# STATUS AND TRENDS OF MERCURY POLLUTION IN THE MARINE ECOSYSTEM OF THE POLISH PART OF THE BALTIC SEA

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## INTRODUCTION

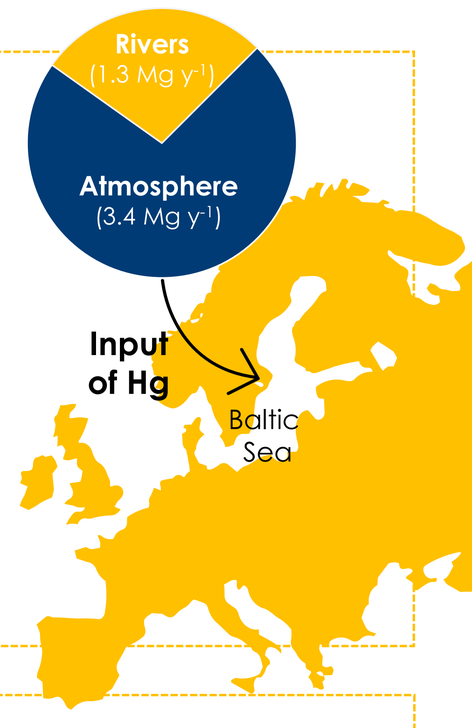
Mercury (Hg) is an element introduced into the environment from **natural sources**, including volcanoes and forest fires, re-emission from the ocean and terrestrial surfaces, and **anthropogenic activities** in the energy production, metallurgy, waste incineration, and other industrial processes. Adverse health effects of Hg include changes in nervous, cardiovascular and reproductive systems.

The marine environment is particularly vulnerable to Hg pollution, as it originates from many different sources. Hg inputs are divided into atmospheric, including both **wet and dry deposition**, waterborne *via* **rivers**, and from direct **point sources** located on land or sea. Hg introduced into the marine environment remains there for a very long time, especially in semi-enclosed inland seas, such as the Baltic Sea. Given the fact that the **consumption of fish** is the predominant source of Hg for humans, studies on the level of this element in the marine ecosystem are of great importance.

## STUDY AIM

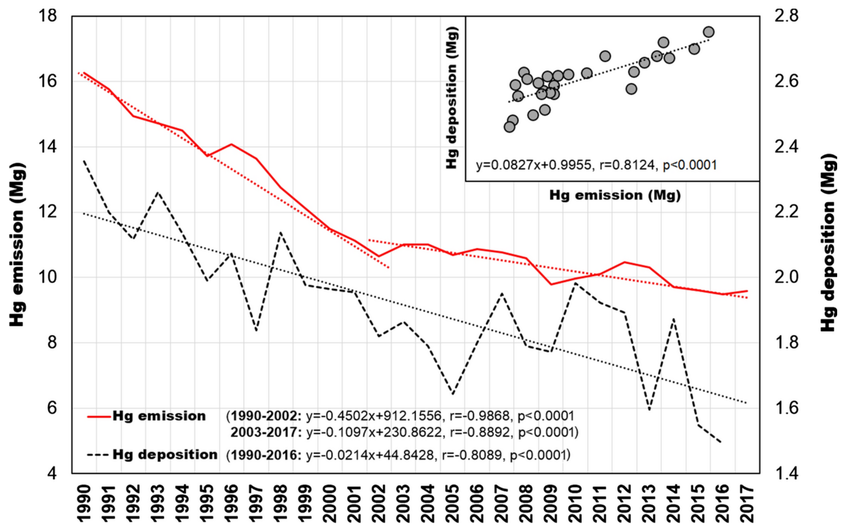
The **main goal** of this study was to assess the **current status** of the Hg pollution of the abiotic and biotic compartments of the southern Baltic Sea, and to indicate the **direction and pace of temporal trends** of Hg level in the context of reduced anthropogenic emissions and changing environment.

This work summarises the findings of studies conducted in the Polish part of the Baltic Sea over the last three decades. For Poland, it was not only a period of socio-political transformation, but also a time of changes in the industrial structure, the development of technology and science, and an increase in ecological awareness.




## CHANGES IN MERCURY INPUT

As a result of the international withdrawal of Hg from commercial products and control technologies, the **Hg emission from Polish territory decreased by 42% since 1990**. Its atmospheric deposition to the southern Baltic Sea dropped simultaneously. Unfortunately, no reliable data are available on the long-term time series of the Hg load introduced to the southern Baltic Sea *via* rivers.




### MISSING PUZZLE

Long-term trend of riverine Hg input

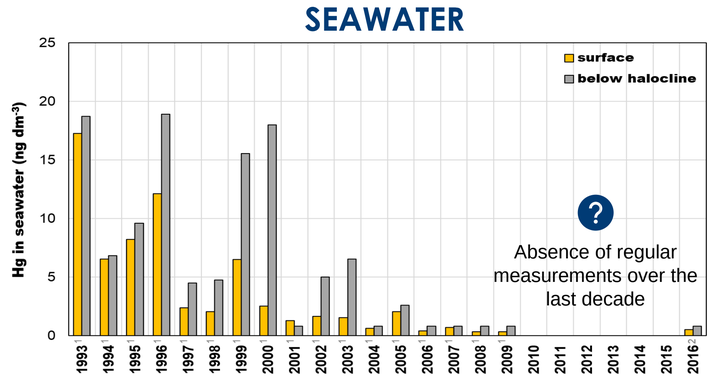
Questionable accuracy of data obtained before 2009 due to the analytical method used

## ENVIRONMENTAL RESPONSE

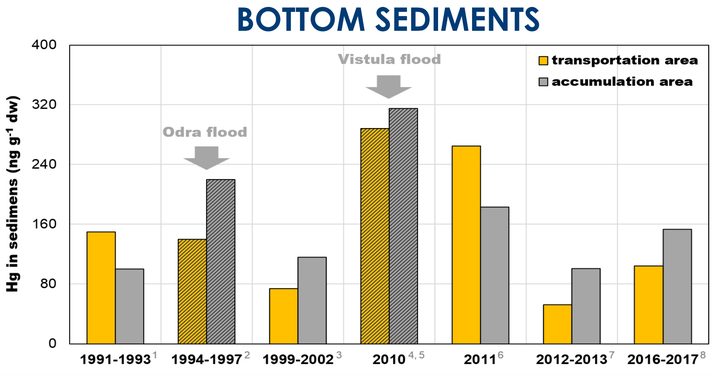
Changes in the atmospheric influx of Hg to the southern Baltic were reflected in **Hg concentration in seawater**. The most significant decrease in Hg level in surface waters occurred in 1993-2000, when it **was reduced 7-fold**. Since 2004, the concentration of Hg remains low, however the data series is incomplete.

For surface **sediments**, the trend was not clear, as the **Hg level was modified by inter-annual variability** and **extreme events**, especially **floods**, which caused up to a 3-fold increase in Hg concentration.

### SEAWATER




### BOTTOM SEDIMENTS



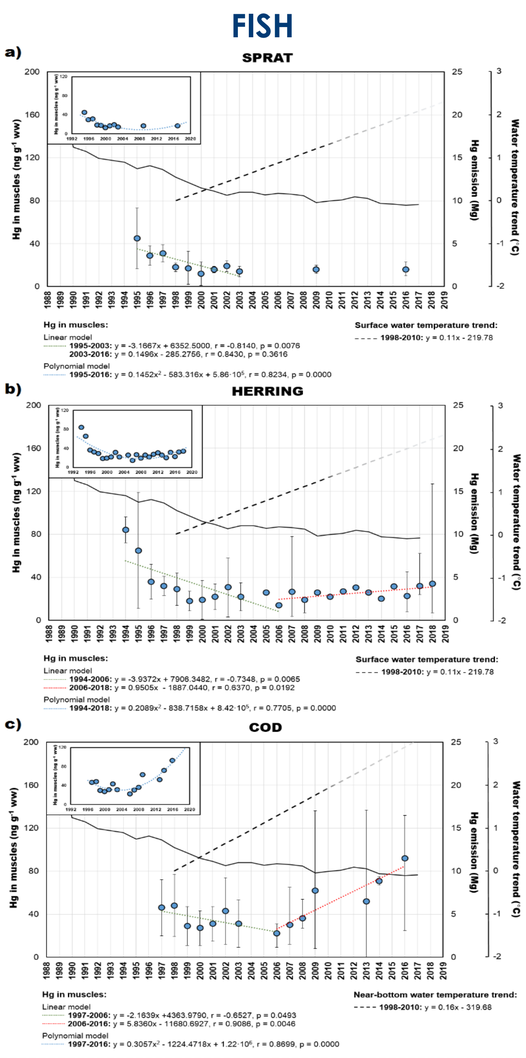

## BIOTIC RESPONSE

Changes in atmospheric deposition of Hg, caused by reduction in its emission, **affected the decrease in its concentration in the marine trophic chain**.

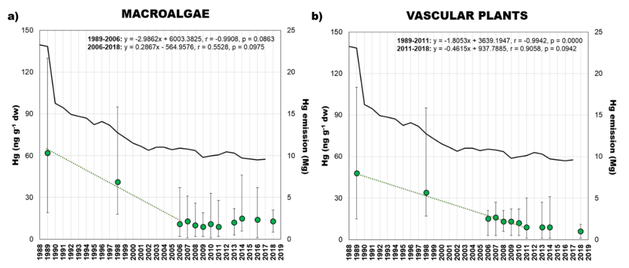
Relationship between Hg concentration in organisms and its emission was statistically significant (p=0.05) for **plants**, **zooplankton**, and two of the three fish species investigated – pelagic **sprat** and **herring**.

For demersal **cod**, a **break in the trend** was noted. The increase of Hg concentration from around 2006 was likely influenced by globally occurring changes – rising water temperature leading to shifts in fish metabolism and food structure.

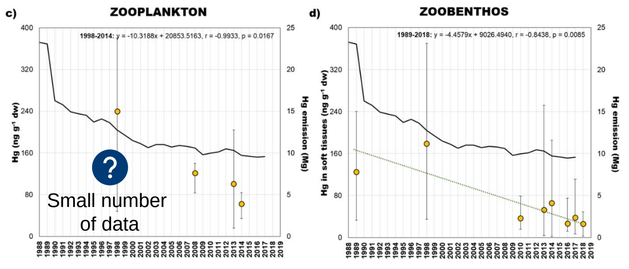
### FISH




### PLANTS




### INVERTEBRATES



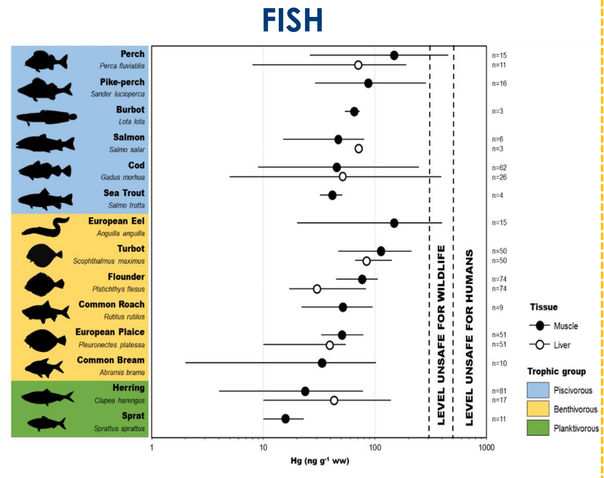

## CURRENT STATUS

Despite the relatively large outflow of Hg from Poland to the southern Baltic Sea, the **Hg concentrations** in abiotic and biotic compartments are **low** and **do not exceed the safe limits**, above which wildlife and humans (300 and 500 ng $g^{-1}$, respectively) would be at risk.

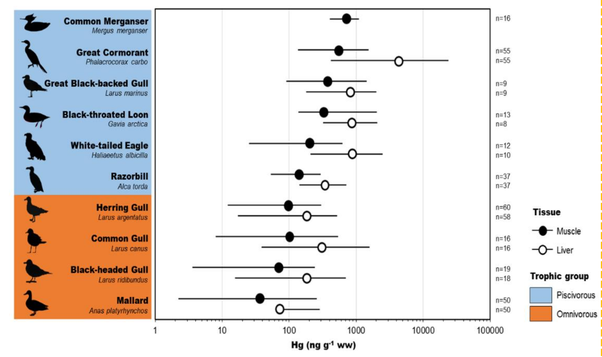
In fish, a clear **impact of trophic level on Hg concentration** was observed. Planktivorous fish (sprat, herring) were characterised by the lowest average Hg concentration, while in piscivorous species (e.g. cod, salmon, perch) the level of Hg increased. However, in some benthivorous fish (flounder, turbot, eel) Hg concentration was elevated and exceeded values in predatory species, which was probably related to the remobilisation of Hg form bottom sediments.

As in fish, the highest Hg concentration in coastal and waterbirds was measured in fish-eating species (e.g. great cormorant, white-tailed eagle, razorbill). In some individuals the Hg level exceeded health-threatening threshold (1 000 ng $g^{-1}$ ).

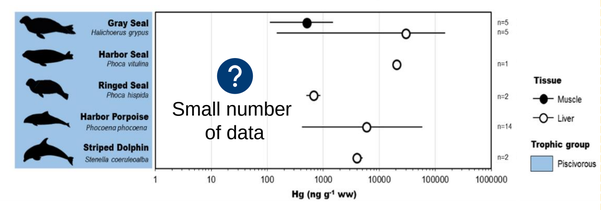
### FISH




### WATERBIRDS




### MAMMALS

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## MORE INFORMATION

Jędruch et al., 2021. *Status and trends of mercury pollution of the atmosphere and terrestrial ecosystems in Poland.* **Ambio**, https://doi.org/10.1007/s13280-021-01505-1

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