A Preliminary Investigation of the Benthic Resources at Deep Water Disposal Site 106

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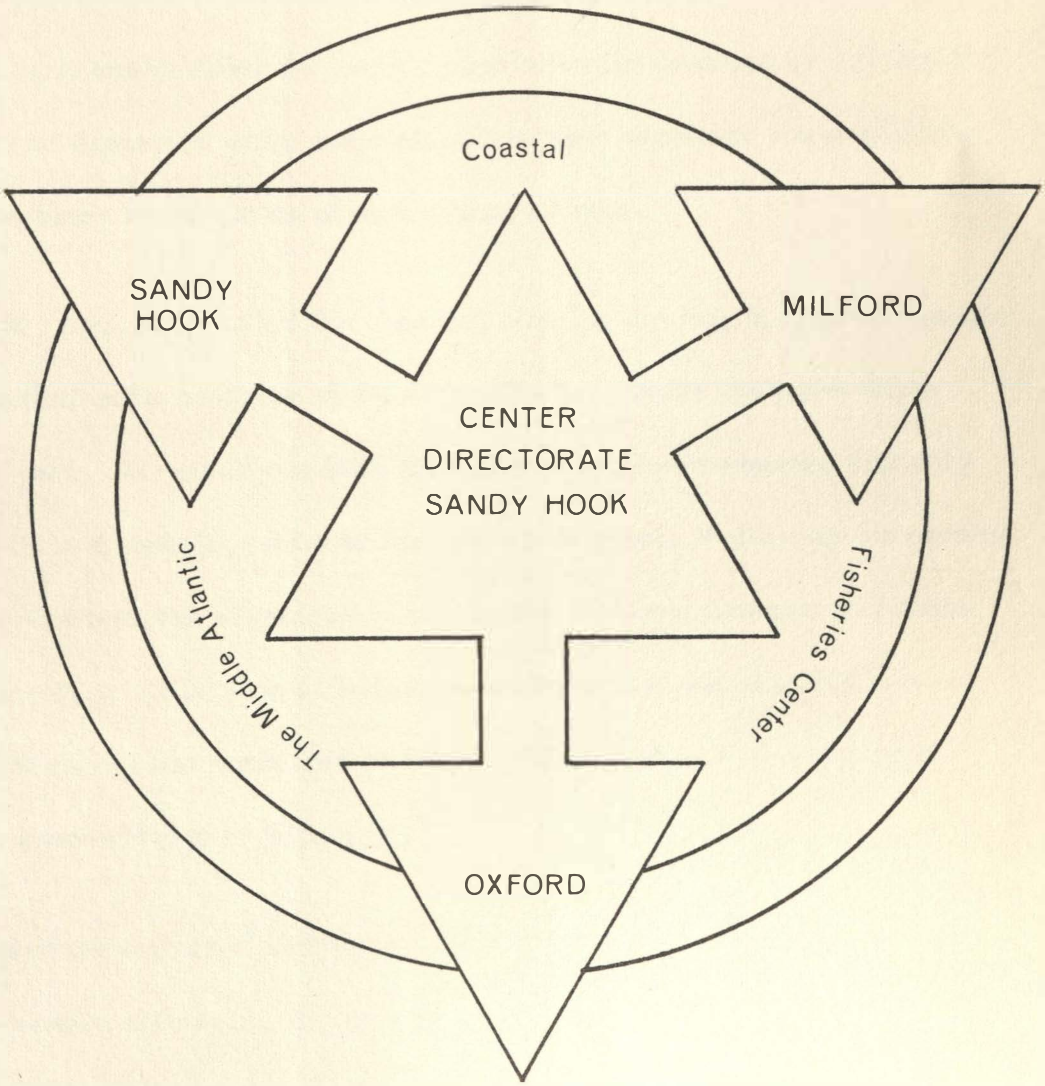

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INTRODUCTION

As noted by Sanders, Hessler and Hampson (1963) the number of benthic samples collected from any particular area of the deep-sea environment is relatively small. Virtually nothing is known about the benthic populations in deep-sea environments presently used for disposal of waste materials. This paper reports on the preliminary findings from a recent investigation of such a disposal area.

Station 106, frequently called the chemical dumping ground, is located approximately 120 nautical miles southeast of New York Harbor, where the water depth exceeds 6,000 feet. As recently as 1968 the Corps of Engineers reported that only one firm, American Cyanimid, had used the area for disposal. Following the general format of an operations plan developed jointly by the National Oceanic and Atmospheric Administration (NOAA) and Environmental Protection Agency (EPA), a baseline benthic survey was conducted at Station 106 as well as at several stations located in the surrounding area (Figure 1).

The principal objectives of the survey included: 1) the determination of the distribution, abundance and diversity of the benthic infauna at Station 106 and surrounding areas; in particular we wished to relate our findings to those previously obtained by other investigators working in the Middle Atlantic Bight at similar water depths (Sanders, Hessler and Hampson, 1965; Wigley and McIntyre, 1964); 2) the establishment of the variation in the infauna in samples collected at Station 106 and at stations surrounding 106 or in similar water depths; 3) the determination of the relationship between the benthic infauna and physical sediment types found at stations in different water depths; 4) the measurement of the quantities of heavy metals in sediments at Station 106 and other stations in similar depths; and 5) the measurement of the body burdens of heavy metals in organisms collected in the general vicinity of Station 106 and at other stations in similar water depths.

MATERIALS AND METHODS

At least two Smith-McIntyre Quantitative Bottom Grab samples (0.1 m^2) were taken at each sampling station (Figure 1). Substantial amounts of surficial sediment were removed from the first of each pair of grabs for analyses for the presence of radioactive materials. Small aliquots of sediment were removed from each pair of samples for heavy metal analysis and grain size distribution. A small core aliquot was also removed for future study of the meiofauna.

The sediments remaining in each grab sample were then washed through standard stainless steel geological screens with apertures of 1.00 and 0.50 mm. The materials remaining on the screens were fixed in formalin and preserved in 70% ethanol.

Biological materials were subsequently picked from the preserved samples using dissecting microscopes. Preliminary identifications were accomplished using the keys and descriptions developed by Hartman (1950, 1965), Pettibone (1957, 1963), Day (1967) and others.

Sediment samples were furnished to Dr. Anthony Cok (Department of Geology, Adelphi University) for standard geological analyses. These data are given in Table 1. Sediments and tissues from epibenthic organisms were analyzed for their content of heavy metals by Mr. Richard Greig (Environmental Chemistry and Microbiology Investigation, NMFS, MACFC, Milford Laboratory, Milford, Conn.) and reported in Graikoski et al., 1974. Their data are given in Tables 2 and 3.

RESULTS

The numbers of individuals found in grab samples collected at each of the seven sampling stations are quite similar, ranging from 19/0.1 m^2 at Station 2 to 48 at Station 7 (see Table 4). The number of taxa, based on very preliminary identifications, found at each station varied from 13 at Station 4 to 20 at Station 5 (Table 4). Diversity (as H') varied from 2.035 at Station 4 to 2.756 at Station 5 (Table 4).

These preliminary data are similar to the findings of several other investigators working in abyssal depths and summarized by Sanders, Hessler and Hampson (1965) in their section on faunal densities and composition. Polychaetes are the dominant taxon, followed by the pericarid crustaceans.

With one exception the metal contents of sediment samples collected in water deeper than 2000 m showed little variation from station to station (Table 2). Station A1 contained somewhat less metal than did the other deep water stations, A2 - A7.

Samples collected at Test Station 1 had considerably less metal (Table 2). This station is located shoreward of the shelf-slope break; the heavy metal content of sediments is similar to values previously found in shelf sediments uncontaminated by domestic and industrial wastes (Pearce, 1972; Greig, 1974).

Sediments were characterized by relatively large amounts of sands, silts and clays. Again, sediments from these depths were previously reported by Sanders, Hessler and Hampson (1965) to consist principally of silts and clays with some sands (see their Table 2).

The heavy metal content of tissues from several taxa of benthic invertebrates and demersal finfish is given in Table 3. These data will be compared to recent data concerned with the body heavy metal burdens of finfish trawled for on the continental shelf.

DISCUSSION AND SUMMARY

Further sampling and statistical analyses are required to determine the extent of between station variation in the infauna and sediment characteristics, including heavy metal content. It is apparent, however, that the abundance of infauna at each station falls within the same order-of-magnitude as noted in abyssal sites by previous investigations. Diversity is also quite similar at all stations.

The sediment heavy metal content does appear elevated relative to uncontaminated continental shelf sediments. The fact that sediment samples collected at Station A1 were somewhat lower in heavy metal content than the other stations raises a number of questions. It is generally assumed that silts and clays have more metals associated with them. Since Stations A2 - A7 are located near the Hudson Canyon outfall it might be possible that materials originating inshore, and having an elevated heavy metal content, are transported seaward via the shelf valley and canyon. Station A1 might be outside the influence of this "system."

At the present time there is no reason to assume that the toxic wastes disposed of at Station 106 have, in any way, impinged upon the sediments or fauna collected at the several benthic sampling stations in the vicinity of 106. The makeup of the benthic assemblages is very similar to what has been reported for deep-sea benthic faunal assemblages found at similar depths along the Gay Head-Bermuda transect (Sanders, Hessler and Hampson, 1965).

Since there was relatively little variation in the heavy metal content of sediments at the several stations we sampled it does not seem likely that the metal content noted in these sediments can be attributed to ocean disposal as presently practiced at Station 106.

The levels of the metals silver, cadmium and chromium did not vary greatly in most of the finfish and invertebrates which were analyzed. Copper, zinc and lead did, however, vary somewhat. Lead showed the greatest variation of the six metals (Table 3).

Liver tissues from the deep-sea slickhead, Alepacephalus agassizi, had the highest levels of silver, cadmium, copper and zinc. The values for these metals are several orders of magnitude greater than the metal concentrations found in windowpane flounder, Scophthalmus aquisis, taken from the sewage sludge and dredge spoil disposal sites in the New York Bight apex (Greig, unpublished data). The levels of the metals in liver tissues from the slickhead were:

cadmium	13.9 ppm
copper	28.6 ppm
silver	1.2 ppm
zinc	271.0 ppm

All values are on a wet weight basis.

Additional liver tissue samples were removed from the deep-sea grenadier, Nematonurus armatus; rattail, Nezumia bairdi; whiting, Merloccius bilinearus; and Halosaupsis macrochin (no common name available). The levels of metals in these tissues were fairly similar to those found in livers of windowpane flounder taken in coastal waters.

Information presented by Windom et al. (1973) on cadmium, copper and zinc values in 35 species of fish obtained from waters of the North Atlantic can be used for comparison with present data. They reported that cadmium in liver tissue was generally less than 1.7 ppm, although one sample contained 5 ppm. Cadmium levels in other organs and whole fish usually were less than 1 ppm; some species, however, had values as high as 2.6 mm. Because their data (Windom et al.) were expressed on a dry weight basis the values obtained by Windom et al., and herein reported, would have to be reduced to about one-fifth, assuming 80% moisture in fish tissues. The highest cadmium level of 5 ppm dry weight found by Windom et al., would be about 1 ppm on a wet weight basis. Copper levels were, in most cases, less than 10 ppm in their fish tissues. The copper level in liver of deep-sea slickhead in our study was 28.6 ppm on a wet weight basis, which is more than triple the highest level of about 9 ppm on a wet weight basis, reported by Windom and co-workers. Copper concentrations in other species of fish obtained in the present study were similar to the levels in fish examined by Windom et al. (1973).

Zinc levels in North Atlantic fish were reported by Windom and co-workers to be in the range of 10 - 80 ppm on a dry weight basis. However, a high level of zinc at 397 ppm for the species Anchoa mitchilli was obtained. This level would be about 80 ppm on a net weight basis. Zinc levels found in most fish in our study were in this same range.

Because of the foregoing it is suggested that additional tissues should be taken from organisms collected at the deep water dump site 106. Analyses of present samples indicate that at least some tissues from individuals of a particular species have a higher than ususal body burden of metals. Scientists have long known that certain species of marine organisms selectively concentrate specific metals; it may be that the slickhead, for instance, is one such organism. In order, however, to adequately assign baselines for heavy metal body burdens in demersal and benthic organisms additional specimens should be collected and analyzed for metals and other contaminants.

ACKNOWLEDGMENTS

Samples were collected during the period 10 - 24 May 1974 when the R/V *Delaware II* was involved in a joint NOAA-EPA operation at dump site 106. Dr. James Thomas, Ecosystems Investigations, was scientific party chief and responsible for field collections. Mr. Richard Greig, Ecosystems Investigations, conducted chemical analyses for heavy metal burdens in organisms and sediment. Mrs. Ann Frame, Mr. David Radosh and Ms. Leslie Rogers (Ecosystems Investigations) were instrumental in sorting and tentatively identifying benthic organisms. Dr. John Pearce, Director, Ecosystems Investigations, was responsible for overall supervision of the project and preparation of the data report.

The data presented in this report are tentative and before referencing the report permission should be obtained from the Director, Middle Atlantic Coastal Fisheries Center.

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Table 1. Sediment Grain Size Distribution.

Because of an injury received by the principal investigator, this data is not available for inclusion in this report at the present time. Table 1 will be sent to Distribution List as soon as it is completed.

Table 2. Trace metal concentrations in the upper 1.5 inches of sediments collected from stations near disposal site 106.

Station and Grab #	Metals (Cmc. in PPM, dry sediment)				
	Cr	Cu	Ni	Pb	Zr
A1, grab 1	16.8	13.4	12.6	16.0	33.2
grab 2	21.8	21.6	20.6	24.0	45.0
A2, grab 1	26.2	28.2	24.2	26.0	60.0
grab 2	23.2	24.0	19.0	28.0	53.0
A3, grab 1	25.6	28.0	22.8	26.0	59.0
grab 2	23.4	19.6	17.8	24.0	58.0
A4, grab 1	27.4	29.6	28.4	32.0	63.0
grab 2	24.2	26.6	24.4	32.0	56.0
A5, grab 1	26.8	31.2	29.6	32.0	61.0
grab 2	28.0	30.6	28.4	26.0	64.0
A6, grab 1	28.6	37.2	32.4	26.0	65.0
grab 2	27.8	34.8	31.8	30.0	53.0
A7, grab 1	25.4	26.2	23.0	26.0	56.0
grab 2	22.6	23.6	22.4	20.0	53.0
A6, N	26.8	32.0	28.6	26.0	56.0
A6, E	24.6	36.0	28.2	26.0	56.0
A6, S	23.4	29.0	29.8	24.0	52.0
A6, SW	26.4	32.6	26.4	28.0	54.0
A6, W	27.4	34.0	27.8	30.0	57.0
A6, NW	26.6	34.6	33.6	28.0	58.0
Test 1, grab 1	6.8	3.0	3.2	6.0	14.8
grab 2	6.6	3.0	4.2	8.0	13.2

Table 3. Trace metal concentrations in marine biota collected offshore in the New York Bight.

Common Name	Scientific Name	N	Tissue	Latitude	Longitude	Metal Concentrations (ppm, wet wt.) Ag	Cd	Cr	Cu	Pb	Zn
Butterfish	Prepilus triacantnus	5	Whole	39°30'N	72°34'W	0.14	0.23	0.54	4.6	1.1	28.8
Deep Sea Slickhead	Alepacephalus agassizi	3	Muscle	38°50'N	72°34.5'W	<0.09	0.09	<0.3	0.2	<0.3	11.6
Deep Sea Slickhead	"	11	Liver	38°50'N	72°34.5'W	1.16	13.9	0.6	28.6	0.5	271.
Deep Sea Slickhead	"	11	Gills	38°50'N	72°34.5'W	0.12	0.27	0.5	1.1	1.3	69.0
Deep Sea grenadier	Nematonurus armatus	3	Muscle	30°09'N	72°19.5'W	<0.08	<0.07	0.4	0.4	<0.4	3.7
Deep Sea grenadier	"	9	Liver	39°09'N	72°19.5'W	<0.1	<0.1	1.1	2.4	<0.6	18.5
Deep Sea grenadier	"	9	Gills	39°09'N	72°19.5'W	0.15	0.08	0.8	1.2	2.0	18.0
	Dicrolene intronigra	11	Whole	39°02'N	72°25'W	0.20	0.17	0.94	2.2	2.1	12.3
Eel	Synaphobranchus kaupi	11	Whole	39°02'N	72°25'W	0.11	0.51	0.58	4.2	1.7	14.7
	Halosaupsis macrochin	4	Muscle	38°38'N	72°06'W	<0.09	<0.07	<0.45	2.7	<0.4	4.3
	Halosaupsis macrochin	3	Liver	38°38'N	72°06'W	0.33	0.30	<0.67	2.0	<0.6	4.9
	Halosaupsis machrochin	3	Gills	38°38'N	72°06'W	0.16	0.13	0.75	1.4	2.3	15.5
	Halosaupsis macrochin	2	Gonad	38°38'N	72°06'W	<0.29	<0.23	1.4	3.6	<1.2	55.5
	Nematonurus armatus	3	Muscle	39°30'N	72°34'W	0.09	<0.07	<0.40	1.2	0.8	9.7
	Nematonurus armatus	3	Gills	39°30'N	72°34'W	<0.10	0.08	0.58	1.4	1.3	27.0
	Pontaster hebitus	18	Whole	38°38'N	72°06'W	0.54	0.83	1.00	4.0	8.0	59.4

Table 3 (cont'd). Trace metal concentrations in marine biota collected offshore in the New York Bight.

Common Name	Scientific Name	N	Tissue	Latitude	Longitude	Metal Concentrations (ppm, wet wt.) Ag	Cd	Cr	Cu	Pb	Zn
Rattail	*Nezumia bairdi*	60	Whole	39°09'N	72°19.5'W	0.17	0.26	0.95	3.0	2.7	32.9
Rattail	"	4	Muscle	39°02'N	72°25'W	<0.08	<0.07	0.45	0.6	0.6	5.8
Rattail	"	4	Liver	39°02'N	72°25'W	0.12	0.79	<0.5	10.9	0.8	59.9
Rattail	"	7	Gills	39°02'N	72°25'W	0.21	0.15	<0.7	2.2	4.2	32.0
Rattail	"	11	Gonad	39°02'N	72°25'W	<0.08	0.15	<0.4	6.5	1.1	56.0
Redcrab		1	Muscle	39°09'N	72°19.5'W	0.16	0.11	0.48	25.2	0.6	51.0
Redcrab		1	Digestive gland	39°09'N	72°19.5'W	0.62	1.14	<0.42	107.	1.2	19.6
Sea Cucumber	*Benthedites giganteus*	1	Whole	38°50'N	72°34.5'W	0.48	0.03	0.23	0.2	0.3	1.3
Whiting	*Merloccius bilinearus*	4	Muscle	39°30'N	72°34'W	<0.09	<0.08	0.49	1.0	<0.3	4.2
Whiting	"	4	Gills	39°30'N	72°34'W	<0.09	0.15	0.54	1.8	2.4	26.8
Whiting	"	4	Liver	39°30'N	72°34'W	0.08	0.29	0.52	14.7	<0.4	12.2
Whiting	"	4	Gonad	39°30'N	72°34'W	<0.09	0.07	0.45	1.2	<0.4	12.7
Witch Flounder	*Glyptocephalus cynoglassus*	58	Whole	39°09'N	72°19.5'W	0.13	0.20	0.73	1.8	3.3	14.7

Table 4. Benthic fauna at deep water (106) stations, #/0.1m².

Species	#1	#2	#3	#4	#5	#6	#7
Actiniaria		1					
Rhyncocaela			2	1	2		1
Nematoda	4	4	5	16	9	2	19
Oligochaeta	2	2		2	1	1	3
Polychaeta:							
Glycera capitata	3		2	1	2		3
Ampictes gunneri						1	
Leanira minor		1					
Syllis cornuta			1			3	
Ancistrosyllis groenlandica						1	
Neopodarke woodsholea			1				
Nereis #1		1					
Mediomastus ambiseta							1
Notomastus latericuis	1		1	4	3	1	
Heteromastus #1		1					
Praxillella gracilis		1					1
Maldanidae #1			1	1	1		
Ammotrypane abranchiata							1
Ammotrypane #1					1		
Nicomache lumbricalis	1						
Prionospio steenstrupi		1					
Spionides #1		1					
Spiophanes #1	1						1
Spiophanes #2					1		2
Paraonis abranchiata					1		
Paraonis sensustricta						1	
Paraonis gracilis		1		1	1		2
Paraonis carnatus					1	1	1
Aricidia tetrabranchia	1		2				
Travisia gravieri			1		1		
Lumbrineris latreille					2	1	
Lumbrineris tenuis		1					
Paecilochaetus fulgaris			8				7
Orbiniidae #1						1	
Paramphiname jeffreysii	1				1		
Tharyx acutus						1	
Tharyx annulosus	1						
Tharyx #1	2	2	2	7	4	1	1
Ampharete #1							1
Terebellidae #1				1			
Terebellides labatus			1				
Sabellides #1			1				
Sipunculida #1		1					
Bivalvia:							
Nucula proxima	2		2				
Bivalve #1			1				
Copepoda	×	×		×	×	×	×
Peracarida:							
Cumacea #1	1						
Cumacea #2					1		
Isopoda #1			1				
Tanaidacea #1						1	
Ampelisca agassizi	3						
Harpinia neglecta		1	1	3	2		
Harpinia abyssi				1			
Euphausiacea #1				3	1	1	
Decapoda #1				1			
Lucifer faxoni						1	
Crustacea #1						1	
Amphipholis squamata	1				3		1
Unidentified vermiform #1			1		3	2	3
Chaetognatha				1	2	1	1
Total # individuals	24	19	34	42	41	21	48
Total # taxa	14	14	18	13	20	17	16
Diversity (H')	2.499	2.507	2.596	2.035	2.720	2.756	2.158

Figure 1. Location of Smith-McIntyre Bottom Grab Stations.