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# Ecosystem approach to fisheries management in the Mediterranean

K. Cochrane and C. de Young<sup>1</sup>

United Nations Food and Agriculture Organization  
Viale delle Terme di Caracalla, 00153 Rome, Italy

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**SUMMARY** – The discussion on EAF (ecosystem approach to fisheries) has moved from definitions and principles to an international call for its implementation to secure the sustainable use of marine and freshwater ecosystems for the benefit of present and future generations. The EAF concept has reached a point of general acceptance by those involved in fisheries and their management and the global political drive is there. However, many countries and regions are still grappling with understanding and interpreting the concept for application within their own context. This paper attempts to address this problem by clarifying the concept, with specific reference to the Mediterranean, identifying some of the more pressing issues in the region and discussing some of the necessary steps to progress in the implementation of EAF.

**Key words:** Ecosystem approach, Mediterranean fisheries, GFCM.

**RESUME** – "L'approche écosystémique de l'aménagement des pêches en Méditerranée". La discussion sur l'approche écosystémique des pêches est passée du stade des définitions et principes à celui d'appel international visant à son application afin de garantir une utilisation durable des écosystèmes marins et d'eau douce au bénéfice des générations présentes et futures. Le concept de l'approche écosystémique des pêches a été accepté par toutes les parties intervenant dans les pêcheries et leur gestion, il existe donc une volonté politique globale. Toutefois, plusieurs pays et régions en sont encore au stade de la compréhension et de l'interprétation du concept du point de vue de son application dans leur propre contexte. Cet article aborde ce problème en éclaircissant le concept, en particulier pour la Méditerranée, en identifiant certaines des questions les plus pressantes dans la région et en examinant certaines des étapes nécessaires pour progresser dans la mise en œuvre de l'approche écosystémique des pêches.

**Mots-clés :** Approche écosystémique, pêches méditerranéennes, CGPM.

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## Introduction – A brief history of EAF at the global level

While scientists and fishers have always been aware of the close interactions between fish stocks and their ecosystem, during the second half of the 20<sup>th</sup> Century fisheries management was dominated by an approach that focused on the population dynamics of the target species only. This development of single-species approaches took place simultaneously with an enormous expansion in fishing capacity driven by major technological advances and the approach, when effectively applied, contributed, and still contributes, substantially to achieving productive fisheries (Hilborn, 2007; Mace, 2004). However, as fishing pressure on marine ecosystems has grown it has become increasingly apparent that fisheries do not only impact on the target resources and that the target resources are affected by many other factors in addition to the fisheries targeting them. This new awareness, in addition to the need to manage ever increasing numbers of users of and pressures on aquatic resources, has led to calls for the implementation of an ecosystem approach to fisheries, also known as ecosystem-based fisheries management.

While the term "ecosystem approach to fisheries" (EAF) and the priority being given to it are new, elements of EAF may be found as early as in the 1982 United Nations Convention on the Law of the Sea (UN LOS)<sup>2</sup>. For example, Article 61 "Conservation of the living resources" requires coastal States to take into account not only the harvested species but also the effects of management measures on

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<sup>1</sup>The opinions expressed in this paper are those of the authors and do not necessarily reflect in any way the views of FAO.

<sup>2</sup> See <http://www.un.org/Depts/los/index.htm>

associated and dependent species "with a view to maintain or restore populations of such associated or dependent species above levels at which their reproduction may become seriously threatened".

However, it could be argued that the formal origins of an ecosystem approach to fisheries can be found in Chapter 17 of Agenda 21 of the 1992 United Nations Conference on Environment and Development (UNCED)<sup>3</sup>. It is written there that: "The marine environment – including the oceans and all seas and adjacent coastal areas – forms an integrated whole that is an essential component of the global life-support system and a positive asset that presents opportunities for sustainable development. International law... sets forth rights and obligations of States and provides the international basis upon which to pursue the protection and sustainable development of the marine and coastal environment and its resources". The 1995 FAO Code of Conduct for Responsible Fisheries was developed and adopted by FAO Member States soon after UNCED and while the Code does not explicitly refer to EAF, the major features and requirements of EAF can be found within the Code. EAF is therefore entirely consistent with the Code.

The role and importance of EAF was emphasized by the 47 countries participating in the Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem, held in October 2001. That Conference produced and adopted the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem, which included the declaration "...that, in an effort to reinforce responsible and sustainable fisheries in the marine ecosystem, we will individually and collectively work on incorporating ecosystem considerations into that management..." (FAO, 2001). This Declaration was recognized and reinforced at the World Summit for Sustainable Development in Johannesburg in 2002<sup>4</sup>. The Plan of Implementation of this Summit included the exhortation to "Encourage the application by 2010 of the ecosystem approach, noting the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem and decision V/6 of the Conference of Parties to the Convention on Biological Diversity".<sup>5</sup> FAO Member States gave further sanction to EAF at the 27<sup>th</sup> Session of COFI in March 2007 where "there was broad agreement that EAF was the appropriate and necessary framework for fisheries management" (FAO, 2007).

EAF therefore can no longer be seen merely as an option for further consideration and there is a global imperative for all countries to move forward in its implementation in order to secure sustainable use of marine and freshwater ecosystems for the benefit of present and future generations. The global political drive is there, as demonstrated in the instruments described above, but many countries and regions are still grappling with understanding and interpreting the concept within their own context. This paper attempts to address this problem by clarifying the concept, with specific reference to the Mediterranean, identifying some of the more pressing issues in the region and discussing some of the necessary steps to progress in the implementation of EAF.

## A generalized EAF

### What is EAF?

While scientists of various disciplines delight in deliberating on the fine details and interpretations of EAF, the basic concept is simple and undeniable: if we want to maintain the supply of goods and services, including the benefits of fisheries, from aquatic ecosystems, we need to manage human impacts on them in a way that does not threaten their current and future integrity and productivity. Out of this simple truth flows the ecosystem approach that is defined as (FAO, 2003): *An Ecosystem Approach to Fisheries strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries.*

Elaborating further on the approach, the Convention on Biological Diversity provided a set of 12 principles for an ecosystem approach (Table 1). These principles are self-explanatory and cover the ecological, political, social and economic fundamentals of an ecosystem approach.

<sup>3</sup> See <http://www.un.org/esa/sustdev/documents/agenda21/index.htm>

<sup>4</sup> See <http://www.un.org/events/wssd/>

<sup>5</sup> Paragraph 30d; [http://www.un.org/esa/sustdev/documents/WSSD\\_POI\\_PD/English/POIToc.htm](http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POIToc.htm)

Table 1. The 12 principles of an ecosystem approach provided by the Convention on Biological Diversity (Decision V/6)

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1. The objectives of management of land, water and living resources are a matter of societal choice.
  2. Management should be decentralized to the lowest appropriate level.
  3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
  4. Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: reduce those market distortions that adversely affect biological diversity; align incentives to promote biodiversity conservation and sustainable use; and internalize costs and benefits in the given ecosystem to the extent feasible.
  5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
  6. Ecosystems must be managed within the limits of their functioning.
  7. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
  8. Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
  9. Management must recognize that change is inevitable.
  10. The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
  11. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
  12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.
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Source: CBD (2000).

The FAO definition is aligned with these more general ecosystem approach (EA) principles while focusing on those aspects which are within the ability of fisheries management bodies to implement. EAF also recognizes the fisheries sector's responsibility and needs in collaborating in a broader multi-sectoral application of the EA.

### EAF links with other sectoral and inter-sectoral processes<sup>6</sup>

The move towards a broader, more integrated and participatory approach to fisheries management reflects some of the fundamental principles underpinning the concept of sustainable development. These principles are shared by other emerging approaches in the field of natural resource and spatial area management, namely the Sustainable Livelihoods Approach (SLA) and Integrated Management (IM). These approaches are complementary to an EAF, and indeed there is substantial overlap in terms of their underlying principles, philosophy and approaches.

Just as the EAF has developed from an understanding of the need to manage fishing on targeted fish stocks in the broader context of the ecosystem, similarly the SLA developed from a recognition of

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<sup>6</sup> From de Young *et al.* (2007).

the need to place natural resources including fisheries, in a larger context of households, communities and socio-economic environments. Adopting livelihoods thinking in EAF implies that fisheries management must look at fishers and fishing fleets in the context of where fishers live –in households, communities and fishery-based economies– just as it deals with the fish in the context of where the fish live, the aquatic ecosystem. Fisheries management thus deals with the fishery as one of a portfolio of livelihood sources (if such alternatives exist) and as potentially linked, through livelihoods, to other economic sectors.

IM (whether of oceans, lakes, coasts, watersheds, etc.) is an approach to manage multiple (often competing) uses of a certain designated area, such as fisheries, aquaculture, forestry, oil and gas exploration, mining, agriculture, shipping and tourism. This involves managing multiple stakeholders (e.g., local fishing communities, industries) as well as interactions among people and ecosystems, and among multiple levels of government. The IM approach is typically characterized by consideration of a multiplicity of resources (e.g., soil, water, fish stocks) and of habitats (e.g., open ocean, estuaries, wetlands, beaches, lakes, rivers), as well as a range of environmental (e.g., changes in water temperature, turbidity and acidity, chemical pollutants and water flows) and socio-economic factors (e.g., expansion of local markets, HIV/AIDS, increase in employment opportunities) that impact on resources and ecosystems.

Typically, IM involves processes for participatory decision making and conflict resolution, and requires a range of information on characteristics of the designated area, from the local climate and the state of the ecosystem, to the relevant natural resources, and the human dimensions (cultural, economic, social). A key aspect of IM is the development and implementation of an institutional framework and management systems that can deal with the numerous linkages and dependencies that exist across the components of these different systems. In the same vein, EAF should be nested within the wider framework of IM.

Thus, the EAF, the SLA and IM are very much complementary, needing to operate in synchrony even while their scope differs with respect to what is being managed. The applicability and relevance of each of these approaches, or combinations thereof, will depend on the context at hand.

## Formulation and implementation of EAF

A number of reports and guidelines have now been produced to assist managers and stakeholders in interpreting and implementing EAF. These include the National Research Council of the United States of America (1999), the Convention on Biological Diversity (Decision V/6 of the Conference of the Parties, 2000), the World Wide Fund for Nature (Ward *et al.*, 2002) and the FAO Guidelines on EAF (FAO, 2003 and 2005a). The FAO Guidelines on EAF (FAO, 2003) were produced as a supplement to the earlier Technical Guidelines for Responsible Fisheries: Fisheries Management (FAO, 1997). They focus strongly on the process of planning and implementation, emphasizing the steps and tasks involved. The details of issues such as the management objectives, the management measures used to achieve those objectives, the capacity of the management agency, and the nature of the fisheries will vary considerably from case to case. It is therefore more useful to present a widely applicable process for arriving at a case-specific solution, rather than to attempt to provide generic solutions that must inevitably lack detail. Since 2003, FAO has been active in assisting a number of countries and regions in planning and implementing EAF, including Brazil, Papua New Guinea, the Lesser Antilles States and the coastal States of the Benguela Current Large Marine Ecosystem (BCLME): Angola, Namibia and South Africa.

There will be many different ways in which EAF can be planned and implemented and management agencies will need to identify the method that is best suited to their particular circumstances. The approach being applied by FAO has, however, been found to be effective in all the cases where it has and is being applied. It builds on the methods developed by the "ecologically sustainable development" (ESD) initiative undertaken in a number of Australian Federal fisheries (Fletcher *et al.*, 2002) and provides a flexible and pragmatic framework that can be applied from different starting points, such as a particular fishery, the whole sector or an ecosystem, and under different conditions ranging from data and information poor situations to cases where extensive and sophisticated scientific knowledge and tools exist. Whatever the method, the approach should be implemented in a comprehensive, participatory manner throughout, driven by the goals and objectives of the management agencies and stakeholders.

Ultimately, implementation of EAF requires an integrated approach across all fisheries operating within the designated ecosystem. It should also be embedded within an equally integrated ecosystem approach for all other sectors and human impacts on that ecosystem. In practice, an incremental approach will generally be the most feasible option and typically will start from, for example, a particular fishery, a management authority covering a number of fisheries or a fishing community. The planning process<sup>7</sup> is presented graphically in Fig. 1 and comprises the following seven steps:

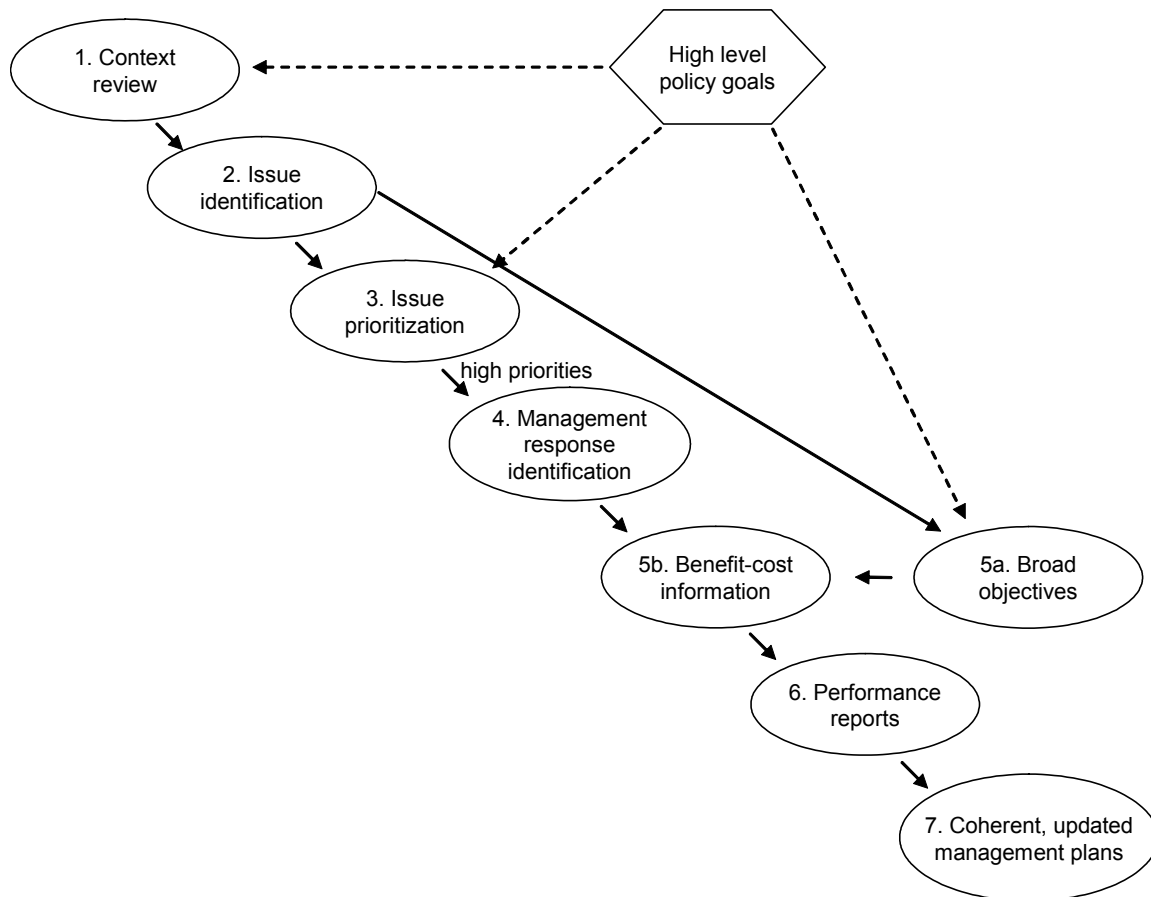


Fig. 1. The process followed in evaluation of the feasibility of EAF in the BCLME. The ovals represent activities undertaken within the BCLME EAF project and the hexagon represents an underlying external input to the EAF. Modified from Cochrane *et al.* (2007).

(i) An initial scoping study of the overall context including the existing goals and objectives, the range of stakeholders, the benefits they derive and their relationships to the ecosystem or fishery, the size, characteristics and impacts of the fisheries, the target resources, the ecosystem as whole, other users and impacters of the ecosystem and all other information pertinent to understanding the fishery and its interactions with the ecosystem.

(ii) "Issue" identification. This is a critical step in defining and understanding what EAF will imply and require in a given case. It involves the participatory identification of all issues of concern, for all stakeholders in the fisheries, that are not being satisfactorily addressed under the existing management strategy and system. Fletcher *et al.* (2002) and FAO (2003) describe a useful approach, based on generic hierarchical trees depicting the range of interactions in a typical fishery, to assist in ensuring that all aspects of EAF are considered in the issue identification process (Fig. 2).

(iii) It is common for a large number of issues of concern to be identified in any particular fishery by the stakeholder group. In the FAO projects and workshops held so far, between 30 and 80 issues are

<sup>7</sup> More detail of this approach can be found in Cochrane *et al.* (2007), which also provides the example of application of the process in the Benguela Current LME.

typically identified for each fishery. The next step is to prioritise these issues, identifying those that are most important and urgent, requiring immediate action and those of lesser, or less immediate, importance. A simple approach based on risk assessment is used, drawing on the best available information whether that is simply stakeholder consensus or a result of sophisticated and validated scientific information.

(iv) Once the high priority issues have been identified, it is necessary to consider what management action, or management response, is necessary to address that issue to ensure that all the objectives for the fishery are being met. In some cases, it may be possible to aggregate issues into common groups which can be addressed by the same management response.

(v) Benefit-cost analyses should be undertaken of the different possible management responses for each issue or group of issues, to ensure that the selected management response is the optimal one to address that problem. These analyses consist of: identifying the broad objectives for the fishery against which costs and benefits needed to be evaluated; and using the best available information, including stakeholder views, evaluating the benefits and costs of each alternative management responses against each broad objective. These analyses provide valuable information to guide managers and decision-makers in selecting the appropriate management response.

(vi) Performance reports are then prepared. Performance reports are effectively sub-components of a management plan, describing the details of the management response for a particular issue or group of issues, as well as the supplementary information such as the indicators, the data necessary to monitor the indicators, and reference points to be used to determine whether the management response is achieving its objectives.

(vii) Finally, the set of performance reports needs to be incorporated into revised, updated management plans. In doing this, it is necessary to ensure that there are no instances of undesired interactions or conflicts between the different management responses. If any such conflicts are identified, modifications may need to be made to the conflicting management responses to reconcile the differences.

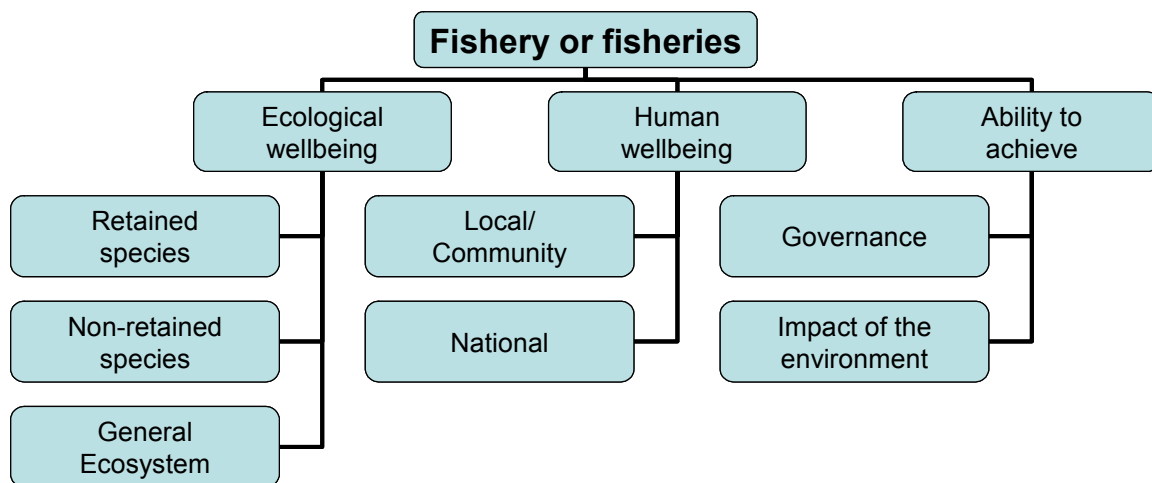


Fig. 2. The basic hierarchical tree used to guide identification of the issues of concern in the fishery or ecosystem under consideration. Additional trees break down the boxes under each of the three second-level headings (Ecological well-being, etc) into more and more detail to assist users to think broadly across all possible issues that could apply in the fishery or ecosystem under consideration. Modified from Fletcher *et al.* (2002).

The next stage in EAF involves implementing the EAF management strategy in terms of the various choices made and actions required to achieve the objectives agreed upon during the strategy

development process. It includes the practical aspects of management including the choice of institutional arrangements, financing, incentive mechanisms and monitoring and enforcement. On-going monitoring of trends, together with informative and participatory mechanisms for evaluation of the EAF process will provide decision-makers and stakeholders with the information needed to follow the progress, efficiency, efficacy, and appropriateness of EAF management plans and policies.

An EAF management strategy also needs to recognise that ecosystems are dynamic and changing continually and that stakeholder goals and priorities also change with time. As a result, and in accordance with the best practices in conventional fisheries management, EAF management should be adaptive; including regular reviews of the effectiveness of the management measures in relation to the objectives and adjusting these measures where necessary.

## Science, knowledge and uncertainty in implementation of EAF

A commonly heard argument in relation to EAF, sometimes as a reason why EAF cannot be implemented, is that there is insufficient knowledge and understanding of ecosystem interactions and functioning to support it. This argument is misleading and reflects a misunderstanding of both the rationale and the core principles of an ecosystem approach. It is also inconsistent with the precautionary approach. The precautionary approach requires that "The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures" (FAO, 1995). As with conventional fisheries management and natural resource use in general, sensible application of the precautionary approach coupled with use of the best available scientific evidence, including stakeholder knowledge, should underpin immediate implementation of EAF. At the same time, efforts should be made to improve knowledge and to reduce uncertainty, especially in those areas where it could lead to improved management responses to the high priority issues that have been identified.

Adaptive management is an essential component of modern fisheries management and provides a means of formally dealing with the uncertainty that pervades all fisheries management. At its most fundamental level, adaptive management involves a process of monitoring key indicators of the performance of a management strategy and, when it is found to be failing to perform as expected, adapting, or tuning, the strategy to bring the performance back on track. In more advanced applications active adaptive management can include the systematic testing of assumptions, careful and precautionary experimenting with actions, responding to any new information, and learning from experiences and experiments to continually feed back into and improve the EAF management strategy. EAF should always be implemented in an adaptive manner.

## EAF in the Mediterranean

One of the 12 principles of the ecosystem approach listed by the CBD (Box 1) is that EAF should seek the appropriate balance between, and integration of, conservation and use of biological diversity. Those principles also state that the objectives of management of land, water and living resources are a matter of societal choice. The consequence of those two principles is that it is for the societies of the Mediterranean to identify the issues, to prioritise them and to reconcile any conflicts that exist between these issues. This brief review can only highlight some of the concerns and issues relevant to EAF that have already been identified in earlier studies and discussions. The final decisions and actions on objectives and management responses rest with the stakeholders and decision-makers of the Mediterranean States, perhaps through application of the approach described in the first section of this paper.

## Existing fisheries management and governance in the region

### *National management regimes*

Although there is no legal obstacle to doing so, the Mediterranean States have not, to date, exercised their right to establish, implement or give effect to claims on exclusive economic zones (EEZs). Reasons cited include the difficulties of delimitation and the desire to preserve basin-wide



access to fisheries (Chevalier, 2005). However, Algeria, Libya, Malta, Spain<sup>8</sup> and Tunisia claim sovereign rights over the living marine resources in protected fishing zones they have proclaimed in the Mediterranean, extending between 25 and 75 nautical miles seaward from their baselines.<sup>9</sup> In addition, in 2004, France declared an Ecological Zone and in 2003, Croatia a Zone of Ecological Protection and Fisheries (Chevalier, 2005). However, apart from the 12 mile territorial seas of each state<sup>10</sup> and the proclaimed protected fishing/ecological zones, the rest of the Mediterranean is high seas; enjoying the restricted freedoms as set out in UNCLOS. Importantly, these high seas lie within close distances to the coasts; rendering their access easy and essentially open. As a contrast, all Black Sea rim countries have established EEZs; therefore, no part of the Black Sea is considered as high seas or international waters.

All states bordering the Mediterranean have enacted management measures to control fishing, mainly aimed at protecting and conserving fishery resources, including legislation requiring the licensing of fishing vessels and regulating the characteristics and use of fishing gear.<sup>11</sup> In addition, almost every Mediterranean country has designated marine or specially protected areas (although varying by type and objectives) and/or had adopted temporal closures to protect, in part, certain species during their reproductive period. Other management tools in use include total allowable catches (TAC) or quotas for large pelagics, minimal landing sizes, protected species and limits on the days at sea. Legislation regarding the treatment of by-catch is rare in the Mediterranean although this is to be expected given its mixed fisheries. Other than licensing, rights or incentive-adjusting measures are infrequently used.

However, reviews of the legislation across the basin have shown a need for updating of legislative frameworks to improve coherency among the countries and to reflect recent international agreements and instruments including the FAO Code of Conduct (GFCM, 2005a and 2007a). It is therefore likely that the legislation in these countries would also need to be updated to incorporate implementation of EAF. For example, it is reported that few states have implemented strategies to ensure conservation of species associated with or dependent on target species. It is also a matter of concern that there is reported to be a low level, or even absence, of stakeholder involvement and consultation in fisheries management in the Mediterranean (CIHEAM, 2003). The Code of Conduct stipulates that 'States should...facilitate consultation with and the effective participation of industry, fishworkers, environmental and other interested organizations in decision-making (FAO, 1995, para 6.13). Without participatory decision-making, effective implementation of EAF will be extremely difficult, if not impossible. Finally, measures of monitoring, control and surveillance (MCS) vary greatly throughout the basin and are not applied in the high seas.

Developing the appropriate portfolio of EAF management measures for each fishery and/or high priority issue and efficiently implementing these measures will depend on the context of the fishery and, therefore, it is not possible to prescribe the ideal set of measures. However, a few generalities are possible: (i) there is no single panacea to ensure sustainable fisheries and healthy ecosystems; (ii) including stakeholders in the process may entail higher costs but should lead to improved compliance with regulations and the resulting mix of measures will benefit from the various and, likely, creative perspectives (i.e. potentially developing win-win situations); and (iii) without a credible system of MCS and appropriate penalties for infractions, compliance with top-down measures risks being low in the face of rising fish prices.

### *Regional governance*

The General Fisheries Commission for the Mediterranean (GFCM) came into force in 1952 and, as of 2007, included 22 Mediterranean and Black Sea states, one non-Mediterranean state, and the

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<sup>8</sup> The Spanish territorial waters are 12 nautical miles from the baseline, but the fisheries protected zone (FPZ) is delimited according to the equidistant line from the opposite coasts of Algeria and Italy and the adjacent coast of France; there is no Spanish FPZ in the Alboran Sea.

<sup>9</sup> The European Union 2002 Community Action Plan advocated the declaration of fisheries protection zones of up to 200 nautical miles to improve fisheries management in the Mediterranean (Chevalier, 2005).

<sup>10</sup> Territorial seas of 6 nautical miles in Greece and Aegean Sea Turkey, 35 nautical miles in Syria, and 3 nautical miles for the UK overseas territories/administered areas in the Mediterranean: Gibraltar, Akrotiri and Dhekelia (GFCM, 2005a).

<sup>11</sup> For a review of management measures legally defined for commercial and recreational fisheries in the Mediterranean countries, see GFCM (2005a) and GFCM (2007), respectively.

European Community. The purpose of the GFCM is to promote the development, conservation, rational management and best use of living marine resources in the areas under national jurisdiction and on the high seas of the Mediterranean and Black Sea. Recently, the GFCM has adopted binding recommendations for fisheries conservation and management concerning spatial area management<sup>12</sup>, deepwater, demersal, small and large pelagic and dolphinfish (*Coryphaena hippurus*) fisheries and has endorsed the EAF as a means of attaining sustainable fisheries.

In addition, the mandate of the International Commission for the Conservation of Atlantic Tunas (ICCAT) includes the Mediterranean Sea and this Commission has issued recommendations and resolutions concerning bluefin tunas (*Thunnus thynnus*) and swordfish (*Xiphias gladius*) in the region. These recommendations were recently endorsed by the GFCM.

Also relevant to EAF is the Mediterranean Action Plan (MAP) of the Barcelona Convention, which was created under the auspices of the United Nations Environment Programme (UNEP) and MAP. MAP and the Barcelona Convention have led to the development and entry into force of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean Sea. The Contracting Parties to the Protocol judged that they needed a concerted strategy and RAC/SPA launched the Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean (SAP BIO). The Mediterranean Commission on Sustainable Development (MCSDD), established in 1995, along with the Agenda Med 21 (1994), also provide a forum for the integration of development and environmental issues in the region. In addition, within the Convention on the Conservation of Migratory Species, the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and the Contiguous Area was adopted in 1996.

Overall, the Mediterranean Sea is well covered by national and international bodies that collectively would have the mandate to plan, implement and manage EAF in the region. It is up to these authorities to progress cooperatively and urgently in order to achieve this. Increased coordination, cooperation and communication within and among relevant institutions and resource user groups will be crucial to the success of EAF implementation in the Mediterranean. Such institutional frameworks have already proven essential in successful attempts at integrated coastal area management within the basin (UNEP/MAP/PAP, 2001).

## Management areas and EAF

Application of EAF in the Mediterranean will require the determination of appropriate boundaries and scale. As stated in the FAO definition of EAF, a fundamental feature of the approach is that it should be applied 'within ecologically meaningful boundaries' and this should be the final goal of implementation of EAF. In practice, however, more rapid progress may be possible with a pragmatic approach that starts within any existing human defined management boundaries (e.g. GFCM geographical sub areas [GSA], GFCM sub-regional projects) and then broadens to take into account the stronger interactions between adjacent management areas. The nature and scale of the boundaries (e.g. national jurisdiction, Mediterranean LME, ecological/physical criteria) will determine the management process, the stakeholders involved, and the legal and institutional arrangements necessary to move from conventional fisheries management towards a Mediterranean EAF.

Human-defined areas already established for the Mediterranean Sea, ordered from basin-wide to the local community level, include the GFCM area, the seven FAO statistical sub-divisions, the 27 GFCM GSAs (30 including the Marmara, Black and Azov Seas), the fisheries operational units (under implementation), national zones (as discussed above), and local regions and communities. From an ecological perspective, seven possible ecosystem types have been proposed (GFCM, 2005b). These are: pelagic shelf, pelagic oceanic, coastal, demersal shelf soft bottom, demersal shelf hard bottom, demersal slope, and demersal deep sea. These ecological types are also likely to consist of smaller, local ecological units in different parts of the Mediterranean and Black Seas (FAO, 2005b). The ecological complexity is therefore potentially huge.

A basin-wide EAF implementation framework, *inter alia* defining the Mediterranean EAF implementation strategy, its stakeholders and institutional requirements, would assist in providing a

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<sup>12</sup> See [www.gfcm.org](http://www.gfcm.org) for the complete list of GFCM Recommendations and Resolutions.

starting point for EAF implementation regardless of the scale chosen (i.e. from basin-wide to local ecosystems). In accordance with the recommendation made by the GFCM Transversal Workshop on Ecosystem Approach to Fisheries (GFCM, 2005b) a pragmatic start could be made by starting from the 27 Mediterranean GSAs but, in parallel, further work on the description of operational units could be undertaken to consider, for example, management of shared stocks. Implementation and stakeholder involvement could benefit from the networks and institutional frameworks provided through the four sub-regional GFCM projects (CopeMed, AdriaMed, EastMed, MedSudMed).

## Important ecosystem issues in the Mediterranean

The Mediterranean Sea occupies an area of about 2.5 million km<sup>2</sup>. It is divided into two main basins, the western and eastern, separated by the Sicily Channel. The human population of the Mediterranean coastal States was 450 million in 1997 and is estimated to reach 600 million by 2020. The Sea receives inflow of water through the Strait of Gibraltar and from the Black Sea, as well as fresh water inflow from a number of rivers, the most important of which, in terms of discharge, are the Rhone, Ebro, the Po and 3 other rivers from the Balkans flowing into the Adriatic Sea. The Mediterranean has, in general, a narrow continental shelf and slope apart from in a few areas such as the northern Adriatic and the Gulf of Gabes where they are wider. It is also oligotrophic with low biological productivity although this appears to be subject to some doubt (CIHEAM, 2003). Nevertheless, the region includes about 7% of the known global marine fauna and 18% of the marine flora, of which 28% are endemic. In total between 10,000 and 12,000 marine species, including 8500 species of macroscopic fauna, have been recorded from the Mediterranean.

The Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean (SAP-BIO, 2003) identified a number of characteristics of the Mediterranean marine ecosystem that were cause for concern. These were: a "simplification" of the structure and species composition of the system; a decline in the population size of sensitive species; declines in population size of endangered species; declines in the population size of species targeted by fisheries; destruction and disturbance of habitats; biological invasions; and what the report described, without further elaboration, as a "deformation of natural dynamics of biodiversity". Collectively, these characteristics clearly demonstrate an ecosystem under serious stress from anthropogenic effects.

UNEP/MAP/PAP (2001) and SAP-BIO (2003) have identified a number of major threats to the Mediterranean marine ecosystem. All of these need to be considered within the framework of EAF. The fisheries managers, agencies and decision-makers should be addressing, with urgency, the threats within their control which will generally be those related to commercial fishing and, in some countries, may also extend to recreational fishing and aquaculture. Where human activities outside of their mandates are having significant impacts, both direct and indirect, on fishery resources the fisheries authorities should be liaising with the authorities with mandates for those activities in order to eliminate or mitigate the impacts. The more important factors are listed below, not in any order of priority.

### *Commercial fisheries*

A wide variety of fishing gear and practices is used in the Mediterranean. Most of the activities are coastal but there are important fisheries offshore such as the pelagic fisheries for bluefin tuna, dolphinfish and for swordfish. FAO (2005b) reported that there is no pressure for assessing the status of the stocks and that adaptive management has not been implemented in the Mediterranean. The primary management measure applied is effort limitation. There is only limited information available on the status of stocks in the Mediterranean: data on catches are variable and there is almost no information on effort (FAO, 2005b). Synthesising the available assessments, (FAO, 2005b) concluded that hake *Merluccius merluccius* is over-exploited, *Mullus barbatus*, *Aristeus antennatus* and *Sardina pilchardus* are fully to over-exploited. Complementing this information, it has also been reported that a number of target species are over-exploited including Albacore tuna (*Thunnus alalunga*), bluefin tuna (*Thunnus thynnus*), Atlantic bonito (*Sarda sarda*), swordfish (*Xiphias gladius*), whiting (*Merluccius merlangus*), red mullet (*Mullus barbatus*), European anchovies (*Engraulis encrasicolus*), and various sardinellas (SAP-BIO, 2003). In addition, a number of shark and ray species including *Mustelus mustelus*, *Scylliorhinus stellaris* and *Squalus blainvillei*, bony fish including *Anguilla anguilla* (listed on CITES Appendix II in 2007), *Epinephelus marginatus*, and others, as well as some

crustaceans and other invertebrates have been described as being threatened by fishing (SAP-BIO 2003). Fishing is also having direct impacts on a number of bycatch species including some species of conservation concern such as chondrichthyans, sea turtles, sea birds and sea mammals (SAP-BIO, 2003; GFCM, 2004). The impact of some trawl gear on sensitive habitats including beds of the sea grass *Posidonia oceanica* and coralligenous habitats is an issue that needs to be addressed in some areas, as is ghost fishing.

Destructive methods being used for fishing in some cases, such as dynamiting and poisoning and the destruction of habitat required for harvesting Mediterranean date mussel (*Lithophaga lithophaga*), are a cause of particular concern.

### *Recreational fisheries*

GFCM (2007a) identified the increase in recreational fishing, generally unmanaged and uncontrolled, in the Mediterranean as being an important threat to the Mediterranean ecosystem and a cause of conflicts among the fisheries sub-sectors. For example, juveniles of a number of demersal commercial species are affected by recreational angling; while spearfishing targets some endangered species. By-catch and live bait issues are also of non-negligible proportions in these fisheries. In addition, they have access to some species, particularly invertebrate species that are forbidden to the commercial fishery.

### *Aquaculture*

The Mediterranean aquaculture industry, especially marine fish farming, has significantly increased in the last three decades<sup>13</sup>. Impacts of aquaculture on the ecosystem and thereby on fisheries include increased eutrophication in the area through addition of feed, chemical pollution from the use of anti-fouling agents and pharmaceutical products for treatment and prevention of disease, degradation of the bottom habitat through sedimentation and the risk of genetic pollution and introduction of alien species. In well-managed aquaculture operations these impacts can be minimised but without suitable management and control, aquaculture can have significant deleterious effects.

### *Pollution*

Pollution is recognised as one of the primary threats affecting the Mediterranean Sea ecosystem and thereby those dependent on its fishery resources. Pollution arises from urban developments, industrial activities, agriculture, aquaculture, thermal power generation and a host of other activities. The harmful products include organic pollutants contributing to eutrophication, toxic substances such as pesticides, heavy metals and other hazardous wastes, and thermal pollution.

### *Coastal zone development and other changes in land use*

There have been profound changes in land use of the coastal areas of the Mediterranean in modern times. Urban expansion is one of the most significant of such changes, together with the infrastructure required for and direct impacts of the some 200 million tourists that visit the Mediterranean each year. In addition, the modernisation and intensification of agriculture and damming and modification of rivers flowing into the Sea has profound consequences for the system. Amongst the impacts from such developments is the destruction of coastal habitats which leads *inter alia* to modifications of sedimentary coastal dynamics resulting in changes to marine habitats, pollution as already described, and direct destruction of crucial habitats such as wetlands and estuaries.

### *Other factors*

A number of other anthropogenic factors are having important negative impacts on the Mediterranean Sea ecosystem. These include invasive species introduced through the opening of the Suez Canal, ballast water, aquaculture and other human activities. SAP-BIO reports that there are already more than 400 alien species present in the Mediterranean Sea. Global warming and climate change are probably already and will continue to bring about changes to the system, including

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<sup>13</sup> See GFCM, 2007b for a review of Mediterranean aquaculture production.

changes to the distribution of species, community composition in some areas and likely changes in productivity and availability of fishery resources.

The net effect of all these impacts is profound and it would be short-sighted for fisheries managers, policy-makers and stakeholders to ignore them. If the quality and productivity of the fishery resources of the Mediterranean are to be at least maintained and preferably restored to their full potential, urgent action needs to be taken across all of the fronts described above. Fisheries agencies and stakeholders need to consider urgently the actions required to minimise negative impacts within their own sector and, at the same time, should be advocating for elimination or mitigation of the impacts that other human activities are having on the ecosystem and thereby on the livelihoods of those dependent on fisheries.

## Social and economic importance of fisheries in the Mediterranean and the potential implications of implementing EAF

The human dimensions of Mediterranean fisheries are as complex and diverse as the species and ecosystems upon which they depend. For example, the Mediterranean States' economies range from low-income food-deficit to highly developed; their coastlines from deserted to heavily urbanised; and their fisheries from unindustrialized and labour intensive to modern and capital intensive.

Although often overlooked in the statistics, these fisheries play important livelihood, food security, cultural, and recreational roles. For example, about 300,000 people earn their living directly from full-time commercial fishing, while 900,000 others are employed in related services and industries. The commercial fishing sector earns Mediterranean countries about US\$ 3.8 billion a year. Consumption of fish in the region is high: 18.4 kg/capita/year, compared to the global average of 16.5 kg/capita/year; with seven of its countries ranging from 22 to 45 kg/capita/year (FAO, 2006).

Interestingly, Mediterranean fisheries provide only around 7.2 kg of the total consumption, with the rest being met through imports, despite the appearance of a general preference in the region for fresh, local products. Import quantities and values of fish products are over twice what the countries export; demonstrating a dependence on imports. Importantly, approximately 50% of Mediterranean country-originating exports are exported to other Mediterranean countries (i.e. intra-Mediterranean trade); while only 22% of imports into Mediterranean countries originate from other Mediterranean countries (i.e. majority extra-Mediterranean sources). Furthermore, the growth of fish products demand is expected to increase in the future, especially in the southern Mediterranean countries (M. Malvarosa, IREPA, pers. comm.), adding additional pressure on the aquatic resources.

There is a long tradition of fishing in the Mediterranean, continued for a variety of reasons including: (i) passage from one generation to the next; (ii) lack of economic alternatives; and (iii) attractive high prices. On the other hand, overcapacity and overfishing are driving rent drain in the region, impacting these livelihoods and creating calls for substantial decreases in fishing effort for certain species.

Although few qualitative or quantitative studies have attempted to evaluate the socio-economic impacts of recreational fisheries in the Mediterranean, anecdotal evidence suggests that these fisheries are of substantial socio-economic importance and that this importance is likely to increase as the tourism sector expands, ports are developed, and disposable incomes increase in the basin.

This mixed set of social and economic drivers forms part of the human context for the EAF management strategy. Without understanding and clarifying, *inter alia*: (i) the societal goals and values with respect to the Mediterranean ecosystem services; (ii) the socio-economic contexts surrounding these fisheries; (iii) the policy and institutional frameworks providing the backbone for management; and (iv) the political dynamics and power disparities as well as the external influences marking the realities of management, an EAF strategy is doomed to fail, to meet with serious unintended consequences, or to dissipate once the initial rush of interest wanes.

Financing the evolution towards EAF will also stem from the EAF context at hand. The use of economic and financial incentive mechanisms within and without the fisheries, government coffers, as well as external conservation financing will all play a role in establishing and sustaining a

Mediterranean EAF strategy. At least equally important will be an understanding and proper use of the social, legal, and institutional incentives that will facilitate EAF implementation. This discussion assumes the logical first step of abolishing existing perverse incentives (i.e. any policy or management measures that incite people or groups to act in a way that negatively impacts on an ecosystem's ability to provide services).

## A process for implementation of EAF

This brief review has highlighted the urgent need for proactive and comprehensive implementation of EAF if declines in the fisheries productivity and biodiversity of the Mediterranean are to be halted and reversed where necessary. Ideally, the process for implementing an integrated, holistic, and participatory approach, such as the EAF, would start from the ground up (i.e. from as decentralized a level as possible). In practice, a more common approach has been for planning and implementation to be initiated and driven, at least in the early stages, at the national level. However, given the high seas nature of many of the Mediterranean fisheries and the tradition of regional cooperation through international bodies (e.g. the GFCM and its regional projects, ICCAT and the European Commission), the Mediterranean countries would benefit from developing an overall GFCM framework for the implementation of the EAF. This framework would define what the *application* of the EAF entails (and does not entail) for the GFCM, across biological, ecological, economic, social and governance dimensions, and provide a guiding process, such as the one presented in this paper, to be followed and adapted to the particularities at the sub-regional, national, and local levels. This process could include leadership on the following enabling activities:

- (i) Initiatives, encompassing all stakeholders, to identify and prioritise issues;
- (ii) Participatory decisions and actions on highest priority issues, possibly starting with pilot scale case studies;
- (iii) Priority inter-disciplinary information to assist in the application of the EAF, including both immediate information required for management and longer-term requirements to improve and strengthen the knowledge base for management;
- (iv) Formal and informal arrangements to address trans-boundary issues – with GFCM playing a facilitating role where appropriate;
- (v) Greater coordination between sectors and government agencies responsible for different sectors to coordinate and catalyse action across all sectors; and
- (vi) Greater stakeholder participation in planning, implementation, review, and information acquisition.

## Conclusions and the way forward

An ecosystem approach to fisheries is now accepted as the necessary framework for ensuring sustainable fisheries. Reinforcing this awareness, this review has demonstrated that there is a critical need for more rapid progress in implementation of EAF in the Mediterranean marine ecosystem which is being impacted and distorted by a number of serious anthropogenic threats. The more important threats include overfishing and other undesirable impacts of commercial and recreational fishing, poorly managed aquaculture operations, pollution, coastal zone development, invasive species and others. GFCM and the national fisheries agencies of the Mediterranean countries have a mandate and responsibility to undertake the necessary action to address the problems being caused by fisheries. In this regard it is important to note that EAF does not replace conventional target-species fisheries management but supplements it. It therefore remains a high priority for these institutions to address the existing weaknesses in conventional fisheries management in order to ensure the sustainability of the target resources. This paper should not be seen as detracting from that need. However, EAF also requires going beyond the direct impacts of fishing on the target species. It is therefore necessary for GFCM and the fisheries management agencies, always in a participatory manner, also to address the wider ecosystem impacts of fisheries and the impacts of the ecosystem

on fishery resources and fisheries. This should be done as a part of a simultaneous wider drive for integrated management of the Mediterranean as a whole. Climate change, increasing populations and expanding coastal zone development add to the urgency. Valuable work towards this end has commenced but much more clearly needs to be done. The process outlined in the previous sections provides a way to achieve this and can be started and pursued more or less simultaneously at a range of scales spanning local, geographical sub areas, the sub-regions and the Sea as a whole.

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