Metal Survey of the Marine Clam *Pitar morrhuana* Collected near a Rhode Island (USA) Electroplating Plant

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Abstract

Benthic fauna were collected from 17 stations in mid-Narragansett Bay, Rhode Island, during September 1973 from the vicinity of the recently-closed Quonset Point electroplating facility. Despite repeated sampling, most of the 14 species of molluscs taken, including the widgeon clam *Pitar morrhuana*, were absent from stations in the immediate vicinity of plant outfalls. In general, *P. morrhuana* captured near outfall sites exhibited high moisture content and elevated body burdens of silver, cadmium, cobalt, chromium, copper, iron, manganese, nickel, lead, and zinc compared to clams of similar size from more distant stations. Observed changes in metal concentrations and moisture content of *P. morrhuana* were probably attributable to plant operations during the preceding 30 years.

Introduction

New England, especially the state of Rhode Island, is a major center for the North American electroplating industry. However, there are no published data in the available literature on metal accumulations in marine biota or non-biological samples collected from discharge outfalls. Accordingly, we selected for investigation the U.S. Naval Air Re-work Facility (NARF) located on Quonset Point, Rhode Island (Fig. 1). The electroplating section of the Quonset Point NARF consisted of about 1500 personnel and operated more or less continuously from 1942 until it was closed in the spring of 1973. During this interval of 30 years, there were no reliable data collected on rates or quantities of wastes, including metals, discharged into Narragansett Bay nor were any studies attempted to assess environmental alterations.

The present account reports on results of a survey that we conducted in autumn of 1973 on content of metals, specifically Ag, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn, in total soft tissues of adult widgeon clam, *Pitar morrhuana*, collected from 17 stations in mid-Narragansett Bay, Rhode Island; some of these stations were in the immediate vicinity of the NARF outfalls (Fig. 1). This paper is one of a series of reports on the Quonset Point NARF, listing metal accumulations in sediments, biota, water column, and sediment interstitial waters (Eisler et al., unpublished data; and 1977), and part of a larger program initiated by our laboratory to evaluate toxicological hazards of complex wastes discharged into saline environments.

Materials and Methods

The 17 stations in the NARF study area (Fig. 1) were sampled for benthic fauna using a Forster-anchor dredge. This stainless-steel device selectively collects sediments to a depth of 10 cm, with a typical sample volume of 18 l. A single collection was made at all stations on 6 September 1973. Muds were washed on deck through a 2 mm stainless-steel mesh using ambient seawater; all organisms observed were removed by hand. Widgeon clams, *Pitar morrhuana*, were frozen at -20°C for 3 to 5 weeks; the remaining organisms collected were identified and archived. A second collection at each station was made on 20 September 1973; if *P. morrhuana* had been collected on
September 1973 at a station, a single dredge sample was taken on 20 September 1973; but if *P. morrhua* were absent from a station sample on 6 September 1973, then three dredge samples were taken from that site on 20 September. Bottom-water temperatures ranged from 18.9° to 19.1°C at all stations on 6 September and from 17.0° to 18.2°C on 20 September. Salinity values for all stations on both collection dates extended between 29.7 and 31.2%.

For analyses, individual clams were thawed at room temperature (ca. 20°C), drained, and the total soft parts of a single clam were placed in an acid-stripped beaker; the shells were discarded. After weighing, samples were dried at 95°C for 24 h, reweighed, then ashed at 425°C for 24 h. On cooling, each sample received 10 ml of concentrated HNO₃; it was then held at 95°C for 24 h, and then at 425°C for an additional 24 h. Ten ml of concentrated HNO₃ was added to the dried cool sample, which was then filtered through Whatman 542 paper and diluted to 50 ml with deionized water. Each sample was analyzed for Ag, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn using a Perkin-Elmer model 403 atomic absorption spectrophotometer and procedures outlined in the manual accompanying the instrument. Analytical precision for individual metals was within 2%, as determined by analysis of several replicates.

**Results**

A total of 30 species of benthic macroinvertebrates were collected from the 17 stations on the two sampling dates: 14 species of molluscs, 8 species of anne-