EU FP7 Project CREAM
Coordinating research in support to application of EAF (Ecosystem Approach to Fisheries) and management advice in the Mediterranean and Black Seas

Deliverable 6.1

Executive Report of the intermediate meeting including a scientific strategy to achieve EAF objectives for 2020

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Table of contents

1 Summary of the report

This report is an outcome of the workshop entitled "Scientific Strategy for a Global Approach to Promote Regional Ecosystem-based Approach to Fisheries (EAF) in the Mediterranean and Black Seas" held in Sète (France) in July 2012.

The workshop was organized by ork-Package 6 of the coordination action CREAM ("Coordinating Research in Support to Application of Ecosystem Approach to Fisheries and Management Advice in the Mediterranean and Black Seas"), funded by the EU Seventh Framework Programme. The main aim of the workshop was to discuss what is needed to advance on a robust scientific strategy to promote EAF in the Mediterranean and Black Seas. Participants discussed a series of scientific recommendations for promoting the coordination of initiatives with the aim of contributing to an operational EAF. Discussion was carried out on (i) what can be learnt from case studies that promote EAF worldwide, (ii) how a scientific strategy for EAF can be built, and (iii) which are the future scientific networking activities to promote EAF. Here we summarize the discussions and conclusions of the workshop, and we present the recommendations and future initiatives proposed to advance EAF in the Mediterranean and Black Seas region.

Participants to the workshop agreed that the achievement of a common vision regarding the Mediterranean and Black Seas region should be one of the first and most important elements towards a successful EAF. A common vision should recognise the need to promote the reconciliation of conservation and exploitation, and to aim for a good socioeconomic and ecological status. The vision should also promote the recovery of ecosystems and rebuilding of marine commercial stocks and predator species. EAF initiatives, carried out worldwide, illustrated that whilst the development of relevant science is essential to render the EAF process operational, the involvement of stakeholders is the key factor that characterises successful initiatives. This is especially important in the Mediterranean and Black Sea context, where many stakeholders show conflicting interests and associated trade-offs.

During the workshop, it became clear that numerous overlapping and poorly coordinated initiatives for EAF exist in the region. The group discussed the integration of the existing initiatives in a coordinated manner and arrived to the conclusion that a scientific network to promote coordinated and operational EAF initiatives created by the scientific community is needed. Ultimately, the discussion was focused on how to build such a network and how to proceed to consolidate the regional scientific vision, with a clear scientific strategy and roadmap, including a diversified toolbox. In the short term, the EAF network should (i) document and coordinate scientific initiatives, (ii) promote the sharing of scientific information and capabilities, (iii) promote data availability, integration, harmonization, and interoperability, (iv) promote training capabilities and capacity building of the scientific community and stakeholders, (v) establish mechanisms to disseminate knowledge, and communicate EAF benefits, and (vi)

promote concrete regional scientific initiatives. In the long run, the network should promote scientific advice on EAF to inform adaptive management and move towards a knowledge-based management approach, and promote EAF implementation at different geographical scales (from local to regional) using a transversal approach. The ultimate goal of the network should be to link management advice to good scientific information and transform policy strategies and goals into operational objectives following a pragmatic, flexible and adaptive approach.

2 Introduction

The need to consider natural changes as well as human activities when analysing and managing marine resources highlights the need to adopt an integrated view of complex ecosystems. Since the productivity of marine resources depends on the ecological state of ecosystems, not only the dynamics of target species, but also the dynamics of non-target organisms, trophic relationships and energy flows, environmental factors and human impacts have to be considered to manage our seas and oceans property (Botsford et al. 1997; Cury et al. 2003; Duda and Sherman 2002; Cury et al. 2008). This can only be achieved through an Ecosystem-based Approach to marine resources Management (EAM), or when dealing specifically with fishing activities, the Ecosystem-based Approach to Fisheries (EAF) (Costanza et al. 1998; Pauly et al. 2002; Pikitch et al. 2004; Link 2011; Christensen and Maclean 2011).

Several national and international governmental bodies are actively promoting the sustainable management of marine resources, and the adoption of the EAF in order to address increasing amounts of anthropogenic pressures on marine environments and conflicts between multiple users competing for space and resources (FAO 2003; Garcia et al. 2003; Garcia and Cochrane 2005; Shannon et al. 2010; Smith et al. 2007; Link et al. 2011). International conventions, treaties and other legal instruments, such as the United Nations Convention on the Law of the Sea (UNCLOS), the Convention on Biological Diversity (CBD), the Agenda 21 of the United Nations, and the FAO Code of Conduct for Responsible Fisheries, promote EAF worldwide. At the European level, the promotion of a sustainable marine environment is now in the agenda of several on-going policies, such as the new Common Fisheries Policy (CFP) and the Marine Strategy Framework Directive (MSFD), which aims at achieving a Good Environmental Status (GES) in EU marine waters by 2020, at the latest (EC 2008).

Making progress towards the EAF is also a timely issue in the Mediterranean and Black Seas region (GFCM-SAC 2005; Cochrane and de Young 2002; Cochrane and de Young 2008; UNEP 2009). The Mediterranean basin is a complex region with high biological diversity and a long history of human activity (Blondel and Aronson 2005; Lotze et al. 2011). The landmasses surrounding this sea are heavily populated. The basin currently includes 21 modern countries with very different (and sometimes conflicting) socioeconomic and cultural traits, and some of the most renowned marine tourist

destinations in the world. As a result of this complex socio-economic and ecological context, the management of Mediterranean and Black Sea resources is seldom coordinated and proactive, and actions are usually taken only after problems have appeared.

To move towards a sustainable use of marine resources, substantial effort and funding is going towards initiatives guided by EAF principles, which are aiming at contributing to the implementation of an EAF in the region. A relevant initiative to promote EAF is the coordination action CREAM ("Coordinating Research in Support to Application of Ecosystem Approach to Fisheries and Management Advice in the Mediterranean and Black Seas"), funded by the EU Seventh Framework Programme (http://www.cream-fp7.eu/). CREAM aims at:

(i) Establishing guidelines for the application of the EAF in the Mediterranean and Black Seas;

(ii) Creating an effective collaboration network among key players in fisheries research and management;

(iii) Developing training and capacity building activities regarding data collection, and methodologies used in fisheries assessment and management.

Participants in CREAM include 22 national research institutes from 17 countries of the Mediterranean and Black Sea with a background in fisheries research, which provide advice to national, regional and international fisheries management organisms. CREAM includes eight European Union member states (Bulgaria, Cyprus, France, Greece, Italy, Malta, Romania, and Spain) and nine non-European countries (Croatia, Egypt, Georgia, Lebanon, Morocco, Russia, Tunisia, Turkey, and Ukraine) (**Figure 1**). The project also includes one intergovernmental organisation, the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), and seeks the active collaboration of five regional and international fisheries management organisms as external participants in order to identify gaps (in terms of data, knowledge, training, coordination). External participants to the project are the Food and Agriculture Organization of the United Nations (FAO), the General Fisheries Commission for the Mediterranean (GFCM), the Commission on the Protection of the Black Sea Against Pollution (BSC), the International Commission for the Conservation of Atlantic Tunas (ICCAT), and the Regional Activity Centre for Specially Protected Areas of the Mediterranean Action Plan of the United Nations Environmental Programme (UNEP RAC/SPA).

CREAM is organized in six work-packages, with Work-Package 6 aiming at:

(i) Strengthening the scientific basis for building a generic framework to implement EAF in the Mediterranean and Black Seas;

(ii) Establishing a network that will coordinate scientific research to make EAF operational.

3 The workshop "Scientific Strategy for a Global Approach to Promote Regional EAF"

CREAM Work-Package 6 organised its first workshop on the 3rd and 4th of July 2012 in Sète, France. The workshop topic was the "Scientific Strategy for a Global Approach to Promote Regional EAF", and was attended by 30 participants.

Participants to the workshop included CREAM partners and a series of recognised experts external to the project, who were invited to enrich the discussion and present interesting initiatives at a regional or international level (the full list of participants is provided in Annex 1, the notes of the meeting are in Annex II, and individual contributions by participants are included in Annex III).

The attendees to the workshop learned from, reflected on and discussed about:

(i) What can be learnt from case studies dedicated to promote EAF around the world?

(ii) How a scientific strategy for an operational EAF in the Mediterranean and Black Seas can be built?

(iii) Which are the future scientific networking activities to promote?

To facilitate discussion and participation, three questions were posed in advance to the experts attending the workshop:

(i) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Mediterranean and Black Sea?

(ii) Which are the scientific gaps that need to be addressed to advance EAF?

(iii) How do you envisage a scientific network for an operational EAF and who would be the key players?

The workshop "Scientific Strategy for a Global Approach to Promote Regional EAF "was organised in a series of sessions that included presentations dealing with key topics, followed by discussions. Following a review of EAF principles and objectives (FAO 2003, 2008; Pikitch et al. 2004; Sissenwine and Murawski 2004), the participants reflected on the need of a worldwide scientific EAF strategy , and its importance in the Mediterranean and Black Sea context, in particular. Additional presentations dealt with what lessons to be learnt from worldwide case studies, and which international and regional initiatives and methods may be useful to contribute to EAF in the region. Special emphasis was placed on important topics in the Mediterranean and Black Seas context, such as the quantification of the impacts of fishing (Tudela 2004), the spread and associated impact of non-indigenous species (Bariche et al. 2004; Azzurro et al. 2011), the multiple stressors and interactions of human activities (Coll et al. 2012; Claudet and Fraschetti 2010; Oczkowskia et al. 2009), the evaluation of ecosystem services (Katsanevakis et al. 2011; Salomidi et al. 2012), and the need to move towards

a spatially-based analysis of human activities (Giakoumi et al. 2012; Stelzenmuller et al. 2012).

During the workshop, novel initiatives at the European or international level were presented. These initiatives could contribute to the EAF application in the region by complementing the available toolbox. Initiatives presented included new research to promote ecological scientific knowledge for EAF (Cury et al. 2011; Lotze and Worm 2009; Pikitch et al. 2012), the incorporation of single species assessment in an EAF context (Colloca et al. 2012), and initiatives on ecological indicators and ecosystem assessments (such as the European MSFD and GES initiative, the STECF (Scientific, Technical and Economic Committee for Fisheries) expert working group on EAF, and the IndiSeas project, EC 2008; Gascuel et al. 2012; Shin et al. 2012; Cardoso et al. 2010). Global modelling initiatives and scenario building (such as the NEREUS project and the new IPBES United Nations initiative, NEREUS 2012; IPBES 2012) were also introduced.

Below we summarize the discussion, topics and conclusions of the workshop, and we present its recommendations, as well as proposed future initiatives to advance towards an operational EAF in the Mediterranean and Black Seas region.

3.1 Relevant science is necessary, but not enough

The group discussed worldwide initiatives towards EAF (including examples from Canada, South Africa, Australia, New Zealand and United States of America) (Shannon et al. 2010; Smith et al. 2007; Fletcher et al. 2010; Link et al. 2011; Curran et al. 2011; Lester et al. 2010). After a comprehensive presentation reviewing what can be learnt from leading case studies, the suitability of these initiatives to be applied in the study area was discussed. Case studies provided clear inspiration to advance EAF, but it was also clear that Mediterranean and Black Sea socioeconomic realities differed considerably. South Africa was identified as the region with the most similarities to the Mediterranean and Black Sea circumstances. Other international or European initiatives that were presented, such as initiatives on ecological indicators like those mentioned above, and ecological modelling approaches (for example, applications of Ecopath with Ecosim, Atlantis, and Osmose models, Christensen and Walters 2011; Fulton 2010; Travers et al. 2007), were presented and positively valued by the group. Several applications of ecological models and indicators (Coll and Libralato 2012) have been developed or are being developed in the region and these will be important contributions to EAF. Links to these initiatives should be made explicit while developing a scientific strategy for EAF in the region (**Figure 2**).

EAF case studies and initiatives illustrated that the development of relevant science based on a clear roadmap, utilizing a diverse toolbox, and with the capacity to adapt the tools and approaches as EAF is implemented, is essential if the EAF process is to succeed. However, the case studies also illustrated that relevant scientific basis is not

enough. In fact, the key factor that characterises successful initiatives worldwide is the involvement of stakeholders in the EAF process (Shannon et al. 2010; Smith et al. 2007; Link 2011). Stakeholders need to be engaged throughout the process, from the development of methods, to the application of the science, i.e. the link of science to management, to the implementation of adaptive management measures, and the subsequent monitoring and assessment of the measures. This could be better achieved through coordination with multi-stakeholder co-management committees overseeing geographically delineated fishing grounds or particular fisheries therein. The group argued this territorial-based co-management is even more important in the Mediterranean and Black Seas context (**Figure 2**), where many stakeholders exist and interact (commercial and recreational fishers, industry, non-governmental and governmental organizations, general public, etc.), exhibiting sometimes conflicting interests and trade-offs.

In fact, early in the discussion, the group recognised that establishing the link between science and the implementation of adaptive management schemes is one of the most difficult issues to ensure the success of EAF. Although this is a key topic worldwide (Link 2011), few experiences show clear success in how to link scientific initiatives at local and regional scales to the societal needs of implementing management actions based on scientific advice in an adaptive manner. The documentation of examples and initiatives that advance towards the implementation of adaptive management and how to translate EAF general principles into concrete management activities is thus of outstanding importance. Unfortunately, successful initiatives in the Mediterranean and Black Seas are few, but the ones that exist set the examples on how to proceed (for example, pioneer case studies through the Mediterranean artisanal fishing platform, www.medartnet.org, and through the Network of Managers of Marine Protected Areas of the Mediterranean Sea, www.medpan.org). The group highlighted that one of the first tasks to pursue in the Mediterranean and Black Seas region should be to identify, document, and promote these successful case studies.

3.2 A coordinated scientific EAF initiative is needed

During the workshop, several initiatives, datasets, methods, as well as past and present projects that aim at directly or indirectly contributing to EAF in the Mediterranean and Black Seas region were reviewed and discussed. Scientific initiatives included projects from national research institutions, collaborative bi-lateral projects and European programmes, initiatives of other regional bodies (such as FAO, GFCM, BSC, ICCAT, UNEP RAC/SPA, or the Mediterranean Scientific Commission CIESM), international projects on indicators and modelling, local and regional pilot studies, and non-governmental organizations activities (e.g., WWF, Oceana). A *status quo* revision is one of the aims of CREAM Work-Packages 2 and 3, which will serve to illustrate that several interesting efforts and initiatives are currently in place, although they are highly heterogeneous (CREAM-WP2 2012).

In fact, at an early stage of the workshop it became clear that numerous local and regional initiatives exist, which have highly overlapping themes and are poorly coordinated. As a consequence, final results may be undermined by redundancy and by creating confusion amongst end users and policy makers. Thus, the group discussed the need to promote the integration of these existing initiatives in a coordinated manner. It was recognized that substantial funding through European projects and national calls is being invested in promoting EAF, but that achievements are still modest due to the limited coordination and the lack of a regional vision. Therefore, there is a real need to integrate what has been done and it is being done, what has been achieved, with what is needed in the future in order to advance the application of EAF.

To progress towards this coordinated regional initiative, the group identified the need to achieve a clear and strong common regional scientific vision on what marine ecosystems in the region should be regarding specific criteria. The Mediterranean and Black Seas are dominated by a human landscape with conflicting interests; therefore the achievement of a common vision is one of the first and most important elements of a successful EAF. The group argued that the vision should recognise the need to promote the reconciliation of conservation and exploitation and to aim for a good socioeconomic and ecological status. Maintaining marine ecosystems in a healthy, productive and resilient condition will ultimately serve to sustain human uses and provide goods and services (Katsanevakis et al. 2011). Since the status of marine resources and ecosystems in the region is delicate (Coll et al. 2010; Coll et al. 2012; Lotze et al. 2011; Abdul Malak et al. 2011), the vision should also promote the recovery of ecosystems, in general, and the rebuilding of marine commercial stocks and predator species, in particular.

A significant part of the Mediterranean and Black Seas region is located within European Union waters (**Figure 1**). Therefore, the group discussed the need to synchronize the vision and the strategy towards EAF with what is being developed at the European level. Current and future policy developments of the new CFP and MSFD (EC 2008) will strongly influence the whole region. In addition, the application of the Barcelona Convention, the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (initiated in 1976), will not only affect European countries. The new European policy will also let to the implementation of new targets in fish stock and to the monitoring of indicators related to the GES targets. Therefore, linking activities at the European level to the regional reality of the Mediterranean and Black Sea is vital, although likely to be challenging.

For an EAF to be successful at the Mediterranean and Black Sea level, the group also emphasized the importance of integrating different visions at different geographic scales, from local to regional levels. This notion promoted an interesting discussion about the geographic scale (or territorial management unit) appropriate for science to be applied in order to better influence management of marine resources. The group suggested that science in the region should be developed with a transversal approach, where both bottom-up and top-down processes between science and management are

needed to promote a scientific strategy integrating different geographical scales. Therefore, scientific initiatives should be able to respond to both local and regional issues using appropriate management units. The transversal view should aim at integrating these two approaches through consultation and cooperation. Science for EAF should be proactive and should establish numerous partnerships with both local and regional institutions, as well as strong links with international initiatives (**Figure 2**).

3.3 Scientific achievements and obstacles in the road to EAF

To date, topics analysed in the Mediterranean and Black Seas region using an EAF approach included: (i) the impact of fishing on commercial species (Colloca et al. 2012), (ii) the impact of intense exploitation of small pelagic fish (Palomera et al. 2007), (iii) reduction of predators and ecosystem changes (Lotze et al. 2011), (iv) selectivity of fishing (Sardà et al. 2006), and by-catch and discarding issues in relation to EAF (Bellido et al. 2011), (v) endangered species (Tsounis et al. 2007), (vi) the modification of benthic habitats and habitat losses and degradation (Claudet and Fraschetti 2010), (vii) the impact of climate change and climate variability (Lloret et al. 2004; Sabatés et al. 2006), (viii) the impact of invasive species (Galil 2009, 2007), (ix) multiple impacts of human activities (including impacts of land-based activities) (Coll et al. 2012), (x) the biodiversity conservation and fisheries benefits of marine protected areas (Garcıa-Charton et al. 2008), and (ix) the socio-economic impacts of fisheries mismanagement and food security (Merino et al. 2007). These topics were in fact similar to topics identified in leading worldwide case studies.

The scientific toolbox used to tackle these issues included: (i) monitoring (mainly in EU countries), and well as stock assessment analyses and models, (ii) ecological and bio-economic models, (iii) data-based and model-based indicators, (iv) fleet-based approaches to assess both the ecological impacts and the socio-economic performances of fleets; (v) spatial datasets and analysis of diversity, threats, and management proposals, and (vi) knowledge from expert judgement and local ecological knowledge. These initiatives have contributed to the advancement of EAF in the region by providing: (i) ecosystem analyses at local and sub-regional scales, (ii) integrated knowledge on the status of several commercial species, (iii) knowledge on ecosystem effects of fishing and ecosystem functioning at local/regional scales, (iv) a set of available ecological models and indicators to use, (v) knowledge on temporal and spatial patterns, and (vi) large potential of expertise knowledge to inform EAF.

However, on-going results of CREAM work packages have illustrated that the capacity to address EAF issues in the region is generally low or medium depending on the areas and topics (CREAM-WP2 2012). During the workshop, the group identified and discussed general topics that need to be tackled to advance EAF in the region in the future. Important scientific challenges identified by the group include:

- Lack of long-term data and spatial datasets, since data on several topics and areas are missing and there are data accessibility issues;

- Lack of data quality measures and uncertainty analyses;
- Limited knowledge on human impacts related to fisheries aside from direct fishing impacts (invasive species, aquaculture, habitat destruction, litter pollution from fishing vessels), as well as other human impacts (including land-based activities), the impact of climate change, and how they interact and accumulate;
- Lack of methods to integrate knowledge and incorporate ecosystem research results into management processes, such as risk assessments methods, marine strategy evaluation procedures, or harvest strategy rules integrated in adaptive management procedures.

The group listed basic scientific knowledge that is lacking in the process to advance EAF in the region. The outcome was a long list of issues and topics, evidencing the fact that basic gaps of knowledge from the region can be found in all topics, from physical-oceanography and ecological topics, to social and economic issues. These topics include:

(i) The description of basic ecological processes and patterns: such as abundance and distribution of marine resources, natural refuges and habitats, migration of species, information on the stock structure and stock connectivity in relation with fisheries management and the location of MPAs, location of nursery and spawning areas, basic ecology of predators and their ecological needs (e.g., minimum prey needed), basic data on taxa indirectly affected by fishing (sharks, seabirds, marine mammals), basic data on the ecology of small pelagic fished and invertebrates (prey of predators), invasive species, endangered species and data deficient species, and data on ecosystem functioning and biodiversity patterns at the community level (mainly species, phylogenetic and functional diversity);

(ii) The effect of anthropogenic pressures and the interaction of stressors and drivers: such as the effects of multiple stressors including their synergies, the effects of environmental variability, the impact of aquaculture on capture fisheries, and land-based human pressures on marine fisheries, the ecological impact of management plans and MPAs, and the potential for recovery of resources and ecosystems;

(iii) Socio-economic subjects: such as the quantification of ecosystem services, total catch and by-catch, real fishing effort, economic evaluations (including true cost of fisheries mismanagement, non-market costs, the sensitivity of ecosystems to public policies, and market/non-market incentives), fishing fleet behaviour, and how to combine socioeconomic and ecological evaluations in a fleet-based approach.

Gaps are also found in methodologies and tools needed to complement the toolbox for EAF. In this regard, the group discussed several methods that are already applied

worldwide that could be adapted to be used in the Mediterranean and Black Seas region. The need for an improvement of scientific methods includes: (i) further standardization of stock assessment methods and harmonization of methods and data, (ii) the extension of indicators and definition of reference points, directions and targets (both limits and thresholds), including the development of indicators of stock status in data poor situations, (iii) the further development of modelling capabilities and scenarios including key human drivers to join global efforts in predicting the future of the oceans, and (iv) the creation or adaptation of tools to incorporate ecosystem research results into management processes. This requires the promotion of a regional toolbox with new and adapted methodologies to span the whole range of approaches needed (**Figure 3**), including monitoring, evaluation, and adaptive management.

Whilst it is evident that the scientific community has the obligation to fill the identified scientific gaps and to develop the required toolbox, a pragmatic approach is clearly required. The group acknowledged that while it is essential to reduce gaps of data and methods, it should be recognised that there will always be gaps in the knowledge and information required to contribute to EAF. Nevertheless, policy makers need to make the best decision they can using the available information. This calls for a pragmatic combination of the precautionary approach, especially when data on basic elements and processes is very limited, with the use of those tools and data which are readily available to provide the best possible scientific advice. Therefore, in addition to promoting the completion of important scientific gaps, the group recognised that it is essential to:

(i) Promote low cost practices for collecting data and developing tools;

(ii) Promote collaborative efforts and improve coordination;

(iii) Complement but avoid repeating existing scientific initiatives;

(iv) Deal with limited financial means and allocation of funds with an effective use of resources.

3.4 Data-poor and data-poor access regions: our Achilles' heel

Data availability is a key question for EAF. The CREAM work packages dealing with initiatives and data that contribute to the EAF are in the process of identifying several regions where data are less abundant (CREAM-WP2 2012). Although countries that are included in the EU Data Collection Framework are more prone to be in the possession of fisheries data, it is clear that basic data regarding abundance, biodiversity, and other relevant parameters is still highly heterogeneous in the region. CREAM is mapping the available resources in order to identify areas and topics that need special attention. This will be a substantial contribution to the delineation of a scientific roadmap, and ultimately to generate some of this lacking data.

However, a large amounts of knowledge are already available, including data collected developed through the Data Collection Framework Initiative of the EU (such as fisheries independent data from the MEDITS and MEDIAS demersal and pelagic surveys, respectively), national projects, regional bodies, other scientific initiatives (such as initiatives from CIESM, IUCN, FAO regional projects and ICCAT), and large-scale initiatives to collate and integrate datasets (such as GEOBON, http://www.earthobservations.org/geobon.shtml, the European contribution to databases for Biodiversity, ECOSCOPE, http://www.ecoscopebc.ird.fr, knowledge based on exploited marine ecosystems, and Marine Knowledge 2020 EU initiative, http://ec.europa.eu/maritimeaffairs/policy/marine_knowledge_2020/index_en.htm). Despite these initiatives, most of these data are not available to the scientific community at large. Therefore, an additional problem to the data-poor situation in the Mediterranean and Black Seas is the limited accessibility to datasets by end users. In fact, it has been recognised that the region is suffering from an endemic problem of data ownership and accessibility. This issue highlights a serious problem of efficiency when developing science to contribute to EAF, impairs the ability to calibrate oceanographic and ecological models, prevents the calculation and standardization of indicators, and overall provides a negative image of the scientific community.

The issues of data availability and access are two major problems that need to be solved in harmony. If public data ownership and data accessibility is not ensured in the future, forthcoming data acquisition initiatives will have limited applicability and contribution to the EAF process in the region. This issue needs to be solved quickly, especially in the current context of limited resources. This requires a major effort from scientists and policy makers to ensure that existing data are accessible with good metadata after being harmonised, standardized, and checked for quality. In the “global information era”, ensuring data availability, interoperability, and quality should be a compulsory requirement accompanying any publicly-funded initiative.

3.5 Novel topics and initiatives with added value

Important topics that add value to the need for a coordinated scientific EAF initiative in the Mediterranean and Black Seas region at a regional scale were highlighted. These topics include: (i) the issue of quantifying the real impact of fisheries by integrating knowledge on different fishing fleet segments and from different areas, (ii) the need to deal with the accelerating non-indigenous species spreads and impacts, (iii) the complexity of considering multiple human impacts, their cumulative effects and interactions, and how they impact productivity patterns, (iv) the need to consider spatial planning and integrated coastal zone management in future analyses moving towards an ecosystem-based spatial approach, and (v) the need to advance our capability to fully quantify ecosystem services and to accurately inform policy makers and society. These topics are briefly highlighted below.

3.5.1 Quantification of the real impact of fishing

Access to data and information on the different fishing fleets operating in the region is difficult. In most cases, data available only covers official landing statistics that do not consider discards, catch that is sold in the black market or is used for consumption of fishers and relatives, and illegal catches, all components of IUU (Illegal, Unregulated and Unreported catches). IUU catches are caused by a lack of control by countries and regional organizations on fishing activities, due to inappropriate or insufficient operational plans and disciplinary measures for those not following the rules, and due to lack of political will (Zeller and Pauly 2007). IUU practices impair the correct assessment of exploited marine species, and complicate or even defeat the development of suitable management actions. They can also have important socio-economic impacts due to conflicts with legal activities, and especially with artisanal and subsistence fishing. This is a fundamental issue in the Mediterranean and Black Seas region where IUU activities are large (Tsikliras et al. 2007; Le Manach et al. 2011).

Despite IUU, official landing statistics aggregated at country level have limited information value since they give no indication of regional landing statistics, and hence can usually not be matched to stock units for stock assessment purposes. The only regional dataset freely available is the GFCM capture production dataset for the region, released in 2010 (http://www.fao.org/fishery/statistics/software/fishstat/en). Biological stock related variables are required in order to carry out stock assessments and to calculate the vast majority of indicators based on fisheries dependent data. Such data is only collected in sufficient detail for a limited number of species at present. In addition, different countries and regional bodies use different data collection protocols and levels of data aggregations, creating additional challenges for scientists attempting to combine data and perform the analyses at the relevant regional scale for shared stocks. Moreover, data on fishing effort is either not available or very difficult to access. In Europe high resolution fishing effort data is in fact being collected by national authorities since the introduction the Vessel Monitoring System (VMS), but such data remains unavailable to scientists (Hinz et al. 2012). Moreover, recreational and artisanal fisheries, which are of high importance in the region, are frequently not included in official statistics by country (Tudela 2004).

In addition to these limitations associated with the calculation of single species target reference points, the multi-gear and multi-species nature of Mediterranean and Black Sea fisheries remains a further stumbling block to quantifying the real impact of fishing. In the region, fishers routinely set out with a number of gears, catching a multitude of species in a single fishing trip (Caddy 2009). The quantification of the real impact of fishing should take into account the multi-gear nature of fisheries, and the resulting high interaction between gears and fleet segments since most of the main target species are exploited by more than one fishing technique or strategy, each often concentrating on individuals of different sizes during different seasons. This poses a considerable challenge with regards to the collection of accurate fisheries data.

Multispecies stock assessments require a vast amount of detailed data, including information on predation mortality rates, and diet data to take into account trophic relationships when calculating species interactions (Magnusson 1995). For the region, such data is not always available and methods to combine the results of single species stock assessment remain in their early stages (Maravelias et al. 2011).

Until the quality of data on fishing activities improves, the capacity to properly evaluate fishing impact on commercial stocks through multi-species reference and target indicators such as the maximum sustainable yield and the side effect of gear selectivity, as well as the impact on non-commercial species, habitats and ecosystems, will be very limited. A coordinated scientific EAF initiative at a regional scale could play an important role at promoting practical measures such as setting up a regional database for fisheries data, as well as integrative studies that deal with the real quantification of seasonal catch and fishing mortality rates, and the impact of multi-species fishing by gear segment.

3.5.2 Non-indigenous species spreads and impacts

The Mediterranean and Black Seas region are not only hot spots of marine biodiversity, but also hot spots of xeno-diversity. So far, 660 multicellular non-indigenous species have been recorded (Galil 2009), and this number grows to almost 1000 species when unicellular taxa and Atlantic migrants are considered (Zenetos 2010). Non-indigenous species (NIS) can have different origins and impacts and they may arrive using different pathways (such as canals, mariculture and aquaculture, shipping, etc.). Some NIS can establish large population, replace indigenous species, and attain commercial importance. Due to the increasing speed and dimension of this phenomenon (Galil 2009; Zenetos et al. 2010), which is probably being exacerbated by climate change (Lejeusne et al. 2010 ; Bianchi 2007; Azzurro 2008), there is an urgent need to collect basic information on the biology and ecology of NIS.

However, detailed information on what the effects of NIS on fisheries and other human activities are is missing. We do not know what are the effects of fisheries on the establishment of NIS populations, and we do not have a complete view of the changes provoked by NIS on natural habitats and ecosystems. For this reasons, it is difficult to estimate the true cost of NIS. As a matter of facts, past opportunities of monitoring and tracking the consequences of these new arrivals in a coordinated way were lost, but the use of Local Ecological Knowledge (LEK) has recently illustrated new possibilities to retrieve historical data and the advantage of cooperation between scientists and local populations (Azzurro et al. 2011). Therefore, a coordinated scientific EAF initiative in the region in collaboration with current efforts (such as CIESM Tropical Signals Program, http://www.ciesm.org/marine/programs/tropicalization.htm) could help promote the monitoring and coordinated collection of data. How marine biodiversity is changing, and what are the present and future impacts of NIS, are questions that cannot be tackled at local scales without losing the real perspective of the phenomenon. This is of special importance if we want to be able to correctly assess the good environmental

status of the region, and improve our knowledge on process-based ecological knowledge. A coordinated EAF initiative could also help increase the awareness of this important topic and the potential associated socioeconomic regional consequences.

3.5.3 Multiple human impacts and interactive effects

The scientific community made substantial progress in the identification and quantification of multiple human threats that impact marine diversity, habitats, and ecosystems in the region (Claudet and Fraschetti 2010; Coll et al. 2010; Lotze et al. 2011; Coll et al. 2012; Giakoumi et al. 2011; Sala et al. 2012, http://globalmarine.nceas.ucsb.edu/mediterranean/). There is currently increasing knowledge on the identification, quantification, and distribution of these multiple stressors. Various EU projects in progress (such as Pegaso, http://www.pegasoproject.eu/, or CoCoNET, http://www.coconet-fp7.eu/) will likely contribute substantially to this knowledge.

However, the way these multiple stressors may interact and combine to impact productivity patterns of marine ecosystems is hardly known (Sala et al. 2000). Multiple impacts may interact and their effects may accumulate, acting synergistically or antagonistically at different ecological levels, from species to community, and ecosystem levels. A comprehensive understanding of these impacts and their interactions is lacking, although it seems that synergistic effects are frequent (Folt et al. 1999; Crain et al. 2008), but see Darling and Côté 2008 (Darling and Côté 2008). Multiple impacts are distributed in a heterogeneous way in the region (Halpern et al. 2008; Coll et al. 2012), and the interaction of these impacts will thus not occur the same way everywhere, and it may affect productivity differently. Moreover, future changes of current human activities (such as climate change, or the invasion of new species), and the appearance and spread of new activities, will likely challenge our current understanding. Additionally, even if some new approaches are currently developed in the frame of the MSFD, the way we can use this knowledge to derive indicators and reference points to inform management remains to be fully explored. A coordinated scientific EAF initiative in the region, in collaboration with existing efforts, could contribute to the documentation of multiple threats data and to the analysis of current and future multiple impacts. Such data is at present frequently scattered and has different spatial and temporal resolutions. This could be achieved by establishing partnerships between data providers and data analysts. To tackle some of these scientific challenges there is a growing need to use and develop novel methodologies of data integration, assimilation and modelling at different scales, taking into account uncertainties in data and processes (Parravicini et al. 2012; Christensen et al. 2012).

3.5.4 Quantification of ecosystem services

To apply the EAF efficiently, there is the need to evaluate and understand socioeconomic costs and benefits of management interventions, in addition to ecological impacts (Katsanevakis et al. 2011). Assigning values to the marine

environment allows assessing the management alternatives. Values can be assigned to the economic value of extracted resources, the provision of environmental services, and to marine biodiversity. However, not only market but also non-market values of the environment have to be taken into account, which is not a simple task because not all ecosystem services are traded on markets and have direct monetary values. The alternatives to monetary valuations are non-monetary assessments that attempt to understand the cause, distribution, and strength of socioeconomic values (for example, by developing assessments using other units such as weight to potential areas of conflict and consensus). Nowadays, there are different techniques that can be applied (Katsanevakis et al. 2011), although there are little examples applied to the Mediterranean and Black Seas region. Another difficulty is how to link resources and habitats to different goods and services since data are not always available and comprehensive (but see an attempt to link habitats to services in European seas, Salomidi et al. 2012).

To make progress for an EAF, the full quantification of the impacts of human activities on ecosystem goods and services including the socioeconomic component is a must. This is of particular importance in complex ecosystems such as the Mediterranean and Black Seas, where food security is a crucial aspect of EAF, and there is thus a real need to quantify the risks of mismanagement, and the benefits of good management. A scientific coordinated EAF network in the region could contribute to the development of regional socioeconomic evaluations, and ensure that forecasting ecological models and indicators are linked with policy scenarios including projections of employment, and population trends.

3.5.5 Spatial analyses and management

It is well acknowledged that the EAF approach needs to take into account the spatial dimension, while bridging regional to local scales (**Figure 2**). Spatial management initiatives, including but not limited to MPAs, are useful tools to contribute to the spatial management process (Katsanevakis et al. 2011; Stelzenmuller et al. 2012). In the Mediterranean and Black Seas region, recent years have witnessed an increase in spatial analyses of ecological and socioeconomic data with the aim of contributing to the integrative knowledge that we have on ecosystems and how to best to advance towards sustainable management and habitat protection (Maiorano et al. 2009; Giakoumi et al. 2011).

However, spatial analyses in the region have mainly been carried out in the context of MPAs and no-take zones. Therefore, there is a need to adopt a more integrative view of the spatial dimension by including other areas, taking into account scientific gaps when performing spatial analyses, including information at different scales. New analyses should include the spatial extent of different, and sometimes conflicting, human activities (for example, fishing effort by fishing gear, including in particular the distribution of bottom trawling and other destructive fishing gear, shipping lanes, the location of permanent structures on the seafloor such as pipelines, cables, wind farms,

tourist areas, protected areas, etc.), as well as current and future spatial management initiatives to propose an adaptive spatial approach to the management of human activities. Multi-stakeholder co-management on territorial management units would allow for an accurate integration of the spatial dimension in the management of fishing activities therein. This would result in a rational time and area management of fishing effort and technical measures ranging from, for example, no-fishing zones to seasonal and/or geographical gear closures.

A regional scientific EAF initiative could contribute towards the coordination and analyses of data in a spatial framework, and could integrate important lessons from successful local case studies to inform EAF regionally. This should be done in collaboration with initiatives that aim at establishing systems of territorial-based co-management, and promote experiments of EAF application, and co-management at the local scale.

To improve our capability to spatially analyse complex topics, there is a need to use and develop novel spatial methodologies, such as marine spatial planning and ocean zoning, and new tools such as remote sensing, spatial quantitative analysis, telemetry, and spatial modelling (Giakoumi et al. 2012; Katsanevakis et al. 2011; Stelzenmuller et al. 2012). Spatial management has obvious links to the other topics and initiatives with the added value mentioned above.

4 EMBASEAS: a new scientific network to promote EAF in the Mediterranean and Black Seas

As a result of the discussion during the workshop, it was clear to the group that a visionary and coordinated scientific network to promote operational EAF initiatives, created by the scientific community following a bottom-up approach in the Mediterranean and Black Seas, is needed. The proposed network, named **EMBASEAS** (the network aiming at being an ambassador to promote **E**af in the **M**editerranean and **B**l**A**ck **SEAS**), should add value to the current situation. Discussion on how to envisage such a scientific network, and who would be key players in the network, followed.

The network should be independent and individually based, but with clear links to regional bodies such as GFCM, FAO, the EU Joint Research Centre, as well as with non-governmental organizations promoting EAF. Key players of the network should be those interested scientists of different disciplines, participating as independent individuals, rather than as national or institutional representatives. The network should have strong links with local and regional organizations involved in EAF initiatives, and seek the involvement of other stakeholders such as professional and recreational fishers, other users of the marine environment, naturalists, local experts, and policy makers.

The ultimate discussion was centred on how to build such a network with the consolidation of a regional scientific vision, with a clear scientific strategy, and plan

(including a diversified toolbox), to promote the rendering the scientific aspect of EAF in the region operational (Figures 2 and 3). Such a network should have the capability to define a clear, strong, and shared vision for EAF in the region. This could be achieved by gaining a broader view on the EAF implementation strategy, in particular by keeping track of what needs to be pursued to ultimately ensure a good status of the Mediterranean and Black Sea ecosystems. The network should identify key objectives and topics, and establish a road map of coordinated actions to accomplish them. The scientific network should also aim to promote the coordination of scientific activities, to date local or fragmented, in an efficient way, using local initiatives but contributing to the regional vision. This would bridge different geographical scales and promote the use of innovative tools such as models, indicators, scenarios, and other integrative tools. The methodology and manner of linking the initiatives from the local to the regional level can be a considerable challenge for the network.

In the short term, the network could start as a coordinated action of scientists to promote the scientific approach of EAF by coordinating activities, and improving the capacity of developing science for EAF in the region. The network should promote concrete scientific actions considering available data, tools, and initiatives at different geographic scales to improve process-based ecological knowledge in the area. The group identified several novel topics and initiatives with added value to the network (e.g., the ecology and impact NIS, cumulative impacts, the impacts of specific fishing gear). One of the first tasks of a coordinated scientific initiative would be to identify, document, and promote successful case studies in the region. This could help establish bridges between scientists, policy makers, and other users of the sea, in a transversal way dealing with the best territorial management unit (**Figure 2**). Other potential immediate activities include the documentation of initiatives, the sharing of already available information and scientific capabilities, the improvement of the training capabilities, and the capacity building of the scientific community and stakeholders, and the establishment of mechanisms to disseminate knowledge to end users.

In the medium-long term, the network should aim at promoting the implementation of an EAF (from the local to the regional level), and providing scientific advice on EAF to inform adaptive management in the region, where at present only stock assessment advice is taken into account (if at all). Thus, the ultimate goal of the network should be to link management advice to good scientific information, thus creating a knowledge-based management approach. By establishing successful liaisons with local and regional organizations and initiatives, needing scientific advice to promote EAF, the scientific network could contribute to the management of territorial units and provide a stable platform to share successful stories, resources, ideas, and expertise. The network could facilitate the discussion of common problems and possible solutions with local applicability in a coordinated manner and under a common regional vision and strategy. Scientists involved in early practices of EAF could find in the network a suitable platform for networking among themselves to learn tactics on how to implement EAF at the local level, while also building a strategy at regional level. Such a network would

face the challenge of delivering and coordinating at the regional strategic level what can be effectively done at the local tactical level, while influencing the decision making process at different geographic scales (**Figure 2**). The ultimate goal should be to link management advice to good scientific information and transform policy strategies and goals into operational objectives. Another important role of the network would be to anticipate the needs of stakeholders – both local communities and managers - and the problems that may occur in the future.

The network should also be used as an opportunity to anticipate the future and invest in tools such as generic and validated models and indicators. In this manner scientists would be able to contribute to initiatives and calls for predicting the dynamics of the ocean, and building scenarios of socio-ecological systems (in cooperation with initiatives such as IPBES, Larigauderine and Mooney 2010). Indeed, it is already clear that in a few years, scientists will have to provide scientific advice on possible future scenarios and the available alternatives to avoid adverse changes in ecosystems and ecosystem services, integrating data on ecology, climate, socioeconomics, and demographics. These tools will enable us to investigate the future of the region, and analyse how to reconcile long-term objectives with local constraints (exploring trade-offs with a suite of socioeconomic and ecological objectives) following the successful initiative of the Intergovernmental Panel on Climate Change. There is thus a clear need to start building on the capability to integrate, modify, improve, innovate, fit and calibrate complex models and frameworks, which will require the promotion of data integration, harmonization, and accessibility. The scientific community has to advance towards can build a roadmap of coordinated actions to develop a common strategy and advance towards the future; and the EMBASEAS network may be a good opportunity to achieve this.

4.1 Immediate activities and priorities

Finally, the group decided to develop a series of immediate activities to promote EMBASEAS:

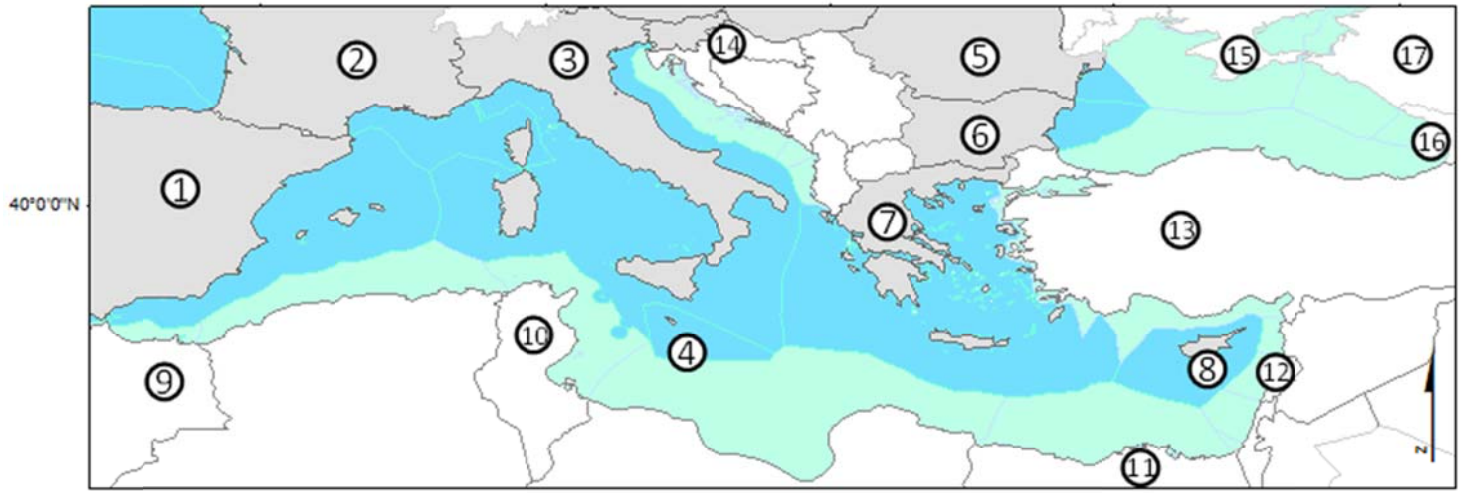
(i) The distribution of workshop material and discussions using scientific literature, and the CREAM website (http://www.cream-fp7.eu/);

(ii) The development of a newsletter to promote the activities of the network, and inform EAF initiatives in the Mediterranean and Black Seas region;

(iii) The design of a website to present and promote EMBASEAS;

(iv) The coordination of efforts to answer to future research calls at the European level to fully implement the scientific network envisaged by the group;

(v) The organization of a second meeting during 2013, with the principal aim of discussing ways to operationally build the scientific network EMBASEAS, and move towards CREAM+ initiatives.



CREAM countries: 1. Spain, 2. France, 3. Italy, 4. Malta, 5. Romania, 6. Bulgaria, 7. Greece, 8. Cyprus, 9. Morocco, 10. Tunisia, 11. Egypt, 12. Lebanon, 13. Turkey, 14. Croatia, 15. Ukraine, 16. Georgia, 17. Russia.

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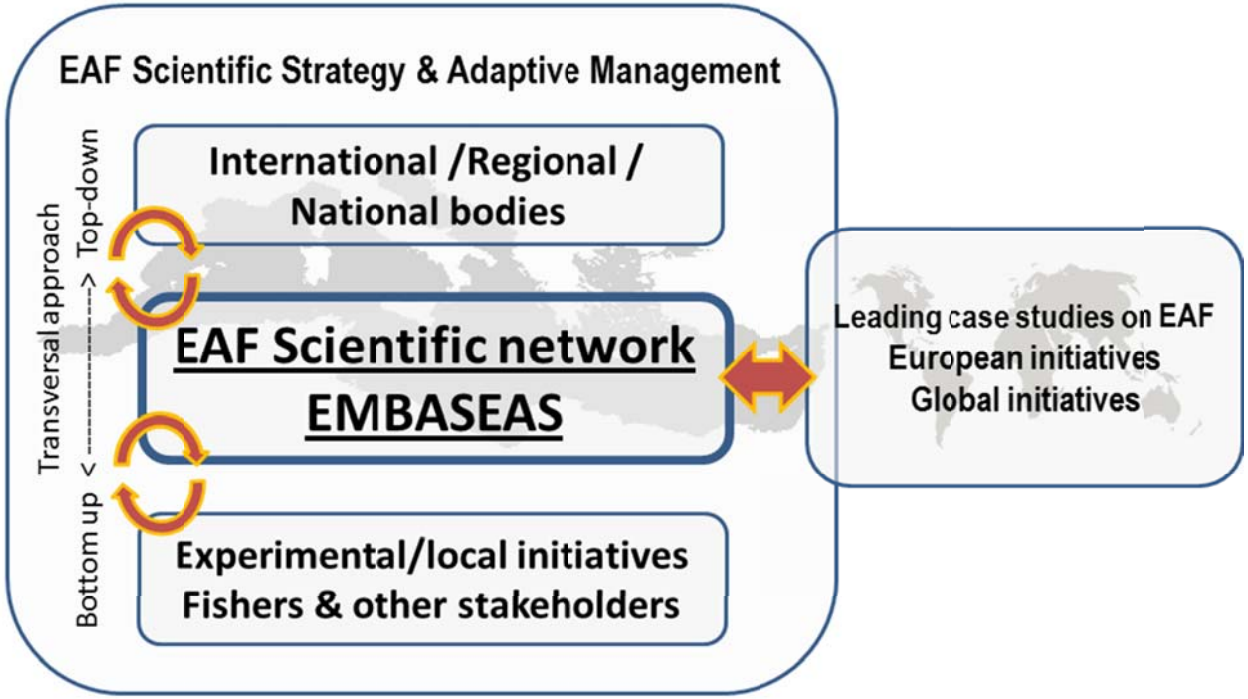
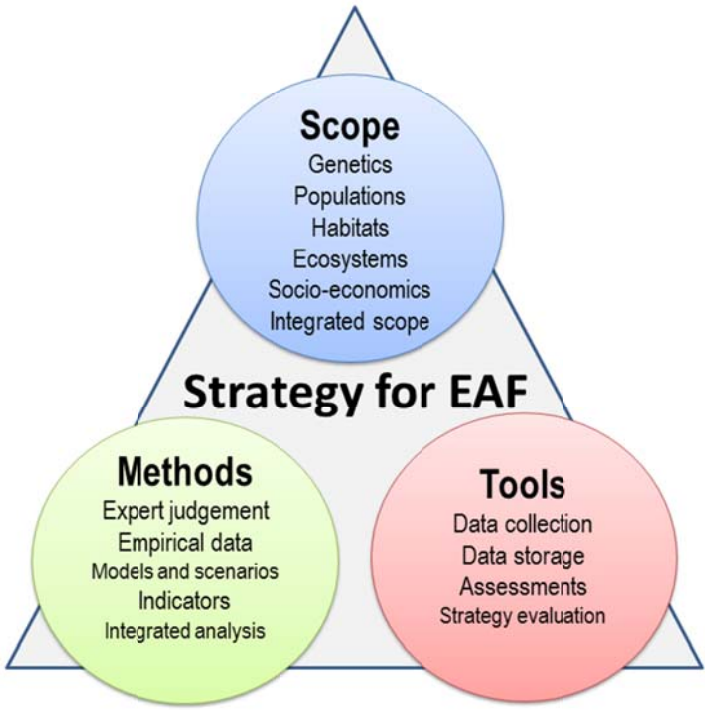

EAF Scientific Strategy & Adaptive Management
Transversal approach
Top-down
Bottom up
International /Regional / National bodies
EAF Scientific network
EMBASEAS
Experimental/local initiatives
Fishers & other stakeholders
Leading case studies on EAF
European initiatives
Global initiatives


Scope
Genetics
Populations
Habitats
Ecosystems
Socio-economics
Integrated scope
Strategy for EAF
Methods
Expert judgement
Empirical data
Models and scenarios
Indicators
Integrated analysis
Tools
Data collection
Data storage
Assessments
Strategy evaluation

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Annexes

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Annex II. Meeting notes

1st CREAM Workshop of Work-package 6
Ecosystem-Approach to Fisheries in the Mediterranean and Black Seas
Scientific Strategy for a Global Approach to Promote Regional EAF
Sète, France, 3-4 July 2012

MINUTES OF THE MEETING

First day of the workshop - 3rd of July. Morning session

Chair: Said Taleb; Rapporteur: Giorgos Bayadas & Marta Coll

09:00	Welcome and domestic arrangements Presentation of all participants	Project Coordinator All participants
09:15	Introduction to CREAM *(1.CREAM_presentationJLleonart.pdf)* Presentation of the agenda *(2.Agenda WP6 workshop_final.pdf)*	WP6 leader P. Cury
9:30	Why do we need EAF? Will a more complicated approach simplify the management of marine resources and the challenge? (10' presentation + 20' discussion) *(3.IntroEaf_PCury.pdf)*	P Cury & M. Coll

Discussion

S. Taleb. Makes a summary of the presentation: We have different visions of the ecosystems and the EAF.

A.F. El-Sayed. What we talk about when discussing EAF? All related issues or only fisheries? Science only or science and implementation?

S. Tudela. My interpretation is that is not so easy to separate science and implementation. There are two big levels of EAF: strategic and tactical level. The strategic level is the larger level, the tactical level is dependent of the type of management and what you are doing at different territorial levels. For example, small scale fisheries in the Catalan Sea are a good example of the need to implement EAF at the local level (tactical) being pragmatic.

P. Cury. Science and implementation is the most difficult issue. We have a lot of discussions about EAF worldwide but we do not know how to link the initiatives at local-regional-global levels. Adaptive management and how to translate EAF principles into concrete management activities is an important issue.

J. Claudet. It is very important to think about the socio-ecological approach to fisheries. We need to think on a regional approach (strategic) for place-based sub-regional management (tactical).

C. Pipitone. Adaptation is the key word. EAF needs a lot of data, but if we wait to have all the data, fish stocks will be depleted and fisheries will collapse. So the strategy is to adapt and advance the management in an effective way taking into account the EAF approach with what we have. A trial and error, adaptive approach is essential to apply the EAF.

G. Bayadas. Socioeconomics issues are important for the EAF approach. Fisheries are activities that have an economic dimension. A good thing to think about is how to bring all together, taking into account the needs and deficiencies of EAF. We need to think on the strategy and the common framework. We need to act as in the ***Marine Strategy Framework Directive (MSFD).***

P. Cury. The MSDF is a top-down strategy. For the EAF in the Mediterranean Sea we need a bottom-up approach. We need to identify the scientific gaps and the strategy, we have been developing the science for EAF without focussed points and direction.

A.F.El-Sayed. To engage the society is a key point, in Easter Mediterranean countries there is a problem about how to engage people and politicians. If EAF is not understood by people it will be impossible to apply it. How can we get all stakeholders on a common understanding?

C. Chaboud. The successes of other case studies in other countries have limited applicability in the Mediterranean because the Mediterranean is very different. Most countries in the Mediterranean do not have EEZs so the governance is also a key point.

J. Claudet. But there are also some local successes in the Mediterranean. There are solutions when the management is horizontal or transversal, not bottom up, not top down.

P. Cury. We need a clear vision on what we want to achieve. For example, in China it is not about ***Good Environmental Status (GES)***, but about production and economics. So that is why it is important to define the final objectives. If they are to achieve GES then the strategy is different than if they are to achieve maximum economic value.

G. Bayadas. Yes, the vision is very important. Thus we need to have a clear message on what is the objective of our approach for the Mediterranean Sea.

S. Taleb. We have to be open to EAF and the importance of the ecosystem. EAF is about reconciling conservation and exploitation. The difficulties are on how to implement EAF from local-regional-global scales.

10:00	Summary of lessons from case studies worldwide and in the Mediterranean (30' presentation + 30' discussion) *(4.LessonsCaseStudies_MColl.pdf)*	M. Coll & P. Cury

Discussion

B. Merigot. How can we have a common approach and tool in order to apply EAF to the Mediterranean and Black Seas that has its specificities (i.e. highly populated, high level of tourism, non-reported catches, multi-species fisheries)?

J. Chaudet. This is very interesting. For the Mediterranean and Black Sea, recreational fisheries are very important so we should not forget this.

A. Gaamour. Target and not target species in the Mediterranean and Black Sea are different. There are specific problems in the Southern part of the Mediterranean. How should we deal with that?

P. Cury. We need good science that contribute to EAF and these case studies are very important to illustrate how to do it, but we need other things a part from good science to do EAF. It is clear that stakeholders are essential in the success of EAF implementation. From SA, Canada, Australia, and European case studies we can learn that the key element is the involvement of stakeholders in the development of methods, the application of science, and the implementation. In Australia it is impressive on how they involve the stakeholders (fishers, industry, NGOs, etc.). This is a key issue. We also need coordinated science initiatives and involvement of stakeholders.

M. Bariche. The Mediterranean and Black Sea are certainly more complex to deal with compared to the mentioned countries. For example the ***Illegal, Unregulated or Unreported catches (IUU)*** are a serious problem, the problem of shared stocks, the high number of countries (sometimes with conflicts) and different rules and regulations.

E. Azzurro. There are also positive conditions to EAF in the Mediterranean and Black Sea. Nowadays there is an enormous capability to share tools and share data, initiatives, information, and circulate facts. It is much easier to be informed and to inform nowadays than before. We can have direct contact with people and this is a key factor.

C. Pipitone. Yes, but we are missing a coordinating body to put together scientists and stakeholders. Nobody is doing that.

D. Gascuel. The important thing is how management incorporates EAF. An important thing is how to include the scientific advice in management and how to summarize the science to inform management. We need management plan to inform how to manage territories (maybe ecosystems). The management of Mediterranean fisheries is still based only on stock assessments, which is a problem.

G. Bayadas. The science will never be the same in the Mediterranean and Black Sea areas due to differences in the regions. But it is important not to use the excuse of specificity of Mediterranean regions to not do anything. We need to know what the elements are in order to include them in the management regimes and how to improve them.

S. Tudela. To discuss governance in the Mediterranean in a good reality check. It is clear that in the Mediterranean and Black Sea, the European Union is the most powerful actor and Europe wants to export their policies to other countries. What happens in Europe will be exported and it is important to take it into account. Europe is discussing a substantial reform of the Fishery Policy now. I am not very happy because the main objective for Europe will be to achieve ***Fishing mortality (F) at the Maximum Sustainable Yield (MSY) Fmsy*** before 2020. The MSDF is also there, but it is not so important and both the MSFD and GES are very uncertain in how their principles will be translated into practice. These policies that come from Europe will condition the whole region. For example, the ***biomass (B) at the Maximum Sustainable Yield (msy) Bmsy*** levels can be very low compared with virgin environment and cannot be useful to obtain GES if we apply the MSY.

In case of stakeholders it is totally true that stakeholders are important. The Mediterranean platform of artisanal fishery is a good example. Recreational fisheries are a problem as J. Claudet said but some associations are also participating in the process of collecting data. For example, in the Catalan Sea some have been useful to collect relevant data.

J. M. Bellido. The problem is complex, but the national support and implementation of the countries is still lacking in many cases. The European commission is pushing for the EAF but a stronger commitment from the managers at national levels is needed. There is the need to do top-down and bottom-up approach, and horizontal approach.

S. Taleb. The countries of the case studies that M. Coll presented are very interesting but they are different from the Mediterranean and Black Sea. Fishing rights are different also in these countries. In the Mediterranean, access is free to all the fishing grounds. So the legal aspects are also important.

11:30	Contributions of CREAM WP 2, 3 and 4 to EAF	WP leaders & all partners
	CREAM WP2 Leader: M. Sbrana *(10' + 20' discussion), (5.WP2_MSbrana.pdf)*	M. Sbrana

Discussion

D. Gascuel. This is interesting. Why the ranking using the scores is done in the quality of the projects? Is this used later on?

A.F. El-Sayed. These results may be a bit misleading due to the fact that they were ranked by different people with different criteria to provide the scores between low-medium-high quality.

Y. Samuel-Rhoads. This is subjective on what we decided in the group. In Rome we discussed this and we decided that this was a good way to try to bring the data together and homogenized the information. It is the first step.

	CREAM WP3 Leader: J. Vigneau (C. Chaboud) *(10' + 20' discussion), (6.WP3_JVigneau.pdf)*	J. Vigneau (by C. Chaboud)

Discussion

S. Tudela. The information on habitat is very low, is this real?

M. Coll. This must be a problem on the way the information on data from CREAM partners is sent to WP2 and WP3, but also points out the fact that to properly map available resources we may have to look at other initiatives that exist and have not been reported to CREAM by the partners.

I. Terrier. The issue of having databases accessible in the Mediterranean Sea is a real problem. It is an issue that is already tackled at the European level. "Marine Knowledge" (http://ec.europa.eu/maritimeaffairs/policy/marine_knowledge_2020/index_en.htm) is another initiative at the EU level that aims at collecting data from different institutions.

J. M. Bellido. The problem with data is a problem of ownership and accessibility.

D. Gascuel. For the European context we should ask the commission for the data.

M. Coll. The access of data is really a difficult issue.

J. Claudet. In this context, the new Fp7 project CoCoNet aims at collecting data as the first activity of the consortium.

M. Coll. This is common to many projects. For example, the Fp7 project Pegaso (http://www.pegasoproject.eu/) is also aiming at collecting the data and making it available, Sesame (http://www.sesame-ip.eu/index.php) had similar aims at collecting data (time series of catch data, abundance, etc.).

C. Chaboud. If we cannot get information on what we have already then we have a real problem of efficiency. There is a problem on sharing data in an efficient way and this is the key to the success of EAF in the future.

T. Rouyer. Where is the data? Nobody knows?

P. Cury. This is a real problem and if we cannot get the data we cannot make good science. Editors are thinking now on getting the data when a paper is published. We are in the middle-age in terms of data. Observatory systems are also producing data that can be used if it is available. So there is the need for a real change regarding this issue.

D. Gascuel. We have to understand how the data collection is working in Europe. Twice per year the countries have to provide the data, that gets aggregated, it is published in the aggregated way and it is put in the bean. Then it is destroyed.

P. Cury. We should state loud that in the Mediterranean is not only that all regions are data poor, some regions do have data but they are data-poor access (poor access to data regions, PDAs).

	CREAM WP4 Leader: J. Lleonart (M. Coll) *(10' + 20' discussion), (7.WP4_JLleonart.pdf)*	J. Lleonart (by M. Coll)

Discussion

D. Gascuel. What about SGMED? What are they doing?

G. Radu. Each country that is in the data collection program has the obligation to give the data to the GFCM.

S. Tudela. What about ICCAT? They are important and are not here?

M. Coll. Jordi Lleonart states in his presentation that ICCAT has not responded yet to WP4.

M. Bariche. What about FAO and all their activities?

M. Coll. Jordi Lleonart states in his presentation that FAO has not signed the MoU yet.

D. Gabiña. There should not be a problem with FAO, but it is just that they are being slow. They are interested in the collaboration but the signature has not arrived yet.

G. Bayadas. Are we going to discuss about the data problem and take an action about the data poor- access region?

P. Cury. As CREAM we could emphasize this and make a formal request to the EU to discuss this problem. This is a big issue for CREAM success.

D. Gabiña. We can make sure we make a request to the EU. We should include it in the meeting minutes.

M. Coll. We do not only need the access to the data, but good metadata, harmonization and interoperability of data available, quality control procedures, how to update datasets, how to store it, etc. This is an important and big issue that CREAM cannot deal with alone.

P. Cury, C. Chaboud & D. Gabiña. We can keep discussing this issue within CREAM and advance on how to deal with it.

First day of the workshop - 3rd of July. Afternoon session

Chair: Michel Bariche; Rapporteur: Ernesto Azzurro & Marta Coll

14:00	Building a network around key topics *Topic 1*: Information systems for scientific support for EAF	All partners J. Vigneau

NOTE: this topic was previously discussed in the morning while presenting WP2 and WP3 results and discussing about data, and since J. Vigneau could not attend the workshop, the group skipped the topic in the afternoon.

	Building a network around key topics *Topic 2*: Anthropogenic impacts, fisheries, sensitive species (15' + 15' discussion), *(8.Topic 2_Impacts_JLleonart.pdf)* (& Additional slides by M. Coll on cumulative impacts)	J. Lleonart (presented by M Coll)

Summary of the topic

We have many different anthropogenic impacts due to fishing such as direct and induced mortality, changes in the community and impacts on habitats. We also have other impacts than fishing. For example, aquaculture that can have many different effects according to the variety of cultures. Impacts can accumulate and overlap. Some impacts are very local, other are more regional. Impacts can be synergistic, additive and antagonistic. What are the strategies to deal with it? We must also find ways and methodologies to follow the evolution of impacts on a temporal scale. Data are usually scattered in different places and in different formats and it will be important to harmonize the process of collection and availability of this information.

Discussion

J. Claudet. CoCoNet will be dealing with some of these cumulative maps in the future. It is very important the way that impacts interact. It is a hot topic and CoCoNet will be developing this in the future. Is CREAM going to work with that?

M. Coll. This is also the aim of other activities, such as Fp7 Pegaso and new projects in the future.

P. Cury. We are discussing topics that are important and that will be interesting to develop in the future, topics that bring added value to the group. Cumulative impacts are one of them.

G. Bayadas. Impacts of commercial fishing and recreational fisheries and connection to aquaculture are also important.

C. Chaboud. Consumption dynamics and dynamics of markets is an important factor as well. For example, if there is market for small hake, even if we forbid it how are we going to deal with it?

P. Cury. The Gulf of Lions is a good example of what to fish: small fish or large fish (such as small hake or large hake). They were eating small hake because the bigger individuals were offshore and had refuges available. Now they are also fished so both are gone. These are specificities that happen with overexploitation.

G. Bayadas. It is dangerous to get small fish, EAF should not promote this.

A.F. El-Sayed. A topic that is important is the temporal management of fisheries and closing fisheries in areas. In some areas may be a good idea, but it others may not work.

A. Tokac. Trawl fishing is prohibited in May in Turkey and there is a recovery of demersal fishery as it is a spawning season. But as soon as the fishing season is opened the recovery is gone.

G. Radu. Trawling in the eastern Mediterranean is a big problem.

M. Bariche. Blooms of non-commercial species are important. What about aquaculture?

A.F. El-Sayed. In Egypt aquaculture is very important for commercial species. They collect juveniles of commercial species to put them in aquaculture facilities to grow. This declines the stocks of wild species and it is important. The estuaries and brackish water lakes are also highly impacted by aquaculture.

M. Bariche. Where the food for this aquaculture does comes from in Egypt?

A.F. El-Sayed. It is mainly made of soy bean and fish meal. They are mostly imported.

P. Cury. We have good examples of cumulative maps and how to combine all this information together and derive indicators of interaction of these impacts and uses. There are many ways to accumulate impacts and represent them.

E. Azzurro. We have cumulative impacts at different levels: species level, community level, ecosystem level. We should take all into account. At the species level we have a lot of examples on how this may happen (when juveniles and adults are subjected to different impacts, for example). So how cumulative impacts are affecting ontogeny phases at the population level is also important.

M. Bariche. Some countries will be affected locally by cumulative impacts; other impacts will be more regional. This is also important.

A.F. El-Sayed. Some local impacts may be regionally important in the future so we have to consider them all.

C. Chaboud. It is also essential to realize that by-catch is a real problem.

S. Tudela. By-catch is a real problem at the EU level. The side effect of selectivity and the implementation of the MSY is related and will be a big issue in the future. Moreover, the issue of spatial planning and bottom trawling is a very important issue in the Mediterranean. This is a topic that Jordi Lleonart wanted to highlight. Is this group ready to provide advice on this?

M. Coll. Maybe we can talk about this in terms of spatial planning and how to spatially plan trawling activities?

P. Cury. We could ask for a project in the Mediterranean to compare gear impacts, this seems to be needed.

M. Coll. The impact of trawling is a taboo topic in the Mediterranean and Black Sea.

D. Gascuel. It is a taboo topic everywhere.

P. Cury. Moreover, now there is a new EU project at looking at the impacts of trawling.

Building a network around key topics — M. Bariche

Topic 3: Non-indigenous species and spreads

(15' + 15' discussion), *(9.Topic3_Invasive_MBariche.pdf)*

Summary of the topic

The Mediterranean is a hotspot of biodiversity, 6-7% world marine biodiversity with less than 1% of total ocean surface area, but also a hotspot of xeno-diversity with almost 1000 species expected so far. Biodiversity generally decreases moving eastward and southwards. Major threats are: habitat degradation, destructive fishing practices, pollution eutrophication and biological invasions. Biological invaders can have different origins and impact. Mariculture and aquaculture can be a source of release of aliens. Species from the tropical Atlantic waters enter through Gibraltar and Red Sea species enter from the Suez Canal. So far 68 non-indigenous fish

species have established large and permanent populations and many have high commercial importance in the Eastern Mediterranean. Species can be divided in high commercial importance, limited commercial importance and potential importance. In the Eastern Mediterranean, 70% of shrimp catch is made by indopacific shrimps. *Portunus pelagicus* is the only crab marketed in the EMED. *Erugosquilla massavensis* has a potential importance. Bivalves such as *Spondylus spinosus* and *Pinctata radiata* can be found in the market all year round. *Rhopilema nomadica* form huge blooms a large part of the year. Invasive fish such as *Lagocephalus sceleratus* are having a population bloom and they have a great impact on the fishery.

Ecological competition with native species may be severe but data are still poor. The increase of *Upeneus moluccensis* has probably forced the native *Mullus barbatus* to shift its distribution toward deeper water. *Saurida undosquamis* decreased the population of *Synodus saurus* which has basically disappeared in shallow waters of the Eastern Mediterranean. The native *Sarpa salpa* has almost completely disappeared in the Eastern Mediterranean due to the competition with *Siganus rivulatus*.

Until the last two decades, Lessepsian species were confined to the eastern part of the Mediterranean, the once called 'Lessepsian province (Por, 1990)'. Today the problem of Lessepsian migration is not limited to this area but these species are moving westward. Due to the speed and dimension of this phenomenon, there is an urgent need to collect basic information on the ecology and biology of NIS: - What are the effects on the various fisheries? – What are the effects on habitats and ecosystems? - What is the true cost of the presence of NIS? - We need to collect LEK (Local Ecological Knowledge) - Scientific network and coordination is needed, - We also need to increase awareness.

Discussion

J.Claudet. The trend shown in the presentation was very interesting, but it could be that the data is biased. We probably have more records now than in the past no? The invasion may be even quicker. It is also important to know what facilitates the invasive species spread, and how fisheries may be a potential solution to reverse the impact of invasive species.

M. Bariche. We could suggest targeting these species to control them. Some of them have real potential for fisheries and others are already being part of the fisheries of some countries in the Eastern Mediterranean Sea.

E. Azzurro. Yes, it is true we have biases because in the last years there is more interest in reporting this information. But this is the only information we have on their distribution. In the past we lost opportunities of monitoring and track the effects of the arrival of these new species. We should learn from this and ask ourselves if there are possibilities to retrieve past information and what we can do for the future.

Fishermen have memories and provide a natural network of observation in the marine fields. Their knowledge can be capitalized to reconstruct recent ecological changes. In recent years this possibility emerged as a new scientific discipline ***(LEK, Local Ecological Knowledge).***

M. Bariche. In the past there was some information and some effort done to track these distributions. So for the most visible species we can say that this information is quite ok.

Y. Samuel-Rhoads. Not all the species are having bad impacts on the native species. We also need to look at how the endemic species are adapting.

A.F. El-Sayed. This is right; some species may have a large economic impact. Another issue is about parasites of these species that could also influence native species and biodiversity.

P. Cury. Invasive species issues translated into scientific objectives can be good news or bad news. But you do not know what is going to happen (so there can be a change that may be giving a good ecological situation or a bad ecological situation that also produces a bad situation in terms of economic value). This is what happened in Namibia with the proliferation of jellyfish and gobies because of overexploitation (these were bad news). We need to evaluate ecosystem services to put the impact of species into context. We can also explore typing points, so how ecosystems may change. So it is important to define GES and the indicators we need to track GES.

A.F. El-Sayed. This cannot be controlled, so it is not about good or bad news but it is about learning how to deal with them (understand them and live with them), to adapt.

P. Cury. Sometimes there are synergies about exploitation and other human impacts that cause ecosystem changes. We should have long terms objectives and one is to rebuild stocks of predators. They will probably cause ecosystem changes, and one can be to make ecosystems more resilient to changes and less vulnerable to invasive species.

S. Tudela. We need to understand how to improve the resilience of ecosystems to these invasions. This may be a good scientific topic to explore. We have a very complex situation. The ecosystem is changing due to various impacts: invasive species, fisheries, and they evolve. Is there any study comparing the dynamic of these species in protected habitats in comparison with exploited habitats?

J. Claudet. E. Sala has a nice paper showing that MPAs reduce the impact of invasive species.

M. Bariche. There are also other studies on good environmental state and resistance of ecosystems to invasive species.

J. Claudet. There are non-linearity in social systems such as in ecological systems (e.g. ecological regime shifts): Even if invasive species can be commercial, there is also reluctance of the people to eat them and commercialize them so it will take time to have a market, fishermen will have to adapt to it, etc.

E. Azzurro. We are identifying three blocks of discussion. The need to be informed, the need to inform people about the potential danger of species, and what can we do to study and manage these new arrivals and their impact on biodiversity. We need to be pragmatic and as much concrete as possible; it is true there is always a gap between the arrival of a new species and the finding of eventual possibilities to use it as a resource. It is not easy for people to change their habits, but there are probably more opportunities to use these invaders than expected. See for instance the examples of siganids in the eastern Mediterranean and of *Anandara inequivalvis* in the Adriatic Sea.

M. Bariche. In terms of the importance they may be commercially important. But for ecological importance, the impact is negative in most of the cases, but it needs to be quantified. The presence of an invasive NIS represents bad news for the ecosystems so we should not be happy when a species has a commercial importance. We need to study intensively those species in order to try to find a solution, because the other alternative is to live with it. The best example is the case of *Petromyzon marinus* in the Great Lakes.

Building a network around key topics — C. Pipitone

Topic 4: Spatial planning, protection (15' + 15' discussion), *(10.Topic4_SP_CPipitone.pdf)*

Summary of the topic

The contribution outlines key points identified by CREAM partners as important for creating an EAF: tools, scientific gaps, and scientific network. Summarizes results and offers proposals for creating a strategy towards a spatial approach to EAF.

Discussion

J. Claudet. The broad definition of MPAs should not be that broad, but it is the one that is used now in many new MPAs, because we call MPA a lot of things and most known benefits of MPAs are related to the presence of areas that are restricted to fishing (i.e. no-take zones). MPAs with the areas of different management plans can be a model to develop in other regions.

C. Pipitone. MPAs are also useful to re-distribute fishing effort. Artisanal fishery should be included in the design and the implementation of the MPAs should be done in a participation context with other stakeholders.

J.M. Bellido. Advancing on spatial planning is much more than just putting MPAs. The scientific gaps should take into account the scale of the planning (meso-scale to macro-scale area).

C. Pipitone. MPAs are a possible way to tackle EAF, but of course we cannot solve the problems of fisheries with MPAs. MPAs are just one possible way to apply spatial planning, but they are not the only tool for spatial planning.

A.F. El-Sayed. MPAs could be expanded to include other species or other topics, so maybe they can also include other topics such as protection of other ecosystem services.

M. Bariche. What can be done with the spatial competition of fishermen, for example, from artisanal and commercial fisheries?

C. Pipitone. We could use MPAs to limit the fishing effort in a spatial context in addition to fishing regulations.

J. Claudet. Most of the MPAs in the Mediterranean are spatially zoned in the following way: a core no-take zone where you cannot fish and other surrounding areas where there are some restrictions on activities but are less restrictive.

Building a network around key topics — M. Coll

Topic 5: Ecosystem models for scientific support

(15' + 15' discussion), *(11.Topic5_Models_MColl.pdf)*

Summary of the topic

Models are tools for the future. A model is a useful representation of reality. Models do not replace single species assessment. Models can expand our understanding of ecological process. Everything we have talked about so far can be evaluated and analyzed with models. There is a huge range of models that can be found in the scientific literature. Message: models are complicated, may be wrong, but are useful to represent reality, and can always be improved. The presentation mentions the importance of models and the types of models available. Models can work at different levels, from species to ecosystems. Some models include human activities. A lot of modeling work going on around the world. Applications in the Mediterranean are focused on EwE, Atlantis, and Osmose. Shows map of where these models have been applied. Describing what each model does and where it's being applied. Ecosystem models attempt to describe all the trophic levels of an ecosystem.

OSMOSE assumes opportunistic predation based on spatial co-occurrence and adequacy of size. Applications are broad. Ecopath and Ecosim now work a bit like R. You can program your own thing. We also need to validate models. Models are oriented to answer questions. If you want to explore future changes we need to rely on IPCC models. You can drive them with environmental parameters. Easily and widely used. Consortium develops EwE new capabilities. 40 models applied in the Mediterranean and Black Sea. Several and diverse applications are available. The

presentation showed that EwE was applied in the Adriatic to look at simulations of recovery and MPA analysis.

Discussion

J. Claudet. All these models that are now available in the Mediterranean and Black Sea, are they applied by different people in different areas?

M. Coll. Yes, they are normally developed by scientists in the regions where they are developed or there is cooperation of scientific teams working together (for example, in the case of the Adriatic where Spanish and Italians have been collaborating for some time). However, as you saw from the presentation, most of them are applied in the northern areas of the Mediterranean Sea.

P. Cury. Models provide very interesting answers for the questions we have. They are integrative tools and there are several applications in the Mediterranean level. They are good tools to have in mind. We need to invest in them because they need to be generic and we need to validate them. Models are useful to answer different scientific questions and should be robust. We would like to make the analogy with IPCC to use models in a "professional" way and use them to predict the future within the IPBES context.

General discussion on how to build a network around key topics — All participants

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Discussion

C. Pipitone. Back to the topic of non-indigenous species: the availability of an empty niche may be one of the reasons of success for a NIS. This could be the case for the crab *Percnon gibbesi*: this is an herbivorous species that has probably found an empty niche in its habitat (rocky boulders at 1-3 meters depth), because potential competitors i.e., other herbivores like limpets and sea urchins have been depleted for human consumption in many areas.

M. Bariche. Well, some scientists have serious doubts about the concept of "empty niches". A "niche" could be compared to the "job" of a species in the environment. The problem is not solved and the issue is highly debatable.

E. Azzurro. There should be ways to collaborate and collect/share data together. The invasive species issue is a good example of how well we could collaborate and answer questions. The problem is a regional or even global problem and we cannot answer it now if we do not collaborate. We may look at scientific details when working at local scale, but we need to work at the integrative levels to gain perspective. We should gain in simplicity in our descriptors and details in advantage of gaining in the representativeness of our science; this is something that we

discuss as well in the CIESM working group. We propose to standardize monitoring protocols, this is needed to replicate studies and understand processes that are now acting at large geographical scales.

C. Chaboud. What we should be thinking on is if there is a value added to have a network in comparison with having independent actions that are not coordinated.

J. Claudet. We all need a network to support EAF in the Mediterranean and the Black Sea. But we need to remember that we are managing people and not ecosystems. It should be a network to discuss common problem and solutions, and then apply them locally to make sure we do not lose the reality.

C. Pipitone. A network would be useful in sharing knowledge and ideas and put them forward, but specially to foster new ideas and initiatives in their territories/local realities. The network should foster local/regional initiatives, but in a coordinated manner.

E. Azzurro. Coordinate regionally or even globally but act locally.

M. Bariche. We need to allow global view and global processes. And get added value to local/regional approaches and activities to sum forces.

S. Tudela. From a conservation perspective, my dream would be to see a network of EAF co-management of territorial units and scientists involve in early practice of EAF networking among themselves to learn on how they implement EAF ideas and strategy at the local level to also build a strategy at regional level. The real challenge is to deliver at strategic level what we need to do at the local level.

J. Claudet. Totally agrees with S. Tudela.

S. Taleb. What we aim at is a network for scientists or for managers? It will be permanent or not?

M. Bariche. Depends on our creativity and what we can find.

D. Gascuel. We cannot confuse two aspects: one is to build advice to produce management advice so we could apply for a STECF working group on EAF for the Mediterranean Sea. Another think is to build a network of scientists to promote EAF in the Mediterranean Sea. The scientific network is the thing we have to build I think. Although we can always push for the first option as well, but can take more time and could go in parallel.

S. Taleb. Maybe it is a scientific program what we want so enable us to interact at the regional level.

M. Bariche. We should promote common scientific topics and applications together that can inform the general public, politicians and stakeholders.

P. Cury. We are talking about EAF for 10 years now, but now we need to produce coordinated answers and we need to have a broader view than we used to have. We need to build a scientific network with a bottom up process using CREAM that can identify key topics to build up between us and define a strategy and a road map to be used in each country, but in a coordinated way and to give coordinated answers. If we do not produce things that are coordinated and that we can produce together as scientists that have added value we will have problems in the future. We need to move on and do like scientists did in IPCC. The future of Mediterranean and Black Sea marine ecosystem is a key topic. We should demonstrate that we can build a roadmap of coordinated actions for the Mediterranean and Black Sea together.

18:00	Closing of the workshop - day 1

Second day of the workshop – 4th of July. Morning session

Chair: Yianna Samuel-Rhoads; Rapporteur: Marina Panayotova & Marta Coll

09:00	What kind of scientific strategy is needed? (10' + 20' discussion), (1.ScientificStrategy_MColl.pdf)	M. Coll & P. Cury

Discussion

J.M. Bellido. It is widely agreed that an ecosystem perspective is needed to implement an EAF, but not only from fishery researches. In many cases fishery researches are aware of the importance of the ecosystem in an exploited environment and the need of an EAF. However this is not so true in other colleagues who are more interested in particular components of the ecosystem. Including the large scientific community as a whole may be difficult to do since some people is not able to think in a more "ecosystem" view and do not see value in including the ecosystem.

A.F. El-Sayed. We need to think on how to approach people that could add value to the network and what role they can play.

G. Bayadas. We have been able to identify different interesting initiatives and tools. We do need now to build a shared vision taking into account the initiatives that are already there. We have now the opportunity to provide recommendations to the EU with our view. But we need to be practical and pragmatic.

Y. Samuel-Rhoads. Are we ready as a group to do this? Or we need more people?

A.F. El-Sayed. Can we ask for help to institutions or to other colleagues?

P. Cury. CREAM is a coordinated action so we can propose a vision and ask for the funding in the future, but we do not need to worry now about the funding now. If we propose some good things we will be able to find funding in the future.

C. Chaboud. The question on how to be linked with GFCM / STECF / FAO initiatives is a good question, but we do not need to be constrained by political traits of these different institutions. We should aim at being independent.

P. Cury. Here we have a bottom-up scientific approach and there is also a WP in CREAM that deals with institutions (WP4) so we can discuss that with WP4 to see how we link with the institutions. We will try to solve the institutional links and the funding links, so WP6 can dedicate the time to think on the strategy and the vision and do not worry too much about the rest.

D. Gascuel. Globally, we need a new scientific advice system to provide advice for management bodies using information at the ecosystem level. The list is too long on what the "EAF Mediterranean body" could aim at doing, but I think it should aim for sure to provide scientific advice for management. The key point could be to try to develop some advice. And this group could try with the bottom-up approach and then see how it goes. The STECF EAF WG is a top-down approach but maybe in the future the Mediterranean could be well represented in STECF if there is a network of scientists that are strong and are willing to be part of it.

Y. Samuel-Rhoads. We look like a super group aiming at doing many things.

J. Claudet. We do not need to decide a priori at what scale we work, but state that different scales are needed. We should use both the bottom-up and top-down approaches, to build a transversal/horizontal view that can be very useful in the Mediterranean and Black Sea. Because we need to realize that in the Mediterranean and Black Sea it is not valid to have scientists giving advice only. It can be a good solution to have a strong scientific network that twice per year meets with stakeholders (managers, fisheries).

M. Coll. I totally agreed with J. Claudet. Can you elaborate on the horizontal view?

J. Claudet. The horizontal/transversal view aims at integrating the two approaches through consultation, cooperation. It is not decision-makers that want to dictate stakeholders what they should do, nor stakeholders trying to convince decision-makers or managers that what they are doing is the good way to manage the resource. There should be first a decentralisation, e.g. a transfer of legislative power to a local entity managing an ecologically and sociologically coherent stretch of coast, which could only be at the appropriate scales for dialogue and cooperation among stakeholders, managers, and scientists. This doesn't preclude at all the necessity to have a network of scientists working on EAF at the regional scale (i.e. Mediterranean and Black Sea) but who will then identify or send experts to these place-based management systems. Another important role of the network would be to try to anticipate the needs of stakeholders and anticipate the problems that may be in the future. Try to think what will happen in 10 years and what both local communities and managers will need from scientists.

D. Gascuel. We need to define units of management. If we want to provide advice we need to know who we are advising. If it is the EU then we need a scale of LMEs or regional seas, if it is local managers, then we need local scales.

J. Claudet. I agree and do not agree with D. Gascuel. Local management is always essential.

G. Bayadas. We are starting very high both aiming at local management and regional management. I agree that we can propose an EAF body with expertise in EAF to promote EAF. It is not our role to think on the future, but to do something pragmatic and shorten the list of the vision.

P. Cury. There are plenty of visions but we need something light, pragmatic and to recognise that at the Mediterranean and Black Sea level there are many initiatives and we need to move toward a more knowledge-based approach, with a diversified toolbox, and know what is happening. There is a lot of expertise at the Mediterranean level than can be exchange very lightly and this will be a very good thing for the Mediterranean. We need a scientific network to achieve the need for new approaches. Also, Europe will be also delighted to bring external expertise to the Mediterranean so we could learn from external initiatives such as South Africa, Australia, and Canada. We need to share this information. At the EU level there is an urgency to do that because EAF has been around for many years but we have not been ready as scientists to move faster enough. We need to show that we can collaborate and coordinate well.

M. Coll. I totally agree with P. Cury. And I would add that to coordinate with stakeholders is fundamental for the success of the initiative, in agreement with J. Claudet.

P. Cury. Yes, regional scientific coordination and coordination with stakeholders are the two key aspects of the EAF network needed in the Mediterranean and Black Sea.

G. Radu. And the third key aspect is how to give scientific advice to advance EAF.

10:00	Ecological scientific knowledge for EAF - Processes and patterns for scientific advice and major scientific gaps (10' + 20' discussion), (2.ScientificGaps_PCury.pdf)	P. Cury

Discussion

J. Claudet. Is it true that jellyfish eat the larvae of forage fish, there is any paper about that?

P. Cury. There are only qualitative studies in that. Key aspect of ecosystem functioning. There is a huge impact of forage fish: aquaculture is putting lots of pressure on them.

S. Tudela. What is the advice for management for forage fish?

P. Cury. The advice is to stop fishing when they are below a certain level. They are up and down but they have to be managed. When they are going down you have to be careful (it is normally the impact of fishing and environment). The management has to be linked with the scientific information (the more you know, the more you can extract from the sea). If you do not know anything, then you have to have a precautionary approach and exploit less.

Y. Samuel-Rhoads. But if we do not know then the managers won't stop fishing or use the information until you have information.

P. Cury. Well, if you do not know, you do not fish, or fish lightly. This is what the precautionary approach under EAF says.

A.F. El-Sayed. There is a debate on what we do with forage fish: fish them and eat them, or transform them into fishmeal for the aquaculture. FAO has put some information on how to manage your stocks sustainably before you can export them for the aquaculture.

P. Cury. This is crucial in the context of food security in the future and there will be choices on what we have to do. It is crucial to build scenarios for each country; you can explore what to do and need to quantify what are the consequences for ecosystem services of different exploitation strategies. The scenarios are important and scientists are responsible to build these scenarios. How to forecast and build scenarios in terms of ecosystem approach and ecosystem services? It is very demanding scientifically and it is a challenge, so that is why we need to coordinate forces. I will talk a bit more about this later on.

	Ecological scientific knowledge for EAF - Incorporating single species assessment in EAF (10' + 20' discussion), *(3.SAEAF_FColloca.pdf)*	F. Colloca (presented by M.Coll

Discussion

S. Tudela. This is what we discussed a bit yesterday and it is essential for EU policy and the current discussion.

D. Gascuel. The question of selectivity is a very important one, there is a debate in changing fishing effort without changing selectivity and this is probably not doing anything at the ecosystem level. We need to be able to increase the catch with more fish in the sea. This is a very important issue.

C. Chaboud. Selectivity is important, and parameters are very important to calculate selectivity impacts. For example, post-escapement mortality, etc.

M. Coll. This is true and per se we could discuss this topic the whole workshop.

P. Cury. Yes, this is important, but the single stock assessment results are not an example of EAF, just of stocks. But what is important for us at the ecosystem level is that probably there is no other ecosystem with such larger exploitation than in the Mediterranean and Black Sea. So one aspect of EAF in the Mediterranean and Black Sea is how to rebuild stocks and ecosystems. This is an important topic in the Mediterranean and Black seas. EAF also needs communication of results and taking action for the stakeholders and for the functioning of the ecosystem. I am

worried about where the Mediterranean and Black Sea will go if we keep on exploiting the way we are now. Cascading effects in the Mediterranean Sea will be important. So as a group we are also going to have to communicate the risks of mismanagement.

J. Claudet. It is important to communicate about the risk but it is also important to communicate successful stories.

P. Cury. As scientists we also need to communicate and inform the public. To inform them and tell them what we find.

D. Gascuel. Managing stocks is part of EAF, but also to learn about the effects at the ecosystem level.

Y. Samuel-Rhoads. But stock assessment is not the only thing in EAF, we need more.

J.M.Bellido. But they are quantitative approaches and are important. We have the data now so we can use it. EAF needs to be a quantitative approach, not only qualitative.

A.F. El-Sayed. In Egypt there is no data. And are these datasets standardized?

M. Coll. This is well published and they are results of working groups that work hard on this, so these results are very likely standardized and correct.

J. Claudet. As a group we should use what it is available and at the same time point out areas where there is poor data so we need further effort to collect information. But we need to keep on working on areas where there is data.

J. M. Bellido. Regarding the implementation of an EAF network in the Mediterranean and Black Sea, we need to be aware that there are many fishery forums (GFCM, EU-STECF, CIESM, etc.) that do similar things, and that we need to know what people are doing. We should avoid duplication and misinterpretation.

M. Coll. Yes, and we should not aim at being the ones collecting this information coming from stock assessments. There are groups that do a good job with it. But we should be aware that this information exists and that we can learn about it.

D. Gascuel. The situation in the Mediterranean and Black Sea is changing a lot and more and more data is available, so data availability will increase.

11:30	Complementing the toolkit for EAF a) Indicators and ecosystem health - The European MSFD and GES (10 ' + 10' discussion), (4.MSFD_FRenaud.pdf)	*F. Renaud* (presented by C. Chaboud)

Discussion

S. Tudela. The indicators inside the MSFD will be chosen by each country so may not be the best. Fmsy will be chosen as well. So we cannot be overoptimistic using MSFD as the good way to deliver EAF in Europe.

C. Chaboud. There are problems with MSFD such as the fact that it is applied at the country level and sustainability is not only at the country level. Moreover, there are no considerations of economic issues or social aspects in the MSFD, for the sustainability there is the need to include ecological, social and economic issues. The MSFD only includes ecological aspects.

D. Gascuel. Fully agree. We have to be careful with that because in Europe there is a feeling that MSFD will be the solution for EAF and fisheries management within an ecosystem prospect. MSFD is based on national waters. The list of indicators was only suggested by Europe but the countries decide on what indicators to include. Some countries have changed the list of indicators a lot. This is now being developed and we are in the process to know what countries are doing. We do not know yet what the list of indicators is. The comparison of indicators by country will be very difficult.

Moreover, the indicators of the MSFD are related to the state of the ecosystem, but not to the pressure of the ecosystem. We also need indicators of pressure in the ecosystem. We will need to pick up some indicators and add others from pressure to manage fisheries in an EAF context in the Mediterranean and Black Sea.

P. Cury. It would be interesting to know what the Eastern-Southern Mediterranean and Black Sea countries think about the MSFD indicators and initiative.

A.F. El-Sayed. Indicators should come from the local levels, from local situations with criteria from individual countries, and then should be integrated at the regional level. So we should start with the local level and rise up to the global level.

P. Cury. So what would be the best strategy for Egypt to select indicators that are pertinent at the local level and useful for your ecosystems?

A.F. El-Sayed. The issue of building and pick up indicators is very difficult in some countries. For us is far away.

S. Tudela. This is important for the southern Mediterranean and Black Sea countries too because the Barcelona Convention is now discussing exactly the same initiative at the Mediterranean Sea level, for countries not part of the EU, so this is not that far away.

A.F. El-Sayed. But the problem is that the people that are discussing things are administrators that do not share the discussions that are happening at the regional level. So at local levels scientists do not know and are not informed. Administrators may just put the information away.

M. Coll. This is interesting and suggests that the EAF scientific network should aim at filling this gap and promoting the sharing of information at the local level to make sure that information

flows and everybody is informed. Information should not only be at the government or administrators level.

C. Chaboud. There is also a problem of collaboration between countries to have common views of common/shared ecosystems. Additionally, we do not have information about the pressures. There is nothing about responses.

J. Claudet. I have published a recent meta-analysis on pressures at the regional Mediterranean level and I had to review all the indicators of the MSFD. Most of these indicators are qualitative; they do not have reference points so you cannot really use them to compare impacts among ecosystems or habitats or countries.

P. Cury. These indicators within the MSFD are initial tools to communicate and inform people about the state of the ecosystem. This is a way to communicate the issues. They aim to be tools for communication, not for scientists. MSFD is too complicated; we need more simple stuff to communicate global and local dynamics.

	Complementing the toolkit for EAF a) Indicators and ecosystem health - STECF-JRC EAF working group (10 ' + 10' discussion), *(5.STECFonEAF_DGascuel.pdf)*	D. Gascuel

Discussion

A.F. El-Sayed. In the Eastern Mediterranean we have a lot of small boats that belong to artisanal fleets, what can we do with that? Could we include them in your analysis?

C. Pipitone. Some boats also are not registered yet are active as fishing boats (that is, they exert fishing effort), so what can we do?

D. Gascuel. This is true, and this is why the group did not include the Mediterranean for now. But it is also true that our analysis include also very small boats, of 10 and 8 meters. And we should also take into account that this is only preliminary and that this method needs to be further developed.

M. Coll. These results are very interesting, I like the fact that this is a pragmatic approach that is working and that provides something with the information there is, so there is something available to discuss. I hope it will be also applied to the Mediterranean and Black Sea. For sure the work of this WG on EAF on European seas can give us inspiration to do things together.

J. Claudet. About the Mediterranean specificity, we need to include recreational fishery in the Mediterranean Sea.

I. Terrier. What about the stocks that are shared in different ecosystems?

D. Gascuel. Some stocks are assessed and others not. But when the information is available we include it in our assessment.

11:30	Complementing the toolkit for EAF (10 ' + 10' discussion)	
	a) Indicators and ecosystem health - The IndiSeas project (10 ' + 10' discussion), *(6.IndiSeas_MCol.pdf)*	M.Coll
	b) Scenarios building and models - IPBES (10 ' + 10' discussion), *(7.IPBES_PCury)*	P. Cury

Discussion

M. Coll. The indiSeas project is the example of a bottom-up approach that can also give us inspiration for the EAF working group.

J. Claudet. This is very interesting approach, how does this work?

P. Cury. It is managed by 4 women.

M. Coll. Each of us tries to secure funding to come to the meetings every year and there is also help from Euroceans and UNEP to meet. Everybody works hard and the ecosystem experts are key for the success of the work.

P. Cury. The IPBES is a top-down approach. Now there are plenty of calls on how to build those scenarios and if we have the data to build these scenarios. Forecasting models and policy scenarios (employment, populations) will be linking ecological and socioeconomic. It is hard work to do and lots of scientific capacity needed but we need to be prepared as a scientific community.

Second day of the workshop – 4th of July. Afternoon session

Philippe Cury; Rapporteur: J. M. Bellido & Marta Coll

14.30	Complementing the toolkit for EAF b) Scenarios building and models - NEREUS regional case study (10 ' + 10' discussion), *(8.NEREUS_AValls,pdf)*	A. Valls

Discussion

C. Chaboud asks a question about the nature of the data, and how they feed the model.

A Valls answer they have data from other projects and there is a module of socio-economic data, which comprises some data related to markets.

C. Chaboud. It will be possible to play online with the model?

A. Valls. The model is fitted to time series, and will be available online to be used to inform managers and stakeholders.

D. Gascuel. Before you have to set an Ecospace model. Do you have one that is global?

A Valls. Ecopath is used as a basis for the NEREUS model. We have a global Ecospace model that covers the entire globe that can have global fish biomass trends although the model is still preliminary.

B. Merigot. Who is doing the socioeconomic and compliance modelling?

A. Valls. There will be specific models for governance that will be carried out by the Stockholm Resilience Centre, partner of the Nereus project.

P. Cury. The objective is really a food security approach so it is very interesting for the Mediterranean and Black Sea level.

M. Coll. Yes, and it is interesting to note that the Mediterranean Sea will be a case study in the Nereus program so we are collaborating to make a good regional case study of the model and be able to use it at the Mediterranean level.

C. Chaboud. Is it including population projections?

A. Valls. It will include different IPCC scenarios regarding socioeconomic outputs of models.

15.00	General discussion - 10 recommendations for a scientific EAF strategy in the Mediterranean and Black Seas *(9.Recommendations_PCury&ALL.pdf)* - How to define future scientific networking activities (CREAM+) - WP5: Discuss the content of courses to be held in 2014	All partners Partner 1

P. Cury. M. Coll and I have put together some recommendations based on what we have been discussing these days. We listed some scientific aspect of EAF that are key in the Mediterranean and Black Sea context, and that add value to our proposed network.

We also listed a series of products that we could aim at producing immediately as a group: a) Newsletter to create a common knowledge, b) Website of the platform, c) Summary paper in Reviews in Fish Biology and Fisheries, d) Ecoscope for the Mediterranean and Black Sea to make data available for the Mediterranean and Black Sea, first with physical data and metadata, and in the future with real data.

Discussion

C. Chaboud. We need to promote a common culture on EAF in the Mediterranean and Black Sea. To do this, capacity building and learning inside the community is a major issue that needs attention. Training is an important point: scientific capacity building should be a priority in our list of things to do.

D. Gabiña. Informs the group on how the training courses in CREAM will be organized and what the state of the art is right now. There are courses to be developed in next years with CREAM. Two courses will be organized at the end of the project, in 2014 (January-April). One will be in Zaragoza (Spain) and the other in Chania (Greece).

P. Cury. CREAM´s main aim is to identify the needs and targets and move towards the EAF implementation in the Mediterranean and Black Sea. It´s a concerted action and more projects or actions will be needed to implement the EAF. If we have ambitions, we will have good funding. There will be a chance to apply for a project as a consortium, there is going to be several calls interesting for the network and we have to be ready for a proposal to ensure progress of the network. There is also the need to have data available throughout EAF databases (Metadata at global and regional level).

M. Bariche. We need institutional agreement from our institutes to build the network. Collaboration is very important and it´s the only way to guarantee success. I suggest writing an official letter which shows intentions for collaboration for all partners. Our report should also include missing points and values.

M. Coll. Yes, we have made a list of missing points and gaps from the contributions of all the experts. Regarding the institutional agreement, I agree it is important but personal experience showed me before that it is better to coordinate with scientists and then we will have the institutional agreement.

M. Bariche. But then you will lose the country institutions if individuals decide not to participate in CREAM anymore.

A.F. El-Sayed. If we work with institutions we cannot work, if we are with them we cannot say anything. We have to be practical but also take the institutions into account. But the individuals are the important contact points here.

M. Bariche. Another activity could be to exchange students around CREAM institutions.

P. Cury. Yes, this is the idea at the long term. In CREAM+ we should aim at exchanging not only information, but also students and scientists. Training for your people and students is a very important thing that we could promote as an EAF scientific network. This is what is being done in Euroceans and it works very well.

D. Gabiña. EC is quite interested in this topic and they can support and fund an EAF project for Mediterranean and Black Sea. The call for 2013 is already on and it´s going to appear soon. We will have to convince the EC Scientific Officer to put up a proposal that will be useful for CREAM in future calls. The call to be launched in July 2013 could be a good opportunity to build a project to start at the beginning of 2015.

M. Bariche. This should be the natural process.

P. Cury. Yes, but we need to start working now and to prove that we have the capacity to coordinate and build a network before the calls come. Otherwise we will not get the funding. We need to start now doing interesting things, building a vision and a strategy and starting to coordinate. We need to have good ideas and push for them.

D. Gabiña. We also need to convince the national representative that our network is a good idea and we need to identify those partners that are potentially important for CREAM+.

C. Pipitone. For this purpose, to proceed with a project for the next calls, it could be very good to have a website to show that we can do things together.

D. Gabiña. CREAM website will have some material for dissemination, as well as internal material. WP2 and WP3 results will be included, and WP6 proceedings as well.

I. Terrier. Answering the new projects for the future, there are already this year some opportunities to collaborate in the Mediterranean Sea. There are topics to look more in detail:

- WP INCO activity 7.3 supporting the coordination of national policies and activities of Member States and/or Associates States on international S&T cooperation (FP7-INCO-2013-3, ERA-NET/ERA-NET PLUS) (be careful: not dedicated to scientists),

- WP ENV topic ENV.2013.6.5-4 Knowledge platforms, networking and uptake of research results for more strategic international R&I cooperation,

They are not specifically adapted to the EAF scientific network but if we hear of proposals of submission, we can remind them of EAF. Especially for the ERA-NET, which might be the embryo of a biggest initiative, if successful, of joining research programmes between the Mediterranean and Black Sea countries (like BONUS for the Baltic Sea: http://www.bonusportal.org/).

J. Claudet. Maybe we need to think about the network first and then answer calls. An efficient network needs to have an animator of the network.

P. Cury. The first newsletter could be done as part of WP6 results that could animate the network.

Y. Samuel-Rhoads. What do we want the network to accomplish? We can prioritize the actions that are proposed. They are good but maybe too long.

S. Taleb. The objective of the network needs to be defined well.

E. Azzurro. We need to identify the expertise that we need in the network and who is doing what. We could make a list of expertises.

G. Bayadas. I agree with Y. Samuel-Rhoads. We need to make a good list of expertise on what we have in our countries and the list of priorities we have. We need to know the potential of each country, as situations are quite different. In which point we are and where we can go in every case (country).

S. Tudela.I will use a couple of minutes to mention some potential synergies with WWF. The prospects are really good and we are happy with the discussion of the group. In WWF we are sympathetic with this effort and we would like to contribute. We are a network on the Mediterranean with 6 offices. We are now in the process on building our strategy and a big part of it will be to implement the EAF in the Mediterranean using pilot cases. We will work a lot on dissemination and capacity building. And we will need links to scientists. We could find a potential synergy and collaborate together, and we could use the EAF scientific network as the scientific platform to consult from our end. We are very good at mobilizing stakeholders and we could be part of that, we could contribute to put the EAF scientific network in touch with stakeholders. WWF is open to any collaboration and we are going to be very supportive with these initiatives.

M. Bariche. NGO collaboration with CREAM could be symbiotic.

P. Cury. Yes, this is useful. We need to cooperate to be a global network and to be useful. The network needs to be productive; we need to publish to get funds. We need positive feedbacks.

M. Coll. IndiSeas is successful because it relies on the people that participate actively.

A.F. El-Sayed. How we are going to make sure we do not repeat things?

M. Bariche, J. Claudet and M. Coll. By collaborating together, and by making sure that we all know what kind of initiatives are going on.

J. Claudet. Do we have a name for the EAF network of scientists?

P. Cury. GlobMed!

The group discussed this and other acronyms and decides there M. Coll will organize a doodle or other system to vote on the acronyms that were proposed by the group. So far the proposals have been:

- **GlobMed** – **Glob**al approach for an ecosystem approach to fisheries in the **Med**iterranean
- **GlobMeB** – **Glob**al approach for an ecosystem approach to fisheries in the **M**editerranean and **B**lack Sea
- **EcoMeB** – **Eco**system approach to fisheries in the **Me**diterranean and **B**lack Sea
- **MedFuture** – **Med**iterranean and black sea **Future**
- **MeBFuture** – **Med**iterranean and **B**lack sea **Future**
- **FishMeB** – **Fish**eries in the **Med**iterranean and **B**lack sea
- **MeBNet - Me**diterranean and **B**lack Sea ecosystem approach to fisheries **Net**work
- **EAFMeB** – **E**cosystem **A**pproach to **F**isheries in the **Me**diterranean and **B**lack Sea
- **MeBEAF - Me**diterranean and **B**lack Sea **E**cosystem **A**pproach to **F**isheries
- **EMBASEA(S) -- E**cosystem Approach to Fisheries in the **M**editerranean and **Bl**a**c**k **SEA(S) *** (the aim of the network being to be the ambassador of EAF in the Mediterranean and Black sea)
- **MedEA**: **Med**iterranean and Black Sea network on **E**cosystem **A**pproach to fisheries

M.Coll. We need to have some immediate products to produce after this workshop. There is a short list that could be:

a) Report of the meeting (rapporteurs to send their report!) (WP6 deliverable D6.1),

b) Summary paper in RFBF (Marta to circulate a draft asap),

c) Newsletter n°1 (Marta and Philippe),

d) Participation in KBBE on Tools and Methods call (there is the possibility to participate in a consortium so partners that are interested please let P. Cury or M. Coll know and we can explore options).

P.Cury. WP6 activities are not restricted to CREAM participants so other institutions can join. It should be an individually based network.

C. Chaboud. The newsletter should be to all participants and open to everybody.

C. Pipitone. We could send the newsletter to other institutions.

M.Coll. Yes, we can put it in CREAM website, sent it to all CREAM partners and participants to the workshop and they can distribute it to other people that may be interested.

The group discusses the immediate products and agrees on what has been proposed.

P. Cury. We need to decide when the next meeting of WP6 will be. It should be October-November 2013. Where should we organise it?

The group discusses different places to host the next meeting. Various places are proposed by participants: France (Sete), Croatia, Cyprus, Spain (Madrid or Barcelona).

P. Cury. WP6 will discuss this and will make a decision regarding the next meeting.

17:00 Closing of the workshop

P. Cury. We need to close the meeting now. We had good discussion, we are facing great challenges, and we have in front of us incredible new opportunities. The CREAM platform is giving us a good chance to coordinate and move on. We will start small but we will be ambitious and this will be good for the Mediterranean and Black Sea.

D. Gabiña thanks all participants and the organizers of the meeting.

Annex III. Contributions to the workshop by partner

New tools for tracking past and current patterns of change in Mediterranean biodiversity

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Climate change and invasive species are having increasing impacts on marine ecosystems but information at the appropriate temporal and geographical scales is often lacking to observe these changes. As a consequence of warming, a number of Mediterranean fishes with tropical or subtropical affinity seem to have already moved northwards with respect to their latitudinal ranges (reviewed by Azzurro, 2008). Species such as *Thalassoma pavo, Sparisoma cretense, Sphyraena viridensis, Caranx crysos* show the clearest examples of distributional changes whilst increasing abundances have been registered for *Sardinella aurita* and possibly for other thermophilic taxa. On the other hand, the spread and success of invasive species is rapidly growing in this basin with profound alteration of biodiversity and quality of fishery resources. Thus, a regional and historical perspective of these changes is urgently needed to improve our predictive capability facing future changes (Azzurro, 2010). Ordinary research methods (based on scientific monitoring programmes) are often inadequate to meet this need, since the efforts that would be needed to monitor and survey marine habitats at scale large enough to perceive temporal and spatial trends is huge. Consequently, the extent of environmental questions may be under appreciated, because of the limited and non-continuous nature of scientific monitoring. Yet, in recent times, survey methods from the social sciences have been adopted to tackle environmental questions, such as these complex changes in marine ecosystems. Participative tools such as "Local Ecological Knowledge" (i.e. the information that a group of people have about local ecosystems) and "Citizen science" (i.e. the public participation in scientific research), are increasingly used to collect large quantities of data and to monitor changes in populations, communities, and ecosystems. These low-cost practices allow researchers to get information that otherwise cannot be gathered, and a number of such initiatives are on-going in Mediterranean Sea. At the same time the involvement of people in the process of data collection generates awareness among the stakeholders and a more conscious way of using

natural resources. In the rush to meet the requirements of ecologists and managers, collaborative efforts and scientific networks are urgently needed. Simultaneously, there is a great interest to build databases and cyber-infrastructures to organize, display and support large-scale ecological research, complementing existing initiatives. Scientific networks should be based at the regional level. Professional fishermen, laypeople and interest groups such as recreational fishers, scuba divers, not professional naturalists etc. would partner with professional scientists, under the umbrella of existing projects (such as "Tropical Signals" of CIESM, http://www.ciesm.org/marine/programs/tropicalization.htm; Observadores del mar http://www.observadoresdelmar.es/,), to follow and reconstruct large scale changes in the marine biota, providing a necessary information to the Ecosystem Approach to Fishery. A study recently published demonstrates the efficacy of these participatory methodologies to investigate and reconstruct complex processes of change in the Mediterranean Sea (Azzurro et al., 2011).

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Non-indigenous species of Indo-Pacific origins in the Mediterranean Sea

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The Mediterranean Sea is a small water body which occupies merely 0.8% of the world's ocean surface and 0.3% of the world's total volume (Lejeusne et al., 2010). Its relatively high biodiversity (6-7% of the world marine species) and high level of endemism (10%) makes it an important biodiversity hotspot (Farrugio et al., 1993; Bianchi & Morri, 2000; Myers et al., 2000; Coll et al., 2010). Biodiversity in the Mediterranean generally decreases from west to east, where it is accepted that strong unfavorable environmental parameters control the easternmost part (Quignard & Tomasini, 2000; Coll et al., 2010). The Mediterranean biodiversity is also under direct threats from increasing anthropogenic pressure, habitat loss and degradation, exploitation, pollution, climate change, eutrophication and species invasions being considered the most significant ones (Coll et al., 2010; Lejeusne *et al.*, 2010).

The construction of the Suez Canal allowed the passage of non-indigenous species (NIS) from the Indo-West Pacific realm; a phenomenon termed Lessepsian migration (Por, 1978). Ever since the appearance of the first NIS in the Mediterranean, the process has been continuous and is ongoing (Spanier & Galil, 1991; Galil, 2008; Mavruk & Avsar, 2008). However, the presence of the first NIS was mainly due to very few resilient species and the real weight of Lessepsian migration was not obvious until the 1970's, when it accelerated significantly due to various reasons (Spanier & Galil, 1991; Bianchi, 2007). Nowadays, it seems it has increased even more dramatically.

Some Lessepsian NIS have quickly become important fishery species in the Eastern Mediterranean (Spanier & Galil, 1991; Golani & Ben-Tuvia, 1995). They constituted, for example, as much as 70% biomass composition in the demersal fisheries in Turkey (Gücü & Bingel, 1994). Today, around 70 species of Lessepsian fishes can be considered established and relatively common in the Mediterranean waters. Several fishes have acquired a commercial importance (10 species) or potential importance (11 species) in the eastern Mediterranean. Shrimp catches are dominated by a few species of penaeids while the only crab and bivalves (3 species) that are marketed in the eastern Mediterranean are Lessepsian species (Bariche, *in press*).

Some NIS have displaced native species and resulted in a decrease in their abundance, even though the causal factors are not well known (Galil, 2007). As such, the success of several Lessepsian NIS has affected native species with similar ecological niches (Ben-Tuvia, 1973;

Spanier & Galil, 1991; Gücü & Bingel, 1994; Golani & Ben-Tuvia, 1995; Harmelin-Vivien et al., 2005). The impact of the abundant jellyfish *Rhopilema nomadica* on the ichthyoplankton assemblages, and thus on the eastern Mediterranean fisheries, is completely unknown but expected to be high. Similarly, the real damage of the presence of pufferfishes on fishery landings, fishing gears as well as on various habitats in the Mediterranean is completely unknown. Furthermore, the presence of new highly toxic and venomous animals, such as *Rhopilema nomadica*, *Lagocephalus sceleratus*, *Plotosus lineatus*, or *Synanceia verrucosa* might result in adverse effects in the close future (Gusmani et al., 1997; Golani, 2002; Bentur et al., 2008; Edelist et al., 2011).

In light of the warming trends of water temperatures, a clear range expansion towards the western parts of the Mediterranean has been observed (Zenetos et al., 2010; Bodilis et al., 2011). This phenomenon was termed "tropicalization" and has changed significantly the NIS distribution (Bianchi, 2007). No clear pattern seems to exist as the spread concerns species established decades ago (e.g. *Siganus luridus*) as well as more recent invaders (e.g. *Fistularia commersonii*, *Lagocephalus sceleratus*) (Turker-Cakir et al., 2009; Hemida & Capapé, 2009). One important marker of global climatic changes, NIS are expected to leave a significant impact on the Mediterranean ecosystem.

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Discards and bycatch in the EAF, with particular focus on the Mediterranean

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

There are many initiatives on progress that can be applied to Med & Black Sea. Regarding discards and bycatch several projects are carrying out . We may highlight the BADMINTON project (BADMINTON, Bycatch And Discards: Management INdicators, Trends and locatiON,http://83.212.243.10/badminton.html), which main aim is to provide a useful set of indicators for assessing and managing trends of bycatch and discards as well as to suggest potential mitigation measures for every particular fishery.

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

In the EU there is intensive data collection of bycatch and discard onboard commercial vessels but until now there have been few attempts to describe the general patterns in these data. In non-european countries data collection is quite variable and usually not continuous in time, with important gaps both in spatial and temporal coverage. Several attempts have been done to produce a general view of the problem, particularly under the GFCM umbrella. It is particularly important the GFCM working group "Second transversal working group on bycatch" held at 7-9 December 2011 held at Antalya, Turkey (available report at www.gfcm.org).

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

The best example is CREAM. A general forum to meet researchers and to discuss problems, needs and next challenges.

Who would be the key players?

Researchers, managers, fishers, NGOs, any other stakeholders. Everyone is needed.

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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As an economist, I would like to underline the actual and potential contribution of economic science to EAF in the Med and Black Sea. But the contribution of economic science is still very limited, even if there are a general demand to better take in account the economic and social aspects in EAF.

1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

1.1 Initiatives:

MedPan (Network of managers of marine protected areas in the Mediterranean). The objective of the network is to improve the effectiveness of marine protected areas management in the Mediterranean. The MedPAN network today counts over 40 members, mainly managers of marine protected areas from the entire Mediterranean basin, and 23 partners that are keen to contribute to the strengthening of the network.

United Nations Environment Programme's Mediterranean Action Plan (UNEP/MAP): for over 30 years and within a context of growing international action for the environment, the 21 states bordering on the Mediterranean and the European Community have together been developing an original mechanism for environmental regional cooperation within the framework of the United Nations Environment Programme's Mediterranean Action Plan (UNEP/MAP). Key Map priorities are: to protect marine and coastal habitats and threatened species, reduction in pollution from land-based sources, intensify integrated planning of coastal areas, monitor the spreading of invasive species.

Blue Plan: the Blue Plan is one of the stakeholders involved in this cooperation. One of the main tasks with which it is entrusted is to produce information and knowledge in order to alert decision-takers and other stakeholders to environmental risks and sustainable development issues in the Mediterranean, and to shape future scenarios to guide decision-taking processes. Blue Plan has recently produced an economic valuation of ecosystem services in the Mediterranean

GFCM

FAO Regional Projects: Copemed, MedSudMed, EstMed…

Mediterranean Aquatic Sciences libraries and information centres Network

EU FP 7 Programmes

COCONET (Towards COast to COast NETworks of marine protected areas): the Project will identify groups of putatively interconnected MPAs in the Mediterranean and the Black Seas, shifting from local (single MPA) to regional (Networks of MPAs) and basin (network of networks) scales. The identification of physical, biological connections and processes that govern patterns of biodiversity distribution. This will enhance policies of effective environmental management, also to ascertain if the existing MPAs are sufficient for ecological networking and to suggest how to design further protection schemes based on effective exchanges between protected areas

PERSEUS (Policy oriented marine Environmental Research for the Southern European Seas) is a research project that assesses the dual impact of human activity and natural pressures on the Mediterranean and Black Seas. PERSEUS merges natural and socio-economic sciences to predict the long-term effects of these pressures on marine ecosystems. The project aims to design an effective and innovative research governance framework, which will provide the basis for policymakers to turn back the tide on marine life degradation

1.2. Tools:

Ecosystems models: (EWE, Osmose, Atlantis ….), of course !!

Bioeconomic models: only a few applications of bioeconomic have been done in the Med. A specific model has been developed for the Med (Mephisto), other models and applications are in development.

Economic evaluation of marine ecosystem services: one study has been done at the Med level (Blue Plan), most experiences are local.

Long Monitoring of ecosystems and resoures. The MEDITS survey program (International bottom trawl survey in the Mediterranean) intends to produce basic information on benthic and demersal species in term of population distribution as well as demographic structure, on the continental shelves and along the upper slopes at a global scale in the Mediterranean Sea, through systematic bottom trawl surveys.

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

I would like to speak about economic and social aspects gaps in EAF. Most EAF models and more general EAF approach are dominated by ecological approach, questions and results, and this may look normal EAF is dealing about impact of fisheries on ecosystem. But some important points to advance EAF need socio-economic approach to be carried up:

-Evaluation of the true cost of fishery mismanagement: today we only take in account market costs (loss of economic rent). A broader approach will involve the estimation of non-market costs (biodiversity and non-market ecosystem services loss. To do that Environment Economics theory and methods have to be used for:

-Identification and assessment of key human drivers of marine ecosystem degradation: fisheries, coastal demography, tourism, pollution

-Sensibility of ecosystem impacting activities to economic and social drivers

-Responses of ecosystem impacting activities to environmental or sectorial public policies and to market and non-market incentives.

-Participate to the production of long term scenarios including key human drivers.

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

1-Improving partnership, exchange of data, knowledge and experience among existing research and management institutions. Despite the positive action of regional Bodies (GFCM for instance) and projects (Copemed, Medsumed), the global approach necessary to promote EAF needs more integration at regional level. Most research teams want now to work on EAF but still at a national level, and then we have national contributions to solve a non-national problem: ecosystems and their resource are a common good between Med and Black Seas countries and their degradation is a shared problem which needs better coordination between scientific actors.

2- Capacity building to help people to achieve scientific excellence in the field of EAF.

Sustain the role of leading scientific institutions and University in the field of EAF for high level training for students and also for scientist and managers who want to improve their skills.

3.-Develop and sustain partnership through the participation to regional EAF research program (probably funded by E.U….). To be viable a network needs to rapidly lead to concrete scientific action !!!

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

- Marine protected areas (MPAs), which are an ecosystem-based management tool (EBM), if used for fisheries management, are an EAF.

- However, for now, they have been showed to have positive fisheries effects only when they are well enforced and only for small scale artisanal fisheries.

- Therefore, MPAs cannot be the unique solution to manage fisheries at the Mediterranean and Black Sea Mediterranean scale. They are a place-based EAF.

- The above mentioned fishery benefits of MPAs rely on exportation of biomass from MPAs (spillover). Another positive effect of MPAs for fisheries rely in the potential they have to positively modify the behavior of fishermen: in well co-managed MPAs (by scientists, fishermen and managers), fishermen can be an integral part of the local management of marine resources, and then fish in a more sustainable way and obtain eco-labels. This can be seen as an important first step towards more regional implementations of EAF.

- Ecological network of MPAs (i.e. based on connectivity) at the regional Mediterranean and Black Sea scale can be a step further towards a coherent regional EAF. The establishment of such network is one of the objectives of the FP7 COCONET project (COast to COast Network).

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

- Connectivity

- More involvement of fishermen (acceptability of new measures is key) and consumers

- Effect on multiple stressors (besides fisheries mortality) on juveniles and adult mortality and food web alterations.

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

- To be effective such a (scientific) social network should also involve fishermen and managers.

- A common shared database (independent of any scientific national institutional structures) should be established and updated regularly

- The coordination could be rotating among the concerned countries as it is for some EU institutions.

Ecosystem models for the scientific support to EAF in the Mediterranean Sea

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For the Ecosystem-based Approach to Fisheries (EAF), adaptations of the scientific method are required, in parallel with changes in the way ecological, social and economic issues are integrated to manage marine resources (Browman et al. 2005a, Browman et al. 2005b). New methodological tools have been developed that contribute to an EAF, such as a selection of ecosystem models (e.g. Christensen and Walters 2004, Fulton and Smith 2004, Shin et al. 2004, Walters et al. 2008, Fulton 2010, Walters et al. 2010, Fulton 2011). Nowadays, ecosystem modelling tools are being developed and applied extensively to support the EAF (Plagányi 2007, FAO 2008).

Recently, there has been an increase on public awareness, leading to a demand for better management of marine resources in the Mediterranean Sea (e.g. UNEP 2009), and to progress towards the development of an ecosystem-based approach (e.g. EU 2001, GFCM-SAC 2005). Several countries around the Mediterranean Sea have signed international treaties and agreements, such as the Convention on Biological Diversity (CBD) or the UN Framework Convention on Climate Change (UNFCCC), which require the adoption of a more holistic ecosystem-approach to the management of resources. Thus contributions to the implementation of an EAF process have been increasing and are especially abundant in the context of

conservation and fisheries (e.g. CIESM 1999, CIESM 2000, Tudela 2004, WWF/IUCN 2004, GFCM 2007, IUCN 2007, CIESM 2008, Cochrane and de Young 2008).

The scientific community around the Mediterranean has also shown a growing interest on ecosystem-based studies, with an increase in research in the development of ecosystem models using available tools such as the *Ecopath with Ecosim* (*EwE*) modelling framework (Christensen and Walters 2004). In the last decades more than 40 applications were developed for Mediterranean waters using the *EwE* model (Coll and Libralato 2012). These models were used to analyse a variety of environmental problems in an ecosystem context. Many applications analysed the ecosystem impacts of fishing and assessed management options. Other studies dealt with the accumulation of pollution through the food web, the impact of aquaculture, or the ecosystem effects of climate change. These developed models contributed to the scientific aspects of an ecosystem-based approach in the region since they integrated human activities within an ecosystem context and evaluated their impact on the marine food web, including environmental and socio-economic factors (Coll and Libralato 2012). These studies also gathered a significant amount of information at an ecosystem level.

In addition, other multispecies models are starting to be applied in the Mediterranean Sea such as the multispecies size-based model OSMOSE (Shin and Cury 2001, Shin et al. 2004, http://www.meece.eu/highlights/osmose.html), which is being developed in the Gulf of Lion, the Adriatic Sea and the Aegean Sea (Y.-J. Shin, personal communication). OSMOSE has been applied to model marine protected areas, fishing moratoriums, overexploitation scenarios, and combined effects of climate change and overexploitation. Applications of the Atlantis model (Fulton et al. 2005, Fulton 2010, http://atlantis.cmar.csiro.au/) are being planned in the Western and Central Mediterranean Sea (B. Fulton, personal communication), with the most advanced one based around Sicily. The Atlantis model considers all parts of marine ecosystems - biophysical, economic and social and its overall structure is based around the Management Strategy Evaluation (MSE) approach, where there is a sub-model for each of the major steps in the adaptive management cycle. This approach means it can be used to evaluate the full suite of management options in the context of global change, coastal development and catchment modification.

All these modelling initiatives represent tools and analysis to advance our scientific knowledge on how marine ecosystems are structure and how they function, and how humans impact marine ecosystems and *viceversa*. They can be applied to evaluate the impact of alternative management scenarios in ecological and socio-economic systems. They can also be used to analyse single species issues such as alternative sources of fishing and predation mortality, connectivity issues of stocks, migration and distribution of species, biological thresholds needed to maintain healthy populations, etc. Therefore, we argue they will be essential in the Mediterranean Sea to move forward the EAF process, as they are key in other areas such as Australia, Canada, and South Africa (Fulton et al. 2007, Plagányi 2007, FAO 2008, Shannon et al. 2010).All these different tools are also used to tackle the issue of integrating hydrodynamic and biogeochemical features

with food web and fisheries dynamics for comprehensive ecosystem descriptions using different details, integrating scheme and coupling methods (Travers et al. 2007, Libralato and Solidoro 2009, Fulton 2010).

Despite the growing development of ecosystem modelling capabilities worldwide and in the Mediterranean Sea, modelling tools are not yet being fully used for real management of marine resources. Hopefully, the accumulation of ecosystem-based knowledge that has occurred over the past decades will be translated into robust, well tested and useful results. A broad consensus derived from improvements and development of useful applications will represent a further step towards a real implementation of an ecosystem-based management of Mediterranean marine resources in the future.

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The IndiSeas International initiative to inform EAF

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One of the challenges faced by the scientific community when contributing to the ecosystem approach to fisheries (EAF) is to agree on a generic set of synthetic ecological indicators that can reflect the effects of fisheries on marine ecosystems, and thus support communication and management processes. Moreover, references points as targets, limits and thresholds are necessary. Therefore, the role of indicators and reference values is fundamental to EAF.

The IndiSeas Working Group (IndiSeas WG) is an international effort established in 2005 under the auspices of the Eur-Oceans Network of Excellence that aims to develop methods to provide indicators-based assessments of the status of exploited marine ecosystems in a comparative framework (Shin and Shannon 2010). The project is divided in two phases: (i) IndiSeas1 (2005–2009) that culminated in the publication of nine papers (Shin and Shannon 2010, Shin et al. 2010b) and a website of comparative analyses (http://www.indiseas.org), and (ii) IndiSeas2 (2010-2013) that is still running and aims at addressing issues raised during the first phase of the project.

During IndiSeas1 the WG gathered and shared indicator expertise across marine ecosystems and member institutions to: (i) chose a set of synthetic ecological indicators; (ii) build a generic dashboard using a common set of interpretation and visualisation methods, and (iii) evaluate the exploitation status of marine ecosystems in a comparative framework. The group selected a suite of eight ecological indicators to describe the state and long and short term trends of nineteen exploited ecosystems using a range of methods to analyse and assess their status (Table 1). The suite of indicators was selected using established criteria, and was intended to reflect different

dynamics, tracking processes that display differential responses to fishing, and to provide a complementary means of assessing marine ecosystem trends and states (Blanchard et al. 2010, Shin et al. 2010a). One of the key important features of IndiSeas1 was that strongly relied on inputs and insights provided by the local experts from participating ecosystems, helping to understand state and trend indicators and to disentangle the effect of other potential ecosystem drivers, such as climate variability (Coll et al. 2010, Jouffe et al. 2010, Link et al. 2010, Shannon et al. 2010).

The main objective of IndiSeas2 (2010–2013) is to refine previous evaluation and communication of the ecological status of marine ecosystems subject to multiple drivers (climate, fishing) in a changing world in support of an EAF (Shin et al. 2012). To do so, IndiSeas2 WG is developing a combination of data driven and ecosystem modelling approaches to evaluate the status of the world's exploited marine ecosystems subjected to multiple drivers. A large effort is being developed in complementing the suite of indicators with biodiversity and conservation-based, environmental and socioeconomic indicators (Shin et al. 2012). The WG is also exploring and testing the set of indicators with development of new methods (integration, reference levels & thresholds , test responsiveness and performance, and modeling). IndiSeas2 is also aiming at increase the coverage to include more ecosystems (Figure 1).

Overall, the IndiSeas project illustrates that the use of simple and available indicators under an ecosystem approach can achieve a real, wide-reaching evaluation of marine ecosystem status caused by fishing (Bundy et al. In press). This is important under the EAF context because the socio-economics of areas where fishing activities develop differs significantly around the globe, and in many countries, insufficient data are available for complex and exhaustive analyses. Moreover, IndiSeas also shows that a comparative framework enables the selection of a robust suite of indicators that are meaningful and measurable over diverse and contrasted conditions. It provides the basis for developing a range of reference values, under different environmental and fishery conditions, against which ecosystems can be assessed. Ultimately, it enables a broader ecosystem perspective and a more complete understanding of ecosystem response to multiple drivers (Bundy et al. In press). By contrast with other indicator initiatives aimed at a global comparison, IndiSeas relies on research survey data rather than commercial catch data. This has the benefit of data being less biased and more robust, but faces the challenge that these are national data, generated and owned by institutions. However, IndiSeas has engaged partner countries from the developed and developing world, their institutions and collaborators in a collective effort to leverage their expertise of individual systems. IndiSeas thus strengthens linkages between global and national indicator development and reporting, in line with the CBD Nagoya Strategic Plan for Biodiversity 2011–2020 (Shin et al. 2012).

Of a total of 35 case studies, IndiSeas2 is currently being applied to 6 Mediterranean case studies: the Southern Catalan Sea, the Gulf of Lions, the North-Central Adriatic Sea, the Gulf of Gabes, the Ionian Sea archipelago, and the North Aegean Sea (www.indiseas.org) (Figure 1). Therefore, we argue that this is an ongoing interesting initiative that could inform the EAF

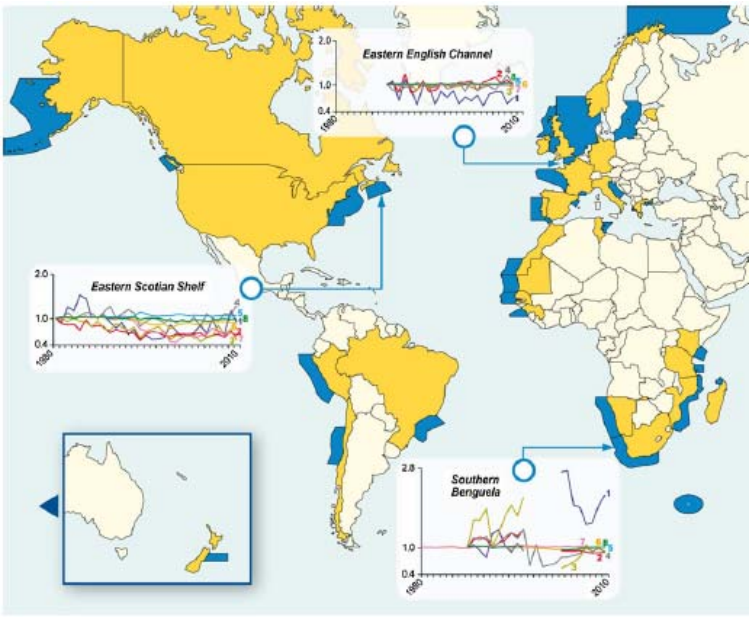
process in the Mediterranean Sea, as it is informing the process in other regions such as Canada and South Africa.

Table 1. Summary of ecological indicators selected by the IndiSeas1 WG and the corresponding management objectives (from Shin et al. 2010b).

Indicators	Headline label	Used for State or Trend	Management objective[a]
Mean length	Fish size	S, T	EF
TL of landings	TL	S, T	EF
Precaution of under- and moderately exploited stocks	% healthy stocks	S	CB
Proportion of predatory fish	% predators	S, T	CB
Mean lifespan	Lifespan	S, T	SR
1/CV of total biomass	Biomass stability	S	SR
Total biomass of surveyed species	Biomass	T	RP
1/(landings/biomass)	Inverse fishing pressure	T	RP

[a]CB, conservation of biodiversity; SR, maintaining ecosystem stability and resistance to perturbation; EF, maintaining ecosystem structure and functioning; RP, maintaining resource potential.

Figure 1. Marine ecosystems considered by the IndiSeas2 program (end of 2011). Blue, the marine ecosystem; yellow, the countries participating in the analyses. Examples of time series of standardized ecological indicators collated by the program. 1) total biomass surveyed, 2) mean length of fish in the community, 3) proportion of predatory fish, 4) mean lifespan, 5) intrinsic vulnerability index of the catch, 6) trophic level of the landings, 7) Marine Trophic Index, 8) trophic level of the surveys. Data source: EEC— IFREMER, France; ESS— Maritimes Region, Fisheries and Oceans anada; SB—Department of Agriculture, Forestry and Fisheries, South Africa (from Shin et al. 2012).



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Incorporating single species assessment in EAF in the Mediterranean Sea

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The number of consistently assessed Mediterranean stocks by GFCM and European Scientific, Technical and Economic Committee for Fisheries (STECF-SGMED: Sub group for the Mediterranean Sea) working groups increased significantly in the last 5 years as a result of the enhanced data collection system and commitment of scientists, elucidating the status of fisheries resources in the Mediterranean. According to STECF (2010), about 84% of the stocks assessed in Mediterranean European countries are overfished and generally characterized by truncated size and age structures. It can be easily demonstrated that under the current fishing regime, stock productivity and fleet profitability are generally impaired by a combination of high fishing mortality and inadequate selectivity pattern. For most of the stocks analysed a simple reduction of the current fishing mortality (Fcur) toward a MSY reference value (FMSY) without any change in the fishing selectivity will neither allow to maximize the stock biomass nor the fisheries yield and revenue. On the contrary, management targets can be achieved only through a radical change in fisheries selectivity, increasing the size at which commercial species are captured by fishing fleets. This will have the effect of producing higher economic yield for the fleets, high biomass at sea and a more natural size composition of the exploited stocks.

Shifting the size of first capture toward the size at which fish cohorts achieve their maximum biomass, the so-called optimal length, would produce in average between 2 and 3 times higher economic yields and much higher biomass-at-sea for the exploited stocks. Moreover, measures aimed at rebuilding of the size structure of commercial fish allow also to mitigate the impact of fishing on ecosystems and fish communities, achieving MSY for increasing number of stocks and thus contribute to restore ecosystem structure and resilience, a fundamental management target in the implementation of EAF.

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Strengthening the scientific basis of EAF Application in Eastern Mediterranean (Egypt)

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

Initiatives and tools:

Few, scattered projects/programs have been carried out considering certain components of the ecosystem, but the integration between them is lacking. Those projects resulted in promising results, but their full scale implementation in actual management practice is still lagging behind.

Egypt is currently participating in a number of EU projects and initiatives related directly or indirectly to EAF. These include:

People for Ecosystem Based Governance in Assessing Sustainable Development of Ocean and Coast (PEGASO (FP6), 2009-2013)- http://www.pegasoproject.eu

Assess and predict changes in the Mediterranean and Black Seas ecosystems as part of the FP6 project (SESAME, FP6)- www.sesame-ip.eu

The future of research on aquaculture in the Mediterranean region (AQUAMED, FP7, 2010-2013)- www.aquamedproject.net

Evaluation of chemical contamination in the Eastern Mediterranean by the method of transplanted mussels (MYTIOR).

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

Scientific gaps that need to be address to advance EAF:

The potential impacts of climate change on the Northern Delta belt and coastal Lagoons.

The Northern delta belt of Egypt is about 1-3 m below sea level. Coastal lagoons fall within this belt. The existence of these areas is threatened by sea level rise, resulting of global warming. Many migratory (catadromous) fishes that live in these lagoons, and spawn in the sea, whereas their offspring return to these lagoons for nursing and growing. These species are very likely to be adversely affected by climate changes. Climate change may also affect the structure,

biodiversity and habitat of fish stocks in the region. Global warming will probably reduce the primary productivity in this sub-basin, which is already oligotrophic, leading to adverse effects on food web and, in turn on fish communities, and ecosystem in general.

However, little information is available on these effects. These issues need considerable attention.

Effects of alien/ invasive species

Fish biodiversity in the Eastern Mediterranean basin has been considerably changed since the opening of the Suez Canal connecting the Red Sea with Mediterranean Sea in 1869. The Canal has favored the northward migration of many erythrean species to the Mediterranean Sea. This process is expected to accelerate with the rise in water salinity following the retention of the Nile outflow by the High Dam (Halim and Rizkalla, 2011). Endemic fish species, species communities, structure, niches, habitats, etc. will be affected by this process. The decrease in abundance of many species, and even the disappearance of some commercial species in Eastern Mediterranean may have been attributed to this process. However, this issue needs more work.

Anthropogenic impacts:

Egyptian Mediterranean coast has been subjected to considerable land-based anthropogenic pressure, including tourism, agricultural and industrial runoffs, urbanization and pollution. This pressure is very likely to increase with increasing coastal human activities, and in turn, will affect fish and fishing industry and aquatic ecosystem as a whole.

Lack of extension and capacity building:

Most of the parties engaged in fisheries activities including, fisheries officers, researchers, NGOs and other stakeholders lack EAP concept. Information is also poorly disseminated.

Poor-data areas:

Data is either lacking or limited in many areas of the Mediterranean Egyptian waters.

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

Building a scientific network for EAF in the Mediterranean and Black seas

Identify the potential, gaps and constraints of EAF

Identify data needs, harmonization, methodologies, training and coordination program;

Collate information on the extent of scientific research programmes being undertaken on EAF. Research gaps in data-poor areas should be filled.

Carrying out training programmes, communication and awareness-raising activities among all stakeholders, at the national and regional levels,

Establishing programmes for training, workshops, technology transfer and exchange of researchers and expertise and coordination between Mediterranean and Black Sea countries;

Establishing mechanisms for dissemination, communication and networking of project results among relevant stakeholders.

Creating a network of stakeholders for promoting the dissemination of science-oriented EAF.

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

At present in Tunisia, there isn't any scientific initiative so tools that can contribute to EAF in the Mediterranean and Black seas.

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

- Definition of the stock units and ecosystems to be considered

- Availability and quality of data : Generally, data (environmental, biological, dynamic, economical, …) are punctual in time and space which opposes to quantitative analysis to identify and evaluate key indicators and their trend;

- Scarcity of studies relative to the impacts of other anthropogenic activities (tourism, industry, aquaculture, …) on fisheries;

- Poor cooperation between the different stakeholders of fisheries and ecosystems especially between scientific institutions (intra and inter) and/or governmental administrations.

These gaps are the result of the adopted strategy to the elaboration and execution of studies on fisheries: the majority of studies are species-oriented (eco-biology, stock assessment, etc.) in an annual basis. Otherwise, this strategy didn't take in account the future application of the EAF.

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

The creation of permanent transversal working group on EAF in the Mediterranean and Black seas attached to the SAC of the GFCM. This WG could be composed by Scientists in the different fields related to fisheries and representatives of NGO and decision makers.

Main conclusions of the STECF experts working group on the development of an effective EAFM in European Seas

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Summary

The experts working group on the "Development of the ecosystem approach to fisheries management (EAFM) in European seas" has been set up by STECF (Scientific technical and economic committee of the European commission) in 2010. It is requested to develop a pragmatic feasibility approach to provide some useful assessments and ecosystem advices in support of EAFM. The presentation will focus on the main conclusions and the general approach developed within this working group.

1. As a first step of EAFM implementation, a reference list of 14 ecosystems has been defined by STECF in European seas. The feasibility analysis conducted by the working group confirms that these ecosystems represent the appropriate scale:

. to synthesise stock status and analyse trends in the ecosystem indicators,

. to study ecological impacts and economic performances of fleet segments,

. to analyse trade-offs between economy and ecology in order to develop fleet-based management of fisheries,

. to define long term management plans,

. to improve dialogue and involve stakeholders in participative management of fisheries.

Reference ecosystems should now be considered in all data collection programs related to fisheries, resources, habitats, etc. They should also be considered as the functional units used in ICES, CGFM and STECF working groups.

2. Three key aspects constitute the work that has to be performed on a regular basis to implement a scientific-based EAFM in European Seas:

. Diagnoses on ecosystem health have to be defined and regularly updated for each of the 14 European ecosystems. Such diagnoses have to take into account stock-based and ecosystem indicators (see below), in close cooperation with the implementation of the MSFD (on the good environmental status of marine ecosystems).

. Both the environmental impacts and the socio-economic performances of the various fleets operating within each ecosystem have to be assessed and monitored.

. For each European ecosystem, one or a limited set of ecosystem and bio-economic models should be set up and used on a regular basis for advice-oriented purposes.

3. As a feasibility test, the working group provided a first diagnosis on the health of seven European ecosystems (Fig. 1). In all these ecosystems, the fishing mortality index exhibits a decreasing trend over the last years, highlighting a decrease in the mean fishing pressure applied to the assessed stocks. But at the same time, the whole spawning biomass of assessed stocks is still decreasing in some ecosystems (Irish Sea, Iberian coast), while it exhibits an improving trend in others (North Sea, Celtic Sea, Bay of Biscay). Even in this (favorable) latter case some ecosystem indicators are still decreasing. The working group concluded that the decrease observed in fishing pressure seems to have not been strong enough or not long enough to allow the recovery of ecosystems from a generally depleted state. It also noticed that some contrasts do exist within ecosystems (for instance, the Bay of Biscay ecosystem seems in better shape or better trend than the West of Scotland/Ireland ecosystem).

		Land. Y	Effort E	Mortal. F	Biom. SSB	Recr. R	Sust. F*	Survey LFI	Survey MMLw	Survey MTL	Land. MMLw	Land. MTL	% asses.
Baltic Sea		↘	→	↘	↺	→	😐	↺	↺	↺	↘	↘	≈ 95
North Sea		↘	↘	↘	↗	↘	😐	↘	↘	?	Low	low	≈ 85
Northwestern Atlantic	West Scot./Irl.	↘	↘	↘	?	↘	😐	?	↘	↘	↘	↘	≈ 90
	Irish Sea	↘	↘	↘	↘	↘	?	→	↗	↘	→	↘	≈ 35

waters	Celtic Sea	↘	↘	↘	↗	↘	☺	?	?	?	low	↘	≈ 40
South western Atlantic waters	Bay of Biscay	→	?	↘	↗	↘	?	↗	→	→	↗	→	≈ 45
	Iberian Coast	↘	?	↘	↘	↘	?	→	→	↗	→	↘	≈ 40

Figure 1. Trends in the main indicators of the Ecosystem health in the seven ecosystems considered as case studies: total landings Y, fishing effort E, mean fishing mortality F, total stock spawning biomass SSB, mean recruitment index R, index of mean sustainable fishing mortality F*, large fish indicator from surveys LFI, mean maximum length MMLw from surveys or from landings, mean trophic level MTL from surveys or from landings, % of landings due to assessed stocks.

4. Ecological impacts and socio-economic performances of the major fleet segments operating within each of the seven considered ecosystems were analyzed, using a set of 13 indicators. Here, a first attempt to draw a synthesis is presented based on averaged indicators (Fig. 2). It clearly highlights that this approach is able to show contrasts which do exist between fleet segments. On average, the major fleet segments (in terms of vessels number) have similar socio-economic performances, but very different ecological impacts. A few fleet segments have high ecological impacts, some with high socio-economic performances while others exhibit rather poor economic performances.

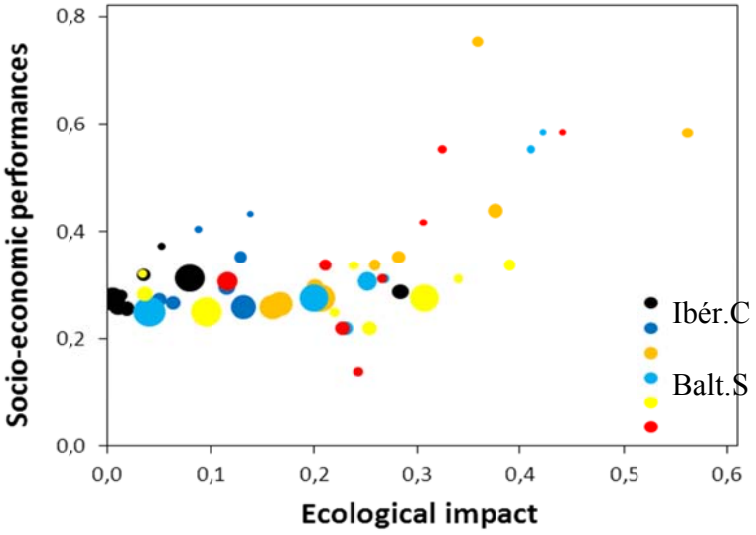

Figure 2. Ecological impact and economic performances of the major fleet segment operating within each ecosystem. Mean ecological impact and s[illegible]c performance of each fleet refer to averages of the 7 and 6 related indicators. Bubbles size is proportional to the number of vessel per fleet segment.

The working group concluded that this kind of fleet-based assessment is the pathway for implementation of efficient EAFM in European Seas (see also Gascuel et al, 2012, *Marine Policy*). In the future, it should clearly be part of a framework used to determine which fleet segments would need to be reduced and which could be developed and to what extent. Environmental assessments should also be used to guide the definition of long term management plans, including some regulation of the fishing effort and fleet-based access rights. It could also support introduction of economic incentives in order to encourage fleets to improve their fishing practices.

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Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

EU projects

RFBs (GFCM, ICCAT, BSC)

UN org (FAO, UNEP RAC/SPA)

GEF

IUCN, MEDPAN, CIESM

NGOs (WWF, Greenpeace, Oceana)

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

Projects and initiatives ignore other similar ones. Need to improve communication and coordination among researchers, institutions and international

Poor technical capacity (i.e. very few scientists trained in EAF concepts and tools)

Limited knowledge on the biology of certain taxa indirectly affected by fishing (eg., elasmobranchs, seabirds, marine turtles)

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

Led by a steering committee composed by scientists of a diversity of countries and international organizations (do not give the leadership to one institute or organization). Scientists selected according to technical capacity, not criteria of country balance or gender balance

The functions must be

Communication among scientists and to society

Coordination of initiatives

Lobbying /fund raising

Training programs

VERY IMPORTANT: the steering committee members as well as all participants in the network act as scientists or experts, NOT AS NATIONAL REPRESENTATIVES.

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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Georgia is a rich country with its hydrobiological resources. The Black sea, numerous rivers, storages and lakes have made it suitable for the development of marine, inland fisheries and aquaculture.

Since 1991 economic difficulties and social conditions, also lose of consumer market of ex Soviet Union has influenced negatively on the fisheries sector. Absence of trade guidance has resulted a wide dissemination of poaching. In Georgia institutional structures supported the fisheries sector; development and guidance of aquaculture have been absence in fact. There is not a legislative and regulatory base.

Lack of educational programs referred to fisheries and aquaculture in training colleges, schools and institutions of higher education, also weak perspectives in supply of job and its progress have explained absence of interests in new generation.

In Georgia there was just one special scientific research institute on marine ecology and fisheries (Marine Ecology and Fisheries Research Institute MEFRI) founded in 1931 and located in Batumi. The Institute worked at issues of fisheries stock, common fisheries resources and their leadership, also specific diversity of the Black Sea Georgian coast and inlands, problems about ecology and aquaculture. Since 1997 with the help of temporary methods (echolocation, mathematical model at.al) in accordance with Ukrainian colleagues the stock assessment of the Black Sea anchovy was implemented. However the institute was reorganized in 2006 and researches in that field were ceased. There are archive data being as reports (not electronic format) on the research of the Black Sea Georgian Coast and quite a few publications.

Nowadays some limited data about marine state and inland water resources have been presented. A state organization of the Black Sea monitoring centre being a branch of the Ministry of Nature Protection of Georgia studied partially fisheries stock established catching quotas up to 2007-2008. At the moment this organization implements basically monitoring of the Black Sea Georgian coast pollution. Our institute WEFRI and nongovernmental organizations research the biodiversity. For the full-fledged investigation that could make a possibility to assess fisheries resources and implement the treatment and monitoring of fisheries law, lack of personnel and financial tools are absence.

In 2004-2005 with support of FAO and other international organizations there was made a management plan for fisheries development and also 20 years development plan for aquaculture. Though unfortunately it has not further been lasted.

For the adoption of Ecosystem Approach of Fisheries it is needed the following issues:

Improvement of legislative base and corresponding it to the international law;

Promotion of institutional level, training of special responsible persons for fisheries;

Create appropriate educational system assisting improvement of marine researches and advance of fisheries, preparation of high qualified personal;

Introduction of modern methods for fisheries stock assessment;

Strengthening the control on use of banned gears, introduction of contemporary methods of catching;

Assistance for modernization of fisheries fleet, rigging vessels by contemporary gears;

Improvement of statistical data system in fisheries.

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Mediterranean and Black seas?

Marine Strategy Framework Directive (MSFD) as a thematic strategy in EU Member States since it has the goal of achieving good environmental status (GES) across all European waters by 2020. Moreover the reformed Common Fisheries Policy (CFP) aims to manage fisheries such that the objectives of the MSFD are not compromised, which is clearly stated in the CFP Green Paper. A number of the qualitative descriptors of the MSFD are affected by fishing; indicators to characterise these have been developed and suggested at several working groups.

EU projects and initiatives:

The MAREA (Mediterranean hAlieutic Resources Evaluation and Advice) project consortium and it's specific projects MEDISEH (Mediterranean Sensitive Habitats Projet) and BEMTOOL. http://mareaproject.net.

EU FP7 project MESMA (Monitoring and Evaluation of Spatially Managed Areas), which is a large scale integrating project which aims at developing strategies, guidelines, tools and a systematic framework to facilitate the integrated monitoring, evaluation and implementation of spatially managed marine areas. See www.mesma.org.

The EU FP7 project GAP II, which aims to bring together scientists, fishers and policy makers to shape sustainable fisheries. The objective of the project is to work together for healthy seas on which society can depend upon for food, income and livelihoods through participation in joint research and shared learning. www.gap2.eu

EU FP7 project PEGASO (People for Ecosystem-based Governance in Accessing Sustainable Development of Ocean and Coast), www.perseus-net.eu/. *NB. Malta is not involved in this project.*

EU FP7 project CoralFISH, which is assessing the interaction between cold water corals, fish and fisheries, in order to develop monitoring and predictive modelling tools for ecosystem based

management in the deep waters of Europe and beyond. http://www.eu-fp7-coralfish.net/. *NB. Malta is not involved in this project.*

EU Fp7 project ODEMM (Options for Delivering Ecosystem-based marine management). The overall aim of the ODEMM project is to develop a set of ecosystem management options that would deliver the objectives of the Marine Strategy Framework Directive, the Habitats Directive, the European Commission Blue Book and the Guidelines for the Integrated Approach to Maritime Policy. http://www.liv.ac.uk/ODEMM/ *NB. Malta is not involved in this project.*

EU FP7 project MYFISH (Maximising yield of fisheries while balancing ecosystem, economic and social concerns). *NB. Malta is not involved in this project.* http://ec.europa.eu/research/bioeconomy/agriculture/projects/myfish_en.htm

2) Which are the scientific gaps in the Mediterranean and Black seas that need to be address to advance EAF?

Lack of information on ecosystems functioning, especially with regards to food webs and inter-species interactions.

Limited information on levels of discarding / by-catch and the impact of fishing on non-target as well as protected species.

Limited information on the location of nursery / spawning areas as well as stock structure general; hence lack of information on suitable population units for management purposes.

Lack of information on demersal habitats, including protected habitats (under habitat directive / Mediterranean regulation).

Need for increased consideration of economic and social parameters, including factors influencing fishing fleet behaviour. Taking into account artisanal fleets and large number of recreational fishermen in the Mediterranean this aspect is in particular is a limiting factor.

3) How do you envisage a scientific network for EAF in the Mediterranean and Black seas? Who could be the key players?

General Fisheries Commission for the Mediterranean (GFCM), in particular through activities of the Sub Committee on Marine Environment and Ecosystems (SCMEE).

FAO regional projects CopeMed, MedSudMed, AdriaMed and EastMed since they have existing regional networks / working groups which include key players already in place.

STECF working group on Ecosystem Approach to Fisheries; STECF EWG 11-13 recommended that the next meeting of this working group should for the first time apply the approach taken for the North of Europe to the Mediterranean.

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Mediterranean and Black seas?

The most abundant and commercially important fish species in the Black Sea are small pelagics – sprat, anchovy and horse mackerel. Anchovy and horse mackerel are migratory, but sprat, as well as most of demersal species, accomplish predominantly local migrations, but cross the EEZ of coastal states. The biology and behavior of commercially important species requires assessments and management to be extended to the whole distribution area of species. For that reason, the status of fish stocks of key species was assessed and managed both at national and regional levels. The recent initiatives related to EAF are:

EU Initiatives

Data Collection program – since 2008, Bulgaria and Romania collect data in the fisheries sector under Council Regulation (EC) No.199/2008. Since 2010, all scientific surveys in Black Sea (EU waters) are joint for Bulgaria and Romania.

EU Funded Projects, related to EAF (KnowSeas, MESMA, PERSEUS, CoCoNET, etc.).

EWG Black Sea under STECF – stock assessment group was establishes under STECF which made assessments of 5 commercially important fish species during the period 2008 – 2011 (Pilling et.al, 2008; Daskalov et.al., 2009; Casey et.al., 2009; Daskalov et.al., 2010; Daskalov et.al., 2011).

NATURA 2000 – ongoing project for enlargement of marine NATURA 2000 sites in Bulgaria.

Regional Intiatives

Black Sea TDA (2007) - recent assessment of the environmental status of the Black Sea, focusing on the major transboundary problems, their causes and what should be done to improve its status in the future.

State of the environment of the Black Sea (2001 – 2006/7) (BSC, 2008).

National Initatives

Legislation in fisheries sector

Harmonization of legislation in the field of fisheries between Bulgaria and Romania (technical measures, temporary fishing bans, etc.)

2) Which are the scientific gaps in the Mediterranean and Black seas that need to be address to advance EAF?

In the Black Sea area there is a need the current fisheries management to be improved. Interactions that occur between fisheries and ecosystems and the effect of natural long-term variability, should be taken into consideration. The major gaps are:

Lack of regional fishery management system with harmonized technical measures at the regional level (fishing bans, permitted fishing gears, mesh size), etc.

Lack of joint regional scientific surveys on shared and migratory stocks.

Assessment of IUU fishing at regional level.

Assessment of the effect of non-sustainable fishing technologies on marine environment.

Lack of standardized fisheries data collection program for the Black Sea in compliance with regional requirements and aiming at enhancing the reliability of the relevant data on landings and discards.

Biodiversity/habitat changes, including alien species introduction

Low level of development of MPAs in the Black Sea.

3) How do you envisage a scientific network for EAF in the Mediterranean and Black seas? Who could be the key players?

Effective scientific network for implementation of EAF in the Black Sea should involve following partners:

All coastal states – including research institutions, governmental bodies, stakeholders, NGOs

Black Sea Commission

EU (EWG Black Sea)

GFCM

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

- Scientific, Technical and Economic Committee on Fisheries (STECF), European Union

- General Fisheries Commission for the Mediterranean (GFCM)

- International Commission for the Conservation of Atlantic Tunas (ICCAT)

- Mediterranean Science Commission (CIESM)

- FAO Eastern Mediterranean Programme (FAO ESTMED)

- Scientific, technical reports and other scientific deliverables from EU funded "Life" projects aiming at identifying the interaction between marine protected species and fisheries (for example, conservation of monk seals versus fisheries, conservation of dolphins versus accidental catches in fishing gear, conservation of marine turtles versus accidental catches in fishing gear, accidental catches of marine birds in fishing gear)

- Mediterranean Action Plan (UNEP/MAP)

- Barcelona Convention

- Convention on Biological Diversity

- CITES

- EU relevant data base with respective scientific projects and initiatives

- Habitats Directive (EC 92/43) and all scientific information gathered by Member States and the European Union

- Birds Directive (EEC 79/409) and all scientific information gathered by Member States and the European Union

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

- Lack of knowledge on the impacts of climate change on the marine environment and marine organisms, especially in the Eastern Mediterranean.

- Knowledge on the impacts of invasive species (mostly lessepsian) on endemic populations especially in the Eastern Mediterranean..

- Governments' ineffectiveness on decision making and implementation of conservation management measures.

- Lack of understanding of each country's particularities and specificities.

- Lack of holistic approach (marine and fisheries research together with other anthropogenic impacts) in scientific applications

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

- Formulation of respective policies and Strategies by Competent Authorities and International Organizations or Other Bodies (eg. National Governments, European Union, FAO, ICCAT, GFCM, UNEP/MAP etc)

- Creation of permanent EAF working groups under the umbrella of international institutions or organizations (European Union, STECF, ICCAT, GFCM, CIESM, FAO Est Med)

- A core group of scientists and policy makers exists that can take a broad set of recommendations and measures and adjust them to each country's characteristics.

- Frequent evaluations will be needed in order to ensure that the measures are having the desired results.

- Key players should not only include fisheries experts, but also, plankton experts, ecosystem modelers, economists, policy makers, sociologists and others.

Spatial approach to ecological base fisheries management in the Mediterranean and Black Sea

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1. The role of spatial planning in the ecological approach to fisheries

The ecological approach to fisheries (EAF) is based on the observation that traditional types of natural resource management have often failed and that a holistic approach based on the inclusion of ecosystem components and processes is required (Curtin & Prellezo, 2010). Due to their spatial nature, ecosystem components (including human activities) are suitable for spatial planning (SP), which is increasingly fostered as a promising way to address the sustainable use of natural resources (Katsanevakis et al., 2011). More specifically, SP aims at reducing user-user or user-environment conflicts whenever multiple uses of space and resources occur (Douvere, 2008), as is the case with fisheries.

SP includes a number of initiatives that span from marine reserves and no-take areas to temporary or permanent single-gear restrictions that take a variety of names: fishing exclusion zones, fishery reserves, fishing boxes, fishery restricted areas (FRAs), no-trawl areas (NTAs), etc. - here we will use the term Marine Protected Areas (MPAs) in a broad sense to group such initiatives. MPAs have many expected “internal” and “external” fisheries benefits. “Internal” benefits include habitat protection, settlement/spawning areas protection, larger sized individuals and higher abundance and biomass. “External” benefits include export of adult biomass (“spillover”) and of offspring, the latter is directly linked to increased reproductive potential (larger and older females produce much more eggs) (Bohnsack, 1998; Gell and Roberts, 2003). The magnitude and extent of the effects of MPAs depend on a number of factors that include life history and mobility of species, level of exploitation, hydrographic regime, availability of suitable habitats, size and age of MPA, enforcement, etc. (Claudet et al., 2008, 2010; Vandeperre et al., 2011). A reliable assessment of such effects - a key factor in any management measure - relies on a robust sampling design based on temporal and spatial controls (Claudet and Guidetti, 2010). There is growing evidence of fisheries benefits from large offshore as well as small inshore MPAs (Gell and Roberts, 2003; Goñi et al., 2011 *inter alia*). A broad and comprehensive review on MPAs as a management tool in the EAF context at a global scale has been published by FAO (2011).

2. The Mediterranean and Black Sea region

The complex and fragmented nature of fisheries, the conflicts between trawl and artisanal fishermen, the short distance between ports and the high biological diversity in the

Mediterranean and Black Sea region, all call for an integrated spatial approach to management. Many MPAs of several different types - from marine reserves to NTAs - have been created in the last three decades, especially in the western basin. Some of them (FRAs, NTAs, *cantonnements de pêche*) were explicitly implemented as a fisheries management tool. While several studies have shown an increase of fish biomass/abundance/size inside MPAs with some clear symptoms of recovery ("internal benefits"), evidence of direct positive effects to fisheries in terms of increased catches or other socioeconomic benefits("external benefits") is still scanty and regards a very limited spatial scale and only a few species from France (Harmelin Vivien et al., 2008; Seytre and Francour, 2008), Spain (Stelzenmuller et al., 2007; Harmelin Vivien et al., 2008; Stobart et al., 2009; Goñi et al., 2010), Italy (Whitmarsh et al., 2002, 2003; Guidetti & Claudet, 2009; Follesa et al., 2011; La Mesa et al., 2011), Malta (Camilleri, 2007).

3. Towards a strategy for a spatial approach to EAF (based on contribution from workshop participants)

3.1 Which are the existing key scientific initiatives and tools that can contribute to a spatial approach to EAF in the Mediterranean and Black Sea?

EU projects: MedSudMed, CoCoNet, MESMA, MAREA

EC regulations and commitments: STECF

International organizations and initiatives: GFCM, UNEP-MAP (RAC/SPA) proposal of high-sea reserve network, MedPAN

Modeling software: OSMOSE, MARXAN, Biological Valuation Tool

3.2 Which are the scientific gaps in the Mediterranean and Black Sea that need to be addressed in support of a spatial approach to EAF?

biodiversity in marine ecosystems

natural and anthropogenic pressures

ecosystem functions and processes

connectivity (oceanography, larval life history)

EFH and other critical areas for fish

low number of MPAs in the Black Sea

low level of involvement of fishermen and other stakeholders in the decisional process and planning phases

need of integrated approach to spatial management

3.3 How do you envisage a scientific network for a spatial approach to EAF in the Mediterranean and Black Sea? Who would be the key players?

sharing data, information, tools, resources and infrastructures is necessary to work in a coordinate and effective way and to reduce costs

governance issues should be taken into account

key players: GFCM, BSC, STECF, research institutions, fishermen organizations, MPA managers, UNEP-MAP, scientist from all relevant fields.

4. Conclusions

MPAs are not a fisheries panacea and they do have detractors who highlight their weak points and foster more traditional management approaches (Tupper et al., 2002; Kaiser, 2005; Jones, 2007). Some major points raised by critics are that (1) MPAs rarely have clear fisheries-oriented objectives, (2) poorly designed monitoring programs do not offer strong evidence of benefits for fisheries, (3) MPAs are effective only with non-mobile species, (4) well enforced traditional methods of fishing effort control may have greater overall fisheries and conservation benefits (Kaiser, 2005).

Despite the many examples of increased biomass and size of fish inside Mediterranean MPAs, spillover to adjacent fishing grounds has been observed only at a small scale and for a few species, and there is still poor evidence of direct benefits to fisheries. Clear management objectives associated with careful zoning design and reliable monitoring programs (Guidetti and Claudet, 2009; Claudet and Guidetti, 2010) may help to overcome these criticisms.

Consideration of societal issues is crucial to the success of SP. MPAs are often unpopular with fishermen, who dislike reductions of their traditional fishing grounds and do not trust promises of long-term benefits. Carefully planned financial compensation (Badalamenti et al., in press), co-management initiatives and concession of user rights may all prove useful for the achievement of management objectives.

A strategy for a spatial based EAF should include the following points:

assessment and evaluation of MPA effectiveness based on a robust design, with special attention to the fulfillment of scientific and societal objectives;

involvement of stakeholders, especially fishermen through co-management and user rights;

consideration of fishing effort displacement and/or concentration at MPA’s borders;

increased research effort for the identification and mapping of (natural and human) ecosystem components;

governance analysis to tackle all societal aspects and ensure compliance;

coordination of SP by a permanent scientific body under the umbrella of international organizations (STECF, GFCM, UNEP-MAP, ...)

in data-poor situations an effort should be made to apply SP on a trial-and-error basis as long and to ensure monitoring of effects;

advance towards the creation and enforcement of high-sea MPAs aimed at large-scale protection of natural refugia, critical habitats and essential fish habitats;

economical use of resources (sharing of databases, vessels, expertise).

Any info on data and initiatives on spatial tools is welcome and highly appreciated.

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Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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WP6 – Summary of Romanian contribution

Introduction

Fishery was the most affected sector by the dramatic changes of the Black Sea ecosystem. On the other hand, fishing activities contribute themselves to the worsening of the ecological situation and for the depletion of the fish stocks through: open access to resources; management regime applied individually by each coastal country; overfishing and illegal fishing; and the use of destructive harvest technique.

The analysis indicators must be specific at Black Sea level because the majority of fish species having commercial value are shared within EEZ of the Black Sea riparian countries (sprat, whiting, anchovy, horse mackerel, dogfish, turbot, etc). Because in the Black Sea area is not a regional fishery management organization, the fisheries regulatory framework is promoted by each coastal country being not harmonized at regional level, even in the case of shared or migratory species. In these conditions each country realised own researches related to the state of the fish resources. The lack of an adequate management in the Black Sea fisheries is also evidenced by the fact that in spite of evident decline of stocks, the fishing effort continued to increase. This fact is very obvious in cases of high value large life fish species as well: sturgeons, turbot, spiny dogfish.

1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Mediterranean and Black seas?

The assessment of fishery status will be carried out through a series of indicators used already by the international organization for management of living resources. Indicators can support effective decision making and policy setting at every stage of the decision-making cycle - during problem identification, policy formulation, implementation, or policy evaluation.

In the case of the Black Sea, the starting point represent the objectives provided by Black Sea Strategic Action Plan and those selected in special seminar organised in Sile (Turkey) in 2003 by Black Sea Commission (BSC) and General Fisheries Council for the Mediterranean (GFCM).

Tools

- AG FOMLR (Advisory Group on Environmental Aspects of Management of Fisheries and Other Living Resources)- Black Sea Commission (BSC);

- RCF (Regional Centre for Fisheries)/ BSC (Black Sea Commission) in frame of BSEP (Black Sea Environmental Programme

- BSC/Black Sea National Focal Points for Fisheries;

- GFCM (General Fisheries Commission for Mediterranean) – Black Sea members of SAC (Scientific Advisory Committee)

- GFCM/WGBS (Working Group for Black Sea);

- GFCM/ Black Sea Focal Points

EC (European Commission) – respectively STECF (Scientific, Technical and Economic Committee for Fisheries) – Black Sea Subgroup for Fish Stock Assessment

Scientific Initiatives

Initiation of regional projects such as:

- Strengthening the regional capacity to support the sustainable management of the Black Sea Fisheries - in the frame of Black Sea Cross Border Cooperation

Priority 2: Sharing resources and competencies for environmental protection and conservation

Measure 2.1 Strengthening the joint knowledge and information base needed to address common challenges in the environmental protection of river and maritime systems

Overall objective

Cooperation between the Black Sea riparian countries for knowing and rationally managing the marine ecosystem and its resources, carrying out diagnostics of fish stocks status as well as advice on management strategies. The major task is to develop methods for joint-regional stock assessment for the Black Sea that will ultimately enable researchers to determine the condition of stocks and advice on management strategies.

- *National Programs for Collection of Fisheries Data*/DCF (Data Collection Framework)– which contains all the necessary information for evaluation by the Sub-group on Research Needs (SGRN) of the Scientific, Technical and Economic Committee on Fisheries (STECF) and the European Commission (EC).

2) Which are the scientific gaps in the Mediterranean and Black seas that need to be address to advance EAF?

Gaps

- The fish stock assessment and monitoring activities at national level are fragmented and irregular;

- There is no process for assessment of fish stocks, even for shared and migratory species, at the regional level. Data and methodologies used at national level for assessment scope are not compatible and comparable for regional purposes;

- The fisheries regulatory framework promoted by each coastal country is not harmonized at regional level, even in the case of shared or migratory species;

- Absence of an common regional view on criteria and methodologies regarding evaluation of marine habitats having a regional importance for conservation of living resources and for establishment of protected areas or of fishing free zone in transboundary context;

- The lack of an adequate management in the Black Sea fisheries is also evidenced by the fact that in spite of evident decline of stocks, the fishing effort continued to increase. This fact is very obvious in cases of high value large life fish species as well: sturgeons, turbot, spiny dogfish.

- Decline of the predatory fish was determined through over-fishing of the migratory fish at some point in their migration route and environmental degradation affecting the behavioural responses of migratory fish;

- In some Black Sea countries large social-economic and political transition amplified the above direct causes of decline.

Existing and necessary data, activities

National level

Existing data: environmental data; annual catch and landing; fishing effort; fishing mortality rates; biomass estimate; structure on size and age of catches; percentage of mature fish; structure on size and age of the stocks; trophic level of each species.

Necessary data: data and information that is not generally compiled or reported, such as information from fishers, communities and indigenous groups; data on catches by small-scale fleets or illegal fishing, local consumption, or other forms of misreporting.

Activities: identification of specific management objectives; setting of indicators; design of data gathering system based on national systems; use of the existing data and programs of data collection and information; use existing information that is not generally compiled or reported, such as information from fishers, communities and indigenous groups; use of expert judgments; monitoring of the extent of fished and unfished areas; correct estimates by qualified scientists of the catches by small-scale fleets or illegal fishing, local consumption, or other forms of misreporting; training of the fisheries scientists; working in an equipped fisheries or marine science laboratory; regular biomass estimates; regular fisheries surveys using standard vessels

and procedures with trained observers/fisheries biologists on board; other biological information used to develop the indicators.

Black Sea level

Necessary data: environmental data; Black Sea annual catch on species; Black Sea fishing effort; fishing mortality rates; biomass of main commercial species

Activities: selecting a framework; clarifying objectives and identifying criteria; identifying methodologies and models used in generating indicators and reference points (methodology sheets); refining the indicators and reference points; development of indicators specific for the Black Sea in order to monitor and assess the state of key resources/habitats; identifying data sources, including traditional knowledge; consider feasibility, data availability, cost and other factors determining the practicality of implementing the indicators; realization of a support data for indicator assessment through an informational system e.g. fisheries statistics, fish stock assessment, multi-disciplinary research, ecosystem monitoring etc.); clarifying the interpretation of the indicators and changes in them; international agreements on standards and data exchange; determining a reporting format, including deciding which graphical representation to use to present the results; coordination at regional level regarding the assessment of fish stocks and the environmental factors influencing them; development of a Regional Black Sea Program and national programs on monitoring of state of aquatic living resources; to take into consideration the information about critical areas during fish stock or aquatic communities lifetime; to undertake research and data collection in order to improve scientific and technical knowledge of fisheries including their interaction with the ecosystem; to encourage regional cooperation in research and assessment of all marine living resources including compilation of regional fisheries statistics;

Recommendations regarding the future management of fishing resources at regional level

The transboundary character of the living resources from the Black Sea imposes the necessity for coordinated efforts at regional level for their exploiting and protection.

- To strengthen the regional legal framework for fishing sustainable management at the Black Sea, through elaboration of legal documents regarding the fishing;

- To harmonize the development strategies of fishing sector with those of environmental protection, through the implementation of concept regarding the fishing management based on ecosystemic approaching and FAO Code of Conduct for a responsible fishing;

- Development of indicators specific for the Black Sea in order to monitor and assess the state of key resources/habitats;

- Selection of key demersal species and their habitats and development of recovery plans for them;

- Based on the lessons learnt to prepare and implement the other fish stocks recovery plans for the Black and Azov Seas;

- To follow principles of responsible fisheries and to implement specific measures based on these principles;

- To harmonize methodologies for assessments and to establish well defined objectives for fisheries sector;

- To elaborate criteria for selection and designating fishing free zones on the national and regional levels;

- To establish marine mammals stranding network on the national and region levels;

- Rapid adoption a regional legally binding document on responsible fisheries;

- To undertake concerted actions to combat illegal fishing and to establish regional consultation mechanism between the Black Sea coastal states;

- To extend/designate protected marine areas of regional significance and establish a network for the Black Sea;

- Cooperation with GFCM, EEA and other relevant organizations on the issues of common interest.

- Finally, protection of living resources from Black Sea must be realized on the basis of an adequate legal and institutional framework both at national and regional level.

3) How do you envisage a scientific network for EAF in the Mediterranean and Black seas? Who could be the key players?

The scientific support will be given by BSC through: BS/AGFOMLR; BS/ RCF; BS/FP; and GFCM through: GFCM/WGBS; GFCM/FP; EC/STECF

A very important role will have the scientists of the Marine Living Resources and Biodiversity Departments from the Institutes responsible for research and assessment of marine living resources in the Black Sea area.

The Key Players

- Research Institutes from Black Sea area

- (BSC)Black Sea Commission

- GFCM (General Fisheries Commission for Mediterranean)

- STECF (Scientific, Technical and Economic Committee for Fisheries)

- National authorities for fisheries, fisheries organizations, fishery enterprises and fishermen from Black Sea area

Contribution of the Marine Strategy Framework Directive (MSFD) to the ecosystem approach to fisheries

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Slide 1: Context of the marine Strategy Frame Directive (MFSD)

EU as developed an environmental protection policy (Birds directive, habitats directive, Water Frame Directive…)

For marine waters : the environmental pillar is the MSFD, is has been officially published in June 2008

Objective : reach GES by 2020

Action plan with progressive steps

Definition of GES according to 11 descriptors focused on different components of marine waters

Ecosystemic approach is recommended (at sub-region scale) and recommendation to collaborate with EU neighbours)

Slide 2: MSFD descriptors,

Presentation of the 11 descriptors according to the type of pressure affecting ecosystems (inputs –physical, chemical, biological- and extractions –physical and biological-) through biological diversity and subsequent trophic web functioning

In order to assess environmental status : descriptors are based on 29 criteria and 56 indicators (structure, pressure and impact)

Descriptor 4 (Trophic web functioning) is the most transversal descriptor: all elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.

The 11 descriptors are connected in order to have a global ecosystemic approach

Slide 3: A focus on Trophic Web functioning (descriptor 4)

Considering descriptor 4: 3 indicators have been selected :

4.1 performance-productivity- of key species or trophic groups

4.2 proportion of selected species at the top of food webs

4.3 Abundance/distribution of key trophic group/species

Good point: the functioning (criteria 1) and the structure (criteria 2 and 3) of the ecosystems are assessed

Limit: Indicators are focused on a reduced number of the food web components

Indicator 4.1.1 (performance-productivity- of key predator species or trophic groups) : limited to birds and marine mammals)

Indicator 4.2.1 (proportion of selected species at the top of foodwebs): limited to demersal fish

Indicator 4.3.1 (Abundance/distribution of key trophic group/species) can be adapted to all the components but no ecosystemic indicator is applicable yet

The way to take into account food webs in MSFD is not an ecosystemic approach as it is focused on the known parts of the ecosystems and available data = more a pragmatic approach

Need to take into account all the components of the food web

Propose much more indicators focused on different components of the food web (including the low levels like primary producers) in order to have a real ecosystemic approach

Slide 4: MSFD achievements and challenges

MSFD achievements to date:

Experts agree on the definition of the GES defined by 11 descriptors

They identifies obstacles that still need to be overcome

Major Challenges are:

To bridge the strong knowledge gaps of marine ecosystems functioning

To bridge the gaps between science and policy

=> A way to move forward is to develop collaborative tools such as platforms

Efficient alternative to physical meetings (thematic forums)

A long term option to structure knowledge and share data

A way to re-use formatted data bases for other purposes/Directives

A powerful tool to apply existing indicators and develop new ones

Slide 5: How MSFD, EAF and any environmental program can meet

MSFD and EAF can meet according to the universality of the tools that can be deployed:

From specific objectives

Common ecosystemic approach

Federate the expertise, the monitoring programs (oceanographic vessels) and share data

Extract relevant data to calculate specific indicators

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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(i) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Mediterranean and Black seas?

Promotion of EAF in the Black Sea is currently engaged, to some extent, Advisory Groups of the Black Sea Commission (Commission on the Protection of the Black Sea Against Pollution). In recent years, the Commission prepared a number of documents of importance to the EAF in the Black Sea: State of Environment Report 2001 - 2006/7 (2008); Implementation of the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea (2009); Final ¨Diagnostic Report¨ to guide improvements to the regular reporting process on the state of the Black Sea environment (August 2010).

Some opportunities for advancement EAF in the Black Sea can be represented as the activities of Working Group on the Black Sea, a specially created by the General Fisheries Commission for the Mediterranean (GFCM).

The most promising is the future development of integration of scientific cooperation (including advance of EAF) under an international Agreement of all the Black Sea countries supporting creation of an Active special international organization for management for scientific researches and management for fisheries in the Black Sea. Such Agreement should be prepared and signed by responsible country authorities. In case of creation mentioned international organization/or Coordination Body that could be an effective instrument to advance of EAF by the mean of carrying out joint research projects covering the all marine fisheries ecosystems of all Black Sea states and developing sounding scientific recommendations for sustainable use of marine water living resources for regions and state authorities (could be based on Council Regulation (EC) No 199/2008 of 25 February 2008).

(ii) Which are the scientific gaps in the Mediterranean and Black seas that need to be address to advance EAF?

A significant gap in the study of the Black Sea is the lack of studies on the effect of fishing on the state of biological diversity; inter specieces relationships and trophyc chains changes. Relevant research will be one of the manifestations of promoting EAF. Their results will help developing of recommendations for fishery optimization.

For the Black Sea there were studies of the effect of trawling and dredging on the state of benthic biocenoses, but the issue remains poorly understood. Conducting this research will develop recommendations for reducing the negative impact of fishing and other kinds of human activities (drilling, dumping, sea transportation, *etc*) on the state of marine ecosystem.

In the Black Sea is still not enough studied the effect of commercial mariculture farms on the environment. Mariculture farms can pollute the marine environment. The study of these processes will contribute to the development of recommendations to reduce pollution.

(iii) How do you envisage a scientific network for EAF in the Mediterranean and Black seas? Who could be the key players?

Scientific network and already created collaboration links which are available through the Black Sea Commission activities, could be the key - stone for creation of a working scientific network for fisheries in the Black Sea as a tool to advance of EAF and improving of fisheries management in the region.

Nevertheless, at present there are no generalized Data Bases on hydrobiology, ichtiology, fisheries and related environmental parameters in any country of region. As it known, exists only specific sets of data in a certing holdings. Also, there are no comprehensive Data Bases on Knowledge for Med&Black Seas fisheries (FishGIS).

These problems could be solved by:

- elaborating of joint approach for creation DB, QC and formats for data exchange;

- creating of National Data Centers on Fisheries (NDCF);

- organization NDCF collaboration;

- development of regional FishGIS (clusters) and their synergy.

These could be done under the umbrella of a special joint EC project.

So, we propose to start preparation of proposal for such project.

Creation of a scientific network on fisheries in region under the planned to be established Black Sea Working Group of GFCM will of a high importance and usefulness.

Key players – scientific research organizations involved in active researches of marine water living resource and their habitats, bodies carrying out control on the fisheries,

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

- Biological social and economic Data Bases (Sampling of Landings, Sea Surveys, Social and Economic studies..)

- Knowledge on biological parameters , on social and economic activities

- Governance means on regional fisheries organizations

- Research institutes in marines sciences

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

- Regular sets of data in fisheries

- Disparities between The north and south countries (knowledge in biological economic social scales)

- Lacking of funding scientific programs in southern countries, and monitoring actions

- Gaps on ecological studies

- Lack of harmonization of national legislation on marines laws

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

- Marine protected area designed at regional scale and deep sea

- Establishment of harmonized scientific programs on resources and ecological aspects at regional scale

- Allocation of sufficient financial means

- Implementation of specifics programs on advertisement on protection of the marines ecosystems

- Key players on regional and local : RFO , scientific communities, professionals, local populations, administrations, decisions makers …….

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Med. & Black Sea?

As a general basis there is the political support of the governments through the Union for the Mediterranean, which launched initiatives like Horizon 2020 to reduce pollution (and in particular a working group on review, monitoring and research) and a conference Euromed on a renewed partnership in research and innovation (April 2012), where issues like 'management of marine environment and resources' were discussed.

Intergovernmental organizations are also providing existing tools and networks to rely upon: e.g. the initiative on videogames for sensibilising people on fishery governance[1] from the Mediterranean Science Commission (CIESM), some FAO projects in support to scientific cooperation for responsible fisheries in the Mediterranean (EASTMED, ADRIAMED, COPEMED), the Mediterranean Action Plan[2] for the Barcelona Convention and the Plan Bleu[3]

[1] www.ciesmseaforum.org/category/fishery

[2] The main objectives of the MAP were to assist the Mediterranean countries to assess and control marine pollution, to formulate their national environment policies, to improve the ability of governments to identify better options for alternative patterns of development, and to optimize the choices for allocation of resources. The focus of MAP gradually shifted to include integrated coastal zone planning and management as the key tool through which solutions are being sought.

[3] Plan Bleu is in charge of the Mediterranean Strategy for Sustainable Development and develops a Mediterranean Information System on Environment and Development

from UNEP (United Nations Environment Programme), specific networks of ocean observing systems like MedGOOS[4] and MOON[5], and some working groups of ICCAT[6] and CGPM[7].

The European Union fosters regional initiatives in the Mediterranean and Black Sea regions in accordance with its strategies (Strategy on improving maritime governance in the Med[8]; EU Black Sea Synergy[9]), work programmes and directives. Some EU political commitments call expressly for EAF and for a regional approach: Marine Strategy Framework Directive, Biodiversity strategy 2020, new Common Fisheries Policy (art.2), development of regional databases for storing and exchanging fisheries data collected under the Data Collection Framework, Integrated Maritime Policy (IMP-MED project[10]). The EU funds cooperation projects for building knowledge and capacities through the Framework Programme for Research and Development (FP7, Directorate General for Research and innovation) like CREAM, PERSEUS[11], COCONET[12], FORCE[13], MEFEPO[14] and through the European Neighbourhood

[4] MedGOOS, the Mediterranean Global Ocean Observing System is a regional alliance of leading marine institutions founded under the auspices of the UNESCO/Intergovernmental Oceanographic Commission (IOC) to provide a concerted approach and common framework for the planning and implementation of the Global Ocean Observing System (GOOS) in the Mediterranean to the benefit of all coastal states in the region. http://www.medgoos.net/

[5] MOON, the Mediterranean Operational Oceanography Network, is the coordinating body of the EuroGOOS Mediterranean Task Team http://www.moon-oceanforecasting.eu/

[6] International Commission for the Conservation of Atlantic Tunas www.iccat.es

[7] General Fisheries Commission for Mediterranean

[8] Communication from the Commission of 11 November 2009 - Towards an Integrated Maritime Policy for better governance in the Mediterranean COM(2009) 466

[9] COM(2007)160 http://ec.europa.eu/world/enp/pdf/com07_160_en.pdf

[10] Project on integrated maritime policy for the Mediterranean http://www.imp-med.eu

[11] PERSEUS, Policy-oriented marine Environmental Research for the Southern European Seas, assesses the dual impact of human activity and natural pressures on the Mediterranean and Black Seas www.perseus-net.eu

[12] Towards Coast to Coast Networks of Marine Protected Areas, coupled with sea-based wind energy potential www.coconet-fp7.eu

[13] Fisheries and aquaculture oriented research capacity in Egypt www.forceproject.eu

[14] Making the European fisheries Ecosystem Operational www.liv.ac.uk/mefepo

Policy Instrument (ENPI, Directorate General EUROPAID Development and cooperation) like CBC-MED[15]. In the view of integrating national research programmes and avoiding double funding, a project like SEAS-ERA[16] wrote a common strategic research agenda for the Mediterranean sea basin. The integration in marine sciences and research programmes will go a step further between EU member states and FP7 associated countries through the Joint Programming Initiative 'Healthy and Productive Seas and Oceans' ('JPI Oceans')[17]. A potential JPI involving EU member states and southern Mediterranean countries, on the successful model of BONUS for the Baltic Sea, is now envisaged. Some topics of the FP7 2013 work programme (WP) are specifically dedicated to the region to prepare the way for a more substantial cooperation: e.g. topics for bridging the gap between research and innovation and for coordination of national policies on international S&T cooperation (activities R2I-ENP and ERA-NET in WP INCO), topic on knowledge platforms, networking and uptake of research results for more strategic international R&I cooperation (WP ENV).

Finally, a lot of existing national initiatives (e.g. the French network MISTRALS[18]and the reflexion workshops on the Mediterranean of the National Research Agency) and bilateral cooperations could back the EAF in the Mediterranean and Black Sea and should not be overlooked.

2) Which are the scientific gaps in the Med.&Black Sea that need to be address to advance EAF?

Sources:

Euromed: results of the session 'Management of marine environment and resources'[19]

SEAS-ERA Strategic Research Agenda for the Mediterranean sea basin[20]

ICES 11 points checklist, and research priorities identified by MEFEPO

Gaps:

Biodiversity, natural and anthropogenic pressures

Time series, ecological and socio-economic indicators

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[15] Cross-border cooperation in the Mediterranean http://www.enpicbcmed.eu/

[16] Towards Integrated Marine Research Strategy and Programmes http://www.seas-era.eu

[17] http://www.jpi-oceans.eu

[18] Mediterranean Integrated STudies at Regional And Local Scales http://www.mistrals-home.org

[19] ec.europa.eu/research/conferences/2012/eoro-mediterranean/index_en.cfm?pg=outcome

[20] http://www.seas-era.eu/np4/%7B$clientServletPath%7D/?newsId=149&fileName=SEAS_ERA_D.7.1.1_Med_SRA.pdf

Integrated monitoring capabilities, data collection and interoperability

Expertise, training in new technologies and multi-disciplinary topics

Link knowledge – policy making; assessment of management measures

Overall, scientists need to go beyond a fragmented approach and integrate their initiatives into a global approach to the Mediterranean, considering all aspects relevant to ecosystem services and the exploitation of marine resources.

We should keep in mind that there will always be gaps in the knowledge and information required but that managers will need to make the best decisions they can using the information that is available.

The legal framework (diverse jurisdictional status of waters) may be an additional problem for the EAF implementation. So far, only Cyprus, Malta and Monaco have adhered to the 1995 UN Fish Stocks Agreement.

3) How do you envisage a scientific network for EAF in the Med.&Black Sea? Who would be the key players?

First of all, a strong investment of resources in national research is a prerequisite for improving regional cooperation. It can be supported but not replaced by the European Commission or by international organisations. Furthermore, the principles of regional ownership, mutual interest and shared benefit will enhance the quality of the cooperation.

In addition to the "classical" competences in fisheries research, the network should include competences to consider the social and economic status of fisheries and associated coastal communities in order to elaborate objectives for fisheries management.

The network needs to work with other stakeholders sharing the Mediterranean & Black Sea waters, and that impact on fisheries or are affected by fisheries: energy sector, tourism, coastal zone development, transport, in the framework of the Integrated Maritime Policy (see the work of the project IMP-MED[21]).

For the success of EAF there is a strong need for an enhanced network of governance with users and countries to exchange data and processes of investigation. It will be a key challenge to overcome the disparities between ecosystems, the fisheries operating, the other sectors exploiting the ecosystems and existing jurisdictional boundaries. Governance in the Mediterranean and Black Seas takes place at different levels, depending on the jurisdictional structure of the maritime space and on the different levels of political and administrative organisation.

Some actors:

[21] http://www.imp-med.eu/En/fourth-working-group-meeting-on-integrated-maritime-policy-in-the-mediterranean_57_25_pg-det

National fisheries research agencies

JPI Ocean, future JPI Med?

Authorities for management, monitoring, control and surveillance of marine zones

EU Regional Advisory Council for the Mediterranean[22], EU Data Collection Framework Regional Coordination Meetings for the Mediterranean and Black Sea region

European Fisheries Technology Platform[23]

CIESM

GFCM, ICCAT

FAO, UNEP-MAP, Plan bleu

Union for the Mediterranean

[22] The RAC MED is a stakeholder-led organization and its role is to enable the European Commission to benefit from the knowledge and experience of stakeholders in the formulation and implementation of fisheries management measures. http://www.racmed.eu

[23] The European Fisheries Technology Platform is a forum where all stakeholders from the fisheries sector can participate in the definition of a common Vision and Strategic Research and Innovation Agenda, driving the necessary innovation efforts forward. It has a working group on sustainability and management www.eftp.eu

Contribution to discussion regarding a Scientific Strategy for a Global Approach to Promote Regional EAF

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1) Which are the existing and key scientific initiatives and tools that can contribute to EAF in the Mediterranean and Black seas?

In the Mediterranean and Black seas:

-International organizations with fisheries mandate, i.e. UN, FAO, OECD, as well as the NGO's that the initiatives made by these organizations are significantly contributing to the strengthening of the collaboration and cooperation both at regional and international level for EAF in the Mediterranean and Black Sea.

-MedPAN as a network of MPAs' managers in Mediterranean together with GFCM-SCMEE as well as Network on the Evaluation and Management of Fishing Resources could play important role to contribute to EAF in Mediterranean and Black Seas.

-ICCAT Sub-Committee on Ecosystems could also play a role to contribute to EAF. ICCAT Sub-Committee on Ecosystems defines and coordinate by-catch assessment, mitigation, and ecosystem issues and issues related to Ecosystem Based Fisheries Management (EBFM).

At the national level:

There are mainly three official authorities that can contribute to EAF for national level in Turkey. These are; the Ministry of Food, Agriculture and Livestock- The Directorate General for Fisheries and Aquaculture, the Ministry of Environment and Urbanization The Directorate General for Natural Assets Protection and .the Ministry of Forestry and Water Affairs -General Directorate of Nature Protection and Natural Parks, respectively.

Great importance is placed on the control of catches, fishing effort and ensuring traceability. Turkey recently established an integrated, national-wide system for effective control, monitoring and surveillance of resources. In this connection, vessel monitoring system, sales notes, logbook registry have been established or updated. Fisheries data to be collected at the recently constructed port offices located at the primary landing ports are expected to further contribute national management.

Additionally, main funding body of Turkish Scientific and Technical Research Council (TÜBİTAK) can be advised to include EAF relevant research subjects in to their priority research areas.

Artificial Reefs as a tool for EAF in Turkey (Case Study)

The Ministry of Food, Agriculture and Livestock decided to prepare a National Artificial Reef Program in 2008.The purposes of the program were described as: to create new fishing grounds in minimally productive muddy areas in order to promote small-scale fisheries to conserve biodiversity in the littoral zone. Three provinces on the Black Sea coasts and all provinces on the Aegean Sea and the Mediterranean Sea coasts were included in the program during its first stage due to the importance of small-scale fisheries.

Preliminary studies were completed between September 2008 and March 2009. The city of Balıkesir located at the northern end of Turkey's Aegean Sea coast was selected as the pilot project area. Previous evidence from Turkey and the rest of the world indicates that artificial reefs should provide the desired outcomes with regard to both biological resources and users. National Artificial Reef Program will help to solve the conflicts of fishing area between small scale fisheries and purse seiners-trawlers. The Artificial Reef Management Plan (ARMP) was prepared by the Ministry together with scientists and will be open to users for discussion. Management options such as gear restrictions, no-take zones, and spatial segregation were accepted in the ARMP. Harvest rotation and closed season regulations are under discussion.

2) Which are the scientific gaps in the Mediterranean and Black seas that need to be address to advance EAF?

-Active fishing effort, catch and discard compositions for different gear types and locations are unknown.

-Landing records are missing or unreliable in most of the cases.

-Lack of comprehensive studies on biodiversity, fragile and essential habitats, distribution and population parameters of YOY (young of the year) fish to start EAF or precautionary approach

-Lack of scientific studies to quantify the exact number and size of MPAs required in Mediterranean and Black Seas

-Scientific studies should stress on lack of willingness to decrease fishing effort to the limit their impacts on the ecosystem is acceptable from the scientific point of view

-Scientific studies should stress on weak willingness to implement precautionary approach in fishery

3) How do you envisage a scientific network for EAF in the Mediterranean and Black seas? Who could be the key players?

GFCM-SCMEE

Network on the Evaluation and Management of Fishing Resources

MedPAN (The Network of the managers of MPAs in Mediterranean) could be the key players.

Scientific Network for EAF: not only scientific bodies in the region but also some regional organizations such as GFCM, MedPAN and related NGOs may be key players in this network.

What is needed to implement the EAF in the Mediterranean?: a view from WWF

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After decades of Common Fishery Policy and three "radical" reforms (we are now in the mid of the third one), there is broad consensus that the history of fisheries management in European waters is actually a history of failure. And the situation in Mediterranean waters (including in the South and the East) is not a better one, with a very high rate of assessed stocks labeled as overfished, rampant overcapacity and diminishing returns.

The Commission proposal identified micromanagement from Brussels as one of the reasons for this failure, but paradoxically the rigid European governance rules don't allow for a real territorialisation of fisheries management subject to common obligations. In spite of these limitations, though, common sense is increasingly finding its way from bottom-up, as the most progressive among Mediterranean fishermen are partnering with scientists, decision makers and NGOs to develop territorial-based co-management approaches.

Territorial-based co-management is indeed the *natural* way to manage fisheries in the Mediterranean and includes assigning fishing opportunities –typically as effort- to fishing operators within well-defined territorial units. Its natural governance counterpart is co-management committees. So for WWF the question is: what is the science needed to allow for EAF to be implemented at the territorial management unit level and, particularly, by inter-stakeholder co-management bodies?

Some immediate implications of this model on the science that is required are:

Fishing effort has to be kept within levels ensuring fish populations stay within (or recover to) sustainable levels, well above B_{MSY} (and simultaneously delivering on GES attributes for a healthy ecosystem status). This means using robust proxies for data-poor mixed fisheries, and being able to advice on precautionary effort levels per gear within every territorial management unit (taking into account that some stocks might straddle over several such TMUs).

Fisheries management will have to use tools and approaches typical of marine spatial planning, including identifying the extent of critical habitats deserving protection within TMUs (such as coralligenous, maërl or seagrass beds) as well as essential fish habitats, and deciding on the required protection measures therein.

The increased commitment of fishermen to sustainable management should also translate into research through their crucial implication in the collection of reliable data sets. This engagement

of the primary stakeholders would certainly decrease the costs of sampling and has the potential to draw credible data. But for this data to be useful, science has to develop robust assessment and monitoring precautionary methodologies based on simple indicators that can be easily obtained from the basic but reliable data collected in typical fishing trips.

In a context of co-management, scientific advice should get buy-in from the rest of co-managers and, particularly, from fishermen. This means an effort should be done to use simple approaches, whenever possible, that could be easily understood by those having to abide by the rules. Likewise, management needs to be adaptive and responsible to the results of real time monitoring.

A historic change in mentalities regarding how to manage fisheries in the Mediterranean has already started, with radically new initiatives such as the establishment of a Mediterranean Platform of Artisanal Fishers which promotes sustainable management in the region, or innovative management schemes such as the first ever “co-management committee” recently established in Catalonia to manage the Mediterranean sandeel fishery, or the successful management of fishing activities in the MPA of Torre Guaceto, Puglia, which constitutes a global reference. Now that the seed of change is firmly in place, it’s imperative that the right science is there to support it. And the prize would be real EAF in the Mediterranean.

The Nereus – Predicting the Future Ocean Program: regional case study of the Mediterranean Sea

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The Nereus – Predicting the Future Ocean Program is an international research project aiming at developing capacity for predicting the status of life in the future global ocean as well as management options. The 9-years project started in 2010, and is a multidisciplinary and collaborative initiative of the Nippon Foundation and the University of British Columbia (UBC) with five additional partners. The partner institutes are building a modeling complex, the "ocean life model", integrating many layers of spatial data, as well as many coupled sub-models, which can be substituted in a flexible manner. Thus, the Nereus model can be seen as an end-to-end model, attempting to represent most of the phenomenon occurring at sea, from physical to biological, economic, and management processes. The core model of the Nereus modeling framework is a spatial food-web model representing the world's oceans, based on an extended version of the Ecospace module from the Ecopath with Ecosim (EwE) approach and software, while a size-based model provides an alternative view. The ocean life model includes more than 1,000 species aggregated into 48 functional groups and 245 fishing fleets, and operates with ½˚ spatial resolution (252,000 spatial cells). The model currently covers the period 1960-2060 and, despite its need for further developments, provides credible general species distribution patterns and global fish biomass trends. The purpose of the ocean life model is to allow testing alternative scenarios of future fishing effort by evaluating how each scenario would impact marine ecosystems. The outcomes from the modeling complex are expected to be of use for global assessments, notably through the UN system. The implementation of new visualization tools will be another major contribution from the project, in order to make science accessible to policy-makers and likeable to the general public, in an effort to link science, policy and people.

As part of the development of the Nereus modeling complex, several models will be developed at the regional scale, initially one for the Mediterranean Sea. The main purpose of the Mediterranean study is to focus on biodiversity issues, especially for fish species for which most data is available, but also for invertebrates, for which additional effort is required. The Mediterranean Sea model, currently under development, is based on the global ocean life model from which it is extracted. However, input data will be improved and made more accurate, notably by developing automated ways of collecting and synthetizing available information which has not yet been considered, such as, for instance, information on biomass, fishing or diet

composition. Then, the methodology developed for the Mediterranean Sea could be applied to any other case study as well as re-used in the global model.

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