

MATERIALS AND METHODS

Macrofauna Samples

This report is based on the analyses of 667 quantitative samples of benthic invertebrates collected at 563 locations (stations). Samples were obtained primarily between 1962 and 1965. Three samples collected in 1957 were inadvertently included in the analysis of this suite. The basic sampling strategy was an 18 km (10 mi) grid whose base orientation was roughly perpendicular to the depth gradient. Station locations for all samples are shown in figure 2. Basic station data is given in a companion report by Wigley, Theroux, and Murray, Northeast Fisheries Center, Woods Hole, Massachusetts, June 30, 1976 (see INTRODUCTION). The regularity of station locations imparted by the grid is evident, but is masked in some places by additional samples between grid lines.

Samples were obtained during the course of 16 research cruises (table 1). Five research vessels were utilized for sampling, three of which, Albatross III, Delaware I, and Albatross IV, were operated by the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration in the Department of Commerce and its predecessor agency the Bureau of Commercial Fisheries then in the Department of the Interior. Two vessels, Gosnold and Asterias, were operated by the Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

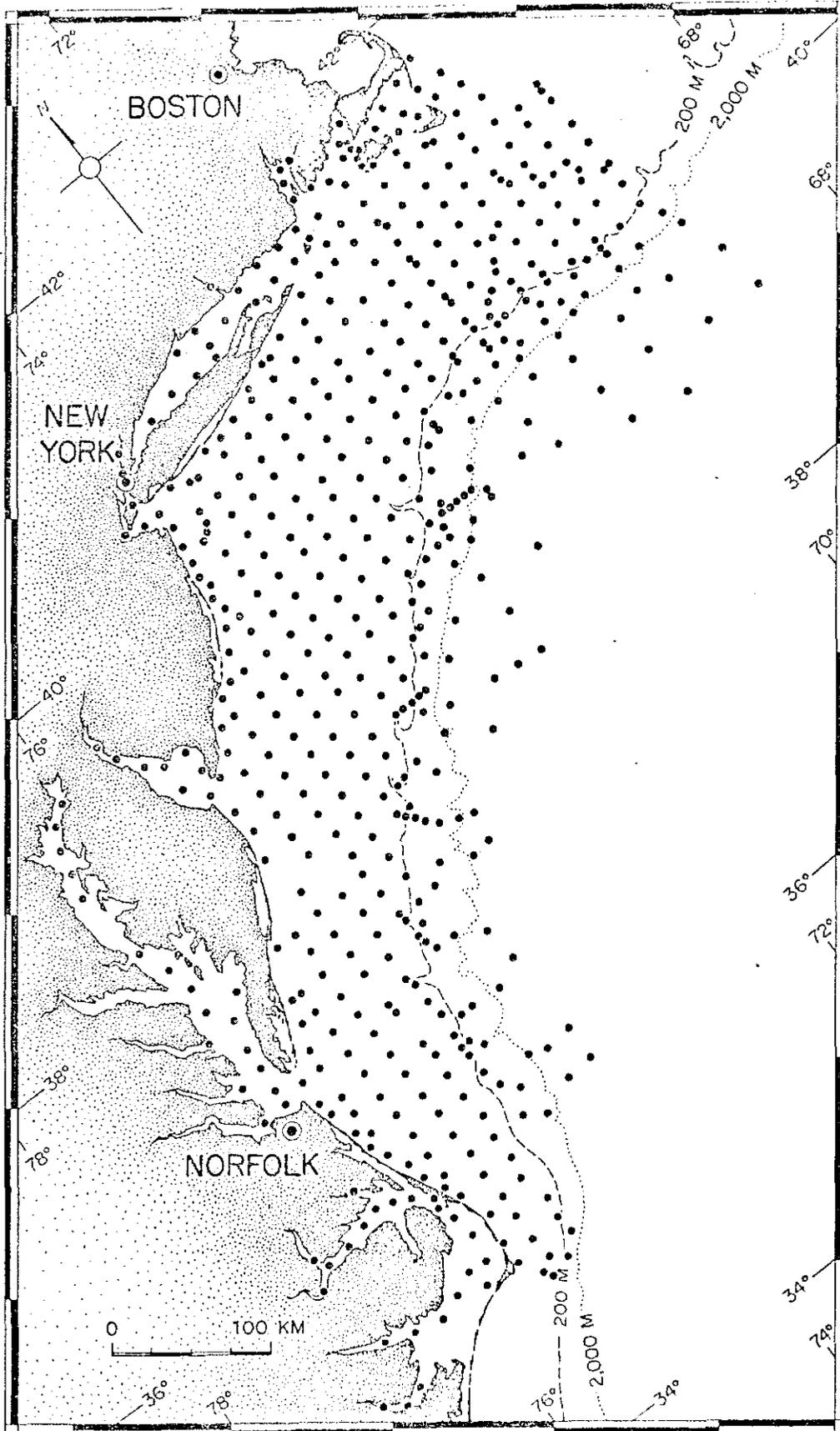


Figure 2.--Chart of station locations where quantitative samples of macrobenthic invertebrates were obtained.

Table 1.--Research vessels, cruise identification and dates, and number of stations sampled.

Vessel and cruise	Cruise date	Number of stations
ALB III - 101	Aug 21-30 1957	3
DEL - 62-7	Jun 13-20 1962	63
GOS - 10	Apr 26 1963	6
GOS - 11	Apr 30 1963	3
GOS - 12	May 2-7 1963	4
GOS - 13	May 9-14 1963	25
GOS - 20	Jul 16 1963	1
GOS - 22	Aug 5-17 1963	10
GOS - 28	Oct 3-6 1963	9
GOS - 29	Oct 8-27 1963	130
GOS - 45	May 15-Jun 30 1964	53
GOS - 49	Aug 1-29 1964	129
AST - 64-1	Apr 22-23 1964	6
AST - 64-2	Jul 1-Aug 9 1964	74
AST - 65-1	May 4-Jun 12 1965	33
ALB IV - 65-11	Aug 17-27 1965	14
Total		563

Quantitative samples were obtained from inshore estuarine areas, the continental shelf, slope and certain portions of the continental rise throughout the Middle Atlantic Bight Region, encompassing an area of 303,521 km² (121,408 mi²). For the purposes of a geographic perspective, the region was divided into subareas designated: Southern New England, New York Bight, and Chesapeake Bight. These subareas, delineated in figure 1, contain 94,700, 82,749, and 126,072 km² (37,880, 33,100, 50,428 mi²), respectively. More detailed data pertaining to the areal expanse of various sub-units within the region are listed in table 2. Each subarea contains a nearly equal number of samples: Southern New England--186 samples; New York Bight--187 samples; Chesapeake Bight--190 samples.

Benthos Sampling Gear

Samples were obtained using three different quantitative grab-type bottom samplers: the Van Veen grab (Holme and McIntyre, 1971); the Smith-McIntyre sampler (Smith and McIntyre, 1954), illustrated in figure 3; and the Campbell grab (Menzies, Smith, Emery, 1963), illustrated in figure 4. All three are reliable devices for obtaining quantitative samples with relative ease under a wide variety of working conditions. Because a small vessel was employed in sampling inshore waters, this restricted the use of bottom samplers to the two smaller ones-- Van Veen and Smith-McIntyre. A total of 13 samples (2%), each covering an area of 0.1 m², were taken with the Van Veen grab; 195 samples (35%) were taken with a 0.1 m²-size Smith-McIntyre grab; and 355 (63%) samples were taken with the 250-kg Campbell grab, each sample covered an area of 0.56 m². These devices provided enough material for both biological and geological analyses.

Table 2.--Areas, in square kilometers, of several bathymetric zones within each subarea and for the entire Middle Atlantic Bight Region.

Bathymetric zone	Subarea			Total
	Southern New England	New York Bight	Chesapeake Bight	
	<u>km²</u>	<u>km²</u>	<u>km²</u>	<u>km²</u>
Bays and Sounds ^{1/}	2,674	3,788 ^{2/}	17,401	23,863
Continental Shelf				
0 - 24 m	5,495	8,035	12,015	25,545
25 - 49 m	8,253	15,045	15,488	38,786
50 - 99 m	16,986	17,604	6,987	41,577
100 -199 m	4,826	3,228	1,930	9,984
	<u>35,560</u>	<u>43,912</u>	<u>36,420</u>	<u>115,892</u>
Continental Slope				
200 - 499 m	1,853	1,129	1,222	4,204
500 - 999 m	1,917	1,515	1,813	5,245
1,000 -1,999 m	3,667	3,514	8,598	15,779
	<u>7,437</u>	<u>6,158</u>	<u>11,633</u>	<u>25,228</u>
Continental Rise				
2,000 - 3,999 m	49,029	28,891	60,618	138,538
Total	94,700	82,749	126,072	303,521

¹Based on areas reported by: Bumpus, Lynde, and Shaw (1973).

²Includes the Gardiners Bay complex (1,078 km²).

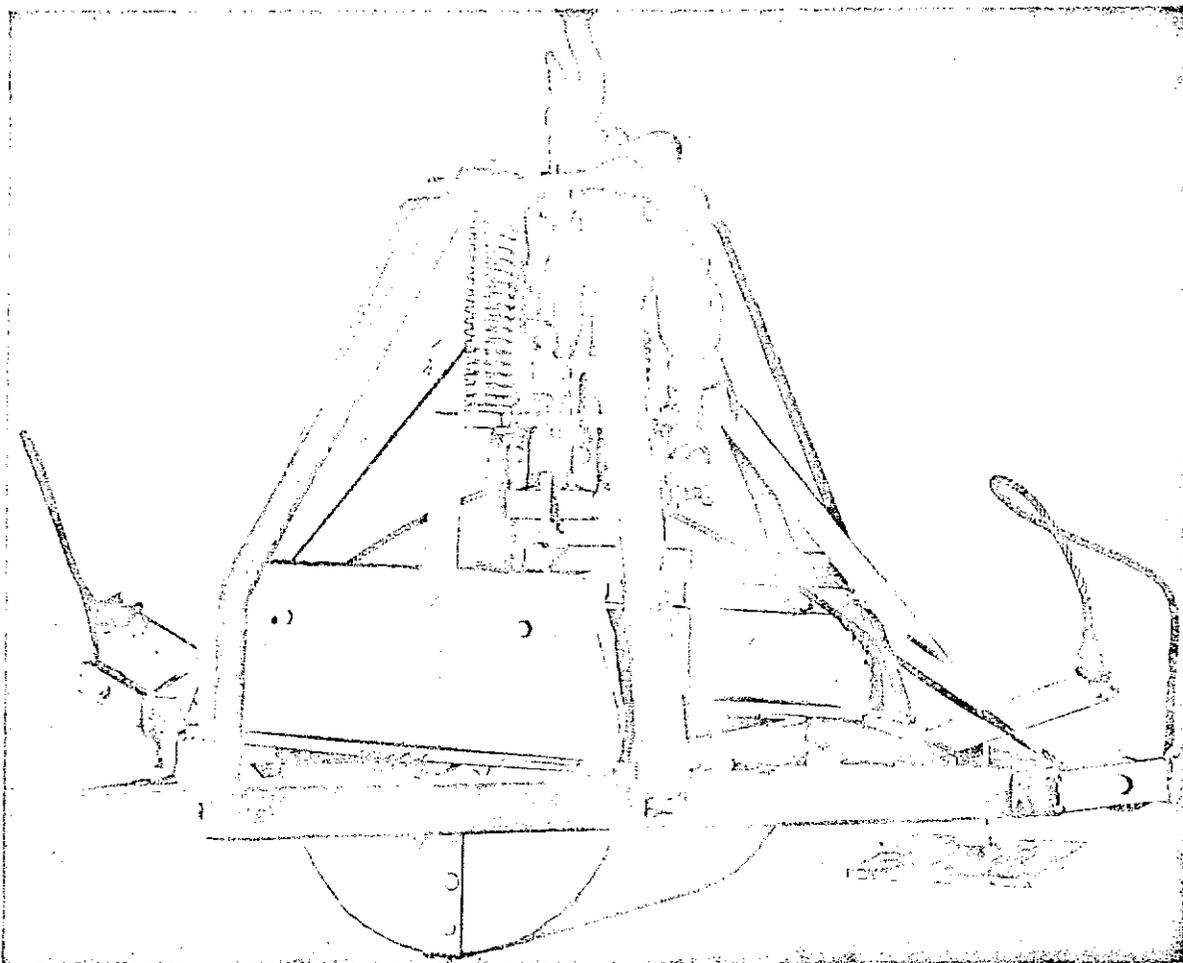


Figure 3.--Side view of the Smith-McIntyre spring-loaded bottom sampler in the closed position. Lead weights on each side are set vertically to impede rotation of the sampler during descent and ascent.

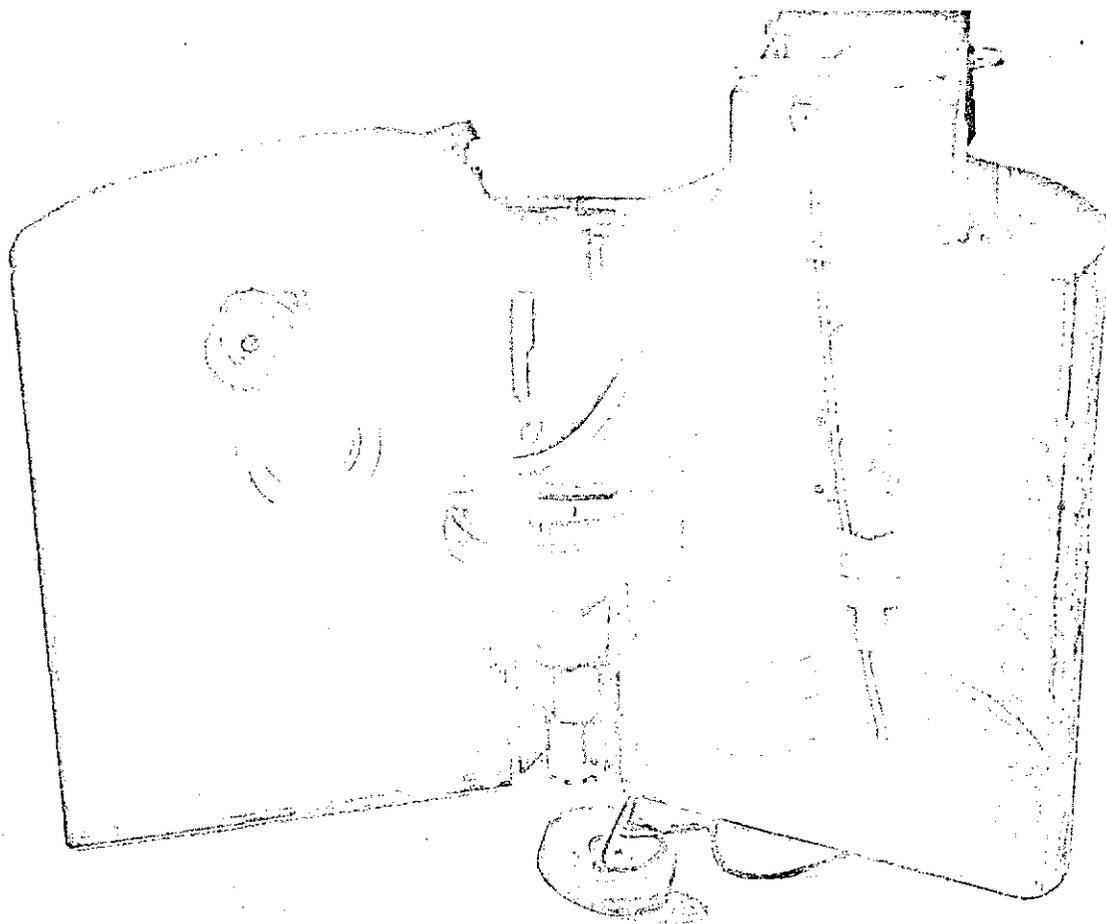


Figure 4.--Bottom view of Campbell grab sampler. Camera is installed in right-hand bucket and strobe light is in the left-hand bucket. Width of the buckets (vertical dimension in photograph) is 57 cm.

In addition to samples of sediment and fauna, the Campbell grab was equipped with an automatic camera and electronic light source (Emery, Merrill, Trumbull, 1965; Emery and Merrill, 1964), which provided a photograph of the sea bottom immediately prior to bottom contact. The camera housing, fastened within one of the buckets of the grab, contained two 35-mm motorized cameras spaced to provide stereo separation, if desired. Usually, during the course of this work, each camera was loaded with a different type of film, one with black and white negative material and the other with reversal (positive), high speed daylight color film. The opposite bucket contained the electronic strobe light which illuminated the area to be photographed. The device was activated at about 1 m above the bottom by means of a trip-weight suspended below the grab. Approximately 200 simultaneous photographs and bottom samples were obtained within the study area. Of this total, 180 photographs were in black and white (examples in figs. 89 to 94) and 20 were in color.

Sample Processing

The method of processing samples from the different sampling devices differed only in the size of the equipment and method of determining sediment volume. Contents of the grab were emptied into a water-tight receptacle large enough to accommodate the maximum amount of substratum the device could contain. Substrate receptacles for the Van Veen and Smith-McIntyre

samplers were 20-liter graduated pails and for the Campbell grab a large rectangular steel tub. This tub also served as the washing container. The volume of the samples was determined prior to any other treatment. The graduated pails used with Van Veen and Smith-McIntyre samplers gave a direct reading of volume whereas pre-calibrated brass dip-sticks were used to determine the volume of Campbell grab samples. Volumes were recorded to the nearest whole liter.

All samples were washed on a sieving screen having 1-mm mesh openings to remove unwanted sediments and retain specimens. Washing methods differed for samples from the two smaller grabs and the larger one. A specially designed wash stand employing adjustable flow shower heads trained onto the mound of sediment contained in a boxlike apparatus was used to wash Van Veen and Smith-McIntyre samples. Water flow gently flooded the organisms out of the sediments and transported them to the sorting sieve where everything greater than 1 mm was retained. Washing of Campbell grab samples was accomplished in the receptacle which received the sample. Water from hoses with variable nozzles floated sediments and organisms through openings in the container to the sieving screens.

Samples containing coarse substrate fractions, i.e., pebbles, cobbles, etc., retained on the screen required further treatment to reduce their bulk for preservation. Sorted out by hand, these larger fractions were examined and if clean (no attached organisms) discarded, those with attached organisms were retained for later treatment. Organisms and sediments

retained by the screen were preserved in a 5% buffered seawater solution of formaldehyde in glass containers, labeled, and stored for transport to the laboratory.

Laboratory treatment of each sample of preserved specimens involved 1) rinsing in fresh water to flush off formalin solution; 2) sorting and identifying to the lowest taxonomic level consistent with accuracy; 3) recording counts of individuals in each taxonomic group; and 4) obtaining damp or wet weights (i.e., excess superficial fluids removed with blotting paper) of each group. Included in the weight measurements are skeletal structures that form an integral part of the living animal. This, of course, includes shells of mollusks, brachiopods, crustaceans, echinoderms, and all other organisms having a shell-like skeleton. Weights do not include hermit crab "houses", amphipod or polychaete tubes, or other accessory structures of that type. After the above treatment, all specimens were preserved in 70% ethanol and stored in suitably labeled containers.

Data Reduction

Certain adjustments to the raw data were required in order to make them comparable, one sample with another. The criterion of comparability chosen was a unit area of 1 square meter. Adjustments were made to account for sampling gear size (area of bottom sampled) and material removed (such as sediment samples for geological analyses) prior to processing.

A MESA (Marine Ecosystems Analysis) formatted, IBM compatible, magnetic computer tape of benthic data was made and submitted to MESA, New York Bight Project office. A major difference between our data processing system and MESA's occurs in the coding schemes used to identify the various taxonomic components. The system we (Demersal Food Chain Investigation at the Northeast Fisheries Center, Woods Hole) employed was an 11-digit code developed by us in 1962, and it differs substantially from the 10-digit code used by MESA. Our code is divided as follows: Phylum (2 digits); Class (1); Order (2); Family (2); Genus (2); Species (2). At present our taxonomic code data-file contains approximately 6,000 names from the U.S. east coast.

Bathymetry

Water depths, in meters, were obtained by means of echo sounders and corrected for hydrophone depth and temperature effects on the velocity of sound.

Temperature

Due to a lack of suitable bottom water temperature information, especially in the southeastern portion of New York Bight and in Chesapeake Bight, alternative means of determining temperatures were required. Minimum and maximum temperatures for each sampling site were obtained from various published sources (see INTRODUCTION) and from measurements obtained by the Northeast Fisheries Center vessels on file at this facility. The range in temperature was determined by subtraction, grouped into range classes, and these range values were used in the temperature analyses.

Geological Samples

A sample of bottom sediment was collected from each macrobenthic sample. A lithological description was made at the time of collection, based on field-analysis techniques. The sample was then placed in a cardboard container, air dried, and brought to the laboratory ashore for detailed determination of grain size composition, a measure of organic carbon, and analyses of other chemical and mineralogical components by geologists of the U.S. Geological Survey and Woods Hole Oceanographic Institution. Analysis results are contained in Woods Hole Oceanographic Institution Reference No. 71-15, Data File, Continental Margin Program Atlantic Coast of the United States, Vols. 1 and 2, compiled and edited by John C. Hathaway, U.S. Geological Survey, Woods Hole, Massachusetts. Data pertaining to bottom sediments and quantity of organic carbon used in our analyses are listed in this document.