

The Adaptive Marine Policy (AMP) toolbox: Supporting policy-makers developing adaptive policies in the Mediterranean and Black Sea



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ABSTRACT

Adaptive management is essential to the practical application of the Ecosystem-Based Approach (EBA). Despite there are frequent assertions that adaptive management is being used, evidence on its success is still limited. Indeed, it is difficult to bring the different elements of adaptive management together in a robust way and to choose the appropriate tools to do it. Therefore, it is necessary to provide a practical framework for adaptive policy action, consistent with the EBA. Accordingly, to operationalize the design and implementation of adaptive policies on the basis of the EBA, the Adaptive Marine Policy toolbox has been developed. The objective of the toolbox is to provide policy-makers a practical framework to design and implement adaptive policies. To show the functionality of the toolbox, the guidelines and resources provided within the toolbox have been applied to the marine litter issue in the Mediterranean and Black Sea as an example. The example application has shown that the toolbox is a useful and operational framework to build a science-policy interface according to the EBA. Despite some resources could be missing from the toolbox, they provide a practical and useful starting point to support the application of the different steps and key activities.

1. Introduction

Marine ecosystems provide multiple services such as provisioning of food, energy and mineral resources, and also the regulation of important functions such as nutrient cycling and climate regulation. However, these ecosystems, and thus the services they provide, are subjected to competing uses such as fishing, food and energy production, waste disposal and marine transport to name a few [1]. The impacts of these activities, together with those of climate change, are leading to concurrent shifts in marine ecosystems, with potentially wide-ranging biological [2] and socioeconomic consequences [3]. There are many uncertainties regarding the consequences of these

shifts, which introduce yet more complexity to the management of marine ecosystems, given that marine ecosystems are intrinsically dynamic and complex (i.e. they continuously evolve through non-linear dynamics and functions) [4,5]. Accordingly, there is a need for an approach which integrates social and ecological concerns in management, accounts for the value of ecosystem services and adjusts to changing circumstances [6]. The environmental management approach which incorporates such considerations is known as the Ecosystem-based Approach (EBA) or Ecosystem Approach (EA) [5]. These terms are used in the same context and could be, therefore, used inter-changeably [5], but for clarity EBA is used in this instance.

Several regulations such as different regional conventions (i.e.

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Helsinki, Oslo-Paris, Barcelona and Bucharest Conventions) and the Convention on Biological Diversity (CBD) require the application of the EBA in order to manage human activities impacting marine ecosystems. On an European policy level, in 2008 the European Union (EU) adopted the Marine Strategy Framework Directive (MSFD) [7]. The MSFD establishes a framework for Member States to develop marine strategies and execute the necessary measures (i.e. through a “Programme of Measures”) to achieve or maintain Good Environmental Status (GES) by 2020. Marine strategies within the MSFD are required to “apply an EBA to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of GES and that the capacity of marine ecosystems to respond to human-induced changes is not compromised, while enabling the sustainable use of marine goods and services by present and future generations” [7]. However, the Directive does not define the concept of EBA and no further elaboration on how to deliver the EBA is provided [4].

The CBD [8], in contrast, provides a detailed description of the EBA, defining it as “A strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. It is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems” [8]. In addition, the CBD requires adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning. As mentioned above, ecosystem processes are often non-linear, which results in discontinuities, leading to surprise and uncertainty [8]. Consequently, management must be adaptive in order to be able to respond to such uncertainties and contain elements of “learning-by-doing” feedback. In fact, adaptive management is seen as an evolving process that includes learning (the accumulation of understanding over time) and adaptation (the adjustment of management over time). The sequential cycle of learning and adaptation targets better understanding of the resource system (i.e. reducing uncertainty), and better management based on that understanding [9]. Consequently, measures may need to be taken even when some cause-effect relationships are not yet fully understood scientifically [8]. The CBD establishes that the presence of uncertainty and knowledge gaps do not justify policy inaction.

However, although adaptive management is essential to the practical application of the EBA and there are frequent assertions that adaptive (learning-based) management is being used, there has been only limited progress in promoting learning-based management and evidence on its success is still limited [4,10]. Indeed, it is difficult to bring the different elements of adaptive management together in a robust and acceptable way and to choose the appropriate tools to do it [4,9]. In fact, several schemes, frameworks, systems and toolboxes have been developed in order to assist policy-making. Some of them, like the toolbox proposed by the EU project on Monitoring and Evaluation of Spatially Managed Areas (<https://publicwiki.deltares.nl/display/MESMA/TOOLS>) and the Ecosystem-Based Management Tools Network (EBM Tools Network; <https://www.ebmtoolsdatabase.org/>), present and describe several tools for policy-making. Other approaches such as the “Step by step guide to an ecosystem based approach to marine spatial planning” [11], make more emphasize in the guidance for structuring policy-making processes. This guide is presented as a comprehensive overview of Marine Spatial Planning (MSP), describing a logical sequence of steps that are all required to achieve desired goals and objectives for marine areas, but without focusing on the technical details of any one of the steps [11].

Though it is necessary to combine both aspects: (i) providing guidelines or a step-by-step overview on the principal steps for designing adaptive policies; and, (ii) proposing and describing different tools which can facilitate the development of those steps. The

Ecosystem Approach to Fisheries (EAF) toolbox (<http://www.fao.org/fishery/eaf-net/toolbox/en>) is based on both aspects and aims to develop and implement an integrated set of management arrangements for a fishery to generate more acceptable, sustainable and beneficial community outcomes. However, the scope of the MSFD as well as other agreements calling for the EBA goes beyond the management of fisheries. For this reason, it is necessary to provide a practical framework for policy action and to enable action to be adaptive as well as consistent with the MSFD and international agreements calling for the EBA.

Accordingly, in order to operationalize the design and implementation of truly adaptive policies on the basis of the EBA, the Adaptive Marine Policy toolbox (hereafter, AMP toolbox) has been developed. The toolbox is focused on the needs of policy-makers of both EU and non-EU Member States around the Mediterranean and the Black Sea, but it is not limited to this geographical context. In addition, in order to show the usefulness of the AMP toolbox to design and implement adaptive measures, under the MSFD and additional regulations calling for the EBA, the guidelines provided within the toolbox are described and the different resources available are illustrated, using information and data from the literature. To demonstrate the value of the toolbox, the issue of marine litter in the Mediterranean and Black Sea will be explored as a directional example.

To sum up, the main objective of this contribution is to present the AMP toolbox and to demonstrate its value for developing adaptive policies under the MSFD and other regulations calling for the EBA. This will be attained by: (i) presenting the core objective and structure of the AMP toolbox (section 2); (ii) explaining the guidelines and resources provided within the toolbox; (iii) exploring the issue of marine litter in the Mediterranean and Black Sea as an example (section 3); and, (iv) providing some concluding remarks and ways forward (section 4).

2. The adaptive marine policy toolbox

2.1. Objective

The overall objective of the AMP toolbox is to provide policy-makers within the Mediterranean and Black Sea the necessary support to develop adaptive policies or measures to achieve or maintain GES under the requirements of the MSFD, as well as different international and regional regulations calling for the application of EBA to the management of human activities.

The tool box can be found here at the following web address: http://www.perseus-net.eu/en/about_the_apf_toolbox/index.html. It has been developed within the PERSEUS (Policy-oriented marine Environmental Research in the Southern EUropean Seas) project, an EU project which aims to support regional policymakers meeting the objectives mentioned above.

To investigate the necessities and the usefulness of the AMP Toolbox, as well as to improve it, different meetings, activities and tests have been performed during the development of the toolbox using real-world problems through participatory approaches with stakeholders. The experimentations have been performed at two levels: (i) Pilot case level (including the Western Mediterranean, Adriatic, Aegean and Western Black Sea); and, (ii) Basin level (i.e. including the Mediterranean and Black Sea) [12–14].

2.2. Structure

The AMP toolbox has been structured in four levels of information, i.e. main page, steps, key activities, resources and examples (Fig. 1). An overview of this structure, including the formats used for each level is given below.

2.2.1. 1st level-main page

This first level presents the structure of the toolbox, which consists of a policy-making cycle suggested by the MSFD. The adaptive and

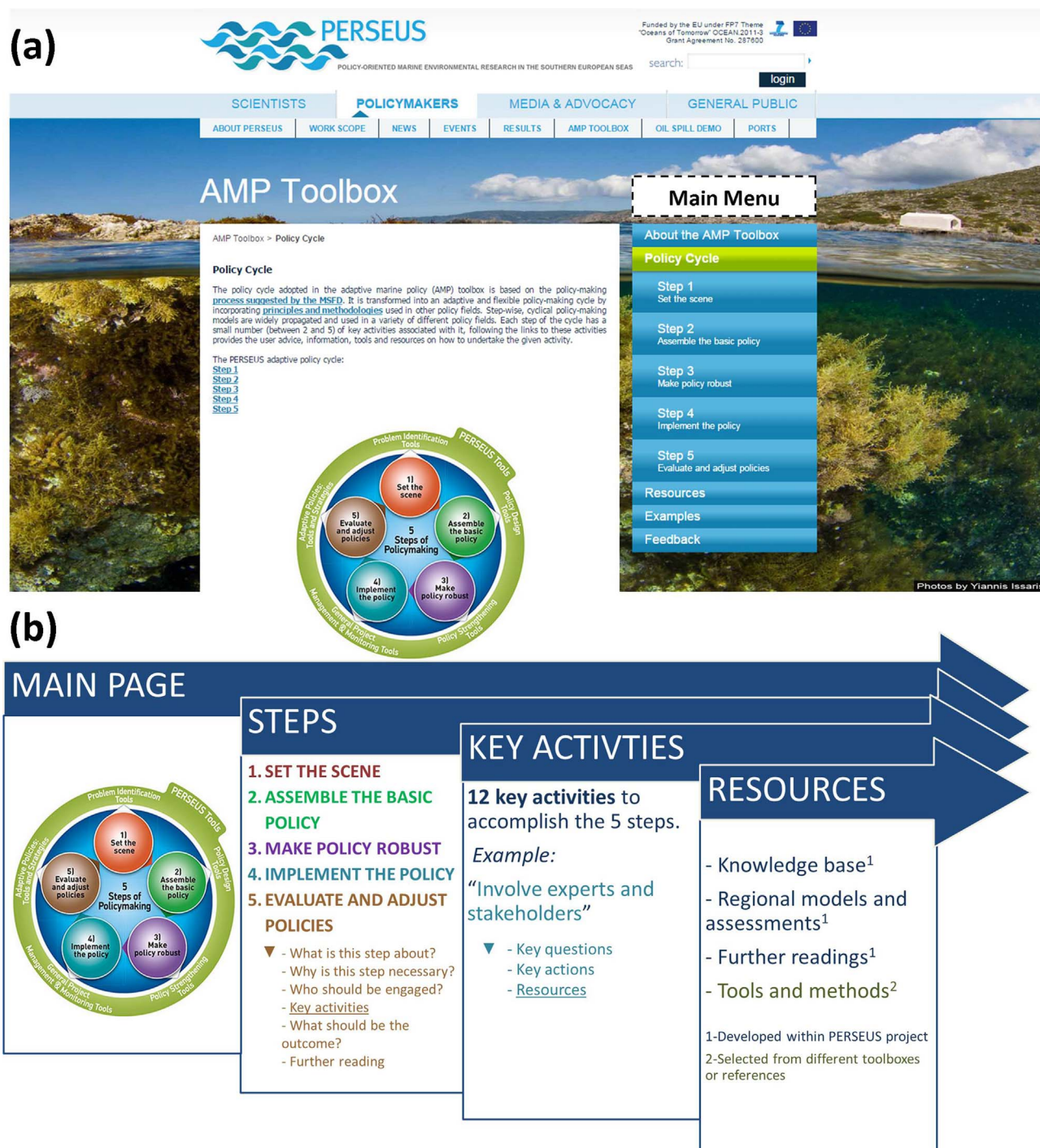


Fig. 1. (a) Main page and (b) four-level structure of the Adaptive Marine Policy Toolbox.

flexible policy-making cycle (including steps and activities) is based on principles used in other policy fields [9,11,15–19], which have been adapted to the specific needs of the MSFD. These principles include: (i) engagement of the broader stakeholder community; (ii) definition of the problem and desired objectives; (iii) transfer of cross-disciplinary and integrated scientific knowledge to decision-makers (i.e. learning contributes to management by helping to inform decision-making); (iv) forward-looking analysis to promote the identification of robust policies across different scenarios and as a basis for further learning; (v) monitoring of the effects of the implementation of new policies; (vi) implementation of actions/policies to allow continued environmental management while learning (reducing uncertainty); (vii) the incorporation of lessons learnt from monitoring the management

interventions (i.e. management contributes to learning) in order to revise models and/or management actions; and (viii) iterative repetition of this cycle or part of it, so that management reduces uncertainties and leads to improved management outcomes over time. In order to be able to put these principles into practice in the policy-making process, different guidelines and resources have been incorporated into the toolbox.

2.2.2. 2nd level-steps

The policy cycle contains five steps: 1-set the scene; 2-assemble a basic policy; 3-make the policy robust; 4-implement the policy; and, 5-evaluate and adjust the policies. The AMP toolbox has been structured in a way that not only allows for a step-wise, cyclical policy-making

approach, but also an independent use of guidelines and resources involved in specific steps of the cycle. The step-wise or the independent implementation of the cycle steps will depend on the nature of the problem studied and the relevance of the steps of the adaptive policy-making process. To this end, the AMP toolbox aims to propose a flexible framework that could be implemented in the different stages of the marine policy-making. Each policy-maker will have to adapt the framework according to her/his own needs and priorities. Moreover, this toolbox is also useful for other societal groups who are not in charge of policy-making, but whom might also be interested in this process, such as: (i) scientists willing to understand how scientific knowledge can be used in policy-making; (ii) stakeholders who may gain or lose with the policies' implementation; and/or (iii) general citizens interested on how our society is managed.

Each one of these steps are presented in a uniform format, including some basic information such as: What is the step about; Why is the step necessary; Who should be engaged in the step; and What should the outcome be (Fig. 1). In addition, and most importantly, the steps provide access to the key activities (3rd Level) necessary to accomplish each step.

2.2.3. 3th level-key activities

The 12 key activities represent a series of actions which need to be taken to achieve the 5 steps and include: "Involve experts and stakeholders"; "Gather information and determine existing conditions"; "Develop a mutual understanding and define principles and goals"; "Develop Scenarios and perform Risk analysis"; "Identify measures"; "Prioritize/assess new measures"; "Check conditions warranting the use of adaptive management"; "Forward looking analysis: assess policy success – and risk factors"; "Design and implement a monitoring plan"; "Evaluate the on-going policy"; and, "Adjust to new uprising issues". The activities are presented in a uniform format as well, including an introduction, key questions, key actions and links to the resources necessary to develop the activity in question (Fig. 1). Note that the same activity can be addressed within different steps.

2.2.4. 4th level-resources

The resources comprise: (i) the "Knowledge base", including seven databases; (ii) different "Tools and methods"; (iii) the "Regional assessments and models dedicated to the Mediterranean and the Black Seas"; and, (iv) "Further readings".

One of the most important objectives of the AMP toolbox is to make available scientific data, information and models (especially those developed within the PERSEUS project) to users and in doing so support policy-making. Accordingly, the "Knowledge base" and the "Regional assessments and models dedicated to marine environmental issues in the Mediterranean- and Black Sea" have been developed from the work performed within the PERSEUS project.

The Knowledge base includes seven user-friendly thematic databases (i.e. Research Projects; Marine valuation; Inventory of Measures; Inventory of Foresight exercises; Inventory of Ecosystem Based Assessment Studies; Legal Inventory; and, Institutional Inventory) and their correspondent deliverables which include several explanations about their development. These databases have been linked to the different activities and steps. Though, the databases are also accessible by a direct link to the resources.

In addition, the "Regional assessments and models" include useful information and knowledge acquired within the PERSEUS project, such as the: (i) Analysis of the main risks of non-achievement of the GES in coastal areas and open sea; (ii) Analysis of the pressures in socio-economic terms on the marine and coastal ecosystems; and, (iii) End to end or ecosystem Models developed within PERSEUS. These resources have been linked to the different activities and steps. However, as well as the rest of the resources they also can be accessed through the direct link to the resources.

Finally, the "Tools and methods" have been selected from different

toolboxes or references already available in the literature or on the web. These include: (i) the MESMA toolbox; (ii) the Marine Scotland toolbox; and, (iii) the EAF toolbox. Moreover, some of the tools have been compiled from resources provided by different governmental departments (e.g. Directorate General of Development and Cooperation, EuropeAid), environmental research groups or companies.

To select the tools a stepwise approach was followed. Firstly, from the abovementioned sources, an inventory of over-160 tools was constructed. Secondly, from this inventory (i.e. 166 entries), 43 "primarily useful" (i.e. tools that can be employed to carry out the different activities and steps) tools were selected. To select these 43 tools from the whole inventory (i.e. 166 entries), different "thematic groups" were organized according to expert's fields of expertise (e.g. economic tools, spatial analysis and ecosystem assessment tools, risk assessment tools and stakeholder analysis tools). Once the thematic group were formed, four selection-criteria were agreed among all the groups: (i) availability of the tool (i.e. whether it can be purchased or is available on the web or not); (ii) simplicity of the tool (i.e. whether the tools is applicable to a wide range of issues/situations or not); (iii) applicability by policy-makers; and, (iv) interest (i.e. whether it is of interest to help achieving the goal of a particular step). The tools with the highest scores became part of the 43 "primarily useful" tools.

Thirdly, from this list of 43 recommended tools, some of the tools were selected and classified as "flag-tools" based on the four selection-criteria mentioned above and best professional judgment. For each one of these "flag-tools" (i.e. highly recommended tools by best professional judgment) a detailed and separate tool page is provided. These detailed pages have a uniform format, providing some basic information on each tool, as well as some supporting-criteria (i.e. cost, capacity needs, background requirements, participation level and time-range required for the application) to assist users selecting the most useful tools for them based on their needs. Note that a given tool can be multi-functional or useful for different purposes, thus it can be linked to different activities and steps. Though, these tools and methods are also accessible by a direct link to the resources.

Finally, it is necessary to underline that the purpose of this level (i.e. "Resources") it is not to compile all the resources available for policy-making, but only to propose some useful tools to help and illustrate each activity and/or step.

3. Insights into the AMP toolbox using marine litter as an example

In this section, the functioning of the AMP toolbox is illustrated, through an example on marine litter, selected as being a key issue for the Mediterranean and the Black Sea. In fact, several agreements and directives such as the MSFD require maintaining properties and quantities of marine litter at levels that do not cause harm to the marine environment. Accordingly, using this important environmental problem as a directorial example, the guidelines provided within the toolbox are described; and the different resources available are illustrated, using information and data from the literature. In other words, using the marine litter as an example, a step-by-step tour is done through the AMP toolbox, looking at different resources within it.

However, in the following, it is assumed that each user of the AMP toolbox is in charge of developing their own place-based policies to tackle their specific problem.

3.1. Step 1-set the scene

The first step in the AMP toolbox is to acknowledge that there is a problem that causes negative impacts and that this merits further analysis and the development of management strategies. Developing a strategy to manage marine litter (as well as other environmental issues) requires a good understanding of the source of the problem, its scale and impact. Accordingly the activity named "Gather information and determining existing conditions" is a key activity at this step. For this

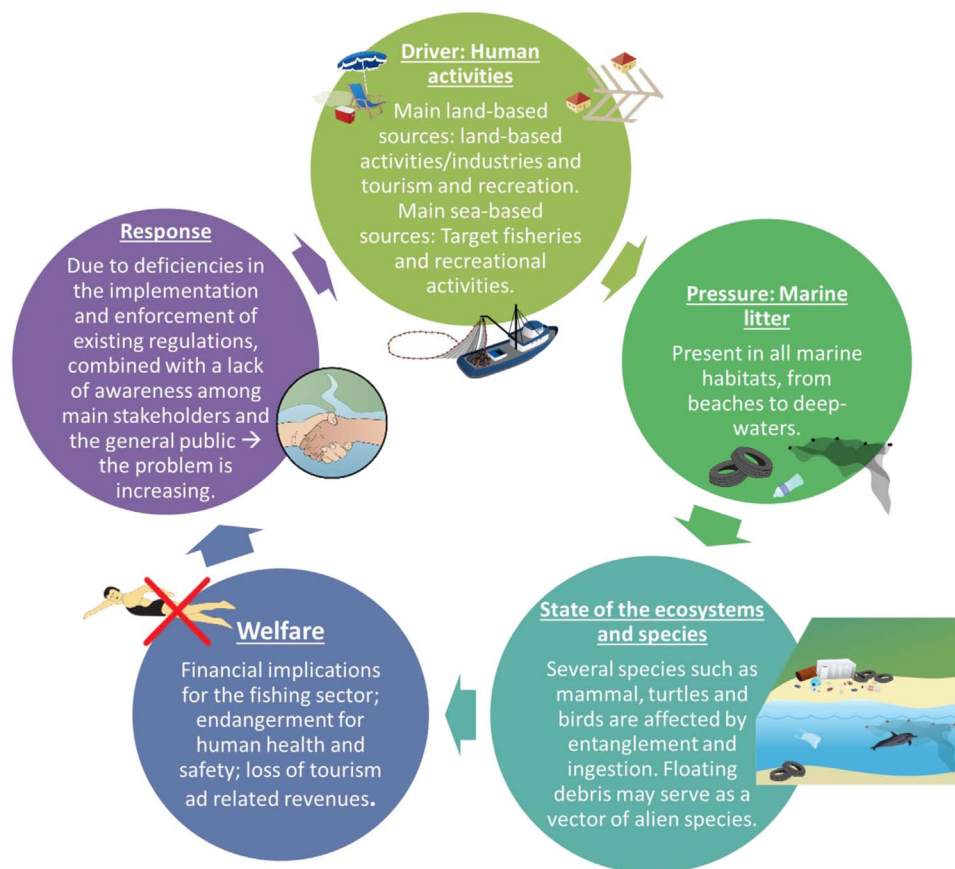


Fig. 2. Application of the Drivers-Pressures-State-Welfare-Responses (DPSWR) framework tool (<http://www.perseus-net.eu/site/content.php?artid=2181>) to the problem of marine litter.

purpose, the “Driver-Pressure-State-Welfare-Response (DPSWR) framework” (Fig. 2) is proposed within this key activity. This tool is a widely-known and potentially useful framework to set the scene [20]. This framework is useful to link the effects that socio-economic uses have in the marine ecosystems as well as the effects that the degradation of the marine environment has on human wellbeing (Fig. 2). However, understanding the extent of the problem is usually complicated as a consequence of data and knowledge limitations. Accordingly, determining key sources of knowledge and finding any knowledge gaps are also an important aim of this step.

Additionally, in this step, as well as throughout the following steps, it is necessary to “Involve experts and stakeholders” (key activity) to make them understand the extent of the problem. This will help to create the political will and support for potential action [21]. In the case of marine litter (as well as different environmental issues), a wide engagement would be necessary (i.e. regional, national and local authorities, maritime sector, tourism sector, fisheries and aquaculture, agriculture, industry, and civil society). Accordingly, to support policy-makers at this stage, several tools such as “Stakeholders Analysis” (see Fig. 3), “Stakeholder meetings” and “Stakeholder workshops” are proposed within this key activity. Note that the tools can also be accessed through the “Resources” section (Fig. 1).

Once the current situation has been defined and before the possible solutions are listed, it is helpful to develop a clear set of objectives the policy needs to address, and the particular issues it needs to take into account. Accordingly, it is important to “Develop a mutual understanding and define principles and goals”. To see a practical example of this key activity in relation to the marine litter issue, the Honolulu Strategy¹ [22] can be consulted within the “Further readings” section of

the toolbox. Within the Honolulu Strategy, the following three objectives have been defined: (i) to reduce the amount and impact of land-based sources of marine debris; (ii) to reduce the amount and impact of sea-based sources of marine debris; and, (iii) to reduce the amount and impact of the accumulated marine debris on shorelines, in benthic habitats, and in pelagic waters.

Goals and targets should be set at the local level, with a stakeholder-led process propagating from local spatial scales upwards toward a unified regional vision and legal formalization. Indeed, cooperation and coordination on a regional seas basis is an asset for a meaningful development and implementation of the EBA [6]. Accordingly, the use of existing institutional structures such as the regional seas commissions and international organization should be promoted [6]. In the “Institutional inventory” of the toolbox some of the intergovernmental organizations related to the marine litter problem can be found. Some of the organizations represented in the “Institutional inventory” (http://www.perseus-net.eu/en/institutional_inventory/index.html) as well as in the literature include the: Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention); Convention for the Prevention of Pollution from Ships (MARPOL) (London protocol); Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention); Convention on Biological Diversity (CBD); UNEP Global Marine Litter; United Nations General Assembly resolutions on Oceans and the Law of the Sea and on sustainable fisheries; Fifth International Marine Debris Conference (5IMDC) and Honolulu strategy; Global

(footnote continued)

Conference (5IMDC) co-hosted by the National Oceanic and Atmospheric Administration (NOAA) in cooperation with the United Nations Environmental Programme (UNEP) and other agencies and organizations for a comprehensive and global effort to reduce the impacts of marine debris (<https://5imdc.wordpress.com/about/honolulustrategy/>).

¹ The Honolulu Strategy was created during the Fifth International Marine Debris

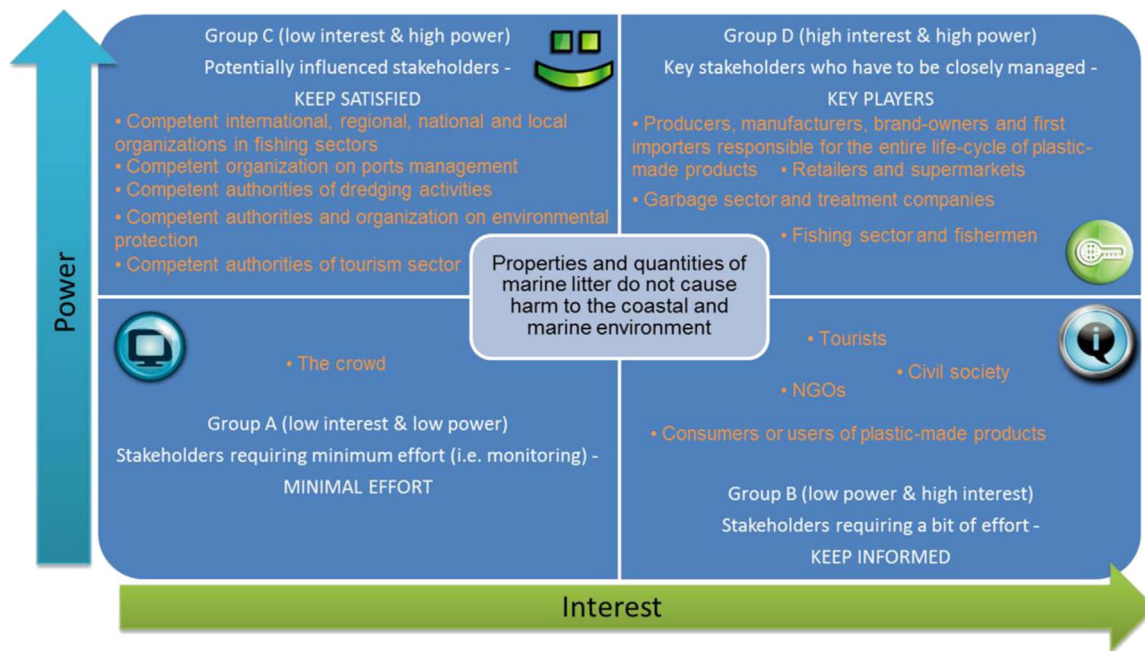


Fig. 3. Application of the Stakeholders analysis tool (<http://www.perseus-net.eu/site/content.php?artid=2195>) to the problem of marine litter.

Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) (and the Global Partnership on Marine Litter (GPML)); International Conference on Prevention and Management of Marine Litter in European Seas; Convention on the Protection of the Black Sea against Pollution (Bucharest Convention) and its protocols; Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention) and its protocols; Mediterranean Action Plan's Ecosystem Approach (EcAp); and, Marine Strategy Framework Directive (MSFD).

Moreover, existing legal and administrative obligations such as international mandates should be identified, with the aim of defining consistent objectives and strategies. A list of examples of legal and administrative instruments managing marine litter can be found in the "Legal inventory" (http://www.perseus-net.eu/en/key_activities/index.html) as well as in the literature provided within the "Further readings" section [23]. Note that although many of the instruments do not target marine litter directly they have an indirect effect on marine litter.

3.2. Step 2-Assemble the basic policy

Once the problem has been addressed and the desired objectives defined, it is necessary to identify and analyse different possible options. Accordingly, this step includes two key activities named: "Identify measures" and "Prioritize/assess new measures". The former requires that the policy-makers look at the full range of possible solutions and develop a list of options taking into consideration the objectives of the policy and the particular issues it needs to take into account. On occasions, a policy is not feasible given political commitments, potential public resistance and/or capacity constraints. Participation by stakeholders enhances the acceptance of instruments as well as offers ideas of whether they could be successful or not. In other words, the involvement of many groups and sectors will help ensure the solution to marine litter is practical and enforceable (i.e. feasible) [21]. For example, fees for waste services are useful to cover the costs of collection and disposal of waste and also to incentivize consumers to reduce the amount of waste they produce. This should, however, be performed carefully to avoid perverse incentives to dump waste elsewhere. Furthermore, the policy should not only include individual instruments or measures (e.g. charging for waste services) but also packages of

complementary instruments (e.g. awareness raising, improvement of waste discharge facilities and infrastructures and simplification of procedures for discharging waste) [21]. In Table 1, a list of potential actions are proposed based on the "Measure inventory" provided within the AMP toolbox as well as on the Regional Plan on Marine Litter Management in the Mediterranean [24] (available at the "Further readings" section).

Another important action at this stage is to define a set of criteria against which the different alternatives will be compared. This selection of criteria will depend on the international or national conditions/circumstances. Some authors [21], (consult "Further Readings" section) have defined ten criteria that can be useful to analyse potential options in order to manage marine litter. After analysing these 10 criteria's potential, the abovementioned authors [21], recommend scoring (by expert judgement) these criteria from 1 (minimum) to 5 (maximum) with the aim of ranking and prioritizing within all the options. This procedure represents a simple way of prioritizing different policy-options, as well as of discussing and defining the right set of criteria against which the different options will be assessed.

3.3. Step 3-Make the policy robust

The policy measures drafted in Step 2 must be assembled into a policy which is robust, as far as possible, against future expected and unexpected conditions. This constitutes probably the most specific and innovative step of the AMP toolbox policy-cycle. For this purpose it is necessary to: (i) identify key factors that could affect policy performance as well as linking them to future scenarios in order to study the way these factors might evolve in the future; and, (ii) develop indicators to help trigger important policy adjustments when needed. Accordingly, "Forward looking analysis: assess policy success and risk factors" and "Design and implement a monitoring plan", are respectively key activities within Step 3.

To identify the key factors that may affect policy performance it is recommendable to develop a deliberative process with multiple stakeholders and experts involved in the implementation of the policy as well as those who are affected by the policy in question. Potential future evolution of the key factors can be projected using scenarios. For instance, within the "Regional Models" section of the toolbox, "Future scenarios of development in the Mediterranean and Black Sea regions"

Table 1

Potential actions to combat marine litter. perseus-net.eu/en/db_inventory_of_mesurements/index.html id = "ce_inter-ref_ir0015" > http://www.perseus-net.eu/en/db_inventory_of_mesurements/index.html

Action	Type of action			
	Prevention	Removal	Land-based	Sea-based
Adequate urban sewer, wastewater treatment plants, and waste management systems to prevent run-off and riverine inputs of litter (e.g. improving sewer overflows and infrastructures).	x		x	
Establishment of voluntary agreements with retailers and supermarkets to set an objective of reduction of plastic bags consumption and /or establishment of plastic bag taxes.	x		x	
Establishment of mandatory Deposits, Return and Restoration System for beverage packaging prioritizing when possible their reuse.	x		x	
Provide adequate facilities in beaches (bins, recycling collection facilities, etc.).		x	x	
Implement National Marine Litter Cleanup Campaigns on a regular basis.		x	x	
Implement sources of revenue to earmark for beach cleaning and maintenance (e.g. tourist taxes, car-parking taxes and waterfront business charges).		x	x	
Eco-tourism labels and certificates.	x		x	
Code of Ethics for Tourism.	x		x	
Ways and means to charge reasonable cost for the use of port reception facilities (e.g. port reception fee) or when applicable, apply No-Special-Fee system.		x		x
Simplify procedures for discharging waste to port reception facilities.		x		x
Notification requirement on the amount and type of waste for disposal before entering the port.		x		x
Sanction or fines for illegal dumping, including littering on the beach, illegal sewage disposal in the coastal zone and rivers and dredging.	x			x
Designation of Special Areas.	x			x
Undertaking an awareness-raising campaign to make fishermen aware of their obligations under different regulations with regard to reporting, marking and retrieval of lost nets.	x			x
Gear marking to indicate ownership.	x			x
Exchange experience on best practice to prevent litter entering into water systems.	x		x	x
Promoting education activities in synergy with existing initiatives in the field of sustainable development and in partnership with civil society.	x		x	x

are presented. For these scenarios, the consequences of connected economic and environmental policies on different economic sectors relevant to the use of marine ecosystem services are described. In Table 2, for instance, the potential future evolution of key sectors, in the Mediterranean and Black Sea, related to the marine litter issue are presented. Scenarios can be then quantified using predictive models. They allow forecasting the potential impacts of the policy under various conditions. Models can be as informal as a verbal description of system dynamics, or as formal as a detailed mathematical expression of change.

Once a set of alternatives have been defined and the criteria have been agreed among the stakeholders (see step 2), it is useful to assess the performance of the alternatives under the different scenarios defined at this step. For this purpose, the “Multi-Cases Tool” is proposed within the “Tools and methods” of the “Resources” section. This is a practical tool to develop a Multiple Criteria Decision Analysis (MCDA) and assess the robustness of the different policy alternatives under different scenarios. In Fig. 4, the different phases of this analysis can be observed. Moreover, apart from the MCDA, several types of assessment methods exist which are useful to assess potential alternatives. These include, for example, impact assessments, cost-effectiveness analysis, and cost-benefit analysis. Information on these tools can be also found within the “Prioritize/assess new measures” key activity.

Monitoring is also a key component in adaptive policies. The key activity named “Design and implement a monitoring plan”, provides information to evaluate the status of the ecosystems (i.e. environmental status, under the MSFD) and the performance of the policy, as well as triggering policy adjustments in case targets are not achieved (see Steps 4 and 5). To make monitoring useful, in Step 3, the motivation of the monitoring, choices on the monitoring strategy (i.e. selecting the targets and associated indicators to monitor and how to monitor them), and the practical limits (e.g. staff and funding) should be made a priority.

The “Commission Decision on criteria and methodological standards on good environmental status of marine waters” [25] (“Further readings” section), sets out the criteria or indicators to be used to assess the extent to which GES is being achieved.

Furthermore, not only should the indicators be defined and standardized, but also the methods to monitor them. Some authors [26], make a summary of different approaches to monitor marine litter in different marine compartments and their positive and negative aspects. Other key relevant documents regarding monitoring methods include the UNEP’s “Operational Guidelines for Comprehensive Beach Litter Assessment” [27], the UNEP/MAP’s “Draft Monitoring and Assessment Methodological Guidance” [28] and the NOAA’s “Recommendations for Monitoring Debris Trends in the Marine Environment” [29]. These key references can be consulted in the “Further readings” section.

Additionally, operational targets should also be defined in relation to the nature of the management action required to achieve GES (e.g. amount of marine debris removed); or to assess progress towards full implementation of a specific measure (e.g. percentage of fishers using alternative/modified fishing gear by fishing fleet or area). In the Honolulu Strategy [22], for example, several indicators are proposed to evaluate management strategies and their enforcement, focused on three areas: (i) decreasing land-based sources of marine debris; (ii) awareness (and use) of fishers and specific groups of ocean users regarding proper waste storage and disposal options; (iii) removal of marine debris accumulations.

3.4. Step 4-Implement the policy

In order to ensure successful policy implementation, several basic conditions need to be arranged. In fact, implementing a policy does not only consist of preparing the legal text, but also ensuring that those who face changes under the new policy understand and expect the policy, its meaning and the implications of their (non-)compliance with it. Accordingly, “Involve experts and stakeholders” and “Draw up an implementation plan” are key activities within this step.

A dedicated implementation plan should provide instructions that are both sufficiently flexible and specific about the actions to be carried out, including who is responsible for these actions and how they can be carried out. A timeline for implementation of the policy should be also included. A “Gantt chart”, as proposed in the latter activity (i.e. “Draw

Table 2
Direction of change for drivers or activities particularly related to marine litter for the five PERSEUS scenarios (http://www.perseus-net.eu/assets/media/PDF/D6.2/2935_2.pdf) for the Mediterranean and Black Sea. Key: 0 same as present state; + more than present state (slow increase); ++ much more than present state (net increase); - less than the present state (slow decrease); -- much more than present state (net decrease).

SECTOR	SCENARIO					
	Business as Usual	Convergence with proactive environmental management	Convergence with reactive environmental management	Heterogeneity with proactive environmental management	Heterogeneity with reactive environmental management	
Mediterranean Sea	Tourism					
	Mass tourism demand	0/+	-	++	0/+	+
	Luxury tourism	0/+	+	++	0/+	-
	Local/cultural tourism	0/+	++	++	+	-
	Eco-tourism	0	++	-	+	0
	Population concentration	++	+	++	+	++
	Coastal settlements	+	0/-	++	0	++
	Fisheries production	0/-	++	0	+	-
	Aquaculture	+	+	++	0/+	+
	Expansion of port areas	0/+	+	++	0/-	0/+
Black Sea	Maritime transport/ ports					
	Maritime transports	0/+	++	++	0/-	0/-
	Tourism					
	Mass tourism demand	0/+	+	++	0/+	-
	Luxury tourism	0	++	+	-	-
	Local/cultural tourism	0/+	++	++	+	-
	Eco-tourism	0/+	++	0/+	+	0
	Population concentration	+	+	++	+	0/+
	Coastal settlements	+	0/+	++	0/+	+
	Fisheries production	0	+	0/+	0/-	-
Mediterranean Sea	Fisheries/ aquaculture					
	Aquaculture	+	+	++	0/+	+
	Expansion of port areas	0/+	++	0/-	0	0/+
	Maritime transport/ports					
	Maritime transports	++	++	0/-	0/-	0/+
	Tourism					
	Mass tourism demand	0/+	+	++	0/+	-
	Luxury tourism	0	++	+	-	-
	Local/cultural tourism	0/+	++	++	+	-
	Eco-tourism	0/+	++	0/+	+	0
Black Sea	Maritime transport/ ports					
	Maritime transports	++	++	0/-	0/-	0/+
	Tourism					
	Mass tourism demand	0/+	+	++	0/+	-
	Luxury tourism	0	++	+	-	-
	Local/cultural tourism	0/+	++	++	+	-
	Eco-tourism	0/+	++	0/+	+	0
	Population concentration	+	+	++	+	0/+
	Coastal settlements	+	0/+	++	0/+	+
	Fisheries production	0	+	0/+	0/-	-
Mediterranean Sea	Fisheries/ aquaculture					
	Aquaculture	+	+	++	0/+	+
	Expansion of port areas	0/+	++	0/-	0	0/+
	Maritime transport/ports					
	Maritime transports	++	++	0/-	0/-	0/+
	Tourism					
	Mass tourism demand	0/+	+	++	0/+	-
	Luxury tourism	0	++	+	-	-
	Local/cultural tourism	0/+	++	++	+	-
	Eco-tourism	0/+	++	0/+	+	0
Black Sea	Maritime transport/ ports					
	Maritime transports	++	++	0/-	0/-	0/+
	Tourism					
	Mass tourism demand	0/+	+	++	0/+	-
	Luxury tourism	0	++	+	-	-
	Local/cultural tourism	0/+	++	++	+	-
	Eco-tourism	0/+	++	0/+	+	0
	Population concentration	+	+	++	+	0/+
	Coastal settlements	+	0/+	++	0/+	+
	Fisheries production	0	+	0/+	0/-	-
Mediterranean Sea	Fisheries/ aquaculture					
	Aquaculture	+	+	++	0/+	+
	Expansion of port areas	0/+	++	0/-	0	0/+
	Maritime transport/ports					
	Maritime transports	++	++	0/-	0/-	0/+
	Tourism					
	Mass tourism demand	0/+	+	++	0/+	-
	Luxury tourism	0	++	+	-	-
	Local/cultural tourism	0/+	++	++	+	-
	Eco-tourism	0/+	++	0/+	+	0

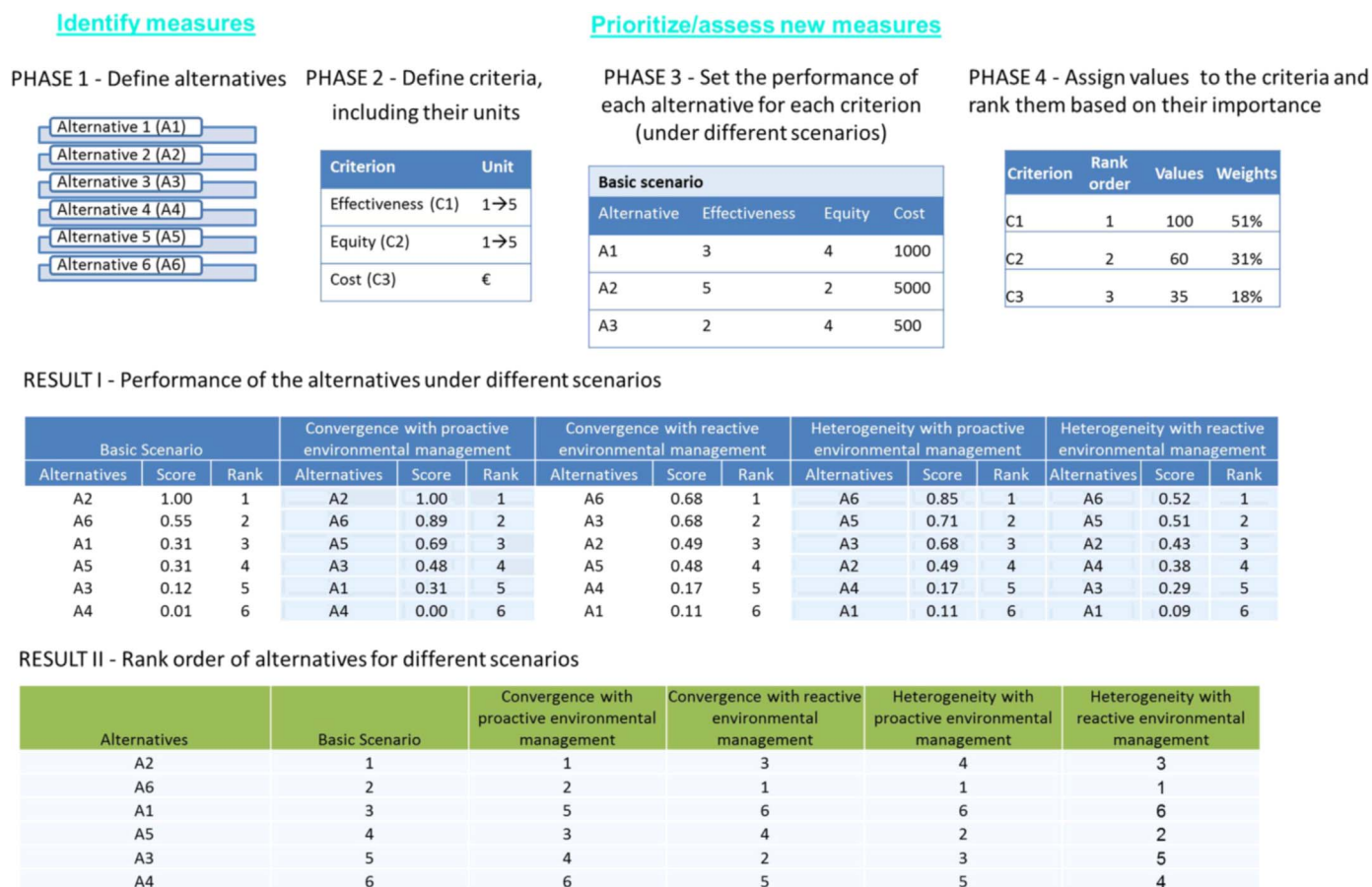


Fig. 4. Example of the different phases or stages of a Multi-Criteria Analysis that need to be accomplished to check the robustness of the defined alternatives under different scenarios.

up an implementation plan”), can be a useful means to organize actions along a timeline.

In Table 3 for example, a hypothetical implementation plan to reduce marine litter at sea is presented, following the “Guide on best practices for Fishing for Litter (FfL) in the Mediterranean” [30].

FfL consists of incentives for fishermen to facilitate clean-up of the floating litter and mainly the seabed from marine litter caught incidentally and/or generated by fishing vessels in their regular activities including derelict fishing gears. Here again it is very important to ensure that the stakeholders (particularly fishermen but also fishing companies, port authorities and waste management authorities and companies) are truly involved in the implementation and make them understand their co-responsibility in generating and solving the problem. Moreover, successful implementation also requires that the regulatory and institutional frameworks will be in place, including the capacity to enforce and monitor the new policy (e.g.: set a coordination group, train fishermen and vessel owners fishing or collecting marine litter at sea, provide vessels bags to collect litter as well as suitable disposal facilities in ports and harbours, etc.).

Once these conditions are fulfilled, the specific actions (i.e. “fish” marine litter at sea, collect marine litter at ports and harbours and manage marine litter for recycling, energy recovery and disposal) as well as the monitoring plan can be put into place.

Though, critical barriers exist inhibiting knowledge exchange among marine scientists, stakeholders and decisions-makers [31–33]. While, scientists generate data to advance knowledge, decision-makers may mobilise specific information to support a particular agenda without always giving consideration to the full range of available evidence or detailed public debate [31,34]. In fact, decision-makers are usually driven by a range of political, economic and social drivers that reflect other societal issues [31,35]. As such decision-makers often

manage a process of negotiation and compromise among the stakeholder [31]. In addition, this situation is often reinforced by the lack of the institutional framework mentioned above (e.g. a lack of organisational support for engagement activities, insufficient time to conduct engagement activities), further preventing and undermining effective knowledge exchange and collaboration among scientists, stakeholders and decision-makers [31–33]. Accordingly, improving knowledge-exchange among all actors is fundamental for supporting the adaptive management of marine resources and to ensure their sustainable management for future generations [31,36].

3.5. Step 5-Evaluate and adjust policies

This step provides both insights in the policy’s outcomes and performance and a basis for its adjustment and improvement. A regular review or evaluation, even when the policy seems to perform well, can help address emerging issues and trigger important policy adjustments [9]. Accordingly this step consists of two key activities, “Evaluate the on-going policy” and “Adjust to new uprising issues”.

Evaluation involves assessing: (i) how much of the problem has been addressed (i.e. measuring the remaining gap between the current status of marine ecosystems and the desired condition or status, through the targets and indicators defined in step 3); and, (ii) whether and to what extent the policy is effective. For example, evaluating the composition (i.e. to identify sources of marine litter) and weight (i.e. to ensure the final waste management) of waste brought ashore or/and the number of vessels that participate in the strategy. Well-designed policies should designate competent authorities for policy evaluation. Evaluation should be conducted by a group outside the implementation team to ensure objectivity. For instance, the tasks of recording weight and composition and weight of waste brought ashore might be

Table 3

Example of an implementation plan to reduce marine litter in the sea. Source: UNEP (DEPI)/MED WG.417/13;

Task name	Example for a strategy to reduce marine litter in the sea	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
Designate and formalize roles and responsibilities.	Set a coordination group to organize the strategies for reducing marine litter in the sea.												
Designate stakeholder to take into account.	Engage: particularly fishermen but also fishing companies, port authorities, and waste management authorities and companies.												
Develop an initial assessment and identify drivers of actual state.	Evaluate the amount of litter in the water column and deposited on the seafloor from sea-based sources (particularly fishing activities), as well as impacts on marine habitats and species.												
Gain management approval and define the scope of the policy.	<u>Objective:</u> remove litter from the sea in an environmentally friendly manner ensuring that properties and quantities of marine litter do not cause harm to the coastal and marine environment. <u>Scope:</u> the strategy will be implemented at Regional scale (i.e. Mediterranean Sea). Though, each country will be in charge of coordinating and implementing the strategies. The practices are expected to be implemented in local areas at small-medium scale according to the specific characteristics of the Mediterranean trawling fishing fleet.												
Define and prioritize measures.	Define incentives for fishing for marine litter, together with a package of complementary measures (e.g. develop codes of conducts for fishermen; undertaken awareness-raising campaigns; promoting educational activities; encourage the private sector to compete in innovative removal technology; sanctions or fines for illegal dumping) to enforce and achieve the objective successfully.												
Assess policy success looking for future uncertainties.	Identify key factors that affect policy performance and define different scenarios (e.g. Business as Usual; Convergence with proactive environmental management; Convergence with reactive environmental management; Heterogeneity with proactive environmental management; Heterogeneity with reactive environmental management) to study the way these factors might evolve in the future.												
Identify and develop environmental and operational targets and indicators.	<u>Environmental indicators:</u> (i) Amount of litter in the water column and deposited on the seafloor; (ii) Trends in the amount, distribution and, where possible, composition of micro-particles; and, (iii) Trends in the amount and composition of litter ingested by marine animals. <u>Operational indicators:</u> (i) Weight and composition of marine debris removed; (ii) Number of vessels and harbours participating in the strategy; and, (iii) Percentage of fishers adopting best practices by fishing fleet or area.												
Implement the planned policy and the monitoring strategy.	➢ Launch awareness-raising campaign. ➢ Train fishermen and all agents involved. ➢ Marine litter collection by fishermen. ➢ Marine litter reception at port. ➢ Marine litter management. ➢ Monitoring												
Document, record and evaluate monitoring results.	Record data (i.e. by qualified personnel) and report results to the coordination team in charge of the policy in order to be evaluated.												
Take corrective actions.	If the evaluation phase reveals a problem, adjustment should be made to improve the efficiency of the policy. For more fundamental changes, new policies may be needed and the whole cycle repeated.												

developed qualified personnel and data might be reported to the coordination team in charge of the policy in order to be evaluated. Concurrently, data on the status of marine ecosystems collected from the monitoring network should be also informed to the coordination team.

Moreover, if evaluation has shown that policy outcomes are not what it was expected initially, in this key activity what more needs to be done (i.e. adjustments) to achieve the objective is defined. If this is the case, the adjustments required should follow in a simplified way the design and implementation process described in Steps 2, 3 and 4, including specific adjustments to the monitoring programme.

For example, if the evaluation phase reveals a problem (e.g. trends in the amount of litter deposited on the seafloor do not improve), recommendations should be made by the competent authority to improve the efficiency of the policy (e.g. increase incentives to collect marine litter and return litter to port facilities; and/or, increase sanctions for dumping). As the new adjustments are performed, they should include procedures that allow the policies to be revised without the need to recourse to lengthy legal procedures [21]. In some cases, institutions should be given the rights to fine-tune the policy (e.g., raise or lower

levels) without overlong legal requirements [21]. This can be useful to reduce the risk of political blockage of a needed development of the policy [21]. However, for more fundamental changes, new policies may be needed and the complete cycle repeated. In addition, in order to learn about the decision-making process, the MSFD, for example, requires the repetition of the complete cycle periodically (i.e. 6-yearly), reconsidering the different phases of the set-up process such as the setting of the objectives and the identification and selection of management alternatives.

4. Conclusions

With the overall aim of operationalizing the design and implementation of adaptive policies under the requirements of the MSFD, as well as different regulations calling for the EBA, the AMP toolbox has been developed. In fact, the AMP toolbox should be understood as a practical framework to support policy-makers designing and implementing adaptive policies and reducing uncertainty through learning-based management, according to the EBA.

The AMP has been structured in a way that allows for a step-wise,

cyclical policy-making approach, as well as an independent use of guidelines and resources involved in specific steps of the cycle. Certainly, the step-wise or the independent implementation of the cycle step will depend on the nature of the problem studied and the relevance of the steps of the adaptive policy-making process. Indeed, the aim of the AMP toolbox is to propose a flexible framework that could be implemented in different stages of the marine policy-making. Each policy-maker will have to adapt the framework according to her/his own need and priorities.

Additionally, in this case, in order to show the utility of the toolbox, the guidelines and resources provided within the toolbox have been described using the marine litter issue in the Mediterranean and Black Sea as a directional example. The example has shown that the toolbox is a useful and operational framework to design and implement adaptive measures according to the EBA and thus improve marine governance. In fact, the technical assistance (i.e. access to information and research) and capacity support provided with the toolbox will enhance the ability of the policy-makers to design and implement effective adaptive policies and to fully comply with the EBA. Although, some resources might be missing from the toolbox (i.e. for the marine litter issue as well as for other environmental problems), the information available supposes a practical and useful starting point to support the application and compilation of the different steps and key activities. In fact, the toolbox (and the “Resources” section in particular) does not pursue to compile all the information and tools available within the Mediterranean and Black Sea for the management of the marine ecosystems, but to provide examples and key information to enhance the ability of the policy-makers to design and implement adaptive policies effectively according to their own needs and priorities.

Despite the important challenges involved in pursuing the update and continuous management of the toolbox (as new knowledge becomes available), this contribution suggests that it is the way forward and something that should be pursued for the longer term.

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