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MERCURY IN BENTHIC ANIMALS

Because the various chemical forms of mercury differ in their toxic, physical, and biochemical properties, it is important to be able to characterize their activities in the environment. Of particular interest are the organomercurials. These compounds are generally considered to be the most dangerous because they exhibit higher chronic toxicities, accumulate in tissues at faster rates, and have longer biological half-lives than inorganic forms.

Sediments enriched in mercury may undergo certain biochemical transformations, sometimes resulting in the methylation of inorganic mercury. If organic mercury produced in this manner escapes to overlying waters, or becomes otherwise available to the indigenous biota, biological uptake may occur. Previous data on contaminated sediments from the Palos Verdes region had shown that small quantities of organic mercury were present (see Page 83). The object of this study was to determine if uptake of mercury had occurred in benthic animals in this region.

The survey involved collection of six different species totaling 96 specimens from the trawl stations shown in Figure 1. Individual tissues were isolated and analyzed for both total and organic mercury. In general, the levels of total mercury appeared to be low and did not reflect the high concentrations found in Palos Verdes sediments. Good correlations were found between concentrations of total and organic mercury in various tissues of Dover sole, *Microstomus pacificus*. There were also high correlations between the levels of total and organic mercury in muscle, kidney, and liver tissues in Dover sole as well as in tissues of other animals. However, mercury levels in the tissues did not appear to be related to sampling location. Thus, these data do not provide evidence of significant mobilization of mercury from sediments to the indigenous marine life off Palos Verdes.

SAMPLING AND ANALYSIS

Specimens were obtained by otter trawls taken at depths of 23, 61, and 137 meters (Figure 1). The animals were rinsed thoroughly with seawater, placed in polyethylene bags, and frozen until dissection could be performed. The tissues were isolated, and each was homogenized as a 50/50 mixture with deionized water, sub-sampled, and analyzed. Total mercury was determined by a wet digestion, flameless atomic absorption (FAA) technique.

Organomercurials were separated from tissues by a commonly used liquid-liquid extraction method and subsequently analyzed by FAA. Procedures are described in detail elsewhere (Eganhouse 1975).

SURVEY RESULTS

Table 1 summarizes the data for all tissues analyzed. Two features of these data are evident:

- The levels of total mercury in tissues are very low, and in no case is the U.S. Food and Drug Administration guideline of 0.5 ppm (mg/wet kg) for edible seafood approached.
- Organic mercury constitutes the major fraction of the total mercury in muscle tissues of several of the animals in the study.

The only other available data with which these can be compared are those from a survey conducted off Palos Verdes in 1974 by the Project. The result? showed a mean concentration of 0.11 mg/wet kg for Dover sole livers (n = 12). This agrees well with the value of 0.12 mg/wet kg we obtained in this study.

With the exception of the gills, there appeared to be a strong relationship among the levels of total mercury in the various tissues of individual Dover sole specimens. As an example, the relation between muscle and liver tissue levels is given in Figure 2.

Despite the small size range of the Dover sole collected, the data showed a significant, although somewhat scattered, relationship between both total and organic mercury and the common measures of growth (weight and standard length). The relationships described above were not found for any of the other animals.

The amount of organic mercury in muscle tissues of most animals was proportional to the total mercury content (Table 2). This result., is not surprising as the majority of the mercury present in the muscle tissues was in the organic form.

An analysis of the data with respect to the proximity to the outfall failed to reveal any distinct distributional patterns (an example is shown in Figure 3). This implies that the tissue mercury content of these benthic animals is not governed significantly by the levels of mercury in the sediments. As a whole, the data lead one to believe that the mercury contained in the Palos Verdes sediments is largely unavailable to the benthic animals that are found there. This is most likely a consequence of the fact that mercury is tightly bound to organic matter in the sediments, or is present as the highly insoluble sulfide.

REFERENCES

Eganhouse, R.P., Jr. 1975. The measurement of total and organic mercury in marine sediments, organisms, and water. TM 221, Coastal Water Research Project, El Segundo, Calif.

Table 1. Levels of total and organic mercury in marine animals collected from the Palos Verdes shelf, 1975.

Species and Tissues	No. of Specimens	Total Mercury (mg/wet kg) Mean	Total Mercury (mg/wet kg) Std. Dev.	Organic Mercury (mg/wet kg) Mean	Organic Mercury (mg/wet kg) Std. Dev.	Average Percent Organic Mercury
Dover sole, *Microstomus pacificus*						
Muscle	16	0.057	0.026	0.041	0.026	70.8
Liver	16	0.124	0.070	0.009*	0.006	9.6
Kidney	16	0.053	0.028	–	–	–
Gills	16	0.024	0.012	0.010	0.006	31.4
Crab, *Mursia gaudichaudii*						
Muscle	11	0.021	0.009	0.017	0.003	87.1
Digestive gland	11	0.030	0.010	0.005	0.002	16.0
Prawn, *Sycionia ingentis*, muscle	24	0.038	0.011	0.029	0.009	70.0
Snail, *Callinaticina oldroydi*						
Foot	8	0.005	0.004	–	–	–
Viscera	8	0.071	0.041	0.016	0.016	50.1
Urchin, *Allocentrotus fragilis*, gonad	3	0.021	0.002	0.003	–	15.8
Sea slug, *Pleurobranchaea californica*, whole body	23	0.015	0.012	0.007	0.003	49.6

*Only six liver samples were large enough to show detectable quantities of organic mercury.

Table 2. Correlation of total mercury with organic mercury in muscle tissue of various benthic organisms from the Palos Verdes shelf, 1975.

	Correlation Coefficient, r	Number of Specimens, n
Dover sole, *Microstomus pacificus*	0.86[a]	16
Crab, *Mursia gaudichaudii*	0.81[b]	6
Prawn, *Sycionia ingentis*	0.58[c]	19
Sea slug, *Pleurobranchaea californica*	0.70[c]	16

a. $p < 0.001$
b. $p < 0.05$
c. $p < 0.01$

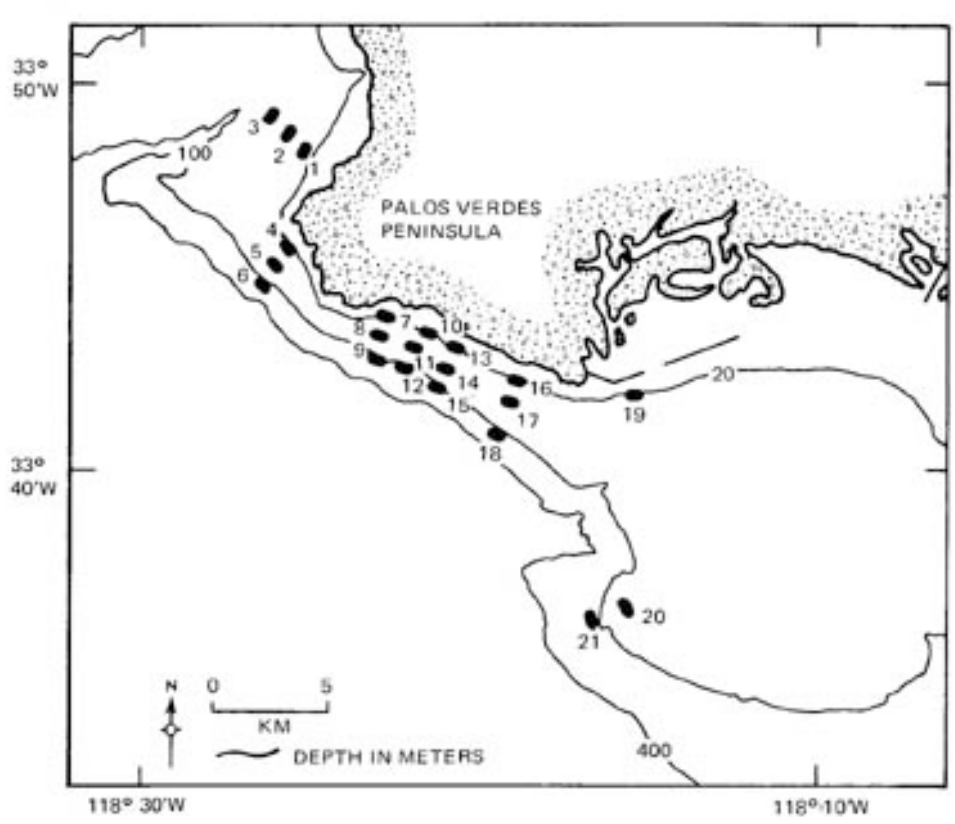

Figure 1. Trawl stations off the Palos Verdes Peninsula.

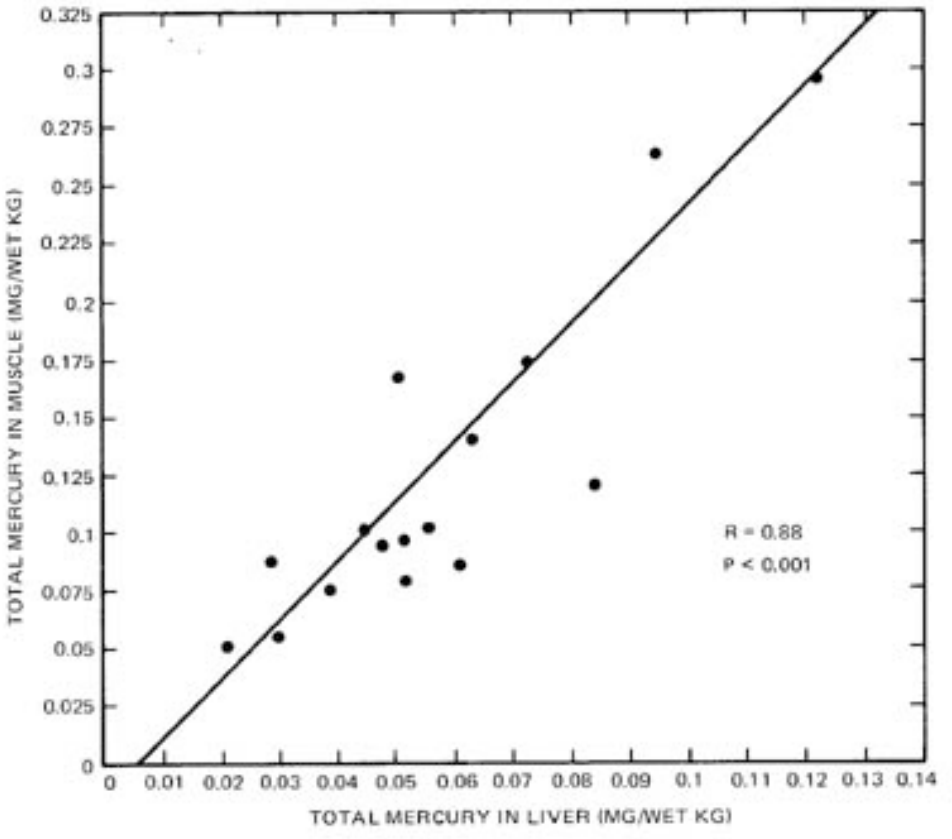

Figure 2. Total mercury in livers of Dover sole versus total mercury content of muscle tissue.

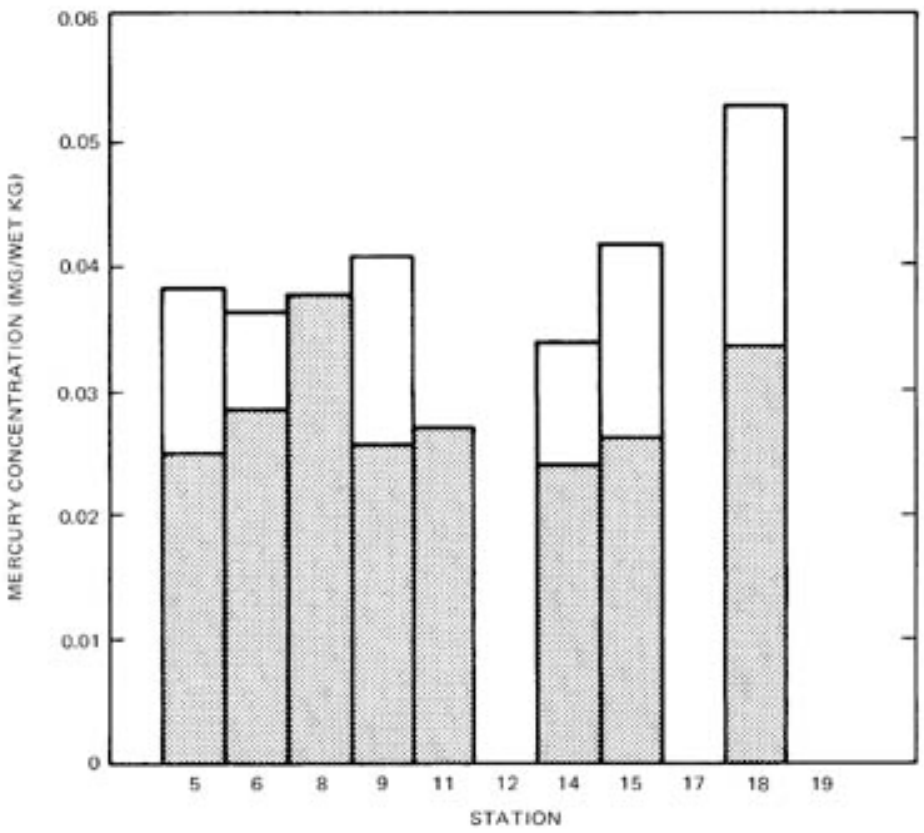

Figure 3. Total and organic mercury in muscle tissue of the ridgeback prawn, *Sycionia ingentis*, at various trawl stations (shown on Figure 1). Line bar indicates total mercury, gray bar indicates organic mercury.