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Considerations of Socio-Economic Input, Related Challenges and Recommendations for Ecosystem-Based Maritime Spatial Planning: A Review

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1. INTRODUCTION

The recent European Directive on Maritime Spatial Planning (MSP) aims to establish a framework to promote the sustainable growth of maritime economies, the sustainable development of marine areas, and the sustainable use of marine resources (EC, 2014). In particular, MSP deals with where and when human activities take place at sea, aiming to achieve ecological, economic, and social objectives that are usually specified through a political process (Ehler and Douvere, 2009). As of January 14, 2017, per the website of the European Commission (EC) on Maritime Affairs (http://ec.europa.eu/maritimeaffairs/policy/maritime_spatial_planning/index_en.htm), within the context of the Blue Growth initiative, MSP aims to provide knowledge, legal certainty, and security in the blue economy by ensuring an efficient and sustainable management of activities at sea. Coordination efficiency for governments, reduced transaction costs for maritime activities and enhanced certainty resulting in an improved investment climate, have been identified as the main economic effects of MSP (EC, 2011).

The MSP process is characterized by integrated, adaptive, dynamic, spatially explicit, participatory, and ecosystem-based elements. According to US scientists and policy experts, ecosystem-based management for the oceans "emphasizes the protection of ecosystem structure, functioning, and key processes; is place-based in focusing on a specific ecosystem and the range of activities affecting it; explicitly accounts for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other non-target species; acknowledges interconnectedness among systems, such as between air, land, and sea; and integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependences" (McLeod et al., 2015). In addition, the concept of "entire ecosystem" also includes humans rather than focusing on a single species, sector, activity, or concern, while the cumulative impacts of different sectors are also considered. Overall, it has been argued that ecosystem-based management should reduce duplication and conflicts and in the long run will likely be more cost-effective (McLeod et al., 2015).

In addition, since the Convention on Biological Diversity (CBD) and the twelve "Malawi Principles" that define the ecosystem approach, there have been various initiatives (from the research community, policy-makers, regulators, conservation, and other stakeholders with a relevant interest) to relate the ecosystem approach to marine management and MSP. Ramieri et al. (2014) present schematically the correspondence between the CBD principles of the ecosystem approach with MSP key principles, while other attempts such as those in Marine Management Organisation (MMO) have revised and adjusted the "Malawi Principles" for marine planning purposes (MMO, 2014a).

Attempts have been focused, as in the UK by the Department for Environment, Food and Rural Affairs (Defra, 2014), MMO (MMO, 2014a) and more collective initiatives (Turner et al., 2014), on making the framework of Ecosystem Services (ESs) operational as a way to integrate the ecosystem approach into marine planning and management. As highlighted in Böhnke-Henrichs et al. (2013), ESs are a suitable framework for analysis and a useful analytical and communication tool for marine planning and management by connecting science on ecosystem processes and functions to changes in human welfare. In addition, the integrating role of ESs is also demonstrated through the European Commission's initiative to connect the Mapping and Assessment of Ecosystems and their Services (MAES) project's methodology with Marine Strategy Framework Directive (MSFD) (EC, 2008) indicators. In this context, the good status of marine ecosystems would also be measured in terms of their capacity to produce resources/deliver services, and MSFD goals would be integrated into the strategic objectives of MSP.

In an aside, it should be noted that two main "types" of MSP have been discussed: On one hand, there is the integrated use of *Maritime* spatial planning based on "soft" sustainability, characterized by a short-term view that reflects utilitarian values. On the other, there is the ecosystem-based *Marine* spatial planning approach, characterized by a "hard" sustainability principle that adopts a longer-term view and reflects ecocentric values (Qiu and Jones, 2013; Jones et al., 2016). Frazão Santos et al. (2014) have argued that most EU initiatives seem to follow the first type. Hence, as Jones (2015) commented, although the overall aim should be integration, there appear to be growing tensions between policies that focus on an ecosystem-based approach, for example the MSFD aiming to achieve Good Ecological Status (GES), and policies that focus on Blue Growth, such as the Integrated Maritime Policy that the MSP Directive legally underpins.

Regarding socioeconomic input, European policies over time have increased the use of economics in "environmental" oriented Directives and have made clear the need for the use of environmental valuation and Cost-Benefit Analysis (CBA). For example, the Water Framework Directive (WFD) (EC, 2000) introduces the term of "disproportionate costs" for derogations, which as noted in Stithou et al. (2013), requires comparing the costs of implementing a water management plan to achieve GES with the potential benefits of achieving GES, implying the use of non-market valuation techniques. Focusing on the marine environment, Hanley et al. (2015) provide a review of existing European legislative drivers for increased use of valuation in coastal and marine policy. Impact assessments in the form of CBA have become established in legislative and administrative practice in the UK and the USA over the last five decades (Börger et al., 2014). In the UK, they have been employed to support policy changes in decision-making on, for example, potential English marine protected areas sites, while relevant guidelines from generic to marine specific have become available to assist government officials and involved stakeholders (Defra, 2013; HM Treasury, 2007; UKFEN, 2012; PSEG, 2015). At this point, economic analyses such as CBA have evolved to avoid certain limitations, for example, by monetizing environmental costs and benefits, incorporating social equity considerations and declining discount rates (Arrow et al., 2014) to emphasize improvements in long-term rather than short-term social welfare.

Drawing mainly from European experience—although most of the issues discussed apply equally to other locations—this paper attempts to offer a broad overview of socioeconomic input, including data, information, methods, tools, and social principles to be employed for an ecosystem approach to MSP. Special emphasis is put on the role of ESs and their valuation, while overall socioeconomic related challenges and recommendations are presented. In particular, the paper is organized as follows. Following this introduction, section 2 presents a generic framework of ecosystem-based MSP to then elaborate on the role of socioeconomic needs and related concepts in a structured fashion in section 3. Then challenges—generic and valuation-specific—are discussed in section 4, while section 5 features conclusions and recommendations.

2. TOWARDS A FRAMEWORK OF ECOSYSTEM-BASED MSP

As mentioned previously, efforts have been made to integrate the ecosystem approach into marine management and planning and make it operational, including initiatives at the national level e.g., the Australian Government's "Guidelines for Applying an Ecosystem Approach in the Oceans" (Department of Environment and Heritage, 2006), "US National Ocean Council: Marine Planning Handbook" (NOC, 2013), and England's initiative "Practical Framework for Outlining the Integration of the Ecosystem Approach into Marine Planning in England" (MMO, 2014a). Theoretical frameworks with a focus on implementing the ecosystem approach at a regional level based on academic research (e.g., FP7 ODEMM, Interreg ADRIPLAN) and practical applications (e.g., Norwegian Ecosystem Based Management (EBM) by Olsen et al., 2007) have also been developed. In addition, larger international initiatives have also been put in place such as the EcAp-MED project 2012-2015, which has been supporting United Nations Environment Programme Mediterranean Action Plan (UNEP/MAP) to implement the Ecosystem Approach in the Mediterranean in synergy with the EU's MSFD principles (UNEP/MAP, 2015).

Managing human activities in the sea and setting up an MSP process in countries with no prior experience requires four initial steps to get organized, as shown on the left side of Figure 1 (Ehler and Douvere, 2009): (i) identify need and establish authority, (ii) obtain financial support, (iii) organize the process through pre-planning, for example, creating the MSP team, developing a work plan, defining the MSP boundaries and timeframe, identifying risks, and developing a contingency plan; and (iv) organize stakeholder participation by determining who to involve in MSP, when and how to involve stakeholders, and how the latter will participate. After setting up the process, steps for producing the plan are defined, as demonstrated in the right side of Figure 1. Next, a previously agreed vision for the area, description of the strategic goals to be achieved aligned with existing policies, definition of planning principles, and the legal framework will create the base for defining and analyzing existing and future conditions, which will allow for assessing the generated options in the next stage. After selecting the preferred option involving stakeholders and making it publicly available, the plan is adopted and implemented. Monitoring and evaluating the performance, including indicators and targets, is an important step that enables revision and adjustment of the plan and the process (goals, objectives, outcomes, and strategies), as well as identifying applied research needs and changes that may have occurred (Gilliland and Laffoley, 2008). Overall, long-term ocean and coastal observing, monitoring and research programs are needed to better understand the workings of marine ecosystems, changes in ocean dynamics, and the effectiveness of management decisions (McLeod et al., 2015). Therefore, when setting up the process it should be adaptive and dynamic and involve learning from activities and changing realities, as demonstrated by the dashed arrow in Figure 1. Another distinctive element of the process is stakeholder engagement, which takes place throughout. The multiple roles of stakeholders include providing direction, knowledge and information, reviewing and validating draft and final plans and even contributing to the monitoring phase. The next section focuses on the role of socioeconomics in this process, particularly in those steps outlined in red, where the discipline is most employed.

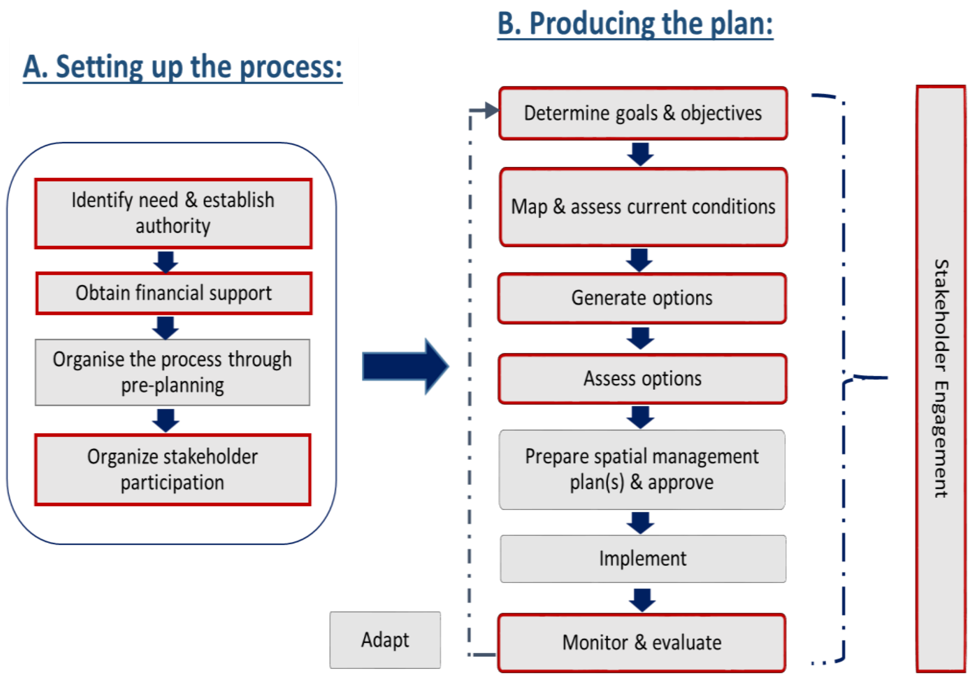

Figure 1. The planning process. Elaboration based on Gilliland and Laffoley, 2008; Ehler and Douvere, 2009

3. AN OVERVIEW OF THE ROLE OF SOCIOECONOMIC INPUT IN ECOSYSTEM-BASED MSP

Socioeconomic elements in an ecosystem-based MSP include data, methods, and tools employed in socioeconomic analysis, as well as related principles and concepts (e.g., stakeholder engagement and social equity). In the context of ecosystem-based MSP, social sciences have a crucial role to play as the focus is on the entire ecosystem, including humans. Socioeconomic input can take place even before the phase producing the plan, in the "setting up the process" stage (Figure 1, highlighted in red), to gain, for example, financial support for planning efforts by defining the net benefits from better planning (Börger et al., 2014), and to enable stakeholder identification through, for example, exploratory interviews, and social network analysis (Ban et al., 2014). Table 1 offers an overview of the contribution of socioeconomic information to ecosystem-based MSP following Figure 1, and highlights examples of information needed to make MSP steps operational. In addition, for each step it lists examples of potential methods and tools to provide this information.

Step 1. Determine goals and objectives

As the table shows, starting the process requires socioeconomic SMART (Specific, Measurable, Attainable, Realistic and Timely) objectives for different sectors, and interests need to be set based on a long-term, common vision. These objectives can be both quantitative (e.g., 10% energy from renewables by 2020) and qualitative (e.g., change in access to a resource), so as to ensure, for example, that people's economic dependence on marine resources has been acknowledged along with a sector's specific goals. This paper assumes that going beyond sectoral analyses and acting transparently will resonate with most coastal inhabitants and thereby gain broader acceptance for planning. This, in turn, will make environmental and social goals more achievable and cause people to rank them higher in terms of social equity and, hence, sustainability. Furthermore, objectives can be set based on ecosystem service provision and linked with MSFD goals. This could assure that points of no return are avoided, marine ecosystems can deliver these ecosystem services, and overall that Blue Growth is consistent with the achievement of GES (Jones et al., 2016). At this step, having identified the relevant stakeholders (to be affected by plans) makes it possible to refine goals and objectives by using methods to combine views, local knowledge, concerns, and needs. In addition, setting ecosystem service objectives requires presenting ES concepts to stakeholders from the beginning and in particular the link between ecosystems and human welfare (Fisher et al., 2008). Using a "conceptual" diagram of the links between the environment and the human activities provides managers and stakeholders with an overall vision of the system, while the participation of the latter in constructing the diagram can help build and share a common understanding of the ecosystem (Herry et al., 2014).

Step 2. Map and assess current conditions

The second step that requires socioeconomic input is that of building the existing ecosystem characterization (baseline information), which includes a social, cultural, and economic overview and assessment of the area (e.g., Gross Value Added (GVA), property values, average expenditure per visitor/day, employment, etc.) along with habitat, biological, and oceanographic analysis (Caldow et al., 2015). In addition, existing legal and administrative systems, as well as institutions, should be considered (Le Cornu et al., 2014). Therefore, focusing on the socioeconomic element, it is important to map marine activities and the usage of marine resources, describe their complexity, including the spatiotemporal variability, intensity and diversity, and define how different social groups, which may be less organized in clubs or associations, depend on the marine environment. At this stage, it is possible to gather baseline data for cumulative impacts assessment, including threshold effects for use intensities or diversities, identify current conflicts and compatibilities among existing human uses and between existing human uses and the environment (Kittinger et al., 2014), as well as consider social equity. Nevertheless, considering practical limitations (e.g., time, data, human resources), incorporation of some social data, and an accurate characterization of human uses in the planning region should be included at a minimum (Kittinger et al., 2014). For this purpose, available official censuses and surveys as well as participatory Geographical Information Systems (GIS), when data (especially social) is lacking, can be helpful.

This step can also include information on the current provision of ESs and values, if possible or applicable, based on current patterns of human use. Overall, the economic valuation of marine ESs can aid the process by translating the impacts on ecosystems to benefits within marine plans, considering the socioeconomic characteristics of the affected population, and help when making trade-offs (e.g., job creation *vs* reduced natural flood defense capacity) under feasible scenarios (Mongruel et al., 2015). Furthermore, ESs valuation, including monetary, can provide a framework to involve different stakeholders and identify preferences and opinions through survey-based and deliberative stated preference approaches (Börger et al., 2014). It can also enable policymakers to design and target marine conservation policies (e.g., extend a network of marine protected areas) that maximize welfare benefits (Christie et al., 2015) and economic incentive mechanisms. Such mechanisms could include fees and taxes but also more innovative and less explored ones such as (in the marine environment case) payments for ecosystem services (Forest Trends and the Katoomba Group, 2010; Bladon et al., 2014). As Börger et al. (2014) comment on the potential for ESs valuation to support marine planning, it provides information, among other things, on the relative importance of existing uses as reflected in their social and economic values, and highlights ecosystem benefits and costs that may otherwise be overlooked. A way to capture the values of ESs in a holistic way is to consider the concept of Total Economic Value (TEV) framework, which takes into account both the use and non-use values individuals and society gain or lose from marginal changes in ESs (Defra, 2007). Figure 2 (next page) demonstrates how the TEV framework can be employed to classify values of ESs derived from the marine environment from a "usefulness to humans" perspective. It also includes the concept of non-anthropocentric values as a distinctive approach to TEV, which holds that the marine environment has value regardless of valuations made of it.

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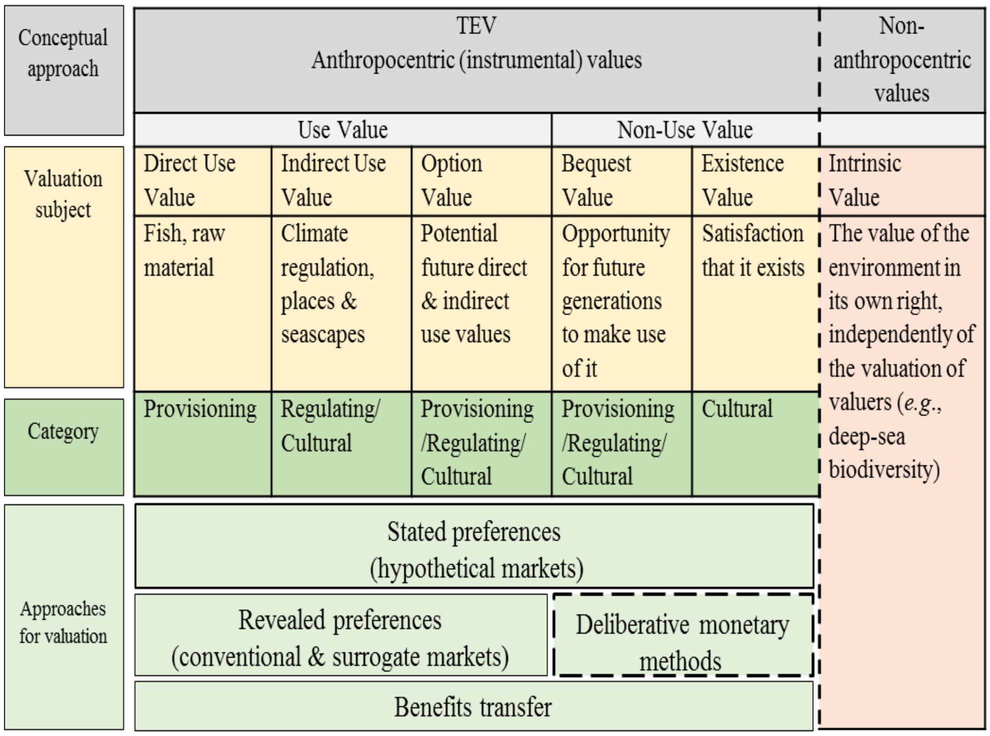

Figure 2. Marine ecosystem services through the Total Economic Value (TEV) framework and approaches for valuation. Elaboration based on Defra, 2007; TEEB, 2010; Turner et al., 2003; Turner et al., 2014; Kenter et al., 2015

Approaches for estimating ESs values vary between preference-based and biophysical (TEEB, 2010). In keeping with the TEV concept, use values and non-use values can be estimated using neoclassical economics methods (TEEB, 2010), including benefit transfer. However, specific challenges arise when moving from provisioning services and benefits to subtler shared/social senses of value (e.g., cultural identity) and deliberative methods may be more appropriate (Kenter et al., 2015). Kenter et al. (2015) discuss the way in which social value is assessed in neoclassical economics and present a range of other monetary and non-monetary techniques that can elicit shared and social values. The authors also explore the relation between shared/social values and TEV and its components (non-use values). As they note deliberative monetary valuation may allow, among others, better incorporation of different types of shared values in relation to the different components of TEV. In a broader context valuation of ESs is not necessarily restricted to economic terms. As Mongruel et al. (2015) argue, when there is concern about the "insurance value", which is closely related to the resilience of the ecosystem and depends on ecological infrastructure and processing capability, "this value is better acknowledged through the precautionary approach or the setting of safe minimum standards than through monetary valuation." In this case, this paper argues that the threshold for strong sustainability appears and the preservation of nature is non-negotiable. Hence, although valuation may improve the effectiveness of decision-making, i.e. when natural capital or ESs are becoming scarcer, economic valuation of ESs could be implemented "for defining the scope and target of use and conservation trade-offs, within the limits of what is substitutable or reversible" (Mongruel et al., 2015). Furthermore, regarding the scale of environmental change (i.e., a local natural asset *vs* a global one), monetary valuation might be more suitable when considering small or marginal changes (Turner et al., 2003). Finally, because of rising awareness of less tangible values (e.g., improved mental and physical health from spending time at sea) and shared (social) values, The Economics of Ecosystems and Biodiversity (TEEB, 2010) recommends using a variety of valuation approaches (monetary and non-monetary), as mixed approaches may overcome disadvantages of particular valuation methods. Overall, there are different approaches, methods, and tools used to obtain metrics for assessing ESs. These may depend on bioethical criteria, uncertainty and risk, how tangible benefits are, how they are perceived in relation to everyday life (e.g., deep-sea ecosystems), scale of change, and scale of value (individual/society), among other factors. In addition, planners should consider results from the perspective of stakeholders and decision-makers, the assessment's goal, and the stage of the management process the assessment is intended to support (Pendleton et al., 2015).

Step 3. Generate options

In order to generate possible alternative future options/scenarios, defining and analyzing future conditions is important. This includes projecting current trends of existing human uses, demographic, cultural, and governance conditions, and estimating new demand for marine space (Ban et al., 2014; Le Cornu et al., 2014; Ramieri et al., 2014). In addition, trends in ESs can be considered. The available methods and tools to enable descriptions of possible futures vary from participatory scenario development tools and dynamic modelling to consultation with experts and use of available reports. For this purpose, combinations such as cumulative impact assessment and scenario development tools are also possible. This step should be informed at a minimum by stakeholders, experts, and available strategies.

Table 1. Examples of Socioeconomic Information, Methods, and Tools Used in Producing Plans

Steps	Type of information	Methods or tools
1. Determine goals and objectives	Quantitative-sectoral (e.g., 10% energy from renewables by 2020), qualitative-community (e.g., change in access to a resource), ecosystem service provision objectives (e.g., fishing-designated areas to provide at least 90% of previous catch for each fishery)	Deliberative democratic methods (supplemented by primary data), community surveys, quantitative analysis of historic data

Steps	Type of information	Methods or tools
2. Map and assess current conditions	- Distribution of human activities and uses - Socio-demographic (e.g., population distribution) and socioeconomic profile of the area (e.g., GVA, property values, average expenditure per visitor/day, employment), including governance characterization - ESs and related values based on current patterns of human use	- GIS including participatory techniques (in a data poor context) - Available censuses and surveys - In the absence of values for ESs (TEEB, 2010): • Preference-based approaches (e.g., non-market valuation methods, deliberative valuation) (see Fig. 2) • Biophysical approaches (e.g., risk analysis)
3. Generate options	Trends in existing human uses, demographic, socio-political, cultural and governance conditions as well as in other drivers of change (e.g., environmental, technological). Also, trends in ESs and requirements for new demand of marine space. Data suitable to feed into available participatory scenario development tools (e.g., SeaSketch)	Available reports, consultation with experts, scenarios workshops, focus groups, deliberative democratic methods, GIS implementations including participatory, dynamic modelling, scenario development tools, cumulative impact assessment, and combinations of these
4. Assess options	-Mainly, distribution of habitats, biophysical and oceanographic information combined with Step 2 information to feed into decision support tools -Knowledge on how various drivers of change under alternative future scenarios lead to spatially explicit changes in environmental condition, ecological function, services, goods and human well-being (Mace et al., 2011)	-Qualitative assessment of the delivery of services, socioeconomic impacts, etc. -Balance Sheets Approach (Turner et al., 2014): Moving from efficiency based CBA to impact analysis considering distribution of gains and losses and including non-use values (loss of cultural assets e.g., seascapes), to trade-off analysis (e.g., deliberative multi-criteria analysis) including wider ethical and policy consequences and shared values depending on the context of environmental change (i.e., slow and simple *vs* complex and dynamic) (see Fig. 3) -Cross-methods e.g., InVEST

Steps	Type of information	Methods or tools
5. Monitor and evaluate	Quantitative and qualitative data to enable developing socioeconomic indicators (e.g., employment rate, income deprivation, number of recreation visits to the coast, (subjective) mental health benefits of visiting the coast, ecosystem service indicators) that measure the effectiveness of management conditional on set objectives (MMO, 2014b). Evaluation to include the effectiveness of the planning process in for example, promoting equity and social justice and the availability of new data and trends	Official statistics, social surveys, qualitative interviews, econometric modelling Institutional analysis, development framework and consideration of subjective psychological factors to explore the link between human behavior and plan's effectiveness (Ban et al., 2014)
Stakeholder Engagement: Overarching "social principle" of involving stakeholders throughout the process to for example shape goals, provide local knowledge and data for baseline information, shape scenarios and overall, review early findings, draft and final plans. Certain stakeholders with monitoring responsibilities will also need to be involved during the monitoring phase. Exploratory interviews and social network analysis can enable stakeholders" identification (Lopes and Videira, 2013)		

Elaboration based on Ehler and Douvere, 2009; TEEB, 2010; Mace et al., 2011; Lopes and Videira, 2013; Ban et al., 2014; Börger et al., 2014; Kittinger et al., 2014; Le Cornu et al., 2014; MMO, 2014b; Turner et al., 2014; McLeod et al., 2015; Kenter et al., 2015

Step 4. Assess options

Following the steps of the planning process and focusing on the assessment of options (Figure 1), planners need to compare alternative options with the "business as usual" scenario in order to support the final decision-making. At this stage, planners need to integrate socioeconomic information with other ecosystem information (habitat, biological, and oceanographic). The link between social and ecological components is demonstrated through the "pressure–state–impacts–response" analysis framework (Turner, 2000), according to which drivers of change (apart from management measures, such as environmental, demographic, economic, socio-political, technological, and behavioral) are effecting ESs, which is translated to impacts on good(s) and therefore, changes in human well-being (Mace et al., 2011). In this context, human well-being is a function of economic, health, and shared (social) value. Therefore, planners at this stage need knowledge of and data on the particular links of the framework (how ecosystems interrelate and function, the interdependence of ecosystems and ESs) to perform social-ecological analysis. In this interconnected dynamic process of assessing trade-offs between different ESs under various scenarios,

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planners can prioritize management actions to provide ESs that benefit people and biodiversity (Chan et al., 2006; Cowling et al., 2008). For example, they can aim to collocate activities with minimum cumulative impacts that maximize provision of ESs based on established objectives (integrated with GES and the preservation of ecosystem resilience).

Overall, there is a wide choice of socioeconomic tools and methods to assess impacts and evaluate planning options. Ben et al. (2013) offer a description of the social science methods and tools in conservation planning relevant to MSP. These include CBA, Multi-Criteria Analysis (MCA), non-market valuation, “green” input–output, social network analysis, cognitive mapping, collaborative mapping, participatory GIS, deliberative democratic methods and consideration of psychological factors. Mongruel et al. (2015) present a variety of the sets of methodologies implemented in the Valuing Ecosystem Services in the Western Channel (VALMER) (EU Interreg project) case study sites, including (apart from the ecological assessment methods of habitats-functions-services relationship assessment and sensitivity assessment) social sciences methods (interviews, surveys, MCA), economic methods (transport costs, choice experiment, ecosystem accounting, Bayesian belief networks, etc.), and cross-methods (Integrated Valuation of Ecosystem Services and Trade-offs (InVEST), system dynamic modelling, etc.). Kittinger et al. (2014) provide examples of spatial approaches and tools used in integrated socio-ecological assessments for ecosystem-based ocean planning including cumulative impact score, monetary value and index of biological value. Similarly, Le Cornu et al. (2014) offer a global assessment of the incorporation of social data in coastal and ocean planning, while Lopes and Videira (2013) suggest an integrated participatory framework for the valuation of marine and coastal ecosystem services that goes beyond economic terms. In particular, with regards to tools, Lopes and Videira (2013) suggest exploratory interviews and social network analysis for identifying stakeholders, system mapping workshops and focus groups to enable conceptualization of how decisions affect ESs, questionnaires, scenarios workshops and dynamic modelling for identifying long-term impacts on ESs, monetary valuation and biophysical indicators for eliciting values, and deliberative methods (e.g., participatory MCA, citizen juries) for value integration and articulation.

Following Table 1, in a poor data context (e.g., lack of monetary values) with limited resources, and as long as uncertainty and risk are not high, this step could include identifying, mapping, and assessing impacts (e.g., changes in ESs provision) in qualitative terms, where necessary. In this case, consultation with stakeholders and experts, in addition to relevant literature, is crucial. As data becomes available, the Balance Sheets Approach (Turner et al., 2014) or cross-methods e.g., InVEST (based on understanding the underlying assumptions and limitations of the tool) could be employed. Regarding the Balance Sheets Approach, Figure 3 shows the logical sequence in decision support methods and processes (Turner et al., 2014), which is also reflected in European policies. For example, although in practice the initial member state assessments regarding MSFD have generally focused on the economic side, this policy demonstrates a shift from an economic appraisal (enabled via CBA or cost-effectiveness analysis) to a wider social appraisal touching upon social equity concerns, fairness, and social effects with a spatial boundary (local/regional) condition. Then, as shown in Figure 3, the social analysis continues but now encompasses values and impacts that are often expressed at the national scale with a variety of underlying ethical criteria (Turner et al., 2014). At this stage, dealing with shared (social) values makes the use of deliberative methods (e.g., MCA) more appropriate. As uncertainty and risk increase and the resilience of the ecosystem is of major concern, the precautionary principle is triggered. In this context, the focus is on "insurance value" and monetary measures are irrelevant.

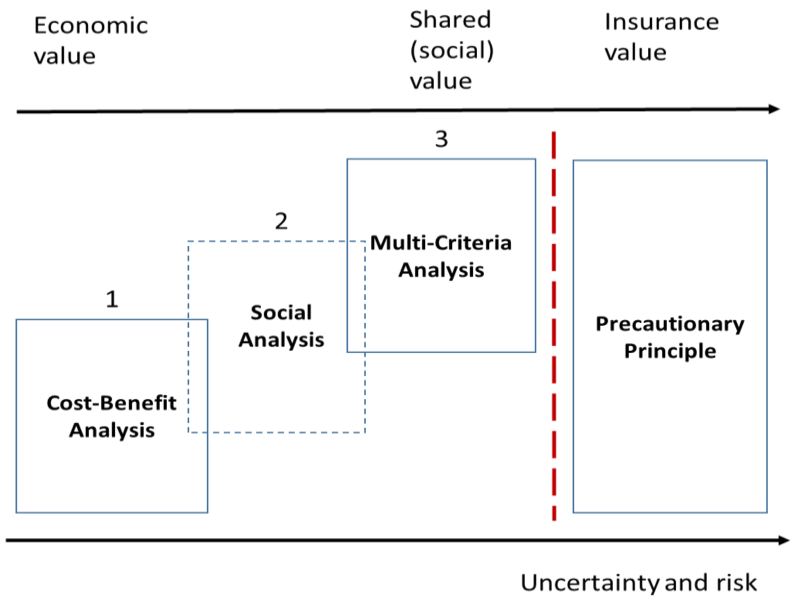

Figure 3. "Balance sheets" approach. Adapted from Turner et al. (2014)

Regarding the choice of tools and methods, Moran et al. (2007) comment that there is a belief that monetary valuation methods and CBA often limit the decision-making process, compared to alternative deliberative or multi-criteria methods that can be more informative for policy-making. Following Vatn (2009), the choice of the tool for analysis is based on very different assumptions concerning the characteristics of environmental resources, the capacities of the individuals involved and the role the methods play in framing the process. For example, the author argues that while CBA assumes individual rationality, deliberative methods assume that individuals can act according to social rationality. The author also developed a general framework for evaluating appraisal methods. Finally, it could be argued that the choice of the tool for analysis may be a sociopolitical one, assuming a democratic society and a societal choice of management objectives as EBM dictates. In this context, how sustainability is perceived (soft *vs* strong) and which criteria are adopted (e.g., efficiency criterion or bioethical criteria) have an important role to play. Nevertheless, concerns have been expressed that when the different parties (conservationists, industry, and government) apply different weights to the costs on the three dimensions of sustainability, no amount of dialogue will find a compromise that seems equally fair from all perspectives (MEAM, 2009).

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Step 5. Monitor and evaluate

Monitoring is an important step that enables revision and adaptation of the plan and the overall process by using indicators that reflect set objectives. Adaptation is a crucial element of marine management, as it also allows identifying new research needs, data and changes that may have occurred. As Table 1 shows, this step requires both qualitative and quantitative data during planning in order to develop socioeconomic indicators that will reflect objectives and measure the effectiveness of the plan. Examples of such indicators include marine and coastal employment rate, (subjective) mental health benefits of visiting the coast, and ecosystem service indicators linked to social outcomes. The development of national marine natural capital accounts may make the latter possible (MMO, 2014b). Furthermore, Börger et al. (2014) note that planners should consider ESs valuation while monitoring the success of a marine plan. More specifically, the authors argue that the assessment of the change in social value following a change in the provision of ESs should enable the analyst to identify which ESs are most important to monitor from a social perspective. Another aspect of monitoring and evaluation may concern the planning process's ability to effectively involve all stakeholders (for example, those affected have an interest and can make a contribution regardless if they are organised in a group or not), give them access to information and have them participate in decision-making. As seen in Table 1 there is a range of available tools and methods for developing indicators. Moreover, planners should also note the role of behavioral economics and related techniques in exploring subjective psychological factors and providing insight on how people may react to different forms of governance. This can provide useful information when designing and evaluating spatial management plan measures.

Finally, regardless of the tool chosen to support decision-making or the availability of data, the participation of all stakeholders (e.g., through participatory governance that accounts for both local interests and those of the wider public (McLeod et al., 2015)), is a minimum prerequisite. Stakeholders not only provide valuable information including local knowledge, interests, and concerns, but their involvement throughout the process also enables them to take ownership of the process by becoming co-planners, an outcome which in turn should enable the successful implementation of the measures (Börger et al., 2014). In addition, stakeholder participation can help build and share a common understanding of the ecosystem as well as promote transparency, integration, and overall effectiveness of planning in achieving its goals by considering a shared definition of the problems and likely solutions within a specific sociocultural and environmental context. In this framework, stakeholders can contribute, for example, to: (i) establishing measurable objectives and targets, according to the common vision which they should also share; (ii) offering local knowledge and expertise, validating available data, and agreeing to baseline evidence requirements and indicators, as well as offering views of future activities and uses; (iii) identifying and prioritizing ESs, benefits derived from ESs and how these benefits are accessed or obtained (MMO, 2014a); (iv) developing options (e.g., through narrative text and visual presentation) to address key issues and discuss different management options; (v) examining the plan to allow public representation, and (vi) monitoring, as certain stakeholders may have monitoring responsibilities. Maguire et al. (2012) discuss in detail the role of stakeholders in the marine planning process and propose a mechanism for managing their involvement, while Lopes and Videira (2013) suggest exploratory interviews and social network analysis to identify them.

Overall, operationalizing an ecosystem-based MSP involves not only qualitative, quantitative, spatial, non-spatial, primary, and secondary data, but also knowing how to link ecosystems to human well-being through an interdisciplinary approach. Furthermore, given that ecosystem-based MSP has socioeconomic and ecological objectives, to involve all sectors of society and include all sources of information, including local knowledge, planners need to collect socioeconomic information from the outset of the planning process.

4. CHALLENGES IN OPERATIONALIZING THE FRAMEWORK

4.1 Generic Challenges

Marine systems pose more challenges to planners than terrestrial systems because the former are three-dimensional living spaces, involve nonlinear systems dynamics and have not been as well studied (Agardy, 2000). In this context, planners have to consider nebulous boundaries, interrelationships among activities of the area, its ecosystems, response to global processes (e.g., climate change), existing mandates and administrative frameworks, and the fact that the area may be important for a use that occurs far from its boundaries. This usually demands a holistic approach, as well as a higher degree of coordination among state agencies and the establishment of more sophisticated monitoring programs.

Regarding socioeconomic input, even in countries with prior experience in marine planning, it has been observed that socioeconomic information and data sources can be of varying quality and confidence and may not cover all sectors (MMO, 2013). Also, a top-down approach might be employed using national data, while high level estimates of the GVA in some cases might be used due to the lack of more detailed and appropriate data (MMO, 2013). Regarding socioeconomic analysis in the Mediterranean, the Plan Bleu (2015) has stressed the need to reconcile national approaches with regional ones. Furthermore, data might be held by many disparate data holders, and involve poor metadata records, poor spatial and temporal records as well as little information on the protocols and standards used to collect and analyze the data (MMO and Marine Scotland, 2012a). In addition, decision-making tools often fail to incorporate indirect economic values (e.g., supply chain data and employment rates) and social data on coastal communities (MMO and Marine Scotland, 2012b). Another important limitation is that socioeconomic and environmental data are rarely collected together.

Social data poses specific challenges for planners. For example, in decision-making for sustainable coastal management in the UK, social information is often lacking or it is not at the appropriate scale, while there is good information on provisioning services and a range of methods (Saunders et al., 2015). In addition, social data often lack the spatial dimension. Therefore, following Le Cornu et al. (2014) practitioners should be aware of important data that either are not spatial in nature or are difficult to ascribe to spatially. Similarly, some social scientists have expressed concerns that an "overreliance on spatial, quantitative analytical methods may potentially devalue or preclude the use and consideration of critical but non-quantitative or non-spatial social information" (Kittinger et al., 2014). As a result, several ESs, especially cultural ones, are not fully considered in management plans or adequately quantified for policy decisions (Costanza et al., 1997).

Other challenges stem from many practitioners" unfamiliarity with social science methods, which are not as commonly applied as biophysical data in ocean planning (Kittinger et al., 2014). In addition, data gaps arise due to the minimal overlap between natural scientists" focus on functions and processes and economists" and other social scientists" focus on people (Mongruel et al., 2015). Finally, practitioners have to deal with rapid shifts in political support, conflicting management goals, and immediate demands that may impede the planning process (Le Cornu et al., 2014). These barriers are in addition to inadequate resources and data.

4.2 Challenges in Valuation

Apart from the above generic issues of concern, researchers and planners have highlighted valuation challenges in light of the growing emphasis on basing marine management and policy analysis following the ESs approach (Austen et al., 2011; Böhnke-Henrichs et al., 2013; Turner et al., 2014). As a result, various ESs classifications have been developed. For example, Liquete et al. (2013) highlight the main categories of goods, services and benefits provided by marine and coastal ecosystems, while Böhnke-Henrichs et al. (2013) suggest an ESs typology that is particularly suitable for ecosystem based management and marine planning. Another example is the typology of UK marine ESs, including supporting, provisioning, regulating, and cultural ESs, developed in the UK National Ecosystem Assessment Follow-on (UK NEAFO) project (Turner et al., 2014). This study also included a literature review on the availability of related valuation studies. As the authors note, this information is likely to shape subsequent UK research that will be a key evidence source for marine plans especially due to the limited number of studies valuing UK marine ESs. Regarding the Mediterranean and Black Sea region, there are extremely few published studies highlighting the potential for future research on coastal and marine ecosystems (Remoundou, 2009), while it is very likely that, as in the case of the UK (Prof Kerry Turner, pers. com., Jan 2014: cited in MMO, 2014a), the available work has not focused on the most valuable or important services. However, it is worth mentioning that initiatives are underway that attempt to scope and capture the socioeconomic importance of coastal and marine waters in the Mediterranean (Plan

Bleu, 2014) or the costs of degradation of the Mediterranean marine ecosystems (ACTeon, 2014). Overall, marine ESs are relatively less explored and a common classification has not been used (Brouwer et al., 2013).

Overall, the integration of ES valuation into marine and coastal policy formation is considered “particularly challenging due to the fact that these ecosystems tend to be large and therefore often overlap multiple political jurisdictions and economic sectors, and may not even be governed by an integrated institutional framework” (Hanley et al., 2015, p. 25). Nevertheless, it is noted that “solid ecological understanding of how those ecosystems are structured, function, and how they are impacted by human activity is sometimes skipped over in the rush to value ecosystem services” (Tundi, 2015). Börger et al. (2014) also note the lack of valuation data for many marine services and physical areas and the difficulties in selecting the baseline, as well as the lack of fundamental natural science knowledge regarding changes in marine ESs. In particular, they point out an inability to link planning scenarios to ecological outcomes and values, since the reliance of ecosystem service provision on biodiversity and ecosystem processes is poorly understood.

Similarly, Hanley et al. (2015) argue that for the economic framework to be useable it requires that first the direct and indirect links between utility and the condition and extent of ecosystems be identified and parameterized. The authors state that for each ecosystem, the analyst needs to be able to identify the contributions to human well-being which result from the functions and structure of this system. However, as they highlight the number of links to be identified and the difficulty in doing so may depend on which kind of ESs is being considered in which kind of ecosystem (e.g., deep-sea ecosystems *vs* mangroves). In addition, the contribution of ESs to benefits should be distinguished from the contributions of other inputs to the production of these benefits (UK NEA, 2011). This requires greater knowledge of interlinkages between and within systems. For this reason, Börger et al. (2014) argue that economic valuation studies are constrained and challenged by the quality of the ecological data and lack of knowledge, which leads to scientific uncertainties. Hence, in view of these difficulties, further research is required in qualitatively linking the occurrence of marine habitats to specific ESs portfolios. The authors also highlight that economists and ecologists can jointly identify how this change in ESs supply will affect the flow of direct and indirect benefits, once behavioral responses to the change in ESs have been taken into account. Nevertheless, as highlighted before, the combined effects of pressures in nature, known as multiple stressors, are less understood. Börger et al. (2014) note that there are applicable methods for measuring the monetary value of this change in benefits, which implies that economists have access to a sufficient range of valuation methods and the resources to apply them. Nonetheless, as mentioned before, monetary valuation may not be appropriate in all cases.

Moreover, practitioners often face inadequate resources and immediate demands in attempting to carry out non-market valuation exercises (Le Cornu et al., 2014), which has resulted in a greater use of value transfer methods. Börger et al. (2014) also

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highlight time and cost constraints that limit the use of valuation studies and make benefit transfer the preferred option. Nevertheless, this option has its own limitations due to, among other factors, the scarcity and inadequacy of primary valuation data, the potential lack of similarity of marine sites and the fact that past values may not always reflect future preferences, making them unsuitable to be used for benefit transfer over long periods of time. Regarding valuation, the authors note that the decadal time frame of marine plans is challenging for original valuation studies, since it may be difficult for people to respond to changes, included in surveys, projected 15 to 20 years in the future, making value estimates relatively unstable.

Following Börger et al. (2014), another major challenge is that not all marine ESs are location-specific (e.g., fish, mammals) making planning at national level difficult. Some marine ESs are not restricted to individual countries and certain marine resources have high mobility. Hence, such services can be valued by people in different countries. As a result, spatial distance poses specific challenges regarding valuation, since different scales should be considered such as those of the socioeconomic system impacted, the ecological functions that support the service, and the scale of the proposed management action (Mongruel et al., 2015). Nevertheless, Börger et al. (2014) maintain that more important than the spatial distance is the cognitive distance that adds to the methodological challenge due to the unfamiliarity of respondents with the environment (especially when exploring non-use values), which they may perceive as relatively unimportant. They also note that few valuation studies have investigated the open ocean and deep sea due to the challenge of communicating complex, ecologically valid ecosystem information. Nor have many studies examined cultural services such as spiritual well-being and heritage. Similarly, Hanley et al. (2015) argue that using choice experiment and contingent valuation may be more problematic when estimating values for deep-sea biodiversity as it could result in under-valuation of deeper waters due to their remoteness and a perceived lack of relevance to everyday life. Hence, in this case seeing environment and natural resource issues through the lens of benefits to humans as perceived by them may be problematic and one could argue that it is more appropriate to see environment as having an intrinsic value (Figure 2).

As aforementioned, less tangible values pose certain challenges for environmental valuation methods. In this sense, De Groot et al. (2002) argue that the value of ecosystem goods and services should be a combination of economic, ecological, and sociocultural values. As highlighted in Turner et al. (2014), values expressed for socio-cultural entities with specific historical conditions and symbolic significance can better manifest themselves through collective social networks such as groups, communities, and even nations. These values can be better estimated through group deliberation and “shared values” elicitation, rather than an individualistic lens. Kenter et al. (2015) provide a comprehensive framework for shared/social values. Hence, it is noted that some ESs such as cultural heritage and spiritual benefits may be at risk of being undervalued and/or less considered, especially in a monetary and spatially oriented decision-making framework/system. In general, Kittinger et al. (2014) find that planners rarely incorporate social data in coastal and ocean planning. Here it should be mentioned the efforts of the Mapping Ocean Wealth in developing local and global maps of the social and economic value of ESs to visualize and quantify the services and resources the ocean provides.

Overall, data and knowledge challenges could be summarized as (Börger et al., 2014; Kittinger et al., 2014; ESA in Practice: Lessons Learned, 2015; Hanley et al., 2015; Mongruel et al., 2015; Saunders et al., 2015): (i) lack of knowledge on the extent and status of marine habitats, species, and overall coastal and marine features, as well as on how changes affect the marine environment and hence benefits while accounting for the contributions of other inputs; (ii) variability in sectors, scales, and time regarding marine socioeconomic data coverage, as well as data of varying quality and confidence and poor metadata records; (iii) limited local data, including in terms of the beneficiaries of ESs, and limited ESs values, which, moreover, may not be robust or focused on the most valuable or important services; (iv) difficulties in eliciting, mapping, and visualizing specific ESs values due to spatial and cognitive distance (e.g., deep-sea biodiversity), as well as scale of value (social *vs* individual) seen in, for example, the valuation of cultural heritage; (v) over-reliance on spatial, quantitative data, which may preclude social information and; (vi) isolated collection of social, economic, and ecological data, practitioners" unfamiliarity with social science methods, and the underrepresentation of social scientists in the planning process. The latter may be because marine management might have been "biased" towards environmental data, creating a vicious cycle that is more difficult to break when financial resources are limited and social science input is not given equal weight. Table 2 attempts to summarize the main challenges and give examples of consequences by linking to the steps of producing the plan as presented in Table 1 and Figure 1.

Table 2. Socioeconomic Challenges and Consequences in Producing the Plan

Types of challenges	Examples of consequences
Data related:	
-Lack of data (e.g., values for ESs, coastal communities characterization) -Variability regarding confidence, coverage (sectors, scales, time, spatial reference)	Difficult to define SMART objectives (Step 1) and robust indicators to monitor effectiveness (Step 5). Not harmonized, equal representativeness of activities and uses (Step 2), less informative scenario building (Step 3), less integrated socio–ecological analysis (Step 4)
Methodological (ESs valuation specific):	
-Uncertainty in ecological data and knowledge on interlinkages -Spatial distance (i.e., services not restricted to individual countries, mobility of certain resources) -Cognitive distance (e.g., deep-sea biodiversity) -Scale of value (e.g., cultural heritage)	Economic valuation studies and in general ESs valuation are constrained, having an impact on producing feasible scenarios, the degree of integration of ecological and social information, as well as on confidence of analysis of marine plan options (Step 4). Reliability of ecosystem service indicators (Step 5)
Organizational:	

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-Socioeconomic and ecological data are not often collected in tandem -Many practitioners are unfamiliar with social science methods -Social scientists are "underrepresented" in the process	Impacts the degree of integration in producing (Step 3) and assessing options (Step 4), non- familiarity with social science methods and needs creates data gaps having an impact on the whole process (all steps, including stakeholder engagement)

Elaboration based on Börger et al., 2014; Kittinger et al., 2014; Hanley et al., 2015; Mongruel et al., 2015; Saunders et al., 2015

5. CONCLUSIONS AND RECOMMENDATIONS

Socioeconomic elements in the MSP process include data that enable (i) specifying socioeconomic objectives and respective indicators for assessing the performance of the plan and the process; (ii) analyzing existing and future conditions and; (iii) providing an insight on human behavior that is crucial for the effectiveness of the management measures related to the plans. Another important social element in the process is stakeholder engagement and incorporation of local knowledge. In addition, socioeconomic methods and tools (e.g., in-depth interviews, focus groups, willingness-to-pay valuation methods, benefit transfer) enable the analyst to identify issues, assess ESs, and capture their values and compare scenarios of potentially competing social goals (e.g., CBA/impact assessment).

However, MSP poses many challenges, especially in countries without prior knowledge. Therefore, developing and promoting a National Marine Research Strategy for the provision of social, economic, and environmental data, research, monitoring, and evaluation/quality assurance seems like an appropriate initial step. In particular, at this stage identifying the appropriate data and information for integrated assessment (e.g., social-ecological models) and monitoring with the contribution of economists, ecologists, and marine managers is crucial. For this purpose, a scoping study to assess the current situation in terms of data and knowledge can help prioritize data gaps. Other important considerations include assuring long-term funding to sustain data collection, research and marine planning (Börger et al., 2014), defining the implementing agencies and organizations of the management plan (administrative and management framework) and forming a coordinating body or entity that will facilitate the process and implement the plan (including data collection). Furthermore, planners should consider social norms that determine informal management procedures, collaboration between different agencies or sectors, legal systems, current rules, and policy tools, as well as setting cross-jurisdictional management goals through formal agreements and goals that reflect interagency management at all levels, and establishing metadata guidelines and standards, central archives, and so on (Ban et al., 2013; McLeod et al., 2015). MSP examples from around the world can provide insight on setting up the process and potential barriers therein.

Regarding input-related challenges for making ecosystem-based MSP operational, as highlighted in the previous section, these include data gaps (e.g., extent and status of marine habitats, socioeconomic data including values for ESs at an appropriate scale, etc.), as well as knowledge and methodological limitations from linking planning scenarios to ecological outcomes and values, to communicating complex, unfamiliar ecosystem information for valuation purposes (Börger et al., 2014; Hanley et al., 2015). Although the challenges posed by the marine environment have been acknowledged, MacLeod et al. (2015) have argued that there is enough knowledge to immediately implement an ecosystem-based approach, and measures may need to be taken even when some cause-and-effect relationships are not yet fully established scientifically (CBD, 2000). Therefore, planning can be based on the best information available at the time, while the “precautionary” and “proportionality” principles also have an important role to play. For example, increased levels of precaution are prudent as ecosystems are pushed further from pre-existing states (MacLeod et al., 2015). In general, as Figure 4 demonstrates, levels of precaution should be proportional to the amount of information available such that the less that is known about a system, the more precautionary management decisions should be (MacLeod et al., 2015), depending also on the degree of risk aversion of parties involved in decision-making.

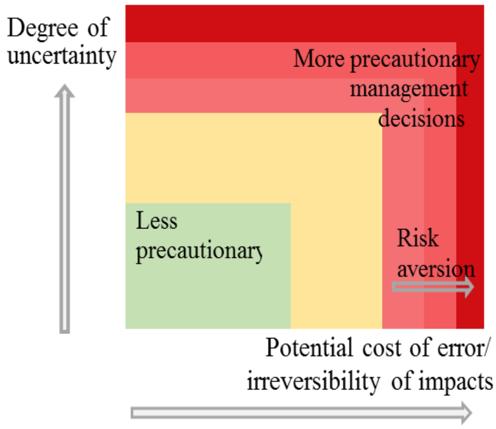

Figure 4. Levels of precaution proportional to information. Intensity of color suggests different degrees of risk aversion

In terms of ESs valuation, although it is a potentially important tool in the marine planning process, its application is still rare. Based on their experience in the United Kingdom and the United States, Börger et al. (2014) recommend supporting MSP by developing a baseline of ecological and economic valuation data in a place-based setting. They also recommend the continued development of integrated valuation databases such as the Marine Ecosystem Services Partnership (MESP) and the National Ocean Economics Program (NOEP) and that they should be developed on international scale to maximize utility of the data. The authors also suggest further standardization and development of valuation approaches making use of innovative tools to convey complex ecological information in the interview setting. Although social scientists are developing innovative methods to characterize various social relationships with ecosystems (Kittinger et al., 2014), research is also needed to properly identify and characterize marine ESs and then provide ES assessment frameworks (Mongruel et al. 2015). Furthermore, the advantages of having a common and agreed typology,

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especially at large scale, is that it will facilitate the primary economic valuation of ESs and the use of benefits transfer, as well as comparisons between different EBM approaches and MSP case studies in order to capitalize on lessons learned (Böhnke-Henrichs et al., 2013). Regardless of these limitations, the principle of proportionality should be considered. For example, "if the change in quantity or value of the ES due to an action will be very small (for example carbon sequestration on a local scale) then there is very limited justification for an assessment" (Pendleton et al., 2015). Ecosystem-based management entails identifying and focusing on the role of key interactions, while adopting smart methods for addressing data gaps (e.g., citizen science and collaboration with existing monitoring programs) (ESA in Practice: Lessons Learned, 2015). Pendleton et al. (2015) have developed a triage system to determine which ESs should be quantified and which measures of ecological output, economic impact or value should be assessed in policy. The authors comment that when disposable resources are insufficient to conduct primary, empirical data collection or monetary valuation, the marine ecosystem service assessment "will be restricted to considering habitats at a broad scale (to match the available data) and to providing qualitative assessments of the delivery of services, based primarily on information from the literature" (Pendleton et al., 2015).

With regards to interdisciplinary research, Hanley et al. (2015) emphasize the need to improve our understanding of how human-induced ecosystem changes affect the provision of ESs, how ecosystems" interaction determines the size of the impact on service provision, and how changes in the provision of such services ultimately affect the welfare of different groups in society. The authors also note the coupled biophysical and human models as an important area of work to focus on instead of data accuracy in each field, as well as initially simpler scenarios of ecosystem change and more straightforward models with improved spatial and temporal resolution and scale. In addition, they suggest following an iterative process between the global understanding of ESs and the focus on key ecological processes or social issues. Regarding uncertainty, Börger et al. (2014) stress the need to highlight potentially irreversible changes and thresholds in the production of ESs and to use and develop methods to handle and communicate this uncertainty. Then, where significant uncertainty remains, assumptions made and confidence assessments should be included as an integral part of ES valuation outputs (Mongruel et al., 2015). Furthermore, focusing more on VALMER's relevant experience, which provides insight into how things are actually implemented, related recommended areas for future research include (ESA in Practice: Lessons Learned, 2015): (i) resilience and thresholds; (ii) cultural services; (iii) moving from bounded marine areas to include connectivity to adjoining marine systems and terrestrial/freshwater interactions; (iv) considering disparity between locations of service supply and location of beneficiaries, how value of services is affected by proximity to beneficiaries, distribution of beneficiaries and "losers" and; (v) better explaining ESs, ideally through case study specific illustrations.

Overall, considering the economic characterization of the plan area with regards to contribution to, for example, economic well-being, experience from countries that already implement MSP shows that further research is needed for a bottom up calculation to be determined for each marine sector, involving an element of primary research to gather data that also includes information on indirect economic values (MMO and Marine Scotland, 2012b; MMO, 2013). For this reason, agreeing on broad categories of data is expected to increase the effectiveness of the process (Turner et al., 2014).

This paper has also emphasized the often overlooked social element of the planning process, which leads to criticisms of the ecosystem-based component of MSP. Regarding social data, Le Cornu et al. (2014) emphasize the need for monitoring programs and a wide variety of social attributes of planning regions, instead of focusing on impacts without, for example, also considering the social benefits associated with a given use. Significantly, the authors argue that such programs should be implemented with existing biophysical monitoring programs in order to enable assessing dynamic socioecological linkages. Gaining an understanding of what kinds of social factors matter, why they matter and how this information should be collected, integrated and interpreted is of paramount importance (Ban et al., 2013), especially since generally a lack of spatial social data may present a major barrier in planning practice. Similarly, Kittinger et al. (2014) emphasize drawing on a wider variety of social, economic, and cultural data that incorporate human attitudes, beliefs, knowledge, preferences, and other aspects of social relationships with marine resources and ecosystems, rather than human uses alone. Furthermore, the authors note that key social principles such as equity, legitimacy, power, and stakeholder engagement are highly relevant to planning processes. Nevertheless, it has been acknowledged that institutional capacity and resource constraints limit practitioners" ability to gather and analyze social and biophysical data. However, incorporation of some social data, and at a minimum an accurate characterization of human uses in the planning region, may be better than none at all, provided that the limitations are acknowledged (Kittinger et al., 2014). In addition, as mentioned in the previous section, over-reliance on spatial, quantitative data may preclude social information or cultural priorities and, therefore, practitioners should simplify and map to the extent this information is not ignored (Le Cornu et al., 2014), while considering a variety of methods (including non-monetary) in their valuation and assessment.

In general, social sciences are broader than economics and include political science, sociology, anthropology, psychology, and other disciplines that aim to shed light on human society and better appreciate the ocean. Following McConney (2015) "social sciences can connect ordinary citizens to the open ocean", while including social scientists with experience in integrating social-ecological ideas in the planning process can provide targeted input (Ban et al., 2013). Therefore, social scientists should pursue synergies across the field in order to achieve a better view of human society and behavior and enable wider assessment of people's perceptions and well-being. For example, regarding economics, there have been cases in which the theory of instrumental rationality and *Homo economicus* fall short in explaining human behavior. At the same time, social scientists need to work closely with natural scientists to address

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social-ecological challenges, an important element in an integrated MSP approach. Overall, social sciences can enable planners to understand how people use, appreciate and benefit from the marine environment, how they affect it, and how they react to new and different forms of governance so as to maximize the effectiveness of planning.

From the above it may seem that an ecosystem approach to MSP is complex and heavily dependent on data. Nevertheless, it is important to remember that it should be an adaptive process that allows adding and refining data rather than producing the best possible data, as well as embedding "lessons learnt" from applying methods and tools. In this context, it is important to know when input is helpful and when it is limiting. For example, since the aim is to achieve a diversity of objectives and not to focus only on sectoral analysis, which attempts to achieve specific strategic objectives, available socioeconomic input should allow setting and monitoring socially identified planning and management objectives. Furthermore, a good way to evaluate input is to ask if stakeholders and local beneficiaries find it useful and meaningful and if it allows a satisfactory degree of integration across policies.

Overall, including socioeconomic input and balancing it with ecological input from the beginning of the process is consistent with ecosystem-based MSP. As this approach considers humans part of the ecosystem, it focuses on all the activities and factors that affect the ecosystem, as well as the benefits humans derive from it. Inability to incorporate socioeconomic information will likely affect the whole process and, in particular, setting diverse objectives, defining informative indicators, building feasible scenarios, improving the social-ecological analysis, and establishing credibility among stakeholders.

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