Sea catchment area are generally well connected to wastewater treatment systems, which results in a large number of hazardous or potentially hazardous substances occurring at elevated concentrations in their sludge and effluent. Some substances are depleted or transformed in the wastewater treatment process, while others remain relatively unaffected (HELCOM 2021). Phenolic substances appear to be frequently occurring, based on available measurements, although they generally are at levels below current environmental quality standards. Polyfluoroalkyl substances (PFASs), in particular PFOS and PFOA, are detected regularly, and many are not removed. Pharmaceuticals have also been shown to remain relatively unaffected by wastewater treatment processes, and levels exceed current environmental quality standards (HELCOM 2021).

Information on riverine and atmospheric sources are available for a few selected priority substances (HELCOM 2021). Data for the period 2015-2017 suggest that inputs of cadmium come mainly through rivers, while mercury and lead are predominantly introduced through atmospheric deposition. The total amount of input differs markedly between the substances, with 27, 5.3 and 356 tonnes per year being recorded for cadmium, mercury and lead, respectively. Only a small amount is estimated to come from point sources. Atmospheric deposition of these substances has generally declined since the 1990s (HELCOM 2020e and HELCOM 2021). The volume and location of dredged material in the Baltic Sea varies between years (e.g. HELCOM 2020b). For example, around nine million tonnes were deposited at 106 sites in 2020, with a little over half of this material being from capital dredging and the rest from maintenance dredging. Around seven million tonnes came from harbours and river estuaries, and most of the dredged material was deposited at locations offshore. Levels of mercury, lead, copper, tributyltin and polycyclic aromatic hydrocarbons in the dredged material were similar to or lower than corresponding values recorded in 2014 or before. However, cadmium levels had increased.

Maritime activities, such as shipping, can emit hazardous substances through spills of oil or other substances. Operational discharges from the cleaning systems of ships are a significant source. With the use of exhaust gas cleaning systems (scrubbers), hazardous substances are released with the discharge of scrubber waters, as well as in grey and bilge waters and through the smokestack. In 2021, the total volume of discharge water from exhaust gas cleaning systems was roughly 286 million cubic metres, mainly from open loop systems. For example, open loop scrubber systems are estimated to generate as much as 8.5% of the total Baltic Sea load of the polyaromatic hydrocarbon anthracene (Ytreberg *et al.*, 2022). Discharges from these activities are increasing.

### Regulations and needs

*Minimizing the input and impact of hazardous substances from human activities is a key goal of the Baltic Sea Action Plan.*

Management objectives relating to hazardous substances are to minimize their input from sea-based activities, enforce international regulations, achieve no illegal discharges and have safe maritime traffic without accidental pollution.

Hazardous substances that enter the aquatic environment often remain for a long time, and their impacts accumulate in the food web. Removing a contaminant once it is present at sea is far more complex and costly than preventing its release, and in several cases is impossible. Furthermore, many substances are persistent and have long recovery times even after their input has been stopped.

Finding measures to reduce or prevent the input of hazardous substances at the source is significantly more achievable and cost-effective than dealing with them once they are already present in the environment.

The complexity of human activities and regulatory levels associated with environmental contaminants makes management response and policy implementation for hazardous substances a significant challenge that warrants strategic development in itself.

Climate change is expected to have significant effects on the Baltic Sea, but there is currently no regional overview of how climate change interacts with hazardous substances (HELCOM and Baltic Earth 2021). A number of direct climate change effects are likely to affect hazardous substances, such as water temperature, atmospheric circulation, solar radiation, acidification, stratification, precipitation, river runoff and sediment transportation. Among indirect effects, factors such as changes in oxygen concentration, microbial processes, non-indigenous species and ecosystem functions could affect the presence and impact of hazardous substances in the Baltic Sea ecosystem (HELCOM 2023c).





### 4.2.3 Marine litter

The status of marine litter in the Baltic Sea is currently evaluated based on beach litter and litter on the seafloor (Figure 4.10, Box 4.4).

The HELCOM threshold value for beach litter is 20 litter items per 100 metres of beach. During 2016-2021, eleven out of the sixteen sub-basins that could be assessed were above this limit and did not reach good status. The subbasins with highest median values were the Sound (313 litter items per 100 m), the Gulf of Riga (156 items) and the Eastern Gotland Basin (96 items). The sub-basins achieving good status for beach litter were Kiel Bay, the Bay of Mecklenburg, the Gdansk Basin and the Western Gotland Basin. The Quark had a median value below the threshold value, but the result was evaluated as uncertain due to limited data. Plastic litter, including single-use items, was the most common litter category, accounting for between 32 and 93% of the total number of litter items (Figure 4.12). Several sub-basins showed a decrease in the total litter count over time, which correlates with a decrease in the count of single-use plastics and plastic litter items.

Data about litter on the seafloor is collected in connection with fish surveys using trawls and is available for some sub-basins (Figure 4.11). Litter in the categories “plastic” and “other” increased during the evaluation period, and these categories thus fail the preliminary threshold value, which is “no significant increase” from 2015 to 2021 in weight, number or probability of catching litter. The category “fisheries-related litter” achieved the threshold when measured in number per square kilometre but not when measured in weight. The remaining categories,

#### BOX 4.4.

**What is marine litter?**

Marine litter comes from a vast range of human sources and reaches different marine compartments. Beach litter is monitored worldwide as a proxy of human impacts on the ecosystem. Information on the amount of litter can indicate general levels of potential harm to marine biota and ecosystems, as well as societal losses in the form of aesthetic values, economic costs and hazards to human health. Litter that has accumulated on the seafloor is equally relevant and can have significant impacts on organisms at sea. Evaluation of litter types and categories helps us understand the sources of marine pollution and assess the efficiency of environmental management measures.

**The Baltic Sea Action Plan states the following ecological objective for marine litter:**

**— No harm to marine life from litter.**

**Figure 4.10.** The impact of marine litter on the marine environment is closely linked to human behaviour.

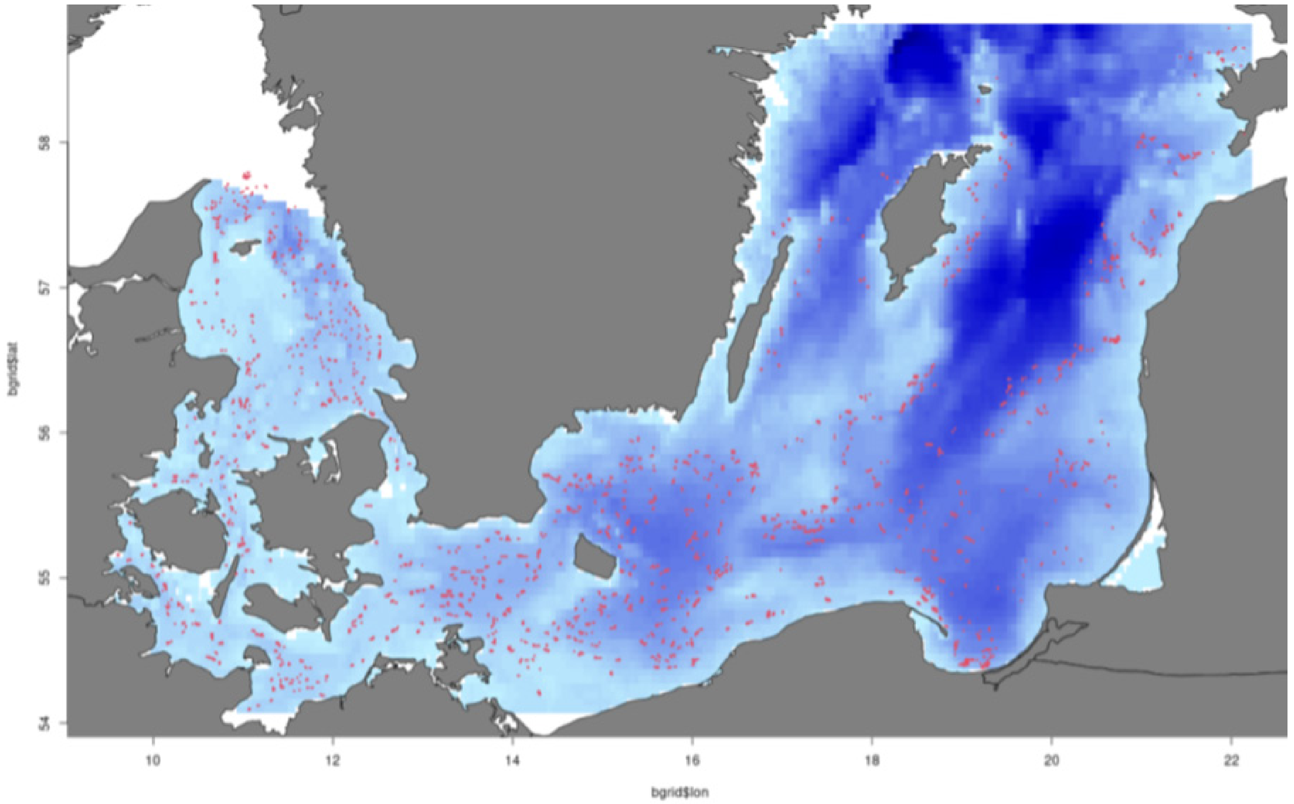


**Figure 4.11.** Sampling locations of sea-floor litter (red) and depth (shades of blue, darker indicating deeper). Note that deep locations and the north and north-eastern parts of the Baltic are not currently sampled, and that the depth map is not aligned with HELCOM assessment unit borders. Sampling of sea-floor litter was started in 2011, by its inclusion in the Baltic Sea International Trawl Survey, but litter categories and sample codes were not fully standardised until 2015. Source: HELCOM 2023c.

"glass", "metal", "natural", "rubber" and "single use plastics", showed no significant increase in weight or number per square kilometre during the evaluation period.

Work is needed to develop these evaluations further, along with evaluations of microlitter and the impacts of litter on biota (HELCOM 2023c).

### Impacts of marine litter in the Baltic Sea ecosystem

Litter may cause harm to animals when they ingest it, either by clogging or injuring their digestive tract or by causing contamination. Another major impact is animals becoming entangled and trapped in lost fishing gear or packaging material. Litter on the seafloor can result in anoxia in the underlying sediments, which alters the biogeochemistry and the benthic community structure (Goldberg 1994). Certain litter types, such as glass bottles and tin cans, may provide substrates for the attachment of sessile biota (Mordecai *et al.* 2011, Moret-Ferguson *et al.* 2010, Pace *et al.* 2007). Heavy plastic items may become colonized by bacteria or loaded with sediments and sink to the seafloor, where they can persist for centuries (Thompson 2006, Derraik 2002, Ye & Andrady 1991). Large plastic items can pose a risk of obstruction or harm to animals, and they leak smaller particles that pose risks to organisms. Litter containing hazardous substances can act as a source of contamination and thereby contribute to chemical impacts on the ecosystem. Marine litter has a socioeconomic impact through the costs associated with cleaning it up, damage to or loss of fishing gear, obstruction of motors and harm to tourism and recreation (Newman *et al.* 2015).

### Sources of marine litter

Marine litter comes from both land and sea-based sources. The types of litter from land are often closely linked with consumer behaviour, such as recreational and tourism activities leaving behind plastic bags, left-overs from beach picnics or cigarette butts. Other land-based sources are riverine inputs and inputs from storm-water overflow. Important sea-based sources are ship-generated waste, such as lost or abandoned fishing gear, foamed plastic or lost fish traps. Beach litter monitoring thus reflects both littering trends along the coastline and litter transported over long distances.

The seafloor is a sink for marine litter, and litter items on the seafloor originate from both maritime activities (e.g. fishing or shipping) and land (Galgani *et al.* 2010, Galgani *et al.* 2015, Pham *et al.* 2014). Lost fishing gear, known as ghost nets, continue trapping marine animals for a long time. Both passive fishing gear, such as traps and nets, and trawls are often lost or discarded. The extent of lost fishing gear in the Baltic Sea is not known, but some examples are available. In 2011, WWF Poland, together with fishermen, scientists and divers, retrieved six tonnes of ghost nets from the Baltic seafloor and two wrecks over 24-days. In 2014, a ghost net project conducted on Rügen by the Ozeaneum Stralsund, archeOmare, the Drosos foundation and WWF Germany removed around 4 tonnes of ghost nets from two wrecks (HELCOM 2023c).





**Figure 4.12.** Lost fishing gear can end up on land, but most often it remains in the sea where it can continue trapping marine animals for a long time.

### Regulations and needs

*HELCOM countries have agreed in the Baltic Sea Action Plan to prevent the generation of waste and its input to the sea, including microplastics, and to significantly reduce amounts of litter on shorelines and in the sea.*

The implementation of the 2021 HELCOM Regional Action Plan on Marine Litter should enable the achievement of the management objectives for marine litter in the Baltic Sea Action Plan. However, there is a need for better geographical coverage in monitoring to evaluate the effect of current actions on marine litter and to define additional ones, if necessary.

Researchers in the fields of climate and marine litter have put forward that commitments against plastic littering in the sea can also increase interest in solving issues related to climate change (Ford *et al.* 2022). The connections between climate change and plastic pollution in the oceans include the fact that plastic contributes to greenhouse gas emissions both throughout its life cycle and as litter in the sea, and that climate change and plastic pollution both occur in all environments. Climate change could worsen the spread of plastic pollution, because litter abundance on coastlines is influenced by water currents and prevailing wind conditions, and rivers are pathways for litter from inland. Changes in precipitation and floods, as well as oceanographic changes, could thus alter litter abundance and the deposition of litter.