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| **Document title** | Update of the underwater noise section within the 'State of the Baltic Sea' report |
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| **Submitted by** | Secretariat |
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## Background

HOD 52-2017 (Outcome of HOD 52-2017, para. 2.39) approved the First version of the 'State of the Baltic Sea report, June 2017' and agreed on its publication on the HELCOM website, with the understanding that a final consolidated report will be prepared by June 2018. The report contains a section on underwater noise which is also to be revised based on the feedback provided by Contracting Parties.

This document compiles comments as provided by Estonia, Germany and Poland to the current version of the section on underwater noise within the 'State of the Baltic Sea report, June 2017' to be addressed in the revised version.

## Action requested

The Meeting is invited to:

- note the comments on the current section on underwater noise in the 'State of the Baltic Sea report, June 2017';
- discuss and agree on further steps to further develop the current text aiming at submitting the revised document to the upcoming HOLAS II Core team meeting, to be held on 28-29 November 2017 for consideration.

## 4.4 UNDERWATER SOUND

*Sound is continuously present in the underwater environment, and is produced naturally by wind, waves, ice, and thunder, as well as by animals. Human activities cause additional sounds which may have a polluting effect. These are typically by-products of marine activities and infrastructure, such as shipping, bridges, or underwater construction work, but are also spread deliberately by the use of eco-sounders, sonars and seismic airguns, for example. HELCOM has developed monitoring of underwater sound, and agreed that 'underwater sound should not have negative impact on marine life in the Baltic Sea'.*

Sound waves propagate over long ranges in water and their impact may occur far from the sources, across national boundaries. Two categories of sound are identified: continuous and impulsive. Continuous sound from a source can be constant, fluctuating, or slowly varying over a long time interval.

Various human activities may generate continuous sound. Examples of such activities are among others bridges, offshore wind turbines, shipping and boating which also influence on the local sound environment. One concern is that human generated continuous sound may mask animals' communication and signals used for orientation.

Impulsive sound is characterised by short duration and a fast pulse rise time. The sound associated with piling, underwater explosions or airgun signals used in seismic surveying are examples of impulsive sound. This type of sound can displace animals, as they are scared away from the area, and can also cause temporary or permanent hearing loss if no mitigation measures are applied.

A good environmental status with respect to underwater sound requires that the level and distribution of both continuous and impulsive sounds should not cause negative impacts on marine life (HELCOM 2013a). At this time, such levels have not been defined for sound sensitive species in the Baltic Sea.

### Continuous low frequency anthropogenic sound

Continuous sound levels in the Baltic Sea were measured in a comprehensive study using automated hydrophone loggers in 2014 by the project Baltic Sea Information on the Acoustic Soundscape (BIAS). The data were used to develop modelled soundscape maps (Figure 4.4.1), which show the spatial and temporal distribution of continuous sound in different frequency bands across the Baltic Sea (1/3 octave bands of 63, 125 and 2000 Hz). The lower frequency bands are typical of ship induced sound, and the higher frequency bands are measured due to their ecological relevance.

The maps identify areas with different levels of continuous sound and at the same time they show the statistically calculated temporal distribution of sound levels at these areas. Continued monitoring is carried out by several

countries on a temporary basis, and a regional programme for monitoring continuous underwater sound is under development.

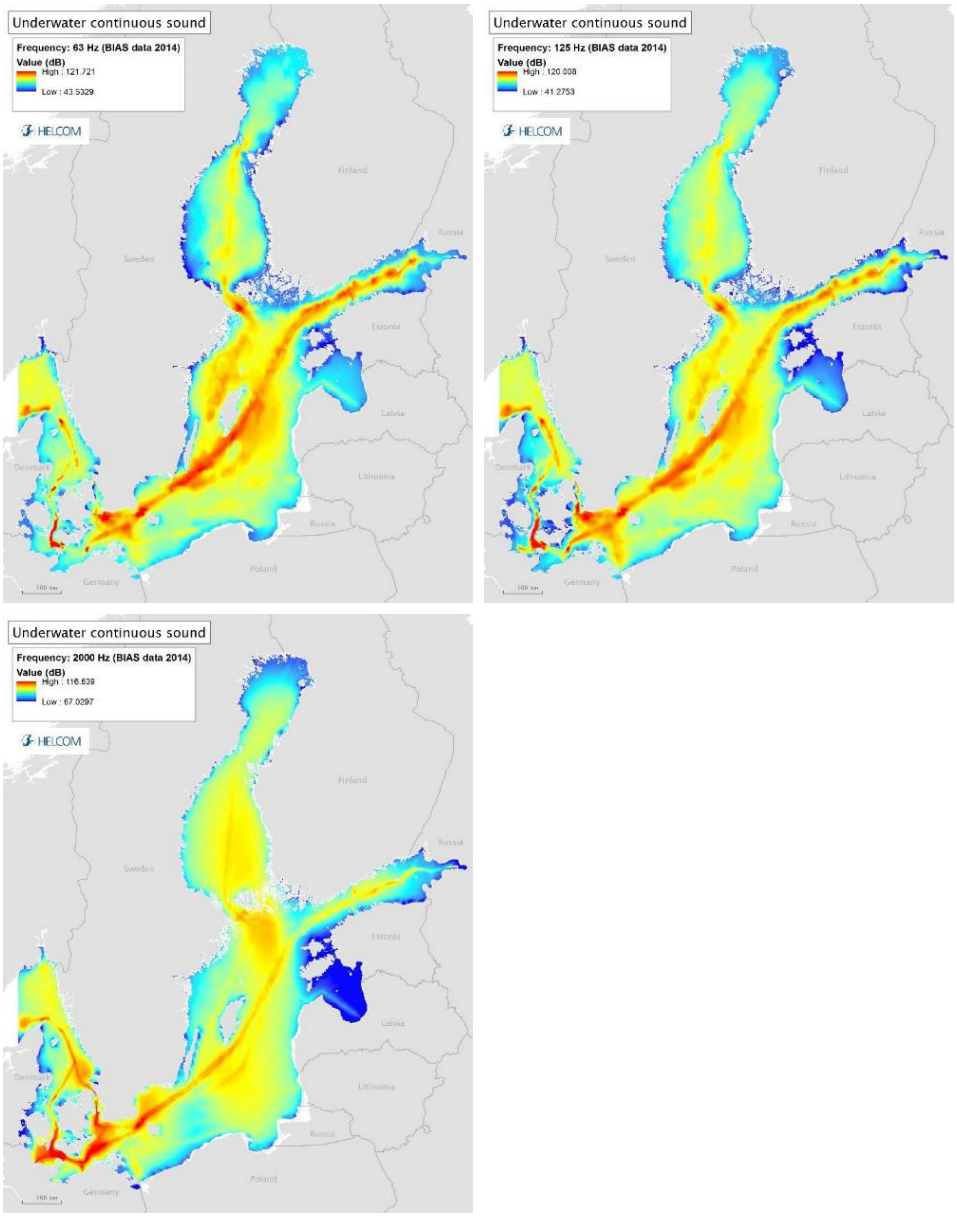
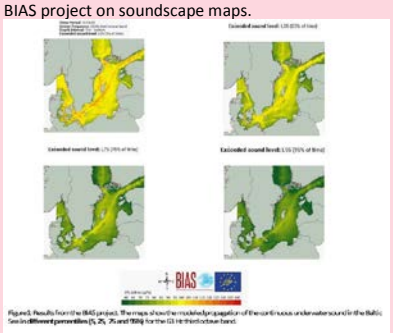



Figure 4.4.1. Soundscape maps in the Baltic Sea, showing underwater continuous sound at 1/3 octave frequency bands of 63 Hz, 125 Hz and 2000 Hz. Areas with high sound level overlap clearly with the location of major shipping routes. The sound produced

**Commented [MR1]: EE:**
1) the figure does not include the noise exceedance level (or 1-percentaile in the statistic) for the three center frequencies: 63Hz, 125Hz and 2kHz. What noise levels are selected for these center frequencies in Figure 4.4.1?
2) In the HOLASI project, source-based data (ships traffic density) was used to "show" underwater noise "pollution" effect in the Baltic Sea. Do we need use three center frequencies: 63Hz, 125Hz and 2kHz determining impact of continuous noise on marine environment?
3) Marine species are more sensitive to higher frequencies. Do we need to use three center frequencies: 63Hz, 125Hz and 2kHz determining impact of continuous noise on marine spices?

**Commented [MR2]: DE:** please use the appropriate (measurement) units ([dB re 1µPa] and use water depth levels. Also add the temporal distribution in percentiles of continuous underwater sound.

**Commented [MR3]: HOD 52-2017**: Add figures from the BIAS project on soundscape maps.



**DE further clarification**: Soundscape maps in the Baltic Sea, on the temporal extension of continuous underwater noise at 1/3 octave frequency bands of 63 Hz statistically calculated on the basis of percentile statistics showing that the high levels occur at 5% of the time and that the intensity levels are for 95% of the time rater low. The results have been extracted with help of the soundscape planning tool of BIAS (2016).

from shipping is within a frequency interval that overlaps with the hearing range of several species. The results have been extracted with help of the soundscape planning tool of BIAS (2016).

## Impulsive sound

Impulsive sounds may cause large scale displacement as well as physical damage to marine animals. In some cases mitigation measures may help to lower the damage.

The occurrence of activities associated with loud impulsive sounds, such as sonar events, airguns and underwater explosions and pile driving, can (since 2015) be logged in a regional registry established by HELCOM and OSPAR and hosted by ICES. Countries have agreed to register these activities, and reports on sound-generating activities have so far been supplied by five countries during the period 2013–2016[1]. Denmark has delivered data on pile driving for 2015 (12 events). Sweden has reported sonar events (90), airguns (31) and underwater explosions (35) in 2015 and Germany pile driving events in 2013 (95) and 2014 (67). Germany had no registered impulsive events in 2015 to be reported according to the reporting guidance (JRC 2014). Lithuania has reported explosions in 2013 (8) and 2016 (12). In the future the registry will provide a quantitative view of activities that generate impulsive sound and their distribution in the Baltic Sea to support future status assessments.

Information from the registry will also support evaluation of possible impacts on species and decisions on mitigation strategies to be applied when conducting impulsive sound generating activities.

**Commented [MR4]: EE:** It seems that for the continuous noise we can use BIAS data (noise maps), but for impulse noise, only source-based data is available. How do relate the impacts from source-based noise sources and measurement-based noise sources? Cf. Baltic Sea Impact Index in Baltic Sea Environment Proceedings No. 122.

**Commented [MR5]: HOD 52-2017:** Add table to impulsive events as reported to the regional registry

## Impacts

Across the Baltic Sea there is strong temporal and spatial variability in sound levels, but as yet it is not clear how much marine species are impacted.

Harbour porpoise and seals are species that are likely to be especially affected by human generated sound. They have very good underwater hearing abilities and rely on sound for their orientation, communication and foraging. Harbour porpoise also uses echolocation to find prey. Many Baltic fish species hear and produce sound at low frequencies (Figure 4.4.2). For example cod uses sound to communicate and to perceive their environment. For most species, including fish, diving birds and the majority of Baltic invertebrates, little is known about what role sound plays, even though it is likely that it is essential in at least some part of their life cycle and that they could be affected by high sound levels.

For the first time in the HELCOM assessment, spatial information of the sound distribution in the Baltic Sea (Figure 4.4.1) has been compared with maps of key areas for sound-sensitive species. The overlap (Figure 4.4.3) gives

[1] Poland reports data as soon as reporting transect data will be fixed

indication of the risks from sound generating activities to different species. Spawning areas for cod and recruitment and foraging areas for harbour porpoise are examples of areas with elevated risk of impact.

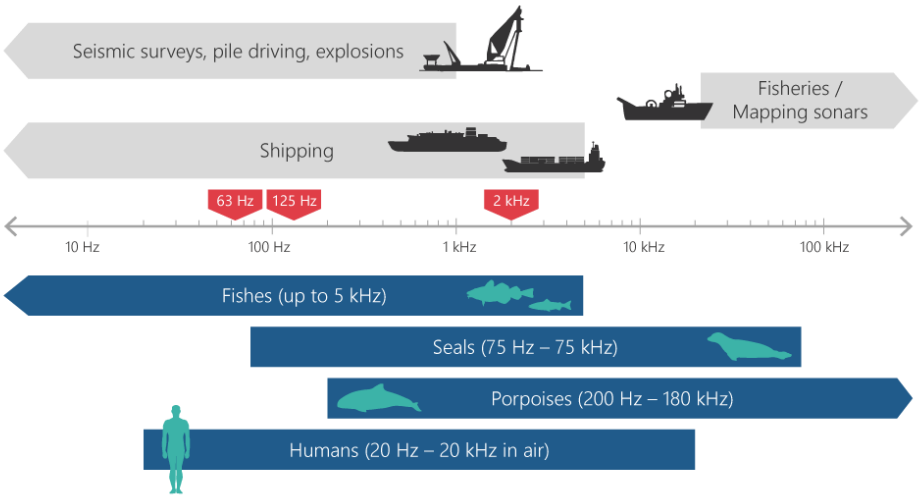



**Figure 4.4.2. Auditory range of some marine species present in the Baltic Sea and sound frequencies generated by human activities.** Human hearing is provided as a reference. After Scholik-Schlomer (2015) adjusted to Baltic Sea conditions. The red fields indicate the monitored frequency bands within BIAS. Source: BIAS 2017.

## A changing sound environment

There is no data to show how sound levels have changed over time in the Baltic Sea. Looking ahead, at least some of the human activities which may generate underwater sound, such as off-shore construction work, energy installations and shipping, as well as dredging and leisure boating are likely to increase. Depending on these developments as well as technical improvements, it is likely that both the level of sound and its character will change over time. Pre-emptive mitigation measures and the implementation of sound reduction solutions are foreseen to play an important role in counteracting and reducing the impact of sound in areas where elevated sound levels are found to impose a risk to sound-sensitive species. Further, maritime spatial planning can help to minimize risks.

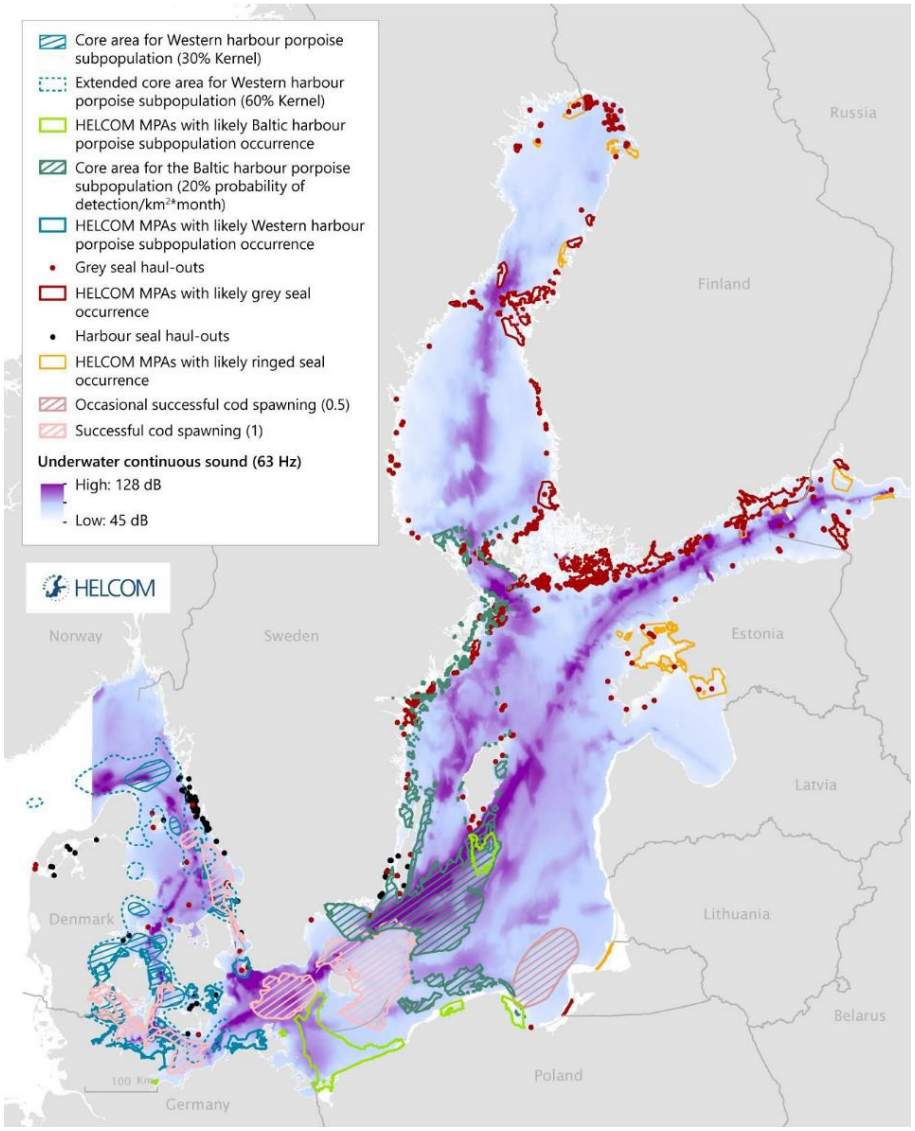



Figure 4.4.3[2]. Overlap of spatial information of the sound distribution in the Baltic Sea with sound sensitive areas derived from biological data on sound sensitive species so far identified. Basedon Schack *et al.* (2016, see HELCOM 2016g).

**Commented [MR6]: PO:** It still requires some analysis regarding the distribution data of such species like harbour porpoise (on the map high density of porpoises is indicated around the Hel Peninsula and mid Polish coast, but there are no data about the presence of the Western harbour porpoise population in the Pomeranian Bay).

**Commented [MR7]: DE:** Further to the HoD-52 Outcome, we understand that with regard to Fig. 4.4.3 (overlap map), the Status Report should make use of Fig. 1 from Document 3-6 [HELCOM Guidelines for establishing environmental targets for underwater noise]. At least, the related (measurement) units, that are needed for better understanding, should be used ([dB re 1µPa], used water depth levels, the temporal distribution in percentiles of continuous underwater sound. Also, add the year of the sound data (complete 2014 or monthly data?).

[2] Figure subject to change according to the revision of the document for HELCOM guidelines for establishing environmental targets for underwater noise (HOD52 doc 3.6).