## Heavy metal levels in deep sea benthic fauna

Nurit KRESS and Hava HORNUNG

National Institute of Oceanography, Israel Oceanographic & Limnological Research, Tel-Shikmona, HAIFA (**Israel**)

Monitoring studies designated to study the influence of waste disposal operations to the marine environment emphasize the benthic compartment of the ecosystem (sediments and fauna), known to be the ultimate sink of contaminants introduced into it.

Within the framework of monitoring studies conducted in deep sea locations (~ 1,500 m depth) off the Israeli coast, heavy metal contents were determined in sediments and benthic fauna, collected during 1987-1991. The species chosen to serve as indicators were: Crustaceans : *Polycheles typhlops* (n=77), *Acanthephyra eximia* (n=23) and *Aristeus antennatus* (n=23); Fish: *Bathypterois mediterraneus* (n = 8) and *Nezumia sclerorhynchus* (n = 15). The species were chosen based on relative abundance, i.e. presence in almost every haul, and on the representation of different phyla.

### Metal concentrations

The concentrations of two non essential metals, mercury and cadmium, and four essential elements : copper, zinc, iron and manganese, were determined in the representative species. Whole specimens were digested with concentrated nitric acid in high pressure decomposition vessels and the metals determined by flame atomic absorption spectroscopy with the exception of mercury, which was determined by cold vapour atomic spectroscopy.

The order of metal concentrations found in the crustaceans was : Fe > Cu > Zn > Mn > Cd > Hg, while in the benthic fish the order was different : Fe > Zn > Mn > Cu > Hg > Cd.

In fish, the level of zinc ranged from 5-12 µg/g wet weight, while copper ranged from 0.5-1.2 µg/g wet weight. In the crustaceans, the level of zinc was similar to that of the benthic fish, while copper concentrations were much higher, ranging between 10 and 130 µg/g wet weight. The differences in copper contents could be attributed to different metabolic processes occurring in crustaceans and fish.

The concentrations of the two non essential metals, mercury and cadmium, found in the crustaceans and benthic fish were much higher than the concentrations found in shallow water species. The crustaceans contained more cadmium than mercury (0.01-2.0 and 0.005-0.3 µg/g wet weight, respectively), while the benthic fish contained mercury ranging from close to the detection limit (0.005 µg/g wet weight) to 1 µg/g wet weight. The high natural concentrations of these two non essential metals in deep sea fauna are not related to the contents of the metals in the sediments (average of 0.01 ppm mercury and 0.12 ppm cadmium; KRESS *et al.*, 1992), and must be a result of the diet and physiological metal regulation of each species. Indeed, it has been found before (FOWLER, 1986) that deep sea pelagic and benthic species in the eastern Mediterranean contain relatively high concentrations of cadmium and mercury.

Manganese concentration in fish ranged between 1-5 µg/g wet weight, while in crustaceans, higher concentrations were observed (1-15 µg/g wet weight). Iron in fish and in the crustaceans *Acanthephyra eximia* and *Aristeus antennatus* ranged between 10-250 µg/g wet weight. The determination of iron concentrations in the crustacean *Polycheles typhlops* posed serious problems. This species is known to live in the sediment, and it was very difficult to eliminate all sediment particles from the animal before analysis, causing a bias in the iron concentration (average iron concentration in the sediments is 6.0%; KRESS *et al.*, 1992).

### Size effects

The dependence of metal concentration on size of the animal must be taken into account when establishing baseline levels (RIDOUT *et al.*, 1989). No size effects were detected for all metals in *Polycheles typhlops*. Cd, Fe, Zn and Mn show a log normal distribution with mean concentrations of 0.45, 282,13 and 10 µg/g wet weight, respectively. Copper shows a bimodal frequency distribution with means at 10 and 56 µg/g wet weight (Fig. 1). Hg concentrations were low and close to the detection limit.

In *Acanthephyra eximia*, a marked negative dependence was found between Cd and Zn and weight of the whole animal (r = -0.60 and -0.61, respectively), while no relationship was observed for Hg, Fe, Cu or Mn (Fig. 2). No definite relationship was found between metal concentration and weight for *Aristeus antennatus*. *Cu* and Zn showed slightly negative dependence on weight. In the benthic fish, a linear relationship exists between Hg and Fe and weight (n=23, r=0.52 and 0.55, respectively). Zn shows a slight negative correlation with weight (n=-0.24), and Cu and Mn concentrations are independent of weight. Cd concentrations were close to the detection limit.

The study of heavy metal concentrations in deep sea fauna, as well as any other constituents, is hindered by sampling time constraints, low abundance of the fauna and the need to analyze a large enough sample in order to filter out the natural variability. The information collected during this study will serve as a baseline for the pristine conditions and will be used for future research on the influence of waste disposal operations in the area.

### Acknowledgements

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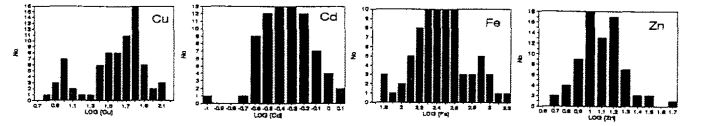


Figure 1: Frequency distribution for the log of observed concentration in Polycheles typhlops

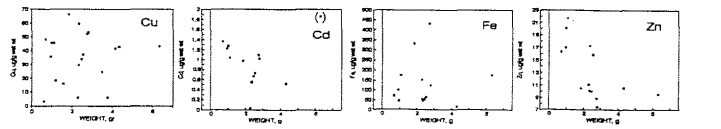


Figure 2: Relations between metal concentration and fresh weight in Acanthephyra eximia

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