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HEAVY METAL ACCUMULATION IN THE LIVER OF ANTARCTIC MINKE WHALE (*BALAENOPTERA ACUTOROSTRATA*) (EXTENDED ABSTRACT)

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Accumulation of heavy metals in Antarctic minke whales, caught in the Antarctic Ocean during the summer whaling seasons of November 1980 to February 1981 and November 1984 to March 1985, was studied in order to elucidate the transfer processes of heavy metals in the Antarctic marine ecosystem. The contents of heavy metals (Fe, Mn, Zn, Cu, Pb, Ni, Co, Cd and Hg) in the liver of *B. acutorostrata* were determined by atomic absorption spectrophotometry, and their concentration levels and variations among the individuals were investigated in relation to biological parameters such as age, body size and sex.

Table 1. Heavy metal concentrations (mean ±SD, CV%) in the liver of Balaenoptera acutorostrata, *whole body of* Euphausia superba *and Antarctic seawater.*

	B. acutorostrata μg/dry g (N=135)	*E. superba* μg/dry g (N=18)	Antarctic seawater μg/L (N=5)	Bioconcentration factor
Fe	4.36± 5.19×10³	12.3 ± 5.25	15.3 ± 9.78	2.8×10⁵
	119	42.7	63.9	
Mn	10.1 ± 2.48	4.92± 2.13	0.08± 0.07	1.3×10³
	24.7	43.3	87.5	
Zn	146 ±28.0	58.8 ±20.2	32.3 ±12.2	4.5×10³
	19.1	34.4	37.8	
Cu	17.2 ± 3.73	55.7 ±12.0	8.88± 5.97	1.9×10³
	21.7	21.5	67.2	
Pb	0.41± 0.20	0.56± 0.20	0.02± 0.01	2.1×10⁴
	48.8	35.7	50.0	
Ni	0.17± 0.10	2.47± 0.50	0.58± 0.06	2.9×10²
	62.2	20.2	10.3	
Co	0.16± 0.10	0.15± 0.06	0.57± 0.15	2.8×10²
	62.5	40.0	26.3	
Cd	38.4 ±21.6	4.32± 1.20	0.07± 0.03	5.5×10⁵
	56.2	27.8	42.9	
Hg	204 ±78.0×10⁻³	10.0 ± 5.2×10⁻³	4.8 ± 6.0×10⁻³	4.3×10⁴
	38.3	52.0	125	

Samples of *E. superba* and Antarctic seawater were collected in the Antarctic Ocean during the cruising periods of the BIOMASS Program (November 1980–March 1981). Bioconcentration factors were calculated from the hepatic metal concentrations in *B. acutorostrata* and the metal concentrations in Antarctic seawater.

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The mean concentrations of heavy metals in the liver of *B. acutorostrata* were in the order of Fe>Zn>Cd>Cu>Mn>Pb>Hg>Ni·Co (Table 1), and their bioconcentration factors (hepatic metal concentration/metal concentration in Antarctic seawater) were relatively high for Fe and Cd and low for Hg, when compared with other marine mammals such as seals and small toothed cetaceans from different waters (DRESCHER *et al.*, 1977; GASKIN *et al.*, 1979; HONDA *et al.*, 1983; WAGEMANN and MUIR, 1984). Such a difference in the accumulation of Cd and Hg in *B. acutorostrata* was dependent on the food item, *Euphausia superba*, which contained a relatively high concentration of Cd and low concentration of Hg (Table 1). Also, a comparatively simple structure of food web in the Antarctic marine ecosystem (KNOX, 1970) is considered to reflect on the very low bioconcentration factor of Hg in this animal.

The hepatic concentrations of heavy metals varied widely among the individuals, especially for Fe (see CV% in Table 1). For most of the metals examined the concentrations were log-normally distributed, differing from a bell-shaped normal distribution.

The concentrations of Fe, Cd and Hg were positively correlated with age, but such a correlation was not observed for the other metals. Figure 1 shows the concentrations of Fe and Cd against age, as examples. While the hepatic Fe concentration linearly increased with age, the concentrations of Cd and Hg increased with age until about 20 years and thereafter decreased year by year. The hepatic Cd and Hg increased with increasing body length within the same age individuals.

The hepatic concentrations of heavy metals in *B. acutorostrata* varied between sexes,

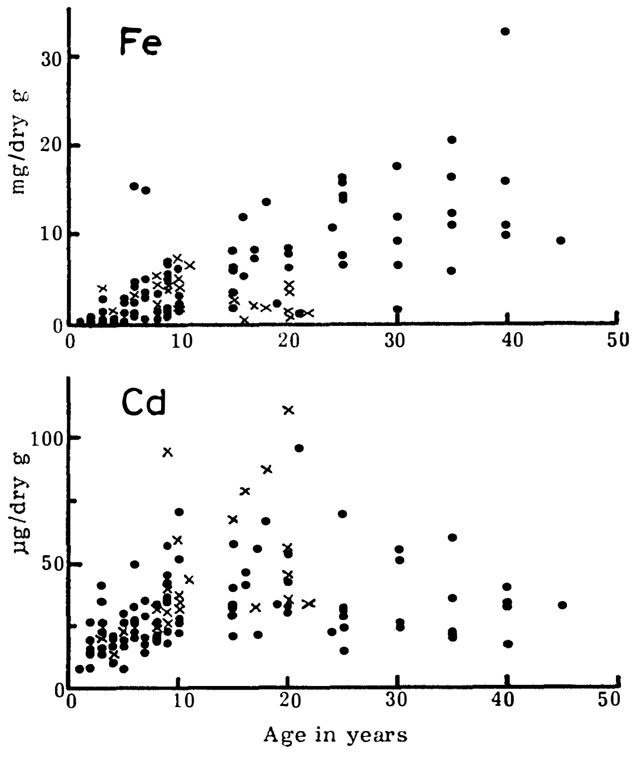

Fig. 1. Age-related accumulation of the hepatic Fe (upper graph) and Cd (lower graph) in B. acutorostrata *(●: male, ×: female).*

and also with sexual status of the matured female. The concentration of Fe was lower in the female than the male (the upper graph in Fig. 1). The concentrations of hepatic Fe, Pb, Ni and Co in the matured females decreased with progress of the gestation.

These variations of the metal concentrations with age, body size and sex were in reasonable agreement with those of other marine mammals reported by GASKIN *et al.* (1979) and HONDA *et al.* (1983). However, a very high concentration of Fe in *B. acutorostrata* and its increase with age may be species-specific. Also, unusual age-related accumulations of Cd and Hg in *B. acutorostrata* (Fig. 1), different from linear increases of the concentrations in other marine mammals, are considered to be due to historical changes of amounts of the food intake, probably as a result of structural disturbances of the Antarctic marine ecosystem due to commercial whalings. Consequently, this indicates that an anthropogenic disturbance of ecosystem influences not only physiological and biological aspects such as population, sexual maturity and growth rate of the minke whale (BEDDINGTON and MAY, 1983), but also the accumulation of toxic metals like Cd and Hg in this animal. The changes of bioaccumulation processes of toxic metals throughout the disruption of ecosystem are especially serious in a simple ecosystem such as the Antarctic Ocean.

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