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Background

This document contains monitoring results of radioactive contaminations of bottom sediments and fish in the southern Baltic Sea in 2018.

Action

The Meeting is invited to take note of the information.

Radioactive contaminations of bottom sediments and fish in the southern Baltic Sea, 2018

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Bottom sediments

Determinations of radioactive contamination of bottom sediments were performed in samples collected in June 2018. As in previous years, sediments core samples were collected at 6 sampling locations during the cruise onboard r/v Baltica – Fig.1.

In 2018, ^{137}Cs and ^{40}K were determined in samples from each location, while determinations of ^{238}Pu and $^{239,240}\text{Pu}$ were limited to two chosen sampling locations. ^{90}Sr was analyzed in the pooled samples from all sampling stations.

The activity concentrations of ^{137}Cs and ^{40}K were determined by gamma spectrometry, plutonium isotopes by radiochemical method and alpha spectrometry, ^{90}Sr was analyzed using radiochemical method and the measurement of ^{90}Y activity concentration after establishing the radioactive equilibration of ^{90}Sr - ^{90}Y .

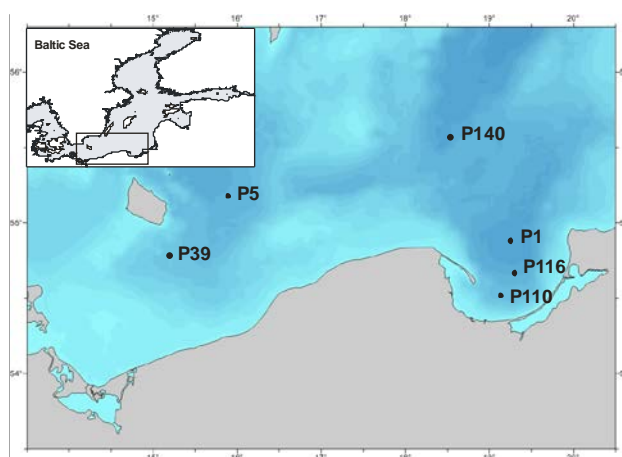


Figure 1. Bottom sediment and water sampling stations

The vertical distributions of ^{137}Cs activity concentrations in bottom sediments in 2018 are shown in Figure 2. At all stations concentrations of ^{137}Cs decrease along the sediment profiles even to single Bq in the deepest layers. There were observed differences in the concentrations related to the location, as it was found in the previous years [1, 2]. The highest concentrations of ^{137}Cs , observed in the Gdansk Basin (P 110, P 116, P 1), were in the range $176 \div 227 \text{ Bq kg}^{-1}_{\text{dw}}$, while in the Bornholm Basin (P 5, P 39) the concentrations in the upper layers were equal to $52.5 \text{ Bq kg}^{-1}_{\text{dw}}$ and $62.3 \text{ Bq kg}^{-1}_{\text{dw}}$, respectively.

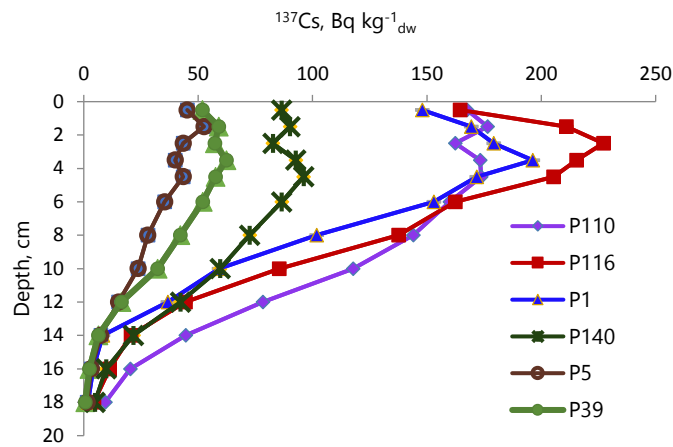


Figure.2. Activity concentrations of ^{137}Cs in bottom sediments

Determination of plutonium in bottom sediments is carried out every three years. In 2018, plutonium analysis was performed in samples from two locations: Eastern Gotland Basin (P 140) and Bornholm Deep (P 5). At station P140 activity concentration of $^{239,240}\text{Pu}$ increase from $1.29 \text{ Bq kg}^{-1}_{\text{dw}}$ observed in the 0-1 cm layer to the maximum concentration - $2.11 \text{ Bq kg}^{-1}_{\text{dw}}$ in the 5-7 cm layer, below which its successive decrease to $0.17 \text{ Bq kg}^{-1}_{\text{dw}}$ was observed in the deepest layer. At station P5 concentrations of $^{239,240}\text{Pu}$ were lower and maximum - $1.28 \text{ Bq kg}^{-1}_{\text{dw}}$ was in 4-5 cm layer (Figure 3).

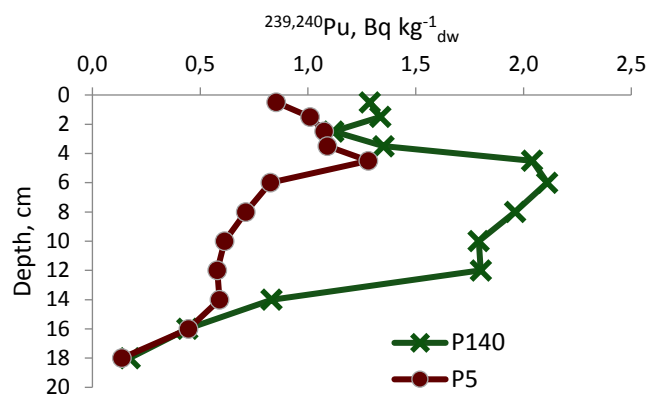


Figure.3. Activity concentrations of $^{239,240}\text{Pu}$ in bottom sediments

Activity concentrations of ^{238}Pu at stations P140 and P5 were in the range $0.002 \div 0.107 \text{ Bq kg}^{-1}_{\text{dw}}$. The ratio of ^{238}Pu to $^{239,240}\text{Pu}$ in both locations was in range $0.02 \div 0.05$ being similar to that determined for the fallout from nuclear weapons tests.

Activity concentrations of ^{90}Sr in bottom sediments were analysed in the integrated samples (layer 0-19 cm). Taking into account all locations ^{90}Sr concentrations stayed in the range $3.21 \div 4.66 \text{ Bq kg}^{-1}_{\text{dw}}$ (Table 1). Activity concentrations of ^{137}Cs , recalculated for the same layer, were 10 -20 times higher, and $^{239,240}\text{Pu}$ concentrations were in similar range to ^{90}Sr . Activity concentrations of ^{40}K were in the range $712 \div 1000 \text{ Bq kg}^{-1}_{\text{dw}}$ depending mainly on the organic matter content and granulometric composition of sediment.

Table 1. Activity concentrations of ^{90}Sr , ^{137}Cs , $^{239,240}\text{Pu}$ and ^{40}K in bottom sediments, layer 0-19cm

Sampling location	^{90}Sr	^{137}Cs	$^{239,240}\text{Pu}$	^{40}K
	Bq kg $^{-1}_{\text{dw}}$			
P110	$3.75 \pm 0.55^{\text{a}}$	$82.1 \pm 1.9^{\text{b}}$	$1.98 \pm 0.09^{\text{b}}$	$712 \pm 20^{\text{b}}$
P116	4.58 ± 0.50	71.4 ± 1.9	2.59 ± 0.10	784 ± 21
P1	4.40 ± 0.50	60.6 ± 1.8	1.24 ± 0.06	870 ± 22
P140	4.66 ± 0.48	48.5 ± 3.4	1.27 ± 0.06	951 ± 23
P5	3.52 ± 0.70	20.5 ± 1.6	0.62 ± 0.03	1000 ± 17
P39	3.21 ± 0.42	27.7 ± 2.2	0.58 ± 0.04	841 ± 17

^a total relative uncertainty^b standard error of mean

Fish

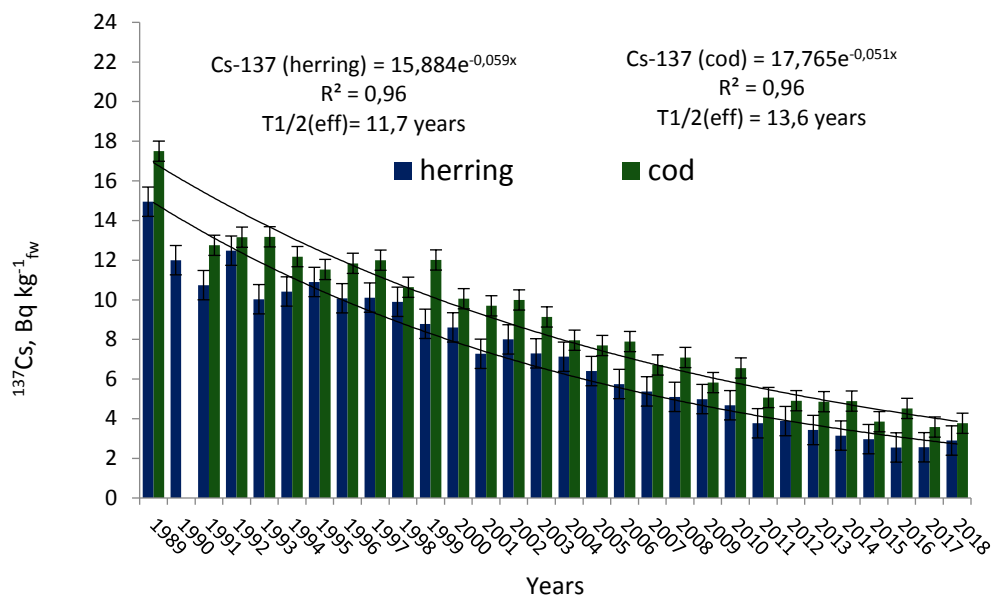
Analysis of radionuclides (^{137}Cs , ^{40}K , ^{226}Ra) was carried out in four fish species specific to the southern Baltic Sea and of commercial importance in Poland: herring, cod, plaice and sprat. Determinations of radionuclides were carried out in fish fillets except of sprat (analyzed as a whole fish without a head). For determination of ^{137}Cs and ^{40}K gamma spectrometry was used, while ^{226}Ra was determined by emanation method.

The differences in ^{137}Cs concentrations associated with the fish species are still noticeable, but they are smaller than in the previous years [1,3]. Currently, ^{137}Cs concentrations in the four fish species are in the range $2.75 \div 3.77$ Bq kg $^{-1}_{\text{f.w.}}$. The concentrations of ^{226}Ra and ^{40}K are in ranges: $0.025 \div 0.084$ Bq kg $^{-1}_{\text{f.w.}}$ and $93.1 \div 122$ Bq kg $^{-1}_{\text{f.w.}}$, respectively (Table 2).

Table 2. The average activity concentrations and the concentration ranges of ^{137}Cs , ^{40}K and ^{226}Ra in the Baltic Sea fish species, 2018

Number of samples	Species (total number of pieces)	Weight of sample [g]	^{137}Cs	^{40}K	^{226}Ra
			Bq kg $^{-1}_{\text{f.w.}}$		
6	Herring (105)	500-525	2.90 ± 0.27	125 ± 8	0.025 ± 0.002
			(2.59 \div 3.29)	(114 \div 130)	(0.023 – 0.027)
6	Sprat (215)	500-550	2.72 ± 0.30	110 ± 5	0.061 ± 0.004
			(2.39 \div 3.18)	(105 \div 117)	(0.059 – 0.061)
5	Cod (31)	510-570	3.77 ± 0.48	119 ± 3	0.084 ± 0.005
			(3.33 \div 4.52)	(116 \div 122)	(0.077 – 0.088)
5	Plaice (52)	500-505	3.02 ± 0.45	93.1 ± 4.9	0.046 ± 0.003
			(2.59 \div 3.69)	(85.8 \div 98.0)	(0.043 – 0.049)

The average ^{137}Cs concentration in 2018 calculated for the four species was equal to $3.10 \pm 0.46 \text{ Bq kg}^{-1}_{\text{fw}}$. There is observed the continuous decreasing trend in activity concentration of ^{137}Cs in the Baltic Sea fish (Figure 4), but they are still higher than that before the Chernobyl accident [4].



References

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