

**Results for Radionuclides in Biota Samples from
2005 and summer 2006**

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This report shows the data obtained from analysing the samples collected on Walther Herwig III cruises in 2005 and in summer 2006. Due to minimal storage capacities in our present laboratory in Hamburg, samples collected in December 2006 were stored in Cuxhaven and will arrive in Hamburg by the end of June 2007. The sampling sites are shown in Fig. 1; note that some of the sites refer to the samples collected in December 2006.

The gamma spectrometric data of fish samples are given in Table 1. Collection of samples referred only to the HELCOM basins 5 (Belt Sea) and 2 (Arkona Sea). Practically, the Chernobyl-derived ^{134}Cs is no longer detectable.

In addition, the updated graphical presentation about the temporal development of ^{137}Cs in cod fillet within four HELCOM basins is shown in Fig. 2. The model curves represent the concentrations averaged between bottom and surface layer ^{137}Cs concentrations in seawater. The expected general decrease of ^{137}Cs within the last 10 years, as demonstrated by model curves for fish from a simplified version of S.P. Nielsen's box-model, is more obviously for the more eastern basins Arkona Sea (2), Bornholm Sea (6) and Southern Baltic Proper (4). The reason that this does not show up as clearly in the Belt Sea (5) is given by the circumstance, that since the early 1990ies more samples came from the eastern part of the Belt Sea box, from the Mecklenburg bay area, however, this is no longer true for samples taken since about 2000. So, there seems to be an underestimation by the model within Belt Sea fish. The different fish concentration factors used in the model curves are given in the legends of Fig. 2. A very rough value of 250 days was used for the biological half-life in order to smooth out the sharp Chernobyl peak found in seawater. It must be emphasised that apart from the Belt Sea the definition of the boxes between HELCOM and the box-model are "not very congruent". However, the averaging of the two layer concentrations from the model improved the agreement between measured data and model mainly in the temporal region of the main increase after the Chernobyl fallout.

In Fig. 2, one outlying value occurred in 2000 in the Southern Baltic Proper: this belonged to a single-specimen-sample of a very large fish, with a total length of 127 cm.

Few samples of other fish than cod (Table 1) showed ^{137}Cs values between about 1 and 5 Bq kg^{-1} ww.

Some results (not yet completed) of alpha spectrometric analyses and analyses of ^{90}Sr of fish samples are shown in Table 2. ^{90}Sr in whole fish sprat is about an order of magnitude larger than the very low values measured in two cod fillet samples. There was only one significant ratio $^{238}\text{Pu}/^{239,240}\text{Pu}$ (in the Kiel Bight) found in three whole fish sprat samples, which is slightly above what we can expect from global fallout. This may indicate an influence of Sellafield/la Hague discharges, for which we found corresponding ratios of about 0.16 in North Sea fish samples.

The samples of small sprat measured as whole fish appear to be very good indicators of Plutonium and Americium isotopes as well as for ^{90}Sr , which makes it more attractive to continue these special analyses in sprat rather than in fish fillets.

For other biota, *Fucus vesiculosus* and *Mytilus edulis* from the station in the 'Greifswald Bodden', the obtained results are shown in table 3. For the 2006 samples, the radiochemistry analyses are still outstanding. Three of the four significantly measured ratios $^{238}\text{Pu}/^{239,240}\text{Pu}$

show a good agreement with an average of about 0.041. This also agrees well with an average of 0.040 obtained for corresponding samples from 2000 to 2003.

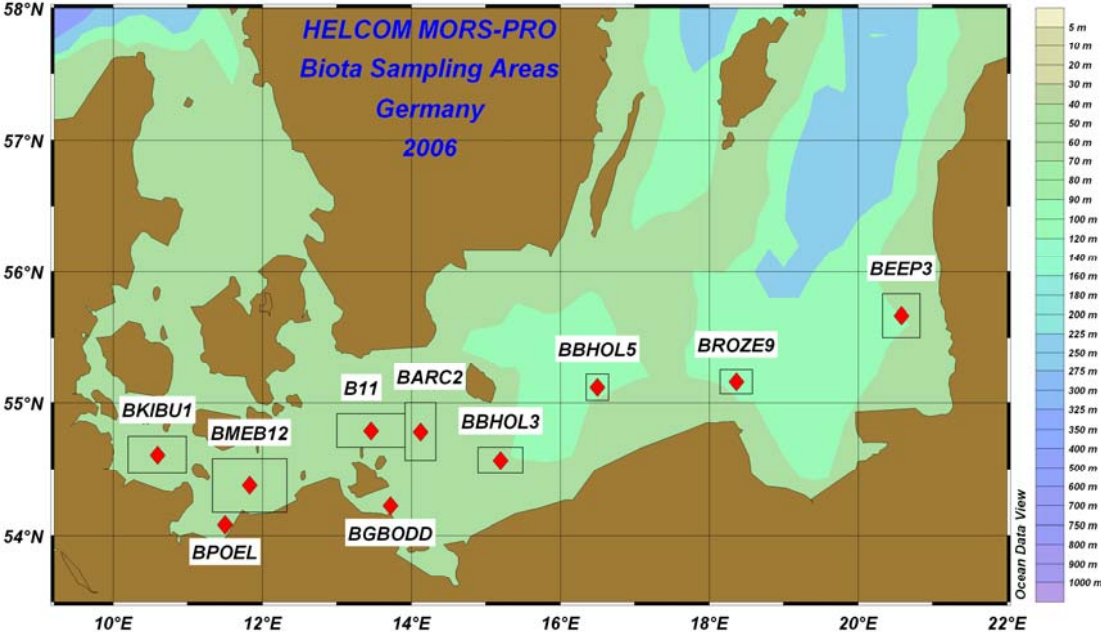
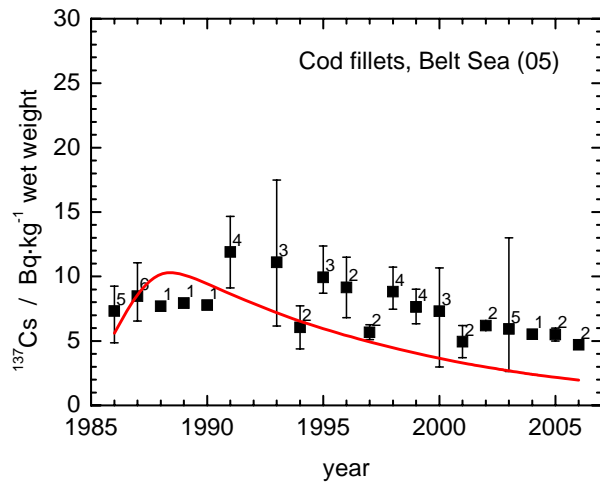
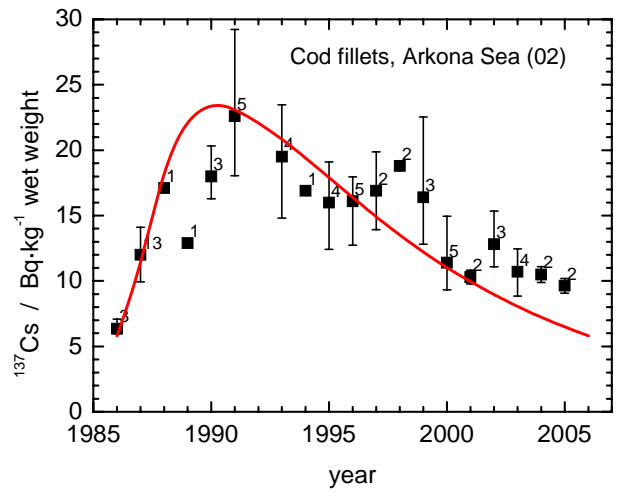


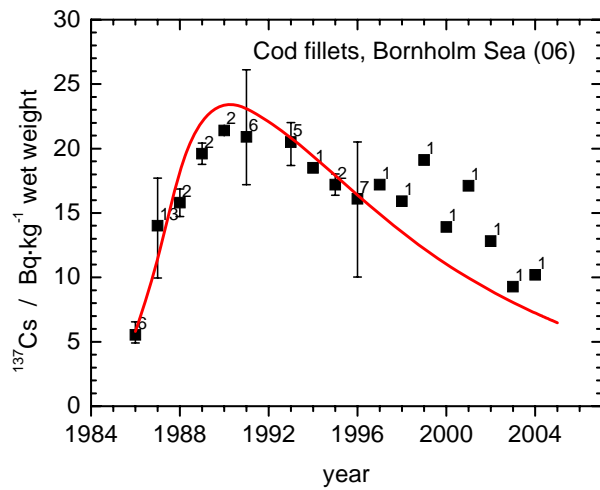
Fig. 1: German MORS-PRO biota sampling sites in 2005 and 2006



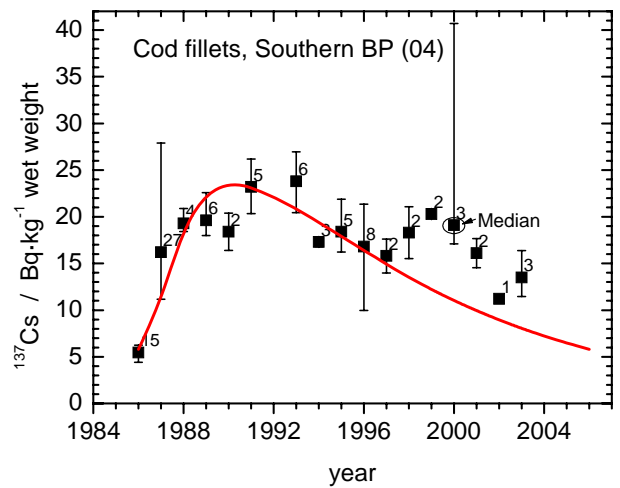
model: Belt Sea; CF = 100 l/kg; $T_{\text{bio}} = 250$ d



model: BS east; CF = 180 l/kg; $T_{\text{bio}} = 250$ d



model: BS east; CF = 180 l/kg; $T_{\text{bio}} = 250$ d



1 value of 40.7: from a sample of 1 large cod (127 cm) from the south-east of the Southern BP;
model: BS east; CF = 180 l/kg; $T_{\text{bio}} = 250$ d

Fig. 1: ^{137}Cs mean values in cod from different boxes (bars indicate the min-max ranges, not standard deviations; sample numbers indicated) and box-model curves; the latter are averaged between bottom and surface layer seawater.

Table 1: Results of gamma spectrometric analyses of fish (in Bq kg⁻¹ wet w.), 2005 and summer of 2006; uncertainties as \pm SD(%)

Species	Date	Station	Basin	Position	⁴⁰ K	¹³⁴ Cs	¹³⁷ Cs
Cod fillets	05.09.2005	BARC2	2	54°46.09'N 13°56.83'E	1.34E+2 \pm 3.6	1.38E-2 \pm 25.	1.02E+1 \pm 3.5
	06.09.2005	BARC2	2	54°46.02'N 13°28.88'E	1.23E+2 \pm 3.6	1.44E-2 \pm 23.	9.07E+0 \pm 3.5
	04.09.2005	BMEB12	5	54°22.67'N 11°23.08'E	1.41E+2 \pm 3.6	<1.48E-2	5.00E+0 \pm 3.5
	07.09.2005	BKIBU1	5	54°29.51'N 10°41.32'E	1.53E+2 \pm 3.6	<3.14E-2	6.00E+0 \pm 3.5
Cod liver	05.09.2005	BARC2	2	54°46.09'N 13°56.83'E	2.96E+1 \pm 3.9	<1.03E-2	1.21E+0 \pm 3.8
	06.09.2005	BARC2	2	54°46.02'N 13°28.88'E	3.03E+1 \pm 3.9	<1.43E-2	1.06E+0 \pm 3.8
	04.09.2005	BMEB12	5	54°22.67'N 11°23.08'E	3.43E+1 \pm 4.0	<2.63E-2	5.29E-1 \pm 4.1
	07.09.2005	BKIBU1	5	54°29.51'N 10°41.32'E	5.36E+1 \pm 4.0	<7.22E-2	6.93E-1 \pm 4.4
Sprat, whole fish	05.09.2005	BARC2	2	54°46.09'N 13°56.83'E	1.07E+2 \pm 3.6	<8.78E-3	5.46E+0 \pm 3.5
	06.09.2005	BARC2	2	54°46.02'N 13°28.88'E	1.06E+2 \pm 3.6	8.36E-3 \pm 27.	5.45E+0 \pm 3.5
	04.09.2005	BMEB12	5	54°17.90'N 11°27.70'E	1.08E+2 \pm 3.6	<1.46E-2	3.30E+0 \pm 3.5
	07.09.2005	BKIBU1	5	54°34.23'N 10°29.91'E	1.10E+2 \pm 3.6	<1.11E-2	2.94E+0 \pm 3.5
Herring, whole fish	06.09.2006	BARC2	2	54°50.24'N 13°59.98'E	1.11E+2 \pm 3.6	<1.08E-2	4.92E+0 \pm 3.5
	07.09.2006	BKIBU1	5	54°32.15'N 10°37.57'E	1.23E+2 \pm 3.6	<1.60E-2	2.67E+0 \pm 3.5
Cod fillets	04.09.2006	BMEB12	5	54°26.88'N 11°22.46'E	1.22E+2 \pm 3.6	<1.01E-2	4.70E+0 \pm 3.5
	07.09.2006	BKIBU1	5	54°32.15'N 10°37.57'E	1.35E+2 \pm 3.6	<1.40E-2	4.70E+0 \pm 3.5
Dab, whole fish	04.09.2006	BMEB12	5	54°26.88'N 11°22.46'E	1.05E+2 \pm 3.6	<1.08E-2	9.21E-1 \pm 3.6
	07.09.2006	BKIBU1	5	54°32.15'N 10°37.57'E	1.05E+2 \pm 3.6	<1.32E-2	1.13E+0 \pm 3.6
Flounder, fillets	05.09.2006	BARC2	2	54°50.63'N 14°02.26'E	1.10E+2 \pm 3.6	7.65E-3 \pm 24.	5.00E+0 \pm 3.5
	06.09.2006	BARC2	2	54°41.80'N 13°49.06'E	1.12E+2 \pm 3.6	<9.32E-3	4.90E+0 \pm 3.5
Plaice, fillets	05.09.2006	BARC2	2	54°56.75'N 14°13.93'E	1.12E+2 \pm 3.6	<1.14E-2	2.57E+0 \pm 3.5
Sprat, whole fish	06.09.2006	BARC2	2	54°50.24'N 13°59.98'E	1.03E+2 \pm 3.6	<1.18E-2	4.68E+0 \pm 3.5

Note: Whole fish samples consisted of rather small fish being too small for taking fillets.

Table 2: Results of alpha spectrometric analyses (in Bq kg⁻¹ wet w.) of fish, 2005; uncertainties as ±SD(%)

Species	Date	Station	Basin	Position	⁹⁰ Sr	²³⁸ Pu	^{239,240} Pu	²⁴¹ Am	²³⁸ Pu/ ^{239,240} Pu	²⁴¹ Am/ ^{239,240} Pu
Cod fillets	05.09.2005	BARC2	2	54°46.09'N 13°56.83'E	1.46E-3 ±25.					
	06.09.2005	BARC2	2	54°46.02'N 13°28.88'E	1.45E-3 ±22.					
	04.09.2005	BMEB12	5	54°22.67'N 11°23.08'E		<2.61E-5	<3.51E-5	<2.78E-5		
	07.09.2005	BKIBU1	5	54°29.51'N 10°41.32'E						
Sprat, whole fish	05.09.2005	BARC2	2	54°46.09'N 13°56.83'E		<5.73E-5	9.51E-4 ±4.2	3.89E-4 ±5.8	<0.0603	0.409
	06.09.2005	BARC2	2	54°46.02'N 13°28.88'E	2.19E-2 ±3.7	<5.21E-5	2.82E-4 ±7.9	9.74E-5 ±12.	<0.1848	0.345
	04.09.2005	BMEB12	5	54°17.90'N 11°27.70'E	1.31E-2 ±4.8					
	07.09.2005	BKIBU1	5	54°34.23'N 10°29.91'E	7.53E-3 ±10.	4.63E-5 ±26.	5.94E-4 ±5.9	3.30E-4 ±6.9	0.0779	0.556

Table 3: Results of analyses of *Fucus vesiculosus* and *Mytilus edulis* (whole body, in Bq kg⁻¹ dry w.), 2005 and summer of 2006, uncertainties as \pm SD(%)

Species	Datum	Station	Basin	Position	⁴⁰ K	¹³⁴ Cs	¹³⁷ Cs
<i>Fucus</i>	15.07.2005	BGBODD	2	54°13.00'N 13°43.00'E	6.76E+2 \pm 3.6	<1.60E-1	1.65E+1 \pm 3.5
<i>vesiculosus</i>	15.10.2005	BGBODD	2	54°13.00'N 13°43.00'E	8.48E+2 \pm 3.6	<1.28E-1	2.60E+1 \pm 3.5
<i>Mytilus</i>	15.07.2005	BGBODD	2	54°13.00'N 13°43.00'E	8.70E+1 \pm 3.8	<1.04E-1	2.36E+0 \pm 3.9
<i>edulis</i>	15.10.2005	BGBODD	2	54°13.00'N 13°43.00'E	8.69E+1 \pm 3.8	<8.84E-2	2.45E+0 \pm 3.9
<i>Fucus</i>	01.04.2006	BGBODD	2	54°13.00'N 13°43.00'E	7.06E+2 \pm 3.6	<1.69E-1	2.92E+1 \pm 3.5
<i>vesiculosus</i>	01.10.2006	BGBODD	2	54°13.00'N 13°43.00'E	7.27E+2 \pm 3.6	<1.12E-1	2.10E+1 \pm 3.5
<i>Mytilus</i>	01.04.2006	BGBODD	2	54°13.00'N 13°43.00'E	7.80E+1 \pm 3.8	<1.03E-1	1.72E+0 \pm 4.0
<i>edulis</i>	01.10.2006	BGBODD	2	54°13.00'N 13°43.00'E	7.44E+1 \pm 3.8	<9.13E-2	1.62E+0 \pm 4.1

Note: the complete information about the sampling date of the 2006 samples was lost from the sample bags while these were stored for a longer time at Rostock and transported to Hamburg in 2007. The date values shown are only fictive ones, we cannot really differentiate between them; however, the ¹³⁷Cs are in good agreement.

Species	Datum	Station	Basin	Position	⁹⁰ Sr	²³⁸ Pu	^{239,240} Pu	²⁴¹ Am	²³⁸ Pu/ ^{239,240} Pu	²⁴¹ Am/ ^{239,240} Pu
<i>Fucus</i>	15.07.2005	BGBODD	2	54°13.00'N 13°43.00'E		1.31E-3 \pm 22.	2.96E-2 \pm 4.3	5.22E-3 \pm 10.	0.0443	0.176
<i>vesiculosus</i>	15.10.2005	BGBODD	2	54°13.00'N 13°43.00'E		1.31E-3 \pm 11.	3.50E-2 \pm 3.0	4.27E-3 \pm 11.	0.0374	0.122
<i>Mytilus</i>	15.07.2005	BGBODD	2	54°13.00'N 13°43.00'E	7.21E+0 \pm 2.6	<9.44E-4	1.42E-2 \pm 6.4	3.99E-3 \pm 15.	<0.0665	0.281
<i>edulis</i>	15.10.2005	BGBODD	2	54°13.00'N 13°43.00'E	6.39E+0 \pm 2.6	8.47E-4 \pm 31.	2.07E-2 \pm 4.6	7.01E-3 \pm 12.	0.0409	0.339