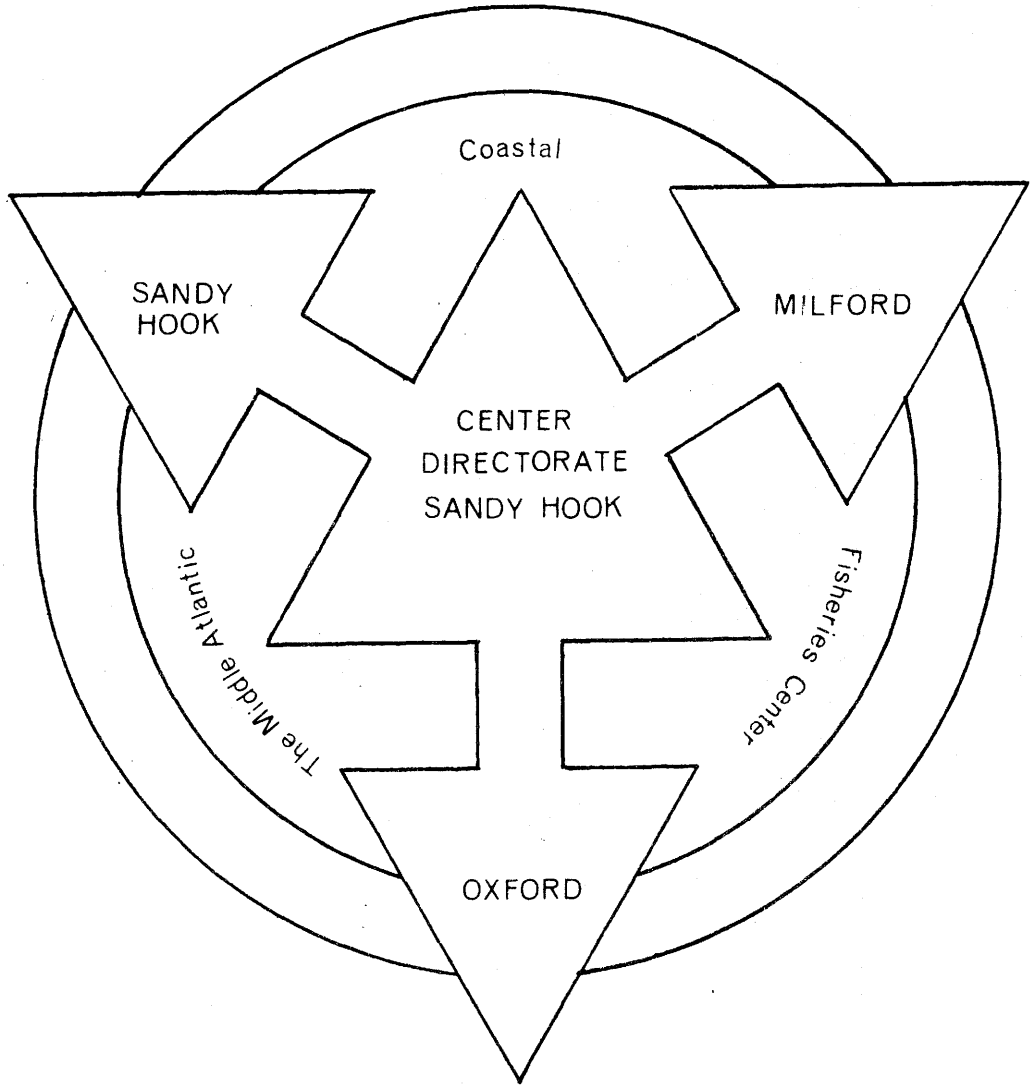
Ratios of Metals in Sediments Collected from the New York Bight

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

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



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COLLECTED FROM THE NEW YORK BIGHT

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

MIDDLE ATLANTIC COASTAL FISHERIES CENTER
HIGHLANDS, NEW JERSEY 07732

AND

ENVIRONMENTAL MICROBIOLOGY AND CHEMISTRY INVESTIGATION
MILFORD, CONNECTICUT 06460

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INTRODUCTION

Large quantities of solid waste materials are disposed of by dumping in oceanic waters of the New York Bight. Attempts have been made to monitor the movement of waste materials from their designated dumping areas to other parts of the New York Bight (Carmody et al., 1973, and Sandy Hook Laboratory, 1972). Although movement of these materials was suggested from data on heavy metals concentrations in bottom sediments, a firm conclusion could not be reached since heavy metals concentrations cannot be used to identify the bottom materials as the solid waste being dumped at the designated sites.

The report presented here deals with one method that, hopefully, could be used to identify a unique characteristic of solid waste materials and, thereby, allow its detection away from the designated dumping sites. The method examined was the ratios of trace metal concentrations found in bottom sediment materials.

MATERIALS AND METHODS

Bottom sediment materials were collected with a Smith-McIntyre grab at 103 stations in the New York Bight. Plastic tubes 1-3/4 inches in diameter were inserted to the depth of the grab, then capped and frozen until prepared for analysis. At the laboratory the top 1-1/2 inches of sediment were removed from the plastic tubes and dried at 60°C for 48 hours; where possible the dried samples were ground into a homogenous sample using glass mortars and pestles. Trace metal analyses were conducted by a procedure previously described (Milford Laboratory, 1974).

RESULTS AND CONCLUSIONS

Ratios of various metals found in bottom sediment material for 103 stations are presented in Tables 1-2. The frequency distribution for these ratios of metals is presented in Tables 3 and 4.

Stations 31-35 and 40-44 are located in the vicinity of the designated sewage and dredge spoils dumping areas. The ratios of metals at these stations generally are among the most frequently occurring ones for all stations examined. Thus, the ratios of trace metals in sediments from the dumping areas are not unusual in comparison to the other stations sampled. Ratios of metals in sediments examined in this report, therefore, do not provide a good means of identifying the solid waste being dumped in the New York Bight.

LITERATURE CITED

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

1973. Trace metals in sediments of New York Bight. Marine Pollution Bulletin, 4 (9): 132-135.

Milford Laboratory

1974. Trace metals in marine biota and sediments collected from offshore waters of New York Bight. Informal Report No. 38. National Marine Fisheries Service, Middle Atlantic Coastal Fisheries Center, Environmental Microbiology and Chemistry Investigation, Milford, Connecticut 06460.

Sandy Hook Laboratory

1972. The effects of waste disposal in the New York Bight. Final Report submitted to U. S. Army Corps of Engineers, Coastal Engineering Research Center, Middle Atlantic Coastal Fisheries Center, Highlands, New Jersey 07732.

Table 1. Ratios of various metals for sediments collected in the New York Bight.

Station No.	Zn/Cr	Zn/Cu	Zn/Ni	Zn/Pb	Pb/Cr	Pb/Cu	Pb/Ni	Ni/Cr	Ni/Cu	Cu/Cr
0-74-1-1	4.43	8.58	13.3	--	--	--	--	0.33	0.65	0.52
0-74-1-2	4.04	6.28	11.3	--	--	--	--	0.36	0.56	0.64
3	6.10	11.41	--	--	--	--	--	--	--	0.53
4	6.16	7.05	--	--	--	--	--	--	--	0.88
5	--	2.22	--	--	--	--	--	--	--	--
6	1.60	2.13	8.0	1.63	0.98	1.31	4.9	0.20	0.27	0.75
7	--	--	--	--	--	--	--	--	--	--
8	6.29	11.62	15.1	--	--	--	--	0.42	0.77	0.54
9	4.20	13.55	21.0	3.00	1.40	4.52	7.0	0.20	0.65	0.31
10	3.70	8.04	18.5	--	--	--	--	0.20	0.44	0.46
11	3.09	6.71	13.8	2.75	1.12	2.44	5.0	0.23	0.49	0.46
12	10.22	20.44	47.0	7.83	1.30	2.61	6.0	0.22	0.44	0.50
13	3.62	5.35	12.3	--	--	--	--	0.29	0.44	0.68
14	4.34	6.78	6.95	2.32	1.88	2.93	3.0	0.63	0.98	0.64
15	--	--	--	--	--	--	--	--	--	--
16	8.13	5.31	3.05	0.58	14.0	9.13	5.25	2.67	1.73	1.53
17	4.35	8.13	9.35	2.33	1.86	3.48	4.00	0.47	0.87	0.54
18	--	--	--	--	--	--	--	--	--	--
19	3.42	4.61	10.6	2.12	1.61	2.17	5.0	0.32	0.44	0.74
20	4.51	5.61	4.6	1.44	3.13	3.90	3.2	0.98	1.22	0.80
21	1.79	2.15	9.8	1.90	0.94	1.13	5.17	0.18	0.22	0.83
22	1.74	1.95	11.43	1.82	0.96	1.07	6.29	0.15	0.17	0.89
23	1.70	2.09	11.9	1.80	0.94	1.16	6.60	0.14	0.18	0.81
24	3.21	5.29	13.5	2.25	1.43	2.35	6.0	0.24	0.39	0.61
25	3.09	5.67	10.2	--	--	--	--	0.30	0.56	0.55
26	3.96	10.57	--	--	--	--	--	--	--	0.38
27	3.27	6.86	--	--	--	--	--	--	--	0.48
28	2.58	3.72	--	1.91	1.35	1.94	--	--	--	0.69
29	2.96	5.69	--	--	--	--	--	--	--	0.52
30	3.26	5.00	--	1.75	1.86	2.86	--	--	--	0.65
31	1.77	2.01	13.57	1.51	1.17	1.33	9.0	0.13	0.15	0.88
32	--	--	--	--	--	--	--	--	--	--
33	1.52	2.0	6.33	1.41	1.08	1.42	4.50	0.24	0.32	0.76
34	0.90	1.59	10.38	1.36	0.66	1.16	7.62	0.09	0.15	0.57
35	1.98	2.08	5.64	1.23	1.60	1.68	4.57	0.35	0.37	0.95
36	--	--	1.85	--	--	--	--	--	--	--
37	--	--	3.00	--	--	--	--	--	--	--
38	5.1	10.93	3.83	2.19	2.33	5.0	1.75	1.33	2.86	0.47
39	3.56	8.9	5.93	2.97	1.20	3.0	2.00	0.60	1.50	0.40
40	2.65	4.97	4.00	2.65	1.00	1.9	1.50	0.67	1.25	0.53
41	1.48	2.70	4.45	1.94	0.77	1.4	2.30	0.33	0.61	0.55
42	3.50	2.92	2.42	1.75	2.00	1.67	1.39	1.44	1.20	1.20
43	23.6	2.42	26.0	2.00	11.82	1.21	13.0	0.91	0.09	9.77
44	6.15	7.24	4.1	1.03	6.0	7.06	4.0	1.50	1.77	0.85
45	4.73	7.10	3.55	2.03	2.33	3.50	1.75	1.33	2.00	0.67

Table 2. Ratios of various metals for sediments collected in the New York Bight continued

Station No.	Zn/Cr	Zn/Cu	Zn/Ni	Zn/Pb	Pb/Cr	Pb/Cu	Pb/Ni	Ni/Cr	Ni/Cu	Cu/Cr
0-74-1-46	--	--	--	--	--	--	--	--	--	--
0-74-1-47	2.07	3.19	5.18	1.73	1.20	1.85	3.00	0.40	0.62	0.65
48	1.42	2.24	5.10	1.11	1.28	2.02	4.60	0.28	0.44	0.63
49	8.30	--	4.15	1.04	8.0	--	4.0	2.0	--	--
50	7.60	--	2.53	--	--	--	--	3.0	--	--
51	3.65	--	2.43	--	--	--	--	1.5	--	--
52	3.77	8.69	3.77	--	--	--	--	1.0	2.31	0.43
53	3.62	5.05	5.43	0.94	3.83	5.35	5.75	0.67	0.93	0.72
54	1.20	2.17	6.50	1.53	0.79	1.42	4.25	0.19	0.33	0.55
55	2.26	2.51	3.77	2.26	1.00	1.11	1.67	0.60	0.67	0.90
56	1.77	1.95	5.30	1.41	1.25	1.38	3.75	0.33	0.37	0.91
57	2.37	3.35	7.10	1.78	1.33	1.89	4.00	0.33	0.47	0.71
58	--	--	--	--	--	--	--	--	--	--
59	3.10	7.75	3.10	2.33	1.33	3.33	1.33	1.00	2.50	0.40
60	1.90	4.00	1.27	--	--	--	--	1.50	3.16	0.48
61	1.80	--	2.25	--	--	--	--	1.00	--	--
62	2.25	--	2.25	--	--	--	--	1.00	--	--
63	2.23	3.72	3.72	1.86	1.20	2.0	2.0	0.60	1.0	0.60
64	3.35	6.70	2.23	--	--	--	--	1.50	3.0	0.50
65	3.67	5.79	2.75	2.20	1.67	2.63	1.25	1.33	2.11	0.63
66	--	--	--	--	--	--	--	--	--	--
67	4.77	6.81	4.77	2.86	1.67	2.38	1.67	1.00	1.43	0.70
68	3.10	--	2.07	--	--	--	--	1.50	--	--
69	3.45	6.27	2.30	1.73	2.00	3.64	1.33	1.50	2.73	0.55
70	10.30	6.44	5.15	2.58	4.00	2.50	2.00	2.00	1.25	1.60
71	3.00	4.62	2.00	--	--	--	--	1.40	2.31	0.65
72	2.63	4.57	3.50	--	--	--	--	0.75	1.30	0.58
73	2.73	--	2.67	--	--	--	--	1.00	--	--
74	3.48	12.64	3.48	3.48	1.00	3.64	3.64	1.00	3.64	0.28
75	1.98	2.95	5.64	1.72	1.15	1.72	3.29	0.35	0.52	0.67
76	2.87	5.38	4.30	--	--	--	--	0.67	1.25	0.53
77	4.30	--	1.43	--	--	--	--	3.0	--	--
78	2.50	--	--	--	--	--	--	--	--	--
79	3.40	6.80	6.80	--	--	--	--	0.50	1.0	0.50
80	3.60	--	10.80	1.80	2.0	--	6.0	0.33	--	--
81	6.60	--	13.20	3.30	2.0	--	4.0	0.50	--	--
82	5.89	12.62	5.89	3.31	1.78	3.81	1.78	1.00	2.14	0.47
83	--	--	--	--	--	--	--	--	--	--
84	3.55	--	--	--	--	--	--	--	--	--
85	1.91	2.59	21.0	1.91	1.0	0.12	11.0	--	--	--
86	--	--	--	--	--	--	--	--	--	--
87	2.60	--	--	--	--	--	--	--	--	--
88	2.20	--	--	--	--	--	--	--	--	--
89	2.0	--	4.0	--	--	--	--	0.50	--	--
90	2.1	--	6.2	--	--	--	--	0.33	--	--

Table 2. Ratios of various metals for sediments collected in the New York Bight (continued).

Station No.	Zn/Cr	Zn/Cu	Zn/Ni	Zn/Pb	Pb/Cr	Pb/Cu	Pb/Ni	Ni/Cr	Ni/Cu	Cu/Cr
0-74-1-91	2.1	4.41	6.4	2.56	0.83	1.72	2.50	0.33	0.69	0.48
0-74-1-92	2.2	3.36	6.67	2.11	1.06	1.59	3.17	0.33	0.50	0.66
93	2.1	3.73	5.23	2.09	1.00	1.79	2.50	0.40	0.71	0.56
94	3.00	5.22	12.0	2.40	1.25	2.17	5.00	0.25	0.44	0.58
95	1.90	--	--	---	--	--	--	--	--	--
96	2.13	4.57	--	1.28	1.67	3.57	--	--	--	0.47
97	3.15	--	--	--	--	--	--	--	--	--
98	2.45	2.23	4.9	1.23	2.0	1.82	4.0	0.50	0.46	1.10
99	3.20	--	--	1.60	2.0	--	--	--	--	--
100	3.10	--	--	--	--	--	--	--	--	--
101	3.25	--	13.0	2.17	1.50	--	6.00	0.25	--	--
102	3.27	--	22.9	2.08	1.57	--	11.00	0.14	--	--
103	4.35	--	--	--	--	--	--	--	--	--

Table 3. Frequency distributions for ratios of metals in sediments collected from the New York Bight.

Pb/Cr		Pb/Cu		Pb/Ni	
Ratio	Frequency	Ratio	Frequency	Ratio	Frequency
0-1	18	0-1	1	0-1	0
1-2	34	1-2	24	1-2	13
2-3	2	2-3	12	2-3	5
3-4	3	3-4	8	3-4	11
4-5	0	4-5	1	4-5	8
5-6	1	5-6	1	5-6	7
8	1	6-7	0	6-7	3
11.8	1	7-8	1	7-8	1
14	1	8-9	0	8-9	1
		9-10	1	9-10	0
				10-11	2
				13	1

Ni/Cr		Ni/Cu		Cu/Cr	
Ratio	Frequency	Ratio	Frequency	Ratio	Frequency
0-0.5	40	0-0.5	22	0-0.5	17
0.5-1.0	17	0.5-1.0	16	0.5-1.0	45
1.0-1.5	11	1.0-1.5	8	1.0-1.5	2
1.5-2.0	2	1.5-2.0	3	1.5-2.0	2
2.0-2.5	0	2.0-2.5	5	9.8	1
2.5-3.0	3	2.5-3.0	2		
		3.0-3.5	2		
		3.5-4.0	1		

Table 4. Frequency distributions for ratios of metals in sediments collected from the New York Bight.

Zn/Cr		Zn/Cu		Zn/Ni	
Ratio	Frequency	Ratio	Frequency	Ratio	Frequency
1-2	18	1-2	1	1-2	4
2-3	21	2-3	18	2-3	11
3-4	30	3-4	4	3-4	11
4-5	10	4-5	6	4-5	8
5-6	2	5-6	10	5-6	10
6-7	5	6-7	9	6-7	7
7-8	1	7-8	4	7-8	2
8-9	2	8-9	5	8-9	0
9-10	0	9-10	0	9-10	2
10-11	2	10-11	2	10-11	4
24	1	11-12	2	11-12	4
		12-13	2	12-13	2
		13-14	1	13-14	5
				15-16	1
				18.5	1
				21	2
				23	1
				26	1
				47	1

Zn/Pb	
Ratio	Frequency
0-0.5	0
0.5-1.0	2
1.0-1.5	10
1.5-2.0	18
2.0-2.5	14
2.5-3.0	7
3.0-3.5	3
7.8	1