



## Tools and methods to support adaptive policy making in marine areas: Review and implementation of the Adaptive Marine Policy Toolbox



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### ABSTRACT

The development of adaptive policies for the management of dynamic and complex ecosystems, such as marine and coastal environments, asks for flexible and innovative tools which account for multifaceted issues, uncertainties and cope with a wide range of future conditions. To date, several tools and methods to support the design and implementation of adaptive policies have been developed by the research community (e.g. data processing and management, stakeholder analysis and participatory methods, numerical and simulation models, assessment approaches). The paper proposes a (four) step-wise methodology to review, analyze, classify and select existing tools dealing with social, economic and environmental issues. Firstly, existing toolboxes were retrieved. Secondly, an in-depth analysis was performed to classify their potential for the development and implementation of adaptive policies in marine areas. Thirdly, selected tools were included in the 'Database of tools and methods' of the wider Adaptive Marine Policy Tool Box, designed within the EU-FP7 PERSEUS project (Policy-oriented Environmental Research in Southern European Seas) to support policy makers with the application of an Adaptive Policy Framework. Finally, a review process was performed based on several qualitative criteria and expert judgment, which allowed to identify a set of valuable 'flag tools' useful to implement each step of the Adaptive Policy Framework.

### 1. Introduction

Marine areas represent complex and dynamic systems facing increasing threats and degradation due to pressures driven by several maritime activities (e.g. fishing, aquaculture, shipping, tourism, discharges of waste water from agriculture and urban areas) with complex interactions between natural and human-induced changes (Douvere and Ehler, 2009). These impacts, together with those of climate change, are triggering severe alterations on biological, chemical and physical processes (e.g. distribution and regime shifts), with cascading effects on socio-economic systems (Crain et al., 2008; Halpern et al., 2008; Sumaila et al., 2011). Effective marine management and planning need to implement a new paradigm for policy making, accounting for multiple and increasing threats as well as natural ecosystems' and socio

economic dynamics (EC, 2008). So far, traditional policies failed to properly consider the not negligible uncertainty and complexity of marine socio-environmental systems. New adaptive policies and management strategies built on scientific evidences, able to deal with heterogeneous, multidimensional, mutable and uncertain challenges, are therefore claimed. According to Walker et al. (2001) adaptive policies are devised not to be optimal for a best estimate future, but robust enough across a range of credible scenarios by staying flexible to adapt to future uncertainties.

Being developed on a science-based 'learning-by-doing' approach, adaptive management is a formal iterative process for resources' organization, which recognizes uncertainty and achieves management goals by raising system knowledge through a structured feedback system (Allen et al., 2011). Adaptive management is one of the key elements of

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Fig. 1. The PERSEUS Adaptive Policy Framework (APF) (Breil et al., 2012).

policy making required by the Marine Strategy Framework Directive (MSFD) (EC, 2008), which addresses numerous challenges related to the analysis of environmental state as well as the sustainable use and planning of territorial waters. An adaptive policy for the management of marine areas is able to be renewed due to a set of monitoring and revision measures and adapted to new circumstances as soon as changes in knowledge, pressures or policy outcomes become more evident.

Moreover, adaptive management plays an essential role in the practical implementation of the Ecosystem-Based Approach (EBA) to the arrangement of human activities (Pikitch et al., 2004; Arkema et al., 2006; Curtin and Prellezo, 2010). It should be applied for ensuring that collective pressure induced by human activities is maintained within certain levels, compatible with Good Environmental Status (GES) goals of EU marine regions (EC, 2008). Although multiple regulatory frameworks ask for the application of the EBA (e.g. the Convention on Biological Diversity (UN, 1992) and the MSFD (EC, 2008)), there has been a scarce progress in promoting its application within marine areas, and evidence on its success is still limited to climate change adaptation (Tompkins and Adger, 2003, 2004; Bennett et al., 2005; Pahl-Wostl, 2007; Ruckelshaus et al., 2008; McCook et al., 2010; Farmer et al., 2012; Williams and Brown, 2014).

In fact, bringing the concept of adaptive management in a robust decision-making framework and choosing appropriate tools to implement adaptive policies proved to be a difficult task (Farmer et al., 2012; Williams and Brown, 2014). This is both due to the lack of user-friendly tools specifically devoted to assist policy makers in developing and implementing adaptive marine policies (e.g. tools able to cope with uncertain and changing environmental and socio-economic conditions); and to the lack of sufficient information for identifying the most suitable tools in relation to a specific decisional issue.

A first attempt to develop a toolbox able to help policy-makers in the application of adaptive management and planning is the Adaptive Marine Policy Tool Box<sup>2</sup> (AMP TB) developed within the EU-FP7-PERSEUS project (<http://www.perseus-net.eu>). The AMP TB guides end-users through a five-step policy cycle (the Adaptive Policy Framework (APF), see Section 2.1), and allows to explore available scientific

data, information, models and tools, useful for the adaptive policy making. Its overall objective is to provide policy-makers, within the Mediterranean and Black Seas, with the necessary guidelines and resources to support process of implementing the MSFD and the achievement of healthy and sustainable marine environment (EC, 2008). Accordingly, within the AMP TB a database with different tools and information is provided.

This paper describes the systematic review and the ranking procedure applied to identify and categorize the tools included in the AMP TB. The final goal is to provide a structured inventory of tools for adaptive management and policy making in marine areas, operationalizing and facilitating tools' selection and application by policy makers and marine managers. The tools were classified according to different thematic areas (e.g. economic evaluation, risk and vulnerability assessment) and objective criteria (e.g. applicability by any end-user, availability to be acquired or purchased), to facilitate a tailored choice based on the problem at hand. The selection criteria driving the choice of the more relevant tools for the application of each step of the APF are described in Section 3; whereas, Section 4 discusses how the retrieved scientific information was organized into a comprehensive database of tools, used later to inform and feed the AMP TB.

## 2. Background

This section introduces the APF concept developed in the framework of the PERSEUS project (Section 2.1). Already existing tools supporting adaptive management are then presented (Section 2.2), highlighting their main contents and features.

### 2.1. The Adaptive Policy Framework

Experience proves that public policies designed for acting within a certain range of conditions are often faced with unforeseen challenges laying outside of that range (Swanson and Bhadwal, 2009; Hall, 2011; Crowley and Walker, 2012). The result is that many policies are unable to face unexpected events or to produce unintended outcomes. Thanks to adaptive policy making, public authorities may avoid developing new expensive and time-consuming policy cycles but just adjusting (learning-by doing) the already existing ones.

Within the PERSEUS project, an adaptive policy making framework (i.e. the APF) was developed in order to support and facilitate the design of integrated and adaptive strategies for ecosystem based management of marine areas (Garmendia et al., 2017; Breil et al., 2012). As represented in Fig. 1, the APF is based on a step-by-step cyclical approach to policy making, where the sequence of phases is structured in five interactive steps: i) setting the scene, ii) assemble the basic policy, iii) make the policy robust, iv) implement the policy, v) evaluate and adjust the policy.

More specifically, the **Step 1 -Setting the scene**-focuses on understanding the issues of concern and identifying priority areas for actions to be taken. A detailed diagnosis of the present state of the marine environment is essential for the detection of drivers, pressures and impacts and the establishment of priorities for policy action, which plays a crucial role within the MSFD (EC, 2008). From a participative point of view, this step aims at creating a common vision on the problem the policy is asked to respond to (i.e. a programme of measures). A key aspect of this step is the setting of a baseline that will act as a benchmark to assess the evolution of key factors and how these will affect the achievement of policy goals as well as to identify potential changes (i.e. factors) which are outside the scope of the policy. Where applied to the MSFD (EC, 2008), Step 1 forecasts ecological, economic and social analysis of the relationship between the marine environmental state and human activities (i.e. initial assessment). A variety of tools and methods can be used to support the implementation of this step, in order to develop adaptive policies. These tools range from stakeholders' mapping frameworks, identifying actors who may

<sup>2</sup> [http://www.perseus-net.eu/en/about\\_the\\_apf\\_toolbox/](http://www.perseus-net.eu/en/about_the_apf_toolbox/).

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