

Mercury Concentration of Stickleback *Gasterosteus aculeatus* from the Gulf of Gdańsk

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Mercury, because of its high toxicity and large anthropogenic inputs and bioaccumulation when transferred through the food chain, is a metal of great environmental interest (Essink 1988, Håkanson *et al.* 1990, Manahan 1991). Relatively high concentrations of industrial discharge with mercury were detected in fish from the Sound, in the western part of the Baltic Sea in the early 1980's (Hansen and Andersen 1987). The Gulf of Gdańsk is an area also potentially receiving some kinds of anthropogenic emissions of mercury due to widespread burning of coal and lignite, and consumption-related discharges of that metal in Poland. For example, 357 and 277 tons of mercury had been imported to Poland in 1976 and 1979, respectively (Falandysz 1992). High concentrations of 0.28–0.63 µg Hg/L were reported recently in water in the Gulf of Gdańsk (BMEPC 1987). These values are of one to two orders of magnitude higher than those reported in water for any other site around the Baltic Sea. Our recent data on mercury in sediment samples collected from the Gulf of Gdańsk showed relatively low contamination (Falandysz *et al.* 1992).

To gain a better insight into the fate and distribution of mercury in the Gdańsk Basin, the levels of mercury were determined in stickleback *Gasterosteus aculeatus* from different sites along the western coastline of the Gulf of Gdańsk, Baltic Sea.

MATERIALS AND METHODS

Specimens of stickleback *Gasterosteus aculeatus* were collected at seven sampling sites along the northwestern shoreline of the Gulf of Gdańsk and in the Oliwa Creek in 1988–1989 (Fig. 1). The fish from each sampling site were grouped into classes according to body length of 1.0–2.9, 3.0–3.9, 4.0–4.9, 5.0–5.9, 6.0–6.9 and 7.0–7.9 cm, if available, and samples were pooled. Four of the pooled samples

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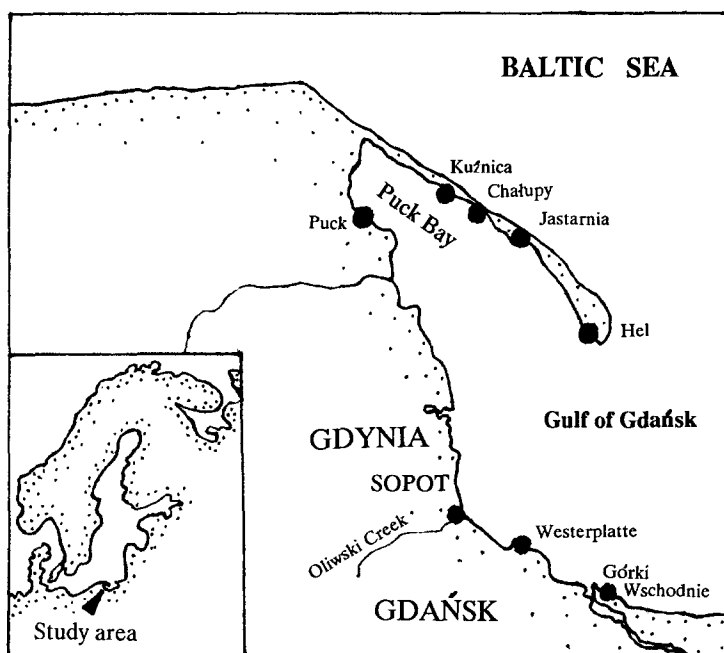


Figure 1. Sampling locations for stickleback in Gulf of Gdańsk

consisted of 100 fish, each having a body length between 1.0-2.9 cm each. The remaining samples consisted of 3 to 14 specimens. The total number of fish in 124 pooled samples was 837. Usually, two pooled samples of fish of definite body length from a particular sampling site were prepared and kept deep frozen until analyzed. Mercury concentrations shown in Fig. 2 represent a mean value obtained from two to three pooled samples of fish.

For the determination of mercury the samples were wet-digested with concentrated nitric acid in a glass apparatus consisting of a round-bottom flask, a partial condenser (30 cm long) and a water cooler. Five to ten ml of 65% nitric acid were added to the sample containing from 3 to 100 whole fish, as indicated above, and the mixture was stored in a round-bottom glass-stoppered flask for 48 hr, and subsequently heated at 100 °C for 2 hr. After the flask cooled, 10 ml of double-distilled water were added and the flask was again heated for 1 hr. After cooling, the water cooler and condenser were rinsed with 10 ml of double-distilled water. The digest was filtered and, after appropriate dilution with double-distilled water, hydroxylamine hydrochloride and stannous chloride in sulphuric acid solution were added to the sample (10 ml). Final determination of the Hg content was made by cold-vapour atomic absorption spectrometry (AAS) using a UV mercury monitor LDC/Milton Roy. The level of detection was 0.2 ppb (Falandysz 1990).

RESULTS AND DISCUSSION

The mean values for total mercury concentrations in whole stickleback of selected body length classes and from the various sampling sites are presented in Figure 2 a-h.

Mercury enters the ecosystem both through anthropogenic sources and natural geological processes. Since in the Gulf of Gdańsk area no natural deposits of mercury are found, any elevated concentrations of this metal detected in fish could be related to anthropogenic sources.

The stickleback is a small and relatively non mobile fish which seems to be suitable for chemical monitoring purposes. Specimens do not usually survive more than 3.5 years. One-year-old sticklebacks range in length between 2 and 5 cm, two-year-olds between 3 and 5.2 cm, and three-year-olds between 4.5 and 7 cm.

The concentrations of mercury in stickleback sampled at different periods and from different sites along the western coastline of the Gulf of Gdańsk varied little (Fig. 2); however, some general observations may be noted. A slight trend in increasing mercury concentration with increase in the body length of stickleback was observed for specimens collected near the town Hel (Fig. 2a) and the cities of Gdynia and Sopot (Fig. 2e). Such mercury patterns in fish may indicate pollution from anthropogenic sources (Essink 1988).

An opposite trend may be observed for stickleback collected near the town Puck (Fig. 2d). Apart from stickleback sampled in April 1989, the specimens collected in April and September 1988 showed a decrease in mercury concentration when body length increased. Much higher concentrations of mercury were found in smaller than in larger sticklebacks collected near the town Puck, which seemed to indicate a possible connection with a municipal sewage outfall (for city of Gdynia) - the potential point source located in the area. This problem should be clarified in further studies.

In the case of fish taken from Oliwski Creek, the sample numbers were too small to support observations shown for such sites as Hel, Gdynia and Sopot. Sticklebacks collected near Kuźnica (Fig. 2b), Jastarnia and Chałupy (Fig. 2c), and Górki Wschodnie (Fig. 2h) did not show a consistent trend in mercury concentration. However, for some sampling periods a steady-state could be observed. Similar conclusions could be drawn for sticklebacks collected near Westerplatte (Fig. 2g), but with the exception of fish of the body length class of 7.5 cm (7.0-7.9) which had a relatively higher concentration of mercury.

The total range of mean mercury concentrations in stickleback ranged between 12 to 110 ppb on a wet basis, excluding the value of 400 ppb (300-490) for those taken near Puck town in April 1988.

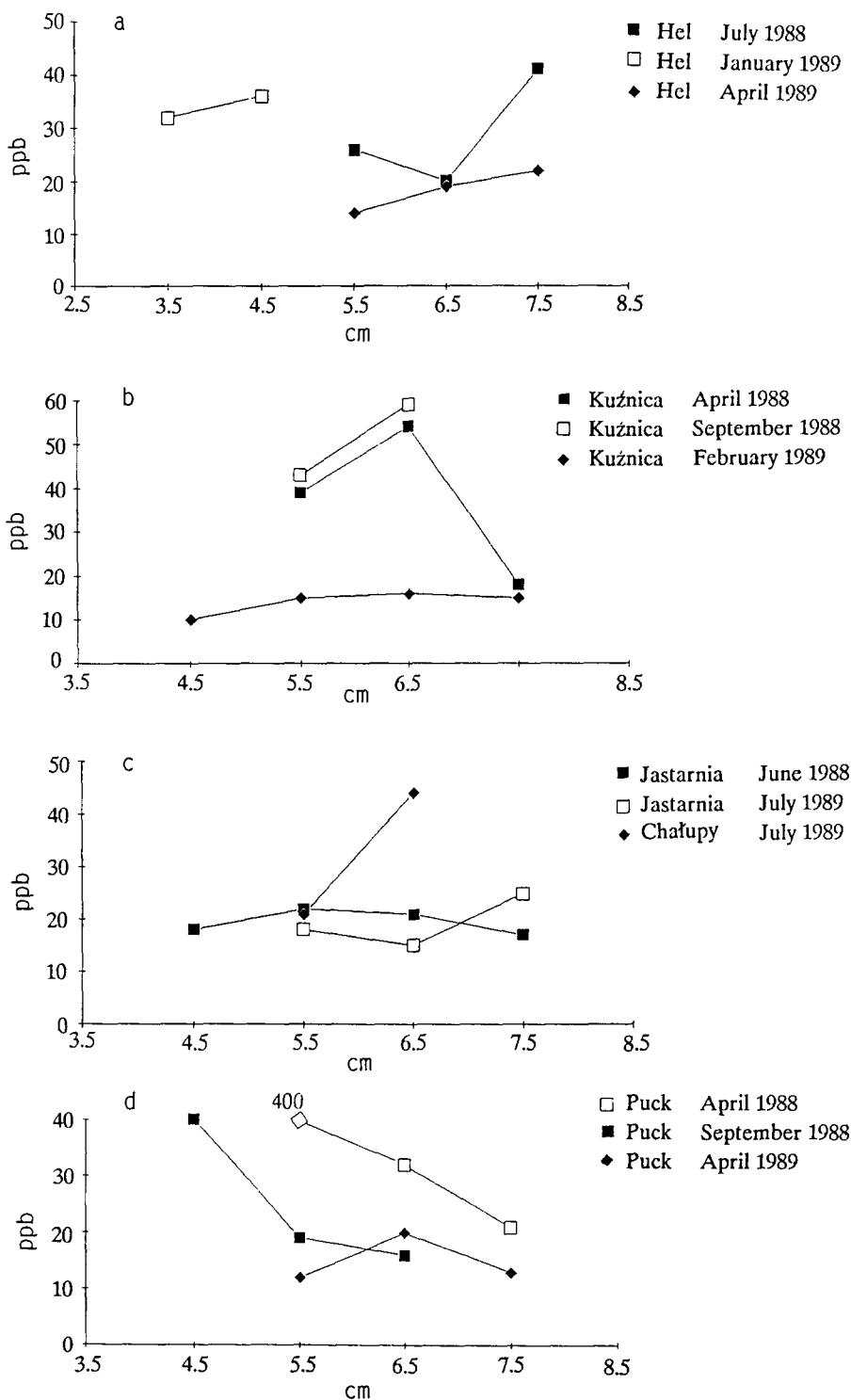


Figure 2a-d. Total mercury concentrations in stickleback (ppb wet wt.).

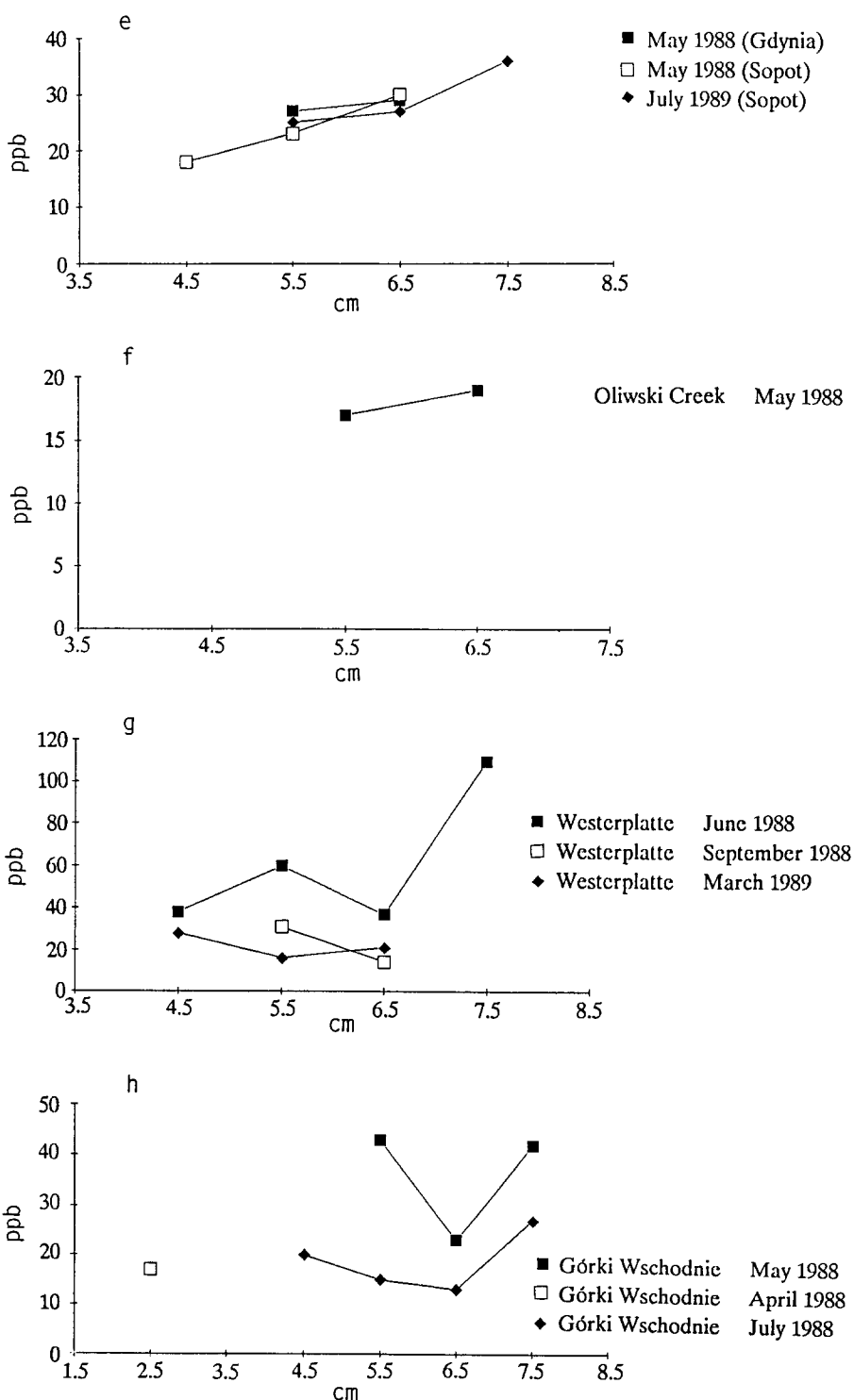


Figure 2e-h. Total mercury concentrations in stickleback (ppb wet wt.).

The present study, based on bioaccumulation of mercury in stickleback from the Gulf of Gdańsk, clearly showed anthropogenic sources of that metal but the concentrations noted usually remained relatively low.

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