Trace Metal Content of Plankton and Zooplankton Collected from the New York Bight and Long Island Sound

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INTRODUCTION

Trace metal composition of marine organisms has received increased attention by the scientific community since the widely publicized discovery of potentially hazardous levels of mercury in certain species of tuna. While most of the attention has been focused on determining whether trace metals can accumulate in organisms to levels potentially hazardous to human health, increased attention also has been given to the area of determining the mechanisms of cycling of trace metals in the marine environment and the possible damage inflicted by metals to the biota in this environment.

To determine the mechanisms of cycling of trace metals in the marine environment, the reservoirs for these metals must be identified and the quantity of metal occurring in these reservoirs determined. WOLF and RICE (1972) have stated that nearly all the metal content of aquatic ecosystems resides in the sediments and water and that the fraction residing in the biota is small. These authors also stated that phytoplankton and zooplankton constitute the most important living elemental reservoirs, in terms of turnover and total physical transport and redistribution processes.

Although plankton constitute an important role in cycling of metals in the marine environment, relatively few studies concerned with movement of metals within plankton systems have been reported in the literature. NICHOLLS et al. (1959) examined a variety of zooplankton species and found measurable quantities of 15 common metals, while antimony, germanium, gallium, gold, and arsenic were sought for but not found. Cadmium was detectable in one species, the squid. TUREKIAN et al. (1973) were able to determine nine rare earth metals in "bulk" plankton samples collected from Long Island Sound.

In the present study various plankton were obtained from Long Island Sound and the New York Bight. The purpose of the study was to obtain baseline data on trace metal levels in zooplankton from these areas and possibly to determine any differences in metal levels related to geographical location of sampling.

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MATERIALS AND METHODS

Plankton were collected with a No. 8 (203 microns) Nitex mesh net, 1/2 meter diameter, that was towed at the surface of the water for half an hour. Samples were kept frozen in plastic jars until processed at the laboratory. The samples were thawed, large debris were removed, and sub-samples were poured into glass beakers and dried at 105°-110°C for 18 hours. In the case of rock crabs, red hake, and shrimps found in the samples, individual organisms were removed with a tweezer and washed with distilled water prior to drying. The dried material was ground into a powder with a Teflon mortar and pestle.

Qualitative descriptions of the zooplankton collected from the New York Bight are presented in Table 1.

TABLE 1

Descriptions of zooplankton collected from stations in the New York Bight.

STATION NO. *	QUALITATIVE DESCRIPTION OF ZOOPLANKTON
1	95%** comb jellyfish
2	95% comb jellyfish
3	60% comb jellyfish, 40% misc.
4	90% comb jellyfish
5	90% crabs
6	95% comb jellyfish
7	90% rock crabs
8	95% rock crabs
9	75% rock crabs, 25% misc.
10	50% red hake, 50% rock crabs
11	80% rock crabs, 10% shrimp
12	95% rock crabs
13	75% rock crabs, 10% shrimp
14	95% rock crabs
15	90% rock crabs
16	60% rock crabs, 20% shrimp
17	95% rock crabs
18	95% jellyfish
19	100% rock crabs

* See Figure 1 for station locations
** % was measured by weight and was only approximate

Station locations are shown in Figure 1. Only one sample was speciated for the Long Island Sound collections; this sample consisted of copepods obtained from Station 21 (Fig. 2). All other samples consisted of unidentified plankton.

The method of GREIG et al. (1975) was used to determine the metal concentrations in dry plankton samples.

RESULTS AND DISCUSSION

Ag, Cd, Cr, Ni

The levels of silver, cadmium, and nickel in plankton did not differ markedly for the various geographic locations from both the New York Bight and Long Island Sound collections (Tables 2, 3). Silver levels ranged from 0.5-1.4 ppm in all samples, whereas cadmium levels were in the range of 0.5-2.4 ppm and nickel levels ranged from 0.9-4.6 ppm for all samples.

TABLE 2

Trace metal concentrations in zooplankton collected from New York Bight.

Station Number	Latitude	Longitude	Metal Concentrations (ppm, dry wt.) Ag	Cd	Cr	Cu	Ni	Pb	Zn
1	40°37'	73°11'	<0.6	1.9	<3.5	<1.6	1.7	12.4	9.9
2	40°31'	73°13'	<0.5	2.4	<6.6	<2.9	1.9	12.3	355.
3	40°33'	73°26'	0.9	1.9	<6.7	15.2	4.6	69.2	454.
4	40°23'	73°29'	0.8	2.2	<8.8	3.5	1.9	11.6	260.
5	40°26'	73°38'	1.2	2.3	<3.3	16.3	3.8	11.8	625.
6	40°21'	73°36'	0.8	1.8	<6.7	9.7	1.9	68.1	47.8
7	40°31'	73°46'	0.9	2.3	<11.2	14.3	<2.4	13.0	91.
8	40°29'	73°43'	0.9	2.3	<3.5	21.5	2.4	13.7	79.2
9	40°27'	73°44'	0.7	1.2	35.2	18.1	2.0	15.1	148.
10	40°24'	73°45'	0.6	1.6	7.0	7.8	3.5	28.4	147.
11	40°22'	73°45'	0.9	2.2	<4.0	13.1	2.7	19.3	165.
12	40°28'	73°47'	1.1	1.5	<6.2	54.4	4.4	20.1	70.9
13	40°27'	73°47'	1.4	2.6	<4.9	37.1	3.6	18.8	86.0
14	40°24'	73°47'	1.1	2.3	<3.4	17.1	2.7	20.8	62.9
15	40°26'	73°53'	1.2	2.1	<4.4	30.8	2.3	21.5	112.
16	40°15'	73°50'	<1.0	2.4	<14.	14.4	<2.8	81.	236.
17	40°13'	73°54'	<0.5	1.9	<3.5	2.9	1.7	10.1	24.5
18	40°05'	73°59'	<1.0	2.1	<14.	<5.2	<2.8	11.9	47.1
19	39°45'	73°52'	1.1	2.6	<3.5	22.2	3.1	16.5	66.7

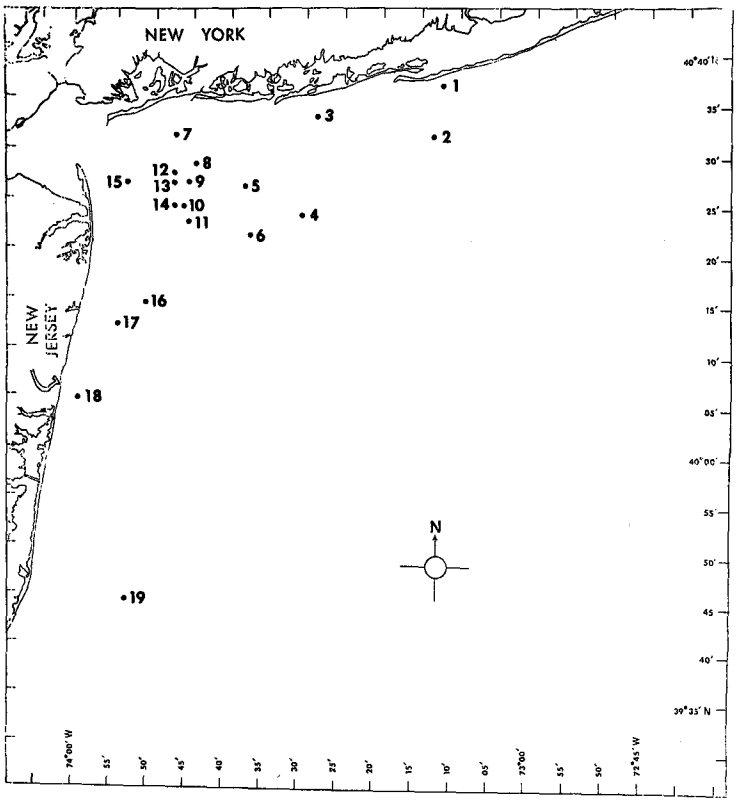

Figure 1. Station positions for zooplankton collections in the New York Bight.

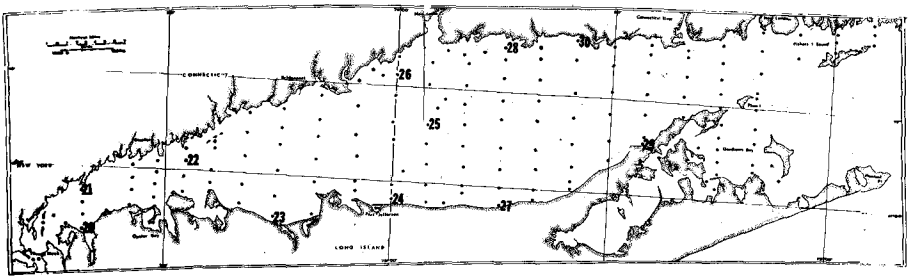

Figure 2. Station positions for plankton collections in Long Island Sound.

TABLE 3

Trace metal concentrations in plankton collected from Long Island Sound.

Station Number	Latitude	Longitude	Metal Concentrations (ppm, dry wt.) Ag	Cd	Cr	Cu	Ni	Pb	Zn
20	40°52'	73°41'	0.6	1.6	2.6	39.3	2.9	19.0	81.5
21	40°56'	73°41'	0.7	1.6	4.7	7.1	4.5	14.8	69.4
22	41°01'	73°28'	<0.7	1.6	<3.0	3.7	2.2	16.8	9.6
23	40°55'	73°15'	<0.7	1.6	<3.4	<2.0	1.6	22.6	7.1
24	40°58'	73°00'	0.5	1.6	<2.1	5.9	3.6	20.8	108.
25	41°06'	72°55'	0.5	1.5	<2.3	4.7	2.4	15.1	45.8
26	41°11'	73°00'	0.5	1.5	<1.1	3.0	1.3	16.9	31.7
27	40°58'	72°45'	0.5	1.6	3.7	14.0	3.6	14.1	136.
28	41°15'	72°45'	0.7	1.6	<2.2	3.0	0.9	17.4	11.8
29	41°06'	72°25'	0.7	1.6	3.3	7.3	2.3	11.1	120.
30	41°16'	72°35'	0.6	1.8	<3.3	9.8	3.5	16.2	82.3

Most samples examined for chromium had concentrations below the detection limits of the method employed (Tables 2, 3). The detection limit for this metal varied considerably for individual plankton samples, because the sample size varied greatly; most lower limits, however, were less than 7 ppm. The highest level of chromium was 35.2 ppm for plankton obtained at Station 9 in the New York Bight (40°27'W and 73°44'N).

Cu, Pb, Zn

The copper, lead, and zinc levels in zooplankton obtained from the New York Bight varied greatly as a function of either species or geographic location. Different species of plankton were not always collected at each geographic location; thus, interspecific differences could not be determined. Individuals of the same species of zooplankton were collected from different geographical locations and large variations in copper, lead, and zinc levels were observed (Table 2). For example, at Station 1 and 2 in the New York Bight, the zooplankton samples consisted of approximately 95% comb jellyfish, and at Station 2 the zinc level was 355 ppm, compared to a level of 9.9 ppm for the sample at Station 1. Lead and copper levels, however, did not differ for the two station locations.

Rock crabs (larvae) were collected from most of the stations sampled in the New York Bight. With one exception, the lead content in these meroplanktonic forms ranged from 10-28 ppm for various geographic locations. The lead content was 68.1 ppm for rock crabs collected at Station 6. Most copper levels ranged from 2.9-22 ppm in these samples; however, levels were 30-54 ppm for rock crabs collected at Stations 12, 13, and 15. Zinc levels in these crustaceans varied greatly; levels ranged from 24.5-625 ppm.

The species of plankton collected from Long Island Sound were not identified because of the condition of the samples after freezing. The copper levels in all but one of these samples ranged from 2-14 ppm, while one sample obtained from the southwestern part of the Sound contained 39.3 ppm of copper (Table 3). The lead levels were fairly uniform for all plankton samples collected in the Sound, 11-23 ppm (Table 3). Zinc levels, on the other hand, varied greatly for the various samples collected in the Sound (Table 3), ranging from 108-120 ppm for samples collected in the south and southeastern parts of the Sound and from 7-82 ppm in samples from the other parts of the Sound.

Use of trade names is merely to facilitate descriptions and does not constitute endorsement by the National Marine Fisheries Service.

REFERENCES

GREIG, R. A., B. A. NELSON, and D. A. NELSON: Mar. Pollut. Bull. 6(5), 72 (1975).

NICHOLLS, G. D., H. CURL, and V. T. BOWEN: Limnol. Oceanogr. 4, 472 (1959).

TUREKIAN, K. K., A. KATZ, and L. CHAN: Limnol. Oceanogr. 18, 240 (1973).

WOLF, D. A., and T. R. RICE: Fish. Bull. 70(3), 959 (1972).