



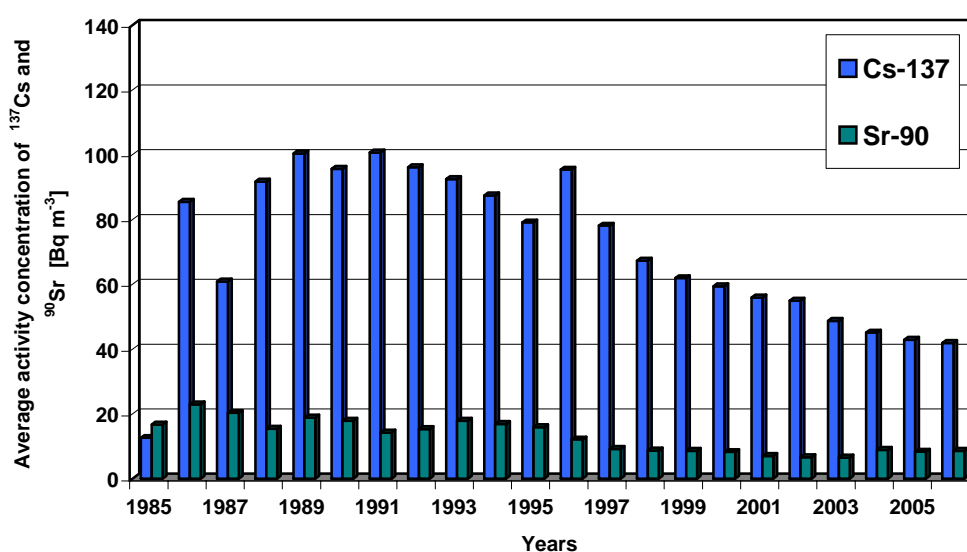
Fish samples were collected from the commercial fisheries: herring from Darlowo and Wladyslawowo fishery regions and perch from the Szczecin Lagoon, in September 2005 and 2006.

Ichthyologic analysis was performed and the weight (W), length (L), age (A), sex (S) and stage of gonad evolution (SGE) were determined for each individual organism. Fish muscles were frozen, freeze-dried, ashed at 450°C and homogenized. Ashed samples were immersed into counting boxes of appropriate geometry and analysed for  $^{137}\text{Cs}$  with gamma spectrometry method using HPGe detector with the relative efficiency of 18% and a resolution of 1.8 keV for peak of 1332 keV of  $^{60}\text{Co}$ . The detector was coupled with an 8192-channel computer analyser.

## Results

Figure 2 presents changes of the average values of  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  activity concentrations in the Southern Baltic Sea in 1985 – 2006. In 2006 the average concentration of  $^{137}\text{Cs}$  decreased only a little. It was equal  $41.9 \text{ Bq m}^{-3}$ , and was lower only of  $1 \text{ Bq m}^{-3}$  than that found in the previous year. The average activity concentration of  $^{90}\text{Sr}$  was equal to  $8.6 \text{ Bq m}^{-3}$  and stayed unchanged in comparison with that in 2005 year.

Concentrations of  $^{137}\text{Cs}$  changed in the range from  $31.2 \text{ Bq m}^{-3}$  to  $49.1 \text{ Bq m}^{-3}$  (Fig. 2). The lowest value was found in the near-bottom waters of the Gdansk Deep – station P1 and in the mouth of the Vistula River (station ZN2), what could be expected because of very low  $^{137}\text{Cs}$  activities observed in river waters. Very similar concentration of  $^{137}\text{Cs}$  was found in the vicinity of the Odra river outflow (the Pomeranian Bay – station SW3). The highest  $^{137}\text{Cs}$  concentration was observed in the surface waters close to the Peninsula of Hel – station ZN4.



**Fig. 2** The average values of  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  activity concentrations in the Southern Baltic Sea in 1985 – 2006.

Generally  $^{137}\text{Cs}$  activities in the southern part of the Baltic Sea were equalized in 2006. Values found in the surface waters in the costal area as well as in offshore regions were very similar. At three sampling stations where the samples were taken along the water profile it was observed that generally  $^{137}\text{Cs}$  concentration decreased with depth, but the differences between activities found in surface and near bottom waters were no so spectacular as those observed in the previous years in the western parts of the polish zone of the Baltic Sea (Bornholm Deep and Bornholm Basin).

Concentrations of  $^{90}\text{Sr}$  changed from  $6.6 \text{ Bq m}^{-3}$  found in the waters of the south-western part of the Gotland Deep (station P140) to  $10 \text{ Bq m}^{-3}$  observed in the Gulf of Gdansk. Distribution of strontium 90 across the whole investigated area was also equalized.

The main difference between  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  distribution was observed in the region of the mouth of Vistula River. As the  $^{137}\text{Cs}$  concentration in this area was the lowest, the  $^{90}\text{Sr}$  concentration found here was relatively high. This simply arises from the considerable participation of river waters in this region. In the case of caesium it can be observed a strong diluting influence of the inflowing river waters, because  $^{137}\text{Cs}$  concentrations in Vistula were so low that reached low limit detection values. Whilst concentrations of  $^{90}\text{Sr}$  in Vistula were still elevated (several times higher than that of caesium), and obtained results indicate that river waters are still important source of  $^{90}\text{Sr}$  (Table 1)

**Table 1.** Activity concentrations of  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  in Vistula River water.

	$^{137}\text{Cs}$						$^{90}\text{Sr}$	
	2000	2001	2002	2003	2004	2005	2005	2006
Weighted mean activity $\text{Bq m}^{-3}$	3.55	1.99	1.91	1.05	1.34	0.8*	3.82	5.02**
Annual fluvial flux $\text{TBq year}^{-1}$	0.12	0.07	0.07	0.04	0.05	0.03	0.14	0.19

\*Values calculated from results obtained from January to July

\*\*Values calculated from results obtained from January to October

Tables 2 and 3 present the results of  $^{137}\text{Cs}$  determination in herring muscle tissue as well as results of ichthyologic analysis. Generally average activity concentrations of  $^{137}\text{Cs}$  found in herring samples were similar as regards sampling year, sampling place, and sex. A little higher value of average activity of  $^{137}\text{Cs}$  was obtained for male individuals taken in 2005, in Wladyslawowo fishery region, what is reflected by an increased concentration factor (defined as a concentration of  $^{137}\text{Cs}$  in fish [  $\text{Bq kg}^{-1} \text{ w.w.}$  ] divided by concentration of  $^{137}\text{Cs}$  in seawater [  $\text{Bq l}^{-1}$  ]). In other cases calculated concentration factors are comparable and close to 100.

**Table 2.** Activity concentration of  $^{137}\text{Cs}$  in the herring muscle tissue (Wladyslawowo)

Year	Sex	Range of length cm	Range of weight g	Age	Average activity concentration of $^{137}\text{Cs}$ $\text{Bq kg}^{-1}$ w.w.	Concentration factor $\text{l kg}^{-1}$ w.w.
2005	Female	21.0 – 23.5	47.4 – 82.3	3	$4.53 \pm 2.56$	95
	Male	20.0 – 23.0	59.4 – 87.1	3 – 4	$6.16 \pm 0.39$	130
2006	Female	21.0 – 23.0	74 – 86	2 – 6	$4.64 \pm 0.82$	95
	Male	21.0 – 23.5	65 – 86	2 – 4	$4.99 \pm 0.73$	102

**Table 3.** Activity concentration of  $^{137}\text{Cs}$  in the herring muscle tissue (Darlowo)

Year	Sex	Length range cm	Weight range g	Age	Average activity concentration of $^{137}\text{Cs}$ $\text{Bq kg}^{-1}$ w.w.	Concentration factor $\text{l kg}^{-1}$ w.w.
2005	Female	21.5 – 24.0	64.6 – 84.5	3 – 4	$4.51 \pm 0.54$	96
	Male	20.5 – 24.0	62.9 – 95.6	3 – 4	$5.06 \pm 1.02$	108
2006	Female	21.0 – 22.0	63 – 73	2 – 6	$5.10 \pm 0.58$	119
	Male	20.0 – 21.5	60 – 71	3 – 6	$4.90 \pm 0.79$	115

In perch muscle tissue samples the lower (than in herring muscle tissue) activities of  $^{137}\text{Cs}$  were found, however in 2006 there was observed a little increase of  $^{137}\text{Cs}$  activities in female and male individuals (Table 4).

**Table 4.** Activity concentration of  $^{137}\text{Cs}$  in the perch muscle tissue (Szczecin Lagoon)

Year	Sex	Length range cm	Weight range g	Age	Average activity concentration of $^{137}\text{Cs}$ $\text{Bq kg}^{-1}$ w.w.	Concentration factor $\text{l kg}^{-1}$ w.w.
2005	Female	18.0 – 18.5	71.1 – 82.1	5 – 6	$1.87 \pm 1.00$	47
	Male	19.0 – 21.0	79.7 – 115.4	5 – 6	$1.48 \pm 0.41$	37
2006	Female	19.5 – 21.5	39.9 – 58.4	5 – 6	$2.41 \pm 0.75$	73
	Male	18.5 – 20.0	31.2 – 53.3	5 – 7	$2.81 \pm 0.73$	85