Chlorinated biphenyl (CB) contamination of small whales in the North Sea and Baltic Sea

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Introduction

A research project has been initiated to investigate the status of the marine mammal (especially the small whales) health in the North Sea and Baltic with reference to chlorinated hydrocarbon contamination. The project aims are 1. development of a sampling technique that offers minimum contamination, especially of blood, 2. quality assurance: a critical evaluation of the available methodologies, 3. understanding the effect of lipid composition on the distribution of these contaminants, 4. evaluating the relevance of toxic CBs to the overall health of the whales, and 5. wholistic interpretation of the toxic risk with biological and pathological data.

We present here preliminary results on CB contamination in white nosed dolphin and harbour porpoise. More samples will be analysed in the coming months. The results will be presented at the conference.

Experimental

Approximately 3 g of blubber, liver, brain and blood tissue from two white nosed dolphin (*Lagenorhynchus albirostr.*) and harbour porpoise (*Phocoena phocoena*) was analysed for CBs using the clean-up procedure of Petrick *et al.* (1988). In brief, the samples were thoroughly mixed with anhydrous sodium sulphate in a mortar and extracted in a soxhlet apparatus using 100 ml of *n*-hexane. An aliquot of this extract was used for the (n-hexane extractable) lipid weight determination. The volume of the extract was reduced initially using a rotary evaporator and finally to smaller volumes (100-200 μl) using a gentle stream of nitrogen for the CB determinations by GC-ECD after clean-up by alumina chromatography and HPLC. CBs in cleaned-up extracts were measured using single capillary column GC-ECD and multidimensional GC-ECD (MDGC-ECD). Single column analysis was carried out using a Siemens SiChromat I - GC equipped with a SE-54 coated column. MDGC was carried out with a Siemens SiChromat-2 GC with SE-54 and

OV-210 columns in series. More details of this technique are available elsewhere (Duinker *et al.* 1988 & Schulz *et al.* 1989). The latter technique resulted in data for important non- and mono- *ortho* Cl CBs with toxic properties. Quantitation was performed using a mixture of individual chlorobiphenyl congener standard solutions of high purity (>99%).

Results and Discussion

Four organs (blubber, liver, brain and blood) were analysed of one white nosed dolphin. Only blood and liver were analysed in one another dolphin and in a harbour porpoise. The highest content of CBs on a lipid basis were found in blubber (>liver >blood >brain). Blood in marine mammals may act as the principal transport medium allowing an equilibrium between the contents of CBs in blood and other organs to be maintained (Duinker *et al.* 1989 & Boon *et al.* 1994). To test this model, the contents of CBs in the various tissues are correlated in Fig. 1. An excellent correlation is found between blood and other organs. The good correlation between CBs in brain and liver (Fig.1) reveals that CBs in blood and organs are in perfect equilibrium. Analysis of any one organ reflects the contaminant situation in the whole animal.

The biotransformation of CBs in these animals is understood from the ratio of a CB congener X to that of a persistent congener, for example CB-153. This ratio in all the three samples is presented in Fig.2. It is obvious from the low X/153 values that these marine animals are capable of metabolizing the lower chlorinated CBs effectively. It is interesting to note that the metabolic efficiencies of two individuals of the same species differ due to differences in physiological conditions and the zone of contamination. White nosed dolphin Nr.1 seems to be more efficient than Nr.2. The recalcitrant CBs in the first animal are CB-138, -149, -180 and -187. On the other hand, CBs -92, 95, 99, 101, 118, 146 and 193 are equally persistent in the other dolphin. The harbour porpoise is different in the sense that CB-149 is as resistent as CB-138 in this animal. Several other CBs are equally recalcitrant (eg. CB -99, -101, -118, -132, -146, -183 and -187). The biotransformation of CBs is effected by Cytochrome P-450 isozymes and X/153 ratios indicate that environmental induction of these enzymes occurred in these animals.

References

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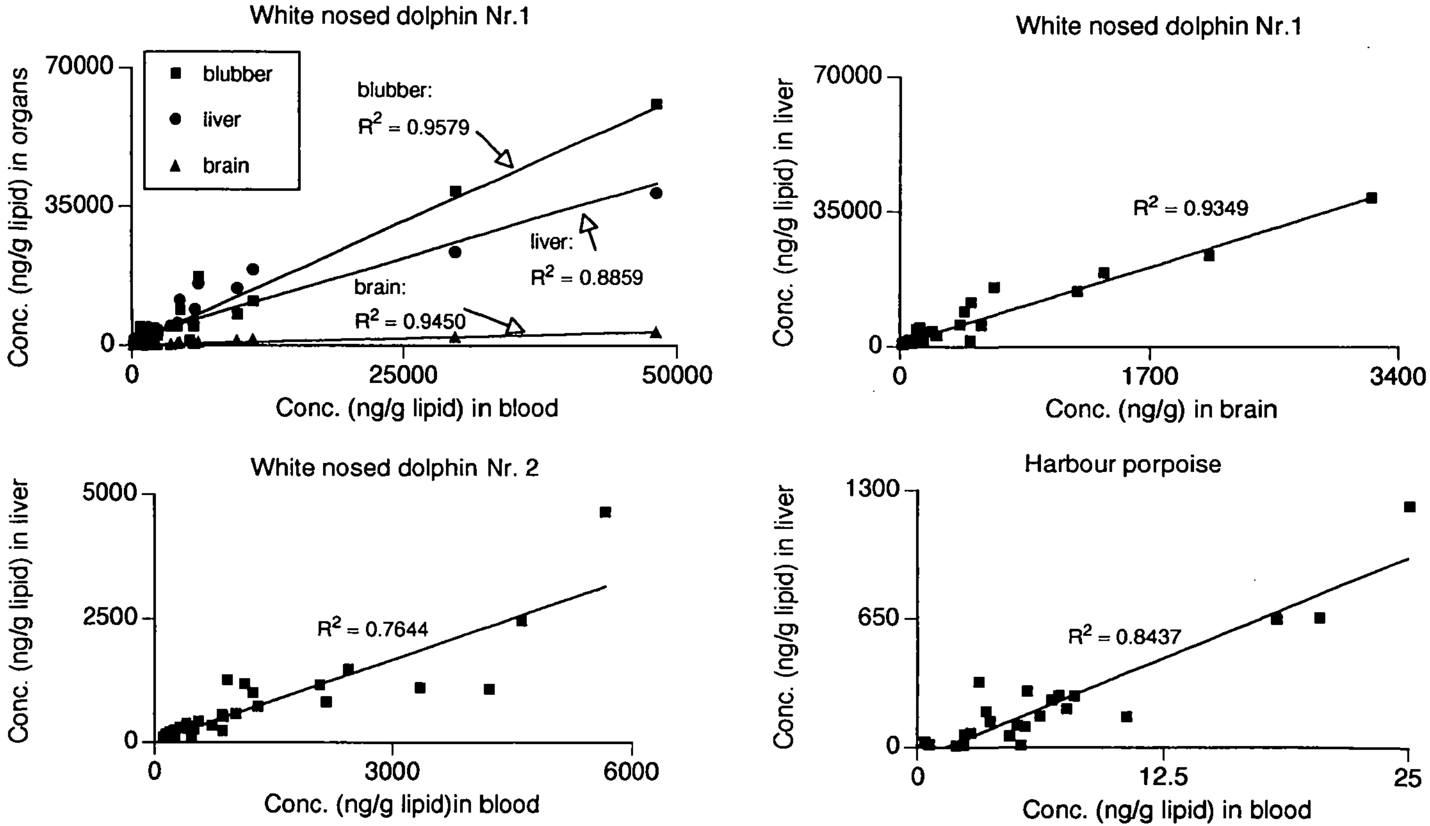

Fig. 1.: The relationship between CB contents in blood and organs

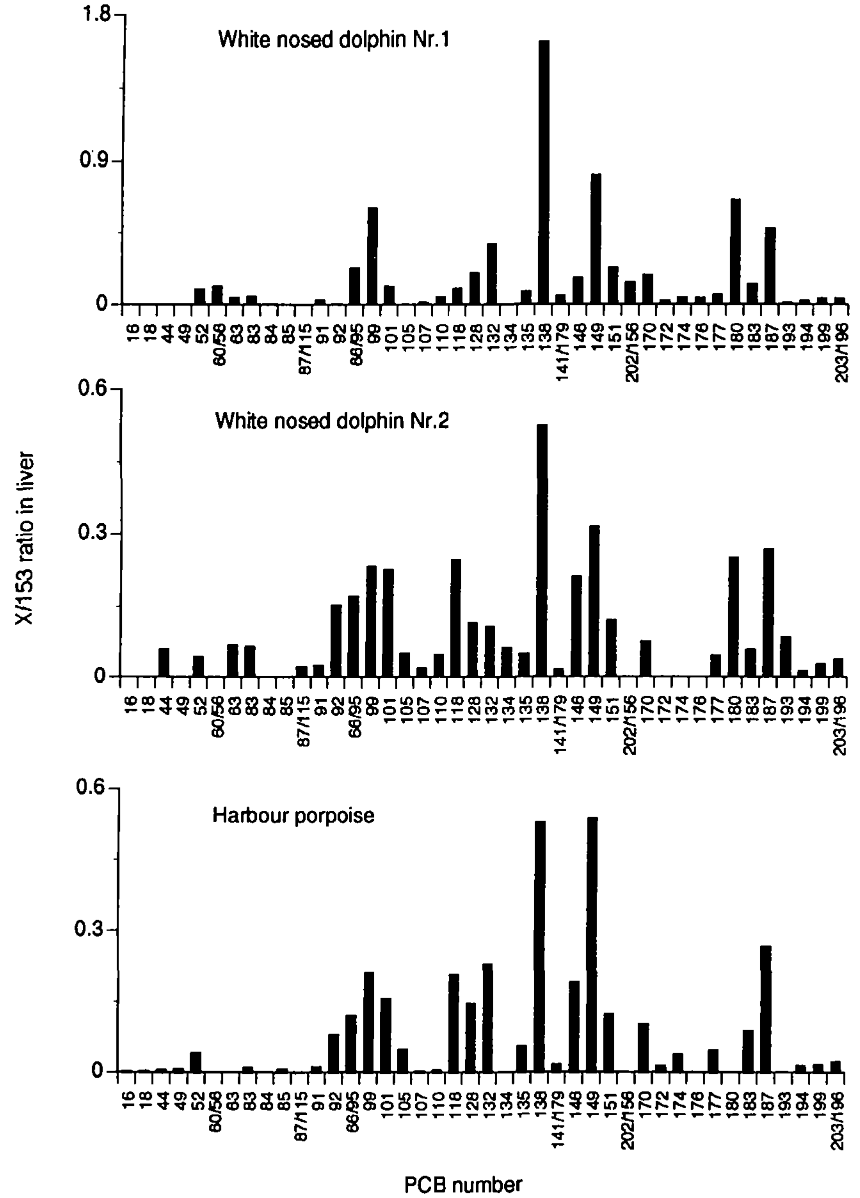

Fig. 2: X/153 ratios in liver (derived from ng/n lipid data)