Joint Danube Survey 3

icpdr iksd

International Commission for the Protection of the Danube River

Internationale Kommission zum Schutz der Donau

Chapter (full report) on: Spatial and temporal trends of Dioxins, PCBs and BDE-209 in Suspended matter and fish, JDS 3 versus JDS 2

Version: 2
Date: 9. September 2014

G. Umlauf
G. Mariani
H. Skejo

European Commission, Joint Research Centre (JRC),
Institute for Environment and Sustainability (IES),
Water Resources Unit,
Via E. Fermi 2749, I-2107 Ispra (VA) - Italy

//// Deutschland //// Österreich //// Česká republika //// Slovensko //// Magyarország //// Slovenija //// Hrvatska //// Bosna i Hercegovina //// Srbija //// Crna Gora //// România //// България //// Moldova ////

Imprint

Published by:
ICPDR – International Commission for the Protection of the Danube River

Contact
ICPDR Secretariat
Vienna International Centre / D0412
P.O. Box 500 / 1400 Vienna / Austria
T: +43 (1) 26060-5738 / F: +43 (1) 26060-5895
icpdr@unvienna.org / www.icpdr.org

Table of content

List of Tables

List of Figures

List of Supplementary Data

1 Introduction

In this study we report on the occurrence of the seventeen 2,3,7,8 chlorinated polychlorinated dibenzo –p- dioxins and dibenzofurans (PCDD/Fs, Dioxins), the sum of the six *marker* or *indicator* polychlorinated biphenyl congeners IUPAC# 28, 52, 101, 138, 153 and 180 (EC-6 PCBs) the 12 *dioxin-like* PCB congeners IUPAC# 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169 and 189 (DL-PCBs, "WHO-PCB") and decabromodiphenylether (BDE-209) in selected samples of suspended matter (SPM) and fish muscle (*Abramis brama*) obtained from the second (JDS 2, summer 2007) and third Joint Danube surveys and (JDS 3, summer 2013) from Germany to the Black Sea.

All investigated compounds fall into the category of semivolatile organic compounds (SOCs). SOCs are characterized by their high octanol/water partition coefficients (K_{ow}) and low vapour pressures. As a result of their lipophilicity, persistence and low volatility PCDD/Fs and PCBs tend to accumulate in the sediments and biota of aquatic systems. In the aqueous phase SOCs associate with suspended particulate matter (SPM), the extent depending on their K_{ow} and the amount and type of SPM available. The transport of SOCs with and log K_{ow} >6 within the water column is mainly associated with the hydraulic remobilization of sediments and the subsequent transport and re-sedimentation of SPM.

While BDE 209 is usually not found to considerable amounts detected in aquatic biota, PCDD/F and PCBs instead, due to their higher absorbability into biota and their resistance to metabolism, are ubiquitously found in fish. Although production of PCBs has been stopped decades ago and PCDD/F emissions are strictly regulated in the EU, there is still a notable contamination of PCDD/F and in particular of DL-PCB in fish samples. Long term observation programs of *Abramis brama* in German rivers from 2003-2008 reveal current levels frequently above the limits for food given by EU legislation, especially for the big rivers Rhine and Elbe and their tributaries Saar and Saale (Neugebauer et al. 2012).

Deca-BDE has long been erroneously characterized as an environmentally stable and inert product that was stable in the environment, not toxic, and therefore of no concern (Alcock and Bubsy 2006). Meanwhile it has been demonstrated, that BDE-209 present in sediments and SPM enters the aquatic food web, and, being rapidly metabolized in fish, contributing to the load of the more toxic lower brominated isomers of the polybrominated diphenyl ethers (PBDEs). Although usually not found in aquatic biota in detectable amounts, a certain bioavailability of BDE-209 is indirectly evidenced by the occurrence of BDE-179, BDE-188 and BDE-202, which are not present in any technical PBDE formulation and are known products of BDE-209 debromination in fish (Vigano et al. 2012).

While PCDD/F were never produced (they are unintentional by-products of poor combustion and a variety of chemical processes), PCBs and PBDEs such as BDE-209 are intentionally produced chemicals with a broad spectrum of industrial and domestic applications such as dielectric fluids, paints, hydraulic oils, plasticisers, flame retardants etc.

In contrast to PCDD/F and PCBs, PBDEs still display rising trends in some environmental compartments including human tissue. Decabromodiphenyl ether (BDE-209) is the primary constituent of a flame retardant formulation widely used in the past decades. Consumption of PBDEs for 1999 in the European Union was estimated to be 150 metric tons penta-, 400 metric tons octa- and 7000 metric tons decaBDE technical products (De Poortere 2000).

Penta BDE technical products were used in epoxy resins, phenol resins, polyesters, polyurethane foam and textiles. Octa BDE technical products are used in acrylonitrile butadiene styrene, polycarbonate and thermosets. Deca BDE products are used in most types of synthetic materials including textiles and polyester used for printed circuit boards (De Wit 2000, OECD 1994).

Several countries already passed legislation to ban Deca BDE for certain uses and The European Union's Restriction of Hazardous Substances Directive (RoHS) has prohibited the use of Deca BDE in electronics and electrical equipment since July 2006. In December 2009, the US Environmental Protection Agency (EPA) launched a 'Deca BDE Phase-Out Initiative' to eliminate the production, importation and sale by 2013.

PCDD/Fs, PCBs and several PBDEs are subject to the Stockholm Convention on Persistent organic Pollutants (POPs).

The toxic effects of PCDD/Fs, PCBs include dermal toxicity, immune toxicity, carcinogenicity, and adverse effects on reproduction, development, and endocrine functions. Although the toxic properties of PBDEs are not entirely evaluated, their structural similarity to PCDD/Fs and PCBs suggests similar toxicological endpoints.

Due to their similar behaviour and toxicological endpoints, PCDD/Fs and DL-PCBs are often evaluated and reported together. Both compound classes are included in a toxicity evaluation scheme that sums up the toxicity of the individual 2, 3, 7, 8 chlorinated congeners of both classes (17 PCDD/Fs and 12 DL-PCBs) expressed as a concentration of toxicity equivalents (TEQs) of the 2, 3, 7, 8-Tetrachloro dibenzo-p-dioxin (TCDD). The toxicity of the individual congeners may vary by orders of magnitude. An early classification limited to the seventeen 2, 3, 7, 8 substituted PCDD/Fs is the I-TEQ scheme (reported by Van den Berg et al., 1998). It has been updated by the WHO in 1998 and 2005 by two schemes including TEQs also the 12 DL-PCBs (Van den Berg et al., 1998, 2006). In existing quality standards both the 1998 and 2005 WHO-TEQ is used, but also the old I-TEQ schemes can be found.

Due to the risk for wildlife and humans arising from PCDD/Fs in sediments quality objectives for PCDD/Fs have been set. Out of eight approaches available (Iannuzzi et al. 1995), the tissue residue-based (TRB) method is the most commonly used. This method defines a safe chemical concentration in sediment, which results in an acceptable tissue concentration in biota. A no observed effect concentration (NOEC) of 200 pg of international toxicity equivalent (I-TEQ)/g dry weight (d.w.) in sediment was derived, but since only few chronic toxicity data were available a safety factor of 10 was applied, which resulted in the proposal of a "safe sediment value" of 20 pg I-TEQ/g d.w. (Evers et al. 1996).

What regards human risk through the aquatic foodchain, the relevant EU food limit values are 3.5 pg WHO_{05}-TEQ/g for PCDD/F and of 6.5pg WHO_{05}-TEQ/g for combined DL-PCB and PCDD/F, both on a fresh weight base. The limit for the sum of the 6 indicator PCBs (PCB 28, PCB 52, PCB 101, PCB 138, PCB 153, PCB 180) in freshwater fish is 75 ng/g, again on a fresh weight base (COM Reg 2011).

2 Methods

2.1 Experimental approach

The aim of the study is the investigation of spatial and temporal trends in SPM and fish (*Abramis brama*).

Samples/results were obtained as far as possible from those sites where the JDS 3 exercise provided a spatial overlap with the '23 supersites' investigated by the JRC during JDS 2 for SOCs present in dissolved phase, SPM, sediment and biota samples. The related data for SPM used in this study for the comparison with 2007 (JDS 2) were taken from the JDS 2 final report (Umlauf et al. 2007). Fish data presented from 2007 (JDS 2) were obtained from fish samples stored at the JRC and analysed together with the samples from 2013 (JDS 3).

As we demonstrated during JDS 2, the presence of PCDD/Fs, EC-6 PCBs, DL-PCBs and BDE-209 in the dissolved phase was negligible or minor in the case of the EC-6 PCBs. Therefore it was decided that during JDS 3 only SPM is sampled, since the SPM associated portion of the investigated compounds fairly represents the total amount in water. Total concentrations water and total discharges may be calculated by applying the concentrations of SPM and the associated discharge data recorded during JDS 3 (Supplement 8).

Since BDE-209 dominated by far the PBDEs detected in SPM during JDS 2, the current study and related discussions in this report aim on BDE-209 only. However, the data for the other important constitutes of the technical PBDE mixtures (BDE-28, -47, -99, -100, -153, -154 and -180) were acquired as well in fish (Supplement 3) and SPM (Supplement 6).

The time trend discussion on the data provided in the study can be considered robust what concerns the concentrations obtained in SPM, but only few spatially corresponding *Abramis. brama* samples could be generated during both surveys. Compared to the total water concentration, the concentration of SOCs in SPM (on a dry weight base) is a more suitable indicator for time trends. Water concentrations display a much higher temporal and spatial variability, mainly because the SPM content of the water column is strongly associated with the hydraulic conditions at the moment of sampling. Total water concentrations are therefore, what concerns SOCs, less meaningful to obtain longer term time trends.

The bream species was selected for this study, since it is a common, territorial and wide-spread species at higher trophic level, which allows conclusions on the status of the *local* aquatic environment (Klein et al. 2010). Moreover, since this species is an edible fish, its contamination is linked to food legislation.

2.2 Sampling

SPM was sampled on board of the Argus using a continuous centrifuge approach.

The centrifuge was a Z61H from Carl Padberg Zentrifugenbau GmbH,(Germany) operating at a cylinder speed of 17000 rpm. Sampling typically took from 30 minutes to several hours, depending on the concentration of suspended solids in water.

Preservation was attained through keeping the samples in the dark and refrigerated (or on ice during transportation) at between 20 ^{o}C and 50 ^{o}C (ISO 5667-15). After shipping to UBA Vienna, the SPM samples were lyophilized and shipped to the JRC.

Fish was sampled by the fish teams of JDS 2 and JDS 3. More details on the sampling techniques as well as sampling site specific information can be obtained from Chapter 2 of the final JDS 3 report.

2.3 Analyses

2.3.1 Overview

A sample preparation method for determination of PCDD/Fs, EC-6 PCBs and DL-PCBs was adopted to include PBDEs in the analysis. The identification/quantification of all compounds was done on the basis of isotope labeled surrogate standards and GC/MS techniques.

2.3.2 Standards & Chemicals

68-CVS and 68-LCS were native and ^{13}C-labelled internal standards for 12 congeners DL-PCBs (Wellington Laboratories Guelph, Ontario, Canada). EC-4058 was native for indicator-PCBs (CIL, Andover, Massachusetts, USA). ^{13}C-labelled PCB-31, PCB-111 and PCB-170 were used as recovery standards (Wellington Laboratories Guelph, Ontario, Canada).

EPA-1613CVS, EPA1613LCS and EPA-1613ISS were native, ^{13}C-labelled internal and recovery standards respectively for 17 PCDDs/Fs. The standards were obtained from Wellington Laboratories (Guelph, Ontario, Canada).

Ten ^{13}C-labelled PBDE congeners were used as internal standards, (in accordance with IUPAC nomenclature: BDE-28, BDE-47, BDE-99, BDE-100, BDE-153, BDE-154, BDE-183; BDE-197, BDE-207 and BDE-209), Nine present in MBDE-MXE-STK solution (in accordance with IUPAC nomenclature: BDE-28, BDE-47, BDE-99, BDE-153, BDE-154, BDE-183; BDE-197, BDE-207 and BDE-209) and one BDE-100 was added from the solution MBDE-100. ^{13}C-labelled BDE-126 and BDE-206 were used as recovery standards. BDE-MXE was native solution. All PBDE standards were obtained from Wellington Laboratories (Guelph, Ontario, Canada).

All organic solvents used were Dioxin analysis grade (Sigma-Aldrich, Buchs SG, Switzerland). Sulphuric acid was 98% extra pure (VWR International s.r.l., Milan, Italy). Cleanup of PCDD/F, PCBs and PBDEs was conducted on ready to use multi-layer (acidic silica, basic alumina and carbon) columns (Fluid Management Systems (FMS) Inc., Watertown, MA, USA).

2.3.3 Extraction and Clean-up

The freeze dried solid samples were extracted with a mixture of n-hexane/acetone (220/30 for SPM and 1/1 for fish tissue) by Soxhlet for 48 h after spiking with isotope-labelled surrogate standards. For SPM copper powder was added to the solvent during the extraction to remove sulphur.

After treatment of the raw extract with concentrated H_2SO_4, extract purification was executed with an automated clean-up system (Power-Prep P6, Fluid Management Systems (FMS) Inc., Watertown, MA, USA). This system was previously described (Abad et al. 2000) and uses a multi-layer silica column (acid/neutral), basic alumina and carbon column combination. Two fractions were collected, one containing mono-ortho PCBs, Indicator-PCBs and PBDEs and one for non-ortho PCBs and PCDD/Fs.

2.3.4 Instrumental

All instrumental analysis of PCDD/Fs, PCBs and PBDEs was based on isotope dilution using HRGC-HRMS (high resolution gas chromatography – high resolution mass spectrometry) for quantification on the basis of EPA1613, EPA 1668 and EPA 1614 methods.

PCBs, PCDD/Fs, PBDEs, were analyzed on double HRGC (Thermo Trace GC Ultra, Thermo Electron, Bremen, Germany), coupled with a DFS high resolution mass spectrometer HRMS (Thermo Electron, Bremen, Germany) operating in the EI-mode at 45 eV with a resolution of >10000. For PCBs and PCDD/Fs the most two abundant ions of the isotopic molecular cluster were recorded for both native and labelled congeners.

For tri- to hepta-brominated diphenyl ethers two ions of the isotopic molecular cluster were recorded, for deca-brominated congeners two isotopic ions of the cluster M^+-2Br were recorded for both native and labeled congeners. The quantified isomers were identified through comparison of retention times of the corresponding standard and the isotopic ratio of the two ions recorded.

Non-ortho PCBs, PCDD/Fs were separated on a BP-DXN 60 m long with 0.25 mm i.d. (inner diameter) and 0.25 µm films (SGE, Victoria, Australia). The following gas-chromatographic conditions were applied for non-ortho PCBs and PCDD/Fs: split/splitless injector at 280 °C, constant flow at 1.0 ml min^{-1} of He, GC-MS interface at 300 °C and a GC program rate: 160 °C with a 1 min. hold, then 2.5 °C min^{-1} to 300 °C and a final hold at 300 °C for 8 min.

Mono-ortho PCBs and Indicator-PCBs were separated on HT-8 capillary columns, both columns types were 60 m long with 0.25 mm i.d. (inner diameter) and 0.25 µm film (SGE, Victoria, Australia).

Gas chromatographic conditions for mono-ortho PCBs were: Split/splitless injector at 280 °C, constant flow at 1.5 ml min^{-1} of He, GC-MS interface at 280 °C and a GC program rate: Starting from 120 °C with 20 °C min^{-1} to 180 °C, 2 °C min^{-1} to 260 °C, and 5 °C min^{-1} to 300 °C, isotherm hold for 4 min.

PBDEs were analyzed on a Sol-Gel-1ms, 15 m with 0.25 mm i.d. and 0.1 µm film GC column (SGE, Victoria, Australia). The following gas-chromatographic conditions were applied: PTV injector with temperature program from 110 to 300 °C at 14.5 °C sec^{-1}, constant flow at 1.0 ml min^{-1} of He, GC-MS interface at 300 °C and a GC program rate: 110 °C with a 1 min. hold, then 20 °C min^{-1} to 300 °C and a final hold at 300 °C for 6 min.

2.3.5 Quality Assurance and Quality Control

The quantified isomers were identified through retention time comparison of the corresponding standard and the isotopic ratios between two ions was recorded for all halogenated compounds analyzed.

Sediment reference materials were analyzed in parallel with SPM samples for PCDD/Fs, DL-PCBs. The concentrations detected were in according to the reference values.

Levels of analytical blanks obtained during the clean-up process were at least 5-10 times lower of the reported concentrations for all compounds studied. The blank level was not subtracted. The reported detection limits were calculated on the bases of a signal to noise ratio of 3/1.

3 Results

The discussion on DL-PCBs and PCDD/F concentrations refers to their concentration of toxicity equivalents (TEQ) using the WHO toxicity equivalency factors (TEFs) established in 2005 (WHO_{05}-TEQ). The sum of the indicator PCBs and PBDEs are discussed on basis of their concentrations. All concentration data for the individual congeners/isomers of PCBs and PCDD/Fs, their toxicity according to the WHO_{98}- and I-TEQ scheme, as well as the concentration data for PBDEs are reported in the Supplementary Data chapter.

3.1 SPM - comparison between JDS 3 (2013) and JDS 2 (2007)

Concentrations/TEQs in SPM are reported on a dry weight base.

3.1.1 PCDD/F

The 2013 downstream profile in Figure 1 shows an equilibrated spatial pattern of the PCDD/Fs within a concentration range between 0.00069 and 0.0041 ng WHO_{05}-TEQ/g (JDS 33) and an average of 0.0021 ng WHO_{05}-TEQ/g. Almost identical concentrations were observed in the 2007 survey with an average of 0.0019 ng WHO_{05}-TEQ/g and a range between 0.00077 - 0.0077 ng WHO_{05}-TEQ/g (Table 1). Also the spatial pattern with slightly higher concentrations in the upper/middle stretch results similar from both surveys.

Figure 1: PCDD/F in SPM, 2013 versus 2007

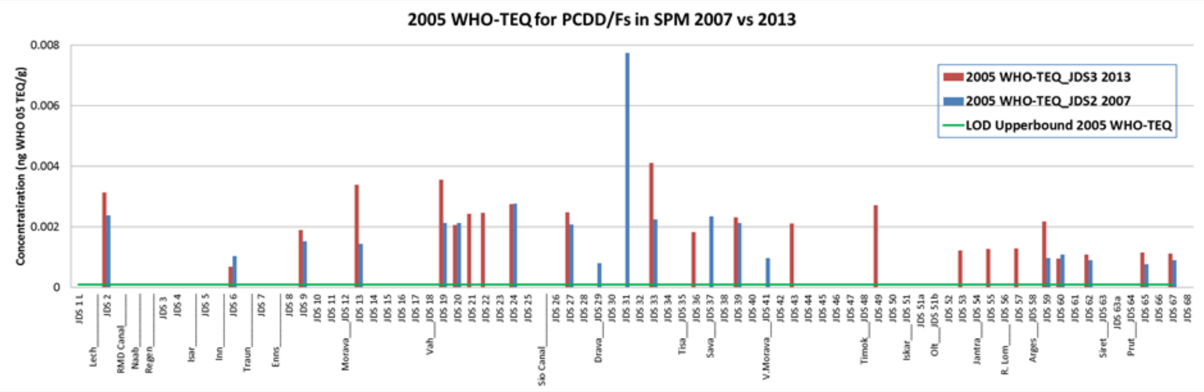


Table 1: PCDD/F – SPM summary

PCDD/F (ng WHO2005 TEQ/g)	JDS 2 2007	JDS 3 2013
N	20	23
min	0.00077	0.00069
mean	0.0019	0.0021
max	0.0077	0.0041
C50	0.0015	0.0021
C90	0.0028	0.0035

3.1.2 PCB

3.1.2.1 Dioxin-like PCBs

Dioxin-like PCBs display a similar spatial pattern as seen for PCDD/Fs and at concentration ranges in TEQ of around 25% of those of the PCDD/Fs, which is a typical observation in soils and sediments impacted by diffuse and long range deposition processes.

The 2013 downstream profile in Figure 2 shows an equilibrated spatial pattern of the DL-PCBs with a concentration range between 0.00018 and 0.0012 ng WHO_{05}-TEQ/g (site JDS2) and an average of 0.00048 ng WHO_{05}-TEQ/g. Almost identical concentrations were observed in the 2007 survey with an average of 0.00044 ng WHO_{05}-TEQ/g and a range between 0.00018 - 0.00090 ng WHO_{05}-TEQ/g (Table 2). As for the PCDD/Fs above (Figure 1), the spatial pattern with slightly higher concentrations in the upper/middle stretch results similar from both surveys, with the spike at site JDS2 higher for the DL-PCBs.

Figure 2: Dioxin-like PCB in SPM, 2013 versus 2007

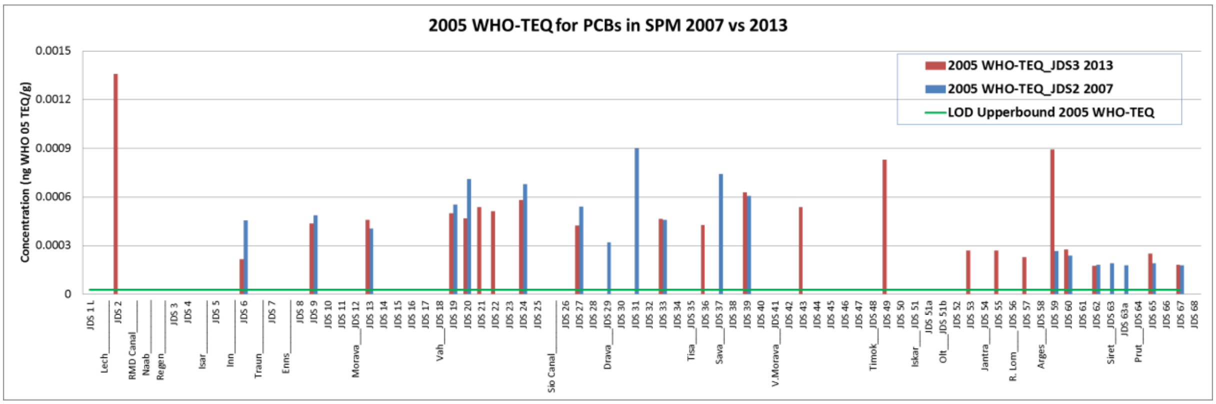


Table 2: Dioxin-like PCB – SPM summary

Dioxin-like PCB (ng WHO_{2005} TEQ/g)	JDS 2 2007	JDS 3 2013
N	20	23
min	0.00018	0.00018
mean	0.00044	0.00048
max	0.00090	0.0014
C50	0.00045	0.00046
C90	0.00074	0.00087

3.1.2.2 Marker/Indicator/EC-6 PCBs

During the 2007 survey, the sum of the EC-6 PCBs was equally distributed between the dissolved phase and the SPM. This needs to be considered if attempting to estimate total water concentrations from the SPM associated concentrations provided during JDS 3.

The 2013 downstream profile in Figure 3 displays an equilibrated spatial pattern of the EC-6 PCBs within a concentration range between 2 – 12.5 ng/g (max at JDS 59, under the influence of River Arges?) and an average of 4.67 ng/g. A tendency of lower concentrations is observed in the middle stretch compared to 2007, while the upper and lower stretches display minor variations. The 2013 maximum concentration value at JDS 59 is 3 times higher though compared to 2007. The mean value and the range are almost identical with that of 2007 (Table 3).

For each of the six individual EC-6 PCBs an EQS for river specific pollutants of 20 ng/g for sediment/suspended solids was set in Germany (BGB 2012). Even the maximum value of 12,5 ng/g we detected during JDS 3 for the *sum* of the EC-6 PCBS is fairly below the German maximum of 20 ng/g for each of the *individual* indicator PCBs.

For comparison in the River Elbe, the 20 ng/g quality standard for suspended solids is frequently exceeded for the individual PCB congeners (Table 5).

Figure 3: Indictor PCB in SPM, 2013 versus 2007

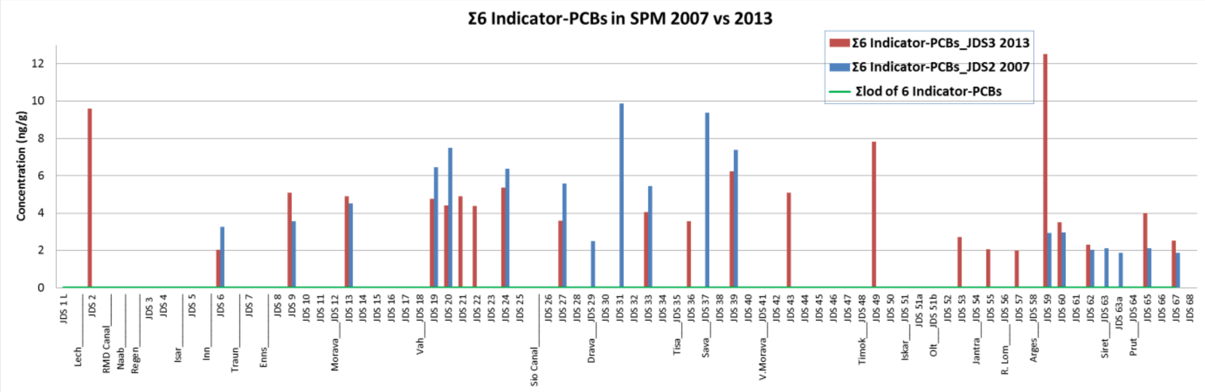


Table 3: Indicator PCB – SPM summary

Σ6 Indicator-PCBs (ng/g)	JDS 2 2007	JDS 3 2013
N	20	23
min	1.88	2.00
mean	4.62	4.67
max	9.87	12.50
C50	3.55	4.39
C90	9.37	8.88

3.1.3 BDE-209

During JDS 2 BDE-209 represented typically around 90% of the total content of PBDEs in SPM (all main constituents of the commercial mixtures were analyses analysed in 2007). Also during 2013 BDE-209 dominated by far the PBDE content in SPM (Supplement 6). Since BDE-209 in the water column was to more than 99% associated with SPM, the total water concentration of BDE-209 (and approximately also the total PBDE concentration) during the JDS 3 exercise can be calculated by using the SPM contents recorded at the individual sampling sites (Supplement 8).

The downstream profile in Figure 4 shows that the spatial pattern, with a tendency of higher concentrations in the middle stretch seen during 2007, is observed similarly in 2013.

However, the 2007 maximum concentrations are present more downstream. This is a typical observation made when local emissions sources or inputs from tributaries decrease. In the absence of fresh inputs, the contaminated sediments are bit by bit remobilized by extreme events, and the maximum contamination in the sediments/SPM of the main river is shifted more downstream. In 2007 Drava, Sava, and Velica Morava had displayed the highest PBDE concentrations in their sediments, and also the Danube itself had its maximum around and downstream their confluence. The concentration pattern in SPM showed a similar picture (Umlauf et al. 2007).

The fact that the maximum in the SPM from 2013has shifted downstream since then, suggests a decrease of inputs from sources and tributaries in the middle stretch, and a tendency of PBDEs being cleaned out of the catchment. Unfortunately we got no 2013 data available from Drava, Sava, and Velica Morava to confirm this hypothesis.

Also the temporal trend suggests a moderate (approx. 30%) decrease of BDE-209 since 2007 (Table 4). Average concentrations decreased from around 14 – 10 ng/g, together with a decrease of the concentration ranges from 2.84-52.1 ng/g in 2007 to 1.53-31.7 ng/g in 2013.

Finally, also the tendency of decreasing concentrations observed in fish from 2007 and 2013 points towards reduced emissions of PBDEs at catchment scale (Table 9, Figure 8).

Figure 4: BDE-209 in SPM, 2013 versus 2007

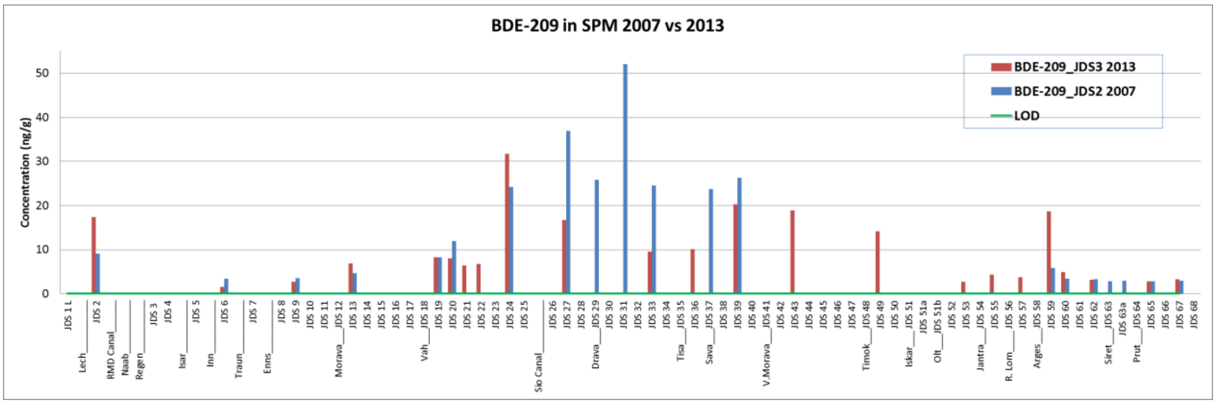


Table 4: BDE-209 – SPM summary

BDE-209 (ng/g)	JDS 2 2007	JDS 3 2013
N	20	23
min	2.84	1.53
mean	13.93	9.69
max	52.1	31.7
C50	7.02	6.88
C90	35.9	19.7

3.2 SPM - Comparison with other surface waters in Europe

Systematically acquired data on SPM are scarcely available, thus our comparison is mainly limited to data from the River Elbe acquired by the authors in an extensive campaign during 2008 under the application of a quasi-identical methodology. In Table 5 the literature data for the investigated compounds in SPM are summarized in comparison with the outcomes of JDS 2 and JDS 3.

Table 5: PCDD/Fs, PCBs, and BDE-209 in SPM - JDS 3 in comparison with literature

PCDD/Fs, Dioxin –like PCBs, Marker PCBs and BDE-209 in SPM, JDS 3 comparison with literature data						
Unit	pg WHO_{05} TEQ/g	pg WHO_{05} TEQ/g	ng/g	ng/g	Reference	Comment
Compound	**PCDD/Fs**	**DL-PCBs**	**EC-6 PCBs**	**BE 209**		
Danube incl Drava & Sava	0.69-4.1; **2.1** 0.77-7.7; **1.9**	0.18-1.36; **0.48** 0.18-0.90; **0.44**	2.0-12.5; **4.7** 1.9- 9.9; **4.6**	1.5-32; **9.7** 2.8-52; **14**	**This study** Umlauf et al. 2007, 2008, 2009,	2013 JDS 3; Min-max; **average** 2007 JDS 2; Min-max; **average**
Elbe	3.9-67.8; **20** 7-150	0.98-5.8; **2.9**	11.5-180; **71.0** 30- 132**		Umlauf et al. 2010, 2011 ARGE Elbe 2010 Stachel et al. 2004	2008, Min-max; **average** 2008 **annual average (sum PCB 138, 153, 180) 2002
Dutch rivers				71 (<9–4600)	De Boer et al. 2003	Median(range)

PCDD/Fs concentration in settling material from the Danube was approximately one order of magnitude lower than in the River Elbe in 2008, where an average of 0.020 (0.0039-0.068) ng WHO_{05}-TEQ/g, is reported (Umlauf et al. 2010, 2011).

DL-PCB concentration in settling material from the Danube was approximately half an order of magnitude lower in the River Elbe in 2008, where an average of 0.0029 (0.00098-0.0058) ng WHO_{05}-TEQ/g is reported (Umlauf et al. 2010, 2011).

Also the 6 Marker PCBs in Danube SPM generally range more than one order of magnitude below the concentrations reported from the Elbe River. ARGE Elbe (2010) reports yearly averages for the sum of PCB 138, 156 and 180 of 30-132 ng/g. Umlauf et al. (2010, 2012) report a concentration average of the EC-6 PCBs of 71 ng/g (11.5-180 ng/g) for the entire Elbe River sampled from the Czech Republic until Hamburg.

Few data on BDE-209 are available for SPM. De Boer et al. (2003) report a median of 71 ng/g at a range between <9 – 4600 ng/g, considerably higher than observed during JDS 2 and JDS 3.

3.3 Fish – comparison between JDS 3 (2013) and JDS 2 (2007)

As mentioned in the introduction, BDE 209 is usually not, or only in considerably low amounts, detected in aquatic biota.

PCDD/F and PCBs instead, due to their higher resistance to metabolism, are ubiquitously found in fish. Although production of PCBs has been stopped decades ago and PCDD/F emissions are strictly regulated in the EU, there is still a notable contamination of PCDD/F and DL-PCB in fish samples present. Long term observation programs of Abramis Brama in German rivers from 2003-2008 reveal levels partially above the limits for food given by EU legislation, especially for the big rivers Rhine and Elbe and their tributaries Saar and Saale (Neugebauer et al. 2012).

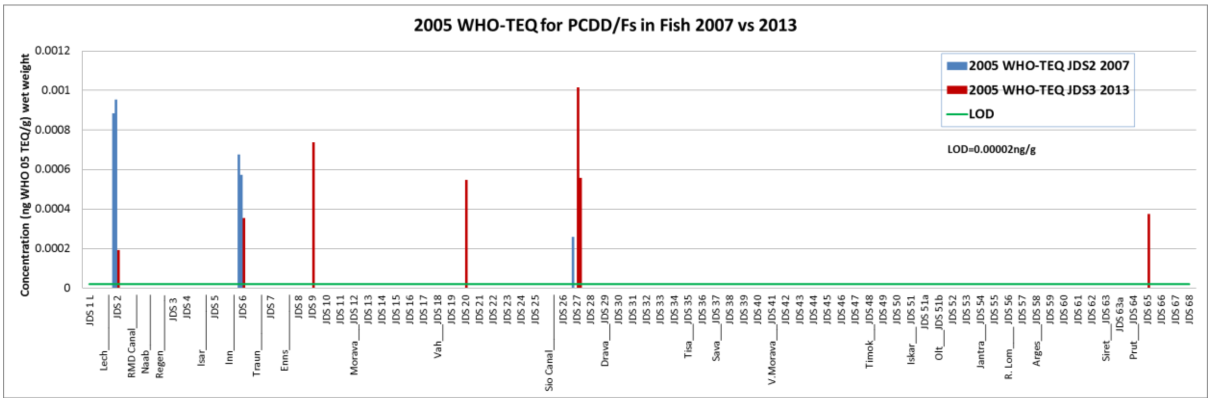
We report on Bream filet on a wet weight basis. This way the EU limits for PCDD/Fs and dioxin like PCBs in food and the new EQS set for biota in EU surface waters, both given on a fresh weight basis, can be compared. The calculation of the results for fish on a dry weight or lipid weight basis can be done using the reported dry weights and lipid contents reported in Supplement 7. Dry weight based concentration data can be approximated by assuming 25% dry mass.

Due to the low numbers of samples obtained during both surveys, the fish data we present may only serve as an indication rather than being interpreted as spatially or temporarily representative. With this respect, it should also be noted, that the 2007 data cover only 2 sites in the upper and one site in the middle stretch.

3.3.1 PCDD/F

The average value during JDS 3 of 0.00054 ng WHO_{05}-TEQ/g was slightly (approx. 20%) lower compared to JDS 2 with 0.00067 ng WHO_{05}-TEQ/g. Maximum value during JDS 3 was at JDS 27 with 0.001 ng WHO_{05}-TEQ/g, while the maximum in 2007 was 0.0095 ng WHO_{05}-TEQ/g at site JDS 2.

Figure 5: PCDD/F in Fish, 2013 versus 2007



The relevant EU food limit value for PCDD/F alone of 0.0035 ng WHO_{05}-TEQ/g in fresh weight (COM Reg 2011) is not exceeded, both in the 2007 and the 2013 samples

Table 6: PCDD/F – Fish summary

PCDD/F (ng WHO_{2005} TEQ/g) wet weight	JDS 2 2007	JDS 3 2013
n	5	7
min	0.00026	0.00019
mean	0.00067	0.00054
max	0.00095	0.0010

3.3.2 PCB

The average value during JDS 3 of 0.016 ng WHO_{05}-TEQ/g was almost 50% lower compared to JDS 2 with 0.0033 ng WHO_{05}-TEQ/g. Maximum value during JDS 3 was 0.0034 ng WHO_{05}-TEQ/g at site JDS2, which displayed also the 2007 maximum of 0.0057 ng WHO_{05}-TEQ/g.

EU legislation on food does not foresee a limit for dioxin-like PCBs alone, but in combination with the toxicity of the PCDD/Fs resulting in a limit for the combined WHO_{05}-TEQ of 0.0065 ng/g on a fresh weight basis. (COM Reg 2011). This limit also corresponds to the recent EQS set for biota in EU surface waters (COM Dir 2013).

Figure 6: Dioxin-like PCB in Fish, 2013 versus 2007

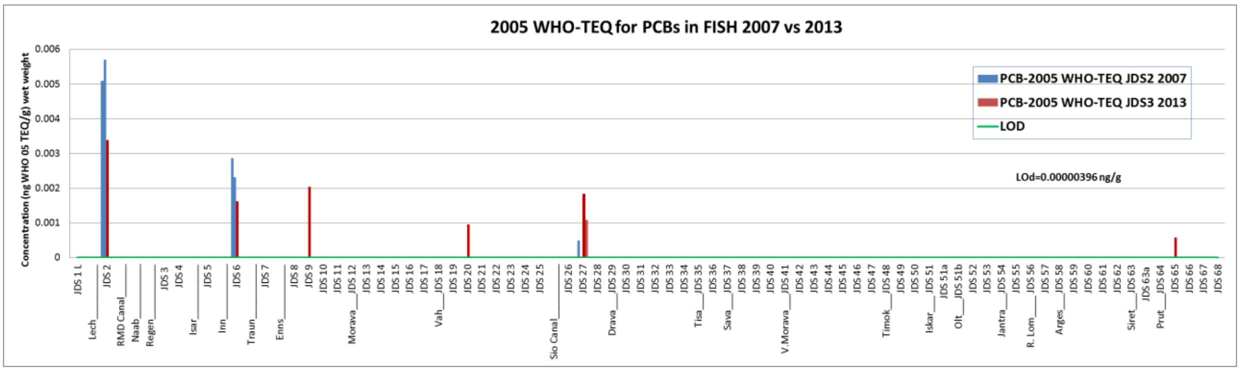


Table 7: Dioxin-like PCB – Fish summary

dioxin-like PCB (ng WHO_{2005} TEQ/g) wet weight	JDS 2 2007	JDS 3 2013
n	5	7
min	0.0006	0.0005
mean	0.0033	0.0016
max	0.0057	0.0034

The combined PCDD/F and PCB WHO_{05}-TEQ of 0.0065 ng WHO_{05}-TEQ/g was not exceeded in any of the 2013 samples. The only site close to the limit is the site JDS2, sampled in 2007. However, in 2007 the limit for combined PCDD/F and PCB toxicity in fish was 0.0080 ng/g WHO_{98}-TEQ (COM Reg 2006), which was not exceeded during that time either.

Figure 7: Indictor PCB in Fish, 2013 versus 2007

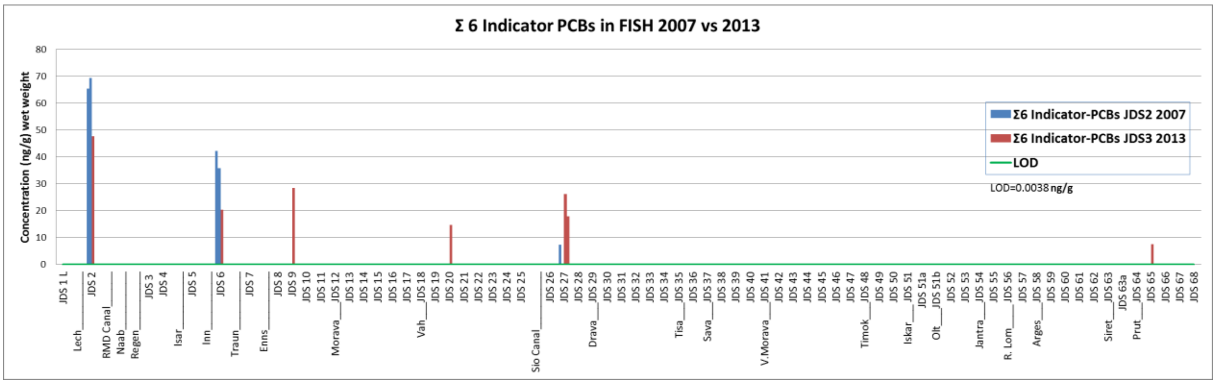


Table 8: Indicator PCB – Fish summary

Σ6 Indicator PCBs (ng/g) wet weight	JDS 2 2007	JDS 3 2013
n	5	7
min	7.3	7.5
mean	44	23.2
max	69.4	47.6

The average value of the EC-6 PCBs during JDS 3 of 23.2 ng/g was almost 50% lower compared to JDS 2 with 44 ng/g. The maximum concentration during JDS 3 was 47.6 ng/g at site JDS2, which displayed also the 2007 maximum with 69.4 ng/g.

The EU food standard of 75 ng/g fresh weight for the Σ6 Indicator PCBs (COM Reg 2011) is not exceeded both in the 2007 and the 2013 samples.

3.3.3 BDE-209

The average value during JDS 3 of 0.056 ng/g was about 50% lower compared to JDS 2 with 0.106 ng/g. Maximum concentration during JDS 3 was 0.127 ng/g at site JDS9, while the 2007 maximum was higher with 0.225 ng/g at site JDS27.

Figure 8: BDE-209 in Fish, 2013 versus 2007

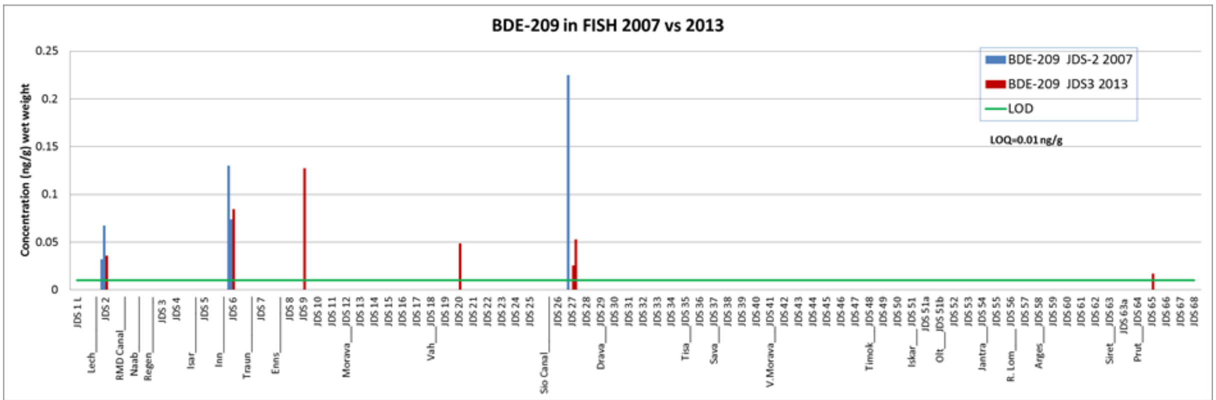


Table 9: BDE-209 – Fish summary

BDE-209 (ng/g) wet weight	JDS 2 2007	JDS 3 2013
n	5	7
min	0.032	0.017
mean	0.106	0.056
max	0.225	0.127

As mentioned earlier, and in contrast to the situation in SPM, BDE-209 appears only in traces in fish, presumably as a result of lower absorptivity and a quick metabolism.

Among all the PBDEs we analysed in fish, BDE-47 instead was the dominant compound with concentrations ranging from 0.2 – 4.8 ng/g in 2013 and 0.6-5.5 ng/g in 2007 (Supplement 3).

3.4 Fish - Comparison with other surface waters in Europe

In Table 10 existing fish data are summarized in comparison with the outcomes of JDS 2 and JDS 3.

Table 10: PCDD/Fs, PCBs, and BDE-209 in fish - JDS 3 in comparison with literature

PCDD/Fs, Dioxin –like PCBs, Marker PCBs and BDE-209 in fish muscle tissue , JDS 3 comparison with literature data Fish						
	pg WHO_{05} TEQ/g	pg WHO_{05} TEQ/g	ng/g	ng/g	Reference	Comment
Compound	**PCDD/Fs**	**DL-PCBs**	**EC-6 PCBs**	**BDE-209**		
Danube incl Drava & Sava	0.19-1.0; **0.54** 0.26-0.95; **0.67**	0.50-3.4; **1.6** 0.60-5.7; **3.3**	7.5-48; **23** 7.3-69**; 44**	0.017-0.13; **0.056** 0.032-0.23; **0.11**	**This study**	2013 JDS 3; 2007 JDS2; Min-max; **average,** ww
Danube	1-3.5	2.5 – 10			Neugebauer et al. 2012	Bream, German stretch. Ulm Kehlheim, Jochenstein 2003 – 2008. WHO_{98} TEQ; ww
North Sea, North Atlantic -				0.04 - 2.8	Paepke and Herrmann 2004	German fish market mix; ; lipid weight
River Vero				86 195	Eljarrat et al. 2007	2004; lipid weight 2005 Barbel ; lipid weight
Elbe	0.8-8.5	2-5			Neugebauer et al. 2012	Bream 2003 – 2008, Prossen, Barby, Blankenese. WHO_{98} TEQ; ww
Elbe	 0.48–12	 1.2–14		<LOQ – 37.3 ng/g Med = 0.97ng/g	Lepom et al. 2002 Stachel et al. 2007	Bream; lipid weight 1989- 2003 - Bream, incl. some Chub and ide: WHO_{98} TEQ; ww
Elbe tributary Mulde	1.8-2.3	0.4-1.8			Neugebauer et al. 2012	Bream 2003 – 2008, Prossen, Barby, Blankenese; WHO_{98} TEQ; ww
Elbe tributary Saale	1.0-2.1	4-6			Neugebauer et al. 2012	Bream 2003 – 2008, Prossen, Barby, Blankenese; ; WHO_{98} TEQ; ww
Rhine	1-9	3-16			Neugebauer et al. 2012	Bream , German stretch 2003 – 2008. Weil, Iffezheim, Koblenz, Bingen; WHO_{98} TEQ; ww
Saar	1.5-3	7-20			Neugebauer et al. 2012	Bream , German stretch 2003 – 2008. Weil, Iffezheim, Koblenz, Bingen; WHO_{98} TEQ; ww
Dutch rivers				<5 (<0.2–<21)	De Boer et al. 2003	Bream, Median(range), nothing detected. Dry weight.
Note: the concentrations found for the comparison of bream based on fresh weight/wet weight (ww) are highlighted in blue						

PCDD/Fs and DL-PCBs: The comparison of PCDD/Fs and DL-PCBs in fish with earlier data (2003-2008) from Neugebauer et al. (2012) support the decreasing concentration trends observed in the Danube in between the surveys JDS 2 and JDS 3.

The predominance of the PCBs in the total dioxin-like toxicity observed in the Danube during both surveys is reported similarly for the other rivers, except for the River Mulde (Neugebauer et al. 2012). This is explained, however, by a particular impact from a historic PCDD/F emission source (Umlauf et al. 2005). The difference to SPM, where PCDD/F dominate over PCBs on a TEQ base, results from the poor bioavailability of the higher molecular PCDD/F with higher log Kow when compared to PCBs. For humans (Moser and McLachlan, 2002) and chicken (Pirard and De Pauw, 2005) it has been demonstrated that for compounds with a log Kow<7 the absorption percentage of the ingested compounds decreases drastically.

The concentrations of PCDD/Fs and DL-PCBs found during JDS 3 generally fit into the low end of the ranges reported by Neugebauer et al. (2012) for the Rivers Elbe, Rhine, and their tributaries.

For the EC-6 PCBs no data for bream on a wet weight basis were found. However, with the DL-PCBs being low in concentration, the marker PCBs are supposed to follow this trend.

Data from BDE-209 are very scarce and reported either on a lipid weight or a dry weight base. While a rather stable dry weight/fresh weight relation of 1:4 can be assumed for comparison, lipid contents of Bream are highly variable (ranging from 0.2- 6.29, typically around 5 % of fresh weight in this study). What regards the average LOD reported by De Boer et al., 2003, their conversion to fresh weight suggests that no BDE-209 was found in bream above 1.25 ng/g in Dutch waters.

Lepom et al. (2002) report a median BDE-209 concentration of 0.97ng/g lipid weight based from the River Elbe. The calculation of our Danube results for BDE-209 on a lipid weight base reveals comparable concentrations: The Danube average concentration in 2013 is 1.1 (0.11-6.1) ng/g lw and that of 2007 is 1.32 (0.22-4.52) ng/g lw. Both data sets contain each one outlier, caused by the fact that the respective bream contained almost no fat. Eliminating these outliers the Danube averages are 0.27 ng/g lw in 2013 and 0.052 in 2007.

The similarity of the BDE-209 concentrations in comparison with the River Elbe is in so far interesting, since PCDD/Fs and PCBs were much higher concentrated there. This could point to a comparatively higher relevance of the brominated flame retardants within the pollutants in the Danube investigated in this study. However, the number of available data for comparison is insufficient to conclude.

4 Conclusions

The longitudinal concentration profile for PCDD/F and PCBs in suspended matter is similar both in 2007 and 2013, while for BDE-209 the concentration maximum from 2007 shifted tendencially from the middle stretch more downstream. From the downstream concentration profile, there is no indication of relevant point sources.

PCDD/F and PCB concentrations in SPM were stable since 2007 except for BDE-209, displaying a 30% decrease in concentration. The observed concentrations in SPM ranged between half- and more than one order of magnitude lower compared to the River Elbe, except for PBDEs.

The concentrations in fish are tendencially deceasing since 2007. PCDD/Fs decreased about 20%, PCBs, both dioxin-like and the sum of 6 marker PCBs and BDE-209 by approximately 50 %.

The concentrations of PCDD/Fs and DL-PCBs in fish generally fit into the low end of the ranges reported for the Rivers Elbe, Rhine, and their tributaries. For the EC-6 PCBs no data for bream on a wet weight basis were found. However, with the DL-PCBs low, the marker PCBs are supposed to follow this trend.

The few data available from the JDS 2 and JDS 3 surveys suggest that BDE-209 in Danube bream is found in concentration levels similar to the River Elbe. Since most other organic pollutants appear up to one order of magnitude lower in the Danube-Elbe comparison, this could be an indication for a higher relative relevance of the compound class of brominated flame retardants in the Danube.

None of the existing EQS values for PCDD/F and PCB in aquatic biota and suspended solids/sediments and none of the EU food limits concerned were exceeded.

5 Acknowledgement

We gratefully acknowledge the JDS 3 team on board of the Argus providing the samples.

6 References

Abad E, Sauló J, Caixach J, Rivera J (2000). Evaluation of a new automated cleanup system for the analysis of polychlorinated dibenzo-p-dioxins and dibenzofurans in environmental samples. Journal of Chromatography 893 (2000) 383-391

Alcock RE and Busby J (2006). Risk migration and scientific advance: the case of flame-retardant compounds. Risk Anal. 26 (2006) 369–81

ARGE Elbe (2010). Gewaesserguetebericht der Elbe 2008. http://www.fgg-elbe.de/dokumente/gewaesserguete.html accessed on 30 June 2014

Bundesgesetzblatt Jahrgang 2011 Teil I, Nr. 37, page 1429, 20.07.2011.Verordnung zum Schutz der Oberflächengewässer (Oberflächengewässerverordnung OGewV), ausgegeben zu Bonn am 25. Juli 2011

De Wit CA (2000). An overview of brominated flame retardants in the environment. Chemosphere 46 (2002) 583–624

De Boer J, Wester PG, Van der Horst A, Leonards PEG (2003). Polybrominated diphenyl ethers in influents, suspended particulate matter, sediments, sewage treatment plant and effluents and biota from the Netherlands. Environmental Pollution 122 (2003) 63–74

De Poortere M (2000). Brominated flame retardants. Presentation, Swedish Society of Toxicology Workshop, Stockholm, February 17. Referenced in De Wit (2002).

EPA 1613. EPA (1994b). Method 1613: Tetra-through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS

EPA 1668. EPA (1999). Method 1668, revision A: Chlorinated Biphenyl Congeners in Water, Soil, Sediment and Tissue by HRGC/HRMS

EPA 1614. EPA (August 2003) Method 1614: Brominated diphenyl ethers in water, soil, sediment, and tissue by HRGC/HRMS. Draft

COM Reg 2006. Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs (Text with EEA relevance). OJ L 364/18

COM Reg 2011. Commission Regulation (EU) No 1259/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for dioxins, dioxin-like PCBs and non dioxin-like PCBs in foodstuffs. OJ L 320/18

COM Dir 2013. Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy. OJ L 226/1

Evers EHG, Laane RWPM, Groeneveld GJJ, Olie K (1996). Levels, temporal trends and risk of dioxins and related compounds in the Dutch aquatic environment. Organohalogen Compounds 28 (1996) 117–122

Iannuzzi TJ, Bonnevie NL, Wenning RJ (1995). An evaluation of current methods for developing sediment quality guidelines for 2,3,7,8-tetrachlorodibenzo-p-dioxin. Arch. Environ. Contam. Toxicol. 28 (1995) 366–377.

Klein R, Bartel M, Tarricone K, Paulus M, Quack M, Teubner D, Wagner G (2010): Guideline for sampling and sample treatment bream (Abramis brama), Berlin, June 2010 http://www.umweltprobenbank.de/en/documents/publications/11544, accessed 26 June 2014

Lepom P, Karasyova T, Sawal G (2002). Occurrence of polybrominated diphenyl ethers in freshwater fish from Germany. Organohalogen Compounds. 58 (2002) 209–212

Moser GA and McLachlan MS (2002). Modeling digestive tract absorption and desorption of lipophilic organic contaminants in humans. Environ. Sci. Technol. 36 (2002) 3318–3325

Neugebauer F, Schröter-Kermani C, Päpke O, Stegemann D, Steeg W (2012). Analytical experiences within the German environmental specimen bank: time trends of PCDD/F and DL-PCB in bream (Abramis brama) caught in German rivers. Organohalogen Compounds 73 (2011) 1340-1343

OECD (1994). Referenced in De Wit (2000).

Paepke O and Herrmann T (2004). Polybrominated diphenylethers (PBDEs) in fish samples of various origin. Organohalogen Compounds 66 (2004) 3921–3926

Pirard C and De Pauw E (2005). Uptake of polychlorodibenzo-p-dioxins, polychlorodibenzofurans and coplanar polychlorobiphenyls in chickens. Environment International 31 (2005) 585-591

Stachel B, Götz R, Herrmann T, Krüger F, Knoth W, Päpke O, Rauhut U, Reincke H, Schwartz R, Steeg E, Uhlig S (2004). The Elbe flood in August 2002 - Occurrence of polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans (PCDD/F) and dioxin-like PCB in suspended particulate matter (SPM), sediment and fish. Water Sci. Technol. 50 (2004)309-16.

Stachel B, Christoph E-H, Götz R, Herrmann T, Krüger F, Kühn T, Lay J, Löffler J, Päpke O, Reincke H, Schröter-Kermani C, Schwartz R, Steeg E, Stehr D, Uhlig S, Umlauf G (2007). Dioxins and dioxin-like PCBs in different fish from the river Elbe and its tributaries, Germany. Journal of Hazardous Materials 148 (2007) 199–209

Umlauf G, Bidoglio G, Christoph E, Kampheus J, Krueger F, Landmann D, Schulz AJ, Schwartz R, Severin K, Stachel B, Stehr D (2005) The Situation of PCDD/Fs and Dioxin-like PCBs after the Flooding of River Elbe and Mulde in 2002. Acta hydrochimica et hydrobiologica 33 (2005) 543-554

Umlauf G, Christoph E, Huber T, Mariani G, Mueller A, Skejo H, Wollgast J (2007). Cross Matrix Inter-Comparison of Semivolatile Organic Compounds in Water, Suspended Particulate Matter, Sediments and Biota. In: Liska I, Wagner F, Slobodnik J (eds.). Joint Danube Survey 2 - Final Scientific Report. ICPDR-International Commission for the Protection of the Danube River, Vienna 174-191. http://www.icpdr.org/main/activities-projects/joint-danube-survey-2

Umlauf G, Christoph H, Huber T, Mariani G, Mueller A, Skejo H, Wollgast J (2008). Full Report on Cross Matrix Comparison of Semivolatile Organic Compounds (SOCs) in Water, Suspended Particulate Matter (SPM), Sediments and Biota - 23 JRC Sites. In: Liska I, Wagner F, Slobodnik J, (eds.) Results of the Joint Danube Survey 2 - 14 August - 27 September 2007. Wien (Austria): ICPDR International Commission for the Protection of the Danube; 2008; 1-144.

Umlauf G, Christoph EH, Huber T, Mariani G, Mueller A, Skejo H, Wollgast J (2009). PBDES in Water, Sediments and Biota of the River Danube from Germany to the Black Sea. Organohalogen Compounds 71 (2009) 737-742

Umlauf G, Mariani G, Skejo H, Mueller A, Baek L, Stachel B, Goetz R (2010). Dioxins and dioxin like PCBs in solid material from the River Elbe its tributaries and from the North Sea. Organohalogen Compounds 72 (2010) 95-99

Umlauf G, Stachel B, Mariani G, Goetz R (2011). Dioxins and PCBs in solid matter from the river Elbe, its tributaries and the North Sea (longitudinal profile, 2008). EUR 24766 EN. Luxembourg: Publications Office of the European Union; 2011 ISBN 978-92-79-19761-1 ISSN 1018-5593 (print), 1831-9424 (online)

Van Den Berg, M., L. Birnbaum, et al. (1998): Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environmental Health Perspectives 106 (12): 775-792

Van Den Berg, M., L. Birnbaum, et al. (2006): Review: The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds Toxicological Sciences 93 (2), 223-241

Vigano L, Roscioli C, Guzzella L (2012). Decabromodiphenyl ether (BDE-209) enters the food web of the River Po and is metabolically debrominated in resident cyprinid fishes. Science of the Total Environment 409 (2011) 4966–4972

Supplementary data

Supplement 1: PCDD/F in fish

Lab. Code:	DP-13-400-150114-7	DP-13-160-150114-1	DP-13-161-150114-2	DP-13-202-150114-3
Sampling Code:	JDS 2	JDS 6	JDS 9	JDS 20
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed (g):	34.247	21.74	22.222	21.552
Dry matter content (%)	14.6	23.0	22.5	23.2
Lipid (%)	0.2	5.19	6.39	3.58
Data analysed:	27-Mar-14	27-Mar-14	27-Mar-14	27-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
2,3,7,8 - substituited PCDD/Fs				
2378-TCDD	0.000043	0.000054	0.000183	0.000183
12378-PeCDD	0.000066	0.000080	0.000183	0.000083
123478-HxCDD	0.000009	0.000051	0.000086	0.000040
123678-HxCDD	0.000013	0.000101	0.000155	0.000088
123789-HxCDD	0.000004	0.000044	0.000064	0.000043
1234678-HpCDD	0.000060	0.000282	0.000408	0.000255
OCDD	0.000139	0.000596	0.000493	0.000422
2378-TCDF	0.000158	0.000940	0.001493	0.001207
12378-PeCDF	0.000051	0.000156	0.000285	0.000164
23478-PeCDF	0.000190	0.000259	0.000483	0.000364
123478-HxCDF	0.000014	0.000068	0.000105	0.000096
123678-HxCDF	0.000009	0.000051	0.000079	0.000059
234678-HxCDF	0.000025	0.000081	0.000115	0.000077
123789-HxCDF	**0.0000070**	**0.0000070**	**0.0000070**	**0.0000070**
1234678-HpCDF	0.000053	0.000141	0.000167	0.000121
1234789-HpCDF	0.000014	0.000024	0.000024	0.000030
OCDF	0.000045	0.000143	0.000082	0.000216
Upper-bound				
I-TEQ	0.00020	0.00037	0.00075	0.00058
1998 WHO-TEQ	0.00023	0.00041	0.00084	0.00062
2005 WHO-TEQ	0.00019	0.00035	0.00074	0.00055
Middle-bound				
I-TEQ	0.00020	0.00037	0.00075	0.00058
1998 WHO-TEQ	0.00023	0.00041	0.00084	0.00062
2005 WHO-TEQ	0.00019	0.00035	0.00074	0.00055
Lower-bound				
I-TEQ	0.00020	0.00037	0.00075	0.00058
1998 WHO-TEQ	0.00023	0.00041	0.00084	0.00062
2005 WHO-TEQ	0.00019	0.00035	0.00074	0.00055
Bold number is LOD				

Lab. Code:	DP-13-206-150114-4	DP-13-207-150114-5	DP-13-375-150114-6	DP-13-401-150114-8
Sampling Code:	JDS 27	JDS 27	JDS 65	JDS 2
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 2 -2007
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed (g):	20.921	18.797	20.747	20.492
Dry matter content (%)	22.5	26.6	24.1	24.4
Lipid (%)	4.78	4.62	2.5	2.99
Data analysed:	27-Mar-14	27-Mar-14	27-Mar-14	27-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
2,3,7,8 - substituited PCDD/Fs				
2378-TCDD	0.000370	0.000169	0.000084	0.000088
12378-PeCDD	0.000147	0.000095	0.000098	0.000138
123478-HxCDD	0.000051	0.000033	0.000049	0.000025
123678-HxCDD	0.000116	0.000072	0.000071	0.000108
123789-HxCDD	0.000075	0.000046	0.000036	0.000027
1234678-HpCDD	0.000234	0.000348	0.000107	0.000187
OCDD	0.000221	0.001356	0.000216	0.000335
2378-TCDF	0.002396	0.001172	0.000782	0.003586
12378-PeCDF	0.000335	0.000189	0.000159	0.000439
23478-PeCDF	0.000641	0.000402	0.000259	0.000812
123478-HxCDF	0.000107	0.000107	0.000064	0.000105
123678-HxCDF	0.000073	0.000068	0.000044	0.000059
234678-HxCDF	0.000087	0.000086	0.000055	0.000071
123789-HxCDF	**0.0000070**	**0.0000070**	**0.0000070**	**0.0000070**
1234678-HpCDF	0.000083	0.000211	0.000076	0.000104
1234789-HpCDF	0.000017	0.000028	0.000012	0.000018
OCDF	0.000056	0.000328	0.000062	0.000056
Upper-bound				
I-TEQ	0.00108	0.00059	0.00038	0.00099
1998 WHO-TEQ	0.00115	0.00064	0.00043	0.00105
2005 WHO-TEQ	0.00101	0.00056	0.00038	0.00088
Middle-bound				
I-TEQ	0.00108	0.00059	0.00038	0.00099
1998 WHO-TEQ	0.00115	0.00064	0.00043	0.00105
2005 WHO-TEQ	0.00101	0.00056	0.00038	0.00088
Lower-bound				
I-TEQ	0.00108	0.00059	0.00038	0.00099
1998 WHO-TEQ	0.00115	0.00064	0.00043	0.00105
2005 WHO-TEQ	0.00101	0.00055	0.00038	0.00088
Bold number is LOD				

Lab. Code:	DP-13-402-150114-9	DP-13-403-150114-10	DP-13-404-150114-11	DP-13-405-150114-12
Sampling Code:	JDS 2	JDS 7	JDS 7	JDS 39
Project:	JDS 2 -2007	JDS 2 -2007	JDS 2 -2007	JDS 2 -2007
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed (g):	21.277	19.763	19.92	23.81
Dry matter content (%)	23.5	25.3	25.1	21.0
Lipid (%)	3.7	4.15	3.21	1.26
Data analysed:	27-Mar-14	27-Mar-14	27-Mar-14	27-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
2,3,7,8 - substituited PCDD/Fs				
2378-TCDD	0.000093	0.000071	0.000061	0.000125
12378-PeCDD	0.000138	0.000102	0.000109	0.000029
123478-HxCDD	0.000038	0.000042	0.000042	0.000012
123678-HxCDD	0.000108	0.000130	0.000096	0.000049
123789-HxCDD	0.000023	0.000042	0.000029	0.000012
1234678-HpCDD	0.000176	0.000302	0.000240	0.000152
OCDD	0.000324	0.000283	0.000237	0.000186
2378-TCDF	0.004046	0.002393	0.001868	0.000442
12378-PeCDF	0.000459	0.000362	0.000302	0.000076
23478-PeCDF	0.000868	0.000647	0.000528	0.000117
123478-HxCDF	0.000104	0.000150	0.000112	0.000047
123678-HxCDF	0.000059	0.000088	0.000065	0.000030
234678-HxCDF	0.000065	0.000102	0.000080	0.000038
123789-HxCDF	**0.0000070**	**0.0000070**	**0.0000070**	**0.0000070**
1234678-HpCDF	0.000090	0.000143	0.000124	0.000121
1234789-HpCDF	0.000022	0.000028	0.000029	0.000021
OCDF	0.000124	0.000059	0.000081	0.000079
Upper-bound				
I-TEQ	0.00107	0.00076	0.00063	0.00027
1998 WHO-TEQ	0.00114	0.00081	0.00068	0.00028
2005 WHO-TEQ	0.00095	0.00068	0.00057	0.00026
Middle-bound				
I-TEQ	0.00107	0.00076	0.00063	0.00027
1998 WHO-TEQ	0.00114	0.00081	0.00068	0.00028
2005 WHO-TEQ	0.00095	0.00068	0.00057	0.00026
Lower-bound				
I-TEQ	0.00107	0.00076	0.00063	0.00027
1998 WHO-TEQ	0.00114	0.00081	0.00068	0.00028
2005 WHO-TEQ	0.00095	0.00068	0.00057	0.00026
Bold number is LOD				

Lab. Code:	DP-BLK-27-0314-4
Sampling Code:	LOD
Project:	JDS 3 -2013
Type of sample:	Fish
Mass wet filled Analysed (g):	20
Dry matter content (%)	na
Lipid (%)	na
Data analysed:	12-May-14
Concentration:	ng/g Wet weight
2,3,7,8 - substituited PCDD/Fs	
2378-TCDD	**0.0000070**
12378-PeCDD	**0.0000070**
123478-HxCDD	**0.0000070**
123678-HxCDD	**0.0000070**
123789-HxCDD	**0.0000070**
1234678-HpCDD	**0.0000100**
OCDD	**0.0000250**
2378-TCDF	**0.0000070**
12378-PeCDF	**0.0000070**
23478-PeCDF	**0.0000070**
123478-HxCDF	**0.0000070**
123678-HxCDF	**0.0000070**
234678-HxCDF	**0.0000070**
123789-HxCDF	**0.0000070**
1234678-HpCDF	**0.0000100**
1234789-HpCDF	**0.0000100**
OCDF	**0.0000250**
Upper-bound	
I-TEQ	**0.00002**
1998 WHO-TEQ	**0.00002**
2005 WHO-TEQ	**0.00002**
Middle-bound	
I-TEQ	**0.00001**
1998 WHO-TEQ	**0.00001**
2005 WHO-TEQ	**0.00001**
Lower-bound	
I-TEQ	**0.00000**
1998 WHO-TEQ	**0.00000**
2005 WHO-TEQ	**0.00000**
Bold number is LOD	

Supplement 2: PCB in fish

Lab. Code:	DP-13-400-150114-7	DP-13-160-150114-1	DP-13-161-150114-2	DP-13-202-150114-3
Sampling Code:	JDS 2	JDS 6	JDS 9	JDS 20
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed (g):	34.247	21.74	22.222	21.552
Dry matter content (%)	14.6	23.0	22.5	23.2
Lipid (%)	0.2	5.19	6.39	3.58
Data analysed:	27-Mar-14	27-Mar-14	27-Mar-14	27-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.0019	0.0027	0.0055	0.0066
PCB-77	0.0106	0.0599	0.1015	0.1167
PCB-126	0.0305	0.0146	0.0183	0.0083
PCB-169	0.0044	0.0023	0.0028	0.0012
Mono-ortho-substituited PCBs				
PCB 105	0.683	0.431	0.531	0.394
PCB 114	0.048	0.023	0.035	0.030
PCB 118	3.369	1.696	2.043	1.440
PCB 123	0.046	0.026	0.032	0.029
PCB 156	1.243	0.527	0.703	0.291
PCB 157	0.166	0.073	0.091	0.041
PCB 167	0.921	0.346	0.433	0.198
PCB 189	0.191	0.072	0.096	0.039
Indicator PCBs				
EC-6				
PCB 28	0.18	0.32	0.59	0.42
PCB 52	0.22	0.84	1.14	0.93
PCB 101	2.59	2.16	2.59	1.99
PCB 138	11.76	4.73	6.25	3.21
PCB 153	23.15	9.02	12.96	5.82
PCB 180	9.73	3.24	4.97	2.24
Σ Indicator PCBs	47.63	20.30	28.50	14.61
Total PCBs for Chlorinated Class				
TRI - CB	0.47	0.83	1.52	1.07
TETRA - CB	2.51	3.46	6.48	4.76
PENTA - CB	12.95	7.87	10.11	6.74
ESA - CB	51.29	18.60	26.89	12.88
EPTA - CB	18.07	6.49	9.33	4.27
Σ Chlorinated Class PCBs	85.29	37.24	54.33	29.73
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.0043	0.0020	0.0026	0.0012
2005 WHO-TEQ	0.0034	0.0016	0.0020	0.0010
Middle-bound				
1998 WHO-TEQ	0.0043	0.0020	0.0026	0.0012
2005 WHO-TEQ	0.0034	0.0016	0.0020	0.0010
Lower-bound				
1998 WHO-TEQ	0.0043	0.0020	0.0026	0.0012
2005 WHO-TEQ	0.0034	0.0016	0.0020	0.0010

Lab. Code:	DP-13-206-150114-4	DP-13-207-150114-5	DP-13-375-150114-6	DP-13-401-150114-8
Sampling Code:	JDS 27	JDS 27	JDS 65	JDS 2
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 2 -2007
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed (g):	20.921	18.797	20.747	20.492
Dry matter content (%)	22.5	26.6	24.1	24.4
Lipid (%)	4.78	4.62	2.5	2.99
Data analysed:	27-Mar-14	27-Mar-14	27-Mar-14	27-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.0088	0.0050	0.0048	0.0090
PCB-77	0.1860	0.0893	0.0834	0.2246
PCB-126	0.0162	0.0095	0.0050	0.0460
PCB-169	0.0024	0.0017	0.0010	0.0054
Mono-ortho-substituited PCBs				
PCB 105	0.636	0.438	0.318	1.265
PCB 114	0.036	0.036	0.027	0.086
PCB 118	2.317	1.639	0.826	5.621
PCB 123	0.042	0.026	0.021	0.072
PCB 156	0.518	0.377	0.136	1.776
PCB 157	0.083	0.052	0.022	0.232
PCB 167	0.373	0.254	0.084	1.169
PCB 189	0.065	0.051	0.016	0.232
Indicator PCBs				
EC-6				
PCB 28	1.02	1.34	0.58	1.09
PCB 52	1.59	0.87	0.72	1.45
PCB 101	2.89	2.01	0.98	5.93
PCB 138	5.94	4.07	1.39	16.17
PCB 153	11.21	7.07	2.73	30.94
PCB 180	3.49	2.58	1.13	9.91
Σ Indicator PCBs	26.15	17.93	7.52	65.49
Total PCBs for Chlorinated Class				
TRI - CB	2.38	3.38	1.53	3.10
TETRA - CB	10.12	3.71	3.93	10.90
PENTA - CB	12.64	7.90	4.43	25.13
ESA - CB	26.31	16.61	7.23	72.45
EPTA - CB	7.48	5.40	2.22	20.40
Σ Chlorinated Class PCBs	58.93	37.01	19.32	131.98
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.0023	0.0014	0.0007	0.0065
2005 WHO-TEQ	0.0018	0.0011	0.0006	0.0051
Middle-bound				
1998 WHO-TEQ	0.0023	0.0014	0.0007	0.0065
2005 WHO-TEQ	0.0018	0.0011	0.0006	0.0051
Lower-bound				
1998 WHO-TEQ	0.0023	0.0014	0.0007	0.0065
2005 WHO-TEQ	0.0018	0.0011	0.0006	0.0051

Lab. Code:	DP-13-402-150114-9	DP-13-403-150114-10	DP-13-404-150114-11	DP-13-405-150114-12
Sampling Code:	JDS 2	JDS 7	JDS 7	JDS 39
Project:	JDS 2 -2007	JDS 2 -2007	JDS 2 -2007	JDS 2 -2007
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed (g):	21.277	19.763	19.92	23.81
Dry matter content (%)	23.5	25.3	25.1	21.0
Lipid (%)	3.7	4.15	3.21	1.26
Data analysed:	27-Mar-14	27-Mar-14	27-Mar-14	27-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.0092	0.0056	0.0045	0.0018
PCB-77	0.2419	0.1241	0.0940	0.0371
PCB-126	0.0516	0.0251	0.0201	0.0043
PCB-169	0.0058	0.0039	0.0035	0.0009
Mono-ortho-substituited PCBs				
PCB 105	1.405	1.017	0.816	0.170
PCB 114	0.087	0.072	0.056	0.011
PCB 118	6.100	4.276	3.496	0.677
PCB 123	0.083	0.059	0.047	0.011
PCB 156	1.949	1.145	0.971	0.156
PCB 157	0.288	0.143	0.130	0.021
PCB 167	1.262	0.747	0.643	0.105
PCB 189	0.237	0.142	0.130	0.022
Indicator PCBs				
EC-6				
PCB 28	1.07	0.74	0.77	0.41
PCB 52	1.73	1.68	1.23	0.46
PCB 101	6.75	5.10	4.14	1.00
PCB 138	16.92	9.88	8.36	1.55
PCB 153	32.61	16.93	14.36	2.74
PCB 180	10.34	7.80	6.85	1.10
Σ Indicator PCBs	69.42	42.14	35.71	7.26
Total PCBs for Chlorinated Class				
TRI - CB	2.86	2.02	2.01	1.03
TETRA - CB	14.31	9.86	8.36	3.22
PENTA - CB	31.68	20.33	17.60	4.28
ESA - CB	85.44	42.43	37.70	7.61
EPTA - CB	21.23	14.23	12.97	2.31
Σ Chlorinated Class PCBs	155.52	88.87	78.64	18.45
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.0072	0.0038	0.0031	0.0006
2005 WHO-TEQ	0.0057	0.0029	0.0023	0.0005
Middle-bound				
1998 WHO-TEQ	0.0072	0.0038	0.0031	0.0006
2005 WHO-TEQ	0.0057	0.0029	0.0023	0.0005
Lower-bound				
1998 WHO-TEQ	0.0072	0.0038	0.0031	0.0006
2005 WHO-TEQ	0.0057	0.0029	0.0023	0.0005

Lab. Code:	DP-BLK-27-0314-4			
Sampling Code:	LOD			
Project:	JDS 3 -2013			
Type of sample:	Fish			
Mass wet filled Analysed (g):	20			
Dry matter content (%)	na			
Lipid (%)	na			
Data analysed:	12-May-14			
	ng/g			
Concentration:	ng/g Wet weight			
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.000030			
PCB-77	0.000030			
PCB-126	0.000030			
PCB-169	0.000030			
Mono-ortho-substituited PCBs				
PCB 105	0.0002			
PCB 114	0.0002			
PCB 118	0.0002			
PCB 123	0.0002			
PCB 156	0.0002			
PCB 157	0.0002			
PCB 167	0.0002			
PCB 189	0.0002			
Indicator PCBs				
EC-6				
PCB 28	0.0020			
PCB 52	0.0010			
PCB 101	0.0002			
PCB 138	0.0002			
PCB 153	0.0002			
PCB 180	0.0002			
Σ Indicator PCBs	0.0038			
Total PCBs for Chlorinated Class				
TRI - CB	n.a.			
TETRA - CB	n.a.			
PENTA - CB	n.a.			
ESA - CB	n.a.			
EPTA - CB	n.a.			
Σ Chlorinated Class PCBs				
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.00000369			
2005 WHO-TEQ	0.00000396			
Middle-bound				
1998 WHO-TEQ	0.00000184			
2005 WHO-TEQ	0.00000198			
Lower-bound				
1998 WHO-TEQ	0.00000000			
2005 WHO-TEQ	0.00000000			

Supplement 3: PBDE in fish

Lab. Code:	BR-13-400-150114-7	BR-13-160-150114-1	BR-13-161-150114-2	BR-13-202-150114-3
Sampling Code:	JDS 2	JDS 6	JDS 9	JDS 20
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed (g):	34.247	21.74	22.222	21.552
Dry matter content (%)	14.6	23.0	22.5	23.2
Lipid (%)	0.2	5.19	6.39	3.58
Data analysed:	31-Mar-14	31-Mar-14	31-Mar-14	31-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
BDE-28	0.013	0.049	0.034	0.038
BDE-47	1.833	1.107	0.911	1.212
BDE-99	0.009	0.050	0.074	0.033
BDE-100	0.583	0.244	0.267	0.213
BDE-153	0.010	0.082	0.104	0.061
BDE-154	0.161	0.084	0.112	0.109
BDE-183	0.001	0.006	0.008	0.005
BDE-209	0.036	0.085	0.127	0.049

Lab. Code:	BR-13-206-150114-4	BR-13-207-150114-5	BR-13-375-150114-6	BR-13-401-150114-8
Sampling Code:	JDS 27	JDS 27	JDS 65	JDS 2
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 2 -2007
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed	20.921	18.797	20.747	20.492
Dry matter content (%)	22.5	26.6	24.1	24.4
Lipid (%)	4.78	4.62	2.5	2.99
Data analysed:	31-Mar-14	31-Mar-14	31-Mar-14	31-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
BDE-28	0.045	0.023	0.011	0.094
BDE-47	1.656	0.878	0.208	4.828
BDE-99	0.024	0.030	0.026	0.032
BDE-100	0.372	0.222	0.061	0.955
BDE-153	0.073	0.035	0.021	0.146
BDE-154	0.116	0.069	0.026	0.206
BDE-183	0.004	0.003	0.002	0.005
BDE-209	0.026	0.053	0.017	0.032

Lab. Code:	BR-13-402-150114-9	BR-13-403-150114-10	BR-13-404-150114-11	BR-13-405-150114-12
Sampling Code:	JDS 2	JDS 7	JDS 7	JDS 39
Project:	JDS 2 -2007	JDS 2 -2007	JDS 2 -2007	JDS 2 -2007
Type of sample:	Fish	Fish	Fish	Fish
Mass wet filled Analysed	21.277	25.3	25.3	25.3
Dry matter content (%)	23.5	4.15	25.1	21.0
Lipid (%)	3.7	3.7	3.21	1.26
Data analysed:	31-Mar-14	31-Mar-14	31-Mar-14	31-Mar-14
Concentration:	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight	ng/g Wet weight
BDE-28	0.109	0.034	0.030	0.022
BDE-47	5.468	2.642	2.430	0.565
BDE-99	0.041	0.029	0.021	0.021
BDE-100	0.999	0.521	0.491	0.109
BDE-153	0.177	0.129	0.115	0.033
BDE-154	0.225	0.207	0.224	0.046
BDE-183	0.005	0.007	0.005	0.002
BDE-209	0.067	0.130	0.074	0.225

Lab. Code:	BR-BLK-15011414			
Sampling Code:	lod			
Project:	JDS 3 -2013			
Type of sample:	Fish			
Mass wet filled Analysed	na			
Dry matter content (%)	na			
Lipid (%)	1.26			
Data analysed:	31-Mar-14			
Concentration:	ng/g Wet weight			
BDE-28	0.001			
BDE-47	0.001			
BDE-99	0.001			
BDE-100	0.001			
BDE-153	0.001			
BDE-154	0.001			
BDE-183	0.001			
BDE-209	0.010			

Supplement 4: PCDD/F in SPM

Lab. Code:	DP-13-377-090114-1	DP-13-378-090114-2	DP-13-379-090114-3	DP-13-380-090114-4
Sampling Code:	JDS 2	JDS 6	JDS 9	JDS 13
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5	5	5	5.05
Data analysed:	31-Jan-14	31-Jan-14	31-Jan-14	31-Jan-14
Concentration:	ng/g	ng/g	ng/g	ng/g
2,3,7,8 - substituited PCDD/Fs				
2378-TCDD	0.00014	0.00003	0.00083	0.00028
12378-PeCDD	0.00044	0.00011	0.00015	0.00019
123478-HxCDD	0.00050	0.00015	0.00019	0.00018
123678-HxCDD	0.0016	0.00042	0.00062	0.00064
123789-HxCDD	0.0010	0.00029	0.00044	0.00042
1234678-HpCDD	0.028	0.0046	0.0081	0.0083
OCDD	0.172	0.029	0.045	0.051
2378-TCDF	0.0032	0.00071	0.00152	0.01341
12378-PeCDF	0.0023	0.00051	0.00088	0.00270
23478-PeCDF	0.0025	0.00052	0.00085	0.00310
123478-HxCDF	0.0028	0.00051	0.00086	0.00137
123678-HxCDF	0.0015	0.00036	0.00057	0.00068
234678-HxCDF	0.0017	0.00042	0.00070	0.00073
123789-HxCDF	0.0008	0.00013	0.00021	0.00029
1234678-HpCDF	0.0082	0.0018	0.0028	0.0029
1234789-HpCDF	0.0013	0.00026	0.00044	0.00048
OCDF	0.020	0.0040	0.0056	0.0064
Upper-bound				
I-TEQ	0.0036	0.0008	0.0020	0.0040
1998 WHO-TEQ	0.0036	0.0008	0.0021	0.0041
2005 WHO-TEQ	0.0031	0.0007	0.0019	0.0034
Middle-bound				
I-TEQ	0.0036	0.0008	0.0020	0.0040
1998 WHO-TEQ	0.0036	0.0008	0.0021	0.0041
2005 WHO-TEQ	0.0031	0.0007	0.0019	0.0034
Lower-bound				
I-TEQ	0.0036	0.0008	0.0020	0.0040
1998 WHO-TEQ	0.0036	0.0008	0.0021	0.0041
2005 WHO-TEQ	0.0031	0.0007	0.0019	0.0034
Total PCDD/Fs				
TCDD	0.0039	0.0010	0.0031	0.0024
PeCDD	0.0063	0.0014	0.0025	0.0028
HxCDD	0.018	0.0042	0.0066	0.0068
HpCDD	0.054	0.0093	0.0158	0.0164
OCDD	0.172	0.029	0.045	0.051
TCDF	0.037	0.0084	0.0187	0.0461
PeCDF	0.038	0.0078	0.0145	0.0222
HxCDF	0.018	0.0040	0.0063	0.0074
HpCDF	0.018	0.0036	0.0052	0.0054
OCDF	0.020	0.0040	0.0056	0.0064
Total PCDDs	0.254	0.045	0.073	0.079
Total PCDFs	0.130	0.028	0.050	0.088
Total PCDD/Fs	0.384	0.073	0.123	0.167

Lab. Code:	DP-13-381-090114-5	DP-13-382-090114-6	DP-13-383-090114-7	DP-13-384-090114-8
Sampling Code:	JDS 19	JDS 20	JDS 21	JDS 22
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5.05	5	4.98	4.99
Data analysed:	31-Jan-14	1-Feb-14	1-Feb-14	1-Feb-14
Concentration:	ng/g	ng/g	ng/g	ng/g
2,3,7,8 - substituited PCDD/Fs				
2378-TCDD	0.00082	0.00053	0.00100	0.00074
12378-PeCDD	0.00032	0.00032	0.00024	0.00032
123478-HxCDD	0.00035	0.00028	0.00025	0.00032
123678-HxCDD	0.00113	0.00097	0.00087	0.00108
123789-HxCDD	0.00079	0.00073	0.00064	0.00080
1234678-HpCDD	0.0146	0.0128	0.0117	0.0136
OCDD	0.091	0.119	0.070	0.087
2378-TCDF	0.00270	0.00162	0.00170	0.00185
12378-PeCDF	0.00377	0.00100	0.00104	0.00126
23478-PeCDF	0.00268	0.00103	0.00106	0.00129
123478-HxCDF	0.00402	0.00116	0.00115	0.00141
123678-HxCDF	0.00144	0.00075	0.00072	0.00082
234678-HxCDF	0.00123	0.00084	0.00092	0.00104
123789-HxCDF	0.00095	0.00027	0.00027	0.00029
1234678-HpCDF	0.0054	0.0043	0.0041	0.0044
1234789-HpCDF	0.00088	0.00058	0.00061	0.00074
OCDF	0.0133	0.0112	0.0104	0.0103
Upper-bound				
I-TEQ	0.0041	0.0022	0.0026	0.0027
1998 WHO-TEQ	0.0041	0.0023	0.0026	0.0027
2005 WHO-TEQ	0.0036	0.0021	0.0024	0.0025
Middle-bound				
I-TEQ	0.0041	0.0022	0.0026	0.0027
1998 WHO-TEQ	0.0041	0.0023	0.0026	0.0027
2005 WHO-TEQ	0.0036	0.0021	0.0024	0.0025
Lower-bound				
I-TEQ	0.0041	0.0022	0.0026	0.0027
1998 WHO-TEQ	0.0041	0.0023	0.0026	0.0027
2005 WHO-TEQ	0.0036	0.0021	0.0024	0.0025
Total PCDD/Fs				
TCDD	0.0043	0.0035	0.0038	0.0049
PeCDD	0.0046	0.0041	0.0038	0.0048
HxCDD	0.0119	0.0109	0.0097	0.0120
HpCDD	0.0300	0.0269	0.0240	0.0279
OCDD	0.091	0.119	0.070	0.087
TCDF	0.0238	0.0181	0.0187	0.0204
PeCDF	0.0262	0.0168	0.0170	0.0203
HxCDF	0.0141	0.0081	0.0084	0.0093
HpCDF	0.0103	0.0080	0.0075	0.0079
OCDF	0.0133	0.0112	0.0104	0.0103
Total PCDDs	0.142	0.165	0.112	0.136
Total PCDFs	0.088	0.062	0.062	0.068
Total PCDD/Fs	0.230	0.227	0.174	0.205

Lab. Code:	DP-13-385-270314-1	DP-13-386-090114-10	DP-13-387-090114-11	DP-13-388-090114-12
Sampling Code:	JDS 24	JDS 27	JDS 33	JDS 36
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	2.55	4.99	5.08	5.03
Data analysed:	12-May-14	1-Feb-14	1-Feb-14	1-Feb-14
Concentration:	ng/g	ng/g	ng/g	ng/g
2,3,7,8 - substituited PCDD/Fs				
2378-TCDD	0.00075	0.00051	0.00240	0.00042
12378-PeCDD	0.00038	0.00041	0.00034	0.00030
123478-HxCDD	0.00036	0.00032	0.00028	0.00031
123678-HxCDD	0.00105	0.00096	0.00090	0.00082
123789-HxCDD	0.00086	0.00071	0.00074	0.00060
1234678-HpCDD	0.0152	0.0123	0.0129	0.0126
OCDD	0.097	0.076	0.092	0.089
2378-TCDF	0.00175	0.00181	0.00173	0.00132
12378-PeCDF	0.00126	0.00136	0.00114	0.00088
23478-PeCDF	0.00123	0.00155	0.00130	0.00092
123478-HxCDF	0.00199	0.00162	0.00132	0.00117
123678-HxCDF	0.00132	0.00120	0.00090	0.00070
234678-HxCDF	0.00170	0.00146	0.00105	0.00082
123789-HxCDF	0.00046	0.00042	0.00031	0.00026
1234678-HpCDF	0.0066	0.0056	0.0051	0.0044
1234789-HpCDF	0.00089	0.00083	0.00062	0.00060
OCDF	0.0118	0.0128	0.0154	0.0133
Upper-bound				
I-TEQ	0.0029	0.0027	0.0043	0.0019
1998 WHO-TEQ	0.0030	0.0028	0.0044	0.0020
2005 WHO-TEQ	0.0027	0.0025	0.0041	0.0018
Middle-bound				
I-TEQ	0.0029	0.0027	0.0043	0.0019
1998 WHO-TEQ	0.0030	0.0028	0.0044	0.0020
2005 WHO-TEQ	0.0027	0.0025	0.0041	0.0018
Lower-bound				
I-TEQ	0.0029	0.0027	0.0043	0.0019
1998 WHO-TEQ	0.0030	0.0028	0.0044	0.0020
2005 WHO-TEQ	0.0027	0.0025	0.0041	0.0018
Total PCDD/Fs				
TCDD	0.0071	0.0055	0.0072	0.0044
PeCDD	0.0055	0.0052	0.0051	0.0038
HxCDD	0.0154	0.0113	0.0111	0.0101
HpCDD	0.0307	0.0256	0.0284	0.0272
OCDD	0.097	0.076	0.092	0.089
TCDF	0.0203	0.0201	0.0185	0.0156
PeCDF	0.0233	0.0226	0.0182	0.0142
HxCDF	0.0161	0.0123	0.0097	0.0079
HpCDF	0.0112	0.0100	0.0096	0.0084
OCDF	0.0118	0.0128	0.0154	0.0133
Total PCDDs	0.155	0.123	0.144	0.135
Total PCDFs	0.083	0.078	0.071	0.059
Total PCDD/Fs	0.238	0.201	0.216	0.194

Lab. Code:	DP-13-389-150114-1	DP-13-390-150114-2	DP-13-391-150114-3	DP-13-392-150114-4
Sampling Code:	JDS 39	JDS 43	JDS 49	JDS 53
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5.03	5.02	5	5
Data analysed:	1-Feb-14	1-Feb-14	1-Feb-14	1-Feb-14
Concentration:	ng/g	ng/g	ng/g	ng/g
2,3,7,8 - substituited PCDD/Fs				
2378-TCDD	0.00050	0.00040	0.00040	0.00017
12378-PeCDD	0.00026	0.00032	0.00041	0.00021
123478-HxCDD	0.00032	0.00031	0.00050	0.00043
123678-HxCDD	0.00107	0.00091	0.00109	0.00060
123789-HxCDD	0.00086	0.00074	0.00109	0.00084
1234678-HpCDD	0.0157	0.0138	0.0197	0.0118
OCDD	0.105	0.094	0.150	0.094
2378-TCDF	0.00195	0.00188	0.00257	0.00095
12378-PeCDF	0.00132	0.00122	0.00147	0.00055
23478-PeCDF	0.00134	0.00125	0.00175	0.00058
123478-HxCDF	0.00171	0.00133	0.00164	0.00074
123678-HxCDF	0.00105	0.00086	0.00117	0.00044
234678-HxCDF	0.00119	0.00114	0.00162	0.00057
123789-HxCDF	0.00032	0.00028	0.00037	0.00017
1234678-HpCDF	0.0062	0.0048	0.0064	0.0024
1234789-HpCDF	0.00083	0.00062	0.00080	0.00030
OCDF	0.0194	0.0125	0.0169	0.0069
Upper-bound				
I-TEQ	0.0026	0.0023	0.0030	0.0013
1998 WHO-TEQ	0.0026	0.0024	0.0031	0.0013
2005 WHO-TEQ	0.0023	0.0021	0.0027	0.0012
Middle-bound				
I-TEQ	0.0026	0.0023	0.0030	0.0013
1998 WHO-TEQ	0.0026	0.0024	0.0031	0.0013
2005 WHO-TEQ	0.0023	0.0021	0.0027	0.0012
Lower-bound				
I-TEQ	0.0026	0.0023	0.0030	0.0013
1998 WHO-TEQ	0.0026	0.0024	0.0031	0.0013
2005 WHO-TEQ	0.0023	0.0021	0.0027	0.0012
Total PCDD/Fs				
TCDD	0.0078	0.0065	0.0075	0.0035
PeCDD	0.0051	0.0050	0.0060	0.0042
HxCDD	0.0127	0.0121	0.0159	0.0117
HpCDD	0.0333	0.0309	0.0434	0.0291
OCDD	0.105	0.094	0.150	0.094
TCDF	0.0242	0.0214	0.0316	0.0099
PeCDF	0.0249	0.0215	0.0301	0.0096
HxCDF	0.0119	0.0100	0.0133	0.0048
HpCDF	0.0117	0.0087	0.0109	0.0039
OCDF	0.0194	0.0125	0.0169	0.0069
Total PCDDs	0.164	0.148	0.223	0.143
Total PCDFs	0.092	0.074	0.103	0.035
Total PCDD/Fs	0.256	0.222	0.326	0.178

Lab. Code:	DP-13-393-130114-5-b	DP-13-394-130114-6	DP-13-395-130114-7	DP-13-396-130114-8
Sampling Code:	JDS 55	JDS 57	JDS 59	JDS 60
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	4.99	4.99	5.14	5.13
Data analysed:	4-Feb-14	3-Feb-14	3-Feb-14	3-Feb-14
Concentration:	ng/g	ng/g	ng/g	ng/g
2,3,7,8 - substituited PCDD/Fs				
2378-TCDD	0.00024	0.00019	0.00027	0.00011
12378-PeCDD	0.00017	0.00024	0.00049	0.00023
123478-HxCDD	0.00029	0.00031	0.00059	0.00030
123678-HxCDD	0.00055	0.00056	0.00147	0.00045
123789-HxCDD	0.00068	0.00077	0.00160	0.00067
1234678-HpCDD	0.0096	0.0109	0.0199	0.0093
OCDD	0.084	0.089	0.119	0.079
2378-TCDF	0.00093	0.00099	0.00164	0.00063
12378-PeCDF	0.00051	0.00063	0.00103	0.00033
23478-PeCDF	0.00068	0.00067	0.00101	0.00042
123478-HxCDF	0.00079	0.00075	0.00092	0.00045
123678-HxCDF	0.00053	0.00049	0.00073	0.00031
234678-HxCDF	0.00071	0.00060	0.00080	0.00040
123789-HxCDF	0.00022	0.00015	0.00018	0.00010
1234678-HpCDF	0.0033	0.0028	0.0036	0.0019
1234789-HpCDF	0.00053	0.00038	0.00055	0.00020
OCDF	0.0107	0.0077	0.0075	0.0060
Upper-bound				
I-TEQ	0.0014	0.0014	0.0022	0.0010
1998 WHO-TEQ	0.0014	0.0014	0.0024	0.0010
2005 WHO-TEQ	0.0013	0.0013	0.0022	0.0009
Middle-bound				
I-TEQ	0.0014	0.0014	0.0022	0.0010
1998 WHO-TEQ	0.0014	0.0014	0.0024	0.0010
2005 WHO-TEQ	0.0013	0.0013	0.0022	0.0009
Lower-bound				
I-TEQ	0.0014	0.0014	0.0022	0.0010
1998 WHO-TEQ	0.0014	0.0014	0.0024	0.0010
2005 WHO-TEQ	0.0013	0.0013	0.0022	0.0009
Total PCDD/Fs				
TCDD	0.0039	0.0041	0.0241	0.0049
PeCDD	0.0032	0.0037	0.0084	0.0032
HxCDD	0.0095	0.0110	0.0176	0.0089
HpCDD	0.0227	0.0256	0.0406	0.0210
OCDD	0.084	0.089	0.119	0.079
TCDF	0.0117	0.0112	0.0160	0.0078
PeCDF	0.0118	0.0101	0.0149	0.0072
HxCDF	0.0065	0.0056	0.0071	0.0000
HpCDF	0.0060	0.0047	0.0051	0.0033
OCDF	0.0107	0.0077	0.0075	0.0060
Total PCDDs	0.123	0.133	0.210	0.117
Total PCDFs	0.047	0.039	0.051	0.024
Total PCDD/Fs	0.170	0.172	0.261	0.142

Lab. Code:	DP-13-397-130114-9	DP-13-398-270314-2	DP-13-399-130114-11		dp-jds3-lod
Sampling Code:	JDS 62	JDS 65	JDS 67		**LOD**
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013		JDS 3 -2013
Type of sample:	SPM	SPM	SPM		SPM
Mass Analysed (g):	5.01	2.29	5		5
Data analysed:	3-Feb-14	12-May-14	3-Feb-14		12-May-14
					adottati
Concentration:	ng/g	ng/g	ng/g		ng/g
2,3,7,8 - substituited PCDD/Fs					
2378-TCDD	0.00011	0.00017	0.00013		0.00003
12378-PeCDD	0.00029	0.00025	0.00034		0.00003
123478-HxCDD	0.00035	0.00032	0.00038		0.00003
123678-HxCDD	0.00058	0.00062	0.00053		0.00003
123789-HxCDD	0.00093	0.00100	0.00090		0.00003
1234678-HpCDD	0.0109	0.0106	0.0101		0.0001
OCDD	0.094	0.085	0.082		0.001
2378-TCDF	0.00059	0.00067	0.00064		0.00003
12378-PeCDF	0.00036	0.00039	0.00036		0.00003
23478-PeCDF	0.00040	0.00051	0.00035		0.00003
123478-HxCDF	0.00057	0.00061	0.00050		0.00003
123678-HxCDF	0.00039	0.00035	0.00037		0.00003
234678-HxCDF	0.00048	0.00053	0.00041		0.00003
123789-HxCDF	0.00013	0.00008	0.00013		0.00003
1234678-HpCDF	0.0020	0.0020	0.0018		0.0001
1234789-HpCDF	0.00028	0.00027	0.00028		0.00010
OCDF	0.0058	0.0074	0.0051		0.0005
Upper-bound					
I-TEQ	0.0011	0.0012	0.0011		0.00009
1998 WHO-TEQ	0.0012	0.0013	0.0012		0.00010
2005 WHO-TEQ	0.0011	0.0012	0.0011		0.00010
Middle-bound					
I-TEQ	0.0011	0.0012	0.0011		0.00004
1998 WHO-TEQ	0.0012	0.0013	0.0012		0.00005
2005 WHO-TEQ	0.0011	0.0012	0.0011		0.00005
Lower-bound					
I-TEQ	0.0011	0.0012	0.0011		0.00000
1998 WHO-TEQ	0.0012	0.0013	0.0012		0.00000
2005 WHO-TEQ	0.0011	0.0012	0.0011		0.00000
Total PCDD/Fs					
TCDD	0.0035	0.0043	0.0041		0.0001
PeCDD	0.0030	0.0031	0.0035		0.0001
HxCDD	0.0100	0.0128	0.0115		0.0000
HpCDD	0.0258	0.0374	0.0236		0.0000
OCDD	0.094	0.085	0.082		0.001
TCDF	0.0068	0.0080	0.0077		0.0000
PeCDF	0.0085	0.0070	0.0075		0.0000
HxCDF	0.0045	0.0044	0.0041		0.0001
HpCDF	0.0036	0.0036	0.0028		0.0000
OCDF	0.0058	0.0074	0.0051		0.0005
Total PCDDs	0.136	0.143	0.125		0.001
Total PCDFs	0.029	0.030	0.027		0.001
Total PCDD/Fs	0.165	0.173	0.152		0.001

Supplement 5: PCB in SPM

Lab. Code:	DP-13-377-090114-1	DP-13-378-090114-2	DP-13-379-090114-3	DP-13-380-090114-4
Sampling Code:	JDS 2	JDS 6	JDS 9	JDS 13
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5	5	5	5.05
Data analysed:	31-Jan-14	31-Jan-14	31-Jan-14	31-Jan-14
Concentration:	ng/g	ng/g	ng/g	ng/g
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.0026	0.0007	0.0011	0.0013
PCB-77	0.0913	0.0217	0.0363	0.0423
PCB-126	0.0123	0.0019	0.0039	0.0040
PCB-169	0.0024	0.0004	0.0007	0.0008
Mono-ortho-substituited PCBs				
PCB 105	0.237	0.069	0.109	0.153
PCB 114	0.011	0.005	0.006	0.007
PCB 118	0.719	0.191	0.368	0.466
PCB 123	0.011	0.004	0.005	0.006
PCB 156	0.288	0.048	0.107	0.129
PCB 157	0.045	0.008	0.016	0.019
PCB 167	0.155	0.025	0.057	0.065
PCB 189	0.049	0.007	0.016	0.019
Indicator PCBs				
EC-6				
PCB 28	0.59	0.23	0.41	0.34
PCB 52	0.58	0.27	0.51	0.45
PCB 101	1.10	0.28	0.75	0.68
PCB 138	2.36	0.43	1.08	1.13
PCB 153	3.02	0.52	1.59	1.46
PCB 180	1.94	0.29	0.77	0.86
Σ Indicator PCBs	9.59	2.03	5.09	4.91
Total PCBs for Chlorinated Class				
TRI - CB	2.08	0.99	1.44	1.21
TETRA - CB	5.51	2.22	4.28	4.34
PENTA - CB	5.19	1.41	3.26	3.08
ESA - CB	10.82	1.93	5.41	5.16
EPTA - CB	5.92	0.95	2.48	2.71
Σ Chlorinated Class PCBs	29.52	7.50	16.88	16.50
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.0015	0.0003	0.0005	0.0006
2005 WHO-TEQ	0.0014	0.0002	0.0004	0.0005
Middle-bound				
1998 WHO-TEQ	0.0015	0.0003	0.0005	0.0006
2005 WHO-TEQ	0.0014	0.0002	0.0004	0.0005
Lower-bound				
1998 WHO-TEQ	0.0015	0.0003	0.0005	0.0006
2005 WHO-TEQ	0.0014	0.0002	0.0004	0.0005
n.a.: not applicable				

Lab. Code:	DP-13-381-090114-5	DP-13-382-090114-6	DP-13-383-090114-7	DP-13-384-090114-8
Sampling Code:	JDS 19	JDS 20	JDS 21	JDS 22
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5.05	5	4.98	4.99
Data analysed:	31-Jan-14	1-Feb-14	1-Feb-14	1-Feb-14
Concentration:	ng/g	ng/g	ng/g	ng/g
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.0017	0.0018	0.0020	0.0021
PCB-77	0.0678	0.0611	0.0706	0.0704
PCB-126	0.0045	0.0042	0.0048	0.0046
PCB-169	0.0008	0.0008	0.0009	0.0009
Mono-ortho-substituited PCBs				
PCB 105	0.129	0.118	0.125	0.122
PCB 114	0.007	0.005	0.005	0.007
PCB 118	0.380	0.340	0.374	0.345
PCB 123	0.006	0.006	0.006	0.006
PCB 156	0.109	0.104	0.104	0.101
PCB 157	0.019	0.016	0.016	0.015
PCB 167	0.058	0.053	0.057	0.053
PCB 189	0.017	0.017	0.017	0.019
Indicator PCBs				
EC-6				
PCB 28	0.47	0.48	0.55	0.45
PCB 52	0.46	0.45	0.55	0.37
PCB 101	0.59	0.52	0.59	0.48
PCB 138	1.05	0.97	1.03	0.96
PCB 153	1.38	1.25	1.40	1.30
PCB 180	0.80	0.72	0.79	0.83
Σ Indicator PCBs	4.76	4.40	4.91	4.39
Total PCBs for Chlorinated Class				
TRI - CB	1.60	1.64	1.85	1.32
TETRA - CB	4.25	4.98	5.35	3.54
PENTA - CB	2.90	2.36	2.84	2.51
ESA - CB	4.84	4.32	4.54	4.45
EPTA - CB	2.55	2.29	2.42	2.54
Σ Chlorinated Class PCBs	16.13	15.59	17.00	14.35
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.0006	0.0005	0.0006	0.0006
2005 WHO-TEQ	0.0005	0.0005	0.0005	0.0005
Middle-bound				
1998 WHO-TEQ	0.0006	0.0005	0.0006	0.0006
2005 WHO-TEQ	0.0005	0.0005	0.0005	0.0005
Lower-bound				
1998 WHO-TEQ	0.0006	0.0005	0.0006	0.0006
2005 WHO-TEQ	0.0005	0.0005	0.0005	0.0005
n.a.: not applicable				

Lab. Code:	DP-13-385-270314-1	DP-13-386-090114-10	DP-13-387-090114-11	DP-13-388-090114-12
Sampling Code:	JDS 24	JDS 27	JDS 33	JDS 36
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	2.55	4.99	5.08	5.03
Data analysed:	12-May-14	1-Feb-14	1-Feb-14	1-Feb-14
Concentration:	ng/g	ng/g	ng/g	ng/g
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.0033	0.0018	0.0018	0.0016
PCB-77	0.1093	0.0572	0.0600	0.0536
PCB-126	0.0051	0.0038	0.0042	0.0038
PCB-169	0.0010	0.0007	0.0009	0.0007
Mono-ortho-substituited PCBs				
PCB 105	0.200	0.090	0.103	0.090
PCB 114	0.017	0.005	0.005	0.004
PCB 118	0.440	0.263	0.302	0.261
PCB 123	0.008	0.004	0.005	0.004
PCB 156	0.113	0.083	0.094	0.085
PCB 157	0.018	0.013	0.015	0.013
PCB 167	0.059	0.044	0.050	0.043
PCB 189	0.015	0.016	0.017	0.015
Indicator PCBs				
EC-6				
PCB 28	0.77	0.39	0.40	0.37
PCB 52	0.63	0.32	0.34	0.31
PCB 101	0.71	0.41	0.47	0.42
PCB 138	1.20	0.77	0.85	0.74
PCB 153	1.30	1.05	1.19	1.02
PCB 180	0.75	0.68	0.81	0.72
Σ Indicator PCBs	5.36	3.60	4.06	3.57
Total PCBs for Chlorinated Class				
TRI - CB	4.08	1.21	1.34	1.30
TETRA - CB	6.04	3.83	2.98	2.66
PENTA - CB	3.34	1.96	2.38	2.21
ESA - CB	5.77	3.50	4.12	3.64
EPTA - CB	1.83	2.12	2.45	2.14
Σ Chlorinated Class PCBs	21.07	12.62	13.27	11.95
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.0007	0.0005	0.0005	0.0005
2005 WHO-TEQ	0.0006	0.0004	0.0005	0.0004
Middle-bound				
1998 WHO-TEQ	0.0007	0.0005	0.0005	0.0005
2005 WHO-TEQ	0.0006	0.0004	0.0005	0.0004
Lower-bound				
1998 WHO-TEQ	0.0007	0.0005	0.0005	0.0005
2005 WHO-TEQ	0.0006	0.0004	0.0005	0.0004
n.a.: not applicable				

Lab. Code:	DP-13-389-150114-1	DP-13-390-150114-2	DP-13-391-150114-3	DP-13-392-150114-4
Sampling Code:	JDS 39	JDS 43	JDS 49	JDS 53
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5.03	5.02	5	5
Data analysed:	1-Feb-14	1-Feb-14	1-Feb-14	1-Feb-14
Concentration:	ng/g	ng/g	ng/g	ng/g
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.0035	0.0027	0.0035	0.0015
PCB-77	0.0945	0.0762	0.0968	0.0408
PCB-126	0.0056	0.0048	0.0074	0.0024
PCB-169	0.0011	0.0009	0.0015	0.0005
Mono-ortho-substituited PCBs				
PCB 105	0.172	0.174	0.221	0.074
PCB 114	0.010	0.011	0.010	0.004
PCB 118	0.492	0.466	0.684	0.204
PCB 123	0.009	0.009	0.011	0.003
PCB 156	0.122	0.110	0.166	0.047
PCB 157	0.020	0.020	0.029	0.008
PCB 167	0.063	0.055	0.101	0.026
PCB 189	0.020	0.016	0.022	0.007
Indicator PCBs				
EC-6				
PCB 28	1.05	0.74	0.81	0.45
PCB 52	0.71	0.52	0.55	0.31
PCB 101	0.74	0.61	0.90	0.33
PCB 138	1.16	1.09	1.72	0.50
PCB 153	1.63	1.37	2.59	0.68
PCB 180	0.94	0.77	1.26	0.44
Σ Indicator PCBs	6.23	5.10	7.83	2.72
Total PCBs for Chlorinated Class				
TRI - CB	3.83	2.56	2.56	1.63
TETRA - CB	6.84	5.52	5.38	3.10
PENTA - CB	3.68	3.24	4.40	1.58
ESA - CB	5.61	4.71	8.06	2.42
EPTA - CB	3.01	2.49	4.09	1.35
Σ Chlorinated Class PCBs	22.96	18.51	24.49	10.07
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.0007	0.0006	0.0010	0.0003
2005 WHO-TEQ	0.0006	0.0005	0.0008	0.0003
Middle-bound				
1998 WHO-TEQ	0.0007	0.0006	0.0010	0.0003
2005 WHO-TEQ	0.0006	0.0005	0.0008	0.0003
Lower-bound				
1998 WHO-TEQ	0.0007	0.0006	0.0010	0.0003
2005 WHO-TEQ	0.0006	0.0005	0.0008	0.0003
n.a.: not applicable				

Lab. Code:	DP-13-393-130114-5-b	DP-13-394-130114-6	DP-13-395-130114-7	DP-13-396-130114-8
Sampling Code:	JDS 55	JDS 57	JDS 59	JDS 60
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	4.99	4.99	5.14	5.13
Data analysed:	4-Feb-14	3-Feb-14	3-Feb-14	3-Feb-14
Concentration:	ng/g	ng/g	ng/g	ng/g
Dioxin-Like PCBs				
Non-ortho-substituited PCBs				
PCB-81	0.0013	0.0012	0.0122	0.0025
PCB-77	0.0353	0.0327	0.2948	0.0624
PCB-126	0.0024	0.0020	0.0077	0.0024
PCB-169	0.0005	0.0005	0.0012	0.0004
Mono-ortho-substituited PCBs				
PCB 105	0.080	0.064	0.442	0.101
PCB 114	0.005	0.004	0.040	0.009
PCB 118	0.224	0.177	1.008	0.264
PCB 123	0.002	0.003	0.028	0.006
PCB 156	0.041	0.036	0.157	0.053
PCB 157	0.009	0.007	0.027	0.008
PCB 167	0.019	0.020	0.077	0.026
PCB 189	0.008	0.006	0.030	0.010
Indicator PCBs				
EC-6				
PCB 28	0.28	0.34	2.95	0.66
PCB 52	0.22	0.23	2.04	0.47
PCB 101	0.28	0.25	1.27	0.37
PCB 138	0.46	0.40	1.65	0.55
PCB 153	0.55	0.51	2.45	0.79
PCB 180	0.26	0.28	2.14	0.66
Σ Indicator PCBs	2.05	2.00	12.50	3.50
Total PCBs for Chlorinated Class				
TRI - CB	0.93	1.21	9.17	2.29
TETRA - CB	2.85	2.14	23.81	4.30
PENTA - CB	1.40	1.27	7.83	2.14
ESA - CB	1.96	1.79	7.88	2.63
EPTA - CB	0.96	0.94	6.08	1.89
Σ Chlorinated Class PCBs	8.10	7.34	54.79	13.26
PCBs in TEQ				
Upper-bound				
1998 WHO-TEQ	0.0003	0.0003	0.0011	0.0003
2005 WHO-TEQ	0.0003	0.0002	0.0009	0.0003
Middle-bound				
1998 WHO-TEQ	0.0003	0.0003	0.0011	0.0003
2005 WHO-TEQ	0.0003	0.0002	0.0009	0.0003
Lower-bound				
1998 WHO-TEQ	0.0003	0.0003	0.0011	0.0003
2005 WHO-TEQ	0.0003	0.0002	0.0009	0.0003
n.a.: not applicable				

Lab. Code:	DP-13-397-130114-9	DP-13-398-270314-2	DP-13-399-130114-11		dp-jds3-lod
Sampling Code:	JDS 62	JDS 65	JDS 67		**LOD**
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013		JDS 3 -2013
Type of sample:	SPM	SPM	SPM		SPM
Mass Analysed (g):	5.01	2.29	5		5
Data analysed:	3-Feb-14	12-May-14	3-Feb-14		12-May-14
Concentration:	ng/g	ng/g	ng/g		
Dioxin-Like PCBs					
Non-ortho-substituited PCBs					
PCB-81	0.0013	0.0025	0.0014		0.00020
PCB-77	0.0360	0.0681	0.0377		0.00020
PCB-126	0.0015	0.0021	0.0016		0.00020
PCB-169	0.0003	0.0005	0.0003		0.00020
Mono-ortho-substituited PCBs					
PCB 105	0.078	0.159	0.085		0.0010
PCB 114	0.005	0.011	0.007		0.0010
PCB 118	0.184	0.312	0.207		0.0010
PCB 123	0.004	0.006	0.004		0.0010
PCB 156	0.040	0.073	0.039		0.0010
PCB 157	0.007	0.011	0.007		0.0010
PCB 167	0.021	0.035	0.020		0.0010
PCB 189	0.006	0.009	0.006		0.0010
Indicator PCBs					
EC-6					
PCB 28	0.43	0.64	0.56		0.010
PCB 52	0.29	0.52	0.34		0.005
PCB 101	0.26	0.56	0.29		0.001
PCB 138	0.42	0.79	0.42		0.001
PCB 153	0.52	0.91	0.55		0.001
PCB 180	0.41	0.58	0.37		0.001
Σ Indicator PCBs	2.32	4.00	2.52		0.019
Total PCBs for Chlorinated Class					
TRI - CB	1.48	3.10	2.03		n.a.
TETRA - CB	3.96	5.05	5.08		n.a.
PENTA - CB	1.30	2.76	1.40		n.a.
ESA - CB	1.76	4.40	1.90		n.a.
EPTA - CB	1.23	1.47	1.15		n.a.
Σ Chlorinated Class PCBs	9.74	16.79	11.56		n.a.
PCBs in TEQ					
Upper-bound					
1998 WHO-TEQ	0.0002	0.0003	0.0002		0.000024
2005 WHO-TEQ	0.0002	0.0003	0.0002		0.000026
Middle-bound					
1998 WHO-TEQ	0.0002	0.0003	0.0002		0.000012
2005 WHO-TEQ	0.0002	0.0003	0.0002		0.000013
Lower-bound					
1998 WHO-TEQ	0.0002	0.0003	0.0002		0.000000
2005 WHO-TEQ	0.0002	0.0003	0.0002		0.000000
n.a.: not applicable					

Supplement 6: PBDE in SPM

Lab. Code:	BR-13-377-090114-1	BR-13-378-090114-2	BR-13-379-090114-3	BR-13-380-090114-4
Sampling Code:	JDS 2	JDS 6	JDS 9	JDS 13
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	4.99	5	5	5.05
Data analysed:	7-Apr-14	7-Apr-14	7-Apr-14	7-Apr-14
BDE-28	0.013	0.006	0.008	0.007
BDE-47	0.308	0.074	0.170	0.118
BDE-99	0.437	0.090	0.168	0.131
BDE-100	0.095	0.020	0.044	0.031
BDE-153	0.092	0.017	0.026	0.018
BDE-154	0.060	0.016	0.018	0.022
BDE-183	0.068	0.019	0.018	0.017
BDE-209	17.339	1.527	2.723	6.884
Bold number: LOD				

Lab. Code:	BR-13-381-090114-5	BR-13-382-090114-6	BR-13-383-090114-7	BR-13-384-090114-8
Sampling Code:	JDS 19	JDS 20	JDS 21	JDS 22
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5.05	5	4.98	4.99
Data analysed:	7-Apr-14	7-Apr-14	7-Apr-14	7-Apr-14
BDE-28	0.008	0.008	0.007	0.007
BDE-47	0.161	0.110	0.200	0.121
BDE-99	0.164	0.119	0.291	0.131
BDE-100	0.044	0.030	0.068	0.040
BDE-153	0.036	0.038	0.053	0.033
BDE-154	0.023	0.029	0.031	0.024
BDE-183	0.019	0.031	0.021	0.030
BDE-209	8.248	7.999	6.378	6.724
Bold number: LOD				

Lab. Code:	BR-13-385-090114-9	BR-13-386-090114-10	BR-13-387-090114-11	BR-13-388-090114-12
Sampling Code:	JDS 24	JDS 27	JDS 33	JDS 36
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5.03	4.99	5.08	5.03
Data analysed:	7-Apr-14	7-Apr-14	7-Apr-14	7-Apr-14
BDE-28	0.007	0.008	0.006	0.011
BDE-47	0.166	0.104	0.106	0.092
BDE-99	0.239	0.148	0.205	0.144
BDE-100	0.054	0.039	0.043	0.040
BDE-153	0.048	0.044	0.062	0.046
BDE-154	0.033	0.026	0.048	0.038
BDE-183	0.059	0.032	0.037	0.024
BDE-209	31.740	16.673	9.581	10.127
Bold number: LOD				

Lab. Code:	BR-13-389-150114-1	BR-13-390-150114-2	BR-13-391-150114-3	BR-13-392-150114-4
Sampling Code:	JDS 39	JDS 43	JDS 49	JDS 53
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	5.03	5.02	5	5
Data analysed:	7-Apr-14	7-Apr-14	7-Apr-14	7-Apr-14
BDE-28	0.015	0.008	0.008	0.005
BDE-47	0.321	0.158	0.088	0.054
BDE-99	0.428	0.175	0.092	0.057
BDE-100	0.094	0.056	0.042	0.016
BDE-153	0.064	0.030	0.043	0.010
BDE-154	0.056	0.026	0.042	0.011
BDE-183	0.034	0.025	0.041	0.006
BDE-209	20.274	18.844	14.127	2.756
Bold number: LOD				

Lab. Code:	BR-13-393-130114-5	BR-13-394-130114-6	BR-13-395-130114-7	BR-13-396-130114-8
Sampling Code:	JDS 55	JDS 57	JDS 59	JDS 60
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013
Type of sample:	SPM	SPM	SPM	SPM
Mass Analysed (g):	4.99	4.99	5.14	5.13
Data analysed:	8-Apr-14	8-Apr-14	8-Apr-14	8-Apr-14
BDE-28	0.005	**0.004**	0.021	0.006
BDE-47	0.056	0.060	0.228	0.079
BDE-99	0.064	0.060	0.276	0.101
BDE-100	0.018	0.017	0.082	0.027
BDE-153	0.017	0.016	0.077	0.013
BDE-154	0.006	0.011	0.064	0.016
BDE-183	0.037	0.009	0.116	0.015
BDE-209	4.366	3.776	18.635	4.918
Bold number: LOD				

Lab. Code:	BR-13-397-130114-9	BR-13-398-130114-10	BR-13-399-130114-11		BR-BLK-270314-4
Sampling Code:	JDS 62	JDS 65	JDS 67		LOD
Project:	JDS 3 -2013	JDS 3 -2013	JDS 3 -2013		JDS 3 -2013
Type of sample:	SPM	SPM	SPM		SPM
Mass Analysed (g):	5.01	5.09	5		5
Data analysed:	8-Apr-14	8-Apr-14	8-Apr-14		28-Apr-14
BDE-28	0.005	**0.002**	**0.002**		0.004
BDE-47	0.060	0.046	0.055		0.004
BDE-99	0.072	0.051	0.061		0.004
BDE-100	0.020	0.014	0.017		0.004
BDE-153	0.022	0.013	0.012		0.004
BDE-154	0.013	0.014	0.011		0.004
BDE-183	0.013	0.010	0.012		0.004
BDE-209	3.208	2.859	3.266		0.100
Bold number: LOD					

Supplement 7: Dry, wet and lipid weight of the fish samples analysed

Bream samples 3013 and 2007		**wet weight**	**dry weight**	**dry matter**	**lipid weight**	**lipid matter**
JRC code	sample name	g	g	%	g	% of dw
13-160	JDS 3 2013 smp.nr **JDS 6** fish (5 subsamples pooled)	54.4	12.5	23.0	1.13	5.19
13-161	JDS 3 2013 smp.nr **JDS 9** fish (5 subsamples pooled)	63.6	14.3	22.5	1.42	6.39
13-202	JDS 3 2013 smp.nr **JDS 20** fish (2 subsamples pooled)	97.7	22.7	23.2	0.77	3.58
13-206	JDS 3 2013 smp.nr **JDS 27** fish (1 sample)	124.3	29.7	23.9	1	4.78
13-207	JDS 3 2013 smp.nr **JDS 27** fish (2 subsamples pooled)	130.3	34.6	26.6	0.87	4.62
13-375	JDS 3 2013 smp.nr **JDS 65** fish	86.3	20.8	24.1	0.52	2.50
13-400	JDS 3 2013 smp.nr **JDS 2** fish Abramis Brama (2 subsamples pooled)	91.6	13.4	14.6	0.07	0.20
13-401	JDS 2 (2007) Fish sample JDS 2 (subsample 1)	62.6	15.3	24.4	0.61	2.99
13-402	JDS 2 (2007) Fish sample JDS 2 (subsample 2)	83.1	19.5	23.5	0.79	3.70
13-403	JDS 2 (2007) Fish sample JDS 7 (subsample 1)	71.6	18.1	25.3	0.82	4.15
13-404	JDS 2 (2007) Fish sample JDS 7 (subsample 2)	77.7	19.5	25.1	0.64	3.21
13-405	JDS 2 (2007) Fish sample JDS 39 (4 subsamples pooled)	26.2	5.5	21.0	0.3	1.26

Procedure for the determination of the lipid content of the fish tissue:

All Soxhlet apparatus and the glass fiber thimbles were extracted (rinsed) 6 hours with toluene prior to extraction of the samples.

The samples were extracted 24 hours on Soxhlet (Hexane/Acetone 50/50).

Each sample was evaporated (on Soxhlet) till approx.. 30 ml, and then using warm n-hex transferred through a NA_2 SO_4 micro-column into a pre-weighed Turbovap -vial.

The sample was then evaporated under nitrogen flow to drynesss, and weighed again after cooling down 30 min (repeated till constant weight). Lipid content was then recorded.

Supplement 8: Basic data recorded at the sampling sites (HYMO_basic _data_summary)

JDS3 Code	Location name	River	rkm	Q- water discharge ($m^3 s^{-1}$) Q measured	Q hourly	Q average	Mean velocity (m/s)	Area (m^2)	D - bed material size D_{16} (mm)	D_{50} (mm)	D_{84} (mm)	C_{susp} (mg/l)	Local slope (‰)	Note
JDS2	Kelheim – gauging station	Danube	2415	230.5	238.0		1.07	215.2	6.930	9.610	22.630	4.7	0.09	
JDS3-up	Geisling power plant	Danube	2365	X			X	X	X	X	X	4.7	0.01	impounded
JDS3-down	Geisling power plant	Danube	2365	244.5			0.58	423.9	3.430	17.080	41.550	6	0.13	
JDS4	Deggendorf	Danube	2285	288.1			0.59	485.2	0.440	3.550	8.370	5.8	0.05	
JDS5	Mühlau	Danube	2258	353.3	370.0		1.2	294	5.370	12.660	21.940	3.8	0.34	
JDS6	Jochenstein	Danube	2205	886,9*			0.26	3414.6	X	X	X	27	0.03	impounded
JDS7	Upstream dam Abwinden-Asten	Danube	2121	980,8*	821.0		0.33	2953.8	0.079	0.150	0.340	20	0.02	impounded
JDS8	Oberloiben	Danube	2007	1157.6	1127.0		0.79	1473.8	15.680	31.710	50.140	13	0.03	
JDS9	Klosterneuburg	Danube	1942	1122.3	1112.0		1.08	1039.7	15.210	34.750	61.230	7.5	0.16	
JDS10	Wildungsmauer	Danube	1895	1211.8	1432.0		1.2	1012.5	22.280	41.110	64.100	13	0.20	
JDS11	Upstream Morava (Hainburg)	Danube	1882	1978.3	1793.0		1.57	1267	7.180	22.970	43.700	24	0.41	
JDS12	Morava (rkm 0.08)	Morava	1880	31.5		33.0	0.15	206.4	0.181	0.556	2.734	11	0.09	
JDS13	Bratislava	Danube	1868	1880,9*		1992.0	1.43	1315.5	14.190	26.025	40.678	24	0.25	
JDS14	Gabcikovo reservoir	Danube	1855	X			X	X	0.0027	0.0128	0.0352	14	0.00	impounded
JDS15	Medvedov/Medve	Danube	1806	1413.5	1380.0		1.15	1279.8	4.689	10.478	21.386	17	0.29	
JDS16	Moson Danube Arm – end (rkm 0.1)	Moson Danube	1794	49.3			0.15	350.6	0.069	0.185	0.378	25	0.01	
JDS17	Klizska Nema	Danube	1790	1463.1	1350.0		1.04	1403.4	3.280	7.460	14.443	15	0.22	
JDS18	Vah (rkm 0.8)	Váh	1766	99.0			0.36	272.1	0.217	0.316	0.452	11	0.00	
JDS19	Iza/Szony	Danube	1761	1527.3	1365.0		0.71	2143.1	0.242	0.414	5.918	14	0.06	
JDS20	Szob	Danube	1707	1521.1	1450.0		0.69	2209.9	0.242	0.421	12.528	10	0.06	
JDS21	Budapest upstream - Megyeri Bridge	Danube	1660	1141,7 main channel	1470.0		0.69	1663.8	0.233	0.392	2.747	12	0.06	discharge splitted Danube-side arm
JDS22	Budapest downstream - M0 bridge	Danube	1630	1482.5	1430.0		0.76	1948.2	0.706	6.471	15.245	12	0.08	
JDS23	Rackeve-Soroksar Danube Arm - rkm 59	Danube	1586	X	1500.0		X	X	X	X	X	X	X	thunderstorm
JDS24	Dunafoldvar	Danube	1560	1780.5	1740.0		1.26	1412.2	0.071	6.131	26.488	20	0.11	
JDS25	Paks	Danube	1532	1922.2			1.07	1819.9	0.242	0.421	9.240	19	0.12	
JDS26	Baja	Danube	1481	1871.2	1737.0		0.87	2146.6	0.217	0.333	0.512	22	0.04	
JDS27	Hercegszanto	Danube	1434	1898.2	1850.0		0.81	2356.3	0.221	0.333	0.495	27	0.04	
JDS28	Upstream Drava	Danube	1384	1922.3		2307.0	0.7	2744.8	0.118	0.188	0.372	33	0.01	
JDS29	Drava (rkm 1.4)	Drava	1379	493.1			0.68	726.2	0.160	0.279	0.428	32	0.04	
JDS30	Downstream Drava (Erdut/Bogojevo)	Danube	1367	2484.7		2307.0	0.81	3076.6	0.206	0.300	0.436	37	X	
JDS31	Ilok/Backa Palanka	Danube	1300	2529.1		2509.0	0.86	2953.6	0.217	0.311	0.444	38	0.05	
JDS32	Upstream Novi-Sad	Danube	1262	2642.4		2543.0	0.8	3285.5	0.210	0.305	0.436	39	X	
JDS33	Downstream Novi-Sad	Danube	1252	2815.6		2799.0	0.94	2997	0.144	0.264	0.421	50	0.02	
JDS34	Upstream Tisa (Stari Slankamen)	Danube	1216	2750.0		2799.0	0.9	3066	0.199	0.300	0.444	50	0.06	
JDS35	Tisa (rkm 1.0)	Tisa	1215	251.9			0.16	1609.6	0.147	0.269	0.421	13	X	
JDS36	Downstream Tisa/Upstream Sava (Belegis)	Danube	1199	2386 main channel			0.92	2605.3	0.217	0.311	0.444	44	0.06	Q splitted Danube-side arm
JDS37	Sava (rkm 7.0)	Sava	1170	385.1			0.15	2547.8	0.0009	0.0180	0.1151	5.5	X	
JDS38	Upstream Pancevo/Downstream Sava	Danube	1159	3171.0			0.46	6880.5	0.141	0.264	0.421	20	0.01	
JDS39	Downstream Pancevo	Danube	1151	2994.7			0.48	6315.3	0.125	0.260	0.421	17	0.07	
JDS40	Upstream Velika Morava	Danube	1107	2868.7			0.36	7754.1	0.129	0.238	0.406	8	0.01	
JDS41	Velika Morava	Velika Morava	1103	46.2			0.08	617.8	0.0515	0.2353	0.4301	16	X	
JDS42	Downstream Velika Morava	Danube	1095	3129.5		2840.0	0.38	8567	0.217	0.316	0.452	7	X	
JDS43	Banatska Palanka/Bazias	Danube	1073	2251,8*		2680.0	0.25	9115.7	0.201	9.382	21.441	7.5	X	impounded
JDS44	Irongate reservoir (Golubac/Koronin)	Danube	1040	2395,5*		2665.0	0.32	8004.1	0.0008	0.0230	0.1610	9.5	X	impounded
JDS45	Irongate reservoir (Tekija/Orsova)	Danube	956	3145,8*		2634.0	0.16	19419	0.0003	0.0020	0.0490	8	X	impounded
JDS46	Vrbica/Simijan	Danube	926	3298,8*		2651.0	0.43	8353.7	0.064	5.248	20.039	2.5	X	impounded
JDS47	Upstream Timok (Rudujevac/Gruia)	Danube	847	2546.9	2515.0		0.7	3628.2	0.340	0.975	4.289	4	0.01	
JDS48	Timok (rkm 0.2)	Timok	845	X			X	X	1.166	3.167	7.875	11	X	
JDS49	Pristol/Novo Selo Harbour	Danube	837	2527.9	2515.0		0.62	4060	0.264	0.512	1.820	4.5	0.01	
JDS50	Downstream Kozloduy	Danube	686	X			X	X	0.217	0.346	0.624	5.5	X	
JDS51	Iskar (rkm 0.3)	Iskar	637	X			X	X	0.071	0.129	0.201	31	X	
JDS52	Downstream Olt	Danube	604	2604.0			0.63	4190.4	0.225	0.365	0.746	11	X	
JDS53	Downstream Zimnicea/Svishtov	Danube	550	2620.2			0.67	3926.5	0.199	0.365	0.992	15	X	
JDS54	Jantra (rkm 1.0)	Jantra	537	13.7			0.18	79.9	0.0008	0.0043	0.2405	125	0.01	
JDS55	Downstream Jantra	Danube	532	2671.9			0.67	4005.2	0.246	0.670	17.268	9	X	
JDS56	Russenski Lom	Russenski Lom	498	X			X	X	X	X	X	X	X	
JDS57	Downstream Ruse/Giurgiu	Danube	488	X			X	X	0.221	0.346	0.658	7.5	X	
JDS58	Arges	Arges	432	X			X	X	X	X	X	17	X	wind, wave
JDS59	Downstream Arges, Oltenita	Danube	429	2816.3			0.72	3939.6	0.221	0.352	0.670	13	X	
JDS60	Chiciu/Silistra	Danube	375	2791.9	2930.0		0.6	4661.3	0.250	0.460	1.636	14	0.01	
JDS61	Giurgeni	Danube	232	2051,3 main channel	2966.0		0.61	3409	0.099	0.136	0.185	31	0.01	Q splitted Danube-side arm
JDS62	Braila	Danube	170	2900.9	2850.0		0.48	6118.7	0.166	0.284	0.436	19	0.01	
JDS63	Siret (rkm 1.0)	Siret	154	80.2			0.43	187.5	0.199	0.294	0.428	115	0.01	
JDS64	Prut (rkm 1.0)	Prut	135	60.6			0.4	160.2	0.0006	0.0020	0.0140	256	0.02	
JDS65	Reni	Danube	132	2997.5	3090.0		0.45	6602.2	0.0050	0.0880	0.3140	24	X	
JDS66	Vilkova - Chilia arm/Kilia arm	Danube	18	1352,5 arm			0.29	4731.4	0.104	0.136	0.178	21	X	Q splitted Danube-side arm
JDS67	Sulina - Sulina arm	Danube	31	738,4 arm			0.47	1592.1	0.217	0.311	0.436	21	X	Q splitted Danube-side arm
JDS68	Sf.Gheorghe - Sf.Gheorghe arm	Danube	104	1001,5 arm			0.4	2518.6	0.114	0.169	0.346	23	X	Q splitted Danube-side arm

	Danube sites	* Q - accurancy influenced by impoundment
	tributary	