of resident bacteria in polluted and unpolluted sediment cores which are storaged at refrigerated temperature or after freezing. Since station location and weather conditions impose serious variables on replication of sampling, it seems desirable that sample storage be studied and defined.

3. Conjugation Under Simulated Marine Conditions. A series of long term viability studies have been recommended previously.[1] Our recent data suggest a transfer of R plasmids* from sewage bacteria to resident bacteria in the sediments at the sewage dump sites but no direct proof of this is available. A laboratory demonstration of such conjugative transfer* in sediment suspension under temperature and salinity conditions similar to that at MESA station 34 would be a first priority and would shed considerable light on the hazards of continued sewage dumping.

4. Statistical Analysis. Although our technique showed reproducible counts of bacterial density on TSA, the error in replicate filtration of larger volumes of sediment cultured on media supplemented with Hg or TE was much greater (see Results), and it would be desirable to continue replicate studies which would permit analysis of variance. Substitution of other inhibitory agents for selection of antimicrobial populations might reduce procedure variance for reasons previously discussed. However, TE was chosen for selection of resistant strains because it is a broad spectrum antibiotic in wide clinical use, and is widely used in feed for poultry, swine, cattle and sheep.[19-20] It is considered very significant as a resistant marker because "the gene that determines this trait is closely linked to the RTF* in most R* factors,"[7] i.e., is readily transferred from donor* to recipient* bacteria. Resistance to mercury compounds has been identified

* See Table 14 for definition of terms.

with plasmids which carry additional antibiotic resistance,[21-25] and it is therefore a convenient marker for screening resistance to antibiotics other than tetracycline, as well as resistance to heavy metals. Because mercury compounds are toxic at very low concentrations, their accumulation in the aquatic environment, particularly through microbial metabolism to methyl-Hg and dimethyl-Hg, and the high concentration of these compounds in fish, this problem has become a world-wide ecological concern.[25a]

5. Potential Biohazard of Resistant Bacteria--Future Sampling. The data reported here fulfills our obligations for sediment analysis as set forth in MESA Contract No. 03-4-043-337. The pollution gradients demonstrated suggest the movement of sediment containing antimicrobial resistant bacteria from the sewage dump site (station 34) in a northeasterly direction toward the Long Island shore. Recent studies indicate that antimicrobial resistant bacteria may be disseminated through marine environments by currents,[9,26] shellfish,[10,26] sediment dislocation,[16] fish,[27-29] and other marine organisms.[10,26] They have been associated with disease in fish[27-29] and increasingly with water borne epidemics in man.[10,31,37-39] Recent reports indicate that ocean bathing water may contain large numbers of bacteria showing multiple antibiotic resistance,[9,10] that "oysters from approved water may contain 14-28 R coliforms per 100 ml,"[10] and that an estimated 10 ml accidental water intake during bathing, may result in ingestion of 2 R+ coliforms*.[10] R+ coliforms readily transfer the genetic capacity for multiple resistance to many gram negative pathogens of widely different genera.[7,10,21-23,30-33] The isolation from marine waters of R plasmid* E. coli which transfer resistance to human pathogens has been documented[10,26] and the transfer of R plasmids* from fish pathogens (particularly plasmids coding for TE^R) has been reported.[27-29] The role of hemolytic strains of Aeromonas hydrophila in human infections, particularly in hospital acquired septicemia, has become a matter of some concern.[34] Watanabe and co-workers[29] identify A. hydrophila as synonymous with A. liquefaciens, and although it is not clear whether antibiotic resistant strains from fish could infect humans, there is ample evidence that coliforms within our alimentary tract could mobilize transfer of antibiotic resistance[30] to a wide variety of pathogens. It might be well to point out that Aeromonas sp.

* See Table 14 for definition of terms.

and many of the other opportunistic pathogens involved in nosocomial infections are gram negative non-lactose fermentors which were not considered human pathogens until the recent increase in drug resistant infections became apparent.[39,31]

In terms of human health hazard, it is significant that sewage treatment processes fail to eliminate pathogens from the effluent,[13,15] although chlorination may reduce the numbers "below demonstrable densities."[35] Sturtevant and Feary found that approximately 1% of coliforms in raw and treated sewage are multiple resistant and that sewage treatment failed to reduce the incidence of R plasmid bacteria which transferred multiple antibiotic resistance.[36] Studies on drug resistant coliforms in sewage maturation ponds indicate that there is a marked increase ("three-fold enrichment") in R+ bacteria in the ponds, and suggest low level transfer of R factors among bacteria in these toxic environments.[36a] In a recent epidemic of shigellosis among swimmers in the Mississippi River,[37] isolates from most of the patients implicated Shigella sonnei showing multiple antibiotic resistance, and it was emphasized that ingestion of small numbers of shigella organisms from swimming water could cause disease. The antibiogram of the shigella isolated from patients was the same as that of S. sonnei isolated from the outflow of a sewage disposal plant 5 miles downstream. Multiple resistant shigella have also been implicated in a water borne infection in India.[38]

In commenting on recent widespread water borne epidemics of antibiotic resistant strains of Salmonella typhi, Shigella dysenteriae strain-1, and Shigella flexneri 2a (which were responsible for 12,500 deaths in Quatemala during the first year of the pandemic), investigators from CDC[39] warn "that as few as 10 Shiga organisms are capable of causing dysentery in humans." They suggest that "in addition to mediating multiple drug resistance, the epidemic R factor demonstrated in these outbreaks may be associated with other independent, or possible linked transfer factors of a yet undefined character that may enhance the virulence of enteric pathogens." They point to the identification of transferable plasmids in E. coli which code for enterotoxin production and enhanced virulence.[40] In view of the increasing biohazard of ecological concentration and distribution of R plasmids bacteria and perhaps undefined associated genetic elements which have only been recognized recently,[41,42,42a]

the need to monitor the incidence of antimicrobial resistant bacteria in the New York Bight seems quite imperative.

Specifically, we recommend:

1. Analysis of sediments and overlying water column for concentration of bacteria resistant to TE and Hg at selected stations from MESA station 34 leading to Long Island beaches along the Long Island transect.

2. Similar analyses of surf zone sediment and water at selected beach areas as follows:

a) beach area with high density swimming population, but no other evidence of pollution (i.e. controlled rain water run-off and no sewage discharge)

b) beach area suspected of other local pollution (i.e. run-off, sewer outlets, or sewage treatment discharge)

c) beaches influenced by Hudson River outflow

These data should aid in defining the public health hazard of the sewage dump site sediments and to fingerprint the actual sources of beach pollution in these areas in the New York Bight.

3. Basic studies on viability, optimal desorption, and transferability, *in situ*, of plasmid genes from multiresistant bacteria resident in sediments from the New York Bight.

References Cited

1. Koditschek, L. K., & P. M. Guyre (1972). "Antimicrobial-Resistant Coliforms Isolated from Sewage Dump Site in the New York Bight." Report Submitted to Sandy Hook Marine Laboratory, NOAA Contract No. N-043-48-72.

2. Koditschek, L. K., & P. Guyre (1974). "Antimicrobial-Resistant Coliforms in New York Bight," Marine Poll. Bull. 5: #5, 71-74.

3. Koditschek, L. K., & P. Guyre (1974). "Resistance Transfer Fecal Coliforms Isolated from the Whippany River," Water Res. 8:747-752.

4. Standard Methods for the Examination of Water and Waste Water, Including Bottom Sediments and Sludges (1971). 13th ed. American Public Health Assoc., Inc., New York.

5. Geldreich, E. E., H. F. Clark, C. B. Huff, & L. C. Best (1965). Fecal Coliform Organism Medium for the Membrane Filter Technique. J. Am. Water Works Assoc., 57:208-214.

6. Bauer, A. W., W. M. M. Kirby, J. C. Sherris, and M. Turck (1966). "Antibiotic Susceptibility Testing by a Standardized Single Disc Method," Am. J. Clin Path. 45, #4:493-496.

7. Davies, J. E., & R. Rownd (1972). "Transmissible Multiple Drug Resistance in Enterobacteriaceae," Science, 176:758-768.

8. Vaituzis, Z., J. D. Nelson, Jr., L. W. Wan, & R. R. Colwell (1975). "Effects of Mercuric Chloride on Growth and Morphology of Selected Strains of Mercury-Resistant Bacteria," Appl. Microb. 29: # 2:275-286.

9. Smith, H. W. (1971). "Incidence of R^+ Escherichia coli in Coastal Bathing Waters of Britain," Nature 234, # 5325, 155-156.

10. Grabow, W. O. K., O. W. Prozesky, & L. S. Smith (1974). "Drug Resistant Coliforms Call for Review of Water Quality Standards," Water Res. 8, 1-9.

11. Cabelli, V. J., M. A. Levin, A. P. Dufour, & L. J. McCabe (1974). "The Development of Criteria for Recreational Waters," to be presented at Int'l. Symposium on Discharge of Sewage from Sea Outfalls, London, August 28.

12. Dutka, B. J. (1973). "Coliforms Are an Inadequate Index of Water Quality," J. Env. Health, 36, #1, 39-46.

13. Buelow, R. W. (1968). "Ocean Disposal of Waste Material," Trans. Nat'l. Symposium Ocean Sci. & Engineering of the Atlantic Shelf, March 19-20, pp. 311-337.

References Cited (Continued)

14. Carlucci, A. F., & D. Pramer (1960). "Evaluation of Factors Affecting the Survival of Escherichia coli in Sea Water I, II, III," Appl. Microbiol., 8:243-255.

15. Rittenberg, S. C., T. Mittwer, & D. Ivler (1958). "Coliform Bacteria in Sediments Around Three Marine Sewage Outfalls," Limnol. & Oceanog. 3, 101-108.

16. Grimes, D. J. (1975). "Release of Sediment-Bound Fecal Coliforms by Dredging," Appl. Microbiol. 29:109-111.

17. Roper, M. M., & K. C. Marshall (1974). "Modification of the Interaction Between Escherichia coli and Bacteriophage in Saline Sediment," Microb. Ecol., 1:1-13.

18. Zzigray, R. M., G. E. Fulk, & W. D. Lawton (1970). "Separation of Donor and Recipient Bacteria by Column Chromatography," J. Bacteriol., 103, #2:302-304.

19. Department of Health, Education & Welfare, FDA 1972. "Antibiotics and Sulfonamide Drugs in Animal Feeds. Proposed Statement of Policy," Federal Register, Feb. 1, 1972:37 FR 2444.

19a. _____ (1972). Report 72-6008 and Appendices.

20. Report of the Joint Committee (1969). "On the Use of Antibiotics in Animal Husbandry and Veterinary Medicine." London, Her Majesty's Printing Office.

21. Dulaney, E. L., & A. L. Laskin, eds. (1971). "The Problems of Drug Resistant Pathogenic Bacteria," Ann. N.Y. Acad. Sci. 182.

22. Kroměry, V., L. Rosival, T. Watanabe, ed. (1972). "Bacterial Plasmids and Antibiotic Resistance," 1st Int'l. Symp. Infectious Antibiotic Resistance, Springer-Verlag, N. Y.

23. Novick, R. F. (1969). "Extrachromosomal Inheritance in Bacteria," Bacteriol. Rev. 33:2:210-263.

24. Smith, D. H. (1967). "R Factors Mediate Resistance to Mercury, Nickel and Cobalt," Science, 156:1114-1116.

25. Summers, A. O., & S. Silver (1972). "Mercury Resistance in a Plasmid-Bearing Strain of Escherichia coli," J. Bacteriology, #122:1228-1236.

25a. Ackefors, H., G. Löfroth, & C. G. Rosen (1970). "Survey of the Mercury Pollution Problem in Sweden with Special Reference to Fish," Oceanogr. Mar. Biol. Ann. Rev., #8:203-224.

References Cited (Continued)

26. Feary, T. W., A. B. Sturtevant, & J. Lankford (1972). "Antibiotic-Resistant Coliforms in Fresh and Salt Water," Arch. Environ. Health, #24:215-220.

27. Aoki, T., S. Egusa, T. Kimura, & T. Watanable (1971). "Detection of R. Factors in Naturally Occuring Aeromonas salmonicida Strains," App. Microbiol. #22:716-717.

28. Aoki, T., S.Egusa, Y. Ogata, & T. Watanab (1971). "Detection of Resistance Factors in Fish Pathogen Aeromonas liquebaciens," J. Gen. Microbiol. #65:343-349.

29. Watanabe, T., T. Aiki, Y. Ogata, & S. Egusa (1971). "R Factors Related to Fish Culturing," Ann. N. Y. Acad. Science, #182:383-410.

30. Anderson, E. S. (1965). "A Rapid Screening Test for Transfer Factors in Drug-sensitive Enterobacteriaceae," Nature, #208:1016-7.

31. Anderson, E. S. (1968). "The Ecology of Transferable Drug Resistance," Ann. Rev. Microbiology, #22:131-180.

32. Watanabe, T. (1963). "Infective Heredity of Multiple Drug Resistance in Bacteria," Bacteriol. Rev., 27:#1:87-115.

33. Anderson, E. S., & H. R. Smith (1972). "Chloramphenicol Resistance in the Typhoid Bacillus," Br. Med. J. #3,329-331.

34. Ketover, B. P., L. S. Young, & D. Armstrong (1973). "Septicemia Due to Aeromonas hydrophila: Clinical and Immunologic Aspects," J. Inf. Dis. 127, #3:284-290.

35. Kabper, P. (1959). "Removal of Pathogenic Microorganisms by Sewage Treatment Processes," Sewage & Ind. Waste #31:1373-1381.

36. Sturtevant, A. B., Jr., & T. W. Feary (1969). "Incidence of Infectious Drug Resistance Among Lactose-Fermenting Bacteria Isolated from Raw and Treated Sewage," Appl. Microb. 18, #3:918-924.

36a. Grabow, W. O. K., Middendorff, I. G., and Prozesky, O. W. (1973)"Survival in maturation ponds of coliform bacteria with transferable drug resistance," Water Research #7:1589-1597.

37. Shaeffer, J., & R. A. Moriarity (1974). "Shigellosis Associated with Swimming in the Mississippi River," Morb. Mort. 23, #46:399.

38. Day, P. M., T. Laskaris, R. R. Sachs, I. Kamei, & J. Chin (1974). "Multiple Antibiotic Resistance in Shigella Dysenteriae-1 from India," Morb. Mort. 23,#48:416.

References Cites (Continued)

39. Gangarosa, E. J., J. V. Bennett, C. Wyatt, P. E. Pierce, J. Olarte, P. M. Hernandes, V. Vazquez, & M. D. Bessudo (1972). "An Epidemic-Associated Episome?" J. Infec. Dis. 126, #2:215-218.

40. Smith, H. W., & M. A. Linggood (1971). "The Transmissible Nature of Enterotoxin Production in a Human Enteropathogenic Strain of Escherichia coli," J. Med. Microbiol. 4:301-305.

41. Berg, P., D. Baltimore, H. W. Boyer, S. H. Cohen, R. W. Davis, D. S. Hogness, D. Nathans, R. Roblin, J. Watson, S. Weissman, & N. D. Zinder (1974). "Potential Biohazards of Recombinant DNA Molecules," Science 185:303.

42. Wade, N. (1974). "Genetic Manipulation: Temporary Embargo Proposed on Research," Science 185:332-334.

42a. Schlessinger, D. (1975) '' First ASM Conference on Extrachromosomal Elements in Bacteris'', inMicrobiology- 1974, ASM, Washington, D.C.

APPENDIX:

Figure 1

Tables 1-15

Acknowledgments

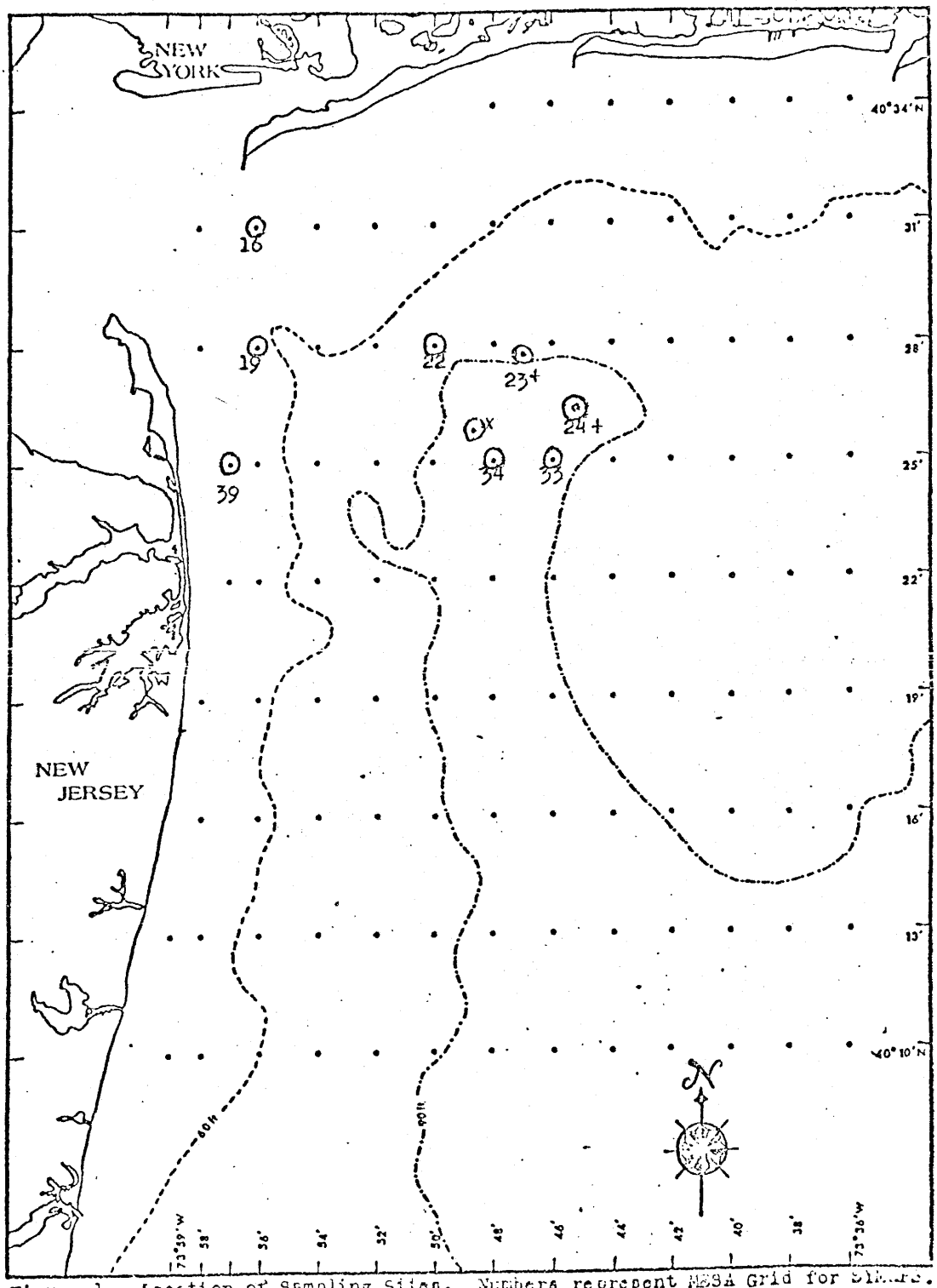


Figure 1. Location of Sampling Sites. Numbers represent MESA Grid for Stations. (see table 1 and text)

Table 1*

SUMMARY OF SAMPLING

Date of Trip	MESA St.*	LORAN	Lat.-Long.	Water Depth	Character of Sample
6/26 Sed. sample Fr[a] & R[a]	Alt. Dump sites 62	NA[b]	39°41'N x 73°20.4'W	19.4 Fathoms	Coarse clean sand + shell fragments
	93	NA[b]	40°12.8'N x 72°44.6'W	30 Fathoms	Fine gray-black sand, uniform grain size, smell of H_2S
7/11[c]	16	5616-3289	40°31'N x 73°56'W	24'	Sand, not visibly high in organic matter
7/11[c]	19	4593-3299	40°28'N x 73°56'W	40'	"
7/19[c]	"	"	"	40'	"
7/29	"	"	"	38'	
7/11[c] Sed. sample	22	4627-3244	40°28'N x 73°50'W	68'	Coarse sand, rich in organic matter, no evident benthic fauna
7/29 Sed. sample	"	"	"	72'	"
7/29 Water sample	"	"	"	40'	Water not at full depth
8/9 (2 grabs)	23+	4645-3216	40°28'N x 73°47'W	84'	Sand not homogeneous, some evidence of pollution, but great diversity of resident species (benthic insects, snails, sea anemones, Nereis + tubes), etc.
Sed. samples: D&F (Fr) E&G (R)		"	"		
Water samples H & I	"	"	"	84'	Overlying water

* Footnotes for this table appear at the end of the table on page 4. The station numbers from Standard MESA SYMAP; location kindly verified by Dr. J. P. Thomas, Sandy Hook Laboratory, Highlands, New Jersey.

Table 1 (Continued)

Date of Trip	MESA St.	LORAN	Lat.-Long.	Water Depth	Character of Sample
7/29 Sed. sample	24+ Site between MESA St. 24 & 33	4642-3203	40°27'N x 73°45'W	92'	Slightly sandy black-mayonnaise; polluted sediment: oxidized top layer, polychaete worms and snails similar to species associated with sludge
Water sample	Obs. sludge barges			40'	Water not at full depth
8/9 (2 grabs) Sed. samples (D&F (Fr)[a] (E&G (R)	24+	4642-3203	40°27'N x 73°45'W		Same as above; evidence of pieces of aluminum foil and other garbage debris
Water sample	"			92'	Full depth water sample
7/11[c] Sed. sample	X	4618-3236	40°26'N x 73°49'W between st. 22 & 34	90'	Some evidence of pollution
7/11[c]	33	4625-3210	40°25'N x 73°46'W	102'	Dark sediment, prob. H_2S
7/19[c]	"	4625-3210	"	98'	Some evidence of pollution

Table 1 (Continued)

Date of Trip	MESA St.	LORAN	Lat.-Long.	Water Depth	Character of Sample
5/21/74 Sed. sample Fr[a]*	34	4616-3227	40°25'N x 73°48'W	NA[b]	Coarse and fine sand with high organic content. Some benthic fauna present
7/11[c] Sed. sample	34	4615-3227	40°25'N x 73°48'W	108'	Gelatinous polluted silt, black-mayonnaise, no visible organisms or remains of life
7/19[c] Sed. samples	"			NA[b]	
7/29 (2 grabs)	34	"	"	120'	Same
Sed. samples: A = surface cores B = cores from interior of grab					
K = sediment (R[a] for 21 days)					
Water sample				surface water	
8/9 (2 grabs)	"	"	"	112'	Same
Sed. samples: E (R) 1st grab G (R) 2nd grab					
D (Fr 12 days)[a]					
F (Fr) Water sample	"			112'	Full depth water sample

* Frozen cores obtained from Dr. Thomas (Delaware II). This sediment did not appear as visibly polluted as the other sediment samples from MESA St. 34 obtained by us on the Rorquel on 7/11, 7/19, 7/29 and 8/9.

Table 1 (Continued)

Date of Trip	MESA St.	LORAN	Lat.-Long.	Water Depth	Character of Sample
7/19) Sed. Samples	39	4558-3312	40°25'N x 73°58'W	22'	Clean sand, shells
7/29)	"	"	"	25'	Clean sand
Water sample				25'	Full depth
8/9 (2 grabs)	39	4558-3312	40°25'N x 73°58'W	32'	Clean sand, shells
Sed. samples:					
D (Fr) 1st grab[a]	"	"	"	"	
E (R) 1st grab					
F (Fr) 2nd grab	"	"	"	"	
G (R) 2nd grab					
Water sample	"	"	"	"	Full depth
7/29 Sed. samples	BS*	NA[b]	NA[b]	app. 2'	Surf sand & small pebbles obtained with large cores; difficult to obtain uniform samples due to surf action
7/29 Water samples	BW**	"	"	Surface water	
8/9 Sed. samples	BS	"	"		
E (R)&(Fr)[a]	"			app. 6'	"
F	"			app. 6'	
H	"			app. 6'	
8/9 Water samples:					
E	BW			Surface water	
F	BW				
G	BW	"	"	"	
H	BW			"	

Footnotes

(a) Fresh refrigerated (R) samples were examined except where samples are designated as frozen (Fr). Sediments are surface cores (except when otherwise designated). 35 mm plastic cores or 20 mm sterile Kim-Kap cores were used. Frozen cores for stations 24+, 34, 39 & BS are in storage since 8/9/74 awaiting future processing.

(b) NA = data not available.

(c) Bad seas hampered sampling.

* BS = surf sediment from several locations at Sandy Hook State Park where people were swimming.

** BW = water from several locations at Sandy Hook State Park where people were swimming.

Table 2

SUMMARY OF SAMPLES EXAMINED

Date of Trip	MESA St.	Temp. of Dredged Sed.	MPN	mFC	Hg^R (d)	Chl^R or TET^R (d)	Bacterial Density (e)
6/26 Sed. samples Fr & R (a)	Alt. Dump sites						
	62	9.5°C	< 2 (f)	ND (g)	ND	ND	(St. 62) Overgrowth on TSA; $1x10^6$ on marine agar (many pigmented colonies)
	93	10.5°C	< 2 (f) AN (h)	ND	ND	ND	$9.2x10^4$ - $1x10^5$
7/11 (c)	16	16°C	< 2	Insig. (g)	Insig.	NA (h)	$1x10^6$
7/11 (c)	19	15°C	< 2	Insig.	Insig.	NA (h)	$9.8x10^4$
7/19 (c)	19	18.5°C	13	Insig.	ND	ND	$1.2x10^5$
7/29	19	20°C	2	Insig.	ND	ND	est. $4x10^4$
7/11 (c)	22	12.5°C	8-11	est. $3.4x10^4$	ND	ND	est. $1.2x10^5$ many spreader colonies
7/29	22	18°C	< 2	Insig.	ND	ND	many spreader colonies $1.5x10^6$
8/9 (2 grabs) Sed. samples: E=(R) 1st grab	23+ Site between MESA St. 23+24	11.5°C	< 2		est. $5x10^3$ many spreaders	est. $6x10^3$	$1.3x10^6$
*G=(R) 1st grab					est. $8x10^3$ many spreaders	est. $4x10^4$	$1.4x10^6$
Water samples		-	< 2	ND	ND	Insig.	$1.9x10^3$ $2x10^3$

* New core processed.

Footnotes for Table 2, see pp.4-5 of Table 2.

Footnotes (a) to (c) same as in Table 1.

Table 2 (continued)

Date of Trip	MESA St.	Temp. of Dredged Sed.	MPN	mFC	$Hg^{R(d)}$	$Chl^{R(d)}$ or TET^{R}	Bacterial Density(e)
7/29 Sed. sample	24+ Site between MESA St. 24 & 33	15°C	< 2	ND	$2x10^4$-$1.1x10^5$	est. $3.6x10^3$ $3.4x10^4$	$1.6x10^6$ $1.7x10^6$ $3x10^6$
Water sample	Obs. sludge barges	NA	<2	Insig.	Insig.	Insig.	$4.2x10^3$
8/9(2 grabs) Sed. samples (D&F (Fr) (E&G (R)	24+	12°C))))	<2	ND	$3. x10^4$ $*6.4x10^3$ $1.8x10^4$ est. $4. x10^4$	$3.3x10^4$ $*9.6x10^3$ est. $1.2x10^4$	$2.8x10^6$ $2.6x10^6$ $2.3x10^6$
Water samples H&I		NA	<2-2	ND	ND	est. 27	$3.3x10^3$
7/11(c) Sed. sample only	X	12°C	2(f)	ND	est. $4x10^3$	Over-growth	Overgrowth est. $1x10^7$
7/11(c) Sed. samples only	33	12°C	<2(f)	ND	> $4x10^4$(i)	Insig.	TMTC
7/19(c)	"	11.5°C	*<2	ND	*TMTC(i)	Insig.	$2.5x10^6$

* New core processed.

Table 2 (continued)

Date of Trip	MESA St.	Temp. of Dredged Sed.	MPN	mFC	Hg^R (d)	Chl^R or TET^R (d)	Bacterial Density (e)
5/21/74 Sed. sample Fr (a)	34	NA	<2 (f)	ND (g)			$2.3x10^6$
	This sample was processed only on mFC media and MPN because we expected to find coliforms.						
7/11 (c) & 7/19 (c)	34	12°C	<2 (f) AN (h)	ND	$2.7x10^4$	Insig. (j)	$8x10^7$ $2.7x10^6$ $2.4x10^6$
7/29(2 grabs) Sed. samples: A = surface cores	34	14°C					
			<2(LTB) (k)	ND	est. $5.6x10^3$	$1.4x10^4$	$5.4x10^7$
			<2(LTB)		est. $9.6x10^4$	Insig. (j)	$2.9x10^6$
B = cores from interior of grab					$2.2x10^4$ $8. x10^4$	$2.4x10^4$ $2.3x10^4$	$2.8x10^6$ $2.7x10^6$
*K = sediment (R for 21 days)			-	ND	TMTC, $1.1x10^5$	est. $3.6x10^4$	$3.4x10^6$ $3.2x10^6$
Water sample		-	-	ND	ND	ND	est. 80
Sed. samples: 8/9(2 grabs)		11°C					
E (R) 1st grab			<2 (LTB)	ND	>$4x10^3$, est. $1.3x10^4$	$2.1x10^4$	$3x10^6$
G (R) 2nd grab			<2(LTB)	ND	$6x10^4$	$1.9x10^4$	$2.7x10^6$
D (Fr 12 days)			<2(LTB)	ND	$3.5x10^4$	$2.1x10^4$	$4.8x10^6$
Water sample			<2-2(LTB)	ND	est 8	est 14	$5.3x10^3$ $4.7x10^3$ $9.3x10^3$

* New core processed.

Table 2 (continued)

Date of Trip	MESA St.	Temp of Dredged Sed.	MPN	mFC	Hg^R (d)	Chl^R or TET^R (d)	Bacterial Density (e)
7/19 (e) Sed. sample	39	17°C	79	est. $3x10^3$	ND	ND	$3.4x10^5$
7/29	39	20°C	< 2	ND	ND	ND	$3.7x10^5$
Sed. sample			< 2	ND	ND	ND	$5.2x10^4$
Water sample		NA	-	Insig.	ND	ND	est. $1.8x10^3$
8/9	39						
2 grabs		18.8°C	< 2				
Sed. samples:							
D (Fr) 1st grab	"	"					
E (R) 1st grab			< 2	ND	ND	ND	$1.6x10^4$
F (Fr) 2nd grab	"	"					
G (R) 2nd grab		"	< 2	ND	ND	ND	$2.4x10^4$ $9.6x10^3$
Water sample	"		13, < 2	est. 32/100 ml	ND	Insig. (4/100 ml)	est. $1.8x10^4$
7/29	BS (l)		< 2, < 2	ND	ND	ND	$1.7x10^5$
8/9							
Sed. samples	BS						
E			2	ND	ND	Insig. (2/10 ml SS)	$3.1x10^6$
F			2	ND	ND	Insig.	$1.8x10^5$
H			2	ND	ND	Insig.	$7.2x10^5$
7/29	BW (m)		49	56	Insig. (4-6/100 ml)	est. 35 lac^+ / $6.9x10^2$ lac^-	$1.6x10^4$
8/9							
Water samples:							
E	BW		11	28	ND*	est.* 3 lac^+*	est.* $5.8x10^3$ many spreaders
F	BW		26	Insig.	ND*	est 6*	$1.6x10^3$*
G	BW		33	NA	NA	NA	NA
H	BW		7	Insig.	ND*	27	$2.3x10^3$*

Footnotes (a)-(c) same as in Table 1.

(d) Hg^R colony counts on TSA supplemented with mercuric chloride (see Materials & Methods); Chl^R or TE^R colony counts on TSA supplemented with chlortetracycline or tetracycline.

(e) Bacterial Density - range or av. no. colonies/100 g sediment or 100 ml water.

(f) False Positive MPN - acid & gas (A/G) in BGLB and PRLB but no confirmed coliforms.

(g) ND - none detected in 10 ml SS (0.25 g wet sediment).
Insig. less than 10 colonies/10 ml SS.

Footnotes continued:

(h) AN - evidence of anaerobic growth.

(i) Countable plates not obtained because at 5 ml SS plates would show too (TMTC) many to count, but at lower conc. no colonies appeared (see text).

(j) Doubtful significance because chlortetracycline was unstable in medium.

(k) LTB = Lauryl tryptose broth gave no false positives.

(l) BS = surf sediment from several locations at Sandy Hook State Park where people were swimming.

(m) BW = water from several locations at Sandy Hook State Park where people were swimming.

* Replica plating from TSA plates revealed a number of Hg^R + TE^R isolates (Table 5)

Table 3

NUMBER OF RESIDENT ISOLATES EXAMINED PER STATION

MESA Station	Hg^R	Chl^R or TE^R
62	ND[b]	ND
93	ND	ND
16	ND	ND
19	7	2
22	ND	3
23+	12	4
24+	20	8
X	5	1
33	6	1
34	40	24
39	2[a]	2[a]
BS	5	3
BW	23	20

[a] Found in only 1 SS by replica plating from TSA colonies only.

[b] ND = none detected.

Table 4

COMPARISON OF WATER LOSS FROM 10 g ALIQUOTS OF WET SEDIMENT

MESA St. Sample	Date Sampled	Sample Designation	Dry Weight	Water Loss on Desiccation: Individual Cores	Water Loss on Desiccation: Range
19	7/19	-	8.1 g	1.9 g	
	7/29	A	8.1 g	1.9 g	1.9-2.0 g
	7/29	B	8.0 g	2.0 g	
22	7/29	A	7.1 g	2.9 g	2.9-3.2 g
	7/29	B	6.8 g	3.2 g	
23+	7/29	A	7.1 g	2.9 g	2.9-3.4 g
	7/29	B	6.6 g	3.4 g	
23+	8/9	E	7.1 g	2.9 g	
	8/9	G	6.3 g	3.7 g	
24+	8/9	E	6.6 g	3.4 g	2.8-3.7 g
	8/9	G	7.2 g	2.8 g	
33	8/19	A	5.2 g	4.8 g	one value available
34	7/19	A	4.7 g	5.3 g	
	7/19	B	6.1 g	3.9	
	7/29	A	5.2 g	4.8	3.4-5.3 g
	7/29	B	6.6 g	3.4	
	8/9	D	4.8 g	5.2	
		E	6.3 g	3.7	
39	7/19	A	8.3 g	1.7 g	1.7-1.8 g
	7/29	A	8.2 g	1.8	
BS	7/29	-	8.4 g	1.6 g	
BS	8/9	E	8.3 g	1.7	1.6-1.7 g
	8/9	F	8.4 g	1.6	

Antibiograms Performed on Some Isolates Recently Resident in Polluted Sediments
Mercury Resistant Isolates from St. 34 Showing Multiple Antibiotic Resistance[a]

Date Sampled	Isolate No.	Antibiotic[b] Resistance										Metal Resistance[b]			
		E	NA	TE	A	S	AM	GM	K	C	G	Hg	Cr	Cu	Pb
7/19/74	05	R[d]	R	R	R		R			R	R	R	R	R[c]	R[c]
	A 01				R		R			R	R	R	R		
	A 04		I[d]		I		I			I	I	R			
	A 06	R		I			I			R		R	R	R	R[c]
	A 07		I	I			R			R		R			
	A 09			R			R			R		R		R	
	A 13			R			R			R	R	R	R	R	R[c]
	A 14		I	I							R	R	R	R	R[c]
	A 16		R	R	R		R			R	R	R	R	R	R[c]
8/9/74	A 30		R	R			R					R	R	R[c]	R[c]
	A 37		R	R			R					R	R	R	R[c]
	A 41	R		R	R	R	R		R		R	R	R	R	
	A 42	R	R	R	R	R	R			R	R	R		R	R
	A 56	R	R	R	R		R		R	R	R	R	R		R
	A 57			R	R		R			R	R	R	R	R	
	A 58	R	R	R	R		R			R	R	R	R		R[c]
	I 12		R	R			R		R	R		R	R		R
	H 67	R	R	R			R		R			R	R		R[c]

(a) Multiple Antibiotic Resistance = resistance to 3 or more antibiotics as defined by the "Zone Size Interpretative Chart" of Kirby-Bauer Method[6]
(b) The potency of antibiotic discs used, and the concentration of metal salts used for disc impregnation will be found under Materials and Methods.
(c) ppt around disc impregnated with the metal salt.
(d) R = resistant, I = intermediate resistance or cloudy zone (i.e., some growth within zone of inhibition.
Note: Blank space indicates inhibition zone around disc of a diameter sufficient to be interpreted as sensitive.[6]

Table 6

Antibiograms[a] Performed on Some Isolates Cultured on TSA + Hg for 5 Months
Mercury Resistant Isolates from St. 34: Note change in antibiotic spectrum following storage and recloning

Date of Sample	Isolate #	Antibiotic Resistance											
		NA	TE	Cl	S	AM	SSS	GM	K	C_{30}	C_5	G	CR
7/29	A 01	I[b]		-[b]	(b)					I	-		-
	A 01a			-						I			-
	A 01b			-						I			-
	A 04	I	I	-			R			-	R	R	-
	A 04a			-						-			-
	A 04b			-						-			-
	A 06	R		-	R	R				-			-
	A 06a	R		-	R	R				-			-
	A 07			-						-			-
	A 09	I	I	-	I		R			-	R	R	-
	A 13	R		-						-			-
	A 13a			-						-			-
	A 13b			-						-	R		-
	A 13c	I		-						-	R		-
	A 13d			-						-	R		-
	A 14	I	I	-						-	R		-
	A 14a	I		-						-			-
	A 16			-						-			-
8/9	A 30	R									-		-
	A 37					R					-		-
	A 40a					I					-		-
	A 40b[c]	I	R	R	I	R			R		-	R	-
	A 40c[c]	I	R	R	I	R			R		-	R	-
	A 40d										-		R
	A 42	R	I		I	R				R	-		R
	E 54a[c]		R	R		I					-		I
	E 55	R	R	R	I	R			I		-		R
	E 55b									R	-		
	E 56					I				R			R
	E 56a					I							R
	E 57												R
	E 58					I				I			R
	E 61b	I	R							I			R

[a] See Table 5 for footnotes and section on Materials and Methods for potencies of antimicrobial discs.

[b] - indicates disc was omitted; blank space indicates organism was sensitive; R = resistance; I = intermediate resistance.[6]

[c] Sub-clone shows greater resistance than original isolate.

Chl or TE Resistant Isolates from St. 34 Showing Multiple Antibiotic Resistance[1]

Date	Isolate #	Antibiotic Resistance	Heavy Metal Resistance
7/29	34 A 23	NA^R, TE^R, A^R, S^R, AM^R, C^R, G^R	Cr^R, Cu^R, $Pb^{R(a)}$
	34 A 29	E^R, TE^R, A^R, S^R, AM^R	Cr^R
	A 45	E^R, TE^R, A^R, S^R, AM^R, K^R, G^R	Hg^R, Cr^R, Cu^R, $Pb^{R(2)}$
	A 47	TE^R, A^R, AM^R, G^R	Hg^R, Cr^R
8/9	E 51	TE^R, A^R, AM^R, K^R, C^R	Cr^R
	E 55	NA^R, TE^R, A^R, AM^R, C^R, G^R	Hg^R, Cr^R, Cu^R, Pb^R
	A 40	E^I, NA^I, TE^R, A^R, AM^I, K^I, C^I	

(a) = ppt around metal disc, other designations same as in Table 5.

(1) These isolates were lost in transfer and therefore were not included in Tables 5 and 6.

Table 8

Antibiograms Performed on Some TE^R Isolates from Bathing Water at Sandy Hook State Park

Isolate #	Antibiotic Resistance[a]									
	E	NA	TE	A	S	AM	GM	K	C	G
BWF 26[b]	R	I	R	R	R	R	R	R	R	R
BWF 27[b]	R	R	R	R		R		I	R	R
BWF 28[b]	R	R	R	R	I	R			R	R
BWF 29[b]	R	R	R	R	R	R		R	R	R
BWF 30[b]	R	I	R	R	R	R		R	R	R
BWF 31[b]	R	R	R	R	R			I	R	R
BWF 32[b]	R	R	R	R				R	R	R
BWF 33[b]	R	R	R	R	I	R			R	R
BWF 34[b]	R	R	R	R	I	R	R	I	R	R
BWF 35[b]	R	I	R	R	R	R	R	R	R	R
BWF 36[b]	I	R	R	R		R			R	R
BWE 44[c]	R	I	R	R	R	R			R	R
BWE 51[c]	R		R	R	R	R		I	R	

(a) See Table 5 for footnotes and section on Materials and Methods for potencies of antibiotic discs. Symbols same as in Table 5.

(b) Isolates BWF 26-36 were Hg^R.

(c) Isolates BWE 44 and BWE 51 were also resistant to Triple Sulfa (Difco Trisulfapyrimidines USP 150 mcg/disc) as well as Cr^R and Cu^R.

Table 9

RECOVERY OF *E. coli* ATCC 11303 AFTER MIXING WITH STERILE SANDY SEDIMENT

	Time of Storage				
	0		3 days	4 days	7 days
	Count[a]	% Recov.	Count	Count	Count
1 ml *E. coli* in TSB	4.7×10^7	100(assumed)	3.8×10^7	4.1×10^7	2.5×10^7
Unblended sediment	1.5×10^7	31.9	-	-	-
Blended sediment	1.1×10^7	23.4	2.4×10^6	1.4×10^6	2.3×10^4
Frozen unblended sediment	-	-	2.4×10^6	5.0×10^5[c]	1.4×10^5
Frozen blended sediment	-	-	$\approx 5.4 \times 10^6$[b]	1.5×10^6	-

(a) Count = colony counts per ml after correction for dilution.

(b) Coalesced colonies, count estimated.

(c) Poor dilution series (10^{-2} = TMTC, 10^{-3} = 25).

Table 10

COLONY COUNTS ON REPLICATE FILTRATIONS OF SEDIMENT SUSPENSION (SS) FROM STATION 34

Nature of Core	Medium	Time of MF Incubation	Vol. SS Filtered	Colony Counts on Replicate MF	Mean	Computed Av.	Standard Deviation	Standard Dev. as % of mean	95% confidence limit
I	TSA	19 hrs	0.1 ml	69,68,72,68,73	70	71/0.1 ml or 710/ml	2.35	±3.3%	2.06
	"		0.05 ml	36,37,38,38,34	36.6		1.67	±4.6%	1.47
	"	48 hrs*	0.1 ml	70,68,71,68,74	70.2	71/0.1 ml or 710/ml	2.5	±3.6%	2.18
	"		0.05 ml	36,35,34,41,32	35.6		3.7	±10.3%	2.95
II[a]	"	20 hrs	0.1 ml	69,79,64,97,78	77.4	84/0.1 ml or 840/ml	12.6	±16.3%	11.07
			0.05 ml	42,42,52,49,42	45.4		4.8	±10.5%	4.18
IA	TSA + Hg[b]	20 hrs	10 ml	91,123,122,TMTC, TMTC[c]	112	11/ml	18.2	±16.2%	20.59
			5 ml	4,1,1,2.1 data not reliable					
IB	TSA + TE[b]	20 hrs	10 ml	62,72,93,103,115	89	9/ml	23.2	±26%	19.15

(a) I, IA and IB were prepared SS from the same core. II was SS prepared from a new core which was stored at 5° C for 21 days.

(b) Concentration of Hg and TE per ml of TSA is indicated under Materials and Methods Section - III.

(c) TMTC = too many colonies to count.

* Colonies overgrown, difficult to count.

Table 11

SAMPLING PROTOCOL

MATERIAL:

1. Navigational chart with sample locations.

2. List of sample site locations by Loran and by longitude and latitude.

3. List of sample sites in the order they are to be sampled; include a column for depth, temperature, and time of sample. The table should contain the station number, the LORAN readings, latitude and longitude, the depth, the temperature, the pH, and sediment characteristics as well.

4. Release forms (NOAA Form 22-1, 3-73) filled out for each non-NOAA employee embarking on vessel.

5. 1 bottle 95% ethanol (PLASTIC).

6. Minimum of 10 sterile KIM-KAPS or other suitable corer per site, to hold approximately 10 g of wet weight sediment.

7. 2 specimen jars (screw cap, 8 cm inside diameter) per site (sterile), for holding filled cores.

8. 1 cooler chest with ice.

9. 4 marking pens.

10. 1 roll labeling tape.

11. 2 celsius thermometers.

12. 1 bar soap.

13. 1 old towel.

14. 1 sterile 150 ml bottle per sample site for pH H_2O.

15. 2 sterile one-liter nalgene bottles per site for H_2O samples.

16. 1 Smith-McIntyre grab sampler.

17. 1 Niskin H_2O bottle.

Table 12

Weight of Kim-Kaps in gms.

1)	2.12804	10)	2.09500
2)	2.1294	11)	2.08825
3)	2.10365	12)	2.11716
4)	2.12713	13)	2.11646
5)	2.12742	14)	2.13000
6)	2.09418	15)	2.09619
7)	2.12587	16)	2.12531
8)	2.12231	17)	2.12486
9)	2.06456	18)	2.12656
		19)	2.09610

Mean = 2.112 gm.

Use 2.1 g tare/Kim-Kap

Table 13

Abbreviations

Hg^R = bacteria resistant to mercury, i.e., colonies growing on media supplemented with 10^{-3} M $HgCl_2$/ml

Chl = chlortetracycline

TE = tetracycline

Chl^R, TE^R = bacteria resistant to the antibiotics chlortetracycline or tetracycline, i.e., colonies growing on media supplemented with 40 mcg/ml of the antibiotic

SS = sediment suspension (see text for preparation)

MF = millipore filter, also membrane filtration

PRLB[4] = phenol red lactose broth) used in presumptive
BGLB[4] = brilliant green lactose bile broth) MPN test for coliforms

LTB[4] = lauryl tryptose broth, used for completed MPN test or for presumptive test where false positive results are found

EMB[4] = eosin methylene blue agar used for confirmed test for coliforms

Table 14

Definitions[7,21-23]

R plasmid	(Synonyms: R factor, resistance factor). A plasmid that carries genetic information for resistance to antibiotics, metals or other toxic substances.
Bacterial plasmid	(Synonyms: extrachromosomal DNA, extrachromosomal group of genes). A stably inherited but usually dispensable replicon, physically separate from the bacterial chromosome and capable of independent replication. Bacterial plasmids often replicate at a faster rate than the bacterial chromosome so that a cell may have several too many copies of a plasmid. Bacterial cells may be host to different plasmids at the same time. The term "episome" is sometimes used but usually connotes extrachromosomal genes which integrate with the bacterial chromosome.
Replicon	A genetic element capable of physically independent replication.
RTF	(Syononyms: resistance transfer factor, transmissible plasmid). Genes associated with a bacterial plasmid, which code for intercell transfer of the plasmid by conjugation. Bacteria which contain RTF are called donors. Bacteria may contain only RTF and show no resistance, but they may mobilize non-transferable R plasmids in a recipient bacteria by donating the RTF to the R plasmid in the recipient (see Discussion in text).
Bacterial conjugation	The process of genetic exchange between bacteria, dependent on cellular contact, in which DNA is transferred from one organism (the donor) to another (the recipient).
lac^+	Bacteria which ferment lactose to give acid and gas (A/G), usually used to denote coliforms in MPN test.[4] On mFC[5] agar lac^+ are identified as typically blue colonies due to a pH change resulting from extensive acid produced by coliforms after fermentation of the lactose in this medium.
lac^-	Bacteria which do not ferment lactose; such colonies appear pink or tan on mFC. Some bacteria ferment lactose to give some acid, but no gas and therefore do not give the typical coliform reactions.

Table 14 (continued)

False positive MPN	Particularly characteristic of Clostridia which ferment lactose and produce much A/G in PRLB and BGLB; use of LTB broth largely eliminates false positives since the lauryl sulfate is inhibitory for gram positive lactose fermentors.
Antibiogram	(Synonym: antimicrobial spectrum). Single disc method for testing the sensitivity of a culture to selected antimicrobial agents.(6)
Nosocomial infection	Hospital-acquired infection, often associated with opportunistic multiple resistant bacteria selected in the hospital environment as a result of the intensive use of antibiotics.
R^+ bacteria	(Synonym: resistance transfer donor). A bacteria containing an R plasmid + RTF and capable of transferring them to a recipient by conjugation. On receiving R + RTF genes (DNA), the recipient becomes a donor. This type of conjugative transfer is very rapid (often less than 10 minutes) and a whole population may become donors by such "genetic infection" with specific DNA.
Multiple resistant bacteria	Bacteria simultaneously resistant to several antibiotics, or other antimicrobials. Usually contain R plasmids.
T plasmid	Any plasmid that encodes a toxin (active on eukaryotes).
Segregation	Separation of a plasmid into two or more independent replicons (also defined as dissociation).
Plasmid recombinants	Composite or recombinant plasmids consisting of covalently joined parts from two or more plasmids.

Table 15

ESTIMATE OF TIME REQUIREMENTS FOR PREPARATION AND SAMPLE ANALYSIS AT 6 STATIONS IN THE NEW YORK BIGHT: TOTAL 73 HRS

SAMPLING	TIME
a) Materials Preparation	
1. Wash and rinse all bottles and jars	1 hr.
2. Prepare Kim-Kaps	2 hrs.
3. Sterilize all	1 hr.
4. Pack materials, prepare lists	1/2 hr.
Total	$4\frac{1}{2}$ hrs.
b) Travel + Round trip MSC - Sandy Hook - 126 miles[a]	3 hrs.
Min: 2 hrs. 40 min., av. 3 hrs.	
c) Prepare vessel, load equipment, etc.	1 hr.
d) Sampling - to sample 6 MESA sites	7 hrs./worker
Multiply x minimum 4 people to	

SAMPLE PROCESSING	
a) Sediment suspension and blending - 1/2 hr. per site x 6 sites	3 hrs.
This includes cleaning and autoclaving	
b) MPN Determination	
1. Presumptive test 10 min. per site x 6 sites	1 hr.
2. Presumptive test results 20 min. per site x 6 sites	2 hrs.
3. Confirmed test - streak EMB 20 min. per site x 6 sites	2 hrs.
4. Confirmed test results 20 min. per site x 6 sites	2 hrs.
5. Completed test 15 min. per site x 6 sites	$1\frac{1}{2}$ hrs.

[a] These estimates are based on the time spent by technicians from Montclair State College microbiology/traveling to use boat at Sandy Hook Marine Lab. The total man hours estimated do not include time required for cloning isolates, checking antibiotic spectrum of each, nor the time required for mating experiments to check each clone for donor capability, i.e., RTF factor.

Table 15 (cont'd)

SAMPLE PROCESSING (cont'd)

6. Results 10 min. per site x 6 sites		1 hr.
7. MPN Computation 10 min. per site x 6 sites		1 hr.
8. Gram Stain	Min.	1 hr.
9. Gram Stain Results	Min.	$1\frac{1}{2}$ hrs.
c) Millipore Filtration		
1. Filtration of approximately 25 MF per site approximately 20 aliquots /hr. = 11/4 hr. per site x 6 sites		71/2 hr.
2. Read results, 29 min /site x 6 sites		2 hr.
3. Replica plating, 20 min/site x 6 sites		2 hr.
4. Read results, 10 min/ site x 6 sites		1 hr.
d) Isolate Selection		
1. Streak on inhibitory medium, 20 min/site x 6		2 hr.
2. Gram stain, av. 20 isolates /site x 6 sites		4 hr.
3. Read gram stain results		2 hr.
Total		73 hr.

Acknowledgments

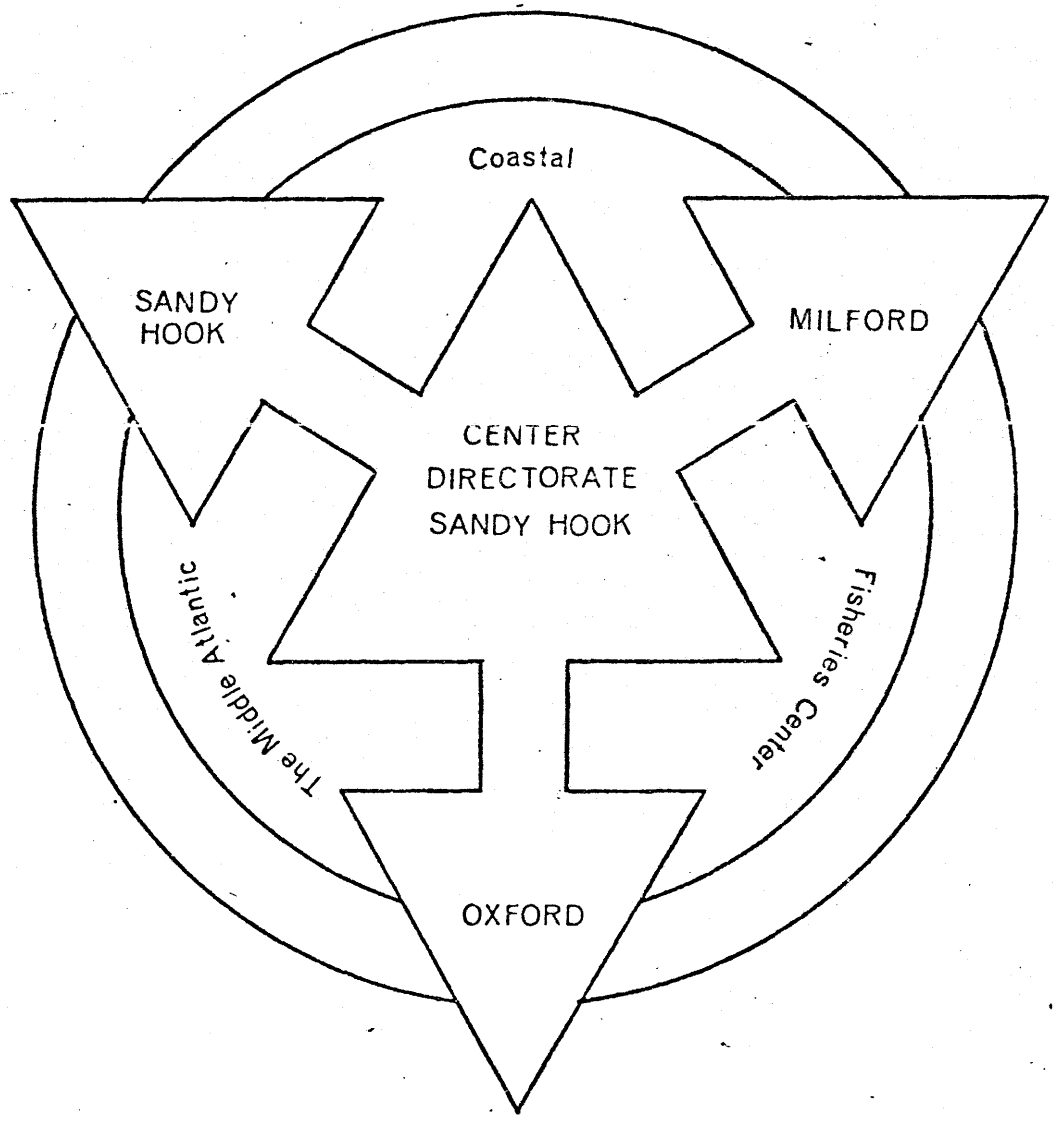
We appreciate the active support and technical assistance of Dr. Kneeland McNultey and all MESA personnel at the Sandy Hook Laboratory, and particularly the continuing interest of Dr. John B. Pearce and Dr. Joel S. O'Connor. The very competent technical assistance of Ms. Lynn Dzurney and Ms. Mary Jean Young is gratefully acknowledged, as well as the part-time technical aid of Ms. Roberta Palmer, Mr. Adam Leczíska, and Dr. David A. Rose. Thanks are due to Mrs. Nancy DuVal and Mrs. Molly Morehead for patient and intelligent secretarial assistance. We are grateful to Dr. Joel Unowsky, Hoffman-La Roche, Inc., Nutley, New Jersey, for his interest in our work. We would like to express our appreciation to the late Dr. Paul Koditschek for his guidance in all matters and particularly in statistics.

CRUISE REPORT
NOAA Ship Delaware II
12-24 February 1975

CRUISE D-75-2

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)

Introduction:

The NOAA Ship Delaware II departed Sandy Hook (SH) 0855 hrs. on 12 Feb. to conduct seabed oxygen consumption studies and Smith-McIntyre bottom grab sampling. Sampling commenced with the multiple corer at 0950 hrs. in a heavy snow storm at station 1 just west of Chapel Hill Channel in Lower Bay. The station was completed by 1040 hrs. and all work was suspended due to snow storm. Ship returned to S.H. arriving 1130 hrs.

On 13 February FRS Delaware II departed SH 0815 hrs. bound for station 2 west of Norton Pt., Coney Is. Commenced multiple coring 0935. Weather very cold. Following station 2 proceeded up the Hudson River to stations 3, 4, 5, 6 and 7 near the Harlem River. At 1330 hrs. proceeded down the Hudson River to station 8 in Ambrose Channel between Sand Hook and Norton Pt. Station 8 completed by 1541 hrs. Ship proceeded to Ambrose Light Tower arriving 1623 hrs. to calibrate RAYDIST. Commence sampling with multiple corer 1727 hrs. at station 9. Sampling with multiple corer, continued with moderate seas and 20-25 kn. NW winds. RAYDIST control exercised to maintain positioning within ¼ nautical mile of station for sampling.

On 14 February inshore stations along New Jersey coast sampled to obtain a lee. RAYDIST calibrated 1115 hrs. at Ambrose Light Tower. Wind and sea decreasing although very cold. At 1810 hrs. commenced Smith-McIntyre sampling to collect samples for the Exxon Research and Engineering Company, Linden (N.J.) and the Exxon Production Research Company, Houston, (Tex.). Samples were also taken at these same six stations for use by Dr. Duedall (Stony Brook) for determining calorific content. Smith-McIntyre sampling was started at 2040 hrs. at a tight grid of 25 stations (1 minute of Lat. & Long. apart) in the sewage sludge disposal area. Smith-McIntyre (2 grabs/station) sampling suspended at 2140 hrs. to return to multiple coring.

On 15 February RAYDIST was calibrated at 1110 hrs. at Ambrose Light Tower. Multiple corer sampling suspended 1235 hrs. to transport 2nd Mate to S.H. due to illness. Departed S.H. 1405 hrs. to commence sampling 1512 hrs. at station 26 for multiple corer. Following station 26 returned to Smith-McIntyre sampling at tight grid over sewage area. Smith-McIntyre sampling suspended 2115 hrs. Multiple corer sampling commenced 2140 hrs.

Multiple coring suspended 0545 hrs. on 16 February. Smith-McIntyre sampling commenced 0620 hrs. to finish tight grid over sewage area. RAYDIST calibrated at Ambrose Light Tower approximately 0900 hrs. Smith-McIntyre sampling of tight grid completed by 1150 hrs. Multiple coring commenced 1300 hrs. to collect a series of 38 samples spaced along a line at a ¼ nautical mile interval between the sewage area and Atlantic Beach,

L.I. Samples are for Dr. Foehrenbach (N.Y. State Dept. of Environmental Cons.). Stations completed 1935 hrs. RAYDIST calibrated 2030 hrs. at Ambrose Light Tower. Commenced multiple coring 2330 hrs.

On 17 February continued multiple coring operations. RAYDIST calibrated 2235 hrs. at Ambrose Light Tower.

Multiple coring operations continued through 1435 hrs. on 18 February. Following station 53 in Swash Channel off Sandy Hook vessel proceeded to S.H. arriving 1508 hrs. to put off scientist, Theresa Yeager, due to illness and to take on water. Depart SH 1820 hrs. Multiple corer sampling commenced 1928 hrs. on 18 February and continued uneventfully through 1500 hrs. on 20 February at station 74. RAYDIST calibrated 1540 hrs. at Ambrose Light Tower. Vessel proceeded to SH arriving 1655 hrs. with multiple corer operations in the apex of the N.Y. Bight completed.

RAYDIST station of Fire Island deactivated. RAYDIST station at Moriches Inlet activated during morning of 21 February. FRS Delaware II depart S.H. 1210 hrs. to commence multiple coring at 1232 at two stations in Lower Bay before proceeding offshore. RAYDIST calibrated 1435 hrs. at Ambrose Light Tower. Commence multiple coring at "HA" buoy 1718 hrs. Then continued sampling down the Hudson Shelf Valley until 2252 hrs. Vessel then proceeded to the proposed alternate waste disposal site - North.

On 22 February commenced Smith-McIntyre sampling 0130 hrs. at northern proposed alternate waste disposal site. At 0425 hrs. collected mud sample for Exxon at the center of the northern area. Smith-McIntyre sampling (5 grabs/station) completed at 0755 hrs. Commenced multiple coring 1010 hrs. Multiple coring of northern area completed 1640 hrs. Vessel proceeded to outer Hudson Shelf Valley between the two proposed alternate waste disposal areas arriving 1930 hrs. for multiple coring. Ship then proceeded to the proposed alternate waste disposal area - South arriving 2130 hrs. Two stations sampled with multiple corer.

On 23 February commenced Smith-McIntyre sampling of southern area 0009 hrs. Smith-McIntyre sampling of south area completed by 0347 hrs. Bottom grab sample for Exxon taken in center of south area 0132 hrs. Multiple coring in south area commenced at 0455 hrs. Drizzle and rain coming caused suspension of activities at 1028 hrs. to head for "B" buoy to get lane count check on RAYDIST. Lost RAYDIST 1110 hrs. Ship headed for "HA" buoy to correct lane count arriving 1340 hrs. Following RAYDIST correction ship repeated two multiple corer stations which had not had good temperature control during the incubation. Then ship headed for "B" buoy for lane count check on RAYDIST arriving 1740 hrs. Multiple coring continued until sampling of the south area was complete at 2100. Vessel then returned to "HA" buoy arriving 2400 hrs. to check RAYDIST.

On 24 February vessel headed for Sandy Hook in dense fog arriving 0445 hrs. Vessel partially off loaded.

On 25 February off loading completed.

SCIENTIFIC PERSONNEL:

Smith-McIntyre grab (bottom) sampling and multiple core operations.

James Thomas - Party Chief
William Phoel
Leslie Rogers
William Drago
Larry D'Andrea
Theresa Yeager
Frank Saunders - RAYDIST operator
Robert Roberson- RAYDIST operator

CRUISE OBJECTIVES:

Objective of this cruise was to provide baseline data necessary to the accomplishment of MESA Task No. 4: Benthic Macrofauna (MACFC Informal Report No. 13). Samples were collected for examination and analysis for macrofauna, heavy metals burdens in sediments, and mechanical properties of sediments (grain size distribution, etc.). Multiple coring operations for seabed oxygen consumption continued (Task No. 3 in MACFC, Informal Report No. 13, Benthic Respiration).

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 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 Tables 1 and 2):

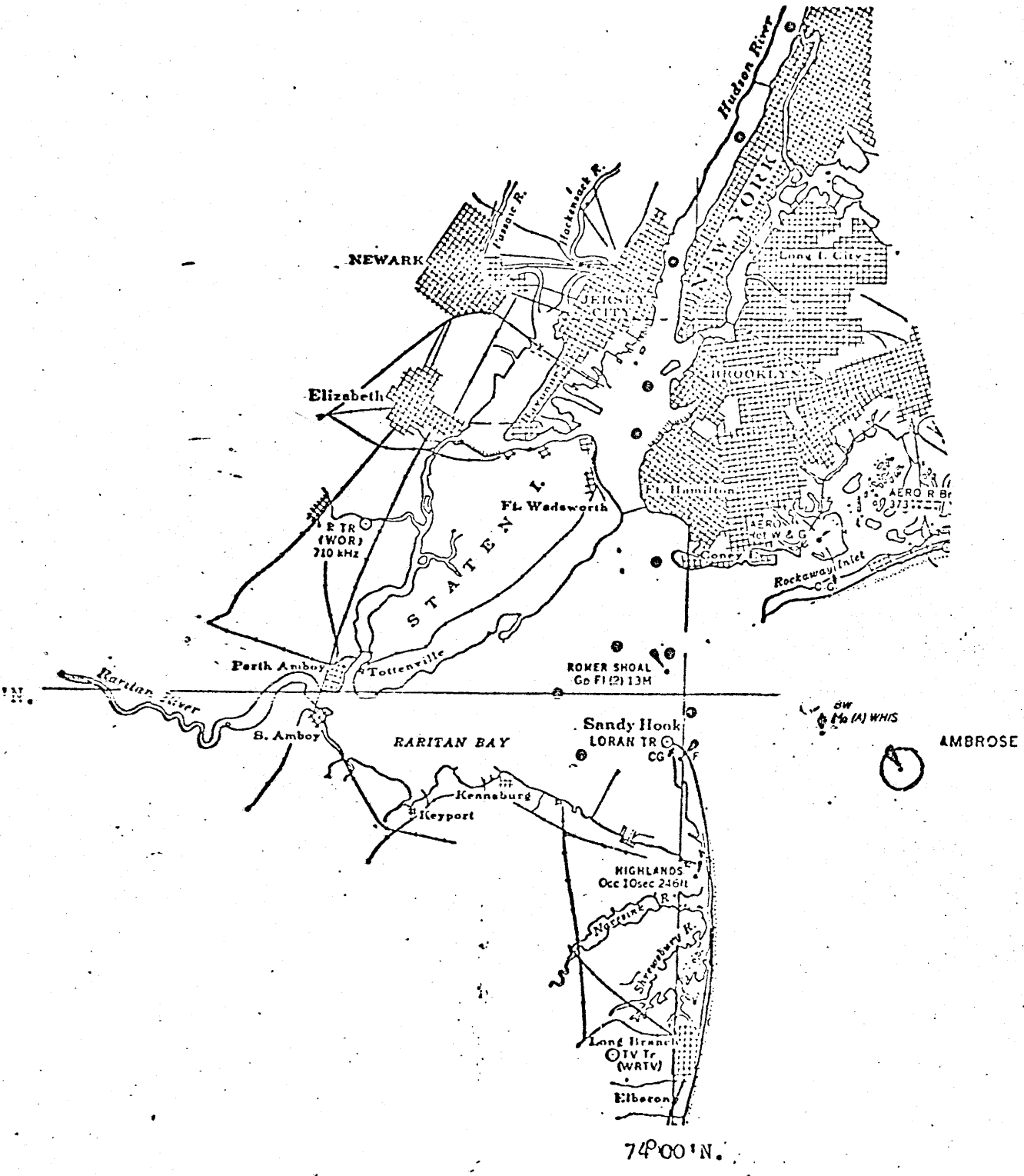


Fig. 1. Multiple corer stations in the Lower Hudson Estuary for seabed oxygen consumption studies 12-24 February 75 on FRS Delaware II (D-75-2)

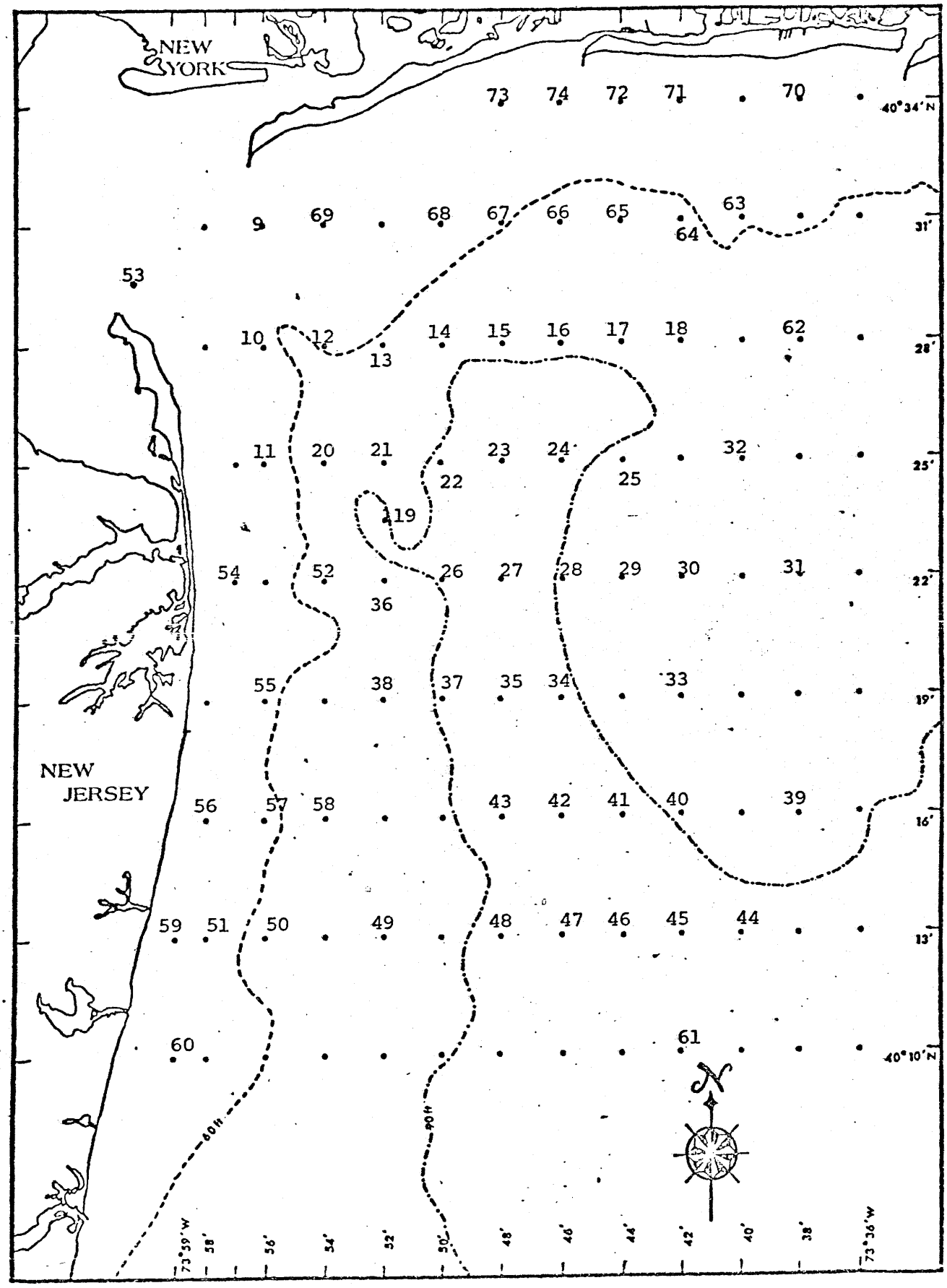


Fig. 2. Multiple corer stations in the Apex of the New York Bight for seabed oxygen consumption studies 12-24 February 75 on FRS Delaware II (D-75-2)

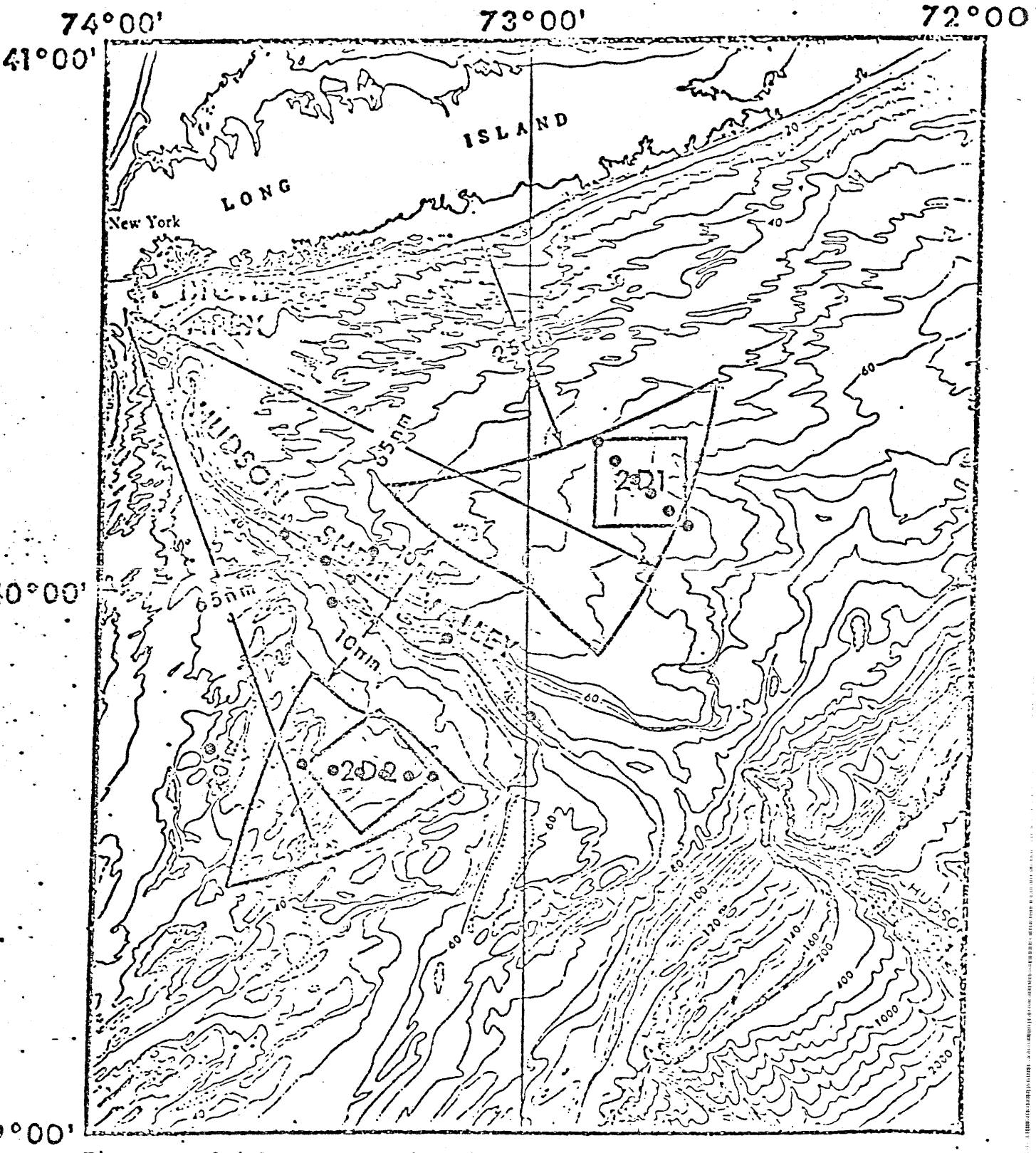


Fig. 3 Multiple corer stations in the Hudson Shelf Valley, adjacent shelf, and proposed alternate waste disposal sites in the New York Bight 12-24 February 75 on FRS Delaware II (D-75-2)

Fig.

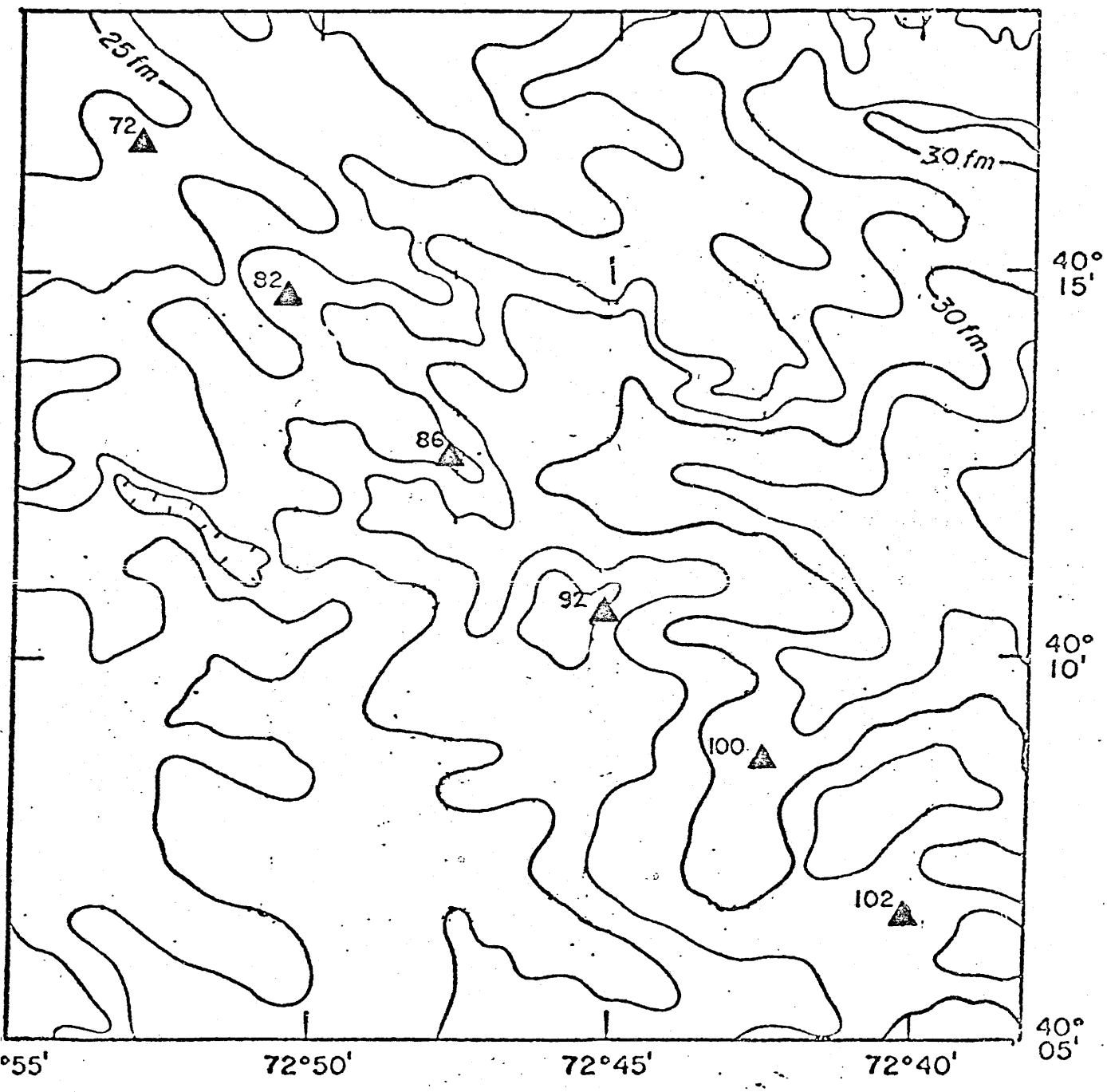
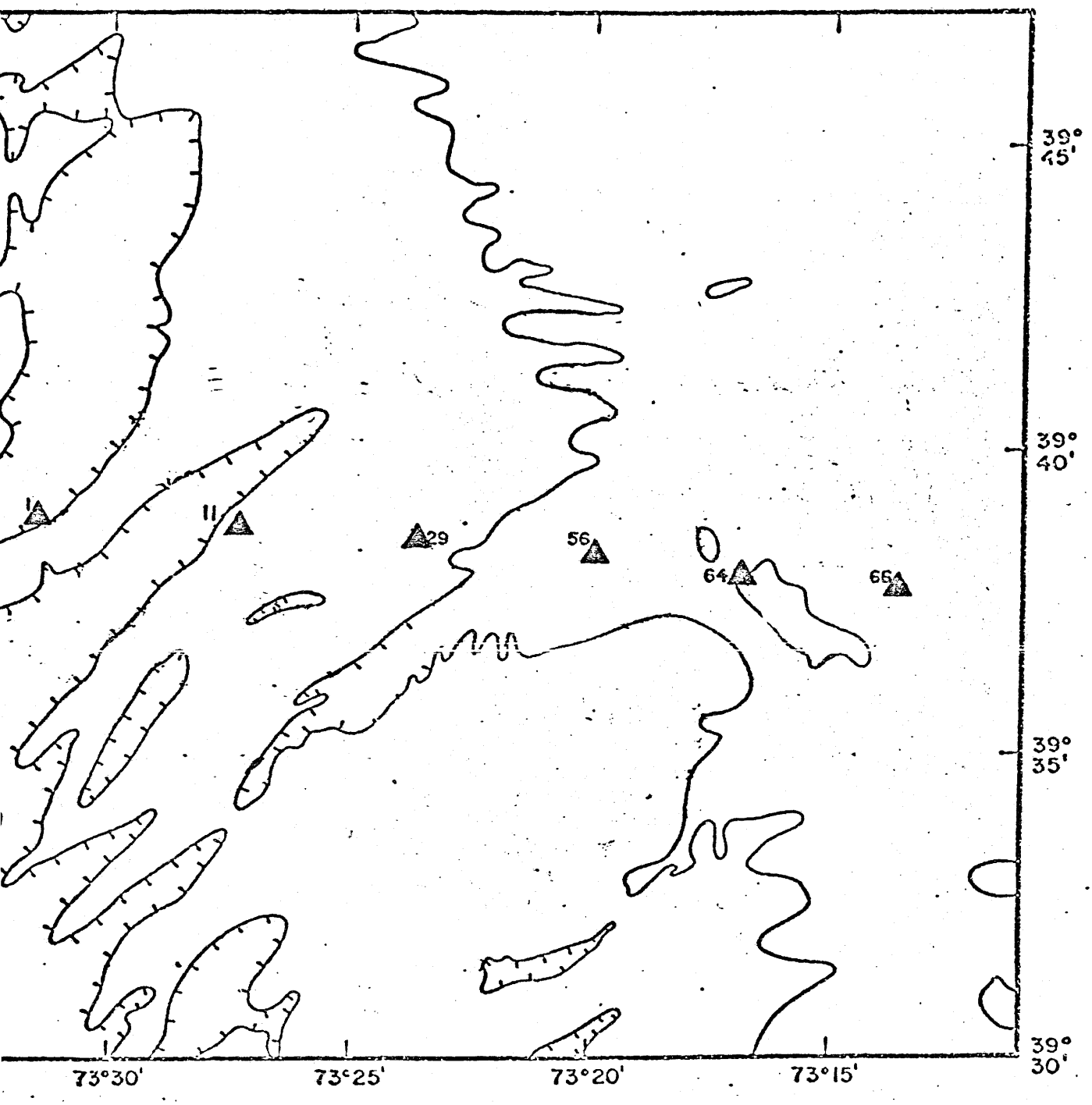


Fig. 4. Bathymetric and sample location map, Area 2D1 (northern area). Contour interval 1 fathom. ▲ Smith-McIntyre bottom grab and multiple corer stations.



ig. 5. Bathymetric and sample location map, Area 2D2 (southern area). Contours are the 20 fm. isobath. ▲ Smith-McIntyre bottom grab and multiple corer sampling stations.

Table 1. Station positions for Multiple coring.

Lower Hudson River		Station #
C & GS 369		
Lower Bay	40°31.2'N, 74°03.25'W	1
Lower Bay	40°34.5'N, 74°01.5' W	2
Upper Bay	40°38.6'N, 74°02.9' W	3
Upper Bay	40°40.3'N, 74°02.31'W	4
Manhattan	40°44.25'N,74°01.1' W	5
C & GS 746		
Upper Manhattan	40°49.54'N,73°57.7'W	6
Spuyten Duyvil	40°52.9 'N,73°55.75'W	7
Romer Shoal	40°31.2' N,74°00.8'W	8

Apex-New York Bight

Lat. N.	Long. W	Sta. #	Lat. N	Long. W	Sta. #
40°31'N,	73°56'W	9	40°22'N,	73°38'W	31
40°28'N,	73°56'W	10	40°25'N,	73°40'W	32
40°25'N,	73°56'W	11	40°19'N,	73°42'W	33
40°28'N,	73°54'W	12	40°19'N,	73°46'W	34
40°28'N,	73°52'W	13	40°19'N,	73°48'W	35
40°28'N,	73°50'W	14	40°22'N,	73°52'W	36
40°28'N,	73°48'W	15	40°19'N,	73°50'W	37
40°28'N,	73°46'W	16	40°19'N,	73°52'W	38
40°28'N,	73°44'W	17	40°16'N,	73°38'W	39
40°28'N,	73°42'W	18	40°16'N,	73°42'W	40
40°23.5'N	73°52'W	19	40°16'N,	73°44'W	41
40°25'N,	73°54'W	20	40°16'N,	73°46'W	42
40°25'N,	73°52'W	21	40°16'N,	73°48'W	43
40°25'N,	73°50'W	22	40°13'N,	73°40'W	44
40°25'N,	73°48'W	23	40°13'N,	73°42'W	45
40°25'N,	73°46'W	24	40°13'N,	73°44'W	46
40°25'N,	73°44'W	25	40°13'N,	73°46'W	47
40°22'N,	73°50'W	26	40°13'N,	73°48'W	48
40°22'N,	73°48'W	27	40°13'N,	73°52'W	49
40°22'N,	73°46'W	28	40°13'N,	73°56'W	50
40°22'N,	73°44'W	29	40°13'N,	73°58'W	51
40°22'N,	73°42'W	30			

Apex-New York Bight (Continued)

Lat. N	Long. W	Sta. #
40°22'N,	73°54'W	52
40°29.56N,	73°59.8'W	53
40°22'N,	73°57'W	54
40°19'N,	73°56'W	55
40°16'N,	73°58'W	56
40°16'N,	73°56'W	57
40°16'N,	73°54'W	58
40°13'N,	73°59'W	59
40°10'N,	73°59'W	60
40°10'N,	73°42'W	61

Lat. N	Long. W	Sta. #
40°28'N,	73°38'W	62
40°31'N,	73°40'W	63
40°31'N,	73°42'W	64
40°31'N,	73°44'W	65
40°31'N,	73°46'W	66
40°31'N,	73°48'W	67
40°31'N,	73°50'W	68
40°31'N,	73°54'W	69
40°34'N,	73°38'W	70
40°34'N,	73°42'W	71
40°34'N,	73°44'W	72
40°34'N,	73°48'W	73
40°34'N,	73°46'W	74

Lower Bay

40°28.15'N,	74°04.55'W	75
40°30.0 'N,	74°05.70'W	76

Table 2. Sampling locations for multiple corer sampling in New York Bight, Hudson Shelf Valley and adjacent Continental Shelf (chart 1108)

	Lat.	Long.	Sta. #
BW "HA"	40°07'N,	73°22'W	77
	40°06'N,	73°34'W	78
	39°59'N,	73°32'W	79
	40°03'N,	73°27'W	80
	39°56'N,	73°11'W	81

Proposed alternate waste disposal site - north

DUPI Sta. #	RAYDIST readings	Rockaway Ft. Tilden	Moriches	Cruise Sta. #
Sta. 72		1989.3	1266.6	82
Sta. 82		2091.4	1332.8	83
Sta. 86		2203.8	1407.6	84
Sta. 92		2307.9	1485.1	85
Sta. 100		2416.5	1567.4	86
Sta. 102		2524.2	1656.2	87

	Lat.	Long.	
Sta. 72	40°16.75'N,	72°53.20'W	82
Sta. 82	40°14.75'N,	72°50.50'W	83
Sta. 86	40°12.70'N,	72°47.75'W	84
Sta. 92	40°10.75'N,	72°45.25'W	85
Sta. 100	40°08.75'N,	72°42.60'W	86
Sta. 102	40°06.67'N,	72°40.04'W	87

Hudson Shelf Valley

Lat.	Long.	
39°47'N,	72°59'W	88

Table 2. (Continued)

Proposed alternate waste disposal site - south

DUPI Sta. #	RAYDIST readings	Rockaway Ft. Tilden	Moriches	Crusie sta. #
Sta. 1		2323	3120	89
Sta. 11		2373	3071	90
Sta. 29		2426	3041	91
Sta. 56		2473	3010	92
Sta. 64		2536	2991	93
Sta. 66		2586	2959	94

	Lat.	Long.	
Sta. 1	39°38.9'N,	73°31.5'W	89
Sta. 11	39°38.8'N,	73°27.3'W	90
Sta. 29	39°38.6'N,	73°23.6'W	91
Sta. 56	39°38.4'N,	73°20.0'W	92
Sta. 64	39°38.0'N,	73°17.0'W	93
Sta. 66	39°37.7'N,	73°14.3'W	94

Continental Shelf off New Jersey

	Lat.	Long.	
R "B" Buoy	39°46'N,	73°45'W	95

Stations 79 and 80 were repeated for improved temperature control.

Multiple core casts to obtain undisturbed bottom sediment with overlying bottom water were made to measure seabed oxygen consumption. Ideally, four cores per station were used to measure 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 12 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 each station and the oxygen decrease was again monitored for 12 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 and 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.

Stations were sampled with the Smith-McIntyre bottom grab sampler as follows (Figs. 6-7 and Table 3 & 4):

Table 3. New York Bight-Apex - Macrofauna, heavy metals burdens in sediment, and the mechanical properties of sediment.

(Only two grabs per station.) Area immediately SE of Ambrose -	Cruise Sta. #
40°23'N, 73°50'W	M-1
40°23'N, 73°49'W	M-2
40°23'N, 73°48'W	M-3
40°23'N, 73°47'W	M-4
40°23'N, 73°46'W	M-5
40°24'N, 73°46'W	M-6
40°24'N, 73°47'W	M-7
40°24'N, 73°48'W	M-8
40°24'N, 73°49'W	M-9
40°24'N, 73°50'W	M-10
40°25'N, 73°50'W	M-11
40°25'N, 73°49'W	M-12
40°25'N, 73°48'W	M-13
40°25'N, 73°47'W	M-14
40°25'N, 73°46'W	M-15
40°26'N, 73°46'W	M-16
40°26'N, 73°47'W	M-17
40°26'N, 73°48'W	M-18
40°26'N, 73°49'W	M-19
40°26'N, 73°50'W	M-20
40°27'N, 73°50'W	M-21
40°27'N, 73°49'W	M-22
40°27'N, 73°48'W	M-23
40°27'N, 73°47'W	M-24
40°27'N, 73°46'W	M-25

Table 4. Sampling locations for benthic macrofauna, heavy metals burdens in sediment, and the mechanical properties of sediments in the New York Bight (five grabs per station).

Proposed Alternate Waste Disposal Site-North
DUPI - North

DUPI Sta. #	Lat.	Long.	Cruise Sta. #
72	40°16.75'N,	72°53.20'W	82
82	40°14.75'N,	72°50.50'W	83
86	40°12.70'N,	72°47.75'W	84
92	40°10.75'N,	72°45.25'W	85
100	40°08.75'N,	72°42.60'W	86
102	40°06.67'N,	72°40.04'W	87

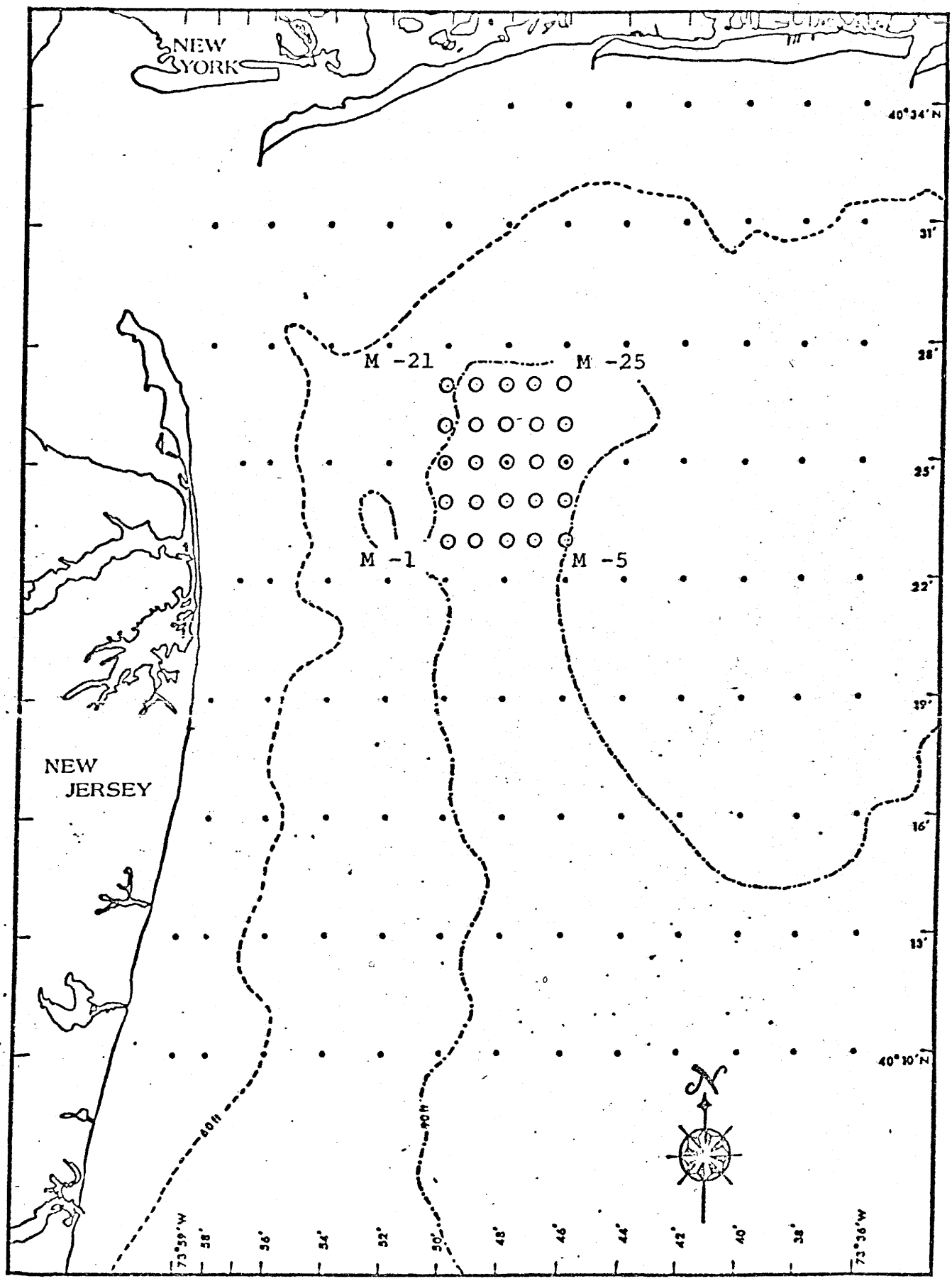


Fig. 6. Sample locations for benthic macrofauna, heavy metals burdens in sediment, and the mechanical properties of sediments using a Smith-McIntyre bottom grab.

Table 4. (Continued)

Proposed Alternate Waste Disposal Site-South
DUPI - South

DUPI Sta. #	Lat.	Long.	Cruise Sta. #
1	39°38.9'N,	73°31.5'W	89
11	39°38.8'N,	73°27.3'W	90
29	39°38.6'N,	73°23.6'W	91
56	39°38.4'N,	73°20.0'W	92
64	39°38.0'N,	73°17.0'W	93
66	39°37.7'N,	73°14.3'W	94

Each grab sample was brought aboard and two cores were removed from near the center of the sample. The cores were taken with 38 mm (1.5 inch) diameter plastic core liners. These cores were labeled and frozen for future analyses for heavy metals and the mechanical properties of sediment. The remainder of the Smith-McIntyre grab sample was removed from the grab and washed through standard geological screens (4 mm, 2 mm, 1 mm). The material trapped on screens (larger than 1 mm) was placed in labeled jars. Buffered formalin was added and the samples were stored for macrofaunal examination.

In addition, selected stations were sampled using the Smith-McIntyre bottom grab to collect samples for the Exxon Research and Engineering Company of Linden, N.J. and the Exxon Production Research Company of Houston, Texas (Figs. 8-11 and Tables 5 & 6), for Dr. Duedall of SUNY Stony Brook, (Fig. 8), and for Dr. Foehrenbach of the N.Y. State Department of Environmental Conservation (Table 7 and Fig. 12).

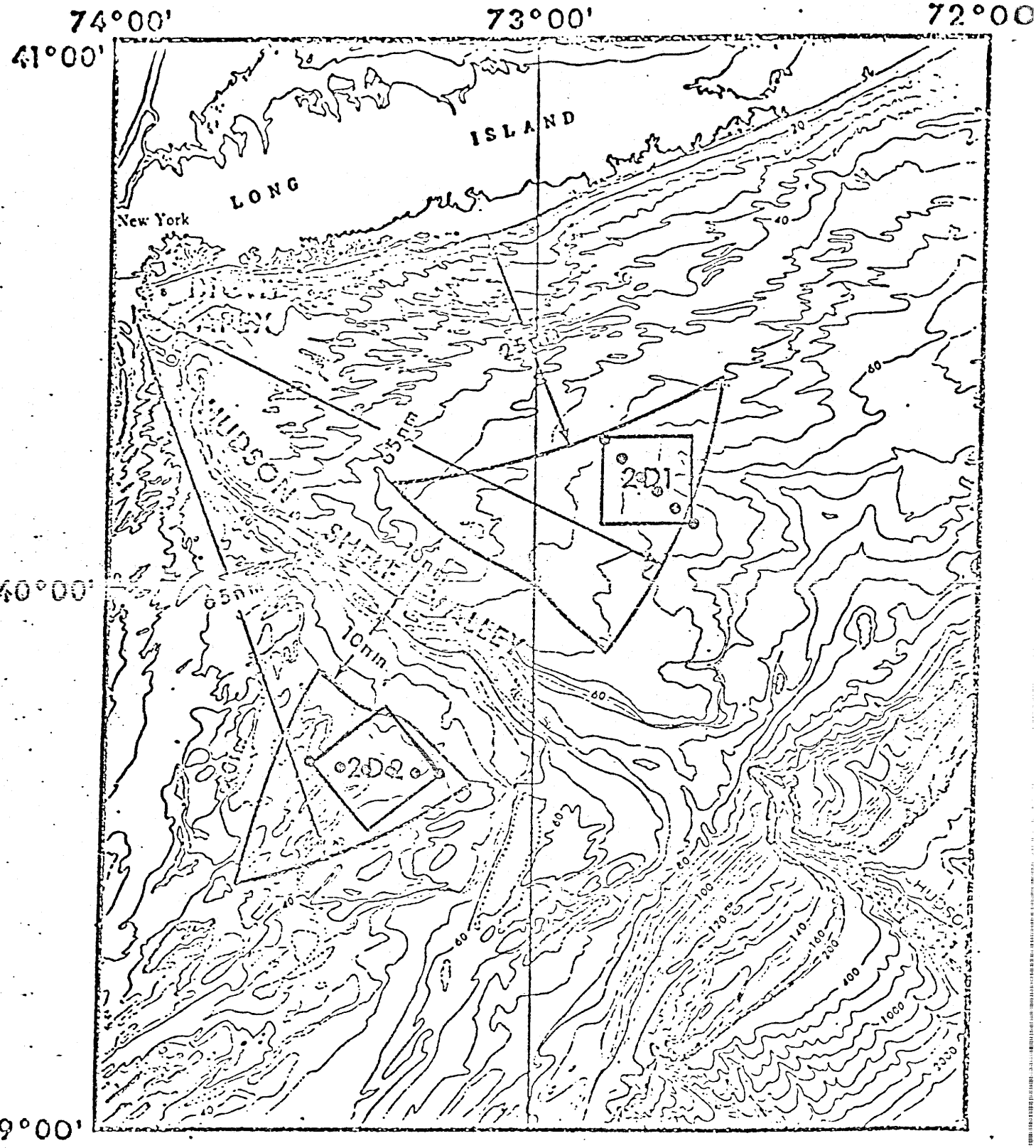


Fig. 7. Sampling locations for benthic macrofauna, heavy metals burdens in sediment, and the mechanical properties of sediments using a Smith-McIntyre bottom grab sampler.

Station positions follow:

Table 5. Sampling locations in the New York Bight Apex for Exxon and Dr. Duedall. One Smith-McIntyre grab sample per station. From each grab sample four sediment cores were removed and frozen for Exxon and one sediment core was removed and frozen for Dr. Duedall.

Lat.	Long.	Cruise Sta. #'s	
40°25'N,	73°44'W	Exxon 1 or	Duedall 1
40°25'N,	73°46'W	2	2
40°25'N,	73°48'W	3	3
40°25'N,	73°50'W	4	4
40°23.5'N,	73°52'W	5	5
40°22'N,	73°54'W	6	6

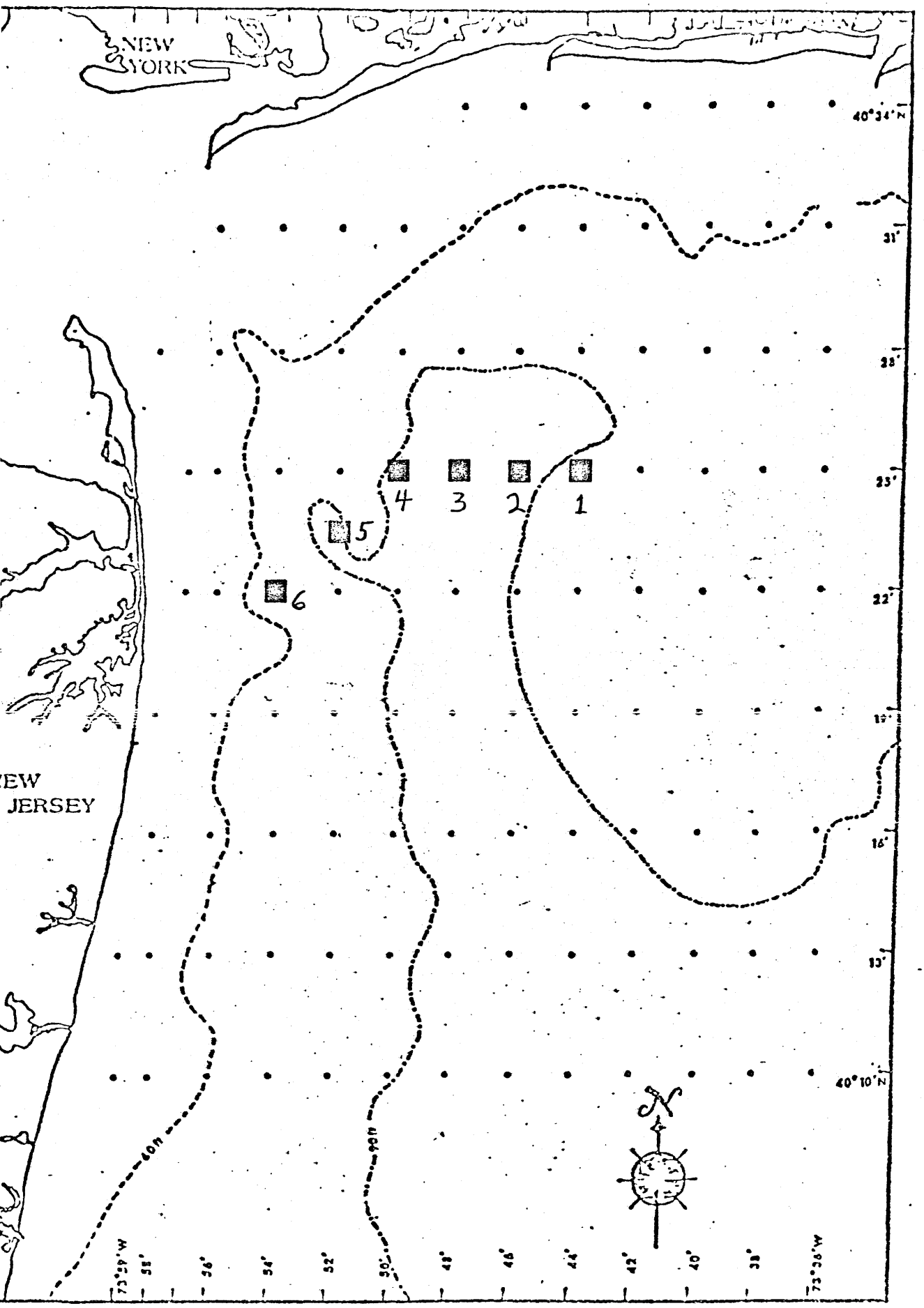
Table 6. Sampling locations in New York Bight proposed alternate waste disposal sites. One Smith-McIntyre bottom grab sample at each station. Four sediment cores removed from each grab sample and frozen for Exxon.

DUPI North-

DUPI #	Lat.	Long.	Cruise Sta. #
86	40°12.70'N,	72°47.75'W	84

DUPI South-

DUPI #	Lat.	Long.	Cruise Sta. #
29	39°38.6'N,	73°23.6'W	91



..8. Sample locations for Smith-McIntyre bottom grab samples for Exxon and Dr. Duedall.

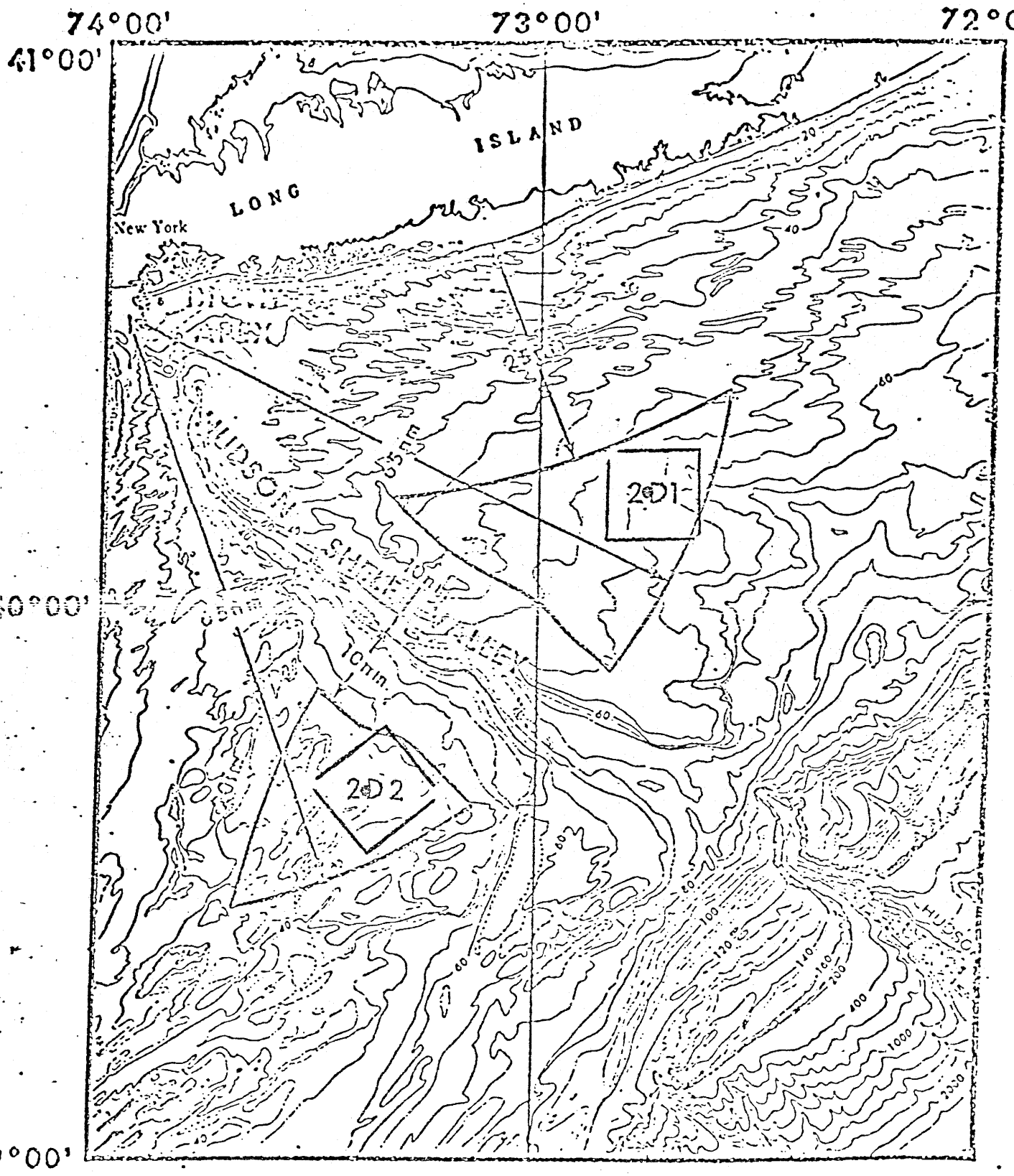


Fig. 9. Sample locations for Smith-McIntyre bottom grab samples for Exxon Research and Engineering Company and Exxon Production Research Company.

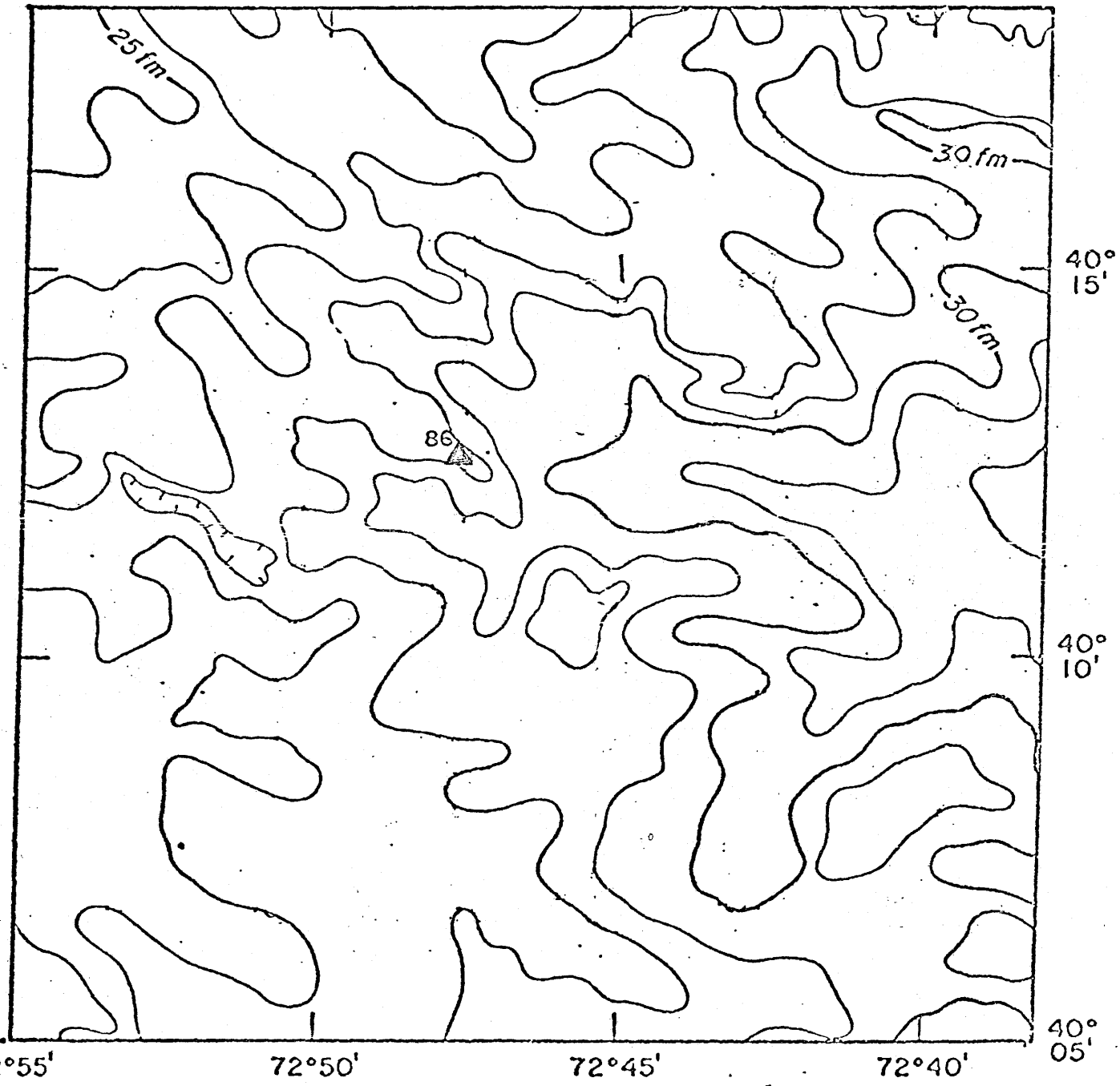
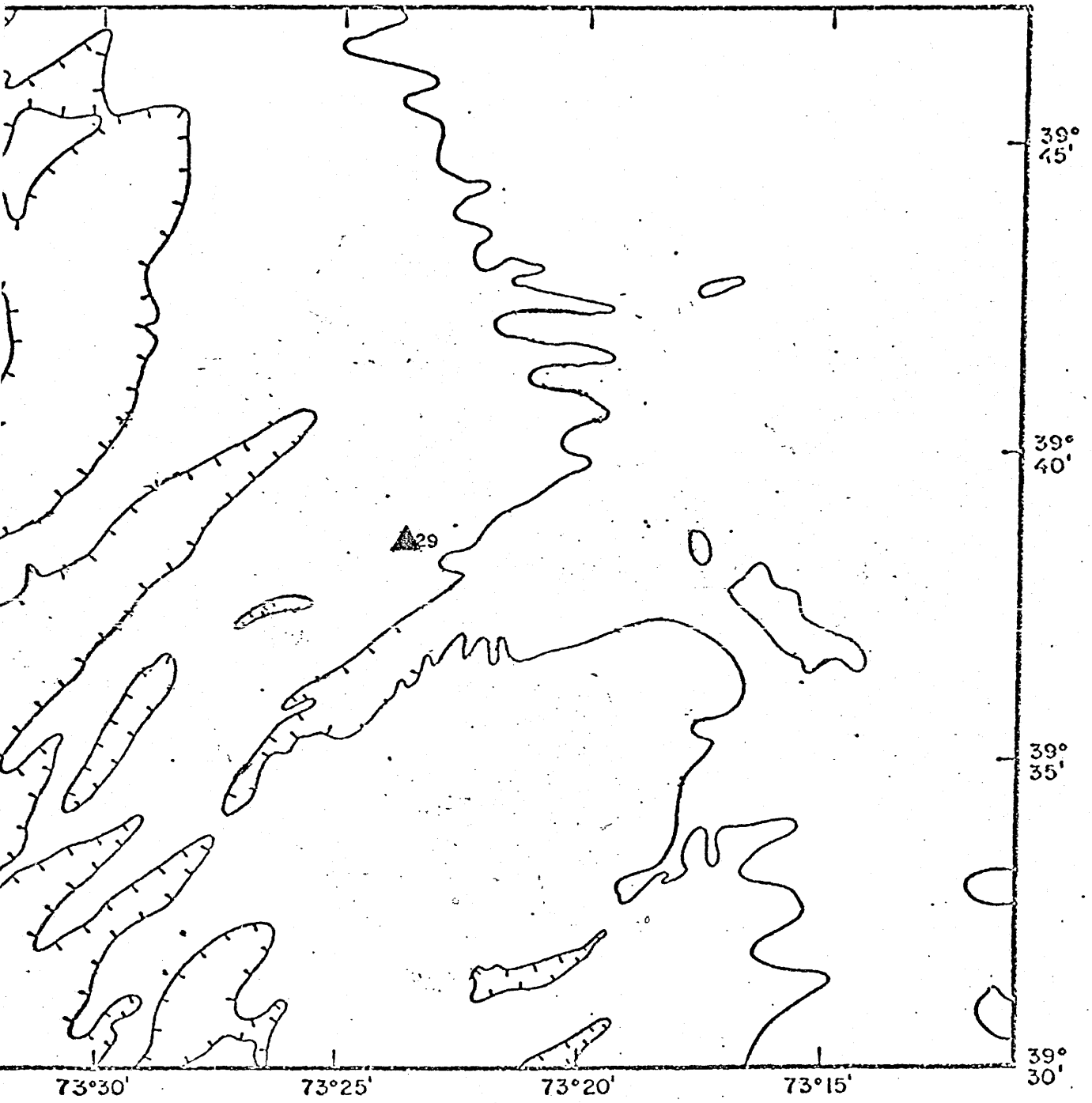


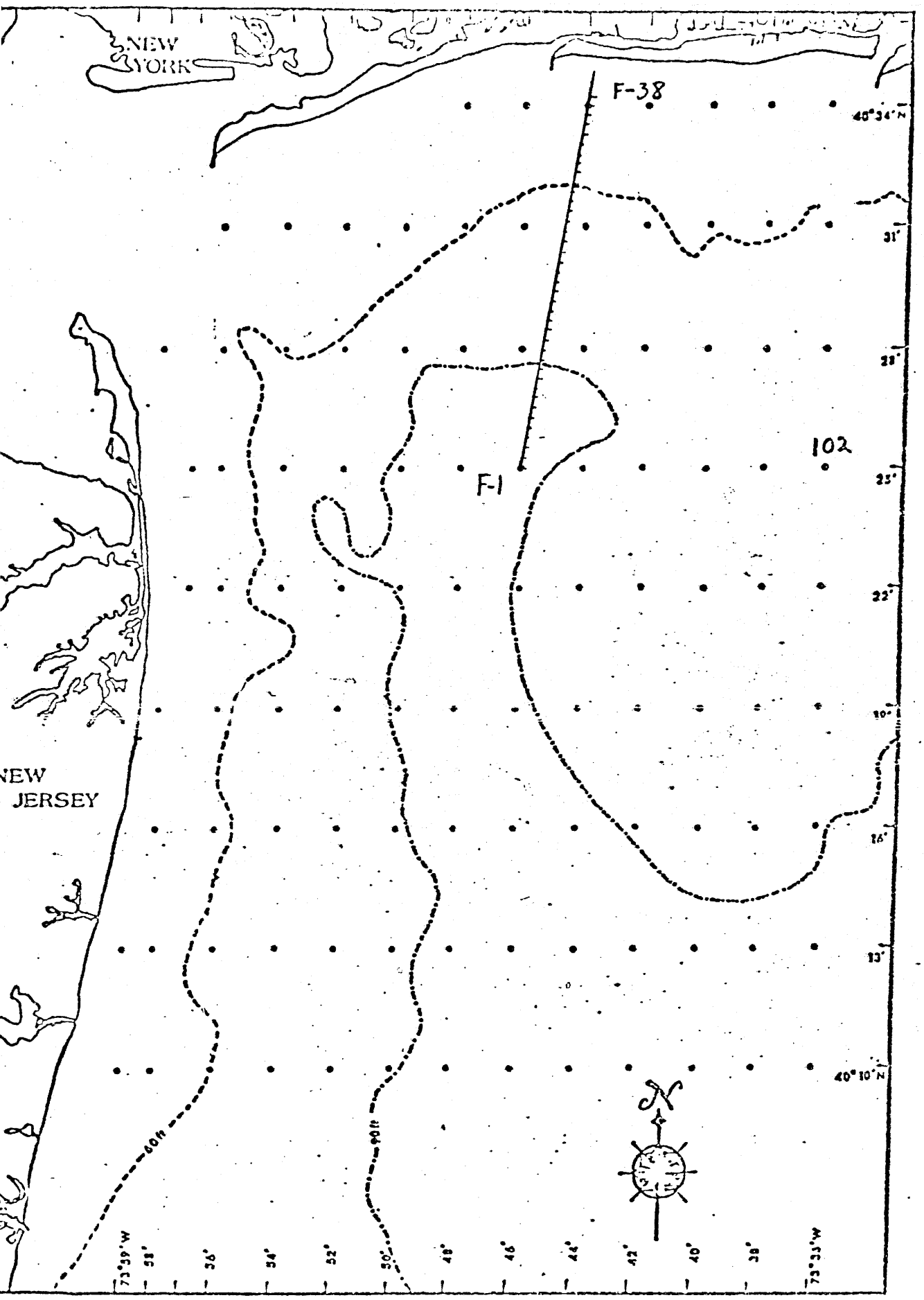
Fig. 10. Bathymetric and sample location map, Area 2D1 (northern area). Contour interval 1 fathom. ▲ Smith-McIntyre bottom grab sample for Exxon.



g. 11. Bathymetric and sample location map, area 2D2 (southern area). Contours are the 20 fm. isobath. ▲ Smith-McIntyre bottom grab sample for Exxon.

Table 7. Sampling locations in the New York Bight Apex for Dr. Foehrenbach. One Smith-McIntyre grab sample per station. One sediment core removed from each grab sample and frozen. Stations approximately one-quarter nautical mile apart.

Lat.			
40° 25.00'	x	73°46.00'	F1
40°25.23'	x	73°45.96'	F2
40°25.49'	x	73°45.86'	F3
40°25.68'	x	73°45.84'	F4
40°25.96'	x	73°45.73'	F5
40°26.23'	x	73°45.75'	F6
40°26.42'	x	73°45.62'	F7
40°26.69'	x	73°45.52'	F8
40°26.97'	x	73°45.50'	F9
40°27.25'	x	73°45.45'	F10
40°27.44'	x	73°45.43'	F11
40°27.70'	x	73°45.36'	F12
40°27.96'	x	73°45.32'	F13
40°28.24'	x	73°45.28'	F14
40°28.48'	x	73°45.24'	F15
40°28.72'	x	73°45.20'	F16
40°28.98'	x	73°45.21'	F17
40°29.18'	x	73°45.25'	F18
40°29.47'	x	73°45.15'	F19
40°29.71'	x	73°45.06'	F20
40°29.92'	x	73°44.99'	F21
40°30.17'	x	73°44.90'	F22
40°30.39'	x	73°44.82'	F23
40°30.69'	x	73°44.73'	F24
40°30.90'	x	73°44.71'	F25
40°31.18'	x	73°44.69'	F26
40°31.41'	x	73°44.65'	F27
40°31.67'	x	73°44.60'	F28
40°31.91'	x	73°44.55'	F29
40°32.14'	x	73°44.50'	F30
40°32.40'	x	73°44.44'	F31
40°32.63'	x	73°44.38'	F32
40°32.89'	x	73°44.32'	F33
40°33.12'	x	73°44.28'	F34
40°33.38'	x	73°44.21'	F35
40°33.59'	x	73°44.15'	F36
40°33.81'	x	73°44.08'	F37
40°33.95'	x	73°43.99'	F38



. 12. Sample locations for Smith-McIntyre bottom grab samples for Dr. Foehrenbach.

Results:

Ninety-seven stations (388 cores) were sampled with the multiple corer to measure total oxygen consumption by the seabed. Seventy-six stations were occupied in the Lower Hudson Estuary and New York Bight Apex. Sixty-five 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 three stations on the adjacent Continental Shelf. The data from these samples are now being processed.

Twenty-five stations (50 samples) for Smith-McIntyre bottom grab sampling were occupied in the New York Bight Apex. The twenty-five stations form a grid (1 x 1 min.) over the sewage sludge disposal area. Beyond the apex six bottom grab stations were occupied in each of the two proposed alternate waste disposal sites (60 samples total). Thus thirty-seven stations were occupied to obtain samples for investigating benthic macrofauna (110 samples), heavy metals burdens in sediment (110 samples), and the mechanical properties of sediments (110 samples).

In addition six stations in the apex (a transect over the dredge spoil and sewage sludge disposal sites) were occupied to collect bottom sediment samples for Exxon Research and Engineering Company of Linden, N.J. and Exxon Production Research Company of Houston, Texas. At the same time the same six stations were also occupied to collect bottom sediment samples for Dr. Iver Duedall of SUNY Stony Brook. Thirty-eight bottom sediment samples were also collected for Dr. Jack Foehrenbach along a transect between the sewage sludge area (40°25'N, 73°46'W) and Atlantic Beach, Long Island

SUBMITTED BY:

James P. Thomas

James P. Thomas, Chief
Biological Oceanography Investigations

Date 4/22/75

John B. Pearce

John B. Pearce, Director
Ecosystems Investigations

Date 23 IV 75

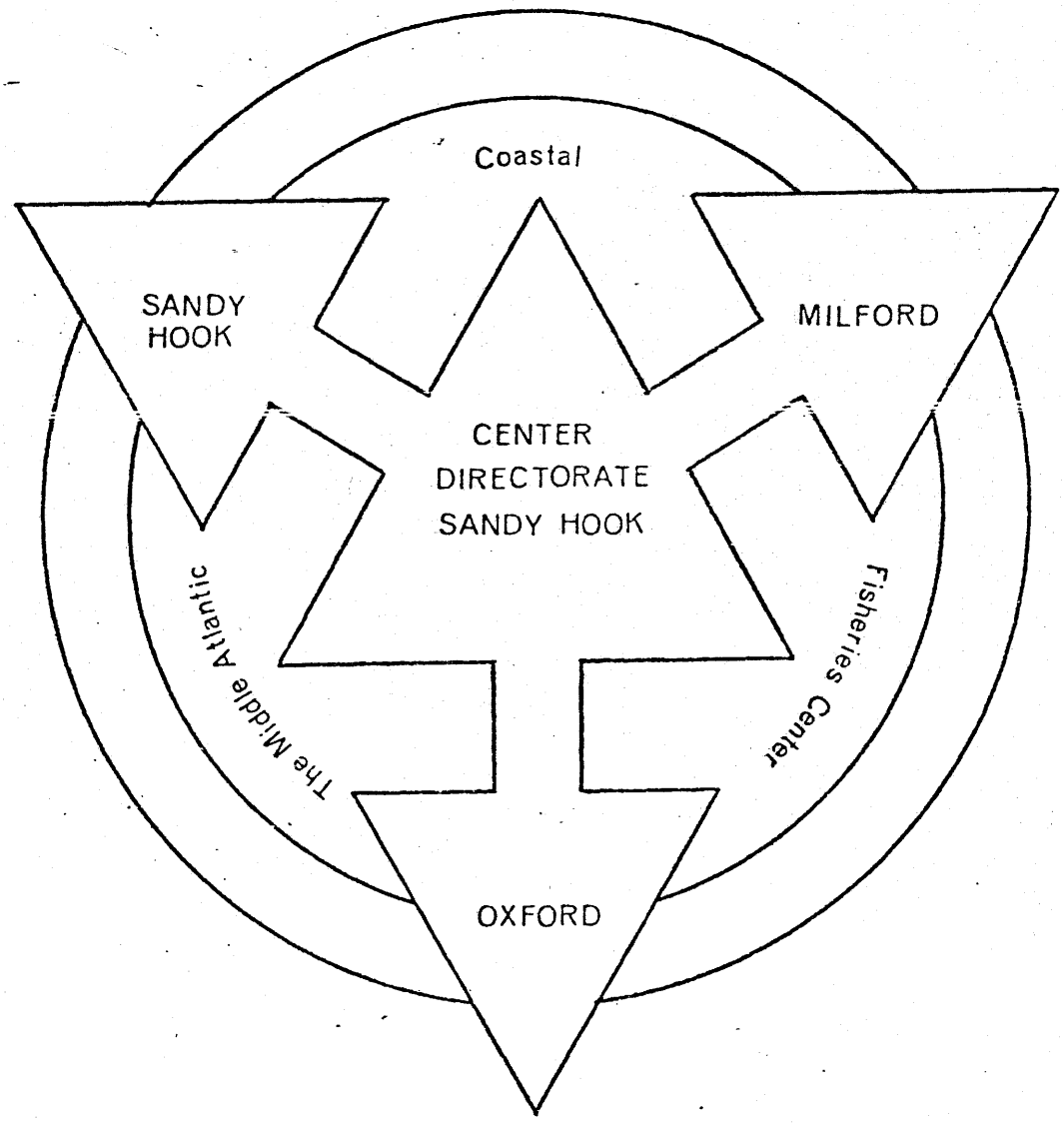
John Hobson

for Carl J. Sindermann, Center Director
Middle Atlantic Coastal Fisheries Center

Date 4/23/75

CRUISE REPORT
NOAA SHIP ALBATROSS IV AND CHARTER VESSEL ATLANTIC TWIN
ALBATROSS - MARCH 4-18, ATLANTIC TWIN - MARCH 18-24
1975 SPRING GROUNDFISH SURVEY
U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



May 7, 1975

CRUISE REPORT

1975 Spring Groundfish Survey

Part I - Middle Atlantic Bight

R/V Albatross IV 75-3 R/V Atlantic Twin 275

Albatross IV sailed from Woods Hole, Mass., on March 4, 1975 and returned March 18, 1975.

The chartered vessel Atlantic Twin sailed from Sandy Hook, New Jersey on March 18 and completed coastal survey operations on March 24, 1975.

The purpose of the two-vessel survey was to conduct the spring groundfish and ichthyoplankton survey in southern New England and Mid-Atlantic Bight waters.

The Albatross surveyed the area from Nantucket to North Carolina from 15 fathoms, to 200 fathoms. The Atlantic Twin occupied stations from Montauk, N. Y. to Atlantic City, N. J. from 5 to 15 fathoms.

The Middle Atlantic Coastal Fisheries Center, headquartered at Sandy Hook, New Jersey now has the responsibility to conduct the Middle Atlantic portion of the groundfish survey. Close cooperation and a common data bank are maintained between this Center and the Northeast Fisheries Center at Woods Hole, Mass. The surveys are a cooperative effort.

CRUISE OBJECTIVES

1. Investigate the distribution, weights and abundance of finfish and invertebrates collected in a standard otter trawl from Martha's Vineyard to Cape Hatteras (see Figure 1).

2. Investigate the distribution and abundance of larval and juvenile fishes collected by 60 cm bongo nets and neuston nets at selected stations in the survey areas.

3. Sample benthic finfish and their larval and juvenile stages intensively within the apex of the New York Bight, to measure variations in the fish populations and determine differences in characteristics within areas of man-induced stress.

4. Make extensive sample collections for colleagues at both participating Centers as well as State and Federal facilities and universities. These samples are generally for life-history studies including age and growth, food habits, maturation and fecundity.

5. During the cruise obtain surface and bottom salinities and temperature profiles at all stations. On special stations take standard hydrographic measurements.

OPERATIONS - METHODS

The location of trawling stations were established prior to the cruise on the basis of random selection of starting points in areas called strata. Strata limits are based on depth, proximity,to major estuaries, bottom type and known fishing grounds.

The Albatross towed a roller rigged modified high-opening #41 trawl with 10-fathom legs and 1500 lb oval doors. The Atlantic Twin towed a modified #36 Yankee trawl with 6 fathom legs, 9 fathom ground cables and 500 lb doors. Scope varied according to depth. Surface and bottom salinity samples were collected and an XBT profile made on each station. During the tow a fathometer trace was taken for subsequent analysis of bottom contours and fish echoes. Catch processing was based on standard groundfish survey procedures; essentially sorting to species, weighing and measuring the entire catch.

Samples taken included preserved whole fish, scales, otoliths, stomachs, and gonads.

Plankton tows at preselected stations were made on the Albatross according to standard MARMAP procedures using 60 cm bongo nets.

A 15-min neuston tow was made from the Albatross using a one-meter Haedrich sampler while the trawl was fishing.

On the Albatross at preselected stations profiles of salinity, temperature, depth and oxygen were taken. A rosette Niskin sampler was used in conjunction with the STDO probe.

RESULTS

The survey completed 113 stations show in Figure 1. Included in the total either as combined or separate stations are 109 trawl hauls, 27 plankton stations and 4 STDO profiles. The Albatross completed 74 stations. The Atlantic Twin, 39 stations. One third of the Albatross time was lost due to bad weather and mechanical breakdowns. This time loss prevented the sampling of stations in North Carolina waters. Weather also curtailed operations on the Atlantic Twin.

A list of species caught with the average weight per tow are shown in Table I. The bombined catch from both vessels is summarized by five areas as shown in Figure 1.

The total catch weighed 24,971 lbs including 8,770 lbs of bony fishes, 14,316 lbs of elasmobranchs, and 1,885 lbs of invertebrates.

Plankton stations are shown in Figure 2. Samples collected during the cruise for life history or other special biological studies are listed in Table 2.

SCIENTIFIC PERSONNEL

Albatross IV

A. Pacheco, Chief Scientist
M. Silverman, Watch Chief
V. Anderson, Watch Chief
P. Berrien
A. Thoms
J. Sibunka
J. Nicholas, NEFC, Woods Hole
L. Despres, NEFC, Woods Hole
E. Lopez Viega, Inst. of Fish., Vigo, Spain
C. Wener, VIMS
L. Chao, VIMS
E. Lewis, VIMS
M. Daher, SMU

Atlantic Twin

T. Azarovitz, Chief Scientist
E. Steady, Watch Chief
R. Cushman
J. Ziskowski
D. Risler
C. Aussicker
D. Ralph, Watch Chief
J. Chertoff
B. Brown

Submitted by:

Harry J. Christensen for

Thomas R. Azarovitz, Chief
Coastal Survey Investigation

Approved by:

Arthur S. Merrill

Arthur S. Merrill, Director
Resource Assessment Investigations

Carl J. Sindermann

Carl J. Sindermann, Center Director
Middle Atlantic Coastal Fisheries Center

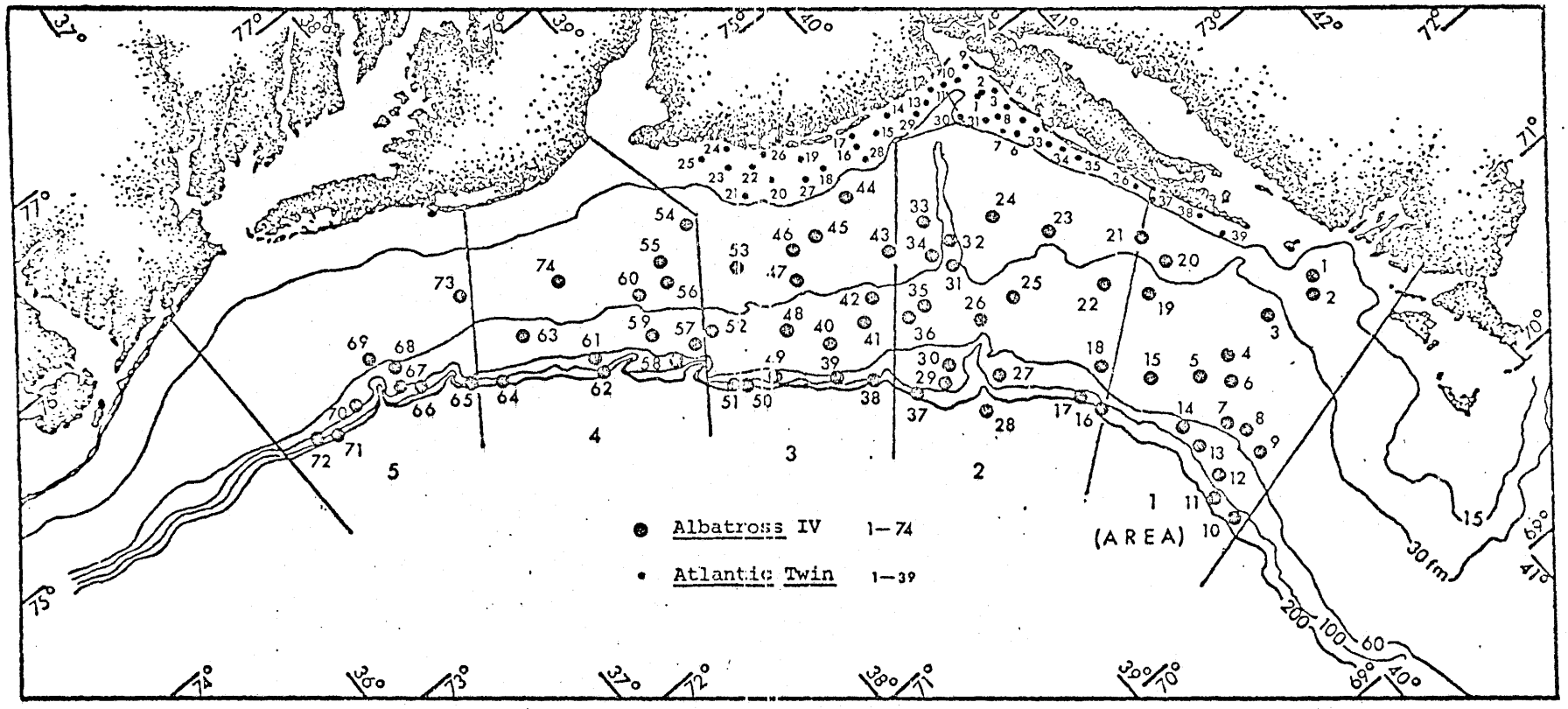


Figure 1. Plot of stations completed during spring groundfish survey, Albatross IV and Atlantic Twin, March 4-24, 1975. Catch areas 1 through 5.

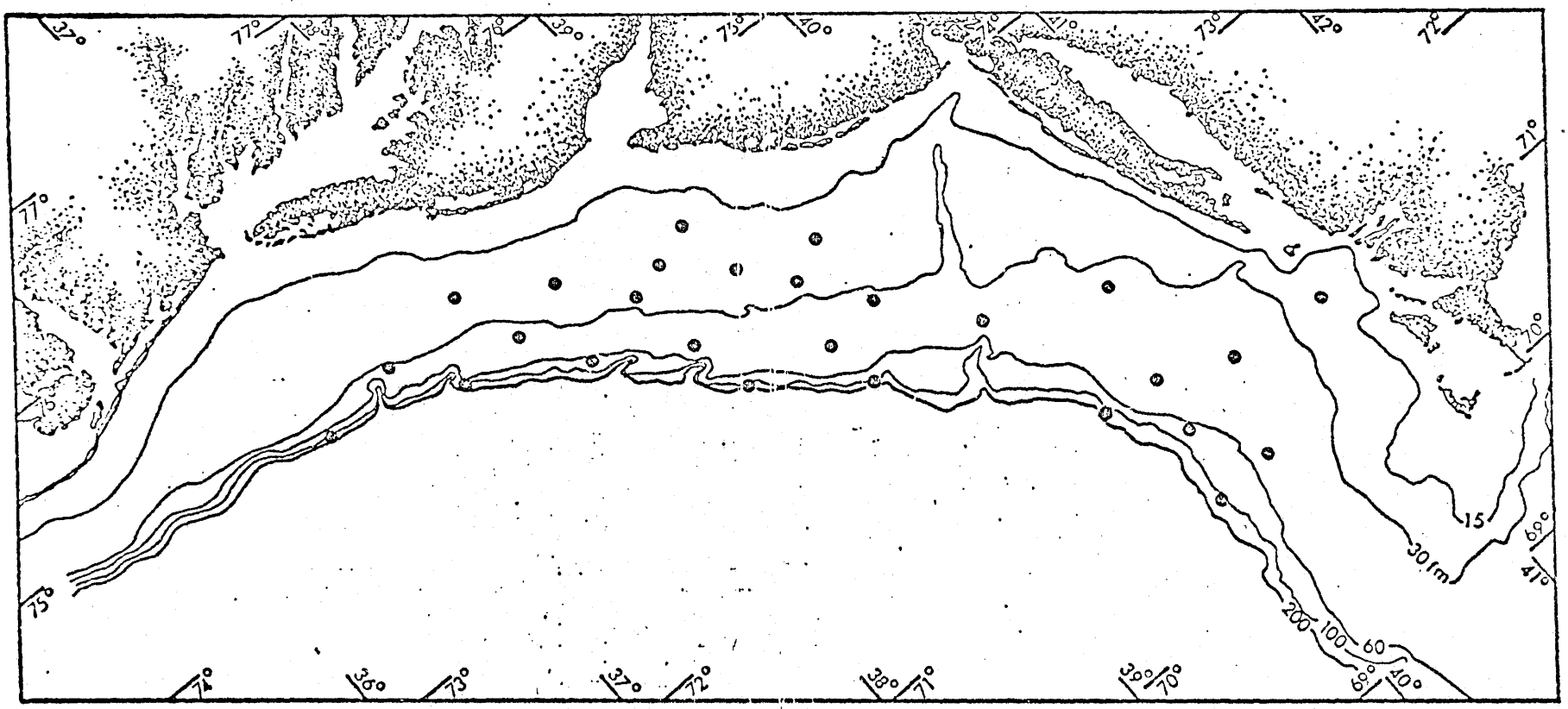


Figure 2. Plot of plankton stations completed during spring groundfish survey, Albatross IV, March 4 - 24, 1975.

Table 1.

Area No. of Tows	1 19	2 34	3 35	4 12	5 8	Total Wt. (lbs)
Hagfish	<.1	<.1	<.1	--	<.1	4.5
Chain dogfish	--	--	<.1	--	--	0.5
Smooth dogfish	--	--	--	--	19.6	157.0
Spiny dogfish	60.1	178.3	79.6	82.1	157.2	12,239.5
Atlantic torpedo	--	--	0.7	--	--	25.0
Little skate	24.6	17.0	19.2	3.7	--	1,765.0
Winter skate	4.1	1.6	<.1	--	--	133.5
Rossette skate	--	<.1	--	--	<.1	1.5
Conger eel	0.2	--	<.1	--	0.6	10.5
Eel Uncl.	--	<.1	--	--	--	0.5
Blueback herring	0.3	<.1	<.1	--	--	7.5
Alewife	4.3	0.5	<.1	2.8	--	101.5
Atlantic menhaden	--	--	<.1	--	--	1.0
Atlantic thread herring	<.1	<.1	0.1	--	--	5.0
American shad	0.1	0.1	<.1	<.1	--	11.0
Bay anchovy	--	--	<.1	--	--	.5
Atlantic argentine	<.1	--	--	--	0.1	1.5
Longtooth angle mouth	--	<.1	--	--	--	0.5
Pearlsides	--	<.1	<.1	<.1	0.1	3.0
Greeneyes	<.1	<.1	<.1	<.1	0.1	5.5
Myctophidae	<.1	<.1	<.1	<.1	0.1	7.0
Lanternfish	--	--	<.1	--	--	0.5
Hatchetfish	--	<.1	<.1	<.1	0.6	2.5
Goosefish	22.3	6.8	1.8	3.6	10.3	809.0
Atlantic batfish	--	<.1	<.1	--	--	2.5
Pollack	0.1	0.8	--	--	--	31.0
Atlantic cod	7.4	10.1	4.1	--	--	630.0
Silver hake	65.2	29.8	5.9	3.0	4.4	2,513.0
Red hake	3.6	7.7	3.4	1.0	1.5	474.0
White hake	1.8	1.2	--	--	--	77.0
Spotted hake	0.1	<.1	0.4	1.4	1.4	49.0
Offshore hake	0.8	0.6	0.1	0.3	0.6	47.0
Gadidae Uncl.	--	<.1	<.1	<.1	0.6	3.5
Fawn cusk-eel	0.7	<.1	<.1	<.1	0.6	20.0
Striped cusk-eel	--	--	0.1	--	--	4.0
Ocean pout	2.5	1.8	1.4	--	--	160.0
Atlantic silverside	--	<.1	<.1	--	--	1.0
Beardfish	--	--	<.1	--	--	0.5

Table 1.--Continued

Area No. of Tows	1 19	2 34	3 35	4 12	5 8	Total Wt. (lbs)
American John-Dory	--	--	<.1	<.1	0.3	3.0
Longspine snipefish	--	--	<.1	0.1	--	3.5
Lined seahorse	--	<.1	<.1	--	--	1.5
Northern pipefish	<.1	0.3	<.1			14.5
Black sea bass	--	<.1	<.1	3.9	25.9	257.5
Cardinal fish	<.1	--	--	--	--	1.0
Tilefish	0.4	<.1	<.1	--	--	9.5
Bluefish	--	--	--	--	0.6	5.0
Scup	--	--	2.9	25.7	51.6	823.0
Tautog	--	--	<.1	--	--	3.0
Cunner	0.3	<.1	--	--	--	6.5
Northern sennet	--	--	<.1	--	--	0.5
Snake blenny	<.1	--	--	--	--	0.5
Rock gunnel	--	--	<.1	--	--	0.5
Sand lance	--	<.1	0.1	--	--	4.5
Atlantic cutlassfish	--	--	--	--	<.1	0.5
Atlantic mackerel	0.2	2.9	<.1	<.1	--	104.0
Butterfish	3.5	0.6	0.4	6.6	68.5	728.5
Blackbelly rosefish	0.2	0.2	0.7	<.1	<.1	15.0
Armored searobin	2.0	0.2	0.7	0.1	0.2	56.0
Northern searobin	0.9	0.1	0.7	42.9	1.4	573.0
Striped searobin	--	--	--	5.6	2.1	84.0
Sea raven	0.2	<.1	<.1	--	--	8.0
Grubby	--	<.1	--	--	--	0.5
Longhorned sculpin	0.2	<.1	0.1	--	--	12.0
Deepwater flounder	<.1	<.1	--	--	--	1.0
Summer flounder	5.2	1.6	0.4	0.8	3.3	206.5
Fourspot flounder	4.9	2.0	0.3	0.8	0.5	186.5
Windowpane	1.6	3.1	5.4	0.3	--	328.0
Etropus sp.	<.1	0.1	0.2	<.1	--	12.5
Citharichthys sp.	0.2	0.1	.1	<.1	0.6	13.5
Bothidae sp.	--	--	<.1	<.1	--	2.0
Yellowtail flounder	2.1	2.0	0.9	--	--	139.5
Winter flounder	0.2	2.4	0.4	--	--	100.0
Witch flounder	<.1	<.1	0.1	0.2	0.4	11.5

Table 1.--Continued

Area No. of Tows	1 19	2 34	3 35	4 12	5 8	Total Wt. (lbs)
Scallops	0.4	4.2	9.8	2.4	0.6	525.5
Loligo	15.2	8.5	14.8	7.6	40.6	1,527.5
Illex	<.1	<.1	0.2	0.2	0.4	15.0
Cancer crabs	0.4	0.2	0.5	0.5	0.5	45.5
Lobster	0.9	0.7	1.5	<.1	3.1	126.5

Table 2. Station and sampling information for 1975 Spring Groundfish Survey.

I.

Station Type	No. of Stations
Trawl	109
Bongo	27
Neuston	109
STDO	4
XBT	82

II. Sampling Information

1. F. Nichy, Age and Growth (NEFC)

Species	Otoliths	Scales
Atlantic cod	9	
Pollock	2	
Silver hake	713	
Red hake	273	
White hake	44	
Goosefish	111	
Windowpane flounder	-	20
Winter flounder	-	9
Gray sole flounder	-	10
Yellowtail flounder	-	50

2. R. Maurer, Feeding Habits (NEFC)

Species	Adults	Juveniles
Silver hake	121	59
Spotted hake	68	-
Red hake	35	2
Butterfish	42	10
Scup	52	10
Yellowtail flounder	34	-
Ocean pout	18	-
Little skates	52	-

3. Dr. R. Livingstone, Jr., Maturity (NEFC)

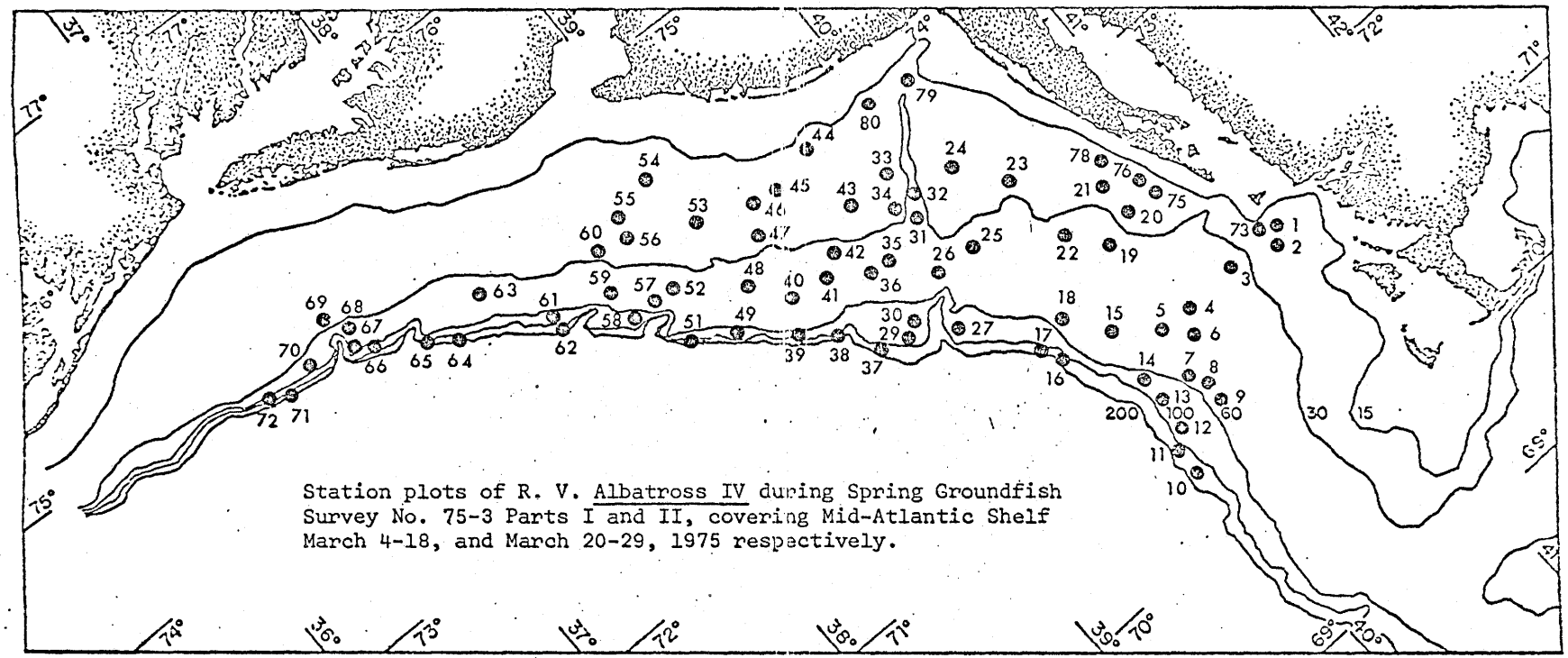
Species	Samples
Atlantic cod	9
Pollock	2
Silver hake	726
Red hake	273
White hake	44
Goosefish	131
Windowpane	20
Winter flounder	10
Gray sole flounder	10
Yellowtail flounder	53

Table 2.--Continued

4. S. Wilk, Life History studies (MACFC)

Species	Samples
Blueback herring	2
Alewife	13
American shad	7
Atlantic menhaden	1
Greeneyes	1
Goosefish	36
Atlantic cod	6
Offshore hake	16
Silver hake	415
Red hake	185
Spotted hake	3
White hake	16
Fawn cusk-eel	53
Ocean pout	20
Tilefish	1
Atlantic mackerel	67
Butterfish	80
Blackbelly rosefish	3
Armored searobin	13
Northern searobin	7
Longhorn sculpin	1
Gulf Stream flounder	6
Etropus sp.	33
Fluke	25
Fourspot flounder	120
Windowpane	54
Witch flounder	4
Yellowtail flounder	42

5. Special Collections
   a. J. Culliney (MBL), R. Turner (Harvard) Wood samples
   b. G. Waring (NEFC) Little skates and butterfish
   c. Dr. C. Hubbs (SIO) hagfish
   d. J. Shaklee (Univ. of Ill.) selected species
   e. Dr. J. Craddoch (WHOI) Myctophids
   f. A. Tibbetts (NEFC) Loligo and Illex, squid.
   g. E. Lewis (VIMS) crustacea
   h. L. Mercer (VIMS) black sea bass
   i. D. Flescher (NEFC) alewives and blueback
   j. Dr. P. Butler (EPA) spiny dogfish and goosefish
   k. Dr. S. Chang (MACFC) summer flounder, scup, butterfish



The above stations 1-72 were completed during Part I and stations 73-134 were completed during Part II of the Albatross IV 1975 Spring Survey. Stations 81-134 are shown on the Georges Bank section of this report. The given species on the following pages are listed and plotted by consecutive station numbers and the average weight given for each species at each station does not include juveniles unless stated. Catches less than a certain weight are plotted on the species chart, but are not listed. The station numbers listed correspond to those plotted on the above chart.

LORAN BEARINGS OF TRAWL STATIONS

PART I

STATION	LORAN BEARINGS	
	1H7	3H4
1	2792	5848
2	2827	5860
3	2846	5727
4	2897	5606
5	2908	5519
6	2934	5645
7	2966	5532
8	2968	5618
9	2996	5692
	1H3	3H4
10	3895	5548
11	3924	5489
	1H7	3H4
12	2993	5466
13	2981	5449
14	2967	5379
15	2919	5301
16	2943	5074
17	2943	5027
18	2917	5115
19	2831	5268
20	2819	5311
21	2796	5220
22	2859	5132
23	2792	4931
24	2783	4717
25	2860	4851
26	2883	4714
27	2927	4735
29	2933	4561
30	2918	4579
31	2839	4620
32	2823	4602
33	2808	4487
34	2831	4526
35	2869	4518
36	2883	4461
37	2932	4436
38	2923	4292
39	2919	4190
40	2897	4118
41	2893	4255
42	2868	4299
43	2837	4358
44	2804	4181
45	2830	4098
46	2843	3995
47	2864	4003
48	2887	3968

STATION	LORAN BEARINGS	
	3H5	3H4
49	2792	3874
51	2810	3731
52	2897	3699
53	3013	3795
54	3066	3620
55	3036	3516
56	3010	3540
57	2906	3599
58	2882	3541
59	2930	3409
60	2988	3377
61	2925	3202
62	2917	3194
63	2974	2982
64	2934	2875
65	2945	2743
66	2945	2550
67	2951	2486
68	2981	2422
69	2989	2388
70	2953	2340
71	2927	2225
72	2927	2142

PART II

STATION	LORAN BEARINGS	
	3H4	1H7
73	5851	2779
75	5390	2762
76	5350	2780
78	5170	2747
79	4555	2735
80	4337	2779
	3H4	1H3
81	5608	3883
82	5707	3868
83	5844	3916
84	5810	3860
85	5770	3844
86	5675	3773
87	5800	3708
88	5820	3610
89	5922	3557
90	5971	3509
91	6008	3457
92	5990	3370
93	6945	3326
94	6045	3280
95	6135	3505
96	6175	3410
97	6195	3437
98	6244	3478
100	6284	3412
101	6307	3335
102	6282	3258
103	6262	3200
104	6305	3120
105	6370	2799
106	6380	2680
107	6276	2805
108	6253	2875
109	6233	2875
110	6144	3084
111	6055	3103
112	6056	2895
113	6052	2815
114	6114	2798
115	6131	2751
116	6190	2644
117	6112	2646
118	6150	2531
119	6145	2502
120	6197	2470
121	6196	2371
122	6236	2400
123	6253	2405
124	6340	2541
125	6348	2385
126	6304	2097
128	6071	3760
129	6122	3768
130	6180	3802
	3H4	1H7
131	6052	2981
132	6150	2982
133	6216	2901
134	6145	2872

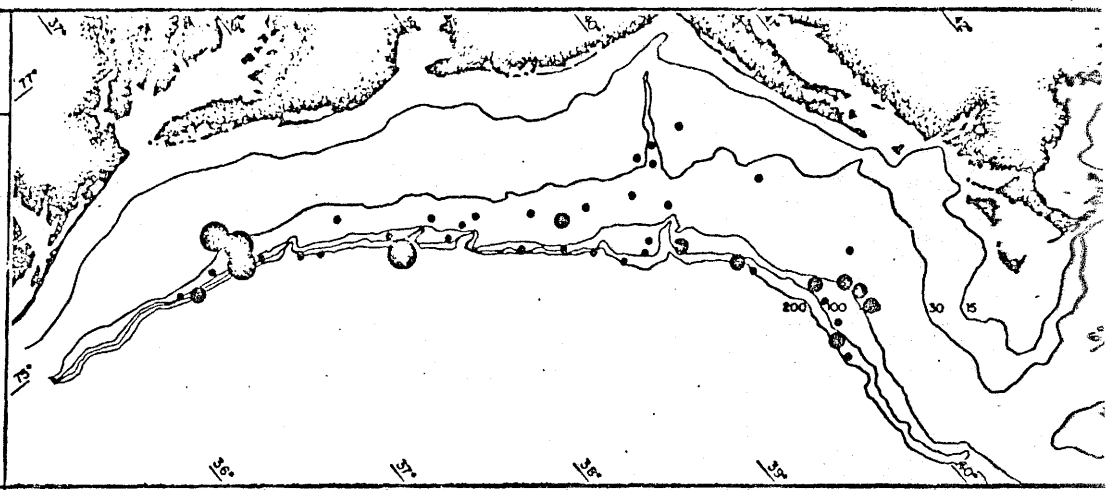
Species:

Butterfish

• = less than 5 lbs.*

● = between 5 and 50 lbs.

◉ = greater than 50 lbs.



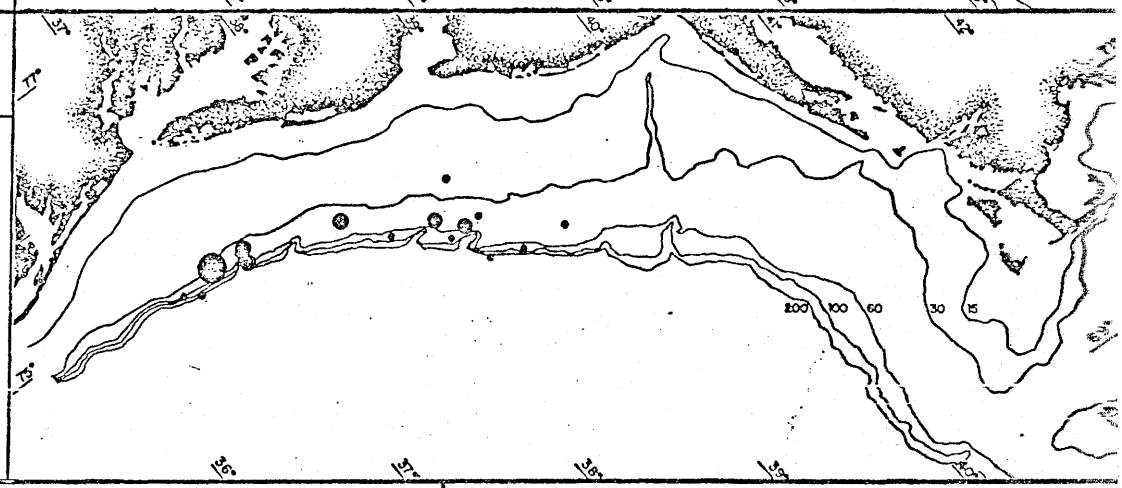
Species:

Black sea bass

• = less than 5 lbs.*

● = between 5 and 25 lbs.

◉ = greater than 25 lbs.



Species: Butterfish

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
7	40°16'	71°08'	090°	56	D	28	0.18
8	40°22'	71°02'	100°	49	D	16	0.25
9	40°19'	70°44'	090°	57	D	5	0.15
11	40°01'	70°48'	305°	130	N	7	0.14
14	40°05'	71°16'	233°	70	N	2	0.22
17	39°49'	71°48'	045°	120	D	-	0.50
27	39°34'	72°13'	045°	75	D	5	0.12
40	39°03'	73°08'	037°	41	D	8	0.30
62	37°57'	73°57'	220°	115	N	68	0.93
67	37°09'	74°36'	190°	56	D	69	0.77
68	37°09'	74°49'	190°	34	D	364	1.33
69	37°07'	74°54'	190°	26	D	68	0.25
71	36°45'	74°39'	180°	110	D	40	0.39

* Catch less than 5 lbs. plotted above, but not listed.

Species: Black sea bass

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
57	38°29'	73°42'	255°	38	N	6	0.85
59	38°17'	73°54'	315°	56	D	24	1.33
63	37°51'	74°25'	330°	37	N	11	1.00
67	37°09'	74°38'	190°	56	D	12	0.37
68	37°09'	74°49'	190°	34	D	5	2.50
70	36°58'	74°43'	190°	47	D	188	0.92

* Catch less than 5 lbs. plotted above, but not listed.

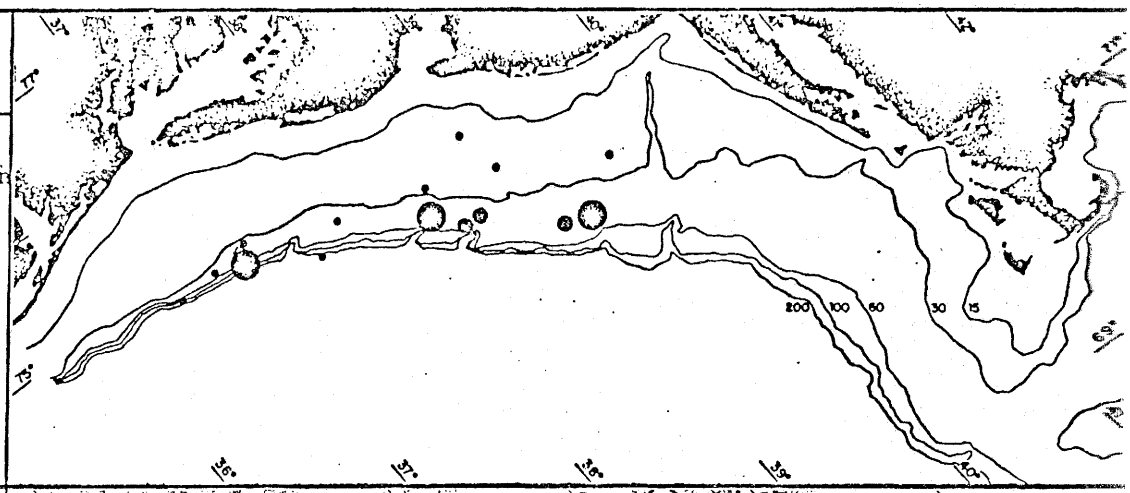
Species:

Scup

• = less than 10 lbs.*

● = between 10 - 50 lbs.

◉ = greater than 50 lbs.

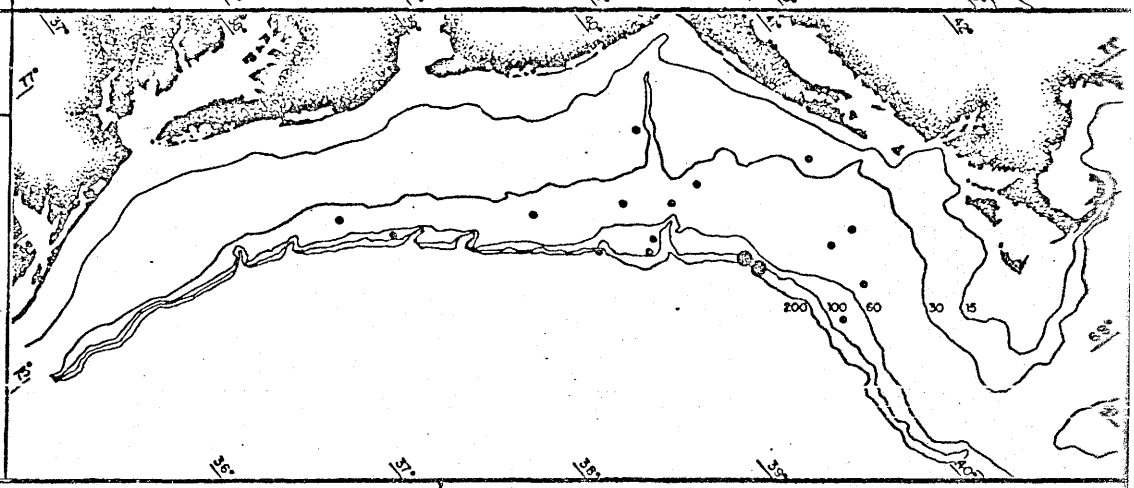


Species:

Mackerel

• = less than 10 lbs.*

◉ = greater than 10 lbs.



Species: Scup

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
40	39°03'	73°08'	037°	41	D	48	0.67
41	39°13'	73°02'	330°	42	D	51	0.85
52	38°36'	73°37'	270°	39	D	37	0.59
57	38°29'	73°42'	255°	38	N	29	0.29
59	38°17'	73°54'	315°	42	D	229	0.67
67	37°09'	74°36'	190°	56	D	395	2.65

* Catch less than 10 lbs plotted above, but not listed.

Species: Mackerel

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
16	39°52'	71°45'	050°	115	D	75	0.73
17	39°49'	71°48'	045°	120	D	14	0.87

* Catch less than 10 lbs. plotted above, but not listed.

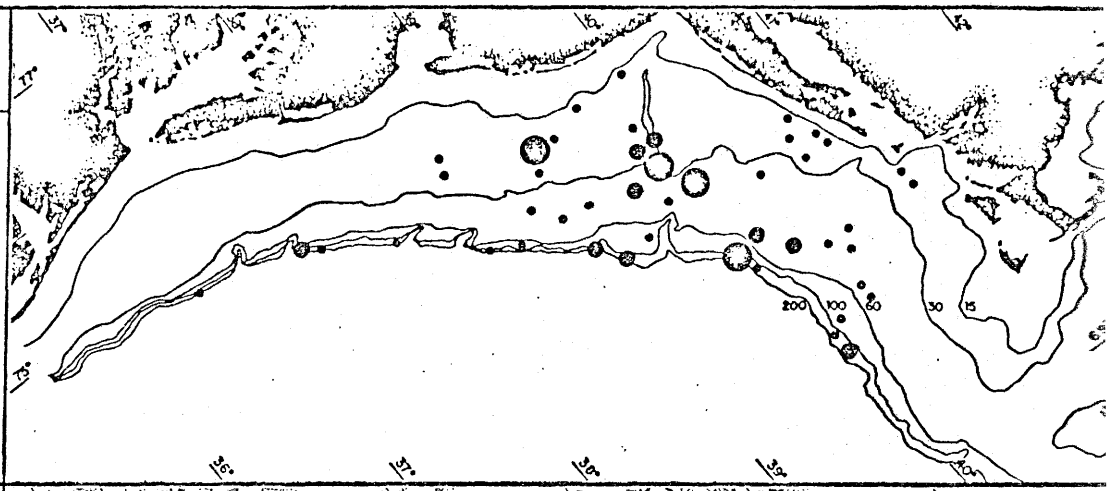
Species:

Red hake

• = less than 10 lbs.*

● = between 10 and 25 lbs.

● = greater than 25 lbs.

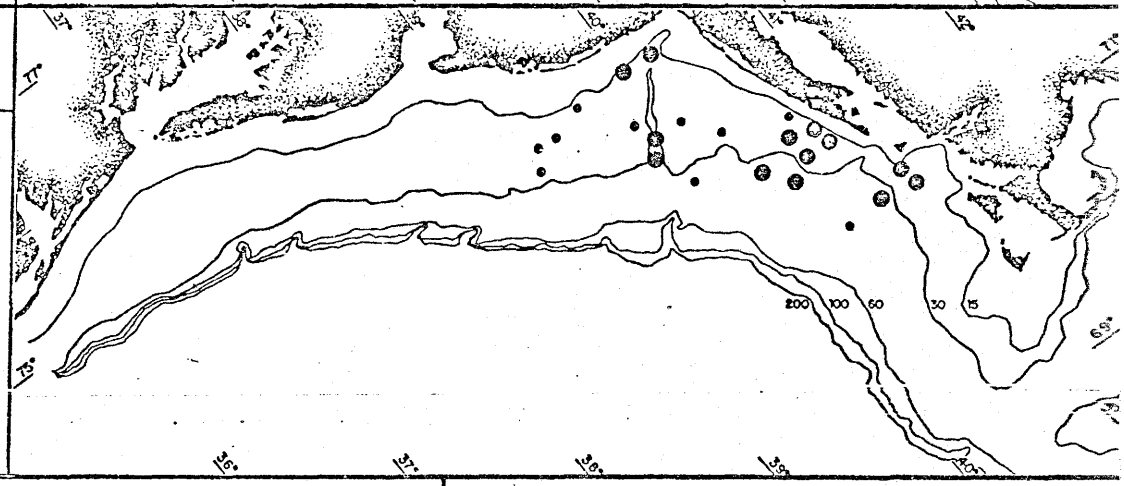


Species:

Yellowtail

• = less than 5 lbs.*

● = between 5 and 20 lbs.



Species: Red hake

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
10	41°04'	71°18'	290°	130	N	10	0.71
15	40°13'	71°40'	310°	47	D	24	0.82
17	39°49'	71°48'	045°	120	D	52	0.38
18	40°02'	71°53'	240°	47	D	23	0.74
25	39°59'	72°33'	100°	36	D	61	0.58
31	39°51'	72°59'	330°	38	D	26	0.81
32	39°54'	73°06'	150°	37	D	17	0.58
34	39°47'	73°09'	120°	25	N	18	1.00
35	39°36'	72°54'	135°	35	N	10	1.00
37	39°12'	72°29'	225°	170	N	10	0.29
38	39°05'	72°43'	190°	125	N	22	0.36
46	39°11'	73°45'	205°	23	N	27	0.87
65	37°28'	74°24'	030°	105	N	11	0.52

* Catch less than 10 lbs. plotted above, but not listed.

Species: Yellowtail

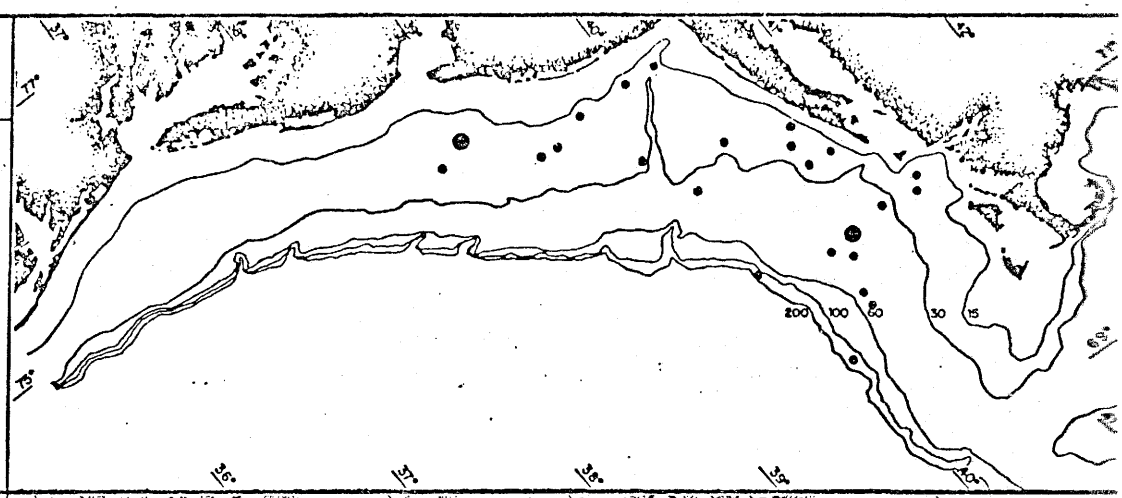
Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
2	41°41'	71°18'	310°	23	N	6	0.75
3	40°54'	71°27'	300°	33	N	8	0.66
19	40°30'	72°09'	090°	32	N	6	0.66
20	40°35'	72°08'	270°	31	N	11	0.68
21	40°34'	72°22'	270°	24	N	5	0.62
22	40°16'	72°12'	190°	33	N	5	0.83
31	39°51'	72°59'	330°	38	D	12	1.20
32	39°54'	73°06'	150°	37	D	5	1.00
73	41°10'	71°24'	315°	24	N	12	0.50
75	40°50'	72°13'	225°	18	N	7	0.87
76	40°45'	72°13'	290°	25	D	18	0.66
79	40°12'	73°38'	070°	19	D	9	0.90
80	39°49'	73°43'	090°	15	N	13	13.0

* Catch less than 5 lbs. plotted above, but not listed.

Species: Alewife

• = less than 10 lbs.*

● = greater than 10 lbs.

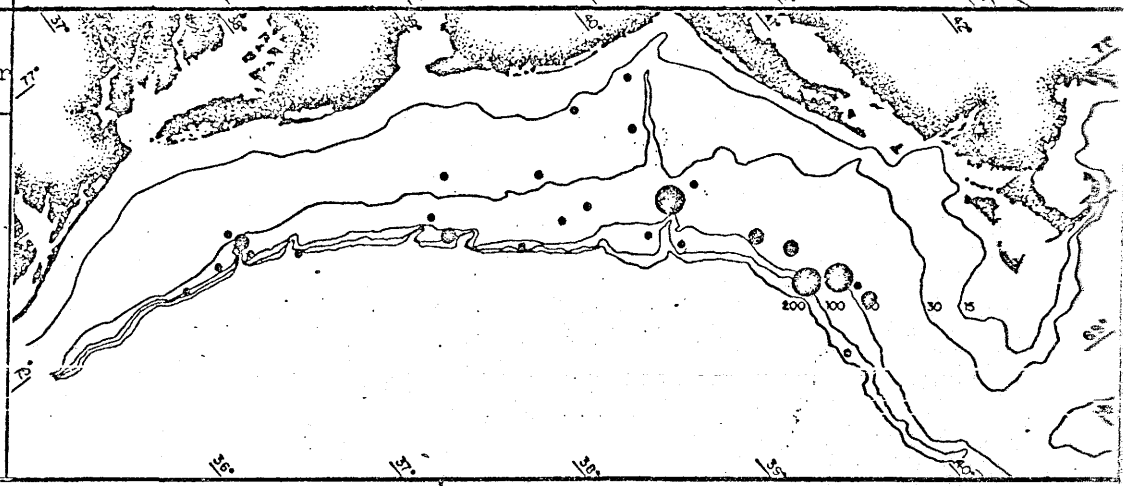


Species: Summer flounder

• = less than 5 lbs. *

● = between 5 and 25 lbs.

● = greater than 25 lbs.



Species: Alewife

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
4	40°37'	71°26'	315°	36	N	65	0.72
54	38°49'	74°14'	150°	21	D	33	0.51

* Catch less than 10 lbs. plotted above, but not listed.

Species: Summer flounder

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
7	40°16'	71°08'	090°	56	D	43	2.15
9	40°19'	70°44'	090°	57	D	20	1.67
14	40°05'	71°16'	233°	70	N	28	3.50
18	40°01'	71°53'	240°	46	D	13	4.33
26	39°45'	72°34'	125°	43	D	32	1.78
58	38°22'	73°39'	060°	63	D	5	1.67
68	37°09'	74°49'	190°	34	D	12	1.00

* Catch less than 5 lbs. plotted above, but not listed.

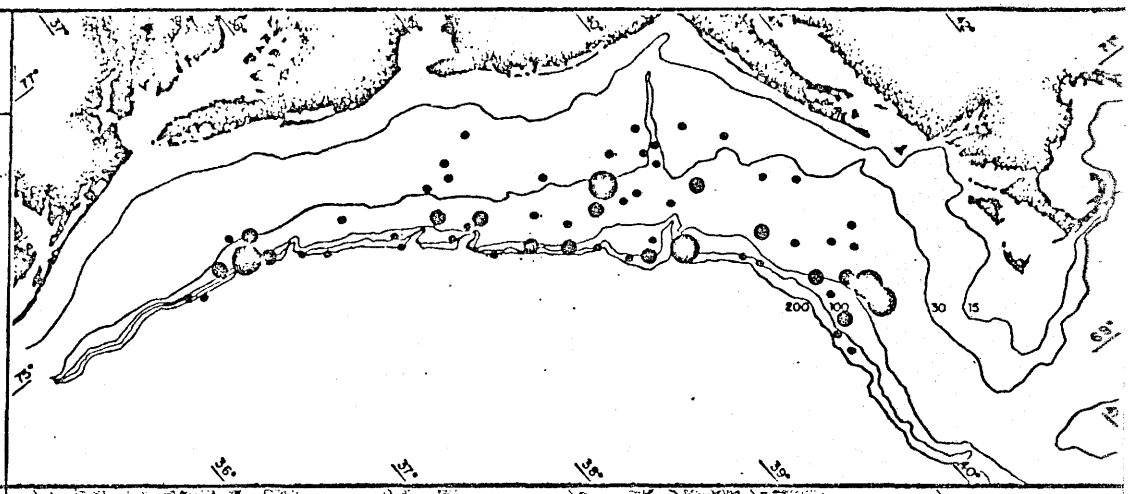
Species:

Loligo (Squid)

•= less than 25 lbs.*

●= between 25 and 50 lbs.

●= greater than 50 lbs.



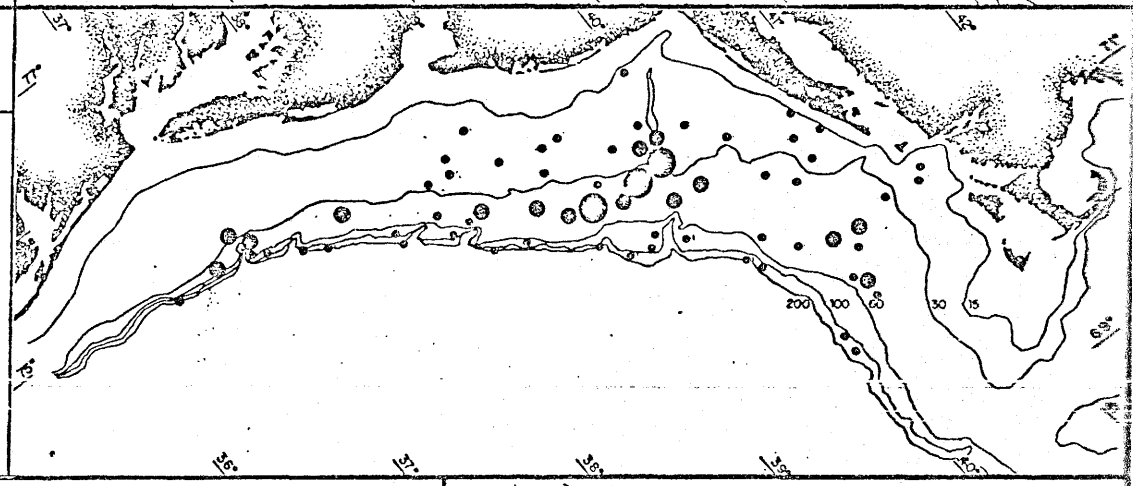
Species:

Spiny dog fish

•= less than 150 lbs.*

●= between 150 and 1000 lbs.

●= greater than 1000 lbs.



Species: Loligo (Squid)

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
7	40°16'	71°08'	090°	56	D	36	0.03
8	40°22'	71°02'	100°	49	D	56	0.03
9	40°19'	70°44'	090°	57	D	56	0.06
12	40°05'	70°57'	280°	85	N	47	0.26
14	40°05'	71°16'	233°	70	N	36	0.16
18	40°02'	71°53'	240°	47	D	63	0.02
25	39°59'	72°33'	100°	36	D	34	0.07
27	39°34'	72°13'	045°	75	D	53	0.15
29	39°20'	72°20'	315°	90	N	46	0.14
39	39°00'	72°51'	210°	66	D	32	0.10
41	39°13'	73°02'	330°	42	D	30	0.53
42	39°23'	73°10'	025°	34	D	63	0.05
49	38°40'	73°13'	210°	65	D	50	0.06
52	38°36'	73°37'	270°	39	D	26	0.06
59	38°17'	73°54'	315°	56	D	26	0.72
66	37°13'	74°33'	035°	68	N	44	0.06
67	37°09'	74°36'	190°	56	D	200	0.01
68	37°09'	74°49'	190°	34	D	27	0.05
70	36°58'	74°43'	190°	47	D	29	0.12

* Catch less than 25 lbs. plotted above, but not listed.

Species: Spiny dog fish

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
4	40°37'	71°26'	315°	36	N	172	2.91
5	40°30'	71°29'	315°	40	N	277	1.28
8	40°22'	71°02'	100°	49	D	216	0.49
25	39°59'	72°33'	100°	36	D	551	4.66
26	39°45'	72°34'	125°	43	D	222	4.03
31	39°51'	72°59'	330°	38	D	1728	2.98
32	39°54'	73°06'	150°	37	D	910	3.64
34	39°47'	73°09'	120°	25	N	266	5.21
35	39°36'	72°54'	135°	35	N	1660	4.82
36	39°29'	72°52'	250°	35	N	281	3.60
40	39°03'	73°08'	037°	41	D	366	2.52
41	39°13'	73°02'	330°	42	D	1528	2.73
48	38°56'	73°23'	180°	36	N	404	3.08
52	38°36'	73°37'	270°	39	D	297	2.85
63	37°51'	74°25'	330°	37	N	318	2.32
68	37°09'	74°49'	190°	34	D	435	8.36
69	37°07'	74°54'	190°	26	D	313	5.90
70	36°58'	74°43'	190°	47	D	441	8.47

* Catch less than 150 lbs. plotted above, but not listed.

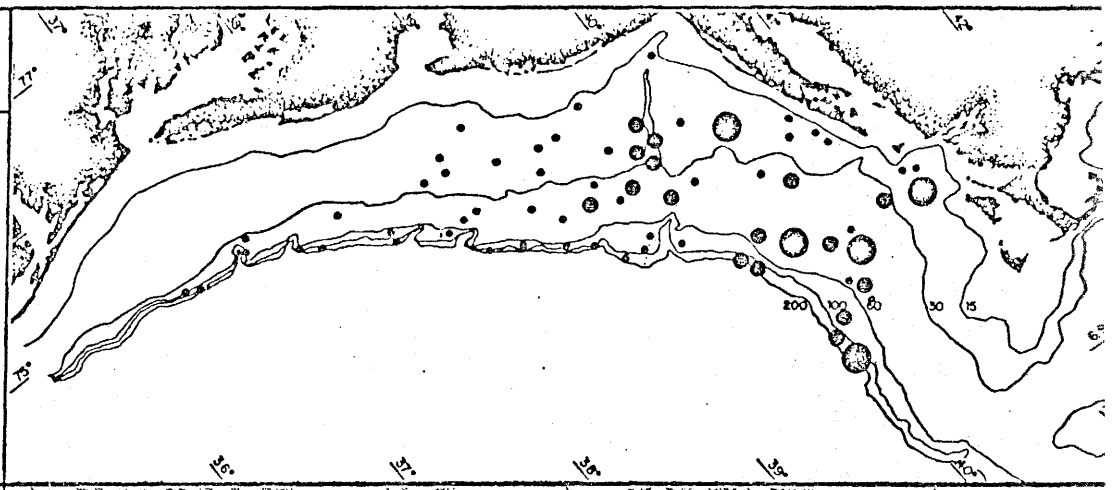
Species:

Silver hake

• = less than 30 lbs.*

● = between 30 and 100 lbs.

◉ = greater than 100 lbs.

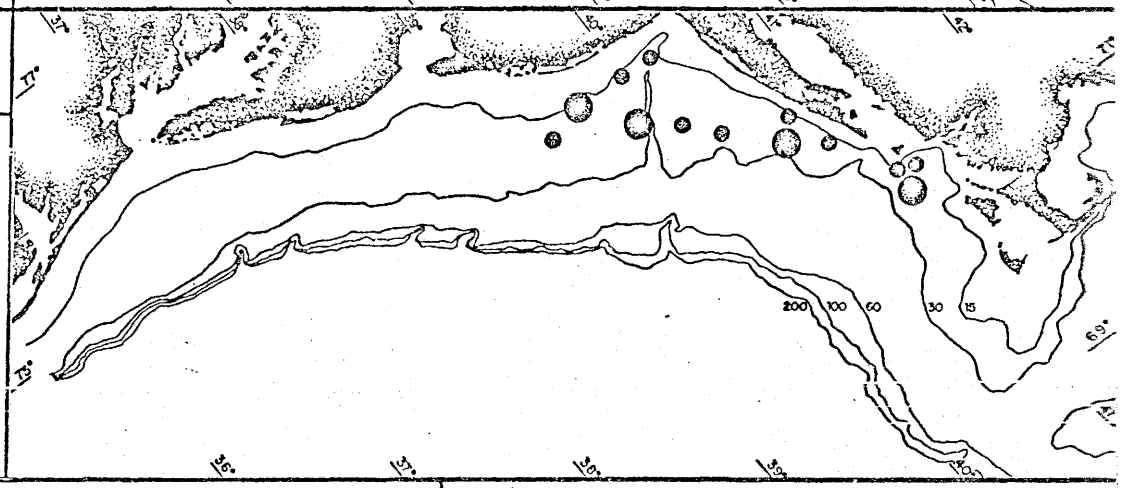


Species:

Cod

● = between 5 and 25 lbs.

◉ = greater than 25 lbs.



Species: Silver hake

Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
2	41°04'	71°18'	310°	23	N	105	0.35
3	40°54'	71°27'	300°	33	N	48	0.36
5	40°30'	71°29'	315°	40	N	32	0.39
6	40°32'	71°13'	140°	39	D	103	0.33
8	40°22'	71°02'	100°	49	D	49	0.44
10	39°59'	70°32'	290°	130	N	122	0.34
11	40°01'	70°48'	305°	130	N	50	0.49
12	40°05'	70°57'	280°	85	N	45	0.54
15	40°13'	71°40'	310°	47	D	323	0.37
16	39°52'	71°45'	050°	115	D	65	0.51
17	39°49'	71°48'	045°	120	D	65	0.59
19	40°30'	72°09'	090°	32	N	60	0.45
23	40°19'	72°48'	276°	26	N	123	0.39
31	39°51'	72°59'	330°	38	D	42	0.49
32	39°54'	73°06'	150°	37	D	36	0.45
33	39°50'	73°21'	115°	24	D	96	0.34
34	39°47'	73°09'	120°	25	N	92	0.51
35	39°36'	72°54'	135°	35	N	54	0.54

* Catch less than 30 lbs. plotted above, but not listed.

Species: Cod

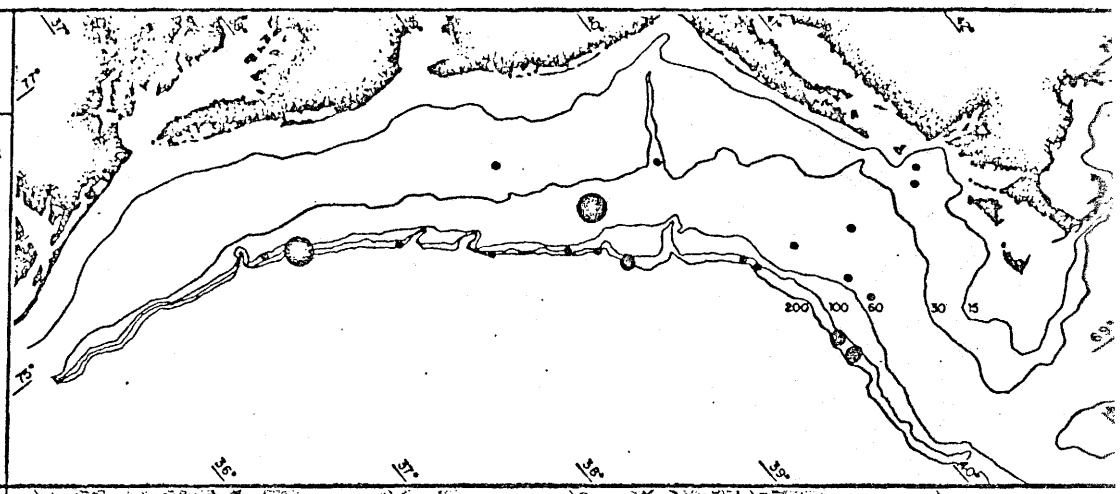
Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
1	41°08'	71°24'	135°	19	N	23	23.0
2	41°41'	71°18'	310°	23	N	36	18.0
21	40°34'	72°22'	270°	24	N	33	33.0
23	40°19'	72°48'	267°	26	N	9	09.0
24	40°09'	73°10'	235°	23	D	13	06.5
33	39°50'	73°21'	115°	24	D	38	19.0
44	39°33'	73°48'	170°	13	N	28	14.0
45	39°21'	73°43'	180°	17	N	12	12.0
73	41°10'	71°24'	315°	24	N	8	08.0
75	40°50'	72°13'	225°	18	N	9	09.0
78	40°42'	72°38'	220°	17	D	7	07.0
79	40°12'	73°38'	070°	19	D	13	06.5
80	39°49'	73°43'	090°	15	N	13	13.0

Species: Lobster

• = less than 5 lbs.*

● = between 5 and 25 lbs.

◉ = greater than 25 lbs.

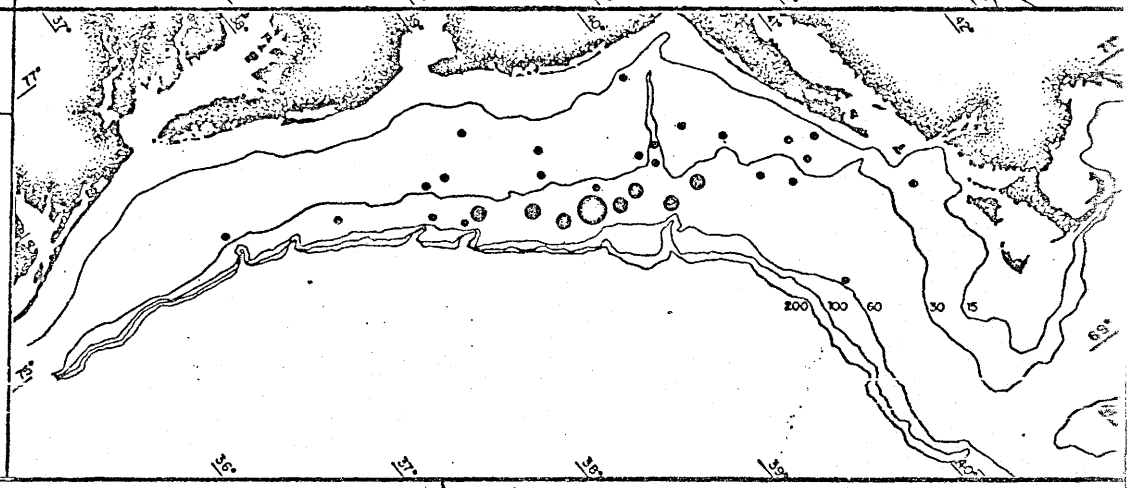


Species: Scallops

•= less than 10 lbs.*

● = between 10 and 50 lbs.

◉ = greater than 50 lbs.



Species: Lobster

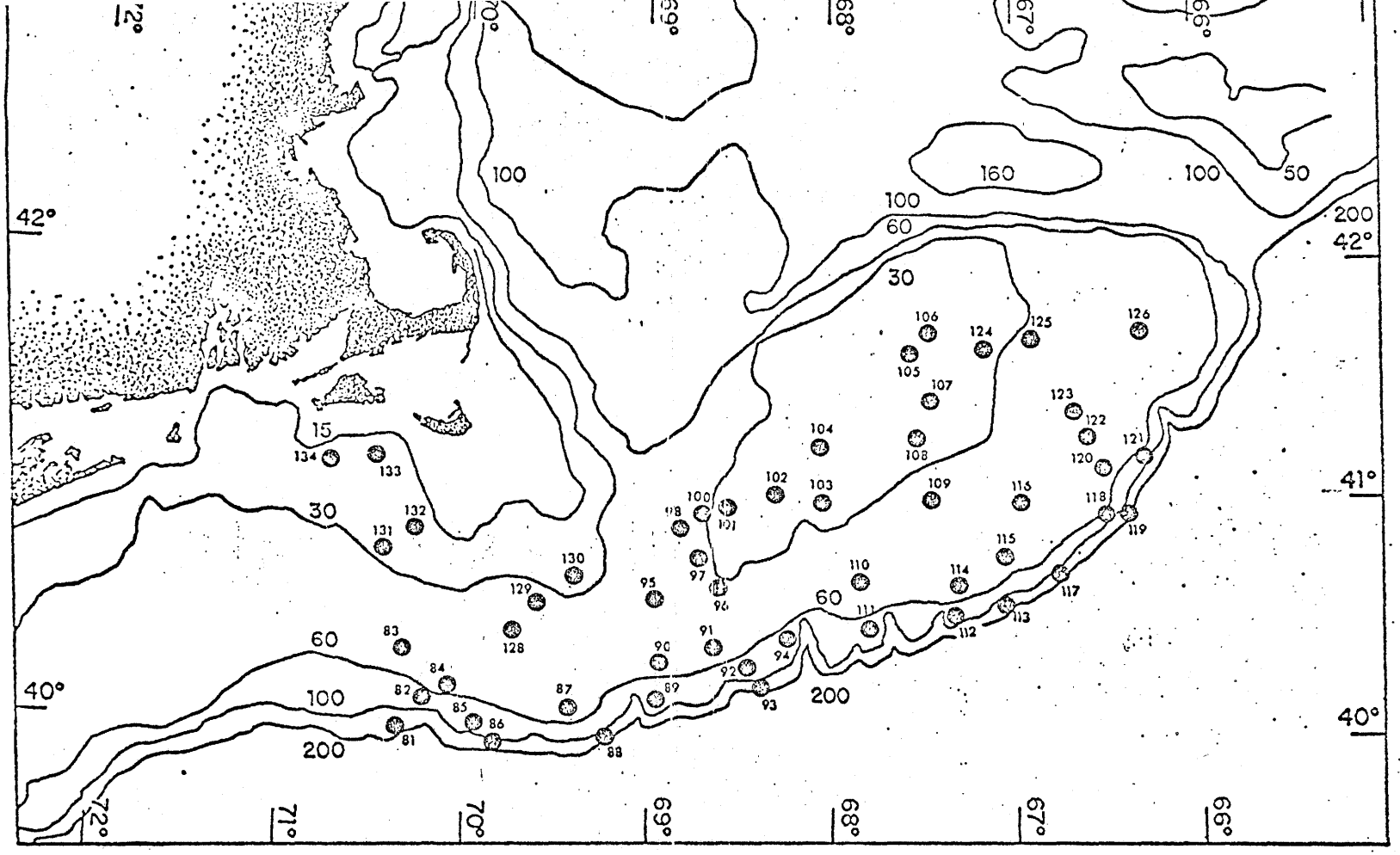
Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
10	39°59'	70°32'	290°	130	D	5	1.25
11	40°01'	70°48'	305°	130	N	6	0.75
37	39°12'	72°29'	225°	170	N	18	1.20
41	39°13'	73°02'	330°	42	D	44	3.38
65	37°28'	74°24'	030°	105	N	22	1.04

* Catch less than 5 lbs. plotted above, but not listed.

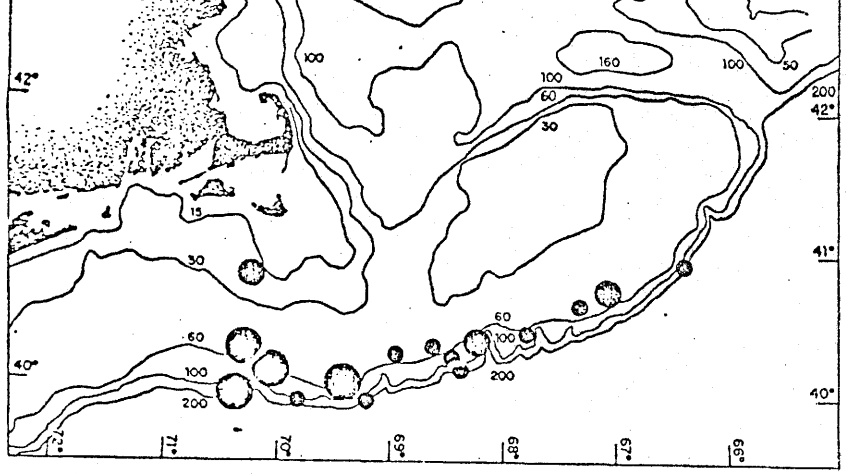
Species: Scallops

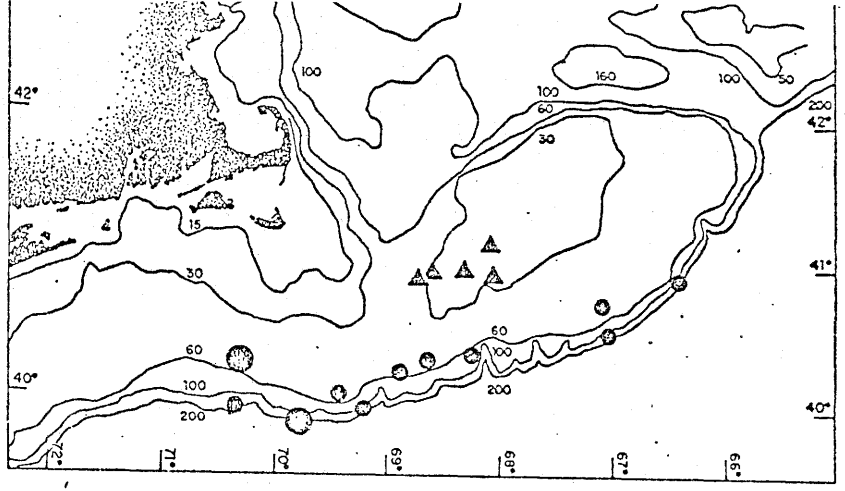
Stn No.	POSITION latitude	POSITION longitude	Tow Direct.	Depth (fms)	Day Nite	Wgt in lbs Total	WT. SIZE (in.) Avg
25	39°59'	72°33'	100°	36	D	42	3.25
26	39°45'	72°34'	125°	43	D	27	3.00
35	39°36'	72°54'	135°	35	N	37	2.75
36	39°29'	72°52'	250°	35	N	26	2.75
40	39°03'	73°08'	037°	41	D	10	2.75
41	39°13'	73°02'	330°	42	D	265	3.00
48	38°56'	73°23'	180°	36	N	28	3.25
52	38°36'	73°37'	270°	39	D	18	2.75

* Catch less than 10 lbs. plotted above, but not listed.



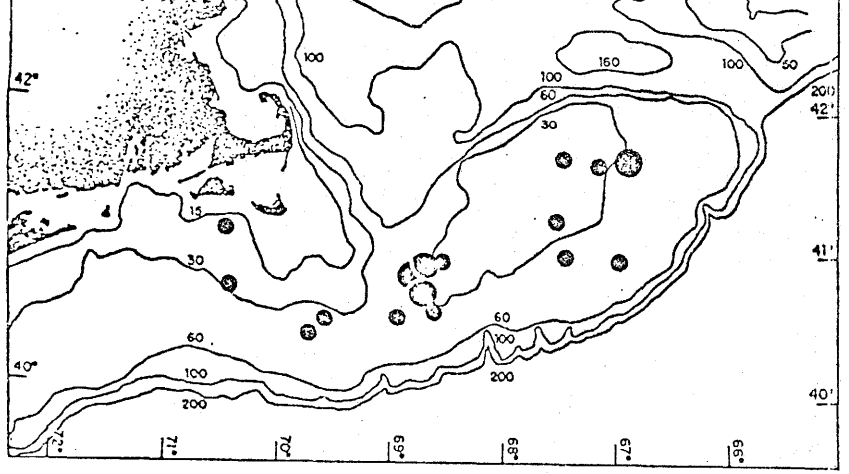
PART II: Plot of stations fished during the spring groundfish survey, Albatross IV cruise 75-3. Stations 73 to 134 were completed in the Georges Bank area (stations 1-72 were completed on the Mid-Atlantic Shelf during Part I). The given species on the following pages are listed and plotted in order of decreasing weight, and the station numbers listed correspond to those plotted on the above chart.

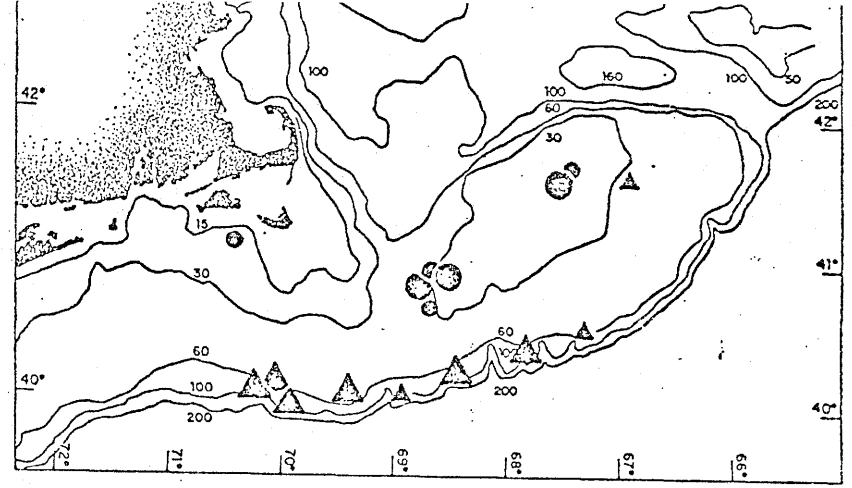




Species: SILVER HAKE	Stn No.	POSITION latitude	POSITION longitude	Tow Direct	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
○ = greater than 50 lbs	83	40°24'	70°24'	090	047	D	160	0.6
	84	40°14'	70°07'	110	056	D	137	0.6
	81	40°02'	70°24'	090	125	D	66	0.4
	87	40°03'	69°29'	090	056	D	65	0.4
○ = between 25 and 50 lbs	94	40°25'	68°16'	060	067	N	36	0.6
	115	40°46'	67°06'	080	052	N	27	0.4
	132	40°55'	70°29'	330	027	D	25	0.4
○ = between 5 and 25 lbs	119	40°55'	66°33'	350	170	D	20	0.7
	114	40°42'	67°11'	020	050	N	18	0.5
	88	40°02'	69°10'	090	110	D	17	0.3
	111	40°27'	67°50'	260	072	D	15	0.5
	90	40°16'	68°51'	030	057	D	13	0.3
	93	40°12'	68°20'	045	175	D	10	0.5
	86	39°55'	69°48'	090	125	N	9	0.2
	91	40°19'	68°42'	075	053	D	8	0.2
	92	40°18'	68°28'	060	075	D	8	0.5

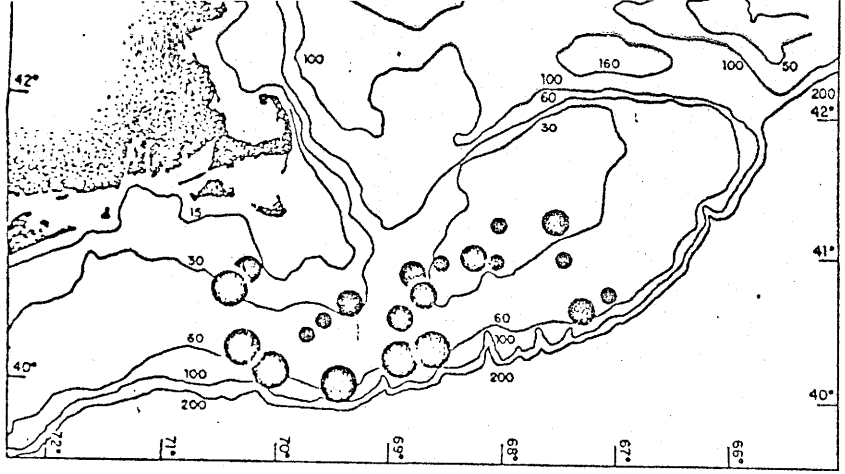
Species: RED HAKE	Stn No.	POSITION latitude	POSITION longitude	Tow Direct	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
○ = greater than 25 lbs	83	40°24'	70°24'	090	047	D	152	0.5
	86	39°55'	69°48'	090	125	N	44	0.5
○ = between 5 and 25 lbs	90	40°16'	68°51'	030	057	D	23	0.4
	88	40°02'	69°10'	090	110	D	22	0.3
	115	40°46'	67°06'	080	052	N	15	0.7
	91	40°19'	68°42'	075	053	D	10	0.5
	94	40°25'	68°16'	060	067	N	9	0.4
	113	40°32'	67°07'	050	155	D	8	0.7
	87	40°03'	69°29'	090	056	D	7	0.9
	119	40°55'	66°33'	350	170	D	7	0.3
	81	40°02'	70°24'	090	125	D	6	0.5
POLLOCK								
△ = greater than 10 lbs	100	40°56'	68°43'	180	030	D	60	8.6
	103	40°58'	68°16'	330	027	D	37	18.5
	104	41°08'	68°11'	340	024	D	20	4.0
	101	41°02'	68°36'	045	024	D	11	11.0
	102	41°00'	68°24'	112	022	D	11	2.2

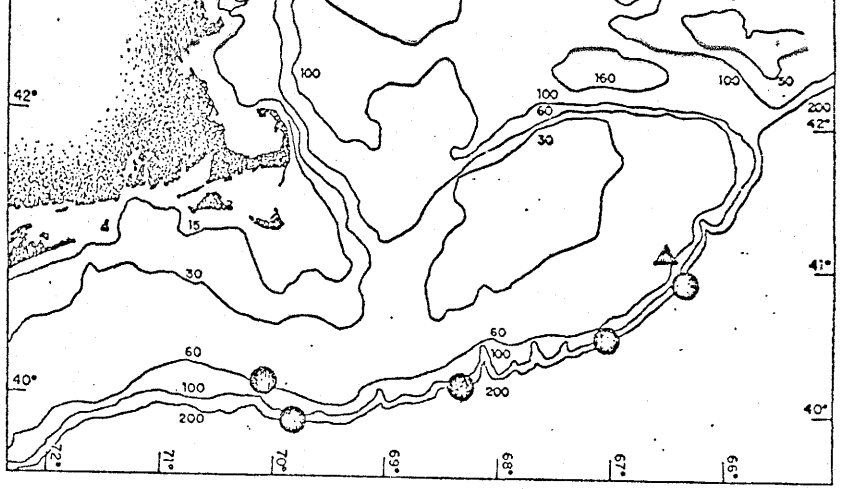




Species: YELLOWTAIL FLOUNDER	Stn No.	POSITION latitude	POSITION longitude	Tow Direct	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
○ = greater than 20 lbs	100	40°56'	68°43'	180	030	D	46	1.9
	125	41°42'	66°57'	080	032	N	27	1.5
	98	40°49'	68°50'	340	040	D	22	1.0
	97	40°43'	68°44'	350	037	D	21	0.9
● = between 5 and 20 lbs	108	41°06'	67°37	260	032	D	16	0.9
	129	40°35'	69°34'	130	033	D	13	0.5
	96	40°42'	68°40'	090	035	D	12	0.7
	106	41°34'	67°30'	350	023	N	12	1.5
	131	41°12'	70°37'	270	016	D	12	0.6
	95	40°35'	68°52'	035	044	N	9	0.7
	101	41°02'	68°36'	045	024	D	9	2.3
	109	41°02'	67°35'	250	035	D	9	0.6
	128	40°29'	69°32'	320	034	D	7	0.6
	116	41°02'	67°01'	080	038	N	5	0.4
	124	41°35'	67°12'	315	027	D	5	1.0
	133	40°49'	70°32'	300	031	D	5	1.3

Species: WINTER FLOUNDER	Stn No.	POSITION latitude	POSITION longitude	Tow Direct	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
○ = greater than 10 lbs	98	40°49'	68°50'	340	037	D	30	3.0
	105	41°32'	67°44'	170	019	N	13	1.9
	101	41°02'	68°36'	045	024	D	12	0.9
● = between 5 and 10 lbs	133	40°49'	70°32'	300	031	D	10	1.3
	100	40°56'	68°43'	180	030	D	9	1.5
	106	41°34'	67°30'	350	023	N	9	2.3
	97	40°43'	68°44'	350	037	D	6	6.0
SUMMER FLOUNDER								
△ = greater than 10 lbs	87	40°03'	69°29'	090	056	D	39	2.0
	82	40°07'	70°16'	080	063	D	38	2.5
	85	40°09'	70°03'	100	065	N	36	3.6
	111	40°27'	67°50'	260	072	D	18	2.6
	92	40°18'	68°28'	060	075	D	17	3.4
	84	40°14'	70°07'	110	056	D	13	1.9
▲ = between 5 and 10 lbs	114	40°42'	67°11'	020	050	N	9	3.0
	89	40°11'	68°60'	070	070	D	6	3.0
	125	41°42'	66°57'	080	032	N	6	3.0

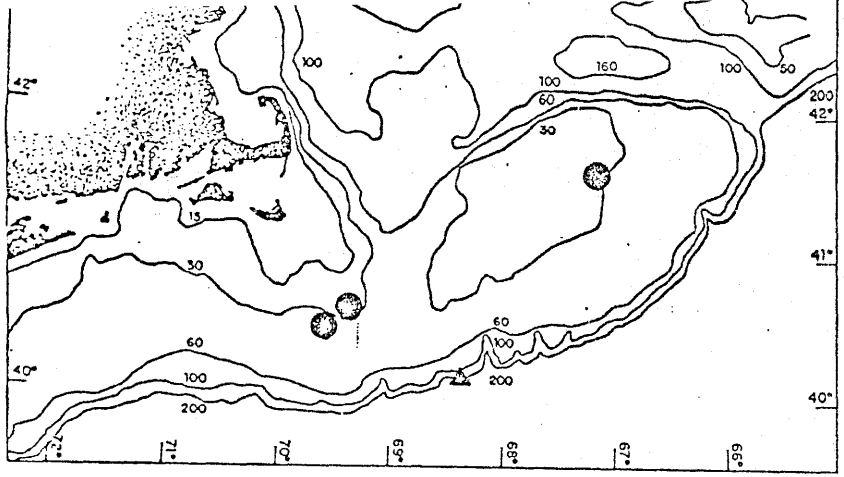


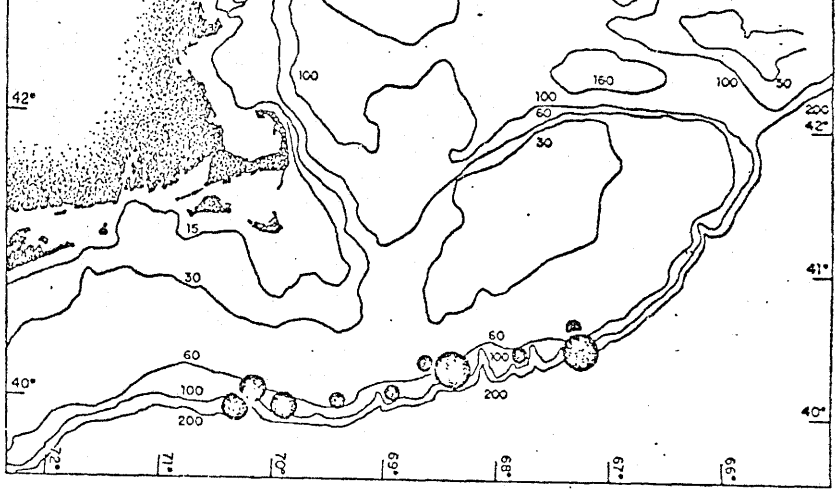


Species: SPINY DOGFISH	Stn No.	POSITION latitude	POSITION longitude	Tow Direct	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
○ = greater than 100 lbs	87	40°03'	69°29'	090	056	D	846	3.0
	84	40°14'	70°07'	110	056	D	464	0.4
	91	40°19'	68°42'	075	053	D	268	4.1
	131	41°12'	70°37'	270	016	D	207	4.2
	90	40°16'	68°51'	030	057	D	179	4.8
	83	40°24'	70°24'	090	047	D	172	3.6
○ = between 25 and 100 lbs	95	40°35'	68°52'	035	044	N	91	4.0
	130	40°42'	69°39'	330	027	D	84	4.9
	98	40°49'	68°50'	340	040	D	43	4.7
	102	41°00'	68°24'	112	022	D	39	10.0
	114	40°42'	67°11'	020	050	N	37	3.1
	108	41°06'	67°37'	260	032	D	36	4.0
	132	40°55'	70°29'	330	027	D	31	6.2
	97	40°43'	68°44'	350	037	D	28	3.5
⊗ = between 10 and 25 lbs	109	41°02'	67°35'	250	035	D	23	3.8
	129	40°35'	69°34'	130	033	D	23	3.8
	101	41°02'	68°36'	045	024	D	22	7.3
	128	40°29'	69°32'	320	034	D	20	6.7
	103	40°58'	68°16'	330	027	D	14	7.0
	115	40°46'	67°06'	080	052	N	14	3.5
	104	41°08'	68°11'	340	024	D	13	4.3

Species: LOBSTER	Stn No.	POSITION latitude	POSITION longitude	Tow Direct	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
⊗ = greater than 5 lbs	93	40°12'	68°20'	045	175	D	65	1.5
	119	40°55'	66°33'	350	170	D	22	1.1
	113	40°32'	67°07'	050	155	D	12	2.4
	84	40°14'	70°07'	110	056	D	9	1.8
	86	39°55'	69°48'	090	125	N	6	0.9

SEA SCALLOPS							WT.	SIZE (in)
▲ = greater than 10 lbs	120	41°06'	66°37'	350	042	D	21	3.8





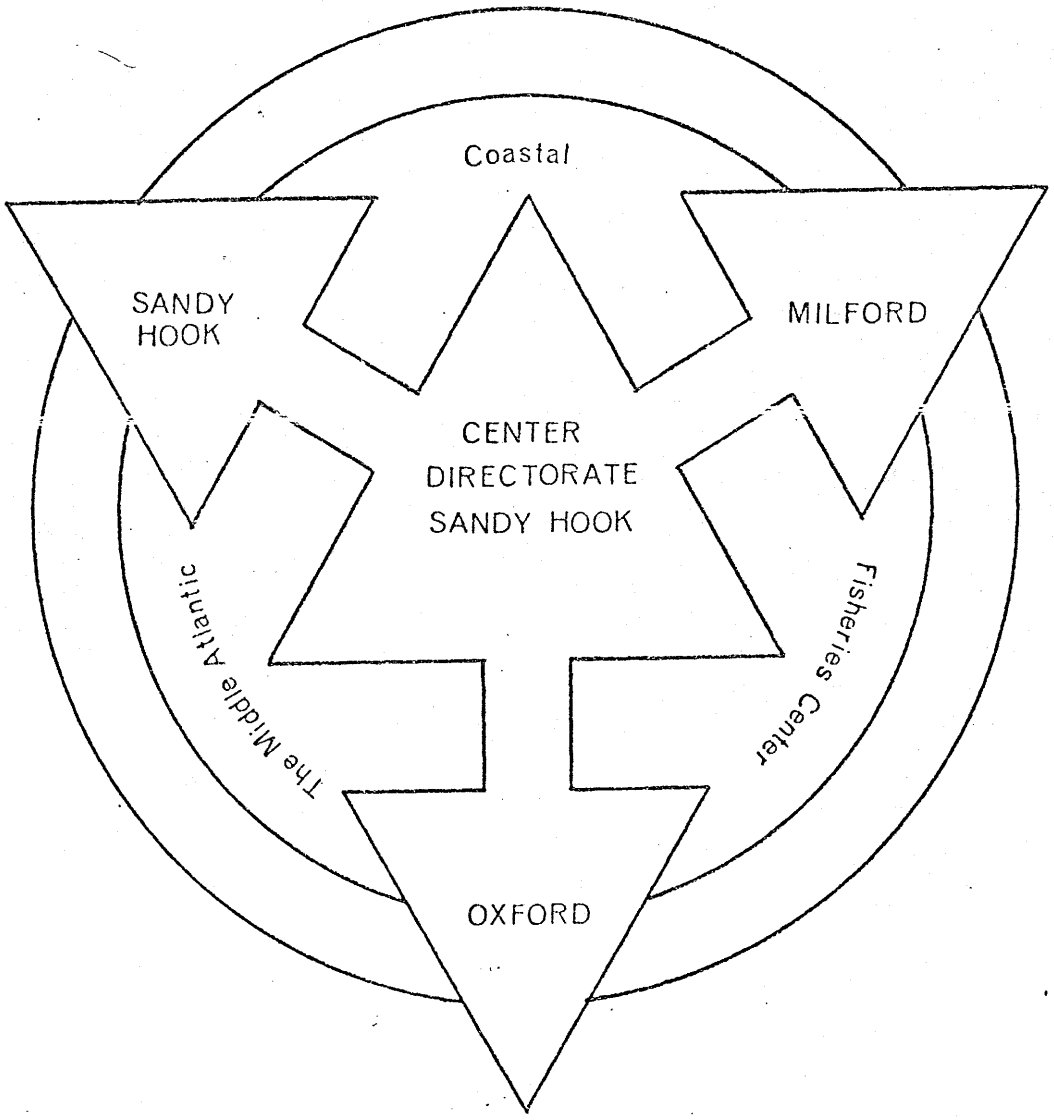
Species: OCEAN POUT	Stn No.	POSITION latitude	POSITION longitude	Tow Direct	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
○ = greater than 10 lbs	130	40°42'	69°39'	330	027	D	40	4.4
	124	41°35'	67°12'	315	027	D	19	3.8
	129	40°35'	69°34'	130	033	D	11	2.2
JONAH CRAB								
▲ = greater than 5 lbs	93	40°12'	68°20'	045	175	D	18	0.4

Species: SQUID(Loligo)	Stn No.	POSITION latitude	POSITION longitude	Tow Direct	Depth (fms)	Day Nite	Wgt in lbs Total	Wgt in lbs Avg
○ = greater than 50 lbs	92	40°18'	68°28'	060	075	D	120	0.1
	112	40°31'	67°20'	075	077	D	111	0.2
○ = between 25 and 50 lbs	81	40°02'	70°24'	090	125	D	48	0.2
	82	40°07'	70°16'	080	063	D	34	0.1
	85	40°09'	70°03'	100	065	N	29	0.1
⊙ = between 5 and 25 lbs	89	40°11'	68°60'	070	070	D	20	0.2
	111	40°27'	67°50'	260	072	D	11	0.3
	121	41°09'	66°23'	350	060	D	11	0.6
	91	40°19'	68°42'	075	053	D	7	0.1
	114	40°42'	67°11'	020	050	N	7	0.2
	87	40°03'	69°29'	090	056	D	5	0.2
	93	40°12'	68°20'	045	175	D	5	0.3

NOTE: ALL SIZES INCLUDED

CRUISE REPORT 475
NOAA SHIP ALBATROSS IV
APRIL 1-10, 1975
MONTHLY ASSESSMENT SURVEY
U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



May 7, 1975

CRUISE REPORT 475

NOAA SHIP ALBATROSS IV

APRIL 1-10, 1975

MONTHLY ASSESSMENT SURVEY

U. S. DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL MARINE FISHERIES SERVICE

MIDDLE ATLANTIC COASTAL FISHERIES CENTER

RESOURCE ASSESSMENT INVESTIGATIONS

SANDY HOOK LABORATORY

HIGHLANDS, NEW JERSEY 07732

MONTHLY ASSESSMENT SURVEY

CRUISE REPORT 475 R/V ALBATROSS IV

INTRODUCTION: The R/V Albatross IV sailed April 1 from Sandy Hook, New Jersey and returned April 10 after conducting a groundfish-ichthyoplankton survey in the New York Bight.

This was the eighth in a continuing series of monthly trawl surveys designed to monitor both juvenile and adult fish populations in a 6300 sq. mi. study area (outlined in Figure 1) between Raritan Bay and the 200-fathom curve near the Hudson Canyon. Additional trawl stations made in the MESA apex (dashed lines, Figure 1) provided intensive coverage in this special area. Collections of finfish from trawl catches were saved for species studies of age, growth and fecundity.

An AEC-supported study designed to show seasonal variations in distribution and abundance of ichthyoplankton was continued during this cruise.

Although the groundfish-ichthyoplankton surveys are separate studies piggybacked on the same cruise, the synopticity of the data will permit a merged application in population models.

SAMPLING PROCEDURES: Trawl stations -- Random stations were selected in sampling strata prior to the cruise. The standard collecting gear for these surveys is a #36 Yankee trawl equipped with 80 ft chain sweep with 5-inch rubber discs, 10-fathom bridles and 1200 lb oval steel doors. The cod end and upper belly are lined with 1/2-inch mesh netting to retain small specimens. Tows are for 1/2-hour at 3-1/2 knots, direction toward the next station and with scope varied according to depth. Fish data were collected simultaneously on 15 stations from shallow areas of the Raritan Bay complex. A 30 ft trawl was used from a small boat, the R/V Rorqual.

All fish and commercially significant invertebrates were identified, sorted to species, weighed and measured. During the measuring process the fish were examined for fin rot. A sample of all bony fishes was frozen for life history studies at the laboratory. Surface and bottom temperatures and salinities are taken on all trawl stations.

Ichthyoplankton stations -- Stations are set in a grid pattern 21 nautical miles apart (Figure 1); 60 cm bongo nets with .333 and .505 mesh netting were used in a standard MARMAP smooth oblique tow from surface to bottom. Discrete depth tows were made using 20 cm bongo nets on a transect off Shinnecock Inlet, N. Y. Standard hydrocasts were made at each ichthyoplankton station and a neuston collection using a Haedrich net was also taken. A series of six hydrographic stations are located near the shelf break. At each of these stations, hydrographic observations will be made as at the plankton stations, but no net tows are made.

RESULTS: A total of 72 stations were occupied during the 10 day cruise. Eighteen smooth oblique tows with 60 cm bongo nets and four discrete depth tows with 20 cm bongo nets were made. The six hydrographic stations near the shelf break were not done due to weather conditions. Strong west winds during most of the cruise severely hindered operations. Station data including catch weights are summarized in Table 1. Forty-eight trawl hauls were made.

The catch totalled 8,768 lbs including 3,012 lbs of bony fishes, 5,187 lbs of sharks and skates and 574 lbs of invertebrates. Fish were frozen for life history investigations.

SCIENTIFIC PERSONNEL:

T. Azarovitz, Chief Scientist
W. Morse, Watch Chief
J. Sibunka
S. Turner
R. Cushman
J. Chertoff
J. Tabachnik
R. Murtagh, Brookhaven Natl. Lab.
E. Freund, Brookhaven Natl. Lab.
L. Esais, Stony Brook Univ.

Submitted by:

Thomas R. Azarovitz, Chief
Coastal Survey Investigation

Approved by:

Arthur S. Merrill, Director
Resource Assessment Investigations

Carl J. Sindermann, Center Director
Middle Atlantic Coastal Fisheries Center

e 1. Station data - Cruise 475

ion	Tot. Wt. Per Sta.	Fin Fish Wt.	Elasmo-branch Wt.	Inverte-brate Tot. Wt.	Lat.	Long.	Depth (m)	Temperature Surf.	Botto
	115	71	4	40	40°27'	73°46'	27	5.0	5.5
	163.5	86.5	65	12	40 30	73 38	17	5.5	5.1
	113	63.5	42	7.5	40 31	73 38	16	5.5	5.2
	215	141	62	12	40 37	73 33	15	5.2	5.0
	126	59.5	53	13.5	40 32	73 26	18	5.2	4.5
	155.5	101	52	2.5	40 18	73 11	38	4.8	4.9
C-2	Ichthyoplankton Station				40 22	73 10	33	4.9	4.8
	138.5	86.5	46	6	40 32	73 11	24	4.8	4.7
	230.5	129.5	93	8	40 32	73 07	24	5.0	4.8
	97.5	80.5	14	3	40 37	73 09	13	4.8	4.6
	147	112	32	3	40 40	72 59	17	4.7	4.7
D-1	Ichthyoplankton Station				40 37	72 50	33	4.9	5.2
	150.5	88.5	59	3	40 35	72 49	16	5.0	5.0
	139.5	106.5	33	0	40 45	72 36	26	5.3	4.9
	Ichthyoplankton Station - Shin. I				40 48	72 31	11	5.8	4.9
	Ichthyoplankton Station - Shin. II				40 47	72 30	24	5.1	4.8
	Ichthyoplankton Station - Shin. III				40 45	72 29	27	5.4	4.9
	Ichthyoplankton Station - Shin. IV				40 43	72 27	31	5.3	5.0
F-1	Ichthyoplankton Station				40 37	72 11	49	5.4	5.4
	192.5	131	60	1.5	40 32	72 29	46	5.3	5.3
	295.5	72	218	5.5	40 24	72 33	49	5.7	7.2
E-2	Ichthyoplankton Station				40 23	72 31	31	5.8	5.8
	476	58	415	3	40 13	72 32	57	6.3	6.1
	117.5	82	35	0.5	40 19	72 59	44	5.7	5.6
	41.5	34.5	1	6	40 01	74 02	17	4.8	4.8
	59	42	8	9	39 52	74 03	16	4.8	4.8
	54.5	29.5	22	3	39 54	73 59	18	4.9	4.9
	34	27	2	5	40 00	73 56	20	5.4	5.4
	87.5	43.5	38	6	40 08	73 55	18	4.6	5.0
	199.5	165.5	31	3	40 13	73 48	31	5.4	5.4
	69	29.5	33	6.5	40 15	73 33	29	4.4	4.4
B-3	Ichthyoplankton Station				40 06	73 30	49	4.8	5.8
	65	18	42	5	40 00	73 38	37	4.8	6.3
	141.5	92	47	2.5	39 52	73 29	38	5.6	6.3
	40.5	33.5	6	1	40 03	73 17	46	5.4	5.4
	235	42	192	1	40 08	72 55	47	5.9	5.9
D-3	Neuston Station				40 07	72 49	49	6.0	6.1
	298.5	22.5	258	18	40 03	72 24	68	6.0	6.5
	849.5	61.5	785	3	40 14	72 09	66	5.3	5.3
	281	5	264	12	40 09	72 01	69	5.6	6.6
F-3	Neuston Station				40 06	72 09	69	5.9	8.1
G-4	Ichthyoplankton Station				39 56	71 51	152	6.5	11.0
	114	66	8	40	39 46	71 49	132	7.4	11.8
	40.5	30	5	5.5	39 43	72 07	122	7.4	11.8
F-5	Ichthyoplankton Station				39 37	72 12	132	7.6	10.3
	138	45.5	69	23.5	39 44	72 14	104	7.5	11.2
	132.5	21	106	5.5	39 47	72 21	82	6.8	10.6
E-4	Ichthyoplankton Station				39 51	72 31	75	6.7	7.4
	532	123	376	33	39 45	72 39	75	6.7	7.4
	92.5	9.5	10	73	39 34	72 20	101	7.5	11.2

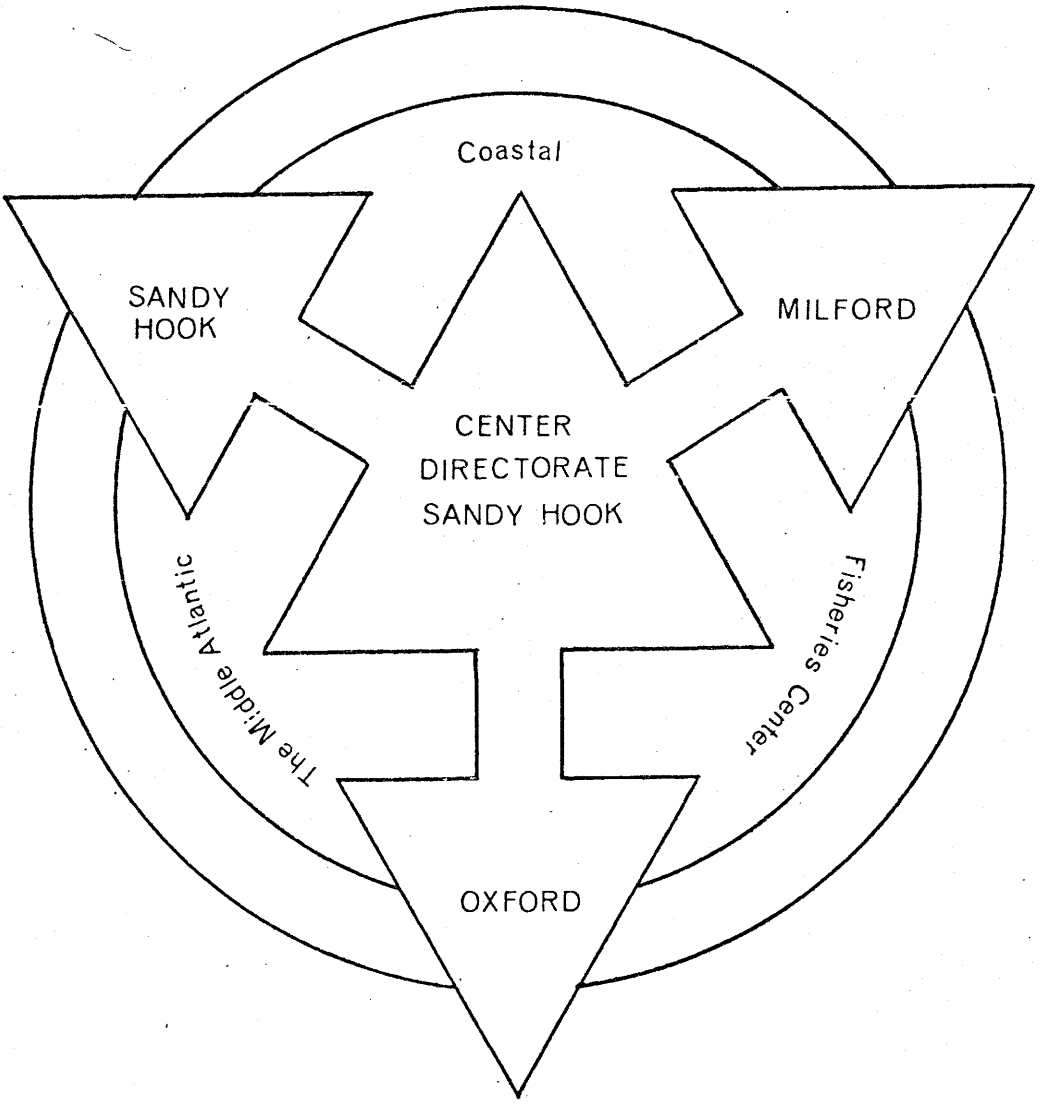
Table 1.--Continued

ion		Tot. Wt. Per Sta.	Fin Fish Wt.	Elasmo-branch Wt.	Inverte-brate Tot. Wt.	Lat.	Long.	Depth (m)	Temperature Surf.	Temperature Bottom
.		138.5	45.5	2.	91.	39 29	72 19	366	7.5	11.9
2	E-6	Ichthyoplankton Station				39 22	72 31	128	7.8	11.8
3	F-7	Ichthyoplankton Station				39 07	72 11	999	8.0	6.0
4		95.5	88	0.5	7	39 14	72 27	183	8.1	11.6
5		34.5	20.5	1.5	12.5	39 11	72 37	139	8.0	12.3
6		90	28	41	21	39 19	72 48	79	7.5	9.2
7	C-6	Ichthyoplankton Station				39 22	73 10	61	7.0	7.0
8		464	28.5	426	9.5	39 28	72 58	66	6.6	6.6
9		271.5	43	227	1.5	39 34	73 05	47	6.5	6.5
0	D-5	Ichthyoplankton Station				39 36	72 50	62	6.7	6.8
		274.5	42.5	224	8	39 52	72 51	64	6.6	6.6
	D-3	Ichthyoplankton Station				40 07	72 50	51	5.6	5.7
		550.5	81.5	433.5	35.5	39 54	73 11	62	6.1	6.1
	C-4	Ichthyoplankton Station				39 51	73 09	57	6.2	6.0
		350.5	130	215	4.5	39 46	73 10	46	8.6	8.4
	B-5	Ichthyoplankton Station				39 37	70 30	46	6.0	6.0
	A-4	Ichthyoplankton Station				39 51	73 46	27	4.9	4.9
	B-3	Ichthyoplankton Station				40 06	73 29	46	5.2	5.5
		85	67.5	17	0.5	40 26	73 37	20	4.9	4.9
	A-2	Ichthyoplankton Station				40 22	73 48	31	4.7	5.2
		34.5	27	7	0.5	40 18	73 49	38	4.9	6.1
		No Fish				40 16	73 50	26	5.0	5.0

CRUISE REPORT D-75-4
NOAA Ship Delaware II
23-30 April 1975

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

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



CRUISE REPORT D-75-4

NOAA Ship Delaware II

23-30 April 1975

U. S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Middle Atlantic Coastal Fisheries Center
Ecosystems Investigations
Sandy Hook Laboratory
Highlands, New Jersey 07732

(Funded by NOAA-MESA Appropriations)

CRUISE REPORT D-75-4
NOAA Ship Delaware II
23-30 April 1975

The NOAA Ship Delaware II departed Sandy Hook, New Jersey (SH) at 0930 hrs on 23 April 1975 to conduct Smith-McIntyre bottom grab sampling. RAYDIST was calibrated on Ambrose Light Tower and sampling commenced at 1330 hrs on 23 April. Sixty stations were sampled offshore from the eastern end of Long Island to the southern end of New Jersey in water depths of 20-35 ftahoms (see Fig. 1 and Table I). Five comparative Smith-McIntyre grab samples and one bottom Niskin water sample were taken at each of the sixty offshore stations.

Each Smith-McIntyre grab was subsampled with 1½" I.D. plastic coring tubes for heavy metal analysis and sediment grain size analyses. The remaining sediments were washed through 1 mm mesh standard geological screens and preserved with 10% buffered formalin.

Water samples were taken for salinity, temperature and dissolved oxygen determinations at each of the sixty stations.

A second area was sampled using the same procedures over the dredge spoil dumping area inshore (see Fig. 2 and Table 2). Two Smith-McIntyre grabs were made at each of twenty-five stations and bottom water samples for salinity, temperature and dissolved oxygen were obtained at five stations.

The RAYDIST unit was calibrated and the ship returned to Sandy Hook dock at 0100 hrs on 30 April 1975.

SCIENTIFIC PERSONNEL:
J. Kneeland McNulty - Chief Scientist
Leslie Helen Rogers - Watch Captain
Harry Glassman
Hank Smeal - volunteer
Peter Murphy - MESA, Stony Brook
Bill Pringle - MESA, Floyd Bennett Field
Frank Saunders - Atlantic Marine Center, Norfolk, Va.

SUBMITTED BY:

J. Kneeland McNulty

J. Kneeland McNulty
Chief Scientist

John B. Pearce

John B. Pearce, Director
Ecosystems Investigations

Carl J. Sindermann

Carl J. Sindermann, Center Director
Middle Atlantic Coastal Fisheries Center

CRUISE REPORT D-75-4
NOAA Ship Delaware II
23-30 April 1975

Table 1. Stations locations, 60 stations, 5 grabs each

	LAT.		LONG.		LAT.		LONG.
1.	74° 2.4'	x	30°39.5'	31.	73°31.6'	x	39°59.1'
2.	46°50.3'	x	46°42 '	32.	73°31.8'	x	40° 7 '
3.	73°30.6'	x	38°50.5'	33.	73°22.1'	x	40° 7.2'
4.	73°55.5'	x	38°49.7'	34.	73° 6 '	x	40° 6.5'
5.	74° 8.8'	x	38°47.5'	35.	72°50.5'	x	40° 5 '
6.	74° 4.6'	x	38°57.6'	36.	72°40 '	x	39°59 '
7.	73°52.3'	x	39° 1.4'	37.	72°29.2'	x	40° 5 '
8.	73°29.5'	x	38°55.9'	38.	72°40.5'	x	40°10.9'
9.	73°29.5'	x	39°	39.	73° 2 '	x	40°14.1'
10.	73°21 '	x	39° 6.9'	40.	73°15.3'	x	40°14.4'
11.	73°35.4'	x	39° 9 '	41.	72°58.6'	x	40°24 '
12.	73°45.5'	x	39°10 '	42.	72°44.9'	x	40°20.3'
13.	73°40 '	x	39°18.7'	43.	72°29.5'	x	40°15.2'
14.	73°25.5'	x	39°16.4'	44.	72°15.4'	x	40°16.5'
15.	73°13 '	x	39°15 '	45.	72° 2 '	x	40°18.3'
16.	73° 4.9'	x	39°21 '	46.	72° 6.4'	x	40°27.9'
17.	73°17.4'	x	39°24.7'	47.	72°20 '	x	40°25.5'
18.	73°30.6'	x	39°25.6'	48.	72°34.2'	x	40°24.7'
19.	73°21 '	x	39°34.5'	49.	72°48.7'	x	40°29.8'
20.	73° 6.2'	x	39°32 '	50.	72°38 '	x	40°34 '
21.	72°52.8'	x	39°32.4'	51.	72°25 '	x	40°35 '
22.	73° .6'	x	39°40.5'	52.	72°12.8'	x	40°36.5'
23.	73°13.5'	x	39°42.4'	53.	71°55.5'	x	40°32.9'
24.	73°22.1'	x	39°46.8'	54.	71°45 '	x	40°39.4'
25.	73° 9 '	x	39°48.5'	55.	71°57.5'	x	40°40.8'
26.	72°37.5'	x	39°49 '	56.	72°12.5'	x	40°46.5'
27.	72°50 '	x	39°52.5'	57.	72° .5'	x	40°50.6'
28.	73° 1.5'	x	39°57 '	58.	71°49.8'	x	40°48.4'
29.	73°14.5'	x	39°59 '	59.	71°42.2'	x	40°48.9'
30.	73°17.9'	x	39°56 '	60.	71°44.9'	x	40°48.8'

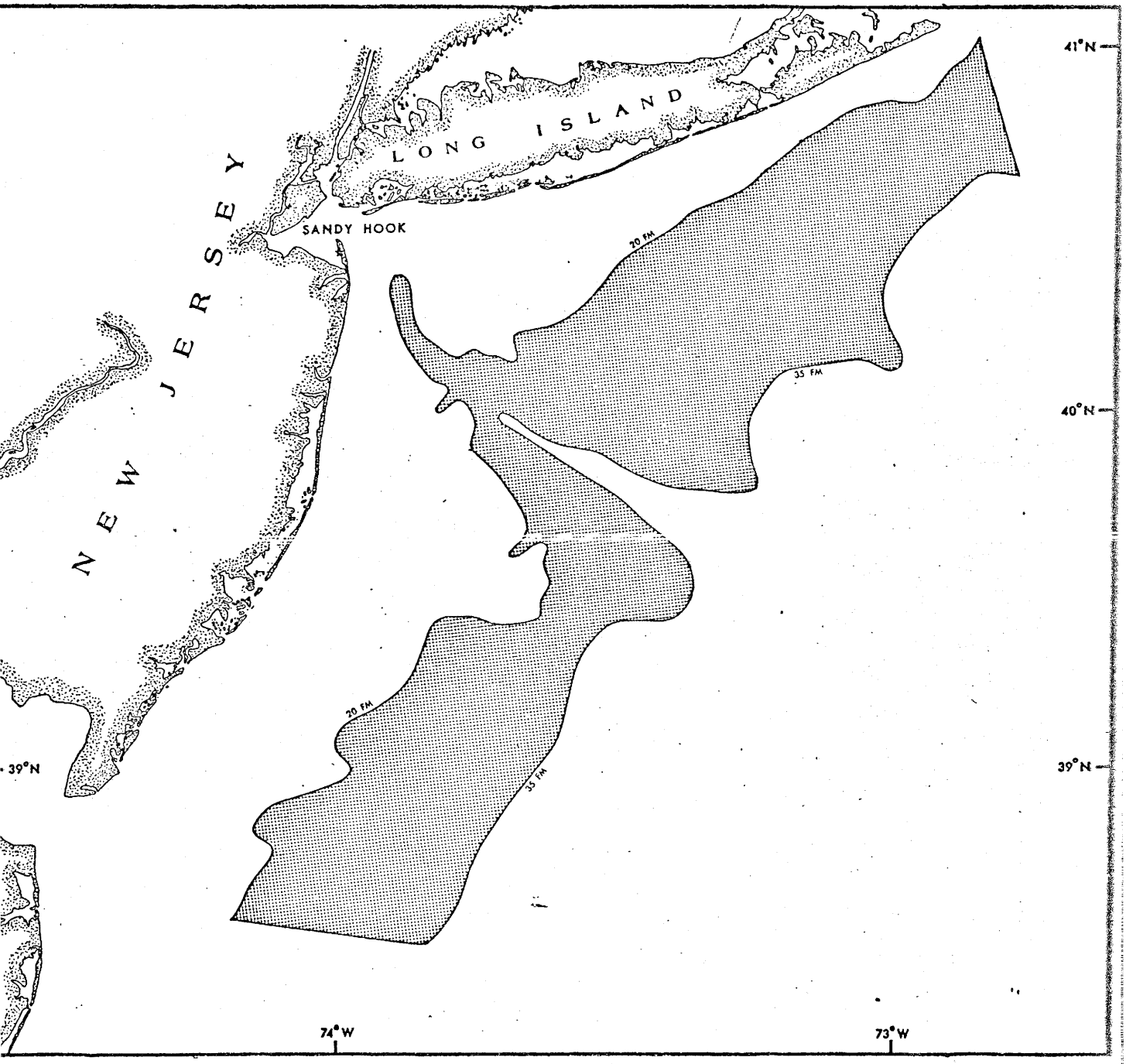
CRUISE REPORT D-75-4
NOAA Ship Delaware II
23-30 April 1975

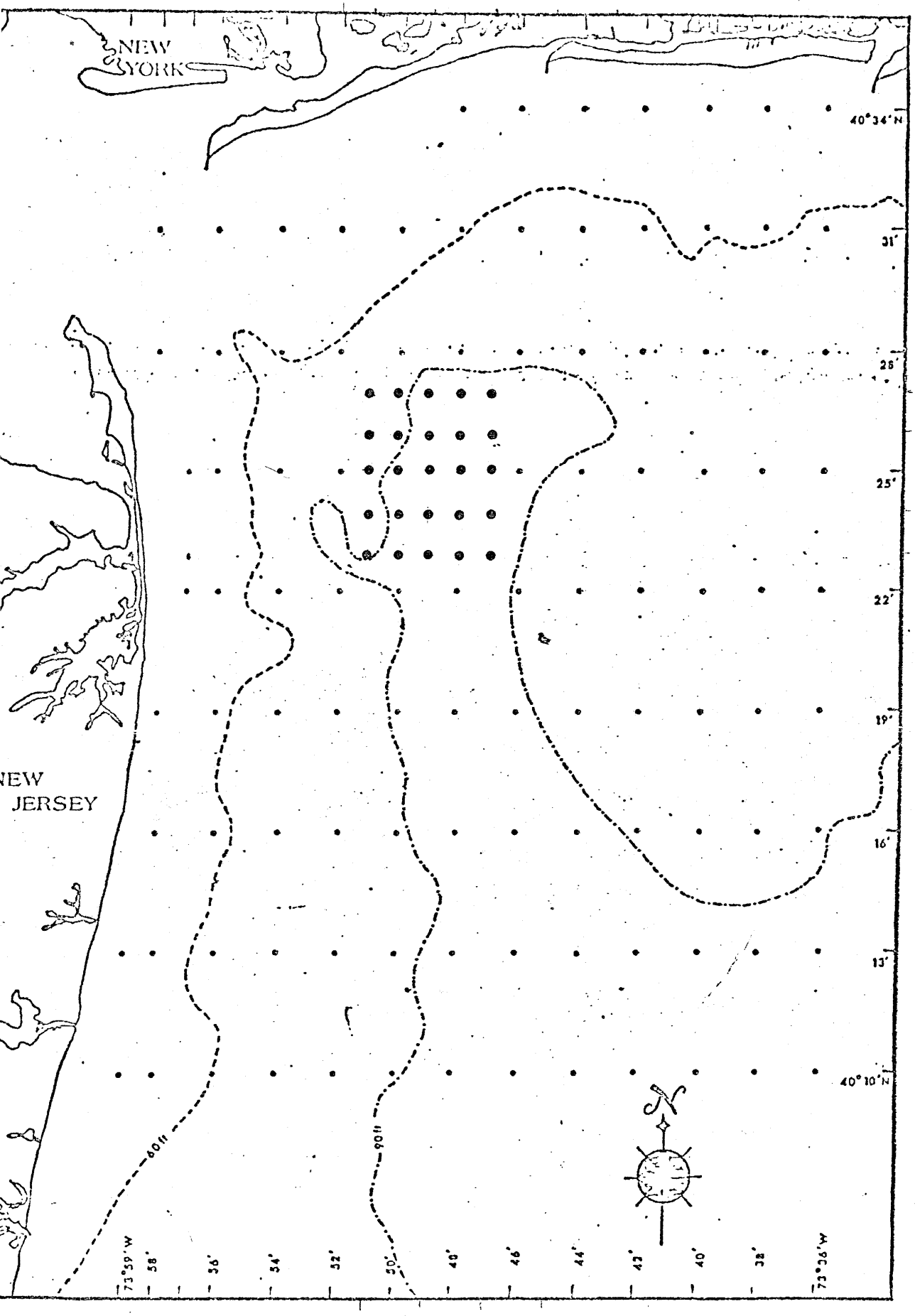
Table II. Dredge Spoils Station Locations, 25 Stations, 2 Grabs each.

Station #			
M26	73°51'	x	40°27'
M27	73°50'	x	40°27'
M28	73°49'	x	40°27'
M29	73°48'	x	40°27'
M30	73°47'	x	40°27'
M31	73°47'	x	40°26'
M32	73°48'	x	40°26'
M33	73°49'	x	40°26'
M34	73°50'	x	40°26'
M35	73°51'	x	40°26'
M36	73°51'	x	40°25'
M37	73°50'	x	40°25'
M38	73°49'	x	40°25'
M39	73°48'	x	40°25'
M40	73°47'	x	40°25'
M41	73°47'	x	40°24'
M42	73°48'	x	40°24'
M43	73°49'	x	40°24'
M44	73°50'	x	40°24'
M45	73°51'	x	40°24'
M46	73°51'	x	40°23'
M47	73°50'	x	40°23'
M48	73°49'	x	40°23'
M49	73°48'	x	40°23'
M50	73°47'	x	40°23'

CRUISE REPORT D-75-4
NOAA Ship Delaware II
23-30 April 1975

Fig. 1. Shaded area indicates sampling area.



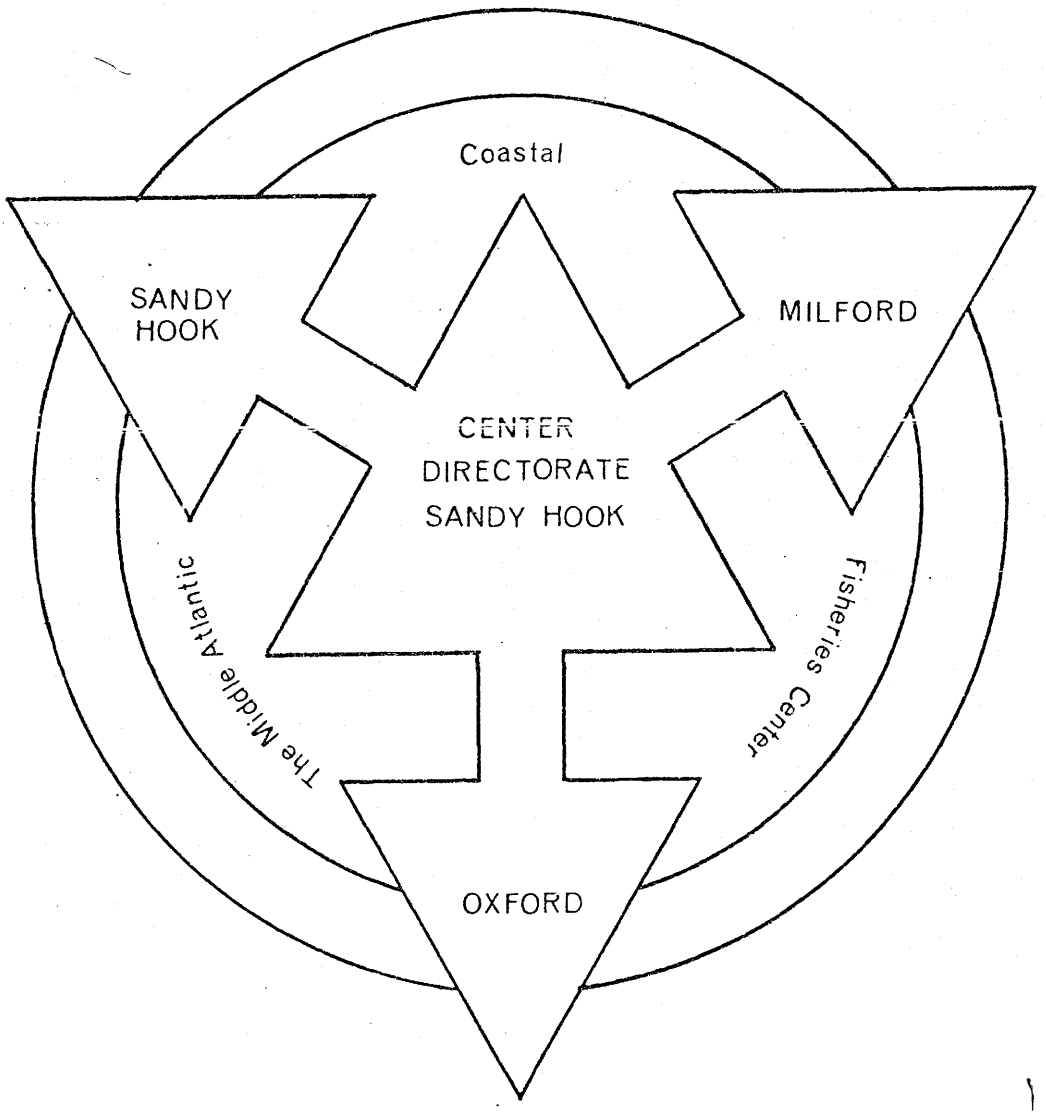

NEW YORK
NEW JERSEY
40°34'N
31'
28'
25'
22'
19'
16'
13'
40°10'N
60ft
90ft
73°59'W
58'
56'
54'
52'
50'
48'
46'
44'
42'
40'
38'
73°36'W

gure 2.

CRUISE REPORT K-75-1
NOAA Ship George B. Kelez
28 May - 2 June 1975

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

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



CRUISE REPORT K-75-1

NOAA Ship George B. Kelez

28 May - 2 June 1975

U. S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Middle Atlantic Coastal Fisheries Center
Ecosystems Investigations
Sandy Hook Laboratory
Highlands, New Jersey 07732

(Funded by NOAA-MESA Appropriations)

CRUISE REPORT K-75-1
NOAA Ship George B. Kelez
28 May - 2 June 1975

The NOAA Ship George B. Kelez arrived at Sandy Hook Dock at 1010 hrs on 28 May 1975 to on load sampling equipment and scientific personnel. The Kelez departed Sandy Hook at 1240 hrs, 28 May 1975 and proceeded to Ambrose Light Tower for RAYDIST calibration. Sampling operations began at 1621 hrs on 28 May at station #1.

At each of the 59 stations (Fig. 1, Table 1) located between Jones Beach and Montauk, Long Island from the beach out to 20 fm, five Smith-McIntyre bottom grabs and one bottom Niskin water bottle were obtained. Each grab was subsampled twice with 1½" coring tubes for grain size determination and heavy metals analysis which were then frozen. The remaining sediments were washed through 1 mm standard geological screen and the material remaining on the screens preserved with 10% buffered formalin.

Bottom water samples were taken for dissolved oxygen and salinity. Temperatures were also taken from each Niskin sample.

The biological sampling was completed at 1900 hrs on 31 May 1975. The Kelez returned to Sandy Hook at 1738 hrs on 2 June 1975 and off loaded scientific equipment and personnel. The Kelez then departed Sandy Hook at 1800 hrs for Floyd Bennett Field, Brooklyn.

SCIENTIFIC PERSONNEL:
Leslie Helen Rogers - Chief Scientist
Larry D'Andrea - Watch Captain
Bill Pringle - MESA, Floyd Bennett Field
Jim Ebert - Volunteer
Bob Decker - Volunteer

SUBMITTED BY:

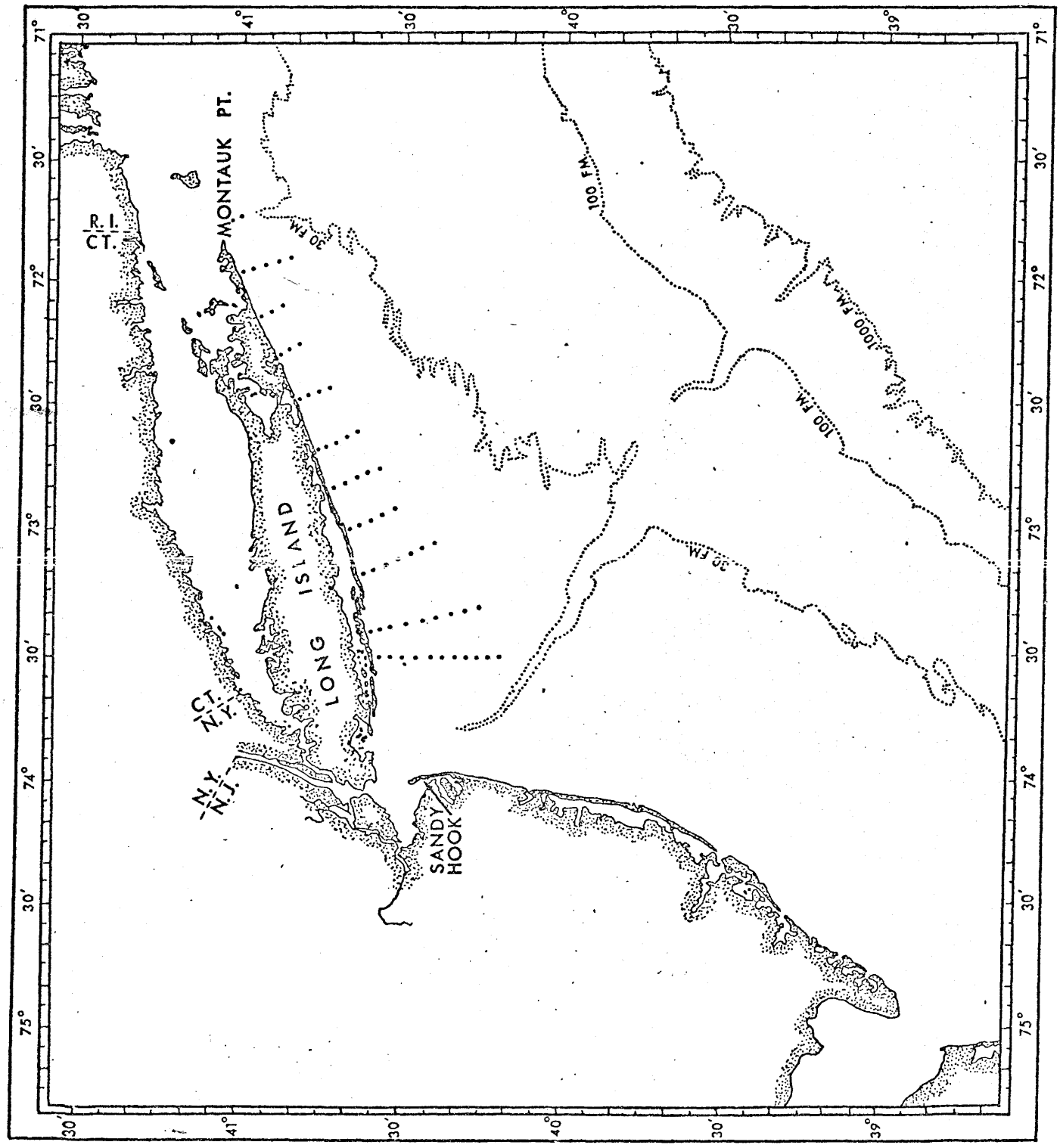
Leslie Helen Rogers
Leslie Helen Rogers
Chief Scientist

John B. Pearce
John B. Pearce, Director
Ecosystems Investigations

Carl Sindermann
Carl J. Sindermann, Center Director
Middle Atlantic Coastal Fisheries Center

CRUISE REPORT K-75-1
NOAA Ship George B. Kelez
28 May - 2 June 1975

Fig. 1. Dots indicate station locations.



CRUISE REPORT K-75-1
NOAA Ship George B. Kelez
28 May - 2 June 1975

Table 1. Stations locations, 59 stations.

	LAT.		LONG.
1.	40°12.1'	x	73°29.6'
2.	40°14.2'	x	73°29.8'
3.	40°16.5'	x	73°29.9'
4.	40°18.7'	x	73°29.8'
5.	40°21.0'	x	73°29.8'
6.	40°23.2'	x	73°29.8'
7.	40°25.8'	x	73°30.0'
8.	40°28.0'	x	73°29.9'
9.	40°29.9'	x	73°29.9'
10.	40°32.3'	x	73°30.0'
11.	40°34.7'	x	73°29.8'
12.	40°36.4'	x	73°22.5'
13.	40°34.5'	x	73°21.3'
14.	40°32.5'	x	73°20.2'
15.	40°30.4'	x	73°19.0'
16.	40°28.4'	x	73°17.7'
17.	40°26.1'	x	73°16.5'
18.	40°24.2'	x	73°15.2'
19.	40°22.0'	x	73°14.1'
20.	40°20.0'	x	73°12.8'
21.	40°24.7'	x	73°05.4'
22.	40°26.8'	x	73°06.3'
23.	40°28.9'	x	73°07.4'
24.	40°31.1'	x	73°08.1'
25.	40°33.4'	x	73°09.1'
26.	40°35.4'	x	73°10.0'
27.	40°37.6'	x	73°10.8'
28.	40°32.1'	x	72°55.1'
29.	40°34.3'	x	72°56.2'
30.	40°36.3'	x	72°57.6'
31.	40°38.4'	x	72°58.8'
32.	40°40.4'	x	73°00.0'
33.	40°35.4'	x	72°45.3'
34.	40°37.5'	x	72°46.3'
35.	40°39.7'	x	72°47.3'
36.	40°41.8'	x	72°48.5'
37.	40°43.8'	x	72°49.6'
38.	40°38.2'	x	72°34.8'
39.	40°40.4'	x	72°35.8'
40.	40°42.5'	x	72°36.8'
41.	40°44.8'	x	72°37.8'
42.	40°46.7'	x	72°38.9'
43.	40°43.3'	x	72°25.1'
44.	40°45.4'	x	72°26.2'
45.	40°47.6'	x	72°27.2'
46.	40°49.6'	x	72°28.1'
47.	40°49.8'	x	72°14.8'
48.	40°51.7'	x	72°16.0'
49.	40°53.5'	x	72°17.4'
50.	40°53.8'	x	72°05.5'
51.	40°56.3'	x	72°05.0'
52.	40°57.8'	x	72°06.1'
53.	40°53.3'	x	71°51.3'
54.	40°55.0'	x	71°53.6'
55.	40°57.0'	x	71°55.2'
56.	40°59.2'	x	71°55.7'
57.	41°01.3'	x	71°56.7'
58.	41°03.5'	x	71°45.4'
59.	41°01.7'	x	71°44.3'