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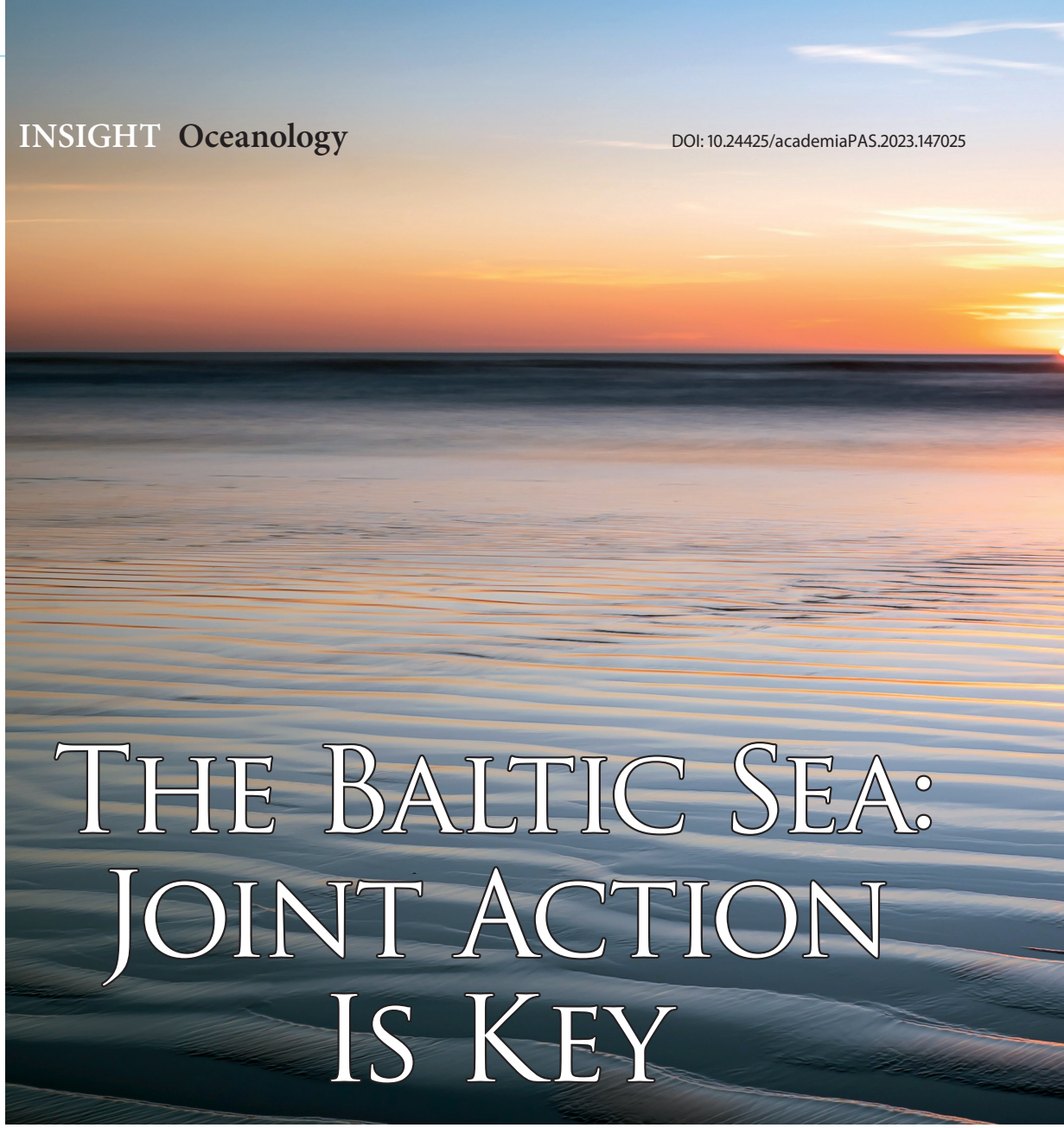

# The Baltic Sea: Joint Action Is Key

Joint action by the countries surrounding the Baltic is crucial for the conservation of the sea's unique ecosystem.

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The Baltic Sea boasts one of the world's most unique ecosystems. For the inhabitants of the countries bordering on the sea – the Baltic countries – it is also an important part of the natural environment, the culture of their countries, and the entire maritime sector (tourism, transportation, industry). Unfortunately, in recent decades, the Baltic has been exposed to various forms of pollution that seriously threaten its ecosystem and human health. These include harmful chemicals and heavy metals that originate from such forms of human activity as transportation, sewage treatment plants, ports and shipyards, industrial plants, agriculture, and dumping sites. Other sources of pollution are shipwrecks and sunken munitions from World War II.

The development of coastal regions and tourism contributes to increased emissions of pollutants, the loss and alteration of coastal habitats, and increased impacts from other human-induced pressures, such as noise and light pollution. Pollutants and nutrients

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(biogenic elements) place a heavy burden on coastal ecosystems: when they enter the Baltic Sea, they can trigger various damaging effects. Certain pollutants, such as oil spills, are easily noticeable, but others may go unnoticed or become evident only when their adverse impact on living organisms is observed. Many pollutants decompose slowly, amplifying their impact as they accumulate within aquatic food webs. The Baltic Sea has been found to contain thousands of substances that pose potential threats to the environment. The most harmful of these are substances that are persistent, toxic, and accumulate in living organisms. Because of the large drainage basins of the rivers that empty into the Baltic and in view of its limited water exchange and shallow depth, the sea's ecosystem is particularly at risk.

## Pollution and eutrophication

Eutrophication is one of the key problems affecting the Baltic Sea. An overabundance of nutrients such as nitrogen and phosphorus leads to rapid growth of algae and cyanobacteria, causing severe (and sometimes toxic) phytoplankton blooms. The consequences include water turbidity, obstructed light penetration, and restricted access to light for plants. The death and decomposition of algae leads to oxygen deficiency, creating areas of diminished oxygen content or even dead, anaerobic zones with no life. Reduced oxygen content in the water causes an increase in the population of anaerobic bacteria, which release hydrogen sulfide, a substance that is harmful to marine organisms.

The area covered by "dead zones" in the Baltic sea have increased over tenfold since the beginning of the twentieth century. Currently, they account for nearly one-fifth of the sea's surface area, which is more than the total area of Denmark, and therefore rank as the largest oxygen-deficient area in European seas. Eutrophication in the Baltic Sea has its sources primarily in agriculture, sewage inflows, and chemicals discharged into rivers. Poland – a country of intensive agricultural practices that has two large rivers flowing into the Baltic (the Vistula and the Oder) – is responsible for the largest supply of

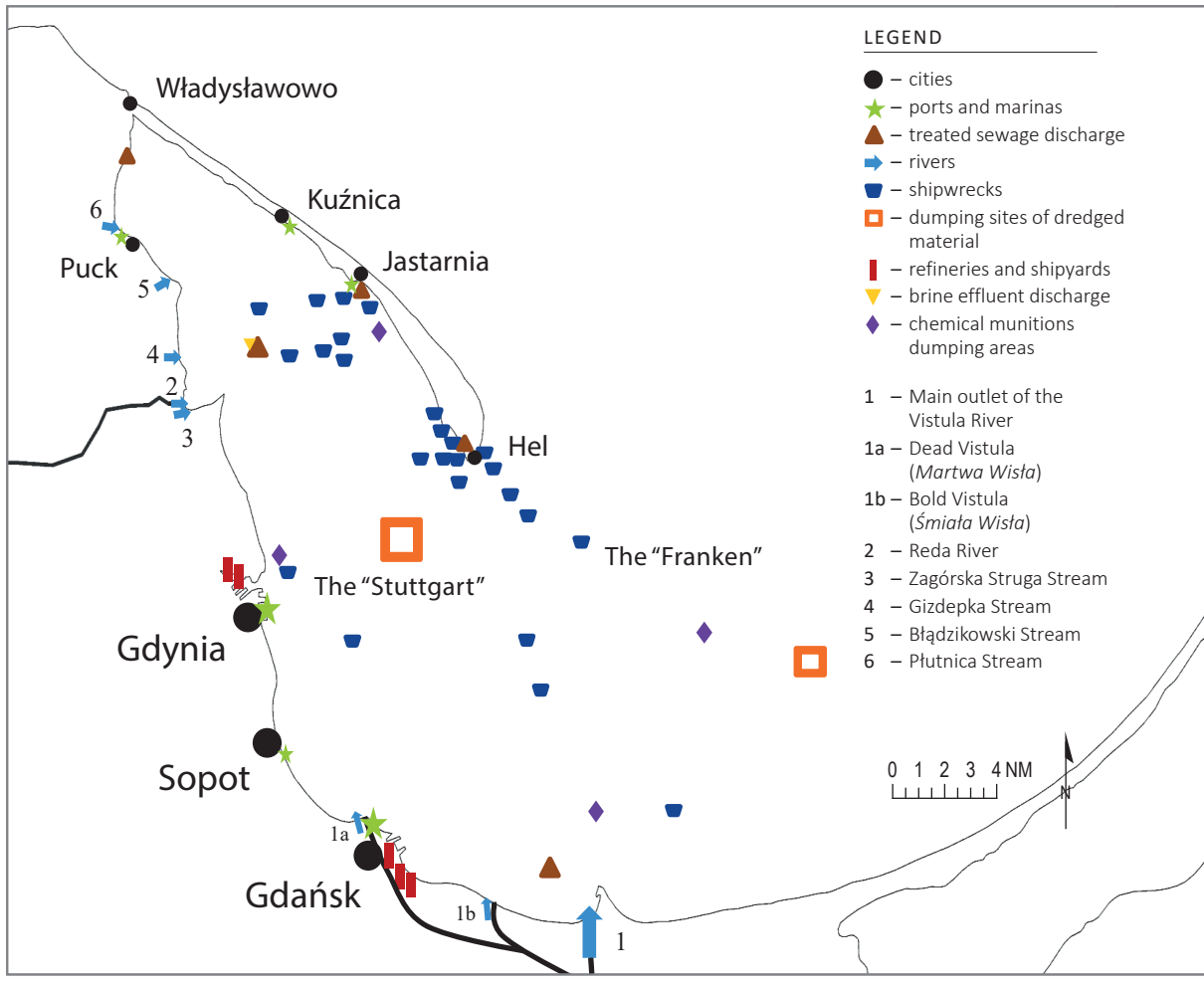
nutrients into the Baltic Sea. Other large rivers that transfer significant amounts of nutrients from land into the Baltic Sea include the Daugava, the Neva, and the Neman.

Another serious threat to the Baltic is posed by chemical pollution, which can be divided into organic and inorganic pollution. Most organic pollutants are man-made substances used as pesticides, flame retardants, surfactants, plasticizers, antioxidants, antifouling agents, pharmaceuticals, and personal care products. The most hazardous organic pollutants are called persistent organic pollutants (POPs). It is important to understand some of their properties. First, they demonstrate considerable resistance to various forms of decomposition: chemical, biological, and photolytic (triggered by light exposure). This means that POPs can remain in the environment over long periods. Other important characteristics of POPs include their hydrophobicity (the ability to repel water), which results in their low solubility. But these substances do dissolve well in phospholipid membranes, which are found in particular in fatty tissues. This leads to the bioaccumulation of POPs in marine organisms. As POPs move up the food chain, their concentrations may increase. In other words, the organisms at the top of the chain may contain more POPs. These substances are among the causes of disease in marine life, including endocrine disruption, cancer, reproductive problems, weakened immune systems, and neurological problems. POPs are blamed for a significant decline in fish and marine mammal populations. Over the past century, human-induced chemical stressors have caused drastic changes in the Baltic ecosystem. The most notable examples include certain animal species: fish, seals, and even white-tailed eagles, whose populations have dwindled dramatically. Controlling and limiting the supply of harmful chemicals is therefore crucial for the health of the entire Baltic ecosystem.

## Heavy metals

The most dangerous groups of inorganic pollutants in the Baltic Sea include heavy metals, including mercu-

Sources of chemical pollution in the Gulf of Gdańsk




Map showing the location of pollution sources in the Gulf of Gdańsk

ry (Hg), lead (Pb), arsenic (As), and cadmium (Cd). Human activity (the metals industry, fossil fuel combustion, transportation) is estimated to be the source of even 95% of heavy metals in the environment. Even with the introduction of effective purification techniques and bans on certain substances, such as leaded gasoline in transportation, permissible concentrations of metals continue to be exceeded. Some heavy metals are highly toxic even at very low concentrations. In marine organisms, cadmium and lead accumulate in the liver, potentially resulting in damage to this organ. Mercury, in turn, accumulates mainly in the muscles. High concentrations of mercury and lead may damage the nervous system. But these elements also have the capacity for bioaccumulation and – in the case of mercury – biomagnification, which means they can also pose a threat to humans. Artificial radioisotopes such as cesium ($^{137}$Cs) and strontium ($^{90}$Sr) are also present in the Baltic Sea in high concentrations. Humans emitted them in large quantities into the atmosphere in the 1950s and 1960s as a result of nuclear testing (the arms race). The disaster that occurred in the Chernobyl Nuclear Power Plant in 1986 was an important source of cesium in the Baltic Sea. The concentrations of $^{137}$Cs and $^{90}$Sr in the Baltic Sea are gradually declining, but large amounts of these pollutants are accumulated in the sea bottom sediments. Any seabed disturbance by humans, whether through bottom trawling or the construction of marine infrastructure, leads to these pollutants being released back into the water, which poses a tangible threat to marine life and, consequently, to humans.

Another problem is posed by pollution from plastic waste. Plastic is ubiquitous in our everyday lives. Unfortunately, it reaches the Baltic Sea both through rivers and from coastal areas. Marine animals often mistake plastic for food and die after eating it. Plastic also breaks down into tiny particles called microplastics, which are difficult to remove and can accumulate in organisms. Combatting plastic pollution has become one of the priorities for protecting the Baltic Sea. Initiatives to reduce its amount in the sea have been undertaken at various levels.

## Action to secure the Baltic's future

To reduce pollution in the Baltic, those interested in its conservation must join forces. The Baltic states and international organizations, such as the Baltic Marine Environment Protection Commission (Helsinki Commission, HELCOM) and the European Union (EU), are undertaking numerous initiatives to protect this unique ecosystem. These include projects to improve water and wastewater management, measures to reduce agricultural runoff, bans on the use of hazardous chemicals, educational campaigns to help reduce the use of plastic, and the development of innovative waste recycling technologies. Likewise, the public must be involved. We are all responsible for protecting the Baltic, and we must take action to reduce our ecological footprint. For example, we can segregate and recycle waste, reduce the consumption of single-use plastic packaging, promote alternative materials and environmentally friendly technologies, and keep rivers and beaches clean, including through regular cleanup campaigns.

Pollution of the Baltic Sea poses a serious problem that requires urgent action. All parties involved in striving to resolve it, including governments, international organizations, and local communities, must work together to restore the health and beauty of this unique ecosystem. It is time to take action to ensure that future generations can enjoy a clean and sustainable Baltic – it not only represents our common heritage, but also serves as a vital source of life and inspiration. ■



Photo 1
Bathymetric rosette for sampling water

Photo 2
Zooplankton net for sampling zooplankton

Further reading:

HELCOM, https://helcom.fi/

WWF, https://www.wwf.pl/

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