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1 **Abstract**

2 Sustainable development is the framing concept assuring that resources are exploited while
3 maintaining the ability of these natural resources to provide for future generations. With human
4 dependence on marine resources increasing, Ecosystem-Based Management (EBM) has been
5 identified as a suitable approach to ensure sustainable development. In order to achieve this, the
6 core principles and elements of EBM should be operational in the maritime/marine spatial
7 planning (MSP) process to ensure that human activities in marine space are ordered to attain
8 ecological, economic and social objectives. However, policies from various states and
9 organizations sometimes do not set a clear precedence for translating principles of EBM and
10 present different and complex approaches to an ecosystem-based marine spatial planning (EB-
11 MSP). Again, a feasible methodology for EBM to be operational in MSP is still vague. This
12 paper therefore presents results from a survey and review of MSP initiatives in Europe, Asia
13 and the Americas. Results showed that essential MSP steps and elements such as adaptive
14 management, setting of planning boundaries, understanding and analysing the ecosystem and
15 future conditions are not fully operational. This paper focuses on a methodology for EB-MSP
16 and gives recommendations on how to ensure that EBM is operational at each stage of an MSP
17 process. It stresses the importance of setting planning boundaries beyond jurisdictional borders
18 to consider bio/eco-regions and cover near-shore waters, the need to have a cross-sector
19 integration, understanding the ecosystem through having an ecosystem service perspective and
20 having a legal framework to ensure that results from monitoring and evaluating of plans are
21 adapted through review and revision.

22 **KEYWORDS:** adaptive management; ecosystem-based marine spatial planning; operational
23 framework; monitoring

24 **1 Introduction**

25 Marine resources play a vital role in social and economic development as industries such as
26 fisheries, tourism, agriculture, pharmaceuticals, shipping and mining all benefit from the
27 resources offered. Increase in consumer demands and improvements in technology, along with
28 population growth rate, has increased the dependency on marine resources. There is the need to
29 strike a balance between economic development, social needs and environmental sustainability
30 when it comes to ocean use and management. One approach and concept that has been
31 supported by many scientists after a merger between various disciplines is the ecosystem-based
32 approach to sea use management, built on the recognition that “the nature of nature itself is
33 integrated” (Misund, 2006).

34
35 In terms of a marine environment, ecosystem-based management (EBM) is defined as an
36 environmental management approach that recognizes the full array of interactions within a
37 marine ecosystem, including humans, rather than considering single issues, species, or
38 ecosystem services in isolation (Christensen, *et al*, 1996). The goal of ecosystem-based marine
39 management is to maintain marine ecosystems in a healthy, productive and resilient condition
40 so that they can sustain human uses of the ocean and provide goods and services (McLeod, *et*
41 *al*, 2005; Foley, *et al*, 2010). EBM represents a paradigm shift from other traditional
42 management approaches which were focused on individual species, on a small spatial scale,

43 lacked research, and were based on a short-term perspective. EBM on the other hand, focuses
44 on the ecosystem as a whole with a long-term perspective, performed at multiple scales with
45 the involvement of stakeholders by using an adaptive management approach (Sherman and
46 Duda, 1999).

47
48 Although most nations and practitioners support EBM and this concept is found in most
49 literature, policies and legislation about coastal and marine management and the practicality
50 and implementation of it is yet to be fully realised as often the concept and its principles are too
51 broad, and complex for planners and resource managers to put into practice to ensure effective
52 implementation of EBM (Arkema, *et al*, 2006). Even though EBM has received considerable
53 attention over recent years and it is a popular term in the ocean management field, there are still
54 few examples, which demonstrate its practical implementation and it still largely remains as a
55 promise unfulfilled (Murawski, 2007).

56
57 The need for an effective marine management cannot be overemphasized as many concepts and
58 processes such as integrated coastal zone management and ocean zoning amongst others have
59 been established and implemented over the past decade. However, opportunities for
60 misunderstanding are ripe in the marine management domain, and once misunderstanding or
61 lack of clarity about objectives of management occurs, the investment of time and energy in
62 spatial tools and approaches may be wasted as conflicts emerge (Agardy, *et al*, 2011).

63
64 Again, a feasible agreed method for translating this attractive concept into operational
65 management practice has been largely discussed but EBM has been implemented in different
66 forms based on different principles (Young, *et al*, 2007; Long, *et al*, 2015.). However,
67 comprehensive, effective and balanced EBM requires a detailed understanding of
68 environmental processes, and also ethical, social and economic processes (Christie, 2011). To
69 address failures in ocean governance, new perspectives have emerged that explore a more
70 holistic approach to manage complex seascapes. These include spatial management approaches
71 such as marine spatial planning, which seek to implement ecosystem-based management
72 (Koehn, *et al*, 2013).

73
74 MSP has been identified as one of the processes for effective implementation of an EBM of
75 maritime use. MSP is defined as “a public process of analysing and allocating the spatial and
76 temporal distribution of human activities in marine areas to achieve ecological, economic, and
77 social objectives that usually have been specified through a political process” (Ehler and
78 Douvere, 2009). MSP is supposed to ensure that maritime uses are planned to be compatible,
79 considering ecosystem services by harmonizing ecological, economic and social objectives.
80 MSP considers all the interactions, connections and structures that make up the marine
81 ecosystem to ensure that ecosystem values are enhanced. MSP is an essential tool for delivering
82 an ecosystem approach and should add value to existing management measures for the marine
83 environment. It should be based on a clear set of principles with a sustainable development
84 purpose (Gilliland and Laffoley, 2008).

85

86 Ecosystem-based MSP (EB-MSP) aims to the maintenance of marine ecosystems in a healthy
87 condition, the sustainable exploitation of ecosystem goods and services, the reduction of
88 conflicts among competing uses of the maritime territory, and the provision of multiple benefits
89 to an as wide as possible array of involved sectors (Katsanevakis, *et al*, 2011).

90

91 This paper therefore presents best approaches and recommendations that were used from
92 different contexts to serve as a learning point for other MSP initiatives. The questions still
93 remaining are “how effective is EBM considering the MSP process”? What is needed to make
94 EBM operational in MSP process? What are the recommendations to ensure that EBM is
95 operational in MSP? The main objective of this paper is to examine the effectiveness of EBM
96 in existing MSP initiatives and to explore, through an empirical methodological approach, how
97 the MSP process can operationally implement EBM. The analysis of MSP case studies and the
98 results of a survey with MSP practitioners is used to support recommendations for an EB-MSP
99 process.

100 1.1 *Ecosystem-Based Management and Marine Spatial Planning*

101 EBM is an approach to natural resources management that considers human society as an
102 integral part of ecosystems (Koehn, *et al*, 2013). The core elements of EBM (Agardy, *et al*,
103 2011), which were developed based on various case studies include the following:

- 104 ✓ Element 1: Recognizing connections within and across ecosystems
- 105 ✓ Element 2: Understanding and addressing cumulative impacts
- 106 ✓ Element 3: Managing for multiple objectives
- 107 ✓ Element 4: Embracing change, learning, and adapting

108 Recently, MSP has been envisaged as a tool to overcome the main challenge in operationalizing
109 EBM, consisting in integrating the human components in ecological and environmental
110 considerations (Domínguez-Tejo, *et al*, 2016). The coupling of MSP and EBM was argued by
111 (Domínguez-Tejo, *et al*, 2016). to represent a new emerging paradigm in sustainable ocean
112 management (Katsanevakis, *et al*, 2011; Crowder and Norse, 2008; Douvere, 2008).

113

114 MSP is an explicit planning approach within an integrated, policy-based approach to the
115 regulation, management and protection of the ecosystem, including the allocation of space that
116 addresses the multiple, cumulative and potentially conflicting uses of the sea and land and
117 thereby facilitates sustainable development (MSSP, 2006). The overall aim of spatial planning
118 is to create and establish a more rational organization of the use of space and the interactions
119 between its uses, to balance demands for development with the need to protect the environment,
120 and to achieve social and economic objectives in an open and planned way (DEFRA, 2006).

121 It is important, however, to recognize that marine spatial management can only influence the
122 spatial and temporal distribution of human activities (Douvere, 2010). MSP is an essential tool
123 for delivering an ecosystem approach (Gilliland and Laffoley, 2008) and a focus on the spatial
124 and temporal aspects of EBM is one way to make an ecosystem based approach more tangible
125 in MSP and as suggested by Douvere (2010) it can be accomplished by defining:

- 126 • The boundaries of the ecosystem to be managed;
- 127 • Ocean spaces with special ecological or biological value within the ecosystem;

- 128 • Ocean spaces with special economic value and potential;
 - 129 • Ocean spaces where the effects of human activities interact positively or negatively with
 - 130 ecological functions and processes; and
 - 131 • Where conflicts are occurring or might occur (uses vs. uses and uses vs. environment).
- 132 In order for MSP to serve as a tool to ensure that the objectives of marine EBM are achieved,
- 133 the components, principles and tools of EBM as highlighted above have to be incorporated into
- 134 the planning process and institutionalized through its implementation.
- 135

136 2 Methodology

137 This research used two key data bases from secondary and primary sources. The output

138 therefore is a combination of a review of relevant reports and documents from literature and the

139 views of EBM and MSP experts acquired through the use of a questionnaire.

140 A review of literature and international guidelines on EBM and MSP was done to identify the

141 core elements and principles which this study focused on for the analysis of the MSP initiatives

142 included in this survey literature review considered EBM publications from the main

143 international organisations (as UNEP, IUCN, etc.) and also the texts resulting from a search

144 based on key words such as the processes and approach for the implementation of EBM and

145 MSP and his presented on Appendix A. The review came out with 7 core elements and

146 principles for an EB-MSP process (Table 1) which were selected based on the number of times

147 each of the literature recognised this element an important step for the implementation of EBM.

148 Questionnaires were constructed based on how core elements of EBM should translate into

149 MSP and to assess how effective this has been in implemented MSP initiatives.

150 Table 1. 7 core elements for an EB-MSP process

151

Defining and analysing existing situation:	1. Selection of plan area and boundary
	2. Scoping, Data collection and Mapping
	3. Understanding structural and functional biodiversity
	4. Cumulative impacts and ecosystem service perspective
Stakeholder participation	5. Cross-sector integration
Planning Phase	6. Setting of Management Measures and trade-off analysis
Implementation and Monitoring:	7. Adaptive Management

152

153 A purposive target audience was used to identify MSP initiatives and experts all over the world.

154 This was done through the dissemination of a questionnaire through a contact list of MSP

155 professionals. The questionnaire was also sent to EBM and MSP professionals platforms such

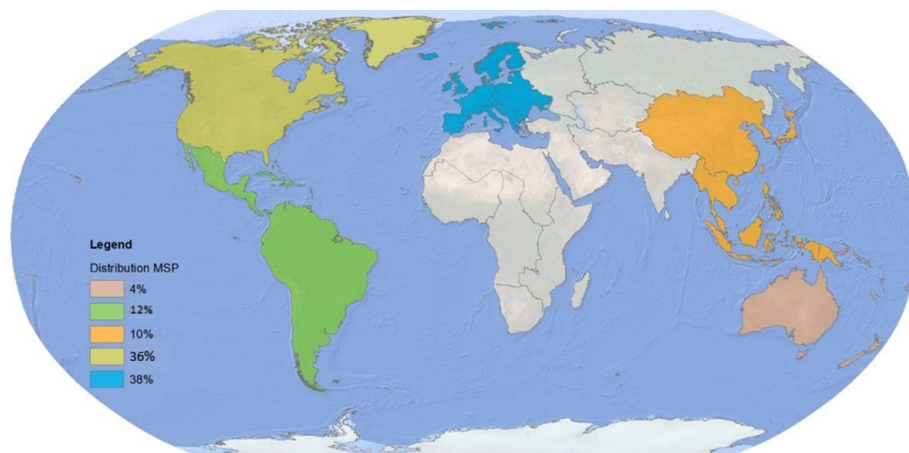
156 as EBM Network and Open Channel. Experts from the International Council for the Exploration

157 of the Sea (ICES) and the National Oceanic and Atmospheric Administration (NOAA) panels

158 were also part of the targeted audience who received the questionnaire. These experts in MSP
 159 and EBM were asked to answer the questionnaire based on the MSP initiative they were
 160 involved in. The results of the survey therefore represent the views of MSP experts involved in
 161 the various initiatives. The wide range and the vast nature of these platforms ensured that MSP
 162 initiatives covered were from different geographical areas, with different drivers and
 163 undertaken by different institutions. As a whole, 51 responses was received from experts; 39
 164 MSP initiatives (shown in Figure 1) were covered from Europe, Asia, United States of America,
 165 Australia, Canada, South and Central America. Each plan that formed part of the survey was
 166 reviewed with a set of 25 questions (Appendix B) and their application at each stage of the
 167 traditional planning process. The recommendations and methodology to make EBM operational
 168 in MSP are focused and structured according to how the 7 core elements are applied in
 169 traditional planning process.

170 Results from the survey were analysed in themes to reflect the various stages of the MSP process
 171 as presented in the results. Most of the results are shown and discussed in percentages while
 172 others (question 9,11,16 and 19) which ask respondent to rank some attributes of the planning
 173 process are discussed in weighted averages. This was crafted from the summed point values
 174 according to the responses of experts after which a weighted average was calculated to show
 175 ranking. The themes and review of literature and marine spatial plans also formed the basis for
 176 the recommended EB-MSP framework proposed in section 4.

177



1. English East inshore and offshore plans
2. US National Ocean Policy
3. Chinese national MSP for 2011-2020
4. Swedish National MSP
5. Belgian MSP
6. Portuguese Maritime Spatial Plan (POEMA)
7. Korean MSP
8. Oregon Territorial Sea Amendment Process
9. TPEA transboundary MSP project
10. Raja Ampat MSP (Indonesia)
11. Shetland Islands' Marine Spatial Plan
12. Our Florida Reefs
13. Semporna Marine Spatial Planning
14. Babitonga Ativa
15. Rhode Island Ocean Special Area Management Plan (Ocean SAMP)
16. Oregon Marine Reserves
17. Marine Planning Partnership for the North Pacific Coast
18. Management Plan for Peninsula Valdés Protected Area
19. Washington State Marine Spatial Plan
20. Polish pilot maritime spatial plans
21. PartISEA project in the Baltic Sea
22. Netherland's Integrated Management Plan for the North Sea 2015
23. New York Statewide Action Plan (SWAP)
24. The Representative Areas Program (RAP) in the Great Barrier Reef
25. Marine renewable energy/ fishing SW UK
26. Coastal Zone Soil Survey of Rhode Island - USDA NRCS
27. US Federal Offshore Renewable Energy Lease Planning
28. Spatial Plans for the German EEZ.
29. Belize Coastal Zone Management Plan
30. Plan Bothnia
31. Sao Paulo's MPA's zoning
32. Integrated Management Plan for the Placencia Bay/Grand Banks
33. Florida Keys National Marine Sanctuary Zoning and Regulatory Review (2013-2014)
34. South Australian Marine Planning Program
35. Dogger Bank Cross Border spatial planning process
36. Identification of conservation priorities associated with ecosystems and biodiversity (Fachada Atlantica-Venezuela)
37. The Norwegian holistic open sea EBM plans for large scale ecosystems
38. Blue Halo Barbuda.

178

179 Fig. 1. MSP initiatives involved in the study

180 **3 Results and Discussion: Analysis of the effectiveness of EBM in MSP**

181 This survey covered mostly MSP initiatives in Europe (38.0%), United States of America
182 (32.0%) with others from Asia (10.0%), South and Central America (12.0%) Australia (4.0%)
183 and Canada (4.0%). Experts involved in this survey mostly came from academia and
184 governmental agencies with 39.2% and 37.3% respectively coming from these institutions
185 (Figure B.1, Appendix B). Major drivers for the MSP initiatives involved in the survey were
186 conservation (33.0%) and energy (28.0%). About 47.0% of energy-driven MSP initiatives were
187 from Europe and the same percentage was from the USA, although USA had 31.0% of the MSP
188 initiatives being conservation-driven MSP as compared to Europe that had none. The European
189 MSP were mainly driven by energy or blue growth goals or for transboundary purposes.

190 3.1 *Defining and Analysing Existing Situation*

191 In setting the planning boundary, only 14.0% of the plans set the plan boundary solely based on
192 the ecosystem boundary (ecological and scientific consideration) as most of the time they are
193 restricted by jurisdictional boundaries. Only 7.8% of plans set their boundaries based on
194 bioregions and coastal watershed and near-shore waters, one of the most dynamic and essential
195 ecosystems with regards to land and sea interaction, are mostly not considered and their impact
196 not analysed during most MSP processes and this is proven by the fact that only 7.8% of plans
197 considered it in their planning area (Figure B.2, Appendix A).

198 It would be preferable for planning units to follow meaningful ecosystem boundaries. In
199 practice, they will also need to take into account socio-political and administrative factors and
200 what is practical and recognisable on the ground and in the water (Gilliland and Laffoley, 2008).

201 It is not surprising that at the stage of understanding the ecosystem and detailing, only 57.0%
202 of plans looked at connectivity between biotic, abiotic and socio-economic patterns and
203 conditions which are important for the life stages of species (Figure B.4, Appendix A).

204 When it comes to how the existing conditions were analysed and understood, 70.0% of
205 responses mentioned that EBM was stated as a principle of the plan, and others analysed the
206 ecosystem; only 59.0% was truly operational by making the ecosystem a priority or by using it
207 as a criterion for trade-offs and decision-making. In effect, it is not enough to state EBM as a
208 principle as EBM can be truly operational in MSP when the ecosystem (services and values)
209 becomes a priority in taking decisions and implementing them accordingly. Only 24.0% of the
210 MSP initiatives analysed ecosystem services and valuation and actually map them out for
211 analysis. Although ecologically/biologically valuable areas were identified (78.0%) and this
212 was a criterion for management or decision making, the ecosystem (value and services) is not
213 really a priority for management as it is not well understood and analysed (Figure B.8, Appendix
214 B). The ecosystem services perspective which is necessary at the analysis stage helps to
215 establish priorities for management by focusing on ecosystem services of highest value and the
216 most critical threats to the delivery of ecosystem services or highly valuable areas (Agardy, *et*
217 *al*, 2011).

218 Another important step at this stage is cumulative impact assessment to understand how human
219 activities impact on the ecosystem and overlap with each other. From the results of the survey,

220 only 53.0% made a cumulative impact analysis, while only 28.0% went ahead with mapping or
221 performing any spatial analysis of these impacts (Figure B.7-B.8, Appendix B).

222 3.2 *Stakeholder Participation*

223 In terms of stakeholder participation in MSP, frequencies from this survey showed that
224 participation is higher at an information and communication phase (Table B.1, Appendix B).
225 These two types of participation are on a horizontal level where interaction is not made in an
226 active way. One of the core element of EBM is cross sectoral integration, in examination of this
227 element it was realised that traditional users of the sea such as conservation and fisheries are
228 engaged in the process at a high level with relatively new users such as renewable energy getting
229 engaged more and more. Tourism and cultural heritage had 58.0% of their stakeholders
230 involved, which is relatively low as compared to other traditional uses above (Table B.3,
231 Appendix B). This might be due to the fact that most MSP initiatives do not usually include
232 coastal and near-shore waters (areas where tourism is mostly dominant) as was discovered at
233 the stage of setting planning boundaries. This point is seconded by the fact that only 25% of
234 MSP initiatives had tourism management plans integrated into the process and only 43% of
235 them integrated coastal development (Figure B.11, Appendix B).

236 For factors that determined the level of stakeholder participation, 33.3% was based on a
237 representation of all sectors affected by the plan and political and legal issues. About 20.0%
238 was based on key sectors which are affected by the plan. About 2.2% by population
239 demographics, while other factors (20.0%) included a combination of political requirement and
240 key sectors affected by the plan and sectors affected by the plan but outside the jurisdiction of
241 the planning area (Figure B.9, Appendix B).

242 Stakeholder participation is important at all stages of the planning process and this was carried
243 out in all stages of the MSP initiatives that were assessed. However, some critical stages had
244 relatively less engagement of stakeholders. Two of these critical stages is in setting the planning
245 boundaries 48.0% and monitoring and evaluation (33.0%) (Figure B.10, Appendix B).

246 3.3 *Planning Phase*

247 During the planning phase, more than half of the management or planning measures that were
248 proposed sought to strengthen knowledge-based decision-making (58.3%) and mainstream
249 conservation issues (77.8%). However, less than half of them (47.0%) considered uncertainty
250 and changes in the dynamics of the ecosystem, for example climate changes. Only 17% of them
251 consider incentives and financing possibilities for the protection of ecosystem biodiversity
252 (Figure B.15, Appendix B). This is of no surprise as most plans discussed above do not
253 extensively understand and analyse ecosystem services and valuation therefore cannot look to
254 innovative ways of financing to protect ecosystem services and support EB-MSP
255 implementation as shown in Figure B.8, Appendix B. Analysing future conditions forms a
256 critical part of the MSP process, however in terms of coming out with a spatial sea use scenario,
257 52.0% of them did not consider scenario generation as it was mostly not undertaken. Most
258 processes just looked at a single sector or use such as conservation (55.0%), 31.0% considered
259 renewable energy orientation while 26.2% and 23.8% considered tourism development and

260 transport and safety management respectively as a scenario for the future. (Figure B.13,
261 Appendix B).

262 With respect to the criteria used in making trade-off analysis, the following ranking was derived
263 in a descending order: Ecologically and biologically valuable areas were listed most as the
264 number one priority with 15 responses as shown in Appendix 1 and a highest weighted average
265 (4.4), Areas of National Security (4.2), Shipping routes and traffic separation schemes (4.1),
266 Ecological areas under international agreements (3.9), Operationalisation of a particular
267 maritime use due to technical requirements (3.7) and Preferential areas and conditions of
268 national importance (3.3) (Table B.4, Appendix B).

269 3.4 *Implementation and Monitoring Phase*

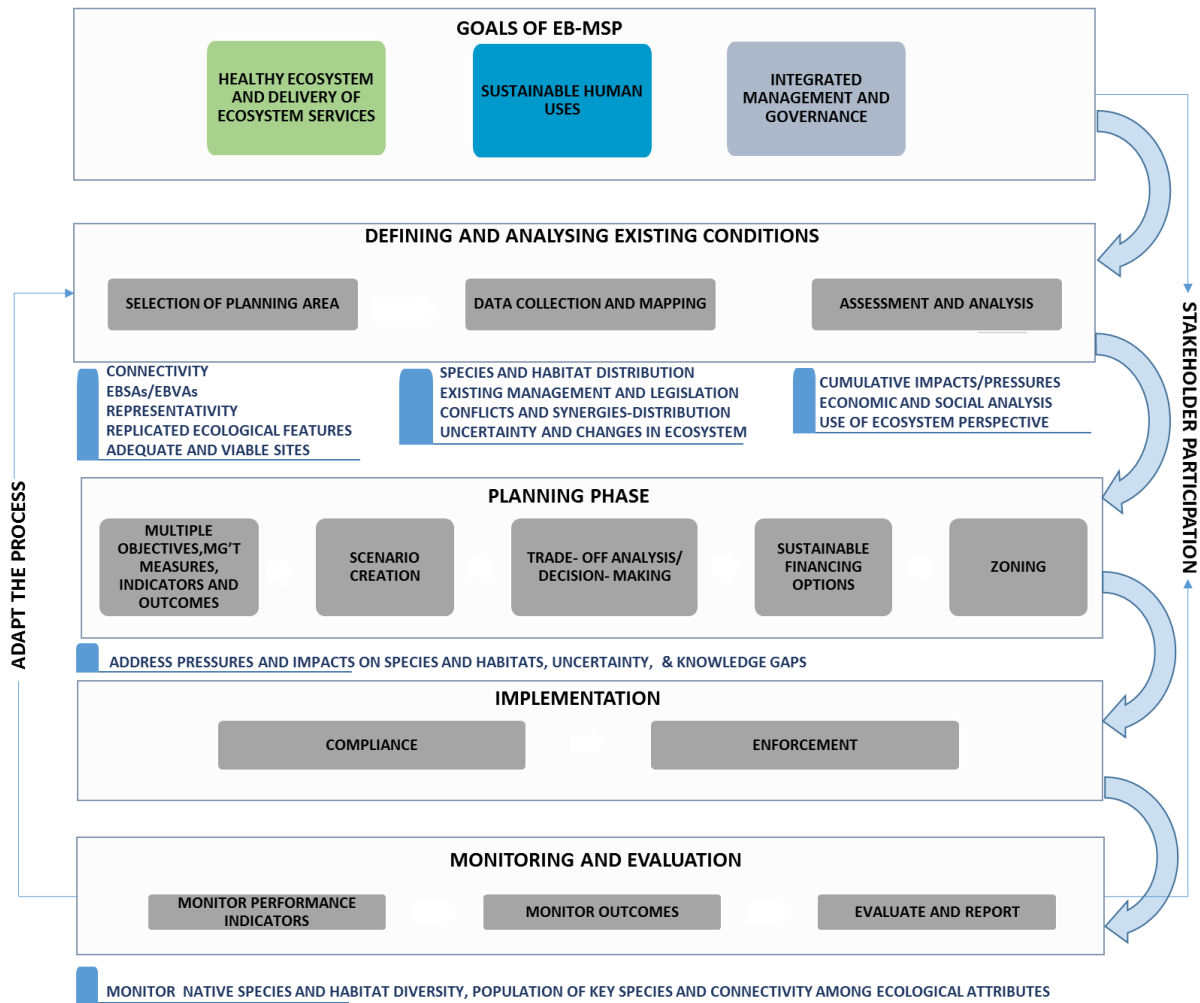
270 Different MSP initiatives employ different forms of monitoring and evaluation. About 51.3%
271 did this by monitoring the state of the ecosystem. About 30.8% measured the performance of
272 the management measures and measured a set of indicators against quantitative goals
273 respectively, while 15.4% measured the time and rate of implementation of management
274 measures to assess if the plan is being followed. About 35.9% did not have monitoring in place
275 yet and it was mostly discussed in concept (Figure B.17, Appendix B). In determining how the
276 results from monitoring the ecosystem were adapted into the plan, 41% modified plan goals and
277 objectives. About 28.2% modified management measures while 20.5% modified desired plan
278 outcomes. About 41.0% did not have their management measures/actions implemented yet
279 although adaptation was planned for. Another approach that was used is the modification of
280 policies (Figure B.16, Appendix B).

281 Finally, although adaptive management is stated as a concept and principle in most of these
282 planning processes, when it comes to how it was implemented or operationalized only 21.0%
283 of the plans that were analysed had an operative mechanism for adaptive management. This
284 was either through having a legal instrument which ensures adaptation or revision of plans over
285 time or had a mechanism for turning monitoring into a retroactive process for new measures or
286 goals to be set (Figure B.18, Appendix B)

287

288 **4 Operational EB-MSP approach**

289 MSP is a promising way to simultaneously achieve social, economic and ecological objectives
290 by means of a more rational and scientifically-based organization of the use of ocean space
291 (Douvere, 2010). However, to achieve these objectives, the ecosystem-based approach, which
292 is one of the attributes for an EB-MSP, should be operational and integrated. The recommendations
293 that are made in this section seek to ensure that the planning process and the EBM (principles,
294 issues and approach) are fitted into each other within a structured process for EB-MSP along
295 with other attributes such as adaptation, integration, future orientation and participation
296 (Douvere, 2010). Figure 2 is a representation of the EB-MSP framework and methodology with
297 specific elements of EB-MSP indicated under each step of the process. Detailed description of
298 each stage of the framework is explained in this section.



299

300

Fig. 2. Proposed Framework and Methodology for EB-MSP.

301 4.1 *Goals of EB-MSP*

302 EB-MSP deals with multiple objectives in the marine area so in setting the goals of EB-MSP,
 303 the objective-based approach should be employed as it promotes management and use of marine
 304 areas and resources in a manner that addresses the multiple needs and expectations of society,
 305 without jeopardizing the options for future generations to benefit from the full range of goods
 306 and services provided by the ocean (Fisheries and Oceans Canada, 2007).

307 The goals for an EB-MSP as developed in the Eastern Scotian Shelf Integrated Management
 308 (ESSIM) Initiative (Fisheries and Oceans Canada, 2007) should ensure the following as shown
 309 in Table 2:

310

311

312

313

314

315 Table 2. Goals of an EB-MSP process

<p><i>1.1.1 Healthy Ecosystem and Delivery of Ecosystem Services</i> The ecosystem should be a priority at this stage where goals and objectives are set. EB-MSP should optimize and harmonize the ecological, environmental and social objectives concerning the ordering of marine space and uses. This can be ensured when the objective is to:</p> <ul style="list-style-type: none"> • Ensure resilient and productive ecosystems with diversity of species and habitat • Ensure strong environmental quality that supports ecosystem functioning and delivery of ecosystem services 	
<p><i>1.1.2 Sustainable Human Uses</i> The goal for an EB-MSP should also ensure that human activities in the marine space are sustainably used for economic and social benefits while not impacting the environment. The objective of this goal is to ensure:</p> <ul style="list-style-type: none"> • Ecologically sustainable use of ocean space and resources. • Sustainable communities and economic well-being. 	<p><i>1.1.3 Integrated Management and Governance</i> An effective EB-MSP process should be based on effective management and governance structures to ensure that stakeholders are empowered and effectively involved. The objective of this goal will be to ensure:</p> <ul style="list-style-type: none"> • Effective governance structures and processes. • Capacity building among stakeholders. • Knowledge building to support integrated management

316

317

318 *4.2 Defining and Analysing Existing Conditions*

319 This stage of the EB-MSP process mainly involved defining the planning area, stock taking
 320 and the analysis of data and maps from the stock taking and data collection stage.

321 *4.2.1 Selection of the planning area and boundary*

322 It was realised that for existing MSP initiatives, the boundary of the planning area was set
 323 normally based on a combination of scientific, environmental, and jurisdictional/political
 324 considerations as well as areas of ecological or biological importance. From these aspects
 325 jurisdictional boundaries are considered a major factor.

326 However, one of the principles and elements of EBM that should be operational at this stage is
 327 to ensure connectivity within and among ecosystems. This can be ensured by setting planning
 328 areas based on bio/eco-regions, as has been exemplified by Australia’s national marine bio
 329 regionalisation where spatial patterns in the benthic and pelagic environments in Australia’s
 330 marine jurisdiction were set at scales appropriate for regional marine planning (Commonwealth
 331 of Australia, 2005). This approach ensures that planning and management units are defined
 332 ecologically, and provides a systematic and spatial framework for finer scale planning and
 333 environmental assessment. It also assists scientist in understanding biogeographical patterns
 334 and as a vehicle for communicating information.

335

336 This approach first of all assists with management of marine resources to ensure that marine
 337 industries are ecologically and economically sustainable. Again, it serves as a tool for
 338 organising spatial information, provides a clear focus on conservation, education, science,

339 environmental inventories and ensures the delineation of biophysical distributions and
340 sustainable management of the marine environment (Commonwealth of Australia, 2005).

341 Similar approaches have been implemented in New Zealand and Canada (Douvere, 2010).
342 However, in areas such as Europe where marine jurisdictional boundaries are so close to each
343 other with many states also involved, this approach has not been successful and indeed the
344 analysis of results shows that only 7.8% of MSP initiatives carried out the process based on
345 bioregions. Although MSP initiatives have been carried out in Europe and there are measures
346 to protect ecologically and biologically valuable areas, it happens that ecosystem patterns and
347 processes are often not consistent with administrative boundaries – that is instead of being set
348 on bioregions or on ecosystem boundaries (Douvere, 2010).

349 A solution to this challenge is the implementation of MSP on a transboundary level based on
350 the bioregions that have been demarcated by the ICES in 2004. This would ensure that EB-MSP
351 is implemented at a bioregional level and the overlaps and conflicting issues between countries
352 are identified and addressed before each country goes into developing MSP for their various
353 jurisdictional areas. Examples can be drawn from the Baltic Sea MSP initiatives (Zaucha,
354 2014). International agreements and policies are critical in ensuring planning beyond
355 jurisdictional boundaries by developing common visions and goals. Countries with shared high
356 level goals and commitments can use them as a point of departure for developing cooperation
357 in cross boarder MSP (Secretariat of the Convention on Biological Diversity and the Scientific
358 and Technical Advisory Panel-GEF, 2012).

359 In addition to using a bioregional approach in setting an ecosystem boundary, the planning area
360 should cover coastal and near-shore waters and the uses and impacts from this area analysed
361 and addressed. This step is important as it was realised from the results of the survey that most
362 MSP plan boundaries are set in a single geographical area and rarely look at an interconnected
363 geographical scope.

364 Apart from using the bio regionalisation approach in setting the boundary of the planning area,
365 it is important that scientific and ecological/environmental consideration (ecosystem boundary)
366 is predominant over just jurisdictional. The planning boundary should ensure that connectivity;
367 ecologically and biologically significant areas; representativity; replicated ecological features;
368 and adequate and viable sites are covered in the area (Convention on Biological Diversity,
369 2009).

370 Another approach to curtail this challenge is to ensure that even if EB-MSP is planned in a
371 stepwise fashion, as in the starting-small case, the outer limits of the larger ecosystem or
372 ecoregion, and the links between habitats within it are considered, in order to lay the
373 groundwork for future adaptive management (Agardy, *et al*, 2011)]. For cross boarder MSP
374 where the area includes different administrations, legal barriers should be identified and
375 adequate legal approaches should be employed to facilitate MSP to ensure that there is a
376 proportional connectivity among the jurisdictional zones (Muñoz, *et al*, 2015). The need for
377 international agreement and policies is therefore necessary to achieve this goal.

378 In setting the boundary, the biophysical and community design principles which have been used
379 for MPA purposes can be explored in MSP (Kirkman, 2013). It is also important to note that
380 there are two different types of boundaries which are boundaries for management (designated
381 by political process and limited in covering natural processes and the ecosystem boundary) and
382 boundaries for analysis or planning (Ehler and Douvère, 2009). The boundaries for planning
383 therefore should not be limited to the coverage of the management area but go further to be set
384 based on a bioregional approach or with an ecosystem boundary perspective. A boundary that
385 is set based on the ecosystem or with biological and ecological consideration sets a strong basis
386 for the planning process to be ecosystem-based. Setting a planning area beyond that of the
387 management area helps to identify and to a large extent capture external sources of influence
388 that have an effect on the management area. This also makes it easy to identify the connected
389 stakeholders in order to propose solutions and measures to any kind of externality that might
390 impact the ecosystem.

391 4.2.2 *Data Collection and Mapping*

392 It is important that information on ecological, economic, environmental and oceanographic
393 conditions are collected and mapped for further analysis. Information on important human uses
394 such as both commercial and recreational fishing; marine transportation; renewable and non-
395 renewable energy production; and sand and gravel mining, among others should be collected
396 and mapped (Ehler and Douvère, 2009). In order to make EBM operational in MSP it is also
397 important, that key ecological features are identified for protection and this can easily be
398 achieved through the bio-profiling process. Apart from using the bio-profiling process, the
399 condition of the ecosystem can be analysed based on the following criteria which is adapted to
400 the Azores scientific criteria and guidance for identifying Ecologically or Biologically
401 Significant Marine Areas (EBSAs) and designing representative MPAs (Convention on
402 Biological Diversity, 2009).

- 403 • Connectivity between biotic, abiotic and socio-economic patterns and conditions which
- 404 are important for the life stages of species
- 405 • Biological diversity
- 406 • Biological productivity
- 407 • Uniqueness or rarity of habitats and species
- 408 • Endangered or species and habitats under threat/vulnerable
- 409 • Natural areas (areas with low level of human degradation)
- 410 • Areas of community and cultural value
- 411 • Areas of high-level importance to human use

413 4.2.3 *Assessment and Analysis*

414 It is important that during all EB-MSP processes, mapping and spatial analysis of cumulative
415 impact are undertaken to understand areas under immense pressures and threat. Having a
416 cumulative impact perspective allows for tailored management and planning measures to help

417 conserve and protect habitats and species that are under pressure. Again, it also serves as a
418 criterion to be considered when making trade-offs and decisions about siting of activities and
419 uses. The Ecosystem-based Risk Assessment (ERA) methodology which involves ranking data
420 based on the identified significant positive and negative interactions between two activities and
421 also incorporates a range of pressures and impacts serves as an approach to make informed
422 management decisions (Kelly, *et al*, 2014).

423 Interaction between the marine area and the coastal area should be something to look at during
424 the analysis stage. EB-MSP should go beyond other traditional approaches by ensuring that the
425 marine area is managed in such a way that the impact of human activities on the marine and
426 coastal ecosystem are considered and the connectivity between these two geographical scopes
427 is managed such that one does not have a negative impact on the other.

428 Again, EBM and adaptive management can be operational at this by analysing uncertainties
429 that can happen within the planning area. This could mainly be climatic changes that might
430 affect the dynamics of the ecosystem or any other unexpected constraints that can hinder the
431 proper functioning of the ecosystem or the implementation of planning measures (economic or
432 political constraints).

433 The use of EBM tools is also a means of ensuring that EBM is operational in MSP. However,
434 if there are constraints such as lack of resources and time, expert advice and review can be relied
435 on, as was done with some MSP initiatives that formed part of this survey.

436 4.3 *Stakeholder Participation*

437 The participation and involvement of stakeholders is the backbone of a successful EB-MSP
438 process. The fact that ecosystem goods and services are, in many instances, external to the
439 market economy or lack proper market valuation is thought to hamper effective planning and
440 management of ecosystems (Kidd, *et al*, 2011). The only sure way to ensure that ecosystem
441 goods and services are properly maintained is through effective stakeholder engagement
442 processes and participation. According to results of the study, stakeholder participation is based
443 on the following factors:

- 444 • Political and legal requirement;
- 445 • A representation of all the sectors affected by plan;
- 446 • Cultural setting of the planning area;
- 447 • Key sectors which are affected by plan; and
- 448 • Population demographics (size of the planning and management area).

449 However, it is important that apart from political and cultural dynamics and requirements of the
450 planning area, stakeholder participation should reflect and be based on all sectors which are
451 affected by the plan. An effective stakeholder participation should ensure that local community
452 actors, environmental NGO's and key sectors are empowered through the process and involved
453 at each stage so that community and societal values will be reflected in the process and that
454 implementation and monitoring of measures are effectively done. Results of this study showed
455 that stakeholders from tourism and coastal development sectors are relatively not fully engaged
456 as compared to other marine sectors as most plans normally focus on sectors from the marine

457 area. Again, only a quarter of the marine spatial initiatives that were studied integrated tourism
458 management plans into the MSP process. It is essential in an EB-MSP process that stakeholders
459 from tourism, cultural heritage and coastal development sectors are all engaged as are the other
460 marine sectors.

461 Due to the complexity of ecosystem functioning and management of multiple objectives and
462 sectors, EB-MSP should ensure that there is a cross-sectorial integration throughout the process.
463 Sectorial integration should move from mainly considering traditional marine sectors such as
464 transportation and conservation, to integrating other emerging marine sectors. Fully
465 operationalizing EBM in MSP would involve a cross-sectorial mechanism to facilitate overall
466 planning and coordination of individual sector policies, such as fisheries, shipping, energy,
467 tourism, and so forth – through which each sector can apply sector policies to implement EB-
468 MSP (Agardy, *et al*, 2011). Management measures from these sectors should all be in tandem
469 with the overall goal and objectives set through the EB-MSP process.

470 Although stakeholder participation is not a clear-cut procedure to follow and its application is
471 dependent on the particular political and cultural setting, participation should, as much as
472 possible, be effective across all forms which are information, communication, consultation,
473 dialoguing, concertation and negotiation to build interest and create a platform for involvement
474 and empowerment.

475 Stakeholder involvement and participation should also be of prime importance at each stage of
476 the EB-MSP process. According to the results of the study, there were two critical stages where
477 there was less stakeholder participation, which are when setting the boundary of the planning
478 area and at the monitoring and evaluation stage. It is important that during the stage of setting
479 the planning boundary, the local community, science community and all the sectors involved
480 are brought together so that a decision about the setting of the planning area would reflect the
481 shared goal and knowledge of the community and institutions and this should follow the concept
482 used in bioregions where “boundaries of a bioregion are best described by the people who live
483 within it” (Miller, 1996). This is a major step as management or planning boundaries should be
484 more bio-or ecological-based with stakeholder involvement. The same applies at the monitoring
485 and evaluation stage where NGOs, the indigenous community and all marine sectors should be
486 all involved in analysing the results, outcomes and achievement of the plan to serve as a basis
487 to ensure easy adaptation.

488 4.4 *Planning Phase*

489 The planning phase of an EB-MSP should look at coming up with planning and management
490 measures, making trade-offs where the ecosystem is a priority and analyse future conditions by
491 scenario creation, innovative and sustainable financing options and zoning for the
492 implementation of regulations.

493

494

495

496 4.4.1 *Multiple Objective, Management Measures, Indicators and Outcomes*

497 Specifying clear goals for MSP increases efficiency and efficacy of the process and EB-MSP
498 process should address multiple sector objectives and issues as against a single or dual sector
499 approach. This raises the need to have common goals and objectives among stakeholders. A
500 multiple objective approach will ensure a holistic thinking across management sectors, so that
501 trade-offs among sectors and objectives can be identified and addressed for a mutually
502 beneficial outcome (Beck, *et al*, 2009).

503 Potential trade-offs of proposed management measures should be explicitly identified and
504 quantified. Planning and management measures are the means by which the desired goals and
505 objectives of the plan would be achieved. This would include spatial and temporal distribution,
506 output, input, and process measures. Management and planning measures should look at
507 addressing the following issues (Kidd, *et al*, 2011):

- 508 • Reducing of threats and impact of human activities on the environment;
- 509 • Ensuring that information is available and research done to make knowledge-based
510 decisions;
- 511 • Seeking to ensure the conservation and sustainable use of the ecosystem but by
512 mainstreaming conservation concerns in all sector management tools;
- 513 • Representation of all the ecosystem components and sectors;
- 514 • Uncertainties and changes in the ecosystem to be addressed, especially climate change
515 and how it affects future uses and future actions in the planning or management area;
516 and
- 517 • Management practices and measure for effective responsibility should lie at the local
518 level as the ecosystem functions on variety of scales

519 For effective evaluation of the implementation of management and planning measures against
520 the goals and objectives, outcome and performance indicators should be set while objectives
521 are being specified during this stage of the planning process (Fisheries and Oceans Canada,
522 2007).

523 4.4.2 *Scenarios and Analysing future conditions*

524 EB-MSP should be a future oriented activity and results from this study show that only half of
525 the MSP initiatives actually made scenario analysis and analysed future conditions. The
526 following represents steps in undertaking scenario and future condition analysis (Ehler and
527 Douvère, 2009):

- 528 • Projecting current trends in the spatial and temporal needs of existing human uses;
- 529 • Estimating spatial and temporal requirements for new demands of ocean space;
- 530 • Identifying possible alternative future scenarios for the planning area; and
- 531 • Selecting the preferred spatial sea use scenario.

532 In projecting current trends, uncertainty and changes in the marine environment and its effect
533 on ecosystem services have to be looked at. Furthermore, the implications for human uses have

534 to be examined and measures proposed for that purpose. In estimating current and temporal
535 ocean space, it is essential that areas for conservation purposes such as MPAs and areas under
536 international conservation agreement are all factored into the process. Various alternatives for
537 future scenarios can be generated; however, conservation-oriented scenarios should be reflected
538 in the preferred spatial sea use scenario that would be chosen. The protection and conservation
539 of biologically and ecologically valuable areas which ensures the maintenance and provision of
540 ecosystem services should be a high priority when selecting a preferred spatial scenario for the
541 future development of a particular marine area.

542 4.4.3 *Trade Offs*

543 In ensuring that EBM is truly operational in MSP, the ecosystem should be a priority when it
544 comes to making trade-offs. Existing MSP initiatives include in this survey made trade off based
545 on a combination of the following factors:

- 546 • Political informed choice;
- 547 • National legislation;
- 548 • Comments from the sectors involved;
- 549 • Environmental Impact Assessment of the uses considered; and
- 550 • Comprehensive evaluation involving all the sectors.

551
552 It is important that decisions on spatial distribution and trade-offs among uses are made after
553 comprehensive evaluation involving all sectors with the ecosystem being a priority. The
554 following are prioritized criteria according to its order of importance that can be used to ensure
555 that environmental and ecosystem priorities are addressed at this stage of the planning process.

- 556 • Ecologically and biologically valuable areas
- 557 • Areas of National Security, e.g. Military Defence area
- 558 • Ecological areas under international agreement e.g. Natura 2000
- 559 • Shipping routes and traffic separation routes
- 560 • Operationalization of a particular maritime use due to technical requirement, (e.g.
561 offshore wind energy is more economically viable when close to the coast)
- 562 • Preferential areas and conditions of national cultural and social importance

563 It is important that in making trade-offs between uses, the environment and the maintenance of
564 ecosystem services is a top priority as proposed in the criteria above. Again, in selecting the
565 preferred spatial use scenario or preferred management strategies instead of political
566 consideration, and with economic effects/benefits being the top most priority, as is the case of
567 existing MSP initiatives that this survey covered, the physical, chemical, and biological
568 cumulative effects of uses should be the prime consideration. Again other factors such as
569 financial feasibility and timing for implementation should also be considered.

570 4.4.4 *Innovative and sustainable financing for EB-MSP*

571 As the plans are being formulated, there is the need to ensure that government has apportioned
572 budgets for planned actions and measures to be implemented, especially those related to

573 ensuring that the ecosystem (services, values, functioning and biodiversity) is maintained and
574 the environment is conserved. Only 17% of plans considered incentives and financing
575 possibilities that strengthen the protection of ecosystem biodiversity. Without specifically
576 looking at how to finance the protection of the ecosystem during the planning process, EBM
577 cannot be truly operational in MSP and the ecosystem (services, value, functioning and
578 biodiversity) cannot be maintained. Other innovative financing options to ensure that the
579 ecosystem services and values are maintained and sustainable use is ensured include (Agardy,
580 *et al*, 2011):

- 581 • Revenue from fees– user fees from marine parks, fees for eco-labelling and certification,
582 non-renewable resource extraction, tourist-related fees, collection of licensing fees
583 (fishing and hunting, for example) to set up conservation funds;
- 584 • Private sector investment in conservation e.g. management of marine parks;
- 585 • Public/private partnerships such as municipal governments teaming up with chambers
586 of commerce, or private financing of public sector resource management;
- 587 • Fines for illegal activities;
- 588 • Trust funds;
- 589 • Income derived from local enterprises (such as the sale of handicrafts); and
- 590 • Payment for Ecosystem Services (PES) systems and associated market offsets by
591 allowing managers of coastal lands or marine resources, be they government agencies
592 or local communities and user groups, to “sell” the protection of ecosystem services to
593 the buyers who most benefit and value them. New revenue streams for management can
594 thus be generated.

595 4.4.5 Zoning

596 One important element that should be introduced at this stage of EB-MSP is ocean zoning.
597 Ocean zoning is defined as ‘a regulatory measure to implement MSP usually consisting of a
598 zoning map and regulations for some or all areas of a marine region’ (Ehler and Douvere, 2007).
599 Zoning has the ability to ensure that regulations are enforced in particular sections of the
600 planning and management area. Zoning ensures minimizing conflicts between incompatible
601 uses by addressing interaction between many uses and takes a holistic view of areas of
602 ecological importance and environmental vulnerability to ensure the delivery of ecosystem
603 services, making it a tool to EBM operational in MSP (Agardy, 2010)

604 4.5 Implementation Phase

605 The implementation stage involves three stages (Ehler and Douvere, 2009). These are
606 implementation of management and planning measures, ensuring compliance and enforcement.
607 It is important to ensure that all sectors are involved in the implementation of management
608 measures and zoning regulation. It is essential to ensure that stakeholders, especially the
609 community, are involved from the onset to make implementation smooth and effective. In trying
610 not to reinvent the wheel and to reduce costs it may be necessary to use existing institutions for
611 the implementation process. To make EBM operational all single-sector management

612 institutions should comply in implementing existing measures and also in generating future
613 plans and programmes in accordance with the spatial management plan and measures.

614 Enforcement of measures can be ensured through inspections, negotiations and legal actions
615 and regulations should be consistently applied on the basis of transparent policies and
616 procedures (Ehler and Douvere, 2009). NGOs should be involved at this stage to detect and
617 report non-compliance.

618 4.6 *Monitoring, Evaluation and Adaptive management*

619 Limited relevant knowledge, information and data in addition to unforeseen changes
620 (economical, political and environmental) in the marine environment and ecosystem are
621 challenges that are common to most MSP initiatives. This calls for an EB-MSP process that is
622 iterative, continuous, and adaptive. At each stage of the process, there should be an evaluation
623 to ensure that set procedures are followed to inform the next stages. Again, to make EBM
624 operational in MSP the process has to be continuous. The first planning cycle should end in a
625 monitoring and evaluation step and results and lessons learnt should be adapted into the next
626 planning cycles.

627 Results from this research showed that the monitoring stage of EB-MSP should include the
628 following:

- 629 • Monitoring the state of the system: focuses on assessing, for example, the status of
630 biodiversity in the marine area, the quality of water, or the overall health of a particular
631 ecosystem (Ehler and Douvere, 2007);
- 632 • Performance monitoring: measuring the actual performance of management measures
633 for example 'are the boundaries of the protected area sufficient to conserve the special
634 habitat?' (Ehler and Douvere, 2007); and
- 635 • Time and rate of implementation: measuring the time and rate of implementation of the
636 management measures to assess if the plan is being followed.

637 For the monitoring process to be easy and effective with meaningful results monitoring should
638 be based on indicators referred to at the setting of goals and objectives stage above. This calls
639 for objectives of the EB-MSP to be specific, measurable, action-oriented and time-bound. The
640 indicators for monitoring should also be readily measurable, cost effective, concrete,
641 interpretable, grounded on scientific theory, sensitive, responsive and specific (Koehn, *et al*
642 2013).

643 Evaluation should be a continuous process in which measures or indicators of performance are
644 defined and systematically compared with programme goals and objectives (Ehler and Douvere,
645 2009). Reporting of the information from evaluation would serve as a basis to adapt the EB-
646 MSP process.

647 Adaptive management in MSP can be achieved by (Ehler and Douvere, 2009):

- 648 • Modifying MSP goals and objectives (for example, if monitoring and evaluation results
649 show that the costs of achieving them outweigh the benefits to society or the
650 environment);

- 651 • Modifying desired MSP outcomes (for example, the level of protection over a large
652 marine protected area could be changed if the desired outcome is not being achieved);
653 and
- 654 • Modifying MSP management measures (for example, alternative combinations of
655 management measures, incentives and institutional arrangements could be suggested if
656 initial strategies are considered ineffective, too expensive, or inequitable).

657 In order to ensure the implementation of an EB-MSP, a framework for monitoring and
658 evaluating spatially managed areas must explicitly consider interactions between ecosystem
659 components, management sectors, institutions and key actors, as well as the cumulative impacts
660 of human activities. This approach has been shown through a 7 step framework based on
661 existing concepts of adaptive management and considers a number of practical examples
662 (Stelzenmüller, *et al*, 2013).

663 For adaptive management, which is one of the essential element of an EB-MSP process to be
664 achieved there should be a legal framework or instrument to ensure that plans and initiatives
665 are adapted from time to time. Adaptive management should not only be stated in concept or
666 only as a principle of the plan but there should be an operational tool that would ensure that
667 experiences, lessons and results from the monitoring and evaluation are adapted to ensure that
668 the EB-MSP is iterative.

669 **5 Conclusions**

670 Demand for ocean space is on the rise as traditional uses such as fisheries, maritime transport
671 and tourism as well as new ones such as renewable offshore energy and aquaculture are
672 expanding. Maritime space is limited and there is a need to optimize social, economic and
673 environmental objectives. EB-MSP is an approach to ensure that sustainable development is
674 achieved through ordering human activities in marine space to guarantee that resources satisfy
675 the need of the current population while maintaining its resilience to provide for future
676 generation. The methodology and process for an EB-MSP should be robust and inculcate EBM
677 principles. There is the need to situate EBM principles and elements into MSP and have a robust
678 and functional EB-MSP. An operational EB-MSP process should consider the following:

679 Firstly, the process should look at setting a boundary for planning which is based on the
680 ecosystem patterns, functions and connectivity (bioregions). In doing this, it has to be ensured
681 that coastal and near-shore waters are covered in the planning boundary. Secondly, it should
682 look at understanding the ecosystem (services, values and functions) to make informed
683 decisions. Again, it should build the interest of the citizenry, expand participation, ensure a
684 cross-sectorial integration and empower the stakeholders that are involved in the process. The
685 process should also be future-oriented to be able to analyse future conditions and provide a
686 direction for future development and maintenance of ecosystem services. Furthermore, it should
687 provide management and planning measures that seek to reduce threats and pressures on the
688 environment, address uncertainty and changes in the marine environment and enforce a
689 knowledge-based decision-making process where the ecosystem is a priority. Lastly, a robust
690 process and methodology should be one which is iterative: to ensure that there is a legal

691 instrument in place so that results from monitoring and evaluation are adapted into the next
692 planning cycles.

693 Apart from all the recommendations above, there should be governance processes to ensure that
694 appropriation of marine resources would not lead to less prioritisation of the environmental
695 conservation goals and ensure that community values and involvement are not limited in the
696 decision-making process. There should also be a conscious effort to ensure that experts from
697 academia who have worked with MSP are more involved at the national level of MSP to
698 influence decision-making.

699 In a nutshell, EBM can be operational in MSP on the whole if there is the political will to apply
700 the principles and methodology of an EB-MSP. To ensure sustainable development,
701 governments of various countries should be committed to the process by ensuring that the
702 methodology is facilitated through adequate financial allocation and legal instruments.

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830 Appendix A: Literature that was reviewed to select the core elements and principles

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832

Literature	Stakeholder involvement	Selection of plan area and boundary	Scoping, Data collection and Mapping	Understanding structural and functional biodiversity	Economic Issues	Dealing with complexity and uncertainty	Assessment and Analysis (cumulative impacts and trade off analysis)	Setting of Management strategies and actions	Interaction between sectors	Adaptive Management
UNEP (2011) Taking Steps toward Marine and Coastal Ecosystem-Based Management- An Introductory Guide										
IUCN's CEM. The Ecosystem Approach: Five Steps to Implementation (Shepherd, 2004)										
Principles and practice of Ecosystem-based management. A guide for conservation practitioners in the tropical western PACIFIC (Clarke and Jupiter, 2010)										
The Ecosystem Approach to Marine Planning and Management (Kidd et al., 2011)										
Key elements and steps in the process of developing ecosystem-based marine spatial planning (Gilliland and Laffoley, 2008)										
Ecosystem-Based Management for the Oceans (McLeod and Leslie, 2009)										
	6	4	4	5	1	3	4	4	3	5

833

834 **Appendix B: Questionnaire and Results**

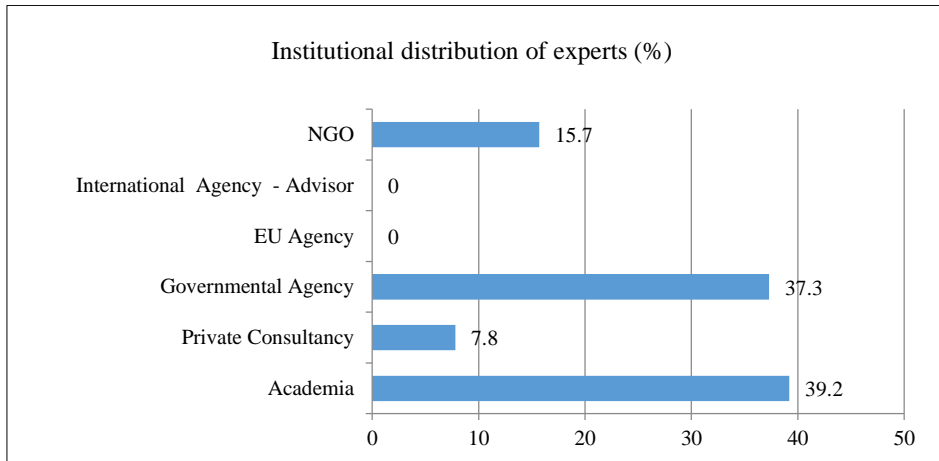
835 1. What is the name of the maritime spatial planning process that you were involved in?

836

837 **Defining and Analysing Existing Situation**

838 2. Which of the following Institutions were you representing at the time of Plan elaboration?

839



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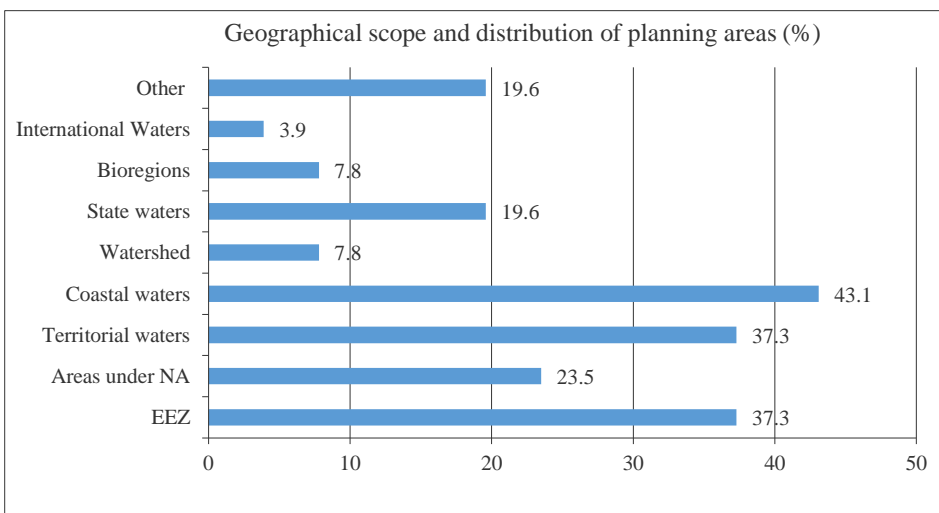
841

842 Fig. B.1. Institutional distribution of experts involved in survey

843

844 3. Which of the following geographical scope were included in the planning area?

845



846

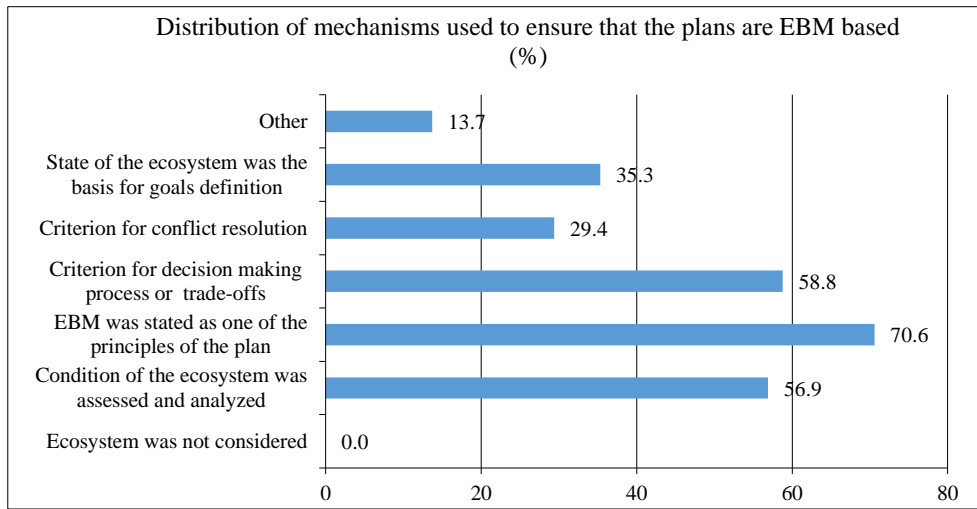
847

848 Fig. B.2. Geographical scope and distribution of planning areas

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850 4. What mechanism was put in place to ensure that the plan is ecosystem based (ecosystem
851 services, values and functions are considered in the planning process)?

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853

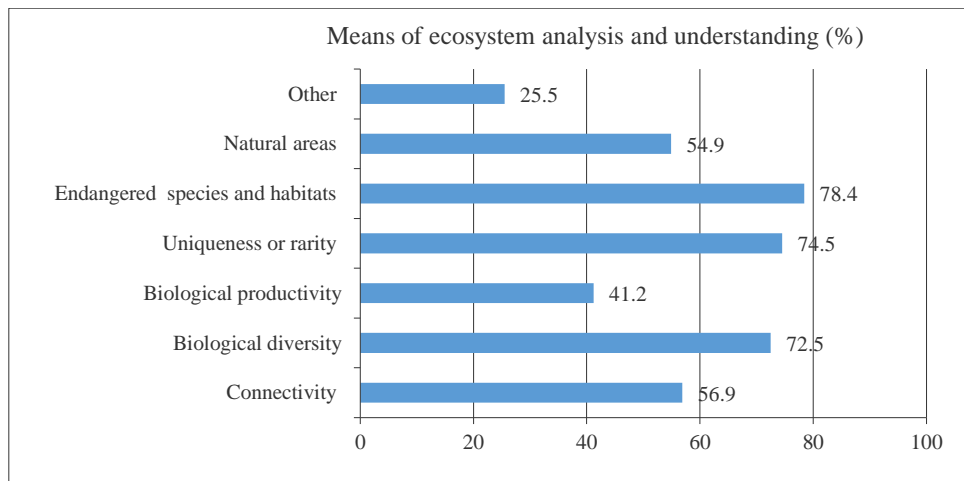
854 Fig. B.3. Distribution of mechanisms used to ensure that plans are ecosystem-based

855

856 5. Which of the following represent how the ecosystem was detailed and understood at the stage
857 of defining and analysing the existing condition? (more than one option)

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Fig. B.4. Means of analysing and understanding the ecosystem

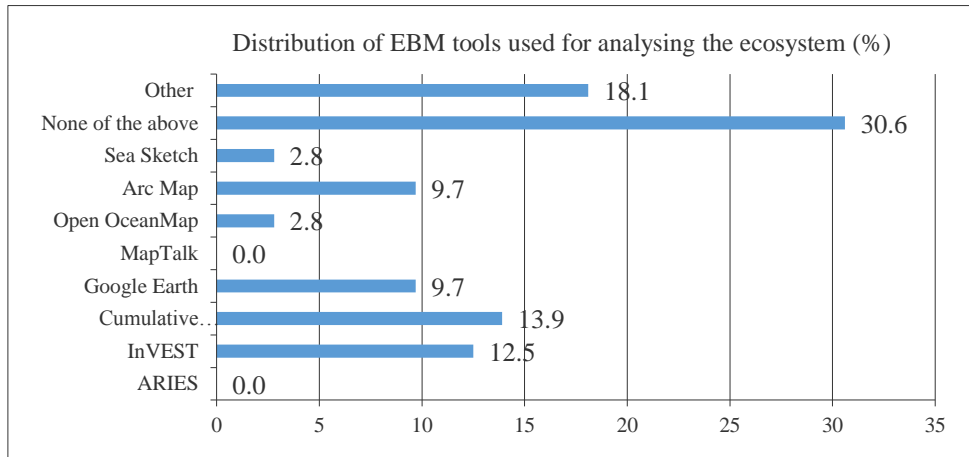
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867 6. Which of the following ecosystem based management tools were used in the characterization
868 phase?

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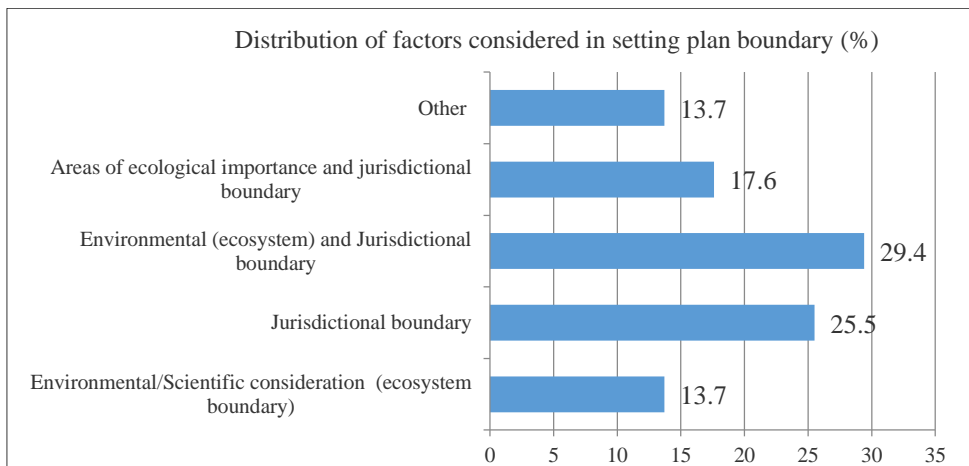
871

872 Fig. B.5. Distribution of EBM tools used for the analysing the ecosystem

873

874 8. In setting the boundary of the planning area and for analysis which of the following factors
875 was taken into consideration?

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878

879 Fig. B.6. Distribution of factors considered in setting the plan boundary

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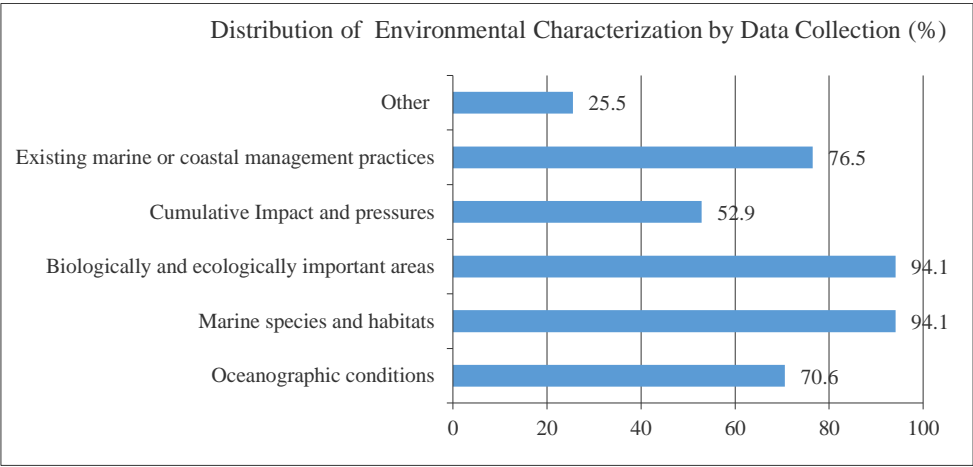
882

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885

886 8. In characterizing the ecosystem, which of the following environmental and ecological
 887 conditions were data or information collected? (You can choose more than one option)
 888



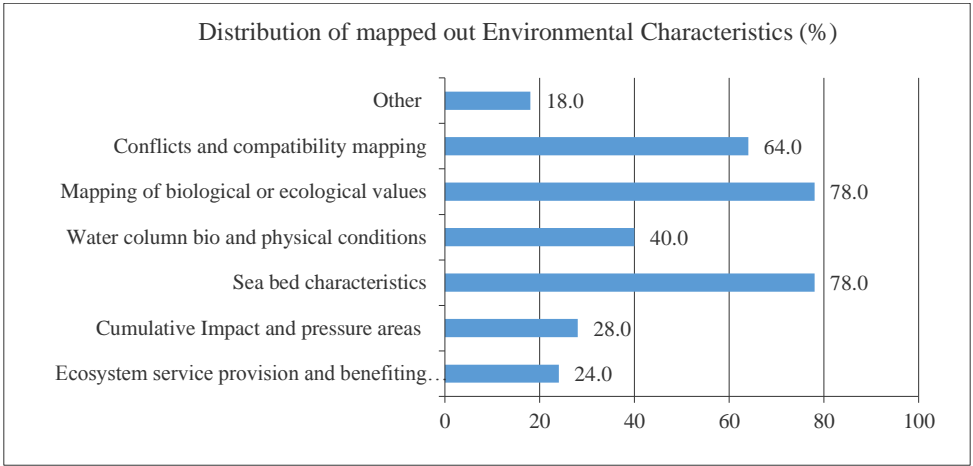
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890

891 Fig. B.7. Distribution of Environmental Characterisation by Data Collection

892

893 9. Which of the following environmental characteristics were mapped out? (You can choose
 894 more than one option)



895

896

897 Fig. B.8. Distribution of mapped out environmental characteristics

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903 **Stakeholder Participation**

904 Table B.1. Ranking of the level of engagement of stakeholders

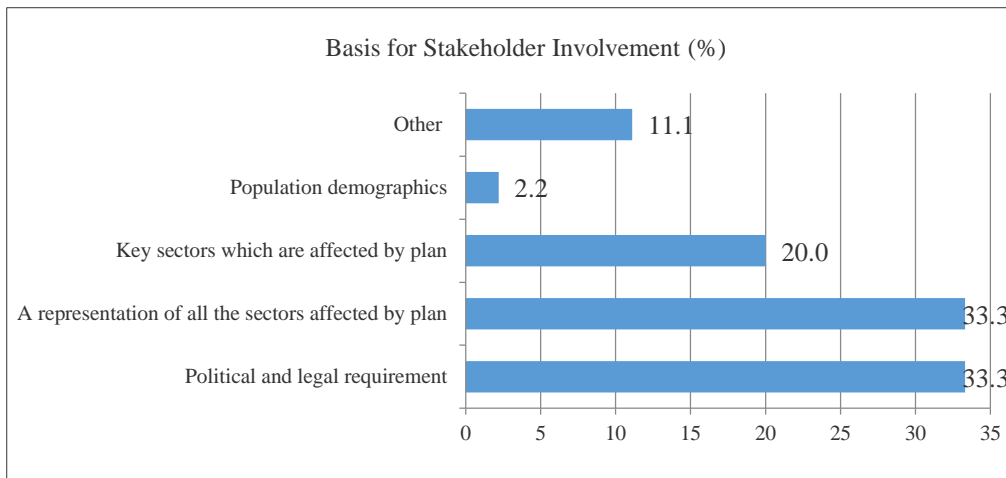
10.How would you rank the level of engagement of stakeholders in the planning process? (From 1 to 5, with 5 really high and 1 really low level?)						
Answer Options	1.Really High	2.High	3.Moderate	4.Low	5.Really Low	Rating Average
Information	9	22	12	3	0	3.80
Communication	10	20	10	6	0	3.74
Dialogue (develop an understanding)	8	20	13	4	1	3.65
Consultation	6	22	11	5	1	3.60
Concertation (determine a common position)	3	17	10	13	3	3.09
Negotiation (reach decision)	3	15	13	12	3	3.07

905

906

907 11. The level of stakeholder participation was based on which of the following factors?

908



909

910 Fig. B.9. Factors for Stakeholder Involvement

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917 Table B.2. Ranking of sectors and stakeholders engaged and integrated

918

12. Please rank the level that the following sectors and stakeholders were actively engaged and integrated into the process (From 1 to 5, with 5 really high and 1 really low level)						
Answer Options	1.Really High	2.High	3.Moderate	4.Low	5.Really Low	Rating Average
Marine conservation/protection	18	18	10	0	0	4.17
Fisheries	16	16	8	3	3	3.85
The science community	16	15	8	6	1	3.85
Renewable energy	14	11	4	5	10	3.32
Heritage (cultural)	11	11	8	8	7	3.24
Tourism	8	14	11	5	7	3.24
Maritime Transport	3	16	13	6	7	3.04
Military Defence	8	9	7	7	13	2.82
Aquaculture	4	8	15	1	15	2.65
Oil and Gas Mining	5	6	6	6	19	2.33
Sand and Gravel Mining	3	5	7	10	18	2.19

919

920

921 Table B.3. Sectors and stakeholders engaged and integrated

922

13. Which of the following sectors and stakeholders were actively engaged and integrated into the process? (You can choose more than one option)	
Answer Options	Response Percent
Marine conservation/protection	95.6%
Fisheries	88.9%
The science community	80.0%
Renewable energy	62.2%
Tourism	57.8%
Maritime Transport	55.6%
Heritage (cultural)	53.3%
Aquaculture	48.9%
Military Defence	46.7%
Oil and Gas Mining	31.1%
Other (please specify)	28.9%
Sand and Gravel Mining	22.2%

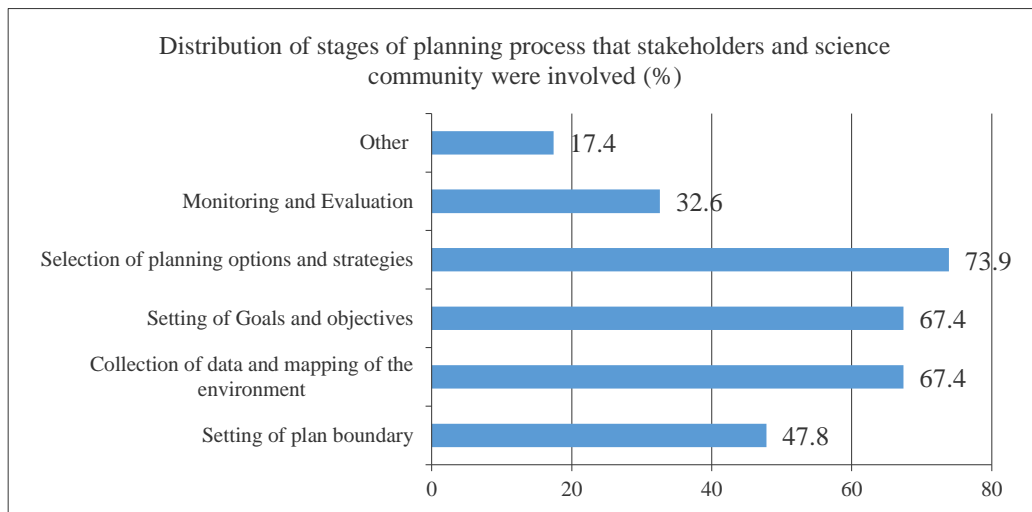
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926 14. Please select at which stages stakeholders and the science community were engaged? (You
 927 can choose more than one option)

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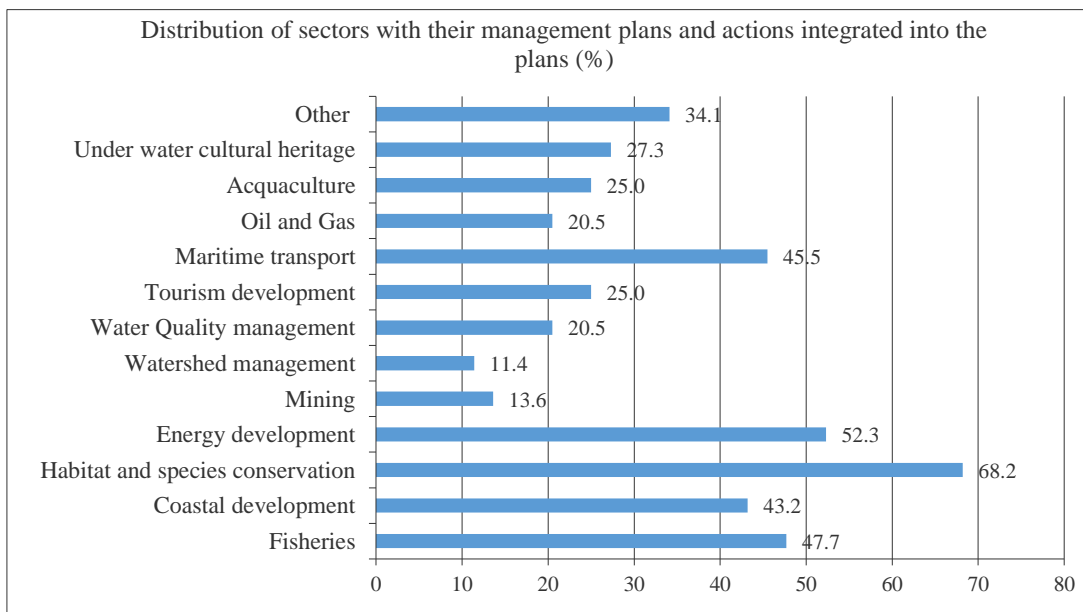
930

931 Fig. B.10. Distribution of stages that stakeholders were involved

932

933 15. Please select from the following sectors have their management plans and actions linked
 934 and integrated into the plan. (You can choose more than one option)

935



936

937

938 Fig. B.11. Distribution of sectors with their management plans integrated into the plans

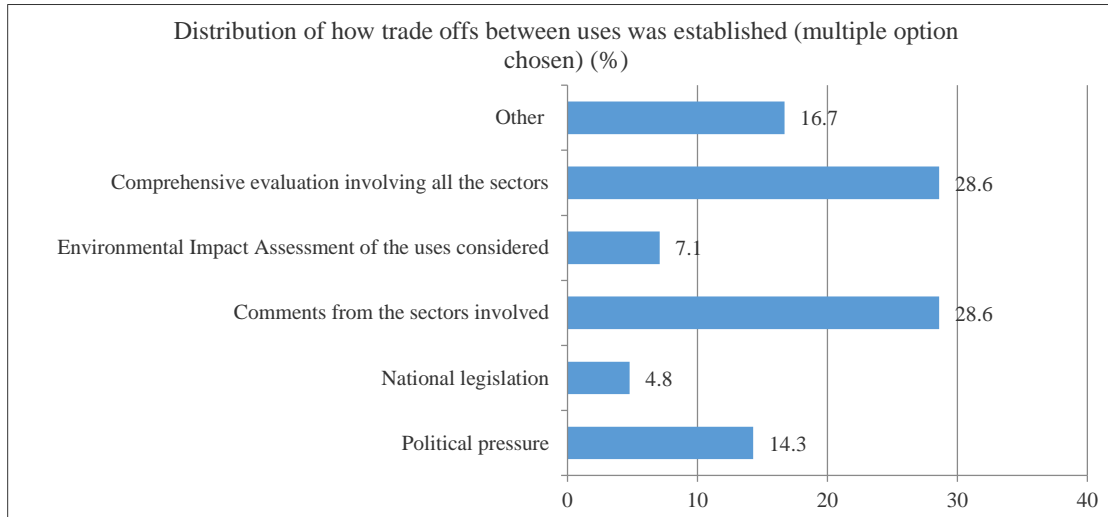
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941 **Planning Phase**

942 16. Which of the following would best describe how trade-offs between uses and sectors were
 943 established?

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947 Fig. B.12. Distribution of how trade-offs between uses was established

948

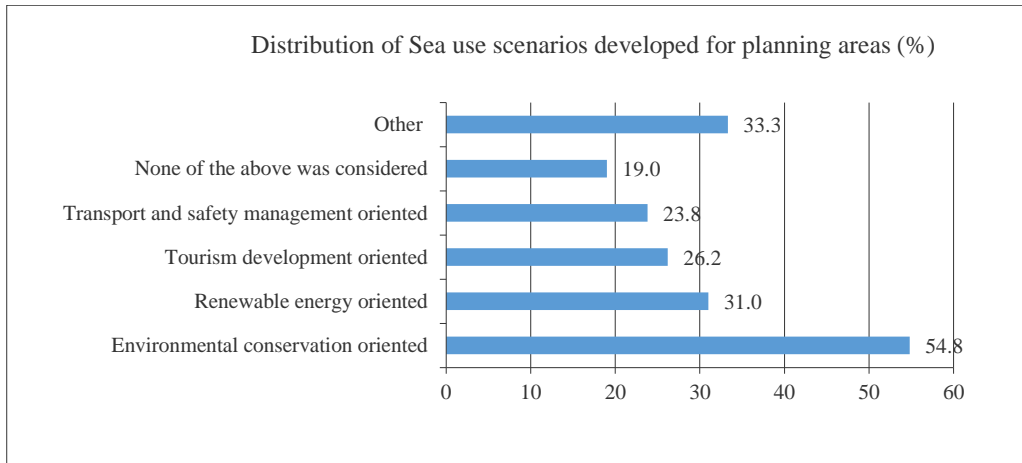
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950 Table B.4. Ranking of criteria for making trade offs

17. Please rate the following criteria according to the order of priority for making trade-offs or decisions among maritime uses from 1 to 6. 1 being the topmost priority and 6 being the least								
Answer Options	1	2	3	4	5	6	N/A	Rating Average
Ecologically and biologically valuable areas	15	3	5	3	5	2	1	4.42
Areas of National Security e.g. military defence area	9	4	4	4	3	2	11	4.23
Shipping routes and traffic separation schemes	4	12	9	7	2	2	5	4.08
Ecological areas under international agreements e.g. Natural 2000, water framework directive etc...	5	3	6	4	3	2	12	3.87
Operationalization of a particular maritime use due to technical requirement E.g. offshore wind energy is more economically viable when close to the coast	4	6	7	9	5	2	7	3.67
Preferential areas and conditions of national cultural and social importance	0	11	6	3	6	6	4	3.31

951 18. Which of the following sea use scenarios were developed to represent the future goal and
 952 objective for development direction of your planning area? (You can choose more than one
 953 option)

954



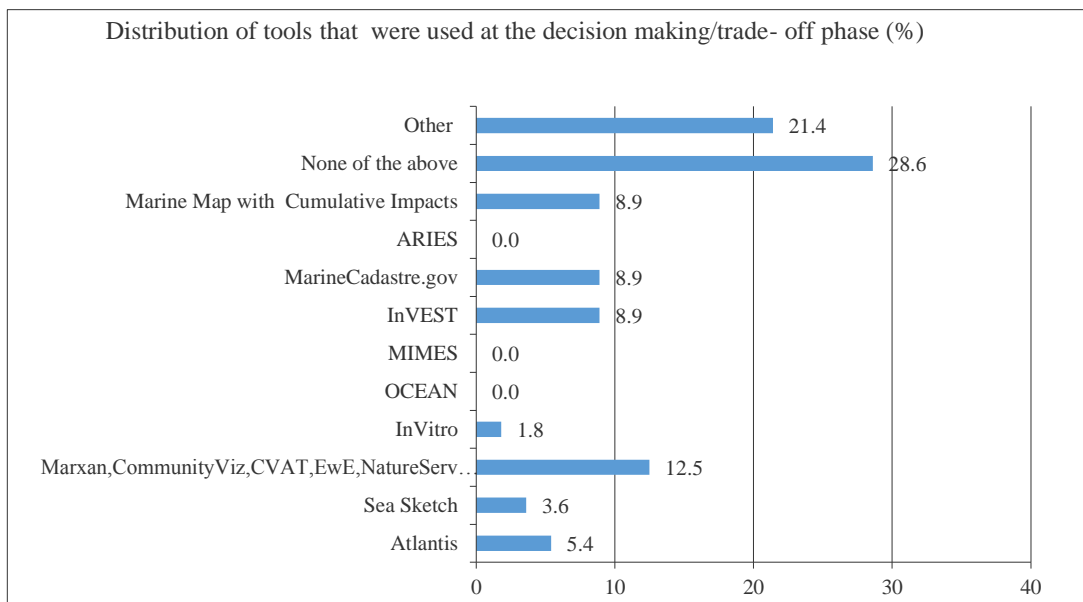
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956 Fig. B.13. Distribution of Sea use scenarios developed

957

958 19. Which of the following tools were used at the decision making/trade off phase for planning
 959 strategy or scenarios? (You can choose more than one option)

960



961

962

963 Fig. B.14. Distribution of tools used at the decision making and trade off stage

964

965

21. Please rate from the following in the order of priority the criteria for selecting the preferred spatial use scenario/preferred management strategies? From 1 to 5. 1 being the topmost priority and 5 being the least .

Answer Options	1	2	3	4	5	N/A	Rating Average
Economic effects and their distribution, e.g., direct and indirect costs and benefits, who wins and who loses;	9	6	10	2	0	8	3.81
Political considerations, e.g., acceptability to public; relation to other management plans;	10	11	9	2	3	5	3.66
Physical, chemical, and biological effects over time, including cumulative effects;	11	7	3	4	4	6	3.59
Timing considerations, e.g., time required to achieve results;	0	7	2	10	7	9	2.35
Feasibility of financing, e.g., financial requirements for implementation	3	2	8	8	10	8	2.35

966

967

968 20. How was the maintenance of ecosystem services considered in your preferred spatial use
969 scenario/management strategy?

970

971

972 Table B.5. Distribution of criteria for selecting the preferred scenario and management
973 strategy

21. Please rate from the following in the order of priority the criteria for selecting the preferred spatial use scenario/preferred management strategies? From 1 to 5. 1 being the topmost priority and 5 being the least .

Answer Options	1	2	3	4	5	N/A	Rating Average
Economic effects and their distribution, e.g., direct and indirect costs and benefits, who wins and who loses;	9	6	10	2	0	8	3.81
Political considerations, e.g., acceptability to public; relation to other management plans;	10	11	9	2	3	5	3.66
Physical, chemical, and biological effects over time, including cumulative effects;	11	7	3	4	4	6	3.59
Timing considerations, e.g., time required to achieve results;	0	7	2	10	7	9	2.35
Feasibility of financing, e.g., financial requirements for implementation	3	2	8	8	10	8	2.35

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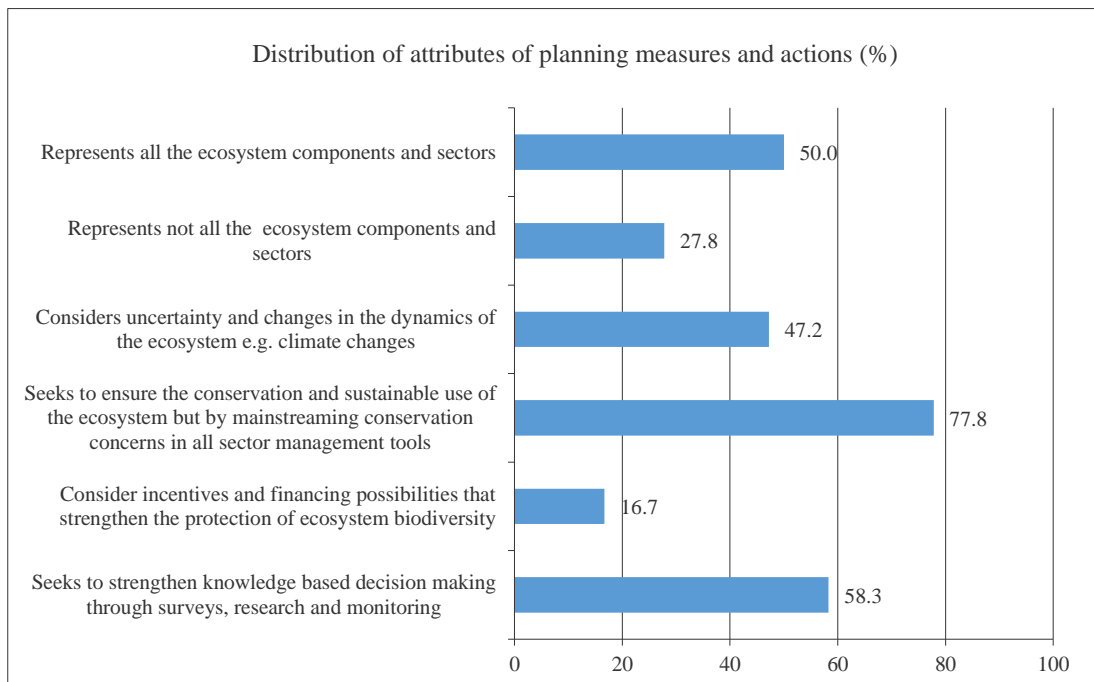
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978 22. Please choose from the following the attributes of planning measures and actions that were
 979 formulated in the process? (You can choose more than one option)

980



981

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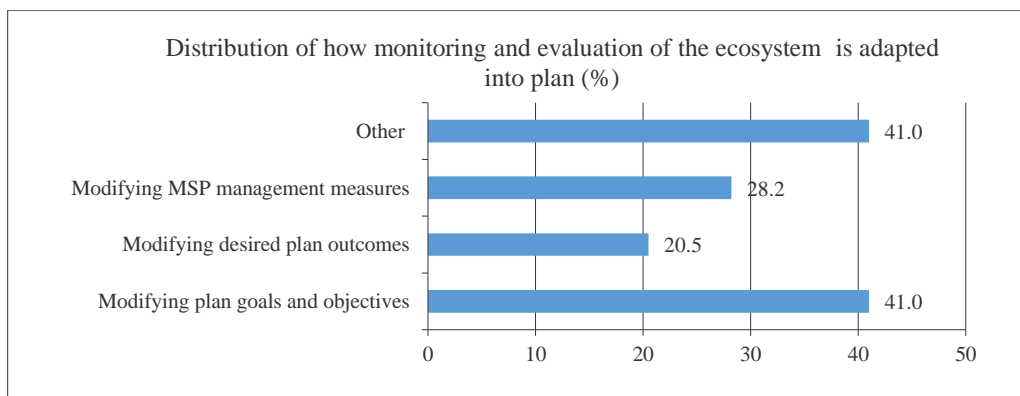
983 Fig. B.15. Distribution of attributes of planning measures and actions

984

985 **Implementation and Monitoring**

986 23. How was the results from the monitoring and evaluation of the ecosystem adapted into the
 987 management process or the plan?

988



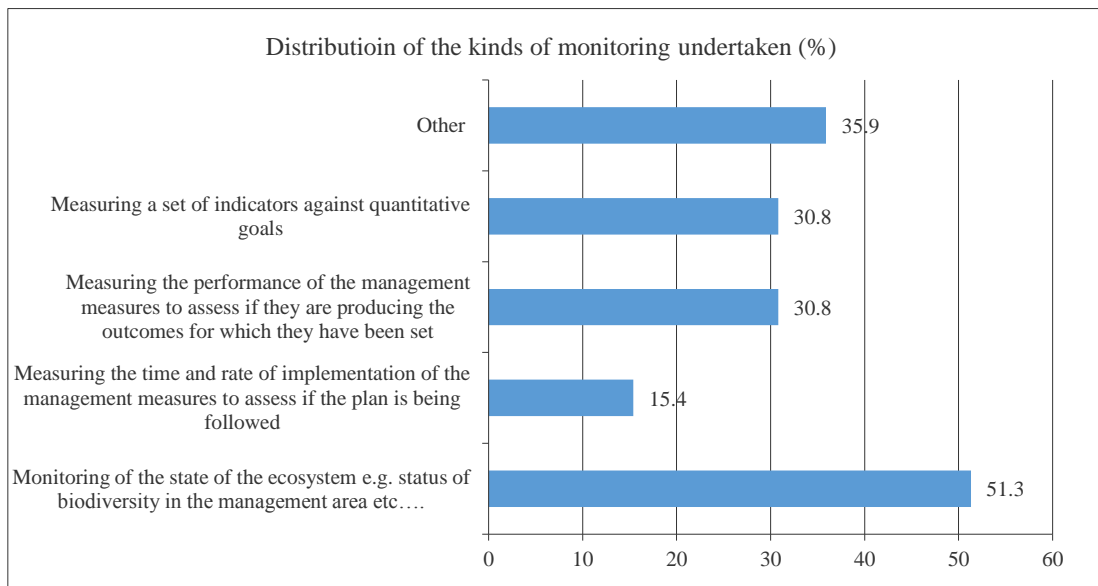
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991 Fig. B.16. Distribution of how monitoring of the ecosystem is adapted

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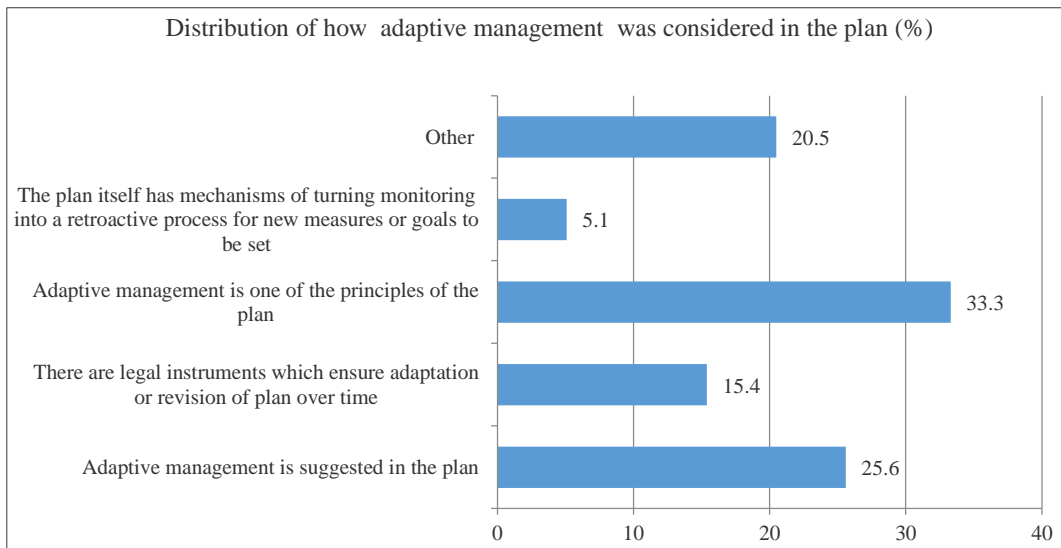
993 24. Which of the following options represents the kind of monitoring that is undertaken by the
 994 process?
 995



996
 997
 998
 999

Fig. B.17. Distribution of the kinds of monitoring

1000 25. How was adaptive management considered in the plan?
 1001



1002
 1003
 1004
 1005

Fig. B.18. Distribution of how adaptive management was considered