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FISH AS AN INDICATOR OF POLLUTION OF THE BALTIC SEA WATERS WITH SOME HEAVY METALS

1. INTRODUCTION

When considering the problem of the pollution of the marine environment with heavy metals, the presence of copper and zinc is discussed, among other things. Several reports in the literature have pointed out enhanced levels of these elements in waters and sediments of estuary and coastal zones and in the tissue ot organisms living in these water bodies [3, 4].

The known ability of aquatic organisms to accumulate heavy metals may be utilised for monitoring environmental pollution. The increased level of the elements in the organisms as compared with that of water facilitates the analytical procedure.

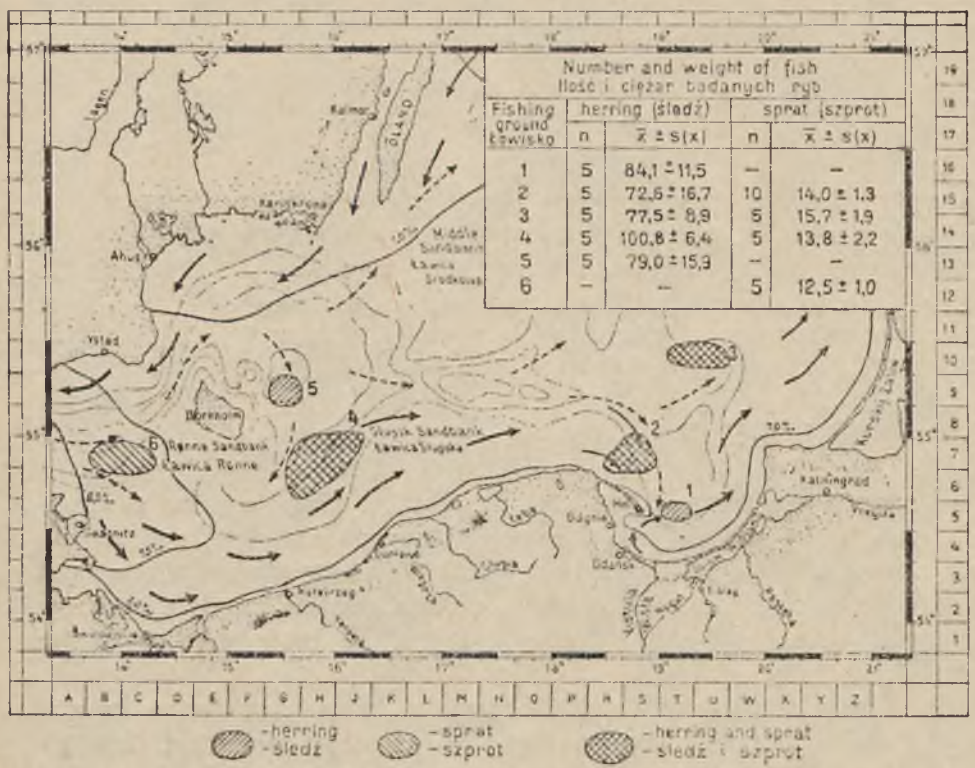
The objectives of this paper were to explain how much the copper and zinc levels in fish taken from various regions of the Baltic Sea are differentiated and to learn whether selected fish species can provide indicators of the pollution of waters with these metals.

2. MATERIAL AND METHODS

A total of 25 herrings (Clupea harengus L.) and 25 sprats (Sprattus sprattus L.), taken in the period February — April 1977, were examined. The locations at which the fish were taken, number of fish and their mean masses are shown in Figure (p. 72).

Whole fish were stored at —36°C before analysis. In the case of herrings, dorsal muscles were analysed and in that of sprats — headed, gutted and definned individuals.

A 10-g sample was wet combusted in 65 per cent HNO_3 for 12 h at room temperature and then for 2 days at 60—70°C. The sample/acid ratio was 1 : 2 (w/v). The wet combustion was performed in an Erlen-



meyer flask covered with a watch glass. After cooling, the solution was filtered into a volumetric flask and made up to 10 cm^3. In this solution the copper content was determined. To determine zinc, aliquots of this solution were diluted 25-fold with deionized water.

The metal content was determined by atomic absorption spectrometry (AAS) in an air-acetylene flame on a Varian Techtron Model 1200 spectrophotometer under optimum conditions. Parallel blank determinations were run. Calibration curves were prepared by the addition method. The results were treated statistically.

3. DISCUSSION OF THE RESULTS

As some authors found correlations between the mass of a fish and the heavy metal level in it [1], an attempt was made to confirm this. The calculated correlation coefficients did not differ substantially from O, thus indicating that there was no such correlation. This finding enabled us to ignore the problem of comparativeness of the masses of fish taken in individual regions.

Table 1. Copper and zinc levels in herrings, μg g^{-1}
Tab. 1. Zawartość miedzi i cynku w śledziach, μg g^{-1}

Fishing ground Łowisko	Copper — Miedź $\bar{x} \pm S(x)$	Homogeneous groups *a* Grupy jednorodne *a*	Fishing ground Łowisko	Zinc — Cynk $\bar{x} \pm S(x)$	Homogeneous groups [a]) Grupy jednorodne
4	0.332±0.142		4	4.851±1.131	
3	0.409±0.065		2	5.598±0.382	
5	0.686±0.077		3	6.200±0.793	
2	0.940±0.117		1	6.205±2.099	
1	1.135±0.286		5	10.547±2.442	

a) Homogeneous groups were determined at $\alpha = 0.05$. — Grupy jednorodne wyznaczono przy $\alpha = 0{,}05$

Table 2. Copper and zinc levels in sprats, μg g^{-1}
Tab. 2. Zawartość miedzi i cynku w szprotach, μg g^{-1}

Fishing ground Łowisko	Copper — Miedź $x \pm S(x)$	Homogeneous groups *a* Grupy jednorodne *a*	Fishing ground Łowisko	Zinc — Cynk $x \pm S(x)$	Homogeneous groups [a]) Grupy jednorodne
2	0.562±0.128		2	20.704±5.431	
6	0.775±0.101		6	24.738±2.798	
4	1.058±0.499		4	25.721±1.637	
3	1.310±0.062		3	34.632±5.432	

[a]) Homogeneous groups were determined at $\alpha_{\alpha} = 0.05$. — Grupy jednorodne wyznaczono przy $\alpha = 0{,}05$

The results showed that the mean levels of copper in herrings and in sprats ranged from 0.332 ± 0.142 to 1.135 ± 0.286 μg g^{-1} (Table 1) and from 0.562 ± 0.128 to $\pm 1.310 \pm 0.062$ μg g^{-1} (Table 2), respectively. The zinc levels were higher and ranged from 4.851 ± 1.131 to 10.547 ± 2.442 μg g^{-1} in herrings and from 20.704 ± 5.431 to 34.632 ± 5.432 μg g^{-1} in sprats.

On the basis of the variance analysis in single classification and on mean grouping by the Tukey method it can be concluded that the highest copper levels in herrings occurred in fish taken in grounds Nos. 1 and 2 and in sprats in fish taken in grounds Nos. 3 and 4. The highest zinc level was noted in herrings taken in ground No. 5 and in sprats taken in ground No. 3. Hence, it can be concluded that the copper and

zinc levels in the Baltic herrings and sprats depend on the location of the ground. This can be explained in terms of differentiation of metal levels in the Baltic Sea found by German authors [2]. It seems likely that the enhanced levels of the elements in fish taken in the coastal regions is due to pollution of the marine environment by man. On the other hand, it is known that water in the regions of deeps with increased salinity has higher metal levels — hence the increased levels of these metals in fish taken there. The correlation between the levels of copper and zinc in fish and the levels of these metals in water suggests that herrings and sprats may provide indicator organisms for the monitoring of water pollution with these metals.

4. CONCLUSIONS

1. Herrings and sprats may provide indicator organisms for the monitoring of water pollution with copper and zinc.
2. The levels of copper and zinc in herrings and sprats taken in the Baltic Sea were found to depend on the location of the fishing grounds.
3. No correlation was found between the mass of fish and the levels of the two metals in their tissues.

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RYBY JAKO WSKAŹNIK ZANIECZYSZCZENIA WÓD BAŁTYKU NIEKTÓRYMI METALAMI CIĘŻKIMI

Streszczenie

W organizmach zwierząt wodnych żyjących w wodach przyujściowych i przybrzeżnych stwierdza się podwyższone zawartości metali ciężkich spowodowane biokoncentracją tych metali. Zdolność organizmów wodnych do kumulacji metali ciężkich umożliwia stosowanie ich jako wskaźników zanieczyszczenia środowiska wodnego. Badano zawartość miedzi (Cu) i cynku (Zn) w śledziach i szprotach z różnych rejonów Bałtyku. Wykazano, że ryby tych gatunków mogą być organizmami wskaźnikowymi w badaniach zanieczyszczenia wód. Stwierdzono, że zawartość miedzi i cynku w śledziach i szprotach bałtyckich zależy od rejonu ich odłowu. Natomiast nie stwierdzono korelacji między ciężarem ryb, a zawartością Cu i Zn w ich tkankach. Wyniki badań poddano analizie statystycznej.

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