CADMIUM AND OTHER HEAVY METALS IN SEA-SKATERS
(Gerridae: Halobates, Rheumatobates)

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Abstract. Exceptionally high concentrations of Cd (100 to 200 ppm dry weight) were found in samples of Halobates collected off Baja California. In contrast, no detectable Cd was found in Rheumatobates collected from mangrove lagoons in the Gulf of California. Concentrations of five other heavy metals in the two marine insects are also presented.

1. Introduction

Measurements of heavy metal or trace element concentrations in various marine organisms abound in the literature (Goldberg, 1972). However, since it is often difficult to obtain samples containing only a single species of zooplankton for such determinations, most of the published data on these organisms are based on mixtures consisting predominantly but not exclusively of copepods, euphausiids, etc. In such samples one has always to consider the possibility of contamination by flakes of paint, in which Cd, Fe, and Pb are often major components. We report here exceptionally high concentrations of Cd found in the sea-skater Halobates collected off the coasts of Baja California.

Halobates is unique in being the only insect found in the open ocean and the only marine invertebrate which lives on, rather than above or below, the sea-air interface (Cheng, 1973, 1974). The special habitat of these insects enables us to sample a single species, free from other organisms. In nature, these insects, which live above the water surface, normally keep their surfaces clean and dry by preening. Since various trace metals are known to be concentrated at the sea-air interface (Duce et al., 1972), we collected and analyzed several samples of Halobates to find out to what extent, if any, their trace metal concentrations reflect those of their environment. For comparison we also analyzed samples of a related gerrid, Rheumatobates, collected from mangrove swamps. Each of the insect samples has been analyzed for 25 major, minor and trace elements; however, data for only six selected trace metals will be discussed here.
2. Materials and Methods

Samples of *Halobates* were collected off the southern end of the Gulf of California during an expedition of the R/V ALPHA HELIX. Two of the stations were outside the Gulf, just off the tip of Cape San Lucas; the third station was inside the Gulf. Handling of the insects was kept to a minimum. Contact with metal instruments and containers was avoided. The insects were dip-netted with a nylon net, kept alive in a glass aquarium onboard for two days, and then flown back to the laboratory at UCLA in individual ‘Whirl-Pak’ plastic bags. To prevent their desiccation, a piece of filter paper moistened with seawater was placed in each bag. On arrival at the laboratory the insects were transferred to a glass aquarium and kept overnight. On the following day, live insects were used in various physiological experiments which will not be discussed in this paper. Those insects that had died were dried at 80°C overnight; whole insects were then analyzed for trace elements by using an optical emission spectrometer system specially designed for the multielement analysis of biological tissues. Confidence in the accuracy of the spectrometric analysis was established by analyzing the Standard Reference Materials 1577 (orchard leaves) and 1571 (bovine liver) provided by the U.S. National Bureau of Standards. Agreement was within 10% of the certified values.

Other samples of *Halobates* dip-netted or collected in neuston nets from the north Pacific Ocean during expedition Southtow 13 on the R/V WASHINGTON, and of *Rheumatobates* dip-netted from mangrove swamps in Baja California during expedition Sea-Skater 1 on the R/V DOLPHIN, were also analyzed. The sampling locality, date, and species collected are given in Table I.

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<th>TABLE I</th>
<th>Sampling data of Halobates and Rheumatobates used in elemental analyses</th>
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**Halobates sobrinus**

H 1–3: Mixed adults dip-netted between 23°10'N 109°17.4'W, and 23°27.9'N 109°23.9'W, Gulf of California, Baja California, Mexico. November 1, 1974.

**Halobates sericeus**


H–5: 10 males, data as above.

H–6: 28 females collected in neuston tow, 28°7.8'N, 155°6.9'W, about 3500 km west of San Diego, February 6, 1973.

H–7: 21 males collected in neuston tow, 31°36.3'N, 128°43'W, about 1000 km west of San Diego, February 18, 1973.

**Rheumatobates aestuarius** Polhemus

R–1: Mixed nymphs collected from mangrove swamp, Isla San Jose, Baja California, April 6, 1973.

R–2: Males collected from mangrove stream, San Gabriel Bay, Isla Espiritu Santo, Baja California, April 1, 1973.

R–3: Females, data as above.

R–4 & 5: Mixed nymphs and adults collected from mangrove swamp, Isla San Jose, Baja California, March 3, 1975.

R–6 & 7: Mixed nymphs and adults collected from mangrove bay, Bahia Falsa near La Paz, Baja California, March 12, 1975.