United Nations Open-ended Informal Consultative Process

on Oceans and the Law of the Sea

The effects of anthropogenic underwater noise

Contribution from the European Union

1) Challenges posed by anthropogenic underwater noise

Marine animals, in particular but not only marine mammals, rely on sound for basic life functions including communication, protection from predators, locating food and mates as well as navigation. They may both produce sounds as well as listen to the sounds around them. Thus, the use of noise as a sense is important for their success and survival and consequently, this makes them extremely sensitive to noise pollution.

As the exploitation of the oceans expands, the levels of anthropogenic noise in the oceans are also increasing and the oceans are increasingly exposed to sounds from human activities, such as shipping and the building of foundations for offshore construction projects. Since noise travels much further in water than it would do on land (traveling through air), this makes its potential impact even greater.

Although the impacts of underwater noise on the marine environment are not well assessed yet and hence not fully understood, nevertheless, underwater noise is an important component to be taken into consideration for protection of the marine environment as it may have detrimental effects on marine animals.

Though, in theory, the behaviour of any species with the ability to sense or use sound may be affected by anthropogenic noise, the extent to which this happens, in most cases, remains however uncertain and can vary between species and according to the nature of the noise. Very loud noises (with high intensity and, usually, short duration such as seismic surveys) may result in permanent damage to marine animals close to the source of such noise while continuous noise (such as shipping and industrial activity) may also impact on their behaviour. Whether a species is affected may also depend on that species' hearing range. There are many difficulties associated with analysing the impacts of noise. For example, it is difficult to understand the severity of effects that noise causes and to identify the level at which these effects become unacceptable. Furthermore, it is difficult to determine exactly which aspects of noise cause adverse effects, for example, whether frequency, repetition rate or other aspects are to blame.

Consequently the main challenge is to ensure that anthropogenic noise can be maintained at levels that do not cause harm to marine ecosystems, while taking into consideration the precautionary approach in view of existing knowledge gaps.

2) Actions and activities undertaken at EU level in relation to anthropogenic underwater noise

- Specific legislation relating to the marine environment

Directive 2008/56/EC of the European Parliament and of the Council establishing a framework for community action in the field of marine environmental policy[1] (Marine Strategy Framework Directive – MSFD) requires EU Member States to achieve or maintain 'good environmental status' of their marine waters by 2020 by developing marine strategies. When determining good environmental status, Member States shall determine a set of characteristics on the basis of 11 qualitative descriptors, one of them aiming at ensuring that "Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment."

In this regard, two types of criteria elements are defined based on Commission Decision (EU) 2017/848[2]: (a) anthropogenic impulsive sound in water and (b) anthropogenic continuous low frequency sound in water. The primary criteria for both types are that the spatial distribution, temporal extent, and the levels of anthropogenic impulsive sound or continuous low-frequency sound sources do not affect populations of marine animals. In both cases the Member States shall establish threshold values for these levels through cooperation at Union level, taking into account regional and subregional specificities. The legislation provides detailed methodological standards as well as specifications and standardised methods for monitoring and assessment for both types of sound sources.

In order to steer this work and advise EU Member States on operational implementation of this descriptor, a technical Group on underwater noise (TG Noise) was set up in 2011. This group is a sub-group of a Commission expert group on the implementation of the MSFD. So far, the work, implemented at EU and regional levels through TG Noise, focused on monitoring issues and was strongly related to activities undertaken in Regional Seas Conventions. Such work included the setting up of a register of loud impulsive noise and the development of a joint monitoring programme for continuous noise. These monitoring programmes are realistic, effective and will provide information for Member States that cannot be obtained through individual monitoring campaigns.

As a consequence, significant progress has been made in this field during the first cycle of implementation of MSFD. For example, a register for impulsive noise is now available at ICES in the Baltic Sea and North-East Atlantic Ocean regions and there is an opportunity to set up joint monitoring programmes for continuous noise from the onset. Meanwhile, TG noise is now focussing on the assessment of impacts of noise and the development of thresholds in relation to the indicators developed in the framework of MSFD. Some projects have already been implemented, e.g. a guide on environmental impacts of noise and use of propagation models to predict the recipient side of noise was published in 2015 (CEFAS)[3].

Regarding the projects, a thorough overview of EU funded projects on underwater noise was elaborated by TG Noise and can be consulted through the following link: https://circabc.europa.eu/sd/a/61fef0a1-0d75-4d4c-8995-6580e757bf84/MSCG_20-2017-07_TG%20Noise%20report.pdf.

- Legislation on environmental impact assessment and nature protection

Directive 2011/92/EU of the European Parliament and the Council, on the assessment of the effects of certain public and private projects on the environment (as amended by Directive

[1] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0056

[2] http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1495097018132&uri=CELEX:32017D0848

[3] http://mcc.jrc.ec.europa.eu/documents/201601081529.pdf

2014/52/EU)[4] applies to all Member States and requires that certain public and private projects likely to have significant effects on the environment by virtue inter alia of their size, nature or location are made subject to an assessment of their environmental effects before they are authorised. If a project is subject to an EIA, a description of the likely significant effects of the project on the environment resulting from, inter alia, noise should be included in the EIA report to be prepared.

The so-called EU nature directives (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive[5]) and Council and European Parliament Directive 2009/147/EC on the conservation of wild birds (Birds Directive[6]) are also relevant. For the Natura 2000 sites designated for the protection of features such as marine animal species listed in Annex II of the Habitats directive, measures are required under Art. 6(2) to avoid any significant disturbance of those species, while different human activities that are likely to have a significant effect on Natura 2000 sites need to be properly assessed and authorized in accordance with the provisions of article 6 (3) and (4) of the Habitats Directive. This provision also includes the obligation to assess the cumulative impacts of different activities on the conservation objectives of the site.

Furthermore, the provisions of Article 12 of the Habitats Directive, which includes an obligation to prohibit deliberate disturbance of strictly protected species, are also particularly relevant in such situation, as all species of cetaceans and a number of marine vertebrates and invertebrates listed in Annex IV(a) benefit from a system of strict protection. The Commission guidance document on 'establishing Natura 2000 sites in the marine environment' contains a specific section on noise pollution[7].

3) Proposals for next steps

At the EU level, priority is now given to the understanding of environmental impacts of noise. This work is preliminary to the development and implementation of measures aiming at noise reduction, as these impacts have to be better understood in order to be efficiently tackled. In this regard, the EU, through its current Framework Programme for Research and Innovation, the Horizon 2020[8] as well as with its predecessor, the 7th Framework Programme[9], is funding research on adverse impacts of anthropogenic underwater noise on the marine environment. More than 15 million euros have been invested in FP7 for projects such as AQUO[10], SONIC[11] and SILENV[12] that addressed the negative effects of noise coming from shipping on marine life while the COMMON SENSE[13] project included a noise sensor for real time monitoring:

- AQUO worked on the assessment and mitigation of noise impacts of the maritime transport on the marine environment and provided to policy makers practical guidelines, acceptable by shipyards and ship owners. The consortium consisted of 13 partners from 8 EU countries. The European Commission contributed with €2,999,571.00.

[4] http://ec.europa.eu/environment/eia/pdf/EIA_Directive_informal.pdf
[5] http://ec.europa.eu/environment/nature/natura2000/marine/docs/marine_guidelines.pdf
[6] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0147
[7] http://ec.europa.eu/environment/nature/natura2000/marine/docs/marine_guidelines.pdf
[8] https://ec.europa.eu/programmes/horizon2020/
[9] https://ec.europa.eu/research/fp7
[10] http://www.aquo.eu/
[11] http://cordis.europa.eu/project/rcn/104925_en.html
[12] http://cordis.europa.eu/project/rcn/92586_en.html
[13] http://www.commonsenseproject.eu

- SONIC developed tools to investigate and mitigate the effects of underwater noise generated by shipping, both in terms of the footprint of an individual ship (a "noise footprint") and of the spatial distribution of sound from a large number of ships contribution to the sound (a "noise map"). The consortium consisted of 12 partners from 7 EU countries. The European Commission contributed with €2,999,972.00.

- SILENV delivered a "green label" proposal that includes recommended target levels for noise and vibrations and associated design guidelines. The consortium consisted of 13 partners from 8 EU countries. The European Commission contributed with €3,487,058.00.

- COMMON SENSE provided easily usable across several platforms, cost-effective, multi-functional innovative sensors to detect reliable in-situ measurements on key parameters by means of methodological standards. The consortium consisted of 14 partners from 6 EU countries and the Former Yugoslav Republic of Macedonia. The European Commission contributed with €4,664,072.00.

Under Horizon 2020 (H2020) the EU research and innovation framework programme covering the period 2014 to 2020, the LeanShips[14] project is working on large ship propellers while the FIBRESHIP[15] project is working on Fibre-Reinforced Polymers in ship-building both of which are expected to reduce noise pollution :

- LeanShips will execute 8 demonstration actions that combine technologies for efficient, less polluting new/retrofitted vessels with end users' requirements. Demonstrators were selected for their end-user commitment (high realisation chance), impact on energy use/emissions, EU-relevance, innovativeness and targeted-TRL at the project end. The consortium consists of 48 partners from 12 EU countries, Norway and Switzerland. The European Commission contributes with €16,726,364.46.

- The main objective of FIBRESHIP is to create a new EU-market to build complete large-length ships in Fibre-Reinforced Polymers enabling its massive application. The consortium consists of 17 partners from 10 EU countries. The European Commission contributes with €8,866,323.

Additionally, in the current Work Programme of H2020 for Societal Challenge 4 'Smart, Green and Integrated Transport'[16], a topic dedicated to under water noise mitigation and environmental impact is foreseen for 2020. Furthermore, in the current Work Programme of H2020 for Societal Challenge 3 'Secure, Clean and Efficient Energy'[17], there are topics on marine energy where environmental impacts should be considered. Moreover, a report[18] on environmental impact of marine energy devices was delivered in March 2016.

[14] http://www.leanships-project.eu

[15] http://www.fibreship.eu/

[16] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-transport_en.pdf

[17] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-energy_en.pdf

[18] https://publications.europa.eu/en/publication-detail/-/publication/01443de6-effa-11e5-8529-01aa75ed71a1/language-en

Contributions of EU Member States

Belgium

RBINS (MUMM) is the responsible authority for the environmental impact assessment of construction activities at sea. During such activities, and especially during pile driving for the placement of offshore wind turbine foundations, very high (impulsive) underwater noise levels were measured (references below). On the basis of the investigations, concrete measures were taken to (1) limit the amplitude of underwater noise and (2) to limit the exposure of marine mammals to this noise. The measures are taken up in the licences for construction, and can be retrieved from http://odnature.naturalsciences.be/mumm/en/windfarms/.

Consultation with the Department of Defence will shortly be initiated to investigate whether measures to limit underwater noise of the detonation of UxO would be practically feasible.

Underwater noise is a subject of legislation and commitments, both nationally and internationally (a.o. in the European Commission's Marine Strategy Framework Directive, OSPAR (see for instance the results of the intermediate assessment: https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/pressures-human-activities/) and ASCOBANS/CMS). It is the subject of projects that have as the objective to agree on techniques to measure and express underwater sound, and to coordinate monitoring and assessment. Studies in Belgium deal with estimating effects of pile driving noise on marine mammals and fish.

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Estonia

Information on mapping, monitoring and assessment of underwater noise

Baltic Sea Information on the Acoustic Soundscape (BIAS) project

Underwater noise is among the most widely distributed pressures in the Baltic Sea (http://stateofthebalticsea.helcom.fi/pressures-and-their-status/underwater-sound/). Estonia participated with the other 5 EU member states (Sweden, Finland, Poland, Germany and Denmark) in the BIAS project (Sept 2012-Aug 2016), which was aimed at supporting a regional assessment of the underwater sound as well as developing effective ways to monitor noise across the Baltic Sea.

The Baltic Sea consists of eight sub-catchment areas (sub-basins) and numerous harbours. It is estimated that about 2000 sizeable ships are at sea at any time, making the number of ships one of the highest in Europe. These ships generate underwater noise that potentially might be harmful for the marine biota. Further information is provided on a BIAS project website https://biasproject.wordpress.com/.

Monitoring of underwater soundscape in Estonia

After BIAS project national monitoring of continuous low-frequency sound in water has been continued by Estonia in 1 station in the Gulf of Finland, where the ship traffic is the most intense. Data is collected, analyzed and stored in compliance with the standards defined in the BIAS project in order to ensure the continuity and uniformity of information on the underwater soundscape both over time and across the Baltic Sea. A GIS-based web-tool was elaborated in 2017 (based on BIAS results) to visualize the monitoring data and provide output for e.g. maritime spatial planning activities (http://deepthought.ttu.ee/mehinst/failid/meremura/main.html).

Participation in the regional work

The Baltic Marine Environment Protection Commission (HELCOM), also known as Helsinki Commission), is an intergovernmental organization dealing with the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention). Estonia is one of the contracting parties to HELCOM. It is a cooperation platform coordinating regional work between the contracting parties.

Estonia takes part in the work of HELCOM EN Noise group, participating in the development of underwater noise indicators and defining threshold values for both, continuous and impulsive noise in the Baltic Sea, elaboration of the monitoring guidelines of underwater noise, researching on the causes and effects of underwater noise on biota, mapping the levels of ambient underwater noise.

Estonia plans to join the HELCOM/OSPAR register of the occurrence of impulsive sounds, which was established recently. Impulsive sound events are currently followed by seismic monitoring (e.g. explosions) and through permits for construction works at sea and coastal areas.

Participation in the EU work

On the EU level, work on underwater noise is coordinated in the MSFD TG Noise group, where Estonia also participates. This technical group provides a common platform for addressing how to develop environmental targets and associated indicators in relation to underwater noise and other forms of energy. This common reflection can then be taken further within each marine region and subregion in the context of regional sea conventions and at a national level. Specific targets are to identify and review existing data and monitoring methods on underwater noise; develop methodological monitoring standards; ensure that underwater noise register (form, outputs) is shaped in a coordinated manner (linked with RSC work, in particular OSPAR, and HELCOM); work on evaluation and assessment of the impacts of underwater noise on marine fauna, and define threshold values for both, impulsive and continuous noise.

Other work on a national level

Several projects are in the preparatory phase in order to study the impact of anthropogenic noise onto fish (e.g. effects of continuous noise on herring, sprat and cod), and mammals (noise exposure of ringed seals as a protected species).

According to MSFD requirements on underwater noise (descriptor 11), environmental impact assessments (EIA) of planned construction activities in the marine areas should also cover this issue. Monitoring of underwater noise during construction work as well as implementation of relevant mitigation measures are a requirement. These must be covered by EIA and further permitting procedure.

Relevant scientific publications

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2. Mustonen M., Klauson A., Laanearu J., Ratassepp M., Folegot T., Clorennec D. “Passenger ship source level determination in shallow water environment,” 4th Int. Conf. on the Effects of Noise on Aquatic Life, Dublin, Ireland 10-16 July 2016, Proc. of Meetings on Acoustics, Vol. 27, 070015, (2017)

Environmental impact assessments

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2. OÜ Inseneribüroo STEIGER. Environmental impact assessment of dredging of sand deposits in the territorial waters of Estonia.
3. A.Klauson, J. Laanearu, M. Mustonen, 2017. Monitoring of underwater acoustic noise in the Gulf of Finland. Tallinn University of Technology.

Finland

Information about mapping, monitoring and assessment of underwater noise in the Baltic Sea

Baltic Sea Information on the Acoustic Soundscape (BIAS) project

The BIAS project was established in September 2012 to support a regional assessment of the underwater sound as well as develop effective ways to monitor noise across the Baltic Sea. The Baltic Sea is a semi-enclosed sea with nine states bordering the sea. It consists of eight sub-catchment areas (sub-basins) and numerous harbours. It is estimated that about 2000 sizeable ships are at sea at any time, making the number of ships one of the highest in Europe. These ships will undoubtedly generate underwater noise that potentially might be harmful for the Environment. A summary of results of BIAS project is found in the BIAS Layman's report*.*

Monitoring of underwater soundscape

After BIAS project (http://bias-project.eu) mapping of underwater soundscape in the Baltic Sea during 2014 monitoring has been continued in selected stations during years 2015 – 2017. The data is collected, analyzed and stored in compliance with the standards defined in BIAS project in order to ensure the continuity and uniformity of information on the underwater soundscape both over time and across the Baltic Sea.

In addition to the selected stations used in monitoring of continuous noise, ad hoc monitoring of selected areas of interest has been conducted during 2017. These include recording of underwater noise during construction work in an offshore windfarm done in collaboration with Hyötytuuli Oy, and recording of underwater soundscape in the inner Helsinki bays done in collaboration with City of Helsinki.

Impacts of underwater noise

Impacts of underwater noise from shipping have been studied in Sustainable Shipping and Environment of the Baltic Sea region (SHEBA, http://www.sheba-project.eu) project. An assessment is made of the potential effects of noise from marine traffic on the marine animals via a synthesis of noise emission and propagation data produced in the project, and of existing research materials.

A series of experiments is planned in order to study the impact of anthropogenic noise on the feeding rate of fish commonly found in coastal areas of Finland. The experiments will be done in a controlled laboratory setting in Tvärminne zoological research station. Underwater recordings have also been made in Lake Saimaa. Saimaa is the only habitat of the extremely endangered Saimaa Ringed Seal that is a close relative of the Baltic Sea Ringed Seal. The aim is to study the use of sound by ringed seal as well as the noise exposure of the animals in order to aid the protection of both ringed seal populations.

HELCOM work on underwater noise

HELCOM (Baltic Marine Environment Protection Commission - Helsinki Commission) is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area, known as the Helsinki Convention. HELCOM Contracting Parties are Denmark, Estonia, the European Union, Finland, Germany, Latvia, Lithuania, Poland, Russia, Sweden and European Union.

- The HELCOM Regional Baltic Underwater Noise Roadmap 2015-2017 including the establishment of a joint HELCOM/OSPAR registry of licensed impulsive sound events, was recently adopted.

- The HELCOM Second Holistic Assessment of the Ecosystem Health of the Baltic Sea includes the status of underwater noise in the Baltic Sea. The first version of the report was released in mid-2017 and can be accessed via the project web page stateofthebalticsea.helcom.fi. The updated report will be finalized by mid-2018.
- "HELCOM input to the process of establishing environmental targets for underwater noise" which e.g. identifies the Baltic species which have the potential to be impacted by noise together with noise sensitive areas and periods of biological significance for these species has been prepared and is under consultation for adoption.
- Within HELCOM HELCOM EN Noise workgroup is active in development of indicators and working towards defining thresholds for both continuous and impulsive noise in the area. HELCOM countries have agreed to collect and report data on marine activities causing **impulsive underwater noise** events, such as pile driving, seismic surveys and explosions. The information is submitted yearly to a shared database maintained by ICES. The information is collected through an online survey that is sent to relevant stakeholders once a year. The answers are processed and submitted to the database of the Finnish Environment Institute (SYKE).

France

L'étude du bruit anthropogénique dans le milieu marin est désormais une thématique importante et en développement, qui s'inscrit pleinement dans les travaux menés en vue de l'évaluation de l'état écologique et la protection du milieu marin.

Les autorités françaises travaillent sur cette thématique dans le cadre de la mise en œuvre de la Directive cadre stratégie pour le milieu marin (DCSMM), mais aussi dans le cadre d'accords internationaux comme la Convention sur la diversité biologique, la Commission baleinière internationale, la Convention sur les Espèces Migratrices (Ascobans et Accobams), Pelagos (Méditerranée) et dans le cadre des conventions de mer régionale OSPAR et Barcelone.

Elles s'efforcent par ailleurs de garantir la prise en compte du concept de pollution sonore dans l'ensemble des enceintes ou textes internationaux traitant de pollutions du milieu marin.

Travaux de connaissance et de surveillance dans le cadre de la DCSMM :

Le programme de surveillance « Bruits sous-marins » en cours de mise en place dans les eaux métropolitaines françaises a pour enjeu la surveillance des impacts potentiels sur les écosystèmes marins des perturbations sonores sous-marines engendrées par les activités humaines. Il est coordonné par le Service Hydrographique et Océanographique de la Marine (SHOM).[19]

Les données obtenues par le programme de surveillance DCSMM permettront d'évaluer les distributions spatiales et temporelles des principales pressions sonores anthropiques et de renseigner les critères du bon état écologique sonore dans le milieu marin, soit la distribution spatiale et calendaire des émissions sonores impulsives ayant potentiellement un impact sur la faune sous-marine (D11.1) et les niveaux sonores ambiants dus aux sources continues (D11.2).

Ce programme se subdivise en 4 sous-programmes :

- Émissions continues : la thématique couverte au premier cycle sera le trafic maritime soumis une surveillance automatique. D'autres types de trafic (pêche récréative ou artisanale, plaisance) et d'autres sources d'émissions continues (rayonnement d'ouvrage en particulier) seront intégrées ultérieurement le cas échéant. Les statistiques de trafic seront exploitées par les outils de modélisation numérique de bruit ambiant.
- Émissions impulsives : ce sous-programme a pour objectif la création d'un registre national des émissions impulsives. Les données entrant dans le périmètre du registre sont les émissions réalisées à partir de sources acoustiques à forte puissance, les explosions sous-marines ainsi que les battements de pieux.
- Bruit ambiant : ce sous-programme a pour objectif la création d'un observatoire *acoustique in-situ* (réseau pérenne d'hydrophones) et d'une base de données de mesures d'opportunité. Les données, archivées au sein d'un dispositif dédié, serviront en particulier à valider les modèles numériques de bruit ambiant.
- Effet des perturbations sonores sur les espèces sensibles : ce sous-programme traitera de la surveillance des corrélations entre le niveau des pressions sonores et l'état écologique des populations des espèces sensibles. Il sera mis en place au deuxième cycle si la faisabilité est

[19] Yann Stephan, *L'océanographie acoustique au SHOM*, 2010 : www.shom.fr/fileadmin/SHOM/PDF/02.../776_1-oceanographie_acoustique.pdf

avérée au 1er cycle. Il s'appuiera en particulier sur les programmes de surveillance des espèces potentiellement impactés par les perturbations sonores. Le laboratoire du Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) à Strasbourg dispose d'une compétence en bioacoustique appliquée.

En Méditerranée**, le projet QuietMed**, financé par la DG Environnement de l'UE, a pour objectif de renforcer la coopération entre les États méditerranéens membres de l'UE sur la thématique « bruit sous-marin ». De janvier 2017 à décembre 2018, il contribuera notamment à combler les lacunes de la surveillance du bruit sous-marin et à améliorer la cohérence et la pertinence de la mise en œuvre de la DCSMM en Méditerranée. Ce projet permettra de définir :

- des approches communes pour la détermination du bon état écologique et la définition des seuils de bon état ;
- des orientations sur les méthodologies pour la surveillance du bruit sous-marin ambiant ;
- le développement d'un registre régional sur le bruit impulsif qui comprend la collecte de données sur le bruit sous-marin.

Réflexion sur les mesures de gestion

Une série d'ateliers de travail **« *Racket in the oceans* »** entre scientifiques et gestionnaires s'est tenue en 2016 pour produire un document de position sur le bruit sous-marin anthropique : Berkowitz Heloïse & Dumez Hervé [eds] (2017) *Racket in the oceans : why underwater noise matters, how to measure and how to manage it*. Paris: *Observatory for Responsible Innovation* / Palaiseau (France): i3-CRG (CNRS – Ecole polytechnique). http://www.debatinginnovation.org/?q=RacketOceans.

En ce qui concerne l'Outre mer, les services du ministère en charge de l'Environnement ont fait produire en 2016 un guide de bonnes pratiques pour limiter l'impact de l'exploration sismique sur les cétacés en **Guyane** :
http://www.guyane.developpement-durable.gouv.fr/spip.php?page=recherche&lang=fr&forcer_lang=true&recherche=exploration&onglet=document

Dans le cadre du **programme de mesures** DCSMM, le ministère en charge de l'environnement a pour objectif d'établir en 2018 une documentation de référence sur la thématique « bruit sous-marin » sur la forme d'un guide méthodologique. Ce guide fournira de l'information et des lignes directrices sur les dispositifs, outils et bonnes pratiques qui permettraient d'éviter ou de réduire l'impact du bruit, notamment sur les espèces les plus sensibles à savoir les mammifères marins (cétacés et pinnipèdes).

Les autorités françaises désirent informer la Présidence et les États membres de la conférence décrite ci-dessous qui sera organisée du 4 au 8 juin 2018 à Paris.

Conférence sur l'acoustique passive et les mammifères marins *(Detection, Classification, Localization, and Density Estimation of marine mammals using passive acoustics).*

L'Université Pierre et Marie Curie, l'Université Paris Sud Orsay, l'Université de Toulon et le CNRS organisent à Paris du 4 au 8 juin 2018 la 8e édition de *l'**International Workshop on Detection, Classification, Localization, and Density Estimation of marine mammals using passive acoustics (DCLDE)***. La thématique principale de cette conférence internationale est

l'étude des cétacés avec une approche respectueuse de ces mammifères marins et de leur environnement, consistant à enregistrer leurs émissions sonores avec des microphones : méthode non invasive, à distance, sans interactions directes avec les cétacés et non impactante pour leurs environnements marins.
http://sabiod.univ-tln.fr/DCLDE/

Lithuania

Regarding anthropogenic underwater noise research in Lithuania, we would like to inform you that such research was not performed in the Lithuanian part of the Baltic Sea. Nevertheless, in order to implement Marine Strategy Framework Directive, Lithuanian Government Decision on Water sector development for 2017–2023 was adopted on February 1st, 2017, where objectives to achieve or maintain good environmental status (GES) of the Baltic Sea were set. One of these objectives is to seek that noise and other forms of energy emitted into the marine environment as a result of anthropogenic activities do not exceed levels having an adverse short-term or long-term effect on marine fauna.

In order to implement the Government Decision, Action plan was adopted on May 5th, 2017, where measures to achieve the underwater noise related objective were set:

1. To draft regulatory documents on the registration and reduction of impulsive noise in the marine environment, including environmentally sensitive areas, important spawning grounds and mammal areas (to be implemented in 2018–2020);
2. To consider the inclusion of the monitoring of noise in the marine environment in the Programme of National Environmental Monitoring in order to assess the status of marine environment with reference to GES criteria (to be implemented in 2017–2022);
3. To establish a procedure for recording underwater impulsive noise and provision of the data to the Impulsive Underwater Noise Register administrated by ICES (to be implemented in 2018).

In addition, it is important to mention, that expert assessment which includes underwater noise aspect for the whole Baltic Sea area was carried out within the framework of the HELCOM project HOLAS II. The report of the project is planned to be approved in the mid-2018.

Malta

Rationale

Underwater noise constitutes the most widely introduced type of energy in the marine environment. Noise is an overall pollutant that has still not been directly defined, although under article 1 of UNCLOS, noise as a pollutant, is defined as an introduction of energy. Current understanding is, that it is, any sound above a pre-defined limit of decibels that can be or is of any annoyance or harm to organisms. The impact of anthropogenic underwater noise and vibrations on marine life is in fact a growing concern, with an increasing body of evidence demonstrating its adverse effect over a large range of taxa.

Various anthropogenic activities can result in the introduction of underwater noise in the marine environment, including (i) Shipping; (ii) Construction works; (iii) Windfarms; (iv) Sonars for bottom imaging and (v) Seismic sources (such as airguns). Underwater noise, is further classified into two main categories: **impulsive** and **continuous**.

As per the Note Verbale sent by DOALOS inviting MS to submit contributions outlining their views on the theme of 'Anthropogenic Underwater Noise' in view of the 19th Informal Consultative Process (ICP) Meeting, to be held at UNHQ in 2018 and it was suggested that contributions could include:

(i) *challenges posed by anthropogenic underwater noise;*

(ii) *actions and activities, including research activities, that have been undertaken at the national, regional and global levels with regard to anthropogenic underwater noise, in particular those undertaken to address its adverse impacts; and*

(iii) *any suggestions for further action to address the adverse impacts of anthropogenic underwater noise.*

According to the EU and international conventions and/or legislation the main impacts of underwater noise are according to: i) physical damage, ii) habitat displacement and iii) biotic hunting and communication disturbance.

Negative impacts of anthropogenic underwater noise are documented on a global scale for at least 55 marine species, with impacts on marine mammals receiving particular attention mainly due to the use of active sonar or seismic surveys coinciding with cetacean mass stranding events

Efforts for monitoring of underwater noise seems to be difficult mainly due to the fact that it is, in its entirety, difficult to differentiate between the impacts of noise on different groups of species. Under EU legislation – the Marine Strategy Framework Directive, EU Member States have to coordinate efforts to look into and provide appropriate systems to monitor underwater noise.

The EU Marine Strategy Framework Directive (2008/56/EC) refers to, in Descriptor 11 of the related Commission Decision, introduction of energy, including underwater noise, to be sustained at levels that do not adversely affect the marine environment.

Underwater noise is a topic that is currently researched globally, with EU legislation and technical subgroups forming a part of its scientific discovery and policy framework. Relevant authorities and research institutes are investing monetary and human resource in deep research in a number of fields within underwater noise, ranging but not limited to: 1) streamlined

description of noise pollution, 2) frequencies that are deemed an annoyance or are harmful to cetaceans, fish, invertebrates etc., 3) terrestrial sources of marine underwater noise and 4) marine/off-shore sources of marine underwater noise (especially shipping, use of sonar etc).

(i) challenges posed by anthropogenic underwater noise;

Research has largely concentrated on the purposes, problems, and progress of radiated underwater noise, self□noise, and ambient noise. Basic problems, involve ascertainment of properties of the noise, identification of noise sources and mechanisms of noise generation, and the discovery and definition of noise dependencies on environmental factors. Major problems are those of noise measurement, noise reduction, and prevention as well as the extent of the effect of the underwater noise on biodiversity, cumulative impacts and if any real thresholds can be found which makes the impact relatively safe for the biodiversity in question.

The process of establishing policy guidelines or regulations for anthropogenic sound exposure (i.e., the application of these exposure criteria) varies among nations, jurisdictions, and legal/policy settings. Such processes should carefully consider the limitations and caveats given with proposed criteria in deciding whether sufficient data currently exist to establish simplistic, broad criteria based solely on exposure levels. In many cases, especially for behavioral disturbance, context specific analyses considering previous studies on species and conditions might, at least for the foreseeable future, be more appropriate than general guidelines.

In the field of ambient noise, most measurements have been of sound□pressure level. *Some* of the noise sources and environmental factors have been identified, and a capability for qualitative and gross prediction has been achieved. Challenging problems however also exist in procedures and instrumentation for noise studies

Though some information is available on effects on marine mammals, still the safe thresholds are not really known and at this point can be at most speculative for certain species which are especially sensitive to noise like beaked whales. Less information is available regarding effects of such underwater noise on fish populations and other species like invertebrates. Noise during the operational phase of projects is likely to be less intrusive but significantly more research is needed to determine the potential for chronic, long term effects. Particular attention should be also paid to identify the range of frequencies utilized by marine organisms and minimize the production of noise within this frequency range.

Malta deems underwater noise as an important pressure in the marine environment which needs to be given due consideration in ecosystem-based management approaches. The generation of underwater noise by anthropogenic activity has been associated with various levels of disturbance to marine biota, particularly those reliant on sound for various biological functions such as communication, navigation, orientation and detection of predators and prey. Cetaceans, turtles, fish and some invertebrates (such as decapod crustaceans) are some of affected species groups. Effects can range from exposures causing no adverse impacts, to behavioural disturbances, to loss of hearing, and to the worst case, mortality.

While action to address and minimise the impacts of underwater noise on marine biota is critical, there is also the need to improve knowledge with respect to the interactions of underwater noise and the marine environment.

Existing scientific knowledge may not be sufficient to enable assessment of all the impacts of underwater noise and effective regulation of this pressure through management processes. Hence the main challenge is to ensure that anthropogenic noise can be maintained at levels that do not case harm to marine ecosystems, while taking into consideration the precautionary approach in view of the mentioned and existing knowledge gaps.

This is considered to be one of the major challenges in addressing underwater noise and significant efforts and resources should be channelled in this regard.

At the EU level, data gaps also exist in relation to the current ambient noise levels in certain marine regions, trends in levels of underwater noise and the distribution of marine biota that is sensitive to sound

(ii) actions and activities, including research activities, that have been undertaken at the national, regional and global levels with regard to anthropogenic underwater noise, in particular those undertaken to address its adverse impacts; and

Impulsive sounds are typically brief, characterised by a large change in amplitude over a short time and containing a wide frequency range (commonly referred to as 'broadband'). Such sounds are generated by explosions, airguns and pile-driving.

Non-impulsive sounds can be broadband or more tonal, continuous or intermittent, with typically only small fluctuations in amplitude. Sources of non-impulsive sounds include shipping, construction (e.g. drilling and dredging) or wind farm operation.

Malta addresses underwater noise as part of the requirements of the EU Marine Strategy Framework Directive (MSFD) with particular reference to the work developed by ACCOBAMS. Within this context, Malta is seeking knowledge improvement in relation to the spatial distribution, temporal extent and levels of anthropogenic impulsive and continuous sound in line with the criteria adopted under MSFD processes.

Collection of data on impulsive underwater noise is being undertaken through collaboration across relevant stakeholders, while dedicated monitoring regimes are being sought in relation to continuous underwater noise. There is still the need however to develop assessment processes in relation to the impacts of underwater noise.

Pending improved knowledge, Malta has recognised the need to strengthen collaboration across Government bodies with a view to promote consideration of underwater noise across relevant sectors and processes. Such collaboration will build on mechanisms which are already in place for specific activities associated with the generation of underwater noise. Shipping is considered to be the main source of continuous sound, also due to the fact that Malta is an important hub for shipping activity. With respect to impulsive underwater noise, seismic surveys may constitute the most important source. Seismic surveys are predominantly used for the purpose of hydrocarbon exploration which in Malta is regulated by means of exploration licenses. Operators licensed to carry out seismic surveys are required to follow the ACCOBAMS guidelines (or equivalent) to address the potential impact of anthropogenic noise on cetaceans in the survey area.

Basic studies *on noise have done through the EU LIFE + MIGRATE project 2012-2016* (LIFE11 NAT/MT/1070, 2012 - 2016) whose aims were to enable studies to be carried out on the population status of the loggerhead turtle and of the bottlenose dolphin in Maltese waters and to identify and designate any important areas for them . Data gathered included 460 hours of acoustic recordings from three hydrophone set-ups: a 200 m long stereo towed array, a VEMCO acoustic tag decoder and a new state of the art autonomous recording system known as "Soundtrap", which captures cetacean vocalisations as well as broadband man-made noise. In this project visual and acoustic surveys of cetaceans and visual surveys of marine turtles covering 5796 km of line transects in Maltese waters were done. This is, to our knowledge, was one of most intense survey performed in Maltese waters and one of the first in terms of acoustic data gathered.

Integrating acoustic and visual data from an uneven coverage was challenging due to the different probability of detection of all survey methods. To account for this source of bias, a correction factor for the survey effort, based on the number of acoustic/visual detections not captured by the other survey method, when both methods were at work, was used. During the simultaneous visual/acoustic survey, acoustic detections were captured visually in 29% of the cases (CF=0.29), while 86% of the sightings were recorded acoustically also (CF=0.86). The corrected survey effort and the number of dolphin detections (visual or acoustic) were fed to a Kernel density estimator using ArcMap. The result was enabled by obtaining a common outcome for both visual and acoustic survey techniques, increasing the sample size of dolphin detections. This study emphasizes the need to develop methods such as these used in this project to solve the analytical challenges posed by using mixed techniques in cetacean population's studies.

Data gathering included mapping of human activities and sampling of underwater noise. Noise sampling stations were conducted at 6 selected stations using both the towed array and the Soundtrap and with the collaboration of University of La Laguna conducted a series of ocean noise pollution samplings and underwater noise levels in the Maltese waters. These underwater noise levels were being recorder with the SoundTrap (Ocean Instruments New Zealand), a broadband miniaturised autonomous recorder with a sampling frequency up to 288 KHz. This hydrophone has been deployed in strategic sampling points around the islands, with the objective of develop a marine underwater noise map and comparing natural acoustic levels around Malta with different kinds of human activities, such as marine traffic. Underwater noise, affects not only marine wildlife but also fisheries and aquaculture.

The acoustics surveys also provided information for future uses of other underwater acoustics monitoring techniques as the uses of TPODs for monitoring dolphins or the use of other autonomous recording devices. During the project, additional acoustic monitoring equipment was tested. One SOUNDTRAP (Ocean Instruments New Zealand), a calibrated autonomous recorder, was deployed at 30m depth (always with sea state <3 in Douglas scale) in a total of 19 sampling points. Points being selected opportunistically. All the SOUNDTRAP recordings had a sampling time of 15 minutes. This is very short but is a random point-sample of noise in the area and provides a methodology easy to follow.

Other existing action in Malta, mainly consists of mitigation measures for the reduction of potential risks to cetacean groups (and other megfauna groups). This action is based on the application of the ACCOBAMS Guidelines (described below) to address the impact of Anthropogenic Noise on Cetaceans in the ACCOBAMS area.

The Continental Shelf Department which regulates exploration and production licenses issued under the Petroleum (Production) Act (Cap. 156), the Continental Shelf Act (Cap. 535) and related subsidiary legislation, require licensed operators in Malta to follow the ACCOBAMS guidelines (or equivalent) to address the potential impact of anthropogenic noise on cetaceans during the acquisition of seismic data using air guns. In addition, licensees using sonar devices and/or air guns are required to provide information on the source noise level.

Such regulation is undertaken in line with International and EU policy, including consideration of environmental issues by such policies. Furthermore, current collaboration between CS and the Environment and Resources Authority (ERA – the authority entrusted with the technical implementation of the MSFD) is achieving consideration of MSFD marine elements and pressures throughout the operational processes. This measure seeks the formalization of such collaboration to ensure a consistent approach towards consideration of MSFD requirements and implementation of MSFD processes through existing licensing regimes in offshore waters.

Similar guidelines have also been used under national jurisdiction for proposals other than those associated with the hydrocarbon exploration. Such guidelines include the United Kingdom's Joint Nature Conservation Committee (JNCC) guidelines for minimizing the risk of injury and disturbance to marine mammals from seismic surveys. Such measures include visual monitoring to check for the presence of marine species prior to and during surveys, passive acoustic monitoring and soft start methods. Consideration of mitigation measures in response to identified significant impacts from generation of underwater noise is also called for under the Environmental Impact Assessment (EIA) Directive (2011/92/EU). Whilst the Directive distinguishes between projects requiring a mandatory EIA, and others for which the decision is left for Member States to take following a screening procedures; for both classes noise is defined as one of the nuisances to be considered.

Extracts of some existing legislation

A number of regional and/or international multilateral environment agreements (MEAs) aimed at the conservation of biodiversity address underwater noise as a pressure on marine biota. In particular underwater noise is given due importance in specialised agreements targeted at the conservation of marine mammals.

A brief description of the decisions and resolutions issued under the conventions or agreements, deemed to be of relevance are included.

ACCOBAMS is a cooperative tool for the conservation of cetaceans (dolphins, whales and porpoises) in the Mediterranean, Black Seas and contiguous Atlantic zones. This agreement is mainly aimed at reducing threats to cetaceans in these areas and improving knowledge of these animals. ACCOBAMS is the first Agreement binding the countries in these subregions and enabling them to work together on a matter of general interest. The Conservation Plan of ACCOBAMS, which is a full part of the Agreement, requires the Parties, amongst others to carry out **impact assessments to provide a basis for regulating activities that might affect cetaceans or their habitats in the Agreement area** and to **establish the conditions under which such activities may be conducted;**

Three resolutions issued under the ACCOBAMS agreement are considered to be particularly relevant to addressing underwater noise in the marine environment. Collectively, these

resolutions [Resolution 2.16 (2004), Resolution 3.10 (2007) and Resolution 4.17 (2010)] call for the following:

- Consideration of underwater noise as a potentially significant threat to marine mammals and other marine wildlife and to address the issue of anthropogenic noise in the marine environment, including cumulative effects, in the light of the best scientific information available;
- To avoid or minimize noise in marine protected areas, as well as in particular in areas containing critical habitat of cetaceans likely to be affected by man-made sound;
- To map the range of underwater noise to which animals are exposed and to define the exposure levels that might affect marine mammals.
- To consider effects of underwater noise in Environmental Impact Assessments and to integrate the issue of anthropogenic noise in management of Marine Protected Areas.

In addition, Resolution 4.17 from the Meeting of the Parties to the ACCOBAMS Agreement (2010) establishes guidelines to address the impact of anthropogenic noise on cetaceans in the ACCOBAMS area. A Working Group was also established by the Secretariat as per Resolution 3.10 to address anthropogenic noise. This Working Group was also tasked with the further development of the guidelines in Resolution

The Conservation Plan of ACCOBAMS, which is a full part of the Agreement, requires the Parties, amongst others to carry out impact assessments to provide a basis for regulating activities that might affect cetaceans or their habitats in the Agreement area and to establish the conditions under which such activities may be conducted. Resolutions issued under the ACCOBAMS agreement [Resolution 2.16 (2004), Resolution 3.10 (2007) and Resolution 4.17 (2010)] call for mapping of the range of underwater noise to which animals are exposed and to define the exposure levels that might affect marine mammals and to consider effects of underwater noise in Environmental Impact Assessments

The Convention on Biological Diversity (CBD) is a major UNEP-driven multilateral environment agreement targeted at the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the utilisation of genetic resources. Decision X/29 (2010) adopted during the tenth meeting of the Conference of the Parties to the CBD, requested the Executive Secretary, in collaboration with Parties, other Governments, and relevant organizations, to compile and synthesize available scientific information on anthropogenic underwater noise and its impacts on marine and coastal biodiversity and habitats. The scientific synthesis of available knowledge about noise impacts on marine wildlife has been completed and presented at the sixteenth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), held in Montreal in 2012. A number of issues related to underwater noise are also addressed in the Strategy Plan for Biodiversity 2011-2020 and its *Aichi Biodiversity Targets*, outlining the expected results of the decisions taken in terms of their direct impact on marine and coastal biodiversity protection. The eleventh meeting of the Conference of the Parties to the Convention (2014) agreed to improve and share knowledge on underwater noise and its impacts on biodiversity, assisting local governments in their research and in developing further methods to assess underwater noise.

The Convention on Conservation of Migratory Species of Wild Animals (Bonn Convention) which aims at the conservation of migratory species and their habitats, asks Parties to the Convention to seek the strict protection of these animals, conserving or restoring the habitats in

which they live, mitigating obstacles to migration and controlling other factors that might endanger them.

The Conference of the Parties of the Bonn Convention, at its Ninth Meeting in 2008 adopted **Resolution 9.19** on the adverse **anthropogenic marine/ocean noise impacts on cetaceans and other biota.**

This resolution calls on Parties to: endeavour to control the impact of introduction of anthropogenic noise pollution in habitats of vulnerable species and in areas where marine mammals or other endangered species may be concentrated, undertake, where appropriate, relevant environmental assessments on the introduction of systems which may lead to noise associated risks for marine mammals. Adopt mitigation measures on the use of high intensity naval sonars until an assessment of their impact on marine mammals, fish and other marine life has been completed, and as far as possible aim to prevent impacts from the use of such sonars, especially in areas known or suspected to be important habitat to species particularly sensitive to active sonars (e.g. beaked whales) and in particular where risks to marine mammals cannot be excluded, taking account of existing national measures and related research in this field. develop provisions for the effective management of anthropogenic noise in CMS daughter agreements and other relevant bodies and Conventions.

At their tenth meeting, the Conference of Parties also adopted resolution 10.24, which reaffirms the need for ongoing and further internationally coordinated research on the impact of underwater noise on cetaceans and other migratory species. This resolution calls on the prevention of adverse effects on cetaceans through the development of appropriate regulatory frameworks or implementation of relevant measures to ensure mitigation of anthropogenic underwater noise. It proposes that environmental impact assessments take full account of the effects of activities on cetaceans, and to integrate the issue of anthropogenic noise in the management plans of marine protected areas, where appropriate.

The European Parliament resolution - P6_TA(2004)0047

The European Parliament resolution on the environmental effects of high-intensity active naval sonars [P6_TA(2004)0047] recommends the adoption of moratoriums aiming to restrict the use of high-intensity active naval sonars until a global assessment of their cumulative environmental impact on marine mammals, fish and other marine life has been completed. It also calls on EU Member States to monitor and investigate in a transparent manner mass strandings and deaths of marine mammals in EU waters which are associated with the use of intense anthropogenic noise.

The International Maritime Organization (IMO)

The Marine Environmental Protection Committee (MEPC) established under the International Maritime Organization (IMO) has also addressed the impact of shipgenerated noise. MEPC 58 approved the inclusion of a new item in the work programme of the Committee on ‘Noise from commercial shipping and its adverse impact on marine life’ and a Correspondence Group was established to identify and address ways to minimize the incidental introduction of noise from commercial shipping operations into the marine environment to reduce potential adverse impacts on marine life. A document on this matter was presented at MEPC 61 putting forward recommendations for future work from this Correspondence Group10.

Internationally, UNEP in collaboration with its sub-organisation MEPC have and continue to focus on in-depth discussions on the potential harmful impacts of underwater noise on marine

life from ships. This work culminated in 2014, when MEPC issued guidelines for minimizing underwater noise from commercial ships. It was envisaged that future work will be needed, with its scope and timing being considered

Guidance Document on Wind Energy Developments and Natura 2000

The European Commission Guidance Document on Wind Energy Developments and Natura 2000 refers to potential impacts of wind farms on marine animals due to marine noise pollution. The guidelines lists the effects of wind farms of potential relevance for marine mammals which include (i) Intense noise during piling-driving, drilling and dredging operations; (ii) continual operational noise and vibrations emanating from the wind turbines; and (iii) effects on prey, such as changes to fish behaviour

The NATO approach

The NATO Undersea Research Center (NURC), located in Italy, runs an international research project SOLMAR (Sound Oceanography and Living Marine Resources), that resulted in the development of the NATO Policy (NATO Staff Instruction 77-04). Initially conceived for sonar research and development, the Policy is being considered a reference for NATO Navies. The SOLMAR Project addresses the issue of underwater noise and its effects on the marine environment and seeks to improve the understanding of anthropogenic noise characteristics which are potentially harmful to animals. The project includes the development of a set of comprehensive databases of oceanography, ecosystem dynamics and living marine resources in the Mediterranean Sea to support the development of models for predicting the presence of marine mammals based on seasonal and environmental parameters.

(iii) any suggestions for further action to address the adverse impacts of anthropogenic underwater noise

Cost-effective and cost-benefit scientific research, including monitoring schemes, should be further reviewed and defined. This will allow countries (globally) to monitor the status of underwater noise and allow implementation processes to begin. It is also important that funding for such research is looked into, on both an EU and international level, and the main contributors to the marine region (i.e. NGOs and other organisations) provide interest as well as research expertise to help reduce underwater noise as much as possible and thus reduce the level of marine anthropogenic disturbance.

It envisaged that future work would be needed in a number of areas, including, i) quantifying and understanding the potential impact of noise on marine species, ii) identifying the types of areas and situations where waterborne noise was potentially most disruptive for marine life, iii) setting specific noise reduction targets iv) and setting operating guidelines for sensitive marine areas.

It envisaged that future work would be needed in a number of areas, and in fact the EU (through a proposal by Malta) has just recently proposed in the Oceans and law of the sea Resolution in para 273, to include that we encourage further research into technologies to reduce the impact of underwater noise on marine life

Malta's current data scenario with respect to underwater noise is limited, both in terms of levels of such pressure and its impacts on marine biota. This scenario limits the extent to which

management regimes can be elaborated to address this pressure on the marine environment. Knowledge improvement is thus fundamental to Malta.

Further knowledge is also required with respect to the current ambient noise levels in marine regions; trends of such levels; distribution of marine biota that may be adversely affected by noise and the corresponding noise levels that may cause detrimental effects.

Spatial Protection Measures

In Malta, Marine areas around two of these Specially Protected Areas (SPAs)have been delineated to control pressures, such as noise and light emission from navigation and other sea-based recreational activities. These include:

- the 1 nm radius around Filfla (Notice to Mariners 16 of 1987) (to be enforced through approval and implementation of the Conservation Order22 for Filfla)
- the 1.1 nm at sea around the Rdum tal-Madonna SPA (Notice to Mariners 2 of 2010).

Establishment of appropriate codes of conduct addressing all forms of disturbance (trampling, light, noise, poaching, agricultural practices, pesticide use) within terrestrial SPAs. EU Birds Directive 2009/147/EC UNEP/MAP Action Plan for the Conservation of Bird Species 1b MSFD 36

This measure will contribute by raising awareness amongst users of areas of close proximity to seabird breeding sites on the existence of these communities and the impacts suffered by anthropogenic disturbances (littering, noise and light pollution, and predation). This should promote behavioural and attitude changes amongst citizens resulting in a reduction of said disturbances, thereby improving habitat conditions.

Netherlands

Summary

This document is intended to provide input from the Netherlands for the discussions on the effects of anthropogenic underwater noise at the 19th Meeting of the United Nations Open-ended Consultative Process on Oceans and the Law of the Sea. It identifies topics where international cooperation is needed to ensure effective management of anthropogenic underwater noise. The main issue is the need to increase our knowledge on potential effects of underwater noise through the monitoring of noise levels in the oceans and by investing in science programs to study the effects of increased noise levels on ecosystems. International cooperation in planning and executing research programs on the effects of underwater noise on the marine environment would be beneficial for, e.g., offshore construction, including cumulative effects, and the use of various types of sonar. Addressing shipping noise requires international action, since decision-making on measures for international shipping falls within the remit of the International Maritime Organization. Approaches to regulation may be further harmonized and, in order to increase common knowledge on sound levels in the oceans, international cooperation, both within joint monitoring programs and between the various international programs, is essential.

Introduction

On 23 December 2016, the United Nations General Assembly adopted resolution 71/257 on Oceans and the law of the sea, in which it decided that the Informal Consultative Process (ICP) shall focus its discussions at its nineteenth meeting, taking place in 2018, on the theme "Anthropogenic underwater noise"[20]. On 10 October 2017, the Office of Legal Affairs of the United Nations invited States to submit a contribution outlining their views on this theme. This document is intended to provide input from the Netherlands for the 19th meeting of the ICP.

Underwater noise was identified as an emerging topic by both the European Union and the Netherlands in the early 2000's, and was included in the European Marine Strategy Framework Directive as descriptor 11 ("Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment")[21].

Over the last decade, substantial progress has been made both in the development of knowledge of underwater noise and its effects and the management of the most relevant activities that generate anthropogenic underwater noise. As underwater noise is transboundary of nature, the Netherlands has worked together with other States, mostly within the European Union and within the Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention'). This document identifies a number of issues where international cooperation is needed to improve our management of anthropogenic underwater noise.

Challenges posed by anthropogenic underwater noise

[20] United Nations General Assembly, resolution 71/257 Oceans and Law of the sea, 2016.

[21] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).

Of anthropogenic energy inputs in the oceans, the most widespread and pervasive is underwater sound. Emissions of anthropogenic sound into the oceans can occur on many scales in both space and time. Anthropogenic sounds may be of a short duration (i.e. impulsive) or may be long lasting (i.e. continuous). Impulsive sounds may however be repeated at intervals (duty cycle), and such repetition may in turn become diffuse with distance and reverberation and eventually become indistinguishable from continuous noise. Higher frequency sounds transmit less well in the marine environment whereas lower frequency sounds can travel far. In summary, there is great variability in transmission of sound in the marine environment.

Marine organisms that are exposed to noise can be adversely affected both on a short timescale (acute effect) and on a long timescale (permanent or chronic effects). Adverse effects can be obvious (e.g. injury, death), but will in many cases be more subtle (e.g. temporary reduction in hearing sensitivity, behavioural effects).

The following sources of anthropogenic underwater noise are identified as main contributors to underwater soundscapes[22]:

- offshore construction (such as pile driving);
- the use of airguns during seismic surveys;
- various types of sonar (including military sonar);
- underwater explosions; and
- commercial shipping.

There are many different types of sound, different scales of input, and a variety of organisms that may be affected. One of the main challenges surrounding anthropogenic underwater noise, especially at the ecosystem scale, is the lack of fundamental knowledge of the levels and trends of noise in the oceans and the effects of anthropogenic underwater noise on marine life.

Actions undertaken by the Netherlands with regard to anthropogenic underwater noise

As required by the European Marine Strategy Framework Directive, the Netherlands developed its first national Marine Strategy in 2012. Although at that time it was clear that underwater noise produced by human activities had increased significantly, it was unclear to what extent such noise would cause problems for populations or ecosystems and what its (cumulative) effects would be as the use of the sea is intensified. The Netherlands government has identified and addressed knowledge gaps and a number of research projects have been carried out, when possible with international cooperation. Over the course of the last years, new knowledge has been developed and where needed regulation has been adapted based on scientific findings. Nevertheless, significant knowledge gaps remain. Some examples of specific themes where international cooperation is needed are given below.

<u>Cumulative effects of offshore construction and present measures</u>

[22] Van der Graaf, A. J., Ainslie, M. A., André, M., Brensing, K., Dalen, J., Dekeling, R. P. A., Robinson, S., Tasker, M. L., Thomsen, F., Werner, S., European Marine Strategy Framework Directive - Good Environmental Status (MSFD GES): Report of the Technical Subgroup on Underwater noise and other forms of energy, 2012. online: http://ec.europa.eu/environment/marine/pdf/MSFD_reportTSG_Noise.pdf.

The Netherlands government intends to increase the amount of sustainable energy, and offshore wind energy in the North Sea has become of increasing importance. However, piling for construction of foundations for wind turbines may generate high levels of underwater sound that can disturb marine life, such as harbour porpoises and seals. A national Underwater Sound Working Group developed an assessment protocol for determining the cumulative effects of impulsive underwater sound on relevant populations of marine mammals in the North Sea.[23] Based on the results of this research, specific regulation was imposed requiring reduction of emitted sound during construction. As underwater noise resulting from offshore construction may have cross-border effects, international cooperation is needed for future improvement of knowledge base and regulation. In the North Sea region, development of a common environmental assessment framework was identified as a necessary next step[24]. International cooperation in planning and executing research programs on the effects of underwater noise on the marine environment would be beneficial to achieve this.

Military sonar

Active sonar is an essential capability for military organizations as it is the only means available to detect underwater targets like modern submarines and mines. As military sonar may endanger sensitive marine life (e.g. whales and dolphins), many States have regulations to ensure responsible use of military sonar. In 2003, the Ministry of Defence of the Kingdom of the Netherlands launched a research program that is still ongoing. The goal of this program is to enable the future responsible use of sonar systems that are essential for defence purposes. Current regulation of the Netherlands is based on knowledge developed in this program, but as at-sea research campaigns to investigate the potential effects of sonar are both complex and costly, international cooperation in this specific field is beneficial. Currently, the Netherlands participates in an international research program with partners from the United States of America, the United Kingdom, Norway and France.[25]

Commercial shipping

Low frequency sounds from human activities may be audible at long ranges, in deep water up to thousands of kilometers. In many areas the ambient noise level has increased due to shipping noise, sometimes supplemented with noise from other activities such as seismic research. As a result of the concern on potential effects of increased underwater ambient noise, the International Maritime Organization adopted voluntary measures to address shipping noise in 2014[26]. As levels and long-term trends, and scale of effects, are not clear at this moment, clarifying effects and the need for additional action is a clear knowledge gap. Addressing

[23] Heinis, F., de Jong, C., and Rijkswaterstaat Underwater Sound Working Group 2015. Framework for assessing ecological and cumulative effects of offshore wind farms: cumulative effects of impulsive underwater sound on marine mammals, TNO 2015 R10335-A, 2015.

[24] Political Declaration on energy cooperation between the North Seas Countries, 2016.

[25] P.H. Kvadsheim, F.-P. Lam, P. Miller, L.D. Sivle, P. Wensveen, M. Roos, P. Tyack, L. Kleivane, F. Visser, C. Curé, S. van IJsselmuide, S. Isojunno, S. von Benda-Beckmann, N. Nordlund, R. Dekeling, The 3S2 experiments – studying the behavioral effects of naval sonar on northern bottlenose whales, humpback whales and minke whales. FFI-rapport 2015/01001, 2015.

[26] International Maritime Organization MEPC.1/Circ.833 Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life, 2014.

shipping noise will need international action since decision-making on measures for international shipping falls within the remit of the International Maritime Organization.

International harmonization of regulation and standardization of terminology

Information exchange on regulatory frameworks and methodology will help improve common understanding and may allow to harmonize approaches in regulation of different States, avoiding differences in national regulations for activities in transboundary areas. The Netherlands has contributed to international harmonization of regulation of underwater noise over the last years through the organization of international meetings to enable exchange of information and collaboration of marine scientists and regulators who are involved with aquatic noise[27]. The Netherlands has also actively supported work in the International Organization for Standardization leading to the establishment of the first ISO standard on underwater sound terminology[28], but it is clear that we still have a long way to go.

Monitoring of underwater sound

The European Marine Strategy Framework Directive requires European Union Member States to develop strategies for their marine waters that should lead to programmes of measures that achieve or maintain good environmental status. As an essential step Member States should establish monitoring programs to enable assessment of the state of the marine waters on a regular basis. Recognizing the need for common methodology, the Netherlands has actively contributed to the common implementation process of the European Marine Strategy Framework Directive, and a common guidance was developed with active support by experts of the Netherlands.[29] This guidance clarified methodology needed, but also advised Member States to work together in setting up both impulsive and ambient noise monitoring systems.

Based on the European guidance, the Netherlands has invested in the definition and implementation of joint monitoring programmes for both impulsive and ambient sound. Through the co-operation under the OSPAR Convention, a registry for marine data has been developed at the International Council for the Exploration of the Sea. States around the North Sea and the Baltic Sea have agreed to use the registry for data on all activities that generate impulsive sounds. This registry has become operational in 2016, and the first assessment of data has been published by OSPAR in the Intermediate Assessment 2017.

Furthermore a three-year development project was initiated to implement a Joint Monitoring Programme for Ambient Noise in the North Sea (JOMOPANS). Seven North Sea countries participate in this project which is led by the Netherlands and will run from 2018 to 2020.

[27] K. Lucke, G. Scowcroft, H.V. Winter, C. Knowlton, F.-P.A. Lam, A.D. Hawkins, A.N. Popper, International harmonization of approaches to define underwater noise exposure criteria and needs of the international regulatory community, Proc. Meet. Acoust., 27 (2016), Article 070010

[28] International Organization for Standardization (ISO) (2016). "ISO/DIS 18405.2 Underwater Acoustics –Terminology". Geneva, April 2016

[29] Dekeling, R. P. A. , Tasker, M,.L., Van der Graaf, A. J., Ainslie, M. A., Andersson, M. H., André, M., Borsani, J. F., Brensing, K., Castellote, M., Cronin, D., Dalen, J., Folegot, T., Leaper, R., Pajala, J., Redman, P., Robinson, S. P., Sigray, P., Sutton, G., Thomsen, F., Werner, S., Wittekind, D., and Young, J. V., Monitoring Guidance for Underwater Noise in European Seas, Part I-III, JRC Scientific and Policy Report EUR 26557 EN/26555 EN/26556 EN, Publications Office of the European Union, Luxembourg, 2014.

Through a combination of measurements and modelling, a spatial distribution of sound levels ('noise maps') will be generated. This can be used to develop and evaluate policies on underwater noise.

As monitoring of underwater sound is a relatively new topic, methodology will continue to be developed in the coming years. To increase common knowledge on sound levels in the oceans (and the potential effect of increased levels of anthropogenic noise) consistency between methodologies used in monitoring programmes is needed to ensure that the obtained data can be compared. International cooperation, both within joint monitoring programmes and between these international programmes, is essential.

Recommendations: future action to address the adverse impacts of anthropogenic underwater noise

Management efforts of States are most often focused on sea areas under their jurisdiction. However, high seas constitute a significant part of the world's oceans. The importance of healthy oceans for the world can hardly be overestimated. Oceans play a crucial role in keeping the earth healthy by producing oxygen and absorbing heat and CO_2. In addition, oceans are an important source of employment in the shipping, tourism, fisheries and the maritime industry, and contribute to global economic growth and prosperity. Oceans are important transportation ways for people, countries and trade flows, and play an increasing role in providing the food supply of a growing world population.

The oceans are in poor health, causing essential user functions to come under pressure. The effects of acidification and warming of the oceans, including changing biodiversity and sea level rise, are already visible in the North Sea and the Caribbean Sea. In addition, human action leads to marine litter, underwater noise and overfishing. A sustainable use and conservation of the oceans and the proper implementation of SDG 14 asks for an international, ambitious effort, within the framework of the UN and other international frameworks (e.g. the EU, OSPAR), aimed at adequate international management.

Of the above mentioned challenges, underwater noise is a relatively new topic, and there is great uncertainty about levels and trends of anthropogenic noise and the potential effects on marine life and the resulting status of the environment. In many States, regulation of underwater noise has not been fully established or is still under development. This means that there is also an opportunity for international cooperation and harmonization to establish adequate management and develop relevant knowledge. In the coming years, the Netherlands will continue its efforts to work internationally to improve our understanding and management of anthropogenic underwater noise.

Poland

Information on the implementation of Task 5 (*developed in the Monitoring and Environmental Information Department on the basis of work reports prepared within the framework of the implementation of the task by the contractor*)
The implementation of a nationwide pilot underwater noise monitoring programme and conducting studies in 2015-2017 on two indicators, i.e. continuous underwater sounds – sailing and underwater impulse sounds – sonars and depth finders, explosions and deterrent devices **as part of the study "Monitoring of the Baltic Sea in the Polish Exclusive Economic Zone in 2014-2017"**

Introduction

Underwater noise testing for the assessment of two indicators: continuous underwater noise and impulse noise results from the implementation of Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), as amended by Directive 2017/845/EU of 17 May 2017. Underwater noise research was introduced into the Baltic Sea monitoring programme in 2014-2017 as a pilot project. The locations for the recording of continuous underwater noise were selected in such a way as to enable the assessment of the environmental status of marine waters in each Polish maritime area (PMA). (*The introduction was prepared by the Monitoring and Environmental Information Department – MEID*).

Indicator monitoring – continuous underwater noise

In order to carry out continuous underwater noise monitoring (ambient noise), the Baltic Sea monitoring contractor (IMGW-PIB Marine Division) [Institute of Meteorology and Water Management – National Research Institute] purchased 6 sets of hydrophones together with anchoring equipment at the end of 2014. The purchase of hydrophones was financed on the basis of Grant agreement No. 825/2014/Wn-11/MN-PO/D concluded between the Institute of Meteorology and Water Management – National Research Institute (IMGW-PIB) and the National Fund for Environmental Protection and Water Management (NFOŚiGW) on 5 December 2014.
The purchased autonomous hydrophones for underwater noise recording Songbird SM3M, manufactured by WildLife (USA), are primarily used to record sounds of marine mammals. They also meet the basic requirements for recording noise emitted by anthropogenic sources, such as vessels or generated during construction work.

Tests of measuring devices

Under the monitoring programme, data collected for three years from the beginning of 2016 will be used to develop an indicator of low-frequency ambient noise generated by shipping activity. The indicator will be used in models and mapping of marine noise level with respect to the frequency band required by Commission Decision 2010/477/EU *(currently 2017/848/EU – commentary of the Department of Monitoring and Environmental Information - MEID).* The development of the indicator will assess whether the defined environmental objective – underwater noise levels that do not interfere with the proper functioning of marine organisms – has been reached.
In 2015, marine tests were conducted to determine the proper location of the measuring equipment, the correct setting of the measuring parameters, and the technical testing of the anchoring system solution appropriate for various marine conditions. After the completion of

the tests, measurements were conducted as part of a pilot monitoring programme in 2016 and 2017.

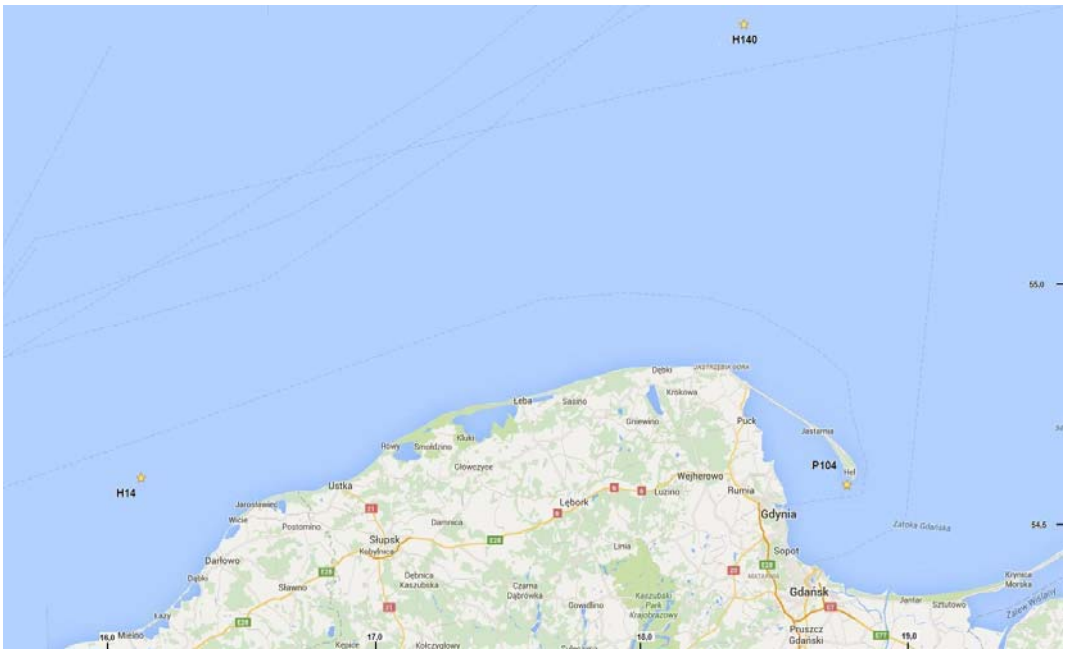

Fig. 1 Location of the anchorage of H14 (near P114 monitoring station), H140 (near P140 monitoring station) and P104 hydrophone stations against the main navigational corridors in the South Baltic (broken lines).

Five units were used for testing. The units were located in the eastern part of the South Baltic and in the Bornholm Basin, 2 to 3 nautical miles from the main shipping routes. The hydrophone location names originate from the nearby monitoring stations. The locations of hydrophones are shown in Figures 1 and 2.

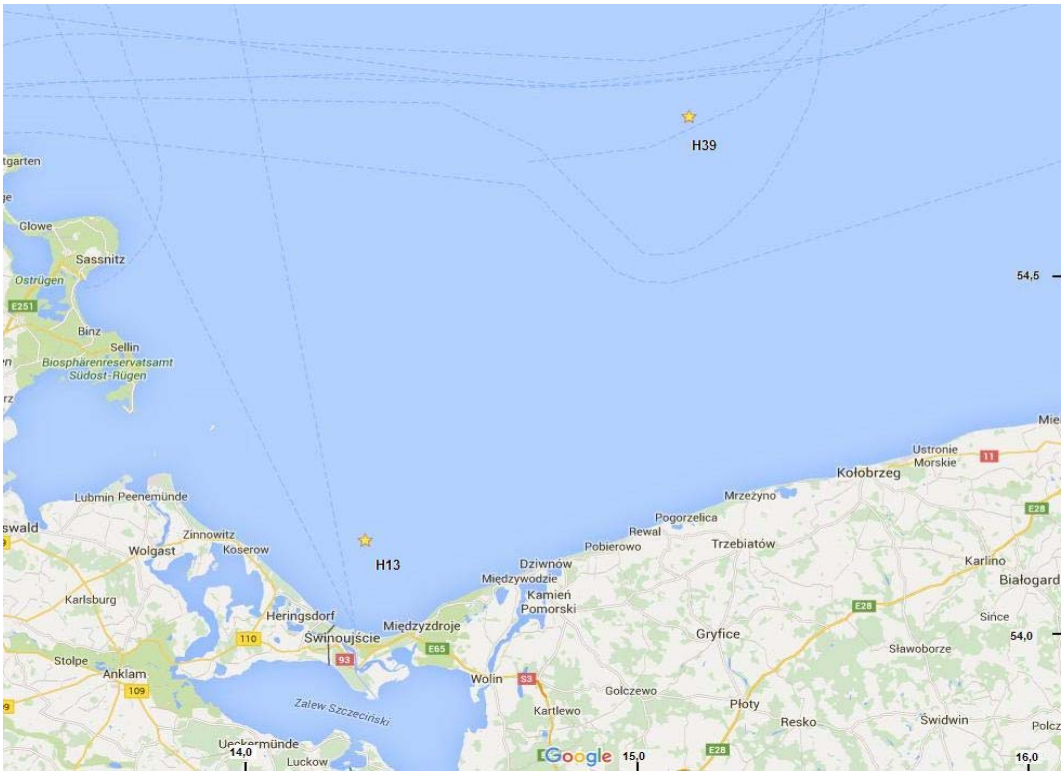

Fig. 2 Location of the anchorage of H13 (near B13 monitoring station) and H39 hydrophone stations (near P39 monitoring station) against the main navigational corridors in the Bornholm Basin (broken lines).

Table 1 contains detailed information on the conducted measurement tests (2015) and pilot studies (2016 and 2017), and the data collected.

Tab. 1. Detailed information on the conducted measurement tests, pilot studies, and the data collected.

Station name	Geographical coordinates		Deployment of measuring units	Removal of measurement units	Start of measurement	End of measurement	Depth of hydrophone immersion [m]	Depth [m]
	Length	Width						
H13	14° 18,387’	54° 04,020’	05-08-2015	16-09-2015	08-08-2015	16-09-2015	11,0	13,0
H39a	15° 30,567’	54° 45,600’	01-03-2016	03-03-2016	01-03-2016	03-03-2016	4,0; 65,0	72,0
HZN4*	18° 37,725’	54° 31,184’	31-10-2016	09-11-2016	31-10-2016	09-11-2016	10,0	50,0
P104	18° 47’24”	54° 34’54”	19-05-2017	25-05-2017	19-05-2017	25-05-2017	10 m above the bottom	31,0

* measurements taken every other day

In order to obtain data on ambient noise, in particular caused by shipping, all selected locations were close to the main shipping lanes. Hydrophone locations were agreed with the relevant Maritime Offices in Gdynia, Slupsk and Szczecin to avoid danger zones for anchorage systems integrity.

In accordance with Commission Decision (2010) intermediate frequencies bands were selected as: 63 and 125 Hz. The frequency of 500 Hz represents the frequency range with typically maximum levels of natural noise (from dynamic sources located on the sea surface), while the frequency of 5 kHz is approximately the upper frequency limiting the range of hearing sensitivity of the herring (*Clupea harengus*).

Results of test measurements

The most popular herring species in the Baltic Sea – herring (*C. harengus*) and sprat (*Sprattus sprattus*) are among the most noise-sensitive fish species. Their response to sounds is highest in low frequencies from tens of Hz to 3-4 kHz. The audibility threshold level (response to sound) in the herring is almost flat for the frequency interval from approximately 30 Hz to about 1 kHz and is approximately 75-80 dB re 1 μPa. Other fish found in the Baltic are probably less sensitive to sounds, while more accurate data is available only for the cod (*Gadus morhua*).

It is believed that among marine organisms exposed to high amplitude noise resulting from, e.g. pile driving or explosions, small fish of the mass of 1 g are most susceptible to organ damage. Damage occurs at peak-to-peak acoustic pressure levels of 214 dB re 1 μPa or SEL at 187 dB re 1 $\mu Pa^{2s.}$

Herring (*C. harengus*) has a small gas bubble (prootic auditory bulla) attached to the otolith, which increases its ability to hear sounds to the frequency of 3-4 kHz. Other Baltic fish that do not have this organ, e.g. cod (*G. morhua*), salmon (*Salmo salar*) or eel (*Anguilla anguilla*) display lower response to sounds below 1 kHz and thus an increased audibility threshold of 75-100 dB // 1 μPa. It is worth noting here that herring is characterised by a lower threshold and a wider frequency band compared to salmon and cod.

Spectral density level histograms (Figure 3) from pilot surveys carried out in the Pomeranian Bay, in four selected thirds illustrate how often the noise levels from vessels, at a distance of approximately 6.5 km from the approach lane Swinoujscie, exceed the noise levels recognised as the audibility threshold for herring (*C. harengus*).

Sweden

Sweden would like to provide the following information to the Secretary General in view of the preparation of his report on Oceans and the Law of the Sea and the 19th meeting of the ICP concerning "Anthropogenic underwater noise". The same information was submitted by Sweden to the Secretariat of the CBD following decision XIII/10 by the CBD COP and included in the Submission by the EU and its Member States.

The most relevant experiences submitted by Sweden

(a) Two EU tools for management have been developed to predict adverse impacts: (1) A registry for impulsive noise events in the North Sea and the Baltic Sea and (2) a soundscape planning tool for continuous noise has been implemented and used for assessment and decision support for continuous low frequency noise in the Baltic Sea. The soundscape planning tool is a result of the project "Baltic Sea Information on the Acoustic Soundscape" (BIAS) https://biasproject.wordpress.com/.

(b) Several scientific research projects have been conducted which significantly contribute to increase the knowledge base with regard to underwater noise and aquatic life. Of significance to highlight are as follows:

1. Studies on free swimming cod in the Gullmarsfjord of the west coast of Sweden (Andersson et al., 2015). The study investigated behaviour change when commercially important fish species Atlantic cod (Gadus morhua) were subjected to ship noise. The study indicated that cod exposed to ship noise not always show a displacement from the area, which might lead to secondary effects.

2. Effects of motorboat noise on foraging behaviour in Eurasian perch (Perca fluviatilis) and roach (Rutilus rutilus): a field experiment (Magnhagen, Johansson, & Sigray, 2017). This study, using authentic sound in a natural habitat, shows that noise exposure may affect thefeeding behaviour of fish, that the response is species-specific, and that habituation and the presence of other species may modify the effects.

3. Offshore exposure experiments on cuttlefish (Cephalopoda) (Solé et al., 2017). These are the first evidences of cephalopods sensitivity to anthropogenic noise sources in their natural habitat. From the measured received power spectrum of the sound sweep, it was indicate that received sound pressure and particle motion levels are associated with acoustic trauma (AQUO) in cephalopods.

4. Estimates of noise source spectra of ships from long term recordings in the Baltic Sea (Karasalo et al., 2017). The procedure was applied to estimate the source strength of over 900 individual ships from more than 2,000 passages. Data was used to enhance the reliability of existing source strength models of ship noise. Considering that the awareness of the adverse effects, e.g. the behaviour and breeding patterns of fish and sea mammals have been found to be negatively affected by anthropogenic underwater radiated noise. The results could be used to more accurately direct mitigation measures.

5. The development of a particle motion sensor (Sigray & Andersson, 2011). This device measures the relevant component of sound wave, especially for fish that use particle motion for detection for frequencies lower than 300 Hz.

6. In a recent doctoral thesis on how noisy environment effect fish behaviour (Blom, 2017) the researchers found that common goby (Pomatoschistus microps) and sand goby (Pomatoschistus minutus) which are typical species in many costal habitats. The two goby species that were exposed to noise barely mated. If they were mating, then it took a lot longer than it did for the fish that lived in a quiet aquarium. In addition, half of the eggs died in the noisy environments before they hatched, and if they hatched, it took longer than the eggs in a quiet environment.

7. Results from a literature review and acoustic modelling exercise have recommended a framework for regulating underwater noise during pile driving activities (Andersson et al., 2016). This work includes harmful sound pressure levels for fish and harbour porpoises, possible mitigation techniques and examples of sound propagation from a pili driving active in four different sea regions around the Swedish coast.

(c) The project Achieve QUieter Oceans by shipping noise footprint reduction (AQUO) investigated hydrodynamic design of propeller to cause less cavitation and noise emission in collaboration with a Swedish ship design company.

(d) "Symphony", a cartographic tool that assesses cumulative effect of pressures on ecosystem components is nearing completion. It includes acoustic pressures (marine traffic noise pollution, operational wind farm noise, approximation of pleasure boats, military explosions) and takes the temporal distribution of porpoises into account, i.e. different breeding and wintering habitats. The methodology behind "Symphony" is based on a series of scientific studies, all of which can be related to global analysis of the cumulative environmental impact in the ocean, published in the Science magazine in 2008.

See also under e) below regarding the soundscape tool from BIAS.

(e) This work has been started as the project BalticBoost. Distributions of sound sensitive species have been identified. By the soundscape modeling tool (distribution and intensity of sound in three dimensions) these areas could be combined with soundscape GIS information from BIAS. This could used for measure to mitigate and plan for activities that cause adverse impacts on biota.

(g) An environmental impact assessment must be prepared by an operator before submitting a permit application for waterworks and environmentally harmful operations. The potential environmental impacts of underwater noise should be included as well as mitigation measures. The "Vindval research programme" is a collaboration between the Swedish Energy Agency and the Swedish Environmental Protection Agency that aims to develop and communicate science-based facts about the impacts of wind power on humans, nature and the environment (Andersson et al., 2016). The project has resulted in a guideline for regulating underwater noise during pile driving. This works as a guidance during the permitting process for example for offshore wind farms (permits must most often be obtained from the land and environment courts). Maximum levels of underwater noise can be regulated in the permit and should in that case be carefully monitored in the monitoring program which is overseen by the supervisory

authority. The EU BONUS project Sustainable Shipping and Environment of the Baltic Sea region (SHEBA) address a wide range of environmental impacts of shipping in the Baltic Sea including underwater noise (BONUS, 2017). New soundscape maps have been produced for two regions in the Baltic Sea and perform a risk assessment and future scenarios for ship traffic intensity.

(h) In 2016 the Swedish government designated a large marine Natura 2000 area in the Baltic Proper for the harbour porpoise (Phocaena phocaena). With more than 10 000 km2 (1 million hectare) this is the largest marine area ever proposed by Sweden as a Natura 2000 site. It includes the majority of the most important breeding ground of the critically endangered Baltic population of harbour porpoise, which mainly is located within Sweden's EEZ. The protection also aims to minimize noise disturbance from activities from pleasure boats as well as commercial boats and their use of underwater sounding devices like sonars.

(i) The HELCOM Expert Network on Underwater Noise (EN-Noise) has developed a "guideline level" concept. The principles behind this have been used by the group for assessing the environmental status of some priority noise-sensitive species in the Baltic Sea under the Helcom core indicators on population trends and abundance. EU TG Noise has also discussed whether these can be used to assess good environmental status (GES) according to MSFD on the pressure indicators for impulsive and continuous underwater sound.

(j) The project Baltic Sea Information on the Acoustic Soundscape (BIAS) has developed standards for continuous sound measurements and data processing (Betke, 2015; Verfuß, 2015). The project Achieve QUieter Oceans by shipping noise footprint reduction (AQUO) developed a guideline together with another EU project addressing the noise footprint from ships, how to measure and suggestions of mitigations(Baudin & Mumm, 2015).

(l) The Achieve QUieter Oceans by shipping noise footprint reduction (AQUO) project involved the ship building and designing industry (Héloïse & Hervé, 2017).

(m) Through active participation in HELCOM, OSPAR and EU's TG Noise Sweden (alongside several other states) is striving to take a leading role on this issue and enhance and promote relevant synergies.

(n) The goal of MSP is to contribute to achieve good environmental status (GES). Within the EU Maritime spatial planning (MSP) the cartographic tool "Symphony" is used in the Swedish MSP as a measure to get an effective progress for GES.

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