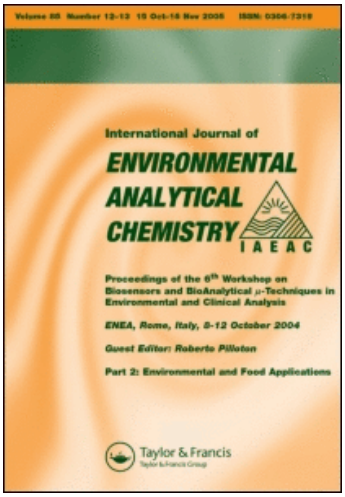

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BIOACCUMULATION OF MERCURY IN THE ANTARCTIC BONY FISH *PAGOTHENIA BERNACCHII*

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This paper presents the results obtained for the levels of total mercury, organic mercury, and total selenium in the muscular tissue of *Pagothenia bernacchii* sampled in Terra Nova Bay (Antarctica) during the 5th Italian Antarctic Expedition (Austral Summer 1989–90). Data are compared with those obtained during the 3rd and 4th Expeditions. Bioaccumulation of mercury occurs in muscular tissue, mainly in the organic form, as already found for several marine organisms from other seas.

KEY WORDS: Mercury, Antarctic, fish.

INTRODUCTION

Bioaccumulation of mercury in muscular tissue of fish is a well established phenomenon. As far the Antarctic is concerned, scarce data is available. Since our previous research provided contrasting results[1], further investigations have been carried out.

The comparison of mercury behaviour in biota from different areas can be useful to better understand the mercury biogeochemical cycle.

EXPERIMENTAL

Specimens of *Pagothenia bernacchii* were collected during the 5th Italian Antarctic Expedition (Austral Summer 1989–90) in Terra Nova Bay (Antarctica).

The samples were stored deep frozen, at −25 °C. They were measured, dissected and analyzed in the Genova laboratory. Analytical determinations were done by atomic absorption spectrometry with the cold vapors technique, after preconcentration over gold, for total mercury; and with the hydride generation method for total selenium. Organic mercury was

Table 1 Precision and accuracy of analytical methods. Results obtained for TORT-1, Lobster Hepatopancreas, Marine Reference Material for trace metals (National Research Council of Canada). All concentrations are in μg/g dry weight. The uncertainties represent 95% tolerance limits. The certified values for Hg-org refers to methylmercury expressed as mercury.

	Hg-org	*Hg-tot*	*Se*
This work	0.125±0.011	0.35±0.02	6.18±0.46
replicates	14	14	10
Certified values	0.128±0.014	0.33±0.06	6.88±0.47

determined, after its extraction, with the same technique used for total mercury. Details of the analytical methodologies used have been already published[1]. Accuracy was controlled by analyzing a Standard Reference Material from the National Research Council of Canada. Results of this control are reported in Table 1.

RESULTS AND DISCUSSION

The muscular tissue of 18 specimens (6 males, 11 females, 1 indetermined) with weights ranging from 60 to 342 g, was analyzed. Results are reported in Table 2.

Table 2 Results obtained for muscular tissue of *Pagothenia bernacchii* collected during the 1989–90 Expedition. The following is reported for each sample: sample code (Samp.); total length in cm; weight in g; sex (F=Female, M=Male, I=Indetermined); fresh weight/dry weight ratio (FW/DW); concentration of total mercury (Hg-t), organic mercury (Hg-o), and selenium (Se) in μg/g DW; percentage of organic mercury.

Samp.	*Length cm*	*Weight g*	*Sex*	*FW/DW*	*Hg-t μg/gDW*	*Hg-o μg/gDW*	*Hg-o%*	*Se μg/gDW*
PB4/1	21.0	120.0	M	5.08	0.367	0.325	88.6	3.56
PB4/2	20.5	102.6	F	5.47	0.360	0.266	73.9	1.64
PB4/3	20.5	114.4	F	5.08	0.302	0.252	83.4	1.67
PB4/4	22.0	136.4	M	5.51	0.675	0.546	80.9	2.08
PB4/5	17.0	60.3	M	5.05	0.415	0.399	96.1	2.68
PB4/6	20.0	109.4	F	5.46	0.235	0.212	90.2	1.74
PB4/7	25.0	203.1	F	5.54	0.434	0.293	67.5	1.38
PB4/8	25.0	199.8	F	5.53	0.504	0.398	79.0	1.79
PB4/9	24.5	214.6	F	5.13	0.336	0.184	54.8	3.32
PB4/1	21.0	120.7	M	5.11	0.776	0.473	61.0	2.61
PB5/1	18.7	108.0	M	4.96	0.230	0.164	71.3	2.24
PB5/2	24.0	187.0	F	4.98	0.526	0.458	87.1	3.90
PB5/3	19.4	88.2	M	4.71	0.412	0.352	85.4	3.35
PB5/4	26.3	245.4	F	6.11	0.486	0.428	88.1	2.78
PB5/5	28.0	342.5	F	5.10	0.687	0.368	53.6	3.45
PB5/6	29.0	325.8	I	5.40	0.990	0.830	83.8	2.95
PB5/7	23.0	149.5	F	4.92	0.399	0.156	39.1	1.99
PB5/8	28.0	302.0	F	5.30	0.670	0.494	73.7	1.84

Total mercury concentration ranges from 0.230 to 0.990 μg/g dry weight (DW), with a median of 0.425 μg/g DW. The organic fraction ranges from 39 to 96% of the total, with a median of 80%. These results do not differ noticeably from those obtained during the 1987–88 and the 1988–89 Expeditions[1-3].

Selenium concentration ranges from 1.38 to 3.90 μg/g DW, with a median of 2.42 μg/g DW. This agrees with the results of the 1988–89 Expedition (median 2.52 μg/g DW), but is lower than that found during the 1987–88 Expedition[1,2] (median 4.27 μg/g DW).

A summary of results obtained is represented as a "Box and Whiskers" plot in Figure 1, together with a comparison to the 1987–88 and the 1988–89 data.

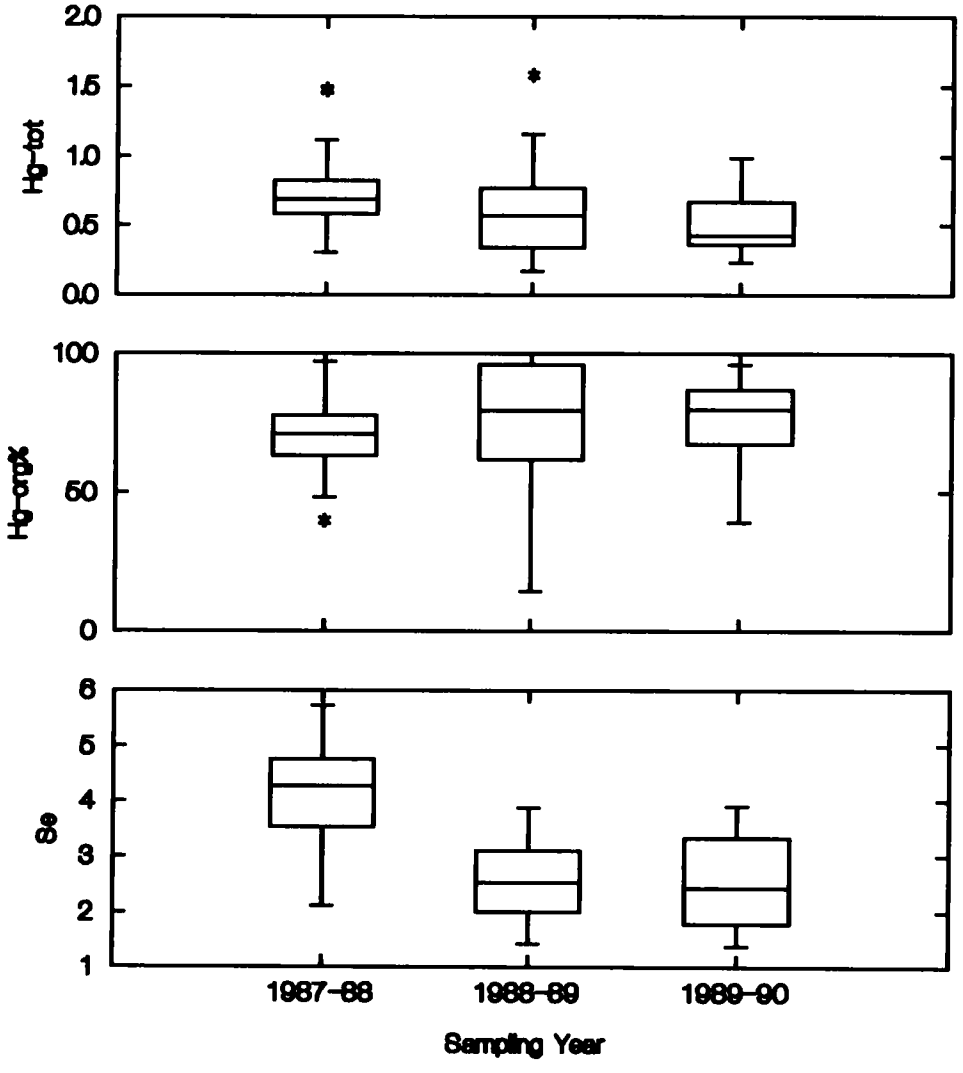

Figure 1 Comparison of results obtained for muscular tissue of *Pagothenia bernacchii* sampled during the 1987–88, 1988–89, and 1989–90 Italian Antarctic Expeditions. Hg-tot and Se concentrations are in μg/g dry weight.

Principal Component Analysis[4] was performed with the following variables: weight, organic mercury, inorganic mercury (obtained as the difference between total and organic mercury), and total selenium. The plot of loadings and scores on the first two eigenvectors is reported in Figure 2.

As can be clearly seen from Figure 2, the 1987–88 data differs significantly from the others. This can be attributed mainly to a higher level of selenium. No evident explanation was found. There is also a clear differentation between males and females. This is in good agreement with the sexual dimorphism described for this species[5,6]. For these reasons a more detailed treatment of data was carried out only on females collected during the 1988–89 and 1989–90 Expeditions. With these values, the bioaccumulation of mercury becomes evident, and the correlation between total mercury concentration and size (weight) of the specimens

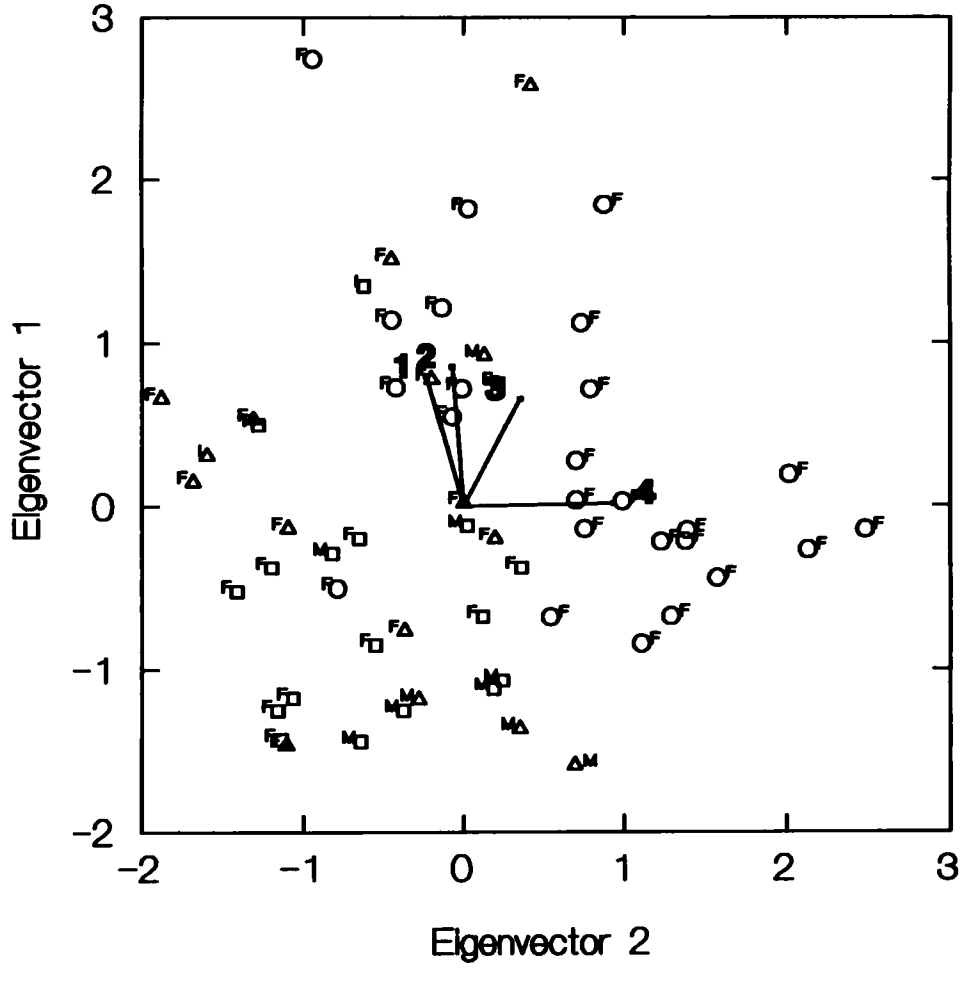

Figure 2 Plot of loadings (1=weight, 2=Hg-org, 3=Hg-inorg, 4=Se) and scores (circles=1987–88, squares=1988–89, triangles=1989–90, M=males, F=females, I=sex indetermined) on the first two eigenvectors.

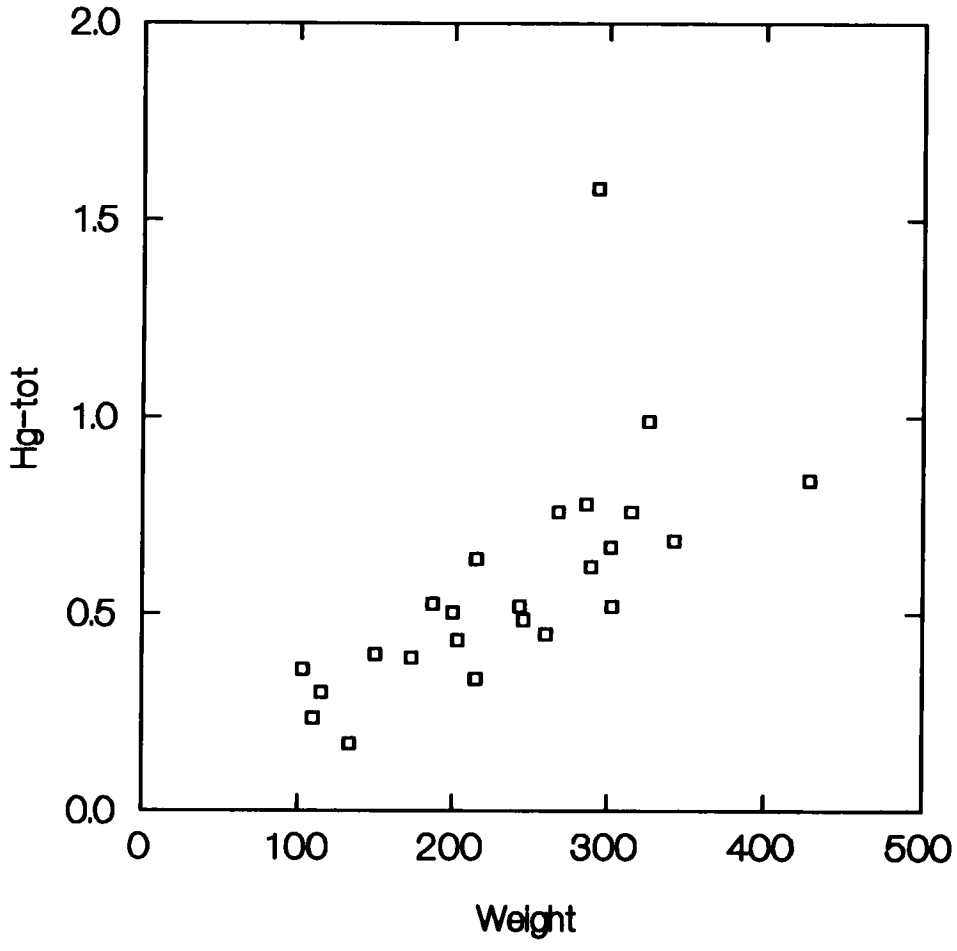

Figure 3 Total mercury (in µg/g DW) vs. weight (in g) for females collected during the 1988–89 and 1989–90 Expeditions.

is highly significant (r=0.838, n=23, discarding one outlier value). This is clearly shown in Figure 3.

This finding, which was not evident from previously published data[1,2], is in good agreement with what happens for most species of marine organisms from other seas (e.g. the Mediterranean). Another similarity exists in the fact that it is mainly the organic mercury that accumulates in the muscular tissue.

As far males are concerned, bioaccumulation seems to occur with at a different rate than that for females, but the available data is not sufficient for any convincing analysis.

Bioaccumulation also explains the small difference in total mercury concentration between the 1989–90 and 1988–89 data (Figure 1), since the 1988–89 specimens were of greater size (weight).

Acknowledgements

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References

1. R. Capelli, V. Minganti, F. Fiorentino and R. De Pellegrini. *Annali di Chimica*, **81,** 357–369 (1991).
2. R. Capelli, R. De Pellegrini, V. Minganti and E. Amato. *Annali di Chimica*, **79,** 561–569 (1989).
3. R. Capelli, V. Minganti, R. De Pellegrini and F. Fiorentino. in *Environmental impact in Antarctica* (Roma, C.N.R., Aula Marconi, 8–9 June 1990) pp. 47–54.
4. D. L. Massart, B. G. M. Vandeginste, S. N. Deming, Y. Michotte and L. Kaufman. *Data handling in science and technology, Volume 2, Chemometrics: a textbook* (Elsevier. 1988).
5. J. C. Hureau. *Bull. Ist. océanogr. Monaco*, **68,** 1–244 (1979).
6. M. Vacchi. *Nat. Sc. Com. Ant., Ocean. Camp. 1987–88., Data Rep.*, **1,** 457–467 (1990).