4.2.4 Non-indigenous species

Thirteen non-indigenous or cryptogenic species appeared for the first time in the Baltic Sea during the assessment period 2016-2021 (Figure 4.14, Box 4.5). The threshold value for good environmental status is no new introductions of non-indigenous species through human activities at the scale of the whole Baltic Sea during the assessment period. Good status for non-indigenous species was therefore not achieved.

The new introductions were recorded in the Kattegat, the Great Belt, Kiel Bay, the Bay of Mecklenburg, the Bornholm Basin, the Gulf of Gdansk, the Archipelago Sea and the Gulf of Finland.

The indicator only considers new human-mediated introductions. Spreading within the Baltic Sea by natural means, such as by migration or aided by water currents, is not part of this indicator.

The trend in the arrival of new non-indigenous or cryptogenic species increased sharply in the second half of the last century and has not shown any signs of decreasing since then (Figure 4.13).

The number of new introductions was higher during the current assessment period (13) than in the previous one (12 introductions in 2011-2016). However, this comparison is complicated by the fact there were significant additional reports provided for the previous assessment period that were not directly included in the that assessment.

BOX 4.5.

What are non-indigenous species?

Non-indigenous species are species that have spread or been transferred as a result of human activities, reaching environments in which they previously did not naturally occur. Non-indigenous species have the potential to cause harm in their new environments through their interactions with naturally occurring species or human activities.

The Baltic Sea Action Plan states the following ecological objective for non-indigenous species:

— **No introductions of non-indigenous species**

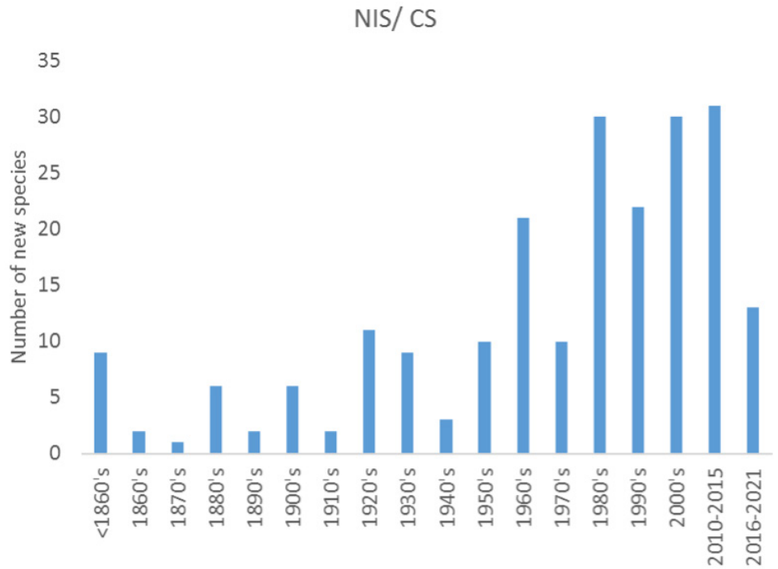

Figure 4.13. The number of non-indigenous species (NIS) introduced to the Baltic Sea over time. The bars indicate the number of new introduced species per time period. Note that the lengths of the last two time periods differ from the others, covering intervals of six instead of ten years. There is a discrepancy between the statistics presented in this figure and the assessment results presented in the text because of retrospective reporting of many new non-indigenous species after the publication of the previous holistic assessment (HELCOM 2018). The threshold value for good status is 0 new introductions. Data are from the Information system on aquatic non-indigenous and cryptogenic species (AquaNIS). Source: HELCOM 2023c.

Impacts of non-indigenous species in the Baltic Sea ecosystem

Non-indigenous species that spread into and become established in the Baltic Sea may harm the natural marine environment. For example, the round goby (*Neogobius melanostomus*), a bottom-dwelling invasive fish originating from the Black Sea and the Caspian Sea, was first observed in the Baltic Sea in 1990. After a few years of low abundance, the species increased dramatically and is now a dominant species in many areas of the Baltic Sea, with the capacity to change interactions in the benthic food web (Kotta *et al.* 2016), and it is still expanding its range in the Baltic Sea.

Overall, non-indigenous species have caused ecological, economic and public health impacts globally (Ruiz *et al.*, 1997, Mack *et al.* 2000, Lockwood *et al.* 2007, Ojaveer and Kotta 2015). Non-indigenous species can induce considerable changes in the structure and dynamics of marine ecosystems. Economic impacts range from financial losses in fisheries to expenses to industries for cleaning intake or outflow pipes and structures from fouling (Black 2001, Williams *et al.* 2010). Public health impacts may also arise from the introduction of pathogens or toxic algae.

The impacts of non-indigenous species can be unpredictable and may be large, especially when they co-occur with other pressures. However, not all non-indigenous species are invasive, spread widely or become abundant. Established non-indigenous species may influence biodiversity and the ecosystem in different ways, and their effects are often difficult to foresee. Risk assessments are important to guide the management of non-indigenous species and to help implement measures at an early stage (Katsanevakis *et al.* 2014). An evaluation of current cumulative negative impacts on marine biodiversity caused by non-indigenous species in the Baltic Sea, based on the Cumulative IMPact of ALien species (CIMPAL) index, is depicted in Figure 4.15. However, our knowledge is very limited for the majority (60%) of wide-spread non-indigenous species in the Baltic Sea (Ojaveer *et al.* 2021).

Sources for the introduction of new non-indigenous species

Maritime transport is the main pathway for the introduction of new non-indigenous species. Harbours and ports are hotspots for both the new introduction of non-indigenous species and their establishment, as they are sites where ships are stationary for extended periods. Harbours and ports also offer suitable places for species to settle, in shallow water or modified habitats (Lehtiniemi *et al.* 2015).

Figure 4.14. The round goby (*Neogobius melanostomus*) is an example of a non-indigenous species that has taken a major role in the Baltic Sea food web, leading to impacts on several other species.

Regulations and needs

The management objective for non-indigenous species under the Baltic Sea Action Plan is "no introductions of non-indigenous species".

Preventative measures are key to limiting non-indigenous species, as the eradication of already established non-indigenous species is difficult and cost-intensive and has generally proven not to be feasible in aquatic environments (Sambrook *et al.* 2014). There are no records of the eradication of established non-indigenous species in the Baltic Sea. Management should therefore primarily aim to prevent further introductions and to minimize the negative effects of the non-indigenous species that have already been introduced. Further monitoring and evaluation of the establishment, risk and potential harm caused by non-indigenous species in the Baltic Sea is also needed.

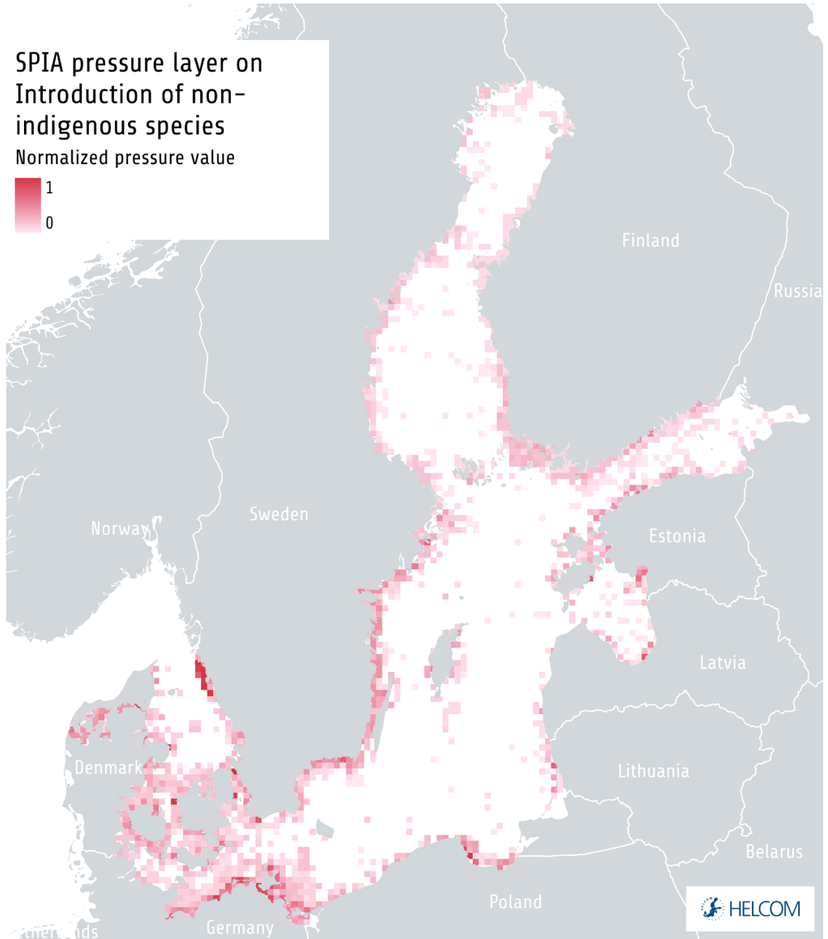

Figure 4.15. Non-indigenous species impacts in the Baltic Sea, as presented in HELCOM (2023e). The layer indicates the cumulative negative impacts on marine biodiversity caused by non-indigenous species based on the index CIMPAL (Cumulative IMPact of ALien species (Katsanevakis et al. 2016). The map shows the normalized pressure values, with increased colour intensity indicating higher pressure. Source: HELCOM 2023e.

4.2.5 Underwater noise

Continuous noise was evaluated for the first time in HELCOM during the current assessment period, by addressing the proportion of the Baltic Sea area exceeding noise levels that may cause adverse biological effects (Box 4.6). The evaluation results indicate a good status of continuous underwater noise in all areas of the Baltic Sea with respect to the risk of behavioural disturbance in fish or marine mammals. With respect to the risk that human-induced noise masks natural sounds, the evaluation indicates good status for marine mammals in all of the Baltic Sea but not good status for fish in 9 out of 17 assessment units. Several aspects of the evaluation method are still under development.

Continuous underwater noise shows considerable variation in space and time (Figure 4.16). Noise levels are clearly higher in shipping lanes than elsewhere in the Baltic Sea, and noise is more widespread in winter than in summer.

BOX 4.6.

What is underwater noise?

Underwater noise measures the contribution of human activities to the sound environment under the sea surface. Both continuous and impulsive noise occur, and the two types vary in their properties and in how they affect aquatic animals. Continuous noise is constant, fluctuating or varying slowly over time, while impulsive noise has a short duration and a fast pulse rise time.

The Baltic Sea Action Plan states the following ecological objective for underwater noise:

— **No or minimal harm to marine life from man-made noise.**

The status of continuous noise is evaluated in relation to the hearing frequencies of fish and marine mammals, at 125 and 500 Hz decidecade bands, respectively. The risk of behavioural disturbance is evaluated based on the median total sound pressure level, and the risk of masking natural sounds is evaluated based on the median excess of a species-specific level. Impulsive noise is evaluated based on the occurrence of impulsive noise-producing events, such as explosions, reported to the regional HELCOM/OSPAR noise registry hosted by ICES (ICES 2015). The distribution of sound was compared to the distribution of harbour porpoises in the Baltic Sea to get a preliminary view of the overlap between sound and the occurrence of harbour porpoises.

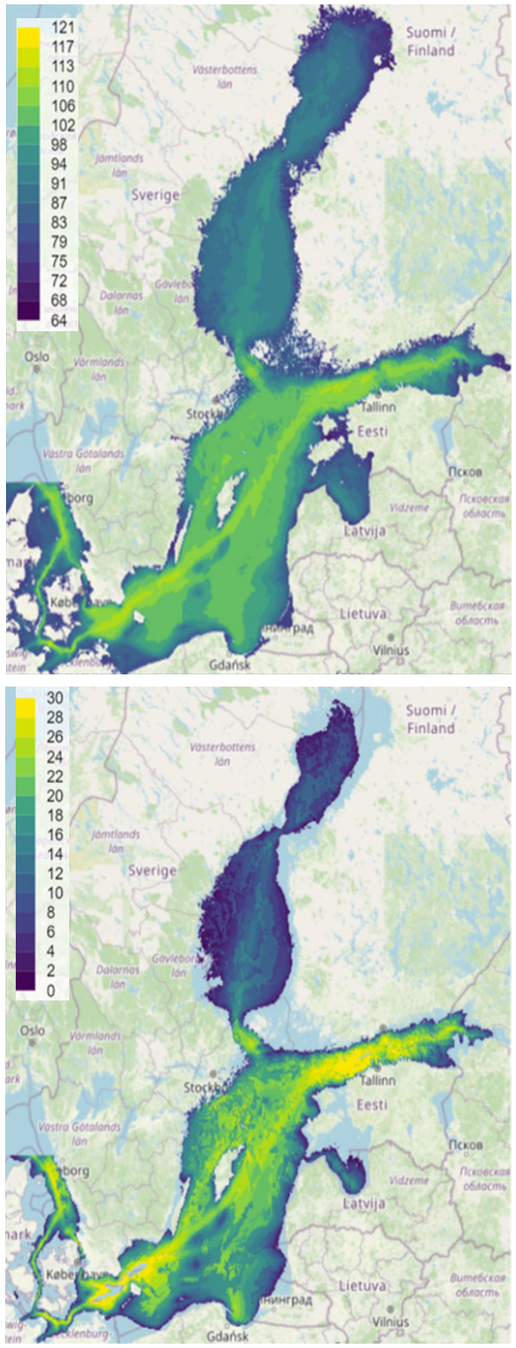

Figure 4.16. Illustration of continuous underwater noise in the Baltic Sea. The upper map shows the median sound pressure level for the third octave band 125 Hz in March 2028, and the map below shows the median excess level for the same. The maps represents the time of the year with the most favourable conditions for the transmission of anthropogenic noise in the Baltic Sea. Source: HELCOM 2023c.