Biomagnification of Chlordane Compounds by Harbour Porpoise *Phocoena phocoena*

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1. Introduction

Chlordane compounds (CHLs) are a broad-spectrum pesticide, and have been used world-wide for many years for control of termites and other insects [1-3]. These chemicals were not used in Poland and their residue concentrations in slaughtered and game animals as well as in human adipose tissue in Poland are low [4,5]. Since many years CHLs are contaminants detectable in the northern chemisphere, including the Baltic Sea and remote marine areas [2,3,6,7]. Neverthless, the knowledge about sources, deposition rates and occurrence of many CHL compounds in the Baltic Sea is very limited.

Chlordane concentrations, including heptachlor, heptachlor epoxide, U82, *trans*-chlordane, MC5, *cis*-chlordane, MC7, oxychlordane, MC6, *trans*-nonachlor and *cis*-nonachlor, and their biomagnification (BMF) factors were determined for harbour porpoise collected from the Polish Baltic coastal waters.

2. Materials and Methods

Harbour porpoises *Phocoena phocoena* were collected dead from the fishing nets in the southern part of the Baltic proper in 1991-1993 (Table 1), while Baltic herrings *Clupea harengus* (3 individuals of the body length between 20-26 cm) were netted in the Gulf of Gdańsk in June 7, 1992. The samples of blubber were kindly provided by Dr. K. Skóra. A whole fish and blubber of harbour porpoise was subjected for chemical analysis.

Table 1
Biometric data of harbour porpoises

Specimen sex and no.	Date of collection	Place of collection	Body weight (kg)	Body length (cm)
Male 1	January 29, 1992	Łeba	38.4	131
Male 2	January 7, 1992	Międzyzdroje	44.8	129
Female 1	December 22, 1991	Władysławowo	38.8	131
Female 2	October 1, 1993	Międzyzdroje	50.0	128

The analytical method used for the determination of chlordanes is a part of a multi-residue procedure of many organochlorines and polynuclear aromatic hydrocarbons [8]. A final quantification of chlordanes was achieved using capillary column (Rtx-5) gas chromatography and low-resolution mass spectrometry (HRGC/LRMS). Extractable organohalogens (EOX), including extractable organochlorines (EOCl), bromines (EOI) and iodines (EOI) were determined using instrumental neutron activation analysis [9].

3. Results and Discussion

Trans-nonachlor, *cis*-chlordane, heptachlor epoxide, *cis*-nonachlor and oxychlordane were found in largest concentration in harbour porpoise and herring, while U82, MC4, *trans*-chlordane, MC5, MC7 and MC6 were minor components, and heptachlor remained undetected (Table 2). The concentrations of CHLs determined in harbour porpoises in this study are very similar to values reported for three individuals collected from the Puck Bay (inner part of the Gulf of Gdańsk) in 1989-1990, which contained in their blubber from 840 to 1400 ngCHLs/g lipid weight [10].

Chlordane compounds contribute only little in EOX quantified in herrings from the Gulf of Gdańsk, which contained EOCl, EOBr and EOI in concentration between 3000-4700, 120-240 and 83-260 ng/g lipid weight, respectively.

Table 2
Concentrations of chlordanes (CHLs) in blubber of harbour porpoise and herring (ng/g l. wt.)

	Specimen and lipid content (%)				
Compound	Male 1 89.2 (%)	Male 2 77.0	Female 1 88.2	Female 2 92.5	Herring 9.0
Heptachlor	ND	ND	ND	ND	ND
Heptachlor epoxide	92	120	82	100	3.9
U82	2.9	8.7	4.5	6.3	0.43
MC4	2.2	6.4	4.0	4.1	0.52
Trans-chlordane	1.6	3.6	3.7	6.5	2.3
MC5	10	22	15	30	3.7
Cis-chlordane	65	170	100	140	14
MC7	1.0	2.0	1.0	2.5	0.73
Oxychlordane	41	170	52	110	6.0
MC6	13	46	16	32	1.7
Trans-nonachlor	160	530	240	340	12
Cis-nonachlor	82	170	85	99	3.6
CHLs	**470**	**1300**	**600**	**870**	**49**

ND, not detected

Residue pattern of chlordane compounds determined in blubber of harbour porpoises in this study was very similar for males and females. *Trans*-chlordane, which is a dominating constituent (24±2%) in technical chlordane, is only a minor component of CHLs in harbour porpoise.

Herrings can be considered as a main prey species for harbour porpoises in the southern part of the Baltic Sea. The concentrations of chlordane compounds in herrings

examined are usually much lower than in blubber of harbour porpoises (Table 1). The ratio of *trans*-nonachlor/*trans*-chlordane, (N/C) ratio, in male and female of harbour porpoises is 125 (100-150) and 59 (52-65), and is 24 and 11 times higher than in herrings, respectively. The lower contribution of *trans*-chlordane (0.50%) in total CHLs in small cetacean such as harbour porpoise when compared to herrings (4.7%) is attributable to metabolic activities for the degradation of that compound by that species of marine mammals.

Biomagnification factors (BMF) were calculated as the chlordane compound concentration in blubber of harbour porpoise divided by the concentration in the food (herring). All chlordane compounds examined are characterised by value of BMF factor higher than 1, and for the most biomagnified *cis*-nonachlor, *trans*-nonachlor, heptachlor epoxide, MC6 and oxychlordane it was between 15 and 30, on the average (Figure 1). Dall's porpoise *Phocoenoides dali* from the North Pacific is able to accumulate *trans*-nonachlor, *cis*-chlordane, *trans*-chlordane, *cis*-nonachlor and oxychlordane, and exhibits high values of biomagnification factor (log BMF between ~1 to ~2) of those compounds when related to eight-armed squid *Gonatopsis borealis*, its main food [1].

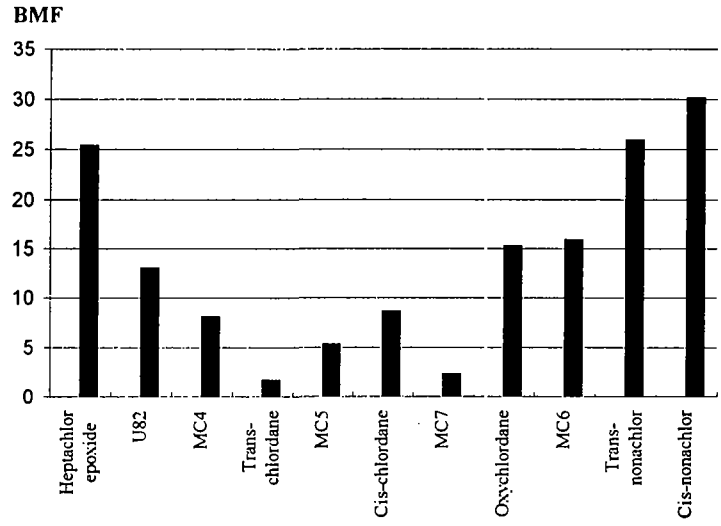

Figure 1. Biomagnification factors (BMF) of chlordanes in harbour porpoise.

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4. References

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