# Non-, Mono-*ortho* and Total PCBs in Black Cormorants and Their Food in the Gulf of Gdańsk, Baltic Sea

Jerzy Falandysz, Adriana Dembowska, Lidia Strandberg, Bo Strandberg*, Per-Anders Bergqvist* and Christoffer Rappe*

Department of Environmental Chemistry & Ecotoxicology, University of Gdańsk, 18 Sobieskiego Str., PL 80-952 Gdańsk, Poland
*Institute of Environmental Chemistry, Umea University, S-901 80 Umea, Sweden

**Abstract**
Concentrations, pattern and bioaccumulation features of non-*ortho*, mono-*ortho* and total PCBs were determined in the liver and breast muscle of black cormorants from the colony near Kąty Rybackie on the south coast of the Gulf of Gdańsk. PCBs were determined employing a multi-residue procedure that includes a non-destructive wide bore open-tube extraction step and than clean-up using semipermeable polyethylene membrane, a Florisil gel column (total PCBs) and further HPLC fractionation of planar (non- and mono-*ortho* PCBs) compounds on activated carbon column and a final separation, identification and quantification with HRGC/LRMS and HRGC/HRMS.
Concentrations of total PCBs in fish were 4000 ng/g lipids and in black cormorant between 34000 in liver and 49000 in the breast muscles ng/g. The TCDD TEQs of non- and mono-*ortho* PCBs in fish and in black cormorant liver and the breast muscles was 0.087, 8.2 and 8.0 pg/g lipids (0.0037, 0.02 and 0.022 pg/g wet weight), respectively. Dominating members in the fingerprint of PCBs in fish were nos. 132/153, 138/160/163/164, 118, 99/113 and 105/127, while in black cormorants were nos. 132/153, 138/160/163/164, 180, 118 and 182/187. When related to potential food items, black cormorants bioaccumulate in their body many PCBs, and the PCB congeners nos. 201, 209, 172/192, 194 and 195 show highest bioaccumulation factor (BAF) values (between 100 and 300).

*Key words*: Polychlorinated biphenyls, chlorobiphenyls, PCBs, CBs, non-*ortho* PCBs, mono-*ortho* PCBs, fish, black cormorant, Baltic Sea

## Introduction

Polychlorinated biphenyls (PCBs) are ubiquitous, persistent and toxic contaminants in the environment. The fish-eating birds like black cormorants are characterised by low activity of hepatic microsomal monooxygenases (1, 2), what would enable them to bioaccumulate high concentrations of persistent organochlorine pollutants.

The objective of this study is to evaluate concentrations, patterns and bioaccumulation features of PCBs in a food chain including fishes and black cormorants from the Gulf of Gdańsk.

**Materials and Methods**

Adult black cormorants (*Phalacrocorax carbo sinensis*) were collected dead by nearshore fishermen as a by-catch during eel (*Anquilla anquilla*) fishing in southwestern part of the Gulf of Gdańsk in summer 1992. Fish such as round goby (*Neogobius malanostomus*), eelpout (*Zoarces viviparus*), herring (*Clupea harengus*), lesser sand eel (*Tobianus tobianus*), sand eel (*Heperoplus lanceolatus*) and lamprey (*Lampetra fluviatilis*) were collected as a possible food items of black cormorant in the Gulf of Gdańsk (3).

The analytical method used for determination of non-*ortho*, mono-*ortho* and total PCBs was described in another paper (4).

**Results and Discussion**

Table 1 presents the results of analysis of non-*ortho*, mono-*ortho* and total PCBs in black cormorants and fishes. In figures 1 and 2 are given the patterns of PCB homologue groups

Table 1. The concentrations of non-*ortho*, mono-*ortho* and total PCBs (ng/g lipids), and TCDD TEQs of non- and mono-*ortho* PCBs (pg/g lipids) in black cormorant and fish.

| | Black cormorant | | Fish |
|---|---|---|---|
| | Liver | Breast muscle | |
| Compound | n=3 | n=3 | (6 species) |
| Non-*ortho* PCBs | | | |
| No. 77 | 3.2 ±0.59 | 4.4 ± 1.2 | 5.2 ± 1.5 |
| No. 126 | 23 ± 6.7 | 21 ± 6.7 | 3.4 ± 1.4 |
| No. 169 | 2.8 ± 1.3 | 2.1 ± 1.1 | 0.10 ± 0.02 |
| Mono-*ortho* PCBs | | | |
| 105 | 1100 ± 270 | 1600 ± 560 | 500 ± 250 |
| 114 | 67 ± 19 | 89 ± 36 | 25 ± 14 |
| 118 | 3100 ± 900 | 4200 ± 1600 | 1200 ± 620 |
| 123 | 130 ± 46 | 120 ± 25 | 42 ± 16 |
| 156 | 670 ± 370 | 680 ± 130 | 200 ± 110 |
| 157 | 120 ± 68 | 270 ± 140 | 51 ± 27 |
| 167 | 700 ± 220 | 950 ± 530 | 150 ± 77 |
| 189 | 54 ± 43 | 110 ± 88 | 5.1 ± 2.6 |
| Total PCBs | 34000 ± 17000 | 49000 ± 31000 | 4000 ± 1700 |
| *TEQs (lipids) | 8.2 ± 2.2 | 8.0 ± 2.4 | 0.087 ± 0.038 |
| *TEQs (wet weight) | 0.022 ± 0.01 | 0.02 ± 0.01 | 0.0037 ± 0.0011 |
| Lipids (%) | 4.6 ± 0.8 | 4.5 ± 0.3 | 5.7 ± 0.8 |

*based on 1997 World Health Organization (WHO) TCDD TEFs for birds and fish, respectively; ± S.E.

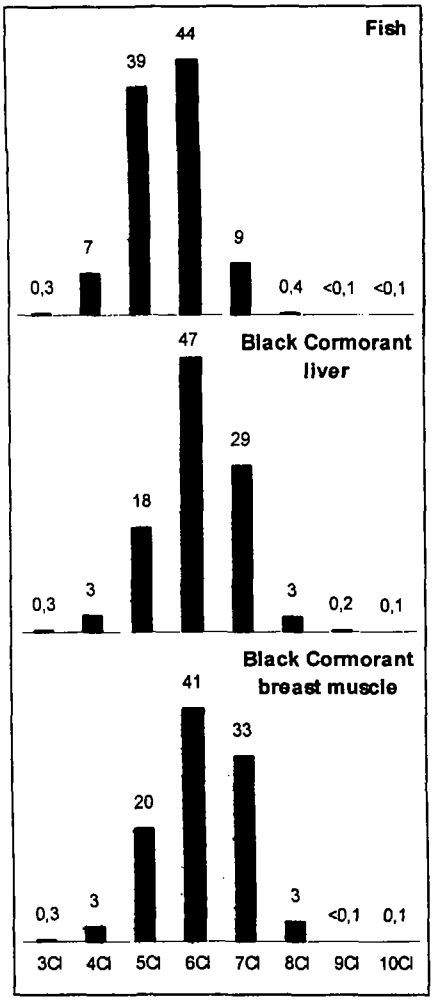


Fig. 1. Pattern (%) of PCB homologue groups in fish and black cormorant.

and individually resolved PCB congeners, respectively, and in Figure 3 are given bioaccumulation factors (BAF) of PCB congeners.

TCDD TEQ value of non- and mono-*ortho* PCBs in black cormorants is ~100 times higher than in fish, what implies a high retention rates of those most toxic PCB members. The total PCB concentration in liver and the breast muscles of black cormorants in this study were between 34000 and 49000 ng/g lipids (1600 and 2200 ng/g wet weight), which is in a lower range of the values reported for cormorants from some other locations (1, 2, 5-7).

The pattern of PCB homologue groups is roughly similar in liver and the breast muscles of black cormorant and when compared to fish tetra- and penta-chlorobiphenyls are much less abundant, while hepta- and octachlorobiphenyls are bioaccumulated in birds (Fig. 1). The pattern of individually resolved PCB peaks differs somewhat between black cormorants and fish (Fig. 2). In fish a dominating PCB congeners are nos. 132/153, 138/160/163/164, 118, 99/113 and 105/127, and in black cormorants nos. such as 132/153, 138/160/163/164, 180, 118, 182/187 and 170/190. The bioaccumulation potential by black cormorants of PCBs present in fishes is shown in Figure 3. The lipid adjusted bioaccumulation factor (BAF) value is between 50 and 300 for several of the PCBs determined in the breast muscle and liver of the cormorants. The most biomagnified PCBs in the black cormorants are congeners no. 201, 209, 194, 172/192, 195, 182/187, 200 and 197.

Two non-*ortho* PCBs, no. 77 and 126 are metabolized by the black cormorants and only no. 169 is bioaccumulated (BAF value between 21 and 28), while all mono-*ortho* PCBs are apparently bioaccumulated by those birds (Table 1).

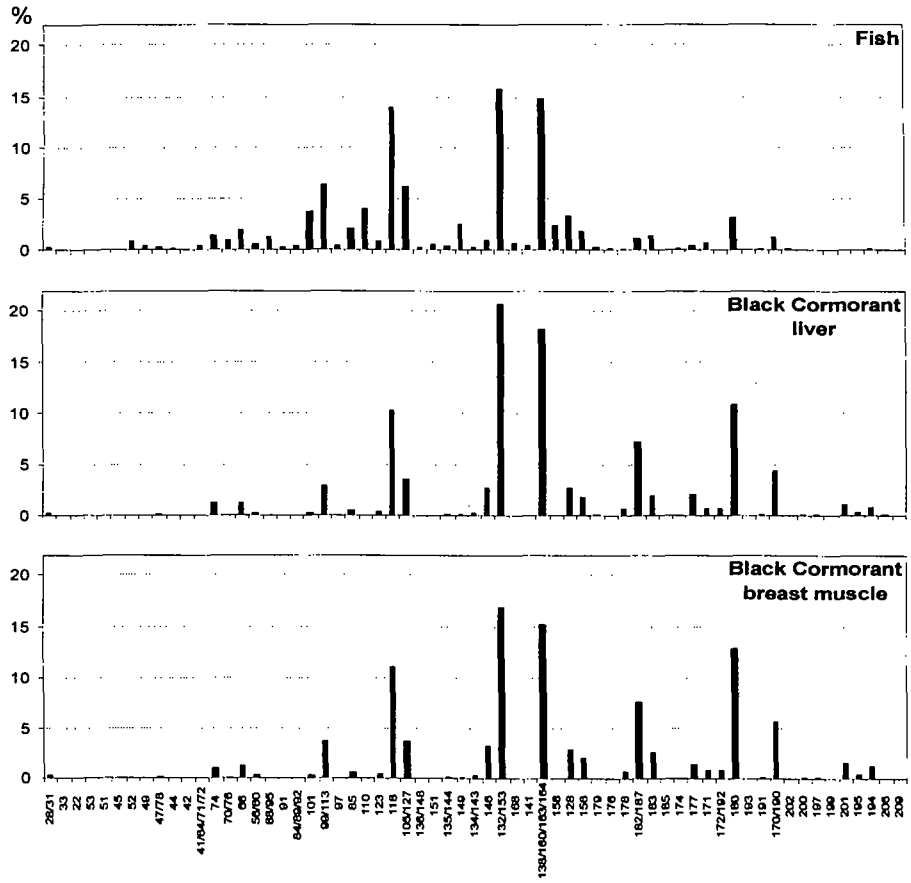


Fig. 2. Pattern (%) of PCBs in fish and black cormorant from the Gulf of Gdańsk.

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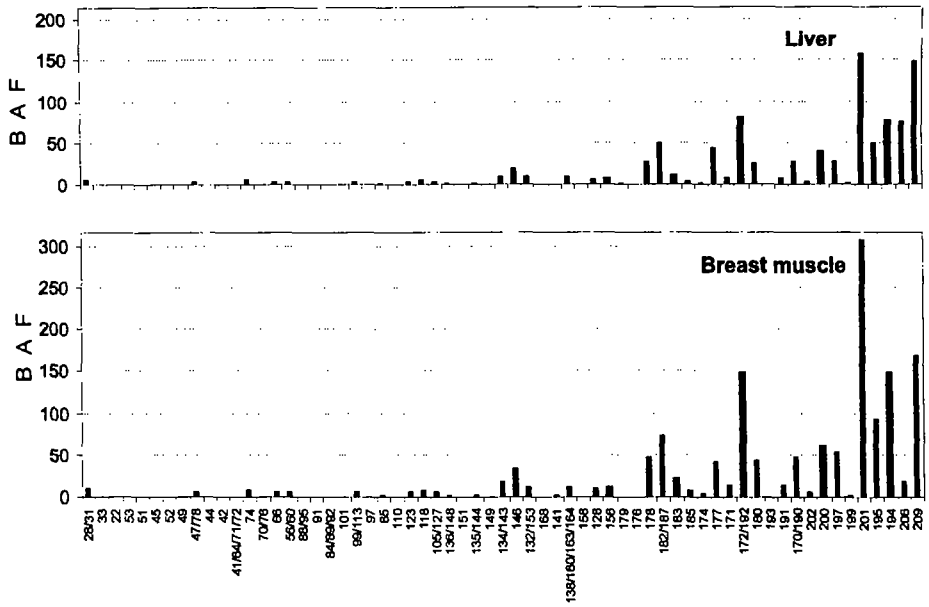


Fig. 3. BAF values of PCBs in liver and the breast muscle of black cormorant.


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