

THE LEVELS OF PCDD/Fs IN FISH IN RIVER KYMIJOKI POLLUTED BY KY-5 MANUFACTURING

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Introduction

Concentrations of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) were studied in seven fish species in the polluted Kymijoki River and its estuary. Kymijoki, the fourth largest river in Finland, is situated in the south-eastern corner of the country. The maximum water discharge is about 700 m³/s, with an average discharge of about 300 m³/s. The area has a long tradition in the paper industry and the river has been heavily polluted by pulp mill effluents as well as the chemical industry. Findings in river sediments reveal high concentrations of PCDD/F compounds and especially higher chlorinated dibenzofurans which occurs as impurities of Ky-5 (1). Preliminary results of the levels of PCDD/Fs in fish in Kymijoki area and its estuary, produced in a joint national project KYPRO involved several universities and research institutes, have been reported earlier (2, 3). In this presentation will be given the final results of PCDD/Fs in fish.

Materials and methods

The fish were caught at 19 localities along the Kymijoki River and its estuary, organized by local fishing authorities with the help of local fishermen. Burbot (*Lota lota*) were sampled during the winter (January and February, 1996); perch (*Perca fluviatilis*), pike (*Esox lucius*), bream (*Abramis brama*) and pike perch (*Stizopedion lucioperca*) in the spring; salmon (*Salmo salar*) in the summer and Baltic herring (*Clupea harengus membras*) in the autumn 1996. The fish represent different levels in the food chain or are living in different ecological environment. All species are used for food. The fish were deep-frozen within one day.

Length, weight, sex and age of fish were measured and muscle, liver and spawn samples were taken from half thawed fish. Homogenates from 3-5 individuals were prepared for the chemical analyses. HRGC/HRMS analysis (number of fish homogenates were 129) of PCDD/Fs in fish has been described in more detail elsewhere (4).

Results and discussion

The levels of PCDD/Fs originated as impurity of Ky-5 manufacturing were higher in the Kymijoki River compared to upstream, Lake Pyhäjärvi (Fig. 1). Elevated levels of these impurities were also detected in all other fish except salmon and Baltic herring in the estuary of the Kymijoki River. The last two species are migrating and consequently accumulate contaminants at large areas in the Baltic Sea.

The levels of PCDD/Fs in fish muscle showed only slightly elevated levels in the Kymijoki area and its estuary as compared to the levels in same species in Finnish freshwaters and sea areas (5). The PCDD/F concentrations were mostly less than 1 pg/g fw I-TEQ (Fig 2). The high levels of bream in the Lake Pyhäjärvi and salmon in the coastal area consisted from other dioxins and furans than as impurities of Ky-5 manufacturing (Figs 1, 2).

The effects of fish age and size to the levels of PCDD/Fs could not clearly been observed because homogenates from several fish were used (Table 1). PCDD/F concentrations in perch at the western coastal area were higher than other coastal or river areas simultaneously with larger and older individuals. However no such correlation of PCDD/Fs and weight or age of pike or salmon was observed.

Lipid content of salmon and Baltic herring muscle were clearly higher than of other fish (Table 1). While PCDD/f concentrations in fat were at the same range in most species the higher lipid content in these two species accounted for a higher contamination per wet weight. Especially the liver and also spawn of the burbot consisted much lipid and also the highest levels of PCDD/Fs (10-230 pg/g fw I-TEQ) were found in these organs.

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References

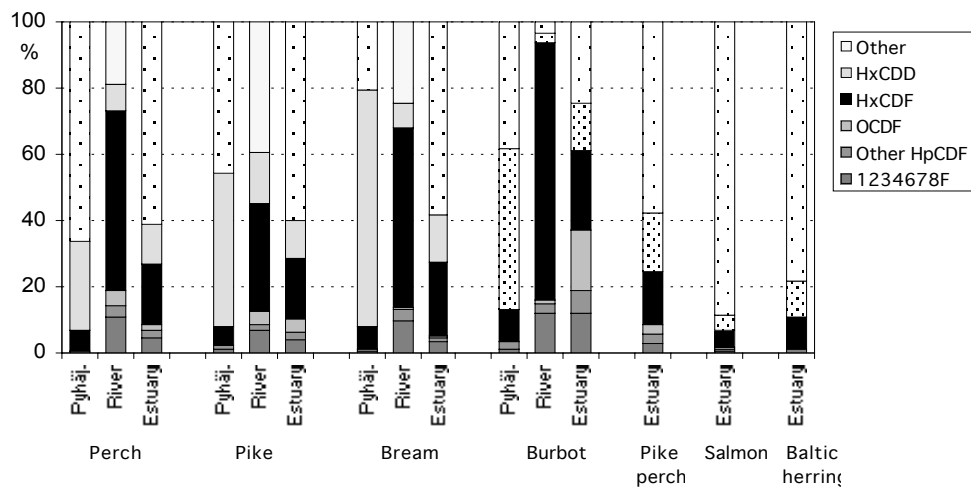
1. Verta, M., Vartiainen, T., Korhonen, M. and Meriläinen, J.J. **1997**. A joint research project on: Occurrence and impacts of organochlorine compounds and heavy metals in the River Kymijoki. In: Fourth Finnish conference at Environmental Sciences. Kuopio.
2. Korhonen, M., Verta, M. and Vartiainen, T. **1997**. *Organohalogen comp.*, Vol 32, 305-310.
3. Mikkelsen, P., Paasivirta, J. and Kiviranta, H. **1998**. *Organohalog. comp.*, Vol 39, 59-62.
4. Vartiainen, T., Saarikoski, S., Jaakkola, J.J and Tuomisto, J. **1997**. *Chemosphere*, 34, 2571
5. Korhonen, M. and Vartiainen, T. **1997**. *Organohalogen compounds*, Vol 32, 299-304.

Environmental Fate and Transport P172

Table 1. Studied fish. Lake Pyhäjärvi is situated upstream from Ky-5 manufactory. Used symbols: n=number of fish, h=homogenates (analyses), m=muscle, l=liver, s=spawn, li=lipid %, w=weight (g), a=age (a); lipid, weight and age are mean values. ¹ including Lake Pyhäjärvi data, ² not homogenated.

	n	h (m/l/s)	li (m/l/s)	w	a
Lake Pyhäjärvi					
Perch	6	1	0.6/ 3.6/ 4.4	210	9
Pike	3	1	0.3/ 5.8/ 2.7	970	9
Bream	3	1	1.0/ 4.1/ 4.4	1200	15
Burbot	5	1	0.5/ 51.0/ -	450	5
Kymijoki River ¹					
Perch	38	5/3/3	0.4/ 3.5/ 5.1	197	6.8
Pike	39	12/7/3	0.3/ 6.3/ 1.6	1174	7.3
Bream	13	5/2/1	0.7/ 3.5/ 4.4	1087	15.5
Burbot	26	7/7/2	0.3/ 29.5/ 10.2	739	6.1
Kymijoki Estuary					
Perch	23	4/2/3	0.5/ 3.6/ 5.2	285	10.3
Pike	10	3/3/3	0.2/ 5.5/ 2.2	1157	5.7
Bream	16	5/3/2	0.4/ 2.5/ 2.5	827	25
Burbot	39	12/3/4	0.3/ 22.5/ 8.9	1020	7.1
Pike perch	14	4/3/1	0.3/ 2.4/ 7.8	603	6.3
Salmon ²	12	12	7.6	5817	4.1
Baltic herring	25	1	1.9	42	5

Figure 1. The levels of PCDD/Fs divided in six groups and calculated as percental partitions.



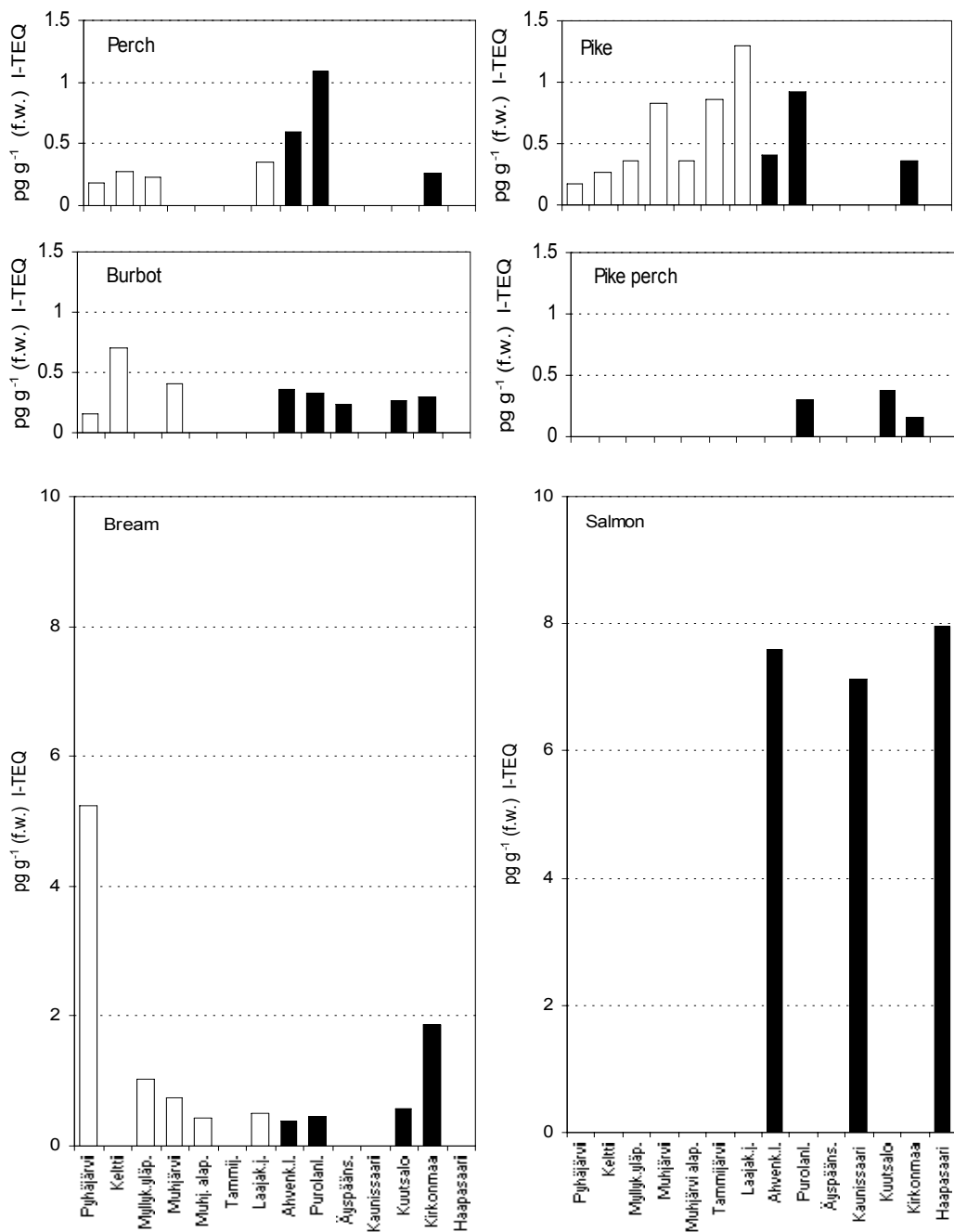


Figure 2. The levels of PCDD/Fs (I-TEQ) in fish muscle in the study areas. White bars denote river areas and black bars estuary areas. Pyhäjärvi is upstream from the pollution source.