Lessons learned – Knowledge integration tools for MSP by BONUS BASMATI

Deliverable 2.4

BASMATI

Baltic Sea Maritime Spatial Planning for Sustainable Ecosystem Services

BONUS

SCIENCE FOR A BETTER FUTURE OF THE BALTIC SEA REGION

BONUS BASMATI

Lessons learned – Knowledge integration tools for MSP by BONUS BASMATI

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Authors:

Søren Q. Eliasen, Elin Cedergren, Andrea Morf and Kira Gee

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Contents

BONUS BASMATI in brief

BONUS call 2015:
Blue Baltic

Project coordinator:
Henning Sten Hansen, Aalborg University, Denmark

Project partners:
Aalborg University, Denmark (AAU)
Aarhus University, Denmark (AU)
Finnish Geospatial Research Institute, Finland (FGI)
Latvian Institute of Aquatic Ecology, Latvia (LIAE)
Leibniz Institute for Baltic Sea Research Warnemünde, Germany (IOW)
Nordregio, Sweden (Nordregio)
University of Turku, Finland (UTU)

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Project abstract:
Maritime Spatial Planning (MSP) requires a spatially explicit framework for decision-making. Against this background the overall objective of BONUS BASMATI was to develop integrated and innovative solutions for MSP from the local to the Baltic Sea Region scale. This was to be realised through multi-level governance structures and interactive information technology aiming at developing an ecologically and socio-economically sound network of protected marine areas covering the Baltic Sea. Based on the results of former MSP projects, the BONUS BASMATI project analysed governance systems and their MSP information needs in the Baltic Sea region, taking first steps towards an operational, transnational model for MSP while maintaining compliance with existing governance systems. BASMATI also developed methods and tools for assessments of different plan proposals, including spatially explicit pressures and effects on maritime ecosystem services. The latter led to the creation of the Baltic Explorer, a spatial decision support system (SDSS) for the Baltic Sea region designed to facilitate broad access to information. During the lifetime of the project (up to 2020), new data was produced and tested in assessments corresponding to policy goals. The data supported the combined analysis of ecosystem service elements: the capacity, flow and benefit of provisioning, regulating and cultural services. A central aim of the project was to facilitate cross-border collaboration, and the project was carried out in close cooperation with relevant stakeholders in the BSR. The impact of the project was facilitated and assessed in transnational case studies that required integrated solutions. The local scale consisted of case study areas in the South-West Baltic, the Latvian territorial and EEZ waters including open parts of the Baltic Sea and the Gulf of Riga. Across the region, a pan-Baltic case study was performed.

Summary

This report, Deliverable 2.4 “Lessons learned – Knowledge integration tools for MSP by BONUS BASMATI” provides an overarching synthesis across the cases and work packages of BONUS BASMATI, an applied research project in the Baltic Sea area. The focus is on tools for Marine or Maritime Spatial Planning (MSP), developed within the project with a focus on knowledge processing, stakeholder involvement and cross-border collaboration. An important practical aim of this report is to support the development and application of the tools in forthcoming local, national, and cross-border MSP processes in the Baltic Sea Region. The primary user groups are planning practitioners and researchers for the continued development of the tools, as well as marine stakeholders interested in digital knowledge processing and sharing tools.

The BONUS BASMATI project Work package 2 “Governance and Maritime Spatial Planning“ has aimed to: 1) establish a conceptual framework for the development of tools facilitating stakeholder participation in sustainable allocation of marine activities; 2) test stakeholder involvement tools; and 3) draw lessons from tests in case studies.

Deliverable 2.4 addresses these objectives by assessing tools developed within BASMATI based on observations, interviews, and surveys. The focus is on highlighting strengths and weaknesses of modelling and scenario tools, as well as providing practical recommendations for using specific tools within the more overarching aims of supporting MSP practice and cross-border collaboration.

The report addresses three main questions: 1) What does the tool seek to achieve, main user and application of the tool? 2) What are the lessons learned from tool development and testing so far in relation to its applicability and limitations with respect to spatial knowledge integration and decision making, stakeholder involvement and cross-border collaboration/cooperation? 3) How ready is the tool for practical application and what tool elements need further development? Five BONUS BASMATI tools were assessed through interviews, observations and literature review:

- Baltic Explorer, an interactive web map application for facilitating collaboration in MSP,
- ESA4MSP, ecosystem approach to value the marine seabed habitats and their contribution to human wellbeing. Assessing the ecosystem components and linkages for assessing the final ecosystem services
- MYTILUS, a tool for cumulative impact assessment and mapping,
- SEANERGY, approach and spatial decision support tool to map potential conflicts and synergies between mare uses and exploring use-use interactions.
- SPACEA, a GIS toolbox for facilitating spatial and environmental suitability analyses, performing simple MSP analyses on mussel farming sites in the south-western Baltic Sea.

The review of the tools shows that:

- the tools mainly address the scoping phase of MSP, but also contribute to drafting MSP plans: especially Baltic Explorer can support consultation at almost any level of intensity that might be desired by the planners and planning authority. For the remaining phases of MSP planning, the tools can support evaluation, which might be part of the scoping phase of the next cycle of MSP.
- For spatial knowledge integration for decision-making the tools bring together different types of data and information, and in preparation for the actual decision assessing and/or visualising the consequences of different planning options. These can support planners as well as involve stakeholders. Stakeholder can reflect on visualisation of the status, and support planners in their decision processes – thereby support information to stakeholders or during consultation.
- A more active involvement of stakeholders is supported by especially Baltic Explorer, where stakeholders can draw their own maps, or do their own assessment of scenarios and can help stakeholders to understand the impact of decisions and to see consequences of actions for themselves. Learning is immediate and enhanced further by the group setting; consultation becomes more interactive, and collaborative scenario

design becomes a possibility. Baltic Explorer might even catalysts change by allowing stakeholders to test their own ideas and thoughts and encourage independent assessment and discussion can help engender greater “power of knowledge” amongst stakeholders

- All tools support cross-border collaboration. The visualisation, which is central for all tools, assists with cooperation at the formal level between national planners and more informal cross-border collaboration between planners as well as stakeholders and might reduce language barriers. The challenges related to data (such as access and availability) are magnified in cross-border contexts by needing data harmonization.
- Cross-border data may not be detailed enough and differences between countries in terms of available data, definitions or data gaps might become more apparent. Agreement is needed on the part of tool users on how to overcome these difficulties, and how to deal with data gaps.

The tools are developed to use in the context of the research project BONUS BASMATI. Nevertheless, they are measured against a technology readiness index leading to commercially ready tools (EC 2017).

- The tools in general need to be demonstrated useful in operational MSP environments to reach the level of being generally available for MSP processes. The collaborative elements of Baltic Explorer and possibly MYTILUS is though closer to be fully applicable for MSP processes in general
- The open access approach and publication of codes in principal allow all planning institutions (national or regional) to further develop the tools.
- A more likely further development would though be new projects where the tools are linked to an ongoing MSP process, for further development and demonstration in use.

Figures, tables, and observation boxes

Figures

Tables

Observation boxes

Abbreviations

Abbreviation	Meaning
CGIS	Collaborative Geographical Information Systems
DST	Decision support tool
EBA	Ecosystem-based approach
ES	Ecosystem services
GIS	Geographical Information Systems
MSP	Maritime Spatial Planning (or Marine Spatial Planning)
SDSS	Spatial Decision Support Systems
TRL	Technology Readiness Level

1 Introduction and aims

This report provides an overarching synthesis across cases and work packages of BONUS BASMATI, an applied research project in the Baltic Sea area. The focus is on tools for Marine or Maritime Spatial Planning, hereafter referred to as MSP, analysed within the project for their applicability for knowledge processing, stakeholder involvement and cross-border collaboration. The primary user groups of the report are planning practitioners and researchers interested in developing tools, but possibly also tool developers in other fields.

Compared to land-based planning, MSP is a relatively recent and fast evolving field of research and practice. Various types of tools are presently being developed and tested to assist in the preparation and implementation of marine plans and the associated organisational processes. Relevant activities that might benefit from tool use include data collection and sharing, analysis, scenarios and forecasts related to environmental, ecological, social and economic issues, the development of maps and other types of geospatial visualisation, as well as the involvement of and collaboration with various types of stakeholders.

The aim of BONUS BASMATI (2017-2020) was to develop integrated and innovative solutions for MSP from the local to the Baltic Sea Region scale. A specific objective was to develop "methods and tools for assessment of different plan proposals, including spatially explicit pressures and effects on maritime ecosystem services." Accordingly, a number of new tools have been developed and tested within BONUS BASMATI, partly based on existing ones[1]. The focus of tool development was twofold: a) to support knowledge processing and integration for spatial decision support and b) to support multi-stakeholder, cross-sector and multi-level governance interaction.

As concluded in relation to the BONUS BALTSPACE project, the distinction between approach and tool is arbitrary and may not always be clear-cut (Kannen et al 2016, p. 9). In this relation though we will distinguish between tool, approach and framework based on definition from the Cambridge Dictionary (2020). A tool as a piece of equipment that you use with your hands to make or repair something, or in a broader sense: something helpful to perform a particular activity, an approach is a way of considering or doing something, while a framework can be seen as a system of rules, ideas, or beliefs that is used to plan or decide something; it is literally or figuratively a supporting structure around which something can be built.

Tool development within BONUS BASMATI was distributed across various work packages and has served to support the project's other tasks as well as ongoing MSP processes. A framework for conflict analysis developed in WP2, for example, (Giacometti et al 2018) has served to deepen the understanding of case studies in WP 6 and provided an approach for analysing and planning stakeholder interaction (reported in a handbook by Giacometti et al. 2020). WP 3 provided both a database and a framework for harmonising data between countries, simplifying the work with spatial data for marine planners (Holzhüter et al 2019). WP 4 developed an analytical framework for conducting sustainability impact assessments of plan proposals (Frederiksen et al 2020).

This report analyses the tools developed in WP 5 (Baltic Explorer) and 6 (case studies). It focuses on concrete tools for spatial data processing, decision making and related interaction, and their potential to be used for knowledge processing and stakeholder interaction. The tools analysed in this report were developed in relation to concrete contexts of application at different geographical scales, namely Riga Bay (Latvia) and a Danish-German case study. Tool development focused on concrete challenges in these areas and took place in the context of ongoing MSP work. Depending on the stage of the MSP process in the three countries, it has been more or less easy to link this work to ongoing MSP practice. Especially in Riga Bay, tool development was easily linked to national MSP both during plan development and later implementation phases.

[1] For more information, see www.bonusbasmati.eu.

The following five BONUS BASMATI products are assessed:

1. Baltic Explorer, an interactive web map application for facilitating collaboration in MSP.
2. The Latvian ecosystem service model, ESA4MSP, which illustrates the complex relations between the ecosystem service components that lead to the final ecosystem services which support human well-being.
3. MYTILUS, a tool set for assessing cumulative impacts of maritime activities and visualising the results on maps.
4. SEANERGY, a tool for assessing interactions between different users to identify conflicts or synergies between the activities.
5. The GIS toolbox SPACEA, which performs simple suitability analysis for MSP based on locating mussel farming sites in the south-western Baltic

The main focus of the assessment is on the experiences and lessons learned from tool development in the project. It is based on various types of data derived from literature study, interviews and observation, as well as from facilitated discussion. The key lines of enquiry are:

1) What does the tool seek to achieve, main user and application of the tool?

2) What are the lessons learned from tool development and testing so far in relation to its applicability and limitations with respect to:
    a. spatial knowledge integration and decision making?
    b. stakeholder involvement?
    c. enabling of cross-border collaboration/cooperation?

3) How ready is the tool for practical application and which aspects need further development?

The report is structured as follows. Chapter 1 presents the background to the report, its aims and the research questions for the present enquiry. Chapter 2 provides selected theoretical reflections regarding the overall purpose of the tools in relation to the MSP process, setting out the overall assessment framework for the tools. It particularly focuses on stakeholder involvement and power sharing, cross-border collaboration and the Technology Readiness Index. Chapter 3 describes the methods used for assessment. Chapter 4 presents the results, analysing each tool individually. It sets out the context of each tool application and the aims of the respective tools before describing the lessons learned from tool development and use. Considerations put forward by the tool developers and observations are discussed, including comments on the general use of the tool and timing in relation to ongoing MSP processes. Chapter 4 also discusses how the tools can enable cross-border collaboration and potential barriers. The concluding chapter 5 summarises findings and discusses the lessons learned and the way forward for these tools – enhancing their contribution to spatial decision support or interactive multi-level, multi-stakeholder and cross-sector governance.

2 Conceptual framework for assessment

This section provides a step-by-step overview of the theoretical analytical background which is operationalised in the assessment framework for the tools (section 2.4). Although everything tends to be linked in MSP, this chapter reflects on some aspects individually before they are brought together in an overall synthesis and assessment framework.

2.1 Key perspectives and terminology

There are many diverging definitions of important concepts in MSP. To avoid confusion, we briefly present a few key terms and how they are used in the context of this report.

Tools for MSP – a broad definition
From a marine spatial planners' perspective, a *tool* can be many things. It can be a map, a meeting technique such as a round table, a flipchart with pens, a database, or a computer application (such as many of the tools presented here). Because planning invariably involves complex tasks of structuring and managing situations and interactions between people, different tools might be combined to form *toolboxes* or *approaches* – which could be *ways of doing things* or more theoretical *frameworks*. As noted by Kannen et al (2016) in the BONUS BALTSPACE project, the "distinction between approach and tool is arbitrary and may not always be clear-cut". An approach that is used to structure an MSP process can be seen as a tool in a broader sense in that it helps to perform a particular activity. Acknowledging Kannen et al. (2016) and Gee et al. (2019), this report uses *the term tool in its broader sense*, including concrete tools (including digital ones), toolboxes and overall approaches, unless it is necessary to be more specific.

MSP - process and output focus
As MSP implies both a *planning process and concrete outputs* in the form of plans and other documents, the understanding of tools in MSP needs to be similarly three-fold (Gee et al. 2019). Firstly, a tool can be a specific *product* or *output*, such as an application or system. Secondly, tools evidently have a *process* element, which comes into play when using the tool. This can be of a technical nature or related to the people using the tool (experts, stakeholders, planners). Thirdly, tools have a process element when they are applied within the MSP process, acting as a facilitator or enabler of particular stages of MSP. Different tools thus vary between greater product and process orientation, depending on whether they deliver an end-product (e.g. a spatial tool) or process (e.g. focus on participation or planning processes) or both. The assessment presented in this report acknowledges and applies this *dual perspective*.

MSP is about the future
In terms of content, any type of planning is future-oriented, setting the course for future developments and situations and taking into account related uncertainties, risks and opportunities. This type of work can occur in different ways and result in three main types of representations of the future: a) *forecasting* or *extrapolations to predict* what *might happen* in the future, b) *visions* representing a *desired future*, possibly followed by *back casting* to find out how to get there, and c) one or more *scenarios* to *explore and/or discuss different possible future situations* and how they might be avoided or reached. *Models and modelling* is a way to represent things and situations, either as a physical object representing a real object (like the model of a house), or as a mathematical or logical description to be used in calculations, e.g. for fore- and back casting. Technically, all five tools analysed here are IT-based and include some kind of software application. This can be used for stakeholder interaction in an MSP process, or as part of more technical data processing and plan development.

Basis in the present policy agenda – criteria relevant for applying tools
Given the overall focus of BONUS and BONUS BASMATI, and given that the ecosystem approach

is widely used as a foundation for MSP (e.g. EU MSP Directive (European Commission 2014), BSR MSP principles (HELCOM HOD 34-2010 and the 54th Meeting of VASAB CSPD/BSR 2010), the Malawi principles can be used as a point of departure (CBD- Report of the Workshop on the Ecosystem Approach 1998). The 12 principles contain four aspects that form the basis for the assessment presented here. The first is adaptive management (Malawi principle 9), implying a repeated learning loop. The second is integrating the best available knowledge using sound science and user knowledge (Malawi principles 11 and 12). The third is focusing on societal choices and stakeholder involvement in terms of knowledge, planning process and priorities (Malawi principles 1, 2 and 11). The fourth is transboundary integration and cross-border collaboration as the sea is one connected ecosystem (Malawi principle 3).

2.2 MSP context: process, phases, functions, roles

BONUS BASMATI has developed a range of concepts, mostly for the purpose of analysing and structuring stakeholder involvement in MSP (see *Handbook: Process, Methods and Tools for Stakeholder Involvement in MSP*; Giacometti et. al 2020). Here we use selected aspects of these concepts to provide a more theoretical foundation for our tool assessment. We specifically focus on the phases of the MSP process, knowledge processing, types of stakeholders and intensities of involvement.

Overall process and phases of MSP and their functions

Conceptually and figuratively, MSP – like any adaptive planning and management process – can be simplified as a continuous loop (fig. 2.1). Here we depict it as four main layers, including one layer containing four overlapping functional process phases (4+4; see also Giacometti et al. 2020).

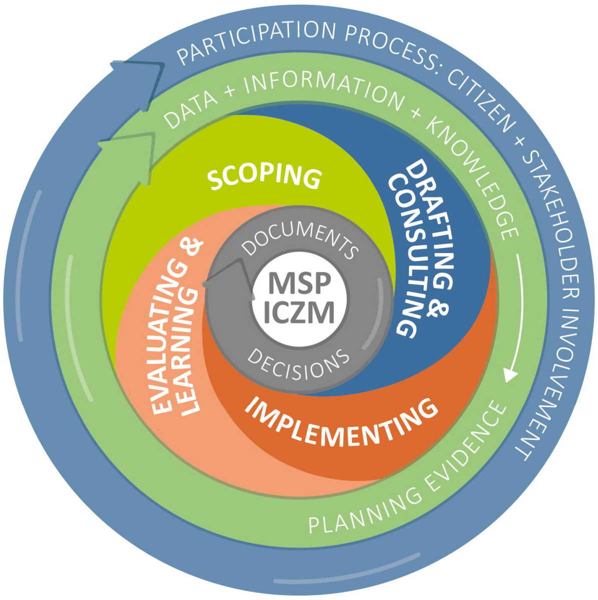
The driving core layer (grey) consists of the formal decisions and documents (both written/printed and digital) that steer the second multicoloured layer composed of four main functional process phases:

- *Scoping* (olive): Setting out the scope of the plan and the planning process takes place early in the loop; it may take considerably longer in the first planning cycle. Scoping implies both knowledge input (e.g. on the current status of the planning area and the problems the plan needs to solve) and stakeholder identification and analysis.
- *Drafting and consulting (dark blue)*: This phase contains possibly several iterations of drafting and revising plans based on new or newly processed knowledge and input from stakeholders.
- *Implementation* (red): This may occur already before a plan is formally adopted and continues through to another loop. It takes place not only through MSP but also through other means (e.g. authorities and stakeholders basing their decisions on draft plans).
- *Evaluation and learning (orange):* This implies formal and informal monitoring and learning and provides input for new rounds of MSP.

A third, green layer stands for the knowledge dimension in MSP: scientific data and other types of knowledge transformed into planning evidence to inform decision making and learning.

The fourth outermost blue layer stands for stakeholder involvement, interlinked with different functional phases, knowledge collection, processing and decision making along the way.

Figure 2.1: The planning process loop of MSP.



(Source: A Mort et al. in Giacometti et al., 2020: 19).

Knowledge processing and integration and spatial decision tools (green arrow)

Like other forms of planning, MSP has a strong knowledge processing component that enables it to make evidence-based decisions. A scientifically sound and broadly accepted evidence base for MSP implies transdisciplinary knowledge integration, i.e. the collection, processing, and synthesising of many different types of knowledge and data. This may be qualitative and quantitative data, and may be derived from science, from management or from the experience and knowledge of sea users. Once collated and processed, this evidence is then used in problem solving, negotiations and decision-making (Saunders 2017). Spatial data plays a key role in MSP, usually as digital maps but also as other forms of visualisation.

In order to form a suitable evidence base, large sets of data must be structured and processed. Complex interrelations between marine activities, system states and desired planning outcomes need to be explored and communicated. Knowledge processing in MSP can make use of digital spatial tools for various situations where complex datasets come into play. Digital tools can be useful for many purposes, including:

- data collection and assembling it from different sources,
- visualisation and mapping,
- iterative processing of large amounts of data (both spatial and numerical),
- modelling to fill marine data gaps,
- extrapolation of ecosystem trends or trends in sea use,
- plan-related social and environmental impact assessments – both cumulative and simple,
- exploring different alternative choices (scenarios) and how to get there,
- checking and evaluating different choices against chosen targets.

The processing of spatial data and knowledge is often handled in geographic information systems (GIS), computer-based tools which also visually share the results in maps. When running scenarios based on spatial knowledge, GIS systems can function as Spatial Decision Support Systems (SDSS), supporting planners and decision makers in their choices and decisions.

Given the importance of data and knowledge integration in MSP, we focus our tool assessment on the capacity of the tools for knowledge processing and integration, and with this their capacity to support decisions.

Process facilitation and stakeholder interaction and tools (blue arrow)

In order to assess their capacity and efficacy, tools need to be analysed based on their intended functions and user groups (as intended by the tool developers). They also need to be assessed in relation to the stakeholders to be involved in MSP and the planned intensity of stakeholder interaction. We will briefly run through some important aspects related to this.

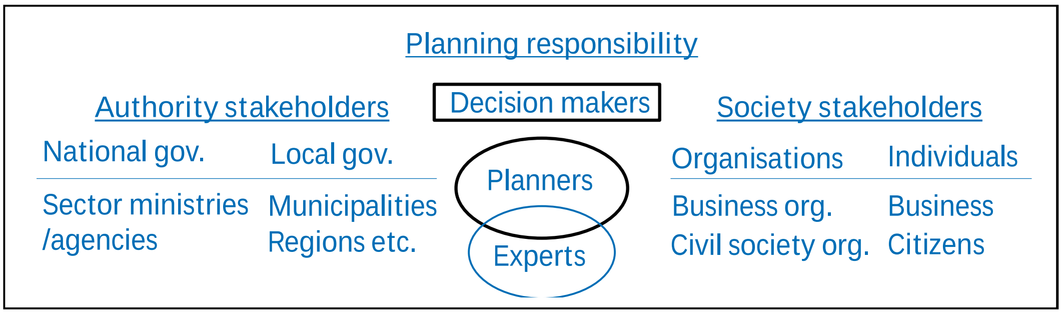
Types of actors in MSP - users of tools

An important distinction in terms of the targeted user groups for MSP tools is between a) those responsible for the process (usually those deciding to apply a particular tool, e.g. planners/process facilitators) and b) participants (stakeholders).

a) Actors responsible for the process, usually planners or specially assigned process facilitators, lead the stakeholder involvement process. They might also be responsible for processing knowledge and developing the content of a plan. Planners might be supported by external and internal experts, and depending on a country's regulations, *decision-makers* may need to take important decisions along the way (e.g. the decision to adopt a plan, usually politicians). Those driving the process will try to get other actors to provide various forms of input and feedback before presenting final plans to decision makers.

b) Among the *participants*, one can differentiate further, e.g. based on the degree of formal involvement and influence stakeholders may have. Each country will have *authority stakeholders* (those with mandate at different levels from national ministries/authorities to local level) and *societal stakeholders* (individuals, user groups, enterprises, and their non-governmental organisations, Fig 2.2). Different stakeholders participating in MSP can vary greatly in terms of their interests, values and needs, as well as their awareness of MSP, their capacity to get involved, and levels of trust and prior engagement. All of this needs to be taken into consideration when designing and deciding to apply specific tools for stakeholder interaction.

Figure 2.2: Main actor groups in MSP and potential user users for the tools developed in the project



(Source: Søren Qvist Eliasen)

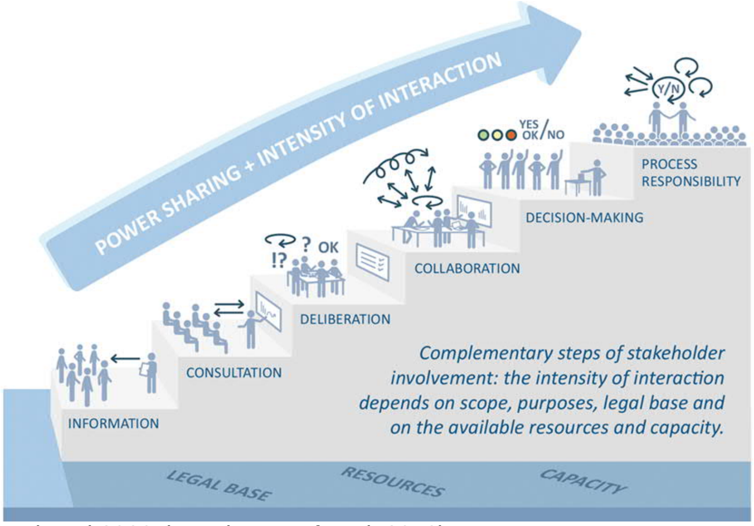
Those with process responsibility can be seen as the *primary and active user groups* for tool use. They are usually able to specify the particular needs a tool should address. The remaining stakeholders can be seen as a more *passive secondary user group,* although this user group is also important for testing a tool in practice. In terms of tool application, process facilitation skills and good command of the tool are crucial factors for choosing tools and assessing their application (see also Gee et al. 2019).

Type of interaction and relation to tools

As pointed out in other deliverables (Giacometti et al. 2020, Morf et al. 2019), interaction with stakeholders brings opportunities for mutual learning and for influencing both the process and the outcomes of MSP. Unless a participatory process provides a truly open space, the power to define problems and solutions ultimately rests with the process owners and overall decision makers – i.e. the responsible planners in association with their respective ministry. A ladder/stairway of MSP participation has been developed (Fig 2-3) that structures the degree of interaction between process leaders and participants into six main categories or steps. The various steps on the stairway are dependent on time and resources, capacity and the regulatory base, and each step has a different degree of power sharing and intensity of interaction (reflected e.g. in forms of communication). The six steps are complementary and comprise:

- *Informing* stakeholders is usually a basic legal requirement; it is characterised by one-way communication.
- *Consultation* is also legally required and often formalised; it entails two-way communication.
- De*liberation* entails more continuous interaction and can lead to joint learning.
- Direct *collaboration* implies intensive interaction between stakeholders working together on specific tasks.
- *Shared decision-making* can refer to only parts of a process or be more all-encompassing.
- *Process responsibility* implies full influence over the entire process or parts of it.

Figure 2.3: Stairway of participation in marine spatial planning.



(From Giacometti et al 2020, based on Morf et al. 2019)

The different levels of interaction also influence what kind of knowledge input stakeholders can provide to the planning process and how much influence they could exert over the process and the final plan.

Aims of the process – aims of tool use (see also above)

Depending on the legislative context and planning tradition, the form and content of a planning process will vary, for instance in whether it is technically or politically driven, whether it is more or less interactive, whether it is cross-sectoral, and whether it encompasses one or several societal goals.

The application of process-related tools in MSP will vary in relation to the above: the context, scope and scale of application, at what stage in the planning process it is used, whether it is used only briefly or over a long time and how well it is linked to the overall MSP process.

From a stakeholder involvement perspective, our tool assessment will therefore consider the context or use situation a tool is intended for, the primary user groups and potential secondary users, whether a tool addresses stakeholder involvement and if so, what degree of interactivity is possible (can be several), during which phases of the MSP process a tool can be used for SI, and the present limitations of tool use and how they could be addressed

Cross-border MSP cooperation and collaboration

A central purpose of BONUS BASMATI was to promote cross-border collaboration in MSP. This analytical dimension is rooted in the overall MSP policy agenda (see earlier) as well as governance research which states that those with a mandate to plan and manage a marine basin and related socio-ecological systems (i.e. the different coastal states) need to interact in order to address issues that cross jurisdictions. Here, it is important to differentiate between *formal* cross-border *cooperation* between nation states and less formalised *collaboration* that may include different types of actors and many forms and forums of interaction.

The EU MSP Directive (European Commission 2014) requires *cooperation* among member states to ensure the maritime spatial plans are coherent and coordinated across the marine region. This requirement has been included in the national legislation of the countries now developing and implementing MSP, although the precise format for international consultation is usually not specified. Suitable formats are chosen by the authorities in each country, often in line with the Espoo convention (UN 2017, Janßen et al. 2018, Morf et al. 2019). According to the Directive, cross-border cooperation is to take place through one or more of three channels: 1) existing institutional cooperation structures such as Regional Sea conventions; 2) networks of national competent authorities or 3) other methods for ensuring coherent and coordinated plans (European Commission 2014). In the Baltic Sea, MSP is an important topic for the Regional Seas Convention of HELCOM and the regional spatial planning collaboration (VASAB). In 2010 a joint MSP working group was formed with formal representation of mandated actors from the Baltic Sea country members of HELCOM and VASAB (HELCOM and VASAB 2014).

Moreover, a number of cross-border MSP projects have been conducted over the last decade, including BaltCoast, BaltSeaPlan, PartiSEApate, Baltic Scope, Baltic LInes or Pan Baltic Scope. According to Kull (et al 2017) and Cedergren (et al 2019), these projects have promoted not just formal cooperation across borders between the countries developing their MSP processes and plans, but also less formal forms of collaboration, networks and activities (such as the cross-border stakeholder meeting in Umeå 2019, which was part of Pan Baltic Scope and where one of the BASMATI tools was tested (observation box 4.1 below).

Our tool assessment therefore includes reflections on how the tools analysed can facilitate cross-border interaction in form of cooperation and collaboration in MSP in a wider sense. This includes how the tool addresses specific challenges of cross-border cooperation at planners´ level and possible collaboration involving cross-border stakeholder groups.

2.3 Technological readiness of tools

The five tools developed within BONUS BASMATI have implied a process of several, partially interactive steps of technology development and testing, related to the (mutual) schooling/learning by developers and different types of users. Like a planning process, the development of a tool is an iterative process, but it is possible to distinguish different stages of technological readiness that range from the original idea to a fully operational tool. To assess the BONUS BASMATI tools, the EU H2020 program index is used which formalises 9 levels of technological readiness in an index of Technology Readiness Levels (TRL) (European Commission 2017). This index ranges from the initial idea and basic principles (TRL 1) to the level where the technology is proven in the operational, often commercial, environment (TRL 9). The levels are defined in table 2.1.

Table 2.1: The scale of Technology readiness levels (TRL) in Horizon 2020

TR-level	Description of content of the TRL
1	Basic principles observed
2	Technology concept formulated
3	Experimental proof of concept
4	Technology validated in lab
5	Technology validated in relevant environment
6	Technology demonstrated in relevant environment
7	System prototype demonstration in operational environment
8	System complete and qualified
9	Actual system proven in operational environment

(Source: European Commission, 2017)

Inspired by Müller and Mouny (2014) we consider the first three TRLs as implying mainly research, while levels 4-6 are the development and 7-9 the deployment of the technology. Levels 1-4 can take place in a laboratory environment, or, as in BONUS BASMATI, on the developers' computer. Levels 5 and 6 refer to a "relevant" environment of application and a test situation. In an MSP project context, this could be events where the tool is validated (and accepted as relevant by the respective users) or where its use is demonstrated by some of the expected users applying it in a particular context or setting. The last TRLs imply that the tool (or set of tools) is demonstrated and tested in the expected operational environment. In terms of MSP, this would be a final version of a tool (or toolbox) used in a real or almost real MSP process. Here, timing with ongoing MSP processes is key but highly challenging.

Given that tool development strongly focused on knowledge integration, content management or facilitating interaction, some developers intentionally used an interactive design process from the very beginning – e.g. FGI developing the Baltic Explorer with a strong user interaction component (e.g. Rönneberg et al. 2019). Others had more focus on the content management and the logic behind the tool and interacted with experts to test these aspects.

2.4 Framework for assessment

In chapter 4, the different tools developed and used in BASMATI will be assessed in alphabetical order. The assessment departs from the intended context of application including user groups and functions of each tool (according to its developers and the ambitions in the BASMATI project description). It then analyses to what degree it has successfully been used in relation to these, using the analytical categories presented above.

The framework has the following structure (note: not all aspects may be addressed by all the tools)

1. The tool and its application so far: Intended functions and user groups and status of application (descriptive part)
    a. Description of the tool
    b. Targeted user groups
    c. Application so far within BASMATI and in relevant MSP contexts

2. Lessons learned: applicability and development status in terms of (analytical part):
    a. Intended functionalities related to planning content and knowledge processing (definitions in section 2.1, further conceptualisation in section 2.2)
    b. Intended functionalities related to process management including stakeholder involvement (the stairway, further concepts, see section 2.2)
    c. Intended functionalities related to the facilitation of cross-border collaboration in MSP (based on terms discussed in section 2.2)
    d. Applicability in specific phases of MSP process based on the above and using a process loop logic (section 2.2)
    e. Status of technological readiness in relation to practical use in MSP based on the above using the TRL index (section 2.3)

3. Overall summary in table form

The overall synthesis and possible ways forward in terms of tool development for MSP distilled from this can be found in chapters 5 and 6.

3 Methods

The report is based on input from a review of literature; reports and scientific articles, including peer reviewed articles describing the BASMATI tools, interviews with tool developers and observations from MSP workshops and meetings where the tools were tested. The organisers of these workshops and meetings were also interviewed.

The literature review provides a basic understanding of the MSP process and is intended to serve as a foundation for evaluating the tools. MSP legislation, academic papers on tools and key working documents and reports produced in BONUS BASMATI were reviewed.

Six semi-structured online interviews were carried out with tool developers, either individually or as a focus group. Respondents were provided with a summary of the interview in the form of tool descriptions, allowing the developers to correct misunderstandings and contribute to the analysis of the tool in relation to the MSP process and its technology readiness level.

Interviews were also conducted with tool users (MSP stakeholders) following test situations, complementing observations of how they were using the tools. This has provided central input for the lessons learned in chapter 5. The observations have focused on situations where the tools were tested or demonstrated, usually as part of MSP events involving authority or societal stakeholders. The main focus was on the collaborative and participatory aspects of the tools. This therefore addressed TRL 5 and later TRLs. There are no observations of “lab tests” of the tools (TRL steps 1-4,[2]), or observations of the game test of Baltic Explorer conducted by the developers (Rönneberg et al 2019).

Table 3.1: Observations made during the BASAMTI project

Place	*Date*	*Tool(s) observed*	*Context*
Umeå, Sweden	9/2019	Baltic Explorer – Test	Pan Baltic Scope project: FIAXSE case, cross-border planner/societal stakeholder event - Observation
Riga, Latvia	2/2020	Baltic Explorer – demon. ESA4MSP – Concept	BASMATI project inviting planners and authority stakeholders to report on MSP and the ecosystem approach -Interview with organiser, Observations, Focus group interview
Online master course, Sweden	4-5/2020	Baltic Explorer	Master course at Gothenburg university. Online course for MSP students. -Interview with organiser
Copenhagen, Denmark	8/2020	Baltic Explorer – demon. SEANERGY Concept, MYTILUS used as basis	Seminar in the SEAPLANSPACE project. Planners and societal stakeholders. -Interview with organisers

Prior to each event, an interview was conducted with the event organisers in order to establish the context in which the tool was to be used and the purpose it was intended to serve. During the event, observation concentrated on how the tool was being used and the interactions between the participants. Feedback was obtained from the users afterwards. After the Riga event a focus group interview was conducted with three participants, in order to obtain a deeper understanding of their experience of using the tool (Baltic Explorer), their understanding of the ecosystem approach (based on the ESA4MSP concept), and their general views of tools like Baltic Explorer (see appendix for the semi-structured interview guide). The event organisers were also interviewed after each event and invited to reflect on tool use and its outcomes (for observation methodology see appendix). No observation took place on the online course, but the course facilitator was interviewed and provided survey results from the participating students.

[2] The tools were demonstrated at project meetings throughout to three-year project period. Especially Baltic Explorer was tested at the yearly meetings.

At all events, organisers handed out a questionnaire that was designed to evaluate the technical function of the tool and specific aspects of the event (Riga: insights gained with respect to the ecosystem approach; online course: the teaching elements). The questionnaires have thus mainly contributed to the further development of the tools but have in some cases also helped to interpret observation and interview results.

Methodological reflections and limitations

Data was collected on different aspects of the tools. Methodological flexibility was necessary because of the varying timelines of tool development and the different focus of the tools. For ESA4MSP and SPACEA, the main user groups are planners and experts; given that these tools were still in the early development stages when tested, tests were necessarily more informal and harder to observe compared to the use of more developed tools at public stakeholder meetings. Observation results are therefore not uniform and not available for all of the tools, reducing the scope for comparative assessment.

Practical testing of the tools had to be aligned with “real” MSP processes in the countries. Some countries such as Denmark, Estonia, Finland and Åland, are still in the drafting and consulting phase, but the majority are close to adopting their MSP plans or have already entered the implementation stage. Evaluation and learning are still under development in many BSR countries. Most of them have conducted a participation process well beyond the formal minimum requirements of one or two consultations on a plan draft and are working with a broad array of tools to collect and process scientific data and integrate stakeholder knowledge into their plans. While this opens opportunities for testing a wide range of tools in different settings, the fact that countries are progressing with their MSP plans also limits opportunities for tool assessment. This is because the MSP process narrows towards the end with respect to stakeholder integration, meaning there is less need for planners to organise stakeholder events or workshops.

Development of technologies/ tools is time-consuming and usually takes longer than an MSP project. Tools that could reasonably be tested only materialised in the last year of the project. By this stage, the scoping and early drafting phases of MSP with open stakeholder meetings had mostly been completed. This limited the operational environment in which the tools could reasonably be tested, and also meant there was less opportunity to organise dedicated tool testing events that could still make a meaningful contribution to the “real” MSP process.

Opportunities for organising dedicated stakeholder events was further limited by the Covid-19 situation which led to events being cancelled or postponed that would have been suitable for testing the tools in a “relevant” MSP setting, such as MSP courses, seminars and workshops.

Irrespective of the challenges outlined in this section, this report should contribute to knowledge development and understanding of tools in MSP and specifically the further development of the BASMATI tools and future implementation in MSP processes.

4 Review of the BASMATI tools

This chapter describes and analyses five tools developed in BASMATI, each analysed individually based on the analytical framework developed in chapter 2 and addressing the three research questions.

The five tools are all software applications that deal with spatial aspects as input to the knowledge base for evidence-based MSP. Using GIS or other modelling, they address different elements such as ecosystem components and services, status of the environment indicators and human use of the sea and can model the consequences of scenarios to be tested in the tools. The output of the analysis takes the form of GIS maps or models, which can be used for decision support or in interactions with groups and individuals with interests in the MSP process.

Table 4.1. The five reviewed tools as developed in BONUS BASMATI

Name of tool/application	Description
BALTIC EXPLORER	Interactive web map application for facilitating collaboration in MSP.
ESA4MSP	Ecosystem approach to value the marine seabed habitats and their contribution to human wellbeing. Assessing the ecosystem components and linkages for assessing the final ecosystem services.
MYTILUS	A toolset for fast cumulative assessment and mapping.
SEANERGY	Approach and spatial decision support tool to map potential conflicts and synergies between mare uses and exploring use-use interactions.
SPACEA GIS toolbox	GIS toolbox for facilitating spatial and environmental suitability analyses, performing simple MSP analyses on mussel farming sites in the south-western Baltic Sea.

4.1 Baltic Explorer – Web map application for Collaborative MSP

Baltic Explorer: Intended functions, user groups and application so far

Description of the tool

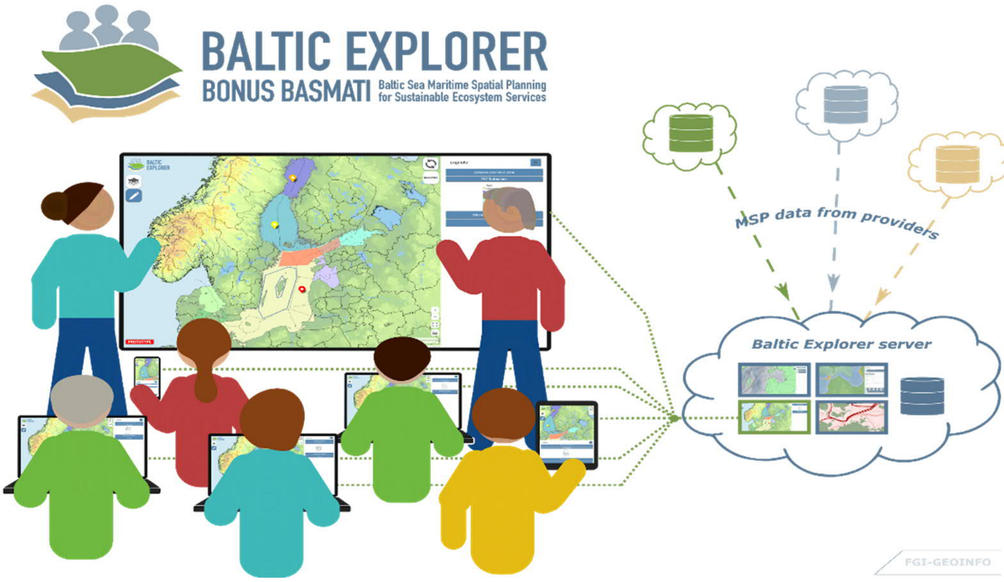
The interactive web-based, open source collaborative GIS tool “Baltic Explorer” was developed as a central part of the BONUS BASMATI project. The tool aims to facilitate collaboration in MSP in the Baltic Sea region by providing users with access to shared digital spatial workspaces and combining spatial tools with data from different remote spatial data infrastructures.

Figure 4.1: Overview of Baltic Explorer. The layers show the web application which can be accessed simultaneously from many different devices in collaborative events.

(Source: Baltic Explorer (n.a.).

Baltic Explorer supports multi-user participation by combining spatial tool functions, such as drawing and editing map input features, with open access spatial data from different maritime actors (e.g. HELCOM). The software is flexible and can be adapted to different user contexts. Key functionalities include multi-user access, user access control (where a moderator can set editing rights depending on the use situation), compatibility across different platforms, individual and shared workspaces as well as web map user interfaces. This enables users to explore spatial data and maps from multiple sources, draw, edit and add features on a base map, share results in multi-user workspaces as well as the possibility to work locally or remotely (from a distance) on multiple devices (Personal communication, 2020; Arki et al., 2020).

Figure 4.2: Illustration of collaborative use of Baltic Explorer



(Source: Arki et al 2020)

Initially, the developers aimed to design a full Spatial Decision Support System (SDSS) for MSP in the Baltic Sea Region, which would facilitate access to information and provide different analytical tools (e.g. suitability analysis or impact assessment). While the analytical element of Baltic Explorer has been developed to some extent (and was tentatively used during an MSP event, see observation box 4.1 below), feedback from the test events led the team to change the core functionalities of BE, giving more emphasis to collaborative functions. This included the opportunity for multiple stakeholders to analyse pre-installed data layers and to add their own knowledge in the form of drawing on the map.

The current format of Baltic Explorer is a collaborative GIS platform (web map application). This platform is separate from the analysis function (SDSS), which can be installed additionally (personal communication, 2020). When using Baltic Explorer online in a web browser, a workspace is set up to which relevant data layers are linked. The Baltic Explorer website is linked to a GIS server, which is a repository for spatial data, mainly retrieved from HELCOM portal, but also from other sources as relevant and necessary for specific use situations. Participants in events are then given access to the workspace and can pick out the data layers they find relevant. They can click layers on and off, e.g. to show examples of sea use or to obtain status information, as input to a discussion. Another functionality is that participants can draw on the map, e.g. to illustrate their own sea use. Depending on the setup, participants can add selected layers to a common map in the workspace.

So far, the developers of Baltic Explorer have created the workspaces with passwords for the stakeholder events. They have also been responsible for uploading data layers to the workspace, especially in cases where national and local spatial data was used at events. It is planned that anyone will be able to register as a user and create their own workspace. This will enable them to access all publicly available data layers pre-installed in Baltic Explorer, as well as upload their own data.

Target group

Initially, when the aim was to develop a Spatial Decision Support System for MSP in the Baltic Sea Region, the main target groups were planners, experts, and GIS experts with responsibility for developing the MSP and the MSP process. The analytical part of Baltic Explorer was to facilitate suitability analyses and impact assessments for these user groups. Analysis was expected to be based on the spatial data from public sources (e.g. HELCOM), data which is only accessible by experts (maybe restricted access or data from project not published etc.), as well as data collected in the collaborative part of the tool.

Over the course of the tool development process, Baltic Explorer came to specifically target collaborative group work, multi-user settings and collaboration with and between stakeholders. Here the main target group is planners with sufficient GIS skills to enable them to upload or select data layers for use in stakeholder events, either during an event or online. Based on the tests the developers confirm that operating Baltic Explorer requires at least some prior knowledge of data input and basic map application functionalities. This is supported by interviews with authority stakeholders (own interview, Riga) who emphasised they would prefer using the tool in dialogue with other authority stakeholders, seeing it as too complex for dialogue with citizen stakeholders. The developers also see use opportunities for Baltic Explorer and the basic software outside the MSP context and for many other types of users.

Application so far in BASMATI and the MSP context

Baltic Explorer has been tested in several MSP workshops throughout the Baltic Sea Region, both in controlled situations and in events that were part of real MSP processes. Participants included planners, national and regional authority representatives, maritime sector representatives, experts, researchers, and students in different constellations (see observation box 4.1). Baltic Explorer was also used in case studies alongside other tools and concepts developed in the BONUS BASMATI project; purposes included geo-visualisation and providing a collaborative spatial platform to carry out analyses and facilitate joint learning (see observation box 4.1). These tests have provided essential insights into how the application could be used for communication and stakeholder involvement in the MSP process. So far, the developers have supported event organisers by setting up the workspaces, adding all relevant data layers, and acting as mentors for the MSP event organisers (in general planners, but in practice the partners of BONUS BASMATI). However, it is possible for anyone to register on the tool's homepage and set up their own workspaces, enabling use of the app without the support of the developers.

Tool testing took place against the background of real MSP processes. Most countries were in their first rounds of MSP, meaning new institutions, new methods and new stakeholder involvement procedures were still being developed. A degree of flexibility was therefore anticipated in the development of Baltic Explorer. Surprisingly, however, developers encountered more or less firmly established MSP procedures and methods in the countries, leaving little room for planners to consider using additional tools such as Baltic Explorer. As a consequence, finding relevant test environments during the early development phase of the tool was a challenge. Challenges were also experienced in presenting prototypes and getting them tested by planners in real-life workshops, as this would have required planners to take time away from their day-to-day work (personal communication, 2020).

Observation box 4.1: Observations from testing Baltic Explorer with stakeholders

Observations from testing Baltic Explorer (BE) are derived from three sessions carried out by the application developers together with project research partners, external project representatives and stakeholders as well as Gothenburg University. Key participants included marine and coastal planners, sectoral representatives, researchers and experts, decision-makers and students. The following sections present observations and reflections in relation to interactions between test participants and application developers, challenges of involving stakeholders and challenges in using the tool collaboratively in MSP.

BE was tested as part of a cross-border workshop in Umeå, Sweden (2018-26-03) that dealt with MSP challenges in the Gulf of Bothnia* as part of the Pan Baltic Scope project. The participants included Finnish and Swedish MSP planners from the national and regional level, sectoral officials, environmental experts, researchers, regional associations and marine stakeholders from the fisheries and offshore wind sectors. An exercise was designed by the workshop organisers and tool developers that aimed to visualise current data and plans in the Gulf of Bothnia, sought to engage participants in discussion and asked them to draw new map layers. Participants were split into two groups and accessed BE on tablets provided on the day or their personal smartphones or computers. Observation showed that tool use did lead participants to discuss sectoral uses and relevant challenges and planning needs. Participants also asked for more detailed data, for example related to fisheries. Sectoral representatives thought that the tool could be useful when negotiating and discussing with planners.

In Riga, Latvia (2020-20-02), BE was used in a workshop that focused on Latvian MSP from an ecosystem perspective. Participants included key representatives from Latvian national and regional ministries and authorities, as well as NGOs. The main competences involved were planning, environmental management and GIS. The workshop included group work where BE was used as an interactive tool. Participants were split into two groups and tasked with designating a new wind farm area using the overlay and analysis function of BE. Observed and interviewed participants stated that BE provided an immediate link between officials from different authorities. They highlighted that BE could also enable the distribution and sharing of data between ministries and planning bodies at different levels, not least to identify solutions for dealing with protected areas for example. They also saw opportunities in BE for linking up with municipalities and thereby increasing precision in data exchange. They emphasized that data aggregation must be at a relevant, often high-resolution level. To use BE within the administrative system, it must be possible to harmonise data and analyses with existing platforms and data systems. Thus, the tool was deemed suitable for the interaction between decision-makers, ministries and knowledgeable stakeholder representatives. At the same time, it was considered too complex for interacting with the general public and stakeholders with less insight in the MSP process and data - the "ordinary people living their coastal lives".

BE was used as a platform for an MSP role play as a part of an online master course on marine governance at Gothenburg University, Sweden (April–May 2020)**. The students` task was to propose a cross-border marine plan for two areas in the Baltic Sea (Sweden-Finland and Estonia-Latvia where official drafts were already in place). The student groups of 16 persons were given roles as planners and 7 stakeholder types with cross-border and/or national interests. Each stakeholder type had their own BE workspace with HELCOM and case specific data layers. Based on analysis of relevant data layers in BE, they drew a map showing their interests. The planners made a plan draft based on the stakeholder maps which was discussed and negotiated at a Zoom meeting and during bilateral meetings between planners and individual stakeholder groups. During the process, new external requirements to plan priorities occurred as a part of the game. The teachers prepared the role play, including research of and processing of relevant local data for data layers in cooperation with the tool developers. During the role play, teachers observed the Zoom meetings and supported the student in using BE, again with tool developers as mentors. The role play revealed that BE could successfully be used by students with varying IT/GIS capabilities (from very little to some GIS experience). The facilitators (teachers) had to have good knowledge of relevant data sources and training in processing and uploading data for new data layers in BE. Here, the tool developers acted as mentors to the teachers/facilitators and they used feedback from teachers and students to make changes during the course. While the previous examples used BE in physical meetings, the course used it in a fully digital context. For this to succeed, BE must be supplemented by adequate communication channels (e.g. for discussions and negotiations). Furthermore, workspaces divided by stakeholder type allowed each stakeholder group to keep information from other stakeholders. In the role play and real life this might reduce mutual learning but strengthen the group in negotiations.

* see more at: http://www.panbalticscope.eu/when-fishing-and-energy-meet-in-gulf-of-bothnia/
** see more at: https://www.gu.se/studera/hitta-utbildning/forvaltning-av-havslandskap-i-tider-av-global-forandring-mar464

(Sources: participant observations, interviews, 2020 - see chapter 3)

Baltic Explorer: Applicability and lessons learned

Functionalities related to planning content

Baltic Explorer contains a range of pre-installed data layers, which can be selected or de-selected for evaluating overlaps. To supplement the preinstalled knowledge, the collaborative part can collect data and knowledge from the participating stakeholders through a functionality where participants can draw elements (polygons and points) on their own data layer and save this in the workspace. The drawings can reflect experience-based knowledge about areas and points of interest and specific uses. In this way the tool can collect the specific spatial knowledge of stakeholders to supplement the scientific knowledge contained in the pre-installed data layers. Experience-based knowledge can thus be included in the evidence basis for planning decisions. Baltic Explorer also contains an analytical part, for identifying areas with certain conditions (e.g. mussels but only few of certain algaes). This function was tested at the stakeholder meeting in Riga, but it is less developed so far, as are the drawing functions.

Functionalities related to process management

The collaborative part of Baltic Explorer has been specially developed. The main functionality of this part is the ability to have several devices (such as PCs, smartphones, iPads etc.) to access the same workspace. The workspace for the certain event at the web application can be worked at a single central unit (e.g. a large screen operated by an organiser or on a touch screen by a group standing around the screen), or all units can contribute with data layers, either by uploading their own drawings (as mentioned above) or by selection and deselection of the pre-installed data layers. Both models have been tested, although the first model with a central unit as a focus for the collaborative work and discussion was most used (as described in observation box 4.1 and in Rönneberg et al. 2019). While the drawing functionality has been less used, the collaborative part of selecting and deselecting data layers was used for collaborative work and discussion of specific tasks – e.g. the location of an offshore wind farm.

In relation to stakeholder involvement Baltic Explorer can support several levels of interaction in the MSP process. Selecting and deselecting data layers is useful for information and consultation, while the collaborative elements of the tool can support greater deliberation or even collaboration in the MSP process. The possibility of opening the use of Baltic Explorer to all registered users holds the potential for certain stakeholders to take responsibility for some elements of plan development, e.g. in smaller planning areas or as input for a full plan.

Potential for promoting cross-border collaboration

The scale and levels of application of Baltic Explorer can vary from local to cross-border – depending on the purpose, users, and the scope and level of detail of the input data. Primarily, Baltic Explorer is designed to support collaborative MSP on a Baltic Sea region scale. The input data infrastructure is based on broadly accessible spatial data from the Baltic Sea Region (e.g. HELCOM data); this data was used in most tests. BE therefore facilitates working with marine issues on a cross-border basis. The available spatial data can also be supplemented with regional or local scale data, which can be relevant even in cross-border events, as was seen at the cross-border event in Umeå (observation box 4.1). Accessing national or regional data, however, might be a challenge with respect to identifying data sources and obtaining the licence to use them. This was an issue even for planners organising national MSP processes.

Other functionalities also enable the use of Baltic Explorer in cross-border collaboration in MSP: it runs in English, is based on international standards and is open source with a source code shared online, which enables open use and development of the application in different contexts.

Input to specific process phases

Baltic Explorer is flexible and can be used for several phases in the MSP process where involvement of stakeholders for collection of knowledge and learning is relevant. The use of Baltic Explorer is obvious in the scoping phase for collecting knowledge from stakeholders of various types, or for initiating discussions and learning between participating stakeholders. The collaborative use of Baltic Explorer is also relevant in relation to consultations (in the drafting and consultation phase), where consequences of a given plan or plan scenarios can be illustrated and discussed. The same opportunities to illustrate consequences is relevant for the evaluation phase, where stakeholders again can collaborate on evaluating the plan and e.g. conflicts between different uses.

Technological readiness level TRL 5-7

At present, the originally planned full GIS software (i.e. Baltic Explorer with the collaborative and analytical part) is run as a prototype. Developers assess its technological readiness as level 5, indicating that it can function in a relevant environment. Development of the tool is an iterative process where functionalities and focus are continuously adapted in response to users, stakeholders, planning activities and the timing of test events in different MSP environments. The collaborative elements of the tool are more developed than others: For example, the online platform is up and running and has been used in MSP-related environments, such as courses for planners and marine sciences students. This part has therefore reached TRL 7. The opportunity for external users to register and create their own workspaces opens the tool for further use. Opportunity to upload own data would allow use also outside the MSP context, even in contexts using other types of data.

In terms of technological readiness, the developers emphasize that Baltic Explorer is flexible and can be adapted to different uses, commercial and non-commercial platforms, and markets. The source code is open source and can therefore be further developed by anyone interested (personal communication, 2020).

Overall assessment

Table 4.2: Assessment of Baltic Explorer

Description of the tool	Interactive web map application for facilitating collaboration in MSP, where users can collaborate on multiple devices in the same map-based workspace
Target group	Main user group: Stakeholders engaging in collaborative processes. Planners and experts with MSP process responsibility are the first user group as they generally prepare the events at which tools will be used.
Application so far in BASMATI and MSP contexts	Baltic Explorer has been used during several case study events within BASMATI and was tested at various other MSP events in the region. The analytical part was tested once, while the collaborative part was used several times to visualise activities and to enable stakeholders to collaboratively discuss planning solutions.
Functionalities related to planning content	The collaborative part includes drawing functionalities for collecting experience-based knowledge from stakeholders. The analytical part allows deeper analysis of combination of layers. The latter elements are only partly developed.
Functionalities related to process-management	A key function of the tool is to facilitate collaborative processes. Shared access to a workspace, even simultaneously contributing from own devices, is a central function. Other process-relevant functions include the drawing function (adding experience-based knowledge) and a new opportunity for registered users to create and use their own workspaces. The tool could potentially support high intensities of interaction – from information and consultation to deliberation and cooperation. The possibility of creating stakeholder-owned workspaces could potentially open up opportunities for developing alternative plans for the whole

	planning area or parts of it.
Functionality for facilitation of cross-border collaboration in MSP	Baltic Explorer is designed to support collaborative MSP on a Baltic Sea region scale. The tool contains spatial data from the Baltic Sea Region (e.g. HELCOM data) and is therefore well suited for cross-border collaboration. Other functionalities that enable cross-border application are that it runs in English and is based on international standards, with a source code shared online. For actual use, supplementary national or local data might be needed. This requires national planners/experts to identify data and data sources and to obtain a licence for using them.
Applicability in specific phases of MSP process	The tool is particularly useful in the scoping phase (collecting stakeholder knowledge), and during the drafting and consultation phase. The tool can also be used in the evaluation phase for evaluation of stakeholder experiences of the new MSP and possible use-conflicts based on this.
Technological readiness in relation to use in MSP	5-7. The originally intended full SDSS Baltic Explorer is developed to a TRL 5, tested in a relevant environment. The collaborative part, the web platform, is developed to a TRL 7, where it is used in operational MSP environments.

4.2 ESA4MSP: Ecosystem Service Assessment tool for MSP

ESA4MSP: Intended functions, user groups and application so far

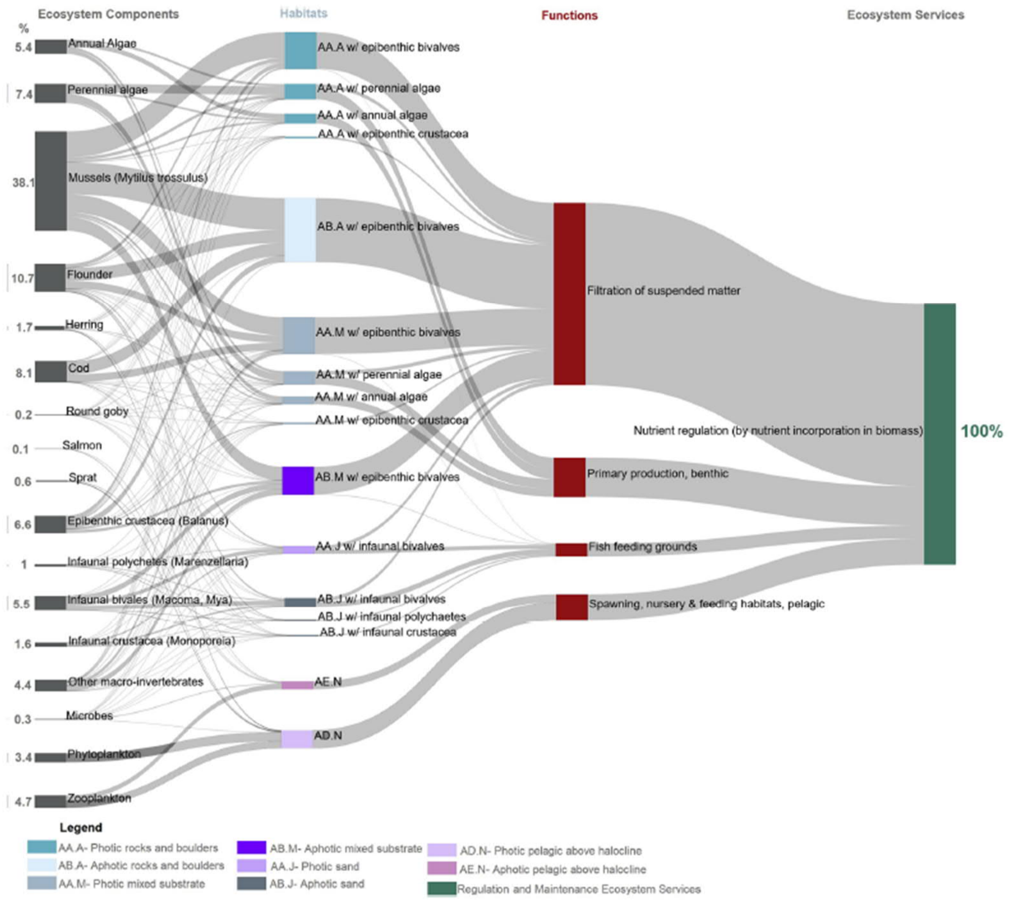
Description of the tool

The Latvian BONUS BASMATI case study focused on an integrated assessment of ecosystem services provided by marine seabed habitats (Strāķe et al 2018). An ecosystem services assessment serves as input for an economic assessment of the values of ecosystem services, which together with the graphic illustration of ecosystem services support the future designation of new Marine Protected Areas (MPA) and MSP in general (Armoškaitė et al 2020). To conduct the analysis, the Ecosystem Service assessment tool ESA4MSP was developed. ESA4MSP consists of two main parts, a matrix and a linkage diagram (fig 4.3):

a) The matrix follows the ecosystem services cascade to quantify the contribution of ecosystem components in the provision of ecosystem services. It ranks the role of different species (from zooplankton to predator fish species) in the maintenance of marine habitat types and is based on expert assessments with deep biological knowledge of the specific sea area, here the Gulf of Riga. The experts further quantitatively assess the links between the different ecosystem components for assessing the capacity of different habitat types to produce ecosystem functions. Finally, ESA4MSP calculates the size of the ecosystem services, i.e. economic, cultural, regulative and maintenance service for human well-being.

b) The linkage diagram visualises the interactions between the elements assessed in the matrix of ecosystem components and habitats. The calculations of function and ecosystem services are illustrated in a diagram of linkages between components, habitats, ecosystem functions and ecosystem services. The diagram is a central part of the tool – allowing good communication of linkages and output of ecosystem services. The diagram below (figure 4.3) illustrates the linkages related to the most important habitats of the Latvian sea area.

Figure 4.3: Graphical representations of the results from the Latvian case study, ecosystem service provision from selected habitats in the Latvian sea area, based on the ESA4MSP linkage diagram.



(Source: Armoškaitė et al., 2020).

ESA4MSP has been developed to assess ecosystem services provided by habitats in the Latvian sea areas with a further aim to develop scenarios for Marine Protected Areas (MPAs) and analyse the ecosystem services the different scenarios will provide.

Target group

The tool mainly addresses planners and experts as it takes expert knowledge assessments and input for constructing the basic matrix of the relative importance of the ecosystem components identified. The graphic is mainly intended to illustrate the different types of ecosystem services and how they contribute to human welfare. This can be used as base information for scenarios – as such it is the experts' illustration directing the planners, which can use the graphic illustration to explain the background to other stakeholders, though with some level of background knowledge about ecosystems and their function.

Application so far in BASMATI and MSP context

The tool has been used for the Latvian case study and in relation to a PhD related to BASMATI. It has not been used formally as part of the Latvian MSP process. Nevertheless, it provided two types of input for planners. Firstly, the graphic illustration has been used at meetings with planners (for MSP and other authority stakeholders) to illustrate ecosystems and ecosystem services, in order to strengthen the ecosystem approach in the MSP planning (e.g. the observed meeting in Riga Feb 2020, see observation box 4.1). Secondly, the knowledge generated with the tool for the Latvian case study was used in an economic assessment of the value of the ecosystem services in the scenarios. This was used in a parallel activity in Latvian case study, as described in Pakalniete and Armoskaite (2019) and Armoskaite et al. (2020).

ESA4MSP: Lessons learned

Functionalities related to planning content

The functionalities of ESA4MSP mainly allow for gathering and processing data from experts for knowledge input to MSP. The tool processes the data in the matrix and calculates the provision of ecosystem services from different types of habitats. The illustration and graphical representations of the services and their production support planners in identifying areas and activities of relevance for further spatial planning.

Functionalities related to process management

Especially the graphical representations can to some extent be used to inform stakeholders, particularly those with some background understanding of ecosystems and the ecosystem approach. ESA4MSP is not primarily intended to promote broader stakeholder involvement and interaction amongst them, although its outputs could be used for these purposes.

Potential for promoting cross-border collaboration

ESA4MSP focusses on Latvian waters and has not been used/tested in relation to cross-border collaboration. Nevertheless, the researchers see good opportunities for using the tool in relation to cross-border collaboration (personal communication, 2020). Although ESA4MSP can (or will be able to) be applied everywhere, it is particularly useful in the Baltic Sea Region as the matrix is based on the HELCOM underwater classification which is accepted by all Baltic Sea countries. Use outside of the Baltic Sea Region would require another common classification system. The language in ESA4MSP is English, meaning the tool could be used wherever English can be used as a working language.

Data input is essential for applying ESA4MSP. The ecosystem components (for the matrix) are well defined by HELCOM for the Baltic Sea Region, although there might be inadequate data at a smaller scale. In cases where data is insufficient, tool users would have to agree on how to make "guesstimates" to cover data gaps. New ecosystem service types have been defined for the specific Latvian case. Agreeing on and defining the ecosystem services to be assessed by ESA4MSP would therefore be critical for using the tool in a cross-border context. In summary, ESA4MSP can therefore be used for establishing a common understanding of ecosystem services as part of cross-border cooperation. Cross-border use requires involvement of local environmental experts for data provision and for agreeing on common standards, e.g. how to define ecosystem services and how to handle the lack of data at any relevant scale.

Input to specific process phases

ESA4MSP mainly addresses the scoping and drafting phases of the MSP process as it generates ecosystem knowledge that can be used in developing planning options. Knowledge about specific ecosystem components, functions and services can help planners to draft scenarios, e.g. for marine protected areas (MPAs).

The graphic part and illustrations can be in dialogue with stakeholders, especially those with background knowledge of ecosystems. Tool outputs can be used for explaining different planning options to stakeholders during the consultation and implementation phases of the plan.

Technological readiness level TRL 5-6

Presently, ESA4MSP has been developed and used to show how different scenarios of protecting seabed habitats in MPAs in Latvian waters would affect ecosystem services. According to the developers ESA4MSP is only accessible for the research group developing the tool (personal communication, Aug. 2020). However, it is in continued use in a PhD project and there are plans to develop it further in a new research project. For use in these contexts, data requirements for the matrix and calculations for ecosystem functions and related services will be standardised so the tool can be applied by other researchers and in other contexts. At the present stage, the tool is at the technology readiness level of 5 or 6, meaning it has been validated in relevant environment (a marine planners´ environment) and at a workshop for authority stakeholders in Riga in February 2020 (mentioned in observation box 4.2). In the latter event ESA4MSP was demonstrated to explain the methodology behind proposed MPA scenarios, as a tangible example of the ecosystem approach in the planning process. The linkage diagram helped the participants to gain a better understanding of the ecosystem approach to some degree (between somewhat and much in the survey conducted by FGI (2020).

Overall assessment

Table 4.3: Assessment of ESA4MSP

Description of the tool	The tool consists of two parts: 1) Data collection in a matrix of links between the different ecosystem components for calculating the capacity of habitat types to produce ecosystem functions. 2) Graphic illustration of linkages and ecosystem services.
Target group	Experts and planners with responsibility for the planning process during the scoping and drafting phase; stakeholders (individuals or organisational) with some background knowledge about ecosystems as a secondary target group for the illustrations produced by the tool.
Application so far in BASMATI and MSP contexts	ESA4MSP was used for the Latvian case study for constructing scenarios of possible MPAs, and for calculating the economic value of ecosystem services in the scenarios. It has not been used directly in Latvian MSP planning. Graphic illustrations were used in an event with authority stakeholders.
Functionalities related to planning content	ESA4MSP handles the collection of expert knowledge and information on ecosystems functionalities, functions, and services. It further process data for assessments and provides graphic illustrations that can be used in plan proposals and decisions.
Functionalities related to process management	ESA4MSP is not designed for MSP process management. Illustrations can be used in some stakeholder events (mainly for information) and possibly as a basis for consultation dialogues.
Functionality for facilitation of cross-border collaboration in MSP	Providing common scenarios for ecosystem service provision from habitats across borders, ESA4MSP could support cross-border cooperation at a national level if there is collaboration between national experts and planers
Applicability in specific phases of MSP process	Data and knowledge collection by the tool are relevant to the scoping and drafting phase. Assessing the scenarios produced by the tool is relevant in the drafting phase. The graphic illustrations can be used for informing stakeholders with some background knowledge of ecosystems functions and services during the consultation phase.
Technological readiness in relation to use in MSP	The tool has been developed to a TRL stage of 5-6, validated in relevant environment and demonstrated in an operational environment at one event.

4.3 MYTILUS: a toolbox for assessing impacts of maritime activities

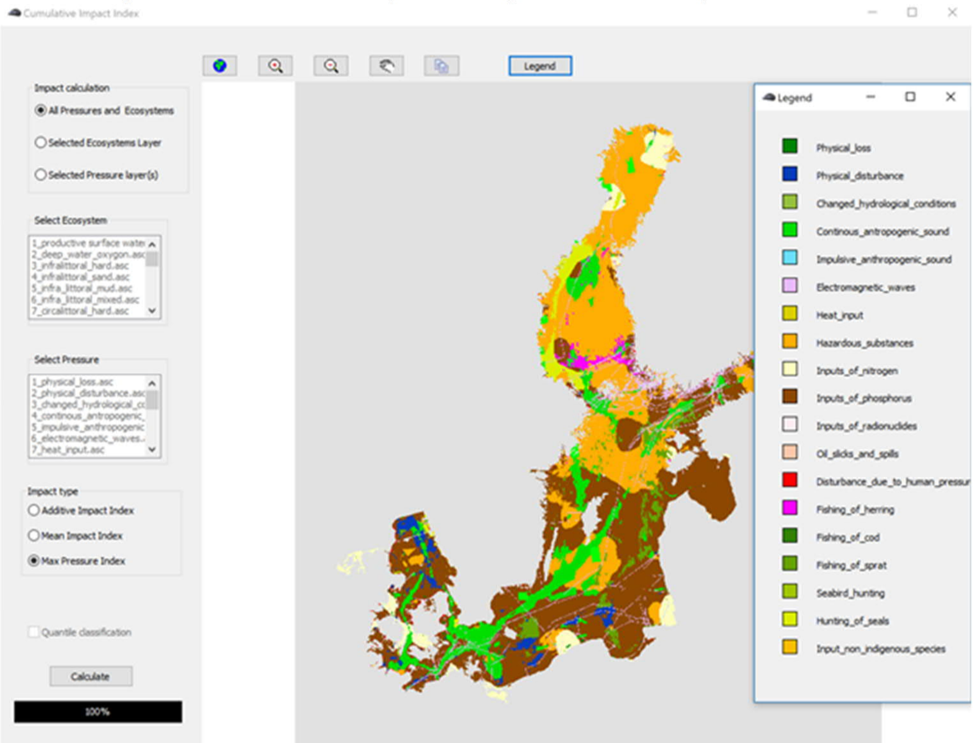
MYTILUS: Intended functions, user groups and application so far

Description of the tool

The toolbox MYTILUS has been developed under the BASMATI project based on technology developed in an earlier project (NorthSEE project, personal communication 2020). MYTILUS has been used as an underlying toolbox e.g. for SEANERGY at a stakeholder meeting (see observation box 4.2 below).

MYTILUS was developed to assess the effects of human activities on marine ecosystems and possible conflicts between activities. Analysing existing tools in the field, it became clear that there was a need to be able to assess the effects of several human activities, and to do calculations and adjustments fast, providing an easy-to-grasp visual result. It was also recognised that for practical implementation the system should be based on free or low-cost technologies (Hansen 2019). MYTILUS is a user-friendly open source toolbox for assessing cumulative impacts of various maritime activities on marine ecosystems and associated services. It applies a scenario-based approach to analyse and visualise the effects of different MSP proposals in a high-performance environment.

Figure 4.4: Example of the visualisation of impact on ecosystems. Screen dump from MYTILUS.



(Source: Arki et al 2020).

MYTILUS is a stand-alone tool which can use several standard data formats as input. It can import raster as well as pressure data from external sources at any scale, depending on the spatial data available. So far HELCOM ecosystem and pressure data were used. The spatially specific data layers can be pre-installed for easy use by anyone without deep GIS knowledge. The outcome is presented as ESRI ASCII raster data which allows for export to ArcGIS or QGIS for further processing.

Loaded with spatial data on ecosystems and human pressure in specific layers, MYTILUS can calculate the cumulative impact of pressures on specific ecosystems and areas in different scenarios. Variates of expected human activities can be added to the specific scenario. It uses a cubic system architecture to package the layer data for faster data processing and therefore mapping output. The fast processing and presentation of maps showing the cumulative impact of the chosen scenario allows different scenarios (varying uses and pressure levels) to be tested within a short time.

Target group

The target group for MYTILUS is experts and planners, including those with less GIS knowledge (use of pre-installed data layers) and the more experienced who can install other data layers and export results to standard GIS applications. At one event, MYTILUS was used as the underlying architecture of the SEANERGY tool (observation box 4.2), where fast processing enabled maps to be updated immediately to show the consequences of different planning options to stakeholders. A secondary user group is thus planners trained in using the tool, who can use it to engage with all types of stakeholders without specific GIS knowledge (authority and societal, organised and individuals).

Application so far in BASMATI and MSP context

MYTILUS was developed to support planners in assessing effects of human activities in the sea as an input for planning and prioritization in the MSP process. In the BASMATI context the tool was used for running the SEANERGY conflict assessment tool.

MYTILUS: Lessons learned

Functionalities related to planning content

MYTILUS is primarily a tool for supporting planners in organising and processing data to assess cumulative impacts of human activities as input for planning scenarios. It is an easily accessible tool, open source and can be operated with pre-installed data layers. For more advanced use own data layers can be added. It supports the easy exchange of data to frequently used GIS software for further analysis and mapping. The fast processing allows testing of cumulative impacts in various scenarios.

Functionalities related to process management

The easy and fast functionalities are also central for use in relation to processes and stakeholder involvement, as demonstrated (observation box 4.2). MYTILUS can be used in dialogue and involvement processes, where changes and adjustments proposed by stakeholders can be visualised quickly. If the application is operated by a planner familiar with MYTILUS, the tool can even be used in dialogue sessions with stakeholders without GIS knowledge, and still contribute with visualisations of the consequences of the various alternatives or adjustments. In that way MYTILUS could be used for information and consultation and potentially also collaboration.

Potential for promoting cross-border collaboration

Cross-border cooperation and collaboration can be supported by MYTILUS. So far it has been developed and tested using data from the Baltic Sea, but it can in principle be used anywhere. Although data was mainly derived from the HELCOM portal covering the whole Baltic Sea, MYTILUS has also been tested at a smaller geographical scale using Swedish data from the national MSP process. Since HELCOM data is accepted and harmonised across the Baltic Sea Region countries, the tool can be readily used for cross-border cooperation in contexts where this data is sufficiently detailed. In other cases, where nationally refined data on human activities is needed, use of the tool for cross-border cooperation depends on access to national data, which might be via national experts participating in the activity, as well as shared data definitions and values.

The need for mutually agreed definitions is even more important if MYTILUS is used for cross-border collaborative processes with stakeholders. Once shared definitions have been established, visualising status and impact information can support dialogue across different groups.

Visualisation can also lead to mutual learning, e.g. by illustrating the consequences of ideas proposed by stakeholders.

Input to specific process phases

MYTILUS can be used in several MSP process phases. It can assess the impacts of various human activities on environmental status as part of the drafting phase. It can also help in drawing up planning alternatives or scenarios by calculating and visualising the consequences of different choices. Fast data processing and updating of maps make the tool a useful addition to the consultation phase.

Technological readiness level TRL 6

At present the MYTILUS application has been developed to a TRL stage 6. The tool has been validated and demonstrated in relevant environments such as the BASMATI PHD course (Hansen 2019). It has also been used as a basis for the SYNERGY tool (mentioned in observation box 4.2), demonstrating its use in the context of conflict and synergy analysis. The next steps depend on opportunities to further use the tool in operational environments, e.g. in ongoing MSP processes. Here the timing of actual MSP processes at national and regional levels is decisive. Other planning settings could also be useful testing environments as the tool is applicable everywhere depending on available data.

Overall assessment

Table 4.4: Assessment of MYTILUS

Description of the tool	MYTILUS is a stand-alone application for geospatial analysis and visualization. It has a user-friendly interface and fast processing for updating the consequences of changes in data input in real time. The output is transferable to professional GIS systems such as ArcGIS or QGIS.
Target groups	The main target groups are experts and planners. Due to its flexibility of with respect to data (using pre-installed data or allowing own data to be used), both those with and without prior GIS knowledge can use the tool. Stakeholders in general are a secondary user group in interactive settings.
Application so far in BASMATI and MSP contexts	MYTILUS has been used at MSP stakeholder events, where it was used for running SEANERGY in a fast way, allowing immediate updates of maps.
Functionalities related to planning content	MYTILUS is primarily a tool for cumulative assessments and visualising scenarios; this can be used for developing plan content.
Functionalities related to process-management	Several functionalities (user-friendly interface, fast processing, and GIS visuality) give MYTILUS a role in stakeholder involvement and dialogue. Operated by a trained planner it can be used for information and consultation and potentially also collaboration.
Functionality for facilitation of cross-border collaboration in MSP	MYTILUS can be used in cross-border contexts depending on data input. Like other tools this requires data at the right scale, as well as agreement on definitions, which implies the involvement of national experts. If these conditions are met MYTILUS can provide a knowledge base for cross-border cooperation between national planners and can help cross-border stakeholder processes through its capacity to visualise scenarios.

Applicability in specific phases of MSP process	MYTILUS is primarily useful for drafting plans, and, if operated by a planner trained in the application, also for events in the consultation phase.
Technological readiness in relation to use in MSP	MYTILUS have been validated and tested in a relevant environment during a PhD course. It was also used as a basis for SEANERGY at a course for maritime planners and has therefore reached TRL level 6.

4.4 SEANERGY: A spatial tool for analysing conflicts and synergies

SEANERGY: Intended functions, user groups and application so far

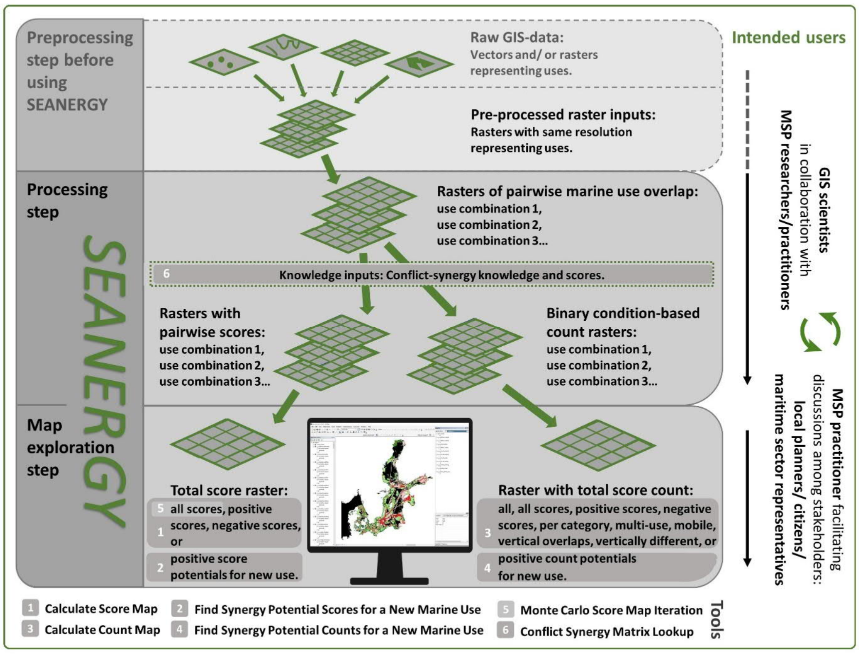
Description of the tool

The GIS based tool SEANERGY, developed in the BONUS BASMATI project and specifically as a PhD project, facilitates a cross-sectoral approach in MSP. It provides options to spatially analyse different stakeholder activities with the aim of strengthening synergies and decreasing conflicts between different marine uses and activities.

Examining synergies and conflicts between human-based uses and the environment (use-environment interactions) is an essential part of MSP, however, the exploration and analysis of interactions between the different marine uses is also critical. Due to intensified claims on marine space and pressures from a variety of marine uses and activities, the concept of co-location is becoming increasingly important in MSP. Spatial-temporal co-location of marine human uses can strengthen synergies between different sectoral uses and their spatial allocation – and can in that regard contribute to conflict mitigation and more efficient use of marine space (Bonnevie, 2020). For this purpose, the SEANERGY tool, developed as an ArcMap toolbox, facilitates a new approach as a spatial decision support tool mapping the potential interactions, conflicts, and synergies between different marine uses (Bonnevie, 2020). Its capacity to identify options for co-location of uses contributes to the cross-sectoral approach pursued by MSP.

The SEANERGY prototype was developed in Python 2.7 as an ArcMap toolbox extension with a geographical focus on the Baltic Sea, applying input marine GIS data from HELCOM in a raster format. Testing the methodology with stakeholders was based on a spatially narrower case study area. By combining results from previous studies and knowledge about conflicts and synergies in the Baltic Sea, the tool developer deduced preliminary scores for different marine uses placed in a pair-wise use-use matrix. SEANERGY was developed to spatially explore the conflict-synergy linkages provided by this matrix. The SEANERGY tool package includes six tools as shown in figure .4.5 below, describing the tool functions, expected users, and application process.

Figure 4.5: Overview of the functionalities, process, and key users of SEANERGY



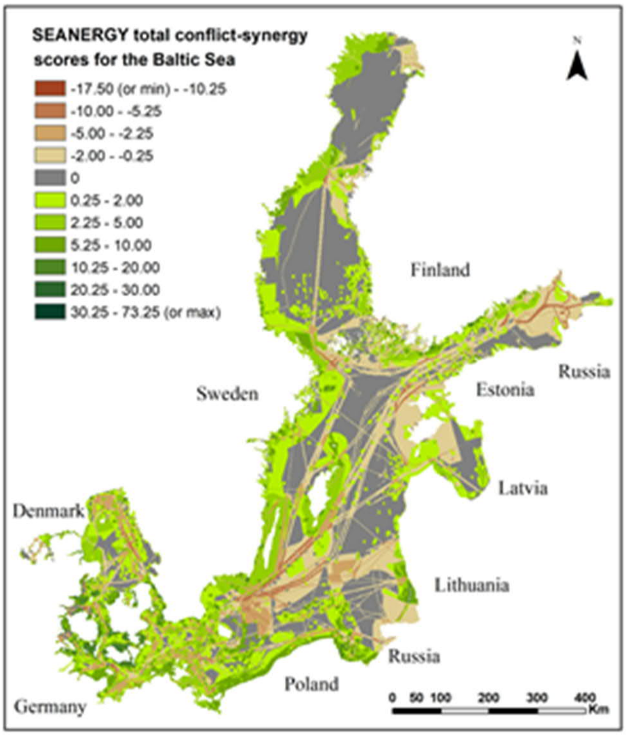
(Source: Bonnevie, 2020).

As shown in figure 4.5, the tool methodology applies scores describing how conflicting or synergetic each pair-wise marine use combination is. It then creates conflict-synergy maps based on where the marine uses spatially overlap within 1x1 km^2 raster cells/squares. Conflict score inputs are negative and synergy score inputs are positive. To conduct an analysis, GIS raster-based data is required for the location of marine uses and a marine pairwise matrix containing the conflict and synergy scores. The prototype also includes an uncertainty analysis that considers score input uncertainty and how result patterns are sensitive to potential input changes.

While the GIS program ArcMap is required to run SEANERGY, both the tool, the source code and the synergy-conflict matrix are freely available on GitHub[3], which allows tool developers (experts or GIS planners) to use it directly or further develop it for specific use.

[3] Available at: https://github.com/IdaMBonnevie/SEANERGY.git

Figure 4.6: A total conflict-synergy score map for the Baltic Sea area based on SEANERGY spatial analysis



(Source: Bonnevie, I, 2020).

Target groups

The key target groups include marine spatial planners, researchers, local planners, GIS experts/facilitators, sectoral stakeholders, and citizens. These user groups can have different degrees of access to SEANERGY, or different roles in using the different functionalities. The preparatory steps and data processing of SEANERGY (applying conflict/synergy scores) can be complex and technical to run, so they depend on GIS experts working in collaboration with MSP planners or researchers. Exploring and discussing the output map could involve stakeholders, planners, and experts, involving e.g. marine sector representatives, local planners and citizens with a stake or interest in the allocation of marine uses. Stakeholders could discuss the output map and request new explorations to be done with the tool – either changing scores and/or change the marine uses to be considered (Bonnevie et al., 2020).

Thus, the targeted user groups include tool facilitators who can work with the data and run analyses, as well as discussion participants and experts/stakeholders engaged in specific marine activities. Depending on the target group, the tool could be used in different ways, and users could be given different access to the tool functionalities. As elaborated by the tool developer, stakeholders could contribute to the score knowledge and even change or evaluate input scores, meaning the tool could enable interactivity across actors with different types of knowledge. Pre-defined scores may be more useful for citizen's participation as citizens may not have enough technical knowledge of the data and how to calculate scores for marine use combinations. Thus, it is mostly the spatial mapping part of the tool that would be interesting for them to explore. But the inclusion of citizens also depends on how the tool facilitators and the planning process address citizens and local knowledge (personal communication, 2020).

Application so far in BASMATI and MSP contexts

At present SEANERGY has been developed and run in a laboratory environment and has not been fully employed with its intended stakeholders or in MSP processes. However, some of the SEANERGY methodology (not the SEANERGY tool itself) was tested in a workshop as part of the

SeaPlanSpace project based on Danish GIS data for a local marine area surrounding the Danish island of Møn, as elaborated further in observation box 4.2 below.

Observation box 4.2: Observations from testing SEANERGY.

SEANERGY was tested in an MSP "relevant environment", namely a seminar on MSP "Sector and stakeholder perspectives: Cultural heritage, recreation and tourism in a sustainability perspective", one of 8 seminars organised by the project SEAPLANSPACE in Copenhagen on Aug. 17, 2020*. Participants included local planners, NGO members, other professionals and local citizens. There were pronounced differences in the background knowledge among the participants, but all had an explicit interest in learning about the planning process and the issues behind it. The moderators were researchers from the BONUS BASMATI project.

The seminar consisted of presentation and discussion of recreation and tourism in relation to MSP, followed by an introduction to the framework for sustainability assessment of plan proposals (developed in BASMATI) and the tool SEANERGY. The tool was used in group work around two cases regarding the location of offshore wind power and aquaculture, respectively. Based on the cases, participants discussed the ecosystem services (goods), who benefits from this and related conflict and synergies.

The first part of the group work focused on the status of marine uses in the case area and the ecosystem goods. For this, Baltic Explorer (see above) was used as tool to illustrate the spatial distribution of uses (e.g. various shipping types, wind power, fisheries, cables etc.) for the case area. The moderator operated the workspace in Baltic Explorer by activating the relevant data layer(s) and maps to be shown for the whole group on a large screen. The map and selected data layer helped focus the discussion on the actual theme. Participants reflected on the current status of the case area (e.g. "so many cables?")-or linked the layers to other factors (e.g. calling for data on bird migration routes or currents).The second part of the group work focused on conflicts and synergies. The moderator presented the SEANERGY conflict-synergy concept and maps and graphs for the Baltic Sea and the case area. This initiated a discussion about scoring (how and who to assess scores, how to score for periodic use), and how to assess the conflict buffer in "neighbouring conflicts" (at what distance can a view of wind turbines influence the market value of summer cottages on the coast?). For the continued discussion, the moderator changed the distance for "neighbouring conflicts" for wind turbines and summer cottages from 3 to 30 km. By running the SEANERGY methodology in the MYTILUS application it took a few seconds to update the map and table. The discussion could then immediately continue based on the new buffer zone.

Participants regarded the SEANERGY method and concept as highly relevant for identify and addressing conflicts and especially potential synergies, however, some questioned the specific scores and how they are set. Observation indicates that the visualisation in maps and graphs helped focus on one (or a few) dimensions at the time and thereby structured the discussions. The focus enabled aha-moments but also made room for individuals to develop experiences related to the topic of focus. At this meeting, some participants did not get the idea of the exact data from graphs and maps. Nevertheless, the mapping of conflict zones and elements of the graphs initiated focused discussions around specific scorings and conflict zones.

A key lesson from the group work is that the tools, including SEANERGY, require in-depth knowledge of the tool to be able to operate it to support the group discussion. Furthermore, the tool (calculation and visualisation of graphs and maps) requires a well-functioning internet connection and computing power. Baltic Explorer worked well as a visualisation tool operated by the moderator as it shows the spatial distribution of relevant layers.

* For more info: https://seaplanspace.eu/education/denmark/

(Sources: participant observations, interviews, 2020 - see section 1.7)

SEANERGY: Lessons Learned

Functionalities related to planning content

SEANERGY can support planners and stakeholders to explore potential synergies and conflicts between different uses. Such analyses, complemented with CIA, are valuable in planning when allocating space and prioritising between different uses.

The tool prototype has focused on the Baltic Sea scale and has purposefully focused on operating at more overall levels, rather that detailed levels of conflicts or synergies. However, the SEANERGY scope and application can to some degree be flexible to suit user needs. Furthermore, it is possible to explore new, not-yet located, marine uses to see their potential synergy areas – or it can be used for scenario analyses for marine uses that already have a spatial location. Another potential is to combine the tool with cumulative environmental impact assessment maps, making it possible to identify areas with both high synergies and low cumulative environmental impacts (see Bonnevie et al. 2019 for an example of how to do this). The tool can serve as an addition to, or methodology in suitability analyses to include a use-use synergy perspective when allocating new marine uses, such as offshore wind power development.

While the tool can be applied at a broad scale, the aim is also to make it operationalizable for local planners in smaller sea spaces and planning contexts – making it flexible to different geographical scales, planning levels, and users engaging in MSP. However, the narrower and more detailed the data become, the more difficult it becomes to collect it (the data might simply not be available) and the more challenging it becomes to evaluate potential synergies and conflicts based on generalized input scores.

Functionalities related to process management

SEANERGY focuses on spatial conflicts and synergies and the interaction between marine uses. It can help provide planners with an overview of spatial patterns of different marine activities and uses in a sea area. For this purpose, it can be used interactively with stakeholders throughout a planning process, and potentially also when assessing the allocation of specific uses in plans.

The fact that stakeholders can contribute to the score knowledge and even change or evaluate input scores means the tool encourages interactivity between actors with different types of knowledge. Stakeholder interaction when using the tool, for example when discussing and valuing the input scores, can enable discussions on how marine uses are valued by different stakeholders (personal communication, 2020).

Potential for promoting cross-border collaboration

SEANERGY operates at an overall level, providing an overview of spatial patterns and interactions between uses at a high level. This can support its application in different cross-border contexts. It could support cross-border consultation and collaboration, for example in assessing different marine uses and their potential conflicts and co-location options.

Although specific data quality varies between countries, the classification of input data available from HELCOM is accepted by all Baltic Sea countries, enabling this data to be used in transboundary planning and analyses. SEANERGY can enable planners and other stakeholders in MSP to apply holistic and cross-sectoral perspectives in planning, which is also integral in cross-border collaboration. It can help planners and stakeholders to work with conflicts and synergies at transboundary scales, avoiding too many conflicting marine uses in close spatial proximity. Achieving a fuller overview of potential use conflicts and synergies could be especially useful for cross-border collaboration in marine areas where levels of use and interests are intense. There are also some practical aspects that enable the use of SEANERGY in cross-border constellations. Firstly, the tool runs in English, which supports its international potential. Secondly, it can run at a sea basin level, which also facilitates cross-border collaboration application. However, a limitation of SEANERGY is that it only focuses on the spatial-temporal dimension of conflicts and synergies, excluding non-spatial, processual conflicts and synergies (personal communication, 2020).

Input to specific planning process phases

SEANERGY can provide valuable input to the scoping phase of MSP by exploring use-use conflicts both in existing and potential use scenarios. Furthermore, drafting and consultation phases can also benefit from using SEANERGY in an interactive environment, engaging stakeholders, planners and experts in looking at map outputs or discussion of scores. It could potentially also be applied in the drafting phase when assessing specific planning scenarios. Finally, for the evaluation phase, the tool could provide valuable analyses of use-use conflicts and synergies.

Assessment of the technological readiness level (TRL)

In terms of the technological readiness index assessment, SEANERGY is at a mid-range stage (TRL 5). It has been validated in the developers' "laboratory", but also through peer review (Bonnevie et al. 2020). The SEANERGY methodology has recently been used (and thereby tested) in a relevant environment, in this case a course for MSP planners and interested stakeholders (as elaborated in observation box 4.1). The tool has thus taken the first steps into stage 5 of TRL, which is validation of the tool in the relevant environment.

Overall assessment

Table 4.5: Assessment of SEANERGY

Description of the tool	SEANERGY is an ArcMap toolbox and decision support system that maps use-use interactions and potential conflicts and synergies between different marine uses. It is composed of six tools; Calculate Score Map, Find Synergy Potential Scores for a new marine use, Calculate Count Map, Find Synergy Potential Counts for a new marine use, as well as a Monte Carlo Score map iteration tool and a Conflict Synergy Matrix Lookup tool.
Target groups	Main user group: GIS experts and MSP planners/researchers (mandatory facilitator role), Optional, secondary user groups: marine sectoral experts, sectoral stakeholders, local planners, and citizens.
Application so far in BASMATI and MSP contexts	Run and validated in a laboratory environment, but also validated through peer review (Bonnevie et al 2020). The methodology has recently been tested in a course for MSP planners and interested stakeholders. SEANERGY has not yet been applied in formal MSP processes.
Functionalities related to planning content	Can support planners and stakeholders to explore synergies and conflicts between different uses. Scenario analyses for allocating marine uses. Another potential is to combine the tool with Cumulative Impact Assessment tools or maps. It is also possible to explore new, not-yet located, marine uses to find potential synergy areas.
Functionalities related to process management	Focuses on the spatial aspects of conflicts and synergies and the interaction between marine uses. It can be used interactively with stakeholders in a planning process.
Potential for promoting cross-border interaction/collaboration	Operates at an overall level. Provides an overview of spatial patterns of interaction between uses and spatial conflicts and synergies, which can support cross-border application. Classifications of input data available from HELCOM are accepted by all Baltic Sea countries, which enables the tool to be used in transboundary planning challenges or analyses. Cross-border collaboration and working with conflicts and synergies at transboundary scales is enabled.
Use in MSP phases	Scoping (possibility to explore use-use conflicts for existing uses and scenarios), Drafting and consultation (collaborative assessment of use-use conflicts or synergies, collaborative assessment of different spatial allocation scenarios), Implementation and Evaluation of the plan and the process (evaluation of existing use-use conflicts/synergies).
Technological Readiness in relation to MSP	Assessed up to level 5. Developed as a small-scale prototype in a laboratory environment. Has recently been tested in an example of the intended and relevant environment.

4.5 SPACEA: GIS toolbox

SPACEA: Targeted functions, user groups and application so far

Description of the tool

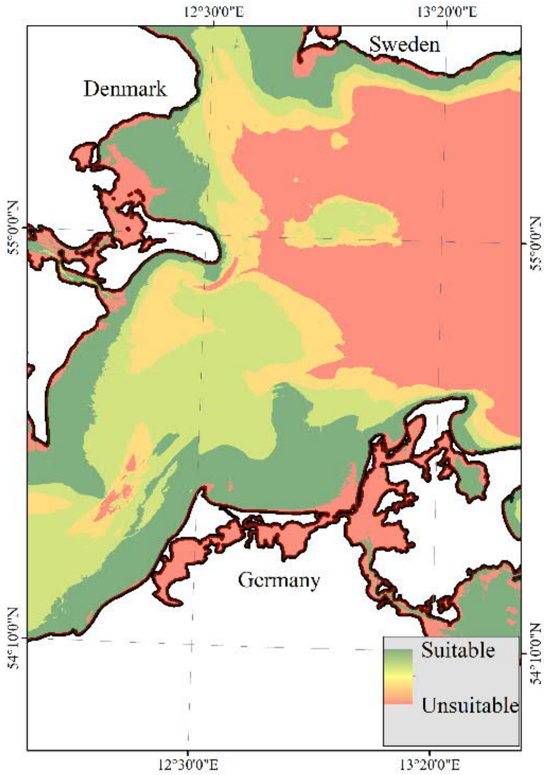
As part of the BONUS BASMATI project, a Danish-German aquaculture case study in the south-western Baltic Sea revealed suitable mussel farming sites by applying a geospatial suitability analysis based on the SPACEA GIS toolbox and an ecological model for assessing the potential synergies of placing a mussel farming site close to a fish farm.

The SPACEA GIS toolbox was developed specifically for spatial analysis. SPACEA combines environmental conditions with different spatial interests, with the aim of revealing conflicts and synergies between different uses and between uses and the environment. The toolbox consists of five GIS tools, which work together to perform suitability analyses. Vector as well as raster-based data can be used, and buffer zones can be created. All five tools are applications that can run with a general GIS program such as ArcGIS. They are "BufferMarineUses", "RasterCreation", EnvironmentalThresholds", "SustainabilityFunction" and "SustainabilityAnalysis". (von Thenen et al 2020 and von Thenen et al 2020 (coming).

When all (sub-)tools are applied, the final outcome is a raster map showing which areas could be suitable for a specific marine use. The toolbox is flexible, meaning the tools can also be used separately for various purposes. SPACEA can use environmental data and data related to marine uses as input. In order to obtain the best possible result, planners need to make sure that the input data is of good quality, relevant and at the right scale. Lower quantity or quality of data (e.g. low resolution) can still be used, but the resolution of the final raster map will be correspondingly low. Nevertheless, SPACEA can be used in data-scarce regions, with some reservations concerning the level of detail of the final output.

The SPACEA GIS toolbox is still under development. Currently, all input data is regarded as equally important, so when data on salinity and chlorophyll is combined, the suitability analysis assumes that both parameters are equally important for mussel farming. However, in multi-criteria analyses, it is very common to apply weights to the criteria, for example saying that salinity accounts for 60% and chlorophyll for 40% of the suitability of an area for mussel farming. At the moment, this cannot be done directly in SPACEA. In a similar way, all marine uses are treated as equal constraints, but weighting could also be applied to the marine use data layers, so that they contribute differently to overall suitability. An existing offshore wind farm, for example, would quite definitely preclude mussel farming (unless the aim is to place a mussel farm within the wind farm), whereas recreational fishing areas may not be as restrictive. The data layer showing recreational fishing areas could thus be given less weight. Therefore, the tool is open to further development of functionalities, depending on future use and financing.

Figure 4.7: Example of using SPACEA to identify suitable depth ranges for mussel farms – from the BASMATI Danish-German case study



(Source: Arki et al., 2020)

Target group

The SPACEA toolbox is designed to require minimal input from the user and can be used by people with different levels of GIS expertise. The more novice GIS user can use the tools in ArcGIS with a similar interface to the other tools provided by the software. More experienced users can run and modify the tools' python scripts in the manner they see best. The main user group for SPACEA as a tool is thus GIS users at novice or expert level, primarily among planners or experts supporting the planners.

Application so far in BASMATI and MSP contexts

In the BONUS BASMATI case study, SPACEA has been used for calculating the effects of different mussel farm locations, possibly as mitigation for fish farming. At present, in relation to the MSP process the SPACEA toolbox employs existing environmental and marine use data as calculated by GIS-knowledgeable planners or experts. The SPACEA tool has not been validated or used in a relevant MSP environment. This is mainly due to timing and the political interest in the assessment. Mussel farming was seen as an element of the "Compensatory marine measures in the establishment or expansion of aquaculture", a law proposed in 2016 and adopted in 2017 in order to enable the establishment of new aquaculture farms in Danish waters (Retsinformation 2016). The law was contested, e.g. in a petition to the European Parliament (2017). In 2019 the Danish Minister for the Environment decided not to issue the executive order that should have implemented the Compensatory Marine Measures Act (Ministry of Environment and Food of Denmark 2019). This has put any further development of aquaculture and compensatory mussel farms on hold. The work regarding mussel farms therefore lost its urgency for the Danish MSP process the case study originally set out to address.

At the BASMATI final conference, there were plans to get the participating planners to try to add different layers in the tool to test its usability and discuss its relevance: would the planners need and make use of the functionalities provided? This, however, could not take place as the BASMATI final conference had to be cancelled due to the COVID-19 situation.

At the moment there are no plans for how to further develop the tool. The developers hope to obtain funding to write a description and possibly publish it at GitHub.com, which is one of the largest hosts for open source projects. This could be a way to publish the tool in an open community of software developers, which would probably include the GIS developers of marine plans.

SPACEA: Lessons Learned

Functionalities related to planning content

The tool in its present form has been used as the basis for the Danish-German case study in BASMATI and the identification of potential mussel farm locations. This was used as a basis for a model-based assessment of the effects of and conditions for mussel farms in certain areas. Depending on the availability of environmental and marine use data, the toolbox can provide maps for draft plans or scenarios for planners which could be used in stakeholder involvement.

Functionalities related to process management

Maps produced by the tool could be used for stakeholder interaction, e.g. for information or for consultation on draft plans. Since some GIS expertise is required to use the tool, this limits its use by non-experts. It is therefore less likely to be useful for events where a high degree of stakeholder interactivity is needed.

Potential for promoting cross-border collaboration

The SPACEA GIS toolbox was developed to support the selection of suitable locations for mussel farms. It is a starting point for assessing the ecological effects of mussel farming but can also be used for suitability analyses of other marine uses. Although the parameters used in the present version are not cross-border, the tool could be used to find best locations in a shared sea. It can also reveal mismatches or conflicts between different uses in a cross-border context. For example, when a use is placed close to another country's EEZ, this may restrict other cross-border uses, e.g. due to safety zones that might be needed around the uses. SPACEA could also reveal sensitive areas close to the border (e.g. oxygen deficiency areas or seagrass beds or the like) that could be affected by uses on the other side. For cross-border applications along these lines, relatively detailed data would be needed (e.g. HELCOM data would probably be too low resolution). Experts from the relevant countries would therefore need to be involved, with knowledge of the relevant data sources and with opportunity to harmonise data to carry out cross-border mapping.

Input to specific planning process phases

SPACEA can be used in the scoping and drafting phases by contributing to preparation of baselines or scenarios. Here, the tool can provide planners with spatial and environmental suitability analyses, for example to identify suitable areas for locating mussel farms.

Assessment of the technological readiness level (TRL)

The SPACEA tool has been developed to level 4, as it has been validated "in laboratory", in the form of serving as a basis for model-based assessment. The SPACEA tool has not been validated or used in relevant environment, which would be planners or experts supporting planners using it for input to an MSP process and draft plans. Allowing planners to test the tool at the BASMATI final conference and to discuss its relevance would have been the first step to bring the SPACEA toolbox to TRL 5. However, due to Covid-19, this event could not take place.

Table 4.6: Assessment of SPACEA toolbox

Description of the tool	SPACEA is a GIS toolbox developed for spatial and environmental suitability analyses. It comprises five sub-tools: Buffer Marine Uses; Raster Creation; Environmental Thresholds; Sustainability Function and Sustainability Analysis. Together the sub-tools produce a suitability analysis in form of a raster map.
Target groups	GIS-knowledgeable planners and experts supporting planners in using the tool.
Application so far in BASMATI and MSP processes	In the BASMATI case study, the tool has been used for calculating the effects of locating mussel farms, possibly as mitigation for fish farming. At present, in relation to the MSP process, the SPACEA toolbox uses existing environmental and marine use data, calculated by GIS knowledgeable planners or experts. The SPACEA tool has not been validated or used in a relevant environment.
Functionalities related to planning content	The tool is primarily an intermediate tool in developing draft plans or for information/consultation. The graphic elements can be used in information material.
Functionalities related to process-management	Maps could be used interactively for information or for consultation on draft plans. The need of GIS expertise reduces the opportunity for non-experts to use it; it is therefore less likely to be useful for higher degrees of interactive use in stakeholder involvement.
Functionality for facilitation of cross-border collaboration in MSP	In a cross-border context the present tool could be used to find best locations in a shared sea, by revealing possible mismatches or conflicts between different uses in cross-border, sensitive areas. For cross-border use more detailed data than the HELCOM data would probably be required. This would require the involvement of national experts with knowledge of detailed data sources and the opportunity to harmonise data to complete cross-border maps.
Applicability in MSP phases	SPACEA is mainly used in the scoping and drafting phases by contributing to the preparation of baselines or scenarios.
Technological readiness in relation to use in MSP	4, validated in laboratory conditions. A planned test in a “relevant” MSP context at the BASMATI final conference was not possible. This would be the first step in reaching TRL level 5.

5 Synthesis and discussion

This chapter first presents a synthesis of the tools developed is provided along with their content, targeted user groups and the status of application in the MSP process. The second section elaborates on the lessons learned so far and the tool´s functionalities in regard spatial knowledge integration and decision making, stakeholder involvement and cross-border collaboration. The third section addresses the potential future use of the tools, their readiness for implementation in the MSP process and the level of readiness for general use.

5.1 Overview and synthesis of the tools

The BONUS BASMTI project has produced five digital tools, all of which contribute to ecosystem-based MSP. They are summarised in table 5.1.

Table 5.1 Summary of the tools regarding content, targeted user group and the recent application in BASMATI and MSP context.

Name of tool	Description of the tool	Target group	Application in BASMATI and MSP so far
BALTIC EXPLORER (section 4.1)	Interactive web map application for facilitating collaboration in MSP. Multiple devices can be connected to the same workspace for mapping and drawing own layers. Less developed analytical part for weighing selected factors.	Main user group: Stakeholders engaged in collaborative processes. Secondary user group: Planners and experts as operators of the tools.	Used in several BASMATI and MSP-related events. The analytical part only used once. The collaborative part has been used for visualising activities and collaboratively discussing plan solutions. Input (drawing) functionality less used.
ESA4MSP (section 4.2)	Two-part tool: (1) A matrix that links different ecosystem components to calculate the capacity of habitat types to produce ecosystem functions; (2) a graphic illustration of these linkages and the resulting ecosystem services	Main user group: Experts and planners responsible for the planning process. Secondary user group (products): Stakeholders with background knowledge about ecosystems	ESA4MSP was used for the Latvian case study for scenarios of possible MPAs and for calculating the economic value of ecosystem services in the scenarios. It has not been used directly in Latvian MSP. Graphic illustrations were used in events with authority stakeholders.
MYTILUS (section 4.3)	Stand-alone application for geospatial analysis and visualization. User-friendly interface and fast processing for real time updating. Output is transferable to professional GIS systems as ArcGIS or QGIS	Main user group: Experts and planners with some or no GIS knowledge. Secondary user group: Stakeholders in interactive settings.	MYTILUS has been used in relation to MSP stakeholder events, where it was used for running SEANERGY in a fast way, allowing quick update of maps.

SEANERGY (section 4.4)	ArcMap toolbox providing a new spatial decision support tool to map use-use interactions in space and potential conflicts and synergies. Comprises six sub-tools.	GIS experts and MSP planners/researchers (mandatory facilitator role). Secondary user group: Stakeholders (marine sector representatives and citizens) in interactive settings and guided by planners.	Run and validated by the developers in a laboratory environment and validated through peer review acceptance. Methodology tested in a course for MSP planners and interested stakeholders, but not yet applied in formal MSP processes.
SPACEA (section 4.5)	GIS toolbox developed for spatial and environmental suitability analyses. Five sub-tools, which together produce a suitability analysis in the form of a raster map.	Main user group: GIS knowledgeable planners and experts supporting planners in using the tool.	Has been used for a BASMATI case study but not yet validated in a real MSP environment.

All tools are spatial GIS-based tools designed to support decisions in ecosystem-based planning. Most of the tools have an analytical part, and all produce visualisations of the analysis, e.g. in the form of cascade mapping, graphs, or maps of the current status of an area, pressures, conflicts, synergies etc.

In general, the main target group for using the tools are planners and supporting experts as those responsible for the planning process and for providing draft plans and scenarios for decision-making. The tools support the collection of data and knowledge and specifically assist in the drafting of MSP proposals during the earlier stages of the planning cycle, although applications in later stages are also conceivable. While planners and experts are the likely primary users of the tools, use of the tools and tool products can then be a way of engaging stakeholders at interactive settings. Planners have already organised events where Baltic Explorer functionalities were used for interaction with and between stakeholders; MYTILUS and SEANERGY can be used in a similar way. In order to use these tools and their products, including Baltic Explorer, stakeholders need some basic knowledge such as map-reading skills or the ability to select data layers or draw own maps. Some stakeholders are therefore likely to be better prepared for using the tools. It is unlikely that "ordinary people living their coastal lives" (as expressed by an authority stakeholder) will be asked to engage with these tools – which was also the experience for the Baltic Explorer developers.

The tools have been used in events directly or indirectly linked to ongoing national or cross-border MSP processes to some extent. Cross-border meetings took place as part of the PanBalticScope and SeaPlanSpace projects; cross-border work also included a university course for marine sciences students who are potential future MSP actors. The empirical data do not show whether the tools have contributed directly to national MSP processes and in what way, e.g. by providing data or knowledge. An indirect contribution to such processes was made through informal contacts between tool developers and national planners during the first "laboratory" stages of tool development (as discussed in chapter 3, methodology).

5.2 Lessons learned

5.2.1 Functionalities related to spatial knowledge integration and decision making

The tools contain innumerable specific technical functionalities. Here we focus on the more general functionalities of the tools and their contribution to spatial knowledge integration and decision making in MSP.

An important common functionality of the tools is their ability to use different types of data. Most are designed to use existing spatial data, drawing on various sources, often HELCOM data (E.g. MYTILUS, Baltic Explorer and SPACEA). Most tools are also capable of integrating spatial data sets collected from national sources.

A second important functionality is to then use the data brought together by the tool to generate knowledge. Baltic Explorer is a good example which allows users (such as stakeholders) to generate their own drawings, indicating e.g. areas of interest. Some tools do not rely on primary data but work with expert assessments, producing knowledge in the form of matrices of ecosystem components (ESA4MSP), or assessments of spatial conflicts and synergies between different uses in the sea (SEANERGY).

A third central functionality of all tools is their ability to visualise different spatial data patterns, allowing changes in assessments to be visualised and potentially different interpretations of data or conditions to be tracked. In the case of ESA4MSP and SEANERGY, initial expert-based assessments (e.g. of linkages between ecosystem components, or the impacts of co-located activities on each other) can be changed based on the input of different stakeholders, and the consequences of such re-assessment re-calculated and visualised. For the other tools, differing assessments can be expressed in data layers, again leading to new maps that visualise any changes that have been made. This ability to visualise different scenarios is central for using the tools in decision support.

In order to encourage widespread use of the tools, especially also in stakeholder involvement contexts, other functionalities have been developed for the tools. MYTILUS explicitly enables maps to be exported to professional GIS systems, allowing further processing to take place and potentially deepening the knowledge basis for planning decisions. Compatibility with existing systems was emphasised by planners as an important consideration in terms of tool usability. In the Riga focus group, planners stated that they needed to be able to use existing data, as well as draw on their experiences of other GIS based tools when considering new tools.

5.2.2 Functionalities related to stakeholder involvement

Functionalities related to stakeholder involvement are related to the visualisation of spatial data and knowledge, the opportunity to generate and update maps and illustrations according to stakeholder input and priorities, and the ability for stakeholders to contribute their own data and knowledge.

Visualisation for information and higher intensity interaction
As mentioned above, all tools are able to visualise the integrated spatial knowledge they produce. Apart from representing technical input for planners and decision-makers during the drafting of a plan, visualisation is a relatively simple way to illustrate a plan or planning options to stakeholders. Visual representations are therefore a useful means of providing quick information to stakeholders at different stages of the MSP process. The only requirement is the ability to read a map, or for reading the ESA4MSP cascade, a basic understanding of the ecosystem service principles. Visualisation therefore supports one-way information as the most basic stage of stakeholder interaction in MSP, but also facilitates higher intensities of interaction as illustrated in figure 2.3.

Dynamic adjustment for consultation and higher intensity interaction

Dynamic and fast updating of data and visualisation opens up opportunities for more intensive dialogue between planners and stakeholders. Although traditional consultation implies two-way communication, this is often formalised as hearings and written comments on plan proposals. Here, stakeholders can provide ideas for consideration, but they do not usually see the spatial consequences their ideas or other people's ideas might have. Tools that can easily take on board new knowledge or priorities and visualise the spatial consequences of ideas or proposals in a discussion are a clear advantage, as observed in the case of SEANERGY using MYTILUS and Baltic Explorer. Direct visualisation of adjustments allows for a more dynamic dialogue between planners and stakeholders and opens the process to higher intensities of interaction between planners and stakeholders. This could pave the way for deliberative and collaborative processes, although the level of intensity will ultimately depend on how much power is shared with stakeholders by the planning authority.

Dynamic adjustment of data (e.g. assessments and choice of data layers) requires tools with fast processing capabilities. SEANERGY running on the MYTILUS platform almost instantly updates graphs and maps, visualising the consequences of changes in the scores of conflicts proposed by participants at the stakeholder meeting. A central functionality of Baltic Explorer is the opportunity to choose among a range of data layers uploaded to a specific workspace. The data layers, representing different spatial knowledge, can be selected and deselected and the map is updated instantly.

For meetings with higher intensities of interaction, preparation is more demanding and time consuming for planners and therefore a question of resources. In the case of Baltic Explorer, the opportunity to select (and deselect) data layers means that the quality of interaction, and the meaningfulness of discussions, increases with the number of data layers that are made available. During the development of Baltic Explorer more than 100 data layers from the HELCOM data portal were installed and are available to all users (all workspaces). For meetings and events at a local level or on specific topics, however, more detailed, higher resolution data may be required and expected by the stakeholders. Low resolution data might miss out local details which are known by stakeholders, which then might not recognise their own local areas and situations; this risks that they lose trust in the presented knowledge. When participants are encouraged to pick and choose the data layers, *they* find relevant, the organising planners must foresee what type of information might be wanted. Preparing for using the tool therefore requires identification of relevant data (and obtaining licences for using it) and uploading it to the workspace of the event. While this can be time-consuming, the collected and processed data and data layers might then contribute to the general knowledge base for the planning and decision-making process.

SEANERGY requires the organiser to do updates during the meeting. Baltic Explorer can be used in the same way (controlled by the organiser) but has also been specifically developed for multi-user collaboration. The workspace can be downloaded by all participants, who can then select data layers or draw areas or points on their screens and re-upload their work to the common workspace. In this way individual practical knowledge can be added to any spatial knowledge derived from other data sources.

General tool availability opens possibilities for highest intensity of interaction

Today the developers of Baltic Explorer create a workspace with passwords for use in each MSP event. In the future all registered users will have access to the web application to create their own workspaces and to access all publicly available data layers (mostly HELCOM). They will also be able to upload their own data layers, although this will require some GIS skills. The tool can then be used by organisations or individuals for their own analysis or planning purposes. Given this degree of flexibility and openness, stakeholders could conceivably develop parts of marine spatial plans, or there could be co-construction of planning content as part of a statutory MSP process. Such possibilities were mentioned by a participant from an environmental NGO at one of the observed meetings. In this way Baltic Explorer could pave the way for stakeholders to take (greater) responsibility for parts of the MSP process.

Capabilities and skills required from planners and stakeholders
In order to make the most of the tools, certain basic skills are needed, both in terms of deploying the tools (planners) and utilising them (planners, stakeholders). In order to choose the tool that is best suited for a situation, and to prepare for its use, the planners organising and running an event need to know what facts are relevant at that particular time, what level of knowledge and capability can be expected from the participants (whether it is stakeholders, planners, or experts) and what topics might be important or contentious in the discussion. When preparing to use Baltic Explorer, for example, relevant data must be identified and uploaded before an event. Where available, the necessary IT and GIS skills can be supplied by staff within the planning organisation, although in the observed cases it was the tool developers that were involved in this as external expert. At the event, the planners must be able to operate the tool proficiently, as well as teach the participants to use it (if these functionalities are activated). Some prior training in the use of the tools is therefore required, either by the developers acting as mentors or making use of user guides if available. This will be a central issue for the continued use of the tool.

Capabilities among the participating stakeholders (authorities and societal) are also decisive for how effectively the tools can be used. While most stakeholders can be expected to have basic map-reading capabilities or can easily learn how to select and deselect map layers, using the multi-user functions of Baltic Explorer requires more advanced IT skills. Stakeholders who want to create and use their own workspaces in Baltic Explorer will need to know (or learn) how to create and upload new data layers. This advanced skill level may limit the range of potential participants in an event and is something that should be taken into consideration by planners when planning for the desired level of interactivity. In Giacometti et al (2020), interviews with Baltic Sea MSP planners revealed that fear of losing time and focus on the plan, as well as challenges in using digital tools lead to a preference of low-tech tools, e.g. physical maps rather than digital tools. Although this was a general comment and not directed at the BASMATI tools, it indicates that planners´ perceptions of digital tools and stakeholder skills o influence their choice of tools for involvement.

5.2.3 Functionalities enabling cross-border collaboration

Cross-border collaboration takes place as formal cooperation between national states but also as less formalised collaboration across borders. Many different types of actors are involved, and many forms and fora for interaction are used. In general, the five tools support and enable cross-border collaboration and cooperation, both in terms of planning content (in the sense of knowledge processing for decision support) and cross-border stakeholder involvement. To some extent, however, the specific cross-border setting creates or reinforces challenges in relation to using the tools.

Visualisation in the form of graphs, linkage diagrams or maps is a useful way of overcoming language barriers. This is relevant in formal consultation processes involving planners and experts, but especially also in less formal collaboration which also includes stakeholders.

The working language of the tools is English. This facilitates use of the tools across borders as English is the working language in most other Baltic (and international) institutions; it is therefore accessible to most planners and many stakeholders. However, working in English and not the national language can constitute a barrier to collaboration, in cases where participants (or some planners) are less proficient or confident in using English. In order to make the tools fully inclusive, translations of texts in the tool, data, names, legends etc. would need to be provided, thus ensuring all stakeholders can engage in collaborative processes and dialogues. Translation has not been brought up in relation to the observed use of tools, and it is not clear whether translation of user-interface texts would be an option. At the same time, translating these short texts is likely to be less costly than report-based translation and communication.

A last factor to take into consideration in the context of cross-border tool use is data availability and harmonisation. The tools have been developed in a Baltic Sea context, and many are using

HELCOM data, most of which has already been harmonised to cover the entire Baltic Sea – anticipating exactly this type of cross-border use. If cross-border collaboration is concerned with more general, aggregated issues, these data are a good basis for using the tools in cross-border contexts. In most of the observed stakeholder events, however, local data at a higher resolution was required – a fact which also applied to the observed cross-border stakeholder meeting. National and local datasets may not be fully accessible, which means that other ways need to be found to fill these data gaps, possibly using national experts with relevant knowledge and/or access. Additional national and local data would then need to be harmonised with respect to categories, definitions etc., and ways would need to be found to deal with data gaps – e.g. using models or “guesstimates”. While data availability and accessibility are common challenges for local and national planning, data issues are magnified when data is to be used for collaboration between countries with different statistical traditions and priorities.

5.3 Readiness for application and further development needs

This section summarises how the tools, based on current experiences, fit with specific phases of the MSP process – and what could and should be done to develop them to a commercial or general use level.

5.3.1 Input to specific process phases

For this report we have described the MSP process as a continuous loop, which takes place in four simplified phases, namely scoping, drafting and consultation, implementation, and evaluation (see chapter 2).

Generally speaking, all tools have an element of data collection (handling different forms of input data), visualisation functions (maps, graphs) and in some cases, data interpretation (processing in ESA4MSP). Therefore, most tools can provide input to the scoping and drafting/consultation phases.

In the scoping phase, collecting current status information is central. Tools can contribute in different ways:

- Baltic Explorer can help planners differentiate between relevant and less relevant information to include (which data layers to include). It can also highlight user knowledge or conflict areas, thus sharpening the focus of the forthcoming planning process.
- ESA4MSP, SEANERGY and SPACEA make a direct contribution to the evidence base for planning decisions in that they collect expert knowledge and assessments on ecosystem components, conflicts and environmental data.

All tools contribute to the drafting and consultation phase. They all process data and knowledge and produce visual outputs. These are very useful for drafting plans as well as informing stakeholders as part of consultation.

- ESA4MSP, SEANERGY, SPACEA and MYTILUS are all capable of processing the collected knowledge into visualisations of possible futures. They all assess (different aspects of) consequences of planning decisions or scenarios, either for marine uses or the environment. As such they can make an important contribution to discussions on preferred planning options, feeding into the production of a draft plan.

- Visualisation of assessment results can be used for consultation activities in this phase – as part of providing information to stakeholders or developing solutions in a more collaborative way.
- Baltic Explorer more directly addresses stakeholder interaction. Maps and especially stakeholder knowledge can be used as an evidence base for drafting plans. The core functionalities of Baltic Explorer focus on the consultation activities of this phase. As discussed in 5.2.2 Baltic Explorer enables different intensities of consultation, possibly even supporting the development of alternative plans drafts.

No examples of support for implementation of plans have been seen. For evaluation of the plan the tools could be relevant again; for collection of new experiences and knowledge from experts and stakeholders and based on this revision of the assessments of consequences (ecosystem services, environmental impacts, conflict and synergies etc.). This could function as evaluation and possible scoping for a new round of MSP planning.

5.3.2 Technological readiness level

The tools have been developed in the context of the BONUS BASMATI research project, and it was never the intention to develop the tools to a commercial level. Nevertheless, we assessed the tools in relation to the "Technology Readiness Levels" outlined by the European Union in relation to the Horizon 2020 programme (European Commission 2017) (see section 3). The first four Technology Readiness Levels (TRL) mainly take place in laboratories and five to six in a relevant environment. The last levels, leading to commercial readiness, are expected to take place in so-called operational environments.

The observations for this report focused on how the tools were used at stakeholder meetings and events, all of which can be considered "relevant" environments. Although none of the events were formally part of national MSP processes, some were closely linked to these processes and therefore had the character of an "operational" environment. This already outlines the level of TRL development of the tools.

Since the first stages of tool development were not directly observed, TRL information relies on what has been provided by the tool developers. The tool developers are researchers with deep knowledge of the scientific field behind their tool. Most also have knowledge of (and occasionally took part in) the national MSP processes (an operational environment). The developers explained that they had ongoing formal and informal contacts to planners and experts in the MSP process while developing the tools in a lab environment (on the computer screen) (personal communication, 2020). These contacts were mostly derived from the BASMATI environment, but some also had contacts via other research and collaboration projects, or through working for a planning authority. The initial stages of tool development were therefore influenced by the developer's background knowledge in their scientific fields, their knowledge of MSP processes, as well as the continued engagement with contacts. Challenges experienced by the developers in this process are also set out in scientific articles, e.g. on MYTILUS (Hansen 2019), ESA4MSP (Armoškaitė et al 2020), SEANERGY (Bonnevie et al 2020), SPACEA (von Thenen et al forthcoming) and Baltic Explorer (Rönneberg et al 2019).

The tools have reached levels 4 to 7 in the TRL index. All are developed and validated "in the lab" (TRL 4), i.e. they have been used for specific calculations or visualisations, depicted in reports or peer-reviewed articles.

Four tools (ESA4MSP, SEANERGY, MYTILUS and Baltic Explorer) have been validated in a relevant environment (TRL 5) at least once. The same was planned for the fifth tool (SPACEA), but due to the COVID-19 situation the scheduled test was never completed. The collaborative part of Baltic Explorer has been demonstrated in more than one relevant environment meaning it can be categorised as TRL 7. Other parts of the tool are less developed (e.g. the drawing opportunities and the analytical part have only been tested once in a relevant environment). MYTILUS has not been observed in an operational environment but it has been used in an operational context. It might therefore be at TRL 8 or 9.

In order for these tools to be used in other planning processes (also outside of MSP), greater technological maturity, proven functional and user-friendliness are required. In TRL terms this means that level 9 needs to be reached, where the tools have proven themselves in an operational environment. To reach this level the development process requires opportunities to demonstrate the tools in different environments and to make some final adjustments. This step is still to be taken for all tools, although MYTILUS might be close. Ideally, this next step requires the tools to be linked to an ongoing MSP process, enabling it to demonstrate its use in an operating MSP environment. Several tools have been made available in full on the free software online site GitHub (e.g. SEANERGY and Baltic Explorer), which allows other developers to use the tools and develop them further.

6 Conclusions and outlook

The report has reviewed the development and status of five tools, developed as a part of the BONUS BASMATI research project:

- Baltic Explorer, an interactive web map application for facilitating collaboration in MSP,
- ESA4MSP, ecosystem approach to value the marine seabed habitats and their contribution to human wellbeing. Assessing the ecosystem components and linkages for assessing the final ecosystem services
- MYTILUS, a tool for cumulative impact assessment and mapping,
- SEANERGY, approach and spatial decision support tool to map potential conflicts and synergies between mare uses and exploring use-use interactions.
- SPACEA, a GIS toolbox for facilitating spatial and environmental suitability analyses, performing simple MSP analyses on mussel farming sites in the south-western Baltic Sea.

The central aim of the tools is to expand the evidence base for MSP and to help assess the consequences of planning proposals/options. Although the tools were developed for specific BASMATI tasks (e.g. to support case studies), they respond to the context of ongoing maritime spatial planning in the Baltic Sea countries, supporting aspirations related to stakeholder involvement and spatial knowledge integration for decision-making. Most of the tools were tested in real-life settings as part of stakeholder meetings or events during the first round of MSP planning.

The review show that the tools mainly address the scoping phase of MSP by supporting the collection of data, such as expert assessments and existing spatial data. The tools also contribute to drafting MSP plans: especially Baltic Explorer can support consultation at almost any level of intensity that might be desired by the planners and planning authority. For the remaining phases of MSP planning, the tools can support evaluation, which might be part of the scoping phase of the next cycle of MSP. Importantly for the longer term, tools also provide structures for the continued collection of data and knowledge for MSP.

Spatial knowledge integration for decision-making involves two aspects: firstly, bringing together different types of data and information, and secondly – in preparation for the actual decision – assessing and/or visualising the consequences of different planning options. Both elements open possibilities for different levels of stakeholder involvement. At the first and most basic level, tools might simply visualise current status information (e.g. marine uses, environmental status), and stakeholders might be asked to select data layers that are important to them in a particular context. Visualising status information in the form of a map or graph can help planners to better understand the context for MSP, and also assist stakeholders who are provided with easy to understand visual information. It also builds up the evidence base for MSP or helps with the early stages of plan development (e.g. to identify priority issues or conflicts of use and communicate this to stakeholders). In this context, the tools are highly relevant for MSP situations with lower intensities of engagement and limited levels of power sharing, e.g. where information needs to be communicated or during consultation (see fig. 2.3).

At a more advanced level of tool use, stakeholders might be able to draw their own maps, or do their own assessment of scenarios. Although the visualisation element of the tools is still important, here the purpose is different. The ability of tools to not only visualise status information, but to depict what could change if parameters were altered (e.g. showing how changing environmental parameters might affect ecosystem services) can help stakeholders to understand the impact of decisions and to see consequences of actions for themselves. Learning is immediate and enhanced further by the group setting; consultation becomes more interactive, and collaborative scenario design becomes a possibility. In a stakeholder event, the fast response of MYTILUS and SEANERGY for instance enabled immediate updating of proposals based on stakeholder input, showing consequences and thereby allowing interactive consultation on planning proposals.

Taken one step further, the tools could act as real catalysts of change. Tools that allow stakeholders to test their own ideas and thoughts and encourage independent assessment and discussion can help engender greater “power of knowledge” amongst stakeholders, challenging the role of planners as the mediators of knowledge and the sole interpreters of information. Stakeholders could design their own scenarios, for example, which could then either be discussed within stakeholder groups and used for internal reflection and learning or brought back to the planners for further discussion. Tools could therefore lead to greater power sharing and shared responsibility in the MSP process – which might ultimately contribute to democratising the MSP process. The visual outputs of the tools also play their own role, in that they can be understood as boundary objects that could become centrepieces of more intense discussions.

All tools support cross-border collaboration. Visualisation, which is central for all tools, assists with cooperation at the formal level between national planners and more informal cross-border collaboration between planners as well as stakeholders. Visualisation might reduce language barriers, although the fact that English is the working language of the tools could be a challenge to some. All of the tools experience data challenges (such as access and availability); these might be magnified in cross-border contexts: Cross-border data may not be detailed enough and differences between countries in terms of available data, definitions or data gaps might become more apparent. Agreement is needed on the part of tool users on how to overcome these difficulties, and how to deal with data gaps.

Although the tools are at an advanced level of technological readiness and were positively evaluated by their users, they have not reached full maturity. More mature tools are more likely to have real influence on the MSP process (as pointed out by Gee et al 2019), not least when users can be empowered to generate their own tool outputs rather than merely discussing the outputs produced by planners or experts.

But how to get there?

The next steps in the development of the tools are demonstration and getting a proven record for the tools in an operational environment. Due to open source programming this would ideally take place in a national or regional planning setting, where national MSP institutions continue to develop the tools to support their own MSP processes. However, resources within national MSP processes are limited (Giacometti 2020). This means that further tool development is most likely in the hands of developers, ideally working in collaboration with planners who already know and have mastered the technology.

Further development of the tools may also take place in the context of projects involving developers and planners. Such projects would offer a natural operational environment for developing and testing the tools, bringing them to the highest TRL and enabling their use in other MSP processes and by planners not involved in their development. Linking such final development to cross-border processes will ensure the mature tools are able to meet the challenges of integrating data from different cultures and knowledge traditions.

The tools could also be developed further in non-MSP contexts, including other marine policy contexts. As several tools can also be used with other types of spatial data, even terrestrial planning could be a basis for further development, as highlighted e.g. by the Baltic Basmati developers.

References

Armoškaitė A., Puriņa I., Aigars J., Strāķe S., Pakalniete K., Frederiksen P., Schrøder L., Hansen H.S. (2020). Establishing the links between marine ecosystem components, functions and services: An ecosystem service assessment tool. Ocean & Coastal Management, Volume 193, 2020, ISSN 0964-5691, https://doi.org/10.1016/j.ocecoaman.2020.105229

Arki, V., Ajanko, J., Luhtala, H., Tolvanen, H. (eds.), (2020). BONUS BASMATI – Supporting maritime spatial planning with science. BONUS BASMATI Deliverable 7.7, September 2020, . Accessed August 2020 at: https://bonusbasmati.eu/wp-content/uploads/2020/09/BONUS_BASMATI_Del_7_7_summary_report.pdf

Bonnevie, I.M., Hansen, H.S., Schrøder, L., (2020) SEANERGY - a spatial tool to facilitate the increase of synergies and to minimise conflicts between human uses at sea, Environmental Modelling and Software (2020), doi: https://doi.org/10.1016/j.envsoft.2020.104808

Bonnevie, I.M. & Hansen, H.S. & Schrøder, L. (2019). Assessing use-use interactions at sea: A theoretical framework for spatial decision support tools facilitating co-location in maritime spatial planning. Marine Policy, Vol. 106, 103533, DOI: 10.1016/j.marpol.2019.103533

Cambridge Dictionary (2020). English Dictionary. Definitions of the words: “Tool”, “Scenario” and “Approach”. Cambridge University Press 2020. Accessed August 2020 at: https://dictionary.cambridge.org/dictionary/english/tool

CBD- Report of the Workshop on the Ecosystem Approach 1998. Lilongwe, Malawi, 26 - 28 January 1998. CONVENTION ON BIOLOGICAL DIVERSITY. UNEP/CBD/COP/4/Inf.9. 20 March 1998. Accessed Sep 2020 at: https://www.cbd.int/doc/meetings/cop/cop-04/information/cop-04-inf-09-en.pdf

Cedergren E., Kull M., Moodie J. & Morf A. 2019. Lessons Learned in Cross-border Maritime Spatial Planning – Experiences and insights from Pan Baltic Scope

European Commission (2014). Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning OJ L 257, 28.8.2014, p. 135–145. Accessed Sept 2020 at: https://eur-lex.europa.eu/eli/dir/2014/89/oj

European Commission (2017). HORIZON 2020 – WORK PROGRAMME 2018-2020. Annex G. Technology readiness levels (TRL). Accessed April 2020 at: https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl_en.pdf

European Parliament (2017). Petition No 0578/2017 by Mads Nikolajsen (Danish) on Denmark's breach of EU environmental legislation to enable expansion of aquaculture. Accessed June 2020 at: https://petiport.secure.europarl.europa.eu/petitions/en/petition/content/0578%252F2017/html/Petition%2BNo%2B0578%252F2017%2Bby%2BMads%2BNikolajsen%2B%2528Danish%2529%2Bon%2BDenmark%2527s%2Bbreach%2Bof%2BEU%2Benvironmental%2Blegislation%2Bto%2Benable%2Bexpansion%2Bof%2Baquaculture

FGI (2020): Baltic Explorer questionnaire. Riga stakeholder meeting Feb. 2020. 21 responses. Finnish Geospatial Research Institute Unpublished.

Frederiksen P., Morf A., von Thenen M., Armoskaite A., Luhtala H., Schiele K. S., Strāķe, S., Hansen H.S.(2020) Proposing an ecosystem services-based framework to assess sustainability impacts of maritime spatial plans (MSP-SA), submitted to Ocean and Coastal Management (June 2020). - Forthcoming

Gee, K., Blazauskas, N., Dahl, K., Göke, C., Hassler, B. et al. (2019) Can tools contribute to integration in MSP?: A comparative review of selected tools and approaches Ocean and Coastal Management, 179: 1-11. DOI: https://doi.org/10.1016/j.ocecoaman.2019.104834

Giacometti,A., Kull M., Moodie J.R., Morf A., Kaae B.C., Institute Kerstin Schiele, von Thenen M., Reiter I.M., Schröder L., Hansen H.S., Dahl K., Luhtala H., Erkkilä-Välimäki A.,Armoskaite A.,Strake S., (2018). Thematic Scoping/Vision Document: report outlining the main conflict and potential synergy areas in cross-border MSP. Oct. 2018. Deliverable 2.2 BONUS BASMATI. Accessed Aug 2020 at: https://bonusbasmati.eu/wp-content/uploads/2019/03/BONUS_BASMATI_Del_2_2_scoping_document.pdf

Giacometti A., Andrea Morf A., Gee K., Kull M., Luhtala H., Cedergren E. (2020) Handbook: Process, Methods and Tools for Stakeholder Involvement in MSP. The Never-Ending Story BASMATI Deliverable 2.3 Handbook Tools & Methods for SI in MSP

Hacking T., Guthrie P. (2008). A framework for clarifying the meaning of Triple Bottom-Line, Integrated, and Sustainability Assessment, Environmental Impact Assessment Review, Volume 28, Issues 2–3, 2008, Pages 73-89, ISSN 0195-9255, https://doi.org/10.1016/j.eiar.2007.03.002. (http://www.sciencedirect.com/science/article/pii/S0195925507000297)

Hansen S.H. (2019), Cumulative impact of societal activities on marine ecosystems and their services. Computational Science and Its Applications – ICCSA 2019 - 19th International Conference, 2019, Proceedings: 19th International Conference, Saint Petersburg, Russia, July 1–4, 2019, Proceedings, Part III. Misra, S., Gervasi, O., Murgante, B., Stankova, E., Korkhov, V., Torre, C., A.C., A. M., Taniar, D., Apduhan, B. O. & Tarantino, E. (red.). Springer, Bind 11621. s. 577-590 14 s. (Lecture Notes in Computer Science (LNCS), Bind 11621).

HELCOM and VASAB 2014. Mandate for the joint HELCOM-VASAB Maritime Spatial Planning Working Group. Accessed at: https://helcom.fi/helcom-at-work/groups/helcom-vasab-maritime-spatial-planning-working-group/mandate-work-plan/

HELCOM HOD 34-2010 and the 54th Meeting of VASAB CSPD/BSR 2010. Baltic Sea Broad-scale Maritime Spatial Planning (MSP) Principles. Accessed Sep. 2020 at: https://helcom.fi/media/documents/HELCOM-VASAB-MSP-Principles.pdf

Holzhüter W., Schiele K., von Thenen M., Maack L., Luhtala H., Viška M. and Strāķe S. (2019). BONUS BASMATI. Database including spatial data on ecosystem services and (anthropogenic) pressures. June 2019, BONUS BASMATI Deliverable 3.2. Accessed August 2020 at: https://bonusbasmati.eu

Janßen H, Varjopuro R, Luttmann A, Morf A and Nieminen H. 2018. Imbalances in interaction for transboundary Marine Spatial Planning: Insights from the Baltic Sea Region. Ocean and Coastal Management 161C: 201-210, doi:10.1016/j.ocecoaman.2018.05.008

Kannen, A, Gee, K, Blazauskas, N, Cormier, R, Dahl, K, Göke, C, Morf, A, Ross, A, Schultz-Zehden, A (2016): BONUS BALTSPACE Deliverable 3.2: A Catalogue of Approaches and Tools for MSP. Geesthacht, March 2016. Accessed April 2020 at: https://www.baltspace.eu/images/publishedreports/BONUS_BALTSPACE_D3-2.pdf

Kull, M., Moodie, J., Giacometti, A. and Morf, A. 2017. Lessons Learned: Obstacles and Enablers When Tackling the Challenges of Cross-Border Maritime Spatial Planning - Experiences from Baltic SCOPE. Stockholm, Espoo and Gothenburg - Baltic SCOPE. Report available online at www.balticscope.eu.

Ministry of Environment and Food of Denmark (2019): Miljøminister: Jeg ønsker ikke flere og større havbrug i Danmark. News August 26 2019. Accessed June 2020 at: https://mfvm.dk/nyheder/nyhed/nyhed/miljoeminister-jeg-oensker-ikke-flere-og-stoerre-havbrug-i-danmark/

Morf A, Gee K, Kull M, Piwowarczyk J. (2019). Towards a ladder of MSP participation. Chapter in Anthology on 'Marine spatial planning – past, present, future', chapter 10 In: Zaucha, J., & Gee, K. (eds). Marine spatial planning – past, present, future. Palgrave Macmillan. Pp. 219-244. ISBN 978-3-319-98695-1 ISBN 978-3-319-98696-8 (eBook); https://doi.org/10.1007/978-3-319-98696-8

Müller M. and Mouny L. (2014) Decision model for Horizon 2020 final report. SwissCore. Brussels 2014. Accessed August 2020 at: https://www.swisscore.org/Lists/Public/Upload/20140407_Decision_Model_H2020.pdf

Pakalniete K. and Armoskaite A. (2019). Economic analysis of "ecosystem services" provided by marine benthic habitats in the Latvian case study. Background document for BONUS BASMATI partners´ meeting on May 9-10 2019. Unpublished.

Retsinformation (2016): Forslag til lov om ændring af lov om miljøbeskyttelse ((Kompenserende marine virkemidler ved etablering eller udvidelse af havbrug) 2016/1 LSV 111. Accessed Sept 2020 at: https://www.retsinformation.dk/eli/ft/20161XX00397

Rönneberg M., Eliasen S.Q., Kettunen P., Kos-ki C. Oksanen J. (2019). Designing Access Control of a Spatial Decision Support System for Collaborative Maritime Spatial Planning. Conference paper, Wien, Austria, DOI: 10.34726/lbs2019.28

Saunders F.(ed) 2017. BONUS BALTSPACE Deliverable D2.4: MSP as a governance approach? Knowledge integration challenges in MSP in the Baltic Sea. BALTSPACE, 2017. 36 p. Accesses Sep 2020 at: https://www.baltspace.eu/published-reports

Strāķe S, Aigars J, Viška M, Pakalniete K, Puriņa I, Thenen M, Schiele K, Luhtala H, ErkkiläVälimäki A, Tolvanen H, Koski C, Specifications for case study designs. BONUS BASMATI Deliverable 6.2, January 2018, www.bonusbasmati.eu

UN 2017. United Nations Economic Commission for Europe. Convention on Environmental Impact Assessment in a Transboundary Context. New York and Geneva, 2017 at: https://www.unece.org/

von Thenen M., Hansen H.S. and Schiele K.S. (Forthcoming). SPACEA: a custom-made GIS toolbox for basic marine spatial planning analyses. Unpublished

Von Thenen M., Maar M., Hansen H.S., Friedland R. and Schiele K.S. (2020) Applying a combined geospatial and farm scale model to identify suitable locations for mussel farming. Marine Pollution Bulleting. 165 (2020) 111254. https://doi.org/10.1016/j.marpolbul.2020.111254

Links to tools analysed and related outputs

In General:

- BONUS BASMATI homepage: https://bonusbasmati.eu/

SPACEA – a GIS toolbox to facilitate easy spatial and environmental suitability analysis

- Presentation at BONUS BASMATI, Final webinar, 9 September 2020: https://bonusbasmati.eu/wp-content/uploads/2020/09/BONUSBASMATI_SPACEA.pdf
- Project deliverables and scientific publications: https://bonusbasmati.eu/results-material/

ESA4MSP – an ecosystem service assessment tool

- Presentation at BONUS BASMATI, Final webinar, 9 September 2020: https://bonusbasmati.eu/wp-content/uploads/2020/09/BONUSBASMATI_ESA4MSP.pdf
- Project deliverables and scientific publications: https://bonusbasmati.eu/results-material/

MYTILUS - a toolset for assessing the impacts of maritime activities

- Presentation at BONUS BASMATI, Final webinar, 9 September 2020:
- Project deliverables and scientific publications: https://bonusbasmati.eu/results-material/
- Conference paper: Cumulative impact of societal activities on marine ecosystems and their services:. https://www.scopus.com/record/display.uri?eid=2-s2.0-85069213968&origin=inward&txGid=5fb08524bc61302e91f75ef8e9fcd863

SEANERGY - a tool for analysing conflicts and synergies between different marine uses

- Source code at GitHub: https://github.com/IdaMBonnevie/SEANERGY.git
- Presentation at BONUS BASMATI, Final webinar, 9 September 2020: https://bonusbasmati.eu/wp-content/uploads/2020/09/BONUSBASMATI_SPACEA.pdf
- Project deliverables and scientific publications: https://bonusbasmati.eu/results-material/

BALTIC EXPLORER – collaborative GIS approach for new interactive MSP

- Homepage: http://balticexplorer.eu
- Concept video, Youtube: https://youtu.be/daydYqgRjLQ
- User Guide: http://balticexplorer.eu/static/umap/BalticExplorerUserGuide.pdf
- Presentation at BONUS BASMATI, Final webinar, 9 September 2020: https://bonusbasmati.eu/wp-content/uploads/2020/09/BONUSBASMATI_BalticExplorer.pdf
- Source code at GitHub: https://github.com/FGI-GEOINFO/Baltic-Explorer
- Project deliverables and scientific publications: https://bonusbasmati.eu/results-material/

APPENDIX

Observation methodology

Focus and goal of the observations
The observations should assess how the tools functions in specific settings with specific stakeholder types. The tools cannot be assessed per se but must be evaluated in relation to the specific context.
The context should be defined as:

- MSP context:
  - Which phase of MSP and what is the purpose of the stakeholder involvement – what type of interaction (according to the ladder) (why)
  - Which stakeholders are involved? (who) – what are their competencies and preconditions for understanding/using the tool – e.g. civil servants at various levels, professionals, stakeholder represents or layman stakeholders?
- Specific setting:
  - The physical context
  - The expected outcome – and the realised outcome of the stakeholder event where the tool is used

The tool to be assessed is a specific artefact, which is used as support for the specific stakeholder interaction and involvement:

- Baltic Explorer – specific parts/elements of BeX
- Models or scenarios developed based on models, when used for illustrating and supporting stakeholder involvement

Empirical input for assessment:

- Interview with the tool developers regarding the character and content of the tool and the purpose of the tool in relation to stakeholder involvement and considerations regarding having/not having organised events for stakeholder involvement and test of the tool for this purpose
- Observation where tool/tools are used for specific stakeholder involvement processes.
  - Interview with the responsible for the specific stakeholder event
    - The context –phase and purpose of stakeholder involvement
    - The expected stakeholder characteristics
    - The practical context for the event
  - Observation during the event/use of tool in the stakeholder involvement process
    - The settings
    - How the tool functioned in the processes and the stakeholder response
  - Evaluation
    - Follow up interview with the event organiser
    - Short interview with one/two or a group of stakeholders and or survey among the stakeholders

Interview guide, example focus group interview Riga Feb. 2020

Focus group interview with 3-5 selected participants in the workshop. Purpose is a) an evaluation of the BE tool and b) input for changes for using the tool – for a discussion regarding maturity of the technology – and user preparedness/readiness for using it.

Marine ecosystem services, protection, approaches, and tools for their assessment in Maritime Spatial Planning
Facilitated by VARAM

Baltic Explorer, through guidance by FGI, will in this workshop serve as an interactive tool for facilitating discussions and testing allocation of offshore windmills – based on an ecosystem-based approach. Participants include representatives from national and regional ministries/authorities and NGOs. The purpose is to boost the competence of MSP and ecosystem services/ecosystem-based approaches among the representatives and ministries and test whether BE is a tool that could be integrated as a working tool among the ministries when handling MSP issues.

Introduction – 5 min
Background questions – 3 min each= 10-15

- Do you work with stakeholder involvement in your work?
    - If so – what type? Citizens/businesses, organisation representatives, officials at other levels (e.g. municipalities)
- Do you have experience of MSP before this workshop?
- Do you have experience of working with tool such as Baltic Explorer?
- What was your motive to participate today?
- What do you associate with the concept “stakeholder involvement tools”?

Experiences of the tool

- Open question: What do you think about the tool (Baltic Explorer)? **5 min**
    - Was it easy/difficult to use?
    - How much did you engage in using it?
    - What did you do when you used it?
        - Why did you do so/why not?
- What did you want to discuss/achieve when your group worked with the tool? **5 min**
    - Did the tool help facilitate your discussions?
        - How so/why not….?
- Have you gained any new knowledge from participating in this workshop using BE? **10 min**
    - Why/Why not/How…?
    - [Note if any mention ecosystem services/ecosystem approach – if not:]
    - Do you see any relation between the concepts of ecosystem service or approach and the groupwork using BE?

We would like to end the session with a round of three enablers and three challenges for a success for working with tools such as BE for help facilitate discussions/information exchange/competence development/stakeholder involvement.

AALBORG UNIVERSITY
DENMARK

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