Baltic Marine Environment Protection Commission
Expert Network on Benthic Habitats EN Benthic 3-2019
Helsinki, Finland, 14-15 November 2019

Document title	Responses to Questionnaire on mapping of habitats, biotopes and species
Code	5-2 rev.1
Category	INF
Agenda Item	5– Workplan for 2018-2021
Submission date	13.11.2019
Submitted by	Secretariat
Reference	

Note: This document has been updated on 13 November 2019.

Background

According to the workplan of the HELCOM Expert Network on Benthic habitats for 2018-2021, the group is to review existing methods and techniques for benthic habitat monitoring to support assessment of extent and quality of habitats.

A questionnaire on mapping of habitats, biotopes and species, was compiled by Finland to facilitate the HELCOM workshop on Benthic Mapping, 12-13 November 2019. The questionnaire was distributed to State & Conservation and EN Benthic on 6 September 2019, and participants of the workshop were invited to respond to the questionnaire by 10 November.

This document contains the compiled responses to the questionnaire.

Action requested

The Meeting is invited to take note of the information.

What is the spatial coverage of your country's/organization's mapping effort? What are the sampling methods of locating mapping points (randomized, grid-based…)?

German Federal Agency for Nature Conservation (works in the EEZ and federal state authorities in territorial waters): In general, we try to map the whole sea area, but with different spatial resolutions. **MPAs are prioritized**, and mapping points are monitoring stations, data from recent projects, new sampling stations in order to fill the gaps. Sampling methods strictly depends on the chosen mapping methods, resolution and targeted biotopes – **mainly stratified random sampling** or **grid based**.

Denmark (Ministry of Environment and Food): Mapping of the seabed habitats in Denmark has been done on a project base. This means that spatial coverage depends on the specific projects. It has depended of the year. Most mapping projects has focused on mapping the seabed **within Natura 2000 sites**, however, the approach when mapping within an area has been **grid-based**. Under MSFD we are now mapping bigger **areas outside Natura 2000 sites as well**. Relating to coverage: We started in 2010 with 10-15 km between survey lines. Now we are mapping with **1,5 km between survey lines**. This is accompanied by **seabed sampling** for instance with haps **and videos/dives**. In some Natura 2000 sites distance between survey lines have been approximately 500 m. For certain habitat types such as bubbling reefs, we have attempted full coverage.

Estonia (Estonian Marine Institute): Spatial coverage of the mapping effort has been very different, depending on the purpose of the mapping project. So far 38% of the whole Estonian marine area (**territorial waters + EEZ**) have been covered by benthic mapping projects in the time period of 2005-2018. In 2018 the modelling effort was made to cover the whole Estonian marine area to model distribution of key benthic species, habitat types according to the Annex I of Habitats directive and MSFD predominant habitat types. Estimation of the reliability (accuracy) or quality of the underlaying existing data was also performed during this exercise. Only very small fraction of mapping effort has been carried out with very high accuracy (100% coverage of multibeam sonar). For 62% of the sea area only existing environmental data layers were used for modelling of the distribution of benthic habitats. Quantitative and semiquantitative sampling is designed using **stratified random approach.**

Latvia (Latvian Institute of Aquatic Ecology): Currently only **all marine Natura 2000** areas are mapped, using **drop-video surveys** and **sampling by divers** on the selected spots. Drop-video points are located on the **grid 500 x 500m**. There are potential reef territories in the EEZ, but they are not mapped yet, as well as other hard substrate habitats outside the protected areas.

The Geological Survey of Sweden: In Swedish **EEZ, 25 meters resolution**. All available records, various methods (transect/area). In complete **HELCOM/OSPAR area, 250 meters resolution**. Modelling from available records.

The Swedish Agency for Marine and Water Management: **Shoreline to EEZ (250 m resolution)** and shoreline to outer county boundary, **5 prioritized counties (10 m)**. Offshore areas (selected banks and deep areas) for locating and identify high nature values. Randomized and occasionally grid-based (Swedish west coast).

Finland (Parks & Wildlife Finland, Finnish Environment Institute): During the 1st phase of national underwater mapping VELMU programme (2005-2015), Finland's marine areas have been surveyed with i.a. **visual mapping methods**, accomplishing 70 000 drop-video points and over 2000 dive transects, and covering the whole coastline. Today we have over 150 000 mapping points, and on average 1,9 mapping points per km^2 (total marine estate 81,169.1 km^2 (EEZ including territories)), but this coverage varies a lot between areas. Such nationwide mapping efforts have resulted in achieving good insight into the distribution and abundance of habitats, biotopes and species in the Finnish marine environment. We have used **grid-based mapping** mostly inside marine national parks and **stratified randomized mapping** points covering the whole Finnish coastline. Most of the dive transects have been located based on subjective aerial image interpretations (and final decisions are made by field crew).

What taxonomic groups, biotopes and habitats does your mapping cover?

German Federal Agency for Nature Conservation: Mapping focuses on sediments (side scan), benthic macrofauna (infauna and epifauna) and flora resulting in predicted HUB biotopes (levels 5 or 6). Main focus: **habitats 1110 (sandbanks), 1170 (reefs) and biotopes protected under national conservation act**: mussel bed, macrophyte meadows, species-rich gravel, coarse sand and shell ground, **MSFD BHT**. Secondary importance: HUB-Level 6 or comparable national biotope types – taxonomic resolution which is required for this step.

Denmark (Ministry of Environment and Food): Depending on the seabed habitats we are mapping, biological "sampling" has either included **dives/videos** on **reefs** with results in registering **macroalgae and reef fauna** (fish etc have also been registered). On **sandy and muddy sediments** haps have been collected registering **infauna**.

Estonia (Estonian Marine Institute): Estonian mapping projects have covered following benthic habitats: 1110 (**Sandbanks**), 1130 (**Estuaries**), 1140 (**Mudflats and sandflats**), 1150 (**Coastal lagoons**), 1160 (**Large shallow inlets and bays**) and 1170 (**Reefs**). 18 habitats from **EBHAB classification** and **MSFD predominant benthic habitat types**. Species: Sampling of the benthic habitats covers **all identifiable macroscopic organisms**. For creation of habitat distribution models, only species used in habitat definitions are modelled. For the assessment of habitat quality, only species listed in relevant methodology are used.

Latvia (Latvian Institute of Aquatic Ecology): Latvian mapping covers **macroalgae and hard bottom zoobenthos species**.

The Geological Survey of Sweden: Substrate classes; probability of presence for **soft, sand, coarse and hard substrates.** Habitats; **Natura/EUNIS/HUB based on substrates**, wave energy and Secchi.

The Swedish Agency for Marine and Water Management: See list of species and habitats. Baltic proper, resolution 250 m: vegetation and epibenthic fauna 40 species or species groups, infauna 10 species or species groups, 25 HUB classes/species groups. Gulf of Bothnia, resolution 250 m: vegetation and epibenthic fauna 18 species or species groups, infauna 6 species or species groups. Västerbotten county, resolution 250 m: vegetation and epibenthic fauna 12 species or species groups, infauna 5 species or species groups, 11 HUB classes/species groups.

The Swedish University of Agricultural Science: New national maps on 1130, 1140, 1610 and 1620 covering both inside and outside of Natura 2000.

AquaBiota Water Research: In addition to the maps listed by SwAM, there have been several mapping projects on county level, covering a number of species and habitats in 10-25 m resolution.

Finland (Parks & Wildlife Finland, Finnish Environment Institute): Natural Resources Institute Finland has mapped abundance and distribution of **fish and fish larvae**; The Geological Survey of Finland has mapped different underwater habitats from geological point of view. On overall, **underwater habitats, biotopes** and species (**macroalgae, underwater vegetation, soft and hard bottom epiphytic and infaunal species**). Both **abiotic** (geological, physical and chemical) and **biotic characteristics** of the marine environment are inventoried. Inventories are conducted particularly to map the distribution of **benthic habitats**, and the **vascular plants**, **macroalgae**, **invertebrates** and **fish** species living in these habitats. After 1st phase of VELMU we have targeted our mappings more

into HD's habitats mapping (**reefs, sandbanks, lagoons, shallow bays and inlets and estuaries**) and of endangered and data deficient species.

What are the mapping methods used in your country/organization for marine habitats, biotopes and species?

German Federal Agency for Nature Conservation: Full spatial coverage with **remote sensing/ satellites** (shallow waters), **multibeam echosounder, side scan sonar**. **Ground truthing** and/or biological component with **video transects, video stills/drop-camera, van Veen -grab, SCUBA-divers** (diving transects, frame sampling).

Denmark (Ministry of Environment and Food): **Seismic/sub bottom profiling**, **side scan** and **multibeam**, these are always accompanied by **biological "sampling"** using either divers, video with ROV and transects and haps samples, as well as grain analysis in some surveys. Main survey methods are depending on the area.

Estonia (Estonian Marine Institute): Mapping methods have evolved since 2005 when they were developed in the framework of the LIFE project "Marine protected areas of the Eastern Baltic Sea" and were further developed by several targeted projects and international cooperation within the Baltic scientific community. Current standard method consists of several steps: 1. Sampling – **Multibeam sampling + quantitative (biomass) and semiquantitative (coverage) sampling of seabottom and benthic communities**. Quantitative sampling is performed by **SCUBA diving** or **bottom samplers**, semiquantitative sampling is performed by SCUBA diving or using UW video systems (**drop-cameras or ROV**). Multibeam coverage of the area is from 10-100%, depending on complexity and purpose of the mapping. Quantitative and semiquantitative sampling is designed using stratified random approach. 2. Data processing and modelling - Several candidate models are built for each biodiversity variable using the following algorithms: generalized additive models (GAM), random forests (RF), and boosted regression trees (BRT). Results of the modelling of biodiversity features (species abundances) are then translated according to the habitat definitions.

Latvia (Latvian Institute of Aquatic Ecology): **Drop-video** surveys and hard bottom **benthic samples** collected **by divers**.

The Geological Survey of Sweden: Continuous mapping and data collection; sampling, geo-acoustics (**side scan, multibeam, seismic**)**.** A transition from map production to environmental modelling.

The Swedish Agency for Marine and Water Management:

- Visual methods as Dropvideo, ROV, diving and snorkeling
- Sediment grabs
- Drones and satellite for mapping biology and bottom characteristics under development
- Multibeam/Backscatter

Finland (Parks & Wildlife Finland, Finnish Environment Institute): Depending of the area and purpose, **drop-video, ROV, drone, side-scan sonar and LiDar** has been used for habitats mapping. **Diving** is used for direct observation of species and habitats and **sampling** of sandy and hard-bottom fauna. For sampling of soft-bottom fauna, **grab samplers** (i.a. Van Veen, Ponar) are operated on board small boats or research vessels. Fish spawning and larval areas are sampled using **scooping**, **white plate**, **Gulf-Olympia sampler** and **remote sensing**. Geological surveys are mainly conducted using **acoustic methods**, particularly **multibeam echo sounding**.

Based on your mapping, do you feel that that you are able to recognize your most valuable protected areas and their characteristics?

German Federal Agency for Nature Conservation: YES, with few exceptions.

Denmark (Ministry of Environment and Food): Yes, with a certain degree of confidence based on the confidence (distance between survey lines and depth) of the mapping project. We have developed a confidence map.

Estonia (Estonian Marine Institute): Borders of protected areas are defined in national legislation. There has not been any coherence or representativity or effectiveness analyses performed for current MPA network on national level. What concerns identification and inventory of marine nature values this has been carried out on project basis. There has been mapping activities to cover existing marine NATURA 2000 areas (e.g. NEMA - Inventory and development of monitoring programme for nature values in Estonian marine areas). Large art of mapping effort so far has been undertaken in connection to EIA projects of offshore energy, aquaculture and other installations. In general, mapping effort is undertaken with the aim of describing the features defining the habitat of interest or other nature value. So, each mapping project is designed to provide maximum information concerning the target habitat or species. Methodology of mapping can vary, depending on the project aims and availability of resources but in general follows the main principles.

Latvia (Latvian Institute of Aquatic Ecology): Initially the Natura 2000 sites were chosen based on bird resting and feeding places. Only later the underlaying underwater habitats were mapped. So, there are other hardbottom substrates which are not mapped and therefore there might be as valuable habitats as in the MPAs.

The Geological Survey of Sweden: We are still working on high-resolution substrate (10 m) and how to assess %-cover directly, not only probability. The Baltic model needs more data from other countries.

The Swedish Agency for Marine and Water Management: No

Finland (Parks & Wildlife Finland, Finnish Environment Institute): Historically, due to lack of underwater information, most of our marine protected areas has been established based on other values (e.g. sea birds, seals, terrestrial nature) and according to recent study, only 1/3 of our underwater values are inside current protection areas. We still lack data enough of underwater characteristics in spatial terms, and we feel that some of the high value areas might still be undiscovered due to lack of knowledge and mapping data. The data collected in VELMU has been used to identify ecologically important marine areas (EMMA work) and valuable areas for protection has also been identified (Virtanen et al. 2018 https://doi.org/10.3389/fmars.2018.00402)

Does your country/organization deliver monitoring of species and habitats? If yes, what taxonomic groups and habitats does it cover? What are the methods and time-interval used in monitoring?

German Federal Agency for Nature Conservation: Monitoring stations for benthos are HELCOM monitoring stations (mainly circalittoral sand & mud). For monitoring **sandbanks, reefs** (including gravel-, coarse sand- and shell-biotopes and macrophyte stands) and **muddy bottoms** dominated by *Arctica islandica*, monitoring comprises grab sampling and video/photo survey. Each station will be at least monitored every sixth year, but each monitoring location (comprises of several stations) more often. For HELCOM-monitoring it's annual with Van Veen grab and video stills.

Denmark (Ministry of Environment and Food): Several monitoring is carried out, which is a separate issue from the habitat mapping projects. This is both **reef monitoring** with divers noting and collecting macroalgae and fauna, coastal transects looking at coastal reefs and **eelgrass beds**, and haps samples on **sandy and muddy seafloor**. Additional non-seabed monitoring is also part of the national monitoring program.

Estonia (Estonian Marine Institute): For marine areas Estonia is currently performing a monitoring programme of benthic habitats (structure and function) for three HD habitat types: 1110 (**sandbanks**), 1140 (**mudflats and sandflats**) and 1170 (**reefs**). Methodology for monitoring of the habitat types 1130, 1150, 1160 is currently developed in national project. Monitoring frequency is once per assessment period (6 years). Assessment methodology follows Torn et al. 2017: Assessment of quality of three marine benthic habitat types in northern Baltic Sea (Ecological Indicators, 73, 772−783). Assessment scheme is based on the quantitative characteristics of defined list of species for each habitat type according to the depth zonation. So, the monitoring activity follows the assessment scheme. In case of quantitative sampling all species are identified, and biomass determined on species level. Detailed methodology of the monitoring of conservation status of benthic habitats (area and range; structure and function) could be found (in Estonian with English summary): http://nema.bef.ee/wp-content/uploads/2015/01/NEMA-seire-metoodika-aruanne-1.pdf

Latvia (Latvian Institute of Aquatic Ecology): There has been national monitoring of Natura 2000 sites since 2014. It is expected to monitor the site once in the 6 years. As in Latvia hard bottom substrates are rare, the **reef habitats** are monitored including macroalgae and hard bottom zoobenthos species. (Of course, there is also regular monitoring of **pelagic habitats**.)

The Geological Survey of Sweden: Some **monitoring of pollutants and nutrients**; few stations, infrequent (6 years)

Finland (Parks & Wildlife Finland, Finnish Environment Institute): Finland lacks a national monitoring programme for MPA's, marine Natura 2000 sites and HD's marine habitats and species. Certain biotopes (**bladderwrack**, **macrophyte communities**, **blue mussels**) are monitored to some extent in coastal areas. **Soft-bottom macrofauna communitie**s are monitored both in the coastal and open sea areas.

Please, based on your experience, give an example of good practices and methodological challenges when mapping habitats, biotopes and species

German Federal Agency for Nature Conservation: Monitoring of infauna is very well developed and should be based on existing protocols, e.g. HELCOM guidelines including quality assurance. Protocols for monitoring of epibenthic species need to be further developed and the same is the case for biotope mapping. For the letter it is important to have clear rules for scale depending delineations and minimum area. Marine biotope mapping is not possible without spatial predictive modelling, therefore an intersubjectively verifiable documentation with error specification is necessary. Colleagues in the North Sea have done a very good example on best practice (MPA Sylt Outer reef). Unfortunately, it is not published.

Denmark (Ministry of Environment and Food): Challenge is optimizing cost vs. coverage.

Estonia (Estonian Marine Institute): In Estonia there have been more than 90 projects and developed datasets since 2005 which have contributed to the mapping effort of benthic habitats and species. Most recent effort of combining those datasets have been carried out in 2018 (TÜ Eesti mereinstituut, 2018) when the modelling was carried out to cover the whole Estonian marine area. Best example of the good practices of single mapping projects could be drawn from the recent reports of NEMA project:

- Project NEMA. Results of mapping of benthic habitats in marine Natura 2000 sites in Estonian territorial waters (In Estonian with English summary): http://nema.bef.ee/wp-content/uploads/2015/01/NEMA-territoriaalmere-kaardistamise-aruanne.pdf
- Project NEMA. Results of mapping of benthic habitats in selected areas of Estonian EEZ (In Estonian with English summary): http://nema.bef.ee/wp-content/uploads/2015/01/NEMA-majandusvoondi-kaardistamise-aruanne.pdf
- During this project the methodology for monitoring and assessing the structure and function of benthic habitat types was developed. Summary document of the project: http://nema.bef.ee/wp-content/uploads/2015/01/NEMA_web.pdf

Latvia (Latvian Institute of Aquatic Ecology): -

The Geological Survey of Sweden:

- A transition from vector maps to focusing on sample data and raster models/machine learning
- Create high-resolution models using all available data and across a complete area (EEZ, Baltic)
- Generalize (classes) and build aggregates (geometry) from this coherent seamless model
- Build a raster stack with all structuring actors/predictors and all model results to create new models; build environment in high resolution bottom-up from geology, physics, chemistry, habitats and species

The Swedish Agency for Marine and Water Management: lack of high resolution abiotic spatial information of bottom characteristics, particularly in the nearshore section along the Swedish coast.

Results from existing biological sampling are of varying quality and often of unknown accuracy. Discrepancy between interpretations by two individuals on same data.

Kågesten, G.; Fiorentino, D.; Baumgartner, F.; Zillén, L. How Do Continuous High-Resolution Models of Patchy Seabed Habitats Enhance Classification Schemes? *Geosciences* **2019**, *9*, 237. https://www.mdpi.com/2076-3263/9/5/237

Finland (Parks & Wildlife Finland): Our national mapping programme started from scratch and has been quite cost-effective and has given a good base for targeted mapping efforts. Challenges we are still facing: Optimizing mapping cost vs. coverage, restrictions in the usage of depth data (military aspect). Full coverage of mapping is impossible - how many mapping sites do we need for gaining good enough knowledge? Accurate protocols for monitoring need to be further developed (epibenthic species, biotope mapping). The MPA's has been established based on other than underwater marine values - marine nature hot spots are still undiscovered/not protected. In some cases, data collection is planned without taking needs of data end users and the final goals of analysis ect. into account.

Do you have an experience on cross-border co-operation regarding mapping? If yes, what kind of?

German Federal Agency for Nature Conservation: Unfortunately, no.

Denmark (Ministry of Environment and Food): No, not yet.

Estonia (Estonian Marine Institute): No cross-border benthic habitat mapping has been conducted by Estonia so far. At the same time Estonia has been participating in different projects dealing with developing methods for benthic habitat mapping and monitoring ("Marine Protected Areas in the Eastern Baltic Sea" (LIFE Project), "Innovative approaches for marine biodiversity monitoring and assessment of conservation status of nature values in the Baltic Sea" (MARMONI Project); Baltic Sea Pilot Project: Testing new concepts for integrated environmental monitoring of the Baltic Sea (BALSAM) etc.

Latvia (Latvian Institute of Aquatic Ecology): No.

The Geological Survey of Sweden: Interreg project SeamBoth; mapping the whole marine environment including substrates and habitats in the northern Bothnian bay, collaboration between Sweden and Finland. https://seamboth.com/

The Swedish Agency for Marine and Water Management: SeamBoth, SeaGIS.

The Swedish University of Agricultural Science: Kvarken flada.

Finland (Parks & Wildlife Finland): Our teams in Quark area and Bothnian bay are doing/have been doing good cross-border co-operation with Swedish authorities and experts in several projects like SeaGis2, Kvarken flada, SeamBoth. We share quite many habitats and species and deal with same kind of problems and challenges for example with SWE, EE and RUS, and we feel that possible co-operation would benefit us all.

Persons who have provided answers for this questionnaire (contact persons for further questions and inquiries)

Dieter Boedeker, German Federal Agency for Nature Conservation

Gesine Lange, German Federal Agency for Nature Conservation

Marie-Louise Krawack, Ministry of Environment and Food, Denmark

Georg Martin, Estonian Marine Institute

Ingrīda Puriņa, Latvian Institute of Aquatic Ecology

Oscar Törnqvist, The Geological Survey of Sweden

Anna Arnkil, Metsähallitus Parks & Wildlife Finland

Heidi Arponen, Metsähallitus Parks & Wildlife Finland

Joonas Hoikkala, Metsähallitus Parks & Wildlife Finland

Henrik Nygård, Finnish Environment Institute

Angelina Olsson, Swedish Agency for Marine and Water Management

Antonia Nystrom Sandman, AquaBiota Water Research

Anna Westling, Swedish University of Agricultural Science