HELCOM Input to the process of establishing environmental targets for underwater noise[1]

(Agreed by HOD 54-2018)

This document will be complemented with future steps and timetable for further work with involvement of relevant HELCOM groups and based on testing.

Introduction

This document has been prepared in HELCOM by HELCOM EN-Noise based on developments under the EU co-financed HELCOM BalticBOOST project and contains guidelines on how environmental targets could be established for underwater noise and is meant to provide regional input to the discussion of these issues in other fora, including other Regional Seas Conventions, United Nations agencies such as the International Maritime Organisation and at European level.

When more knowledge and experience becomes available and agreement on principles and threshold values in other relevant fora is reached, the document will be revisited with the aim of final adoption of principles and threshold values by HELCOM.

Environmental targets are defined as the level of pressure that is consistent with reaching a good environmental status. The pillar of this input is two decision support trees, one for impulsive and one for continuous noise, which aim at identifying the need of establishing environmental targets for underwater noise using a risk-based approach. Such risk based approach considers the effect of noise on the conservation status of noise-sensitive species. In this respect, whether guidance levels are exceeded during relevant biological time periods is considered. Further work is needed on the definition of these guidance levels, which are to be developed based on the knowledge available. This knowledge is gathered on the species-specific principles proposed both for continuous and impulsive noise. Since it is not possible to account for all sensitive times and areas in this document, additional information may be needed for the risk based approach.

Background

Human-generated sources of impulsive noise with the highest intensity are explosions, pile driving, seismic explorations and low frequency sonars, whereas anthropogenic noise of a more continuous nature encompasses sources such as energy installations (e.g. pipelines and oil platforms), continuous dredging, shipping, or renewable energy operations (e.g. windfarms).

Many aquatic animals in the Baltic such as the harbour porpoise, ringed seal, harbour seal and grey seal, as well as fish species such as herring and cod rely on sound for navigation, finding prey or avoiding predators, and for communication. Noise may disrupt behaviours, increase stress levels, mask important signals and/or reduce the hearing sensitivity either temporarily (TTS) or permanently (PTS) in an individual.

Identification of species sensitive to underwater noise and areas

In the BalticBOOST project, current knowledge on impacts of underwater noise on animals in the Baltic Sea was summarized in a report on 'Noise Sensitivity of Animals in the Baltic Sea'. The report has been reviewed by the State and Conservation Working Group and HOD 51-2016 agreed to publish the report in the Baltic Sea Environment Proceedings (BSEP). In this report, a list of priority species sensitive to underwater noise in the Baltic Sea was identified based on hearing sensitivity, impact of noise (i.e. known or suspected

[1] This input does not prejudge the mandatory or recommendatory nature of the targets.

susceptibility of a species to effects of noise), threat status, commercial value, spatial distribution and data availability. It consists of the four Baltic marine mammal species: harbour porpoises, ringed seals, harbour seals, and grey seals, as well as three species of fish: cod, sprat and herring.

The report also summarized important spatio-temporal information for the identified species sensitive to underwater noise in the Baltic Sea, as presented in Table 1 and the preliminary map in Figure 1. Based on comments received at GEAR 15-2016 (Outcome of GEAR 15-2016, para. 4.12) additional sensitive areas for harbour porpoises in the Western Baltic Sea (Pomeranian Bay and protected areas east of Rügen as well as Puck Bay) were included in the map of sound sensitive areas. Finnish feedback provided after HOD 51-2016 has also improved the map. The identification of sensitive time periods and areas for priority species form an essential basis for the proposed principles and determination of the need to establish environmental targets.

Table 1. Periods of biological significance for each of the identified priority species sensitive to underwater noise. Periods not applicable to a species are marked in blue.

Species	**Calving/Pupping period**	**Mating/spawning period**	**Nursing Period**	**Moulting period**
Harbour porpoise (*Phocoena phocoena*)	June-September	June-September	July through the year	N.A
Harbour seal (*Phoca vitulina*)	May-June	July-August	June-July	August
Ringed seal (*Phoca hispida botnica)*	February-March	Thought to occur during the nursing period	February-April	April –May
Grey seal (*Halichoerus grypus*)	February-March	March-April	February-April	May-June
Cod (*Gadus morhua*)	N.A	[March-December]	N.A	N.A
Herring (*Clupea harengus*)	N.A	Spring and autumn	N.A	N.A
Sprat (*Sprattus sprattus*)	N.A	March-August	N.A	N.A

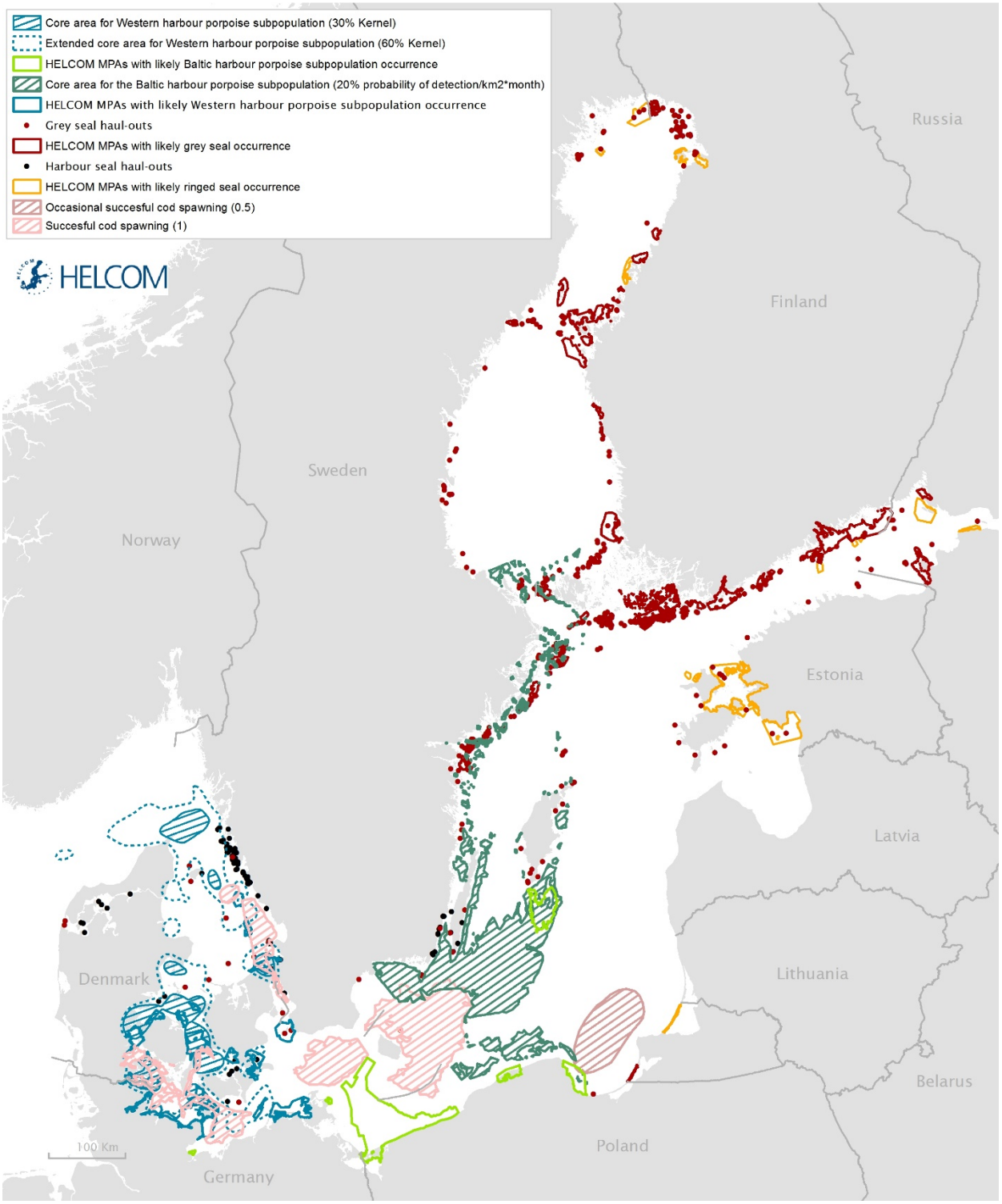

Figure 1 – Noise sensitive areas derived from biological data on species sensitive to underwater noise so far identified. For harbour porpoises important areas are based on established marine protected areas (MPA) where this species occur as well as recent findings. For the Western Baltic subpopulation, important areas are based on tagging and acoustic survey data (Teilmann et al., 2008; Sveegaard et al., 2016) and MPA where this species occur (HELCOM MPA database). For the Baltic subpopulation important areas are based on acoustic survey data (ASCOBANS, 2016) and MPA where this species occur (HELCOM MPA database). For harbour seals and grey seals, areas are based on data of identified haul-outs (from the HELCOM core indicator report on "Distribution of Baltic seals"), and for grey seals also on MPA where the species occurs (HELCOM MPA database). Harbour seals and grey seal haul-outs are used by seals only for a few weeks and this does not reflect the full range of marine areas used by harbour seals nor grey seals. This gap in data should be addressed in future reports. Important areas for ringed seals are based on MPA where the species occurs (HELCOM MPA database). For the fish species important areas are based on known spawning grounds. Cod spawning grounds (HELCOM HOLAS II Dataset: Cod spawning areas, 2017). For migrating species it may be necessary to take measures to ensure migration without physical or acoustic barriers. More sites may be added as data becomes available, i.a. important foraging areas and other fish species. Continuous sound (such as from ships) and its effects on marine life needs further investigation. Contracting Parties are encouraged to support further research.

Use of information on existing assessments of status of marine mammals and others

The environmental status for some of the priority species sensitive to underwater noise in the Baltic is already being assessed at the population level through the HELCOM core indicators 'Populations trends and abundance of seals' and 'Distribution of Baltic seals'. The assessments are done based on abundance and population growth rate (population trend), and on distribution relative to pristine distribution as seen, or occupation of currently available haul-out sites. HELCOM core indicator threshold values for the different populations is achieved when the species specific growth rate is achieved, when there is a certain abundance of individuals in each management unit, and when all available haul-outs are occupied with no decrease in area of occupation. The current environmental status for those animals is to be used when establishing environmental targets. In addition, other biological indicator methods could be explored in the future, including bioindicators (see Annex 1).

HELCOM input to the process of establishing environmental targets for underwater noise

Effects of noise on the level of population are still poorly understood, and HELCOM indicators to assess status in relation to underwater noise has therefore not yet been developed.

Tables 2 and 3 outline a qualitative description of conditions to be met to consider good status to be achieved and are meant to facilitate a coherent approach among the countries. They are meant to be used to develop guidance levels i.e. thresholds of noise consistent with good status for each species sensitive to underwater noise and furthermore the establishment of environmental targets, i.e. the reduction in pressure needed to reach good status, if the national evaluation show that is needed.

As HELCOM Input it will be used to seek synergies with the work of OSPAR and be provided as input to the work of EU TG Noise and the decision to establish GES principles and threshold values which is to be made at Union level. Also the international framework provided by IMO (in relation to continuous noise) is applicable when considering further work.

*Table 2. Principles for defining guidance levels of **impulsive underwater noise** consistent with good status for species sensitive to underwater noise.*

Species	Principles for impulsive underwater noise
Harbour porpoise	Levels of anthropogenic noise should not: – cause injury on individual animals – cause loss of habitat, through displacement, for a significant period of time or significant loss of habitat that leads to a decrease on the population level that affects the conservation status - affect the energy budget of individual animals nor reproduction to a degree that leads to a decrease on the population level that affects the conservation status; particular emphasis should be on calving and nursing grounds and biological sensitive times
Harbour seal / Ringed seal / Grey seal	Levels of anthropogenic noise should not: – cause injury on individual animals – cause loss of habitat, through displacement, for a significant period of time or significant loss of habitat that leads to a decrease on the population level that affects the conservation status – affect the energy budget of individual animals nor reproduction to a degree that leads to a decrease on the population level that affects the conservation status; particular emphasis should be on calving and nursing grounds and biological sensitive times
Cod/Sprat/Herring	Levels of anthropogenic noise should not: – Inflict death or injury on individuals which affect the stocks in spawning areas at critical timing – cause significant loss of habitat through displacement for a significant period of time that leads to a decrease of the stocks

*Table 3. Principles for defining guidance levels of **continuous underwater noise** consistent with good status for species sensitive to underwater noise.*

Species	Principles for continuous underwater noise
Harbour porpoise	Levels of anthropogenic noise should not: - cause injury on individual animals - cause loss of habitat, through displacement, for a significant period of time or significant loss of habitat that leads to a decrease in the population level that affects the conservation status - affect the energy budget of individual animals nor reproduction to a degree that leads to a decrease in the population level that affects the conservation status; particular emphasis should be on calving and nursing grounds and biological sensitive times - cause masking leading to a decrease in the population level
Harbour seal/Ringed seal/Grey seal	Levels of anthropogenic noise should not: - cause injury on individual animals - cause loss of habitat, through displacement, for a significant period of time or significant loss of habitat that leads to a decrease in the population level that affects the conservation status - affect the energy budget of individual animals nor reproduction to a degree that leads to a decrease in the population level that affects the conservation status; particular emphasis should be on calving and nursing grounds and biological sensitive times - cause masking leading to a decrease in the population level
Cod/herring/sprat	Levels of anthropogenic noise should not: - Inflict death or injury on individuals which affect the stocks in spawning areas at critical timing - cause significant loss of habitat through displacement for a significant period of time that leads to a decrease of the stocks - cause behavioural disruption and/or masking in spawning areas at critical timing leading to a decrease of the stocks

Decision support trees for setting environmental targets for continuous and impulsive noise

It is proposed that environmental targets are defined based on a risk based approach, risk assessment and the best available scientific information, utilizing a precautionary approach.

Decision support trees for establishing environmental targets for impulsive noise and continuous noise have been developed in HELCOM (Figure 2 and 3).). These should be based on the use of scientific results and knowledge on decision support trees. Decision support trees are meant as a tool that countries can choose to use for identifying areas/situations where environmental targets are needed. Continuous sound (such as from ships) and its effects on marine life needs further investigation. Contracting Parties are encouraged to support further research.

Further clarifications on terms used in Figure 2 and 3:

- Guidance levels: thresholds of noise consistent with good status for each of the species sensitive to underwater noise,
- Assessment based on principles shows conservation status is compromised (Table 2 and 3): assessment of the status of the species in noise sensitive area is to be conducted using all information available, including status assessment for the population and expert judgement,
- Environmental target: required reduction in pressure consistent with achieving good status for species identified as sensitive to underwater noise,
- For Figure 3, for the box on “noise levels assessed in noise sensitive area”: monitoring has been conducted for continuous underwater noise and assessed in noise sensitive areas (Figure 1).

As soon as case studies illustrating the use and applicability of the decision support trees become available they will be compiled and included as an annex to this document. Relative importance of or cumulative impact of impulsive and continuous noise should be considered.

IMPULSIVE NOISE

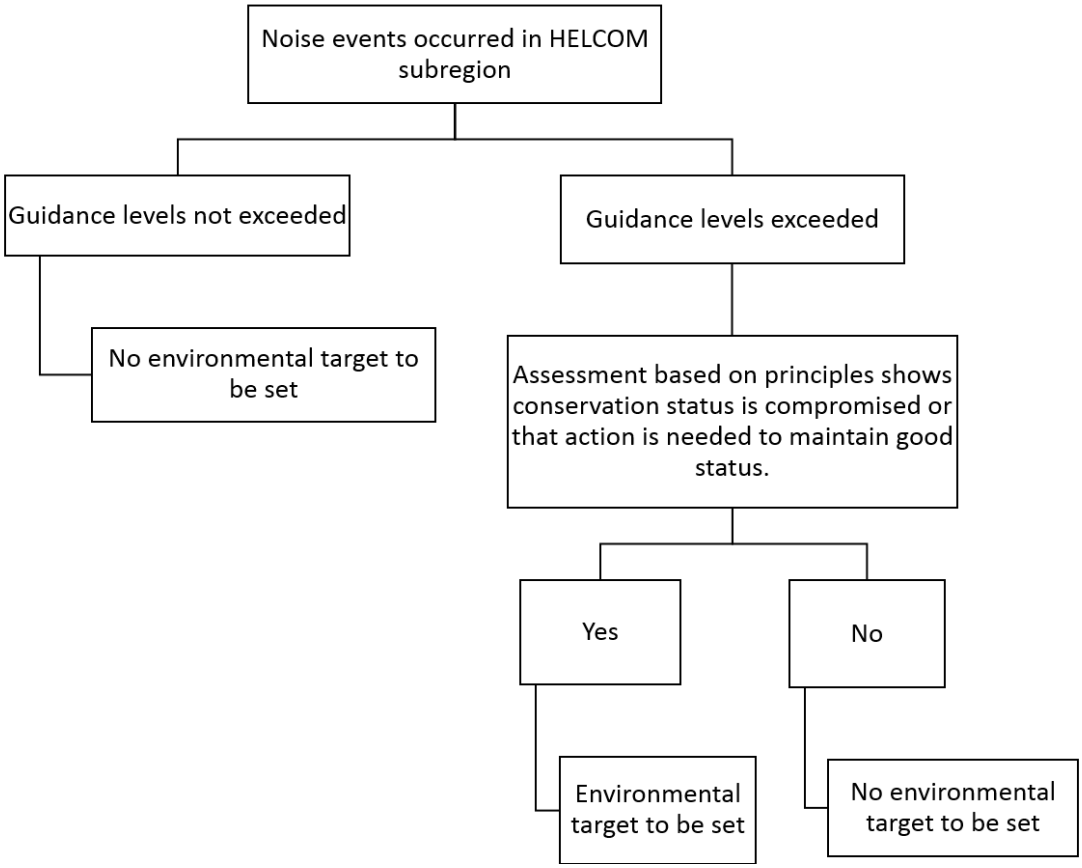

Figure 2. Decision support tree to be used for establishing environmental targets for impulsive noise.

CONTINUOUS NOISE

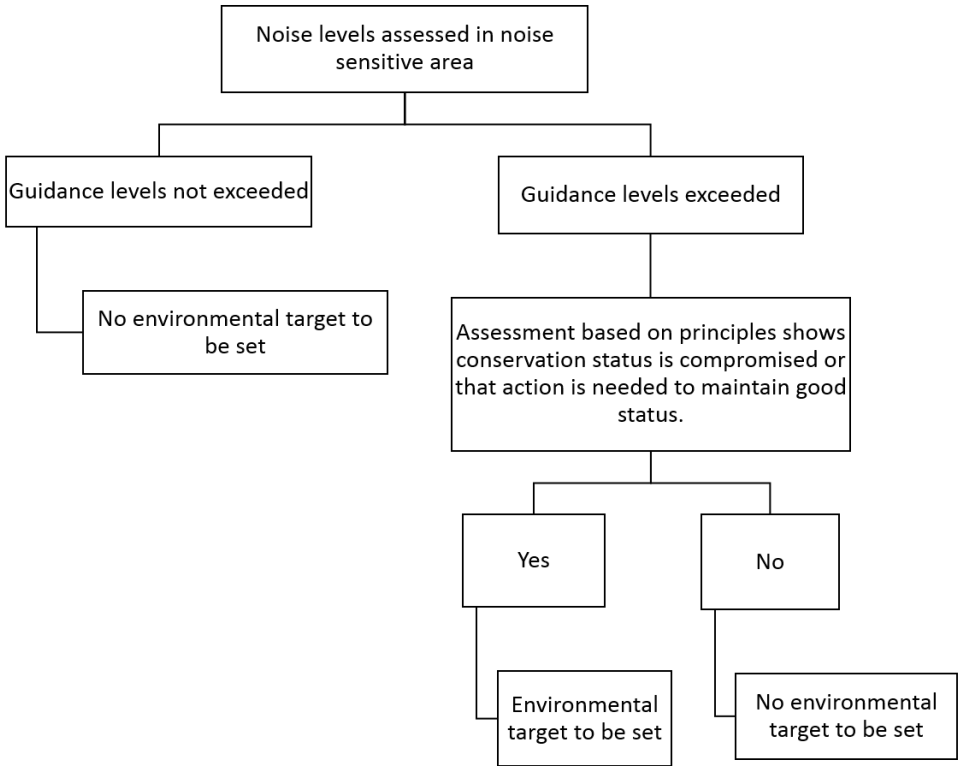

Figure 3. Decision support tree to be used for establishing environmental targets for continuous noise.

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Annex 1. Potential biological indicator methods to be considered in future work (an example used in Russian waters in the Gulf of Finland)

Complex investigations into the level of degradation of ecosystem in the eastern Gulf of Finland, including of grey seal and ringed seal habitat, could be possible by using the biomarker method. Beginning from 1990-s Russia gained essential practical experience in the use of innovative technologies of monitoring ecological safety of marine areas based on bioelectronics systems. In bioelectronics systems animals are included in the primary transformers being part of the electronic registration system of some physiological and behavioral biomarkers that reflect integral reactions of animals as a consequence of changes in the environment status. Such systems increase the accuracy of environment status assessments, simplify and decrease the cost of aquatic environment status control system in comparison to, for example, physical-chemical analytical methods and standard bioindication methods. For measuring biomarkers the use of cardiac activity characteristics of crayfishes and mussels is proposed, as well as mussel folds movements. Besides, in previous years in Russia, together with the study of the impact of such ecological factors as chemical pollution of marine areas or change of salinity on these mussels, the investigation on low frequency noise of different intensity impact was carried out. In addition the use of local types of mussels and crayfish as bioindicators enables to control the acoustic pollution of the Gulf of Finland not only in local sites of the grey seal and ringed seal habitat but practically in the whole area of the Gulf of Finland, that provides the possibility of integral assessment of acoustic noise impact on the Gulf of Finland ecosystem.

For studying the impulsive or other types of underwater noise impact the use of cage methods for the investigation of biological impact of anthropogenic load on ecosystems seems to be rather promising. These methods are widely applicable in the EU countries. Mussels can be put in special cages in the indicated marine area, including in highly developed biological species habitat (according to the HELCOM input) and serve as bioindicators for comparatively fast (e.g. during one summer period) preliminary noise pollution assessment of the marine areas ecosystem of the Gulf of Finland. The possibility to distinguish a “noise component” as a separate factor in the integral assessment of the negative impact to a living organism of ecologically unfavorable environment bioindicator is quite probable. It is important to note the possibility (and reasonability) of conducting in parallel with marine investigation an experiment under laboratory conditions with identical bioindicators.