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Expert Group on Monitoring of Radioactive Substances in the Baltic Sea

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Background

This document contains monitoring results on the concentrations of Cs-137 and Sr-90 in seawater and fish in the Polish economic zone in 2014, compiled by the Institute of Meteorology and Water Management - National Research Institute, Maritime Branch, Gdynia.

Action required

The Meeting is invited to take note of the information.

^{137}Cs and ^{90}Sr in the Polish economic zone (seawater and fish), in 2014

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Seawater samples were collected in June 2014 during the cruise onboard r/v 'Baltica'. Sampling was carried out at 19 stations located in the southern region of the Baltic Sea (Fig.1 and Fig.2). Samples were taken from surface, bottom (2 m above the seabed) and along water profile at 5 stations. Simultaneously salinity and temperature were measured along sampling profile.

^{137}Cs activity concentration in seawater samples was measured with gamma spectrometry, using an HPGe detector, with a relative efficiency of 41% and a resolution of 1.8 keV for peak of 1332 keV of ^{60}Co. The detector was coupled with an 8192-channel computer analyser and GENIE 2000 software. ^{90}Sr activity concentration was determined by radiochemical method followed by β-radiation measurements of ^{90}Y samples using Low-Level Beta Counter FHT 7700T (ESM Eberline) with the background count rate of 0.01 counts s^{-1} and the minimum detectable activity of 3 mBq per sample.

In 2014, the average concentration of ^{137}Cs in seawater of the southern Baltic was equal to 27.3 Bq m^{-3} and was a little higher as compared to the previous year (25.2 Bq m^{-3}) – Fig. 3. The lowest activity concentration of ^{137}Cs was found in the vicinity of the Vistula River outflow. It was only 6.5 Bq m^{-3} in surface waters characterized by salinity 0.37 and temperature of 20.5°C. This means that the contribution of riverine outflow was dominating. At the same time the ^{137}Cs concentration in near bottom waters was 22.8 Bq m^{-3}, with salinity 7.1. Relatively low concentration (17.2 Bq m^{-3}) was found in the Oder River mouth, in the Pomeranian Bay, which is also related to the dilution effect of the river water in which the concentration of ^{137}Cs did not exceed the limit of determination. In the open sea area, the lowest ^{137}Cs activities were found in the near bottom water (as a result of diluting effect of the inflowing North Sea waters) in the Bornholm Deep (18.7 Bq m^{-3}) where salinity was equal to 16.5 and in the Slupsk Furrow (17.3 Bq m^{-3}). The highest activity was noted in surface coastal water (38.5 Bq m^{-3}) in the surface water near the Hel Peninsula (34.7 Bq m^{-3}) and in the bottom water in the eastern Gotland Basin (34.9 Bq m^{-3}).

Taking into account four subbasins recommended by the HELCOM Monitoring and Assessment Strategy, the lowest mean concentration of ^{137}Cs (22,3 Bq m^{-3}) was found in coastal water of the Gdansk Basin, where also the lowest average concentration in surface water (17,5 Bq m^{-3}) was found, while the mean activity in the near bottom water (29.3 Bq m^{-3}) was similar to that calculated for the Bornholm Basin and the Eastern Gotland Basin. The average concentrations of 137Cs in the surface and near bottom water found in the Bornholm Basin, the Eastern Gotland Basin and the Gdansk Basin fell in a narrow range (Fig. 4).

In 2014, the average activity of ^{90}Sr (calculated as a mean value of all results obtained in the year) specific for the southern Baltic waters was equal to 6.6 m^{-3} (Fig. 2), that is only a slightly higher than the value found in 2013 – 6.1 Bq m^{-3}. ^{90}Sr concentrations in seawater varied in the range, from 4.5 Bq m^{-3} to 8.9 Bq m^{-3} (Fig.2).The lowest value of ^{90}Sr was found in the surface water in the Vistula River mouth. The highest value of ^{90}Sr concentration was recorded in the Bornholm Deep at depth of 40 m.

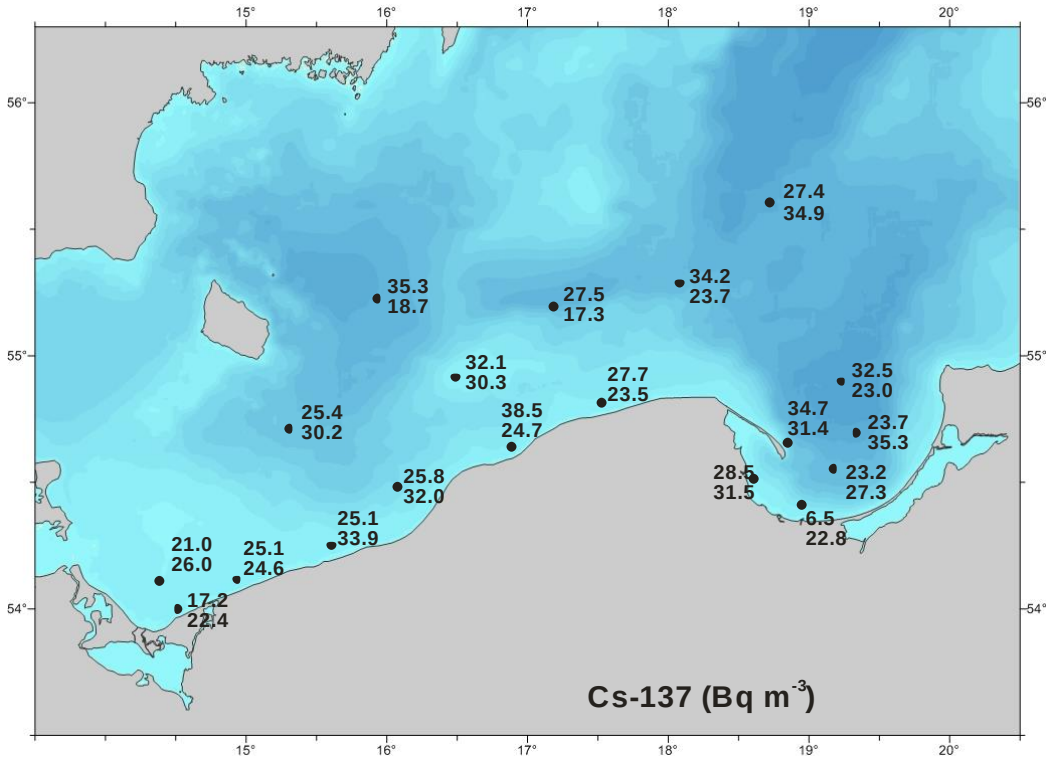

Fig.1 ^{137}Cs activity concentrations in surface and near-bottom water in the Polish sector of the Baltic Sea.

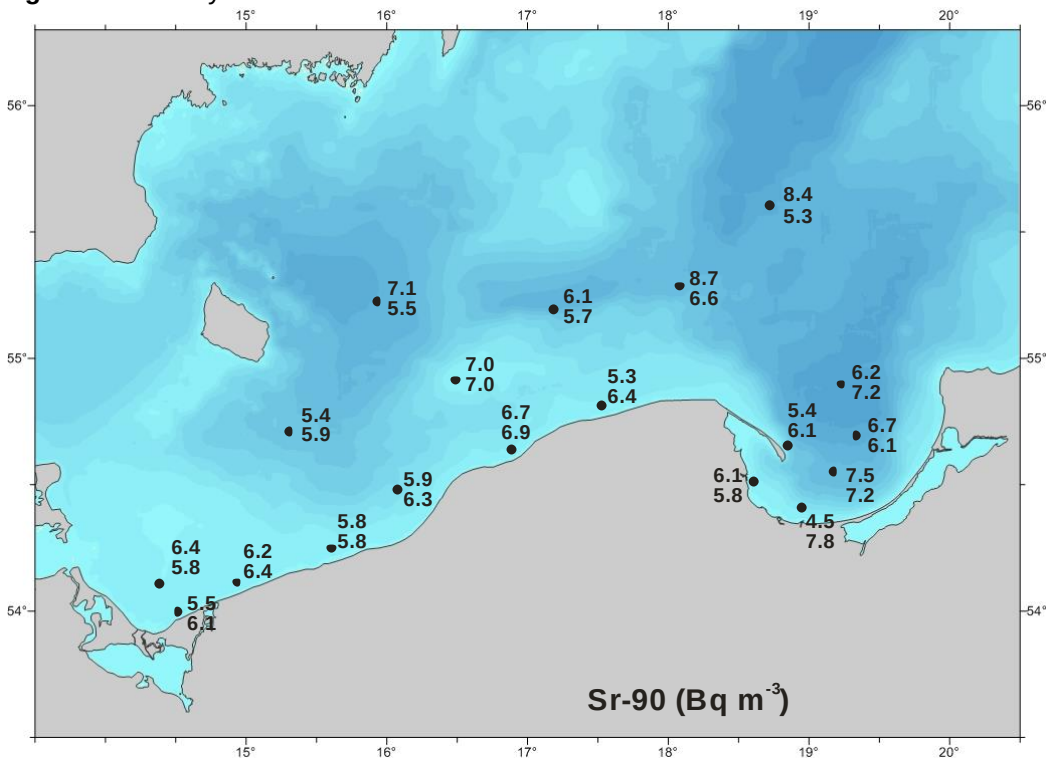

Fig.2 ^{90}Sr activity concentrations in surface and near-bottom water in the Polish sector of the Baltic Sea.

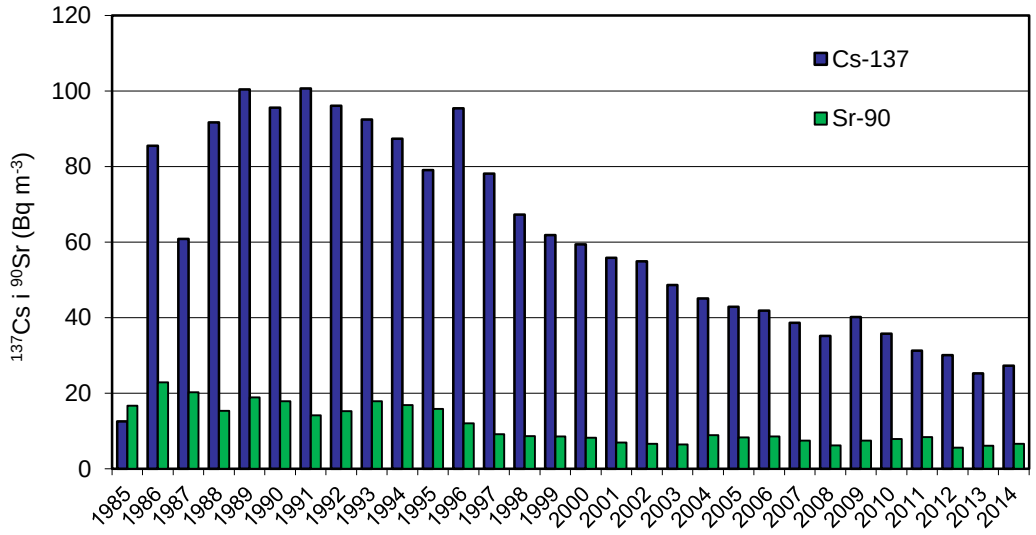

Fig.3 Average activity concentrations of ^{137}Cs and ^{90}Sr in seawater, in the Polish sector of the Baltic Sea in 2014

In 2014, the average concentrations of ^{90}Sr calculated, for four sub-basins were very similar; 6.5 Bq m^{-3} in the Bornholm Basin, 6.9 Bq m^{-3} in the Eastern Gotland Basin, 6.6 Bq m^{-3} in the Gdansk Basin and 6.1 Bq m^{-3} in the coastal waters of the Gdansk Basin (Fig. 4). The lowest mean value (5.3 Bq m^{-3}), specific for the surface water was found in coastal waters of the Gdansk Basin, and the highest one (7.5 Bq m^{-3}) in the Eastern Gotland Basin. The mean concentrations of ^{90}Sr in the near bottom water varied in a narrow range from, 6.1 Bq m^{-3} in the Eastern Gotland Basin to 6.8 Bq m^{-3} in coastal waters of Gdansk Basin.

The marked changes in the vertical distribution of ^{137}Cs in the water column were observed in the Bornholm Deep (Fig. 5). Beneath 40 m depth, an increase in salinity was accompanied by a decrease in ^{137}Cs activity. In the Gulf of Gdansk, close to the Hel Peninsula and in Gotland Basin, in areas with weaker vertical stratification, the activities of ^{137}Cs in the water column oscillated around 30 Bq m^{-3}. In the case of ^{90}Sr concentrations, vertical distributions were much more homogeneous in all locations.

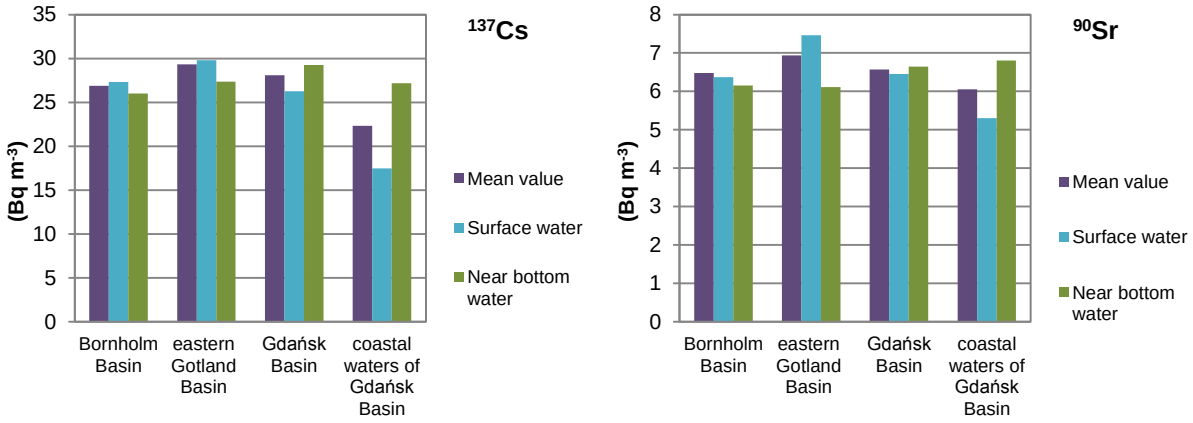

Fig. 4 Average activities of ^{137}Cs and ^{90}Sr surface and near bottom waters in selected areas of the Polish sector of the Baltic Sea.

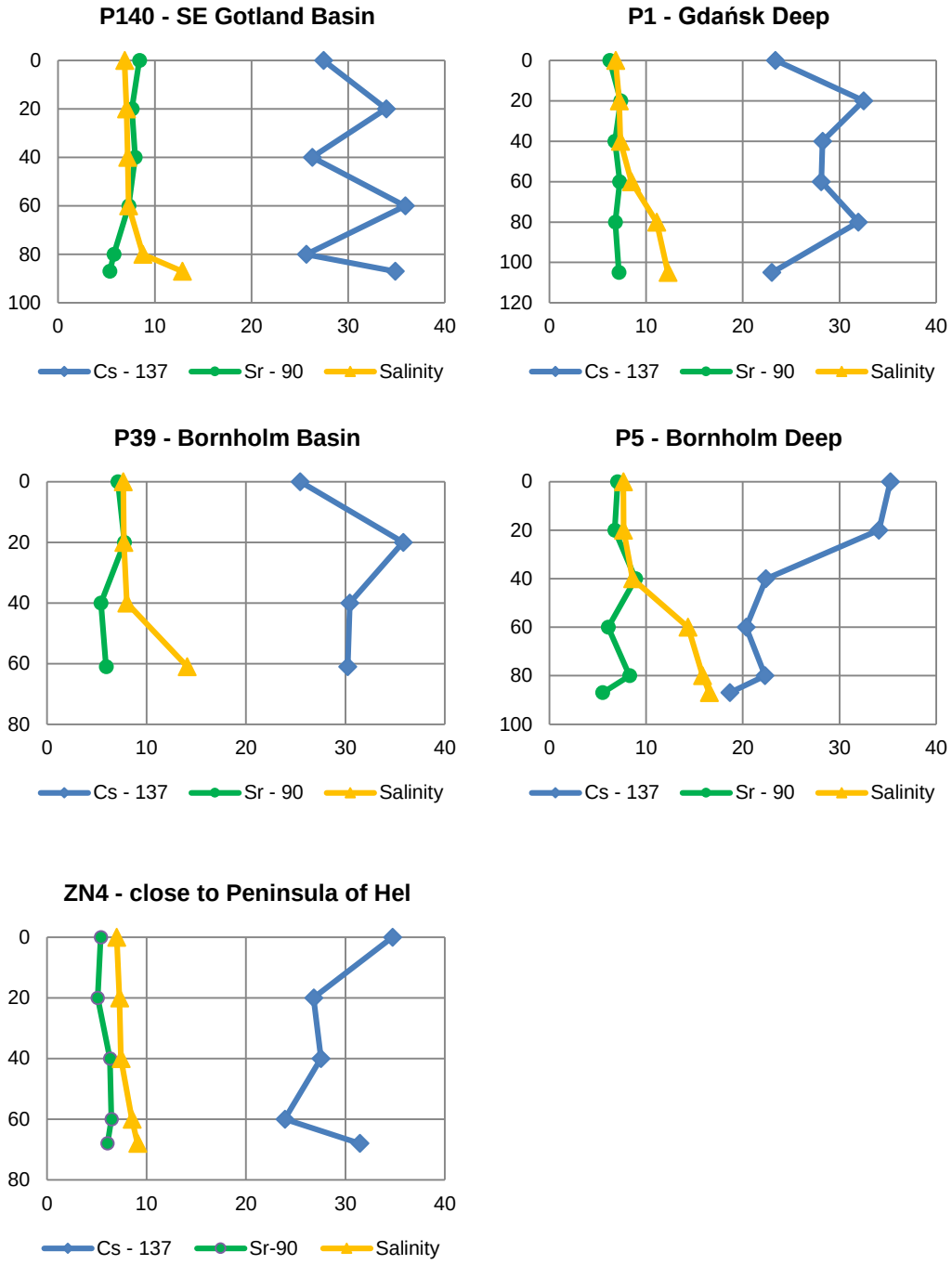

Fig. 5 Vertical distribution of ^{137}Cs and ^{90}Sr in water column at 5 stations in the Polish sector of the Baltic Sea.

In 2014, additional analyses were undertaken to determine ^{137}Cs and ^{90}Sr concentrations of in perch (*Perca fluviatilis*) caught in the Vistula Lagoon and Szczecin Lagoon. ^{137}Cs activity in fish in the Szczecin Lagoon varied within a relatively wide range, from 3.03 Bq kg^{-1} w.w. to 8.75 Bq kg^{-1} w.w. in the case of females and from 3.80 Bq kg^{-1} w.w. to 7.91 Bq kg^{-1} w.w. in the case of males (Fig. 6).The mean values were similar, 5.05 Bq kg^{-1} w.w.- for females and 5.98 Bq kg^{-1} w.w. – for males. In the Vistula Lagoon concentration of radioactive cesium remained at lower levels for both female and male individuals, as the average values amounted to 2.58 Bq kg^{-1} w.w. (female) and 1.83 Bq kg^{-1} w.w. (male).

In the case of ^{90}Sr, its concentrations were also definitely higher in fish from the Szczecin Lagoon, where the average activities were equal to 127.6 mBq kg^{-1} w.w. in male individuals and 142.7 mBq kg^{-1} w.w. in females while in the Vistula Lagoon the respective values were 74.1 mBq kg^{-1} w.w. – males and 88.4 mBq kg^{-1} w.w. – females (Fig.7). The possible reason for such differences could be related to salinity observed in these basins, from 2 to 5 in the Vistula Lagoon, and much lower from 0.5 to 2 in the Szczecin Lagoon.

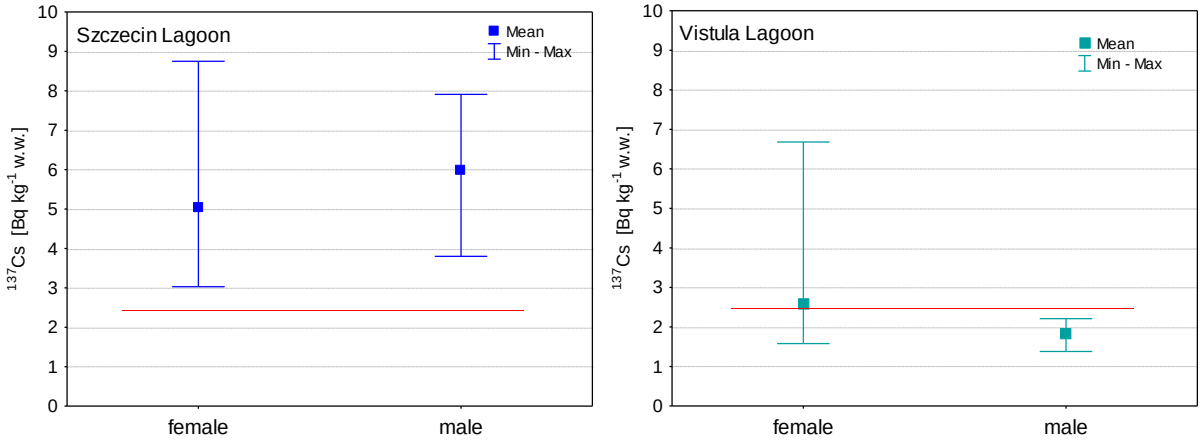

Fig. 6 Concentrations of ^{137}Cs in perch (*Perca fluviatilis*) in the Szczecin Lagoon and Vistula Lagoon.

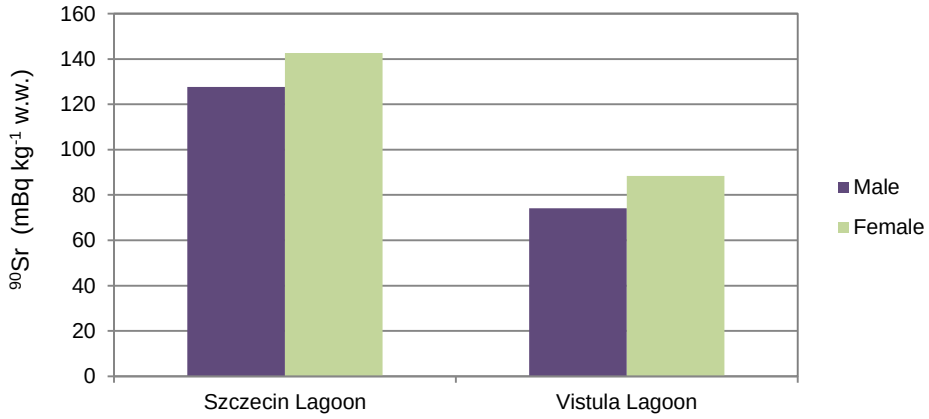

Fig. 7 Concentrations of ^{90}Sr in perch (*Perca fluviatilis*) in the Szczecin Lagoon and Vistula Lagoon.