Contamination of wild freshwater fish with dioxins and PCBs

Updated BfR Opinion[*] Nr. 027/2010, 16 June 2010

Freshwater fish may be contaminated with dioxins and polychlorinated biphenyls (PCBs). Based on data from the Dioxin Database Federation/Länder and the database of the Federal Office of Consumer Protection and Food Safety (BVL), the Federal Institute for Risk Assessment (BfR) has evaluated the health risks associated with the consumption of freshwater fish. In particular, it was seen that eels contain higher concentrations of dioxins and PCBs than other species of fish. More than half (64%) of all samples analysed exceeded the valid EU maximum levels of 12 pg WHO-TEQ (includes dioxins and dioxin-like PCBs) per gram wet weight. With the exception of five samples from Lake Constance, the WHO-TEQ mean values from all fresh water regions analysed for eels exceeded the legal maximum levels.

For other fish species, only isolated cases contained concentrations that far exceeded the maximum levels of 8 pg WHO-TEQ per gram wet weight specified for these fish. According to data available to BfR, 9% of samples of freshwater fish analysed – excluding eel - exceeded the maximum level.

The consumption of fatty fish such as eel can contribute considerably to the intake of dioxins and PCBs in humans. Frequent consumption of higher amounts of these kinds of fish species with increased concentrations of dioxins and PCBs should thus be avoided. However, the lifetime consumption of eel even with WHO-TEQ concentrations below the legal maximum may also cause consumers to exceed the tolerable weekly intake (TWI) value. This value applies to the intake of WHO-TEQ from all kinds of sources.

Data analysed in the present Opinion support BfR recommendations in previous Opinions which state that consumption advice may be necessary in order to protect consumers who consume large quantities of fatty fish even if concentrations do not exceed the maximum levels.

1 Subject of the assessment

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has requested from the Federal Institute for Risk Assessment (BfR) a health assessment concerning the contamination of wild freshwater fish with dioxins and PCBs. Regulation (EC) No 1881/2006 lays down maximum levels for dioxins and dioxin-like PCBs in muscle meat of fish and fishery products as well as for derived products thereof. Separate maximum levels are provided in the above mentioned Regulation for muscle meat of eel (*Anguilla anguilla*) and products thereof. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) has provided the Federal Institute for Risk Assessment with various data on fish as a basis for its health risk assessment.

[*] Update of BfR Opinion Nr. 013/2010, 12 February 2010

2 Results

The evaluation is based on data provided by the Dioxin Database Federation/Länder and the database of the Federal Office of Consumer Protection and Food Safety (BVL). As the data did not distinguish between aquaculture and wild fish, the evaluation does not differentiate between the two. The evaluation thus does not concern wild fish in particular.

The data collection is not representative. The information available cannot help to determine to what extent the measured dioxin and dioxin-like polychlorinated biphenyls (DL-PCBs) reflect the concentrations to which consumers of eel available on the German market are actually exposed.

A large portion of concentrations in eels (91% in eels with indication of origin, 64% in all eels) exceeded the maximum level of 12 pg WHO-TEQ/kg wet weight as laid down in Reg. (EC) No 1881/2006.

In isolated cases in other species of fish (excluding eel) concentrations have been analysed that far exceed the maximum levels of 8 pg WHO-TEQ/kg wet weight as laid down in Reg. (EC) No 1881/2006. Overall, 9% of levels determined in all fish exceeded the maximum levels.

Fish with dioxin and DL-PCB concentrations that exceed the maximum levels are not marketable.

Through the consumption of eel with dioxin and DL-PCB concentrations that reflect the mean concentrations of all fish analysed here, an individual who consumes a daily portion of 200 g over a period of seven to 15 weeks would – at an assumed total overall daily intake of 1 pg WHO-TEQ/kg body weight through other foodstuffs – reach 100% of the tolerable weekly intake (TWI).

However, it is possible that consumers exceed the TWI even if they consume eel with WHO-TEQ concentrations below the existing maximum levels (12 pg WHO-TEQ/g wet weight). For example, an individual who consumes a daily portion of 200 g of eel over a period of five weeks would – at an assumed total overall daily intake of 1 pg WHO-TEQ/kg body weight through other foodstuffs – reach 100% of the tolerable weekly intake (TWI).

The data evaluated in this Opinion support BfR recommendations in a previous Opinion (BfR 2006) stating that dietary recommendations may be necessary in order to protect consumers who consume large quantities of fatty fish even if concentrations do not exceed the maximum levels. The unbalanced and long-term consumption of fatty fish with high dioxin and PCB concentrations (e.g. eel) should be avoided.

Anglers and their families constitute a special risk group if they catch and consume freshwater fish from bodies of water with higher WHO-TEQ concentrations. This group of people is not protected by legislation since foodstuffs obtained in this manner are not subject to official controls. In this instance, the criteria for consumption advice introduced in the BfR Opinion of 12 October 2009 could be applied. However in the view of BfR, it is not possible to develop specific recommendations for fish consumption in relation to certain river basins, on the basis of available data.

3 Reasons

3.1 Possible risk sources

3.1.1 Dioxins and dioxin-like polychlorinated biphenyls

The chemical properties of dioxins (including polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) and dioxin-like polychlorinated biphenyls (DL-PCBs)) are defined in BfR Opinion Nr. 041/2006, 1 June 2006 (BfR 2006), which also provides clarification of the term toxic equivalents (TEQs).

In the present Opinion, the sum of dioxin TEQs (WHO-PCDD/F-TEQ) and DL-PCB TEQs (WHO-PCB-TEQ) is referred to as sum of dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ, in the text abbreviated as WHO-TEQ).

According to Regulation (EC) No 1881/2006, the following maximum levels are in force for dioxins and DL-PCBs for the food categories to be assessed here:

Table 1: Maximum levels for dioxins and DL-PCBs in Regulation (EC) No 1881/2006

Product	Maximum level	
	Sum of dioxins (WHO-PCDD/F-TEQ)	Sum of dioxins and dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ)
Muscle meat of fish and fishery products and products thereof, excluding eel	4.0 pg/g wet weight	8.0 pg/g wet weight
Muscle meat of eel (*Anguilla anguilla*) and products thereof	4.0 pg/g wet weight	12.0 pg/g wet weight

3.1.2 Wild freshwater fish

In the meeting of the Expert Committee “Persistent Organic Pollutants in Food” (POP) on 12 January 2010 in Brussels, the term “wild freshwater fish” was discussed. It was suggested that the nomenclature of Regulation (EC) No 2065/2001 laying down detailed rules for the application of Council Regulation (EC) No 104/2000 as regards informing consumers about fishery and aquaculture products be used. According to this, a potential definition of the category would be “wild freshwater fish excluding diadromous fish” (migrating fish). This definition is considered not appropriate for the present Opinion as the most comprehensive data sets available are on eels, which cannot be classified as wild freshwater fish according to this definition since eels are diadromous fish. Furthermore, according to BVL the data available allow no distinction between fish samples from wild freshwater fish and those from aquaculture. In the present Opinion, the term “freshwater fish” is used uniformly for all species for which data on levels of dioxins and dioxin-like PCBs have been provided.

3.2 Toxicology

The toxicology of dioxins and dioxin-like PCBs is also addressed in BfR Opinion Nr. 041/2001, 1 June 2006 (BfR 2006).

For the risk characterisation in the present Opinion, BfR refers to the tolerable weekly intake (TWI) derived by the Scientific Committee on Food (SCF) in 2001 for the group of dioxins and DL-PCBs expressed as WHO-TEQ of 14 pg/kg body weight (bw) as it was done in the BfR Opinion of 17 August 2009 (BfR 2009).

3.3. Exposure

BMU has provided the following data and findings from various sources on the concentrations of dioxins and PCBs:

1. Evaluation of findings available in the Dioxin Database Federation/Länder and the BVL database; BVL report of 30 October 2009 on data availability

2. Findings of the Federal Environment Agency (UBA) in the German Environmental Specimen Bank

3. Findings from Rhineland-Palatinate from 30 July 2009

4. Scientific publication “Thirty year monitoring of PCBs and organochlorine pesticides in eel from the Netherlands” and

5. UBA report of 30 September 2009

The risk characterisation is primarily based on data from the BVL report of 30 October 2009. These are depicted in Section 3.3.1.1. The additional sources listed above are summarised briefly to complement the evaluation of these data. The reports and findings listed above in Points 1-5 are addressed in Sections 3.3.1.2, 3.3.1.3 and 3.3.1.4.

3.3.1 Concentrations of WHO-TEQ in eels and fish

3.3.1.1 Evaluation of findings available in the Dioxin Database Federation/Länder as well as the findings available to the BVL database; BVL report of 30 October 2009

The most comprehensive data are provided by the evaluation of the Dioxin Database Federation/Länder as well as the BVL database (cp. 3.3. Exposure, Point 1).

The report on data (3.3. Exposure, l.c.) suggests that samples with a definitive indication of origin in regard to river basin as well as samples that lack a definitive indication of origin do not allow a distinction between aquaculture fish and samples of wild animals. The data can therefore be evaluated according to “with” or “without indication of origin”, but not according to “aquaculture” or “wild”.

The data provided are to be considered heterogeneous and not representative (cp. BVL report on data of 30 October 2009). However, the data for eels were considered suitable for statistical evaluation. The evaluation of eel and fish and fishery products excluding eel is carried out separately with the data provided.

The evaluation of the data provided is based on WHO-TEQ. Therefore, only those data are evaluated which include WHO-TEQ in the data sets provided.

Evaluation of data on eel

The data were divided and evaluated according to “eels with indication of origin”, “eels without indication of origin” and “all eels”. BVL indicated that the data are heterogeneous and not representative. An analysis of both data sets “eels with indication of origin” and “eels without indication of origin” reveals obvious differences. Thus only six out of 69 values (8.82%) in the first data set are below the maximum levels for WHO-TEQ in eels of 12 pg/g wet weight defined in Reg. (EC) No 1881/2006, while 40 out of 59 samples without indication of origin (67.8%) are below the maximum level. If all data are taken into account, 46 out of 127 (36.2%) samples are below the maximum levels. The 95th percentile of all eel samples is 53.5 pg/g wet weight and thus greatly exceeds the maximum levels for WHO-TEQ defined in Regulation (EC) No 1881/2006.

Table 2: Evaluation of data on dioxin and DL-PCB concentrations in freshwater eels in Germany based on WHO-TEQ

Matrix	Number of samples (n)	MV±SD (pg/g)	Minimum (pg/g)	Maximum (pg/g)	Number of values <12pg/g* (%)	Median (pg/g) n	P 95 (pg/g)
Eels with indication of origin	68	30.82± 14.44	3.48	68.7	6 (8.82%)	27.05	55.36
Eels without indication of origin	59	12.99 ± 15.06	1.53	89.4	40 (67.80%)	8.69	33.99
All eels	127	21.06 ± 16.50	1.53	89.4	46 (36.22%)	16.7	53.54

MW±SD: mean value ± standard deviation, P 95: 95th percentile; *12 pg/g wet weight: maximum level according to Reg (EC) No 1881/2006

High levels in samples of “eels with indication of origin” may result when samples in certain regions are perhaps taken based on certain suspected risks in contrast to samples taken of “eels without indication of origin” which might include a relatively higher portion of less contaminated aquaculture eels. However the present data include no information in regard to this aspect.

Evaluation of data on fish and fishery products excluding eel

Table 3 summarises WHO-TEQ levels of various fish species (excluding eel) in Rhine River, Lake Constance, Neckar River, Moselle River, Saar River, the Danube, the River Elbe and the Baltic Sea. A mean value was not calculated due to the high degree of heterogeneous data.

Table 3: Evaluation of data on dioxin and DL-PCB concentrations in various freshwater fish species in Germany based on WHO-TEQ

Species	Number of samples (n)	Minimum (pg/g)	Maximum (pg/g)	Number of values <8pg/g* (%)
Northern pike (*Esox lucius*)	6	0.09	2.31	6 (100%)
Common roach (*Rutilus rutilus*)	9	0.69	3.87	9 (100%)
Common dace (*Leuciscus leuciscus*)	4	1.16	7.19	4 (100%)
Tench (*Tinca tinca*)	4	0.18	35.8	2 (50%)
Carp[#] (*Cyprinus carprio*)	46	0.05	48.3	44 (96%)
Salmon** (*Salmo salar*[##])	12	0.06	3.58	12 (100%)
European perch (*Perca fluviatilis*)	8	0.12	5.77	8 (100%)
Carp bream (*Abramis brama*)	9	0.45	44.8	6 (67%)
Wels catfish (*Siluris glanis*)	4	0.26	11.1	2 (50%)
Various[§]	11	0.18	3.58	11 (100%)
All species[#]	115	0.05	48.3	105 (91%)

*8 pg/g wet weight: maximum levels according to Regulation (EG) No 1881/2006; [#]including filets and pieces; **including Baltic Sea data; [##]only filets and pieces; [§]various species with at most 2 samples: whitefish (*Coregonus sp.*), European whitefish (*Coregonus wartmanni*), zander (*Stizostedion lucioperca*), ide/id/orfe (*Leuciscus idus*), crucian carp (*Carassius carassius*), the carp family (*Cyprinidae*), perch-like fish, cod-like fish

Table 3 depicts the number of samples per species (n), the lowest and highest concentrations of dioxins and DL-PCBs, referred to as WHO-TEQ in picograms per gram as well as the number of samples that are below the maximum level of 8 pg/g WHO-TEQ. A large share (91%) of the total 115 data for WHO-TEQ is below the maximum levels laid down in Regulation (EC) No 1881/2006. In examining the maximum concentrations, isolated samples revealed very high concentrations. The highest concentration of 48.3 pg/g wet weight was determined for a carp (*Cyprinus carprio*) from a pond without further indication of origin. The two highest concentrations revealed no correlation with fat content. Very high WHO-TEQ concentrations were also found in isolated samples of carp bream (*Abramis brama*) from the Neckar and Rhine Rivers. In all cases were fish of these species exceeded the maximum levels, they were also found to contain high percentages of fat (between 6.2 and 13.2%). Additional exceedances were found in tenches (*Tinca tinca*) and wels catfish (*Siluris glanis*), though only a very small number of samples was available for these.

The data provided lead to the conclusion that the freshwater fish studied here are predominantly less contaminated than eels. However, especially for carps and carp breams, concentrations were determined that were many times higher than the maximum WHO-TEQ levels laid down in Regulation (EC) No 1881/2006. Due to the small number of samples from one region or missing information, the WHO-TEQ concentrations cannot be allocated to certain bodies of water/regions.

3.3.1.2 Findings from the Federal Environment Agency (UBA) within the German Environmental Specimen Bank (see 3.3. Exposure, Point 2)

The depiction of UBA findings within the German Environmental Specimen Bank (l.c.) show the dioxin and PCB contamination (referred to as WHO-TEQ PCB and WHO-TEQ PCDD/PCDF) of carp breams (*Abramis brama*) in Rhine and Elbe regions from the years 1995 (Rhine) and 1993 (Elbe) to 2008.

The data presented here often exceed the maximum levels for WHO-PCDD/F-TEQ and WHO-TEQ laid down in Reg. (EC) No 1881/2006 (36% of results for individual years exceed the maximum levels for WHO-PCDD/F-TEQ at the Rhine sites investigated, 27% at the Elbe sites, 75% exceed the maximum level for WHO-TEQ at the Rhine sites investigated, 30% at the Elbe sites).

At most investigation sites, the PCB share of WHO-TEQ is considerably higher than the dioxin share in the vast majority of years investigated (exception: Elbe at Blankenese since 2002). A general trend of decreasing dioxin or PCB concentrations in carp breams over the period of time investigated – as it was described for eels in the Netherlands (see 3.3. Exposure, Points 4 and 5) – cannot be verified on the basis of data presented here.

The depiction of research results provides no information regarding individual values or the number of fish analysed in each case. It can therefore not be used for a risk characterisation of dioxin and DL-PCB intake through freshwater fish for consumers in Germany.

3.3.1.3 Findings of the environmental ministry of Rhineland-Palatinate 30 July 2009 (see 3.3. Exposure, Point 3)

An additional data set provided by BMU includes data provided by the Rhineland-Palatinate environmental ministry (*Ministeriums für Umwelt, Forsten und Verbraucherschutz Rheinland-Pfalz*) of composite samples of different species of fish (excluding eel) from the Rhine River and tributaries regarding dioxins, DL-PCBs and indicator PCB (report, 30 July 2009, summary of data in Table 4).

Table 4: Dioxins and DL-PCBs in fish from the Rhine River and its tributaries

River	Number of composite samples	Number of fish	WHO-TEQ min-max (pg/g wet weigh)	Number of composite samples <8 pg WHO-TEQ /g wet weight* (%)
Rhine	16	213	2.0 – 45.0	4 (25%)
Lahn	5	86	2.1 – 6.4	5 (100%)
Ahr	3	21	2.0 – 15.5	2 (67%)
Nahe	6	21	1.0 – 20.6	2 (33%)

*8 pg WHO-TEQ/g wet weight: maximum level according to Regulation (EC) No 1881/2006; min/max: minimum/maximum detected concentration of the composite sample

The WHO-TEQ concentrations of composite samples from the Rhine were between 2 and 45 pg/g, in the Lahn River between 2.1 and 6.4 pg/g, in the Ahr between 2.0 and 15.5 pg/g and in the Nahe between 1 and 20.6 pg/g wet weight. The MUFV used these results to determine the intake of WHO-TEQ as well as the percentage of TWI and the number of weekly portions necessary to reach 100% of the TWI based on an assumed portion size of 200 g and a body weight of 60 kg. These were used to derive dietary recommendations for the examined rivers based on BfR criteria ("Criteria for dietary recommendations for freshwater fish contaminated with dioxins and PCBs" (BfR 2009)) (cp. leaflet for anglers in Rhineland-Palatinate[1]). For example, if the additional intake of dioxins through other foodstuffs is also taken into account, the consumption of a 200 g portion of the analysed fish from the Rhine within a span of four weeks and a budgetary consideration of the TWI concept would be just about tolerable.

In contrast to the data referred to in 3.3. Exposure, Point 1 due to the exact indication of origin, these data allow an evaluation of individual stretches of river provided the samples are representative.

3.3.1.4 Research report "Thirty year monitoring of PCBs and organochlorine pesticides in eel from the Netherlands" and UBA report of 30 September 2009 (3.3. Exposure, Points 4 and 5)

Both articles refer to data on PCB concentrations in composite samples from 25 eels each from the Netherlands from 1977 to 2007. The data collection is described as representative (cp. UBA report of 30 September 2009). The temporal trend of the development of concentrations suggests that a permanent decrease below the legal maximum levels of 12 pg WHO-TEQ/g wet weight cannot be expected until after 2055.

As the published results do not include the values of WHO-TEQ concentrations, the data of the study cannot be used for a risk characterisation in the present Opinion. However, it is revealed that a decrease in contamination to a tolerable level is expected to take many years.

3.3.2 Consumption

Based on the available data, a model exposure scenario will be calculated in which hypothetical consumption and contamination data are contrasted in order to derive the resulting tolerable weekly intake (TWI) reached. This model calculation is carried out according to the BfR Opinion on the 18th meeting of the Bund/Länder working group DIOXINE (17 June 2009) on the topic of dioxin and PCB contaminants in certain foodstuffs, agenda item 1, development of criteria for consumption advice or marketing ban (BfR 2009). This model calculation is based on an assumed portion of 200 g eel or fish and fishery products of other species excluding eel.

3.4 Risk characterisation

3.4.1 Eel

The calculation of hypothetical intake of WHO-TEQ through the consumption of one portion of eel was carried out according to the BfR Opinion on the development of dietary criteria (BfR 2009) (Table 5). This assumes one portion of 200 g. The following depicts a comparable evaluation (Table 6) based on data provided on WHO-TEQ in eel (see 3.3. Exposure,

[1] *"Merkblatt für Angler in Rheinland-Pfalz"*, published in April 2010: available in German at: http://www.wasser.rlp.de/servlet/is/2027/Merkblatt_April2010.pdf?command=downloadContent&filename=Merkblatt_April2010.pdf

Point 1). Also based on an assumed portion size of 200 g, the 5th and 95th percentiles as well as the median values were used as basis.

These data were used to calculate the points at which the consumption of 200 g of eel with certain WHO-TEQ concentrations (not taking into account other foodstuffs) would reach or exceed the TWI (Tables 3 and 4). Furthermore, it was indicated how often (rounded to full weeks) 200 g of eel with certain WHO-TEQ concentrations could be consumed provided that 100% of the TWI is reached. All other foodstuffs with the exception of eel were taken into account at a total mean daily intake of 1 pg WHO-TEQ/kg bw.

Table 5: Hypothetical intake of dioxins and PCBs (WHO-TEQ) through the consumption of eel and the resulting share of TWI reached depending on the frequency of portions consumed

WHO-TEQ concentrations in eel (pg/g eel)	WHO-TEQ concentrations per 200g of eel* (pg)	WHO-TEQ intake through the consumption of 200g of eel* (pg/kg BW)**	Share of TWI# reached through the consumption of 200g of eel# (%)	100% TWI# reached through the consumption of 200g eel in x weeks##
2	400	6.7	48	1
4	800	13.3	96	2
6	1200	20.0	143	3
8	1600	26.7	191	4
10	2000	33.3	238	5
12	2400	40.0	286	6
15	3000	50.0	357	8
20	4000	66.7	476	10
25	5000	83.3	595	12
30	6000	100.0	714	15
35	7000	116.7	834	17
40	8000	133.3	950	19
45	9000	150.0	1071	22
50	10000	166.7	1161	24

*based on a portion size of 200 g
**calculated for one person weighing 60 kg
#TWI: 14 pg WHO-TEQ per kg BW per week (SCF 2001)
##all other foodstuffs except fish (only eel is assumed for the consumption of fish) are taken into account in total at a mean daily intake of 1 pg WHO-TEQ/kg BW. The weeks have been rounded to full weeks.

Table 6: Intake of dioxins and PCBs (WHO-TEQ) through the consumption of eel and the resulting share of TWI reached depending on the frequency of consumption based on collected data (see 3.3. Exposure, Point 1)

WHO-TEQ concentrations in eel (pg/g eel)		WHO-TEQ concentrations per 200g of eel (pg)	WHO-TEQ intake through the consumption of 200g of eel* (pg/kg BW)**	Share of TWI# reached through the consumption of 200g of eell# (%)	100% TWI# reached through the consumption of 200g eel in x weeks##
Data of eels with indication of origin					
P 05	5.32	1064	17.7	127	3
P 95	55.36	11072	184.5	1318	27
Median	27.05	5410	90.2	644	13
MV	30.82	6164	102.7	734	15
Data of eels without indication of origin					
P 05	2.24	448	7.5	53	1
P 95	33.99	6798	113.2	809	17
Median	8.69	1738	29.0	207	5
MV	12.99	2598	43.3	309	7
Data of all eels					
P 05	2.65	531	8.8	63	2
P 95	53.54	10708	178.5	1275	26
Median	16.70	3340	55.7	398	8
MV	21.06	4211	70.2	501	10

MV: mean value
*based on a portion size of 200 g
**calculated for one person weighing 60 kg.
#TWI: 14 pg WHO-TEQ per kg BW per week
##all other foodstuffs except fish (only eel is assumed for the consumption of fish) are taken into account in total at a mean daily intake of 1 pg WHO-TEQ/kg BW. The weeks have been rounded to full weeks.

On the basis of the data sets provided (not representative), it must be assumed that the risk of consumption of eel containing concentrations of dioxins and DL-PCBs that exceed the maximum levels laid down in Regulation (EC) No 1881/2006 is high. Even at minimum concentrations of 1.53 pg WHO-TEQ/g that were detected, the consumption of one portion of eel (200 g) would constitute up to 35% of the TWI. It must be considered that, taking into account all data collected for eel, only about one third were found to contain concentrations below the maximum level of WHO-TEQ (12 pg/g wet weight) laid down in Regulation (EC) No 1881/2006. The overall high concentrations in samples of “eel with indication of origin” are therefore due to the fact that many regions are especially contaminated.

3.4.2 Fish and fishery products excluding eel

The consumption scenario for the hypothetical intake of dioxins and DL-PCBs in Table 5 can be applied to all species of fish. Refer to the BfR Opinion on the 18th meeting of the Bund/Länder working group DIOXINE (17 June 2009) on the topic of dioxin and PCB contaminants in certain foodstuffs (BfR 2009) in this regard. Due to insufficient data, a comparable evaluation based on data provided on WHO-TEQ concentrations in fish (see 3.3. Exposure, Point 1) is not possible.

Overall the WHO-TEQ concentrations in species summarised under “fish and fishery products excluding eel” were considerably lower than in eels. Model calculations were therefore carried out for concentrations of 0.05 to 2 pg WHO-TEQ/kg wet weight and the resulting share of TWI reached in addition to Table 3 (Table 7). The calculated shares of TWI reached illustrate that even the consumption of 200g of fish containing 2 pg WHO-TEQ/g wet weight with PCDD/F + DL-PCB concentrations below the maximum levels laid down in Reg. (EC) No 1881/2006 can lead to a 48% share of TWI. This does not take the intake through other foodstuffs into account. At concentrations of 0.5 pg/kg PCDD/F + DL-PCB, the consumption of a 200 g portion constitutes 12% of the TWI (only through the consumption of fish). If an additional total mean daily intake of 1 pg WHO-TEQ per kg body weight through other foodstuffs is also taken into account, 3 portions of fish at 200 g with a WHO-TEQ concentration of 0.5 pg/g fish lead to 100% of the tolerable weekly intake.

105 out of 115 samples (91%) of the species of fish taken into consideration were found to contain dioxin and DL-PCB concentrations below the maximum level of 8 pg WHO-TEQ/g wet weight laid down in Regulation (EC) No 1881/2006. Exceedances of maximum levels were determined in 10 out of 115 samples (9%). The maximum concentration was 48.3 pg WHO-TEQ/g wet weight in one carp. Due to a lack of indication of origin or few data with indication of origin, no relationship can be established between WHO-TEQ concentrations and the river basins in question.

Table 7: Hypothetical intake of dioxins and PCB (WHO-TEQ) through the consumption of fish and the resulting share of TWI reached depending on frequency of portions consumed

WHO-TEQ concentrations in fish (pg/g fish)	WHO-TEQ concentrations per 200g of fish* (pg)	WHO-TEQ intake through the consumption of 200g of fish* (pg/kg BW)**	Share of TWI# reached through the consumption of 200g of fish (%)	Share of TWI# reached through the consumption of 200g fish in x weeks##
0.05	19	0.2	1	0.03
0.10	20	0.3	2	0.04
0.50	100	1.7	12	0.2 (3x/week)
1.00	200	3.3	24	0.5 (2x/week)
1.50	300	5.0	36	0.7 (1x/week)
2.00	400	6.7	48	1 (1x/week)

*based on a portion size of 200 g
**calculated for one person weighing 60 kg
#TWI: 14 pg WHO-TEQ per kg BW per week
##all other foodstuffs except fish are taken into account in total at a mean daily intake of 1 pg WHO-TEQ/kg BW. The weeks have been rounded to full weeks.

4 References

BfR 2006: EU-Höchstgehalte für Dioxine und dioxinähnliche PCB in Fisch schützen Vielverzehrer von fetthaltigem Fisch nicht immer ausreichend; Gesundheitliche Bewertung Nr. 041/2006 des BfR vom 1. Juni 2006 [Online]; Available online in German only: http://www.bfr.bund.de/cm/208/eu_hoechstgehalte_fuer_dioxine_und_dioxinaehnliche_pcb_in_fisch.pdf (retrieved 2 Februar 2010)

BFR 2009: Stellungnahme zum Follow up der 18. Sitzung der Bund/Länder-Arbeitsgruppe Dioxine (17. Juni 2009) zum Thema „Kontaminanten bestimmter Lebensmittel mit Dioxinen und PCB", TOP 1, Erarbeitung von Kriterien für Verzehrsempfehlungen bzw. Verkehrsverbote

SCF 2001: Opinion of Scientific Committee on Food on the Risk Assessment of Dioxins and Dioxin-like PCBs in Food. Available on http://ec.europa.eu/food/fs/sc/scf/out90_en.pdf (retrieved 9 February 2010)

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