Polychlorinated Biphenyls and other Organochlorine Pollutants in Perch (*Perca fluviatilis*) from the Latvian environment

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Introduction

Although polychlorinated biphenyls (PCBs) have been extensively studied for several decades, comparatively little is known about the levels of PCBs and other organochlorine pollutants in ecosystems of the Latvian environment. The concentrations of total PCBs and sDDT in fish from the Eastern Baltic have been reported (1-3). Levels of PCBs in perch from the coastal waters of Latvia, including several locations within the Gulf of Riga are also published (3-5). Furthermore, presence and concentrations of a "new" environmental contaminant, bis (4-chlorophenyl) sulfone (BCPS), in biota were reported in one of these papers (4). However, to our knowledge only one study has been reported so far on PCBs or other organohalogen contaminants in the fresh-water ecosystems of the Baltic States (6). Sjöåsen and co-workers report concentrations of PCBs and sDDT in otters (*Lutra lutra*), roach (*Rutilus rutilus*), and amphibians from catchment areas of two Latvian rivers (6).

The aim of this paper is to summarize the data on the levels of PCBs and DDE in perch (*Perca fluviatilis*) from Latvian inland waters. Some data on other organohalogen pollutants, namely hexachlorobenzene (HCB) and the two major hexachlorocyclohexane (HCH) isomers, are also presented. The overall goal is to give a general overview of the situation concerning these contaminants in the Latvian environment.

Materials and Methods

Perch (*Perca fluviatilis*) were collected in eight lakes and several locations on rivers Lielupe and Daugava between 1995 and 1997 (Table 1). Both for analysis of individual and pooled samples, approximately 10 g of muscle was homogenized and extracted as described earlier (7), however diethyl ether was replaced by methyl *tert*-butyl ether. The amount of extracted lipids was determined gravimetrically for each sample. Two different sample cleanup methods were used for different sets of samples. The sulfuric acid method as described by Jensen *et al.* (7) followed by additional sample purification on silica gel – sulfuric acid (0.5 g, 2/1, w/w) columns (4) was

used for samples from all of the lakes. Five individual samples from each river location (sampled in 1997) were also cleaned up by this method.

A more extensive method, involving gel permeation chromatography (GPC) for removal of lipids and subsequent sample fractionation on a high performance liquid chromatography (HPLC) Nucleosil-NO_2 column, was used for the rest of the samples. A detailed description of the entire method, including the instruments used and the chromatographic conditions for both GPC and HPLC, is published elsewhere (4). The quantitative analysis was performed on a GC/ECD. Total PCBs concentrations were quantified in relation to Clophen A50 with the relative congener composition as reported by Schultz *et al.* (8). DDE, the HCH isomers and HCB were quantified by comparison to authentic standards.

Table 1. Sampling locations and years for lakes and rivers in Latvia where perch were collected. River sample locations are arranged by increasing distance downstream. n - number of analyzed samples; p - number of specimens included in the pooled samples.

No.	Location	Year	n	p	No.	Location	Year	n	p
	Lakes:					**River Lielupe:**			
1	Baltezers	1995	1	5	9	Bauska	1995	1	8
2	Inesis	1995	1	5	10	Jelgava	1997	9	
3	Alauksts	1995	1	5	11	Kalnciems	1997	10	
4	Raznas	1995	1	5	12	Sloka	1997	9	
5	Siksalas	1996	9			**River Daugava:**			
6	Engure	1996	11		13	Lielvarde	1997	10	
7	Kishezers	1996	10		14	Salaspils	1995	1	10
8	Burtnieks	1996	13		15	Dole	1997	10	
					16	Daugavgriva	1997	10	

Results and Discussion

The concentrations of total PCBs and DDE expressed in ng/g on lipid weight basis (ng/g l.w.) are presented in Figure 1 for all locations except Lake Kishezers, where the highest PCB concentrations were found. The mean PCB concentration in the samples from this lake was 2400 ng/g l.w. (standard deviation - 2000 ng/g l.w.). Kishezers is located within the city limits of Riga, the most heavily industrialized area in Latvia. Notably, the lowest PCB concentration among the ten perch of Lake Kishezers (980 ng/g l.w.) exceeds all other concentrations found in the lakes in our study. Most of the other lakes are located in rural areas apart from industrial activities. Concentrations of both PCBs and DDE in perch of these rural lakes are in the same range as those in perch and roach from locally unpolluted lakes in Sweden (9).

Daugava and Lielupe are the two largest rivers in Latvia with outflows in the Gulf of Riga. The mean total PCB concentrations were fairly similar in six of the eight river locations and in

general higher than those of the lakes. However, at both locations on River Lielupe upstream from the city of Jelgava (No. 9, 10), the concentrations were comparable with those of the samples from the rural lakes (Figure 1). The reported PCB concentration range of four pooled roach samples from the catchment areas of rivers Gauja and Venta in Latvia is 83 – 200 ng/g l.w. (6). Apparently total PCB concentrations below 300 ng/g l.w. represent the baseline contamination in the relatively pristine areas of Latvian rivers. The considerably higher PCB concentration at the location downstream from the city of Jelgava (No. 11) might indicate the presence of point pollution sources in Jelgava. However several smaller rivers and streams covering a wide catchment area join River Lielupe between the city and this sampling site. Thus, the possible PCB sources might also be located in the catchment area of these streams.

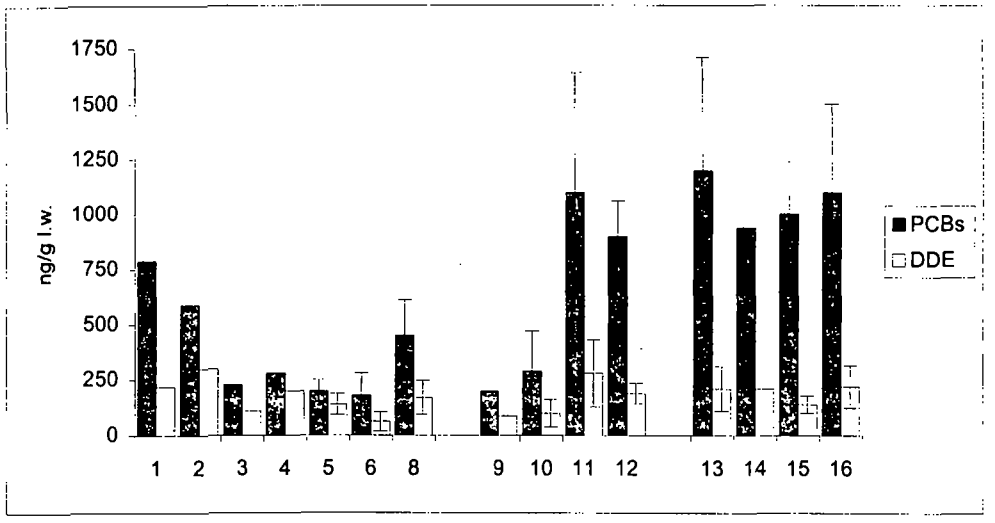

Figure 1. Concentrations of total PCBs and DDE in perch from Latvian lakes and rivers. Arithmetic means and standard deviations are presented for the locations where individual samples were analyzed. The location numbers correspond to those in Table 1. River sample locations, Lielupe (No. 9-12) and Daugava (13-16), are arranged by increasing distance downstream.

In contrast to Lielupe, roughly the same mean PCB concentrations were found in perch from all four locations on River Daugava. Only Daugavgriva is situated downstream from Riga City at the River Daugava outflow in the Gulf of Riga. The reported total PCB concentrations in perch collected in 1993 (3), 1994 and 1995 (5) at Daugavgriva are 1800, 1400 and 1400 ng/g l.w., respectively. The total PCB concentration found in our study in perch collected at Daugavgriva in 1997 was 1100 ng/g l.w.. Thus the Riga metropolitan area may not be as serious a pollution source of PCBs to the Gulf of Riga, at least via River Daugava.

The concentrations of two hexachlorocyclohexane (HCH) isomers and hexachlorobenzene (HCB) were determined in perch from four lakes (sampled 1996, Table 1). The mean concentration ranges of α-HCH and γ- HCH were 4.3 – 12 and 8.3 – 18 ng/g l.w. respectively.

The mean HCB concentration in Lake Kishezers samples was 30 ng/g l.w., whereas the concentrations in the three other lakes ranged from 8.8 to 16 ng/g l.w.. The reported geometric mean value ranges of perch and roach from three lakes in Sweden are 8 – 17 ng/g l.w. for α-HCH, 7 – 17 ng/g l.w. for γ- HCH, and 6 – 27 ng/g l.w. for HCB (9), and thus similar to the results found in perch from the four Latvian lakes in our study. Most likely the major source of these pollutants in the investigated lakes in Latvia is long-range air transport.

PCBs were detected in all the lakes and rivers in our study. Perch from Lake Kishezers had particularly high PCB concentrations. PCB levels increase in perch taken from River Lielupe with increasing distance downstream. Perch concentrations indicate that the city of Jelgava may be a source of PCBs to the river. In contrast, perch PCB concentrations are relatively constant in River Daugava despite the fact that the city of Riga is located just upstream from the Daugavgriva location (No. 16, Figure 1).

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