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Analys av bromerade flamskyddsmedel i Östersjöfisk

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Levels of flame retardants in fish from the Baltic Sea, Sweden 2004

INTRODUCTION

Polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecane (HBCD) are commonly used brominated flame retardants (BFRs) in products such as computers, furniture, carpets and other materials. PBDEs and HBCD are incorporated into the matrix without chemical binding. Since they are not bound to the polymer product, they have the potential to leak and escape into the environment (Hutzinger et al. 1976; Hutzinger and Thoma 1987). Due to their chemical properties, lipophilicity and persistence, these substances have been detected in several biological matrices. The toxic effects are not yet fully understood, but for example, neurodevelopmental as well as thyroid hormone alterations has been reported (for review see Darnerud 2003).

For risk assessment purposes, the Swedish National Food Administration has during the last years conducted surveys on levels of selected persistent organic pollutants (POPs) in fish from the Baltic region. These studies have included the “traditional” POPs, such as PCBs, PCDD/DFs, and pesticides, as well as polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecane (HBCD). The aim with the present survey is to obtain relevant BFR data for the ongoing evaluation of levels and trends of these contaminants in fish, as a base for human risk assessment.

METHODS AND MATERIALS

The study contains results from analyses of eel (*Anguilla anguilla*; silver and yellow eel), brown trout (*Salmo trutta*), salmon (*Salmo salar*), herring (*Clupea harengus*), sprat (*Sprattus sprattus*), vendace (*Coregonus albula*), arctic char (*Salvelinus alpinus*), turbot (*Psetta maxima*), mackerel (*Scomber scombrus*), shrimps (*Pandalus borealis*) and mussels (*Mytilus edulis*) from various waters in Sweden, i.e. the Baltic sea, the lakes Vänern, Vättern, Mälaren, Hjälmaren, Rebnisjaure and the Swedish west coast.

Generally, the analyses were carried out on muscle tissue except for herring and sprat, where in almost all samples, the muscle including skin was analysed. In the pooled samples, equal amounts of tissue (muscle) were taken from the area around the dorsal fin from each fish, except for herring and sprat where whole fillet with skin was taken. The tissue was pooled and thoroughly homogenised. Analyses of the PBDEs (PBDE congeners 28, 47, 66, 99, 100, 138, 153, 154 and 183) and HBCD were performed at NFA, Uppsala, Sweden. The samples were extracted with mixtures of acetone/n-hexane and n-hexane/diethyl ether. After evaporation the lipid content was determined gravimetrically and the lipids were then removed by treatment with sulphuric acid (Atuma *et al.* 2000). The samples were quantified using GC-ECD with dual capillary columns.

RESULTS AND DISCUSSION

Table 1 gives a summary of basic data for the fish and seafood species in the study, i.e. gender, catching location and year, number of individuals in pooled sample, fat content in analysed tissue, age, weight and length. For brown trout and salmon, the age reported correspond to the number of years spent in the sea (after two-three years as parr-smolt in the river). It is important to note that the concentration of organic contaminants can vary considerably in individuals from the same location, depending on factors such as age, fat content, size, etc (Kiviranta *et al.* 2003). Earlier investigations have shown that levels of POPs in fish from a single location can vary from year to year and season to season (Bignert *et al.* 1994). The results presented in this report are therefore only representative of the sampling occasion in question.

Table 2 shows the results from the analysis of brominated flame-retardants in fish muscle, fish muscle including skin, fish roe, shrimps and in mussels.

Analytical data for PBDE 28 is not included in this report due to problems with coelution. For all fish samples, analytical data for PBDE 138 and PBDE 183 were below the limit of quantification (LOQ). Because of this, these data are not included in the calculations of sum PBDE.

In the analyses of PBDE congeners 47, 66, 99, 100, 153, and 154, the percentage of samples below LOQ were 0.2 %, 20%, 0.4 %, 0.2 %, 22 % and 20 %, respectively. Values below LOQ for all congeners were set to $\frac{1}{2}$ LOQ in the calculations of sum PBDE and HBCD. For sum PBDE, the percentage difference after adjusting $\frac{1}{2}$ LOQ from values to LOQ or 0 was 0-13 % (median 0.3 %). Exceptions were three samples that had levels of PBDE congeners all below LOQ. These are two samples of arctic char from lake Rebnisjaure and one sample of turbot from the waters near Gotland.

Sum PBDE values generally show a good positive correlation to the fat content in fish from all locations ($r = 0.54$, Spearman $p < 0.0001$). However, the fish from lakes Vänern and Vättern and eel are not included in the calculation since the eels have a high fat content but quite low levels of PBDEs, and fish from lakes Vänern and Vättern have a similar fat content, but relatively higher levels of PBDEs, compared to fish from other locations.

PBDE 47 is the major congener contributing to the sum PBDE. The contribution is on average 39 % (min 25 % and max 77 %). Interestingly, fish from lake Vättern and lake Vänern have a larger contribution of PBDE 47 than fish from other locations (52 - 64 %).

PBDE 47 correlates well with the sum PBDE in the analysed fish samples ($r = 0.97$, Spearman $p < 0.0001$). PBDE 47 also correlates well with the levels of HBCD ($r = 0.93$, Spearman $p < 0.0001$).

A direct comparison of PBDE and HBCD levels in arctic char from lake Vättern and Lake Rebnisjaure was not done due to large differences in size of the fish sampled in the two locations. However, the data suggest that there are higher levels of flame retardants in lake Vättern compared to lake Rebnisjaure.

Furthermore, the levels of PBDE and HBCD in vendace roe from lake Vänern seems to be elevated as compared to the levels in vendace roe from the Luleå archipelago. Both of these comparisons suggest that lakes Vänern and Vättern are more polluted by flame retardants than the northern parts of Sweden. This tendency is not seen in salmon living in the Baltic Sea area. This is probably due to the migratory behaviour of salmon. Salmon live their first one or two years in the river as parr-smolt, after which they migrate to the Baltic proper. They only return to the river for spawning. This explains why the levels of contaminants in salmon

from the Baltic Sea area tends to be in the same range, irrespective of where the salmon were caught.

It is interesting to note the differences in PBDE and HBCD levels in herring with or without skin including the subcutaneous lipids (i. e. samples FF20020510-13). It appears as that by removing the skin and subcutaneous lipids, it is possible to reduce the levels of PBDEs and HBCD with 38-57 %. This is in accordance with earlier results that have shown a significant decrease (approx. 60%) of PCB levels in herring muscle without skin and subcutaneous lipids as compared to herring analysed with skin (Aune *et al.* 2003).

Further comparisons and statistical analyses of the fishes from different locations are not useful due to differences in size and age in fish from the same locations as well as between locations.

Table 1. Background data for the fish and seafood analysed. f= female, m= male.

No	Species (gender)	Location caught	Year	No of individ.	Fat (%)	Age (yrs)				Weight (g)				Length (cm)			
						mean	med	min	max	mean	med	min	max	mean	med	min	max
FF20000024	Eel	Valjeviken	2000	19	18.3	-	-	-	-	391	372	290	636	56.9	56.5	50	64
FF20000025	Eel	Marsö	2000	21	16.6	-	-	-	-	369	352	208	527	57.1	56	49	67
FF20000026	Eel	Kvädöfjärden	2000	20	13.6	-	-	-	-	339	322	220	641	57.2	57	49	73
FF20000027	Eel	Sturkö	2000	20	14.7	-	-	-	-	360	347	250	538	57.6	57.5	52	63
FF20010181	Eel (f)	Hjälmaren	2001	10	22.1	14.9	15	12	19	944	958	617	1186	75.5	77	68	81
FF20010182	Eel (f)	Mälaren	2001	10	20.2	12.8	13	12	13	688	645	561	878	71.1	69.8	66	77.5
FF20020092	Eel	Gbg S archipelago	2001	10	8.6	7.8	7	6	10	85.3	83	69	115	38.4	38	34	43
FF20010004	Salmon (f)	Gotland	2000	1	10.1	1				4259				74			
FF20010005	Salmon (f)	Gotland	2000	1	3.8	1				4960				74			
FF20010006	Salmon (m)	Gotland	2000	1	9.2	1				3609				67.5			
FF20010007	Salmon (f)	Gotland	2000	1	8.3	1				4397				70			
FF20010008	Salmon (m)	Gotland	2000	1	5.4	1				3282				69			
FF20010009	Salmon (f)	Gotland	2000	1	7.8	1				4079				70			
FF20010010	Salmon (f)	Gotland	2000	1	8.4	1				4141				73			
FF20010011	Salmon (m)	Gotland	2000	1	6.7	1				4561				76			
FF20010012	Salmon (m)	Gotland	2000	1	9.8	1				3410				68			
FF20010013	Salmon (m)	Gotland	2000	1	9.7	1				4415				73			
FF20010238	Salmon	S Vättern Visingsö	2001	10	3.9	1.4	1	1	3	3574	3088	2267	6742	68	66	60	79.5
FF20020035	Salmon	N Vättern	2001	10	3.5	1.4	1	1	2	2955	3084	2015	3655	64.5	64	59.5	71
FF20020106	Salmon	N Vänern	2002	10	5.7	1.6	1.5	1	3	3516	3558	2845	4123	67.9	67.8	63.5	71
FF20020117	Salmon (f)	Vänern Dalbosjön	2001	7	4.6	1.4	1	1	2	3215	3283	2656	3605	65.7	66	63	68.5
FF20020332	Salmon (f)	Luleå archipelago	2002	9	5.7	2	2	2	2	6910	6890	6050	7680	87.9	87	83	93
FF20020333	Salmon (m)	Luleå archipelago	2002	11	7.6	1.9	2	1	3	5800	5630	3890	7760	83.4	83	73	98
FF20020334	Salmon (m)	Luleå archipelago	2002	10	8.0	2.6	3	2	3	10450	10170	8730	12630	98.3	98	92	105

No	Species (gender)	Location caught	Year	No of individ.	Fat (%)	Age (yrs)				Weight (g)				Length (cm)			
						mean	med	min	max	mean	med	min	max	mean	med	min	max
FF20020335	Salmon (f)	Luleå archipelago	2002	10	7.3	2.8	3	2	3	9560	9210	8070	12170	95.4	95	89	107
FF20020356	Salmon	Baltic Sea	2002	10	4.5	1.9	2	1	3	4000	4200	2900	4900	78.4	78	71	86
FF20020369	Salmon	Baltic Sea	2002	10	5.7	2	2	2	2	3900	4200	2900	4900	77.6	77.5	72	82
FF20020380	Salmon	Baltic Sea	2002	9	6.4	2	2	2	2	6400	6400	5000	7300	87.8	88	78.5	91.5
FF20020390	Salmon	Baltic Sea	2002	9	8.7	2	2	2	2	6500	6400	5600	7300	88.4	89	82	92
FF20020400	Salmon	Baltic Sea	2002	6	9.1	2.5	2.5	2	3	10100	8600	7700	18300	98.0	93	92	121
FF20020407	Salmon	Baltic Sea	2002	8	8.9	1.9	2	1	2	2500	2600	1900	2800	69.0	69.5	64	73
FF20020417	Salmon	Gävle bay	2002	9	8.7	2	2	1	3	5280	4910	3460	8390	76.8	73.5	70	95.5
FF20020428	Salmon	Gävle Bay	2002	10	8.2	1.4	1	1	2	5180	4910	3850	7910	76.5	74.5	69.5	87.5
FF20020436	Salmon	Gävle Bay	2002	7	7.1	2.9	3	2	4	10800	10970	8550	13300	99.5	102	94	103
FF20020443	Salmon	Gävle Bay	2002	6	7.7	2.8	3	2	4	10580	10640	8720	12250	99.0	98.8	95	102
FF20030011	Salmon	Vänern	2002	9	6.4	3	3	2	4	3280	3190	2940	3670	67.1	66	64	74.5
FF20030022	Salmon	Vänern	2002	10	6.7	3.1	3	2	4	4540	4450	3900	5710	71.6	71	68	77
FF20030030	Salmon	Vättern	2002	7	9.2	3.3	3	2	4	4860	5160	3110	5670	72.6	75	65.5	77
FF20030038	Salmon	Vättern	2002	7	10.2	3.9	4	3	4	7630	8100	5960	8720	83.0	81.5	79	89.5
FF20030069	Salmon	Vänern	2003	10	6.0	2.6	3	2	3	3250	3310	2740	3860	64.4	64.5	60	68.5
FF20030077	Salmon	Vänern	2003	7	7.9	3.3	3	2	5	4610	4290	4090	5670	71.3	71	65	78.5
FF20030086	Salmon	Vättern	2003	8	4.3	3.1	3	3	4	6170	5900	4250	8380	84.8	85	78	90
FF20010193	B. Trout (f)	N Vänern	2001	9	1.6	3.1	3	2	4	4868	5033	2303	7259	75.9	77	63	86.5
FF20010206	B. Trout (f)	Gotland	2001	1	2.1	0				541				38			
FF20010207	B. Trout (f)	Gotland	2001	1	0.8	1				1911				62			
FF20010208	B. Trout (m)	Gotland	2001	1	1.1	0				754				41			
FF20010209	B. Trout (f)	Gotland	2001	1	1.5	1				1190				48			
FF20010210	B. Trout (f)	Gotland	2001	1	0.8	2				1538				53.5			
FF20010211	B. Trout (f)	Gotland	2001	1	0.6	1				2237				59			
FF20010212	B. Trout (f)	Gotland	2001	1	1.4	3				1722				56			
FF20010213	B. Trout (m)	Gotland	2001	1	2.3	2				2838				53.5			
FF20010227	B. Trout (f)	S Vättern Visingsö	2001	7	1.2	2	2	1	3	1781	1374	746	3133	57.4	51	47	76
FF20020138	B. Trout (f)	Vänern. Dalbosjön	2001	10	2.0	3.0	3	2	3.5	4013	4130	2443	5640	72.6	73	66	79
FF20020167	B. Trout (f)	N Vättern	2002	9	1.6	1.4	1	0	3	1168	1184	535	1984	50.2	49.5	41	58

No	Species (gender)	Location caught	Year	No of individ.	Fat (%)	Age (yrs)				Weight (g)				Length (cm)			
						mean	med	min	max	mean	med	min	max	mean	med	min	max
FF20020010	Arctic char (f)	S Vättern Visingsö	2001	10	2.9	6.8	7.0	5.6	7.5	1014	1032	793	1284	49.6	50.5	44.5	53
FF20020047	Arctic char	N Vättern	2001	10	3.1	5.5	5.4	4.8	6.4	707	674	535	928	43.8	43.3	40.5	48
FF20020225	Arctic char	Rebnisjaure	2002	11	1.3	4.5	4	4	7	379	374	297	484	35.1	35	32	41
FF20020248	Arctic char	Rebnisjaure	2002	22	0.9	3.3	3	3	5	164	167	96	217	26.2	26.3	22	29.5
FF20010018	Herring (f)	Fladen	2000	4	7.4	3.5	3.5	3	4	62.5	60.3	51.6	77.9	20.9	20.5	20	22.5
FF20010019	Herring (m)	Fladen	2000	4	5.8	3.3	3	3	4	52.6	51.7	45.6	61.6	19.3	19	18.5	20.5
FF20020211	Herring	Kattegatt	2001	59	9.4	0.6	0	0	3	36.5	27.9	14.96	86.73	17.2	16.5	12.5	23.2
FF20020336	Herring	Rugen	2002	15	9.2	3.7	4	2	5	90.3	91.5	68.4	98.9	22.6	22.7	21.1	23.8
FF20020337	Herring	Rugen	2002	15	9.3	3.1	3	2	5	74.2	74.7	57.9	90.6	21.1	21.1	19.1	23
FF20020338	Herring	Rugen	2002	17	3.4	3.6	4	2	7	62.7	63.4	50.3	73.7	21.2	21.4	19.1	22.5
FF20020339	Herring	Rugen	2002	18	5.8	2.4	2	1	5	59.2	60.3	38.5	80.7	20.2	20.7	17.5	22.7
FF20020340	Herring	Rugen	2002	20	1.9	2.4	2	1	4	54.2	55.9	37.7	69.1	20.2	20.2	18.2	22.1
FF20020341	Herring	Rugen	2002	15	1.6	2.8	3	2	4	69.9	67.4	59.6	89.5	22.1	21.9	20.6	24.2
FF20020510	Herring with skin	Rugen	2002	36	6.4	2.9	3	1	5	49.6	46.8	28	76.1	18.9	19	15.6	21.8
FF20020511	Herring without skin	Rugen	2002	36	3.2	2.9	3	1	5	49.6	46.8	28	76.1	18.9	19	15.6	21.8
FF20020512	Herring without skin	Rugen	2002	30	3.2	2.7	2	2	5	48.7	48	34.6	68.8	19.5	19.5	17.3	22.1
FF20020513	Herring with skin	Rugen	2002	30	6.5	2.7	2	2	5	48.7	48	34.6	68.8	19.5	19.5	17.3	22.1
FF20020210	Sprat	Baltic Sea	2001	50	9.6	3.6	4	0	8	20.3	13.9	10.26	52.45	14.5	13.4	11.8	20.2
FF20020250	Sprat	Baltic Sea	2002	22	9.2	5.0	5	2	8	9.2	9.53	6.42	12.03	11.8	11.8	10.5	12.8
FF20020342	Sprat	Baltic Sea	2002	106	11.7	4.1	3	1	8	9.3	9.2	4	13.8	11.5	11.5	9.1	13.3
FF20020343	Sprat	Baltic Sea	2002	105	9.6	4.2	3	2	9	9.6	9.3	5.4	15.4	11.6	11.5	9.5	13.5
FF20020346	Sprat	Baltic Sea	2002	96	10.3	4.2	3	2	9	9.7	9.7	6.2	13.7	11.7	11.7	9.8	13.7
FF20020347	Sprat	Baltic Sea	2002	104	10.3	3.9	3	2	8	9.4	9.7	5.8	12.1	11.5	11.5	9.9	12.8
FF20020357	Sprat	Baltic Sea	2002	100	6.2	5	5	2	10	9.1	9	4.1	14.9	11.8	11.8	9.7	14.5
FF20020358	Sprat	Baltic Sea	2002	102	6.9	4.1	3	2	9	8.9	9	4.6	13.7	11.6	11.5	10.1	13.7

No	Species (gender)	Location caught	Year	No of individ.	Fat (%)	Age (yrs)				Weight (g)				Length (cm)			
						mean	med	min	max	mean	med	min	max	mean	med	min	max
FF20020454	Turbot (f)	Gotland	2002	10	1.0	7.5	8	5	11	704	706	543	929	33.5	33.5	30.5	35
FF20020465	Turbot (f)	Gotland	2002	10	0.9	8.5	8	5	14	1116	1124	922	1377	38.2	38	35	43
FF20020476	Turbot (f)	Gotland	2002	10	0.8	5.4	5	4	8	649	667	529	750	32.9	32	31	36
FF20020487	Turbot (f)	S Marsö	2002	9	0.7	7.4	8	5	11	724	656	426	1099	33.4	33	27.5	39
FF20020509	Turbot (f)	NE Gotland	2002	10	0.8	9	9.5	5	13	903	814	472	1695	36.9	37	31	46.5
FF20020288	Vendace roe	Vänern	2002		9.7												
FF20020516	Vendace roe	Luleå	2000	69	10.9	-	-	-	-	16.6	16.3	12.3	36.2	13.5	13.3	12	17.5
FF20020517	Vendace roe	Vänern	2002	88	13.9	-	-	-	-	27.9	27.4	23	40.7	16.0	16	14.5	17.8
FF20020007	Shrimps	Skagerack	2001		1.5												
FF20020008	Mussels	Skagerack	2001		2.2												
FF20020009	Mackerel	Skagerack	2001	20	11.1	3.0	3	1	8	393	360	215	835	34.6	34.5	29	44.5

Table 2. Concentrations of sum PBDE (congeners BDE 47, 66, 99, 100, 153, 154) and HBCD in fish muscle, fish muscle + skin, fish roe, shrimps and mussels ($\mu\text{g}/\text{kg}$ fresh weight) from 72 pooled and 18 single fish samples caught in Swedish waters. Values below LOQ were set to $\frac{1}{2}$ LOQ in the calculations of sum PBDE. Please note that there are large differences in age and size within the species reported.

No	Species	Location caught	Year	No of indiv.	Fat (%)	Sum PBDEs	BDE-47	BDE-99	BDE-100	HBCD
FF20000024	Eel	Valjeviken	2000	19	18.3	0.67	0.44	0.03	0.14	0.32
FF20000025	Eel	Marsö	2000	21	16.6	0.85	0.56	0.03	0.16	0.55
FF20000026	Eel	Kvädöfjärden	2000	20	13.6	0.82	0.50	<0.025	0.16	0.55
FF20000027	Eel	Sturkö	2000	20	14.7	0.52	0.31	0.03	0.08	0.31
FF20010181	Eel	Hjälmaren	2001	10	22.1	0.58	0.33	0.06	0.09	1.6
FF20010182	Eel	Mälaren	2001	10	20.2	1.4	0.85	0.09	0.20	1.6
FF20020092	Eel	Gothenburg S archipelago	2001	10	8.6	0.49	0.36	<0.025	0.07	0.70
FF20010004	Salmon	Gotland	2000	1	10.1	3.1	2.2	0.40	0.34	2.4
FF20010005	Salmon	Gotland	2000	1	3.8	1.8	1.2	0.25	0.20	1.5
FF20010006	Salmon	Gotland	2000	1	9.2	2.8	2.0	0.31	0.32	1.9
FF20010007	Salmon	Gotland	2000	1	8.3	1.7	1.2	0.20	0.20	1.5
FF20010008	Salmon	Gotland	2000	1	5.4	1.8	1.2	0.18	0.28	1.1
FF20010009	Salmon	Gotland	2000	1	7.8	2.7	1.8	0.38	0.30	1.7
FF20010010	Salmon	Gotland	2000	1	8.4	2.4	1.7	0.26	0.27	1.3
FF20010011	Salmon	Gotland	2000	1	6.7	1.7	1.2	0.20	0.19	1.3
FF20010012	Salmon	Gotland	2000	1	9.8	3.5	2.4	0.47	0.39	2.6
FF20010013	Salmon	Gotland	2000	1	9.7	2.7	1.9	0.33	0.31	1.5
FF20010238	Salmon	S.Vättern Visingsö	2001	10	3.9	5.5	2.2	1.2	1.12	3.8
FF20020035	Salmon	N Vättern	2001	10	3.5	3.8	1.6	0.71	0.82	1.6
FF20020106	Salmon	N Vänern	2002	10	5.7	4.1	2.2	0.55	0.66	3.4
FF20020117	Salmon	Vänern Dalbosjön	2001	7	4.6	3.5	1.9	0.40	0.65	1.6
FF20020332	Salmon	Luleå archipelago	2002	9	5.7	4.3	2.8	0.58	0.53	4.4
FF20020333	Salmon	Luleå arch.	2002	11	7.6	4.5	2.9	0.56	0.61	3.2
FF20020334	Salmon	Luleå arch.	2002	10	8.0	5.1	3.2	0.69	0.68	3.3
FF20020335	Salmon	Luleå arch.	2002	10	7.3	4.7	3.0	0.64	0.61	3.4
FF20020356	Salmon	Baltic Sea	2002	10	4.5	2.2	1.4	0.31	0.28	1.5
FF20020369	Salmon	Baltic Sea	2002	10	5.7	2.6	1.7	0.36	0.31	1.7
FF20020380	Salmon	Baltic Sea	2002	9	6.4	2.9	1.9	0.37	0.35	1.9
FF20020390	Salmon	Baltic Sea	2002	9	8.7	4.4	2.9	0.61	0.55	2.9
FF20020400	Salmon	Baltic Sea	2002	6	9.1	4.5	2.9	0.60	0.52	3.1
FF20020407	Salmon	Baltic Sea	2002	8	8.9	5.2	3.5	0.68	0.62	3.6
FF20020417	Salmon	Gävle Bay	2002	9	8.7	3.7	2.5	0.42	0.51	2.2
FF20020428	Salmon	Gävle Bay	2002	10	8.2	3.7	2.4	0.42	0.52	2.1
FF20020436	Salmon	Gävle Bay	2002	7	7.1	4.8	3.1	0.58	0.68	3.2
FF20020443	Salmon	Gävle Bay	2002	6	7.7	5.0	3.3	0.60	0.68	3.3
FF20030011	Salmon	Vänern	2002	9	6.4	2.5	1.4	0.28	0.43	1.7
FF20030022	Salmon	Vänern	2002	10	6.7	2.6	1.4	0.29	0.46	1.8
FF20030030	Salmon	Vättern	2002	7	9.2	4.9	1.8	1.3	0.78	2.4
FF20030038	Salmon	Vättern	2002	7	10.2	6.9	2.8	1.4	1.4	3.9
FF20030069	Salmon	Vänern	2003	10	6.0	3.2	1.7	0.41	0.60	2.0
FF20030077	Salmon	Vänern	2003	7	7.9	5.0	2.5	0.68	0.93	2.8
FF20030086	Salmon	Vättern	2003	8	4.3	7.7	3.0	1.5	1.7	4.0

No	Species	Location caught	Year	No of indiv.	Fat (%)	Sum PBDEs	BDE-47	BDE-99	BDE-100	HBCD
FF20010193	B. Trout	N Vänern	2001	9	1.6	7.3	3.4	1.4	1.4	4.2
FF20010206	B. Trout	Gotland	2001	1	2.1	0.55	0.37	0.08	0.06	0.41
FF20010207	B. Trout	Gotland	2001	1	0.8	3.0	1.9	0.48	0.35	1.7
FF20010208	B. Trout	Gotland	2001	1	1.1	1.9	1.3	0.27	0.22	1.5
FF20010209	B. Trout	Gotland	2001	1	1.5	0.63	0.44	0.09	0.06	0.64
FF20010210	B. Trout	Gotland	2001	1	0.8	0.99	0.68	0.11	0.14	1.0
FF20010211	B. Trout	Gotland	2001	1	0.6	2.9	1.9	0.44	0.37	2.2
FF20010212	B. Trout	Gotland	2001	1	1.4	4.5	3.0	0.49	0.68	4.2
FF20010213	B. Trout	Gotland	2001	1	2.3	1.9	1.3	0.20	0.25	1.6
FF20010227	B. Trout	S.Vättern	2001	7	1.2	14.1	5.1	3.5	2.7	6.2
FF20020138	B. Trout	Visingsö								
FF20020138	B. Trout	Vänern.	2001	10	2.0	4.9	2.1	1.3	0.79	1.6
FF20020167	B. Trout	Dalbosjön								
FF20020167	B. Trout	N Vättern	2002	9	1.6	3.2	1.3	0.74	0.61	2.2
FF20020010	Arctic char	S Vättern	2001	10	2.9	9.8	5.0	1.3	1.9	7.8
FF20020047	Arctic char	Visingsö								
FF20020047	Arctic char	N Vättern	2001	10	3.1	4.8	2.5	0.68	0.87	3.9
FF20020225	Arctic char	Rebnisjaure	2002	11	1.3	0.11	<0.05	0.032	<0.025	0.09
FF20020248	Arctic char	Rebnisjaure	2002	22	0.9	0.09	<0.05	<0.025	<0.025	0.06
FF20010018	Herring	Fladen	2000	4	7.4	1.3	0.78	0.25	0.16	1.5
FF20010019	Herring	Fladen	2000	4	5.8	0.77	0.52	0.13	0.08	1.1
FF20020211	Herring	Kattegatt	2001	59	9.4	1.5	0.95	0.22	0.19	0.95
FF20020336	Herring	Rugen	2002	15	9.2	3.2	2.0	0.50	0.33	2.5
FF20020337	Herring	Rugen	2002	15	9.3	3.1	2.0	0.42	0.35	2.6
FF20020338	Herring	Rugen	2002	17	3.4	2.1	1.4	0.24	0.23	1.8
FF20020339	Herring	Rugen	2002	18	5.8	1.3	0.84	0.17	0.15	1.4
FF20020340	Herring	Rugen	2002	20	1.9	1.3	0.78	0.21	0.14	1.3
FF20020341	Herring	Rugen	2002	15	1.6	1.5	0.92	0.23	0.18	1.4
FF20020510	Herring	Rugen	2002	36	6.4	1.2	0.74	0.19	0.12	1.5
FF20020511	Herring with skin	Rugen	2002	36	3.2	0.60	0.40	0.10	0.07	0.73
FF20020512	Herring without skin	Rugen	2002	30	3.2	0.51	0.34	0.09	0.05	0.54
FF20020513	Herring with skin	Rugen	2002	30	6.5	1.1	0.68	0.19	0.11	1.4
FF20020210	Sprat	Baltic Sea	2001	50	9.6	2.4	1.6	0.33	0.24	1.7
FF20020250	Sprat	Baltic Sea	2002	22	9.2	2.0	1.4	0.21	0.22	1.7
FF20020342	Sprat	Baltic Sea	2002	106	11.7	1.6	1.1	0.21	0.16	1.3
FF20020343	Sprat	Baltic Sea	2002	105	9.6	1.5	1.0	0.16	0.15	1.3
FF20020346	Sprat	Baltic Sea	2002	96	10.3	1.8	1.2	0.22	0.18	1.3
FF20020347	Sprat	Baltic Sea	2002	104	10.3	1.5	1.0	0.17	0.15	1.3
FF20020357	Sprat	Baltic Sea	2002	100	6.2	1.5	1.0	0.14	0.16	1.3
FF20020358	Sprat	Baltic Sea	2002	102	6.9	1.4	0.98	0.17	0.14	1.3
FF20020454	Turbot	Gotland	2002	10	1.0	0.39	0.25	0.04	0.05	0.06
FF20020465	Turbot	Gotland	2002	10	0.9	0.44	0.28	0.04	0.06	0.08
FF20020476	Turbot	Gotland	2002	10	0.8	0.26	0.18	<0.025	<0.05	0.05

No	Species	Location caught	Year	No of indiv.	Fat (%)	Sum PBDEs	BDE-47	BDE-99	BDE-100	HBCD
FF20020487	Turbot	S Marsö	2002	9	0.7	0.29	0.19	0.03	0.04	0.06
FF20020509	Turbot	NE Gotland	2002	10	0.8	0.50	0.35	0.04	0.07	0.06
FF20020288	Vendace roe	Vänern	2002		9.7	5.1	2.35	1.3	0.77	2.6
FF20020516	Vendace roe	Luleå	2000	69	10.9	1.9	1.02	0.47	0.21	0.32
FF20020517	Vendace roe	Vänern	2002	88	13.9	7.0	3.33	1.7	1.1	2.9
FF20020007	Shrimps	Skagerack	2001		1.5	0.21	0.147	0.01	0.03	0.03
FF20020008	Mussels	Skagerack	2001		2.2	0.12	0.069	0.02	0.02	0.21
FF20020009	Mackerel	Skagerack	2001	20	11.1	2.5	1.49	0.42	0.29	1.1

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