BONUS MARES[1]

Multi-method Assessment for Resilient Ecosystem Services and human-nature system integration

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Deliverable 4.8-4.9

MARES geospatial decision support tool-kit methodology and user guide for knowledge transfer on ecosystem services and their resilience under different future scenarios

Joint deliverable for

D4.8 MARES tool-kit: methodology and user guide

D4.9 Report on the implementation of the geospatial decision support tool to be used among project participants and stakeholders for transferring knowledge and data related to ecosystem services and their resilience under different future scenarios[2]

Dr. Jonne Kotta, UTARTU
Marjo Maidell and Maurizio Sajeva, Pellervo Economic Research PTT

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[2] The two original deliverables D4.8 and D4.9 have been joined because the second contains the first, to realise a solid description of the MARES geoportal development, consisting of the background and purpose, its contents and functionalities, testing and further improvements

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Heini	*Ahtiainen*
Juris	*Aigars*
Naufal	*Alimov*
Georgios	*Angelakis*
Robert	*Aps*
Christine	*Bertram*
Wouter	*Blankestijn*
Riccardo Giuseppe	*Boschetto*
Mats	*Godenhielm*
Melanie	*Heckwolf*
Paula	*Horne*
Christiaan	*Hummel*
Henning Sten	*Hansen*
Herman	*Hummel*
Tanel	*Ilmjärv*
Eduard	*Interwies*
Susanna	*Jernberg*
Kaisa	*Karttunen*
Kristin	*Kuhn*
Tin-Yu	*Lai*
Mark	*Lemon*
Anu	*Lähteenmäki-Uutela*
Kimmo	*Mäkilä*
Fiona	*Nevzati*
Marina	*Orlova*
Stina	*Powell*
Thorsten	*Reusch*
Anda	*Ruskule*
Anni	*Savikurki*
Lise	*Schroeder*
Meelis	*Sirendi*
Paul	*Tuda*
Vassiliki	*Vassilopoulou*
Adam	*Wozniczka*

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1 Preface

Ecosystem services are defined here as natural ecosystems' assets and processes – either economic or non-economic – that are direct or indirect source of wellbeing and satisfaction of material or immaterial human needs for present and future generations. Ecosystem services refer to the numerous benefits that humans derive from ecosystems (Danley and Widmark, 2016).

Supporting, provisioning and regulating services create a foundation for socio-economic benefits that people derive from the functioning ecosystems, including recreational, cultural and aesthetic values. In light of the current global ecological crisis (Brand et al., 2020) there is an ever-increasing need to value, highlight and better communicate how ecosystems support human well-being and identify which management practices and policies can help us reach the Sustainable Development Goals (SDGs). In WP3, BONUS MARES has introduced a definition of ecosystem services as '*natural ecosystems' assets and processes – either economic or non-economic – that are direct or indirect source of wellbeing and satisfaction of material or immaterial human needs for present and future generations'.*

To support innovative ideas and help the ocean economy transformation towards a greener future, it is essential to quantify, value, and map current ecosystem services and their relationships to human well-being. Within the BONUS MARES project, we systematically quantified the coastal ecosystem services of the Baltic Sea from three key habitats: macroalgae, mussel beds, and seagrass from the published scientific literature.

Under WP3 a general review of ecosystem services valuation methods has been performed and a process of social learning about possible combinations of methods, both economic and non-economic, discussed with experts. Under work-package 4 we realised a user-friendly web-platform for dissemination and communication, including a geo-spatial representation of the heterogeneity of the knowledge of ecosystem services produced by the three habitats and the impacts produced on these services by multitude human activities including climate change.

In addition to the systematic quantification of ecosystem services from the scientific literature, we need to quantify other relevant information from non-academic sources. The geo-spatial decision support tool provides such functionality by enabling a collection of valuable information from various stakeholders in order to develop better methodological basis (e.g. combination of different methods, economic and non-economic) on the integrated assessment and valuation of ecosystem services along different dimensions (natural, economic, human, social), referring to the approach of the Five Capitals Model of Sustainability (Forum for the Future 2020). Thus, using a multi-criteria approach and a systematic holistic assessment across multiple dimensions —the *Eco-GAME*—, the geo-spatial

representation tool supports evaluation of integrated methodological approaches, which can complement ecological knowledge with economic aspects in support to decision-making.

The incorporation and aggregation of the various tasks contained in the different work-packages, into the web-based geospatial (GIS) decision support tool project realises the BONUS MARES primary goal to *'perform a meta-evaluation for the observation and monitoring of ecosystem services of the Baltic Sea region and an analysis of the strength of science-policy interaction'*. The GIS support tool consists of dynamically linked databases, an analysis engine, and a portal for the systematic geo-spatial representation and synthesis of the interactions that exist between different ecosystem services and human systems. The support tool also communicates the impacts of possible future scenarios on these services and suggests best practices for assessing ecosystem services. Moreover, the geoportal represents a user-friendly platform for dissemination and communication for the use of stakeholders, policy makers, scientists and the general public. In order to allow the research community and the stakeholders to make use of the MARES *Eco-GAME* meta-evaluation tool for future applications, the GIS-portal will be maintained and updated beyond the duration of this research project by the use of UTARTU internal resources.

In this report, we combine project deliverable 4.8 and 4.9 and give an instructional overview of the interactive geospatial decision support tool (D4.8), included in the more general geoportal development (D4.9). This combination provides a solid description of the MARES geoportal development, consisting of the background and purpose, its contents and functionalities, testing and further improvements.

The present first version of the MARES geoportal will continue to be developed and improved based on the suggestions made during this project and on the continuous participation and improvement.

The geoportal will be used as a basis for the development already planned for the MAREA project (*From MARine Ecosystem Accounting to integrated governance for sustainable planning of marine and coastal areas*), already funded by the Interreg Central Baltic programme, which is just starting in this month of June 2020.

2 The geospatial (GIS) decision support tool in MARES

The MARES geoportal currently includes two main sections. First section, namely "Literature review", summarises the results from the systematic, scientific literature analysis implemented during the MARES work package 2 (WP2). It presents the level of economic, natural, human and social knowledge associated with selected three habitats and the ecosystem services that they produce, at regional level. This method was chosen because of its strength in collecting secondary data, as well as critically

appraise and synthesize research studies. This synthesis enables linking the existing assessment of ecosystem services to economic research and policy-making on environmental management and suggests potential approaches for future research.

The second section of the MARES geoportal contains the participatory dynamic framework, developed for the collection of expert knowledge on ecosystem service valuation methods. As the systematic literature analysis has focused on peer-reviewed scientific publications, much relevant knowledge contained in non-peer-reviewed material, reports or policy documents, is missing. However, it was remarked how even if non-peer-reviewed, this knowledge could be reliable enough. Therefore, the MARES tool-kit is planned to gather all this other kind of knowledge as well, mentioning the source.

The BONUS MARES bottom-up approach has searched for knowledge, which links habitats to final services. Therefore, much of the existing knowledge limited to the economic (monetary and non-monetary) valuation of ecosystem services and that does not refer to the selected habitats was not included. The intention of the MARES geo spatial tool-kit is to stimulate contributions that would combine different methods, in order to increase the reliability and qualitative level of evaluations (both ecological, biophysical and economic). Therefore, even in the absence of linkages methods can be proposed and recalled then in the future in order to be possibly combined with other methods for specific purposes.

The systematic literature analysis performed has been carried out by the *Eco-GAME* framework (Sajeva et al. 2020), for the meta-evaluation of existing non-economic knowledge in WP2, by systematic literature analysis and of economic knowledge in WP3, through a participatory expert meeting and a Simulation Laboratory is explained in more detail in Deliverable 3.2. and recalled in the next section for the MARES tool-kit user guide.

The spatial representation, combined with appropriate meta-information, clarifies the multifaceted spatially-explicit knowledge on the studied ecosystem services, as well as their cumulative threats. Moreover, the outcomes that involve habitats, services produced, and interactions can be spatially analysed for specific selected regions, such as, for instance the Helcom regions (e.g. the Gulf of Finland). These possibilities for spatial analysis give the MARES geospatial decision tool-kit a strategic function for informing decision-making about the trade-offs in marine policy and spatial planning.

3 MARES GIS tool-kit and user-guide

This user guide explains the main functions of the MARES tool-kit. This is composed by two sections:

1. the first section is meant for consultation about existing non economic knowledge on three selected habitats—submerged vegetation, seagrass beds and mussel reefs—and on ecological functions and ecosystem services these generate.
2. the second section is meant for dynamic interaction about methods or combinations of methods, which can be proposed for improving the quality of methods, also by their combinations, in order to transfer knowledge for decision making

3.1 The *Eco-GAME* framework: instruction to use

Both sections of the MARES GIS decision support tool take advantage of the *Eco-GAME* meta-evaluation framework (Sajeva et al 2020), referring to the Five Capitals Model of the Forum for the Future (2020): Natural, Social, Human, and Economic (Table 1).

Table 1. Description of four capital dimensions and fields of science involved.

Capital dimension	Fields of science involved/experts/actors	Aim
Natural	Natural science, biology, ecology, environmental accounting, Life Cycle Assessment (LCA)	Natural systems' sustainability, knowledge transfer about ecosystems and their functions.
Human	Sociology, anthropology, food science, security and food security, health science, psychology, occupational health, equality and gender studies, labour and civil rights (representative of citizens and workers, unions), non-profit health or human relevant international organizations, or NGO	Meeting most important human needs and capabilities
Social	Administrators and rulers, representing and interpreting societal and political aims	Representation of societal aims by formal and informal institutions
Economic	Ecosystem services valuation, integrated multi-dimensional sustainability assessments	Translating knowledge on human needs and ecosystem-related information for the use of decision-making

GAME stands for Governance Assessment Matrix Exercise (Sajeva 2016), an evaluation framework for governance for sustainability and social learning that has been further developed and adapted to realise the *Eco-GAME* for the meta-evaluation of methods for the appreciation of ecosystem services.

The *Eco-GAME* meta-evaluation is based on expert educated input, based on accredited sources of knowledge. The Eco-GAME matrix scores range from 0 (knowledge gap) to 7 (identification of a future vision and a policy to reach UN Sustainable Development Goals). The meta-evaluation is performed for four capital dimensions: Natural, Human, Social and Economic (Forum for the Future 2020), described in detail in Table 1.

Table 2. The attributes and levels of Eco-GAME (Sajeva et al 2020)

Eco-GAME levels of science relevance for SDGs-based decision-making			
Level of knowledge relevance		**Example**	**Score Xi**
Human-nature system integration: analysis effectiveness for policy purposes according to SDGs	The analysis produces metrics to practically and effectively assess performances related to UN Sustainable Development Goals (SDGs)	The analysis can effectively provide multi-dimensional evaluations for local employment, gender equality, health, well-being or environmental health deriving from fisheries activities, directly referred to SDGs	**7**
Dynamic multi-dimensional interaction	The analysis assesses systemic impacts of ecosystem services across economic, human, social and natural dimensions (please, check the dimensions concerned)	The analysis can assess the revenue generated by fish markets and the improvements in population health, security or well-being (measurable impact).	**6**
Forecasting	The analysis forecasts future systemic impacts of ecosystem services	The analysis can forecast the state of health of the ecosystem in terms of fish population and/or the generated well-being (e.g. increased employment) in the long run	**5**
Dynamic uni-dimensional interaction	The analysis assesses interactions between parts of the ecosystem/service within one dimension	The analysis can assess the revenue generated in the fish market.	**4**
Static quantitative	The analysis assesses quantitative aspects of ecosystem services	The analysis can tell us quantity of fish or give fish a value, for instance through price	**3**
Static qualitative	The analysis provides qualitative assessment of ecosystem services	The analysis is suitable to discover the species of fishes or provides uncountable valuations (high or low value)	**2**
Discovering knowledge	The analysis allows to discover knowledge	A method reveals the presence of fish	**1**
Not applicable	The methodology is unsuitable to the purpose	A method is not suitable for telling us whether there are fishes or not in the sea	**0**

Please note that, for the current version of the geoportal, assigning a given attribute automatically implies matching also the lower attributes.

The framework (see Table 2) associate attributes that describe the quality of the method, in the same way as a competency matrix, to scores.

For the first phase, experts scored from 0 - 7 how the studied ecological processes translated into ecosystem services (Fig. 4 in the next section). For this phase, the systematic literature analysis is considered as the most effective, and can be updated in the future by further rounds on missing literature.

However, for the second phase, a participatory and referred expert elicitation, that include non peer-reviewed, but still reliable knowledge, has been considered key to assess methods or their combination in support to decision-making.

3.2 Section 1 - Consultation about existing information

The first section provides quantifiable input data which can be consulted and used for the participatory interaction that takes place in the second. On the main page of the geoportal (http://www.sea.ee/esq/review/main) all MARES data can be found and queried.

The current geoportal data layer includes information from published scientific literature, derived from quantitative, statistical methods commonly used in natural sciences, apprised by systematic literature review (657 scientific publications from the Baltic Sea area) and fulfilling a number of criteria (Figure 1):

(1) Location: studies were carried out in the Baltic Sea, Skagerrak or Kattegat

(2) Object of investigation: mussel beds, seagrass or macroalgae

(3) Type of data: original data (e.g., experimental, observational or modelling but no reviews) and

(4) Nature of consequence or implication searched for: addressed ecosystem services or climate change effects on the target ecosystems.

MARES tool-kit bottom-up approach

The identification of ecosystem services does not refer to existing classification systems. It follows a free approach of science integration of all services and functions directly or indirectly relevant for human well-being and primarily basic more objective human needs, according to the definition provided in section 1, the capitals considered (see Table 1) and the Sustainable Development Goals (SDGs).

For the consultation, three filters can be specified: the geographic basin of interest (one or multiple) in the Baltic Sea based on HELCOM divisions; ecosystem and type of ecosystem service of interest.

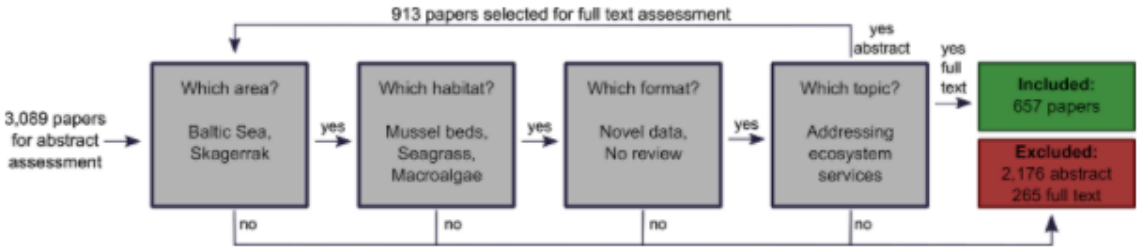

Figure 1: Workflow of systematic literature evaluation. *The decision flowchart displays the four criteria used during abstract and full text assessment for filtering papers relevant to our objectives.*

Example: in Figure 2 we have selected the Gulf of Finland as a study basin (selected study region borders become dark red), and we inquire information about regulating & maintenance ecosystem services of macroalgae. These three filters: basins(s), habitat(s), and ecosystem services in any desired combination allow the user to filter data across various ecosystems and coastal regions of the Baltic Sea.

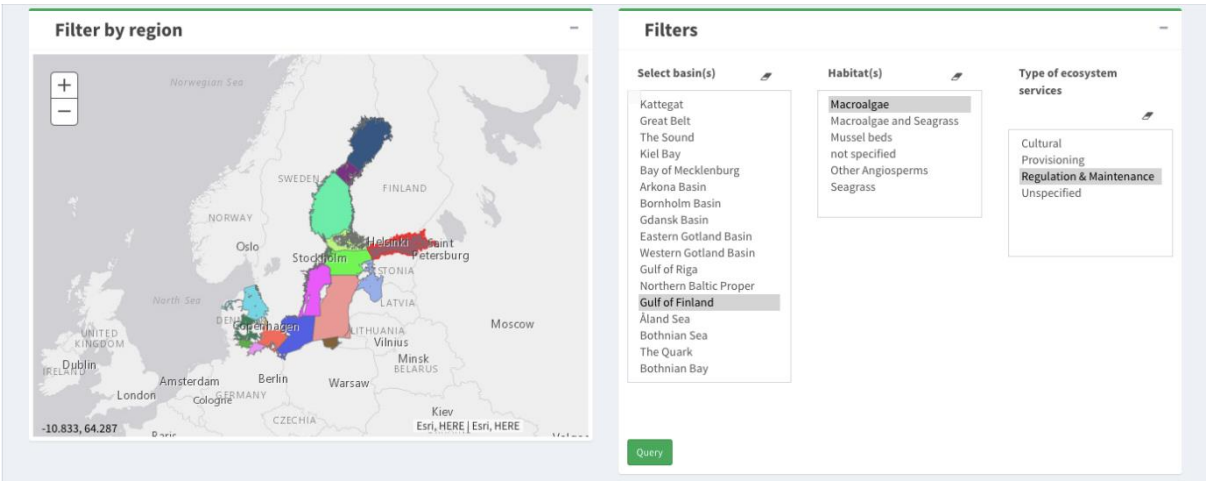

Figure 2. Geoportal main page with filters by the Gulf of Finland; Macroalgae and Regulating & Maintenance ecosystem services. All possible sub-categories of each three filters were outlined in full: Basins (n=17); Habitats (n=6); Ecosystem service (n=4)

When querying the results, the geoportal will display *Eco-GAME* matrix results about the current state of knowledge of the user selected ecosystem services/habitats/regions as well as knowledge transfer of ecosystem services through the four value dimensions. The user can also easily view, access, and download raw data (CSV or Excel) associated with predefined filtering criteria. First graph illustrates the current knowledge on different ecosystem services along different dimensions (Figure 3). The user can visualise the *Eco-GAME* scores as displayed in an aggregated (Economic, Natural, Human and Social for each selected ecosystem services (left-hand side of Figure 3) or in non-aggregated form by individual scoring circles (0-7) (Figure 4).

In the used example, Eco-GAME revealed good quantitative information about how ecosystems generated the service, but limited knowledge on how this function translates into socio-economic benefits.

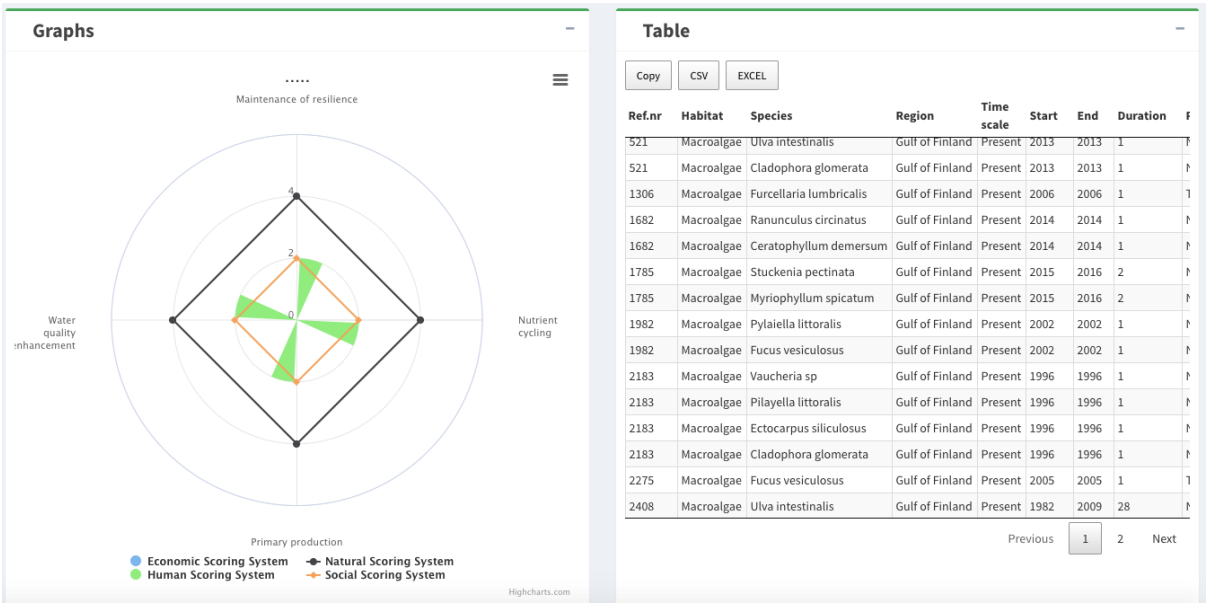

Figure 3. Eco-GAME matrix scores through four value dimensions (left) and raw data collected through the systematic literature review (right).

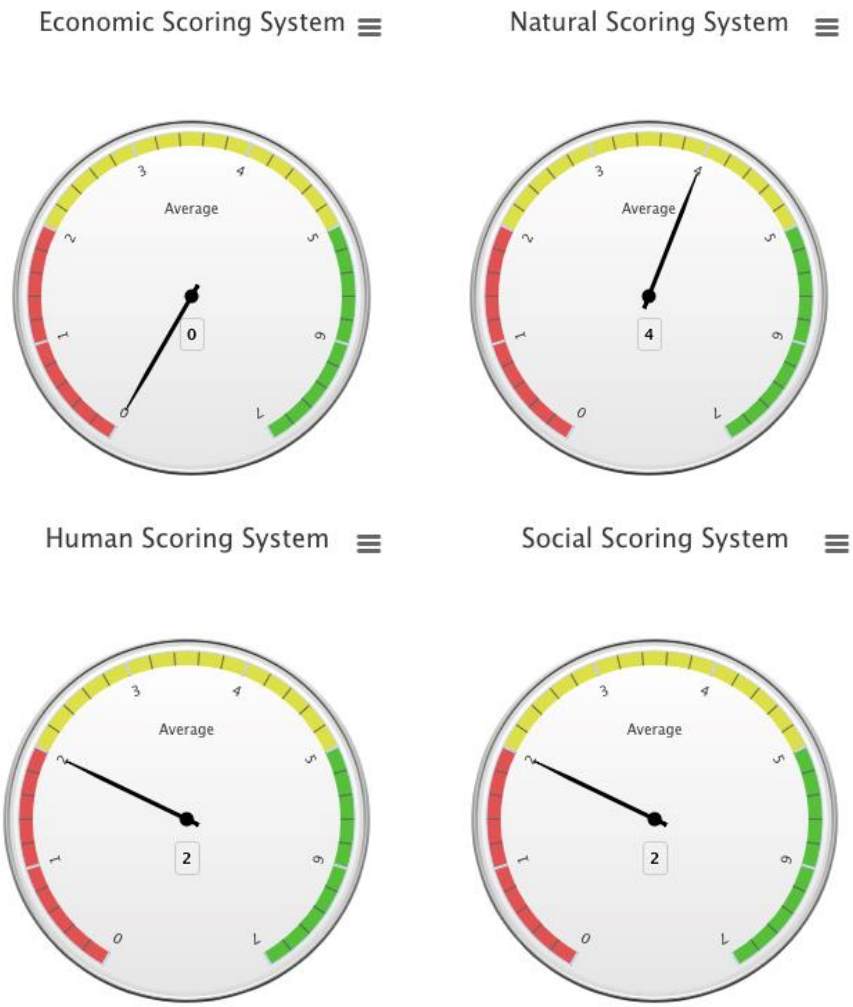

Figure 4. An alternative version to display Eco-GAME matric value dimensions (natural, social, human, and economic) based on expert opinion on the scale of 0-7.

3.2.1 Communication of threats and pressures to the Baltic Sea environment

Another valuable output that is not visually displayed through Eco-GAME scores but can be found in the downloadable raw data table (right-hand side of Fig. 3) is information related to pressures. This is, for instance, represented by the total of 38 pressures that were assessed concerning ecosystem services a systematic literature review, including both direct (e.g., boating / physical disturbance) or indirect (e.g., acidification, warming) anthropogenic pressures that impacted or are expected to impact the ecosystem services.

The geo portal currently shows assessments of approximately 63% of the total number of ecosystem services detected in the Baltic Sea. The most commonly addressed pressures and their interacting effects in the context of coastal ecosystem services in the Baltic Sea environment were toxins, nutrients, and the changes in salinity and temperature under future climate conditions. It is important to note that the most recurrent assessed pressures might not necessarily represent the most severe threats to coastal ecosystems and their services. Information about the negative impacts of pressures on ecosystems and services they provide in the Baltic Sea region can help to guide greener management actions and reduce harmful impacts where necessary.

3.3 Section 2 – Expert elicitation on integrated evaluation (and valuation) methodologies

The *Eco-GAME* framework applied to the first section put in evidence that ecosystem service valuation methods are complementary to other assessments (e.g. on the status of ecosystem components). In order to improve the *Eco-GAME* performances, a web dynamic and participatory interface has been developed (http://www.sea.ee/esq/participatory/tool) in a second section.

Users are invited to 'play' their own *Eco-GAME*, by inserting knowledge about ecosystem services and related valuation method(s) or their combinations, as well as the level of knowledge achieved. Users can assess 'type' and 'amount' of information methods or their combinations (economic or non-economic) are able to deliver about an ecosystem service in a particular area.

To play the *Eco-GAME* follow the steps to are listed hereafter:

1. Specify the knowledge about the ecosystem service in the interactive form (e.g. ecosystem service, habitat, species, region).
2. Click on the green 'plus' icon to pick up one or more methods from the existing lists, according to the different capital dimensions. This functionality allows to combine methods and add multi-dimensionality. In case you would like to propose a method, which is not listed, provide a separate description for it.
3. Provide a reference to the knowledge, e.g. a piece of academic or practical literature.

4. For the selected combination of ecosystem service and method(s), provide your assessment according to the *Eco-GAME* scores (see Table 1) along four dimensions (see Table 2) on the basis of referred/supported evidence (publication or research done).
5. Submit the inserted data by clicking "Add feedback".

In the earlier versions of the geoportal expert knowledge could be inserted also on the interlinkages of the ecosystem services and relationships between different pressures and ecosystem services – these features have however been removed from the current version of the geoportal and returned to the development phase.

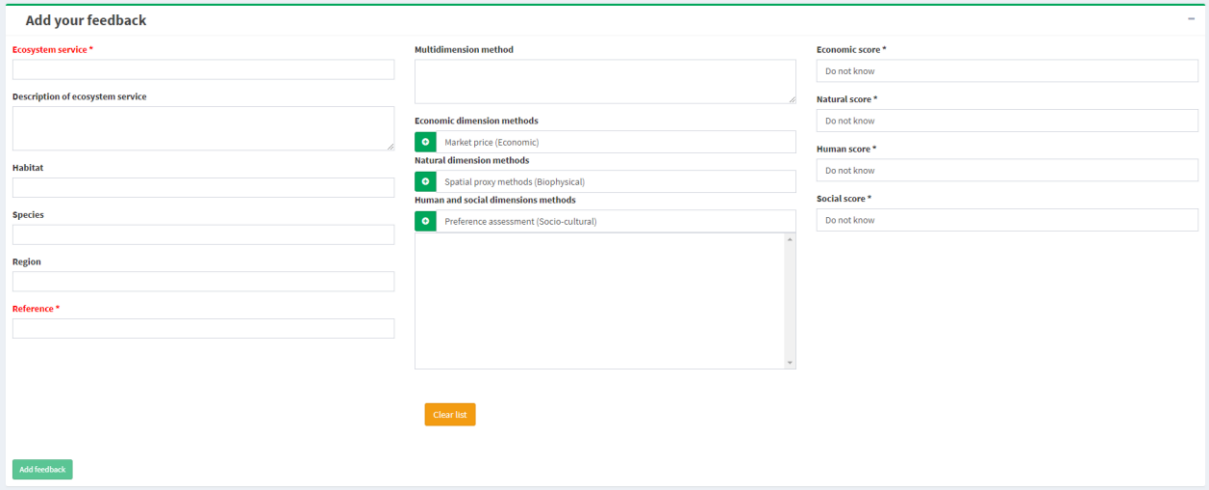

Figure 5. Outline of the data entry form of online tool-kit about the studied ecosystem services, related parameters, assessment methods and Eco-GAME evaluation along different dimensions

Once the participant has identified the ecosystem service, a further evaluation by the portal administrators will classify entries according to existing ecosystem service classification systems, or will assign a classification as intermediate ecosystem service or function.

3.4 Interpretation of results

All users' results (including own insertions) can be visualised in tables and graphs of *Eco-GAME* scores and by the final index.

For each entry, the portal assesses the total amount and quality of information delivered for each capital dimensions (Natural, Human, Social, Economic) by specific combination of methods (Eco-GAME index; Sajeva et al 2020) as shown by the formula below, which is an average of the collected inputs (one for each capital), multiplied by the minimum value. This allows to 'punish' evaluations which are more discrepant among the considered capitals or too low values in one of the capitals.

$$Eco - GAME\ index = E = \min x_i \sum_{i=1}^{4} x_i /4$$

The graph in Figure 6 summarises the expert knowledge by calculating the average of Eco-GAME indices given for a certain ecosystem service – valuation method(s) combinations. When more meta-evaluations are produced for the same ecosystem service and the same method or combination of methods, clearly these may differ from one another. Therefore, a standard deviation is calculated to appraise the uncertainty of different meta-evaluations.

In this way, the end-users of the portal would be informed about the strength of linkages between different methodologies when assessing our performances related to reaching the UN SDGs. Figure 7 (dependency wheel) gives an example of a graphical output which assesses the strength of linkages among different methods with higher linkages suggesting better synergies among methods to deliver information on various ecosystem services.

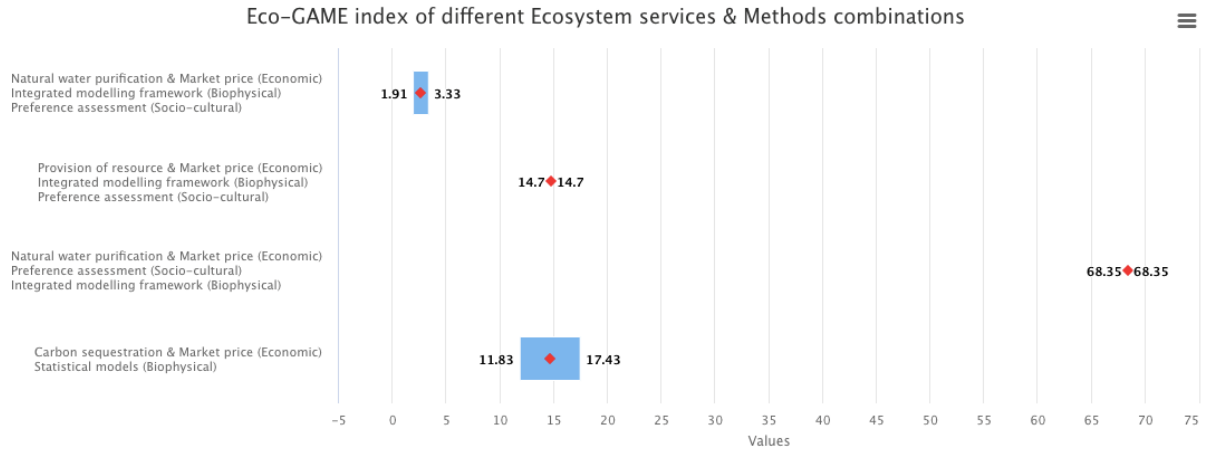

Figure 6. An example of the Eco – GAME index (mean and standard deviation) for different combinations of ecosystem services and study methods.

The user can also easily view, access, and download raw data (CSV or Excel) associated with the expert knowledge.

Ultimately, the portal informs us best ways to assess and manage different ecosystem services in order to reach the UN SDGs. The MARES multi-method tool-kit serves as a practical framework for the economic and non-economic meta-evaluation of marine ecosystem services in the whole Baltic Sea area (or beyond) and strengthen knowledge transfer in science policy-interactions about the efficiency of different methods to deliver knowledge on ecosystems services. With time, as the expert knowledge inserted to the tool-kit accumulates and can be aggregated, the interpretation of the data will be further developed, in particular paying attention to the needs of the decision-makers at different levels.

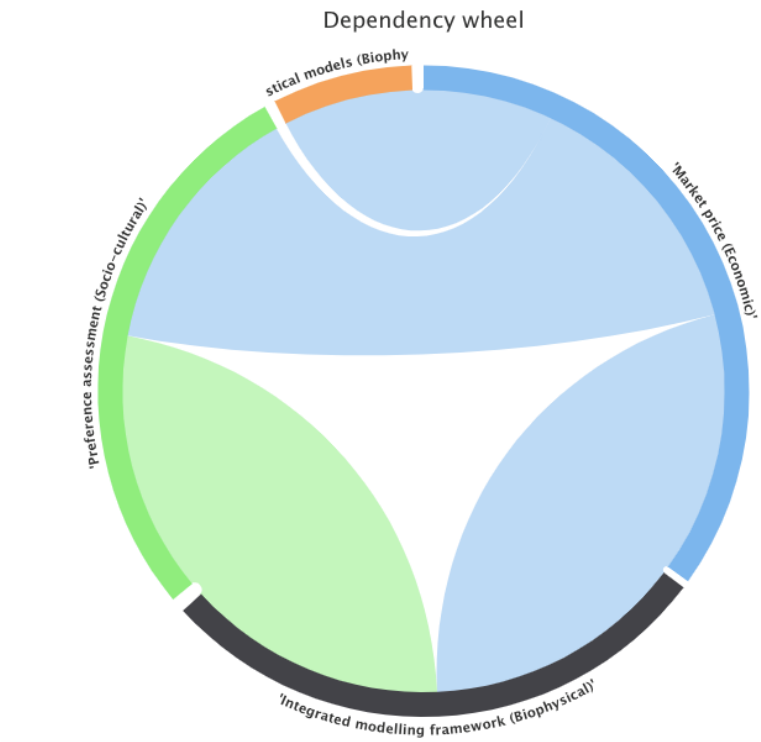

Figure 7. Chart showing a dependency wheel which assesses the strength of linkages among different methods with higher linkages suggesting better synergies among methods to deliver information on various ecosystem services.

4 Participatory testing and further development of the geoportal

The participatory MARES tool-kit and geoportal has been tested during the *Eco-GAME* SimLab, in occasion of the participatory workshop with the expert platform in February 2020. During the SimLab, experts were divided into small groups to test different functionalities of the MARES tool-kit and to give feedback both on its usability and contents. On the basis of this feedback, the geoportal was then updated and further developed: the current version of the participatory tool-kit, which is presented in the previous sections, already reflects some of the suggestions done during this SimLab event.

4.1 Feedback

The version of the MARES tool-kit presented for the testing allowed to perform more advanced analyses. The geoportal functions were sometimes considered as too complex, so that the geoportal has been updated and simplified.

The MARES expert meetings highlighted the need to find and communicate the links from ecosystem and habitats, to ecosystem functions and finally to ecosystem services benefiting human beings. The communication of the existing knowledge about these relationships would help to make the importance and relevance of habitats in providing specific services visible and concrete. The availability of this knowledge, in a form that is easy to access, would facilitate and promote its use in evidence-based planning and decision-making processes.

One of the key issues raised during the testing event dealt with the range of ecosystem services that could be selected as a target of the valuation. The range of ecosystem services was considered to be too wide, including both intermediate and final services. As stated by several experts, the valuation methods are suitable only for the valuation of final services. Moreover, when assessing also functions (intermediate services), a problem of double counting may arise. This view was to some extent challenged, claiming that classification of environmental services adds unnecessary complexity to the exercise and hides the contribution of intermediate services in the production of final services.

A further suggestion was made on this topic, proposing that valuation methods could indeed be connected only to final environmental services, but while doing this, the expert would see the list of intermediate services contributing to the final service. Actually some economists claim that economic valuation methods of final services and other non economic methods (e.g. ecology based) assessing intermediate functions are not commensurable, and they cannot be assessed by the same meta-evaluation framework. According to this view economic valuation should be a complement of the ecological one and added on top of that. This would mean that once the ecosystem functions have been physically and ecologically assessed (Natural capital), and once human basic needs and well-being would have been assured (Human capital), then, valuation methods would allow to support choices on the side of societal aims (Social capital). However, even if this view is theoretically valid, actually practice shows that this does not happen in practice. Valuation methods are actually used to support decision-making and are not communicating that given choices would jeopardise Natural or Human capital equilibrium. The different assessments are not integrated in practice, nor take into account of the respective outcomes. To make an example, the communication of a price for a fish species does not include the total maximum amount that is possible to catch, without putting a risk the species itself.

Therefore, in order to provide a higher level of quality in the knowledge transfer, a combination of methods should be applied. By a combination of methods, which MARES geoportal could allow, the price could be increased for instance of an amount that is required to maintain or recover the habitat that is put at risk.

The final cost would be equal to the market price (resulting from mechanisms of offer and demand, referring to Social capital) plus a quote which is required to pay back the Natural capital (maintaining/recovering habitat and ecosystem functions). In case the use of a given resource would cause irreversible impacts, the cost of recovering would result infinite and would allow to protect sensitive and important environments. This could be one way to practically implement the conceptual vision of the economic valuation as complementary to the ecological one.

In this way, data or data sources on the intermediate services would be made available, and this would strengthen the understanding about the linkages between ecosystems, ecosystem functions and the services that actually bring benefits to human beings.

Feedback on the functionalities of the participatory tool-kit was also given, i.e. a suggestion to add a field for 'multi-dimensional method', which cannot categorised under any of the value dimensions singularly considered. This proposal has been taken into account in the current version of the geoportal.

4.2 Further development

The geo-spatial representation of the knowledge on habitats and ecosystem services enables an effective and powerful communication to decision-making and the society at large. Similar approaches have been applied for example in the context of Mapping Ocean Wealth[3], a project developed by The Nature Conservancy. This project aims to spatially present the value of ecosystem services created by marine and coastal ecosystems on the local level. Through this work, the project has developed maps illustrating both the habitat coverage and the intensities of ecosystem service created by the habitat (Carnell et al. 2019). Burdon et al. (2019) have developed similar maps through a process of participatory mapping in the UK.

Obviously, this task involves several challenges. Ecological processes are complex and the chains linking habitats to functions and in turn to services are not always (partially or totally) known. Some ecosystems produce services jointly, therefore making it difficult to distinct the share of each specific ecosystem that contributes to generate the service. Also, some ecosystem services are more visible than others and therefore more suitable to spatial representation, especially at local or sub-regional scale. Implementing a similar mapping in the Baltic Sea context would require considerably more resources.

Despite of limitations, the MARES geoportal, illustrating the linkages between habitats and ecosystem services that benefit humans in different ways, could bring many benefits. It could indeed be a starting point for a continuous, long-term process, collecting data from different parts of the Baltic Sea and providing a suitable basis for aggregating scientific knowledge on the services that specific ecosystems produce and that can be further detailed and connected to the locations of the habitats. In this way, the MARES tool-kit forms an extensive and Baltic Sea-wide data set, based on academic knowledge, that can be used and further developed for decision-making.

Several different kinds of platforms containing spatial data on the Baltic Sea already exist. In order to advance the usability of data, it would be advisable to use interfaces to connect the MARES geoportal to other suitable and well-known web-portals. For example, HELCOM, a governing body of the Helsinki Convention, maintains

[3] https://oceanwealth.org/

a Map and Data Service4, providing a multitude of geospatial data sets relevant for policy-making at the Baltic Sea level. The European Marine Observation and Data Network (EMODnet) is a long-term initiative that collects and presents European marine data from various organizations through the European Atlas of the Seas portal5. National-level initiatives also exist, such as the recently launched itämeri.fi -portal6, which collects and shares Baltic Sea -related spatial datasets, services and interfaces developed by different Finnish organisations.

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[5] https://ec.europa.eu/maritimeaffairs/atlas/maritime_atlas

[6] https://itameri.fi/fi-FI

Annex I

List of 3.12 expert meeting participants

	First name	Last name	Country	Organisation	Type of organization
1	Heini	Ahtiainen	Finland	HELCOM	Other
2	Juris	Aigars	Latvia	Latvian Institute of Aquatic Ecology	Research
3	Robert	Aps	Estonia	University of Tartu, Estonian Marine Institute	Research
4	Christine	Bertram	Germany	Kiel Institute for the World Economy	Research
5	Riccardo Giuseppe	Boschetto	Italy	ISPRA	Public/Governmental
6	Christiaan	Hummel	The Netherlands	Royal Netherlands Institute for Sea Research	Research
7	Herman	Hummel	The Netherlands	Royal Netherlands Institute for Sea Research	Research
8	Eduard	Interwies	Germany	InterSus - Sustainability Services	Other
9	Susanna	Jernberg	Finland	Finnish Environment Institute	Public/Governmental
10	Marina	Orlova	Russia	Federal budgetary scientific organization "Saint-Petersburg research center of the Russian academy of science" (SPBRC RAS)	Research
11	Anneliis	Peterson	Estonia	Estonian Marine Institute	Research
13	Paul	Tuda	Germany	Leibniz Centre for Tropical Marine Research (ZMT)	Research
14	Vassiliki	Vassilopoulou	Greece	Hellenic Centre Marine Research	Research
16	Adam	Wozniczka	Poland	National Marine Fisheries Research Institute	Research
17	Maurizio	Sajeva	Finland	Pellervo Economic Research PTT	Research
18	Paula	Horne	Finland	Pellervo Economic Research PTT	Research
20	Mats	Godenhielm	Finland	Pellervo Economic Research PTT	Research
21	Marjo	Maidell	Finland	Pellervo Economic Research PTT	Research
22	Wouter	Blankestijn	Sweden	Swedish University of Agricultural Sciences (SLU), Division of Environmental Communication	Research
23	Stina	Powell	Sweden	Swedish University of Agricultural Sciences (SLU), Division of Environmental Communication	Research
24	Tin-Yu	Lai	Finland	University of Helsinki	Research

BONUS MARES[7] - Participatory workshop, Suomenlinna, 3rd of December 2019, list of participants

First name	Last name	Country	Organisation	Expertise
Georgios	Angelakis	Greece	CHIEAM-MAICh	Business and management (E5)
Robert	Aps	Estonia	University of Tartu, Estonian Marine Institute	Baltic Sea (N2)
Wouter	Blankestijn	Sweden	Swedish University of Agricultural Sciences (SLU)	Environmental Communication
Mats	**Godenhielm**	Finland	Pellervo Economic Research	Economics (E3)
Melanie	Heckwolf	Germany	GEOMAR	Marine biology (N3)
Hansen	Henning Sten	Denmark	Aalborg University	Ecosystem Services (H5)
Christiaan	Hummel	The Netherlands	Royal Netherlands Institute for Sea Research	Ecosystem services (H3)
Herman	Hummel	The Netherlands	Royal Netherlands Institute for Sea Research	Marine biology (N1)
Eduard	Interwies	Germany	InterSus - Sustainability Services	Ecosystem services valuation (E2)
Mark	Lemon	UK	De Montfort University	Systems' integration (S2)
Fiona	Nevzati	Estonia	Estonian University of Life Sciences	Ecosystem services (H1)
Kaisa	Karttunen	Finland	e2	Policy communication (S3)
Kristin	Kuhn	Germany	Leibniz University Hannover	Ecosystem services (H7)
Tanel	Ilmjärv	Estonia	Vetik OU	Business and management (E7)
Jonne	**Kotta**	Estonia	Estonian Marine Institute	Marine biology (S1)
Marjo	**Maidell**	Finland	Pellervo Economic Research	Economics (E6)
Kimmo	**Mäkilä**	Finland	Pellervo Economic Research	Science communication (S7)
Anneliis	**Peterson**	Estonia	Estonian Marine Institute	Marine biology (N5)
Stina	Powell	Sweden	Swedish University of Agricultural Sciences (SLU)	Environmental Communication
Thorsten	Reusch	Germany	GEOMAR	Marine biology (S6)
Anda	Ruskule	Latvia	Baltic Environmental Forum	Ecosystem services (H6)
Maurizio	**Sajeva**	Finland	Pellervo Economic Research	Sustainability evaluation (H2)
Anni	Savikurki	Finland	e2	Policy communication (S4)
Lise	Schroeder	Denmark	Aalborg University	Baltic Sea (N7)
Meelis	Sirendi	Finland	BONUS EEIG	Baltic sea (S5)
Vassiliki	Vassilopoulou	Greece	Hellenic Centre Marine Research	Marine biology (N4)
Adam	Wozniczka	Poland	National Marine Fisheries Research Institute	Marine biology (N6)

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