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.

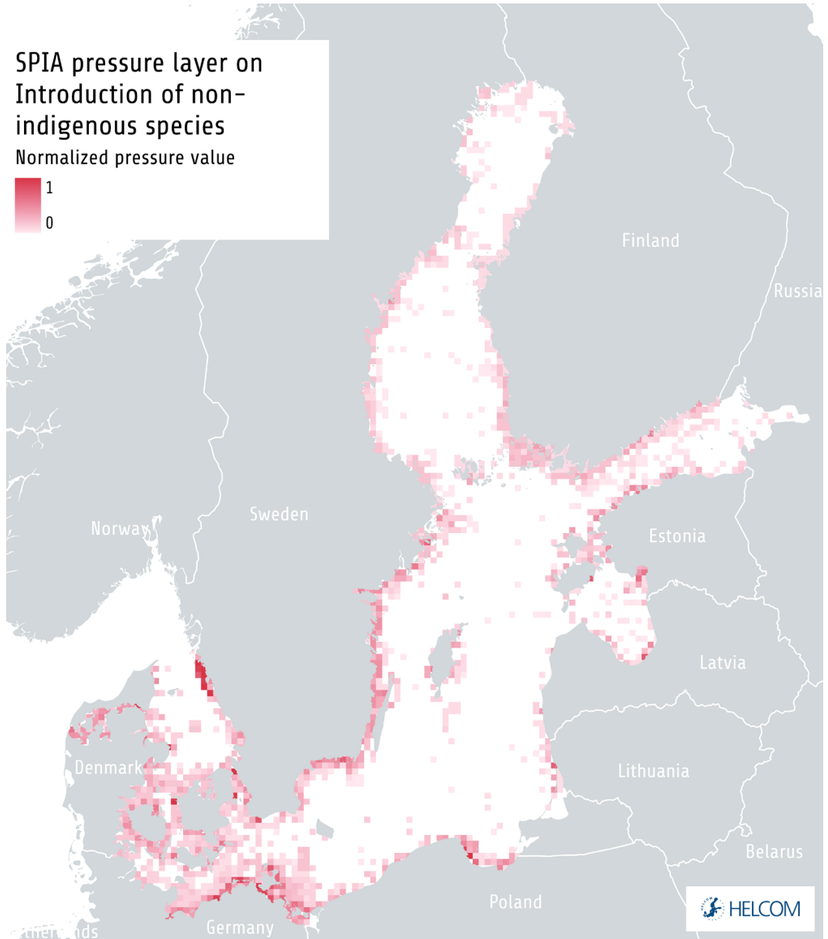

Figure 4.15. Non-indigenous species impacts in the Baltic Sea, as presented in HELCOM (2023e). The layer indicates the cumulative negative impacts on marine biodiversity caused by non-indigenous species based on the index CIMPAL (Cumulative IMPact of ALien species (Katsanevakis et al. 2016). The map 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.

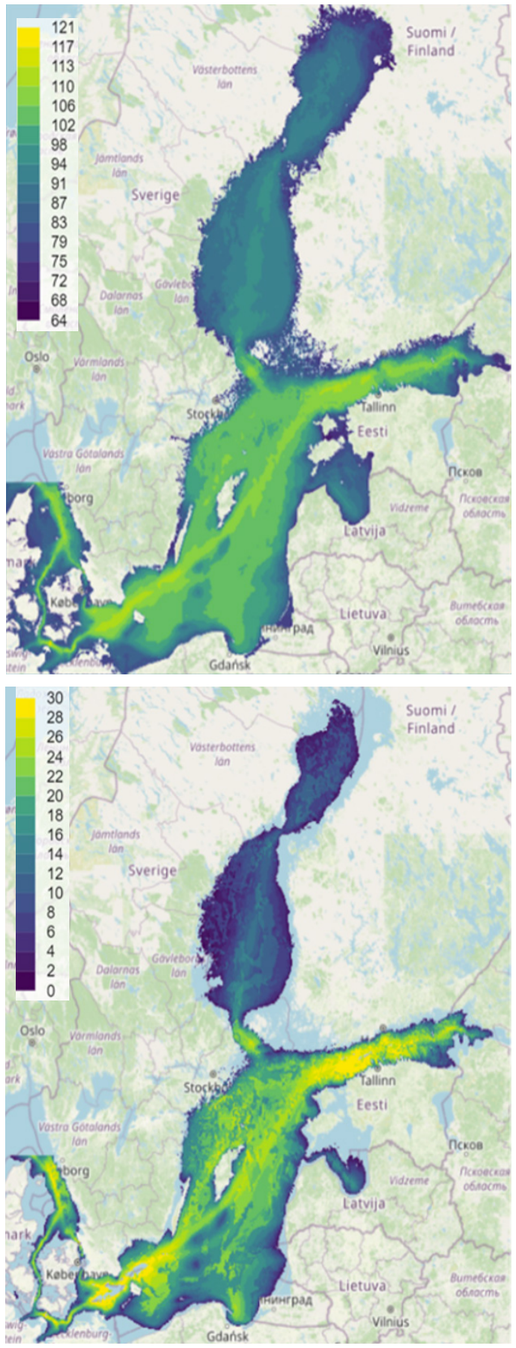

Figure 4.16. Illustration of continuous underwater noise in the Baltic Sea. The upper map shows the median sound pressure level for the third octave band 125 Hz in March 2028, and the map below shows the median excess level for the same. The maps represents the time of the year with the most favourable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

Additionally, the potential effect of continuous noise on mobile species was addressed by combining the HELCOM SPIA pressure layer representing input of continuous noise with information on the distribution of fifteenmobile species and their habitats (HELCOM 2023e). According to the obtained results, the highest average potential effect of continuous underwater noise occurs in the south-western Baltic Sea, where all ships entering or leaving the inner parts of the sea pass through a rather narrow area, compressing the traffic. The Arkona basin is also a hotspot for the occurrence of mobile species, intensifying the impact of this area (Figure 4.17).

Preliminary evaluations of reported impulsive noise indicate that there was enough undisturbed habitat for harbour porpoises in the Baltic Sea to avoid the impacts of low- and mid-frequency impulsive sounds during the assessment period. The area of habitat exposed and disturbed remained clearly below 10% of its HELCOM area habitat per day, based on the occurrence of impulsive noise-producing activities reported by Contracting Parties (Figure 4.18).

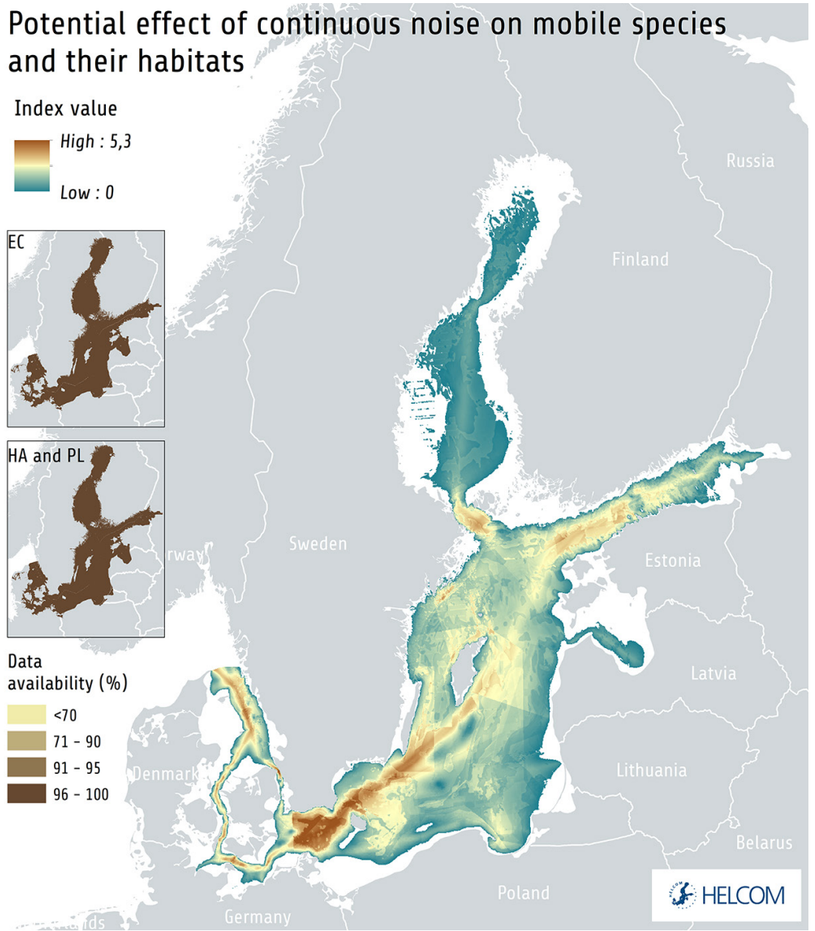

Figure 4.17. Areas with potentially highest impact from continuous underwater noise on mobile species. The map is based on the HELCOM pressure layer on inputs of continuous noise combined with information on the distribution of fifteen mobile species and their habitats (HELCOM 2023e). The highest average potential impact occurs in the south-western Baltic Sea, where all ships entering or leaving the Baltic Sea pass through a rather narrow area. The Arkona basin is also a hotspot for the occurrence of mobile species, which increases the potential impact. Source: HELCOM 2023e.

State of the Baltic Sea
Third HELCOM holistic assessment 2016–2021

State of the Baltic Sea 2023
4. Protect and restore the Baltic Sea and its biodiversity

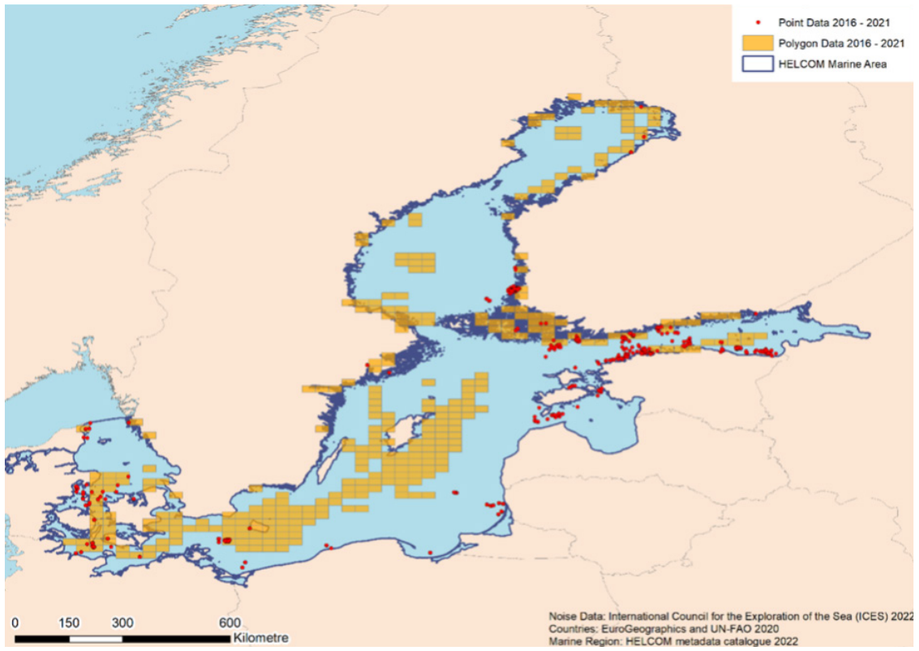

Figure 4.18. Impulsive noise activities reported for the period 2016 – 2021 in the HELCOM area. Data are from the HELCOM noise registry (ICES 2015). Source: HELCOM 2023c.

Impacts of underwater noise in the Baltic Sea ecosystem

Noise can affect aquatic life in several ways. Continuous noise at certain frequencies and high intensity can mask the natural acoustic communication of animals and decrease their ability to hear biologically relevant sounds, such as sounds involved in locating prey. It can also disturb their natural behaviour.

Although loud impulsive noises do not persist, they can nevertheless induce a range of impacts depending on their intensity. Certain levels of impulsive noise can cause biological disturbance by inducing stress and behavioural changes in, for example, fish and marine mammals (Wysocki *et al.* 2006, Santully *et al.* 1999), particularly in harbour porpoises (e.g. Madsen *et al.* 2006, Brandt *et al.* 2009, Tougaard *et al.* 2009, Tougaard *et al.* 2012, Dähne *et al.* 2013) but also in harbour seals (e.g. Jacobs and Terhune 2002, Gordon *et al.* 2015, Kastelein *et al.* 2015). Such disturbances may deter animals from an area or prevent them from carrying out normal feeding or reproductive behaviour. At higher levels, noise can have an impact on an animal's auditory system, leading to temporarily or permanently impaired hearing (Lucke *et al.* 2009, Finneran 2015). Very high levels of impulsive noise can lead to further physiological injury or death.

Sources of underwater noise in the Baltic Sea

Continuous noise in the Baltic Sea comes mainly from maritime transport. Other sources of continuous noise include fishing vessels, energy installations, leisure boats and dredging. Noise from ships sailing at service speed is primarily from their engine and propeller, with secondary components being machinery and the movement of the hull through the water. Sound waves propagate efficiently in water, so sounds from point sources are heard much farther away than in air.

The most intense sources of loud impulsive noise are explosions, pile driving, seismic exploration and low frequency sonar. Unless mitigation measures are used to reduce the propagation of impulsive noise, activities such as explosions and piling may have effects at vast distances from the source. For example, impulsive noise input from pile driving activities was shown to induce avoidance reactions and thus disturbance to harbour porpoises at a distance of 25 km (Dähne *et al.* 2013). Effective mitigation measures exist to significantly reduce the effect distance and to temporarily deter animals from the remaining impacted area.

Regulations and needs

Reducing noise to levels that do not adversely affect marine life is a key management objective of the Baltic Sea Action Plan.

The envisaged revised International Maritime Organization Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life and the HELCOM Regional Action Plan on Underwater Noise are expected to lead to the achievement of this objective. However, compulsory regulations will likely be needed to achieve a significant reduction in underwater noise from shipping.

Furthermore, as spatial and temporal threshold values for underwater noise have just been adopted at the EU level, formal discussions and agreements are still needed about how these should be applied with respect to, for example, spatial assessment units, habitat size and sound levels that result in biologically adverse negative effects.

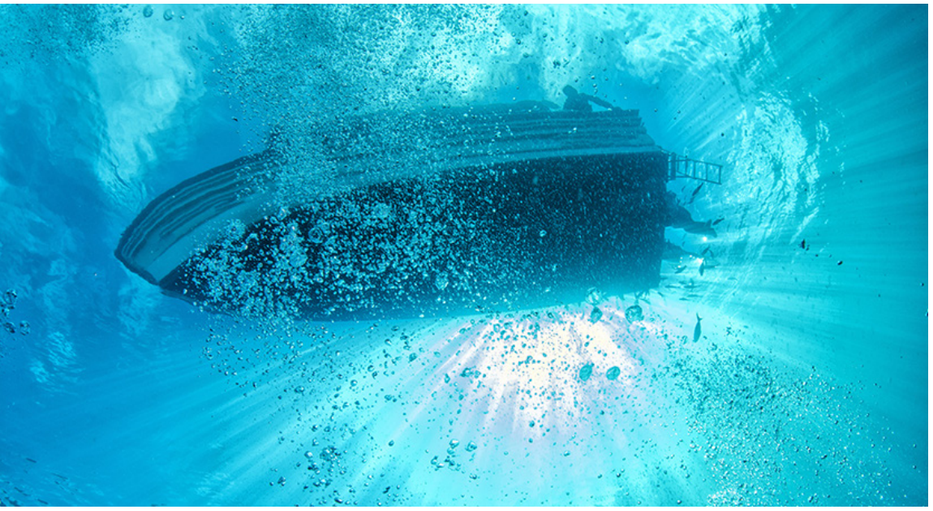

Figure 4.19. Contoinuous noise comes from boats and vessels of all sizes.

4.3. Pressures from activities at sea

Several pressures on the Baltic Sea derive from our direct use of the sea and its resources. Extractive pressures are associated with fishing, hunting and the extraction of materials from the seabed, such as sand and minerals. Physical pressures come from activities such as dredging, bottom trawling and marine construction.

The assessment results for pressures stemming from sea-based activities are presented here for the extraction of fish, unintentional by-catches, hunting of birds and mammals, and sea-floor loss and disturbance. More detailed results can be found in the HELCOM thematic assessment of biodiversity status (HELCOM 2023a) and its underlying indicator reports.

As these pressures are extractive or lead to physical alterations of the seabed, they have direct impacts on the affected species and habitats. Careful planning and regulation of the activities is needed to ensure sustainable use.

4.3.1 Extraction of fish

The status assessment of fish presented in Chapter 3 integrates the status of fishing pressure in the evaluation of commercially important fish stocks (Box 4.7). Out of fifteen commercial stocks that could be fully evaluated, only four showed good status on average during 2016-2021 (Figures 4.20-4.21). Stocks showing good status with respect to both fishing pressure and stock size were plaice in the Baltic Sea, herring in the Gulf of Riga and the Gulf of Bothnia, and vendace in the Swedish part of the Bothnian Bay, although the latter two stocks showed a decreasing trend in stock size.

Looking specifically at fishing pressure, threshold values were not achieved for eight of the seventeen stocks that could be evaluated for this indicator; these were four pelagic and four demersal stocks. Threshold values for stock size was not achieved for two pelagic stocks, four demersal stocks and eel (Table 4.1).

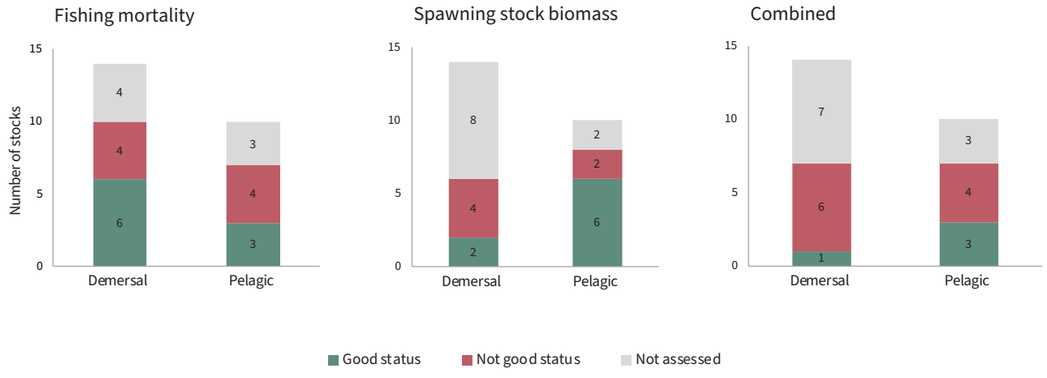

Figure 4.20. Number of pelagic and demersal commercial fish stocks in good and not good status with respect to fishing mortality (left), stock size (spawning stock biomass, middle), and both aspects combined (right). The colours denote whether the average value during 2016–2021 achieved (green) or failed (red) the 2021 threshold value. The number of fish stocks not assessed in each case is indicated in grey.