Baltic Marine Environment Protection Commission

Working Group on the State of the Environment and Nature Conservation

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Background

HELCOM MetDev WP2 on economic and social analyses (ESA) work with conceptional and operational relationships between the marine environment and human welfare. It works to further develop regional methods and results for economic and social analyses to support the holistic assessment of the marine environment by addressing some of the shortcomings and development needs identified in previous regional ESA work.

This document describes MetDev WP 2 tasks B and provides information on the progress on assessment of the ecosystem services approach and marine ecosystem accounting for HOLAS III.

Action requested

The Meeting is invited to consider and endorse the approach for assessing ecosystem services for the HOLAS III assessment to be submitted to HOD 61-2021 for approval.

Assessment of ecosystem services and ecosystem accounting (HELCOM MetDev project)

Overview of MetDev Work Package 2: Economic and Social Analyses

During the MetDev project, links between socio-economic indicators, ecosystem services, ecosystem components and human welfare have been analysed, and related regional methods developed. More specifically, the MetDev project will contribute to Driver-Activity-Pressure-State-Impact-Measures (DAPSIM) cycle by adding improved integration of ESA and environmental assessments along with following activities:

- Task B: Methodology development and initial implementation of the ecosystem services approach by identifying ecosystem service supply areas in cooperation with the analysis of status and the analysis of pressures and impacts on the marine environment,
- Task C: Describing a general approach for ecosystem accounting applicable for the marine environment, and application to the Baltic Sea and providing illustrations of marine ecosystem accounting for specific ecosystem components.

In addition to providing information on state of the environment the HOLAS III assessment, and its economic and social analyses, MetDev WP2 gives important insights to guide further efforts. In general, MetDev WP2 has built on previous HELCOM experiences and economic and social analyses for the State of the Baltic Sea report (HOLAS II), tool developments (TAPAS and SPICE projects, 2016-2018), maritime spatial planning efforts (Pan Baltic Scope project, 2018-2019) and analyses of existing and new measures to support the Baltic Sea Action Plan update (ACTION project and SOM Platform, 2019-2020). It also ties into implementation of the roadmap for continued HELCOM work on ESA.

Besides MetDev, HELCOM BLUES[1] project (2021-2022) supports the work on ecosystem services for HOLAS III through work on estimating the benefits of improvements in environmental estates and ecosystem services in the Baltic Sea.

Methodology development for tasks b) of the HELCOM MetDev project

Ecosystem Service Approach

In order to understand and conceptualize how the marine ecosystem contributes to human well-being, the ecosystem services approach is a commonly used method in environmental policy making and management. This approach can be seen as a way of understanding the complex relationship between nature and humans, to support decision- and policy making with the aim of ensuring a sustainable use of resources (Martin-Ortega et al., 2015).

[1] The "HELCOM Biodiversity, Litter, Underwater noise and Effective regional measures for the Baltic Sea" (HELCOM BLUES) project is led by HELCOM and co-funded by the European Union. More information at https://blues.helcom.fi

Ecosystem services are classified in three categories in Common International Classification of Ecosystem Services (CICES):

- Provisioning (e.g., food provisioning, material, and medical resources)
- Regulating and Maintenance (e.g., filtration and storage of nutrients, storage of hazardous substances, erosion control, nursery habitats, pest control, climate control by photosynthesis or sequestration in sediments)
- Cultural (e.g., recreation through active and passive interactions)

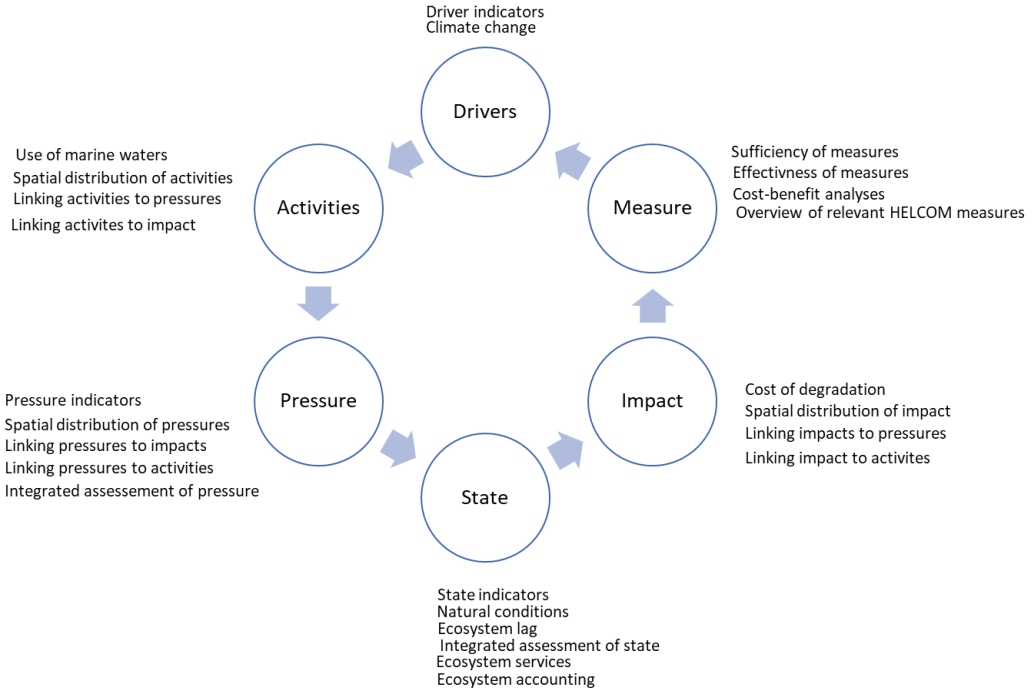

Figure 1. Initial representation of how the various topic planned for inclusion in HOLAS III are divided across the DAPSIM assessment framework. Note the placement of the Ecosystem services and ecosystem accounting as an integral part of the assessment of state.

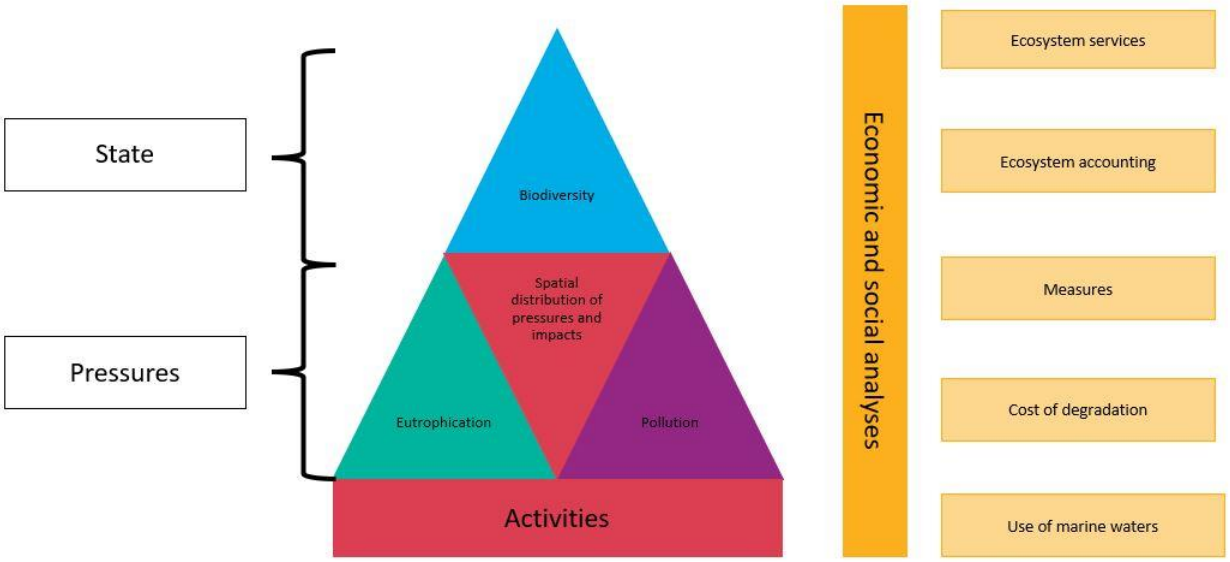

Figure 2. A conceptual representation of the division and internal logic across topics covered by the thematic assessments planned under HOLAS III. In this figure the activities underpin the pressures, which in turn affect the state of biodiversity. The economic and social analyses are by their nature horizontal, with the various aspects under this thematic assessment providing supporting information to each of the topics under the four other thematic assessments. In the figure green indicates topics and the thematic assessment for biodiversity, yellow indicates topics and thematic assessments which focus on pressures and purple indicates topics and the thematic assessment associated with economic and social analyses.

Ecosystem components function as service providers and thus the distribution of ecosystem components can be connected to ecosystem service supply areas. The identification and validation of such ecosystems service supply areas help to illustrate the concrete contribution of the health and status of marine environment to human wellbeing (see figure 1 and 2). In practice this translates to that the presence of one or several components in a given area can function as proxy indicators of an area supplying a given service. These can then be used to calculate the potential capacity of an ecosystem to provide a service (this is referred to as ecosystem service supply capacity).

In other words, we use the spatial information on where ecosystem components exist in the Baltic Sea to understand ecosystem service supply capacity (Figure 3). Later, this information is used in marine ecosystem accounting process to value ecosystem services in order to understand the complex relationship between environment and society.

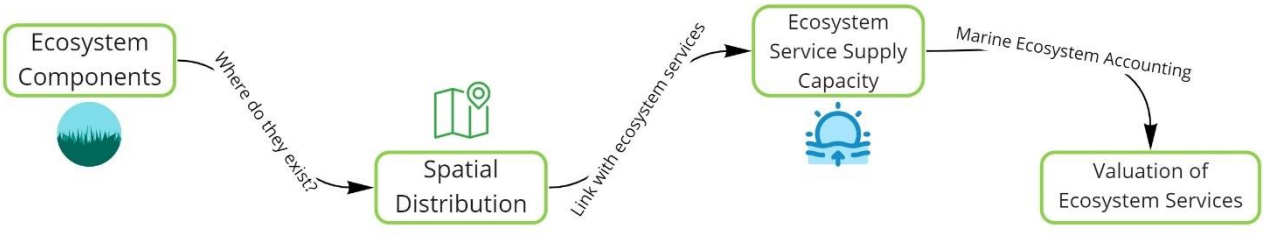

Figure 3: Use of ecosystem components and their spatial distribution in identification of ecosystem service supply capacity and marine ecosystem accounting.

In MetDev WP2, the aim has been to use this framework, develop approaches and collect background information for identifying and assessing marine and coastal ecosystem services for the Baltic Sea to support the third holistic assessment (see Figure 4). Task 2b collected information from existing assessments on the provision and value of Baltic Sea ecosystem services. It has further developed the use of ecosystem services

approach in regional ESA, for use under HOLAS III, through advancing existing information and methods as illustrated in Figure 4.

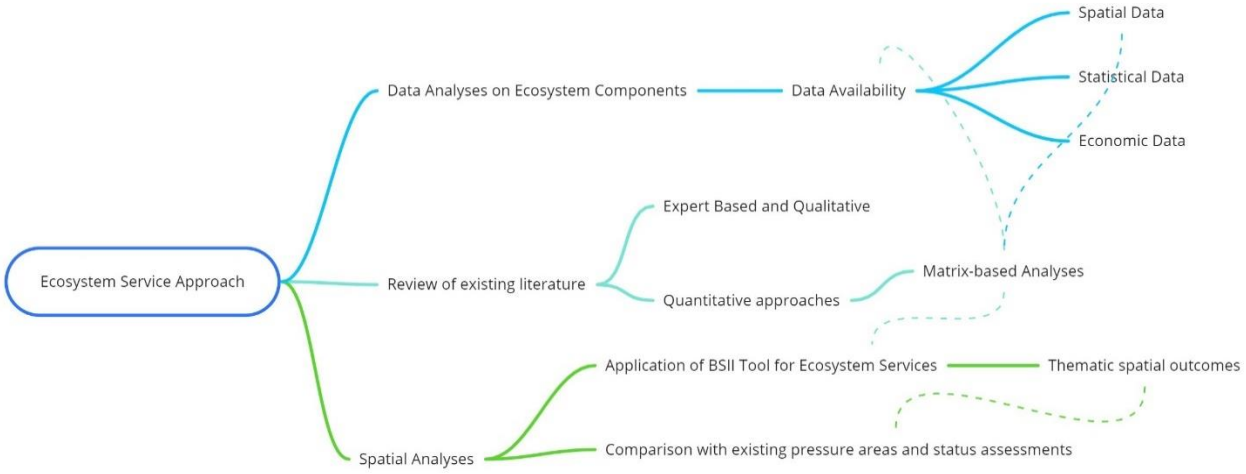

Figure 4: Activity process for initial implementation of the ecosystem services approach by identifying ecosystem services of the marine areas in cooperation with the analysis of status and the analysis of pressures and impacts on the marine environment.

Review of existing literature

As an initial step, it is essential to analyze existing literature and efforts with regards to ecosystem services in the Baltic Sea region, in order to create an overview of different approaches, identify those best suited for regional assessment and develop these further as a part of ESA process in MetDev Project. Therefore, a comprehensive literature review was performed on recent ecosystem service assessment studies in the Baltic region. A similar literature review highlighting important scientific articles on ecosystem services valuation in the Baltic region was recently conducted by Inacio et al., 2020. These two efforts together provided a list of 33 studies available for the region including international examples, taking a variety of approaches, both qualitative and quantitative efforts (Annex Table 1). In addition, these studies approached the topic from different angles, looking at social, monetary, and/or environmental benefits depending on the study in question. Most of these studies analyzed present ecosystem services, with only a smaller subset focused on the past or future status of ecosystem services, mainly with a non-spatial approach. Approximately 30% of the studies were performed on a Baltic Sea region scale, focusing a specific service, with the remaining studies being either local or national in scope. Besides, although there are several assessments available which look at ecosystem service and valuation, the socioeconomic benefits of these services were not clearly discussed. In conclusion, it is acknowledged that, an up-to-date Baltic Sea scale ecosystem service assessment showing spatially explicit ES supply capacity areas is needed. Further, outcomes of this exercise can be used in identification of socioeconomic benefits of these services. Besides regional studies, international approaches and frameworks can be adapted in the Baltic Sea regions. As the baseline of this process, the latest available spatial data should be collected. As it was identified by Inacio et al. (2020), HELCOM plays a central role in terms of data collection and synthesis reporting in the Baltic region and is thus well placed to progress the work.

Spatial Analyses

As it was shown in Figure 3, spatial distribution of components was used to highlight where do they exist. Spatial representation of ecosystem service supply capacity is significant to explain and assess the potential of ecosystem services as a function of ecosystem processes. Spatial analysis allows us to explore complex location-oriented environmental issues, better understand where and what is occurring in the Baltic Sea and

create solutions. As in many examples, spatial distribution of ecosystem components (e.g., distribution maps for species) and maps for important ecosystem areas (e.g., SPAs) is used to understand important areas for high ecosystem service provision.

Mapping ecosystem service supply areas with high quality and updated spatial data during HOLAS III assessment, will lend new perspectives to decision-makers, help to detect and quantify patterns, and highlight the ecosystem service characteristics of Baltic Sea.

Spatial Pressure and Impact Assessment Tool Application for Ecosystem Service Valuation

As a part of Pan Baltic Scope Project, a new version of the decision support tool, Baltic Sea Impact Index (BSII), visualized the relationship between human activity – pressures and pressures – ecosystem components. Following scoping work done in Autumn 2020, it was agreed that this tool should function as the core for the development of a new, expanded tool to assess regional spatial pressures and impacts for HOLAS III. This development is taking place under WP 1 of the MetDev project. In addition to illustrating improved activity-pressure-impact relationship, the development under PanBaltic Scope project also expanded the functionality of the tool to include novel ways of identifying potential ecosystem services supply areas in the Baltic Sea region by using a matrix approach. In that matrix, ecosystem services supply potential was presented spatially utilizing the distribution and density of ecosystem components in the Baltic Sea. Distribution of ecosystem components was shown with absence/presence/density raster data and the supply of the ecosystem services were calculated based on the overlap of the rasters.

It was concluded that the tools initial ES matrix has high potential to spatially identify and value ecosystem services in the Baltic Sea Region and can be further developed and modified as part of WP 2 of the MetDev project. This development was done in close cooperation with WP1 and the work on the new spatial pressures and impacts tool. Based on the initial literature review, several matrix-based methods and scientific articles have been selected to be adapted and included in the development efforts:

- Capacity assessment of marine ecosystems to supply ecosystem services (EEA, 2015)
- Habitat based ecosystem service provision matrix (Potts et al., 2013, Townsend et al.,2018)
- Relative importance of habitats to ecosystem service potential (Geange et al., 2018)
- Multidimensional assessment of ecosystem services by richness and hotspot analyses (Manea et al., 2019)
- Linkage matrix of marine ecosystem services and ecosystem components (Culhane et al., 2018)
- Links between marine ecosystem components, functions, and services (Armoskaite et al., 2020)

According to selected scientific methodologies (Armoskaite et al., 2020, Culhane et al., 2018) and existing Baltic Sea ecosystem service valuation studies (Inacio et al., 2020), ecosystem services typology relevant for the Baltic Sea marine environment was adapted. Next, a binary and unidirectional matrix was developed based on the Baltic Sea ecosystem component classification. This matrix illustrates the relationship between predominant habitats, biotic groups and ecosystem services in the Baltic Sea Region (Annex Table 2). Utilizing this matrix and the underlying available ecosystem component data, ecosystem service supply areas were identified. For HOLAS III the intention is to produce spatial outcomes for general and theme-based distribution of supply areas for ecosystem services.

In practice, SPIA tool for ES use 1km2 grid cells (436375 grid cells in total) as database and calculate the ES supply capacity of each grid based on the relationship of each ecosystem component with given ecosystem services (based on the initial ES matrix produced during Pan Baltic Scope project, Culhane et al., 2018, and Armoskaite et al., 2020). Basically, it calculates the sum of ecosystem component which provides a specific service in a specific grid cell, and it aggregates all results and shows the supply capacity between 0 and 1. Using this methodology, SPIA tool for ES provides several types of maps:

- Assessment layers for each combination of ecosystem service and ecosystem component sub-group,
- Aggregated layers of all ecosystem services within each sub-group,
- A total ecosystem services raster layer.

Data Analyses on Ecosystem Components

As it was identified in the literature review, data quality was an important challenge in the previous Baltic Scale ecosystem service assessments. In order to define precise measures to protect environment, high resolution, reliable and up to date data is essential. Therefore, we performed an available data analysis on ecosystem components starting from HELCOM MADS and external spatial data sources. Although this analysis highlighted current spatial data availability, HELCOM will keep collecting the latest data during HOLAS III period using data calls.

In MetDev WP2, available spatial layers for ecosystem components with the highest data quality were identified to support analyses. In total, 42 different ecosystem components maps were selected to be used in the analysis. Characteristics of these maps were:

- The spatial resolution of the maps is at 1km x 1km, 5km x 5km and Baltic Sea sub-basins scale. Most of the available underlying data is raster based and presents absence/presence. Only abundance and distribution data have degree levels (e.g., cod abundance: low / medium / high).
- Several external data sources were used (EU Sea Map, BIAS, Lund University, HELCOM Red List Assessment, SAMBAH, BITS and literature and national data efforts) in order to fill the spatial data gap. Data quality was classified in the metadata section for each map.
- Previously, some of the spatial layers have been modelled using environmental variables, expert judgement and consultation. Although this decreased the data confidence, it provides a practical solution for data poor situations.

Data requirement to apply ecosystem approach framework in HOLAS III

The preliminary assessment in MetDev WP2 represents a proof-of-concept application of the ecosystem service approach in the Baltic Sea using the available spatial data in HELCOM MADS. In addition to available spatial data (Table 1), strong response to the HOLAS III data call is critically important to secure robust identification of potential ecosystem service supply areas. For some of the ecosystem component layers in HELCOM MADS Data the current resolution is low (5km2) for performing accurate analyses. In the long run increased national efforts to secure observation data on the distribution of ecosystem components would likely have the largest impact to improve the assessment results. For some ecosystem components point presence data has been rescaled to a gridded format (5km^2 raster) in order to be able to include the data in the analyses. This carries with it the risk to significantly overestimate the area of distribution area. Further data filtering effort would be highly beneficial.

Table 1: Ecosystem components used in the Ecosystem Service Supply Areas tool application

Ecosystem Components	
EC_01: Productive surface waters	EC_22: Baltic Esker Islands
EC_02: Oxygenated deep waters	EC_23: Submarine structures made by leaking gas
EC_03: Infralittoral hard bottom	EC_24: Boreal Baltic islets and small islands
EC_04: Infralittoral sand	EC_25: Cod abundance
EC_05: Infralittoral mud	EC_26: Cod spawning area
EC_06: Infralittoral mixed	EC_27: Herring abundance
EC_07: Circalittoral hard bottom	EC_28: Sprat abundance
EC_08: Circalittoral sand	EC_31: Recruitment areas of perch
EC_09: Circalittoral mud	EC_32: Recruitment areas of pikeperch
EC_10: Circalittoral mixed	EC_34: Wintering seabirds
EC_11: Furcellaria lumbricalis	EC_35: Breeding seabird colonies
EC_12: Zostera marina	EC_37: Grey seal abundance
EC_13: Charophytes	EC_39: Harbour seal abundance
EC_14: Mytilus edulis	EC_41: Ringed seal distribution
EC_15: Fucus sp	EC_42: Distribution of harbour porpoise
EC_16: Sandbanks	ES_FH: Spawning areas of cod
EC_17: Estuaries	ES_FH: Spawning areas of herring
EC_18: Mudflats and sandflats	ES_FH: Spawning areas of sprat
EC_19: Coastal lagoons	ES_FH: Spawning areas of European flounder
EC_20: Large shallow inlets and bays	ES_FH: Spawning areas of Baltic flounder
EC_21: Reefs	ES_FH: Recruitment areas of flounders

Ecosystem Services used in this exercise

Based on the spatial distribution of ecosystem components in the Baltic Sea and their relationship with ecosystem services (Figure 5), potential supply areas for the following ecosystem services were identified utilizing the available spatial data. In line with ecosystem service categorization used in the Millennium Ecosystem Assessment, regulatory and maintenance (RM), and cultural (C) ecosystem services were used in the exercise.

Although there are several ecosystem services provided in the Baltic Sea which could be connected to ecosystem components, data availability and selected matrix-based literature (Culhane et al., 2018, Armoskaite et al., 2020) were the main factors while selecting the services. It is worth noting that the ecosystem components used in the proof-of-concept exercise (see Table 1 for an overview of ecosystem components used) have the potential to provide many more ecosystem services than those listed below. Additional services can be linked to the ECs as part of HOLAS III by adding them to the ES matrix.

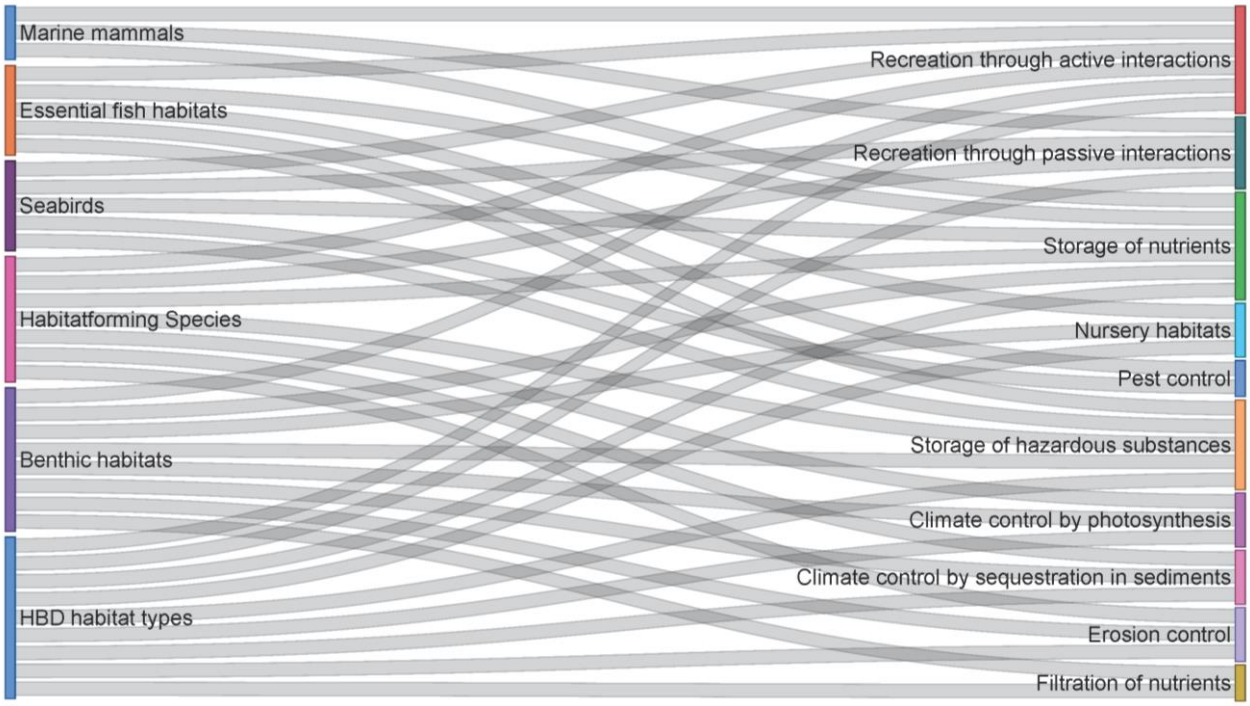

Figure 5: Sankey diagram showing the rspaelationship of ecosystem component groups and ecosystem services based on ecosystem service matrix used in SPIA tool

Filtration of nutrients – RM

Filtration of nutrients refers to absorb and filter nutrients from the water, acting as a natural filtration system. In the Millennium Ecosystem Assessment (MEA, 2005) water purification (including nutrient filtration) are considered benefits obtained by regulating ecosystem processes, which contribute to human wellbeing by securing access to clean water.

Storage of nutrients – RM

Plants are able to take up and store nutrients from the soil as well as from the air, and these nutrients can then form the basis of food chains, to be used by a wide range of other life forms. Nutrient storage ecosystem service supports cleaning of water and mitigates eutrophication, and possibly reduces growth of opportunistic macroalgae and phytoplankton.

Storage of hazardous substances – RM

Consumed or bioturbated, hazardous substances constitute a risk to ecosystem health and function, while decreasing the value of ecosystem services like food for consumption and enjoyment of recreation. Several toxic substances can be found in algae and exposure to these algal toxins can cause illness among humans and animals. Habitat forming species play a major role in water purification, filtering, and storage of hazardous substances.

Erosion control - RM

Erosion control represents a critical ecosystem service provided by the kelp forest and specific benthic habitats and will be increasingly important along many coastlines as the consequences of climate change.

Nursery habitats - RM

Baltic Sea consist of dense underwater seagrass and other algae areas and essential fish habitats which provide shelter for many other organisms, and function as nursery habitats for many coastal fish species.

Pest control - RM

Natural pest control ecosystem service is highly relevant for ensuring food provision (Zulka, 2014). This ecosystem service implies biological control against potential pests and invasive species.

Climate control by photosynthesis – RM

As primary producers, habitat forming species use energy from sun to convert inorganic material to organic matter through photosynthesis and affect the biochemical cycles, therefore regulate the global climate by using CO2.

Climate control by sequestration in sediments - RM

Coastal habitats have been identified as important carbon sinks. Sequestration of carbon in marine sediments provides long-term storage of anthropogenic CO2.

Recreation through active interactions – C

Active recreation is leisure time physical activity undertaken in the coastal and marine areas such as fishing, swimming, or surfing.

Recreation through passive interactions – C

Recreation through passive interactions can be considered as cultural heritage, spiritual enrichment, cognitive development, recreation, and aesthetic experience.

Ecosystem Service Supply Areas by Ecosystem Component Categories

As was explained above in spatial analysis section, the SPIA tool was applied using the latest available spatial data in the Baltic Sea region. 42 ecosystem component distribution maps were classified as belonging to one or several of the following ecosystem component groups: benthic habitats, habitat forming species, essential fish habitats, marine mammals, seabirds, and HBD habitat types. Based on the relationship of each ecosystem component and ecosystem services shown in the tool matrix (Annex Table 2), potential supply areas of listed ecosystem services were identified.

Although initial maps below show areas where the ES supply capacity is high in the Baltic Sea, these results can be further improved using the updated spatial data during HOLAS III. New spatial layers for ecosystem components are expected as a result of the HOLAS III data call.

Total ecosystem service supply

In addition to ecosystem component groups analyses the SPIA tool can produce a total ecosystem service result. The total ecosystem service raster layer considers all ecosystem component categories and each potential ecosystem service in the area (Figure 6). The total ecosystem service supply potential map represents the areas where more ecosystem components overlap. Red areas show higher potential of ecosystem service supply and blue areas show low potential of ecosystem service supply. Initial results show that coastline of Germany, Sweden, Denmark, and Estonia has the highest potential for total ecosystem service supply.

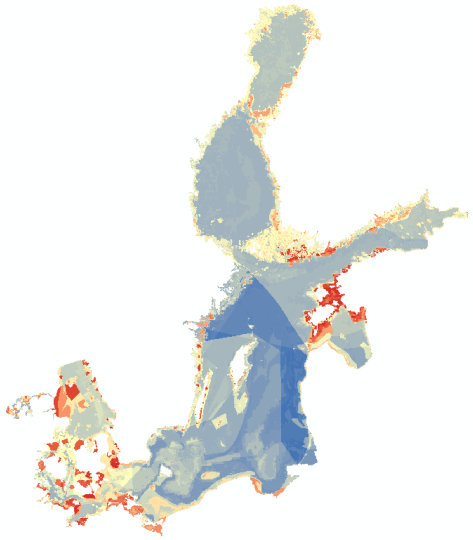

Figure 6: Potential ecosystem service supply areas in the Baltic Sea considering distribution of ecosystem components.

Benthic habitats

In general, benthic habitats provide a diverse set of ecosystem services, such as filtration of nutrients, storage of nutrients, storage of hazardous substances, erosion control, nursery habitats, climate control by photosynthesis, climate control by sequestration in sediments, recreation through active interactions. Benthic habitats generally provide more ecosystems services closer to coastline and in shallow waters, compared to offshore areas and deeper waters (Galparsoro et al., 2014). This change is likely to be explained by vegetation areas in infralittoral zone and lack of scientific knowledge for most of the services provided by distant benthic habitats.

Results show that this is the case also in the Baltic Sea where ecosystem services provided by benthic habitats mainly occur in the shallow coastal areas (Figure 7). This high potential ES supply areas can be seen off the coastlines of all Baltic Sea countries. In addition, countries with archipelago areas, such as Finland, show higher potential due to longer coastlines. These areas can be significantly important for important ecosystem services such as nursery habitat areas, which allow the occurrence of related biotic groups and other ecosystem components.

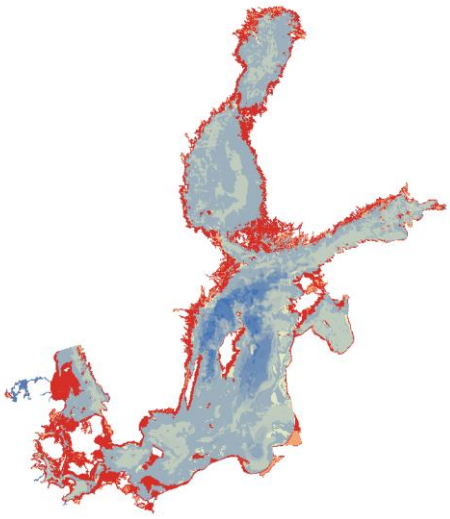

Figure 7: Potential ecosystem services supply areas provided by benthic habitats.

Habitat forming Species

The habitat forming species ecosystem component group consists of the distribution of *Furcellaria lumbricalis* (red algae), *Zostera marina* (seagrass), Charophytes (freshwater green algae), *Mytilus edulis* (blue mussel), and Fucus (brown algae). These ecosystem components are critical for ecosystem function and provide potential supply areas for essential ecosystem services such as: storage of nutrients, storage of hazardous substances, erosion control, climate control by photosynthesis, climate control by sequestration in sediments, recreation through both active and passive interactions.

For instance, *Zostera marina* provides important supply areas for most of above-mentioned services by sequestering carbon through photosynthesis. In addition, the habitat forming species provides important fish habitats, which enable other, secondary, ecosystem services to occur. According to the results, habitat forming species are mainly occurring on the eastern coast of Sweden, southern coast of Finland and coast of Estonia (Figure 8).

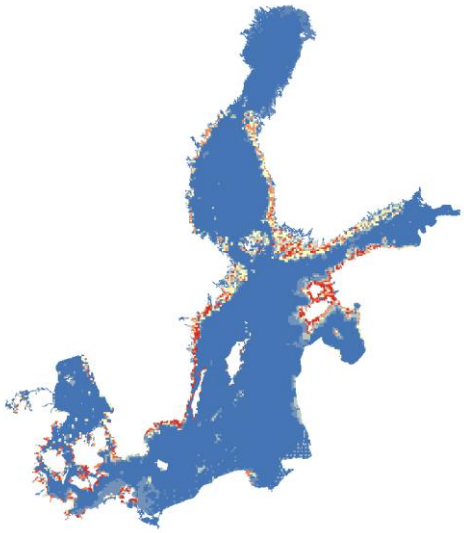

Figure 8: Potential ecosystem services supply areas provided by habitat forming species.

Essential fish habitats

In this category, essential fish habitats in the Baltic Sea Region were analysed to understand potential supply areas for storage of nutrients, storage of hazardous substances, nursery habitats, pest control, and recreation through active interactions ecosystem services. These habitats represent spawning areas of cod, herring, sprat, European flounder and Baltic flounder, and recruitment areas of flounders, perch, and pikeperch. These spatial layers recently became available and have been used for the first time in the potential ecosystem services supply identification. Results show that these areas of high potential supply can primarily be found in the southern Baltic Sea, mainly in the offshore areas (Figure 9).

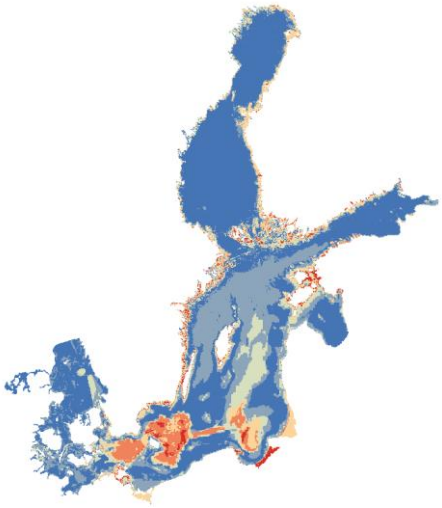

Figure 9: Potential ecosystem services supply areas provided by essential fish habitats.

Important areas for seabirds

Seabird wintering and breeding areas provide several ecosystem services, such as storage of nutrients, storage of hazardous substances, pest control, recreation through active interactions, and recreation through passive interactions. Due to lack of observation data, seabird wintering and breeding areas were identified based on special protection areas (SPAs). The areas of high potential supply are mainly in the southwest and northeast coast of the Baltic Sea (Figure 10).

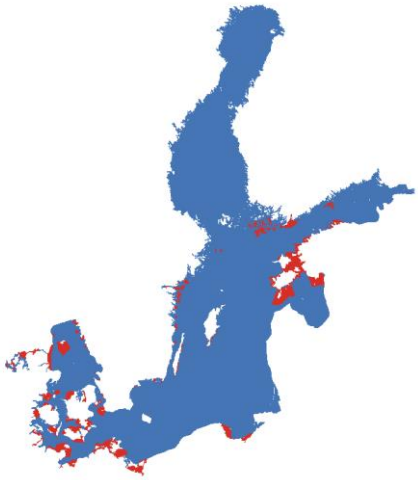

Figure 10: Ecosystem services supply areas provided by important areas for seabirds (SPAs).

Important areas for Marine mammals

Important areas for marine mammals were used to identify potential supple areas of storage of nutrients, recreation through active interactions, and recreation through passive interactions ecosystem services. Although the spatial information of these areas was used in the calculation, data quality was low and available data was based on expert opinion. The most important areas for ecosystem service supply linked to marine mammals occur in the southwest of the Baltic Sea (Figure 11).

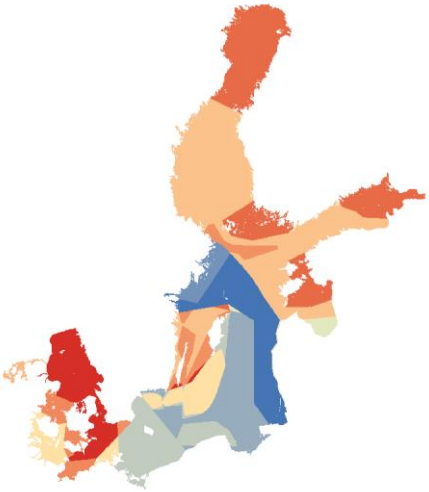

Figure 11: Ecosystem services supply areas provided by marine mammals.

Habitats Directive habitat types

HBD habitat types are composed of sandbanks, estuaries, mudflats, lagoons, inlets and bays, reefs, esker islands, submarine structures, and islands. These areas provide potential supply areas of filtration of nutrients, storage of nutrients, storage of hazardous substances, erosion control, nursery habitats, climate control by photosynthesis, climate control by sequestration in sediments, and recreation through active and passive interactions. They are mainly located in the east of Sweden and south of Finland (Figure 12).

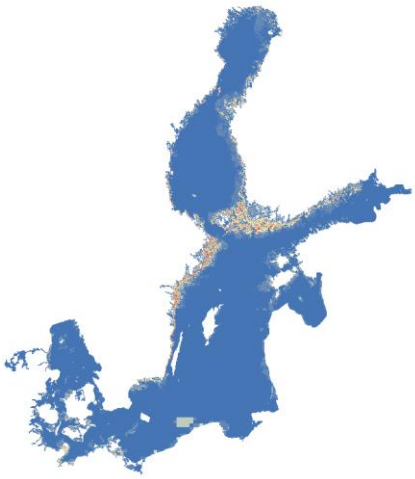

Figure 12: Ecosystem services supply areas provided by EU Habitats Directive habitat types.

Pressures on the important ecosystem service supply areas

Human activities-based pressures have a particular influence on ecosystem service provision. Identifying main pressures in the ecosystem service supply areas can help to define concrete measures and support ecosystem-based management in the Baltic Sea. During HOLAS III assessment, updated pressure areas will be used to analyse ecosystem service supply areas, and risk areas for ecosystem service provision will be identified.

Using the batch tool (a function of the tool which combines pressure assessment and ES supply capacity assessment) provided with SPIA tool, a Baltic Sea impact assessment was applied with respect to areas identified as important for the provision of ecosystem services. Results address either each combination of ecosystem service or ecosystem component sub-group, following the same structure as in the ES tools, respectively.

Since the proposal is that the latest version of SPIA tool using the latest available pressure and ecosystem component layers will be used during HOLAS III, these results will naturally be updated in HOLAS III process and are presented here as a proof of concept illustrating what type of spatial results can be produced using the method. Figure 13 shows an illustration of areas of potential high pressure which overlap with important ecosystem service supply areas. In addition, the “calculate the matrix” feature of now available in SPIA, allows the user to identify type and number of pressures.

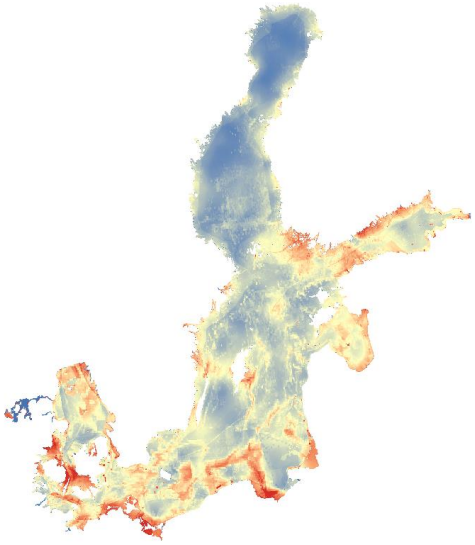

Figure 13: Pressure areas in the important areas for the provision of nursey habitat ecosystem service provided by benthic habitats.

Expected MetDev WP2 task 2 outputs by end of 2021

- Advancement of an ecosystem services typology relevant for the Baltic Sea marine environment using existing scientific practices
- Development of a unidirectional matrix-based method to illustrate the relationship between ecosystem components and ecosystem services
- Application of ecosystem service valuation tool with the most recent data available for the ecosystem components
- Spatial outcomes for general and theme-based distribution of supply areas for ecosystem services provision and pressure areas in the important ecosystem service provision areas.

Overview of progress on Work Plan

In line with the information in this document and the planned tasks for the remining part of 2021 it is foreseen that the full work plan will be implemented by the end of the project. The majority of the tasks, including tool application, marine ecosystem accounting pilot application and analyses of the results is planned for the second half of 2021.

- **Table 2: Summary of progress and timeline for tasks in WP2 activity**

Task	Work ongoing	Planned schedule for task
Review of existing literature on ecosystem service valuation studies	Done	Q1/21
Data availability analyses and identification of data requirement	Done	Q1/21 – Q2/21
Tool application to identify supply capacity of ecosystem services	Done	Q2/21 – Q3/21
Preparation of thematic and spatial results for ecosystem service supply capacity	Done	Q3/21
Improvement of results by using new available spatial data for ecosystem components and pressures	x	Q4/21
Comparison analyses for ecosystem services, pressure areas and environmental status assessments	x	Q4/21

Gaps and barriers identified as part of the work

- Ecosystem service supply capacity was identified based on component-service relationship. This relationship in the ES matrix can be improved by Including ecosystem functions (e.g., primary production) between components and services.
- Although ecosystem service supply capacity maps can be produced using the spatial distribution, ecosystem service valuation requires more specific information regarding ecosystem condition and functions.
- Lack of high spatial resolution distribution data decreased the quality of the results. Several spatial data layers are based on modelling efforts and over-estimated. Using available environmental parameters, data filtering should be performed, and new results should be validated by experts.
- Layers for some spatial layers (e.g., marine mammals) are based on expert opinion / participatory mapping and very skeptical. Enhanced monitoring effort in Baltic Sea scale is required to have observation-based maps. Besides, new data layers should be included for important areas for seabirds.
- Large scale representation of ecosystem service supply capacity can help to understand the density of important ecosystem components providing services, however, pilot studies in data rich areas can give more accurate results.

Use in HOLAS III and presentation of results

The HOLAS III assessment will be the first-time ecosystem services are concretely included in a HELCOM assessment. The intention is to include ecosystem services as topical part of the thematic assessment of Economic and Social Analyses, as well as incorporate results and information horizontally into the relevant chapters of the State of the Baltic Sea report (see Figure 14).

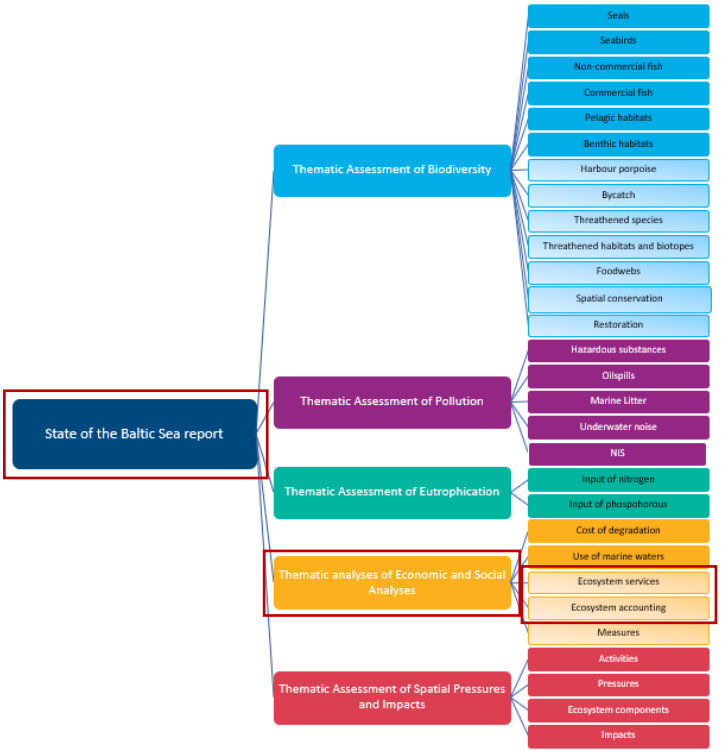

Figure 14: State of Baltic Sea report and corresponding thematic assessments. Ecosystem services are included in thematic analyses of Economic and Social Analyses.

Results are planned to be used in HOLAS III to provide contextual information, strengthening the links across different parts of the DAPSIM cycle and to improve the holistic approach which is the ultimate aim of the assessment (Figure 15). The information is intended to be presented both topically, explaining the

relevance and linkages of the services with other topics under HOLAS III, as well as spatially, showing the distribution of supply areas for ecosystem services. These are intended for use in the HOLAS III process by:

- Performing an expert-based validation analyses to MetDev spatial outcomes using workshops and participatory mapping
- Produce updated and improved spatial distribution of ES maps incorporating the latest available spatial data for ecosystem components and pressures by applying the SPIA tool for spatial distribution ES supply areas.
- Cross-referencing ecosystem service provision areas with other assessment such as pressure areas and status assessments
- Analysis of statistical information achieved by SPIA tool application for pressure sources in the important ecosystem service provision areas
- Identifying and where possible illustrate the relationship of ecosystem services with other DAPSIM framework components such as pressures and human activities.

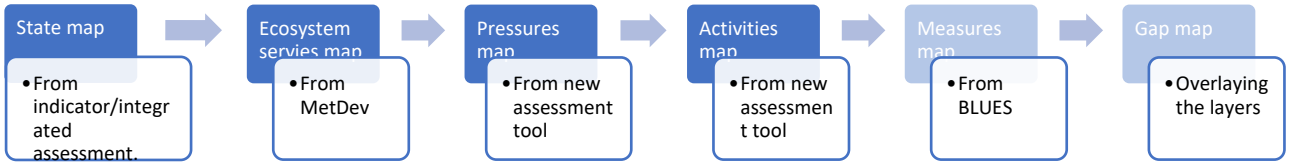

Figure 15: Potential integration and combination of output maps from thematic assessments during HOLAS III assessment.

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